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Contents

1 Summary

This report contains information about the operation of Geoscience Australia's ten permanent geomagnetic observatories and repeat station sites occupied during the years 2013 to 2016.

Preliminary information regarding the activities and services of Geoscience Australia's Geomagnetism Team, distribution of geomagnetic data, geomagnetic instrumentation and data processing procedures is also provided.

Magnetic time-series data are not featured in this report and are best obtained via the internet from Geoscience Australia's geomagnetism homepage[1] or from the INTERMAGNET global geomagnetic observatory network[2], to which Geoscience Australia contributes geomagnetic data.

Much of this report consists of the reproduction of plaintext files that accompany the yearly submission of definitive geomagnetic data to INTERMAGNET. These include:

- 'readme' files (with minor editing), which for Geoscience Australia's permanent geomagnetic observatories usually include information regarding instrumentation, meteorological conditions, timing corrections, missing data, significant events and aggregate statistics
- annual mean values files.

INTERMAGNET baseline value files are not reproduced although plots are provided.

For the Canberra, Gingin and Mawson Station geomagnetic observatories, K geomagnetic activity indices are listed. Additionally, for the Canberra and Gingin geomagnetic observatories, the disseminating plaintext files transmitted monthly to the Observatori de l'Ebre, Spain, in contribution to the International Service on Rapid Magnetic Variations are reproduced.

Geomagnetic data used in the 2015 revision of the Australian Geomagnetic Reference Field model were obtained from a geomagnetic repeat station survey that took place during 2008 to 2014. For this campaign, during 2013 to 2014, repeat station sites in Weipa, Hobart, Lord Howe Island, Nouméa, Norfolk Island, Kavieng and Vanimo were occupied.

For all repeat station sites occupied during 2013 to 2014, this report provides details of:

- adopted normal field values
- annual change estimates
- instrumentation.

[1] Minute values available from http://www.ga.gov.au/oracle/geomag/minute_ftp.jsp (accessed 2018-10-24).

[2] http://www.intermagnet.org/ (accessed 2018-10-24).

2 Notation and conventions

Figure 2.1 indicates the notation used in this report for describing the magnetic flux density vector at the point to which geomagnetic data are reduced at a ground-based geomagnetic observatory.

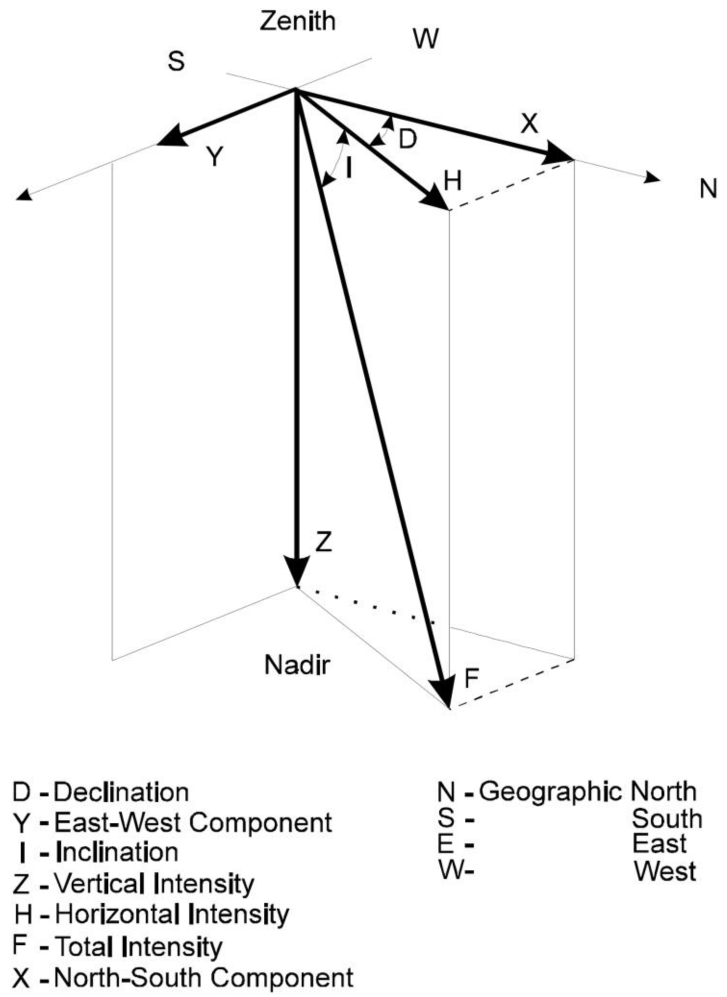

Figure 2.1 Relations among the magnetic elements. Figure reproduced with permission from the INTERMAGNET Technical Reference Manual Version 4.6 (ed. St-Louis 2012, p. 23, sec. 6.2, fig. 1).

The magnitude of the magnetic flux density vector and its dimensional components are usually quantized in units of nanoteslas (nT), where 1 T = 1 $kg \cdot s^{-2} \cdot A^{-1}$ in the SI base units. Historically, other units have been used. Equivalent units are given in Table 1.

Table 1 Equivalent magnetic flux density units.

10^4 Gauss
1 Weber/meter^2
10^9 gamma
1 Tesla

At Geoscience Australia's (GA) magnetic observatories most vector variometers (see Section 5.1 Variometers) are positioned such that at the time of installation Z is in the direction of local gravity and H is approximately equally distributed between X and Y. In reproduced INTERMAGNET 'readme' files in Section 7 Permanent observatories this orientation is described as 'NW, NE, Z'.

During 2013 to 2016, the majority of GA's magnetic observatories had only one set of continuously recording variometers. Such sets of variometers are identified by the 3-character IAGA code[3] of the observatory to which they belong. Where an observatory has more than one set of variometers, additional sets of variometers have arbitrary 3-character identifiers (e.g. Canberra observatory has had the CNB and CN1 sets of variometers).

Another convention used for identifying instrumentation is to refer to an instrument as a combination of a text string indicating the type of instrument or manufacturer or product name and the serial numbers of its components. For example, 'DIM DI0102/311864' refers to the declination-inclination fluxgate magnetometer (see Section 5.2 Absolute magnetometers) consisting of the single channel Danish Meteorological Institute (DMI) fluxgate magnetometer sensor with serial number DI0102 and the Zeiss 020B theodolite with serial number 311864.

Concerning GA's geomagnetic data products (see Section 4 Data distribution), Table 2 lists some terms used internally and within this report to describe various data types as well as any equivalences to external data type definitions.

For elements of this report that *aren't* reproduced from other sources, references to data types refer to the internal terms. For elements that *are* reproduced (such as INTERMAGNET 'readme' files) it cannot be guaranteed that references to data types refer to the internal terms; though it is usual and can usually be determined from context.

[3] Codes assigned by the International Association of Geomagnetism and Aeronomy (IAGA) for identification in several international observatory networks.

Table 2 Internal data type definitions and comparison to external equivalents. IAGA2002 Data Exchange Format data types have been omitted because ambiguity in their definitions[4].

Internal term	Internal term description	Closest INTERMAGNET data type equivalent	INTERMAGNET data type description[1]
Raw (V)	Variometer data in digitizer counts. No spike or corrupt data removal, no baseline reference measurements (BRM) or temperature corrections. No time shifts. Vector data in instrument coordinates (ABC).	Reported (R)	The raw data obtained from the IMO (in nanoteslas), either by satellite, computer link, or other means, without any reference measurements (RM) or other modifications applied to it.
Preliminary/Reported/Real-time (P)	Data in nanoteslas and in the XYZ coordinates. Temperature corrections applied but without removal of spikes or periods of contamination, time shifts or other modifications. Preliminary baselines applied (usually those used for quasi-definitive data production).	n/a	n/a
n/a	n/a	Adjusted (A)	The reported data with RM, spike removal, timeshifts, and/or other modifications applied to it. It is emphasized that only one adjusted version of the data would be allowed to be completed within 7 days of receipt of the reported data to prevent the proliferation of multiple versions of the adjusted data.
Quasi-definitive/Adjusted (Q)	Same as INTERMAGNET equivalent.	Quasi-definitive (Q)	Quasi-definitive data are defined as data that have been corrected using provisional baselines. Produced soon after their acquisition, their accuracy is intended to be very close to that of an observatory's definitive data product. 98% of the differences between quasi-definitive and definitive data (X, Y, Z) monthly mean values should be less than 5 nT.
Definitive (D)	Same as INTERMAGNET equivalent.	Definitive (D)	Definitive data are defined as the final adopted data values. Definitive data will only be distributed by the institution responsible for the observatory.

[1] *Edited from http://www.intermagnet.org/faqs-eng.php#data-types (accessed 2018-01-15).*

[4] http://www.intermagnet.org/faqs-eng.php#data-types (accessed 2018-01-15).

The arithmetic mean (AM) and standard deviation (SD) are used to indicate the central tendency and statistical dispersion of a sample, respectively (i.e. AM ± SD).

ISO 8601:2004 notation is used to represent dates, times, intervals and durations.

IAGA codes[3] are used often to refer to observatories.

Terms such as ‘absolute shelter’ or ‘absolute house’ refer to the non-magnetic shelters where absolute observations are taken. Similarly, some GA magnetic observatories may have a ‘control house’ where instrumentation control electronics are housed.

3 Activities and services

3.1 Permanent geomagnetic observatories

During 2013 to 2016, GA operated ten permanent geomagnetic observatories within Australia and Antarctica. Table 3 lists these observatories and Figure 3.1 shows their relative locations.

Table 3 Locations of geomagnetic observatories operated by GA during 2013–2016.

Observatory location	IAGA code	Latitude	Longitude
West Island, Cocos (Keeling) Islands	CKI	-012.1875°	096.8336°
Kakadu, Northern Territory	KDU	-012.69°	132.47°
Charters Towers, Queensland	CTA	-020.1°	146.3°
Learmonth, Western Australia	LRM	-022.22°	114.1°
Alice Springs, Northern Territory	ASP	-023.77°	133.88°
Gingin, Western Australia	GNG	-031.356°	115.715°
Canberra, Australian Capital Territory	CNB	-035.32°	149.36°
Macquarie Island Station, Tasmania	MCQ	-054.5°	158.95°
Mawson Station, Australian Antarctic Territory	MAW	-067.6°	062.88°
Casey Station, Australian Antarctic Territory	CSY	-066.283°	110.533°

Source: http://www.intermagnet.org/imos/imotblobs-eng.php (accessed 2017-12-21).

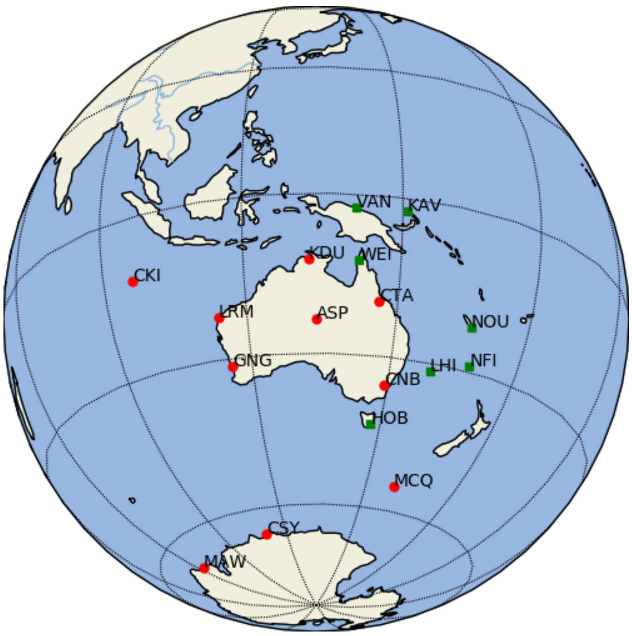

Figure 3.1 Relative locations of GA permanent geomagnetic observatories operated (red dots) and repeat station sites occupied (green squares) during 2013–2016.

3.2 Repeat stations

GA maintains a network of magnetic repeat stations throughout continental Australia and its offshore islands, Papua New Guinea and New Caledonia. Stations are occupied every few years to measure geomagnetic secular variation. Repeat stations are located in areas between and outside the GA observatory network to improve spatial coverage. Data from the repeat station network contribute to the Australian Geomagnetic Reference Field (AGRF) models and secular variation model of the Australian region (see Section 3.4).

Repeat station sites occupied during 2013–2016 are shown in Table 4 and Figure 3.1.

Table 4 Repeat station sites occupied during 2013–2016.

Observatory location	Code	Latitude	Longitude	Occupation dates
Weipa, Queensland	WEI	-12.6794°	141.9231°	2013-05-22/24
Hobart, Tasmania	HOB	-42.8347°	147.5106°	2013-05-27/29
Lord Howe Island	LHI	-31.5431°	159.0786°	2013-06-06/09
Nouméa, New Caledonia	NOU	-22.0097°	166.1994°	2014-03-03/06
Norfolk Island	NFI	-29.0425°	167.9381°	2014-03-11/14
Kavieng, Papua New Guinea	KAV	-02.5789°	150.8056°	2014-05-29/06-01
Vanimo, Papua New Guinea	VAN	-02.6934°	141.3044°	2014-06-02/06

3.3 Antarctic operations

GA contributes to the Australian National Antarctic Research Expedition (ANARE) through its MCQ, CSY and MAW magnetic observatories. Operations at these observatories are supervised and managed from GA headquarters in Canberra with logistic and operational support provided by the Australian Antarctic Division (AAD).

3.4 The Australian Geomagnetic Reference Field model

The AGRF model is a series of spherical cap harmonic models which describe the geomagnetic field and its secular variation in the Australian region. From 1990 to 2015 the AGRF has been updated at five yearly epochs. A main field model is produced for each five yearly epoch, along with a prospective secular variation model to extend the life of the model until its next revision.

The AGRF model represents the Earth's main magnetic field originating from the core and the broad-scale crustal field. The AGRF does not model short-term variations of the magnetic field with time, such as those caused by solar activity or from electrical currents in the ionosphere. The AGRF is derived from vector magnetic data from ground level, aircraft and satellite surveys as well as the network of geomagnetic observatories and repeat stations run by GA and neighbouring countries.

3.5 Magnetometer calibration

Canberra magnetic observatory hosts the GA Magnetometer Calibration Facility. Built in 1999, in collaboration with the Department of Defence, it comprises a Finnish/Ukrainian-designed 3-axis coil system used to calibrate observatory tri-axial variometers and client instrumentation.

During 2016 the control system and software at the facility were upgraded and modernised. Data analysis and coil calibration methods and software were also upgraded at this time.

3.6 Compass calibration

GA provides a service for calibrating and testing direction finding and other instrumentation. This service is used by civilian and military agencies requiring the calibration of compasses and compass theodolites as well as the determination of magnetic signatures of other equipment.

4 Data distribution

4.1 Time-series data

Observatory and period-specific details of data distribution are given the reproduced (with minor editing) INTERMAGNET ‘readme’ files in Section 7 Permanent observatories.

For 2013–2016 and for all GA observatories, preliminary 1-minute time-series data were made available in near real-time on the public GA website[5]. One-minute time-series were also sent to the Edinburgh INTERMAGNET GIN (Geomagnetic Information Node) using HTTP and these data were then made available on the public INTERMAGNET website[6].

For 2013–2016 and for all GA observatories, definitive 1-minute time-series data, annual means, baseline information and metadata were submitted to INTERMAGNET to standards described in the *INTERMAGNET Technical Reference Manual Version 4.6*.

Australian magnetic observatory data have been contributed to INTERMAGNET since the first CD of definitive data was produced (ed. St-Louis 2012, p. 13, sec. 4.2). Table 5 summarises the history of GA’s INTERMAGNET contributions.

Data were also provided in response to direct requests from government, educational institutions, industry and individuals.

Table 5 History of GA’s INTERMAGNET contributions.

IMO	First published on CD/DVD	Data first transmitted in near real-time
CNB	1991	1994-10
GNA	1994	Early 1995
ASP	1999	1999-12
CTA	2000	2001-08
KDU	2000	2001-08
MCQ	2001	2002-06
LRM	2005	2005-08-23
MAW	2005	2005-11-24
CSY	2011	2011-07-15
GNG	2012	2012-10-09

4.2 Magnetic activity indices

K indices (Bartels et al. 1939) for CNB, GNA, GNG and MAW were derived using a computer-assisted method developed at GA. The method uses the linear-phase, robust, non-linear smoothing (LRNS)

[5] http://www.ga.gov.au/oracle/geomag/gafoyer.jsp (accessed 2017-12-21).

[6] http://www.intermagnet.org/data-donnee/dataplot-eng.php (accessed 2017-12-21).

algorithm (Hattingh et al. 1989) to estimate the quiet or 'non-K' daily variation. This initial estimate can be adjusted on-screen using a spline fitting technique. The estimated non-K variation for the day is then automatically subtracted from the magnetic variations and the residual scaled for K indices.

Canberra (and its predecessors Toolangi and Melbourne) and Hartland (and its predecessors Abinger and Greenwich) in the UK are the two observatories used to determine the aa antipodal activity index (Mayaud 1971).

Canberra is also one of thirteen mid-latitude observatories used in the derivation of the planetary three hourly Kp range index (Bartels 1949). Of these observatories, only Canberra and Eyrewell (NZ) are in the southern hemisphere. K indices from CNB and GNG also contribute to the derivation of the am index (Mayaud 1968).

K indices from both CNB and GNG were provided to:

- IPS, Sydney, from where they are further distributed to recipients of IPS bulletins and reports
- the International Service of Geomagnetic Indices (ISGI), France, for the compilation of the aa and am indices.

K indices from CNB were also provided to:

- GFZ Helmholtz Centre Potsdam, Germany, for the derivation of global geomagnetic activity indicators
- the University of Newcastle, Australia
- the geomagnetism team of the British Geological Survey (BGS)
- Collecte Localisation Satellites (CLS) and Centre national d'études spatiales (CNES), France
- Royal Observatory of Belgium (ROB), Brussels.

All routine K index information was transmitted by email.

4.3 Storms and rapid variations

Details of principal magnetic storms, sudden storm commencements (SSCs), solar flare effects (SFEs) and other rapid magnetic variations at CNB and GNG were provided monthly to the:

- World Data Center for Solar-Terrestrial Physics (WDC-STP), USA
- World Data Center (WDC) for Geomagnetism, Kyoto, Japan
- Observatori de l'Ebre, Spain.

4.4 Australian Geomagnetism Reports

The *Australian Geomagnetism Report* was first published as the monthly *Observatory Report* in September 1952. The series was renamed the *Geophysical Observatory Report* in January 1953 (vol. 1, no. 1) and became the *Australian Geomagnetism Report* in January 1990 (vol. 38, no. 1). The monthly series became an annual report with volume 41 (for the year 1993).

From 1999 the *Australian Geomagnetism Report* has been produced in digital form only. These may be viewed or downloaded at GA's public website[7].

Details of other reports containing Australian geomagnetic data are given in volumes 43 and 44 of the *Australian Geomagnetism Report*.

4.5 Public web services

The public GA website offers facilities for:

- downloading and displaying preliminary and definitive 1-minute time-series data for all GA IMOs[8]
- querying the latest iteration of the AGRF model[9]
- obtaining K indices for CNB, GNG and MAW[10]
- obtaining K indices for Gnangara geomagnetic observatory (GNA) which was superseded by GNG in 2013[10]
- visualising the first time derivative of the total intensity, F[11].

Additionally, GA magnetic time-series data and activity indices are available through INTERMAGNET, the Kyoto and Edinburgh WDCs for Geomagnetism and ISGI.

[7] http://www.ga.gov.au/scientific-topics/positioning-navigation/geomagnetism/australian-geomagnetism-report (accessed 2017-12-21).

[8] http://www.ga.gov.au/oracle/geomag/minute_ftp.jsp (accessed 2017-12-21); http://www.ga.gov.au/oracle/geomag/gafoyer.jsp (accessed 2017-12-21).

[9] http://www.ga.gov.au/oracle/geomag/agrfform.jsp (accessed 2017-12-21).

[10] http://www.ga.gov.au/oracle/geomag/geomagnetism_indices.jsp (accessed 2017-12-21).

[11] http://www.ga.gov.au/geomag/wideareamag/ (accessed 2017-12-21).

5 Instrumentation

5.1 Variometers

The standard variometer system used at GA magnetic observatories consists of a 3-component vector variometer and a total-field scalar variometer. Time-series data are recorded digitally and transmitted to GA in near real-time.

Vector variometer sensors at GA observatories are orientated such that the two horizontal components have similar magnitude. In the typical configuration the horizontal sensors are aligned at 45° to the magnetic meridian (i.e. magnetic NW and NE) and the third sensor is vertical, in the direction of local gravity. However, at MCQ each sensor makes an angle of approximately 55° with the magnetic vector so that all three components have similar magnitude.

One of the benefits of these alignments is the optimisation of the 'Delta-F Check' (ΔF) (eds Mandea & Korte 2011, pp. 132-133, sec. 6.2.3.2) quality control test which compares the difference between F determined using the vector variometer and F obtained from the scalar variometer. Additionally, should one of the vector channels become unserviceable, vector data may be recovered using the remaining two channels and the scalar variometer data.

During 2013–2016, GA magnetic observatories employed Danish Meteorological Institute (DMI) FGE[12], LEMI LLC. (LEMI) and Narod Geophysics Ltd. (NGL) 3-component vector variometers. Some sites had more than one vector variometer.

FGE variometers provided single-ended analogue output that required digitization prior to recording on the data acquisition (DAQ) computer/system. NGL variometers provided an 8 sps (samples per second) digital signal via an integrated analog-to-digital converter (ADC). NGL variometers also benefitted from a UTC (Coordinated Universal Time) synchronized pulse per second (PPS) for timing control.

Most fluxgate variometers integrated temperature sensors into their magnetic sensor and electronics components. Where available, these two temperature data channels were also recorded to correct for temperature variations (see Section 6.1 Data reduction) and for state of health (SOH) monitoring.

5.2 Absolute magnetometers

Declination-inclination fluxgate magnetometers (DI-flux/DIM, see Jankowski & Sucksdorff 1996, sec. 5) and total-field scalar magnetometers are used in GA observatories as part of the 'absolute observations' routine used to calibrate an observatory's variometer(s).

The DIMs used at GA magnetic observatories consist of combinations of DMI Model G or Bartington MAG 01H fluxgate sensors mounted on either Zeiss Jena 020B or 010B non-magnetic theodolites.

Absolute observations at most observatories are performed nominally weekly using the 'offset/residual' method (Lauridsen 1985). In this method, the theodolite is set to the whole number of

[12] Production of FGE variometers has since moved to the Technical University of Denmark (DTU). Current model specifications available at http://www.space.dtu.dk/english/research/instruments_systems_methods/3-axis_fluxgate_magnetometer_model_fgm-fge.aspx (accessed 2017-12-21).

arc minutes nearest a null (0 nT) fluxgate output. The theodolite circle reading and a series of eight fluxgate time and value readings are then recorded in each position. Until October 2013, the 'zero/null' method (Kerridge 1988) continued to be used at Alice Springs observatory. In this method, the theodolite is set to achieve a null fluxgate output and a single theodolite reading is recorded in each position.

5.3 Reference magnetometers

Participation in the IAGA Workshops on Geomagnetic Observatory Instruments, Data Acquisition and Processing relate the Australian reference magnetometers to international standards. Absolute instruments used at Australian observatories are periodically compared with the designated 'reference DIM' (DIM B0610H/160459), sometimes indirectly through the 'travelling DIM' (DIM DI135/100856).

5.4 Data acquisition system

DAQ computers used at GA's magnetic observatories consist of the in-house Geophysical Data Application Platform (GDAP) software built around the proprietary QNX Neutrino[13] real-time operating system (RTOS) running on x86 single-board computers (SBCs).

Timing is governed by a software clock which is maintained to within 1 millisecond of UTC using an external GPS receiver providing NMEA 0183[14] strings and PPS interrupt signals. The Network Time Protocol (NTP), which can maintain a software clock to within 10 milliseconds of UTC depending on network congestion and server accuracy[15], is also used for a backup software clock at some observatories.

Advantech Co., Ltd. ADAM-4017[16] and MinGeo Ltd. ObsDaq[17] ADCs were used to convert analogue outputs from the DMI FGE to digital data for recording on DAQ computers. The NGL variometers had integrated ADCs (see Section 5.1 Variometers).

The ADAM-4017 ADCs sampled at 1 sps, with triggering provided by the DAQ computer. Digital output from the integrated NGL variometer ADCs and the ObsDaq ADCs were Gaussian filtered on the DAQ computer prior to recording 1-second values.

Uninterruptible Power Supplies (UPS) or DC battery power supplies were installed at all observatories, supplying power to DAQ computers and variometers in the advent of primary power outage. Lightning surge filters were installed where required.

[13] https://www.qnx.com/content/qnx/en/products/neutrino-rtos/neutrino-rtos.html (accessed 2017-12-21).

[14] A specification for communication between marine electronics, including GNSS receivers.

[15] http://www.ntp.org/ntpfaq/NTP-s-algo.htm#Q-ACCURATE-CLOCK (accessed 2017-12-21).

[16] Configured to operate with different input voltage ranges depending on observatory. Specifications available from http://www.advantech.net.au/products/gf-5vtd/adam-4017/mod_170c40f4-e6ac-485e-9df9-1e6ef60f971f (accessed 2017-12-21).

[17] http://www.mingeo.com/prod-obsdaq.html (accessed 2018-11-16).

6 Data processing

6.1 Data reduction

With constant scale and orientation values, Equation (1) defines the model applied to the arbitrarily orientated, near orthogonal raw vector variometer data A, B, C to enable the reduction of the X, Y, Z magnetic elements and derived elements D, I, H and F (see Section 2 Notation and conventions).

$$\begin{bmatrix} X(t) \\ Y(t) \\ Z(t) \end{bmatrix} = \boldsymbol{S} \cdot \begin{bmatrix} A(t) \\ B(t) \\ C(t) \end{bmatrix} + \boldsymbol{b} + \boldsymbol{d}(t) + \boldsymbol{q}(t) \tag{1}$$

In (1):

- matrix **S** combines constant scale and orientation values
- vector **b** applies DC baseline values
- vector **d** applies drifts and steps from DC baselines
- vector **q** compensates for vector variometer sensor and electronics temperature effects.

6.2 Data retrieval

Recorded data are transmitted to GA via different routes and network access technologies (DSL, LTE, VSAT, etc.) depending on the observatory.

In a first pass, a GA host retrieves raw data from the DAQ computer frequently through rsync[18] over the Secure Shell (SSH) protocol. This raw data is then automatically processed with instrumentation constants and baselines to provide provisional data to subscribers in almost real-time. For this, only a select number of protocols are supported.

Data is more thoroughly inspected and quality controlled by GA Geomagnetism Team ‘observatory managers’ prior to distributing quasi-definitive and definitive data to INTERMAGNET.

6.3 Recording intervals and mean values

During 2013–2016, at GA magnetic observatories, vector and scalar variometer data were recorded at 1-second and 10-second intervals, respectively (see Section 5.4 Data acquisition system).

Vector variometer minute means were obtained by using the INTERMAGNET recommended digital filter (ed. St-Louis 2012, sec. 2.2).

Up to 12 missing 1-second records were filled by linear interpolation. If more than 12 1-second records were missing, the associated minute mean was not calculated.

[18] An efficient file synchronisation utility program incorporating data differencing.

Scalar variometer minute means were derived from the seven enclosing 10-second records, centred on the minute. At least three out of the seven 10-second records needed to be present for the minute mean to be calculated.

Hourly means were derived from the minute means for the hour (minutes 00 to 59). At least 12 minute means needed to be present for the hourly mean to be calculated.

Daily means were derived from the hourly means for the day (hours 00 to 23). All 24 hourly values needed to be present for the daily mean to be calculated.

Monthly means were derived from the daily means for the month. At least one daily mean was required for the monthly mean to be calculated.

6.3.1 Annual means

Three different annual mean values were derived:

- the ‘All Days’ annual mean from all available minute means in the year
- the ‘Quiet Days’ annual mean from all minute means falling within each month’s five quietest days, according to ISGI’s monthly international quietest days (Q-days)[19]
- the ‘Disturbed Days’ annual mean from all minute values falling within each month’s five most disturbed days, according to ISGI’s monthly international most disturbed days (D-days)[19].

Annual mean values for the total intensity, F, are derived solely from vector variometer data and missing data is not infilled from scalar variometer data where available.

[19] http://isgi.unistra.fr/events_qdays.php (accessed 2017-12-21).

7 Permanent observatories

This section lists information regarding the permanent geomagnetic observatories operated by GA during 2013 to 2016.

7.1 Cocos (Keeling) Islands

7.1.1 INTERMAGNET 'readme' files

7.1.1.1 2013

```
                                 CKI
        COCOS-KEELING ISLANDS OBSERVATORY INFORMATION 2013
ACKNOWLEDGE-  Users of the CKI data should acknowledge:
      -MENTS: Geoscience Australia

STATION ID:   CKI

LOCATION:     West Island, Cocos-Keeling Islands,
              Western Australia, Australia

ORGANISATION: Geoscience Australia

CO-LATITUDE:  102.1874 Deg.
LONGITUDE:    96.8336 Deg. E
ELEVATION:    4.9 metres AMSL

ABSOLUTE
INSTRUMENTS:  DI-fluxgate magnetometer (DIM)
              GSM90 Overhauser-effect magnetometer

RECORDING
VARIOMETER:   Three component suspended DTU fluxgate
              magnetometer (FGE-K2); Total field
              Overhauser-effect magnetometer (GSM90)

ORIENTATION:  The two horizontal fluxgate channels were
              aligned equally about the magnetic meridian
              at the time of installation. The third
              fluxgate channel is vertical. (ABZ)

DYNAMIC RANGE:+/- 1600 nT

RESOLUTION:   0.032 nT

SAMPLING RATE:1 second

FILTER TYPE:  Intermagnet

BACKUP
VARIOMETER:   none

K-NUMBERS:    none
K9-LIMIT:     280 nT
```

GINS: Edinburgh
SATELLITE: Http upload

OBSERVERS: Trevor Menadue
Will Tankard
Sean Fitzgerald
Alana Moore
Matthew Price
Michael Conway
Andrew Lewis
Peter Crosthwaite

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WWW: http://www.ga.gov.au

NOTES:

Cocos-Keeling Islands Geomagnetic Observatory is located on West Island, Cocos-Keeling Islands in the Indian Ocean (in the jurisdiction of Western Australia). It is located close to the Bureau of Meteorology's weather station, in a narrow strip between the airstrip and the lagoon, and shares its surroundings with a golf course. Geoscience Australia (GA) also operates a GNSS base station nearby, and a CTBT Infrasound station on the island. Planning for the magnetic observatory began in 2008 when Professor Andrew Jackson, Swiss Federal Institute of Technology (ETH), approached Geoscience Australia. In 2009 the Australian Ionospheric Prediction Service (IPS), part of the Australian Bureau of Meteorology (BoM), joined the planning process. IPS constructed the variometer enclosure, and the observatory was equipped by GA in August 2011 with a solar powered variometer system with radio telemetry to the BoM station; variometer and absolute equipment were provided by GA and ETH. The vector variometer demonstrated enormous baseline drifts and was unusable; it was replaced in March 2012, and delivered acceptable data from then. CKI was accepted as an INTERMAGNET observatory on 2013-12-16.

The magnetic observatory comprises:

* a concrete-brick vector variometer enclosure, with foam/fibreglass roof, where the vector variometer sensor and electronics, and scalar variometer electronics are housed;
* a small concrete-brick scalar variometer sensor enclosure;
* a fibreglass box under 4 solar panels containing solar power supply system, acquisition computer, radio telemetry equipment;
* a radio mast and antenna;

* (within the BoM) a radio telemetry receiver connected to the BoM network;
* a marble-topped fibreglass absolute pier, lightly protected from wind and sun;
* auxiliary repeat-stations for historical connection and observatory security.

Key data for the observatory are given in Table 1.1.

Table 1.1 Key observatory data.

IAGA code:	CKI
Commenced operation:	01 April 2012
Geographic latitude:	12d 11' 14.8" S
Geographic longitude:	96d 50' 01.0" E
Geomagnetic latitude:	
Geomagnetic longitude:	
K 9 index lower limit:	280 nT
Principal pier:	Pier AO
Pier elevation (top):	4.9 m AMSL
Principal reference mark:	Windsock
Reference mark azimuth:	256d 15' 17"
Reference mark distance:	370 m
Observers:	
T Menadue	
M Conway	
W Tankard	
S Fitzgerald	
A Moore	
M Price	
P Crosthwaite	
A Lewis	

Local meteorological conditions

The meteorological temperature at CKI during 2013 varied from a minimum +22C (2013-07-23) to a maximum +31.6C (2013-02-19). Daily minimum temperatures varied from +22C to +27.6C (average +25+/-1C); daily maximum temperatures varied from +26.1C to +31.6C (average +29+/-1C); daily temperature ranges varied from 2.1C to 7.6C (average 4+/-1C).

The daily maximum wind gust varied from 17 to 94 km/h (average 45+/-12 km/h).

The maximum wind gust occurred on 2013-02-24, during a weather event which delivered 831 mm of rain from 2013-02-23 to 2013-02-25, including 450 mm on 2013-02-25 alone. During this event the BoM weather observer reported that "the recent heavy rains came with 9m swells and that the variometer was under water". The storm deposited large amounts of debris on the islands and caused several washouts. The observatory variometer is only a few metres above sea level.

Variometers

The variometers used during 2013 are described in Table 1.2.

Analogue outputs from the three fluxgate sensors, and the sensor and electronics temperatures, were converted to digital data using an ADAM 4017 analogue-to-digital converter mounted inside the fluxgate electronics unit. These data and the digital PPM data were recorded on the data acquisition computer located in the Solar Power "Green Box".

The magnetic sensors were located in the concrete aboveground vaults. Both vaults were fairly well insulated to minimise short period temperature fluctuations.

The equipment is completely self-contained. The only outside connection is a radio-link for communications; data acquisition is not dependent on communications.

From installation in 2011-08, the vector variometer enclosure suffered from leakage through the roof, accumulating several centimetres of water inside. The fluxgate variometers were unstable - it is possible that high humidity was the cause of the instability. In 2012-07 the roofs of both the scalar and vector enclosures were covered with fibreglass solving the leakage problem - silica gel was installed inside the cover of the DMI fluxgate sensor. The equipment has been reasonably stable since then, although there remains occasional unexplained vector variometer misbehaviour.

The scalar variometer began to fail in 2013-09, data quality deteriorated over time. The electronics was replaced during a maintenance visit 2013-11/2013-12.

The DMI FGE variometer scale-value, alignment, and temperature sensitivity parameters were measured at the magnetometer calibration facility at Canberra observatory before installation at CKI. The sensor assembly was aligned with the two horizontal fluxgate sensors at 45d to the declination at the time of installation and the Z fluxgate sensor vertical. This alignment was achieved by setting the X and Y offsets equal and rotating the instrument until the X and Y ordinates were equal. This method has been found to be accurate using tests performed at the calibration facility.

No part of the variometer system was temperature regulated. Temperature stability of the variometers was reasonable.

The DMI sensor temperature ranged from 28C to 33C during the year. There was a daily signal about 1/10th C, a weather system signal (about 2 weeks) which was quite variable, superimposed on a seasonal signal. The most significant temperature shift commenced 2013-02-19 and was -4C in 6 days (overlapping the high rainfall event noted above). The DMI electronics temperature ranged from 32C to 37C; it had a daily variation a few tenths C, but was otherwise very similar the sensor temperature. The sensor was very near the electronics and protected by an extra layer of foam insulation.

Variometer data timing was controlled by the QNX data-acquisition computer clock which was maintained using both the 1 PPS and data stream output of a GPS clock. A small error occasionally occurred just after computer resets which was corrected within a few minutes. Time corrections were logged automatically.

Table 1.2. Magnetic variometers used in 2013.

See Appendix C for a schematic of their configuration.

3-component variometer:	DMI FGE
Serial number:	E0461 / S0250 (since Mar 2012)
Type:	suspended; linear-core fluxgate
Orientation:	NW, NE, Z
Acquisition interval:	1 s
A/D converter:	ADAM 4017 module (+/-5V)
Scale value:	0.032 nT / count
Total-field variometer:	GEM Systems GSM90
Serial number:	0023526 / 03768 (Jan-Aug) 3106198 / 03768 (Dec)
Type:	Overhauser effect
Acquisition interval:	10 s
Resolution:	0.01 nT
Data acquisition system:	ARK3360 computer, QNX6.5 OS
Timing:	Garmin GPS clock
Communications:	Freewave radio link to BoM office, Internet through BoM

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock about once per minute. During 2013, most adjustments to the system clock were less than 1 ms, however there were 5829 in excess of 1 ms. Those that exceeded 10 ms are reported below.

2013-01-20	19:31:29	+0.012 s	
2013-02-06	21:48:10	+0.013 s	
	22:03:43	+0.011 s	
	22:22:01	+0.026 s	
2013-02-21	23:09:59	+0.011 s	
2013-05-12	02:27:31	+6.000 s	Note below
	02:39:22	-6.000 s	
2013-07-31	02:10:10	+0.014 s	
2013-08-07	04:53:33	-5.042 s	Replaced acquisition computer
2013-08-22	02:58:22	+1.000 s	Note below
	03:07:19	-1.000 s	
2013-09-02	09:11:01	-19.000 s	Note below
	09:16:59	+19.000 s	
	11:37:43	+3.000 s	Note below
	11:47:20	-3.000 s	
2013-09-16	04:57:41	+0.350 s	
	06:59:21	-1.000 s	Note below
	07:12:21	+1.000 s	
2013-09-19	21:55:15	-65.000 s	Note below
	22:04:56	+65.000 s	
2013-10-07	21:29:40	-0.506 s	
2013-10-14	12:25:26	-16.000 s	Note below
	12:36:56	+16.000 s	
2013-11-11	23:40:09	+0.473 s	Restarted Clock program
2013-11-24	17:38:35	+13.000 s	Note below
	17:39:28	-13.000 s	

There were 8 pairs of very large correction pairs of magnitude 1 to 65 whole seconds. The second of each pair counters the first. This was caused by a software error in the GPS clock programs. After each negative time jump, several seconds of data were not recorded. At the time this report and definitive data were prepared, there was no software to conveniently correct these problems. Data for 2013-09-19, having the largest time error of 65 s was corrected by manually binary-editing the raw data file. No other data were corrected.

Absolute instruments

The principal absolute magnetometers used at Cocos-Keeling Islands and their adopted corrections for 2013 are described in Table 1.3.

DIM observations were performed using the offset method. All DIM and PPM measurements were made on the principal pier at the standard height except during a period July-August when there was no working absolute PPM; during that time the variometer PPM data was used.

Table 1.3 describes the corrections applied to the absolute magnetometers to align them with the Australian reference instruments held in Canberra.

At the 2013 mean magnetic field values at Cocos-Keeling Islands the D, I and F corrections translate to corrections of:

dX = 0.0 nT   dY = 0.0 nT   dZ = 0.0 nT

These instrument corrections have been applied to the data described in this report and to other published definitive data.

Table 1.3. Absolute magnetometers

and their adopted corrections for 2013.
Corrections are applied in the sense
Standard =Instrument + correction.

```
DI fluxgate:    DMI
Serial number:  DI0102 (Jan - Sep)
                DI0134 (Oct - Dec)
Theodolite:     Zeiss 020B
Serial number:  311864 (Jan - Sep)
                359142 (Oct - Dec)
Resolution:     0.1'
D correction:   0.0'
I correction:   0.0'
Total-field magnetometer:  GEM Systems GSM90
Serial number:  3091315 / 42186 (Jan - Jul)
                Variometer GSM (Jul - Aug)
                3091316 / 761100 (Aug - Dec)
Type:           Overhauser effect
Resolution:     0.01 nT
Correction:     0.0 nT
```

Baselines

Acceptable observations were made on 40 days during 2013; usually a pair of observations was made on each of those days. Baselines measurements used two DI theodolite magnetometers, two absolute scalar magnetometers, and at times the variometer scalar magnetometer corrected to the absolute pier.

The means and standard deviations of the weekly absolute observations from the final adopted variometer model and data were:

	mean	stdev
X	-0.1 nT	0.7 nT
Y	-0.3 nT	1.2 nT
Z	-0.1 nT	0.7 nT
D	-2 "	7 "
I	0 "	4 "
F	0.0 nT	0.2 nT

Observed and adopted baseline values in X, Y and Z are shown in Figure 1.1.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2013 CKI definitive data and real time reported 1-minute data sets (CKI definitive - CKI real time) were:

	X	Y	Z
Average	-0.7	+0.1	-0.2
Std.dev	+0.6	+0.3	+1.2
Min	-1.7	-0.3	-1.2
Max	+0.3	+0.6	+2.3

The CKI 2013 reported real time data are within the specification for INTERMAGNET Quasi-definitive data (although they contain contaminated minute data, but not enough to severely effect monthly averages). This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2013 CKI definitive data and quasi-definitive 1-minute data sets (CKI definitive - CKI quasi-definitive) were:

	X	Y	Z
Average	-0.1	-0.1	-0.1
Std.dev	+0.2	+0.3	+0.3
Min	-0.4	-0.6	-0.4
Max	+0.2	+0.1	+0.5

The CKI 2013 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The observing staff of the Bureau of Meteorology operate the

geomagnetic observatory, including making weekly absolute observations. The only absolute observation training conducted by staff of the GA geomagnetism section was a very brief introduction to Trevor Menadue at the end of the initial installation of equipment in 2011-08 (with not all absolute equipment operational), and a more reasonable introduction to Michael Conway in 2013-12. There were manuals and instructions provided. There has been a high turnover of observers (by the norms of geomagnetic observations at least), and most observers have had their training handed down from the predecessors, who themselves had similar less-than-adequate training. Under the circumstances, it is fortuitous that acceptable observations were made and good quality data could be delivered. The Bureau staff has provided excellent assistance and quality observations. Will Tankard made observations when on duty throughout 2013 and provided continuity, excellent observations, and training to other staff, although he himself received no training from GA. It is possible that the computer assisted observations using the GObs observation recording program on a tablet PC was useful achieving results.

The observatory is on a mown grass area, surrounded by an invasive plant "cabbage bush", coconut palms, other trees, a golf course and airstrip apron. It is very close to the atoll's lagoon. It is necessary to mow around the observatory, including the variometer, to keep the observatory from being consumed by cabbage bush, and so there are regular monthly data losses for a few hours. This is unavoidable. There are other data losses that may be caused by golfers, bird watchers, tourists in general, but these are not documented.

When possible, the duty Bureau observer performed absolute observations weekly. Observations were recorded directly on a tablet PC (with a building GPS for setting the time to with a few seconds or better). The observation file was emailed to GA, where they were processed.

The absolute GSM90 failed, and the variometer GSM90 was used for absolute control from July to August. A replacement absolute GSM90 was used from August to December. The variometer GSM90 failed in September, and was replaced during a maintenance visit in late November.

Adon Butterfield visited the observatory beginning 2013-08-06 for a few days. He replaced the failed GSM90 absolute electronics, replaced the Getac tablet PC, installed an analogue-to-digital converter in the absolute DMI fluxgate electronics to make observations easier, and replaced the acquisition ARK3360 computer with one loaded with QNX6.5 software.

Andrew Lewis and Peter Crosthwaite visited the observatory from 2013-11-26 to 2013-12-03. During this visit they
* replaced faulty variometer GSM90 electronics
* installed voltage regulators close to both the vector and scalar variometers
* upgraded the GPS clock firmware
* made checks and calibrations of the observatory equipment

* confirmed using sun shots and geodetic measurements the azimuth from the primary pier to the primary mark
* made a map using GPS of the observatory
* finally gave some on-site geomagnetic absolute measurement training to Michael Conway
* located and determined pier differences to the nearby repeat stations D and E

They also searched for another repeat station, A, on Direction Island - the site was not found. It is likely that the island has been re-shaped by the ocean and that the site is now in the sea. A structure should have existed nearby station A; it was not found, although there is broken brickwork in the sea nearby. They also spent some time on maintenance of the CTBTO infrasound station. (See Geomagnetism Note 2013-18.)

Data were retrieved from the data-acquisition system every 4 minutes using rsync over ssh in near real-time using the network connection.

The distribution of Cocos-Keeling Islands 2013 data is described in Table 1.4. Data losses are identified in Table A.1.

Table 1.4. Distribution of Cocos-Keeling Islands 2013 data.

Recipient	Status	Sent
1-second values		
IPS Radio and Space Services	preliminary	real time
WDC for Geomagnetism-Kyoto	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time
ETH, Zurich	preliminary	real time
WDC for Geomagnetism-Kyoto	preliminary	daily
INTERMAGNET	quasi definitive	January 2014
INTERMAGNET	definitive	July 2014

Significant events

2013-01-22	ISGI issue K9 limit of 280 nT for CKI (TRIM D2013-11898)
2013-03-13	Sean Fitzgerald replaced by Alana-Jayne Moore a few weeks ago. Both assisted Will Tankard with mag obs.
2013-03-19	Reports from Paul Jamieson at CKI is that variometer vault is dry. Will reported that the recent heavy rains came with 9m swells and that the variometer was under water - presumably water collected around the var vault area (below top of concrete?)
2013-06-14	Alana leaves CKI today replaced by Matthew Price
2013-07-19	No GSM90 obs on 12 and 19 July - can't get it to work. Some drift in (DIM) fluxgate readings 12-July-2013 and maybe on 19-July-2013.
2013-07-30	Tested GSM90_3091316 for CKI absolutes with CNB sensor 21867. Possible 0.2nT difference - this was original CKI absolute PPM damaged during initial installation. Adon Butterfield to

```
           install.
2013-08-06 Adon Butterfield due to arrive Cocos today to
           service infrasound and upgrade geomag QNX/Getac
           /DI flux(A/D) and investigate absolute GSM90
           problem. Matthew Price due to leave Cocos when
           Will Tankard returns from leave. Michael Conway
           new OIC/BoM.
2013-08-07 Adon Butterfield at CKI Met Office.
           Tried old GSM90 electronics, didn't talk to
           Getac, Tried new GSM90 electronics, talked OK to
           Getac, and talked ok to replacement Getac.
           Replaced ARK computer to QNX6.5 system. High
           rate of data errors on Adam ch5 through
           GdapDeviceAdam, although none seen on qtalk.
           All errors on baseline channel, apparently first
           character of response which should be 0x3E('>'),
           but comes out as 0x9F or 0x3F('?').
           Removed use of baseline channel in Adam.cfg,
           scan only ch 0:4 and this seemed to operate OK
           but baseline drift no longer followed.
           06:50 power off/on SOH and DMI switches, tested
           for data errors, and still same situation.
           Reverted to no baseline channel.
2013-08-17 Observations again showed unexpected variations
           in DI fluxgate readings.
           Will was careful to note that he was operating
           the equipment correctly. Replacement GSM90 is
           in use.
2013-08-19 01:35 Stopped GdapDeviceAdam drivers and copied
           modified version of driver.
           Restarted driver for both mag and soh.
           Modification is to ignore first data character
           from Adam A/D (--adam.ignorefirstdatacharacter)
           The baseline channel was reintroduced at this
           point. There was ~0.2nT change in FCheck.
           When looking at data (GdapCALs) I (PGC) noticed
           missing data values but nothing reported in log
           file.
           All missing points were at :08, :28, :48 seconds!
           There doesn't seem to be data missing except
           during the times I was looking at it. This is
           very puzzling.
           Something similar (2013-08-19 at :16, :36, :56,
           2013-07-25 :17, :37, :57) happens at LRM where
           GdapCALs is running continuously.
2013-09-02 Received transported goods from CKI
           GSM90 3091315 - did not talk to computer with
           returned cable
           Getac GA 0063314 E100 S/N RC363E0112 (not
           Handbook record RC353E0112)
           ARK3360 KSA197301
2013-09-10 qtalk to GSM90 variometer while not functioning.
           Noted that signal indicator was "09" - F values
           scattered and of no use.
           Restarted GdapDeviceGSM90 about 05:00
2013-09-13 GdapClockGm software errors?
  2013-09-13 17:04:43.0 N Gm Adj by 1259 (1303) defer
  2013-09-13 17:07:40.1 N Gm Adj by -2946 (1292) defer
  2013-09-13 17:08:03.5 N2 Gm NMEA 0 89 0 1024
    5387239054106000
```

```
NOT REPORTED TO GEOMAG MAIL?
  2013-09-13 17:08:06.6 N2 Gm NMEA 0 89 0 1024 5075879600
  2013-09-13 17:08:09.6 N3 Gm NMEA 0 89 1 1024 5075870360
  2013-09-16 04:55:35.8 I Gm Started RESTARTED
  2013-09-16 04:57:41.0 N Gm Adj by 350088896 (3158) LL
  2013-09-16 04:58:03.6 N2 Gm NMEA 0 89 0 1024
    5745286362415910
  2013-09-16 04:58:06.7 N2 Gm NMEA 0 89 0 1024 5075879460

Restart GdapClockGm
  2013-09-16 05:00:11.0 N Gm Adj by 247352 (3113) defer L
  2013-09-16 05:01:42.0 N Gm Adj by -235 (3105) defer
  2013-09-16 05:02:42.0 N Gm Adj by -1179 (3079) defer
  2013-09-19 21:55:15.0 N Gm Adj by -65000000294 (1210) LL
ANOTHER VERY LARGE UPDATE
  2013-09-19 21:55:28.7 I TFI Thread watchdog action
  2013-09-19 21:55:32.8 I MAG Thread watchdog action
  2013-09-19 21:55:35.9 I SOH Thread watchdog action
  2013-09-19 21:55:55.0 N Gm Adj by 372 (1215) defer
  2013-09-19 21:56:40.1 N Gm Adj by 30 (1214) defer
  2013-09-19 21:57:40.0 N Gm Adj by -36 (1209) defer
  2013-09-19 21:58:40.0 N Gm Adj by 565 (1215) defer
  2013-09-19 21:59:40.1 N Gm Adj by 692 (1224) defer
  2013-09-19 22:00:40.0 N Gm Adj by -701 (1204) defer
  2013-09-19 22:01:40.0 N Gm Adj by 1775 (1225) defer
  2013-09-19 22:04:26.0 N Gm Adj by 64999999559 (1241) LL
REVERSED HERE

Clock seemed correct at 22:34:30 according to pips/1194.
  2013-10-02    04:40:40 Adj 6442 (5037)
last clock adjustment for some time, restarted GdapClockGm
  2013-10-07 21:27:49.9 I Gm Started
  2013-10-07 21:29:40.0 N Gm Adj by -506096503 (1924) LL
  2013-10-07 21:30:03.4 N2 Gm NMEA 0 89 0 1024
    8860194441740300

GdapClockGm failed again almost immediately, restarted
GdapClockGm again
  2013-10-07 21:32:34.0 N Gm Adj by 132396 (1932) defer L
  2013-10-07 21:33:42.0 N Gm Adj by -596 (1918) defer

2013-10-08 First obs with replacement DI theodolite/fluxgate
           (degrees/minutes) and presumably keyboard/shelf.
           Excellent results.
2013-10-12 Telemetry failed due to ISP gateway migration
2013-10-15 03:10 telemetry re-instated.
2013-10-23 Data Contamination - On that day there was a
           lot more heavy traffic moving around the
           observatory. We had 4 deliveries of concrete by
           a concrete truck and there was other activity as
           well.
2013-10-29 Observations not as good as usual.
2013-11-11 Good observations.
2013-11-11 Noticed that GdapClockGm hadn't made corrections
           since sometime 2013-11-04 but not reported by
           cron jobs. Looked at Gm data - Version 3.2 needs
           upgrading to 3.8
           Restarted GdapClockGm
  2013-11-11 23:39:20.6 I Gm Started
  2013-11-11 23:40:09.0 N Gm Adj by 472508258 (2661) LL
  2013-11-11 23:41:42.0 N Gm Adj by -5089 (2613) defer
```

```
  2013-11-11 23:42:43.0 N Gm Adj by 683 (2653) defer

2013-11-26 PGC/AML arrived CKI for maintenance visit.
2013-12-03 PGC/AML departed CKI
2013-12-09 Noticed that left two MachR running for soh/cks,
           hence duplicate files

Appendix A. Data losses
-----------------------

Table A.1. Cocos (Keeling) Islands data losses.
----------------------------------------------
Date       Interval(hh:mm)  Data loss (minutes)
Vector data

2013-01-23 13:11 - 13:11    1
2013-02-17 08:37 - 09:12 36
2013-03-17 07:40 - 08:12 33
2013-03-18 02:57 - 03:02 6
2013-03-29 06:11 - 06:35 25
2013-04-26 08:48 - 08:49 2
2013-04-27 04:18 - 04:57 40
2013-05-06 10:40 - 10:40 1
2013-05-12 05:26 - 05:32 7
2013-05-24 06:06 - 06:06 1
2013-05-30 03:39 - 03:42 4
2013-06-17 07:42 - 09:13 92
2013-07-05 07:10 - 07:48 39
2013-07-13 04:59 - 06:20 82
2013-07-15 08:27 - 08:34 8
2013-08-02 01:52 - 01:56 5
2013-08-07 00:00 - 05:54 355
2013-08-07 06:37 - 06:37 1
2013-08-07 06:43 - 06:52 10
2013-08-08 09:18 - 09:18 1
2013-08-08 10:49 - 10:52 4
2013-08-15 10:17 - 10:17 1
2013-08-15 10:39 - 10:40 2
2013-08-16 15:12 - 15:13 2
2013-08-16 22:13 - 22:13 1
2013-08-16 22:40  -  22:41  2
2013-08-16  22:53  -  22:53  1
2013-08-16  23:02  -  23:02  1
2013-08-17  09:00  -  09:01  2
2013-08-17  11:12  -  11:14  3
2013-08-17  11:16  -  11:16  1
2013-08-17  11:18  -  11:18  1
2013-08-18  08:51  -  08:51  1
2013-08-18  09:01  -  09:01  1
2013-08-18  10:34  -  10:35  2
2013-08-18  10:40  -  10:40  1
2013-08-18  10:42  -  10:42  1
2013-08-18  10:47  -  10:48  2
2013-08-18  10:50  -  10:54  5
2013-08-19  01:35  -  01:36  2
2013-08-21  08:17  -  08:37  21
2013-09-02  09:17  -  09:17  1
2013-09-04  09:28  -  09:51  24
2013-09-25  08:10  -  08:30  21
2013-10-14  12:37  -  12:37  1
2013-10-23  05:08  -  06:12  65
```

2013-10-24	16:07	-	16:07	1
2013-10-24	16:11	-	16:12	2
2013-10-31	02:05	-	02:05	1
2013-10-31	02:07	-	02:07	1
2013-10-31	02:09	-	02:11	3
2013-11-13	09:23	-	09:44	22
2013-11-27	03:35	-	11:04	450
2013-11-27	11:30	-	11:37	8
2013-11-27	11:42	-	11:49	8
2013-12-02	00:34	-	00:47	14
2013-12-26	05:38	-	05:42	5
2013-12-26	06:49	-	06:50	2
2013-12-30	09:50	-	10:09	20
2013-12-31	10:29	-	10:29	1

Scalar data

2013-01-23	13:11	-	13:11	1
2013-02-17	08:37	-	09:12	36
2013-03-17	07:40	-	08:12	33
2013-03-18	02:57	-	03:02	6
2013-03-29	06:11	-	06:35	25
2013-04-26	08:48	-	08:49	2
2013-04-27	04:18	-	04:57	40
2013-05-12	05:26	-	05:32	7
2013-05-30	03:40	-	03:42	3
2013-06-17	07:42	-	09:13	92
2013-07-05	07:10	-	07:48	39
2013-07-13	04:59	-	06:19	81
2013-07-15	08:28	-	08:33	6
2013-08-02	01:53	-	01:56	4
2013-08-07	00:00	-	04:52	293
2013-08-09	04:31	-	04:34	4
2013-08-10	03:11	-	03:13	3
2013-08-10	03:15	-	03:15	1
2013-08-10	03:22	-	03:23	2
2013-08-10	03:42	-	03:43	2
2013-08-10	03:53	-	03:53	1
2013-08-10	03:59	-	04:06	8
2013-08-10	04:08	-	04:09	2
2013-08-10	04:13	-	04:13	1
2013-08-10	04:49	-	04:49	1
2013-08-12	05:56	-	05:56	1
2013-08-12	05:58	-	05:58	1
2013-08-21	08:18	-	08:36	19
2013-08-24	04:47	-	04:51	5
2013-08-28	02:02	-	02:16	15
2013-08-28	02:18	-	02:18	1
2013-08-28	02:30	-	02:35	6
2013-08-28	02:42	-	03:03	22
2013-08-30	03:29	-	03:31	3
2013-08-30	03:33	-	03:33	1
2013-08-30	07:32	-	07:33	2
2013-08-30	07:55	-	07:55	1
2013-08-30	08:33	-	08:34	2
2013-08-30	08:37	-	08:37	1
2013-08-30	08:56	-	08:58	3
2013-08-30	09:00	-	09:59	60
2013-08-30	10:08	-	10:08	1
2013-08-31	03:07	-	03:07	1
2013-08-31	03:10	-	03:10	1
2013-08-31	03:48	-	03:48	1

```
2013-08-31  07:20  -  07:21  2
2013-08-31  10:15  -  10:16  2
2013-08-31  10:18  -  10:18  1
2013-09-01  00:01  -
2013-11-27         -  23:59  126719
2013-12-26  05:38  -  05:41  4
2013-12-26  06:50  -  06:50  1
2013-12-30  09:50  -  10:08  19
2013-12-31  10:29  -  10:29  1


Table A.12. Summary of 2013 data losses from Australian
observatories.
-------------------------------------------------------
Observatory Vector          Scalar
           (minutes)   (%)  (minutes)   (%)
Cocos (Keeling)Islands
            1456     0.28   127589  24.27

Appendix C. Variometer configurations
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Staff
-----
Table 3. Canberra-based staff.
-----------------------------
Name Classification Responsibility
Adrian Hitchman EL2 Section Leader
Peter Crosthwaite EL1
  Digital acquisition, system and software development
  and maintenance; Canberra, Cocos-Keeling Islands and
  Mawson observatories
Bill Jones APS6
  Observatory and system scientific and technical support;
  Alice Springs, Learmonth and Casey observatories
Andrew Lewis EL1
  Operations Manager; Australian Geomagnetic Reference
  Field model; Charters Towers, Learmonth, Gnangara and
  Gingin observatories
Liejun Wang EL1
  Information management; compass calibrations; Kakadu and
  Macquarie Island observatories
Jim Whatman APS6
  Technical support

Table 4. Observatory-based staff.
--------------------------------
Name Organisation/Company Observatory Period

Trevor Menadue BoM Cocos-Keeling Islands
  January 2013
Will Tankard BoM Cocos-Keeling Islands
  January - December 2013
Sean Fitzgerald BoM Cocos-Keeling Islands
  January - February 2013
Alana Moore BoM Cocos-Keeling Islands
  March - April 2013
Matthew Price BoM Cocos-Keeling Islands
  June - July 2013
Michael Conway BoM Cocos-Keeling Islands
  August - December 2013
```

```
                < END >
```

7.1.1.2 2014

```
                                 CKI
        COCOS-KEELING ISLANDS OBSERVATORY INFORMATION 2014
ACKNOWLEDGE-  Users of the CKI data should acknowledge:
      -MENTS: Geoscience Australia

STATION ID:   CKI

LOCATION:     West Island, Cocos-Keeling Islands,
              Western Australia, Australia

ORGANISATION: Geoscience Australia

CO-LATITUDE:  102.1874 Deg.
LONGITUDE:    96.8336 Deg. E
ELEVATION:    4.9 metres AMSL

ABSOLUTE
INSTRUMENTS:  DI-fluxgate magnetometer (DIM)
              GSM90 Overhauser-effect magnetometer

RECORDING
VARIOMETER:   Three component suspended DTU fluxgate
              magnetometer (FGE-K2); Total field
              Overhauser-effect magnetometer (GSM90)

ORIENTATION:  The two horizontal fluxgate channels were
              aligned equally about the magnetic meridian
              at the time of installation. The third
              fluxgate channel is vertical. (ABZ)

DYNAMIC RANGE:+/- 1600 nT

RESOLUTION:   0.032 nT

SAMPLING RATE:1 second

FILTER TYPE:  Intermagnet

BACKUP
VARIOMETER:   none

K-NUMBERS:    none
K9-LIMIT:     280 nT

GINS:         Edinburgh
SATELLITE:    Http upload


OBSERVERS:    Michael Conway
              Joshua Hofman
              Will Tankard
              Alana Moore
              Andrew Lewis
              Liejun Wang
```

CONTACT: Geomagnetism Project
Geoscience Australia
G.P.O. Box 378
Canberra, A.C.T., 2601
Australia

Tel: + 61-2-6249-9111
Fax: + 61-2-6249-9986
e-mail: geomag@ga.gov.au
WWW: http://www.ga.gov.au

NOTES:

Cocos-Keeling Islands Geomagnetic Observatory is located on West Island, Cocos-Keeling Islands in the Indian Ocean (in the jurisdiction of Western Australia). It is located close to the Bureau of Meteorology's weather station, in a narrow strip between the airstrip and the lagoon, and shares its surroundings with a golf course. Geoscience Australia (GA) also operates a GNSS base station nearby, and a CTBT Infrasound station on the island. Planning for the magnetic observatory began in 2008 when Professor Andrew Jackson, Swiss Federal Institute of Technology (ETH) approached Geoscience Australia. In 2009 the Australian Ionospheric Prediction Service (IPS), part of the Australian Bureau of Meteorology (BoM), joined the planning process. IPS constructed the variometer enclosure, and the observatory was equipped by GA in August 2011 with a solar powered variometer system with radio telemetry to the BoM station; variometer and absolute equipment were provided by GA and ETH. The vector variometer demonstrated enormous baseline drifts and was unusable; it was replaced in March 2012, and delivered acceptable data from then. CKI was accepted as an INTERMAGNET observatory on 2013-12-16.

The magnetic observatory comprises:

* a concrete-brick vector variometer enclosure, with foam/fibreglass roof, where the vector variometer sensor and electronics, and scalar variometer electronics are housed;
* a concrete-brick scalar variometer sensor enclosure;
* a fibreglass box under 4 solar panels containing solar power system, acquisition computer, radio telemetry equipment;
* a radio mast and antenna;
* (within the BoM) a radio telemetry receiver connected to the BoM network;
* a marble-topped fibreglass absolute pier, lightly protected from wind and sun;
* auxiliary repeat-stations for historical connection and observatory security.

Key data for the observatory are given in Table 1.

Table 1. Key observatory data.

IAGA code:	CKI
Commenced operation:	01 April 2012

```
Geographic latitude:      12d 11' 14.8" S
Geographic longitude:     96d 50' 01.0" E
Geomagnetic latitude:     21d 37' 48.0" S
Geomagnetic longitude:    168d 54' 36.0 E
K 9 index lower limit:    280 nT
Principal pier:           Pier AO
Pier elevation (top):     4.9 m AMSL
Principal reference mark: Windsock
Reference mark azimuth:   256d 15' 17"
Reference mark distance:  370 m
Observers:
    M. Conway
    J. Hofman
    W. Tankard
    A. Moore
    A. Lewis (GA)
    L. Wang (GA)
```

Local meteorological conditions

The meteorological temperature at CKI during 2014 varied from a minimum +22.2 C (2014-06-25) to a maximum +32.5 C (2014-02-13). Daily minimum temperatures varied from +22.2 C to +28.0 C (average +25.3+/-1.1 C); daily maximum temperatures varied from +26.4 C to +32.5 C (average +29.5+/-1.1 C); daily temperature ranges varied from 1.5 C to 7.9 C (average 4.2+/-1.0 C).

The daily maximum wind gust varied from 19 to 102 km/h (average 43.1+/-10.8 km/h). The maximum wind gust was recorded on 2014-12-25 when Category one tropical cyclone Kate passed nearby. This cyclone did not cause any damage to the observatory.

Variometers

The variometers used during 2014 are described in Table 2.

Analogue outputs from the three fluxgate sensors, and the sensor and electronics temperatures, were converted to digital data using an ADAM 4017 analogue-to-digital converter mounted inside the fluxgate electronics unit. These data and the digital PPM data were recorded on the data acquisition computer located in the Solar Power "Green Box".

The magnetic sensors were located in the concrete above ground vaults. Both vaults were fairly well insulated to minimise short period temperature fluctuations.

The equipment is completely self-contained. The only outside connection is a radio-link for communications; data acquisition is not dependent on communications.

From installation in 2011-08, the vector variometer enclosure suffered from leakage through the roof, accumulating several centimetres of water inside. The fluxgate variometers were unstable - it is possible that high humidity was the cause of the instability. In 2012-07 the roofs of both the scalar and vector enclosures were covered with fibreglass solving the leakage problem.

Silica gel was installed inside the cover of the DMI fluxgate sensor. The equipment has been reasonably stable since then, although there remains occasional unexplained vector variometer misbehaviour.

The scalar variometer began to fail in 2013-09, data quality deteriorated over time. The electronics was replaced during a maintenance visit 2013-11/2013-12, and data quality has been good throughout 2014.

The DMI FGE variometer scale-value, alignment, and temperature sensitivity parameters were measured at the magnetometer calibration facility at Canberra observatory before installation at CKI. The sensor assembly was aligned with the two horizontal fluxgate sensors at 45d to the declination at the time of installation and the Z fluxgate sensor vertical. To achieve this alignment at the time of installation, the sensor is rotated horizontally until the X and Y ordinates are equally about geomagnetic north. This method has been found to be accurate using tests performed at the calibration facility.

The fluxgate sensor was bumped during the removal of a wooden box during a maintenance visit on 2014-07-20. Later absolute observation data showed that the sensor had been rotated by 12'.

The variometer system is not temperature regulated, but for 2014 was reasonably stable. The DMI sensor daily average temperature ranged from 28.6 C (2014-07-16)to 33.4 C (2014-12-09) during the year. The DMI electronics temperature ranged from 32.1 C (2014-06-19) to 37.0 C (2014-12-08); its daily variation was very similar to the sensor temperature. The sensor was very near the electronics and protected by an extra layer of foam insulation.

Variometer data timing was controlled by the QNX data-acquisition computer clock which was maintained using both the 1 PPS and data stream output of a GPS clock. A small error occasionally occurred just after computer resets which was corrected within a few minutes. Time corrections were logged automatically.

Table 2. Magnetic variometers used in 2014.

3-component variometer:	DMI FGE
Serial number:	E0461 / S0250 (since Mar 2012)
Type:	suspended; linear-core fluxgate
Orientation:	NW, NE, Z
Acquisition interval:	1 s
A/D converter:	ADAM 4017 module (+/-5V)
Scale value:	0.032 nT / count
Total-field variometer:	GEM Systems GSM90
Serial number:	3106198 / 03768 (Dec)
Type:	Overhauser effect
Acquisition interval:	10 s
Resolution:	0.01 nT
Data acquisition system:	ARK3360 computer, QNX6.5 OS
Timing:	Garmin GPS clock
Communications:	Freewave radio link to BoM office,

Internet through BoM

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock about once per minute. During 2014, 360 adjustments to the system of less than 1 ms were made. There were also 2 adjustments in excess of 10ms and these are reported below.

```
2014-05-19   04:51:41.0 +1,018 s, System restart
2014-06-19   07:46:49.1 +0.425 s
```

Absolute instruments

The principal absolute magnetometers used at Cocos-Keeling Islands and their adopted corrections for 2014 are described in Table 3.

DIM observations were performed using the offset method. All DIM and PPM measurements were made on the principal pier at the standard height except during a period July-August when there was no working absolute PPM; during that time the variometer PPM data was used.

Table 3 describes the corrections applied to the absolute magnetometers to align them with the Australian reference instruments held in Canberra.

At the 2014 mean magnetic field values at Cocos-Keeling Islands the D, I and F corrections translate to corrections of:

dX = 0.0 nT   dY = 0.0 nT   dZ = 0.0 nT

These instrument corrections have been applied to the data described in this report and to other published definitive data.

The CKI standard absolute instrument DIM (DI0134D/359142) was compared to the travelling reference instrument (B0610H/160459) during a maintenance visit in 2014-11. Two separate instrument comparisons were made, one on 2014-11-26/27 and the other on 2014-11-28 on pier AO using the standard windsock azimuth mark. The instrument differences were calculated through baselines using the CKI variometer. The instrument differences measured in 2014-11 indicate corrections to DI0134D/359142 of 0.00' in declination and -0.15' in inclination. More instrument comparisons will be carried out in 2015 to confirm new correction value for inclination.

Table 3. Absolute magnetometers
----
and their adopted corrections for 2014.
Corrections are applied in the sense
Standard =Instrument + correction.

DI fluxgate: DMI

```
Serial number:  DI0134
Theodolite:     Zeiss 020B
Serial number:  359142
Resolution:     0.1'
D correction:   0.0'
I correction:   0.0'
Total-field magnetometer:  GEM Systems GSM90
Serial number:  3091316 / 761100
Type:           Overhauser effect
Resolution:     0.01 nT
Correction:     0.00 nT

Baselines
---------
Acceptable observations were made on 36 days during 2014
weekly observation, and 4 days during 2014-11 visit.
Usually a pair of observations was made on each of those
days. Baselines measurements used two DI theodolite
magnetometers, two absolute scalar magnetometers, and at
times the variometer scalar magnetometer corrected to the
absolute pier.

The variometer baseline drifts were within 4nT range for X
and Y channels, and 7nT range for Z channel. Piecewise
linear drifts were applied to the observed baseline
residuals from the weekly absolute observations.

There were baseline steps in XYZ on 2014-07-20 due to the
variometer sensor being bumped during the maintenance.
The steps were
X:   3.24 nT
Y: 123.69 nT
Z:   0.0  nT

Over the period 2014-06-14 to 2014-06-15, 2014-07-08
to 2017-07-20, unexplained Z behaviour occurred in the
variometer data. Z(C) channel was discarded, and
recovered using the remaining 2 channels of the vector
variometer and the scalar variometer data channel.

The periods of Z channel data recovery were:
2014-06-14T23:50 - 2014-06-15T05:00
2014-06-15T16:00 - 2014-06-15T17:30
2014-06-15T18:30 - 2014-06-15T20:00
2014-06-15T22:43 - 2014-06-15T22:47
2014-07-08T13:40 - 2014-07-20T04:28
The value of Fv - Fs can only be 0 (within rounding and
drift tolerances) during periods of data recovery.

The final Fv-Fs values for the year varied from -0.2nT to
0.5nT. The means and standard deviations of the weekly
absolute observations from the final adopted variometer
model and data were:

     mean      stdev
X  -0.0 nT    0.3 nT
Y  -0.3 nT    1.0 nT
Z  +0.1 nT    0.3 nT
D  -2"        6"
I  +0"        2"
F  -0.1 nT    0.2 nT
```

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2014 CKI definitive data and real time reported 1-minute data sets (CKI definitive - CKI real time) were:

	X	Y	Z
Average	-0.1	+8.2	+0.5
Std.dev	+1.1	+20.5	+1.1
Min	-2.1	-2.4	-2.3
Max	+1.3	+55.7	+2.1

The CKI 2014 reported real time data are not within the specification for INTERMAGNET Quasi-definitive data due to the Y channel. The larger standard deviation in Y channel is caused by 123 nT baseline change on 2014-07-20 and the baseline change was not corrected until later absolute observations were processed.

The annual statistics of the 12 monthly averages of the difference between the 2014 CKI definitive data and quasi-definitive 1-minute data sets (CKI definitive - CKI quasi-definitive) were:

	X	Y	Z
Average	-0.1	-0.2	+0.1
Std.dev	+0.2	+0.5	+0.2
Min	-0.4	-1.2	-0.1
Max	+0.2	+0.6	+0.6

The CKI 2014 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The observing staff of the Bureau of Meteorology operate the geomagnetic observatory, including making weekly absolute observations. The only absolute observation training conducted by staff of the GA geomagnetism section was a very brief introduction to Trevor Menadue at the end of the initial installation of equipment in 2011-08 (with not all absolute equipment operational), and a more reasonable introduction to Michael Conway in 2013-12. There were manuals and instructions provided. There has been a high turnover of observers (by the norms of geomagnetic observations at least), and most observers have had their training handed down from their predecessors, who themselves had similar less-than-adequate training. Under the circumstances, it is fortuitous that acceptable observations were made and good quality data could be delivered. The Bureau staff has provided excellent assistance and quality observations. Will Tankard made observations when on duty throughout 2013, and his last observation was on 2014-01-14, and then Joshua Hofman took over the duty. Through 2014, both Joshua and Michael were the primary observers.

The observatory is on a mown grass area, surrounded by an invasive plant "cabbage bush", coconut palms, other trees, a golf course and airstrip apron. It is very close to the atoll's lagoon. It is necessary to mow around the observatory, including the variometer, to keep the observatory from being consumed by cabbage bush, and so there are regular monthly data losses for a few hours. This is unavoidable. There are other data losses that may be caused by golfers, bird watchers, tourists in general, but these are not documented.

When possible, the duty Bureau observer performed absolute observations weekly. Observations were recorded directly on a tablet PC (with a built-in GPS for setting the time to with a few seconds or better). The observation file was emailed to GA, where they were processed.

A GA technical officer visited the observatory on 2014-07-20 for a few days and replaced the silica gel inside the cover of the fluxgate magnetometer sensor. To gain access to the sensor a wooden box need to be dismantled. During dismantling the box collapsed onto the sensor. Later absolute observations indicated that the sensor had been rotated by about 12' from its original position. These absolute observations were used to adjust the variometer baselines.

Andrew Lewis and Liejun Wang visited the observatory from 2014-11-25 to 2014-11-29. During this visit they

* undertook checks and calibrations on the observatory equipment;
* re-measured station differences between the observatory pier and the repeat stations;
* replaced the Getac tablet PC;
* replaced the silica gel in the fluxgate magnetometer
* provided training to the local observers;
* carried out maintenance to the CTBTO infrasound station IS06

Data were retrieved from the data-acquisition system every 4 minutes using rsync over ssh in near real-time using the network connection.

The distribution of Cocos-Keeling Islands 2014 data is described in Table 4. Data losses are identified in Table A.1.

Table 4. Distribution of Cocos-Keeling Islands 2014 data.

Recipient	Status	Sent
1-second values		
IPS Radio and Space Services	preliminary	real time
WDC for Geomagnetism-Kyoto	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time
ETH, Zurich	preliminary	real time
WDC for Geomagnetism-Kyoto	preliminary	daily
INTERMAGNET	quasi-definitive	monthly
	definitive	August 2015

Significant events

```
2014-01-01  Will Tankard in final days before transfer
            to new posting, being replaced by
            Joshua Hofman.
2014-02-05  Main observers names are Michael Conway
            and Joshua Hofman during 2014.
2014-03-22  ~22:00, A channel misbehaved; offset and slow
            recovery.
2014-03-25  mowed around the variometer area this morning
            from about 0015-0035UTC.
2014-04-17/18
            Some Fv-Fs curiosity - an excursion of few
            tenths nT after 23: for an hour or so. No
            apparent cause. Ignore for QD data purposes.
2014-04-23  ~00:17 upgraded GdapClockGm, stopped and
            restarted rc.clock
2014-04-28  10:41:15 - 10:42:45 data errors
2014-05-09  Craig put vent in green box, new screws in
            variometer vault.
2014-05-19  Lost communication with CKI - Mike could http
            to radios from Cocos Met, and ping computer.
            However, we could not ssh to CKI - Contact
            failed about 2014-05-17 12:00,
            resumed 2014-05-18 00:00 and failed again at
            2014-05-18 04:00. Mike rebooted/etc/system/
            sysinit Wed Aug 07 04:52:35 UTC 2013 -
            System RESTART
            /etc/system/sysinit Mon May 19 04:49:31
            UTC 2014 - System RESTART
            Possibly large number of zombie data retrieval
            jobs clogged up the system?
            SOH did not restart.!!
            rc.acquisition is set to use ser1 but rc.soh is
            set to use ser6 - ser6 seems correct!
            rmdir /dev/soh then /etc/rc.d/rc.soh and it
            worked OK but ended up with two MachR's
            recording cks data.
            Stopped one MachR (cks) and deleted seq 04 -
            will results in a missing sequence next restart
            which may be a surprise.
2014-05-24  Unexplained event in Z variometer channel
            about 03:00
2014-06-02  Sent GSM90 cable for absolutes (exCKI
            3013-08/09 Tested OK PGC 2013-10-27 and
            2014-06-02) to KDU Andy Ralph)
2014-06-14/15
            M6.2 earthquake nearby well registered on
            magnetic records. Not felt at CKI.
            FCheck changes (cause unknown) apparently in Z
            channel.
2014-06-18  Can't communicate to ga-cki-mag1 computer -
            asked Michael/Josh to power off/on.
2014-06-19  Communication reestablished without
            intervention, however subsequently Michael
            responded to a request to power cycle the
            system
2014-06-20  Noticed that SOH was restarted by
            /etc/rc.d/rc.acquisition on /dev/ser1.
            Corrected to /dev/ser6.
2014-07-02  Sent QD 2014/06 after switch off Z various
            times, excluding various bad data periods
```

```
2014-07-07  Z channel of variometer suddenly went noisy.
            Weather has been windy, not particularly
            wet though.
2014-07-11  Joshua had a look in the variometer vault and
            found 2 species of ants nesting inside - he
            will look in the electronics for clues.
2014-07-18  Two SOH MachR's running since about day 171
            causing two files per day with different
            sequence numbers. One instance was stopped
            today. John Ruyssenaers (GA) due at CKI for
            maintenance trip. He will be replacing the
            silica gel in DMI sensor and electronics.
2014-07-20  John dismantled wooden box around sensor and
            it collapsed onto the sensor. He spent some
            time prying the cover off the sensor. Overall
            the process appears to have moved the sensor
            (later obs->12' rotation). He found that the
            existing Silica Gel was wet, and installed new
            Silica Gel into sensor.
2014-07-21  Removed remains of wooden box from sensor.
2014-07-22  Alana's obs indicate 12' rotation, no change
            in Z. To be confirmed with more obs next week.
2014-07-29  Grass cutting with shears (near Pier AO)
2014-08-15  ~08:40 disturbance - no known cause
2014-11-25/29
            Maintenance visit - AML/LJW.
            2014-11-26 replaced the silica gel in DMI
            sensor. comparisons, sunshots, rounds, obs on
            station D. swap out Getac #11 for Getac #14.
2014-12-03  Send replacement USB extension cable for
            keyboard and replacement PICO DB25 cable
            via express post
2014-12-15  Contamination - probably mowing.
2014-12-23  No obs this week - preparing for cyclone
            expected on 2014-12-25
2014-12-25/26
            Category 1 cyclone passed nearby - no damage
            to observatory.
2014-12-31  Joshua taking leave, Brayden Marshall
            standing in.


----------------------------------------------------------

Appendix A. Data losses
-----------------------

Table A.1. Cocos (Keeling) Islands data losses.
----------------------------------------------
Date       Interval(hh:mm)  Data loss (minutes)
Vector data (mainly due to system restart,
maintenance visit, mowing)

2014-01-22    XYZ     00:37 - 00:57  (21)
2014-01-24    XYZ     08:42 - 08:53  (12)
2014-01-24    XYZ     09:07 - 09:13  (7)
2014-02-03    XYZ     10:45 - 10:45  (1)
2014-02-09    XYZ     01:27 - 01:27  (1)
2014-02-22    XYZ     01:16 - 01:16  (1)
2014-03-09    XYZ     04:20 - 04:21  (2)
2014-03-25    XYZ     00:15 - 00:33  (19)
```

```
2014-04-28    XYZ     10:42 - 10:42  (1)
2014-05-07    XYZ     02:11 - 02:29  (19)
2014-05-19    XYZ     04:49 - 04:50  (2)
2014-06-14    XYZ     11:12 - 11:20  (9)
2014-06-19    XYZ     07:44 - 07:46  (3)
2014-06-20    XYZ     06:17 - 06:42  (26)
2014-06-22    XYZ     04:28 - 04:39  (12)
2014-07-07    XYZ     09:35 - 09:52  (18)
2014-07-11    XYZ     05:36 - 06:56  (81)
2014-07-20    XYZ     03:30 - 04:30  (61)
2014-07-21    XYZ     02:23 - 02:31  (9)
2014-08-15    XYZ     08:38 - 08:55  (18)
2014-09-17    XYZ     03:36 - 03:49  (14)
2014-09-23    XYZ     07:34 - 07:55  (22)
2014-09-27    XYZ     09:10 - 09:20  (11)
2014-10-19    XYZ     06:25 - 07:56  (92)
2014-10-22    XYZ     07:07 - 07:14  (8)
2014-11-13    XYZ     02:09 - 02:25  (17)
2014-11-17    XYZ     00:39 - 00:39  (1)
2014-11-17    XYZ     00:44 - 00:44  (1)
2014-11-25    XYZ     09:50 - 09:51  (2)
2014-11-26    XYZ     01:38 - 02:12  (35)
2014-11-26    XYZ     03:10 - 03:40  (31)
2014-12-03    XYZ     06:36 - 06:39  (4)
2014-12-15    XYZ     05:13 - 05:55  (43)

Total: 604

Scalar data
2014-01-22    F      00:37 - 00:56  (20)
2014-01-24    F      08:42 - 08:53  (12)
2014-01-24    F      09:07 - 09:12  (6)
2014-02-09    F      01:27 - 01:27  (1)
2014-02-22    F      01:16 - 01:16  (1)
2014-03-09    F      04:21 - 04:21  (1)
2014-03-25    F      00:15 - 00:33  (19)
2014-04-28    F      10:42 - 10:42  (1)
2014-05-07    F      02:11 - 02:29  (19)
2014-05-19    F      04:49 - 04:49  (1)
2014-06-14    F      11:13 - 11:20  (8)
2014-06-19    F      07:44 - 07:45  (2)
2014-06-20    F      06:17 - 06:42  (26)
2014-06-22    F      04:29 - 04:39  (11)
2014-07-07    F      09:35 - 09:52  (18)
2014-07-11    F      05:36 - 06:56  (81)
2014-07-20    F      03:31 - 04:29  (59)
2014-07-21    F      02:23 - 02:31  (9)
2014-08-15    F      08:38 - 08:55  (18)
2014-09-17    F      03:37 - 03:49  (13)
2014-09-23    F      07:34 - 07:55  (22)
2014-09-27    F      09:10 - 09:19  (10)
2014-10-19    F      06:26 - 07:56  (91)
2014-10-22    F      07:08 - 07:14  (7)
2014-11-13    F      02:10 - 02:25  (16)
2014-11-17    F      00:39 - 00:39  (1)
2014-11-17    F      00:44 - 00:44  (1)
2014-11-25    F      09:50 - 09:51  (2)
2014-11-26    F      01:38 - 02:12  (35)
2014-11-26    F      03:11 - 03:40  (30)
2014-12-15    F      05:14 - 05:54  (41)
```

Total: 582

Table A.2. Summary of 2014 data losses from Australian observatories.

Observatory	Vector (minutes)	(%)	Scalar (minutes)	(%)
Cocos (Keeling)Islands	604	0.12	582	0.11

< END >

7.1.1.3 2015

CKI

COCOS-KEELING ISLANDS OBSERVATORY INFORMATION 2015

ACKNOWLEDGE- -MENTS: Users of the CKI data should acknowledge: Geoscience Australia

STATION ID: CKI

LOCATION: West Island, Cocos-Keeling Islands, Western Australia, Australia

ORGANISATION: Geoscience Australia

CO-LATITUDE: 102.1874 Deg.
LONGITUDE: 96.8336 Deg. E
ELEVATION: 4.9 metres AMSL

ABSOLUTE INSTRUMENTS: DI-fluxgate magnetometer (DIM)
GSM90 Overhauser-effect magnetometer

RECORDING VARIOMETER: Three component suspended DTU fluxgate magnetometer (FGE-K2); Total field Overhauser-effect magnetometer (GSM90)

ORIENTATION: The two horizontal fluxgate channels were aligned equally about the magnetic meridian at the time of installation. The third fluxgate channel is vertical. (ABZ)

DYNAMIC RANGE:+/- 1600 nT

RESOLUTION: 0.032 nT

SAMPLING RATE:1 second

FILTER TYPE: Intermagnet

BACKUP VARIOMETER: none

K-NUMBERS: none
K9-LIMIT: 280 nT

GINS: Edinburgh
SATELLITE: Http upload

OBSERVERS: Michael Conway
Joshua Hofman

CONTACT: Geomagnetism Project
Geoscience Australia
G.P.O. Box 378
Canberra, A.C.T., 2601
Australia

Tel: + 61-2-6249-9111
Fax: + 61-2-6249-9986
e-mail: geomag@ga.gov.au
WWW: http://www.ga.gov.au

NOTES:

Cocos-Keeling Islands Geomagnetic Observatory is located on West Island, Cocos-Keeling Islands in the Indian Ocean (in the jurisdiction of Western Australia). It is located close to the Bureau of Meteorology's weather station, in a narrow strip between the airstrip and the lagoon, and shares its surroundings with a golf course. Geoscience Australia (GA) also operates a GNSS base station nearby, and a CTBT Infrasound station on the island. Planning for the magnetic observatory began in 2008 when Professor Andrew Jackson, Swiss Federal Institute of Technology (ETH) approached Geoscience Australia. In 2009 the Australian Ionospheric Prediction Service (IPS), part of the Australian Bureau of Meteorology (BoM), joined the planning process. IPS constructed the variometer enclosure, and the observatory was equipped by GA in August 2011 with a solar powered variometer system with radio telemetry to the BoM station; variometer and absolute equipment were provided by GA and ETH. The vector variometer demonstrated enormous baseline drifts and was unusable; it was replaced in March 2012, and delivered acceptable data from then. CKI was accepted as an INTERMAGNET observatory on 2013-12-16.

The magnetic observatory comprises:

* a concrete-brick vector variometer enclosure, with foam/fibreglass roof, where the vector variometer sensor and electronics, and scalar variometer electronics are housed;
* a concrete-brick scalar variometer sensor enclosure;
* a fibreglass box under 4 solar panels containing solar power system, acquisition computer, radio telemetry equipment;
* a radio mast and antenna;
* (within the BoM) a radio telemetry receiver connected to the BoM network;
* a marble-topped fibreglass absolute pier, lightly protected from wind and sun;
* auxiliary repeat-stations for historical connection and observatory security.

Key data for the observatory are given in Table 1.

Table 1. Key observatory data.

```
IAGA code:                CKI
Commenced operation:      01 April 2012
Geographic latitude:      12d 11' 14.8" S
Geographic longitude:     96d 50' 01.0" E
Geomagnetic latitude:     21d 37' 48.0" S
Geomagnetic longitude:    168d 54' 36.0 E
K 9 index lower limit:    280 nT
Principal pier:           Pier AO
Pier elevation (top):     4.9 m AMSL
Principal reference mark: Windsock
Reference mark azimuth:   256d 15' 17"
Reference mark distance:  370 m
Observers:    Michael Conway
              Joshua Hofman
```

Local meteorological conditions

The meteorological temperature at CKI during 2015 varied from a minimum +21.2 C (2015-08-11) to a maximum +32.8 C (2015-04-07). Daily minimum temperatures varied from +21.2 C to +28.3 C (average +25.3+/-1.1 C); daily maximum temperatures varied from +26.2 C to +32.8 C (average +29.6+/-1.1 C); daily temperature ranges varied from 1.4 C to 7.7 C (average 4.3+/-1.0 C).

The daily maximum wind gust varied from 19 to 87 km/h (average 40.3+/-10.1 km/h). The maximum wind gust was recorded on 2015-08-10.

All weather data is provided by the Australian Government Bureau of Meteorology.

Variometers

The variometers used during 2015 are described in Table 2.

Analogue outputs from the three fluxgate sensors, and the sensor and electronics temperatures, were converted to digital data using an ADAM 4017 analogue-to-digital converter mounted inside the fluxgate electronics unit. These data and the digital PPM data were recorded on the data acquisition computer located in the Solar Power "Green Cabinet".

The magnetic sensors were located in the concrete above ground vaults. Both vaults were fairly well insulated to minimise short period temperature fluctuations.

The equipment is completely self-contained. The only outside connection is a radio-link for communications; data acquisition is not dependent on communications.

From installation in 2011-08, the vector variometer enclosure suffered from leakage through the roof, accumulating several centimetres of water inside. The fluxgate variometers were unstable - it is possible that high humidity was the cause of the instability. In 2012-07 the roofs of both the scalar and vector enclosures were covered with fibreglass solving the leakage problem.

Silica gel was installed inside the cover of the DMI fluxgate sensor. The equipment has been reasonably stable since then, although there remains occasional vector variometer misbehaviour due to high humidity :
2015-03-21 to 03-23, unstable Y (B) channel.
2015-11-23 to 12-07, Z (C) channel failure.

The scalar variometer data quality has been good throughout 2015.

The DMI FGE variometer scale-value, alignment, and temperature sensitivity parameters were measured at the magnetometer calibration facility at Canberra observatory before installation at CKI. The sensor assembly was aligned with the two horizontal fluxgate sensors at 45d to the declination at the time of installation and the Z fluxgate sensor vertical. To achieve this alignment at the time of installation, the sensor is rotated horizontally until the X and Y ordinates are equally about geomagnetic north. This method has been found to be accurate using tests performed at the calibration facility.

The variometer system is not temperature regulated, but for 2015 was reasonably stable. The DMI sensor daily average temperature ranged from 28.2 C (2015-08-12) to 33.5 C (2015-12-23) during the year. The DMI electronics temperature ranged from 32.5 C (2015-08-12) to 38.0 C (2015-12-23); Electronics temperature daily variation was very similar to the sensor temperature. The sensor was very near the electronics and protected by an extra layer of foam insulation.

Variometer data timing was controlled by the QNX data-acquisition computer clock which was maintained using both the 1 PPS and data stream output of a GPS clock. A small error occasionally occurred just after computer resets which was corrected within a few minutes. Time corrections were logged automatically.

For the 2016 definitive data the vector and scalar data were not automatically spike filtered. Any spikes were removed by excluding vector data where appropriate.

Table 2. Magnetic variometers used in 2015.

3-component variometer:	DMI FGE
Serial number:	E0461 / S0250 (since Mar 2012)
Type:	suspended; linear-core fluxgate
Orientation:	NW, NE, Z
Acquisition interval:	1 s
A/D converter:	ADAM 4017 module (+/-5V)
Scale value:	0.032 nT / count
Total-field variometer:	GEM Systems GSM90
Serial number:	3106198 / 03768
Type:	Overhauser effect
Acquisition interval:	10 s
Resolution:	0.01 nT
Data acquisition system:	ARK3360 computer, QNX6.5 OS
Timing:	Garmin GPS clock
Communications:	Freewave radio link to BoM office, Internet through BoM

```
Variometer clock corrections
----------------------------
Time stamps applied to the variometer data were obtained
from the acquisition computer system clock. That clock was
synchronised to a GPS clock about once per minute. During
2015, total 371 adjustments to the system were made.
There were also 6 adjustments in excess of 10 ms and
these are reported below.

2015-01-27  05:42:03     1.073 s  System reboot
2015-05-11  07:25:57     0.717 s
2015-07-01  00:00:40    -1.000 s  leap second correction

2015-10-09  23:05:20    backward time jump
2015-10-09  23:03:51    -107.000 s recorded, actually -90s.

2015-10-09  23:15:20    107.000 s
2015-10-09  23:17:08    time correction

2015-11-23  22:51:54     1.107 s  System reboot

During the clock error period from 23:05:21 to 23:17:07,
the system recorded 691s data points with wrong timestamps
over a period of 707s. Data from 23:05:21 to 23:17:07 are
excluded in the final report.


Absolute instruments
--------------------
The principal absolute magnetometers used at Cocos-Keeling
Islands and their adopted corrections for 2015 are
described in Table 3.

DIM observations were performed using the offset method.
All DIM and PPM measurements were made on the principal
pier at the standard height except during a period
June-July when there was a PPM cable problem; during
that time the variometer PPM data were used.

There were no obs for two weeks during July, as the Pico
data logger GJY03/123 failed. Pico data logger GJY03/129
was posted to replace the faulty Pico unit on 2015-08-03.

Table 3 describes the corrections applied to the absolute
magnetometers to align them with the Australian reference
instruments held in Canberra.

At the 2015 mean magnetic field values at Cocos-Keeling
Islands the D, I and F corrections translate to corrections
of:

dX = 0.0 nT    dY = 0.0 nT    dZ = 0.0 nT

These instrument corrections have been applied to the data
described in this report and to other published definitive
data.

The CKI standard absolute instrument DIM (DI0134D/359142)
was compared to the travelling reference instrument
(B0610H/160459) during a maintenance visit in 2014-11.
```

Results were reported in the 2014 readme file.
There was no instrument comparison during 2015.

Table 3. Absolute magnetometers
----
and their adopted corrections for 2015.
Corrections are applied in the sense
Standard =Instrument + correction.

```
DI fluxgate:    DMI
Serial number:  DI0134
Theodolite:     Zeiss 020B
Serial number:  359142
Resolution:     0.1'
D correction:   0.0'
I correction:   0.0'
Pico Data logger: GJY03/123 (to 2015-07-22)
                  GJY03/129 (from 2015-08-03)
Total-field magnetometer:  GEM Systems GSM90
Serial number:  3091316 / 761100
Type:           Overhauser effect
Resolution:     0.01 nT
Correction:     0.00 nT
```

Baselines

Acceptable observations were made on 42 days during 2015 weekly observation. Usually a pair of observations was made on each of those days using the absolute instruments listed in Table 3.

The variometer baseline drifts were within 4nT range for X and Y channels, and 5nT range for Z channel. Piecewise linear drifts were applied to the observed baseline residuals from the weekly absolute observations.

On 2015-11-23, C (Z) started to drift downward at 15:00, and drifted rapidly, then followed by 1 hour of very noisy data and intermittent spikes. The problem was caused by excessive moisture inside the DMI variometer sensor unit as experienced in the previous years.

The silica gel sachets inside the variometer dome were replaced on 2015-12-07, and the Z channel re-commenced operating shortly afterwards.

The periods of 2015-11-23 and 2015-12-07, Z(C) channel was discarded, and recovered using the remaining 2 channels of the vector variometer and the scalar variometer data channel. The value of Fv-Fs can only be 0 (within rounding and drift tolerances) during periods of data recovery.

The final Fv-Fs values for the year varied from -0.25nT to 0.50nT. The means and standard deviations of the weekly absolute observations from the final adopted variometer model and data were:

```
   Mean
X  +0.0 nT
Y  +0.1 nT
```

Z +0.1 nT
D +0.3"
I +0.1"
F -0.0 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2015 CKI definitive data and real time reported 1-minute data sets (CKI definitive - CKI real time) were:

	X	Y	Z
Average	+0.6	-1.2	-1959.5
Std.dev	+0.7	+1.5	4901.1
Min	-0.8	-2.7	-15870.1
Max	+1.4	+0.7	+1.5

The CKI 2015 reported real time data are not within the specification for INTERMAGNET Quasi-definitive data due to the Z channel misbehaviour during 2015-11-23 and 2015-12-07. Z(C) channel was recovered using the remaining 2 channels of the vector variometer and the scalar variometer data in Quasi-definitive and definitive data

The annual statistics of the 12 monthly averages of the difference between the 2015 CKI definitive data and quasi-definitive 1-minute data sets (CKI definitive - CKI quasi-definitive) were:

	X	Y	Z
Average	+0.5	-0.7	+0.1
Std.dev	+0.7	+1.1	+0.7
Min	-0.7	-2.3	-1.7
Max	+1.4	+0.7	+1.1

The CKI 2015 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The observing staff of the Bureau of Meteorology operate the geomagnetic observatory, including making weekly absolute observations. Through 2015, Joshua and Michael were the primary observers.

The observatory is on a mown grass area, surrounded by an invasive plant "cabbage bush", coconut palms, other trees, a golf course and airstrip apron. It is very close to the atoll's lagoon. It is necessary to mow around the observatory, including the variometer, to keep the observatory from being consumed by cabbage bush, and so there are regular monthly data losses for a few hours. This is unavoidable. There are other data losses that may be caused by golfers, bird watchers, tourists in general, but these are not documented.

When possible, the duty Bureau observer performed absolute observations weekly. Observations were recorded directly on a tablet PC (with a built-in GPS for setting the time to with a few seconds or better). The observation files were emailed to GA, where they were processed.

Data were retrieved from the data-acquisition system every 4 minutes using rsync over ssh in near real-time using the network connection.

The distribution of Cocos-Keeling Islands 2015 data is described in Table 4. Data losses are identified in Table A.1.

Table 4. Distribution of Cocos-Keeling Islands 2015 data.

Recipient	Status	Sent
1-second values		
BoM SWS	preliminary	real time
WDC for Geomagnetism-Kyoto	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time
ETH, Zurich	preliminary	real time
WDC for Geomagnetism-Kyoto	preliminary	daily
INTERMAGNET	quasi-definitive	monthly
	definitive	August 2016

Significant events

2015-01-27	netstat -a and ps -A shows many zombie sshd, sh and rsync jobs on system 05:41:40 scheduled reboot to clear system
2015-03-21	12:44-12:51 apparently problems on Y/B channel; this is the most serious phase, but there are problems around this time probably from the same B channel problem. 21/03 to 23/04
2015-03-31	08:30-10 Fcheck jump and contamination.
2015-04-03	Mowing around the variometer 06:40
2015-04-16	Test new 4 wheel absolute cart for magnetism at GA. The safe distance is 15 m
2015-04-21	Send new absolute instrument trolley to Perth for on forwarding to CKI BoM office
2015-04-30	ppm reading quality is "c" in the first set and mix of "a" and "c" and in the second set.
2015-05-07	New absolute trolley received at CKI. The trolley must be at least 15 m from the pier during observations to avoid contamination.
2015-05-08	02:32 lost comms to system
2015-05-11	07:00 Joshua checks radios and system in green box - all looks good - he logs in using the Getac and runs GdapCALs (not entirely successfully) but confirms that the PC is running. 07:20 (approx) Joshua reboots system by cycling power
2015-05-14	Joshua checks radio at remote (greenbox)end all OK. Check cabling and Met network as far as rack to local radio - all OK Confirm network status lights on local radio do not function.
2015-05-18	noise in XYZ and F between 00:24:00 to 00:41:20

2015-05-27	Michael has problems with absolute PPM and then Gobs software crashes. Only gets up to eu on forward obs, #c quality on PPM so obs are not useable and have not been added to the abs.obs file. Send helpful tips.
2015-06-16	05 UT new network radios installed and comms re-instated.
2015-06-17	processed obs data files from 19 May to 17 June. XYZ baselines look all ok.
2015-06-23	02 UT lost comms
2015-06-24	Tripped electrical circuit breaker found on geomag/geodesy rack. Reset and repower equipment. Michael away for 2 weeks, stand-in observer will be Alana. She has done observations before.
2015-06-25	a GSM90 cable and an 9 pin extension cable were posted to CKI.
2015-06-30	No F reading on AO in the absolute observation due to the faulty PPM cable. using scalar variometer data (vault) as the absolute PPM on AO. Pier dif: PPM (AO) = 3 (FV) + variometer PPM.
2015-07-06	05:30 mowing around variometer
2015-07-09	new PPM power cables arrived. Time on Gtac was not corrected before taking obs. Time fields on the obs data need -18s adjustment. extract -A -00:00:18 190
2015-07-13	created a scan job for CKI 1s reported data. 1s data to Intermagnet hourly.
2015-07-15	posted (MN4275690)a pico (ADC16, GJY03/129) and a cable to CKI. Joshua (last week) and Alana (today) both had a problem of getting data to Getac via the Pico box.
2015-07-22	No F reading as Michael could not get the PPM working. unknown reasons. using scalar variometer data as the absolute PPM on AO. Last obs used pico s/n GJY03/123
2015-08-03	No obs for last week. changed the pico s/n to GJY03/129 from this week
2015-08-10	Obs mark readings are wrong with 12.0' difference. Also PPM triaxial cable has a problem and this looks to be the problem with the PPM readings. Discarded this set of obs data. No obs for the last three weeks.
2015-08-17	Craig took a new PPM sensor cable and Poly-tarp to CKI.
2015-08-20	The new PPM sensor cable used in the absolute observation from this week.
2015-09-22	Activities around the observatory with cabbage-bush pruning, cross-country runs.
2015-10-08	05-05:25 trimming cabbage bush around observatory - contamination. Noted car tracks through the observatory grounds. - unknown timing.
2015-10-09	23:04 107s backward time jump in data.
2015-10-28	Poor connection between keyboard USB and Getac. No obs. Afterwards, tested ok at the office.
2015-11-10	Sent USB 90 degrees adapter x 2 and one Port saver for Getac.
2015-11-23	Z (C) channel failure

```
              15:00   Z channel starts to drift downward
              16:45:15 Z channel very rapid drift down
              followed by 1 hour of very noisy data and
              then rapid drift up with intermittent spikes.
              22:50 Reboot system. Rapid drift in Z channel
              continues.
2015-11-25    Theodolite on the cement pad was knocked over
              and fell on the pad. It fell on the side of
              mirror reflector. The theodolite looks
              undamaged by checking the absolute
              observations.
              Sent 10 sachets of Silica gel moisture
              absorber to CKI.  Toll Global: 813009011614.
2015-12-07    Silica gel arrived at CKI. Josh seeks
              permission from BOM to work in a confined
              space.
2015-12-11    Planed to change silica gel on 15 Dec.
2015-12-15    ~00:54 The silica replacement job has been
              completed. No immediate improvement in Z
              channel.
2015-12-16    Faulty Z channel of the magnetometer has
              come good again from 08:00 15 Dec. Small step
              in Z baseline 1.7nT(?)
---------------------------------------------------------

Appendix A. Data losses
-----------------------

Table A.1. Cocos (Keeling) Islands data losses.
----------------------------------------------
Date       Interval(hh:mm)  Data loss (minutes)
Vector data (mainly due to system restart,
maintenance visit, mowing)

2015-01-27    XYZ     05:41 - 05:41  (1)
2015-02-01    XYZ     16:52 - 16:52  (1)
2015-02-11    XYZ     11:03 - 11:04  (2)
2015-02-12    XYZ     05:06 - 05:20  (15)
2015-03-21    XYZ     12:40 - 13:00  (21)
2015-03-25    XYZ     10:59 - 10:59  (1)
2015-03-31    XYZ     08:44 - 09:49  (66)
2015-04-03    XYZ     06:42 - 07:02  (21)
2015-05-11    XYZ     06:34 - 06:54  (21)
2015-05-11    XYZ     07:24 - 07:25  (2)
2015-05-12    XYZ     02:00 - 02:00  (1)
2015-05-18    XYZ     00:24 - 00:41  (18)
2015-06-12    XYZ     02:55 - 03:01  (7)
2015-06-23    XYZ     02:04 - 02:05  (2)
2015-07-06    XYZ     05:17 - 05:34  (18)
2015-09-05    XYZ     01:09 - 01:12  (4)
2015-09-09    XYZ     10:50 - 10:50  (1)
2015-09-09    XYZ     18:32 - 18:32  (1)
2015-09-09    XYZ     22:17 - 22:17  (1)
2015-10-05    XYZ     13:51 - 13:51  (1)
2015-10-08    XYZ     05:15 - 05:16  (2)
2015-10-09    XYZ     23:16 - 23:17  (2)
2015-10-14    XYZ     08:12 - 08:31  (20)
2015-11-18    XYZ     15:31 - 15:31  (1)
2015-11-23    XYZ     22:50 - 22:51  (2)
2015-12-15    XYZ     00:38 - 01:00  (23)
2015-12-20    XYZ     18:30 - 18:31  (2)
```

```
2015-12-20    XYZ     20:23 - 20:23  (1)
2015-12-31    XYZ     13:15 - 13:15  (1)

Total: 259

Scalar data
2015-01-27    F      05:41 - 05:41  (1)
2015-02-01    F      16:52 - 16:52  (1)
2015-02-11    F      11:03 - 11:04  (2)
2015-03-25    F      10:59 - 10:59  (1)
2015-03-31    F      08:44 - 09:49  (66)
2015-04-03    F      06:42 - 07:02  (21)
2015-04-14    F      15:15 - 15:15  (1)
2015-05-11    F      06:34 - 06:54  (21)
2015-05-11    F      07:24 - 07:25  (2)
2015-05-12    F      02:00 - 02:00  (1)
2015-05-18    F      00:24 - 00:41  (18)
2015-06-12    F      02:55 - 03:01  (7)
2015-06-22    F      19:44 - 19:44  (1)
2015-06-23    F      02:04 - 02:05  (2)
2015-07-06    F      05:17 - 05:34  (18)
2015-09-05    F      01:09 - 01:12  (4)
2015-09-09    F      10:50 - 10:50  (1)
2015-09-09    F      18:32 - 18:32  (1)
2015-09-09    F      22:17 - 22:17  (1)
2015-09-11    F      14:28 - 14:29  (2)
2015-10-05    F      13:51 - 13:51  (1)
2015-10-08    F      05:14 - 05:16  (3)
2015-10-09    F      23:06 - 23:17  (12)
2015-10-13    F      15:01 - 15:01  (1)
2015-10-14    F      08:11 - 08:32  (22)
2015-10-26    F      09:26 - 09:27  (2)
2015-11-18    F      15:31 - 15:31  (1)
2015-11-23    F      22:50 - 22:51  (2)
2015-11-28    F      09:35 - 09:35  (1)
2015-12-15    F      00:38 - 01:00  (23)
2015-12-20    F      18:30 - 18:31  (2)
2015-12-20    F      20:23 - 20:24  (2)
2015-12-31    F      13:15 - 13:15  (1)

Total: 245

                     < END >
```

7.1.1.4 2016

```
                                  CKI
        COCOS-KEELING ISLANDS OBSERVATORY INFORMATION 2016
ACKNOWLEDGE-  Users of the CKI data should acknowledge:
      -MENTS: Geoscience Australia

STATION ID:   CKI

LOCATION:     West Island, Cocos-Keeling Islands,
              Western Australia, Australia

ORGANISATION: Geoscience Australia

CO-LATITUDE:  102.1874 Deg.
```

```
LONGITUDE:    96.8336 Deg. E
ELEVATION:    4.9 metres AMSL

ABSOLUTE
INSTRUMENTS:  DI-fluxgate magnetometer (DIM)
              GSM90 Overhauser-effect magnetometer

RECORDING
VARIOMETER:   Three component suspended DTU fluxgate
              magnetometer (FGE-K2); Total field
              Overhauser-effect magnetometer (GSM90)

ORIENTATION:  The two horizontal fluxgate channels were
              aligned equally about the magnetic meridian
              at the time of installation. The third
              fluxgate channel is vertical. (ABZ)

DYNAMIC RANGE:+/- 1600 nT

RESOLUTION:   0.032 nT

SAMPLING RATE:1 second

FILTER TYPE:  Intermagnet

BACKUP
VARIOMETER:   none

K-NUMBERS:    none
K9-LIMIT:     280 nT

GINS:         Edinburgh
SATELLITE:    Http upload


OBSERVERS:    Michael Conway
              Joshua Hofman
              Alannah-Jane Moore
              Dee Taaffe
              Andrew Lewis
              Bill Jones

CONTACT:      Geomagnetism Project
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              Tel: + 61-2-6249-9111
              Fax: + 61-2-6249-9986
              e-mail: geomag@ga.gov.au
              WWW: http://www.ga.gov.au


NOTES:

Cocos-Keeling Islands Geomagnetic Observatory is located on
West Island, Cocos-Keeling Islands in the Indian Ocean (in
the jurisdiction of Western Australia). It is located close
to the Bureau of Meteorology's weather station, in a narrow
strip between the airstrip and the lagoon, and shares its
```

surroundings with a golf course. Geoscience Australia (GA) also operates a GNSS base station nearby, and a CTBT Infrasound station on the island. Planning for the magnetic observatory began in 2008 when Professor Andrew Jackson, Swiss Federal Institute of Technology (ETH) approached Geoscience Australia. In 2009 the Australian Ionospheric Prediction Service (IPS), part of the Australian Bureau of Meteorology (BoM), joined the planning process. IPS constructed the variometer enclosure, and the observatory was equipped by GA in August 2011 with a solar powered variometer system with radio telemetry to the BoM station; variometer and absolute equipment were provided by GA and ETH. From installation the vector variometer demonstrated large baseline drifts and was unusable; it was replaced in March 2012, and delivered acceptable data from then.
CKI was accepted as an INTERMAGNET observatory on 2013-12-16.

The magnetic observatory comprises:

* an aerated concrete-brick vector variometer enclosure, with foam/fibreglass roof, where the vector variometer sensor and electronics, and scalar variometer electronics are housed;
* an aerated concrete-brick scalar variometer sensor enclosure;
* a fibreglass box under 4 solar panels containing solar power system, acquisition computer, radio telemetry equipment;
* a radio mast and antenna;
* (within the BoM) a radio telemetry receiver connected to the BoM network;
* a marble-topped fibreglass absolute pier, lightly protected from wind and sun;
* two auxiliary repeat-stations for historical connection and observatory security.

Key data for the observatory are given in Table 1.

Table 1. Key observatory data.

IAGA code:	CKI
Commenced operation:	01 April 2012
Geographic latitude:	12d 11' 14.8" S
Geographic longitude:	96d 50' 01.0" E
Geomagnetic latitude:	21d 37' 48.0" S
Geomagnetic longitude:	168d 54' 36.0 E
K 9 index lower limit:	280 nT
Principal pier:	Pier AO
Pier elevation (top):	4.9 m AMSL
Principal reference mark:	Windsock
Reference mark azimuth:	256d 15' 17"
Reference mark distance:	370 m
Observers:	Michael Conway
	Joshua Hofman
	Alannah-Jane Moore
	Dee Taaffe
	Andrew Lewis
	Bill Jones

Local meteorological conditions

The meteorological temperature at CKI during 2016 varied from a minimum +22.2 C (2016-08-25) to a maximum +32.1 C (2016-02-27). Daily minimum temperatures varied from +22.2 C to +28.4 C (average +25.3+/-1.2 C); daily maximum temperatures varied from +26.8 C to +32.1 C (average +29.6+/-1.2 C); daily temperature ranges varied from 2.0 C to 7.8 C (average 4.2+/-1.0 C).

The daily maximum wind gust varied from 17 to 81 km/h (average 43.2+/-10.5 km/h). The maximum wind gust was recorded on 2016-02-13.

All weather data is provided by the Australian Government Bureau of Meteorology.

Variometers

The variometers used during 2016 are described in Table 2.

Analogue outputs from the three fluxgate sensors, and the sensor and electronics temperatures, were converted to digital data using an ADAM 4017 analogue-to-digital converter mounted inside the fluxgate electronics unit. These data and the digital PPM data were recorded on the data acquisition computer located in the "Green Cabinet".

The magnetic sensors were located in the concrete above ground vaults. Both vaults were fairly well insulated to minimise short period temperature fluctuations.

The observatory is completely self-contained. The only outside connection is a radio-link for communications; data acquisition is not dependent on communications.

From installation in 2011-08, the vector variometer enclosure suffered from leakage through the roof, accumulating several centimetres of water inside. The fluxgate variometers were unstable - it is possible that high humidity was the cause of the instability. In 2012-07 the rooves of both the scalar and vector enclosures were covered with fibreglass solving the leakage problem. Silica gel was installed inside the cover of the DMI fluxgate sensor. The DMI fluxgate magnetometer has been reasonably stable provided Silica gel sachets are replaced at most once every 12 months.

The scalar variometer data quality was good from 2016-01-01 to 2016-09-10 when the scalar variometer failed suddenly due to unknown causes, but possibly because of high humidity affecting the electronics console (s/n 3106198). There was no data from the instrument until the damaged electronic console was replaced with electronics console s/n 0023526 on 2016-11-30.
The replacement instrument produced poor quality data with significant amounts of intermittent data loss.

The DMI FGE variometer scale-value, alignment, and temperature sensitivity parameters were measured at the magnetometer calibration facility at Canberra observatory before installation at CKI. The sensor assembly was aligned with the two horizontal fluxgate sensors at 45d to the declination at the time of installation and the Z fluxgate sensor vertical. To achieve this alignment at the time of installation, the sensor is rotated horizontally until the X and Y ordinates are equally about geomagnetic north. This method has been found to be accurate using tests performed at the calibration facility.

The variometer system is not temperature regulated, but for 2016 was reasonably stable. The DMI sensor daily average temperature ranged from 28.7 C (2016-07-22)to 34.0 C (2016-02-25) during the year. The DMI electronics temperature ranged from 32.2 C (2016-07-24) to 37.6 C (2016-02-25); Electronics temperature daily variation was similar to the sensor temperature. The sensor was near the electronics and protected by an extra layer of foam insulation.

Variometer data timing was controlled by the QNX data-acquisition computer clock which was maintained using both the 1 PPS and data stream output of a GPS clock. A small error occasionally occurred just after computer resets which was corrected within a few minutes. Time corrections were logged automatically and listed below.

In addition to the magnetometer data, system state-of-health (SOH) data have also been monitored and recorded since the observatory commenced. The SOH data comprised one sample every 10 seconds of solar charge current; system supply current; system battery voltage; variometer vault temperature and green box (acquisition system) temperature. Data were digitised with an ADAM4017 digitiser unit and recorded on the data acquisition computer.

Table 2. Magnetic variometers used in 2016.

3-component variometer:	DMI FGE
Serial number:	E0461 / S0250 (since Mar 2012)
Type:	suspended; linear-core fluxgate
Orientation:	NW, NE, Z
Acquisition interval:	1 s
A/D converter:	ADAM 4017 module (+/-5V)
Scale value:	0.032 nT / count
Total-field variometer:	GEM Systems GSM90
Serial number:	3106198 / 03768 to 2016-11-29
Serial number:	0023526 / 03768 from 2016-11-30
Type:	Overhauser effect
Acquisition interval:	10 s
Resolution:	0.01 nT
Data acquisition system:	ARK3360 computer, QNX6.5 OS
Timing:	Garmin GPS clock
Communications:	Freewave radio link to BoM office, Internet through BoM

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock about once per minute. During 2016, there were 6 adjustments in excess of 1 ms and these are reported below.

```
2016-02-20      19:23:38    17.000 s  GPS clock error
                19:29:23   -17.000 s
2016-04-23      04:45:26     5.000 s
                04:54:36    -5.000 s
2016-07-12      02:56:56    -0.290 s
2016-09-12      00:28:22     0.886 s
2016-11-04      01:03:36    15.000 s  GPS clock error
                01:12:06   -15.000 s
2016-11-30      04:57:28     0.265 s System reboot
```

During the clock error period from 2016-02-20 19:23:38 to 19:29:23, the system recorded 363s data points with wrong timestamps over a period of 368s. From 2016-11-04 01:03:36 to 01:12:06, the system recorded 526s data points with wrong time stamps over a period of 538s. These periods of data with incorrect time stamps remained in the reported, quasi-definitive and definitive one-minute data.

Absolute instruments

The principal absolute magnetometers used at Cocos-Keeling Islands and their adopted corrections for 2016 are described in Table 3.

DIM observations were performed using the offset method. All DIM and PPM measurements were made on the principal pier at the standard height.

Table 3 describes the corrections applied to the absolute magnetometers to align them with the Australian reference instruments held in Canberra.

At the 2016 mean magnetic field values (X=34640,Y=-1344, Z=-32625) at Cocos-Keeling Islands the D, I and F corrections translate to corrections of:

2016-01-01 00:00 to 2016-12-01 23:59
dX = 0.0 nT   dY = 0.0 nT   dZ = 0.0 nT

2016-12-02 00:00 to 2016-12-31 23:59
dX = -0.51 nT   dY = -0.99 nT   dZ = -0.50 nT

These instrument corrections have been applied to the data described in this report and to other published definitive data.

The CKI standard absolute instrument DIM (DI0134D/359142) was compared to the travelling reference instrument (DI0135D/100856) during a maintenance visit in 2016-12-02.

As no instrument corrections had been previously adopted for 359142/DI0134D, this comparison will be used to adopted correction from 2016-12-02 as -0.10' for declination and -0.05' for inclination.

No travelling reference PPM was taken to CKI for the 2016-12 visit, so there are no PPM comparison results. The adopted PPM correction is zero.

```
Table 3. Absolute magnetometers
and their adopted corrections for 2016.
Corrections are applied in the sense
Standard =Instrument + correction.

DI fluxgate:    DMI
Serial number:  DI0134
Theodolite:     Zeiss 020B
Serial number:  359142
Resolution:     0.1'
D correction:   0.0'   to 2016-12-01 23:59
D correction:   -0.1'  from 2016-12-02 00:00
I correction:   0.0'   to 2016-12-01 23:59
I correction:   -0.05' from 2016-12-02 00:00
Pico Data logger: GJY03/123 (to 2015-07-22)
                  GJY03/129 (from 2015-08-03)
Total-field magnetometer:  GEM Systems GSM90
Serial number:  3091316 / 761100
Type:           Overhauser effect
Resolution:     0.01 nT
Correction:     0.00 nT

Baselines
---------
Acceptable observations were made on 44 weekly observations
during 2016. During 2016-11-30 to 2016-12-02 maintenance
visit, there were 11 sets of absolute data, they were
counted as one weekly observation. Usually a pair of
observations was made during each weekly observations using
the absolute instruments listed in Table 3.

The variometer baseline drifted within a range of 2 nT
for the X and Y channels and 4 nT for the Z channel except
for a few absolute data made on
2016-04-12, 2016-02-17, 2016-03-16
2016-08-23, 2016-12-01;
2016-06-24, 2016-07-22,2016-12-01.
On these days the quality of the observations was
compromised as indicated by absolute observation quality
control flags.

A scalar variometer GSM90 baseline is defined by F
measured in the weekly observations minus F measured by
scalar variometer. The baseline varied within +/-0.5nT in
general until 2016-09-09. During 2016-09-10 to 2016-11-30,
the scalar variometer failed. The scalar variometer
baseline remained unchanged from 2016-11-30 after swapping
replacing the electronics console.

Fv-Fs values for the year varied within a range of 4 nT.
The Fv-Fs pattern mirrors the Z channel baseline
residuals.

On 2016-11-30, silica gel packs inside DMI FGE
3-component variometer were also replaced. The Z channel
baseline drifted 2 nT over the next 6 weeks and then
stabilized. This may be due to a gradual reduction of
moisture inside the variometer dome.

Piecewise linear drifts were applied to the observed
```

baseline residuals from the weekly absolute observations. After baseline adjusting the vector data the range of Fv-Fs was reduced to lie in the range -0.4 nT to 0.6 nT. The standard deviations of the weekly absolute observations from the final adopted variometer model and data were:

X 1.0 nT
Y 1.3 nT
Z 1.1 nT
H 1.0 nT
D 7.6"
I 6.0"
F 0.6 nT

Observations on 2016-08-04 were excluded as outliers due to a 10 nT offset in the Y channel baseline residual.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2016 CKI definitive data and real time reported 1-minute data sets (CKI definitive - CKI real time) were:

	X	Y	Z
Average	-1.2	-0.3	-0.1
Std.dev	+0.4	+0.8	+1.9
Min	-1.6	-1.3	-3.5
Max	-0.7	+0.8	+4.5

The CKI 2016 reported real time data are within the specification for INTERMAGNET Quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2016 CKI definitive data and quasi-definitive 1-minute data sets (CKI definitive - CKI quasi-definitive) were:

	X	Y	Z
Average	-1.1	-0.3	-0.0
Std.dev	+0.4	+0.8	+0.7
Min	-1.7	-1.3	-1.6
Max	-0.7	+0.9	+0.7

The CKI 2016 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The observing staff of the Bureau of Meteorology make weekly absolute observations.

The observatory is on a mown grass area, surrounded by an invasive plant "cabbage bush", coconut palms, other trees, a golf course and airstrip. It is very close to the atoll's lagoon. It is necessary to mow around the observatory, including the variometer, to keep the observatory from being consumed by cabbage bush, and so there are regular monthly data losses for a few hours. This is unavoidable. There are other periods of contamination that may be caused by golfers, bird watchers, tourists in general, but these are not documented.

No automatic de-spiking was applied to any of the data for the year but some contaminated data have been manually excluded from the quasi-definitive and definitive data.

When possible, the duty Bureau observer performed absolute observations weekly. The residual (offset) method of DIM observations were made using a PICO ADC-16 analogue to digital converter to digitise the DIM fluxgate offsets. Both DIM and PPM data were record directly onto a Getac tablet PC using GA developed GObs software. Timing for absolute observations was set using the built-in GPS in the computer. The observation files were emailed to GA, where they were processed.

Data were retrieved from the data-acquisition system every 4 minutes using rsync over ssh using the network connection.

Two maintenance visits were made to Cocos Islands geomagnetic observatory during 2016:

2016-04-04 and 2016-04-12 to repair and upgrade the absolute shelter.

2016-11-29 and 2016-12-03 to replace a failed variometer GSM90 proton magnetometer, replace the humidity control sachets inside the DMI fluxgate variometer sensor, and compare the CKI absolute DIM against the travelling reference DIM, and carry out general services.

The distribution of Cocos-Keeling Islands 2016 data is described in Table 4. Data losses are identified in Table A.1.

Table 4. Distribution of Cocos-Keeling Islands 2016 data.

Recipient	Status	Sent
1-second values		
BoM SWS	preliminary	real time
WDC for Geomagnetism-Kyoto	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time
ETH, Zurich	preliminary	real time
WDC for Geomagnetism-Kyoto	preliminary	daily
INTERMAGNET	quasi-definitive	monthly
	definitive	July 2017

Significant events

2016-02-02	02:35 Inspection of observatory area to prepare quote to trim cabbage bush
2016-02-09	possible cyclone in the area in the coming few days.
2016-02-20	19:29:30 backward time jumps in data file
2016-02-23	new battery box 20150821-01 and a charger to CKI to replace the old battery box.

```
             (new power cables are not included, will use
             the existing PPM and DIM cables)
2016-03-08   mowed the paddock around the observatory this
             afternoon, from 0930-1000utc.
             The cabbage bush is growing very rapidly
2016-03-22   Josh's last obs data.
2016-03-31   02:33 - 07:00 island wide power outage
             interrupts telemetry but system continuous
             without interruption
2016-04-05   5-12 visit to CKI - upgrade absolute shelter
2016-04-15   Data contamination probably caused by mowing
2016-04-18   Pruning cabbage bush on SE perimeter scheduled
             for today and tomorrow - expect data
             contamination
2016-04-26   noticed the Pico data logger ADC16, GJY03/129
             was used from 2015-08-03. sent an updated
             configuration file for data capture.
2016-06-09   Three "b" quality PPM data in this week obs.
2016-06-17   Dee Taaffe did this week obs for the first
             time, the mark readings are not correct.
             A few b quality PPM readings in the second set.
2016-06-23   Dee did this obs. problems in declination
             readings. PPM readings in the last set
             were b and c quality. Two "a" readings were
             offset by -22 nT. It looks like the readings
             were contaminated or GSM90 sensor might not be
             placed on the pier.
2016-06-24   Dee re-did obs. the results are good. but PPM
             readings in the last set were b and c quality
2016-07-12   ~02:50 reboot to clear TCP stack
2016-07-22   PPM data were incorrect although quality
             is "a". Replace the absolute PPM data with
             data from the variometer PPM and apply a
             scalar pier difference
             absolute PPM (AO) = 3 (FV) + variometer PPM,
             A few "b" quality PPM readings in the second
             set of the absolute PPM.
2016-09-10   03:17 no variometer PPM
2016-09-12   00:27 tried re-starting GdapDeviceGSM90, and
             then PC, no success. power cycled PPM
             variometer, and still no data.
2016-11-16   Mowing around variometer - contamination
2016-11-30   Maintenance visit 2016-11-29 to
             2016-12-03. Locks on green cabinet replaced
             Computer shutdown to replace PPM console
             (3106198 with 0023526) 04:55:29 to 04:56:59.
             Silica gel packs also replaced at this time.
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Appendix A. Data losses
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Table A.1. Cocos (Keeling) Islands data losses.
--------------------------------------------------
Date       Interval(hh:mm)  Data loss (minutes)
Vector data (mainly due to system restart,
maintenance visit, mowing)

2016-01-09    XYZ     00:33 - 00:52  (20)
2016-01-18    XYZ     01:13 - 01:58  (46)
2016-02-03    XYZ     03:44 - 03:46  (3)
```

2016-02-21	XYZ	02:43 - 02:48	(6)
2016-03-02	XYZ	12:52 - 13:13	(22)
2016-03-06	XYZ	20:22 - 20:25	(4)
2016-03-08	XYZ	09:34 - 09:51	(18)
2016-03-16	XYZ	21:20 - 21:21	(2)
2016-04-05	XYZ	08:47 - 08:50	(4)
2016-04-05	XYZ	09:49 - 09:52	(4)
2016-04-05	XYZ	10:13 - 10:25	(13)
2016-04-07	XYZ	01:43 - 01:55	(13)
2016-04-15	XYZ	00:27 - 00:28	(2)
2016-04-15	XYZ	06:37 - 06:49	(13)
2016-04-18	XYZ	00:43 - 04:26	(224)
2016-05-09	XYZ	07:28 - 07:49	(22)
2016-05-23	XYZ	05:39 - 05:54	(16)
2016-06-10	XYZ	06:57 - 07:05	(9)
2016-06-17	XYZ	05:49 - 06:00	(12)
2016-07-12	XYZ	02:55 - 02:56	(2)
2016-07-21	XYZ	03:51 - 04:09	(19)
2016-07-24	XYZ	17:35 - 17:35	(1)
2016-09-02	XYZ	13:58 - 13:58	(1)
2016-09-04	XYZ	17:29 - 17:30	(2)
2016-09-12	XYZ	00:27 - 00:28	(2)
2016-11-16	XYZ	01:20 - 01:50	(31)
2016-11-30	XYZ	04:08 - 05:27	(80)

Total: 591

Scalar data
(From 2016-09-10, scalar variometer failed. the electronic console was replaced on 2016-12-01. About 81 days data loss. scalar variometer then worked periodically from 2016-12-01)

2016-01-09	F	00:33 - 00:52	(20)
2016-01-18	F	01:13 - 01:58	(46)
2016-02-03	F	03:45 - 03:46	(2)
2016-02-21	F	02:44 - 02:48	(5)
2016-03-02	F	12:52 - 13:13	(22)
2016-03-06	F	20:22 - 20:25	(4)
2016-03-08	F	09:34 - 09:51	(18)
2016-04-05	F	08:47 - 08:49	(3)
2016-04-05	F	09:49 - 09:52	(4)
2016-04-05	F	10:14 - 10:25	(12)
2016-04-07	F	01:43 - 01:55	(13)
2016-04-15	F	00:27 - 00:28	(2)
2016-04-15	F	06:37 - 06:48	(12)
2016-04-18	F	00:43 - 04:26	(224)
2016-05-09	F	07:28 - 07:48	(21)
2016-05-23	F	05:39 - 05:54	(16)
2016-06-10	F	06:57 - 07:05	(9)
2016-06-17	F	05:49 - 06:00	(12)
2016-07-12	F	02:55 - 02:55	(1)
2016-07-21	F	03:52 - 04:09	(18)
2016-07-24	F	17:35 - 17:35	(1)
2016-09-02	F	13:58 - 13:58	(1)
2016-09-04	F	17:30 - 17:30	(1)
2016-09-10	F	03:17 -	
2016-12-01	F	- 00:14	(117898)
2016-12-01	F	00:17 - 00:26	(10)
2016-12-01	F	00:28 - 00:29	(2)
2016-12-01	F	00:31 - 00:33	(3)

2016-12-01	F	00:35 - 00:43	(9)
2016-12-01	F	00:45 - 01:03	(19)
2016-12-01	F	01:06 - 01:13	(8)
2016-12-01	F	01:15 - 01:15	(1)
2016-12-01	F	01:18 - 01:19	(2)
2016-12-01	F	01:21 - 01:25	(5)
2016-12-01	F	01:27 - 01:33	(7)
2016-12-01	F	01:35 - 01:44	(10)
2016-12-01	F	01:46 - 01:46	(1)
2016-12-01	F	01:48 - 01:49	(2)
2016-12-01	F	01:52 - 01:52	(1)
2016-12-01	F	01:54 - 01:54	(1)
2016-12-01	F	01:56 - 01:56	(1)
2016-12-01	F	01:58 - 01:58	(1)
2016-12-01	F	02:00 - 02:12	(13)
2016-12-01	F	02:15 - 02:15	(1)
2016-12-01	F	02:17 - 02:17	(1)
2016-12-01	F	02:20 - 02:22	(3)
2016-12-01	F	02:24 - 02:24	(1)
2016-12-01	F	02:26 - 02:26	(1)
2016-12-01	F	02:29 - 02:29	(1)
2016-12-01	F	02:31 - 02:35	(5)
2016-12-01	F	02:37 - 02:37	(1)
2016-12-01	F	02:39 - 02:40	(2)
2016-12-01	F	02:42 - 02:58	(17)
2016-12-01	F	03:00 - 03:00	(1)
2016-12-01	F	03:02 - 03:03	(2)
2016-12-01	F	03:05 - 03:11	(7)
2016-12-01	F	03:13 - 03:13	(1)
2016-12-01	F	03:17 - 03:20	(4)
2016-12-01	F	03:24 - 03:24	(1)
2016-12-01	F	03:28 - 03:31	(4)
2016-12-01	F	03:33 - 03:37	(5)
2016-12-01	F	03:39 - 03:40	(2)
2016-12-01	F	03:43 - 03:45	(3)
2016-12-01	F	03:47 - 03:49	(3)
2016-12-01	F	03:51 - 03:51	(1)
2016-12-01	F	03:53 - 03:54	(2)
2016-12-01	F	03:58 - 03:58	(1)
2016-12-01	F	04:00 - 04:02	(3)
2016-12-01	F	04:04 - 04:04	(1)
2016-12-01	F	04:06 - 04:06	(1)
2016-12-01	F	04:08 - 04:08	(1)
2016-12-01	F	04:11 - 04:21	(11)
2016-12-01	F	04:25 - 04:26	(2)
2016-12-01	F	04:29 - 04:30	(2)
2016-12-01	F	04:32 - 04:32	(1)
2016-12-01	F	04:36 - 04:37	(2)
2016-12-01	F	04:39 - 04:41	(3)
2016-12-01	F	04:43 - 04:44	(2)
2016-12-01	F	04:46 - 04:47	(2)
2016-12-01	F	04:49 - 04:50	(2)
2016-12-01	F	04:52 - 04:53	(2)
2016-12-01	F	04:55 - 04:58	(4)
2016-12-01	F	05:00 - 05:04	(5)
2016-12-01	F	05:06 - 05:08	(3)
2016-12-01	F	05:10 - 05:10	(1)
2016-12-01	F	05:12 - 05:15	(4)
2016-12-01	F	05:17 - 05:18	(2)
2016-12-01	F	05:20 - 05:21	(2)
2016-12-01	F	05:23 - 05:32	(10)

2016-12-01	F	05:34 - 05:39	(6)
2016-12-01	F	05:41 - 05:41	(1)
2016-12-01	F	05:43 - 05:45	(3)
2016-12-01	F	05:48 - 05:48	(1)
2016-12-01	F	05:50 - 05:53	(4)
2016-12-01	F	05:55 - 06:01	(7)
2016-12-01	F	06:03 - 06:03	(1)
2016-12-01	F	06:05 - 06:07	(3)
2016-12-01	F	06:10 - 06:11	(2)
2016-12-01	F	06:13 - 06:13	(1)
2016-12-01	F	06:15 - 06:19	(5)
2016-12-01	F	06:22 - 06:26	(5)
2016-12-01	F	06:28 - 06:33	(6)
2016-12-01	F	06:35 - 06:47	(13)
2016-12-01	F	06:50 - 06:51	(2)
2016-12-01	F	06:53 - 06:54	(2)
2016-12-01	F	06:56 - 06:59	(4)
2016-12-01	F	07:01 - 07:04	(4)
2016-12-01	F	07:06 - 07:07	(2)
2016-12-01	F	07:09 - 07:09	(1)
2016-12-01	F	07:11 - 07:17	(7)
2016-12-01	F	07:19 - 07:20	(2)
2016-12-01	F	07:22 - 07:24	(3)
2016-12-01	F	07:26 - 07:39	(14)
2016-12-01	F	07:41 - 08:02	(22)
2016-12-01	F	08:04 - 08:50	(47)
2016-12-01	F	08:52 - 09:21	(30)
2016-12-01	F	09:23 - 16:45	(443)
2016-12-01	F	16:47 - 17:08	(22)
2016-12-01	F	17:10 - 19:12	(123)
2016-12-01	F	19:15 - 19:31	(17)
2016-12-01	F	19:33 - 19:41	(9)
2016-12-01	F	19:43 - 19:46	(4)
2016-12-01	F	19:48 - 19:48	(1)
2016-12-01	F	19:50 - 20:00	(11)
2016-12-01	F	20:02 - 20:06	(5)
2016-12-01	F	20:08 - 20:08	(1)
2016-12-01	F	20:10 - 20:10	(1)
2016-12-01	F	20:13 - 20:15	(3)
2016-12-01	F	20:20 - 20:21	(2)
2016-12-01	F	20:23 - 20:25	(3)
2016-12-01	F	20:28 - 20:42	(15)
2016-12-01	F	20:44 - 20:47	(4)
2016-12-01	F	20:49 - 20:49	(1)
2016-12-01	F	20:51 - 20:52	(2)
2016-12-01	F	20:54 - 20:54	(1)
2016-12-01	F	20:56 - 20:57	(2)
2016-12-01	F	20:59 - 21:00	(2)
2016-12-01	F	21:03 - 21:06	(4)
2016-12-01	F	21:15 - 21:26	(12)
2016-12-01	F	21:28 - 21:31	(4)
2016-12-01	F	21:34 - 21:35	(2)
2016-12-01	F	21:38 - 21:40	(3)
2016-12-01	F	21:43 - 21:44	(2)
2016-12-01	F	21:54 - 21:54	(1)
2016-12-01	F	21:58 - 21:58	(1)
2016-12-01	F	22:00 - 22:00	(1)
2016-12-01	F	22:05 - 22:05	(1)
2016-12-01	F	22:08 - 22:08	(1)
2016-12-01	F	22:10 - 22:13	(4)
2016-12-01	F	22:15 - 22:17	(3)

2016-12-01	F	22:19 - 22:19	(1)
2016-12-01	F	22:21 - 22:24	(4)
2016-12-01	F	22:26 - 22:28	(3)
2016-12-01	F	22:33 - 22:34	(2)
2016-12-01	F	22:36 - 22:36	(1)
2016-12-01	F	22:41 - 22:43	(3)
2016-12-01	F	22:45 - 22:46	(2)
2016-12-01	F	22:48 - 22:51	(4)
2016-12-01	F	22:53 - 22:53	(1)
2016-12-01	F	23:00 - 23:01	(2)
2016-12-01	F	23:03 - 23:03	(1)
2016-12-01	F	23:05 - 23:05	(1)
2016-12-01	F	23:07 - 23:08	(2)
2016-12-01	F	23:17 - 23:17	(1)
2016-12-01	F	23:21 - 23:21	(1)
2016-12-01	F	23:23 - 23:23	(1)
2016-12-01	F	23:25 - 23:25	(1)
2016-12-01	F	23:30 - 23:30	(1)
2016-12-01	F	23:32 - 23:32	(1)
2016-12-01	F	23:39 - 23:40	(2)
2016-12-01	F	23:42 - 23:42	(1)
2016-12-01	F	23:47 - 23:47	(1)
2016-12-01	F	23:53 - 23:55	(3)
2016-12-02	F	00:04 - 00:06	(3)
2016-12-02	F	00:08 - 00:08	(1)
2016-12-02	F	00:11 - 00:11	(1)
2016-12-02	F	00:13 - 00:13	(1)
2016-12-02	F	00:21 - 00:22	(2)
2016-12-02	F	00:27 - 00:27	(1)
2016-12-02	F	00:33 - 00:35	(3)
2016-12-02	F	00:44 - 00:46	(3)
2016-12-02	F	00:48 - 00:49	(2)
2016-12-02	F	00:53 - 00:54	(2)
2016-12-02	F	00:59 - 01:00	(2)
2016-12-02	F	01:07 - 01:08	(2)
2016-12-02	F	01:19 - 01:19	(1)
2016-12-02	F	01:24 - 01:24	(1)
2016-12-02	F	01:26 - 01:26	(1)
2016-12-02	F	01:32 - 01:32	(1)
2016-12-02	F	01:51 - 01:51	(1)
2016-12-02	F	02:04 - 02:04	(1)
2016-12-02	F	02:06 - 02:06	(1)
2016-12-02	F	02:13 - 02:13	(1)
2016-12-02	F	02:32 - 02:32	(1)
2016-12-02	F	02:44 - 02:44	(1)
2016-12-02	F	03:11 - 03:11	(1)
2016-12-02	F	03:15 - 03:15	(1)
2016-12-02	F	03:19 - 03:19	(1)
2016-12-02	F	03:29 - 03:29	(1)
2016-12-02	F	03:33 - 03:34	(2)
2016-12-02	F	03:49 - 03:49	(1)
2016-12-02	F	03:54 - 03:54	(1)
2016-12-02	F	04:10 - 04:10	(1)
2016-12-02	F	04:45 - 04:45	(1)
2016-12-02	F	04:59 - 04:59	(1)
2016-12-02	F	05:01 - 05:02	(2)
2016-12-02	F	05:06 - 05:06	(1)
2016-12-02	F	05:12 - 05:12	(1)
2016-12-02	F	05:16 - 05:16	(1)
2016-12-02	F	05:20 - 05:20	(1)
2016-12-02	F	05:23 - 05:25	(3)

2016-12-02	F	05:34 - 05:34	(1)
2016-12-02	F	05:37 - 05:37	(1)
2016-12-02	F	05:44 - 05:44	(1)
2016-12-02	F	05:46 - 05:46	(1)
2016-12-02	F	05:48 - 05:48	(1)
2016-12-02	F	05:50 - 05:50	(1)
2016-12-02	F	05:54 - 05:55	(2)
2016-12-02	F	05:58 - 05:59	(2)
2016-12-02	F	06:03 - 06:03	(1)
2016-12-02	F	06:06 - 06:08	(3)
2016-12-02	F	06:15 - 06:15	(1)
2016-12-02	F	06:18 - 06:18	(1)
2016-12-02	F	06:22 - 06:22	(1)
2016-12-02	F	06:27 - 06:27	(1)
2016-12-02	F	06:30 - 06:31	(2)
2016-12-02	F	06:34 - 06:35	(2)
2016-12-02	F	06:37 - 06:38	(2)
2016-12-02	F	06:40 - 06:40	(1)
2016-12-02	F	06:45 - 06:45	(1)
2016-12-02	F	06:47 - 06:52	(6)
2016-12-02	F	06:54 - 06:54	(1)
2016-12-02	F	06:58 - 06:59	(2)
2016-12-02	F	07:05 - 07:05	(1)
2016-12-02	F	07:14 - 07:15	(2)
2016-12-02	F	07:17 - 07:18	(2)
2016-12-02	F	07:22 - 07:22	(1)
2016-12-02	F	07:25 - 07:28	(4)
2016-12-02	F	07:30 - 07:30	(1)
2016-12-02	F	07:32 - 07:32	(1)
2016-12-02	F	07:37 - 07:37	(1)
2016-12-02	F	07:39 - 07:40	(2)
2016-12-02	F	07:42 - 07:43	(2)
2016-12-02	F	07:45 - 07:46	(2)
2016-12-02	F	07:48 - 07:48	(1)
2016-12-02	F	07:50 - 07:53	(4)
2016-12-02	F	07:55 - 07:55	(1)
2016-12-02	F	07:57 - 07:57	(1)
2016-12-02	F	08:03 - 08:04	(2)
2016-12-02	F	08:06 - 08:07	(2)
2016-12-02	F	08:11 - 08:11	(1)
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2016-12-02	F	08:15 - 08:15	(1)
2016-12-02	F	08:18 - 08:20	(3)
2016-12-02	F	08:24 - 08:29	(6)
2016-12-02	F	08:32 - 08:32	(1)
2016-12-02	F	08:34 - 08:37	(4)
2016-12-02	F	08:39 - 08:41	(3)
2016-12-02	F	08:44 - 08:46	(3)
2016-12-02	F	08:48 - 08:48	(1)
2016-12-02	F	08:51 - 08:51	(1)
2016-12-02	F	08:53 - 08:54	(2)
2016-12-02	F	08:56 - 08:57	(2)
2016-12-02	F	09:00 - 09:01	(2)
2016-12-02	F	09:06 - 09:06	(1)
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2016-12-02	F	09:12 - 09:13	(2)
2016-12-02	F	09:15 - 09:17	(3)
2016-12-02	F	09:19 - 09:19	(1)
2016-12-02	F	09:21 - 09:21	(1)
2016-12-02	F	09:25 - 09:26	(2)
2016-12-02	F	09:29 - 09:30	(2)

2016-12-02	F	09:33 - 09:35	(3)
2016-12-02	F	09:37 - 09:39	(3)
2016-12-02	F	09:41 - 09:41	(1)
2016-12-02	F	09:43 - 09:43	(1)
2016-12-02	F	09:46 - 09:46	(1)
2016-12-02	F	09:51 - 09:51	(1)
2016-12-02	F	09:56 - 09:57	(2)
2016-12-02	F	09:59 - 10:00	(2)
2016-12-02	F	10:03 - 10:03	(1)
2016-12-02	F	10:06 - 10:11	(6)
2016-12-02	F	10:15 - 10:18	(4)
2016-12-02	F	10:20 - 10:21	(2)
2016-12-02	F	10:23 - 10:24	(2)
2016-12-02	F	10:26 - 10:28	(3)
2016-12-02	F	10:30 - 10:31	(2)
2016-12-02	F	10:34 - 10:34	(1)
2016-12-02	F	10:37 - 10:37	(1)
2016-12-02	F	10:40 - 10:49	(10)
2016-12-02	F	10:51 - 10:56	(6)
2016-12-02	F	10:58 - 11:02	(5)
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2016-12-02	F	11:06 - 11:07	(2)
2016-12-02	F	11:09 - 11:09	(1)
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2016-12-02	F	11:18 - 11:18	(1)
2016-12-02	F	11:21 - 11:21	(1)
2016-12-02	F	11:23 - 11:24	(2)
2016-12-02	F	11:27 - 11:29	(3)
2016-12-02	F	11:33 - 11:36	(4)
2016-12-02	F	11:38 - 11:41	(4)
2016-12-02	F	11:45 - 11:46	(2)
2016-12-02	F	11:48 - 11:49	(2)
2016-12-02	F	11:51 - 11:51	(1)
2016-12-02	F	11:54 - 11:59	(6)
2016-12-02	F	12:02 - 12:11	(10)
2016-12-02	F	12:13 - 12:19	(7)
2016-12-02	F	12:23 - 12:25	(3)
2016-12-02	F	12:27 - 12:28	(2)
2016-12-02	F	12:30 - 12:36	(7)
2016-12-02	F	12:38 - 12:40	(3)
2016-12-02	F	12:42 - 12:47	(6)
2016-12-02	F	12:50 - 12:51	(2)
2016-12-02	F	12:53 - 12:53	(1)
2016-12-02	F	12:58 - 12:58	(1)
2016-12-02	F	13:00 - 13:01	(2)
2016-12-02	F	13:03 - 13:07	(5)
2016-12-02	F	13:10 - 13:10	(1)
2016-12-02	F	13:12 - 13:14	(3)
2016-12-02	F	13:16 - 13:18	(3)
2016-12-02	F	13:20 - 13:21	(2)
2016-12-02	F	13:24 - 13:25	(2)
2016-12-02	F	13:30 - 13:32	(3)
2016-12-02	F	13:35 - 13:37	(3)
2016-12-02	F	13:39 - 13:41	(3)
2016-12-02	F	13:45 - 13:55	(11)
2016-12-02	F	13:57 - 13:58	(2)
2016-12-02	F	14:03 - 14:10	(8)
2016-12-02	F	14:12 - 14:12	(1)
2016-12-02	F	14:14 - 14:14	(1)
2016-12-02	F	14:16 - 14:16	(1)
2016-12-02	F	14:18 - 14:19	(2)

2016-12-02	F	14:21 - 14:22	(2)
2016-12-02	F	14:24 - 14:26	(3)
2016-12-02	F	14:28 - 14:28	(1)
2016-12-02	F	14:30 - 14:35	(6)
2016-12-02	F	14:37 - 14:39	(3)
2016-12-02	F	14:41 - 14:41	(1)
2016-12-02	F	14:46 - 14:47	(2)
2016-12-02	F	14:49 - 14:51	(3)
2016-12-02	F	14:54 - 14:58	(5)
2016-12-02	F	15:00 - 15:03	(4)
2016-12-02	F	15:05 - 15:05	(1)
2016-12-02	F	15:07 - 15:07	(1)
2016-12-02	F	15:10 - 15:14	(5)
2016-12-02	F	15:17 - 15:17	(1)
2016-12-02	F	15:21 - 15:21	(1)
2016-12-02	F	15:23 - 15:23	(1)
2016-12-02	F	15:25 - 15:25	(1)
2016-12-02	F	15:27 - 15:27	(1)
2016-12-02	F	15:30 - 15:30	(1)
2016-12-02	F	15:32 - 15:32	(1)
2016-12-02	F	15:40 - 15:40	(1)
2016-12-02	F	15:43 - 15:44	(2)
2016-12-02	F	15:47 - 15:47	(1)
2016-12-02	F	15:50 - 15:50	(1)
2016-12-02	F	15:57 - 16:00	(4)
2016-12-02	F	16:05 - 16:08	(4)
2016-12-02	F	16:11 - 16:11	(1)
2016-12-02	F	16:15 - 16:16	(2)
2016-12-02	F	16:24 - 16:25	(2)
2016-12-02	F	16:30 - 16:30	(1)
2016-12-02	F	16:32 - 16:32	(1)
2016-12-02	F	16:34 - 16:37	(4)
2016-12-02	F	16:39 - 16:43	(5)
2016-12-02	F	16:46 - 16:49	(4)
2016-12-02	F	16:51 - 16:52	(2)
2016-12-02	F	16:56 - 16:56	(1)
2016-12-02	F	16:59 - 17:01	(3)
2016-12-02	F	17:04 - 17:04	(1)
2016-12-02	F	17:06 - 17:07	(2)
2016-12-02	F	17:16 - 17:16	(1)
2016-12-02	F	17:19 - 17:19	(1)
2016-12-02	F	17:28 - 17:28	(1)
2016-12-02	F	17:34 - 17:34	(1)
2016-12-02	F	17:41 - 17:43	(3)
2016-12-02	F	17:54 - 17:55	(2)
2016-12-02	F	18:00 - 18:01	(2)
2016-12-02	F	18:04 - 18:04	(1)
2016-12-02	F	18:10 - 18:10	(1)
2016-12-02	F	18:12 - 18:12	(1)
2016-12-02	F	18:15 - 18:15	(1)
2016-12-02	F	18:27 - 18:28	(2)
2016-12-02	F	18:43 - 18:43	(1)
2016-12-02	F	18:54 - 18:54	(1)
2016-12-02	F	18:59 - 18:59	(1)
2016-12-02	F	19:03 - 19:03	(1)
2016-12-02	F	19:28 - 19:28	(1)
2016-12-02	F	19:30 - 19:30	(1)
2016-12-02	F	19:32 - 19:32	(1)
2016-12-02	F	19:54 - 19:55	(2)
2016-12-02	F	20:04 - 20:04	(1)
2016-12-02	F	20:11 - 20:11	(1)

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2016-12-02	F	20:35 - 20:35	(1)
2016-12-02	F	20:39 - 20:39	(1)
2016-12-02	F	21:17 - 21:17	(1)
2016-12-02	F	21:23 - 21:23	(1)
2016-12-02	F	21:31 - 21:31	(1)
2016-12-02	F	21:36 - 21:36	(1)
2016-12-02	F	22:03 - 22:03	(1)
2016-12-02	F	22:47 - 22:47	(1)
2016-12-02	F	22:50 - 22:50	(1)
2016-12-02	F	23:29 - 23:29	(1)
2016-12-02	F	23:38 - 23:38	(1)
2016-12-03	F	00:21 - 00:21	(1)
2016-12-03	F	02:38 - 02:38	(1)
2016-12-03	F	03:19 - 03:19	(1)
2016-12-03	F	03:25 - 03:25	(1)
2016-12-03	F	03:28 - 03:28	(1)
2016-12-03	F	04:00 - 04:00	(1)
2016-12-03	F	04:03 - 04:03	(1)
2016-12-03	F	04:07 - 04:07	(1)
2016-12-03	F	04:14 - 04:14	(1)
2016-12-03	F	04:17 - 04:17	(1)
2016-12-03	F	04:37 - 04:37	(1)
2016-12-03	F	04:46 - 04:46	(1)
2016-12-03	F	04:52 - 04:52	(1)
2016-12-03	F	05:17 - 05:17	(1)
2016-12-03	F	05:22 - 05:24	(3)
2016-12-03	F	05:29 - 05:29	(1)
2016-12-03	F	05:31 - 05:31	(1)
2016-12-03	F	05:41 - 05:41	(1)
2016-12-03	F	05:57 - 05:57	(1)
2016-12-03	F	06:02 - 06:02	(1)
2016-12-03	F	06:04 - 06:04	(1)
2016-12-03	F	06:10 - 06:10	(1)
2016-12-03	F	06:13 - 06:13	(1)
2016-12-03	F	06:21 - 06:21	(1)
2016-12-03	F	06:26 - 06:26	(1)
2016-12-03	F	06:29 - 06:29	(1)
2016-12-03	F	06:36 - 06:36	(1)
2016-12-03	F	06:42 - 06:42	(1)
2016-12-03	F	06:45 - 06:45	(1)
2016-12-03	F	06:47 - 06:47	(1)
2016-12-03	F	07:00 - 07:00	(1)
2016-12-03	F	07:08 - 07:08	(1)
2016-12-03	F	07:11 - 07:14	(4)
2016-12-03	F	07:22 - 07:22	(1)
2016-12-03	F	07:27 - 07:27	(1)
2016-12-03	F	07:30 - 07:30	(1)
2016-12-03	F	07:34 - 07:34	(1)
2016-12-03	F	07:38 - 07:39	(2)
2016-12-03	F	07:46 - 07:47	(2)
2016-12-03	F	07:49 - 07:49	(1)
2016-12-03	F	07:53 - 07:53	(1)
2016-12-03	F	07:55 - 07:57	(3)
2016-12-03	F	07:59 - 08:00	(2)
2016-12-03	F	08:03 - 08:03	(1)
2016-12-03	F	08:08 - 08:08	(1)
2016-12-03	F	08:12 - 08:15	(4)
2016-12-03	F	08:17 - 08:18	(2)
2016-12-03	F	08:21 - 08:21	(1)

2016-12-03	F	08:27 - 08:27	(1)
2016-12-03	F	08:29 - 08:29	(1)
2016-12-03	F	08:32 - 08:38	(7)
2016-12-03	F	08:41 - 08:42	(2)
2016-12-03	F	08:44 - 08:44	(1)
2016-12-03	F	08:46 - 08:52	(7)
2016-12-03	F	08:55 - 08:56	(2)
2016-12-03	F	08:59 - 08:59	(1)
2016-12-03	F	09:01 - 09:03	(3)
2016-12-03	F	09:05 - 09:07	(3)
2016-12-03	F	09:10 - 09:12	(3)
2016-12-03	F	09:14 - 09:15	(2)
2016-12-03	F	09:18 - 09:21	(4)
2016-12-03	F	09:23 - 09:23	(1)
2016-12-03	F	09:26 - 09:34	(9)
2016-12-03	F	09:36 - 09:46	(11)
2016-12-03	F	09:48 - 09:52	(5)
2016-12-03	F	09:54 - 09:58	(5)
2016-12-03	F	10:01 - 10:02	(2)
2016-12-03	F	10:05 - 10:07	(3)
2016-12-03	F	10:09 - 10:09	(1)
2016-12-03	F	10:11 - 10:11	(1)
2016-12-03	F	10:13 - 10:18	(6)
2016-12-03	F	10:20 - 10:21	(2)
2016-12-03	F	10:23 - 10:25	(3)
2016-12-03	F	10:27 - 10:41	(15)
2016-12-03	F	10:43 - 10:44	(2)
2016-12-03	F	10:46 - 10:46	(1)
2016-12-03	F	10:49 - 10:53	(5)
2016-12-03	F	10:55 - 10:56	(2)
2016-12-03	F	10:58 - 11:14	(17)
2016-12-03	F	11:16 - 11:19	(4)
2016-12-03	F	11:21 - 11:26	(6)
2016-12-03	F	11:28 - 11:30	(3)
2016-12-03	F	11:32 - 11:32	(1)
2016-12-03	F	11:35 - 11:47	(13)
2016-12-03	F	11:49 - 12:05	(17)
2016-12-03	F	12:07 - 12:17	(11)
2016-12-03	F	12:20 - 12:28	(9)
2016-12-03	F	12:30 - 12:31	(2)
2016-12-03	F	12:34 - 12:34	(1)
2016-12-03	F	12:36 - 12:36	(1)
2016-12-03	F	12:39 - 13:06	(28)
2016-12-03	F	13:08 - 13:11	(4)
2016-12-03	F	13:13 - 13:20	(8)
2016-12-03	F	13:22 - 13:26	(5)
2016-12-03	F	13:28 - 13:31	(4)
2016-12-03	F	13:33 - 13:37	(5)
2016-12-03	F	13:39 - 13:46	(8)
2016-12-03	F	13:48 - 13:48	(1)
2016-12-03	F	13:52 - 13:52	(1)
2016-12-03	F	13:54 - 13:59	(6)
2016-12-03	F	14:01 - 14:08	(8)
2016-12-03	F	14:11 - 14:11	(1)
2016-12-03	F	14:13 - 14:15	(3)
2016-12-03	F	14:17 - 14:19	(3)
2016-12-03	F	14:21 - 14:25	(5)
2016-12-03	F	14:27 - 14:30	(4)
2016-12-03	F	14:32 - 14:34	(3)
2016-12-03	F	14:36 - 14:37	(2)
2016-12-03	F	14:39 - 14:39	(1)

2016-12-03	F	14:41 - 14:41	(1)
2016-12-03	F	14:43 - 14:44	(2)
2016-12-03	F	14:46 - 14:47	(2)
2016-12-03	F	14:49 - 14:52	(4)
2016-12-03	F	14:54 - 14:55	(2)
2016-12-03	F	14:57 - 14:57	(1)
2016-12-03	F	14:59 - 15:00	(2)
2016-12-03	F	15:02 - 15:03	(2)
2016-12-03	F	15:05 - 15:08	(4)
2016-12-03	F	15:10 - 15:13	(4)
2016-12-03	F	15:15 - 15:19	(5)
2016-12-03	F	15:21 - 15:39	(19)
2016-12-03	F	15:41 - 15:41	(1)
2016-12-03	F	15:43 - 15:49	(7)
2016-12-03	F	15:51 - 15:53	(3)
2016-12-03	F	15:56 - 15:57	(2)
2016-12-03	F	16:00 - 16:00	(1)
2016-12-03	F	16:02 - 16:04	(3)
2016-12-03	F	16:06 - 16:16	(11)
2016-12-03	F	16:19 - 16:20	(2)
2016-12-03	F	16:22 - 16:24	(3)
2016-12-03	F	16:27 - 16:29	(3)
2016-12-03	F	16:31 - 16:31	(1)
2016-12-03	F	16:33 - 16:35	(3)
2016-12-03	F	16:37 - 16:38	(2)
2016-12-03	F	16:42 - 16:42	(1)
2016-12-03	F	16:47 - 16:50	(4)
2016-12-03	F	16:52 - 16:52	(1)
2016-12-03	F	16:54 - 16:55	(2)
2016-12-03	F	17:02 - 17:02	(1)
2016-12-03	F	17:04 - 17:04	(1)
2016-12-03	F	17:06 - 17:06	(1)
2016-12-03	F	17:08 - 17:09	(2)
2016-12-03	F	17:11 - 17:11	(1)
2016-12-03	F	17:13 - 17:13	(1)
2016-12-03	F	17:16 - 17:16	(1)
2016-12-03	F	17:18 - 17:18	(1)
2016-12-03	F	17:21 - 17:21	(1)
2016-12-03	F	17:25 - 17:26	(2)
2016-12-03	F	17:33 - 17:34	(2)
2016-12-03	F	17:36 - 17:36	(1)
2016-12-03	F	17:41 - 17:41	(1)
2016-12-03	F	17:44 - 17:45	(2)
2016-12-03	F	17:47 - 17:47	(1)
2016-12-03	F	17:54 - 17:54	(1)
2016-12-03	F	17:56 - 17:56	(1)
2016-12-03	F	17:58 - 17:58	(1)
2016-12-03	F	18:00 - 18:01	(2)
2016-12-03	F	18:04 - 18:04	(1)
2016-12-03	F	18:09 - 18:09	(1)
2016-12-03	F	18:16 - 18:16	(1)
2016-12-03	F	18:20 - 18:20	(1)
2016-12-03	F	18:23 - 18:23	(1)
2016-12-03	F	18:27 - 18:27	(1)
2016-12-03	F	18:33 - 18:33	(1)
2016-12-03	F	18:35 - 18:36	(2)
2016-12-03	F	18:40 - 18:40	(1)
2016-12-03	F	18:42 - 18:42	(1)
2016-12-03	F	18:48 - 18:48	(1)
2016-12-03	F	18:51 - 18:51	(1)
2016-12-03	F	18:56 - 18:56	(1)

2016-12-03	F	19:00 - 19:01	(2)
2016-12-03	F	19:03 - 19:03	(1)
2016-12-03	F	19:08 - 19:08	(1)
2016-12-03	F	19:10 - 19:10	(1)
2016-12-03	F	19:13 - 19:15	(3)
2016-12-03	F	19:17 - 19:18	(2)
2016-12-03	F	19:24 - 19:24	(1)
2016-12-03	F	19:27 - 19:27	(1)
2016-12-03	F	19:31 - 19:31	(1)
2016-12-03	F	19:34 - 19:34	(1)
2016-12-03	F	19:45 - 19:45	(1)
2016-12-03	F	19:47 - 19:47	(1)
2016-12-03	F	19:52 - 19:53	(2)
2016-12-03	F	20:11 - 20:11	(1)
2016-12-03	F	20:22 - 20:22	(1)
2016-12-03	F	20:27 - 20:27	(1)
2016-12-03	F	20:39 - 20:40	(2)
2016-12-03	F	21:11 - 21:11	(1)
2016-12-03	F	21:39 - 21:39	(1)
2016-12-03	F	22:05 - 22:05	(1)
2016-12-03	F	22:23 - 22:23	(1)
2016-12-04	F	01:47 - 01:47	(1)
2016-12-04	F	05:16 - 05:16	(1)
2016-12-04	F	05:51 - 05:51	(1)
2016-12-04	F	05:55 - 05:55	(1)
2016-12-04	F	06:44 - 06:44	(1)
2016-12-04	F	07:20 - 07:20	(1)
2016-12-04	F	07:31 - 07:31	(1)
2016-12-04	F	07:38 - 07:38	(1)
2016-12-04	F	07:46 - 07:46	(1)
2016-12-04	F	07:55 - 07:55	(1)
2016-12-04	F	07:57 - 07:57	(1)
2016-12-04	F	08:05 - 08:05	(1)
2016-12-04	F	08:13 - 08:13	(1)
2016-12-04	F	08:15 - 08:15	(1)
2016-12-04	F	08:18 - 08:18	(1)
2016-12-04	F	08:25 - 08:25	(1)
2016-12-04	F	08:34 - 08:35	(2)
2016-12-04	F	08:37 - 08:40	(4)
2016-12-04	F	08:44 - 08:44	(1)
2016-12-04	F	08:48 - 08:48	(1)
2016-12-04	F	08:51 - 08:51	(1)
2016-12-04	F	08:57 - 08:57	(1)
2016-12-04	F	09:02 - 09:02	(1)
2016-12-04	F	09:05 - 09:06	(2)
2016-12-04	F	09:10 - 09:12	(3)
2016-12-04	F	09:17 - 09:18	(2)
2016-12-04	F	09:22 - 09:22	(1)
2016-12-04	F	09:26 - 09:26	(1)
2016-12-04	F	09:28 - 09:28	(1)
2016-12-04	F	09:30 - 09:30	(1)
2016-12-04	F	09:32 - 09:32	(1)
2016-12-04	F	09:34 - 09:35	(2)
2016-12-04	F	09:39 - 09:39	(1)
2016-12-04	F	09:42 - 09:44	(3)
2016-12-04	F	09:46 - 09:46	(1)
2016-12-04	F	09:50 - 09:50	(1)
2016-12-04	F	09:52 - 09:52	(1)
2016-12-04	F	09:54 - 09:55	(2)
2016-12-04	F	09:59 - 09:59	(1)
2016-12-04	F	10:04 - 10:04	(1)

2016-12-04	F	10:06 - 10:07	(2)
2016-12-04	F	10:12 - 10:12	(1)
2016-12-04	F	10:15 - 10:18	(4)
2016-12-04	F	10:23 - 10:23	(1)
2016-12-04	F	10:25 - 10:25	(1)
2016-12-04	F	10:28 - 10:29	(2)
2016-12-04	F	10:31 - 10:32	(2)
2016-12-04	F	10:35 - 10:35	(1)
2016-12-04	F	10:39 - 10:39	(1)
2016-12-04	F	10:43 - 10:43	(1)
2016-12-04	F	10:45 - 10:46	(2)
2016-12-04	F	10:48 - 10:50	(3)
2016-12-04	F	10:52 - 10:54	(3)
2016-12-04	F	10:56 - 10:56	(1)
2016-12-04	F	10:58 - 11:00	(3)
2016-12-04	F	11:02 - 11:06	(5)
2016-12-04	F	11:08 - 11:12	(5)
2016-12-04	F	11:14 - 11:20	(7)
2016-12-04	F	11:22 - 11:25	(4)
2016-12-04	F	11:27 - 11:28	(2)
2016-12-04	F	11:30 - 11:30	(1)
2016-12-04	F	11:33 - 11:34	(2)
2016-12-04	F	11:36 - 11:37	(2)
2016-12-04	F	11:39 - 11:39	(1)
2016-12-04	F	11:41 - 11:43	(3)
2016-12-04	F	11:46 - 11:46	(1)
2016-12-04	F	11:48 - 11:50	(3)
2016-12-04	F	11:53 - 11:56	(4)
2016-12-04	F	11:58 - 12:00	(3)
2016-12-04	F	12:03 - 12:03	(1)
2016-12-04	F	12:05 - 12:11	(7)
2016-12-04	F	12:14 - 12:17	(4)
2016-12-04	F	12:19 - 12:21	(3)
2016-12-04	F	12:24 - 12:24	(1)
2016-12-04	F	12:26 - 12:29	(4)
2016-12-04	F	12:31 - 12:39	(9)
2016-12-04	F	12:41 - 12:42	(2)
2016-12-04	F	12:44 - 12:45	(2)
2016-12-04	F	12:47 - 12:48	(2)
2016-12-04	F	12:50 - 12:52	(3)
2016-12-04	F	12:54 - 12:56	(3)
2016-12-04	F	12:58 - 12:59	(2)
2016-12-04	F	13:02 - 13:04	(3)
2016-12-04	F	13:06 - 13:10	(5)
2016-12-04	F	13:12 - 13:12	(1)
2016-12-04	F	13:15 - 13:16	(2)
2016-12-04	F	13:18 - 13:20	(3)
2016-12-04	F	13:23 - 13:23	(1)
2016-12-04	F	13:25 - 13:28	(4)
2016-12-04	F	13:31 - 13:37	(7)
2016-12-04	F	13:39 - 13:40	(2)
2016-12-04	F	13:43 - 13:43	(1)
2016-12-04	F	13:45 - 13:47	(3)
2016-12-04	F	13:49 - 13:56	(8)
2016-12-04	F	13:59 - 14:00	(2)
2016-12-04	F	14:02 - 14:05	(4)
2016-12-04	F	14:07 - 14:10	(4)
2016-12-04	F	14:13 - 14:17	(5)
2016-12-04	F	14:19 - 14:20	(2)
2016-12-04	F	14:25 - 14:25	(1)
2016-12-04	F	14:27 - 14:30	(4)

2016-12-04	F	14:33 - 14:35	(3)
2016-12-04	F	14:37 - 14:42	(6)
2016-12-04	F	14:44 - 14:47	(4)
2016-12-04	F	14:49 - 14:49	(1)
2016-12-04	F	14:51 - 14:51	(1)
2016-12-04	F	14:54 - 14:54	(1)
2016-12-04	F	14:57 - 14:57	(1)
2016-12-04	F	14:59 - 14:59	(1)
2016-12-04	F	15:01 - 15:01	(1)
2016-12-04	F	15:03 - 15:04	(2)
2016-12-04	F	15:06 - 15:07	(2)
2016-12-04	F	15:10 - 15:10	(1)
2016-12-04	F	15:13 - 15:15	(3)
2016-12-04	F	15:17 - 15:24	(8)
2016-12-04	F	15:26 - 15:33	(8)
2016-12-04	F	15:35 - 15:35	(1)
2016-12-04	F	15:37 - 15:38	(2)
2016-12-04	F	15:40 - 15:40	(1)
2016-12-04	F	15:43 - 15:43	(1)
2016-12-04	F	15:46 - 15:49	(4)
2016-12-04	F	15:51 - 15:51	(1)
2016-12-04	F	15:53 - 15:55	(3)
2016-12-04	F	15:57 - 16:03	(7)
2016-12-04	F	16:08 - 16:10	(3)
2016-12-04	F	16:12 - 16:12	(1)
2016-12-04	F	16:14 - 16:14	(1)
2016-12-04	F	16:16 - 16:16	(1)
2016-12-04	F	16:18 - 16:19	(2)
2016-12-04	F	16:22 - 16:24	(3)
2016-12-04	F	16:26 - 16:26	(1)
2016-12-04	F	16:30 - 16:30	(1)
2016-12-04	F	16:32 - 16:32	(1)
2016-12-04	F	16:35 - 16:35	(1)
2016-12-04	F	16:37 - 16:39	(3)
2016-12-04	F	16:42 - 16:42	(1)
2016-12-04	F	16:44 - 16:46	(3)
2016-12-04	F	16:49 - 16:52	(4)
2016-12-04	F	16:54 - 16:54	(1)
2016-12-04	F	16:56 - 16:57	(2)
2016-12-04	F	17:00 - 17:03	(4)
2016-12-04	F	17:05 - 17:05	(1)
2016-12-04	F	17:09 - 17:09	(1)
2016-12-04	F	17:12 - 17:12	(1)
2016-12-04	F	17:14 - 17:16	(3)
2016-12-04	F	17:22 - 17:23	(2)
2016-12-04	F	17:25 - 17:25	(1)
2016-12-04	F	17:27 - 17:30	(4)
2016-12-04	F	17:34 - 17:36	(3)
2016-12-04	F	17:43 - 17:46	(4)
2016-12-04	F	17:49 - 17:49	(1)
2016-12-04	F	17:51 - 17:51	(1)
2016-12-04	F	17:53 - 17:53	(1)
2016-12-04	F	17:55 - 17:56	(2)
2016-12-04	F	17:58 - 18:01	(4)
2016-12-04	F	18:05 - 18:05	(1)
2016-12-04	F	18:07 - 18:07	(1)
2016-12-04	F	18:11 - 18:12	(2)
2016-12-04	F	18:16 - 18:16	(1)
2016-12-04	F	18:18 - 18:19	(2)
2016-12-04	F	18:22 - 18:22	(1)
2016-12-04	F	18:24 - 18:24	(1)

2016-12-04	F	18:28 - 18:28	(1)
2016-12-04	F	18:32 - 18:32	(1)
2016-12-04	F	18:34 - 18:36	(3)
2016-12-04	F	18:45 - 18:45	(1)
2016-12-04	F	18:47 - 18:48	(2)
2016-12-04	F	18:52 - 18:52	(1)
2016-12-04	F	18:56 - 18:57	(2)
2016-12-04	F	19:01 - 19:01	(1)
2016-12-04	F	19:03 - 19:03	(1)
2016-12-04	F	19:05 - 19:06	(2)
2016-12-04	F	19:11 - 19:12	(2)
2016-12-04	F	19:20 - 19:20	(1)
2016-12-04	F	19:36 - 19:36	(1)
2016-12-04	F	19:41 - 19:42	(2)
2016-12-04	F	19:45 - 19:45	(1)
2016-12-04	F	19:56 - 19:56	(1)
2016-12-04	F	19:59 - 20:00	(2)
2016-12-04	F	20:06 - 20:06	(1)
2016-12-04	F	20:10 - 20:10	(1)
2016-12-04	F	20:14 - 20:14	(1)
2016-12-04	F	20:23 - 20:23	(1)
2016-12-04	F	20:57 - 20:57	(1)
2016-12-04	F	21:02 - 21:02	(1)
2016-12-04	F	21:22 - 21:22	(1)
2016-12-04	F	21:37 - 21:37	(1)
2016-12-04	F	21:40 - 21:40	(1)
2016-12-04	F	21:53 - 21:53	(1)
2016-12-04	F	22:16 - 22:16	(1)
2016-12-04	F	22:51 - 22:51	(1)
2016-12-04	F	23:00 - 23:00	(1)
2016-12-05	F	00:34 - 00:34	(1)
2016-12-05	F	00:51 - 00:51	(1)
2016-12-05	F	03:42 - 03:42	(1)
2016-12-05	F	04:29 - 04:29	(1)
2016-12-05	F	04:37 - 04:37	(1)
2016-12-05	F	05:15 - 05:15	(1)
2016-12-05	F	05:22 - 05:23	(2)
2016-12-05	F	05:26 - 05:26	(1)
2016-12-05	F	05:41 - 05:41	(1)
2016-12-05	F	05:50 - 05:50	(1)
2016-12-05	F	05:55 - 05:55	(1)
2016-12-05	F	06:07 - 06:07	(1)
2016-12-05	F	06:09 - 06:09	(1)
2016-12-05	F	06:14 - 06:14	(1)
2016-12-05	F	06:17 - 06:17	(1)
2016-12-05	F	06:28 - 06:28	(1)
2016-12-05	F	06:31 - 06:33	(3)
2016-12-05	F	06:37 - 06:37	(1)
2016-12-05	F	06:39 - 06:43	(5)
2016-12-05	F	06:45 - 06:45	(1)
2016-12-05	F	06:48 - 06:49	(2)
2016-12-05	F	06:51 - 06:52	(2)
2016-12-05	F	06:58 - 06:58	(1)
2016-12-05	F	07:04 - 07:05	(2)
2016-12-05	F	07:09 - 07:10	(2)
2016-12-05	F	07:12 - 07:12	(1)
2016-12-05	F	07:15 - 07:15	(1)
2016-12-05	F	07:18 - 07:22	(5)
2016-12-05	F	07:25 - 07:25	(1)
2016-12-05	F	07:27 - 07:28	(2)
2016-12-05	F	07:32 - 07:32	(1)

2016-12-05	F	07:34 - 07:36	(3)
2016-12-05	F	07:38 - 07:40	(3)
2016-12-05	F	07:43 - 07:43	(1)
2016-12-05	F	07:45 - 07:49	(5)
2016-12-05	F	07:51 - 07:59	(9)
2016-12-05	F	08:01 - 08:01	(1)
2016-12-05	F	08:03 - 08:16	(14)
2016-12-05	F	08:18 - 08:29	(12)
2016-12-05	F	08:31 - 08:35	(5)
2016-12-05	F	08:37 - 09:37	(61)
2016-12-05	F	09:39 - 09:45	(7)
2016-12-05	F	09:47 - 10:49	(63)
2016-12-05	F	10:53 - 10:56	(4)
2016-12-05	F	10:58 - 11:02	(5)
2016-12-05	F	11:04 - 11:08	(5)
2016-12-05	F	11:10 - 11:10	(1)
2016-12-05	F	11:13 - 11:16	(4)
2016-12-05	F	11:18 - 11:28	(11)
2016-12-05	F	11:30 - 11:40	(11)
2016-12-05	F	11:42 - 11:55	(14)
2016-12-05	F	11:57 - 12:01	(5)
2016-12-05	F	12:03 - 12:12	(10)
2016-12-05	F	12:14 - 12:28	(15)
2016-12-05	F	12:30 - 12:48	(19)
2016-12-05	F	12:50 - 12:54	(5)
2016-12-05	F	12:56 - 13:31	(36)
2016-12-05	F	13:33 - 14:44	(72)
2016-12-05	F	14:47 - 14:56	(10)
2016-12-05	F	14:58 - 15:04	(7)
2016-12-05	F	15:06 - 15:18	(13)
2016-12-05	F	15:20 - 15:31	(12)
2016-12-05	F	15:33 - 15:41	(9)
2016-12-05	F	15:43 - 15:44	(2)
2016-12-05	F	15:46 - 15:47	(2)
2016-12-05	F	15:49 - 15:56	(8)
2016-12-05	F	15:58 - 15:58	(1)
2016-12-05	F	16:01 - 16:02	(2)
2016-12-05	F	16:04 - 16:08	(5)
2016-12-05	F	16:10 - 16:15	(6)
2016-12-05	F	16:17 - 16:20	(4)
2016-12-05	F	16:22 - 16:30	(9)
2016-12-05	F	16:33 - 16:35	(3)
2016-12-05	F	16:37 - 16:47	(11)
2016-12-05	F	16:49 - 16:50	(2)
2016-12-05	F	16:52 - 16:56	(5)
2016-12-05	F	16:58 - 17:09	(12)
2016-12-05	F	17:11 - 17:15	(5)
2016-12-05	F	17:17 - 17:26	(10)
2016-12-05	F	17:31 - 17:34	(4)
2016-12-05	F	17:36 - 17:36	(1)
2016-12-05	F	17:38 - 17:38	(1)
2016-12-05	F	17:40 - 17:41	(2)
2016-12-05	F	17:43 - 17:45	(3)
2016-12-05	F	17:47 - 17:49	(3)
2016-12-05	F	17:52 - 17:56	(5)
2016-12-05	F	18:03 - 18:04	(2)
2016-12-05	F	18:06 - 18:06	(1)
2016-12-05	F	18:08 - 18:08	(1)
2016-12-05	F	18:10 - 18:10	(1)
2016-12-05	F	18:15 - 18:15	(1)
2016-12-05	F	18:17 - 18:18	(2)

2016-12-05	F	18:20 - 18:21	(2)
2016-12-05	F	18:25 - 18:25	(1)
2016-12-05	F	18:28 - 18:28	(1)
2016-12-05	F	18:32 - 18:32	(1)
2016-12-05	F	18:34 - 18:34	(1)
2016-12-05	F	18:37 - 18:40	(4)
2016-12-05	F	18:44 - 18:44	(1)
2016-12-05	F	18:51 - 18:51	(1)
2016-12-05	F	18:56 - 18:56	(1)
2016-12-05	F	19:01 - 19:02	(2)
2016-12-05	F	19:06 - 19:06	(1)
2016-12-05	F	19:14 - 19:14	(1)
2016-12-05	F	19:18 - 19:21	(4)
2016-12-05	F	19:24 - 19:24	(1)
2016-12-05	F	19:32 - 19:32	(1)
2016-12-05	F	19:34 - 19:34	(1)
2016-12-05	F	19:46 - 19:46	(1)
2016-12-05	F	19:51 - 19:51	(1)
2016-12-05	F	19:53 - 19:53	(1)
2016-12-05	F	19:57 - 19:57	(1)
2016-12-05	F	20:46 - 20:46	(1)
2016-12-05	F	21:15 - 21:15	(1)
2016-12-05	F	21:19 - 21:19	(1)
2016-12-05	F	21:51 - 21:51	(1)
2016-12-05	F	21:54 - 21:54	(1)
2016-12-05	F	22:15 - 22:15	(1)
2016-12-06	F	01:04 - 01:04	(1)
2016-12-06	F	05:22 - 05:22	(1)
2016-12-06	F	06:34 - 06:34	(1)
2016-12-06	F	06:58 - 06:58	(1)
2016-12-06	F	07:11 - 07:11	(1)
2016-12-06	F	07:26 - 07:27	(2)
2016-12-06	F	07:29 - 07:29	(1)
2016-12-06	F	07:32 - 07:32	(1)
2016-12-06	F	07:34 - 07:34	(1)
2016-12-06	F	07:47 - 07:47	(1)
2016-12-06	F	07:50 - 07:50	(1)
2016-12-06	F	07:54 - 07:54	(1)
2016-12-06	F	08:01 - 08:02	(2)
2016-12-06	F	08:04 - 08:05	(2)
2016-12-06	F	08:08 - 08:08	(1)
2016-12-06	F	08:11 - 08:11	(1)
2016-12-06	F	08:13 - 08:13	(1)
2016-12-06	F	08:15 - 08:15	(1)
2016-12-06	F	08:19 - 08:19	(1)
2016-12-06	F	08:22 - 08:22	(1)
2016-12-06	F	08:30 - 08:30	(1)
2016-12-06	F	08:33 - 08:33	(1)
2016-12-06	F	08:35 - 08:35	(1)
2016-12-06	F	08:37 - 08:38	(2)
2016-12-06	F	08:41 - 08:41	(1)
2016-12-06	F	08:43 - 08:43	(1)
2016-12-06	F	08:45 - 08:45	(1)
2016-12-06	F	08:47 - 08:48	(2)
2016-12-06	F	08:50 - 08:51	(2)
2016-12-06	F	08:53 - 08:53	(1)
2016-12-06	F	08:58 - 08:58	(1)
2016-12-06	F	09:00 - 09:03	(4)
2016-12-06	F	09:10 - 09:10	(1)
2016-12-06	F	09:13 - 09:15	(3)
2016-12-06	F	09:18 - 09:18	(1)

2016-12-06	F	09:20 - 09:22	(3)
2016-12-06	F	09:24 - 09:25	(2)
2016-12-06	F	09:28 - 09:45	(18)
2016-12-06	F	09:47 - 09:54	(8)
2016-12-06	F	09:56 - 10:04	(9)
2016-12-06	F	10:06 - 10:15	(10)
2016-12-06	F	10:20 - 10:24	(5)
2016-12-06	F	10:26 - 10:29	(4)
2016-12-06	F	10:31 - 10:32	(2)
2016-12-06	F	10:34 - 10:40	(7)
2016-12-06	F	10:42 - 10:47	(6)
2016-12-06	F	10:49 - 11:07	(19)
2016-12-06	F	11:09 - 11:53	(45)
2016-12-06	F	11:55 - 14:35	(161)
2016-12-06	F	14:37 - 15:07	(31)
2016-12-06	F	15:09 - 15:20	(12)
2016-12-06	F	15:22 - 15:49	(28)
2016-12-06	F	15:51 - 15:54	(4)
2016-12-06	F	15:57 - 16:00	(4)
2016-12-06	F	16:03 - 16:03	(1)
2016-12-06	F	16:05 - 16:14	(10)
2016-12-06	F	16:16 - 16:16	(1)
2016-12-06	F	16:18 - 16:18	(1)
2016-12-06	F	16:20 - 16:21	(2)
2016-12-06	F	16:23 - 16:29	(7)
2016-12-06	F	16:32 - 16:39	(8)
2016-12-06	F	16:41 - 16:49	(9)
2016-12-06	F	16:51 - 16:51	(1)
2016-12-06	F	16:53 - 16:55	(3)
2016-12-06	F	16:57 - 17:00	(4)
2016-12-06	F	17:03 - 17:08	(6)
2016-12-06	F	17:10 - 17:17	(8)
2016-12-06	F	17:19 - 17:27	(9)
2016-12-06	F	17:29 - 17:33	(5)
2016-12-06	F	17:36 - 17:38	(3)
2016-12-06	F	17:41 - 17:44	(4)
2016-12-06	F	17:46 - 17:47	(2)
2016-12-06	F	17:53 - 17:54	(2)
2016-12-06	F	17:57 - 17:57	(1)
2016-12-06	F	18:00 - 18:00	(1)
2016-12-06	F	18:02 - 18:02	(1)
2016-12-06	F	18:05 - 18:05	(1)
2016-12-06	F	18:07 - 18:08	(2)
2016-12-06	F	18:12 - 18:15	(4)
2016-12-06	F	18:17 - 18:17	(1)
2016-12-06	F	18:21 - 18:22	(2)
2016-12-06	F	18:24 - 18:28	(5)
2016-12-06	F	18:35 - 18:36	(2)
2016-12-06	F	18:42 - 18:46	(5)
2016-12-06	F	18:48 - 18:48	(1)
2016-12-06	F	18:50 - 18:50	(1)
2016-12-06	F	18:53 - 18:55	(3)
2016-12-06	F	18:59 - 19:00	(2)
2016-12-06	F	19:03 - 19:05	(3)
2016-12-06	F	19:07 - 19:07	(1)
2016-12-06	F	19:10 - 19:11	(2)
2016-12-06	F	19:14 - 19:15	(2)
2016-12-06	F	19:17 - 19:17	(1)
2016-12-06	F	19:20 - 19:21	(2)
2016-12-06	F	19:23 - 19:25	(3)
2016-12-06	F	19:29 - 19:29	(1)

2016-12-06	F	19:38 - 19:40	(3)
2016-12-06	F	19:47 - 19:47	(1)
2016-12-06	F	19:50 - 19:50	(1)
2016-12-06	F	20:00 - 20:00	(1)
2016-12-06	F	20:02 - 20:02	(1)
2016-12-06	F	20:08 - 20:08	(1)
2016-12-06	F	20:24 - 20:24	(1)
2016-12-06	F	20:26 - 20:26	(1)
2016-12-06	F	20:32 - 20:32	(1)
2016-12-06	F	20:38 - 20:38	(1)
2016-12-07	F	06:50 - 06:51	(2)
2016-12-07	F	07:00 - 07:00	(1)
2016-12-07	F	07:02 - 07:02	(1)
2016-12-07	F	07:06 - 07:06	(1)
2016-12-07	F	07:22 - 07:22	(1)
2016-12-07	F	07:24 - 07:25	(2)
2016-12-07	F	07:31 - 07:31	(1)
2016-12-07	F	07:34 - 07:34	(1)
2016-12-07	F	07:40 - 07:40	(1)
2016-12-07	F	07:44 - 07:44	(1)
2016-12-07	F	07:53 - 07:53	(1)
2016-12-07	F	08:01 - 08:04	(4)
2016-12-07	F	08:06 - 08:06	(1)
2016-12-07	F	08:08 - 08:08	(1)
2016-12-07	F	08:10 - 08:10	(1)
2016-12-07	F	08:12 - 08:14	(3)
2016-12-07	F	08:16 - 08:18	(3)
2016-12-07	F	08:21 - 08:21	(1)
2016-12-07	F	08:23 - 08:24	(2)
2016-12-07	F	08:26 - 08:27	(2)
2016-12-07	F	08:29 - 08:30	(2)
2016-12-07	F	08:32 - 08:33	(2)
2016-12-07	F	08:35 - 08:36	(2)
2016-12-07	F	08:38 - 08:38	(1)
2016-12-07	F	08:43 - 08:44	(2)
2016-12-07	F	08:46 - 08:46	(1)
2016-12-07	F	08:48 - 08:49	(2)
2016-12-07	F	08:52 - 08:52	(1)
2016-12-07	F	08:55 - 08:57	(3)
2016-12-07	F	09:01 - 09:10	(10)
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2016-12-07	F	09:17 - 09:25	(9)
2016-12-07	F	09:27 - 09:42	(16)
2016-12-07	F	09:44 - 09:47	(4)
2016-12-07	F	09:50 - 18:25	(516)
2016-12-07	F	18:27 - 18:39	(13)
2016-12-07	F	18:41 - 18:44	(4)
2016-12-07	F	18:46 - 18:47	(2)
2016-12-07	F	18:50 - 18:50	(1)
2016-12-07	F	18:52 - 18:56	(5)
2016-12-07	F	18:58 - 19:02	(5)
2016-12-07	F	19:04 - 19:15	(12)
2016-12-07	F	19:17 - 19:20	(4)
2016-12-07	F	19:22 - 19:30	(9)
2016-12-07	F	19:32 - 19:35	(4)
2016-12-07	F	19:37 - 19:37	(1)
2016-12-07	F	19:39 - 19:39	(1)
2016-12-07	F	19:42 - 19:45	(4)
2016-12-07	F	19:47 - 19:47	(1)
2016-12-07	F	19:49 - 19:49	(1)
2016-12-07	F	19:51 - 19:51	(1)

2016-12-07	F	19:54 - 19:55	(2)
2016-12-07	F	20:02 - 20:05	(4)
2016-12-07	F	20:08 - 20:10	(3)
2016-12-07	F	20:12 - 20:13	(2)
2016-12-07	F	20:17 - 20:18	(2)
2016-12-07	F	20:21 - 20:21	(1)
2016-12-07	F	20:24 - 20:24	(1)
2016-12-07	F	20:26 - 20:26	(1)
2016-12-07	F	20:28 - 20:28	(1)
2016-12-07	F	20:30 - 20:30	(1)
2016-12-07	F	20:33 - 20:33	(1)
2016-12-07	F	20:35 - 20:37	(3)
2016-12-07	F	20:44 - 20:45	(2)
2016-12-07	F	20:49 - 20:49	(1)
2016-12-07	F	20:52 - 20:52	(1)
2016-12-07	F	20:55 - 20:55	(1)
2016-12-07	F	20:59 - 20:59	(1)
2016-12-07	F	21:01 - 21:02	(2)
2016-12-07	F	21:04 - 21:04	(1)
2016-12-07	F	21:06 - 21:06	(1)
2016-12-07	F	21:09 - 21:10	(2)
2016-12-07	F	21:14 - 21:14	(1)
2016-12-07	F	21:18 - 21:18	(1)
2016-12-07	F	21:20 - 21:21	(2)
2016-12-07	F	21:25 - 21:25	(1)
2016-12-07	F	21:27 - 21:27	(1)
2016-12-07	F	21:31 - 21:31	(1)
2016-12-07	F	21:39 - 21:39	(1)
2016-12-07	F	21:44 - 21:44	(1)
2016-12-07	F	21:46 - 21:48	(3)
2016-12-07	F	21:52 - 21:52	(1)
2016-12-07	F	21:55 - 21:56	(2)
2016-12-07	F	21:59 - 21:59	(1)
2016-12-07	F	22:07 - 22:07	(1)
2016-12-07	F	22:23 - 22:23	(1)
2016-12-07	F	22:31 - 22:31	(1)
2016-12-07	F	22:47 - 22:47	(1)
2016-12-07	F	23:17 - 23:17	(1)
2016-12-07	F	23:23 - 23:23	(1)
2016-12-08	F	01:20 - 01:20	(1)
2016-12-08	F	03:24 - 03:24	(1)
2016-12-08	F	05:39 - 05:39	(1)
2016-12-08	F	05:55 - 05:55	(1)
2016-12-08	F	06:04 - 06:05	(2)
2016-12-08	F	06:16 - 06:16	(1)
2016-12-08	F	06:50 - 06:50	(1)
2016-12-08	F	07:03 - 07:03	(1)
2016-12-08	F	07:06 - 07:06	(1)
2016-12-08	F	07:14 - 07:15	(2)
2016-12-08	F	07:21 - 07:21	(1)
2016-12-08	F	07:26 - 07:26	(1)
2016-12-08	F	07:35 - 07:35	(1)
2016-12-08	F	07:37 - 07:37	(1)
2016-12-08	F	07:43 - 07:43	(1)
2016-12-08	F	07:48 - 07:48	(1)
2016-12-08	F	07:52 - 07:52	(1)
2016-12-08	F	07:59 - 07:59	(1)
2016-12-08	F	08:03 - 08:04	(2)
2016-12-08	F	08:06 - 08:09	(4)
2016-12-08	F	08:14 - 08:14	(1)
2016-12-08	F	08:18 - 08:18	(1)

2016-12-08	F	08:20 - 08:20	(1)
2016-12-08	F	08:22 - 08:24	(3)
2016-12-08	F	08:26 - 08:27	(2)
2016-12-08	F	08:30 - 08:30	(1)
2016-12-08	F	08:33 - 08:33	(1)
2016-12-08	F	08:36 - 08:40	(5)
2016-12-08	F	08:42 - 08:43	(2)
2016-12-08	F	08:45 - 08:48	(4)
2016-12-08	F	08:50 - 08:50	(1)
2016-12-08	F	08:52 - 08:52	(1)
2016-12-08	F	08:55 - 08:58	(4)
2016-12-08	F	09:00 - 09:01	(2)
2016-12-08	F	09:04 - 09:04	(1)
2016-12-08	F	09:06 - 09:06	(1)
2016-12-08	F	09:08 - 09:10	(3)
2016-12-08	F	09:12 - 09:12	(1)
2016-12-08	F	09:14 - 09:14	(1)
2016-12-08	F	09:16 - 09:19	(4)
2016-12-08	F	09:22 - 09:27	(6)
2016-12-08	F	09:29 - 09:37	(9)
2016-12-08	F	09:39 - 09:44	(6)
2016-12-08	F	09:47 - 09:50	(4)
2016-12-08	F	09:53 - 09:54	(2)
2016-12-08	F	09:56 - 09:57	(2)
2016-12-08	F	09:59 - 10:00	(2)
2016-12-08	F	10:02 - 10:05	(4)
2016-12-08	F	10:07 - 10:16	(10)
2016-12-08	F	10:18 - 10:21	(4)
2016-12-08	F	10:23 - 10:31	(9)
2016-12-08	F	10:33 - 10:56	(24)
2016-12-08	F	10:58 - 11:03	(6)
2016-12-08	F	11:05 - 11:10	(6)
2016-12-08	F	11:12 - 11:18	(7)
2016-12-08	F	11:20 - 11:42	(23)
2016-12-08	F	11:44 - 12:41	(58)
2016-12-08	F	12:43 - 13:16	(34)
2016-12-08	F	13:19 - 13:47	(29)
2016-12-08	F	13:49 - 14:03	(15)
2016-12-08	F	14:05 - 14:11	(7)
2016-12-08	F	14:13 - 14:21	(9)
2016-12-08	F	14:23 - 14:27	(5)
2016-12-08	F	14:29 - 14:35	(7)
2016-12-08	F	14:37 - 14:42	(6)
2016-12-08	F	14:44 - 15:03	(20)
2016-12-08	F	15:06 - 15:29	(24)
2016-12-08	F	15:31 - 15:37	(7)
2016-12-08	F	15:40 - 15:41	(2)
2016-12-08	F	15:43 - 15:46	(4)
2016-12-08	F	15:48 - 15:49	(2)
2016-12-08	F	15:51 - 15:52	(2)
2016-12-08	F	15:54 - 16:00	(7)
2016-12-08	F	16:02 - 16:12	(11)
2016-12-08	F	16:14 - 16:20	(7)
2016-12-08	F	16:22 - 16:26	(5)
2016-12-08	F	16:28 - 16:29	(2)
2016-12-08	F	16:31 - 16:34	(4)
2016-12-08	F	16:36 - 16:50	(15)
2016-12-08	F	16:52 - 16:52	(1)
2016-12-08	F	16:54 - 16:57	(4)
2016-12-08	F	17:01 - 17:04	(4)
2016-12-08	F	17:07 - 17:07	(1)

2016-12-08	F	17:10 - 17:10	(1)
2016-12-08	F	17:13 - 17:13	(1)
2016-12-08	F	17:15 - 17:15	(1)
2016-12-08	F	17:19 - 17:25	(7)
2016-12-08	F	17:27 - 17:27	(1)
2016-12-08	F	17:29 - 17:29	(1)
2016-12-08	F	17:32 - 17:32	(1)
2016-12-08	F	17:34 - 17:34	(1)
2016-12-08	F	17:36 - 17:36	(1)
2016-12-08	F	17:41 - 17:43	(3)
2016-12-08	F	17:45 - 17:49	(5)
2016-12-08	F	17:53 - 17:53	(1)
2016-12-08	F	17:55 - 17:59	(5)
2016-12-08	F	18:01 - 18:01	(1)
2016-12-08	F	18:04 - 18:04	(1)
2016-12-08	F	18:11 - 18:12	(2)
2016-12-08	F	18:15 - 18:17	(3)
2016-12-08	F	18:20 - 18:20	(1)
2016-12-08	F	18:22 - 18:24	(3)
2016-12-08	F	18:27 - 18:33	(7)
2016-12-08	F	18:35 - 18:35	(1)
2016-12-08	F	18:39 - 18:39	(1)
2016-12-08	F	18:41 - 18:41	(1)
2016-12-08	F	18:46 - 18:46	(1)
2016-12-08	F	18:50 - 18:51	(2)
2016-12-08	F	18:54 - 18:56	(3)
2016-12-08	F	19:03 - 19:03	(1)
2016-12-08	F	19:10 - 19:10	(1)
2016-12-08	F	19:12 - 19:12	(1)
2016-12-08	F	19:16 - 19:16	(1)
2016-12-08	F	19:22 - 19:22	(1)
2016-12-08	F	19:25 - 19:26	(2)
2016-12-08	F	19:28 - 19:28	(1)
2016-12-08	F	19:32 - 19:32	(1)
2016-12-08	F	19:34 - 19:34	(1)
2016-12-08	F	19:38 - 19:39	(2)
2016-12-08	F	19:41 - 19:41	(1)
2016-12-08	F	19:55 - 19:56	(2)
2016-12-08	F	20:02 - 20:02	(1)
2016-12-08	F	20:23 - 20:23	(1)
2016-12-08	F	20:26 - 20:26	(1)
2016-12-08	F	20:28 - 20:28	(1)
2016-12-08	F	22:48 - 22:48	(1)
2016-12-09	F	06:16 - 06:16	(1)
2016-12-09	F	06:18 - 06:18	(1)
2016-12-09	F	06:30 - 06:30	(1)
2016-12-09	F	06:44 - 06:44	(1)
2016-12-09	F	06:49 - 06:50	(2)
2016-12-09	F	06:57 - 06:57	(1)
2016-12-09	F	07:08 - 07:09	(2)
2016-12-09	F	07:11 - 07:12	(2)
2016-12-09	F	07:17 - 07:18	(2)
2016-12-09	F	07:31 - 07:32	(2)
2016-12-09	F	07:35 - 07:36	(2)
2016-12-09	F	07:40 - 07:40	(1)
2016-12-09	F	07:45 - 07:46	(2)
2016-12-09	F	07:49 - 07:50	(2)
2016-12-09	F	07:52 - 07:54	(3)
2016-12-09	F	07:57 - 07:57	(1)
2016-12-09	F	07:59 - 08:07	(9)
2016-12-09	F	08:09 - 08:13	(5)

2016-12-09	F	08:15 - 19:58	(704)
2016-12-09	F	20:00 - 20:01	(2)
2016-12-09	F	20:03 - 20:04	(2)
2016-12-09	F	20:06 - 20:08	(3)
2016-12-09	F	20:10 - 20:16	(7)
2016-12-09	F	20:18 - 20:20	(3)
2016-12-09	F	20:22 - 20:26	(5)
2016-12-09	F	20:28 - 20:30	(3)
2016-12-09	F	20:32 - 20:32	(1)
2016-12-09	F	20:35 - 20:35	(1)
2016-12-09	F	20:37 - 20:52	(16)
2016-12-09	F	20:56 - 20:56	(1)
2016-12-09	F	20:58 - 20:59	(2)
2016-12-09	F	21:01 - 21:08	(8)
2016-12-09	F	21:11 - 21:13	(3)
2016-12-09	F	21:15 - 21:18	(4)
2016-12-09	F	21:20 - 21:23	(4)
2016-12-09	F	21:25 - 21:28	(4)
2016-12-09	F	21:31 - 21:33	(3)
2016-12-09	F	21:35 - 21:38	(4)
2016-12-09	F	21:41 - 21:42	(2)
2016-12-09	F	21:44 - 21:44	(1)
2016-12-09	F	21:46 - 21:46	(1)
2016-12-09	F	21:48 - 21:50	(3)
2016-12-09	F	21:52 - 21:55	(4)
2016-12-09	F	21:57 - 21:57	(1)
2016-12-09	F	21:59 - 22:01	(3)
2016-12-09	F	22:03 - 22:10	(8)
2016-12-09	F	22:15 - 22:15	(1)
2016-12-09	F	22:19 - 22:19	(1)
2016-12-09	F	22:21 - 22:21	(1)
2016-12-09	F	22:25 - 22:29	(5)
2016-12-09	F	22:31 - 22:31	(1)
2016-12-09	F	22:33 - 22:33	(1)
2016-12-09	F	22:35 - 22:35	(1)
2016-12-09	F	22:38 - 22:38	(1)
2016-12-09	F	22:44 - 22:45	(2)
2016-12-09	F	22:53 - 22:53	(1)
2016-12-09	F	22:55 - 22:55	(1)
2016-12-09	F	23:00 - 23:02	(3)
2016-12-09	F	23:04 - 23:06	(3)
2016-12-09	F	23:13 - 23:13	(1)
2016-12-09	F	23:18 - 23:18	(1)
2016-12-09	F	23:23 - 23:23	(1)
2016-12-09	F	23:28 - 23:28	(1)
2016-12-09	F	23:30 - 23:30	(1)
2016-12-09	F	23:32 - 23:32	(1)
2016-12-09	F	23:35 - 23:36	(2)
2016-12-09	F	23:38 - 23:38	(1)
2016-12-09	F	23:47 - 23:47	(1)
2016-12-09	F	23:57 - 23:57	(1)
2016-12-10	F	00:01 - 00:04	(4)
2016-12-10	F	00:49 - 00:49	(1)
2016-12-10	F	00:52 - 00:52	(1)
2016-12-10	F	01:19 - 01:19	(1)
2016-12-10	F	02:06 - 02:06	(1)
2016-12-10	F	03:02 - 03:02	(1)
2016-12-10	F	03:31 - 03:31	(1)
2016-12-10	F	03:33 - 03:33	(1)
2016-12-10	F	03:37 - 03:37	(1)
2016-12-10	F	03:47 - 03:47	(1)

2016-12-10	F	04:41 - 04:41	(1)
2016-12-10	F	04:52 - 04:52	(1)
2016-12-10	F	04:58 - 04:58	(1)
2016-12-10	F	05:10 - 05:11	(2)
2016-12-10	F	05:14 - 05:14	(1)
2016-12-10	F	05:17 - 05:17	(1)
2016-12-10	F	05:25 - 05:25	(1)
2016-12-10	F	05:31 - 05:31	(1)
2016-12-10	F	05:34 - 05:35	(2)
2016-12-10	F	05:38 - 05:38	(1)
2016-12-10	F	05:41 - 05:41	(1)
2016-12-10	F	05:48 - 05:48	(1)
2016-12-10	F	05:54 - 05:54	(1)
2016-12-10	F	05:56 - 05:56	(1)
2016-12-10	F	06:04 - 06:04	(1)
2016-12-10	F	06:15 - 06:16	(2)
2016-12-10	F	06:19 - 06:19	(1)
2016-12-10	F	06:23 - 06:23	(1)
2016-12-10	F	06:27 - 06:27	(1)
2016-12-10	F	06:29 - 06:30	(2)
2016-12-10	F	06:32 - 06:32	(1)
2016-12-10	F	06:37 - 06:37	(1)
2016-12-10	F	06:39 - 06:41	(3)
2016-12-10	F	06:44 - 06:44	(1)
2016-12-10	F	06:46 - 06:46	(1)
2016-12-10	F	06:48 - 06:48	(1)
2016-12-10	F	06:50 - 06:51	(2)
2016-12-10	F	06:58 - 06:58	(1)
2016-12-10	F	07:00 - 07:00	(1)
2016-12-10	F	07:02 - 07:04	(3)
2016-12-10	F	07:06 - 07:07	(2)
2016-12-10	F	07:09 - 07:14	(6)
2016-12-10	F	07:18 - 07:20	(3)
2016-12-10	F	07:22 - 07:31	(10)
2016-12-10	F	07:33 - 07:34	(2)
2016-12-10	F	07:36 - 07:51	(16)
2016-12-10	F	07:53 - 19:39	(707)
2016-12-10	F	19:42 - 20:18	(37)
2016-12-10	F	20:20 - 20:38	(19)
2016-12-10	F	20:40 - 20:40	(1)
2016-12-10	F	20:42 - 20:43	(2)
2016-12-10	F	20:45 - 21:19	(35)
2016-12-10	F	21:21 - 21:26	(6)
2016-12-10	F	21:28 - 21:28	(1)
2016-12-10	F	21:30 - 21:30	(1)
2016-12-10	F	21:33 - 21:33	(1)
2016-12-10	F	21:35 - 21:41	(7)
2016-12-10	F	21:44 - 21:48	(5)
2016-12-10	F	21:50 - 21:52	(3)
2016-12-10	F	21:54 - 22:00	(7)
2016-12-10	F	22:03 - 22:04	(2)
2016-12-10	F	22:06 - 22:06	(1)
2016-12-10	F	22:08 - 22:13	(6)
2016-12-10	F	22:16 - 22:19	(4)
2016-12-10	F	22:24 - 22:26	(3)
2016-12-10	F	22:28 - 22:33	(6)
2016-12-10	F	22:36 - 22:36	(1)
2016-12-10	F	22:39 - 22:41	(3)
2016-12-10	F	22:43 - 22:44	(2)
2016-12-10	F	22:46 - 22:46	(1)
2016-12-10	F	22:52 - 22:56	(5)

2016-12-10	F	22:58 - 22:58	(1)
2016-12-10	F	23:01 - 23:01	(1)
2016-12-10	F	23:03 - 23:04	(2)
2016-12-10	F	23:06 - 23:06	(1)
2016-12-10	F	23:09 - 23:09	(1)
2016-12-10	F	23:12 - 23:12	(1)
2016-12-10	F	23:17 - 23:19	(3)
2016-12-10	F	23:21 - 23:21	(1)
2016-12-10	F	23:23 - 23:23	(1)
2016-12-10	F	23:25 - 23:27	(3)
2016-12-10	F	23:30 - 23:30	(1)
2016-12-10	F	23:32 - 23:34	(3)
2016-12-10	F	23:37 - 23:37	(1)
2016-12-10	F	23:43 - 23:44	(2)
2016-12-10	F	23:47 - 23:47	(1)
2016-12-10	F	23:51 - 23:52	(2)
2016-12-11	F	00:06 - 00:06	(1)
2016-12-11	F	00:11 - 00:11	(1)
2016-12-11	F	00:17 - 00:17	(1)
2016-12-11	F	00:19 - 00:19	(1)
2016-12-11	F	00:24 - 00:24	(1)
2016-12-11	F	00:32 - 00:32	(1)
2016-12-11	F	00:34 - 00:34	(1)
2016-12-11	F	00:37 - 00:37	(1)
2016-12-11	F	00:40 - 00:40	(1)
2016-12-11	F	00:42 - 00:42	(1)
2016-12-11	F	00:45 - 00:46	(2)
2016-12-11	F	00:53 - 00:53	(1)
2016-12-11	F	00:59 - 00:59	(1)
2016-12-11	F	01:11 - 01:11	(1)
2016-12-11	F	01:18 - 01:18	(1)
2016-12-11	F	01:23 - 01:23	(1)
2016-12-11	F	01:26 - 01:26	(1)
2016-12-11	F	01:31 - 01:31	(1)
2016-12-11	F	01:39 - 01:39	(1)
2016-12-11	F	01:43 - 01:45	(3)
2016-12-11	F	01:50 - 01:50	(1)
2016-12-11	F	02:07 - 02:07	(1)
2016-12-11	F	02:25 - 02:25	(1)
2016-12-11	F	02:29 - 02:32	(4)
2016-12-11	F	02:38 - 02:38	(1)
2016-12-11	F	02:40 - 02:40	(1)
2016-12-11	F	03:05 - 03:05	(1)
2016-12-11	F	03:10 - 03:10	(1)
2016-12-11	F	03:17 - 03:17	(1)
2016-12-11	F	03:19 - 03:19	(1)
2016-12-11	F	03:29 - 03:29	(1)
2016-12-11	F	03:41 - 03:41	(1)
2016-12-11	F	03:44 - 03:44	(1)
2016-12-11	F	03:48 - 03:48	(1)
2016-12-11	F	03:59 - 03:59	(1)
2016-12-11	F	04:03 - 04:03	(1)
2016-12-11	F	04:12 - 04:12	(1)
2016-12-11	F	04:18 - 04:18	(1)
2016-12-11	F	04:28 - 04:30	(3)
2016-12-11	F	04:32 - 04:32	(1)
2016-12-11	F	04:37 - 04:37	(1)
2016-12-11	F	04:41 - 04:41	(1)
2016-12-11	F	04:43 - 04:44	(2)
2016-12-11	F	04:52 - 04:52	(1)
2016-12-11	F	05:04 - 05:04	(1)

2016-12-11	F	05:08 - 05:08	(1)
2016-12-11	F	05:12 - 05:12	(1)
2016-12-11	F	05:20 - 05:20	(1)
2016-12-11	F	05:23 - 05:24	(2)
2016-12-11	F	05:30 - 05:30	(1)
2016-12-11	F	05:35 - 05:35	(1)
2016-12-11	F	05:37 - 05:38	(2)
2016-12-11	F	05:41 - 05:41	(1)
2016-12-11	F	05:43 - 05:45	(3)
2016-12-11	F	05:48 - 05:49	(2)
2016-12-11	F	05:52 - 05:52	(1)
2016-12-11	F	05:54 - 05:54	(1)
2016-12-11	F	05:58 - 05:58	(1)
2016-12-11	F	06:00 - 06:00	(1)
2016-12-11	F	06:02 - 06:05	(4)
2016-12-11	F	06:09 - 06:09	(1)
2016-12-11	F	06:12 - 06:12	(1)
2016-12-11	F	06:14 - 06:16	(3)
2016-12-11	F	06:21 - 06:23	(3)
2016-12-11	F	06:25 - 06:25	(1)
2016-12-11	F	06:30 - 06:30	(1)
2016-12-11	F	06:33 - 06:33	(1)
2016-12-11	F	06:35 - 06:35	(1)
2016-12-11	F	06:37 - 06:38	(2)
2016-12-11	F	06:40 - 06:43	(4)
2016-12-11	F	06:45 - 06:45	(1)
2016-12-11	F	06:47 - 06:54	(8)
2016-12-11	F	06:56 - 06:56	(1)
2016-12-11	F	06:58 - 07:01	(4)
2016-12-11	F	07:04 - 07:13	(10)
2016-12-11	F	07:15 - 07:18	(4)
2016-12-11	F	07:20 - 07:55	(36)
2016-12-11	F	07:57 - 07:58	(2)
2016-12-11	F	08:00 - 08:05	(6)
2016-12-11	F	08:07 - 08:20	(14)
2016-12-11	F	08:22 - 18:43	(622)
2016-12-11	F	18:45 - 18:50	(6)
2016-12-11	F	18:52 - 18:58	(7)
2016-12-11	F	19:00 - 19:01	(2)
2016-12-11	F	19:03 - 19:09	(7)
2016-12-11	F	19:11 - 19:24	(14)
2016-12-11	F	19:26 - 19:29	(4)
2016-12-11	F	19:31 - 19:42	(12)
2016-12-11	F	19:45 - 19:48	(4)
2016-12-11	F	19:50 - 19:51	(2)
2016-12-11	F	19:53 - 20:02	(10)
2016-12-11	F	20:04 - 20:08	(5)
2016-12-11	F	20:10 - 20:15	(6)
2016-12-11	F	20:18 - 20:21	(4)
2016-12-11	F	20:23 - 20:23	(1)
2016-12-11	F	20:25 - 20:32	(8)
2016-12-11	F	20:34 - 20:37	(4)
2016-12-11	F	20:39 - 20:46	(8)
2016-12-11	F	20:48 - 20:48	(1)
2016-12-11	F	20:51 - 20:51	(1)
2016-12-11	F	20:54 - 20:54	(1)
2016-12-11	F	20:56 - 20:57	(2)
2016-12-11	F	21:01 - 21:03	(3)
2016-12-11	F	21:05 - 21:06	(2)
2016-12-11	F	21:08 - 21:09	(2)
2016-12-11	F	21:11 - 21:15	(5)

2016-12-11	F	21:18 - 21:21	(4)
2016-12-11	F	21:23 - 21:23	(1)
2016-12-11	F	21:25 - 21:25	(1)
2016-12-11	F	21:30 - 21:30	(1)
2016-12-11	F	21:36 - 21:37	(2)
2016-12-11	F	21:40 - 21:40	(1)
2016-12-11	F	21:43 - 21:46	(4)
2016-12-11	F	21:48 - 21:48	(1)
2016-12-11	F	21:52 - 21:52	(1)
2016-12-11	F	21:54 - 21:54	(1)
2016-12-11	F	22:01 - 22:02	(2)
2016-12-11	F	22:05 - 22:07	(3)
2016-12-11	F	22:09 - 22:11	(3)
2016-12-11	F	22:13 - 22:14	(2)
2016-12-11	F	22:17 - 22:17	(1)
2016-12-11	F	22:23 - 22:25	(3)
2016-12-11	F	22:28 - 22:28	(1)
2016-12-11	F	22:30 - 22:30	(1)
2016-12-11	F	22:33 - 22:34	(2)
2016-12-11	F	22:37 - 22:37	(1)
2016-12-11	F	22:44 - 22:45	(2)
2016-12-11	F	23:01 - 23:01	(1)
2016-12-11	F	23:05 - 23:05	(1)
2016-12-11	F	23:08 - 23:10	(3)
2016-12-11	F	23:15 - 23:15	(1)
2016-12-11	F	23:18 - 23:18	(1)
2016-12-11	F	23:23 - 23:23	(1)
2016-12-11	F	23:30 - 23:30	(1)
2016-12-11	F	23:39 - 23:39	(1)
2016-12-11	F	23:41 - 23:41	(1)
2016-12-11	F	23:45 - 23:46	(2)
2016-12-11	F	23:52 - 23:52	(1)
2016-12-11	F	23:58 - 23:58	(1)
2016-12-12	F	00:01 - 00:01	(1)
2016-12-12	F	00:07 - 00:08	(2)
2016-12-12	F	00:17 - 00:17	(1)
2016-12-12	F	00:22 - 00:22	(1)
2016-12-12	F	00:25 - 00:25	(1)
2016-12-12	F	00:28 - 00:28	(1)
2016-12-12	F	00:36 - 00:36	(1)
2016-12-12	F	00:38 - 00:38	(1)
2016-12-12	F	00:49 - 00:49	(1)
2016-12-12	F	00:52 - 00:52	(1)
2016-12-12	F	00:54 - 00:54	(1)
2016-12-12	F	00:57 - 00:57	(1)
2016-12-12	F	01:08 - 01:08	(1)
2016-12-12	F	01:29 - 01:30	(2)
2016-12-12	F	01:52 - 01:52	(1)
2016-12-12	F	02:00 - 02:00	(1)
2016-12-12	F	02:08 - 02:08	(1)
2016-12-12	F	04:38 - 04:38	(1)
2016-12-12	F	04:55 - 04:55	(1)
2016-12-12	F	05:46 - 05:46	(1)
2016-12-12	F	05:55 - 05:56	(2)
2016-12-12	F	06:18 - 06:18	(1)
2016-12-12	F	06:48 - 06:48	(1)
2016-12-12	F	07:35 - 07:35	(1)
2016-12-12	F	08:46 - 08:46	(1)
2016-12-12	F	10:01 - 10:01	(1)
2016-12-15	F	10:39 - 10:39	(1)
2016-12-15	F	10:41 - 10:41	(1)

2016-12-15	F	11:23 - 11:23	(1)
2016-12-15	F	12:18 - 12:19	(2)
2016-12-15	F	12:26 - 12:26	(1)
2016-12-15	F	12:41 - 12:41	(1)
2016-12-15	F	12:44 - 12:44	(1)
2016-12-15	F	12:57 - 12:58	(2)
2016-12-15	F	13:09 - 13:09	(1)
2016-12-15	F	13:32 - 13:32	(1)
2016-12-15	F	13:44 - 13:44	(1)
2016-12-15	F	13:59 - 13:59	(1)
2016-12-15	F	14:01 - 14:01	(1)
2016-12-15	F	14:04 - 14:04	(1)
2016-12-15	F	14:30 - 14:30	(1)
2016-12-15	F	14:34 - 14:34	(1)
2016-12-15	F	14:36 - 14:36	(1)
2016-12-15	F	14:50 - 14:50	(1)
2016-12-15	F	14:52 - 14:52	(1)
2016-12-15	F	15:07 - 15:07	(1)
2016-12-15	F	15:13 - 15:14	(2)
2016-12-15	F	15:30 - 15:30	(1)
2016-12-15	F	15:41 - 15:41	(1)
2016-12-15	F	16:32 - 16:32	(1)
2016-12-15	F	16:43 - 16:43	(1)
2016-12-15	F	17:09 - 17:09	(1)
2016-12-15	F	17:15 - 17:15	(1)
2016-12-16	F	11:03 - 11:03	(1)
2016-12-16	F	11:06 - 11:07	(2)
2016-12-16	F	11:19 - 11:19	(1)
2016-12-16	F	11:22 - 11:22	(1)
2016-12-16	F	11:26 - 11:26	(1)
2016-12-16	F	11:32 - 11:32	(1)
2016-12-16	F	11:35 - 11:35	(1)
2016-12-16	F	11:42 - 11:42	(1)
2016-12-16	F	11:48 - 11:48	(1)
2016-12-16	F	11:54 - 11:54	(1)
2016-12-16	F	12:04 - 12:06	(3)
2016-12-16	F	12:11 - 12:11	(1)
2016-12-16	F	12:15 - 12:16	(2)
2016-12-16	F	12:18 - 12:21	(4)
2016-12-16	F	12:28 - 12:28	(1)
2016-12-16	F	12:38 - 12:39	(2)
2016-12-16	F	12:43 - 12:43	(1)
2016-12-16	F	12:47 - 12:47	(1)
2016-12-16	F	12:53 - 12:54	(2)
2016-12-16	F	13:00 - 13:00	(1)
2016-12-16	F	13:05 - 13:05	(1)
2016-12-16	F	13:10 - 13:10	(1)
2016-12-16	F	13:13 - 13:13	(1)
2016-12-16	F	13:17 - 13:18	(2)
2016-12-16	F	13:23 - 13:25	(3)
2016-12-16	F	13:29 - 13:29	(1)
2016-12-16	F	13:33 - 13:33	(1)
2016-12-16	F	13:37 - 13:39	(3)
2016-12-16	F	13:47 - 13:47	(1)
2016-12-16	F	13:55 - 13:55	(1)
2016-12-16	F	14:03 - 14:03	(1)
2016-12-16	F	14:11 - 14:11	(1)
2016-12-16	F	14:15 - 14:15	(1)
2016-12-16	F	14:18 - 14:18	(1)
2016-12-16	F	14:22 - 14:22	(1)
2016-12-16	F	14:26 - 14:26	(1)

2016-12-16	F	14:31 - 14:31	(1)
2016-12-16	F	14:37 - 14:38	(2)
2016-12-16	F	14:40 - 14:40	(1)
2016-12-16	F	14:42 - 14:44	(3)
2016-12-16	F	14:46 - 14:49	(4)
2016-12-16	F	14:53 - 14:53	(1)
2016-12-16	F	14:57 - 14:57	(1)
2016-12-16	F	14:59 - 14:59	(1)
2016-12-16	F	15:04 - 15:05	(2)
2016-12-16	F	15:08 - 15:08	(1)
2016-12-16	F	15:15 - 15:18	(4)
2016-12-16	F	15:23 - 15:23	(1)
2016-12-16	F	15:30 - 15:30	(1)
2016-12-16	F	15:33 - 15:33	(1)
2016-12-16	F	15:42 - 15:42	(1)
2016-12-16	F	15:50 - 15:50	(1)
2016-12-16	F	15:54 - 15:54	(1)
2016-12-16	F	15:57 - 15:57	(1)
2016-12-16	F	16:00 - 16:00	(1)
2016-12-16	F	16:03 - 16:03	(1)
2016-12-16	F	16:13 - 16:14	(2)
2016-12-16	F	16:16 - 16:17	(2)
2016-12-16	F	16:19 - 16:21	(3)
2016-12-16	F	16:23 - 16:23	(1)
2016-12-16	F	16:30 - 16:30	(1)
2016-12-16	F	16:37 - 16:37	(1)
2016-12-16	F	16:39 - 16:40	(2)
2016-12-16	F	16:49 - 16:49	(1)
2016-12-16	F	16:51 - 16:51	(1)
2016-12-16	F	16:55 - 16:56	(2)
2016-12-16	F	16:59 - 16:59	(1)
2016-12-16	F	17:05 - 17:06	(2)
2016-12-16	F	17:14 - 17:14	(1)
2016-12-16	F	17:16 - 17:16	(1)
2016-12-16	F	17:19 - 17:19	(1)
2016-12-16	F	17:22 - 17:22	(1)
2016-12-16	F	17:26 - 17:27	(2)
2016-12-16	F	17:29 - 17:29	(1)
2016-12-16	F	17:31 - 17:34	(4)
2016-12-16	F	17:42 - 17:42	(1)
2016-12-16	F	17:49 - 17:49	(1)
2016-12-16	F	17:55 - 17:55	(1)
2016-12-16	F	17:57 - 17:57	(1)
2016-12-16	F	18:03 - 18:03	(1)
2016-12-16	F	18:07 - 18:07	(1)
2016-12-16	F	18:11 - 18:12	(2)
2016-12-16	F	18:17 - 18:17	(1)
2016-12-16	F	18:21 - 18:21	(1)
2016-12-16	F	18:45 - 18:46	(2)
2016-12-17	F	06:50 - 06:50	(1)
2016-12-17	F	07:49 - 07:49	(1)
2016-12-17	F	08:05 - 08:05	(1)
2016-12-17	F	08:08 - 08:08	(1)
2016-12-17	F	08:13 - 08:13	(1)
2016-12-17	F	08:16 - 08:16	(1)
2016-12-17	F	08:31 - 08:31	(1)
2016-12-17	F	08:38 - 08:39	(2)
2016-12-17	F	08:45 - 08:46	(2)
2016-12-17	F	08:51 - 08:55	(5)
2016-12-17	F	08:58 - 09:01	(4)
2016-12-17	F	09:03 - 09:03	(1)

2016-12-17	F	09:08 - 09:08	(1)
2016-12-17	F	09:10 - 09:12	(3)
2016-12-17	F	09:16 - 09:21	(6)
2016-12-17	F	09:23 - 09:25	(3)
2016-12-17	F	09:30 - 09:32	(3)
2016-12-17	F	09:34 - 09:35	(2)
2016-12-17	F	09:38 - 09:40	(3)
2016-12-17	F	09:42 - 09:42	(1)
2016-12-17	F	09:44 - 09:47	(4)
2016-12-17	F	09:50 - 09:50	(1)
2016-12-17	F	09:54 - 09:54	(1)
2016-12-17	F	09:57 - 10:00	(4)
2016-12-17	F	10:02 - 10:05	(4)
2016-12-17	F	10:07 - 10:08	(2)
2016-12-17	F	10:10 - 10:13	(4)
2016-12-17	F	10:15 - 10:18	(4)
2016-12-17	F	10:21 - 10:25	(5)
2016-12-17	F	10:27 - 10:27	(1)
2016-12-17	F	10:29 - 11:29	(61)
2016-12-17	F	11:31 - 13:11	(101)
2016-12-17	F	13:13 - 14:36	(84)
2016-12-17	F	14:38 - 14:44	(7)
2016-12-17	F	14:46 - 14:46	(1)
2016-12-17	F	14:48 - 14:50	(3)
2016-12-17	F	14:52 - 15:15	(24)
2016-12-17	F	15:17 - 15:54	(38)
2016-12-17	F	15:56 - 16:28	(33)
2016-12-17	F	16:30 - 16:41	(12)
2016-12-17	F	16:43 - 16:49	(7)
2016-12-17	F	16:51 - 16:55	(5)
2016-12-17	F	16:57 - 17:01	(5)
2016-12-17	F	17:03 - 17:05	(3)
2016-12-17	F	17:07 - 17:09	(3)
2016-12-17	F	17:11 - 17:17	(7)
2016-12-17	F	17:19 - 17:21	(3)
2016-12-17	F	17:24 - 17:26	(3)
2016-12-17	F	17:28 - 17:32	(5)
2016-12-17	F	17:35 - 17:35	(1)
2016-12-17	F	17:37 - 17:39	(3)
2016-12-17	F	17:42 - 17:46	(5)
2016-12-17	F	17:48 - 17:49	(2)
2016-12-17	F	17:51 - 17:51	(1)
2016-12-17	F	17:53 - 17:59	(7)
2016-12-17	F	18:02 - 18:11	(10)
2016-12-17	F	18:13 - 18:18	(6)
2016-12-17	F	18:20 - 18:23	(4)
2016-12-17	F	18:25 - 18:26	(2)
2016-12-17	F	18:30 - 18:30	(1)
2016-12-17	F	18:32 - 18:32	(1)
2016-12-17	F	18:35 - 18:40	(6)
2016-12-17	F	18:43 - 18:43	(1)
2016-12-17	F	18:47 - 18:47	(1)
2016-12-17	F	18:49 - 18:52	(4)
2016-12-17	F	18:54 - 18:55	(2)
2016-12-17	F	18:57 - 19:04	(8)
2016-12-17	F	19:06 - 19:06	(1)
2016-12-17	F	19:09 - 19:12	(4)
2016-12-17	F	19:17 - 19:17	(1)
2016-12-17	F	19:20 - 19:25	(6)
2016-12-17	F	19:28 - 19:28	(1)
2016-12-17	F	19:32 - 19:34	(3)

2016-12-17	F	19:36 - 19:37	(2)
2016-12-17	F	19:40 - 19:42	(3)
2016-12-17	F	19:44 - 19:44	(1)
2016-12-17	F	19:46 - 19:46	(1)
2016-12-17	F	19:49 - 19:49	(1)
2016-12-17	F	19:55 - 19:57	(3)
2016-12-17	F	19:59 - 19:59	(1)
2016-12-17	F	20:02 - 20:02	(1)
2016-12-17	F	20:09 - 20:09	(1)
2016-12-17	F	20:11 - 20:12	(2)
2016-12-17	F	20:18 - 20:18	(1)
2016-12-17	F	20:25 - 20:25	(1)
2016-12-17	F	20:30 - 20:30	(1)
2016-12-17	F	20:38 - 20:38	(1)
2016-12-17	F	20:41 - 20:41	(1)
2016-12-17	F	20:53 - 20:53	(1)
2016-12-17	F	21:00 - 21:00	(1)
2016-12-17	F	21:13 - 21:13	(1)
2016-12-17	F	21:26 - 21:26	(1)
2016-12-17	F	22:10 - 22:10	(1)
2016-12-18	F	05:31 - 05:31	(1)
2016-12-18	F	06:49 - 06:49	(1)
2016-12-18	F	07:48 - 07:48	(1)
2016-12-18	F	08:41 - 08:41	(1)
2016-12-18	F	09:30 - 09:30	(1)
2016-12-18	F	09:38 - 09:38	(1)
2016-12-18	F	10:04 - 10:04	(1)
2016-12-18	F	10:07 - 10:07	(1)
2016-12-18	F	10:19 - 10:19	(1)
2016-12-18	F	10:31 - 10:31	(1)
2016-12-18	F	10:51 - 10:51	(1)
2016-12-18	F	10:57 - 10:58	(2)
2016-12-18	F	11:01 - 11:01	(1)
2016-12-18	F	11:11 - 11:11	(1)
2016-12-18	F	11:27 - 11:27	(1)
2016-12-18	F	11:31 - 11:31	(1)
2016-12-18	F	11:41 - 11:42	(2)
2016-12-18	F	11:49 - 11:50	(2)
2016-12-18	F	11:52 - 11:52	(1)
2016-12-18	F	11:57 - 11:58	(2)
2016-12-18	F	12:00 - 12:00	(1)
2016-12-18	F	12:07 - 12:07	(1)
2016-12-18	F	12:09 - 12:09	(1)
2016-12-18	F	12:18 - 12:18	(1)
2016-12-18	F	12:25 - 12:25	(1)
2016-12-18	F	12:28 - 12:28	(1)
2016-12-18	F	12:35 - 12:35	(1)
2016-12-18	F	12:43 - 12:43	(1)
2016-12-18	F	12:46 - 12:46	(1)
2016-12-18	F	12:50 - 12:51	(2)
2016-12-18	F	12:56 - 12:56	(1)
2016-12-18	F	12:58 - 12:58	(1)
2016-12-18	F	13:02 - 13:02	(1)
2016-12-18	F	13:06 - 13:06	(1)
2016-12-18	F	13:11 - 13:11	(1)
2016-12-18	F	13:17 - 13:17	(1)
2016-12-18	F	13:21 - 13:21	(1)
2016-12-18	F	13:24 - 13:24	(1)
2016-12-18	F	13:29 - 13:31	(3)
2016-12-18	F	13:34 - 13:34	(1)
2016-12-18	F	13:39 - 13:39	(1)

2016-12-18	F	13:45 - 13:45	(1)
2016-12-18	F	13:48 - 13:48	(1)
2016-12-18	F	13:57 - 13:58	(2)
2016-12-18	F	14:37 - 14:37	(1)
2016-12-18	F	15:09 - 15:09	(1)
2016-12-18	F	15:16 - 15:16	(1)
2016-12-18	F	15:29 - 15:29	(1)
2016-12-18	F	18:52 - 18:52	(1)
2016-12-18	F	19:08 - 19:08	(1)
2016-12-19	F	09:34 - 09:34	(1)
2016-12-19	F	09:48 - 09:48	(1)
2016-12-19	F	09:51 - 09:51	(1)
2016-12-19	F	10:06 - 10:06	(1)
2016-12-19	F	10:18 - 10:18	(1)
2016-12-19	F	10:25 - 10:26	(2)
2016-12-19	F	10:30 - 10:30	(1)
2016-12-19	F	10:34 - 10:34	(1)
2016-12-19	F	10:54 - 10:54	(1)
2016-12-19	F	11:06 - 11:07	(2)
2016-12-19	F	11:10 - 11:10	(1)
2016-12-19	F	11:14 - 11:14	(1)
2016-12-19	F	11:18 - 11:18	(1)
2016-12-19	F	11:23 - 11:23	(1)
2016-12-19	F	11:26 - 11:28	(3)
2016-12-19	F	11:30 - 11:32	(3)
2016-12-19	F	11:36 - 11:36	(1)
2016-12-19	F	11:40 - 11:40	(1)
2016-12-19	F	11:43 - 11:43	(1)
2016-12-19	F	11:45 - 11:45	(1)
2016-12-19	F	11:49 - 11:49	(1)
2016-12-19	F	11:53 - 11:53	(1)
2016-12-19	F	11:55 - 11:55	(1)
2016-12-19	F	11:58 - 12:00	(3)
2016-12-19	F	12:02 - 12:03	(2)
2016-12-19	F	12:06 - 12:07	(2)
2016-12-19	F	12:11 - 12:12	(2)
2016-12-19	F	12:15 - 12:15	(1)
2016-12-19	F	12:17 - 12:18	(2)
2016-12-19	F	12:20 - 12:20	(1)
2016-12-19	F	12:22 - 12:24	(3)
2016-12-19	F	12:30 - 12:30	(1)
2016-12-19	F	12:33 - 12:33	(1)
2016-12-19	F	12:36 - 12:37	(2)
2016-12-19	F	12:39 - 12:41	(3)
2016-12-19	F	12:46 - 12:48	(3)
2016-12-19	F	12:52 - 12:55	(4)
2016-12-19	F	13:02 - 13:04	(3)
2016-12-19	F	13:06 - 13:06	(1)
2016-12-19	F	13:09 - 13:09	(1)
2016-12-19	F	13:12 - 13:12	(1)
2016-12-19	F	13:14 - 13:14	(1)
2016-12-19	F	13:17 - 13:17	(1)
2016-12-19	F	13:20 - 13:21	(2)
2016-12-19	F	13:24 - 13:27	(4)
2016-12-19	F	13:31 - 13:31	(1)
2016-12-19	F	13:34 - 13:34	(1)
2016-12-19	F	13:38 - 13:39	(2)
2016-12-19	F	13:43 - 13:46	(4)
2016-12-19	F	13:50 - 13:51	(2)
2016-12-19	F	13:53 - 13:53	(1)
2016-12-19	F	13:55 - 13:55	(1)

2016-12-19	F	13:58 - 13:58	(1)
2016-12-19	F	14:00 - 14:02	(3)
2016-12-19	F	14:06 - 14:07	(2)
2016-12-19	F	14:11 - 14:15	(5)
2016-12-19	F	14:18 - 14:18	(1)
2016-12-19	F	14:22 - 14:22	(1)
2016-12-19	F	14:26 - 14:28	(3)
2016-12-19	F	14:30 - 14:30	(1)
2016-12-19	F	14:33 - 14:33	(1)
2016-12-19	F	14:36 - 14:36	(1)
2016-12-19	F	14:41 - 14:42	(2)
2016-12-19	F	14:44 - 14:45	(2)
2016-12-19	F	14:47 - 14:48	(2)
2016-12-19	F	14:50 - 14:51	(2)
2016-12-19	F	14:53 - 14:53	(1)
2016-12-19	F	14:57 - 14:58	(2)
2016-12-19	F	15:02 - 15:04	(3)
2016-12-19	F	15:09 - 15:09	(1)
2016-12-19	F	15:11 - 15:12	(2)
2016-12-19	F	15:14 - 15:14	(1)
2016-12-19	F	15:16 - 15:16	(1)
2016-12-19	F	15:18 - 15:18	(1)
2016-12-19	F	15:22 - 15:23	(2)
2016-12-19	F	15:28 - 15:28	(1)
2016-12-19	F	15:30 - 15:35	(6)
2016-12-19	F	15:37 - 15:37	(1)
2016-12-19	F	15:39 - 15:44	(6)
2016-12-19	F	15:46 - 15:51	(6)
2016-12-19	F	15:55 - 15:57	(3)
2016-12-19	F	16:00 - 16:00	(1)
2016-12-19	F	16:04 - 16:04	(1)
2016-12-19	F	16:06 - 16:06	(1)
2016-12-19	F	16:09 - 16:11	(3)
2016-12-19	F	16:13 - 16:13	(1)
2016-12-19	F	16:19 - 16:20	(2)
2016-12-19	F	16:24 - 16:24	(1)
2016-12-19	F	16:26 - 16:27	(2)
2016-12-19	F	16:29 - 16:29	(1)
2016-12-19	F	16:31 - 16:33	(3)
2016-12-19	F	16:37 - 16:37	(1)
2016-12-19	F	16:40 - 16:41	(2)
2016-12-19	F	16:44 - 16:44	(1)
2016-12-19	F	16:50 - 16:50	(1)
2016-12-19	F	16:52 - 16:52	(1)
2016-12-19	F	16:55 - 16:57	(3)
2016-12-19	F	16:59 - 16:59	(1)
2016-12-19	F	17:02 - 17:02	(1)
2016-12-19	F	17:05 - 17:06	(2)
2016-12-19	F	17:12 - 17:12	(1)
2016-12-19	F	17:19 - 17:19	(1)
2016-12-19	F	17:21 - 17:21	(1)
2016-12-19	F	17:25 - 17:25	(1)
2016-12-19	F	17:37 - 17:37	(1)
2016-12-19	F	17:44 - 17:44	(1)
2016-12-19	F	17:46 - 17:46	(1)
2016-12-19	F	17:51 - 17:52	(2)
2016-12-19	F	17:57 - 17:57	(1)
2016-12-19	F	17:59 - 18:01	(3)
2016-12-19	F	18:11 - 18:11	(1)
2016-12-19	F	18:13 - 18:13	(1)
2016-12-19	F	18:18 - 18:18	(1)

2016-12-19	F	18:29 - 18:29	(1)
2016-12-19	F	18:43 - 18:43	(1)
2016-12-19	F	18:45 - 18:45	(1)
2016-12-19	F	18:49 - 18:49	(1)
2016-12-19	F	18:53 - 18:55	(3)
2016-12-19	F	19:19 - 19:19	(1)
2016-12-19	F	19:24 - 19:24	(1)
2016-12-19	F	19:38 - 19:38	(1)
2016-12-19	F	20:58 - 20:58	(1)
2016-12-19	F	21:34 - 21:34	(1)
2016-12-20	F	06:19 - 06:19	(1)
2016-12-20	F	06:53 - 06:53	(1)
2016-12-20	F	07:00 - 07:00	(1)
2016-12-20	F	07:29 - 07:29	(1)
2016-12-20	F	07:43 - 07:43	(1)
2016-12-20	F	07:46 - 07:46	(1)
2016-12-20	F	07:49 - 07:49	(1)
2016-12-20	F	08:03 - 08:04	(2)
2016-12-20	F	08:15 - 08:15	(1)
2016-12-20	F	08:22 - 08:23	(2)
2016-12-20	F	08:30 - 08:30	(1)
2016-12-20	F	08:32 - 08:32	(1)
2016-12-20	F	08:34 - 08:34	(1)
2016-12-20	F	08:37 - 08:38	(2)
2016-12-20	F	08:43 - 08:45	(3)
2016-12-20	F	08:49 - 08:52	(4)
2016-12-20	F	08:58 - 09:01	(4)
2016-12-20	F	09:03 - 09:08	(6)
2016-12-20	F	09:17 - 09:17	(1)
2016-12-20	F	09:19 - 09:19	(1)
2016-12-20	F	09:24 - 09:29	(6)
2016-12-20	F	09:32 - 09:32	(1)
2016-12-20	F	09:34 - 09:39	(6)
2016-12-20	F	09:41 - 09:44	(4)
2016-12-20	F	09:46 - 09:47	(2)
2016-12-20	F	09:50 - 09:50	(1)
2016-12-20	F	09:52 - 10:02	(11)
2016-12-20	F	10:04 - 10:09	(6)
2016-12-20	F	10:11 - 10:18	(8)
2016-12-20	F	10:20 - 10:30	(11)
2016-12-20	F	10:32 - 10:35	(4)
2016-12-20	F	10:37 - 10:37	(1)
2016-12-20	F	10:39 - 11:12	(34)
2016-12-20	F	11:14 - 12:00	(47)
2016-12-20	F	12:02 - 16:33	(272)
2016-12-20	F	16:35 - 16:59	(25)
2016-12-20	F	17:01 - 17:01	(1)
2016-12-20	F	17:03 - 17:11	(9)
2016-12-20	F	17:13 - 17:43	(31)
2016-12-20	F	17:45 - 17:48	(4)
2016-12-20	F	17:50 - 18:12	(23)
2016-12-20	F	18:14 - 18:21	(8)
2016-12-20	F	18:23 - 18:46	(24)
2016-12-20	F	18:48 - 18:51	(4)
2016-12-20	F	18:53 - 19:05	(13)
2016-12-20	F	19:07 - 19:24	(18)
2016-12-20	F	19:26 - 19:30	(5)
2016-12-20	F	19:32 - 19:35	(4)
2016-12-20	F	19:37 - 19:39	(3)
2016-12-20	F	19:41 - 19:45	(5)
2016-12-20	F	19:47 - 19:48	(2)

2016-12-20	F	19:50 - 19:54	(5)
2016-12-20	F	19:57 - 19:58	(2)
2016-12-20	F	20:00 - 20:00	(1)
2016-12-20	F	20:03 - 20:04	(2)
2016-12-20	F	20:06 - 20:11	(6)
2016-12-20	F	20:13 - 20:18	(6)
2016-12-20	F	20:20 - 20:20	(1)
2016-12-20	F	20:22 - 20:22	(1)
2016-12-20	F	20:25 - 20:27	(3)
2016-12-20	F	20:31 - 20:32	(2)
2016-12-20	F	20:34 - 20:38	(5)
2016-12-20	F	20:40 - 20:41	(2)
2016-12-20	F	20:43 - 20:43	(1)
2016-12-20	F	20:45 - 20:47	(3)
2016-12-20	F	20:49 - 20:49	(1)
2016-12-20	F	20:51 - 20:52	(2)
2016-12-20	F	20:55 - 20:55	(1)
2016-12-20	F	20:58 - 20:59	(2)
2016-12-20	F	21:02 - 21:02	(1)
2016-12-20	F	21:04 - 21:05	(2)
2016-12-20	F	21:09 - 21:09	(1)
2016-12-20	F	21:12 - 21:12	(1)
2016-12-20	F	21:15 - 21:15	(1)
2016-12-20	F	21:17 - 21:17	(1)
2016-12-20	F	21:21 - 21:21	(1)
2016-12-20	F	21:23 - 21:24	(2)
2016-12-20	F	21:27 - 21:30	(4)
2016-12-20	F	21:32 - 21:32	(1)
2016-12-20	F	21:37 - 21:37	(1)
2016-12-20	F	21:44 - 21:44	(1)
2016-12-20	F	21:53 - 21:53	(1)
2016-12-20	F	21:59 - 21:59	(1)
2016-12-20	F	22:03 - 22:03	(1)
2016-12-20	F	22:05 - 22:07	(3)
2016-12-20	F	22:19 - 22:19	(1)
2016-12-20	F	22:24 - 22:24	(1)
2016-12-20	F	22:31 - 22:31	(1)
2016-12-20	F	22:45 - 22:45	(1)
2016-12-20	F	22:56 - 22:58	(3)
2016-12-20	F	23:07 - 23:07	(1)
2016-12-20	F	23:09 - 23:09	(1)
2016-12-20	F	23:16 - 23:16	(1)
2016-12-20	F	23:27 - 23:27	(1)
2016-12-20	F	23:31 - 23:31	(1)
2016-12-20	F	23:38 - 23:38	(1)
2016-12-20	F	23:55 - 23:55	(1)
2016-12-20	F	23:59 - 23:59	(1)
2016-12-21	F	03:04 - 03:04	(1)
2016-12-21	F	04:09 - 04:09	(1)
2016-12-21	F	04:31 - 04:31	(1)
2016-12-21	F	04:56 - 04:56	(1)
2016-12-21	F	05:15 - 05:15	(1)
2016-12-21	F	05:35 - 05:35	(1)
2016-12-21	F	05:42 - 05:42	(1)
2016-12-21	F	05:52 - 05:52	(1)
2016-12-21	F	06:04 - 06:04	(1)
2016-12-21	F	06:15 - 06:15	(1)
2016-12-21	F	06:18 - 06:18	(1)
2016-12-21	F	06:22 - 06:22	(1)
2016-12-21	F	06:34 - 06:34	(1)
2016-12-21	F	06:54 - 06:55	(2)

2016-12-21	F	06:58 - 06:58	(1)
2016-12-21	F	07:03 - 07:03	(1)
2016-12-21	F	07:07 - 07:07	(1)
2016-12-21	F	07:09 - 07:09	(1)
2016-12-21	F	07:13 - 07:13	(1)
2016-12-21	F	07:17 - 07:21	(5)
2016-12-21	F	07:28 - 07:28	(1)
2016-12-21	F	07:30 - 07:31	(2)
2016-12-21	F	07:33 - 07:34	(2)
2016-12-21	F	07:41 - 07:43	(3)
2016-12-21	F	07:48 - 07:52	(5)
2016-12-21	F	07:54 - 07:54	(1)
2016-12-21	F	07:56 - 07:56	(1)
2016-12-21	F	07:58 - 07:58	(1)
2016-12-21	F	08:00 - 08:01	(2)
2016-12-21	F	08:04 - 08:04	(1)
2016-12-21	F	08:06 - 08:17	(12)
2016-12-21	F	08:19 - 08:27	(9)
2016-12-21	F	08:29 - 08:39	(11)
2016-12-21	F	08:41 - 08:53	(13)
2016-12-21	F	08:55 - 08:58	(4)
2016-12-21	F	09:00 - 09:00	(1)
2016-12-21	F	09:02 - 19:31	(630)
2016-12-21	F	19:33 - 19:42	(10)
2016-12-21	F	19:44 - 19:45	(2)
2016-12-21	F	19:47 - 20:03	(17)
2016-12-21	F	20:05 - 20:18	(14)
2016-12-21	F	20:20 - 20:20	(1)
2016-12-21	F	20:22 - 20:25	(4)
2016-12-21	F	20:27 - 20:27	(1)
2016-12-21	F	20:29 - 20:32	(4)
2016-12-21	F	20:34 - 20:36	(3)
2016-12-21	F	20:38 - 20:38	(1)
2016-12-21	F	20:42 - 20:42	(1)
2016-12-21	F	20:44 - 20:48	(5)
2016-12-21	F	20:54 - 20:54	(1)
2016-12-21	F	20:59 - 20:59	(1)
2016-12-21	F	21:01 - 21:01	(1)
2016-12-21	F	21:05 - 21:05	(1)
2016-12-21	F	21:07 - 21:07	(1)
2016-12-21	F	21:11 - 21:14	(4)
2016-12-21	F	21:16 - 21:17	(2)
2016-12-21	F	21:20 - 21:21	(2)
2016-12-21	F	21:26 - 21:26	(1)
2016-12-21	F	21:30 - 21:31	(2)
2016-12-21	F	21:33 - 21:36	(4)
2016-12-21	F	21:38 - 21:39	(2)
2016-12-21	F	21:42 - 21:42	(1)
2016-12-21	F	21:44 - 21:44	(1)
2016-12-21	F	21:46 - 21:46	(1)
2016-12-21	F	21:48 - 21:51	(4)
2016-12-21	F	21:53 - 21:55	(3)
2016-12-21	F	21:57 - 22:00	(4)
2016-12-21	F	22:10 - 22:10	(1)
2016-12-21	F	22:13 - 22:13	(1)
2016-12-21	F	22:15 - 22:15	(1)
2016-12-21	F	22:17 - 22:17	(1)
2016-12-21	F	22:27 - 22:27	(1)
2016-12-21	F	22:34 - 22:34	(1)
2016-12-21	F	22:41 - 22:44	(4)
2016-12-21	F	22:47 - 22:48	(2)

2016-12-21	F	22:52 - 22:52	(1)
2016-12-21	F	22:54 - 22:54	(1)
2016-12-21	F	22:56 - 22:56	(1)
2016-12-21	F	23:02 - 23:02	(1)
2016-12-21	F	23:10 - 23:10	(1)
2016-12-21	F	23:20 - 23:20	(1)
2016-12-21	F	23:22 - 23:22	(1)
2016-12-21	F	23:28 - 23:28	(1)
2016-12-21	F	23:37 - 23:37	(1)
2016-12-21	F	23:39 - 23:39	(1)
2016-12-21	F	23:49 - 23:49	(1)
2016-12-22	F	00:04 - 00:04	(1)
2016-12-22	F	00:21 - 00:22	(2)
2016-12-22	F	00:35 - 00:35	(1)
2016-12-22	F	01:22 - 01:22	(1)
2016-12-22	F	01:41 - 01:41	(1)
2016-12-22	F	01:56 - 01:56	(1)
2016-12-22	F	02:39 - 02:40	(2)
2016-12-22	F	05:14 - 05:14	(1)
2016-12-22	F	06:34 - 06:34	(1)
2016-12-22	F	06:36 - 06:36	(1)
2016-12-22	F	06:42 - 06:42	(1)
2016-12-22	F	06:46 - 06:46	(1)
2016-12-22	F	06:51 - 06:51	(1)
2016-12-22	F	07:02 - 07:04	(3)
2016-12-22	F	07:13 - 07:13	(1)
2016-12-22	F	07:18 - 07:18	(1)
2016-12-22	F	07:20 - 07:20	(1)
2016-12-22	F	07:24 - 07:24	(1)
2016-12-22	F	07:26 - 07:28	(3)
2016-12-22	F	07:40 - 07:40	(1)
2016-12-22	F	07:42 - 07:42	(1)
2016-12-22	F	07:44 - 07:44	(1)
2016-12-22	F	07:54 - 07:55	(2)
2016-12-22	F	08:03 - 08:03	(1)
2016-12-22	F	08:05 - 08:06	(2)
2016-12-22	F	08:08 - 08:10	(3)
2016-12-22	F	08:12 - 08:12	(1)
2016-12-22	F	08:14 - 08:15	(2)
2016-12-22	F	08:17 - 08:20	(4)
2016-12-22	F	08:24 - 08:25	(2)
2016-12-22	F	08:27 - 08:31	(5)
2016-12-22	F	08:33 - 08:35	(3)
2016-12-22	F	08:40 - 08:42	(3)
2016-12-22	F	08:46 - 08:48	(3)
2016-12-22	F	08:51 - 08:51	(1)
2016-12-22	F	08:55 - 08:56	(2)
2016-12-22	F	08:59 - 08:59	(1)
2016-12-22	F	09:02 - 09:10	(9)
2016-12-22	F	09:16 - 09:21	(6)
2016-12-22	F	09:24 - 09:24	(1)
2016-12-22	F	09:26 - 09:26	(1)
2016-12-22	F	09:28 - 09:28	(1)
2016-12-22	F	09:30 - 09:30	(1)
2016-12-22	F	09:32 - 09:32	(1)
2016-12-22	F	09:35 - 09:36	(2)
2016-12-22	F	09:38 - 09:40	(3)
2016-12-22	F	09:42 - 09:46	(5)
2016-12-22	F	09:48 - 09:48	(1)
2016-12-22	F	09:52 - 09:52	(1)
2016-12-22	F	09:54 - 09:55	(2)

2016-12-22	F	09:57 - 10:06	(10)
2016-12-22	F	10:08 - 10:08	(1)
2016-12-22	F	10:10 - 10:11	(2)
2016-12-22	F	10:13 - 10:16	(4)
2016-12-22	F	10:18 - 10:35	(18)
2016-12-22	F	10:37 - 10:39	(3)
2016-12-22	F	10:41 - 10:42	(2)
2016-12-22	F	10:44 - 10:46	(3)
2016-12-22	F	10:48 - 10:53	(6)
2016-12-22	F	10:55 - 11:06	(12)
2016-12-22	F	11:09 - 11:23	(15)
2016-12-22	F	11:25 - 11:34	(10)
2016-12-22	F	11:36 - 11:40	(5)
2016-12-22	F	11:42 - 11:43	(2)
2016-12-22	F	11:45 - 12:40	(56)
2016-12-22	F	12:43 - 12:59	(17)
2016-12-22	F	13:01 - 13:09	(9)
2016-12-22	F	13:11 - 13:15	(5)
2016-12-22	F	13:18 - 13:48	(31)
2016-12-22	F	13:50 - 13:52	(3)
2016-12-22	F	13:54 - 14:08	(15)
2016-12-22	F	14:10 - 14:11	(2)
2016-12-22	F	14:13 - 14:28	(16)
2016-12-22	F	14:30 - 14:53	(24)
2016-12-22	F	14:55 - 15:02	(8)
2016-12-22	F	15:04 - 15:08	(5)
2016-12-22	F	15:10 - 15:27	(18)
2016-12-22	F	15:30 - 15:31	(2)
2016-12-22	F	15:33 - 15:35	(3)
2016-12-22	F	15:37 - 15:52	(16)
2016-12-22	F	15:54 - 15:55	(2)
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2016-12-22	F	16:17 - 16:19	(3)
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2016-12-22	F	16:27 - 16:31	(5)
2016-12-22	F	16:33 - 16:33	(1)
2016-12-22	F	16:35 - 16:36	(2)
2016-12-22	F	16:38 - 16:38	(1)
2016-12-22	F	16:44 - 16:44	(1)
2016-12-22	F	16:46 - 16:47	(2)
2016-12-22	F	16:49 - 16:49	(1)
2016-12-22	F	16:51 - 16:54	(4)
2016-12-22	F	16:56 - 16:59	(4)
2016-12-22	F	17:03 - 17:03	(1)
2016-12-22	F	17:07 - 17:08	(2)
2016-12-22	F	17:11 - 17:12	(2)
2016-12-22	F	17:14 - 17:14	(1)
2016-12-22	F	17:16 - 17:18	(3)
2016-12-22	F	17:20 - 17:23	(4)
2016-12-22	F	17:25 - 17:27	(3)
2016-12-22	F	17:29 - 17:29	(1)
2016-12-22	F	17:33 - 17:34	(2)
2016-12-22	F	17:36 - 17:40	(5)
2016-12-22	F	17:43 - 17:43	(1)
2016-12-22	F	17:45 - 17:45	(1)
2016-12-22	F	17:47 - 17:47	(1)
2016-12-22	F	17:53 - 17:54	(2)
2016-12-22	F	17:59 - 17:59	(1)

2016-12-22	F	18:01 - 18:02	(2)
2016-12-22	F	18:05 - 18:06	(2)
2016-12-22	F	18:08 - 18:09	(2)
2016-12-22	F	18:12 - 18:12	(1)
2016-12-22	F	18:14 - 18:15	(2)
2016-12-22	F	18:28 - 18:29	(2)
2016-12-22	F	18:36 - 18:36	(1)
2016-12-22	F	18:38 - 18:39	(2)
2016-12-22	F	18:43 - 18:44	(2)
2016-12-22	F	18:55 - 18:55	(1)
2016-12-22	F	19:01 - 19:01	(1)
2016-12-22	F	19:08 - 19:08	(1)
2016-12-22	F	19:12 - 19:12	(1)
2016-12-22	F	19:16 - 19:16	(1)
2016-12-22	F	19:28 - 19:28	(1)
2016-12-22	F	19:32 - 19:32	(1)
2016-12-22	F	19:48 - 19:48	(1)
2016-12-22	F	19:53 - 19:53	(1)
2016-12-22	F	19:57 - 19:57	(1)
2016-12-22	F	20:06 - 20:07	(2)
2016-12-22	F	20:36 - 20:36	(1)
2016-12-22	F	20:42 - 20:42	(1)
2016-12-22	F	20:59 - 20:59	(1)
2016-12-22	F	21:07 - 21:07	(1)
2016-12-22	F	22:04 - 22:04	(1)
2016-12-22	F	22:20 - 22:20	(1)
2016-12-23	F	07:30 - 07:30	(1)
2016-12-23	F	07:58 - 07:58	(1)
2016-12-23	F	08:14 - 08:14	(1)
2016-12-23	F	08:18 - 08:18	(1)
2016-12-23	F	08:29 - 08:29	(1)
2016-12-23	F	08:33 - 08:33	(1)
2016-12-23	F	08:35 - 08:35	(1)
2016-12-23	F	08:38 - 08:38	(1)
2016-12-23	F	08:48 - 08:48	(1)
2016-12-23	F	09:01 - 09:01	(1)
2016-12-23	F	09:04 - 09:05	(2)
2016-12-23	F	09:13 - 09:13	(1)
2016-12-23	F	09:24 - 09:24	(1)
2016-12-23	F	09:39 - 09:39	(1)
2016-12-23	F	09:41 - 09:41	(1)
2016-12-23	F	09:51 - 09:51	(1)
2016-12-23	F	09:57 - 09:57	(1)
2016-12-23	F	10:01 - 10:04	(4)
2016-12-23	F	10:07 - 10:08	(2)
2016-12-23	F	10:18 - 10:18	(1)
2016-12-23	F	10:20 - 10:21	(2)
2016-12-23	F	10:24 - 10:24	(1)
2016-12-23	F	10:28 - 10:30	(3)
2016-12-23	F	10:33 - 10:33	(1)
2016-12-23	F	10:35 - 10:35	(1)
2016-12-23	F	10:38 - 10:38	(1)
2016-12-23	F	10:40 - 10:40	(1)
2016-12-23	F	10:44 - 10:44	(1)
2016-12-23	F	10:46 - 10:47	(2)
2016-12-23	F	10:53 - 10:54	(2)
2016-12-23	F	10:56 - 10:56	(1)
2016-12-23	F	10:59 - 10:59	(1)
2016-12-23	F	11:01 - 11:02	(2)
2016-12-23	F	11:04 - 11:11	(8)
2016-12-23	F	11:13 - 11:13	(1)

2016-12-23	F	11:15 - 11:21	(7)
2016-12-23	F	11:23 - 11:26	(4)
2016-12-23	F	11:29 - 11:33	(5)
2016-12-23	F	11:36 - 11:36	(1)
2016-12-23	F	11:38 - 11:38	(1)
2016-12-23	F	11:40 - 11:41	(2)
2016-12-23	F	11:43 - 11:44	(2)
2016-12-23	F	11:47 - 11:47	(1)
2016-12-23	F	11:49 - 11:50	(2)
2016-12-23	F	11:53 - 11:54	(2)
2016-12-23	F	11:56 - 11:57	(2)
2016-12-23	F	11:59 - 12:09	(11)
2016-12-23	F	12:11 - 12:14	(4)
2016-12-23	F	12:16 - 12:18	(3)
2016-12-23	F	12:21 - 12:22	(2)
2016-12-23	F	12:25 - 12:31	(7)
2016-12-23	F	12:33 - 12:39	(7)
2016-12-23	F	12:42 - 12:43	(2)
2016-12-23	F	12:45 - 12:47	(3)
2016-12-23	F	12:49 - 12:51	(3)
2016-12-23	F	12:53 - 12:56	(4)
2016-12-23	F	13:01 - 13:03	(3)
2016-12-23	F	13:05 - 13:08	(4)
2016-12-23	F	13:10 - 13:14	(5)
2016-12-23	F	13:16 - 13:21	(6)
2016-12-23	F	13:23 - 13:24	(2)
2016-12-23	F	13:26 - 13:27	(2)
2016-12-23	F	13:30 - 13:30	(1)
2016-12-23	F	13:32 - 13:39	(8)
2016-12-23	F	13:41 - 13:43	(3)
2016-12-23	F	13:46 - 13:57	(12)
2016-12-23	F	13:59 - 14:01	(3)
2016-12-23	F	14:04 - 14:05	(2)
2016-12-23	F	14:10 - 14:13	(4)
2016-12-23	F	14:15 - 14:15	(1)
2016-12-23	F	14:17 - 14:19	(3)
2016-12-23	F	14:21 - 14:23	(3)
2016-12-23	F	14:25 - 14:25	(1)
2016-12-23	F	14:28 - 14:29	(2)
2016-12-23	F	14:31 - 14:32	(2)
2016-12-23	F	14:34 - 14:36	(3)
2016-12-23	F	14:38 - 14:38	(1)
2016-12-23	F	14:40 - 14:41	(2)
2016-12-23	F	14:43 - 14:50	(8)
2016-12-23	F	14:55 - 14:55	(1)
2016-12-23	F	14:58 - 15:00	(3)
2016-12-23	F	15:02 - 15:02	(1)
2016-12-23	F	15:04 - 15:06	(3)
2016-12-23	F	15:08 - 15:12	(5)
2016-12-23	F	15:14 - 15:17	(4)
2016-12-23	F	15:19 - 15:22	(4)
2016-12-23	F	15:24 - 15:24	(1)
2016-12-23	F	15:26 - 15:34	(9)
2016-12-23	F	15:36 - 15:37	(2)
2016-12-23	F	15:39 - 15:40	(2)
2016-12-23	F	15:42 - 15:43	(2)
2016-12-23	F	15:46 - 15:46	(1)
2016-12-23	F	15:49 - 15:50	(2)
2016-12-23	F	15:53 - 15:53	(1)
2016-12-23	F	15:58 - 15:58	(1)
2016-12-23	F	16:04 - 16:07	(4)

2016-12-23	F	16:11 - 16:11	(1)
2016-12-23	F	16:18 - 16:18	(1)
2016-12-23	F	16:21 - 16:22	(2)
2016-12-23	F	16:29 - 16:31	(3)
2016-12-23	F	16:36 - 16:44	(9)
2016-12-23	F	16:48 - 16:48	(1)
2016-12-23	F	16:53 - 16:54	(2)
2016-12-23	F	16:56 - 16:58	(3)
2016-12-23	F	17:08 - 17:08	(1)
2016-12-23	F	17:12 - 17:12	(1)
2016-12-23	F	17:16 - 17:16	(1)
2016-12-23	F	17:18 - 17:20	(3)
2016-12-23	F	17:28 - 17:29	(2)
2016-12-23	F	17:32 - 17:32	(1)
2016-12-23	F	17:57 - 17:57	(1)
2016-12-23	F	18:04 - 18:05	(2)
2016-12-23	F	18:11 - 18:12	(2)
2016-12-23	F	18:22 - 18:22	(1)
2016-12-23	F	18:25 - 18:25	(1)
2016-12-23	F	18:33 - 18:33	(1)
2016-12-23	F	18:39 - 18:39	(1)
2016-12-23	F	18:48 - 18:48	(1)
2016-12-23	F	18:50 - 18:50	(1)
2016-12-23	F	18:52 - 18:52	(1)
2016-12-23	F	19:05 - 19:05	(1)
2016-12-23	F	19:08 - 19:08	(1)
2016-12-23	F	19:33 - 19:33	(1)
2016-12-23	F	19:36 - 19:36	(1)
2016-12-23	F	19:59 - 19:59	(1)
2016-12-23	F	20:22 - 20:22	(1)
2016-12-23	F	20:34 - 20:34	(1)
2016-12-23	F	20:41 - 20:41	(1)
2016-12-24	F	06:15 - 06:15	(1)
2016-12-24	F	07:24 - 07:24	(1)
2016-12-24	F	07:51 - 07:51	(1)
2016-12-24	F	08:29 - 08:29	(1)
2016-12-24	F	08:36 - 08:36	(1)
2016-12-24	F	08:48 - 08:48	(1)
2016-12-24	F	08:55 - 08:55	(1)
2016-12-24	F	08:57 - 08:57	(1)
2016-12-24	F	09:02 - 09:02	(1)
2016-12-24	F	09:04 - 09:04	(1)
2016-12-24	F	09:07 - 09:07	(1)
2016-12-24	F	09:11 - 09:11	(1)
2016-12-24	F	09:17 - 09:18	(2)
2016-12-24	F	09:20 - 09:20	(1)
2016-12-24	F	09:23 - 09:23	(1)
2016-12-24	F	09:32 - 09:33	(2)
2016-12-24	F	09:35 - 09:35	(1)
2016-12-24	F	09:38 - 09:38	(1)
2016-12-24	F	09:45 - 09:46	(2)
2016-12-24	F	09:50 - 09:52	(3)
2016-12-24	F	09:55 - 09:55	(1)
2016-12-24	F	09:58 - 09:58	(1)
2016-12-24	F	10:02 - 10:02	(1)
2016-12-24	F	10:04 - 10:05	(2)
2016-12-24	F	10:09 - 10:09	(1)
2016-12-24	F	10:11 - 10:13	(3)
2016-12-24	F	10:15 - 10:16	(2)
2016-12-24	F	10:19 - 10:21	(3)
2016-12-24	F	10:23 - 10:24	(2)

2016-12-24	F	10:27 - 10:31	(5)
2016-12-24	F	10:33 - 10:38	(6)
2016-12-24	F	10:41 - 10:42	(2)
2016-12-24	F	10:44 - 10:56	(13)
2016-12-24	F	10:58 - 10:59	(2)
2016-12-24	F	11:02 - 11:03	(2)
2016-12-24	F	11:05 - 11:30	(26)
2016-12-24	F	11:32 - 12:01	(30)
2016-12-24	F	12:03 - 12:05	(3)
2016-12-24	F	12:07 - 12:13	(7)
2016-12-24	F	12:16 - 12:21	(6)
2016-12-24	F	12:23 - 13:00	(38)
2016-12-24	F	13:02 - 13:26	(25)
2016-12-24	F	13:28 - 13:28	(1)
2016-12-24	F	13:30 - 13:48	(19)
2016-12-24	F	13:50 - 13:53	(4)
2016-12-24	F	13:55 - 14:00	(6)
2016-12-24	F	14:03 - 14:20	(18)
2016-12-24	F	14:22 - 14:46	(25)
2016-12-24	F	14:48 - 15:18	(31)
2016-12-24	F	15:20 - 15:21	(2)
2016-12-24	F	15:23 - 15:39	(17)
2016-12-24	F	15:41 - 15:52	(12)
2016-12-24	F	15:54 - 16:17	(24)
2016-12-24	F	16:19 - 16:25	(7)
2016-12-24	F	16:27 - 16:29	(3)
2016-12-24	F	16:31 - 16:33	(3)
2016-12-24	F	16:35 - 16:35	(1)
2016-12-24	F	16:37 - 16:41	(5)
2016-12-24	F	16:43 - 16:43	(1)
2016-12-24	F	16:46 - 16:50	(5)
2016-12-24	F	16:52 - 16:58	(7)
2016-12-24	F	17:00 - 17:08	(9)
2016-12-24	F	17:11 - 17:12	(2)
2016-12-24	F	17:17 - 17:20	(4)
2016-12-24	F	17:22 - 17:22	(1)
2016-12-24	F	17:25 - 17:25	(1)
2016-12-24	F	17:27 - 17:27	(1)
2016-12-24	F	17:30 - 17:30	(1)
2016-12-24	F	17:32 - 17:37	(6)
2016-12-24	F	17:40 - 17:42	(3)
2016-12-24	F	17:45 - 17:50	(6)
2016-12-24	F	17:52 - 17:57	(6)
2016-12-24	F	17:59 - 18:03	(5)
2016-12-24	F	18:05 - 18:09	(5)
2016-12-24	F	18:11 - 18:16	(6)
2016-12-24	F	18:18 - 18:19	(2)
2016-12-24	F	18:23 - 18:26	(4)
2016-12-24	F	18:29 - 18:31	(3)
2016-12-24	F	18:33 - 18:34	(2)
2016-12-24	F	18:39 - 18:39	(1)
2016-12-24	F	18:44 - 18:44	(1)
2016-12-24	F	18:47 - 18:50	(4)
2016-12-24	F	18:53 - 18:53	(1)
2016-12-24	F	18:57 - 18:57	(1)
2016-12-24	F	19:00 - 19:03	(4)
2016-12-24	F	19:06 - 19:06	(1)
2016-12-24	F	19:13 - 19:13	(1)
2016-12-24	F	19:15 - 19:15	(1)
2016-12-24	F	19:19 - 19:21	(3)
2016-12-24	F	19:24 - 19:24	(1)

2016-12-24	F	19:27 - 19:27	(1)
2016-12-24	F	19:30 - 19:31	(2)
2016-12-24	F	19:33 - 19:33	(1)
2016-12-24	F	19:35 - 19:36	(2)
2016-12-24	F	19:39 - 19:40	(2)
2016-12-24	F	19:44 - 19:44	(1)
2016-12-24	F	19:46 - 19:46	(1)
2016-12-24	F	19:48 - 19:48	(1)
2016-12-24	F	19:54 - 19:54	(1)
2016-12-24	F	19:56 - 19:56	(1)
2016-12-24	F	19:58 - 19:59	(2)
2016-12-24	F	20:01 - 20:01	(1)
2016-12-24	F	20:03 - 20:03	(1)
2016-12-24	F	20:26 - 20:26	(1)
2016-12-24	F	20:29 - 20:29	(1)
2016-12-24	F	20:36 - 20:36	(1)
2016-12-24	F	20:43 - 20:43	(1)
2016-12-24	F	20:49 - 20:50	(2)
2016-12-24	F	20:57 - 20:57	(1)
2016-12-24	F	21:09 - 21:09	(1)
2016-12-24	F	21:18 - 21:18	(1)
2016-12-24	F	22:29 - 22:29	(1)
2016-12-24	F	22:52 - 22:52	(1)
2016-12-25	F	07:07 - 07:07	(1)
2016-12-25	F	07:20 - 07:20	(1)
2016-12-25	F	08:22 - 08:22	(1)
2016-12-25	F	08:50 - 08:50	(1)
2016-12-25	F	08:53 - 08:53	(1)
2016-12-25	F	09:12 - 09:12	(1)
2016-12-25	F	09:29 - 09:29	(1)
2016-12-25	F	09:37 - 09:37	(1)
2016-12-25	F	09:59 - 09:59	(1)
2016-12-25	F	10:18 - 10:18	(1)
2016-12-25	F	10:28 - 10:28	(1)
2016-12-25	F	10:30 - 10:31	(2)
2016-12-25	F	10:45 - 10:45	(1)
2016-12-25	F	10:49 - 10:49	(1)
2016-12-25	F	10:53 - 10:53	(1)
2016-12-25	F	10:59 - 10:59	(1)
2016-12-25	F	11:02 - 11:02	(1)
2016-12-25	F	11:09 - 11:09	(1)
2016-12-25	F	11:16 - 11:16	(1)
2016-12-25	F	11:21 - 11:21	(1)
2016-12-25	F	11:26 - 11:29	(4)
2016-12-25	F	11:31 - 11:32	(2)
2016-12-25	F	11:34 - 11:35	(2)
2016-12-25	F	11:39 - 11:41	(3)
2016-12-25	F	11:45 - 11:46	(2)
2016-12-25	F	11:52 - 11:52	(1)
2016-12-25	F	11:54 - 11:55	(2)
2016-12-25	F	11:57 - 11:58	(2)
2016-12-25	F	12:00 - 12:00	(1)
2016-12-25	F	12:02 - 12:02	(1)
2016-12-25	F	12:05 - 12:07	(3)
2016-12-25	F	12:12 - 12:12	(1)
2016-12-25	F	12:18 - 12:18	(1)
2016-12-25	F	12:25 - 12:26	(2)
2016-12-25	F	12:28 - 12:28	(1)
2016-12-25	F	12:37 - 12:37	(1)
2016-12-25	F	12:39 - 12:40	(2)
2016-12-25	F	12:42 - 12:44	(3)

2016-12-25	F	12:46 - 12:47	(2)
2016-12-25	F	12:50 - 12:55	(6)
2016-12-25	F	12:59 - 12:59	(1)
2016-12-25	F	13:02 - 13:04	(3)
2016-12-25	F	13:06 - 13:08	(3)
2016-12-25	F	13:10 - 13:10	(1)
2016-12-25	F	13:12 - 13:13	(2)
2016-12-25	F	13:15 - 13:16	(2)
2016-12-25	F	13:19 - 13:19	(1)
2016-12-25	F	13:21 - 13:22	(2)
2016-12-25	F	13:24 - 13:26	(3)
2016-12-25	F	13:28 - 13:29	(2)
2016-12-25	F	13:31 - 13:34	(4)
2016-12-25	F	13:41 - 13:42	(2)
2016-12-25	F	13:45 - 13:45	(1)
2016-12-25	F	13:47 - 13:47	(1)
2016-12-25	F	13:50 - 13:51	(2)
2016-12-25	F	13:53 - 13:53	(1)
2016-12-25	F	13:56 - 13:56	(1)
2016-12-25	F	13:58 - 14:01	(4)
2016-12-25	F	14:03 - 14:03	(1)
2016-12-25	F	14:05 - 14:05	(1)
2016-12-25	F	14:09 - 14:11	(3)
2016-12-25	F	14:14 - 14:14	(1)
2016-12-25	F	14:16 - 14:16	(1)
2016-12-25	F	14:19 - 14:19	(1)
2016-12-25	F	14:22 - 14:22	(1)
2016-12-25	F	14:26 - 14:26	(1)
2016-12-25	F	14:29 - 14:31	(3)
2016-12-25	F	14:36 - 14:37	(2)
2016-12-25	F	14:40 - 14:40	(1)
2016-12-25	F	14:42 - 14:43	(2)
2016-12-25	F	14:47 - 14:50	(4)
2016-12-25	F	14:52 - 14:54	(3)
2016-12-25	F	14:56 - 14:56	(1)
2016-12-25	F	14:58 - 14:59	(2)
2016-12-25	F	15:03 - 15:05	(3)
2016-12-25	F	15:08 - 15:08	(1)
2016-12-25	F	15:13 - 15:14	(2)
2016-12-25	F	15:16 - 15:19	(4)
2016-12-25	F	15:22 - 15:22	(1)
2016-12-25	F	15:29 - 15:29	(1)
2016-12-25	F	15:31 - 15:31	(1)
2016-12-25	F	15:33 - 15:34	(2)
2016-12-25	F	15:38 - 15:39	(2)
2016-12-25	F	15:41 - 15:41	(1)
2016-12-25	F	15:46 - 15:46	(1)
2016-12-25	F	15:55 - 15:56	(2)
2016-12-25	F	15:58 - 15:58	(1)
2016-12-25	F	16:08 - 16:09	(2)
2016-12-25	F	16:11 - 16:14	(4)
2016-12-25	F	16:25 - 16:26	(2)
2016-12-25	F	16:29 - 16:29	(1)
2016-12-25	F	16:33 - 16:33	(1)
2016-12-25	F	16:38 - 16:38	(1)
2016-12-25	F	16:43 - 16:43	(1)
2016-12-25	F	16:45 - 16:45	(1)
2016-12-25	F	16:47 - 16:47	(1)
2016-12-25	F	17:08 - 17:08	(1)
2016-12-25	F	17:13 - 17:13	(1)
2016-12-25	F	17:22 - 17:22	(1)

2016-12-25	F	17:24 - 17:24	(1)
2016-12-25	F	17:35 - 17:35	(1)
2016-12-25	F	17:37 - 17:37	(1)
2016-12-25	F	17:44 - 17:44	(1)
2016-12-25	F	17:46 - 17:46	(1)
2016-12-25	F	17:48 - 17:48	(1)
2016-12-25	F	18:40 - 18:40	(1)
2016-12-25	F	20:06 - 20:06	(1)
2016-12-26	F	10:26 - 10:26	(1)
2016-12-26	F	10:32 - 10:32	(1)
2016-12-26	F	11:42 - 11:42	(1)
2016-12-26	F	12:08 - 12:08	(1)
2016-12-26	F	12:12 - 12:12	(1)
2016-12-26	F	12:35 - 12:35	(1)
2016-12-26	F	13:46 - 13:46	(1)
2016-12-26	F	13:48 - 13:48	(1)
2016-12-26	F	14:00 - 14:00	(1)
2016-12-26	F	14:03 - 14:03	(1)
2016-12-26	F	14:05 - 14:05	(1)
2016-12-26	F	14:07 - 14:07	(1)
2016-12-26	F	14:09 - 14:09	(1)
2016-12-26	F	14:37 - 14:37	(1)
2016-12-26	F	14:45 - 14:45	(1)
2016-12-26	F	15:22 - 15:22	(1)
2016-12-26	F	15:28 - 15:28	(1)
2016-12-26	F	15:35 - 15:35	(1)
2016-12-26	F	15:46 - 15:46	(1)
2016-12-26	F	15:51 - 15:52	(2)
2016-12-26	F	16:05 - 16:05	(1)
2016-12-26	F	16:15 - 16:16	(2)
2016-12-26	F	16:51 - 16:51	(1)
2016-12-26	F	17:17 - 17:17	(1)
2016-12-26	F	18:04 - 18:04	(1)
2016-12-27	F	08:05 - 08:05	(1)
2016-12-27	F	08:09 - 08:09	(1)
2016-12-27	F	08:11 - 08:12	(2)
2016-12-27	F	08:16 - 08:16	(1)
2016-12-27	F	08:25 - 08:25	(1)
2016-12-27	F	08:34 - 08:34	(1)
2016-12-27	F	08:36 - 08:36	(1)
2016-12-27	F	08:44 - 08:44	(1)
2016-12-27	F	08:50 - 08:50	(1)
2016-12-27	F	08:52 - 08:52	(1)
2016-12-27	F	08:54 - 08:54	(1)
2016-12-27	F	08:57 - 08:57	(1)
2016-12-27	F	08:59 - 08:59	(1)
2016-12-27	F	09:02 - 09:02	(1)
2016-12-27	F	09:06 - 09:06	(1)
2016-12-27	F	09:09 - 09:10	(2)
2016-12-27	F	09:14 - 09:14	(1)
2016-12-27	F	09:16 - 09:24	(9)
2016-12-27	F	09:27 - 09:28	(2)
2016-12-27	F	09:30 - 09:30	(1)
2016-12-27	F	09:32 - 09:33	(2)
2016-12-27	F	09:35 - 09:36	(2)
2016-12-27	F	09:38 - 21:58	(741)
2016-12-27	F	22:00 - 22:01	(2)
2016-12-27	F	22:03 - 22:03	(1)
2016-12-27	F	22:06 - 22:06	(1)
2016-12-27	F	22:08 - 22:08	(1)
2016-12-27	F	22:10 - 22:11	(2)

2016-12-27	F	22:13 - 22:15	(3)
2016-12-27	F	22:17 - 22:17	(1)
2016-12-27	F	22:19 - 22:20	(2)
2016-12-27	F	22:24 - 22:24	(1)
2016-12-27	F	22:27 - 22:27	(1)
2016-12-27	F	22:29 - 22:29	(1)
2016-12-27	F	22:31 - 22:31	(1)
2016-12-27	F	22:34 - 22:40	(7)
2016-12-27	F	22:42 - 22:42	(1)
2016-12-27	F	22:45 - 22:45	(1)
2016-12-27	F	22:49 - 22:49	(1)
2016-12-27	F	22:51 - 22:55	(5)
2016-12-27	F	22:57 - 22:59	(3)
2016-12-27	F	23:01 - 23:02	(2)
2016-12-27	F	23:08 - 23:08	(1)
2016-12-27	F	23:11 - 23:11	(1)
2016-12-27	F	23:13 - 23:13	(1)
2016-12-27	F	23:16 - 23:17	(2)
2016-12-27	F	23:23 - 23:23	(1)
2016-12-27	F	23:29 - 23:29	(1)
2016-12-27	F	23:40 - 23:40	(1)
2016-12-27	F	23:42 - 23:42	(1)
2016-12-27	F	23:50 - 23:52	(3)
2016-12-27	F	23:58 - 23:58	(1)
2016-12-28	F	00:04 - 00:05	(2)
2016-12-28	F	00:09 - 00:09	(1)
2016-12-28	F	00:12 - 00:12	(1)
2016-12-28	F	00:14 - 00:15	(2)
2016-12-28	F	00:21 - 00:21	(1)
2016-12-28	F	00:24 - 00:24	(1)
2016-12-28	F	00:27 - 00:27	(1)
2016-12-28	F	00:37 - 00:38	(2)
2016-12-28	F	00:40 - 00:40	(1)
2016-12-28	F	00:44 - 00:44	(1)
2016-12-28	F	00:56 - 00:56	(1)
2016-12-28	F	00:59 - 00:59	(1)
2016-12-28	F	01:03 - 01:03	(1)
2016-12-28	F	01:30 - 01:30	(1)
2016-12-28	F	01:33 - 01:33	(1)
2016-12-28	F	01:52 - 01:52	(1)
2016-12-28	F	02:01 - 02:01	(1)
2016-12-28	F	02:15 - 02:15	(1)
2016-12-28	F	02:31 - 02:31	(1)
2016-12-28	F	02:51 - 02:51	(1)
2016-12-28	F	03:18 - 03:18	(1)
2016-12-28	F	04:46 - 04:46	(1)
2016-12-28	F	04:50 - 04:50	(1)
2016-12-28	F	05:30 - 05:30	(1)
2016-12-28	F	05:34 - 05:35	(2)
2016-12-28	F	05:47 - 05:47	(1)
2016-12-28	F	06:01 - 06:01	(1)
2016-12-28	F	06:05 - 06:05	(1)
2016-12-28	F	06:14 - 06:14	(1)
2016-12-28	F	06:17 - 06:17	(1)
2016-12-28	F	06:24 - 06:24	(1)
2016-12-28	F	06:28 - 06:28	(1)
2016-12-28	F	06:37 - 06:37	(1)
2016-12-28	F	06:39 - 06:40	(2)
2016-12-28	F	06:54 - 06:54	(1)
2016-12-28	F	07:00 - 07:00	(1)
2016-12-28	F	07:03 - 07:03	(1)

2016-12-28	F	07:07 - 07:07	(1)
2016-12-28	F	07:09 - 07:09	(1)
2016-12-28	F	07:11 - 07:11	(1)
2016-12-28	F	07:13 - 07:14	(2)
2016-12-28	F	07:20 - 07:20	(1)
2016-12-28	F	07:23 - 07:23	(1)
2016-12-28	F	07:25 - 07:27	(3)
2016-12-28	F	07:31 - 07:31	(1)
2016-12-28	F	07:35 - 07:39	(5)
2016-12-28	F	07:41 - 07:42	(2)
2016-12-28	F	07:46 - 07:49	(4)
2016-12-28	F	07:51 - 22:01	(851)
2016-12-28	F	22:03 - 22:08	(6)
2016-12-28	F	22:10 - 22:10	(1)
2016-12-28	F	22:12 - 22:12	(1)
2016-12-28	F	22:18 - 22:18	(1)
2016-12-28	F	22:20 - 22:24	(5)
2016-12-28	F	22:26 - 22:26	(1)
2016-12-28	F	22:28 - 22:30	(3)
2016-12-28	F	22:32 - 22:33	(2)
2016-12-28	F	22:36 - 22:36	(1)
2016-12-28	F	22:38 - 22:39	(2)
2016-12-28	F	22:41 - 22:42	(2)
2016-12-28	F	22:44 - 22:48	(5)
2016-12-28	F	22:50 - 22:51	(2)
2016-12-28	F	22:55 - 22:57	(3)
2016-12-28	F	23:01 - 23:06	(6)
2016-12-28	F	23:11 - 23:11	(1)
2016-12-28	F	23:15 - 23:15	(1)
2016-12-28	F	23:17 - 23:17	(1)
2016-12-28	F	23:19 - 23:20	(2)
2016-12-28	F	23:23 - 23:23	(1)
2016-12-28	F	23:26 - 23:27	(2)
2016-12-28	F	23:30 - 23:30	(1)
2016-12-28	F	23:32 - 23:32	(1)
2016-12-28	F	23:34 - 23:34	(1)
2016-12-28	F	23:36 - 23:36	(1)
2016-12-28	F	23:38 - 23:38	(1)
2016-12-28	F	23:50 - 23:50	(1)
2016-12-28	F	23:53 - 23:53	(1)
2016-12-29	F	00:03 - 00:03	(1)
2016-12-29	F	00:09 - 00:09	(1)
2016-12-29	F	00:13 - 00:13	(1)
2016-12-29	F	00:33 - 00:33	(1)
2016-12-29	F	00:53 - 00:53	(1)
2016-12-29	F	01:36 - 01:37	(2)
2016-12-29	F	01:44 - 01:44	(1)
2016-12-29	F	02:00 - 02:00	(1)
2016-12-29	F	02:38 - 02:38	(1)
2016-12-29	F	02:43 - 02:43	(1)
2016-12-29	F	02:53 - 02:53	(1)
2016-12-29	F	03:36 - 03:36	(1)
2016-12-29	F	04:53 - 04:53	(1)
2016-12-29	F	04:56 - 04:56	(1)
2016-12-29	F	05:01 - 05:01	(1)
2016-12-29	F	05:13 - 05:13	(1)
2016-12-29	F	05:21 - 05:21	(1)
2016-12-29	F	05:28 - 05:28	(1)
2016-12-29	F	05:35 - 05:35	(1)
2016-12-29	F	05:41 - 05:41	(1)
2016-12-29	F	05:44 - 05:44	(1)

2016-12-29	F	05:46 - 05:46	(1)
2016-12-29	F	05:57 - 06:00	(4)
2016-12-29	F	06:03 - 06:03	(1)
2016-12-29	F	06:05 - 06:05	(1)
2016-12-29	F	06:11 - 06:11	(1)
2016-12-29	F	06:14 - 06:14	(1)
2016-12-29	F	06:16 - 06:16	(1)
2016-12-29	F	06:18 - 06:18	(1)
2016-12-29	F	06:21 - 06:21	(1)
2016-12-29	F	06:24 - 06:24	(1)
2016-12-29	F	06:26 - 06:28	(3)
2016-12-29	F	06:31 - 06:32	(2)
2016-12-29	F	06:34 - 06:35	(2)
2016-12-29	F	06:38 - 06:38	(1)
2016-12-29	F	06:40 - 06:41	(2)
2016-12-29	F	06:44 - 06:44	(1)
2016-12-29	F	06:46 - 06:50	(5)
2016-12-29	F	06:53 - 21:29	(877)
2016-12-29	F	21:31 - 21:35	(5)
2016-12-29	F	21:37 - 21:37	(1)
2016-12-29	F	21:39 - 21:44	(6)
2016-12-29	F	21:46 - 21:47	(2)
2016-12-29	F	21:49 - 22:12	(24)
2016-12-29	F	22:14 - 22:14	(1)
2016-12-29	F	22:16 - 22:20	(5)
2016-12-29	F	22:22 - 22:37	(16)
2016-12-29	F	22:40 - 22:43	(4)
2016-12-29	F	22:45 - 22:45	(1)
2016-12-29	F	22:47 - 22:47	(1)
2016-12-29	F	22:49 - 22:49	(1)
2016-12-29	F	22:52 - 22:53	(2)
2016-12-29	F	22:57 - 22:58	(2)
2016-12-29	F	23:00 - 23:00	(1)
2016-12-29	F	23:02 - 23:03	(2)
2016-12-29	F	23:06 - 23:08	(3)
2016-12-29	F	23:10 - 23:10	(1)
2016-12-29	F	23:16 - 23:19	(4)
2016-12-29	F	23:21 - 23:21	(1)
2016-12-29	F	23:23 - 23:34	(12)
2016-12-29	F	23:36 - 23:38	(3)
2016-12-29	F	23:40 - 23:46	(7)
2016-12-29	F	23:48 - 23:48	(1)
2016-12-29	F	23:50 - 23:55	(6)
2016-12-29	F	23:57 - 23:59	(3)
2016-12-30	F	00:01 - 00:02	(2)
2016-12-30	F	00:04 - 00:05	(2)
2016-12-30	F	00:07 - 00:08	(2)
2016-12-30	F	00:11 - 00:11	(1)
2016-12-30	F	00:16 - 00:21	(6)
2016-12-30	F	00:23 - 00:25	(3)
2016-12-30	F	00:29 - 00:29	(1)
2016-12-30	F	00:33 - 00:33	(1)
2016-12-30	F	00:35 - 00:37	(3)
2016-12-30	F	00:39 - 00:39	(1)
2016-12-30	F	00:41 - 00:41	(1)
2016-12-30	F	00:43 - 00:45	(3)
2016-12-30	F	00:47 - 00:48	(2)
2016-12-30	F	00:51 - 00:51	(1)
2016-12-30	F	00:53 - 00:55	(3)
2016-12-30	F	00:57 - 00:57	(1)
2016-12-30	F	01:03 - 01:03	(1)

2016-12-30	F	01:09 - 01:09	(1)
2016-12-30	F	01:13 - 01:13	(1)
2016-12-30	F	01:28 - 01:28	(1)
2016-12-30	F	01:47 - 01:47	(1)
2016-12-30	F	01:52 - 01:52	(1)
2016-12-30	F	02:05 - 02:05	(1)
2016-12-30	F	02:10 - 02:10	(1)
2016-12-30	F	02:13 - 02:13	(1)
2016-12-30	F	02:23 - 02:24	(2)
2016-12-30	F	02:31 - 02:31	(1)
2016-12-30	F	02:35 - 02:35	(1)
2016-12-30	F	02:43 - 02:43	(1)
2016-12-30	F	02:47 - 02:47	(1)
2016-12-30	F	02:55 - 02:55	(1)
2016-12-30	F	03:11 - 03:11	(1)
2016-12-30	F	03:19 - 03:19	(1)
2016-12-30	F	03:46 - 03:47	(2)
2016-12-30	F	03:52 - 03:53	(2)
2016-12-30	F	04:04 - 04:05	(2)
2016-12-30	F	04:11 - 04:11	(1)
2016-12-30	F	04:16 - 04:16	(1)
2016-12-30	F	04:21 - 04:21	(1)
2016-12-30	F	04:26 - 04:26	(1)
2016-12-30	F	04:37 - 04:39	(3)
2016-12-30	F	04:41 - 04:41	(1)
2016-12-30	F	04:48 - 04:48	(1)
2016-12-30	F	04:51 - 04:51	(1)
2016-12-30	F	05:14 - 05:18	(5)
2016-12-30	F	05:20 - 05:20	(1)
2016-12-30	F	05:25 - 05:25	(1)
2016-12-30	F	05:29 - 05:29	(1)
2016-12-30	F	05:31 - 05:32	(2)
2016-12-30	F	05:35 - 05:35	(1)
2016-12-30	F	05:37 - 05:37	(1)
2016-12-30	F	05:43 - 05:46	(4)
2016-12-30	F	05:48 - 05:48	(1)
2016-12-30	F	05:51 - 05:51	(1)
2016-12-30	F	05:53 - 05:57	(5)
2016-12-30	F	06:01 - 06:01	(1)
2016-12-30	F	06:07 - 06:08	(2)
2016-12-30	F	06:19 - 06:19	(1)
2016-12-30	F	06:22 - 06:22	(1)
2016-12-30	F	06:24 - 06:24	(1)
2016-12-30	F	06:27 - 06:27	(1)
2016-12-30	F	06:29 - 06:30	(2)
2016-12-30	F	06:32 - 06:34	(3)
2016-12-30	F	06:36 - 06:37	(2)
2016-12-30	F	06:39 - 06:44	(6)
2016-12-30	F	06:47 - 06:52	(6)
2016-12-30	F	06:54 - 06:55	(2)
2016-12-30	F	06:57 - 07:00	(4)
2016-12-30	F	07:02 - 07:04	(3)
2016-12-30	F	07:06 - 22:05	(900)
2016-12-30	F	22:07 - 22:07	(1)
2016-12-30	F	22:09 - 22:12	(4)
2016-12-30	F	22:15 - 22:15	(1)
2016-12-30	F	22:17 - 22:20	(4)
2016-12-30	F	22:22 - 22:25	(4)
2016-12-30	F	22:27 - 22:29	(3)
2016-12-30	F	22:31 - 22:31	(1)
2016-12-30	F	22:36 - 22:40	(5)

2016-12-30	F	22:43 - 22:48	(6)
2016-12-30	F	22:52 - 22:53	(2)
2016-12-30	F	22:56 - 22:57	(2)
2016-12-30	F	23:00 - 23:00	(1)
2016-12-30	F	23:02 - 23:02	(1)
2016-12-30	F	23:04 - 23:04	(1)
2016-12-30	F	23:06 - 23:06	(1)
2016-12-30	F	23:08 - 23:08	(1)
2016-12-30	F	23:10 - 23:12	(3)
2016-12-30	F	23:14 - 23:20	(7)
2016-12-30	F	23:22 - 23:22	(1)
2016-12-30	F	23:24 - 23:24	(1)
2016-12-30	F	23:26 - 23:27	(2)
2016-12-30	F	23:29 - 23:29	(1)
2016-12-30	F	23:33 - 23:35	(3)
2016-12-30	F	23:37 - 23:38	(2)
2016-12-30	F	23:42 - 23:42	(1)
2016-12-30	F	23:45 - 23:45	(1)
2016-12-30	F	23:48 - 23:50	(3)
2016-12-30	F	23:56 - 23:57	(2)
2016-12-31	F	00:00 - 00:00	(1)
2016-12-31	F	00:05 - 00:06	(2)
2016-12-31	F	00:11 - 00:14	(4)
2016-12-31	F	00:17 - 00:18	(2)
2016-12-31	F	00:21 - 00:22	(2)
2016-12-31	F	00:26 - 00:27	(2)
2016-12-31	F	00:29 - 00:29	(1)
2016-12-31	F	00:31 - 00:31	(1)
2016-12-31	F	00:33 - 00:33	(1)
2016-12-31	F	00:35 - 00:35	(1)
2016-12-31	F	00:38 - 00:38	(1)
2016-12-31	F	00:40 - 00:40	(1)
2016-12-31	F	00:42 - 00:42	(1)
2016-12-31	F	00:44 - 00:49	(6)
2016-12-31	F	00:52 - 00:52	(1)
2016-12-31	F	00:57 - 00:58	(2)
2016-12-31	F	01:00 - 01:00	(1)
2016-12-31	F	01:05 - 01:05	(1)
2016-12-31	F	01:09 - 01:09	(1)
2016-12-31	F	01:13 - 01:13	(1)
2016-12-31	F	01:20 - 01:22	(3)
2016-12-31	F	01:27 - 01:27	(1)
2016-12-31	F	01:32 - 01:33	(2)
2016-12-31	F	01:36 - 01:36	(1)
2016-12-31	F	01:43 - 01:43	(1)
2016-12-31	F	01:45 - 01:46	(2)
2016-12-31	F	01:50 - 01:50	(1)
2016-12-31	F	01:52 - 01:52	(1)
2016-12-31	F	01:55 - 01:55	(1)
2016-12-31	F	01:58 - 01:58	(1)
2016-12-31	F	02:00 - 02:01	(2)
2016-12-31	F	02:03 - 02:04	(2)
2016-12-31	F	02:08 - 02:08	(1)
2016-12-31	F	02:12 - 02:12	(1)
2016-12-31	F	02:20 - 02:20	(1)
2016-12-31	F	02:22 - 02:22	(1)
2016-12-31	F	02:25 - 02:25	(1)
2016-12-31	F	02:37 - 02:37	(1)
2016-12-31	F	02:39 - 02:39	(1)
2016-12-31	F	02:42 - 02:43	(2)
2016-12-31	F	02:51 - 02:51	(1)

2016-12-31	F	02:54 - 02:54	(1)
2016-12-31	F	02:57 - 02:57	(1)
2016-12-31	F	03:00 - 03:00	(1)
2016-12-31	F	03:05 - 03:05	(1)
2016-12-31	F	03:08 - 03:08	(1)
2016-12-31	F	03:13 - 03:14	(2)
2016-12-31	F	03:28 - 03:28	(1)
2016-12-31	F	03:46 - 03:46	(1)
2016-12-31	F	03:59 - 04:01	(3)
2016-12-31	F	04:11 - 04:11	(1)
2016-12-31	F	04:13 - 04:13	(1)
2016-12-31	F	04:16 - 04:16	(1)
2016-12-31	F	04:18 - 04:18	(1)
2016-12-31	F	04:32 - 04:32	(1)
2016-12-31	F	04:36 - 04:36	(1)
2016-12-31	F	04:39 - 04:39	(1)
2016-12-31	F	04:43 - 04:43	(1)
2016-12-31	F	04:50 - 04:50	(1)
2016-12-31	F	04:52 - 04:53	(2)
2016-12-31	F	04:55 - 04:55	(1)
2016-12-31	F	04:57 - 04:57	(1)
2016-12-31	F	05:13 - 05:13	(1)
2016-12-31	F	05:24 - 05:24	(1)
2016-12-31	F	05:28 - 05:28	(1)
2016-12-31	F	05:30 - 05:30	(1)
2016-12-31	F	05:34 - 05:35	(2)
2016-12-31	F	05:43 - 05:43	(1)
2016-12-31	F	05:46 - 05:46	(1)
2016-12-31	F	05:49 - 05:51	(3)
2016-12-31	F	05:54 - 05:57	(4)
2016-12-31	F	06:00 - 06:00	(1)
2016-12-31	F	06:04 - 06:04	(1)
2016-12-31	F	06:06 - 06:06	(1)
2016-12-31	F	06:08 - 06:08	(1)
2016-12-31	F	06:10 - 06:10	(1)
2016-12-31	F	06:12 - 06:16	(5)
2016-12-31	F	06:18 - 06:18	(1)
2016-12-31	F	06:21 - 06:21	(1)
2016-12-31	F	06:23 - 06:25	(3)
2016-12-31	F	06:27 - 06:31	(5)
2016-12-31	F	06:34 - 06:37	(4)
2016-12-31	F	06:39 - 06:46	(8)
2016-12-31	F	06:48 - 07:00	(13)
2016-12-31	F	07:02 - 07:07	(6)
2016-12-31	F	07:09 - 07:16	(8)
2016-12-31	F	07:18 - 07:19	(2)
2016-12-31	F	07:21 - 07:27	(7)
2016-12-31	F	07:29 - 07:32	(4)
2016-12-31	F	07:34 - 07:35	(2)
2016-12-31	F	07:37 - 07:54	(18)
2016-12-31	F	07:56 - 22:08	(853)
2016-12-31	F	22:10 - 22:41	(32)
2016-12-31	F	22:43 - 22:58	(16)
2016-12-31	F	23:00 - 23:01	(2)
2016-12-31	F	23:03 - 23:12	(10)
2016-12-31	F	23:14 - 23:49	(36)
2016-12-31	F	23:51 - 23:59	(9)

Total: 135503

7.1.2 Baseline values

7.1.2.1 2013

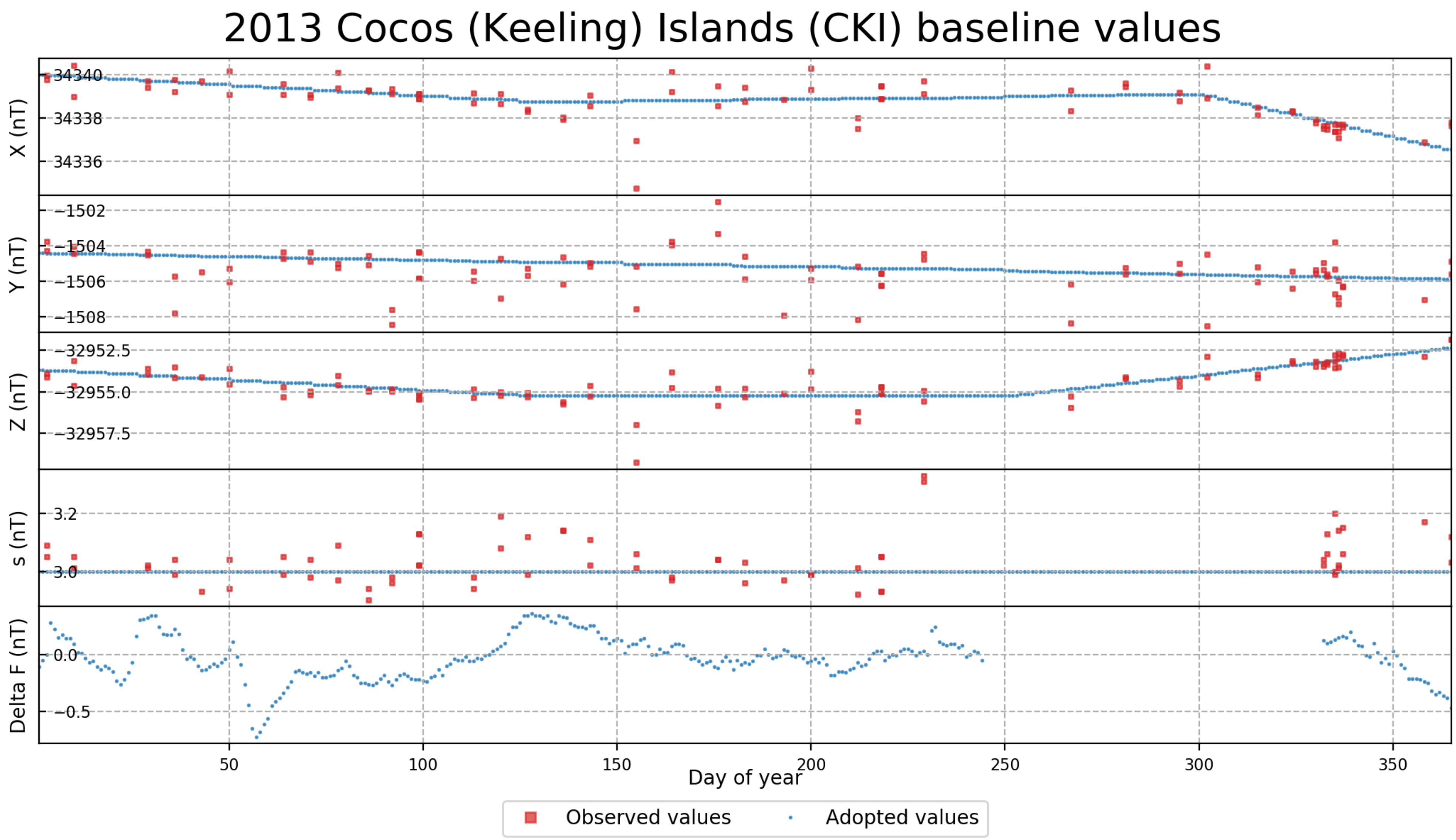

Figure 7.1 Cocos (Keeling) Islands (CKI) baseline values for 2013. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.1.2.2 2014

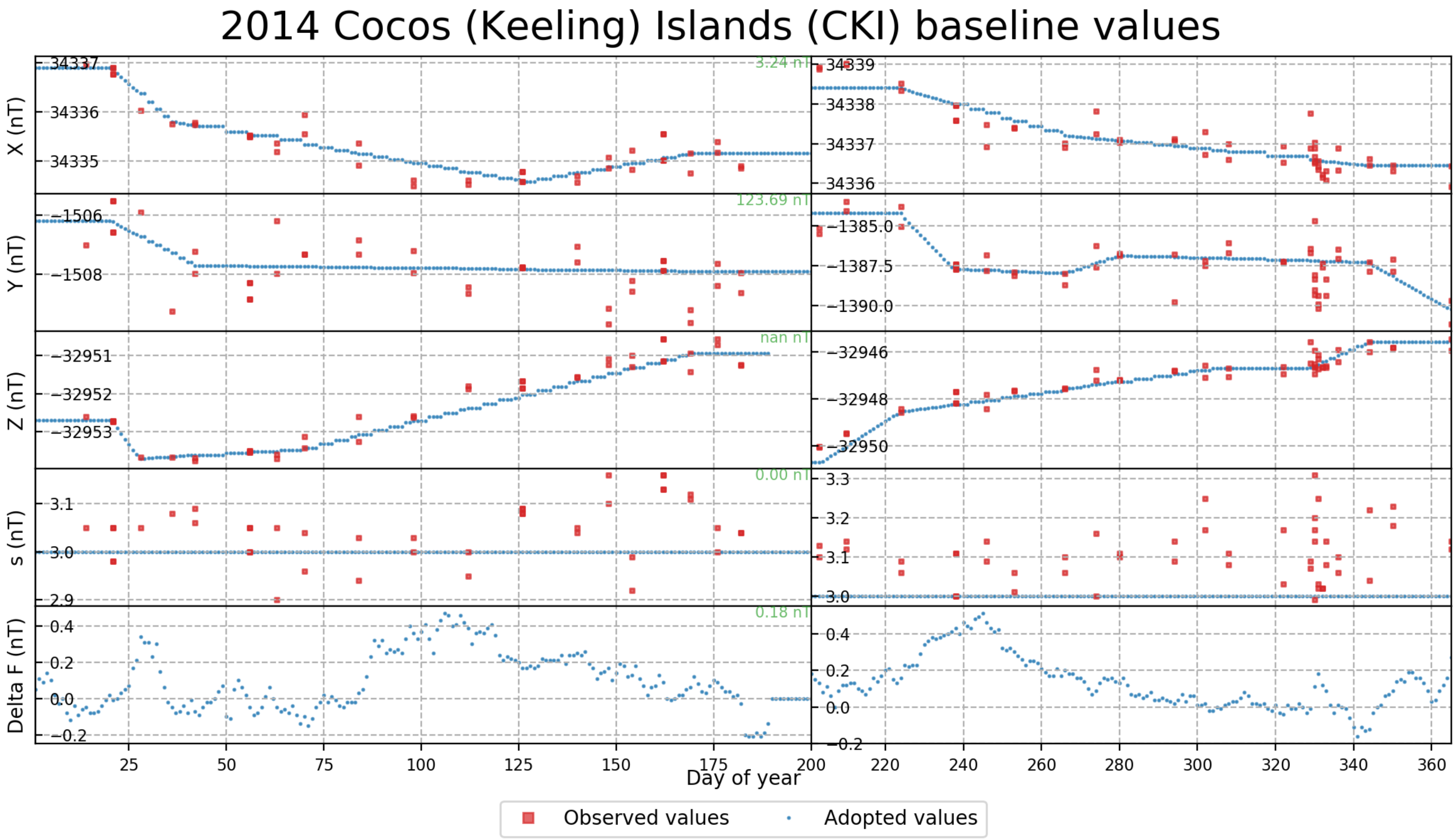

Figure 7.2 Cocos (Keeling) Islands (CKI) baseline values for 2014. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.1.2.3 2015

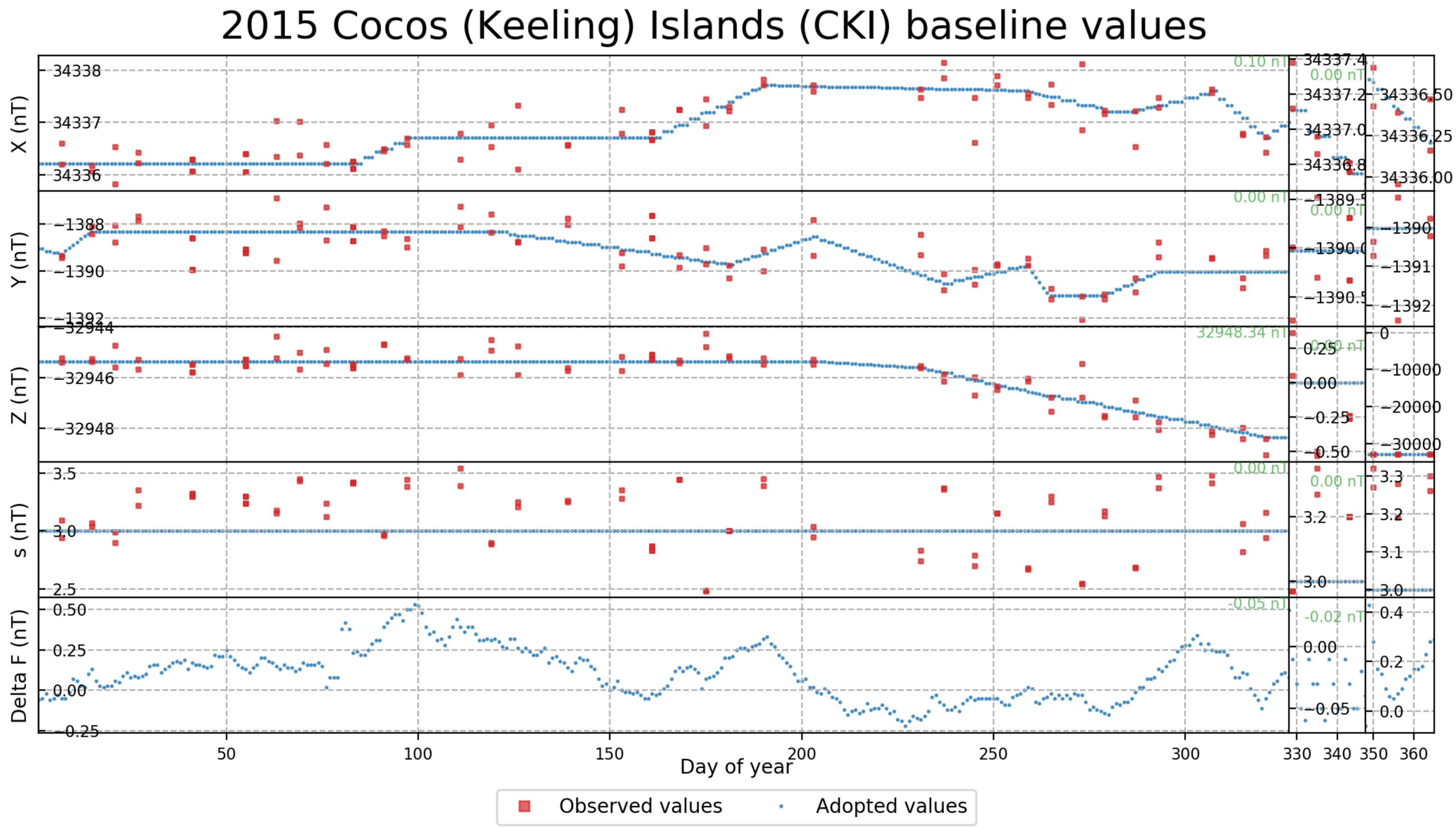

Figure 7.3 Cocos (Keeling) Islands (CKI) baseline values for 2015. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.1.2.4 2016

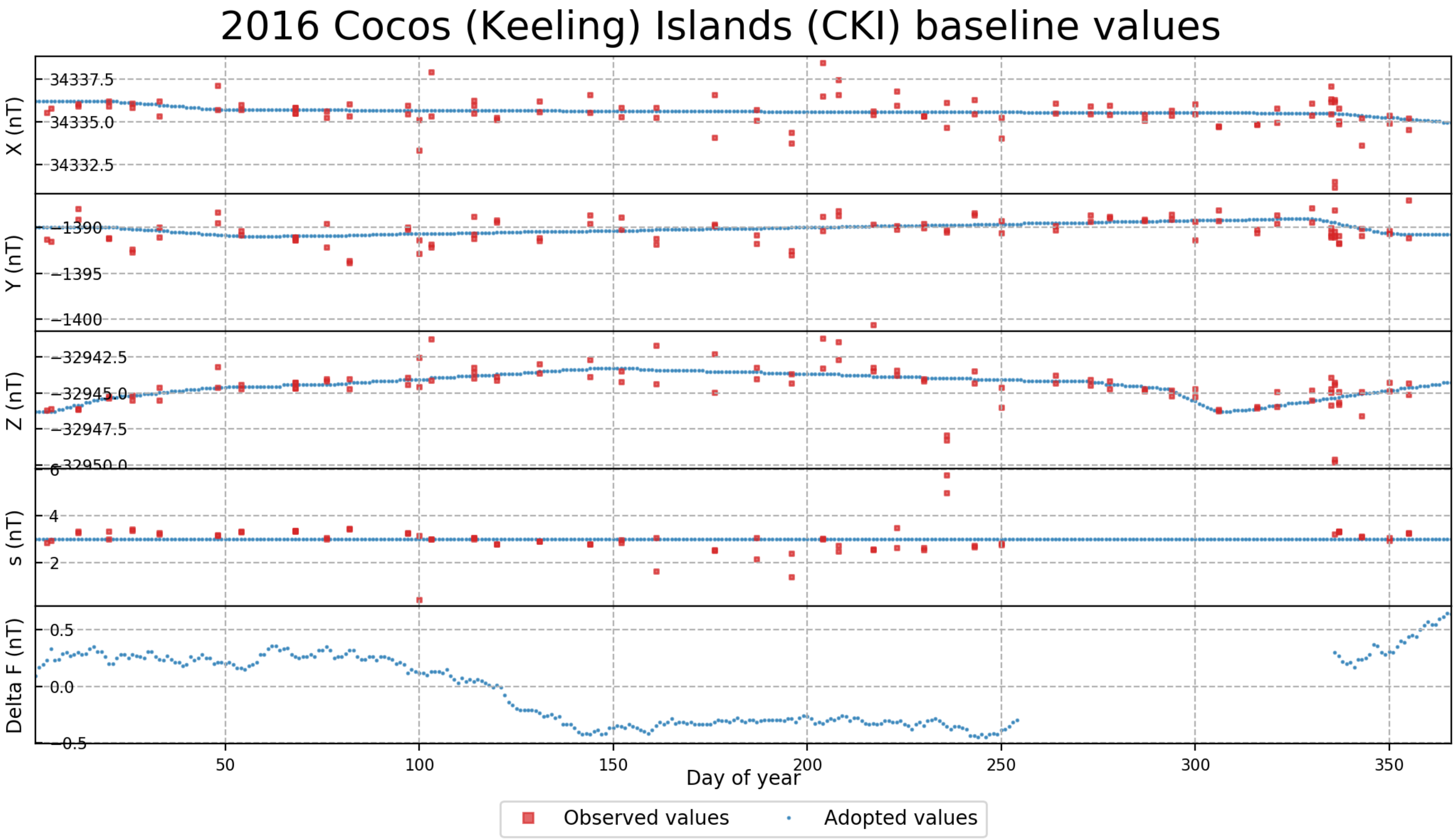

Figure 7.4 Cocos (Keeling) Islands (CKI) baseline values for 2016. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.1.3 Annual mean values

7.1.3.1 DIH

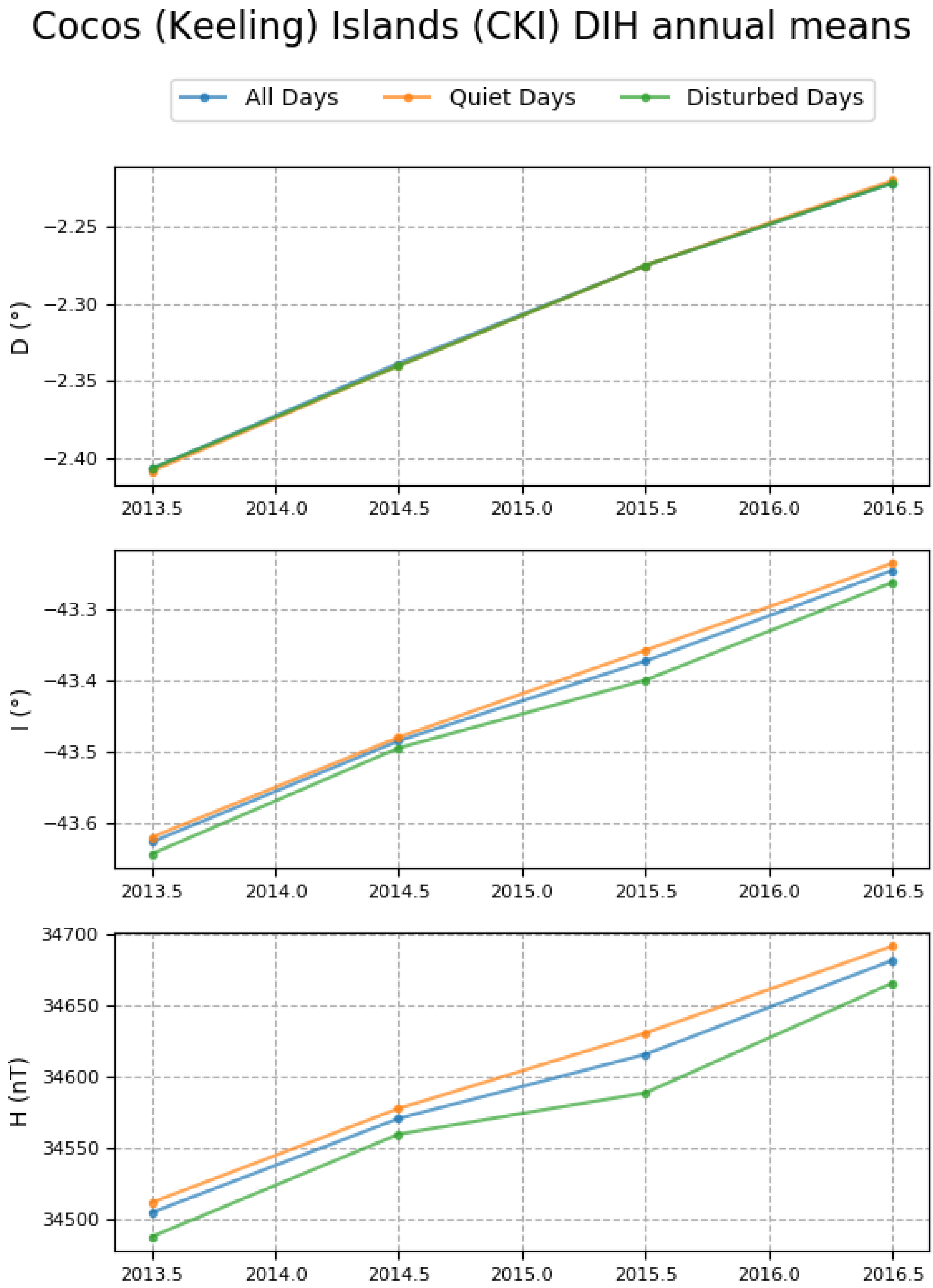

Figure 7.5 Cocos (Keeling) Islands (CKI) annual mean values in DIH until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.1.3.2 XYZF

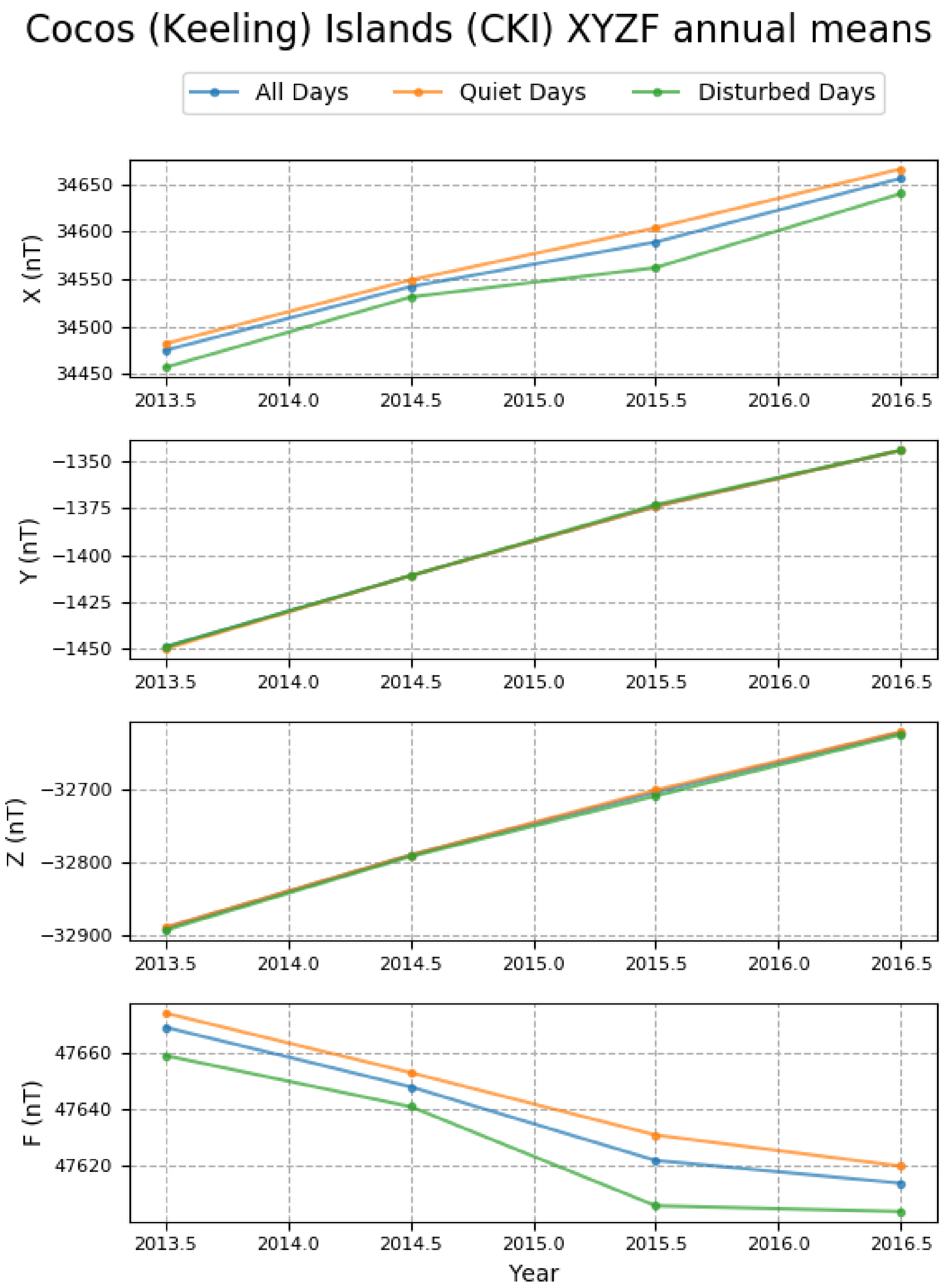

Figure 7.6 Cocos (Keeling) Islands (CKI) annual mean values in XYZF until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.1.3.3 2016 INTERMAGNET annual mean values file

ANNUAL MEAN VALUES

COCOS-KEELING ISLANDS, CKI, AUSTRALIA

COLATITUDE: 102.1874 LONGITUDE: 96.8336 E ELEVATION: 4.9 metres

YEAR	D Deg Min	I Deg Min	H nT	X nT	Y nT	Z nT	F nT	*	ELE	Note
2013.500	-2 24.4	-43 37.6	34505	34475	-1449	-32890	47669	A	ABZ	1
2014.500	-2 20.3	-43 29.1	34571	34542	-1411	-32790	47648	A	ABZ	
2015.500	-2 16.5	-43 22.4	34616	34589	-1374	-32704	47622	A	ABZ	
2016.500	-2 13.3	-43 14.8	34682	34656	-1344	-32622	47614	A	ABZ	
2013.500	-2 24.5	-43 37.2	34512	34482	-1450	-32889	47674	Q	ABZ	1
2014.500	-2 20.4	-43 28.8	34578	34549	-1411	-32790	47653	Q	ABZ	
2015.500	-2 16.5	-43 21.5	34631	34604	-1374	-32701	47631	Q	ABZ	
2016.500	-2 13.2	-43 14.2	34692	34666	-1344	-32621	47620	Q	ABZ	
2013.500	-2 24.4	-43 38.6	34488	34457	-1449	-32893	47659	D	ABZ	1
2014.500	-2 20.4	-43 29.7	34560	34531	-1411	-32792	47641	D	ABZ	
2015.500	-2 16.5	-43 24.0	34589	34562	-1373	-32709	47606	D	ABZ	
2016.500	-2 13.3	-43 15.8	34666	34640	-1344	-32625	47604	D	ABZ	

* A = All days
* Q = 5 International Quiet days each month
* D = 5 International Disturbed days each month

ELE = Elements recorded

Notes:

1. The elements recorded from 2011 were magnetic NW, NE and Vertical (ABZ), from which the standard magnetic elements were derived.

7.2 Kakadu

7.2.1 INTERMAGNET 'readme' files

7.2.1.1 2013

```
                              KDU
                KAKADU OBSERVATORY INFORMATION 2013

 ACKNOWLEDGE-   Users of the KDU data should acknowledge:
       -MENTS:   Geoscience Australia

   STATION ID: KDU
     LOCATION: Kakadu National Park, Northern Territory,
                Australia
 ORGANISATION: Geoscience Australia
  CO-LATITUDE: 102.69 Deg.
    LONGITUDE: 132.47 Deg. E
    ELEVATION: 15 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DIM) and Proton
               Precession Magnetometer (GEM GSM90)

    RECORDING
   VARIOMETER: Three component DMI FGE fluxgate
               magnetometer
               GEM GSM90 proton precession magnetometer

  ORIENTATION: ABZ (Magnetic NW, Magnetic NE and Vertical)
DYNAMIC RANGE: +/- 1500nT
   RESOLUTION: 0.032nT
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: none

    K-NUMBERS: none
     K9-LIMIT:

         GINS: Edinburgh
    SATELLITE: E-mail

    OBSERVERS: A. Ralph
               L. Wang


      CONTACT: Geomagnetism Project
               Geoscience Australia
               G.P.O. Box 378
               Canberra,  A.C.T.,  2601
               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9986
               e-mail: geomag@ga.gov.au
               www: http://www.ga.gov.au/
```

NOTES:

Kakadu Geophysical Observatory is located in the Northern Territory, 210 km east of Darwin and 40 km west of Jabiru on the Arnhem Highway, near the South Alligator Ranger Station, Kakadu National Park. It comprises magnetic and seismological observatories and a gravity station. Kakadu magnetic observatory is situated on unconsolidated ferruginous and clayey sand. Continuous magnetic-field recording began there in March 1995.

The magnetic observatory comprises:

* a 3×3 m air-conditioned concrete-brick Control House, with concrete ceiling and aluminium cladding and roof, where recording instrumentation and control equipment are housed;

* a 3×3 m roofed Absolute Shelter, 50 m NW of the Control House, that houses a 380 mm square fibre-mesh-concrete observation pier (Pier A), the top of which is 1200 mm from the concrete floor;

* two 300 mm diameter azimuth pillars, both about 100 m from Pier A and with approximate true bearings of 27d and 238d;

* two 600 mm square underground vaults that house the variometer sensors, both located 50 to 60 m from the Control House, one to its SSW and one to its WSW (cables between the sensor vaults and the Control House are routed via underground conduits), and;

* a concrete slab, with tripod foot placements and a marker plate, used as an external reference site E (at a standard height of 1.6 m above the marker plate). The marker plate is 60 m, at a bearing of 331d, from the principal observation pier A.

Key data for the observatory are given in Table 1.1.

IAGA code: KDU
Commenced operation: 05 March 1995
Geographic latitude: 12d41'10.9" S
Geographic longitude: 132d28'20.5" E
Geomagnetic latitude: -21.81d
Geomagnetic longitude: 205.69d
K 9 index lower limit: 300 nT
Principal pier: Pier A
Pier elevation (top): 14.6 m AMSL
Principal reference mark: Pillar AW
Reference mark azimuth: 237d52.8'
Reference mark distance: 99.6 m
Observer: A. Ralph

Table 1.1 Key observatory data.

Local meteorological conditions

The meteorological temperature at Jabiru airport (about 50km to the observatory) during 2013 varied from a minimum 15.1C (2013-07-02) to a maximum 41.2C (2013-11-01). Daily minimum temperatures varied from 15.1C to 28.8C (average +23.5+/-2.5C); daily maximum temperatures varied from 26.4C to 41.2C (average 35.2+/-2.4C); daily temperature ranges varied from 2.0C to 18.8C (average 11.7+/-2.8C).

The daily maximum wind gust varied from 17 to 76 km/h (average 36.9+/-8.6 km/h). The maximum daily maximum wind gust was 76 km/h on 2013-11-01. The minimum daily maximum wind gust was 17 km/h on 2013-12-29.

Variometers

The variometers used during 2013 are described in Table 1.2.

```
3-component variometer: DMI FGE
Serial number: E0198/S0183
Type: suspended; linear fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
Resolution: 0.032 nT
A/D converter: ADAM 4017 module (±5V)
Total-field variometer: GEM Systems GSM-90
Serial number: 4071413/42185
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Data acquisition system: GDAP: PC-104 computer, QNX OS
                         ARK3360F QNX6.5 (from 2013-12-05)
Timing: Trimble Acutime GPS clock
Communications: 9600b VSAT satellite link
```

Table 1.2. Magnetic variometers used in 2013.

Analogue outputs from the three fluxgate sensors, and the sensor and electronics temperatures, were converted to digital data using an ADAM 4017 analogue-to-digital converter mounted inside the fluxgate electronics unit. These data and the digital PPM data were recorded on the data acquisition computer located in the Control House.

The magnetic sensors were located in the concrete underground vaults: the fluxgate sensor in the northern vault (the one nearer the Absolute Shelter); and the PPM sensor in the southern vault. Both vaults were completely buried in soil to minimise temperature fluctuations.

The GSM90 variometer electronics was located in the covered vault with its sensor. DC power and data cables ran between the GSM90 vault and the Control House.

The fluxgate electronics console was placed in its own partially insulated plastic box, resting on the concrete floor in the Control Hut, with some bricks for heat-sinks to minimise temperature fluctuations. This arrangement proved to be effective in reducing the amplitude of temperature fluctuations with periods of the order of hours.

The equipment was protected from power blackouts, surges and lightning strikes by a mains filter, an uninterruptible power supply and a surge absorber. The data connections between the acquisition computer and both the DMI and the PPM variometers were via serial cables

Although some lightning protection measures were incorporated in its original construction, Kakadu Observatory has suffered lightning damage since its installation in 1995. Additional protection measures were taken in December 1998 and October 1999, including the installation of an ERICO system. The ERICO System 3000 (Advanced Integrated Lightning Protection), comprising a Dynasphere Air Termination unit, mast, and copper-coated-steel earthing rod, was designed to protect an area of 80 m radius. Lengths of copper ribbon and aluminium power cables buried in shallow trenches towards the Absolute Shelter, in the opposite direction, and from the Control House to and around both variometer sensor vaults, and a conducting loop around the Control House, were connected to the ERICO system. The upgraded lightning protection measures are working well, and no data loss occurred in 2013 due to lightning strikes.

The DMI FGE variometer scale-value, alignment, and temperature sensitivity parameters were measured at the magnetometer calibration facility at Canberra observatory before installation at Kakadu. The sensor assembly was aligned with the two horizontal fluxgate sensors at 45d to the declination at the time of installation and the Z fluxgate sensor vertical. This alignment was achieved by setting the X and Y offsets equal and rotating the instrument until the X and Y ordinates were equal. This method has been found to be accurate using tests performed at the calibration facility.

The Control House, which houses the DMI electronics, had its temperature maintained by an air conditioning unit. During 2013 the temperature of the DMI electronics ranged from 23.8C (in the winter months) to 27.8C (in the summer months). The annual temperature variation of 4.0C converted to variations 0.2 nT, 0.7 nT and 0.0 nT in the X, Y and Z channels.

The DMI sensor temperature ranged from 26.9C to 34.0C during the year. Although buried underground, it varied during the year in accordance with the seasons at long periods and probably with barometric pressure systems at short periods. The annual temperature variation of 7.1C converted to variations 0.2 nT, 0.4 nT and 0.5 nT in the X, Y and Z channels.

DMI variometer data from 2013-12-04 02:45:52 to 03:00:50 were contaminated due to maintenance work near the variometer vault. There were 16 minutes data loss in the filtered 1 minute DMI dataset.

Data from the GSM-90 variometer has a few seconds data loss during most of 2013 in the 10 second dataset. There were 5 minutes data loss in 1 minute filtered data set

DMI 1-second data required de-spiking. The de-spiking parameters required a spike to exceed 0.2 nT and 10 times the average "spike-factor" of the previous minute of data. Typically between 0 to 100s data were rejected in pre-monsoon and monsoon seasons from Nov to Mar due to thunderstorms. Highest rejection rate were on 2013-12-28 106s rejected. GSM90 10-seconds data required de-spiking. The de-spiking parameters required a spike to exceed 1 nT and 10 times the average "spike-factor" of the following minute of data. A few points of the 10 seconds data were rejected in pre-monsoon and monsoon seasons, with the maximum 15 points reject on 2013-12-13.

Variometer data timing was controlled by the QNX data-acquisition computer clock which was maintained using both the 1 PPS and data stream output of a GPS clock. A small error occasionally occurred just after computer resets which was corrected within a few minutes.
Time corrections were logged automatically.

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2013, adjustments to the system clock were less than 1 ms except on the following occasions:

```
2013-12-05 22:12:25   -9.611s
           Soon after the acquisition system starts after
           the system upgraded.
```

Absolute instruments

The principal absolute magnetometers used at Kakadu and their adopted corrections for 2013 are described in Table 1.3.

DI fluxgate: DMI flux
Serial number: DI0049
Theodolite: Zeiss 020B
Serial number: 311847
Resolution: 0.1'
D correction: -0.05'
I correction: -0.15'
Total-field magnetometer: GEM Systems GSM-90
Serial number: 4081421/42186
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT

Table 1.3.

Absolute magnetometers and their adopted
corrections for 2013. Corrections are applied in the
sense Standard = Instrument + correction.

DIM observations at Kakadu were performed using the offset
method. All DIM and PPM measurements were made on the
principal pier at the standard height.

Table 1.3 describes the corrections applied to the absolute
magnetometers to align them to the international standard
as defined at IAGA workshops.

Absolute instrument corrections for DI0049/311847 were
checked through a number of instrument comparisons carried
out at the Canberra and Kakadu geomagnetic observatories
in 2012. In 2013 there is one comparison between
DI0049/311847 and travel standard DIM B0610H/160459 during
the maintenance visit in Dec 2013. It appears that there is
a small variation in declination correction in comparison
with 2012 results. No change to the instrument correction
is recommend for 2013, therefore the correction to the
international standard still remains -0.05 in D and -0.15
for I.

At the 2013 mean magnetic field values at Kakadu the D, I
and F corrections translate to corrections of:
X =-1.26 nT   Y = 0.59 nT   Z =-1.55 nT

These instrument corrections have been applied to the data
described in this report and to other published definitive
data.

Baselines

There were 39 pairs of weekly absolute measurements during
2013. 4 sets of daily measurements were taken during
maintenance visit from 2013-12-04 and 2013-12-08.
The remaining 35 were undertaken from 2013-01-15 to
2013-11-10. There were no absolute observations for 4 weeks
during middle of June to middle of July due to absence of
the observer. The absolute observation data through 2013
were in good quality, and vector variometer baseline
variations were reasonably well controlled though the
baseline observations. X and Y channel baselines drifted
linearly through 2013 within about 20 nT. Z channel
baseline was relatively stable, and drifted within less
than 5 nT.

The F difference time series Fv-Fs was plotted to check
variometer baseline variations throughout 2013. This F
difference displays three distinguishing steps in vector
variometer baselines on 26 Jan, 13 Feb and 4 April:
12:40:34 26-01-2013: dX=-3.37, dY=-4.02
04:02:55 13-02-2013: dX=-3.16, dY=-3.78
14:17:52 04-04-2013: dX=-2.97, dY=-3.44
There was no specific event for the above variometer
baseline jumps.
The vector variometer baselines were determined as usual
from both the absolute measurements and the scalar F data,

but weighting the F data relatively higher.

The means and standard deviations of the weekly absolute observations from the final adopted variometer model and data were:

	means	stdev
X	-0.2 nT	0.9 nT
Y	+0.1 nT	1.2 nT
Z	+0.2 nT	0.9 nT
D	+0.5"	7.3"
I	-0.1"	5.5"
F	-0.3nT	0.4 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2013 KDU definitive data and real time reported 1-minute data sets (KDU definitive - KDU real time) were:

	X	Y	Z
Average	+2.2	+0.5	+0.2
Std.dev	+3.0	+2.0	+1.6
Min	-3.7	-4.3	-1.8
Max	+6.3	+2.8	+2.0

The KDU 2013 reported real time data has relatively larger variations due to spikes caused by lightning strikes, and baseline steps due to maintenance work. Baselines were updated quarterly to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2013 KDU definitive data and quasi-definitive 1-minute data sets (KDU definitive - KDU quasi-definitive) were:

	X	Y	Z
Average	+0.7	+0.4	+1.1
Std.dev	+0.4	+1.0	+0.7
Min	+0.1	-1.4	+0.1
Max	+1.3	+2.8	+2.0

Operations

When possible, local observer, Andy Ralph, performed absolute observations weekly. Andy was trained at Kakadu Observatory in 2006-09 with refresher training during maintenance visits by Geomagnetism staff from Canberra. In general, absolute observations were of good quality. Occasionally some observations were unacceptable, the most likely reason being magnetic contamination.

Absolute observation data were recorded in a Getac tablet and digital files were emailed back to Canberra where they were reduced and used to calibrate the variometer data. The GObs software for the Getac tablet was updated during the maintenance visit in 2013-12 to capture the DMI fluxgate magnetometer output through a Pico data logger.

On weekly visits, Andy checked the operation of the observatory and maintained the observatory in good condition, such as building pest control, mowing grass and changing batteries.

L Wang from GA visited the observatory on 2013-12-04 to 2013-12-08 to carry out annual maintenance work, instrument comparisons, and training observers. During this visit, the data acquisition computer was upgraded to ARK3360F QNX6.5, and the GObs software for the Getac tablet was updated.

Data were retrieved from the data-acquisition system at least every 10 minutes using rsync over ssh in near real-time using the network connection.

Vector data were contaminated due to earthquakes from 2013-04-20 04:52:22 to 2013-04-20 04:58:20, and from 2013-09-01 11:54:02 to 2013-09-01 11:59:25.

Vector data were lost due to computer upgrade from 2013-12-05 22:20:18 to 22:20:27.

The distribution of Kakadu 2013 data is described in Table 1.4. Data losses are identified in Table A.1.

Data distribution

Recipient Status Sent

1-second values
IPS Radio and Space Services preliminary real time
INTERMAGNET preliminary real time

1-minute values
INTERMAGNET preliminary real time
INTERMAGNET preliminary daily
INTERMAGNET quasi-definitive quarterly
INTERMAGNET definitive July 2014
WDC for Geomagnetism preliminary real time

Table 1.4. Distribution of 2013 data.

Significant events

2013-03-23	Andy mowed and cut bushes at the observatory as bushes blocked view to the Azimuth marker
2013-04-20	04:52 earthquake is clear in the 1-s data.
2013-04-27	Site maintenance by AR
2013-06-06	Replacement cable for DMI DIM sent via express post
2013-06-15	First obs with new DMI cable. Andy will be on leave until 16th July. No absolute observations for 4 weeks.
2013-07-22	Andy returned from holiday.
2013-08-12	00:53:45 6.2 magnitude earthquake in Banda Sea (100km depth). Noise data in the vector

	variometer.
2013-09-01	11:54, earthquake at Kepulauan Barat Daya, Indonesia, isnt obvious in the definitive 1-minute data, but is clear in the 1-s data.
2013-09-06	Y baseline updated.
2013-10-13	Tried to use a Bunnings umbrella to shelter the tablet PC. The umbrella was found quite magnetic. The umbrella was used in the first PPM reading, and then then removed.
2013-11-11	One of the two USB ports on Getac (s/n rc863e0155) tablet PC is broken.
2013-11-18	APR is not well and no obs.
2013-12-03	to 12-08 observatory maintenance visit by LJW.
2013-12-04	02:46UT to 03:00UT contamination.
2013-12-05	22:10 acquisition computer upgraded.
2013-12-10	Andy arranged the repair of the leaking A/C in the control room. The floor is wet.
2013-12-18	Andy was not well and no obs for the last week and this week.

Appendix A. Data losses

Date		Interval (hh:mm)	Data loss (minutes)	
Vector data				
2013-04-20	XYZ	04:52 - 04:59	(8)	(Earthquake)
2013-09-01	XYZ	11:54 - 12:00	(7)	(Earthquake)
2013-12-04	XYZ	02:46 - 03:01	(16)	(PC upgrade)

Total: 31

Scalar data

2013-01-27	F	10:34 - 10:34	(1)
2013-01-27	F	10:49 - 10:49	(1)
2013-01-27	F	10:51 - 10:51	(1)
2013-03-15	F	09:05 - 09:05	(1)
2013-10-02	F	04:34 - 04:34	(1)

Total: 5

Table A.1. Kakadu data losses.

Observatory	Vector	Scalar
Kakadu	31 min 0.006%	5 min 0.00095%

Appendix B. Backup data

NO BACKUP DATA AT KDU

```
                   <END>
```

7.2.1.2 2014

```
                                  KDU
               KAKADU OBSERVATORY INFORMATION 2014

 ACKNOWLEDGE-  Users of the KDU data should acknowledge:
       -MENTS:  Geoscience Australia

   STATION ID: KDU
     LOCATION: Kakadu National Park, Northern Territory,
                Australia
 ORGANISATION: Geoscience Australia
  CO-LATITUDE: 102.686 Deg.
    LONGITUDE: 132.472 Deg. E
    ELEVATION: 14 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DIM) and Proton
               Precession Magnetometer (GEM GSM90)

    RECORDING
   VARIOMETER: Three component DMI FGE fluxgate
               magnetometer
               GEM GSM90 proton precession magnetometer

  ORIENTATION: ABZ (Magnetic NW, Magnetic NE and Vertical)
DYNAMIC RANGE: +/- 1600 nT
   RESOLUTION: 0.032 nT
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: none

    K-NUMBERS: none
     K9-LIMIT: 300 nT

         GINS: Edinburgh
    SATELLITE: HTTP and E-mail

    OBSERVERS: A. Ralph
               L. Wang


      CONTACT: Geomagnetism Project
               Geoscience Australia
               G.P.O. Box 378
               Canberra,  A.C.T.,  2601
               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9999
               e-mail: geomag@ga.gov.au
               www: http://www.ga.gov.au/

   NOTES:
Kakadu Geophysical Observatory is located in the Northern
Territory, 210 km east of Darwin and 40 km west of Jabiru
```

on the Arnhem Highway, near the South Alligator Ranger Station, Kakadu National Park. It comprises magnetic and seismological observatories and a gravity station. Kakadu magnetic observatory is situated on unconsolidated ferruginous and clayey sand. Continuous magnetic-field recording began there in March 1995.

The magnetic observatory comprises:

* a 3×3 m air-conditioned concrete-brick Control House, with concrete ceiling and aluminium cladding and roof, where recording instrumentation and control equipment are housed;

* a 3×3 m roofed Absolute Shelter, 50 m NW of the Control House, that houses a 380 mm square fibre-mesh-concrete observation pier (Pier A), the top of which is 1200 mm from the concrete floor;

* two 300 mm diameter azimuth pillars, both about 100 m from Pier A and with approximate true bearings of 27d and 238d;

* two 600 mm square underground vaults that house the variometer sensors, both located 50 to 60 m from the Control House, one to its SSW and one to its WSW (cables between the sensor vaults and the Control House are routed via underground conduits), and;

* a concrete slab, with tripod foot placements and a marker plate, used as an external reference site E (at a standard height of 1.6 m above the marker plate). The marker plate is 60 m, at a bearing of 331d, from the principal observation pier A.

Key data for the observatory are given in Table 1.

IAGA code: KDU
Commenced operation: 05 March 1995
Geographic latitude: 12d41'10.9" S
Geographic longitude: 132d28'20.5" E
Geomagnetic latitude: -21.81d
Geomagnetic longitude: 205.69d
K 9 index lower limit: 300 nT
Principal pier: Pier A
Pier elevation (top): 14.6 m AMSL
Principal reference mark: Pillar AW
Reference mark azimuth: 237d52.8'
Reference mark distance: 99.6 m
Observer: A. Ralph

Table 1 Key observatory data.

Local meteorological conditions

The meteorological temperature at Jabiru airport (about 50km to the observatory) during 2014 varied from a minimum of 13.2 degC (2014-08-22) to a maximum 41.6 degC (2014-10-29). Daily minimum temperatures varied from

13.2 degC to 28.5 degC (average +22.6+/-3.2 degC); daily maximum temperatures varied from 28.6 degC to 41.6 degC (average 34.7+/-2.6 degC); daily temperature ranges varied from 4.3 degC to 21.3 degC (average 12.1+/-3.5 degC).

The daily maximum wind gust varied from 17 to 74 km/h (average 36.6+/-8.4 km/h). The maximum daily maximum wind gust was 74 km/h on 2014-02-03. The minimum daily maximum wind gust was 17 km/h on 2014-04-16.

These conditions have been derived from data supplied by the Bureau of Meteorology (http://www.bom.gov.au).

Variometers

The variometers used during 2014 are described in Table 2.

3-component variometer: DMI FGE
Serial number: E0198/S0183
Type: suspended; linear fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
Resolution: 0.032 nT
A/D converter: ADAM 4017 module (±5V)
Total-field variometer: GEM Systems GSM-90
Serial number: 4071413/42185
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Data acquisition system: ARK3360F QNX6.5
Timing: Trimble Acutime GPS clock
Communications: VSAT satellite link

Table 2. Magnetic variometers used in 2014.

Analogue outputs from the three fluxgate sensors, and the sensor and electronics temperatures, were converted to digital data using an ADAM 4017 analogue-to-digital converter mounted inside the fluxgate electronics unit. These data and the digital PPM data were recorded on the data acquisition computer located in the Control House.

The magnetic sensors were located in the concrete underground vaults: the fluxgate sensor in the northern vault (the one nearer the Absolute Shelter); and the PPM sensor in the southern vault. Both vaults were completely buried in soil to minimise temperature fluctuations.

The GSM90 variometer electronics was located in the covered vault with its sensor. DC power and data cables ran between the GSM90 vault and the Control House.

The fluxgate electronics console was placed in its own partially insulated plastic box, resting on the concrete floor in the Control Hut, with some bricks for heat-sinks to minimise temperature fluctuations. This arrangement proved to be effective in reducing the amplitude of temperature fluctuations with periods of the order of hours.

The geomagnetic equipment shared power with the seismic equipment; a 12 V battery bank charged from 240 V power supplied by a generator at the nearby South Alligator range station. An inverter running off the 12 V supply provided 240 V 50 Hz power to the DMI fluxgate electronics. The power system had a backup capacity of several days and the equipment was protected from surges and lightning strikes by power filters and a surge absorber.

The data connections between the acquisition computer and both the DMI and the PPM variometers were via serial cables.

Although some lightning protection measures were incorporated in its original construction, Kakadu Observatory has suffered lightning damage since its installation in 1995. Additional protection measures were taken in December 1998 and October 1999, including the installation of an ERICO system. The ERICO System 3000 (Advanced Integrated Lightning Protection), comprising a Dynasphere Air Termination unit, mast, and copper-coated-steel earthing rod, was designed to protect an area of 80 m radius. Lengths of copper ribbon and aluminium power cables buried in shallow trenches towards the Absolute Shelter, in the opposite direction, and from the Control House to and around both variometer sensor vaults, and a conducting loop around the Control House, were connected to the ERICO system. The upgraded lightning protection measures are working well, and no data losses occurred in 2014 due to lightning strikes.

The DMI FGE variometer scale-value, alignment, and temperature sensitivity parameters were measured at the magnetometer calibration facility at Canberra observatory before installation at Kakadu. The sensor assembly was aligned with the two horizontal fluxgate sensors at 45d to the declination at the time of installation and the Z fluxgate sensor vertical. This alignment was achieved by setting the X and Y offsets equal and rotating the instrument until the X and Y ordinates were equal. This method has been found to be accurate using tests performed at the calibration facility.

The Control House, which houses the DMI electronics, had its temperature maintained by an air conditioning unit During 2014 the temperature of the DMI electronics ranged from 24.2 degC to 33.2 degC. Air conditioning performance during the period 2014-02-08 to 2014-06-28 appeared sub-optimal, leading to daily fluctuations in electronics temperature of approximately 5.5 degC. After 2014-06-28, the electronics temperature stabilised for the remainder of the year, with the exception of one brief spike on 2014-10-01. The annual temperature variation of 9C gave total variations of 0.4 nT, 1.5 nT and 0.0 nT in the X, Y and Z channels respectively.

The DMI sensor temperature ranged from 26.4 degC to 33.3 degC during the year. Although buried underground, it varied during the year in accordance with the seasons at long periods and probably with barometric pressure systems at short periods. The annual temperature variation of 6.9C converted to variations 0.3 nT, 0.4 nT and 0.5 nT in the X, Y and Z channels respectively.

DMI variometer data were affected by 4 events attributable to other than thunderstorms. 3 minutes of data on 2014-06-18 from 21:58 - 22:00 were affected by a small step in X-channel of unknown cause. 2 episodes of constant variometer noise approx. 3-5 times the background noise level occurred for unknown reasons on 2014-06-22 from 12:43 - 12:52 for 10 minutes and 2014-08-13 09:13 - 11:00 for 108 minutes. One minute of data were lost for an acquisition computer reboot on 2014-10-01 at 07:15.

Data from the GSM-90 variometer have data losses of generally one or two minutes duration in the one-minute data set occurring mainly during the monsoon season of October through April. The total loss was 305 minutes, 296 minutes attributable to thunderstorms. One minute of data were lost for an acquisition computer reboot on 2014-10-01 at 07:15. The remaining 8 minutes were attributed to unknown sources.

DMI 1 second data were de-spiked. The de-spiking parameters required a spike to exceed 5 times an average "spike-factor" of three local data pairs or a noise parameter, whichever was greater. Parametric modification occurred on a case-by-case basis during periods such as severe thunderstorms and sudden commencements to preserve signal integrity and data quality.

GSM90 10 second data were de-spiked. The de-spiking parameters required a spike to exceed 9 times an average "spike-factor" of three local data pairs or a noise parameter, whichever was greater. Parametric modification occurred on a case-by-case basis during periods such as severe thunderstorms and sudden commencements to preserve signal integrity and data quality.

Variometer timing was controlled by the QNX data-acquisition computer clock which was maintained using both the 1 PPS and data stream output of a GPS clock. An error occasionally occurred just after computer resets which were corrected within a few minutes. Time corrections were logged automatically.

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2014, adjustments to the system clock were less than 1 ms except on the following occasion, which occurred just after an acquisition system reboot:

```
2014-10-01      07:16:30     0.170 s
```

Absolute instruments

The principal absolute magnetometers used at Kakadu and their adopted corrections for 2014 are described in Table 3.

DI fluxgate: DMI flux
Serial number: DI0049D
Theodolite: Zeiss 020B
Serial number: 311847
Resolution: 0.1'
D correction: -0.05'
I correction: -0.15'
From: 2014-01-01
To: 2014-12-31

Total-field magnetometer: GEM Systems GSM-90
Serial number: 4081421/42186
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT
From: 2014-01-01
To: 2014-05-10

Total-field magnetometer: GEM Systems GSM-90
Serial number: 4071413/42185 (Note: variometer/vault PPM)
Type: Overhauser effect
Resolution: 0.01 nT
Correction: -0.5 nT
From: 2014-05-11
To: 2014-07-21

Total-field magnetometer: GEM Systems GSM-90
Serial number: 8092903/83386
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT
From: 2014-07-22
To: 2014-12-31

Table 3.

Absolute magnetometers and their adopted corrections for 2014. Corrections are applied in the sense Standard = Instrument + correction.

DIM observations at Kakadu were performed using the offset method. All DIM and PPM measurements were made on the principal pier at the standard height.

Table 3 describes the corrections applied to the absolute magnetometers to align them to the international standard as defined at IAGA workshops.

Absolute instrument corrections for DI0049D/311847 were checked through a number of instrument comparisons carried out at the Canberra and Kakadu geomagnetic observatories in 2012. In 2014 there is one comparison between DI0049D/311847 and travel reference DIM B0610H/160459 during the maintenance visit in September 2014. It appears that there is a variation in declination correction in comparison with 2012 results. No change to the instrument correction is recommended for 2014 and more measurements are recommended for 2015. Therefore the correction to the international standard still remains -0.05 in D and -0.15 for I.

At the 2014 mean magnetic field values at Kakadu the D, I and F corrections translate to corrections of:
X =-1.26 nT   Y = -0.59 nT   Z =-1.55 nT

Note the Y correction seems to have been incorrectly reported as +0.59 nT in the 2013 and 2014 reports. However the correct value has been used during calculations.

These instrument corrections have been applied to the data described in this report and to other published data.

Baselines

There were 42 pairs of weekly absolute measurements during 2014. 8 sets of daily measurements were taken during maintenance visit from 2014-09-22 and 2014-09-26. The remaining 34 were undertaken from 2014-01-02 to 2014-12-31. There was a break in observations for approximately one month between 2014-08-18 and 2014-09-14, followed by another break from 2014-09-28 until 2014-10-18. The absolute observations data through 2014 were of reasonable quality albeit somewhat dispersed. A possible source of contamination was discovered during the September maintenance visit, however no obvious offset effect on the absolute measurements was noticeable and dispersion of results continued after the contamination source was removed. Y channel baselines drifted through 2014 within about 14 nT, X channel within about 10 nT and Z channel within about 6 nT.

The F difference time series Fv - Fs was plotted to check variometer baseline variations throughout 2014. There was some sub-daily cycling of the order of 1 nT during the period of February to June, especially noticeable during the months of March and April. This is attributed to some cycling of the Control Hut temperature due to sub-optimal air-conditioning control during this time. No particular steps in the F difference were noticeable throughout 2014. As a result the vector variometer baselines were determined as usual from both the absolute measurements and the scalar F data, but weighting the F data relatively higher by prioritising the zeroing of Fv - Fs against the fitting of dispersed absolute measurements in the baseline variation calculation.

The means and standard deviations of the weekly absolute observations from the final adopted variometer model and data were:

Mean   Std.dev

X	-0.4 nT	1.5 nT
Y	0.0 nT	1.6 nT
Z	-0.3 nT	1.8 nT
D	+0"	9"
I	-2"	11"
F	-0.1 nT	0.5 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2014 KDU definitive data and real time reported 1-minute data sets (KDU definitive - KDU real time) were:

	X	Y	Z
Average	+0.1	-0.1	+1.2
Std.dev	+3.5	+3.4	+1.7
Min	-5.8	-5.2	-1.8
Max	+5.2	+4.7	+3.9

The KDU 2014 reported real time data have relatively larger variations due to spikes caused by lightning strikes. Baselines were updated monthly to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2014 KDU definitive data and quasi-definitive 1-minute data sets (KDU definitive - KDU quasi-definitive) were:

	X	Y	Z
Average	+1.3	-0.1	+1.2
Std.dev	+1.2	+1.2	+0.9
Min	-0.7	-2.9	-0.2
Max	+3.0	+1.7	+2.7

Operations

When possible, local observer, Andy Ralph, performed absolute observations weekly. Andy was trained at Kakadu Observatory in September 2006 with refresher training during maintenance visits by Geomagnetism staff from Canberra. In general, absolute observations were of good quality. Occasionally some observations were unacceptable, the most likely reason being magnetic contamination.

Absolute observation data were recorded in a Getac tablet and digital files were emailed back to Canberra where they were reduced and used to calibrate the variometer data.

On weekly visits, Andy checked the operation of the observatory and maintained the observatory in good condition, such as building pest control, mowing grass and changing batteries.

L Wang from GA visited the observatory on 2014-09-22 to 2014-09-27 to carry out annual maintenance work, instrument comparisons and observer training. Magnetic contamination near the absolute measurement pier was discovered during this time and the source was removed.

Data were retrieved from the data-acquisition system at least every 10 minutes using rsync over ssh in near real-time using the network connection.

Vector data were contaminated due to earthquakes:
from 2014-02-06 20:30:55 to 2014-02-06 20:34:00
from 2014-03-19 14:39:40 to 2014-03-19 14:43:10
from 2014-04-07 12:58:00 to 2014-04-07 13:01:00
from 2014-04-12 20:27:35 to 2014-04-12 20:41:00
from 2014-04-27 16:24:35 to 2014-04-27 16:28:56
from 2014-08-06 11:47:00 to 2014-08-06 11:50:00
from 2014-10-13 22:07:10 to 2014-10-13 22:10:20
from 2014-12-05 10:46:50 to 2014-12-05 10:48:00
from 2014-12-06 22:06:43 to 2014-12-06 22:13:20
from 2014-12-14 12:02:08 to 2014-12-14 12:02:30, and
from 2014-12-22 13:02:55 to 2014-12-22 13:05:00

There were two episodes of high frequency-type noise causing a constant background noise 3-5 times higher than normal on the variometer. The cause remains unknown:
from 2014-06-22 12:42:20 to 2014-06-22 12:51:50, and
from 2014-08-13 09:12:30 to 2014-08-13 11:00:30

One minute of data were lost due to an acquisition computer reboot on 2014-10-01:
from 2014-10-01 07:15:00 to 2014-10-01 07:16:00

The distribution of Kakadu 2014 data is described in Table 4. Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au). Data losses are identified in Appendix A and Table A.1.

Data distribution

Recipient	Status	Sent
1-second values		
IPS Radio and Space Services	reported	realtime
INTERMAGNET	reported	hourly
1-minute values		
INTERMAGNET	reported	realtime
INTERMAGNET	reported	daily
INTERMAGNET	definitive	August 2015
INTERMAGNET	quasidefintive	quarterly
WDC for Geomagnetism (Japan)	reported	realtime

Table 4. Distribution of 2014 data.

Significant Events at KDU in 2014

2014-01-25 Only one obs due to GObs software failure
2014-02-01 No obs due to monsoons - road to observatory cut.

```
2014-02-08 No Obs, observer away from site
2014-02-28 Air conditioner fixed a month ago. No Obs,
           observer is not well.
2014-03-17 ground maintenance mowing will be carried out
           next week.
2014-04-22 Fv  Fs jump?
2014-05-11 No absolute PPM data.
2014-05-26 Can not take reading from Absolute GSM90. the
           message is "time out".
2014-05-30 left the wheel barrow (to carry the gear) about
           5m from the obs hut.
2014-06-16 Asked Andy to post the absolute GSM90
           electronics back to GA.
2014-06-23 From 2014-05-11 variometer PPM data used for
           absolute PPM observations.
           pier difference is FP = absolute PPM -
           variometer PPM (GSM90_4071413 # 42185)
           Average of FP in December 2013 is
            -15.3231 +/- 0.25
           Average of FP in selected dates is
            -15.1078 +/- 0.25
           the adopted absolute PPM is variometer PPM
            -15.2 +/-0.25
           X, Y and Z difference at F were calculated using
           same D and I at pier A
           PIER-DIFFERENCES (Strictly algebraic):
           Site_1 - Site_2
           PIERDIFF KDU A KDU F
            2014 1. 2104 366.   -11.74  -0.67  +9.82
2014-06-25 Received GSM90 electronics 4081421 and two
           cables. Tested at GA office. GSM90 electronics
           responded to the commands issued by a PC, but
           responses were incorrect. The KDU PPM cable is
           faulty.
2014-06-25 GSM90 8092903 (GA0050637)/sensor 83386 is
           selected to replace the faulty sn4081421
2014-07-01 GSM90 8092903/83386 and CNB GSM90_905926/21867
           compared. F = -0.01. see temp_182.obs tested
           both GSM90 PPMs using a Zapper tester.
           GSM90_905926/21867 - GSM90 8092903/83386
           66666: 0.09
           50000: 0.05
           40000: 0.02
           33333: 0.02
           25000: 0.01
           (info/2014-07-01SM90 8092903SN83386_tetser.xlsx)
2014-07-02 Posted GSM90 8092903/83386 to KDU via road
           freight.
2014-07-22 GSM90_8092903 # 83386 PPM used in the absolute
           observation.
2014-07-28 23:08 earthquake noise on variometer data.
2014-08-28 06:25 earthquake noise on variometer data.
2014-09-17 updated insinfo.con file in which a new scale
           value for DI0049 Pico (digital) is entered.
           DIM DI0049D 1.015   1.015   0 0 0.1 0.1
            # using Pico FJY06/01
2014-09-22 Maintenance visit LJW Mon to Thu - obs /
           comparisons/ pier diff/ replace PC monitor
           No obs training but discover contamination of
           observations due to magnetic radio
2014-09-27 Obs visit (LJW, AML, Gordon Oliver) to return
```

```
           PPM and other equipment that was used in Darwin.
2014-10-01 07:15 reboot to clear tcp TIME_WAIT connections
           - ssh/telnet from GA but most from foreign IP
           addresses


Appendix A.  Data lost
------------------------

Date         Interval        Data lost
             (hh:mm)         (minutes)
Vector data

2014-02-06    XYZ     20:31 - 20:34  (4)  (Earthquake)
2014-03-19    XYZ     14:40 - 14:43  (4)  (Earthquake)
2014-04-07    XYZ     12:58 - 13:01  (4)  (Earthquake)
2014-04-12    XYZ     20:28 - 20:41  (14)(Earthquake)
2014-04-27    XYZ     16:25 - 16:29  (5)  (Earthquake)
2014-06-18    XYZ     21:58 - 22:00  (3)  (Small step in
                                           X-channel,
                                           unknown cause)
2014-06-22    XYZ     12:43 - 12:52  (10)(Constant
                                           variometer noise,
                                           unknown cause)
2014-08-06    XYZ     11:47 - 11:50  (4)  (Unknown noise,
                                           possibly
                                           earthquake)
2014-08-13    XYZ     09:13 - 11:00  (108)(Constant
                                           variometer noise,
                                           unknown cause)
2014-08-28    XYZ     06:25 - 06:28  (4)  (Earthquake)
2014-10-01    XYZ     07:15 - 07:15  (1)  (Acquisition
                                           computer reboot)
2014-10-13    XYZ     22:07 - 22:10  (4)  (Earthquake)
2014-12-05    XYZ     10:47 - 10:48  (2)  (Suspect
                                           earthquake)
2014-12-06    XYZ     22:07 - 22:13  (7)  (Earthquake)
2014-12-14    XYZ     12:02 - 12:02  (1)  (Earthquake)
2014-12-22    XYZ     13:03 - 13:05  (3)  (Earthquake)

Total: 178

Scalar data

Most missing data were single or perhaps dual point spikes.
They are concentrated during the monsoon season of October
through April and are likely caused by thunderstorms.
Events caused by other reasons have been listed where
known, otherwise lightning-induced loss can be assumed.

2014-01-01    F      23:34 - 23:34  (1)
2014-01-04    F      12:51 - 12:51  (1)
2014-01-04    F      13:10 - 13:12  (3)
2014-01-04    F      13:22 - 13:23  (2)
2014-01-04    F      13:25 - 13:25  (1)
2014-01-04    F      13:30 - 13:31  (2)
2014-01-04    F      13:37 - 13:37  (1)
2014-01-04    F      13:42 - 13:42  (1)
2014-01-04    F      13:45 - 13:45  (1)
2014-01-04    F      13:49 - 13:49  (1)
2014-01-04    F      14:11 - 14:11  (1)
```

2014-01-04	F	16:09 - 16:09	(1)	
2014-01-06	F	07:48 - 07:48	(1)	
2014-01-06	F	09:19 - 09:19	(1)	
2014-01-06	F	09:36 - 09:36	(1)	
2014-01-06	F	09:49 - 09:49	(1)	
2014-01-06	F	09:52 - 09:52	(1)	
2014-01-09	F	09:19 - 09:19	(1)	
2014-01-09	F	09:27 - 09:27	(1)	
2014-01-09	F	09:29 - 09:29	(1)	
2014-01-09	F	09:43 - 09:43	(1)	
2014-01-09	F	09:47 - 09:47	(1)	
2014-01-09	F	09:58 - 09:58	(1)	
2014-01-09	F	10:02 - 10:02	(1)	
2014-01-09	F	10:06 - 10:06	(1)	
2014-01-09	F	10:13 - 10:13	(1)	
2014-01-09	F	10:33 - 10:33	(1)	
2014-01-09	F	14:01 - 14:01	(1)	
2014-01-10	F	09:08 - 09:08	(1)	
2014-01-10	F	11:37 - 11:37	(1)	
2014-01-11	F	09:28 - 09:28	(1)	
2014-01-11	F	14:44 - 14:44	(1)	
2014-01-13	F	04:04 - 04:04	(1)	
2014-01-13	F	15:33 - 15:33	(1)	
2014-01-15	F	22:02 - 22:02	(1)	
2014-01-18	F	02:53 - 02:53	(1)	
2014-01-21	F	14:17 - 14:18	(2)	
2014-01-22	F	10:32 - 10:32	(1)	(Unknown cause)
2014-01-22	F	16:35 - 16:35	(1)	
2014-01-23	F	10:34 - 10:34	(1)	
2014-01-26	F	09:12 - 09:12	(1)	
2014-01-26	F	10:22 - 10:22	(1)	
2014-01-26	F	11:11 - 11:11	(1)	
2014-01-26	F	13:53 - 13:53	(1)	
2014-02-01	F	14:09 - 14:09	(1)	
2014-02-01	F	14:15 - 14:15	(1)	
2014-02-01	F	15:28 - 15:28	(1)	
2014-02-04	F	03:59 - 03:59	(1)	
2014-02-04	F	18:36 - 18:36	(1)	
2014-02-05	F	06:09 - 06:09	(1)	
2014-02-08	F	04:11 - 04:11	(1)	
2014-02-08	F	10:13 - 10:13	(1)	
2014-02-09	F	13:46 - 13:48	(3)	
2014-02-10	F	11:08 - 11:08	(1)	
2014-02-16	F	04:50 - 04:50	(1)	
2014-02-16	F	10:10 - 10:10	(1)	
2014-02-17	F	06:57 - 06:57	(1)	
2014-02-20	F	04:06 - 04:06	(1)	
2014-02-20	F	08:42 - 08:43	(2)	
2014-02-20	F	08:49 - 08:49	(1)	
2014-02-20	F	08:52 - 08:52	(1)	
2014-02-20	F	09:19 - 09:19	(1)	
2014-02-21	F	12:03 - 12:03	(1)	
2014-02-23	F	10:12 - 10:12	(1)	
2014-02-27	F	04:01 - 04:01	(1)	
2014-02-27	F	16:55 - 16:55	(1)	
2014-03-05	F	07:48 - 07:48	(1)	
2014-03-05	F	08:52 - 08:52	(1)	
2014-03-05	F	13:56 - 13:56	(1)	
2014-03-06	F	09:18 - 09:18	(1)	
2014-03-06	F	09:36 - 09:36	(1)	
2014-03-06	F	09:38 - 09:38	(1)	

2014-03-06	F	10:14 - 10:14	(1)	
2014-03-06	F	10:35 - 10:35	(1)	
2014-03-06	F	13:13 - 13:13	(1)	
2014-03-07	F	15:30 - 15:30	(1)	
2014-03-09	F	07:52 - 07:52	(1)	
2014-03-09	F	09:56 - 09:56	(1)	
2014-03-10	F	07:51 - 07:51	(1)	
2014-03-10	F	07:55 - 07:55	(1)	
2014-03-10	F	07:58 - 07:58	(1)	
2014-03-11	F	22:52 - 22:52	(1)	(Unknown cause)
2014-03-13	F	08:04 - 08:04	(1)	
2014-03-13	F	08:25 - 08:25	(1)	
2014-03-13	F	08:43 - 08:43	(1)	
2014-03-13	F	09:12 - 09:12	(1)	
2014-03-13	F	09:22 - 09:23	(2)	
2014-03-13	F	09:27 - 09:27	(1)	
2014-03-13	F	09:36 - 09:36	(1)	
2014-03-14	F	05:41 - 05:41	(1)	
2014-03-15	F	15:34 - 15:34	(1)	
2014-03-15	F	16:09 - 16:09	(1)	
2014-03-16	F	13:09 - 13:09	(1)	
2014-03-23	F	20:23 - 20:23	(1)	
2014-03-24	F	10:48 - 10:48	(1)	
2014-03-30	F	00:55 - 00:55	(1)	
2014-03-30	F	07:01 - 07:01	(1)	
2014-03-30	F	14:33 - 14:33	(1)	
2014-03-30	F	14:56 - 14:56	(1)	(Unknown cause)
2014-03-30	F	15:01 - 15:01	(1)	
2014-04-01	F	09:15 - 09:15	(1)	
2014-04-01	F	09:41 - 09:42	(2)	
2014-04-01	F	09:58 - 09:58	(1)	
2014-04-01	F	18:17 - 18:17	(1)	
2014-04-03	F	11:23 - 11:23	(1)	(Unknown cause)
2014-04-06	F	12:29 - 12:29	(1)	
2014-04-06	F	15:42 - 15:42	(1)	
2014-04-08	F	09:33 - 09:33	(1)	
2014-04-08	F	10:35 - 10:35	(1)	
2014-04-10	F	07:58 - 07:58	(1)	
2014-04-10	F	10:27 - 10:27	(1)	
2014-04-10	F	10:58 - 10:58	(1)	
2014-04-10	F	12:21 - 12:21	(1)	
2014-04-12	F	06:30 - 06:30	(1)	
2014-04-12	F	15:02 - 15:02	(1)	
2014-04-13	F	07:40 - 07:40	(1)	
2014-04-15	F	14:17 - 14:17	(1)	
2014-04-20	F	12:27 - 12:27	(1)	
2014-04-20	F	12:55 - 12:55	(1)	
2014-04-25	F	10:51 - 10:52	(2)	(Unknown cause)
2014-04-25	F	17:40 - 17:41	(2)	
2014-04-27	F	09:11 - 09:11	(1)	
2014-04-27	F	13:19 - 13:19	(1)	
2014-04-27	F	13:21 - 13:21	(1)	(Unknown cause)
2014-04-27	F	13:25 - 13:25	(1)	
2014-04-27	F	13:29 - 13:29	(1)	
2014-04-27	F	13:32 - 13:32	(1)	
2014-04-27	F	13:40 - 13:40	(1)	
2014-04-27	F	13:43 - 13:43	(1)	
2014-04-27	F	14:50 - 14:50	(1)	
2014-04-27	F	15:06 - 15:06	(1)	
2014-05-03	F	12:11 - 12:11	(1)	
2014-05-08	F	15:20 - 15:21	(2)	

2014-05-10	F	03:24 - 03:24	(1)	
2014-05-15	F	08:16 - 08:16	(1)	(Unknown cause)
2014-05-22	F	13:45 - 13:45	(1)	(Unknown cause)
2014-05-29	F	10:19 - 10:19	(1)	
2014-05-30	F	12:40 - 12:40	(1)	
2014-06-08	F	08:09 - 08:09	(1)	
2014-06-08	F	08:17 - 08:17	(1)	
2014-06-08	F	08:45 - 08:45	(1)	
2014-06-08	F	09:31 - 09:31	(1)	
2014-06-16	F	13:08 - 13:08	(1)	
2014-07-28	F	05:51 - 05:53	(3)	
2014-08-02	F	14:11 - 14:12	(2)	
2014-08-18	F	14:28 - 14:28	(1)	
2014-08-19	F	18:28 - 18:28	(1)	
2014-09-03	F	10:57 - 10:57	(1)	
2014-09-12	F	03:37 - 03:37	(1)	
2014-09-12	F	22:45 - 22:46	(2)	
2014-09-13	F	00:35 - 00:35	(1)	
2014-09-13	F	02:13 - 02:13	(1)	
2014-09-19	F	07:56 - 07:56	(1)	
2014-09-20	F	15:13 - 15:13	(1)	
2014-09-29	F	09:16 - 09:16	(1)	
2014-09-29	F	19:13 - 19:13	(1)	
2014-10-01	F	05:32 - 05:32	(1)	
2014-10-01	F	07:15 - 07:15	(1)	(Acquisition computer reboot)
2014-10-01	F	10:28 - 10:28	(1)	
2014-10-15	F	12:55 - 12:55	(1)	
2014-10-17	F	04:13 - 04:13	(1)	
2014-10-22	F	05:15 - 05:15	(1)	
2014-10-22	F	10:50 - 10:50	(1)	
2014-10-22	F	16:44 - 16:44	(1)	
2014-10-23	F	05:45 - 05:45	(1)	
2014-10-23	F	07:37 - 07:37	(1)	
2014-10-25	F	17:00 - 17:00	(1)	
2014-10-30	F	10:10 - 10:10	(1)	
2014-10-30	F	10:33 - 10:33	(1)	
2014-10-30	F	12:06 - 12:06	(1)	
2014-11-02	F	13:17 - 13:17	(1)	
2014-11-03	F	07:54 - 07:54	(1)	
2014-11-03	F	08:50 - 08:50	(1)	
2014-11-03	F	09:54 - 09:54	(1)	
2014-11-04	F	08:54 - 08:54	(1)	
2014-11-05	F	06:55 - 06:55	(1)	
2014-11-05	F	07:30 - 07:30	(1)	
2014-11-05	F	07:34 - 07:34	(1)	
2014-11-05	F	07:42 - 07:42	(1)	
2014-11-05	F	08:33 - 08:33	(1)	
2014-11-05	F	13:15 - 13:15	(1)	
2014-11-05	F	14:01 - 14:01	(1)	
2014-11-05	F	18:41 - 18:41	(1)	
2014-11-08	F	22:27 - 22:27	(1)	
2014-11-11	F	12:03 - 12:03	(1)	
2014-11-14	F	07:55 - 07:55	(1)	
2014-11-17	F	10:44 - 10:44	(1)	
2014-11-18	F	12:44 - 12:44	(1)	
2014-11-20	F	06:12 - 06:12	(1)	
2014-11-22	F	02:25 - 02:25	(1)	
2014-11-23	F	18:49 - 18:49	(1)	
2014-11-24	F	11:01 - 11:01	(1)	
2014-11-24	F	11:17 - 11:17	(1)	

2014-11-25	F	06:28 - 06:28	(1)
2014-11-25	F	06:53 - 06:53	(1)
2014-11-25	F	07:09 - 07:09	(1)
2014-11-25	F	07:26 - 07:26	(1)
2014-11-25	F	15:48 - 15:48	(1)
2014-11-25	F	16:23 - 16:23	(1)
2014-11-25	F	16:56 - 16:56	(1)
2014-11-25	F	17:51 - 17:51	(1)
2014-11-25	F	18:08 - 18:08	(1)
2014-11-25	F	18:24 - 18:24	(1)
2014-11-27	F	14:00 - 14:00	(1)
2014-11-28	F	09:33 - 09:33	(1)
2014-11-29	F	12:51 - 12:51	(1)
2014-12-01	F	01:42 - 01:42	(1)
2014-12-02	F	06:33 - 06:33	(1)
2014-12-02	F	07:51 - 07:51	(1)
2014-12-02	F	10:33 - 10:33	(1)
2014-12-02	F	11:14 - 11:14	(1)
2014-12-02	F	11:19 - 11:19	(1)
2014-12-02	F	11:53 - 11:53	(1)
2014-12-02	F	11:56 - 11:56	(1)
2014-12-02	F	12:03 - 12:03	(1)
2014-12-02	F	13:49 - 13:49	(1)
2014-12-02	F	14:09 - 14:09	(1)
2014-12-02	F	14:28 - 14:28	(1)
2014-12-02	F	14:48 - 14:48	(1)
2014-12-02	F	23:55 - 23:55	(1)
2014-12-03	F	12:10 - 12:10	(1)
2014-12-04	F	09:29 - 09:29	(1)
2014-12-04	F	10:12 - 10:12	(1)
2014-12-05	F	11:26 - 11:26	(1)
2014-12-06	F	16:55 - 16:55	(1)
2014-12-06	F	17:28 - 17:28	(1)
2014-12-07	F	00:06 - 00:06	(1)
2014-12-07	F	07:12 - 07:12	(1)
2014-12-07	F	07:36 - 07:36	(1)
2014-12-07	F	07:49 - 07:49	(1)
2014-12-07	F	08:10 - 08:10	(1)
2014-12-07	F	08:39 - 08:39	(1)
2014-12-07	F	08:47 - 08:47	(1)
2014-12-09	F	05:32 - 05:32	(1)
2014-12-09	F	05:55 - 05:55	(1)
2014-12-09	F	06:10 - 06:10	(1)
2014-12-10	F	04:03 - 04:03	(1)
2014-12-10	F	06:08 - 06:08	(1)
2014-12-10	F	17:18 - 17:18	(1)
2014-12-12	F	07:16 - 07:16	(1)
2014-12-13	F	14:15 - 14:15	(1)
2014-12-15	F	05:39 - 05:39	(1)
2014-12-15	F	06:32 - 06:32	(1)
2014-12-15	F	06:41 - 06:41	(1)
2014-12-16	F	07:01 - 07:01	(1)
2014-12-17	F	07:05 - 07:05	(1)
2014-12-17	F	07:24 - 07:24	(1)
2014-12-17	F	07:33 - 07:33	(1)
2014-12-17	F	07:46 - 07:46	(1)
2014-12-17	F	08:45 - 08:45	(1)
2014-12-17	F	09:31 - 09:31	(1)
2014-12-18	F	10:45 - 10:45	(1)
2014-12-18	F	10:47 - 10:47	(1)
2014-12-18	F	12:18 - 12:18	(1)

```
2014-12-18    F      12:20 - 12:20  (1)
2014-12-18    F      18:13 - 18:13  (1)
2014-12-19    F      15:10 - 15:10  (1)
2014-12-19    F      17:21 - 17:21  (1)
2014-12-19    F      17:31 - 17:31  (1)
2014-12-19    F      17:54 - 17:54  (1)
2014-12-20    F      06:29 - 06:29  (1)
2014-12-20    F      12:51 - 12:51  (1)
2014-12-20    F      17:18 - 17:18  (1)
2014-12-20    F      17:22 - 17:23  (2)
2014-12-20    F      21:25 - 21:25  (1)
2014-12-20    F      21:28 - 21:28  (1)
2014-12-21    F      09:05 - 09:05  (1)
2014-12-22    F      08:59 - 08:59  (1)
2014-12-23    F      09:51 - 09:51  (1)
2014-12-23    F      09:53 - 09:53  (1)
2014-12-23    F      10:52 - 10:52  (1)
2014-12-23    F      11:34 - 11:34  (1)
2014-12-23    F      16:51 - 16:51  (1)
2014-12-24    F      15:45 - 15:45  (1)
2014-12-25    F      10:40 - 10:40  (1)
2014-12-25    F      13:23 - 13:23  (1)
2014-12-25    F      13:42 - 13:42  (1)
2014-12-25    F      13:44 - 13:44  (1)
2014-12-25    F      14:46 - 14:46  (1)
2014-12-28    F      06:21 - 06:21  (1)
2014-12-28    F      06:30 - 06:30  (1)
2014-12-28    F      07:23 - 07:23  (1)
2014-12-28    F      07:51 - 07:51  (1)
2014-12-28    F      11:03 - 11:03  (1)
2014-12-28    F      14:24 - 14:24  (1)
2014-12-28    F      19:50 - 19:50  (1)
2014-12-30    F      03:16 - 03:16  (1)

Total: 305


Table A.1. Kakadu data loss.
---------

Observatory   Vector           Scalar
Kakadu        178 min 0.034%   305 min 0.058%


Appendix B. Backup data
-----------------------
NO BACKUP DATA AT KDU


                    <END>
```

7.2.1.3 2015

```
                                KDU
              KAKADU OBSERVATORY INFORMATION 2015

 ACKNOWLEDGE-  Users of the KDU data should acknowledge:
       -MENTS:  Geoscience Australia
```

```
   STATION ID: KDU
     LOCATION: Kakadu National Park, Northern Territory,
                Australia
 ORGANISATION: Geoscience Australia
  CO-LATITUDE: 102.686 Deg.
    LONGITUDE: 132.472 Deg. E
    ELEVATION: 14 metres

     ABSOLUTE
  INSTRUMENTS: DI-Fluxgate Magnetometer (DIM) and Proton
               Precession Magnetometer (GEM GSM-90)

    RECORDING
   VARIOMETER: Three component DMI FGE Fluxgate
               Magnetometer (DMI)
               Proton Precession Magnetometer (GEM GSM-90)

  ORIENTATION: ABZ (Magnetic NW, Magnetic NE and Vertical)
DYNAMIC RANGE: +/- 1600 nT
   RESOLUTION: 0.032 nT
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: none

    K-NUMBERS: none
     K9-LIMIT: 300 nT

         GINS: Edinburgh
    SATELLITE: HTTP and E-mail

    OBSERVERS: A. Ralph
               A. Koch
               S. Toms
               A. Lewis
               L. Wang

      CONTACT: Geomagnetism Project
               Geoscience Australia
               G.P.O. Box 378
               Canberra,  A.C.T.,  2601
               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9999
               e-mail: geomag@ga.gov.au
               www: http://www.ga.gov.au/
```

NOTES:

Kakadu Geophysical Observatory is located in the Northern Territory, 210 km east of Darwin and 40 km west of Jabiru on the Arnhem Highway, near the South Alligator Ranger Station, Kakadu National Park. It comprises magnetic and seismological observatories and a gravity station. Kakadu magnetic observatory is situated on unconsolidated ferruginous and clayey sand. Continuous magnetic-field recording began there in March 1995.

The magnetic observatory comprises:

* a 3x3 m air-conditioned concrete-brick Control House, with concrete ceiling and aluminium cladding and roof, where recording instrumentation and control equipment are housed;

* a 3x3 m roofed Absolute Shelter, 50 m NW of the Control House, that houses a 380x380 mm fibre-mesh-concrete principal observation pier (Pier A), the top of which is 1200 mm from the concrete floor;

* two 300 mm diameter azimuth pillars, both about 100 m from Pier A with approximate true bearings of 27d and 238d;

* two 600x600 mm underground vaults that house the variometer sensors, both located 50 to 60 m from the Control House, one to its SSW and one to its WSW (cables between the sensor vaults and the Control House are routed via underground conduits), and;

* a concrete slab, with tripod foot placements and a marker plate, used as an external reference site E (at a standard height of 1.6 m above the marker plate). The marker plate is 60 m, at a bearing of 331d, from pier A.

Key data for the observatory are given in Table 1.

IAGA code: KDU
Commenced operation: 05 March 1995
Geographic latitude: 12d 41' 10.9" S
Geographic longitude: 132d 28' 20.5" E
Geomagnetic latitude: -21.81d
Geomagnetic longitude: 205.69d
K 9 index lower limit: 300 nT
Principal pier: Pier A
Pier elevation (top): 14.6 m AMSL
Principal reference mark: Pillar AW
Reference mark azimuth: 237d 52.8'
Reference mark distance: 99.6 m
Observers: A. Ralph
           A. Koch
           S. Toms
           A. Lewis
           L. Wang

Table 1 Key observatory data.

Local meteorological conditions

The meteorological temperature at Jabiru airport (about 50km to the observatory) during 2015 varied from a minimum of 14.3 degC (2015-08-18) to a maximum 41.2 degC (2015-11-08). Daily minimum temperatures varied from 14.3 degC to 28.5 degC (average 22.9+/-2.8 degC); daily maximum temperatures varied from 26.7 degC to 41.2 degC (average 35.0+/-2.5 degC); daily temperature ranges varied from 4.0 degC to 19.8 degC (average 12.1+/-2.9 degC).

The daily maximum wind gust varied from 20 to 83 km/h (average 38+/-9 km/h). The maximum daily maximum wind gust was 83 km/h on 2015-04-07. The minimum daily maximum wind gust was 20 km/h on 2015-02-05, 2015-03-02 and 2015-03-18.

These conditions have been derived from data supplied by the Bureau of Meteorology (http://www.bom.gov.au).

Variometers

The variometers used during 2015 are described in Table 2.

3-component vector variometer: DMI FGE
Serial number: E0198/S0183
Type: suspended; linear fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
Resolution: 0.032 nT
A/D converter: ADAM 4017 module (±5V)

Total-field variometer: GEM Systems GSM-90
Serial number: 4071413/42185
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Data acquisition system: ARK3360F QNX6.5
Timing: Trimble Acutime GPS clock
Communications: VSAT satellite link

Table 2. Magnetic variometers used in 2015.

Analogue outputs from the vector variometer, and the sensor and electronics temperatures, were converted to digital data using an ADAM 4017 analogue-to-digital converter mounted inside the vector variometer electronics unit. These data and the digital total-field variometer data were recorded on the data acquisition computer located in the Control House.

The magnetic sensors were located in the concrete underground vaults: the vector variometer sensor in the northern vault (the one nearer the Absolute Shelter) and the total-field variometer sensor in the southern vault. Both vaults were completely buried in soil to minimise temperature fluctuations.

The total-field variometer electronics were located in the covered vault with its sensor. DC power and data cables ran between the total-field variometer vault and the Control House.

The vector variometer electronics console was placed in its own partially insulated plastic box, resting on the concrete floor in the Control Hut, with some bricks for heat-sinks to minimise temperature fluctuations. This arrangement proved to be effective in reducing the amplitude of temperature fluctuations with periods of the order of hours.

The geomagnetic equipment shared power with the seismic equipment; a 12 V battery bank charged from 240 V power supplied by a generator at the nearby South Alligator Ranger Station. An inverter running off the 12 V supply provided 240 V 50 Hz power to the vector variometer electronics. The power system had a backup capacity of several days and the equipment was protected from surges and lightning strikes by power filters and a surge absorber.

The data connections between the acquisition computer and both the vector and total-field variometers were via serial cables.

Data were retrieved from the data-acquisition system at least every 10 minutes using rsync over ssh in near real-time using the network connection.

Although some lightning protection measures were incorporated in its original construction, Kakadu Observatory has suffered lightning damage since its installation in 1995. Additional protection measures were taken in December 1998 and October 1999, including the installation of an ERICO system. The ERICO System 3000 (Advanced Integrated Lightning Protection), comprising a Dynasphere Air Termination unit, mast, and copper-coated-steel earthing rod, was designed to protect an area of 80 m radius. Lengths of copper ribbon and aluminium power cables connected to the ERICO system were connected as follows:
- buried in shallow trenches towards the Absolute Shelter then in the opposite direction,
- from the Control House to and around both variometer sensor vaults,
- and a conducting loop around the Control House.

The upgraded lightning protection measures are working well and no instrument damage occurred in 2015 due to lightning strikes.

The vector variometer scale-value, alignment, and temperature sensitivity parameters were measured at the magnetometer calibration facility at Canberra observatory before installation at Kakadu. The sensor assembly was aligned with the two horizontal fluxgate sensors at 45d to the declination at the time of installation and the Z fluxgate sensor vertical. This alignment was achieved by setting the X and Y offsets equal and rotating the instrument until the X and Y ordinates were equal. This method has been found to be accurate using tests performed at the calibration facility.

The Control House, which houses the vector variometer electronics, had its temperature maintained by an air-conditioning unit (A/C). During 2015 the temperature of the vector variometer electronics ranged from 25.5 degC to 34.8 degC. A/C performance was sub-optimal during the period 2015-01-01 11:00 to 2015-03-23 02:00. A/C replacement occurred on 2015-03-23 and afterwards the vector variometer electronics temperature was more tightly controlled. The annual temperature variation of 9.3 degC gave total variations of 0.4 nT, -1.6 nT and 0.0 nT in the X, Y and Z channels respectively.

The vector variometer sensor temperature ranged from 25.7 degC to 35.3 degC during the year. Although buried underground, the sensor temperature varied during the year in accordance with the seasons at long periods. The annual temperature variation of 9.6 degC converted to variations of 0.3 nT, -0.6 nT and -0.7 nT in the X, Y and Z channels respectively.

Vector data lost to earthquakes are manually excluded by cross-matching Geoscience Australia's publicly available earthquake database against the vector data and are listed in Appendix A.

Two minutes of data were lost due to acquisition computer reboots on 2015-04-28 at 23:03 and 2015-11-25 at 22:21.

Total vector variometer data loss for 2015 was 453 minutes, composed of:
- One particularly severe thunderstorm resulting in the exclusion of 98 minutes of data on 2015-02-02,
- 130 minutes of data lost to maintenance on 2015-03-11, 2015-03-22 and 2015-08-09,
- 209 minutes of data lost to recognised earthquakes in 48 separate events,
- 6 minutes lost to unknown X and Y contamination on 2015-08-17,
- 8 minutes lost in 4 separate events on 2015-03-28, 2015-07-12 (2) and 2015-08-04 due to unrecognised quake-like disturbances,
- and 2 individual minutes (2015-04-28 and 2015-11-25) due to acquisition computer reboots.

The GSM-90 total-field variometer underwent a progressive failure throughout the year until 2015-11-05 21:00. This resulted in progressively more unreliable data; the first signs were 5 hour periods of increased noise linked to unidentified man-made interference. The unreliability slowly worsened culminating in substantial continuous data noise that could override the usual noise filters during the period 2015-09-30 to 2015-11-05 20:55. Development and application of a pre-filter exclusion algorithm saw successful retrieval of a majority of the total-field data points during this period; the alternative was exclusion of this total-field data. After parametric adjustment a successful restart of the total-field variometer was achieved on 2015-11-05 at approximately 21:02 resulting in near-noiseless operation thereafter.

The total total-field variometer loss for 2015 was 8831 minutes. The data loss list for 2015-09-30 through 2015-11-05 runs to many thousands of lines and has therefore been omitted. Instead, a summary total of the (non-contiguous) data loss for this period has been included with the cumulative data loss for the period 2015-09-30 to 2015-11-05 20:52 being 7920 minutes. There was also an unexplained spike at 2015-02-16 12:10:44 and exponential decay thereafter for approximately 19 minutes to 12:30:00 in (Fv - Fs) traceable to the total-field variometer. The decay has been excluded and the baseline values adjusted for the spike. Maintenance events accounted for approximately 133 minutes of lost data on 2015-03-11, 2015-03-22 and 2015-08-09. One particularly severe thunderstorm resulted in the exclusion of 98 minutes of data on 2015-02-02. Otherwise most missing data were single or perhaps dual point spikes. Most of the individual or dual spikes are concentrated during the monsoon season of October through April and are likely caused by thunderstorms. Events caused by other reasons have been listed where known, otherwise lightning-induced loss can be assumed.

Exclusions caused by vector and total-field data losses are listed in Appendix A. These data exclusions have been applied before data was filtered.

Three different filters (normal, PPM (GSM-90, the total-field variometer) and thunderstorm) plus unfiltered data tailored to the appropriate circumstances were applied to the 1 second vector variometer and interpolated 1 second (from 10 second) total-field variometer data. Whereas previously a filter was applied in UTC day blocks, filtering has been applied for specific time intervals. Filter details and applied times are listed in Appendix C.

The normal filter works well for occasional spikes and is the default used. The PPM filter is biased towards total-field variometer noise. The thunderstorm filter is biased towards removing vector variometer (vector) noise but also processes the total-field variometer data. Vector variometer data were unaffected by the total-field variometer issues. Where PPM noise filter and thunderstorm filter application overlaps priority is given to the thunderstorm filter to preserve as much vector variometer data as possible. Unfiltered data were substituted where filter performance was suboptimal and unfiltered data were good, for example Sudden Storm Commencements (SSC).

A pre-filter followed by PPM filter was employed for the period of 2015-10-01 through 2015-11-05. The pre-filter excluded data points with (Fv - Fs) >+1.5 nT or (Fv - Fs) <-1.25 nT and was followed by PPM filter application. Note PPM filter application ceases after the total-field variometer adjustment on 2015-11-05 21:00.

Further filter details may be found in Appendix C.

Variometer clock corrections

Variometer timing was controlled by the QNX data-acquisition computer clock which was maintained using both the 1 PPS and data stream output of a GPS clock. An error occasionally occurred just after computer resets which were corrected within a few minutes. Time corrections were logged automatically. Time stamps applied to the variometer data were obtained from the acquisition computer system clock which was synchronised to a GPS clock. During 2015, adjustments to the system clock were less than 1 ms except as follows:

2015-01-13	23:20:15	-0.004 s	unknown
2015-04-28	23:04:29	0.848 s	CPU reboot

```
2015-07-01      00:00:41    -1.000 s    leap second
2015-11-25      22:21:50     0.673 s    CPU reboot
```

Absolute instruments

The principal absolute magnetometers used at Kakadu and their adopted corrections for 2015 are described in Table 3.

DI fluxgate: DMI flux
Serial number: DI0049D
Theodolite: Zeiss 020B
Serial number: 311847
Resolution: 0.1'
D correction: -0.05'
I correction: -0.15'
From: 2015-01-01
To: 2015-12-31

Total-field magnetometer: GEM Systems GSM-90
Serial number: 8092903/83386
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT
From: 2015-01-01
To: 2015-03-01
From: 2015-03-30
To: 2015-12-31

Total-field magnetometer: GEM Systems GSM-90
Serial number: 4071413/42185 (Note: variometer/vault GSM-90)
Type: Overhauser effect
Resolution: 0.01 nT
Correction: -0.5 nT
From: 2015-03-02
To: 2015-03-29

Table 3.

Absolute magnetometers and their adopted corrections for 2015. Corrections are applied in the sense Standard = Instrument + correction.

DIM observations at Kakadu were performed using the offset method. All DIM and total-field variometer measurements were made on Pier A at the standard height.

Due to apparent failure of the absolute total-field variometer, data adjusted to Pier A from the scalar total-field variometer was substituted for the period of 2015-03-01 to 2015-03-30.

Table 3 describes the corrections applied to the absolute magnetometers to align them to the international standard as defined at IAGA workshops.

Absolute instrument corrections for DI0049D/311847 were checked through a number of instrument comparisons carried out at the Canberra and Kakadu geomagnetic observatories in 2012. In 2015 there was one comparison between

DI0049D/311847 and travel reference DIM B0610H/160459 during the maintenance visit in August 2015. It appears that there is a variation in declination correction in comparison with 2012 results. No change to the instrument correction is recommended for 2015 and more measurements are recommended for 2016. Therefore the correction to the international standard still remains -0.05 in D and -0.15 for I.

At the 2015 mean magnetic field values at Kakadu the D, I and F corrections translate to corrections of:
dX =-1.64 nT   dY =-0.61 nT   dZ =-1.23 nT

These instrument corrections have been applied to the data described in this report and to other published data.

Baselines

There were a total of 52 pairs of absolute measurements with 40 pairs of unevenly distributed standard weekly absolute measurements by observers during 2015, 9 pairs during the maintenance visit from 2015-08-07 to 2015-08-11 and 3 pairs undertaken during a visit in early October on 2015-01-08 and 2015-10-09. There were substantial breaks in weekly measurements between 2015-02-01 and 2015-03-02, followed by another break from 2015-03-30 until 2015-04-26, both caused by various issues with equipment. The 2015 weekly absolute observations data were of reasonable quality albeit somewhat dispersed, especially towards the end of the year when the observer did not have the benefit of Geoscience Australia staff training. Three weekly observers were employed during 2015; there were two other Geoscience Australia observers used during visits. The data formed a usable set for 2015.

X channel baselines drifted through 2015 within about 2.5 nT, Y channel within about 3.9 nT and Z channel within about 2.9 nT. Across the year there was no major drift trend for any channel.

The F difference time series (Fv - Fs) was plotted to monitor variometer baseline variations throughout 2015.

There was some diurnal cycling of the (Fv - Fs) of about 1 nT before 2015-03-23 and around 0.7 nT afterwards. The reduction is attributed to a new, more effective A/C installation on 2015-03-23. One particular (Fv - Fs) step followed by an exponential decay was noted in the F difference on 2015-02-16, the decay was edited out and the jump adjusted. The reason for this occurrence is unknown. Occasional rises ('humps') of approximately 0.6-0.8 nT in the (Fv - Fs) were noted throughout the year especially during November and these tallied with known power outages when the A/C would have been non-operational.
The standard deviations of the weekly absolute observations from the final adopted variometer model and data were:

	Std.dev
X	1.5 nT
Y	1.2 nT

Z	1.9 nT
D	7"
I	11"
F	0.3 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2015 KDU definitive data and real time reported 1-minute data sets (KDU definitive - KDU real time) were:

	X	Y	Z
Average	+2.4	+0.2	-0.8
Std.dev	+2.4	+1.7	+2.2
Min	+0.2	-2.4	-5.5
Max	+7.3	+3.1	+1.7

The KDU 2015 reported real time data have relatively larger variations due to spikes caused by lightning strikes, earthquakes and other disruptions. Baselines were updated monthly to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2015 KDU definitive data and quasi-definitive 1-minute data sets (KDU definitive - KDU quasi-definitive) were:

	X	Y	Z
Average	+1.2	+0.1	-0.7
Std.dev	+1.2	+1.3	+0.9
Min	-0.7	-1.2	-2.4
Max	+2.6	+3.1	+0.9

Operations

Absolute observation data were recorded on a Getac PC tablet using software developed by Geoscience Australia and digital files were emailed back to Canberra where they were reduced and used to calibrate the variometer data.

On weekly visits, the local observer checked the operation of the observatory and maintained the observatory in good condition, such as building pest control, mowing grass, and changing batteries. A. Ralph coordinated locally the replacement of the Control House A/C.

A. Lewis and L. Wang from GA visited the observatory on 2015-08-07 and 2015-08-11 to carry out annual maintenance work, instrument installation, comparisons and observer training.

A slow burn bushfire burnt across the site on 2015-08-22 or 2015-08-23. Preventive work by the local observer (A. Koch) stopped significant damage to the site however the (non-magnetic) fences surrounding the total-field and vector variometer vaults were destroyed. No change in readings was noted and data continued to be acquired during this period.

Data distribution

The distribution of Kakadu 2015 data is described in Table 4. Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au). Data losses are identified in Appendix A and Table A.1.

Recipient	Status	Sent
1-second values		
BoM Space Weather Services	reported	realtime
INTERMAGNET	reported	hourly
1-minute values		
INTERMAGNET	reported	realtime
INTERMAGNET	reported	daily
INTERMAGNET	definitive	August 2016
INTERMAGNET	quasidefintive	quarterly
WDC for Geomagnetism (Japan)	reported	realtime

Table 4. Distribution of 2015 data.

Significant Events at KDU in 2015

2015-02-18	The A/C inspection happened approx "middle of the day, around lunchtime" Wednesday according to Andy. See notes below 2015-02-19.
2015-02-19	Results of A/C service. Wasps nesting in external unit cleaned out Internal unit requires new fan motor. Cyclone delaying obs until next week
2015-02-25	Expected A/C replacement of internal fan motor expected around now (to be confirmed).
2015-03-01	No obs 1-Feb to 2-Mar.
2015-03-04	Replaced bad PPM data with variometer PPM data in day061 obs. One suspect data set (forward) commented out.
2015-03-10	Replaced bad PPM data with variometer PPM data in day066 obs. Return of PPM equipment requested.
2015-03-10	A/C servicing- inspection and clean, motor replacement. No noticeable contamination
2015-03-11	A/C servicing- regas, further damage found-replacement recommended. Contamination excluded ~05:33-06:13
2015-03-23	A/C replaced today (local time) Contamination ~2015/03/22 22:29:00 to 2015/03/22 23:52:05 excluded
2014-03-30	PPM electronics and cabling returns for testing.
2015-04-08	Can't find any probs with PPM electronics box + signal cable + power/comms cable.
2015-04-14	Return of PPM + cables to Kakadu.
2015-04-19	Battery in absolute battery box fails. Obs not possible.
2015-04-20	New absolute battery box and CTek charger sent to KDU.
2015-04-25	No obs 30-Mar to 25-Apr.
2015-04-26	First observation with new absolute battery box (s/n 20150101-01) and first obs with returned PPM.

```
2015-04-28  23:03 reboot to clear tcp stack of "TIME-WAIT"
            jobs
2015-08-07  08-07 to 08-11 Observatory visit - training
            new observer, calibration and maintenance
2015-08-07  First obs by Anton (Tony) Koch.
2015-08-13  Send replacement DMI DIM extension cable and
            PICO analogue input cable
2015-08-29  Slow burn bushfire in observatory area
            damage To azimuth mark fences, variometer vault
            fences. Tony cleaned up leaves around huts so
            no damage to huts.
2015-09-23  ~0800 - ~1200 rise in (Fv - Fs) Power
            outage (A/C off, temp rise)
2015-10-08  Visit- install induction coil magnetometers
            plus some maintenance
2015-10-09  ~0730-0830 LJW noticed a power outage.
            (Fv - Fs) change approx 0745-0845, back down
            to previous level by ~0915.
            Electronics temp rise~ 0800-0915, levels off
            thereafter. Noisy (Fv - Fs) then started ~0900,
2015-10-15  (Fv - Fs) seems to be starting to get a few
            spikes...
2015-10-19  Possible power outage- check for (Fv - Fs)
            jump (A/C off, temp rise)
2015-10-28  First Obs by Steve Toms
2015-10-30  Note (Fv - Fs) very noisy now: PPM seems to
            have been degrading since about 15-Oct
            (Fv - Fs) very bad from about 15 Oct on into
            November.
2015-11-05  PPM noise fixed. 20:55 (approx) stop PPM driver,
            adjust to long polarise, add 1.5s to trigger
            time; restart driver 21:02
2015-11-25  Power outages 24-Nov ~ 0547 -0609 and 0804-
            0858 (power resumes- batt charging- ~0600,
            ~0900)
2015-11-25  22:21 reboot to clear TCP stack - AML
2015-11-26  power outage ~0530, power back by 0600
            (Fv - Fs) rise
2015-12-07  Couple of small variometer spikes (poss.
            lightning?) ~0007-0008

Appendix A.  Data losses
------------------------
Vector data
Vector data was generally reliable, with most loss being
due to recognised earthquakes (209 min), equipment
maintenance (130 min) and one particularly severe
thunderstorm (98 min). A few episodes of unexplained
interference occurred. 6 minutes of unexplained X and Y
contamination occurred on 2015-08-17.

Date                     Interval  Data lost
                         (hh:mm)   (minutes)
2015-01-05    XYZ     03:18 - 03:19  (2) Quake Banda Sea
2015-01-06    XYZ     16:38 - 16:38  (1) Quake Banda Sea
2015-01-12    XYZ     20:27 - 20:32  (6) Quake Aru Is
2015-01-17    XYZ     23:41 - 23:46  (6) Quake Banda Sea
2015-01-25    XYZ     00:33 - 00:34  (2) Quake Banda Sea
2015-01-31    XYZ     17:32 - 17:35  (4) Quake Banda Sea
2015-02-02    XYZ     09:22 - 10:59 (98) Thunderstorm
2015-02-05    XYZ     18:22 - 18:24  (3) Quake Banda Sea
```

2015-02-27	XYZ	13:48 - 13:59	(12)	Quake Flores Sea
2015-03-09	XYZ	06:47 - 06:50	(4)	Quake Banda Sea
2015-03-11	XYZ	05:34 - 06:13	(40)	A/C servicing
2015-03-11	XYZ	09:42 - 09:43	(2)	Quake Banda Sea
2015-03-13	XYZ	09:25 - 09:25	(1)	Quake Banda Sea
2015-03-15	XYZ	14:26 - 14:27	(2)	Quake Banda Sea
2015-03-22	XYZ	22:29 - 23:52	(84)	A/C replacement
2015-03-25	XYZ	14:02 - 14:03	(2)	Quake Banda Sea
2015-03-28	XYZ	18:44 - 18:45	(2)	unknown
2015-04-01	XYZ	09:38 - 09:44	(7)	Quake Tanimbar Is
2015-04-04	XYZ	17:50 - 17:54	(5)	Quake Banda Sea
2015-04-08	XYZ	05:59 - 05:59	(1)	Quake Banda Sea
2015-04-08	XYZ	08:24 - 08:25	(2)	Quake Banda Sea
2015-04-10	XYZ	22:58 - 22:58	(1)	Quake Banda Sea
2015-04-14	XYZ	23:43 - 23:46	(4)	Quake Banda Sea
2015-04-28	XYZ	23:03 - 23:03	(1)	CPU Reboot
2015-05-12	XYZ	07:24 - 07:28	(5)	Quake Banda Sea
2015-05-14	XYZ	17:40 - 17:44	(5)	Quake Banda Sea
2015-05-30	XYZ	11:30 - 11:39	(10)	Quake, Japan
2015-06-01	XYZ	10:31 - 10:33	(3)	Quake Banda Sea
2015-06-15	XYZ	17:43 - 17:47	(5)	Quake Timor
2015-06-25	XYZ	13:46 - 13:49	(4)	Quake Tanimbar Is
2015-07-11	XYZ	22:52 - 22:52	(1)	Quake Banda Sea
2015-07-12	XYZ	06:06 - 06:07	(2)	unknown
2015-07-12	XYZ	06:16 - 06:17	(2)	unknown
2015-07-19	XYZ	23:53 - 23:53	(1)	Quake Banda Sea
2015-07-27	XYZ	21:44 - 21:56	(13)	Quake Irian Jaya
2015-08-04	XYZ	04:47 - 04:48	(2)	unknown
2015-08-09	XYZ	23:10 - 23:15	(6)	Maintenance
2015-08-11	XYZ	15:55 - 16:00	(6)	Quake Banda Sea
2015-08-14	XYZ	22:06 - 22:08	(3)	Quake Tanimbar Is
2015-08-17	XYZ	02:28 - 02:29	(2)	X, Y contamination
2015-08-17	XYZ	02:47 - 02:48	(2)	X, Y contamination
2015-08-17	XYZ	03:02 - 03:03	(2)	X, Y contamination
2015-08-18	XYZ	20:51 - 20:54	(4)	Quake Banda Sea
2015-09-06	XYZ	01:47 - 01:48	(2)	Quake Tanimbar Is
2015-09-16	XYZ	07:45 - 07:46	(2)	Quake N Molucca
2015-09-24	XYZ	15:57 - 16:01	(5)	Quake Irian Jaya
2015-09-27	XYZ	02:58 - 03:02	(5)	Quake Banda Sea
2015-10-15	XYZ	23:16 - 23:16	(1)	Quake Banda Sea
2015-10-30	XYZ	10:30 - 10:32	(3)	Quake Banda Sea
2015-11-02	XYZ	16:39 - 16:45	(7)	Quake Banda Sea
2015-11-04	XYZ	03:47 - 03:50	(4)	Quake Timor
2015-11-11	XYZ	23:38 - 23:42	(5)	Quake Banda Sea
2015-11-18	XYZ	02:00 - 02:05	(6)	Quake Banda Sea
2015-11-21	XYZ	09:08 - 09:14	(7)	Quake Tanimbar Is
2015-11-25	XYZ	22:21 - 22:21	(1)	CPU Reboot
2015-12-09	XYZ	10:24 - 10:35	(12)	Quake Banda Sea
2015-12-10	XYZ	18:59 - 19:02	(4)	Quake Banda Sea
2015-12-13	XYZ	06:44 - 06:48	(5)	Quake Banda Sea
2015-12-15	XYZ	19:04 - 19:07	(4)	Quake Banda Sea
2015-12-20	XYZ	20:45 - 20:46	(2)	Quake Banda Sea
2015-12-24	XYZ	23:13 - 23:18	(6)	Quake Banda Sea
2015-12-26	XYZ	06:48 - 06:49	(2)	Quake Banda Sea

Total: 453

Scalar data

Most missing data can be attributed to progressive total-field variometer failure (as explained above), maintenance, a sudden jump, individual thunderstorm

spikes during monsoon season (roughly October April)
and decay plus one particularly
severe thunderstorm that was unable to be filtered
effectively. A summary of the unexplained individual
events for each month has been made with the vast majority
single minute losses. Accountable events are listed
separately. The data loss list for 2015-09-30 through
2015-11-05 runs to many thousands of lines and has
therefore been omitted. Instead, a summary total of the
(non-contiguous) data loss for this period has been
included with the data loss for the period 2015-09-30 to
2015-11-05 2052 being 7920 points (minutes).

```
Unexplained individual events
Date                             Data lost
                                 (minutes)
2015-01       F                     59
2015-02       F                    106
2015-03       F                    131
2015-04       F                     92
2015-05       F                     42
2015-06       F                     32
2015-07       F                     21
2015-08       F                      9
2015-09-01    F      00:00 -
2015-09-29    F              23:59  140
2015-09-30    F      00:00
2015-11-05    F            - 20:52   7920  (non-contiguous)
2015-11-05    F      21:05
2015-11-30    F            - 23:59    6
2015-12       F                     11

Accountable events
2015-02-02    F      09:22 - 10:59   98 Thunderstorm
2015-02-16    F      12:11 - 12:30   20 Unexplained change
2015-03-11    F      05:34 - 06:13   40 A/C Servicing
2015-03-22    F      22:29 - 23:52   84 A/C replacement
2015-04-28    F      23:03 - 23:03    1 CPU Reboot
2015-08-09    F      23:00 - 23:08    9 Maintenance
2015-11-05    F      20:55 - 21:03    9 PPM reconfiguration
2015-11-25    F      22:21 - 22:21    1 CPU Reboot

Total: 8831
```

Appendix C. Data filter usage

The de-spiking parameters required a spike to exceed a
multiple ("Factor") times a discriminating value. The
discriminating value is calculated as 8/9 * 100 percentile
value from a buffer of recently calculated deviations. A
deviation is the minimum deviation of the point from the
linear interpolations of 3 local pairs of points. The
buffer is formed of recent deviations or from the noise
level ("Noise"), whichever is greater. The spike is
corrected if the three local interpolations agree to
better than 9/8 * discriminating value, otherwise the
point is marked as "missing."

"Raw" prefix parameters affect raw data, non-prefix
parameters affect derived data. Vector parameters affect
the vector variometer data and scalar parameters affect

the total-field variometer data. More than one filter stage can be applied. A parameter is turned off by setting its Factor to zero.

The parameters used are as follows:
Normal filter
rawVectorFactor=5
rawVectorNoise=4
scalarFactor=9
scalarNoise=0.1

Thunderstorm filter
scalarFactor=4
scalarNoise=1
scalarFactor1=9
scalarNoise1=0.1
rawVectorFactor=5
rawVectorNoise=4
vectorFactor=6
vectorNoise=0.05

PPM (GSM-90 total-field variometer) filter
scalarFactor=3
scalarNoise=.4
scalarFactor1=5
scalarNoise1=0.1
rawVectorFactor=5
rawVectorNoise=4
rawVectorFactor1=4
rawVectorNoise1=3

Filter Application List
Times that the different filters were applied throughout 2015, except for the period 2015-10-01 through 2015-11-05 where the pre-filter plus PPM (GSM-90 total-field variometer) filter was applied. Times other than listed have had the "normal" filter applied. "Unfilt" refers to the substitution of unfiltered data.

2015-10-01 through 2015-11-05 was subject to a manual "truncation" of noisy data points before applying the PPM filter, as this block was processed separately it is not listed below.

PPM   = GSM-90 total-field variometer filtered data
tstorm = thunderstorm filtered data
unfilt = unfiltered data

DoY	Date	Time start	Time end	Filter to use
4	4/01/2015	16:45	16:45	unfilt
6	6/01/2015	5:30	10:30	PPM
6	6/01/2015	6:17	6:17	unfilt
9	9/01/2015	9:30	11:30	tstorm
10	10/01/2015	9:30	10:15	tstorm
13	13/01/2015	10:30	15:30	PPM
13	13/01/2015	6:30	11:30	tstorm
19	19/01/2015	1:00	6:15	PPM
22	22/01/2015	4:00	7:00	tstorm
24	24/01/2015	7:00	10:00	tstorm
26	26/01/2015	6:00	11:00	PPM
26	26/01/2015	4:30	7:30	tstorm

27	27/01/2015	15:47	15:48	unfilt
28	28/01/2015	7:30	9:30	tstorm
32	1/02/2015	6:30	11:00	tstorm
33	2/02/2015	11:00	16:00	PPM
33	2/02/2015	7:45	12:45	tstorm
34	3/02/2015	7:00	8:30	tstorm
39	8/02/2015	8:30	14:00	tstorm
40	9/02/2015	16:00	21:00	PPM
40	9/02/2015	6:30	10:00	tstorm
40	9/02/2015	14:10	14:10	unfilt
42	11/02/2015	8:00	10:00	tstorm
43	12/02/2015	1:30	6:40	PPM
45	14/02/2015	8:00	11:00	tstorm
46	15/02/2015	9:00	12:00	tstorm
47	16/02/2015	8:30	11:00	tstorm
48	17/02/2015	9:00	11:00	tstorm
49	18/02/2015	6:00	8:30	tstorm
50	19/02/2015	6:30	11:30	PPM
50	19/02/2015	18:55	20:00	tstorm
55	24/02/2015	6:00	13:00	tstorm
57	26/02/2015	11:30	16:30	PPM
57	26/02/2015	9:20	14:00	tstorm
58	27/02/2015	6:00	12:00	tstorm
59	28/02/2015	8:00	11:10	tstorm
60	1/03/2015	7:25	18:15	tstorm
61	2/03/2015	5:30	10:30	PPM
63	4/03/2015	20:28	20:28	unfilt
64	5/03/2015	12:30	12:30	unfilt
65	6/03/2015	8:15	15:30	tstorm
66	7/03/2015	7:30	9:30	tstorm
66	7/03/2015	14:00	17:15	tstorm
68	9/03/2015	10:30	15:30	PPM
71	12/03/2015	9:34	9:34	unfilt
71	12/03/2015	12:42	12:42	unfilt
71	12/03/2015	15:05	15:05	unfilt
71	12/03/2015	16:02	16:02	unfilt
73	14/03/2015	8:55	11:35	tstorm
75	16/03/2015	15:30	20:30	PPM
75	16/03/2015	6:30	8:00	tstorm
75	16/03/2015	6:42	6:44	unfilt
76	17/03/2015	4:45	4:47	unfilt
76	17/03/2015	15:40	15:40	unfilt
80	21/03/2015	8:40	10:35	tstorm
81	22/03/2015	7:56	7:57	unfilt
81	22/03/2015	8:03	8:04	unfilt
81	22/03/2015	8:53	8:53	unfilt
82	23/03/2015	20:30	23:59	PPM
82	23/03/2015	11:34	11:34	unfilt
83	24/03/2015	0:00	1:30	PPM
83	24/03/2015	13:52	13:52	unfilt
83	24/03/2015	16:12	16:12	unfilt
85	26/03/2015	5:07	6:01	tstorm
90	31/03/2015	1:30	6:30	PPM
93	3/04/2015	3:40	3:40	unfilt
93	3/04/2015	12:09	12:09	unfilt
93	3/04/2015	15:50	15:50	unfilt
96	6/04/2015	7:56	10:51	tstorm
97	7/04/2015	6:20	9:16	tstorm
100	10/04/2015	6:53	6:53	unfilt
103	13/04/2015	1:00	6:00	PPM
103	13/04/2015	9:39	12:11	tstorm

110	20/04/2015	6:00	11:00	PPM
117	27/04/2015	11:00	16:00	PPM
124	4/05/2015	15:45	21:00	PPM
126	6/05/2015	1:45	6:45	PPM
131	11/05/2015	13:44	13:45	unfilt
133	13/05/2015	6:30	12:00	PPM
140	20/05/2015	11:30	16:45	PPM
147	27/05/2015	16:30	21:45	PPM
154	3/06/2015	0:30	5:45	PPM
159	8/06/2015	10:42	10:42	unfilt
160	9/06/2015	14:33	14:33	unfilt
161	10/06/2015	5:30	10:45	PPM
168	17/06/2015	10:30	15:30	PPM
173	22/06/2015	5:45	5:46	unfilt
173	22/06/2015	18:34	18:36	unfilt
173	22/06/2015	23:10	23:10	unfilt
175	24/06/2015	15:30	20:40	PPM
175	24/06/2015	7:30	7:30	unfilt
176	25/06/2015	13:39	13:39	unfilt
181	30/06/2015	1:15	6:15	PPM
188	7/07/2015	6:00	11:15	PPM
191	10/07/2015	23:46	23:46	unfilt
194	13/07/2015	9:37	9:37	unfilt
195	14/07/2015	11:00	16:15	PPM
202	21/07/2015	16:00	21:00	PPM
209	28/07/2015	21:00	23:59	PPM
209	28/07/2015	12:28	12:28	unfilt
210	29/07/2015	0:00	2:00	PPM
212	31/07/2015	14:11	14:11	unfilt
217	5/08/2015	1:50	6:00	PPM
218	6/08/2015	1:30	6:30	PPM
239	27/08/2015	3:16	3:16	unfilt
240	28/08/2015	15:14	15:14	unfilt
241	29/08/2015	0:11	0:11	unfilt
241	29/08/2015	0:41	0:41	unfilt
242	30/08/2015	23:53	23:53	unfilt
243	31/08/2015	12:51	12:51	unfilt
244	1/09/2015	15:30	20:30	PPM
245	2/09/2015	18:57	18:57	unfilt
246	3/09/2015	19:21	19:21	unfilt
247	4/09/2015	6:43	6:43	unfilt
247	4/09/2015	20:38	20:38	unfilt
249	6/09/2015	6:35	6:35	unfilt
251	8/09/2015	5:00	10:00	PPM
252	9/09/2015	10:10	10:10	unfilt
256	13/09/2015	10:07	10:07	unfilt
256	13/09/2015	10:07	10:07	unfilt
256	13/09/2015	11:07	11:07	unfilt
256	13/09/2015	12:44	12:44	unfilt
258	15/09/2015	10:30	15:30	PPM
259	16/09/2015	8:32	8:32	unfilt
260	17/09/2015	6:17	6:17	unfilt
261	18/09/2015	14:55	14:55	unfilt
261	18/09/2015	21:07	21:07	unfilt
262	19/09/2015	2:12	2:12	unfilt
262	19/09/2015	4:13	4:13	unfilt
262	19/09/2015	8:31	8:31	unfilt
263	20/09/2015	3:10	3:10	unfilt
263	20/09/2015	3:16	3:16	unfilt
263	20/09/2015	6:04	6:05	unfilt
263	20/09/2015	11:20	11:20	unfilt

265	22/09/2015	15:15	20:15	PPM
266	23/09/2015	12:00	18:00	PPM
267	24/09/2015	4:45	9:00	PPM
268	25/09/2015	9:05	9:05	unfilt
268	25/09/2015	11:46	11:46	unfilt
269	26/09/2015	17:49	17:49	unfilt
271	28/09/2015	6:12	6:12	unfilt
271	28/09/2015	13:51	13:51	unfilt
271	28/09/2015	17:31	17:31	unfilt
271	28/09/2015	21:45	21:45	unfilt
272	29/09/2015	1:29	1:29	unfilt
272	29/09/2015	2:49	2:49	unfilt
272	29/09/2015	5:18	5:18	unfilt
272	29/09/2015	5:31	5:31	unfilt
272	29/09/2015	16:50	16:50	unfilt
272	29/09/2015	20:18	20:18	unfilt
272	29/09/2015	21:55	21:55	unfilt
273	30/09/2015	0:00	23:59	PPM
309	5/11/2015	0:00	20:54	PPM
314	10/11/2015	10:31	10:31	unfilt
315	11/11/2015	6:50	12:00	tstorm
315	11/11/2015	11:42	11:42	unfilt
315	11/11/2015	11:45	11:45	unfilt
315	11/11/2015	11:47	11:47	unfilt
318	14/11/2015	10:00	12:00	tstorm
318	14/11/2015	10:43	10:43	unfilt
319	15/11/2015	15:01	15:03	unfilt
322	18/11/2015	15:12	15:12	unfilt
330	26/11/2015	6:00	8:00	tstorm
332	28/11/2015	5:20	6:30	tstorm
333	29/11/2015	10:30	15:00	tstorm
333	29/11/2015	12:10	12:10	unfilt
333	29/11/2015	12:18	12:18	unfilt
336	2/12/2015	14:30	16:40	tstorm
337	3/12/2015	15:00	17:00	tstorm
338	4/12/2015	7:30	9:15	tstorm
339	5/12/2015	3:30	5:30	tstorm
343	9/12/2015	14:38	14:38	unfilt
343	9/12/2015	14:53	14:53	unfilt
347	13/12/2015	7:15	10:45	tstorm
348	14/12/2015	14:47	14:47	unfilt
348	14/12/2015	14:50	14:50	unfilt
352	18/12/2015	16:13	16:13	unfilt
353	19/12/2015	16:18	16:18	unfilt
354	20/12/2015	5:29	5:29	unfilt
354	20/12/2015	12:14	12:14	unfilt
359	25/12/2015	20:26	20:26	unfilt
365	31/12/2015	13:15	13:15	unfilt

<END>

7.2.1.4 2016

KDU
KAKADU OBSERVATORY INFORMATION 2016

ACKNOWLEDGE- Users of the KDU data should acknowledge:
-MENTS: Geoscience Australia

STATION ID: KDU

```
      LOCATION: Kakadu National Park, Northern Territory,
                 Australia
  ORGANISATION: Geoscience Australia
   CO-LATITUDE: 102.686 Deg.
     LONGITUDE: 132.472 Deg. E
     ELEVATION: 14 metres

      ABSOLUTE
   INSTRUMENTS: DI-Fluxgate Magnetometer (DIM) and Proton
                Precession Magnetometer (GEM GSM-90)

     RECORDING
    VARIOMETER: Three component DMI FGE Fluxgate
                Magnetometer (DMI)
                Proton Precession Magnetometer (GEM GSM-90)

   ORIENTATION: ABZ (Magnetic NW, Magnetic NE and Vertical)
 DYNAMIC RANGE: +/- 1600 nT
    RESOLUTION: 0.032 nT
 SAMPLING RATE: 1 second
   FILTER TYPE: Intermagnet

        BACKUP
    VARIOMETER: none

     K-NUMBERS: none
      K9-LIMIT: 300 nT

          GINS: Edinburgh
     SATELLITE: HTTP and E-mail

     OBSERVERS: S. Toms
                A. Lewis
                L. Wang
                W. Jones

       CONTACT: Geomagnetism Project
                Geoscience Australia
                G.P.O. Box 378
                Canberra,  A.C.T.,  2601
                Australia

                Tel: + 61-2-6249-9111
                Fax: + 61-2-6249-9999
                e-mail: geomag@ga.gov.au
                www: http://www.ga.gov.au/

   NOTES:
Kakadu Geophysical Observatory is located in the Northern
Territory, 210 km east of Darwin and 40 km west of Jabiru
on the Arnhem Highway, near the South Alligator Ranger
Station, Kakadu National Park. It comprises magnetic and
seismological observatories and a gravity station. Kakadu
magnetic observatory is situated on unconsolidated
ferruginous and clayey sand. Continuous magnetic-field
recording began there in March 1995.

The magnetic observatory comprises:

* a 3x3 m air-conditioned concrete-brick Control House,
with concrete ceiling and aluminium cladding and roof,
```

where recording instrumentation and control equipment are housed;

* a 3x3 m roofed Absolute Shelter, 50 m NW of the Control House, that houses a 380x380 mm fibre-mesh-concrete principal observation pier (Pier A), the top of which is 1200 mm from the concrete floor;

* two 300 mm diameter azimuth pillars, both about 100 m from Pier A with approximate true bearings of 27d and 238d;

* two 600x600 mm underground vaults that house the variometer sensors, both located 50 to 60 m from the Control House, one to its SSW and one to its WSW (cables between the sensor vaults and the Control House are routed via underground conduits), and;

* a concrete slab, with tripod foot placements and a marker plate, used as an external reference site E (at a standard height of 1.6 m above the marker plate). The marker plate is 60 m, at a bearing of 331d, from pier A.

Key data for the observatory are given in Table 1.

IAGA code: KDU
Commenced operation: 05 March 1995
Geographic latitude: 12d 41' 10.9" S
Geographic longitude: 132d 28' 20.5" E
Geomagnetic latitude: -21.81d
Geomagnetic longitude: 205.69d
K 9 index lower limit: 300 nT
Principal pier: Pier A
Pier elevation (top): 14.6 m AMSL
Principal reference mark: Pillar AW
Reference mark azimuth: 237d 52.8'
Reference mark distance: 99.6 m
Observers: S. Toms
           A. Lewis
           L. Wang
           W. Jones

Table 1 Key observatory data.

Local meteorological conditions

The meteorological conditions at Jabiru (46 km East of the observatory) during 2016 were as follows:

The temperature varied from a minimum of 14.6 degC (2016-07-18) to a maximum of 39.3 degC (2016-10-19). Daily minimum temperatures varied from 14.6 degC to 27.8 degC (average 24.0+/-2.4 degC); daily maximum temperatures varied from 26.4 degC to 39.3 degC (average 35.5+/-2.0 degC); daily temperature ranges varied from 4.9 degC to 18.9 degC (average 11.4+/-2.3 degC).

The daily maximum wind gust varied from 17 to 98 km/h (average 36+/-10 km/h). The maximum daily maximum wind gust was 98 km/h (2016-11-02). The minimum daily maximum wind gust was 17 km/h (2016-05-26, 2016-06-08).

These conditions have been derived from data supplied by the Bureau of Meteorology (http://www.bom.gov.au).

Variometers

The variometers used during 2016 are described in Table 2.

3-component vector variometer: DMI FGE
Serial number: E0198/S0183
Type: suspended; linear fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
Resolution: 0.032 nT
A/D converter: ADAM 4017 module (±5V)

Total-field variometer: GEM Systems GSM-90
Serial number: 4071413/42185
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Data acquisition system: ARK3360F QNX6.5
Timing: Trimble Acutime GPS clock
Communications: VSAT satellite link

Table 2. Magnetic variometers used in 2016.

Analogue outputs from the vector variometer, and the sensor and electronics temperatures, were converted to digital data using an ADAM 4017 analogue-to-digital converter mounted inside the vector variometer electronics unit. These data and the digital total-field variometer data were recorded on the data acquisition computer located in the Control House.

The magnetic sensors were located in the concrete underground vaults: the vector variometer sensor in the northern vault (the one nearer the Absolute Shelter) and the total-field variometer sensor in the southern vault. Both vaults were completely buried in soil to minimise temperature fluctuations.

The total-field variometer electronics were located in the covered vault with its sensor. DC power and data cables ran between the total-field variometer vault and the Control House.

The vector variometer electronics console was placed in its own partially insulated plastic box, resting on the concrete floor in the Control Hut, with some bricks for heat-sinks to minimise temperature fluctuations. This arrangement proved to be effective in reducing the amplitude of temperature fluctuations with periods of the order of hours.

During the maintenance visit of 2016-05-24 to 2016-05-27 active temperature control for the DTU fluxgate electronics unit was installed on 2016-05-25 using two 50 W AC heater pads mounted inside a thermally insulated box along with the magnetometer electronics. The temperature inside the box is monitored and controlled with a Cal3300 PID temperature control, an autonomous unit which can be monitored and controlled remotely. The temperature control system does not have backup power. A set point value of 30 degC was initialised so the system will actively heat against the air-conditioned room temperature of approx. 25 degC.

The geomagnetic equipment shared power with the seismic equipment; a 12 V battery bank charged from 240 V power supplied by a generator at the nearby South Alligator Ranger Station. An inverter running off the 12 V supply provided 240 V 50 Hz power to the vector variometer electronics. The power system had a backup capacity of several days and the equipment was protected from surges and lightning strikes by power filters and a surge absorber.

The data connections between the acquisition computer and both the vector and total-field variometers were via serial cables.

Data were retrieved from the data-acquisition system at least every 10 minutes using rsync over ssh in near real-time using the network connection.

Although some lightning protection measures were incorporated in its original construction, Kakadu Observatory has suffered lightning damage since its installation in 1995. Additional protection measures were taken in December 1998 and October 1999, including the installation of an ERICO system. The ERICO System 3000 (Advanced Integrated Lightning Protection), comprising a Dynasphere Air Termination unit, mast, and copper-coated-steel earthing rod, was designed to protect an area of 80 m radius. Lengths of copper ribbon and aluminium power cables connected to the ERICO system were connected as follows:
* buried in shallow trenches towards the Absolute Shelter then in the opposite direction,
* from the Control House to and around both variometer sensor vaults,
* and a conducting loop around the Control House. The upgraded lightning protection measures are working well and no instrument damage occurred in 2016 due to lightning strikes.

The vector variometer scale-value, alignment, and temperature sensitivity parameters were measured at the magnetometer calibration facility at Canberra observatory before installation at Kakadu. The sensor assembly was aligned with the two horizontal fluxgate sensors at 45d to the declination at the time of installation and the Z fluxgate sensor vertical. This alignment was achieved by setting the X and Y offsets equal and rotating the instrument until the X and Y ordinates were equal. This method has been found to be accurate using tests performed at the calibration facility.

The Control House, which houses the vector variometer electronics, had its temperature maintained by an air-conditioning unit (A/C). During 2016 the temperature of the vector variometer electronics ranged from 23.6 degC to 28.8 degC. A temperature controlled enclosure was installed around the electronics on 2016-05-25 and afterwards the vector variometer electronics temperature was more tightly controlled. The annual temperature variation of 5.2 degC gave total variations of -0.2 nT, -0.9 nT and 0.0 nT in the X, Y and Z channels respectively.

The vector variometer sensor temperature ranged from 26.1 degC to 35.3 degC during the year. Although buried underground, the sensor temperature varied during the year in accordance with the seasons at long periods. The annual temperature variation of 9.2 degC converted to variations of 0.3 nT, -0.6 nT and -0.6 nT in the X, Y and Z channels respectively.

19144 min of both vector and total-field data were lost due to an acquisition computer failure between 2015-08-03 at 23:26:30 until 2016-08-17 06:30:24.

Total vector variometer data loss for 2016 was 19820 min minutes, broken down as follows:

* 19144 min to a failed acquisition PC
* 329 min to recognised earthquakes
* 327 min to maintenance
* 8 min of unexplained quake-like interference
* 12 min of unknown or unexplained contamination.

Vector data lost to earthquakes are manually excluded by cross-matching Geoscience Australias publicly available earthquake database against the vector data.

Vector variometer data loss events are listed in Appendix A.

The total total-field variometer loss for 2016 was 19577 min, broken down as follows:

* 19144 min to a failed acquisition PC
* 306 min to maintenance
* 329 min to recognised earthquakes
* 11 min of unknown or other events
* 116 min of unlisted short events.

Total-field variometer data loss events are listed in Appendix A.

Data exclusions are applied before data is filtered.

Two different filters, a normal filter and a thunderstorm filter, have been employed to the 1 second vector variometer and interpolated 1 second (from 10 second) total-field variometer data. Data were filtered one UTC day at a time. One day (2016-05-30) of unfiltered data was substituted to remove a spurious filter artefact.

The normal filter works well for occasional spikes and is the default used. The thunderstorm filter is biased towards removing vector variometer (vector) noise but also processes the total-field variometer data.

Filter details and applied days are listed in Appendix C.

Variometer clock corrections

Variometer timing was controlled by the QNX data-acquisition computer clock which was maintained using both the 1 PPS and data stream output of a GPS clock. Time corrections were logged automatically however the data before 2016-08-03 was lost when the acquisition PC failed. Time stamps applied to the variometer data were obtained from the acquisition computer system clock which was synchronised to a GPS clock. From 2016-08-03 adjustments to the system clock were less than 1 ms except as follows:

```
2016-08-17      06:34:41    -0.516 s Replacement PC
                                     installation
```

Absolute instruments

The principal absolute magnetometers used at Kakadu and their adopted corrections for 2016 are described in Table 3.

DI fluxgate: DMI flux
Serial number: DI0049D
Theodolite: Zeiss 020B
Serial number: 311847
Resolution: 0.1'
D correction: -0.05'
I correction: -0.15'

Total-field magnetometer: GEM Systems GSM-90
Serial number: 8092903/83386
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT

Table 3.

Absolute magnetometers and their adopted corrections for 2016. Corrections are applied in the sense Standard = Instrument + correction.

DIM observations at Kakadu were performed using the offset method. All DIM and total-field variometer measurements were made on Pier A at the standard height.

Table 3 describes the corrections applied to the absolute magnetometers to align them to the international standard as defined at IAGA workshops.

Absolute instrument corrections for DI0049D/311847 were checked through a number of instrument comparisons carried out at the Canberra and Kakadu geomagnetic observatories in 2012. In 2016 there was one comparison between DI0049D/311847 and travel reference DIM DI0135D/100856 during the maintenance visit in May 2016. The comparison was favourable and no change to the instrument correction is recommended for 2016 and more measurements are recommended for 2017. Therefore the correction to the international standard still remains -0.05 in D and -0.15 for I.

At the 2016 mean magnetic field values at Kakadu the D, I and F corrections translate to corrections of:
dX =-1.65 nT   dY =-0.61 nT   dZ =-1.23 nT

These instrument corrections have been applied to the data described in this report and to other published data.

Baselines

There were 54 pairs of absolute measurements with 45 pairs of mostly evenly distributed standard weekly absolute measurements by the local observer during 2016, 7 pairs during the maintenance visit from 2016-05-23 to 2016-05-26 and 2 pairs during a visit from 2016-10-15 to 2016-10-16. There was a small break in observations during the acquisition computer failure from 2016-08-01 to 2016-08-17. The 2016 weekly absolute observations data were of reasonable quality albeit somewhat dispersed especially from 2016-07-25 onwards. Only two observation pairs had one half excluded due to errors or contamination. There was one observer employed during 2016; there were three other Geoscience Australia observers used during visits. The data formed a usable set for 2016.

X channel baselines drifted through 2016 within about 2.0 nT, Y channel within about 2.9 nT and Z channel within about 1.6 nT. Across the year there was no major drift trend for any channel. There were no baseline steps for 2016.

The F difference time series (Fv - Fs) was plotted to monitor variometer baseline variations throughout 2016. There was some diurnal cycling of the (Fv - Fs) with a maximum change of about 0.5 nT, more generally around 0.25 nT. Occasional rises ('humps') of approximately 0.5 nT in the (Fv - Fs) were noted throughout the year and these correlated with known power outages when the electronics temperature rose and both the A/C and temperature controlled environment would have been non-operational.

For 2016 the standard deviations of the weekly absolute observations from the final adopted variometer model and data were:

	Std.dev
X	1.7 nT
Y	1.5 nT
Z	2.0 nT
D	8"
I	12"
F	0.2 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2016 KDU definitive data and real time reported 1-minute data sets (KDU definitive - KDU real time) were:

	X	Y	Z
Average	+0.2	+1.3	-0.1
Std.Dev	+0.4	+1.1	+0.5
Min	-0.5	-0.4	-0.8
Max	+0.9	+3.0	+0.6

The KDU 2016 reported real time data have relatively larger variations due to spikes caused by lightning strikes, earthquakes and other disruptions. Baselines were updated monthly to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2016 KDU definitive data and quasi-definitive 1-minute data sets (KDU definitive - KDU quasi-definitive) were:

	X	Y	Z
Average	-0.0	+0.8	-0.0
Std.Dev	+0.3	+0.9	+0.5
Min	-0.4	-0.7	-0.9
Max	+0.6	+2.5	+0.6

Operations

Absolute observation data were recorded on a Getac PC tablet using software developed by Geoscience Australia and digital files were emailed back to Canberra where they were processed and used to calibrate the variometer data.

On weekly visits, the local observer checked the operation of the observatory and maintained the observatory in good condition with tasks such as building pest control, mowing grass and changing batteries.

Geoscience Australia staff visited the observatory on 2016-05-24 and 2016-05-27 to carry out annual maintenance work, instrument installation, comparisons and observer training.

A temperature controlled thermal insulation box was installed around the vector variometer electronics on 2016-05-25.

The remains of the burnt fences from the previous year's bushfire were removed and new fences made of non-magnetic materials were installed on 2016-05-24 and 2015-05-26.

Data were lost due to an acquisition computer failure on 2016-08-03. A new acquisition computer was shipped to the observer who installed it on our behalf and data resumed on 2016-08-17.

There was a follow-up visit by another Geoscience

Australia staff member accompanied by two visitors on 2016-10-15 - 2016-10-16 during which a check was carried out on the state of the observatory and some more observations taken.

Data distribution

The distribution of Kakadu 2016 data is described in Table 4. Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au). Data losses are identified in Appendix A and Table A.1.

Recipient	Status	Sent
1-second values		
BoM Space Weather Services	reported	realtime
INTERMAGNET	reported	hourly
1-minute values		
INTERMAGNET	reported	realtime
INTERMAGNET	reported	daily
INTERMAGNET	definitive	July 2017
INTERMAGNET	quasidefintive	quarterly
WDC for Geomagnetism (Japan)	reported	realtime

Table 4. Distribution of Kakadu 2016 data.

Significant Events at KDU in 2016

NOTE DATE	EVENT INFO
2016-02-16	Fix to door lock ~ 1000-1130 local time (~0030-0200 UTC)
2016-05-20	Comms problems ~17-19 May - Loss of comms ~17-May - Reboot of comms 19-May ~06-0700 UTC - Any unsent data retrieved manually 20-May
2016-05-23	Observatory visit from 23 - 27/05 (Geoscience Australia staff) Re-configure thermal insulation on DMI electronics in control hut and install Cal3300 temperature control unit set for 30 C Re-build fences around vector and scalar vaults and azimuth pier NW Repair fence around azimuth pier NE Station difference to station E, Sunshots, round of angles, DIM comparisons, DIM parameters Meet with observer.
2016-05-24	00:00 - 01:00 variometer data contaminated due to maintenance work.
2016-05-25	Observatory visit 23-27 May by Geoscience Australia staff- interference expected
2016-08-03	23:32 Reboot to clear TCP stack; system fails to restart
2016-08-08	06:30 Observer checks system and confirms system disk failure attempts reboot, unsuccessful
2016-08-17	06:00 replace data acquisition computer. Data lost from 03-Aug 23:26:30 until 17-Aug 06:30:24
2016-10-15/16	Visit by Geoscience Australia staff member

```
            and 2 visitors from Kyoto University to
            recover induction magnetometer, carry out some
            observations and check observatory condition
2016-11-02  03UT start cronjob to log Cal3300 electronics
            temperature every hour  ->
            /log/Cal330Temperature
2016-11-15  23:50 Update PID parameters on electronics
            Cal3300 temperature controller;
              Register Param  Old Value       New Value
              0x0085   Band    0.1            3.7
              0x018a    Dac    1.5        1.5
              0x018b  Int.T    5.0       18.0
              0x018c  Der.T   25.0       62.0
              0x018d  Cyc.t   20.0       40.0
2016-12-13  Change to Cal3300 PID parameters on 2016-11-15
            did not improve temperature stability of
            electronics
            01:40 change back to original PID values
            (except cycle time):
              0x0085   Band    0.1;
              0x018a    Dac    1.5;
              0x018b  Int.T    5.0;
              0x018c  Der.T   25.0;
              0x018d  Cyc.t   40.0

Appendix A.  Data losses
------------------------
Vector data

Date                     Interval  Data lost
                         (hh:mm)   (minutes)
2016-01-05    XYZ     05:32 - 05:32  (1) Quake Banda Sea
2016-01-11    XYZ     23:43 - 23:44  (2) Quake Banda Sea
2016-01-17    XYZ     15:32 - 15:36  (5) Quake Banda Sea
2016-02-12    XYZ     10:08 - 10:10  (3) Quake Sumba Reg.
2016-02-16    XYZ     00:42 - 01:05  (24) Maintenance
2016-02-20    XYZ     11:11 - 11:15  (5) Quake Banda Sea
2016-02-25    XYZ     12:19 - 12:22  (4) Quake Banda Sea
2016-03-02    XYZ     13:05 - 13:34  (30) Quake Sumatra
2016-03-03    XYZ     08:39 - 08:42  (4) Quake Timor
2016-03-19    XYZ     08:53 - 08:58  (6) Quake Banda Sea
2016-03-21    XYZ     05:43 - 05:49  (7) Unknown
2016-03-25    XYZ     19:52 - 19:52  (1) Quake Banda Sea
2016-04-06    XYZ     20:37 - 20:42  (6) Quake Banda Sea
2016-04-14    XYZ     23:17 - 23:23  (7) Quake Banda Sea
2016-04-22    XYZ     04:50 - 04:53  (4) Quake Banda Sea
2016-04-26    XYZ     04:23 - 04:27  (5) Quake Papua, Ind
2016-04-28    XYZ     20:18 - 20:19  (2) Quake-like
2016-05-09    XYZ     15:21 - 15:25  (5) Quake Banda Sea
2016-05-20    XYZ     18:17 - 18:30  (14) Quake Alice Spr.
2016-05-23    XYZ     23:50 -
2016-05-24    XYZ     - 00:44        (55) Maintenance
2016-05-24    XYZ     00:47 - 00:48  (2) Maintenance
2016-05-24    XYZ     07:12 - 07:18  (7) Maintenance
2016-05-24    XYZ     07:25 - 07:59  (35) Maintenance
2016-05-24    XYZ     23:08 - 23:09  (2) Maintenance
2016-05-24    XYZ     23:13 - 23:13  (1) Maintenance
2016-05-25    XYZ     04:08 - 04:15  (8) Maintenance
2016-05-25    XYZ     06:31 - 06:40  (10) Maintenance
2016-05-26    XYZ     01:52 - 03:31  (100) Maintenance
2016-05-26    XYZ     05:16 - 06:13  (58) Maintenance
```

2016-05-26	XYZ	10:56 - 10:58	(3) Maintenance
2016-05-26	XYZ	21:10 - 21:31	(22) Maintenance
2016-05-29	XYZ	18:23 - 18:26	(4) Quake Banda Sea
2016-06-05	XYZ	16:28 - 16:34	(7) Quake Banda Sea
2016-06-07	XYZ	19:19 - 19:21	(3) Q. N. Molucca Sea
2016-06-09	XYZ	07:00 - 07:02	(3) Unknown
2016-06-10	XYZ	13:29 - 13:31	(3) Quake Banda Sea
2016-06-14	XYZ	22:14 - 22:16	(3) Quake Papua, Ind.
2016-06-17	XYZ	08:43 - 08:44	(2) Quake Banda Sea
2016-06-21	XYZ	04:55 - 04:58	(4) Quake Banda Sea
2016-06-26	XYZ	03:00 - 03:01	(2) Quake Banda Sea
2016-07-07	XYZ	10:14 - 10:17	(4) Quake Banda Sea
2016-07-18	XYZ	05:34 - 05:36	(3) Quake Timor
2016-07-23	XYZ	02:29 - 02:30	(2) Quake Banda Sea
2016-07-29	XYZ	21:25 - 21:28	(4) Quake Mariana Is.
2016-07-30	XYZ	14:50 - 14:51	(2) Quake-like
2016-08-03	XYZ	23:27 -	
2016-08-17	XYZ	- 06:30	(19144) Acq. PC fail
2016-08-18	XYZ	04:39 - 04:42	(4) Quake Bowen Qld.
2016-08-18	XYZ	11:21 - 11:24	(4) Quake Banda Sea
2016-08-23	XYZ	19:43 - 19:49	(7) Quake Flores Sea
2016-09-13	XYZ	06:43 - 06:43	(1) Quake Banda Sea
2016-09-15	XYZ	19:50 - 19:51	(2) Quake Seram
2016-09-16	XYZ	05:47 - 05:49	(3) Quake Banda Sea
2016-09-20	XYZ	00:14 - 00:18	(5) Quake Banda Sea
2016-09-23	XYZ	05:12 - 05:15	(4) Quake Banda Sea
2016-09-24	XYZ	11:30 - 11:32	(3) Quake Banda Sea
2016-09-30	XYZ	22:48 - 22:49	(2) Quake Banda Sea
2016-10-15	XYZ	05:26 - 05:27	(2) Unknown
2016-10-15	XYZ	08:11 - 08:11	(1) Quake New Britain
2016-10-17	XYZ	06:19 - 06:26	(8) Quake New Britain
2016-10-19	XYZ	00:31 - 00:32	(2) Quake Java Sea
2016-11-06	XYZ	05:27 - 05:28	(2) Quake Banda Sea
2016-11-06	XYZ	09:58 - 10:00	(3) Quake Halls Ck NT
2016-11-09	XYZ	14:55 - 14:55	(1) Q. Bismarck Sea
2016-11-09	XYZ	14:58 - 14:58	(1) Q. Bismarck Sea
2016-11-13	XYZ	11:27 - 11:50	(24) Q. Wellington NZ
2016-11-17	XYZ	16:59 - 17:03	(5) Quake Banda Sea
2016-11-19	XYZ	12:04 - 12:05	(2) Quake Banda Sea
2016-11-30	XYZ	02:31 - 02:35	(5) Q. Tanimbar Is.
2016-11-30	XYZ	02:44 - 02:50	(7) Q. Tanimbar Is.
2016-12-02	XYZ	23:22 - 23:23	(2) Quake-like
2016-12-05	XYZ	01:16 - 01:21	(6) Quake Banda Sea
2016-12-08	XYZ	17:45 - 18:10	(26) Q. Solomon Is.
2016-12-12	XYZ	16:25 - 16:27	(3) Quake- unknown
2016-12-16	XYZ	15:01 - 15:02	(2) Quake-like
2016-12-17	XYZ	10:57 - 11:18	(22) Q. New Ireland
2016-12-17	XYZ	11:37 - 11:40	(4) Q. New Ireland
2016-12-20	XYZ	07:16 - 07:20	(5) Quake Banda Sea
2016-12-21	XYZ	00:19 - 00:36	(18) Quake N. Timor
2016-12-29	XYZ	22:34 - 22:39	(6) Q. Sumbawa Reg.

Total: 19820

Scalar data

Date		Interval (hh:mm)	Data lost (minutes)
2016-01-04	F	17:05 - 17:06	(2)
2016-01-06	F	07:36 - 07:36	(1)
2016-01-13	F	10:51 - 10:51	(1)

2016-01-20	F	17:22 - 17:22	(1)
2016-01-20	F	17:52 - 17:52	(1)
2016-02-02	F	14:56 - 14:58	(3)
2016-02-08	F	14:38 - 14:38	(1)
2016-02-15	F	12:48 - 12:48	(1)
2016-02-15	F	13:08 - 13:08	(1)
2016-02-16	F	00:42 - 01:05	(24) Maintenance
2016-02-17	F	08:17 - 08:17	(1)
2016-02-22	F	15:11 - 15:11	(1)
2016-02-23	F	00:46 - 00:46	(1)
2016-03-03	F	12:56 - 12:56	(1)
2016-03-09	F	14:07 - 14:07	(1)
2016-03-11	F	12:52 - 12:52	(1)
2016-03-11	F	14:10 - 14:10	(1)
2016-03-12	F	15:48 - 15:48	(1)
2016-03-14	F	00:39 - 00:39	(1)
2016-03-14	F	22:54 - 22:54	(1)
2016-03-28	F	19:06 - 19:06	(1) Artefact
2016-03-30	F	12:44 - 12:44	(1)
2016-03-31	F	14:34 - 14:34	(1)
2016-04-01	F	19:59 - 19:59	(1)
2016-04-03	F	14:28 - 14:28	(1)
2016-04-14	F	12:09 - 12:09	(1)
2016-04-17	F	19:35 - 19:35	(1)
2016-04-17	F	20:20 - 20:20	(1)
2016-05-01	F	14:14 - 14:15	(2)
2016-05-03	F	16:38 - 16:39	(2) Unknown
2016-05-06	F	11:57 - 11:57	(1)
2016-05-06	F	12:14 - 12:14	(1)
2016-05-06	F	15:53 - 15:53	(1)
2016-05-06	F	15:59 - 15:59	(1)
2016-05-08	F	13:10 - 13:10	(1)
2016-05-23	F	21:38 - 21:39	(2) Maintenance
2016-05-24	F	00:51 - 00:54	(4)
2016-05-24	F	21:16 - 22:18	(63) Maintenance
2016-05-24	F	22:37 - 23:11	(35) Maintenance
2016-05-26	F	01:51 - 03:31	(101) Maintenance
2016-05-26	F	05:15 - 06:13	(59) Maintenance
2016-05-26	F	21:10 - 21:31	(22) Maintenance
2016-05-27	F	13:13 - 13:13	(1)
2016-06-07	F	10:02 - 10:02	(1) Unknown
2016-06-09	F	07:00 - 07:02	(3) Unknown
2016-06-29	F	15:11 - 15:11	(1)
2016-07-20	F	01:13 - 01:13	(1)
2016-07-22	F	16:33 - 16:33	(1)
2016-07-24	F	17:26 - 17:26	(1)
2016-07-24	F	17:35 - 17:36	(2)
2016-07-27	F	13:22 - 13:22	(1)
2016-07-27	F	13:27 - 13:27	(1)
2016-07-27	F	13:57 - 13:57	(1)
2016-07-29	F	16:16 - 16:16	(1)
2016-08-02	F	23:37 - 23:37	(1)
2016-08-03	F	02:12 - 02:12	(1)
2016-08-03	F	03:52 - 03:53	(2)
2016-08-03	F	16:06 - 16:06	(1)
2016-08-03	F	23:27 -	
2016-08-17	F	- 06:30	(19144) Acq. PC Fail
2016-08-19	F	13:13 - 13:13	(1)
2016-08-21	F	15:07 - 15:09	(3)
2016-08-23	F	20:40 - 20:40	(1)
2016-08-25	F	09:30 - 09:30	(1)

2016-09-01	F	14:01 - 14:01	(1)	
2016-09-02	F	01:56 - 01:56	(1)	
2016-09-02	F	13:20 - 13:21	(2)	
2016-09-02	F	13:58 - 13:58	(1)	
2016-09-02	F	14:08 - 14:08	(1)	
2016-09-03	F	05:50 - 05:50	(1)	
2016-09-03	F	07:26 - 07:26	(1)	
2016-09-04	F	11:13 - 11:13	(1)	Unknown
2016-09-04	F	12:50 - 12:51	(2)	
2016-09-04	F	17:30 - 17:30	(1)	
2016-09-05	F	09:36 - 09:37	(2)	
2016-09-07	F	11:44 - 11:44	(1)	
2016-09-20	F	02:03 - 02:03	(1)	
2016-09-25	F	11:45 - 11:45	(1)	
2016-09-26	F	12:49 - 12:49	(1)	
2016-09-28	F	13:15 - 13:15	(1)	
2016-09-29	F	09:42 - 09:42	(1)	
2016-09-29	F	13:04 - 13:04	(1)	
2016-09-29	F	14:55 - 14:55	(1)	
2016-10-01	F	05:33 - 05:33	(1)	
2016-10-01	F	16:51 - 16:51	(1)	
2016-10-02	F	11:44 - 11:44	(1)	
2016-10-05	F	12:05 - 12:05	(1)	
2016-10-06	F	16:27 - 16:27	(1)	
2016-10-10	F	01:24 - 01:24	(1)	
2016-10-15	F	11:44 - 11:44	(1)	
2016-10-17	F	16:36 - 16:36	(1)	
2016-10-22	F	14:32 - 14:32	(1)	
2016-10-23	F	07:43 - 07:43	(1)	
2016-10-23	F	18:19 - 18:19	(1)	
2016-10-24	F	12:37 - 12:37	(1)	
2016-10-26	F	12:00 - 12:00	(1)	
2016-10-26	F	15:48 - 15:48	(1)	Fast Oscillation
2016-10-26	F	17:00 - 17:00	(1)	Fast Oscillation
2016-10-27	F	10:51 - 10:51	(1)	
2016-10-27	F	16:01 - 16:01	(1)	
2016-10-30	F	13:38 - 13:38	(1)	
2016-11-01	F	13:08 - 13:08	(1)	
2016-11-02	F	00:20 - 00:20	(1)	
2016-11-02	F	12:25 - 12:25	(1)	
2016-11-03	F	10:54 - 10:54	(1)	
2016-11-06	F	12:07 - 12:07	(1)	
2016-11-10	F	17:09 - 17:09	(1)	
2016-11-12	F	11:42 - 11:42	(1)	
2016-11-12	F	14:30 - 14:30	(1)	
2016-11-18	F	02:14 - 02:14	(1)	
2016-11-22	F	13:58 - 13:58	(1)	
2016-11-26	F	13:07 - 13:07	(1)	
2016-12-21	F	15:35 - 15:35	(1)	
2016-12-21	F	15:53 - 15:53	(1)	
2016-12-24	F	09:48 - 09:48	(1)	
2016-12-25	F	11:15 - 11:15	(1)	
2016-12-25	F	11:33 - 11:33	(1)	Unknown
2016-12-27	F	17:22 - 17:22	(1)	
2016-12-31	F	10:16 - 10:16	(1)	

Total: 19577

Table A.1. Kakadu data loss.

Observatory	Vector	Scalar
Kakadu	19820 min 3.761%	19577 min 3.715%

Appendix B. Backup data

There is no backup data at Kakadu.

Appendix C. Data filter usage

The de-spiking parameters required a spike to exceed a multiplier "Factor" times a discriminating value. The discriminating value is calculated as 8/9 * 100 percentile value from a buffer of recently calculated deviations. A deviation is the minimum deviation of the point from the linear interpolations of 3 local pairs of points. The buffer is formed of recent deviations or from the noise level "Noise", whichever is greater. The spike is corrected if the three local interpolations agree to better than 9/8 * discriminating value, otherwise the point is marked as "missing".

"Raw" prefix parameters affect raw data, non-prefix parameters affect derived data. Vector parameters affect the vector variometer data and scalar parameters affect the total-field variometer data. More than one filter stage can be applied. A parameter is turned off by setting its Factor to zero.

The parameters used are as follows:
Normal filter
rawVectorFactor=5
rawVectorNoise=4
scalarFactor=9
scalarNoise=0.1

Thunderstorm filter
scalarFactor=4
scalarNoise=1
scalarFactor1=9
scalarNoise1=0.1
rawVectorFactor=5
rawVectorNoise=4
vectorFactor=6
vectorNoise=0.05

Filter Application
One day of unfiltered data (2016-05-30) was substituted for normal-filtered data to remove a spurious filter artefact.

Thunderstorm-filtered days are listed below.

The balance of 2016 has had the normal filter applied.

Thunderstorm filtered days

DoY	Date
6	6/01/2016
7	7/01/2016
12	12/01/2016
13	13/01/2016
15	15/01/2016

18	18/01/2016
20	20/01/2016
21	21/01/2016
23	23/01/2016
26	26/01/2016
27	27/01/2016
28	28/01/2016
29	29/01/2016
30	30/01/2016
33	2/02/2016
35	4/02/2016
38	7/02/2016
40	9/02/2016
41	10/02/2016
42	11/02/2016
43	12/02/2016
45	14/02/2016
46	15/02/2016
48	17/02/2016
49	18/02/2016
50	19/02/2016
54	23/02/2016
55	24/02/2016
56	25/02/2016
57	26/02/2016
58	27/02/2016
59	28/02/2016
63	3/03/2016
64	4/03/2016
66	6/03/2016
68	8/03/2016
69	9/03/2016
70	10/03/2016
71	11/03/2016
72	12/03/2016
74	14/03/2016
75	15/03/2016
77	17/03/2016
78	18/03/2016
79	19/03/2016
80	20/03/2016
82	22/03/2016
86	26/03/2016
91	31/03/2016
121	30/04/2016
122	1/05/2016
130	9/05/2016
273	29/09/2016
277	3/10/2016
295	21/10/2016
307	2/11/2016
309	4/11/2016
311	6/11/2016
318	13/11/2016
330	25/11/2016
333	28/11/2016
334	29/11/2016
335	30/11/2016
346	11/12/2016
348	13/12/2016
350	15/12/2016

```
351  16/12/2016
358  23/12/2016
363  28/12/2016

                    <END>
```

7.2.2 Baseline values

7.2.2.1 2013

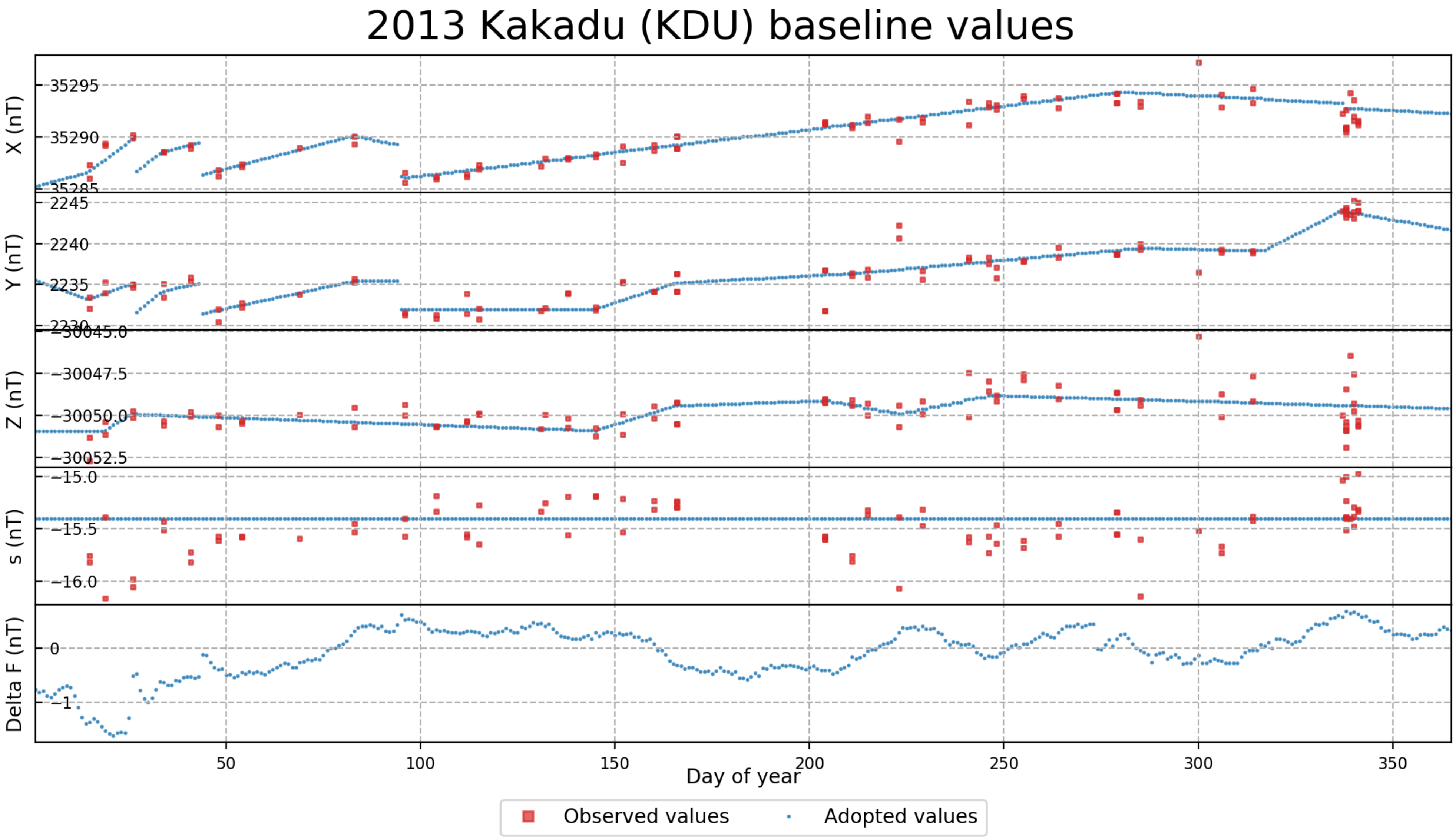

Figure 7.7 Kakadu (KDU) baseline values for 2013. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.2.2.2 2014

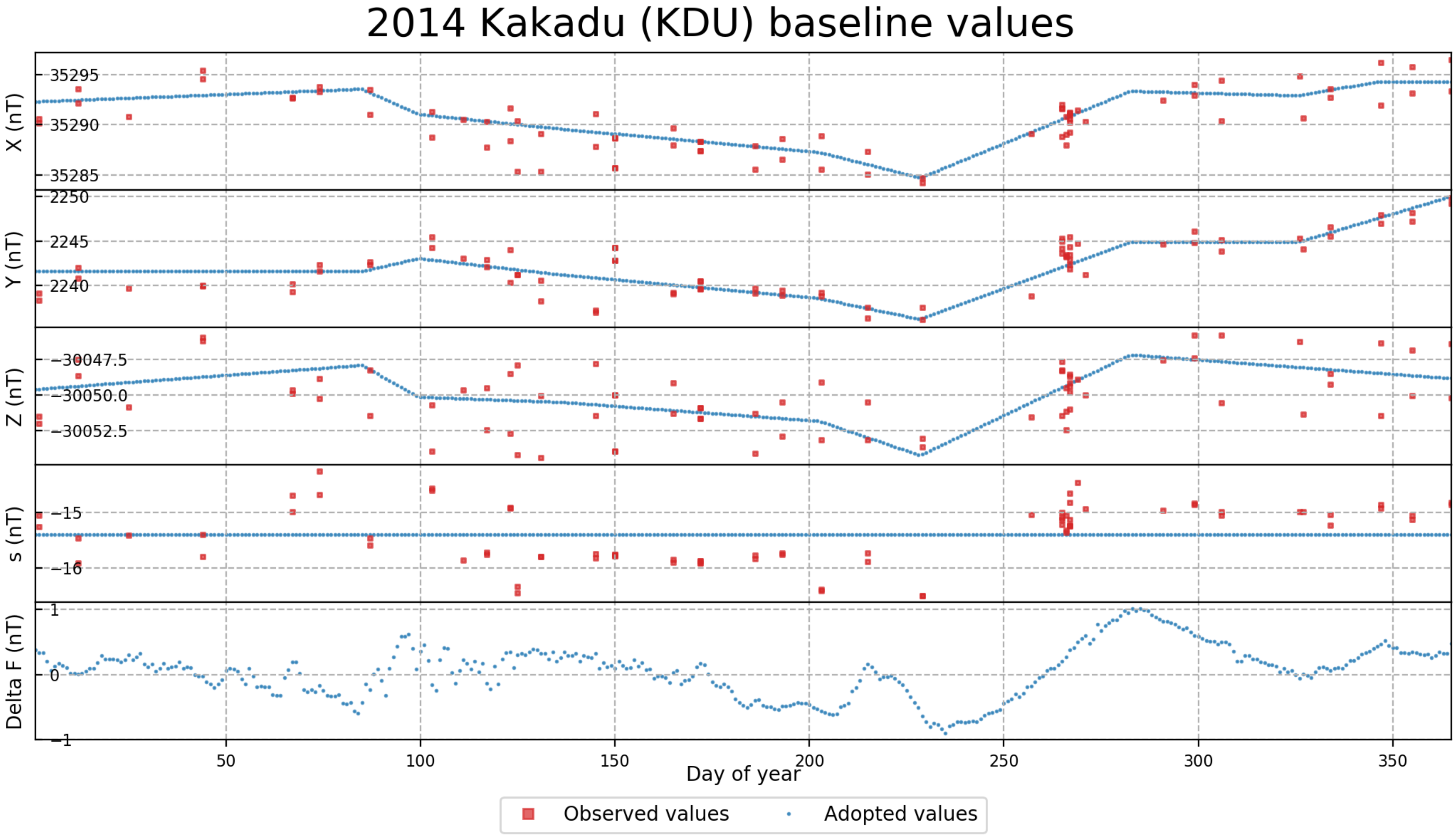

Figure 7.8 Kakadu (KDU) baseline values for 2014. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.2.2.3 2015

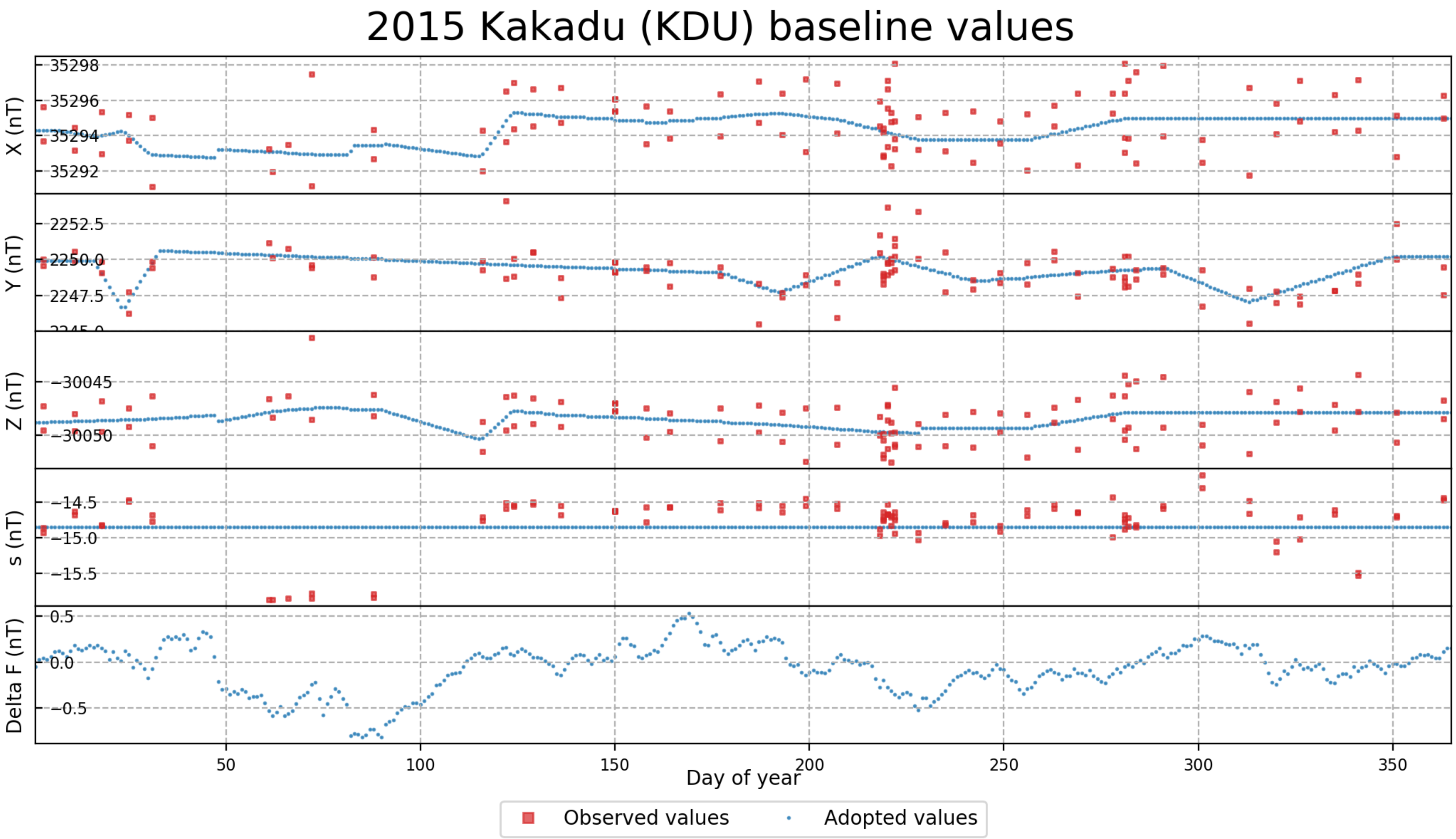

Figure 7.9 Kakadu (KDU) baseline values for 2015. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.2.2.4 2016

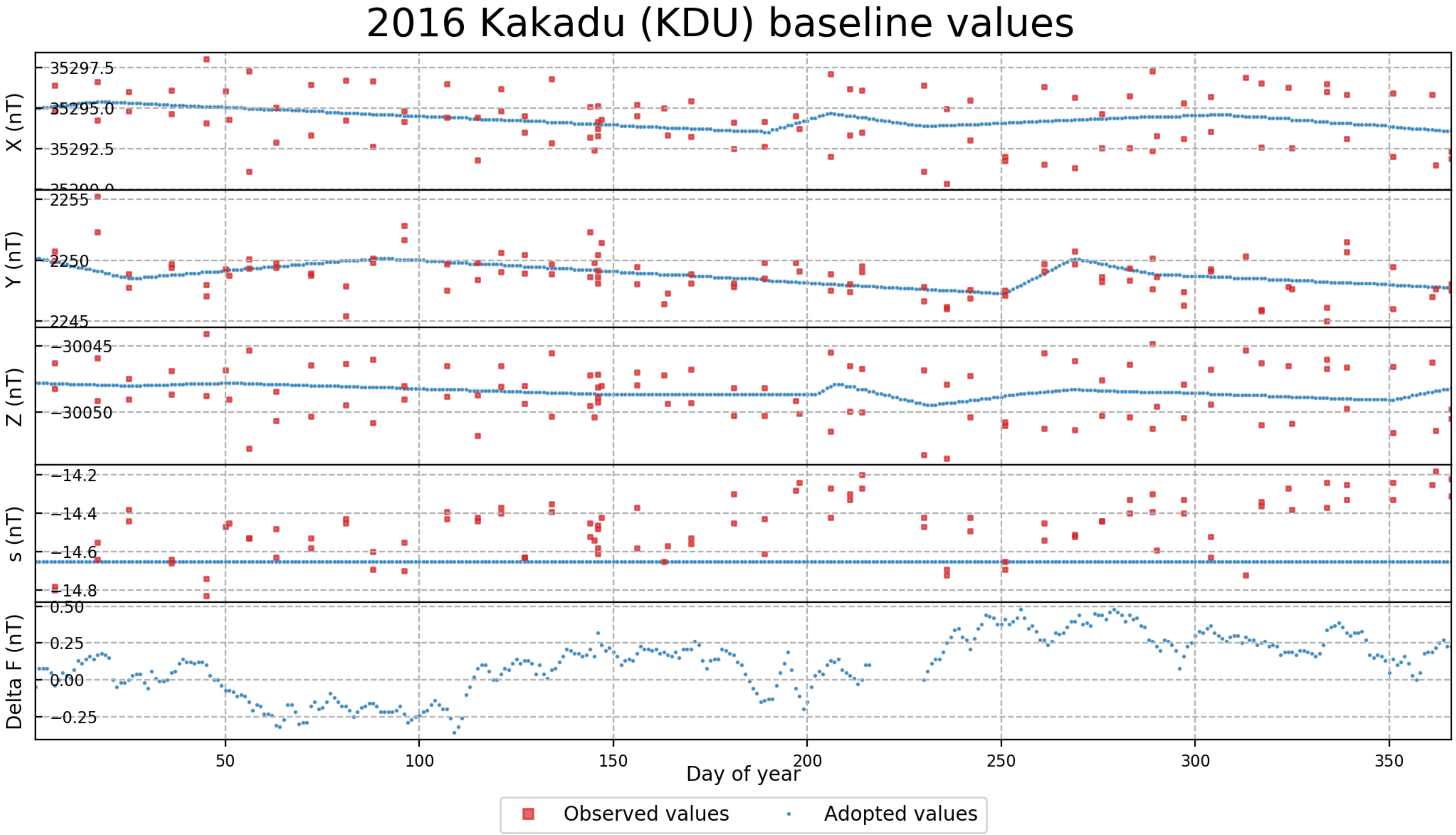

Figure 7.10 Kakadu (KDU) baseline values for 2016. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.2.3 Annual mean values

7.2.3.1 DIH

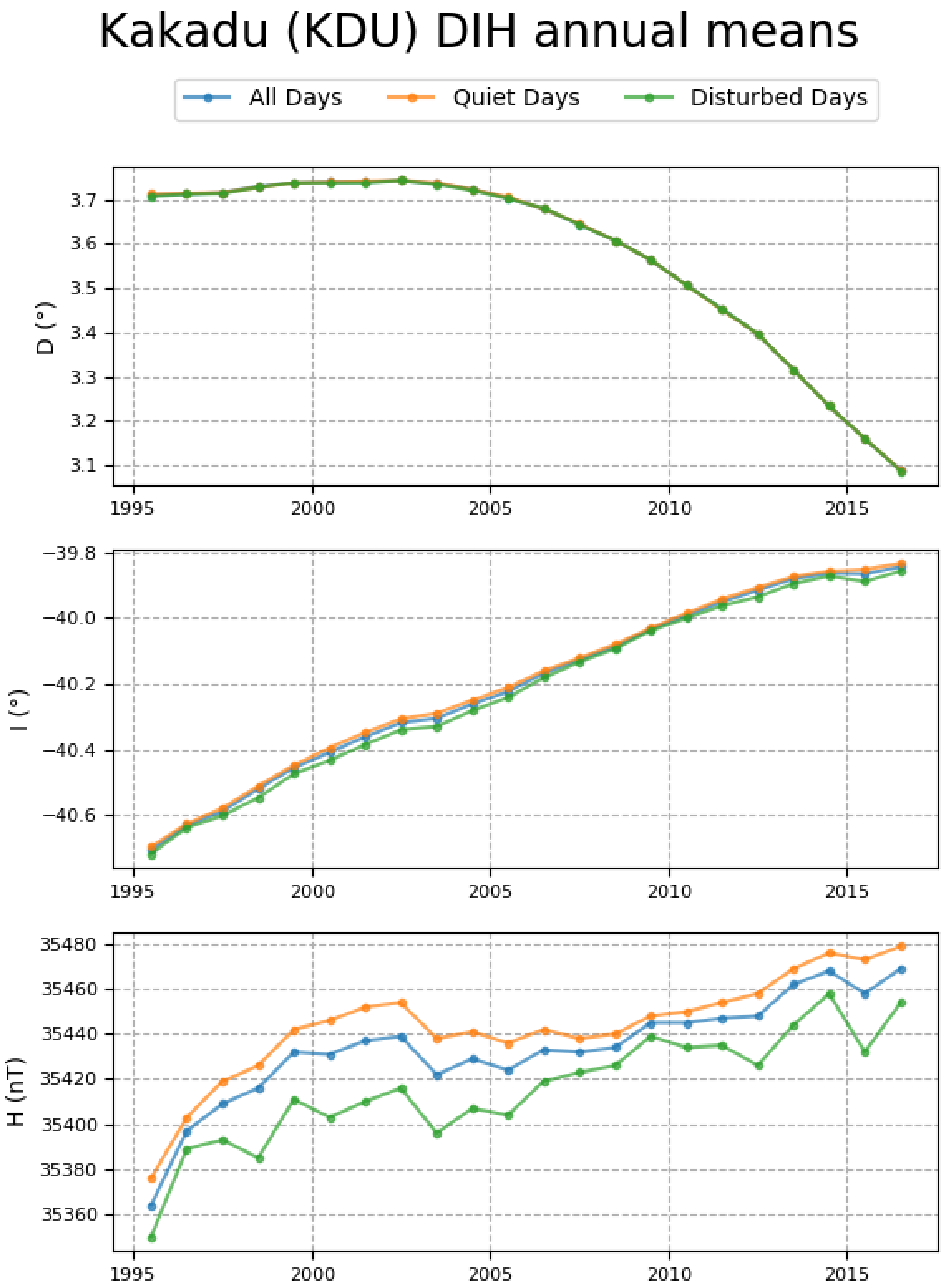

Figure 7.11 Kakadu (KDU) annual mean values in DIH until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.2.3.2 XYZF

Figure 7.12 Kakadu (KDU) annual mean values in XYZF until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.2.3.3 2016 INTERMAGNET annual mean values file

ANNUAL MEAN VALUES

KAKADU, KDU, AUSTRALIA

COLATITUDE: 102.69 LONGITUDE: 132.47 E ELEVATION: 15 metres

YEAR	D Deg	D Min	I Deg	I Min	H nT	X nT	Y nT	Z nT	F nT	*	ELE	Note
1995.500	3	42.6	-40	42.4	35364	35290	2288	-30424	46650	A	ABZ	1
1996.500	3	42.7	-40	37.9	35397	35323	2292	-30373	46642	A	ABZ	
1997.500	3	42.9	-40	35.3	35409	35334	2294	-30336	46626	A	ABZ	
1998.500	3	43.7	-40	31.2	35416	35341	2303	-30269	46589	A	ABZ	
1999.500	3	44.2	-40	27.4	35432	35357	2309	-30216	46566	A	ABZ	
2000.500	3	44.3	-40	24.5	35431	35356	2310	-30163	46531	A	ABZ	
2001.500	3	44.3	-40	21.7	35437	35362	2310	-30118	46507	A	ABZ	
2002.500	3	44.5	-40	19.1	35439	35364	2312	-30075	46480	A	ABZ	
2003.500	3	44.1	-40	18.3	35422	35347	2308	-30046	46449	A	ABZ	
2004.500	3	43.3	-40	15.7	35429	35354	2299	-30005	46428	A	ABZ	
2005.500	3	42.2	-40	13.4	35424	35350	2288	-29960	46395	A	ABZ	
2006.500	3	40.7	-40	10.1	35433	35360	2273	-29910	46370	A	ABZ	
2007.500	3	38.6	-40	7.6	35432	35361	2252	-29864	46339	A	ABZ	
2008.500	3	36.4	-40	5.2	35434	35364	2229	-29823	46314	A	ABZ	
2009.500	3	33.8	-40	2.0	35445	35377	2203	-29777	46293	A	ABZ	
2010.500	3	30.4	-39	59.5	35445	35378	2168	-29732	46263	A	ABZ	
2011.500	3	27.1	-39	57.0	35447	35382	2134	-29690	46238	A	ABZ	2
2012.500	3	23.8	-39	54.9	35448	35386	2100	-29655	46217	A	ABZ	
2013.500	3	18.9	-39	52.8	35462	35402	2050	-29629	46211	A	ABZ	
2014.500	3	14.0	-39	51.8	35468	35412	2000	-29617	46208	A	ABZ	
2015.500	3	9.6	-39	51.9	35458	35404	1954	-29611	46196	A	ABZ	
2016.500	3	5.3	-39	50.6	35469	35418	1911	-29597	46196	A	ABZ	
1995.500	3	42.7	-40	41.8	35376	35302	2290	-30425	46660	Q	ABZ	
1996.500	3	42.8	-40	37.6	35403	35328	2292	-30372	46646	Q	ABZ	
1997.500	3	42.9	-40	34.7	35419	35345	2295	-30335	46634	Q	ABZ	
1998.500	3	43.6	-40	30.7	35426	35351	2303	-30269	46596	Q	ABZ	
1999.500	3	44.2	-40	26.9	35442	35367	2310	-30215	46573	Q	ABZ	
2000.500	3	44.3	-40	23.7	35446	35370	2312	-30161	46541	Q	ABZ	
2001.500	3	44.4	-40	20.9	35452	35376	2312	-30116	46517	Q	ABZ	
2002.500	3	44.5	-40	18.4	35454	35378	2313	-30074	46491	Q	ABZ	
2003.500	3	44.2	-40	17.4	35438	35363	2309	-30043	46459	Q	ABZ	
2004.500	3	43.3	-40	15.0	35441	35366	2301	-30003	46435	Q	ABZ	
2005.500	3	42.3	-40	12.7	35436	35362	2290	-29959	46403	Q	ABZ	
2006.500	3	40.7	-40	9.6	35442	35369	2274	-29909	46376	Q	ABZ	
2007.500	3	38.7	-40	7.3	35438	35367	2253	-29864	46344	Q	ABZ	
2008.500	3	36.4	-40	4.8	35440	35370	2230	-29823	46318	Q	ABZ	
2009.500	3	33.8	-40	1.8	35448	35380	2203	-29776	46295	Q	ABZ	
2010.500	3	30.4	-39	59.1	35450	35384	2168	-29731	46267	Q	ABZ	
2011.500	3	27.0	-39	56.5	35454	35390	2134	-29689	46243	Q	ABZ	2
2012.500	3	23.8	-39	54.4	35458	35395	2100	-29655	46224	Q	ABZ	
2013.500	3	18.9	-39	52.4	35469	35410	2051	-29628	46216	Q	ABZ	
2014.500	3	14.0	-39	51.4	35476	35419	2001	-29616	46213	Q	ABZ	
2015.500	3	9.6	-39	51.1	35473	35419	1955	-29609	46206	Q	ABZ	
2016.500	3	5.3	-39	50.0	35479	35427	1911	-29595	46202	Q	ABZ	
1995.500	3	42.4	-40	43.1	35350	35276	2286	-30426	46641	D	ABZ	
1996.500	3	42.7	-40	38.3	35389	35315	2291	-30373	46636	D	ABZ	
1997.500	3	42.8	-40	36.1	35393	35319	2292	-30337	46615	D	ABZ	
1998.500	3	43.6	-40	32.8	35385	35310	2300	-30273	46568	D	ABZ	

1999.500	3	44.2	-40	28.5	35411	35336	2308	-30218	46552	D	ABZ	
2000.500	3	44.2	-40	26.0	35403	35328	2307	-30166	46512	D	ABZ	
2001.500	3	44.2	-40	23.1	35410	35335	2307	-30121	46488	D	ABZ	
2002.500	3	44.5	-40	20.4	35416	35341	2311	-30077	46464	D	ABZ	
2003.500	3	44.0	-40	19.8	35396	35321	2305	-30050	46431	D	ABZ	
2004.500	3	43.2	-40	16.9	35407	35332	2297	-30008	46412	D	ABZ	
2005.500	3	42.1	-40	14.5	35404	35330	2286	-29963	46381	D	ABZ	
2006.500	3	40.8	-40	10.9	35419	35346	2273	-29911	46359	D	ABZ	
2007.500	3	38.6	-40	8.0	35423	35351	2251	-29865	46332	D	ABZ	
2008.500	3	36.4	-40	5.6	35426	35356	2228	-29824	46308	D	ABZ	
2009.500	3	33.8	-40	2.3	35439	35371	2202	-29777	46288	D	ABZ	
2010.500	3	30.4	-40	0.0	35434	35368	2167	-29733	46256	D	ABZ	
2011.500	3	27.1	-39	57.7	35435	35370	2133	-29692	46230	D	ABZ	2
2012.500	3	23.8	-39	56.1	35426	35364	2099	-29658	46202	D	ABZ	
2013.500	3	18.9	-39	53.7	35444	35385	2049	-29631	46198	D	ABZ	
2014.500	3	14.0	-39	52.3	35458	35401	1999	-29618	46201	D	ABZ	
2015.500	3	9.6	-39	53.3	35432	35378	1953	-29614	46178	D	ABZ	
2016.500	3	5.2	-39	51.4	35454	35402	1909	-29599	46185	D	ABZ	

* A = All days
* Q = 5 International Quiet days each month
* D = 5 International Disturbed days each month

ELE = Elements recorded

Notes:

1. The elements recorded were
    A: magnetic NW
    B: magnetic NE and
    Z: Vertical
   from which the standard magnetic elements were derived.

2. There was a +2nT step in X, and a -2nT step in Z across the 2010-2011 year boundary. See baselines section in 2011 readme file for explanation.

7.3 Charters Towers

7.3.1 INTERMAGNET 'readme' files

7.3.1.1 2013

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                              CTA
           CHARTERS TOWERS OBSERVATORY INFORMATION 2013

ACKNOWLEDGE-  Users of the CTA data should acknowledge:
      -MENTS: Geoscience Australia

  STATION ID: CTA
    LOCATION: CHARTERS TOWERS, Queensland,
              Australia
ORGANISATION: Geoscience Australia

  COLATITUDE: 110 05'25"
   LONGITUDE: 146 15'51"E
   ELEVATION: Above mean sea level (top pier C):370 m

    ABSOLUTE
 INSTRUMENTS: DIM: DI0036/394050
              PPM: GSM90_3091318 sensor 91472
   RECORDING
  VARIOMETER: Non-suspended DMI fluxgate magnetometer
              Proton precession magnetometer.

 ORIENTATION: Magnetic NW, NE and Vertical (ABZ)
     DYNAMIC
       RANGE: +/-1600 nT
  RESOLUTION:    0.032 nT
    SAMPLING
        RATE: 1 second
 FILTER TYPE: Intermagnet

   K-NUMBERS: None
    K9-LIMIT: 300 nT

        GINS: Edinburgh
   SATELLITE: http upload

   OBSERVERS: B.M. Stevenson
              A.M. Lewis

     CONTACT: Geomagnetism Section
              Geoscience Australia
              G.P.O. Box 378
              Canberra, A.C.T., 2601
              Australia

              Tel: + 61-2-6249-9111
              Fax: + 61-2-6249-9986
              e-mail: geomag@ga.gov.au
              WWW: http://www.ga.gov.au/

NOTES:
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Charters Towers is 120 km southwest of Townsville in north Queensland. The Charters Towers magnetic observatory is located at Towers Hill, 1.7 km southwest of the town centre, in an area leased to Geoscience Australia by the Charters Towers Regional Council.

The observatory comprises:

- a disused gold mine adit ("the tunnel") approximately 100 m into the northern side of Towers Hill, which houses the magnetic variometers;
- an absolute shelter on a hillside approximately 150 m to the south-west of the tunnel, and
- a VSAT communications dish outside the tunnel.

Continuous magnetic-field recording commenced at the observatory in June 1983

Key data for the observatory are summarised in Table 1.

IAGA code	: CTA
Commenced operation	: June 1983
Geographic latitude	: 20d 05' 25" S
Geographic longitude	: 146d 15' 51" E
Geomagnetic latitude	: -27.84d
Geomagnetic longitude	: 220.99d
K 9 index lower limit	: 300 nT
Principal pier	: Pier C
Pier elevation (top)	: 370 m AMSL
Principal reference mark	: Post Office spire
Reference mark azimuth	: 34d 40' 45"
Reference mark distance	: 1.75 km
Observer	: B.M. Stephenson

Table 1 Key observatory data.
---------- Geographic coordinates are derived using the Geodetic Datum of Australia 1994 (GDA94)

LOCAL METEOROLOGICAL CONDITIONS

The meteorological temperature at Charters Towers during 2013 varied from a minimum 6 C (2013-06-16) to a maximum 42 C (2013-12-31). Daily minimum temperatures varied from 2 C to 25 C (average 17+/-4 C); daily maximum temperatures varied from 20 C to 42 C (average 31+/-4 C); daily temperature ranges varied from 1 C to 28 C (average 14+/-4 C).

VARIOMETERS

The variometers used during 2013 are described in Table 2.

The vector variometer at the Charters Towers observatory was a DMI FGE non-suspended 3-component fluxgate magnetometer with the sensor mounted on a concrete pillar and orientated magnetic-NW, magnetic-NE, and vertical. Throughout 2013 an overhauser total field magnetometer monitored variations of the magnetic total intensity, F. The total field sensor was mounted on a concrete pillar. Acquisition system timing was derived from a Garmin GPS-16 clock and is discussed

further below.
Although not temperature controlled, the temperature within the tunnel where the variometer sensors and electronics were located varied over a range of 2 degrees Celsius throughout the year, the temperature of the fluxgate sensor ranged from about 26.5 C in (Jul-Aug) to about 28.3 C in March. There was no discernible diurnal temperature variation.
The data acquisition system (except the DMI fluxgate magnetometer and GSM90 total field magnetometer electronics) was housed in an air-conditioned room in an adjacent arm of the tunnel. The data acquisition computer was upgraded in February 2013.
Sub nanoTesla interference between the total field and fluxgate data during the total field polarisation cycles of the overhauser magnetometer (6 times per minute) continues to be a problem at the observatory.
There were several short periods of disturbance to the variometer data during 2013. Periods of contaminated data were removed from the one-second fluxgate and ten-second PPM data. Data were also spike filtered using an automatic de-spiking algorithm.
The definitive one-minute data were calculated from these de-spiked data. Data loss from the one-minute data set is detailed below.

3-component variometer	: DMI FGE (Version G)
Serial number	: E0227/S0210
Type	: non-suspended; linear fluxgate
Orientation	: magnetic NW, NE, Z
Acquisition interval	: 1 s
Resolution	: 0.032 nT
A/D converter	: ADAM 4017 module (+/-5V)
Total-field variometer	: GEM Systems GSM 90
Serial number	: 4081420/42178
Type	: Overhauser effect
Acquisition interval	: 10 s
Resolution	: 0.01 nT
Data acquisition system	: GDAP
	: PC-104 computer, QNX OS
Timing	: Garmin GPS16 clock
Communications	: VSAT TCP/IP network

Table 2 Magnetic variometers.

VARIOMETER CLOCK CORRECTIONS

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During the first months of 2013 the timing control system performed poorly, with many corrections, some up to 1 second in magnitude. The problem was caused by a faulty GPS clock. The faulty GPS clock was replaced in February 2013. Automatic adjustments to the system clock were greater than 1 ms on the following occasions:

2013-01-05	17:43:13	0.001 s
	22:01:03	0.001 s
	22:11:04	-0.001 s

	22:51:54	0.001 s
2013-01-06	06:51:02	-0.001 s
	12:41:03	-0.001 s
	13:05:21	0.001 s
	14:31:04	-0.001 s
	14:43:59	-0.002 s
	15:01:04	0.001 s
	15:11:03	-0.001 s
	16:43:54	-0.001 s
	17:01:47	0.002 s
	17:12:32	-0.001 s
	17:51:47	0.002 s
	18:12:31	-0.001 s
	19:11:46	0.001 s
	19:21:04	-0.001 s
	20:22:31	0.003 s
	20:31:04	-0.001 s
	21:11:46	0.001 s
	21:31:47	0.001 s
	21:41:03	0.001 s
	21:51:47	-0.001 s
	22:52:32	-0.001 s
2013-01-07	00:32:30	-0.001 s
	01:06:06	0.001 s
	03:01:49	-0.001 s
	03:22:29	0.001 s
	04:34:08	0.001 s
	05:21:04	-0.001 s
	05:33:13	0.001 s
	05:41:46	-0.002 s
	06:11:03	0.001 s
	06:31:04	-0.002 s
	08:01:47	0.001 s
	08:12:32	0.002 s
	09:01:07	-0.001 s
	09:42:29	-0.001 s
	10:01:02	-0.001 s
	10:11:03	0.001 s
	10:36:14	-0.002 s
	10:51:48	-0.001 s
	11:01:06	0.001 s
	11:21:04	-0.001 s
	11:51:02	0.002 s
	12:01:46	-0.001 s
	12:31:49	-0.004 s
	13:14:01	0.002 s
	14:04:03	0.002 s
	15:21:04	0.002 s
	15:41:03	-0.001 s
	16:01:03	0.002 s
	16:12:29	0.001 s
	17:11:04	-0.001 s
	18:21:47	0.001 s
	18:51:04	0.001 s
	19:11:04	-0.002 s
	19:51:04	-0.001 s
	20:11:48	-0.001 s
	20:22:32	0.001 s
	20:51:46	-0.001 s
	22:31:07	-0.001 s
	23:51:03	-0.001 s

	23:51:03	-0.001	s
2013-01-08	01:01:47	0.001	s
	01:11:49	0.001	s
	01:32:32	-0.001	s
	02:13:14	-0.003	s
	02:32:29	-0.001	s
	02:41:04	0.001	s
	03:11:03	0.001	s
	04:21:46	0.003	s
	04:31:46	0.001	s
	05:31:51	0.001	s
	06:01:47	0.001	s
	06:13:15	-0.002	s
	06:42:30	0.001	s
	07:01:47	0.002	s
	07:11:47	0.002	s
	07:41:03	-0.001	s
	08:13:13	0.002	s
	08:41:03	0.001	s
	11:01:04	0.001	s
	12:01:47	0.001	s
	12:31:46	0.001	s
	13:28:31	-0.001	s
	13:41:47	0.001	s
	14:01:03	-0.001	s
	14:31:03	0.001	s
	15:01:03	0.002	s
	15:11:05	0.002	s
	15:22:30	-0.001	s
	16:01:04	0.001	s
	16:11:47	-0.001	s
	18:43:13	-0.002	s
	19:31:46	0.002	s
	19:51:03	0.001	s
	20:01:46	-0.002	s
	20:11:03	0.001	s
	21:52:28	0.001	s
	22:41:04	0.002	s
	23:52:30	0.002	s
	23:52:30	0.002	s
2013-01-09	00:32:30	-0.001	s
	00:52:29	-0.001	s
	01:12:30	0.001	s
	01:41:03	0.001	s
	01:51:46	0.001	s
	02:01:46	0.002	s
	02:12:31	-0.001	s
	02:21:46	0.001	s
	02:41:47	-0.001	s
	02:51:04	0.001	s
	03:31:47	0.001	s
	04:21:46	0.001	s
	04:31:04	0.002	s
	04:42:29	0.001	s
	04:53:15	0.001	s
	05:21:47	0.002	s
	05:41:06	0.002	s
	05:52:30	0.002	s
	06:06:10	0.001	s
	06:31:46	-0.001	s
	06:41:04	-0.001	s

	07:41:03	0.001 s
	08:21:46	0.002 s
	08:48:21	-0.003 s
	09:32:32	-0.002 s
	09:43:57	0.003 s
	10:25:25	0.001 s
	11:32:08	-0.001 s
	11:51:48	0.001 s
	12:12:31	0.001 s
	12:21:04	-0.001 s
	13:11:03	0.002 s
	13:31:03	-0.002 s
	14:41:04	-0.001 s
	15:01:04	0.001 s
	15:21:04	0.001 s
	15:32:29	0.001 s
	16:01:47	-0.001 s
	16:21:04	0.001 s
	20:01:03	0.002 s
	20:31:03	-0.002 s
	23:41:48	-0.001 s
	23:41:48	-0.001 s
2013-01-10	01:45:27	0.001 s
	03:31:03	0.002 s
	05:31:47	0.002 s
	05:42:31	0.001 s
	05:51:03	0.001 s
	07:31:03	-0.001 s
	07:41:03	-0.001 s
	08:02:31	-0.001 s
	08:33:57	-0.003 s
	09:11:54	-0.001 s
	10:12:50	0.003 s
2013-01-11	23:43:57	0.008 s
2013-01-12	03:52:09	0.001 s
	23:02:59	1.005 s
2013-01-13	16:35:56	-1.000 s
	17:11:03	1.000 s
	17:30:39	-1.000 s
	17:53:51	1.000 s
	20:35:14	-1.000 s
	21:14:33	1.000 s
	21:52:10	-1.000 s
	22:11:05	1.000 s
	22:25:15	-1.000 s
	22:31:03	1.000 s
2013-01-14	02:02:27	-1.000 s
	02:08:04	1.000 s
	02:15:22	-1.000 s
	02:42:01	1.000 s
	06:21:44	-1.000 s
	06:54:25	1.000 s
	11:51:45	-1.000 s
	12:38:45	1.000 s
	13:36:25	-1.000 s
	14:35:57	1.000 s
	14:57:41	-1.000 s
	23:31:02	1.000 s
	23:51:04	-1.000 s
	23:31:02	1.000 s
	23:51:04	-1.000 s

2013-01-15	03:04:21	1.000	s
	03:10:12	-1.000	s
	03:59:15	1.000	s
	04:45:23	-1.000	s
	04:53:49	1.000	s
	06:01:04	-1.000	s
	08:45:59	1.000	s
	08:54:32	-1.000	s
2013-01-22	01:43:56	0.001	s
	14:11:44	-0.001	s
	15:43:14	0.003	s
	15:51:50	0.001	s
	16:01:05	0.001	s
	16:21:04	-0.001	s
	16:31:05	-0.001	s
	16:41:49	0.002	s
	16:51:05	-0.001	s
	17:01:48	-0.002	s
	17:22:32	-0.001	s
	17:43:12	-0.001	s
	18:01:03	0.001	s
	18:21:03	0.001	s
	20:01:46	0.001	s
	20:21:04	0.001	s
	21:03:14	-0.002	s
	21:51:48	-0.002	s
	22:01:04	-0.002	s
	23:41:03	-0.001	s
	23:41:03	-0.001	s
2013-01-23	01:31:03	0.002	s
	01:51:03	-0.002	s
	02:01:47	0.001	s
	06:21:47	0.001	s
	08:51:04	0.001	s
	10:11:04	0.001	s
	11:22:30	0.001	s
	11:32:31	-0.001	s
	11:52:28	0.002	s
	12:02:30	0.001	s
	12:11:48	-0.001	s
	12:21:47	0.001	s
	13:16:45	-0.002	s
	13:51:48	0.002	s
	14:01:46	0.001	s
	14:08:20	-0.001	s
	14:47:45	-0.002	s
	15:12:31	-0.003	s
	15:35:25	0.002	s
	15:51:05	-0.001	s
	16:51:04	-0.002	s
	17:22:30	0.002	s
	17:51:03	0.001	s
	18:41:03	0.001	s
	18:51:47	0.002	s
	19:53:14	-0.001	s
	20:03:17	0.001	s
	20:21:04	0.002	s
	20:31:46	0.002	s
	21:32:32	0.001	s
	22:41:04	0.001	s
	23:31:03	0.001	s

	23:31:03	0.001	s
2013-01-24	00:01:04	0.001	s
	00:31:09	-0.001	s
	01:01:49	0.001	s
	01:21:09	0.001	s
	01:41:47	0.001	s
	01:52:32	-0.001	s
	02:21:04	0.001	s
	02:33:13	-0.001	s
	02:41:48	0.002	s
	03:11:03	0.001	s
	03:21:03	-0.001	s
	03:41:04	0.001	s
	04:11:03	-0.001	s
	04:31:46	-0.001	s
	05:21:03	0.001	s
	05:41:04	0.001	s
	05:51:03	0.001	s
	06:13:15	0.003	s
	06:41:47	0.002	s
	07:01:04	0.002	s
	07:13:19	0.002	s
	08:23:55	-0.004	s
	08:51:10	-0.001	s
	09:34:01	-0.002	s
	10:13:13	0.001	s
	10:51:46	0.002	s
	11:01:03	-0.001	s
	11:52:32	-0.001	s
	12:01:03	0.002	s
	12:41:04	0.001	s
	12:51:47	0.002	s
	13:33:17	0.001	s
	15:01:03	0.004	s
	15:21:46	0.001	s
	15:31:09	-0.001	s
	15:43:12	0.001	s
	16:21:52	0.001	s
	18:11:05	-0.001	s
	19:16:09	0.002	s
	19:31:04	0.001	s
	19:51:48	-0.001	s
	20:51:03	-0.002	s
	21:11:04	0.002	s
	21:41:05	0.002	s
	22:35:32	0.002	s
	22:51:04	-0.001	s
	23:02:35	0.001	s
	23:21:46	-0.002	s
	23:21:46	-0.002	s
2013-01-25	00:31:04	0.002	s
	00:41:10	0.002	s
	01:32:37	-0.002	s
	02:03:14	0.002	s
	02:12:30	-0.002	s
	02:51:46	-0.001	s
	02:57:37	-0.001	s
	03:21:03	0.002	s
	03:53:12	0.002	s
	05:31:05	0.001	s
	05:41:52	0.002	s

	06:01:03	0.002 s
	06:11:05	-0.001 s
	07:01:47	0.001 s
	07:51:03	0.001 s
	08:01:04	0.001 s
	08:21:48	0.003 s
	08:31:03	0.001 s
	08:51:03	0.001 s
	09:01:54	-0.002 s
	09:31:47	0.001 s
	10:01:03	-0.001 s
	10:11:50	0.001 s
	10:41:09	-0.001 s
	10:57:01	-0.002 s
	11:11:03	-0.002 s
	12:12:33	-0.001 s
	22:51:04	0.001 s
	23:31:03	0.002 s
	23:31:03	0.002 s
2013-01-26	00:21:04	0.001 s
	00:31:04	0.001 s
	03:01:46	0.002 s
	03:41:04	-0.001 s
	05:11:04	-0.001 s
	06:52:33	0.002 s
2013-01-27	13:51:30	0.002 s
	22:17:50	-0.002 s
2013-01-29	00:52:24	1.009 s
	15:37:21	-1.000 s
	16:21:45	1.000 s
	16:30:08	-1.000 s
	16:48:04	1.000 s
	16:52:22	-1.000 s
	17:20:09	1.000 s
	19:33:09	-1.000 s
	21:10:53	1.000 s
2013-01-30	01:07:08	-1.000 s
	01:39:01	1.000 s
	10:52:27	-1.000 s
	13:32:57	1.000 s
	14:56:39	-1.000 s
	21:50:51	1.000 s
	22:25:14	-1.000 s
	22:30:23	1.000 s
	22:51:44	-1.000 s
	23:01:06	1.000 s
	23:25:39	-1.000 s
2013-01-31	00:14:53	1.000 s
	00:38:00	-1.000 s
	01:56:40	1.000 s
	02:03:53	-1.000 s
	02:30:11	1.000 s
	04:11:49	-1.000 s
	04:25:50	1.000 s
	04:52:28	-1.000 s
	05:53:10	1.000 s
	07:50:09	-1.000 s
2013-02-06	15:31:03	0.001 s
	16:31:03	0.002 s
2013-02-07	12:51:02	0.001 s
	14:21:03	0.001 s

```
            16:31:03  0.001 s
            16:52:31 -0.002 s
            18:51:46  0.001 s
            19:24:43  0.002 s
            19:31:47  0.001 s
            19:41:03  0.001 s
            23:01:05 -0.002 s
            23:11:52  0.001 s
            23:31:47  0.002 s
            23:31:47  0.002 s
2013-02-08  00:01:05 -0.002 s
            00:11:04  0.002 s
            00:21:04  0.002 s
            00:41:05  0.002 s
            01:36:17  0.002 s
            02:04:08  0.004 s
            02:31:48 -0.002 s
            02:51:04  0.001 s
            03:27:32  0.004 s
            04:41:05 -0.001 s
            05:01:49  0.002 s
            05:12:30  0.002 s
            05:51:49  0.001 s
            06:01:04  0.001 s
            06:21:52  0.002 s
            07:51:47  0.001 s
            08:01:03  0.001 s
            08:11:46 -0.001 s
            09:02:31 -0.002 s
            09:13:11  0.003 s
            09:41:05 -0.001 s
            09:52:31 -0.001 s
            10:11:05 -0.001 s
            10:56:09  0.001 s
            11:21:04  0.001 s
            11:52:32  0.002 s
            12:21:47 -0.001 s
            12:32:29  0.001 s
            13:52:32  0.001 s
            14:22:31  0.002 s
            14:51:04 -0.001 s
            15:31:04  0.002 s
            15:43:18  0.001 s
            16:41:04  0.001 s
            16:51:04 -0.001 s
            17:41:03  0.001 s
            17:51:03  0.002 s
            18:01:04 -0.001 s
            18:31:03  0.001 s
            19:11:03 -0.002 s
            19:42:29  0.002 s
            19:51:47  0.001 s
            20:01:04 -0.001 s
            20:33:17  0.001 s
            20:51:47  0.002 s
            21:01:03  0.002 s
            21:12:31 -0.002 s
            21:41:50  0.001 s
            22:41:04  0.001 s
            23:11:46  0.001 s
            23:21:46  0.002 s
```

	23:45:22	0.003	s
	23:21:46	0.002	s
	23:45:22	0.003	s
2013-02-09	00:03:19	0.001	s
	00:21:46	-0.002	s
	00:33:16	-0.002	s
	00:51:46	-0.002	s
	01:01:03	0.001	s
	01:11:46	0.001	s
	01:41:03	0.001	s
	03:41:03	0.002	s
	03:51:03	0.001	s
	04:12:29	-0.001	s
	04:52:30	-0.002	s
	05:03:11	0.002	s
	05:31:05	0.002	s
	05:41:46	-0.001	s
	06:32:28	0.002	s
	07:11:46	0.002	s
	07:51:46	-0.001	s
	08:01:47	-0.001	s
	08:21:05	-0.001	s
	08:41:06	0.002	s
	09:01:47	0.001	s
	09:21:48	-0.001	s
	09:31:05	0.001	s
	09:41:03	-0.002	s
	11:01:47	-0.002	s
	11:21:46	-0.001	s
	11:41:03	0.001	s
	11:52:31	-0.002	s
	12:12:31	0.001	s
	12:32:30	0.001	s
	13:01:03	-0.001	s
	13:15:26	0.002	s
	13:31:05	0.001	s
	14:02:32	0.002	s
	14:11:05	0.001	s
	18:21:03	-0.001	s
	18:41:03	0.001	s
	18:51:03	0.002	s
	21:21:04	-0.002	s
	21:34:40	-0.001	s
	22:02:31	0.002	s
	22:11:03	0.001	s
	22:31:03	0.001	s
	22:51:03	0.001	s
2013-02-10	00:42:29	0.002	s
	01:21:03	0.001	s
	01:54:41	-0.003	s
	02:51:04	0.001	s
	03:01:47	-0.002	s
	03:31:04	-0.002	s
	03:41:04	-0.001	s
	03:56:11	0.003	s
	04:51:03	0.001	s
	05:01:03	-0.002	s
	05:13:17	0.002	s
	05:42:29	0.001	s
	06:01:47	0.002	s
	06:11:47	0.002	s

```
              06:21:46 -0.002 s
              06:33:59 -0.002 s
              06:51:03  0.002 s
              08:11:04  0.002 s
              08:31:05 -0.001 s
              09:31:47  0.001 s
              11:12:32 -0.001 s
              11:41:03  0.001 s
              13:11:03  0.001 s
              13:52:30 -0.002 s
              21:41:05 -0.001 s
              22:21:03 -0.001 s
2013-02-11    05:31:04 -0.001 s
              05:41:48 -0.001 s
              06:46:50 -0.002 s
              07:11:04  0.001 s
              08:01:04  0.002 s
              15:57:19 -0.001 s
2013-02-12    03:07:27  0.333 s
              03:34:42 -0.933 s
              03:48:21  0.169 s
              04:15:27  0.636 s
              05:02:46  0.932 s
              21:07:45  0.003 s
2013-02-14    01:04:40 -0.001 s
              01:40:41  1.000 s
2013-03-15    00:23:15 -0.022 s
2013-08-01    18:14:16  1.186 s
2013-08-12    02:14:46  0.006 s
              02:24:39 -1.000 s
2013-09-26    06:13:57  0.849 s
```

ABSOLUTE INSTRUMENTS

The principal absolute magnetometers used at CTA and their adopted corrections for 2013 are described in Table 3.

```
DI fluxgate                : DMI
Serial number              : DI0036
Theodolite                 : Zeiss 020B
Serial number              : 394050
Resolution                 :  0.1
D correction               :  0.0
I correction               : -0.2
Total-field magnetometer   : GEM Systems GSM90
Serial number              : 3091318/91472
Type                       : Overhauser effect
Resolution                 : 0.01 nT
Correction                 : 0.0 nT
```

```
Table 3      Absolute magnetometers
----------   and their adopted corrections for 2013.
             Instrument corrections are applied in the
             sense Standard = Instrument + correction.
```

The variometers at CTA were calibrated nominally weekly with a pair of absolute observations. Both absolute PPM and DIM observations were performed on Pier C in the Absolute Shelter. On-site recording of absolute observation data was upgraded from pen and paper to

a tablet PC in February 2013.
The principal absolute magnetometers used and their adopted corrections for 2013 are described in Table 3. The D and I corrections applied in 2013 were determined through instrument comparisons performed during maintenance and calibration visits, most recently in February 2013. Instrument corrections are to the international reference. At the 2013 all-day mean field levels at Charters Towers these D. I and F corrections convert to:

X: -2.2nT Y: -0.3 nT Z: -1.9 nT

These instrument corrections have been applied to data throughout 2013.

BASELINES

Derivation of final baseline parameters for the fluxgate variometer was done by manual fitting a piece-wise linear function, including steps as required, to the weekly observed absolute observations baseline residuals. There were 54 pairs of absolute observations. The DMI E0227/S0210 variometer performed well throughout 2013. The baseline drifts had a range of about 4 nT in the X, Y and Z components throughout the year.
The standard deviations in the difference between the weekly absolute observations and the final adopted vector variometer model and data were:

X	0.5 nT	D	04"
Y	0.7 nT	I	03"
Z	0.4 nT	F	0.2 nT

Throughout the year the difference between the total field derived from the CTA vector variometer and the total field measured with the CTA scalar variometer varied over a range of about 1.5 nT.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2013 CTA definitive data and real time reported 1-minute data-sets (CTA definitive - CTA real time) were:

	X	Y	Z
Average	-0.6	-0.2	-0.1
Std.dev	0.9	0.8	1.0
Min	-2.1	-1.5	-2.0
Max	+1.1	+0.5	+1.4

The CTA 2013 reported real time data are within the specification for INTERMAGNET quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.
The annual statistics of the 12 monthly averages of the difference between the 2013 CTA definitive data and quasi-definitive 1-minute data sets (CTA definitive - CTA quasi-definitive) were:

	X	Y	Z
Average	-0.1	0.1	0.7

Std.dev	0.2	0.4	0.3
Min	-0.5	-0.7	0.3
Max	+0.3	+0.5	1.1

The CTA 2013 quasi-definitive data are within the specification for INTERMAGNET quasi-definitive data.

OPERATIONS

The on-site observer-in-charge at CTA observatory, Mr Brad Stevenson, performed weekly absolute observations and checks.
Analogue outputs from the DMI FGE 3-channel fluxgate, as well as the fluxgate sensor and electronics temperature channels, were digitized with an ADAM 4017 A/D converter mounted inside the DMI electronics console. Data were recorded at 1 second intervals in the components A (NW), B (NE) and Z as well as the DMI variometer sensor and electronics temperatures. These digital data were recorded on an acquisition computer running the Gdap data acquisition system in a QNX operating system. The acquisition system was upgraded from a Wafer 5823 single-board-computer (sbc) running QNX6.3 to an ARK3360F sbc running QNX6.5 in February 2013.
The data acquisition software (Gdap) was also upgraded at this time.
The digital data from the PPM variometer, cycling once every 10 seconds, were recorded on the acquisition computer. Data files were telemetered from CTA to Geoscience Australia in Canberra through a VSAT TCP/IP network. Data transfer delay time was between 2 to 15 minutes. Both one-second fluxgate and ten-second total field variometer data sets were run through a de-spiking filter before calculating definitive and quasi-definitive one-minute averages using the standard 90-second Intermagnet Gaussian filter for the fluxgate data and a 60-second box-car filter for the total field data.
The system was powered by a 12 V battery-backed supply which also powered the Charters Towers seismic observatory.
The 240 V AC DMI fluxgate electronics was powered with a dedicated inverter running from the 12 V seismic system.
Acquisition system timing control was provided by a Garmin GPS16 clock. In the first months of 2013 there were a significant number of system timing corrections with a magnitude greater than 1 ms, including numerous corrections with a magnitude of 1 s. These have degraded the timing accuracy of the data until mid February 2013 when the GPS clock was replaced.
The distribution of Charters Towers 2013 data is described in Table 4. Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au). Data losses are identified below.

Recipient	Status	Sent
1-second values		
IPS Radio and Space Services	reported	realtime
INTERMAGNET	reported	hourly
1-minute values		
INTERMAGNET	reported	realtime
INTERMAGNET	reported	daily

```
INTERMAGNET                     definitive      July 2014
INTERMAGNET                     quasidefintive  quarterly
WDC for Geomagnetism (Japan)    reported        realtime

Table 4  Distribution of Charters Towers 2013 data.
---------

SIGNIFICANT EVENTS
------------------
2013-02-09   Final observation recorded on paper
2013-02-11   Data contamination during maintenance
2013-02-12   Replace Wafer5823 acquisition computer with
             ARK3360, QNX6.5 using RS485 for DMI data.
             Replace GPS clock. Introduce Getac E110
             for absolute observations.  DIM comparisons
             and tests, PPM test and local survey,
             Round of angles, observations, observer
             training. All obs from today done using Getac
             tablet device
2013-02-16   First observation by Brad using Getac E110.
2013-02-19   Replacement 24 V absolute battery box charger
             sent to CTA
2013-03-15   Noticed GdapClockGm could not connect to NMEA
             Apparently had not been working since 7 March
             Slay/Restarting using rc.clock didn't work
             used qtalk and p232 dtr of 0x2f8 in another
             window, and the clock came alive
             Then restarted rc.clock and it was OK
             2013-03-15 00:23:15.1 N Gm Adj by -21696783 nS
2013-06-14   Spikes/contamination in XYZ and F data
2013-08-12   GdapClockGm could not connect to NMEA data
             Last Correction recorded :
             2013-07-01 23:59:42.0 N Gm Adj by -788 nS
             slay GdapClockGm and /etc/rc.d/rc.clock ...
             02:14:46.0 N Gm Adj by 6211172 nS
2013-08-27   22:29:40.6 D1 Gm NMEA Re/open Clock failed
2013-08-28   2013-08-28 02:26:06.5 I Gm Started
             2013-08-28 02:26:11.3 D1 Gm NMEA Re/open
             2013-08-28 02:27:31.0 N Gm Adj by -47908 nS
2013-09-09   11:18:40.5 GdapClockGM failed
2013-09-10   00:50 restart GdapClockGm
2013-09-13   restart GdapClockGM
             02:58:17.0 N Gm Adj by 340799 nS
2013-09-24   07:55:40.5 D1 Gm NMEA Re/open
2013-09-24   07:56:03.9 GdapClockGm failed
2013-09-25   01:47:44.1 N Gm Adj by -238700  nS
2013-09-26   01:46 Stop/restart GdapClockGM no improvement
             Slay again, check with qtalk - no NMEA data
             p232 dtr of 0x2f8  check with qtalk NMEA OK
             restart 01:54 - still no luck ,
             try p232 dtr of 0x2f8 a few times
             01:58 slay again
             02:07 Reboot system no improvement
2013-10-14   03:00 - 03:20 Fire extinguishers checked,
             Light bulb changed  in tunnel
2013-11-27   08:16:00 Instantaneous jump in Z channel
2013-12-31   Restart GdapClockGm after few days of failure

K INDICES
----------
No magnetic indices are routinely scaled for the
```

```
Charters Towers Observatory.

ANNUAL MEAN VALUES
------------------
The annual mean values for Charters Towers are available in
the file "yearmean.cta" and graphically through the
IMCDView software.

HOURLY MEAN VALUES
------------------
Plots of hourly mean values for Charters Tower are
available through the IMCDView software.

DATA LOSSES
----------
Variometer data XYZ:
2013-02-11    XYZ     21:23 - 21:24  (2)
2013-02-11    XYZ     23:59 - 23:59  (1)
2013-02-12    XYZ     04:28 - 05:02  (35)
2013-06-14    XYZ     04:45 - 04:48  (4)
2013-06-14    XYZ     05:17 - 05:19  (3)
2013-06-14    XYZ     07:33 - 07:36  (4)
2013-06-14    XYZ     09:18 - 09:20  (3)
2013-09-26    XYZ     02:06 - 02:08  (3)
2013-10-14    XYZ     04:09 - 04:13  (5)

Total: 60

2013-02-12    F      00:43 - 05:01  (259)
2013-02-12    F      21:34 - 21:35  (2)
2013-06-14    F      04:46 - 04:48  (3)
2013-06-14    F      05:18 - 05:19  (2)
2013-06-14    F      07:34 - 07:36  (3)
2013-06-14    F      09:19 - 09:20  (2)
2013-09-26    F      02:07 - 02:07  (1)
2013-10-14    F      04:10 - 04:12  (3)

Total: 275
                   < END>
```

7.3.1.2 2014

```
                           CTA
          CHARTERS TOWERS OBSERVATORY INFORMATION 2014

ACKNOWLEDGE-  Users of the CTA data should acknowledge:
      -MENTS: Geoscience Australia

  STATION ID: CTA
    LOCATION: CHARTERS TOWERS, Queensland,
              Australia
ORGANISATION: Geoscience Australia

 CO-LATITUDE: 110.090
   LONGITUDE: 146.264
   ELEVATION: 370 m Above mean sea level (top pier C)

    ABSOLUTE
 INSTRUMENTS: DIM: DI0036/394050 (to 2014-05-26)
                   DI0036D/394050 with Pico ADC16
```

```
                        #GJY03/100 (from 2014-05-26)
                PPM: GSM90_3091318 sensor 91472
   RECORDING
  VARIOMETER: Non-suspended DMI fluxgate magnetometer
              Proton precession magnetometer.

 ORIENTATION: Magnetic NW, NE and Vertical (ABZ)
     DYNAMIC
       RANGE: +/-1600 nT
  RESOLUTION:    0.032 nT
    SAMPLING
        RATE: 1 second
 FILTER TYPE: Intermagnet

   K-NUMBERS: None
    K9-LIMIT: 300 nT

        GINS: Edinburgh
   SATELLITE: http upload

   OBSERVERS: B.M. Stevenson
              A.M. Lewis

     CONTACT: Geomagnetism Section
              Geoscience Australia
              G.P.O. Box 378
              Canberra, A.C.T., 2601
              Australia

              Tel: + 61-2-6249-9111
              Fax: + 61-2-6249-9986
              e-mail: geomag@ga.gov.au
              WWW: http://www.ga.gov.au/

NOTES:
-----
Charters Towers is 120 km southwest of
Townsville in north Queensland. The Charters Towers
magnetic observatory is located at Towers Hill, 1.7 km
southwest of the town centre, in an area leased to
Geoscience Australia by the Charters Towers Regional
Council.
The observatory comprises:
  - a disused gold mine adit ("the tunnel") approximately
    100 m into the northern side of Towers Hill, which
    houses the magnetic variometers;
  - an absolute shelter on a hillside approximately 150 m
    to the south-west of the tunnel, and
  - a VSAT communications dish outside the tunnel.

Continuous magnetic-field recording commenced at the
observatory in June 1983

Key data for the observatory are summarised in Table 1.

IAGA code                  : CTA
Commenced operation        : June 1983
Geographic latitude        : 20d 05' 25" S
Geographic longitude       : 146d 15' 51" E
Geomagnetic latitude       : -27.84d
Geomagnetic longitude      : 220.99d
```

```
K 9 index lower limit     : 300 nT
Principal pier            : Pier C
Pier elevation (top)      : 370 m AMSL
Principal reference mark  : Post Office spire
Reference mark azimuth    : 34d 40' 45"
Reference mark distance   : 1.75 km
Observer                  : B.M. Stevenson
```

Table 1 Key observatory data.
---------- Geographic coordinates are derived using the
            Geodetic Datum of Australia 1994 (GDA94)

LOCAL METEOROLOGICAL CONDITIONS

The meteorological temperature at Charters Towers during 2014 varied from a minimum 2 C (2014-07-20) to a maximum 42 C (2015-01-05). Daily minimum temperatures varied from 2 C to 27 C (average 17+/-5 C); daily maximum temperatures varied from 19 C to 42 C (average 30+/-4 C); daily temperature ranges varied from 2 C to 30 C (average 13+/-4 C).

VARIOMETERS

The variometers used during 2014 are listed in Table 2.

The vector variometer at the Charters Towers observatory was a DMI FGE non-suspended 3-component fluxgate magnetometer with the sensor mounted on a concrete pillar and orientated magnetic-NW, magnetic-NE, and vertical. An overhauser total field magnetometer monitored variations of the magnetic total intensity, F. The total field sensor was mounted on a concrete pillar. Acquisition system timing was derived from a Garmin GPS-16 clock and is discussed further below.
Although not temperature controlled, the temperature within the tunnel where the variometer sensors and electronics were located varied over a range of 2 degrees Celsius throughout the year, the temperature of the fluxgate sensor ranged from about 26.2 C in (Jul) to 28.1 C in February. There was no discernible diurnal temperature variation.
The data acquisition system (except both the DMI fluxgate and GSM90 electronics) was housed in an air-conditioned room in an adjacent arm of the tunnel.
Both the fluxgate and total field data were spike filtered using an automatic de-spiking algorithm. For fluxgate data a spike detection required a value to deviate from the local linear trend by 3 times the maximum of 0.3 nT, or 8/9 fractile of deviations during the following minute or so. For total field data a spike detection required a value to deviate from the local linear trend by 10 times the maximum of 0.1 nT, or 8/9 fractile of deviations during the following minute or so.
The definitive one-minute data were calculated from these de-spiked one-second data using the INTERMAGNET gaussian digital filtering. Data loss from the one-minute data set is detailed below.

```
3-component variometer    : DMI FGE (Version G)
```

```
Serial number              : E0227/S0210
Type                       : non-suspended; linear fluxgate
Orientation                : magnetic NW, NE, Z
Acquisition interval       : 1 s
Resolution                 : 0.032 nT
A/D converter              : ADAM 4017 module (+/-5V)
Total-field variometer     : GEM Systems GSM 90
Serial number              : 4081420/42178
Type                       : Overhauser effect
Acquisition interval       : 10 s
Resolution                 : 0.01 nT
Data acquisition system    : GDAP
                           : PC-104 computer, QNX6.5 OS
Timing                     : Garmin GPS16 clock
Communications             : VSAT TCP/IP network
```

Table 2 Magnetic variometers.

VARIOMETER CLOCK CORRECTIONS

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. The timing system was damage by a lightning strike in January 2014 and was not repaired until 2014-02-18. Automatic adjustments to the system clock were greater than 1 ms on the following occasions:

2014-02-18	06:13:39	4.151 s
	06:19:39	-1.000 s
2014-02-19	03:07:32	0.007 s
2014-02-21	03:50:15	0.010 s
2014-10-01	07:05:59	0.369 s

ABSOLUTE INSTRUMENTS

The principal absolute magnetometers used at CTA and their adopted corrections are listed in Table 3.

```
DI fluxgate                : DMI
Serial number              : DI0036 (to 2014-05-26)
                           : DI0036D + Pico ADC16 GJY03/100
                            (from 2014-05-26)
Theodolite                 : Zeiss 020B
Serial number              : 394050
Resolution                 :  0.1
D correction               :  0.0
I correction               : -0.2
Total-field magnetometer   : GEM Systems GSM90
Serial number              : 3091318/91472
Type                       : Overhauser effect
Resolution                 : 0.01 nT
Correction                 : 0.0 nT
```

Table 3 Absolute magnetometers and their adopted corrections. Instrument corrections are applied in the sense Standard = Instrument + correction.

The variometers at CTA were calibrated nominally weekly with a pair of absolute observations. Both absolute PPM and DIM observations were performed on Pier C in the absolute shelter. The DI fluxgate electronics was upgraded for digital output on 2014-05-26. A Pico ADC16 analogue to digital converter was used to digitise the analogue output which was recorded on a Getac Tablet PC running Windows 7 and the GObs absolute observation data acquisition software.
Problems with the DI fluxgate observations over the period 2014-07-05 and 2014-08-05 were found to be caused by an insecure fluxgate sensor. The sensor was re-secured on 2014-08-16 but all observations affected by the problem were discarded.
The principal absolute magnetometers used and their adopted corrections are list in Table 3. The D and I corrections were determined through instrument comparisons performed during maintenance and calibration visits, most recently in May 2014. Instrument corrections are to the international reference. At the 2014 all-day mean field levels at Charters Towers these D. I and F corrections convert to:

X: -2.2nT Y: -0.3 nT Z: -1.9 nT

These instrument corrections have been applied to data throughout the year.

BASELINES

Derivation of final baseline parameters for the fluxgate variometer was done by manual fitting a piece-wise linear function, including steps as required, to the weekly observed absolute observations baseline residuals. There were 49 pairs of absolute observations used to adopt baselines throughout the year.
The DMI E0227/S0210 variometer performed well throughout the year. The baseline drifts had a range of about 3 nT in the X, Y and Z components throughout the year. There were several baseline jumps caused by engineering works in the tunnel. The standard deviations of the difference between the weekly absolute observations and the final adopted vector variometer model and data were:

X	0.5 nT	D	04"
Y	0.6 nT	I	03"
Z	0.5 nT	F	0.3 nT

Throughout the year the difference between the total field derived from the vector variometer and the total field measured with the scalar variometer (Fv - Fs) varied over a range of about 2 nT. This trend was also reflected in the difference between the weekly absolute total field observations and the continuously recording scalar variometer. It is suspected seasonal changes in the magnetic environment at the variometer total field pier are the cause.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the definitive data and real time reported 1-minute data-sets (definitive - real time) were:

	X	Y	Z
Average	+1.5	-0.4	+0.7
Std.dev	1.9	1.8	1.2
Min	-0.1	-3.9	-0.2
Max	+5.1	+3.6	+4.0

The reported real time data are within the specification for INTERMAGNET quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.
The annual statistics of the 12 monthly averages of the difference between the definitive data and quasi-definitive 1-minute data sets (definitive - quasidefinitive) were:

	X	Y	Z
Average	+0.1	+0.1	+0.1
Std.dev	0.2	0.4	0.2
Min	-0.2	-0.6	-0.2
Max	+0.7	+0.6	0.4

The quasi-definitive data are within the specification for INTERMAGNET quasi-definitive data.

OPERATIONS

The on-site observer-in-charge at CTA observatory, Mr Brad Stevenson, performed weekly absolute observations and checks.
Analogue outputs from the DMI FGE 3-channel fluxgate, as well as the fluxgate sensor and electronics temperature channels, were digitized with an ADAM 4017 A/D converter mounted inside the DMI electronics console. Data were recorded at 1 second intervals in the components A (NW), B (NE) and Z as well as the DMI variometer sensor and electronics temperatures. These digital data were recorded on an acquisition computer running the Gdap data acquisition system in a QNX operating system.
The digital data from the PPM variometer, cycling once every 10 seconds, were recorded on the acquisition computer. Data files were telemetered to Geoscience Australia in Canberra through a VSAT TCP/IP network. Data transfer delay time was between 2 to 15 minutes.
The data acquisition system was powered by a 12 V battery-backed supply which also powered the Charters Towers seismic observatory.
The 240 V AC DMI fluxgate electronics was powered with a dedicated inverter running from the 12 V seismic system.
Acquisition system timing control was provided by a Garmin GPS16 clock. A lightning strike on 2014-01-09 damaged the GPS timing system and one communications port on the acquisition computer causing data loss from the scalar magnetometer. The GPS clock was replace on 2014-02-18.
The scalar magnetometer was swapped to a free communications port on 2014-01-23.
Sub nanoTesla interference between the total field and fluxgate data during the total field polarisation cycles (6 times per minute) continues to be a problem

at the observatory.
There were numerous periods of disturbance to the variometer data, mostly due to engineering works in the tunnel which were required to improve safety by upgrading the timber support structures and lagging. These periods of contamination were removed from the data. The engineering works also caused some permanent baseline jumps which have been applied to the data.

The distribution of Charters Towers data is described in Table 4. Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au). Data losses are identified below.

Recipient	Status	Sent
1-second values		
IPS Radio and Space Services	reported	realtime
INTERMAGNET	reported	hourly
1-minute values		
INTERMAGNET	reported	realtime
INTERMAGNET	reported	daily
INTERMAGNET	definitive	July 2015
INTERMAGNET	quasidefintive	quarterly
WDC for Geomagnetism (Japan)	reported	realtime

Table 4 Distribution of Charters Towers data.

SIGNIFICANT EVENTS

2014-01-09	18:00 telemtry failure. Lightning damage to VSAT power and GPS re-transmitter amplifier. Spare GPS amplifier and power installed and system running. GPS clock is working but no clock adjustments, no GPS pulse and NMEA data flagged as unreliable. No data from GSM90 and no response to commands. System time appears less than 1 sec different to telephone time
2014-01-11	No data 22:35 - 22:39 during system tests
2014-01-16	GSM90_3091319 sent as replacement variometer (electronics only)
2014-01-18	23:00 replace GPS antenna at front of tunnel.
2014-01-20	22:40 stop and restart GdapClock - still no 1-sec pulse or clock corrections
2014-01-21	Replace variometer PPM with 3091319 - no data or communications. 03:51-03:52 fluxgate data loss
2014-01-22	Check GSM90 electronics power at plug - O.K. Check GSM90_4081420 (electronics removed from system yesterday) on Getac using absolute power and data cable - all O.K. Some data loss
2014-01-23	Swap PPM from ser3 to ser4 and get it working. 00:08. Ser3 is probably damaged. Request re-installation of GSM90_4081420 as variometer on Sunday.
2014-02-09	No obs this weekend due to rain.
2014-02-18	Seismic Maintenance visit - Dave Pownall

```
              and Adon Butterfield. Data contamination
              GPS clock replaced.
2014-02-19    Data contamination
2014-04-14    Tunnel engineering inspection by MegaPlan
              01-01:30.
              01:05 - 01:06 and 01:15 - 01:25 contamination
2014-04-22    02:00 fire extinguisher inspection in tunnel
              22-22:30 working in seismometer room
              Fs jump at 22:14
2014-05-26    Maintenance visit - AML
              Upgrade absolute DIFlux to digital operations
              with Pico ADC GJY03/100
2014-06-27    07:45-08:09 Data contamination, reason unknown
2014-07-10    Pelican case provided for absolute instruments
2014-07-16    00:37 - small jump in X channel
2014-08-16    DIM Fluxgate sensor found to be loose -
              tightened just before observations.
              The loose sensor explains the problems
              with absolute observations over the last two
              months. Most observations between 2014-07-05
              and  2014-08-08 inclusive have been discarded
2014-08-18    Tunnel engineering works in progress all
              this week - data contamination
2014-08-27    Fv-Fs drifts over a few hours and Fs jump
              between obs on 22 and 28 August
2014-09-12    Tunnel engineering works re-commence and
              continue all this week - data contamination
2014-09-13    Tunnel engineering contaminates variometer
              data during second absolute obs.
2014-09-18    No tunnel work since last Sunday 2014-09-14
2014-09-26    Tunnel engineering works Fri 26 to
              Mon 29 September
2014-10-01    07:05  reboot to clear TCP TIME_WAIT
              connections
2014-10-13    Tunnel engineering works for next two days
2014-10-14    Tunnel work completed until next week.
2014-10-24    Contamination, presumably engineering works
2014-10-25    Tunnel engineering works now completed

K INDICES
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No magnetic indices are routinely scaled for the
Charters Towers Observatory.

ANNUAL MEAN VALUES
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The annual mean values for Charters Towers are available in
the file "yearmean.cta" and graphically through the
IMCDView software.

HOURLY MEAN VALUES
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Plots of hourly mean values for Charters Tower are
available through the IMCDView software.

DATA LOSSES
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Variometer data XYZ:

2014-01-11     XYZ     22:35 - 22:39    (5)
2014-01-22     XYZ     22:01 - 22:01    (1)
```

```
2014-02-18    XYZ     23:41 -
2014-02-19    XYZ           - 04:50  (310)
2014-02-19    XYZ     23:20 -
2014-02-20    XYZ           - 01:00  (101)
2014-02-21    XYZ     03:51 - 03:51    (1)
2014-04-14    XYZ     01:05 - 01:06    (2)
2014-04-14    XYZ     01:15 - 01:25   (11)
2014-06-27    XYZ     07:46 - 08:10   (25)
2014-08-18    XYZ     02:10 - 02:10    (1)
2014-08-19    XYZ     22:38 - 22:38    (1)
2014-08-19    XYZ     23:00 -
2014-08-20    XYZ           - 03:00  (241)
2014-08-27    XYZ     03:00 - 11:00  (481)
2014-08-28    XYZ     01:39 - 01:39    (1)
2014-09-11    XYZ     01:54 - 01:55    (2)
2014-09-11    XYZ     02:05 - 02:06    (2)
2014-09-11    XYZ     08:16 - 08:18    (3)
2014-09-11    XYZ     09:31 - 09:32    (2)
2014-09-12    XYZ     22:23 -
2014-09-13    XYZ           - 04:42  (380)
2014-09-13    XYZ     22:36 -
2014-09-14    XYZ           - 00:01   (86)
2014-09-27    XYZ     00:17 - 00:18    (2)
2014-10-01    XYZ     07:05 - 07:05    (1)
2014-10-12    XYZ     23:35 -
2014-10-13    XYZ           - 05:00  (326)
2014-10-13    XYZ     22:40 -
2014-10-14    XYZ           - 03:00  (261)
2014-10-23    XYZ     23:44 -
2014-10-24    XYZ           - 03:45  (242)

Total: 2488

2014-01-07    F      18:00 -
2014-01-23    F            - 00:08 (21969)
2014-01-23    F      00:13 - 00:13      (1)
2014-01-23    F      00:30 - 00:30      (1)
2014-01-23    F      01:24 - 01:24      (1)
2014-01-23    F      01:52 - 01:52      (1)
2014-01-23    F      02:14 - 02:14      (1)
2014-01-23    F      02:26 - 02:27      (2)
2014-01-23    F      02:39 - 02:39      (1)
2014-01-23    F      02:43 - 02:43      (1)
2014-01-23    F      04:12 - 04:13      (2)
2014-01-23    F      04:38 - 04:38      (1)
2014-01-23    F      05:16 - 05:16      (1)
2014-01-23    F      06:33 - 06:33      (1)
2014-01-23    F      07:22 - 07:22      (1)
2014-01-23    F      07:30 - 07:30      (1)
2014-01-23    F      08:27 - 08:27      (1)
2014-01-23    F      08:40 - 08:40      (1)
2014-01-23    F      09:05 - 09:05      (1)
2014-01-23    F      09:33 - 09:33      (1)
2014-01-23    F      09:41 - 09:41      (1)
2014-01-23    F      09:55 - 09:55      (1)
2014-01-23    F      10:44 - 10:44      (1)
2014-01-23    F      11:07 - 11:07      (1)
2014-01-23    F      12:11 - 12:11      (1)
2014-01-23    F      12:17 - 12:17      (1)
2014-01-23    F      12:29 - 12:29      (1)
2014-01-23    F      12:51 - 12:51      (1)
```

2014-01-23	F	13:02 - 13:02	(1)
2014-01-23	F	13:20 - 13:20	(1)
2014-01-23	F	13:26 - 13:26	(1)
2014-01-23	F	14:27 - 14:27	(1)
2014-01-23	F	14:54 - 14:54	(1)
2014-01-23	F	15:06 - 15:06	(1)
2014-01-23	F	15:47 - 15:47	(1)
2014-01-23	F	15:55 - 15:55	(1)
2014-01-23	F	16:14 - 16:14	(1)
2014-01-23	F	18:46 - 18:46	(1)
2014-01-23	F	18:52 - 18:52	(1)
2014-01-23	F	19:26 - 19:26	(1)
2014-01-23	F	19:31 - 19:31	(1)
2014-01-23	F	20:16 - 20:16	(1)
2014-01-23	F	20:44 - 20:44	(1)
2014-01-23	F	22:31 - 22:31	(1)
2014-01-23	F	23:38 - 23:38	(1)
2014-01-24	F	01:03 - 01:03	(1)
2014-01-24	F	01:14 - 01:15	(2)
2014-01-24	F	01:34 - 01:34	(1)
2014-01-24	F	01:41 - 01:41	(1)
2014-01-24	F	01:46 - 01:46	(1)
2014-01-24	F	02:03 - 02:03	(1)
2014-01-24	F	02:18 - 02:18	(1)
2014-01-24	F	02:56 - 02:56	(1)
2014-01-24	F	03:41 - 03:41	(1)
2014-01-24	F	04:08 - 04:08	(1)
2014-01-24	F	04:22 - 04:22	(1)
2014-01-24	F	04:32 - 04:32	(1)
2014-01-24	F	05:15 - 05:15	(1)
2014-01-24	F	06:17 - 06:17	(1)
2014-01-24	F	07:13 - 07:13	(1)
2014-01-24	F	07:23 - 07:23	(1)
2014-01-24	F	07:25 - 07:25	(1)
2014-01-24	F	07:35 - 07:35	(1)
2014-01-24	F	07:49 - 07:49	(1)
2014-01-24	F	08:14 - 08:14	(1)
2014-01-24	F	09:09 - 09:09	(1)
2014-01-24	F	09:14 - 09:14	(1)
2014-01-24	F	10:11 - 10:11	(1)
2014-01-24	F	11:57 - 11:57	(1)
2014-01-24	F	12:41 - 12:41	(1)
2014-01-24	F	13:05 - 13:05	(1)
2014-01-24	F	13:40 - 13:40	(1)
2014-01-24	F	13:54 - 13:54	(1)
2014-01-24	F	14:19 - 14:19	(1)
2014-01-24	F	14:29 - 14:29	(1)
2014-01-24	F	14:33 - 14:33	(1)
2014-01-24	F	15:18 - 15:18	(1)
2014-01-24	F	15:27 - 15:27	(1)
2014-01-24	F	15:49 - 15:49	(1)
2014-01-24	F	15:54 - 15:54	(1)
2014-01-24	F	16:59 - 16:59	(1)
2014-01-24	F	17:06 - 17:06	(1)
2014-01-24	F	17:31 - 17:31	(1)
2014-01-24	F	17:55 - 17:55	(1)
2014-01-24	F	18:05 - 18:05	(1)
2014-01-24	F	20:51 - 20:51	(1)
2014-01-24	F	21:21 - 21:22	(2)
2014-01-24	F	22:25 - 22:25	(1)
2014-01-24	F	23:18 - 23:18	(1)

2014-01-25	F	00:16 - 00:16	(1)
2014-01-25	F	00:51 - 00:52	(2)
2014-01-25	F	01:31 - 01:31	(1)
2014-01-25	F	01:47 - 01:47	(1)
2014-01-25	F	02:32 - 02:32	(1)
2014-01-25	F	02:58 - 02:58	(1)
2014-01-25	F	03:10 - 03:10	(1)
2014-01-25	F	03:24 - 03:25	(2)
2014-01-25	F	03:42 - 03:42	(1)
2014-01-25	F	03:57 - 03:57	(1)
2014-01-25	F	05:14 - 05:14	(1)
2014-01-25	F	05:23 - 05:23	(1)
2014-01-25	F	05:53 - 05:53	(1)
2014-01-25	F	06:05 - 06:05	(1)
2014-01-25	F	06:21 - 06:21	(1)
2014-01-25	F	06:43 - 06:43	(1)
2014-01-25	F	06:49 - 06:49	(1)
2014-01-25	F	07:01 - 07:01	(1)
2014-01-25	F	07:06 - 07:06	(1)
2014-01-25	F	07:15 - 07:15	(1)
2014-01-25	F	07:19 - 07:19	(1)
2014-01-25	F	07:47 - 07:47	(1)
2014-01-25	F	07:52 - 07:52	(1)
2014-01-25	F	08:32 - 08:32	(1)
2014-01-25	F	08:44 - 08:44	(1)
2014-01-25	F	08:51 - 08:51	(1)
2014-01-25	F	09:21 - 09:21	(1)
2014-01-25	F	09:41 - 09:42	(2)
2014-01-25	F	10:10 - 10:10	(1)
2014-01-25	F	10:13 - 10:13	(1)
2014-01-25	F	10:15 - 10:15	(1)
2014-01-25	F	10:20 - 10:20	(1)
2014-01-25	F	10:24 - 10:24	(1)
2014-01-25	F	10:29 - 10:29	(1)
2014-01-25	F	12:16 - 12:16	(1)
2014-01-25	F	13:07 - 13:07	(1)
2014-01-25	F	13:45 - 13:45	(1)
2014-01-25	F	15:00 - 15:00	(1)
2014-01-25	F	15:17 - 15:17	(1)
2014-01-25	F	15:59 - 15:59	(1)
2014-01-25	F	16:39 - 16:39	(1)
2014-01-25	F	18:02 - 18:02	(1)
2014-01-25	F	18:14 - 18:14	(1)
2014-01-25	F	18:23 - 18:24	(2)
2014-01-25	F	18:31 - 18:31	(1)
2014-01-25	F	19:22 - 19:22	(1)
2014-01-25	F	20:42 - 20:42	(1)
2014-01-25	F	20:51 - 20:51	(1)
2014-01-25	F	21:10 - 21:10	(1)
2014-01-25	F	21:14 - 21:14	(1)
2014-01-25	F	21:39 - 21:39	(1)
2014-01-25	F	22:01 - 22:01	(1)
2014-01-25	F	22:17 - 22:17	(1)
2014-02-01	F	14:15 - 14:15	(1)
2014-02-02	F	07:45 - 07:45	(1)
2014-02-08	F	04:11 - 04:11	(1)
2014-02-09	F	13:47 - 13:48	(2)
2014-02-16	F	04:50 - 04:50	(1)
2014-02-16	F	04:56 - 04:56	(1)
2014-02-16	F	05:29 - 05:29	(1)
2014-02-18	F	06:06 - 06:06	(1)

2014-02-18	F	23:41 -		
2014-02-19	F	-	04:50	(310)
2014-02-19	F	23:20 -		
2014-02-20	F	-	01:00	(101)
2014-02-20	F	04:06 -	04:06	(1)
2014-02-20	F	06:44 -	06:44	(1)
2014-02-21	F	03:51 -	03:51	(1)
2014-02-23	F	08:00 -	08:00	(1)
2014-03-12	F	13:11 -	13:11	(1)
2014-03-14	F	00:13 -	00:13	(1)
2014-03-25	F	21:34 -	21:34	(1)
2014-03-30	F	00:55 -	00:55	(1)
2014-03-30	F	10:29 -	10:29	(1)
2014-04-05	F	11:30 -	11:30	(1)
2014-04-05	F	11:45 -	11:45	(1)
2014-04-14	F	01:05 -	01:06	(2)
2014-04-14	F	01:15 -	01:25	(11)
2014-04-16	F	10:51 -	10:51	(1)
2014-04-20	F	11:42 -	11:42	(1)
2014-04-20	F	12:55 -	12:55	(1)
2014-04-20	F	19:53 -	19:53	(1)
2014-05-08	F	15:20 -	15:21	(2)
2014-05-23	F	22:39 -	22:39	(1)
2014-06-08	F	04:51 -	04:51	(1)
2014-06-08	F	08:09 -	08:09	(1)
2014-06-08	F	09:00 -	09:00	(1)
2014-06-11	F	09:44 -	09:44	(1)
2014-06-27	F	07:46 -	07:46	(1)
2014-07-22	F	12:36 -	12:36	(1)
2014-07-22	F	14:16 -	14:16	(1)
2014-07-28	F	05:51 -	05:53	(3)
2014-07-28	F	14:56 -	14:56	(1)
2014-08-02	F	14:11 -	14:11	(1)
2014-08-11	F	14:22 -	14:22	(1)
2014-08-18	F	02:10 -	02:10	(1)
2014-08-19	F	18:28 -	18:28	(1)
2014-08-19	F	21:39 -	21:39	(1)
2014-08-19	F	22:38 -	22:38	(1)
2014-08-19	F	23:00 -		
2014-08-20	F	-	03:00	(241)
2014-08-27	F	03:00 -	11:00	(481)
2014-08-28	F	01:39 -	01:39	(1)
2014-08-30	F	09:32 -	09:32	(1)
2014-08-30	F	11:24 -	11:24	(1)
2014-09-03	F	10:57 -	10:57	(1)
2014-09-11	F	01:55 -	01:55	(1)
2014-09-11	F	08:16 -	08:18	(3)
2014-09-11	F	09:31 -	09:32	(2)
2014-09-12	F	03:37 -	03:37	(1)
2014-09-12	F	22:23 -		
2014-09-13	F	-	04:42	(380)
2014-09-13	F	22:36 -		
2014-09-14	F	-	00:01	(86)
2014-09-20	F	15:13 -	15:13	(1)
2014-09-22	F	12:32 -	12:33	(2)
2014-09-25	F	11:59 -	11:59	(1)
2014-09-27	F	00:17 -	00:18	(2)
2014-09-27	F	11:39 -	11:39	(1)
2014-10-01	F	07:05 -	07:05	(1)
2014-10-12	F	09:33 -	09:33	(1)
2014-10-12	F	12:22 -	12:22	(1)

```
2014-10-12    F      23:35 -
2014-10-13    F            - 05:00   (326)
2014-10-13    F      22:40 -
2014-10-14    F            - 03:00   (261)
2014-10-15    F      12:55 - 12:56     (2)
2014-10-17    F      04:13 - 04:13     (1)
2014-10-22    F      05:15 - 05:15     (1)
2014-10-22    F      10:50 - 10:51     (2)
2014-10-23    F      23:44 -
2014-10-24    F            - 03:45   (242)
2014-11-01    F      07:06 - 07:07     (2)
2014-11-05    F      13:15 - 13:15     (1)
2014-11-08    F      22:27 - 22:28     (2)
2014-11-10    F      02:22 - 02:22     (1)
2014-11-16    F      09:17 - 09:17     (1)
2014-11-19    F      13:39 - 13:39     (1)
2014-11-21    F      09:47 - 09:47     (1)
2014-11-21    F      09:50 - 09:50     (1)
2014-11-23    F      11:00 - 11:00     (1)
2014-12-02    F      06:33 - 06:33     (1)
2014-12-05    F      11:26 - 11:26     (1)
2014-12-07    F      00:06 - 00:06     (1)
2014-12-09    F      11:00 - 11:00     (1)
2014-12-09    F      11:24 - 11:24     (1)
2014-12-12    F      05:06 - 05:06     (1)
2014-12-12    F      12:41 - 12:41     (1)
2014-12-25    F      13:42 - 13:42     (1)

Total: 24648


  <END>
```

7.3.1.3 2015

```
                          CTA
          CHARTERS TOWERS OBSERVATORY INFORMATION 2015

ACKNOWLEDGE-  Users of the CTA data should acknowledge:
      -MENTS: Geoscience Australia

  STATION ID: CTA
    LOCATION: CHARTERS TOWERS, Queensland,
              Australia
ORGANISATION: Geoscience Australia

 CO-LATITUDE: 110.090
   LONGITUDE: 146.264
   ELEVATION: 370 m Above mean sea level (top pier C)

    ABSOLUTE
 INSTRUMENTS: DIM: DI0036D/394050 with Pico ADC16
                   S/N GJY03/100
              PPM: GSM90_3091318 sensor 91472
   RECORDING
 VARIOMETER: (1) to 2015-07-17: Non-suspended DMI fluxgate
              magnetometer and GSM90 Proton precession
              magnetometer.
             (2) 2015-09-08 to 2015-11-17: Non-suspended
              Narod Geophysics fluxgate magnetometer and
              Geometrics G856 proton precession
```

```
               magnetometer
              (3) from 2015-11-18: Suspended DMI fluxgate
                magnetometer and GSM90 Proton precession
                magnetometer.
 ORIENTATION: Magnetic NW, NE and Vertical (ABZ)
     DYNAMIC
       RANGE: (1)+/-1600 nT (2)full field (3)+/- 10000 nT
  RESOLUTION: (1)  0.032 nT (2)  0.01 nT  (3)    0.001 nT

    SAMPLING
        RATE: 1 second
 FILTER TYPE: Intermagnet

   K-NUMBERS: None
    K9-LIMIT: 300 nT

        GINS: Edinburgh
   SATELLITE: http upload

   OBSERVERS: B.M. Stevenson
              A.M. Lewis
              W.V. Jones

     CONTACT: Geomagnetism Section
              Geoscience Australia
              G.P.O. Box 378
              Canberra, A.C.T., 2601
              Australia

              Tel: + 61-2-6249-9111
              Fax: + 61-2-6249-9986
              e-mail: geomag@ga.gov.au
              WWW: http://www.ga.gov.au/

Notes:
-----
Charters Towers is 120 km southwest of
Townsville in north Queensland. The Charters Towers
magnetic observatory is located at Towers Hill, 1.7 km
southwest of the town centre, in an area leased to
Geoscience Australia by the Charters Towers Regional
Council.
The observatory comprises:
  - a disused gold mine adit ("the tunnel") approximately
    100 m into the northern side of Towers Hill, which
    houses the magnetic variometers;
  - an absolute shelter on a hillside approximately 150 m
    to the south-west of the tunnel, and
  - a VSAT communications dish outside the tunnel.

Continuous magnetic-field recording commenced at the
observatory in June 1983.

Key data for the observatory are summarised in Table 1.

IAGA code                 : CTA
Commenced operation       : June 1983
Geographic latitude       : 20d 05' 25" S
Geographic longitude      : 146d 15' 51" E
Geomagnetic latitude      : -27.84d
Geomagnetic longitude     : 220.99d
```

```
K 9 index lower limit     : 300 nT
Principal pier            : Pier C
Pier elevation (top)      : 370 m AMSL
Principal reference mark  : Post Office spire
Reference mark azimuth    : 34d 40' 45"
Reference mark distance   : 1.75 km
Observers                 : B.M. Stevenson
                            A.M. Lewis
                            W.V. Jones

Table 1  Key observatory data.
----------  Geographic coordinates are derived using the
            Geodetic Datum of Australia 1994 (GDA94)


Local Meteorological Conditions
-------------------------------
The meteorological temperature at Charters Towers during
2015 varied from a minimum 4 C (2015-07-15) to a maximum
40 C (2015-02-21). Daily minimum temperatures varied from
4 C to 27 C (average 18+/-5 C); daily maximum temperatures
varied from 20 C to 40 C (average 31+/-4 C); daily
temperature ranges varied from 4 C to 20 C (average
13+/-3 C).
Daily weather observations for Chaters Towers airport
(station ID 034084) provided by Australian Government,
Bureau of Meteorology.

Variometers
-----------
The variometers used during 2015 are listed in Table 2.
Three different vector variometers were used at the
Charters Towers observatory throughout 2015 due to
instrumentation damage and replacements resulting from a
collapse of the tunnel's rock wall on 2015-04-25. The
collapse occurred within a few meters of the fluxgate sensor
and while not directly damaging the sensor, loose rocks
covered the cabling and the unstable condition of the
surrounding material caused increasing data problems until
2015-07-17, after which the data became unusable. Data
collection continued until 2015-08-31 when the vector
magnetometer sensor cable was cut and the instrument
removed to allow clean up and repair the tunnel support
structures. Data between 2015-07-17 and 2015-08-31 were
not suitable for release as definitive data. There was
total data loss from 2015-08-31 until 2015-09-08.
On 2015-09-08 a temporary variometer was installed at an
outdoor location about 5.8 km to the north-east of the
Charters Towers absolute observation shelter. The variomter
instruments and recording equipment for this temporary
installation were set up in a tent and powered with
batteries and solar panels. The system was accessed
remotely through the mobile telephone network for data
download and system management. Weekly absolute
observations continued uninterrupted on the standard
absolute pier.
Engineering repair work was carried out to rectify the
problems with the support structures in the tunnel from
August to October 2015.
On 2015-11-18 an upgraded variometer system was
re-installed in the repaired tunnel.
```

The discussions below are divided into three time periods corresponding to the periods of definitive data from the three different variometer systems:
(1) 2015-01-01 to 2015-07-17
(2) 2015-09-08 to 2015-11-17
(3) 2015-11-18 to 2015-12-31

Period (1): Until 2015-08-31 a DMI FGE non-suspended 3-component fluxgate magnetometer with the sensor mounted on a concrete pillar in the tunnel and orientated magnetic-NW, magnetic-NE, and vertical. An overhauser total field magnetometer monitored variations of the magnetic total intensity, F. The total field sensor was mounted on a concrete pillar. Acquisition system timing was derived from a Garmin GPS-16 clock and is discussed further below.
Although not temperature controlled, the temperature within the tunnel where the variometer sensors and electronics were located varied over a range of only a few degrees celsius throughout the period. The data acquisition system (except DMI fluxgate and GSM90 electronics units) was housed in an air-conditioned room in an adjacent arm of the tunnel.
The initial rock wall collapse occurred on 2015-04-25. Data remained useable until 2015-07-16 when the unstable conditions of the rock and support structures in the tunnel degraded the quality of the data.
From 2015-07-16 until 2015-08-31 the data became usable, so there is total definitive data loss between 2015-07-17 and 2015-09-08.
Period (2): From 2015-09-08 until 2015-11-17 a Narod Geophysics Limited non-suspended 3-component ring-core fluxgate magnetometer with sensor on a marble base and mounted on three 20 cm phosphor bronze pegs driven into the soil. The sensor was orientated magnetic-NW, magnetic-NE, and vertical. A proton precession total field magnetometer was set up to monitor variations of the magnetic total intensity but failed to produce any useful data throughout the entire period. The total field sensor was mounted on a pole 1.2 m above ground level and secured with guy ropes. The acquisition system was installed in a tent and powered by 2 12 V 50 Ah batteries recharged with solar panels. System timing was derived from a Garmin GPS-16 clock, timing corrections were applied but not recorded to a log file.
There was no temperature control to either sensor or electronics and so both were subjected to ambient temperature. The fluxgate sensor was covered with a thermally insulated box to retard temperature variations.
Period (3): From 2015-11-18 a DMI FGE suspended 3-component fluxgate magnetometer was re-installed into the repaired tunnel. The sensor was mounted on the same concrete pillar as the previous fluxgate magnetometer and orientated magnetic-NW, magnetic-NE, and vertical. The DMI fluxgate had been upgraded for a range of +/- 10000 nT and the 1 Hz analogue filter removed. Data were digitised with an ObsDaq 24 bit digital to analogue converter. The native 128 Hz data from the ObsDaq were filtered to 16 Hz and again to 1 Hz.
A GEM Systems GSM90 overhauser total field magnetometer monitored variations of the magnetic total intensity, F.

The total field sensor was moved further from the fluxgate sensor compared to its previous location in period 1. This removed the magnetic interference between the two magnetometers which has been a problem at the observatory for some years.
Acquisition system timing was derived from a Garmin GPS-16 clock. For all data periods the definitive data from both the fluxgate and total field data were spike filtered using an automatic de-spiking algorithm.
For fluxgate data from period (1) and (3) a spike detection required a value in the derived data to deviate from the local linear trend by 5 times the maximum of 0.2 nT or 8/9 fractile of deviations during the following minute or so. On average 32, 3 and 1 seconds of data per day were detected in the X, Y and Z derived data throughout the year, most of the spikes were located during the period between the initial rock fall (2015-04-25) and the end of usable data (2015-07-17) in period 1.
For total field data a spike detection required a value to deviate from the local linear trend by 10 times the maximum of 0.1 nT, or 8/9 fractile of deviations during the following minute or so. When spikes could not be corrected they were removed.
For fluxgate data from period 2 (2015-09-08 to 2015-11-17) a two stage filter was applied. First to the raw data, when a spike detection required a value in the data to deviate from the local linear trend by 4 times the maximum of 10 digitiser counts or 8/9 fractile of deviations during the following minute or so. On average 16, 45 and 43 seconds of data per day were detected in the raw A, B, C channel data during period 2.
A second filter was then applied to the derived data such that a spike detection required a value in the data to deviate from the local linear trend by 4 times the maximum of 0.1 nT or 8/9 fractile of deviations during the following minute or so.
A small number of days of definitive data were not filtered. Filtering unnecessarily removed some scalar data during periods of rapid magnetic fluctuations, these unfiltered days are listed in the table below.
The definitive one-minute data were calculated from these de-spiked one-second data using INTERMAGNET gaussian digital filtering. Data losses from the one-minute data set are detailed below.

Period (1) 2015-01-01 to 2015-07-19

3-component variometer	: DMI FGE (Version G)
Serial number	: E0227/S0210
Type	: non-suspended; linear fluxgate
Orientation	: magnetic NW, NE, Z
Acquisition interval	: 1 s
Resolution	: 0.032 nT
A/D converter	: ADAM 4017 module (+/-5V)
Total-field variometer	: GEM Systems GSM 90
Serial number	: 4081420/42178
Type	: Overhauser effect
Acquisition interval	: 10 s
Resolution	: 0.01 nT
Data acquisition system	: GDAP
	: ARK3360F computer, QNX6.5 OS
Timing	: Garmin GPS16 clock

```
Communications            : VSAT TCP/IP network

Period (2) 2015-09-08 to 2015-11-17
3-component variometer    : Narod Geophysics Ltd.
Serial number             : AGSO2506-1 with sensor 9004-4
Type                      : non-suspended; ring core
                            fluxgate
Orientation               : magnetic NW, NE, Z
Acquisition interval      : 1 s
Resolution                : 0.01 nT
A/D converter             : Digital output from mag.
Total-field variometer    : Geometrics 856
Serial number             : 277000/090201
Type                      : proton precession magnetometer
Acquisition interval      : 10 s
Resolution                : 0.2 nT
Data acquisition system   : GDAP
                          : TC-486 PC-104 computer,
                            QNX6.3 OS
Timing                    : Garmin GPS16 clock
Communications            : HSPA Mobile telephone TCP/IP
                            network
period (3) 2015-11-18 onwards
3-component variometer    : DMI FGE (Version G)
Serial number             : E0462/S0227
Type                      : suspended; linear fluxgate
Orientation               : magnetic NW, NE, Z
Acquisition interval      : 1 s
Resolution                : 0.001 nT
A/D converter             : ObsDaq 24-bit S/N OD-55C0E002
Total-field variometer    : GEM Systems GSM 90
Serial number             : 4081420/42178
Type                      : Overhauser effect
Acquisition interval      : 10 s
Resolution                : 0.01 nT
Data acquisition system   : GDAP
                          : ARK3360F computer, QNX6.5 OS
Timing                    : Garmin GPS16 clock
Communications            : VSAT TCP/IP network

Table 2 Magnetic variometers.
---------

Variometer Clock Corrections
----------------------------
Time stamps applied to the variometer data were obtained
from the acquisition computer system clock. That clock
was synchronised to a GPS clock. Automatic adjustments to
the system clock were greater than 10 ms on the
following occasions in periods (1) and (3):

2015-04-28      07:04:22     0.647 s system reboot
2015-07-01      00:00:40    -1.000 s leap second
2015-11-17      03:41:57     0.526 s new variometer system

Clock corrections were applied but not logged during
period (2)(from 2015-09-08 to 2015-11-17)

Absolute Instruments
--------------------
The principal absolute magnetometers used at CTA and
```

their adopted corrections are listed in Table 3.

DI fluxgate	: DMI
Serial number	: DI0036D + Pico ADC16 GJY03/100
Theodolite	: Zeiss 020B
Serial number	: 394050
Resolution	: 0.1'
D correction	: 0.0'
I correction	: -0.2'
Total-field magnetometer	: GEM Systems GSM90
Serial number	: 3091318/91472
Type	: Overhauser effect
Resolution	: 0.01 nT
Correction	: 0.0 nT

Table 3 — Absolute magnetometers and their adopted corrections. Instrument corrections are applied in the sense Standard = Instrument + correction.

The variometers at CTA were calibrated nominally weekly with a pair of absolute observations. Both absolute PPM and DIM observations were performed on Pier C in the absolute shelter. A Pico ADC16 analogue to digital converter was used to digitise the analogue output from the DIM fluxgate which was recorded on a Getac Tablet PC running Windows 7 and "GObs" absolute observation data acquisition software.
The principal absolute magnetometers used and their adopted corrections are listed in Table 3. The D and I corrections were determined through instrument comparisons performed during maintenance and calibration visits, most recently in May 2014. Instrument corrections are to the international reference. At the 2015 all-day mean field levels at Charters Towers these D, I and F corrections convert to:

X: -2.2nT   Y: -0.3 nT   Z: -1.9 nT

These instrument corrections have been applied to data throughout the year.

Baselines

Derivation of final baseline parameters for the fluxgate variometer was done by manual fitting a piece-wise linear function, including steps as required, to the weekly observed absolute observations baseline residuals. There were about 58 pairs of absolute observations used to adopt baselines throughout the year. Observations on 2015-01-23 and 2015-03-27 were discarded as outliers. The baseline drifts had a range of about 5 nT in the X, Y and Z components throughout the year. There were several baseline jumps caused by changing the variometers and engineering work in the tunnel. The standard deviations of the difference between the weekly absolute observations and the final adopted vector variometer model and data were:

D	06"	X	0.6 nT
I	04"	Y	0.9 nT
H	0.9 nT	Z	0.8 nT
F	0.8 nT		

Throughout the year the difference between the total field derived from the vector variometer and the total field measured with the scalar variometer (Fv - Fs) varied over a range of about 2 nT. Steps were applied to the scalar baseline on several occasions throughout the year where necessary.
There is a 2 nT step in the Fs baseline applied at the beginning of the year to force Fv-Fs close to zero. Ground movements in the tunnel probably cause instabilities in the Fs baseline.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the available monthly averages of the difference between the definitive data and real time reported 1-minute data-sets (definitive - real time) were:

	X	Y	Z
Average	-0.5	0.0	+0.4
Std.dev	1.1	1.3	2.0
Min	-3.3	-2.0	-1.8
Max	+0.6	+1.8	+4.8

The reported real time data are within the specification for INTERMAGNET quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.
The annual statistics of the available monthly averages of the difference between the definitive data and quasi-definitive 1-minute data sets (definitive - quasi-definitive) were:

	X	Y	Z
Average	-0.1	-0.3	-0.2
Std.dev	0.3	0.6	0.7
Min	-0.6	-1.3	-1.6
Max	+0.2	+0.5	1.0

The quasi-definitive data are within the specification for INTERMAGNET quasi-definitive data.

Operations

The on-site observer-in-charge at CTA observatory, Mr Brad Stevenson, performed weekly absolute observations and checks.
From 2015-01-01 to 2015-07-17 (period 1) the analogue outputs from the DMI FGE 3-channel fluxgate, as well as the fluxgate sensor and electronics temperature channels, were digitized with an ADAM 4017 A/D converter mounted inside the DMI electronics console. Data were recorded at 1 second intervals in the components A (NW), B (NE) and Z as well as the DMI variometer sensor and electronics temperatures. These digital data were recorded on an acquisition computer running the Gdap data acquisition system on a QNX operating system.
The digital data from the PPM variometer, cycling once every 10 seconds, were recorded on the acquisition computer. Data files were telemetered to Geoscience Australia in Canberra through a VSAT TCP/IP network. Data transfer delay time was between 2 to 15 minutes. The data acquisition system was powered

by a 12 V battery-backed supply which also powered the Charters Towers seismic observatory.
The 240 V AC DMI fluxgate electronics was powered with a dedicated inverter running from the 12 V seismic system. Acquisition system timing control was provided by a Garmin GPS16 clock.
Sub nanoTesla interference between the total field and fluxgate data during the total field polarisation cycles (6 times per minute) continued to be a problem during this period.
From 2015-09-08 to 2015-11-17 (period 2) the digital outputs from the NGL fluxgate as well as the fluxgate sensor and electronics temperature channels were recorded at 1 second intervals in the components A (NW),B (NE) and Z. These digital data were recorded on an acquisition computer running the Gdap data acquisition system in a QNX operating system. The digital data from the PPM variometer, cycling once every 10 seconds, were recorded on the acquisition computer but these data were not usable due to instrument problems. Data files were telemetered to Geoscience Australia in Canberra hourly during daylight hours through a mobile phone HSPA network. The data acquisition system was powered by 12 V batteries with solar panel charging. Acquisition system timing control was provided by a Garmin GPS16 clock.
From 2015-11-18 (period 3) the analogue outputs from the DMI FGE 3-channel fluxgate, as well as the fluxgate sensor and electronics temperature channels were digitized with an ObsDaq 24-bit A/D converter. The DMI fluxgate variometer was a 12 V DC instrument and power for the ObsDaq was supplied from the DMI electronics. Data were recorded at 1 second intervals in the components A (NW), B (NE) and Z. The 128 Hz data from the ObsDaq digitiser were gaussian filtered to 16 Hz and then again to 1 Hz before being recorded on an acquisition computer running the Gdap data acquisition system on a QNX operating system. 10 second digital data from the PPM variometer were also recorded using the same system. Data files were telemetered to Geoscience Australia in Canberra through a VSAT TCP/IP network. Data transfer delay time was between 2 to 15 minutes.
The distribution of Charters Towers data is described in Table 4. Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au). Data losses are identified below.

Recipient	Status	Sent
1-second values		
BoM Space Weather Services	reported	realtime
INTERMAGNET	reported	hourly
1-minute values		
INTERMAGNET	reported	realtime
INTERMAGNET	reported	daily
INTERMAGNET	definitive	July 2016
INTERMAGNET	quasidefintive	monthly
WDC for Geomagnetism (Japan)	reported	realtime

Table 4 Distribution of Charters Towers data.

```
Significant Events
------------------
2015-01-25   04:34 telemetry failure. Possibly associated
             with lightning storm at that time. Replacement
             modem and modem DC/DC converter sent to site
             Also a small baseline jump at this time
2015-01-30   Satellite modem and DC/DC converter replaced
             - still no data flowing.
2015-02-07   Data communication restarts after visit by
             GA technical team.
2015-02-12   ~03:25 data communications fails again
             23:45 Replace satellite dish BUC
2015-02-17   Install another new satellite modem sent
             from SpeedCast Satellite data provider
             in Adelaide. Data now flowing again
2015-03-31   03:00 Fire extinguisher inspection in tunnel
2015-04-25   11:17 Rock fall and wall collapse causes
             baseline jump
2015-04-28   07:03  reboot to clear tcp stack of
             "TIME-WAIT" jobs
2015-05-13   Visual confirmation of rock wall collapse
             between fluxgate electronics and sensor.
             Cables have been disturbed but system running
             and sensor orientation appears unchanged.
             Seismometer data confirms timing of baseline
             jump from 25 April was due to rock-wall
             collapse
2015-05-25   Tunnel engineering inspection scheduled this
             week
2015-05-27   00:40 Tunnel inspection in progress
2015-05-31   23:50 - 23:59 spikes on vector and scalar
             data. Reason unknown
2015-07-15   21:10 Jump in PPM data and increased noise.
             "b" tuning. Change Fs baseline;
             Fs data now unreliable.
2015-07-19   jump in baseline X,Y absolute residuals
             XYZ data now unreliable
2015-07-31   Stop PPM driver and try PPM long polarise and
             re-tune, still "b" tuning
2015-08-26   05:59:20 instantaneous jump in PPM, but no
             change in data quality.
             No jump in vector data.
2015-08-28   22:24-22:28 and 22:53 to 22:58 contamination
             due to tunnel engineering work.
             Second absolute observation was affected by
             corrupt variometer data.
             23:00 jump and change in character of PPM data
             Noise decreases from 2 nT p-p to 0.5 nT p-p
2015-08-31   04:06 equipment switched off, cables cut and
             sensors moved to prepare for tunnel work
2015-09-07   Maintenance visit. Install temporary
             variometer (CT2) at location
             -20 02 44.049 / 146 16 57.678 retrieve DMI
             fluxgate E0227/S0210 and return it to Canberra
             for repairs. Also obs/sun obs etc
2015-09-26   Leaking pipe to fire hose at tunnel entrance
             repaired
2015-10-01   05:00 Fire extinguisher inspection in tunnel
2015-11-17   Installation visit AML/WVJ
             DMI fluxgate E0462/S0227 and GSM90 PPM
             4081420/42178 installed in the repaired tunnel
```

```
              Both instruments are working now, but there
              is some interference between GSM90 and DMI
              fluxgate.
              23:23:10 GSM90 turned off to test GSM90
              interfering with DMI.
2015-11-18    ~00:13:00 CT2 variometer system stopped
              GSM90 sensor moved further from DMI
              sensor, distance is now 12 m. GSM90 on at
              03:12:10, no obvious interference to DMI data.
2015-11-25    00:10 restart CTA data delivery to customers

K-Indices
----------
No magnetic indices are routinely scaled for the
Charters Towers Observatory.

Annual Mean Values
------------------
The annual mean values for Charters Towers are available in
the file "yearmean.cta" and graphically through the
IMCDView software.

Hourly Mean Values
------------------
Plots of hourly mean values for Charters Tower are
available through the IMCDView software.

Spike filtering not applied
---------------------------
Month     Day of Month
January   07, 26
February
March     03, 11, 17, 18, 22
April
May
June      22
July
August
September
October
November
December  19, 22, 24

Data Losses
----------
Total data loss occurred between 2015-07-16 to
2015-09-08 when variometer data were unstable
or unavailable.

Variometer data XYZ: (minutes)
2015-02-08    XYZ     04:03 - 04:03      (1)
2015-04-28    XYZ     07:03 - 07:03      (1)
2015-05-27    XYZ     00:09 - 00:15      (7)
2015-05-31    XYZ     23:54 - 23:55      (2)
2015-06-01    XYZ     00:00 - 00:00      (1)
2015-07-08    XYZ     00:09 - 00:13      (5)
2015-07-16    XYZ     21:09 -
2015-09-08    XYZ           - 02:01  (76613)
2015-09-08    XYZ     02:41 - 02:47      (7)
2015-11-18    XYZ     03:03 - 03:10      (8)
2015-11-18    XYZ     06:52 - 06:52      (1)
```

2015-11-18	XYZ	06:54 - 06:54	(1)
2015-11-19	XYZ	00:10 - 00:10	(1)
2015-11-19	XYZ	00:14 - 00:14	(1)
2015-12-04	XYZ	21:02 - 21:20	(19)
2015-12-17	XYZ	05:38 - 06:00	(23)

Total: 76691 minutes (53.25 days)

Variometer data F: (minutes)

2015-01-04	F	07:59 - 07:59	(1)
2015-01-07	F	09:38 - 09:38	(1)
2015-01-07	F	10:54 - 10:54	(1)
2015-01-12	F	11:47 - 11:47	(1)
2015-01-15	F	08:17 - 08:17	(1)
2015-01-16	F	07:09 - 07:09	(1)
2015-01-21	F	05:03 - 05:04	(2)
2015-01-22	F	10:31 - 10:31	(1)
2015-01-22	F	10:45 - 10:45	(1)
2015-01-22	F	11:11 - 11:11	(1)
2015-01-25	F	04:43 - 04:43	(1)
2015-01-25	F	04:54 - 04:54	(1)
2015-01-25	F	05:13 - 05:13	(1)
2015-02-01	F	16:52 - 16:52	(1)
2015-02-09	F	14:10 - 14:10	(1)
2015-02-09	F	14:13 - 14:13	(1)
2015-02-10	F	14:08 - 14:08	(1)
2015-02-23	F	12:05 - 12:05	(1)
2015-02-23	F	12:10 - 12:10	(1)
2015-02-23	F	12:13 - 12:13	(1)
2015-02-23	F	12:17 - 12:18	(2)
2015-02-23	F	12:23 - 12:23	(1)
2015-02-23	F	12:35 - 12:35	(1)
2015-02-23	F	12:52 - 12:52	(1)
2015-02-28	F	15:55 - 15:55	(1)
2015-03-01	F	17:16 - 17:16	(1)
2015-03-08	F	11:18 - 11:18	(1)
2015-03-19	F	09:03 - 09:03	(1)
2015-03-22	F	09:01 - 09:01	(1)
2015-03-24	F	13:52 - 13:52	(1)
2015-03-25	F	18:52 - 18:52	(1)
2015-03-29	F	01:01 - 01:01	(1)
2015-04-03	F	03:41 - 03:41	(1)
2015-04-12	F	15:13 - 15:13	(1)
2015-04-15	F	12:58 - 12:58	(1)
2015-04-16	F	03:15 - 03:15	(1)
2015-04-16	F	19:14 - 19:14	(1)
2015-04-25	F	11:17 - 11:17	(1)
2015-04-28	F	07:03 - 07:03	(1)
2015-05-08	F	10:54 - 10:54	(1)
2015-05-11	F	13:44 - 13:45	(2)
2015-05-13	F	01:01 - 01:01	(1)
2015-05-13	F	02:30 - 02:30	(1)
2015-05-13	F	06:38 - 06:38	(1)
2015-05-18	F	23:15 - 23:16	(2)
2015-05-27	F	00:09 - 00:15	(7)
2015-05-31	F	23:54 - 23:56	(3)
2015-05-31	F	23:59 -	
2015-06-01	F	- 00:00	(2)
2015-06-08	F	10:42 - 10:42	(1)
2015-06-09	F	14:33 - 14:33	(1)
2015-06-10	F	11:00 - 11:00	(1)

```
2015-06-15    F      01:57 - 01:57        (1)
2015-06-21    F      17:13 - 17:13        (1)
2015-06-23    F      02:00 - 02:00        (1)
2015-06-23    F      05:11 - 05:11        (1)
2015-06-25    F      08:50 - 08:50        (1)
2015-06-25    F      13:39 - 13:39        (1)
2015-06-25    F      14:44 - 14:44        (1)
2015-07-08    F      00:09 - 00:13        (5)
2015-07-09    F      13:56 - 13:56        (1)
2015-07-10    F      23:46 - 23:46        (1)
2015-07-12    F      23:22 - 23:22        (1)
2015-07-13    F      09:37 - 09:37        (1)
2015-07-16    F      21:08 -
2015-11-18    F            - 04:00  (178973)
2015-11-27    F      12:26 - 12:26        (1)
2015-11-27    F      14:31 - 14:31        (1)
2015-12-04    F      21:01 - 21:15       (15)
2015-12-10    F      13:12 - 13:12        (1)
2015-12-11    F      07:41 - 07:41        (1)
2015-12-14    F      14:48 - 14:48        (1)
2015-12-19    F      18:27 - 18:27        (1)
2015-12-20    F      00:54 - 00:54        (1)
2015-12-20    F      03:29 - 03:29        (1)
2015-12-20    F      05:29 - 05:29        (1)
2015-12-20    F      06:01 - 06:01        (1)
2015-12-20    F      06:14 - 06:14        (1)
2015-12-20    F      06:27 - 06:28        (2)
2015-12-20    F      12:14 - 12:14        (1)
2015-12-20    F      14:20 - 14:20        (1)
2015-12-22    F      10:40 - 10:40        (1)
2015-12-25    F      08:19 - 08:19        (1)
2015-12-29    F      11:30 - 11:30        (1)
2015-12-29    F      14:23 - 14:23        (1)
2015-12-30    F      13:59 - 14:00        (2)
2015-12-31    F      13:15 - 13:15        (1)

Total: 179090 (minutes) (124.37 days)
```

7.3.1.4 2016

```
                             CTA
          CHARTERS TOWERS OBSERVATORY INFORMATION 2016

ACKNOWLEDGE-  Users of the CTA data should acknowledge:
      -MENTS: Geoscience Australia

  STATION ID: CTA
    LOCATION: CHARTERS TOWERS, Queensland,
              Australia
ORGANISATION: Geoscience Australia

 CO-LATITUDE: 110.090
   LONGITUDE: 146.264
   ELEVATION: 370 m above mean sea level (top pier C)

    ABSOLUTE
 INSTRUMENTS: DIM: DMI model G fluxgate on Zeiss 020
                    with Pico ADC16
              PPM: GEM GSM90 Proton precession magnetometer
   RECORDING
```

```
 VARIOMETER:   Suspended DMI fluxgate
               magnetometer and GSM90 Proton precession
               magnetometer.
 ORIENTATION: Magnetic NW, NE and Vertical (ABZ)
     DYNAMIC
       RANGE: +/- 10000 nT
  RESOLUTION: 0.001 nT

    SAMPLING
        RATE: 1 second
 FILTER TYPE: 91 point Intermagnet

   K-NUMBERS: None
    K9-LIMIT: 300 nT

        GINS: Edinburgh
   SATELLITE: http upload

   OBSERVERS: B.M. Stevenson

     CONTACT: Geomagnetism Section
              Geoscience Australia
              G.P.O. Box 378
              Canberra, A.C.T., 2601
              Australia

              Tel: + 61-2-6249-9111
              Fax: + 61-2-6249-9986
              e-mail: geomag@ga.gov.au
              WWW: http://www.ga.gov.au/

Notes:
-----
Charters Towers is 120 km southwest of
Townsville in north Queensland. The Charters Towers
magnetic observatory is located at Towers Hill, 1.7 km
southwest of the town centre, in an area leased to
Geoscience Australia by the Charters Towers Regional
Council.
The observatory comprises:
  - a disused gold mine adit ("the tunnel") approximately
    100 m into the northern side of Towers Hill, which
    houses the magnetic variometers;
  - an absolute shelter on a hillside approximately 150 m
    to the south-west of the tunnel, and
  - a VSAT communications dish outside the tunnel.

Continuous magnetic-field recording commenced at the
observatory in June 1983.
Power and communication facilities are shared between
the geomagnetic observatory and seismic station which
is co-located in the tunnel.

Key data for the observatory are summarised in Table 1.

IAGA code                 : CTA
Commenced operation       : June 1983
Geographic latitude       : 20d 05' 25" S
Geographic longitude      : 146d 15' 51" E
Geomagnetic latitude      : -27.84d
Geomagnetic longitude     : 220.99d
```

```
K 9 index lower limit     : 300 nT
Principal pier            : Pier C
Pier elevation (top)      : 370 m AMSL
Principal reference mark  : Post Office spire
Reference mark azimuth    : 34d 40' 45"
Reference mark distance   : 1.75 km
Observers                 : B.M. Stevenson
```

Table 1 Key observatory data.
---------- Geographic coordinates are derived using the
            Geodetic Datum of Australia 1994 (GDA94)

Local Meteorological Conditions

The meteorological temperature at Charters Towers during 2016 at Charters Towers airport, about 5 km from the observatory site, varied from a minimum 6 C (2016-06-30) to a maximum 41 C (2016-02-18). Daily minimum temperatures varied from 6 C to 27 C (average 19+/-4 C); daily maximum temperatures varied from 13 C to 41 C (average 31+/-4 C); daily temperature ranges varied from 1 C to 20 C (average 12+/-3 C).
Daily weather observations for Chaters Towers airport (station ID 034084) provided by Australian Government, Bureau of Meteorology.

Variometers

The variometers used during 2016 are listed in Table 2.
The DMI FGE suspended 3-component fluxgate magnetometer has the sensor mounted on an aerated concrete pillar and orientated magnetic-NW, magnetic-NE, and vertical. The entire pillar and sensor was enclosed by an insulating foam box to slow any temperature variations.
The DMI electronics and ObsDaq digitiser are installed in a thermally insulated plastic box. The fluxgate analogue data were digitised with an ObsDaq 24 bit digital-to-analogue converter. The native 128 samples per second (sps) from the ObsDaq were filtered to 16 sps and again to 1 sps using guassian filters. The DMI fluxgate has a range of +/- 10000 nT and resolution of 1 pT.
The DMI fluxgate variometer is a 12 V DC instrument and power for the ObsDaq was supplied from the DMI electronics.
A GEM Systems GSM90 overhauser total field magnetometer monitored variations of the magnetic total intensity with 10 sps.
Acquisition system timing is derived from the acquisition computer clock which is corrected with a Garmin GPS-16 clock.
There is no active temperature control inside the Charters Towers tunnel but the temperature measured at the fluxgate magnetometer sensor and electronics shows no diurnal variation and a temperature range of 1.6 degrees celsius throughout the year. The temperature varied most rapidly in the colder months between May and September.
The definitive one-minute data were calculated from the one-second data using INTERMAGNET gaussian digital filtering on both the vector and scalar data. Data losses from the one-minute data set are detailed below.
From 2016-09-27T04:30, after a sudden sub-nanoTesla jump in the scalar magnetometer baseline, regular interference

started affecting the vertical channel of the vector data and the scalar total field data. The interference took the form of a regular sub-nanotesla (0.2 nT) decrease in the Z channel lasting several seconds and re-occurring about every 18 minutes. This problem decreased slowly but persisted into December. The cause of the interference is unknown but electrical interference from battery charging is suspected. This interference remains in the dataset and is visible in the Fv-Fs data channel. No automatic de-spiking was used in preparing the definitive data but periods of contaminated data or single point spikes were excluded from processing after visual inspection. Data affected by earthquakes were also excluded. See the data loss and significant events tables below for more information

```
3-component variometer    : DMI FGE (Version G)
Serial number             : E0462/S0227
Type                      : suspended; linear fluxgate
Orientation               : magnetic NW, NE, Z
Acquisition interval      : 1 s
Resolution                : 0.001 nT
A/D converter             : ObsDaq 24-bit S/N OD-55C0E002
Total-field variometer    : GEM Systems GSM 90
Serial number             : 4081420/42178
Type                      : Overhauser effect
Acquisition interval      : 10 s
Resolution                : 0.01 nT
Data acquisition system   : Geoscience Australia
                          : Geophysical Data Acquistion
                          : Platform (GDAP)
                          : ARK3360F computer, QNX6.5 OS
Timing                    : Garmin GPS16 clock
Communications            : VSAT TCP/IP network
```

Table 2 Magnetic variometers.

Variometer Clock Corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. Automatic adjustments to the system clock were greater than 1 ms on the following occasion:

```
2016-08-22      04:06:42     1.796 s  system reboot
```

Absolute Instruments

The principal absolute magnetometers used at CTA and their adopted corrections are listed in Table 3.

```
DI fluxgate               : DMI
Serial number             : DI0036D + Pico ADC16 GJY03/100
Theodolite                : Zeiss 020B
Serial number             : 394050
Resolution                :  0.1'
D correction              :  0.0'
I correction              : -0.2'
```

```
Total-field magnetometer  : GEM Systems GSM90
Serial number             : 3091318/91472
Type                      : Overhauser effect
Resolution                : 0.01 nT
Correction                : 0.0 nT
```

```
Table 3       Absolute magnetometers
----------    and their adopted corrections.
              Instrument corrections are applied in the
              sense Standard = Instrument + correction.
```

The variometers at CTA are calibrated nominally weekly with a pair of absolute observations. Both absolute PPM and DIM observations are performed on Pier C in the absolute shelter. The offset method is used for all DIM observations. A Pico ADC-16 analogue to digital converter digitised the analogue output from the DIM fluxgate which was recorded on a Getac Tablet PC running Windows-7 and the Geoscience Australia "GObs" absolute observation data acquisition software.
The principal absolute magnetometers used and their adopted corrections are listed in Table 3. The D and I corrections were determined through instrument comparisons performed during maintenance and calibration visits, most recently in May 2014. Instrument corrections are to the international reference. At the 2016 all-day mean field levels at Charters Towers these D, I and F corrections convert to:

```
  X: -2.2nT       Y: -0.3 nT       Z: -1.9 nT
```

These instrument corrections have been applied to data throughout the year.

Baselines

Derivation of final baseline parameters for the fluxgate variometer was done by manual fitting a piece-wise linear function, including steps as required, to the weekly observed absolute observations baseline residuals. There were 53 pairs of absolute observations used to adopt baselines throughout the year.
The baseline drifts had a range of about 2 nT in the X and Z components throughout the year. The Y components baselines drifted over a range of about 10 nT. There were two sub nanoTelsa baseline jumps of unknown cause on the vector fluxgate data.
The difference between total field observations derived from the vector fluxgate and total field measured from the continuously recording variometer scalar magnetometer drifted over a range of about 1 nT over the year, probably due to environmental changes driven by ground-water in the tunnel. This difference was corrected using steps when required. There were also several unexplained sudden jumps in the scalar baseline, possibly caused by rock movements within the tunnel.
The standard deviations of the difference between the weekly absolute observations and the final adopted vector variometer model and data were:

	Std Dev
D	05"
I	02"

H	0.3 nT
F	0.2 nT
X	0.3 nT
Y	0.7 nT
Z	0.3 nT

Throughout the year the difference between the final total field derived from the vector variometer and the total field measured with the scalar variometer after baseline corrections (Fv - Fs) varied over a range of about 0.75 nT.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of monthly averages of the difference between the definitive one-minute data and real time reported 1-minute data-sets (definitive - real time) were:

	X	Y	Z
Average	-0.4	1.1	-0.2
Std.dev	0.7	1.4	0.1
Min	-2.0	-0.9	-0.4
Max	0.5	3.4	0.1

The reported real time data are within the specification for INTERMAGNET quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.
The annual statistics of the monthly averages of the difference between the definitive one-minute data and quasi-definitive 1-minute data sets (definitive - quasi-definitive) were:

	X	Y	Z
Average	0.0	0.0	0.0
Std.dev	0.3	0.3	0.1
Min	-0.4	-0.6	-0.1
Max	0.6	0.6	0.3

The quasi-definitive data are within the specification for INTERMAGNET quasi-definitive data.

Operations

The on-site observer-in-charge at CTA observatory, Mr Brad Stevenson, performed weekly absolute observations and checks.
The 1-second vector data and 10 second total field data were recorded to daily data files using the Geophysical Data Acquisition platform software running on an ARK3360F industrial computer using the QNX operating system. Data files were uploaded to Geoscience Australia in Canberra through a VSAT TCP/IP network. Data transfer delay time was between 2 to 15 minutes.
From 2016-10-05 the obsDaq digitiser state-of-health (SOH) information was also logged to file. SOH data recorded the ObsDaq input supply voltage and internal temperature at 1 second intervals.
The GPS clock used to maintain system timing received a re-transmitting GPS signal within the tunnel via a GPS antenna mounted with a clear view of the sky outside the tunnel portal.

Repair work to the tunnel support structures commenced in early November and continued into December. The work did not cause any significant disruption to the observatory operations.

The distribution of Charters Towers data is described in Table 4. Preliminary one-minute data were also available on the GA web (http://www.ga.gov.au).

Data losses are identified below.

Recipient	Status	Sent
1-second values		
BoM Space Weather Services	reported	realtime
INTERMAGNET	reported	hourly
1-minute values		
INTERMAGNET	reported	realtime
INTERMAGNET	reported	daily
INTERMAGNET	definitive	July 2017
INTERMAGNET	quasidefintive	monthly
WDC for Geomagnetism (Japan)	reported	realtime

Table 4 Distribution of Charters Towers data.

Significant Events

2016-01-12/14	Seismic system maintenance work
2016-01-29	06:43:23 jump in X and Z channels. Possibly during electrical storm 08:30 Earthquake
2016-04-22	04:30 Fire extinguisher inspection in the tunnel. Control room airconditioner not working
2016-05-03	Civil works on Towers Hill road until 06 May Construction on walking path from external GA seismic building to top of the Towers Hill
2016-06-20	01UT engineering inspection of tunnel
2016-07-06	07:40 vector data contamination
2016-08-18	04:30 Magnitude 5.8 earthquake near Bowen, Queensland
2016-08-22	04:04 reboot ga-cta-mag1 to clear tcp stack (uptime 279 days before reboot)
2016-09-27	04:29:30 0.5 nT Fv-Fs jump followed by periodic interference in Z channel every 18 minutes lasting throughout Sep/Oct/Nov. The cause is unknown but possibly related to battery charging.
2016-10-05	Set up CTS (CTA State-of-health) data logging on acquisition computer to record: DMI sensor temp; DMI electronics temp; obsdaq input voltage; obsdaq temperature
2016-10-11	Start auto download for state-of-health files
2016-10-12	Initialise SOH logging on system reboots. 23:10 Fire extinguisher checks Some data contamination
2016-10-13	01UT Change data downloads from two-hop via rhe-geomag and DC-prod1 to direct-get via rhe-geomag
2016-11-07	Tunnel repair work to commence this week and continue for three weeks
2016-11-21	Evidence of tunnel work ~23:46 and 23:52

```
2016-12-21    00:17  Mag6.9 earthquake in Banda Sea

K-Indices
----------
No magnetic indices are routinely scaled for the
Charters Towers Observatory.

Annual Mean Values
------------------
The annual mean values for Charters Towers are available in
the file "yearmean.cta" and graphically through the
IMCDView software.

Hourly Mean Values
------------------
Plots of hourly mean values for Charters Tower are
available through the IMCDView software.

Data Losses
-----------
2016-01-12    XYZ     21:54 - 21:55   (2)
2016-01-12    XYZ     22:00 - 22:00   (1)
2016-01-12    XYZ     23:10 - 23:11   (2)
2016-01-12    XYZ     23:22 - 23:22   (1)
2016-01-13    XYZ     01:58 - 01:58   (1)
2016-01-13    XYZ     02:11 - 02:11   (1)
2016-01-13    XYZ     02:20 - 02:20   (1)
2016-01-13    XYZ     04:32 - 04:32   (1)
2016-01-13    XYZ     04:37 - 04:37   (1)
2016-01-13    XYZ     04:43 - 04:43   (1)
2016-01-13    XYZ     04:49 - 04:49   (1)
2016-01-13    XYZ     04:55 - 04:55   (1)
2016-01-13    XYZ     05:08 - 05:08   (1)
2016-01-13    XYZ     05:26 - 05:26   (1)
2016-01-13    XYZ     05:42 - 05:42   (1)
2016-01-13    XYZ     23:54 -
2016-01-14    XYZ           - 00:00   (7)
2016-01-14    XYZ     00:03 - 00:03   (1)
2016-01-14    XYZ     00:13 - 00:14   (2)
2016-01-14    XYZ     00:22 - 00:22   (1)
2016-01-14    XYZ     00:27 - 00:27   (1)
2016-01-14    XYZ     01:32 - 01:32   (1)
2016-01-14    XYZ     05:24 - 05:25   (2)
2016-01-14    XYZ     05:57 - 05:57   (1)
2016-01-14    XYZ     21:43 - 21:44   (2)
2016-01-15    XYZ     01:23 - 01:23   (1)
2016-01-15    XYZ     01:25 - 01:25   (1)
2016-01-15    XYZ     02:02 - 02:02   (1)
2016-01-15    XYZ     02:08 - 02:09   (2)
2016-01-25    XYZ     11:09 - 11:09   (1)
2016-01-25    XYZ     11:22 - 11:22   (1)
2016-01-25    XYZ     11:31 - 11:31   (1)
2016-01-25    XYZ     11:37 - 11:37   (1)
2016-01-25    XYZ     11:39 - 11:39   (1)
2016-01-25    XYZ     11:52 - 11:52   (1)
2016-01-25    XYZ     11:54 - 11:54   (1)
2016-01-25    XYZ     12:09 - 12:09   (1)
2016-01-25    XYZ     12:35 - 12:35   (1)
2016-01-25    XYZ     15:08 - 15:08   (1)
2016-01-25    XYZ     15:21 - 15:21   (1)
2016-01-25    XYZ     15:24 - 15:24   (1)
```

2016-02-06	XYZ	05:28 - 05:28	(1)
2016-02-06	XYZ	05:50 - 05:51	(2)
2016-02-06	XYZ	05:57 - 05:57	(1)
2016-02-06	XYZ	05:59 - 05:59	(1)
2016-02-06	XYZ	06:03 - 06:04	(2)
2016-02-06	XYZ	06:08 - 06:08	(1)
2016-02-06	XYZ	06:12 - 06:12	(1)
2016-02-06	XYZ	06:15 - 06:15	(1)
2016-02-06	XYZ	06:20 - 06:20	(1)
2016-02-17	XYZ	11:51 - 11:52	(2)
2016-02-29	XYZ	15:22 - 15:22	(1)
2016-02-29	XYZ	15:24 - 15:25	(2)
2016-02-29	XYZ	15:29 - 15:30	(2)
2016-02-29	XYZ	15:33 - 15:33	(1)
2016-02-29	XYZ	15:44 - 15:44	(1)
2016-02-29	XYZ	15:51 - 15:51	(1)
2016-02-29	XYZ	15:53 - 15:53	(1)
2016-02-29	XYZ	15:56 - 15:56	(1)
2016-02-29	XYZ	15:58 - 15:58	(1)
2016-02-29	XYZ	16:01 - 16:01	(1)
2016-02-29	XYZ	16:08 - 16:08	(1)
2016-02-29	XYZ	16:16 - 16:16	(1)
2016-03-02	XYZ	13:14 - 13:24	(11)
2016-03-08	XYZ	02:37 - 02:39	(3)
2016-03-08	XYZ	03:10 - 03:10	(1)
2016-03-17	XYZ	13:41 - 13:42	(2)
2016-03-30	XYZ	12:44 - 12:44	(1)
2016-04-22	XYZ	04:36 - 04:36	(1)
2016-04-29	XYZ	02:23 - 02:24	(2)
2016-04-29	XYZ	02:36 - 02:36	(1)
2016-05-20	XYZ	18:23 - 18:25	(3)
2016-06-01	XYZ	22:49 - 22:51	(3)
2016-06-01	XYZ	23:00 - 23:01	(2)
2016-06-01	XYZ	23:09 - 23:10	(2)
2016-06-03	XYZ	05:38 - 05:39	(2)
2016-06-03	XYZ	05:52 - 05:53	(2)
2016-06-15	XYZ	11:49 - 11:49	(1)
2016-06-16	XYZ	05:43 - 05:46	(4)
2016-06-16	XYZ	06:00 - 06:03	(4)
2016-06-20	XYZ	00:52 - 00:53	(2)
2016-06-20	XYZ	04:57 - 04:58	(2)
2016-06-20	XYZ	05:29 - 05:30	(2)
2016-06-30	XYZ	06:52 - 06:53	(2)
2016-06-30	XYZ	07:09 - 07:23	(15)
2016-06-30	XYZ	07:49 - 07:51	(3)
2016-07-12	XYZ	04:25 - 04:26	(2)
2016-07-12	XYZ	04:50 - 04:50	(1)
2016-07-27	XYZ	02:02 - 02:03	(2)
2016-07-27	XYZ	02:21 - 02:22	(2)
2016-07-27	XYZ	03:58 - 03:59	(2)
2016-07-27	XYZ	04:05 - 04:06	(2)
2016-07-27	XYZ	07:58 - 07:59	(2)
2016-07-27	XYZ	08:09 - 08:09	(1)
2016-07-27	XYZ	09:17 - 09:19	(3)
2016-08-13	XYZ	00:51 - 00:52	(2)
2016-08-13	XYZ	01:29 - 01:30	(2)
2016-08-17	XYZ	03:35 - 03:45	(11)
2016-08-18	XYZ	04:31 - 04:34	(4)
2016-08-22	XYZ	04:04 - 04:05	(2)
2016-09-03	XYZ	08:46 - 08:46	(1)
2016-09-08	XYZ	00:44 - 00:47	(4)

2016-09-08	XYZ	01:17 - 01:21	(5)
2016-09-08	XYZ	07:35 - 07:39	(5)
2016-09-08	XYZ	08:08 - 08:09	(2)
2016-09-08	XYZ	09:30 - 09:34	(5)
2016-09-08	XYZ	23:42 - 23:42	(1)
2016-09-23	XYZ	19:26 - 20:47	(82)
2016-10-12	XYZ	23:04 - 23:06	(3)
2016-11-12	XYZ	09:18 - 09:18	(1)
2016-11-12	XYZ	09:24 - 09:24	(1)
2016-11-12	XYZ	09:34 - 09:34	(1)
2016-11-12	XYZ	09:44 - 09:45	(2)
2016-11-12	XYZ	09:53 - 09:53	(1)
2016-11-13	XYZ	11:19 - 11:28	(10)
2016-12-08	XYZ	17:43 - 18:08	(26)
2016-12-10	XYZ	08:12 - 08:12	(1)
2016-12-10	XYZ	08:19 - 08:19	(1)
2016-12-10	XYZ	08:21 - 08:21	(1)
2016-12-10	XYZ	08:32 - 08:32	(1)
2016-12-10	XYZ	08:34 - 08:34	(1)
2016-12-10	XYZ	08:43 - 08:43	(1)
2016-12-10	XYZ	09:23 - 09:23	(1)
2016-12-10	XYZ	09:30 - 09:30	(1)
2016-12-10	XYZ	09:42 - 09:45	(4)
2016-12-10	XYZ	09:49 - 09:49	(1)
2016-12-17	XYZ	10:55 - 11:15	(21)
2016-12-31	XYZ	07:05 - 07:05	(1)
2016-12-31	XYZ	07:07 - 07:07	(1)
2016-12-31	XYZ	07:11 - 07:11	(1)

Total: 375 (0.26 days)

2016-01-12	F	21:53 - 21:56	(4)
2016-01-12	F	23:23 - 23:23	(1)
2016-01-13	F	01:58 - 01:58	(1)
2016-01-13	F	02:01 - 02:02	(2)
2016-01-13	F	02:11 - 02:11	(1)
2016-01-13	F	02:20 - 02:20	(1)
2016-01-13	F	02:22 - 02:22	(1)
2016-01-13	F	02:24 - 02:26	(3)
2016-01-13	F	02:29 - 02:30	(2)
2016-01-13	F	04:32 - 04:34	(3)
2016-01-13	F	04:39 - 04:40	(2)
2016-01-13	F	04:43 - 04:43	(1)
2016-01-13	F	04:45 - 04:46	(2)
2016-01-13	F	04:54 - 04:56	(3)
2016-01-13	F	05:00 - 05:00	(1)
2016-01-13	F	05:07 - 05:08	(2)
2016-01-13	F	05:10 - 05:12	(3)
2016-01-13	F	05:26 - 05:27	(2)
2016-01-13	F	05:42 - 05:42	(1)
2016-01-13	F	23:35 -	
2016-01-14	F	- 00:00	(26)
2016-01-14	F	00:03 - 00:03	(1)
2016-01-14	F	00:13 - 00:14	(2)
2016-01-14	F	00:22 - 00:22	(1)
2016-01-14	F	00:27 - 00:28	(2)
2016-01-14	F	01:31 - 01:33	(3)
2016-01-14	F	05:24 - 05:26	(3)
2016-01-14	F	05:55 - 05:57	(3)
2016-01-15	F	01:23 - 01:25	(3)
2016-01-15	F	02:02 - 02:02	(1)

```
2016-01-15     F       02:08 - 02:09    (2)
2016-02-05     F       05:50 - 05:50    (1)
2016-02-05     F       08:02 - 08:03    (2)
2016-02-16     F       14:20 - 14:21    (2)
2016-02-29     F       15:44 - 15:44    (1)
2016-04-03     F       15:21 - 15:21    (1)
2016-04-06     F       13:56 - 13:57    (2)
2016-04-22     F       04:36 - 04:36    (1)
2016-05-30     F       16:25 - 16:25    (1)
2016-06-05     F       21:59 - 21:59    (1)
2016-06-20     F       00:51 - 00:54    (4)
2016-06-23     F       03:48 - 03:48    (1)
2016-06-24     F       10:58 - 10:58    (1)
2016-07-02     F       13:18 - 13:19    (2)
2016-07-09     F       04:16 - 04:16    (1)
2016-07-13     F       05:23 - 05:23    (1)
2016-07-25     F       08:52 - 08:52    (1)
2016-07-25     F       08:54 - 08:54    (1)
2016-08-22     F       04:04 - 04:05    (2)
2016-08-23     F       19:54 - 19:54    (1)
2016-09-01     F       14:01 - 14:01    (1)
2016-09-05     F       09:37 - 09:37    (1)
2016-09-20     F       20:01 - 20:01    (1)
2016-09-23     F       19:26 - 20:47   (82)
2016-09-25     F       11:47 - 11:48    (2)
2016-09-25     F       15:54 - 15:54    (1)
2016-10-02     F       11:11 - 11:12    (2)
2016-10-02     F       11:43 - 11:44    (2)
2016-10-04     F       11:26 - 11:26    (1)
2016-10-05     F       03:46 - 03:46    (1)
2016-10-12     F       23:04 - 23:06    (3)
2016-10-15     F       11:47 - 11:47    (1)
2016-10-17     F       10:33 - 10:33    (1)
2016-10-30     F       04:38 - 04:38    (1)
2016-11-10     F       06:28 - 06:28    (1)
2016-11-10     F       06:55 - 06:55    (1)
2016-11-10     F       07:04 - 07:04    (1)
2016-11-12     F       09:34 - 09:34    (1)
2016-11-12     F       09:49 - 09:49    (1)
2016-11-12     F       17:32 - 17:33    (2)
2016-11-13     F       14:39 - 14:40    (2)
2016-11-25     F       04:41 - 04:41    (1)
2016-12-09     F       14:13 - 14:13    (1)
2016-12-10     F       08:32 - 08:32    (1)
2016-12-10     F       09:23 - 09:23    (1)
2016-12-10     F       09:30 - 09:30    (1)
2016-12-10     F       09:49 - 09:49    (1)
2016-12-10     F       09:57 - 09:58    (2)
2016-12-21     F       15:53 - 15:54    (2)
2016-12-23     F       09:56 - 09:56    (1)
2016-12-25     F       10:52 - 10:52    (1)
2016-12-25     F       11:33 - 11:34    (2)

Total: 233 (0.16 days)
```

7.3.2 Baseline values

7.3.2.1 2013

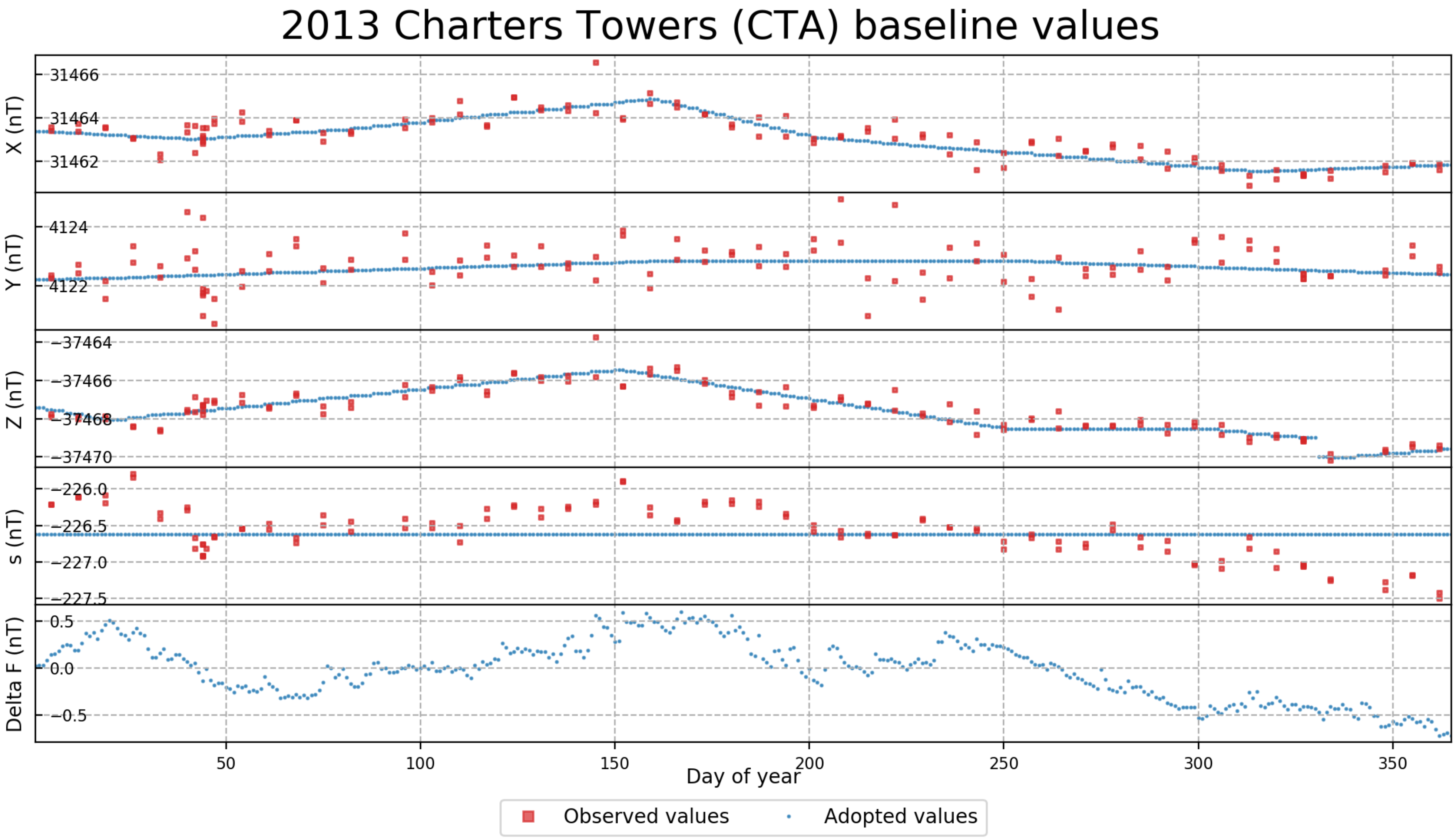

Figure 7.13 Charters Towers (CTA) baseline values for 2013. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.3.2.2 2014

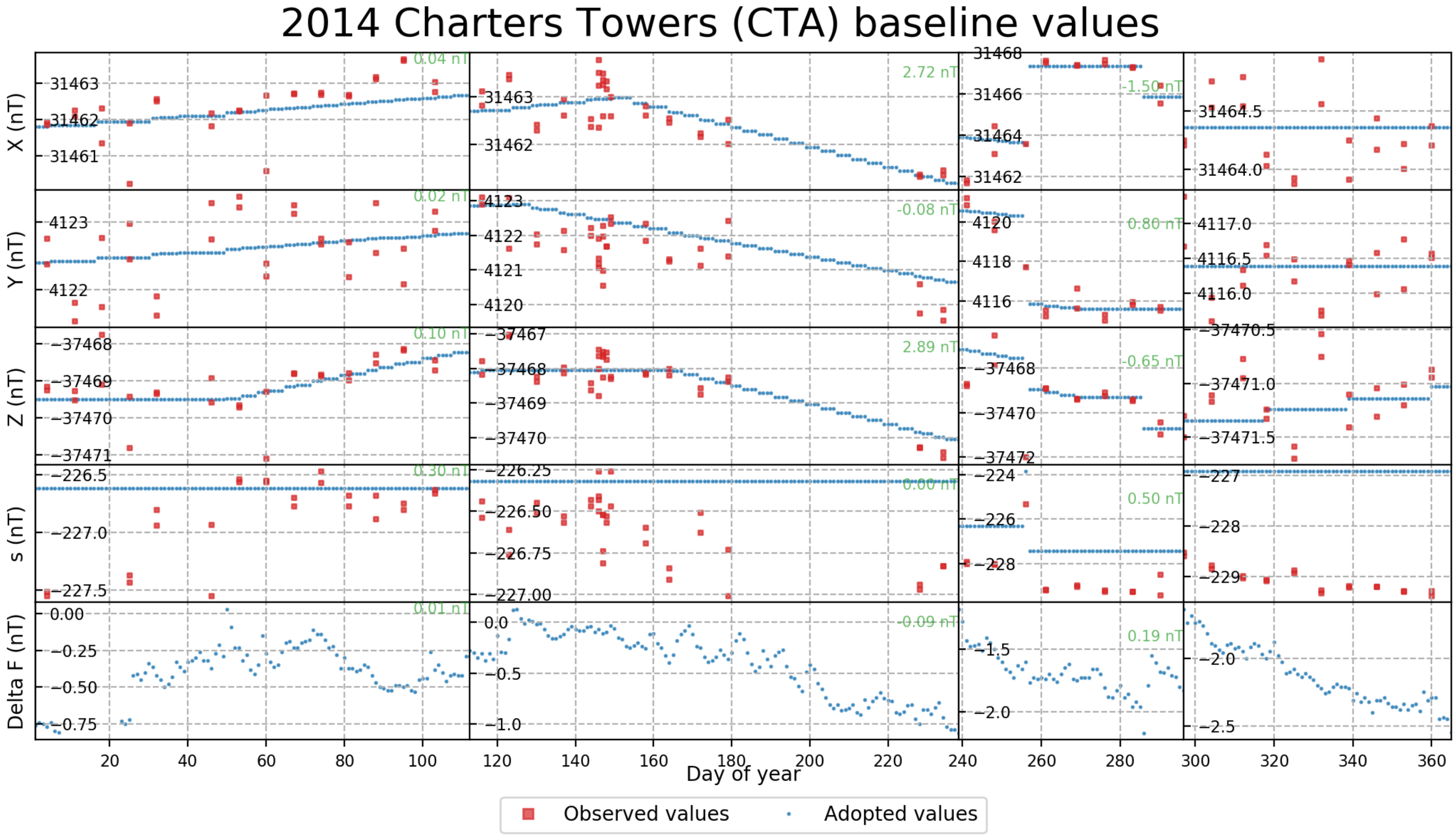

Figure 7.14 Charters Towers (CTA) baseline values for 2014. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.3.2.3 2015

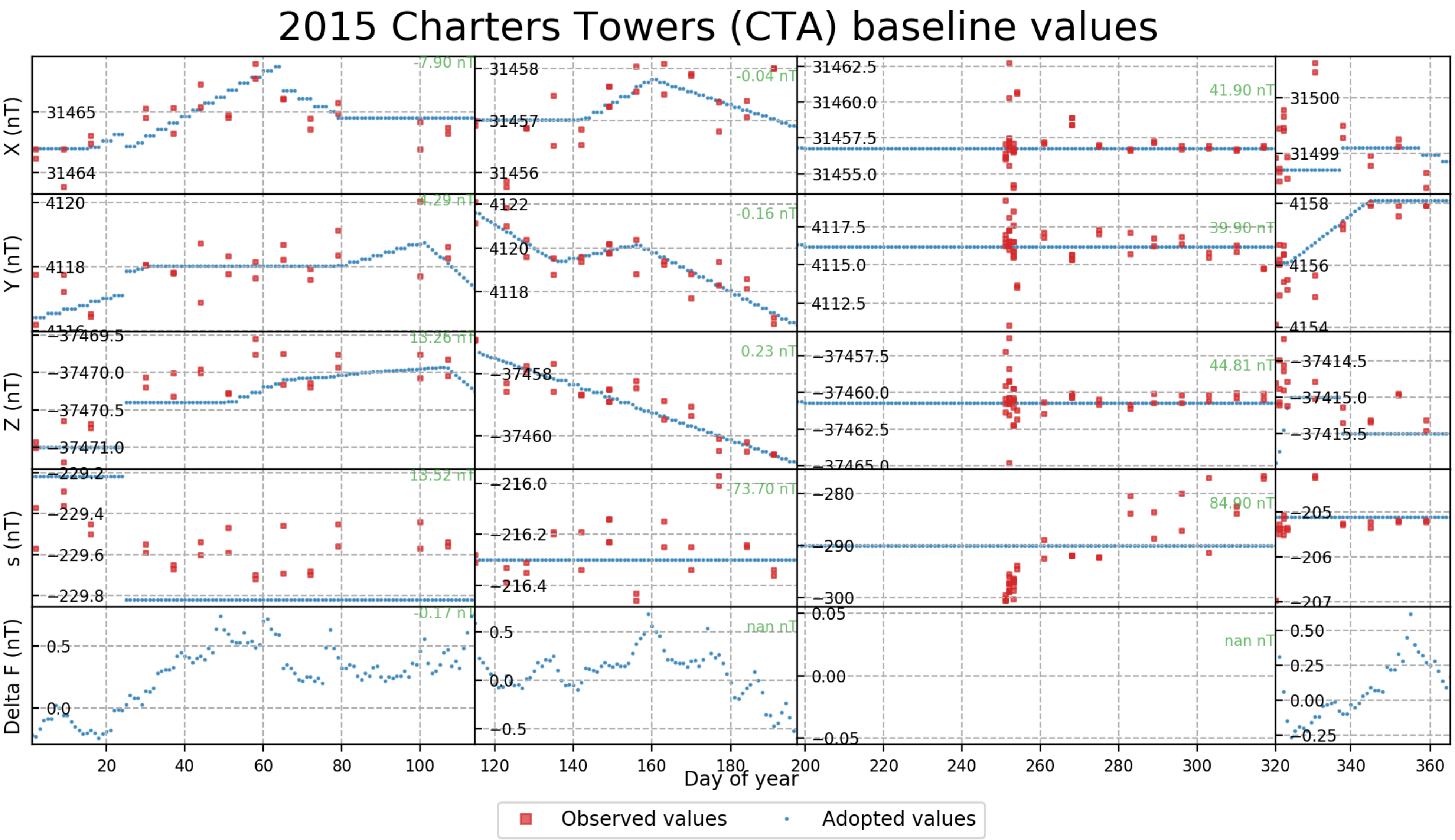

Figure 7.15 Charters Towers (CTA) baseline values for 2015. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.3.2.4 2016

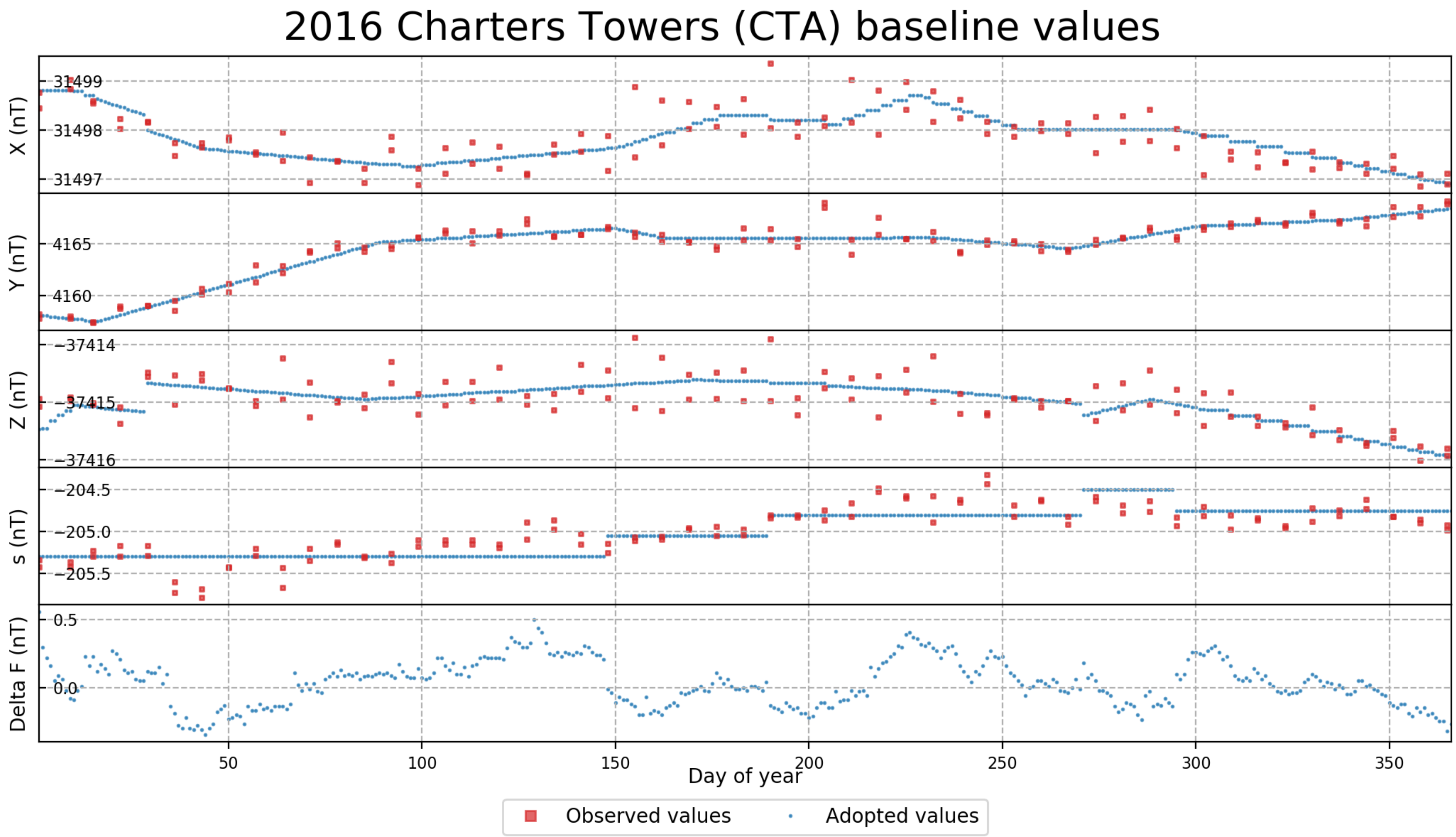

Figure 7.16 Charters Towers (CTA) baseline values for 2016. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.3.3 Annual mean values

7.3.3.1 DIH

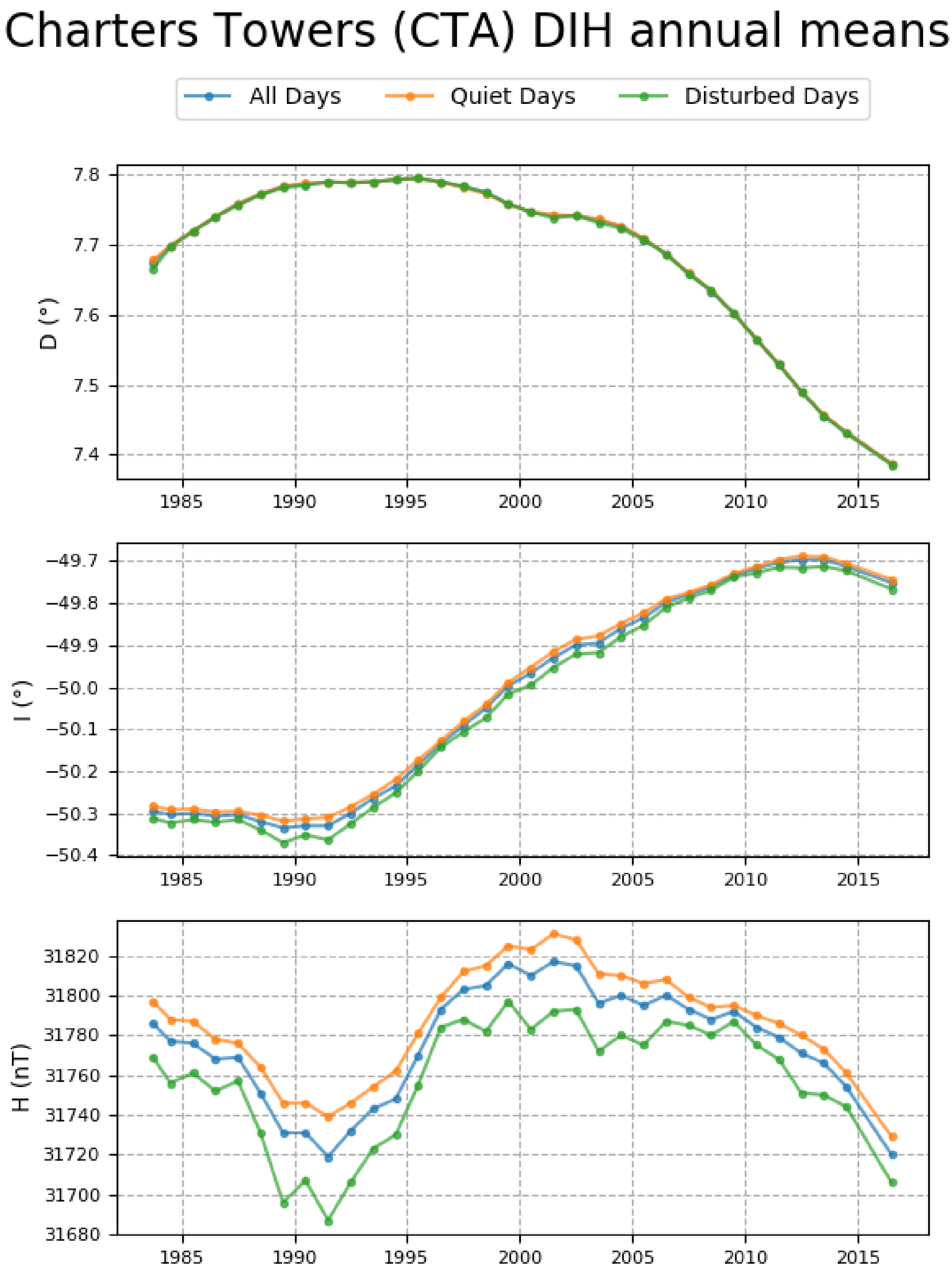

Figure 7.17 Charters Towers (CTA) annual mean values in DIH until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.3.3.2 XYZF

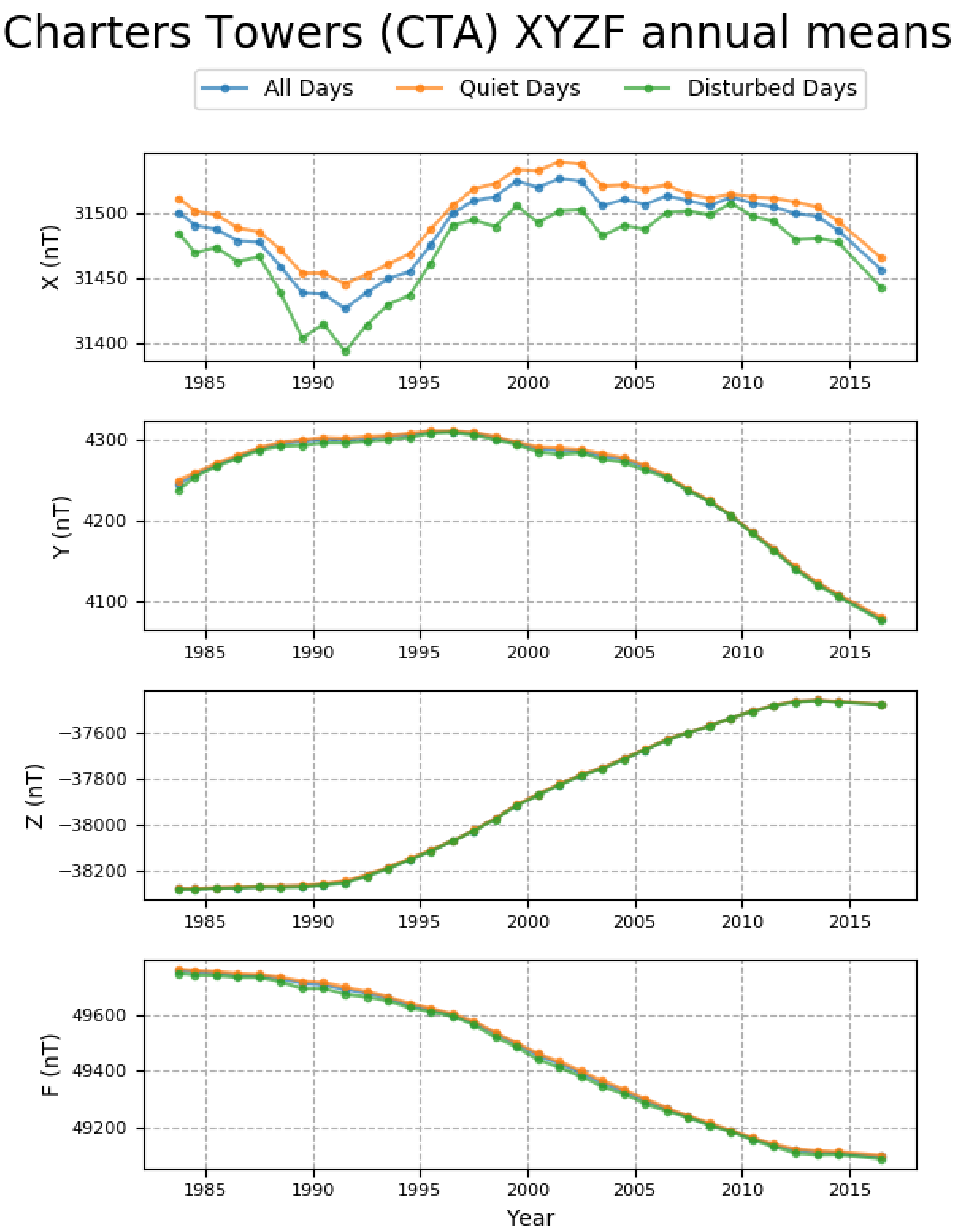

Figure 7.18 Charters Towers (CTA) annual mean values in XYZF until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.3.3.3 2016 INTERMAGNET annual mean values file

ANNUAL MEAN VALUES

CHARTERS TOWERS, CTA, AUSTRALIA

COLATITUDE: 110.090   LONGITUDE: 146.264 E   ELEVATION:370 metres

YEAR	D		I		H	X	Y	Z	F	*	ELE	Note
	Deg	Min	Deg	Min	nT	nT	nT	nT	nT			
1983.729	7	40.4	-50	17.7	31786	31501	4244	-38280	49756	A	XYZ	
1984.500	7	41.9	-50	18.2	31777	31491	4256	-38280	49751	A	XYZ	
1985.500	7	43.2	-50	18.0	31776	31488	4268	-38276	49747	A	XYZ	
1986.500	7	44.4	-50	18.4	31768	31479	4278	-38274	49740	A	XYZ	
1987.500	7	45.5	-50	18.2	31769	31478	4288	-38271	49738	A	XYZ	
1988.500	7	46.3	-50	19.2	31751	31459	4294	-38270	49727	A	XYZ	
1989.500	7	47.0	-50	20.1	31731	31439	4297	-38267	49711	A	XYZ	
1990.500	7	47.2	-50	19.8	31731	31438	4299	-38260	49706	A	XYZ	
1991.500	7	47.4	-50	19.8	31719	31427	4299	-38248	49689	A	XYZ	
1992.500	7	47.3	-50	18.0	31732	31439	4300	-38221	49676	A	XYZ	
1993.500	7	47.4	-50	15.9	31743	31450	4303	-38188	49658	A	XYZ	
1994.500	7	47.6	-50	14.1	31748	31455	4305	-38151	49633	A	XYZ	
1995.500	7	47.7	-50	11.1	31770	31476	4309	-38112	49617	A	XYZ	
1996.500	7	47.4	-50	08.1	31793	31500	4309	-38071	49600	A	XYZ	
1997.500	7	47.0	-50	05.5	31803	31510	4307	-38024	49571	A	XYZ	
1998.500	7	46.5	-50	03.0	31805	31513	4302	-37972	49533	A	XYZ	
1999.500	7	45.5	-49	59.8	31816	31525	4295	-37913	49494	A	XYZ	1
2000.500	7	44.8	-49	58.0	31810	31520	4288	-37866	49455	A	XYZ	2
2001.500	7	44.5	-49	55.8	31817	31527	4286	-37823	49426	A	ABZ	
2002.500	7	44.5	-49	54.0	31815	31525	4285	-37781	49392	A	ABZ	
2003.500	7	44.1	-49	53.7	31796	31506	4279	-37751	49357	A	ABZ	
2004.500	7	43.6	-49	51.6	31800	31511	4275	-37710	49328	A	ABZ	
2005.500	7	42.5	-49	50.1	31795	31507	4265	-37670	49294	A	ABZ	
2006.500	7	41.2	-49	47.9	31800	31514	4253	-37627	49265	A	ABZ	
2007.500	7	39.5	-49	46.8	31793	31510	4237	-37596	49237	A	ABZ	3
2008.500	7	38.0	-49	45.7	31788	31506	4223	-37565	49210	A	ABZ	
2009.500	7	36.1	-49	44.0	31792	31513	4205	-37532	49187	A	ABZ	
2010.500	7	33.9	-49	43.1	31784	31508	4185	-37503	49160	A	ABZ	
2011.500	7	31.7	-49	42.2	31779	31505	4164	-37477	49137	A	ABZ	
2012.500	7	29.4	-49	41.8	31771	31500	4141	-37459	49118	A	ABZ	
2013.500	7	27.3	-49	41.8	31766	31498	4122	-37454	49111	A	ABZ	
2014.500	7	25.9	-49	42.8	31754	31487	4107	-37461	49108	A	ABZ	
2015.500	7	24.6	-49	44.9	31726	31461	4092	-37473	49100	I	ABZ	4
2016.500	7	23.2	-49	45.1	31720	31457	4078	-37472	49095	A	ABZ	
1983.729	7	40.7	-50	17.0	31797	31512	4249	-38278	49761	Q	XYZ	
1984.500	7	41.9	-50	17.5	31788	31502	4258	-38278	49756	Q	XYZ	
1985.500	7	43.2	-50	17.4	31787	31499	4270	-38274	49752	Q	XYZ	
1986.500	7	44.4	-50	17.8	31778	31489	4280	-38272	49745	Q	XYZ	
1987.500	7	45.5	-50	17.7	31776	31486	4289	-38269	49742	Q	XYZ	
1988.500	7	46.4	-50	18.3	31764	31472	4296	-38268	49733	Q	XYZ	
1989.500	7	47.0	-50	19.1	31746	31454	4299	-38265	49719	Q	XYZ	
1990.500	7	47.3	-50	18.8	31746	31454	4302	-38257	49714	Q	XYZ	
1991.500	7	47.3	-50	18.6	31739	31446	4301	-38244	49698	Q	XYZ	
1992.500	7	47.4	-50	17.1	31746	31453	4303	-38218	49683	Q	XYZ	
1993.500	7	47.4	-50	15.3	31754	31461	4304	-38185	49663	Q	XYZ	
1994.500	7	47.6	-50	13.2	31762	31469	4307	-38148	49640	Q	XYZ	
1995.500	7	47.7	-50	10.4	31781	31488	4310	-38109	49622	Q	XYZ	
1996.500	7	47.4	-50	07.7	31799	31506	4310	-38070	49603	Q	XYZ	
1997.500	7	46.9	-50	04.9	31812	31519	4308	-38023	49576	Q	XYZ	
1998.500	7	46.4	-50	02.5	31815	31523	4303	-37971	49537	Q	XYZ	

1999.500	7 45.5	-49 59.3	31825	31534	4296	-37911	49499	Q	XYZ	1
2000.500	7 44.8	-49 57.2	31823	31533	4290	-37864	49461	Q	XYZ	2
2001.500	7 44.6	-49 54.9	31831	31540	4289	-37821	49433	Q	ABZ	
2002.500	7 44.5	-49 53.2	31828	31538	4287	-37780	49400	Q	ABZ	
2003.500	7 44.2	-49 52.7	31811	31521	4282	-37749	49365	Q	ABZ	
2004.500	7 43.6	-49 50.9	31810	31522	4277	-37708	49334	Q	ABZ	
2005.500	7 42.6	-49 49.4	31806	31519	4267	-37668	49300	Q	ABZ	
2006.500	7 41.2	-49 47.4	31808	31522	4255	-37625	49269	Q	ABZ	
2007.500	7 39.6	-49 46.5	31799	31515	4238	-37595	49240	Q	ABZ	3
2008.500	7 38.1	-49 45.4	31794	31512	4224	-37565	49214	Q	ABZ	
2009.500	7 36.1	-49 43.8	31795	31515	4206	-37532	49189	Q	ABZ	
2010.500	7 33.9	-49 42.8	31790	31513	4185	-37502	49163	Q	ABZ	
2011.500	7 31.8	-49 41.8	31786	31512	4165	-37476	49140	Q	ABZ	
2012.500	7 29.4	-49 41.3	31780	31509	4142	-37458	49123	Q	ABZ	
2013.500	7 27.4	-49 41.4	31773	31505	4123	-37453	49115	Q	ABZ	
2014.500	7 25.9	-49 42.4	31761	31494	4108	-37459	49112	Q	ABZ	
2015.500	7 24.7	-49 44.0	31741	31475	4094	-37471	49107	I	ABZ	4
2016.500	7 23.2	-49 44.6	31729	31466	4080	-37471	49100	Q	ABZ	

1983.729	7 39.9	-50 18.7	31769	31485	4237	-38281	49746	D	XYZ	
1984.500	7 41.8	-50 19.4	31756	31470	4253	-38283	49740	D	XYZ	
1985.500	7 43.1	-50 18.9	31761	31474	4266	-38277	49739	D	XYZ	
1986.500	7 44.4	-50 19.3	31752	31463	4276	-38276	49732	D	XYZ	
1987.500	7 45.4	-50 18.9	31757	31467	4286	-38272	49732	D	XYZ	
1988.500	7 46.3	-50 20.4	31731	31439	4291	-38274	49716	D	XYZ	
1989.500	7 46.9	-50 22.2	31696	31404	4292	-38272	49693	D	XYZ	
1990.500	7 47.1	-50 21.1	31707	31415	4295	-38263	49693	D	XYZ	
1991.500	7 47.4	-50 21.8	31687	31394	4295	-38253	49672	D	XYZ	
1992.500	7 47.3	-50 19.5	31706	31414	4297	-38225	49663	D	XYZ	
1993.500	7 47.4	-50 17.2	31723	31430	4299	-38191	49648	D	XYZ	
1994.500	7 47.6	-50 15.1	31730	31437	4302	-38154	49624	D	XYZ	
1995.500	7 47.7	-50 12.0	31755	31462	4307	-38114	49609	D	XYZ	
1996.500	7 47.4	-50 08.6	31784	31491	4308	-38072	49595	D	XYZ	
1997.500	7 47.0	-50 06.4	31788	31495	4305	-38026	49563	D	XYZ	
1998.500	7 46.5	-50 04.4	31782	31490	4299	-37976	49520	D	XYZ	
1999.500	7 45.5	-50 01.0	31797	31506	4293	-37916	49484	D	XYZ	1
2000.500	7 44.8	-49 59.7	31783	31493	4284	-37870	49440	D	XYZ	2
2001.500	7 44.3	-49 57.2	31792	31502	4281	-37826	49412	D	ABZ	
2002.500	7 44.5	-49 55.3	31793	31503	4283	-37784	49380	D	ABZ	
2003.500	7 43.9	-49 55.1	31772	31483	4275	-37755	49345	D	ABZ	
2004.500	7 43.4	-49 52.8	31780	31491	4271	-37713	49318	D	ABZ	
2005.500	7 42.4	-49 51.2	31775	31488	4261	-37671	49283	D	ABZ	
2006.500	7 41.2	-49 48.6	31787	31501	4252	-37629	49258	D	ABZ	
2007.500	7 39.5	-49 47.3	31785	31502	4236	-37597	49233	D	ABZ	3
2008.500	7 38.1	-49 46.2	31780	31499	4222	-37567	49206	D	ABZ	
2009.500	7 36.1	-49 44.3	31787	31508	4205	-37532	49184	D	ABZ	
2010.500	7 33.9	-49 43.7	31775	31498	4183	-37504	49155	D	ABZ	
2011.500	7 31.7	-49 42.9	31768	31494	4162	-37479	49131	D	ABZ	
2012.500	7 29.4	-49 43.0	31751	31480	4139	-37462	49107	D	ABZ	
2013.500	7 27.3	-49 42.8	31750	31481	4120	-37456	49102	D	ABZ	
2014.500	7 25.8	-49 43.4	31744	31478	4105	-37462	49103	D	ABZ	
2015.500	7 24.6	-49 46.3	31702	31437	4088	-37477	49087	I	ABZ	4
2016.500	7 23.1	-49 46.0	31706	31443	4076	-37474	49088	D	ABZ	

* A = All days
* Q = 5 International Quiet days each month
* D = 5 International Disturbed days each month

ELE = Elements recorded

Notes:

1. The elements recorded from 1983 to 27 August 2000 were magnetic X,Y,Z.(EDA instrument).

2. The elements recorded from 27 August 2000 were magnetic NW, NE and vertical (DMI instrument), from which the standard magnetic elements were derived. The NW, NE & Vertical components recorded are denoted A, B and Z respectively.

3. Before 31 Dec 2006, the CTA absolute instruments were corrected to the Canberra Observatory reference. The corrections for D, I, and F were zero. From 00:00 01 Jan 2007, the CTA absolute instruments were corrected to the international reference.

4. Annual means for 2015 calculated from incomplete dataset. Data from 2015-07-17 (day 198) to 2015-09-08 (day 251) are not available

7.4 Learmonth

7.4.1 INTERMAGNET 'readme' files

7.4.1.1 2013

```
                              LRM
             LEARMONTH OBSERVATORY INFORMATION 2013

 ACKNOWLEDGE-  Users of the LRM data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: LRM
     LOCATION: Learmonth Solar Observatory, Exmouth,
               Western Australia, Australia
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 112.22 Deg.
    LONGITUDE: 114.10 Deg. E
    ELEVATION: 004 metres

     ABSOLUTE
  INSTRUMENTS: DMI: DI0051 Zeiss 313888
               GSM: GSM90_2101216 Sensor 83387
                    from 2013-01-24
                    GSM90_4081416 sensor 73103


    RECORDING
   VARIOMETER: Three component suspended fluxgate
               magnetometer(Danish Meteorological
               Institute, Model FGE)
               GEM GSM90 Proton Precession
               Magnetometer

   ORIENTATION: Magnetic Northwest, Northeast and Vertical
 DYNAMIC RANGE: +/- 1600nT
    RESOLUTION: 0.03nT
 SAMPLING RATE: 1 second
   FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: None

    K-NUMBERS: None
     K9-LIMIT: 300nT

         GINS: Edinburgh
    SATELLITE: http upload

    OBSERVERS: Owen Giersch
               Jenny Howse
               Andrew Lewis

      CONTACT: Geomagnetism Group
               Geoscience Australia
               G.P.O. Box 378
               Canberra,  A.C.T.,  2601
               Australia
```

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WWW: http://www.ga.gov.au

NOTES:

Learmonth

The Learmonth magnetic observatory is located on North West Cape about 1100 km north of Perth and 35 km from Exmouth in Western Australia. The magnetic observatory is co-located with the Learmonth Solar Observatory, which is jointly staffed by IPS Radio and Space Services and the United States of America Air Force. The observatory complex is situated on coastal sand dunes bordering the Exmouth Gulf. The magnetic observatory consists of:
* three underground vaults located on IPS land, housing variometer sensors and control equipment;
* an Absolute Shelter, located on land belonging to the Royal Australian Air Force (RAAF) 200 m from the solar observatory, enclosing a concrete observation pier (Pier A), the top of which is 1200 mm above the concrete floor, and;
* an external tripod observation station on RAAF land.

Table 1. Key observatory data.
IAGA code: LRM
Commenced operation: November 1986
Geographic latitude: 22d 13' 19" S
Geographic longitude: 114d 06' 03" E
Geomagnetic latitude: -31.89d
Geomagetic longitude: 187.07d
K 9 index lower limit: 300 nT
Principal pier: Pier A
Pier elevation (top): 4 m AMSL
Principal reference mark: West windsock
Reference mark azimuth: 283d 02' 18"
Reference mark distance: 1 km approx.
Observer: O. Giersch,
J. Howse,
A. Lewis.

Local meteorological conditions

The meteorological temperature at Learmonth during 2013 varied from a minimum +5 deg C (2013-07-22) to a maximum +46.9 deg C (2013-02-06). Daily minimum temperatures varied from +5 deg C to +29.6 deg C (average +18.4 +/-5.4 deg C); daily maximum temperatures varied from +17.5 deg C to +46.9 deg C (average +32.3 +/-6.1 deg C).

The daily maximum wind gust varied from 19 to 80 km/h (average 42 +/-10.1 km/h). The maximum daily maximum wind gust was 80 km/h in January. The minimum daily maximum wind gust was 19 km/h in August. No data were recorded on the hours of sunshine by the Bureau of Meteorology.

Variometers

The variometers used during 2013 are described in Table 2. The recording equipment, some of the variometer electronic control equipment, and back-up power were housed in the Radio Solar Telescope Network (RSTN) building of the Solar Observatory. The magnetometers and control electronics were housed in three semi-underground concrete vaults, each 800×800×800 mm, lying in a north-south line about 110 m from the RSTN building. The vaults are about 7 m apart and are covered in local sand. The fluxgate sensor was in the northern most vault with the control electronics in the central vault. A GSM-90 total-field sensor was in the southern most vault with its electronics in the central vault.

Underground conduits containing sensor cables connected the central vault to the two sensor vaults. An underground conduit between the RSTN building and the central vault contained 12 V DC power and digital data cables. The variometer and recording system were powered by a 12 V DC battery box charged from 240 V AC mains power. The recording computer and 12 V DC battery box were housed in the RSTN building. System timing was provided by a GPS clock with time corrections applied automatically and logged. Timing corrections greater than 10 ms are listed in Variometer clock corrections below.

Table 2. Magnetic variometers used in 2013.
3-component variometer: DMI FGE
Serial number: E0271 / S0237
Type: suspended; linear-core fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
A/D converter: ADAM 4017 module (+/-5V)
Scale value: 0.032 nT / count
Period of use: 2013-01-01 to 2013-12-31

Total-field variometer: GEM Systems GSM-90
Serial number: 8092903 / 83385
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Period of use: 2013-01-01 to 2013-08-31

Total-field variometer: GEM Systems GSM-90
Serial number: 8092904 / 83385
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Period of use: 2013-08-31 to 2013-12-31

Data acquisition system:
GDAP:
ARK3660F Industrial computer
QNX OS 6.3 till 2013-04-08

GDAP:
ARK3660F Industrial computer
QNX OS 6.5 from 2013-04-08

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2013, no adjustments to the system clock greater than 10 ms occurred. Corrections of 1 or 2 milliseconds did occur on 2101 occasions between 2013-01-01 and 2013-04-06. After this time, with the installation of the new acquisition computer no corrections greater than 1 millisecond were recorded.

Absolute instruments

The principal absolute magnetometers used at Learmonth and their adopted corrections for 2013 are described in Table 3.

The absolute DIM fluxgate instrument, DI0051/313888, was compared to the Canberra geomagnetic observatory reference instrument DI0086/353756 on 2009-07-21, 2009-07-28, 2009-08-17, 2009-08-25, 2009-09-01, and 2009-09-22 at the Canberra geomagnetic observatory before being deployed to Learmonth. Adopted Instrument corrections were -0.05', and -0.10' in D and I respectively.

During 2013 no comparisons where made between the travelling reference DIM fluxgate (DIM B0610H/160459) and the Learmonth absolute instrument (DIM DI0051/313888). Therefore the adopted differences as determined in 2012 will be used for 2013.

The adopted differences between the LRM instruments and the international average (as defined by observations at IAGA instrument workshops) are given in Table 3.

Table 3. Absolute magnetometers and their adopted corrections for 2013. Corrections are applied in the sense Standard = Instrument + correction.
DI fluxgate: DMI
Serial number: DI0051
Theodolite: Zeiss 020B
Serial number: 313888
Resolution: 0.1'
D correction: -0.05'
I correction: -0.10'
Period of use: 2013-01-01 to 2013-12-31

Total field magnetometer: GEM Systems GSM 90
Serial number: 2101216 / 83387
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT
Period of use: 2013-01-01 to 2013-02-07

Total field magnetometer: GEM Systems GSM 90
Serial number: 4081416 / 73103
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT
Period of use: 2013-02-07 to 2013-12-31

Timing: Trimble Acutime GPS clock

Communications:
There are two telemetry paths available, either via radio modem to Giralia seismic station and then VSAT to Canberra or via IPS dedicated data line to Sydney and then via internet to Canberra.

At the 2013 mean magnetic-field values at Learmonth (X=30047 nT, Y=203 nT, Z= -43542 nT) the D, I and F corrections translate to corrections of:

dX = -1.26 nT dY = -0.45 nT   dZ = -0.87 nT

These corrections have been applied to all LRM 2013 final data.

Baselines

The standard deviations of the differences between the weekly absolute observations and the final adopted variometer model and data were:

X	0.7 nT
Y	0.8 nT
Z	0.6 nT
F	0.7 nT
D	6"
I	2"

Throughout 2013 adopted baselines drifted within ranges of
X = 8.7 nT
Y = 10.3 nT
Z = 9.8 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2013 LRM definitive data and real time reported 1-minute data sets
(LRM definitive - LRM real time) were:

	X	Y	Z
Average	-0.5	-0.5	+1.0
Std.dev	+46.9	+70.3	+117.7
Min	-115.3	-175.3	-256.6
Max	+103.6	+153.2	+292.9

The differences in the mean values between the definitive data and reported data indicate good consistency. The results of the standard deviation, minimum and maximum values showed greater variability and this can be attributed to the temperature related issue reported in the operations section below.

The LRM 2013 reported real time data are within the specification for INTERMAGNET Quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2013 LRM definitive data and quasi-definitive 1-minute data sets
(LRM definitive - LRM quasi-definitive) were:

	X	Y	Z
Average	-0.3	+0.06	-0.4
Std.dev	+0.5	+0.3	+0.4
Min	-1.4	-0.5	-1.2
Max	+0.3	+0.8	+0.04

The LRM 2013 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

Absolute observations were performed weekly by Owen Giersch and Jenny Howse from IPS Radio and Space Services (IPS). Variometer data were downloaded about every 3-10 minutes through a TCP/IP network connection. One-minute data were then automatically processed to reported status, made available on the Geoscience Australia website, and sent to the Edinburgh INTERMAGNET GIN via e-mail/HTTP. Data were also provided to IPS Radio and Space Services via a direct serial link from the acquisition computer in the RSTN building. IPS applied nominal scale values and rotation parameters.

The data communication errors that began after the lightning strike in 2012 continued into 2013. These errors were between the fluxgate variometer and the acquisition computer, compounded by 1-minute averaging of temperature, caused derived magnetic data to be corrupted for 1 minute blocks (hh:mm:30 - hh:mm:30). These corrupted data were sent to real-time clients. To complete the definitive data for 2013, the specialised software written previously, was again used to compared each temperature value to those surrounding it. If the value was shown to be outside the defined set of parameters, it was modified to that of the surrounding values. The data was then reprocessed, with the errors caused by the incorrect recording of the temperature corrected by the software. The derived magnetic 1 second data may have contained other errors which were separate to the communication error affecting the recorded temperatures. These data were then processed using a de-spiking filter which removed these errors from the dataset. The one second data removed by the filter was not recoverable. The installation of a new acquisition computer in early April corrected the data communications errors.

The first observations were collected on day 003 (2013-01-03) but these could not be reduced as the absolute total-field magnetometer (PPM) had failed. The absolute PPM was subsequently attached to the acquisition computer for testing on day 011 (2013-01-11). This resulted in a few minutes of data loss from the variometer total-field magnetometer. The absolute PPM, GSM-90_2101216/83387 was replaced on day 024 (2013-01-24) with GSM-90_4081416/73103. The magnetometer was returned to Geoscience Australia for testing and repair. The first absolute observations did not occur until day 038 (2013-02-07) when all personnel had returned to work and a tropical cyclone had passed by. For the remainder of the year a total 44 pairs of absolute observations were collected.

The installation of a new acquisition computer occurred over days 97 and 98 (2013-04-07 and 2013-04-08). A new ARK3660F/QNX6.5 acquisition computer replaced the existing ARK3360F/QNX6.3 which had been installed the previous year following a lightning strike at the observatory. This change over resulted in a total loss of 54 minutes of data.

From early May the variometer total-field magnetometer began to exhibit intermittent data drop outs. Throughout May and June the magnetometer continued to deteriorate. On day 208 (2013-07-27) the magnetometer ceased to function. The electronics (serial no.8092903) were replaced on day 243 (2013-08-31) with another set of electronics (serial no.8092904), the sensor 21889 remained in place. This resulted in some contamination of the vector data, which is thought to have been caused by the movement of air between the central vault and the sensor vault via the conduit. This destabilised the internal temperature in the sensor vault and required several days to stabilise once the lid of the central lid was replaced. At the next opportunity it is recommended that foam inserts been placed into the open end of the conduit in the central vault.

During this visit the DMI fluxgate theodolite electronics were upgraded to allow digital output to be recorded on the Getac tablet. The Gobs software was also upgraded to record this output in a digital format. The two observers were also given training in the upgraded hardware and software.

Communications with the variometer total-field magnetometer failed on day 261 (2013-09-18). The observer tested the system on day 267 (2013-09-24)and ascertained that the ADAM4520 analogue to digital converter had failed. A replacement was sent to the observatory and was installed on day 281 (2013-12-08).

On day 315 (2013-11-11), the Z component of the vector magnetometer became stuck at -45632nT. The device driver was stopped and restarted at approximately 21:48 UTC to clear the problem but this failed. Cycling the power to the vector magnetometer also failed to correct the problem. Data delivery was suspended at this time to all clients except for IPS. On day 318 (2013-11-14) the Z channel began to work again, but the cause of this failure remains unknown. In preparing the definitive data it was noted that at the time of this failure in the Z channel, a small jump also occurred in the X and Y channels. This data was deemed to unreliable and has been removed from the definitive data.

On day 329 (2013-11-25) the network link to Learmonth was lost. No data was lost for this period and was retrieved once the link was re-established.

Early on day 339 (2013-12-05), the reported X, Y and F data exhibited contamination. This was caused by vehicles near the vaults. These data were removed from the definitive data.

The distribution of Learmonth 2013 data is described in Table 4. Data losses are identified in Table 5.

Table 4. Distribution of Learmonth 2013 data.

Recipient	Status	Sent
1 second values		
IPS Radio and Space Services	preliminary	real time
INTERMAGNET	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	quasi-definitive	monthly
INTERMAGNET	definitive	July 2014
WDC for Geomagnetism Kyoto	preliminary	real time
WDC for Geomagnetism Kyoto	preliminary	daily

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Significant events
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2013-01-02   GdapClock stops at 04:40. Restart at 23:47 but
             does not work. Shutdown at 23:50:35.
             Correction at 23:52:11 of 202ms.
2013-01-03   JH reports problem with PPM during Absolutes.
             No data recorded for PPM.
2013-01-09   No obs this week all away. TC Narelle also
             likely to be nearby.
2013-01-11   Testing absolute PPM on acquisition system
             variometer PPM switched off for a few minutes
             around 04UT
2013-01-14   23:12:29 Made adjustment to Bt values for day
             363 2012
             LRM Bt 2012 363.328124995      -201.45
             LRM Bt 2012 363.328842592      -417.45
2013-01-15   Above Values incorrect changed to
             LRM Bt 2012 363.328124995      367.00
2013-01-24   Absolute PPM GSM90-2101216 replaced with
             GSM90-4081416
2013-04-06   Large earthquake in Irian Jaya. 04:47
2013-04-08-9 AML at LRM - switched to new computer
             QNX6.5 ~00:50 on 2013-04-08
             First Obs with Getac tablet PC and GObs by AML
             Problems with absolute battery box
             * Switch from GdapIPS to GdapCALs for IPS data
             feed.*
2013-05-09   JMH sends in obs but timing is wrong by 1 hour
             Not sure which way not able to confirm in what
             direction. Obs discarded.
2013-05-30   Possible contamination in PPM at 19:41:20 to
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	20:14:50. Several nT jump no known reason.
2013-06-02	20:44:59 Same jump in PPM as before.
2013-06-03	00:50:30 As above. 02:30 Variometer GSM90 PPM data reading 75000 nT with quality "29" 02:33 re-tune and switch off auto-tuning. AML
2013-06-14	OG advises that due to rain he will not be able to collect geomagnetic obs.
2013-06-28	JH reports trouble with GSM90 PPM during observations. Tablet PC reports "Time-Out".
2013-07-17	Send request to LRM to look at GPS clock antenna. OG reports back that it is white so seems to ga-lrm-mag1 $ cat /proc/ham/CALS/. info still a Trimble GPS installed there.
2013-07-23	PPM issue continues to deteriorate. It is more often off than on, and when it is on measures 75140.??nT.
2013-07-31	HAM report for CALS / GdapCALs failure for IPS delivery at LRM Path : CALS Entity Pid : 1541857311 Num conditions : 1 Entity type : ATTACHED Stats: Created : 2013/06/25 05:54:50:836730064 Last Death : 2013/07/09 06:38:07:784163732 Restarted : 2013/07/09 06:38:07:785163605 Num Restarts : 1
2013-08-09	Path : CALS Entity Pid : 1991643167 Num conditions : 1 Entity type : ATTACHED Stats: Created : 2013/06/25 05:54:50:836730064 Last Death : 2013/08/05 01:32:29:389205199 Restarted : 2013/08/05 01:32:29:390205072 Num Restarts : 2
2013-08-19	/bin/sh /etc/rc.d/calsHAMscript 2114846751 Aug 12 09:42 /usr/local/bin/GdapCALs -Slrm -Vlrm -D/mag -fA -clrminfo.con -b2013blv.lrm -e -i 2114863137 Aug 12 09:42 GdapCALs -Slrm -Vlrm -D/mag -fA -clrminfo.con -b2013blv.lrm 2114900002 Aug 12 09:43 Seems that 2114900002 is superfluous; 2013-08-18,19 regular missing second values slay 2114900002 about 04:25
2013-08-30	Upgrade DI0051 for analogue output to PICO ADC16 digitiser S/N FJY06/136 Upgrade GETAC for new GObs with PICO interface and also install Getac GGA GPS clock setting onto GETAC
2013-08-31	Contamination from lid of central vault being opened to replace PPM electronics. Removed GSM-90 8092903/83385. Replaced with GSM-90 8092904/83385. First Obs with PICO s/n FJY06/136 and USB keyboard (Jaycar Digitech XC-5146) baseline jump in X between 294 and 310. Possibly day 303 14:16?
2013-09-01	Earthquake in the Banda sea at approx 11:50

	6.4 Mag.
2013-09-18	04:50 Variometer PPM fails suddenly No response via qtalk
2013-09-24	OG checks GSM90 ADAM4520 in RSTN and finds it is not powered, tries in alternate battery box socket and still no power. Send replacement ADAM4520
2013-10-04	Replacement ADAM4520 installed on PPM data line in RSTN
2013-10-08	PPM data flowing again and re-starting the driver
2013-10-09	Send replacement DIM theodolite DMI extension cable.
2013-11-11	02:40 C (Z) channel stuck on full scale 21:48 Stop and restart GdapDeviceAdam 23:31:06 disconnect power to magnetometers in the vault for 30 seconds
2013-11-12	Switch off delivery of LRM data to IMAG and Japan. Continue delivery to IPS
2013-11-18	16:35 C (Z) channel comes back on-scale and takes several hours to settle down Fcheck seems to have stabilised by 23:59.
2013-11-25	from 22:53 25 Nov (UT),lost link through IPS internet. Ssh acq@192.168.33.238 using Lindsays PC and display data using GdapCALs. Instruments are all running. Tried /home/geomar/bin/XgetObsLRMG through Giraliar with no success.
2013-11-26	Asked IPS (Campbell Thomson) to check the IPS internet connection. There were a few network link roll-over testing outages throughout the day (25 - 26 Dec) within the BoM network that would have affected the SSH connection to LSO. Confirmed GA expected IP 192.104.44.129 is allowed access to IP 138.24.1.196 port 20023 tried ssh -v -p 20023 acq@138.24.1.196 on geomag@galah to test login and response. No response.
2013-11-27	Computer reboot unknown cause. at 03:30 (UT) restarted PC. the link through IPS still not working. edited crontab file to change XgetObsLRM to XgetObsLRMG via Giraliar. It works.
2013-12-05	Strange changes in X, Y and Total field but not Z. Send email to OG asking if anything is happening. OG replies that ELF/Serv building is being removed so there are cranes and trucks out near variometers. Requested dates and times from OG to enable careful review of the data. Estimated times are 00:45UT to 01:15UT. Confirmed by OG Spike in X and Y at 00:44, 00:54, 01:09, 02:13 02:17 and 02:44. Check carefully
2013-12-06	Temporary data outage as Lindsay is upgrading VSAT modem at Girl. 03:18:29 (later switched to IPS network)
2013-12-10	Lindsay rebooted LRM after changing /etc/hosts entries for new satellite provider 2013-12-06. new address is 192.245.110.78

2013-12-15 Day 347 Z baseline change 12:57:00 to 13:00:30 fix if possible otherwise delete.

2013-12-19 Last obs for 2013. OG return 2014-01-13 but don't expect them straight away.
At approx. 14:14:30, Z returns virtual flat values of -43524 + or - 0.2. Does not seem like a real response. Question this for definitive.

Data Losses for 2013

Table 5. Data losses.

Variometer data XYZ:

2013-02-21	XYZ	21:19 - 21:19	(1)
2013-02-25	XYZ	00:00 - 00:00	(1)
2013-03-10	XYZ	01:08 - 01:09	(2)
2013-04-07	XYZ	23:59 -	
2013-04-08	XYZ	- 00:52	(54)
2013-04-08	XYZ	04:28 - 04:29	(2)
2013-04-08	XYZ	08:43 - 08:45	(3)
2013-08-31	XYZ	00:00 - 00:10	(11)
2013-08-31	XYZ	00:25 - 00:32	(8)
2013-08-31	XYZ	01:15 - 01:19	(5)
2013-08-31	XYZ	01:22 - 01:40	(19)
2013-08-31	XYZ	01:45 - 01:47	(3)
2013-08-31	XYZ	01:49 - 01:50	(2)
2013-11-11	XYZ	02:20 -	
2013-11-14	XYZ	- 19:22	(5343)
2013-11-25	XYZ	22:54 -	
2013-11-26	XYZ	- 00:00	67)
2013-11-27	XYZ	03:30 - 03:32	(3)
2013-12-06	XYZ	10:01 - 10:03	(3)

Total: 5527

Scalar Data F:

2013-01-11	F	04:13 - 04:21	(9)
2013-01-11	F	04:23 - 04:23	(1)
2013-04-08	F	00:00 - 00:54	(55)
2013-04-08	F	04:29 - 04:29	(1)
2013-04-08	F	08:44 - 08:44	(1)
2013-05-30	F	19:52 - 20:15	(24)
2013-06-02	F	20:13 - 20:13	(1)
2013-06-02	F	20:46 - 21:22	(37)
2013-06-03	F	00:51 - 02:34	(104)
2013-06-03	F	05:21 - 05:21	(1)
2013-06-03	F	05:32 - 05:33	(2)
2013-06-03	F	06:27 - 06:27	(1)
2013-06-03	F	06:44 - 06:45	(2)
2013-06-03	F	06:47 - 06:47	(1)
2013-06-03	F	06:49 - 07:00	(12)
2013-06-03	F	07:37 - 07:37	(1)
2013-06-03	F	11:40 - 11:40	(1)
2013-06-03	F	11:42 - 11:43	(2)
2013-06-03	F	11:45 - 12:05	(21)
2013-06-03	F	14:16 - 14:16	(1)
2013-06-03	F	20:17 - 20:23	(7)
2013-06-03	F	20:29 - 20:30	(2)

2013-06-04	F	15:53 - 15:53	(1)
2013-06-04	F	15:55 - 16:03	(9)
2013-06-04	F	16:05 - 16:07	(3)
2013-06-05	F	09:30 - 11:28	(119)
2013-06-05	F	11:54 - 11:54	(1)
2013-06-05	F	12:01 - 12:01	(1)
2013-06-06	F	10:09 - 12:07	(119)
2013-06-06	F	12:10 - 12:12	(3)
2013-06-06	F	12:43 - 13:20	(38)
2013-06-06	F	15:04 - 15:07	(4)
2013-06-06	F	15:09 - 15:14	(6)
2013-06-06	F	15:19 - 15:35	(17)
2013-06-06	F	15:39 - 15:41	(3)
2013-06-06	F	15:45 - 15:50	(6)
2013-06-06	F	16:18 - 16:20	(3)
2013-06-06	F	16:51 - 19:29	(159)
2013-06-06	F	19:32 - 19:36	(5)
2013-06-06	F	19:40 - 19:48	(9)
2013-06-06	F	19:52 - 19:53	(2)
2013-06-06	F	20:22 - 20:49	(28)
2013-06-06	F	20:54 - 20:56	(3)
2013-06-06	F	21:14 - 21:14	(1)
2013-06-06	F	21:17 - 21:21	(5)
2013-06-06	F	21:25 - 21:35	(11)
2013-06-06	F	21:42 - 21:43	(2)
2013-06-06	F	22:11 - 22:17	(7)
2013-06-06	F	22:35 - 22:42	(8)
2013-06-06	F	22:49 - 22:55	(7)
2013-06-06	F	22:58 - 23:00	(3)
2013-06-06	F	23:28 - 23:28	(1)
2013-06-06	F	23:31 - 23:34	(4)
2013-06-07	F	04:22 - 04:23	(2)
2013-06-07	F	04:46 - 04:46	(1)
2013-06-07	F	05:57 - 05:58	(2)
2013-06-07	F	07:40 - 07:40	(1)
2013-06-07	F	09:04 - 09:04	(1)
2013-06-07	F	15:55 - 15:59	(5)
2013-06-07	F	18:36 - 18:36	(1)
2013-06-08	F	03:15 - 04:24	(70)
2013-06-08	F	04:51 - 05:01	(11)
2013-06-08	F	05:03 - 05:10	(8)
2013-06-08	F	05:12 - 05:18	(7)
2013-06-08	F	05:21 - 05:21	(1)
2013-06-08	F	05:25 - 05:37	(13)
2013-06-08	F	05:41 - 05:49	(9)
2013-06-08	F	05:51 - 06:00	(10)
2013-06-08	F	06:03 - 06:03	(1)
2013-06-08	F	06:05 - 06:06	(2)
2013-06-08	F	06:08 - 06:12	(5)
2013-06-08	F	06:18 - 06:18	(1)
2013-06-08	F	06:22 - 06:30	(9)
2013-06-08	F	06:44 - 06:44	(1)
2013-06-08	F	06:48 - 06:50	(3)
2013-06-08	F	06:52 - 06:52	(1)
2013-06-08	F	07:00 - 07:01	(2)
2013-06-08	F	07:03 - 07:04	(2)
2013-06-08	F	07:09 - 07:28	(20)
2013-06-08	F	07:30 - 07:31	(2)
2013-06-08	F	07:33 - 07:43	(11)
2013-06-08	F	07:45 - 07:45	(1)
2013-06-08	F	07:48 - 07:52	(5)

2013-06-08	F	07:55 - 07:56	(2)
2013-06-08	F	07:58 - 08:06	(9)
2013-06-08	F	08:14 - 08:15	(2)
2013-06-08	F	08:18 - 08:18	(1)
2013-06-08	F	08:21 - 08:39	(19)
2013-06-08	F	08:41 - 08:51	(11)
2013-06-08	F	08:53 - 08:54	(2)
2013-06-08	F	09:44 - 09:47	(4)
2013-06-08	F	10:29 - 10:30	(2)
2013-06-08	F	10:34 - 10:36	(3)
2013-06-08	F	10:38 - 10:38	(1)
2013-06-08	F	10:40 - 10:41	(2)
2013-06-08	F	10:45 - 10:48	(4)
2013-06-08	F	10:50 - 10:52	(3)
2013-06-08	F	10:55 - 10:55	(1)
2013-06-08	F	11:00 - 11:00	(1)
2013-06-08	F	11:08 - 11:16	(9)
2013-06-08	F	11:18 - 11:25	(8)
2013-06-08	F	11:28 - 12:22	(55)
2013-06-08	F	12:24 - 12:27	(4)
2013-06-08	F	12:29 - 12:29	(1)
2013-06-08	F	12:34 - 12:34	(1)
2013-06-08	F	12:56 - 12:56	(1)
2013-06-08	F	13:01 - 13:04	(4)
2013-06-08	F	13:06 - 13:14	(9)
2013-06-08	F	13:16 - 13:54	(39)
2013-06-08	F	14:33 - 14:34	(2)
2013-06-08	F	14:37 - 14:37	(1)
2013-06-08	F	18:24 - 18:24	(1)
2013-06-08	F	19:01 - 19:06	(6)
2013-06-08	F	19:12 - 19:12	(1)
2013-06-08	F	21:32 - 22:48	(77)
2013-06-08	F	22:50 - 22:52	(3)
2013-06-08	F	22:54 - 22:54	(1)
2013-06-08	F	22:57 - 22:57	(1)
2013-06-08	F	23:00 - 23:11	(12)
2013-06-08	F	23:15 - 23:19	(5)
2013-06-09	F	03:51 - 04:26	(36)
2013-06-09	F	04:29 - 04:32	(4)
2013-06-09	F	04:34 - 04:37	(4)
2013-06-09	F	04:40 - 04:40	(1)
2013-06-09	F	04:42 - 04:44	(3)
2013-06-09	F	17:09 - 17:09	(1)
2013-06-09	F	17:11 - 17:17	(7)
2013-06-09	F	17:25 - 17:25	(1)
2013-06-09	F	22:07 - 22:07	(1)
2013-06-10	F	00:39 - 00:39	(1)
2013-06-10	F	02:54 - 03:12	(19)
2013-06-10	F	03:15 - 03:15	(1)
2013-06-10	F	03:17 - 03:22	(6)
2013-06-10	F	03:39 - 03:40	(2)
2013-06-10	F	03:46 - 03:51	(6)
2013-06-10	F	03:53 - 03:55	(3)
2013-06-10	F	05:33 - 05:37	(5)
2013-06-10	F	05:54 - 05:54	(1)
2013-06-10	F	05:58 - 06:03	(6)
2013-06-10	F	06:05 - 06:07	(3)
2013-06-10	F	06:10 - 06:19	(10)
2013-06-10	F	06:39 - 06:39	(1)
2013-06-10	F	07:12 - 07:16	(5)
2013-06-10	F	08:04 - 08:07	(4)

2013-06-10	F	08:09 - 08:10	(2)
2013-06-10	F	08:57 - 09:01	(5)
2013-06-11	F	02:38 - 02:39	(2)
2013-06-11	F	02:49 - 02:49	(1)
2013-06-11	F	02:52 - 03:03	(12)
2013-06-11	F	03:08 - 03:10	(3)
2013-06-11	F	03:12 - 03:17	(6)
2013-06-11	F	03:25 - 03:27	(3)
2013-06-11	F	04:53 - 04:54	(2)
2013-06-11	F	05:03 - 05:32	(30)
2013-06-11	F	05:45 - 05:46	(2)
2013-06-11	F	07:15 - 07:18	(4)
2013-06-11	F	07:20 - 07:21	(2)
2013-06-11	F	22:39 - 22:42	(4)
2013-06-11	F	22:44 - 22:45	(2)
2013-06-11	F	22:52 - 23:22	(31)
2013-06-11	F	23:24 - 23:24	(1)
2013-06-11	F	23:26 - 23:29	(4)
2013-06-11	F	23:31 - 23:41	(11)
2013-06-12	F	00:29 - 00:29	(1)
2013-06-12	F	00:31 - 00:41	(11)
2013-06-12	F	00:50 - 00:51	(2)
2013-06-12	F	00:53 - 01:00	(8)
2013-06-12	F	01:10 - 01:10	(1)
2013-06-12	F	01:41 - 01:42	(2)
2013-06-12	F	01:45 - 01:45	(1)
2013-06-12	F	01:47 - 01:48	(2)
2013-06-12	F	01:52 - 01:52	(1)
2013-06-12	F	05:25 - 05:25	(1)
2013-06-12	F	05:28 - 05:30	(3)
2013-06-12	F	05:33 - 05:35	(3)
2013-06-12	F	05:37 - 05:59	(23)
2013-06-12	F	06:02 - 06:08	(7)
2013-06-12	F	06:15 - 06:16	(2)
2013-06-12	F	06:19 - 06:20	(2)
2013-06-12	F	06:27 - 06:32	(6)
2013-06-12	F	06:34 - 06:37	(4)
2013-06-12	F	06:54 - 06:57	(4)
2013-06-12	F	07:00 - 07:01	(2)
2013-06-12	F	07:11 - 07:11	(1)
2013-06-12	F	07:13 - 07:16	(4)
2013-06-12	F	08:56 - 09:02	(7)
2013-06-12	F	09:06 - 09:07	(2)
2013-06-12	F	11:10 - 11:10	(1)
2013-06-12	F	11:16 - 11:16	(1)
2013-06-12	F	11:18 - 11:20	(3)
2013-06-12	F	11:35 - 11:35	(1)
2013-06-12	F	14:38 - 14:41	(4)
2013-06-12	F	14:51 - 14:58	(8)
2013-06-12	F	15:17 - 15:32	(16)
2013-06-12	F	15:35 - 15:36	(2)
2013-06-12	F	16:00 - 16:03	(4)
2013-06-12	F	16:14 - 16:14	(1)
2013-06-12	F	17:11 - 17:11	(1)
2013-06-12	F	17:24 - 17:25	(2)
2013-06-12	F	17:52 - 17:52	(1)
2013-06-12	F	17:57 - 17:57	(1)
2013-06-12	F	17:59 - 17:59	(1)
2013-06-12	F	18:02 - 18:05	(4)
2013-06-12	F	18:14 - 18:26	(13)
2013-06-12	F	18:30 - 18:40	(11)

2013-06-12	F	18:42 - 18:47	(6)
2013-06-12	F	22:09 - 22:09	(1)
2013-06-12	F	22:12 - 22:31	(20)
2013-06-12	F	22:33 - 22:37	(5)
2013-06-12	F	22:44 - 22:54	(11)
2013-06-12	F	23:01 - 23:22	(22)
2013-06-12	F	23:27 - 23:39	(13)
2013-06-12	F	23:41 - 23:42	(2)
2013-06-12	F	23:49 -	
2013-06-13	F	- 00:03	(15)
2013-06-13	F	00:12 - 00:18	(7)
2013-06-13	F	00:52 - 00:54	(3)
2013-06-13	F	01:08 - 01:08	(1)
2013-06-13	F	01:47 - 01:47	(1)
2013-06-13	F	01:52 - 01:52	(1)
2013-06-13	F	01:59 - 02:01	(3)
2013-06-13	F	04:06 - 04:07	(2)
2013-06-13	F	04:12 - 04:13	(2)
2013-06-13	F	04:17 - 04:17	(1)
2013-06-13	F	04:27 - 04:27	(1)
2013-06-13	F	04:32 - 04:34	(3)
2013-06-13	F	04:36 - 04:42	(7)
2013-06-13	F	04:44 - 04:44	(1)
2013-06-13	F	04:46 - 05:24	(39)
2013-06-13	F	05:26 - 05:34	(9)
2013-06-13	F	05:36 - 06:15	(40)
2013-06-13	F	06:18 - 06:34	(17)
2013-06-13	F	06:36 - 06:36	(1)
2013-06-13	F	06:39 - 06:40	(2)
2013-06-13	F	06:42 - 07:47	(66)
2013-06-13	F	07:50 - 07:51	(2)
2013-06-13	F	07:53 - 08:25	(33)
2013-06-13	F	09:22 - 09:23	(2)
2013-06-13	F	09:37 - 09:49	(13)
2013-06-13	F	09:51 - 09:52	(2)
2013-06-13	F	09:58 - 10:03	(6)
2013-06-13	F	10:07 - 10:15	(9)
2013-06-13	F	11:09 - 11:23	(15)
2013-06-13	F	12:01 - 12:48	(48)
2013-06-13	F	12:50 - 12:53	(4)
2013-06-13	F	12:55 - 14:00	(66)
2013-06-13	F	14:02 - 14:25	(24)
2013-06-13	F	14:28 - 14:31	(4)
2013-06-13	F	14:33 - 14:34	(2)
2013-06-13	F	14:36 - 18:16	(221)
2013-06-13	F	18:18 - 18:21	(4)
2013-06-13	F	18:36 - 18:36	(1)
2013-06-13	F	18:40 - 18:40	(1)
2013-06-13	F	18:42 - 18:51	(10)
2013-06-13	F	18:56 - 19:01	(6)
2013-06-13	F	19:04 - 19:09	(6)
2013-06-14	F	01:49 - 01:49	(1)
2013-06-14	F	02:08 - 02:08	(1)
2013-06-14	F	02:17 - 02:19	(3)
2013-06-14	F	04:04 - 04:04	(1)
2013-06-14	F	07:36 - 07:36	(1)
2013-06-14	F	07:59 - 07:59	(1)
2013-06-14	F	08:21 - 08:23	(3)
2013-06-14	F	09:08 - 09:11	(4)
2013-06-15	F	02:34 - 02:41	(8)
2013-06-15	F	02:43 - 02:46	(4)

2013-06-15	F	02:50 - 02:50	(1)
2013-06-15	F	02:54 - 02:55	(2)
2013-06-15	F	02:59 - 02:59	(1)
2013-06-15	F	03:38 - 03:38	(1)
2013-06-15	F	03:54 - 03:58	(5)
2013-06-15	F	09:01 - 09:01	(1)
2013-06-15	F	09:52 - 09:52	(1)
2013-06-15	F	11:56 - 11:56	(1)
2013-06-15	F	15:24 - 15:27	(4)
2013-06-15	F	18:57 - 19:10	(14)
2013-06-15	F	19:33 - 19:35	(3)
2013-06-15	F	19:38 - 20:05	(28)
2013-06-15	F	20:07 - 20:09	(3)
2013-06-15	F	20:12 - 20:15	(4)
2013-06-15	F	20:23 - 20:30	(8)
2013-06-15	F	20:33 - 20:35	(3)
2013-06-15	F	20:44 - 20:44	(1)
2013-06-15	F	20:47 - 21:21	(35)
2013-06-15	F	21:27 - 21:29	(3)
2013-06-15	F	21:35 - 21:35	(1)
2013-06-15	F	21:46 - 21:47	(2)
2013-06-16	F	07:30 - 07:30	(1)
2013-06-16	F	10:37 - 10:37	(1)
2013-06-16	F	10:39 - 12:10	(92)
2013-06-16	F	12:28 - 12:33	(6)
2013-06-16	F	12:36 - 13:04	(29)
2013-06-16	F	13:08 - 13:24	(17)
2013-06-16	F	13:49 - 13:49	(1)
2013-06-16	F	13:55 - 13:56	(2)
2013-06-16	F	14:14 - 14:23	(10)
2013-06-16	F	14:35 - 14:41	(7)
2013-06-16	F	15:06 - 15:11	(6)
2013-06-16	F	15:36 - 15:36	(1)
2013-06-16	F	15:42 - 15:42	(1)
2013-06-16	F	15:57 - 15:57	(1)
2013-06-18	F	10:35 - 10:35	(1)
2013-06-18	F	10:41 - 10:42	(2)
2013-06-18	F	10:47 - 10:53	(7)
2013-06-18	F	10:59 - 11:04	(6)
2013-06-18	F	11:14 - 11:14	(1)
2013-06-18	F	11:23 - 11:24	(2)
2013-06-18	F	11:31 - 11:36	(6)
2013-06-18	F	21:23 - 21:28	(6)
2013-06-18	F	21:35 - 21:35	(1)
2013-06-18	F	21:37 - 21:38	(2)
2013-06-18	F	21:40 - 21:43	(4)
2013-06-18	F	21:55 - 22:01	(7)
2013-06-19	F	01:26 - 01:34	(9)
2013-06-19	F	01:36 - 01:39	(4)
2013-06-19	F	01:42 - 01:42	(1)
2013-06-19	F	01:44 - 01:52	(9)
2013-06-19	F	03:14 - 03:16	(3)
2013-06-19	F	03:19 - 03:19	(1)
2013-06-19	F	03:23 - 03:29	(7)
2013-06-19	F	03:49 - 03:50	(2)
2013-06-19	F	03:54 - 03:54	(1)
2013-06-19	F	04:08 - 04:31	(24)
2013-06-19	F	04:33 - 04:47	(15)
2013-06-19	F	04:58 - 05:00	(3)
2013-06-19	F	05:09 - 05:13	(5)
2013-06-19	F	05:17 - 05:40	(24)

2013-06-19	F	05:42 - 05:47	(6)
2013-06-19	F	05:50 - 05:59	(10)
2013-06-19	F	06:15 - 06:16	(2)
2013-06-19	F	10:57 - 11:21	(25)
2013-06-19	F	11:30 - 11:31	(2)
2013-06-19	F	15:10 - 15:11	(2)
2013-06-19	F	15:23 - 15:23	(1)
2013-06-19	F	15:27 - 15:28	(2)
2013-06-19	F	16:49 - 16:49	(1)
2013-06-19	F	16:55 - 16:55	(1)
2013-06-19	F	16:57 - 16:57	(1)
2013-06-19	F	16:59 - 17:00	(2)
2013-06-19	F	17:45 - 17:55	(11)
2013-06-19	F	18:11 - 18:36	(26)
2013-06-19	F	19:54 - 19:55	(2)
2013-06-19	F	19:57 - 20:30	(34)
2013-06-19	F	20:35 - 20:52	(18)
2013-06-19	F	20:57 - 20:57	(1)
2013-06-19	F	21:00 - 21:00	(1)
2013-06-19	F	21:05 - 21:05	(1)
2013-06-19	F	21:07 - 21:07	(1)
2013-06-19	F	22:10 - 22:24	(15)
2013-06-19	F	22:32 - 22:32	(1)
2013-06-20	F	06:09 - 06:09	(1)
2013-06-20	F	06:19 - 06:20	(2)
2013-06-20	F	06:22 - 06:27	(6)
2013-06-20	F	06:31 - 06:31	(1)
2013-06-20	F	06:40 - 06:40	(1)
2013-06-20	F	06:42 - 06:54	(13)
2013-06-20	F	06:56 - 07:00	(5)
2013-06-20	F	09:46 - 09:49	(4)
2013-06-20	F	09:52 - 09:56	(5)
2013-06-20	F	10:13 - 10:14	(2)
2013-06-20	F	10:45 - 10:45	(1)
2013-06-20	F	11:19 - 11:19	(1)
2013-06-20	F	11:39 - 11:40	(2)
2013-06-20	F	12:27 - 16:33	(247)
2013-06-20	F	16:36 - 16:55	(20)
2013-06-20	F	17:02 - 17:13	(12)
2013-06-20	F	17:15 - 17:15	(1)
2013-06-20	F	17:17 - 17:53	(37)
2013-06-20	F	17:55 - 18:02	(8)
2013-06-20	F	18:04 - 18:19	(16)
2013-06-20	F	18:22 - 18:37	(16)
2013-06-20	F	18:39 - 19:59	(81)
2013-06-20	F	20:04 - 22:45	(162)
2013-06-20	F	22:51 -	
2013-06-21	F	- 00:38	(108)
2013-06-21	F	00:41 - 00:45	(5)
2013-06-21	F	00:48 - 02:31	(104)
2013-06-21	F	02:34 - 03:40	(67)
2013-06-21	F	03:47 - 04:08	(22)
2013-06-21	F	04:10 - 04:16	(7)
2013-06-21	F	04:19 - 04:19	(1)
2013-06-21	F	04:23 - 04:23	(1)
2013-06-21	F	04:27 - 04:27	(1)
2013-06-21	F	04:29 - 04:30	(2)
2013-06-21	F	04:36 - 04:37	(2)
2013-06-21	F	05:17 - 05:24	(8)
2013-06-21	F	05:26 - 05:27	(2)
2013-06-21	F	07:38 - 07:40	(3)

2013-06-21	F	07:52 - 07:52	(1)
2013-06-21	F	07:55 - 07:55	(1)
2013-06-21	F	07:57 - 07:57	(1)
2013-06-21	F	08:05 - 13:11	(307)
2013-06-21	F	13:15 - 13:24	(10)
2013-06-21	F	13:30 - 17:49	(260)
2013-06-21	F	17:56 - 17:56	(1)
2013-06-21	F	17:58 - 18:03	(6)
2013-06-21	F	18:05 - 18:08	(4)
2013-06-21	F	18:10 - 18:10	(1)
2013-06-21	F	18:14 - 19:19	(66)
2013-06-21	F	19:21 - 19:26	(6)
2013-06-21	F	19:28 - 19:53	(26)
2013-06-21	F	19:55 - 20:01	(7)
2013-06-21	F	20:04 - 20:07	(4)
2013-06-21	F	20:15 - 20:18	(4)
2013-06-21	F	20:20 - 20:20	(1)
2013-06-21	F	20:25 - 21:38	(74)
2013-06-21	F	21:41 - 22:01	(21)
2013-06-21	F	22:04 - 22:04	(1)
2013-06-21	F	22:06 - 22:10	(5)
2013-06-21	F	22:12 - 22:52	(41)
2013-06-21	F	22:54 - 23:35	(42)
2013-06-21	F	23:46 -	
2013-06-22	F	- 01:35	(110)
2013-06-22	F	01:38 - 01:38	(1)
2013-06-22	F	01:41 - 01:45	(5)
2013-06-22	F	01:55 - 02:06	(12)
2013-06-22	F	02:10 - 02:21	(12)
2013-06-22	F	02:23 - 02:23	(1)
2013-06-22	F	02:26 - 02:26	(1)
2013-06-22	F	09:26 - 09:26	(1)
2013-06-22	F	09:29 - 09:46	(18)
2013-06-22	F	10:03 - 10:04	(2)
2013-06-22	F	11:18 - 11:18	(1)
2013-06-22	F	11:24 - 11:24	(1)
2013-06-22	F	11:26 - 11:32	(7)
2013-06-22	F	11:34 - 11:35	(2)
2013-06-22	F	11:40 - 11:40	(1)
2013-06-22	F	13:13 - 13:13	(1)
2013-06-22	F	13:32 - 13:32	(1)
2013-06-22	F	13:37 - 14:12	(36)
2013-06-22	F	14:15 - 14:28	(14)
2013-06-22	F	14:40 - 14:40	(1)
2013-06-22	F	14:48 - 14:48	(1)
2013-06-22	F	14:50 - 14:50	(1)
2013-06-22	F	14:57 - 14:59	(3)
2013-06-22	F	15:31 - 15:31	(1)
2013-06-23	F	12:58 - 12:59	(2)
2013-06-23	F	13:21 - 13:43	(23)
2013-06-23	F	13:45 - 13:52	(8)
2013-06-23	F	14:24 - 14:24	(1)
2013-06-23	F	14:33 - 14:33	(1)
2013-06-23	F	14:48 - 14:48	(1)
2013-06-23	F	14:56 - 15:24	(29)
2013-06-23	F	15:32 - 15:33	(2)
2013-06-23	F	15:39 - 15:48	(10)
2013-06-23	F	15:50 - 16:22	(33)
2013-06-23	F	16:25 - 16:25	(1)
2013-06-23	F	16:34 - 19:00	(147)
2013-06-23	F	19:14 - 19:14	(1)

2013-06-23	F	19:19 - 19:19	(1)
2013-06-23	F	19:25 - 19:25	(1)
2013-06-23	F	23:46 -	
2013-06-24	F	- 00:31	(46)
2013-06-24	F	01:30 - 01:32	(3)
2013-06-24	F	01:35 - 01:35	(1)
2013-06-24	F	01:39 - 01:50	(12)
2013-06-24	F	01:54 - 01:58	(5)
2013-06-24	F	02:00 - 02:01	(2)
2013-06-24	F	02:04 - 02:06	(3)
2013-06-24	F	02:09 - 02:48	(40)
2013-06-24	F	02:50 - 02:50	(1)
2013-06-24	F	02:52 - 02:54	(3)
2013-06-24	F	02:56 - 02:57	(2)
2013-06-24	F	02:59 - 03:03	(5)
2013-06-24	F	03:14 - 03:52	(39)
2013-06-24	F	03:55 - 03:56	(2)
2013-06-24	F	04:06 - 04:31	(26)
2013-06-24	F	04:33 - 04:47	(15)
2013-06-24	F	04:51 - 05:59	(69)
2013-06-24	F	06:27 - 06:28	(2)
2013-06-24	F	06:47 - 06:53	(7)
2013-06-24	F	06:56 - 07:02	(7)
2013-06-24	F	07:45 - 07:46	(2)
2013-06-24	F	07:58 - 07:58	(1)
2013-06-24	F	08:26 - 08:28	(3)
2013-06-24	F	08:42 - 08:42	(1)
2013-06-24	F	08:50 - 08:53	(4)
2013-06-24	F	08:55 - 08:56	(2)
2013-06-24	F	08:58 - 08:59	(2)
2013-06-24	F	09:01 - 09:02	(2)
2013-06-24	F	09:06 - 09:06	(1)
2013-06-24	F	09:11 - 09:11	(1)
2013-06-24	F	09:20 - 09:27	(8)
2013-06-24	F	09:29 - 09:30	(2)
2013-06-24	F	09:59 - 10:01	(3)
2013-06-24	F	10:04 - 10:08	(5)
2013-06-24	F	10:35 - 10:35	(1)
2013-06-24	F	10:38 - 10:39	(2)
2013-06-24	F	10:55 - 10:57	(3)
2013-06-24	F	11:02 - 11:05	(4)
2013-06-24	F	11:35 - 11:35	(1)
2013-06-24	F	11:41 - 11:44	(4)
2013-06-24	F	15:14 - 15:14	(1)
2013-06-24	F	15:27 - 15:28	(2)
2013-06-25	F	14:21 - 14:25	(5)
2013-06-25	F	14:27 - 14:27	(1)
2013-06-25	F	14:56 - 14:56	(1)
2013-06-25	F	14:58 - 15:01	(4)
2013-06-25	F	15:17 - 15:27	(11)
2013-06-25	F	15:32 - 15:32	(1)
2013-06-25	F	15:46 - 15:49	(4)
2013-06-25	F	15:59 - 16:17	(19)
2013-06-25	F	16:20 - 16:30	(11)
2013-06-25	F	16:47 - 17:03	(17)
2013-06-25	F	17:05 - 17:10	(6)
2013-06-25	F	17:12 - 17:13	(2)
2013-06-25	F	17:15 - 17:15	(1)
2013-06-25	F	17:18 - 17:37	(20)
2013-06-25	F	17:40 - 17:40	(1)
2013-06-25	F	18:01 - 19:01	(61)

2013-06-25	F	19:18 - 19:23	(6)
2013-06-25	F	19:29 - 19:33	(5)
2013-06-25	F	19:38 - 19:38	(1)
2013-06-25	F	19:42 - 19:58	(17)
2013-06-26	F	23:01 - 23:03	(3)
2013-06-27	F	02:00 - 02:00	(1)
2013-06-27	F	02:02 - 02:06	(5)
2013-06-27	F	02:08 - 02:09	(2)
2013-06-27	F	02:11 - 02:12	(2)
2013-06-27	F	02:18 - 02:23	(6)
2013-06-27	F	03:30 - 03:32	(3)
2013-06-27	F	03:34 - 03:37	(4)
2013-06-27	F	03:39 - 03:41	(3)
2013-06-27	F	03:46 - 03:46	(1)
2013-06-27	F	04:12 - 04:15	(4)
2013-06-27	F	04:28 - 04:29	(2)
2013-06-27	F	06:51 - 06:52	(2)
2013-06-27	F	07:12 - 07:18	(7)
2013-06-27	F	07:24 - 07:27	(4)
2013-06-27	F	17:47 - 18:22	(36)
2013-06-27	F	19:33 - 19:33	(1)
2013-06-27	F	19:35 - 19:35	(1)
2013-06-27	F	21:16 - 21:30	(15)
2013-06-27	F	21:35 - 22:04	(30)
2013-06-28	F	08:43 - 08:43	(1)
2013-06-28	F	09:02 - 09:04	(3)
2013-06-28	F	09:10 - 09:31	(22)
2013-06-28	F	20:06 - 20:07	(2)
2013-06-29	F	04:39 - 04:39	(1)
2013-06-29	F	08:46 - 08:46	(1)
2013-06-29	F	08:52 - 08:56	(5)
2013-06-29	F	08:59 - 09:00	(2)
2013-06-29	F	09:02 - 09:03	(2)
2013-06-29	F	09:10 - 09:11	(2)
2013-06-29	F	09:20 - 09:20	(1)
2013-06-29	F	09:22 - 09:22	(1)
2013-06-29	F	09:29 - 09:29	(1)
2013-06-29	F	09:31 - 09:31	(1)
2013-06-29	F	10:52 - 10:53	(2)
2013-06-29	F	11:14 - 11:15	(2)
2013-06-29	F	11:20 - 11:24	(5)
2013-06-29	F	13:37 - 13:37	(1)
2013-06-29	F	13:42 - 13:43	(2)
2013-06-29	F	13:48 - 13:48	(1)
2013-06-29	F	13:57 - 13:59	(3)
2013-06-29	F	14:01 - 14:04	(4)
2013-06-29	F	14:11 - 14:11	(1)
2013-06-29	F	18:58 - 19:05	(8)
2013-06-29	F	19:07 - 19:10	(4)
2013-06-29	F	19:12 - 19:16	(5)
2013-06-29	F	19:20 - 19:23	(4)
2013-06-29	F	19:25 - 19:43	(19)
2013-06-29	F	19:58 - 20:04	(7)
2013-06-29	F	20:13 - 20:13	(1)
2013-06-29	F	20:15 - 20:16	(2)
2013-06-29	F	20:18 - 21:32	(75)
2013-06-29	F	21:41 - 21:42	(2)
2013-06-29	F	21:49 - 21:49	(1)
2013-06-29	F	22:17 - 22:17	(1)
2013-06-29	F	22:26 - 22:26	(1)
2013-06-29	F	22:40 - 22:40	(1)

2013-06-29	F	22:42 - 22:51	(10)
2013-06-29	F	22:55 - 23:45	(51)
2013-06-29	F	23:59 -	
2013-06-30	F	- 00:16	(18)
2013-06-30	F	00:19 - 00:27	(9)
2013-06-30	F	00:30 - 00:45	(16)
2013-06-30	F	00:50 - 00:50	(1)
2013-06-30	F	00:55 - 00:57	(3)
2013-06-30	F	01:06 - 01:27	(22)
2013-06-30	F	01:29 - 01:30	(2)
2013-06-30	F	01:32 - 01:41	(10)
2013-06-30	F	01:43 - 02:02	(20)
2013-06-30	F	02:04 - 02:36	(33)
2013-06-30	F	02:38 - 02:44	(7)
2013-06-30	F	02:46 - 02:58	(13)
2013-06-30	F	03:03 - 03:03	(1)
2013-06-30	F	03:05 - 03:07	(3)
2013-06-30	F	03:13 - 03:25	(13)
2013-06-30	F	03:27 - 03:36	(10)
2013-06-30	F	03:38 - 03:58	(21)
2013-06-30	F	04:00 - 06:13	(134)
2013-06-30	F	06:15 - 06:16	(2)
2013-06-30	F	06:27 - 06:27	(1)
2013-06-30	F	06:34 - 06:34	(1)
2013-06-30	F	06:37 - 06:41	(5)
2013-06-30	F	06:52 - 07:09	(18)
2013-06-30	F	07:16 - 07:16	(1)
2013-06-30	F	07:18 - 07:19	(2)
2013-06-30	F	07:35 - 07:39	(5)
2013-06-30	F	08:03 - 08:08	(6)
2013-06-30	F	08:22 - 08:50	(29)
2013-06-30	F	08:53 - 09:06	(14)
2013-06-30	F	09:10 - 09:12	(3)
2013-06-30	F	09:17 - 09:19	(3)
2013-06-30	F	09:22 - 09:24	(3)
2013-06-30	F	09:30 - 09:30	(1)
2013-06-30	F	09:40 - 09:40	(1)
2013-06-30	F	09:42 - 09:51	(10)
2013-06-30	F	09:54 - 09:54	(1)
2013-06-30	F	10:14 - 10:23	(10)
2013-06-30	F	10:25 - 10:50	(26)
2013-06-30	F	11:09 - 11:10	(2)
2013-06-30	F	11:42 - 11:44	(3)
2013-06-30	F	11:49 - 11:52	(4)
2013-06-30	F	11:54 - 11:56	(3)
2013-06-30	F	12:11 - 12:19	(9)
2013-06-30	F	12:24 - 12:37	(14)
2013-06-30	F	12:40 - 15:19	(160)
2013-06-30	F	15:21 - 15:51	(31)
2013-06-30	F	15:57 - 16:00	(4)
2013-06-30	F	16:35 - 16:36	(2)
2013-06-30	F	16:43 - 16:43	(1)
2013-06-30	F	16:45 - 17:08	(24)
2013-06-30	F	17:12 - 17:16	(5)
2013-06-30	F	17:18 - 17:43	(26)
2013-06-30	F	18:13 - 18:13	(1)
2013-06-30	F	18:18 - 18:18	(1)
2013-06-30	F	18:22 - 18:22	(1)
2013-06-30	F	18:31 - 18:37	(7)
2013-06-30	F	18:40 - 18:41	(2)
2013-06-30	F	18:48 - 18:48	(1)

2013-06-30	F	19:09 - 19:10	(2)
2013-06-30	F	21:04 - 21:09	(6)
2013-06-30	F	21:15 - 21:19	(5)
2013-06-30	F	21:26 - 21:26	(1)
2013-06-30	F	23:42 - 23:42	(1)
2013-07-01	F	00:03 - 00:09	(7)
2013-07-01	F	00:14 - 00:14	(1)
2013-07-01	F	00:17 - 00:25	(9)
2013-07-01	F	00:29 - 02:44	(136)
2013-07-01	F	02:53 - 02:55	(3)
2013-07-01	F	02:57 - 03:34	(38)
2013-07-01	F	03:41 - 03:41	(1)
2013-07-01	F	03:56 - 04:10	(15)
2013-07-01	F	04:12 - 04:14	(3)
2013-07-01	F	04:53 - 04:54	(2)
2013-07-01	F	05:11 - 05:17	(7)
2013-07-01	F	06:39 - 06:41	(3)
2013-07-01	F	12:53 - 12:53	(1)
2013-07-01	F	14:06 - 14:06	(1)
2013-07-01	F	14:24 - 14:26	(3)
2013-07-01	F	15:27 - 15:37	(11)
2013-07-01	F	15:41 - 15:41	(1)
2013-07-01	F	15:43 - 15:44	(2)
2013-07-01	F	15:46 - 15:46	(1)
2013-07-01	F	15:49 - 15:52	(4)
2013-07-01	F	15:58 - 15:58	(1)
2013-07-01	F	16:01 - 16:01	(1)
2013-07-01	F	16:06 - 16:06	(1)
2013-07-01	F	16:18 - 16:21	(4)
2013-07-01	F	16:23 - 16:23	(1)
2013-07-01	F	16:27 - 16:44	(18)
2013-07-01	F	16:46 - 16:52	(7)
2013-07-01	F	17:29 - 17:37	(9)
2013-07-01	F	17:39 - 17:43	(5)
2013-07-01	F	17:46 - 17:48	(3)
2013-07-01	F	17:52 - 17:57	(6)
2013-07-01	F	18:00 - 18:00	(1)
2013-07-01	F	18:02 - 18:05	(4)
2013-07-01	F	18:08 - 18:09	(2)
2013-07-01	F	18:18 - 18:19	(2)
2013-07-01	F	18:21 - 18:21	(1)
2013-07-01	F	18:33 - 18:38	(6)
2013-07-01	F	18:41 - 18:42	(2)
2013-07-01	F	18:55 - 18:55	(1)
2013-07-01	F	18:57 - 19:00	(4)
2013-07-01	F	19:05 - 19:07	(3)
2013-07-01	F	19:29 - 19:29	(1)
2013-07-01	F	19:44 - 19:47	(4)
2013-07-01	F	20:52 - 20:52	(1)
2013-07-01	F	20:54 - 20:54	(1)
2013-07-01	F	20:57 - 21:45	(49)
2013-07-01	F	22:05 - 22:08	(4)
2013-07-01	F	22:10 - 22:11	(2)
2013-07-01	F	22:13 - 22:14	(2)
2013-07-01	F	22:16 - 22:17	(2)
2013-07-01	F	22:21 - 22:23	(3)
2013-07-01	F	22:33 - 22:48	(16)
2013-07-02	F	00:39 - 00:39	(1)
2013-07-02	F	00:41 - 00:42	(2)
2013-07-02	F	00:48 - 00:49	(2)
2013-07-02	F	00:51 - 01:11	(21)

2013-07-02	F	01:39 - 01:39	(1)
2013-07-02	F	01:42 - 01:51	(10)
2013-07-02	F	01:56 - 01:57	(2)
2013-07-02	F	01:59 - 02:12	(14)
2013-07-02	F	02:30 - 02:32	(3)
2013-07-02	F	02:39 - 02:40	(2)
2013-07-02	F	02:42 - 02:42	(1)
2013-07-02	F	02:46 - 02:46	(1)
2013-07-02	F	02:49 - 02:50	(2)
2013-07-02	F	02:57 - 02:57	(1)
2013-07-02	F	03:02 - 03:03	(2)
2013-07-02	F	03:05 - 03:05	(1)
2013-07-02	F	03:26 - 03:26	(1)
2013-07-02	F	03:32 - 03:33	(2)
2013-07-02	F	04:33 - 04:34	(2)
2013-07-02	F	04:51 - 07:16	(146)
2013-07-02	F	07:21 - 07:25	(5)
2013-07-02	F	07:31 - 07:32	(2)
2013-07-02	F	07:34 - 08:38	(65)
2013-07-02	F	08:40 - 09:31	(52)
2013-07-02	F	09:33 - 09:34	(2)
2013-07-02	F	09:40 - 09:42	(3)
2013-07-02	F	09:45 - 09:45	(1)
2013-07-02	F	09:48 - 09:52	(5)
2013-07-02	F	09:58 - 16:05	(368)
2013-07-02	F	16:16 - 19:04	(169)
2013-07-02	F	19:06 - 23:17	(252)
2013-07-02	F	23:25 - 23:53	(29)
2013-07-02	F	23:56 -	
2013-07-03	F	- 00:04	(9)
2013-07-03	F	00:14 - 00:14	(1)
2013-07-03	F	00:16 - 00:16	(1)
2013-07-03	F	00:21 - 00:34	(14)
2013-07-03	F	00:39 - 00:41	(3)
2013-07-03	F	00:43 - 01:05	(23)
2013-07-03	F	01:08 - 01:27	(20)
2013-07-03	F	01:31 - 01:31	(1)
2013-07-03	F	01:33 - 01:45	(13)
2013-07-03	F	02:00 - 02:08	(9)
2013-07-03	F	02:17 - 02:18	(2)
2013-07-03	F	02:25 - 02:35	(11)
2013-07-03	F	02:38 - 02:43	(6)
2013-07-03	F	03:24 - 03:37	(14)
2013-07-03	F	03:49 - 04:08	(20)
2013-07-03	F	04:12 - 04:35	(24)
2013-07-03	F	04:38 - 04:50	(13)
2013-07-03	F	04:59 - 05:01	(3)
2013-07-03	F	05:05 - 05:58	(54)
2013-07-03	F	06:02 - 06:02	(1)
2013-07-03	F	06:14 - 06:15	(2)
2013-07-03	F	06:24 - 06:24	(1)
2013-07-03	F	06:27 - 06:32	(6)
2013-07-03	F	06:34 - 09:38	(185)
2013-07-03	F	09:40 - 09:57	(18)
2013-07-03	F	10:04 - 10:04	(1)
2013-07-03	F	10:09 - 10:17	(9)
2013-07-03	F	10:30 - 10:31	(2)
2013-07-03	F	10:39 - 10:48	(10)
2013-07-03	F	10:51 - 11:11	(21)
2013-07-03	F	11:15 - 11:28	(14)
2013-07-03	F	11:41 - 11:41	(1)

2013-07-03	F	11:43 - 11:54	(12)
2013-07-03	F	11:57 - 12:03	(7)
2013-07-03	F	12:05 - 12:13	(9)
2013-07-03	F	12:20 - 12:54	(35)
2013-07-03	F	13:01 -	
2013-07-04	F	- 04:52	(952)
2013-07-04	F	06:53 - 06:53	(1)
2013-07-04	F	07:07 - 07:07	(1)
2013-07-04	F	07:14 - 07:14	(1)
2013-07-04	F	07:17 - 07:20	(4)
2013-07-04	F	07:43 - 07:44	(2)
2013-07-04	F	07:47 - 08:07	(21)
2013-07-04	F	08:09 - 08:10	(2)
2013-07-04	F	08:17 - 08:20	(4)
2013-07-04	F	08:52 - 08:53	(2)
2013-07-04	F	08:59 - 09:02	(4)
2013-07-04	F	09:46 - 09:46	(1)
2013-07-04	F	09:50 - 09:53	(4)
2013-07-04	F	10:14 - 10:14	(1)
2013-07-04	F	10:16 - 10:16	(1)
2013-07-04	F	10:30 - 10:30	(1)
2013-07-04	F	10:37 - 10:37	(1)
2013-07-04	F	11:08 - 11:08	(1)
2013-07-04	F	11:35 - 11:35	(1)
2013-07-04	F	12:26 - 12:32	(7)
2013-07-04	F	13:01 - 13:01	(1)
2013-07-04	F	13:05 - 13:06	(2)
2013-07-04	F	13:08 - 13:11	(4)
2013-07-04	F	13:26 - 13:30	(5)
2013-07-04	F	13:34 - 14:16	(43)
2013-07-04	F	14:36 - 14:38	(3)
2013-07-04	F	15:24 - 15:27	(4)
2013-07-04	F	17:31 - 17:49	(19)
2013-07-04	F	17:56 - 18:00	(5)
2013-07-04	F	18:43 - 18:55	(13)
2013-07-04	F	19:29 - 21:00	(92)
2013-07-04	F	21:03 - 21:03	(1)
2013-07-04	F	21:05 - 22:51	(107)
2013-07-04	F	22:55 - 23:02	(8)
2013-07-04	F	23:11 - 23:30	(20)
2013-07-04	F	23:32 - 23:40	(9)
2013-07-04	F	23:48 -	
2013-07-05	F	- 01:39	(112)
2013-07-05	F	01:41 - 01:46	(6)
2013-07-05	F	01:48 - 01:52	(5)
2013-07-05	F	01:57 - 02:21	(25)
2013-07-05	F	02:27 - 02:27	(1)
2013-07-05	F	02:30 - 02:35	(6)
2013-07-05	F	02:39 - 04:51	(133)
2013-07-05	F	04:54 - 05:53	(60)
2013-07-05	F	05:55 - 07:38	(104)
2013-07-05	F	07:40 - 07:50	(11)
2013-07-05	F	08:08 - 08:10	(3)
2013-07-05	F	08:15 - 08:18	(4)
2013-07-05	F	08:43 - 08:43	(1)
2013-07-05	F	09:29 - 09:33	(5)
2013-07-05	F	09:38 - 09:54	(17)
2013-07-05	F	10:02 - 10:03	(2)
2013-07-05	F	10:05 - 11:09	(65)
2013-07-05	F	11:15 - 13:34	(140)
2013-07-05	F	14:00 - 14:02	(3)

2013-07-05	F	14:10 - 14:16	(7)
2013-07-05	F	14:19 - 14:19	(1)
2013-07-05	F	14:22 - 14:24	(3)
2013-07-05	F	14:26 - 14:44	(19)
2013-07-05	F	14:49 - 15:01	(13)
2013-07-05	F	15:42 - 16:07	(26)
2013-07-05	F	16:29 - 16:50	(22)
2013-07-05	F	17:30 - 17:30	(1)
2013-07-05	F	17:38 - 17:40	(3)
2013-07-05	F	19:35 - 19:35	(1)
2013-07-05	F	19:39 - 19:55	(17)
2013-07-05	F	20:01 - 20:09	(9)
2013-07-05	F	20:15 - 20:22	(8)
2013-07-05	F	20:30 -	
2013-07-06	F	- 04:45	(496)
2013-07-06	F	04:52 - 11:01	(370)
2013-07-06	F	11:03 - 11:11	(9)
2013-07-06	F	11:17 - 11:43	(27)
2013-07-06	F	11:46 - 14:24	(159)
2013-07-06	F	14:30 - 15:30	(61)
2013-07-06	F	15:32 - 15:33	(2)
2013-07-06	F	15:40 - 15:44	(5)
2013-07-06	F	16:14 - 16:19	(6)
2013-07-06	F	16:24 - 16:24	(1)
2013-07-06	F	17:50 - 18:00	(11)
2013-07-06	F	18:02 - 18:19	(18)
2013-07-06	F	18:21 - 19:07	(47)
2013-07-06	F	19:11 - 19:12	(2)
2013-07-06	F	19:14 - 19:14	(1)
2013-07-06	F	19:39 - 19:48	(10)
2013-07-06	F	19:55 - 20:08	(14)
2013-07-06	F	20:10 - 20:14	(5)
2013-07-06	F	20:16 - 20:26	(11)
2013-07-06	F	20:28 - 20:32	(5)
2013-07-06	F	20:43 - 20:49	(7)
2013-07-06	F	21:19 - 21:21	(3)
2013-07-06	F	21:29 - 21:37	(9)
2013-07-06	F	21:49 - 21:50	(2)
2013-07-06	F	21:52 - 21:59	(8)
2013-07-06	F	22:02 - 22:02	(1)
2013-07-06	F	22:06 - 22:23	(18)
2013-07-06	F	22:27 - 22:39	(13)
2013-07-06	F	22:44 - 22:47	(4)
2013-07-06	F	22:49 - 22:54	(6)
2013-07-06	F	23:01 - 23:02	(2)
2013-07-06	F	23:04 - 23:08	(5)
2013-07-06	F	23:10 - 23:15	(6)
2013-07-06	F	23:30 - 23:31	(2)
2013-07-06	F	23:42 - 23:43	(2)
2013-07-06	F	23:45 -	
2013-07-07	F	- 00:41	(57)
2013-07-07	F	00:44 - 00:44	(1)
2013-07-07	F	01:48 - 01:49	(2)
2013-07-07	F	01:59 - 01:59	(1)
2013-07-07	F	02:04 - 02:05	(2)
2013-07-07	F	02:11 - 02:23	(13)
2013-07-07	F	02:26 - 02:31	(6)
2013-07-07	F	02:33 - 02:37	(5)
2013-07-07	F	02:42 - 02:44	(3)
2013-07-07	F	02:57 - 02:58	(2)
2013-07-07	F	03:33 - 03:33	(1)

2013-07-07	F	03:40 - 03:50	(11)
2013-07-07	F	04:05 - 04:05	(1)
2013-07-07	F	04:17 - 04:18	(2)
2013-07-07	F	04:28 - 04:30	(3)
2013-07-07	F	04:40 - 04:45	(6)
2013-07-07	F	04:53 - 04:57	(5)
2013-07-07	F	05:00 - 05:01	(2)
2013-07-07	F	05:21 - 05:21	(1)
2013-07-07	F	10:02 - 10:02	(1)
2013-07-07	F	10:06 - 10:06	(1)
2013-07-07	F	10:08 - 10:10	(3)
2013-07-07	F	10:14 - 10:49	(36)
2013-07-07	F	10:57 - 11:03	(7)
2013-07-07	F	11:05 - 11:06	(2)
2013-07-07	F	11:11 - 11:12	(2)
2013-07-07	F	11:36 - 12:21	(46)
2013-07-07	F	12:28 - 12:36	(9)
2013-07-07	F	12:43 - 12:48	(6)
2013-07-07	F	12:50 - 12:54	(5)
2013-07-07	F	12:56 - 13:59	(64)
2013-07-07	F	14:02 - 14:04	(3)
2013-07-07	F	14:19 - 14:19	(1)
2013-07-07	F	18:42 - 18:47	(6)
2013-07-07	F	18:53 - 18:54	(2)
2013-07-07	F	19:04 - 19:04	(1)
2013-07-07	F	19:11 - 19:12	(2)
2013-07-07	F	19:24 - 19:35	(12)
2013-07-07	F	20:11 - 20:13	(3)
2013-07-07	F	21:16 - 21:16	(1)
2013-07-07	F	21:21 - 21:21	(1)
2013-07-07	F	21:23 - 21:23	(1)
2013-07-07	F	21:25 - 21:26	(2)
2013-07-07	F	21:58 - 22:18	(21)
2013-07-07	F	22:23 - 22:28	(6)
2013-07-07	F	22:30 - 22:31	(2)
2013-07-07	F	23:02 - 23:02	(1)
2013-07-08	F	00:06 - 00:06	(1)
2013-07-08	F	00:08 - 00:09	(2)
2013-07-08	F	00:13 - 00:13	(1)
2013-07-08	F	00:15 - 00:18	(4)
2013-07-08	F	00:20 - 00:22	(3)
2013-07-08	F	00:34 - 00:36	(3)
2013-07-08	F	00:40 - 00:47	(8)
2013-07-08	F	01:02 - 01:02	(1)
2013-07-08	F	01:06 - 01:08	(3)
2013-07-08	F	01:11 - 01:11	(1)
2013-07-08	F	01:13 - 01:14	(2)
2013-07-08	F	01:38 - 01:41	(4)
2013-07-08	F	01:47 - 01:47	(1)
2013-07-08	F	02:09 - 02:09	(1)
2013-07-08	F	02:11 - 02:15	(5)
2013-07-08	F	02:22 - 02:22	(1)
2013-07-08	F	02:26 - 02:33	(8)
2013-07-08	F	02:37 - 02:38	(2)
2013-07-08	F	02:41 - 02:45	(5)
2013-07-08	F	02:48 - 02:49	(2)
2013-07-08	F	02:51 - 03:12	(22)
2013-07-08	F	03:15 - 03:20	(6)
2013-07-08	F	03:22 - 03:22	(1)
2013-07-08	F	03:38 - 03:38	(1)
2013-07-08	F	03:48 - 03:50	(3)

2013-07-08	F	03:52 - 08:07	(256)
2013-07-08	F	08:09 - 10:02	(114)
2013-07-08	F	10:04 - 10:34	(31)
2013-07-08	F	10:36 - 14:28	(233)
2013-07-08	F	14:32 - 14:32	(1)
2013-07-08	F	14:34 - 15:12	(39)
2013-07-08	F	15:15 -	
2013-07-09	F	- 21:47	(1833)
2013-07-09	F	21:49 - 21:50	(2)
2013-07-09	F	21:55 - 21:59	(5)
2013-07-09	F	22:05 - 22:05	(1)
2013-07-09	F	22:16 - 22:18	(3)
2013-07-09	F	22:23 - 22:25	(3)
2013-07-09	F	22:29 - 22:40	(12)
2013-07-09	F	23:55 -	
2013-07-10	F	- 00:19	(25)
2013-07-10	F	00:22 - 00:24	(3)
2013-07-10	F	01:07 - 01:09	(3)
2013-07-10	F	01:23 - 01:23	(1)
2013-07-10	F	02:03 - 02:06	(4)
2013-07-10	F	02:15 - 02:47	(33)
2013-07-10	F	02:52 - 02:54	(3)
2013-07-10	F	02:58 - 03:18	(21)
2013-07-10	F	03:20 - 04:26	(67)
2013-07-10	F	04:44 - 04:45	(2)
2013-07-10	F	05:19 - 06:20	(62)
2013-07-10	F	06:22 - 06:23	(2)
2013-07-10	F	06:26 - 06:26	(1)
2013-07-10	F	06:35 - 06:38	(4)
2013-07-10	F	06:40 - 06:43	(4)
2013-07-10	F	06:52 - 07:01	(10)
2013-07-10	F	08:51 - 08:52	(2)
2013-07-10	F	09:40 - 09:43	(4)
2013-07-10	F	10:37 - 10:37	(1)
2013-07-10	F	11:48 - 13:18	(91)
2013-07-10	F	13:32 - 13:32	(1)
2013-07-10	F	13:36 - 13:37	(2)
2013-07-10	F	13:57 - 14:02	(6)
2013-07-10	F	14:16 - 14:16	(1)
2013-07-10	F	14:24 - 14:25	(2)
2013-07-10	F	14:31 - 14:31	(1)
2013-07-10	F	14:40 - 14:45	(6)
2013-07-10	F	15:04 - 15:07	(4)
2013-07-10	F	15:47 - 15:48	(2)
2013-07-10	F	16:06 - 16:06	(1)
2013-07-10	F	16:23 - 16:23	(1)
2013-07-10	F	16:26 - 17:18	(53)
2013-07-10	F	17:25 - 17:30	(6)
2013-07-10	F	17:37 - 17:42	(6)
2013-07-10	F	17:54 - 19:30	(97)
2013-07-10	F	19:33 - 20:08	(36)
2013-07-10	F	20:19 - 20:31	(13)
2013-07-10	F	20:33 - 20:37	(5)
2013-07-10	F	20:42 - 20:50	(9)
2013-07-10	F	20:53 - 21:36	(44)
2013-07-10	F	21:38 - 21:39	(2)
2013-07-10	F	21:41 - 21:45	(5)
2013-07-10	F	21:47 - 21:47	(1)
2013-07-10	F	21:49 -	
2013-07-11	F	- 00:01	(133)
2013-07-11	F	00:03 - 00:03	(1)

2013-07-11	F	00:07 - 00:39	(33)
2013-07-11	F	00:58 - 01:02	(5)
2013-07-11	F	01:04 - 02:34	(91)
2013-07-11	F	02:38 - 02:45	(8)
2013-07-11	F	02:57 - 02:57	(1)
2013-07-11	F	02:59 - 03:07	(9)
2013-07-11	F	03:09 - 03:17	(9)
2013-07-11	F	03:19 - 04:41	(83)
2013-07-11	F	04:43 - 05:16	(34)
2013-07-11	F	05:24 - 05:30	(7)
2013-07-11	F	05:54 - 05:58	(5)
2013-07-11	F	06:07 - 06:19	(13)
2013-07-11	F	06:25 - 06:37	(13)
2013-07-11	F	06:59 - 08:23	(85)
2013-07-11	F	08:25 - 08:26	(2)
2013-07-11	F	09:00 - 09:01	(2)
2013-07-11	F	09:03 - 09:09	(7)
2013-07-11	F	09:57 - 10:06	(10)
2013-07-11	F	10:21 - 10:21	(1)
2013-07-11	F	10:29 - 11:08	(40)
2013-07-11	F	11:10 - 17:06	(357)
2013-07-11	F	17:08 - 19:55	(168)
2013-07-11	F	19:57 - 19:57	(1)
2013-07-11	F	19:59 - 23:05	(187)
2013-07-11	F	23:07 -	
2013-07-15	F	- 10:19	(4993)
2013-07-15	F	10:26 - 10:29	(4)
2013-07-15	F	10:42 - 10:43	(2)
2013-07-15	F	10:52 - 11:11	(20)
2013-07-15	F	11:13 - 11:17	(5)
2013-07-15	F	11:20 - 11:21	(2)
2013-07-15	F	11:23 - 11:23	(1)
2013-07-15	F	11:26 - 11:34	(9)
2013-07-15	F	11:37 - 12:06	(30)
2013-07-15	F	12:56 - 12:57	(2)
2013-07-15	F	12:59 - 13:22	(24)
2013-07-15	F	13:25 - 13:25	(1)
2013-07-15	F	13:27 - 13:27	(1)
2013-07-15	F	13:30 - 13:53	(24)
2013-07-15	F	13:59 - 14:03	(5)
2013-07-15	F	14:10 - 14:10	(1)
2013-07-15	F	14:13 - 14:31	(19)
2013-07-15	F	14:47 -	
2013-07-16	F	- 07:08	(982)
2013-07-16	F	07:11 - 08:33	(83)
2013-07-16	F	08:38 - 08:39	(2)
2013-07-16	F	08:41 - 08:41	(1)
2013-07-16	F	08:44 - 08:46	(3)
2013-07-16	F	08:51 - 08:52	(2)
2013-07-16	F	08:54 - 08:56	(3)
2013-07-16	F	08:59 - 09:17	(19)
2013-07-16	F	09:22 - 09:23	(2)
2013-07-16	F	09:33 - 10:59	(87)
2013-07-16	F	11:01 - 12:16	(76)
2013-07-16	F	12:19 - 12:26	(8)
2013-07-16	F	12:28 - 12:36	(9)
2013-07-16	F	12:42 - 12:51	(10)
2013-07-16	F	13:01 - 14:28	(88)
2013-07-16	F	14:31 - 14:35	(5)
2013-07-16	F	14:43 - 14:45	(3)
2013-07-16	F	14:54 - 14:54	(1)

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2013-07-16    F      15:02 - 15:08  (7)
2013-07-16    F      15:12 - 15:44  (33)
2013-07-16    F      15:46 - 15:51  (6)
2013-07-16    F      15:53 - 16:02  (10)
2013-07-16    F      16:04 -
2013-07-17    F            - 01:12  (549)
2013-07-17    F      01:15 - 01:38  (24)
2013-07-17    F      01:45 - 01:45  (1)
2013-07-17    F      01:47 - 01:50  (4)
2013-07-17    F      01:53 - 01:53  (1)
2013-07-17    F      02:00 - 02:01  (2)
2013-07-17    F      02:04 - 02:04  (1)
2013-07-17    F      02:06 - 02:08  (3)
2013-07-17    F      02:10 - 02:17  (8)
2013-07-17    F      02:20 - 03:02  (43)
2013-07-17    F      03:06 - 03:18  (13)
2013-07-17    F      03:20 - 03:23  (4)
2013-07-17    F      03:26 - 04:09  (44)
2013-07-17    F      04:12 - 04:47  (36)
2013-07-17    F      04:49 - 05:17  (29)
2013-07-17    F      05:22 - 06:43  (82)
2013-07-17    F      06:45 - 07:00  (16)
2013-07-17    F      07:02 - 07:04  (3)
2013-07-17    F      07:06 - 07:08  (3)
2013-07-17    F      07:10 -
2013-07-18    F            - 14:31  (1882)
2013-07-18    F      14:34 - 14:34  (1)
2013-07-18    F      14:38 - 15:16  (39)
2013-07-18    F      15:18 - 22:51  (454)
2013-07-18    F      22:55 - 22:55  (1)
2013-07-18    F      22:57 -
2013-07-20    F            - 01:10  (1574)
2013-07-20    F      01:15 -
2013-07-24    F            - 10:21  (6307)
2013-07-24    F      10:29 -
2013-07-26    F            - 22:30  (3602)
2013-07-26    F      22:34 - 22:34  (1)
2013-07-26    F      22:36 - 22:39  (4)
2013-07-26    F      22:41 - 22:45  (5)
2013-07-26    F      22:48 - 23:21  (34)
2013-07-26    F      23:25 - 23:25  (1)
2013-07-26    F      23:27 - 23:27  (1)
2013-07-26    F      23:29 -
2013-08-31    F            - 01:49  (50541)
2013-09-18    F      04:46 -
2013-10-07    F            - 22:41  (28436)
2013-11-25    F      22:55 - 23:59  (65)
2013-11-27    F      03:31 - 03:32  (2)
2013-12-06    F      10:02 - 10:02  (1)

Total: 118370

Annual mean values
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The annual mean values for Learmonth are set out in
the yearmean file.

Indices
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No magnetic indices are routinely calculated for the
Learmonth  observatory.
```

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                                   < END >
```

7.4.1.2 2014

```
                                    LRM
               LEARMONTH OBSERVATORY INFORMATION 2014

 ACKNOWLEDGE-  Users of the LRM data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: LRM
     LOCATION: Learmonth Solar Observatory, Exmouth,
               Western Australia, Australia
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 112.22 Deg.
    LONGITUDE: 114.10 Deg. E
    ELEVATION: 004 metres

     ABSOLUTE
  INSTRUMENTS: DMI: DI0051D Zeiss 313888
               GSM: GSM90_4081416 sensor 73103

    RECORDING
   VARIOMETER: Three component suspended fluxgate
               magnetometer (Danish Meteorological
               Institute, Model FGE)
               GEM GSM90 Proton Precession
               Magnetometer

   ORIENTATION: Magnetic northwest, northeast and vertical
 DYNAMIC RANGE: +/- 1600nT
    RESOLUTION: 0.03nT
 SAMPLING RATE: 1 second
   FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: None

    K-NUMBERS: None
     K9-LIMIT: 300nT

         GINS: Edinburgh
    SATELLITE: http upload

    OBSERVERS: Vasily Lobzin
               Owen Giersch

      CONTACT: Geomagnetism Group
               Geoscience Australia
               G.P.O. Box 378
               Canberra, A.C.T., 2601
               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9969
               e-mail: geomag@ga.gov.au
               WWW: http://www.ga.gov.au
```

NOTES:

Learmonth

The Learmonth magnetic observatory is located on North West Cape about 1100 km north of Perth and 35 km from Exmouth in Western Australia. The magnetic observatory is co-located with the Learmonth Solar Observatory (LSO), which is jointly staffed by IPS Radio and Space Services and the United States of America Air Force. The observatory complex is situated on coastal sand dunes bordering the Exmouth Gulf.
The magnetic observatory consists of:
* three underground vaults located on IPS land, housing variometer sensors and control equipment;
* an Absolute Shelter, located on land belonging to the Royal Australian Air Force (RAAF) 200 m from the solar observatory, enclosing a concrete observation pier (Pier A), the top of which is 1200 mm above the concrete floor, and;
* a remote reference station (B) on RAAF land.

Table 1. Key observatory data.
IAGA code: LRM
Commenced operation: November 1986
Geographic latitude: 22d 13' 19" S
Geographic longitude: 114d 06' 03" E
Geomagnetic latitude: -31.89d
Geomagnetic longitude: 187.07d
K 9 index lower limit: 300 nT
Principal pier: Pier A
Pier elevation (top): 4 m AMSL
Principal reference mark: West windsock
Reference mark azimuth: 283d 02' 18"
Reference mark distance: 1 km approx.
Observer: V. Lobzin
          O. Giersch

Local meteorological conditions

The meteorological temperature at Learmonth during 2014 varied from a minimum +4.6 deg C (2014-07-25) to a maximum +48.0 deg C (2014-01-09). Daily minimum temperatures varied from +4.6 deg C to +28.0 deg C (average +17.5 +/-5.2 deg C) daily maximum temperatures varied from +17.9 deg C to +48.0 deg C (average +32.3 +/-5.8 deg C).

The daily maximum wind gust varied from 17 to 65 km/h (average 36 +/-9.8 km/h). The maximum daily maximum wind gust was 65 km/h in March and May. The minimum daily maximum wind gust was 17 km/h in May. No data were recorded on the hours of sunshine by the Bureau of Meteorology.

Variometers

The variometers used during 2014 are described in Table 2. The recording equipment, some of the variometer electronic control equipment, and back-up power were housed in the Radio Solar Telescope Network (RSTN) building of the Solar Observatory. The magnetometers and control electronics were housed in three semi-underground concrete vaults, each

800×800×800 mm, lying in a north-south line about 110 m to the east of the RSTN building. The vaults are about 7 m apart and are covered in local sand. The DMI fluxgate sensor was located in the northern most vault and the GSM-90 total-field sensor in the southern most vault. The electronics for both the DMI fluxgate and the GSM-90 total-field were housed in the central vault.

Underground conduits containing sensor cables connected the central vault to the two sensor vaults. An underground conduit between the RSTN building and the central vault contained 12 V DC power and digital data cables. The variometer and recording system were powered by a 12 V DC battery box charged from 240 V AC mains power. The recording computer and 12 V DC battery box were housed in the RSTN building. System timing was provided by a GPS clock with time corrections applied automatically and logged. Timing corrections greater than 10 ms are listed in Variometer clock corrections below.

Table 2. Magnetic variometers used in 2014.
3-component variometer: DMI FGE
Serial number: E0271 / S0237
Type: suspended; linear-core fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
A/D converter: ADAM 4017 module (+/-5V)
Scale value: 0.032 nT / count
Period of use: 2014-01-01 to 2014-12-31

Total-field variometer: GEM Systems GSM-90
Serial number: 8092904 / 83385
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Period of use: 2014-01-01 to 2014-12-31

Data acquisition system: GDAP: ARK3660F Industrial
Computer QNX OS 6.5
Timing: Trimble Acutime GPS clock

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2014, there was one adjustment to the system clock greater than 10 ms. This was due to a reboot of the acquisition computer and is listed below.

2014-10-01 06:57:05 -0.399 s

Absolute instruments

The principal absolute magnetometers used at Learmonth and their adopted corrections for 2014 are described in Table 3.

The absolute DIM fluxgate instrument, DI0051/313888, was compared to the Canberra geomagnetic observatory reference instrument DI0086/353756 on 2009-07-21, 2009-07-28, 2009-08-17, 2009-08-25, 2009-09-01, and 2009-09-22 at the Canberra geomagnetic observatory before being deployed to Learmonth. Adopted Instrument corrections were -0.05', and -0.10' in D and I respectively.

During 2014 maintenance visit; instrument comparisons were made between the travelling reference DIM fluxgate (DIM B0610H/160459) and the Learmonth absolute instrument (DIM DI0051/313888). The adopted differences as determined in 2009 remain unchanged for 2014.

The adopted differences between the LRM instruments and the international average (as defined by observations at IAGA instrument workshops) are given in Table 3.

Table 3. Absolute magnetometers and their adopted corrections for 2014. Corrections are applied in the sense Standard = Instrument + correction.

DI fluxgate: DMI
Serial number: DI0051D + Pico ADC16 FJY06/136
Theodolite: Zeiss 020B
Serial number: 313888
Resolution: 0.1'
D correction: -0.05'
I correction: -0.10'
Period of use: 2014-01-01 to 2014-12-31

Total field magnetometer: GEM Systems GSM-90
Serial number: 4081416 / 73103
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT
Period of use: 2014-01-01 to 2014-12-31

At the 2014 mean magnetic-field values at Learmonth (X=30102 nT, Y=184 nT, Z= -43478 nT) the D, I and F corrections translate to corrections of:

dX = -1.26 nT dY = -0.45 nT dZ = -0.88 nT

These corrections have been applied to all LRM 2014 final data.

Communications

There are two telemetry paths available, either via radio modem to Giralia seismic station and then VSAT to Canberra or via IPS dedicated data line to Sydney and then via internet to Canberra.

Baselines

The fluxgate variometer baselines were controlled by 52 sets of weekly absolute observations for the year using the offset method.

The final baseline parameters for the variometer were completed by manually fitting a piece-wise linear function to the absolute observations. This function included drifts or jumps, when required, to obtain a good fit to the weekly absolute observation baseline residuals. Baseline drifted in all three channels over the course of the year. Scatter in the baseline residuals was generally small throughout the year with a range of 4.3 nT.

Throughout 2014 adopted baselines drifted within ranges of
X = -1.6 nT to +1.3 nT
Y = -1.9 nT to +2.3 nT
Z = -1.0 nT to +0.8 nT

Outliers in the absolute observations were excluded on days 224, 347, 308 and 352.

The final Fv-Fs values for the year varied from -1.6 nT to 1.5 nT. The standard deviations in the 2014 weekly absolute observations from the final adopted variometer model and data were:

X	0.5 nT
Y	1.2 nT
Z	0.4 nT
F	0.4 nT
D	8"
I	2"

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2014 LRM definitive data and real time reported 1-minute data sets (LRM definitive - LRM real time) were:

	X	Y	Z
Average	+0.4	-0.2	-0.2
Std.dev	+1.7	+1.1	+1.5
Min	-2.5	-2.3	-2.7
Max	+2.2	+1.5	+2.4

The differences in the mean values between the definitive data and reported data indicate good consistency.

The LRM 2014 reported real time data are within the specification for INTERMAGNET Quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2014 LRM definitive data and quasi-definitive 1-minute data sets (LRM definitive - LRM quasi-definitive) were:

	X	Y	Z
Average	+0.2	+0.1	-0.1
Std.dev	+0.8	+0.7	+0.5
Min	-0.8	-1.5	-1.1

Max   +1.8   +0.9   +0.6

The LRM 2014 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

Absolute observations were performed weekly by Owen Giersch and Vasily Lobzin from IPS Radio and Space Services (IPS). Variometer data were downloaded every 3-10 minutes through a TCP/IP network connection. One-minute data were then automatically processed to reported status, made available on the Geoscience Australia website, and sent to the Edinburgh INTERMAGNET GIN via e-mail/HTTP. Data were also provided to IPS Radio and Space Services via a direct serial link from the acquisition computer in the RSTN building. IPS applied nominal scale values and rotation parameters.

The first observations for the year were collected on day 016 (2014-01-16), as the observer was away on leave prior to this. There were three other periods when weekly observations were not collected. The first of these was in late March when the observer was attending a conference. This prompted the other solar physicist employed at the LSO to suggest that he be given observer training. The responsibility for the collection of absolute observations could then be shared between two observers. This training was provided during the next maintenance visit which occurred in early August. The second period occurred in mid-April when the tablet used to record absolute observations failed. A new tablet was air freighted to Learmonth to replace the faulty unit. The third period occurred in late April when the observer was on leave. For the year a total 52 pairs of absolute observations were collected.

Throughout the year the DMI fluxgate magnetometer would record spurious 1 second data in one or two channels. These events were entirely random and no cause has been determined. The timing of these events was noted and these data have been excluded from the definitive data for 2014.

At the beginning of August (2014-08-01), daily checks of the real-time data showed unusual excursions occurring in the data. This appeared to be due to contamination and an inquiry was sent to the observer . The observer replied that they had a large 100 tonne crane on site to help with the upgrade of the radio dish. The observer had thought that the distance between the variometers and the crane was sufficient. Later measurement using a GPS showed that the crane was 110m from the variometers.

In early August a maintenance visit by an officer from Geoscience Australia was undertaken. During this visit observer training was provided to the solar physicist as the second observer at the LSO. This training was provided on the morning of 2014-08-12 and the afternoon of the 2014-08-13. During this visit comparisons were also made between the travelling reference absolute instrument (DIM B0610H/160459)and the Learmonth absolute instrument (DIM DI0051/313888) on 2014-08-12 on pier A.

A gradient survey was also conducted around pier A and the absolute shelter on the 2014-08-12. These were then compared with the previous survey conducted during the maintenance visit in 2013. No contamination of the pier had occurred since the last visit.

The differences between pier A and the remote reference station B were also measured on the 2014-08-13. These results were compared to those measured in 2013 and they agree (within expected errors) with these previous measurements.

During an absolute observation it was noted that birds were removing glass fibres from the roof sheeting of the absolute shelter. After the completion of the absolute observation a ladder was borrowed from the LSO to investigate the roof. This investigation showed that the fibreglass sheeting on the roof had deteriorated in the sun and was no longer waterproof with large holes throughout.

Given the deteriorated state of the roof, a simple gradient survey of 28 soundings was conducted at 1 m intervals outside the absolute shelter to a distance of 3 m. This would give a baseline for later comparison after any remediation work was concluded. This would ensure that the general area around the absolute shelter remained magnetically clean.

In mid-October permission was given to search for a contractor to replace the roof of the absolute shelter. Given the age of the shelter, it was decided that it would be prudent to have the shelter tested for asbestos prior to any quotes being received from contractors. The testing showed the presence of chrysotile asbestos in the fascias of the shelter. The advice received from the testing facility was that this asbestos was stable if left undisturbed. As the fibreglass sheeting need to be replaced it was thought that this would be an opportune time to replace these fascias with a product that did not contain asbestos. Quotes were sort from several builders in the Exmouth region. Only two quotes were received with Chapman Enterprises being the successful tenderer.

The distribution of Learmonth 2014 data is described in Table 4. Data losses are identified in Table 5.

Table 4. Distribution of Learmonth 2014 data.

Recipient	Status	Sent
1 second values		
IPS Radio and Space Services	preliminary	real time
INTERMAGNET	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time

```
INTERMAGNET        preliminary       daily
INTERMAGNET        quasi-definitive  monthly
INTERMAGNET        definitive        July 2015
WDC for
Geomagnetism Kyoto preliminary       real time
WDC for
Geomagnetism Kyoto preliminary       daily
```

```
Significant events
------------------------------------------------------------
2014-01-03 No absolute observations between 2013-12-19 and
           2014-01-16. Observer is on leave.
2014-02-07 04:30 swap telemetry from IPS to Giralia as IPS
           link is too slow to operate reliably due to
           network problems at IPS in Sydney.
2014-02-10 22:00 swap telemetry from Giralia back to IPS
           link.
2014-02-14 02:44:46 to 02:45:45 X channel odd data.
           Also at 01:52 to  02:00 using lookq X and Y have
           square form up and down movements.
           Another spike occurs at 02:45 in X and Y.
2014-02-15 Another unusual change in X at 11:54
2014-02-17 Another unusual change, this time in Y at
           10:43:30. Change in X at 14:22:30
2014-03-28 Spikes in variometer due to T.Storm.
2014-03-31 No observations for last week, observer away in
           Canberra.
2014-04-11 Observer reports fault with tablet. No obs for
           this week. Replacement sent on 2014-04-14.
2014-04-16 New tablet has arrived at LSO.
2014-04-17 Observer away from 2014-04-17 till 2014-04-27.
2014-04-30 lrmobs.cp and insinfo files updated to recognise
           that pico used to collect DIM data.
           lrm14abs.obs file has been also updated so that
           DI0051 is changed to DI0051D.
2014-05-16 Thunderstorm starting day 135 ~22:20 and through
           to ~01:10 day 136.
2014-08-01 ~01:12 onwards, large crane within grounds of
           LSO causing changes in XY and F. Not in Z.
           Possibly there for several days.
2014-08-07 ~07:12 possible effect of crane again.
2014-08-11 Maintenance visit by WVJ between 2014-08-11 and
           2014-08-15. Training for VL in abs obs.
           Comparisons of DIM and PPM, ROA's etc. Abs
           shelter roof needs replacing.
2014-09-20 Request from LSO for RCD boards for geomag
           equipment to meet WHS site requirements. Two
           boards purchased and sent 2014-09-25 via
           Australia Post. Arrived 2014-10-03.
2014-10-01 06:56 reboot to clear TIME_WAIT tcp connections.
2014-10-03 C.Thomson (IPS) notification that new static IP
           address to be assigned to system.
2014-10-14 Email Clayton Lord to request quote for repairs
           to roof of abs hut.
2014-11-05 Change network config for IPS/BoM network
           upgrade
           Assigned IP:   134.178.176.180
           Netmask:       255.255.255.224
           Gateway:       134.178.176.161
           (AML) Update /etc/hosts; /etc/rc.d/rc.network
```

```
           ifconfig  wm1 down; ifconfig wm1 local1 netmask
           255.255.255.224 up route change default gate
           - System not rebooted
2014-11-06 05:00 (AML) switch over to IPS/BoM network
           Update GMAlias, GMHosts, XgetObsLRM
2014-11-07 Update getObsGPSLRM for new ssh port (AML)
2014-11-07 Phone call with Clayton, request that sample of
           facia be sent for testing for asbestos.
2014-11-17 Test comes back and confirms that facia has
           white asbestos in it. Request quote for repair
           that includes replacement of facia with new
           board. Discuss the different materials available
           to replace the roof sheeting. Fibreglass or
           polycarbonate sheeting. Polycarbonate
           recommended for durability and longevity.
2014-11-19 Pay for testing and tagging of electrical
           equipment. Log book is part of cost. ERA is
           the company who conducted testing.
2014-12-08 Central vault being re-buried, contamination
           in data between 22:32:33 and 22:37:30. New
           gravel will be needed during next visit.

Data Losses for 2014
---------------------

Table 5. Data losses.

Variometer data XYZ:
2014-04-08    XYZ     02:43 - 02:43  (1)
2014-08-01    XYZ     01:12 - 02:10  (59)
2014-08-07    XYZ     06:07 - 07:16  (70)
2014-08-07    XYZ     07:24 - 07:24  (1)
2014-10-01    XYZ     06:56 - 06:56  (1)

Total: 132


Scalar Data F:
2014-08-01    F      01:12 - 02:10  (59)
2014-08-07    F      06:07 - 07:16  (70)
2014-08-07    F      07:24 - 07:24  (1)
2014-10-01    F      06:56 - 06:56  (1)

Total: 131

Annual mean values
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The annual mean values for Learmonth are set out in
the yearmean file.

Indices
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No magnetic indices are routinely calculated for the
Learmonth  observatory.

                           < END >
```

7.4.1.3 2015

```
                              LRM
             LEARMONTH OBSERVATORY INFORMATION 2015

 ACKNOWLEDGE-  Users of the LRM data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: LRM
     LOCATION: Learmonth Solar Observatory, Exmouth,
               Western Australia, Australia
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 112.222 Deg.
    LONGITUDE: 114.101 Deg. E
    ELEVATION: 004 metres

     ABSOLUTE
  INSTRUMENTS: DMI: DI0051D Zeiss 313888
               GSM: GSM90_4081416 sensor 73103

    RECORDING
   VARIOMETER: Three component suspended fluxgate
               magnetometer (Danish Meteorological
               Institute, Model FGE)
               GEM GSM90 Proton Precession
               Magnetometer

   ORIENTATION: Magnetic northwest, northeast and vertical
 DYNAMIC RANGE: +/- 1600nT
    RESOLUTION: 0.03nT
 SAMPLING RATE: 1 second
   FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: None

    K-NUMBERS: None
     K9-LIMIT: 300nT

         GINS: Edinburgh
    SATELLITE: http upload

    OBSERVERS: Vasily Lobzin
               Owen Giersch
               John Dudley
               William Jones

      CONTACT: Geomagnetism Group
               Geoscience Australia
               G.P.O. Box 378
               Canberra, A.C.T., 2601
               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9969
               e-mail: geomag@ga.gov.au
               WWW: http://www.ga.gov.au

NOTES:

Learmonth
```

The Learmonth magnetic observatory is located on North West Cape about 1100 km north of Perth and 35 km from Exmouth in Western Australia. The magnetic observatory is co-located with the Learmonth Solar Observatory (LSO), which is jointly staffed by Bureau of Meteorology Space Weather Services (BoM SWS)and the United States of America Air Force (USAAF). The observatory complex is situated on coastal sand dunes bordering the Exmouth Gulf.

The magnetic observatory consists of:
* three underground vaults located on BoM SWS land, housing variometer sensors and control equipment;
* an Absolute Shelter, located on land belonging to the Royal Australian Air Force (RAAF) 200 m from the solar observatory, enclosing a concrete observation pier (Pier A), the top of which is 1200 mm above the concrete floor, and;
* a remote reference station (B) on RAAF land.

Table 1. Key observatory data.
IAGA code: LRM
Commenced operation: November 1986
Geographic latitude: 22d 13' 19" S
Geographic longitude: 114d 06' 03" E
Geomagnetic latitude: -31.89d
Geomagnetic longitude: 187.07d
K 9 index lower limit: 300 nT
Principal pier: Pier A
Pier elevation (top): 4 m AMSL
Principal reference mark: West windsock
Reference mark azimuth: 283d 02' 18"
Reference mark distance: 1 km approx.
Observer: V. Lobzin
          O. Giersch
          J. Dudley
          W. Jones

Local meteorological conditions

The meteorological temperature at Learmonth during 2015 varied from a minimum +6.6 deg C (2015-07-01) to a maximum +47.0 deg C (2015-01-07). Daily minimum temperatures varied from +6.6 deg C to +30.0 deg C (average +17.9 +/-4.9 deg C) daily maximum temperatures varied from +17.6 deg C to +47.0 deg C (average +31.9 +/-5.7 deg C); daily temperature ranges varied from 1.6 C to 41 C (average 14.0+/-4.5 C).

The daily maximum wind gust varied from 17 to 180 km/h (average 40 +/-14.8 km/h). The maximum daily maximum wind gust was 180 km/h in March. The minimum daily maximum wind gust was 17 km/h in April. No data were recorded on the hours of sunshine by the Bureau of Meteorology.

All weather data was provided by the Australian Government- Bureau of Meteorology.

Variometers

The variometers used during 2015 are described in Table 2.

The recording equipment, some of the variometer electronic control equipment, and back-up power were housed in the Radio Solar Telescope Network (RSTN) building of the Solar Observatory. The magnetometers and control electronics were housed in three semi-underground concrete vaults, each 800×800×800 mm, lying in a north-south line about 110 m to the east of the RSTN building. The vaults are about 7 m apart and are covered in local sand. The DMI fluxgate sensor was located in the northern most vault and the GSM-90 total-field sensor in the southern most vault. The electronics for both the DMI fluxgate and the GSM-90 total-field were housed in the central vault.

Underground conduits containing sensor cables connected the central vault to the two sensor vaults. An underground conduit between the RSTN building and the central vault contained 12 V DC power and digital data cables. The variometer and recording system were powered by a 12 V DC battery box charged from 240 V AC mains power. The recording computer and 12 V DC battery box were housed in the RSTN building. System timing was provided by a GPS clock with time corrections applied automatically and logged. Timing corrections greater than 10 ms are listed in Variometer clock corrections below.

Table 2. Magnetic variometers used in 2015.
3-component variometer: DMI FGE
Serial number: E0271 / S0237
Type: suspended; linear-core fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
A/D converter: ADAM 4017 module (+/-5V)
Scale value: 0.032 nT / count
Period of use: 2015-01-01 to 2015-12-31

Total-field variometer: GEM Systems GSM-90
Serial number: 8092904 / 83385
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Period of use: 2015-01-01 to 2015-12-31

Data acquisition system: GDAP: ARK3660F Industrial Computer QNX OS 6.5
Timing: Trimble Acutime GPS clock

A despiking filter was applied throughout the year to the DMI 1-second variometer data. The spike detection required a value to deviate from the local linear trend by 5.2 times the maximum of 0.5nT, or 8/9 fractile of deviations during the following minute. Each day was then reviewed for either over or under filtering. If days were found to have been over filtered then that day was re-processed without any filter applied and an entry was made in the lrmExclude.cfg file. If a day was found to have been underfiltered then a second more aggressive filter was applied by 3.5 times the maximum of 0.075nT. Days when these were applied are listed in the appendix.

The 10-second scalar variometer data were also despiked on most days. A spike detection required a value to

deviate from the local linear trend by 10 times the
maximum of 0.1 nT, or 8/9 fractile of deviations during
the following minute or so. Days on which no scalar
filtering was applied are listed in the appendix.

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2015, there were five adjustments to the system clock greater than 1 ms. In March a cyclone caused damage to the GPS clock. The clock was replaced on 2015-03-24 and restarted on 2015-05-27. The correction in July was caused by the application of a leap second. In December the computer was rebooted to clear the TCP stack.

2015-03-24	03:51:15	-0.018 s
	03:52:41	-0.003 s
2015-05-27	06:51:34	0.909 s
2015-07-01	00:00:40	-1.000 s
2015-12-30	21:20:37	1.647 s

Absolute instruments

The principal absolute magnetometers used at Learmonth and their adopted corrections for 2015 are described in Table 3.

The absolute DIM fluxgate instrument, DI0051/313888, was compared to the Canberra geomagnetic observatory reference instrument DI0086/353756 on 2009-07-21, 2009-07-28, 2009-08-17, 2009-08-25, 2009-09-01, and 2009-09-22 at the Canberra geomagnetic observatory before being deployed to Learmonth. Adopted Instrument corrections were -0.05', and -0.10' in D and I respectively.

During the 2014 maintenance visit; instrument comparisons were made between the traveling reference DIM fluxgate (DIM B0610H/160459) and the Learmonth absolute instrument (DIM DI0051/313888). No instrument comparisons were made during 2015 therefore adopted differences as determined in 2014 will be used for 2015.

The adopted differences between the LRM instruments and the international average (as defined by observations at IAGA instrument workshops) are given in Table 3.

Table 3. Absolute magnetometers and their adopted corrections for 2015. Corrections are applied in the sense Standard = Instrument + correction.

DI fluxgate: DMI
Serial number: DI0051D + Pico ADC16 FJY06/136
Theodolite: Zeiss 020B
Serial number: 313888
Resolution: 0.1'
D correction: -0.05'
I correction: -0.10'
Period of use: 2015-01-01 to 2015-12-31

Total field magnetometer: GEM Systems GSM-90
Serial number: 4081416 / 73103
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT
Period of use: 2015-01-01 to 2015-12-31

At the 2015 mean magnetic-field values at Learmonth (X=30140 nT, Y=168 nT, Z= -43427 nT) the D, I and F corrections translate to corrections of:

dX = -1.3 nT dY = -0.5 nT   dZ = -0.9 nT

These corrections have been applied to all LRM 2015 final data.

Communications

There are two telemetry paths available, either via radio modem to Giralia seismic station and then VSAT to Canberra or via BoM SWS dedicated data line to Sydney and then via internet to Canberra.

Baselines

The fluxgate variometer baselines were controlled by 54 sets of weekly absolute observations for the year using the offset method.

The final baseline parameters for the variometer were completed by manually fitting a piece-wise linear function to the absolute observations. This function included drifts or jumps, when required, to obtain a good fit to the weekly absolute observation baseline residuals. The baselines drifted in all three channels over the course of the year. Scatter in the baseline residuals was generally small throughout the year within a range of 1.5 nT.

Throughout 2015 adopted baselines drifted within ranges of
X = -1.6 nT to +1.3 nT
Y = -2.0 nT to +2.4 nT
Z = -1.0 nT to +0.8 nT

Outliers in the absolute observations were excluded on days 265, 279, and 363.

The final Fv-Fs values for the year varied from -0.6 nT to 0.8 nT. The standard deviations in the 2015 weekly absolute observations from the final adopted variometer model and data were:

X   0.5 nT
Y   0.9 nT
Z   0.4 nT
F   0.4 nT
D   8"
I   2"

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2015 LRM definitive data and real time reported 1-minute data sets
(LRM definitive - LRM real time) were:

	X	Y	Z
Average	+0.6	-0.3	-0.3
Std.dev	+2.1	+1.0	+1.3
Min	-2.2	-1.9	-2.4
Max	+3.8	+1.6	+1.7

The differences in the mean values between the definitive data and reported data indicate good consistency.

The LRM 2015 reported real time data are within the specification for INTERMAGNET Quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2015 LRM definitive data and quasi-definitive 1-minute data sets
(LRM definitive - LRM quasi-definitive) were:

	X	Y	Z
Average	+0.4	+0.1	-0.3
Std.dev	+0.7	+0.5	+0.6
Min	-0.6	-1.0	-1.5
Max	+2.0	+0.8	+0.8

The LRM 2015 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

Absolute observations were performed weekly by Owen Giersch and Vasily Lobzin from Space Weather Service (BoM SWS)and John Dudley (BoM). Variometer data were downloaded every 3-10 minutes through a TCP/IP network connection. One-minute data were then automatically processed to reported status, made available on the Geoscience Australia website, and sent to the Edinburgh INTERMAGNET GIN via e-mail/HTTP. Data were also provided to Space Weather Services via a direct serial link from the acquisition computer in the RSTN building. SWS then applied nominal scale values and rotation parameters.

The first observations for the year were collected on day 002 (2015-01-02). There was only one interruption to the collection of observations when Tropical Cyclone Olwyn passed directly over the LSO on day 071, 2015-03-12.

In early March, (2015-03-02 to 2015-03-05), a maintenance visit to the LSO was undertaken by two officers from Geoscience Australia. The main purpose of the visit was to supervise the replacement of the roof on the absolute shelter. All new materials used in the upgrade were tested for magnetism before installation. During the upgrade some components of the roof containing white asbestos were replaced with non-asbestos fibre cement sheeting.

Absolute observations were conducted on remote reference station B before and after the work to measure any magnetic contamination caused by the replacement of the roof. No contamination was identified.

In March (2015-03-11, 2015-03-12), Tropical Cyclone Olywn passed directly over the LSO. The LSO was shutdown and evacuated during this time. The variometer system continued to operate during this period and no data were lost. The system timing failed and it was found the Trimble Acutime GPS clock had been broken during the cyclone. As connector pins on the clock had corroded the clock and cable were replaced on 2015-03-24. System timing corrections were managed using a local ntp server while the GPS clock was unavailable.

The radio link between the LSO and Giralia seismic station is via a FreeWave radio system. This system uses a radio antenna mount on a steel pole outside the RSTN building. During the cyclone this steel pole snapped off at ground level. To re-establish this link, the pole will need to be replaced and the antenna installed. It is not known at this time if any damage has occurred at Giralia. A site visit will be required to establish this.

At the beginning of May (2015-05-01), Tropical Cyclone Quang approached the Exmouth region. The LSO was once again evacuated as a precaution. As during Cyclone Olwyn, the variometer system was left running during this period and no data were lost.

In early May, a proposal to build a space debris tracking facility adjacent to the LSO was received for comment. Agreement was reached to re-locate the proposed location of the facility outside the 100 m radius magnetic quiet zone which surrounds the magnetic observatory variometers and absolute pier.

In July (2015-07-21), as part of the tracking facility preparations, a building site survey caused contamination of variometer data between 00:34:26 and 00:38:48. These data have been excluded from the definitive data submission.

Construction of the tracking facility commenced on 2015-11-09. There has been no identified interference to the variometer data but building construction traffic has caused occasional temporary interruptions to weekly absolute observations. Construction of the facility is scheduled for completion in 2016.

At the end of September observer Owen Giersch departed the observatory, followed soon after by Vasily Lobzin in late October. The duties of magnetic observer were assumed by John Dudley, the station manager of the Learmonth Meteorological Office on 2015-10-13.

The distribution of Learmonth 2015 data is described in Table 4. Data losses are identified in Table 5.

Table 4. Distribution of Learmonth 2015 data.

Recipient	Status	Sent
1 second values		
BoM SWS	reported	real time
INTERMAGNET	reported	real time
1-minute values		
INTERMAGNET	reported	real time
INTERMAGNET	reported	daily
INTERMAGNET	quasi-definitive	monthly
INTERMAGNET	definitive	July 2016
WDC for Geomagnetism Kyoto	reported	real time
WDC for Geomagnetism Kyoto	reported	daily

Significant events

```
-----------------------------------------------------------
2015-02-05 13:40 spikes possibly due to lightning.
2015-03-02 Maintenance visit WVJ/PJ (Mon to Fri)
           stations diffs to B, supervision and materials
           testing for replacement of absolute shelter roof
           stations diffs
2015-03-05 00:50 (approx) top up sand cover on central
           variometer vault
2015-03-11 23:14 possible mains power down due to cyclone
           Olwyn shutdown.
           14:00 change in Elec temp, corresponding change
           in F check.
2015-03-12 GPS clock not functioning
2015-03-15 ~ 23UT Switch timing to ntp using local server
           initial offset was 0.1 seconds
           takes over an hour to start applying corrections
           Cyclone damage to radio link pole at LSO.
           Radio link antenna will be removed and placed
           into storage in workshop. Replacement
           will be required for link to be re-established.
           02:56 Slay GdapClockTr while ntpd is running
           and until replacement clock can be installed
2015-03-17 Spare trimble GPS clock sent.
2015-03-18 GPS clock installed but cable connector highly
           corroded. Pins break off, new cable sent along
           with flexible conduit and cable ties. Some brass
           screws for flashing on abs shelter as well, as
           reported by VL.
           Post for antenna for radio link to Giralia is
           broken. Antenna is assumed to be alright from
           OG. New parts needed are Gal Post, PVC conduit,
           J box, also possible are new connectors for
           cable. Old post was 3m above ground with antenna
           2m above ground.
2015-03-24 03:51 Trimble GPS clock (S/N 0260042354) and
           cable (9360-50 REV B DCA 9712) installed and
           tested OK ntpd stopped
2015-03-31 ~06 LSO network failure
2015-05-01 TC Quang approaching Exmouth, LSO shutdown but
           geomag system left running.
2015-05-04 Email traffic concerning Laser station at LSO
2015-05-08 Email from OG concerning GPS clock antenna
           needing to be relocated to north side of RSTN.
```

```
2015-05-15 06:50 scheduled reboot to clear TCP stack
2015-05-19 Antenna for radio link to Giralia is stored in
           workshop building on a desk and possibly labelled
2015-07-21 Contamination 00:37 - 00:38. Builders conducting
           survey.
2015-08-21 OG to leave the LSO.
2015-09-08 JD assisting with the weekly absolute
           observations.
2015-09-22 Reverse obs not useable. Problem with Absolute
           battery box going flat. Put on charge overnight
           to see if this is problem. Ruled out the input
           fuse as the problem.
2015-09-23 Observer confirms that battery charge level is
           10v. Order a new 12v 7A/h battery from Autopro
           Exmouth (08) 9949 1337. Cost $56.60
2015-09-25 Send replacement Ctek charger for absolute
           battery box S/N  56825R21W3000985 12V 0.8 A.
2015-10-13 Last day for VL, JD is now only person
           performing obs.
2015-10-14 Ctek charger returned.
2015-10-15 Elec temp has jump, no corresponding jump in
           head though. Small alteration in variometer
           data X=-0.06nT, Y=+0.04nT and Z=-0.21. Watch
           for any others that may be cumulative in effect.
2015-10-28 JD checking out area near variometer with
           building set to occur nearby. JD also confirms
           that fuse in power line in battery box was the
           problem after all.
2015-10-29 Ascertain that JD is not aware of location of
           variometer vaults. Supply photos and Google
           image to assist with detailing location.
2015-11-09 Work scheduled to commence on EOS facility,
           3 weeks of ground clearing and concreting
           to be completed before Christmas.
2015-12-29 21:19 reboot to clear TCP stack
2015-12-30 reboot

Data Losses for 2015
---------------------

Table 5. Data losses.

Variometer data XYZ:
2015-03-06    XYZ     00:31 - 00:39  (9)
2015-05-27    XYZ     06:50 - 06:50  (1)
2015-06-04    XYZ     06:32 - 06:32  (1)
2015-07-21    XYZ     00:35 - 00:38  (4)
2015-12-30    XYZ     21:19 - 21:19  (1)

Total: 16

Scalar Data F:
2015-01-07    F      06:17 - 06:17  (1)
2015-01-07    F      07:05 - 07:05  (1)
2015-01-07    F      08:31 - 08:35  (5)
2015-01-07    F      08:55 - 08:55  (1)
2015-02-23    F      17:44 - 17:45  (2)
2015-03-06    F      00:32 - 00:39  (8)
2015-05-27    F      06:50 - 06:50  (1)
2015-06-23    F      02:00 - 02:00  (1)
2015-07-10    F      23:27 - 23:27  (1)
```

```
2015-07-10    F      23:46 - 23:46  (1)
2015-07-21    F      00:35 - 00:38  (4)
2015-09-20    F      06:35 - 06:35  (1)
2015-11-30    F      08:35 - 08:35  (1)
2015-12-30    F      21:19 - 21:19  (1)

Total: 29

Vector filtering was not applied on following days:
Month     Day of month
January   14 15

More aggressive vector filtering was  applied on
following days:
Month     Day of month
January   10 15 16
February  36 58
March     63
May       136

Scalar filtering was not applied on following days:
Month     Day of month
January   07

Annual mean values
------------------
The annual mean values for Learmonth are set out in
the yearmean file.

Indices
-------
No magnetic indices are routinely calculated for the
Learmonth  observatory.

                             < END >
```

7.4.1.4 2016

```
                              LRM
             LEARMONTH OBSERVATORY INFORMATION 2016

 ACKNOWLEDGE-  Users of the LRM data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: LRM
     LOCATION: Learmonth Solar Observatory, Exmouth,
               Western Australia, Australia
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 112.222 Deg.
    LONGITUDE: 114.101 Deg. E
    ELEVATION: 004 metres

     ABSOLUTE
  INSTRUMENTS: DMI: DI0051D Zeiss 313888
               GSM: GSM90_4081416 sensor 73103

    RECORDING
   VARIOMETER: Three component suspended fluxgate
               magnetometer (Danish Meteorological
```

```
                Institute, Model FGE)
                GEM GSM90 Proton Precession
                Magnetometer

   ORIENTATION: Magnetic northwest, northeast and vertical
 DYNAMIC RANGE: +/- 1600nT
    RESOLUTION: 0.03nT
 SAMPLING RATE: 1 second
   FILTER TYPE: Intermagnet

        BACKUP
   VARIOMETER: None

     K-NUMBERS: None
      K9-LIMIT: 300nT

          GINS: Edinburgh
     SATELLITE: http upload

     OBSERVERS: J. Hofman
                J. Dudley
                L. Mainsbridge
                W. Jones

       CONTACT: Geomagnetism Group
                Geoscience Australia
                G.P.O. Box 378
                Canberra, A.C.T., 2601
                Australia

                Tel: + 61-2-6249-9111
                Fax: + 61-2-6249-9969
                e-mail: geomag@ga.gov.au
                WWW: http://www.ga.gov.au

NOTES:

Learmonth
---------
The Learmonth magnetic observatory is located on North West
Cape about 1100 km north of Perth and 35 km from Exmouth in
Western Australia. The magnetic observatory is co-located
with the Learmonth Solar Observatory (LSO), which is
jointly staffed by Bureau of Meteorology Space Weather
Services (BoM SWS) and the United States of America Air
Force (USAAF). The observatory complex is situated on
coastal sand dunes bordering the Exmouth Gulf.

The magnetic observatory consists of:
* three underground vaults located on BoM SWS land, housing
variometer sensors and control equipment;
* an Absolute Shelter, located on land belonging to the
Royal Australian Air Force (RAAF) 200 m from the solar
observatory, enclosing a concrete observation pier
(Pier A), the top of which is 1200 mm above the concrete
floor, and;
* a remote reference station (B) on RAAF land.

Table 1. Key observatory data.
IAGA code:                LRM
Commenced operation:      November 1986
```

```
Geographic latitude:      22d 13' 19" S
Geographic longitude:     114d 06' 03" E
Geomagnetic latitude:     -31.89d
Geomagnetic longitude:    187.07d
K 9 index lower limit:    300 nT
Principal pier:           Pier A
Pier elevation (top):     4 m AMSL
Principal reference mark: West windsock
Reference mark azimuth:   283d 02' 18"
Reference mark distance:  1 km approx.
Observer: J. Hofman
          J. Dudley
          L. Mainsbridge
          W. Jones
```

Local meteorological conditions

The meteorological temperature at Learmonth during 2016 varied from a minimum +5.0 deg C (2016-08-23) to a maximum +46.0 deg C (2016-02-13). Daily minimum temperatures varied from +5.0 deg C to +27.5 deg C (average +17.6 +/-4.9 deg C) daily maximum temperatures varied from +18.4 deg C to +46.0 deg C (average +32.0 +/-6.3 deg C); daily temperature ranges varied from 0.8 C to 29 C (average 14.5 +/-4.2 C).

The daily maximum wind gust varied from 20 to 70 km/h (average 41 +/-9.0 km/h). The maximum daily maximum wind gust was 70 km/h in January. The minimum daily maximum wind gust was 20 km/h in June and July. No data were recorded on the hours of sunshine by the Bureau of Meteorology.

All weather data was provided by the Australian Government- Bureau of Meteorology.

Variometers

The variometers used during 2016 are described in Table 2. The recording equipment, some of the variometer electronic control equipment, and back-up power were housed in the Radio Solar Telescope Network (RSTN) building of the Solar Observatory. The magnetometers and control electronics were housed in three semi-underground concrete vaults, each 800×800×800 mm, lying in a north-south line about 110 m to the east of the RSTN building. The vaults are about 7 m apart and are covered in local sand. The vector sensor (DMI fluxgate) was located in the northern most vault and the scalar sensor (GSM90) in the southern most vault. The electronics for both the vector and scalar sensors were housed in the central vault.

Underground conduits containing sensor cables connected the central vault to the two sensor vaults. An underground conduit between the RSTN building and the central vault contained 12 V DC power and digital data cables. The variometer and recording system were powered by a 12 V DC back-up battery box charged from 240 V AC mains power. The recording computer and 12 V DC back-up battery box were housed in the RSTN building. System timing was provided by a GPS clock with time corrections applied automatically and logged. Timing corrections greater than 10 ms are listed in

Variometer clock corrections below.

Table 2. Magnetic variometers used in 2016.

3-component vector magnetometer:	DMI FGE
Serial number:	E0271 / S0237
Type:	suspended linear-core fluxgate
Orientation:	NW, NE, Z
Acquisition interval:	1 s
A/D converter:	ADAM 4017 module (+/-5V)
Scale value:	0.032 nT / count
Period of use:	2016-01-01 to 2016-12-31
Scalar magnetometer:	GEM Systems GSM90
Serial number:	8092904 / 83385
Type:	Overhauser effect
Acquisition interval:	10 s
Resolution:	0.01 nT
Period of use:	2016-01-01 to 2016-12-31
Data acquisition system:	GDAP ARK3660F Industrial Computer QNX OS 6.5
Timing:	TrimbleAcutime GPS clock

No spike filtering was applied to the real-time reported vector data through the year. A spike filter was applied to the quasi-definitive and definitive vector data for the year. The spike filter, Vector (A) required the value of a spike to deviate from the local linear trend by 5.2 (Factor) times the maximum of 0.5 nT, (Noise) or 8/9 fractile of deviations during the following minute. These parameters are listed below as Vector (A) parameters. These days were then reviewed for either over or under filtering by visual inspection. Days found to have been over filtered were re-processed without any spike filtering and any spikes manually excluded. No days were found to be under filtered so a more aggressive filter has not been applied to the quasi-definitive or definitive data for 2016.

Vector filtering parameters as applied to quasi-definitive and definitive data.

Vector (A)
vectorFactor=5.2
vectorNoise=0.5

No filtering was applied to the scalar reported real-time, quasi-definitive or definitive data for 2016.

Throughout the year periods of increased noise were noted in the 1 second vector data, particularly in the Z channel. During these periods the noise level would approximately doubled to +/- 0.4 nT, compared to the background noise of about +/- 0.2 nT.

The periods of increased noise last between 15 minutes to over 12 hours and occurred up to several times per day on a few days each month, with a minimum of 1 day in August to a maximum 11 days in March.

The source of this noise has not been identified. It is visible in the 1 second data, but only marginally so in the 1 minute data on certain days (e.g. 2016-01-17T15:19)

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2016, there were fifteen adjustments to the system clock greater than 1 ms.

```
2016-06-24 03:39:10    16.884 s Battery replacement
           03:42:04   -17.000 s Compensate over correction
2016-09-08 02:05:55     0.891 s Computer shutdown.
           02:16:48     0.919 s Relocated to desk top
           03:38:42     1.167 s during floor replacement
2016-10-25 06:30:42    -0.058 s
2016-10-31 03:58:43    -0.058 s
2016-11-06 03:03:40    -0.592 s
2016-11-07 04:08:54    -0.067 s
2016-11-13 02:41:57    -0.803 s
2016-11-18 04:01:46    -0.079 s
2016-11-22 06:43:51    -0.250 s
2016-11-23 03:30:28    -0.076 s
2016-11-28 05:34:25    -0.226 s
2016-12-19 06:55:39    -0.312 s
```

On one occasion the power to the GPS clock was interrupted and it appears the clock re-booted on GPS time rather than UTC time and forced a timing correction of about 17.0 s. A correction from GPS time to UTC time of -17.0 seconds was applied 174 seconds later. This period of data with incorrect time-stamp has been excluded from the 2016 definitive data.

Absolute instruments

The principal absolute magnetometers used at Learmonth and their adopted corrections for 2016 are described in Table 3. A Getac tablet PC with GObs acquisition software was used to record the absolute observations using the off-set method. The fluxgate off-set measurements were digitised with a PICO ADC-16. This allows the GObs software to communicate with both the scalar and the DIM vector magnetometers. The Getac tablet timing was synchronised with the internal GPS.

The principal absolute magnetometers used at Learmonth and their adopted corrections for 2016 are described in Table 3.

The absolute DIM fluxgate instrument, DI0051/313888, was compared to the Canberra geomagnetic observatory reference instrument DI0086/353756 on 2009-07-21, 2009-07-28, 2009-08-17, 2009-08-25, 2009-09-01, and 2009-09-22 at the Canberra geomagnetic observatory before being deployed to Learmonth. Adopted Instrument corrections were -0.05', and -0.10' in D and I respectively.

The adopted differences between the LRM instruments and the international average (as defined by observations at IAGA instrument workshops) are given in Table 3.

Table 3. Absolute magnetometers and their adopted corrections for 2016. Corrections are applied in the sense Standard = Instrument + correction.

DI fluxgate: DMI	
Serial number:	DI0051D + Pico ADC16 FJY06/136
Theodolite:	Zeiss 020B
Serial number:	313888
Resolution:	0.1'
D correction:	-0.05'
I correction:	-0.10'
Period of use:	2016-01-01 to 2016-12-31

Total field magnetometer:	GEM Systems GSM90
Serial number:	4081416 / 73103
Type:	Overhauser effect
Resolution:	0.01 nT
Correction:	0.0 nT
Period of use:	2016-01-01 to 2016-12-31

A maintenance visit occurred in June (2016-06-20 to 2016-06-25). Comparisons were made between the Learmonth absolute DIM and the travelling reference DIM during this maintenance visit. The adopted instrument corrections were left unchanged.
The adopted corrections for DI0051D/313888 to the international standard are given in Table 3.

At the 2016 mean magnetic-field values at Learmonth (X=30195 nT, Y=155 nT, Z= -43376 nT) the D, I and F corrections translate to corrections of:

dX = -1.3 nT dY = -0.5 nT   dZ = -0.9 nT

These corrections have been applied to all LRM 2016 data.

Communications

There is currently only one communications line which is via the BoM SWS dedicated data line to Sydney and then via Internet to Canberra.

Baselines

The fluxgate variometer baselines were controlled by 50 sets of weekly absolute observations for the year.

The final baseline parameters for the variometer were completed by manually fitting a piece-wise linear function to the absolute observations residuals. This function included drifts or jumps, when required. The baselines drifted in all three channels over the course of the year. Scatter in the baseline residuals was generally small throughout the year within a range of about 3 nT. Occasionally a pair of absolute observations would contain an outlier which was removed.

Throughout 2016 adopted baselines drifted within ranges of 2.5, 1.8 and 1.6 nT in X, Y and Z respectively

Outliers in the absolute observations were excluded on days 026, 074, 229, 271, 327, 342 and 355.

The final Fv-Fs values for the year drifted in early March. This coincided with the construction of a new gravel road near the absolute hut. Vector pier differences between the absolute pier and the remote reference station were measured in June and did not indicate any change in pier difference compared to previous results.

The final Fv-Fs values for the year had several baseline corrections applied and the daily mean values of Fv-Fs had a range of 1.2 nT throughout the year.

The standard deviations in the 2016 weekly absolute observations from the final adopted variometer model and data were:

X	0.3 nT
Y	0.7 nT
Z	0.4 nT
F	0.3 nT
D	5"
I	2"
H	0.3 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2016 LRM definitive data and real time reported 1-minute data sets (LRM definitive - LRM real time) were:

	X	Y	Z
Average	0.0	+0.8	-0.1
Std.dev	+1.2	+0.6	+0.6
Min	-1.6	+0.1	-1.7
Max	+2.4	+1.6	+0.8

The differences in the mean values between the definitive data and reported data indicate good consistency.

The LRM 2016 reported real time data are within the specification for INTERMAGNET quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2016 LRM definitive data and quasi-definitive 1-minute data sets (LRM definitive - LRM quasi-definitive) were:

	X	Y	Z
Average	-0.2	+0.9	+0.1
Std.dev	+0.9	+1.0	+0.4
Min	-2.3	+0.1	-0.5
Max	+1.5	+2.8	+0.8

The LRM 2016 quasi-definitive data are within the specification for INTERMAGNET quasi-definitive data.

Operations

Absolute observations were performed weekly by Joshua Hofman from Space Weather Service (BoM SWS); John Dudley and Lincoln Mainsfield (BoM). Variometer data were downloaded every 3-10 minutes through a TCP/IP network connection. Data were then automatically processed to reported status, made available on the Geoscience Australia website, and sent to the Edinburgh INTERMAGNET GIN via e-mail/HTTP. Data were also provided to SWS via a direct serial link from the acquisition computer in the RSTN building. SWS then applied nominal scale values and rotation parameters.

The first observations for the year were collected on day 004 (2016-01-04). Most subsequent observations were then collected weekly.

There were two interruptions to the collection of real-time data. The first occurred during the yearly maintenance visit (2016-06-24) when the battery in the variometer battery back-up system was replaced. The second occurred in September (2016-09-08) when the computer was relocated from the shelving to the desktop in preparation for the removal of the asbestos flooring in the RSTN building.

In early March, a gravel road was created between the boundary fence of the LSO and the absolute shelter to allow access to the recently constructed Western Australia Space Situational Awareness (WASSA) facility. During the construction, a gravel walking track was also installed between the absolute shelter and the small access gate in the LSO boundary fence.

During the visit, observations on both pier A and remote reference station B were made. Pier differences were calculated between the two locations which indicate that the construction of the WASSA and gravel roads has had no measurable effect on the magnetic environment at pier A. The calculated Fv-Fs values during this time showed an approximately 1 nT negative drift.

A total-field gradient survey was conducted with the PPM sensor 22.5 cm above ground level. Two lines of measurements were made. The first was from the absolute pier toward the boundary gate in a northerly direction. This covered a large section of the gravel walking track. There was no change compared to previously measured gradient surveys out to about 28 m from the absolute pier. The values then changed by up to 25 nT, corresponding with the new gravel road and other buried infrastructure.

The second line extended in a north easterly direction from the absolute hut towards a culvert in the new gravel road. These data showed a uniform gradient from the absolute shelter. The new road culvert, approximately 27 m from the absolute shelter, caused strong gradients in the total field measurements.

In August a relief meteorological observer was given geomagnetic observer training as one of the normal observers was going on extended leave in September and October.

Four earthquakes affected the magnetic data throughout the year on 2016-07-08, 2016-08-18, 2016-12-21 and 2016-12-29. The data affected by these earthquakes have been removed from the 2016 quasi-definitive and definitive data.

The distribution of Learmonth 2016 data is described in Table 4. Data losses are identified in Table 5.

Table 4. Distribution of Learmonth 2016 data.

Recipient	Status	Sent
1 second values		
BoM SWS	reported	real time
INTERMAGNET	reported	real time
1-minute values		
INTERMAGNET	reported	real time
INTERMAGNET	reported	daily
INTERMAGNET	quasi-definitive	monthly
INTERMAGNET	definitive	July 2017
WDC for Geomagnetism Kyoto	reported	real time
WDC for Geomagnetism Kyoto	reported	daily

Significant events

```
-----------------------------------------------------------
2016-01-04  Mark readings change by 1 min in first reading.
            Use with caution.
2016-04-18  Gravel placed on track from gate to absolute
            shelter.
2016-06-01  Spikes in Y channel late in day.
2016-06-21  Yearly maintenance - tidy equipment in RSTN
2016-06-24  Data excluded after variometer battery replaced
2016-07-08  Norseman earthquake 5.6 09:47:24-09:49:59 UTC.
2016-08-09  New temporary observer LM being trained. He
            will assume duties while JD is away on leave.
2016-08-18  Earthquake ~04:45 off of coast near Bowen.
2016-08-30  DB9 adapter failed when collecting
            reverse PPM block. No PPM data. Use scalar
            variometer data for obs.
            Then apply pier difference
            pier difference: absolute PPM (AO) = 17.5
               + variometer PPM
2016-09-05  This week may see some data outages as the LSO
            tests options for the comms server being moved
            prior to the RSTN floor replacement.
2016-09-08  Acq computer shutdown to allow it to be
            relocated to the desk prior to floor
            replacement. Time = 02:25
2016-10-18  Possible contamination due to firebreak mowing.
2016-11-08  JH to leave at end of week. JD has returned and
            will assume sole obs responsibilities till OIC
            role at LSO is sorted out.
2016-12-07  Corrupt data in Y component ~04:30 to ~07:00.
```

	Data has been excluded.
2016-12-21	00:25 - 00:36 Mag6.9 quake in Banda Sea.
	Observer requested new wheels for trolley.
	Notified by observer for plans to replace the sheep fence around car park with high cyclone link fence.
	Observer will be on leave so no observations till 2nd Jan 2017.
2016-12-29	Earthquake Mag6.4 Sumbawa Indonesia.
	22:35 - 22:38

Data Losses for 2016

Table 5. Data losses.

Variometer data XYZ:

2016-01-09	XYZ	06:19 - 06:19	(1)
2016-01-09	XYZ	08:32 - 09:02	(31)
2016-01-28	XYZ	03:05 - 03:06	(2)
2016-01-28	XYZ	03:36 - 03:36	(1)
2016-01-28	XYZ	03:38 - 03:38	(1)
2016-01-28	XYZ	03:40 - 03:40	(1)
2016-01-28	XYZ	03:45 - 03:45	(1)
2016-03-02	XYZ	03:26 - 03:27	(2)
2016-03-02	XYZ	12:56 - 13:32	(37)
2016-03-03	XYZ	03:07 - 03:16	(10)
2016-03-04	XYZ	07:10 - 07:10	(1)
2016-03-04	XYZ	07:20 - 07:26	(7)
2016-05-20	XYZ	18:20 - 18:32	(13)
2016-05-28	XYZ	16:46 - 16:48	(3)
2016-06-01	XYZ	22:29 - 22:33	(5)
2016-06-01	XYZ	22:35 - 22:36	(2)
2016-06-01	XYZ	22:53 - 22:53	(1)
2016-06-01	XYZ	23:02 - 23:02	(1)
2016-06-01	XYZ	23:10 - 23:12	(3)
2016-06-09	XYZ	04:18 - 04:19	(2)
2016-06-22	XYZ	07:10 - 07:15	(6)
2016-06-24	XYZ	03:18 - 03:42	(25)
2016-07-05	XYZ	03:55 - 03:57	(3)
2016-07-08	XYZ	09:48 - 09:50	(3)
2016-08-18	XYZ	04:46 - 04:50	(5)
2016-09-08	XYZ	02:05 - 02:05	(1)
2016-09-08	XYZ	02:15 - 02:16	(2)
2016-09-08	XYZ	02:20 - 03:37	(78)
2016-11-09	XYZ	01:54 - 01:54	(1)
2016-12-02	XYZ	06:37 - 06:37	(1)
2016-12-02	XYZ	07:29 - 07:29	(1)
2016-12-05	XYZ	01:20 - 01:22	(3)
2016-12-05	XYZ	07:16 - 07:17	(2)
2016-12-07	XYZ	05:13 - 06:59	(107)
2016-12-21	XYZ	00:25 - 00:36	(12)
2016-12-29	XYZ	22:36 - 22:38	(3)

Total: 378 (0.26 days)

Scalar Data F:

2016-01-28	F	03:05 - 03:05	(1)
2016-01-28	F	03:40 - 03:40	(1)
2016-01-28	F	03:45 - 03:45	(1)
2016-06-22	F	07:10 - 07:15	(6)

```
2016-06-24    F      03:18 - 03:34  (17)
2016-06-24    F      03:39 - 03:42  (4)
2016-09-08    F      02:05 - 02:05  (1)
2016-09-08    F      02:15 - 02:16  (2)
2016-09-08    F      02:20 - 03:37  (78)
2016-11-09    F      01:54 - 01:54  (1)
2016-12-07    F      05:13 - 06:59  (107)

Total: 219 (0.15 days)

Annual mean values
------------------
The annual mean values for Learmonth are available in
the file "yearmean.lrm" and graphically through the
IMCDView software.

Hourly Mean Values
------------------
Plots of hourly mean values for Learmonth are available
through the IMCDView software.

Indices
-------
No magnetic indices are routinely calculated for the
Learmonth  observatory.

                             < END >
```

7.4.2 Baseline values

7.4.2.1 2013

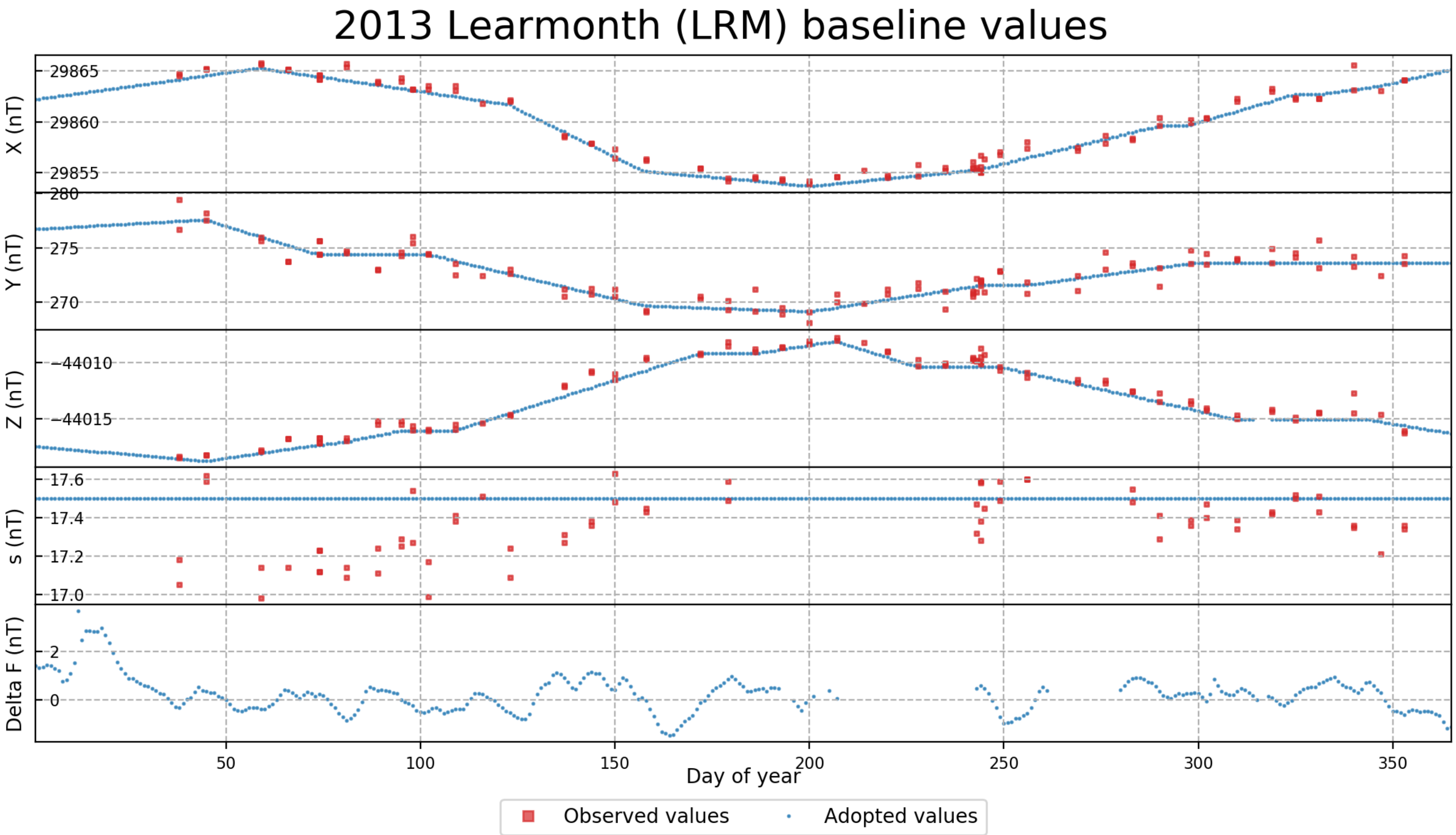

Figure 7.19 Learmonth (LRM) baseline values for 2013. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.4.2.2 2014

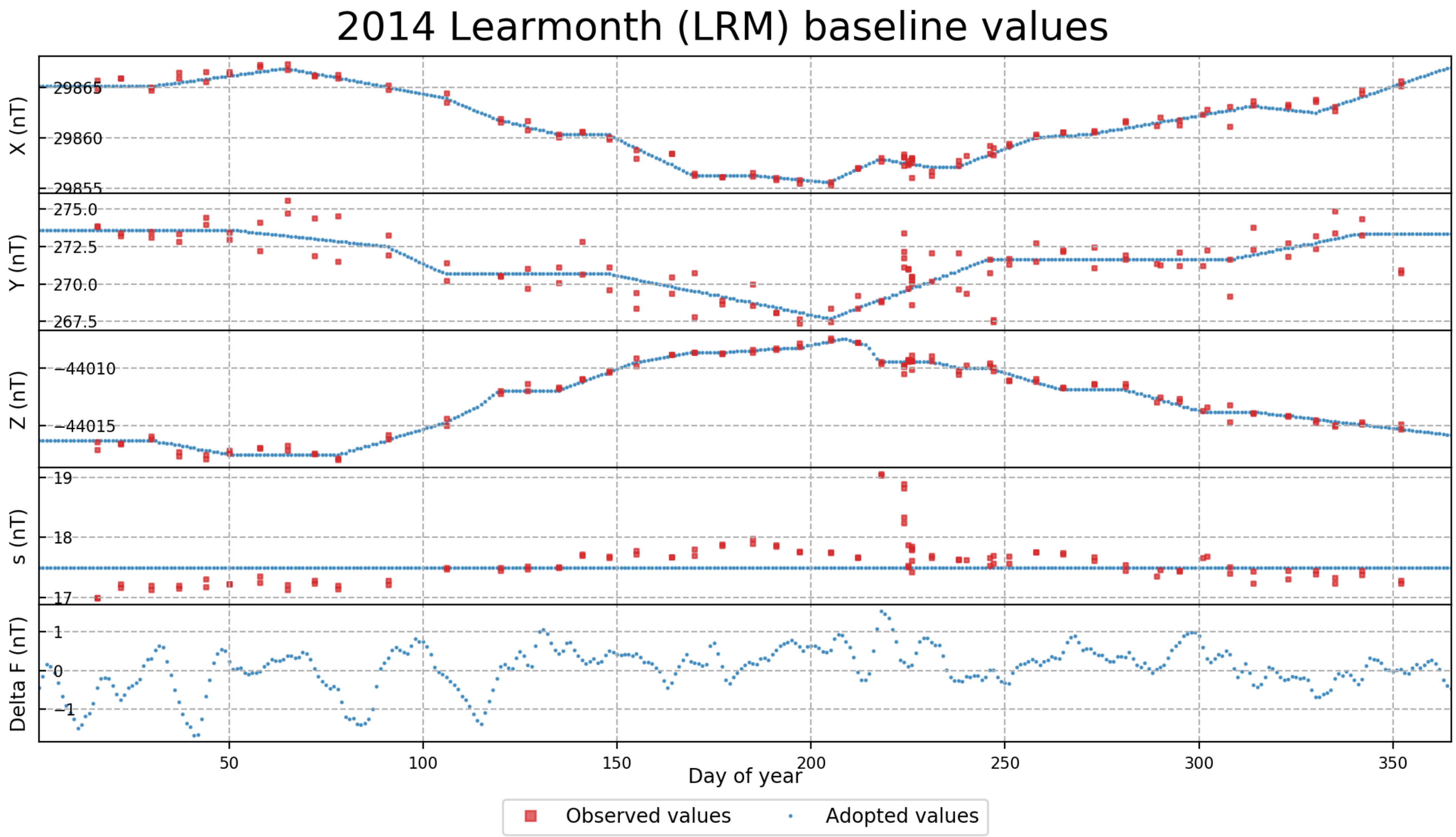

Figure 7.20 Learmonth (LRM) baseline values for 2014. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.4.2.3 2015

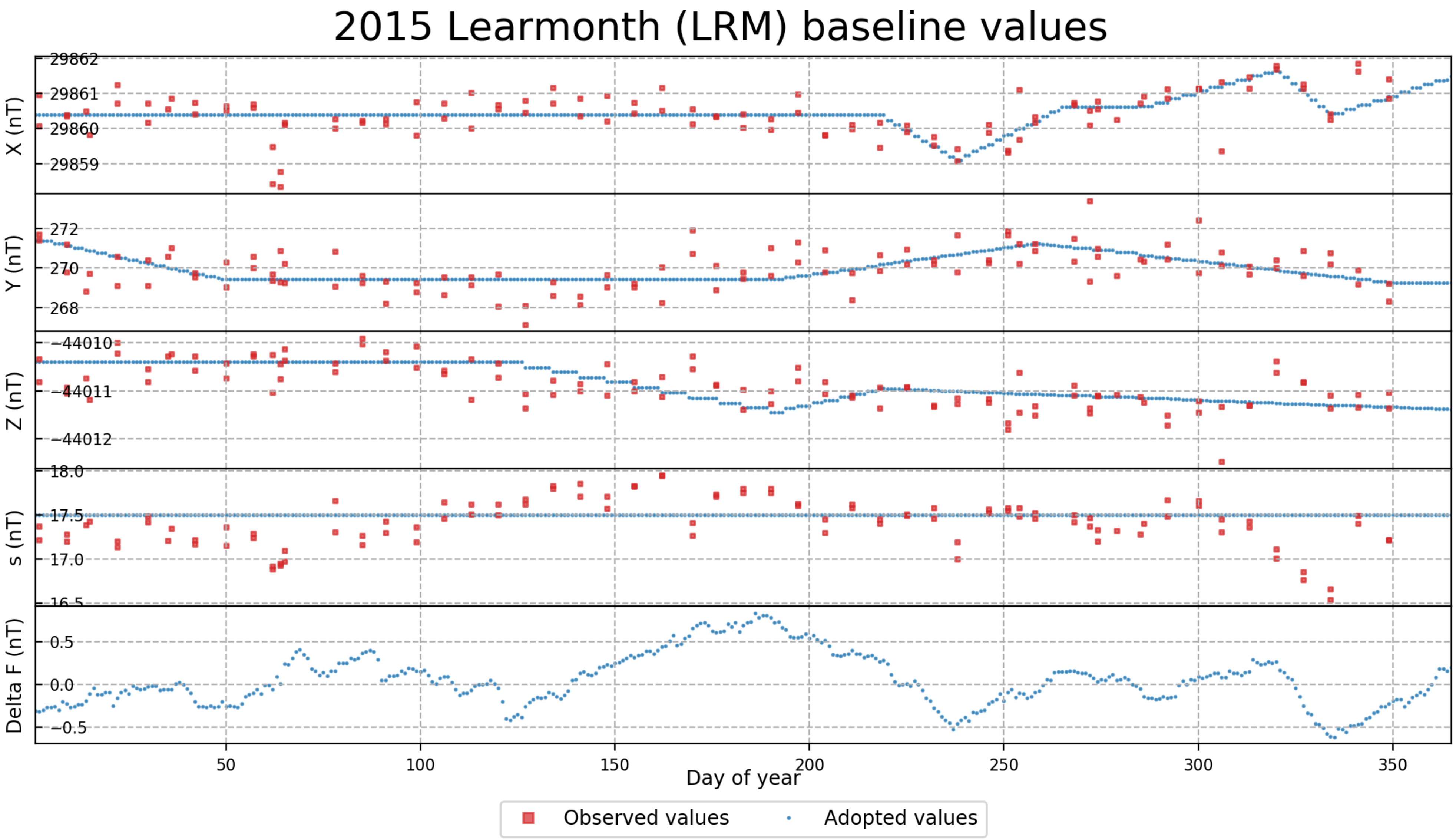

Figure 7.21 Learmonth (LRM) baseline values for 2015. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.4.2.4 2016

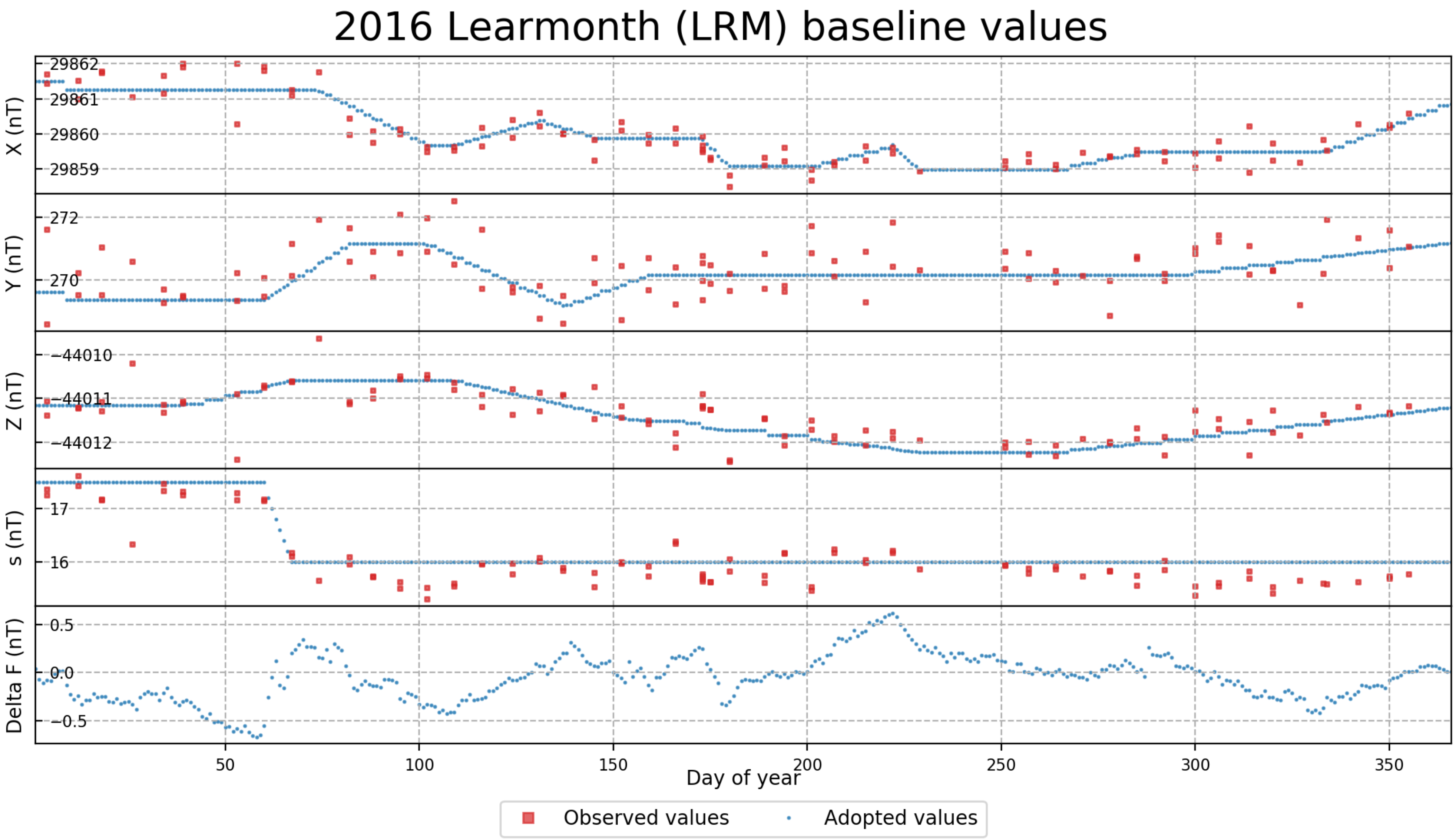

Figure 7.22 Learmonth (LRM) baseline values for 2016. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.4.3 Annual mean values

7.4.3.1 DIH

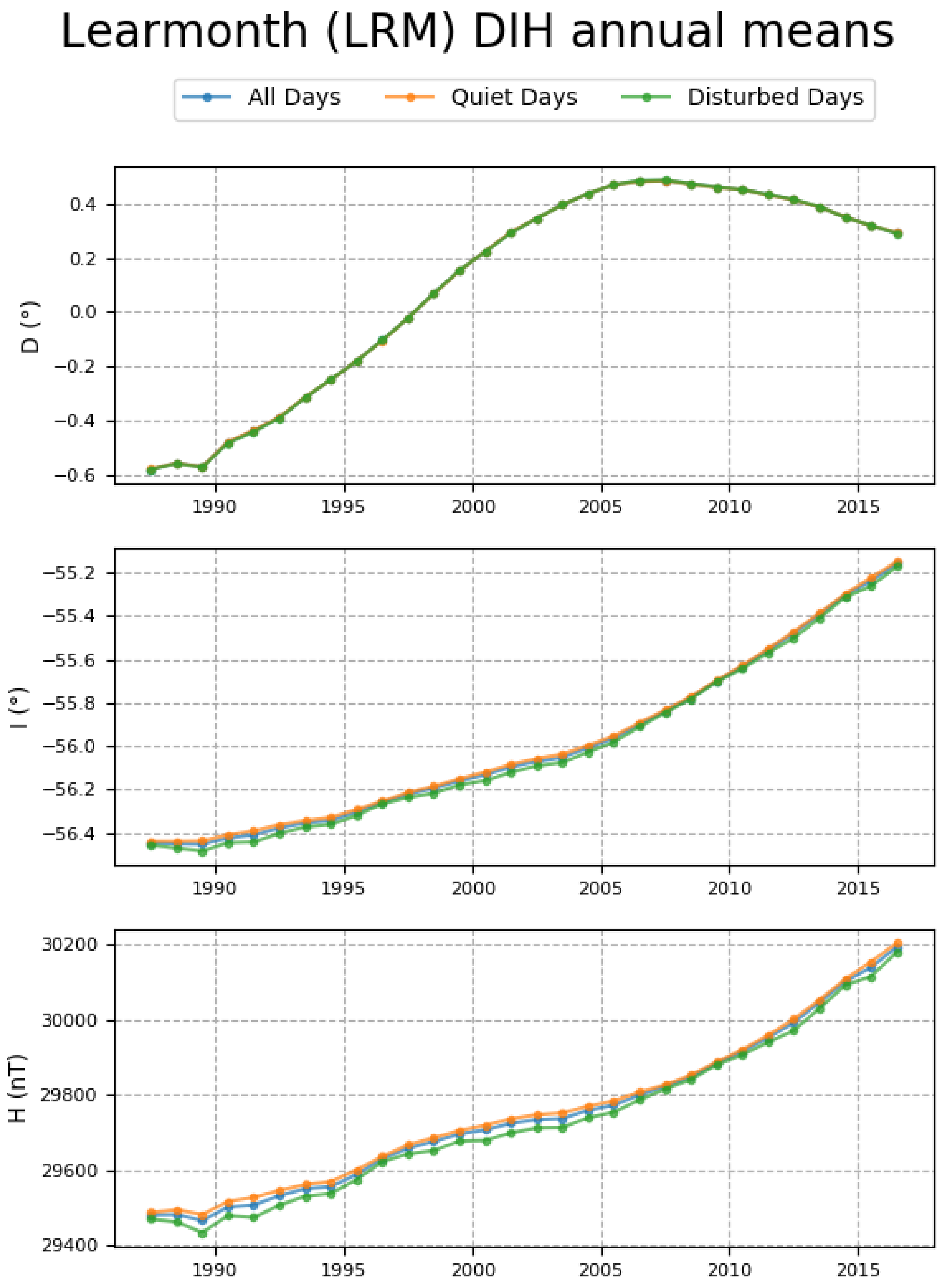

Figure 7.23 Learmonth (LRM) annual mean values in DIH until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.4.3.2 XYZF

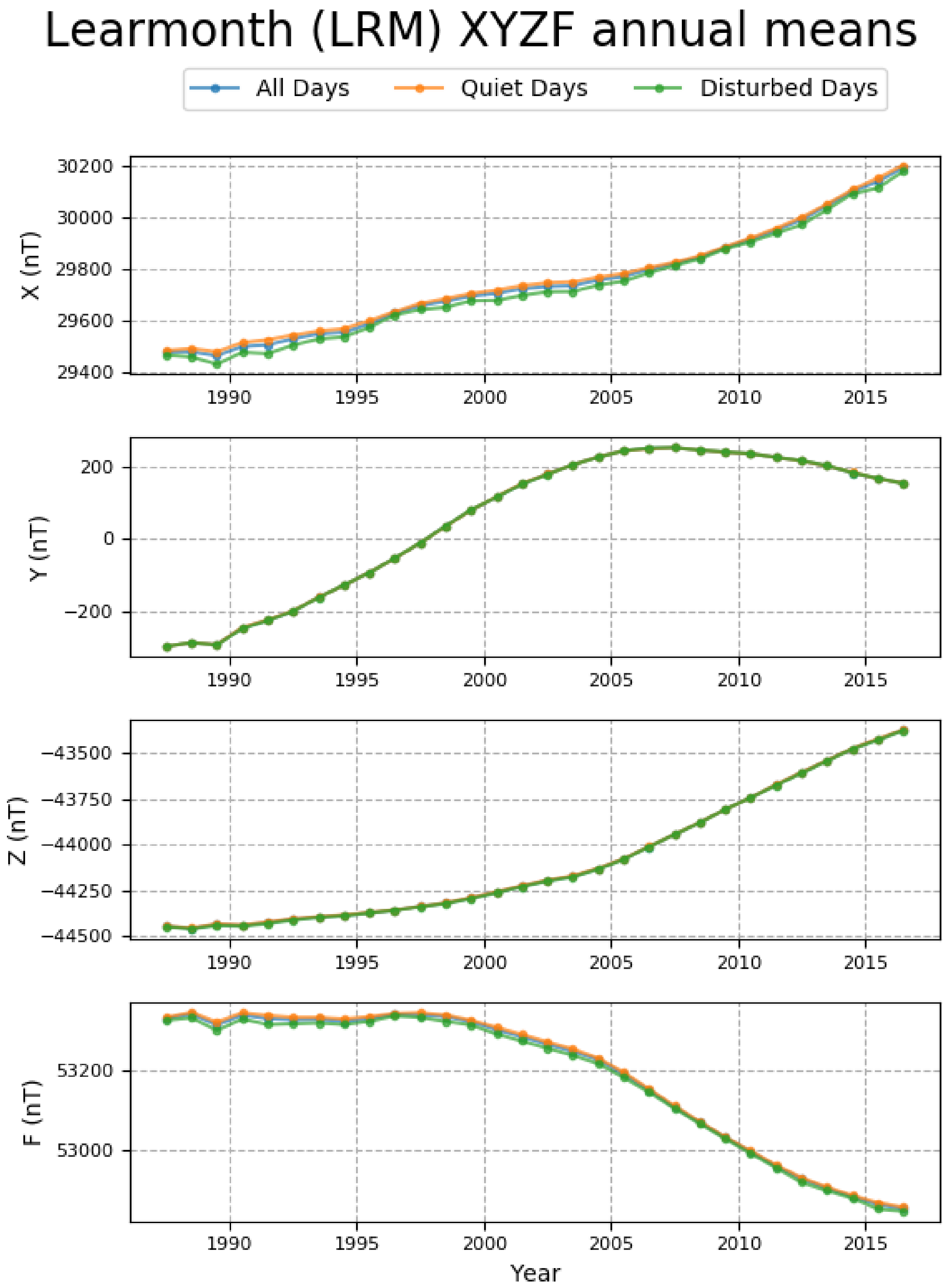

Figure 7.24 Learmonth (LRM) annual mean values in XYZF until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.4.3.3 2016 INTERMAGNET annual mean values file

```
                           ANNUAL MEAN VALUES
                        LEARMONTH, LRM, AUSTRALIA

 COLATITUDE: 112.222    LONGITUDE: 114.101 E    ELEVATION: 4 metres

 YEAR       D         I         H       X        Y       Z       F     * ELE Note
          Deg Min   Deg Min     nT      nT       nT      nT      nT

 1987.500  -0 34.9 -56 26.7  29480  29478   -299 -44446  53334 A  DHZ
 1988.500  -0 33.5 -56 27.0  29481  29479   -288 -44457  53344 A  DHZ
 1989.500  -0 34.3 -56 27.1  29465  29464   -294 -44436  53317 A  DHZ
 1990.500  -0 28.8 -56 25.4  29501  29500   -247 -44441  53342 A  DHZ
 1991.500  -0 26.3 -56 24.5  29507  29506   -226 -44426  53333 A  DHZ
 1992.500  -0 23.4 -56 22.6  29531  29530   -201 -44407  53330 A  DHZ
 1993.500  -0 18.9 -56 21.2  29550  29549   -162 -44396  53331 A  DHZ
 1994.500  -0 15.0 -56 20.5  29555  29555   -129 -44386  53326 A  DHZ
 1995.500  -0 10.8 -56 18.2  29588  29588    -93 -44373  53333 A  DHZ
 1996.500  -0 06.2 -56 15.5  29630  29630    -54 -44358  53344 A  DHZ
 1997.500  -0 01.3 -56 13.3  29658  29658    -11 -44338  53343 A  DHZ
 1998.500   0 04.2 -56 11.6  29676  29676     36 -44320  53338 A  DHZ
 1999.500   0 09.2 -56 09.6  29696  29696     80 -44292  53325 A  DHZ
 2000.500   0 13.5 -56 07.9  29707  29706    116 -44260  53305 A  ABZ    1
 2001.500   0 17.7 -56 05.7  29724  29724    153 -44227  53287 A  ABZ
 2002.500   0 20.8 -56 04.2  29734  29733    180 -44197  53268 A  ABZ
 2003.500   0 23.8 -56 03.1  29737  29736    206 -44174  53250 A  ABZ
 2004.500   0 26.3 -56 00.4  29759  29758    228 -44132  53229 A  ABZ
 2005.500   0 28.3 -55 57.8  29773  29772    245 -44079  53192 A  ABZ
 2006.500   0 29.1 -55 53.9  29800  29799    252 -44012  53152 A  ABZ
 2007.500   0 29.2 -55 50.3  29823  29822    254 -43946  53109 A  ABZ
 2008.500   0 28.5 -55 46.5  29848  29847    247 -43880  53070 A  ABZ
 2009.500   0 27.8 -55 42.0  29885  29884    241 -43809  53032 A  ABZ
 2010.500   0 27.2 -55 37.9  29916  29915    237 -43744  52996 A  ABZ
 2011.500   0 26.1 -55 33.4  29953  29952    227 -43675  52959 A  ABZ
 2012.500   0 24.9 -55 28.8  29993  29992    217 -43608  52927 A  ABZ
 2013.500   0 23.3 -55 23.5  30047  30047    203 -43542  52903 A  ABZ
 2014.500   0 21.1 -55 18.1  30103  30102    184 -43478  52882 A  ABZ
 2015.500   0 19.2 -55 14.3  30140  30140    168 -43427  52862 A  ABZ
 2016.500   0 17.6 -55 09.4  30195  30195    155 -43376  52851 A  ABZ

 1987.500  -0 34.8 -56 26.3  29486  29484   -299 -44445  53336 Q  DHZ
 1988.500  -0 33.5 -56 26.3  29494  29492   -288 -44455  53349 Q  DHZ
 1989.500  -0 34.3 -56 26.2  29481  29479   -294 -44433  53324 Q  DHZ
 1990.500  -0 28.7 -56 24.5  29516  29515   -246 -44439  53348 Q  DHZ
 1991.500  -0 26.2 -56 23.4  29527  29526   -225 -44423  53341 Q  DHZ
 1992.500  -0 23.3 -56 21.7  29545  29544   -200 -44405  53336 Q  DHZ
 1993.500  -0 18.8 -56 20.5  29561  29560   -162 -44394  53336 Q  DHZ
 1994.500  -0 15.0 -56 19.7  29569  29569   -129 -44384  53332 Q  DHZ
 1995.500  -0 10.8 -56 17.5  29600  29600    -93 -44371  53338 Q  DHZ
 1996.500  -0 06.3 -56 15.2  29636  29635    -54 -44357  53346 Q  DHZ
 1997.500  -0 01.3 -56 12.8  29667  29667    -11 -44338  53348 Q  DHZ
 1998.500   0 04.1 -56 11.1  29686  29686     35 -44318  53342 Q  DHZ
 1999.500   0 09.2 -56 09.0  29705  29705     80 -44290  53329 Q  DHZ
 2000.500   0 13.5 -56 07.1  29719  29719    117 -44258  53311 Q  ABZ    1
 2001.500   0 17.8 -56 05.0  29736  29736    154 -44225  53293 Q  ABZ
 2002.500   0 20.8 -56 03.4  29747  29747    180 -44195  53274 Q  ABZ
 2003.500   0 23.8 -56 02.2  29752  29751    206 -44171  53256 Q  ABZ
 2004.500   0 26.3 -55 59.8  29770  29769    228 -44130  53233 Q  ABZ
 2005.500   0 28.3 -55 57.2  29784  29783    245 -44078  53197 Q  ABZ
 2006.500   0 29.0 -55 53.4  29808  29807    251 -44011  53155 Q  ABZ
```

2007.500	0 29.2	-55 50.0	29827	29826	254	-43945	53112	Q	ABZ	
2008.500	0 28.4	-55 46.2	29853	29852	247	-43879	53072	Q	ABZ	
2009.500	0 27.7	-55 41.8	29888	29887	241	-43809	53033	Q	ABZ	
2010.500	0 27.2	-55 37.6	29921	29921	237	-43744	52998	Q	ABZ	
2011.500	0 26.0	-55 33.0	29960	29959	227	-43673	52962	Q	ABZ	
2012.500	0 24.9	-55 28.3	30002	30001	217	-43607	52930	Q	ABZ	
2013.500	0 23.3	-55 23.1	30054	30053	203	-43541	52906	Q	ABZ	
2014.500	0 21.1	-55 17.8	30109	30109	185	-43477	52885	Q	ABZ	
2015.500	0 19.2	-55 13.4	30155	30154	168	-43424	52867	Q	ABZ	
2016.500	0 17.7	-55 08.9	30205	30204	155	-43375	52855	Q	ABZ	

1987.500	-0 34.9	-56 27.3	29469	29467	-299	-44448	53329	D	DHZ	
1988.500	-0 33.6	-56 28.2	29461	29459	-288	-44460	53335	D	DHZ	
1989.500	-0 34.4	-56 29.0	29433	29431	-295	-44441	53303	D	DHZ	
1990.500	-0 29.0	-56 26.7	29478	29477	-249	-44445	53332	D	DHZ	
1991.500	-0 26.5	-56 26.5	29473	29472	-227	-44431	53318	D	DHZ	
1992.500	-0 23.5	-56 24.1	29506	29505	-201	-44412	53320	D	DHZ	
1993.500	-0 18.9	-56 22.3	29530	29529	-163	-44398	53322	D	DHZ	
1994.500	-0 14.9	-56 21.6	29537	29537	-128	-44389	53318	D	DHZ	
1995.500	-0 10.9	-56 19.1	29574	29574	-94	-44374	53326	D	DHZ	
1996.500	-0 06.2	-56 16.0	29622	29622	-53	-44359	53340	D	DHZ	
1997.500	-0 01.3	-56 14.2	29643	29643	-11	-44340	53336	D	DHZ	
1998.500	0 04.2	-56 13.0	29652	29652	36	-44322	53326	D	DHZ	
1999.500	0 09.3	-56 10.7	29677	29677	81	-44295	53317	D	DHZ	
2000.500	0 13.4	-56 09.5	29679	29679	116	-44264	53294	D	ABZ	1
2001.500	0 17.6	-56 07.2	29699	29698	152	-44230	53276	D	ABZ	
2002.500	0 20.8	-56 05.4	29712	29712	179	-44200	53258	D	ABZ	
2003.500	0 23.8	-56 04.5	29713	29713	206	-44177	53240	D	ABZ	
2004.500	0 26.3	-56 01.6	29739	29738	227	-44135	53219	D	ABZ	
2005.500	0 28.3	-55 58.9	29754	29753	245	-44082	53184	D	ABZ	
2006.500	0 29.2	-55 54.6	29787	29786	253	-44013	53146	D	ABZ	
2007.500	0 29.3	-55 50.7	29816	29814	254	-43946	53106	D	ABZ	
2008.500	0 28.5	-55 46.9	29841	29840	247	-43881	53066	D	ABZ	
2009.500	0 27.8	-55 42.2	29880	29879	242	-43809	53029	D	ABZ	
2010.500	0 27.2	-55 38.5	29907	29906	237	-43745	52991	D	ABZ	
2011.500	0 26.1	-55 34.1	29941	29940	227	-43677	52955	D	ABZ	
2012.500	0 25.0	-55 30.1	29972	29972	218	-43612	52918	D	ABZ	
2013.500	0 23.4	-55 24.5	30031	30031	204	-43545	52897	D	ABZ	
2014.500	0 21.0	-55 18.7	30093	30093	184	-43479	52878	D	ABZ	
2015.500	0 19.3	-55 15.7	30116	30115	169	-43431	52851	D	ABZ	
2016.500	0 17.5	-55 10.3	30181	30180	154	-43378	52845	D	ABZ	

* A = All days
* Q = 5 International Quiet days each month
* D = 5 International Disturbed days each month

ELE = Elements recorded

Notes:
1 The elements measured are actually Magnetic NW, NE and Vertical

7.5 Alice Springs

7.5.1 INTERMAGNET 'readme' files

7.5.1.1 2013

```
                                  ASP
                 ALICE SPRINGS OBSERVATORY INFORMATION 2013

 ACKNOWLEDGE-  Users of ASP data should acknowledge:
       -MENTS:  Geoscience Australia

   STATION ID: ASP
     LOCATION: Alice Springs, Northern Territory,
                Australia
 ORGANISATION: Geoscience Australia (GA)

  CO-LATITUDE: 113.76 Deg.
    LONGITUDE: 133.88 Deg. E
    ELEVATION: 557 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate magnetometer
               Proton precession magnetometer

    RECORDING
   VARIOMETER: Three-component fluxgate magnetometer
               Proton precession magnetometer

  ORIENTATION: ABZ (Magnetic NW, Magnetic NE and Vertical)

DYNAMIC RANGE: DMI magnetometer: +/- 1600 nT

   RESOLUTION: DMI magnetometer: 0.032 nT

SAMPLING RATE: 1 second (vector) and 10 second (scalar)
  FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: None

    K-NUMBERS: None
     K9-LIMIT: 350 nT

         GINS: Edinburgh
    SATELLITE: Http delivery

    OBSERVERS: S. Evans
               R. Maddocks
               V. Rooke
               A. Lewis
               W. Jones


      CONTACT: Geomagnetism Project
               Geoscience Australia
               GPO Box 378
               Canberra  ACT  2601
```

Australia

Tel: + 61-2-6249-9111
Fax: + 61-2-6249-9986
E-mail: geomag@ga.gov.au
WWW: http://www.ga.gov.au

NOTES:

Site

The Alice Springs magnetic observatory is located approximately 10 km south of Alice Springs in the Northern Territory, on the Centre for Appropriate Technology (CAT), a national indigenous science and technology organisation. The observatory is situated on an alluvial plain over tertiary sediments, overlying late Proterozoic carbonates and quartzites.

The observatory comprises:
* a 3×3 m insulated air-conditioned concrete-brick Control House where recording instrumentation and control equipment are housed;
* a 3×3 m Absolute Shelter, 80 m southeast of the Control House, which encloses a concrete observation pier (Pier G); the top of the pier is 1277 mm above the concrete floor;
* two 300 mm diameter azimuth pillars about 85 m from the absolute shelter at approximate true bearings of 130 deg and 255 deg, and;
* two small (1 m3) underground vaults located approximately 50 m north and 50 m east of the Control House in which the variometer sensors and electronics are housed.

Local meteorological conditions

The meteorological temperature at Alice Springs during 2013 varied from a minimum -1.1 deg C (2013-07-25) to a maximum +44.4 deg C (2013-01-12). Daily minimum temperatures varied from -1.1 deg C to +28.3 deg C (average 14.0 +/- 7 deg C); daily maximum temperatures varied from 10.9 deg C to +44.4 deg C (average 30.8 +/- 8 deg C). The daily maximum wind gust varied from 19 km/h to 91 km/h (average 41.2 +/- 10 km/h).
The maximum daily maximum wind gust was 91 km/h in January.
The minimum daily maximum wind gust was 19 km/h in May.
There was from 0 to 13.4 (average 9.5 +/- 4) hours of sunshine according to the meteorological definition.

Variometers

The variometers used during 2013 are described in Table 2. The DMI fluxgate sensor and electronics were housed in the eastern underground vault and the PPM sensor and electronics in the northern vault. The fluxgate vault was insulated inside with foam. Both vaults were covered with soil to minimize diurnal temperature fluctuations. The recording equipment was housed in the Control House.

Despite being in buried vaults, the DMI sensor temperature ranged from 13 deg C to 31 deg C during the year and the electronics from 18 deg C to 35 deg C. Consequently, the DMI X, Y and Z channels exhibited temperature-related variations of 1.0 nT, 0.2 nT and 1.7 nT, respectively.

Throughout the year, random single points of data were noted in both the fluxgate and scalar variometers. These data were inconsistent with the data surrounding them and were tracked and analysed to determine their cause. Human sources of these points were eliminated as many occurred after local midnight when the grounds of the CAT facility are closed. Natural sources such as localised thunderstorms were also eliminated as these did not correspond to any storms. It would appear that these are randomly generated within the system and will require further investigation during the next maintenance visit. For 2013 they have been deleted from these data via visual inspection of the 1 second data.

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2013, four large corrections occurred on 2013-10-28. This was due to the replacement of the PC-104 acquisition computer.
It was replaced with an ARK 3360 acquisition computer and QNX 6.5 acquisition software.

These corrections were
2013-10-28 22:40:54.1 13.13s
2013-10-28 22:49:25.1 -15.99s
2013-10-28 22:55:57.1 -23.26s
2013-10-29 00:08:47.1 10.40s

Absolute instruments

The principal absolute magnetometers used at Alice Springs and their adopted corrections for 2013 are described in Table 3. A Hewlett Packard H4300 hand-held computer was used to communicate via the serial data port of the PPM. This system was replaced in late October with a Getac tablet and Gobs acquisition software. This new system can communicate with both the PPM and the DIM when the later has been upgraded to allow digital output from the electronics.
Five visits were made to the Alice Springs Observatory throughout the year. These trips were combined with other Geoscience Australia work so the opportunity to compare the Alice Springs absolute DIM DI0052/313887 with the travelling reference DIM B0610H/160459 did not occur in 2013. The last comparison between the travelling reference and the Alice Springs absolute was 2012-11-08 (Jones 2012). For 2013 the previously adopted corrections from 2012 have been used.

The adopted corrections for DIM0052/313887 to the international standard are given in Table 3.
At the 2012 mean magnetic field values at Alice Springs (X=30040 nT, Y=2557 nT, Z= -43806 nT) the D, I and F corrections in Table 5.3 translate to corrections of:
dX = -1.3 nT dY = 0.8 nT dZ = -0.9 nT
These corrections have been applied to all Alice Springs

2013 final data.

Baselines

The fluxgate variometer baselines were controlled by 23 sets of weekly zero absolute observations up until 2013-07-30. Training was then provided to the observer in the off-set method. An extended period with no observer occurred between 2013-08-30 and 2013-10-28. Between 2013-10-28 and 2013-10-30 a visit was conducted for the purpose of training the new local observer. A total of 15 weekly absolute observations using the off-set method were measured for this period.

The F check continues to exhibit a curved trend over the course of the year. Comparison to the ambient temperature seems to indicate an inverse relationship exists between the ambient temperature and the curve in the F check.

```
Table 1. Key observatory data.
IAGA code: ASP
Commenced operation: June 1992
Geographic latitude: 23 deg 45' 39.6" S
Geographic longitude: 133 deg 53' 00.0" E
Geomagnetic latitude: -32.35 deg
Geomagnetic longitude: 208.63 deg
K 9 index lower limit: 350 nT
Principal pier: Pier G
Pier elevation (top): 557 m AMSL
Principal reference mark: Pillar B
Reference mark azimuth: 255 deg 00' 50"
Reference mark distance: 85 m
Observers: S. Evans
           R. Maddocks
           V. Rooke
           A. Lewis
           W. Jones

Table 2. Magnetic variometers used in 2013.
3-component variometer: DMI FGE
Serial number: E0306 / S0261
Type: suspended; linear-core fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
A/D converter: ADAM 4017 module ( +/- 5V)
Scale value: 0.032 nT / count
Total-field variometer: GEM Systems GSM-90
Serial number: 4081419 / 42177
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Data acquisition system: GDAP: PC-104 computer, QNX OS
                         From 2013-10-28
                         GDAP: ARK3360/QNX6.5
Timing: Trimble Acutime GPS clock
Communications: NextG modem
```

Table 3. Absolute magnetometers and their adopted corrections for 2013. Corrections are applied in the sense Standard = Instrument + correction.
DI fluxgate: DMI

Serial number: DI0052
Theodolite: Zeiss 020B
Serial number: 313887
Resolution: 0.1'
D correction: +0.1'
I correction: -0.1'
Total-field magnetometer: GEM Systems GSM-90
Serial number: 4081422 / 01504
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT
The final FCheck values for the year varied within a range of about 5 nT. The standard deviations in the 2013 weekly absolute observations from the final adopted variometer model and data were:

	Stdev
X	0.6 nT
Y	1.0 nT
Z	0.5 nT
D	07"
I	03"
F	0.3 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2013 ASP definitive data and real time reported 1-minute data sets
(ASP definitive - ASP real time) were:

	X	Y	Z
Average	+0.3	+0.2	+0.3
Std.dev	+1.1	+0.9	+1.1
Min	-2.3	-1.0	-1.3
Max	+1.6	+2.6	+2.9

The ASP 2013 reported real time data are within the specification for INTERMAGNET Quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.
The annual statistics of the 12 monthly averages of the difference between the 2013 ASP definitive data and quasi-definitive 1-minute data sets
(ASP definitive - ASP quasi-definitive) were:

	X	Y	Z
Average	+0.5	-0.07	-0.05
Std.dev	+0.5	+0.7	+0.3
Min	-0.3	-1.1	-0.5
Max	+1.5	+1.0	+0.4

The ASP 2013 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The observatory is located approximately 150 m from the Alice Springs Data Acquisition Facility (DAF). Magnetic time-series data were transferred to Geoscience Australia in Canberra every 5 minutes via the NextG mobile network.

The QNX acquisition computer used a GPS clock (both pulse-per-second and absolute-time-code) to set the system time. The clock was checked from Geoscience Australia regularly to ensure it was working correctly. If not, it was reset remotely or, if necessary, the computer was re-booted. The PC-104 computer and QNX acquisition software was replaced with an ARK3360 industrial computer and QNX 6.5 acquisition software during a visit between the 2013-10-28 and 2013-10-30.

In January, observer training was given to Vincent Rooke (GA) at the Alice Springs observatory as alternate observer. This training allowed observations to continue when the regular observer Shaun Evans was away completing training in Darwin and during subsequent holidays. This allowed several extra observations to be completed that would have otherwise been missed. Vincent was trained in the off-set absolute method and the use of a tablet with the Gobs software installed.

In May Jim Whatman (GA) visited the observatory while completing work around the Alice Springs area. At this time the lock on the observatory door was upgraded to the generic GA lock. This change removes the need to visit the DAF to obtain a key to access the building. This will give the option for maintenance to be undertaken by GA officers who might happen to be in the area for other work.

The Facilities Manager for the Centre for Appropriate Technology (CAT), from which the observatory site is leased, advised that mowing of fire breaks would occur within the grounds at the beginning of July. It was expected that mowing would occur in the general area of the magnetometers around 2013-07-09. No contamination was noted in the data during this period.

In August a team was sent the Alice Springs region to replace some rapid deployment aftershock kits at sites south of Alice Springs. As a part of this trip there was the opportunity to visit the observatory, this allowed for an upgrade to the DMI electronics to be completed. This upgrade allows digital output from the electronics to be recorded by a Getac tablet and Gobs software. Training for the primary observer was also undertaken in the offset absolute method.

During September and October it was decided that due to the work commitments at the DAF it was no longer feasible for Geoscience Australia employees in Alice Springs to continue as observers. Applications were sought from the public for a contracted observer. After review of several applications Mr Roland Maddocks was employed as the primary observer in Alice Springs. Observer training was undertaken in late October using the offset absolute method. For the rest of the year weekly observations were undertaken in the offset absolute method.
During this training period the acquisition computer, a PC-104 with QNX software was upgraded to the latest ARK3360 industrial computer with QNX 6.5 software. This resulted in several small stoppages of data and these have been noted in the Variometer Clock corrections.

In November as part of an Australian wide upgrade of satellite uplinks, a team was sent to the Alice Springs region to upgrade several GPS stations communication links. Shortly before this time the local observer had reported an intermittent bug in the Gobs software. A visit was made to the observatory to assess the problem. Unfortunately this problem did not occur during this observation. This bug has since been investigated and a solution is being sought.

The Ant Research project also recommenced in November and it was noted by the observer that the project seemed to be close to the variometers and pier. The observer discussed the requirements for the magnetic quiet zone with the team leader, Mr Patrick Schultheiss. The observer took the opportunity to show the research team around the observatory and highlighted to them the areas of most concern. Contact was then made with Professor Ken Cheng, head of the research unit responsible for the research project. This contact facilitated further contact between the team leader and the geomagnetism section. A meeting at the observatory was made for 2013-11-29 where both Mr Patrick Schultheiss and Professor Cheng were in attendance. Further information on the operation of the observatory was supplied to the research team and the location of the variometer vaults and pier was confirmed to them. The research team indicated that the project would run until early March 2014.

Table 4. Distribution of Alice Springs 2013 data.

1-second values		
IPS	preliminary	real time
INTERMAGNET	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	Quasi-definitive	monthly
INTERMAGNET	definitive	July 2013
WDC for Geomagnetism	preliminary	real time
WDC for Geomagnetism	preliminary	daily

Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au).

Significant events

2013-01-29	WVJ in ASP to train VCR for observations on-site until 2013-01-31
2013-01-30	First obs by VCR
2013-02-20	Day 051, VCR first obs alone, review for definitive
2013-04-06	Day 096 Large earthquake in Iran Jaya picked up on magnetometers. 04:47
2013-05-06	Weekly obs quiet inconsistent. Ask VCR if he might be able to get obs in this week.

2013-05-16	Jim Whatman at observatory - replaced lock on control hut door with standard network lock.
2013-07-09	Possible contamination for fire break mowing. No further evidence though SE emailed on 2013-07-10 identifying possible mowing.
2013-08-16	No obs for week ending 2013-08-06, very busy building AR unit.
2013-08-26	WVJ completes obs with John Pring. Then head to Ernabella and Mulga Park to replace aftershock kits on 2013-08-27. Upgrade DIM and software on 2013-08-28 with another obs. Sunshots and round of angles and obs on 2013-08-29 on pier G, install signs. Sunshots, round of angles and obs on Station H on 2013-08-30, no PPM as not working with Algiz. Observer training with upgraded system and to off-set method in afternoon.
2013-09-01	Earthquake approx. 11:50 to 12:00 in Banda sea 6.4 mag
2013-09-05	New PICO to ASP with Laurie. SN 201309 01. Replace current one that may be faulty.
2013-09-06	Obs collected but not useable. Last useable obs on day 242.
2013-09-13	No Obs as observer busy.
2013-09-16	Observer now on 5 weeks holidays. Set to return on the 2013-10-21 day 294. Searching for a new observer to be contracted for work.
2013-10-15	Day 288 change in Fcheck remove for definitive.
2013-10-21	05:21 and 05:26 X, Y and Z shift contamination or instrument noise? remove for definitive.
2013-10-23	Shaun Evans now on leave till 2013-11-02.
2013-10-28	AML at ASP. (2013-10-28 to 2013-11-01) First obs using PICO Late 2013-10-28 replaced computer with ARK3360/QNX6.5. Change over power for Trimble GPS to battery box Stoppages 21:52:30~21:55:50 - change over power for DMI ADAM4520 to battery box 22:38:30~23:07:06. replace ACQ PC with ARK3360/QNX6.5
2013-10-29	Reboot at 00:08 to get VGA screen working Training new observer - Roland Maddocks (RSM).
2013-10-30	Training Roland Maddocks. First useful obs by Roland Maddocks. Obs on station H etc (late in UT day)
2013-10-31	Another small change. 02:02 UT mostly in Z, some in X, ? over Y. Remove for definitive. Training Roland Maddocks
2013-11-04	Insert missing data from day 301 from old PC but baseline file has been changed hence there is a step.
2013-11-07	First solo observation by Roland Maddocks (RSM)
2013-11-11	From day 312 small spikes in PPM randomly occurring. monitor. Day 315 ~23:46 good example
2013-11-15	Notified that Ant research has started again. Possible explanation for spikes in PPM?
2013-11-19	Roland notifies that ant research guys have taken non-magnetic shelves. They are clear of the vaults. Local contact details are Patrick Schultheiss 0447 599564. Roland has shown them the vaults and asked them to keep away. Contamination at ~03:53 all channels and then ~04:23 in F.

2013-11-29 Visit observatory. Talk with Patrick Schultheiss and Prof Ken Cheng. Back up what Roland talked about. Undertook an absolute obs to see if could replicate abs software crash. Did not happen for me, but Roland shutdown system and then restarted and it did it for him. The only difference that I could see was that I checked that assist and voice were off and then that the pico was on.
2013-12-02 Thunderstorm in area 02:15 to `06:00 UT. Numerous spikes in data.
2013-12-03 More thunderstorms 08:30 UT 14:00 UT onwards
2013-12-12 Spike in PPM at ~22:55:30.

Data Losses for 2013

Date	Interval (hh:mm)	Data loss (minutes)
Vector data		
2013-03-12	06:31 - 06:31	(1)
2013-03-30	03:42 - 03:42	(1)
2013-03-31	10:55 - 10:56	(2)
2013-04-02	22:33 - 22:33	(1)
2013-04-02	23:34 - 23:34	(1)
2013-04-02	23:54 - 23:54	(1)
2013-05-10	15:45 - 15:45	(1)
2013-05-25	09:16 - 09:16	(1)
2013-08-06	00:55 - 00:55	(1)
2013-08-06	01:03 - 01:03	(1)
2013-08-06	01:35 - 01:35	(1)
2013-09-12	01:08 - 01:08	(1)
2013-10-27	23:59 - 23:59	(1)
2013-10-28	21:52 - 21:56	(5)
2013-10-28	23:06 - 23:07	(2)
2013-10-29	00:07 - 00:08	(2)
	Total:	23

Date	Interval (hh:mm)	Data loss (minutes)
Scalar data		
2013-10-28	23:11 - 23:11	1
2013-10-28	23:54 - 23:54	1
2013-10-29	00:08 - 00:08	1
	Total	3

Annual mean values

The annual mean values for Alice Springs are set out in the yearmean file.

Indices

No magnetic indices are routinely calculated for the Alice Springs observatory.

< END >

7.5.1.2 2014

```
                                    ASP
              ALICE SPRINGS OBSERVATORY INFORMATION 2014

 ACKNOWLEDGE-  Users of ASP data should acknowledge:
       -MENTS:  Geoscience Australia

   STATION ID: ASP
     LOCATION: Alice Springs, Northern Territory,
                Australia
 ORGANISATION: Geoscience Australia (GA)

  CO-LATITUDE: 113.76 Deg.
    LONGITUDE: 133.8830 Deg. E
    ELEVATION: 557 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate magnetometer
               Proton precession magnetometer

    RECORDING
   VARIOMETER: Three-component fluxgate magnetometer
               Proton precession magnetometer

  ORIENTATION: ABZ (Magnetic NW, Magnetic NE and Vertical)

DYNAMIC RANGE: DMI magnetometer: +/- 1600 nT

   RESOLUTION: DMI magnetometer: 0.032 nT

SAMPLING RATE: 1 second (vector) and 10 second (scalar)
  FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: None

    K-NUMBERS: None
     K9-LIMIT: 350 nT

         GINS: Edinburgh
    SATELLITE: Http delivery

    OBSERVER: R. Maddocks


      CONTACT: Geomagnetism Project
               Geoscience Australia
               GPO Box 378
               Canberra  ACT  2601
               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9986
               E-mail: geomag@ga.gov.au
               WWW: http://www.ga.gov.au

   NOTES:

Site
-----
```

The Alice Springs magnetic observatory is located approximately 10 km south of Alice Springs in the Northern Territory, on the Centre for Appropriate Technology (CAT), a national indigenous science and technology organisation. The observatory is situated on an alluvial plain over tertiary sediments, overlying late Proterozoic carbonates and quartzites.

The observatory comprises:
* a 3×3 m insulated air-conditioned concrete-brick Control House where recording instrumentation and control equipment are housed;

* a 3×3 m Absolute Shelter, 80 m southeast of the Control House, which encloses a concrete observation pier (Pier G); the top of the pier is 1277 mm above the concrete floor;

* two 300 mm diameter azimuth pillars about 85 m from the absolute shelter at approximate true bearings of 130 deg and 255 deg,

* two small (1 metre cubed) underground vaults; one located approximately 50 m to the north and the other 50 m to the east of the Control House, housing the variometer sensors and electronics.
and;

* a remote reference station (H) located 73m at 195 deg from Pier G.

Table 1. Key observatory data.
IAGA code: ASP
Commenced operation: June 1992
Geographic latitude: 23 deg 45' 39.6" S
Geographic longitude: 133 deg 53' 00.0" E
Geomagnetic latitude: -32.35 deg
Geomagnetic longitude: 208.63 deg
K 9 index lower limit: 350 nT
Principal pier: Pier G
Pier elevation (top): 557 m AMSL
Principal reference mark: Pillar B
Reference mark azimuth: 255 deg 00' 50"
Reference mark distance: 85 m
Observer: R. Maddocks

Local meteorological conditions

The meteorological temperature at Alice Springs during 2014 varied from a minimum -3.0 deg C (2014-07-03) to a maximum +44.9 deg C (2014-01-02 and 2014-11-13). Daily minimum temperatures varied from -3.0 deg C to +29.7 deg C (average 13.2 +/- 8 deg C); daily maximum temperatures varied from 7.5 deg C to +44.9 deg C (average 29.7 +/- 8 deg C). The daily maximum wind gust varied from 17 km/h to 87 km/h (average 40.7 +/- 10 km/h). The maximum daily maximum wind gust was 87 km/h in December. The minimum daily maximum wind gust was 17 km/h in May. There was from 0 to 13.4 (average 9.7 +/- 3) hours of sunshine according to the meteorological definition.

Variometers

The variometers used during 2014 are described in Table 2. The DMI fluxgate sensor and electronics were housed in the eastern underground vault and the PPM sensor and electronics in the northern vault. The fluxgate vault was insulated inside with foam. Both vaults were covered with soil to minimize diurnal temperature fluctuations. The recording equipment was housed in the Control House.

Despite being in buried vaults, the variometers experienced slightly different variations in temperature. The DMI sensor ranged from 14 deg C to 30 deg C during the year and the electronics from 19 deg C to 34 deg C.

Throughout the year, random single points of data were noted in both the fluxgate and scalar variometers. These data were inconsistent with surrounding data and were tracked and analysed to determine their cause. Human sources of these points were eliminated as many occurred after local midnight when the grounds of the CAT facility are closed. Natural sources such as localised thunderstorms were also eliminated as these did not correspond to any storms. They have been deleted from the data via filtering and visual inspection of the 1 second and 10 second data.

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. The system clock was synchronised to a GPS clock. During 2014, one large correction occurred on 2014-06-15. This was due to work being conducted at the local electrical sub-station which lasted for most of the day.

The correction was
2014-06-15 13:54:50 0.415 s

Absolute Instruments

The principal absolute magnetometers used at Alice Springs and their adopted corrections for 2014 are described in Table 3. A Getac tablet PC with Gobs acquisition software was used to record the absolute observations. This system can communicate with both the PPM and the DIM.

No visits were made to the Alice Springs Observatory during the year. The last comparison between the travelling reference DIM and the Alice Springs absolute DIM was 2012-11-08. For 2014 the previously adopted corrections from 2012 have been used.

The adopted corrections for DIM0052/313887 to the international standard are given in Table 3.
At the 2014 mean magnetic field values at Alice Springs (X=30069 nT, Y=2503 nT, Z= -43770 nT) the D, I and F corrections in Table 5.3 translate to corrections of:
dX = -1.3 nT dY = 0.8 nT dZ = -0.9 nT
These corrections have been applied to all Alice Springs 2014 final data.

Baselines

The fluxgate variometer baselines were controlled by 50 sets of weekly absolute observations for the year using the offset method.

The final baseline parameters for the variometer were completed by manually fitting a piece-wise linear function to the absolute observations. This function included drifts or jumps, when required, to obtain a good fit to the weekly absolute observation baseline residuals. Baseline drifted in all three channels over the course of the year. Baselines ranged over about 4 nT throughout the year.

The Fv - Fs varied over the course of the year. Comparison to the ambient temperature indicate an inverse relationship exists between the temperature and the curve in the Fv - Fs. This may indicate that there is an environmental component which is influencing the Fv - Fs.

Table 2. Magnetic variometers used in 2014.
3-component variometer: DMI FGE
Serial number: E0306 / S0261
Type: suspended; linear-core fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
A/D converter: ADAM 4017 module (+/- 5V)
Scale value: 0.032 nT / count
Period of use: 2014-01-01 to 2014-12-31

Total-field variometer: GEM Systems GSM-90
Serial number: 4081419 / 42177
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Period of use: 2014-01-01 to 2014-12-31

Data acquisition system: GDAP: ARK3360/QNX6.5
Timing: Trimble Acutime GPS clock
Communications: NextG modem

Table 3. Absolute magnetometers and their adopted corrections for 2014. Corrections are applied in the sense Standard = Instrument + correction.
DI fluxgate: DMI
Serial number: DI0052D
Theodolite: Zeiss 020B
Serial number: 313887
Resolution: 0.1'
D correction: +0.1'
I correction: -0.1'
Total-field magnetometer: GEM Systems GSM-90
Serial number: 4081422 / 01504
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT

The final Fv - Fs values for the year varied within a range of about 4.5 nT. The standard deviations in the 2014 weekly absolute observations from the final adopted variometer model and data were:

X	0.6 nT
Y	1.0 nT
Z	0.4 nT
D	7"
I	3"
F	0.3 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2014 ASP definitive data and real time reported 1-minute data sets
(ASP definitive - ASP real time) were:

	X	Y	Z
Average	-0.1	-0.1	+0.1
Std.dev	+0.9	+0.9	+1.1
Min	-1.3	-1.1	-1.6
Max	+1.1	+1.5	+2.1

The ASP 2014 reported real time data are within the specification for INTERMAGNET Quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2014 ASP definitive data and quasi-definitive 1-minute data sets
(ASP definitive - ASP quasi-definitive) were:

	X	Y	Z
Average	-0.1	-0.1	-0.2
Std.dev	+0.7	+0.9	+0.6
Min	-1.1	-1.5	-1.6
Max	+1.0	+1.5	+0.7

The ASP 2014 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

Magnetic time-series data were transferred to Geoscience Australia in Canberra every 5 minutes via the NextG mobile network. The QNX 6.5 acquisition computer used a GPS clock (both pulse-per-second and absolute-time-code) to set the system time. The clock was checked from Geoscience Australia regularly to ensure it was working correctly. If not, it was reset remotely or, if necessary, the computer was re-booted.

The last maintenance visit to the Alice Springs observatory occurred in November 2013. The visit was incorporated into upgrade work on satellite uplinks at various Geoscience Australia seismic and geodetic stations around Australia. No maintenance visit occurred during 2014.

The variometers at Alice Springs are generally very stable, As previously noted the variometer instruments occasionally record a spike in the data. These spikes are attributed to randomly generated measurements in the individual instruments.

Fire breaks on the internal fence were ploughed at the beginning of February. Contamination was noted in the data on 2014-02-06 between 00:00:00 UTC and 02:00:00 UTC. Areas of the fire breaks were also mown on 2014-08-28 with contamination being noted from 01:00:00 UTC.

A power outage occurred on 2014-06-15 when substation was upgraded. The observatory back-up power supply allowed the system to continue running for some time after the loss of power with a total of 601 minutes of data being lost.

During the absolute observation on 2014-09-13 the batteries in the absolute observatory back-up power supply failed. The monitor for the acquisition computer was also found to have failed.

During the last week of November and early December Alice Springs experienced several days of severe thunderstorms causing spikes on the magnetic data. The spikes were identified manually and excluded from the data set.

Table 4. Distribution of Alice Springs 2014 data.

1-second values		
IPS	preliminary	real time
INTERMAGNET	preliminary	hourly
1-minute values		
INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	Quasi-definitive	monthly
INTERMAGNET	definitive	July 2015
WDC for Geomagnetism	preliminary	real time
WDC for Geomagnetism	preliminary	daily

Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au).

Significant events

2014-01-16	RSM reports that gate to observatory was open. He has closed it.
2014-01-20	Spike in Z at 05:14:28 and shift between 05:16:48 and 05:17:28.
2014-01-28	Jump in X, Y and Z at 02:09 to 02:11 Jump in Z ~+0.75nT at 16:28:57. Return jump at 16:58:05 ~-1.5nT. Cause not known.
2014-02-06	00 - 02 (approx) Ploughing fire break internal to perimeter fence. Small interference noted between 036 ~23:38 and 037 00:17. Z only.

```
2014-03-05  Ant research people have left site.
2014-03-14  Lots of spikes in variometer, possible
            thunderstorm activity?
2014-03-15  Lots more spikes especially in Z.
2014-03-16  As above.
2014-03-19  more spikes in variometer
2014-03-20  more spikes again.
2014-03-21  more spikes.
2014-03-24  more spikes.
2014-04-01  Possible contamination in PPM at 13:40:00 to
            13:41:25.
2014-04-02  Spikes in PPM
2014-04-07  Contamination 07:50 to 08:00
2014-04-23  Control hut A/C not functioning - cycle power
            to fix problem.
2014-04-25  05-07 grass slashing around control and
            absolute hut
201-05-05   Scatter in residuals noticed. Observer asked
            to check mounting screws on fluxgate.
            Both screws loose, but one closest to vertical
            circle can not be tightened properly.
2014-06-13  PPM spikes from 03:34:30UTC.
2014-06-15  Data stops at 02:04:31 to 04:28:52
                          11:39:07 to 11:59:47
            System rebooted
            Reboot data loss is 13:53:30 to 13:54:00
            Local power supply was interrupted by
            electricity supplier working on transformers.
2014-06-22  ~06:00:40 to 06:01:00 steps in XYZ variometer
            channels. Cause not identified at this time.
2014-06-23  Steps in variometer channels, 02:37:00.
2014-07-09  Possible contamination at ~16:11
2014-07-14  Slashing and fire-break work around observatory
            occurring this week. Possible contamination on
            day 200 (2014/07/19)22:12:30 for about 20secs.
2014-08-06 ~23:06:14 to 23:06:36 change in X and Z.
           ~ X = -1nT, Z = +1.5nT
2014-08-28 CAT advises mowing to take place within the
           observatory grounds. From about 01:00 onwards
2014-09-10 Between 07:22:59 and 07:37:33 unexplained
           missing data. Suspect power outage.
2014-09-13 Absolute observatory back-up power supply fails
           - only half observation completed. Acquisition
           PC screen fails. Unexplained changes in XYZ and
           F at 04:48 and 04:55, contamination? or is it
           power outage.
2014-09-15 Arrange for two Century PS1270 batteries from
           Outback Batteries. Arrange a replacement 19"
           monitor.
2014-11-21 Step in X ~0.25nT and Z ~0.5nT. At 06:16:40
           Cause unknown. Thunderstorm also in area at
           around this time.
2014-11-22 Thunderstorm at around 09:00 to 11:10 and also
           latter on 12:00 till 14:15.
2014-11-23 Thunderstorm from 09:00 to 11:00 and then
           smaller one 12:00 to 14:00.
2014-11-30  More thunderstorms 06:00 to 07:30.

Data Losses for 2014
--------------------
Date           Interval     Data loss
```

		(hh:mm)	(minutes)
Vector data			
2014-01-28	XYZ	02:10 - 02:10	(1)
2014-01-28	XYZ	16:29 - 16:29	(1)
2014-03-14	XYZ	22:18 - 22:18	(1)
2014-03-15	XYZ	03:30 - 03:31	(2)
2014-03-24	XYZ	17:30 - 17:36	(7)
2014-06-15	XYZ	02:05 - 12:05	(601)
2014-06-15	XYZ	13:54 - 13:54	(1)
2014-06-22	XYZ	06:01 - 06:01	(1)
2014-08-09	XYZ	03:48 - 03:52	(5)
2014-09-10	XYZ	07:23 - 07:43	(21)

Total: 641

Date		Interval (hh:mm)	Data loss (minutes)
Scalar data			
2014-01-01	F	23:33 - 23:33	(1)
2014-01-02	F	05:13 - 05:13	(1)
2014-01-09	F	20:14 - 20:14	(1)
2014-01-09	F	20:24 - 20:24	(1)
2014-01-14	F	23:07 - 23:07	(1)
2014-02-01	F	14:09 - 14:09	(1)
2014-02-08	F	01:10 - 01:10	(1)
2014-02-08	F	01:17 - 01:17	(1)
2014-02-08	F	01:51 - 01:51	(1)
2014-02-08	F	02:45 - 02:45	(1)
2014-02-08	F	04:11 - 04:12	(2)
2014-02-08	F	07:06 - 07:07	(2)
2014-02-08	F	07:46 - 07:46	(1)
2014-02-08	F	07:50 - 07:50	(1)
2014-02-09	F	13:47 - 13:47	(1)
2014-02-15	F	13:18 - 13:18	(1)
2014-02-15	F	22:00 - 22:00	(1)
2014-02-15	F	22:04 - 22:04	(1)
2014-02-15	F	22:06 - 22:07	(2)
2014-02-15	F	22:18 - 22:18	(1)
2014-02-15	F	23:11 - 23:11	(1)
2014-02-16	F	01:08 - 01:09	(2)
2014-02-16	F	01:28 - 01:28	(1)
2014-02-16	F	04:50 - 04:51	(2)
2014-02-16	F	04:56 - 04:56	(1)
2014-02-16	F	05:29 - 05:30	(2)
2014-02-16	F	06:07 - 06:07	(1)
2014-02-16	F	08:14 - 08:14	(1)
2014-02-16	F	15:10 - 15:10	(1)
2014-02-19	F	05:39 - 05:39	(1)
2014-02-20	F	03:49 - 03:50	(2)
2014-02-20	F	04:06 - 04:06	(1)
2014-02-20	F	04:59 - 04:59	(1)
2014-02-23	F	08:00 - 08:00	(1)
2014-02-23	F	22:07 - 22:08	(2)
2014-02-23	F	22:22 - 22:22	(1)
2014-02-27	F	16:52 - 16:53	(2)
2014-02-27	F	16:55 - 16:55	(1)
2014-02-27	F	21:55 - 21:55	(1)
2014-02-27	F	22:01 - 22:01	(1)
2014-03-05	F	23:18 - 23:18	(1)
2014-03-19	F	15:21 - 15:21	(1)
2014-03-25	F	20:04 - 20:04	(1)

2014-04-05	F	22:43 - 22:43	(1)
2014-04-05	F	23:08 - 23:08	(1)
2014-04-05	F	23:20 - 23:20	(1)
2014-04-20	F	11:22 - 11:23	(2)
2014-04-20	F	11:36 - 11:36	(1)
2014-04-20	F	11:42 - 11:45	(4)
2014-04-20	F	12:07 - 12:07	(1)
2014-04-20	F	12:54 - 12:55	(2)
2014-04-20	F	23:08 - 23:09	(2)
2014-04-21	F	00:07 - 00:07	(1)
2014-04-21	F	01:23 - 01:23	(1)
2014-04-21	F	05:27 - 05:27	(1)
2014-04-29	F	22:19 - 22:19	(1)
2014-06-02	F	23:29 - 23:29	(1)
2014-06-07	F	16:54 - 16:55	(2)
2014-06-08	F	04:50 - 04:51	(2)
2014-06-08	F	05:06 - 05:06	(1)
2014-06-08	F	05:13 - 05:13	(1)
2014-06-08	F	05:27 - 05:27	(1)
2014-06-08	F	06:08 - 06:09	(2)
2014-06-08	F	06:26 - 06:26	(1)
2014-06-08	F	08:08 - 08:09	(2)
2014-06-08	F	08:43 - 08:43	(1)
2014-06-08	F	08:45 - 08:46	(2)
2014-06-08	F	09:11 - 09:11	(1)
2014-06-08	F	09:20 - 09:20	(1)
2014-06-08	F	12:24 - 12:24	(1)
2014-06-15	F	02:05 - 12:04	(600)
2014-06-15	F	13:54 - 13:54	(1)
2014-06-22	F	06:01 - 06:01	(1)
2014-07-28	F	05:52 - 05:52	(1)
2014-07-28	F	06:38 - 06:38	(1)
2014-07-28	F	06:40 - 06:40	(1)
2014-08-02	F	14:11 - 14:12	(2)
2014-09-10	F	07:24 - 07:39	(16)
2014-09-11	F	23:45 - 23:45	(1)
2014-09-13	F	00:52 - 00:52	(1)
2014-09-13	F	00:55 - 00:55	(1)
2014-09-13	F	04:52 - 04:53	(2)
2014-09-14	F	02:51 - 02:51	(1)
2014-09-16	F	04:21 - 04:21	(1)
2014-09-16	F	04:23 - 04:23	(1)
2014-09-19	F	07:48 - 07:48	(1)
2014-10-12	F	12:22 - 12:22	(1)
2014-10-14	F	16:45 - 16:45	(1)
2014-11-04	F	22:14 - 22:14	(1)
2014-11-04	F	23:13 - 23:13	(1)
2014-11-05	F	00:03 - 00:04	(2)
2014-11-09	F	23:47 - 23:47	(1)
2014-11-10	F	02:21 - 02:22	(2)
2014-11-14	F	01:38 - 01:38	(1)
2014-11-14	F	06:50 - 06:50	(1)
2014-12-01	F	22:12 - 22:12	(1)
2014-12-01	F	23:15 - 23:15	(1)
2014-12-02	F	05:53 - 05:53	(1)
2014-12-06	F	09:47 - 09:47	(1)
2014-12-06	F	22:49 - 22:49	(1)
2014-12-06	F	23:15 - 23:15	(1)
2014-12-06	F	23:17 - 23:17	(1)
2014-12-06	F	23:24 - 23:24	(1)
2014-12-06	F	23:36 - 23:36	(1)

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2014-12-06    F      23:55 - 23:55  (1)
2014-12-07    F      00:01 - 09:59  (599)
2014-12-07    F      16:01 - 16:01  (1)
2014-12-08    F      21:47 - 21:47  (1)
2014-12-08    F      23:03 - 23:03  (1)
2014-12-08    F      23:08 - 23:08  (1)
2014-12-23    F      13:10 - 13:11  (2)
2014-12-24    F      01:13 - 01:13  (1)

Total: 1349

Annual mean values
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The annual mean values for Alice Springs are set out in
the yearmean file.


Indices
-------

No magnetic indices are routinely calculated for the
Alice Springs observatory.

                             < END >
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7.5.1.3 2015

```
                                 ASP
              ALICE SPRINGS OBSERVATORY INFORMATION 2015

 ACKNOWLEDGE-  Users of ASP data should acknowledge:
       -MENTS:  Geoscience Australia

   STATION ID: ASP
     LOCATION: Alice Springs, Northern Territory,
                Australia
 ORGANISATION: Geoscience Australia (GA)

  CO-LATITUDE: 113.76 Deg.
    LONGITUDE: 133.8830 Deg. E
    ELEVATION: 557 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate magnetometer
               Proton precession magnetometer

    RECORDING
   VARIOMETER: Three-component fluxgate magnetometer
               Proton precession magnetometer

  ORIENTATION: ABZ (Magnetic NW, Magnetic NE and Vertical)

DYNAMIC RANGE: DMI magnetometer: +/- 1600 nT

   RESOLUTION: DMI magnetometer: 0.032 nT

SAMPLING RATE: 1 second (vector) and 10 second (scalar)
  FILTER TYPE: Intermagnet

       BACKUP
```

```
   VARIOMETER: None

    K-NUMBERS: None
     K9-LIMIT: 350 nT

         GINS: Edinburgh
    SATELLITE: HTTP delivery

    OBSERVER: R. Maddocks
              W. Jones


      CONTACT: Geomagnetism Project
               Geoscience Australia
               GPO Box 378
               Canberra  ACT  2601
               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9986
               E-mail: geomag@ga.gov.au
               WWW: http://www.ga.gov.au

   NOTES:

Site
-----
The Alice Springs magnetic observatory is located
approximately 10 km south of Alice Springs in the Northern
Territory, on the Centre for Appropriate Technology (CAT),
a national indigenous science and technology organisation.
The observatory is situated on an alluvial plain over
tertiary sediments, overlying late Proterozoic carbonates
and quartzites.

The observatory comprises:
* a 3×3 m insulated air-conditioned concrete-brick Control
House where recording instrumentation and control equipment
are housed;

* a 3×3 m Absolute Shelter, 80 m southeast of the Control
House, which encloses a concrete observation pier (Pier G);
the top of the pier is 1277 mm above the concrete floor;

* two 300 mm diameter azimuth pillars about 85 m from the
absolute shelter at approximate true bearings of 130 deg
and 255 deg,

* two small (1 metre cubed) underground vaults; one located
approximately 50 m to the north and the other 50 m to the
east of the Control House, housing the variometer sensors
and electronics.
and

* a remote reference station (H) located 73m at a true
bearing of 195 deg from Pier G.

Table 1. Key observatory data.
IAGA code: ASP
Commenced operation: June 1992
Geographic latitude: 23 deg 45' 39.6" S
```

Geographic longitude: 133 deg 53' 00.0" E
Geomagnetic latitude: -32.35 deg
Geomagnetic longitude: 208.63 deg
K 9 index lower limit: 350 nT
Principal pier: Pier G
Pier elevation (top): 557 m AMSL
Principal reference mark: Pillar B
Reference mark azimuth: 255 deg 00' 50"
Reference mark distance: 85 m
Observer: R. Maddocks
W. Jones

Local meteorological conditions

The meteorological temperature at Alice Springs during 2015 varied from a minimum -5.0 deg C (2015-07-20) to a maximum +42.5 deg C (2015-03-19). Daily minimum temperatures varied from -5.0 deg C to +29.2 deg C (average 12.7 +/- 8 deg C); daily maximum temperatures varied from 14.7 deg C to +42.5 deg C (average 29.1 +/- 7 deg C); daily temperature ranges varied from 1.6 C to 26.2 C (average 16.5+/-5.0 C).

The daily maximum wind gust varied from 19 km/h to 76 km/h (average 39.5 +/- 9 km/h). The maximum daily maximum wind gust was 76 km/h in November. The minimum daily maximum wind gust was 19 km/h in April and July. There was from 0 to 13.2 (average 9.8 +/- 3) hours of sunshine according to the meteorological definition.

All weather data was provided by the
Australian Government- Bureau of Meteorology.

Variometers

The variometers used during 2015 are described in Table 2. The DMI fluxgate sensor and electronics were housed in the eastern underground vault and the PPM sensor and electronics in the northern vault. The fluxgate electronics were insulated with foam. Both vaults were covered with soil to minimize diurnal temperature fluctuations. The recording equipment was housed in the Control House.

The measured temperature of the DMI sensor ranged from 16 deg C to 30 deg C during the year. The corresponding measured temperature of the DMI electronics ranged from 22 deg C to 34 deg C.

Throughout the year single point spikes on both the vector and scalar variometer data were not uncommon.
After investigation and eliminating natural causes these spikes have been deleted from the data via filtering and visual inspection of the 1 second and 10 second data.

A despiking filter was applied throughout the year to the DMI 1-second variometer data. The spike detection required a value to deviate from the local linear trend by 5.2 times the maximum of 0.5 nT, or 8/9 fractile of deviations during the following minute. Each day was then reviewed for either over or under filtering by visually inspection. If days were found to have been over filtered then that day was re-processed without any filter applied and spikes manually excluded. If a day was found to be under filtered then a more aggressive filter was applied. Days when these were applied are listed in the appendix.

The 10-second scalar variometer data were also despiked on most days. A spike detection required a value to deviate from the local linear trend by 10 times the maximum of 0.1 nT, or 8/9 fractile of deviations during the following minute or so. Each day was then reviewed for either over or under filtering. If over filtering was found then the day was re-processed with the filter removed. If under filtering was found progressively more aggressive filtering was applied. These days were then reviewed again for over filtering manual exclusion were added where necessary. The days when more aggressive scalar filtering was applied are listed in the appendix.

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. The system clock was synchronised to a GPS clock. During 2015, corrections larger than 10 ms occurred on three occasions. These corrections are listed below.

The correction was

2015-01-27	06:00:50	0.524 s	reboot
2015-04-30	06:05:00	0.071 s	installing regulator
2015-07-01	00:00:41	-1.000 s	leap second

Absolute Instruments

The principal absolute magnetometers used at Alice Springs and their adopted corrections for 2015 are described in Table 3. A Getac tablet PC with GObs acquisition software was used to record the absolute observations. This system can communicate with both the PPM and the DIM.

One visit was made to the Alice Springs Observatory during the year to undertake upgrade work. No comparisons were made between the Alice Springs absolute DIM and the travelling reference DIM during 2015. The last comparison between the travelling reference DIM and the Alice Springs absolute DIM was 2012-11-08. For 2015 the previously adopted corrections from 2012 have been used.

The adopted corrections for DI0052D/313887 to the international standard are given in Table 3.
At the 2015 mean magnetic field values at Alice Springs (X=30065 nT, Y=2476 nT, Z= -43766 nT) the D, I and F corrections in Table 3 translate to corrections of:

dX = -1.3 nT dY = 0.8 nT dZ = -0.9 nT

These corrections have been applied to all Alice Springs 2015 final data.

Baselines

The fluxgate variometer baselines were controlled by 50

sets of weekly absolute observations for the year using the offset method.

The final baseline parameters for the variometer were completed by manually fitting a piece-wise linear function to the absolute observations. This function included drifts or jumps when required. The baselines drifted in all three channels over the course of the year with a range of about 4 nT.

Throughout the year jumps were noted in the vector variometer data, predominantly in the vertical component. These jumps were investigated and found to coincide with a loss of mains power. On average these jumps were approximately +/- 0.4nT. Smaller jumps were also occasionally noted in the horizontal components.

Fv-Fs once again exhibited a curve over the course of the year similar to that seen in previous years.
A comparison to the ambient temperature indicated an inverse relationship exists between the temperature and the curve in Fv-Fs. This may indicate that there is an environmental component which is influencing Fs. For 2015 a stepped baseline was applied to Fs which had not been applied in previous years. The range of Fv-Fs for 2015 was initally about 2 nT, this was reduced to 0.5 nT with the application of the baseline steps. The value of Fv - Fs was adjusted to be centred around zero for the year.

Table 2. Magnetic variometers used in 2015.
3-component variometer: DMI FGE
Serial number: E0306 / S0261
Type: suspended; linear-core fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
A/D converter: ADAM 4017 module (+/- 5V)
Resolution: 0.032 nT
Period of use: 2015-01-01 to 2015-12-31

Total-field variometer: GEM Systems GSM-90
Serial number: 4081419 / 42177
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Period of use: 2015-01-01 to 2015-12-31

Data acquisition system: GDAP: ARK3360/QNX6.5
Timing: Trimble Acutime GPS clock
Communications: NextG modem

Table 3. Absolute magnetometers and their adopted corrections for 2015. Corrections are applied in the sense Standard = Instrument + correction.
DI fluxgate: DMI
Serial number: DI0052D
Theodolite: Zeiss 020B
Serial number: 313887
Resolution: 0.1'
D correction: +0.1'
I correction: -0.1'

Total-field magnetometer: GEM Systems GSM-90
Serial number: 4081422 / 01504
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT

The Fv - Fs values for the year varied within a range of about 0.6 nT. The standard deviations in the 2015 weekly absolute observations from the final adopted variometer model and data were:

X	0.5 nT
Y	0.9 nT
Z	0.5 nT
D	6"
I	2"
F	0.4 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2015 ASP definitive data and real time reported 1-minute data sets
(ASP definitive - ASP real time) were:

	X	Y	Z
Average	+0.6	+0.2	+0.4
Std.dev	+0.5	+1.4	+1.2
Min	-0.6	-2.0	-1.4
Max	+1.2	+3.7	+2.7

The ASP 2015 reported real time data are within the specification for INTERMAGNET Quasi-definitive data. This was in part due to keeping baselines updated to produce monthly quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2015 ASP definitive data and quasi-definitive 1-minute data sets
(ASP definitive - ASP quasi-definitive) were:

	X	Y	Z
Average	+0.5	-0.1	+0.2
Std.dev	+0.3	+0.4	+0.5
Min	+0.1	-0.9	-0.7
Max	+0.9	+0.5	+0.8

The ASP 2015 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

Magnetic time-series data were transferred to Geoscience Australia in Canberra every 5 minutes via the NextG mobile network. The QNX 6.5 acquisition computer used a GPS clock (both pulse-per-second and absolute-time-code) to set the system time. The clock was checked from Geoscience Australia regularly to ensure it was working correctly. If not, it was reset remotely or, if necessary, the computer was re-booted.

In March (2015-03-11) periods of data exhibited steps lasting between 30 minutes to 6 hours. These steps were most prevalent in the vertical component but they were also noted in the horizontal components at different times. Investigations showed these steps appeared to coincide with a loss of mains power. These jumps in the vertical component averaged approximately +/- 0.4 nT and less in the horizontal components. For 2015, these steps have been identified and corrected in quasi-definitive and definitive data.

Throughout the year GA's satellite ground station was planning to relocate a 10 m antenna from Darwin to Alice Springs. One of the proposed sites for this new antenna was within 140 m of station H and 200 m of the absolute pier. Given this is a large piece of infrastructure, it may impact on the operations of the observatory. To quantify any changes that may occur observations on the remote reference stations at Alice Springs airport were made. Stations E and F were occupied during a maintenance visit (2015-04-28 to 2015-05-06) and pier differences were calculated and compared.

The other priorities for the maintenance visit were to install 12 V DC-DC voltage regulators in the variometer vaults and to replace a heavy concrete lid on the vector variometer vault with a fibreglass lid. These upgrades required the acquisition system to be shut down while the upgrades were undertaken. This resulted in the loss of some data

In July 2015-07-23, the variometer scalar magnetometer stopped at 08:10:30. The magnetometer then restarted again at 08:28:00. The cause and subsequent restart of the magnetometer was investigated but a cause was never determined.

Also in July (2015-07-27) at approximately 21:41, an earthquake was recorded in the vector variometer data. This period of data has been excluded from the definitive data.

At the end of August (2015-08-29) the absolute scalar magnetometer failed to communicate with the Getac/Gobs system. A replacement tri-axial sensor cable was sent. No absolute scalar data was available for the absolute observations on 2015-08-29 and 2015-09-04. For these observations variometer scalar data was substituted in place of the absolute scalar data.

In November (2015-11-11) a second earthquake recorded by the variometer system was noted. Affected data have been excluded from the definitive dataset.

Table 4. Distribution of Alice Springs 2015 data.

1-second values		
BoM SWS	preliminary	real time
INTERMAGNET	preliminary	hourly

```
1-minute values
INTERMAGNET    preliminary  real time
INTERMAGNET    preliminary  daily
INTERMAGNET    Quasi-
               definitive   monthly
INTERMAGNET    definitive   July 2016
WDC for Geomagnetism
               preliminary  real time
WDC for Geomagnetism
               preliminary  daily
```

Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au).

```
Significant events
------------------
2015-01-27  Many zombie data retrieval jobs
            05:59:40 reboot to clear jobs
2015-02-05  Observer is away from 2015-02-05 to
            2015-02-18.
2015-02-23  Mowing of firebreaks in paddock. No sign of
            contamination in data.
            Spikes in PPM from 05:42 for ~2hours not
            associated with mowing.
2015-03-11  4 periods have been excluded from data as there
            is a shift occurring particular in Z but also
            to a lesser extent in Y.
2015-04-08  trimming grass around observatory
2015-04-25  Z channel 1 to 2 nT of noise in the Z component
            over two days, Unknown cause.
2015-04-28  Maintenance visit - Jones and Jamieson
2015-04-30  00:15 commence uncovering PPM vault
2015-05-08  Call from observer, DIM data not recorded on
            Getac. A2D is set to off, data records after
            hitting DIFluxAuto button. Email updated
            GMO_asp.xml for copying to Gobs with
            instructions.
2015-05-11  QD data changes made after lid replaced
            X = -3.3nT
            Y = 11.5nT
            Z = -2.4nT
2015-07-23  Step in Z at ~00:52. PPM stops at 08:10:30 but
            then restarts at 08:28:00. Unknown reason.
2015-07-27  Earthquake Iran Jaya 21:41:21 UTC, arrival
            is about 21:46
2015-07-30  Observer away in field next week. No Obs.
2015-08-29  No Absolute PPM data as cable is broken. Send
            new yellow PPM cable and power/data cable. Need
            use variometer PPM for absolutes.
            No absolute PPM data as cable broken, used
            variometer PPM instead.
2015-09-04  No Absolute PPM (Fg). data were processed by
            using the scalar PPM data (Fs). Fg= Fv+ 107.46.
2015-09-11  New cables have arrived and fix the problem.
            Old cables will be returned for repair.
2015-10-08  Many PPM spikes
2015-10-12  04:48 stop and restart GSM90 driver with a
            change to long polarise and 4.5 s trigger
            delay in attempt to improve data quality.
2015-11-03  contamination from rotary-hoe for firebreak.
2015-11-11  approx 23:43 arrival of earthquake 5.7
```

```
              banda sea
2015-12-16  Thunder storm ~05:30UTC

Data Losses for 2015
--------------------
Date           Interval     Data loss
               (hh:mm)     (minutes)
Vector data
2015-01-07    XYZ     06:17 - 06:20  (4)
2015-01-07    XYZ     06:31 - 06:34  (4)
2015-01-07    XYZ     07:04 - 07:06  (3)
2015-01-07    XYZ     07:42 - 07:45  (4)
2015-01-07    XYZ     07:47 - 07:47  (1)
2015-01-07    XYZ     08:25 - 08:34  (10)
2015-01-26    XYZ     08:35 - 08:36  (2)
2015-01-27    XYZ     06:00 - 06:00  (1)
2015-02-09    XYZ     14:10 - 14:11  (2)
2015-02-27    XYZ     13:49 - 13:58  (10)
2015-03-11    XYZ     00:01 - 00:02  (2)
2015-03-11    XYZ     01:52 - 01:52  (1)
2015-03-11    XYZ     02:09 - 02:10  (2)
2015-03-11    XYZ     05:25 - 05:25  (1)
2015-03-14    XYZ     07:36 - 07:38  (3)
2015-03-22    XYZ     07:57 - 07:57  (1)
2015-03-22    XYZ     08:04 - 08:04  (1)
2015-03-24    XYZ     13:52 - 13:52  (1)
2015-03-28    XYZ     11:50 - 11:52  (3)
2015-04-10    XYZ     06:51 - 06:53  (3)
2015-04-30    XYZ     04:32 - 07:36  (185)
2015-04-30    XYZ     21:01 -
2015-05-01    XYZ     - 08:36        (696)
2015-06-13    XYZ     06:05 - 06:05  (1)
2015-07-20    XYZ     09:15 - 09:21  (7)
2015-07-20    XYZ     10:39 - 10:39  (1)
2015-07-23    XYZ     08:11 - 09:33  (83)
2015-07-27    XYZ     21:47 - 21:56  (10)
2015-07-28    XYZ     12:26 - 12:28  (3)
2015-09-05    XYZ     13:42 - 13:42  (1)
2015-10-24    XYZ     18:55 - 18:56  (2)
2015-11-20    XYZ     06:51 - 06:56  (6)
2015-11-21    XYZ     00:24 - 01:39  (76)
2015-11-29    XYZ     18:26 - 18:26  (1)
2015-12-09    XYZ     10:27 - 10:27  (1)
2015-12-21    XYZ     23:56 - 23:59  (4)
2015-12-29    XYZ     11:28 - 11:30  (3)

Total: 1139

Date           Interval     Data loss
               (hh:mm)     (minutes)
Scalar data
2015-01-27    F      06:00 - 06:00  (1)
2015-04-06    F      04:23 - 04:24  (2)
2015-04-30    F      00:12 -
2015-05-01    F      - 08:40        (1949)
2015-05-18    F      23:15 - 23:15  (1)
2015-06-22    F      18:36 - 18:36  (1)
2015-07-23    F      08:11 - 08:30  (20)
2015-09-09    F      06:56 - 06:59  (4)
2015-09-20    F      06:04 - 06:05  (2)
2015-09-26    F      16:14 - 16:18  (5)
```

```
2015-09-30    F      16:17 - 16:28  (12)
2015-10-06    F      15:00 - 15:05  (6)
2015-10-09    F      15:56 - 15:56  (1)
2015-10-10    F      22:28 - 22:28  (1)
2015-10-12    F      04:48 - 04:48  (1)
2015-10-15    F      19:02 - 19:07  (6)
2015-10-19    F      08:21 - 08:29  (9)
2015-10-20    F      07:49 - 07:49  (1)
2015-11-21    F      00:24 - 01:39  (76)
2015-11-27    F      12:26 - 12:56  (31)
2015-11-27    F      14:31 - 15:01  (31)
2015-12-18    F      15:10 - 15:14  (5)
2015-12-18    F      15:36 - 15:42  (7)
2015-12-18    F      16:12 - 16:19  (8)
2015-12-21    F      23:56 - 23:59  (4)
2015-12-30    F      08:40 - 08:40  (1)

Total: 2185


ASP More aggressive vector filtering was
applied on following days
----------------------------------------
Month     Day of the year

January   01 02 07 09 18
February  32
March     60 70
April     91
May       121 150
June      152 164 167
July      182
August    213
September 244 261
October   274
November  305 306 325 333 334
December  335 350 359

ASP Scalar filtering was not applied on
following days
---------------------------------------
Month     Day of the year
January
February
March
April
May       121 123 124 128 129
June
July
August
September
October   277 278 279 281 283 284 285 292 293 294
          295 296 297 298 299 300 302 303 304
November  305 306 308 309 310 311 312 313 315 318
          319 321 322 323 324 325 326 327 328 329 331 333
December  337 347 349 350 351 356 357 360 362 363 364 365


Annual mean values
------------------
The annual mean values for Alice Springs are set out in
```

```
the yearmean file.

Indices
-------
No magnetic indices are routinely calculated for the
Alice Springs observatory.

                             < END >
```

7.5.1.4 2016

```
                                 ASP
              ALICE SPRINGS OBSERVATORY INFORMATION 2016

 ACKNOWLEDGE-  Users of ASP data should acknowledge:
       -MENTS:  Geoscience Australia

   STATION ID: ASP
     LOCATION: Alice Springs, Northern Territory,
                Australia
 ORGANISATION: Geoscience Australia (GA)

  CO-LATITUDE: 113.76 Deg.
    LONGITUDE: 133.8830 Deg. E
    ELEVATION: 557 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate magnetometer (DIM)
               DIM DI0052 Theodolite 313887
               GSM90 Overhauser-effect magnetometer
               GSM90_4081422/sensor 01504

    RECORDING
   VARIOMETER: Suspended DMI fluxgate magnetometer
               GSM90 Proton precession magnetometer.

  ORIENTATION: ABZ (Magnetic NW, Magnetic NE and Vertical)

DYNAMIC RANGE: DMI magnetometer: +/- 1600 nT

   RESOLUTION: DMI magnetometer: 0.032 nT

SAMPLING RATE: 1 second (vector) and 10 second (scalar)
  FILTER TYPE: Intermagnet 90 second gaussian

       BACKUP
   VARIOMETER: None

    K-NUMBERS: None
     K9-LIMIT: 350 nT

         GINS: Edinburgh
    SATELLITE: HTTP delivery

     OBSERVER: R. Maddocks
               L. Wang
               A. Lewis

      CONTACT: Geomagnetism Project
               Geoscience Australia
```

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WWW: http://www.ga.gov.au

NOTES:

Site

The Alice Springs magnetic observatory is located approximately 10 km south of Alice Springs in the Northern Territory, on the Centre for Appropriate Technology (CAT), a national indigenous science and technology organisation. The observatory is situated on an alluvial plain over tertiary sediments, overlying late Proterozoic carbonates and quartzites.

The observatory comprises:
* a 3×3 m insulated air-conditioned concrete-brick Control House where recording instrumentation and control equipment are housed;

* a 3×3 m Absolute Shelter, 80 m southeast of the Control House, which encloses a concrete observation pier (Pier G); the top of the pier is 1277 mm above the concrete floor;

* two 300 mm diameter azimuth pillars about 85 m from the absolute shelter at approximate true bearings of 130 deg and 255 deg,

* two small (1 metre cubed) underground vaults; one located approximately 50 m to the north and the other 50 m to the east of the Control House, housing the variometer sensors and electronics.

and

* a remote reference station (H) located 73m at a true bearing of 195 deg from Pier G.

Table 1. Key observatory data.
IAGA code: ASP
Commenced operation: June 1992
Geographic latitude: 23 deg 45' 39.6" S
Geographic longitude: 133 deg 53' 00.0" E
Geomagnetic latitude: -32.35 deg
Geomagnetic longitude: 208.63 deg
K 9 index lower limit: 350 nT
Principal pier: Pier G
Pier elevation (top): 557 m AMSL
Principal reference mark: Pillar B
Reference mark azimuth: 255 deg 00' 50"
Reference mark distance: 85 m
Observer: R. Maddocks
L. Wang
A. Lewis

Local meteorological conditions

The meteorological temperature at Alice Springs during 2016 varied from a minimum -4.0 deg C (2016-07-15) to a maximum +42.6 deg C (2016-02-24). Daily minimum temperatures varied from -4.0 deg C to +27.7 deg C (average 13.8 +/- 7 deg C); daily maximum temperatures varied from 11.1 deg C to +42.6 deg C (average 29.4 +/- 7 deg C); daily temperature ranges varied from 2.1 C to 26.0 C (average 15.6 +/- 5.0 C).

The daily maximum wind gust varied from 19 km/h to 96 km/h (average 39.8 +/- 10 km/h). The maximum daily maximum wind gust was 96 km/h in November. The minimum daily maximum wind gust was 19 km/h which occurred 3 times in May, June and July. There was from 0 to 13.2 (average 10.2 +/- 3) hours of sunshine according to the meteorological definition.

All weather data was provided by the Australian Government Bureau of Meteorology.

Variometers

The variometers used during 2016 are described in Table 2. The vector magnetometer was housed in the eastern underground vault. It is comprised of a suspended 3-axis fluxgate sensor and electronics built by the Danish Meteorological Institute (DMI). The electronics are further insulated with high density 'blue' foam board.

The scalar magnetometer was housed in the northern vault and is comprised of a GEMSYS GSM90 sensor and console. Both vaults were covered with soil to minimize diurnal temperature fluctuations. The recording equipment was housed in the Control House.

A sample of soil collected from the immediate vicinity of the scalar magnetometer vault on 2016-07-27 was sub-sampled and analysed for magnetic mineral content. The sample was found to contain 0.3% (by weight) of magnetite and 2.5% (by weight) of paramagnetic minerals, probably primarily ilmenite.

The measured temperature of the vector sensor ranged from 16 deg C to 32 deg C during the year. The corresponding measured temperature of the vector electronics ranged from 22 deg C to 36 deg C.

During the first half of the year random single point spikes in the scalar magnetometer data were not uncommon. After investigation and eliminating natural causes these spikes have been deleted from the data via filtering and visual inspection of the 10 second data.

The scalar magnetometer stopped working on 2016-06-17 after lightning struck near to the observatory. The scalar magnetometer GSM90_4081419/42177, was replaced on 2016-07-26 with GSM90_8092901/83383. The random spikes have not continued since the scalar magnetometer has been replaced.

No spike filtering was applied to the real-time reported vector data through the year. After visual inspection of the vector data, 43 days were found to require spike filtering applied to quasi-definitive and definitive vector data. The first spike filter, Vector (A) required the value of a spike to deviate from the local linear trend by 5.2 (Factor) times the maximum of 0.5 nT, (Noise) or 8/9 fractile of deviations during the following minute. These parameter are listed below as Vector (A) parameters. These days were then reviewed for either over or under filtering by visual inspection. Days found to have been over filtered were re-processed without any spike filtering and any spikes were manually excluded. The filtered days are listed. Days found to be under filtered were reprocessed using a more aggressive filter Vector (B). The parameters for Vector (B) and the days when it was applied are listed below.

```
Vector (A) parameters:
vectorFactor = 5.2
vectorNoise = 0.5

Days filtered using Vector (A):
007 008 017 023 048 050 051 052 054 055 055 112 114 115 117

Vector (B) parameters:
vectorFactor = 3.5
vectorbNoise = 0.075

Days filtered using Vector (B):
011 012 019 020 034 053 056 066 092 104 105 106 113 202 243
258 259 261 263 267 272 273 299 339 342 354

Daily statistics, 1-second samples identified as spikes:
                   X     Y     Z
Mean               0.1   0.1   0.1
Std. Dev           0.9   0.6   0.8
Maximum           17.0   11.0 15.0
Days with at-
-least one spike   9     8     7
```

No spike filtering was applied to the real-time scalar data through the year. After visual inspection of the scalar data, 72 days were found to require spike filtering which was applied to quasi-definitive and definitive 10-second scalar data. The spike filter, Scalar (4) required the value of a spike to deviate from the local linear trend by 8 times the maximum of 0.1 nT, or 8/9 fractile of deviations during the following minute. These parameter are listed below as Scalar (4) parameters and the days that it was applied. These days were then reviewed for either over or under filtering by visual inspection. Days found to have been over filtered were re-processed without any filter applied and the spikes were manually excluded. The days when this filter was applied are listed below.

The filtering parameters used during 2016

Scalar (4) parameters:

```
scalarFactor=8
scalarNoise=0.100

The days when Scalar (4) was applied were
002, 003, 004, 005, 006, 012, 016, 017, 019, 020, 021, 022,
023, 027, 031, 046, 047, 050, 051, 052, 053, 054, 055, 056,
057, 063, 064, 066, 068, 078, 079, 080, 023, 092, 094, 095,
096, 097, 099, 100, 101, 102, 103, 106, 107, 110, 111, 112,
113, 114, 117, 118, 119, 120, 121, 124, 125, 126, 127, 128,
120, 130, 136, 141, 147, 149, 140, 160, 163, 164, 339, 365

Daily statistics for scalar spike filtering
                   F
Mean               4
Std. Dev          22
Maximum          266
Days with at-
-least one spike  29


Table 2. Magnetic variometers used in 2016.
3-component variometer:        DMI FGE
Serial number:                 E0306 / S0261
Type:                          suspended; linear-core
                               fluxgate
Orientation:                   NW, NE, Z
Acquisition interval:          1 s
A/D converter:                 ADAM 4017 module (+/- 5V)
Resolution:                    0.032 nT
Period of use:                 2016-01-01 to 2016-12-31

Total-field variometer:        GEM Systems GSM90
Serial number:                 4081419 / 42177
Type:                          Overhauser effect
Acquisition interval:          10 s
Resolution:                    0.01 nT
Period of use:                 2016-01-01 to 2016-06-17

Total-field variometer:        GEM Systems GSM90
Serial number:                 8092901 / 83383
Type:                          Overhauser effect
Acquisition interval:          10 s
Resolution:                    0.01 nT
Period of use:                 2016-07-26 to 2016-12-31

Data acquisition system:       GDAP on ARK3360/QNX6.5
Timing:                        Trimble Acutime GPS clock
Communications:                NextG modem

Variometer clock corrections
----------------------------
Time stamps applied to the variometer data were obtained
from the acquisition computer system clock. The system
clock was synchronised to a GPS clock. Corrections larger
than 1 ms occurred on seven occasions.
These corrections are listed below.

Date       Time     Duration(s) Cause
2016-03-04 23:49:59   17.722   Computer shutdown
           23:54:26  -17.000   Compensate over correction
2016-03-09 01:19:02   17.653   computer shutdown
```

```
           01:29:25  -17.000   Compensate over correction
2016-07-26 00:34:42    0.923   Replace scalar magnetometer
2016-08-11 03:35:57   17.320   Computer shutdown
           03:44:24  -17.000   Compensate over correction
```

On three occasions the power to the GPS clock was interrupted and it appears the clock re-booted on GPS time rather than UTC time and forced a timing correction of about 17 s. Within the following 630 seconds UTC time was applied with another correction of about -17.0 seconds. These three periods of data with incorrect time-stamps have been excluded from the 2016 definitive data.

Absolute Instruments

The principal absolute magnetometers used at Alice Springs and their adopted corrections for 2016 are described in Table 3. A Getac tablet PC with GObs acquisition software was used to record the absolute observations using the off-set method. The fluxgate off-set measurements were digitised with a PICO ADC-16. This allows the Gobs software to communicate with both the scalar and the DIM vector magnetometers. The Getac tablet timing was synchronised with the internal GPS.

Table 3. Absolute magnetometers and their adopted corrections for 2016. Corrections are applied in the sense Standard = Instrument + correction.

DI fluxgate:	DMI
Serial number:	DI0052D
Theodolite:	Zeiss 020B
Serial number:	313887
Resolution:	0.1'
D correction:	+0.1'
I correction:	-0.1'
Period of use:	2016-01-01 to 2016-12-31
PICO serial number:	ADC16 FJY06/083

Total-field magnetometer:	GEM Systems GSM90
Serial number:	4081422 / 01504
Type:	Overhauser effect
Resolution:	0.01 nT
Correction:	0.0 nT
Period of use:	2016-01-01 to 2016-12-31

A maintenance visit occurred in July (2016-07-26 to 2016-08-28). Comparisons were made between the Alice Springs absolute DIM and the travelling reference DIM during this maintenance visit. The adopted instrument corrections were left unchanged.
The adopted corrections for DI0052D/313887 to the international standard are given in Table 3.

At the 2016 mean magnetic field values at Alice Springs (X=30081 nT, Y=2456 nT, Z= -43753 nT) the D, I and F corrections in Table 3 translate to corrections of:

dX = -1.3 nT dY = 0.8 nT dZ = -0.9 nT

Prior to installation, the variometer scalar magnetometer GSM90_8092901/83383 was compared to the absolute scalar magnetometer GSM90_1081422/01504. The results indicated that adopted corrections should remain unchanged.

These instrment corrections have been applied to all Alice Springs 2016 data.

Baselines

The fluxgate variometer baselines were controlled by 55 sets of weekly absolute observations for the year using the offset method.

The final baseline parameters for the variometer were completed by manually fitting a piece-wise linear function to the absolute observations. This function included drifts or jumps when required. The baselines drifted in all three channels over the course of the year in a range of about 5.5 nT.

Throughout the year jumps were noted in the vector variometer data, predominantly in the vertical component. These jumps were found to coincide with a loss of mains power. On average these jumps were approximately +/- 0.4nT. Smaller jumps were also occasionally noted in the horizontal components.

Fv-Fs once again exhibited a curve over the course of the year, which is similar to previous years. A comparison to the ambient temperature indicated an inverse relationship exists between the temperature and the curve in Fv-Fs. This may indicate that there is an environmental component which is influencing Fs. For 2016 a stepped baseline was again applied to Fs. The range of Fv-Fs for 2016 was initially about 6 nT, this was reduced to 0.5 nT with the application of F baseline steps. The value of Fv - Fs was adjusted to be centred around zero for the year.

The baseline corrected Fv - Fs values for the year varied within a range of about 1.2 nT. The standard deviations in the 2016 weekly absolute observations from the final adopted variometer model and data were:

```
X   0.5 nT
Y   1.0 nT
Z   0.5 nT
D   7"
I   7"
F   0.3 nT
H   0.5 nT
```

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2016 ASP definitive data and real time reported 1-minute data sets (ASP definitive - ASP real time) were:

	X	Y	Z
Average	-0.1	-0.2	+0.9
Std.dev	+0.8	+0.7	+1.8

Min	-1.4	-2.0	-1.4
Max	+0.9	+0.4	+4.9

The ASP 2016 reported real time data are within the specification for INTERMAGNET Quasi-definitive data. This was in part due to keeping baselines updated to produce monthly quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2016 ASP definitive data and quasi-definitive 1-minute data sets (ASP definitive - ASP quasi-definitive) were:

	X	Y	Z
Average	+0.1	-0.2	+0.4
Std.dev	+0.6	+0.5	+0.7
Min	+1.2	-1.0	-0.3
Max	+1.1	+0.4	+1.7

The ASP 2016 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

Magnetic time-series data were transferred to Geoscience Australia in Canberra every 5 minutes via the NextG mobile network. The QNX 6.5 acquisition computer used a GPS clock (both pulse-per-second and absolute-time-code) to set the system time. Timing and clock operation was monitored via daily state-of-health messages.

Short periods of mains power outages occurred throughout the year. These caused sub-nanoTesla steps in the vector data. Even though the power is supplied via the back-up battery system and a voltage regulator is installed at the variometer electronics, measurements at the vault show a voltage drop coincides with the steps in the vector data. The 10 second scalar data remains unaffected.

In late January (2016-01-30), the mains power stopped for approximately 6 hours when maintenance work on a nearby transformer was undertaken. The backup power system was able to supply power for most of this time but eventually the system stopped. Once the main power was returned a short period of data was corrupted while the battery was brought back up to charge. These data have been excluded from the definitive data.

In June (2016-06-17) the scalar variometer magnetometer stopped working after a nearby lightning strike. This lightning strike also disabled the telephone line to the control hut. The damaged GSM90 console and sensor (GSM90_4081419/42177) was replaced with GSM90_8092901/83383 on 2016-07-26.

On 2016-08-24 the GPS clock antenna was moved from the side of the air conditioner unit to the adjacent external wall of the control hut. The air-conditioning unit in the control hut was serviced on 2016-08-26, but may need to be replaced within the next two years.

Table 4. Distribution of Alice Springs 2016 data.

1-second values

BoM SWS	preliminary	real time
INTERMAGNET	preliminary	hourly

1-minute values

INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	Quasi-definitive	monthly
INTERMAGNET	definitive	July 2016
WDC for Geomagnetism (Kyoto)	preliminary	real time
WDC for Geomagnetism (Kyoto)	preliminary	daily

Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au).

Significant events

2016-01-09	Power outage 07:38 affected system, PPM stopped working till 08:35. Need to exclude some XYZ data as well.
2016-01-30	Variometer PPM stops working between 05:03:10 and 08:19:35. Town generator failed. Some data excluded. Will also need to do an EZ 030.50462296296 -0.25nT 030.5046296296 0.25nT
2016-02-03	Jump in Z EZ 34.6492824074 -0.8nT EZ 34.6712847222 0.8nT
2016-02-14	Jump in Z fixed during QD
2016-03-04	Back-up battery systemchanged over. Vector data loss 064-23:39:28 to 23:47:08 Scalar data loss 064-23:39:19 to 065-00:01:00 New battery box s/n 20140716 (Ctek charger) Increase in noise on data possibly associated with new battery box charger.
2016-03-07	Spike.cfg scalar filter 2 applied.
2016-03-07	22:03 New battery box disconnected from mains power to test noise 22:28 Battery box re-connected to mains power 22:03:44
2016-03-09	Computer shutdown at 00:54:29. Old battery box swapped back in. System restarts at 01:16:24 when power is restored. Need to exclude to 01:19:24 due to ramp up as seen in FV-Fs.
2016-05-13	Observer reports problem with setting time on Getac. Re-try later with success but timing was -9.785s out. Obs process correctly.
2016-05-19	CAT entering paddock to conduct weed spraying.
2016-05-23	Nearby 6.1 quake 20-May ~18:14:50-~18:30.
2016-06-05	Earthquake, Banda sea 16:29:43-16:37:12
2016-06-17	Mains power outage at 00:19:37 step in data Thunder storms and rain ~12:25:20UT variometer PPM stops delivering data
2016-06-20	~07UT Local observer cycles power to variometer GSM90 and data converters. No improvement, output from GSM90 remains garbled. Confirms

```
             land-line telephone has failed.
2016-07-26  Variometer PPM replaced with
            GSM90 8092901/83383. Restarts at 02:00:11.
2016-07-27  Scalar variometer vault re-buried. PM local
            time.
2016-08-04  GPS clock relocated from air conditioner to
            wall by GA Mechanical engineers.
2016-08-05  Call Telstra and report damaged phone line.
            Repair organised for 2016-08-09
            8am - 12pm local time with observer in
            attendance.
2016-08-08  New variometer battery box, Getac battery and
            absolute battery - Getac charger cable shipped
            to observer.
2016-08-09  Site visit by Telstra to repair phone line.
            Observer attends site but Telstra fails to
            arrive, too busy. Re-scheduled to 2016-08-11.
2016-08-11  Computer shutdown remotely so that the observer
            can replace the variometer battery box
            03:25:29-03:33:10. Observer is also
            attending site for Telstra technician.
            Telstra fail to attend site again.
2016-08-15  Telstra fail to attend again.
2016-08-16  Telstra rings observer and organises to attend
            today. Phone is fixed, they have booked in for
            2016-08-22 to look at second line.
2016-08-18  Earthquake ~04:38 off coast near Bowen.
2016-08-21  Some single point spikes, watch for others in
            coming days.
2016-08-24  Telstra technician visits, confirms only one
            phone line int observatory and sets the number
            to 8955 5447.
2016-08-26  Air-Con serviced by TDC today.
            Observer confirms landline telephone number is
            8955 5447.
2016-09-02  No obs for 3 weeks while observer away on
            leave. Observer will be visiting Canberra.
2016-09-20  Observer visits GA, has site visit to CNB for
            training.
2016-10-08  No observations for 2 weeks while observer
            is away in the field.
2016-11-06  Possible power outage. Earthquake at Halls Cr
            Approx. 09:57:39 to 09:59:36
2016-11-07  Possible power outage.
2016-11-10  Possible power outage.
2016-11-13  Possible power outage.
            NZ Earthquake 7.9M 11:22:25-11:40:33UTC
2016-12-16  CAT weed-spraying in grounds
2016-12-21  00:21 - 00:32:00 Mag6.9 quake in Banda Sea
2016-12-26  05:06 (approx.) data telemetry stops.
            NextG problem

Data Losses for 2016
--------------------
Date           Interval     Data loss
               (hh:mm)     (minutes)
Vector data
2016-01-09    XYZ     07:39 - 10:07  (149)
2016-01-30    XYZ     10:14 - 10:14  (1)
2016-01-30    XYZ     12:11 - 12:11  (1)
2016-02-14    XYZ     21:11 - 21:12  (2)
```

2016-02-14	XYZ	22:13 - 22:14	(2)
2016-03-04	XYZ	23:40 - 23:56	(17)
2016-03-05	XYZ	00:04 - 00:08	(5)
2016-03-07	XYZ	22:04 - 22:06	(3)
2016-03-07	XYZ	22:29 - 22:30	(2)
2016-03-08	XYZ	00:19 - 00:21	(3)
2016-03-09	XYZ	00:55 - 01:29	(35)
2016-04-01	XYZ	02:37 - 02:38	(2)
2016-04-01	XYZ	02:40 - 02:40	(1)
2016-04-01	XYZ	02:43 - 02:43	(1)
2016-05-13	XYZ	00:49 - 00:49	(1)
2016-05-20	XYZ	18:15 - 18:21	(7)
2016-06-05	XYZ	16:30 - 16:37	(8)
2016-06-17	XYZ	08:23 - 08:23	(1)
2016-06-17	XYZ	12:18 - 12:18	(1)
2016-06-17	XYZ	12:27 - 12:28	(2)
2016-07-26	XYZ	00:33 - 00:33	(1)
2016-07-26	XYZ	23:14 - 23:14	(1)
2016-07-28	XYZ	01:36 - 01:37	(2)
2016-07-28	XYZ	01:45 - 01:49	(5)
2016-07-28	XYZ	02:49 - 02:49	(1)
2016-08-11	XYZ	03:26 - 03:44	(19)
2016-08-18	XYZ	04:37 - 04:41	(5)
2016-10-04	XYZ	23:16 - 23:19	(4)
2016-10-05	XYZ	00:15 - 00:30	(16)
2016-10-05	XYZ	12:05 - 12:05	(1)
2016-10-14	XYZ	21:24 - 21:24	(1)
2016-11-06	XYZ	09:58 - 09:59	(2)
2016-11-13	XYZ	20:13 - 20:13	(1)
2016-11-17	XYZ	02:08 - 02:08	(1)
2016-11-17	XYZ	02:34 - 02:34	(1)
2016-11-20	XYZ	22:42 - 22:42	(1)
2016-11-28	XYZ	21:21 - 21:21	(1)
2016-12-05	XYZ	01:20 - 01:25	(6)
2016-12-07	XYZ	23:17 - 23:17	(1)
2016-12-08	XYZ	17:52 - 18:06	(15)
2016-12-20	XYZ	21:46 - 22:08	(23)
2016-12-21	XYZ	00:21 - 00:32	(12)
2016-12-21	XYZ	22:58 - 23:23	(26)

Total: 390 (0.27 days)

Date		Interval (hh:mm)	Data loss (minutes)
Scalar data			
2016-01-09	F	07:39 - 08:35	(57)
2016-01-30	F	05:04 - 08:50	(227)
2016-02-03	F	17:08 - 17:09	(2)
2016-02-16	F	12:09 - 12:09	(1)
2016-03-04	F	23:40 -	
2016-03-05	F	- 00:00	(21)
2016-03-09	F	00:55 - 01:29	(35)
2016-05-20	F	18:16 - 18:20	(5)
2016-06-05	F	16:30 - 16:37	(8)
2016-06-17	F	12:18 - 12:19	(2)
2016-06-17	F	12:26 -	
2016-07-26	F	- 07:43	(55878)
2016-07-27	F	03:50 - 14:32	(643)
2016-07-28	F	01:38 - 02:50	(73)
2016-08-11	F	03:26 - 03:44	(19)
2016-10-04	F	23:16 - 23:19	(4)

```
2016-10-05    F      00:15 - 00:30    (16)
2016-10-05    F      12:05 - 12:05     (1)

Total: 56992 (39.6 days)
Parameters

Annual Mean Values
------------------
The annual mean values for Alice Springs are available in
the file "yearmean.asp" and graphically through the
IMCDView software.

Hourly Mean Values
------------------
Plots of hourly mean values for Alice Springs are available
through the IMCDView software.

                             < END >
```

7.5.2 Baseline values

7.5.2.1 2013

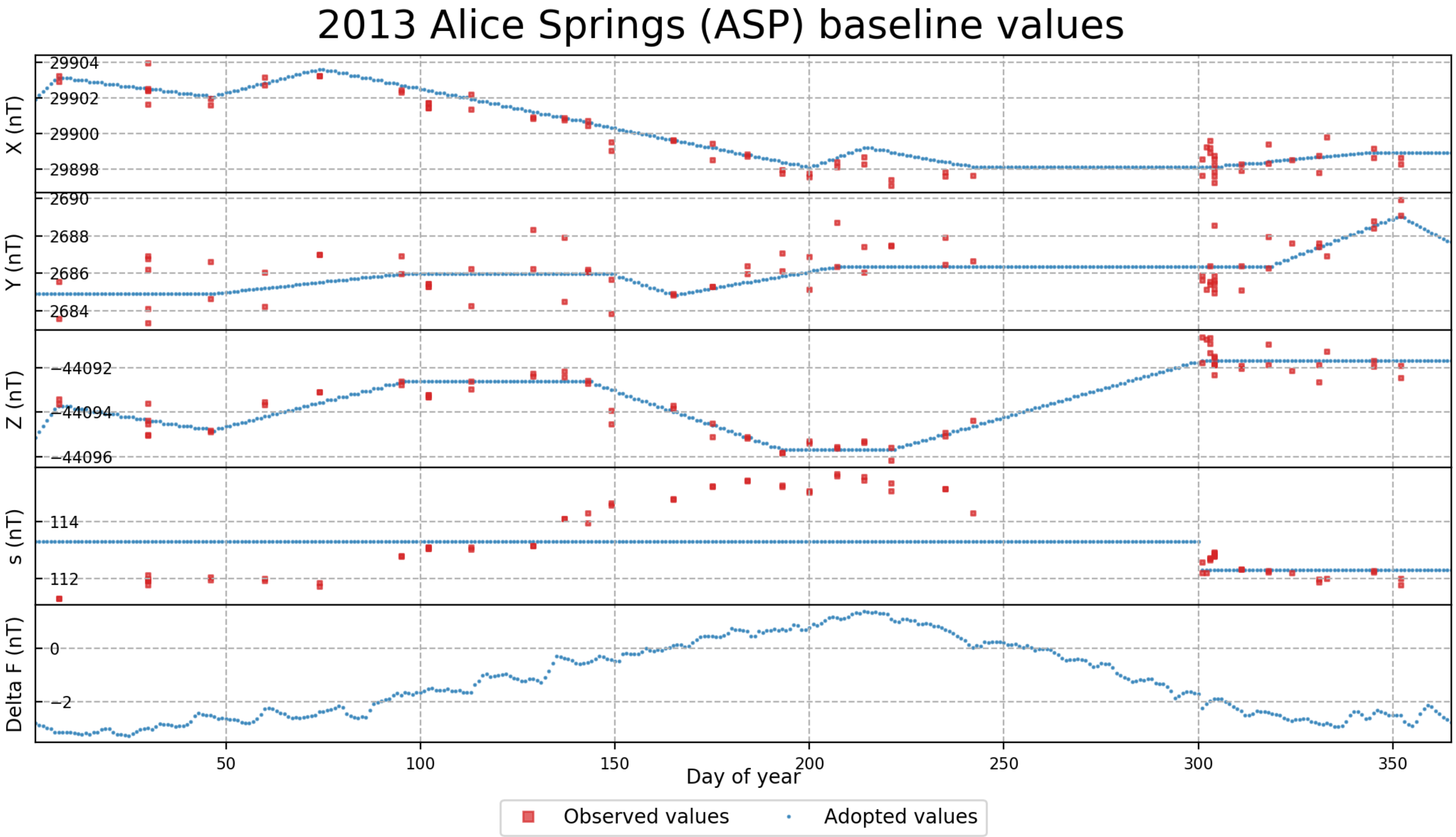

Figure 7.25 Alice Springs (ASP) baseline values for 2013. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.5.2.2 2014

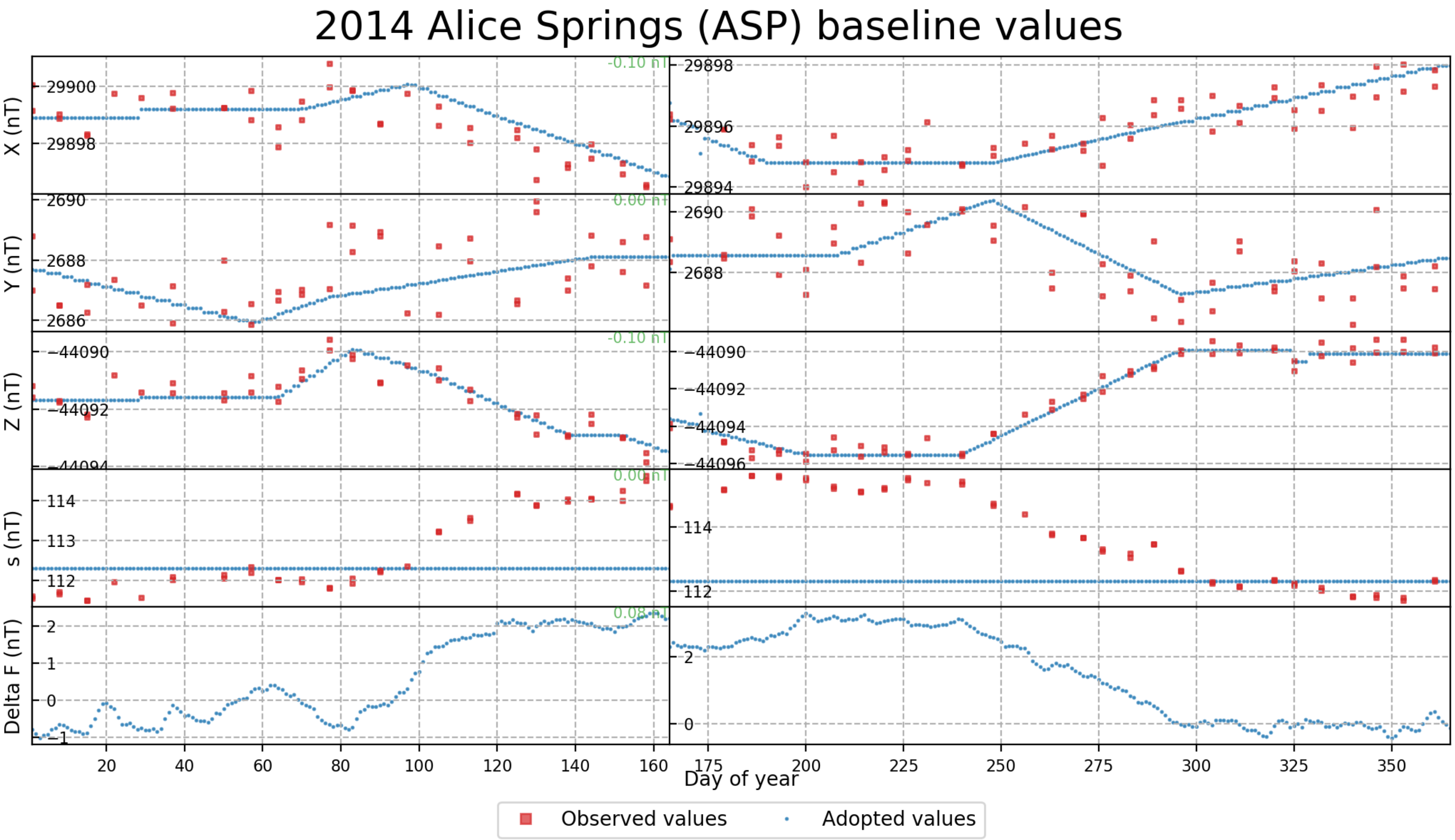

Figure 7.26 Alice Springs (ASP) baseline values for 2014. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.5.2.3 2015

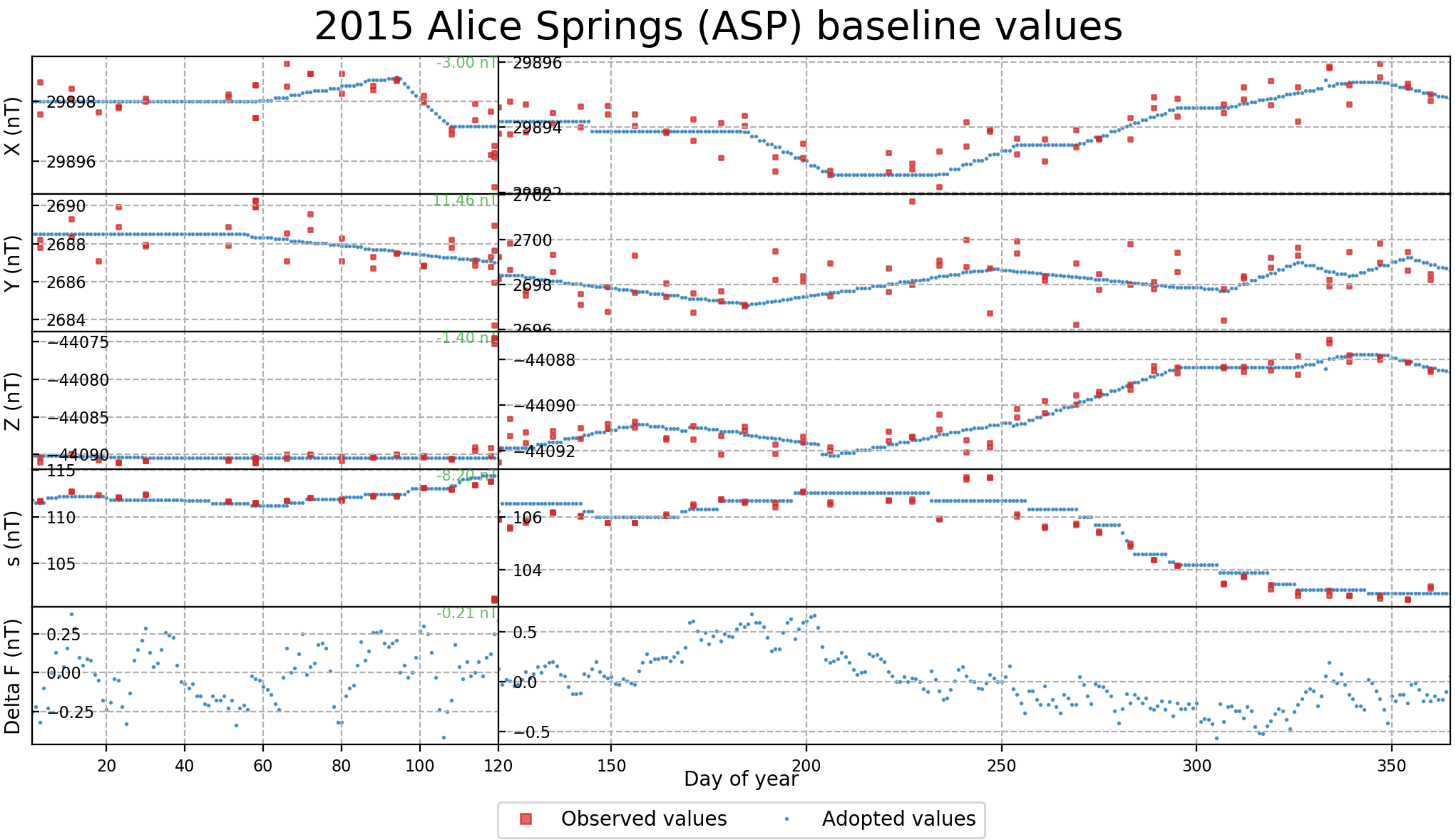

Figure 7.27 Alice Springs (ASP) baseline values for 2015. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.5.2.4 2016

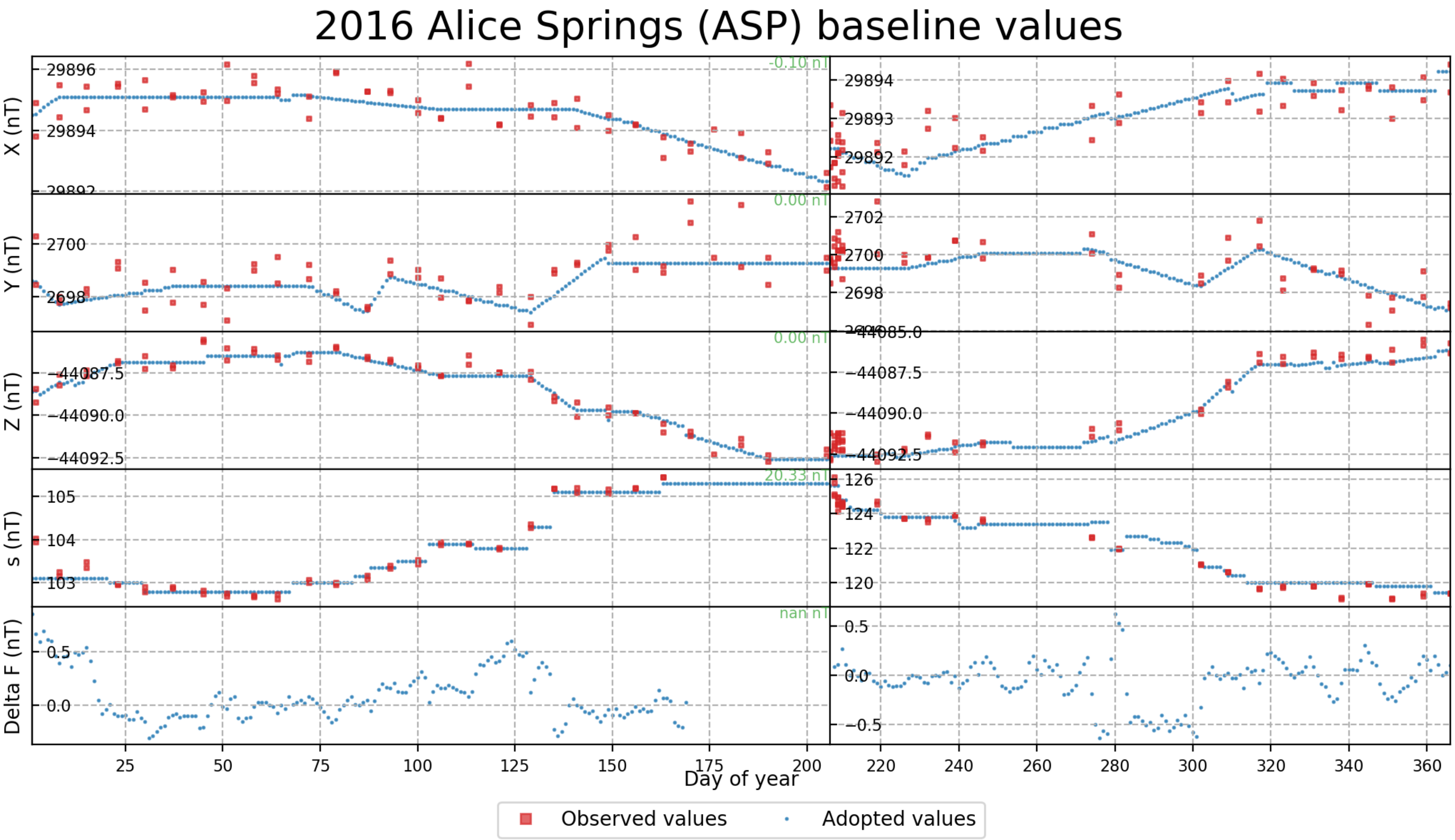

Figure 7.28 Alice Springs (ASP) baseline values for 2016. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.5.3 Annual mean values

7.5.3.1 DIH

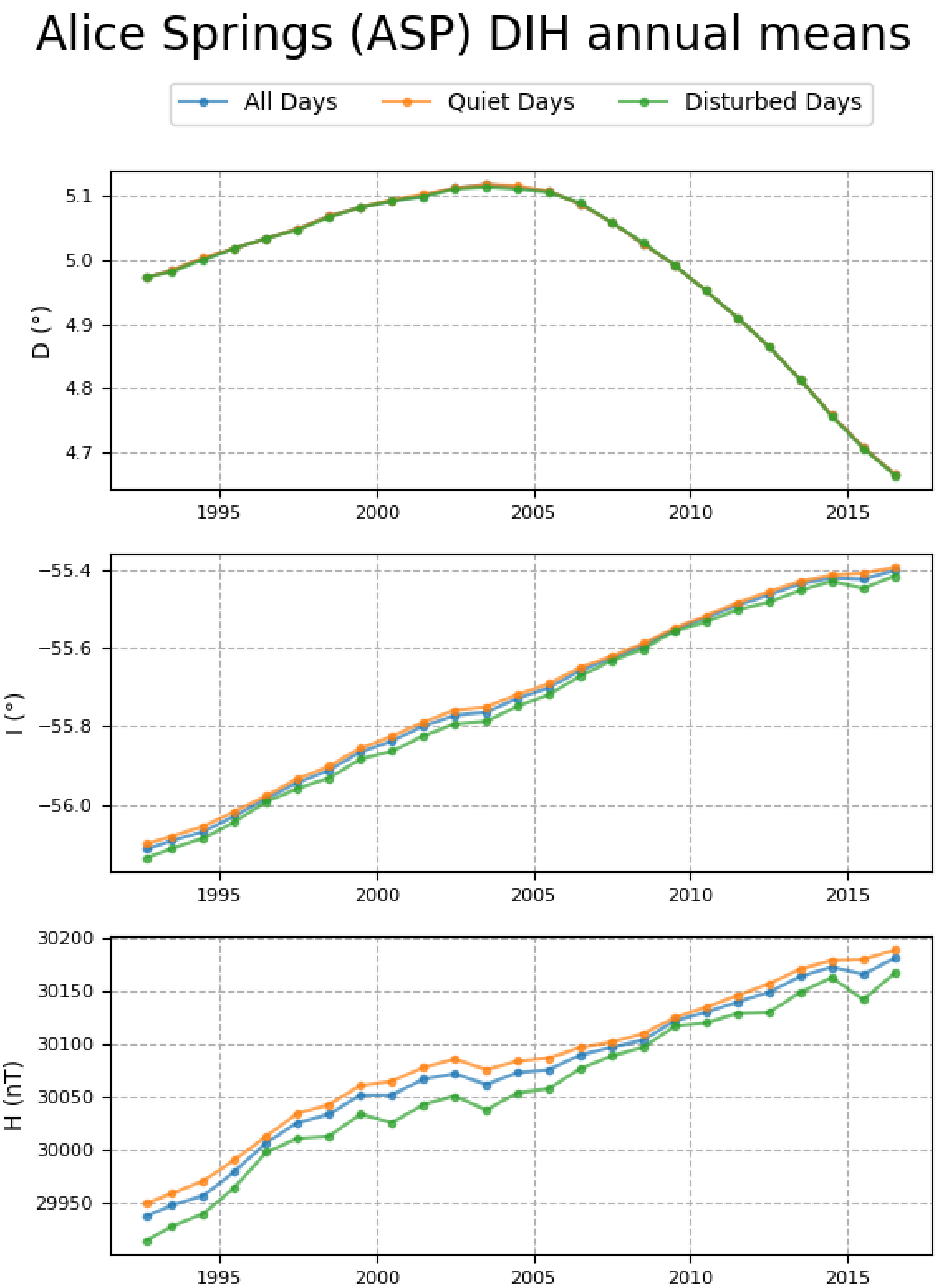

Figure 7.29 Alice Springs (ASP) annual mean values in DIH until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.5.3.2 XYZF

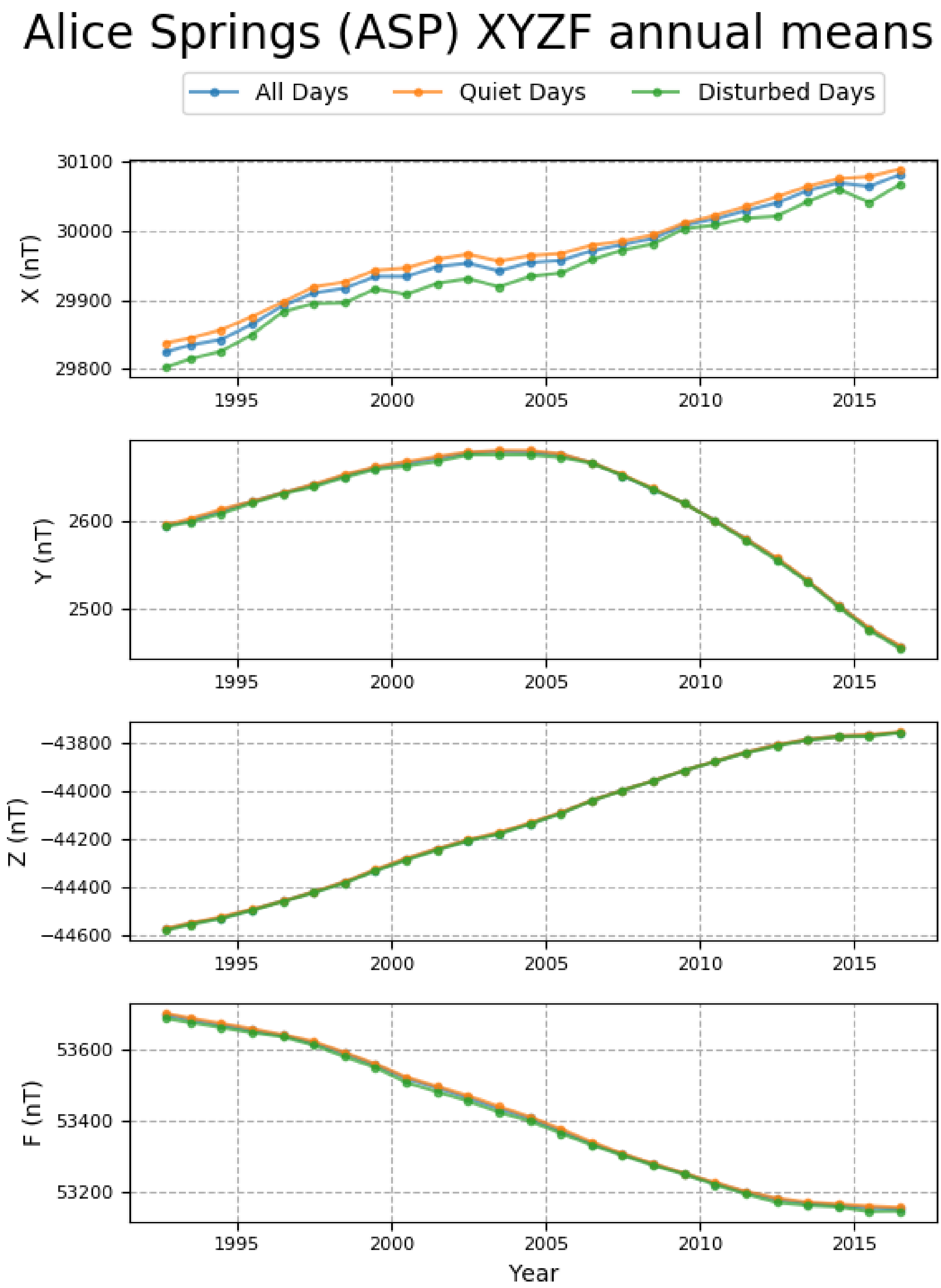

Figure 7.30 Alice Springs (ASP) annual mean values in XYZF until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.5.3.3 2016 INTERMAGNET annual mean values file

```
                      ANNUAL MEAN VALUES

                  ALICE SPRINGS, ASP, AUSTRALIA

COLATITUDE: 113.76    LONGITUDE: 133.88 E    ELEVATION: 557 metres

  YEAR       D         I          H       X       Y       Z       F    * ELE Note
          Deg Min   Deg Min       nT      nT      nT      nT      nT

1992.700 004 58.4 -56 06.8  29938  29825   2595 -44575  53695 A  XYZ   1
1993.500 004 59.0 -56 05.5  29948  29835   2601 -44552  53682 A  XYZ
1994.500 005 00.1 -56 04.1  29957  29843   2612 -44528  53667 A  XYZ
1995.500 005 01.1 -56 01.7  29980  29865   2623 -44494  53652 A  XYZ
1996.500 005 02.0 -55 59.0  30007  29892   2633 -44458  53638 A  XYZ
1997.500 005 02.9 -55 56.6  30026  29910   2642 -44421  53617 A  XYZ
1998.500 005 04.1 -55 54.7  30034  29917   2653 -44379  53587 A  XYZ
1999.500 005 04.9 -55 51.9  30052  29934   2662 -44329  53555 A  XYZ
2000.500 005 05.5 -55 50.2  30052  29934   2667 -44282  53517 A  XYZ
2001.500 005 06.0 -55 47.9  30067  29948   2673 -44241  53491 A  XYZ
2002.500 005 06.7 -55 46.3  30072  29953   2679 -44203  53463 A  XYZ
2003.500 005 07.0 -55 45.8  30062  29942   2681 -44175  53433 A  XYZ
2004.500 005 06.8 -55 43.7  30073  29954   2680 -44134  53406 A  XYZ
2005.500 005 06.4 -55 42.0  30076  29957   2677 -44090  53371 A  ABZ   2
2006.500 005 05.2 -55 39.4  30090  29971   2668 -44038  53336 A  ABZ
2007.500 005 03.5 -55 37.5  30097  29980   2653 -43995  53305 A  ABZ
2008.500 005 01.5 -55 35.6  30104  29989   2637 -43956  53277 A  ABZ
2009.500 004 59.5 -55 33.1  30122  30008   2621 -43913  53251 A  ABZ
2010.500 004 57.1 -55 31.3  30130  30017   2601 -43875  53224 A  ABZ
2011.500 004 54.6 -55 29.4  30140  30029   2580 -43837  53199 A  ABZ
2012.500 004 51.9 -55 27.8  30149  30040   2557 -43806  53179 A  ABZ
2013.500 004 48.8 -55 26.1  30164  30058   2531 -43783  53168 A  ABZ
2014.500 004 45.5 -55 25.2  30173  30069   2503 -43770  53162 A  ABZ
2015.500 004 42.5 -55 25.4  30166  30064   2476 -43766  53155 A  ABZ
2016.500 004 40.0 -55 24.1  30181  30081   2455 -43753  53152 A  ABZ

1992.700 004 58.4 -56 06.0  29950  29838   2596 -44572  53700 Q  XYZ   1
1993.500 004 59.0 -56 04.8  29959  29845   2603 -44550  53686 Q  XYZ
1994.500 005 00.2 -56 03.3  29971  29857   2614 -44524  53672 Q  XYZ
1995.500 005 01.1 -56 01.0  29991  29876   2623 -44492  53656 Q  XYZ
1996.500 005 02.0 -55 58.6  30013  29897   2633 -44458  53640 Q  XYZ
1997.500 005 02.9 -55 56.0  30035  29919   2643 -44419  53621 Q  XYZ
1998.500 005 04.1 -55 54.1  30043  29926   2654 -44377  53590 Q  XYZ
1999.500 005 04.9 -55 51.3  30061  29943   2663 -44326  53558 Q  XYZ
2000.500 005 05.6 -55 49.5  30065  29946   2669 -44279  53521 Q  XYZ
2001.500 005 06.1 -55 47.3  30078  29959   2675 -44239  53495 Q  XYZ
2002.500 005 06.7 -55 45.5  30086  29966   2680 -44201  53469 Q  XYZ
2003.500 005 07.0 -55 45.0  30076  29956   2682 -44171  53439 Q  XYZ
2004.500 005 06.9 -55 43.1  30084  29964   2682 -44131  53410 Q  XYZ
2005.500 005 06.4 -55 41.4  30087  29967   2678 -44088  53376 Q  ABZ   2
2006.500 005 05.2 -55 38.9  30097  29979   2668 -44037  53340 Q  ABZ
2007.500 005 03.5 -55 37.2  30102  29985   2654 -43995  53307 Q  ABZ
2008.500 005 01.5 -55 35.3  30110  29994   2638 -43955  53279 Q  ABZ
2009.500 004 59.5 -55 32.9  30125  30011   2621 -43912  53252 Q  ABZ
2010.500 004 57.1 -55 31.0  30135  30022   2601 -43874  53226 Q  ABZ
2011.500 004 54.6 -55 29.0  30146  30035   2580 -43836  53201 Q  ABZ
2012.500 004 51.9 -55 27.3  30157  30049   2558 -43805  53182 Q  ABZ
2013.500 004 48.8 -55 25.7  30171  30064   2532 -43782  53171 Q  ABZ
2014.500 004 45.5 -55 24.8  30179  30075   2503 -43769  53165 Q  ABZ
2015.500 004 42.5 -55 24.5  30180  30078   2477 -43763  53160 Q  ABZ
```

2016.500	004 40.0	-55 23.6	30189	30089	2456	-43751	53156	Q	ABZ	
1992.700	004 58.4	-56 08.1	29915	29803	2594	-44579	53686	D	XYZ	1
1993.500	004 58.9	-56 06.7	29928	29815	2599	-44556	53674	D	XYZ	
1994.500	005 00.0	-56 05.1	29940	29826	2609	-44531	53660	D	XYZ	
1995.500	005 01.1	-56 02.6	29965	29850	2621	-44497	53646	D	XYZ	
1996.500	005 02.0	-55 59.5	29998	29883	2632	-44460	53634	D	XYZ	
1997.500	005 02.8	-55 57.5	30011	29895	2640	-44423	53611	D	XYZ	
1998.500	005 04.0	-55 55.9	30013	29896	2651	-44383	53578	D	XYZ	
1999.500	005 04.9	-55 53.0	30034	29916	2660	-44332	53548	D	XYZ	
2000.500	005 05.5	-55 51.8	30026	29908	2664	-44287	53506	D	XYZ	
2001.500	005 05.9	-55 49.4	30043	29924	2669	-44245	53480	D	XYZ	
2002.500	005 06.6	-55 47.6	30051	29931	2677	-44207	53454	D	XYZ	
2003.500	005 06.8	-55 47.2	30038	29919	2677	-44178	53423	D	XYZ	
2004.500	005 06.6	-55 44.9	30054	29934	2677	-44137	53398	D	XYZ	
2005.500	005 06.3	-55 43.1	30058	29939	2674	-44093	53364	D	ABZ	2
2006.500	005 05.3	-55 40.2	30077	29958	2667	-44040	53331	D	ABZ	
2007.500	005 03.5	-55 37.9	30089	29972	2653	-43997	53302	D	ABZ	
2008.500	005 01.6	-55 36.1	30097	29981	2637	-43957	53274	D	ABZ	
2009.500	004 59.5	-55 33.4	30117	30003	2621	-43913	53249	D	ABZ	
2010.500	004 57.1	-55 31.9	30120	30008	2600	-43876	53220	D	ABZ	
2011.500	004 54.6	-55 30.1	30129	30018	2578	-43840	53194	D	ABZ	
2012.500	004 51.9	-55 28.9	30130	30021	2555	-43810	53170	D	ABZ	
2013.500	004 48.8	-55 27.1	30149	30042	2530	-43786	53162	D	ABZ	
2014.500	004 45.4	-55 25.7	30163	30060	2501	-43772	53158	D	ABZ	
2015.500	004 42.4	-55 26.8	30142	30041	2474	-43770	53145	D	ABZ	
2016.500	004 39.9	-55 24.9	30167	30067	2453	-43754	53146	D	ABZ	

* A = All days
* Q = 5 International Quiet days each month
* D = 5 International Disturbed days each month

ELE = Elements recorded

Notes:

1. The observatory commenced operation on 1 June 1992
   Hence no data from 01 Jan 1992 to 31 May 1992

2. A new variometer was installed on 14 Sep 2005 that
   was aligned in the magnetic-NW, magnetic-NE and
   vertical orientations.

7.6 Gingin

7.6.1 INTERMAGNET 'readme' files

7.6.1.1 2013

```
                           GNG
          GINGIN OBSERVATORY INFORMATION 2013


ACKNOWLEDGE-  Users of the GNG data should acknowledge:
      -MENTS: Geoscience Australia

  STATION ID: GNG
    LOCATION: GINGIN, Western Australia
              Australia
ORGANISATION: Geoscience Australia

 COLATITUDE: 121 21'23"
  LONGITUDE: 115 42'55"E
  ELEVATION: Above mean sea level (top pier A):50 m

    ABSOLUTE
 INSTRUMENTS: DI-fluxgate magnetometer (DIM)
              DIM DI0037 Theodolite 390444
              GSM90 Overhauser-effect magnetometer
              S/N GSM90_3091317  with sensor 91457
   RECORDING
  VARIOMETER: Suspended DMI fluxgate magnetometer
              GSM90 Proton precession magnetometer.

 ORIENTATION: Magnetic NW, NE and Vertical (ABZ)
     DYNAMIC
       RANGE: +/- 1,600 nT
  RESOLUTION:    0.032 nT
    SAMPLING
        RATE: 1 second
 FILTER TYPE: Intermagnet

   K-NUMBERS: Computer assisted hand scaling
    K9-LIMIT: 430 nT

        GINS: Edinburgh
   SATELLITE: via HTTP

   OBSERVERS: S. Pryde, C. Lord
              A.M. Lewis, W.V. Jones, P. Jamieson

     CONTACT: Geomagnetism
              Geoscience Australia
              G.P.O. Box 378
              Canberra,  A.C.T.,  2601
              Australia

              Tel: + 61-2-6249-9111
              Fax: + 61-2-6249-9986
              e-mail: geomag@ga.gov.au
              WWW: http://www.ga.gov.au/
```

NOTES:
GINGIN

Gingin magnetic observatory is located in southwest Western Australia approximately 100 km north of the city of Perth, 20 km west of the town of Gingin. The Gingin observatory was established to replace the Gnangara observatory which closed in 2013. The Gingin observatory site was chosen after an extensive search of the areas surrounding Perth. Both Gnangara and Gingin observatories were run in parallel from 2011-11 and throughout 2012.

The Gingin site is located adjacent to the Australian International Gravitational Observatory (AIGO) and the Gingin Gravity Discovery Centre on well drained sand with magnetic gradients of less than 1 nT/m.
The Gingin observatory consists of:

a Variometer Vault covered with local sand, housing the recording equipment, fluxgate variometer sensor and electronics, total-field variometer sensor and electronics, and GPS clock;

an Absolute House approximately 70 m northwest of the vault;

an external tripod reference station approximately 70 m north of the Absolute House, and;

an azimuth reference mark approximately 90 m south of the Absolute House.

Construction of the observatory took place during 2008. The vault and hut are built from re-constituted limestone blocks. The T shaped variometer vault was covered with local sand to enhance thermal stability. The absolute pier was constructed from a fibreglass tube with a marble top.

Variometer instrumentation was installed in October 2009. During installation magnetic contamination was discovered in both the Absolute House and Variometer Vault. The contamination was later found to be largely due to magnetic bolts used during construction to fix wooden framework to the masonry. Other sources of contamination existed in security doors, door and window locks, weather strips and light fittings. Over the following two years the Absolute House was de-contaminated. Magnetic contamination remains in the Variometer Vault. Routine weekly absolute observations commenced in the magnetically clean Absolute House in 2011-11 and fully calibrated observatory data commenced on 2011-11-16.

Key data for the observatory are summarised in Table 1

IAGA code	: GNG
Commenced operation	: November 2011
Geographic latitude	: 31d 21' 23" S
Geographic longitude	: 115d 42' 55" E
Geomagnetic latitude	: -41.06d

Geomagnetic longitude	: 189.01d
K 9 index lower limit	: 430 nT
Principal pier	: Pier A
Pier elevation (top)	: 50 m MSL
Principal reference mark	: Pillar S
Reference mark azimuth	: 186d 38' 32"
Reference mark distance	: 90 m
Observer	: S. Pryde, C. Lord A.M. Lewis, W.V. Jones P. Jamieson.

Table 1 Key observatory data.
Geographic coordinates are derived using the World Geodetic system 1984 (WGS84)

Local meteorological conditions

The meteorological temperature at the nearby Gingin airfield during 2013 varied from a minimum -1.4C (2013-07-08) to a maximum +42.0C (2013-12-14). Daily minimum temperatures varied from -1.4C to +26.6C (average 11.8 +/-6C); daily maximum temperatures varied from 14.6C to 42.0C (average 26.0 +/-7C); daily temperature ranges varied from 2C to 28C (average 14.2 +/-5C).

VARIOMETERS

The variometers used during 2013 are summarised in Table 2.
The principal variometer at the Gingin observatory is a DMI FGE suspended 3-component fluxgate magnetometer. The fluxgate sensor was installed on a plinth in the western arm of the T-shaped Variometer Vault. The fluxgate sensors are orientated magnetic-NW, magnetic-NE, and vertical. An Overhauser total-field magnetometer installed in the eastern arm of the vault monitors variations in the magnetic total intensity.

The variometer was powered by a 12 V 18Ah battery with mains trickle charger, under/over voltage cut-off protection, mains power filters and voltage regulators to deliver a constant 12 V to both the vector and scalar magnetometers.

Variometer data are retrieved via a TCP/IP network connection through a NextG mobile telephone modem. The acquisition system timing is synchronised using a GPS clock.

There is no active temperature control in the Variometer Vault, but the vault is well insulated with foam inside and local sand outside. This insulation suppressed diurnal temperature variations but an annual temperature range of 15C was measured inside the vault.

3-component variometer	: DMI FGE (Version G)
Serial number	: E0383/S0319
Type	: suspended; linear fluxgate
Orientation	: magnetic NW, NE, Z

```
Acquisition interval      : 1 s
Resolution                : 0.032 nT
A/D converter             : ADAM 4017 module (±5V)
Total-field variometer    : GEM Systems GSM 90
Serial number             : GSM90_708729/21889
Type                      : Overhauser effect
Acquisition interval      : 10 s
Resolution                : 0.01 nT
Data acquisition system   : GDAP
                          : PC-104 computer, QNX OS
Timing                    : Garmin GPS16-HVS GPS clock
Communications            : HSPA Mobile telephone TCP/IP
                            network
```

Table 2 Magnetic variometers.

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During the first 3 months of 2013, the timing control system performed poorly, with many corrections of about 1 second in magnitude, until the faulty GPS clock was replaced in 2013-04. Adjustments to the system clock which were greater than 1 ms are listed below.

2013-02-04	19:41:09	0.003 s
2013-02-05	19:39:50	0.001 s
2013-02-06	11:26:27	0.002 s
	12:51:15	0.002 s
	15:16:35	0.001 s
	19:48:34	0.006 s
	21:05:56	0.001 s
	21:21:52	1.000 s
2013-02-08	09:58:44	0.002 s
	11:19:22	0.002 s
	12:43:29	0.003 s
	12:49:04	-1.000 s
	12:56:47	1.000 s
	14:42:36	-1.000 s
	15:13:30	1.002 s
	17:21:37	-1.000 s
	19:43:10	1.001 s
	20:40:37	-1.000 s
	20:58:08	1.000 s
2013-02-09	03:24:53	-0.999 s
	03:44:31	1.000 s
	08:31:07	-1.000 s
	09:02:47	1.001 s
	09:20:21	-1.000 s
	10:03:58	1.001 s
	10:37:46	-0.999 s
	11:20:42	1.000 s
	11:51:43	-1.000 s
	13:32:26	1.000 s
	14:30:50	-0.998 s
	15:14:28	1.001 s
	15:19:25	-1.000 s
	15:48:16	1.001 s

	17:16:14	-0.999 s	
	19:44:04	1.000 s	
	20:23:26	-1.000 s	
	21:33:06	0.002 s	
	22:03:22	1.001 s	
	22:54:41	-0.999 s	
	23:10:53	1.000 s	
2013-02-10	00:05:00	0.001 s	
	01:28:01	-0.999 s	
	01:58:17	1.001 s	
	02:26:25	0.001 s	
	03:14:09	-0.999 s	
	03:59:55	1.001 s	
	05:39:33	-0.999 s	
	05:47:17	1.000 s	
	08:20:37	-1.001 s	
	15:57:57	0.999 s	
	16:59:32	-1.000 s	
	19:50:23	1.000 s	
	20:10:01	-1.000 s	
	22:18:12	1.000 s	
	22:46:13	-0.999 s	
	23:28:17	1.001 s	
	23:45:49	-0.999 s	
2013-02-11	00:04:44	1.000 s	
	00:08:14	-1.000 s	
	00:10:21	1.000 s	
	00:59:23	-1.000 s	
	03:02:04	-0.002 s	
	04:28:17	0.998 s	
	05:18:42	-1.000 s	
	06:42:51	0.997 s	
	08:09:41	-1.000 s	
	16:16:47	0.999 s	
	16:50:27	-1.000 s	
2013-02-12	00:10:03	1.000 s	
	00:30:25	-1.000 s	
	04:37:28	0.999 s	
	05:14:45	-1.000 s	
	06:49:04	0.999 s	
	08:00:48	-1.000 s	
	16:17:00	1.000 s	
	16:46:28	-1.001 s	
2013-02-13	00:26:29	-0.001 s	
	04:30:49	1.000 s	
	05:08:00	-1.001 s	
	06:45:20	1.000 s	
	07:56:08	-1.001 s	
	16:42:41	-0.002 s	
2013-02-14	00:21:26	-0.001 s	
	05:01:46	-0.002 s	
	06:48:03	1.000 s	
	07:43:38	-1.002 s	
2013-04-05	04:03:17	0.002 s	change acq. PC and GPS
	04:08:36	0.001 s	
	04:15:33	0.002 s	
2013-08-28	03:19:41	0.725 s	
2013-08-30	03:39:15	-3.631 s	system reboot

ABSOLUTE INSTRUMENTS

The variometers at GNG were calibrated nominally weekly with a pair of absolute observations. Both absolute PPM and DIM observations were performed on Pier A in the Absolute House. Table 3 lists the absolute instruments used at Gingin in 2013.

On 2013-04-05 a Getac tablet computer was introduced into the absolute routine to record data and provide timing control, replacing a stop watch, HP PDA, pencil and paper recording. On 2013-08-19 the DMI fluxgate was upgraded so analogue output could be digitised with an external analogue to digital converter (Pico ADC16 digitizer S/N GJY03/108) and interfaced to the Getac tablet computer for automatic recording of fluxgate offsets. The first observation using this digital fluxgate offset data was performed on 2013-08-27.

Absolute instrument corrections applied in 2013 were determined through instrument comparisons performed during maintenance and calibration visits at Gingin. No instrument comparisons were performed in 2013. The most recent instrument comparisons were made in 2012-08. The adopted corrections applied to the absolute magnetometers to correct them to the international standard as measured at IAGA workshops through the Australian reference instruments held in Canberra are described in Table 3.

At the 2013 mean magnetic field values at Gingin of X= 23868 nT, Y= -685 nT, Z= -52735 nT, the D, I and F corrections translate to corrections of:
dX = -2.3 nT   dY = -0.3 nT   dZ = -1.0 nT
These corrections have been applied to all Gingin 2013 final data.

DI fluxgate	: DMI
Serial number	: DI0037
Theodolite	: Zeiss 020B
Serial number	: 390444
Resolution	: 0.1
D correction	: -0.05
I correction	: -0.15
Total-field magnetometer	: GEM Systems GSM 90
Serial number	: GSM90_3091317/91457
Type	: Overhauser effect
Resolution	: 0.01 nT
Correction	: 0.0 nT

Table 3   Absolute magnetometers
---------- and their adopted corrections for 2013.
            Instrument corrections are applied in the
            sense Standard = Instrument + correction.

BASELINES

Derivation of final baseline values for the fluxgate variometer was done by fitting a piece-wise linear spline (including steps where required) to the weekly observed absolute observations baseline residuals. The fluxgate variometer suffered from short-term baseline instabilities during 2013. There were multiple baseline instabilities over the period 2013-04-23 to

2013-04-25 affecting the A (X) channel every 10 minutes or so and lasting from 20s to 1 minute. Affected data were removed resulting in short periods of data loss over that period. Numerous sub nanoTesla symmetric positive and negative baseline steps lasting up to several hours are also present in the data. These have not been fixed or removed from the definitive data.

Throughout 2013 the overall baseline drifts had a range of about 5 nT in X and Z and about 8 nT in the Y component. The standard deviations in the difference between the weekly absolute observations and the final adopted vector variometer model and data were:

X	0.9 nT
Y	1.2 nT
Z	0.5 nT
D	10"
I	03"
F	0.3 nT

Throughout 2013 the difference between the daily average of total field measured with the vector variometer with final baseline parameters applied and the scalar variometer varied over a range of about 1.5 nT.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2013 GNG definitive data and real time reported 1-minute data sets (GNG definitive - GNG reported) were:

	X	Y	Z
Average	+0.6	+1.1	+0.4
Std.dev	+1.0	+2.3	+0.5
Min	-0.9	-2.2	-0.4
Max	+2.1	+3.7	+1.2

The GNG 2013 reported real time data are within the specification for INTERMAGNET quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.
The annual statistics of the 12 monthly averages of the difference between the 2013 GNG definitive data and quasi-definitive 1-minute data sets (GNG definitive - GNG quasi-definitive) were:

	X	Y	Z
Average	+0.5	+0.4	+0.1
Std.dev	+0.4	+0.6	+0.4
Min	-0.1	-0.6	-0.4
Max	+1.1	+2.0	+0.9

The GNG 2013 quasi-definitive data are within the specification for INTERMAGNET quasi-definitive data.

OPERATIONS

The local observer, Mr Stephen Pryde performed weekly absolute observations and checks throughout most of the year. Mr Chris Lord took over observer duties when Stephen was unavailable between July to October.

Two maintenance visits were made to the observatory during the year. In April the QNX6.3 acquisition computer was replaced with a QNX6.5 unit running an updated version of GDAP. The faulty GPS clock was also replaced at this time. In August the variometer and absolute power systems was serviced and the absolute observations routine upgraded.

Analogue outputs from the DMI FGE 3-channel fluxgate, as well as the fluxgate sensor and electronics temperature channels, were digitized with an ADAM 4017 A/D converter mounted inside the FGE electronics console. Data were recorded at 1 second intervals in the components A (NW), B (NE), C (Z). These digital data were recorded on an acquisition computer running the Geophysical Data Acquisition Platform (GDAP) software on the QNX operating system. The digital data from the GSM-90 variometer, cycling once every 10 seconds, were also recorded on the acquisition computer.

The variometer power system battery was replaced in August causing a short period of data loss.

The GSM-90 variometer failed for an extended period several times in 2013 causing significant periods of scalar data loss from January to March and also December.

The acquisition system timing control was provided by a Garmin GPS16 GPS clock. Prior to 2013-04-05 a faulty GPS clock caused a significant number of system timing corrections, including numerous corrections of 1 s followed a few minutes later by a matching correction reversing the previous one. These timing errors have not been corrected, resulting in a degradation of timing accuracy for the data before 2013-04-05. After the GPS clock was replaced on 2013-04-05 timing accuracy was improved. All timing corrections greater than 1 ms which have been applied to the system are listed above.

Data files were telemetered to Geoscience Australia in Canberra through an HSPA mobile telephone TCP/IP network. The data transfer delay time was between 2 and 15 minutes. The definitive and quasi-definitive datasets derived from one-second fluxgate and ten-second total field variometer data sets were run through a de-spiking filter. The vector raw data de-spiking parameters required a spike to exceed 15 counts and 6 times the average variability of neighbouring raw data. The scalar data de-spiking parameters required a spike to exceed 0.1 nT and 10 times the average variability of neighbouring data. Reported data were not spike filtered. Definitive one-minute averages were derived from definitive one-second data using the 90-second Intermagnet Gaussian filter for both the vector and interpolated scalar data.

Real-time and daily one-second and one-minute data were delivered to the Edinburgh Geomagnetic Information Node throughout the year. Additionally, data were provided to ISGI and World Data centre for Geomagnetism, Kyoto

University. Preliminary 1 minute data were also available on the GA web site (http://www.ga.gov.au).

The distribution of Gingin 2013 data is described in Table 4. Data losses are identified below.

Table 4. Distribution of Gingin 2013 data.

Recipient	Status	Sent
1-second values		
INTERMAGNET	reported	hourly
WDC, Kyoto	reported	realtime
IPS, Australia	reported	realtime
1-minute values		
INTERMAGNET	reported	realtime
INTERMAGNET	quasi-definitive	quarterly
INTERMAGNET	reported	daily
INTERMAGNET	definitive	August 2014
ISGI, France	reported	realtime
ISGI, France	reported	daily
WDC, Kyoto	reported	realtime
U Oulu, Finland	reported	hourly
K indices		
ISGI, France	reported	weekly
IPS, Australia	reported	weekly
Principal magnetic storms and rapid variations		
WDC Solar Terrest. Physics, NOAA		monthly
WDC Geomagnetism, Kyoto		monthly
Observatori de lEbre,Spain		monthly

SIGNIFICANT EVENTS 2013

2013-01-01	00:00 GNG officially replaced GNA Variometer PPM producing "B" quality readings intermittently periods of missing F data
2013-01-15	Change K9 limit from 450 to 430 on advice from ISGI. All K indices before 2013-01-13 must be re-scaled.
2013-01-25	All GNG K indices (scaled using K9 = 450) replaced in database with re-calculated indices (using K9 = 430)
2013-04-05	AML at GNG swapping computer to QNX6.5 and GPS clock with V3.80 firmware and 19200b Introduce Getac tablet and GObs for absolute data recording. First obs with Getac on 2013-04-05 AML, then first by SWP on 2013-04-06
2013-04-23	Steps in X (~1nT) roughly every 10 min lasting about 30 seconds - data discarded
2013-04-24	Steps in X still prevalent but becoming less frequent towards end of day.
2013-04-25	Steps in X cease after about 00:40
2013-07-22	First obs by Chris Lord
2013-08-19	Paul Jamieson at observatory for observations. DI0037 upgraded for analogue output to PICO ADC16 digitizer S/N GJY03/108 by Paul Jamieson

```
                 but not used
2013-08-27       AML at observatory. First obs with PICO
                 s/n GJY03/108 and upgraded GObs on Getac
2013-08-28       Replace absolute battery box batteries
                 Replace variometer battery box batteries
                 System powered off for battery change
                 2013-08-28 03:19:41 GPS Adj 725495951 nS
                 03:20 GdapClockGm failed
2013-08-30       03:37 slay GdapClockGm
                 03:38 /etc/rc.d/rc.clock
                 2013-08-30 03:39:15 GPS Adj -3631098806 nS
                 System now seems correct comparing pips
                 and Telstra 1194 times. Error as expected
                 given that normal rate is -10826 and rate
                 after system restart was 10098, and clock
                 program failed before system stabilised.
2013-09-01       WVJ at observatory for observations.
                 Mark (Gravity centre tech) advised that
                 hazard reduction burning will be occurring
                 soon.
                 Mag 6.4 quake origin 11:52:30, disturbance
                 on data 12:04
2013-09-27       First observation by Chris Lord using PICO
                 digital DIM output
2013-12-03       Variometer F readings starting to go bad
```

K indices

K indices for Gingin have been derived using a computer-assisted method developed at Geoscience Australia and based on the IAGA-accepted LRNS algorithm. K indices were scaled from reported time-series data. K indices have been scaled from GNG data since 2010-08-01 and provided to the International Service of Geomagnetic Indices (ISGI) since 2011-12-13 in preparation to swap from Gnangara to Gingin as a source of K indices for the global am index and its derivatives.
K indices were scaled using a K9 limit of 450 nT from 2010-08-01 until 2013-01-14. Preliminary GNG K-indices delivered weekly to ISGI between 2011-12-13 and 2013-01-14 were scaled using K9 = 450 nT. On 2013-01-15 the K9 limit for GNG was updated from 450 nT to the official value of 430 nT (supplied by ISGI). All GNG K indices from 2010-08-01 to 2013-01-14 were rescaled using K9=430 nT.
K indices from Gingin contribute to the global am index and its derivatives. K indices measured in 2013 are available on the 2013 Intermagnet DVD through the IMCDView software.

DATA LOSSES

Variometer data XYZ:

```
2013-04-05    XYZ     02:56 - 02:58  (3)
2013-04-06    XYZ     04:49 - 05:10  (22)
2013-04-23    XYZ     00:00 - 00:01  (2)
2013-04-23    XYZ     00:17 - 00:17  (1)
2013-04-23    XYZ     00:35 - 00:35  (1)
2013-04-23    XYZ     00:52 - 00:53  (2)
2013-04-23    XYZ     01:07 - 01:08  (2)
2013-04-23    XYZ     01:25 - 01:25  (1)
```

2013-04-23	XYZ	01:40 - 01:41	(2)
2013-04-23	XYZ	01:56 - 01:56	(1)
2013-04-23	XYZ	02:10 - 02:11	(2)
2013-04-23	XYZ	02:25 - 02:26	(2)
2013-04-23	XYZ	02:36 - 02:37	(2)
2013-04-23	XYZ	02:50 - 02:51	(2)
2013-04-23	XYZ	03:09 - 03:09	(1)
2013-04-23	XYZ	03:27 - 03:27	(1)
2013-04-23	XYZ	03:45 - 03:46	(2)
2013-04-23	XYZ	04:04 - 04:04	(1)
2013-04-23	XYZ	04:21 - 04:21	(1)
2013-04-23	XYZ	04:38 - 04:39	(2)
2013-04-23	XYZ	05:12 - 05:13	(2)
2013-04-23	XYZ	05:30 - 05:30	(1)
2013-04-23	XYZ	05:51 - 05:52	(2)
2013-04-23	XYZ	06:34 - 06:34	(1)
2013-04-23	XYZ	09:05 - 09:06	(2)
2013-04-23	XYZ	09:57 - 09:57	(1)
2013-04-23	XYZ	10:05 - 10:05	(1)
2013-04-23	XYZ	10:45 - 10:45	(1)
2013-04-23	XYZ	11:12 - 11:12	(1)
2013-04-23	XYZ	11:17 - 11:17	(1)
2013-04-23	XYZ	11:22 - 11:22	(1)
2013-04-23	XYZ	12:02 - 12:02	(1)
2013-04-23	XYZ	13:06 - 13:06	(1)
2013-04-23	XYZ	13:22 - 13:22	(1)
2013-04-23	XYZ	13:26 - 13:26	(1)
2013-04-23	XYZ	15:13 - 15:13	(1)
2013-04-23	XYZ	15:22 - 15:22	(1)
2013-04-23	XYZ	15:28 - 15:28	(1)
2013-04-23	XYZ	15:40 - 15:40	(1)
2013-04-23	XYZ	15:45 - 15:45	(1)
2013-04-23	XYZ	15:50 - 15:50	(1)
2013-04-23	XYZ	15:57 - 15:57	(1)
2013-04-23	XYZ	16:21 - 16:21	(1)
2013-04-23	XYZ	16:26 - 16:26	(1)
2013-04-23	XYZ	16:46 - 16:46	(1)
2013-04-23	XYZ	17:09 - 17:09	(1)
2013-04-23	XYZ	17:20 - 17:20	(1)
2013-04-23	XYZ	17:27 - 17:27	(1)
2013-04-23	XYZ	20:18 - 20:19	(2)
2013-04-23	XYZ	20:25 - 20:25	(1)
2013-04-23	XYZ	20:32 - 20:32	(1)
2013-04-23	XYZ	20:39 - 20:40	(2)
2013-04-23	XYZ	20:47 - 20:47	(1)
2013-04-23	XYZ	22:00 - 22:00	(1)
2013-04-23	XYZ	22:29 - 22:29	(1)
2013-04-23	XYZ	22:38 - 22:38	(1)
2013-04-23	XYZ	22:51 - 22:51	(1)
2013-04-23	XYZ	23:05 - 23:05	(1)
2013-04-23	XYZ	23:17 - 23:17	(1)
2013-04-23	XYZ	23:26 - 23:26	(1)
2013-04-23	XYZ	23:54 - 23:54	(1)
2013-04-24	XYZ	00:27 - 00:27	(1)
2013-04-24	XYZ	01:09 - 01:09	(1)
2013-04-24	XYZ	01:22 - 01:22	(1)
2013-04-24	XYZ	01:30 - 01:30	(1)
2013-04-24	XYZ	01:39 - 01:39	(1)
2013-04-24	XYZ	02:19 - 02:19	(1)
2013-04-24	XYZ	02:24 - 02:24	(1)
2013-04-24	XYZ	02:36 - 02:36	(1)

2013-04-24	XYZ	02:55 - 02:55	(1)
2013-04-24	XYZ	03:09 - 03:10	(2)
2013-04-24	XYZ	03:16 - 03:16	(1)
2013-04-24	XYZ	03:30 - 03:30	(1)
2013-04-24	XYZ	03:46 - 03:47	(2)
2013-04-24	XYZ	04:02 - 04:02	(1)
2013-04-24	XYZ	04:13 - 04:13	(1)
2013-04-24	XYZ	04:28 - 04:28	(1)
2013-04-24	XYZ	04:37 - 04:37	(1)
2013-04-24	XYZ	04:46 - 04:46	(1)
2013-04-24	XYZ	05:00 - 05:00	(1)
2013-04-24	XYZ	05:09 - 05:09	(1)
2013-04-24	XYZ	05:20 - 05:20	(1)
2013-04-24	XYZ	05:29 - 05:29	(1)
2013-04-24	XYZ	06:07 - 06:07	(1)
2013-04-24	XYZ	07:23 - 07:23	(1)
2013-04-24	XYZ	07:40 - 07:40	(1)
2013-04-24	XYZ	07:47 - 07:47	(1)
2013-04-24	XYZ	08:05 - 08:05	(1)
2013-04-24	XYZ	08:18 - 08:18	(1)
2013-04-24	XYZ	08:29 - 08:29	(1)
2013-04-24	XYZ	09:29 - 09:29	(1)
2013-04-24	XYZ	09:43 - 09:43	(1)
2013-04-24	XYZ	10:31 - 10:31	(1)
2013-04-24	XYZ	10:41 - 10:41	(1)
2013-04-24	XYZ	10:58 - 10:58	(1)
2013-04-24	XYZ	11:21 - 11:21	(1)
2013-04-24	XYZ	15:55 - 15:55	(1)
2013-04-24	XYZ	16:28 - 16:28	(1)
2013-04-24	XYZ	16:55 - 16:55	(1)
2013-04-24	XYZ	17:37 - 17:37	(1)
2013-04-24	XYZ	17:56 - 17:56	(1)
2013-04-24	XYZ	19:23 - 19:23	(1)
2013-04-24	XYZ	19:36 - 19:36	(1)
2013-04-24	XYZ	20:10 - 20:10	(1)
2013-04-24	XYZ	20:24 - 20:24	(1)
2013-04-24	XYZ	20:39 - 20:39	(1)
2013-04-24	XYZ	21:55 - 21:55	(1)
2013-04-24	XYZ	22:11 - 22:11	(1)
2013-04-24	XYZ	22:35 - 22:35	(1)
2013-04-24	XYZ	22:50 - 22:50	(1)
2013-04-25	XYZ	00:17 - 00:17	(1)
2013-04-25	XYZ	00:32 - 00:32	(1)
2013-04-25	XYZ	00:45 - 00:45	(1)
2013-06-09	XYZ	14:28 - 14:34	(7)
2013-08-28	XYZ	03:01 - 03:17	(17)
2013-09-01	XYZ	12:03 - 12:11	(9)
2013-11-21	XYZ	11:03 - 11:03	(1)

Total: 187

Scalar Data F:

2013-01-01	F	00:00 -	
2013-02-12	F	- 23:59	(61920)
2013-02-17	F	19:00 - 19:00	(1)
2013-03-07	F	20:45 - 20:45	(1)
2013-03-07	F	23:43 - 23:43	(1)
2013-03-08	F	00:00 -	
2013-03-18	F	- 17:59	(15480)
2013-03-21	F	10:01 - 21:00	(660)
2013-04-05	F	02:53 - 02:54	(2)

```
2013-08-21    F      03:06 - 03:06     (1)
2013-08-28    F      03:01 - 03:17    (17)
2013-11-21    F      11:03 - 11:03     (1)
2013-12-02    F      15:01 -
2013-12-13    F            - 00:00  (14940)

Total: 93024

Observatory Vector       Scalar
           (minutes) (%) (minutes) (%)
Gingin      187      0.04  93024 17.70
```

7.6.1.2 2014

```
                           GNG
          GINGIN OBSERVATORY INFORMATION 2014

ACKNOWLEDGE-  Users of the GNG data should acknowledge:
      -MENTS: Geoscience Australia

  STATION ID: GNG
    LOCATION: GINGIN, Western Australia
              Australia
ORGANISATION: Geoscience Australia

 CO-LATITUDE: 121.356 deg
   LONGITUDE: 115.715 deg E
   ELEVATION: Above mean sea level (top pier A):50 m

    ABSOLUTE
 INSTRUMENTS: DI-fluxgate magnetometer (DIM)
              DIM DI0037 Theodolite 390444
              GSM90 Overhauser-effect magnetometer
              GSM90_3091317/sensor 91457
   RECORDING
  VARIOMETER: Suspended DMI fluxgate magnetometer
              GSM90 Proton precession magnetometer.

 ORIENTATION: Magnetic NW, NE and Vertical (ABZ)
     DYNAMIC
       RANGE: +/- 1,600 nT
  RESOLUTION:    0.032 nT
    SAMPLING
        RATE: 1 second
 FILTER TYPE: Intermagnet

   K-NUMBERS: Computer assisted hand scaling
    K9-LIMIT: 430 nT

        GINS: Edinburgh
   SATELLITE: via HTTP

   OBSERVERS: S. Pryde

     CONTACT: Geomagnetism
              Geoscience Australia
              G.P.O. Box 378
              Canberra,  A.C.T.,  2601
              Australia
```

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WWW: http://www.ga.gov.au/

NOTES:

GINGIN

Gingin magnetic observatory is located in southwest Western Australia approximately 100 km north of the city of Perth, 20 km west of the town of Gingin. The Gingin observatory was established to replace the Gnangara observatory which closed in 2013. Both Gnangara and Gingin observatories were run in parallel from 2011-11 and throughout 2012.

The pier difference between the two observatory sites, as calculated using 2012 definitive all-day annual means in the sense (GNG - GNA) is:

X = +299 nT
Y = +77 nT
Z = +417 nT
H = +296 nT
F = -260 nT
D = +0.210 degrees
I = +0.435 degrees

The Gingin site is located adjacent to the Australian International Gravitational Observatory (AIGO) and the Gingin Gravity Discovery Centre on well drained sand with magnetic gradients of less than 1 nT/m.
The Gingin observatory consists of:

a Variometer Vault covered with local sand, housing the recording equipment, fluxgate variometer sensor and electronics, total-field variometer sensor and electronics, and GPS clock;

an Absolute House approximately 70 m northwest of the vault;

an external tripod reference station approximately 70 m north of the Absolute House, and;

an azimuth reference mark approximately 90 m south of the Absolute House.

Construction of the observatory took place during 2008. The vault and hut are built from re-constituted limestone blocks. The T shaped variometer vault was covered with local sand to enhance thermal stability. The absolute pier was constructed from a fibreglass tube with a marble top.

Variometer instrumentation was installed in October 2009. During installation magnetic contamination was discovered in both the Absolute House and Variometer Vault. The contamination was later found to be largely due to magnetic bolts used during construction to fix wooden framework to the masonry. Other sources of contamination existed in security doors, door and window locks, weather strips and light fittings. Over the following two years the Absolute House was de-contaminated. Magnetic contamination remains in the Variometer Vault. Routine weekly absolute observations commenced in the magnetically clean Absolute House in 2011-11 and fully calibrated observatory data commenced on 2011-11-16.

Key data for the observatory are summarised in Table 1

IAGA code	: GNG
Commenced operation	: November 2011
Geographic latitude	: 31d 21' 23" S
Geographic longitude	: 115d 42' 55" E
Geomagnetic latitude	: -41.06d
Geomagnetic longitude	: 189.01d
K 9 index lower limit	: 430 nT
Principal pier	: Pier A
Pier elevation (top)	: 50 m MSL
Principal reference mark	: Pillar S
Reference mark azimuth	: 186d 38' 32"
Reference mark distance	: 90 m
Observer	: S. Pryde

Table 1 Key observatory data.
Geographic coordinates are derived using the World Geodetic system 1984 (WGS84)

Local meteorological conditions

The meteorological temperature at the nearby Gingin airfield during 2014 varied from a minimum -0.8 C (2014-06-15) to a maximum +44.5 C (2014-01-11). Daily minimum temperatures varied from -0.8 C to +29.8 C (average 11.5 +/-5 C); daily maximum temperatures varied from 14.4 C to 44.5 C (average 26.0 +/-6 C); daily temperature ranges varied from 3.3 C to 25.8 C (average 14.5 +/-5 C).

VARIOMETERS

The variometers used throughout the year are summarised in Table 2.
The principal variometer at the Gingin observatory is a DMI FGE suspended 3-component fluxgate magnetometer. The fluxgate sensor was installed on a plinth in the western arm of the T-shaped Variometer Vault. The fluxgate sensors are orientated magnetic-NW, magnetic-NE, and vertical. An GEM GSM90 Overhauser total-field magnetometer installed in the eastern arm of the vault monitors variations in the magnetic total intensity. The total-field variometer failed on 2014-02-13 and was replaced on 2014-02-17.

The variometer system was powered by a 12 V 18 Ah battery with mains trickle charger, under/over voltage cut-off protection, mains power filters and voltage regulators to deliver a constant 12 V to both the vector and scalar magnetometers. The acquisition system timing is synchronised using a GPS clock.

Variometer data are retrieved via a TCP/IP connection through the NextG mobile telephone network.

There is no active temperature control in the Variometer Vault, but the vault is well insulated with foam inside and local sand outside. This insulation suppressed diurnal temperature variations but an annual temperature range of about 15 C was measured inside the vault.

3-component variometer	: DMI FGE (Version G)
Serial number	: E0383/S0319
Type	: suspended; linear fluxgate
Orientation	: magnetic NW, NE, Z
Acquisition interval	: 1 s
Resolution	: 0.032 nT
A/D converter	: ADAM 4017 module (+/-5V)
Total-field variometer	: GEM Systems GSM 90
Serial number	: GSM90_708729/21889 (to 2014-02-17)
	: GSM90_3091319/21889 (from 2014-02-17)
Type	: Overhauser effect
Acquisition interval	: 10 s
Resolution	: 0.01 nT
Data acquisition system	: GDAP
	: PC-104 computer, QNX6.5 OS
Timing	: Garmin GPS16-HVS GPS clock
Communications	: HSPA Mobile telephone TCP/IP network

Table 2 Magnetic variometers.

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. Adjustments to the system clock which were greater than 1 ms are listed below.

2014-04-17	02:16:45	-0.033 s	Reset clock controller
2014-05-20	00:30:41	0.358 s	System reboot

ABSOLUTE INSTRUMENTS

The variometers at GNG were calibrated nominally weekly with a pair of absolute observations. Both absolute PPM and DIM observations were performed on Pier A in the Absolute House. Table 3 lists the absolute instruments used at Gingin.

Absolute instrument corrections applied to the data were determined through instrument comparisons performed during maintenance and calibration visits at Gingin. No instrument comparisons were performed in 2014. The most recent instrument comparisons were made in 2015-02. The adopted corrections applied to the absolute magnetometers to correct them to the international standard as measured at IAGA workshops through the Australian reference instruments held in Canberra are described in Table 3.

At the annual mean magnetic field values at Gingin of
X= 23919 nT, Y= -690 nT, Z= -52704 nT, the D, I and F
corrections translate to corrections of:
dX = -2.3 nT   dY = -0.3 nT   dZ = -1.0 nT
These corrections have been applied to all the Gingin
final data.

DI fluxgate	: DMI
Serial number	: DI0037
Theodolite	: Zeiss 020B
Serial number	: 390444
Resolution	: 0.1'
D correction	: -0.05'
I correction	: -0.15'
Total-field magnetometer	: GEM Systems GSM 90
Serial number	: GSM90_3091317/91457
Type	: Overhauser effect
Resolution	: 0.01 nT
Correction	: 0.0 nT

Table 3   Absolute magnetometers
---------- and their adopted corrections.
Instrument corrections are applied in the
sense Standard = Instrument + correction.

BASELINES

Derivation of final baseline values for the fluxgate
variometer was done by fitting a piece-wise linear
spline (including steps where required) to the weekly
observed absolute observations baseline residuals. The
fluxgate variometer suffered from short-term baseline
instabilities during the year and the A (X) channel
jumped between two semi-stable states separated by several
nT during the period 2014-01 to 2014-03. As there were no
absolute observations available in the higher of the two
states the recorded A channel was discarded when in the
higher state and A channel data were recovered using the
remaining 2 channels of the vector variometer and the
scalar variometer data channel.
Over the period 2014-02-13 2014-02-17 no scalar variometer
data were available so A channel data could not be
recovered resulting in vector data loss.

The periods of A channel data recovery were:
2014-01-19T07:00 - 2014-01-20T15:00
2014-02-02T01:00 - 2014-02-02T11:00
2014-02-03T06:00 - 2014-02-05T22:00
2014-02-10T13:00 - 2014-02-11T19:00
2014-02-12T05:00 - 2014-02-12T14:00
2014-02-13T04:00 - 2014-02-13T14:00
2014-02-18T00:00 - 2014-03-08T20:00
The value of Fv - Fs can only be 0 (within rounding and
drift tolerances) during periods of data recovery.

Throughout the year there were multiple
sub-nanoTesla baseline instabilities affecting the A (X)
channel and lasting up to several hours. These have
not been fixed or removed from the definitive data and are
visible in Fv - Fs on many days.

The overall baseline drifts over the year had a range of about 6 nT in the X and Y channels and 2 nT in the Z channel. The standard deviations in the difference between the weekly absolute observations and the final adopted vector variometer model and data were:

X = 0.5 nT
Y = 0.9 nT
Z = 0.2 nT
F = 0.2 nT
H = 0.5 nT
D = 08"
I = 02"

The difference between the daily average of total field measured with the vector variometer with final baseline parameters applied and the scalar variometer (Fv - Fs) varied over a range of about 1 nT.

Real-time, Quasi-definitive and Definitive data comparison

Annual statistics of the 12 monthly averages of the difference between the GNG definitive data and real time reported 1-minute data sets (GNG definitive - GNG reported) were:

	X	Y	Z
Average	-0.6	+0.8	+0.2
Std.dev	1.0	3.8	0.9
Min	-1.8	-3.8	-1.3
Max	+1.4	+8.0	+1.8

The GNG reported real time data are within the specification for INTERMAGNET quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.
The annual statistics of the 12 monthly averages of the difference between the GNG definitive data and quasi-definitive 1-minute data sets (GNG definitive - GNG quasi-definitive) were:

	X	Y	Z
Average	-0.4	+0.1	+0.3
Std.dev	0.5	0.5	0.3
Min	-1.3	-0.8	-0.2
Max	+0.4	+0.9	+0.7

The GNG quasi-definitive data are within the specification for INTERMAGNET quasi-definitive data.

OPERATIONS

The local observer, Mr Stephen Pryde performed weekly absolute observations and checks throughout the year.

Analogue outputs from the DMI FGE 3-channel fluxgate, as well as the fluxgate sensor and electronics temperature channels, were digitized with an ADAM 4017 A/D converter mounted inside the FGE electronics console. Data were recorded at 1 second intervals in the components A (NW), B (NE), C (Z). These digital data were recorded on an acquisition computer running the Geophysical

Data Acquisition Platform (GDAP) software on the QNX operating system. The digital data from the GSM90 variometer, cycling once every 10 seconds, were also recorded on the acquisition computer.

The GSM90 variometer failed in February causing a significant period of scalar data loss and also preventing recovery of vector data over that period.

The acquisition system timing control was provided by a Garmin GPS16 GPS clock. All timing corrections greater than 1 ms which have been applied to the system are listed above.

Data files were telemetered to Geoscience Australia in Canberra through an HSPA mobile telephone TCP/IP network. The data transfer delay time was between 2 and 15 minutes. The definitive and quasi-definitive datasets derived from one-second fluxgate and ten-second total field variometer data sets were run through a de-spiking filter. For fluxgate data a spike detection required a value to deviate from the local linear trend by 6 times the maximum of 15 digitiser counts (about 0.5 nT) or 8/9 fractile of deviations during the following minute or so. For total field data a spike detection required a value to deviate from the local linear trend by 4 times the maximum of 0.1 nT or 8/9 fractile of deviations during the following minute or so. Data spikes were corrected where possible. Some spikes not automatically detected were removed manually. Reported data were not spike filtered. Definitive one-minute averages were derived from definitive one-second data using the 90-second Intermagnet Gaussian filter for both the vector and interpolated scalar data.

Real-time and daily one-second and one-minute data were delivered to the Edinburgh Geomagnetic Information Node throughout the year. Additionally, data were provided to International Services for Geomagnetic Indices and World Data centre for Geomagnetism, Kyoto University and others. Preliminary 1 minute data were also available on the GA web site (http://www.ga.gov.au).

The distribution of Gingin data is described in Table 4.

Table 4. Distribution of Gingin data.

Recipient	Status	Sent
1-second values		
INTERMAGNET	reported	hourly
WDC, Kyoto	reported	realtime
IPS, Australia	reported	realtime
1-minute values		
INTERMAGNET	reported	realtime
INTERMAGNET	quasi-definitive	monthly
INTERMAGNET	reported	daily
INTERMAGNET	definitive	August 2015
ISGI, France	reported	realtime
ISGI, France	reported	daily

```
WDC, Kyoto      reported        realtime
U Oulu, Finland reported        hourly

K indices
ISGI, France    reported        weekly
IPS, Australia  reported        weekly

Principal magnetic storms and rapid variations
WDC Solar Terrest. Physics, NOAA monthly
WDC Geomagnetism, Kyoto          monthly
Observatori de l'Ebre,Spain      monthly

SIGNIFICANT EVENTS
-----------------------
2014-01-13       23:00 Work on mains power - temporary
                 generator installed at Gravity observatory
                 which also supply power to GNG.
2014-02-05       12-20 Fv-Fs excursion, correlates with
                 apparent instability in A (X) channel
                 only. Fv -Fs returned to the same level at
                 end of excursion.
2014-02-10       12:30 - 23:30 another Fv-Fs anomaly
                 rapid onset appears to be in A channel
2014-02-13       14:02 variometer scalar variometer stops
2014-02-17       23:20 replace variometer GSM90 electronics
                 with GSM90_3091319 barcode 0029004
2014-02-26       DPaW machinery on site clearing vegetation
                 and widening roads
2014-03-14       Commence temporary real-time delivery of
                 1m data to Johns Hopkins Univ.
2014-03-26       Update DIM ID to reflect Pico DI0037D
2014-04-16       09:11 lost NMEA data from GPS clock
                 still have 1 s pulse
2014-04-17       02:15 restart clock driver
2014-04-23       Upgraded GdapClockGm, stopped at end of
                 2014-04-22 restarted at start of
                 2014-04-23 (<0.5ms correction)
2014-05-11       23:44 Re-commencement of Fv-Fs problems
2014-05-20       00:29 reboot to clear TCP stack
2014-06-12       Electronics temperature channel becomes
                 anomalous from 15:00 to 2014-06-16T15:00
2014-08-02       Electronics temperature anomalies and
                 inconsistencies re-commence
2014-08-06       00:19 - 00:23 noise of unknown origin
2014-08-28       Electronics temperature stabilises
2014-08-30       Electronics temperature anomalies and
                 inconsistencies recommence
2014-10-23       Prescribed burn of area scheduled to
                 commence today
2014-10-29       03:22 & 03:38  contamination
2014-10-30       data contamination due to prescribed burn
2014-10-31       data contamination due to prescribed burn
2014-11-04       05:59-06:00 Data contamination
2014-11-06       Electronics temperature channel rapid
                 variations until 2014-11-13
2014-11-15       more unstable electronics temp data
2014-11-16       02:18:30-02:19:00 data contamination
2014-11-26       Thunderstorms from approx 06:20 to around
                 08:30

K indices
```

```
----------
K indices for Gingin have been derived using a
computer-assisted method developed at Geoscience Australia
and based on the IAGA-accepted LRNS algorithm. K indices
were scaled from reported time-series data. K indices have
been scaled over some periods of missing definitive data
as those reported data were suitable for K-index scaling
but not suitable as definitive data. K indices from Gingin
contribute to the global am index and its derivatives.
The K indices are available on the Intermagnet DVD through
the IMCDView software.

DATA LOSSES
-----------
Variometer data XYZ:
2014-02-13    XYZ     13:55 -
2014-02-18    XYZ           - 00:00(6366)
2014-02-20    XYZ     21:50 - 23:04  (75)
2014-02-21    XYZ     00:00 - 02:17 (138)
2014-02-26    XYZ     00:08 - 00:08   (1)
2014-02-26    XYZ     00:29 - 00:29   (1)
2014-02-26    XYZ     02:46 - 02:46   (1)
2014-02-26    XYZ     03:46 - 03:47   (2)
2014-02-26    XYZ     04:01 - 04:01   (1)
2014-02-26    XYZ     15:36 - 15:37   (2)
2014-02-26    XYZ     23:24 - 23:24   (1)
2014-03-05    XYZ     04:30 - 04:30   (1)
2014-03-05    XYZ     06:01 - 06:01   (1)
2014-03-05    XYZ     08:49 - 08:49   (1)
2014-03-05    XYZ     10:55 - 10:55   (1)
2014-03-05    XYZ     11:51 - 11:51   (1)
2014-03-05    XYZ     11:53 - 11:54   (2)
2014-03-05    XYZ     11:56 - 11:57   (2)
2014-03-05    XYZ     12:05 - 12:06   (2)
2014-03-05    XYZ     12:09 - 12:09   (1)
2014-03-05    XYZ     12:24 - 12:24   (1)
2014-03-05    XYZ     12:29 - 12:29   (1)
2014-03-05    XYZ     12:34 - 12:34   (1)
2014-03-05    XYZ     12:36 - 12:36   (1)
2014-03-05    XYZ     12:41 - 12:42   (2)
2014-03-05    XYZ     12:46 - 12:46   (1)
2014-03-05    XYZ     12:50 - 12:50   (1)
2014-03-05    XYZ     13:01 - 13:01   (1)
2014-03-05    XYZ     13:04 - 13:05   (2)
2014-03-05    XYZ     13:16 - 13:16   (1)
2014-03-05    XYZ     13:18 - 13:18   (1)
2014-03-05    XYZ     13:20 - 13:20   (1)
2014-03-05    XYZ     13:38 - 13:38   (1)
2014-03-05    XYZ     13:44 - 13:44   (1)
2014-03-05    XYZ     13:54 - 13:54   (1)
2014-03-05    XYZ     14:06 - 14:06   (1)
2014-03-05    XYZ     14:08 - 14:09   (2)
2014-03-05    XYZ     14:11 - 14:12   (2)
2014-03-05    XYZ     14:23 - 14:23   (1)
2014-03-05    XYZ     14:25 - 14:25   (1)
2014-03-05    XYZ     14:30 - 14:30   (1)
2014-03-05    XYZ     14:32 - 14:33   (2)
2014-03-05    XYZ     14:40 - 14:40   (1)
2014-03-05    XYZ     14:44 - 14:44   (1)
2014-03-05    XYZ     14:50 - 14:50   (1)
2014-03-05    XYZ     15:11 - 15:11   (1)
```

2014-03-05	XYZ	15:13 - 15:13	(1)
2014-03-05	XYZ	15:15 - 15:15	(1)
2014-03-05	XYZ	15:34 - 15:34	(1)
2014-03-05	XYZ	15:37 - 15:37	(1)
2014-03-05	XYZ	15:41 - 15:41	(1)
2014-03-05	XYZ	15:43 - 15:43	(1)
2014-03-05	XYZ	15:50 - 15:50	(1)
2014-03-05	XYZ	15:56 - 15:56	(1)
2014-03-05	XYZ	16:00 - 16:00	(1)
2014-03-05	XYZ	16:04 - 16:05	(2)
2014-03-05	XYZ	16:10 - 16:10	(1)
2014-03-05	XYZ	16:14 - 16:14	(1)
2014-03-05	XYZ	16:16 - 16:16	(1)
2014-03-05	XYZ	16:19 - 16:19	(1)
2014-03-05	XYZ	16:53 - 16:53	(1)
2014-03-05	XYZ	17:33 - 17:33	(1)
2014-03-05	XYZ	17:35 - 17:36	(2)
2014-03-05	XYZ	23:18 - 23:18	(1)
2014-03-30	XYZ	07:21 - 07:21	(1)
2014-04-12	XYZ	20:38 - 20:55	(18)
2014-04-13	XYZ	06:20 - 06:23	(4)
2014-05-20	XYZ	00:28 - 00:29	(2)
2014-06-11	XYZ	01:49 - 02:02	(14)
2014-07-06	XYZ	07:57 - 08:05	(9)
2014-08-06	XYZ	01:00 - 01:35	(36)
2014-10-29	XYZ	03:20 - 03:41	(22)
2014-10-30	XYZ	07:38 - 07:39	(2)
2014-10-30	XYZ	08:40 - 13:18	(279)
2014-10-31	XYZ	01:59 - 02:00	(2)
2014-10-31	XYZ	02:41 - 03:46	(66)
2014-11-01	XYZ	00:35 - 00:37	(3)
2014-11-01	XYZ	01:25 - 01:28	(4)
2014-11-02	XYZ	02:00 - 02:00	(1)
2014-11-02	XYZ	02:36 - 02:36	(1)
2014-11-02	XYZ	04:54 - 04:54	(1)
2014-11-03	XYZ	07:29 - 07:29	(1)
2014-11-04	XYZ	05:59 - 06:00	(2)
2014-11-05	XYZ	05:32 - 05:32	(1)
2014-11-08	XYZ	03:27 - 03:27	(1)
2014-11-08	XYZ	03:35 - 03:37	(3)
2014-11-16	XYZ	02:19 - 02:19	(1)
2014-11-22	XYZ	03:14 - 03:14	(1)
2014-11-26	XYZ	06:16 - 08:25	(130)

Total: 7256 minutes

Scalar Data F:

2014-02-13	F	13:55 -	
2014-02-18	F	- 00:00	(6366)
2014-02-20	F	21:50 - 23:04	(75)
2014-02-21	F	00:00 - 02:18	(139)
2014-03-22	F	14:27 - 14:27	(1)
2014-04-05	F	04:39 - 04:39	(1)
2014-04-05	F	10:58 - 10:58	(1)
2014-04-05	F	11:30 - 11:30	(1)
2014-04-05	F	11:45 - 11:45	(1)
2014-04-05	F	12:34 - 12:34	(1)
2014-04-13	F	06:20 - 06:23	(4)
2014-04-17	F	00:50 - 00:50	(1)
2014-04-17	F	01:01 - 01:01	(1)
2014-04-17	F	01:13 - 01:14	(2)

2014-04-17	F	01:16 - 01:20	(5)
2014-04-17	F	01:22 - 01:22	(1)
2014-04-17	F	01:26 - 01:26	(1)
2014-04-17	F	01:29 - 01:29	(1)
2014-04-17	F	01:33 - 01:33	(1)
2014-04-17	F	01:36 - 01:37	(2)
2014-04-17	F	01:52 - 01:52	(1)
2014-04-17	F	06:45 - 06:45	(1)
2014-04-17	F	06:47 - 06:47	(1)
2014-04-17	F	07:07 - 07:07	(1)
2014-04-20	F	22:20 - 22:20	(1)
2014-04-20	F	22:48 - 22:48	(1)
2014-04-20	F	23:52 - 23:53	(2)
2014-04-21	F	00:06 - 00:06	(1)
2014-04-21	F	01:00 - 01:00	(1)
2014-05-20	F	00:28 - 00:29	(2)
2014-05-20	F	17:59 - 17:59	(1)
2014-05-20	F	18:52 - 18:52	(1)
2014-05-20	F	19:04 - 19:04	(1)
2014-05-20	F	20:57 - 20:57	(1)
2014-05-27	F	08:16 - 08:16	(1)
2014-05-27	F	08:37 - 08:37	(1)
2014-05-27	F	09:10 - 09:10	(1)
2014-05-27	F	09:18 - 09:18	(1)
2014-06-02	F	01:40 - 01:43	(4)
2014-07-14	F	06:45 - 06:45	(1)
2014-07-14	F	06:50 - 06:50	(1)
2014-07-14	F	07:16 - 07:17	(2)
2014-07-14	F	07:20 - 07:20	(1)
2014-07-14	F	07:22 - 07:22	(1)
2014-07-14	F	07:59 - 08:09	(11)
2014-08-06	F	01:00 - 01:35	(36)
2014-09-13	F	00:52 - 00:52	(1)
2014-09-13	F	00:55 - 00:55	(1)
2014-09-13	F	01:33 - 01:33	(1)
2014-09-13	F	07:16 - 07:16	(1)
2014-10-12	F	12:21 - 12:22	(2)
2014-10-19	F	23:29 - 23:29	(1)
2014-10-29	F	03:20 - 03:41	(22)
2014-10-30	F	07:38 - 07:39	(2)
2014-10-30	F	08:40 - 13:18	(279)
2014-10-31	F	01:59 - 02:00	(2)
2014-10-31	F	02:41 - 03:46	(66)
2014-11-01	F	00:35 - 00:37	(3)
2014-11-01	F	01:25 - 01:28	(4)
2014-11-02	F	02:00 - 02:00	(1)
2014-11-02	F	02:36 - 02:36	(1)
2014-11-02	F	04:54 - 04:55	(2)
2014-11-03	F	07:29 - 07:29	(1)
2014-11-04	F	05:59 - 06:00	(2)
2014-11-05	F	05:31 - 05:32	(2)
2014-11-08	F	03:27 - 03:27	(1)
2014-11-08	F	03:36 - 03:36	(1)
2014-11-16	F	02:19 - 02:19	(1)
2014-11-18	F	01:08 - 01:25	(18)
2014-11-22	F	03:14 - 03:14	(1)
2014-11-27	F	05:36 - 05:36	(1)
2014-11-27	F	17:58 - 17:58	(1)
2014-11-27	F	21:57 - 21:57	(1)
2014-12-08	F	16:46 - 16:47	(2)
2014-12-25	F	13:44 - 13:44	(1)

```
2014-12-26    F      13:31 - 13:31    (1)
2014-12-26    F      13:57 - 13:57    (1)
2014-12-26    F      14:01 - 14:03    (3)
2014-12-26    F      14:05 - 14:05    (1)
2014-12-26    F      14:09 - 14:09    (1)
2014-12-26    F      14:11 - 14:11    (1)
2014-12-26    F      14:13 - 14:13    (1)

Total: 7113 minutes
```

7.6.1.3 2015

```
                           GNG
          GINGIN OBSERVATORY INFORMATION 2015

ACKNOWLEDGE-  Users of the GNG data should acknowledge:
      -MENTS: Geoscience Australia

  STATION ID: GNG
    LOCATION: GINGIN, Western Australia
              Australia
ORGANISATION: Geoscience Australia

 CO-LATITUDE: 121.356 deg
   LONGITUDE: 115.715 deg E
   ELEVATION: Above mean sea level (top pier A):50 m

    ABSOLUTE
 INSTRUMENTS: DI-fluxgate magnetometer (DIM)
              DIM DI0037 Theodolite 390444
              GSM90 Overhauser-effect magnetometer
              GSM90_3091317/sensor 91457
   RECORDING
  VARIOMETER: Suspended DMI fluxgate magnetometer
              GSM90 Proton precession magnetometer.

 ORIENTATION: Magnetic NW, NE and Vertical (ABZ)
     DYNAMIC
       RANGE: +/- 1,600 nT
  RESOLUTION:    0.032 nT
    SAMPLING
        RATE: 1 second
 FILTER TYPE: Intermagnet

   K-NUMBERS: Computer assisted hand scaling
    K9-LIMIT: 430 nT

        GINS: Edinburgh
   SATELLITE: via HTTP

   OBSERVERS: S. Pryde
              L. Wang

     CONTACT: Geomagnetism
              Geoscience Australia
              G.P.O. Box 378
              Canberra,  A.C.T.,  2601
              Australia

              Tel: + 61-2-6249-9111
```

Fax: + 61-2-6249-9986
e-mail: geomag@ga.gov.au
WWW: http://www.ga.gov.au/

NOTES:

GINGIN

Gingin magnetic observatory is located in southwest Western Australia approximately 100 km north of the city of Perth, 20 km west of the town of Gingin. The Gingin observatory was established to replace the Gnangara observatory which closed in 2013. Both Gnangara and Gingin observatories were run in parallel from November 2011 and throughout 2012.
The pier difference between the two observatory sites, as calculated using 2012 definitive all-day annual means in the sense (GNG - GNA) is:

X = +299 nT
Y = +77 nT
Z = +417 nT
H = +296 nT
F = -260 nT
D = +0.210 degrees
I = +0.435 degrees

The Gingin site is located adjacent to the Australian International Gravitational Observatory (AIGO) and the Gingin Gravity Discovery Centre on well drained sand with magnetic gradients of less than 1 nT/m.
The Gingin observatory consists of:

a Variometer Vault covered with local sand, housing the recording equipment, fluxgate variometer sensor and electronics, total-field variometer sensor and electronics, and GPS clock;

an Absolute House approximately 70 m northwest of the vault;

an external tripod reference station approximately 70 m north of the Absolute House, and;

an azimuth reference mark approximately 90 m south of the Absolute House.

Construction of the observatory took place during 2008. The vault and hut are built from re-constituted limestone blocks. The T shaped variometer vault was covered with local sand to enhance thermal stability. The absolute pier was constructed from a fibreglass tube with a marble top.
Variometer instrumentation was installed in October 2009. During installation magnetic contamination was discovered in both the Absolute House and Variometer Vault. The contamination was later found to be largely due to magnetic bolts used during construction to affix wooden framework to the masonry. Other sources of contamination existed in security doors, door and window locks, weather strips and

light fittings. Over the following two years the Absolute House was de-contaminated. Magnetic contamination remains in the Variometer Vault. Routine weekly absolute observations commenced in the magnetically clean Absolute House in 2011-11 and fully calibrated observatory data commenced on 2011-11-16.

Key data for the observatory are summarised in Table 1

IAGA code	: GNG
Commenced operation	: November 2011
Geographic latitude	: 31d 21' 23" S
Geographic longitude	: 115d 42' 55" E
Geomagnetic latitude	: -41.06d
Geomagnetic longitude	: 189.01d
K 9 index lower limit	: 430 nT
Principal pier	: Pier A
Pier elevation (top)	: 50 m MSL
Principal reference mark	: Pillar S
Reference mark azimuth	: 186d 38' 32"
Reference mark distance	: 90 m
Observer	: S. Pryde, L. Wang

Table 1 Key observatory data.
Geographic coordinates are derived using the World Geodetic system 1984 (WGS84)

Local meteorological conditions

The meteorological temperature at the nearby Gingin airfield varied from a minimum -2.5 C (2015-07-09) to a maximum +44.4 C (2015-01-05). Daily minimum temperatures varied from -2.5 C to +23.9 C (average 11.2 +/-5 C); daily maximum temperatures varied from 14.5 C to 44.4 C (average 26.2 +/-7 C); daily temperature ranges varied from 2.5 C to 29.9 C (average 15.0 +/-5 C).
Daily weather observations for Gingin airport (station ID 009178) provided by Australian Government, Bureau of Meteorology.

VARIOMETERS

The variometers used throughout the year are summarised in Table 2. The principal variometer at the Gingin observatory is a DMI FGE suspended 3-component fluxgate magnetometer. The fluxgate sensor was installed on a plinth in the western arm of the T-shaped Variometer Vault. The fluxgate sensors are orientated magnetic-NW, magnetic-NE, and vertical.
A GEM GSM90 Overhauser total-field magnetometer installed in the eastern arm of the vault monitors variations in the magnetic total intensity.
The variometer system was powered by a 12 V 18 Ah battery with mains trickle charger, under/over voltage cut-off protection, mains power filters and voltage regulators to deliver a constant 12 V to both the vector and scalar magnetometers. The acquisition system timing is synchronised using a GPS clock.
Variometer data are retrieved via a TCP/IP connection through the NextG mobile telephone network.
There is no active temperature control in the variometer

vault, but the vault is well insulated with foam inside and local sand outside. This insulation suppressed diurnal temperature variations but an annual temperature range of about 14 C was measured inside the vault.

Throughout the year the fluxgate magnetometer showed multiple sub-nanoTesla baseline instabilities lasting several hours and affecting the A (X) channel. These problems manifest most clearly in the Fv-Fs channel. The cause of the problems remains unknown. The fluxgate instrument is scheduled for replacement as soon as possible. The scalar magnetometer had numerous periods of spikey or missing data lasting up to several hours, often late in the UT day.

3-component variometer	: DMI FGE (Version G)
Serial number	: E0383/S0319
Type	: suspended; linear fluxgate
Orientation	: magnetic NW, NE, Z
Acquisition interval	: 1 s
Resolution	: 0.032 nT
A/D converter	: ADAM 4017 module (+/-5V)
Total-field variometer	: GEM Systems GSM 90
Serial number	: GSM90_3091319/21889
Type	: Overhauser effect
Acquisition interval	: 10 s
Resolution	: 0.01 nT
Data acquisition system	: GDAP
	: PC-104 computer, QNX6.5 OS
Timing	: Garmin GPS16-HVS GPS clock
Communications	: HSPA Mobile telephone TCP/IP network

Table 2 Magnetic variometers.

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. Adjustments to the system clock which were greater than 1 ms are listed below.

2015-01-27	05:52:41	0.912 s	scheduled reboot
2015-03-01	02:05:49	1.036 s	unscheduled reboot
2015-06-12	00:57:45	0.396 s	unscheduled reboot
2015-07-01	00:00:40	-1.000 s	leap second
2015-12-18	11:44:41	0.933 s	unscheduled reboot

ABSOLUTE INSTRUMENTS

The variometers at GNG were calibrated nominally weekly with a pair of absolute observations. Both absolute PPM and DIM observations were performed on Pier A in the Absolute House. 57 pairs of observations were made throughout the year. Table 3 lists the absolute instruments used at Gingin.
Absolute instrument corrections applied to the data were determined through instrument comparisons performed during maintenance and calibration visits at Gingin, most recently in February 2015. The adopted corrections applied to the absolute magnetometers to

```
correct them to the international standard as measured
at IAGA workshops through the Australian reference
instruments held in Canberra are described in Table 3.
At the annual mean magnetic field values at Gingin of
X= 23954 nT, Y= -693 nT, Z= -52689 nT, the D, I and F
corrections translate to corrections of:
dX = -2.3 nT      dY = -0.3 nT     dZ = -1.0 nT
These corrections have been applied to all the Gingin
final data.

DI fluxgate                : DMI
Serial number              : DI0037D + Pico ADC16 GJY03/108
Theodolite                 : Zeiss 020B
Serial number              : 390444
Resolution                 :  0.1'
D correction               :  -0.05'
I correction               :  -0.15'
Total-field magnetometer   : GEM Systems GSM 90
Serial number              : GSM90_3091317/91457
Type                       : Overhauser effect
Resolution                 : 0.01 nT
Correction                 : 0.0 nT

Table  3     Absolute magnetometers
----------   and  their  adopted corrections.
             Instrument corrections are applied in the
             sense Standard = Instrument + correction.

BASELINES
----------
Derivation of final baseline values for the fluxgate
variometer was done by fitting a piece-wise linear
spline (including steps where required) to the weekly
observed absolute observations baseline residuals.
Over the period 2015-03-30T00:10:13 - 2015-03-30T01:03:48
the A (X) channel of the fluxgate variometer suffered from
short-term baseline instabilities and data were recovered
using the remaining 2 channels of the vector variometer and
the scalar variometer data over that period.
The value of Fv - Fs can only be 0 (within rounding and
drift tolerances) during such periods of data recovery.
Throughout the year there were multiple sub-nanoTesla
baseline instabilities affecting the A (X) channel and
lasting up to several hours. These have
not been fixed or removed from the definitive data and are
visible in Fv - Fs on many days.
The overall baseline drifts over the year had a range
of about 3 nT in the X and Y channels and 1 nT in the Z
channel. The standard deviations in the difference between
the weekly absolute observations and the final adopted
vector variometer model and data were:

X =   0.6 nT  F =   0.2 nT
Y =   0.8 nT  H =   0.6 nT
Z =   0.3 nT  D =   07"
              I =   02"

The difference between the daily average of
total field measured with the vector variometer with final
baseline parameters applied and the scalar variometer
(Fv - Fs) varied over a range of about 2 nT.
```

Real-time, Quasi-definitive and Definitive data comparison

Annual statistics of the 12 monthly averages of the difference between the GNG definitive data and real time reported 1-minute data sets (GNG definitive - GNG reported) were:

	X	Y	Z
Average	+0.1	-0.1	+0.2
Std.dev	0.9	1.1	0.4
Min	-2.1	-2.2	-0.6
Max	+1.3	+2.1	+1.0

The GNG reported real time data are within the specification for INTERMAGNET quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.
The annual statistics of the 12 monthly averages of the difference between the GNG definitive data and quasi-definitive 1-minute data sets (GNG definitive - GNG quasi-definitive) were:

	X	Y	Z
Average	+0.2	0.0	+0.3
Std.dev	0.4	0.3	0.2
Min	-0.7	-0.7	0.0
Max	+1.0	+0.7	+0.5

The GNG quasi-definitive data are within the specification for INTERMAGNET quasi-definitive data.

OPERATIONS

The local observer, Mr Stephen Pryde performed weekly absolute observations and checks throughout the year. Analogue outputs from the DMI FGE 3-channel fluxgate, as well as the fluxgate sensor and electronics temperature channels, were digitized with an ADAM 4017 A/D converter mounted inside the FGE electronics console. Data were recorded at 1 second intervals in the components A (NW), B (NE), C (Z). These digital data were recorded on an acquisition computer running the Geophysical Data Acquisition Platform (GDAP) software on the QNX operating system. The digital data from the GSM90 variometer, cycling once every 10 seconds, were also recorded on the acquisition computer.
The acquisition system timing control was provided by a Garmin GPS16 GPS clock. All timing corrections greater than 1 ms which have been applied to the system are listed above.
Data files were telemetered to Geoscience Australia in Canberra through an HSPA mobile telephone TCP/IP network. The data transfer delay time was between 2 and 15 minutes.
The definitive and quasi-definitive datasets derived from one-second fluxgate and ten-second total field variometer data sets were run through a de-spiking filter. For fluxgate data a spike detection required a value to deviate from the local linear trend by 6 times the maximum of 15 digitiser counts (about 0.5 nT) or 8/9 fractile of deviations during the following minute or so. For total field data a spike detection required a value to deviate

from the local linear trend by 4 times the maximum of 0.1 nT or 8/9 fractile of deviations during the following minute or so. Data spikes were corrected where possible. Spikes not automatically detected were removed manually. On average 4, 1, 1 and 75 data samples per day were removed or corrected from the raw X, Y and Z and F channels respectively. Reported data were not spike filtered. Selected days of definitive data were not filtered as filtering unnecessarily removed some scalar data during periods of rapid magnetic fluctuations. The unfiltered days are listed below. Definitive one-minute averages were derived from definitive one-second data using the 90-second Intermagnet Gaussian filter for both the vector and interpolated scalar data. Real-time and daily one-second and one-minute data were delivered to the Edinburgh Geomagnetic Information Node throughout the year. Additionally, data were provided to International Services for Geomagnetic Indices and World Data centre for Geomagnetism, Kyoto University and others. Preliminary 1 minute data were made also available on the GA web site (http://www.ga.gov.au).

The distribution of Gingin data is described in Table 4.

Recipient	Status	Sent
1-second values		
INTERMAGNET	reported	hourly
WDC, Kyoto	reported	realtime
BoM SWS	reported	realtime
1-minute values		
INTERMAGNET	reported	realtime
INTERMAGNET	quasi-definitive	monthly
INTERMAGNET	reported	daily
INTERMAGNET	definitive	August 2016
ISGI, France	reported	realtime
ISGI, France	reported	daily
WDC, Kyoto	reported	realtime
U Oulu, Finland	reported	hourly
K indices		
ISGI, France	reported	weekly
BoM SWS, Australia	reported	weekly
Principal magnetic storms and rapid variations		
WDC Solar Terrest. Physics, NOAA		monthly
WDC Geomagnetism, Kyoto		monthly
Observatori de l'Ebre,Spain		monthly

Table 4. Distribution of Gingin data.

Significant Events

2015-01-10	Scalar variometer spike from 08 onwards
2015-01-27	05:50:35 reboot to clear TCP stack
2015-02-17/20	Maintenance visit. Replace Getac tablet computer and absolute battery box. DIM comparisons, pier diffs, sun shots, observer training. Vault entered approx

```
                 2015-02-19T08:30
2015-03-01       02:02:35 reboot- reason unknown
                 Z blv jump 01:38:28
                 No PPM data 01:38  - 02:04 reason unknown
2015-03-30       00:10:13 -  01:03:48 X channel instability.
                 last part of absolute observation affected
                 by bad variometer data.
                 20:33-22:15 PPM noisy
                 K-indices scaled and sent before data
                 could be fixed by recovering A channel.
                 K indices re-scaled and reloaded on
                 2015-04-07 but not re-sent.
2015-04-30       19:40-19:51 electrical storm data spikes
2015-05-27       New trolley to transport absolute
                 instruments
2015-06-05       04:23:12. Contamination in variometer
2015-06-11       00:53 unscheduled reboot - reason unknown
2015-07-23       Testing a large rain making apparatus in
                 carpark about 250 m from observatory.
2015-12-18       reboot - possible power outage.
```

K-Indices

K indices for Gingin have been derived using a computer-assisted method developed at Geoscience Australia and based on the IAGA-accepted LRNS algorithm. K indices were scaled from reported time-series data. K indices have been scaled over some periods of missing definitive data as those reported data were suitable for K-index scaling but not suitable as definitive data. K indices from Gingin contribute to the global am index and its derivatives. The K-indices are available on the Intermagnet DVD through the IMCDView software.

Annual Mean Values

The annual mean values for Gingin are available in the file "yearmean.gng" and graphically through the IMCDView software.

Hourly Mean Values

Plots of hourly mean values for Gingin are available through the IMCDView software.

Spike Filtering not applied to Definitive data

Month	Day of Month
January	07,26
February	
March	17
April	
May	13
June	22, 23, 25
July	28,31
August	15 (08:29-08:30)
September	
October	06 (12:26,13:24)
November	
December	19

DATA LOSSES

Variometer data XYZ: (missing minutes)

2015-01-25	XYZ	08:06 - 08:06	(1)
2015-01-27	XYZ	05:50 - 05:51	(2)
2015-01-27	XYZ	06:29 - 06:29	(1)
2015-03-01	XYZ	02:03 - 02:04	(2)
2015-03-01	XYZ	02:49 - 02:49	(1)
2015-03-30	XYZ	00:11 - 00:11	(1)
2015-03-30	XYZ	00:19 - 00:19	(1)
2015-03-30	XYZ	00:22 - 00:22	(1)
2015-03-30	XYZ	00:32 - 00:33	(2)
2015-03-30	XYZ	00:40 - 00:40	(1)
2015-03-30	XYZ	00:43 - 00:43	(1)
2015-03-30	XYZ	00:47 - 00:47	(1)
2015-03-30	XYZ	00:59 - 00:59	(1)
2015-03-30	XYZ	01:01 - 01:03	(3)
2015-06-05	XYZ	04:23 - 04:23	(1)
2015-06-12	XYZ	00:54 - 00:56	(3)
2015-07-25	XYZ	01:27 - 01:28	(2)
2015-09-19	XYZ	04:53 - 04:54	(2)
2015-09-19	XYZ	05:04 - 05:05	(2)
2015-09-20	XYZ	03:27 - 03:30	(4)
2015-12-18	XYZ	11:17 - 11:40	(24)

Total: 57 (minutes)

Scalar Data F: (missing minutes)

2015-01-01	F	04:35 - 04:35	(1)
2015-01-04	F	16:45 - 16:45	(1)
2015-01-07	F	08:29 - 08:34	(6)
2015-01-10	F	08:00 - 18:00	(601)
2015-01-10	F	20:47 - 20:47	(1)
2015-01-10	F	20:51 - 20:51	(1)
2015-01-10	F	21:07 - 21:07	(1)
2015-01-10	F	21:13 - 21:14	(2)
2015-01-10	F	21:19 -	
2015-01-11	F	- 01:00	(222)
2015-01-12	F	11:47 - 11:47	(1)
2015-01-14	F	07:10 - 07:10	(1)
2015-01-15	F	14:23 - 14:23	(1)
2015-01-21	F	14:19 - 14:19	(1)
2015-01-22	F	11:07 - 11:07	(1)
2015-01-22	F	13:09 - 13:09	(1)
2015-01-22	F	13:19 - 13:19	(1)
2015-01-25	F	08:06 - 08:06	(1)
2015-01-25	F	11:09 - 11:09	(1)
2015-01-25	F	15:08 - 15:08	(1)
2015-01-27	F	05:50 - 05:51	(2)
2015-01-27	F	15:46 - 15:46	(1)
2015-01-28	F	08:52 - 08:52	(1)
2015-01-28	F	10:08 - 10:08	(1)
2015-01-29	F	04:36 - 04:36	(1)
2015-01-29	F	12:07 - 12:07	(1)
2015-01-29	F	12:10 - 12:10	(1)
2015-01-29	F	12:15 - 12:15	(1)
2015-01-29	F	12:29 - 12:29	(1)
2015-01-29	F	12:39 - 12:39	(1)
2015-01-29	F	12:55 - 12:55	(1)
2015-01-29	F	14:15 - 14:15	(1)
2015-01-29	F	15:00 - 15:00	(1)

2015-01-29	F	19:23 - 19:23	(1)
2015-01-30	F	16:18 - 16:19	(2)
2015-01-30	F	20:12 - 20:12	(1)
2015-02-01	F	10:58 - 10:58	(1)
2015-02-01	F	11:00 - 11:00	(1)
2015-02-01	F	11:04 - 11:04	(1)
2015-02-01	F	11:06 - 11:06	(1)
2015-02-01	F	11:11 - 11:11	(1)
2015-02-01	F	11:13 - 11:13	(1)
2015-02-01	F	11:26 - 11:26	(1)
2015-02-01	F	16:30 - 16:30	(1)
2015-02-01	F	16:51 - 16:53	(3)
2015-02-01	F	21:08 - 21:08	(1)
2015-02-01	F	23:17 - 23:17	(1)
2015-02-02	F	00:01 - 00:01	(1)
2015-02-02	F	01:31 - 01:31	(1)
2015-02-02	F	01:34 - 01:34	(1)
2015-02-02	F	02:51 - 02:53	(3)
2015-02-02	F	04:27 - 04:28	(2)
2015-02-02	F	04:45 - 04:45	(1)
2015-02-02	F	04:55 - 04:55	(1)
2015-02-02	F	04:58 - 04:58	(1)
2015-02-02	F	05:11 - 05:12	(2)
2015-02-02	F	05:14 - 05:14	(1)
2015-02-02	F	05:27 - 05:27	(1)
2015-02-02	F	09:23 - 09:23	(1)
2015-02-02	F	09:28 - 09:29	(2)
2015-02-02	F	09:31 - 09:31	(1)
2015-02-02	F	09:33 - 09:33	(1)
2015-02-02	F	11:10 - 11:10	(1)
2015-02-02	F	12:43 - 12:43	(1)
2015-02-02	F	15:15 - 15:15	(1)
2015-02-02	F	18:02 - 18:02	(1)
2015-02-02	F	18:53 - 18:53	(1)
2015-02-03	F	04:34 - 04:34	(1)
2015-02-03	F	06:06 - 06:06	(1)
2015-02-03	F	08:38 - 08:38	(1)
2015-02-03	F	08:53 - 08:53	(1)
2015-02-03	F	09:02 - 09:02	(1)
2015-02-03	F	14:16 - 14:16	(1)
2015-02-04	F	06:21 - 06:21	(1)
2015-02-07	F	05:12 - 05:12	(1)
2015-02-09	F	14:10 - 14:10	(1)
2015-02-09	F	15:13 - 15:13	(1)
2015-02-10	F	14:08 - 14:08	(1)
2015-02-17	F	16:16 - 16:17	(2)
2015-02-17	F	16:31 - 16:31	(1)
2015-02-17	F	16:33 - 16:35	(3)
2015-02-18	F	16:06 - 16:07	(2)
2015-02-25	F	13:58 - 13:59	(2)
2015-02-25	F	14:22 - 14:22	(1)
2015-02-25	F	16:51 - 16:51	(1)
2015-02-27	F	14:37 - 14:37	(1)
2015-02-27	F	15:38 - 15:38	(1)
2015-02-28	F	14:28 - 14:28	(1)
2015-02-28	F	14:33 - 14:34	(2)
2015-02-28	F	15:55 - 15:55	(1)
2015-02-28	F	16:17 - 16:17	(1)
2015-02-28	F	20:06 - 20:06	(1)
2015-03-01	F	01:38 - 02:04	(27)
2015-03-01	F	02:07 - 02:07	(1)

2015-03-01	F	02:10 - 02:10	(1)
2015-03-01	F	02:12 - 02:12	(1)
2015-03-01	F	04:29 - 04:29	(1)
2015-03-01	F	17:16 - 17:17	(2)
2015-03-01	F	22:52 - 22:52	(1)
2015-03-02	F	06:07 - 06:07	(1)
2015-03-02	F	07:01 - 07:01	(1)
2015-03-02	F	07:18 - 07:18	(1)
2015-03-02	F	14:37 - 14:37	(1)
2015-03-03	F	11:41 - 11:42	(2)
2015-03-04	F	09:53 - 09:53	(1)
2015-03-05	F	16:16 - 16:16	(1)
2015-03-07	F	00:48 - 00:48	(1)
2015-03-07	F	13:51 - 13:51	(1)
2015-03-07	F	13:55 - 13:56	(2)
2015-03-07	F	16:38 - 16:39	(2)
2015-03-10	F	08:52 - 08:52	(1)
2015-03-10	F	08:55 - 08:55	(1)
2015-03-10	F	08:57 - 08:57	(1)
2015-03-11	F	09:30 - 09:30	(1)
2015-03-11	F	09:56 - 09:56	(1)
2015-03-11	F	10:11 - 10:13	(3)
2015-03-11	F	10:17 - 10:18	(2)
2015-03-12	F	09:34 - 09:34	(1)
2015-03-12	F	14:48 - 14:49	(2)
2015-03-12	F	15:01 - 15:01	(1)
2015-03-12	F	15:05 - 15:06	(2)
2015-03-14	F	23:16 - 23:17	(2)
2015-03-15	F	08:51 - 08:53	(3)
2015-03-15	F	08:56 - 08:56	(1)
2015-03-16	F	07:54 - 07:55	(2)
2015-03-17	F	15:33 - 15:33	(1)
2015-03-17	F	16:00 - 16:00	(1)
2015-03-18	F	00:01 - 00:01	(1)
2015-03-18	F	00:13 - 00:13	(1)
2015-03-18	F	00:23 - 00:23	(1)
2015-03-18	F	00:25 - 00:25	(1)
2015-03-18	F	00:29 - 00:29	(1)
2015-03-18	F	00:31 - 00:31	(1)
2015-03-18	F	00:45 - 00:45	(1)
2015-03-18	F	00:54 - 00:54	(1)
2015-03-18	F	03:55 - 03:56	(2)
2015-03-18	F	07:24 - 07:27	(4)
2015-03-21	F	13:11 - 13:11	(1)
2015-03-22	F	04:27 - 04:27	(1)
2015-03-22	F	05:56 - 05:57	(2)
2015-03-22	F	07:41 - 07:41	(1)
2015-03-22	F	07:57 - 07:57	(1)
2015-03-22	F	08:02 - 08:05	(4)
2015-03-22	F	08:12 - 08:13	(2)
2015-03-22	F	08:15 - 08:15	(1)
2015-03-22	F	08:18 - 08:19	(2)
2015-03-22	F	08:25 - 08:25	(1)
2015-03-22	F	08:34 - 08:34	(1)
2015-03-22	F	08:38 - 08:39	(2)
2015-03-22	F	08:41 - 08:42	(2)
2015-03-22	F	08:49 - 08:51	(3)
2015-03-22	F	08:55 - 08:55	(1)
2015-03-22	F	08:59 - 09:01	(3)
2015-03-22	F	09:12 - 09:12	(1)
2015-03-22	F	09:42 - 09:45	(4)

2015-03-22	F	10:14 - 10:14	(1)
2015-03-23	F	01:31 - 01:31	(1)
2015-03-23	F	01:40 - 01:41	(2)
2015-03-23	F	01:57 - 01:57	(1)
2015-03-23	F	02:02 - 02:02	(1)
2015-03-23	F	02:08 - 02:10	(3)
2015-03-23	F	02:12 - 02:13	(2)
2015-03-23	F	02:18 - 02:19	(2)
2015-03-23	F	02:22 - 02:22	(1)
2015-03-23	F	02:26 - 02:26	(1)
2015-03-23	F	02:29 - 02:31	(3)
2015-03-23	F	02:39 - 02:43	(5)
2015-03-23	F	02:46 - 02:47	(2)
2015-03-23	F	02:50 - 02:50	(1)
2015-03-23	F	02:54 - 02:55	(2)
2015-03-23	F	03:00 - 03:00	(1)
2015-03-23	F	03:04 - 03:04	(1)
2015-03-23	F	03:06 - 03:06	(1)
2015-03-23	F	03:09 - 03:09	(1)
2015-03-23	F	03:23 - 03:24	(2)
2015-03-23	F	03:29 - 03:31	(3)
2015-03-23	F	03:54 - 03:55	(2)
2015-03-23	F	04:31 - 04:33	(3)
2015-03-23	F	04:40 - 04:40	(1)
2015-03-23	F	04:45 - 04:45	(1)
2015-03-23	F	05:02 - 05:02	(1)
2015-03-23	F	05:32 - 05:32	(1)
2015-03-23	F	05:39 - 05:39	(1)
2015-03-23	F	08:40 - 08:43	(4)
2015-03-23	F	08:50 - 08:51	(2)
2015-03-23	F	09:07 - 09:07	(1)
2015-03-23	F	11:30 - 11:30	(1)
2015-03-23	F	14:12 - 14:12	(1)
2015-03-24	F	13:52 - 13:53	(2)
2015-03-24	F	16:12 - 16:12	(1)
2015-03-25	F	07:35 - 07:35	(1)
2015-03-25	F	08:09 - 08:09	(1)
2015-03-25	F	08:19 - 08:20	(2)
2015-03-25	F	10:08 - 10:09	(2)
2015-03-25	F	10:14 - 10:16	(3)
2015-03-25	F	10:18 - 10:18	(1)
2015-03-25	F	10:27 - 10:28	(2)
2015-03-25	F	10:31 - 10:34	(4)
2015-03-25	F	10:43 - 10:43	(1)
2015-03-25	F	10:45 - 10:46	(2)
2015-03-25	F	10:59 - 11:00	(2)
2015-03-25	F	11:03 - 11:03	(1)
2015-03-25	F	11:06 - 11:06	(1)
2015-03-25	F	11:20 - 11:20	(1)
2015-03-25	F	11:25 - 11:25	(1)
2015-03-25	F	11:30 - 11:31	(2)
2015-03-25	F	20:02 - 21:33	(92)
2015-03-25	F	21:37 - 21:37	(1)
2015-03-25	F	21:39 - 21:39	(1)
2015-03-27	F	08:30 - 08:33	(4)
2015-03-27	F	08:36 - 08:36	(1)
2015-03-27	F	08:38 - 08:38	(1)
2015-03-27	F	08:40 - 08:41	(2)
2015-03-27	F	08:43 - 08:44	(2)
2015-03-27	F	08:49 - 08:52	(4)
2015-03-27	F	08:55 - 08:57	(3)

2015-03-27	F	08:59 - 08:59	(1)
2015-03-28	F	06:10 - 06:10	(1)
2015-03-29	F	02:48 - 02:48	(1)
2015-03-29	F	20:33 - 20:34	(2)
2015-03-29	F	20:51 - 20:52	(2)
2015-03-29	F	21:11 - 21:11	(1)
2015-03-29	F	21:14 - 21:14	(1)
2015-03-29	F	21:34 - 21:35	(2)
2015-03-29	F	21:38 - 21:38	(1)
2015-03-29	F	21:44 - 21:44	(1)
2015-03-29	F	21:46 - 21:47	(2)
2015-03-29	F	22:12 - 22:12	(1)
2015-03-30	F	07:39 - 07:39	(1)
2015-03-30	F	07:44 - 07:44	(1)
2015-03-30	F	20:31 - 22:30	(120)
2015-03-31	F	08:33 - 08:33	(1)
2015-03-31	F	20:51 - 20:52	(2)
2015-03-31	F	20:57 - 20:57	(1)
2015-03-31	F	21:11 - 21:12	(2)
2015-03-31	F	21:14 - 21:14	(1)
2015-03-31	F	21:42 - 21:43	(2)
2015-03-31	F	21:53 - 21:54	(2)
2015-03-31	F	22:06 - 22:06	(1)
2015-04-02	F	00:54 - 00:54	(1)
2015-04-02	F	01:29 - 01:29	(1)
2015-04-02	F	01:31 - 01:32	(2)
2015-04-03	F	00:04 - 00:04	(1)
2015-04-03	F	00:21 - 00:21	(1)
2015-04-03	F	01:59 - 01:59	(1)
2015-04-03	F	02:02 - 02:02	(1)
2015-04-03	F	02:05 - 02:05	(1)
2015-04-03	F	02:30 - 02:30	(1)
2015-04-03	F	02:55 - 02:55	(1)
2015-04-03	F	08:02 - 08:02	(1)
2015-04-03	F	08:15 - 08:15	(1)
2015-04-03	F	08:31 - 08:31	(1)
2015-04-03	F	14:10 - 14:10	(1)
2015-04-03	F	14:18 - 14:18	(1)
2015-04-03	F	14:23 - 14:23	(1)
2015-04-03	F	14:29 - 14:29	(1)
2015-04-03	F	14:35 - 14:35	(1)
2015-04-03	F	15:33 - 15:34	(2)
2015-04-03	F	20:10 - 20:10	(1)
2015-04-03	F	20:15 - 20:35	(21)
2015-04-03	F	20:37 - 20:37	(1)
2015-04-03	F	20:40 - 20:40	(1)
2015-04-04	F	01:53 - 01:54	(2)
2015-04-04	F	02:27 - 02:27	(1)
2015-04-04	F	02:29 - 02:29	(1)
2015-04-04	F	02:31 - 02:31	(1)
2015-04-04	F	04:16 - 04:16	(1)
2015-04-04	F	04:20 - 04:20	(1)
2015-04-04	F	08:10 - 08:10	(1)
2015-04-04	F	08:26 - 08:26	(1)
2015-04-04	F	08:32 - 08:32	(1)
2015-04-04	F	08:38 - 08:38	(1)
2015-04-04	F	14:20 - 14:20	(1)
2015-04-04	F	14:23 - 14:23	(1)
2015-04-04	F	14:27 - 14:27	(1)
2015-04-04	F	14:30 - 14:31	(2)
2015-04-04	F	14:39 - 14:40	(2)

2015-04-04	F	14:44 - 14:44	(1)
2015-04-04	F	15:31 - 15:31	(1)
2015-04-04	F	20:02 - 20:02	(1)
2015-04-04	F	20:15 - 20:34	(20)
2015-04-05	F	04:35 - 04:35	(1)
2015-04-05	F	05:37 - 05:38	(2)
2015-04-05	F	08:25 - 08:25	(1)
2015-04-05	F	08:28 - 08:28	(1)
2015-04-05	F	08:30 - 08:30	(1)
2015-04-05	F	08:40 - 08:41	(2)
2015-04-05	F	08:43 - 08:43	(1)
2015-04-05	F	08:45 - 08:46	(2)
2015-04-05	F	14:19 - 14:19	(1)
2015-04-05	F	14:22 - 14:23	(2)
2015-04-05	F	14:32 - 14:33	(2)
2015-04-05	F	14:37 - 14:37	(1)
2015-04-05	F	14:41 - 14:42	(2)
2015-04-05	F	14:47 - 14:47	(1)
2015-04-05	F	14:51 - 14:51	(1)
2015-04-05	F	20:17 - 20:17	(1)
2015-04-05	F	20:21 - 20:52	(32)
2015-04-06	F	04:00 - 04:00	(1)
2015-04-09	F	08:11 - 08:12	(2)
2015-04-10	F	01:37 - 01:37	(1)
2015-04-10	F	01:57 - 01:57	(1)
2015-04-10	F	02:27 - 02:29	(3)
2015-04-10	F	02:32 - 02:33	(2)
2015-04-10	F	06:53 - 06:53	(1)
2015-04-10	F	08:43 - 08:43	(1)
2015-04-10	F	16:03 - 16:03	(1)
2015-04-10	F	22:02 - 22:03	(2)
2015-04-10	F	22:05 - 22:06	(2)
2015-04-10	F	22:12 - 22:15	(4)
2015-04-10	F	22:17 - 22:18	(2)
2015-04-10	F	22:21 - 22:21	(1)
2015-04-10	F	22:25 - 22:27	(3)
2015-04-10	F	22:32 - 22:32	(1)
2015-04-10	F	22:34 - 22:34	(1)
2015-04-10	F	22:37 - 22:38	(2)
2015-04-11	F	22:00 - 22:40	(41)
2015-04-12	F	01:05 - 01:05	(1)
2015-04-12	F	15:13 - 15:13	(1)
2015-04-12	F	22:04 - 22:29	(26)
2015-04-12	F	22:32 - 22:33	(2)
2015-04-13	F	22:00 - 22:34	(35)
2015-04-14	F	15:00 - 15:00	(1)
2015-04-14	F	15:14 - 15:16	(3)
2015-04-14	F	15:26 - 15:28	(3)
2015-04-14	F	17:22 - 17:23	(2)
2015-04-14	F	23:01 -	
2015-04-15	F	- 00:12	(72)
2015-04-15	F	13:22 - 13:23	(2)
2015-04-15	F	23:09 - 23:09	(1)
2015-04-16	F	00:49 - 00:49	(1)
2015-04-16	F	00:52 - 00:52	(1)
2015-04-16	F	00:55 - 00:55	(1)
2015-04-16	F	00:59 - 00:59	(1)
2015-04-16	F	15:30 - 15:31	(2)
2015-04-16	F	16:06 - 16:06	(1)
2015-04-16	F	22:40 - 22:41	(2)
2015-04-16	F	23:23 - 23:23	(1)

2015-04-16	F	23:42 - 23:43	(2)
2015-04-16	F	23:52 - 23:52	(1)
2015-04-17	F	00:06 - 00:06	(1)
2015-04-17	F	00:14 - 00:15	(2)
2015-04-17	F	00:18 - 00:18	(1)
2015-04-17	F	06:25 - 06:25	(1)
2015-04-17	F	10:05 - 10:05	(1)
2015-04-17	F	10:14 - 10:14	(1)
2015-04-17	F	10:16 - 10:16	(1)
2015-04-17	F	10:19 - 10:19	(1)
2015-04-17	F	10:25 - 10:28	(4)
2015-04-17	F	10:34 - 10:35	(2)
2015-04-17	F	10:44 - 10:44	(1)
2015-04-17	F	10:46 - 10:47	(2)
2015-04-17	F	10:56 - 10:56	(1)
2015-04-17	F	11:14 - 11:16	(3)
2015-04-17	F	11:18 - 11:18	(1)
2015-04-17	F	11:21 - 11:21	(1)
2015-04-17	F	11:24 - 11:24	(1)
2015-04-17	F	11:28 - 11:30	(3)
2015-04-17	F	11:36 - 11:37	(2)
2015-04-17	F	11:39 - 11:39	(1)
2015-04-17	F	11:53 - 11:53	(1)
2015-04-17	F	11:56 - 11:56	(1)
2015-04-17	F	20:01 - 22:03	(123)
2015-04-18	F	01:35 - 01:35	(1)
2015-04-18	F	23:42 - 23:44	(3)
2015-04-18	F	23:47 - 23:47	(1)
2015-04-19	F	23:35 - 23:35	(1)
2015-04-20	F	04:46 - 04:46	(1)
2015-04-20	F	04:48 - 04:48	(1)
2015-04-20	F	05:00 - 05:00	(1)
2015-04-20	F	05:02 - 05:02	(1)
2015-04-20	F	05:12 - 05:12	(1)
2015-04-20	F	05:23 - 05:24	(2)
2015-04-20	F	10:03 - 10:03	(1)
2015-04-20	F	10:09 - 10:10	(2)
2015-04-20	F	10:35 - 10:35	(1)
2015-04-20	F	10:38 - 10:38	(1)
2015-04-20	F	15:08 - 15:09	(2)
2015-04-20	F	15:31 - 15:32	(2)
2015-04-21	F	01:18 - 01:19	(2)
2015-04-21	F	02:44 - 02:44	(1)
2015-04-21	F	04:02 - 04:02	(1)
2015-04-21	F	05:45 - 05:46	(2)
2015-04-21	F	05:48 - 05:48	(1)
2015-04-21	F	23:34 - 23:34	(1)
2015-04-21	F	23:37 - 23:39	(3)
2015-04-21	F	23:48 - 23:49	(2)
2015-04-22	F	00:08 - 00:08	(1)
2015-04-22	F	00:34 - 00:34	(1)
2015-04-22	F	23:52 - 23:52	(1)
2015-04-22	F	23:58 - 23:59	(2)
2015-04-23	F	00:01 - 00:01	(1)
2015-04-23	F	00:24 - 00:25	(2)
2015-04-23	F	00:30 - 00:30	(1)
2015-04-24	F	09:09 - 09:09	(1)
2015-04-24	F	09:15 - 09:16	(2)
2015-04-24	F	09:23 - 09:24	(2)
2015-04-24	F	09:34 - 09:34	(1)
2015-04-24	F	09:37 - 09:37	(1)

2015-04-24	F	09:42 - 09:42	(1)
2015-04-24	F	10:07 - 10:07	(1)
2015-04-24	F	10:11 - 10:14	(4)
2015-04-24	F	13:11 - 13:11	(1)
2015-04-24	F	13:14 - 13:14	(1)
2015-04-24	F	13:26 - 13:26	(1)
2015-04-24	F	13:28 - 13:29	(2)
2015-04-24	F	13:33 - 13:33	(1)
2015-04-24	F	13:45 - 13:50	(6)
2015-04-24	F	13:52 - 13:55	(4)
2015-04-24	F	13:58 - 13:58	(1)
2015-04-24	F	14:00 - 14:00	(1)
2015-04-24	F	14:03 - 14:03	(1)
2015-04-24	F	14:05 - 14:05	(1)
2015-04-24	F	14:07 - 14:07	(1)
2015-04-24	F	14:09 - 14:09	(1)
2015-04-24	F	17:01 - 18:15	(75)
2015-04-24	F	21:00 - 22:10	(71)
2015-04-24	F	22:14 - 22:15	(2)
2015-04-25	F	00:55 - 00:55	(1)
2015-04-25	F	01:04 - 01:04	(1)
2015-04-25	F	01:07 - 01:08	(2)
2015-04-25	F	01:18 - 01:18	(1)
2015-04-25	F	01:35 - 01:35	(1)
2015-04-25	F	07:58 - 08:00	(3)
2015-04-25	F	08:04 - 08:06	(3)
2015-04-25	F	08:10 - 08:11	(2)
2015-04-25	F	08:18 - 08:18	(1)
2015-04-25	F	08:21 - 08:21	(1)
2015-04-25	F	08:24 - 08:25	(2)
2015-04-25	F	08:33 - 08:33	(1)
2015-04-25	F	08:42 - 08:42	(1)
2015-04-25	F	08:46 - 08:46	(1)
2015-04-25	F	08:48 - 08:49	(2)
2015-04-25	F	08:51 - 08:51	(1)
2015-04-25	F	08:53 - 08:56	(4)
2015-04-25	F	21:01 - 22:57	(117)
2015-04-26	F	08:06 - 08:08	(3)
2015-04-26	F	08:11 - 08:11	(1)
2015-04-26	F	08:14 - 08:14	(1)
2015-04-26	F	08:18 - 08:19	(2)
2015-04-26	F	08:22 - 08:22	(1)
2015-04-26	F	08:26 - 08:26	(1)
2015-04-26	F	08:33 - 08:33	(1)
2015-04-26	F	08:35 - 08:39	(5)
2015-04-26	F	08:44 - 08:47	(4)
2015-04-26	F	08:50 - 08:55	(6)
2015-04-26	F	21:03 - 22:53	(111)
2015-04-27	F	08:05 - 08:05	(1)
2015-04-27	F	08:31 - 08:31	(1)
2015-04-27	F	08:40 - 08:40	(1)
2015-04-27	F	08:42 - 08:42	(1)
2015-04-27	F	21:11 - 21:11	(1)
2015-04-27	F	21:31 - 21:31	(1)
2015-04-27	F	21:52 - 21:53	(2)
2015-04-27	F	21:55 - 21:55	(1)
2015-04-27	F	22:21 - 22:21	(1)
2015-04-27	F	22:50 - 22:50	(1)
2015-04-29	F	00:09 - 00:09	(1)
2015-04-29	F	00:42 - 00:42	(1)
2015-04-29	F	11:03 - 11:04	(2)

2015-04-30	F	00:02 - 01:04	(63)
2015-04-30	F	01:11 - 01:11	(1)
2015-05-01	F	09:34 - 09:34	(1)
2015-05-01	F	09:38 - 09:38	(1)
2015-05-01	F	09:40 - 09:40	(1)
2015-05-01	F	09:43 - 09:43	(1)
2015-05-01	F	09:55 - 09:55	(1)
2015-05-01	F	09:58 - 09:58	(1)
2015-05-01	F	10:04 - 10:04	(1)
2015-05-01	F	10:06 - 10:07	(2)
2015-05-01	F	10:13 - 10:15	(3)
2015-05-01	F	10:18 - 10:18	(1)
2015-05-01	F	10:21 - 10:22	(2)
2015-05-01	F	10:27 - 10:29	(3)
2015-05-01	F	10:31 - 10:31	(1)
2015-05-01	F	10:33 - 10:35	(3)
2015-05-01	F	10:37 - 10:41	(5)
2015-05-01	F	10:44 - 10:45	(2)
2015-05-01	F	10:49 - 10:49	(1)
2015-05-01	F	10:56 - 10:59	(4)
2015-05-01	F	11:01 - 11:02	(2)
2015-05-01	F	11:04 - 11:04	(1)
2015-05-01	F	11:07 - 11:07	(1)
2015-05-01	F	11:12 - 11:12	(1)
2015-05-01	F	11:15 - 11:18	(4)
2015-05-01	F	11:20 - 11:21	(2)
2015-05-01	F	11:25 - 11:29	(5)
2015-05-01	F	11:31 - 11:34	(4)
2015-05-01	F	11:36 - 11:37	(2)
2015-05-01	F	11:42 - 11:42	(1)
2015-05-01	F	11:45 - 11:48	(4)
2015-05-02	F	01:04 - 01:04	(1)
2015-05-02	F	01:06 - 01:06	(1)
2015-05-02	F	01:11 - 01:12	(2)
2015-05-02	F	01:24 - 01:24	(1)
2015-05-02	F	01:30 - 01:30	(1)
2015-05-02	F	01:32 - 01:33	(2)
2015-05-02	F	01:36 - 01:39	(4)
2015-05-02	F	01:41 - 01:41	(1)
2015-05-02	F	01:44 - 01:44	(1)
2015-05-03	F	01:39 - 01:39	(1)
2015-05-06	F	01:35 - 01:35	(1)
2015-05-06	F	01:43 - 01:44	(2)
2015-05-06	F	06:10 - 06:10	(1)
2015-05-06	F	10:34 - 10:34	(1)
2015-05-07	F	23:13 - 23:13	(1)
2015-05-08	F	00:06 - 00:06	(1)
2015-05-08	F	00:16 - 00:16	(1)
2015-05-08	F	00:29 - 00:29	(1)
2015-05-08	F	00:54 - 00:55	(2)
2015-05-08	F	01:03 - 01:03	(1)
2015-05-08	F	23:01 - 23:04	(4)
2015-05-09	F	00:09 - 00:09	(1)
2015-05-09	F	00:51 - 00:51	(1)
2015-05-09	F	00:54 - 00:54	(1)
2015-05-09	F	00:58 - 00:58	(1)
2015-05-09	F	01:03 - 01:04	(2)
2015-05-09	F	01:16 - 01:16	(1)
2015-05-09	F	01:18 - 01:18	(1)
2015-05-09	F	01:21 - 01:21	(1)
2015-05-09	F	23:30 - 23:32	(3)

2015-05-10	F	00:29 - 00:29	(1)
2015-05-10	F	01:19 - 01:19	(1)
2015-05-10	F	23:31 - 23:32	(2)
2015-05-11	F	01:36 - 01:36	(1)
2015-05-11	F	02:07 - 02:07	(1)
2015-05-11	F	13:44 - 13:45	(2)
2015-05-12	F	10:35 - 10:35	(1)
2015-05-13	F	00:00 - 00:00	(1)
2015-05-13	F	00:09 - 00:12	(4)
2015-05-13	F	21:44 - 21:45	(2)
2015-05-13	F	21:49 - 21:49	(1)
2015-05-13	F	21:51 - 21:51	(1)
2015-05-13	F	21:53 - 21:54	(2)
2015-05-13	F	21:57 - 21:57	(1)
2015-05-13	F	22:09 - 22:11	(3)
2015-05-13	F	22:22 - 22:23	(2)
2015-05-13	F	23:35 - 23:35	(1)
2015-05-13	F	23:43 - 23:43	(1)
2015-05-13	F	23:45 - 23:46	(2)
2015-05-13	F	23:51 - 23:52	(2)
2015-05-14	F	00:02 - 00:02	(1)
2015-05-14	F	00:08 - 00:08	(1)
2015-05-14	F	03:37 - 03:37	(1)
2015-05-14	F	03:45 - 03:46	(2)
2015-05-14	F	03:54 - 03:54	(1)
2015-05-14	F	08:51 - 08:52	(2)
2015-05-14	F	08:54 - 08:54	(1)
2015-05-14	F	09:00 - 09:00	(1)
2015-05-14	F	09:06 - 09:06	(1)
2015-05-14	F	09:08 - 09:09	(2)
2015-05-14	F	09:14 - 09:14	(1)
2015-05-14	F	09:16 - 09:17	(2)
2015-05-14	F	09:36 - 09:37	(2)
2015-05-14	F	09:42 - 09:43	(2)
2015-05-14	F	09:56 - 09:56	(1)
2015-05-14	F	09:59 - 10:01	(3)
2015-05-14	F	10:03 - 10:03	(1)
2015-05-14	F	10:05 - 10:07	(3)
2015-05-14	F	10:12 - 10:12	(1)
2015-05-14	F	22:01 - 22:01	(1)
2015-05-14	F	22:12 - 22:12	(1)
2015-05-14	F	22:20 - 22:23	(4)
2015-05-14	F	22:57 - 22:57	(1)
2015-05-14	F	23:04 - 23:04	(1)
2015-05-14	F	23:06 - 23:06	(1)
2015-05-14	F	23:09 - 23:09	(1)
2015-05-14	F	23:16 - 23:16	(1)
2015-05-14	F	23:22 - 23:23	(2)
2015-05-14	F	23:35 - 23:36	(2)
2015-05-14	F	23:38 - 23:38	(1)
2015-05-14	F	23:40 - 23:41	(2)
2015-05-14	F	23:47 - 23:47	(1)
2015-05-15	F	06:46 - 06:46	(1)
2015-05-15	F	21:05 - 21:34	(30)
2015-05-15	F	21:43 - 21:44	(2)
2015-05-15	F	21:47 - 21:47	(1)
2015-05-15	F	21:51 - 21:51	(1)
2015-05-15	F	21:57 - 22:00	(4)
2015-05-15	F	22:02 - 22:02	(1)
2015-05-15	F	22:04 - 22:05	(2)
2015-05-15	F	22:10 - 22:12	(3)

2015-05-16	F	18:00 - 18:00	(1)
2015-05-18	F	23:14 - 23:15	(2)
2015-05-19	F	00:33 - 00:33	(1)
2015-05-19	F	00:35 - 00:35	(1)
2015-05-19	F	00:39 - 00:39	(1)
2015-05-19	F	22:54 - 22:54	(1)
2015-05-19	F	22:59 - 22:59	(1)
2015-05-19	F	23:01 - 23:01	(1)
2015-05-19	F	23:26 - 23:26	(1)
2015-05-19	F	23:28 - 23:29	(2)
2015-05-19	F	23:44 - 23:44	(1)
2015-05-19	F	23:47 - 23:47	(1)
2015-05-19	F	23:57 - 23:57	(1)
2015-05-20	F	00:05 - 00:06	(2)
2015-05-20	F	00:10 - 00:10	(1)
2015-05-20	F	00:21 - 00:21	(1)
2015-05-20	F	00:35 - 00:35	(1)
2015-05-22	F	08:52 - 08:52	(1)
2015-05-28	F	23:44 - 23:44	(1)
2015-05-28	F	23:50 - 23:50	(1)
2015-05-29	F	23:33 - 23:33	(1)
2015-05-30	F	00:16 - 00:16	(1)
2015-05-30	F	00:26 - 00:26	(1)
2015-05-30	F	00:41 - 00:43	(3)
2015-05-30	F	00:51 - 00:51	(1)
2015-05-30	F	00:57 - 00:57	(1)
2015-05-30	F	01:04 - 01:05	(2)
2015-05-30	F	23:32 - 23:32	(1)
2015-05-30	F	23:34 - 23:34	(1)
2015-05-30	F	23:40 - 23:41	(2)
2015-05-30	F	23:44 - 23:44	(1)
2015-05-31	F	00:47 - 00:47	(1)
2015-05-31	F	00:50 - 00:51	(2)
2015-05-31	F	01:01 - 01:01	(1)
2015-05-31	F	23:38 - 23:38	(1)
2015-05-31	F	23:57 -	
2015-06-01	F	- 00:00	(4)
2015-06-01	F	00:35 - 00:35	(1)
2015-06-01	F	01:03 - 01:03	(1)
2015-06-01	F	01:15 - 01:15	(1)
2015-06-03	F	23:31 - 23:33	(3)
2015-06-03	F	23:50 - 23:50	(1)
2015-06-04	F	00:42 - 00:42	(1)
2015-06-04	F	00:51 - 00:51	(1)
2015-06-04	F	08:01 - 08:01	(1)
2015-06-04	F	23:51 - 23:51	(1)
2015-06-05	F	00:07 - 00:07	(1)
2015-06-05	F	08:10 - 08:11	(2)
2015-06-05	F	08:20 - 08:21	(2)
2015-06-05	F	08:35 - 08:35	(1)
2015-06-05	F	08:43 - 08:43	(1)
2015-06-05	F	08:45 - 08:45	(1)
2015-06-05	F	08:49 - 08:49	(1)
2015-06-05	F	08:55 - 08:55	(1)
2015-06-05	F	09:18 - 09:18	(1)
2015-06-05	F	09:20 - 09:21	(2)
2015-06-05	F	11:46 - 11:46	(1)
2015-06-05	F	12:10 - 12:10	(1)
2015-06-05	F	12:39 - 12:39	(1)
2015-06-05	F	12:56 - 12:57	(2)
2015-06-05	F	13:01 - 13:02	(2)

2015-06-05	F	13:19 - 13:20	(2)
2015-06-05	F	13:24 - 13:24	(1)
2015-06-05	F	13:32 - 13:33	(2)
2015-06-05	F	13:39 - 13:39	(1)
2015-06-05	F	23:38 - 23:38	(1)
2015-06-05	F	23:53 - 23:53	(1)
2015-06-06	F	00:44 - 00:45	(2)
2015-06-06	F	00:57 - 00:57	(1)
2015-06-06	F	01:14 - 01:14	(1)
2015-06-06	F	01:19 - 01:19	(1)
2015-06-06	F	01:26 - 01:26	(1)
2015-06-06	F	01:32 - 01:32	(1)
2015-06-06	F	01:35 - 01:37	(3)
2015-06-06	F	23:32 - 23:33	(2)
2015-06-06	F	23:55 - 23:56	(2)
2015-06-06	F	23:58 - 23:58	(1)
2015-06-07	F	00:02 - 00:03	(2)
2015-06-07	F	00:06 - 00:10	(5)
2015-06-07	F	00:38 - 00:38	(1)
2015-06-07	F	01:36 - 01:37	(2)
2015-06-08	F	00:28 - 00:28	(1)
2015-06-08	F	00:43 - 00:43	(1)
2015-06-08	F	01:08 - 01:08	(1)
2015-06-08	F	01:24 - 01:24	(1)
2015-06-08	F	02:06 - 02:07	(2)
2015-06-08	F	02:09 - 02:09	(1)
2015-06-08	F	02:18 - 02:21	(4)
2015-06-08	F	02:23 - 02:23	(1)
2015-06-08	F	02:37 - 02:39	(3)
2015-06-08	F	02:53 - 02:53	(1)
2015-06-08	F	02:55 - 02:56	(2)
2015-06-08	F	02:59 - 02:59	(1)
2015-06-08	F	03:02 - 03:02	(1)
2015-06-08	F	03:08 - 03:08	(1)
2015-06-08	F	03:10 - 03:10	(1)
2015-06-08	F	10:42 - 10:42	(1)
2015-06-08	F	14:23 - 14:23	(1)
2015-06-09	F	00:06 - 00:07	(2)
2015-06-09	F	08:41 - 08:41	(1)
2015-06-09	F	08:47 - 08:48	(2)
2015-06-09	F	08:53 - 08:53	(1)
2015-06-09	F	09:02 - 09:03	(2)
2015-06-09	F	09:05 - 09:08	(4)
2015-06-09	F	09:15 - 09:15	(1)
2015-06-09	F	09:23 - 09:23	(1)
2015-06-09	F	09:27 - 09:29	(3)
2015-06-09	F	09:44 - 09:45	(2)
2015-06-09	F	09:50 - 09:50	(1)
2015-06-09	F	10:00 - 10:01	(2)
2015-06-09	F	10:19 - 10:19	(1)
2015-06-09	F	10:23 - 10:23	(1)
2015-06-09	F	10:29 - 10:29	(1)
2015-06-09	F	10:32 - 10:32	(1)
2015-06-09	F	14:31 - 14:33	(3)
2015-06-09	F	23:32 - 23:32	(1)
2015-06-09	F	23:47 - 23:47	(1)
2015-06-10	F	00:22 - 00:22	(1)
2015-06-10	F	00:33 - 00:33	(1)
2015-06-10	F	01:35 - 01:36	(2)
2015-06-10	F	06:55 - 06:55	(1)
2015-06-10	F	07:59 - 07:59	(1)

2015-06-10	F	10:06 - 10:06	(1)
2015-06-11	F	01:16 - 01:16	(1)
2015-06-11	F	07:28 - 07:28	(1)
2015-06-11	F	07:59 - 07:59	(1)
2015-06-11	F	08:09 - 08:10	(2)
2015-06-11	F	23:55 - 23:55	(1)
2015-06-12	F	00:08 - 00:08	(1)
2015-06-12	F	00:54 - 00:56	(3)
2015-06-12	F	16:16 - 16:16	(1)
2015-06-12	F	16:21 - 16:22	(2)
2015-06-12	F	23:37 - 23:37	(1)
2015-06-13	F	00:33 - 00:33	(1)
2015-06-13	F	00:48 - 00:49	(2)
2015-06-13	F	00:55 - 00:55	(1)
2015-06-13	F	01:07 - 01:07	(1)
2015-06-13	F	23:42 - 23:42	(1)
2015-06-13	F	23:47 - 23:47	(1)
2015-06-13	F	23:50 - 23:50	(1)
2015-06-13	F	23:53 - 23:53	(1)
2015-06-13	F	23:56 - 23:56	(1)
2015-06-14	F	00:06 - 00:06	(1)
2015-06-14	F	00:10 - 00:10	(1)
2015-06-14	F	23:47 - 23:47	(1)
2015-06-15	F	00:55 - 00:55	(1)
2015-06-15	F	01:22 - 01:22	(1)
2015-06-15	F	01:52 - 01:52	(1)
2015-06-15	F	01:57 - 01:57	(1)
2015-06-15	F	02:23 - 02:23	(1)
2015-06-15	F	05:15 - 05:15	(1)
2015-06-15	F	06:44 - 06:44	(1)
2015-06-16	F	00:16 - 00:16	(1)
2015-06-16	F	00:40 - 00:40	(1)
2015-06-17	F	00:41 - 00:41	(1)
2015-06-17	F	23:11 - 23:11	(1)
2015-06-18	F	14:26 - 14:27	(2)
2015-06-21	F	17:09 - 17:09	(1)
2015-06-21	F	17:12 - 17:12	(1)
2015-06-22	F	19:01 - 19:01	(1)
2015-06-22	F	19:18 - 19:18	(1)
2015-06-22	F	19:35 - 19:35	(1)
2015-06-25	F	05:00 - 05:00	(1)
2015-06-25	F	05:26 - 05:26	(1)
2015-06-28	F	00:28 - 00:28	(1)
2015-06-28	F	01:07 - 01:07	(1)
2015-06-28	F	05:28 - 05:28	(1)
2015-06-29	F	07:35 - 07:35	(1)
2015-06-30	F	16:03 - 16:03	(1)
2015-06-30	F	22:44 - 22:44	(1)
2015-06-30	F	22:47 - 22:47	(1)
2015-06-30	F	22:58 - 22:58	(1)
2015-06-30	F	23:01 - 23:01	(1)
2015-06-30	F	23:14 - 23:15	(2)
2015-06-30	F	23:53 - 23:55	(3)
2015-07-01	F	00:27 - 00:27	(1)
2015-07-01	F	00:32 - 00:32	(1)
2015-07-01	F	14:38 - 14:38	(1)
2015-07-03	F	22:01 - 22:01	(1)
2015-07-03	F	22:03 - 22:03	(1)
2015-07-03	F	22:26 - 22:26	(1)
2015-07-04	F	13:37 - 13:39	(3)
2015-07-04	F	23:39 -	

2015-07-05	F	- 00:00	(22)
2015-07-05	F	00:04 - 00:04	(1)
2015-07-05	F	00:08 - 00:10	(3)
2015-07-05	F	00:12 - 00:13	(2)
2015-07-05	F	00:15 - 00:15	(1)
2015-07-05	F	00:17 - 00:17	(1)
2015-07-05	F	00:41 - 00:41	(1)
2015-07-05	F	01:14 - 01:14	(1)
2015-07-05	F	04:36 - 04:36	(1)
2015-07-10	F	00:32 - 00:32	(1)
2015-07-10	F	23:27 - 23:27	(1)
2015-07-10	F	23:46 - 23:46	(1)
2015-07-11	F	00:33 - 00:33	(1)
2015-07-11	F	00:36 - 00:36	(1)
2015-07-11	F	00:52 - 00:52	(1)
2015-07-11	F	01:05 - 01:05	(1)
2015-07-11	F	01:14 - 01:15	(2)
2015-07-11	F	01:22 - 01:22	(1)
2015-07-11	F	01:29 - 01:29	(1)
2015-07-11	F	01:57 - 01:57	(1)
2015-07-11	F	04:03 - 04:05	(3)
2015-07-11	F	07:49 - 07:49	(1)
2015-07-12	F	01:22 - 01:22	(1)
2015-07-12	F	01:33 - 01:33	(1)
2015-07-12	F	03:08 - 03:08	(1)
2015-07-12	F	06:56 - 06:56	(1)
2015-07-12	F	07:35 - 07:35	(1)
2015-07-12	F	23:22 - 23:22	(1)
2015-07-13	F	01:36 - 01:36	(1)
2015-07-13	F	02:31 - 02:31	(1)
2015-07-13	F	15:52 - 15:52	(1)
2015-07-14	F	01:01 - 01:01	(1)
2015-07-15	F	00:35 - 00:35	(1)
2015-07-15	F	01:03 - 01:03	(1)
2015-07-15	F	01:20 - 01:20	(1)
2015-07-16	F	22:31 - 22:31	(1)
2015-07-16	F	22:35 - 22:35	(1)
2015-07-16	F	22:37 - 22:37	(1)
2015-07-16	F	22:42 - 22:42	(1)
2015-07-16	F	22:47 - 22:48	(2)
2015-07-16	F	23:56 - 23:56	(1)
2015-07-17	F	00:03 - 00:04	(2)
2015-07-17	F	00:21 - 00:21	(1)
2015-07-17	F	00:29 - 00:29	(1)
2015-07-17	F	00:58 - 00:59	(2)
2015-07-17	F	01:02 - 01:02	(1)
2015-07-19	F	00:09 - 00:10	(2)
2015-07-20	F	10:43 - 10:43	(1)
2015-07-21	F	22:03 - 22:03	(1)
2015-07-21	F	22:40 - 22:41	(2)
2015-07-21	F	22:51 - 22:51	(1)
2015-07-25	F	01:27 - 01:28	(2)
2015-07-25	F	23:46 - 23:46	(1)
2015-07-26	F	00:36 - 00:37	(2)
2015-07-26	F	01:22 - 01:25	(4)
2015-07-26	F	05:16 - 05:16	(1)
2015-07-26	F	05:30 - 05:30	(1)
2015-07-27	F	00:08 - 00:08	(1)
2015-07-27	F	01:20 - 01:20	(1)
2015-07-28	F	03:33 - 03:35	(3)
2015-07-30	F	00:47 - 00:48	(2)

2015-08-01	F	00:41 - 00:42	(2)
2015-08-01	F	00:55 - 00:56	(2)
2015-08-01	F	01:05 - 01:05	(1)
2015-08-02	F	00:34 - 00:34	(1)
2015-08-02	F	00:56 - 00:56	(1)
2015-08-02	F	01:04 - 01:04	(1)
2015-08-02	F	01:18 - 01:18	(1)
2015-08-02	F	01:25 - 01:25	(1)
2015-08-02	F	01:29 - 01:31	(3)
2015-08-02	F	01:33 - 01:33	(1)
2015-08-02	F	14:24 - 14:24	(1)
2015-08-03	F	00:58 - 00:58	(1)
2015-08-03	F	01:33 - 01:35	(3)
2015-08-03	F	01:43 - 01:43	(1)
2015-08-03	F	01:51 - 01:51	(1)
2015-08-03	F	02:03 - 02:04	(2)
2015-08-03	F	02:15 - 02:15	(1)
2015-08-03	F	02:25 - 02:25	(1)
2015-08-03	F	23:46 - 23:46	(1)
2015-08-05	F	01:10 - 01:10	(1)
2015-08-06	F	01:14 - 01:14	(1)
2015-08-07	F	06:14 - 06:14	(1)
2015-08-07	F	14:14 - 14:14	(1)
2015-08-08	F	02:41 - 02:41	(1)
2015-08-09	F	15:00 - 15:00	(1)
2015-08-09	F	15:25 - 15:27	(3)
2015-08-12	F	14:55 - 14:55	(1)
2015-08-13	F	17:02 - 17:02	(1)
2015-08-14	F	01:15 - 01:15	(1)
2015-08-15	F	01:31 - 01:33	(3)
2015-08-15	F	01:36 - 01:36	(1)
2015-08-15	F	01:43 - 01:43	(1)
2015-08-15	F	01:46 - 01:47	(2)
2015-08-15	F	01:51 - 01:51	(1)
2015-08-15	F	01:54 - 01:56	(3)
2015-08-15	F	02:04 - 02:04	(1)
2015-08-15	F	16:18 - 16:18	(1)
2015-08-15	F	23:55 - 23:55	(1)
2015-08-16	F	00:16 - 00:16	(1)
2015-08-16	F	00:18 - 00:18	(1)
2015-08-16	F	00:47 - 00:47	(1)
2015-08-16	F	00:54 - 00:54	(1)
2015-08-16	F	00:56 - 00:56	(1)
2015-08-16	F	01:55 - 01:55	(1)
2015-08-17	F	04:52 - 04:53	(2)
2015-08-20	F	01:04 - 01:05	(2)
2015-08-21	F	14:23 - 14:23	(1)
2015-08-23	F	00:56 - 00:56	(1)
2015-08-23	F	00:59 - 00:59	(1)
2015-08-23	F	01:01 - 01:04	(4)
2015-08-23	F	01:12 - 01:12	(1)
2015-08-23	F	01:21 - 01:22	(2)
2015-08-23	F	01:24 - 01:24	(1)
2015-08-23	F	01:29 - 01:33	(5)
2015-08-23	F	01:37 - 01:37	(1)
2015-08-23	F	01:42 - 01:42	(1)
2015-08-23	F	01:44 - 01:44	(1)
2015-08-23	F	01:46 - 01:46	(1)
2015-08-23	F	01:55 - 01:58	(4)
2015-08-23	F	23:43 - 23:43	(1)
2015-08-24	F	00:22 - 00:22	(1)

2015-08-24	F	00:58 - 00:58	(1)
2015-08-24	F	01:03 - 01:04	(2)
2015-08-24	F	01:06 - 01:06	(1)
2015-08-24	F	01:15 - 01:15	(1)
2015-08-24	F	01:58 - 01:58	(1)
2015-08-24	F	03:08 - 03:10	(3)
2015-08-25	F	23:50 - 23:50	(1)
2015-08-26	F	00:16 - 00:16	(1)
2015-08-26	F	00:19 - 00:19	(1)
2015-08-26	F	00:32 - 00:33	(2)
2015-08-26	F	00:49 - 00:49	(1)
2015-08-26	F	00:55 - 00:55	(1)
2015-08-26	F	01:18 - 01:18	(1)
2015-08-26	F	01:21 - 01:21	(1)
2015-08-26	F	17:18 - 17:18	(1)
2015-08-27	F	00:07 - 00:07	(1)
2015-08-27	F	00:09 - 00:09	(1)
2015-08-27	F	00:24 - 00:28	(5)
2015-08-27	F	00:32 - 00:34	(3)
2015-08-27	F	00:36 - 00:36	(1)
2015-08-27	F	00:38 - 00:38	(1)
2015-08-27	F	00:47 - 00:47	(1)
2015-08-27	F	03:16 - 03:16	(1)
2015-08-27	F	03:56 - 03:56	(1)
2015-08-27	F	23:27 -	
2015-08-28	F	- 01:18	(112)
2015-08-28	F	15:13 - 15:14	(2)
2015-08-28	F	17:48 - 17:49	(2)
2015-08-28	F	22:18 -	
2015-08-29	F	- 00:00	(103)
2015-08-29	F	00:05 - 00:06	(2)
2015-08-29	F	00:11 - 00:12	(2)
2015-08-29	F	00:14 - 00:14	(1)
2015-09-01	F	12:00 - 12:00	(1)
2015-09-02	F	01:42 - 01:42	(1)
2015-09-02	F	03:17 - 03:17	(1)
2015-09-03	F	00:06 - 00:06	(1)
2015-09-03	F	00:13 - 00:13	(1)
2015-09-03	F	00:17 - 00:17	(1)
2015-09-03	F	00:22 - 00:22	(1)
2015-09-03	F	00:25 - 00:25	(1)
2015-09-03	F	00:28 - 00:28	(1)
2015-09-03	F	00:40 - 00:41	(2)
2015-09-03	F	00:47 - 00:47	(1)
2015-09-03	F	01:03 - 01:03	(1)
2015-09-03	F	01:08 - 01:09	(2)
2015-09-03	F	01:11 - 01:11	(1)
2015-09-03	F	01:16 - 01:16	(1)
2015-09-03	F	01:20 - 01:21	(2)
2015-09-04	F	19:10 - 19:10	(1)
2015-09-05	F	13:42 - 13:42	(1)
2015-09-06	F	00:05 - 00:05	(1)
2015-09-06	F	00:16 - 00:16	(1)
2015-09-06	F	00:35 - 00:35	(1)
2015-09-06	F	00:40 - 00:40	(1)
2015-09-06	F	01:03 - 01:04	(2)
2015-09-06	F	01:11 - 01:12	(2)
2015-09-07	F	15:23 - 15:23	(1)
2015-09-07	F	15:26 - 15:26	(1)
2015-09-08	F	00:01 - 00:03	(3)
2015-09-08	F	01:03 - 01:03	(1)

2015-09-08	F	02:30 - 02:30	(1)
2015-09-08	F	02:56 - 02:57	(2)
2015-09-08	F	05:36 - 05:37	(2)
2015-09-08	F	05:47 - 05:47	(1)
2015-09-08	F	22:27 - 22:28	(2)
2015-09-08	F	22:32 - 22:32	(1)
2015-09-08	F	22:50 - 22:50	(1)
2015-09-08	F	22:57 - 22:57	(1)
2015-09-08	F	23:36 - 23:36	(1)
2015-09-08	F	23:51 - 23:51	(1)
2015-09-09	F	00:09 - 00:12	(4)
2015-09-09	F	00:14 - 00:14	(1)
2015-09-09	F	00:22 - 00:24	(3)
2015-09-09	F	00:34 - 00:37	(4)
2015-09-09	F	00:46 - 00:48	(3)
2015-09-09	F	00:50 - 00:51	(2)
2015-09-09	F	00:53 - 00:53	(1)
2015-09-09	F	06:58 - 06:59	(2)
2015-09-09	F	07:04 - 07:05	(2)
2015-09-09	F	07:36 - 07:36	(1)
2015-09-09	F	07:59 - 08:00	(2)
2015-09-09	F	08:06 - 08:06	(1)
2015-09-09	F	08:16 - 08:17	(2)
2015-09-09	F	08:24 - 08:24	(1)
2015-09-09	F	10:51 - 10:52	(2)
2015-09-09	F	21:31 - 22:50	(80)
2015-09-09	F	23:17 - 23:17	(1)
2015-09-10	F	00:25 - 00:27	(3)
2015-09-10	F	01:09 - 01:09	(1)
2015-09-10	F	15:59 - 15:59	(1)
2015-09-11	F	06:13 - 06:13	(1)
2015-09-11	F	06:19 - 06:19	(1)
2015-09-11	F	06:22 - 06:22	(1)
2015-09-11	F	07:55 - 07:55	(1)
2015-09-11	F	08:00 - 08:02	(3)
2015-09-11	F	08:04 - 08:04	(1)
2015-09-11	F	08:15 - 08:16	(2)
2015-09-11	F	08:27 - 08:28	(2)
2015-09-11	F	08:30 - 08:30	(1)
2015-09-11	F	08:33 - 08:33	(1)
2015-09-11	F	08:36 - 08:36	(1)
2015-09-11	F	08:39 - 08:39	(1)
2015-09-11	F	08:45 - 08:45	(1)
2015-09-11	F	08:57 - 08:57	(1)
2015-09-11	F	08:59 - 08:59	(1)
2015-09-11	F	09:24 - 09:25	(2)
2015-09-11	F	09:27 - 09:27	(1)
2015-09-11	F	09:31 - 09:31	(1)
2015-09-11	F	09:38 - 09:38	(1)
2015-09-11	F	09:44 - 09:44	(1)
2015-09-11	F	09:46 - 09:46	(1)
2015-09-11	F	09:54 - 09:54	(1)
2015-09-11	F	10:02 - 10:05	(4)
2015-09-11	F	14:29 - 14:29	(1)
2015-09-11	F	14:43 - 14:44	(2)
2015-09-11	F	14:49 - 14:49	(1)
2015-09-11	F	22:03 - 22:03	(1)
2015-09-12	F	13:50 - 13:50	(1)
2015-09-14	F	00:41 - 00:41	(1)
2015-09-14	F	01:20 - 01:20	(1)
2015-09-15	F	00:12 - 00:12	(1)

2015-09-16	F	23:37 - 23:37	(1)
2015-09-17	F	01:10 - 01:10	(1)
2015-09-17	F	01:26 - 01:26	(1)
2015-09-19	F	04:53 - 04:54	(2)
2015-09-19	F	05:04 - 05:05	(2)
2015-09-20	F	00:27 - 00:27	(1)
2015-09-20	F	03:27 - 03:30	(4)
2015-09-20	F	06:04 - 06:05	(2)
2015-09-20	F	07:26 - 07:26	(1)
2015-09-20	F	12:48 - 12:48	(1)
2015-09-20	F	21:05 - 21:06	(2)
2015-09-20	F	21:11 - 21:13	(3)
2015-09-20	F	21:21 - 21:21	(1)
2015-09-20	F	21:37 - 21:39	(3)
2015-09-20	F	21:48 - 21:48	(1)
2015-09-20	F	21:58 - 21:58	(1)
2015-09-20	F	22:10 - 22:10	(1)
2015-09-20	F	22:19 - 22:21	(3)
2015-09-20	F	22:25 - 22:25	(1)
2015-09-20	F	22:27 - 22:27	(1)
2015-09-21	F	07:54 - 07:54	(1)
2015-09-21	F	08:04 - 08:04	(1)
2015-09-21	F	21:09 - 21:11	(3)
2015-09-21	F	21:13 - 21:13	(1)
2015-09-21	F	21:21 - 21:21	(1)
2015-09-21	F	21:24 - 21:24	(1)
2015-09-21	F	21:41 - 21:41	(1)
2015-09-21	F	21:59 - 21:59	(1)
2015-09-21	F	22:03 - 22:03	(1)
2015-09-21	F	22:05 - 22:05	(1)
2015-09-21	F	22:10 - 22:10	(1)
2015-09-21	F	22:16 - 22:16	(1)
2015-09-21	F	22:23 - 22:23	(1)
2015-09-21	F	22:37 - 22:37	(1)
2015-09-21	F	23:51 - 23:51	(1)
2015-09-22	F	00:51 - 00:51	(1)
2015-09-22	F	07:32 - 07:32	(1)
2015-09-22	F	07:55 - 07:55	(1)
2015-09-22	F	14:53 - 14:53	(1)
2015-09-22	F	21:00 - 21:00	(1)
2015-09-22	F	21:02 - 21:02	(1)
2015-09-22	F	21:12 - 21:12	(1)
2015-09-22	F	21:40 - 21:40	(1)
2015-09-22	F	21:57 - 21:57	(1)
2015-09-22	F	22:04 - 22:04	(1)
2015-09-23	F	06:02 - 06:02	(1)
2015-09-23	F	07:19 - 07:19	(1)
2015-09-23	F	07:23 - 07:23	(1)
2015-09-23	F	07:32 - 07:32	(1)
2015-09-23	F	16:55 - 16:56	(2)
2015-09-23	F	21:00 - 21:00	(1)
2015-09-23	F	21:08 - 21:09	(2)
2015-09-23	F	21:12 - 21:13	(2)
2015-09-23	F	21:39 - 21:41	(3)
2015-09-23	F	21:59 - 22:04	(6)
2015-09-23	F	22:45 - 22:45	(1)
2015-09-24	F	00:13 - 00:13	(1)
2015-09-24	F	21:01 - 21:01	(1)
2015-09-24	F	21:09 - 21:09	(1)
2015-09-24	F	21:21 - 21:21	(1)
2015-09-24	F	21:28 - 21:28	(1)

2015-09-24	F	21:37 - 21:37	(1)
2015-09-24	F	21:39 - 21:42	(4)
2015-09-24	F	22:19 - 22:19	(1)
2015-09-24	F	23:00 - 23:00	(1)
2015-09-24	F	23:02 - 23:02	(1)
2015-09-24	F	23:06 - 23:06	(1)
2015-09-24	F	23:13 - 23:13	(1)
2015-09-24	F	23:16 - 23:17	(2)
2015-09-24	F	23:19 - 23:21	(3)
2015-09-24	F	23:28 - 23:28	(1)
2015-09-24	F	23:31 - 23:31	(1)
2015-09-24	F	23:33 - 23:39	(7)
2015-09-25	F	07:59 - 08:00	(2)
2015-09-25	F	09:01 - 09:01	(1)
2015-09-25	F	09:05 - 09:05	(1)
2015-09-25	F	09:16 - 09:16	(1)
2015-09-25	F	09:25 - 09:25	(1)
2015-09-25	F	09:52 - 09:52	(1)
2015-09-25	F	10:40 - 10:40	(1)
2015-09-25	F	11:28 - 11:28	(1)
2015-09-25	F	11:30 - 11:30	(1)
2015-09-25	F	12:05 - 12:07	(3)
2015-09-25	F	12:26 - 12:26	(1)
2015-09-25	F	13:31 - 13:31	(1)
2015-09-25	F	21:00 - 21:02	(3)
2015-09-25	F	21:14 - 21:14	(1)
2015-09-25	F	21:21 - 21:21	(1)
2015-09-25	F	21:32 - 21:32	(1)
2015-09-25	F	22:03 - 22:05	(3)
2015-09-25	F	22:21 - 22:22	(2)
2015-09-25	F	22:36 - 22:37	(2)
2015-09-25	F	22:47 - 22:47	(1)
2015-09-25	F	23:19 - 23:19	(1)
2015-09-26	F	18:14 - 18:14	(1)
2015-09-26	F	21:01 - 21:02	(2)
2015-09-26	F	21:19 - 21:19	(1)
2015-09-26	F	21:22 - 21:22	(1)
2015-09-26	F	21:29 - 21:29	(1)
2015-09-26	F	21:32 - 21:33	(2)
2015-09-26	F	21:35 - 21:36	(2)
2015-09-26	F	21:40 - 21:40	(1)
2015-09-26	F	21:53 - 21:53	(1)
2015-09-26	F	22:20 - 22:20	(1)
2015-09-26	F	22:35 - 22:36	(2)
2015-09-26	F	22:46 - 22:47	(2)
2015-09-26	F	23:03 - 23:03	(1)
2015-09-26	F	23:06 - 23:07	(2)
2015-09-26	F	23:26 - 23:26	(1)
2015-09-27	F	00:04 - 00:04	(1)
2015-09-27	F	00:14 - 00:14	(1)
2015-09-27	F	00:21 - 00:21	(1)
2015-09-27	F	00:27 - 00:28	(2)
2015-09-27	F	00:45 - 00:45	(1)
2015-09-27	F	00:53 - 00:53	(1)
2015-09-27	F	08:53 - 08:53	(1)
2015-09-27	F	09:03 - 09:04	(2)
2015-09-27	F	09:20 - 09:20	(1)
2015-09-27	F	09:24 - 09:24	(1)
2015-09-27	F	09:44 - 09:44	(1)
2015-09-28	F	09:55 - 09:58	(4)
2015-09-28	F	10:09 - 10:10	(2)

2015-09-28	F	10:13 - 10:13	(1)
2015-09-28	F	10:16 - 10:17	(2)
2015-09-28	F	10:22 - 10:23	(2)
2015-09-28	F	10:30 - 10:30	(1)
2015-09-28	F	10:33 - 10:33	(1)
2015-09-28	F	10:36 - 10:36	(1)
2015-09-28	F	10:39 - 10:41	(3)
2015-09-28	F	10:44 - 10:44	(1)
2015-09-28	F	10:48 - 10:49	(2)
2015-09-28	F	11:07 - 11:07	(1)
2015-09-28	F	20:30 - 20:33	(4)
2015-09-28	F	20:39 - 20:39	(1)
2015-09-28	F	20:51 - 20:51	(1)
2015-09-28	F	20:55 - 20:55	(1)
2015-09-28	F	21:10 - 21:11	(2)
2015-09-28	F	21:50 - 21:51	(2)
2015-09-28	F	23:04 - 23:04	(1)
2015-09-29	F	20:57 - 20:57	(1)
2015-09-29	F	21:51 - 21:51	(1)
2015-10-01	F	20:32 - 20:33	(2)
2015-10-01	F	20:36 - 20:36	(1)
2015-10-01	F	21:10 - 21:10	(1)
2015-10-02	F	15:29 - 15:29	(1)
2015-10-02	F	15:40 - 15:40	(1)
2015-10-02	F	15:50 - 15:51	(2)
2015-10-02	F	15:56 - 15:56	(1)
2015-10-02	F	16:00 - 16:00	(1)
2015-10-02	F	16:03 - 16:03	(1)
2015-10-02	F	17:03 - 17:04	(2)
2015-10-02	F	17:07 - 17:07	(1)
2015-10-02	F	17:15 - 17:16	(2)
2015-10-02	F	17:22 - 17:22	(1)
2015-10-02	F	20:44 - 20:44	(1)
2015-10-02	F	21:00 - 21:00	(1)
2015-10-02	F	21:09 - 21:11	(3)
2015-10-02	F	22:30 - 22:30	(1)
2015-10-02	F	22:43 - 22:43	(1)
2015-10-03	F	15:04 - 15:05	(2)
2015-10-03	F	15:14 - 15:15	(2)
2015-10-03	F	15:39 - 15:39	(1)
2015-10-03	F	15:43 - 15:44	(2)
2015-10-03	F	16:24 - 16:24	(1)
2015-10-03	F	16:50 - 16:50	(1)
2015-10-03	F	16:54 - 16:54	(1)
2015-10-03	F	17:03 - 17:04	(2)
2015-10-03	F	17:12 - 17:12	(1)
2015-10-03	F	17:16 - 17:16	(1)
2015-10-03	F	17:20 - 17:21	(2)
2015-10-03	F	20:31 - 20:31	(1)
2015-10-03	F	21:08 - 21:11	(4)
2015-10-03	F	21:50 - 21:51	(2)
2015-10-03	F	22:01 - 22:01	(1)
2015-10-03	F	22:31 - 22:31	(1)
2015-10-03	F	22:35 - 22:35	(1)
2015-10-03	F	22:40 - 22:40	(1)
2015-10-03	F	22:42 - 22:42	(1)
2015-10-03	F	22:45 - 22:45	(1)
2015-10-03	F	22:47 - 22:47	(1)
2015-10-03	F	23:07 - 23:07	(1)
2015-10-04	F	15:07 - 15:07	(1)
2015-10-04	F	16:03 - 16:03	(1)

2015-10-04	F	16:23 - 16:24	(2)
2015-10-04	F	20:30 - 20:30	(1)
2015-10-04	F	21:04 - 21:04	(1)
2015-10-04	F	21:08 - 21:10	(3)
2015-10-05	F	07:50 - 07:51	(2)
2015-10-05	F	08:00 - 08:00	(1)
2015-10-05	F	08:04 - 08:04	(1)
2015-10-05	F	13:50 - 13:52	(3)
2015-10-05	F	14:20 - 14:21	(2)
2015-10-05	F	14:23 - 14:23	(1)
2015-10-05	F	15:03 - 15:03	(1)
2015-10-05	F	15:08 - 15:08	(1)
2015-10-05	F	15:16 - 15:16	(1)
2015-10-05	F	15:20 - 15:20	(1)
2015-10-05	F	15:39 - 15:40	(2)
2015-10-05	F	18:19 - 18:22	(4)
2015-10-05	F	18:24 - 18:25	(2)
2015-10-05	F	18:27 - 18:27	(1)
2015-10-05	F	18:30 - 18:31	(2)
2015-10-05	F	18:35 - 18:44	(10)
2015-10-05	F	18:47 - 18:47	(1)
2015-10-05	F	18:50 - 18:50	(1)
2015-10-05	F	18:59 - 19:03	(5)
2015-10-05	F	19:09 - 19:11	(3)
2015-10-05	F	19:13 - 19:13	(1)
2015-10-05	F	19:17 - 19:22	(6)
2015-10-05	F	19:25 - 19:25	(1)
2015-10-05	F	19:29 - 19:29	(1)
2015-10-05	F	19:38 - 19:40	(3)
2015-10-05	F	21:10 - 21:10	(1)
2015-10-05	F	21:44 - 21:44	(1)
2015-10-06	F	11:30 - 11:30	(1)
2015-10-06	F	12:35 - 12:35	(1)
2015-10-06	F	15:28 - 15:28	(1)
2015-10-06	F	15:35 - 15:35	(1)
2015-10-06	F	18:17 - 18:30	(14)
2015-10-06	F	18:41 - 18:41	(1)
2015-10-06	F	18:43 - 18:46	(4)
2015-10-06	F	18:59 - 19:00	(2)
2015-10-06	F	19:03 - 19:03	(1)
2015-10-06	F	19:15 - 19:15	(1)
2015-10-06	F	19:29 - 19:32	(4)
2015-10-06	F	19:43 - 19:44	(2)
2015-10-06	F	19:47 - 19:47	(1)
2015-10-06	F	19:49 - 19:49	(1)
2015-10-06	F	20:30 - 20:31	(2)
2015-10-06	F	20:33 - 20:33	(1)
2015-10-06	F	20:39 - 20:39	(1)
2015-10-06	F	20:46 - 20:48	(3)
2015-10-06	F	20:54 - 20:55	(2)
2015-10-06	F	20:59 - 20:59	(1)
2015-10-06	F	21:09 - 21:10	(2)
2015-10-07	F	08:50 - 08:50	(1)
2015-10-07	F	08:59 - 08:59	(1)
2015-10-07	F	10:14 - 10:15	(2)
2015-10-07	F	10:30 - 10:30	(1)
2015-10-07	F	11:08 - 11:08	(1)
2015-10-07	F	11:36 - 11:36	(1)
2015-10-07	F	16:12 - 16:12	(1)
2015-10-07	F	17:06 - 17:06	(1)
2015-10-07	F	20:33 - 20:33	(1)

2015-10-07	F	20:45 - 20:45	(1)
2015-10-07	F	20:47 - 20:47	(1)
2015-10-07	F	20:50 - 20:50	(1)
2015-10-07	F	20:54 - 20:54	(1)
2015-10-07	F	21:01 - 21:01	(1)
2015-10-07	F	21:06 - 21:06	(1)
2015-10-07	F	21:11 - 21:11	(1)
2015-10-07	F	21:25 - 21:25	(1)
2015-10-07	F	21:29 - 21:29	(1)
2015-10-07	F	21:31 - 21:31	(1)
2015-10-07	F	23:28 - 23:28	(1)
2015-10-07	F	23:32 - 23:32	(1)
2015-10-08	F	00:02 - 00:02	(1)
2015-10-08	F	00:57 - 00:57	(1)
2015-10-08	F	04:14 - 04:15	(2)
2015-10-08	F	07:42 - 07:42	(1)
2015-10-08	F	07:55 - 07:55	(1)
2015-10-08	F	08:29 - 08:31	(3)
2015-10-08	F	08:33 - 08:33	(1)
2015-10-08	F	10:09 - 10:09	(1)
2015-10-08	F	10:29 - 10:29	(1)
2015-10-08	F	10:45 - 10:45	(1)
2015-10-08	F	10:47 - 10:47	(1)
2015-10-08	F	10:52 - 10:53	(2)
2015-10-08	F	10:57 - 11:01	(5)
2015-10-08	F	11:14 - 11:14	(1)
2015-10-08	F	18:14 - 18:15	(2)
2015-10-08	F	18:18 - 18:19	(2)
2015-10-08	F	18:23 - 18:23	(1)
2015-10-08	F	18:25 - 18:27	(3)
2015-10-08	F	18:30 - 18:32	(3)
2015-10-08	F	18:34 - 18:34	(1)
2015-10-08	F	18:37 - 18:37	(1)
2015-10-08	F	18:41 - 18:42	(2)
2015-10-08	F	18:44 - 18:47	(4)
2015-10-08	F	18:49 - 18:51	(3)
2015-10-08	F	18:55 - 18:55	(1)
2015-10-08	F	18:57 - 19:02	(6)
2015-10-08	F	19:10 - 19:10	(1)
2015-10-08	F	19:13 - 19:16	(4)
2015-10-08	F	20:30 - 20:30	(1)
2015-10-08	F	20:34 - 20:35	(2)
2015-10-08	F	21:28 - 21:28	(1)
2015-10-08	F	21:31 - 21:31	(1)
2015-10-08	F	21:40 - 21:40	(1)
2015-10-08	F	21:55 - 21:55	(1)
2015-10-09	F	06:41 - 06:41	(1)
2015-10-09	F	13:27 - 13:27	(1)
2015-10-09	F	18:00 - 19:23	(84)
2015-10-09	F	20:30 - 20:31	(2)
2015-10-09	F	20:33 - 20:33	(1)
2015-10-09	F	20:44 - 20:44	(1)
2015-10-09	F	20:47 - 20:47	(1)
2015-10-09	F	20:57 - 20:57	(1)
2015-10-09	F	21:00 - 21:00	(1)
2015-10-09	F	21:03 - 21:04	(2)
2015-10-09	F	21:06 - 21:06	(1)
2015-10-09	F	21:09 - 21:09	(1)
2015-10-09	F	21:12 - 21:13	(2)
2015-10-09	F	21:16 - 21:16	(1)
2015-10-09	F	21:23 - 21:23	(1)

2015-10-09	F	21:29 - 21:30	(2)
2015-10-09	F	21:33 - 21:33	(1)
2015-10-09	F	21:37 - 21:39	(3)
2015-10-09	F	21:49 - 21:50	(2)
2015-10-09	F	22:10 - 22:10	(1)
2015-10-10	F	10:52 - 10:52	(1)
2015-10-10	F	11:12 - 11:14	(3)
2015-10-10	F	11:17 - 11:18	(2)
2015-10-10	F	11:24 - 11:24	(1)
2015-10-10	F	11:26 - 11:26	(1)
2015-10-10	F	11:31 - 11:31	(1)
2015-10-10	F	11:51 - 11:51	(1)
2015-10-10	F	11:53 - 11:53	(1)
2015-10-10	F	12:00 - 12:00	(1)
2015-10-10	F	20:30 - 20:31	(2)
2015-10-10	F	20:33 - 20:33	(1)
2015-10-10	F	20:36 - 20:37	(2)
2015-10-10	F	20:39 - 20:39	(1)
2015-10-10	F	20:41 - 20:42	(2)
2015-10-10	F	20:45 - 20:45	(1)
2015-10-10	F	20:49 - 20:49	(1)
2015-10-10	F	20:55 - 20:56	(2)
2015-10-10	F	21:06 - 21:07	(2)
2015-10-10	F	21:14 - 21:14	(1)
2015-10-10	F	21:17 - 21:18	(2)
2015-10-10	F	21:24 - 21:24	(1)
2015-10-10	F	21:28 - 21:28	(1)
2015-10-10	F	21:34 - 21:41	(8)
2015-10-10	F	21:47 - 21:48	(2)
2015-10-10	F	21:51 - 21:53	(3)
2015-10-10	F	21:56 - 21:59	(4)
2015-10-10	F	22:02 - 22:02	(1)
2015-10-11	F	08:45 - 08:45	(1)
2015-10-11	F	09:31 - 09:31	(1)
2015-10-11	F	18:47 - 18:47	(1)
2015-10-11	F	20:53 - 20:53	(1)
2015-10-11	F	21:04 - 21:07	(4)
2015-10-11	F	22:01 - 22:02	(2)
2015-10-12	F	08:44 - 08:44	(1)
2015-10-12	F	09:04 - 09:04	(1)
2015-10-12	F	09:20 - 09:20	(1)
2015-10-12	F	16:44 - 16:44	(1)
2015-10-12	F	21:01 - 21:01	(1)
2015-10-12	F	21:03 - 21:04	(2)
2015-10-12	F	21:11 - 21:12	(2)
2015-10-12	F	21:17 - 21:17	(1)
2015-10-12	F	21:39 - 21:41	(3)
2015-10-13	F	10:15 - 10:15	(1)
2015-10-13	F	15:01 - 15:04	(4)
2015-10-13	F	20:31 - 20:31	(1)
2015-10-13	F	20:38 - 20:38	(1)
2015-10-13	F	21:04 - 21:04	(1)
2015-10-13	F	21:39 - 21:39	(1)
2015-10-13	F	21:57 - 21:58	(2)
2015-10-14	F	09:48 - 09:48	(1)
2015-10-14	F	10:27 - 10:29	(3)
2015-10-14	F	10:38 - 10:38	(1)
2015-10-14	F	10:45 - 10:45	(1)
2015-10-14	F	21:04 - 21:07	(4)
2015-10-15	F	09:44 - 09:46	(3)
2015-10-15	F	09:52 - 09:54	(3)

2015-10-15	F	09:59 - 10:01	(3)
2015-10-15	F	10:03 - 10:06	(4)
2015-10-15	F	10:12 - 10:15	(4)
2015-10-15	F	10:17 - 10:18	(2)
2015-10-15	F	10:21 - 10:21	(1)
2015-10-15	F	10:23 - 10:23	(1)
2015-10-15	F	10:31 - 10:34	(4)
2015-10-15	F	10:40 - 10:41	(2)
2015-10-15	F	10:44 - 10:45	(2)
2015-10-15	F	20:48 - 20:48	(1)
2015-10-15	F	21:02 - 21:02	(1)
2015-10-15	F	21:04 - 21:06	(3)
2015-10-15	F	21:14 - 21:14	(1)
2015-10-16	F	09:53 - 09:53	(1)
2015-10-16	F	09:59 - 09:59	(1)
2015-10-16	F	10:07 - 10:07	(1)
2015-10-16	F	10:22 - 10:22	(1)
2015-10-16	F	10:28 - 10:28	(1)
2015-10-16	F	10:34 - 10:34	(1)
2015-10-16	F	13:59 - 13:59	(1)
2015-10-16	F	20:39 - 20:39	(1)
2015-10-16	F	20:49 - 20:49	(1)
2015-10-16	F	20:52 - 20:54	(3)
2015-10-16	F	20:59 - 20:59	(1)
2015-10-16	F	21:03 - 21:10	(8)
2015-10-16	F	21:17 - 21:20	(4)
2015-10-16	F	21:25 - 21:25	(1)
2015-10-16	F	21:28 - 21:29	(2)
2015-10-16	F	21:31 - 21:31	(1)
2015-10-16	F	21:34 - 21:34	(1)
2015-10-16	F	22:00 - 22:00	(1)
2015-10-16	F	22:10 - 22:10	(1)
2015-10-17	F	18:12 - 18:12	(1)
2015-10-17	F	18:14 - 18:14	(1)
2015-10-17	F	18:28 - 18:29	(2)
2015-10-17	F	18:33 - 18:33	(1)
2015-10-17	F	18:43 - 18:44	(2)
2015-10-17	F	18:57 - 19:00	(4)
2015-10-17	F	19:08 - 19:08	(1)
2015-10-17	F	19:11 - 19:11	(1)
2015-10-17	F	19:14 - 19:14	(1)
2015-10-17	F	21:04 - 21:07	(4)
2015-10-17	F	21:22 - 21:23	(2)
2015-10-17	F	21:30 - 21:30	(1)
2015-10-17	F	21:32 - 21:32	(1)
2015-10-17	F	21:39 - 21:39	(1)
2015-10-18	F	18:01 - 18:01	(1)
2015-10-18	F	18:27 - 18:29	(3)
2015-10-18	F	18:43 - 18:44	(2)
2015-10-18	F	18:53 - 18:53	(1)
2015-10-18	F	18:58 - 19:00	(3)
2015-10-18	F	19:14 - 19:14	(1)
2015-10-18	F	20:33 - 20:33	(1)
2015-10-19	F	18:28 - 18:28	(1)
2015-10-19	F	18:43 - 18:45	(3)
2015-10-19	F	18:58 - 18:58	(1)
2015-10-19	F	19:13 - 19:13	(1)
2015-10-19	F	20:30 - 20:31	(2)
2015-10-19	F	20:57 - 20:57	(1)
2015-10-19	F	21:24 - 21:24	(1)
2015-10-20	F	13:02 - 13:03	(2)

2015-10-20	F	17:59 - 18:00	(2)
2015-10-20	F	18:02 - 18:02	(1)
2015-10-20	F	18:28 - 18:29	(2)
2015-10-20	F	18:33 - 18:33	(1)
2015-10-20	F	18:44 - 18:44	(1)
2015-10-20	F	18:55 - 18:55	(1)
2015-10-20	F	18:57 - 18:58	(2)
2015-10-20	F	19:06 - 19:06	(1)
2015-10-20	F	19:13 - 19:15	(3)
2015-10-20	F	20:58 - 21:01	(4)
2015-10-20	F	21:13 - 21:13	(1)
2015-10-21	F	08:03 - 08:03	(1)
2015-10-21	F	08:07 - 08:07	(1)
2015-10-21	F	08:12 - 08:12	(1)
2015-10-21	F	20:30 - 20:33	(4)
2015-10-21	F	20:57 - 20:57	(1)
2015-10-21	F	21:30 - 21:30	(1)
2015-10-21	F	21:36 - 21:36	(1)
2015-10-22	F	17:58 - 17:58	(1)
2015-10-22	F	18:28 - 18:28	(1)
2015-10-22	F	18:43 - 18:44	(2)
2015-10-22	F	20:51 - 20:52	(2)
2015-10-22	F	20:59 - 21:00	(2)
2015-10-23	F	17:00 - 17:00	(1)
2015-10-23	F	17:32 - 17:32	(1)
2015-10-23	F	17:51 - 17:51	(1)
2015-10-23	F	20:30 - 20:30	(1)
2015-10-23	F	20:52 - 20:52	(1)
2015-10-23	F	20:56 - 20:57	(2)
2015-10-24	F	02:54 - 02:55	(2)
2015-10-24	F	14:24 - 14:24	(1)
2015-10-24	F	16:59 - 16:59	(1)
2015-10-24	F	17:10 - 17:10	(1)
2015-10-24	F	17:13 - 17:14	(2)
2015-10-24	F	17:28 - 17:28	(1)
2015-10-24	F	17:42 - 17:44	(3)
2015-10-24	F	17:58 - 17:59	(2)
2015-10-24	F	18:03 - 18:04	(2)
2015-10-24	F	20:54 - 20:54	(1)
2015-10-24	F	20:56 - 20:56	(1)
2015-10-24	F	21:01 - 21:01	(1)
2015-10-25	F	17:43 - 17:43	(1)
2015-10-25	F	18:09 - 18:09	(1)
2015-10-25	F	20:29 - 20:31	(3)
2015-10-25	F	20:56 - 20:57	(2)
2015-10-25	F	21:09 - 21:10	(2)
2015-10-26	F	17:42 - 17:42	(1)
2015-10-27	F	17:43 - 17:43	(1)
2015-10-27	F	20:59 - 20:59	(1)
2015-10-31	F	08:02 - 08:02	(1)
2015-10-31	F	18:14 - 18:14	(1)
2015-11-01	F	12:33 - 12:39	(7)
2015-11-02	F	12:05 - 12:05	(1)
2015-11-02	F	14:38 - 14:40	(3)
2015-11-03	F	07:29 - 07:30	(2)
2015-11-03	F	07:54 - 07:54	(1)
2015-11-03	F	08:00 - 08:01	(2)
2015-11-03	F	13:01 - 13:02	(2)
2015-11-03	F	13:06 - 13:06	(1)
2015-11-03	F	20:51 - 20:53	(3)
2015-11-04	F	00:22 - 00:23	(2)

2015-11-04	F	03:54 - 03:54	(1)
2015-11-04	F	03:56 - 03:56	(1)
2015-11-04	F	04:33 - 04:34	(2)
2015-11-04	F	04:37 - 04:37	(1)
2015-11-04	F	04:41 - 04:42	(2)
2015-11-04	F	05:08 - 05:09	(2)
2015-11-04	F	06:19 - 06:19	(1)
2015-11-04	F	06:21 - 06:21	(1)
2015-11-04	F	06:28 - 06:28	(1)
2015-11-04	F	06:31 - 06:31	(1)
2015-11-04	F	12:32 - 12:33	(2)
2015-11-04	F	13:02 - 13:04	(3)
2015-11-05	F	10:34 - 10:35	(2)
2015-11-05	F	16:26 - 16:26	(1)
2015-11-07	F	06:53 - 06:53	(1)
2015-11-07	F	07:04 - 07:05	(2)
2015-11-07	F	07:12 - 07:12	(1)
2015-11-07	F	07:58 - 07:58	(1)
2015-11-07	F	10:34 - 10:34	(1)
2015-11-07	F	16:58 - 17:00	(3)
2015-11-07	F	17:12 - 17:12	(1)
2015-11-07	F	17:15 - 17:15	(1)
2015-11-07	F	17:25 - 17:25	(1)
2015-11-07	F	17:28 - 17:29	(2)
2015-11-07	F	17:37 - 17:37	(1)
2015-11-07	F	17:40 - 17:40	(1)
2015-11-07	F	17:43 - 17:45	(3)
2015-11-07	F	17:59 - 17:59	(1)
2015-11-07	F	18:10 - 18:10	(1)
2015-11-08	F	17:45 - 17:45	(1)
2015-11-09	F	10:32 - 10:32	(1)
2015-11-09	F	15:57 - 15:58	(2)
2015-11-09	F	16:06 - 16:06	(1)
2015-11-09	F	16:58 - 17:03	(6)
2015-11-09	F	17:11 - 17:12	(2)
2015-11-09	F	17:14 - 17:16	(3)
2015-11-09	F	17:28 - 17:28	(1)
2015-11-09	F	17:33 - 17:33	(1)
2015-11-09	F	17:41 - 17:46	(6)
2015-11-10	F	03:15 - 03:15	(1)
2015-11-10	F	10:31 - 10:32	(2)
2015-11-10	F	16:59 - 17:00	(2)
2015-11-10	F	17:08 - 17:08	(1)
2015-11-10	F	17:14 - 17:14	(1)
2015-11-10	F	17:26 - 17:31	(6)
2015-11-10	F	17:42 - 17:44	(3)
2015-11-10	F	17:58 - 17:58	(1)
2015-11-10	F	18:01 - 18:02	(2)
2015-11-10	F	18:04 - 18:04	(1)
2015-11-10	F	23:30 - 23:30	(1)
2015-11-10	F	23:38 - 23:39	(2)
2015-11-11	F	13:00 - 13:01	(2)
2015-11-11	F	16:59 - 18:08	(70)
2015-11-11	F	23:03 - 23:03	(1)
2015-11-11	F	23:29 - 23:29	(1)
2015-11-12	F	16:59 - 17:01	(3)
2015-11-12	F	17:14 - 17:14	(1)
2015-11-12	F	17:43 - 17:46	(4)
2015-11-12	F	17:58 - 17:59	(2)
2015-11-12	F	23:10 - 23:10	(1)
2015-11-13	F	16:53 - 16:53	(1)

2015-11-13	F	16:59 - 17:00	(2)
2015-11-13	F	17:12 - 17:13	(2)
2015-11-13	F	17:27 - 17:27	(1)
2015-11-13	F	17:37 - 17:37	(1)
2015-11-13	F	17:43 - 17:43	(1)
2015-11-13	F	17:45 - 17:45	(1)
2015-11-13	F	17:55 - 17:55	(1)
2015-11-13	F	17:58 - 17:59	(2)
2015-11-13	F	23:12 - 23:12	(1)
2015-11-13	F	23:34 - 23:34	(1)
2015-11-14	F	16:58 - 18:12	(75)
2015-11-14	F	22:59 - 23:00	(2)
2015-11-14	F	23:08 - 23:08	(1)
2015-11-14	F	23:13 - 23:14	(2)
2015-11-14	F	23:16 - 23:16	(1)
2015-11-14	F	23:18 - 23:18	(1)
2015-11-14	F	23:20 - 23:21	(2)
2015-11-14	F	23:28 - 23:28	(1)
2015-11-14	F	23:30 - 23:31	(2)
2015-11-14	F	23:39 - 23:41	(3)
2015-11-15	F	15:01 - 15:03	(3)
2015-11-15	F	16:58 - 17:00	(3)
2015-11-15	F	17:05 - 17:05	(1)
2015-11-15	F	17:08 - 17:08	(1)
2015-11-15	F	17:11 - 17:11	(1)
2015-11-15	F	17:25 - 17:25	(1)
2015-11-15	F	17:30 - 17:33	(4)
2015-11-15	F	17:35 - 17:35	(1)
2015-11-15	F	17:37 - 17:43	(7)
2015-11-15	F	17:54 - 17:59	(6)
2015-11-15	F	18:05 - 18:07	(3)
2015-11-15	F	18:10 - 18:10	(1)
2015-11-15	F	23:03 - 23:04	(2)
2015-11-15	F	23:13 - 23:13	(1)
2015-11-15	F	23:17 - 23:18	(2)
2015-11-15	F	23:26 - 23:26	(1)
2015-11-15	F	23:28 - 23:30	(3)
2015-11-15	F	23:33 - 23:33	(1)
2015-11-15	F	23:35 - 23:35	(1)
2015-11-15	F	23:38 - 23:38	(1)
2015-11-15	F	23:40 - 23:40	(1)
2015-11-16	F	07:28 - 07:32	(5)
2015-11-16	F	10:00 - 10:01	(2)
2015-11-16	F	10:04 - 10:05	(2)
2015-11-16	F	10:07 - 10:07	(1)
2015-11-16	F	10:10 - 10:10	(1)
2015-11-16	F	10:14 - 10:14	(1)
2015-11-16	F	10:16 - 10:16	(1)
2015-11-16	F	10:18 - 10:20	(3)
2015-11-16	F	10:26 - 10:26	(1)
2015-11-16	F	10:28 - 10:28	(1)
2015-11-16	F	10:33 - 10:34	(2)
2015-11-16	F	10:39 - 10:41	(3)
2015-11-16	F	16:58 - 18:15	(78)
2015-11-16	F	22:58 - 23:27	(30)
2015-11-16	F	23:35 - 23:35	(1)
2015-11-16	F	23:40 - 23:40	(1)
2015-11-17	F	09:58 - 10:11	(14)
2015-11-17	F	10:28 - 10:28	(1)
2015-11-17	F	10:35 - 10:38	(4)
2015-11-17	F	10:40 - 10:41	(2)

2015-11-17	F	16:25 - 16:25	(1)
2015-11-17	F	16:59 - 16:59	(1)
2015-11-17	F	17:13 - 17:14	(2)
2015-11-17	F	17:22 - 17:23	(2)
2015-11-17	F	17:26 - 17:46	(21)
2015-11-17	F	17:52 - 17:52	(1)
2015-11-17	F	17:57 - 18:00	(4)
2015-11-17	F	23:19 - 23:20	(2)
2015-11-18	F	09:58 - 10:27	(30)
2015-11-18	F	14:58 - 14:59	(2)
2015-11-18	F	15:12 - 15:13	(2)
2015-11-18	F	15:31 - 15:33	(3)
2015-11-18	F	15:55 - 15:55	(1)
2015-11-18	F	16:23 - 16:23	(1)
2015-11-18	F	16:37 - 16:37	(1)
2015-11-18	F	16:40 - 16:40	(1)
2015-11-18	F	16:44 - 16:44	(1)
2015-11-18	F	16:59 - 16:59	(1)
2015-11-18	F	18:34 - 18:34	(1)
2015-11-18	F	18:58 - 18:59	(2)
2015-11-18	F	19:37 - 19:40	(4)
2015-11-18	F	23:00 - 23:01	(2)
2015-11-18	F	23:11 - 23:11	(1)
2015-11-18	F	23:15 - 23:15	(1)
2015-11-18	F	23:18 - 23:18	(1)
2015-11-18	F	23:23 - 23:24	(2)
2015-11-19	F	09:59 - 10:01	(3)
2015-11-19	F	10:10 - 10:10	(1)
2015-11-19	F	14:59 - 14:59	(1)
2015-11-19	F	16:58 - 16:58	(1)
2015-11-19	F	17:15 - 17:16	(2)
2015-11-19	F	17:18 - 17:18	(1)
2015-11-19	F	17:25 - 17:25	(1)
2015-11-19	F	17:51 - 17:52	(2)
2015-11-19	F	18:00 - 18:00	(1)
2015-11-19	F	18:05 - 18:05	(1)
2015-11-19	F	18:28 - 18:29	(2)
2015-11-19	F	18:39 - 18:39	(1)
2015-11-19	F	18:57 - 18:58	(2)
2015-11-19	F	19:00 - 19:00	(1)
2015-11-19	F	19:19 - 19:19	(1)
2015-11-19	F	19:36 - 19:44	(9)
2015-11-19	F	19:46 - 19:46	(1)
2015-11-19	F	19:50 - 19:50	(1)
2015-11-19	F	19:52 - 19:53	(2)
2015-11-19	F	19:56 - 19:56	(1)
2015-11-19	F	20:03 - 20:03	(1)
2015-11-19	F	20:06 - 20:07	(2)
2015-11-19	F	20:09 - 20:09	(1)
2015-11-19	F	20:13 - 20:13	(1)
2015-11-19	F	20:17 - 20:17	(1)
2015-11-19	F	23:04 - 23:04	(1)
2015-11-19	F	23:12 - 23:13	(2)
2015-11-19	F	23:18 - 23:18	(1)
2015-11-20	F	14:58 - 14:58	(1)
2015-11-20	F	15:02 - 15:02	(1)
2015-11-20	F	15:08 - 15:08	(1)
2015-11-20	F	15:11 - 15:11	(1)
2015-11-20	F	15:13 - 15:13	(1)
2015-11-20	F	15:15 - 15:15	(1)
2015-11-20	F	15:23 - 15:23	(1)

2015-11-20	F	15:38 - 15:40	(3)
2015-11-20	F	15:44 - 15:44	(1)
2015-11-20	F	16:03 - 16:03	(1)
2015-11-21	F	14:59 - 14:59	(1)
2015-11-21	F	15:36 - 15:40	(5)
2015-11-21	F	15:43 - 15:43	(1)
2015-11-21	F	15:45 - 15:48	(4)
2015-11-21	F	15:57 - 15:58	(2)
2015-11-21	F	16:00 - 16:01	(2)
2015-11-21	F	16:05 - 16:06	(2)
2015-11-21	F	16:10 - 16:10	(1)
2015-11-21	F	16:12 - 16:17	(6)
2015-11-22	F	06:03 - 06:03	(1)
2015-11-22	F	14:58 - 14:59	(2)
2015-11-22	F	15:23 - 16:17	(55)
2015-11-23	F	15:05 - 15:05	(1)
2015-11-23	F	15:38 - 15:41	(4)
2015-11-23	F	15:44 - 15:46	(3)
2015-11-23	F	15:52 - 15:53	(2)
2015-11-23	F	15:57 - 15:58	(2)
2015-11-23	F	16:01 - 16:02	(2)
2015-11-23	F	16:04 - 16:04	(1)
2015-11-23	F	16:07 - 16:07	(1)
2015-11-23	F	16:09 - 16:16	(8)
2015-11-23	F	23:10 - 23:10	(1)
2015-11-23	F	23:13 - 23:13	(1)
2015-11-23	F	23:20 - 23:21	(2)
2015-11-23	F	23:23 - 23:24	(2)
2015-11-23	F	23:27 - 23:27	(1)
2015-11-23	F	23:50 - 23:50	(1)
2015-11-23	F	23:52 - 23:55	(4)
2015-11-23	F	23:57 - 23:57	(1)
2015-11-24	F	00:01 - 00:01	(1)
2015-11-24	F	00:14 - 00:14	(1)
2015-11-24	F	00:16 - 00:16	(1)
2015-11-24	F	00:20 - 00:20	(1)
2015-11-24	F	00:37 - 00:37	(1)
2015-11-24	F	09:03 - 09:03	(1)
2015-11-24	F	09:11 - 09:11	(1)
2015-11-24	F	14:59 - 14:59	(1)
2015-11-24	F	15:06 - 15:06	(1)
2015-11-24	F	15:27 - 15:28	(2)
2015-11-24	F	15:34 - 15:34	(1)
2015-11-24	F	16:16 - 16:16	(1)
2015-11-24	F	16:39 - 16:40	(2)
2015-11-24	F	17:18 - 17:19	(2)
2015-11-24	F	17:43 - 17:43	(1)
2015-11-24	F	17:48 - 17:48	(1)
2015-11-24	F	18:06 - 18:06	(1)
2015-11-24	F	18:09 - 18:11	(3)
2015-11-24	F	18:14 - 18:15	(2)
2015-11-25	F	08:59 - 08:59	(1)
2015-11-25	F	17:19 - 17:19	(1)
2015-11-25	F	17:32 - 17:32	(1)
2015-11-25	F	17:48 - 17:48	(1)
2015-11-25	F	17:57 - 17:57	(1)
2015-11-25	F	17:59 - 17:59	(1)
2015-11-25	F	18:15 - 18:16	(2)
2015-11-26	F	08:58 - 09:00	(3)
2015-11-26	F	14:59 - 14:59	(1)
2015-11-26	F	15:14 - 15:14	(1)

2015-11-26	F	15:28 - 15:28	(1)
2015-11-26	F	15:36 - 15:36	(1)
2015-11-26	F	15:57 - 15:59	(3)
2015-11-26	F	16:08 - 16:08	(1)
2015-11-26	F	16:26 - 16:26	(1)
2015-11-26	F	16:38 - 16:39	(2)
2015-11-26	F	17:17 - 17:18	(2)
2015-11-26	F	17:20 - 17:20	(1)
2015-11-26	F	17:43 - 17:44	(2)
2015-11-26	F	17:47 - 17:48	(2)
2015-11-26	F	18:00 - 18:00	(1)
2015-11-26	F	18:06 - 18:06	(1)
2015-11-26	F	18:14 - 18:14	(1)
2015-11-27	F	14:31 - 14:31	(1)
2015-11-27	F	14:46 - 14:46	(1)
2015-11-27	F	14:48 - 14:49	(2)
2015-11-27	F	15:39 - 15:39	(1)
2015-11-27	F	15:46 - 15:46	(1)
2015-11-27	F	16:28 - 16:28	(1)
2015-11-27	F	16:34 - 16:34	(1)
2015-11-28	F	12:18 - 12:18	(1)
2015-11-28	F	12:20 - 12:20	(1)
2015-11-28	F	15:00 - 15:00	(1)
2015-11-28	F	15:07 - 15:07	(1)
2015-11-28	F	15:14 - 15:14	(1)
2015-11-28	F	15:27 - 15:27	(1)
2015-11-28	F	15:29 - 15:29	(1)
2015-11-28	F	15:32 - 15:32	(1)
2015-11-28	F	15:57 - 16:00	(4)
2015-11-28	F	16:15 - 16:15	(1)
2015-11-28	F	16:28 - 16:29	(2)
2015-11-28	F	16:31 - 16:32	(2)
2015-11-28	F	16:38 - 16:38	(1)
2015-11-28	F	16:41 - 16:41	(1)
2015-11-28	F	16:45 - 16:53	(9)
2015-11-29	F	14:58 - 14:59	(2)
2015-11-29	F	15:27 - 15:28	(2)
2015-11-29	F	15:58 - 15:58	(1)
2015-11-29	F	16:29 - 16:29	(1)
2015-11-29	F	16:33 - 16:33	(1)
2015-11-29	F	16:42 - 16:42	(1)
2015-11-29	F	16:47 - 16:47	(1)
2015-11-29	F	16:49 - 16:49	(1)
2015-11-30	F	04:08 - 04:08	(1)
2015-11-30	F	04:10 - 04:10	(1)
2015-11-30	F	06:39 - 06:39	(1)
2015-11-30	F	09:09 - 09:09	(1)
2015-11-30	F	13:50 - 13:50	(1)
2015-11-30	F	14:59 - 14:59	(1)
2015-11-30	F	15:27 - 15:29	(3)
2015-11-30	F	16:22 - 16:22	(1)
2015-11-30	F	16:29 - 16:29	(1)
2015-12-01	F	09:12 - 09:12	(1)
2015-12-01	F	14:58 - 14:59	(2)
2015-12-01	F	15:17 - 15:17	(1)
2015-12-01	F	15:22 - 15:23	(2)
2015-12-01	F	15:25 - 15:25	(1)
2015-12-01	F	15:56 - 15:56	(1)
2015-12-01	F	16:28 - 16:29	(2)
2015-12-01	F	20:36 - 20:36	(1)
2015-12-02	F	14:18 - 14:18	(1)

2015-12-02	F	15:06 - 15:06	(1)
2015-12-02	F	15:31 - 15:31	(1)
2015-12-02	F	15:43 - 15:43	(1)
2015-12-02	F	16:01 - 16:02	(2)
2015-12-02	F	16:28 - 16:28	(1)
2015-12-02	F	16:41 - 16:42	(2)
2015-12-03	F	15:25 - 15:25	(1)
2015-12-03	F	15:34 - 15:34	(1)
2015-12-03	F	16:19 - 16:19	(1)
2015-12-03	F	16:29 - 16:29	(1)
2015-12-03	F	16:34 - 16:34	(1)
2015-12-03	F	16:52 - 16:52	(1)
2015-12-04	F	14:59 - 14:59	(1)
2015-12-04	F	15:28 - 15:28	(1)
2015-12-04	F	16:27 - 16:29	(3)
2015-12-04	F	16:31 - 16:31	(1)
2015-12-06	F	15:31 - 15:32	(2)
2015-12-06	F	16:01 - 16:02	(2)
2015-12-06	F	16:07 - 16:07	(1)
2015-12-06	F	16:09 - 16:09	(1)
2015-12-07	F	11:58 - 11:58	(1)
2015-12-07	F	14:37 - 14:37	(1)
2015-12-09	F	14:37 - 14:38	(2)
2015-12-09	F	14:53 - 14:54	(2)
2015-12-10	F	21:00 - 21:00	(1)
2015-12-10	F	21:13 - 21:13	(1)
2015-12-11	F	05:44 - 05:44	(1)
2015-12-11	F	12:29 - 12:29	(1)
2015-12-11	F	21:00 - 21:00	(1)
2015-12-11	F	21:07 - 21:09	(3)
2015-12-11	F	21:17 - 21:17	(1)
2015-12-11	F	21:20 - 21:26	(7)
2015-12-12	F	01:10 - 01:10	(1)
2015-12-12	F	04:50 - 04:50	(1)
2015-12-12	F	06:36 - 06:37	(2)
2015-12-12	F	07:32 - 07:32	(1)
2015-12-12	F	07:52 - 07:52	(1)
2015-12-12	F	08:38 - 08:38	(1)
2015-12-12	F	20:58 - 20:58	(1)
2015-12-12	F	21:06 - 21:06	(1)
2015-12-12	F	21:15 - 21:15	(1)
2015-12-13	F	14:39 - 14:40	(2)
2015-12-14	F	10:15 - 10:15	(1)
2015-12-14	F	14:34 - 14:34	(1)
2015-12-14	F	14:48 - 14:48	(1)
2015-12-14	F	14:50 - 14:50	(1)
2015-12-14	F	18:52 - 18:52	(1)
2015-12-14	F	20:59 - 20:59	(1)
2015-12-14	F	21:09 - 21:09	(1)
2015-12-14	F	21:28 - 21:28	(1)
2015-12-15	F	21:10 - 21:10	(1)
2015-12-15	F	21:19 - 21:19	(1)
2015-12-16	F	20:58 - 21:00	(3)
2015-12-16	F	21:05 - 21:05	(1)
2015-12-16	F	21:14 - 21:14	(1)
2015-12-16	F	21:16 - 21:20	(5)
2015-12-16	F	21:23 - 21:23	(1)
2015-12-16	F	21:26 - 21:26	(1)
2015-12-16	F	21:28 - 21:30	(3)
2015-12-16	F	21:33 - 21:36	(4)
2015-12-17	F	20:58 - 20:58	(1)

2015-12-17	F	21:10 - 21:10	(1)
2015-12-17	F	21:17 - 21:17	(1)
2015-12-17	F	21:27 - 21:27	(1)
2015-12-18	F	11:17 - 11:40	(24)
2015-12-18	F	16:13 - 16:14	(2)
2015-12-18	F	21:21 - 21:21	(1)
2015-12-18	F	21:34 - 21:34	(1)
2015-12-19	F	20:58 - 20:59	(2)
2015-12-19	F	21:03 - 21:03	(1)
2015-12-20	F	00:54 - 00:55	(2)
2015-12-20	F	01:00 - 01:00	(1)
2015-12-20	F	03:15 - 03:15	(1)
2015-12-20	F	03:29 - 03:29	(1)
2015-12-20	F	04:45 - 04:45	(1)
2015-12-20	F	04:56 - 04:56	(1)
2015-12-20	F	05:14 - 05:14	(1)
2015-12-20	F	05:18 - 05:19	(2)
2015-12-20	F	05:29 - 05:30	(2)
2015-12-20	F	05:53 - 05:54	(2)
2015-12-20	F	05:56 - 05:56	(1)
2015-12-20	F	06:01 - 06:02	(2)
2015-12-20	F	06:05 - 06:05	(1)
2015-12-20	F	06:11 - 06:11	(1)
2015-12-20	F	06:14 - 06:14	(1)
2015-12-20	F	06:24 - 06:24	(1)
2015-12-20	F	06:27 - 06:28	(2)
2015-12-20	F	06:32 - 06:32	(1)
2015-12-20	F	12:09 - 12:09	(1)
2015-12-20	F	12:13 - 12:15	(3)
2015-12-20	F	14:23 - 14:23	(1)
2015-12-20	F	18:54 - 18:54	(1)
2015-12-20	F	18:58 - 18:58	(1)
2015-12-20	F	21:05 - 21:06	(2)
2015-12-20	F	21:14 - 21:15	(2)
2015-12-20	F	21:17 - 21:19	(3)
2015-12-20	F	21:24 - 21:25	(2)
2015-12-20	F	21:31 - 21:34	(4)
2015-12-20	F	22:59 - 22:59	(1)
2015-12-21	F	00:03 - 00:04	(2)
2015-12-21	F	00:06 - 00:06	(1)
2015-12-21	F	21:03 - 21:03	(1)
2015-12-22	F	06:42 - 06:42	(1)
2015-12-22	F	10:14 - 10:14	(1)
2015-12-22	F	10:40 - 10:40	(1)
2015-12-22	F	21:09 - 21:09	(1)
2015-12-22	F	21:14 - 21:14	(1)
2015-12-22	F	21:24 - 21:24	(1)
2015-12-22	F	21:26 - 21:27	(2)
2015-12-22	F	21:34 - 21:34	(1)
2015-12-23	F	21:01 - 21:01	(1)
2015-12-23	F	21:03 - 21:04	(2)
2015-12-23	F	21:10 - 21:10	(1)
2015-12-23	F	21:14 - 21:14	(1)
2015-12-23	F	21:28 - 21:28	(1)
2015-12-23	F	21:31 - 21:31	(1)
2015-12-23	F	21:34 - 21:34	(1)
2015-12-24	F	12:24 - 12:24	(1)
2015-12-24	F	12:28 - 12:29	(2)
2015-12-24	F	20:58 - 20:58	(1)
2015-12-24	F	21:11 - 21:11	(1)
2015-12-24	F	21:17 - 21:17	(1)

```
2015-12-24    F      21:35 - 21:35    (1)
2015-12-25    F      08:19 - 08:19    (1)
2015-12-25    F      13:49 - 13:49    (1)
2015-12-25    F      13:53 - 13:53    (1)
2015-12-25    F      20:26 - 20:26    (1)
2015-12-25    F      20:58 - 20:58    (1)
2015-12-25    F      21:30 - 21:30    (1)
2015-12-25    F      21:34 - 21:34    (1)
2015-12-26    F      04:24 - 04:24    (1)
2015-12-26    F      21:10 - 21:10    (1)
2015-12-27    F      13:32 - 13:32    (1)
2015-12-27    F      20:59 - 20:59    (1)
2015-12-28    F      08:38 - 08:38    (1)
2015-12-28    F      12:45 - 12:45    (1)
2015-12-28    F      21:03 - 21:04    (2)
2015-12-28    F      21:08 - 21:08    (1)
2015-12-28    F      21:15 - 21:15    (1)
2015-12-28    F      21:27 - 21:27    (1)
2015-12-28    F      21:31 - 21:31    (1)
2015-12-29    F      14:23 - 14:23    (1)
2015-12-29    F      21:12 - 21:12    (1)
2015-12-29    F      21:27 - 21:27    (1)
2015-12-30    F      14:00 - 14:00    (1)
2015-12-30    F      21:13 - 21:13    (1)
2015-12-30    F      21:21 - 21:21    (1)
2015-12-31    F      13:13 - 13:13    (1)
2015-12-31    F      13:15 - 13:16    (2)
2015-12-31    F      21:26 - 21:26    (1)
2015-12-31    F      22:44 - 22:45    (2)
2015-12-31    F      23:11 - 23:12    (2)

Total: 5623 (minutes)
```

7.6.1.4 2016

```
                             GNG
          GINGIN OBSERVATORY INFORMATION 2016

ACKNOWLEDGE-  Users of the GNG data should acknowledge:
      -MENTS: Geoscience Australia

  STATION ID: GNG
    LOCATION: GINGIN, Western Australia
              Australia
ORGANISATION: Geoscience Australia

 CO-LATITUDE: 121.356 deg
   LONGITUDE: 115.715 deg E
   ELEVATION: Above mean sea level (top pier A):50 m

    ABSOLUTE
 INSTRUMENTS: DI-fluxgate magnetometer (DIM)
              DIM DI0037 Theodolite 390444
              GSM90 Overhauser-effect magnetometer
              GSM90_3091317/sensor 91457
   RECORDING
  VARIOMETER: Suspended DMI fluxgate magnetometer
              GSM90 Proton precession magnetometer.
```

```
 ORIENTATION: Magnetic NW, NE and Vertical (ABZ)
     DYNAMIC
       RANGE: +/- 1,600 nT
  RESOLUTION:    0.032 nT
    SAMPLING
        RATE: 1 second
 FILTER TYPE: Intermagnet

   K-NUMBERS: Computer assisted hand scaling
    K9-LIMIT: 430 nT

        GINS: Edinburgh
   SATELLITE: via HTTP

   OBSERVERS: S. Pryde
              A. Lewis
              W. Jones

     CONTACT: Geomagnetism
              Geoscience Australia
              G.P.O. Box 378
              Canberra,  A.C.T.,  2601
              Australia

              Tel: + 61-2-6249-9111
              Fax: + 61-2-6249-9986
              e-mail: geomag@ga.gov.au
              WWW: http://www.ga.gov.au/

NOTES:
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GINGIN
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Gingin magnetic observatory is located in southwest Western
Australia approximately 100 km north of the city of Perth,
20 km west of the town of Gingin. The Gingin observatory
was established to replace the Gnangara observatory which
closed in 2013. Both Gnangara and Gingin observatories were
run in parallel from November 2011 and throughout 2012.
The pier difference between the two observatory sites, as
calculated using 2012 definitive all-day annual means in
the sense (GNG - GNA) is:

X = +299 nT
Y =  +77 nT
Z = +417 nT
H = +296 nT
F = -260 nT
D = +0.210 degrees
I = +0.435 degrees

The Gingin site is located adjacent to the Australian
International Gravitational Observatory (AIGO) and the
Gingin Gravity Discovery Centre. The observatory is sited
on well drained sand with magnetic gradients of less than
1 nT/m.

The Gingin observatory consists of:

       a Variometer Vault covered with local sand,
```

housing the recording equipment, fluxgate variometer sensor and electronics, total-field variometer sensor and electronics, and GPS clock;

an Absolute House approximately 70 m northwest of the vault;

an external tripod reference station approximately 70 m north of the Absolute House, and;

an azimuth reference mark approximately 90 m south of the Absolute House.

Construction of the observatory took place during 2008. The vault and hut are built from re-constituted limestone blocks. The T shaped variometer vault was covered with local sand to enhance thermal stability. The absolute pier was constructed from a fibreglass tube with a marble top.
Variometer instrumentation was installed in October 2009. During installation magnetic contamination was discovered in both the Absolute House and Variometer Vault. The contamination was later found to be largely due to magnetic bolts used during construction to affix wooden framework to the masonry. Other sources of contamination existed in security doors, door and window locks, weather strips and light fittings. Over the following two years the Absolute House was de-contaminated. Magnetic contamination remains in the Variometer Vault. Routine weekly absolute observations commenced in the magnetically clean Absolute House in 2011-11 and fully calibrated observatory data commenced on 2011-11-16.

Key data for the observatory are summarised in Table 1

IAGA code	: GNG
Commenced operation	: November 2011
Geographic latitude	: 31d 21' 23" S
Geographic longitude	: 115d 42' 55" E
Geomagnetic latitude	: -41.06d
Geomagnetic longitude	: 189.01d
K 9 index lower limit	: 430 nT
Principal pier	: Pier A
Pier elevation (top)	: 50 m MSL
Principal reference mark	: Pillar S
Reference mark azimuth	: 186d 38' 32"
Reference mark distance	: 90 m
Observer	: S. Pryde, A. Lewis, W. Jones

Table 1 Key observatory data.
---------- Geographic coordinates are derived using the World Geodetic system 1984 (WGS84)

Local meteorological conditions

The meteorological temperature at the nearby Gingin airfield varied from a minimum -1.2 C (2016-07-13) to a maximum +44.4 C (2016-02-10). Daily minimum temperatures varied from -2.5 C to +26.5 C (average 10.7 +/-6 C); daily maximum temperatures varied from 12.1 C to 44.4 C (average 24.7 +/-7 C); daily temperature ranges varied from 1.7 C

to 29.9 C (average 14.0 +/-5 C).
Daily weather observations for Gingin airport (station ID 009178) provided by Australian Government, Bureau of Meteorology.

VARIOMETERS

The variometers used throughout the year are summarised in Table 2. The principal variometer at the Gingin observatory is a DMI FGE suspended 3-component fluxgate magnetometer. The fluxgate sensor was installed on a plinth in the western arm of the T-shaped Variometer Vault. The fluxgate sensors are orientated magnetic-NW, magnetic-NE, and vertical.
A GEM GSM90 Overhauser total-field magnetometer installed in the eastern arm of the vault monitors variations in the magnetic total intensity.
Analogue outputs from the DMI FGE 3-channel fluxgate, as well as the fluxgate sensor and electronics temperature channels, were digitized with an ADAM 4017 A/D converter mounted inside the FGE electronics console. Data were recorded at 1 second intervals in the components A (NW), B (NE), C (Z). These digital data were recorded on an acquisition computer running the Geophysical Data Acquisition Platform (GDAP) software on the QNX operating system. The digital data from the GSM90 variometer, cycling once every 10 seconds, were also recorded on the acquisition computer.
The acquisition system timing control was provided by a Garmin GPS16 GPS clock. All timing corrections greater than 1 ms which have been applied to the system are listed below.
The variometer system was powered by a 12 V 18 Ah battery with mains trickle charger, under/over voltage cut-off protection, mains power filters and voltage regulators to deliver a constant 12 V to both the vector and scalar magnetometers. The acquisition system timing is synchronised using a GPS clock.
Variometer data are retrieved via a TCP/IP connection through the NextG mobile telephone network.
There was no active temperature control in the variometer vault until late November 2016 (see Operations section below). The vault is well insulated with foam inside and local sand outside. This insulation suppressed diurnal temperature variations but an annual temperature range of about 14 C was measured inside the vault.
Throughout the year the fluxgate magnetometer showed multiple sub-nanoTesla baseline instabilities lasting several hours and affecting the A (X) channel. These problems manifest most clearly in the Fv-Fs channel. The cause of the problems remains unknown. A second vector fluxgate instrument is scheduled installation in 2016. The scalar magnetometer performed poorly for most of the year with numerous periods of spikey or missing data lasting up to several hours a day. A significant amount of scalar data had to be discarded. Data quality filtering at acquisition time was enhanced on 2016-06-22 to automatically reject poor quality data as self-identified in the GSM90 data string. The scalar variometer electronics unit was replaced on 2016-11-26.

```
3-component variometer    : DMI FGE (Version G)
Serial number             : E0383/S0319
Type                      : suspended; linear fluxgate
Orientation               : magnetic NW, NE, Z
Acquisition interval      : 1 s
Resolution                : 0.032 nT
A/D converter             : ADAM 4017 module (+/-5V)
Total-field variometer    : GEM Systems GSM 90
Serial number             : GSM90_3091319/21889
                            (to 2016-11-26)
                          : GSM90_4081421/21889
                            (from 2016-11-26)
Type                      : Overhauser effect
Acquisition interval      : 10 s
Resolution                : 0.01 nT
Data acquisition system   : Geophysical Data Acquisition
                            Platform (GDAP)
                          : PC-104 computer, QNX6.5 OS
Timing                    : Garmin GPS16-HVS GPS clock
Communications            : HSPA Mobile telephone TCP/IP
                            network
Table 2  Magnetic variometers.
---------

Variometer clock corrections
-----------------------------
Time stamps applied to the variometer data were obtained
from the acquisition computer system clock. That clock
was synchronised to a GPS clock. Adjustments to the
system clock which were greater than 1 ms are listed below.

2016-03-12      23:52:20     0.153 s
2016-03-13      01:17:42     1.471 s
2016-03-29      06:35:40     0.359 s  reboot power failure
2016-06-22      00:17:43     1.120 s  reboot power failure
                00:50:40    -0.003 s
                07:38:41     0.544 s
                08:07:40    -0.002 s
2016-08-17      05:16:01     0.599 s  reboot
                06:29:40    -0.002 s
2016-10-19      23:05:41     0.505 s  reboot
                23:23:40    -0.002 s
2016-11-26      06:15:41     0.686 s  reboot

ABSOLUTE INSTRUMENTS
--------------------
The variometers at GNG were calibrated nominally weekly
with a pair of absolute observations. Both absolute PPM
and DIM observations were performed on Pier A in the
Absolute House. The residual (offset) method of absolute
observations was used for the DIM observations with
the DIM offsets being digitized with a PICO
ACD-16 analogue to digital converter and recorded on
a Getac E110 tablet PC running the GA developed GObs
software to capture the absolute observation data. Timing
was recorded using the tablet PC internal clock
synchronised to the internal GPS receiver. A total of 55
pairs of observations were made throughout the year.
Table 3 lists the absolute instruments used at Gingin.
Absolute instrument corrections applied to the data were
determined through instrument comparisons performed during
```

maintenance and calibration visits at Gingin, most recently in November 2016. The adopted corrections applied to the absolute magnetometers to correct them to the international standard as measured at IAGA workshops through the Australian reference instruments held in Canberra are described in Table 3.
The fluxgate sensor on the DIM theodolite was bumped and misaligned by 11 minutes-of-arc in the horizontal plane in early October 2016. This misalignment remained stable until it was corrected during a maintenance visit in late November. The quality of the absolute observations was unaffected by the sensor alignment. All other instrument parameters remained stable throughout the year.

At the annual mean magnetic field values at Gingin of X= 24004 nT, Y= -695 nT, Z= -52668 nT, the D, I and F corrections translate to corrections of:
dX = -2.3 nT   dY = -0.3 nT   dZ = -1.0 nT
These corrections have been applied to all the Gingin final data.

DI fluxgate	: DMI
Serial number	: DI0037D + Pico ADC16 GJY03/108
Theodolite	: Zeiss 020B
Serial number	: 390444
Resolution	: 0.1'
D correction	: -0.05'
I correction	: -0.15'
Total-field magnetometer	: GEM Systems GSM 90
Serial number	: GSM90_3091317/91457
Type	: Overhauser effect
Resolution	: 0.01 nT
Correction	: 0.0 nT

Table 3   Absolute magnetometers
---------- and their adopted corrections.
            Instrument corrections are applied in the
            sense Standard = Instrument + correction.

BASELINES

Derivation of final baseline values for the fluxgate variometer was done by fitting a piece-wise linear spline (including steps where required) to the weekly observed absolute observations baseline residuals.
Throughout the year there were multiple sub-nanoTesla baseline instabilities affecting the A (X) channel and lasting up to several hours. These have not been fixed or removed from the definitive data and are visible in Fv - Fs on many days.
There was one sub-nanoTesla jump in the X and Z baselines on 2016-06-19, the cause was unknown.
The overall baseline drifts over the year had a range of about 6 , 4 and 3 nT in the X, Y and Z channels.
The standard deviations in the difference between the weekly absolute observations and the final adopted vector variometer model and data were:

X =   0.9 nT
Y =   1.0 nT

Z = 0.5 nT
F = 0.3 nT
H = 0.9 nT
D = 09"
I = 04"

The difference between the daily average of total field measured with the vector variometer with final baseline parameters applied and the scalar variometer (Fv - Fs) varied over a range of about 1.5 nT across the year.

Real-time, Quasi-definitive and Definitive data comparison

Annual statistics of the 12 monthly averages of the difference between the GNG definitive data and real time reported 1-minute data sets (GNG definitive - GNG reported) were:

	X	Y	Z
Average	+0.4	+0.2	+0.0
Std.dev	1.4	0.8	0.6
Min	-2.4	-1.0	-0.7
Max	+2.4	+1.3	+1.2

The GNG reported real time data are within the specification for INTERMAGNET quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.
The annual statistics of the 12 monthly averages of the difference between the GNG definitive data and quasi-definitive 1-minute data sets (GNG definitive - GNG quasi-definitive) were:

	X	Y	Z
Average	+0.1	0.1	+0.1
Std.dev	0.5	0.5	0.3
Min	-0.4	-0.5	-0.3
Max	+1.3	+0.8	+0.6

The GNG quasi-definitive data are within the specification for INTERMAGNET quasi-definitive data.

OPERATIONS

The local observer, Mr Stephen Pryde, performed weekly absolute observations and checks throughout the year.
Data files were telemetered to Geoscience Australia in Canberra through an HSPA mobile telephone TCP/IP network. The data transfer delay time was between 2 and 15 minutes.
System timing checks were reported daily via automatic state-of-health messages.
A maintenance visit was made to the observatory over the period 26 - 29 November 2016. During the visit active temperature control for the DTU fluxgate electronics unit was installed using two 50 W AC heater pads mounted inside a thermally insulated box along with the magnetometer electronics. The temperature inside the box is monitored and controlled with a Cal3300 PID temperature control, an autonomous unit which can be monitored and controlled remotely. The temperature control system does not have backup power. A set point value of 30 C was initialised so the system will actively heat on

all but a small number of the hottest summer days in January and February.
Also during the visit, the poorly performing GSM90 scalar variometer electronics unit (GSM90_3091319) was replaced with GSM90_4081421.
The GSM90 sensor was not changed. The failing battery in the backup power supply was replaced and the backup power system was augmented with a second 12V 18Ah battery to extend the period of backup power.
The definitive and quasi-definitive datasets derived from one-second fluxgate and ten-second total field variometer data sets were run through a de-spiking filter. For vector fluxgate data a spike detection required a value to deviate from the local linear trend by 6 times the maximum of 15 digitiser counts (about 0.5 nT) or 8/9 fractile of deviations during the following minute or so. For total field data a spike detection required a value to deviate from the local linear trend by 4 times the maximum of 0.2 nT or 8/9 fractile of deviations during the following minute or so. Data spikes were corrected where possible. On average 0 0 0 and 56 data samples per day were removed or corrected from the raw X, Y and Z and F channels. The maximum number of spike detections on any single day were 8, 9, 5 and 466 in X, Y, Z and F. These spike statistics confirm the poor performance of the scalar magnetometer.
In addition the derived one-second vector fluxgate data was also spike filtered such that a spike detection required a value to deviate from the local linear trend by 5 times the maximum of 0.2 nT or 8/9 fractile of deviations during the following minute or so. Data spikes were corrected where possible. On average 3, 0, 0 data samples per day were removed or corrected from the derived X, Y and Z channels. The maximum number of spike detections on any single day were 120, 19 and 8 in the X, Y, Z channels.
Spikes not automatically detected were removed manually.
Periods of contaminated data or data affected by earthquakes were also removed from the quasi-definitive and definitive data sets. Reported data were not spike filtered.
Selected days of definitive scalar data were not filtered as filtering unnecessarily removed some data during periods of rapid magnetic fluctuations. The unfiltered days are listed below.
Definitive one-minute averages were derived from definitive one-second data using the 90-second Intermagnet Gaussian filter for both the vector and interpolated scalar data.
Real-time and daily one-second and one-minute data were delivered to the Edinburgh Geomagnetic Information Node throughout the year. Additionally, data were provided to International Services for Geomagnetic Indices and World Data centre for Geomagnetism, Kyoto University and others.
Preliminary 1 minute data were made also available on the GA web site (http://www.ga.gov.au).

The distribution of Gingin data is described in Table 4.

Recipient	Status	Sent
1-second values		
INTERMAGNET	reported	hourly
WDC, Kyoto	reported	realtime

BoM SWS	reported	realtime
1-minute values		
INTERMAGNET	reported	realtime
INTERMAGNET	quasi-definitive	monthly
INTERMAGNET	reported	daily
INTERMAGNET	definitive	July 2017
ISGI, France	reported	realtime
ISGI, France	reported	daily
WDC, Kyoto	reported	realtime
U Oulu, Finland	reported	hourly
K indices		
ISGI, France	reported	weekly
BoM SWS, Australia	reported	weekly
Principal magnetic storms and rapid variations		
WDC Solar Terrest. Physics, NOAA		monthly
WDC Geomagnetism, Kyoto		monthly
Observatori de l'Ebre,Spain		monthly

Table 4. Distribution of Gingin data.

Significant Events

2016-01-17	Either late on day 17 or early day 18 a truck delivering a shipping container arrives nearby at the Telescope building.
2016-03-29	05:58 - 06:31 data loss and reboot due to power failure - reason for power failure unknown. Backup power system battery may have failed.
2016-04-20	Final PPM obs done during noisy period for variometer
2016-05-22	22:12 ~ 07:29 05/23 noisy PPM data.
2016-06-21	23UT reboot and data loss across day change
2016-06-22	01UT "c" quality readings on PPM data change GSM90 filter from "ab" to "a"
2016-06-25	jump in X, Z absolute residuals following this date
2016-07-08	09:43 Mag 5.6 Norseman earthquake at 09:40:50
2016-07-13	missing scalar variometer data filtered by acquisition system due to poor quality indicator in data string
2016-07-24	Variometer PPM last recorded measurement at 10:54:29.91.
2016-08-17	Several hours of data loss and a reboot Probably power problems
2016-09-21	Tour of observatory by group of Indonesian geophysicists. Variometer vault door opened during this visit
2016-09-27	02:40 Adjust system clock rate from 838114250 to 838104193
2016-09-30	Clock rate change made permanent in start up file
2016-10-11	DIM sensor horizontal misalignment sudden change from +2' to -11'. No known bump to instrument

2016-10-19	Data loss and unscheduled reboot
2016-11-26	GNG maintenance visit 26/11 - 29/11 System shutdown 05:31:29 to 06:11:06 to change battery in battery box; install external additional external battery; replace PPM electronics (3091317 with 4081421); install temperature controller (Cal3300 slave 02 on /dev/ser6) and insulation foam box for DIM electronics.
2016-11-28	06 System running on batteries while variometer battery box power supply is replaced 23:15 enter vault briefly to check battery box power supply.
2016-12-08	18:00 earthquake
2016-12-14	18:12 - 18:50 probable mains power outage electronics temperature drops
2016-12-21	00:17 Mag6.9 quake in Banda Sea
2016-12-26	05:06 (approx) data telemetry stops - NextG problem

K-Indices

K indices for Gingin have been derived using a computer-assisted method developed at Geoscience Australia and based on the IAGA-accepted LRNS algorithm. K indices were scaled from reported time-series data. K indices have been scaled over some periods of missing definitive data as those reported data were suitable for K-index scaling but not suitable as definitive data. K indices from Gingin contribute to the global am index and its derivatives.
The K-indices are available on the Intermagnet DVD through the IMCDView software.

Annual Mean Values

The annual mean values for Gingin are available in the file "yearmean.gng" and graphically through the IMCDView software.

Hourly Mean Values

Plots of hourly mean values for Gingin are available through the IMCDView software.

Spike Filtering not applied to definitive scalar data

Month	Day of Month
January	
February	
March	
April	
May	
June	
July	19
August	
September	25
October	27, 30
November	09, 12, 24
December	28

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DATA LOSSES
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Variometer data XYZ:     (missing minutes)
2016-01-03    XYZ     15:21 - 15:29    (9)
2016-03-02    XYZ     13:06 - 13:20   (15)
2016-03-12    XYZ     22:56 - 23:47   (52)
2016-03-13    XYZ     00:42 - 01:14   (33)
2016-03-29    XYZ     05:51 - 06:31   (41)
2016-05-20    XYZ     18:20 - 18:31   (12)
2016-05-28    XYZ     16:42 - 16:42    (1)
2016-06-21    XYZ     23:41 - 23:57   (17)
2016-06-21    XYZ     23:59 -
2016-06-22    XYZ           - 03:57  (239)
2016-06-22    XYZ     07:07 - 08:52  (106)
2016-07-08    XYZ     09:44 - 09:46    (3)
2016-08-17    XYZ     02:38 - 05:15  (158)
2016-10-19    XYZ     22:27 - 23:03   (37)
2016-11-14    XYZ     02:57 - 02:57    (1)
2016-11-26    XYZ     05:28 - 06:15   (48)
2016-11-28    XYZ     06:07 - 06:29   (23)
2016-11-28    XYZ     23:15 - 23:18    (4)
2016-12-08    XYZ     18:02 - 18:15   (14)
2016-12-21    XYZ     00:28 - 00:38   (11)

Total: 824  (0.57 days)

Scalar Data F:           (missing minutes)
2016-01-01    F      00:50 - 00:51      (2)
2016-01-01    F      00:57 - 00:57      (1)
2016-01-02    F      20:57 - 21:25     (29)
2016-01-03    F      13:36 - 13:37      (2)
2016-01-03    F      21:03 - 21:04      (2)
2016-01-03    F      21:18 - 21:19      (2)
2016-01-04    F      17:05 - 17:07      (3)
2016-01-04    F      20:58 - 20:58      (1)
2016-01-05    F      20:59 - 20:59      (1)
2016-01-05    F      21:05 - 21:05      (1)
2016-01-05    F      21:08 - 21:08      (1)
2016-01-05    F      21:10 - 21:10      (1)
2016-01-05    F      21:14 - 21:16      (3)
2016-01-05    F      21:20 - 21:20      (1)
2016-01-05    F      21:22 - 21:22      (1)
2016-01-05    F      21:25 - 21:26      (2)
2016-01-05    F      23:29 - 23:29      (1)
2016-01-06    F      02:56 - 02:56      (1)
2016-01-06    F      03:05 - 03:06      (2)
2016-01-06    F      05:59 - 05:59      (1)
2016-01-06    F      06:27 - 06:27      (1)
2016-01-06    F      06:41 - 06:41      (1)
2016-01-06    F      07:36 - 07:36      (1)
2016-01-06    F      08:05 - 08:05      (1)
2016-01-06    F      08:09 - 08:09      (1)
2016-01-06    F      20:58 - 20:59      (2)
2016-01-06    F      21:18 - 21:18      (1)
2016-01-06    F      21:51 - 21:51      (1)
2016-01-06    F      22:03 - 22:03      (1)
2016-01-06    F      22:13 - 22:13      (1)
2016-01-06    F      22:16 - 22:16      (1)
2016-01-06    F      22:19 - 22:20      (2)
2016-01-06    F      22:24 - 22:25      (2)
2016-01-06    F      22:38 - 22:38      (1)
```

2016-01-06	F	22:42 - 22:42	(1)
2016-01-06	F	22:47 - 22:47	(1)
2016-01-06	F	22:49 - 22:50	(2)
2016-01-07	F	14:38 - 14:38	(1)
2016-01-07	F	20:59 - 20:59	(1)
2016-01-07	F	21:09 - 21:09	(1)
2016-01-07	F	21:28 - 21:28	(1)
2016-01-07	F	21:41 - 21:42	(2)
2016-01-08	F	08:49 - 08:49	(1)
2016-01-08	F	14:06 - 14:07	(2)
2016-01-08	F	20:58 - 20:58	(1)
2016-01-08	F	21:27 - 21:28	(2)
2016-01-08	F	21:33 - 21:33	(1)
2016-01-09	F	10:34 - 10:34	(1)
2016-01-09	F	21:27 - 21:27	(1)
2016-01-09	F	21:29 - 21:29	(1)
2016-01-09	F	21:35 - 21:35	(1)
2016-01-09	F	21:37 - 21:37	(1)
2016-01-09	F	21:46 - 21:46	(1)
2016-01-09	F	21:59 - 21:59	(1)
2016-01-09	F	22:16 - 22:16	(1)
2016-01-10	F	20:59 - 20:59	(1)
2016-01-10	F	21:03 - 21:03	(1)
2016-01-10	F	21:31 - 21:31	(1)
2016-01-10	F	21:43 - 21:43	(1)
2016-01-10	F	21:58 - 21:58	(1)
2016-01-10	F	22:03 - 22:03	(1)
2016-01-10	F	22:15 - 22:15	(1)
2016-01-10	F	22:17 - 22:17	(1)
2016-01-11	F	21:37 - 21:39	(3)
2016-01-11	F	22:04 - 22:04	(1)
2016-01-12	F	12:41 - 12:41	(1)
2016-01-12	F	21:38 - 21:38	(1)
2016-01-13	F	13:45 - 13:45	(1)
2016-01-13	F	19:37 - 19:38	(2)
2016-01-13	F	19:50 - 19:50	(1)
2016-01-13	F	20:07 - 20:11	(5)
2016-01-13	F	20:16 - 20:16	(1)
2016-01-13	F	20:18 - 20:18	(1)
2016-01-13	F	20:21 - 20:24	(4)
2016-01-13	F	20:28 - 20:32	(5)
2016-01-13	F	20:35 - 20:35	(1)
2016-01-13	F	21:32 - 21:32	(1)
2016-01-13	F	21:57 - 21:57	(1)
2016-01-14	F	12:55 - 12:55	(1)
2016-01-14	F	21:37 - 21:37	(1)
2016-01-14	F	21:39 - 21:42	(4)
2016-01-14	F	22:08 - 22:08	(1)
2016-01-15	F	14:34 - 14:34	(1)
2016-01-15	F	21:23 - 21:23	(1)
2016-01-15	F	22:01 - 22:01	(1)
2016-01-15	F	22:03 - 22:03	(1)
2016-01-15	F	22:07 - 22:07	(1)
2016-01-15	F	22:11 - 22:11	(1)
2016-01-16	F	21:49 - 21:49	(1)
2016-01-16	F	21:53 - 21:53	(1)
2016-01-16	F	21:59 - 22:00	(2)
2016-01-16	F	22:02 - 22:03	(2)
2016-01-16	F	22:10 - 22:10	(1)
2016-01-16	F	22:13 - 22:13	(1)
2016-01-17	F	21:46 - 21:46	(1)

2016-01-17	F	22:07 - 22:07	(1)
2016-01-17	F	22:09 - 22:09	(1)
2016-01-19	F	21:15 - 21:15	(1)
2016-01-19	F	21:30 - 21:30	(1)
2016-01-19	F	21:34 - 21:34	(1)
2016-01-19	F	21:42 - 21:42	(1)
2016-01-19	F	22:09 - 22:09	(1)
2016-01-20	F	10:40 - 10:41	(2)
2016-01-20	F	10:50 - 10:50	(1)
2016-01-20	F	13:20 - 13:20	(1)
2016-01-20	F	14:01 - 14:03	(3)
2016-01-20	F	17:22 - 17:22	(1)
2016-01-20	F	17:52 - 17:53	(2)
2016-01-20	F	17:55 - 17:55	(1)
2016-01-20	F	18:25 - 18:25	(1)
2016-01-20	F	21:38 - 21:39	(2)
2016-01-21	F	05:47 - 05:47	(1)
2016-01-21	F	20:57 - 20:58	(2)
2016-01-21	F	22:09 - 22:09	(1)
2016-01-21	F	22:12 - 22:12	(1)
2016-01-22	F	21:19 - 21:19	(1)
2016-01-22	F	21:51 - 21:51	(1)
2016-01-22	F	22:04 - 22:05	(2)
2016-01-23	F	13:03 - 13:03	(1)
2016-01-23	F	21:34 - 21:34	(1)
2016-01-23	F	21:37 - 21:38	(2)
2016-01-23	F	21:41 - 21:42	(2)
2016-01-23	F	21:45 - 21:45	(1)
2016-01-23	F	21:54 - 21:55	(2)
2016-01-24	F	18:32 - 18:32	(1)
2016-01-25	F	22:13 - 22:13	(1)
2016-01-26	F	09:01 - 09:01	(1)
2016-01-26	F	21:20 - 21:21	(2)
2016-01-26	F	21:41 - 21:41	(1)
2016-01-26	F	22:01 - 22:01	(1)
2016-01-28	F	22:18 - 22:18	(1)
2016-01-28	F	22:38 - 22:38	(1)
2016-01-28	F	22:52 - 22:53	(2)
2016-01-29	F	21:58 - 21:58	(1)
2016-01-29	F	22:12 - 22:12	(1)
2016-01-30	F	16:13 - 16:13	(1)
2016-01-31	F	23:26 - 23:26	(1)
2016-02-01	F	00:12 - 00:12	(1)
2016-02-01	F	00:34 - 00:34	(1)
2016-02-01	F	00:40 - 00:40	(1)
2016-02-01	F	00:46 - 00:46	(1)
2016-02-01	F	00:48 - 00:48	(1)
2016-02-01	F	00:56 - 00:56	(1)
2016-02-01	F	01:02 - 01:02	(1)
2016-02-01	F	01:06 - 01:06	(1)
2016-02-01	F	01:20 - 01:21	(2)
2016-02-01	F	01:37 - 01:37	(1)
2016-02-01	F	01:43 - 01:43	(1)
2016-02-01	F	01:46 - 01:46	(1)
2016-02-01	F	01:54 - 01:54	(1)
2016-02-01	F	01:57 - 01:57	(1)
2016-02-01	F	02:01 - 02:02	(2)
2016-02-01	F	02:07 - 02:07	(1)
2016-02-01	F	02:09 - 02:09	(1)
2016-02-01	F	02:11 - 02:11	(1)
2016-02-01	F	02:13 - 02:14	(2)

2016-02-01	F	02:29 - 02:29	(1)
2016-02-01	F	02:33 - 02:33	(1)
2016-02-01	F	02:49 - 02:49	(1)
2016-02-01	F	03:17 - 03:17	(1)
2016-02-01	F	03:19 - 03:22	(4)
2016-02-01	F	03:24 - 03:26	(3)
2016-02-01	F	03:33 - 03:34	(2)
2016-02-01	F	03:37 - 03:40	(4)
2016-02-01	F	03:43 - 03:46	(4)
2016-02-01	F	03:48 - 03:52	(5)
2016-02-01	F	03:54 - 03:58	(5)
2016-02-01	F	04:00 - 04:00	(1)
2016-02-01	F	04:03 - 04:04	(2)
2016-02-01	F	04:08 - 04:08	(1)
2016-02-01	F	04:12 - 04:13	(2)
2016-02-01	F	04:15 - 04:15	(1)
2016-02-01	F	04:29 - 04:29	(1)
2016-02-01	F	04:33 - 04:34	(2)
2016-02-01	F	04:36 - 04:36	(1)
2016-02-02	F	14:25 - 14:26	(2)
2016-02-02	F	14:55 - 14:58	(4)
2016-02-02	F	21:37 - 21:39	(3)
2016-02-02	F	22:26 - 22:27	(2)
2016-02-02	F	23:13 - 23:13	(1)
2016-02-03	F	12:01 - 12:01	(1)
2016-02-03	F	12:16 - 12:19	(4)
2016-02-03	F	12:24 - 12:24	(1)
2016-02-03	F	12:28 - 12:28	(1)
2016-02-03	F	12:31 - 12:31	(1)
2016-02-03	F	12:36 - 12:36	(1)
2016-02-03	F	12:38 - 12:39	(2)
2016-02-03	F	12:43 - 12:45	(3)
2016-02-03	F	12:48 - 12:49	(2)
2016-02-03	F	12:53 - 12:56	(4)
2016-02-03	F	13:03 - 13:03	(1)
2016-02-03	F	13:21 - 13:22	(2)
2016-02-03	F	13:25 - 13:25	(1)
2016-02-03	F	13:29 - 13:30	(2)
2016-02-03	F	13:33 - 13:34	(2)
2016-02-03	F	13:43 - 13:45	(3)
2016-02-03	F	13:53 - 13:54	(2)
2016-02-03	F	13:56 - 13:58	(3)
2016-02-03	F	14:01 - 14:02	(2)
2016-02-03	F	14:10 - 14:10	(1)
2016-02-03	F	14:14 - 14:14	(1)
2016-02-03	F	14:17 - 14:20	(4)
2016-02-03	F	14:24 - 14:25	(2)
2016-02-03	F	14:35 - 14:35	(1)
2016-02-03	F	14:37 - 14:38	(2)
2016-02-03	F	14:42 - 14:42	(1)
2016-02-03	F	14:55 - 14:55	(1)
2016-02-03	F	14:58 - 14:58	(1)
2016-02-03	F	15:00 - 15:00	(1)
2016-02-03	F	15:04 - 15:05	(2)
2016-02-03	F	15:10 - 15:13	(4)
2016-02-03	F	15:15 - 15:18	(4)
2016-02-03	F	15:20 - 15:20	(1)
2016-02-03	F	15:23 - 15:24	(2)
2016-02-03	F	15:27 - 15:29	(3)
2016-02-03	F	15:33 - 15:34	(2)
2016-02-03	F	15:41 - 15:41	(1)

2016-02-03	F	15:45 - 15:50	(6)
2016-02-03	F	15:53 - 15:54	(2)
2016-02-03	F	16:25 - 20:21	(237)
2016-02-03	F	20:24 - 20:26	(3)
2016-02-03	F	21:58 - 22:01	(4)
2016-02-03	F	22:27 - 22:27	(1)
2016-02-04	F	12:00 - 12:00	(1)
2016-02-04	F	13:58 - 13:58	(1)
2016-02-04	F	14:20 - 14:20	(1)
2016-02-04	F	14:31 - 14:31	(1)
2016-02-04	F	14:36 - 14:36	(1)
2016-02-04	F	14:38 - 14:38	(1)
2016-02-04	F	14:40 - 14:41	(2)
2016-02-04	F	14:45 - 14:47	(3)
2016-02-04	F	14:53 - 14:53	(1)
2016-02-04	F	14:56 - 14:56	(1)
2016-02-04	F	14:59 - 14:59	(1)
2016-02-04	F	15:03 - 15:04	(2)
2016-02-04	F	15:06 - 15:08	(3)
2016-02-04	F	15:11 - 15:11	(1)
2016-02-04	F	15:15 - 15:16	(2)
2016-02-04	F	15:18 - 15:18	(1)
2016-02-04	F	15:21 - 15:21	(1)
2016-02-04	F	15:26 - 15:30	(5)
2016-02-04	F	15:35 - 15:35	(1)
2016-02-04	F	15:43 - 15:43	(1)
2016-02-04	F	15:52 - 15:52	(1)
2016-02-04	F	15:55 - 15:55	(1)
2016-02-04	F	16:29 - 16:30	(2)
2016-02-04	F	16:35 - 16:35	(1)
2016-02-04	F	16:41 - 16:42	(2)
2016-02-04	F	16:46 - 16:46	(1)
2016-02-04	F	16:48 - 16:49	(2)
2016-02-04	F	16:51 - 16:52	(2)
2016-02-04	F	16:55 - 16:56	(2)
2016-02-04	F	17:02 - 17:02	(1)
2016-02-04	F	17:04 - 17:04	(1)
2016-02-04	F	17:11 - 17:13	(3)
2016-02-04	F	17:15 - 17:15	(1)
2016-02-04	F	17:26 - 17:26	(1)
2016-02-04	F	17:29 - 17:29	(1)
2016-02-04	F	17:31 - 17:33	(3)
2016-02-04	F	17:35 - 17:35	(1)
2016-02-04	F	17:44 - 17:44	(1)
2016-02-04	F	17:48 - 17:48	(1)
2016-02-04	F	17:51 - 17:53	(3)
2016-02-04	F	17:59 - 17:59	(1)
2016-02-04	F	18:04 - 18:04	(1)
2016-02-04	F	18:06 - 18:08	(3)
2016-02-04	F	18:28 - 18:29	(2)
2016-02-04	F	18:34 - 18:36	(3)
2016-02-04	F	18:38 - 18:38	(1)
2016-02-04	F	18:42 - 18:45	(4)
2016-02-04	F	18:54 - 18:54	(1)
2016-02-04	F	18:56 - 19:02	(7)
2016-02-04	F	19:04 - 19:09	(6)
2016-02-04	F	19:11 - 19:12	(2)
2016-02-04	F	19:16 - 19:16	(1)
2016-02-04	F	19:19 - 19:20	(2)
2016-02-04	F	19:22 - 19:24	(3)
2016-02-04	F	19:26 - 19:26	(1)

2016-02-04	F	19:53 - 19:55	(3)
2016-02-04	F	19:58 - 19:59	(2)
2016-02-04	F	20:01 - 20:01	(1)
2016-02-04	F	20:04 - 20:05	(2)
2016-02-04	F	20:14 - 20:15	(2)
2016-02-04	F	20:22 - 21:07	(46)
2016-02-04	F	21:09 - 21:09	(1)
2016-02-04	F	21:17 - 21:17	(1)
2016-02-04	F	21:20 - 21:22	(3)
2016-02-04	F	21:27 - 21:27	(1)
2016-02-04	F	21:30 - 21:31	(2)
2016-02-04	F	21:36 - 21:39	(4)
2016-02-04	F	21:45 - 21:45	(1)
2016-02-04	F	21:53 - 21:56	(4)
2016-02-04	F	21:59 - 22:02	(4)
2016-02-04	F	22:05 - 22:05	(1)
2016-02-04	F	22:07 - 22:07	(1)
2016-02-04	F	22:09 - 22:09	(1)
2016-02-04	F	22:18 - 22:18	(1)
2016-02-04	F	22:20 - 22:20	(1)
2016-02-04	F	22:24 - 22:27	(4)
2016-02-04	F	22:38 - 22:40	(3)
2016-02-04	F	22:44 - 22:44	(1)
2016-02-04	F	22:47 - 22:48	(2)
2016-02-04	F	22:50 - 22:50	(1)
2016-02-05	F	07:53 - 07:53	(1)
2016-02-05	F	13:38 - 13:38	(1)
2016-02-05	F	19:16 - 19:16	(1)
2016-02-05	F	21:58 - 21:59	(2)
2016-02-06	F	16:55 - 16:55	(1)
2016-02-06	F	22:02 - 22:03	(2)
2016-02-06	F	22:44 - 22:45	(2)
2016-02-06	F	23:06 - 23:06	(1)
2016-02-06	F	23:08 - 23:08	(1)
2016-02-07	F	15:24 - 15:24	(1)
2016-02-07	F	15:36 - 15:37	(2)
2016-02-07	F	21:53 - 21:53	(1)
2016-02-07	F	22:01 - 22:01	(1)
2016-02-07	F	22:05 - 22:05	(1)
2016-02-08	F	14:38 - 14:39	(2)
2016-02-09	F	11:18 - 11:18	(1)
2016-02-10	F	05:10 - 05:10	(1)
2016-02-10	F	20:58 - 20:58	(1)
2016-02-11	F	12:24 - 12:24	(1)
2016-02-11	F	12:31 - 12:31	(1)
2016-02-11	F	12:40 - 12:40	(1)
2016-02-11	F	13:04 - 13:05	(2)
2016-02-11	F	13:47 - 13:47	(1)
2016-02-11	F	13:51 - 13:52	(2)
2016-02-11	F	14:00 - 14:00	(1)
2016-02-11	F	14:09 - 14:09	(1)
2016-02-11	F	14:18 - 14:19	(2)
2016-02-11	F	14:21 - 14:22	(2)
2016-02-11	F	14:27 - 14:27	(1)
2016-02-11	F	14:29 - 14:29	(1)
2016-02-11	F	14:31 - 14:32	(2)
2016-02-11	F	14:34 - 14:34	(1)
2016-02-11	F	14:46 - 14:46	(1)
2016-02-11	F	15:01 - 15:01	(1)
2016-02-11	F	15:04 - 15:04	(1)
2016-02-11	F	15:10 - 15:10	(1)

2016-02-11	F	15:14 - 15:14	(1)
2016-02-11	F	15:17 - 15:19	(3)
2016-02-11	F	15:25 - 15:25	(1)
2016-02-11	F	15:28 - 15:28	(1)
2016-02-11	F	15:33 - 15:34	(2)
2016-02-11	F	15:41 - 15:41	(1)
2016-02-11	F	15:43 - 15:43	(1)
2016-02-11	F	15:45 - 15:45	(1)
2016-02-11	F	15:47 - 15:49	(3)
2016-02-11	F	15:52 - 15:56	(5)
2016-02-11	F	16:29 - 16:30	(2)
2016-02-11	F	16:35 - 16:35	(1)
2016-02-11	F	16:40 - 16:40	(1)
2016-02-11	F	16:43 - 16:44	(2)
2016-02-11	F	16:50 - 16:51	(2)
2016-02-11	F	16:54 - 16:56	(3)
2016-02-11	F	17:06 - 17:06	(1)
2016-02-11	F	17:14 - 17:14	(1)
2016-02-11	F	17:36 - 17:36	(1)
2016-02-11	F	17:41 - 17:41	(1)
2016-02-11	F	18:12 - 18:12	(1)
2016-02-11	F	18:20 - 18:21	(2)
2016-02-11	F	18:27 - 18:30	(4)
2016-02-11	F	18:36 - 18:41	(6)
2016-02-11	F	18:46 - 18:46	(1)
2016-02-11	F	18:49 - 18:49	(1)
2016-02-11	F	18:54 - 18:54	(1)
2016-02-11	F	18:57 - 18:57	(1)
2016-02-11	F	18:59 - 18:59	(1)
2016-02-11	F	19:11 - 19:11	(1)
2016-02-11	F	19:13 - 19:22	(10)
2016-02-11	F	19:25 - 19:31	(7)
2016-02-11	F	19:33 - 19:35	(3)
2016-02-11	F	19:47 - 19:53	(7)
2016-02-11	F	19:55 - 19:57	(3)
2016-02-11	F	20:04 - 20:05	(2)
2016-02-11	F	20:07 - 20:08	(2)
2016-02-11	F	20:10 - 20:13	(4)
2016-02-11	F	20:17 - 20:18	(2)
2016-02-11	F	20:21 - 20:27	(7)
2016-02-12	F	14:58 - 14:59	(2)
2016-02-12	F	15:16 - 15:16	(1)
2016-02-12	F	15:27 - 15:27	(1)
2016-02-12	F	15:57 - 16:56	(60)
2016-02-12	F	21:38 - 21:38	(1)
2016-02-12	F	21:40 - 21:40	(1)
2016-02-12	F	21:55 - 21:55	(1)
2016-02-12	F	22:02 - 22:02	(1)
2016-02-12	F	22:11 - 22:11	(1)
2016-02-12	F	22:14 - 22:15	(2)
2016-02-14	F	06:06 - 06:06	(1)
2016-02-14	F	08:00 - 08:01	(2)
2016-02-14	F	08:03 - 08:05	(3)
2016-02-14	F	08:08 - 08:08	(1)
2016-02-14	F	08:10 - 08:10	(1)
2016-02-14	F	16:15 - 16:16	(2)
2016-02-14	F	21:28 - 21:29	(2)
2016-02-14	F	21:31 - 21:32	(2)
2016-02-14	F	21:36 - 21:36	(1)
2016-02-14	F	21:58 - 21:59	(2)
2016-02-14	F	22:01 - 22:04	(4)

2016-02-14	F	22:08 - 22:09	(2)
2016-02-14	F	22:16 - 22:18	(3)
2016-02-14	F	22:22 - 22:22	(1)
2016-02-14	F	22:26 - 22:26	(1)
2016-02-15	F	01:17 - 01:18	(2)
2016-02-15	F	01:20 - 01:21	(2)
2016-02-15	F	01:24 - 01:25	(2)
2016-02-15	F	01:31 - 01:40	(10)
2016-02-15	F	01:47 - 01:48	(2)
2016-02-15	F	01:50 - 01:53	(4)
2016-02-15	F	02:07 - 02:07	(1)
2016-02-15	F	02:12 - 02:15	(4)
2016-02-15	F	02:17 - 02:23	(7)
2016-02-15	F	02:28 - 02:28	(1)
2016-02-15	F	10:55 - 10:55	(1)
2016-02-15	F	11:00 - 11:01	(2)
2016-02-15	F	11:07 - 11:07	(1)
2016-02-15	F	11:17 - 11:18	(2)
2016-02-15	F	11:27 - 11:32	(6)
2016-02-15	F	11:35 - 11:36	(2)
2016-02-15	F	11:39 - 11:39	(1)
2016-02-15	F	11:44 - 11:44	(1)
2016-02-15	F	12:48 - 12:48	(1)
2016-02-15	F	13:07 - 13:08	(2)
2016-02-15	F	13:26 - 13:26	(1)
2016-02-15	F	13:58 - 13:58	(1)
2016-02-15	F	17:58 - 17:59	(2)
2016-02-15	F	18:29 - 18:29	(1)
2016-02-15	F	18:41 - 18:41	(1)
2016-02-15	F	18:46 - 18:46	(1)
2016-02-15	F	18:51 - 18:51	(1)
2016-02-15	F	18:53 - 18:53	(1)
2016-02-15	F	19:01 - 19:03	(3)
2016-02-15	F	19:12 - 19:12	(1)
2016-02-15	F	19:15 - 19:17	(3)
2016-02-15	F	19:23 - 19:24	(2)
2016-02-15	F	19:28 - 19:29	(2)
2016-02-15	F	19:33 - 19:33	(1)
2016-02-15	F	23:40 - 23:41	(2)
2016-02-15	F	23:43 - 23:45	(3)
2016-02-15	F	23:55 - 23:55	(1)
2016-02-15	F	23:58 -	
2016-02-16	F	- 00:00	(3)
2016-02-16	F	00:03 - 00:03	(1)
2016-02-16	F	00:06 - 00:09	(4)
2016-02-16	F	00:12 - 00:12	(1)
2016-02-16	F	00:16 - 00:16	(1)
2016-02-16	F	00:18 - 00:19	(2)
2016-02-16	F	00:22 - 00:22	(1)
2016-02-16	F	00:29 - 00:30	(2)
2016-02-16	F	01:53 - 01:53	(1)
2016-02-16	F	01:57 - 01:59	(3)
2016-02-16	F	02:22 - 02:23	(2)
2016-02-16	F	03:57 - 03:58	(2)
2016-02-16	F	04:12 - 04:12	(1)
2016-02-16	F	04:15 - 04:16	(2)
2016-02-16	F	04:19 - 04:20	(2)
2016-02-16	F	04:27 - 04:28	(2)
2016-02-16	F	04:31 - 04:31	(1)
2016-02-16	F	04:33 - 04:35	(3)
2016-02-16	F	04:40 - 04:41	(2)

2016-02-16	F	06:27 - 06:27	(1)
2016-02-16	F	06:30 - 06:32	(3)
2016-02-16	F	06:37 - 06:41	(5)
2016-02-16	F	06:43 - 06:44	(2)
2016-02-16	F	06:50 - 06:51	(2)
2016-02-16	F	08:43 - 08:44	(2)
2016-02-16	F	08:48 - 08:48	(1)
2016-02-16	F	08:57 - 08:58	(2)
2016-02-16	F	09:01 - 09:01	(1)
2016-02-16	F	09:03 - 09:03	(1)
2016-02-16	F	09:05 - 09:08	(4)
2016-02-16	F	12:51 - 12:52	(2)
2016-02-16	F	14:18 - 14:18	(1)
2016-02-16	F	14:20 - 14:20	(1)
2016-02-16	F	14:39 - 14:39	(1)
2016-02-16	F	20:36 - 20:36	(1)
2016-02-16	F	20:38 - 20:38	(1)
2016-02-16	F	21:20 - 21:20	(1)
2016-02-16	F	21:42 - 21:42	(1)
2016-02-16	F	21:52 - 21:53	(2)
2016-02-16	F	21:57 - 22:30	(34)
2016-02-16	F	23:52 - 23:52	(1)
2016-02-17	F	01:43 - 01:43	(1)
2016-02-17	F	01:57 - 01:57	(1)
2016-02-17	F	02:00 - 02:00	(1)
2016-02-17	F	02:04 - 02:05	(2)
2016-02-17	F	02:08 - 02:08	(1)
2016-02-17	F	02:11 - 02:11	(1)
2016-02-17	F	02:13 - 02:14	(2)
2016-02-17	F	02:17 - 02:17	(1)
2016-02-17	F	02:23 - 02:23	(1)
2016-02-17	F	04:43 - 04:43	(1)
2016-02-17	F	04:50 - 04:51	(2)
2016-02-17	F	07:28 - 07:30	(3)
2016-02-17	F	07:32 - 07:32	(1)
2016-02-17	F	07:35 - 07:35	(1)
2016-02-17	F	07:46 - 07:46	(1)
2016-02-17	F	12:56 - 12:57	(2)
2016-02-17	F	13:07 - 13:07	(1)
2016-02-17	F	14:39 - 14:39	(1)
2016-02-17	F	22:24 - 22:27	(4)
2016-02-17	F	22:31 - 22:31	(1)
2016-02-17	F	22:39 - 22:40	(2)
2016-02-17	F	23:00 - 23:01	(2)
2016-02-17	F	23:22 - 23:22	(1)
2016-02-17	F	23:29 - 23:29	(1)
2016-02-17	F	23:34 - 23:34	(1)
2016-02-17	F	23:41 - 23:41	(1)
2016-02-17	F	23:49 - 23:50	(2)
2016-02-17	F	23:53 - 23:54	(2)
2016-02-17	F	23:57 - 23:57	(1)
2016-02-17	F	23:59 - 23:59	(1)
2016-02-18	F	00:02 - 00:02	(1)
2016-02-18	F	00:08 - 00:11	(4)
2016-02-18	F	00:16 - 00:16	(1)
2016-02-18	F	00:18 - 00:18	(1)
2016-02-18	F	00:21 - 00:21	(1)
2016-02-18	F	01:28 - 01:33	(6)
2016-02-18	F	20:59 - 20:59	(1)
2016-02-18	F	21:43 - 21:45	(3)
2016-02-18	F	21:48 - 21:49	(2)

2016-02-18	F	21:52 - 21:52	(1)
2016-02-18	F	21:57 - 21:57	(1)
2016-02-18	F	22:01 - 22:01	(1)
2016-02-18	F	22:06 - 22:06	(1)
2016-02-18	F	22:25 - 22:26	(2)
2016-02-18	F	23:42 - 23:42	(1)
2016-02-18	F	23:46 - 23:48	(3)
2016-02-18	F	23:57 - 23:57	(1)
2016-02-19	F	00:04 - 00:04	(1)
2016-02-19	F	00:11 - 00:12	(2)
2016-02-19	F	00:19 - 00:19	(1)
2016-02-19	F	00:21 - 00:21	(1)
2016-02-19	F	01:28 - 01:29	(2)
2016-02-19	F	01:32 - 01:33	(2)
2016-02-19	F	01:43 - 01:43	(1)
2016-02-19	F	01:46 - 01:47	(2)
2016-02-19	F	01:54 - 01:54	(1)
2016-02-19	F	13:19 - 13:20	(2)
2016-02-19	F	13:42 - 13:42	(1)
2016-02-19	F	16:09 - 16:09	(1)
2016-02-19	F	21:50 - 21:50	(1)
2016-02-19	F	22:16 - 22:16	(1)
2016-02-19	F	22:36 - 22:36	(1)
2016-02-19	F	22:44 - 22:47	(4)
2016-02-19	F	22:55 - 22:55	(1)
2016-02-19	F	22:59 - 22:59	(1)
2016-02-19	F	23:01 - 23:02	(2)
2016-02-19	F	23:04 - 23:04	(1)
2016-02-19	F	23:11 - 23:12	(2)
2016-02-19	F	23:20 - 23:20	(1)
2016-02-19	F	23:25 - 23:28	(4)
2016-02-19	F	23:32 - 23:32	(1)
2016-02-19	F	23:34 - 23:35	(2)
2016-02-19	F	23:40 - 23:41	(2)
2016-02-19	F	23:46 - 23:50	(5)
2016-02-20	F	07:30 - 07:30	(1)
2016-02-20	F	21:20 - 21:20	(1)
2016-02-20	F	22:10 - 22:10	(1)
2016-02-20	F	22:16 - 22:17	(2)
2016-02-20	F	22:20 - 22:20	(1)
2016-02-20	F	22:26 - 22:27	(2)
2016-02-20	F	22:32 - 22:33	(2)
2016-02-20	F	22:40 - 22:40	(1)
2016-02-20	F	22:46 - 22:46	(1)
2016-02-20	F	22:49 - 22:51	(3)
2016-02-21	F	01:28 - 01:30	(3)
2016-02-21	F	01:35 - 01:36	(2)
2016-02-21	F	22:42 - 22:42	(1)
2016-02-22	F	00:35 - 00:35	(1)
2016-02-22	F	02:08 - 02:09	(2)
2016-02-22	F	05:49 - 05:49	(1)
2016-02-22	F	06:01 - 06:01	(1)
2016-02-22	F	06:10 - 06:10	(1)
2016-02-22	F	07:30 - 07:30	(1)
2016-02-22	F	07:36 - 07:36	(1)
2016-02-22	F	07:48 - 07:48	(1)
2016-02-22	F	09:52 - 09:52	(1)
2016-02-22	F	15:09 - 15:09	(1)
2016-02-22	F	15:11 - 15:12	(2)
2016-02-22	F	22:44 - 22:44	(1)
2016-02-22	F	23:28 - 23:30	(3)

2016-02-22	F	23:32 - 23:32	(1)
2016-02-22	F	23:37 - 23:38	(2)
2016-02-22	F	23:44 - 23:45	(2)
2016-02-23	F	01:58 - 01:58	(1)
2016-02-23	F	02:08 - 02:08	(1)
2016-02-23	F	02:20 - 02:20	(1)
2016-02-23	F	05:47 - 05:48	(2)
2016-02-23	F	05:51 - 06:09	(19)
2016-02-23	F	07:28 - 07:39	(12)
2016-02-23	F	07:44 - 07:50	(7)
2016-02-23	F	09:28 - 09:29	(2)
2016-02-23	F	09:42 - 09:42	(1)
2016-02-23	F	09:45 - 09:46	(2)
2016-02-23	F	09:48 - 09:48	(1)
2016-02-23	F	22:31 - 22:31	(1)
2016-02-23	F	22:43 - 22:43	(1)
2016-02-23	F	22:47 - 22:47	(1)
2016-02-23	F	22:54 - 22:54	(1)
2016-02-23	F	23:09 - 23:09	(1)
2016-02-23	F	23:18 - 23:18	(1)
2016-02-23	F	23:28 - 23:28	(1)
2016-02-23	F	23:30 - 23:31	(2)
2016-02-23	F	23:33 - 23:34	(2)
2016-02-23	F	23:41 - 23:41	(1)
2016-02-23	F	23:45 - 23:45	(1)
2016-02-23	F	23:47 - 23:48	(2)
2016-02-23	F	23:52 - 23:52	(1)
2016-02-23	F	23:55 - 23:55	(1)
2016-02-24	F	02:12 - 02:13	(2)
2016-02-24	F	02:15 - 02:15	(1)
2016-02-24	F	02:21 - 02:21	(1)
2016-02-24	F	05:47 - 05:47	(1)
2016-02-24	F	05:50 - 05:50	(1)
2016-02-24	F	05:52 - 05:52	(1)
2016-02-24	F	06:01 - 06:03	(3)
2016-02-24	F	06:06 - 06:08	(3)
2016-02-24	F	06:10 - 06:11	(2)
2016-02-24	F	07:42 - 07:45	(4)
2016-02-24	F	07:49 - 07:50	(2)
2016-02-24	F	09:01 - 09:16	(16)
2016-02-24	F	09:21 - 09:21	(1)
2016-02-24	F	09:23 - 09:23	(1)
2016-02-24	F	09:25 - 09:25	(1)
2016-02-24	F	10:05 - 10:05	(1)
2016-02-24	F	10:08 - 10:12	(5)
2016-02-24	F	10:46 - 10:46	(1)
2016-02-24	F	10:57 - 10:57	(1)
2016-02-24	F	11:15 - 11:15	(1)
2016-02-24	F	11:55 - 11:55	(1)
2016-02-24	F	12:00 - 12:00	(1)
2016-02-24	F	12:09 - 12:10	(2)
2016-02-24	F	12:29 - 12:29	(1)
2016-02-24	F	13:12 - 13:12	(1)
2016-02-24	F	21:28 - 21:28	(1)
2016-02-24	F	22:09 - 22:09	(1)
2016-02-24	F	22:27 - 22:27	(1)
2016-02-24	F	22:29 - 22:32	(4)
2016-02-24	F	22:34 - 22:47	(14)
2016-02-24	F	22:51 - 22:51	(1)
2016-02-25	F	08:37 - 08:37	(1)
2016-02-25	F	08:39 - 08:39	(1)

2016-02-25	F	08:44 - 08:44	(1)
2016-02-25	F	08:47 - 08:49	(3)
2016-02-25	F	08:55 - 08:55	(1)
2016-02-25	F	09:00 - 09:00	(1)
2016-02-25	F	09:03 - 09:07	(5)
2016-02-25	F	09:09 - 09:09	(1)
2016-02-25	F	09:11 - 09:11	(1)
2016-02-25	F	20:57 - 21:23	(27)
2016-02-25	F	21:54 - 22:14	(21)
2016-02-26	F	01:34 - 01:35	(2)
2016-02-26	F	01:39 - 01:39	(1)
2016-02-26	F	01:43 - 01:43	(1)
2016-02-26	F	01:46 - 01:50	(5)
2016-02-26	F	02:25 - 02:25	(1)
2016-02-26	F	05:40 - 05:40	(1)
2016-02-26	F	20:58 - 20:59	(2)
2016-02-26	F	21:07 - 21:11	(5)
2016-02-26	F	21:13 - 21:14	(2)
2016-02-26	F	21:16 - 21:16	(1)
2016-02-26	F	21:19 - 21:23	(5)
2016-02-26	F	21:34 - 21:34	(1)
2016-02-26	F	21:53 - 21:54	(2)
2016-02-26	F	21:57 - 21:58	(2)
2016-02-26	F	22:00 - 22:02	(3)
2016-02-26	F	22:06 - 22:08	(3)
2016-02-26	F	22:10 - 22:14	(5)
2016-02-27	F	01:31 - 01:31	(1)
2016-02-27	F	01:33 - 01:33	(1)
2016-02-27	F	01:35 - 01:35	(1)
2016-02-27	F	01:40 - 01:41	(2)
2016-02-27	F	01:46 - 01:46	(1)
2016-02-27	F	23:13 - 23:13	(1)
2016-02-27	F	23:18 - 23:18	(1)
2016-02-27	F	23:23 - 23:23	(1)
2016-02-27	F	23:36 - 23:36	(1)
2016-02-28	F	00:12 - 00:14	(3)
2016-02-28	F	00:16 - 00:16	(1)
2016-02-28	F	00:24 - 00:42	(19)
2016-02-28	F	00:50 - 00:50	(1)
2016-02-28	F	01:00 - 01:00	(1)
2016-02-28	F	07:28 - 08:20	(53)
2016-02-28	F	23:06 - 23:06	(1)
2016-02-28	F	23:25 - 23:25	(1)
2016-02-28	F	23:28 - 23:29	(2)
2016-02-28	F	23:50 - 23:50	(1)
2016-02-29	F	00:08 - 00:08	(1)
2016-02-29	F	00:17 - 00:18	(2)
2016-02-29	F	00:21 - 00:21	(1)
2016-02-29	F	00:23 - 00:23	(1)
2016-02-29	F	00:33 - 00:47	(15)
2016-02-29	F	07:12 - 07:13	(2)
2016-02-29	F	07:23 - 07:23	(1)
2016-02-29	F	07:26 - 07:26	(1)
2016-02-29	F	07:32 - 07:34	(3)
2016-02-29	F	07:40 - 07:40	(1)
2016-02-29	F	13:58 - 13:58	(1)
2016-02-29	F	14:06 - 14:06	(1)
2016-02-29	F	14:35 - 14:36	(2)
2016-02-29	F	14:48 - 14:49	(2)
2016-02-29	F	14:53 - 14:53	(1)
2016-02-29	F	15:15 - 15:16	(2)

2016-02-29	F	15:20 - 15:20	(1)
2016-02-29	F	15:34 - 15:34	(1)
2016-02-29	F	15:36 - 17:42	(127)
2016-02-29	F	17:46 - 17:46	(1)
2016-02-29	F	17:57 - 17:58	(2)
2016-02-29	F	18:01 - 18:01	(1)
2016-02-29	F	18:03 - 18:03	(1)
2016-02-29	F	18:05 - 18:05	(1)
2016-02-29	F	18:07 - 18:07	(1)
2016-02-29	F	18:13 - 18:13	(1)
2016-02-29	F	18:20 - 18:20	(1)
2016-02-29	F	18:31 - 18:31	(1)
2016-02-29	F	18:49 - 18:49	(1)
2016-02-29	F	19:16 - 19:16	(1)
2016-02-29	F	19:19 - 19:20	(2)
2016-02-29	F	19:25 - 19:25	(1)
2016-02-29	F	19:30 - 21:47	(138)
2016-03-01	F	00:03 - 00:03	(1)
2016-03-01	F	00:13 - 00:13	(1)
2016-03-01	F	00:16 - 00:17	(2)
2016-03-01	F	14:01 - 14:03	(3)
2016-03-01	F	14:07 - 14:10	(4)
2016-03-01	F	14:13 - 14:13	(1)
2016-03-01	F	14:18 - 14:18	(1)
2016-03-01	F	14:24 - 14:25	(2)
2016-03-01	F	14:34 - 14:36	(3)
2016-03-01	F	14:38 - 14:38	(1)
2016-03-01	F	14:41 - 14:43	(3)
2016-03-01	F	14:46 - 14:47	(2)
2016-03-01	F	14:51 - 14:51	(1)
2016-03-01	F	14:54 - 14:54	(1)
2016-03-01	F	14:56 - 14:57	(2)
2016-03-01	F	15:01 - 15:01	(1)
2016-03-01	F	15:05 - 15:05	(1)
2016-03-01	F	15:08 - 15:08	(1)
2016-03-01	F	15:21 - 15:21	(1)
2016-03-01	F	15:50 - 21:46	(357)
2016-03-01	F	22:58 - 22:58	(1)
2016-03-01	F	23:21 - 23:21	(1)
2016-03-02	F	00:28 - 00:28	(1)
2016-03-02	F	14:55 - 17:56	(182)
2016-03-02	F	21:03 - 21:04	(2)
2016-03-02	F	21:06 - 21:08	(3)
2016-03-02	F	21:12 - 21:13	(2)
2016-03-02	F	21:15 - 21:15	(1)
2016-03-02	F	21:17 - 21:17	(1)
2016-03-02	F	21:22 - 21:22	(1)
2016-03-02	F	21:26 - 21:27	(2)
2016-03-02	F	22:02 - 22:04	(3)
2016-03-02	F	22:12 - 22:13	(2)
2016-03-02	F	22:16 - 22:17	(2)
2016-03-02	F	22:29 - 22:29	(1)
2016-03-02	F	22:34 - 22:34	(1)
2016-03-02	F	22:39 - 22:39	(1)
2016-03-02	F	22:41 - 22:41	(1)
2016-03-03	F	21:58 - 21:59	(2)
2016-03-03	F	22:01 - 22:03	(3)
2016-03-03	F	22:08 - 22:10	(3)
2016-03-03	F	22:21 - 22:25	(5)
2016-03-03	F	22:27 - 22:30	(4)
2016-03-03	F	22:35 - 22:35	(1)

2016-03-03	F	22:42 - 22:42	(1)
2016-03-03	F	22:49 - 22:49	(1)
2016-03-04	F	02:05 - 02:05	(1)
2016-03-04	F	21:59 - 21:59	(1)
2016-03-04	F	22:02 - 22:02	(1)
2016-03-04	F	22:07 - 22:07	(1)
2016-03-04	F	22:13 - 22:13	(1)
2016-03-04	F	22:19 - 22:19	(1)
2016-03-04	F	22:27 - 22:27	(1)
2016-03-04	F	22:37 - 22:42	(6)
2016-03-04	F	22:44 - 22:44	(1)
2016-03-04	F	22:46 - 22:48	(3)
2016-03-04	F	22:50 - 22:52	(3)
2016-03-05	F	01:59 - 01:59	(1)
2016-03-05	F	02:27 - 02:27	(1)
2016-03-05	F	06:28 - 06:29	(2)
2016-03-05	F	06:39 - 06:39	(1)
2016-03-05	F	06:49 - 06:49	(1)
2016-03-05	F	21:57 - 22:53	(57)
2016-03-06	F	06:24 - 06:24	(1)
2016-03-06	F	07:11 - 07:11	(1)
2016-03-06	F	08:04 - 08:04	(1)
2016-03-06	F	11:05 - 11:05	(1)
2016-03-06	F	11:08 - 11:08	(1)
2016-03-06	F	11:12 - 11:12	(1)
2016-03-06	F	11:14 - 11:15	(2)
2016-03-06	F	11:27 - 11:27	(1)
2016-03-06	F	11:36 - 11:37	(2)
2016-03-06	F	11:43 - 11:43	(1)
2016-03-06	F	11:54 - 14:47	(174)
2016-03-06	F	15:33 - 15:33	(1)
2016-03-06	F	15:36 - 15:36	(1)
2016-03-06	F	15:42 - 15:42	(1)
2016-03-06	F	15:49 - 15:49	(1)
2016-03-06	F	15:54 - 15:54	(1)
2016-03-06	F	16:17 - 16:18	(2)
2016-03-06	F	16:35 - 16:35	(1)
2016-03-06	F	16:46 - 16:46	(1)
2016-03-06	F	17:04 - 19:22	(139)
2016-03-06	F	19:53 - 19:53	(1)
2016-03-06	F	20:22 - 20:23	(2)
2016-03-06	F	20:29 - 20:29	(1)
2016-03-06	F	21:59 - 22:00	(2)
2016-03-06	F	22:04 - 22:04	(1)
2016-03-06	F	22:08 - 22:08	(1)
2016-03-06	F	22:10 - 22:11	(2)
2016-03-06	F	22:13 - 22:13	(1)
2016-03-06	F	22:28 - 22:29	(2)
2016-03-06	F	22:31 - 22:32	(2)
2016-03-06	F	22:37 - 22:38	(2)
2016-03-06	F	22:40 - 22:40	(1)
2016-03-06	F	22:43 - 22:45	(3)
2016-03-06	F	22:47 - 22:47	(1)
2016-03-06	F	22:49 - 22:53	(5)
2016-03-06	F	23:25 - 23:25	(1)
2016-03-06	F	23:46 - 23:47	(2)
2016-03-07	F	00:19 - 00:19	(1)
2016-03-07	F	01:16 - 01:17	(2)
2016-03-07	F	01:20 - 01:20	(1)
2016-03-07	F	01:22 - 01:22	(1)
2016-03-07	F	01:24 - 01:24	(1)

2016-03-07	F	01:26 - 01:28	(3)
2016-03-07	F	11:14 - 11:14	(1)
2016-03-07	F	11:36 - 11:36	(1)
2016-03-07	F	11:38 - 11:38	(1)
2016-03-07	F	11:50 - 11:51	(2)
2016-03-07	F	12:08 - 12:08	(1)
2016-03-07	F	12:12 - 12:13	(2)
2016-03-07	F	12:23 - 12:24	(2)
2016-03-07	F	12:27 - 12:27	(1)
2016-03-07	F	12:34 - 12:34	(1)
2016-03-07	F	12:39 - 12:39	(1)
2016-03-07	F	12:45 - 12:45	(1)
2016-03-07	F	12:50 - 12:50	(1)
2016-03-07	F	12:53 - 12:56	(4)
2016-03-07	F	12:59 - 12:59	(1)
2016-03-07	F	13:02 - 13:03	(2)
2016-03-07	F	13:10 - 13:10	(1)
2016-03-07	F	13:14 - 13:15	(2)
2016-03-07	F	13:17 - 13:20	(4)
2016-03-07	F	13:23 - 13:24	(2)
2016-03-07	F	13:26 - 13:26	(1)
2016-03-07	F	13:28 - 13:28	(1)
2016-03-07	F	13:30 - 13:30	(1)
2016-03-07	F	13:37 - 13:37	(1)
2016-03-07	F	13:42 - 13:43	(2)
2016-03-07	F	13:47 - 13:48	(2)
2016-03-07	F	13:53 - 13:53	(1)
2016-03-07	F	15:28 - 15:28	(1)
2016-03-07	F	15:30 - 15:30	(1)
2016-03-07	F	15:51 - 15:51	(1)
2016-03-07	F	16:07 - 16:07	(1)
2016-03-07	F	16:28 - 16:28	(1)
2016-03-07	F	16:57 - 17:01	(5)
2016-03-07	F	17:03 - 17:05	(3)
2016-03-07	F	17:07 - 17:07	(1)
2016-03-07	F	17:10 - 17:10	(1)
2016-03-07	F	17:18 - 17:18	(1)
2016-03-07	F	17:24 - 17:24	(1)
2016-03-07	F	17:26 - 17:27	(2)
2016-03-07	F	17:34 - 17:34	(1)
2016-03-07	F	17:38 - 17:38	(1)
2016-03-07	F	17:40 - 17:40	(1)
2016-03-07	F	17:42 - 17:42	(1)
2016-03-07	F	17:44 - 17:44	(1)
2016-03-07	F	17:48 - 17:48	(1)
2016-03-07	F	17:50 - 17:50	(1)
2016-03-07	F	17:57 - 17:57	(1)
2016-03-07	F	18:01 - 18:02	(2)
2016-03-07	F	18:04 - 18:05	(2)
2016-03-07	F	18:09 - 18:09	(1)
2016-03-07	F	18:12 - 18:13	(2)
2016-03-07	F	18:16 - 18:16	(1)
2016-03-07	F	18:18 - 18:20	(3)
2016-03-07	F	18:23 - 18:24	(2)
2016-03-07	F	18:26 - 18:26	(1)
2016-03-07	F	18:46 - 18:46	(1)
2016-03-07	F	21:58 - 22:03	(6)
2016-03-07	F	22:08 - 22:08	(1)
2016-03-07	F	22:27 - 22:28	(2)
2016-03-07	F	22:43 - 22:44	(2)
2016-03-07	F	22:51 - 22:52	(2)

2016-03-07	F	22:54 - 22:55	(2)
2016-03-07	F	22:57 - 22:58	(2)
2016-03-08	F	12:53 - 12:53	(1)
2016-03-08	F	21:57 - 21:58	(2)
2016-03-08	F	22:02 - 22:05	(4)
2016-03-08	F	22:10 - 22:10	(1)
2016-03-08	F	22:17 - 22:17	(1)
2016-03-08	F	22:21 - 22:21	(1)
2016-03-08	F	22:24 - 22:24	(1)
2016-03-08	F	22:26 - 22:26	(1)
2016-03-08	F	22:44 - 22:45	(2)
2016-03-09	F	10:58 - 10:58	(1)
2016-03-09	F	11:47 - 11:47	(1)
2016-03-09	F	11:54 - 11:54	(1)
2016-03-09	F	11:56 - 11:56	(1)
2016-03-09	F	12:13 - 12:13	(1)
2016-03-09	F	12:15 - 12:16	(2)
2016-03-09	F	12:30 - 12:30	(1)
2016-03-09	F	12:44 - 12:44	(1)
2016-03-09	F	12:56 - 12:56	(1)
2016-03-09	F	13:07 - 13:08	(2)
2016-03-09	F	13:10 - 13:13	(4)
2016-03-09	F	13:16 - 13:16	(1)
2016-03-09	F	13:21 - 13:22	(2)
2016-03-09	F	13:24 - 13:26	(3)
2016-03-09	F	13:42 - 13:42	(1)
2016-03-09	F	13:50 - 13:50	(1)
2016-03-09	F	13:52 - 13:52	(1)
2016-03-09	F	13:56 - 13:57	(2)
2016-03-09	F	14:04 - 14:04	(1)
2016-03-09	F	14:06 - 14:07	(2)
2016-03-09	F	14:10 - 14:10	(1)
2016-03-09	F	14:13 - 14:13	(1)
2016-03-09	F	14:15 - 14:16	(2)
2016-03-09	F	14:18 - 14:19	(2)
2016-03-09	F	14:22 - 14:25	(4)
2016-03-09	F	14:29 - 14:30	(2)
2016-03-09	F	14:34 - 14:34	(1)
2016-03-09	F	14:38 - 14:39	(2)
2016-03-09	F	14:41 - 14:42	(2)
2016-03-09	F	14:44 - 14:45	(2)
2016-03-09	F	14:51 - 14:51	(1)
2016-03-09	F	14:53 - 14:54	(2)
2016-03-09	F	14:56 - 14:56	(1)
2016-03-09	F	15:32 - 15:32	(1)
2016-03-09	F	15:42 - 15:42	(1)
2016-03-09	F	15:52 - 15:54	(3)
2016-03-09	F	15:57 - 15:57	(1)
2016-03-09	F	16:00 - 16:00	(1)
2016-03-09	F	16:08 - 16:08	(1)
2016-03-09	F	16:14 - 16:14	(1)
2016-03-09	F	16:16 - 16:17	(2)
2016-03-09	F	16:20 - 16:21	(2)
2016-03-09	F	16:32 - 16:32	(1)
2016-03-09	F	16:39 - 16:42	(4)
2016-03-09	F	16:47 - 16:47	(1)
2016-03-09	F	16:52 - 16:53	(2)
2016-03-09	F	17:06 - 17:06	(1)
2016-03-09	F	17:09 - 17:10	(2)
2016-03-09	F	17:18 - 17:19	(2)
2016-03-09	F	17:27 - 17:29	(3)

2016-03-09	F	17:36 - 17:39	(4)
2016-03-09	F	17:45 - 17:45	(1)
2016-03-09	F	17:48 - 17:48	(1)
2016-03-09	F	17:50 - 17:51	(2)
2016-03-09	F	18:01 - 18:01	(1)
2016-03-09	F	18:03 - 18:03	(1)
2016-03-09	F	18:05 - 18:05	(1)
2016-03-09	F	18:07 - 18:08	(2)
2016-03-09	F	18:13 - 18:13	(1)
2016-03-09	F	18:16 - 18:16	(1)
2016-03-09	F	18:19 - 18:19	(1)
2016-03-09	F	18:21 - 18:21	(1)
2016-03-09	F	18:24 - 18:31	(8)
2016-03-09	F	18:33 - 18:33	(1)
2016-03-09	F	18:36 - 18:37	(2)
2016-03-09	F	18:40 - 18:40	(1)
2016-03-09	F	18:42 - 18:45	(4)
2016-03-09	F	18:47 - 18:48	(2)
2016-03-09	F	18:50 - 18:55	(6)
2016-03-09	F	18:58 - 19:17	(20)
2016-03-09	F	19:22 - 19:25	(4)
2016-03-09	F	20:31 - 20:31	(1)
2016-03-09	F	20:42 - 20:53	(12)
2016-03-09	F	20:56 - 21:01	(6)
2016-03-09	F	21:06 - 21:10	(5)
2016-03-09	F	21:13 - 21:17	(5)
2016-03-09	F	21:22 - 21:22	(1)
2016-03-09	F	21:26 - 21:26	(1)
2016-03-09	F	21:29 - 21:33	(5)
2016-03-09	F	21:35 - 21:42	(8)
2016-03-10	F	14:18 - 14:19	(2)
2016-03-10	F	20:28 - 20:30	(3)
2016-03-10	F	20:32 - 20:34	(3)
2016-03-10	F	20:36 - 20:37	(2)
2016-03-10	F	20:41 - 20:44	(4)
2016-03-10	F	20:50 - 20:50	(1)
2016-03-10	F	21:02 - 21:02	(1)
2016-03-10	F	21:06 - 21:06	(1)
2016-03-10	F	21:08 - 21:09	(2)
2016-03-10	F	21:12 - 21:14	(3)
2016-03-10	F	21:18 - 21:18	(1)
2016-03-10	F	21:20 - 21:20	(1)
2016-03-10	F	21:22 - 21:22	(1)
2016-03-10	F	21:26 - 21:28	(3)
2016-03-10	F	21:31 - 21:31	(1)
2016-03-10	F	21:33 - 21:33	(1)
2016-03-10	F	21:35 - 21:35	(1)
2016-03-10	F	21:37 - 21:40	(4)
2016-03-10	F	21:43 - 21:45	(3)
2016-03-10	F	21:49 - 21:49	(1)
2016-03-11	F	02:45 - 02:45	(1)
2016-03-11	F	03:11 - 03:11	(1)
2016-03-11	F	07:26 - 07:26	(1)
2016-03-11	F	13:58 - 13:59	(2)
2016-03-11	F	14:03 - 14:03	(1)
2016-03-11	F	14:08 - 14:11	(4)
2016-03-11	F	23:17 - 23:18	(2)
2016-03-11	F	23:38 - 23:39	(2)
2016-03-11	F	23:47 - 23:50	(4)
2016-03-11	F	23:57 - 23:59	(3)
2016-03-12	F	00:02 - 00:04	(3)

2016-03-12	F	00:07 - 00:07	(1)
2016-03-12	F	00:09 - 00:09	(1)
2016-03-12	F	00:13 - 00:16	(4)
2016-03-12	F	00:18 - 00:19	(2)
2016-03-12	F	00:23 - 00:24	(2)
2016-03-12	F	04:46 - 04:46	(1)
2016-03-12	F	05:18 - 05:18	(1)
2016-03-12	F	05:41 - 05:42	(2)
2016-03-12	F	07:00 - 07:01	(2)
2016-03-12	F	07:41 - 07:42	(2)
2016-03-12	F	07:56 - 07:56	(1)
2016-03-12	F	15:48 - 15:49	(2)
2016-03-12	F	16:27 - 16:28	(2)
2016-03-12	F	17:06 - 17:07	(2)
2016-03-12	F	20:22 - 21:36	(75)
2016-03-12	F	23:06 - 23:47	(42)
2016-03-13	F	00:50 - 01:14	(25)
2016-03-13	F	20:32 - 20:32	(1)
2016-03-13	F	20:38 - 20:39	(2)
2016-03-13	F	20:41 - 20:43	(3)
2016-03-13	F	20:48 - 20:48	(1)
2016-03-13	F	20:50 - 20:50	(1)
2016-03-13	F	20:55 - 21:02	(8)
2016-03-13	F	21:05 - 21:05	(1)
2016-03-13	F	21:07 - 21:07	(1)
2016-03-13	F	21:11 - 21:11	(1)
2016-03-13	F	21:17 - 21:23	(7)
2016-03-13	F	21:26 - 21:26	(1)
2016-03-13	F	21:28 - 21:30	(3)
2016-03-13	F	21:32 - 21:33	(2)
2016-03-13	F	21:36 - 21:36	(1)
2016-03-13	F	21:41 - 21:43	(3)
2016-03-13	F	21:45 - 21:45	(1)
2016-03-14	F	01:29 - 01:29	(1)
2016-03-14	F	01:33 - 01:34	(2)
2016-03-14	F	02:00 - 02:00	(1)
2016-03-14	F	02:17 - 02:17	(1)
2016-03-14	F	02:30 - 02:31	(2)
2016-03-14	F	04:13 - 04:14	(2)
2016-03-14	F	04:21 - 04:21	(1)
2016-03-14	F	04:25 - 04:25	(1)
2016-03-14	F	04:31 - 04:31	(1)
2016-03-14	F	04:33 - 04:33	(1)
2016-03-14	F	04:42 - 04:42	(1)
2016-03-14	F	05:19 - 05:19	(1)
2016-03-14	F	06:58 - 06:58	(1)
2016-03-14	F	07:41 - 07:41	(1)
2016-03-14	F	19:42 - 19:42	(1)
2016-03-14	F	19:53 - 19:53	(1)
2016-03-14	F	19:55 - 19:55	(1)
2016-03-14	F	20:31 - 20:31	(1)
2016-03-14	F	20:42 - 20:43	(2)
2016-03-14	F	20:52 - 20:54	(3)
2016-03-14	F	20:56 - 21:00	(5)
2016-03-14	F	21:02 - 21:03	(2)
2016-03-14	F	21:06 - 21:06	(1)
2016-03-14	F	21:12 - 21:14	(3)
2016-03-14	F	21:16 - 21:16	(1)
2016-03-14	F	21:23 - 21:24	(2)
2016-03-14	F	21:26 - 21:26	(1)
2016-03-14	F	21:28 - 21:32	(5)

2016-03-14	F	21:35 - 21:37	(3)
2016-03-14	F	21:39 - 21:40	(2)
2016-03-14	F	21:43 - 21:44	(2)
2016-03-14	F	21:47 - 21:47	(1)
2016-03-14	F	21:49 - 21:49	(1)
2016-03-14	F	21:51 - 21:51	(1)
2016-03-14	F	21:53 - 21:53	(1)
2016-03-14	F	22:45 - 22:45	(1)
2016-03-14	F	22:47 - 22:47	(1)
2016-03-14	F	22:53 - 22:54	(2)
2016-03-14	F	23:00 - 23:00	(1)
2016-03-15	F	00:02 - 00:02	(1)
2016-03-15	F	00:31 - 00:31	(1)
2016-03-15	F	00:36 - 00:37	(2)
2016-03-15	F	01:06 - 01:06	(1)
2016-03-15	F	01:17 - 01:17	(1)
2016-03-15	F	01:21 - 01:21	(1)
2016-03-15	F	01:29 - 01:29	(1)
2016-03-15	F	01:58 - 01:58	(1)
2016-03-15	F	04:37 - 04:37	(1)
2016-03-15	F	04:55 - 04:55	(1)
2016-03-15	F	08:09 - 08:09	(1)
2016-03-15	F	08:14 - 08:14	(1)
2016-03-15	F	08:19 - 08:19	(1)
2016-03-15	F	08:30 - 08:30	(1)
2016-03-15	F	08:33 - 08:33	(1)
2016-03-15	F	08:53 - 08:54	(2)
2016-03-15	F	08:56 - 08:56	(1)
2016-03-15	F	08:59 - 08:59	(1)
2016-03-15	F	09:05 - 09:05	(1)
2016-03-15	F	10:58 - 10:58	(1)
2016-03-15	F	11:24 - 11:24	(1)
2016-03-15	F	11:34 - 11:34	(1)
2016-03-15	F	11:39 - 11:40	(2)
2016-03-15	F	11:52 - 11:52	(1)
2016-03-15	F	12:02 - 12:02	(1)
2016-03-15	F	12:10 - 12:11	(2)
2016-03-15	F	12:15 - 12:15	(1)
2016-03-15	F	12:17 - 12:18	(2)
2016-03-15	F	12:22 - 12:22	(1)
2016-03-15	F	12:24 - 12:24	(1)
2016-03-15	F	12:28 - 12:29	(2)
2016-03-15	F	12:35 - 12:35	(1)
2016-03-15	F	12:47 - 12:47	(1)
2016-03-15	F	13:00 - 13:02	(3)
2016-03-15	F	13:05 - 13:06	(2)
2016-03-15	F	13:09 - 13:09	(1)
2016-03-15	F	13:14 - 13:19	(6)
2016-03-15	F	13:22 - 13:22	(1)
2016-03-15	F	13:24 - 13:27	(4)
2016-03-15	F	13:30 - 13:30	(1)
2016-03-15	F	13:34 - 13:34	(1)
2016-03-15	F	13:36 - 13:36	(1)
2016-03-15	F	13:44 - 13:46	(3)
2016-03-15	F	13:48 - 13:48	(1)
2016-03-15	F	13:50 - 13:53	(4)
2016-03-15	F	14:13 - 14:15	(3)
2016-03-15	F	14:18 - 14:18	(1)
2016-03-15	F	14:23 - 14:23	(1)
2016-03-15	F	14:27 - 14:28	(2)
2016-03-15	F	14:30 - 14:30	(1)

2016-03-15	F	14:34 - 14:35	(2)
2016-03-15	F	14:39 - 14:39	(1)
2016-03-15	F	14:44 - 14:47	(4)
2016-03-15	F	14:53 - 14:53	(1)
2016-03-15	F	15:29 - 15:29	(1)
2016-03-15	F	15:31 - 15:31	(1)
2016-03-15	F	15:33 - 15:37	(5)
2016-03-15	F	15:42 - 15:42	(1)
2016-03-15	F	15:45 - 15:45	(1)
2016-03-15	F	15:48 - 15:48	(1)
2016-03-15	F	15:57 - 15:58	(2)
2016-03-15	F	16:04 - 16:07	(4)
2016-03-15	F	16:11 - 16:13	(3)
2016-03-15	F	16:15 - 16:15	(1)
2016-03-15	F	16:21 - 16:21	(1)
2016-03-15	F	16:28 - 16:28	(1)
2016-03-15	F	16:35 - 16:37	(3)
2016-03-15	F	16:47 - 16:47	(1)
2016-03-15	F	16:50 - 16:51	(2)
2016-03-15	F	17:00 - 17:03	(4)
2016-03-15	F	17:12 - 17:13	(2)
2016-03-15	F	17:15 - 17:18	(4)
2016-03-15	F	17:20 - 17:21	(2)
2016-03-15	F	17:23 - 17:23	(1)
2016-03-15	F	17:26 - 17:26	(1)
2016-03-15	F	17:52 - 17:52	(1)
2016-03-15	F	17:54 - 17:54	(1)
2016-03-15	F	17:57 - 17:57	(1)
2016-03-15	F	18:02 - 18:02	(1)
2016-03-15	F	18:11 - 18:11	(1)
2016-03-15	F	18:14 - 18:16	(3)
2016-03-15	F	18:18 - 18:19	(2)
2016-03-15	F	18:23 - 18:24	(2)
2016-03-15	F	18:26 - 18:28	(3)
2016-03-15	F	18:38 - 18:38	(1)
2016-03-15	F	18:40 - 18:40	(1)
2016-03-15	F	18:45 - 18:45	(1)
2016-03-15	F	18:47 - 18:48	(2)
2016-03-15	F	18:50 - 18:54	(5)
2016-03-15	F	18:58 - 18:58	(1)
2016-03-15	F	19:03 - 19:06	(4)
2016-03-15	F	19:09 - 19:09	(1)
2016-03-15	F	19:12 - 19:17	(6)
2016-03-15	F	19:19 - 19:26	(8)
2016-03-15	F	20:20 - 20:20	(1)
2016-03-15	F	20:31 - 20:31	(1)
2016-03-15	F	20:34 - 20:39	(6)
2016-03-15	F	20:43 - 20:43	(1)
2016-03-15	F	20:46 - 20:47	(2)
2016-03-15	F	20:49 - 20:54	(6)
2016-03-15	F	20:56 - 20:57	(2)
2016-03-15	F	20:59 - 20:59	(1)
2016-03-15	F	21:05 - 21:05	(1)
2016-03-15	F	21:15 - 21:16	(2)
2016-03-15	F	21:24 - 21:25	(2)
2016-03-15	F	21:27 - 21:27	(1)
2016-03-15	F	21:29 - 21:30	(2)
2016-03-15	F	21:37 - 21:38	(2)
2016-03-15	F	21:42 - 21:42	(1)
2016-03-15	F	21:45 - 21:46	(2)
2016-03-15	F	21:48 - 21:52	(5)

2016-03-15	F	21:54 - 21:56	(3)
2016-03-15	F	21:58 - 21:58	(1)
2016-03-15	F	22:03 - 22:04	(2)
2016-03-15	F	22:08 - 22:09	(2)
2016-03-16	F	11:25 - 12:25	(61)
2016-03-16	F	12:27 - 12:29	(3)
2016-03-16	F	12:31 - 12:33	(3)
2016-03-16	F	12:35 - 12:35	(1)
2016-03-16	F	12:38 - 12:39	(2)
2016-03-16	F	12:41 - 12:41	(1)
2016-03-16	F	12:43 - 12:43	(1)
2016-03-16	F	12:47 - 12:47	(1)
2016-03-16	F	12:54 - 12:54	(1)
2016-03-16	F	12:57 - 12:58	(2)
2016-03-16	F	13:00 - 13:00	(1)
2016-03-16	F	13:02 - 13:03	(2)
2016-03-16	F	15:28 - 15:28	(1)
2016-03-16	F	15:34 - 15:34	(1)
2016-03-16	F	15:42 - 15:42	(1)
2016-03-16	F	15:44 - 15:45	(2)
2016-03-16	F	15:53 - 15:53	(1)
2016-03-16	F	16:15 - 17:32	(78)
2016-03-16	F	17:34 - 17:36	(3)
2016-03-16	F	20:29 - 20:30	(2)
2016-03-16	F	20:32 - 20:32	(1)
2016-03-16	F	20:34 - 20:37	(4)
2016-03-16	F	20:44 - 20:45	(2)
2016-03-16	F	20:50 - 20:50	(1)
2016-03-16	F	20:53 - 20:54	(2)
2016-03-16	F	20:58 - 20:58	(1)
2016-03-16	F	21:01 - 21:03	(3)
2016-03-16	F	21:08 - 21:08	(1)
2016-03-16	F	21:16 - 21:16	(1)
2016-03-16	F	21:21 - 21:22	(2)
2016-03-16	F	21:24 - 21:24	(1)
2016-03-16	F	21:30 - 21:32	(3)
2016-03-16	F	21:36 - 21:43	(8)
2016-03-16	F	21:45 - 21:45	(1)
2016-03-16	F	21:52 - 21:55	(4)
2016-03-16	F	22:01 - 22:08	(8)
2016-03-16	F	22:10 - 22:12	(3)
2016-03-17	F	02:28 - 02:28	(1)
2016-03-17	F	06:23 - 06:23	(1)
2016-03-17	F	07:16 - 07:16	(1)
2016-03-17	F	09:49 - 09:49	(1)
2016-03-17	F	10:58 - 10:58	(1)
2016-03-17	F	11:27 - 12:23	(57)
2016-03-17	F	17:03 - 17:04	(2)
2016-03-18	F	01:09 - 01:55	(47)
2016-03-18	F	08:04 - 08:04	(1)
2016-03-18	F	08:15 - 08:16	(2)
2016-03-18	F	08:26 - 08:27	(2)
2016-03-18	F	08:29 - 08:29	(1)
2016-03-18	F	08:38 - 08:39	(2)
2016-03-18	F	11:20 - 11:20	(1)
2016-03-18	F	16:25 - 16:25	(1)
2016-03-18	F	20:24 - 22:45	(142)
2016-03-19	F	23:53 - 23:59	(7)
2016-03-20	F	00:01 - 00:01	(1)
2016-03-20	F	00:03 - 00:32	(30)
2016-03-20	F	00:39 - 00:39	(1)

2016-03-20	F	00:47 - 00:48	(2)
2016-03-20	F	00:51 - 00:51	(1)
2016-03-20	F	00:55 - 00:57	(3)
2016-03-20	F	01:04 - 01:05	(2)
2016-03-20	F	01:19 - 01:19	(1)
2016-03-20	F	01:23 - 01:25	(3)
2016-03-20	F	01:27 - 01:29	(3)
2016-03-20	F	08:01 - 08:01	(1)
2016-03-20	F	08:09 - 08:11	(3)
2016-03-20	F	08:23 - 08:24	(2)
2016-03-20	F	20:27 - 20:40	(14)
2016-03-20	F	20:45 - 20:45	(1)
2016-03-20	F	20:47 - 20:48	(2)
2016-03-20	F	20:51 - 20:51	(1)
2016-03-20	F	20:57 - 21:12	(16)
2016-03-20	F	21:18 - 21:51	(34)
2016-03-20	F	21:53 - 21:54	(2)
2016-03-20	F	21:57 - 21:57	(1)
2016-03-20	F	22:02 - 22:02	(1)
2016-03-20	F	22:06 - 22:06	(1)
2016-03-20	F	22:16 - 22:29	(14)
2016-03-20	F	22:36 - 22:36	(1)
2016-03-20	F	22:39 - 22:44	(6)
2016-03-20	F	22:47 - 22:48	(2)
2016-03-20	F	22:50 - 22:50	(1)
2016-03-21	F	01:54 - 01:54	(1)
2016-03-21	F	01:56 - 01:56	(1)
2016-03-21	F	01:58 - 02:00	(3)
2016-03-21	F	02:08 - 02:09	(2)
2016-03-21	F	02:13 - 02:13	(1)
2016-03-21	F	02:23 - 02:25	(3)
2016-03-21	F	02:31 - 02:31	(1)
2016-03-21	F	02:52 - 03:22	(31)
2016-03-21	F	03:24 - 03:24	(1)
2016-03-21	F	03:31 - 03:31	(1)
2016-03-21	F	03:36 - 03:36	(1)
2016-03-21	F	03:41 - 03:42	(2)
2016-03-21	F	03:45 - 03:47	(3)
2016-03-21	F	03:51 - 03:51	(1)
2016-03-21	F	03:53 - 03:53	(1)
2016-03-21	F	04:01 - 04:04	(4)
2016-03-21	F	04:08 - 04:08	(1)
2016-03-21	F	04:13 - 04:13	(1)
2016-03-21	F	05:58 - 05:58	(1)
2016-03-21	F	06:14 - 06:14	(1)
2016-03-21	F	06:18 - 06:18	(1)
2016-03-21	F	06:23 - 06:23	(1)
2016-03-21	F	06:26 - 06:27	(2)
2016-03-21	F	06:53 - 06:54	(2)
2016-03-21	F	06:56 - 06:56	(1)
2016-03-21	F	06:58 - 07:02	(5)
2016-03-21	F	07:04 - 07:05	(2)
2016-03-21	F	07:11 - 07:11	(1)
2016-03-21	F	07:15 - 07:15	(1)
2016-03-21	F	07:17 - 07:17	(1)
2016-03-21	F	07:19 - 07:21	(3)
2016-03-21	F	07:32 - 07:32	(1)
2016-03-21	F	07:58 - 07:59	(2)
2016-03-21	F	08:02 - 08:02	(1)
2016-03-21	F	08:09 - 08:10	(2)
2016-03-21	F	08:16 - 08:16	(1)

2016-03-21	F	20:27 - 20:29	(3)
2016-03-21	F	20:33 - 20:33	(1)
2016-03-21	F	20:35 - 20:35	(1)
2016-03-21	F	20:38 - 20:38	(1)
2016-03-21	F	20:42 - 20:44	(3)
2016-03-21	F	20:47 - 20:48	(2)
2016-03-21	F	20:54 - 20:54	(1)
2016-03-21	F	20:57 - 20:58	(2)
2016-03-21	F	21:01 - 21:02	(2)
2016-03-21	F	21:04 - 21:05	(2)
2016-03-21	F	21:08 - 21:08	(1)
2016-03-21	F	21:12 - 21:12	(1)
2016-03-21	F	21:15 - 21:18	(4)
2016-03-21	F	21:24 - 21:26	(3)
2016-03-21	F	21:30 - 21:31	(2)
2016-03-21	F	21:33 - 21:39	(7)
2016-03-21	F	21:43 - 21:43	(1)
2016-03-21	F	21:46 - 21:47	(2)
2016-03-21	F	21:56 - 21:56	(1)
2016-03-21	F	21:58 - 21:58	(1)
2016-03-21	F	22:13 - 22:13	(1)
2016-03-21	F	22:18 - 22:19	(2)
2016-03-21	F	22:22 - 22:24	(3)
2016-03-21	F	22:29 - 22:30	(2)
2016-03-21	F	22:41 - 22:41	(1)
2016-03-21	F	22:54 - 22:54	(1)
2016-03-22	F	08:48 - 08:48	(1)
2016-03-23	F	20:28 - 21:54	(87)
2016-03-23	F	22:17 - 22:21	(5)
2016-03-23	F	22:23 - 22:25	(3)
2016-03-23	F	22:34 - 22:34	(1)
2016-03-23	F	22:47 - 22:50	(4)
2016-03-23	F	22:53 - 22:56	(4)
2016-03-23	F	23:00 - 23:00	(1)
2016-03-23	F	23:03 - 23:04	(2)
2016-03-23	F	23:09 - 23:09	(1)
2016-03-23	F	23:11 - 23:14	(4)
2016-03-24	F	08:01 - 08:01	(1)
2016-03-24	F	08:03 - 08:03	(1)
2016-03-24	F	08:16 - 08:21	(6)
2016-03-24	F	08:24 - 08:25	(2)
2016-03-24	F	09:03 - 09:04	(2)
2016-03-24	F	20:28 - 22:44	(137)
2016-03-25	F	00:17 - 00:17	(1)
2016-03-25	F	01:28 - 01:29	(2)
2016-03-25	F	01:31 - 01:32	(2)
2016-03-25	F	01:34 - 01:35	(2)
2016-03-25	F	01:43 - 01:43	(1)
2016-03-25	F	01:50 - 01:50	(1)
2016-03-25	F	01:53 - 01:54	(2)
2016-03-25	F	02:07 - 02:08	(2)
2016-03-25	F	02:10 - 02:10	(1)
2016-03-25	F	02:13 - 02:13	(1)
2016-03-25	F	02:22 - 02:22	(1)
2016-03-25	F	02:24 - 02:25	(2)
2016-03-25	F	02:28 - 02:28	(1)
2016-03-25	F	02:33 - 02:37	(5)
2016-03-25	F	02:42 - 02:44	(3)
2016-03-25	F	02:51 - 02:53	(3)
2016-03-25	F	02:59 - 03:00	(2)
2016-03-25	F	03:04 - 03:06	(3)

2016-03-25	F	03:09 - 03:10	(2)
2016-03-25	F	03:14 - 03:14	(1)
2016-03-25	F	03:18 - 03:18	(1)
2016-03-25	F	03:21 - 03:21	(1)
2016-03-25	F	03:23 - 03:26	(4)
2016-03-25	F	03:30 - 03:31	(2)
2016-03-25	F	03:36 - 03:38	(3)
2016-03-25	F	05:27 - 05:27	(1)
2016-03-25	F	05:37 - 05:37	(1)
2016-03-25	F	05:41 - 05:41	(1)
2016-03-25	F	05:49 - 05:50	(2)
2016-03-25	F	06:24 - 06:24	(1)
2016-03-25	F	06:27 - 06:27	(1)
2016-03-25	F	06:32 - 06:32	(1)
2016-03-25	F	06:34 - 06:34	(1)
2016-03-25	F	06:36 - 06:36	(1)
2016-03-25	F	06:54 - 06:54	(1)
2016-03-25	F	07:11 - 07:12	(2)
2016-03-25	F	07:17 - 07:17	(1)
2016-03-25	F	07:19 - 07:19	(1)
2016-03-25	F	07:22 - 07:22	(1)
2016-03-25	F	07:25 - 07:25	(1)
2016-03-25	F	07:27 - 07:30	(4)
2016-03-25	F	07:34 - 07:34	(1)
2016-03-27	F	08:35 - 08:35	(1)
2016-03-27	F	08:37 - 08:37	(1)
2016-03-27	F	20:27 - 22:36	(130)
2016-03-27	F	22:40 - 22:40	(1)
2016-03-28	F	07:49 - 07:56	(8)
2016-03-28	F	07:59 - 07:59	(1)
2016-03-28	F	08:04 - 08:07	(4)
2016-03-28	F	08:09 - 08:09	(1)
2016-03-28	F	08:13 - 08:13	(1)
2016-03-28	F	08:15 - 08:18	(4)
2016-03-28	F	08:20 - 08:21	(2)
2016-03-28	F	08:23 - 08:23	(1)
2016-03-28	F	08:26 - 08:28	(3)
2016-03-28	F	08:31 - 08:33	(3)
2016-03-28	F	08:35 - 08:35	(1)
2016-03-28	F	08:39 - 08:40	(2)
2016-03-28	F	14:05 - 14:05	(1)
2016-03-28	F	14:07 - 14:07	(1)
2016-03-28	F	14:09 - 14:09	(1)
2016-03-28	F	14:13 - 14:13	(1)
2016-03-28	F	14:23 - 14:24	(2)
2016-03-28	F	14:34 - 14:34	(1)
2016-03-28	F	14:36 - 14:36	(1)
2016-03-28	F	14:43 - 14:43	(1)
2016-03-28	F	14:47 - 14:50	(4)
2016-03-28	F	14:53 - 14:53	(1)
2016-03-28	F	14:55 - 14:56	(2)
2016-03-28	F	15:01 - 15:03	(3)
2016-03-28	F	15:12 - 15:12	(1)
2016-03-28	F	15:14 - 15:14	(1)
2016-03-28	F	15:19 - 15:19	(1)
2016-03-28	F	15:22 - 15:23	(2)
2016-03-28	F	15:25 - 15:25	(1)
2016-03-28	F	15:27 - 15:27	(1)
2016-03-28	F	15:30 - 15:30	(1)
2016-03-28	F	15:46 - 15:47	(2)
2016-03-28	F	16:00 - 16:00	(1)

2016-03-28	F	16:15 - 16:15	(1)
2016-03-28	F	16:19 - 16:21	(3)
2016-03-28	F	16:23 - 16:23	(1)
2016-03-28	F	16:28 - 16:30	(3)
2016-03-28	F	16:34 - 16:34	(1)
2016-03-28	F	16:36 - 16:37	(2)
2016-03-28	F	16:42 - 16:50	(9)
2016-03-28	F	16:53 - 16:53	(1)
2016-03-28	F	16:55 - 16:56	(2)
2016-03-28	F	16:58 - 16:58	(1)
2016-03-28	F	17:06 - 17:14	(9)
2016-03-28	F	17:16 - 17:16	(1)
2016-03-28	F	17:20 - 17:21	(2)
2016-03-28	F	17:26 - 17:26	(1)
2016-03-28	F	17:28 - 17:28	(1)
2016-03-28	F	17:33 - 17:33	(1)
2016-03-28	F	17:36 - 17:56	(21)
2016-03-28	F	19:06 - 19:06	(1)
2016-03-28	F	20:27 - 21:15	(49)
2016-03-28	F	23:29 - 23:29	(1)
2016-03-28	F	23:31 - 23:31	(1)
2016-03-28	F	23:35 - 23:35	(1)
2016-03-28	F	23:37 - 23:37	(1)
2016-03-28	F	23:42 - 23:44	(3)
2016-03-28	F	23:46 - 23:46	(1)
2016-03-28	F	23:50 - 23:54	(5)
2016-03-28	F	23:57 - 23:58	(2)
2016-03-29	F	00:00 - 00:01	(2)
2016-03-29	F	00:07 - 00:08	(2)
2016-03-29	F	00:10 - 00:11	(2)
2016-03-29	F	00:17 - 00:19	(3)
2016-03-29	F	00:21 - 00:22	(2)
2016-03-29	F	00:35 - 00:35	(1)
2016-03-29	F	00:40 - 00:40	(1)
2016-03-29	F	00:50 - 00:50	(1)
2016-03-29	F	00:58 - 01:00	(3)
2016-03-29	F	01:04 - 01:04	(1)
2016-03-29	F	01:06 - 01:07	(2)
2016-03-29	F	05:59 - 06:31	(33)
2016-03-29	F	16:54 - 16:55	(2)
2016-03-29	F	20:27 - 22:53	(147)
2016-03-30	F	12:41 - 12:41	(1)
2016-03-30	F	12:44 - 12:44	(1)
2016-03-30	F	12:54 - 12:56	(3)
2016-03-30	F	20:24 - 22:37	(134)
2016-03-31	F	07:54 - 07:57	(4)
2016-03-31	F	08:06 - 08:08	(3)
2016-03-31	F	08:12 - 08:12	(1)
2016-03-31	F	08:18 - 08:22	(5)
2016-03-31	F	13:57 - 22:57	(541)
2016-03-31	F	23:01 - 23:02	(2)
2016-03-31	F	23:04 - 23:06	(3)
2016-03-31	F	23:13 - 23:13	(1)
2016-03-31	F	23:17 - 23:17	(1)
2016-03-31	F	23:20 - 23:21	(2)
2016-03-31	F	23:24 - 23:24	(1)
2016-03-31	F	23:32 - 23:32	(1)
2016-03-31	F	23:34 - 23:35	(2)
2016-03-31	F	23:37 - 23:37	(1)
2016-03-31	F	23:50 - 23:53	(4)
2016-04-01	F	00:17 - 00:18	(2)

2016-04-01	F	00:21 - 00:27	(7)
2016-04-01	F	00:30 - 00:30	(1)
2016-04-01	F	00:43 - 00:43	(1)
2016-04-01	F	00:45 - 00:46	(2)
2016-04-01	F	00:48 - 00:49	(2)
2016-04-01	F	03:34 - 03:34	(1)
2016-04-01	F	03:47 - 03:48	(2)
2016-04-01	F	03:52 - 03:52	(1)
2016-04-01	F	03:54 - 03:54	(1)
2016-04-01	F	03:56 - 03:56	(1)
2016-04-01	F	04:01 - 04:01	(1)
2016-04-01	F	04:07 - 04:08	(2)
2016-04-01	F	04:41 - 04:41	(1)
2016-04-01	F	04:43 - 04:45	(3)
2016-04-01	F	05:16 - 05:17	(2)
2016-04-01	F	05:22 - 05:22	(1)
2016-04-01	F	05:29 - 05:29	(1)
2016-04-01	F	05:33 - 05:33	(1)
2016-04-01	F	05:38 - 05:39	(2)
2016-04-01	F	05:42 - 05:42	(1)
2016-04-01	F	05:44 - 05:44	(1)
2016-04-01	F	05:48 - 05:48	(1)
2016-04-01	F	14:19 - 14:19	(1)
2016-04-01	F	14:45 - 14:45	(1)
2016-04-01	F	15:54 - 15:54	(1)
2016-04-01	F	16:10 - 16:11	(2)
2016-04-01	F	20:27 - 23:22	(176)
2016-04-02	F	20:27 - 23:46	(200)
2016-04-03	F	11:52 - 15:11	(200)
2016-04-03	F	15:19 - 15:19	(1)
2016-04-03	F	15:24 - 15:24	(1)
2016-04-03	F	15:49 - 19:12	(204)
2016-04-03	F	20:27 - 20:29	(3)
2016-04-03	F	20:44 - 20:44	(1)
2016-04-03	F	21:04 - 22:35	(92)
2016-04-03	F	22:42 - 22:42	(1)
2016-04-03	F	22:44 - 22:46	(3)
2016-04-03	F	22:51 - 22:51	(1)
2016-04-03	F	23:00 - 23:00	(1)
2016-04-03	F	23:06 - 23:08	(3)
2016-04-03	F	23:10 - 23:10	(1)
2016-04-03	F	23:12 - 23:13	(2)
2016-04-03	F	23:17 - 23:17	(1)
2016-04-03	F	23:19 - 23:20	(2)
2016-04-03	F	23:22 - 23:23	(2)
2016-04-03	F	23:36 - 23:39	(4)
2016-04-03	F	23:41 - 23:44	(4)
2016-04-04	F	02:58 - 03:00	(3)
2016-04-04	F	03:04 - 03:05	(2)
2016-04-04	F	03:14 - 03:14	(1)
2016-04-04	F	03:17 - 03:17	(1)
2016-04-04	F	03:19 - 03:19	(1)
2016-04-04	F	03:40 - 03:40	(1)
2016-04-04	F	03:46 - 03:47	(2)
2016-04-04	F	03:56 - 03:57	(2)
2016-04-04	F	04:32 - 04:33	(2)
2016-04-04	F	04:37 - 04:37	(1)
2016-04-04	F	04:40 - 04:40	(1)
2016-04-04	F	04:42 - 04:42	(1)
2016-04-04	F	04:45 - 04:45	(1)
2016-04-04	F	05:08 - 05:08	(1)

2016-04-04	F	14:13 - 18:57	(285)
2016-04-04	F	20:27 - 22:32	(126)
2016-04-04	F	22:34 - 22:36	(3)
2016-04-04	F	22:40 - 22:41	(2)
2016-04-04	F	22:44 - 22:44	(1)
2016-04-04	F	22:47 - 22:47	(1)
2016-04-04	F	22:49 - 22:49	(1)
2016-04-04	F	23:07 - 23:12	(6)
2016-04-04	F	23:14 - 23:15	(2)
2016-04-04	F	23:20 - 23:20	(1)
2016-04-04	F	23:25 - 23:25	(1)
2016-04-04	F	23:28 - 23:31	(4)
2016-04-04	F	23:33 - 23:38	(6)
2016-04-04	F	23:43 - 23:43	(1)
2016-04-05	F	20:24 - 21:13	(50)
2016-04-06	F	00:06 - 00:10	(5)
2016-04-06	F	00:13 - 00:13	(1)
2016-04-06	F	00:16 - 00:16	(1)
2016-04-06	F	00:24 - 00:26	(3)
2016-04-06	F	00:28 - 00:30	(3)
2016-04-06	F	00:43 - 00:43	(1)
2016-04-06	F	00:47 - 00:47	(1)
2016-04-06	F	00:49 - 00:49	(1)
2016-04-06	F	01:03 - 01:03	(1)
2016-04-06	F	01:29 - 01:29	(1)
2016-04-06	F	01:34 - 01:34	(1)
2016-04-06	F	01:36 - 01:37	(2)
2016-04-06	F	01:39 - 01:39	(1)
2016-04-06	F	01:45 - 01:46	(2)
2016-04-06	F	01:51 - 01:51	(1)
2016-04-06	F	01:55 - 01:55	(1)
2016-04-06	F	01:57 - 01:57	(1)
2016-04-06	F	01:59 - 02:03	(5)
2016-04-06	F	15:06 - 15:06	(1)
2016-04-06	F	15:20 - 15:20	(1)
2016-04-06	F	20:26 - 23:27	(182)
2016-04-07	F	00:07 - 00:09	(3)
2016-04-07	F	00:11 - 00:11	(1)
2016-04-07	F	00:15 - 00:15	(1)
2016-04-07	F	00:20 - 00:21	(2)
2016-04-07	F	00:23 - 00:24	(2)
2016-04-07	F	00:26 - 00:26	(1)
2016-04-07	F	00:31 - 00:33	(3)
2016-04-07	F	00:39 - 00:40	(2)
2016-04-07	F	00:42 - 00:45	(4)
2016-04-07	F	00:53 - 00:57	(5)
2016-04-07	F	01:00 - 01:00	(1)
2016-04-07	F	01:30 - 01:30	(1)
2016-04-07	F	01:33 - 01:33	(1)
2016-04-07	F	04:09 - 04:09	(1)
2016-04-07	F	04:15 - 04:15	(1)
2016-04-07	F	06:43 - 06:43	(1)
2016-04-07	F	12:44 - 12:46	(3)
2016-04-07	F	12:50 - 12:51	(2)
2016-04-07	F	12:56 - 12:56	(1)
2016-04-07	F	12:59 - 12:59	(1)
2016-04-07	F	13:18 - 13:18	(1)
2016-04-07	F	13:28 - 13:29	(2)
2016-04-07	F	13:38 - 13:38	(1)
2016-04-07	F	13:47 - 13:47	(1)
2016-04-07	F	13:55 - 13:55	(1)

2016-04-07	F	14:07 - 14:08	(2)
2016-04-07	F	14:28 - 14:29	(2)
2016-04-07	F	14:40 - 14:42	(3)
2016-04-07	F	14:49 - 14:50	(2)
2016-04-07	F	15:00 - 15:01	(2)
2016-04-07	F	15:05 - 15:06	(2)
2016-04-07	F	15:08 - 15:08	(1)
2016-04-07	F	15:10 - 15:10	(1)
2016-04-07	F	15:12 - 15:12	(1)
2016-04-07	F	15:21 - 15:22	(2)
2016-04-07	F	15:31 - 15:31	(1)
2016-04-07	F	15:33 - 15:33	(1)
2016-04-07	F	15:40 - 15:40	(1)
2016-04-07	F	15:44 - 15:46	(3)
2016-04-07	F	16:04 - 16:04	(1)
2016-04-07	F	16:32 - 18:38	(127)
2016-04-07	F	20:26 - 23:16	(171)
2016-04-07	F	23:18 - 23:19	(2)
2016-04-07	F	23:21 - 23:21	(1)
2016-04-07	F	23:23 - 23:23	(1)
2016-04-07	F	23:25 - 23:26	(2)
2016-04-07	F	23:28 - 23:30	(3)
2016-04-07	F	23:34 - 23:36	(3)
2016-04-07	F	23:41 - 23:41	(1)
2016-04-07	F	23:43 - 23:43	(1)
2016-04-07	F	23:47 - 23:47	(1)
2016-04-07	F	23:51 - 23:51	(1)
2016-04-08	F	01:03 - 01:09	(7)
2016-04-08	F	01:11 - 01:12	(2)
2016-04-08	F	01:14 - 01:14	(1)
2016-04-08	F	01:16 - 01:16	(1)
2016-04-08	F	01:18 - 01:19	(2)
2016-04-08	F	21:53 - 23:53	(121)
2016-04-09	F	01:04 - 01:04	(1)
2016-04-09	F	23:45 - 23:45	(1)
2016-04-09	F	23:49 - 23:50	(2)
2016-04-09	F	23:54 - 23:55	(2)
2016-04-09	F	23:57 - 23:59	(3)
2016-04-10	F	00:04 - 00:05	(2)
2016-04-10	F	00:08 - 00:08	(1)
2016-04-10	F	00:10 - 00:12	(3)
2016-04-10	F	00:20 - 00:21	(2)
2016-04-10	F	00:23 - 00:23	(1)
2016-04-10	F	00:26 - 00:26	(1)
2016-04-10	F	00:34 - 00:35	(2)
2016-04-10	F	00:41 - 00:41	(1)
2016-04-10	F	00:52 - 00:57	(6)
2016-04-10	F	00:59 - 00:59	(1)
2016-04-10	F	01:06 - 01:09	(4)
2016-04-10	F	01:11 - 01:12	(2)
2016-04-10	F	01:15 - 01:15	(1)
2016-04-10	F	20:23 - 22:34	(132)
2016-04-10	F	23:55 - 23:56	(2)
2016-04-10	F	23:58 - 23:58	(1)
2016-04-11	F	00:07 - 00:59	(53)
2016-04-12	F	18:41 - 18:41	(1)
2016-04-13	F	00:13 - 00:40	(28)
2016-04-13	F	00:56 - 00:56	(1)
2016-04-13	F	01:00 - 01:00	(1)
2016-04-13	F	01:03 - 01:03	(1)
2016-04-13	F	01:29 - 01:29	(1)

2016-04-13	F	01:32 - 01:32	(1)
2016-04-13	F	01:35 - 01:36	(2)
2016-04-13	F	01:45 - 01:47	(3)
2016-04-13	F	02:14 - 02:14	(1)
2016-04-13	F	02:36 - 02:36	(1)
2016-04-13	F	02:49 - 02:49	(1)
2016-04-13	F	06:08 - 06:08	(1)
2016-04-13	F	06:19 - 06:19	(1)
2016-04-13	F	09:11 - 11:18	(128)
2016-04-13	F	21:52 -	
2016-04-14	F	- 01:24	(213)
2016-04-14	F	02:12 - 02:12	(1)
2016-04-14	F	02:39 - 02:39	(1)
2016-04-14	F	04:56 - 04:56	(1)
2016-04-14	F	16:13 - 16:15	(3)
2016-04-14	F	22:43 -	
2016-04-15	F	- 01:12	(150)
2016-04-15	F	01:17 - 01:17	(1)
2016-04-15	F	01:19 - 01:22	(4)
2016-04-15	F	01:34 - 01:34	(1)
2016-04-15	F	01:39 - 01:39	(1)
2016-04-15	F	02:12 - 02:12	(1)
2016-04-15	F	02:16 - 02:16	(1)
2016-04-15	F	02:42 - 02:42	(1)
2016-04-15	F	03:07 - 03:08	(2)
2016-04-15	F	04:10 - 04:10	(1)
2016-04-15	F	04:16 - 04:16	(1)
2016-04-15	F	04:29 - 04:29	(1)
2016-04-15	F	04:35 - 04:36	(2)
2016-04-15	F	04:39 - 04:40	(2)
2016-04-15	F	04:46 - 04:47	(2)
2016-04-15	F	07:04 - 07:04	(1)
2016-04-15	F	15:35 - 15:35	(1)
2016-04-15	F	15:48 - 21:30	(343)
2016-04-15	F	21:32 - 21:32	(1)
2016-04-15	F	21:35 - 21:36	(2)
2016-04-15	F	21:50 - 21:51	(2)
2016-04-15	F	21:53 - 21:54	(2)
2016-04-15	F	21:56 - 21:56	(1)
2016-04-15	F	21:59 - 22:02	(4)
2016-04-15	F	22:04 - 22:04	(1)
2016-04-15	F	22:08 - 22:10	(3)
2016-04-15	F	22:14 - 22:14	(1)
2016-04-15	F	22:16 - 22:16	(1)
2016-04-15	F	22:19 - 22:20	(2)
2016-04-15	F	22:22 - 22:23	(2)
2016-04-15	F	22:25 - 22:26	(2)
2016-04-15	F	22:32 - 22:32	(1)
2016-04-15	F	22:34 - 22:35	(2)
2016-04-15	F	22:41 - 22:42	(2)
2016-04-15	F	22:51 - 22:51	(1)
2016-04-15	F	22:55 - 22:55	(1)
2016-04-15	F	22:59 - 22:59	(1)
2016-04-15	F	23:01 - 23:02	(2)
2016-04-15	F	23:06 - 23:06	(1)
2016-04-15	F	23:13 - 23:15	(3)
2016-04-15	F	23:18 - 23:19	(2)
2016-04-15	F	23:21 - 23:21	(1)
2016-04-15	F	23:24 - 23:24	(1)
2016-04-15	F	23:33 - 23:33	(1)
2016-04-15	F	23:39 - 23:40	(2)

2016-04-15	F	23:43 - 23:43	(1)
2016-04-15	F	23:57 - 23:58	(2)
2016-04-16	F	00:01 - 00:01	(1)
2016-04-16	F	00:06 - 00:06	(1)
2016-04-16	F	00:10 - 00:10	(1)
2016-04-16	F	00:12 - 00:13	(2)
2016-04-16	F	00:16 - 00:16	(1)
2016-04-16	F	00:21 - 00:21	(1)
2016-04-16	F	00:24 - 00:28	(5)
2016-04-16	F	00:31 - 00:32	(2)
2016-04-16	F	00:47 - 00:48	(2)
2016-04-16	F	00:59 - 01:00	(2)
2016-04-16	F	01:02 - 01:02	(1)
2016-04-16	F	01:06 - 01:06	(1)
2016-04-16	F	01:13 - 01:13	(1)
2016-04-16	F	01:23 - 01:23	(1)
2016-04-16	F	01:27 - 01:27	(1)
2016-04-16	F	01:31 - 01:31	(1)
2016-04-16	F	01:35 - 01:35	(1)
2016-04-16	F	01:39 - 01:39	(1)
2016-04-16	F	01:45 - 01:45	(1)
2016-04-16	F	01:49 - 01:49	(1)
2016-04-16	F	01:51 - 01:52	(2)
2016-04-16	F	01:57 - 01:57	(1)
2016-04-16	F	03:12 - 03:12	(1)
2016-04-16	F	13:57 - 14:00	(4)
2016-04-16	F	14:03 - 14:05	(3)
2016-04-16	F	14:09 - 14:09	(1)
2016-04-16	F	14:15 - 14:15	(1)
2016-04-16	F	14:18 - 14:18	(1)
2016-04-16	F	14:34 - 14:34	(1)
2016-04-16	F	14:37 - 14:38	(2)
2016-04-16	F	14:44 - 14:44	(1)
2016-04-16	F	14:49 - 14:50	(2)
2016-04-16	F	14:57 - 14:57	(1)
2016-04-16	F	15:00 - 15:00	(1)
2016-04-16	F	15:02 - 15:02	(1)
2016-04-16	F	15:04 - 15:04	(1)
2016-04-16	F	15:09 - 15:09	(1)
2016-04-16	F	15:11 - 15:12	(2)
2016-04-16	F	15:14 - 15:15	(2)
2016-04-16	F	15:19 - 15:19	(1)
2016-04-16	F	15:21 - 15:21	(1)
2016-04-16	F	15:24 - 15:24	(1)
2016-04-16	F	15:26 - 15:27	(2)
2016-04-16	F	15:33 - 15:35	(3)
2016-04-16	F	15:37 - 15:38	(2)
2016-04-16	F	15:43 - 15:43	(1)
2016-04-16	F	15:49 - 15:49	(1)
2016-04-16	F	16:00 - 16:00	(1)
2016-04-16	F	16:02 - 16:02	(1)
2016-04-16	F	16:04 - 16:04	(1)
2016-04-16	F	16:07 - 16:10	(4)
2016-04-16	F	16:18 - 16:18	(1)
2016-04-16	F	16:22 - 16:22	(1)
2016-04-16	F	16:31 - 16:31	(1)
2016-04-16	F	16:33 - 16:34	(2)
2016-04-16	F	16:36 - 16:37	(2)
2016-04-16	F	16:42 - 16:43	(2)
2016-04-16	F	16:45 - 16:46	(2)
2016-04-16	F	16:56 - 16:56	(1)

2016-04-16	F	16:58 - 16:58	(1)
2016-04-16	F	17:03 - 17:03	(1)
2016-04-16	F	17:07 - 17:07	(1)
2016-04-16	F	17:09 - 17:09	(1)
2016-04-16	F	17:11 - 17:11	(1)
2016-04-16	F	17:13 - 17:14	(2)
2016-04-16	F	17:20 - 17:20	(1)
2016-04-16	F	17:23 - 17:24	(2)
2016-04-16	F	17:27 - 17:28	(2)
2016-04-16	F	17:33 - 17:33	(1)
2016-04-16	F	17:38 - 17:38	(1)
2016-04-16	F	17:56 - 19:59	(124)
2016-04-16	F	20:04 - 20:04	(1)
2016-04-16	F	20:07 - 20:07	(1)
2016-04-16	F	20:10 - 20:10	(1)
2016-04-16	F	20:12 - 20:12	(1)
2016-04-16	F	20:15 - 20:15	(1)
2016-04-16	F	20:19 - 20:21	(3)
2016-04-16	F	20:29 - 20:29	(1)
2016-04-16	F	20:31 - 20:33	(3)
2016-04-16	F	20:37 - 20:38	(2)
2016-04-16	F	20:40 - 20:40	(1)
2016-04-16	F	20:44 - 20:46	(3)
2016-04-16	F	20:50 - 20:50	(1)
2016-04-16	F	20:54 - 20:54	(1)
2016-04-16	F	20:58 - 20:59	(2)
2016-04-16	F	21:10 - 21:10	(1)
2016-04-16	F	21:12 - 21:13	(2)
2016-04-16	F	21:16 - 21:18	(3)
2016-04-16	F	21:22 - 21:22	(1)
2016-04-16	F	21:26 - 21:29	(4)
2016-04-16	F	21:32 - 21:35	(4)
2016-04-16	F	21:38 - 21:38	(1)
2016-04-16	F	21:40 - 21:40	(1)
2016-04-16	F	21:44 - 21:44	(1)
2016-04-16	F	21:47 - 21:49	(3)
2016-04-16	F	21:51 - 21:51	(1)
2016-04-16	F	21:56 - 21:57	(2)
2016-04-16	F	22:00 - 22:01	(2)
2016-04-16	F	22:05 - 22:05	(1)
2016-04-16	F	22:08 - 22:11	(4)
2016-04-16	F	22:14 - 22:15	(2)
2016-04-16	F	22:21 - 22:23	(3)
2016-04-16	F	22:25 - 22:28	(4)
2016-04-16	F	22:34 - 22:34	(1)
2016-04-16	F	22:36 - 22:36	(1)
2016-04-16	F	22:38 - 22:38	(1)
2016-04-16	F	22:43 - 22:45	(3)
2016-04-16	F	22:53 - 22:53	(1)
2016-04-16	F	22:58 - 22:58	(1)
2016-04-16	F	23:00 - 23:00	(1)
2016-04-16	F	23:04 - 23:05	(2)
2016-04-16	F	23:09 - 23:09	(1)
2016-04-16	F	23:12 - 23:12	(1)
2016-04-16	F	23:14 - 23:14	(1)
2016-04-16	F	23:16 - 23:18	(3)
2016-04-16	F	23:20 - 23:20	(1)
2016-04-16	F	23:38 - 23:39	(2)
2016-04-16	F	23:41 - 23:41	(1)
2016-04-16	F	23:43 - 23:44	(2)
2016-04-16	F	23:47 - 23:48	(2)

2016-04-16	F	23:51 - 23:52	(2)
2016-04-16	F	23:54 - 23:56	(3)
2016-04-17	F	00:00 - 00:01	(2)
2016-04-17	F	00:05 - 00:06	(2)
2016-04-17	F	00:10 - 00:10	(1)
2016-04-17	F	00:13 - 00:14	(2)
2016-04-17	F	00:23 - 00:23	(1)
2016-04-17	F	00:25 - 00:25	(1)
2016-04-17	F	00:31 - 00:31	(1)
2016-04-17	F	00:33 - 00:33	(1)
2016-04-17	F	00:38 - 00:38	(1)
2016-04-17	F	00:40 - 00:40	(1)
2016-04-17	F	00:43 - 00:43	(1)
2016-04-17	F	00:45 - 00:45	(1)
2016-04-17	F	00:47 - 00:49	(3)
2016-04-17	F	00:53 - 00:53	(1)
2016-04-17	F	00:56 - 00:59	(4)
2016-04-17	F	01:01 - 01:04	(4)
2016-04-17	F	03:41 - 03:41	(1)
2016-04-17	F	14:27 - 14:27	(1)
2016-04-17	F	14:29 - 14:29	(1)
2016-04-17	F	14:54 - 14:54	(1)
2016-04-17	F	14:59 - 14:59	(1)
2016-04-17	F	19:11 - 19:11	(1)
2016-04-17	F	19:36 - 19:36	(1)
2016-04-17	F	22:56 - 22:56	(1)
2016-04-17	F	23:00 - 23:00	(1)
2016-04-17	F	23:03 - 23:03	(1)
2016-04-17	F	23:05 - 23:05	(1)
2016-04-17	F	23:08 - 23:08	(1)
2016-04-17	F	23:10 - 23:11	(2)
2016-04-17	F	23:30 - 23:30	(1)
2016-04-17	F	23:32 - 23:32	(1)
2016-04-17	F	23:36 - 23:36	(1)
2016-04-17	F	23:43 - 23:43	(1)
2016-04-17	F	23:45 - 23:45	(1)
2016-04-17	F	23:48 - 23:51	(4)
2016-04-17	F	23:56 - 23:57	(2)
2016-04-17	F	23:59 -	
2016-04-18	F	- 00:00	(2)
2016-04-18	F	00:14 - 00:15	(2)
2016-04-18	F	00:17 - 00:17	(1)
2016-04-18	F	00:21 - 00:25	(5)
2016-04-18	F	00:31 - 00:33	(3)
2016-04-18	F	00:36 - 00:37	(2)
2016-04-18	F	00:39 - 00:39	(1)
2016-04-18	F	00:50 - 00:52	(3)
2016-04-18	F	01:00 - 01:01	(2)
2016-04-18	F	01:07 - 01:08	(2)
2016-04-18	F	01:11 - 01:11	(1)
2016-04-18	F	01:14 - 01:17	(4)
2016-04-18	F	01:20 - 01:20	(1)
2016-04-18	F	01:43 - 01:43	(1)
2016-04-19	F	22:15 -	
2016-04-20	F	- 02:33	(259)
2016-04-20	F	08:13 - 08:15	(3)
2016-04-20	F	08:19 - 08:21	(3)
2016-04-20	F	08:24 - 08:25	(2)
2016-04-20	F	08:29 - 08:30	(2)
2016-04-20	F	08:35 - 08:36	(2)
2016-04-20	F	08:42 - 08:42	(1)

2016-04-20	F	08:44 - 08:44	(1)
2016-04-20	F	08:46 - 08:47	(2)
2016-04-20	F	08:50 - 08:50	(1)
2016-04-20	F	08:52 - 08:58	(7)
2016-04-20	F	21:57 - 23:40	(104)
2016-04-20	F	23:48 - 23:51	(4)
2016-04-20	F	23:53 - 23:53	(1)
2016-04-20	F	23:56 - 23:57	(2)
2016-04-20	F	23:59 - 23:59	(1)
2016-04-21	F	00:04 - 00:04	(1)
2016-04-21	F	00:10 - 00:10	(1)
2016-04-21	F	00:22 - 00:25	(4)
2016-04-21	F	00:37 - 00:38	(2)
2016-04-21	F	00:51 - 00:52	(2)
2016-04-21	F	01:19 - 01:39	(21)
2016-04-21	F	07:57 - 07:57	(1)
2016-04-21	F	08:00 - 08:00	(1)
2016-04-21	F	08:04 - 10:00	(117)
2016-04-21	F	13:55 - 15:45	(111)
2016-04-21	F	16:46 - 18:45	(120)
2016-04-21	F	21:04 - 22:40	(97)
2016-04-21	F	23:01 - 23:03	(3)
2016-04-21	F	23:05 - 23:05	(1)
2016-04-21	F	23:07 - 23:08	(2)
2016-04-21	F	23:10 - 23:13	(4)
2016-04-21	F	23:16 - 23:17	(2)
2016-04-21	F	23:20 - 23:20	(1)
2016-04-21	F	23:23 - 23:25	(3)
2016-04-21	F	23:28 - 23:28	(1)
2016-04-21	F	23:30 - 23:31	(2)
2016-04-21	F	23:35 - 23:37	(3)
2016-04-21	F	23:42 - 23:43	(2)
2016-04-21	F	23:48 - 23:48	(1)
2016-04-21	F	23:54 - 23:54	(1)
2016-04-21	F	23:56 - 23:56	(1)
2016-04-21	F	23:58 -	
2016-04-22	F	- 00:00	(3)
2016-04-22	F	00:04 - 00:04	(1)
2016-04-22	F	00:07 - 00:52	(46)
2016-04-22	F	00:54 - 00:55	(2)
2016-04-22	F	01:01 - 01:01	(1)
2016-04-22	F	01:04 - 01:06	(3)
2016-04-22	F	01:10 - 01:11	(2)
2016-04-22	F	01:17 - 01:17	(1)
2016-04-22	F	01:19 - 01:20	(2)
2016-04-22	F	01:23 - 01:23	(1)
2016-04-22	F	01:25 - 01:26	(2)
2016-04-22	F	01:28 - 01:29	(2)
2016-04-22	F	02:39 - 02:39	(1)
2016-04-22	F	21:47 - 22:31	(45)
2016-04-22	F	22:33 - 22:33	(1)
2016-04-22	F	22:37 - 22:38	(2)
2016-04-22	F	22:40 - 22:40	(1)
2016-04-22	F	22:43 - 22:45	(3)
2016-04-22	F	22:47 - 22:51	(5)
2016-04-22	F	22:55 - 23:01	(7)
2016-04-22	F	23:21 - 23:21	(1)
2016-04-22	F	23:27 - 23:27	(1)
2016-04-22	F	23:34 - 23:34	(1)
2016-04-22	F	23:36 - 23:36	(1)
2016-04-22	F	23:38 - 23:38	(1)

2016-04-22	F	23:40 - 23:40	(1)
2016-04-22	F	23:45 - 23:45	(1)
2016-04-22	F	23:50 - 23:50	(1)
2016-04-22	F	23:53 - 23:54	(2)
2016-04-23	F	00:02 - 00:04	(3)
2016-04-23	F	00:12 - 00:18	(7)
2016-04-23	F	00:20 - 00:21	(2)
2016-04-23	F	00:24 - 00:25	(2)
2016-04-23	F	00:28 - 00:30	(3)
2016-04-23	F	00:32 - 00:37	(6)
2016-04-23	F	00:40 - 00:40	(1)
2016-04-23	F	00:42 - 00:43	(2)
2016-04-23	F	00:45 - 00:46	(2)
2016-04-23	F	00:49 - 00:51	(3)
2016-04-23	F	00:53 - 00:53	(1)
2016-04-23	F	01:04 - 01:04	(1)
2016-04-23	F	01:07 - 01:09	(3)
2016-04-23	F	01:11 - 01:11	(1)
2016-04-23	F	01:13 - 01:13	(1)
2016-04-23	F	01:16 - 01:16	(1)
2016-04-23	F	19:56 - 19:56	(1)
2016-04-23	F	19:58 - 19:58	(1)
2016-04-23	F	20:05 - 20:05	(1)
2016-04-23	F	20:07 - 21:11	(65)
2016-04-23	F	21:13 - 21:14	(2)
2016-04-23	F	21:18 - 21:18	(1)
2016-04-23	F	21:20 - 21:21	(2)
2016-04-23	F	21:24 - 21:25	(2)
2016-04-23	F	21:31 - 21:34	(4)
2016-04-23	F	21:38 - 21:38	(1)
2016-04-23	F	21:40 - 21:40	(1)
2016-04-23	F	21:43 - 21:43	(1)
2016-04-23	F	21:47 - 21:49	(3)
2016-04-23	F	21:51 - 21:55	(5)
2016-04-23	F	22:04 - 22:06	(3)
2016-04-23	F	22:12 - 22:13	(2)
2016-04-23	F	22:20 - 22:20	(1)
2016-04-23	F	22:24 - 22:25	(2)
2016-04-23	F	22:28 - 22:30	(3)
2016-04-23	F	22:34 - 22:35	(2)
2016-04-23	F	22:37 - 22:37	(1)
2016-04-23	F	22:39 - 22:39	(1)
2016-04-23	F	22:42 - 22:44	(3)
2016-04-23	F	22:46 - 22:48	(3)
2016-04-23	F	22:51 - 22:52	(2)
2016-04-23	F	23:03 - 23:04	(2)
2016-04-23	F	23:07 - 23:07	(1)
2016-04-23	F	23:09 - 23:09	(1)
2016-04-23	F	23:12 - 23:13	(2)
2016-04-23	F	23:15 - 23:17	(3)
2016-04-23	F	23:19 - 23:19	(1)
2016-04-23	F	23:25 - 23:25	(1)
2016-04-23	F	23:38 - 23:38	(1)
2016-04-23	F	23:42 - 23:42	(1)
2016-04-23	F	23:50 - 23:53	(4)
2016-04-23	F	23:55 - 23:55	(1)
2016-04-23	F	23:57 - 23:58	(2)
2016-04-24	F	00:04 - 00:05	(2)
2016-04-24	F	00:07 - 00:18	(12)
2016-04-24	F	00:22 - 00:26	(5)
2016-04-24	F	00:29 - 00:31	(3)

2016-04-24	F	00:33 - 00:33	(1)
2016-04-24	F	00:38 - 00:39	(2)
2016-04-24	F	00:48 - 00:48	(1)
2016-04-24	F	00:51 - 00:51	(1)
2016-04-24	F	00:56 - 00:56	(1)
2016-04-24	F	00:58 - 01:01	(4)
2016-04-24	F	01:07 - 01:09	(3)
2016-04-24	F	01:11 - 01:12	(2)
2016-04-24	F	01:14 - 01:15	(2)
2016-04-24	F	01:17 - 01:20	(4)
2016-04-24	F	01:28 - 01:30	(3)
2016-04-24	F	01:32 - 01:32	(1)
2016-04-24	F	01:38 - 01:38	(1)
2016-04-24	F	01:40 - 01:40	(1)
2016-04-24	F	01:43 - 01:43	(1)
2016-04-24	F	01:45 - 01:45	(1)
2016-04-24	F	01:48 - 01:51	(4)
2016-04-24	F	04:11 - 04:11	(1)
2016-04-24	F	06:35 - 06:35	(1)
2016-04-24	F	07:13 - 07:13	(1)
2016-04-24	F	15:34 - 15:34	(1)
2016-04-24	F	15:39 - 15:39	(1)
2016-04-24	F	15:43 - 15:43	(1)
2016-04-24	F	16:13 - 16:14	(2)
2016-04-24	F	21:51 - 21:52	(2)
2016-04-24	F	21:57 - 21:57	(1)
2016-04-24	F	22:03 - 22:03	(1)
2016-04-24	F	22:05 - 22:07	(3)
2016-04-24	F	22:09 - 22:20	(12)
2016-04-24	F	22:27 - 22:27	(1)
2016-04-24	F	22:29 - 22:31	(3)
2016-04-24	F	22:33 - 22:33	(1)
2016-04-24	F	22:38 - 22:38	(1)
2016-04-24	F	22:41 - 22:41	(1)
2016-04-24	F	22:43 - 22:43	(1)
2016-04-24	F	22:45 - 22:45	(1)
2016-04-24	F	23:07 - 23:07	(1)
2016-04-24	F	23:10 - 23:10	(1)
2016-04-24	F	23:12 - 23:14	(3)
2016-04-24	F	23:18 - 23:18	(1)
2016-04-24	F	23:23 - 23:23	(1)
2016-04-24	F	23:27 - 23:28	(2)
2016-04-24	F	23:43 - 23:43	(1)
2016-04-24	F	23:46 - 23:46	(1)
2016-04-24	F	23:51 - 23:52	(2)
2016-04-24	F	23:54 - 23:56	(3)
2016-04-25	F	00:00 - 01:13	(74)
2016-04-26	F	02:56 - 02:56	(1)
2016-04-27	F	15:09 - 15:10	(2)
2016-04-27	F	23:33 - 23:33	(1)
2016-04-27	F	23:36 - 23:41	(6)
2016-04-27	F	23:44 - 23:44	(1)
2016-04-27	F	23:46 - 23:46	(1)
2016-04-27	F	23:48 - 23:48	(1)
2016-04-27	F	23:55 - 23:55	(1)
2016-04-27	F	23:58 - 23:58	(1)
2016-04-28	F	00:03 - 00:03	(1)
2016-04-28	F	00:09 - 00:11	(3)
2016-04-28	F	00:15 - 00:15	(1)
2016-04-28	F	00:22 - 00:35	(14)
2016-04-28	F	00:40 - 00:40	(1)

2016-04-28	F	00:43 - 00:43	(1)
2016-04-28	F	00:45 - 00:45	(1)
2016-04-28	F	00:47 - 00:48	(2)
2016-04-28	F	00:51 - 00:52	(2)
2016-04-28	F	00:54 - 00:55	(2)
2016-04-28	F	01:02 - 01:02	(1)
2016-04-28	F	01:10 - 01:13	(4)
2016-04-28	F	01:18 - 01:18	(1)
2016-04-28	F	07:47 - 07:47	(1)
2016-04-28	F	07:50 - 07:50	(1)
2016-04-28	F	07:52 - 07:57	(6)
2016-04-28	F	22:54 - 22:54	(1)
2016-04-28	F	22:56 - 22:57	(2)
2016-04-28	F	22:59 - 23:00	(2)
2016-04-28	F	23:04 - 23:05	(2)
2016-04-28	F	23:09 - 23:13	(5)
2016-04-28	F	23:16 - 23:16	(1)
2016-04-28	F	23:19 - 23:26	(8)
2016-04-29	F	00:52 - 00:52	(1)
2016-04-29	F	00:55 - 00:55	(1)
2016-04-29	F	00:57 - 00:57	(1)
2016-04-29	F	00:59 - 01:01	(3)
2016-04-29	F	01:05 - 01:05	(1)
2016-04-29	F	01:07 - 01:07	(1)
2016-04-29	F	01:09 - 01:09	(1)
2016-04-29	F	01:21 - 01:21	(1)
2016-04-29	F	01:25 - 01:25	(1)
2016-04-29	F	01:29 - 01:29	(1)
2016-04-29	F	01:31 - 01:33	(3)
2016-04-29	F	01:35 - 01:35	(1)
2016-04-29	F	01:40 - 01:41	(2)
2016-04-29	F	01:43 - 01:44	(2)
2016-04-30	F	01:22 - 01:22	(1)
2016-04-30	F	01:25 - 01:26	(2)
2016-04-30	F	01:28 - 01:28	(1)
2016-04-30	F	01:33 - 01:33	(1)
2016-04-30	F	01:38 - 01:38	(1)
2016-04-30	F	01:40 - 01:41	(2)
2016-04-30	F	01:43 - 01:43	(1)
2016-04-30	F	01:51 - 01:51	(1)
2016-04-30	F	01:53 - 01:53	(1)
2016-04-30	F	05:15 - 05:15	(1)
2016-04-30	F	06:15 - 06:15	(1)
2016-04-30	F	06:17 - 06:18	(2)
2016-04-30	F	06:20 - 06:20	(1)
2016-04-30	F	22:56 -	
2016-05-01	F	- 01:19	(144)
2016-05-01	F	01:21 - 01:21	(1)
2016-05-01	F	01:24 - 01:25	(2)
2016-05-01	F	14:14 - 14:14	(1)
2016-05-01	F	14:31 - 14:32	(2)
2016-05-01	F	14:47 - 14:48	(2)
2016-05-01	F	22:05 - 23:30	(86)
2016-05-01	F	23:37 - 23:37	(1)
2016-05-01	F	23:39 - 23:39	(1)
2016-05-01	F	23:42 - 23:42	(1)
2016-05-01	F	23:46 - 23:46	(1)
2016-05-01	F	23:50 - 23:51	(2)
2016-05-01	F	23:53 - 23:53	(1)
2016-05-01	F	23:59 - 23:59	(1)
2016-05-02	F	00:01 - 00:01	(1)

2016-05-02	F	00:04 - 00:04	(1)
2016-05-02	F	00:10 - 00:11	(2)
2016-05-02	F	00:14 - 00:14	(1)
2016-05-02	F	00:16 - 00:16	(1)
2016-05-02	F	00:18 - 01:24	(67)
2016-05-02	F	01:37 - 01:37	(1)
2016-05-02	F	01:43 - 01:43	(1)
2016-05-02	F	01:48 - 01:48	(1)
2016-05-02	F	02:00 - 02:00	(1)
2016-05-02	F	02:03 - 02:03	(1)
2016-05-02	F	02:11 - 02:11	(1)
2016-05-02	F	02:23 - 02:24	(2)
2016-05-02	F	02:42 - 02:43	(2)
2016-05-02	F	02:45 - 02:45	(1)
2016-05-02	F	02:51 - 02:51	(1)
2016-05-02	F	02:53 - 02:53	(1)
2016-05-02	F	02:57 - 02:57	(1)
2016-05-02	F	03:05 - 03:05	(1)
2016-05-02	F	03:13 - 03:13	(1)
2016-05-02	F	03:17 - 03:17	(1)
2016-05-02	F	03:21 - 03:21	(1)
2016-05-02	F	03:27 - 03:27	(1)
2016-05-02	F	03:45 - 03:46	(2)
2016-05-02	F	03:53 - 03:53	(1)
2016-05-02	F	03:59 - 04:00	(2)
2016-05-02	F	04:04 - 04:04	(1)
2016-05-02	F	05:16 - 05:17	(2)
2016-05-02	F	05:20 - 05:20	(1)
2016-05-02	F	05:25 - 05:25	(1)
2016-05-02	F	05:28 - 05:29	(2)
2016-05-02	F	05:31 - 05:32	(2)
2016-05-02	F	05:35 - 05:37	(3)
2016-05-02	F	05:48 - 05:48	(1)
2016-05-02	F	23:09 - 23:09	(1)
2016-05-02	F	23:48 - 23:48	(1)
2016-05-03	F	00:00 - 00:00	(1)
2016-05-03	F	00:08 - 00:09	(2)
2016-05-03	F	00:11 - 00:15	(5)
2016-05-03	F	00:17 - 00:24	(8)
2016-05-03	F	00:27 - 00:27	(1)
2016-05-03	F	00:29 - 00:30	(2)
2016-05-03	F	00:32 - 00:32	(1)
2016-05-03	F	00:39 - 00:41	(3)
2016-05-03	F	00:45 - 00:45	(1)
2016-05-03	F	00:47 - 00:47	(1)
2016-05-03	F	00:53 - 00:53	(1)
2016-05-03	F	00:55 - 00:55	(1)
2016-05-03	F	16:38 - 16:39	(2)
2016-05-03	F	21:17 - 23:22	(126)
2016-05-03	F	23:25 - 23:25	(1)
2016-05-03	F	23:27 - 23:27	(1)
2016-05-03	F	23:29 - 23:29	(1)
2016-05-03	F	23:34 - 23:34	(1)
2016-05-03	F	23:42 - 23:45	(4)
2016-05-03	F	23:49 - 23:51	(3)
2016-05-03	F	23:53 - 23:54	(2)
2016-05-03	F	23:56 - 23:57	(2)
2016-05-04	F	00:02 - 00:03	(2)
2016-05-04	F	00:07 - 00:07	(1)
2016-05-04	F	00:26 - 00:26	(1)
2016-05-04	F	00:31 - 00:32	(2)

2016-05-04	F	00:39 - 00:41	(3)
2016-05-04	F	00:45 - 00:45	(1)
2016-05-04	F	00:48 - 00:48	(1)
2016-05-04	F	00:59 - 01:00	(2)
2016-05-04	F	01:05 - 01:05	(1)
2016-05-04	F	01:09 - 01:11	(3)
2016-05-04	F	01:15 - 01:16	(2)
2016-05-04	F	01:19 - 01:21	(3)
2016-05-04	F	01:23 - 01:24	(2)
2016-05-04	F	01:28 - 01:29	(2)
2016-05-04	F	01:32 - 01:33	(2)
2016-05-04	F	01:35 - 01:35	(1)
2016-05-04	F	01:38 - 01:42	(5)
2016-05-04	F	01:44 - 01:44	(1)
2016-05-04	F	01:46 - 02:00	(15)
2016-05-04	F	14:14 - 14:14	(1)
2016-05-04	F	22:18 - 23:19	(62)
2016-05-04	F	23:28 - 23:28	(1)
2016-05-04	F	23:37 - 23:38	(2)
2016-05-04	F	23:43 - 23:43	(1)
2016-05-04	F	23:48 - 23:48	(1)
2016-05-04	F	23:57 - 23:57	(1)
2016-05-05	F	00:11 - 00:12	(2)
2016-05-05	F	00:14 - 00:15	(2)
2016-05-05	F	00:17 - 00:18	(2)
2016-05-05	F	00:23 - 00:26	(4)
2016-05-05	F	00:31 - 00:31	(1)
2016-05-05	F	00:35 - 00:35	(1)
2016-05-05	F	00:38 - 00:39	(2)
2016-05-05	F	00:45 - 00:45	(1)
2016-05-05	F	00:49 - 00:50	(2)
2016-05-05	F	00:56 - 00:57	(2)
2016-05-05	F	01:04 - 01:07	(4)
2016-05-05	F	01:09 - 01:10	(2)
2016-05-05	F	01:13 - 01:13	(1)
2016-05-05	F	01:16 - 01:19	(4)
2016-05-05	F	01:21 - 01:22	(2)
2016-05-05	F	22:01 - 22:01	(1)
2016-05-05	F	22:03 - 22:03	(1)
2016-05-05	F	22:10 - 22:11	(2)
2016-05-05	F	22:15 - 22:15	(1)
2016-05-05	F	22:27 - 22:30	(4)
2016-05-05	F	23:13 -	
2016-05-06	F	- 00:01	(49)
2016-05-06	F	00:07 - 00:07	(1)
2016-05-06	F	00:13 - 00:13	(1)
2016-05-06	F	00:20 - 00:23	(4)
2016-05-06	F	00:27 - 00:27	(1)
2016-05-06	F	00:31 - 00:32	(2)
2016-05-06	F	00:35 - 00:35	(1)
2016-05-06	F	00:37 - 00:37	(1)
2016-05-06	F	00:39 - 00:40	(2)
2016-05-06	F	00:42 - 00:45	(4)
2016-05-06	F	00:48 - 00:49	(2)
2016-05-06	F	00:53 - 00:53	(1)
2016-05-06	F	00:56 - 00:56	(1)
2016-05-06	F	00:58 - 00:58	(1)
2016-05-06	F	01:02 - 01:02	(1)
2016-05-06	F	01:06 - 01:06	(1)
2016-05-06	F	01:09 - 01:09	(1)
2016-05-06	F	01:11 - 01:15	(5)

2016-05-06	F	01:17 - 01:17	(1)
2016-05-06	F	01:20 - 01:20	(1)
2016-05-06	F	01:22 - 01:22	(1)
2016-05-06	F	01:27 - 01:27	(1)
2016-05-06	F	01:33 - 01:33	(1)
2016-05-06	F	01:40 - 01:40	(1)
2016-05-06	F	01:45 - 01:46	(2)
2016-05-06	F	01:56 - 01:56	(1)
2016-05-06	F	02:06 - 02:11	(6)
2016-05-06	F	02:16 - 02:16	(1)
2016-05-06	F	02:23 - 02:24	(2)
2016-05-06	F	02:26 - 02:28	(3)
2016-05-06	F	02:32 - 02:32	(1)
2016-05-06	F	02:34 - 02:34	(1)
2016-05-06	F	02:36 - 02:39	(4)
2016-05-06	F	02:41 - 02:41	(1)
2016-05-06	F	02:45 - 02:45	(1)
2016-05-06	F	03:04 - 03:05	(2)
2016-05-06	F	03:07 - 03:07	(1)
2016-05-06	F	03:12 - 03:12	(1)
2016-05-06	F	03:18 - 03:18	(1)
2016-05-06	F	11:57 - 11:57	(1)
2016-05-06	F	15:53 - 15:53	(1)
2016-05-06	F	15:55 - 15:55	(1)
2016-05-06	F	15:59 - 16:00	(2)
2016-05-08	F	01:18 - 01:19	(2)
2016-05-08	F	01:21 - 01:21	(1)
2016-05-08	F	01:23 - 01:23	(1)
2016-05-08	F	01:25 - 01:25	(1)
2016-05-08	F	01:55 - 01:55	(1)
2016-05-08	F	02:46 - 02:47	(2)
2016-05-08	F	03:05 - 03:05	(1)
2016-05-08	F	03:11 - 03:11	(1)
2016-05-08	F	03:17 - 03:17	(1)
2016-05-08	F	05:18 - 05:18	(1)
2016-05-08	F	13:10 - 13:11	(2)
2016-05-08	F	22:02 - 23:19	(78)
2016-05-08	F	23:23 - 23:23	(1)
2016-05-08	F	23:32 - 23:32	(1)
2016-05-08	F	23:36 - 23:36	(1)
2016-05-08	F	23:38 - 23:39	(2)
2016-05-08	F	23:41 - 23:42	(2)
2016-05-08	F	23:47 - 23:47	(1)
2016-05-08	F	23:49 - 23:49	(1)
2016-05-08	F	23:51 - 23:51	(1)
2016-05-08	F	23:56 - 23:59	(4)
2016-05-09	F	00:04 - 00:05	(2)
2016-05-09	F	00:11 - 00:14	(4)
2016-05-09	F	00:19 - 00:22	(4)
2016-05-09	F	00:24 - 00:26	(3)
2016-05-09	F	00:30 - 00:47	(18)
2016-05-09	F	00:49 - 00:49	(1)
2016-05-09	F	00:51 - 00:51	(1)
2016-05-09	F	01:00 - 01:01	(2)
2016-05-09	F	01:04 - 01:06	(3)
2016-05-09	F	01:12 - 01:13	(2)
2016-05-09	F	01:15 - 01:15	(1)
2016-05-09	F	01:18 - 01:18	(1)
2016-05-09	F	01:20 - 01:20	(1)
2016-05-09	F	01:22 - 01:23	(2)
2016-05-09	F	01:25 - 01:26	(2)

2016-05-09	F	01:28 - 01:31	(4)
2016-05-09	F	01:39 - 01:40	(2)
2016-05-09	F	01:43 - 01:43	(1)
2016-05-09	F	01:45 - 01:45	(1)
2016-05-09	F	01:51 - 01:51	(1)
2016-05-09	F	01:56 - 01:57	(2)
2016-05-09	F	01:59 - 01:59	(1)
2016-05-09	F	02:03 - 02:04	(2)
2016-05-09	F	02:11 - 02:11	(1)
2016-05-09	F	02:13 - 02:13	(1)
2016-05-09	F	02:15 - 02:15	(1)
2016-05-09	F	02:18 - 02:18	(1)
2016-05-09	F	02:20 - 02:23	(4)
2016-05-09	F	02:31 - 02:31	(1)
2016-05-09	F	02:35 - 02:35	(1)
2016-05-09	F	02:40 - 02:40	(1)
2016-05-09	F	02:42 - 02:42	(1)
2016-05-09	F	02:53 - 02:53	(1)
2016-05-09	F	02:56 - 02:58	(3)
2016-05-09	F	03:14 - 03:14	(1)
2016-05-09	F	03:30 - 03:30	(1)
2016-05-09	F	03:47 - 03:47	(1)
2016-05-09	F	03:51 - 03:51	(1)
2016-05-09	F	03:57 - 03:58	(2)
2016-05-09	F	04:01 - 04:01	(1)
2016-05-09	F	04:06 - 04:07	(2)
2016-05-09	F	04:15 - 04:17	(3)
2016-05-09	F	04:22 - 04:22	(1)
2016-05-09	F	04:24 - 04:24	(1)
2016-05-09	F	06:01 - 06:01	(1)
2016-05-09	F	06:08 - 06:11	(4)
2016-05-09	F	06:13 - 06:13	(1)
2016-05-09	F	22:22 - 23:26	(65)
2016-05-09	F	23:30 - 23:30	(1)
2016-05-09	F	23:38 - 23:38	(1)
2016-05-09	F	23:51 - 23:51	(1)
2016-05-10	F	00:01 - 01:23	(83)
2016-05-10	F	04:38 - 04:38	(1)
2016-05-10	F	21:33 -	
2016-05-11	F	- 00:00	(148)
2016-05-11	F	00:02 - 01:02	(61)
2016-05-11	F	01:15 - 01:18	(4)
2016-05-11	F	01:20 - 01:21	(2)
2016-05-11	F	01:26 - 01:29	(4)
2016-05-11	F	07:56 - 08:40	(45)
2016-05-11	F	21:39 - 23:55	(137)
2016-05-11	F	23:58 - 23:58	(1)
2016-05-12	F	00:00 - 00:00	(1)
2016-05-12	F	00:02 - 00:02	(1)
2016-05-12	F	00:04 - 00:04	(1)
2016-05-12	F	00:10 - 00:11	(2)
2016-05-12	F	00:14 - 00:14	(1)
2016-05-12	F	00:23 - 00:23	(1)
2016-05-12	F	00:31 - 00:31	(1)
2016-05-12	F	00:42 - 00:46	(5)
2016-05-12	F	00:50 - 00:51	(2)
2016-05-12	F	00:57 - 00:57	(1)
2016-05-12	F	01:00 - 01:01	(2)
2016-05-12	F	01:03 - 01:06	(4)
2016-05-12	F	01:10 - 01:10	(1)
2016-05-12	F	01:24 - 01:24	(1)

2016-05-12	F	01:27 - 01:28	(2)
2016-05-12	F	01:35 - 01:35	(1)
2016-05-12	F	07:55 - 08:01	(7)
2016-05-12	F	08:05 - 08:05	(1)
2016-05-12	F	08:07 - 08:08	(2)
2016-05-12	F	08:38 - 08:38	(1)
2016-05-12	F	08:40 - 08:40	(1)
2016-05-12	F	08:48 - 08:49	(2)
2016-05-12	F	08:53 - 08:53	(1)
2016-05-12	F	08:57 - 08:57	(1)
2016-05-12	F	09:03 - 09:03	(1)
2016-05-12	F	09:05 - 09:05	(1)
2016-05-12	F	09:07 - 09:07	(1)
2016-05-12	F	09:09 - 09:09	(1)
2016-05-12	F	09:14 - 09:14	(1)
2016-05-12	F	09:18 - 09:19	(2)
2016-05-12	F	09:24 - 09:24	(1)
2016-05-12	F	09:28 - 09:28	(1)
2016-05-12	F	09:30 - 09:30	(1)
2016-05-12	F	19:56 - 22:34	(159)
2016-05-12	F	22:39 - 22:39	(1)
2016-05-12	F	22:41 - 22:41	(1)
2016-05-12	F	22:44 - 22:44	(1)
2016-05-12	F	22:46 - 22:46	(1)
2016-05-12	F	22:48 - 22:48	(1)
2016-05-12	F	22:56 - 22:56	(1)
2016-05-12	F	23:02 - 23:02	(1)
2016-05-12	F	23:09 - 23:09	(1)
2016-05-12	F	23:14 - 23:16	(3)
2016-05-12	F	23:19 - 23:19	(1)
2016-05-12	F	23:28 - 23:28	(1)
2016-05-12	F	23:38 - 23:38	(1)
2016-05-12	F	23:45 - 23:45	(1)
2016-05-12	F	23:47 - 23:47	(1)
2016-05-12	F	23:50 - 23:50	(1)
2016-05-12	F	23:52 - 23:55	(4)
2016-05-12	F	23:59 -	
2016-05-13	F	- 00:00	(2)
2016-05-13	F	00:05 - 00:05	(1)
2016-05-13	F	00:07 - 00:10	(4)
2016-05-13	F	00:12 - 00:12	(1)
2016-05-13	F	00:16 - 00:16	(1)
2016-05-13	F	00:28 - 00:28	(1)
2016-05-13	F	01:10 - 01:13	(4)
2016-05-13	F	01:18 - 01:18	(1)
2016-05-13	F	01:56 - 01:56	(1)
2016-05-13	F	02:41 - 02:41	(1)
2016-05-13	F	04:26 - 04:26	(1)
2016-05-13	F	04:42 - 04:42	(1)
2016-05-13	F	04:46 - 04:46	(1)
2016-05-13	F	05:20 - 05:20	(1)
2016-05-13	F	05:57 - 05:57	(1)
2016-05-13	F	07:18 - 07:19	(2)
2016-05-13	F	07:22 - 07:22	(1)
2016-05-13	F	07:31 - 07:31	(1)
2016-05-13	F	07:40 - 07:42	(3)
2016-05-13	F	07:44 - 07:44	(1)
2016-05-13	F	20:01 - 20:03	(3)
2016-05-13	F	20:07 - 20:07	(1)
2016-05-13	F	20:14 - 20:14	(1)
2016-05-13	F	20:17 - 20:17	(1)

2016-05-13	F	20:19 - 20:19	(1)
2016-05-13	F	20:22 - 20:23	(2)
2016-05-13	F	20:26 - 20:26	(1)
2016-05-13	F	20:37 - 20:37	(1)
2016-05-13	F	20:42 - 20:42	(1)
2016-05-13	F	20:45 - 20:45	(1)
2016-05-13	F	20:53 - 21:15	(23)
2016-05-13	F	21:47 - 23:13	(87)
2016-05-14	F	00:18 - 00:18	(1)
2016-05-14	F	00:23 - 00:24	(2)
2016-05-14	F	00:30 - 00:30	(1)
2016-05-14	F	00:33 - 00:33	(1)
2016-05-14	F	00:54 - 00:54	(1)
2016-05-14	F	01:04 - 01:04	(1)
2016-05-14	F	01:08 - 01:08	(1)
2016-05-14	F	01:10 - 01:10	(1)
2016-05-14	F	10:11 - 10:11	(1)
2016-05-14	F	19:54 -	
2016-05-15	F	- 00:00	(247)
2016-05-15	F	00:03 - 00:04	(2)
2016-05-15	F	00:07 - 00:08	(2)
2016-05-15	F	00:10 - 00:10	(1)
2016-05-15	F	00:14 - 00:14	(1)
2016-05-15	F	00:16 - 00:18	(3)
2016-05-15	F	00:20 - 00:21	(2)
2016-05-15	F	00:25 - 00:25	(1)
2016-05-15	F	00:27 - 00:28	(2)
2016-05-15	F	00:30 - 00:30	(1)
2016-05-15	F	00:32 - 00:33	(2)
2016-05-15	F	00:35 - 00:36	(2)
2016-05-15	F	00:40 - 00:40	(1)
2016-05-15	F	00:45 - 00:46	(2)
2016-05-15	F	00:48 - 00:50	(3)
2016-05-15	F	00:52 - 00:52	(1)
2016-05-15	F	00:54 - 00:54	(1)
2016-05-15	F	00:56 - 00:56	(1)
2016-05-15	F	00:59 - 00:59	(1)
2016-05-15	F	01:13 - 01:13	(1)
2016-05-15	F	01:16 - 01:16	(1)
2016-05-15	F	01:20 - 01:20	(1)
2016-05-15	F	19:50 - 23:44	(235)
2016-05-15	F	23:48 - 23:48	(1)
2016-05-15	F	23:55 - 23:59	(5)
2016-05-16	F	00:04 - 00:04	(1)
2016-05-16	F	00:09 - 00:10	(2)
2016-05-16	F	00:15 - 00:15	(1)
2016-05-16	F	00:21 - 00:21	(1)
2016-05-16	F	00:25 - 00:25	(1)
2016-05-16	F	00:30 - 00:30	(1)
2016-05-16	F	00:32 - 00:33	(2)
2016-05-16	F	00:35 - 00:35	(1)
2016-05-16	F	00:37 - 00:37	(1)
2016-05-16	F	00:39 - 00:39	(1)
2016-05-16	F	00:41 - 00:41	(1)
2016-05-16	F	00:43 - 00:44	(2)
2016-05-16	F	00:46 - 00:46	(1)
2016-05-16	F	00:48 - 00:48	(1)
2016-05-16	F	00:50 - 00:50	(1)
2016-05-16	F	00:54 - 01:00	(7)
2016-05-16	F	01:05 - 01:06	(2)
2016-05-16	F	01:11 - 01:12	(2)

2016-05-16	F	01:23 - 01:24	(2)
2016-05-16	F	01:31 - 01:32	(2)
2016-05-16	F	01:34 - 01:35	(2)
2016-05-16	F	01:39 - 01:40	(2)
2016-05-16	F	01:46 - 01:46	(1)
2016-05-16	F	01:51 - 01:52	(2)
2016-05-16	F	01:55 - 01:55	(1)
2016-05-16	F	01:59 - 01:59	(1)
2016-05-16	F	02:07 - 02:08	(2)
2016-05-16	F	02:10 - 02:10	(1)
2016-05-16	F	02:12 - 02:12	(1)
2016-05-16	F	02:16 - 02:20	(5)
2016-05-16	F	02:22 - 02:22	(1)
2016-05-16	F	02:24 - 02:24	(1)
2016-05-16	F	02:27 - 02:27	(1)
2016-05-16	F	02:29 - 02:29	(1)
2016-05-16	F	02:33 - 02:35	(3)
2016-05-16	F	02:37 - 02:37	(1)
2016-05-16	F	02:39 - 02:39	(1)
2016-05-16	F	04:14 - 04:14	(1)
2016-05-16	F	04:25 - 04:25	(1)
2016-05-16	F	04:27 - 04:28	(2)
2016-05-16	F	04:46 - 04:47	(2)
2016-05-16	F	04:50 - 04:50	(1)
2016-05-16	F	04:58 - 04:58	(1)
2016-05-16	F	05:05 - 05:05	(1)
2016-05-16	F	05:09 - 05:09	(1)
2016-05-16	F	05:11 - 05:11	(1)
2016-05-16	F	05:13 - 05:13	(1)
2016-05-16	F	05:15 - 05:15	(1)
2016-05-16	F	05:17 - 05:17	(1)
2016-05-16	F	05:19 - 05:20	(2)
2016-05-16	F	05:32 - 05:33	(2)
2016-05-16	F	05:36 - 05:38	(3)
2016-05-16	F	05:40 - 05:40	(1)
2016-05-16	F	05:42 - 05:43	(2)
2016-05-16	F	05:50 - 05:51	(2)
2016-05-16	F	22:50 - 22:51	(2)
2016-05-16	F	22:53 - 22:56	(4)
2016-05-16	F	22:59 - 22:59	(1)
2016-05-16	F	23:08 - 23:09	(2)
2016-05-16	F	23:12 - 23:16	(5)
2016-05-16	F	23:24 - 23:24	(1)
2016-05-16	F	23:29 - 23:30	(2)
2016-05-16	F	23:38 - 23:39	(2)
2016-05-17	F	00:08 - 00:12	(5)
2016-05-17	F	00:19 - 00:19	(1)
2016-05-17	F	00:27 - 00:28	(2)
2016-05-17	F	00:30 - 00:30	(1)
2016-05-17	F	00:36 - 00:39	(4)
2016-05-17	F	00:41 - 00:42	(2)
2016-05-17	F	00:44 - 00:44	(1)
2016-05-17	F	00:48 - 00:48	(1)
2016-05-17	F	00:51 - 00:53	(3)
2016-05-17	F	00:56 - 00:56	(1)
2016-05-17	F	01:04 - 01:04	(1)
2016-05-17	F	14:36 - 14:36	(1)
2016-05-17	F	14:38 - 14:40	(3)
2016-05-17	F	20:24 - 23:25	(182)
2016-05-17	F	23:28 - 23:29	(2)
2016-05-17	F	23:33 - 23:33	(1)

2016-05-17	F	23:35 - 23:35	(1)
2016-05-17	F	23:41 - 23:41	(1)
2016-05-17	F	23:44 - 23:46	(3)
2016-05-17	F	23:49 - 23:52	(4)
2016-05-17	F	23:59 - 23:59	(1)
2016-05-18	F	00:12 - 00:12	(1)
2016-05-18	F	00:23 - 00:23	(1)
2016-05-18	F	00:28 - 00:28	(1)
2016-05-18	F	00:30 - 00:30	(1)
2016-05-18	F	00:36 - 00:37	(2)
2016-05-18	F	00:39 - 00:39	(1)
2016-05-18	F	01:04 - 01:05	(2)
2016-05-18	F	01:12 - 01:12	(1)
2016-05-18	F	01:15 - 01:15	(1)
2016-05-18	F	01:17 - 01:18	(2)
2016-05-18	F	01:20 - 01:22	(3)
2016-05-18	F	01:24 - 01:28	(5)
2016-05-18	F	01:38 - 01:38	(1)
2016-05-18	F	19:57 - 22:11	(135)
2016-05-18	F	22:16 - 22:17	(2)
2016-05-18	F	22:21 - 22:21	(1)
2016-05-18	F	22:25 - 22:26	(2)
2016-05-18	F	22:29 - 22:30	(2)
2016-05-18	F	22:35 - 22:36	(2)
2016-05-18	F	22:42 - 22:44	(3)
2016-05-18	F	22:48 - 22:50	(3)
2016-05-18	F	22:52 - 22:53	(2)
2016-05-18	F	22:55 - 22:56	(2)
2016-05-18	F	23:00 - 23:00	(1)
2016-05-18	F	23:06 - 23:07	(2)
2016-05-18	F	23:09 - 23:12	(4)
2016-05-18	F	23:18 - 23:18	(1)
2016-05-18	F	23:25 - 23:25	(1)
2016-05-18	F	23:34 - 23:34	(1)
2016-05-18	F	23:38 - 23:38	(1)
2016-05-18	F	23:41 - 23:41	(1)
2016-05-18	F	23:43 - 23:44	(2)
2016-05-19	F	00:10 - 01:16	(67)
2016-05-19	F	22:22 - 22:23	(2)
2016-05-19	F	22:28 - 22:28	(1)
2016-05-19	F	22:33 - 22:34	(2)
2016-05-19	F	23:25 - 23:26	(2)
2016-05-19	F	23:33 - 23:33	(1)
2016-05-19	F	23:35 - 23:36	(2)
2016-05-19	F	23:40 - 23:42	(3)
2016-05-19	F	23:48 - 23:49	(2)
2016-05-19	F	23:51 - 23:52	(2)
2016-05-19	F	23:59 - 23:59	(1)
2016-05-20	F	00:03 - 00:04	(2)
2016-05-20	F	00:08 - 00:10	(3)
2016-05-20	F	00:12 - 00:12	(1)
2016-05-20	F	00:23 - 00:23	(1)
2016-05-20	F	00:25 - 00:25	(1)
2016-05-20	F	00:27 - 00:27	(1)
2016-05-20	F	00:30 - 00:31	(2)
2016-05-20	F	00:38 - 00:38	(1)
2016-05-20	F	00:40 - 00:41	(2)
2016-05-20	F	00:45 - 00:45	(1)
2016-05-20	F	00:47 - 00:48	(2)
2016-05-20	F	00:51 - 00:51	(1)
2016-05-20	F	00:58 - 00:58	(1)

2016-05-20	F	01:02 - 01:03	(2)
2016-05-20	F	01:06 - 01:06	(1)
2016-05-20	F	01:14 - 01:14	(1)
2016-05-20	F	01:19 - 01:19	(1)
2016-05-20	F	01:21 - 01:21	(1)
2016-05-20	F	01:23 - 01:28	(6)
2016-05-20	F	01:38 - 01:38	(1)
2016-05-21	F	02:25 - 02:25	(1)
2016-05-21	F	03:37 - 03:37	(1)
2016-05-21	F	03:55 - 03:55	(1)
2016-05-22	F	04:49 - 04:49	(1)
2016-05-22	F	22:11 - 23:58	(108)
2016-05-23	F	00:03 - 00:03	(1)
2016-05-23	F	00:05 - 01:12	(68)
2016-05-23	F	01:16 - 01:16	(1)
2016-05-23	F	01:19 - 01:20	(2)
2016-05-23	F	01:22 - 01:25	(4)
2016-05-23	F	01:28 - 01:28	(1)
2016-05-23	F	01:33 - 01:33	(1)
2016-05-23	F	01:35 - 01:37	(3)
2016-05-23	F	01:39 - 01:39	(1)
2016-05-23	F	01:42 - 01:43	(2)
2016-05-23	F	01:45 - 01:48	(4)
2016-05-23	F	01:56 - 01:57	(2)
2016-05-23	F	02:02 - 02:02	(1)
2016-05-23	F	02:06 - 02:06	(1)
2016-05-23	F	02:09 - 02:09	(1)
2016-05-23	F	02:11 - 02:12	(2)
2016-05-23	F	02:14 - 02:14	(1)
2016-05-23	F	02:18 - 02:18	(1)
2016-05-23	F	02:27 - 02:28	(2)
2016-05-23	F	02:31 - 02:33	(3)
2016-05-23	F	02:36 - 02:36	(1)
2016-05-23	F	02:41 - 02:42	(2)
2016-05-23	F	02:44 - 02:45	(2)
2016-05-23	F	02:47 - 02:48	(2)
2016-05-23	F	02:50 - 02:51	(2)
2016-05-23	F	02:53 - 02:54	(2)
2016-05-23	F	02:57 - 03:00	(4)
2016-05-23	F	03:11 - 03:11	(1)
2016-05-23	F	03:14 - 03:14	(1)
2016-05-23	F	03:16 - 03:16	(1)
2016-05-23	F	03:20 - 03:20	(1)
2016-05-23	F	03:29 - 03:29	(1)
2016-05-23	F	03:42 - 03:43	(2)
2016-05-23	F	03:54 - 03:55	(2)
2016-05-23	F	04:00 - 04:28	(29)
2016-05-23	F	06:18 - 06:18	(1)
2016-05-23	F	06:25 - 06:25	(1)
2016-05-23	F	06:33 - 06:35	(3)
2016-05-23	F	06:38 - 06:39	(2)
2016-05-23	F	06:48 - 06:48	(1)
2016-05-23	F	06:50 - 06:51	(2)
2016-05-23	F	06:54 - 06:55	(2)
2016-05-23	F	07:12 - 07:12	(1)
2016-05-24	F	22:18 - 23:29	(72)
2016-05-24	F	23:39 - 23:39	(1)
2016-05-24	F	23:53 - 23:55	(3)
2016-05-24	F	23:59 - 23:59	(1)
2016-05-25	F	00:04 - 00:04	(1)
2016-05-25	F	00:07 - 00:07	(1)

2016-05-25	F	01:05 - 01:07	(3)
2016-05-26	F	00:13 - 00:13	(1)
2016-05-26	F	00:17 - 00:17	(1)
2016-05-26	F	00:19 - 00:20	(2)
2016-05-26	F	00:23 - 00:23	(1)
2016-05-26	F	00:26 - 00:26	(1)
2016-05-26	F	00:31 - 00:31	(1)
2016-05-26	F	00:39 - 00:39	(1)
2016-05-26	F	00:41 - 00:43	(3)
2016-05-26	F	22:42 - 23:07	(26)
2016-05-26	F	23:12 - 23:12	(1)
2016-05-26	F	23:14 - 23:15	(2)
2016-05-26	F	23:18 - 23:20	(3)
2016-05-26	F	23:24 - 23:24	(1)
2016-05-26	F	23:31 - 23:32	(2)
2016-05-26	F	23:34 - 23:40	(7)
2016-05-26	F	23:45 - 23:46	(2)
2016-05-26	F	23:50 - 23:50	(1)
2016-05-26	F	23:52 - 23:52	(1)
2016-05-26	F	23:54 - 23:54	(1)
2016-05-26	F	23:59 - 23:59	(1)
2016-05-27	F	00:02 - 00:02	(1)
2016-05-27	F	00:05 - 00:05	(1)
2016-05-27	F	00:19 - 00:20	(2)
2016-05-27	F	00:22 - 00:22	(1)
2016-05-27	F	00:25 - 00:25	(1)
2016-05-27	F	00:29 - 00:29	(1)
2016-05-27	F	00:32 - 00:34	(3)
2016-05-27	F	00:40 - 00:40	(1)
2016-05-27	F	00:45 - 00:45	(1)
2016-05-27	F	00:51 - 00:51	(1)
2016-05-27	F	01:22 - 01:22	(1)
2016-05-27	F	01:24 - 01:24	(1)
2016-05-27	F	01:30 - 01:30	(1)
2016-05-27	F	01:47 - 01:47	(1)
2016-05-27	F	02:00 - 02:00	(1)
2016-05-27	F	06:52 - 06:52	(1)
2016-05-27	F	07:14 - 07:14	(1)
2016-05-27	F	07:54 - 07:54	(1)
2016-05-27	F	07:56 - 08:56	(61)
2016-05-28	F	01:02 - 01:02	(1)
2016-05-28	F	22:56 - 23:59	(64)
2016-05-29	F	00:02 - 00:04	(3)
2016-05-29	F	00:06 - 00:06	(1)
2016-05-29	F	00:12 - 00:12	(1)
2016-05-29	F	00:16 - 00:16	(1)
2016-05-29	F	00:23 - 00:23	(1)
2016-05-29	F	00:29 - 00:29	(1)
2016-05-29	F	00:34 - 00:34	(1)
2016-05-29	F	00:37 - 00:37	(1)
2016-05-29	F	00:39 - 00:41	(3)
2016-05-29	F	00:44 - 00:44	(1)
2016-05-29	F	00:46 - 00:46	(1)
2016-05-29	F	00:52 - 00:52	(1)
2016-05-29	F	00:59 - 00:59	(1)
2016-05-29	F	01:08 - 01:09	(2)
2016-05-29	F	01:21 - 01:21	(1)
2016-05-29	F	22:31 - 23:53	(83)
2016-05-29	F	23:57 - 23:57	(1)
2016-05-30	F	00:03 - 00:05	(3)
2016-05-30	F	00:07 - 00:09	(3)

2016-05-30	F	00:13 - 00:13	(1)
2016-05-30	F	00:15 - 00:35	(21)
2016-05-30	F	00:37 - 00:37	(1)
2016-05-30	F	00:39 - 00:40	(2)
2016-05-30	F	00:44 - 00:45	(2)
2016-05-30	F	00:47 - 00:47	(1)
2016-05-30	F	00:52 - 00:52	(1)
2016-05-30	F	01:03 - 01:06	(4)
2016-05-30	F	01:08 - 01:11	(4)
2016-05-30	F	01:13 - 01:13	(1)
2016-05-30	F	01:15 - 01:15	(1)
2016-05-30	F	01:17 - 01:18	(2)
2016-05-30	F	01:21 - 01:23	(3)
2016-05-30	F	01:29 - 01:30	(2)
2016-05-30	F	01:34 - 01:35	(2)
2016-05-30	F	01:39 - 01:39	(1)
2016-05-30	F	01:41 - 01:42	(2)
2016-05-30	F	01:47 - 01:48	(2)
2016-05-30	F	01:54 - 01:58	(5)
2016-05-30	F	02:00 - 02:01	(2)
2016-05-30	F	02:12 - 02:13	(2)
2016-05-30	F	02:25 - 02:26	(2)
2016-05-30	F	02:28 - 02:29	(2)
2016-05-30	F	02:32 - 02:33	(2)
2016-05-30	F	02:36 - 02:39	(4)
2016-05-30	F	02:41 - 02:41	(1)
2016-05-30	F	02:44 - 02:44	(1)
2016-05-30	F	02:57 - 02:58	(2)
2016-05-30	F	03:24 - 03:24	(1)
2016-05-30	F	03:32 - 03:32	(1)
2016-05-30	F	03:39 - 03:40	(2)
2016-05-30	F	03:53 - 03:53	(1)
2016-05-30	F	03:56 - 03:56	(1)
2016-05-30	F	03:58 - 03:58	(1)
2016-05-30	F	04:03 - 04:03	(1)
2016-05-30	F	04:05 - 04:05	(1)
2016-05-30	F	04:09 - 04:10	(2)
2016-05-30	F	04:12 - 04:13	(2)
2016-05-30	F	04:15 - 04:17	(3)
2016-05-30	F	04:29 - 04:29	(1)
2016-05-30	F	04:31 - 04:32	(2)
2016-05-30	F	04:34 - 04:35	(2)
2016-05-30	F	04:39 - 04:39	(1)
2016-05-30	F	04:44 - 04:44	(1)
2016-05-30	F	04:46 - 04:46	(1)
2016-05-30	F	05:02 - 05:02	(1)
2016-05-30	F	05:05 - 05:05	(1)
2016-05-30	F	05:08 - 05:09	(2)
2016-05-30	F	05:11 - 05:11	(1)
2016-05-30	F	05:14 - 05:14	(1)
2016-05-30	F	05:16 - 05:16	(1)
2016-05-30	F	05:18 - 05:19	(2)
2016-05-30	F	05:24 - 05:25	(2)
2016-05-30	F	05:30 - 05:30	(1)
2016-05-30	F	05:33 - 05:33	(1)
2016-05-30	F	05:35 - 05:35	(1)
2016-05-30	F	05:37 - 05:41	(5)
2016-05-30	F	05:47 - 05:47	(1)
2016-05-30	F	05:50 - 05:52	(3)
2016-05-30	F	05:54 - 05:57	(4)
2016-05-30	F	06:00 - 06:00	(1)

2016-05-30	F	06:15 - 06:16	(2)
2016-05-30	F	06:19 - 06:19	(1)
2016-05-30	F	06:27 - 06:29	(3)
2016-05-30	F	06:32 - 06:33	(2)
2016-05-30	F	06:36 - 06:36	(1)
2016-05-30	F	06:38 - 06:38	(1)
2016-05-30	F	06:41 - 06:41	(1)
2016-05-30	F	06:45 - 06:49	(5)
2016-05-30	F	06:51 - 06:53	(3)
2016-05-30	F	07:01 - 07:02	(2)
2016-05-30	F	07:04 - 07:05	(2)
2016-05-30	F	07:07 - 07:07	(1)
2016-05-30	F	07:09 - 07:09	(1)
2016-05-30	F	07:13 - 07:13	(1)
2016-05-30	F	07:16 - 07:18	(3)
2016-05-30	F	07:23 - 07:24	(2)
2016-05-30	F	07:29 - 07:30	(2)
2016-05-30	F	07:33 - 07:33	(1)
2016-05-30	F	07:39 - 07:39	(1)
2016-05-30	F	07:45 - 07:45	(1)
2016-05-30	F	07:49 - 07:50	(2)
2016-05-30	F	07:55 - 07:57	(3)
2016-05-30	F	07:59 - 08:01	(3)
2016-05-30	F	08:06 - 08:06	(1)
2016-05-30	F	08:08 - 08:08	(1)
2016-05-30	F	08:10 - 08:10	(1)
2016-05-30	F	08:12 - 08:13	(2)
2016-05-30	F	08:16 - 08:17	(2)
2016-05-30	F	16:21 - 16:21	(1)
2016-05-30	F	16:23 - 16:24	(2)
2016-05-30	F	22:52 - 23:17	(26)
2016-05-30	F	23:19 - 23:19	(1)
2016-05-30	F	23:21 - 23:22	(2)
2016-05-30	F	23:24 - 23:24	(1)
2016-05-30	F	23:26 - 23:27	(2)
2016-05-30	F	23:30 - 23:30	(1)
2016-05-30	F	23:34 - 23:37	(4)
2016-05-30	F	23:46 - 23:46	(1)
2016-05-30	F	23:50 - 23:50	(1)
2016-05-30	F	23:53 - 23:53	(1)
2016-05-30	F	23:56 - 23:56	(1)
2016-05-30	F	23:58 - 23:59	(2)
2016-05-31	F	00:17 - 00:19	(3)
2016-05-31	F	00:21 - 00:22	(2)
2016-05-31	F	00:24 - 00:24	(1)
2016-05-31	F	00:26 - 00:27	(2)
2016-05-31	F	00:29 - 00:29	(1)
2016-05-31	F	00:35 - 00:39	(5)
2016-05-31	F	00:43 - 00:47	(5)
2016-05-31	F	00:51 - 00:52	(2)
2016-05-31	F	01:07 - 01:09	(3)
2016-05-31	F	01:22 - 01:22	(1)
2016-05-31	F	01:24 - 01:24	(1)
2016-05-31	F	01:28 - 01:28	(1)
2016-05-31	F	15:02 - 15:03	(2)
2016-05-31	F	15:28 - 15:30	(3)
2016-05-31	F	22:12 - 23:43	(92)
2016-05-31	F	23:45 - 23:45	(1)
2016-05-31	F	23:48 - 23:48	(1)
2016-05-31	F	23:55 - 23:55	(1)
2016-06-01	F	00:05 - 00:06	(2)

2016-06-01	F	00:10 - 00:14	(5)
2016-06-01	F	00:22 - 00:22	(1)
2016-06-01	F	00:24 - 00:24	(1)
2016-06-01	F	00:36 - 00:37	(2)
2016-06-01	F	00:40 - 00:40	(1)
2016-06-01	F	00:47 - 00:50	(4)
2016-06-01	F	00:54 - 00:55	(2)
2016-06-01	F	01:00 - 01:01	(2)
2016-06-01	F	01:04 - 01:04	(1)
2016-06-01	F	01:06 - 01:09	(4)
2016-06-01	F	01:11 - 01:18	(8)
2016-06-01	F	01:20 - 01:22	(3)
2016-06-01	F	01:24 - 01:24	(1)
2016-06-01	F	21:17 - 23:48	(152)
2016-06-01	F	23:54 - 23:54	(1)
2016-06-01	F	23:56 - 23:58	(3)
2016-06-02	F	00:02 - 00:03	(2)
2016-06-02	F	00:05 - 00:06	(2)
2016-06-02	F	00:09 - 00:10	(2)
2016-06-02	F	00:12 - 00:13	(2)
2016-06-02	F	00:15 - 00:17	(3)
2016-06-02	F	00:19 - 00:19	(1)
2016-06-02	F	00:23 - 00:23	(1)
2016-06-02	F	00:27 - 00:27	(1)
2016-06-02	F	00:31 - 00:32	(2)
2016-06-02	F	00:37 - 00:38	(2)
2016-06-02	F	00:40 - 00:42	(3)
2016-06-02	F	00:44 - 00:45	(2)
2016-06-02	F	00:48 - 00:48	(1)
2016-06-02	F	00:52 - 00:52	(1)
2016-06-02	F	00:55 - 00:55	(1)
2016-06-02	F	00:57 - 01:00	(4)
2016-06-02	F	01:02 - 01:03	(2)
2016-06-02	F	01:09 - 01:10	(2)
2016-06-02	F	01:13 - 01:13	(1)
2016-06-02	F	01:31 - 01:31	(1)
2016-06-02	F	21:49 - 21:55	(7)
2016-06-02	F	21:57 - 21:58	(2)
2016-06-02	F	22:00 - 22:01	(2)
2016-06-02	F	22:04 - 22:04	(1)
2016-06-02	F	22:11 - 22:20	(10)
2016-06-02	F	22:29 - 22:29	(1)
2016-06-02	F	22:32 - 22:32	(1)
2016-06-02	F	22:37 - 22:37	(1)
2016-06-02	F	22:42 - 22:44	(3)
2016-06-02	F	22:51 - 22:54	(4)
2016-06-02	F	22:58 - 22:59	(2)
2016-06-02	F	23:01 - 23:07	(7)
2016-06-02	F	23:18 - 23:18	(1)
2016-06-02	F	23:20 - 23:20	(1)
2016-06-02	F	23:27 - 23:27	(1)
2016-06-02	F	23:30 - 23:30	(1)
2016-06-02	F	23:53 - 23:53	(1)
2016-06-02	F	23:55 - 23:55	(1)
2016-06-02	F	23:59 -	
2016-06-03	F	- 00:00	(2)
2016-06-03	F	00:16 - 00:18	(3)
2016-06-03	F	00:22 - 00:23	(2)
2016-06-03	F	00:26 - 00:26	(1)
2016-06-03	F	00:28 - 00:28	(1)
2016-06-03	F	00:31 - 00:31	(1)

2016-06-03	F	00:41 - 00:41	(1)
2016-06-03	F	01:00 - 01:00	(1)
2016-06-03	F	01:04 - 01:05	(2)
2016-06-03	F	01:07 - 01:07	(1)
2016-06-03	F	01:10 - 01:10	(1)
2016-06-03	F	01:13 - 01:13	(1)
2016-06-03	F	01:17 - 01:17	(1)
2016-06-03	F	01:21 - 01:22	(2)
2016-06-03	F	01:26 - 01:31	(6)
2016-06-03	F	01:37 - 01:38	(2)
2016-06-03	F	01:40 - 01:42	(3)
2016-06-03	F	01:44 - 01:46	(3)
2016-06-03	F	01:50 - 01:51	(2)
2016-06-04	F	22:01 -	
2016-06-05	F	- 01:08	(188)
2016-06-05	F	01:10 - 01:11	(2)
2016-06-05	F	05:14 - 05:14	(1)
2016-06-05	F	20:57 - 20:57	(1)
2016-06-05	F	21:50 -	
2016-06-06	F	- 01:07	(198)
2016-06-06	F	01:17 - 01:21	(5)
2016-06-06	F	02:25 - 02:25	(1)
2016-06-06	F	06:21 - 06:21	(1)
2016-06-06	F	06:46 - 06:46	(1)
2016-06-06	F	06:48 - 06:48	(1)
2016-06-08	F	23:07 - 23:11	(5)
2016-06-08	F	23:13 - 23:13	(1)
2016-06-08	F	23:15 - 23:18	(4)
2016-06-08	F	23:23 - 23:27	(5)
2016-06-08	F	23:29 - 23:30	(2)
2016-06-08	F	23:38 - 23:39	(2)
2016-06-08	F	23:43 - 23:43	(1)
2016-06-08	F	23:55 - 23:56	(2)
2016-06-08	F	23:59 - 23:59	(1)
2016-06-09	F	00:01 - 00:05	(5)
2016-06-09	F	00:10 - 00:10	(1)
2016-06-09	F	00:14 - 00:19	(6)
2016-06-09	F	00:28 - 00:29	(2)
2016-06-09	F	00:37 - 00:37	(1)
2016-06-09	F	00:49 - 00:49	(1)
2016-06-09	F	00:54 - 00:54	(1)
2016-06-09	F	00:58 - 00:58	(1)
2016-06-09	F	01:00 - 01:01	(2)
2016-06-09	F	01:09 - 01:10	(2)
2016-06-09	F	01:12 - 01:12	(1)
2016-06-09	F	01:14 - 01:14	(1)
2016-06-09	F	01:16 - 01:17	(2)
2016-06-09	F	23:17 - 23:17	(1)
2016-06-09	F	23:23 - 23:23	(1)
2016-06-09	F	23:58 - 23:59	(2)
2016-06-10	F	00:04 - 00:04	(1)
2016-06-10	F	00:07 - 00:07	(1)
2016-06-10	F	00:20 - 00:20	(1)
2016-06-10	F	00:27 - 00:29	(3)
2016-06-10	F	00:31 - 00:32	(2)
2016-06-10	F	00:37 - 00:39	(3)
2016-06-10	F	00:43 - 00:44	(2)
2016-06-10	F	00:48 - 00:48	(1)
2016-06-10	F	00:50 - 00:50	(1)
2016-06-10	F	00:52 - 00:52	(1)
2016-06-10	F	00:54 - 00:55	(2)

2016-06-10	F	00:57 - 01:02	(6)
2016-06-10	F	01:07 - 01:07	(1)
2016-06-10	F	01:10 - 01:10	(1)
2016-06-10	F	01:15 - 01:16	(2)
2016-06-10	F	01:18 - 01:18	(1)
2016-06-11	F	00:30 - 01:56	(87)
2016-06-11	F	02:32 - 02:32	(1)
2016-06-11	F	02:52 - 02:52	(1)
2016-06-12	F	00:11 - 00:13	(3)
2016-06-12	F	00:15 - 00:17	(3)
2016-06-12	F	00:19 - 00:19	(1)
2016-06-12	F	00:22 - 00:24	(3)
2016-06-12	F	00:30 - 00:31	(2)
2016-06-12	F	00:42 - 00:44	(3)
2016-06-12	F	00:48 - 00:48	(1)
2016-06-12	F	00:56 - 00:56	(1)
2016-06-12	F	00:59 - 00:59	(1)
2016-06-12	F	01:01 - 01:04	(4)
2016-06-12	F	01:06 - 01:06	(1)
2016-06-12	F	01:08 - 01:08	(1)
2016-06-12	F	01:10 - 01:10	(1)
2016-06-12	F	01:14 - 01:15	(2)
2016-06-12	F	01:18 - 01:19	(2)
2016-06-12	F	01:24 - 01:24	(1)
2016-06-12	F	01:27 - 01:27	(1)
2016-06-12	F	01:29 - 01:29	(1)
2016-06-12	F	01:31 - 01:31	(1)
2016-06-12	F	01:33 - 01:34	(2)
2016-06-12	F	01:37 - 01:38	(2)
2016-06-12	F	18:22 - 18:23	(2)
2016-06-13	F	23:38 - 23:42	(5)
2016-06-13	F	23:47 - 23:47	(1)
2016-06-13	F	23:53 - 23:53	(1)
2016-06-13	F	23:59 - 23:59	(1)
2016-06-14	F	00:07 - 00:07	(1)
2016-06-14	F	00:18 - 00:20	(3)
2016-06-14	F	00:26 - 00:27	(2)
2016-06-14	F	00:29 - 00:31	(3)
2016-06-14	F	00:35 - 00:37	(3)
2016-06-14	F	00:39 - 00:39	(1)
2016-06-14	F	00:44 - 00:46	(3)
2016-06-14	F	00:48 - 00:48	(1)
2016-06-14	F	00:50 - 00:53	(4)
2016-06-14	F	00:55 - 00:57	(3)
2016-06-14	F	00:59 - 00:59	(1)
2016-06-14	F	01:01 - 01:05	(5)
2016-06-14	F	01:09 - 01:09	(1)
2016-06-14	F	01:16 - 01:19	(4)
2016-06-14	F	01:23 - 01:23	(1)
2016-06-14	F	02:50 - 02:50	(1)
2016-06-14	F	19:12 - 19:12	(1)
2016-06-14	F	23:02 - 23:02	(1)
2016-06-14	F	23:45 - 23:45	(1)
2016-06-15	F	00:06 - 00:06	(1)
2016-06-15	F	02:12 - 02:13	(2)
2016-06-15	F	03:33 - 03:33	(1)
2016-06-15	F	04:01 - 04:01	(1)
2016-06-15	F	13:29 - 13:29	(1)
2016-06-15	F	21:54 - 22:04	(11)
2016-06-15	F	22:07 - 22:07	(1)
2016-06-15	F	22:09 - 22:09	(1)

2016-06-15	F	22:11 - 22:18	(8)
2016-06-15	F	22:20 - 22:23	(4)
2016-06-15	F	22:28 - 22:29	(2)
2016-06-15	F	22:32 - 22:32	(1)
2016-06-15	F	22:39 - 22:41	(3)
2016-06-15	F	22:43 - 22:43	(1)
2016-06-15	F	22:45 - 22:48	(4)
2016-06-15	F	22:51 - 22:51	(1)
2016-06-15	F	22:59 - 22:59	(1)
2016-06-15	F	23:32 - 23:32	(1)
2016-06-15	F	23:36 - 23:38	(3)
2016-06-15	F	23:45 - 23:45	(1)
2016-06-16	F	00:38 - 01:56	(79)
2016-06-16	F	02:54 - 02:54	(1)
2016-06-16	F	05:04 - 05:04	(1)
2016-06-16	F	06:11 - 06:11	(1)
2016-06-16	F	22:17 -	
2016-06-17	F	- 01:32	(196)
2016-06-17	F	22:31 -	
2016-06-18	F	- 02:00	(210)
2016-06-18	F	04:07 - 04:07	(1)
2016-06-18	F	21:35 - 23:00	(86)
2016-06-18	F	23:09 -	
2016-06-19	F	- 00:00	(52)
2016-06-19	F	00:03 - 00:03	(1)
2016-06-19	F	00:06 - 01:38	(93)
2016-06-19	F	03:36 - 03:36	(1)
2016-06-19	F	06:05 - 06:05	(1)
2016-06-20	F	03:53 - 03:53	(1)
2016-06-21	F	22:53 - 22:56	(4)
2016-06-21	F	22:59 - 23:01	(3)
2016-06-21	F	23:06 - 23:08	(3)
2016-06-21	F	23:11 - 23:13	(3)
2016-06-21	F	23:15 - 23:19	(5)
2016-06-21	F	23:24 - 23:25	(2)
2016-06-21	F	23:27 - 23:32	(6)
2016-06-21	F	23:35 - 23:35	(1)
2016-06-21	F	23:41 -	
2016-06-22	F	- 03:58	(258)
2016-06-22	F	07:06 - 08:53	(108)
2016-06-22	F	16:42 - 16:42	(1)
2016-06-23	F	22:37 - 23:01	(25)
2016-06-24	F	00:44 - 01:23	(40)
2016-06-27	F	00:20 - 00:26	(7)
2016-06-27	F	01:56 - 03:05	(70)
2016-06-27	F	04:00 - 04:06	(7)
2016-07-04	F	07:33 - 07:33	(1)
2016-07-04	F	20:16 - 20:17	(2)
2016-07-04	F	21:54 - 22:52	(59)
2016-07-05	F	21:02 - 22:15	(74)
2016-07-07	F	05:01 - 05:01	(1)
2016-07-07	F	17:43 - 17:43	(1)
2016-07-08	F	02:25 - 02:26	(2)
2016-07-09	F	04:13 - 04:17	(5)
2016-07-10	F	03:13 - 03:13	(1)
2016-07-10	F	06:19 - 06:19	(1)
2016-07-12	F	00:48 - 23:11	(1344)
2016-07-13	F	04:43 - 04:43	(1)
2016-07-13	F	05:10 - 05:10	(1)
2016-07-13	F	05:23 - 05:23	(1)
2016-07-13	F	06:15 - 06:15	(1)

2016-07-13	F	07:27 - 07:27	(1)
2016-07-13	F	07:35 - 07:35	(1)
2016-07-13	F	07:39 - 07:41	(3)
2016-07-14	F	03:58 - 03:58	(1)
2016-07-14	F	04:49 - 04:49	(1)
2016-07-14	F	08:04 - 08:04	(1)
2016-07-14	F	21:46 -	
2016-07-15	F	- 20:05	(1340)
2016-07-16	F	00:08 - 00:53	(46)
2016-07-16	F	06:17 - 06:18	(2)
2016-07-16	F	07:01 - 07:01	(1)
2016-07-20	F	00:56 - 00:56	(1)
2016-07-20	F	00:59 - 00:59	(1)
2016-07-20	F	01:10 - 01:13	(4)
2016-07-20	F	01:29 - 01:31	(3)
2016-07-20	F	01:45 - 01:45	(1)
2016-07-20	F	04:00 - 04:00	(1)
2016-07-20	F	23:52 -	
2016-07-21	F	- 22:11	(1340)
2016-07-24	F	10:55 -	
2016-07-25	F	- 09:35	(1361)
2016-07-25	F	14:23 - 14:23	(1)
2016-07-27	F	07:35 -	
2016-07-28	F	- 06:30	(1376)
2016-07-28	F	08:54 - 09:34	(41)
2016-07-28	F	17:12 - 17:12	(1)
2016-07-28	F	17:23 - 17:23	(1)
2016-07-28	F	20:07 -	
2016-07-29	F	- 01:16	(310)
2016-07-29	F	06:56 - 06:56	(1)
2016-07-29	F	16:15 - 16:16	(2)
2016-07-29	F	16:32 - 16:32	(1)
2016-07-29	F	17:01 - 17:03	(3)
2016-07-29	F	21:31 -	
2016-07-30	F	- 01:56	(266)
2016-07-30	F	19:57 -	
2016-07-31	F	- 18:03	(1327)
2016-08-02	F	23:27 - 23:28	(2)
2016-08-02	F	23:33 - 23:33	(1)
2016-08-02	F	23:35 - 23:37	(3)
2016-08-02	F	23:47 - 23:50	(4)
2016-08-02	F	23:57 -	
2016-08-03	F	- 00:08	(12)
2016-08-03	F	01:02 - 01:10	(9)
2016-08-03	F	03:52 - 03:53	(2)
2016-08-03	F	04:45 - 04:45	(1)
2016-08-03	F	05:07 -	
2016-08-04	F	- 03:55	(1369)
2016-08-04	F	12:16 - 12:17	(2)
2016-08-04	F	15:04 - 15:04	(1)
2016-08-04	F	15:31 - 15:31	(1)
2016-08-04	F	15:34 - 15:34	(1)
2016-08-04	F	15:47 - 15:47	(1)
2016-08-04	F	16:06 - 16:06	(1)
2016-08-04	F	16:10 - 16:11	(2)
2016-08-04	F	22:05 -	
2016-08-05	F	- 01:35	(211)
2016-08-05	F	06:23 - 06:23	(1)
2016-08-05	F	06:25 - 06:25	(1)
2016-08-05	F	08:58 - 08:59	(2)
2016-08-05	F	10:17 - 10:18	(2)

2016-08-05	F	21:31 -	
2016-08-06	F	- 21:25	(1435)
2016-08-07	F	07:08 - 07:08	(1)
2016-08-08	F	15:17 - 15:18	(2)
2016-08-09	F	00:40 - 23:30	(1371)
2016-08-10	F	07:18 - 07:18	(1)
2016-08-10	F	10:13 - 10:13	(1)
2016-08-10	F	23:19 - 23:42	(24)
2016-08-11	F	04:38 - 04:38	(1)
2016-08-11	F	06:36 - 06:36	(1)
2016-08-12	F	00:58 -	
2016-08-13	F	- 01:31	(1474)
2016-08-13	F	22:13 -	
2016-08-14	F	- 02:31	(259)
2016-08-15	F	11:53 -	
2016-08-16	F	- 09:46	(1314)
2016-08-16	F	16:18 - 16:18	(1)
2016-08-16	F	21:25 - 21:34	(10)
2016-08-17	F	02:30 - 18:03	(934)
2016-08-18	F	12:53 - 12:53	(1)
2016-08-19	F	13:13 - 13:13	(1)
2016-08-19	F	13:21 - 13:21	(1)
2016-08-21	F	06:46 -	
2016-08-22	F	- 04:52	(1327)
2016-08-23	F	19:25 - 19:25	(1)
2016-08-23	F	20:40 - 20:40	(1)
2016-08-24	F	00:56 - 01:03	(8)
2016-08-24	F	12:46 -	
2016-08-25	F	- 11:27	(1362)
2016-08-25	F	17:41 - 17:41	(1)
2016-08-27	F	15:26 - 15:26	(1)
2016-08-27	F	16:15 - 16:16	(2)
2016-08-28	F	05:01 - 05:02	(2)
2016-08-28	F	15:13 -	
2016-08-29	F	- 13:15	(1323)
2016-09-01	F	07:17 - 07:17	(1)
2016-09-01	F	14:01 - 14:01	(1)
2016-09-01	F	17:29 -	
2016-09-02	F	- 15:23	(1315)
2016-09-03	F	00:52 - 00:54	(3)
2016-09-03	F	00:57 - 01:20	(24)
2016-09-03	F	03:39 - 03:39	(1)
2016-09-03	F	05:44 - 05:45	(2)
2016-09-03	F	05:48 - 05:50	(3)
2016-09-03	F	06:16 - 06:17	(2)
2016-09-03	F	06:52 - 06:53	(2)
2016-09-03	F	07:26 - 07:27	(2)
2016-09-03	F	07:32 - 07:32	(1)
2016-09-03	F	12:24 - 12:25	(2)
2016-09-03	F	12:28 - 12:28	(1)
2016-09-03	F	12:34 - 12:34	(1)
2016-09-03	F	23:57 -	
2016-09-04	F	- 00:41	(45)
2016-09-04	F	11:13 - 11:13	(1)
2016-09-04	F	12:50 - 12:51	(2)
2016-09-04	F	17:30 - 17:30	(1)
2016-09-04	F	23:18 - 23:56	(39)
2016-09-05	F	00:02 - 03:38	(217)
2016-09-05	F	09:36 - 09:36	(1)
2016-09-05	F	16:31 - 16:31	(1)
2016-09-06	F	00:02 - 01:44	(103)

2016-09-07	F	00:00	-	20:11	(1212)
2016-09-10	F	21:07	-		
2016-09-11	F		-	00:00	(174)
2016-09-11	F	19:58	-		
2016-09-12	F		-	14:30	(1113)
2016-09-18	F	14:31	-	14:31	(1)
2016-09-20	F	01:23	-	01:23	(1)
2016-09-20	F	01:57	-	01:57	(1)
2016-09-20	F	02:03	-	02:03	(1)
2016-09-20	F	03:15	-	03:15	(1)
2016-09-20	F	03:34	-	03:34	(1)
2016-09-20	F	03:49	-	03:49	(1)
2016-09-20	F	03:53	-	03:53	(1)
2016-09-20	F	04:27	-	04:27	(1)
2016-09-20	F	04:30	-	04:30	(1)
2016-09-20	F	04:35	-	04:35	(1)
2016-09-20	F	05:11	-	05:11	(1)
2016-09-20	F	08:25	-	08:25	(1)
2016-09-20	F	17:06	-	17:06	(1)
2016-09-21	F	04:59	-	04:59	(1)
2016-09-21	F	05:05	-	05:05	(1)
2016-09-21	F	06:41	-	06:42	(2)
2016-09-21	F	07:04	-	07:04	(1)
2016-09-21	F	07:08	-	07:08	(1)
2016-09-21	F	07:11	-	07:11	(1)
2016-09-22	F	03:28	-	03:28	(1)
2016-09-22	F	05:57	-	05:57	(1)
2016-09-22	F	06:22	-	06:22	(1)
2016-09-22	F	06:44	-	06:45	(2)
2016-09-22	F	06:56	-	06:56	(1)
2016-09-22	F	06:58	-	06:58	(1)
2016-09-22	F	07:06	-	07:06	(1)
2016-09-22	F	07:39	-	07:39	(1)
2016-09-22	F	07:58	-	07:58	(1)
2016-09-26	F	07:13	-		
2016-09-27	F		-	04:02	(1250)
2016-09-27	F	14:52	-	14:52	(1)
2016-09-27	F	14:57	-	14:57	(1)
2016-09-27	F	22:17	-	22:18	(2)
2016-09-28	F	01:17	-	01:17	(1)
2016-09-28	F	01:29	-	01:29	(1)
2016-09-28	F	04:11	-	04:11	(1)
2016-09-28	F	04:39	-	04:40	(2)
2016-09-28	F	13:14	-	13:15	(2)
2016-09-28	F	23:15	-	23:15	(1)
2016-09-28	F	23:42	-	23:42	(1)
2016-09-28	F	23:44	-	23:45	(2)
2016-09-29	F	00:08	-	01:24	(77)
2016-09-29	F	05:52	-	05:52	(1)
2016-09-29	F	09:42	-	09:42	(1)
2016-09-29	F	13:04	-	13:04	(1)
2016-09-29	F	14:55	-	14:56	(2)
2016-09-29	F	15:10	-	15:10	(1)
2016-09-29	F	22:54	-		
2016-09-30	F		-	01:14	(141)
2016-09-30	F	17:56	-	17:56	(1)
2016-09-30	F	22:32	-	23:07	(36)
2016-10-01	F	16:51	-	16:51	(1)
2016-10-02	F	11:44	-	11:45	(2)
2016-10-02	F	19:58	-	19:58	(1)
2016-10-02	F	22:36	-		

2016-10-03	F	- 20:33	(1318)
2016-10-04	F	11:26 - 11:26	(1)
2016-10-04	F	11:53 - 11:54	(2)
2016-10-04	F	23:36 - 23:37	(2)
2016-10-05	F	12:04 - 12:05	(2)
2016-10-05	F	15:36 - 15:37	(2)
2016-10-05	F	23:27 - 23:49	(23)
2016-10-06	F	15:57 - 15:58	(2)
2016-10-06	F	16:27 - 16:28	(2)
2016-10-06	F	16:30 - 16:30	(1)
2016-10-07	F	14:45 - 14:45	(1)
2016-10-07	F	15:18 - 15:19	(2)
2016-10-07	F	15:22 - 15:22	(1)
2016-10-15	F	11:43 - 11:47	(5)
2016-10-15	F	17:00 - 17:00	(1)
2016-10-15	F	17:04 - 17:04	(1)
2016-10-15	F	21:44 - 22:24	(41)
2016-10-16	F	18:15 - 18:16	(2)
2016-10-16	F	23:30 - 23:41	(12)
2016-10-17	F	00:44 - 00:45	(2)
2016-10-17	F	00:50 - 00:51	(2)
2016-10-17	F	01:49 - 01:49	(1)
2016-10-17	F	03:18 - 03:18	(1)
2016-10-17	F	03:37 - 03:38	(2)
2016-10-17	F	03:51 - 03:52	(2)
2016-10-17	F	04:49 - 04:51	(3)
2016-10-17	F	05:44 - 06:09	(26)
2016-10-17	F	06:35 - 06:38	(4)
2016-10-17	F	06:42 - 06:42	(1)
2016-10-17	F	08:32 - 08:32	(1)
2016-10-17	F	16:35 - 16:36	(2)
2016-10-17	F	16:39 - 16:39	(1)
2016-10-17	F	21:35 - 21:55	(21)
2016-10-17	F	21:57 - 22:33	(37)
2016-10-17	F	23:33 - 23:41	(9)
2016-10-18	F	02:49 - 03:37	(49)
2016-10-19	F	22:21 -	
2016-10-20	F	- 01:17	(177)
2016-10-22	F	14:32 - 14:32	(1)
2016-10-22	F	14:53 - 14:53	(1)
2016-10-22	F	15:04 - 15:04	(1)
2016-10-22	F	22:00 - 22:33	(34)
2016-10-23	F	07:35 - 07:36	(2)
2016-10-23	F	07:43 - 07:43	(1)
2016-10-23	F	07:55 - 07:55	(1)
2016-10-23	F	12:28 - 12:29	(2)
2016-10-23	F	17:35 - 17:36	(2)
2016-10-23	F	18:19 - 18:20	(2)
2016-10-24	F	07:02 - 07:07	(6)
2016-10-24	F	12:36 - 12:37	(2)
2016-10-25	F	12:04 - 12:04	(1)
2016-10-25	F	13:06 - 13:06	(1)
2016-10-25	F	13:16 - 13:17	(2)
2016-10-25	F	16:50 - 16:50	(1)
2016-10-25	F	18:38 - 18:38	(1)
2016-10-25	F	22:13 - 22:13	(1)
2016-10-26	F	03:16 - 03:16	(1)
2016-10-26	F	04:04 - 04:04	(1)
2016-10-26	F	04:22 - 04:23	(2)
2016-10-26	F	08:15 - 08:15	(1)
2016-10-26	F	08:25 - 08:25	(1)

2016-10-26	F	11:59 - 12:00	(2)
2016-10-26	F	15:47 - 15:47	(1)
2016-10-26	F	16:39 - 16:39	(1)
2016-10-26	F	17:00 - 17:00	(1)
2016-10-28	F	17:26 - 17:52	(27)
2016-10-28	F	18:02 - 18:36	(35)
2016-10-29	F	08:37 - 08:37	(1)
2016-10-30	F	04:38 - 04:38	(1)
2016-10-31	F	12:34 - 12:43	(10)
2016-10-31	F	13:08 - 13:08	(1)
2016-10-31	F	13:18 - 13:18	(1)
2016-10-31	F	13:41 - 13:41	(1)
2016-11-01	F	10:11 - 10:11	(1)
2016-11-01	F	13:08 - 13:08	(1)
2016-11-02	F	12:25 - 12:25	(1)
2016-11-02	F	16:34 - 16:34	(1)
2016-11-02	F	23:16 - 23:16	(1)
2016-11-03	F	13:47 - 13:47	(1)
2016-11-06	F	12:07 - 12:07	(1)
2016-11-10	F	17:09 - 17:09	(1)
2016-11-11	F	16:21 - 16:23	(3)
2016-11-12	F	17:03 - 17:05	(3)
2016-11-13	F	02:36 - 02:36	(1)
2016-11-13	F	07:39 - 07:39	(1)
2016-11-13	F	07:44 - 07:44	(1)
2016-11-13	F	08:03 - 08:03	(1)
2016-11-13	F	12:02 - 12:02	(1)
2016-11-13	F	14:39 - 14:41	(3)
2016-11-13	F	16:20 - 16:21	(2)
2016-11-14	F	01:22 - 01:22	(1)
2016-11-14	F	02:57 - 02:57	(1)
2016-11-14	F	03:39 - 03:39	(1)
2016-11-14	F	04:41 - 04:41	(1)
2016-11-14	F	13:55 - 13:55	(1)
2016-11-14	F	14:09 - 14:09	(1)
2016-11-22	F	13:58 - 13:59	(2)
2016-11-22	F	17:23 - 17:23	(1)
2016-11-24	F	13:27 - 13:28	(2)
2016-11-26	F	05:28 - 06:15	(48)
2016-11-26	F	13:06 - 13:07	(2)
2016-11-28	F	06:07 - 06:29	(23)
2016-11-28	F	23:15 - 23:18	(4)
2016-11-29	F	11:31 - 11:31	(1)
2016-11-30	F	13:39 - 13:40	(2)
2016-12-02	F	13:33 - 13:33	(1)
2016-12-03	F	15:05 - 15:05	(1)
2016-12-06	F	12:22 - 12:22	(1)
2016-12-06	F	12:29 - 12:29	(1)
2016-12-06	F	12:41 - 12:42	(2)
2016-12-08	F	10:01 - 10:01	(1)
2016-12-08	F	13:38 - 13:39	(2)
2016-12-08	F	23:56 - 23:56	(1)
2016-12-09	F	02:07 - 02:07	(1)
2016-12-09	F	06:13 - 06:13	(1)
2016-12-09	F	06:16 - 06:16	(1)
2016-12-09	F	10:42 - 10:43	(2)
2016-12-09	F	18:34 - 18:34	(1)
2016-12-10	F	00:20 - 00:20	(1)
2016-12-10	F	01:24 - 01:24	(1)
2016-12-10	F	03:23 - 03:23	(1)
2016-12-10	F	05:49 - 05:50	(2)

2016-12-10	F	07:17 - 07:17	(1)
2016-12-10	F	07:44 - 07:44	(1)
2016-12-10	F	09:20 - 09:20	(1)
2016-12-10	F	13:20 - 13:20	(1)
2016-12-10	F	15:32 - 15:32	(1)
2016-12-15	F	10:29 - 10:29	(1)
2016-12-15	F	12:42 - 12:42	(1)
2016-12-18	F	13:47 - 13:47	(1)
2016-12-19	F	18:58 - 18:58	(1)
2016-12-20	F	08:29 - 08:29	(1)
2016-12-20	F	09:14 - 09:16	(3)
2016-12-20	F	09:18 - 09:18	(1)
2016-12-21	F	12:48 - 12:48	(1)
2016-12-21	F	12:52 - 12:52	(1)
2016-12-21	F	15:17 - 15:18	(2)
2016-12-21	F	15:34 - 15:35	(2)
2016-12-21	F	15:53 - 15:53	(1)
2016-12-21	F	15:57 - 15:57	(1)
2016-12-21	F	16:04 - 16:04	(1)
2016-12-22	F	00:54 - 00:56	(3)
2016-12-22	F	00:59 - 00:59	(1)
2016-12-22	F	03:22 - 03:23	(2)
2016-12-22	F	09:44 - 09:45	(2)
2016-12-22	F	10:00 - 10:00	(1)
2016-12-22	F	13:44 - 13:44	(1)
2016-12-23	F	03:34 - 03:34	(1)
2016-12-23	F	05:58 - 05:58	(1)
2016-12-23	F	06:02 - 06:02	(1)
2016-12-23	F	06:45 - 06:47	(3)
2016-12-23	F	07:03 - 07:03	(1)
2016-12-23	F	07:06 - 07:07	(2)
2016-12-23	F	07:12 - 07:13	(2)
2016-12-23	F	11:45 - 11:45	(1)
2016-12-23	F	15:51 - 15:52	(2)
2016-12-23	F	16:07 - 16:08	(2)
2016-12-23	F	18:10 - 18:10	(1)
2016-12-24	F	06:18 - 06:18	(1)
2016-12-25	F	06:51 - 06:51	(1)
2016-12-25	F	10:49 - 10:50	(2)
2016-12-25	F	11:33 - 11:33	(1)
2016-12-25	F	14:09 - 14:09	(1)
2016-12-25	F	16:22 - 16:22	(1)
2016-12-26	F	00:15 - 00:15	(1)
2016-12-26	F	01:56 - 01:56	(1)
2016-12-26	F	03:17 - 03:17	(1)
2016-12-26	F	04:47 - 04:48	(2)
2016-12-26	F	05:01 - 05:01	(1)
2016-12-26	F	05:03 - 05:03	(1)
2016-12-26	F	05:40 - 05:40	(1)
2016-12-26	F	05:46 - 05:46	(1)
2016-12-26	F	07:27 - 07:28	(2)
2016-12-26	F	11:17 - 11:17	(1)
2016-12-26	F	11:19 - 11:19	(1)
2016-12-26	F	11:21 - 11:21	(1)
2016-12-26	F	12:58 - 12:58	(1)
2016-12-26	F	17:59 - 17:59	(1)
2016-12-27	F	07:03 - 07:03	(1)
2016-12-27	F	10:32 - 10:32	(1)
2016-12-27	F	10:41 - 10:41	(1)
2016-12-27	F	13:12 - 13:12	(1)
2016-12-29	F	14:01 - 14:01	(1)

```
2016-12-29    F      14:25 - 14:25      (1)
2016-12-31    F      10:04 - 10:04      (1)
2016-12-31    F      10:16 - 10:17      (2)
2016-12-31    F      13:34 - 13:34      (1)
2016-12-31    F      15:15 - 15:16      (2)

Total: 47411 (32.9 days)
```

7.6.2 Baseline values

7.6.2.1 2013

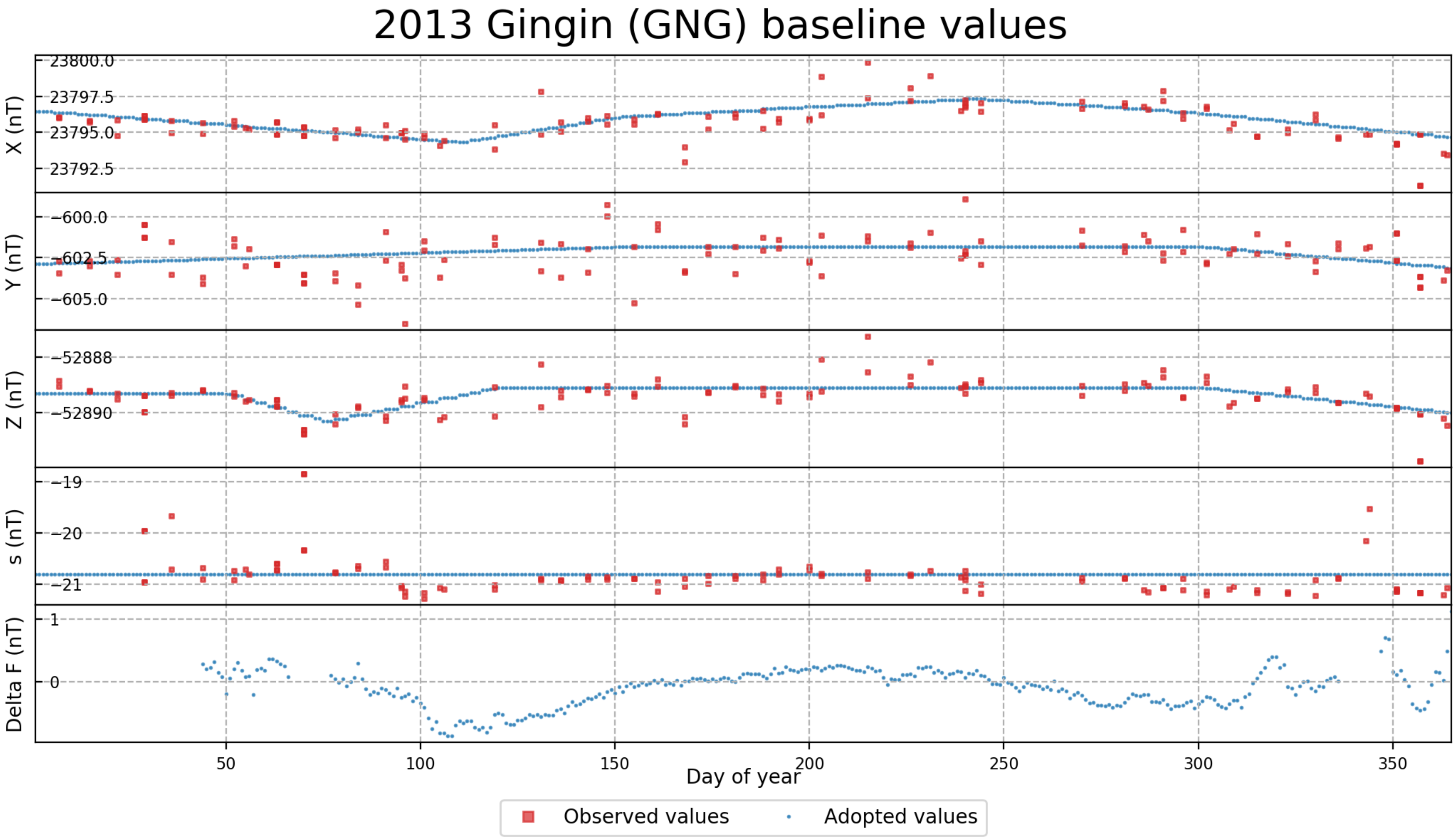

Figure 7.31 Gingin (GNG) baseline values for 2013. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.6.2.2 2014

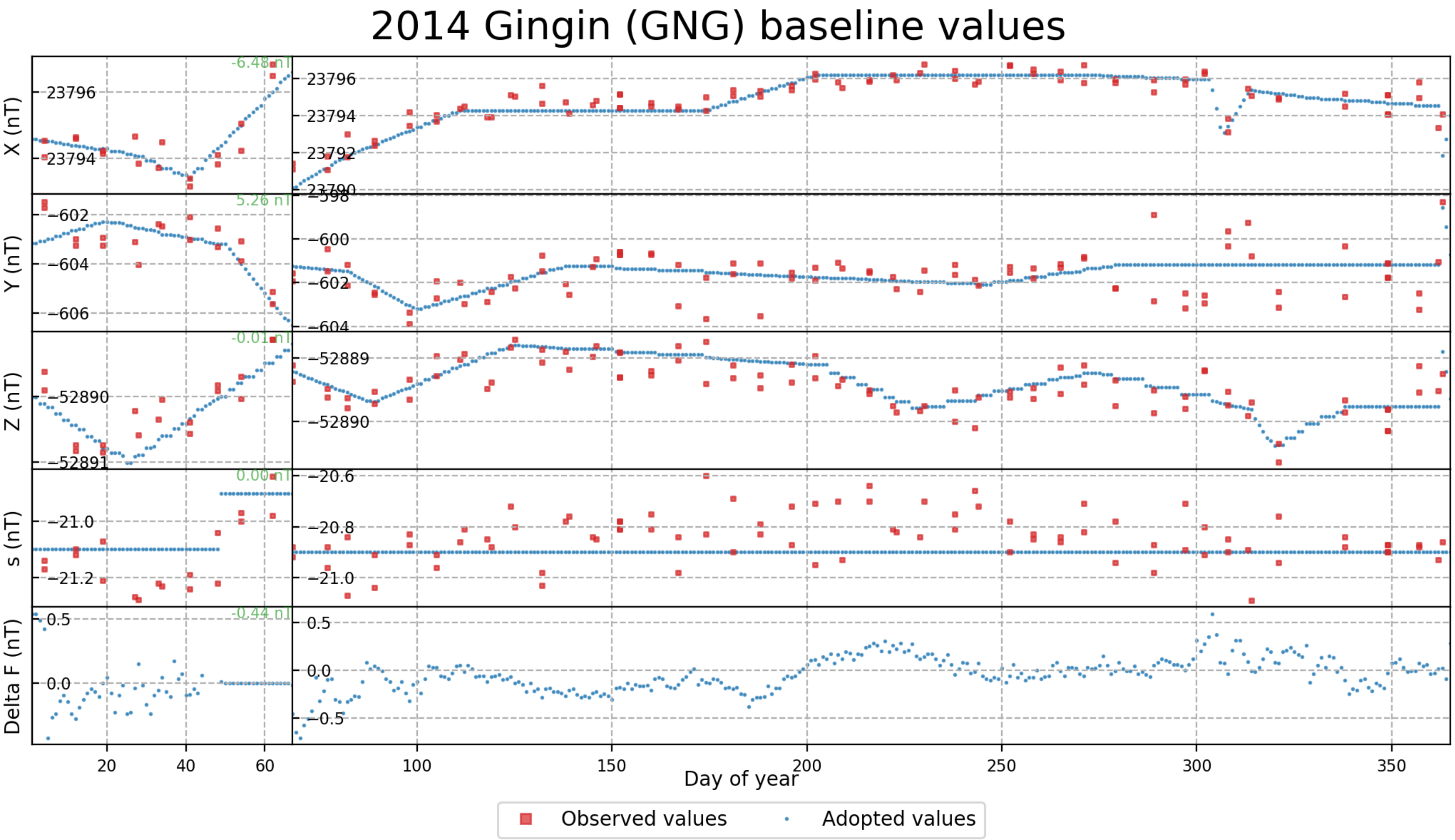

Figure 7.32 Gingin (GNG) baseline values for 2014. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.6.2.3 2015

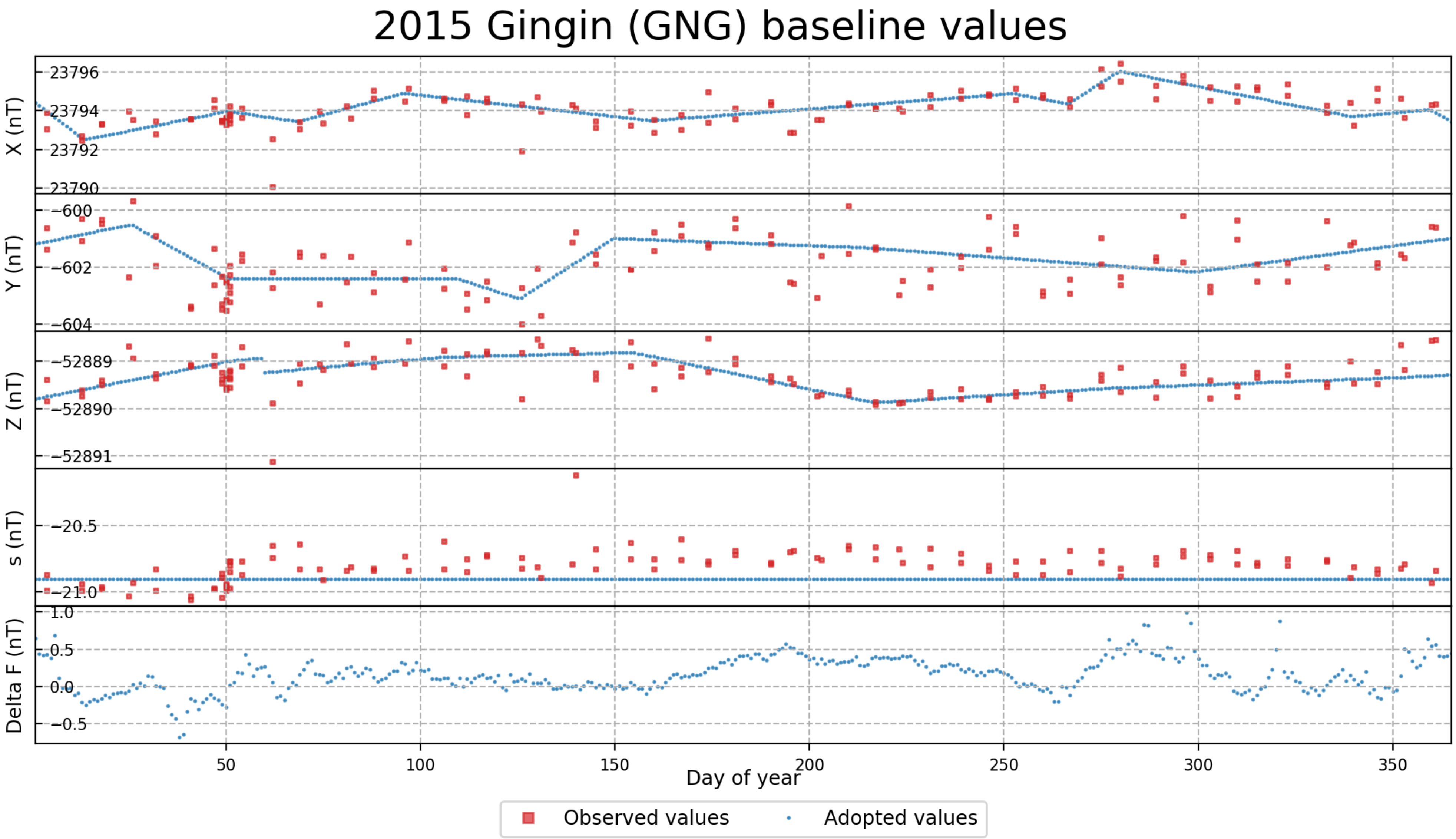

Figure 7.33 Gingin (GNG) baseline values for 2015. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.6.2.4 2016

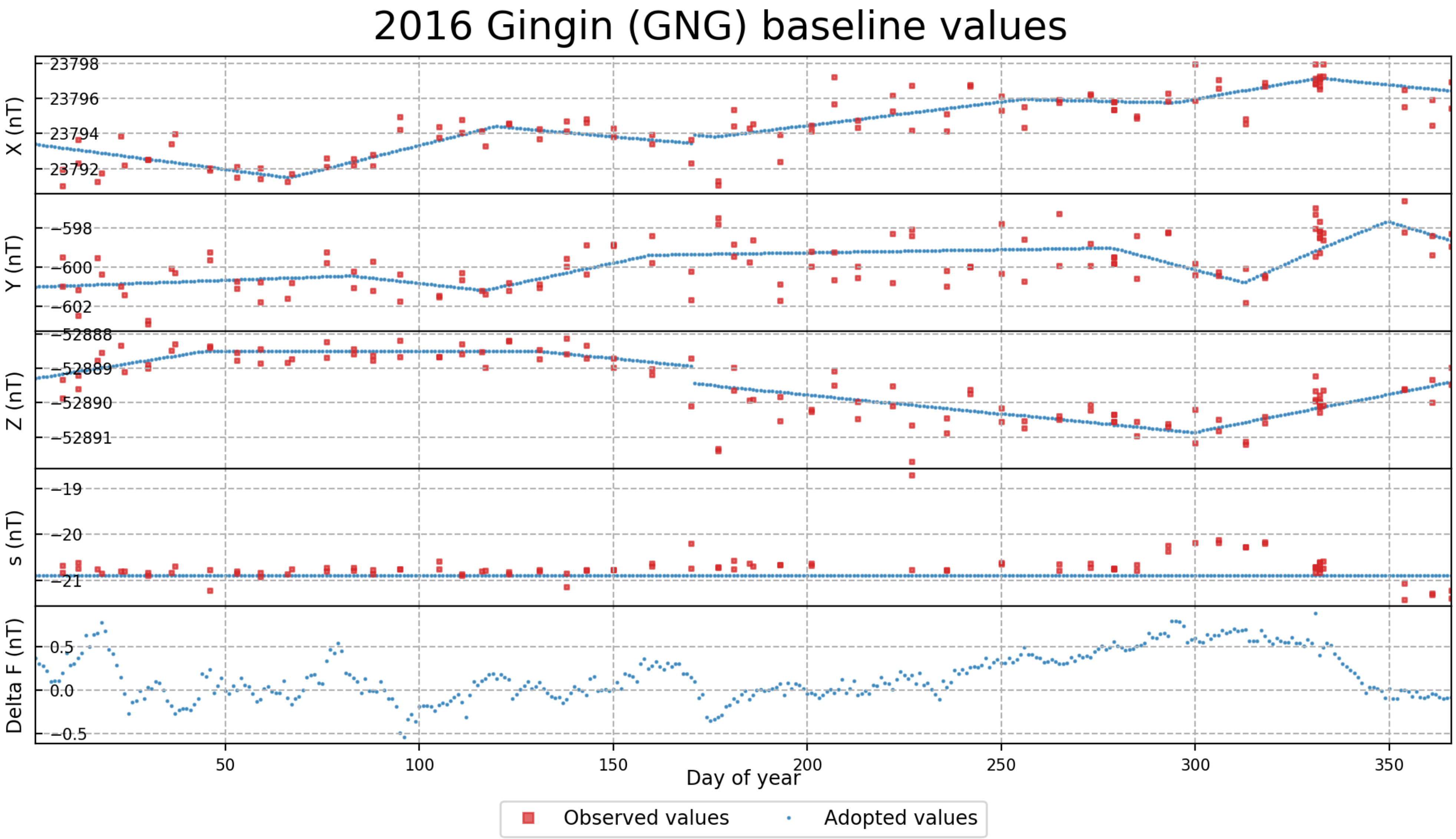

Figure 7.34 Gingin (GNG) baseline values for 2016. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.6.3 Annual mean values

7.6.3.1 DIH

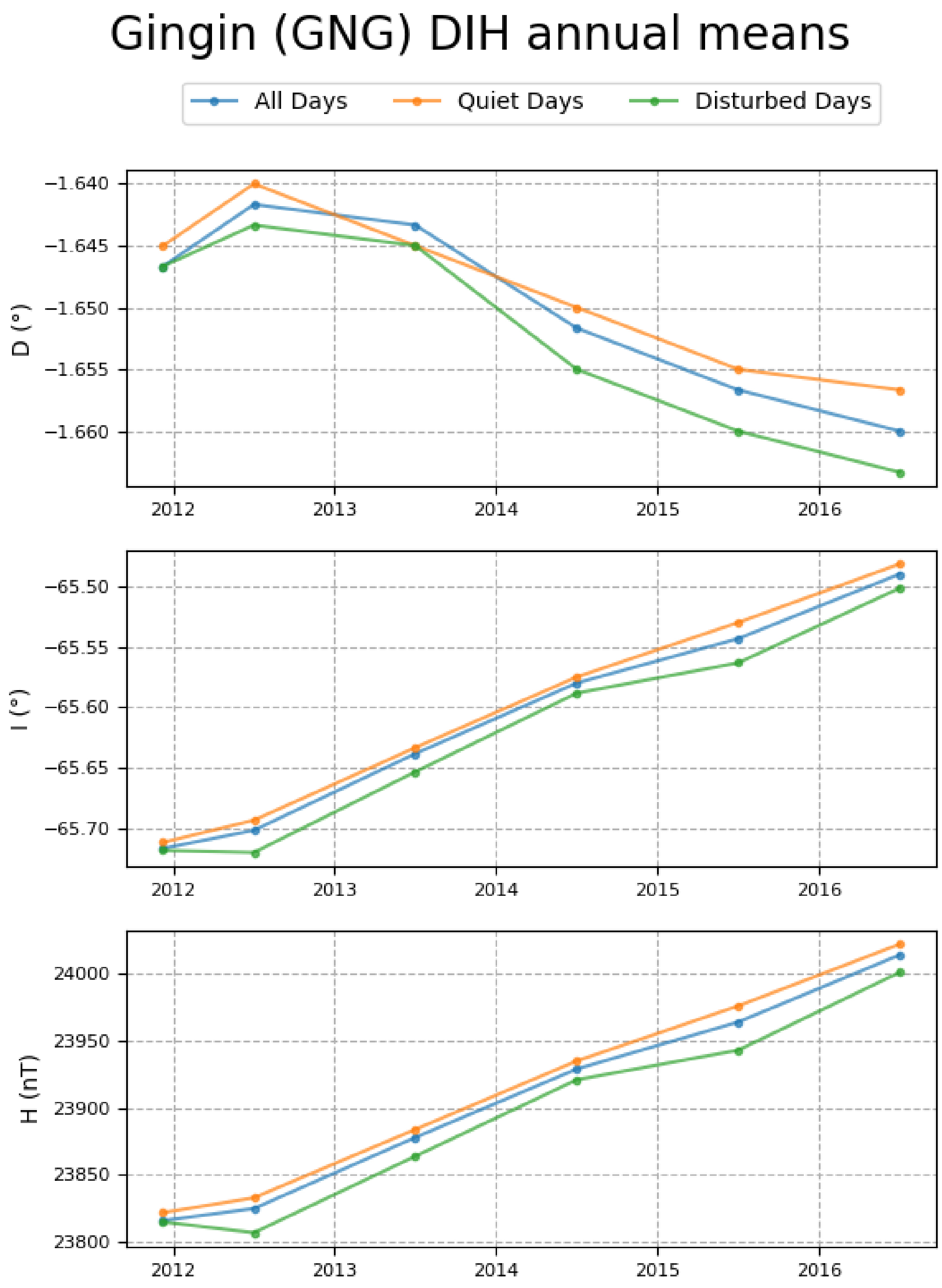

Figure 7.35 Gingin (GNG) annual mean values in DIH until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.6.3.2 XYZF

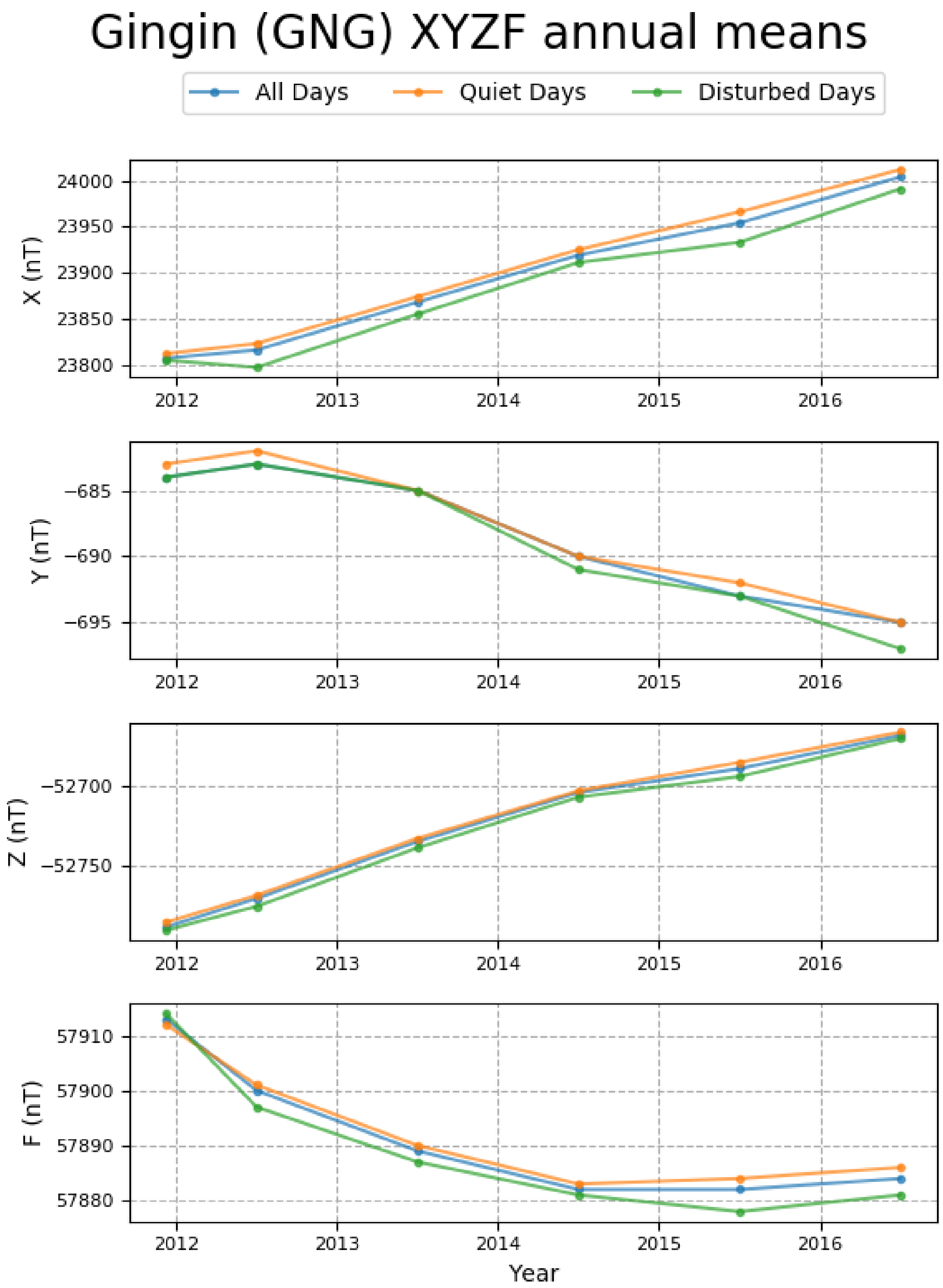

Figure 7.36 Gingin (GNG) annual mean values in XYZF until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.6.3.3 2016 INTERMAGNET annual mean values file

```
                     ANNUAL MEAN VALUES

                     Gingin, GNG, AUSTRALIA


 COLATITUDE: 121.356   LONGITUDE: 115.715 E   ELEVATION:050 metres

   YEAR      D         I          H       X       Y      Z       F   * ELE Note
          Deg Min  Deg Min       nT      nT      nT     nT      nT
 2011.937  -1 38.8 -65 43.0  23816  23807   -684 -52789  57913 A ABZ  1,2
 2012.500  -1 38.5 -65 42.1  23825  23816   -683 -52771  57900 A ABZ    2
 2013.500  -1 38.6 -65 38.3  23878  23868   -685 -52735  57889 A ABZ
 2014.500  -1 39.1 -65 34.8  23929  23919   -690 -52704  57882 A ABZ
 2015.500  -1 39.4 -65 32.6  23964  23954   -693 -52689  57882 A ABZ
 2016.500  -1 39.6 -65 29.4  24014  24004   -695 -52668  57884 A ABZ

 2011.937  -1 38.7 -65 42.7  23822  23812   -683 -52786  57912 Q ABZ  1,2
 2012.500  -1 38.4 -65 41.6  23833  23823   -682 -52769  57901 Q ABZ    2
 2013.500  -1 38.7 -65 38.0  23884  23874   -685 -52733  57890 Q ABZ
 2014.500  -1 39.0 -65 34.5  23935  23925   -690 -52703  57883 Q ABZ
 2015.500  -1 39.3 -65 31.8  23976  23966   -692 -52685  57884 Q ABZ
 2016.500  -1 39.4 -65 28.9  24022  24012   -695 -52666  57886 Q ABZ

 2011.937  -1 38.8 -65 43.1  23815  23805   -684 -52791  57914 D ABZ  1,2
 2012.500  -1 38.6 -65 43.2  23807  23797   -683 -52776  57897 D ABZ    2
 2013.500  -1 38.7 -65 39.2  23864  23855   -685 -52739  57887 D ABZ
 2014.500  -1 39.3 -65 35.3  23921  23911   -691 -52707  57881 D ABZ
 2015.500  -1 39.6 -65 33.8  23943  23933   -693 -52694  57878 D ABZ
 2016.500  -1 39.8 -65 30.1  24001  23991   -697 -52670  57881 D ABZ

* A = All days
* Q = 5 International Quiet days each month
* D = 5 International Disturbed days each month

ELE = Elements recorded

Notes:
 1. Calibrated time-series data commenced on 2011-11-16T00:00UT

 2. The elements recorded were magnetic NW, NE  and vertical
    (DMI instrument), from which the standard magnetic elements
    were derived. The NW, NE & Vertical components recorded are
    denoted A, B and Z respectively.
```

7.6.4 K indices

7.6.4.1 2013

Table 6 Gingin (GNG) K index values for 2013. For each cell, 3-hourly K indices are given then the daily K sum (after the whitespace character). Dashes ('-') indicate that insufficient data were available to compute either the K indices or K sum. K indices enclosed in parentheses indicate that the K index was computed with missing data.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	10000000 01	20112323 14	33355654 34	12231212 14	22345463 29	54644323 31	12220010 08	11111211 09	21113331 15	11212212 12	21113121 12	33224202 18
02	00211211 08	33333332 23	32312443 22	10000132 07	22112231 14	33344344 28	11110110 06	10000110 03	12324222 18	66532444 34	10011202 07	20000001 03
03	21001101 06	10122212 11	22221232 16	10001110 04	11111220 09	22211233 16	11000201 05	00001111 04	20212223 14	41000121 09	12111022 10	21213232 16
04	10000012 04	11211321 12	31021111 10	11012110 07	10111122 09	32221122 15	11000111 05	11222434 19	20222121 12	10000001 02	11121312 12	21101221 10
05	21110000 05	22102011 09	10001221 07	(0)1000111 04	11212210 10	31212121 13	12122222 14	43343232 24	00000010 01	00000001 01	20111202 09	10022111 08
06	10012232 11	11100112 07	11001011 05	21111121 10	21222122 14	13333534 25	23434333 25	22212013 13	21112132 13	00000001 01	21111213 12	21110211 09
07	21011013 09	22232222 17	12221101 10	21123210 12	23222321 17	33543221 23	21101100 06	21101010 06	01100001 03	21111210 09	22344232 22	21101223 12
08	21131222 14	22323312 18	00111122 08	11100100 04	22111311 12	22321001 11	11101111 07	00000001 01	22212110 11	10013256 18	22110101 08	55422442 28
09	31110012 09	21110021 08	21023221 13	11110001 05	11111000 05	11213331 15	01111333 13	12232131 15	11100010 04	54444423 30	33464313 27	10013312 11
10	10101111 06	21120322 13	21010212 09	11221013 11	11102011 07	23322220 16	43345344 30	21222001 10	00023332 13	32122212 15	33233334 24	22112211 12
11	11121023 11	21101222 11	22201101 09	11211112 10	01010101 04	00113221 10	23543452 28	11121112 10	21112232 14	21122211 12	32334432 24	11112111 09
12	31011121 10	20022222 12	21212322 15	21201111 09	11110011 06	11100010 04	11212223 14	00010132 07	10111123 10	01011123 09	21011001 06	11010011 05
13	21123333 18	32121245 20	21110010 06	22110012 09	21210210 09	11000000 02	33211233 18	21222433 19	21112442 17	20001110 05	01003001 05	00113212 10
14	42233222 20	32432221 19	11012112 09	23332222 19	30133322 17	10010020 04	22254454 28	22202123 14	31212111 12	01335433 22	00111112 07	44323353 27
15	32112122 14	10011232 10	13311012 12	11100032 08	31223211 15	21201101 08	32444232 24	33342424 25	10000012 04	33142123 19	21212433 18	21213411 15
16	21121233 15	21013432 16	23222212 16	20000222 08	34223333 23	10000010 02	01111121 08	34225432 25	21111211 10	21123232 16	32323222 19	22211212 13
17	43224532 25	21224342 20	21565564 34	01001100 03	22223441 20	10100011 04	01101112 07	22213212 15	21202232 14	21233321 17	22221112 13	21000131 08
18	32334333 24	11111113 10	32321111 14	10000010 02	34333242 24	11102210 08	10115552 20	21220222 13	11012322 12	11000020 04	22110112 10	12100212 09
19	41112323 17	21223222 16	22201112 11	00000000 00	32223323 20	10000022 05	22444332 24	10101210 06	32443332 24	00000100 01	21012222 12	21101233 13
20	32333111 17	21243322 19	22223334 21	00112000 04	22002231 12	22222343 20	21110110 07	10000002 03	20222003 11	01000102 04	21213010 10	33110111 11
21	21000212 08	32211233 17	44311012 16	01000100 02	01111022 08	22223233 19	11112222 12	33233333 23	11233332 18	00000201 03	11001011 05	22221112 13
22	01000001 02	23224334 23	11121132 12	20101110 06	32223332 20	33342133 22	10001113 07	33322235 23	21202111 10	00221122 10	10010011 04	11120101 07
23	11100001 04	21122242 16	21134343 21	02111223 12	21121221 12	34331434 25	11001021 06	32333332 22	21100121 08	21110101 07	23333222 20	21111011 08
24	10000001 02	10111221 09	21122210 11	33344343 27	22234244 23	33334543 28	01102011 06	21223211 14	21145312 19	11110000 04	10000001 02	11100202 07
25	01010323 10	00101112 06	10111111 07	22122331 16	33244455 30	32110212 12	11111344 16	01132222 13	21210002 08	11200002 06	11000000 02	32233321 19
26	43434445 31	21213231 15	21000000 03	23244542 26	33322432 22	00000121 04	33314232 21	21111212 11	00000010 01	10100103 06	00000111 03	21222101 11
27	21102211 10	11212101 09	23334654 30	22212322 16	22233232 19	00003232 10	22223431 19	12123453 21	00000101 02	01111121 08	21111201 09	10100021 05
28	11102222 11	21212124 15	31131321 15	10113232 13	23222210 14	33223445 26	11211222 12	31232211 15	00000000 00	22110000 06	10001101 04	11102113 10
29	11012200 07		32444433 27	21012012 09	00000000 00	43475354 35	11012110 07	10001100 03	10000011 03	10133122 13	12222342 18	32221311 15
30	11010111 06		33222132 18	21122113 13	00000010 01	22223321 17	01112121 09	00122335 16	22200000 06	21244334 23	20222223 15	10111101 06
31	00110112 06		20000222 08		00002334 12		10001231 08	42333112 19		20023322 14		31212122 14

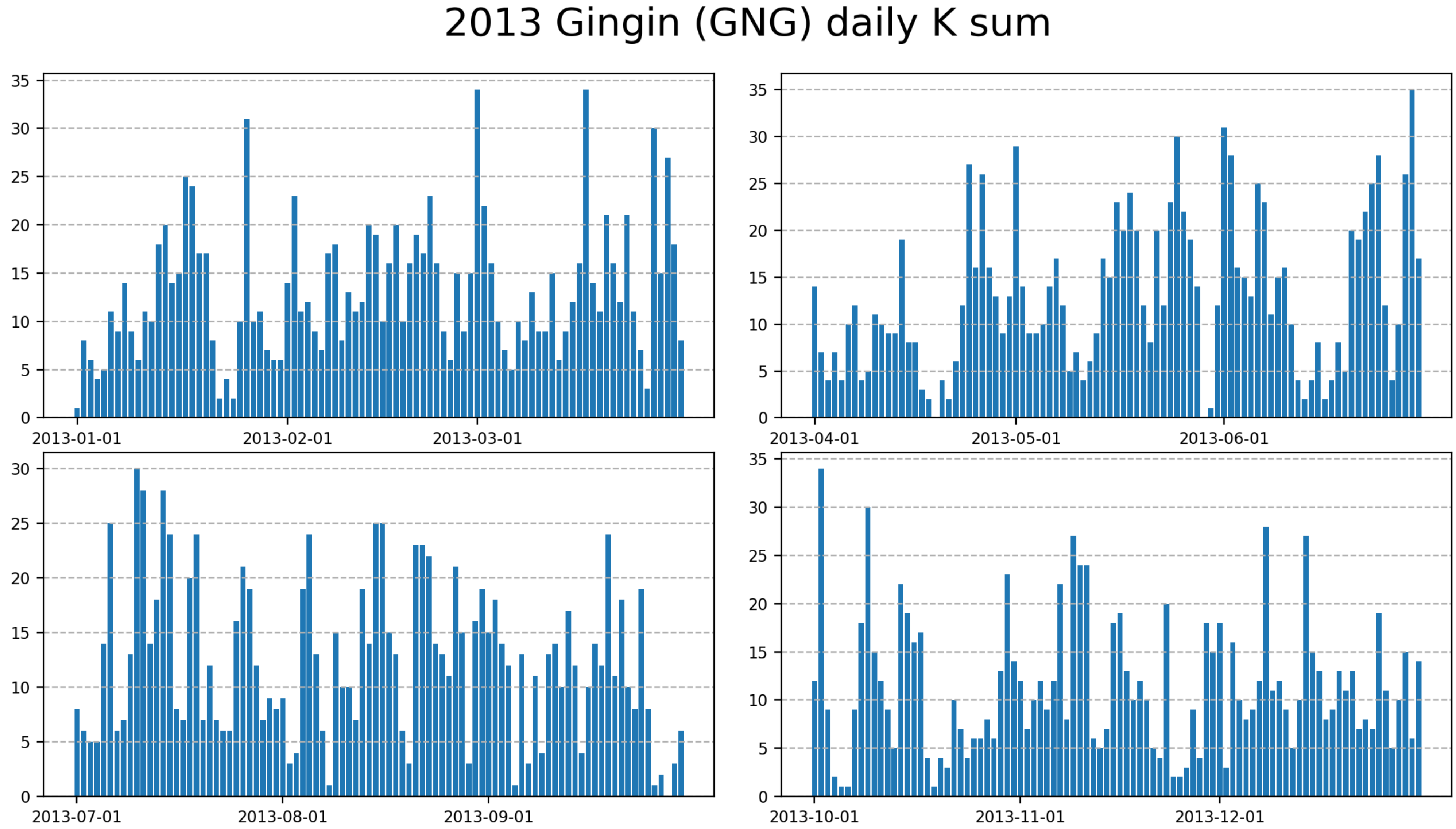

Figure 7.37 2013 Gingin (GNG) daily K sum.

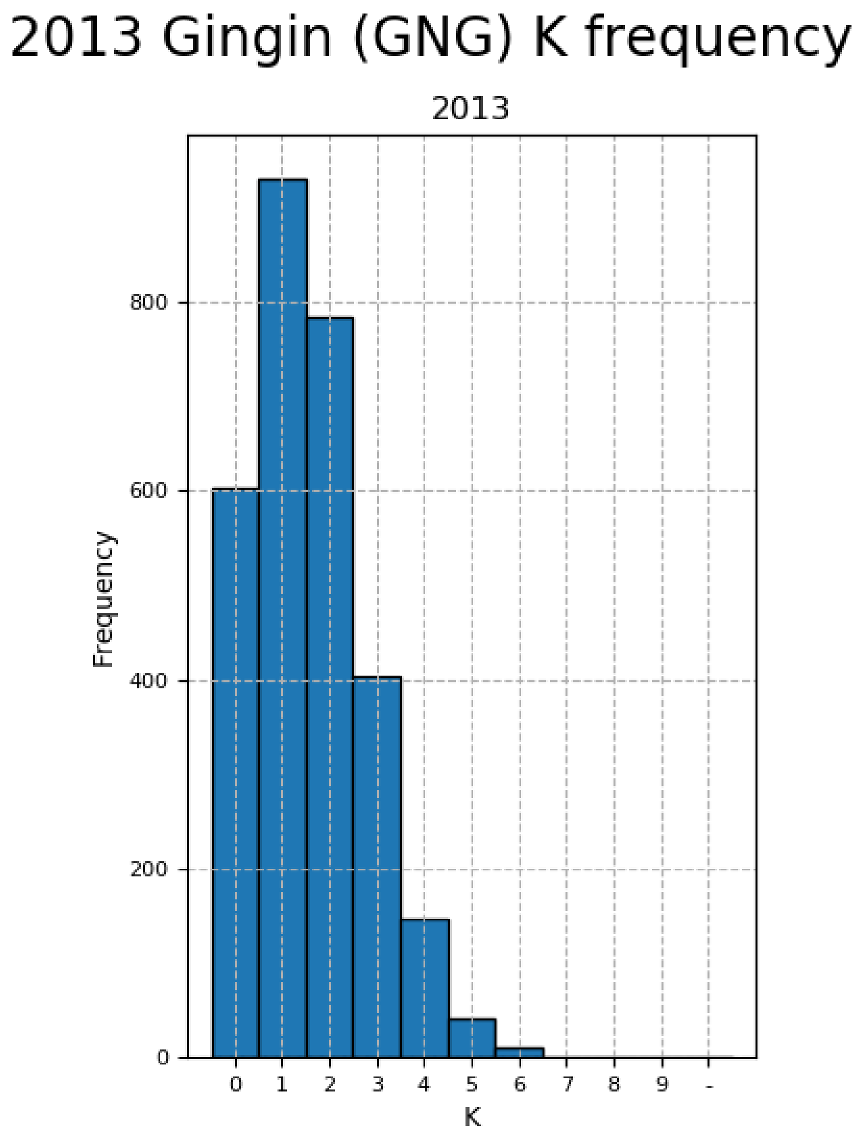

Figure 7.38 2013 Gingin (GNG) 3-hourly K index frequency plots.

7.6.4.2 2014

Table 7 Gingin (GNG) K index values for 2014. For each cell, 3-hourly K indices are given then the daily K sum (after the equals sign). Dashes ('-') indicate that insufficient data were available to compute either the K indices or K sum. K indices enclosed in parentheses indicate that the K index was computed with missing data.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	21224344 22	10101223 10	21132123 15	11101212 09	22211011 10	10120100 05	10000000 01	21122223 15	22233232 19	21232331 17	21322222 16	23222234 20
02	32323342 22	32311112 14	31110000 06	10000322 08	10000000 01	10100011 04	01102000 04	22233422 20	22223233 19	12221322 15	21123332 17	33213332 20
03	22232322 18	33212312 17	11022101 08	21112212 12	00000143 08	21110111 08	22232100 12	11010132 09	21221122 13	11101311 09	30111013 10	21132243 18
04	21132222 15	22111112 11	21013212 12	11212311 12	22422221 17	11111212 10	11111001 06	22332232 19	21222101 11	11221012 10	22345555 31	31113333 18
05	32102101 10	21212113 13	21112232 14	11134333 19	22222342 19	01221023 11	00000002 02	22213342 19	12222222 15	22211212 13	43334223 24	22134212 17
06	11101111 07	32123212 16	20213232 15	30000002 05	01110000 03	21000122 08	10021001 05	21222322 16	12322333 19	21001012 07	22213114 16	12233345 23
07	11011332 12	10112334 15	10101112 07	11313532 19	00012112 07	21211333 16	11012111 08	11112131 11	21300000 06	31001012 08	22232323 19	42345443 29
08	22012123 13	53434253 29	20101101 06	10013210 08	23253433 25	34544331 27	11111132 11	32231000 11	01110122 08	22233333 21	23213212 16	32234334 24
09	32222143 19	32213252 20	10100011 04	00222321 12	21210001 07	12221121 12	21121122 12	10100110 04	22111232 14	33223222 19	31211233 16	31244332 22
10	22121212 13	32112242 17	11121011 08	10000110 03	21110122 10	11222211 12	22112211 12	10112231 11	20000233 10	11100212 08	33444532 28	32332122 18
11	00101132 08	22211123 14	11011111 07	12221323 16	33231232 19	21222321 15	11111121 09	10001313 09	33232114 19	21233211 15	32222124 18	11101122 09
12	21222234 18	42112221 15	21111223 13	42344334 27	12222121 13	11100000 03	12222211 13	31112353 19	43232546 29	01123121 11	23111122 13	32334334 25
13	33321104 17	21220002 09	43312222 19	42232252 22	01101001 04	11001111 06	11020011 06	12123021 12	42412222 19	11202322 13	21122123 14	22223222 17
14	42323233 22	11212101 09	22212102 12	11210032 10	20001112 07	22111121 11	10213321 13	00011021 05	11000000 02	11124545 23	33313333 22	22123342 19
15	21011211 09	32013335 20	21110012 08	11112121 10	11100121 07	21210001 07	21222321 15	10012111 07	01110001 04	42322312 19	32234234 23	33234323 23
16	12001001 05	54434443 31	10100000 02	00122011 07	21102110 08	12112211 11	11101011 06	10000010 02	22221132 15	21022213 13	33333422 23	22124223 18
17	00001112 05	21001122 09	10000102 04	32212332 18	01110101 05	22311113 14	11100121 07	10123202 11	21001223 11	12112224 15	11123442 18	22221312 15
18	10000110 03	11223333 18	11112221 11	32111123 14	21100211 08	22222335 21	10000000 01	11301121 10	32111132 14	33234423 24	32124312 18	32212223 17
19	20001210 06	34345323 27	21211121 11	33323442 24	11211111 09	33322233 21	00010000 01	10221246 18	42324432 24	32223133 19	20213232 15	32222332 19
20	00112211 08	15445433 29	21121121 11	32133443 23	01011100 04	22332312 18	00101000 02	21211012 10	32113212 15	32344444 28	21232342 19	32213213 17
21	32223322 19	21123322 16	32232322 19	43443411 24	10000011 03	12210001 07	11012221 10	22233222 18	13111112 11	32324333 23	22243343 23	22323344 23
22	22233212 17	32222323 19	21112112 11	11110212 09	11101323 12	11101022 08	20002111 07	11001001 04	21233322 18	32233422 21	22122233 17	54222322 22
23	31211121 12	22333444 25	32211122 14	11122322 14	32201555 23	00000002 02	10000132 07	10100111 05	21133332 18	21123342 18	22233333 21	22253235 24
24	21001112 08	22112321 14	20101121 08	22232232 18	12102210 09	21100010 05	02122111 10	00000000 00	32234534 26	31123433 20	22122321 15	52123332 21
25	21101223 12	40002202 10	10021134 12	32023432 19	11000310 06	01111322 11	22120001 08	00001000 01	42333233 23	31213323 18	11112222 12	21114334 19
26	21210221 11	20000001 03	42320032 16	11122121 11	11110000 04	00012110 05	12231121 13	00001012 04	33234433 25	21223332 18	22223101 13	42222254 23
27	11001212 08	11112455 20	21233221 16	10001102 05	00100021 04	00000021 03	12110001 06	12343443 24	33333322 22	21232323 18	23212222 16	32222112 15
28	11101223 11	32331212 17	21223133 17	21021101 08	11000011 04	11123221 13	12221421 15	23333432 23	22123332 18	31123333 19	21223223 17	21122343 18
29	32312312 17		21121004 11	10001012 05	00033221 11	21101022 09	11000110 04	22343234 23	21233243 20	21111331 13	22322232 18	22235635 28
30	11200011 06		20110021 07	22334251 22	02112441 15	32100000 06	11000000 02	22154232 21	32233322 20	10122123 12	23231343 21	33324333 24
31	21011001 06		11113320 12		11000000 02		01111222 10	21242344 22		11222222 14		21223512 18

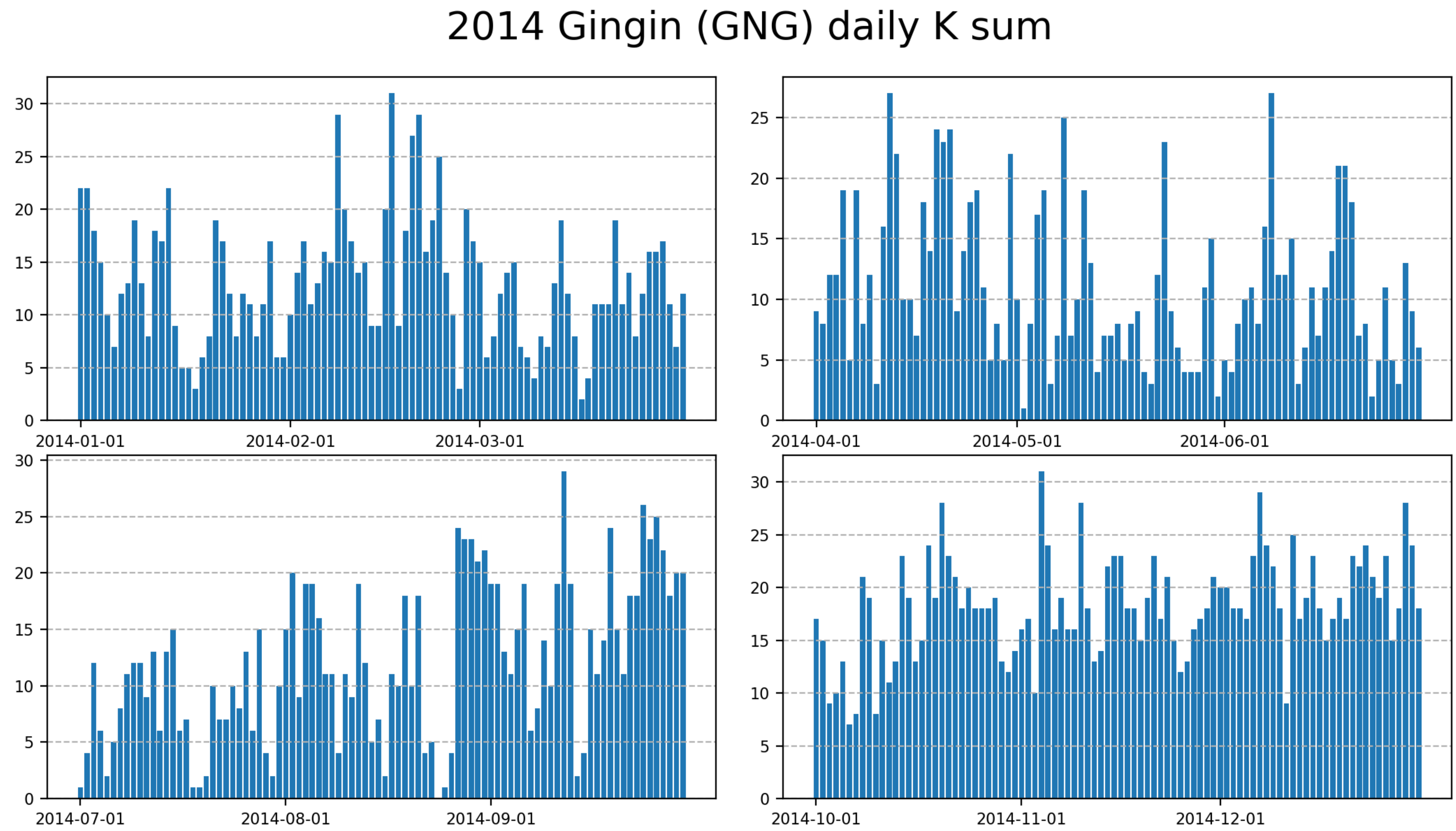

Figure 7.39 2014 Gingin (GNG) daily K sum.

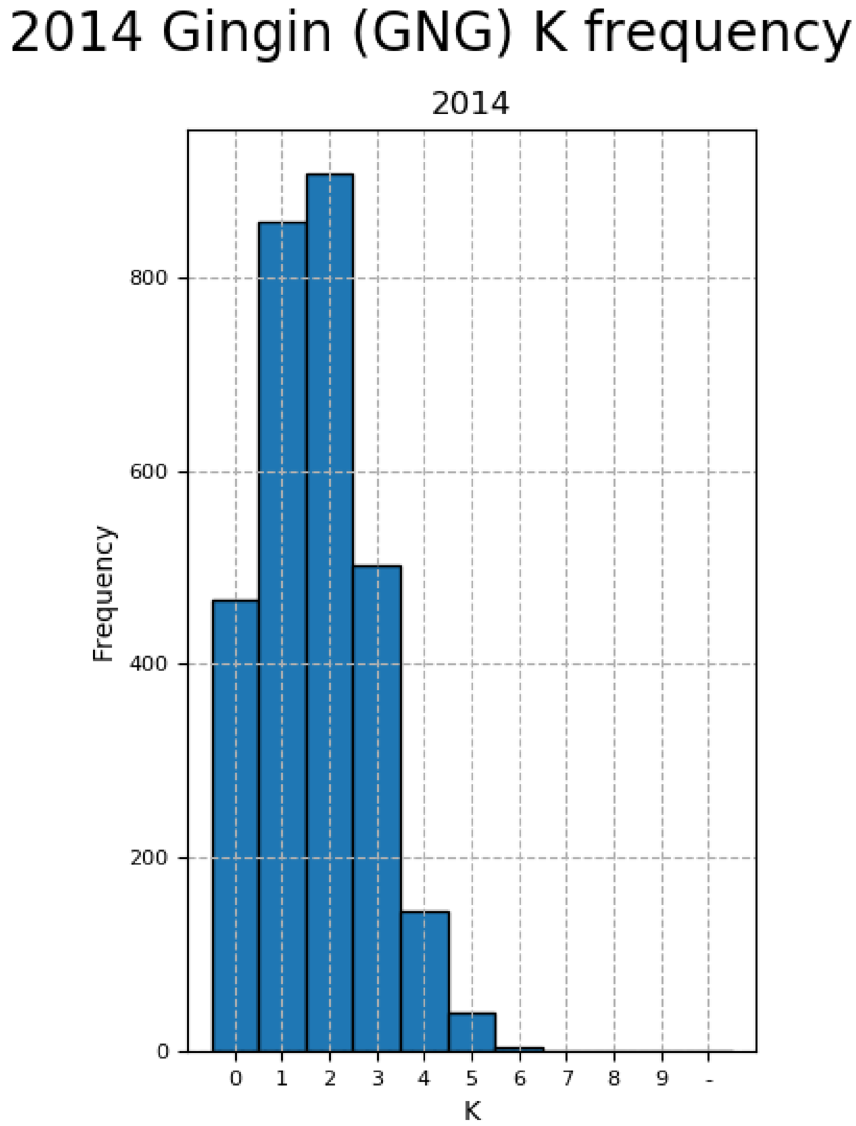

Figure 7.40 2014 Gingin (GNG) 3-hourly K index frequency plots.

7.6.4.3 2015

Table 8 Gingin (GNG) K index values for 2015. For each cell, 3-hourly K indices are given then the daily K sum (after the whitespace character). Dashes ('-') indicate that insufficient data were available to compute either the K indices or K sum. K indices enclosed in parentheses indicate that the K index was computed with missing data.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	21112222 13	32332444 25	53332323 24	32221222 16	22200112 10	21120020 08	11112110 08	22111331 14	21122012 11	21113443 19	12224111 14	31124533 22
02	21233234 20	54343443 30	33454432 28	12323243 20	23211233 17	00000000 00	01100000 02	31214321 17	21111332 14	33333332 23	10014402 12	21213212 14
03	43332121 19	33234433 25	42133233 21	31223323 19	22321211 14	01110000 03	00000000 00	12113211 12	12111223 13	23222322 18	33545452 31	21011112 09
04	11233545 24	11124312 15	11133012 12	22213422 18	21213321 15	00000100 01	10013254 16	12113232 15	33343332 24	32323324 22	34455222 27	11111101 07
05	43323234 24	12234434 23	21113312 14	22101222 12	10132111 10	00000000 00	44333332 25	11000221 07	12333432 21	22354322 23	21344423 23	21233432 20
06	32332443 24	21211111 10	22322233 19	21201111 09	33434542 28	12111100 07	33322131 18	22243333 22	22233253 22	21124544 23	30113354 20	23244443 26
07	32664333 30	22342223 20	32224443 24	22001010 06	22101211 10	01111123 10	21110112 09	12335411 20	22235566 31	34345565 35	54555442 34	33334433 26
08	33323323 22	33322233 21	32234321 20	10000221 06	32222111 14	34545533 32	10111321 10	22334222 20	43313223 21	45445553 35	22134344 23	31234222 19
09	32323212 18	21104221 13	31000111 07	32222233 19	11031222 12	33213332 20	12212122 13	12242332 19	33565455 36	32154443 26	32332445 26	22123332 18
10	22232312 17	11102222 11	22101012 09	54434322 27	11242232 17	23333332 22	11100123 09	22223221 16	21213453 21	32312412 18	43455533 32	34333443 27
11	33332222 20	22012102 10	23313331 19	23444422 25	22134323 20	22223321 17	34333333 25	32222122 16	34666733 38	21113342 17	42334431 24	32344442 26
12	22223322 18	21112212 12	22233311 17	10101130 07	11334343 22	12112221 12	23223332 20	12212323 16	33443312 23	12253544 26	11221211 11	23322312 18
13	22223322 18	10012111 07	21113111 11	21211220 11	45535454 35	21223222 16	23455543 31	23333221 19	11143431 18	22342544 26	10124433 18	11132112 12
14	21124221 15	11000103 06	12101113 10	10223442 18	23212113 15	53242222 22	31111111 10	01121112 09	11232532 19	33344442 27	32133112 16	11124556 25
15	21124202 14	22123222 16	22212332 17	32245453 28	22242222 18	22345232 23	12112122 12	21466443 30	22255333 25	21122222 14	21122223 15	42224423 23
16	22222122 15	12122134 16	33432322 22	33354455 32	11113121 11	32221222 16	23231221 16	53544444 33	22223323 19	22213212 15	32334322 22	32100012 09
17	22111012 10	43332335 26	34577767 46	43333332 24	11100120 06	22333311 18	12011110 07	23455542 30	32331103 16	11134342 19	20222332 16	11012342 14
18	22012202 11	43224333 24	53456654 38	22222443 21	12223134 18	21112210 10	00011121 06	22211312 14	22343233 22	33463332 27	22132445 23	21011112 09
19	21011122 10	22211332 16	32355333 27	31212232 16	33321222 18	21110000 05	00100000 01	32224432 22	22332013 16	01111022 08	32231122 16	11112444 18
20	21100001 05	11222112 12	42443344 28	22212233 17	22213110 12	00000000 00	00022100 05	22224323 20	34555533 33	21123352 19	22331102 14	45445575 39
21	22223433 21	22022212 13	32223212 17	33444323 26	00100101 03	00101322 09	21222122 14	11212122 12	32122212 15	11235322 19	31111113 12	54344323 28
22	43223233 22	21012221 11	22543211 20	21223222 16	11001000 03	12333474 27	12122322 15	10123332 15	22413222 18	20101332 12	12201111 09	22452233 23
23	32221322 17	32333433 24	33344424 27	13210011 09	00110010 03	55454233 31	32432332 22	23444332 25	12233332 19	21112322 14	10002001 04	22223343 21
24	11013322 13	43332213 21	22124432 20	21011010 06	11000010 03	32333221 19	22113222 15	11222120 11	32211222 15	32111142 15	10000101 03	32223123 18
25	21111223 13	11333322 18	22234332 21	00000000 00	00000000 00	23455533 30	12121123 13	11122342 16	22134102 15	31213212 15	10000000 01	22223222 17
26	33343433 26	20112022 10	21212233 16	10000000 01	12211221 12	21220101 09	31121221 13	22345544 29	21010331 11	10100001 03	00001121 05	32224334 23
27	32222333 20	10001212 07	22224311 17	10112221 10	00113312 11	22211001 09	12243222 18	33434545 31	12100021 07	00013012 07	21121222 13	21234222 18
28	32222212 16	21222443 20	01222224 15	11122110 09	21122111 11	23323232 20	12123232 16	52234554 30	20001122 08	10000110 03	11112133 13	32233202 17
29	21023343 18		43223233 22	00021112 07	02111212 10	11211100 07	11122020 09	42231321 18	21100001 05	10012012 07	12233233 19	10013322 12
30	32211352 19		22000022 08	11200020 06	11101111 07	12100222 10	11113233 15	11100121 07	11010011 05	11014323 15	22542223 22	10102212 09
31	22112333 17		00222323 14		01101211 07		22124324 20	11110221 09		11112213 12		43346445 33

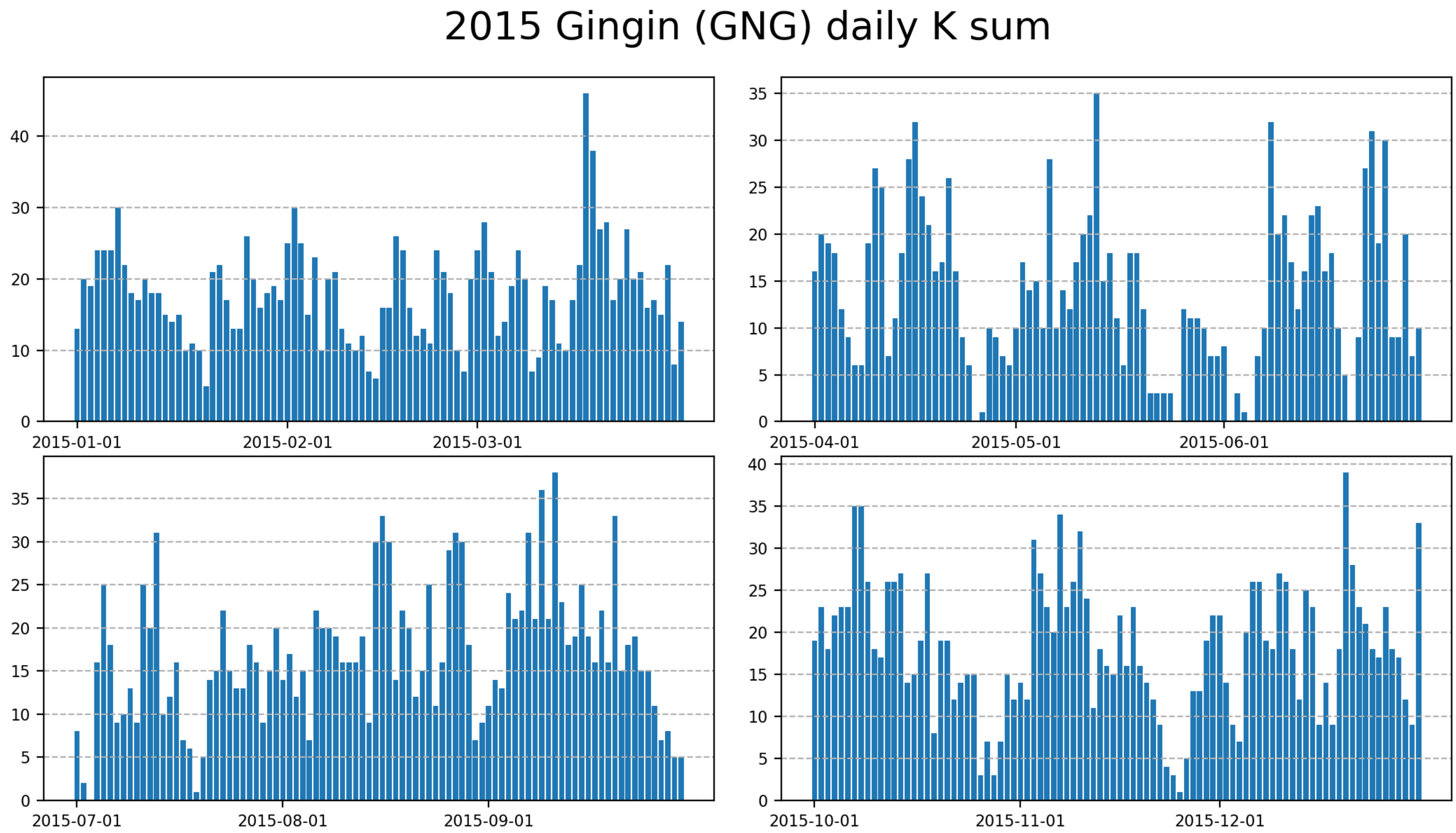

Figure 7.41 2015 Gingin (GNG) daily K sum.

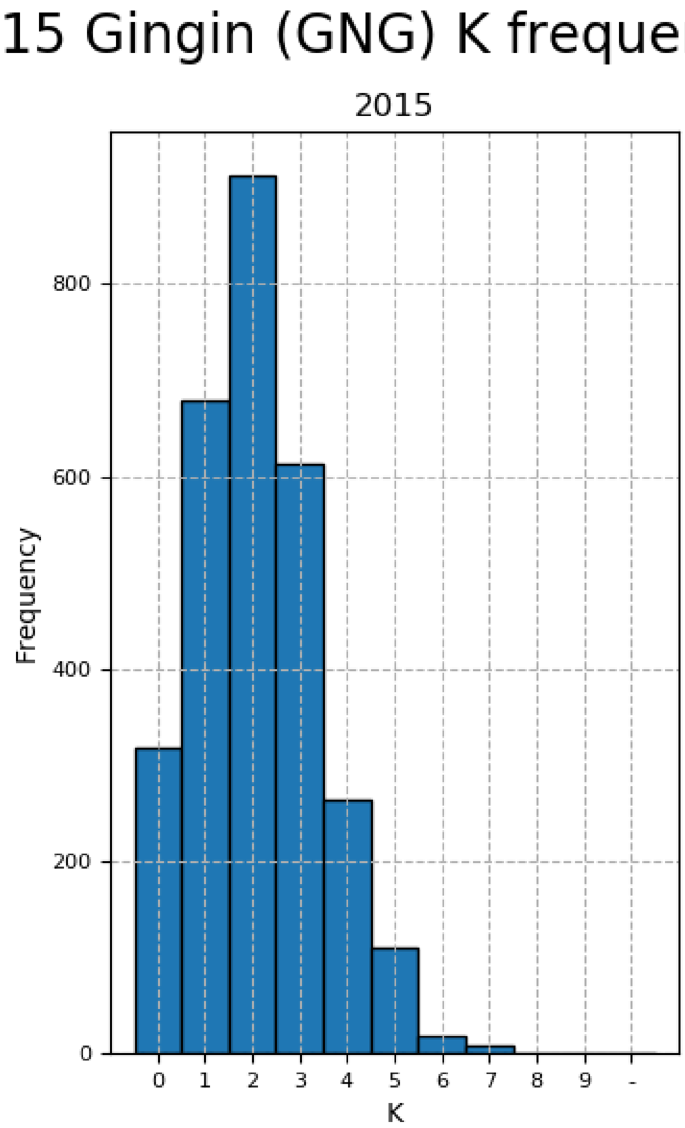

Figure 7.42 2015 Gingin (GNG) 3-hourly K index frequency plots.

7.6.4.4 2016

Table 9 Gingin (GNG) K index values for 2016. For each cell, 3-hourly K indices are given then the daily K sum (after the whitespace character). Dashes ('-') indicate that insufficient data were available to compute either the K indices or K sum. K indices enclosed in parentheses indicate that the K index was computed with missing data.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	43333133 23	21230100 09	22112212 13	10000022 05	21224444 23	01113211 10	12211100 08	10000010 02	22435454 29	23223343 22	10244323 19	23311001 11
02	42322222 19	10012323 12	12112412 14	30003553 19	34234554 30	02010000 03	01103222 11	02222334 18	45235434 30	22134343 22	22124424 21	10112211 09
03	22212212 14	43211212 16	22223212 16	31221324 18	32332332 21	10000000 01	12121222 13	34454532 30	33545543 32	22213343 20	32444334 27	00000220 04
04	11211221 11	22133212 16	31000100 05	22123112 14	20012310 09	00000021 03	12231131 14	23234441 23	32444453 29	33144342 24	11101020 06	01011111 06
05	21222323 17	32223232 19	10122101 08	11013232 13	01233322 16	12224443 22	10000101 03	13343323 22	33332333 23	31222322 17	20000001 03	21002222 11
06	42332323 22	31112222 14	01332565 25	22224321 18	21124443 21	34354332 27	00000012 03	22243332 21	23332232 20	11200332 12	10123112 11	21224312 17
07	42243332 23	21222422 17	43234445 29	11111255 17	31112223 15	22022242 16	23333353 25	22213322 17	22134432 21	21112321 13	10211100 06	20212443 18
08	21234222 18	43322111 17	21114220 13	32010001 07	55456755 42	11032101 09	23355432 27	31113430 16	22243222 19	22132221 15	10012001 05	33234543 27
09	21122312 14	21233222 17	11122322 14	00000201 03	53245344 30	10001020 04	22334321 20	13233323 20	00000212 05	10013231 11	10322222 14	32342444 26
10	22222233 18	32010222 12	20123232 15	11221012 10	33344233 25	01013232 12	23233221 18	23342333 23	11100012 06	22212442 19	22234434 24	32234422 22
11	22213343 20	31223233 19	23245343 26	10002331 10	21000112 07	22212224 17	22123232 17	12221323 16	00013211 08	11110002 06	32222333 20	33233431 22
12	42223332 21	32233233 21	22211331 15	22123465 25	11011011 06	11222232 15	32343223 22	22223222 17	21112111 10	11001114 09	23254443 27	21111222 12
13	34123332 21	33321103 16	22211001 09	42344433 27	10112332 13	23223122 17	22222212 15	21112221 12	10111111 07	22355454 30	32343342 24	11112112 10
14	32222233 19	21222312 15	01011344 14	31246544 29	20232222 15	12122265 21	22341222 18	11112010 07	21123242 17	41333211 18	22233333 21	10021121 08
15	21111212 11	11223123 15	33333453 27	21011112 09	32224342 22	32233110 15	22332222 18	10111101 06	21112111 10	22223333 20	21123212 14	11111110 07
16	20022110 08	43355664 36	41344245 27	00133544 20	23333322 21	21122222 14	32214121 16	00012212 08	10010220 06	31223353 22	11100021 06	21000011 05
17	10211212 10	43435455 33	33343333 25	32233433 23	12333342 21	11223231 15	11112222 12	--211032 -	20011001 05	33353443 28	10100212 07	10122233 14
18	22011213 12	44443453 31	10233332 17	21210111 09	22223101 13	12222221 14	01210000 04	21213212 14	10024311 12	32322213 18	11000211 06	32223222 18
19	42342213 21	32233542 24	32344422 24	00001000 01	21222221 14	22211311 13	00001203 06	00013121 08	10123323 15	21121221 12	00001211 05	21111222 12
20	21254554 28	21113212 13	22123553 23	01121011 07	22211011 10	11100011 05	43312210 16	21100000 04	53242423 25	20000010 03	11222112 12	10112313 12
21	44334544 31	21001133 11	22112232 15	11111122 10	23332431 21	01011110 05	00111201 06	00012412 10	31231012 13	10000001 02	22112333 17	31134543 24
22	33223233 21	11011212 09	21121002 09	22113323 17	22233210 15	01011332 11	11232331 16	10100221 07	21110000 05	21123332 17	11233434 21	43333343 26
23	23324311 19	22011134 14	21211232 14	11123223 15	02120010 06	12101224 13	13320011 11	12135454 25	01101102 06	03223332 18	31221242 17	32343443 26
24	22222342 19	22222232 17	20121212 11	11212541 17	11132110 10	33322323 21	20111454 18	42143224 22	11111133 12	22334322 21	32334443 26	22323423 21
25	11000000 02	22221213 15	32111201 11	11222221 13	01010100 03	21112232 14	32455333 28	11233333 19	32133253 22	32346545 32	34324353 27	32153442 24
26	10221121 10	33202221 15	00001011 03	21113233 16	00000012 03	11122334 17	11002221 09	20001231 09	22234334 23	33355544 32	31232333 20	32334323 23
27	13121102 11	11121121 10	32322332 20	02114432 17	12022242 15	31211021 11	00001002 03	11021110 07	42254533 28	22334442 24	22223221 16	32223232 19
28	11222221 13	31212111 12	22111133 14	11122100 08	33432332 23	12122220 12	12322443 21	00021010 04	33255554 32	22334434 25	21112322 14	21111201 09
29	20001211 07	20112112 10	32233311 18	11000000 02	21111234 15	10010221 07	33232432 22	00023232 12	33455533 31	44435333 29	21022132 13	11112311 11
30	11000101 04		21113332 16	01114342 16	22221322 16	01000142 08	31111121 11	22224444 24	32343452 26	32235332 23	12111210 09	11012211 09
31	21222323 17		21121112 11		12322433 20		10011210 06	21201123 12		22233322 19		11145343 22

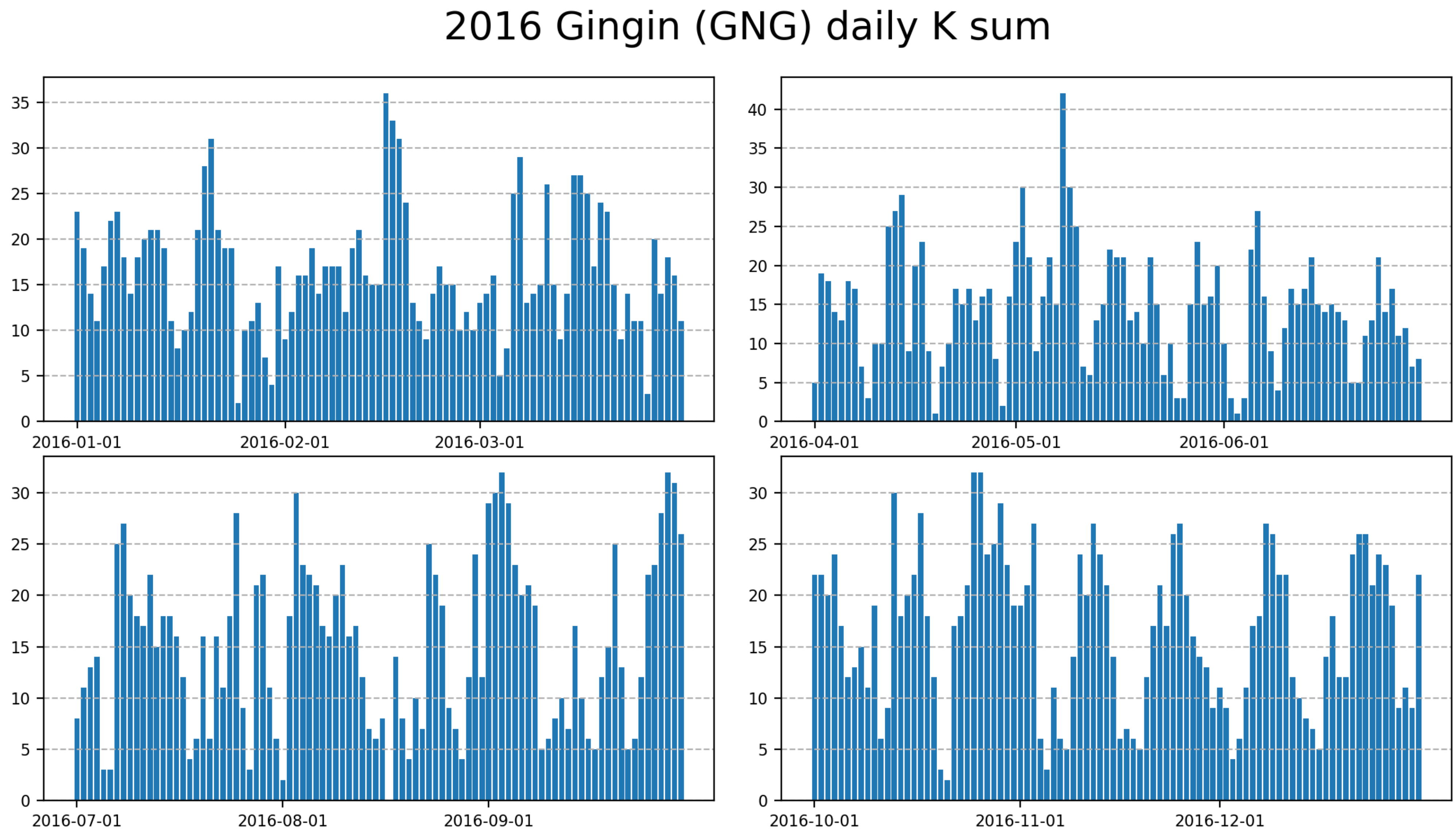

Figure 7.43 2016 Gingin (GNG) daily K sum.

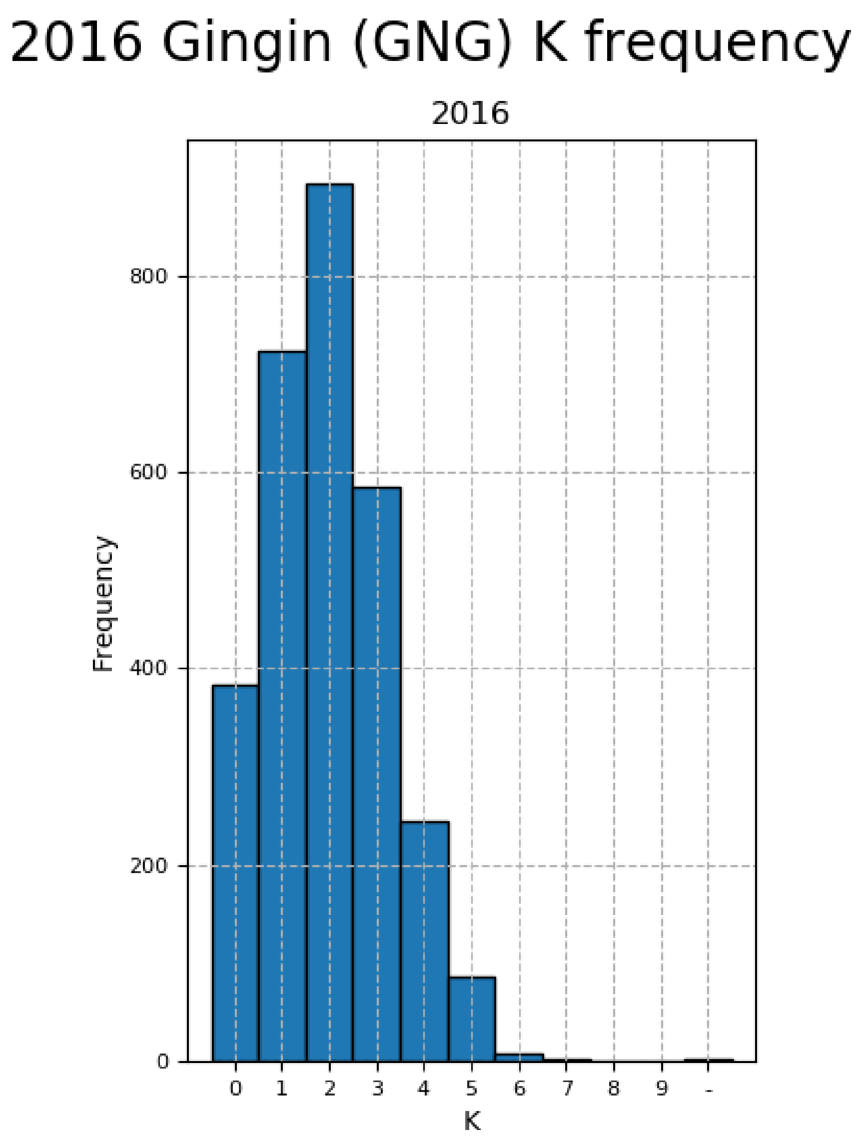

Figure 7.44 2016 Gingin (GNG) 3-hourly K index frequency plots.

7.6.5 Storm reports

This section reproduces the disseminating plaintext file that is submitted to Observatori de l'Ebre, Spain, monthly, in contribution to the International Service on Rapid Magnetic Variations.

7.6.5.1 2013

7.6.5.1.1 January

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                (GNG) Geomagnetic data for Jan 2013
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L    M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
13 Jan 19 17 33    ssc      a        18.77  14.36  4.57
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
----------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
______________________________________________________________________
Nil
----------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
---------------------------------------------------------------------------
UT-Date                K - i n d i c e s          K-sum
13 Jan 01     1   0   0   0     0   0   0   0      1
13 Jan 02     0   0   2   1     1   2   1   1      8
13 Jan 03     2   1   0   0     1   1   0   1      6
13 Jan 04     1   0   0   0     0   0   1   2      4
13 Jan 05     2   1   1   1     0   0   0   0      5
13 Jan 06     1   0   0   1     2   2   3   2      11
13 Jan 07     2   1   0   1     1   0   1   3      9
13 Jan 08     2   1   1   3     1   2   2   2      14
13 Jan 09     3   1   1   1     0   0   1   2      9
13 Jan 10     1   0   1   0     1   1   1   1      6
13 Jan 11     1   1   1   2     1   0   2   3      11
13 Jan 12     3   1   0   1     1   1   2   1      10
13 Jan 13     2   1   1   2     3   3   3   3      18
13 Jan 14     4   2   2   3     3   2   2   2      20
13 Jan 15     3   2   1   1     2   1   2   2      14
13 Jan 16     2   1   1   2     1   2   3   3      15
13 Jan 17     4   3   2   2     4   5   3   2      25
13 Jan 18     3   2   3   3     4   3   3   3      24
13 Jan 19     4   1   1   1     2   3   2   3      17
13 Jan 20     3   2   3   3     3   1   1   1      17
13 Jan 21     2   1   0   0     0   2   1   2      8
13 Jan 22     0   1   0   0     0   0   0   1      2
13 Jan 23     1   1   1   0     0   0   0   1      4
13 Jan 24     1   0   0   0     0   0   0   1      2
13 Jan 25     0   1   0   1     0   3   2   3      10
13 Jan 26     4   3   4   3     4   4   4   5      31
13 Jan 27     2   1   1   0     2   2   1   1      10
13 Jan 28     1   1   1   0     2   2   2   2      11
13 Jan 29     1   1   0   1     2   2   0   0      7
13 Jan 30     1   1   0   1     0   1   1   1      6
13 Jan 31     0   0   1   1     0   1   1   2      6
Mean of K-Sum is  11.0
Frequency Distribution of K-Indices
```

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	63	88	52	33	10	2	0	0	0	0	0

7.6.5.1.2 February

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Feb 2013
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement	SSC-amplitudes	Max. 3hr-K-indices	Storm Ranges	UT End
Yr Mth Dy Hr Mn	D(') H(nT) Z(nT)	Day(3Hr Periods) K	D(') H(nT) Z(nT)	Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
13 Feb 14 06 11	ssc	a	22.41	15.95	5.35
13 Feb 16 12 09	ssc	a	23.17	3.81	2.97

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
13 Feb 01	2	0	1	1	2	3	2	3	14
13 Feb 02	3	3	3	3	3	3	3	2	23
13 Feb 03	1	0	1	2	2	2	1	2	11
13 Feb 04	1	1	2	1	1	3	2	1	12
13 Feb 05	2	2	1	0	2	0	1	1	9
13 Feb 06	1	1	1	0	0	1	1	2	7
13 Feb 07	2	2	2	3	2	2	2	2	17
13 Feb 08	2	2	3	2	3	3	1	2	18
13 Feb 09	2	1	1	1	0	0	2	1	8
13 Feb 10	2	1	1	2	0	3	2	2	13
13 Feb 11	2	1	1	0	1	2	2	2	11
13 Feb 12	2	0	0	2	2	2	2	2	12
13 Feb 13	3	2	1	2	1	2	4	5	20
13 Feb 14	3	2	4	3	2	2	2	1	19
13 Feb 15	1	0	0	1	1	2	3	2	10
13 Feb 16	2	1	0	1	3	4	3	2	16
13 Feb 17	2	1	2	2	4	3	4	2	20
13 Feb 18	1	1	1	1	1	1	1	3	10
13 Feb 19	2	1	2	2	3	2	2	2	16
13 Feb 20	2	1	2	4	3	3	2	2	19
13 Feb 21	3	2	2	1	1	2	3	3	17
13 Feb 22	2	3	2	2	4	3	3	4	23
13 Feb 23	2	1	1	2	2	2	4	2	16
13 Feb 24	1	0	1	1	1	2	2	1	9
13 Feb 25	0	0	1	0	1	1	1	2	6
13 Feb 26	2	1	2	1	3	2	3	1	15
13 Feb 27	1	1	2	1	2	1	0	1	9
13 Feb 28	2	1	2	1	2	1	2	4	15

Mean of K-Sum is 14.1
Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	20	70	89	34	10	1	0	0	0	0	0

7.6.5.1.3 March

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Mar 2013
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
13 Mar 01 03 00	...	1(6)	6	21.6	121.2	79.9	Mar 02 03
13 Mar 17 06 02	5.46,15.77,8.56	17(4,7)	6	26.8	170.5	124.5	Mar 18 03
13 Mar 27 00 00	...	27(6)	6	15.7	51.9	57.8	Mar 28 03

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
13 Mar 15 05 26	ssc	a	23.09	16.4	5.64
13 Mar 17 06 02	ssc	a	15.77	37.77	8.56

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
13 Mar 01	3	3	3	5	5	6	5	4	34
13 Mar 02	3	2	3	1	2	4	4	3	22
13 Mar 03	2	2	2	2	1	2	3	2	16
13 Mar 04	3	1	0	2	1	1	1	1	10
13 Mar 05	1	0	0	0	1	2	2	1	7
13 Mar 06	1	1	0	0	1	0	1	1	5
13 Mar 07	1	2	2	2	1	1	0	1	10
13 Mar 08	0	0	1	1	1	1	2	2	8
13 Mar 09	2	1	0	2	3	2	2	1	13
13 Mar 10	2	1	0	1	0	2	1	2	9
13 Mar 11	2	2	2	0	1	1	0	1	9
13 Mar 12	2	1	2	1	2	3	2	2	15
13 Mar 13	2	1	1	1	0	0	1	0	6
13 Mar 14	1	1	0	1	2	1	1	2	9
13 Mar 15	1	3	3	1	1	0	1	2	12
13 Mar 16	2	3	2	2	2	2	1	2	16
13 Mar 17	2	1	5	6	5	5	6	4	34
13 Mar 18	3	2	3	2	1	1	1	1	14
13 Mar 19	2	2	2	0	1	1	1	2	11
13 Mar 20	2	2	2	2	3	3	3	4	21
13 Mar 21	4	4	3	1	1	0	1	2	16
13 Mar 22	1	1	1	2	1	1	3	2	12
13 Mar 23	2	1	1	3	4	3	4	3	21
13 Mar 24	2	1	1	2	2	2	1	0	11
13 Mar 25	1	0	1	1	1	1	1	1	7
13 Mar 26	2	1	0	0	0	0	0	0	3
13 Mar 27	2	3	3	3	4	6	5	4	30
13 Mar 28	3	1	1	3	1	3	2	1	15
13 Mar 29	3	2	4	4	4	4	3	3	27
13 Mar 30	3	3	2	2	2	1	3	2	18
13 Mar 31	2	0	0	0	0	2	2	2	8

Mean of K-Sum is 14.5
Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	34	81	72	35	15	7	4	0	0	0	0

7.6.5.1.4 April

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                   (GNG) Geomagnetic data for Apr 2013
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L    M A G N E T I C   S T O R M S
-------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
_____________________________________________________________________________________

Nil
-------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)    Z
_________________________________________________________
13 Apr 13 22 54    ssc       a       14.69  5.35    1.42
13 Apr 23 04 52    ssc       c       9.8    8.8     4.02
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                  K - i n d i c e s             K-sum
13 Apr 01      1   2   2   3     1   2   1   2      14
13 Apr 02      1   0   0   0     0   1   3   2      7
13 Apr 03      1   0   0   0     1   1   1   0      4
13 Apr 04      1   1   0   1     2   1   1   0      7
13 Apr 05     (0)  1   0   0     0   1   1   1      4
13 Apr 06      2   1   1   1     1   1   2   1      10
13 Apr 07      2   1   1   2     3   2   1   0      12
13 Apr 08      1   1   1   0     0   1   0   0      4
13 Apr 09      1   1   1   1     0   0   0   1      5
13 Apr 10      1   1   2   2     1   0   1   3      11
13 Apr 11      1   1   2   1     1   1   1   2      10
13 Apr 12      2   1   2   0     1   1   1   1      9
13 Apr 13      2   2   1   1     0   0   1   2      9
13 Apr 14      2   3   3   3     2   2   2   2      19
13 Apr 15      1   1   1   0     0   0   3   2      8
13 Apr 16      2   0   0   0     0   2   2   2      8
13 Apr 17      0   1   0   0     1   1   0   0      3
13 Apr 18      1   0   0   0     0   0   1   0      2
13 Apr 19      0   0   0   0     0   0   0   0      0
13 Apr 20      0   0   1   1     2   0   0   0      4
13 Apr 21      0   1   0   0     0   1   0   0      2
13 Apr 22      2   0   1   0     1   1   1   0      6
13 Apr 23      0   2   1   1     1   2   2   3      12
13 Apr 24      3   3   3   4     4   3   4   3      27
13 Apr 25      2   2   1   2     2   3   3   1      16
13 Apr 26      2   3   2   4     4   5   4   2      26
13 Apr 27      2   2   2   1     2   3   2   2      16
13 Apr 28      1   0   1   1     3   2   3   2      13
13 Apr 29      2   1   0   1     2   0   1   2      9
13 Apr 30      2   1   1   2     2   1   1   3      13
Mean of K-Sum is   9.7
Frequency Distribution of K-Indices
K-Index :    0    1    2    3    4    5    6    7    8    9    -
            70   86   56   21   6    1    0    0    0    0    0
--------------------------------------------------------------------------
```

7.6.5.1.5 May

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                   (GNG) Geomagnetic data for May 2013
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
```

Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
13 May 01 06 02	...	1(7)	6	20.3	105.0	82.8	May 02 03

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
13 May 18 01 09	ssc*	c	4.76	23.44*	4.69
13 May 19 23 08	ssc	a	13.36	23.8	6.34
13 May 24 18 10	ssc	a	25.22	41.11	11.15
13 May 27 06 49	ssc	c	1.98	11.61	2.27
13 May 31 16 19	ssc	a	10.87	12.65	4.01

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
13 May 13	01:57	02:19	02:41	5.4	1.8	4.51	solar
13 May 15	01:31	01:54	02:53	10.58	4.44	10.25	solar

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
13 May 01	2	2	3	4	5	4	6	3	29
13 May 02	2	2	1	1	2	2	3	1	14
13 May 03	1	1	1	1	1	2	2	0	9
13 May 04	1	0	1	1	1	1	2	2	9
13 May 05	1	1	2	1	2	2	1	0	10
13 May 06	2	1	2	2	2	1	2	2	14
13 May 07	2	3	2	2	2	3	2	1	17
13 May 08	2	2	1	1	1	3	1	1	12
13 May 09	1	1	1	1	1	0	0	0	5
13 May 10	1	1	1	0	2	0	1	1	7
13 May 11	0	1	0	1	0	1	0	1	4
13 May 12	1	1	1	1	0	0	1	1	6
13 May 13	2	1	2	1	0	2	1	0	9
13 May 14	3	0	1	3	3	3	2	2	17
13 May 15	3	1	2	2	3	2	1	1	15
13 May 16	3	4	2	2	3	3	3	3	23
13 May 17	2	2	2	2	3	4	4	1	20
13 May 18	3	4	3	3	3	2	4	2	24
13 May 19	3	2	2	2	3	3	2	3	20
13 May 20	2	2	0	0	2	2	3	1	12
13 May 21	0	1	1	1	1	0	2	2	8
13 May 22	3	2	2	2	3	3	3	2	20
13 May 23	2	1	1	2	1	2	2	1	12
13 May 24	2	2	2	3	4	2	4	4	23
13 May 25	3	3	2	4	4	4	5	5	30
13 May 26	3	3	3	2	2	4	3	2	22
13 May 27	2	2	2	3	3	2	3	2	19
13 May 28	2	3	2	2	2	2	1	0	14
13 May 29	0	0	0	0	0	0	0	0	0
13 May 30	0	0	0	0	0	0	1	0	1
13 May 31	0	0	0	0	2	3	3	4	12

Mean of K-Sum is 14.1

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	41	64	80	44	15	3	1	0	0	0	0

7.6.5.1.6 June

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Jun 2013
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

```
                   P R I N C I P A L    M A G N E T I C    S T O R M S
-----------------------------------------------------------------------------------
Commencement       SSC-amplitudes     Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)   Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
___________________________________________________________________________________

13 Jun 27 14 39    1.38,17.13,3.69    29(4)             6  36.5  178.1 131.3   Jun 30 00
-----------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality     Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C     H(x)   D(y)   Z
_________________________________________________________
13 Jun 19 23 06    ssc      c         4.09   5.62   1.75
13 Jun 27 14 39    ssc      a         17.13  9.49   3.69
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s          K-sum
13 Jun 01     5   4   6   4     4   3   2   3      31
13 Jun 02     3   3   3   4     4   3   4   4      28
13 Jun 03     2   2   2   1     1   2   3   3      16
13 Jun 04     3   2   2   2     1   1   2   2      15
13 Jun 05     3   1   2   1     2   1   2   1      13
13 Jun 06     1   3   3   3     3   5   3   4      25
13 Jun 07     3   3   5   4     3   2   2   1      23
13 Jun 08     2   2   3   2     1   0   0   1      11
13 Jun 09     1   1   2   1     3   3   3   1      15
13 Jun 10     2   3   3   2     2   2   2   0      16
13 Jun 11     0   0   1   1     3   2   2   1      10
13 Jun 12     1   1   1   0     0   0   1   0      4
13 Jun 13     1   1   0   0     0   0   0   0      2
13 Jun 14     1   0   0   1     0   0   2   0      4
13 Jun 15     2   1   2   0     1   1   0   1      8
13 Jun 16     1   0   0   0     0   0   1   0      2
13 Jun 17     1   0   1   0     0   0   1   1      4
13 Jun 18     1   1   1   0     2   2   1   0      8
13 Jun 19     1   0   0   0     0   0   2   2      5
13 Jun 20     2   2   2   2     2   3   4   3      20
13 Jun 21     2   2   2   2     3   2   3   3      19
13 Jun 22     3   3   3   4     2   1   3   3      22
13 Jun 23     3   4   3   3     1   4   3   4      25
13 Jun 24     3   3   3   3     4   5   4   3      28
13 Jun 25     3   2   1   1     0   2   1   2      12
13 Jun 26     0   0   0   0     0   1   2   1      4
13 Jun 27     0   0   0   0     3   2   3   2      10
13 Jun 28     3   3   2   2     3   4   4   5      26
13 Jun 29     4   3   4   7     5   3   5   4      35
13 Jun 30     2   2   2   2     3   3   2   1      17
Mean of K-Sum is  15.3
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           49   50   57   54   21    7    1    1    0    0    0
--------------------------------------------------------------------------
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7.6.5.1.7 July

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                 (GNG) Geomagnetic data for Jul 2013
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L    M A G N E T I C    S T O R M S
-----------------------------------------------------------------------------------
Commencement       SSC-amplitudes     Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)   Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
___________________________________________________________________________________
```

13 Jul 18 06 30 ... 18(5,6,7) 5 17.6 74.7 43.6 Jul 19 21

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C	Chief movement(nT) H(x)	 D(y)	 Z
13 Jul 09 20 54	ssc b	2.86	13.71	3.52

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	 Max	 End	Amplitude in nT H(x)	 D(y)	 Z	Confirmation

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
13 Jul 01	1	2	2	2	0	0	1	0	8
13 Jul 02	1	1	1	1	0	1	1	0	6
13 Jul 03	1	1	0	0	0	2	0	1	5
13 Jul 04	1	1	0	0	0	1	1	1	5
13 Jul 05	1	2	1	2	2	2	2	2	14
13 Jul 06	2	3	4	3	4	3	3	3	25
13 Jul 07	2	1	1	0	1	1	0	0	6
13 Jul 08	1	1	1	0	1	1	1	1	7
13 Jul 09	0	1	1	1	1	3	3	3	13
13 Jul 10	4	3	3	4	5	3	4	4	30
13 Jul 11	2	3	5	4	3	4	5	2	28
13 Jul 12	1	1	2	1	2	2	2	3	14
13 Jul 13	3	3	2	1	1	2	3	3	18
13 Jul 14	2	2	2	5	4	4	5	4	28
13 Jul 15	3	2	4	4	4	2	3	2	24
13 Jul 16	0	1	1	1	1	1	2	1	8
13 Jul 17	0	1	1	0	1	1	1	2	7
13 Jul 18	1	0	1	1	5	5	5	2	20
13 Jul 19	2	2	4	4	4	3	3	2	24
13 Jul 20	2	1	1	1	0	1	1	0	7
13 Jul 21	1	1	1	1	2	2	2	2	12
13 Jul 22	1	0	0	0	1	1	1	3	7
13 Jul 23	1	1	0	0	1	0	2	1	6
13 Jul 24	0	1	1	0	2	0	1	1	6
13 Jul 25	1	1	1	1	1	3	4	4	16
13 Jul 26	3	3	3	1	4	2	3	2	21
13 Jul 27	2	2	2	2	3	4	3	1	19
13 Jul 28	1	1	2	1	1	2	2	2	12
13 Jul 29	1	1	0	1	2	1	1	0	7
13 Jul 30	0	1	1	1	2	1	2	1	9
13 Jul 31	1	0	0	0	1	2	3	1	8

Mean of K-Sum is 13.5

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	38	97	53	31	21	8	0	0	0	0	0

7.6.5.1.8 August

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Aug 2013
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(')	 H(nT)	 Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	 K	Storm Ranges D(')	 H(nT)	 Z(nT)	UT End Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C	Chief movement(nT) H(x)	 D(y)	 Z

```
13 Aug 20 22 28   ssc      c        7.59   4.82   1.29
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z

Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s           K-sum
13 Aug 01      1   1   1   1     1   2   1   1      9
13 Aug 02      1   0   0   0     0   1   1   0      3
13 Aug 03      0   0   0   0     1   1   1   1      4
13 Aug 04      1   1   2   2     2   4   3   4      19
13 Aug 05      4   3   3   4     3   2   3   2      24
13 Aug 06      2   2   2   1     2   0   1   3      13
13 Aug 07      2   1   1   0     1   0   1   0      6
13 Aug 08      0   0   0   0     0   0   0   1      1
13 Aug 09      1   2   2   3     2   1   3   1      15
13 Aug 10      2   1   2   2     2   0   0   1      10
13 Aug 11      1   1   1   2     1   1   1   2      10
13 Aug 12      0   0   0   1     0   1   3   2      7
13 Aug 13      2   1   2   2     2   4   3   3      19
13 Aug 14      2   2   2   0     2   1   2   3      14
13 Aug 15      3   3   3   4     2   4   2   4      25
13 Aug 16      3   4   2   2     5   4   3   2      25
13 Aug 17      2   2   2   1     3   2   1   2      15
13 Aug 18      2   1   2   2     0   2   2   2      13
13 Aug 19      1   0   1   0     1   2   1   0      6
13 Aug 20      1   0   0   0     0   0   0   2      3
13 Aug 21      3   3   2   3     3   3   3   3      23
13 Aug 22      3   3   3   2     2   2   3   5      23
13 Aug 23      3   2   3   3     3   3   3   2      22
13 Aug 24      2   1   2   2     3   2   1   1      14
13 Aug 25      0   1   1   3     2   2   2   2      13
13 Aug 26      2   1   1   1     1   2   1   2      11
13 Aug 27      1   2   1   2     3   4   5   3      21
13 Aug 28      3   1   2   3     2   2   1   1      15
13 Aug 29      1   0   0   0     1   1   0   0      3
13 Aug 30      0   0   1   2     2   3   3   5      16
13 Aug 31      4   2   3   3     3   1   1   2      19
Mean of K-Sum is  13.6
Frequency Distribution of K-Indices
K-Index :    0    1    2    3    4    5    6    7    8    9    -
            45   67   74   46   12    4    0    0    0    0    0
--------------------------------------------------------------------------
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7.6.5.1.9 September

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                (GNG) Geomagnetic data for Sep 2013
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
-------------------------------------------------------------------------------------
Commencement       SSC-amplitudes     Max. 3hr-K-indices    Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)   Day(3Hr Periods)  K   D(')  H(nT) Z(nT)   Mth Dy Hr

Nil
-------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality     Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C     H(x)   D(y)    Z

Nil
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
```

	Start	Max	End	H(x)	D(y)	Z
Nil						

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
13 Sep 01	2	1	1	1	3	3	3	1	15
13 Sep 02	1	2	3	2	4	2	2	2	18
13 Sep 03	2	0	2	1	2	2	2	3	14
13 Sep 04	2	0	2	2	2	1	2	1	12
13 Sep 05	0	0	0	0	0	0	1	0	1
13 Sep 06	2	1	1	1	2	1	3	2	13
13 Sep 07	0	1	1	0	0	0	0	1	3
13 Sep 08	2	2	2	1	2	1	1	0	11
13 Sep 09	1	1	1	0	0	0	1	0	4
13 Sep 10	0	0	0	2	3	3	3	2	13
13 Sep 11	2	1	1	1	2	2	3	2	14
13 Sep 12	1	0	1	1	1	1	2	3	10
13 Sep 13	2	1	1	1	2	4	4	2	17
13 Sep 14	3	1	2	1	2	1	1	1	12
13 Sep 15	1	0	0	0	0	0	1	2	4
13 Sep 16	2	1	1	1	1	2	1	1	10
13 Sep 17	2	1	2	0	2	2	3	2	14
13 Sep 18	1	1	0	1	2	3	2	2	12
13 Sep 19	3	2	4	4	3	3	3	2	24
13 Sep 20	2	0	2	2	2	0	0	3	11
13 Sep 21	1	1	2	3	3	3	3	2	18
13 Sep 22	2	1	2	0	2	1	1	1	10
13 Sep 23	2	1	1	0	0	1	2	1	8
13 Sep 24	2	1	1	4	5	3	1	2	19
13 Sep 25	2	1	2	1	0	0	0	2	8
13 Sep 26	0	0	0	0	0	0	1	0	1
13 Sep 27	0	0	0	0	0	1	0	1	2
13 Sep 28	0	0	0	0	0	0	0	0	0
13 Sep 29	1	0	0	0	0	0	1	1	3
13 Sep 30	2	2	2	0	0	0	0	0	6

Mean of K-Sum is 10.2

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	70	72	67	24	6	1	0	0	0	0	0

7.6.5.1.10 October

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Oct 2013
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
13 Oct 02 01 54	-13.26*,-23.03*,-12(1,2)		6	27.6	156.5	56.7	Oct 03 01
13 Oct 08 20 21	5.4,56.66,13.77	8(8)	6	25.9	127.0	72.9	Oct 09 18

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
13 Oct 02 01 54	ssc*	a	-23.03*	-92.24*	-15.9*
13 Oct 08 20 21	ssc	a	56.66	37.66	13.77
13 Oct 26 22 44	ssc*	b	2.67	-21.24*	-3.98*
13 Oct 29 10 33	ssc*	b	9.49	13.86*	2.33

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
13 Oct 24	00:25	00:37	00:52	3.06	-0.78	-3.46	solar

13 Oct 25	07:57	08:03	08:14	1.64	1.38	2.86	solar
13 Oct 29	21:48	21:55	22:08	9.14	0.84	1.91	solar

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
13 Oct 01	1	1	2	1	2	2	1	2	12
13 Oct 02	6	6	5	3	2	4	4	4	34
13 Oct 03	4	1	0	0	0	1	2	1	9
13 Oct 04	1	0	0	0	0	0	0	1	2
13 Oct 05	0	0	0	0	0	0	0	1	1
13 Oct 06	0	0	0	0	0	0	0	1	1
13 Oct 07	2	1	1	1	1	2	1	0	9
13 Oct 08	1	0	0	1	3	2	5	6	18
13 Oct 09	5	4	4	4	4	4	2	3	30
13 Oct 10	3	2	1	2	2	2	1	2	15
13 Oct 11	2	1	1	2	2	2	1	1	12
13 Oct 12	0	1	0	1	1	1	2	3	9
13 Oct 13	2	0	0	0	1	1	1	0	5
13 Oct 14	0	1	3	3	5	4	3	3	22
13 Oct 15	3	3	1	4	2	1	2	3	19
13 Oct 16	2	1	1	2	3	2	3	2	16
13 Oct 17	2	1	2	3	3	3	2	1	17
13 Oct 18	1	1	0	0	0	0	2	0	4
13 Oct 19	0	0	0	0	0	1	0	0	1
13 Oct 20	0	1	0	0	0	1	0	2	4
13 Oct 21	0	0	0	0	0	2	0	1	3
13 Oct 22	0	0	2	2	1	1	2	2	10
13 Oct 23	2	1	1	1	0	1	0	1	7
13 Oct 24	1	1	1	1	0	0	0	0	4
13 Oct 25	1	1	2	0	0	0	0	2	6
13 Oct 26	1	0	1	0	0	1	0	3	6
13 Oct 27	0	1	1	1	1	1	2	1	8
13 Oct 28	2	2	1	1	0	0	0	0	6
13 Oct 29	1	0	1	3	3	1	2	2	13
13 Oct 30	2	1	2	4	4	3	3	4	23
13 Oct 31	2	0	0	2	3	3	2	2	14

Mean of K-Sum is 11.0

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	80	72	51	24	14	4	3	0	0	0	0

7.6.5.1.11 November

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Nov 2013
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
13 Nov 08 23 50	...	9(4)	6	20.2	88.7	95.9	Nov 09 21

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C	Chief movement(nT) H(x)	D(y)	Z
Nil				

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
13 Nov 03	05:20	05:22	05:33	3.74	1.92	4.58	solar
13 Nov 05	22:10	22:14	22:23	8.79	1.98	4.72	solar
13 Nov 08	04:23	04:26	04:37	7.42	2.04	6.39	solar
13 Nov 10	05:10	05:14	05:29	18.33	2.04	8.32	solar

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
13 Nov 01	2	1	1	1	3	1	2	1	12
13 Nov 02	1	0	0	1	1	2	0	2	7
13 Nov 03	1	2	1	1	1	0	2	2	10
13 Nov 04	1	1	1	2	1	3	1	2	12
13 Nov 05	2	0	1	1	1	2	0	2	9
13 Nov 06	2	1	1	1	1	2	1	3	12
13 Nov 07	2	2	3	4	4	2	3	2	22
13 Nov 08	2	2	1	1	0	1	0	1	8
13 Nov 09	3	3	4	6	4	3	1	3	27
13 Nov 10	3	3	2	3	3	3	3	4	24
13 Nov 11	3	2	3	3	4	4	3	2	24
13 Nov 12	2	1	0	1	1	0	0	1	6
13 Nov 13	0	1	0	0	3	0	0	1	5
13 Nov 14	0	0	1	1	1	1	1	2	7
13 Nov 15	2	1	2	1	2	4	3	3	18
13 Nov 16	3	2	3	2	3	2	2	2	19
13 Nov 17	2	2	2	2	1	1	1	2	13
13 Nov 18	2	2	1	1	0	1	1	2	10
13 Nov 19	2	1	0	1	2	2	2	2	12
13 Nov 20	2	1	2	1	3	0	1	0	10
13 Nov 21	1	1	0	0	1	0	1	1	5
13 Nov 22	1	0	0	1	0	0	1	1	4
13 Nov 23	2	3	3	3	3	2	2	2	20
13 Nov 24	1	0	0	0	0	0	0	1	2
13 Nov 25	1	1	0	0	0	0	0	0	2
13 Nov 26	0	0	0	0	0	1	1	1	3
13 Nov 27	2	1	1	1	1	2	0	1	9
13 Nov 28	1	0	0	0	1	1	0	1	4
13 Nov 29	1	2	2	2	2	3	4	2	18
13 Nov 30	2	0	2	2	2	2	2	3	15

Mean of K-Sum is 11.6

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	52	81	65	32	9	0	1	0	0	0	0

7.6.5.1.12 December

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Dec 2013
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
13 Dec 07 20 17	...	8(1,2)	5	20.2	125.1	51.6	Dec 08 23

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
13 Dec 13 13 23	ssc	a	24.89	7.09	3.38
13 Dec 15 17 28	ssc*	a	-35.68*	-22.33	-9.32

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
13 Dec 01	3	3	2	2	4	2	0	2	18
13 Dec 02	2	0	0	0	0	0	0	1	3
13 Dec 03	2	1	2	1	3	2	3	2	16

UT-Date									K-sum
13 Dec 04	2	1	1	0	1	2	2	1	10
13 Dec 05	1	0	0	2	2	1	1	1	8
13 Dec 06	2	1	1	1	0	2	1	1	9
13 Dec 07	2	1	1	0	1	2	2	3	12
13 Dec 08	5	5	4	2	2	4	4	2	28
13 Dec 09	1	0	0	1	3	3	1	2	11
13 Dec 10	2	2	1	1	2	2	1	1	12
13 Dec 11	1	1	1	1	2	1	1	1	9
13 Dec 12	1	1	0	1	0	0	1	1	5
13 Dec 13	0	0	1	1	3	2	1	2	10
13 Dec 14	4	4	3	2	3	3	5	3	27
13 Dec 15	2	1	2	1	3	4	1	1	15
13 Dec 16	2	2	2	1	1	2	1	2	13
13 Dec 17	2	1	0	0	0	1	3	1	8
13 Dec 18	1	2	1	0	0	2	1	2	9
13 Dec 19	2	1	1	0	1	2	3	3	13
13 Dec 20	3	3	1	1	0	1	1	1	11
13 Dec 21	2	2	2	2	1	1	1	2	13
13 Dec 22	1	1	1	2	0	1	0	1	7
13 Dec 23	2	1	1	1	1	0	1	1	8
13 Dec 24	1	1	1	0	0	2	0	2	7
13 Dec 25	3	2	2	3	3	3	2	1	19
13 Dec 26	2	1	2	2	2	1	0	1	11
13 Dec 27	1	0	1	0	0	0	2	1	5
13 Dec 28	1	1	1	0	2	1	1	3	10
13 Dec 29	3	2	2	2	1	3	1	1	15
13 Dec 30	1	0	1	1	1	1	0	1	6
13 Dec 31	3	1	2	1	2	1	2	2	14

Mean of K-Sum is 11.7

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	40	103	69	26	7	3	0	0	0	0	0

7.6.5.2 2014

7.6.5.2.1 January

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Jan 2014
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement	SSC-amplitudes	Max. 3hr-K-indices		Storm Ranges	UT End
Yr Mth Dy Hr Mn	D(') H(nT) Z(nT)	Day(3Hr Periods)	K	D(') H(nT) Z(nT)	Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
14 Jan 07 15 12	ssc	a	27.0	4.0	2.77
14 Jan 09 20 08	ssc	a	38.49	11.98	5.15

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
14 Jan 30	06:36	06:40	06:52	4.34	1.56	3.37	solar

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Jan 01	2	1	2	2	4	3	4	4	22
14 Jan 02	3	2	3	2	3	3	4	2	22
14 Jan 03	2	2	2	3	2	3	2	2	18
14 Jan 04	2	1	1	3	2	2	2	2	15
14 Jan 05	3	2	1	0	2	1	0	1	10

14 Jan 06	1	1	1	0	1	1	1	1	7
14 Jan 07	1	1	0	1	1	3	3	2	12
14 Jan 08	2	2	0	1	2	1	2	3	13
14 Jan 09	3	2	2	2	2	1	4	3	19
14 Jan 10	2	2	1	2	1	2	1	2	13
14 Jan 11	0	0	1	0	1	1	3	2	8
14 Jan 12	2	1	2	2	2	2	3	4	18
14 Jan 13	3	3	3	2	1	1	0	4	17
14 Jan 14	4	2	3	2	3	2	3	3	22
14 Jan 15	2	1	0	1	1	2	1	1	9
14 Jan 16	1	2	0	0	1	0	0	1	5
14 Jan 17	0	0	0	0	1	1	1	2	5
14 Jan 18	1	0	0	0	0	1	1	0	3
14 Jan 19	2	0	0	0	1	2	1	0	6
14 Jan 20	0	0	1	1	2	2	1	1	8
14 Jan 21	3	2	2	2	3	3	2	2	19
14 Jan 22	2	2	2	3	3	2	1	2	17
14 Jan 23	3	1	2	1	1	1	2	1	12
14 Jan 24	2	1	0	0	1	1	1	2	8
14 Jan 25	2	1	1	0	1	2	2	3	12
14 Jan 26	2	1	2	1	0	2	2	1	11
14 Jan 27	1	1	0	0	1	2	1	2	8
14 Jan 28	1	1	1	0	1	2	2	3	11
14 Jan 29	3	2	3	1	2	3	1	2	17
14 Jan 30	1	1	2	0	0	0	1	1	6
14 Jan 31	2	1	0	1	1	0	0	1	6

Mean of K-Sum is 12.2

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	42	83	81	34	8	0	0	0	0	0	0

7.6.5.2.2 February

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Jan 2014
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
14 Feb 15 13 18	1.26,27.43,3.64	15(8),16(1)	5	23.9	88.7	81.0	Feb 16 23
14 Feb 27 16 51	...	27(7,8)	5	16.0	144.1	73.9	Feb 28 12

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
14 Feb 07 17 06	ssc	b	20.14	8.97	4.36
14 Feb 13 09 44	ssc	c	11.77	4.8	0.94
14 Feb 15 13 18	ssc	a	27.43	8.86	3.64
14 Feb 27 16 50	ssc	a	47.86	13.45	7.13

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
14 Feb 01	07:18	07:26	07:39	3.62	1.26	4.87	solar
14 Feb 13	01:34	01:44	01:54	-6.06	-1.2	-3.98	solar
14 Feb 13	06:04	06:10	06:19	2.29	0.78	1.91	solar
14 Feb 25	00:43	00:52	01:43	-16.43	-5.94	-13.15	solar

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Jan 31	2	1	0	1	1	0	0	1	6
14 Feb 01	1	0	1	0	1	2	2	3	10
14 Feb 02	3	2	3	1	1	1	1	2	14
14 Feb 03	3	3	2	1	2	3	1	2	17

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14 Feb 04     2   2   1   1     1   1   1   2      11
14 Feb 05     2   1   2   1     2   1   1   3      13
14 Feb 06     3   2   1   2     3   2   1   2      16
14 Feb 07     1   0   1   1     2   3   3   4      15
14 Feb 08     5   3   4   3     4   2   5   3      29
14 Feb 09     3   2   2   1     3   2   5   2      20
14 Feb 10     3   2   1   1     2   2   4   2      17
14 Feb 11     2   2   2   1     1   1   2   3      14
14 Feb 12     4   2   1   1     2   2   2   1      15
14 Feb 13     2   1   2   2     0   0   0   2      9
14 Feb 14     1   1   2   1     2   1   0   1      9
14 Feb 15     3   2   0   1     3   3   3   5      20
14 Feb 16     5   4   4   3     4   4   4   3      31
14 Feb 17     2   1   0   0     1   1   2   2      9
14 Feb 18     1   1   2   2     3   3   3   3      18
14 Feb 19     3   4   3   4     5   3   2   3      27
14 Feb 20     1   5   4   4     5   4   3   3      29
14 Feb 21     2   1   1   2     3   3   2   2      16
14 Feb 22     3   2   2   2     2   3   2   3      19
14 Feb 23     2   2   3   3     3   4   4   4      25
14 Feb 24     2   2   1   1     2   3   2   1      14
14 Feb 25     4   0   0   0     2   2   0   2      10
14 Feb 26     2   0   0   0     0   0   0   1      3
14 Feb 27     1   1   1   1     2   4   5   5      20
14 Feb 28     3   2   3   3     1   2   1   2      17
14 Mar 01     2   1   1   3     2   1   2   3      15
Mean of K-Sum is  16.3
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           23   64   75   48   20   10    0    0    0    0    0
--------------------------------------------------------------------------
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7.6.5.2.3 March

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                (GNG) Geomagnetic data for Mar 2014
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement      SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn   D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date           Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn   ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
14 Mar 25 20 05   ssc      a        13.7   22.95  6.89
14 Mar 29 22 31   ssc      b        5.9    -7.59  -1.72
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                     K - i n d i c e s            K-sum
14 Mar 01     2   1   1   3     2   1   2   3      15
14 Mar 02     3   1   1   1     0   0   0   0      6
14 Mar 03     1   1   0   2     2   1   0   1      8
14 Mar 04     2   1   0   1     3   2   1   2      12
14 Mar 05     2   1   1   1     2   2   3   2      14
14 Mar 06     2   0   2   1     3   2   3   2      15
14 Mar 07     1   0   1   0     1   1   1   2      7
14 Mar 08     2   0   1   0     1   1   0   1      6
14 Mar 09     1   0   1   0     0   0   1   1      4
14 Mar 10     1   1   1   2     1   0   1   1      8
```

14 Mar 11	1	1	0	1	1	1	1	1	7
14 Mar 12	2	1	1	1	1	2	2	3	13
14 Mar 13	4	3	3	1	2	2	2	2	19
14 Mar 14	2	2	2	1	2	1	0	2	12
14 Mar 15	2	1	1	1	0	0	1	2	8
14 Mar 16	1	0	1	0	0	0	0	0	2
14 Mar 17	1	0	0	0	0	1	0	2	4
14 Mar 18	1	1	1	1	2	2	2	1	11
14 Mar 19	2	1	2	1	1	1	2	1	11
14 Mar 20	2	1	1	2	1	1	2	1	11
14 Mar 21	3	2	2	3	2	3	2	2	19
14 Mar 22	2	1	1	1	2	1	1	2	11
14 Mar 23	3	2	2	1	1	1	2	2	14
14 Mar 24	2	0	1	0	1	1	2	1	8
14 Mar 25	1	0	0	2	1	1	3	4	12
14 Mar 26	4	2	3	2	0	0	3	2	16
14 Mar 27	2	1	2	3	3	2	2	1	16
14 Mar 28	2	1	2	2	3	1	3	3	17
14 Mar 29	2	1	1	2	1	0	0	4	11
14 Mar 30	2	0	1	1	0	0	2	1	7
14 Mar 31	1	1	1	1	3	3	2	0	12

Mean of K-Sum is 10.8

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	45	102	73	24	4	0	0	0	0	0	0

7.6.5.2.4 April

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Apr 2014
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L M A G N E T I C S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods) K	Storm Ranges D(') H(nT) Z(nT)	UT End Mth Dy Hr

Nil

S U D D E N S T O R M C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C		Chief movement(nT) H(x)	D(y)	Z
14 Apr 20 10 52	ssc*	a	30.85*	9.44	4.34

S O L A R F L A R E E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation

Nil

K - I N D I C E S O F G E O M A G N E T I C A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Apr 01	1	1	1	0	1	2	1	2	9
14 Apr 02	1	0	0	0	0	3	2	2	8
14 Apr 03	2	1	1	1	2	2	1	2	12
14 Apr 04	1	1	2	1	2	3	1	1	12
14 Apr 05	1	1	1	3	4	3	3	3	19
14 Apr 06	3	0	0	0	0	0	0	2	5
14 Apr 07	1	1	3	1	3	5	3	2	19
14 Apr 08	1	0	0	1	3	2	1	0	8
14 Apr 09	0	0	2	2	2	3	2	1	12
14 Apr 10	1	0	0	0	0	1	1	0	3
14 Apr 11	1	2	2	2	1	3	2	3	16
14 Apr 12	4	2	3	4	4	3	3	4	27
14 Apr 13	4	2	2	3	2	2	5	2	22
14 Apr 14	1	1	2	1	0	0	3	2	10
14 Apr 15	1	1	1	1	2	1	2	1	10
14 Apr 16	0	0	1	2	2	0	1	1	7

```
14 Apr 17     3   2   2   1     2   3   3   2     18
14 Apr 18     3   2   1   1     1   1   2   3     14
14 Apr 19     3   3   3   2     3   4   4   2     24
14 Apr 20     3   2   1   3     3   4   4   3     23
14 Apr 21     4   3   4   4     3   4   1   1     24
14 Apr 22     1   1   1   1     0   2   1   2     9
14 Apr 23     1   1   1   2     2   3   2   2     14
14 Apr 24     2   2   2   3     2   2   3   2     18
14 Apr 25     3   2   0   2     3   4   3   2     19
14 Apr 26     1   1   1   2     2   1   2   1     11
14 Apr 27     1   0   0   0     1   1   0   2     5
14 Apr 28     2   1   0   2     1   1   0   1     8
14 Apr 29     1   0   0   0     1   0   1   2     5
14 Apr 30     2   2   3   3     4   2   5   1     22
Mean of K-Sum is  13.8
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           38   74   67   42   16    3    0    0    0    0    0
--------------------------------------------------------------------------
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7.6.5.2.5 May

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                   (GNG) Geomagnetic data for May 2014
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L    M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________

14 May 23 15 00    ...               23(6,7,8)         5  18.7  54.6  44.2    May 24 09
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)    D(y)    Z
_________________________________________________________
14 May 03 17 49    ssc      c        4.28    1.92    2.39
14 May 29 09 31    ssc      b        7.42    4.11    0.58
---------------------------------------------------------
                      S O L A R   F L A R E   E F F E C T S
----------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
______________________________________________________________________
Nil
----------------------------------------------------------------------
     K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y
---------------------------------------------------------------------------
UT-Date                 K - i n d i c e s            K-sum
14 May 01     2   2   2   1     1   0   1   1     10
14 May 02     1   0   0   0     0   0   0   0     1
14 May 03     0   0   0   0     0   1   4   3     8
14 May 04     2   2   4   2     2   2   2   1     17
14 May 05     2   2   2   2     2   3   4   2     19
14 May 06     0   1   1   1     0   0   0   0     3
14 May 07     0   0   0   1     2   1   1   2     7
14 May 08     2   3   2   5     3   4   3   3     25
14 May 09     2   1   2   1     0   0   0   1     7
14 May 10     2   1   1   1     0   1   2   2     10
14 May 11     3   3   2   3     1   2   3   2     19
14 May 12     1   2   2   2     2   1   2   1     13
14 May 13     0   1   1   0     1   0   0   1     4
14 May 14     2   0   0   0     1   1   1   2     7
14 May 15     1   1   1   0     0   1   2   1     7
14 May 16     2   1   1   0     2   1   1   0     8
14 May 17     0   1   1   1     0   1   0   1     5
14 May 18     2   1   1   0     0   2   1   1     8
14 May 19     1   1   2   1     1   1   1   1     9
14 May 20     0   1   0   1     1   1   0   0     4
14 May 21     1   0   0   0     0   0   1   1     3
14 May 22     1   1   1   0     1   3   2   3     12
```

14 May 23	3	2	2	0	1	5	5	5	23
14 May 24	1	2	1	0	2	2	1	0	9
14 May 25	1	1	0	0	0	3	1	0	6
14 May 26	1	1	1	1	0	0	0	0	4
14 May 27	0	0	1	0	0	0	2	1	4
14 May 28	1	1	0	0	0	0	1	1	4
14 May 29	0	0	0	3	3	2	2	1	11
14 May 30	0	2	1	1	2	4	4	1	15
14 May 31	1	1	0	0	0	0	0	0	2

Mean of K-Sum is 9.2

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	81	90	51	16	6	4	0	0	0	0	0

7.6.5.2.6 June

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Jun 2014
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement	SSC-amplitudes	Max. 3hr-K-indices		Storm Ranges	UT End
Yr Mth Dy Hr Mn	D(') H(nT) Z(nT)	Day(3Hr Periods)	K	D(') H(nT) Z(nT)	Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
14 Jun 07 16 53	ssc	a	25.32	15.95	5.34
14 Jun 10 05 50	ssc	c	4.35	7.46	2.6
14 Jun 23 23 08	ssc	a	3.88	5.84	2.04

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Jun 01	1	0	1	2	0	1	0	0	5
14 Jun 02	1	0	1	0	0	0	1	1	4
14 Jun 03	2	1	1	1	0	1	1	1	8
14 Jun 04	1	1	1	1	1	2	1	2	10
14 Jun 05	0	1	2	2	1	0	2	3	11
14 Jun 06	2	1	0	0	0	1	2	2	8
14 Jun 07	2	1	2	1	1	3	3	3	16
14 Jun 08	3	4	5	4	4	3	3	1	27
14 Jun 09	1	2	2	2	1	1	2	1	12
14 Jun 10	1	1	2	2	2	2	1	1	12
14 Jun 11	2	1	2	2	2	3	2	1	15
14 Jun 12	1	1	1	0	0	0	0	0	3
14 Jun 13	1	1	0	0	1	1	1	1	6
14 Jun 14	2	2	1	1	1	1	2	1	11
14 Jun 15	2	1	2	1	0	0	0	1	7
14 Jun 16	1	2	1	1	2	2	1	1	11
14 Jun 17	2	2	3	1	1	1	1	3	14
14 Jun 18	2	2	2	2	2	3	3	5	21
14 Jun 19	3	3	3	2	2	2	3	3	21
14 Jun 20	2	2	3	3	2	3	1	2	18
14 Jun 21	1	2	2	1	0	0	0	1	7
14 Jun 22	1	1	1	0	1	0	2	2	8
14 Jun 23	0	0	0	0	0	0	0	2	2
14 Jun 24	2	1	1	0	0	0	1	0	5
14 Jun 25	0	1	1	1	1	3	2	2	11
14 Jun 26	0	0	0	1	2	1	1	0	5

```
14 Jun 27     0   0   0   0     0   0   2   1     3
14 Jun 28     1   1   1   2     3   2   2   1     13
14 Jun 29     2   1   1   0     1   0   2   2     9
14 Jun 30     3   2   1   0     0   0   0   0     6
Mean of K-Sum is  10.3
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            58   90   64   23   3    2    0    0    0    0    0
--------------------------------------------------------------------------
```

7.6.5.2.7 July

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                 (GNG) Geomagnetic data for Jul 2014
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)    Z
_________________________________________________________
14 Jul 03 00 42    ssc*     c        4.34   9.58*  1.66
14 Jul 14 14 32    ssc      a        16.09  8.34   2.49
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s          K-sum
14 Jul 01     1   0   0   0     0   0   0   0     1
14 Jul 02     0   1   1   0     2   0   0   0     4
14 Jul 03     2   2   2   3     2   1   0   0     12
14 Jul 04     1   1   1   1     1   0   0   1     6
14 Jul 05     0   0   0   0     0   0   0   2     2
14 Jul 06     1   0   0   2     1   0   0   1     5
14 Jul 07     1   1   0   1     2   1   1   1     8
14 Jul 08     1   1   1   1     1   1   3   2     11
14 Jul 09     2   1   1   2     1   1   2   2     12
14 Jul 10     2   2   1   1     2   2   1   1     12
14 Jul 11     1   1   1   1     1   1   2   1     9
14 Jul 12     1   2   2   2     2   2   1   1     13
14 Jul 13     1   1   0   2     0   0   1   1     6
14 Jul 14     1   0   2   1     3   3   2   1     13
14 Jul 15     2   1   2   2     2   3   2   1     15
14 Jul 16     1   1   1   0     1   0   1   1     6
14 Jul 17     1   1   1   0     0   1   2   1     7
14 Jul 18     1   0   0   0     0   0   0   0     1
14 Jul 19     0   0   0   1     0   0   0   0     1
14 Jul 20     0   0   1   0     1   0   0   0     2
14 Jul 21     1   1   0   1     2   2   2   1     10
14 Jul 22     2   0   0   0     2   1   1   1     7
14 Jul 23     1   0   0   0     0   1   3   2     7
14 Jul 24     0   2   1   2     2   1   1   1     10
14 Jul 25     2   2   1   2     0   0   0   1     8
14 Jul 26     1   2   2   3     1   1   2   1     13
14 Jul 27     1   2   1   1     0   0   0   1     6
14 Jul 28     1   2   2   2     1   4   2   1     15
14 Jul 29     1   1   0   0     0   1   1   0     4
14 Jul 30     1   1   0   0     0   0   0   0     2
14 Jul 31     0   1   1   1     1   2   2   2     10
Mean of K-Sum is  7.7
```

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	82	103	55	7	1	0	0	0	0	0	0

7.6.5.2.8 August

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Aug 2014
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
14 Aug 19 06 57	2.22,11.79,4.72	19(8)	6	22.1	69.2	46.3	Aug 20 03

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
14 Aug 19 06 57	ssc	b	11.79	15.37	4.72

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Aug 01	2	1	1	2	2	2	2	3	15
14 Aug 02	2	2	2	3	3	4	2	2	20
14 Aug 03	1	1	0	1	0	1	3	2	9
14 Aug 04	2	2	3	3	2	2	3	2	19
14 Aug 05	2	2	2	1	3	3	4	2	19
14 Aug 06	2	1	2	2	2	3	2	2	16
14 Aug 07	1	1	1	1	2	1	3	1	11
14 Aug 08	3	2	2	3	1	0	0	0	11
14 Aug 09	1	0	1	0	0	1	1	0	4
14 Aug 10	1	0	1	1	2	2	3	1	11
14 Aug 11	1	0	0	0	1	3	1	3	9
14 Aug 12	3	1	1	1	2	3	5	3	19
14 Aug 13	1	2	1	2	3	0	2	1	12
14 Aug 14	0	0	0	1	1	0	2	1	5
14 Aug 15	1	0	0	1	2	1	1	1	7
14 Aug 16	1	0	0	0	0	0	1	0	2
14 Aug 17	1	0	1	2	3	2	0	2	11
14 Aug 18	1	1	3	0	1	1	2	1	10
14 Aug 19	1	0	2	2	1	2	4	6	18
14 Aug 20	2	1	2	1	1	0	1	2	10
14 Aug 21	2	2	2	3	3	2	2	2	18
14 Aug 22	1	1	0	0	1	0	0	1	4
14 Aug 23	1	0	1	0	0	1	1	1	5
14 Aug 24	0	0	0	0	0	0	0	0	0
14 Aug 25	0	0	0	0	1	0	0	0	1
14 Aug 26	0	0	0	0	1	0	1	2	4
14 Aug 27	1	2	3	4	3	4	4	3	24
14 Aug 28	2	3	3	3	3	4	3	2	23
14 Aug 29	2	2	3	4	3	2	3	4	23
14 Aug 30	2	2	1	5	4	2	3	2	21
14 Aug 31	2	1	2	4	2	3	4	4	22

Mean of K-Sum is 12.4

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	58	70	67	37	13	2	1	0	0	0	0

7.6.5.2.9 September

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                  (GNG) Geomagnetic data for Sep 2014
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
-----------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
___________________________________________________________________________________

14 Sep 11 23 44    -6.12*,8.25,-8.21*12(8)             6  19.3  92.0  53.5    Sep 13 09
-----------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)    D(y)    Z
_________________________________________________________
14 Sep 11 23 44    ssc*     a        8.25    -42.71*-8.21*
14 Sep 12 15 54    ssc      a        52.37   12.96  7.56
---------------------------------------------------------
                      S O L A R   F L A R E   E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy      UT of movement       Amplitude in nT    Confirmation
               Start  Max   End     H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s           K-sum
14 Sep 01     2   2   2   3     3   2   3   2       19
14 Sep 02     2   2   2   2     3   2   3   3       19
14 Sep 03     2   1   2   2     1   1   2   2       13
14 Sep 04     2   1   2   2     2   1   0   1       11
14 Sep 05     1   2   2   2     2   2   2   2       15
14 Sep 06     1   2   3   2     2   3   3   3       19
14 Sep 07     2   1   3   0     0   0   0   0       6
14 Sep 08     0   1   1   1     0   1   2   2       8
14 Sep 09     2   2   1   1     1   2   3   2       14
14 Sep 10     2   0   0   0     0   2   3   3       10
14 Sep 11     3   3   2   3     2   1   1   4       19
14 Sep 12     4   3   2   3     2   5   4   6       29
14 Sep 13     4   2   4   1     2   2   2   2       19
14 Sep 14     1   1   0   0     0   0   0   0       2
14 Sep 15     0   1   1   1     0   0   0   1       4
14 Sep 16     2   2   2   2     1   1   3   2       15
14 Sep 17     2   1   0   0     1   2   2   3       11
14 Sep 18     3   2   1   1     1   1   3   2       14
14 Sep 19     4   2   3   2     4   4   3   2       24
14 Sep 20     3   2   1   1     3   2   1   2       15
14 Sep 21     1   3   1   1     1   1   1   2       11
14 Sep 22     2   1   2   3     3   3   2   2       18
14 Sep 23     2   1   1   3     3   3   3   2       18
14 Sep 24     3   2   2   3     4   5   3   4       26
14 Sep 25     4   2   3   3     3   2   3   3       23
14 Sep 26     3   3   2   3     4   4   3   3       25
14 Sep 27     3   3   3   3     3   3   2   2       22
14 Sep 28     2   2   1   2     3   3   3   2       18
14 Sep 29     2   1   2   3     3   2   4   3       20
14 Sep 30     3   2   2   3     3   3   2   2       20
14 Oct 01     2   1   2   3     2   3   3   1       17
Mean of K-Sum is  16.3
Frequency Distribution of K-Indices
K-Index :    0    1    2    3    4    5    6    7    8    9    -
            24   49   91   67   14    2    1    0    0    0    0
--------------------------------------------------------------------------
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7.6.5.2.10 October

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                  (GNG) Geomagnetic data for Oct 2014
Location:    Geographic:-31.356d  115.715d
```

K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement	SSC-amplitudes	Max. 3hr-K-indices		Storm Ranges	UT End
Yr Mth Dy Hr Mn	D(') H(nT) Z(nT)	Day(3Hr Periods)	K	D(') H(nT) Z(nT)	Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date	Type & Quality	Chief movement(nT)
Yr Mth Dy Hr Mn	ssc/ssc* A,B,C	H(x) D(y) Z

Nil

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement	Amplitude in nT	Confirmation
	Start Max End	H(x) D(y) Z	

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Oct 01	2	1	2	3	2	3	3	1	17
14 Oct 02	1	2	2	2	1	3	2	2	15
14 Oct 03	1	1	1	0	1	3	1	1	9
14 Oct 04	1	1	2	2	1	0	1	2	10
14 Oct 05	2	2	2	1	1	2	1	2	13
14 Oct 06	2	1	0	0	1	0	1	2	7
14 Oct 07	3	1	0	0	1	0	1	2	8
14 Oct 08	2	2	2	3	3	3	3	3	21
14 Oct 09	3	3	2	2	3	2	2	2	19
14 Oct 10	1	1	1	0	0	2	1	2	8
14 Oct 11	2	1	2	3	3	2	1	1	15
14 Oct 12	0	1	1	2	3	1	2	1	11
14 Oct 13	1	1	2	0	2	3	2	2	13
14 Oct 14	1	1	1	2	4	5	4	5	23
14 Oct 15	4	2	3	2	2	3	1	2	19
14 Oct 16	2	1	0	2	2	2	1	3	13
14 Oct 17	1	2	1	1	2	2	2	4	15
14 Oct 18	3	3	2	3	4	4	2	3	24
14 Oct 19	3	2	2	2	3	1	3	3	19
14 Oct 20	3	2	3	4	4	4	4	4	28
14 Oct 21	3	2	3	2	4	3	3	3	23
14 Oct 22	3	2	2	3	3	4	2	2	21
14 Oct 23	2	1	1	2	3	3	4	2	18
14 Oct 24	3	1	1	2	3	4	3	3	20
14 Oct 25	3	1	2	1	3	3	2	3	18
14 Oct 26	2	1	2	2	3	3	3	2	18
14 Oct 27	2	1	2	3	2	3	2	3	18
14 Oct 28	3	1	1	2	3	3	3	3	19
14 Oct 29	2	1	1	1	1	3	3	1	13
14 Oct 30	1	0	1	2	2	1	2	3	12
14 Oct 31	1	1	2	2	2	2	2	2	14

Mean of K-Sum is 16.2

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	14	66	88	63	15	2	0	0	0	0	0

7.6.5.2.11 November

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Nov 2014
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement	SSC-amplitudes	Max. 3hr-K-indices		Storm Ranges	UT End
Yr Mth Dy Hr Mn	D(') H(nT) Z(nT)	Day(3Hr Periods)	K	D(') H(nT) Z(nT)	Mth Dy Hr

14 Nov 03 22 39	-4.32,5.1,-6.52*	4(5,6,7,8)	5	18.2	90.5	96.4	Nov 05 15

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
14 Nov 03 22 39	ssc*	c	5.1	-30.33	-6.52*

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s							K-sum
14 Nov 01	2	1	3	2	2	2	2	2	16
14 Nov 02	2	1	1	2	3	3	3	2	17
14 Nov 03	3	0	1	1	1	0	1	3	10
14 Nov 04	2	2	3	4	5	5	5	5	31
14 Nov 05	4	3	3	3	4	2	2	3	24
14 Nov 06	2	2	2	1	3	1	1	4	16
14 Nov 07	2	2	2	3	2	3	2	3	19
14 Nov 08	2	3	2	1	3	2	1	2	16
14 Nov 09	3	1	2	1	1	2	3	3	16
14 Nov 10	3	3	4	4	4	5	3	2	28
14 Nov 11	3	2	2	2	2	1	2	4	18
14 Nov 12	2	3	1	1	1	1	2	2	13
14 Nov 13	2	1	1	2	2	1	2	3	14
14 Nov 14	3	3	3	1	3	3	3	3	22
14 Nov 15	3	2	2	3	4	2	3	4	23
14 Nov 16	3	3	3	3	3	4	2	2	23
14 Nov 17	1	1	1	2	3	4	4	2	18
14 Nov 18	3	2	1	2	4	3	1	2	18
14 Nov 19	2	0	2	1	3	2	3	2	15
14 Nov 20	2	1	2	3	2	3	4	2	19
14 Nov 21	2	2	2	4	3	3	4	3	23
14 Nov 22	2	2	1	2	2	2	3	3	17
14 Nov 23	2	2	2	3	3	3	3	3	21
14 Nov 24	2	2	1	2	2	3	2	1	15
14 Nov 25	1	1	1	1	2	2	2	2	12
14 Nov 26	2	2	2	2	3	1	0	1	13
14 Nov 27	2	3	2	1	2	2	2	2	16
14 Nov 28	2	1	2	2	3	2	2	3	17
14 Nov 29	2	2	3	2	2	2	3	2	18
14 Nov 30	2	3	2	3	1	3	4	3	21

Mean of K-Sum is 18.3
Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	4	43	101	69	18	5	0	0	0	0	0

7.6.5.2.12 December

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Dec 2014
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
14 Dec 23 11 15	6.54,84.02,6.87	23(4,8),24(1)	5	15.8	123.0	52.2	Dec 24 06
14 Dec 29 09 00	...	29(6)	6	16.6	103.9	52.9	Dec 30 06

S U D D E N   S T O R M   C O M M E N C E M E N T S

```
UT Date              Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn      ssc/ssc* A,B,C    H(x)    D(y)    Z
_________________________________________________________
14 Dec 21 19 11      ssc       b       32.41   26.72   9.1
14 Dec 22 15 10      ssc       b       20.03   15.8    5.16
14 Dec 23 11 15      ssc       a       84.02   45.73   6.87
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement       Amplitude in nT    Confirmation
              Start  Max   End     H(x)  D(y)    Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s           K-sum
14 Dec 01     2   3   2   2     2   2   3   4     20
14 Dec 02     3   3   2   1     3   3   3   2     20
14 Dec 03     2   1   1   3     2   2   4   3     18
14 Dec 04     3   1   1   1     3   3   3   3     18
14 Dec 05     2   2   1   3     4   2   1   2     17
14 Dec 06     1   2   2   3     3   3   4   5     23
14 Dec 07     4   2   3   4     5   4   4   3     29
14 Dec 08     3   2   2   3     4   3   3   4     24
14 Dec 09     3   1   2   4     4   3   3   2     22
14 Dec 10     3   2   3   3     2   1   2   2     18
14 Dec 11     1   1   1   0     1   1   2   2     9
14 Dec 12     3   2   3   3     4   3   3   4     25
14 Dec 13     2   2   2   2     3   2   2   2     17
14 Dec 14     2   2   1   2     3   3   4   2     19
14 Dec 15     3   3   2   3     4   3   2   3     23
14 Dec 16     2   2   1   2     4   2   2   3     18
14 Dec 17     2   2   2   2     1   3   1   2     15
14 Dec 18     3   2   2   1     2   2   2   3     17
14 Dec 19     3   2   2   2     2   3   3   2     19
14 Dec 20     3   2   2   1     3   2   1   3     17
14 Dec 21     2   2   3   2     3   3   4   4     23
14 Dec 22     5   4   2   2     2   3   2   2     22
14 Dec 23     2   2   2   5     3   2   3   5     24
14 Dec 24     5   2   1   2     3   3   3   2     21
14 Dec 25     2   1   1   1     4   3   3   4     19
14 Dec 26     4   2   2   2     2   2   5   4     23
14 Dec 27     3   2   2   2     2   1   1   2     15
14 Dec 28     2   1   1   2     2   3   4   3     18
14 Dec 29     2   2   2   3     5   6   3   5     28
14 Dec 30     3   3   3   2     4   3   3   3     24
14 Dec 31     2   1   2   2     3   5   1   2     18
Mean of K-Sum is  20.1
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            1   33   101   76   26   10   1    0    0    0    0
--------------------------------------------------------------------------
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7.6.5.3 2015

7.6.5.3.1 January

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin               (GNG) Geomagnetic data for Jan 2015
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement         SSC-amplitudes     Max. 3hr-K-indices   Storm Ranges         UT End
Yr Mth Dy Hr Mn      D(') H(nT) Z(nT)   Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________
15 Jan 07 06 17      1.68,26.75,4.98    7(3,4)            6  21.7  188.3 130.7   Jan 08 18
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date              Type & Quality    Chief movement(nT)
```

Yr Mth Dy Hr Mn	ssc/ssc* A,B,C	H(x)	D(y)	Z
15 Jan 07 06 17	ssc a	26.75	11.65	4.98
15 Jan 26 08 34	ssc b	22.21	16.44	4.62

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
15 Jan 01	2	1	1	1	2	2	2	2	13
15 Jan 02	2	1	2	3	3	2	3	4	20
15 Jan 03	4	3	3	3	2	1	2	1	19
15 Jan 04	1	1	2	3	3	5	4	5	24
15 Jan 05	4	3	3	2	3	2	3	4	24
15 Jan 06	3	2	3	3	2	4	4	3	24
15 Jan 07	3	2	6	6	4	3	3	3	30
15 Jan 08	3	3	3	2	3	3	2	3	22
15 Jan 09	3	2	3	2	3	2	1	2	18
15 Jan 10	2	2	2	3	2	3	1	2	17
15 Jan 11	3	3	3	3	2	2	2	2	20
15 Jan 12	2	2	2	2	3	3	2	2	18
15 Jan 13	2	2	2	2	3	3	2	2	18
15 Jan 14	2	1	1	2	4	2	2	1	15
15 Jan 15	2	1	1	2	4	2	0	2	14
15 Jan 16	2	2	2	2	2	1	2	2	15
15 Jan 17	2	2	1	1	1	0	1	2	10
15 Jan 18	2	2	0	1	2	2	0	2	11
15 Jan 19	2	1	0	1	1	1	2	2	10
15 Jan 20	2	1	1	0	0	0	0	1	5
15 Jan 21	2	2	2	2	3	4	3	3	21
15 Jan 22	4	3	2	2	3	2	3	3	22
15 Jan 23	3	2	2	2	1	3	2	2	17
15 Jan 24	1	1	0	1	3	3	2	2	13
15 Jan 25	2	1	1	1	1	2	2	3	13
15 Jan 26	3	3	3	4	3	4	3	3	26
15 Jan 27	3	2	2	2	2	3	3	3	20
15 Jan 28	3	2	2	2	2	2	1	2	16
15 Jan 29	2	1	0	2	3	3	4	3	18
15 Jan 30	3	2	2	1	1	3	5	2	19
15 Jan 31	2	2	1	1	2	3	3	3	17

Mean of K-Sum is 17.7

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	11	42	105	70	15	3	2	0	0	0	0

7.6.5.3.2 February

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Feb 2015
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(')	H(nT)	Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
Nil									

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C	Chief movement(nT) H(x)	D(y)	Z
Nil				

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
15 Feb 01	3	2	3	3	2	4	4	4	25
15 Feb 02	5	4	3	4	3	4	4	3	30
15 Feb 03	3	3	2	3	4	4	3	3	25
15 Feb 04	1	1	1	2	4	3	1	2	15
15 Feb 05	1	2	2	3	4	4	3	4	23
15 Feb 06	2	1	2	1	1	1	1	1	10
15 Feb 07	2	2	3	4	2	2	2	3	20
15 Feb 08	3	3	3	2	2	2	3	3	21
15 Feb 09	2	1	1	0	4	2	2	1	13
15 Feb 10	1	1	1	0	2	2	2	2	11
15 Feb 11	2	2	0	1	2	1	0	2	10
15 Feb 12	2	1	1	1	2	2	1	2	12
15 Feb 13	1	0	0	1	2	1	1	1	7
15 Feb 14	1	1	0	0	0	1	0	3	6
15 Feb 15	2	2	1	2	3	2	2	2	16
15 Feb 16	1	2	1	2	2	1	3	4	16
15 Feb 17	4	3	3	3	2	3	3	5	26
15 Feb 18	4	3	2	2	4	3	3	3	24
15 Feb 19	2	2	2	1	1	3	3	2	16
15 Feb 20	1	1	2	2	2	1	1	2	12
15 Feb 21	2	2	0	2	2	2	1	2	13
15 Feb 22	2	1	0	1	2	2	2	1	11
15 Feb 23	3	2	3	3	3	4	3	3	24
15 Feb 24	4	3	3	3	2	2	1	3	21
15 Feb 25	1	1	3	3	3	3	2	2	18
15 Feb 26	2	0	1	1	2	0	2	2	10
15 Feb 27	1	0	0	0	1	2	1	2	7
15 Feb 28	2	1	2	2	2	4	4	3	20

Mean of K-Sum is 16.5
Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	17	54	78	50	23	2	0	0	0	0	0

7.6.5.3.3 March

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Mar 2015
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
15 Mar 17 04 45	2.88*,36.53,5.88	17(4,5,6,8)	7	40.7	260.1	181.4	Mar 18 03
15 Mar 18 09 00	...	18(5,6)	6	26.4	93.2	78.2	Mar 19 18

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
15 Mar 11 05 13	ssc	b	14.65	11.84	4.35
15 Mar 17 04 45	ssc*	b	36.53	19.95*	5.88
15 Mar 31 08 33	ssc	a	13.97	4.6	1.01

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
15 Mar 10	03:20	03:24	03:34	5.65	-1.38	-1.0	solar

K - I N D I C E S O F G E O M A G N E T I C A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
15 Mar 01	5	3	3	3	2	3	2	3	24
15 Mar 02	3	3	4	5	4	4	3	2	28
15 Mar 03	4	2	1	3	3	2	3	3	21
15 Mar 04	1	1	1	3	3	0	1	2	12
15 Mar 05	2	1	1	1	3	3	1	2	14
15 Mar 06	2	2	3	2	2	2	3	3	19
15 Mar 07	3	2	2	2	4	4	4	3	24
15 Mar 08	3	2	2	3	4	3	2	1	20
15 Mar 09	3	1	0	0	0	1	1	1	7
15 Mar 10	2	2	1	0	1	0	1	2	9
15 Mar 11	2	3	3	1	3	3	3	1	19
15 Mar 12	2	2	2	3	3	3	1	1	17
15 Mar 13	2	1	1	1	3	1	1	1	11
15 Mar 14	1	2	1	0	1	1	1	3	10
15 Mar 15	2	2	2	1	2	3	3	2	17
15 Mar 16	3	3	4	3	2	3	2	2	22
15 Mar 17	3	4	5	7	7	7	6	7	46
15 Mar 18	5	3	4	5	6	6	5	4	38
15 Mar 19	3	2	3	5	5	3	3	3	27
15 Mar 20	4	2	4	4	3	3	4	4	28
15 Mar 21	3	2	2	2	3	2	1	2	17
15 Mar 22	2	2	5	4	3	2	1	1	20
15 Mar 23	3	3	3	4	4	4	2	4	27
15 Mar 24	2	2	1	2	4	4	3	2	20
15 Mar 25	2	2	2	3	4	3	3	2	21
15 Mar 26	2	1	2	1	2	2	3	3	16
15 Mar 27	2	2	2	2	4	3	1	1	17
15 Mar 28	0	1	2	2	2	2	2	4	15
15 Mar 29	4	3	2	2	3	2	3	3	22
15 Mar 30	2	2	0	0	0	0	2	2	8
15 Mar 31	0	0	2	2	2	3	2	3	14

Mean of K-Sum is 19.7

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	14	42	79	69	28	9	3	4	0	0	0

7.6.5.3.4 April

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Apr 2015
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L M A G N E T I C S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
15 Apr 15 09 00	...	15(5,7),16(4,7,8)	5	21.4	115.0	66.9	Apr 17 12

S U D D E N S T O R M C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C	Chief movement(nT) H(x)	D(y)	Z

Nil

S O L A R F L A R E E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation

Nil

K - I N D I C E S O F G E O M A G N E T I C A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
15 Apr 01	3	2	2	2	1	2	2	2	16
15 Apr 02	1	2	3	2	3	2	4	3	20
15 Apr 03	3	1	2	2	3	3	2	3	19

```
15 Apr 04     2   2   2   1     3   4   2   2     18
15 Apr 05     2   2   1   0     1   2   2   2     12
15 Apr 06     2   1   2   0     1   1   1   1     9
15 Apr 07     2   2   0   0     1   0   1   0     6
15 Apr 08     1   0   0   0     0   2   2   1     6
15 Apr 09     3   2   2   2     2   2   3   3     19
15 Apr 10     5   4   4   3     4   3   2   2     27
15 Apr 11     2   3   4   4     4   4   2   2     25
15 Apr 12     1   0   1   0     1   1   3   0     7
15 Apr 13     2   1   2   1     1   2   2   0     11
15 Apr 14     1   0   2   2     3   4   4   2     18
15 Apr 15     3   2   2   4     5   4   5   3     28
15 Apr 16     3   3   3   5     4   4   5   5     32
15 Apr 17     4   3   3   3     3   3   3   2     24
15 Apr 18     2   2   2   2     2   4   4   3     21
15 Apr 19     3   1   2   1     2   2   3   2     16
15 Apr 20     2   2   2   1     2   2   3   3     17
15 Apr 21     3   3   4   4     4   3   2   3     26
15 Apr 22     2   1   2   2     3   2   2   2     16
15 Apr 23     1   3   2   1     0   0   1   1     9
15 Apr 24     2   1   0   1     1   0   1   0     6
15 Apr 25     0   0   0   0     0   0   0   0     0
15 Apr 26     1   0   0   0     0   0   0   0     1
15 Apr 27     1   0   1   1     2   2   2   1     10
15 Apr 28     1   1   1   2     2   1   1   0     9
15 Apr 29     0   0   0   2     1   1   1   2     7
15 Apr 30     1   1   2   0     0   0   2   0     6
Mean of K-Sum is  14.7
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           44   50   80   39   21   6    0    0    0    0    0
--------------------------------------------------------------------------
```

7.6.5.3.5 May

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin               (GNG) Geomagnetic data for May 2015
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement      SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn   D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________

15 May 12 06 31   ...               13(2,3,5,7)       5  14.2  135.7 48.6    May 14 06
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date           Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn   ssc/ssc* A,B,C    H(x)   D(y)    Z
_________________________________________________________
15 May 06 01 42   ssc*     c        1.82   -12.05*-1.89
---------------------------------------------------------
                      S O L A R   F L A R E   E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy      UT of movement      Amplitude in nT    Confirmation
               Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                 K - i n d i c e s          K-sum
15 May 01     2   2   2   0     0   1   1   2     10
15 May 02     2   3   2   1     1   2   3   3     17
15 May 03     2   2   3   2     1   2   1   1     14
15 May 04     2   1   2   1     3   3   2   1     15
15 May 05     1   0   1   3     2   1   1   1     10
15 May 06     3   3   4   3     4   5   4   2     28
15 May 07     2   2   1   0     1   2   1   1     10
15 May 08     3   2   2   2     2   1   1   1     14
15 May 09     1   1   0   3     1   2   2   2     12
15 May 10     1   1   2   4     2   2   3   2     17
```

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15 May 11     2   2   1   3     4   3   2   3     20
15 May 12     1   1   3   3     4   3   4   3     22
15 May 13     4   5   5   3     5   4   5   4     35
15 May 14     2   3   2   1     2   1   1   3     15
15 May 15     2   2   2   4     2   2   2   2     18
15 May 16     1   1   1   1     3   1   2   1     11
15 May 17     1   1   1   0     0   1   2   0     6
15 May 18     1   2   2   2     3   1   3   4     18
15 May 19     3   3   3   2     1   2   2   2     18
15 May 20     2   2   2   1     3   1   1   0     12
15 May 21     0   0   1   0     0   1   0   1     3
15 May 22     1   1   0   0     1   0   0   0     3
15 May 23     0   0   1   1     0   0   1   0     3
15 May 24     1   1   0   0     0   0   1   0     3
15 May 25     0   0   0   0     0   0   0   0     0
15 May 26     1   2   2   1     1   2   2   1     12
15 May 27     0   0   1   1     3   3   1   2     11
15 May 28     2   1   1   2     2   1   1   1     11
15 May 29     0   2   1   1     1   2   1   2     10
15 May 30     1   1   1   0     1   1   1   1     7
15 May 31     0   1   1   0     1   2   1   1     7
Mean of K-Sum is  12.6
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           43   89   67   32   12    5    0    0    0    0    0
--------------------------------------------------------------------------
```

7.6.5.3.6 June

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                 (GNG) Geomagnetic data for Jun 2015
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement      SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn   D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________

15 Jun 07 21 06   ...               8(3,5,6)          5  11.9  135.3 48.8    Jun 08 23
15 Jun 21 16 44   1.44,23.37,4.55   22(7)             7  34.9  280.7 82.5    Jun 23 15
15 Jun 25 03 00   ...               25(4,5,6)         5  15.8  95.8  52.8    Jun 26 03
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date           Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn   ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
15 Jun 21 16 44   ssc      a        23.37  10.04  4.55
15 Jun 22 18 33   ssc      a        89.9   42.68  12.71
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy    UT of movement      Amplitude in nT    Confirmation
             Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                 K - i n d i c e s          K-sum
15 Jun 01     2   1   1   2     0   0   2   0     8
15 Jun 02     0   0   0   0     0   0   0   0     0
15 Jun 03     0   1   1   1     0   0   0   0     3
15 Jun 04     0   0   0   0     0   1   0   0     1
15 Jun 05     0   0   0   0     0   0   0   0     0
15 Jun 06     1   2   1   1     1   1   0   0     7
15 Jun 07     0   1   1   1     1   1   2   3     10
15 Jun 08     3   4   5   4     5   5   3   3     32
15 Jun 09     3   3   2   1     3   3   3   2     20
15 Jun 10     2   3   3   3     3   3   3   2     22
15 Jun 11     2   2   2   2     3   3   2   1     17
15 Jun 12     1   2   1   1     2   2   2   1     12
15 Jun 13     2   1   2   2     3   2   2   2     16
```

```
15 Jun 14     5   3   2   4     2   2   2   2     22
15 Jun 15     2   2   3   4     5   2   3   2     23
15 Jun 16     3   2   2   2     1   2   2   2     16
15 Jun 17     2   2   3   3     3   3   1   1     18
15 Jun 18     2   1   1   1     2   2   1   0     10
15 Jun 19     2   1   1   1     0   0   0   0     5
15 Jun 20     0   0   0   0     0   0   0   0     0
15 Jun 21     0   0   1   0     1   3   2   2     9
15 Jun 22     1   2   3   3     3   4   7   4     27
15 Jun 23     5   5   4   5     4   2   3   3     31
15 Jun 24     3   2   3   3     3   2   2   1     19
15 Jun 25     2   3   4   5     5   5   3   3     30
15 Jun 26     2   1   2   2     0   1   0   1     9
15 Jun 27     2   2   2   1     1   0   0   1     9
15 Jun 28     2   3   3   2     3   2   3   2     20
15 Jun 29     1   1   2   1     1   1   0   0     7
15 Jun 30     1   2   1   0     0   2   2   2     10
Mean of K-Sum is  13.8
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            58   50   68   43   9    11   0    1    0    0    0
--------------------------------------------------------------------------
```

7.6.5.3.7 July

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin               (GNG) Geomagnetic data for Jul 2015
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L    M A G N E T I C    S T O R M S
------------------------------------------------------------------------------------
Commencement      SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn   D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________

15 Jul 13 00 00   ...               13(4,5,6)         5  15.8  91.4  56.8    Jul 14 03
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date           Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn   ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
15 Jul 10 15 55   ssc      c        4.69   2.83   0.97
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement       Amplitude in nT    Confirmation
              Start  Max   End     H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                   K - i n d i c e s          K-sum
15 Jul 01     1   1   1   1     2   1   1   0     8
15 Jul 02     0   1   1   0     0   0   0   0     2
15 Jul 03     0   0   0   0     0   0   0   0     0
15 Jul 04     1   0   0   1     3   2   5   4     16
15 Jul 05     4   4   3   3     3   3   3   2     25
15 Jul 06     3   3   3   2     2   1   3   1     18
15 Jul 07     2   1   1   1     0   1   1   2     9
15 Jul 08     1   0   1   1     1   3   2   1     10
15 Jul 09     1   2   2   1     2   1   2   2     13
15 Jul 10     1   1   1   0     0   1   2   3     9
15 Jul 11     3   4   3   3     3   3   3   3     25
15 Jul 12     2   3   2   2     3   3   3   2     20
15 Jul 13     2   3   4   5     5   5   4   3     31
15 Jul 14     3   1   1   1     1   1   1   1     10
15 Jul 15     1   2   1   1     2   1   2   2     12
15 Jul 16     2   3   2   3     1   2   2   1     16
15 Jul 17     1   2   0   1     1   1   1   0     7
15 Jul 18     0   0   0   1     1   1   2   1     6
15 Jul 19     0   0   1   0     0   0   0   0     1
15 Jul 20     0   0   0   2     2   1   0   0     5
```

15 Jul 21	2	1	2	2	2	1	2	2	14
15 Jul 22	1	2	1	2	2	3	2	2	15
15 Jul 23	3	2	4	3	2	3	3	2	22
15 Jul 24	2	2	1	1	3	2	2	2	15
15 Jul 25	1	2	1	2	1	1	2	3	13
15 Jul 26	3	1	1	2	1	2	2	1	13
15 Jul 27	1	2	2	4	3	2	2	2	18
15 Jul 28	1	2	1	2	3	2	3	2	16
15 Jul 29	1	1	1	2	2	0	2	0	9
15 Jul 30	1	1	1	1	3	2	3	3	15
15 Jul 31	2	2	1	2	4	3	2	4	20

Mean of K-Sum is 13.3

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	40	78	73	43	10	4	0	0	0	0	0

7.6.5.3.8 August

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Aug 2015
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	 K	Storm Ranges D(')	 H(nT)	 Z(nT)	UT End Mth Dy Hr
15 Aug 15 08 29	2.1,34.83,4.76	15(4,5)	6	21.8	163.9	106.4	Aug 16 21
15 Aug 17 03 00	...	17(4,5,6)	5	17.1	60.6	47.2	Aug 17 21
15 Aug 26 04 12	...	26(5,6)	5	17.2	73.8	59.8	Aug 26 21
15 Aug 27 15 00	...	27(6,8),28(1,6,7)	5	25.3	111.9	90.3	Aug 28 23

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	 A,B,C	Chief movement(nT) H(x)	 D(y)	 Z
15 Aug 15 08 29	ssc	a	34.83	14.81	4.76

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	 Max	 End	Amplitude in nT H(x)	 D(y)	 Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K	-	i	n	d	i	c	e s	K-sum
15 Aug 01	2	2	1	1	1	3	3	1	14
15 Aug 02	3	1	2	1	4	3	2	1	17
15 Aug 03	1	2	1	1	3	2	1	1	12
15 Aug 04	1	2	1	1	3	2	3	2	15
15 Aug 05	1	1	0	0	0	2	2	1	7
15 Aug 06	2	2	2	4	3	3	3	3	22
15 Aug 07	1	2	3	3	5	4	1	1	20
15 Aug 08	2	2	3	3	4	2	2	2	20
15 Aug 09	1	2	2	4	2	3	3	2	19
15 Aug 10	2	2	2	2	3	2	2	1	16
15 Aug 11	3	2	2	2	2	1	2	2	16
15 Aug 12	1	2	2	1	2	3	2	3	16
15 Aug 13	2	3	3	3	3	2	2	1	19
15 Aug 14	0	1	1	2	1	1	1	2	9
15 Aug 15	2	1	4	6	6	4	4	3	30
15 Aug 16	5	3	5	4	4	4	4	4	33
15 Aug 17	2	3	4	5	5	5	4	2	30
15 Aug 18	2	2	2	1	1	3	1	2	14
15 Aug 19	3	2	2	2	4	4	3	2	22
15 Aug 20	2	2	2	2	4	3	2	3	20
15 Aug 21	1	1	2	1	2	1	2	2	12
15 Aug 22	1	0	1	2	3	3	3	2	15
15 Aug 23	2	3	4	4	4	3	3	2	25

UT-Date									K-sum
15 Aug 24	1	1	2	2	2	1	2	0	11
15 Aug 25	1	1	1	2	2	3	4	2	16
15 Aug 26	2	2	3	4	5	5	4	4	29
15 Aug 27	3	3	4	3	4	5	4	5	31
15 Aug 28	5	2	2	3	4	5	5	4	30
15 Aug 29	4	2	2	3	1	3	2	1	18
15 Aug 30	1	1	1	0	0	1	2	1	7
15 Aug 31	1	1	1	1	0	2	2	1	9

Mean of K-Sum is 18.5

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	9	60	86	47	31	13	2	0	0	0	0

7.6.5.3.9 September

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Sep 2015
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
15 Sep 07 12 57	...	7(7,8)	6	26.5	103.2	92.6	Sep 08 09
15 Sep 09 06 47	...	9(4)	6	23.3	140.1	116.6	Sep 10 00
15 Sep 11 07 38	...	11(6)	7	34.1	198.2	95.7	Sep 11 18
15 Sep 15 06 00	...	15(4,5)	5	11.8	28.0	48.8	Sep 15 21
15 Sep 20 06 04	6.3,35.64,16.65	20(3,4,5,6)	5	19.9	125.0	91.3	Sep 20 18

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
15 Sep 20 06 04	ssc	a	35.64	43.92	16.65
15 Sep 26 17 07	ssc	c	6.85	8.98	2.99
15 Sep 27 20 33	ssc	c	0.77	3.69	0.64

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
15 Sep 01	2	1	1	2	2	0	1	2	11
15 Sep 02	2	1	1	1	1	3	3	2	14
15 Sep 03	1	2	1	1	1	2	2	3	13
15 Sep 04	3	3	3	4	3	3	3	2	24
15 Sep 05	1	2	3	3	3	4	3	2	21
15 Sep 06	2	2	2	3	3	2	5	3	22
15 Sep 07	2	2	2	3	5	5	6	6	31
15 Sep 08	4	3	3	1	3	2	2	3	21
15 Sep 09	3	3	5	6	5	4	5	5	36
15 Sep 10	2	1	2	1	3	4	5	3	21
15 Sep 11	3	4	6	6	6	7	3	3	38
15 Sep 12	3	3	4	4	3	3	1	2	23
15 Sep 13	1	1	1	4	3	4	3	1	18
15 Sep 14	1	1	2	3	2	5	3	2	19
15 Sep 15	2	2	2	5	5	3	3	3	25
15 Sep 16	2	2	2	2	3	3	2	3	19
15 Sep 17	3	2	3	3	1	1	0	3	16
15 Sep 18	2	2	3	4	3	2	3	3	22
15 Sep 19	2	2	3	3	2	0	1	3	16
15 Sep 20	3	4	5	5	5	5	3	3	33
15 Sep 21	3	2	1	2	2	2	1	2	15
15 Sep 22	2	2	4	1	3	2	2	2	18
15 Sep 23	1	2	2	3	3	3	3	2	19

```
15 Sep 24      3   2   2   1      1   2   2   2      15
15 Sep 25      2   2   1   3      4   1   0   2      15
15 Sep 26      2   1   0   1      0   3   3   1      11
15 Sep 27      1   2   1   0      0   0   2   1      7
15 Sep 28      2   0   0   0      1   1   2   2      8
15 Sep 29      2   1   1   0      0   0   0   1      5
15 Sep 30      1   1   0   1      0   0   1   1      5
15 Oct 01      2   1   1   1      3   4   4   3      19
Mean of K-Sum is  18.7
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            19   52   71   68   16   15   6    1    0    0    0
--------------------------------------------------------------------------
```

7.6.5.3.10 October

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                (GNG) Geomagnetic data for Oct 2015
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

15 Oct 07 06 00    ...               7(7)              6  25.2  160.5 85.4   Oct 08 21
15 Oct 18 03 00    ...               18(4)             6  21.2  94.6  106.9  Oct 18 15
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)    Z
_________________________________________________________
15 Oct 24 18 55    ssc       a       23.06  23.98  7.23
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement       Amplitude in nT    Confirmation
              Start  Max   End     H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                 K - i n d i c e s            K-sum
15 Oct 01      2   1   1   1      3   4   4   3      19
15 Oct 02      3   3   3   3      3   3   3   2      23
15 Oct 03      2   3   2   2      2   3   2   2      18
15 Oct 04      3   2   3   2      3   3   2   4      22
15 Oct 05      2   2   3   5      4   3   2   2      23
15 Oct 06      2   1   1   2      4   5   4   4      23
15 Oct 07      3   4   3   4      5   5   6   5      35
15 Oct 08      4   5   4   4      5   5   5   3      35
15 Oct 09      3   2   1   5      4   4   4   3      26
15 Oct 10      3   2   3   1      2   4   1   2      18
15 Oct 11      2   1   1   1      3   3   4   2      17
15 Oct 12      1   2   2   5      3   5   4   4      26
15 Oct 13      2   2   3   4      2   5   4   4      26
15 Oct 14      3   3   3   4      4   4   4   2      27
15 Oct 15      2   1   1   2      2   2   2   2      14
15 Oct 16      2   2   2   1      3   2   1   2      15
15 Oct 17      1   1   1   3      4   3   4   2      19
15 Oct 18      3   3   4   6      3   3   3   2      27
15 Oct 19      0   1   1   1      1   0   2   2      8
15 Oct 20      2   1   1   2      3   3   5   2      19
15 Oct 21      1   1   2   3      5   3   2   2      19
15 Oct 22      2   0   1   0      1   3   3   2      12
15 Oct 23      2   1   1   1      2   3   2   2      14
15 Oct 24      3   2   1   1      1   1   4   2      15
15 Oct 25      3   1   2   1      3   2   1   2      15
15 Oct 26      1   0   1   0      0   0   0   1      3
15 Oct 27      0   0   0   1      3   0   1   2      7
15 Oct 28      1   0   0   0      0   1   1   0      3
```

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15 Oct 29      1    0    0    1      2    0    1    2      7
15 Oct 30      1    1    0    1      4    3    2    3      15
15 Oct 31      1    1    1    1      2    2    1    3      12
Mean of K-Sum is  18.1
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           22   58   67   53   31   15    2    0    0    0    0
--------------------------------------------------------------------------
```

7.6.5.3.11 November

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin               (GNG) Geomagnetic data for Nov 2015
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L    M A G N E T I C    S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices    Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________

15 Nov 03 01 35    -3.54,13.7,5.82   3(3,5,7),4(4,5)   5  23.0  147.2 109.3   Nov 04 15
15 Nov 06 18 19    3.0,39.1,7.6      6(7),7(1,3,4,5)   5  25.0  163.6 84.5    Nov 07 21
15 Nov 08 11 47    ...               9(8),10(4,5,6)    5  16.2  90.0  71.8    Nov 11 21
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
15 Nov 03 01 35    ssc      c        13.7   -24.56 5.82
15 Nov 06 18 19    ssc      a        39.1   21.08  7.6
15 Nov 20 06 49    ssc      a        23.28  14.33  5.07
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s           K-sum
15 Nov 01      1    2    2    2      4    1    1    1      14
15 Nov 02      1    0    0    1      4    4    0    2      12
15 Nov 03      3    3    5    4      5    4    5    2      31
15 Nov 04      3    4    4    5      5    2    2    2      27
15 Nov 05      2    1    3    4      4    4    2    3      23
15 Nov 06      3    0    1    1      3    3    5    4      20
15 Nov 07      5    4    5    5      5    4    4    2      34
15 Nov 08      2    2    1    3      4    3    4    4      23
15 Nov 09      3    2    3    3      2    4    4    5      26
15 Nov 10      4    3    4    5      5    5    3    3      32
15 Nov 11      4    2    3    3      4    4    3    1      24
15 Nov 12      1    1    2    2      1    2    1    1      11
15 Nov 13      1    0    1    2      4    4    3    3      18
15 Nov 14      3    2    1    3      3    1    1    2      16
15 Nov 15      2    1    1    2      2    2    2    3      15
15 Nov 16      3    2    3    3      4    3    2    2      22
15 Nov 17      2    0    2    2      2    3    3    2      16
15 Nov 18      2    2    1    3      2    4    4    5      23
15 Nov 19      3    2    2    3      1    1    2    2      16
15 Nov 20      2    2    3    3      1    1    0    2      14
15 Nov 21      3    1    1    1      1    1    1    3      12
15 Nov 22      1    2    2    0      1    1    1    1      9
15 Nov 23      1    0    0    0      2    0    0    1      4
15 Nov 24      1    0    0    0      0    1    0    1      3
15 Nov 25      1    0    0    0      0    0    0    0      1
15 Nov 26      0    0    0    0      1    1    2    1      5
15 Nov 27      2    1    1    2      1    2    2    2      13
15 Nov 28      1    1    1    1      2    1    3    3      13
15 Nov 29      1    2    2    3      3    2    3    3      19
15 Nov 30      2    2    5    4      2    2    2    3      22
```

```
Mean of K-Sum is  17.3
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           29   57   63   45   30   16   0    0    0    0    0
--------------------------------------------------------------------------
```

7.6.5.3.12 December

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin               (GNG) Geomagnetic data for Dec 2015
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement        SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn     D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________

15 Dec 14 13 21     0.9,22.51,4.5     14(8)             6  19.6  114.1 52.0    Dec 15 06
15 Dec 19 16 17     2.82,53.64,8.44   20(7)             7  28.0  191.2 112.8   Dec 21 18
15 Dec 31 00 52     -4.44,-7.27,-5.06 31(5)             6  22.6  137.1 92.8    Jan 01 15
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date             Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn     ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
15 Dec 14 13 21     ssc      b        22.51  6.31   4.5
15 Dec 19 16 17     ssc      a        53.64  19.91  8.44
15 Dec 31 00 52     ssc      c        -7.27  -30.9  -5.06
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s         K-sum
15 Dec 01     3   1   1   2    4   5   3   3      22
15 Dec 02     2   1   2   1    3   2   1   2      14
15 Dec 03     2   1   0   1    1   1   1   2      9
15 Dec 04     1   1   1   1    1   1   0   1      7
15 Dec 05     2   1   2   3    3   4   3   2      20
15 Dec 06     2   3   2   4    4   4   4   3      26
15 Dec 07     3   3   3   3    4   4   3   3      26
15 Dec 08     3   1   2   3    4   2   2   2      19
15 Dec 09     2   2   1   2    3   3   3   2      18
15 Dec 10     3   4   3   3    3   4   4   3      27
15 Dec 11     3   2   3   4    4   4   4   2      26
15 Dec 12     2   3   3   2    2   3   1   2      18
15 Dec 13     1   1   1   3    2   1   1   2      12
15 Dec 14     1   1   1   2    4   5   5   6      25
15 Dec 15     4   2   2   2    4   4   2   3      23
15 Dec 16     3   2   1   0    0   0   1   2      9
15 Dec 17     1   1   0   1    2   3   4   2      14
15 Dec 18     2   1   0   1    1   1   1   2      9
15 Dec 19     1   1   1   1    2   4   4   4      18
15 Dec 20     4   5   4   4    5   5   7   5      39
15 Dec 21     5   4   3   4    4   3   2   3      28
15 Dec 22     2   2   4   5    2   2   3   3      23
15 Dec 23     2   2   2   2    3   3   4   3      21
15 Dec 24     3   2   2   2    3   1   2   3      18
15 Dec 25     2   2   2   2    3   2   2   2      17
15 Dec 26     3   2   2   2    4   3   3   4      23
15 Dec 27     2   1   2   3    4   2   2   2      18
15 Dec 28     3   2   2   3    3   2   0   2      17
15 Dec 29     1   0   0   1    3   3   2   2      12
15 Dec 30     1   0   1   0    2   2   1   2      9
15 Dec 31     4   3   3   4    6   4   4   5      33
Mean of K-Sum is  19.4
Frequency Distribution of K-Indices
```

```
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           12   50   77   57   39   10    2    1    0    0    0
--------------------------------------------------------------------------
```

7.6.5.4 2016

7.6.5.4.1 January

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin               (GNG) Geomagnetic data for Jan 2016
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes   Max. 3hr-K-indices    Storm Ranges       UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

16 Jan 20 09 00    ...               20(4,6,7),21(6)   5  22.6  111.5 120.2  Jan 22 03
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality   Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
16 Jan 16 10 05    ssc*     c        11.49* 2.06   0.62
16 Jan 18 21 56    ssc      b        13.69  -13.96 -3.14
16 Jan 27 04 14    ssc      b        -14.67 -1.69  -1.46
16 Jan 27 05 55    ssc      b        14.83  8.17   2.87
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                   K - i n d i c e s          K-sum
16 Jan 01     4   3   3   3     3   1   3   3        23
16 Jan 02     4   2   3   2     2   2   2   2        19
16 Jan 03     2   2   2   1     2   2   1   2        14
16 Jan 04     1   1   2   1     1   2   2   1        11
16 Jan 05     2   1   2   2     2   3   2   3        17
16 Jan 06     4   2   3   3     2   3   2   3        22
16 Jan 07     4   2   2   4     3   3   3   2        23
16 Jan 08     2   1   2   3     4   2   2   2        18
16 Jan 09     2   1   1   2     2   3   1   2        14
16 Jan 10     2   2   2   2     2   2   3   3        18
16 Jan 11     2   2   2   1     3   3   4   3        20
16 Jan 12     4   2   2   2     3   3   3   2        21
16 Jan 13     3   4   1   2     3   3   3   2        21
16 Jan 14     3   2   2   2     2   2   3   3        19
16 Jan 15     2   1   1   1     1   2   1   2        11
16 Jan 16     2   0   0   2     2   1   1   0        8
16 Jan 17     1   0   2   1     1   2   1   2        10
16 Jan 18     2   2   0   1     1   2   1   3        12
16 Jan 19     4   2   3   4     2   2   1   3        21
16 Jan 20     2   1   2   5     4   5   5   4        28
16 Jan 21     4   4   3   3     4   5   4   4        31
16 Jan 22     3   3   2   2     3   2   3   3        21
16 Jan 23     2   3   3   2     4   3   1   1        19
16 Jan 24     2   2   2   2     2   3   4   2        19
16 Jan 25     1   1   0   0     0   0   0   0        2
16 Jan 26     1   0   2   2     1   1   2   1        10
16 Jan 27     1   3   1   2     1   1   0   2        11
16 Jan 28     1   1   2   2     2   2   2   1        13
16 Jan 29     2   0   0   0     1   2   1   1        7
16 Jan 30     1   1   0   0     0   1   0   1        4
16 Jan 31     2   1   2   2     2   3   2   3        17
Mean of K-Sum is  16.3
Frequency Distribution of K-Indices
```

```
K-Index :    0    1    2    3    4    5    6    7    8    9    -
            20   54   100   50   20    4    0    0    0    0    0
--------------------------------------------------------------------------
```

7.6.5.4.2 February

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin               (GNG) Geomagnetic data for Feb 2016
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________

16 Feb 16 03 00    ...               16(6,7)           6  18.8  95.4  69.2    Feb 18 21
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)    Z
_________________________________________________________
Nil
---------------------------------------------------------
                      S O L A R   F L A R E   E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s           K-sum
16 Feb 01     2   1   2   3     0   1   0   0       9
16 Feb 02     1   0   0   1     2   3   2   3      12
16 Feb 03     4   3   2   1     1   2   1   2      16
16 Feb 04     2   2   1   3     3   2   1   2      16
16 Feb 05     3   2   2   2     3   2   3   2      19
16 Feb 06     3   1   1   1     2   2   2   2      14
16 Feb 07     2   1   2   2     2   4   2   2      17
16 Feb 08     4   3   3   2     2   1   1   1      17
16 Feb 09     2   1   2   3     3   2   2   2      17
16 Feb 10     3   2   0   1     0   2   2   2      12
16 Feb 11     3   1   2   2     3   2   3   3      19
16 Feb 12     3   2   2   3     3   2   3   3      21
16 Feb 13     3   3   3   2     1   1   0   3      16
16 Feb 14     2   1   2   2     2   3   1   2      15
16 Feb 15     1   1   2   2     3   1   2   3      15
16 Feb 16     4   3   3   5     5   6   6   4      36
16 Feb 17     4   3   4   3     5   4   5   5      33
16 Feb 18     4   4   4   4     3   4   5   3      31
16 Feb 19     3   2   2   3     3   5   4   2      24
16 Feb 20     2   1   1   1     3   2   1   2      13
16 Feb 21     2   1   0   0     1   1   3   3      11
16 Feb 22     1   1   0   1     1   2   1   2       9
16 Feb 23     2   2   0   1     1   1   3   4      14
16 Feb 24     2   2   2   2     2   2   3   2      17
16 Feb 25     2   2   2   2     1   2   1   3      15
16 Feb 26     3   3   2   0     2   2   2   1      15
16 Feb 27     1   1   1   2     1   1   2   1      10
16 Feb 28     3   1   2   1     2   1   1   1      12
16 Feb 29     2   0   1   1     2   1   1   2      10
Mean of K-Sum is  16.7
Frequency Distribution of K-Indices
K-Index :    0    1    2    3    4    5    6    7    8    9    -
            14   59   86   49   15    7    2    0    0    0    0
--------------------------------------------------------------------------
```

7.6.5.4.3 March

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Mar 2016
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
16 Mar 06 07 25	...	6(7)	6	19.9	121.1	62.3	Mar 08 03
16 Mar 20 10 32	...	20(6,7)	5	12.2	53.9	34.2	Mar 21 00

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
16 Mar 14 17 15	ssc	a	15.41	6.49	3.6

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s							K-sum
16 Mar 01	2	2	1	1	2	2	1	2	13
16 Mar 02	1	2	1	1	2	4	1	2	14
16 Mar 03	2	2	2	2	3	2	1	2	16
16 Mar 04	3	1	0	0	0	1	0	0	5
16 Mar 05	1	0	1	2	2	1	0	1	8
16 Mar 06	0	1	3	3	2	5	6	5	25
16 Mar 07	4	3	2	3	4	4	4	5	29
16 Mar 08	2	1	1	1	4	2	2	0	13
16 Mar 09	1	1	1	2	2	3	2	2	14
16 Mar 10	2	0	1	2	3	2	3	2	15
16 Mar 11	2	3	2	4	5	3	4	3	26
16 Mar 12	2	2	2	1	1	3	3	1	15
16 Mar 13	2	2	2	1	1	0	0	1	9
16 Mar 14	0	1	0	1	1	3	4	4	14
16 Mar 15	3	3	3	3	3	4	5	3	27
16 Mar 16	4	1	3	4	4	2	4	5	27
16 Mar 17	3	3	3	4	3	3	3	3	25
16 Mar 18	1	0	2	3	3	3	3	2	17
16 Mar 19	3	2	3	4	4	4	2	2	24
16 Mar 20	2	2	1	2	3	5	5	3	23
16 Mar 21	2	2	1	1	2	2	3	2	15
16 Mar 22	2	1	1	2	1	0	0	2	9
16 Mar 23	2	1	2	1	1	2	3	2	14
16 Mar 24	2	0	1	2	1	2	1	2	11
16 Mar 25	3	2	1	1	1	2	0	1	11
16 Mar 26	0	0	0	0	1	0	1	1	3
16 Mar 27	3	2	3	2	2	3	3	2	20
16 Mar 28	2	2	1	1	1	1	3	3	14
16 Mar 29	3	2	2	3	3	3	1	1	18
16 Mar 30	2	1	1	1	3	3	3	2	16
16 Mar 31	2	1	1	2	1	1	1	2	11

Mean of K-Sum is 16.2
Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	24	66	77	53	19	8	1	0	0	0	0

7.6.5.4.4 April

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Apr 2016
Location: Geographic:-31.356d 115.715d

```
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L    M A G N E T I C   S T O R M S
-------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
_____________________________________________________________________________________

16 Apr 02 15 00    ...               2(6,7)            5  15.2  87.1  32.5    Apr 03 03
16 Apr 12 18 30    10.32,31.69,20.09 12(7)             6  17.2  87.1  43.8    Apr 13 03
16 Apr 14 07 36    ...               14(5)             6  22.7  64.2  67.6    Apr 14 23
-------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
16 Apr 12 18 30    ssc      a        31.69  72.15  20.09
16 Apr 30 04 25    ssc      c        7.44   6.92   2.9
---------------------------------------------------------
                     S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date               K - i n d i c e s          K-sum
16 Apr 01     1   0   0   0     0   0   2   2     5
16 Apr 02     3   0   0   0     3   5   5   3     19
16 Apr 03     3   1   2   2     1   3   2   4     18
16 Apr 04     2   2   1   2     3   1   1   2     14
16 Apr 05     1   1   0   1     3   2   3   2     13
16 Apr 06     2   2   2   2     4   3   2   1     18
16 Apr 07     1   1   1   1     1   2   5   5     17
16 Apr 08     3   2   0   1     0   0   0   1     7
16 Apr 09     0   0   0   0     0   2   0   1     3
16 Apr 10     1   1   2   2     1   0   1   2     10
16 Apr 11     1   0   0   0     2   3   3   1     10
16 Apr 12     2   2   1   2     3   4   6   5     25
16 Apr 13     4   2   3   4     4   4   3   3     27
16 Apr 14     3   1   2   4     6   5   4   4     29
16 Apr 15     2   1   0   1     1   1   1   2     9
16 Apr 16     0   0   1   3     3   5   4   4     20
16 Apr 17     3   2   2   3     3   4   3   3     23
16 Apr 18     2   1   2   1     0   1   1   1     9
16 Apr 19     0   0   0   0     1   0   0   0     1
16 Apr 20     0   1   1   2     1   0   1   1     7
16 Apr 21     1   1   1   1     1   1   2   2     10
16 Apr 22     2   2   1   1     3   3   2   3     17
16 Apr 23     1   1   1   2     3   2   2   3     15
16 Apr 24     1   1   2   1     2   5   4   1     17
16 Apr 25     1   1   2   2     2   2   2   1     13
16 Apr 26     2   1   1   1     3   2   3   3     16
16 Apr 27     0   2   1   1     4   4   3   2     17
16 Apr 28     1   1   1   2     2   1   0   0     8
16 Apr 29     1   1   0   0     0   0   0   0     2
16 Apr 30     0   1   1   1     4   3   4   2     16
Mean of K-Sum is  13.8
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           46   75   57   34   18   8    2    0    0    0    0
--------------------------------------------------------------------------
```

7.6.5.4.5 May

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                (GNG) Geomagnetic data for May 2016
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L    M A G N E T I C   S T O R M S
-------------------------------------------------------------------------------------
```

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
16 May 02 12 00	...	2(6,7)	5	15.4	77.5	44.9	May 03 03
16 May 08 01 09	...	8(6)	7	32.3	155.4	99.9	May 09 06

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C	Chief movement(nT) H(x)	D(y)	Z
Nil				

S O L A R F L A R E E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
16 May 01	2	1	2	2	4	4	4	4	23
16 May 02	3	4	2	3	4	5	5	4	30
16 May 03	3	2	3	3	2	3	3	2	21
16 May 04	2	0	0	1	2	3	1	0	9
16 May 05	0	1	2	3	3	3	2	2	16
16 May 06	2	1	1	2	4	4	4	3	21
16 May 07	3	1	1	1	2	2	2	3	15
16 May 08	5	5	4	5	6	7	5	5	42
16 May 09	5	3	2	4	5	3	4	4	30
16 May 10	3	3	3	4	4	2	3	3	25
16 May 11	2	1	0	0	0	1	1	2	7
16 May 12	1	1	0	1	1	0	1	1	6
16 May 13	1	0	1	1	2	3	3	2	13
16 May 14	2	0	2	3	2	2	2	2	15
16 May 15	3	2	2	2	4	3	4	2	22
16 May 16	2	3	3	3	3	3	2	2	21
16 May 17	1	2	3	3	3	3	4	2	21
16 May 18	2	2	2	2	3	1	0	1	13
16 May 19	2	1	2	2	2	2	2	1	14
16 May 20	2	2	2	1	1	0	1	1	10
16 May 21	2	3	3	3	2	4	3	1	21
16 May 22	2	2	2	3	3	2	1	0	15
16 May 23	0	2	1	2	0	0	1	0	6
16 May 24	1	1	1	3	2	1	1	0	10
16 May 25	0	1	0	1	0	1	0	0	3
16 May 26	0	0	0	0	0	0	1	2	3
16 May 27	1	2	0	2	2	2	4	2	15
16 May 28	3	3	4	3	2	3	3	2	23
16 May 29	2	1	1	1	1	2	3	4	15
16 May 30	2	2	2	2	1	3	2	2	16
16 May 31	1	2	3	2	2	4	3	3	20

Mean of K-Sum is 16.8

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	31	50	79	53	24	9	1	1	0	0	0

7.6.5.4.6 June

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Jun 2016
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
16 Jun 14 17 00	...	14(7)	6	15.8	74.3	42.1	Jun 15 15

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C		Chief movement(nT) H(x)	D(y)	Z
16 Jun 04 18 34	ssc	c	1.02	7.53	1.62

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
16 Jun 01	0	1	1	1	3	2	1	1	10
16 Jun 02	0	2	0	1	0	0	0	0	3
16 Jun 03	1	0	0	0	0	0	0	0	1
16 Jun 04	0	0	0	0	0	0	2	1	3
16 Jun 05	1	2	2	2	4	4	4	3	22
16 Jun 06	3	4	3	5	4	3	3	2	27
16 Jun 07	2	2	0	2	2	2	4	2	16
16 Jun 08	1	1	0	3	2	1	0	1	9
16 Jun 09	1	0	0	0	1	0	2	0	4
16 Jun 10	0	1	0	1	3	2	3	2	12
16 Jun 11	2	2	2	1	2	2	2	4	17
16 Jun 12	1	1	2	2	2	2	3	2	15
16 Jun 13	2	3	2	2	3	1	2	2	17
16 Jun 14	1	2	1	2	2	2	6	5	21
16 Jun 15	3	2	2	3	3	1	1	0	15
16 Jun 16	2	1	1	2	2	2	2	2	14
16 Jun 17	1	1	2	2	3	2	3	1	15
16 Jun 18	1	2	2	2	2	2	2	1	14
16 Jun 19	2	2	2	1	1	3	1	1	13
16 Jun 20	1	1	1	0	0	0	1	1	5
16 Jun 21	0	1	0	1	1	1	1	0	5
16 Jun 22	0	1	0	1	1	3	3	2	11
16 Jun 23	1	2	1	0	1	2	2	4	13
16 Jun 24	3	3	3	2	2	3	2	3	21
16 Jun 25	2	1	1	1	2	2	3	2	14
16 Jun 26	1	1	1	2	2	3	3	4	17
16 Jun 27	3	1	2	1	1	0	2	1	11
16 Jun 28	1	2	1	2	2	2	2	0	12
16 Jun 29	1	0	0	1	0	2	2	1	7
16 Jun 30	0	1	0	0	0	1	4	2	8

Mean of K-Sum is 12.4

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	49	69	80	29	10	2	1	0	0	0	0

7.6.5.4.7 July

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Jul 2016
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
16 Jul 07 03 00	...	7(7),8(4,5)	5	14.4	81.5	58.1	Jul 08 21
16 Jul 24 15 27	0.3,7.59,1.47	24(7),25(4,5)	5	13.6	90.3	48.3	Jul 26 00

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C	Chief movement(nT) H(x)	D(y)	Z

16 Jul 19 23 50	ssc	a	16.04	9.36	2.07
16 Jul 24 15 27	ssc	c	7.59	1.99	1.47

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
16 Jul 01	1	2	2	1	1	1	0	0	8
16 Jul 02	0	1	1	0	3	2	2	2	11
16 Jul 03	1	2	1	2	1	2	2	2	13
16 Jul 04	1	2	2	3	1	1	3	1	14
16 Jul 05	1	0	0	0	0	1	0	1	3
16 Jul 06	0	0	0	0	0	0	1	2	3
16 Jul 07	2	3	3	3	3	3	5	3	25
16 Jul 08	2	3	3	5	5	4	3	2	27
16 Jul 09	2	2	3	3	4	3	2	1	20
16 Jul 10	2	3	2	3	3	2	2	1	18
16 Jul 11	2	2	1	2	3	2	3	2	17
16 Jul 12	3	2	3	4	3	2	2	3	22
16 Jul 13	2	2	2	2	2	2	1	2	15
16 Jul 14	2	2	3	4	1	2	2	2	18
16 Jul 15	2	2	3	3	2	2	2	2	18
16 Jul 16	3	2	2	1	4	1	2	1	16
16 Jul 17	1	1	1	1	2	2	2	2	12
16 Jul 18	0	1	2	1	0	0	0	0	4
16 Jul 19	0	0	0	0	1	2	0	3	6
16 Jul 20	4	3	3	1	2	2	1	0	16
16 Jul 21	0	0	1	1	1	2	0	1	6
16 Jul 22	1	1	2	3	2	3	3	1	16
16 Jul 23	1	3	3	2	0	0	1	1	11
16 Jul 24	2	0	1	1	1	4	5	4	18
16 Jul 25	3	2	4	5	5	3	3	3	28
16 Jul 26	1	1	0	0	2	2	2	1	9
16 Jul 27	0	0	0	0	1	0	0	2	3
16 Jul 28	1	2	3	2	2	4	4	3	21
16 Jul 29	3	3	2	3	2	4	3	2	22
16 Jul 30	3	1	1	1	1	1	2	1	11
16 Jul 31	1	0	0	1	1	2	1	0	6

Mean of K-Sum is 14.1

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	43	62	78	47	12	6	0	0	0	0	0

7.6.5.4.8 August

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin (GNG) Geomagnetic data for Aug 2016
Location: Geographic:-31.356d 115.715d
K9 range: 430nT
Variometer: LC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(')	H(nT)	Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
16 Aug 16 11 57	ssc	b	8.27	4.24	1.49
16 Aug 29 10 18	ssc	c	7.51	4.3	1.71

S O L A R   F L A R E   E F F E C T S

```
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
______________________________________________________________________
Nil
----------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
---------------------------------------------------------------------------
UT-Date                K - i n d i c e s           K-sum
16 Aug 01     1   0   0   0     0   0   1   0     2
16 Aug 02     0   2   2   2     2   3   3   4     18
16 Aug 03     3   4   4   5     4   5   3   2     30
16 Aug 04     2   3   2   3     4   4   4   1     23
16 Aug 05     1   3   3   4     3   3   2   3     22
16 Aug 06     2   2   2   4     3   3   3   2     21
16 Aug 07     2   2   2   1     3   3   2   2     17
16 Aug 08     3   1   1   1     3   4   3   0     16
16 Aug 09     1   3   2   3     3   3   2   3     20
16 Aug 10     2   3   3   4     2   3   3   3     23
16 Aug 11     1   2   2   2     1   3   2   3     16
16 Aug 12     2   2   2   2     3   2   2   2     17
16 Aug 13     2   1   1   1     2   2   2   1     12
16 Aug 14     1   1   1   1     2   0   1   0     7
16 Aug 15     1   0   1   1     1   1   0   1     6
16 Aug 16     0   0   0   1     2   2   1   2     8
16 Aug 17     -   -   2   1     1   0   3   2     -
16 Aug 18     2   1   2   1     3   2   1   2     14
16 Aug 19     0   0   0   1     3   1   2   1     8
16 Aug 20     2   1   1   0     0   0   0   0     4
16 Aug 21     0   0   0   1     2   4   1   2     10
16 Aug 22     1   0   1   0     0   2   2   1     7
16 Aug 23     1   2   1   3     5   4   5   4     25
16 Aug 24     4   2   1   4     3   2   2   4     22
16 Aug 25     1   1   2   3     3   3   3   3     19
16 Aug 26     2   0   0   0     1   2   3   1     9
16 Aug 27     1   1   0   2     1   1   1   0     7
16 Aug 28     0   0   0   2     1   0   1   0     4
16 Aug 29     0   0   0   2     3   2   3   2     12
16 Aug 30     2   2   2   2     4   4   4   4     24
16 Aug 31     2   1   2   0     1   1   2   3     12
Mean of K-Sum is  14.5
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           44   60   71   46   21   4    0    0    0    0    2
---------------------------------------------------------------------------
```

7.6.5.4.9 September

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                (GNG) Geomagnetic data for Sep 2016
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
-------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges         UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)    Mth Dy Hr
_____________________________________________________________________________________

16 Sep 03 03 00    ...               3(3,5,6)          5  13.6  72.9  43.8     Sep 04 03
16 Sep 28 03 00    ...               28(4,5,6,7)       5  19.7  88.7  71.1     Sep 28 23
16 Sep 29 03 00    ...               29(4,5,6)         5  15.1  126.4 75.4     Sep 30 03
-------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
----------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)    D(y)    Z
__________________________________________________________
16 Sep 17 09 25    ssc      c        8.7     1.98    0.89
----------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
----------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
______________________________________________________________________
Nil
```

```
--------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
-------------------------------------------------------------------------
UT-Date               K - i n d i c e s          K-sum
16 Sep 01     2   2   4   3     5   4   5   4     29
16 Sep 02     4   5   2   3     5   4   3   4     30
16 Sep 03     3   3   5   4     5   5   4   3     32
16 Sep 04     3   2   4   4     4   4   5   3     29
16 Sep 05     3   3   3   3     2   3   3   3     23
16 Sep 06     2   3   3   3     2   2   3   2     20
16 Sep 07     2   2   1   3     4   4   3   2     21
16 Sep 08     2   2   2   4     3   2   2   2     19
16 Sep 09     0   0   0   0     0   2   1   2     5
16 Sep 10     1   1   1   0     0   0   1   2     6
16 Sep 11     0   0   0   1     3   2   1   1     8
16 Sep 12     2   1   1   1     2   1   1   1     10
16 Sep 13     1   0   1   1     1   1   1   1     7
16 Sep 14     2   1   1   2     3   2   4   2     17
16 Sep 15     2   1   1   1     2   1   1   1     10
16 Sep 16     1   0   0   1     0   2   2   0     6
16 Sep 17     2   0   0   1     1   0   0   1     5
16 Sep 18     1   0   0   2     4   3   1   1     12
16 Sep 19     1   0   1   2     3   3   2   3     15
16 Sep 20     5   3   2   4     2   4   2   3     25
16 Sep 21     3   1   2   3     1   0   1   2     13
16 Sep 22     2   1   1   1     0   0   0   0     5
16 Sep 23     0   1   1   0     1   1   0   2     6
16 Sep 24     1   1   1   1     1   1   3   3     12
16 Sep 25     3   2   1   3     3   2   5   3     22
16 Sep 26     2   2   2   3     4   3   3   4     23
16 Sep 27     4   2   2   5     4   5   3   3     28
16 Sep 28     3   3   2   5     5   5   5   4     32
16 Sep 29     3   3   4   5     5   5   3   3     31
16 Sep 30     3   2   3   4     3   4   5   2     26
Mean of K-Sum is  17.6
Frequency Distribution of K-Indices
K-Index :    0    1    2    3    4    5    6    7    8    9    -
            31   57   53   52   27   20   0    0    0    0    0
-------------------------------------------------------------------------
```

7.6.5.4.10 October

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin               (GNG) Geomagnetic data for Oct 2016
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
-----------------------------------------------------------------------------------
Commencement      SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges      UT End
Yr Mth Dy Hr Mn   D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
___________________________________________________________________________________

16 Oct 12 22 12   -4.92,9.14,-7.07* 13(4,5,7)         5  18.9  145.6 95.3   Oct 14 18
16 Oct 25 06 00   ...               25(5)             6  22.9  127.4 82.0   Oct 26 21
-----------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date           Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn   ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
16 Oct 12 22 12   ssc*     a        9.14   -34.52 -7.07*
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
--------------------------------------------------------------------
Yr Mth Dy    UT of movement      Amplitude in nT    Confirmation
             Start  Max   End    H(x)  D(y)   Z
____________________________________________________________________
Nil
--------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
-------------------------------------------------------------------------
UT-Date               K - i n d i c e s          K-sum
16 Oct 01     2   3   2   2     3   3   4   3     22
16 Oct 02     2   2   1   3     4   3   4   3     22
```

```
16 Oct 03     2   2   2   1     3   3   4   3     20
16 Oct 04     3   3   1   4     4   3   4   2     24
16 Oct 05     3   1   2   2     2   3   2   2     17
16 Oct 06     1   1   2   0     0   3   3   2     12
16 Oct 07     2   1   1   1     2   3   2   1     13
16 Oct 08     2   2   1   3     2   2   2   1     15
16 Oct 09     1   0   0   1     3   2   3   1     11
16 Oct 10     2   2   2   1     2   4   4   2     19
16 Oct 11     1   1   1   1     0   0   0   2     6
16 Oct 12     1   1   0   0     1   1   1   4     9
16 Oct 13     2   2   3   5     5   4   5   4     30
16 Oct 14     4   1   3   3     3   2   1   1     18
16 Oct 15     2   2   2   2     3   3   3   3     20
16 Oct 16     3   1   2   2     3   3   5   3     22
16 Oct 17     3   3   3   5     3   4   4   3     28
16 Oct 18     3   2   3   2     2   2   1   3     18
16 Oct 19     2   1   1   2     1   2   2   1     12
16 Oct 20     2   0   0   0     0   0   1   0     3
16 Oct 21     1   0   0   0     0   0   0   1     2
16 Oct 22     2   1   1   2     3   3   3   2     17
16 Oct 23     0   3   2   2     3   3   3   2     18
16 Oct 24     2   2   3   3     4   3   2   2     21
16 Oct 25     3   2   3   4     6   5   4   5     32
16 Oct 26     3   3   3   5     5   5   4   4     32
16 Oct 27     2   2   3   3     4   4   4   2     24
16 Oct 28     2   2   3   3     4   4   3   4     25
16 Oct 29     4   4   4   3     5   3   3   3     29
16 Oct 30     3   2   2   3     5   3   3   2     23
16 Oct 31     2   2   2   3     3   3   2   2     19
Mean of K-Sum is  18.8
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           22   39   73   72   29   12   1    0    0    0    0
--------------------------------------------------------------------------
```

7.6.5.4.11 November

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin               (GNG) Geomagnetic data for Nov 2016
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L    M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes   Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality   Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)    D(y)    Z
_________________________________________________________
16 Nov 05 22 26    ssc      c        1.19    -7.1    -2.01
16 Nov 09 06 43    ssc      a        18.74   13.3    4.09
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement       Amplitude in nT    Confirmation
              Start  Max    End    H(x)   D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                 K - i n d i c e s           K-sum
16 Nov 01     1   0   2   4     4   3   2   3     19
16 Nov 02     2   2   1   2     4   4   2   4     21
16 Nov 03     3   2   4   4     4   3   3   4     27
16 Nov 04     1   1   1   0     1   0   2   0     6
16 Nov 05     2   0   0   0     0   0   0   1     3
16 Nov 06     1   0   1   2     3   1   1   2     11
16 Nov 07     1   0   2   1     1   1   0   0     6
```

```
16 Nov 08     1   0   0   1     2   0   0   1     5
16 Nov 09     1   0   3   2     2   2   2   2     14
16 Nov 10     2   2   2   3     4   4   3   4     24
16 Nov 11     3   2   2   2     2   3   3   3     20
16 Nov 12     2   3   2   5     4   4   4   3     27
16 Nov 13     3   2   3   4     3   3   4   2     24
16 Nov 14     2   2   2   3     3   3   3   3     21
16 Nov 15     2   1   1   2     3   2   1   2     14
16 Nov 16     1   1   1   0     0   0   2   1     6
16 Nov 17     1   0   1   0     0   2   1   2     7
16 Nov 18     1   1   0   0     0   2   1   1     6
16 Nov 19     0   0   0   0     1   2   1   1     5
16 Nov 20     1   1   2   2     2   1   1   2     12
16 Nov 21     2   2   1   1     2   3   3   3     17
16 Nov 22     1   1   2   3     3   4   3   4     21
16 Nov 23     3   1   2   2     1   2   4   2     17
16 Nov 24     3   2   3   3     4   4   4   3     26
16 Nov 25     3   4   3   2     4   3   5   3     27
16 Nov 26     3   1   2   3     2   3   3   3     20
16 Nov 27     2   2   2   2     3   2   2   1     16
16 Nov 28     2   1   1   1     2   3   2   2     14
16 Nov 29     2   1   0   2     2   1   3   2     13
16 Nov 30     1   2   1   1     1   2   1   0     9
Mean of K-Sum is  15.3
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           34   58   73   48   25    2    0    0    0    0    0
-------------------------------------------------------------------------
```

7.6.5.4.12 December

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Gingin                 (GNG) Geomagnetic data for Dec 2016
Location:    Geographic:-31.356d  115.715d
K9 range:  430nT
Variometer: LC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
-----------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices    Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K   D(')  H(nT) Z(nT)   Mth Dy Hr
___________________________________________________________________________________

Nil
-----------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)    D(y)    Z
_________________________________________________________
16 Dec 06 07 43    ssc       c       10.58   4.86    1.32
---------------------------------------------------------
                      S O L A R   F L A R E   E F F E C T S
--------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
____________________________________________________________________
Nil
--------------------------------------------------------------------
     K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y
-------------------------------------------------------------------------
UT-Date                 K - i n d i c e s          K-sum
16 Dec 01     2   3   3   1     1   0   0   1     11
16 Dec 02     1   0   1   1     2   2   1   1     9
16 Dec 03     0   0   0   0     0   2   2   0     4
16 Dec 04     0   1   0   1     1   1   1   1     6
16 Dec 05     2   1   0   0     2   2   2   2     11
16 Dec 06     2   1   2   2     4   3   1   2     17
16 Dec 07     2   0   2   1     2   4   4   3     18
16 Dec 08     3   3   2   3     4   5   4   3     27
16 Dec 09     3   2   3   4     2   4   4   4     26
16 Dec 10     3   2   2   3     4   4   2   2     22
16 Dec 11     3   3   2   3     3   4   3   1     22
16 Dec 12     2   1   1   1     1   2   2   2     12
16 Dec 13     1   1   1   1     2   1   1   2     10
16 Dec 14     1   0   0   2     1   1   2   1     8
```

16 Dec 15	1	1	1	1	1	1	1	0	7
16 Dec 16	2	1	0	0	0	0	1	1	5
16 Dec 17	1	0	1	2	2	2	3	3	14
16 Dec 18	3	2	2	2	3	2	2	2	18
16 Dec 19	2	1	1	1	1	2	2	2	12
16 Dec 20	1	0	1	1	2	3	1	3	12
16 Dec 21	3	1	1	3	4	5	4	3	24
16 Dec 22	4	3	3	3	3	3	4	3	26
16 Dec 23	3	2	3	4	3	4	4	3	26
16 Dec 24	2	2	3	2	3	4	2	3	21
16 Dec 25	3	2	1	5	3	4	4	2	24
16 Dec 26	3	2	3	3	4	3	2	3	23
16 Dec 27	3	2	2	2	3	2	3	2	19
16 Dec 28	2	1	1	1	1	2	0	1	9
16 Dec 29	1	1	1	1	2	3	1	1	11
16 Dec 30	1	1	0	1	2	2	1	1	9
16 Dec 31	1	1	1	4	5	3	4	3	22

Mean of K-Sum is 15.6

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	25	75	67	52	25	4	0	0	0	0	0

7.7 Canberra

7.7.1 INTERMAGNET 'readme' files

7.7.1.1 2013

```
                                   CNB
              CANBERRA OBSERVATORY INFORMATION 2013
ACKNOWLEDGE-  Users of the CNB data should acknowledge:
      -MENTS: Geoscience Australia

STATION ID:   CNB
LOCATION:     Canberra, Australian Capital Territory,
              Australia
ORGANISATION: Geoscience Australia

CO-LATITUDE:  125.31 Deg.
LONGITUDE:    149.36 Deg. E
ELEVATION:    859 metres

ABSOLUTE
INSTRUMENTS:  DI-fluxgate magnetometer (DIM)
              GSM90 Overhauser-effect magnetometer

RECORDING
VARIOMETER:   Three component Narod ringcore fluxgate
              (RCF) magnetometer;
              GSM90 Overhauser-effect magnetometer

ORIENTATION:  Magnetic NW, NE and Vertical
DYNAMIC RANGE:unlimited
RESOLUTION:   0.025nT
SAMPLING RATE:1 second
FILTER TYPE:  Intermagnet

BACKUP
VARIOMETER:   LEMI fluxgate variometer

K-NUMBERS:    Computer-assisted scaling
K9-LIMIT:     450 nT

GINS:         Edinburgh
SATELLITE:    E-mail to 2008-03-11
              Http from 2008-03-11

OBSERVERS:    P. Crosthwaite
              A. Hitchman
              W. Jones
              A. Lewis
              L. Wang

CONTACT:      Geomagnetism Project
              Geoscience Australia
              G.P.O. Box 378
              Canberra,  A.C.T.,  2601
              Australia

              Tel: + 61-2-6249-9111
              Fax: + 61-2-6249-9986
```

e-mail: geomag@ga.gov.au
WWW: http://www.ga.gov.au

NOTES:

Some of those details are available from the INTERMAGNET definitive data set using IMCDViewer software.

The Canberra magnetic observatory is the principal observatory in the Australian geomagnetic observatory network. It is located in the Australian Capital Territory, approximately 30 km to the east of the city of Canberra.

The observatory is on an 8 hectare site and comprises:

* an office building for historical reasons called the Recorder House;

* a Variometer House 85 m NW of the Recorder House;

* a Secondary Variometer House some 80 m west of the Recorder House;

* an Absolute House 65 m NE of the Recorder House;

* a Comparison House 12 m west of the Absolute House;

* a sheltered external observation site near the Absolute House;

* four azimuth pillars;

* two tripod stations for azimuth control and external magnetic reference;

* the Geoscience Australia Magnetometer Calibration Facility 120 m SE of the Recorder House;

* a Test House 220 m north of the Recorder House (which now houses Australian Tsunami Warning System (ATWS) equipment);

* an ATWS vault, and;

* a seismic vault.

Table 8.1. Key observatory data.

IAGA code: CNB	
Commenced operation:	1978
Geographic latitude:	35d 18' 52.6" S
Geographic longitude:	149d 21' 45.4" E
Geomagnetic latitude:	-42.17d
Geomagnetic longitude:	227.23d
K 9 index lower limit:	450 nT
Principal pier:	Pier AW
Pier elevation (top):	859 m AMSL
Principal reference mark:	NW pillar
Reference mark azimuth:	328d 37' 03"
Reference mark distance:	137.3 m
Observer in charge:	P.Crosthwaite

Local meteorological conditions

The meteorological temperature at Canberra Airport during 2013 varied from a minimum -6.0C (2013-07-25) to a maximum +42.0C (2013-01-18). Daily minimum temperatures varied from -6.0C to +20.5C (average +6.2+/-5.8C); daily maximum temperatures varied from +8.0C to +42.0C (average 21.7+/-6.9C); daily temperature ranges varied from 0.8C to 28.4C (average 15.5+/-5.4C). An average day around the peak of summer varied from 15C to 32C; an average day around peak of winter varied from 1C to 14C.

The daily maximum wind gust varied from 13 to 93 km/h (average 42+/-14 km/h). The maximum daily maximum wind gust was 93 km/h on 2013-11-21. The minimum daily maximum wind gust was 13 km/h in 2013-07-02.

Variometers

The variometers used during 2013 are described in Table 8.2.

Two 3-component variometer systems operated at the Canberra observatory in 2013.

A Narod ring-core fluxgate operated on a pier in the eastern room of the Variometer House. The room was temperature-stabilised with a globe heater. An Overhauser-effect GSM90 scalar variometer was housed in the western room of the same building. An acquisition computer in the western room recorded both vector and scalar data; timing was controlled by a Trimble Acutime GPS clock.

A LEMI fluxgate variometer operated on a pier in the Secondary Variometer House. The room was temperature-stabilised with a globe heater. An acquisition computer was located in the same room; timing was controlled by a Garmin GPS clock. The GSM90 scalar data (accessed across the local area network) from the Narod variometer system were also recorded with LEMI data.

During 2013, preliminary real-time 3-component variations were supplied to users and data repositories using the time series recorded by the Narod magnetometer. The 2013 definitive 3 component data set for the observatory was also derived from the Narod time series. No gaps in-filled with LEMI data during 2013. Weekly, semi-monthly, and monthly K indices and storm reports were scaled from the Narod data.

The variometer environments were controlled only by a heater, which was generally adequate on cold to mild days. However, on hot days the variometer temperatures were not well controlled. Further, the Narod sensor temperature has not functioned for some years, although it is in the same room as the temperature-monitored electronics.

The daily average Narod-electronics temperature appeared to vary from 24.5C (2013-08-20) to 26.5C (2013-01-18) during the year. The daily-average LEMI-sensor temperature appeared to vary from 22.1C (2013-08-20) to 30.4C (2013-01-08) during the year; the sensor temperature was well controlled from April to October, but not during hotter months. The daily-average LEMI-electronics temperature appeared to vary from 35.6C (2013-08-20) to 45.9C (2013-01-08) during the year.

The periods of greatest temperature stability (April to October) coincide with the best agreement between definitive Narod and LEMI data. During April to October, daily average Narod and LEMI data agree within 1 nT. During other periods, agreement is within 4 nT in X and Y (Z data agree within 1 nT throughout the year). Inadequate temperature control is one of the major influences on data quality. I think that this evidence indicates we may be able to produce 1 nT absolute accuracy data if we can produce a temperature stable environment, and that our current installation can only produce an accuracy of at best several nT during much of the year.

Narod 1-second data required de-spiking. On average 35 seconds per day of Z data were corrected, and about 10 seconds per day of X and Y data. The highest error rates were on thunderstorm days.

(A spike detection required a value to deviate from the local linear trend by 5 times the maximum of (0.1nT, or 8/9 fractile of deviations during the following minute or so).)

The LEMI data were not used in 2013 definitive data, but were of high quality and useful to determine data corruption.

No de-spiking was applied to the GSM90 data.

Table 8.2. Magnetic variometers used in 2013.

See Appendix C for a schematic of their configuration.

3-component variometer: Narod (CNB)
Serial number: 9004-2
Type: ring-core fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
Scale value: 0.025 nT/count

3-component variometer: LEMI (CN1)
Serial number: 004_A
Type: linear-core fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
A/D converter: ADAM 4017 module (+/-5V)
Scale value: 0.05 nT/count

Total-field variometer: GEM Systems GSM90
Serial number: 803810 / 81225
Type: Overhauser effect
Acquisition interval:10 s
Resolution: 0.01 nT

Data acquisition system:
GDAP: PC-104 computer, QNX OS

```
Timing:         Garmin / Trimble GPS clocks
Communications:radio link
```

Variometer clock corrections

Time stamps applied to the primary (Narod) variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2013, adjustments to the system clock were less than 1 ms except on the following occasions:

CNB

```
2013-02-19    02:03:00 +0.002 s

2013-07-12    07:39:05 +0.001 s

2013-07-29    02:09:01 +0.001 s
```

Time stamps were applied in the same manner to the backup (LEMI) variometer data from an independent acquisition computer system clock. That clock was synchronised to a GPS clock. During 2013, adjustments to that system clock were less than 1 ms except on the following occasions:

```
2013-10-20    23:51:17 +1.357 s
              System restart as clock program failed
```

Absolute instruments

The principal absolute magnetometers used at Canberra and their adopted corrections for 2013 are described in Table 8.3. The absolute instruments used at Canberra also served as the Australian observatory reference instruments.

The instrument corrections given in Table 8.3 for DIM DI0086/353756 were obtained from comparisons against the travelling reference, B0610H/160459, at Canberra observatory on 2008-07-30. International comparison via a travelling reference PPM to other nations' PPMs and frequency standards results in the correction adopted for GSM90 905926/21867.

At the 2013 mean magnetic field values at Canberra (X=23180 nT, Y=5145 nT, Z= -52986 nT) these D, I and F corrections translate to corrections of:

```
DX = -2.2 nT    DY = -0.8 nT    DZ = -1.0 nT
```

These corrections have been applied to Canberra 2013 final data.

The absolute instrument parameters showed no unexplained unusual pattern during 2013.

DIM DI0086/353756 fluxgate offset T0 was -5.1+/-1.5 nT; its sensor misalignment angles d and e were altered by a bump in 2013-01-22 and realigned on 2013-01-29; they changed by about 1 to 2 in mid-June for no recorded reason. On most occasions from July, a Pico Analogue to Digital converter was used to record the fluxgate readings automatically.

The standard deviation of the difference between GSM90 905926/21867 and the variometer GSM90 during each set of 8 readings during 2013 was -0.09+/-0.15 nT.

Table 8.3. Absolute magnetometers and their adopted corrections for 2013.

Corrections are applied in the sense Standard = Instrument + correction.

```
DI fluxgate:   DMI
Serial number: DI0086
Theodolite:    Zeiss 020B
Serial number: 353756
Resolution:    0.1
D correction:  -0.05
I correction:  -0.15

Total-field magnetometer: GEM Systems GSM90
Serial number: 905926 / 21867
Type:          Overhauser effect
Resolution:    0.01 nT
Correction:    0.0 nT
```

Baselines

The automated procedure that fits a piecewise linear spline curve to the baseline residuals to derive final baseline parameters for the variometers was not applied for 2013 as it was for some previous years. Instead linear splines were adopted manually. The adopted baselines had a range of 7 nT, 4 nT and 2 nT in X, Y and Z during 2013.

With drift corrections applied, the standard deviations in the difference of absolute observations from the final variometer model were:

X 0.8 nT
Y 1.2 nT
Z 0.4 nT
D 10"
I 3"
F 0.3 nT

These data are based on 113 observations, comprising mostly weekly pairs of observations.

With drift corrections applied, there was a 0.7 nT range and 0.1 nT standard deviation in the daily-average FCheck throughout the year.

Observed and adopted baseline values in X, Y and Z for 2013 are shown in Figure 8.1.

For comparison, the corresponding standard deviations for the LEMI variometer were:

X 0.9 nT
Y 1.1 nT
Z 0.5 nT
D 10"

I 3"
F 0.3 nT

Both the Narod and LEMI variometers performed very well throughout 2013. The difference between the absolute and variometer GSM90s showed little variation throughout the year - the difference (after correcting for scalar pier difference) was -0.09 +/- 0.15 nT with a range [-.45 nT,+.25 nT].

The Narod baseline variation throughout the year seemed to follow a seasonal pattern, and I would conclude that the baselines are influenced by environmental factors and not random drift. As reported in the 2012 report, using uncorrected baselines, the Narod FCheck throughout the year appeared to be correlated to the electronics temperature delayed by 19 days at 3.6 nT/C. During 2013, there appeared a similar pattern with a 30 day delay at 2.9 nT/C. Again, I cannot explain this apparent correlation.

The LEMI FCheck followed a different pattern and was well within a range +/-1 nT. Overall, the LEMI baseline changes were smaller than for the Narod. Note that the LEMI sensor is suspended and is positioned on a larger pier than the Narod.

Variometer comparison

The 2013 definitive Canberra data (100% primary Narod variometer and 0 % LEMI variometer) were compared to the LEMI variometer data. Both Narod and LEMI data sets were aligned using the same methodology using the one set of absolute observations and used to create INTERMAGNET Archive Format binary files which were compared. The LEMI data were processed a little less thoroughly than the Narod data.

The annual statistics of the 525394 available minute-differences of the two data sets (Narod - LEMI) were:

	X	Y	Z
Average	-0.3	0.0	-0.2
Std.dev	+1.0	+1.1	+0.4
Min	-5.2	-4.6	-1.2
Max	+2.3	+4.9	+1.4

The annual statistics of the 365 daily averages of the difference between the two 1-minute data sets (Narod - LEMI) were:

	X	Y	Z
Average	-0.3	+0.0	+0.2
Std.dev	+0.9	+1.0	+0.4
Min	-4.0	-3.9	-1.0
Max	+1.4	+3.6	+1.1

The annual statistics of the 12 monthly averages of the difference between the two 1-minute data sets (Narod - LEMI) were:

	X	Y	Z
Average	-0.3	-0.0	+0.2

```
Std.dev  +0.7 +0.8 +0.4
Min      -1.6 -1.1 -0.5
Max      +0.8 +1.5 +0.6
```

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2013 CNB definitive data and real time reported 1-minute data sets (CNB definitive - CNB real time) were:

```
           X    Y    Z
Average  -0.2 +0.4 -0.1
Std.dev  +1.3 +1.2 +1.0
Min      -2.0 -1.7 -2.3
Max      +1.8 +2.1 +1.0
```

The CNB 2013 reported real time data are within
the specification for INTERMAGNET Quasi-definitive data.
This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2013 CNB definitive data and quasi-definitive 1-minute data sets (CNB definitive - CNB quasi-definitive) were:

```
           X    Y    Z
Average  -0.1 +0.0 +0.1
Std.dev  +0.6 +0.6 +0.3
Min      -1.3 -1.3 -0.2
Max      +0.6 +0.7 +0.6
```

The CNB 2013 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

Weekly absolute observations were performed by staff of the Geomagnetism Project. Other duties included computer assisted hand scaling of K indices and monitoring database and data-delivery programs.

Data from the Narod, LEMI and GSM90 variometers were acquired on a computer at the observatory and were automatically retrieved to Geoscience Australia via a radio link every 2 to 6 minutes.

Quasi-definitive data were delivered to the Edinburgh GIN monthly on most occasions.

The distribution of Canberra 2013 data is described in Table 8.4. Data losses are identified in Table A.6.

Data from all magnetometers (Narod, LEMI, and GSM90) from 2013-05-28T03:37 to 2013-05-28T03:41 were corrupted (5 minutes); the reason is not known. Data from all magnetometers (Narod, LEMI, and GSM90) from 2013-10-14T20:59 to 2013-10-15T00:18 were corrupted (200 minutes) by unauthorised helicopter operations (ACT Government, Territory and Municipal Services).

```
Table 8.4. Distribution of Canberra 2013 data.
----------------------------------------------
Recipient Status Sent
1-second values
IPS Radio and Space Services preliminary realtime
INTERMAGNET preliminary real time

1-minute values
INTERMAGNET preliminary real time
INTERMAGNET preliminary daily
INTERMAGNET quasi-definitive monthly
INTERMAGNET definitive June 2014
WDC for Geomagnetism preliminary real time
ISGI, France preliminary real time
ISGI, France preliminary daily
GeoForschungsZentrum, Germany preliminary 3-hourly
NOAA Space Weather Prediction Center preliminary Real-time
University of Oulu, Finland preliminary hourly

K indices

IPS Radio and Space Services weekly
University of Newcastle weekly
British Geological Survey weekly
CLS, CNES, France weekly
ISGI, France weekly
Royal Observatory of Belgium weekly
GeoForschungsZentrum, Germany semi-monthly

Principal magnetic storms and rapid variations

WDC for Solar-Terrestrial Physics monthly
WDC for Geomagnetism monthly
Observatori de lEbre,Spain monthly

Significant events
------------------
2013-01-22 Standard DIM topples over. Sensor knocked
           slightly. Second obs collected but very high X2.
           Poor observation.
2013-01-23 Comparison made between standard DIM and
           back-up travel reference.
           D= +0.0018 I= -0.0026. Good correlation in
           residuals between day 21 and day 23.
           Maybe remove day 22?
2013-02-09 looks like a LEMI Z channel change 05:36
           causing .4 nT shift in FCheck over 10 to 20
           seconds
2013-02-13 Comparison of DI0134 359142 was performed on
           04 Feb and 13 Feb.The vertical circle of the DIM
           appeared sticky.
           See comments on temp_034.obs and temp_042.obs
2013-02-19 Forest closure 28th of Feb to the 3rd of Mar.
2013-02-22 Sent NGL QD data 2013/01
2013-02-25 Sent NGL QD data 2012/07 to 2012/12
2013-04-04 GdapClock stopped working 23:10. Tested with
           qtalk (&p232 dtr off 0x2f8 in a different shell)
           and the Garmin was OK.
           Restarted clock program 2013-04-05 00:55
           05/04/13 00:54:58 - CLK I 0 Started
           05/04/13 00:55:59 - CLK I 0 Correction 1365123359
```

```
           593512676 C 0s 727331 R 0s 1588
           05/04/13 00:56:41 - CLK I 0 Correction 1365123401
           593862478 C 0s 28140 R 0s 1559
2013-05-28 03:37 Corrupted data on both CNB and CN1
           variometers.Unidentifed cause.
2013-07-16 Absolute observations - keys left in absolute
           hut door during observations by mistake/PGC.
2013-08-02 Training Paul Jamieson at observatory; 1 fwd
           Obs PJ then 1 rev Obs PGC
2013-09-22 Mountain bike event in East Kowen Forest 0730
           - 1400 LT. Trail preparations prior to this date.
2013-10-14/15 Data contamination on both systems.
           Helicopter and refueling truck operating inside
           the observatory near the variometer buildings.
           Apparently authorised by ACT TAMS. Request
           operations to move away from the variometer
           buildings.
2013-10-15 Rang ACT TAMS "Public Use Team" on 6205 8794 -
           contact provided was Rebecca Blundell
           0417 934 911. The operations will finish today,
           GA's contact details recorded in their system
           for future use.
           Contamination in 1st ~18 min of 2013/10/15 when
           trucks moved away from narod and Lemi.
           WVJ. Spoke with Lexi Williams (ACT TAMS Fire
           Management Unit) 02 6205 281 / 0419 161 387
           wrt getting observatory site into their atlas,
           including contact details and a note to contact
           GA before entering the site.
2013-10-20 23:40 Enter Backup variometer hut (LEMI) for
           Antarctic Training.
           Restart CN1 to fix clock problem.
           CN1 last correction 18/10/13 00:11:40;
           Restarted GdapClock 2013-10-20 23:40:no
           reaction! Shutdown 23:49
           Correction 23:51:17 1.357s
2013-11-13 Discover circuit breaker for UPS to MagCAL
           tripped. Reset breaker and start-up UPS,
           UPS blows-up and smokes when it is switched from
           stand-by to "on-line". Bring UPS back to office
2013-11-19 LM and JW install Powerware 9120 UPS + battery
           box in control hut for MAGCAL
2013-12-13 Ativo on site all day. Fixing sign and any
           other maintainence issues. Not expected to enter
           variometer huts but possibly Magcal. Asked if
           they could note times they enter.

Annual mean values
------------------
The annual mean values for Canberra are set out in Table 8.5
and displayed with the secular variation in Figure 8.2.

Hourly mean values
------------------
Plots of the hourly mean values for Canberra 2013 data are
shown in Figure 8.3.

K indices
---------
K indices for Canberra have been derived using a
computer-assisted method developed at Geoscience Australia
```

and based on the IAGA-accepted LRNS algorithm. Canberra K indices contribute to the global Kp and aa indices, the southern hemisphere Ks index, and all their derivatives. K indices measured in 2013 are listed in Table 8.6. The frequency distribution of the K indices and the annual mean daily K sum are given in Table 8.7. Principal magnetic storms observed at Canberra are listed in Table 8.8, storm sudden commencements in Table 8.9 and solar flare effects Table 8.10.

Figure 8.1. Canberra 2013 baseline plots.

Table 8.5. Canberra annual mean values calculated using monthly mean values over All days, the 5 International Quiet days and the 5 International Disturbed days in each month.
Plots of these data with secular variation in X, Y, Z and F are shown in Figure 8.2.

Year	Days	D (d)		I (d)		H(nT)	X(nT)	Y(nT)	Z(nT)	F(nT)	
2013.5	A	12	30.8	-65	51.7	23744	23180	5145	-52986	58063	ABZ
2013.5	Q	12	30.8	-65	51.4	23750	23186	5146	-52985	58064	ABZ
2013.5	D	12	30.9	-65	52.5	23730	23166	5142	-52989	58060	ABZ

Appendix A. Data losses

Table A.8 Canberra data losses.

Date	Interval (hh:mm)	Data loss (minutes)
Vector data		
2013-05-28	03:37 - 03:41	5
2013-10-14	20:59 -	
2013-10-15	- 00:18	200
Scalar data		
2013-05-28	03:37 - 03:41	5
2013-10-14	20:59 -	
2013-10-15	- 00:18	200

Table A.12. Summary of 2013 data losses from Australian observatories.

Observatory	Vector (minutes)	(%)	Scalar (minutes)	(%)
Canberra	205	0.04	205	0.04

Appendix B. Backup data

Table B.1. Canberra CN1 data used for infill of CNB variometer during 2013.

Date	Interval (hh:mm)	Data infilled (minutes)
	nil	0

```
                     < END >
```

7.7.1.2 2014

```
                                       CNB
              CANBERRA OBSERVATORY INFORMATION 2014
ACKNOWLEDGE-  Users of the CNB data should acknowledge:
      -MENTS: Geoscience Australia

STATION ID:   CNB
LOCATION:     Canberra, Australian Capital Territory,
              Australia
ORGANISATION: Geoscience Australia

CO-LATITUDE:  125.314 Deg.
LONGITUDE:    149.363 Deg. E
ELEVATION:    859 metres

ABSOLUTE
INSTRUMENTS:  DI-fluxgate magnetometer (DIM)
              GSM90 Overhauser-effect magnetometer

RECORDING
VARIOMETER:   Three component Narod ringcore fluxgate
              (RCF) magnetometer;
              GSM90 Overhauser-effect magnetometer

ORIENTATION:  Magnetic NW, NE and Vertical
DYNAMIC RANGE:unlimited
RESOLUTION:   0.025nT
SAMPLING RATE:1 second
FILTER TYPE:  Intermagnet

BACKUP
VARIOMETER:   LEMI fluxgate variometer

K-NUMBERS:    Computer-assisted scaling
K9-LIMIT:     450 nT

GINS:         Edinburgh
SATELLITE:    E-mail to 2008-03-11
              Http from 2008-03-11

OBSERVERS:    P. Crosthwaite
              W. Jones
              A. Lewis
              L. Wang
              P. Burke

CONTACT:      Geomagnetism Project
              Geoscience Australia
              G.P.O. Box 378
              Canberra,  A.C.T.,  2601
              Australia

              Tel: + 61-2-6249-9111
              Fax: + 61-2-6249-9986
              e-mail: geomag@ga.gov.au
              WWW: http://www.ga.gov.au
```

NOTES:

The Canberra magnetic observatory is the principal observatory in the Australian geomagnetic observatory network. It is located in the Australian Capital Territory, approximately 30 km to the east of the city of Canberra.

The observatory is on an 8 hectare site and comprises:

* an office building, for historical reasons called the Recorder House;

* a Variometer House 85 m NW of the Recorder House;

* a Secondary Variometer House some 80 m west of the Recorder House;

* an Absolute House 65 m NE of the Recorder House;

* a Comparison House 12 m west of the Absolute House;

* a sheltered external observation site near the Absolute House;

* four azimuth pillars;

* two tripod stations for azimuth control, one available for external magnetic reference;

* the Geoscience Australia Magnetometer Calibration Facility 120 m SE of the Recorder House;

* a Test House 220 m north of the Recorder House (which now houses Australian Tsunami Warning System (ATWS) equipment);

* an Australian Tsunami Warning System seismometer vault;

* an old seismic vault.

Table 1. Key observatory data.

IAGA code: CNB	
Commenced operation:	1978
Geographic latitude:	35d 18' 52.6" S
Geographic longitude:	149d 21' 45.4" E
Geomagnetic latitude:	-42.17d
Geomagnetic longitude:	227.23d
K 9 index lower limit:	450 nT
Principal pier:	Pier AW
Pier elevation (top):	859 m AMSL
Principal reference mark:	NW pillar
Reference mark azimuth:	328d 37' 03"
Reference mark distance:	137.3 m
Observer in charge:	P.Crosthwaite

Local meteorological conditions

The meteorological temperature at Canberra Airport during the year varied from a minimum -7.6 C (2014-08-05) to a maximum +40.2 C (2014-01-15). Daily minimum temperatures varied from -7.6 C to +18.8 C (average +6.7+/-6.1 C); daily maximum temperatures varied from +7.0 C to +40.2 C (average 21.5+/-7.4 C); daily temperature ranges varied from 2.1 C to 28.5 C (average 14.8+/-5.4 C).

The daily maximum wind gust varied from 13 to 100 km/h (average 40+/-14 km/h). The maximum daily maximum wind gust was on 2014-05-27. The minimum daily maximum wind gust occurred on three days 2014-04-01, 2014-06-11 and 2014-07-03.

Variometers

The variometers used during the year are described in Table 2.

Two 3-component variometer systems operated at the Canberra observatory.

The CNB system comprised a Narod ring-core fluxgate operated on a pier in the eastern room of the Variometer House. The room was temperature-stabilised with a globe heater. An Overhauser-effect GSM90 scalar variometer was housed in the western room of the same building. An acquisition computer in the western room recorded both vector and scalar data; timing was controlled by a Trimble Acutime GPS clock.

The CN1 system comprised a LEMI fluxgate variometer operated on a pier in the Secondary Variometer House. The room was temperature-stabilised with a globe heater. An acquisition computer was located in the same room; timing was controlled by a Garmin GPS clock. The GSM90 scalar data (accessed across the local area network) from the Narod variometer system were also recorded with LEMI data.

Preliminary (reported) real-time 3-component variations were supplied to users and data repositories using the time series recorded by the CNB Narod magnetometer. The 2014 definitive 3 component data set for the observatory was also derived from the CNB Narod time series.

Data gaps in the definitive CNB Narod time series were filled with data from the backup CN1 LEMI system where possible. There remains missing data on 2014-05-21 and 23 as the backup LEMI variometer also had some unreliable data over that period due to power instabilities. Details of infilled data are listed at the end of this document

Weekly, semi-monthly, and monthly K indices and storm reports were scaled from the reported CNB Narod data.

The temperatures of the variometers were controlled only by heating, which was generally adequate on cold to mild days. However, on hot days the variometer temperatures were not well controlled. Further, the Narod sensor temperature has not functioned for some years, although it is in the same room as the temperature-monitored electronics.

The Narod-electronics temperature varied from 23.5 C (2014-05) to 27.3 C (2014-01), with a range of 1 C over the period March to October. The electronics temperature range increased to over 2 degrees per month for the hotter months.

Narod vector variometer 1-second data required de-spiking. Despiking was done in two stage, first on the raw data and then on the derived data. A spike detection in the raw data required a value to deviate from the local linear trend by 5 times the maximum of 4 digitiser counts, or 8/9 fractile of deviations during the following minute or so. On average 28, 30 and 110 seconds of data per day were detected in the raw A, B and C channels. A spike detection in the derived data required a value to deviate from the local linear trend by 4 times the maximum of 0.1 nT or 8/9 fractile of deviations during the following minute or so. On average 28, 9 and 15 seconds of data per day were corrected from the derived X, Y and Z channels.

The scalar variometer data were also despiked and a spike detection required a value to deviate from the local linear trend by 10 times the maximum of 0.1 nT, or 8/9 fractile of deviations during the following minute or so.

```
Table 2. Magnetic variometers
---------------------------------------------
3-component variometer: Narod (CNB)
Serial number: 9004-2
Type:          ring-core fluxgate
Orientation:   NW, NE, Z
Acquisition interval: 1 s
Scale value:   0.025 nT/count

3-component variometer: LEMI (CN1)
Serial number: 004_A
Type:          linear-core fluxgate
Orientation:   NW, NE, Z
Acquisition interval: 1 s
A/D converter: ADAM 4017 module (+/-5V)
Scale value:   0.05 nT/count

Total-field variometer: GEM Systems GSM90
Serial number: 803810 / 81225
Type:          Overhauser effect
Acquisition interval:10 s
Resolution:    0.01 nT

Data acquisition system:
GDAP:          PC-104 computer, QNX OS
Timing:        Garmin / Trimble GPS clocks
Communications:network radio link
```

```
Variometer clock corrections
----------------------------
```

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. Adjustments to the CNB system clock were less than 1 ms except on the following occasions:

```
CNB
2014-05-21      05:55:42     0.706 s System reboot
                23:58:09    16.005 s Problems with software
2014-05-22      00:03:38   -16.000 s Problems with software
2014-06-23      03:58:38     0.409 s
2014-06-25      00:15:52    -0.001 s
2014-08-11      01:18:41     0.001 s
```

Absolute instruments

The principal absolute magnetometers used at Canberra and their adopted corrections are described in Table 3. The absolute instruments used at Canberra also served as the Australian observatory reference instruments. A DIM fluxgate theodolite and an overhauser total field instrument where used to make absolute observations. DIM observations were made using the offset method. The offset data from the DIM fluxgate were digitised using a PICO ADC-16 analogue to digital converter and recorded on a tablet PC running MS-Windows and a data observation recording software.

The instrument corrections given in Table 3 for DIM DI0086D/353756 were adopted from comparisons against the travelling reference, B0610H/160459, at Canberra observatory 2008-07-30 and are checked approximately monthly through comparisons. International comparison via a travelling reference PPM to other nations' PPMs and frequency standards results in the correction adopted for GSM90 905926/21867.

At the 2014 mean magnetic field values at Canberra (X=23175 nT, Y=5151 nT, Z= -52975 nT) these D, I and F corrections translate to corrections of:

DX = -2.2 nT   DY = -0.8 nT   DZ = -1.0 nT

These corrections have been applied to Canberra 2014 final data.

The absolute instrument parameters showed no unexplained pattern during the year.

Table 3. Absolute magnetometers and their adopted corrections
----
Corrections are applied in the sense Standard = Instrument + correction.

```
DI fluxgate:   DMI
Serial number: DI0086D + Pico ADC16 FJY06/112
Theodolite:    Zeiss 020B
Serial number: 353756
Resolution:    0.1'
D correction:  -0.05'
I correction:  -0.15'

Total-field magnetometer: GEM Systems GSM90
Serial number: 905926 / 21867
Type:          Overhauser effect
```

Resolution: 0.01 nT
Correction: 0.0 nT

Baselines

Baselines were adopted by manual fitting of a piecewise linear spline functon (with steps where required) to absolute observation residuals. The adopted baselines had a range of 7 nT, 5 nT and 4 nT in X, Y and Z during the year.

With drift corrections applied, the standard deviations in the difference of absolute observations from the final variometer model were:

X 0.7 nT
Y 1.3 nT
Z 0.4 nT
D 11"
I 3"
F 0.3 nT
H 0.7 nT

These data are based on 125 observations, comprising mostly weekly pairs of observations.

With drift corrections applied, there was a 1.5 nT range and 0.3 nT standard deviation in the daily-average Fv-Fs throughout the year.

The Narod baseline variation throughout the year seemed to follow a seasonal pattern, probably influenced by environmental factors and not random drift.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2014 CNB definitive data and real time reported 1-minute data sets (CNB definitive - CNB real time) were:

	X	Y	Z
Average	+0.4	+0.2	0.0
Std.dev	1.3	0.7	0.7
Min	-2.1	-1.3	-0.8
Max	+2.1	+1.5	+1.3

The CNB reported real time data are within the specification for INTERMAGNET Quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the CNB definitive data and quasi-definitive 1-minute data sets (CNB definitive - CNB quasi-definitive) were:

	X	Y	Z
Average	-0.1	+0.1	0.0
Std.dev	0.4	0.7	0.3
Min	-0.9	-1.6	-0.6

Max +0.6 +0.8 +0.4

The CNB 2014 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

Weekly absolute observations were performed by staff of the Geomagnetism Project as were other duties included computer assisted hand scaling of K indices and monitoring database and data-delivery programs.

Data from the Narod, LEMI and GSM90 variometers were acquired on computers at the observatory and were automatically retrieved to Geoscience Australia via a network radio link every 2 to 6 minutes.

Quasi-definitive data were delivered to the Edinburgh GIN monthly on most occasions.

The distribution of Canberra data is described in Table 4. Data losses are identified at the end of this document.

Data were lost on 2014-01-08 due to a computer disk failure Data from all magnetometers (Narod, LEMI, and GSM90) were lost on 2014-05-21 and 2014-05-23 due to extended interruptions to mains power caused by forestry operations.

Table 4. Distribution of Canberra data.

Recipient	Status	Sent
1-second values:		
IPS Radio and Space Services	preliminary	real time
INTERMAGNET	preliminary	hourly
WDC for Geomagnetism(Kyoto)	preliminary	real time
1-minute values:		
INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	quasi-def	monthly
INTERMAGNET	definitive	July 2015
WDC for Geomagnetism(Kyoto)	preliminary	real time
ISGI, France	preliminary	real time
ISGI, France	preliminary	daily
GeoForschungsZentrum,Germany	preliminary	3-hourly
NOAA SWPC	preliminary	real time
University of Oulu, Finland	preliminary	hourly
K indices:		
IPS Radio and Space Services		weekly
University of Newcastle		weekly
British Geological Survey		weekly
CLS, CNES, France		weekly
ISGI, France		weekly
Royal Observatory of Belgium		weekly
GeoForschungsZentrum, Germany		semi-monthly
Principal magnetic storms and rapid variations		
WDC for Solar-Terrestrial Physics		monthly

```
WDC for Geomagnetism                    monthly
Observatori de l'Ebre,Spain             monthly

Significant events
------------------
2014-01-09  Last few minutes of day 008 missing due to
            disk problems on ga-cnb-mag2.
            Day 008 file no longer exists on disk
            Missing data are permanently lost
            03:30 commence logging CNB data onto CN1
            computer (NGL + PPM) as a backup. CN1 data
            accidently stopped logging from 03:30 to 04:14
2014-01-16  07:34:30 CN1 electronics temperature range jump
            07:35:30 CN1 electronics temperature jump
            Intermittent short bursts of noise of CN1
            fluxgate data over the last few days.
2014-01-29  Replaced CNB acquisition computer as disc
            problems increasing. Noticed some GPS TSIP
            communication problems after installation.
            Changeover about 2014-01-29T00 +/- 10 minutes.
            03:37 reboot CN1 after
            "ln -si npm-qnet-14_lite.so npm-qnet.so"
            in /lib/dll to enable qnet 6.3.2->6.5.0 system
            (new ga-cnb-mag2 with GSM90). Also
            "ln -si /net/ga-cnb-mag2.net.intra/dev/tfi/f f"
            in /mag to record F data. Note baseline shift
            due to re-ranging temperature channel and
            change to Fs baseline
2014-02-18  11:24 - 11:06 significant backward time jump in
            CN1 PPM data
2014-02-25  Forestry logging operations near second gate
            from the highway
2014-02-27  Vehicle driven too close to mag huts.
            CN1 (LEMI)  01:44:02,
            CNB (Narod) 01:44:16 for about 15 seconds
2014-03-01  Australian Rally Championship in Kowen Forest
            01-02 March. Preparations 24-28 February.
            Forest closed 01-02 March.
2014-01-18  Modified most CNB obs DI0086 to DI0086D
            (not 2014-02-18) to refelct use of PICO ADC in
            absolute observations - did not alter data in
            CN1 observation files
            DI0086D scale value tests confirmed current
            adopted SV
2014-04-05  24 hour mountain bike race to pass SE corner of
            observatory. Race cancelled due to wet weather
2014-04-08  Forestry road grader outside boundary fence in
            SW corner at approx 01:55 UTC.
2014-04-29  Spoke with ACT Forestry about planned forest
            harvesting and need to arrange a power outage
            to clear around the power lines. The outage
            could last for up to three days. Forestry
            provided contact details for Essential Energy
2014-05-06  Replaced CN1 (LEMI) computer with ARK3360F
            Install additional battery to LEMI battery box
            Noticed some glitches in data after the
            installation presumably due to battery power
            supply. Changed temperature setting from 25C
            to 15C.
            ~02:00 installed ARK3360F N4A1E KSA0650291
            CN1 201401 65
```

BatteryBox 20110801 ex GNA Apr 2013
with extension battery PS12180-12V18Ah
via 10A fused socket
Required network extension cable for GPS clock
to improve installation

2014-05-13 22:45 to 23:51 ACT forestry logging machine and truck on southern boundary, moved through SW gate.

2014-05-19 Step in FCheck 19:22 in cn1. Possible forestry machinery?

2014-05-20 ~02:00 Forestry machine working around the south-west corner of the observatory.
23:30 (approx) mains power off for forestry operations

2014-05-21 02:45 (approx) NGL UPS batteries fail and data stops on NGL. LEMI vector data continues through power outage but suffers from instabilities
05:27 (approx) mains power restarts
08:00 NGL variometer temperature stabilises
09:00 LEMI variometer temperature stabilises
Forestry operations in vicinity - fence removed from around the top locked gate. Tree felling and pruning in power line easement
re-arrange UPS power as follows:
  switch off magcald
  ctl hut network switch power moved from mains to EATON UPS
  modem switched off and removed from EATON UPS
  MAGCAL disconnected from POWERWARE UPS
  NGL system disconnected from EATON (23:52) and connected to POWERWARE UPS (23:52:30)
  Now running on EATON: CTL PC + network switch
  Now running on POWERWARE: NGL system
  There is no UPS power to MAGCAL

2014-05-21 23:58:09.0 Large clock correction

2014-05-22 00:03:38.0 Large clock correction
00:08 momentary power glitch.
22:24 probable commencement of mains power outage - more forestry operations

2014-05-23 No NGL data loss but data are unstable
04:00 (approx) probable re-start of mains power
06:00 (approx) NGL variometer temperature stabilises
09:00 (approx) LEMI data stabilises

2014-05-27 Show PTB routine.

2014-06-02 More forestry operations evident
Magnetotelluric equipment testing in progress during weekly observation

2014-06-10 04:00 onwards, forestry truck SW corner

2014-06-11 Asbestos audit. Entered secondary variometer building between 23:11 and 23:20 UTC. Entered primary variometer building between 23:52 and 23:57 UTC.

2014-06-23 03:40 (approx) UPS overload and failure: Powerware UPS driving both magcal and NGL NGL system stops. Swap NGL system back to Eaton UPS. Trimble GPS clock not working properly
03:48 reboot system

2014-06-24 Forestry work on fence line directly east of

```
           magcal.
2014-06-25  Updated GdapClockTr program consistent with
            recent changes to GdapClockGm.
            00:15 Stopped old version
            ~00:12, started new version
2014-08-11  Adjust ga-cnb-mag2 (CNB) clock rate from
            838113546(using -5500) to 838118936. First
            correction larger than normal
            Adjust ga-cnb-mag3 (LEMI) clock rate from
            838120947 (using -4700) to 838117008
2014-08-21  23:10 contamination caused by asbestos
            remediation work.
2014-09-07  Mountain bike race?
2014-09-10  00-01 Site inspection, GA property services
2014-09-17  00-02 contamination on CN1 Fv-Fs, possible
            interference around secondary variometer hut
2014-10-15  Enter secondary variometer Hut for AAD training
2014-12-04  Site visit by ATIVO with contractors to quote
            on repairs to MagCal truss.
            Visit by ATWS with 2 work experience students
2014-12-09  07:50 CNB (NGL) temperature channel problems
2014-12-12  13:50 CNB temperature channel problems
            22:07; 22:59 CN1 (LEMI) sudden jumps and
            instability to 2014-12-13 01:53.
2014-12-15  23:00 CN1 (LEMI) sudden jump  followed by 10
            minute incomplete recovery Thunderstorm during
            observations. Collected 3 DIM observations but
            only 2 PPM observations.
2014-12-16  01:00 CN1 (LEMI) sudden jump and incomplete
            recovery over following 5 minutes largely in
            Z channel. May have associated temperature
            channel anomaly
2014-12-27  11:50 - 15:00 CNB (NGL) temperature channel
            problems
2014-12-31  13:20 - 23:29 CNB (NGL) temperature channel
            problems

K indices
---------
K indices for Canberra were derived using a
computer-assisted method developed at Geoscience Australia
and based on the IAGA-accepted LRNS algorithm. Canberra K
indices contribute to the global Kp and aa indices, the
southern hemisphere Ks index, and all their derivatives. K
indices are available on the INTERMAGNET DVD. K-index data
were scaled from reported data. Reported data were
available during some periods of definitive data loss.

Canberra data losses
-------------------------------
Date       Interval (hh:mm) Data loss (minutes)
Vector data
2014-01-08    XYZ     23:58 - 23:59  (2)
2014-02-27    XYZ     01:44 - 01:45  (2)
2014-04-17    XYZ     13:27 - 13:27  (1)
2014-05-21    XYZ     05:27 - 08:00  (154)
2014-05-21    XYZ     23:52 - 23:53  (2)
2014-05-21    XYZ     23:58 - 23:58  (1)
2014-05-23    XYZ     04:03 - 06:00  (118)
2014-06-03    XYZ     02:14 - 02:14  (1)
2014-06-11    XYZ     23:53 - 23:56  (4)
```

```
2014-06-23    XYZ     03:46 - 03:48  (3)
2014-09-14    XYZ     07:21 - 07:21  (1)
2014-09-19    XYZ     14:00 - 14:00  (1)
2014-11-02    XYZ     23:47 - 23:47  (1)
2014-12-03    XYZ     05:45 - 05:45  (1)
2014-12-03    XYZ     05:47 - 05:47  (1)
Total: 293

Scalar data
2014-01-08    F      23:58 - 23:59   (2)
2014-01-28    F      23:06 -
2014-01-29    F            - 00:04  (59)
2014-02-16    F      04:31 - 04:31   (1)
2014-05-21    F      00:00 - 08:00 (481)
2014-05-21    F      23:52 - 23:53   (2)
2014-05-21    F      23:58 - 23:58   (1)
2014-05-22    F      22:24 -
2014-05-23    F            - 06:00 (457)
2014-06-11    F      23:52 - 23:56   (5)
2014-06-23    F      03:46 - 03:48   (3)
2014-07-26    F      09:10 - 09:20  (11)
2014-12-03    F      03:48 - 03:48   (1)

Total: 1023

Canberra CN1 data used for infill of CNB definitive data
--------------------------------------------------------
Date        Interval (hh:mm) Data infilled (minutes)
2014-01-28 23:06 - 23:59  ( 54)
2014-01-29 00:00 - 00:04  (  5)
2014-05-21 00:00 - 05:26  (327)
2014-05-22 22:24 - 23:59  ( 96)
2014-06-23 00:00 - 04:02  (243)
2014-12-27 11:47 - 13:18  ( 92)


                     < END >
```

7.7.1.3 2015

```
                                   CNB
              CANBERRA OBSERVATORY INFORMATION 2015
ACKNOWLEDGE-  Users of the CNB data should acknowledge:
      -MENTS: Geoscience Australia

STATION ID:   CNB
LOCATION:     Canberra, Australian Capital Territory,
              Australia
ORGANISATION: Geoscience Australia

CO-LATITUDE:  125.314 Deg.
LONGITUDE:    149.363 Deg. E
ELEVATION:    859 metres

ABSOLUTE
INSTRUMENTS:  DI-fluxgate magnetometer (DIM)
              GSM90 Overhauser-effect magnetometer

RECORDING
VARIOMETER:   Three component Narod ringcore fluxgate
```

```
               (RCF) magnetometer;
               GSM90 Overhauser-effect magnetometer

ORIENTATION:  Magnetic NW, NE and Vertical
DYNAMIC RANGE:unlimited
RESOLUTION:   0.025nT
SAMPLING RATE:1 second
FILTER TYPE:  Intermagnet

BACKUP
VARIOMETER:   LEMI fluxgate variometer

K-NUMBERS:    Computer-assisted scaling
K9-LIMIT:     450 nT

GINS:         Edinburgh via Http delivery
SATELLITE:    via internet

OBSERVERS:    A. Lewis
              W. Jones
              L. Wang
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              Canberra,  A.C.T.,  2601
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              Tel: + 61-2-6249-9111
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              e-mail: geomag@ga.gov.au
              WWW: http://www.ga.gov.au
```

NOTES:

The Canberra magnetic observatory is the principal observatory in the Australian geomagnetic observatory network. It is located in the Australian Capital Territory, approximately 30 km to the east of the city of Canberra.

The observatory is on an 8 hectare site and comprises:

* an office building, for historical reasons called the Recorder House;

* a Variometer House 85 m NW of the Recorder House;

* a Secondary Variometer House some 80 m west of the Recorder House;

* an Absolute House 65 m NE of the Recorder House;

* a Comparison House 12 m west of the Absolute House;

* a sheltered external observation site near the Absolute House;

* four azimuth pillars;

* two tripod stations for azimuth control, one available

for external magnetic reference;

* the Geoscience Australia Magnetometer Calibration Facility 120 m SE of the Recorder House;

* a Test House 220 m north of the Recorder House (which now houses Australian Tsunami Warning System (ATWS) seismological equipment);

* an Australian Tsunami Warning System seismometer vault;

* an old seismic vault.

Table 1. Key observatory data.

IAGA code: CNB	
Commenced operation:	1978
Geographic latitude:	35d 18' 52.6" S
Geographic longitude:	149d 21' 45.4" E
Geomagnetic latitude:	-42.17d
Geomagnetic longitude:	227.23d
K 9 index lower limit:	450 nT
Principal pier:	Pier AW
Pier elevation (top):	859 m AMSL
Principal reference mark:	NW pillar
Reference mark azimuth:	328d 37' 03"
Reference mark distance:	137.3 m
Observer in charge:	A. Lewis

Local meteorological conditions

The meteorological temperature at Canberra Airport during the year varied from a minimum -7.0 C (2015-07-03) to a maximum +37.0 C (2015-12-20). Daily minimum temperatures varied from -7.0 C to +19.5 C (average +6.4+/-6.3 C); daily maximum temperatures varied from +7.3 C to +37.0 C (average 21.1+/-7.0 C); daily temperature ranges varied from 2.5 C to 25.7 C (average 14.6+/-5.0 C).

The daily maximum wind gust varied from 13 to 78 km/h (average 39+/-13 km/h). The maximum daily maximum wind gust occurred on three days, 2015-05-10, 2015-09-15 and 2015-12-01 The minimum daily maximum wind gust occurred on 2015-07-23.

Daily weather observations for Canberra airport (station ID 070351) provided by Australian Government, Bureau of Meteorology.

Variometers

The variometers used during the year are described in Table 2.

Two 3-component variometer systems operated at the Canberra observatory.

The CNB system comprised a Narod ring-core fluxgate operated on a pier in the eastern room of the Variometer House. The room was temperature-stabilised with a globe heater. An Overhauser-effect GSM90 scalar variometer was housed in the western room of the same building. An acquisition computer in the western room recorded both vector and scalar data; timing was controlled by a Trimble Acutime GPS clock.

The CN1 system comprised a LEMI fluxgate variometer operated on a pier in the Secondary Variometer House. The room was temperature-stabilised with a globe heater. An acquisition computer was located in the same room; timing was controlled by a Garmin GPS clock. The GSM90 scalar data (accessed across the local area network) from the Narod variometer system were also recorded with LEMI data.

Preliminary (reported) real-time 3-component variations were supplied to users and data repositories using the time series recorded by the CNB Narod magnetometer. The 2015 definitive 3 component data set for the observatory was also derived from the CNB Narod time series.

Weekly, semi-monthly, and monthly K indices and storm reports were scaled from the reported CNB Narod data.

Data gaps in the definitive CNB Narod time series were filled with data from the backup CN1 LEMI system where possible. There remains significant periods of missing data on 2015-04-28, 2015-04-29, 2015-05-13, 2015-05-15 and 2015-08-05 as the backup variometer also had unreliable data due to gardening, painting work or power problems contaminating both systems simultaneoulsy. Details of infilled data are listed at the end of this document.

The temperatures of the variometers were controlled only by heating, which was generally adequate on cold to mild days. However, on hot days the variometer temperatures were not well controlled. Further, the CNB Narod sensor temperature monitor has not functioned for some years and in 2015 the CNB Narod electronics temperature monitor also became unreliable. For this reason the 2015 definitive data does not include temperature corrections. Ignoring temperature corrections has not significantly degraded the quality of the data for the vast majority of the year because variometer temperature variations are generally small. However for a few hot days in late December larger temperature variations in the variometer rooms have degraded the quality of the data.

Excluding spikes and electronics temperature channel instabilities the averaged hourly Narod-electronics temperature varied from 23.6 C (2015-07) to 26.6 (2015-12) and ranged over 1 C for March to October, with an increased temperature range over the hotter months in January-February and November-December.

Narod vector variometer 1-second data required de-spiking. Despiking was done in two stages, first on the raw data and then on the derived data. A spike detection in the raw data required a value to deviate from the local linear trend by 5 times the maximum of 4 digitiser counts, or 8/9 fractile of deviations during the following minute or so. On average 36, 37 and 116 seconds of data per day were detected in the raw A, B and C channels. A spike detection in the derived data required a value to deviate from the local linear trend by 5 times the maximum of 0.1 nT or 8/9 fractile of deviations during the following minute or so. On average 11, 2 and 0 seconds of data per day were corrected from the derived X, Y and Z channels.

The 10-second scalar variometer data were also despiked on most days. A spike detection required a value to deviate from the local linear trend by 5 times the maximum of 0.2 nT, or 8/9 fractile of deviations during the following minute or so. Scalar de-spiking was not applied on all days, those days on which no scalar filtering was applied are listed in the appendix.

Data quality from the CNB Narod vector variometer has been decreasing over recent years. The instrument is due for replacement in 2016.

```
Table 2. Magnetic variometers
---------------------------------------------
3-component variometer: Narod (CNB)
Serial number: 9004-2
Type:          ring-core fluxgate
Orientation:   NW, NE, Z
Acquisition interval: 1 s
Scale value:   0.025 nT/count

3-component variometer: LEMI (CN1)
Serial number: 004_A
Type:          linear-core fluxgate
Orientation:   NW, NE, Z
Acquisition interval: 1 s
A/D converter: ADAM 4017 module (+/-5V)
Scale value:   0.05 nT/count

Total-field variometer: GEM Systems GSM90
Serial number: 803810 / 81225
Type:          Overhauser effect
Acquisition interval:10 s
Resolution:    0.01 nT

Data acquisition system:
GDAP:          PC-104 computer, QNX OS
Timing:        Garmin / Trimble GPS clocks
Communications:network radio link
```

```
Variometer clock corrections
----------------------------
```

Time stamps applied to the variometer data were obtained from the acquisition computer system clock.
That clock was synchronised to a GPS clock. Adjustments to the CNB system clock were less than 1 ms except on the following occasions:

```
CNB
2015-04-28     06:53:09     0.244 s  system reboot
2015-07-01     00:00:40    -1.000 s  leap second
2015-12-18     04:52:59     0.518 s  system reboot
```

Absolute instruments

The principal absolute magnetometers used at Canberra and their adopted corrections are described in Table 3. The absolute instruments used at Canberra also served as the Australian observatory reference instruments. A DIM fluxgate theodolite and an overhauser total field instrument where used to make absolute observations. DIM observations were made using the offset method. The offset data from the DIM fluxgate were digitised using a PICO ADC-16 analogue to digital converter and recorded on a tablet PC running MS-Windows and a data observation recording software.

The instrument corrections given in Table 3 for DIM DI0086D/353756 were adopted from comparisons against the travelling reference, B0610H/160459, at Canberra observatory 2008-07-30 and are checked approximately monthly through comparisons. International comparison via a travelling reference PPM to other nations' PPMs and frequency standards results in the correction adopted for GSM90 905926/21867.

At the 2015 mean magnetic field values at Canberra (X=23157 nT, Y=5156 nT, Z= -52973 nT) these D, I and F corrections translate to corrections of:

DX = -2.2 nT   DY = -0.8 nT   DZ = -1.0 nT

These corrections have been applied to Canberra 2015 final data.

The absolute instrument parameters showed no unexplained pattern during the year.

Table 3. Absolute magnetometers and their adopted corrections
----
Corrections are applied in the sense Standard = Instrument + correction.

DI fluxgate: DMI
Serial number: DI0086D + Pico ADC16 FJY06/112
Theodolite: Zeiss 020B
Serial number: 353756
Resolution: 0.1'
D correction: -0.05'
I correction: -0.15'

Total-field magnetometer: GEM Systems GSM90
Serial number: 905926 / 21867
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT

Baselines

Baselines were adopted by manual fitting of a piecewise linear spline functon (with steps where required) to absolute observation residuals. The adopted baselines had a range of 7 nT, 6 nT and 4 nT in X, Y and Z during

the year.

With drift corrections applied, the standard deviations in the difference of absolute observations from the final variometer model were:

X 0.6 nT
Y 0.6 nT
Z 0.3 nT
D 06"
I 02"
F 0.3 nT
H 0.6 nT

These data are based on 120 observations, comprising mostly weekly pairs of observations.

With drift corrections applied, there was a 3 nT range and 0.4 nT standard deviation in the daily-average Fv-Fs throughout the year.

The Narod baseline variation throughout the year seemed to follow a seasonal pattern, probably influenced by environmental factors and not random drift.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2015 CNB definitive data and real time reported 1-minute data sets (CNB definitive - CNB real time) were:

	X	Y	Z
Average	+0.1	+0.2	-0.1
Std.dev	1.4	1.4	0.9
Min	-2.0	-2.3	-1.8
Max	+3.0	+1.8	+1.6

The CNB reported real time data are within the specification for INTERMAGNET Quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the CNB definitive data and quasi-definitive 1-minute data sets (CNB definitive - CNB quasi-definitive) were:

	X	Y	Z
Average	-0.0	-0.3	-0.1
Std.dev	0.5	0.3	0.2
Min	-0.5	-0.8	-0.5
Max	+1.0	+0.5	+0.4

The CNB quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

Weekly absolute observations were performed by GA staff as were other duties included computer assisted hand scaling of K indices and monitoring database and data-delivery systems.

Data from the Narod, LEMI and GSM90 variometers were acquired on computers at the observatory and were automatically retrieved to Geoscience Australia via a network radio link every 2 to 6 minutes.

Quasi-definitive data were delivered to the Edinburgh GIN monthly on most occasions.

The distribution of Canberra data is described in Table 4. Data losses are identified at the end of this document.

In May, a failing roof truss was replaced on the magnetometer calibration facility building. Exterior painting to all buildings was also done in May. The interior of the recording house was upgraded and painted in November.

The GPS clock controlling timing for the backup (CN1) variometer system failed and was replaced in October. Voltage regulators were installed for the LEMI variometer on the CN1 system in September.

Table 4. Distribution of Canberra data.

Recipient	Status	Sent
1-second values:		
BoM Space Weather Services	reported	real time
INTERMAGNET	reported	hourly
WDC for Geomagnetism(Kyoto)	reported	real time
1-minute values:		
INTERMAGNET	reported	real time
INTERMAGNET	reported	daily
INTERMAGNET	quasi-def	monthly
INTERMAGNET	definitive	July 2015
WDC for Geomagnetism(Kyoto)	reported	real time
ISGI, France	reported	real time
ISGI, France	reported	daily
GeoForschungsZentrum,Germany	reported	3-hourly
NOAA SWPC	reported	real time
University of Oulu, Finland	reported	hourly
K indices:		
BoM Space Weather Services		weekly
University of Newcastle		weekly
British Geological Survey		weekly
CLS, CNES, France		weekly
ISGI, France		weekly
Royal Observatory of Belgium		weekly
GeoForschungsZentrum, Germany		semi-monthly
Principal magnetic storms and rapid variations		
WDC for Solar-Terrestrial Physics		monthly
WDC for Geomagnetism		monthly
Observatori de l'Ebre,Spain		monthly

Significant events

```
------------------
2015-01-13   Training of observers for Antarctic duty
2015-02-19   00:42 onwards; CN1 (LEMI) sudden jumps in all
             three vector channels
2015-02-24   Keys left in lock on the absolute house during
             observations. Removed keys and did one set of
             obs for comparison. The results from three
             sets of obs are consistent
2015-03-22   23:13 - 23:21 Contamination at MagCal, similar
             but not identical at both test magnetometers
             (DTU and NGL).
2015-03-26   22-24 maintenance/gardener/builder site
             inspection
2015-03-27   27-29  Twenty-four hour mountain bike race
             around Kowen forest
2015-04-07   Install second brass nut on theodolite 353756
             cable post after obs today. Thunderstorm
             during observations.
2015-04-28   06:46 reboot CN1 system to clear very long TCP
             stack of "TIME_WAIT" jobs
             06:52  reboot CNB (NGL) system to clear very
             long TCP stack of "TIME_WAIT" jobs
2015-04-28   23:20 commencement of data contamination due
             to garden maintenance work
2015-04-29   00:00 - 05:00 and 22:30 - 23:30 gardening work
2015-05-12   Standard obs as well as 4 observations on Gs,
             only 2 useable though.
2015-05-13   Painters commence work at observatory - data
             contamination
2015-05-15   Painting is completed
             Forest is closed for 2 days due to a car
             rally.
2015-05-19   Building maintenance (truss replacement) on
             west end of MagCal building - replacement
             completed by about 02UT but rain prevented
             completion of re-painting.
             Observer enters Primary and secondary
             variometer buildings after observations
2015-05-20   Painting completed on magcal truss.
2015-05-28   maintenance inspection of painting and truss
             repair.
2015-07-11   ~10:30 possible power outage (magcal temp
             drops - spikes on LEMI and NGL)
2015-07-31   weed spraying in pine forest around
             observatory
2015-08-05   05:40-06:50 probable interruption to power
             (disturbances on CN1 and CNB
             temperature/Fcheck)
2015-09-01   Install voltage regulator (s/n 20150727_01)
             onto LEMI variometer -> blv jump in LEMI
             Measure dimensions of piers in variometer
             houses
2015-09-21   05:48 Fv-Fs jump on CN1 system
2015-09-29   Enter CN1 LEMI hut for AAD training
2015-10-03   11:00 start of data problems on CN1 system.
             Repeating anomalies in Fv-Fs (0.6 nT) and
             Z (1 nT) lasting about 10 minutes with
             decreasing time between repeats. Sometimes
             also visible in head temperature but not
             always. Not visible in X and Y.
2015-10-04   CN1 data problems continue with increasing
```

	return rate
2015-10-07	06:50 Final CN1 data anomaly
2015-10-09	Possible power failure 09:15 - 09:35 (obvious in MAGCAL NGL temperature channels)
2015-10-13	Enter backup (LEMI) hut - switch heater to "summer" 25C Enter primary (NGL) hut - confirm PPS from GPS is available in west room
2015-10-14	21:56 CN1 GPS clock failure.
2015-10-15	02:32 Stop clock driver software on CN1 to manually check output 02:39 Restart clock driver; no improvement
2015-10-19	Replace failed Garmin GPS clock on CN1 system with Garmin GPS16HVS S/N 81127275 (Ex CSY) part number 011-00732-03, Firmware v3.20 The antenna is mounted inside the hut and is getting adequate signal.
2015-10-22	Site visit for section leader and technical officers.
2015-11-01	Maintenance team measuring up recording house for upgrade to kitchen/toilet. New materials for interiror upgrade stored in recording house
2015-11-06	Renovation work underway in recording house and top house.
2015-11-19	0520 -0920. CN1 Fv-Fs changes/steps
2015-12-18	04:51 reboot to clear TCP stack (CNB) 04:56 reboot to clear TCP stack (CN1)

K indices

K indices for Canberra were derived using a computer-assisted method developed at Geoscience Australia and based on the IAGA-accepted LRNS algorithm. Canberra K indices contribute to the global Kp and aa indices, the southern hemisphere Ks index, and all their derivatives. K indices are available on the INTERMAGNET DVD. K-index data were scaled from reported data. Reported data and data from the backup variometer system were available during some periods of definitive data loss.

Canberra data losses

Vector data

Date		Interval (hh:mm)	Data loss (minutes)
2015-04-25	XYZ	03:45 - 03:45	(1)
2015-04-28	XYZ	06:52 - 06:52	(1)
2015-04-28	XYZ	23:20 - 23:48	(29)
2015-04-29	XYZ	02:07 - 02:09	(3)
2015-05-11	XYZ	13:45 - 13:45	(1)
2015-05-12	XYZ	11:58 - 11:58	(1)
2015-05-13	XYZ	00:49 - 01:39	(51)
2015-05-13	XYZ	02:32 - 02:32	(1)
2015-05-15	XYZ	03:50 - 04:21	(32)
2015-05-22	XYZ	12:36 - 12:37	(2)
2015-06-13	XYZ	02:07 - 02:07	(1)
2015-06-15	XYZ	03:50 - 03:50	(1)
2015-06-15	XYZ	03:53 - 03:53	(1)
2015-06-23	XYZ	02:57 - 02:58	(2)
2015-06-23	XYZ	03:07 - 03:08	(2)

```
2015-07-11    XYZ     10:54 - 10:54  ( 1)
2015-07-12    XYZ     03:23 - 03:23  ( 1)
2015-07-16    XYZ     11:52 - 11:52  ( 1)
2015-07-28    XYZ     12:28 - 12:28  ( 1)
2015-08-05    XYZ     05:39 - 07:14  (96)
2015-08-12    XYZ     07:10 - 07:10  ( 1)
2015-10-20    XYZ     13:02 - 13:03  ( 2)
2015-11-18    XYZ     15:12 - 15:13  ( 2)
2015-12-18    XYZ     04:52 - 04:52  ( 1)

Total: 235

Scalar data
Date                 Interval (hh:mm)  Data loss (minutes)
2015-01-01    F      04:35 - 04:35  ( 1)
2015-01-02    F      23:43 - 23:43  ( 1)
2015-01-03    F      00:16 - 00:16  ( 1)
2015-01-03    F      05:10 - 05:10  ( 1)
2015-01-04    F      06:29 - 06:29  ( 1)
2015-01-05    F      07:02 - 07:02  ( 1)
2015-01-06    F      20:23 - 20:23  ( 1)
2015-01-07    F      08:31 - 08:31  ( 1)
2015-01-08    F      05:15 - 05:15  ( 1)
2015-01-12    F      11:47 - 11:48  ( 2)
2015-01-21    F      04:46 - 04:46  ( 1)
2015-01-22    F      11:07 - 11:07  ( 1)
2015-01-22    F      11:11 - 11:11  ( 1)
2015-01-28    F      07:36 - 07:36  ( 1)
2015-01-29    F      23:28 - 23:28  ( 1)
2015-02-01    F      22:07 - 22:08  ( 2)
2015-02-02    F      00:07 - 00:07  ( 1)
2015-02-02    F      00:14 - 00:14  ( 1)
2015-02-02    F      01:22 - 01:22  ( 1)
2015-02-02    F      01:33 - 01:34  ( 2)
2015-02-02    F      04:55 - 04:55  ( 1)
2015-02-02    F      05:11 - 05:11  ( 1)
2015-02-02    F      05:14 - 05:14  ( 1)
2015-02-02    F      06:47 - 06:47  ( 1)
2015-02-02    F      10:46 - 10:46  ( 1)
2015-02-03    F      02:11 - 02:11  ( 1)
2015-02-03    F      03:50 - 03:51  ( 2)
2015-02-03    F      05:08 - 05:08  ( 1)
2015-02-03    F      06:19 - 06:19  ( 1)
2015-02-03    F      07:02 - 07:02  ( 1)
2015-02-03    F      21:47 - 21:47  ( 1)
2015-02-03    F      22:40 - 22:40  ( 1)
2015-02-09    F      14:10 - 14:10  ( 1)
2015-02-09    F      14:12 - 14:13  ( 2)
2015-02-10    F      14:08 - 14:08  ( 1)
2015-02-28    F      15:55 - 15:55  ( 1)
2015-03-01    F      22:29 - 22:29  ( 1)
2015-03-01    F      22:52 - 22:52  ( 1)
2015-03-01    F      22:54 - 22:54  ( 1)
2015-03-02    F      06:07 - 06:07  ( 1)
2015-03-02    F      21:48 - 21:48  ( 1)
2015-03-02    F      21:54 - 21:54  ( 1)
2015-03-02    F      22:36 - 22:36  ( 1)
2015-03-02    F      22:59 - 22:59  ( 1)
2015-03-02    F      23:09 - 23:09  ( 1)
2015-03-04    F      23:25 - 23:25  ( 1)
2015-03-07    F      02:49 - 02:49  ( 1)
```

2015-03-07	F	22:53 - 22:53	(1)
2015-03-07	F	23:00 - 23:00	(1)
2015-03-08	F	06:54 - 06:54	(1)
2015-03-08	F	11:18 - 11:18	(1)
2015-03-12	F	09:33 - 09:34	(2)
2015-03-17	F	05:20 - 05:20	(1)
2015-03-17	F	05:46 - 05:47	(2)
2015-03-17	F	05:49 - 05:49	(1)
2015-03-17	F	05:54 - 05:54	(1)
2015-03-17	F	07:05 - 07:05	(1)
2015-03-17	F	08:55 - 08:55	(1)
2015-03-17	F	14:40 - 14:41	(2)
2015-03-17	F	16:04 - 16:04	(1)
2015-03-17	F	16:16 - 16:16	(1)
2015-03-17	F	22:30 - 22:30	(1)
2015-03-17	F	23:00 - 23:00	(1)
2015-03-17	F	23:07 - 23:09	(3)
2015-03-17	F	23:34 - 23:34	(1)
2015-03-18	F	00:01 - 00:01	(1)
2015-03-18	F	00:12 - 00:12	(1)
2015-03-18	F	00:22 - 00:22	(1)
2015-03-18	F	00:27 - 00:28	(2)
2015-03-18	F	00:31 - 00:31	(1)
2015-03-18	F	14:29 - 14:29	(1)
2015-03-19	F	04:22 - 04:22	(1)
2015-03-19	F	04:26 - 04:26	(1)
2015-03-19	F	06:41 - 06:41	(1)
2015-03-19	F	09:03 - 09:03	(1)
2015-03-21	F	13:11 - 13:11	(1)
2015-03-23	F	04:30 - 04:30	(1)
2015-03-23	F	04:32 - 04:32	(1)
2015-03-23	F	04:35 - 04:35	(1)
2015-03-25	F	11:00 - 11:00	(1)
2015-03-25	F	21:01 - 21:01	(1)
2015-03-25	F	21:05 - 21:05	(1)
2015-03-25	F	22:01 - 22:01	(1)
2015-03-25	F	23:40 - 23:40	(1)
2015-03-28	F	06:10 - 06:10	(1)
2015-03-29	F	00:25 - 00:25	(1)
2015-03-29	F	01:01 - 01:01	(1)
2015-03-29	F	01:06 - 01:06	(1)
2015-03-29	F	01:09 - 01:09	(1)
2015-03-29	F	01:58 - 01:58	(1)
2015-03-29	F	02:48 - 02:49	(2)
2015-04-04	F	01:54 - 01:54	(1)
2015-04-04	F	02:31 - 02:31	(1)
2015-04-04	F	02:42 - 02:43	(2)
2015-04-04	F	03:45 - 03:45	(1)
2015-04-04	F	04:05 - 04:05	(1)
2015-04-04	F	04:20 - 04:21	(2)
2015-04-05	F	22:10 - 22:10	(1)
2015-04-07	F	02:12 - 02:12	(1)
2015-04-10	F	05:24 - 05:24	(1)
2015-04-12	F	15:13 - 15:13	(1)
2015-04-14	F	08:47 - 08:48	(2)
2015-04-15	F	12:58 - 12:58	(1)
2015-04-16	F	00:33 - 00:33	(1)
2015-04-16	F	00:55 - 00:55	(1)
2015-04-16	F	22:40 - 22:41	(2)
2015-04-17	F	00:05 - 00:05	(1)
2015-04-17	F	00:33 - 00:33	(1)

2015-04-17	F	00:52 - 00:52	(1)
2015-04-17	F	06:25 - 06:25	(1)
2015-04-18	F	00:55 - 00:55	(1)
2015-04-18	F	01:37 - 01:37	(1)
2015-04-18	F	01:39 - 01:39	(1)
2015-04-18	F	02:03 - 02:03	(1)
2015-04-18	F	03:14 - 03:14	(1)
2015-04-20	F	15:09 - 15:09	(1)
2015-04-21	F	02:09 - 02:09	(1)
2015-04-21	F	02:42 - 02:44	(3)
2015-04-21	F	02:52 - 02:52	(1)
2015-04-21	F	04:02 - 04:02	(1)
2015-04-25	F	03:45 - 03:45	(1)
2015-04-26	F	00:51 - 00:51	(1)
2015-04-28	F	06:52 - 06:52	(1)
2015-04-28	F	23:20 - 23:48	(29)
2015-04-29	F	02:07 - 02:09	(3)
2015-04-29	F	11:03 - 11:04	(2)
2015-05-12	F	12:50 - 12:50	(1)
2015-05-13	F	00:49 - 01:40	(52)
2015-05-13	F	01:58 - 01:58	(1)
2015-05-13	F	02:00 - 02:00	(1)
2015-05-13	F	02:30 - 02:30	(1)
2015-05-13	F	02:32 - 02:32	(1)
2015-05-13	F	03:01 - 03:02	(2)
2015-05-13	F	06:37 - 06:38	(2)
2015-05-14	F	03:51 - 03:51	(1)
2015-05-14	F	03:54 - 03:54	(1)
2015-05-14	F	04:56 - 05:22	(27)
2015-05-15	F	03:50 - 04:21	(32)
2015-05-15	F	05:21 - 05:22	(2)
2015-05-15	F	06:02 - 06:02	(1)
2015-05-15	F	06:46 - 06:46	(1)
2015-05-19	F	02:12 - 02:13	(2)
2015-06-08	F	10:42 - 10:43	(2)
2015-06-09	F	02:40 - 02:40	(1)
2015-06-09	F	03:28 - 03:28	(1)
2015-06-10	F	03:44 - 03:44	(1)
2015-06-10	F	11:00 - 11:00	(1)
2015-06-10	F	22:54 - 22:54	(1)
2015-06-11	F	01:36 - 01:36	(1)
2015-06-14	F	22:41 - 22:41	(1)
2015-06-14	F	22:47 - 22:47	(1)
2015-06-15	F	01:57 - 01:57	(1)
2015-06-15	F	02:12 - 02:12	(1)
2015-06-15	F	03:05 - 03:05	(1)
2015-06-15	F	03:50 - 03:50	(1)
2015-06-15	F	04:53 - 04:53	(1)
2015-06-15	F	06:08 - 06:08	(1)
2015-06-23	F	00:59 - 00:59	(1)
2015-06-23	F	03:42 - 03:42	(1)
2015-06-23	F	03:53 - 03:53	(1)
2015-07-04	F	21:17 - 21:17	(1)
2015-07-05	F	00:11 - 00:11	(1)
2015-07-05	F	00:14 - 00:15	(2)
2015-07-09	F	13:55 - 13:55	(1)
2015-07-10	F	22:53 - 22:53	(1)
2015-07-10	F	23:02 - 23:02	(1)
2015-07-10	F	23:27 - 23:27	(1)
2015-07-10	F	23:35 - 23:35	(1)
2015-07-10	F	23:46 - 23:46	(1)

2015-07-10	F	23:50 - 23:50	(1)
2015-07-11	F	00:11 - 00:11	(1)
2015-07-11	F	04:03 - 04:03	(1)
2015-07-11	F	04:25 - 04:25	(1)
2015-07-11	F	21:59 - 21:59	(1)
2015-07-11	F	22:18 - 22:18	(1)
2015-07-11	F	22:53 - 22:53	(1)
2015-07-11	F	23:09 - 23:09	(1)
2015-07-11	F	23:52 - 23:52	(1)
2015-07-11	F	23:56 - 23:56	(1)
2015-07-12	F	02:14 - 02:14	(1)
2015-07-12	F	02:22 - 02:22	(1)
2015-07-12	F	02:31 - 02:31	(1)
2015-07-12	F	03:09 - 03:09	(1)
2015-07-12	F	23:22 - 23:22	(1)
2015-07-12	F	23:26 - 23:26	(1)
2015-07-13	F	01:36 - 01:36	(1)
2015-07-13	F	09:37 - 09:38	(2)
2015-07-21	F	05:57 - 05:57	(1)
2015-07-23	F	07:42 - 07:42	(1)
2015-07-27	F	11:10 - 11:10	(1)
2015-07-27	F	23:08 - 23:08	(1)
2015-08-09	F	23:00 - 23:00	(1)
2015-08-09	F	23:16 - 23:16	(1)
2015-08-09	F	23:26 - 23:26	(1)
2015-08-09	F	23:45 - 23:45	(1)
2015-08-09	F	23:48 - 23:48	(1)
2015-08-12	F	07:10 - 07:10	(1)
2015-08-17	F	14:10 - 14:10	(1)
2015-08-21	F	14:23 - 14:23	(1)
2015-08-28	F	15:14 - 15:14	(1)
2015-09-01	F	01:36 - 01:55	(20)
2015-09-08	F	00:00 - 00:00	(1)
2015-09-08	F	00:02 - 00:02	(1)
2015-09-08	F	22:54 - 22:54	(1)
2015-09-09	F	04:47 - 04:47	(1)
2015-09-09	F	06:59 - 06:59	(1)
2015-09-09	F	07:02 - 07:04	(3)
2015-09-09	F	07:13 - 07:13	(1)
2015-09-09	F	10:10 - 10:10	(1)
2015-09-09	F	10:49 - 10:52	(4)
2015-09-09	F	18:31 - 18:32	(2)
2015-09-10	F	15:59 - 15:59	(1)
2015-09-11	F	20:25 - 20:25	(1)
2015-09-11	F	22:03 - 22:03	(1)
2015-09-11	F	22:16 - 22:16	(1)
2015-09-13	F	10:07 - 10:07	(1)
2015-09-22	F	03:07 - 03:07	(1)
2015-09-23	F	06:02 - 06:02	(1)
2015-09-24	F	05:11 - 05:11	(1)
2015-09-24	F	05:14 - 05:14	(1)
2015-09-25	F	10:17 - 10:18	(2)
2015-10-07	F	21:31 - 21:31	(1)
2015-10-07	F	21:34 - 21:34	(1)
2015-10-07	F	23:32 - 23:32	(1)
2015-10-08	F	00:10 - 00:10	(1)
2015-10-08	F	00:12 - 00:13	(2)
2015-10-08	F	00:38 - 00:38	(1)
2015-10-08	F	02:25 - 02:25	(1)
2015-10-08	F	03:05 - 03:05	(1)
2015-10-08	F	03:11 - 03:11	(1)

2015-10-08	F	03:13 - 03:13	(1)
2015-10-08	F	04:05 - 04:05	(1)
2015-10-08	F	21:28 - 21:28	(1)
2015-10-08	F	21:31 - 21:32	(2)
2015-10-08	F	22:28 - 22:28	(1)
2015-10-08	F	22:37 - 22:37	(1)
2015-10-08	F	22:46 - 22:47	(2)
2015-10-08	F	22:49 - 22:49	(1)
2015-10-10	F	07:45 - 07:45	(1)
2015-10-14	F	09:48 - 09:49	(2)
2015-10-20	F	13:02 - 13:03	(2)
2015-10-21	F	12:47 - 12:47	(1)
2015-10-24	F	20:59 - 21:01	(3)
2015-10-25	F	03:22 - 03:22	(1)
2015-11-01	F	12:35 - 12:35	(1)
2015-11-02	F	12:06 - 12:06	(1)
2015-11-04	F	01:12 - 01:12	(1)
2015-11-04	F	04:32 - 04:32	(1)
2015-11-04	F	04:34 - 04:34	(1)
2015-11-04	F	04:36 - 04:36	(1)
2015-11-04	F	04:41 - 04:42	(2)
2015-11-04	F	06:29 - 06:31	(3)
2015-11-07	F	05:22 - 05:22	(1)
2015-11-07	F	07:04 - 07:04	(1)
2015-11-10	F	10:31 - 10:32	(2)
2015-11-15	F	15:01 - 15:01	(1)
2015-11-19	F	01:10 - 01:10	(1)
2015-11-20	F	04:35 - 04:35	(1)
2015-11-29	F	08:40 - 08:40	(1)
2015-11-30	F	03:38 - 03:38	(1)
2015-12-06	F	11:26 - 11:26	(1)
2015-12-10	F	01:31 - 01:32	(2)
2015-12-10	F	22:40 - 22:40	(1)
2015-12-11	F	04:02 - 04:02	(1)
2015-12-11	F	05:43 - 05:45	(3)
2015-12-11	F	05:47 - 05:47	(1)
2015-12-11	F	07:41 - 07:42	(2)
2015-12-11	F	23:40 - 23:40	(1)
2015-12-12	F	00:00 - 00:00	(1)
2015-12-12	F	00:06 - 00:06	(1)
2015-12-12	F	00:11 - 00:11	(1)
2015-12-12	F	00:13 - 00:13	(1)
2015-12-12	F	01:10 - 01:10	(1)
2015-12-14	F	21:32 - 21:32	(1)
2015-12-18	F	00:00 - 00:00	(1)
2015-12-18	F	04:52 - 04:52	(1)
2015-12-20	F	03:21 - 03:22	(2)
2015-12-20	F	20:23 - 20:24	(2)
2015-12-22	F	10:57 - 10:58	(2)
2015-12-24	F	01:10 - 01:11	(2)
2015-12-24	F	06:41 - 06:41	(1)
2015-12-24	F	12:28 - 12:29	(2)
2015-12-26	F	04:24 - 04:24	(1)
2015-12-26	F	04:45 - 04:45	(1)
2015-12-26	F	04:52 - 04:52	(1)
2015-12-26	F	06:39 - 06:40	(2)
2015-12-26	F	21:43 - 21:43	(1)
2015-12-26	F	21:51 - 21:51	(1)
2015-12-29	F	07:23 - 07:23	(1)
2015-12-30	F	14:00 - 14:00	(1)
2015-12-31	F	22:45 - 22:45	(1)

```
2015-12-31    F      23:19 - 23:19  ( 1)

Total: 503

CNB Scalar filtering switched off on following days
---------------------------------------------------
Month     Day of month
January   07 26
February  01 04
March     03 11 17 22 23 24 26 31
April     03 10
May       06 11 18
June      22 23 25
July      28 31
August    15 27
September 07 09 20
October   13 24
November  03 05 18 28
December  19 20 22 25

CN1 backup data used for infill of CNB definitive data
-------------------------------------------------------
Date       Interval (hh:mm) Data infilled (minutes)
2015-05-14 04:58 - 05:20  ( 23)
2015-05-19 00:53 - 00:58  (  6)
2015-09-01 01:37 - 01:55  ( 17)
2015-10-13 01:51 - 01:57  (  7)

                     < END >
```

7.7.1.4 2016

```
                                   CNB
              CANBERRA OBSERVATORY INFORMATION 2016
ACKNOWLEDGE-  Users of the CNB data should acknowledge:
      -MENTS: Geoscience Australia

STATION ID:   CNB
LOCATION:     Canberra, Australian Capital Territory,
              Australia
ORGANISATION: Geoscience Australia

CO-LATITUDE:  125.314 Deg.
LONGITUDE:    149.363 Deg. E
ELEVATION:    859 metres

ABSOLUTE
INSTRUMENTS:  DI-fluxgate magnetometer (DIM)
              GSM90 Overhauser-effect magnetometer

RECORDING
VARIOMETER:   Narod ringcore three-axis fluxgate
              magnetometer (RCF-S100)(to 2016-04-30)
              DMI FGE non-suspended three-axis fluxgate
              magnetometer (from 2016-05-01)

              GSM90 Overhauser-effect magnetometer

ORIENTATION:  Magnetic NW, NE and Vertical
DYNAMIC RANGE: +/- 70000 nT (for RCF)
```

```
                +/- 10000 nT (for DMI)
RESOLUTION:    0.025 nT (RCF)
               0.001 nT (DMI)
SAMPLING RATE:1 second
FILTER TYPE:   Intermagnet

BACKUP
VARIOMETER:    LEMI suspended fluxgate
                 (to 2016-03-30)
               DMI FGE non-suspended fluxgate
                 (2016-03-30 to 2016-04-30)
               Narod S100 ringcore fluxgate (RCF-S100)
                 (2016-05-01 to 2016-10-31)
               Narod PC-104 ringcore fluxgate (RCF-PC104)
                 (2016-11-01 to 2016-12-31)

K-NUMBERS:     Computer-assisted scaling
K9-LIMIT:      450 nT

GINS:          Edinburgh via Http delivery
SATELLITE:     internet

OBSERVERS:     A. Lewis
               W. Jones
               L. Wang
               P. Burke

CONTACT:       Geomagnetism Project
               Geoscience Australia
               G.P.O. Box 378
               Canberra,  A.C.T.,  2601
               Australia

               Tel: + 61-2-6249-9111
               e-mail: geomag@ga.gov.au
               WWW: http://www.ga.gov.au
```

NOTES:

The Canberra magnetic observatory is the principal observatory in the Australian geomagnetic observatory network. It is located in the Australian Capital Territory, approximately 30 km to the east of the city of Canberra.

The observatory is on an 8 hectare site and comprises:

* an office building, for historical reasons called the Recorder House;

* a Variometer House 85 m NW of the Recorder House;

* a Secondary Variometer House some 80 m west of the Recorder House;

* an Absolute House 65 m NE of the Recorder House;

* a Comparison House 12 m west of the Absolute House;

* a sheltered external observation site near the Absolute House;

* four azimuth pillars;

* two tripod stations for azimuth control, one available for external magnetic reference;

* the Geoscience Australia Magnetometer Calibration Facility 120 m SE of the Recorder House;

* a Test House 220 m north of the Recorder House (which now houses Australian Tsunami Warning System (ATWS) seismological equipment);

* an Australian Tsunami Warning System seismometer vault;

* an old seismic vault.

Table 1. Key observatory data.

IAGA code: CNB	
Commenced operation:	1978
Geographic latitude:	35d 18' 52.6" S
Geographic longitude:	149d 21' 45.4" E
Geomagnetic latitude:	-42.17d
Geomagnetic longitude:	227.23d
K 9 index lower limit:	450 nT
Principal pier:	Pier AW
Pier elevation (top):	859 m AMSL
Principal reference mark:	NW pillar
Reference mark azimuth:	328d 37' 03"
Reference mark distance:	137.3 m
Observer in charge:	A.Lewis

Local meteorological conditions

The meteorological temperature at Canberra Airport during the year varied from a minimum -5.5 C (2016-06-15) to a maximum +39.3 C (2016-01-13). Daily minimum temperatures varied from -5.5 C to +21.8 C (average +7.6+/-5.9 C); daily maximum temperatures varied from +7.1 C to +39.3 C (average 21.2+/-7.3 C); daily temperature ranges varied from 2.0 C to 26.1 C (average 13.6+/-5.1 C).
The daily maximum wind gust for measured days varied from 13 to 96 km/h (average 41+/-13 km/h). The maximum daily maximum wind gust occurred on 2016-10-04. The minimum daily maximum wind gust occurred on 2016-06-26.
Daily weather observations for Canberra airport (station ID 070351) provided by Australian Government, Bureau of Meteorology.

Variometers

The variometers used during the year are described in Table 2.
Two 3-component variometer systems operated at the Canberra observatory, referred to as the CNB system and the CN1 system.
Over the period 2016-01-01 to 2016-11-01 the CNB system comprised a Narod ring-core fluxgate with the sensor and electronics in the eastern room of the Variometer House. The room was temperature-stabilised with a globe heater.

From 2016-11-01 the CNB system was upgraded with a PC-104 Narod ring-core fluxgate with the sensor in the eastern room of the Variometer House and the electronics located in the western room. The eastern room was temperature-stabilised with a globe heater and both the electronics and sensor were enclosed in separate thermally insulated boxes in which temperature was maintained using two 50 W heater pads in each box, under the control of two separate CAL3300 PID heater controllers.

Throughout the year the CNB system logged data from an Overhauser-effect GSM90 scalar variometer housed in the western room of the Variometer House. An acquisition computer in the western room recorded both vector and scalar data; timing was controlled by a Trimble Acutime GPS clock.

Over the period 2016-01-01 to 2016-03-30 the CN1 system comprised a LEMI fluxgate variometer digitised with an ADAM 4017 16 bit analogue to digital converter. The LEMI sensor was located on a pier in the Secondary Variometer House. The room was temperature-stabilised with a globe heater.

From 2016-03-30 the CN1 system was replaced with a non-suspended DMI fluxgate variometer with extended range of +/- 10000 nT and an ObsDAQ 24 bit analogue to digital converter. The variometer room was temperature-stabilised with a globe heater and an additional two 50 W heater pads inside a thermal box enclosing the pier, the magnetometer sensor and magnetometer electronics, which were controlled with a single Cal3300 PID controller. The acquisition computer for the CN1 system was located in the same room; timing for the computer was controlled by a Garmin GPS clock. Scalar data from the GSM90 total field magnetometer was accessed across the local area network from the CNB variometer system and recorded with CN1 data.

Recording of state-of-health (SOH) data for the CN1 system commenced on 2016-05-03. The SOH data comprised 1 sample per second of the variometer sensor and electronics temperature (also recorded with the CN1 magnetic data files) and ObsDaq internal temperature and supply voltage. Prior to 2016-05-03 SOH data were not recorded.

Preliminary real-time (reported) 3-component data which had been scaled and baseline corrected were supplied to users and data repositories using the time series recorded by the CNB system throughout the year.

Quasi-definitive data were distributed approximately monthly using the time series data from the CNB system from January to April (inclusive) and from the CN1 system from May to December (inclusive).

The 2016 definitive time series data were derived from the CNB Narod system over the period 2016-01-01 to 2016-04-30 (inclusive) and from the CN1 DMI/ObsDAQ system for the period 2016-05-01 to 2016-12-31 (inclusive)

Weekly, semi-monthly, and monthly K indices and storm reports were scaled from the reported data from the CNB system.

Data gaps in the definitive time series were filled with data from the backup CN1/CNB system where possible. There remains a significant period of missing data on 2016-02-25 when the CNB system had no data and the CN1

system had unreliable data due to power problems. Details of infilled data are listed at the end of this document.
Throughout the year the temperatures of the variometer used for definitive data were controlled only by heating. This was adequate on cold to mild days. However, on hot days there was increased temperature variability. Further, the CNB Narod sensor temperature channel was not functioning and the CNB Narod electronics temperature channel had intervals of bad data in the period 2016-01-01 to 2016-04-30. For this reason the 2016 definitive data up to 2016-04-30 does not include variometer temperature corrections. Ignoring temperature corrections has not significantly degraded the quality of the data because temperature variations were generally small.
Over the period 2016-01-01 to 2016-04-30 the CNB Narod electronics temperature varied from 24 C (in April) to 27 C (in January). From 2016-05-01 to 2016-12-31 the CN1 DMI variometer sensor temperature varied from 20 C (in July) to 28 C (in November) and the variometer electronics temperature varied over the range 23 to 31 C.
The vector variometer 1-second data from which quasi-definitive and definitive one-minute data were derived were de-spiked. Despiking was done in two stages, first on the raw data one second data and then on the derived one second data.
From 2016-01-01 to 2016-04-30 a spike detection in the raw data required a value to deviate from the local linear trend by 5 times the maximum of 4 digitiser counts, or 8/9 fractile of deviations during the following minute or so. On average 12, 12 and 39 seconds of data per day were detected in the raw A, B and C channels with the maximum on any one day being 105, 115 and 94.
A spike detection in the derived data required a value to deviate from the local linear trend by 5 times the maximum of 0.1 nT or 8/9 fractile of deviations during the following minute or so. On average 3, 1 and 0 seconds of data per day were corrected from the derived X, Y and Z channels with the maximum on any one day of 10, 21 and 0.
From 2016-05-01 to 2016-12-31 a spike detection in the raw data required a value to deviate from the local linear trend by 5 times the maximum of 100 digitiser counts, or 8/9 fractile of deviations during the following minute or so. On average 5, 6 and 1 seconds of data per day were detected in the raw A, B and C channels with the maximum on any one day being 68, 63 and 23.
A spike detection in the derived data required a value to deviate from the local linear trend by 5 times the maximum of 0.1 nT or 8/9 fractile of deviations during the following minute or so. On average 0, 0 and 0 seconds of data per day were corrected from the derived X, Y and Z channels, with a maximum on any one day being 19, 8 and 2.
The 10-second scalar variometer data were also despiked on most days. A spike detection required a value to deviate from the local linear trend by 5 times the maximum of 0.2 nT, or 8/9 fractile of deviations during the following minute or so. On average there were 2 spike detections per day with a maximum on any one day being 30.
Scalar de-spiking was not applied on all days. The days on which no scalar filtering was applied are listed in the appendix.

```
Table 2. Magnetic variometers
---------------------------------------------
Period:                  2016-01-01 to 2016-11-01
3-component variometer: Narod  non-suspended (CNB)
                        (RCF-S100)
Serial number:           9004-2
Type:                    ring-core fluxgate
Orientation:             NW, NE, Z
Acquisition interval:    1 s
Scale value:             0.025 nT/count

Period:                  2016-11-01 to 2016-12-31
3-component variometer: Narod  non-suspended (CNB)
                        (RCF-PC104)
Serial number:           200907-02/9004-01
Type:                    ring-core fluxgate
Orientation:             NW, NE, Z
Acquisition interval:    1 s
Scale value:             0.001 nT/count

Period:                  2016-01-01 to 2016-03-30
3-component variometer: LEMI suspended (CN1)
Serial number:           004_A
Type:                    linear-core fluxgate
Orientation:             NW, NE, Z
Acquisition interval:    1 s
A/D converter:           ADAM 4017 module (+/-5V)
Scale value:             0.05 nT/count

Period:                  2016-03-30 to 2016-12-31
3-component variometer: DMI non-suspended (CN1)
Serial number:           E0227/S0210
Type:                    linear-core fluxgate
Orientation:             NW, NE, Z
Acquisition interval:    1 s
A/D converter:           ObsDAQ S/N OD-55DE011
Scale value:             0.001 nT/count


Total-field variometer: GEM Systems GSM90
Serial number:           803810 / 81225
Type:                    Overhauser effect
Acquisition interval:    10 s
Resolution:              0.01 nT

Data acquisition system:
GDAP:                    Ark3360F industrial computer,
                         QNX6.5 OS
Timing:                  Garmin (CN1) / Trimble (CNB)
                         GPS clocks
Communications:          network radio link

Variometer clock corrections
----------------------------
Time stamps applied to the variometer data were obtained
from the acquisition computer system clock.
That clock was synchronised to a GPS clock. Adjustments
to the system clock from which definitive data were
derived were less than 1 ms except on the following
occasions:
```

```
CNB
2016-02-25      21:36:56    15.980 s System reboot
                21:39:24   -17.000 s GPS-UTC correction

2016-05-11      20:19:16     0.001 s
2016-06-18      22:07:10     0.040 s
2016-06-23      08:34:49    -0.001 s
                09:02:40     0.002 s
2016-10-28      06:09:12     0.761 s
```

Data from 2016-02-25T21:36:56 to 21:39:24 subject to the 17 second timing offset have been excluded from the definitive data.

Absolute instruments

The principal absolute magnetometers used at Canberra and their adopted corrections are described in Table 3.
The absolute instruments used at Canberra also served as the Australian observatory reference instruments. A DIM fluxgate theodolite and an overhauser total field instrument where used to make absolute observations. DIM observations were made using the offset method. The offset data from the DIM fluxgate were digitised using a PICO ADC-16 analogue to digital converter and recorded on a Getac Windows tablet PC running GObs absolute observation recording software.
The instrument corrections given in Table 3 for DIM DI0086D/353756 were adopted from comparisons against the travelling reference, B0610H/160459, at Canberra observatory and are checked approximately monthly through comparisons. International comparison via a travelling reference PPM to other nations' PPMs and frequency standards results in the correction adopted for GSM90_905926/21867
At the 2016 mean magnetic field values at Canberra (X=23156 nT, Y=5162 nT, Z= -52959 nT) these D, I and F corrections translate to corrections of:

DX = -2.2 nT   DY = -0.8 nT   DZ = -1.0 nT

These corrections have been applied to Canberra 2016 reported, adjusted, quasi-definitive and definitive data.
The absolute instrument parameters showed no unexplained pattern during the year.

Table 3. Absolute magnetometers and their adopted corrections
----

Corrections are applied in the sense
Standard = Instrument + correction

DI fluxgate:	DMI
Serial number:	DI0086D + Pico ADC16 FJY06/112
Theodolite:	Zeiss 020B
Serial number:	353756
Resolution:	0.1'
D correction:	-0.05'
I correction:	-0.15'

```
Total-field magnetometer: GEM Systems GSM90
Serial number:            905926 / 21867
Type:                     Overhauser effect
Resolution:               0.01 nT
Correction:               0.0 nT

Baselines
---------
Baselines were adopted by manual fitting of a piecewise
linear spline function (with steps where required) to
absolute observation residuals. a total of 53 observations,
usually made in pairs of weekly observations were used
through the year. One pair of observation (2016-12-12) was
discarded as an outlier. The adopted baselines had a range
of 4 nT, 7 nT and 3 nT in X, Y and Z during the year.
With drift corrections applied, the standard deviations in
the difference of absolute observations from the final
variometer model were:

X 0.6 nT
Y 1.1 nT
Z 0.3 nT
D 10"
I 02"
F 0.3 nT
H 0.6 nT

There was a 1.6 nT range and 0.2 nT standard deviation
in the daily-average of Fv-Fs throughout the year.
The baseline variation throughout the year seemed to
follow a seasonal pattern, probably influenced by
environmental factors.

Real-time (Reported), Quasi-definitive and Definitive data
----------------------------------------------------------
The annual statistics of the 12 monthly averages of the
difference between the 2016 CNB definitive data and real
time reported 1-minute data sets (CNB definitive - CNB real
time) were:

           X    Y    Z
Average  -0.6  0.5 -0.2
Std.dev   1.6  2.1  1.2
Min      -3.1 -2.0 -1.7
Max       1.9  5.9  2.4

The CNB reported real time data are within
the specification for INTERMAGNET Quasi-definitive data.
This was in part due to keeping baselines updated to
produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the
difference between the CNB definitive data and
quasi-definitive 1-minute data sets (CNB definitive - CNB
quasi-definitive) were:

           X    Y    Z
Average   0.2  0.0  0.0
Std.dev   0.3  0.4  0.5
Min      -0.2 -0.7 -1.1
Max       0.6  0.5  0.9
```

The CNB quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

Weekly absolute observations were performed by GA staff as were other duties including computer assisted hand scaling of K indices and monitoring database and data-delivery systems.
Data from the CNB and CN1 systems were acquired on computers at the observatory and were automatically retrieved to Geoscience Australia via a network radio link every 2 to 6 minutes.
Quasi-definitive data were delivered to the Edinburgh GIN monthly on most occasions.
The distribution of Canberra data is described in Table 4. Data losses are identified at the end of this document.
On 2016-02-24 the power to the observatory was switched off for power line maintenance and this caused data losses on 2016-02-25 for the CNB system and unreliable data from the CN1 system when backup power systems did not re-start.
The CN1 LEMI variometer was replaced on 2016-03-30 with a DMI non-suspended fluxgate. Power and temperature control system were also upgraded at the same time.
The CNB RCF-S100 Narod ring core fluxgate variometer was replaced on 2016-11-01 with a RCF-PC104 Narod ring core fluxgate variometer. Power systems and temperature control systems were also upgraded at the same time. The work on CNB system caused contamination of the definitive scalar data set and those data have been removed.
After several months of development and testing the GA Magnetometer Calibration facility at Canberra observatory was upgraded with new hardware, control and analysis software on 2016-05-03.
The calibration system coils and coil current generator power supplies remained unchanged but the current control and monitoring systems were upgraded with new hardware.
The Linux desktop control computer was upgraded to a ARK3360F industrial single board PC running the QNX operating system.
On 2016-06-03 the Z calibration coil current generator power supply was replaced after the original supply was found to be faulty.
Occasional compass calibrations were performed for external clients throughout the year. This compass calibration work was incorporated into the weekly observation routine.
Further details on activities at the observatory are set out below in the significant events section.

Table 4. Distribution of Canberra data.

Recipient	Status	Sent
1-second values:		
BoM Space Weather Services	reported	real time
INTERMAGNET	reported	hourly
WDC for Geomagnetism(Kyoto)	reported	real time

1-minute values:

INTERMAGNET	reported	real time
INTERMAGNET	reported	daily
INTERMAGNET	quasi-def	monthly
INTERMAGNET	definitive	July 2017
WDC for Geomagnetism(Kyoto)	reported	real time
ISGI, France	reported	real time
ISGI, France	reported	daily
GeoForschungsZentrum,Germany	reported	3-hourly
NOAA SWPC	reported	real time
University of Oulu, Finland	reported	hourly

K indices:

BoM Space Weather Services	weekly
University of Newcastle	weekly
British Geological Survey	weekly
CLS, CNES, France	weekly
ISGI, France	weekly
Royal Observatory of Belgium	weekly
GeoForschungsZentrum, Germany	semi-monthly

Principal magnetic storms and rapid variations

WDC for Solar-Terrestrial Physics (NOAA/NCEI)	monthly
WDC for Geomagnetism (Kyoto, Japan)	monthly
Observatori de l'Ebre,Spain	monthly

Significant events

2016-01-28	Thunderstorm - lightning spikes
2016-02-09	08:00:50 CN1 jump in ABZ fluxgate channels 09:59:30 CN1 corresponding jump in reverse direction, reasons unknown
2016-02-24	Mains power off for power line maintenance. No notification received. Probable time of mains failure 22:23
2016-02-25	Obs visit confirms power down and circuit breakers undisturbed - both control hut UPS units stopped. There is work being undertaken on power lines near the highway by Essential Energy - will be completed by 04UT 04:40 Essential Energy confirm power reconnected by 04UT but still no data from site by 05:30 21UT Visit site: CNB UPS has failed to go on-line and requires manual intervention. CN1 port on Control room network switch failed to re-initialise and required manual intervention. CN1 system did not stop but CNB and PPM failed from about 2016-02-25T00:09 to 21:29. CNB UPS sustained CNB system for about 1h 50m. CN1 battery box sustained CN1 system for 5h10m but with data instabilities. MagCal battery box sustained MAGCAL system running PPM throughout the power outage. 21:39:30.58 backward time jumps
2016-03-29	From 22:15 -replace CN1 LEMI variometer with DMI E0227/S0210 and ObsDaq E011. Install Cal3300 temperature control and new foam insulation around whole pier, enclosing both sensor and electronics and obsDaq A2D and cable. Remove failed GPS clock. Replace

	battery box batteries (2 x 12V 18 AH)
	Tidy and re-arrange acquisition system
	Drill some cable access holes in equipment shelving in the calibration building
	Gardeners spraying weeds - there will be contamination of CNB data with no backup CN1 data.
	Cleaners in control hut and top hut.
	21:53 Change DMI standard temperature to 25C and temperature controller set point to 25C
2016-03-31	Visit MagCal to scope system upgrade
2016-03-31	Change temperature set point to 27.5
2016-04-01	24 hour mountain bike event in forest around observatory. Preparations and set up for several days before the event. Forest access restricted from 03-21 to 04-04
2016-04-05	Finish work on thermal insulation box around the DMI pier in secondary variometer
2016-04-29	21:17 Radio link failure at GA end - no data deliveries
2016-05-02	00:30 Radio link re-started
2016-05-03	Install equipment mounting board in MagCal (ObsDaq, M7024U, Adam etc) Check batteries for Powerware UPS to MagCal. 06:11 start logging CN1 ObsDaq SOH data as 1 second samples in "C1S" files Channel a = DMI sensor temp; b = DMI electronics temp; c = aux2; (no signal) e = auxv; (ObsDaq supply voltage) h = auxt; (ObsDaq internal temp)
2016-05-10	04:03 - 04:05 (Approx) mains power off to backup variometer equipment Switch second ceramic heater to "permanently on" in backup variometer hut.
2016-05-12	Heating system cannot hold temperature at 27.5C 00:23 change CN1 standard temperature from 27.5 to 20.0 change CN1 Cal3300 set point from 27.5 to 20
2016-05-30	Change C1S (CN1 SOH) recording parameters to minimise file size.
2016-06-03	Magcal Upgrades: (Commencing ~00UT) Install new cable between resistors (X1-R) and ObsDaq using Russian plug (KLS15-RCS01_PC19) Replace Z BOP power supply (S/N E135708) with new BOP power supply (S/N 161536) Install third M7024U D2A (S/N *0051)and swap channels from X=1/0 Y=1/2 Z=2/0 to X=1/0 Y=2/0 Z=3/0.
2016-06-10	MagCal - resistor-obsdaq cable using Russian plug gives bad Z results when wiggled at the resistor end. Disconnect and investigate - no problems identified.
2016-06-17	MagCal - re-terminate individual USB cables from resistors to ObsDaq with ring crimp terminals at resistor end and install to bypass the faulty Russian connector. USB white to I2 terminals, USB green to

```
               I1 terminals.
               Replace 100 V 2.2 mF capacitors across
               voltage output on all BOPs with
               250V 2.2 mF capacitors.
2016-07-07     MagCal - replace individual USB cables
               from resistors-ObsDaq with USB cables
               through new Russian 19-pin plug into
               resistors
               Replace Batteries in Powerware UPS in
               control hut (UPS backs up MagCal system)
2016-07-13     22:44:43 Increase DMI CN1 variometer
               Cal3300 temperature controller cycle time
               from 20 to 40 seconds
2016-07-17     23:45 change Canberra C1S data
               retrievals from $DEV to $PROD
2016-08-16     Building maintenance - install fire
               extinguishers in control hut and seismic hut
2016-08-20     CN1 20:27 - 20:50 sudden jump in data
               and change in temperature - no evidence
               of power failure - data excluded.
2016-09-29     07:14 Change CN1 temperature set-point
               from 27.5 to 25
2016-09-30     change CN1 and C1S data retrievals
               from two-hop via sun-geomag/DC-prod1
               to one-hop via rhe-geomag
2016-10-10     AAD training at observatory 10-12 Oct
2016-10-12     Change CNB data retrievals from two-hop
               via sun-geomag to one-hop via rhe-geomag
               22:49 reboot to clear TCP stack on CNB
               (ga-cnb-mag2)
2016-10-13/14  Cleaners working in control hut, seismic hut
2016-10-24     23:15  Gardeners near backup variometer
                      Gardeners near primary variometer
2016-10-28     06:06 reboot CN1 - stuck jobs.
               Eastern fence line requires repair + some
               other sections.
2016-10-31     Stop CNB system to upgrade to new
               NGL variometer (NGL 200907-02/9004-1)
2016-11-01     Upgrading primary variometer
               GdapDeviceNGLB, MachR upgraded
               NGL 9004-1/S100 barcode 2386 replaced with
               NGL3 PC104 S/N 9004-2/200907-2 on /dev/ser1
               Observation on variometer fluxgate pier VE
               (but no azimuth mark readings)
               Cal3300 temperature control for sensor and
               electronics on /dev/ser6 (01 = sensor;
               02 = electronics)
               Replace broken heater globe in sensor room;
               Replace PPM sensor stand base;
               Replace thermal insulation around sensor
               pier (VE); install electronics in W room
               inside thermal insulation box; replace all
               power supplies with variometer battery box
               and appropriate cabling; install voltage
               regulators on PPM and NGL  power.
               Scalar data is corrupted during this work.
2016-11-14     CN1 - change two ceramic elements from
               "always on" to "controlled"
               Cal3300 temperature was 28 degrees.
               CNB - install expanding foam in gaps in top
               of thermal box around sensor in East room
```

	Replace non-magnetic heater in comparison house.
	23:45 CNB electronics Cal3300 temperature controller (slave 02) "TuneAtSetPoint"
2016-11-15	00:25 Auto tune completed New PID parameter significantly improves temperature stability
2016-11-16	Change daily plot scale to "NGLv3Aus" for CNB 02:44 Increase temperature set point to 27.5 for CNB sensor
2016-11-21	22:50 change heater controllers to "winter (15C)" in both primary and secondary variometer huts. Not expecting a change in temperature of magnetometers as they are controlled by Cal3300 units.
2016-11-22	04:59 decrease temperature set point to 25.0 for CNB sensor Remove "electronics" Cal3300 (slave 02) heater controller from MagCal for use in GNG
2016-12-12	Discard absolute observation as an outlier
2016-12-13	01:36 - 02:34 (approx) probable interruption to mains power
2016-12-16	Backup variometer temperature control cannot maintain 25 C set point. 04:35 Update backup variometer Cal3300 parameter; 0x0190 PL.1 from 90% to 100%
2016-12-21	00:17 Mag6.9 quake in Banda Sea

K indices

K indices for Canberra were derived using a computer-assisted method developed at Geoscience Australia and based on the IAGA-accepted LRNS algorithm. Canberra K indices contribute to the global Kp and aa indices, the southern hemisphere Ks index, and all their derivatives. K indices are available on the INTERMAGNET DVD. K-index data were scaled from reported data. Reported data and data from the backup variometer system were available during some periods of definitive data loss.

Canberra data losses

Vector data

Date		Interval (hh:mm)	Data loss (minutes)	
2016-02-25	XYZ	00:10 - 23:22	(1393)	Power problems
2016-03-29	XYZ	23:05 - 23:17	(13)	
2016-03-29	XYZ	23:40 - 23:40	(1)	
2016-05-04	XYZ	10:18 - 10:19	(2)	
2016-05-06	XYZ	08:36 - 08:36	(1)	
2016-05-10	XYZ	04:03 - 04:07	(5)	
2016-06-17	XYZ	13:23 - 13:23	(1)	
2016-07-10	XYZ	02:42 - 02:42	(1)	
2016-07-29	XYZ	22:38 - 22:38	(1)	
2016-07-30	XYZ	03:57 - 03:58	(2)	
2016-08-09	XYZ	10:02 - 10:02	(1)	
2016-08-10	XYZ	01:02 - 01:02	(1)	
2016-08-10	XYZ	06:28 - 06:28	(1)	
2016-08-23	XYZ	20:40 - 20:40	(1)	
2016-09-01	XYZ	03:04 - 03:05	(2)	
2016-09-01	XYZ	03:31 - 03:31	(1)	

2016-09-12	XYZ	22:29 - 22:29	(1)
2016-09-12	XYZ	22:52 - 22:52	(1)
2016-09-27	XYZ	04:18 - 04:18	(1)
2016-09-27	XYZ	04:25 - 04:25	(1)
2016-10-06	XYZ	23:19 - 23:20	(2)
2016-10-10	XYZ	23:05 - 23:05	(1)
2016-10-10	XYZ	23:21 - 23:21	(1)
2016-10-24	XYZ	22:11 - 22:16	(6)
2016-10-24	XYZ	23:35 - 23:36	(2)
2016-10-28	XYZ	06:08 - 06:08	(1)
2016-11-14	XYZ	01:46 - 01:49	(4)
2016-11-21	XYZ	22:54 - 22:55	(2)
2016-12-14	XYZ	08:02 - 08:02	(1)
2016-12-14	XYZ	08:09 - 08:09	(1)
2016-12-31	XYZ	02:32 - 02:33	(2)
2016-12-31	XYZ	02:40 - 02:41	(2)
2016-12-31	XYZ	10:16 - 10:16	(1)

Total: 1457 (1.01 days)

Scalar data

Date		Interval (hh:mm)	Data loss (minutes)
2016-01-04	F	17:06 - 17:07	(2)
2016-01-05	F	23:29 - 23:29	(1)
2016-01-06	F	02:55 - 02:56	(2)
2016-01-06	F	02:58 - 02:58	(1)
2016-01-06	F	03:05 - 03:06	(2)
2016-01-06	F	03:38 - 03:39	(2)
2016-01-06	F	05:59 - 05:59	(1)
2016-01-06	F	06:40 - 06:41	(2)
2016-01-06	F	07:35 - 07:37	(3)
2016-01-06	F	08:09 - 08:09	(1)
2016-01-11	F	22:51 - 22:51	(1)
2016-01-14	F	14:21 - 14:21	(1)
2016-01-20	F	09:59 - 09:59	(1)
2016-01-20	F	17:20 - 17:24	(5)
2016-01-25	F	08:28 - 08:29	(2)
2016-01-29	F	15:31 - 15:31	(1)
2016-02-02	F	14:55 - 14:57	(3)
2016-02-05	F	13:37 - 13:37	(1)
2016-02-10	F	09:45 - 09:46	(2)
2016-02-12	F	05:54 - 05:54	(1)
2016-02-16	F	14:21 - 14:21	(1)
2016-02-25	F	00:10 - 23:22	(1393)
2016-03-06	F	07:11 - 07:11	(1)
2016-03-06	F	08:04 - 08:04	(1)
2016-03-06	F	23:25 - 23:26	(2)
2016-03-06	F	23:31 - 23:31	(1)
2016-03-06	F	23:44 - 23:44	(1)
2016-03-06	F	23:47 - 23:47	(1)
2016-03-07	F	00:19 - 00:19	(1)
2016-03-07	F	00:24 - 00:24	(1)
2016-03-07	F	00:37 - 00:37	(1)
2016-03-07	F	00:50 - 00:50	(1)
2016-03-07	F	01:45 - 01:45	(1)
2016-03-07	F	03:24 - 03:24	(1)
2016-03-07	F	03:45 - 03:45	(1)
2016-03-07	F	03:50 - 03:51	(2)
2016-03-07	F	04:51 - 04:52	(2)
2016-03-11	F	14:03 - 14:04	(2)
2016-03-11	F	14:09 - 14:10	(2)

2016-03-12	F	01:30 - 01:30	(1)
2016-03-12	F	03:20 - 03:22	(3)
2016-03-12	F	03:36 - 03:36	(1)
2016-03-12	F	03:40 - 03:40	(1)
2016-03-12	F	05:00 - 05:01	(2)
2016-03-13	F	02:36 - 02:36	(1)
2016-03-14	F	19:42 - 19:43	(2)
2016-03-14	F	19:52 - 19:52	(1)
2016-03-14	F	19:55 - 19:55	(1)
2016-03-14	F	21:19 - 21:19	(1)
2016-03-14	F	22:43 - 22:43	(1)
2016-03-14	F	22:48 - 22:48	(1)
2016-03-14	F	22:53 - 22:55	(3)
2016-03-14	F	23:00 - 23:00	(1)
2016-03-15	F	00:37 - 00:37	(1)
2016-03-15	F	01:11 - 01:11	(1)
2016-03-15	F	01:17 - 01:17	(1)
2016-03-15	F	03:54 - 03:54	(1)
2016-03-15	F	03:57 - 03:57	(1)
2016-03-15	F	04:02 - 04:04	(3)
2016-03-16	F	23:45 - 23:45	(1)
2016-03-17	F	09:49 - 09:49	(1)
2016-03-20	F	12:53 - 12:54	(2)
2016-03-22	F	08:48 - 08:48	(1)
2016-03-25	F	00:17 - 00:17	(1)
2016-03-26	F	12:09 - 12:09	(1)
2016-03-29	F	03:39 - 03:39	(1)
2016-03-29	F	23:05 - 23:17	(13)
2016-03-29	F	23:28 - 23:30	(3)
2016-03-30	F	06:27 - 06:27	(1)
2016-04-03	F	02:05 - 02:05	(1)
2016-04-04	F	13:58 - 13:58	(1)
2016-04-06	F	13:45 - 13:46	(2)
2016-04-10	F	07:42 - 07:43	(2)
2016-04-13	F	02:35 - 02:36	(2)
2016-04-14	F	12:09 - 12:09	(1)
2016-04-17	F	03:23 - 03:23	(1)
2016-04-22	F	02:38 - 02:38	(1)
2016-04-22	F	09:24 - 09:24	(1)
2016-04-23	F	22:21 - 22:22	(2)
2016-04-24	F	02:37 - 02:37	(1)
2016-04-24	F	05:57 - 05:57	(1)
2016-04-24	F	06:29 - 06:29	(1)
2016-04-24	F	06:36 - 06:36	(1)
2016-04-24	F	06:51 - 06:51	(1)
2016-04-24	F	07:02 - 07:02	(1)
2016-04-26	F	12:32 - 12:32	(1)
2016-04-30	F	06:15 - 06:15	(1)
2016-04-30	F	06:17 - 06:17	(1)
2016-05-01	F	14:14 - 14:14	(1)
2016-05-02	F	00:43 - 00:43	(1)
2016-05-02	F	00:47 - 00:47	(1)
2016-05-03	F	08:54 - 08:54	(1)
2016-05-06	F	11:57 - 11:57	(1)
2016-05-06	F	12:01 - 12:01	(1)
2016-05-06	F	12:14 - 12:14	(1)
2016-05-08	F	01:09 - 01:09	(1)
2016-05-08	F	02:47 - 02:47	(1)
2016-05-08	F	03:21 - 03:21	(1)
2016-05-09	F	00:26 - 00:26	(1)
2016-05-10	F	04:03 - 04:07	(5)

2016-05-17	F	14:36 - 14:36	(1)
2016-05-17	F	14:39 - 14:39	(1)
2016-05-21	F	03:41 - 03:41	(1)
2016-05-21	F	03:46 - 03:46	(1)
2016-05-24	F	02:24 - 02:24	(1)
2016-05-25	F	09:59 - 09:59	(1)
2016-05-30	F	09:35 - 09:35	(1)
2016-05-30	F	16:23 - 16:24	(2)
2016-05-30	F	23:45 - 23:45	(1)
2016-05-31	F	15:07 - 15:07	(1)
2016-06-05	F	20:42 - 20:42	(1)
2016-06-05	F	21:55 - 21:56	(2)
2016-06-05	F	21:59 - 21:59	(1)
2016-06-05	F	22:21 - 22:21	(1)
2016-06-05	F	23:04 - 23:04	(1)
2016-06-05	F	23:15 - 23:16	(2)
2016-06-05	F	23:20 - 23:21	(2)
2016-06-06	F	00:19 - 00:19	(1)
2016-06-06	F	05:53 - 05:54	(2)
2016-06-07	F	10:02 - 10:02	(1)
2016-06-10	F	03:48 - 03:48	(1)
2016-06-10	F	03:53 - 03:53	(1)
2016-06-13	F	00:22 - 00:22	(1)
2016-06-13	F	00:35 - 00:35	(1)
2016-06-13	F	02:18 - 02:18	(1)
2016-06-13	F	04:25 - 04:26	(2)
2016-06-13	F	04:39 - 04:39	(1)
2016-06-14	F	20:25 - 20:26	(2)
2016-06-14	F	23:02 - 23:02	(1)
2016-06-14	F	23:51 - 23:51	(1)
2016-06-15	F	00:06 - 00:06	(1)
2016-06-15	F	02:51 - 02:51	(1)
2016-06-15	F	04:01 - 04:01	(1)
2016-06-15	F	04:18 - 04:18	(1)
2016-06-15	F	04:32 - 04:33	(2)
2016-06-15	F	04:47 - 04:48	(2)
2016-06-16	F	05:04 - 05:04	(1)
2016-06-19	F	05:48 - 05:49	(2)
2016-06-19	F	05:58 - 05:59	(2)
2016-06-19	F	06:03 - 06:03	(1)
2016-06-19	F	06:06 - 06:06	(1)
2016-06-23	F	06:21 - 06:21	(1)
2016-06-24	F	10:58 - 10:58	(1)
2016-06-25	F	01:36 - 01:36	(1)
2016-07-07	F	23:32 - 23:32	(1)
2016-07-09	F	02:21 - 02:21	(1)
2016-07-09	F	02:32 - 02:32	(1)
2016-07-09	F	21:25 - 21:25	(1)
2016-07-12	F	23:55 - 23:56	(2)
2016-07-13	F	02:31 - 02:31	(1)
2016-07-13	F	03:10 - 03:10	(1)
2016-07-13	F	04:51 - 04:51	(1)
2016-07-13	F	05:23 - 05:23	(1)
2016-07-13	F	05:26 - 05:26	(1)
2016-07-13	F	05:57 - 05:57	(1)
2016-07-13	F	06:15 - 06:16	(2)
2016-07-13	F	07:08 - 07:08	(1)
2016-07-13	F	07:27 - 07:27	(1)
2016-07-13	F	07:35 - 07:35	(1)
2016-07-15	F	04:14 - 04:14	(1)
2016-07-15	F	04:19 - 04:19	(1)

2016-07-15	F	05:57 - 05:57	(1)
2016-07-16	F	00:26 - 00:26	(1)
2016-07-16	F	00:30 - 00:30	(1)
2016-07-16	F	05:19 - 05:19	(1)
2016-07-16	F	05:21 - 05:21	(1)
2016-07-16	F	06:17 - 06:17	(1)
2016-07-20	F	00:56 - 00:56	(1)
2016-07-20	F	01:10 - 01:14	(5)
2016-07-20	F	01:17 - 01:17	(1)
2016-07-20	F	01:46 - 01:46	(1)
2016-07-20	F	01:51 - 01:51	(1)
2016-07-20	F	01:56 - 01:56	(1)
2016-07-20	F	02:07 - 02:07	(1)
2016-07-20	F	03:59 - 04:00	(2)
2016-07-20	F	09:58 - 09:59	(2)
2016-07-20	F	10:07 - 10:08	(2)
2016-07-24	F	17:26 - 17:26	(1)
2016-07-24	F	21:19 - 21:20	(2)
2016-07-24	F	22:24 - 22:24	(1)
2016-07-24	F	22:28 - 22:28	(1)
2016-07-25	F	00:30 - 00:30	(1)
2016-07-25	F	08:51 - 08:52	(2)
2016-07-25	F	08:56 - 08:57	(2)
2016-07-27	F	01:11 - 01:11	(1)
2016-07-27	F	01:14 - 01:14	(1)
2016-07-29	F	01:15 - 01:15	(1)
2016-07-30	F	20:50 - 20:50	(1)
2016-08-02	F	22:47 - 22:47	(1)
2016-08-02	F	23:49 - 23:49	(1)
2016-08-03	F	01:32 - 01:32	(1)
2016-08-03	F	02:10 - 02:12	(3)
2016-08-03	F	03:52 - 03:53	(2)
2016-08-03	F	04:45 - 04:45	(1)
2016-08-03	F	23:59 - 23:59	(1)
2016-08-06	F	09:42 - 09:42	(1)
2016-08-09	F	06:31 - 06:31	(1)
2016-08-10	F	07:18 - 07:18	(1)
2016-08-10	F	22:56 - 22:56	(1)
2016-08-10	F	23:20 - 23:21	(2)
2016-08-11	F	00:30 - 00:31	(2)
2016-08-11	F	01:21 - 01:21	(1)
2016-08-11	F	03:09 - 03:10	(2)
2016-08-11	F	04:28 - 04:28	(1)
2016-08-11	F	04:38 - 04:38	(1)
2016-08-11	F	04:49 - 04:49	(1)
2016-08-11	F	06:36 - 06:36	(1)
2016-08-12	F	04:28 - 04:29	(2)
2016-08-12	F	06:06 - 06:06	(1)
2016-08-23	F	20:37 - 20:37	(1)
2016-08-23	F	20:40 - 20:40	(1)
2016-08-25	F	06:10 - 06:10	(1)
2016-08-25	F	09:22 - 09:22	(1)
2016-09-01	F	06:48 - 06:48	(1)
2016-09-01	F	23:37 - 23:37	(1)
2016-09-02	F	03:20 - 03:20	(1)
2016-09-02	F	03:23 - 03:23	(1)
2016-09-02	F	04:34 - 04:34	(1)
2016-09-02	F	04:41 - 04:41	(1)
2016-09-02	F	05:29 - 05:29	(1)
2016-09-03	F	01:42 - 01:42	(1)
2016-09-03	F	01:44 - 01:44	(1)

2016-09-03	F	01:46 - 01:46	(1)
2016-09-03	F	02:09 - 02:09	(1)
2016-09-03	F	02:12 - 02:12	(1)
2016-09-03	F	03:01 - 03:01	(1)
2016-09-03	F	03:29 - 03:29	(1)
2016-09-03	F	03:40 - 03:40	(1)
2016-09-03	F	03:42 - 03:42	(1)
2016-09-03	F	05:41 - 05:41	(1)
2016-09-03	F	05:49 - 05:50	(2)
2016-09-03	F	07:25 - 07:26	(2)
2016-09-04	F	12:50 - 12:50	(1)
2016-09-05	F	09:36 - 09:36	(1)
2016-09-08	F	06:53 - 06:53	(1)
2016-09-16	F	00:25 - 00:25	(1)
2016-09-16	F	00:33 - 00:34	(2)
2016-09-20	F	01:23 - 01:24	(2)
2016-09-20	F	02:03 - 02:04	(2)
2016-09-20	F	02:11 - 02:12	(2)
2016-09-20	F	03:49 - 03:49	(1)
2016-09-20	F	05:11 - 05:11	(1)
2016-09-21	F	04:44 - 04:44	(1)
2016-09-21	F	04:59 - 04:59	(1)
2016-09-21	F	06:50 - 06:50	(1)
2016-09-22	F	06:04 - 06:04	(1)
2016-09-22	F	07:39 - 07:39	(1)
2016-09-27	F	12:40 - 12:40	(1)
2016-09-27	F	22:19 - 22:20	(2)
2016-09-28	F	00:44 - 00:44	(1)
2016-09-28	F	01:04 - 01:05	(2)
2016-09-28	F	01:07 - 01:07	(1)
2016-09-28	F	01:17 - 01:17	(1)
2016-09-28	F	01:27 - 01:28	(2)
2016-09-28	F	03:18 - 03:19	(2)
2016-09-28	F	03:32 - 03:32	(1)
2016-09-28	F	04:04 - 04:04	(1)
2016-09-28	F	04:11 - 04:13	(3)
2016-09-28	F	20:06 - 20:07	(2)
2016-09-29	F	09:49 - 09:49	(1)
2016-09-30	F	00:55 - 00:55	(1)
2016-09-30	F	07:03 - 07:03	(1)
2016-09-30	F	11:45 - 11:45	(1)
2016-10-01	F	05:33 - 05:33	(1)
2016-10-04	F	06:40 - 06:40	(1)
2016-10-04	F	06:42 - 06:42	(1)
2016-10-04	F	06:44 - 06:45	(2)
2016-10-04	F	06:50 - 06:50	(1)
2016-10-04	F	07:08 - 07:08	(1)
2016-10-09	F	13:42 - 13:42	(1)
2016-10-12	F	22:13 - 22:13	(1)
2016-10-13	F	05:19 - 05:19	(1)
2016-10-16	F	21:03 - 21:03	(1)
2016-10-16	F	21:11 - 21:11	(1)
2016-10-16	F	21:20 - 21:20	(1)
2016-10-16	F	21:22 - 21:22	(1)
2016-10-16	F	23:00 - 23:00	(1)
2016-10-16	F	23:22 - 23:23	(2)
2016-10-16	F	23:30 - 23:31	(2)
2016-10-17	F	00:21 - 00:21	(1)
2016-10-17	F	03:24 - 03:25	(2)
2016-10-17	F	03:35 - 03:35	(1)
2016-10-17	F	03:37 - 03:37	(1)

2016-10-17	F	03:39 - 03:39	(1)
2016-10-17	F	03:51 - 03:52	(2)
2016-10-17	F	04:34 - 04:34	(1)
2016-10-17	F	04:50 - 04:50	(1)
2016-10-17	F	21:37 - 21:38	(2)
2016-10-17	F	21:57 - 21:57	(1)
2016-10-17	F	22:00 - 22:00	(1)
2016-10-17	F	22:02 - 22:02	(1)
2016-10-17	F	23:45 - 23:45	(1)
2016-10-18	F	00:58 - 00:58	(1)
2016-10-18	F	05:23 - 05:23	(1)
2016-10-22	F	21:42 - 21:43	(2)
2016-10-23	F	07:35 - 07:37	(3)
2016-10-23	F	07:43 - 07:43	(1)
2016-10-23	F	07:55 - 07:55	(1)
2016-10-24	F	12:36 - 12:37	(2)
2016-10-25	F	22:11 - 22:11	(1)
2016-10-25	F	22:14 - 22:14	(1)
2016-10-25	F	22:16 - 22:16	(1)
2016-10-25	F	22:42 - 22:42	(1)
2016-10-25	F	22:59 - 22:59	(1)
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2016-10-26	F	00:50 - 00:50	(1)
2016-10-26	F	00:53 - 00:53	(1)
2016-10-26	F	03:18 - 03:18	(1)
2016-10-26	F	03:24 - 03:24	(1)
2016-10-26	F	04:10 - 04:10	(1)
2016-10-26	F	11:59 - 12:00	(2)
2016-10-27	F	00:45 - 00:45	(1)
2016-10-27	F	10:51 - 10:51	(1)
2016-10-27	F	12:17 - 12:17	(1)
2016-10-27	F	16:01 - 16:02	(2)
2016-10-28	F	06:08 - 06:08	(1)
2016-10-30	F	01:13 - 01:13	(1)
2016-10-30	F	04:38 - 04:38	(1)
2016-10-30	F	07:18 - 07:18	(1)
2016-10-31	F	22:54 -	
2016-11-01	F	- 04:23	(330)
2016-11-02	F	12:25 - 12:25	(1)
2016-11-03	F	06:18 - 06:18	(1)
2016-11-03	F	10:54 - 10:54	(1)
2016-11-05	F	06:32 - 06:32	(1)
2016-11-06	F	08:01 - 08:01	(1)
2016-11-06	F	12:07 - 12:07	(1)
2016-11-12	F	11:24 - 11:24	(1)
2016-11-12	F	21:08 - 21:09	(2)
2016-11-12	F	21:44 - 21:44	(1)
2016-11-12	F	22:23 - 22:23	(1)
2016-11-13	F	00:47 - 00:47	(1)
2016-11-13	F	02:35 - 02:36	(2)
2016-11-13	F	03:10 - 03:10	(1)
2016-11-13	F	03:52 - 03:52	(1)
2016-11-13	F	21:43 - 21:43	(1)
2016-11-13	F	21:46 - 21:46	(1)
2016-11-13	F	21:52 - 21:52	(1)
2016-11-13	F	21:54 - 21:55	(2)
2016-11-13	F	22:13 - 22:14	(2)
2016-11-13	F	22:18 - 22:18	(1)
2016-11-14	F	01:15 - 01:15	(1)
2016-11-14	F	01:18 - 01:19	(2)
2016-11-14	F	01:30 - 01:30	(1)

2016-11-14	F	02:57 - 02:58	(2)
2016-11-14	F	03:06 - 03:07	(2)
2016-11-14	F	03:39 - 03:39	(1)
2016-11-14	F	21:57 - 21:57	(1)
2016-11-14	F	22:44 - 22:44	(1)
2016-11-15	F	05:09 - 05:09	(1)
2016-11-22	F	13:58 - 13:58	(1)
2016-11-26	F	06:32 - 06:32	(1)
2016-11-26	F	13:06 - 13:07	(2)
2016-12-07	F	22:18 - 22:18	(1)
2016-12-08	F	03:58 - 03:59	(2)
2016-12-08	F	04:46 - 04:46	(1)
2016-12-08	F	23:24 - 23:25	(2)
2016-12-08	F	23:57 - 23:57	(1)
2016-12-09	F	02:07 - 02:08	(2)
2016-12-09	F	02:18 - 02:18	(1)
2016-12-09	F	20:55 - 20:56	(2)
2016-12-09	F	22:19 - 22:20	(2)
2016-12-09	F	23:42 - 23:42	(1)
2016-12-10	F	00:21 - 00:21	(1)
2016-12-13	F	01:29 - 04:01	(153)
2016-12-20	F	08:29 - 08:30	(2)
2016-12-20	F	09:16 - 09:17	(2)
2016-12-22	F	03:23 - 03:23	(1)
2016-12-23	F	03:12 - 03:12	(1)
2016-12-23	F	04:00 - 04:01	(2)
2016-12-23	F	04:52 - 04:52	(1)
2016-12-23	F	05:58 - 05:58	(1)
2016-12-23	F	06:08 - 06:08	(1)
2016-12-23	F	09:56 - 09:56	(1)
2016-12-24	F	06:43 - 06:43	(1)
2016-12-25	F	03:54 - 03:54	(1)
2016-12-25	F	04:22 - 04:23	(2)
2016-12-25	F	06:51 - 06:51	(1)
2016-12-25	F	23:50 - 23:50	(1)
2016-12-26	F	00:00 - 00:00	(1)
2016-12-26	F	00:15 - 00:15	(1)
2016-12-26	F	03:16 - 03:16	(1)
2016-12-26	F	04:47 - 04:47	(1)
2016-12-26	F	05:03 - 05:03	(1)
2016-12-26	F	06:36 - 06:36	(1)
2016-12-27	F	07:03 - 07:03	(1)
2016-12-31	F	10:16 - 10:16	(1)

Total: 2382 (1.65 days)

CNB Scalar filtering switched off on following days

Month	Day of month
January	02, 21
February	08, 13, 16
March	18
April	
May	07, 08
June	
July	19, 24, 27
August	02, 04, 05, 06, 21
September	02, 03, 29
October	02, 15, 26
November	09, 12, 24
December	06, 10, 21, 22 ,25, 27, 28

```
CNB reported data used for infill of CNB definitive data
-------------------------------------------------------
Date       Interval (hh:mm) Data infilled (minutes)
2016-08-20 01:50 - 01:51  (  2)
           01:56 - 01:57  (  2)
           20:24 - 21:00  ( 37)
2016-12-13 01:29 - 04:00  (152)
           04:58 - 04:58  (  1)


                     < END >
```

7.7.2 Baseline values

7.7.2.1 2013

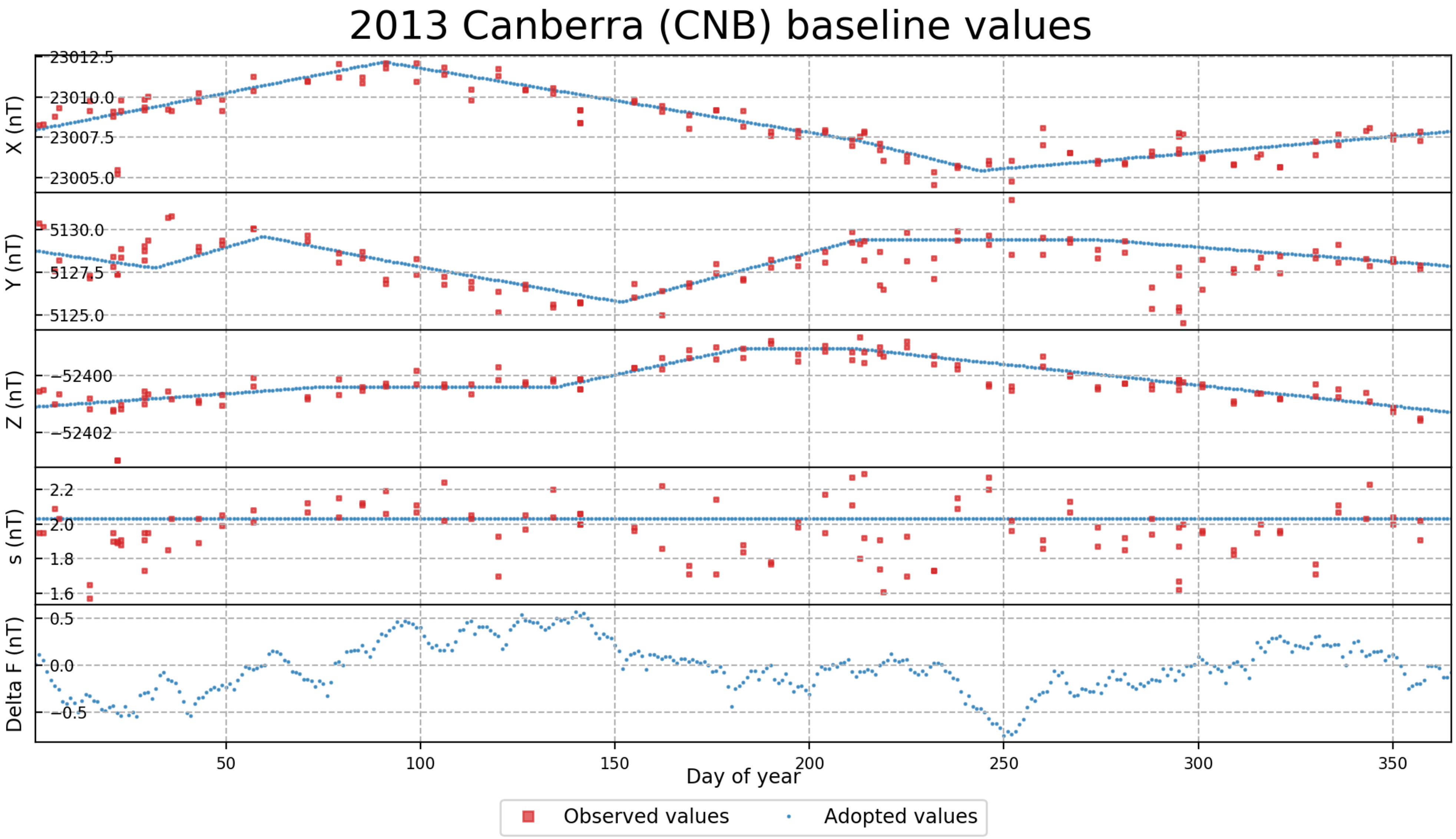

Figure 7.45 Canberra (CNB) baseline values for 2013. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.7.2.2 2014

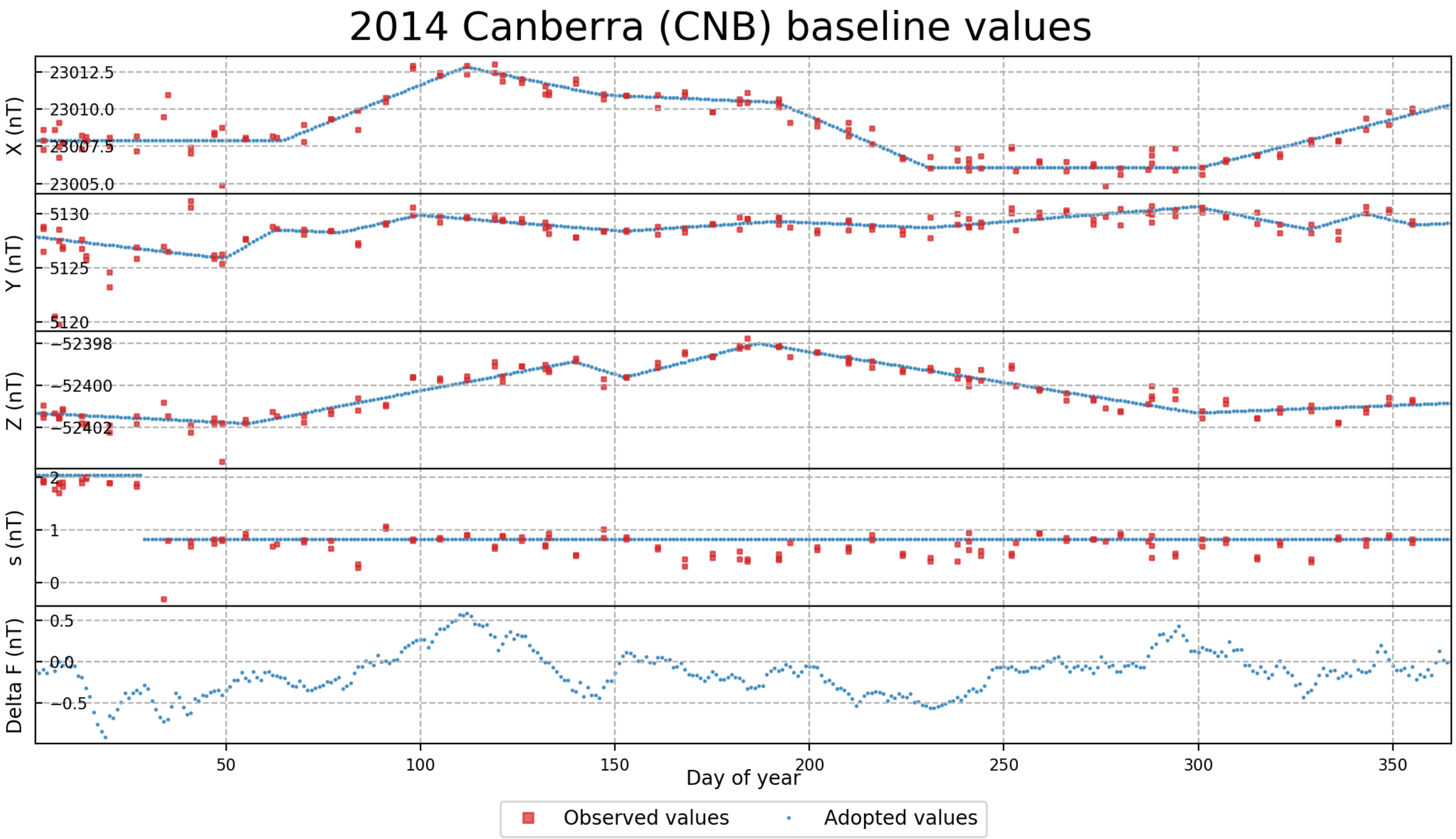

Figure 7.46 Canberra (CNB) baseline values for 2014. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.7.2.3 2015

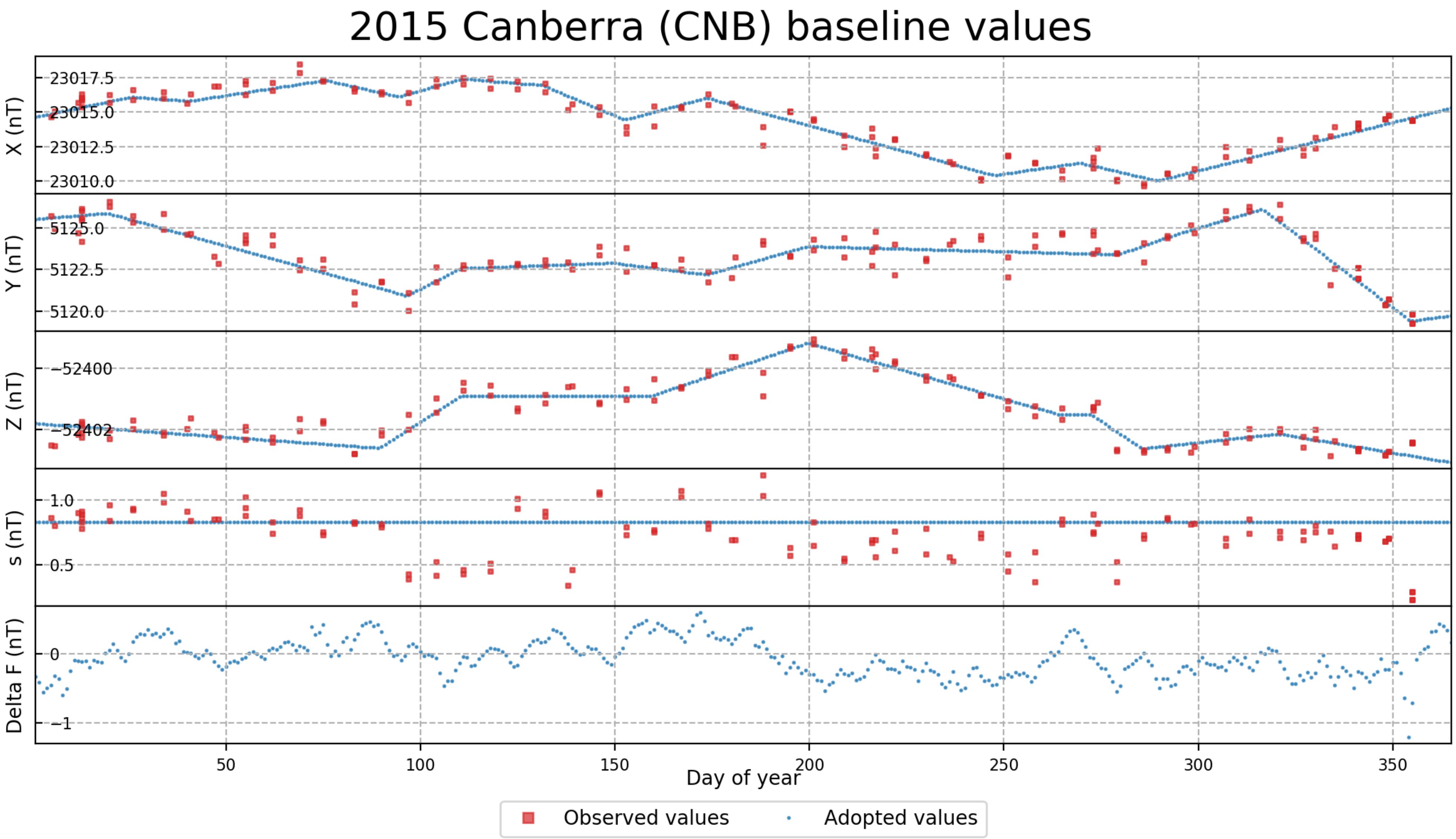

Figure 7.47 Canberra (CNB) baseline values for 2015. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.7.2.4 2016

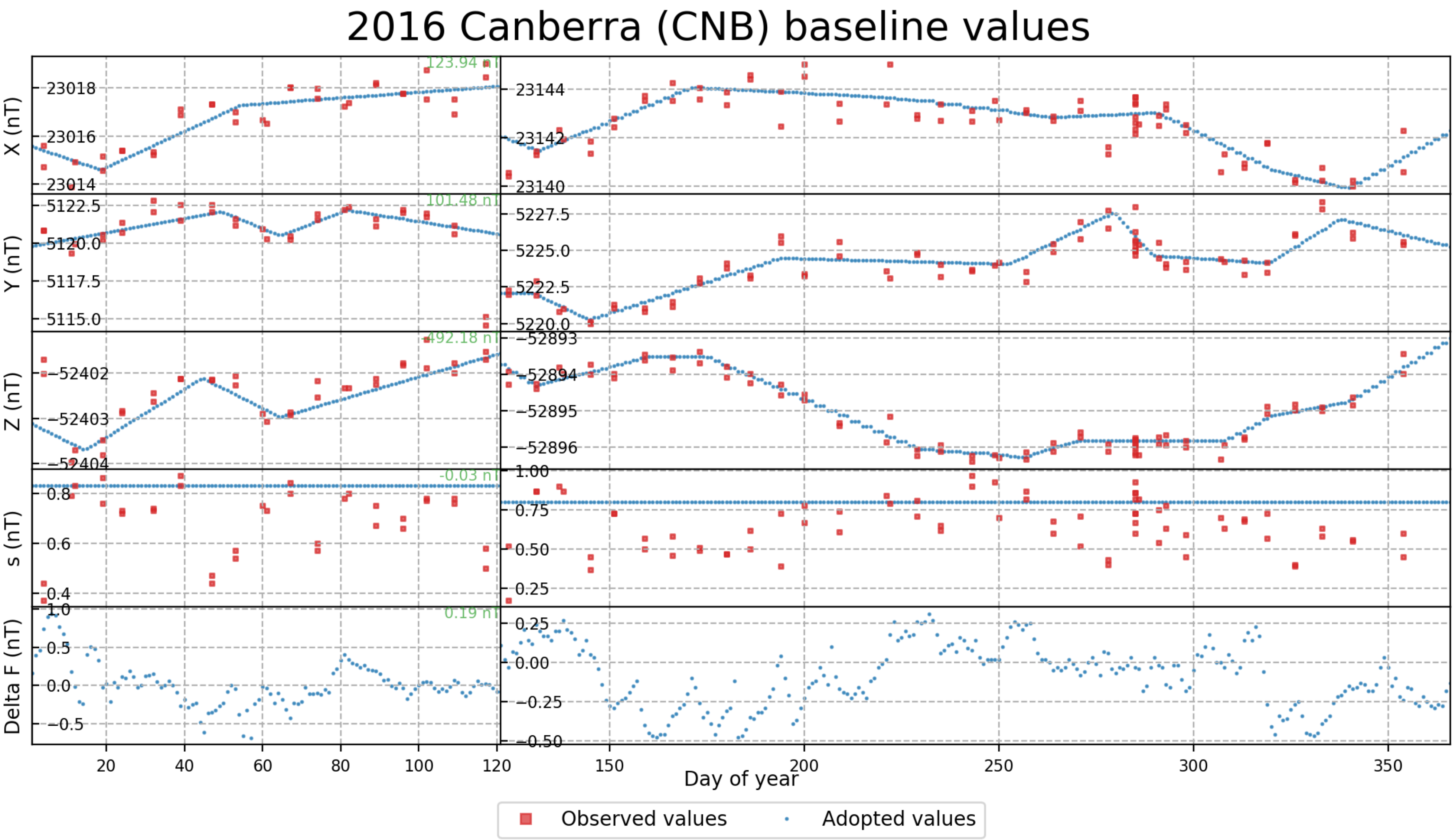

Figure 7.48 Canberra (CNB) baseline values for 2016. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.7.3 Annual mean values

7.7.3.1 DIH

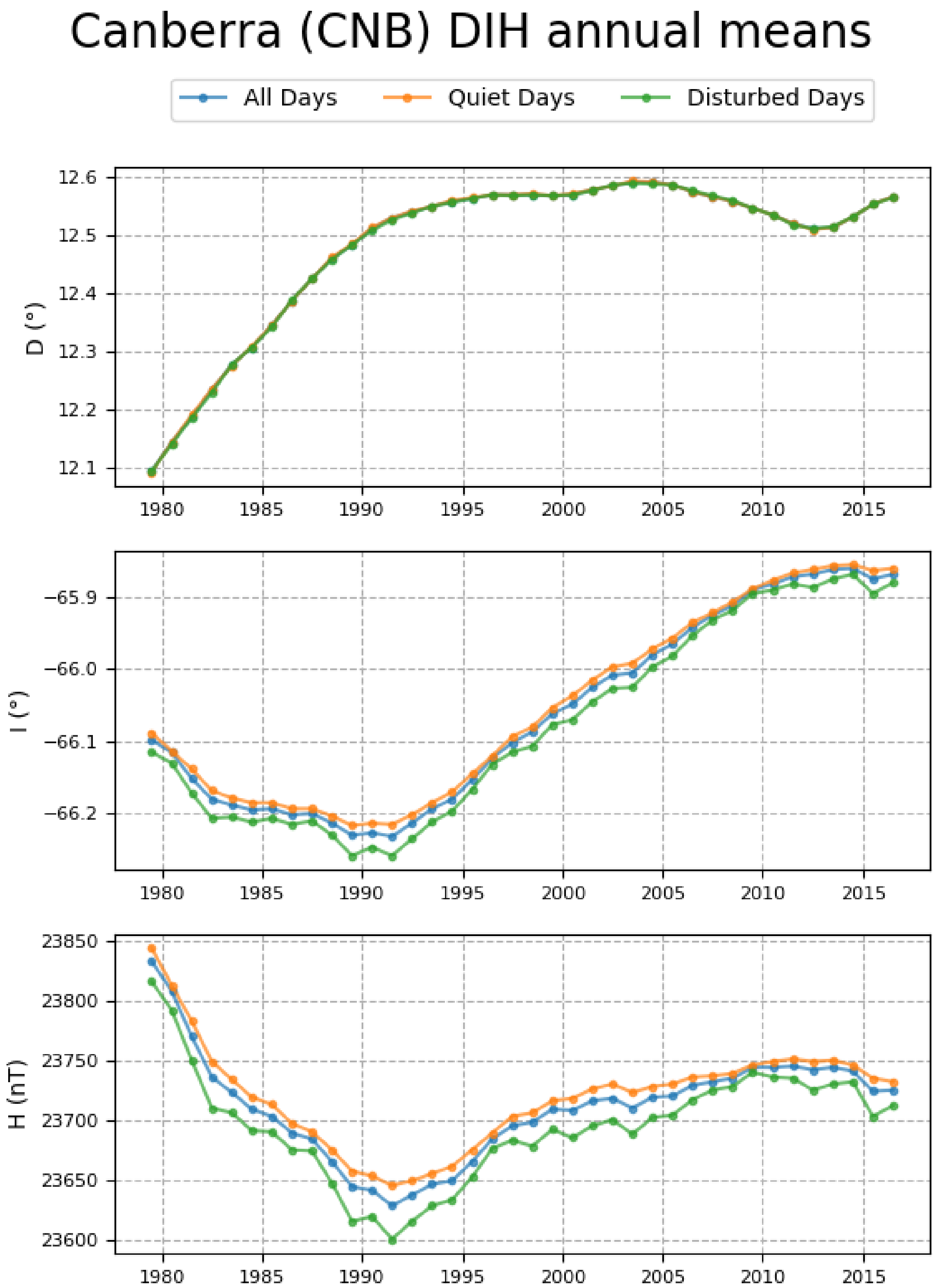

Figure 7.49 Canberra (CNB) annual mean values in DIH until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.7.3.2 XYZF

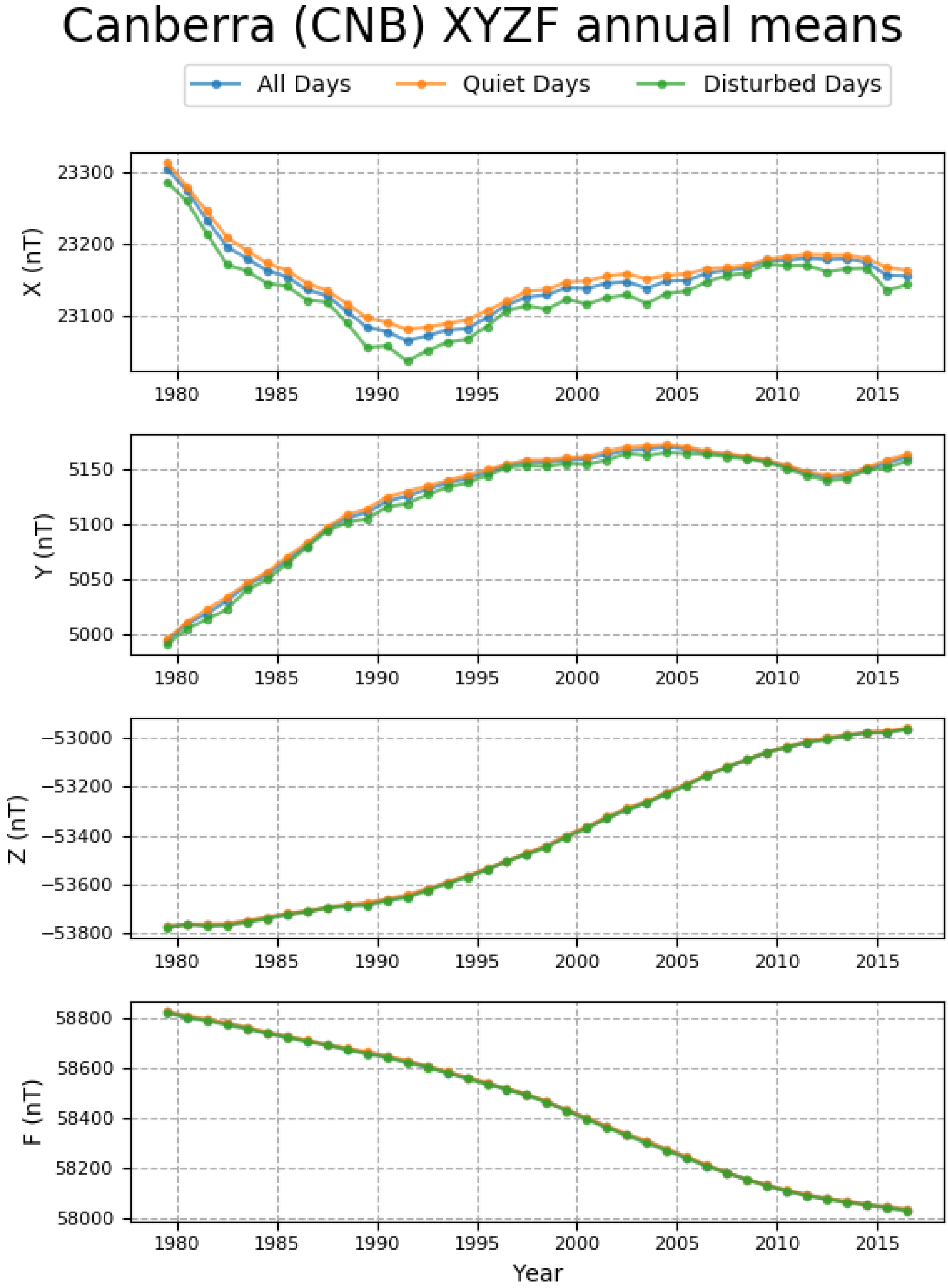

Figure 7.50 Canberra (CNB) annual mean values in XYZF until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.7.3.3 2016 INTERMAGNET annual mean values file

ANNUAL MEAN VALUES

CANBERRA, CNB, AUSTRALIA

COLATITUDE: 125.314 LONGITUDE: 149.363 E ELEVATION: 859 metres

YEAR	D Deg	D Min	I Deg	I Min	H nT	X nT	Y nT	Z nT	F nT	*	ELE	Note
1979.500	12	5.6	-66	5.9	23833	23305	4993	-53778	58822	A	DFI	
1980.500	12	8.6	-66	6.9	23808	23275	5009	-53767	58801	A	DFI	
1981.500	12	11.2	-66	9.1	23770	23234	5018	-53771	58791	A	DFI	
1982.500	12	14.0	-66	10.8	23736	23197	5030	-53769	58775	A	DFI	
1983.500	12	16.6	-66	11.3	23723	23180	5044	-53756	58758	A	DFI	
1984.500	12	18.4	-66	11.7	23709	23164	5054	-53741	58739	A	DFI	
1985.500	12	20.7	-66	11.6	23703	23155	5067	-53726	58723	A	DFI	
1986.500	12	23.2	-66	12.1	23689	23137	5081	-53716	58707	A	DFI	
1987.500	12	25.5	-66	12.0	23684	23129	5096	-53699	58690	A	DFI	
1988.500	12	27.6	-66	12.8	23665	23107	5106	-53690	58674	A	DFI	
1989.500	12	29.0	-66	13.8	23644	23085	5111	-53683	58659	A	DFI	
1990.500	12	30.7	-66	13.6	23641	23079	5121	-53667	58643	A	DFI	
1991.500	12	31.8	-66	13.9	23628	23066	5126	-53652	58624	A	DFI	
1992.500	12	32.4	-66	12.8	23637	23073	5132	-53625	58603	A	DFI	
1993.500	12	33.0	-66	11.6	23646	23081	5138	-53597	58581	A	DFI	
1994.500	12	33.5	-66	10.8	23649	23083	5142	-53571	58559	A	DFI	
1995.500	12	33.8	-66	09.2	23665	23098	5148	-53540	58537	A	DFI	1
1996.500	12	34.2	-66	07.4	23684	23116	5154	-53507	58514	A	ABZ	2
1997.500	12	34.2	-66	06.1	23695	23127	5157	-53476	58491	A	ABZ	
1998.500	12	34.2	-66	05.2	23698	23130	5157	-53444	58463	A	ABZ	
1999.500	12	34.1	-66	03.7	23709	23140	5159	-53403	58429	A	ABZ	
2000.500	12	34.2	-66	02.9	23708	23139	5160	-53367	58396	A	ABZ	
2001.500	12	34.7	-66	01.5	23716	23146	5164	-53327	58362	A	ABZ	
2002.500	12	35.1	-66	00.5	23718	23148	5168	-53291	58331	A	ABZ	
2003.500	12	35.5	-66	00.3	23710	23139	5169	-53264	58303	A	ABZ	
2004.500	12	35.5	-65	58.8	23719	23149	5171	-53225	58271	A	ABZ	
2005.500	12	35.2	-65	57.9	23720	23150	5169	-53190	58240	A	ABZ	
2006.500	12	34.5	-65	56.5	23729	23160	5166	-53151	58207	A	ABZ	
2007.500	12	34.0	-65	55.5	23732	23164	5164	-53118	58179	A	ABZ	
2008.500	12	33.5	-65	54.7	23735	23167	5161	-53088	58152	A	ABZ	
2009.500	12	32.8	-65	53.4	23744	23177	5158	-53057	58128	A	ABZ	
2010.500	12	32.1	-65	52.9	23744	23178	5153	-53035	58107	A	ABZ	
2011.500	12	31.2	-65	52.3	23745	23181	5147	-53015	58089	A	ABZ	
2012.500	12	30.7	-65	52.1	23742	23179	5143	-53000	58075	A	ABZ	
2013.500	12	30.8	-65	51.7	23744	23180	5145	-52986	58063	A	ABZ	
2014.500	12	31.9	-65	51.6	23741	23175	5151	-52975	58051	A	ABZ	
2015.500	12	33.2	-65	52.5	23724	23157	5156	-52973	58042	A	ABZ	
2016.500	12	34.0	-65	52.1	23725	23156	5162	-52959	58030	A	ABZ	
1979.500	12	05.5	-66	05.3	23844	23315	4995	-53775	58824	Q	DFI	
1980.500	12	08.6	-66	06.8	23813	23280	5010	-53769	58806	Q	DFI	
1981.500	12	11.4	-66	08.3	23783	23246	5022	-53767	58792	Q	DFI	
1982.500	12	14.1	-66	10.1	23749	23210	5033	-53766	58778	Q	DFI	
1983.500	12	16.5	-66	10.7	23734	23191	5046	-53753	58760	Q	DFI	
1984.500	12	18.5	-66	11.1	23719	23174	5056	-53739	58741	Q	DFI	
1985.500	12	20.7	-66	11.1	23713	23164	5070	-53724	58724	Q	DFI	
1986.500	12	23.2	-66	11.6	23697	23146	5083	-53714	58709	Q	DFI	
1987.500	12	25.5	-66	11.6	23690	23136	5097	-53698	58691	Q	DFI	
1988.500	12	27.7	-66	12.2	23675	23118	5109	-53687	58676	Q	DFI	
1989.500	12	29.1	-66	13.0	23657	23098	5114	-53680	58662	Q	DFI	

1990.500	12 30.8	-66 12.8	23653	23092	5125	-53663	58645	Q	DFI
1991.500	12 31.8	-66 12.9	23645	23082	5130	-53647	58627	Q	DFI
1992.500	12 32.5	-66 12.1	23649	23085	5135	-53622	58605	Q	DFI
1993.500	12 33.0	-66 11.1	23655	23090	5140	-53594	58583	Q	DFI
1994.500	12 33.6	-66 10.2	23661	23095	5145	-53568	58561	Q	DFI
1995.500	12 33.9	-66 08.7	23675	23108	5150	-53537	58538	Q	DFI
1996.500	12 34.2	-66 07.2	23689	23121	5155	-53506	58515	Q	ABZ
1997.500	12 34.2	-66 05.6	23703	23135	5159	-53474	58492	Q	ABZ
1998.500	12 34.3	-66 04.8	23706	23137	5159	-53443	58464	Q	ABZ
1999.500	12 34.1	-66 03.2	23716	23148	5161	-53400	58430	Q	ABZ
2000.500	12 34.3	-66 02.2	23718	23149	5162	-53365	58398	Q	ABZ
2001.500	12 34.7	-66 00.9	23726	23156	5167	-53324	58364	Q	ABZ
2002.500	12 35.1	-65 59.8	23730	23159	5171	-53289	58334	Q	ABZ
2003.500	12 35.6	-65 59.5	23723	23152	5172	-53261	58306	Q	ABZ
2004.500	12 35.5	-65 58.3	23728	23157	5173	-53223	58273	Q	ABZ
2005.500	12 35.2	-65 57.4	23730	23159	5171	-53188	58242	Q	ABZ
2006.500	12 34.5	-65 56.1	23736	23166	5167	-53149	58208	Q	ABZ
2007.500	12 34.0	-65 55.3	23737	23168	5165	-53117	58180	Q	ABZ
2008.500	12 33.5	-65 54.4	23739	23171	5162	-53087	58153	Q	ABZ
2009.500	12 32.8	-65 53.3	23746	23179	5159	-53056	58128	Q	ABZ
2010.500	12 32.1	-65 52.6	23749	23183	5154	-53034	58108	Q	ABZ
2011.500	12 31.2	-65 52.0	23751	23186	5148	-53013	58090	Q	ABZ
2012.500	12 30.6	-65 51.7	23749	23185	5145	-52998	58076	Q	ABZ
2013.500	12 30.8	-65 51.4	23750	23185	5146	-52985	58064	Q	ABZ
2014.500	12 31.9	-65 51.3	23746	23180	5152	-52973	58052	Q	ABZ
2015.500	12 33.2	-65 51.8	23735	23168	5159	-52969	58044	Q	ABZ
2016.500	12 34.0	-65 51.6	23732	23164	5164	-52957	58032	Q	ABZ
1979.500	12 5.6	-66 6.9	23816	23287	4990	-53782	58819	D	DFI
1980.500	12 8.4	-66 7.8	23792	23260	5004	-53770	58798	D	DFI
1981.500	12 11.1	-66 10.3	23750	23215	5013	-53776	58787	D	DFI
1982.500	12 13.7	-66 12.4	23710	23172	5022	-53773	58769	D	DFI
1983.500	12 16.6	-66 12.3	23706	23163	5040	-53760	58754	D	DFI
1984.500	12 18.4	-66 12.7	23691	23146	5049	-53745	58735	D	DFI
1985.500	12 20.5	-66 12.4	23690	23142	5064	-53729	58719	D	DFI
1986.500	12 23.3	-66 12.9	23675	23123	5079	-53717	58703	D	DFI
1987.500	12 25.5	-66 12.6	23674	23120	5094	-53701	58688	D	DFI
1988.500	12 27.5	-66 13.8	23647	23091	5102	-53693	58670	D	DFI
1989.500	12 29.0	-66 15.5	23615	23057	5105	-53690	58654	D	DFI
1990.500	12 30.5	-66 14.8	23619	23059	5116	-53671	58639	D	DFI
1991.500	12 31.6	-66 15.5	23600	23038	5119	-53658	58618	D	DFI
1992.500	12 32.3	-66 14.1	23615	23052	5127	-53630	58600	D	DFI
1993.500	12 33.0	-66 12.7	23628	23064	5134	-53601	58578	D	DFI
1994.500	12 33.4	-66 11.8	23633	23068	5138	-53574	58555	D	DFI
1995.500	12 33.8	-66 10.0	23652	23086	5145	-53542	58533	D	DFI
1996.500	12 34.2	-66 07.9	23676	23108	5152	-53508	58512	D	ABZ
1997.500	12 34.1	-66 06.9	23683	23115	5154	-53479	58488	D	ABZ
1998.500	12 34.2	-66 06.4	23678	23110	5153	-53450	58459	D	ABZ
1999.500	12 34.1	-66 04.6	23692	23124	5156	-53407	58427	D	ABZ
2000.500	12 34.2	-66 04.2	23685	23117	5155	-53372	58392	D	ABZ
2001.500	12 34.6	-66 02.7	23695	23126	5159	-53331	58358	D	ABZ
2002.500	12 35.2	-66 01.6	23700	23130	5165	-53296	58328	D	ABZ
2003.500	12 35.4	-66 01.5	23688	23118	5163	-53266	58295	D	ABZ
2004.500	12 35.3	-65 59.8	23702	23132	5166	-53229	58267	D	ABZ
2005.500	12 35.2	-65 58.9	23704	23135	5165	-53194	58236	D	ABZ
2006.500	12 34.6	-65 57.2	23717	23148	5164	-53153	58204	D	ABZ
2007.500	12 34.1	-65 55.9	23725	23157	5162	-53119	58177	D	ABZ
2008.500	12 33.6	-65 55.1	23728	23160	5160	-53089	58151	D	ABZ
2009.500	12 32.8	-65 53.7	23740	23173	5157	-53058	58127	D	ABZ
2010.500	12 32.1	-65 53.4	23736	23170	5151	-53036	58105	D	ABZ
2011.500	12 31.1	-65 52.9	23735	23171	5145	-53017	58087	D	ABZ

2012.500	12 30.7	-65 53.2	23725	23162	5140	-53005	58072	D	ABZ
2013.500	12 30.9	-65 52.5	23730	23166	5142	-52989	58060	D	ABZ
2014.500	12 31.9	-65 52.1	23732	23167	5150	-52977	58049	D	ABZ
2015.500	12 33.2	-65 53.7	23703	23136	5152	-52977	58038	D	ABZ
2016.500	12 33.9	-65 52.8	23712	23144	5158	-52960	58026	D	ABZ

* A = All days
* Q = 5 International Quiet days each month
* D = 5 International Disturbed days each month

ELE = Elements recorded

Notes:

1. The elements recorded from November 1995 were magnetic NW, NE and Vertical, from which the standard magnetic elements were derived.

2. The NW, NE & Vertical components recorded since November 1995 are denoted A, B and Z respectively.

7.7.4 K indices

7.7.4.1 2013

Table 10 Canberra (CNB) K index values for 2013. For each cell, 3-hourly K indices are given then the daily K sum (after the whitespace character). Dashes ('-') indicate that insufficient data were available to compute either the K indices or K sum. K indices enclosed in parentheses indicate that the K index was computed with missing data.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	10000001 02	10111212 09	33455433 30	11231201 11	13435452 27	34545322 28	22330000 10	11011110 06	22223311 16	01212122 11	12123100 10	24323202 18
02	00222112 10	13333222 19	23312322 18	10000111 04	22231221 15	33443323 25	00000100 01	00000110 02	12324100 13	56433433 31	01021102 07	10000000 01
03	12001000 04	10122211 10	22221211 13	00000000 00	11111120 08	22111223 14	00000100 01	10001001 03	10222112 11	30000120 06	13220022 12	12223221 15
04	11000022 06	11102221 10	10122001 07	01012100 05	10211101 07	23220112 13	01000100 02	11331433 19	11132011 10	00000000 00	01122312 12	11111011 07
05	11110000 04	12112000 07	10101100 04	00001001 02	01113210 09	21112111 10	12122121 12	23343322 22	00010001 02	00000000 00	10121103 09	01031011 07
06	01022222 11	00000011 02	01011010 04	11211110 08	11232111 12	13443423 24	13443333 24	12112012 10	12012111 09	00001011 03	00010112 05	21211112 11
07	11011012 07	12342111 15	12232001 11	01123110 09	32322210 15	24543210 21	20002000 04	11100000 03	01110000 03	11111111 08	22344122 20	10101113 08
08	01111213 10	23423302 19	00110011 04	01100000 02	11221310 11	22321000 10	01201010 05	00000000 00	23112110 11	11012145 15	12211001 08	45422421 24
09	21110011 07	12110011 07	11022210 09	11110000 04	01120000 04	12123322 16	00121211 08	12232011 12	01110001 04	44442323 26	23443322 23	11111212 10
10	00100011 03	22220111 11	11010211 07	02221002 09	11002000 04	23322220 16	22344333 24	11132000 08	00033322 13	22132201 13	23233222 19	12212011 10
11	00112012 07	11211112 10	22201100 08	01111113 09	01010000 02	00012211 07	13523331 21	11021100 06	11022111 09	11122101 09	23434310 20	01112001 06
12	21112111 10	00022213 10	21122121 12	22211100 09	00020000 02	11100000 03	11222111 11	00011112 06	10111012 07	10001112 06	11010000 03	00011000 02
13	21213333 18	21221133 15	11110000 04	22110013 10	11100100 04	01000000 01	23211121 13	20132322 15	21222421 16	10000000 01	00002001 03	11113212 12
14	33222121 16	23433220 19	01023201 09	23433212 20	10233322 16	00010010 02	22354333 25	22202213 14	11112001 07	11344322 20	00111001 04	33323333 23
15	12113111 11	00022111 07	04321011 12	11110022 08	31223210 14	10110100 04	33444221 23	22232422 19	10000011 03	33242113 19	11211322 13	22213311 15
16	12211122 12	10013331 12	22232211 15	11000112 06	23223323 20	00000000 00	00011110 04	34334422 25	00121101 06	22123212 15	22323222 18	22221112 13
17	34324532 26	01234332 18	12555553 31	00011000 02	11112231 12	00111000 03	11101111 07	22213101 12	22202222 14	12232211 14	22222022 14	21000121 07
18	12334233 21	10001113 07	23321121 15	10000010 02	23333222 20	01001110 04	00224432 17	11220121 10	11023212 12	10000012 04	10101000 03	11110112 08
19	31102223 14	01223221 13	12201112 10	00000000 00	22332323 20	00000121 04	12434322 21	11001200 05	22443222 21	00000101 02	00102211 07	22102222 13
20	23433001 16	12144312 18	22113333 18	00122000 05	21012210 09	11122231 13	21111000 06	00000002 02	11223002 11	10000002 03	11213010 09	33210112 13
21	11100112 07	22211121 12	44311011 15	00000110 02	01110011 05	23322222 18	01012210 07	23233333 22	01122321 12	10100100 03	00000010 01	22210011 09
22	00001000 01	22134322 19	12021121 10	11011101 06	21223221 15	22332222 18	00001102 04	23212223 17	11202101 08	11321112 12	00010021 04	01120000 04
23	01200000 03	11122121 11	21134334 21	02211222 12	02021121 09	33431323 22	11001000 03	33343322 23	12100020 06	11120001 06	33433211 20	10000001 02
24	00000000 00	01121110 07	22232211 15	32244432 24	12233243 20	11234432 20	10002001 04	11122110 09	12245311 19	32010000 06	00010001 02	00100112 05
25	01121323 13	00111112 07	00111111 06	22132221 15	34345344 30	22210201 10	12011233 13	01232210 11	12200001 06	01100012 05	00000000 00	13333321 19
26	33333534 27	01113121 10	11010000 03	13343322 21	34422231 21	00000100 01	23213221 16	11121211 10	00000000 00	01000102 04	00000112 04	11112111 09
27	11101211 08	01211100 06	23334433 25	12212201 11	12233232 18	00003212 08	21123321 15	11132243 17	00000100 01	01211111 08	11111201 08	00000021 03
28	02002211 08	01211113 10	21131321 14	00023121 09	23332100 14	33223343 23	11111111 08	21221100 09	00000000 00	22110000 06	01001100 03	00111113 08
29	00101000 02		23443422 24	20112001 07	00000000 00	33565332 30	11112100 07	00001100 02	00000001 01	10133122 13	13332332 20	21221211 12
30	00000101 02		43221122 17	11222102 11	00000000 00	22123121 14	02111011 07	00122223 12	21100000 04	11344423 22	21222123 15	00211101 06
31	00110101 04		11000211 06		00002222 08		00001110 03	22333101 15		00132312 12		22312122 15

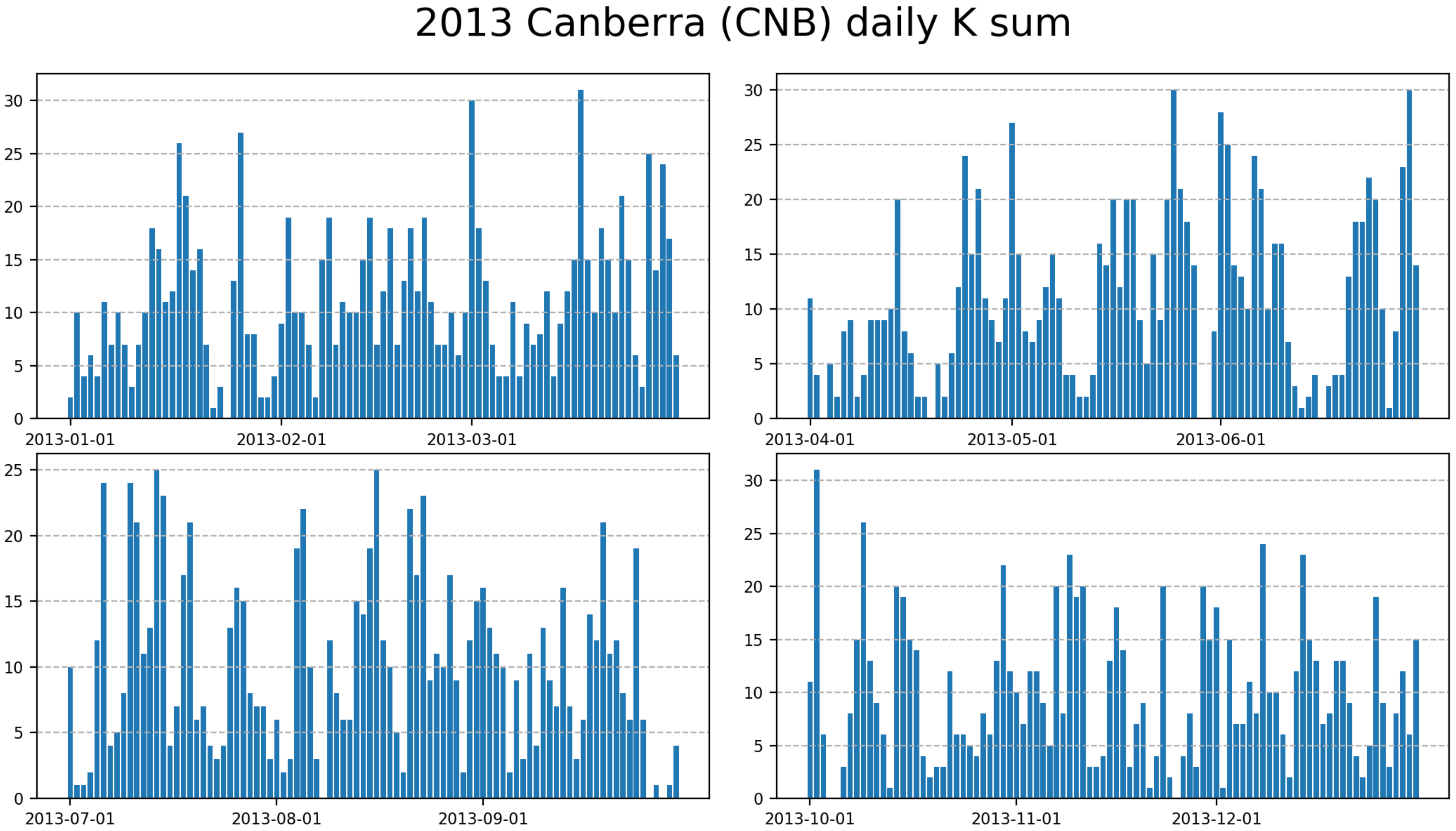

Figure 7.51 2013 Canberra (CNB) daily K sum.

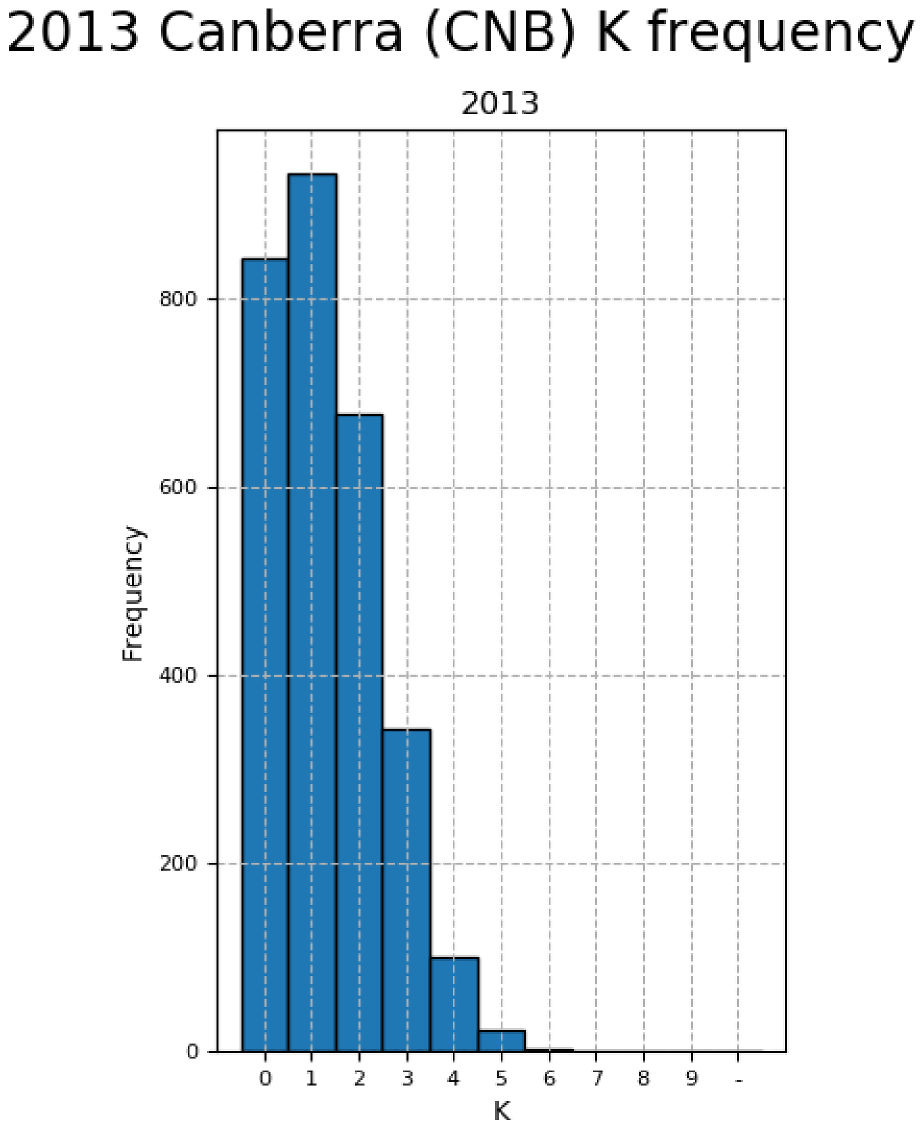

Figure 7.52 2013 Canberra (CNB) 3-hourly K index frequency plots.

7.7.4.2 2014

Table 11 Canberra (CNB) K index values for 2014. For each cell, 3-hourly K indices are given then the daily K sum (after the whitespace character). Dashes ('-') indicate that insufficient data were available to compute either the K indices or K sum. K indices enclosed in parentheses indicate that the K index was computed with missing data.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	11334333 21	10112212 10	21222012 12	01101211 07	12101010 06	10120100 05	01000000 01	01132122 12	12233221 16	22231321 16	11322221 14	12322234 19
02	33323232 21	12201112 10	31110001 07	11010111 06	00100000 01	00000011 02	00102000 03	11233311 15	11123222 14	12122211 12	11123321 14	23313321 18
03	22232212 16	22111311 12	10132001 08	01123211 11	00000132 06	22110010 07	22232000 11	02010121 07	22231111 13	01100201 05	31120013 11	21232222 16
04	22133122 16	22111112 11	11013213 12	12111210 09	13442111 17	00111201 06	00221000 05	12432222 18	11122001 08	12321112 13	21344343 24	12213323 17
05	22111101 09	22202122 13	11111212 10	11233323 18	02222321 14	00221002 07	00000001 01	12213331 16	12221221 13	22212112 13	34343233 25	12234212 17
06	01101111 06	22113312 15	01213121 11	10000001 02	00100000 01	10000111 04	00010000 01	22223211 15	13222322 17	12111011 08	13212113 14	12332334 21
07	11111322 12	00112323 12	01101001 04	22213421 17	00012101 05	12221323 16	10012100 05	21122021 11	12310000 07	12001001 05	22232223 18	32335433 26
08	22112112 12	44533232 26	01100101 04	11013101 08	13453422 24	24644321 26	01112110 07	22131000 09	01110112 07	22233222 18	12222213 15	32233223 20
09	22222133 17	22213242 18	00100000 01	11112221 11	11320001 08	01220110 07	11110011 06	00210011 05	12111121 10	23332222 19	21211222 13	32234232 21
10	11112201 09	21221232 15	01131000 06	00000001 01	12221011 10	01212201 09	11212210 10	11111222 11	10010113 07	21000101 05	33454422 27	22333112 17
11	01112122 10	12211113 12	01012121 08	12221212 13	22132121 14	11131111 10	00120110 05	10111313 11	23132113 16	11133211 13	33222224 20	11101122 09
12	10122233 14	33111222 15	11011112 08	32435222 23	22231211 14	01000000 01	11322110 11	21111343 16	54233545 31	11123011 10	22111111 10	22434333 24
13	23311102 13	20120001 06	32322211 16	23331241 19	10011000 03	00000100 01	11020000 04	21123011 11	32412221 17	11202221 11	11111111 08	23213312 17
14	32313212 17	11222102 11	12122101 10	11210021 08	10001100 03	12221010 09	00223311 12	10010001 03	11000000 02	12224444 23	23423223 21	12222332 17
15	11000101 04	11103335 17	01010000 02	11221101 09	00000110 02	10120001 05	01122210 09	00013200 06	01010001 03	33312201 15	22234223 20	22224323 20
16	00100001 02	44434433 29	00100000 01	00122001 06	01002100 04	01102111 07	00101010 03	01000000 01	22221111 12	11022312 12	32334322 22	22123233 18
17	11001001 04	12111112 10	00010001 02	22212221 14	00000000 00	22311112 13	01100010 03	00023200 07	11001212 08	22121113 13	01113232 13	22121222 14
18	00000010 01	21213322 16	02212211 11	12121112 11	11101111 07	21222334 19	00000000 00	01201110 06	22211021 11	33223322 20	22223311 16	22212223 16
19	00000000 00	34445222 26	11211001 07	23333331 21	01101101 05	33221122 16	00010000 01	00231135 15	23333432 23	22223022 15	21223111 13	22221223 16
20	00111102 06	14344312 22	01122001 07	32134343 23	00121000 04	12332311 16	00101000 02	11221011 09	21123201 12	22233433 22	11231231 14	32322223 19
21	21223323 18	21123311 14	21133311 15	33343311 21	00000000 00	11320001 08	01101210 06	22232121 15	13211111 11	22423322 20	23233222 19	12323233 19
22	12233123 17	12232312 16	10112111 08	12121101 09	11000312 08	01101021 06	10002101 05	02001000 03	11233211 14	22233322 19	22222132 16	34322212 19
23	22211111 11	11433444 24	21101112 09	11122221 12	31101434 17	00000002 02	10000111 04	00010100 02	21232331 17	22133222 17	12233222 17	22263224 23
24	12101001 06	02121211 10	01101100 04	22332222 18	11101100 05	21110010 06	01122000 06	00011000 02	23334433 25	21223423 19	11213321 14	32223221 17
25	11111212 10	30111112 10	00122124 12	21023331 15	11000200 04	10211221 10	10221000 06	00001000 01	22332122 17	21123222 15	10112122 10	11113333 16
26	12210111 09	00100001 02	21320012 11	01122110 08	11110000 04	00122100 06	11322111 12	00011001 03	23234323 22	21233322 18	11113001 08	33221243 20
27	11001202 07	11122554 21	12232110 12	10001101 04	00000010 01	00000010 01	11210001 06	02343331 19	33333322 22	22242222 18	14312223 18	22212111 12
28	11111223 12	31330111 13	11223022 13	21131000 08	11010010 04	11023221 12	12221310 12	13333321 19	12133222 16	22223322 18	11113222 13	11111232 12
29	22322212 16		22120003 10	00001003 04	00032220 09	11010012 06	01100110 04	33342232 22	11233232 17	11111210 08	11322222 15	23244534 27
30	11100010 04		11111011 07	22333341 21	02222330 14	21100010 05	21000000 03	23144112 18	12233222 17	01022122 10	22222333 19	33323222 20
31	10111000 04		01023210 09		11000000 02		11111111 08	11253223 19		12112121 11		12223312 16

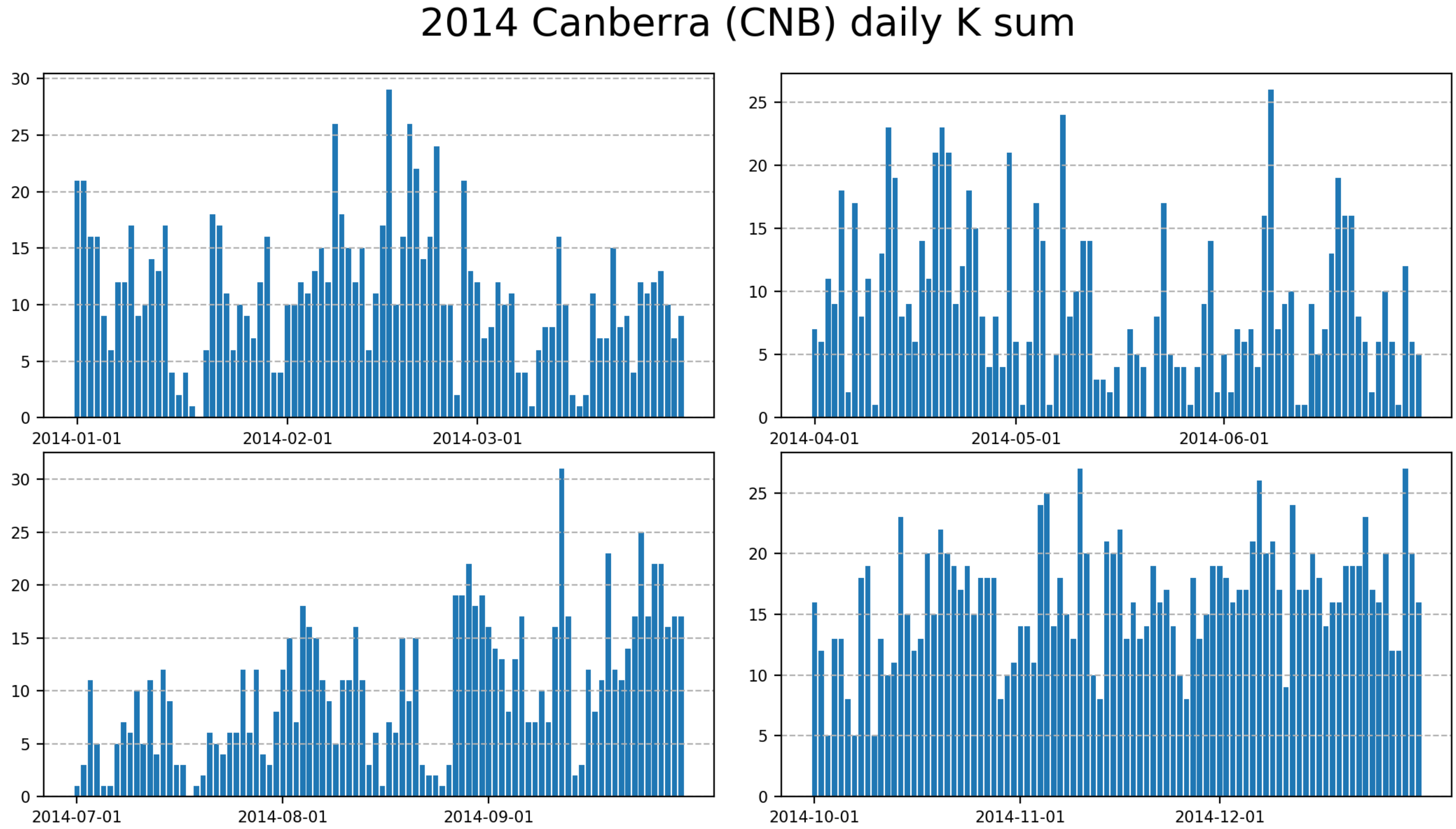

Figure 7.53 2014 Canberra (CNB) daily K sum.

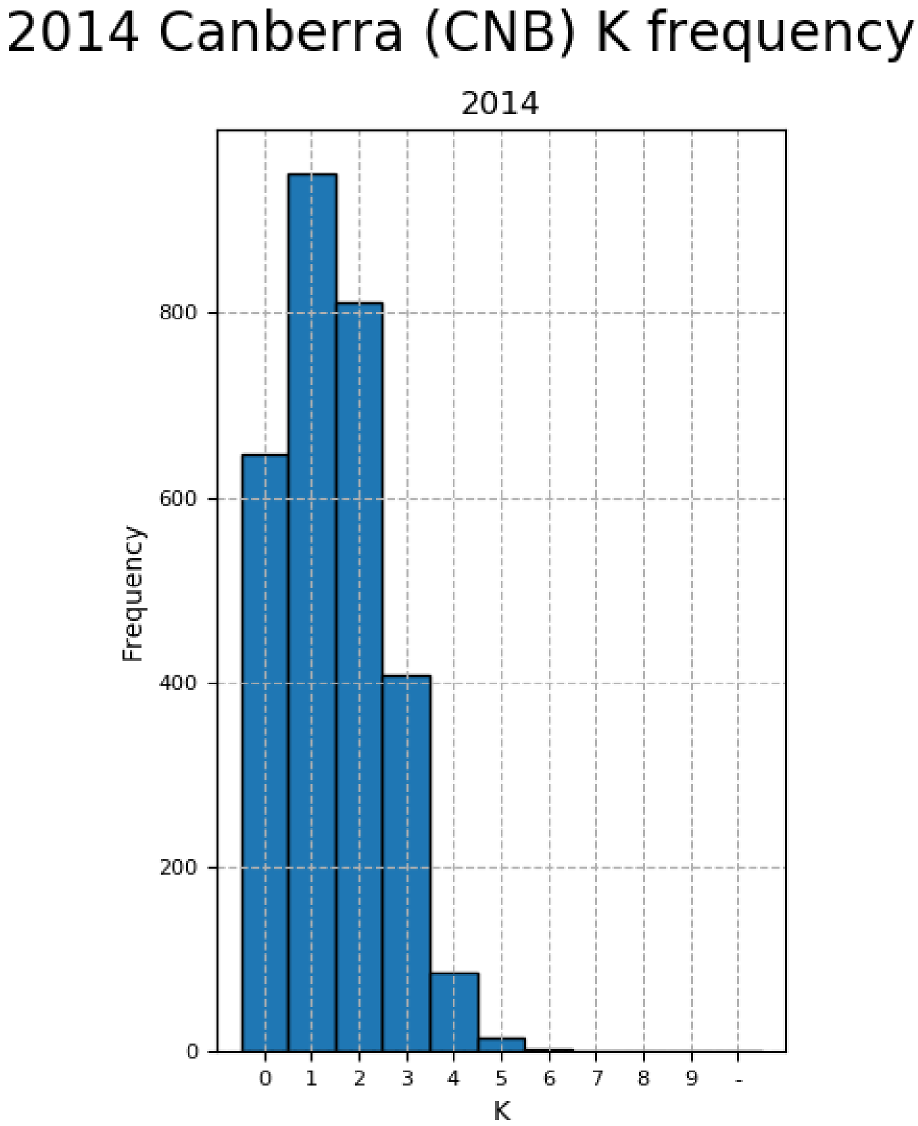

Figure 7.54 2014 Canberra (CNB) 3-hourly K index frequency plots.

7.7.4.3 2015

Table 12 Canberra (CNB) K index values for 2015. For each cell, 3-hourly K indices are given then the daily K sum (after the whitespace character). Dashes ('-') indicate that insufficient data were available to compute either the K indices or K sum. K indices enclosed in parentheses indicate that the K index was computed with missing data.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	11112112 10	32422334 23	34342123 22	11221222 13	22001101 07	11120010 06	00011100 03	22112321 14	11122001 08	12113323 16	13234210 16	22234322 20
02	22323223 19	34342333 25	24554322 27	12233233 19	12211122 12	00000000 00	00000000 00	21313211 14	10101222 09	12333322 19	00013302 09	11323211 14
03	34332110 17	33333332 23	22233112 16	33213323 20	13221111 12	00011000 02	00000000 00	11112110 08	12112223 14	13223322 18	24545342 29	11011111 07
04	02134534 22	21224311 16	01133011 10	22223311 16	11212311 12	00000000 00	00003243 12	01112121 09	32344322 23	23433213 21	35554222 28	12111101 08
05	43323222 21	12224423 20	10113111 09	12101212 10	00132002 08	00010000 01	45232322 23	00001111 04	03232332 18	23453211 21	11334312 18	12343422 21
06	23332332 21	22321110 12	13322122 16	11201001 06	33334431 24	01022000 05	44332121 20	01243311 15	13333232 20	11123423 17	21122234 17	23343323 23
07	32654324 29	11442223 19	23333423 23	11000000 02	12111211 10	00011111 05	10110000 03	11435310 18	22335554 29	24465563 35	33554431 28	33334332 24
08	44333222 23	13332232 19	22234211 17	00001110 03	12231100 10	23545532 29	00111220 07	11333212 16	43313223 21	35445433 31	12133233 18	32233122 18
09	21323112 15	21113221 13	21000102 06	23232222 18	00031221 09	32212322 17	01002110 05	12342322 19	33464454 33	33244422 24	22332343 22	12112321 13
10	22223311 16	01102212 09	12121001 08	44544322 28	11233111 13	22333221 18	10000113 06	22222121 14	21322342 19	22302211 13	33454333 28	34333233 24
11	22332222 18	12123101 11	13223331 18	23354322 24	12234321 18	23222210 14	33333332 23	22222101 12	24665633 35	21123221 14	43433321 23	23333322 21
12	12223322 17	11112211 10	12132210 12	01101111 06	22323232 19	01112210 08	23333232 21	22212312 15	23443211 20	12353332 22	11220101 08	22322312 17
13	22223212 16	00012001 04	11013111 09	22222211 14	(3)4445433 30	11222221 13	23554432 28	24333210 18	11144432 20	12342533 23	11033433 18	12122101 10
14	21223121 14	00010001 02	01112102 08	11213333 17	22212112 13	32241211 16	21210111 09	00000010 01	12132422 17	32353221 21	22233112 16	11123444 20
15	12224201 14	12123101 11	12212221 13	23254333 25	01232122 13	22345322 23	11111111 08	22456432 28	22244322 21	11231212 13	01231111 10	43223422 22
16	23222012 14	11122133 14	33432311 20	34454345 32	10112111 08	22331211 15	11131110 09	33543332 26	22213322 17	12213201 12	12333332 20	32100011 08
17	11111011 07	33342333 24	25566766 43	33433322 23	11100110 05	13333310 17	11011100 05	23454432 27	33231101 14	21133232 17	01221332 14	11022132 12
18	10012102 07	44433222 24	43555543 34	22232332 19	12233123 17	22221200 11	00011010 03	23111201 11	11343222 18	23464322 26	12232335 21	11100111 06
19	10011112 07	22311222 15	33455323 28	22122122 14	32121121 13	10010000 02	00010000 01	32334321 21	22342112 17	01211001 06	33232121 17	01111444 16
20	11110010 05	22222101 12	43433234 26	22122122 14	22212000 09	00000000 00	00021000 03	21134221 16	24644432 29	11133231 15	23430012 15	35456555 38
21	22212433 19	31112112 12	22333111 16	33344322 24	00000001 01	10000321 07	21222111 12	01102111 07	33122201 14	12244311 18	21000001 04	33344312 23
22	42233122 19	11011212 09	22544111 20	21333212 17	00001000 01	13433374 28	00122221 10	00233322 15	33413212 19	10211122 10	22101010 07	22443111 18
23	23222211 15	23333323 22	23234323 22	12111001 07	00021000 03	55554232 31	22433221 19	12544321 22	12323331 18	21012222 12	00101001 03	22222222 16
24	11113222 13	24333222 21	12134422 19	11011000 04	00000000 00	32433220 19	11103210 09	21232110 12	22201112 11	22301132 14	00000100 01	22324212 18
25	11111213 11	11333221 16	22234222 19	00000000 00	00010000 01	13454332 25	11231112 12	11232221 14	22134101 14	21213211 13	00000000 00	22213222 16
26	33343422 24	11111001 06	11202212 11	00001000 01	11111210 08	11230001 08	20131120 10	23354333 26	21000221 08	10110010 04	01011111 06	22223333 20
27	23322323 20	00011202 06	22223211 15	00112111 07	00012201 06	22221001 10	11243111 14	24444443 29	01100011 04	01112011 07	12221111 11	22233212 17
28	21222102 12	12222333 18	02232212 14	11132100 09	11022110 08	23323221 18	12232221 15	43344543 30	00001111 04	00000000 00	11123112 12	22223101 13
29	21122233 16		33233121 18	00021111 06	01121211 09	11221100 08	11022010 07	32141321 17	11110000 04	00112011 06	12322222 16	10013311 10
30	12211122 12		01010001 03	01100010 03	01111000 04	12000221 08	11122232 14	10010001 03	00000000 00	11024313 15	33543222 24	00112201 07
31	12112322 14		01223321 14		01100110 04		12124322 17	12000121 07		10122213 12		33346445 32

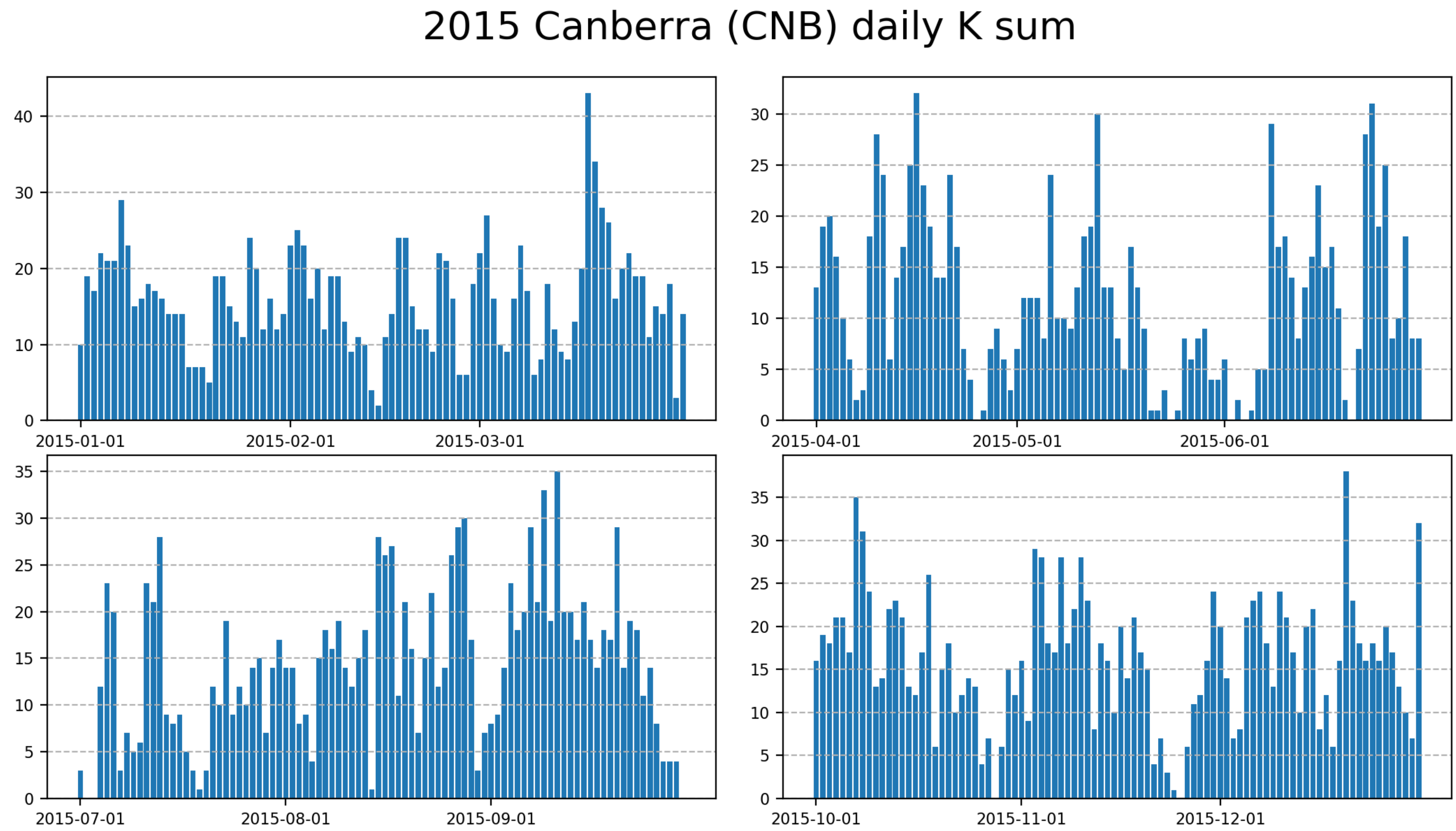

Figure 7.55 2015 Canberra (CNB) daily K sum.

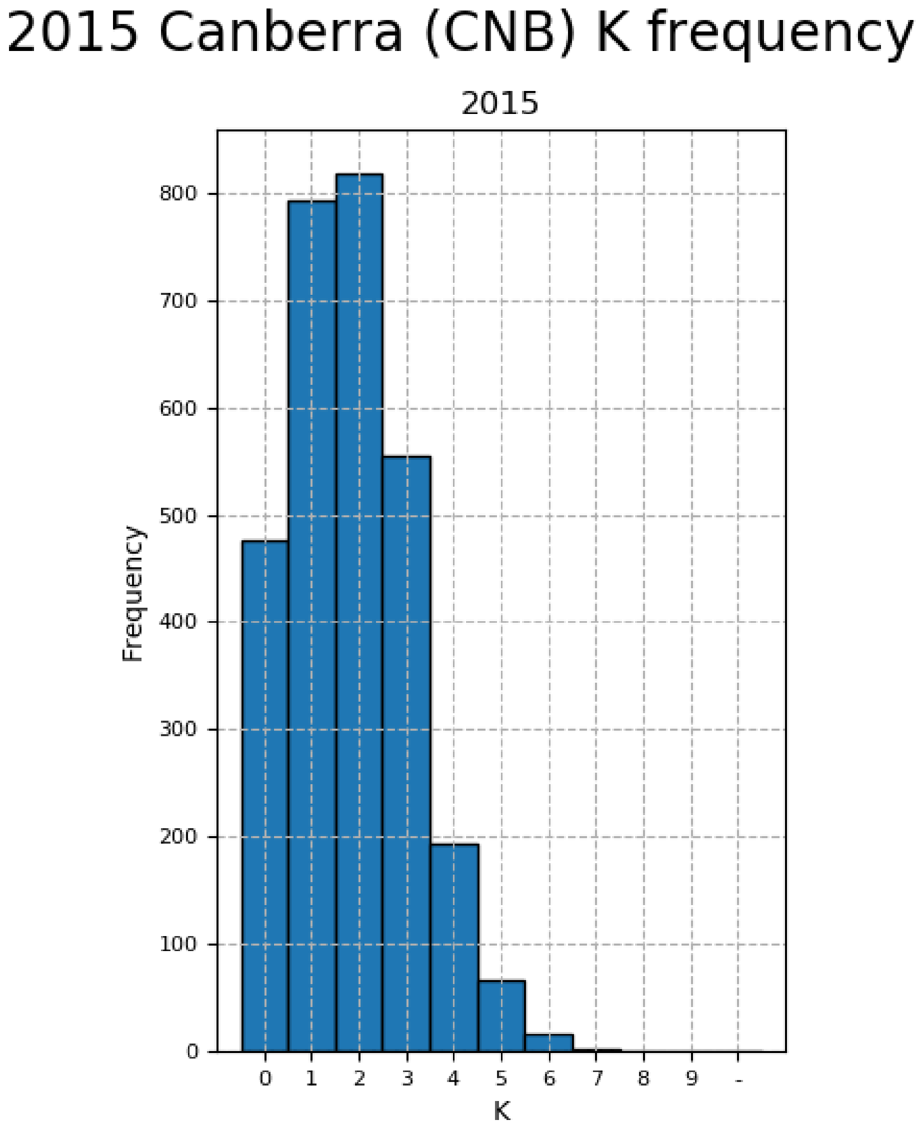

Figure 7.56 2015 Canberra (CNB) 3-hourly K index frequency plots.

7.7.4.4 2016

Table 13 Canberra (CNB) K index values for 2016. For each cell, 3-hourly K indices are given then the daily K sum (after the whitespace character). Dashes ('-') indicate that insufficient data were available to compute either the K indices or K sum. K indices enclosed in parentheses indicate that the K index was computed with missing data.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	33433122 21	12220100 08	13222102 13	10000011 03	11133432 18	11122210 10	12331000 10	10000000 01	22444343 26	13233332 20	11243223 18	13201000 07
02	32332221 18	00111322 10	02121311 11	10002533 14	34233444 27	00011000 02	00012112 07	02122324 16	45245423 29	22334342 23	21124312 16	11111111 08
03	13212212 14	22211201 11	12232202 14	12231312 15	24332222 20	00000000 00	22121212 13	33454432 28	24545433 30	22213222 16	12443322 21	10000000 01
04	12211210 10	11113311 12	11000100 03	22112001 09	11022200 08	00000011 02	10221020 08	23345431 25	22343433 24	23344232 23	11110010 05	02010001 04
05	12222323 17	23223212 17	01112001 06	00013121 08	02233321 16	11344432 22	00000000 00	13343312 20	23332332 21	22333211 17	11010001 04	12002222 11
06	32333322 21	11122211 11	02322454 22	10233210 12	21134442 21	34354321 25	00010011 03	21243221 17	22322222 17	11200221 09	01222112 11	11334211 16
07	33343321 22	20222411 14	33333333 24	01211143 13	32123211 15	11131231 13	22223333 20	31113311 14	33133421 20	11112220 10	11211100 07	01222433 17
08	11233111 13	23322111 15	11123210 11	22110000 06	54555653 38	12132100 10	22354322 23	21123430 16	22343212 19	12132111 12	00012000 03	23334543 27
09	11221112 11	11243111 14	01033311 12	00000100 01	43333333 25	10001010 03	21334321 19	12243312 18	10001011 04	00113111 08	00322112 11	23343333 24
10	12222212 14	11011001 05	02123221 13	11332012 13	23344321 22	00012120 06	22233111 15	22342222 19	02100001 04	12212331 15	33233523 24	22233322 19
11	13312332 18	21223112 14	03345332 23	00011320 07	21000001 04	21222112 13	11123221 13	11121322 13	00013210 07	01110011 05	21122223 15	33222321 18
12	32213222 17	22243222 19	22121321 14	22123443 21	01121000 05	01222231 13	13443222 21	32223221 17	12112100 08	11010113 08	24254323 25	22101212 11
13	34223221 19	23311111 13	02210001 06	33444431 26	00222321 12	22132110 12	22222211 14	11112120 09	01121001 06	22445442 27	23233232 20	11112111 09
14	12222112 13	12223311 15	01111234 13	12255432 24	10242022 13	21112253 17	23342221 19	11002000 04	11123222 14	22232210 14	11233312 16	00121111 07
15	11211101 08	12322112 14	23432333 23	20011111 07	22113331 16	32233210 16	13331211 15	00111100 04	11121101 08	22232313 18	11123101 10	01211111 08
16	01022101 07	42345544 31	42243133 22	00242433 18	22343221 19	10022111 08	21113111 11	00002202 06	00010210 04	21333332 20	01100011 04	11100001 04
17	01221111 09	33434445 30	34343322 24	23233322 20	12333322 19	11233221 15	11122111 10	11112011 08	10021000 04	23442432 24	01100111 05	10112223 12
18	11011123 10	34444343 29	11233312 16	21221000 08	12232100 11	12222111 12	10110000 03	12123201 12	00134311 13	12222211 13	00010200 03	22223202 15
19	33342102 18	22233432 21	12354321 21	00001000 01	11322220 13	12111200 08	00001203 06	00112120 07	00233323 16	12221210 11	00001210 04	12211122 12
20	13255544 29	12212100 09	12223441 19	00231000 06	22110011 08	12110011 07	33322210 16	11111000 05	32341312 19	10000010 02	00122111 08	12121312 13
21	35344433 29	12101011 07	12212211 12	00120111 06	13432321 19	00011000 02	00111101 05	00012311 08	22131001 10	01000000 01	12212122 13	12134532 21
22	23223222 18	01111211 08	22221001 10	11112322 13	11233110 12	10112332 13	00232231 13	11010200 05	12110000 05	11122311 12	22233333 21	33333332 23
23	23323321 19	11001023 08	12221112 12	12123222 15	01121000 05	13100223 12	22321000 10	12134343 21	12110111 08	03223221 15	22222111 13	13343322 21
24	12222332 17	11223111 12	10121111 08	21112431 15	01032000 06	22323222 18	10121342 14	32143223 20	11111111 08	22334322 21	22334333 23	22323322 19
25	10000000 01	11221112 11	21111100 07	11121110 08	00010000 01	21111122 11	33454321 25	11342222 17	23133233 20	22356434 29	34334332 25	33244322 23
26	00221121 09	23201110 10	00001001 02	10122112 10	00000000 00	10132312 13	01013200 07	21101221 10	11234333 20	44454533 32	22132221 15	32333322 21
27	13221102 12	02221111 10	23332322 20	11323321 16	12022221 12	32311011 12	00001000 01	11021100 06	22353423 24	33333433 25	22223112 15	22232111 14
28	01331110 10	21212001 09	22111122 12	10122000 06	22422331 19	22222220 14	12322232 17	00021000 03	33255433 28	12333333 21	11222212 13	11111221 10
29	11111100 06	10111001 05	23233311 18	01000000 01	12231112 13	11110110 06	23333321 20	00022221 09	34564422 30	34434232 25	11012111 08	11112201 09
30	00010101 03		21123222 15	02223322 16	22321311 15	00010122 06	21110011 07	11124332 17	22343331 21	33344322 24	11101100 05	01012201 07
31	02222212 13		12122101 10		10322322 15		00010200 03	11101011 06		12332211 15		01134331 16

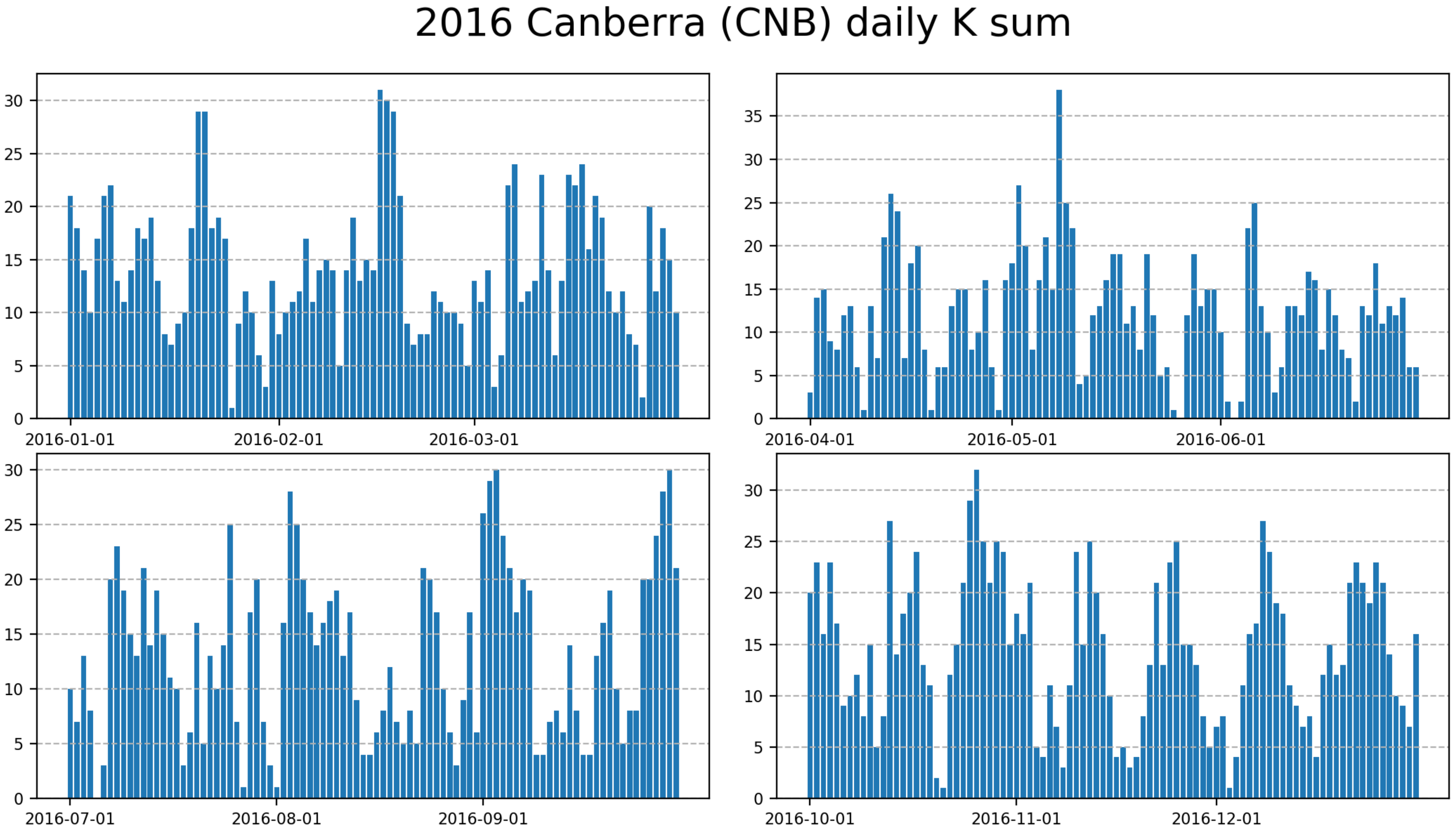

Figure 7.57 2016 Canberra (CNB) daily K sum.

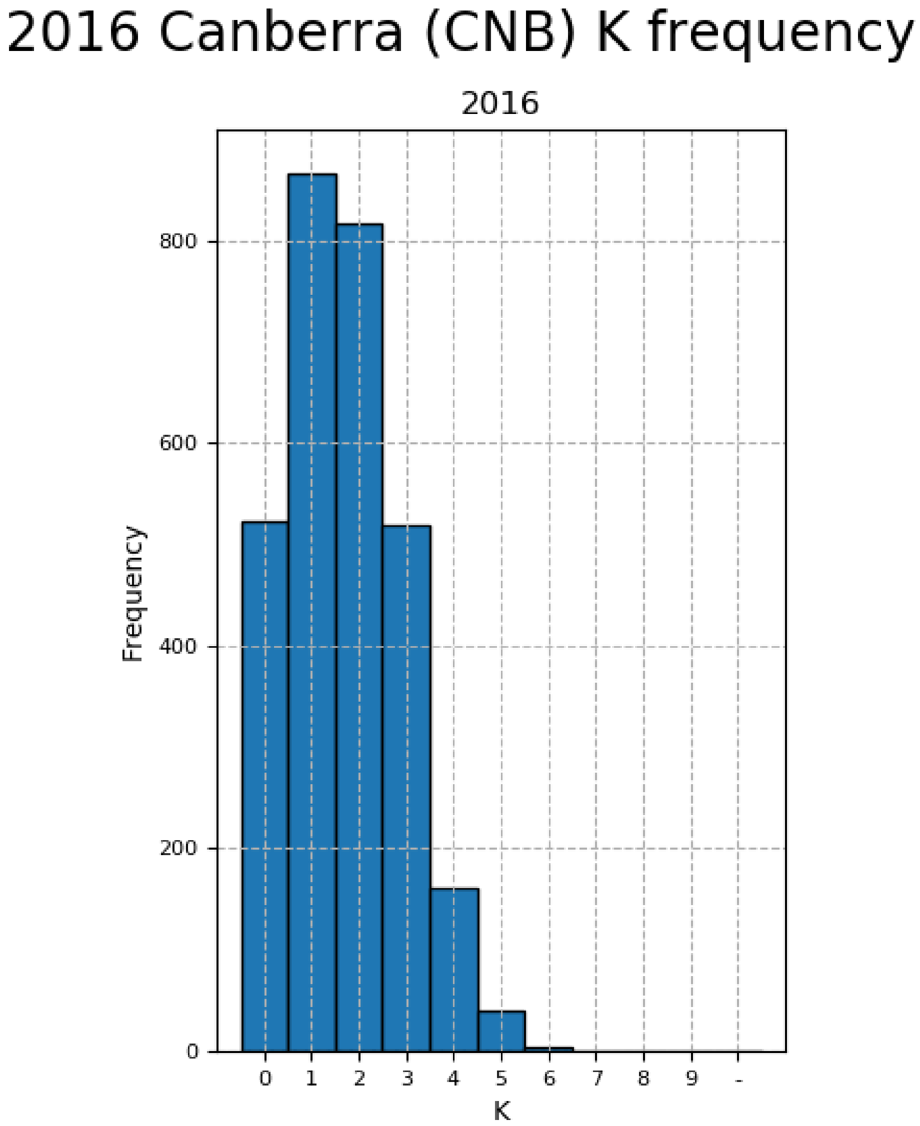

Figure 7.58 2016 Canberra (CNB) 3-hourly K index frequency plots.

7.7.5 Storm reports

This section reproduces the disseminating plaintext file that is submitted to Observatori de l'Ebre, Spain, monthly, in contribution to the International Service on Rapid Magnetic Variations.

7.7.5.1 2013

7.7.5.1.1 January

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra              (CNB) Geomagnetic data for Jan 2013
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                    P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
13 Jan 19 17 33    ssc      a        12.7   6.71   1.26
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
             Start  Max   End     H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s          K-sum
13 Jan 01     1   0   0   0     0   0   0   1      2
13 Jan 02     0   0   2   2     2   1   1   2      10
13 Jan 03     1   2   0   0     1   0   0   0      4
13 Jan 04     1   1   0   0     0   0   2   2      6
13 Jan 05     1   1   1   1     0   0   0   0      4
13 Jan 06     0   1   0   2     2   2   2   2      11
13 Jan 07     1   1   0   1     1   0   1   2      7
13 Jan 08     0   1   1   1     1   2   1   3      10
13 Jan 09     2   1   1   1     0   0   1   1      7
13 Jan 10     0   0   1   0     0   0   1   1      3
13 Jan 11     0   0   1   1     2   0   1   2      7
13 Jan 12     2   1   1   1     2   1   1   1      10
13 Jan 13     2   1   2   1     3   3   3   3      18
13 Jan 14     3   3   2   2     2   1   2   1      16
13 Jan 15     1   2   1   1     3   1   1   1      11
13 Jan 16     1   2   2   1     1   1   2   2      12
13 Jan 17     3   4   3   2     4   5   3   2      26
13 Jan 18     1   2   3   3     4   2   3   3      21
13 Jan 19     3   1   1   0     2   2   2   3      14
13 Jan 20     2   3   4   3     3   0   0   1      16
13 Jan 21     1   1   1   0     0   1   1   2      7
13 Jan 22     0   0   0   0     1   0   0   0      1
13 Jan 23     0   1   2   0     0   0   0   0      3
13 Jan 24     0   0   0   0     0   0   0   0      0
13 Jan 25     0   1   1   2     1   3   2   3      13
13 Jan 26     3   3   3   3     3   5   3   4      27
13 Jan 27     1   1   1   0     1   2   1   1      8
13 Jan 28     0   2   0   0     2   2   1   1      8
13 Jan 29     0   0   1   0     1   0   0   0      2
13 Jan 30     0   0   0   0     0   1   0   1      2
13 Jan 31     0   0   1   1     0   1   0   1      4
Mean of K-Sum is  9.4
Frequency Distribution of K-Indices
```

```
K-Index :    0    1    2    3    4    5    6    7    8    9    -
            83   84   46   28   5    2    0    0    0    0    0
--------------------------------------------------------------------------
```

7.7.5.1.2 February

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Feb 2013
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)    D(y)    Z

_________________________________________________________
13 Feb 14 06 11    ssc      b        29.68  8.73    0.36
13 Feb 16 12 09    ssc      a        25.52  1.0     5.01
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement       Amplitude in nT    Confirmation
              Start  Max   End     H(x)  D(y)   Z

_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s          K-sum
13 Feb 01     1   0   1   1     1   2   1   2      9
13 Feb 02     1   3   3   3     3   2   2   2      19
13 Feb 03     1   0   1   2     2   2   1   1      10
13 Feb 04     1   1   1   0     2   2   2   1      10
13 Feb 05     1   2   1   1     2   0   0   0      7
13 Feb 06     0   0   0   0     0   0   1   1      2
13 Feb 07     1   2   3   4     2   1   1   1      15
13 Feb 08     2   3   4   2     3   3   0   2      19
13 Feb 09     1   2   1   1     0   0   1   1      7
13 Feb 10     2   2   2   2     0   1   1   1      11
13 Feb 11     1   1   2   1     1   1   1   2      10
13 Feb 12     0   0   0   2     2   2   1   3      10
13 Feb 13     2   1   2   2     1   1   3   3      15
13 Feb 14     2   3   4   3     3   2   2   0      19
13 Feb 15     0   0   0   2     2   1   1   1      7
13 Feb 16     1   0   0   1     3   3   3   1      12
13 Feb 17     0   1   2   3     4   3   3   2      18
13 Feb 18     1   0   0   0     1   1   1   3      7
13 Feb 19     0   1   2   2     3   2   2   1      13
13 Feb 20     1   2   1   4     4   3   1   2      18
13 Feb 21     2   2   2   1     1   1   2   1      12
13 Feb 22     2   2   1   3     4   3   2   2      19
13 Feb 23     1   1   1   2     2   1   2   1      11
13 Feb 24     0   1   1   2     1   1   1   0      7
13 Feb 25     0   0   1   1     1   1   1   2      7
13 Feb 26     0   1   1   1     3   1   2   1      10
13 Feb 27     0   1   2   1     1   1   0   0      6
13 Feb 28     0   1   2   1     1   1   1   3      10
Mean of K-Sum is  11.4
Frequency Distribution of K-Indices
K-Index :    0    1    2    3    4    5    6    7    8    9    -
            39   91   60   27   7    0    0    0    0    0    0
--------------------------------------------------------------------------
```

7.7.5.1.3 March

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Mar 2013
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement      SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn   D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________

13 Mar 01 03 00   ...               1(4,5)            5  14.9  141.8 34.4    Mar 02 00
13 Mar 17 06 00   0.78,52.52,3.57   17(3,4,5,6,7)     5  23.5  194.5 71.0    Mar 18 12
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date           Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn   ssc/ssc* A,B,C    H(x)   D(y)    Z
_________________________________________________________
13 Mar 15 05 26   ssc      a        35.66  11.03  2.0
13 Mar 17 06 00   ssc      a        52.52  5.38   3.57
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s           K-sum
13 Mar 01      3   3   4   5     5   4   3   3      30
13 Mar 02      2   3   3   1     2   3   2   2      18
13 Mar 03      2   2   2   2     1   2   1   1      13
13 Mar 04      1   0   1   2     2   0   0   1      7
13 Mar 05      1   0   1   0     1   1   0   0      4
13 Mar 06      0   1   0   1     1   0   1   0      4
13 Mar 07      1   2   2   3     2   0   0   1      11
13 Mar 08      0   0   1   1     0   0   1   1      4
13 Mar 09      1   1   0   2     2   2   1   0      9
13 Mar 10      1   1   0   1     0   2   1   1      7
13 Mar 11      2   2   2   0     1   1   0   0      8
13 Mar 12      2   1   1   2     2   1   2   1      12
13 Mar 13      1   1   1   1     0   0   0   0      4
13 Mar 14      0   1   0   2     3   2   0   1      9
13 Mar 15      0   4   3   2     1   0   1   1      12
13 Mar 16      2   2   2   3     2   2   1   1      15
13 Mar 17      1   2   5   5     5   5   5   3      31
13 Mar 18      2   3   3   2     1   1   2   1      15
13 Mar 19      1   2   2   0     1   1   1   2      10
13 Mar 20      2   2   1   1     3   3   3   3      18
13 Mar 21      4   4   3   1     1   0   1   1      15
13 Mar 22      1   2   0   2     1   1   2   1      10
13 Mar 23      2   1   1   3     4   3   3   4      21
13 Mar 24      2   2   2   3     2   2   1   1      15
13 Mar 25      0   0   1   1     1   1   1   1      6
13 Mar 26      1   1   0   1     0   0   0   0      3
13 Mar 27      2   3   3   3     4   4   3   3      25
13 Mar 28      2   1   1   3     1   3   2   1      14
13 Mar 29      2   3   4   4     3   4   2   2      24
13 Mar 30      4   3   2   2     1   1   2   2      17
13 Mar 31      1   1   0   0     0   2   1   1      6
Mean of K-Sum is  12.8
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           46   87   62   33   13    7    0    0    0    0    0
--------------------------------------------------------------------------
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7.7.5.1.4 April

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Apr 2013
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```
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L    M A G N E T I C   S T O R M S
----------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
__________________________________________________________________________________

Nil
----------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
13 Apr 13 22 50    ssc       a       8.72   -22.99 11.74
13 Apr 23 04 52    ssc       b       9.95   3.95   1.13
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
             Start  Max   End     H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s          K-sum
13 Apr 01     1   1   2   3     1   2   0   1      11
13 Apr 02     1   0   0   0     0   1   1   1      4
13 Apr 03     0   0   0   0     0   0   0   0      0
13 Apr 04     0   1   0   1     2   1   0   0      5
13 Apr 05     0   0   0   0     1   0   0   1      2
13 Apr 06     1   1   2   1     1   1   1   0      8
13 Apr 07     0   1   1   2     3   1   1   0      9
13 Apr 08     0   1   1   0     0   0   0   0      2
13 Apr 09     1   1   1   1     0   0   0   0      4
13 Apr 10     0   2   2   2     1   0   0   2      9
13 Apr 11     0   1   1   1     1   1   1   3      9
13 Apr 12     2   2   2   1     1   1   0   0      9
13 Apr 13     2   2   1   1     0   0   1   3      10
13 Apr 14     2   3   4   3     3   2   1   2      20
13 Apr 15     1   1   1   1     0   0   2   2      8
13 Apr 16     1   1   0   0     0   1   1   2      6
13 Apr 17     0   0   0   1     1   0   0   0      2
13 Apr 18     1   0   0   0     0   0   1   0      2
13 Apr 19     0   0   0   0     0   0   0   0      0
13 Apr 20     0   0   1   2     2   0   0   0      5
13 Apr 21     0   0   0   0     0   1   1   0      2
13 Apr 22     1   1   0   1     1   1   0   1      6
13 Apr 23     0   2   2   1     1   2   2   2      12
13 Apr 24     3   2   2   4     4   4   3   2      24
13 Apr 25     2   2   1   3     2   2   2   1      15
13 Apr 26     1   3   3   4     3   3   2   2      21
13 Apr 27     1   2   2   1     2   2   0   1      11
13 Apr 28     0   0   0   2     3   1   2   1      9
13 Apr 29     2   0   1   1     2   0   0   1      7
13 Apr 30     1   1   2   2     2   1   0   2      11
Mean of K-Sum is  8.1
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            91   80   49   15   5    0    0    0    0    0    0
--------------------------------------------------------------------------
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7.7.5.1.5 May

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for May 2013
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L    M A G N E T I C   S T O R M S
----------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
```

Yr Mth Dy Hr Mn	D(') H(nT) Z(nT)	Day(3Hr Periods)	K	D(') H(nT) Z(nT)	Mth Dy Hr
Nil					

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
13 May 19 23 10	ssc*	a	3.63	17.74*	6.64
13 May 24 18 11	ssc	b	5.1	26.21	4.85
13 May 31 16 18	ssc	b	7.3	6.87	0.5

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
13 May 15	01:31	01:52	02:53	26.31	1.2	4.85	solar

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
13 May 01	1	3	4	3	5	4	5	2	27
13 May 02	2	2	2	3	1	2	2	1	15
13 May 03	1	1	1	1	1	1	2	0	8
13 May 04	1	0	2	1	1	1	0	1	7
13 May 05	0	1	1	1	3	2	1	0	9
13 May 06	1	1	2	3	2	1	1	1	12
13 May 07	3	2	3	2	2	2	1	0	15
13 May 08	1	1	2	2	1	3	1	0	11
13 May 09	0	1	1	2	0	0	0	0	4
13 May 10	1	1	0	0	2	0	0	0	4
13 May 11	0	1	0	1	0	0	0	0	2
13 May 12	0	0	0	2	0	0	0	0	2
13 May 13	1	1	1	0	0	1	0	0	4
13 May 14	1	0	2	3	3	3	2	2	16
13 May 15	3	1	2	2	3	2	1	0	14
13 May 16	2	3	2	2	3	3	2	3	20
13 May 17	1	1	1	1	2	2	3	1	12
13 May 18	2	3	3	3	3	2	2	2	20
13 May 19	2	2	3	3	2	3	2	3	20
13 May 20	2	1	0	1	2	2	1	0	9
13 May 21	0	1	1	1	0	0	1	1	5
13 May 22	2	1	2	2	3	2	2	1	15
13 May 23	0	2	0	2	1	1	2	1	9
13 May 24	1	2	2	3	3	2	4	3	20
13 May 25	3	4	3	4	5	3	4	4	30
13 May 26	3	4	4	2	2	2	3	1	21
13 May 27	1	2	2	3	3	2	3	2	18
13 May 28	2	3	3	3	2	1	0	0	14
13 May 29	0	0	0	0	0	0	0	0	0
13 May 30	0	0	0	0	0	0	0	0	0
13 May 31	0	0	0	0	2	2	2	2	8

Mean of K-Sum is 12.0

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	65	63	67	41	9	3	0	0	0	0	0

7.7.5.1.6 June

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Jun 2013
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
13 Jun 27 14 38	1.08,16.89,1.56	29(4)	6	27.0	186.7	75.6	Jun 30 06

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
13 Jun 19 23 06	ssc	c	5.07	0.89	0.93
13 Jun 27 14 38	ssc	a	16.89	7.26	1.56

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
13 Jun 01	3	4	5	4	5	3	2	2	28
13 Jun 02	3	3	4	4	3	3	2	3	25
13 Jun 03	2	2	1	1	1	2	2	3	14
13 Jun 04	2	3	2	2	0	1	1	2	13
13 Jun 05	2	1	1	1	2	1	1	1	10
13 Jun 06	1	3	4	4	3	4	2	3	24
13 Jun 07	2	4	5	4	3	2	1	0	21
13 Jun 08	2	2	3	2	1	0	0	0	10
13 Jun 09	1	2	1	2	3	3	2	2	16
13 Jun 10	2	3	3	2	2	2	2	0	16
13 Jun 11	0	0	0	1	2	2	1	1	7
13 Jun 12	1	1	1	0	0	0	0	0	3
13 Jun 13	0	1	0	0	0	0	0	0	1
13 Jun 14	0	0	0	1	0	0	1	0	2
13 Jun 15	1	0	1	1	0	1	0	0	4
13 Jun 16	0	0	0	0	0	0	0	0	0
13 Jun 17	0	0	1	1	1	0	0	0	3
13 Jun 18	0	1	0	0	1	1	1	0	4
13 Jun 19	0	0	0	0	0	1	2	1	4
13 Jun 20	1	1	1	2	2	2	3	1	13
13 Jun 21	2	3	3	2	2	2	2	2	18
13 Jun 22	2	2	3	3	2	2	2	2	18
13 Jun 23	3	3	4	3	1	3	2	3	22
13 Jun 24	1	1	2	3	4	4	3	2	20
13 Jun 25	2	2	2	1	0	2	0	1	10
13 Jun 26	0	0	0	0	0	1	0	0	1
13 Jun 27	0	0	0	0	3	2	1	2	8
13 Jun 28	3	3	2	2	3	3	4	3	23
13 Jun 29	3	3	5	6	5	3	3	2	30
13 Jun 30	2	2	1	2	3	1	2	1	14

Mean of K-Sum is 12.7

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	66	52	62	41	13	5	1	0	0	0	0

7.7.5.1.7 July

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Jul 2013
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(')	H(nT)	Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z

```
Nil
---------------------------------------------------------
                      S O L A R   F L A R E   E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max    End    H(x)   D(y)    Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                 K - i n d i c e s           K-sum
13 Jul 01      2   2   3   3     0   0   0   0      10
13 Jul 02      0   0   0   0     0   1   0   0      1
13 Jul 03      0   0   0   0     0   1   0   0      1
13 Jul 04      0   1   0   0     0   1   0   0      2
13 Jul 05      1   2   1   2     2   1   2   1      12
13 Jul 06      1   3   4   4     3   3   3   3      24
13 Jul 07      2   0   0   0     2   0   0   0      4
13 Jul 08      0   1   2   0     1   0   1   0      5
13 Jul 09      0   0   1   2     1   2   1   1      8
13 Jul 10      2   2   3   4     4   3   3   3      24
13 Jul 11      1   3   5   2     3   3   3   1      21
13 Jul 12      1   1   2   2     2   1   1   1      11
13 Jul 13      2   3   2   1     1   1   2   1      13
13 Jul 14      2   2   3   5     4   3   3   3      25
13 Jul 15      3   3   4   4     4   2   2   1      23
13 Jul 16      0   0   0   1     1   1   1   0      4
13 Jul 17      1   1   1   0     1   1   1   1      7
13 Jul 18      0   0   2   2     4   4   3   2      17
13 Jul 19      1   2   4   3     4   3   2   2      21
13 Jul 20      2   1   1   1     1   0   0   0      6
13 Jul 21      0   1   0   1     2   2   1   0      7
13 Jul 22      0   0   0   0     1   1   0   2      4
13 Jul 23      1   1   0   0     1   0   0   0      3
13 Jul 24      1   0   0   0     2   0   0   1      4
13 Jul 25      1   2   0   1     1   2   3   3      13
13 Jul 26      2   3   2   1     3   2   2   1      16
13 Jul 27      2   1   1   2     3   3   2   1      15
13 Jul 28      1   1   1   1     1   1   1   1      8
13 Jul 29      1   1   1   1     2   1   0   0      7
13 Jul 30      0   2   1   1     1   0   1   1      7
13 Jul 31      0   0   0   0     1   1   1   0      3
Mean of K-Sum is  10.5
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           74   83   46   31   12   2    0    0    0    0    0
--------------------------------------------------------------------------
```

7.7.5.1.8 August

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Aug 2013
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)    D(y)    Z
_________________________________________________________
13 Aug 20 22 28    ssc       b        5.04    15.1    4.92
---------------------------------------------------------
                      S O L A R   F L A R E   E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max    End    H(x)   D(y)    Z
```

```
______________________________________________________________________
Nil
----------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
---------------------------------------------------------------------------
UT-Date               K - i n d i c e s          K-sum
13 Aug 01     1   1   0   1     1   1   1   0     6
13 Aug 02     0   0   0   0     0   1   1   0     2
13 Aug 03     1   0   0   0     1   0   0   1     3
13 Aug 04     1   1   3   3     1   4   3   3     19
13 Aug 05     2   3   3   4     3   3   2   2     22
13 Aug 06     1   2   1   1     2   0   1   2     10
13 Aug 07     1   1   1   0     0   0   0   0     3
13 Aug 08     0   0   0   0     0   0   0   0     0
13 Aug 09     1   2   2   3     2   0   1   1     12
13 Aug 10     1   1   1   3     2   0   0   0     8
13 Aug 11     1   1   0   2     1   1   0   0     6
13 Aug 12     0   0   0   1     1   1   1   2     6
13 Aug 13     2   0   1   3     2   3   2   2     15
13 Aug 14     2   2   2   0     2   2   1   3     14
13 Aug 15     2   2   2   3     2   4   2   2     19
13 Aug 16     3   4   3   3     4   4   2   2     25
13 Aug 17     2   2   2   1     3   1   0   1     12
13 Aug 18     1   1   2   2     0   1   2   1     10
13 Aug 19     1   1   0   0     1   2   0   0     5
13 Aug 20     0   0   0   0     0   0   0   2     2
13 Aug 21     2   3   2   3     3   3   3   3     22
13 Aug 22     2   3   2   1     2   2   2   3     17
13 Aug 23     3   3   3   4     3   3   2   2     23
13 Aug 24     1   1   1   2     2   1   1   0     9
13 Aug 25     0   1   2   3     2   2   1   0     11
13 Aug 26     1   1   1   2     1   2   1   1     10
13 Aug 27     1   1   1   3     2   2   4   3     17
13 Aug 28     2   1   2   2     1   1   0   0     9
13 Aug 29     0   0   0   0     1   1   0   0     2
13 Aug 30     0   0   1   2     2   2   2   3     12
13 Aug 31     2   2   3   3     3   1   0   1     15
Mean of K-Sum is   11.2
Frequency Distribution of K-Indices
K-Index :    0    1    2    3    4    5    6    7    8    9    -
            66   72   64   38   8    0    0    0    0    0    0
---------------------------------------------------------------------------
```

7.7.5.1.9 September

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra                 (CNB) Geomagnetic data for Sep 2013
Location:     Geographic:-35.314d  149.363d
K9 range:   450nT
Variometer: RC
                   P R I N C I P A L    M A G N E T I C   S T O R M S
-------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
_____________________________________________________________________________________

Nil
-------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
Nil
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
----------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
______________________________________________________________________
Nil
----------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
---------------------------------------------------------------------------
UT-Date               K - i n d i c e s          K-sum
```

13 Sep 01	2	2	2	2	3	3	1	1	16
13 Sep 02	1	2	3	2	4	1	0	0	13
13 Sep 03	1	0	2	2	2	1	1	2	11
13 Sep 04	1	1	1	3	2	0	1	1	10
13 Sep 05	0	0	0	1	0	0	0	1	2
13 Sep 06	1	2	0	1	2	1	1	1	9
13 Sep 07	0	1	1	1	0	0	0	0	3
13 Sep 08	2	3	1	1	2	1	1	0	11
13 Sep 09	0	1	1	1	0	0	0	1	4
13 Sep 10	0	0	0	3	3	3	2	2	13
13 Sep 11	1	1	0	2	2	1	1	1	9
13 Sep 12	1	0	1	1	1	0	1	2	7
13 Sep 13	2	1	2	2	2	4	2	1	16
13 Sep 14	1	1	1	1	2	0	0	1	7
13 Sep 15	1	0	0	0	0	0	1	1	3
13 Sep 16	0	0	1	2	1	1	0	1	6
13 Sep 17	2	2	2	0	2	2	2	2	14
13 Sep 18	1	1	0	2	3	2	1	2	12
13 Sep 19	2	2	4	4	3	2	2	2	21
13 Sep 20	1	1	2	2	3	0	0	2	11
13 Sep 21	0	1	1	2	2	3	2	1	12
13 Sep 22	1	1	2	0	2	1	0	1	8
13 Sep 23	1	2	1	0	0	0	2	0	6
13 Sep 24	1	2	2	4	5	3	1	1	19
13 Sep 25	1	2	2	0	0	0	0	1	6
13 Sep 26	0	0	0	0	0	0	0	0	0
13 Sep 27	0	0	0	0	0	1	0	0	1
13 Sep 28	0	0	0	0	0	0	0	0	0
13 Sep 29	0	0	0	0	0	0	0	1	1
13 Sep 30	2	1	1	0	0	0	0	0	4

Mean of K-Sum is 8.5

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	87	77	57	13	5	1	0	0	0	0	0

7.7.5.1.10 October

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Oct 2013
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(') H(nT) Z(nT)	UT End Mth Dy Hr
13 Oct 02 01 56	-6.42,59.94,21.59	2(2)	6	21.4 173.8 87.6	Oct 03 01

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
13 Oct 02 01 56	ssc	a	59.94	-44.38	21.59
13 Oct 08 20 21	ssc	a	13.12	-50.15	16.3
13 Oct 26 22 44	ssc*	b	2.44*	-13.24*	4.71*
13 Oct 29 10 33	ssc	b	13.26	7.67	3.11

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
13 Oct 24	00:25	00:35	00:48	-1.22	-2.88	4.37	solar
13 Oct 25	02:59	03:07	03:17	-0.77	0.0	1.62	solar
13 Oct 28	04:37	04:40	05:21	14.09	1.98	3.27	solar
13 Oct 29	21:48	21:55	22:09	13.49	1.44	1.84	solar

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
13 Oct 01	0	1	2	1	2	1	2	2	11

13 Oct 02	5	6	4	3	3	4	3	3	31
13 Oct 03	3	0	0	0	0	1	2	0	6
13 Oct 04	0	0	0	0	0	0	0	0	0
13 Oct 05	0	0	0	0	0	0	0	0	0
13 Oct 06	0	0	0	0	1	0	1	1	3
13 Oct 07	1	1	1	1	1	1	1	1	8
13 Oct 08	1	1	0	1	2	1	4	5	15
13 Oct 09	4	4	4	4	2	3	2	3	26
13 Oct 10	2	2	1	3	2	2	0	1	13
13 Oct 11	1	1	1	2	2	1	0	1	9
13 Oct 12	1	0	0	0	1	1	1	2	6
13 Oct 13	1	0	0	0	0	0	0	0	1
13 Oct 14	1	1	3	4	4	3	2	2	20
13 Oct 15	3	3	2	4	2	1	1	3	19
13 Oct 16	2	2	1	2	3	2	1	2	15
13 Oct 17	1	2	2	3	2	2	1	1	14
13 Oct 18	1	0	0	0	0	0	1	2	4
13 Oct 19	0	0	0	0	0	1	0	1	2
13 Oct 20	1	0	0	0	0	0	0	2	3
13 Oct 21	1	0	1	0	0	1	0	0	3
13 Oct 22	1	1	3	2	1	1	1	2	12
13 Oct 23	1	1	1	2	0	0	0	1	6
13 Oct 24	3	2	0	1	0	0	0	0	6
13 Oct 25	0	1	1	0	0	0	1	2	5
13 Oct 26	0	1	0	0	0	1	0	2	4
13 Oct 27	0	1	2	1	1	1	1	1	8
13 Oct 28	2	2	1	1	0	0	0	0	6
13 Oct 29	1	0	1	3	3	1	2	2	13
13 Oct 30	1	1	3	4	4	4	2	3	22
13 Oct 31	0	0	1	3	2	3	1	2	12

Mean of K-Sum is 9.8

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	87	78	44	23	13	2	1	0	0	0	0

7.7.5.1.11 November

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Nov 2013
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement	SSC-amplitudes	Max. 3hr-K-indices	Storm Ranges	UT End
Yr Mth Dy Hr Mn	D(') H(nT) Z(nT)	Day(3Hr Periods) K	D(') H(nT) Z(nT)	Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date	Type & Quality	Chief movement(nT)
Yr Mth Dy Hr Mn	ssc/ssc* A,B,C	H(x) D(y) Z

Nil

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
13 Nov 03	05:20	05:22	05:33	12.7	1.98	-2.6	solar
13 Nov 05	22:10	22:12	22:23	-6.88	-2.46	2.19	solar
13 Nov 08	04:22	04:25	04:37	14.7	2.28	-2.76	solar
13 Nov 10	05:10	05:14	05:29	14.01	3.42	-4.28	solar

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
13 Nov 01	1	2	1	2	3	1	0	0	10
13 Nov 02	0	1	0	2	1	1	0	2	7
13 Nov 03	1	3	2	2	0	0	2	2	12
13 Nov 04	0	1	1	2	2	3	1	2	12

```
13 Nov 05     1   0   1   2     1   1   0   3     9
13 Nov 06     0   0   0   1     0   1   1   2     5
13 Nov 07     2   2   3   4     4   1   2   2     20
13 Nov 08     1   2   2   1     1   0   0   1     8
13 Nov 09     2   3   4   4     3   3   2   2     23
13 Nov 10     2   3   2   3     3   2   2   2     19
13 Nov 11     2   3   4   3     4   3   1   0     20
13 Nov 12     1   1   0   1     0   0   0   0     3
13 Nov 13     0   0   0   0     2   0   0   1     3
13 Nov 14     0   0   1   1     1   0   0   1     4
13 Nov 15     1   1   2   1     1   3   2   2     13
13 Nov 16     2   2   3   2     3   2   2   2     18
13 Nov 17     2   2   2   2     2   0   2   2     14
13 Nov 18     1   0   1   0     1   0   0   0     3
13 Nov 19     0   0   1   0     2   2   1   1     7
13 Nov 20     1   1   2   1     3   0   1   0     9
13 Nov 21     0   0   0   0     0   0   1   0     1
13 Nov 22     0   0   0   1     0   0   2   1     4
13 Nov 23     3   3   4   3     3   2   1   1     20
13 Nov 24     0   0   0   1     0   0   0   1     2
13 Nov 25     0   0   0   0     0   0   0   0     0
13 Nov 26     0   0   0   0     0   1   1   2     4
13 Nov 27     1   1   1   1     1   2   0   1     8
13 Nov 28     0   1   0   0     1   1   0   0     3
13 Nov 29     1   3   3   3     2   3   3   2     20
13 Nov 30     2   1   2   2     2   1   2   3     15
Mean of K-Sum is   9.9
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            80   66   59   28   7    0    0    0    0    0    0
--------------------------------------------------------------------------
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7.7.5.1.12 December

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Dec 2013
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L    M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
13 Dec 13 13 23    ssc      a        27.48  2.05   5.56
13 Dec 15 17 28    ssc*     a        -27.21*-9.75* -4.48*
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                 K - i n d i c e s           K-sum
13 Dec 01     2   4   3   2     3   2   0   2     18
13 Dec 02     1   0   0   0     0   0   0   0     1
13 Dec 03     1   2   2   2     3   2   2   1     15
13 Dec 04     1   1   1   1     1   0   1   1     7
13 Dec 05     0   1   0   3     1   0   1   1     7
13 Dec 06     2   1   2   1     1   1   1   2     11
13 Dec 07     1   0   1   0     1   1   1   3     8
13 Dec 08     4   5   4   2     2   4   2   1     24
13 Dec 09     1   1   1   1     1   2   1   2     10
13 Dec 10     1   2   2   1     2   0   1   1     10
```

```
13 Dec 11      0    1    1    1      2    0    0    1      6
13 Dec 12      0    0    0    1      1    0    0    0      2
13 Dec 13      1    1    1    1      3    2    1    2      12
13 Dec 14      3    3    3    2      3    3    3    3      23
13 Dec 15      2    2    2    1      3    3    1    1      15
13 Dec 16      2    2    2    2      1    1    1    2      13
13 Dec 17      2    1    0    0      0    1    2    1      7
13 Dec 18      1    1    1    1      0    1    1    2      8
13 Dec 19      2    2    1    0      2    2    2    2      13
13 Dec 20      3    3    2    1      0    1    1    2      13
13 Dec 21      2    2    2    1      0    0    1    1      9
13 Dec 22      0    1    1    2      0    0    0    0      4
13 Dec 23      1    0    0    0      0    0    0    1      2
13 Dec 24      0    0    1    0      0    1    1    2      5
13 Dec 25      1    3    3    3      3    3    2    1      19
13 Dec 26      1    1    1    1      2    1    1    1      9
13 Dec 27      0    0    0    0      0    0    2    1      3
13 Dec 28      0    0    1    1      1    1    1    3      8
13 Dec 29      2    1    2    2      1    2    1    1      12
13 Dec 30      0    0    2    1      1    1    0    1      6
13 Dec 31      2    2    3    1      2    1    2    2      15
Mean of K-Sum is  10.2
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           58   100   61   24    4    1    0    0    0    0    0
--------------------------------------------------------------------------
```

7.7.5.2 2014

7.7.5.2.1 January

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Jan 2014
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L    M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes     Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)   Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality     Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C     H(x)    D(y)    Z
_________________________________________________________
14 Jan 07 15 12    ssc      a         30.37   4.54    5.67
14 Jan 09 20 09    ssc*     a         23.96   12.79*  4.8
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement       Amplitude in nT    Confirmation
              Start  Max   End     H(x)  D(y)   Z
_____________________________________________________________________
14 Jan 30     06:36  06:41 06:50   1.84  0.54   1.1   solar
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s           K-sum
14 Jan 01      1    1    3    3      4    3    3    3      21
14 Jan 02      3    3    3    2      3    2    3    2      21
14 Jan 03      2    2    2    3      2    2    1    2      16
14 Jan 04      2    2    1    3      3    1    2    2      16
14 Jan 05      2    2    1    1      1    1    0    1      9
14 Jan 06      0    1    1    0      1    1    1    1      6
14 Jan 07      1    1    1    1      1    3    2    2      12
14 Jan 08      2    2    1    1      2    1    1    2      12
14 Jan 09      2    2    2    2      2    1    3    3      17
14 Jan 10      1    1    1    1      2    2    0    1      9
14 Jan 11      0    1    1    1      2    1    2    2      10
14 Jan 12      1    0    1    2      2    2    3    3      14
```

14 Jan 13	2	3	3	1	1	1	0	2	13
14 Jan 14	3	2	3	1	3	2	1	2	17
14 Jan 15	1	1	0	0	0	1	0	1	4
14 Jan 16	0	0	1	0	0	0	0	1	2
14 Jan 17	1	1	0	0	1	0	0	1	4
14 Jan 18	0	0	0	0	0	0	1	0	1
14 Jan 19	0	0	0	0	0	0	0	0	0
14 Jan 20	0	0	1	1	1	1	0	2	6
14 Jan 21	2	1	2	2	3	3	2	3	18
14 Jan 22	1	2	2	3	3	1	2	3	17
14 Jan 23	2	2	2	1	1	1	1	1	11
14 Jan 24	1	2	1	0	1	0	0	1	6
14 Jan 25	1	1	1	1	1	2	1	2	10
14 Jan 26	1	2	2	1	0	1	1	1	9
14 Jan 27	1	1	0	0	1	2	0	2	7
14 Jan 28	1	1	1	1	1	2	2	3	12
14 Jan 29	2	2	3	2	2	2	1	2	16
14 Jan 30	1	1	1	0	0	0	1	0	4
14 Jan 31	1	0	1	1	1	0	0	0	4

Mean of K-Sum is 10.5

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	54	97	65	31	1	0	0	0	0	0	0

7.7.5.2.2 February

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Jan 2014
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
14 Feb 27 16 51	1.74,47.33,7.76	27(6,7)	5	14.4	148.7	28.2	Feb 28 12

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
14 Feb 07 17 05	ssc	b	19.06	6.13	2.45
14 Feb 13 09 45	ssc	b	11.47	3.97	2.08
14 Feb 15 13 18	ssc	a	24.86	6.56	3.2
14 Feb 20 03 20	ssc	c	31.78	-18.15	8.74
14 Feb 27 16 51	ssc	a	47.33	11.84	7.76

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
14 Feb 13	01:37	01:46	01:56	-6.98	1.56	1.39	solar
14 Feb 13	06:04	06:13	06:21	-0.77	0.84	1.24	solar
14 Feb 25	00:43	01:04	02:05	-31.39	-9.06	17.04	solar

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Jan 31	1	0	1	1	1	0	0	0	4
14 Feb 01	1	0	1	1	2	2	1	2	10
14 Feb 02	1	2	2	0	1	1	1	2	10
14 Feb 03	2	2	1	1	1	3	1	1	12
14 Feb 04	2	2	1	1	1	1	1	2	11
14 Feb 05	2	2	2	0	2	1	2	2	13
14 Feb 06	2	2	1	1	3	3	1	2	15
14 Feb 07	0	0	1	1	2	3	2	3	12
14 Feb 08	4	4	5	3	3	2	3	2	26
14 Feb 09	2	2	2	1	3	2	4	2	18
14 Feb 10	2	1	2	2	1	2	3	2	15
14 Feb 11	1	2	2	1	1	1	1	3	12

14 Feb 12	3	3	1	1	1	2	2	2	15
14 Feb 13	2	0	1	2	0	0	0	1	6
14 Feb 14	1	1	2	2	2	1	0	2	11
14 Feb 15	1	1	1	0	3	3	3	5	17
14 Feb 16	4	4	4	3	4	4	3	3	29
14 Feb 17	1	2	1	1	1	1	1	2	10
14 Feb 18	2	1	2	1	3	3	2	2	16
14 Feb 19	3	4	4	4	5	2	2	2	26
14 Feb 20	1	4	3	4	4	3	1	2	22
14 Feb 21	2	1	1	2	3	3	1	1	14
14 Feb 22	1	2	2	3	2	3	1	2	16
14 Feb 23	1	1	4	3	3	4	4	4	24
14 Feb 24	0	2	1	2	1	2	1	1	10
14 Feb 25	3	0	1	1	1	1	1	2	10
14 Feb 26	0	0	1	0	0	0	0	1	2
14 Feb 27	1	1	1	2	2	5	5	4	21
14 Feb 28	3	1	3	3	0	1	1	1	13
14 Mar 01	2	1	2	2	2	0	1	2	12

Mean of K-Sum is 14.4

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	25	85	72	34	19	5	0	0	0	0	0

7.7.5.2.3 March

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Mar 2014
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods) K	Storm Ranges D(') H(nT) Z(nT)	UT End Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
14 Mar 25 20 03	ssc	a	17.97	4.47	2.63
14 Mar 29 22 33	ssc	b	-4.07	-9.65	4.59

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
14 Mar 02	23:17	23:21	23:25	0.0	-0.36	0.74	solar
14 Mar 11	03:47	03:51	04:00	4.37	0.9	2.0	solar

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Mar 01	2	1	2	2	2	0	1	2	12
14 Mar 02	3	1	1	1	0	0	0	1	7
14 Mar 03	1	0	1	3	2	0	0	1	8
14 Mar 04	1	1	0	1	3	2	1	3	12
14 Mar 05	1	1	1	1	1	2	1	2	10
14 Mar 06	0	1	2	1	3	1	2	1	11
14 Mar 07	0	1	1	0	1	0	0	1	4
14 Mar 08	0	1	1	0	0	1	0	1	4
14 Mar 09	0	0	1	0	0	0	0	0	1
14 Mar 10	0	1	1	3	1	0	0	0	6
14 Mar 11	0	1	0	1	2	1	2	1	8
14 Mar 12	1	1	0	1	1	1	1	2	8
14 Mar 13	3	2	3	2	2	2	1	1	16
14 Mar 14	1	2	1	2	2	1	0	1	10
14 Mar 15	0	1	0	1	0	0	0	0	2
14 Mar 16	0	0	1	0	0	0	0	0	1
14 Mar 17	0	0	0	1	0	0	0	1	2

14 Mar 18	0	2	2	1	2	2	1	1	11
14 Mar 19	1	1	2	1	1	0	0	1	7
14 Mar 20	0	1	1	2	2	0	0	1	7
14 Mar 21	2	1	1	3	3	3	1	1	15
14 Mar 22	1	0	1	1	2	1	1	1	8
14 Mar 23	2	1	1	0	1	1	1	2	9
14 Mar 24	0	1	1	0	1	1	0	0	4
14 Mar 25	0	0	1	2	2	1	2	4	12
14 Mar 26	2	1	3	2	0	0	1	2	11
14 Mar 27	1	2	2	3	2	1	1	0	12
14 Mar 28	1	1	2	2	3	0	2	2	13
14 Mar 29	2	2	1	2	0	0	0	3	10
14 Mar 30	1	1	1	1	1	0	1	1	7
14 Mar 31	0	1	0	2	3	2	1	0	9

Mean of K-Sum is 8.3

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	76	105	50	16	1	0	0	0	0	0	0

7.7.5.2.4 April

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Apr 2014
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods) K	Storm Ranges D(') H(nT) Z(nT)	UT End Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
14 Apr 20 10 56	ssc	a	32.78	6.62	7.3
14 Apr 29 21 01	ssc	c	-0.58	3.72	1.65

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Apr 01	0	1	1	0	1	2	1	1	7
14 Apr 02	1	1	0	1	0	1	1	1	6
14 Apr 03	0	1	1	2	3	2	1	1	11
14 Apr 04	1	2	1	1	1	2	1	0	9
14 Apr 05	1	1	2	3	3	3	2	3	18
14 Apr 06	1	0	0	0	0	0	0	1	2
14 Apr 07	2	2	2	1	3	4	2	1	17
14 Apr 08	1	1	0	1	3	1	0	1	8
14 Apr 09	1	1	1	1	2	2	2	1	11
14 Apr 10	0	0	0	0	0	0	0	1	1
14 Apr 11	1	2	2	2	1	2	1	2	13
14 Apr 12	3	2	4	3	5	2	2	2	23
14 Apr 13	2	3	3	3	1	2	4	1	19
14 Apr 14	1	1	2	1	0	0	2	1	8
14 Apr 15	1	1	2	2	1	1	0	1	9
14 Apr 16	0	0	1	2	2	0	0	1	6
14 Apr 17	2	2	2	1	2	2	2	1	14
14 Apr 18	1	2	1	2	1	1	1	2	11
14 Apr 19	2	3	3	3	3	3	3	1	21
14 Apr 20	3	2	1	3	4	3	4	3	23
14 Apr 21	3	3	3	4	3	3	1	1	21
14 Apr 22	1	2	1	2	1	1	0	1	9

14 Apr 23	1	1	1	2	2	2	2	1	12
14 Apr 24	2	2	3	3	2	2	2	2	18
14 Apr 25	2	1	0	2	3	3	3	1	15
14 Apr 26	0	1	1	2	2	1	1	0	8
14 Apr 27	1	0	0	0	1	1	0	1	4
14 Apr 28	2	1	1	3	1	0	0	0	8
14 Apr 29	0	0	0	0	1	0	0	3	4
14 Apr 30	2	2	3	3	3	3	4	1	21

Mean of K-Sum is 11.9

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	45	88	61	38	7	1	0	0	0	0	0

7.7.5.2.5 May

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for May 2014
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L M A G N E T I C S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods) K	Storm Ranges D(') H(nT) Z(nT)	UT End Mth Dy Hr

Nil

S U D D E N S T O R M C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
14 May 03 17 47	ssc	c	6.18	1.13	1.21
14 May 29 09 31	ssc	b	6.91	2.11	1.76

S O L A R F L A R E E F F E C T S

Yr Mth Dy	UT of movement Start Max End	Amplitude in nT H(x) D(y) Z	Confirmation

Nil

K - I N D I C E S O F G E O M A G N E T I C A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 May 01	1	2	1	0	1	0	1	0	6
14 May 02	0	0	1	0	0	0	0	0	1
14 May 03	0	0	0	0	0	1	3	2	6
14 May 04	1	3	4	4	2	1	1	1	17
14 May 05	0	2	2	2	2	3	2	1	14
14 May 06	0	0	1	0	0	0	0	0	1
14 May 07	0	0	0	1	2	1	0	1	5
14 May 08	1	3	4	5	3	4	2	2	24
14 May 09	1	1	3	2	0	0	0	1	8
14 May 10	1	2	2	2	1	0	1	1	10
14 May 11	2	2	1	3	2	1	2	1	14
14 May 12	2	2	2	3	1	2	1	1	14
14 May 13	1	0	0	1	1	0	0	0	3
14 May 14	1	0	0	0	1	1	0	0	3
14 May 15	0	0	0	0	0	1	1	0	2
14 May 16	0	1	0	0	2	1	0	0	4
14 May 17	0	0	0	0	0	0	0	0	0
14 May 18	1	1	1	0	1	1	1	1	7
14 May 19	0	1	1	0	1	1	0	1	5
14 May 20	0	0	1	2	1	0	0	0	4
14 May 21	0	0	0	0	0	0	0	0	0
14 May 22	1	1	0	0	0	3	1	2	8
14 May 23	3	1	1	0	1	4	3	4	17
14 May 24	1	1	1	0	1	1	0	0	5
14 May 25	1	1	0	0	0	2	0	0	4
14 May 26	1	1	1	1	0	0	0	0	4
14 May 27	0	0	0	0	0	0	1	0	1
14 May 28	1	1	0	1	0	0	1	0	4

```
14 May 29     0   0   0   3     2   2   2   0      9
14 May 30     0   2   2   2     2   3   3   0      14
14 May 31     1   1   0   0     0   0   0   0      2
Mean of K-Sum is  7.0
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           116   77   34   14   6    1    0    0    0    0    0
--------------------------------------------------------------------------
```

7.7.5.2.6 June

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Jun 2014
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

14 Jun 07 16 53   1.74,23.06,2.09   8(3)              6  15.3  131.2 47.8    Jun 08 18
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
14 Jun 07 16 53    ssc      b        23.06  11.86  2.09
14 Jun 10 05 50    ssc      c        6.48   1.66   0.79
14 Jun 23 23 07    ssc*     a        10.02  -12.51*5.82
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s         K-sum
14 Jun 01     1   0   1   2     0   1   0   0      5
14 Jun 02     0   0   0   0     0   0   1   1      2
14 Jun 03     2   2   1   1     0   0   1   0      7
14 Jun 04     0   0   1   1     1   2   0   1      6
14 Jun 05     0   0   2   2     1   0   0   2      7
14 Jun 06     1   0   0   0     0   1   1   1      4
14 Jun 07     1   2   2   2     1   3   2   3      16
14 Jun 08     2   4   6   4     4   3   2   1      26
14 Jun 09     0   1   2   2     0   1   1   0      7
14 Jun 10     0   1   2   1     2   2   0   1      9
14 Jun 11     1   1   1   3     1   1   1   1      10
14 Jun 12     0   1   0   0     0   0   0   0      1
14 Jun 13     0   0   0   0     0   1   0   0      1
14 Jun 14     1   2   2   2     1   0   1   0      9
14 Jun 15     1   0   1   2     0   0   0   1      5
14 Jun 16     0   1   1   0     2   1   1   1      7
14 Jun 17     2   2   3   1     1   1   1   2      13
14 Jun 18     2   1   2   2     2   3   3   4      19
14 Jun 19     3   3   2   2     1   1   2   2      16
14 Jun 20     1   2   3   3     2   3   1   1      16
14 Jun 21     1   1   3   2     0   0   0   1      8
14 Jun 22     0   1   1   0     1   0   2   1      6
14 Jun 23     0   0   0   0     0   0   0   2      2
14 Jun 24     2   1   1   1     0   0   1   0      6
14 Jun 25     1   0   2   1     1   2   2   1      10
14 Jun 26     0   0   1   2     2   1   0   0      6
14 Jun 27     0   0   0   0     0   0   1   0      1
14 Jun 28     1   1   0   2     3   2   2   1      12
14 Jun 29     1   1   0   1     0   0   1   2      6
14 Jun 30     2   1   1   0     0   0   1   0      5
Mean of K-Sum is  8.3
Frequency Distribution of K-Indices
```

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	87	84	50	14	4	0	1	0	0	0	0

7.7.5.2.7 July

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Jul 2014
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement	SSC-amplitudes	Max. 3hr-K-indices		Storm Ranges	UT End
Yr Mth Dy Hr Mn	D(') H(nT) Z(nT)	Day(3Hr Periods)	K	D(') H(nT) Z(nT)	Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
14 Jul 03 00 43	ssc	c	3.88	-5.45	3.41
14 Jul 14 14 32	ssc	a	17.1	3.91	1.89

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Jul 01	0	1	0	0	0	0	0	0	1
14 Jul 02	0	0	1	0	2	0	0	0	3
14 Jul 03	2	2	2	3	2	0	0	0	11
14 Jul 04	0	0	2	2	1	0	0	0	5
14 Jul 05	0	0	0	0	0	0	0	1	1
14 Jul 06	0	0	0	1	0	0	0	0	1
14 Jul 07	1	0	0	1	2	1	0	0	5
14 Jul 08	0	1	1	1	2	1	1	0	7
14 Jul 09	1	1	1	1	0	0	1	1	6
14 Jul 10	1	1	2	1	2	2	1	0	10
14 Jul 11	0	0	1	2	0	1	1	0	5
14 Jul 12	1	1	3	2	2	1	1	0	11
14 Jul 13	1	1	0	2	0	0	0	0	4
14 Jul 14	0	0	2	2	3	3	1	1	12
14 Jul 15	0	1	1	2	2	2	1	0	9
14 Jul 16	0	0	1	0	1	0	1	0	3
14 Jul 17	0	1	1	0	0	0	1	0	3
14 Jul 18	0	0	0	0	0	0	0	0	0
14 Jul 19	0	0	0	1	0	0	0	0	1
14 Jul 20	0	0	1	0	1	0	0	0	2
14 Jul 21	0	1	1	0	1	2	1	0	6
14 Jul 22	1	0	0	0	2	1	0	1	5
14 Jul 23	1	0	0	0	0	1	1	1	4
14 Jul 24	0	1	1	2	2	0	0	0	6
14 Jul 25	1	0	2	2	1	0	0	0	6
14 Jul 26	1	1	3	2	2	1	1	1	12
14 Jul 27	1	1	2	1	0	0	0	1	6
14 Jul 28	1	2	2	2	1	3	1	0	12
14 Jul 29	0	1	1	0	0	1	1	0	4
14 Jul 30	2	1	0	0	0	0	0	0	3
14 Jul 31	1	1	1	1	1	1	1	1	8

Mean of K-Sum is 5.5
Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	122	86	34	6	0	0	0	0	0	0	0

7.7.5.2.8 August

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Aug 2014
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods) K	Storm Ranges D(') H(nT) Z(nT)	UT End Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C		Chief movement(nT) H(x)	D(y)	Z
14 Aug 19 06 57	ssc	b	13.83	3.44	1.04

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Aug 01	0	1	1	3	2	1	2	2	12
14 Aug 02	1	1	2	3	3	3	1	1	15
14 Aug 03	0	2	0	1	0	1	2	1	7
14 Aug 04	1	2	4	3	2	2	2	2	18
14 Aug 05	1	2	2	1	3	3	3	1	16
14 Aug 06	2	2	2	2	3	2	1	1	15
14 Aug 07	2	1	1	2	2	0	2	1	11
14 Aug 08	2	2	1	3	1	0	0	0	9
14 Aug 09	0	0	2	1	0	0	1	1	5
14 Aug 10	1	1	1	1	1	2	2	2	11
14 Aug 11	1	0	1	1	1	3	1	3	11
14 Aug 12	2	1	1	1	1	3	4	3	16
14 Aug 13	2	1	1	2	3	0	1	1	11
14 Aug 14	1	0	0	1	0	0	0	1	3
14 Aug 15	0	0	0	1	3	2	0	0	6
14 Aug 16	0	1	0	0	0	0	0	0	1
14 Aug 17	0	0	0	2	3	2	0	0	7
14 Aug 18	0	1	2	0	1	1	1	0	6
14 Aug 19	0	0	2	3	1	1	3	5	15
14 Aug 20	1	1	2	2	1	0	1	1	9
14 Aug 21	2	2	2	3	2	1	2	1	15
14 Aug 22	0	2	0	0	1	0	0	0	3
14 Aug 23	0	0	0	1	0	1	0	0	2
14 Aug 24	0	0	0	1	1	0	0	0	2
14 Aug 25	0	0	0	0	1	0	0	0	1
14 Aug 26	0	0	0	1	1	0	0	1	3
14 Aug 27	0	2	3	4	3	3	3	1	19
14 Aug 28	1	3	3	3	3	3	2	1	19
14 Aug 29	3	3	3	4	2	2	3	2	22
14 Aug 30	2	3	1	4	4	1	1	2	18
14 Aug 31	1	1	2	5	3	2	2	3	19

Mean of K-Sum is 10.5
Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	73	77	54	36	6	2	0	0	0	0	0

7.7.5.2.9 September

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Sep 2014
Location: Geographic:-35.314d 149.363d
K9 range: 450nT

Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods) K	Storm Ranges D(') H(nT) Z(nT)	UT End Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C	Chief movement(nT) H(x)	D(y)	Z
14 Sep 11 23 44	ssc* a	13.95	-23.02*	10.22
14 Sep 12 15 54	ssc a	61.34	10.59	8.09

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start Max End	Amplitude in nT H(x) D(y) Z	Confirmation

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K	-	i	n	d	i	c	e s	K-sum
14 Sep 01	1	2	2	3	3	2	2	1	16
14 Sep 02	1	1	1	2	3	2	2	2	14
14 Sep 03	2	2	2	3	1	1	1	1	13
14 Sep 04	1	1	1	2	2	0	0	1	8
14 Sep 05	1	2	2	2	1	2	2	1	13
14 Sep 06	1	3	2	2	2	3	2	2	17
14 Sep 07	1	2	3	1	0	0	0	0	7
14 Sep 08	0	1	1	1	0	1	1	2	7
14 Sep 09	1	2	1	1	1	1	2	1	10
14 Sep 10	1	0	0	1	0	1	1	3	7
14 Sep 11	2	3	1	3	2	1	1	3	16
14 Sep 12	5	4	2	3	3	5	4	5	31
14 Sep 13	3	2	4	1	2	2	2	1	17
14 Sep 14	1	1	0	0	0	0	0	0	2
14 Sep 15	0	1	0	1	0	0	0	1	3
14 Sep 16	2	2	2	2	1	1	1	1	12
14 Sep 17	1	1	0	0	1	2	1	2	8
14 Sep 18	2	2	2	1	1	0	2	1	11
14 Sep 19	2	3	3	3	3	4	3	2	23
14 Sep 20	2	1	1	2	3	2	0	1	12
14 Sep 21	1	3	2	1	1	1	1	1	11
14 Sep 22	1	1	2	3	3	2	1	1	14
14 Sep 23	2	1	2	3	2	3	3	1	17
14 Sep 24	2	3	3	3	4	4	3	3	25
14 Sep 25	2	2	3	3	2	1	2	2	17
14 Sep 26	2	3	2	3	4	3	2	3	22
14 Sep 27	3	3	3	3	3	3	2	2	22
14 Sep 28	1	2	1	3	3	2	2	2	16
14 Sep 29	1	1	2	3	3	2	3	2	17
14 Sep 30	1	2	2	3	3	2	2	2	17
14 Oct 01	2	2	2	3	1	3	2	1	16

Mean of K-Sum is 14.2

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	26	78	82	52	7	3	0	0	0	0	0

7.7.5.2.10 October

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Oct 2014
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods) K	Storm Ranges D(') H(nT) Z(nT)	UT End Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
14 Oct 14 14 16	ssc	c	13.03	4.56	1.47
14 Oct 21 09 02	ssc	b	14.29	-15.69	8.34

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Oct 01	2	2	2	3	1	3	2	1	16
14 Oct 02	1	2	1	2	2	2	1	1	12
14 Oct 03	0	1	1	0	0	2	0	1	5
14 Oct 04	1	2	3	2	1	1	1	2	13
14 Oct 05	2	2	2	1	2	1	1	2	13
14 Oct 06	1	2	1	1	1	0	1	1	8
14 Oct 07	1	2	0	0	1	0	0	1	5
14 Oct 08	2	2	2	3	3	2	2	2	18
14 Oct 09	2	3	3	3	2	2	2	2	19
14 Oct 10	2	1	0	0	0	1	0	1	5
14 Oct 11	1	1	1	3	3	2	1	1	13
14 Oct 12	1	1	1	2	3	0	1	1	10
14 Oct 13	1	1	2	0	2	2	2	1	11
14 Oct 14	1	2	2	2	4	4	4	4	23
14 Oct 15	3	3	3	1	2	2	0	1	15
14 Oct 16	1	1	0	2	2	3	1	2	12
14 Oct 17	2	2	1	2	1	1	1	3	13
14 Oct 18	3	3	2	2	3	3	2	2	20
14 Oct 19	2	2	2	2	3	0	2	2	15
14 Oct 20	2	2	2	3	3	4	3	3	22
14 Oct 21	2	2	4	2	3	3	2	2	20
14 Oct 22	2	2	2	3	3	3	2	2	19
14 Oct 23	2	2	1	3	3	2	2	2	17
14 Oct 24	2	1	2	2	3	4	2	3	19
14 Oct 25	2	1	1	2	3	2	2	2	15
14 Oct 26	2	1	2	3	3	3	2	2	18
14 Oct 27	2	2	2	4	2	2	2	2	18
14 Oct 28	2	2	2	2	3	3	2	2	18
14 Oct 29	1	1	1	1	1	2	1	0	8
14 Oct 30	0	1	0	2	2	1	2	2	10
14 Oct 31	1	2	1	1	2	1	2	1	11

Mean of K-Sum is 14.2

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	21	69	110	40	8	0	0	0	0	0	0

7.7.5.2.11 November

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Nov 2014
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(')	H(nT)	Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C		Chief movement(nT) H(x)	D(y)	Z
14 Nov 02 09 45	ssc	b	9.4	1.99	2.28
14 Nov 03 22 44	ssc	b	-8.73	3.17	1.73

S O L A R F L A R E E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S O F G E O M A G N E T I C A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
14 Nov 01	1	1	3	2	2	2	2	1	14
14 Nov 02	1	1	1	2	3	3	2	1	14
14 Nov 03	3	1	1	2	0	0	1	3	11
14 Nov 04	2	1	3	4	4	3	4	3	24
14 Nov 05	3	4	3	4	3	2	3	3	25
14 Nov 06	1	3	2	1	2	1	1	3	14
14 Nov 07	2	2	2	3	2	2	2	3	18
14 Nov 08	1	2	2	2	2	2	1	3	15
14 Nov 09	2	1	2	1	1	2	2	2	13
14 Nov 10	3	3	4	5	4	4	2	2	27
14 Nov 11	3	3	2	2	2	2	2	4	20
14 Nov 12	2	2	1	1	1	1	1	1	10
14 Nov 13	1	1	1	1	1	1	1	1	8
14 Nov 14	2	3	4	2	3	2	2	3	21
14 Nov 15	2	2	2	3	4	2	2	3	20
14 Nov 16	3	2	3	3	4	3	2	2	22
14 Nov 17	0	1	1	1	3	2	3	2	13
14 Nov 18	2	2	2	2	3	3	1	1	16
14 Nov 19	2	1	2	2	3	1	1	1	13
14 Nov 20	1	1	2	3	1	2	3	1	14
14 Nov 21	2	3	2	3	3	2	2	2	19
14 Nov 22	2	2	2	2	2	1	3	2	16
14 Nov 23	1	2	2	3	3	2	2	2	17
14 Nov 24	1	1	2	1	3	3	2	1	14
14 Nov 25	1	0	1	1	2	1	2	2	10
14 Nov 26	1	1	1	1	3	0	0	1	8
14 Nov 27	1	4	3	1	2	2	2	3	18
14 Nov 28	1	1	1	1	3	2	2	2	13
14 Nov 29	1	1	3	2	2	2	2	2	15
14 Nov 30	2	2	2	2	2	3	3	3	19

Mean of K-Sum is 16.0

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	6	70	96	54	13	1	0	0	0	0	0

7.7.5.2.12 December

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Dec 2014
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L M A G N E T I C S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
14 Dec 23 11 15	-3.54*,104.31,18.623(4)		6	13.5	168.7	40.4	Dec 24 03

S U D D E N S T O R M C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C		Chief movement(nT) H(x)	D(y)	Z
14 Dec 21 19 12	ssc	c	14.83	8.71	0.62
14 Dec 22 15 09	ssc	b	15.57	9.67	2.41

```
14 Dec 23 11 15   ssc*     a        104.31 -24.67*18.61
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                 K - i n d i c e s          K-sum
14 Dec 01      1   2   3   2     2   2   3   4      19
14 Dec 02      2   3   3   1     3   3   2   1      18
14 Dec 03      2   1   2   3     2   2   2   2      16
14 Dec 04      1   2   2   1     3   3   2   3      17
14 Dec 05      1   2   2   3     4   2   1   2      17
14 Dec 06      1   2   3   3     2   3   3   4      21
14 Dec 07      3   2   3   3     5   4   3   3      26
14 Dec 08      3   2   2   3     3   2   2   3      20
14 Dec 09      3   2   2   3     4   2   3   2      21
14 Dec 10      2   2   3   3     3   1   1   2      17
14 Dec 11      1   1   1   0     1   1   2   2      9
14 Dec 12      2   2   4   3     4   3   3   3      24
14 Dec 13      2   3   2   1     3   3   1   2      17
14 Dec 14      1   2   2   2     2   3   3   2      17
14 Dec 15      2   2   2   2     4   3   2   3      20
14 Dec 16      2   2   1   2     3   2   3   3      18
14 Dec 17      2   2   1   2     1   2   2   2      14
14 Dec 18      2   2   2   1     2   2   2   3      16
14 Dec 19      2   2   2   2     1   2   2   3      16
14 Dec 20      3   2   3   2     2   2   2   3      19
14 Dec 21      1   2   3   2     3   2   3   3      19
14 Dec 22      3   4   3   2     2   2   1   2      19
14 Dec 23      2   2   2   6     3   2   2   4      23
14 Dec 24      3   2   2   2     3   2   2   1      17
14 Dec 25      1   1   1   1     3   3   3   3      16
14 Dec 26      3   3   2   2     1   2   4   3      20
14 Dec 27      2   2   2   1     2   1   1   1      12
14 Dec 28      1   1   1   1     1   2   3   2      12
14 Dec 29      2   3   2   4     4   5   3   4      27
14 Dec 30      3   3   3   2     3   2   2   2      20
14 Dec 31      1   2   2   2     3   3   1   2      16
Mean of K-Sum is  18.2
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            1    43   113  74   14   2    1    0    0    0    0
--------------------------------------------------------------------------
```

7.7.5.3 2015

7.7.5.3.1 January

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Jan 2015
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement      SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn   D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

15 Jan 07 06 17   0.84,43.3,4.5     7(3)              6  26.6  201.6 56.3   Jan 08 18
------------------------------------------------------------------------------------
  S U D D E N  S T O R M  C O M M E N C E M E N T S
---------------------------------------------------------
UT Date           Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn   ssc/ssc* A,B,C    H(x)   D(y)   Z
_________________________________________________________
15 Jan 07 06 17   ssc      a        43.3   5.82   4.5
15 Jan 26 08 35   ssc      b        15.15  10.34  3.53
---------------------------------------------------------
```

```
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)    Z
_____________________________________________________________________
15 Jan 13     04:19  04:26 04:40  3.31  2.1     6.14  solar
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s           K-sum
15 Jan 01     1   1   1   1     2   1   1   2       10
15 Jan 02     2   2   3   2     3   2   2   3       19
15 Jan 03     3   4   3   3     2   1   1   0       17
15 Jan 04     0   2   1   3     4   5   3   4       22
15 Jan 05     4   3   3   2     3   2   2   2       21
15 Jan 06     2   3   3   3     2   3   3   2       21
15 Jan 07     3   2   6   5     4   3   2   4       29
15 Jan 08     4   4   3   3     3   2   2   2       23
15 Jan 09     2   1   3   2     3   1   1   2       15
15 Jan 10     2   2   2   2     3   3   1   1       16
15 Jan 11     2   2   3   3     2   2   2   2       18
15 Jan 12     1   2   2   2     3   3   2   2       17
15 Jan 13     2   2   2   2     3   2   1   2       16
15 Jan 14     2   1   2   2     3   1   2   1       14
15 Jan 15     1   2   2   2     4   2   0   1       14
15 Jan 16     2   3   2   2     2   0   1   2       14
15 Jan 17     1   1   1   1     1   0   1   1       7
15 Jan 18     1   0   0   1     2   1   0   2       7
15 Jan 19     1   0   0   1     1   1   1   2       7
15 Jan 20     1   1   1   1     0   0   1   0       5
15 Jan 21     2   2   2   1     2   4   3   3       19
15 Jan 22     4   2   2   3     3   1   2   2       19
15 Jan 23     2   3   2   2     2   2   1   1       15
15 Jan 24     1   1   1   1     3   2   2   2       13
15 Jan 25     1   1   1   1     1   2   1   3       11
15 Jan 26     3   3   3   4     3   4   2   2       24
15 Jan 27     2   3   3   2     2   3   2   3       20
15 Jan 28     2   1   2   2     2   1   0   2       12
15 Jan 29     2   1   1   2     2   2   3   3       16
15 Jan 30     1   2   2   1     1   1   2   2       12
15 Jan 31     1   2   1   1     2   3   2   2       14
Mean of K-Sum is  15.7
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            14   67   101   50   13   2    1    0    0    0    0
--------------------------------------------------------------------------
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7.7.5.3.2 February

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Feb 2015
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
-----------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
___________________________________________________________________________________

Nil
-----------------------------------------------------------------------------------
  S U D D E N  S T O R M  C O M M E N C E M E N T S
------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)    Z
______________________________________________________
Nil
------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)    Z
_____________________________________________________________________
Nil
```

```
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date              K - i n d i c e s          K-sum
15 Feb 01     3   2   4   2     2   3   3   4     23
15 Feb 02     3   4   3   4     2   3   3   3     25
15 Feb 03     3   3   3   3     3   3   3   2     23
15 Feb 04     2   1   2   2     4   3   1   1     16
15 Feb 05     1   2   2   2     4   4   2   3     20
15 Feb 06     2   2   3   2     1   1   1   0     12
15 Feb 07     1   1   4   4     2   2   2   3     19
15 Feb 08     1   3   3   3     2   2   3   2     19
15 Feb 09     2   1   1   1     3   2   2   1     13
15 Feb 10     0   1   1   0     2   2   1   2     9
15 Feb 11     1   2   1   2     3   1   0   1     11
15 Feb 12     1   1   1   1     2   2   1   1     10
15 Feb 13     0   0   0   1     2   0   0   1     4
15 Feb 14     0   0   0   1     0   0   0   1     2
15 Feb 15     1   2   1   2     3   1   0   1     11
15 Feb 16     1   1   1   2     2   1   3   3     14
15 Feb 17     3   3   3   4     2   3   3   3     24
15 Feb 18     4   4   4   3     3   2   2   2     24
15 Feb 19     2   2   3   1     1   2   2   2     15
15 Feb 20     2   2   2   2     2   1   0   1     12
15 Feb 21     3   1   1   1     2   1   1   2     12
15 Feb 22     1   1   0   1     1   2   1   2     9
15 Feb 23     2   3   3   3     3   3   2   3     22
15 Feb 24     2   4   3   3     3   2   2   2     21
15 Feb 25     1   1   3   3     3   2   2   1     16
15 Feb 26     1   1   1   1     1   0   0   1     6
15 Feb 27     0   0   0   1     1   2   0   2     6
15 Feb 28     1   2   2   2     2   3   3   3     18
Mean of K-Sum is  14.9
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           24   65   68   53   14    0    0    0    0    0    0
--------------------------------------------------------------------------
```

7.7.5.3.3 March

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra                 (CNB) Geomagnetic data for Mar 2015
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement        SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges         UT End
Yr Mth Dy Hr Mn     D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________

15 Mar 02 03 00     ...               2(3,4)            5  15.6  100.6 35.9    Mar 02 18
15 Mar 17 04 45     1.44,64.66,5.69   17(6)             7  30.9  338.3 87.1    Mar 18 03
15 Mar 18 06 00     ...               18(3,4,5,6),19(4,55  18.6  145.4 48.6    Mar 19 18
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date             Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn     ssc/ssc* A,B,C    H(x)   D(y)    Z
_________________________________________________________
15 Mar 11 05 13     ssc      b        21.82  9.42    1.3
15 Mar 17 04 45     ssc      a        64.66  10.15   5.69
15 Mar 31 08 32     ssc*     a        15.94* -7.28*  5.04
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)    Z
_____________________________________________________________________
15 Mar 12     04:42  04:44 04:56  -2.0  1.32    -2.71 solar
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date              K - i n d i c e s          K-sum
15 Mar 01     3   4   3   4     2   1   2   3     22
```

```
15 Mar 02      2   4   5   5     4   3   2   2      27
15 Mar 03      2   2   2   3     3   1   1   2      16
15 Mar 04      0   1   1   3     3   0   1   1      10
15 Mar 05      1   0   1   1     3   1   1   1      9
15 Mar 06      1   3   3   2     2   1   2   2      16
15 Mar 07      2   3   3   3     3   4   2   3      23
15 Mar 08      2   2   2   3     4   2   1   1      17
15 Mar 09      2   1   0   0     0   1   0   2      6
15 Mar 10      1   2   1   2     1   0   0   1      8
15 Mar 11      1   3   2   2     3   3   3   1      18
15 Mar 12      1   2   1   3     2   2   1   0      12
15 Mar 13      1   1   0   1     3   1   1   1      9
15 Mar 14      0   1   1   1     2   1   0   2      8
15 Mar 15      1   2   2   1     2   2   2   1      13
15 Mar 16      3   3   4   3     2   3   1   1      20
15 Mar 17      2   5   5   6     6   7   6   6      43
15 Mar 18      4   3   5   5     5   5   4   3      34
15 Mar 19      3   3   4   5     5   3   2   3      28
15 Mar 20      4   3   4   3     3   2   3   4      26
15 Mar 21      2   2   3   3     3   1   1   1      16
15 Mar 22      2   2   5   4     4   1   1   1      20
15 Mar 23      2   3   2   3     4   3   2   3      22
15 Mar 24      1   2   1   3     4   4   2   2      19
15 Mar 25      2   2   2   3     4   2   2   2      19
15 Mar 26      1   1   2   0     2   2   1   2      11
15 Mar 27      2   2   2   2     3   2   1   1      15
15 Mar 28      0   2   2   3     2   2   1   2      14
15 Mar 29      3   3   2   3     3   1   2   1      18
15 Mar 30      0   1   0   1     0   0   0   1      3
15 Mar 31      0   1   2   2     3   3   2   1      14
Mean of K-Sum is  17.3
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           21   64   74   54   19   11    4    1    0    0    0
--------------------------------------------------------------------------
```

7.7.5.3.4 April

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra              (CNB) Geomagnetic data for Apr 2015
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement      SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn   D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date           Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn   ssc/ssc* A,B,C    H(x)    D(y)    Z
_________________________________________________________
15 Apr 09 02 12   ssc       b       17.24   1.89    3.94
---------------------------------------------------------
                      S O L A R   F L A R E   E F F E C T S
----------------------------------------------------------------------
Yr Mth Dy     UT of movement       Amplitude in nT    Confirmation
             Start  Max   End      H(x)  D(y)   Z
______________________________________________________________________
Nil
----------------------------------------------------------------------
     K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y
---------------------------------------------------------------------------
UT-Date                   K - i n d i c e s          K-sum
15 Apr 01      1   1   2   2     1   2   2   2      13
15 Apr 02      1   2   2   3     3   2   3   3      19
15 Apr 03      3   3   2   1     3   3   2   3      20
15 Apr 04      2   2   2   2     3   3   1   1      16
15 Apr 05      1   2   1   0     1   2   1   2      10
15 Apr 06      1   1   2   0     1   0   0   1      6
15 Apr 07      1   1   0   0     0   0   0   0      2
```

```
15 Apr 08      0    0    0    0      1    1    1    0      3
15 Apr 09      2    3    2    3      2    2    2    2      18
15 Apr 10      4    4    5    4      4    3    2    2      28
15 Apr 11      2    3    3    5      4    3    2    2      24
15 Apr 12      0    1    1    0      1    1    1    1      6
15 Apr 13      2    2    2    2      2    2    1    1      14
15 Apr 14      1    1    2    1      3    3    3    3      17
15 Apr 15      2    3    2    5      4    3    3    3      25
15 Apr 16      3    4    4    5      4    3    4    5      32
15 Apr 17      3    3    4    3      3    3    2    2      23
15 Apr 18      2    2    2    3      2    3    3    2      19
15 Apr 19      2    2    1    2      2    1    2    2      14
15 Apr 20      2    2    1    2      2    1    2    2      14
15 Apr 21      3    3    3    4      4    3    2    2      24
15 Apr 22      2    1    3    3      3    2    1    2      17
15 Apr 23      1    2    1    1      1    0    0    1      7
15 Apr 24      1    1    0    1      1    0    0    0      4
15 Apr 25      0    0    0    0      0    0    0    0      0
15 Apr 26      0    0    0    0      1    0    0    0      1
15 Apr 27      0    0    1    1      2    1    1    1      7
15 Apr 28      1    1    1    3      2    1    0    0      9
15 Apr 29      0    0    0    2      1    1    1    1      6
15 Apr 30      0    1    1    0      0    0    1    0      3
Mean of K-Sum is  13.4
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            50   63   66   43   13   5    0    0    0    0    0
--------------------------------------------------------------------------
```

7.7.5.3.5 May

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra              (CNB) Geomagnetic data for May 2015
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)    D(y)    Z
_________________________________________________________
15 May 06 01 42    ssc       c       4.68    -11.44 3.91
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)    Z
_____________________________________________________________________
15 May 05     22:07  22:13 22:31  9.56  0.96   3.96  solar
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                    K - i n d i c e s           K-sum
15 May 01      2    2    0    0      1    1    0    1      7
15 May 02      1    2    2    1      1    1    2    2      12
15 May 03      1    3    2    2      1    1    1    1      12
15 May 04      1    1    2    1      2    3    1    1      12
15 May 05      0    0    1    3      2    0    0    2      8
15 May 06      3    3    3    3      4    4    3    1      24
15 May 07      1    2    1    1      1    2    1    1      10
15 May 08      1    2    2    3      1    1    0    0      10
15 May 09      0    0    0    3      1    2    2    1      9
15 May 10      1    1    2    3      3    1    1    1      13
15 May 11      1    2    2    3      4    3    2    1      18
15 May 12      2    2    3    2      3    2    3    2      19
15 May 13     (3)   4    4    4      5    4    3    3      (30)
15 May 14      2    2    2    1      2    1    1    2      13
```

```
15 May 15      0   1   2   3     2   1   2   2      13
15 May 16      1   0   1   1     2   1   1   1      8
15 May 17      1   1   1   0     0   1   1   0      5
15 May 18      1   2   2   3     3   1   2   3      17
15 May 19      3   2   1   2     1   1   2   1      13
15 May 20      2   2   2   1     2   0   0   0      9
15 May 21      0   0   0   0     0   0   0   1      1
15 May 22      0   0   0   0     1   0   0   0      1
15 May 23      0   0   0   2     1   0   0   0      3
15 May 24      0   0   0   0     0   0   0   0      0
15 May 25      0   0   0   1     0   0   0   0      1
15 May 26      1   1   1   1     1   2   1   0      8
15 May 27      0   0   0   1     2   2   0   1      6
15 May 28      1   1   0   2     2   1   1   0      8
15 May 29      0   1   1   2     1   2   1   1      9
15 May 30      0   1   1   1     1   0   0   0      4
15 May 31      0   1   1   0     0   1   1   0      4
Mean of K-Sum is  9.9
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            71   89   55   25   7    1    0    0    0    0    0
--------------------------------------------------------------------------
```

7.7.5.3.6 June

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Jun 2015
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes     Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)   Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

15 Jun 07 21 06    ...                8(3,5,6)          5  12.7  157.6 62.4   Jun 08 23
15 Jun 21 16 45    0.78,25.09,4.78    22(7)             7  37.4  292.4 120.1  Jun 23 15
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality     Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C     H(x)    D(y)    Z
_________________________________________________________
15 Jun 05 09 40    ssc      c         3.87    0.45    0.97
15 Jun 21 16 45    ssc      a         25.09   5.47    4.78
15 Jun 22 18 34    ssc*     a         75.18   54.95*  5.16
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s          K-sum
15 Jun 01      1   1   1   2     0   0   1   0      6
15 Jun 02      0   0   0   0     0   0   0   0      0
15 Jun 03      0   0   0   1     1   0   0   0      2
15 Jun 04      0   0   0   0     0   0   0   0      0
15 Jun 05      0   0   0   1     0   0   0   0      1
15 Jun 06      0   1   0   2     2   0   0   0      5
15 Jun 07      0   0   0   1     1   1   1   1      5
15 Jun 08      2   3   5   4     5   5   3   2      29
15 Jun 09      3   2   2   1     2   3   2   2      17
15 Jun 10      2   2   3   3     3   2   2   1      18
15 Jun 11      2   3   2   2     2   2   1   0      14
15 Jun 12      0   1   1   1     2   2   1   0      8
15 Jun 13      1   1   2   2     2   2   2   1      13
15 Jun 14      3   2   2   4     1   2   1   1      16
15 Jun 15      2   2   3   4     5   3   2   2      23
15 Jun 16      2   2   3   3     1   2   1   1      15
15 Jun 17      1   3   3   3     3   3   1   0      17
```

```
15 Jun 18      2   2   2   2     1   2   0   0     11
15 Jun 19      1   0   0   1     0   0   0   0     2
15 Jun 20      0   0   0   0     0   0   0   0     0
15 Jun 21      1   0   0   0     0   3   2   1     7
15 Jun 22      1   3   4   3     3   3   7   4     28
15 Jun 23      5   5   5   5     4   2   3   2     31
15 Jun 24      3   2   4   3     3   2   2   0     19
15 Jun 25      1   3   4   5     4   3   3   2     25
15 Jun 26      1   1   2   3     0   0   0   1     8
15 Jun 27      2   2   2   2     1   0   0   1     10
15 Jun 28      2   3   3   2     3   2   2   1     18
15 Jun 29      1   1   2   2     1   1   0   0     8
15 Jun 30      1   2   0   0     0   2   2   1     8
Mean of K-Sum is  12.1
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            75   50   62   34   9    9    0    1    0    0    0
--------------------------------------------------------------------------
```

7.7.5.3.7 July

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Jul 2015
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
____________________________________________________________________________________

15 Jul 13 00 00    ...               13(3,4)           5  12.8  91.2  45.2    Jul 14 03
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)    Z
_________________________________________________________
15 Jul 10 15 56    ssc      c        3.52   1.7    1.2
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                 K - i n d i c e s          K-sum
15 Jul 01      0   0   0   1     1   1   0   0     3
15 Jul 02      0   0   0   0     0   0   0   0     0
15 Jul 03      0   0   0   0     0   0   0   0     0
15 Jul 04      0   0   0   0     3   2   4   3     12
15 Jul 05      4   5   2   3     2   3   2   2     23
15 Jul 06      4   4   3   3     2   1   2   1     20
15 Jul 07      1   0   1   1     0   0   0   0     3
15 Jul 08      0   0   1   1     1   2   2   0     7
15 Jul 09      0   1   0   0     2   1   1   0     5
15 Jul 10      1   0   0   0     0   1   1   3     6
15 Jul 11      3   3   3   3     3   3   3   2     23
15 Jul 12      2   3   3   3     3   2   3   2     21
15 Jul 13      2   3   5   5     4   4   3   2     28
15 Jul 14      2   1   2   1     0   1   1   1     9
15 Jul 15      1   1   1   1     1   1   1   1     8
15 Jul 16      1   1   1   3     1   1   1   0     9
15 Jul 17      1   1   0   1     1   1   0   0     5
15 Jul 18      0   0   0   1     1   0   1   0     3
15 Jul 19      0   0   0   1     0   0   0   0     1
15 Jul 20      0   0   0   2     1   0   0   0     3
15 Jul 21      2   1   2   2     2   1   1   1     12
15 Jul 22      0   0   1   2     2   2   2   1     10
15 Jul 23      2   2   4   3     3   2   2   1     19
15 Jul 24      1   1   1   0     3   2   1   0     9
```

15 Jul 25	1	1	2	3	1	1	1	2	12
15 Jul 26	2	0	1	3	1	1	2	0	10
15 Jul 27	1	1	2	4	3	1	1	1	14
15 Jul 28	1	2	2	3	2	2	2	1	15
15 Jul 29	1	1	0	2	2	0	1	0	7
15 Jul 30	1	1	1	2	2	2	3	2	14
15 Jul 31	1	2	1	2	4	3	2	2	17

Mean of K-Sum is 10.6

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	73	80	52	31	9	3	0	0	0	0	0

7.7.5.3.8 August

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Aug 2015
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
15 Aug 15 08 29	2.52*,39.83,10.21	15(5)	6	18.7	192.8	53.2	Aug 16 21

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
15 Aug 15 08 29	ssc*	a	39.83	17.22*	10.21

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
15 Aug 01	2	2	1	1	2	3	2	1	14
15 Aug 02	2	1	3	1	3	2	1	1	14
15 Aug 03	1	1	1	1	2	1	1	0	8
15 Aug 04	0	1	1	1	2	1	2	1	9
15 Aug 05	0	0	0	0	1	1	1	1	4
15 Aug 06	0	1	2	4	3	3	1	1	15
15 Aug 07	1	1	4	3	5	3	1	0	18
15 Aug 08	1	1	3	3	3	2	1	2	16
15 Aug 09	1	2	3	4	2	3	2	2	19
15 Aug 10	2	2	2	2	2	1	2	1	14
15 Aug 11	2	2	2	2	2	1	0	1	12
15 Aug 12	2	2	2	1	2	3	1	2	15
15 Aug 13	2	4	3	3	3	2	1	0	18
15 Aug 14	0	0	0	0	0	0	1	0	1
15 Aug 15	2	2	4	5	6	4	3	2	28
15 Aug 16	3	3	5	4	3	3	3	2	26
15 Aug 17	2	3	4	5	4	4	3	2	27
15 Aug 18	2	3	1	1	1	2	0	1	11
15 Aug 19	3	2	3	3	4	3	2	1	21
15 Aug 20	2	1	1	3	4	2	2	1	16
15 Aug 21	0	1	1	0	2	1	1	1	7
15 Aug 22	0	0	2	3	3	3	2	2	15
15 Aug 23	1	2	5	4	4	3	2	1	22
15 Aug 24	2	1	2	3	2	1	1	0	12
15 Aug 25	1	1	2	3	2	2	2	1	14
15 Aug 26	2	3	3	5	4	3	3	3	26
15 Aug 27	2	4	4	4	4	4	4	3	29
15 Aug 28	4	3	3	4	4	5	4	3	30
15 Aug 29	3	2	1	4	1	3	2	1	17
15 Aug 30	1	0	0	1	0	0	0	1	3

```
15 Aug 31      1   2   0   0     0   1   2   1      7
Mean of K-Sum is  15.7
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           31   70   66   47   26    7    1    0    0    0    0
-------------------------------------------------------------------------
```

7.7.5.3.9 September

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Sep 2015
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
-----------------------------------------------------------------------------------
Commencement       SSC-amplitudes     Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)   Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
___________________________________________________________________________________

15 Sep 07 13 00    ...                7(5,6,7)          5  21.8  168.1 51.4    Sep 08 09
15 Sep 09 06 47    ...                9(4)              6  22.7  143.9 56.5    Sep 10 00
15 Sep 11 07 38    ...                11(3,4,6)         6  26.9  128.5 63.9    Sep 11 18
15 Sep 20 06 04    2.34,39.1,3.22     20(3)             6  15.8  148.1 43.4    Sep 20 21
-----------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality     Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C     H(x)    D(y)    Z
_________________________________________________________
15 Sep 20 06 04    ssc      a         39.1    16.36   3.22
15 Sep 26 16 13    ssc      c         3.11    -1.34   0.74
---------------------------------------------------------
                      S O L A R   F L A R E   E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max    End    H(x)  D(y)    Z
_____________________________________________________________________
15 Sep 29     05:09  05:16 05:33  5.44  0.66    0.93  solar
---------------------------------------------------------------------
     K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y
-------------------------------------------------------------------------
UT-Date                K - i n d i c e s          K-sum
15 Sep 01      1   1   1   2     2   0   0   1      8
15 Sep 02      1   0   1   0     1   2   2   2      9
15 Sep 03      1   2   1   1     2   2   2   3     14
15 Sep 04      3   2   3   4     4   3   2   2     23
15 Sep 05      0   3   2   3     2   3   3   2     18
15 Sep 06      1   3   3   3     3   2   3   2     20
15 Sep 07      2   2   3   3     5   5   5   4     29
15 Sep 08      4   3   3   1     3   2   2   3     21
15 Sep 09      3   3   4   6     4   4   5   4     33
15 Sep 10      2   1   3   2     2   3   4   2     19
15 Sep 11      2   4   6   6     5   6   3   3     35
15 Sep 12      2   3   4   4     3   2   1   1     20
15 Sep 13      1   1   1   4     4   4   3   2     20
15 Sep 14      1   2   1   3     2   4   2   2     17
15 Sep 15      2   2   2   4     4   3   2   2     21
15 Sep 16      2   2   2   1     3   3   2   2     17
15 Sep 17      3   3   2   3     1   1   0   1     14
15 Sep 18      1   1   3   4     3   2   2   2     18
15 Sep 19      2   2   3   4     2   1   1   2     17
15 Sep 20      2   4   6   4     4   4   3   2     29
15 Sep 21      3   3   1   2     2   2   0   1     14
15 Sep 22      3   3   4   1     3   2   1   2     19
15 Sep 23      1   2   3   2     3   3   3   1     18
15 Sep 24      2   2   2   0     1   1   1   2     11
15 Sep 25      2   2   1   3     4   1   0   1     14
15 Sep 26      2   1   0   0     0   2   2   1      8
15 Sep 27      0   1   1   0     0   0   1   1      4
15 Sep 28      0   0   0   0     1   1   1   1      4
15 Sep 29      1   1   1   1     0   0   0   0      4
15 Sep 30      0   0   0   0     0   0   0   0      0
15 Oct 01      1   2   1   1     3   3   2   3     16
Mean of K-Sum is  16.6
```

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	32	57	71	52	26	5	5	0	0	0	0

7.7.5.3.10 October

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Oct 2015
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
15 Oct 07 03 00	...	7(4,7)	6	24.8	144.3	83.9	Oct 08 21
15 Oct 18 03 00	...	18(4)	6	22.6	114.2	44.2	Oct 18 15

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
15 Oct 24 18 55	ssc	b	23.77	8.13	7.8

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
15 Oct 01	1	2	1	1	3	3	2	3	16
15 Oct 02	1	2	3	3	3	3	2	2	19
15 Oct 03	1	3	2	2	3	3	2	2	18
15 Oct 04	2	3	4	3	3	2	1	3	21
15 Oct 05	2	3	4	5	3	2	1	1	21
15 Oct 06	1	1	1	2	3	4	2	3	17
15 Oct 07	2	4	4	6	5	5	6	3	35
15 Oct 08	3	5	4	4	5	4	3	3	31
15 Oct 09	3	3	2	4	4	4	2	2	24
15 Oct 10	2	2	3	0	2	2	1	1	13
15 Oct 11	2	1	1	2	3	2	2	1	14
15 Oct 12	1	2	3	5	3	3	3	2	22
15 Oct 13	1	2	3	4	2	5	3	3	23
15 Oct 14	3	2	3	5	3	2	2	1	21
15 Oct 15	1	1	2	3	1	2	1	2	13
15 Oct 16	1	2	2	1	3	2	0	1	12
15 Oct 17	2	1	1	3	3	2	3	2	17
15 Oct 18	2	3	4	6	4	3	2	2	26
15 Oct 19	0	1	2	1	1	0	0	1	6
15 Oct 20	1	1	1	3	3	2	3	1	15
15 Oct 21	1	2	2	4	4	3	1	1	18
15 Oct 22	1	0	2	1	1	1	2	2	10
15 Oct 23	2	1	0	1	2	2	2	2	12
15 Oct 24	2	2	3	0	1	1	3	2	14
15 Oct 25	2	1	2	1	3	2	1	1	13
15 Oct 26	1	0	1	1	0	0	1	0	4
15 Oct 27	0	1	1	1	2	0	1	1	7
15 Oct 28	0	0	0	0	0	0	0	0	0
15 Oct 29	0	0	1	1	2	0	1	1	6
15 Oct 30	1	1	0	2	4	3	1	3	15
15 Oct 31	1	0	1	2	2	2	1	3	12

Mean of K-Sum is 16.0
Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	27	70	70	53	17	8	3	0	0	0	0

7.7.5.3.11 November

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Nov 2015
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L    M A G N E T I C    S T O R M S
----------------------------------------------------------------------------------
Commencement       SSC-amplitudes     Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)   Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
__________________________________________________________________________________

15 Nov 03 01 35    1.8*,15.25,9.13    3(3,5),4(2,3,4)   5  18.3  159.1 53.0    Nov 04 18
15 Nov 06 18 19    2.1,28.84,2.87     7(3,4)            5  21.7  134.5 79.1    Nov 07 21
----------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality     Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C     H(x)   D(y)    Z
_________________________________________________________
15 Nov 03 01 35    ssc*     c         15.25  12.54* 9.13
15 Nov 06 18 19    ssc      a         28.84  14.52  2.87
15 Nov 20 06 51    ssc      a         25.9   2.57   4.13
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                   K - i n d i c e s          K-sum
15 Nov 01      1   3   2   3     4   2   1   0     16
15 Nov 02      0   0   0   1     3   3   0   2     9
15 Nov 03      2   4   5   4     5   3   4   2     29
15 Nov 04      3   5   5   5     4   2   2   2     28
15 Nov 05      1   1   3   3     4   3   1   2     18
15 Nov 06      2   1   1   2     2   2   3   4     17
15 Nov 07      3   3   5   5     4   4   3   1     28
15 Nov 08      1   2   1   3     3   2   3   3     18
15 Nov 09      2   2   3   3     2   3   4   3     22
15 Nov 10      3   3   4   5     4   3   3   3     28
15 Nov 11      4   3   4   3     3   3   2   1     23
15 Nov 12      1   1   2   2     0   1   0   1     8
15 Nov 13      1   1   0   3     3   4   3   3     18
15 Nov 14      2   2   2   3     3   1   1   2     16
15 Nov 15      0   1   2   3     1   1   1   1     10
15 Nov 16      1   2   3   3     3   3   3   2     20
15 Nov 17      0   1   2   2     1   3   3   2     14
15 Nov 18      1   2   2   3     2   3   3   5     21
15 Nov 19      3   3   2   3     2   1   2   1     17
15 Nov 20      2   3   4   3     0   0   1   2     15
15 Nov 21      2   1   0   0     0   0   0   1     4
15 Nov 22      2   2   1   0     1   0   1   0     7
15 Nov 23      0   0   1   0     1   0   0   1     3
15 Nov 24      0   0   0   0     0   1   0   0     1
15 Nov 25      0   0   0   0     0   0   0   0     0
15 Nov 26      0   1   0   1     1   1   1   1     6
15 Nov 27      1   2   2   2     1   1   1   1     11
15 Nov 28      1   1   1   2     3   1   1   2     12
15 Nov 29      1   2   3   2     2   2   2   2     16
15 Nov 30      3   3   5   4     3   2   2   2     24
Mean of K-Sum is  15.3
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            42   58   56   57   17   10   0    0    0    0    0
--------------------------------------------------------------------------
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7.7.5.3.12 December

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Dec 2015
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Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
-------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
_____________________________________________________________________________________

15 Dec 19 16 17    2.4*,48.58,5.51   20(5)             6  22.2  253.5 99.0    Dec 21 18
15 Dec 31 00 51    -2.58,13.33,11.14 31(5)             6  26.1  182.4 90.6    Jan 01 15
-------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)    Z
_________________________________________________________
15 Dec 14 13 22    ssc      b        20.34  2.01    5.41
15 Dec 19 16 17    ssc*     a        48.58  16.4*   5.51
15 Dec 31 00 51    ssc      c        13.33  -17.66 11.14
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                K - i n d i c e s          K-sum
15 Dec 01     2   2   2   3     4   3   2   2      20
15 Dec 02     1   1   3   2     3   2   1   1      14
15 Dec 03     1   1   0   1     1   1   1   1      7
15 Dec 04     1   2   1   1     1   1   0   1      8
15 Dec 05     1   2   3   4     3   4   2   2      21
15 Dec 06     2   3   3   4     3   3   2   3      23
15 Dec 07     3   3   3   3     4   3   3   2      24
15 Dec 08     3   2   2   3     3   1   2   2      18
15 Dec 09     1   2   1   1     2   3   2   1      13
15 Dec 10     3   4   3   3     3   2   3   3      24
15 Dec 11     2   3   3   3     3   3   2   2      21
15 Dec 12     2   2   3   2     2   3   1   2      17
15 Dec 13     1   2   1   2     2   1   0   1      10
15 Dec 14     1   1   1   2     3   4   4   4      20
15 Dec 15     4   3   2   2     3   4   2   2      22
15 Dec 16     3   2   1   0     0   0   1   1      8
15 Dec 17     1   1   0   2     2   1   3   2      12
15 Dec 18     1   1   1   0     0   1   1   1      6
15 Dec 19     0   1   1   1     1   4   4   4      16
15 Dec 20     3   5   4   5     6   5   5   5      38
15 Dec 21     3   3   3   4     4   3   1   2      23
15 Dec 22     2   2   4   4     3   1   1   1      18
15 Dec 23     2   2   2   2     2   2   2   2      16
15 Dec 24     2   2   3   2     4   2   1   2      18
15 Dec 25     2   2   2   1     3   2   2   2      16
15 Dec 26     2   2   2   2     3   3   3   3      20
15 Dec 27     2   2   2   3     3   2   1   2      17
15 Dec 28     2   2   2   2     3   1   0   1      13
15 Dec 29     1   0   0   1     3   3   1   1      10
15 Dec 30     0   0   1   1     2   2   0   1      7
15 Dec 31     3   3   3   4     6   4   4   5      32
Mean of K-Sum is  17.2
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           16   63   79   59   23   6    2    0    0    0    0
--------------------------------------------------------------------------
```

7.7.5.4 2016

7.7.5.4.1 January

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Jan 2016
```

Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
16 Jan 20 09 00	...	20(4,5,6),21(2)	5	22.7	81.2	56.0	Jan 22 00

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement(nT) H(x)	D(y)	Z
16 Jan 16 10 06	ssc*	c	12.26*	4.61	3.03*
16 Jan 18 21 56	ssc*	a	4.58	-34.19*	13.21*
16 Jan 27 04 15	ssc	b	-21.25	-4.2	-3.01
16 Jan 27 05 55	ssc	b	22.88	7.92	2.05

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K	-	i n d	i c	e	s			K-sum
16 Jan 01	3	3	4	3	3	1	2	2	21
16 Jan 02	3	2	3	3	2	2	2	1	18
16 Jan 03	1	3	2	1	2	2	1	2	14
16 Jan 04	1	2	2	1	1	2	1	0	10
16 Jan 05	1	2	2	2	2	3	2	3	17
16 Jan 06	3	2	3	3	3	3	2	2	21
16 Jan 07	3	3	3	4	3	3	2	1	22
16 Jan 08	1	1	2	3	3	1	1	1	13
16 Jan 09	1	1	2	2	1	1	1	2	11
16 Jan 10	1	2	2	2	2	2	1	2	14
16 Jan 11	1	3	3	1	2	3	3	2	18
16 Jan 12	3	2	2	1	3	2	2	2	17
16 Jan 13	3	4	2	2	3	2	2	1	19
16 Jan 14	1	2	2	2	2	1	1	2	13
16 Jan 15	1	1	2	1	1	1	0	1	8
16 Jan 16	0	1	0	2	2	1	0	1	7
16 Jan 17	0	1	2	2	1	1	1	1	9
16 Jan 18	1	1	0	1	1	1	2	3	10
16 Jan 19	3	3	3	4	2	1	0	2	18
16 Jan 20	1	3	2	5	5	5	4	4	29
16 Jan 21	3	5	3	4	4	4	3	3	29
16 Jan 22	2	3	2	2	3	2	2	2	18
16 Jan 23	2	3	3	2	3	3	2	1	19
16 Jan 24	1	2	2	2	2	3	3	2	17
16 Jan 25	1	0	0	0	0	0	0	0	1
16 Jan 26	0	0	2	2	1	1	2	1	9
16 Jan 27	1	3	2	2	1	1	0	2	12
16 Jan 28	0	1	3	3	1	1	1	0	10
16 Jan 29	1	1	1	1	1	1	0	0	6
16 Jan 30	0	0	0	1	0	1	0	1	3
16 Jan 31	0	2	2	2	2	2	1	2	13

Mean of K-Sum is 14.4

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	28	74	83	50	9	4	0	0	0	0	0

7.7.5.4.2 February

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Feb 2016
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
16 Feb 16 03 00	...	16(5,6),17(8)	5	15.2	129.7	42.1	Feb 18 23

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc* A,B,C	Chief movement(nT) H(x)	D(y)	Z
Nil				

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
16 Feb 01	1	2	2	2	0	1	0	0	8
16 Feb 02	0	0	1	1	1	3	2	2	10
16 Feb 03	2	2	2	1	1	2	0	1	11
16 Feb 04	1	1	1	1	3	3	1	1	12
16 Feb 05	2	3	2	2	3	2	1	2	17
16 Feb 06	1	1	1	2	2	2	1	1	11
16 Feb 07	2	0	2	2	2	4	1	1	14
16 Feb 08	2	3	3	2	2	1	1	1	15
16 Feb 09	1	1	2	4	3	1	1	1	14
16 Feb 10	1	1	0	1	1	0	0	1	5
16 Feb 11	2	1	2	2	3	1	1	2	14
16 Feb 12	2	2	2	4	3	2	2	2	19
16 Feb 13	2	3	3	1	1	1	1	1	13
16 Feb 14	1	2	2	2	3	3	1	1	15
16 Feb 15	1	2	3	2	2	1	1	2	14
16 Feb 16	4	2	3	4	5	5	4	4	31
16 Feb 17	3	3	4	3	4	4	4	5	30
16 Feb 18	3	4	4	4	4	3	4	3	29
16 Feb 19	2	2	2	3	3	4	3	2	21
16 Feb 20	1	2	2	1	2	1	0	0	9
16 Feb 21	1	2	1	0	1	0	1	1	7
16 Feb 22	0	1	1	1	1	2	1	1	8
16 Feb 23	1	1	0	0	1	0	2	3	8
16 Feb 24	1	1	2	2	3	1	1	1	12
16 Feb 25	1	1	2	2	1	1	1	2	11
16 Feb 26	2	3	2	0	1	1	1	0	10
16 Feb 27	0	2	2	2	1	1	1	1	10
16 Feb 28	2	1	2	1	2	0	0	1	9
16 Feb 29	1	0	1	1	1	0	0	1	5

Mean of K-Sum is 13.5

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	26	91	67	28	17	3	0	0	0	0	0

7.7.5.4.3 March

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Mar 2016
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(') H(nT) Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
Nil							

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement (nT) H(x)	D(y)	Z
16 Mar 14 17 15	ssc	b	14.24	1.82	2.83

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement Start	Max	End	Amplitude in nT H(x)	D(y)	Z	Confirmation
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
16 Mar 01	1	3	2	2	2	1	0	2	13
16 Mar 02	0	2	1	2	1	3	1	1	11
16 Mar 03	1	2	2	3	2	2	0	2	14
16 Mar 04	1	1	0	0	0	1	0	0	3
16 Mar 05	0	1	1	1	2	0	0	1	6
16 Mar 06	0	2	3	2	2	4	5	4	22
16 Mar 07	3	3	3	3	3	3	3	3	24
16 Mar 08	1	1	1	2	3	2	1	0	11
16 Mar 09	0	1	0	3	3	3	1	1	12
16 Mar 10	0	2	1	2	3	2	2	1	13
16 Mar 11	0	3	3	4	5	3	3	2	23
16 Mar 12	2	2	1	2	1	3	2	1	14
16 Mar 13	0	2	2	1	0	0	0	1	6
16 Mar 14	0	1	1	1	1	2	3	4	13
16 Mar 15	2	3	4	3	2	3	3	3	23
16 Mar 16	4	2	2	4	3	1	3	3	22
16 Mar 17	3	4	3	4	3	3	2	2	24
16 Mar 18	1	1	2	3	3	3	1	2	16
16 Mar 19	1	2	3	5	4	3	2	1	21
16 Mar 20	1	2	2	2	3	4	4	1	19
16 Mar 21	1	2	2	1	2	2	1	1	12
16 Mar 22	2	2	2	2	1	0	0	1	10
16 Mar 23	1	2	2	2	1	1	1	2	12
16 Mar 24	1	0	1	2	1	1	1	1	8
16 Mar 25	2	1	1	1	1	1	0	0	7
16 Mar 26	0	0	0	0	1	0	0	1	2
16 Mar 27	2	3	3	3	2	3	2	2	20
16 Mar 28	2	2	1	1	1	1	2	2	12
16 Mar 29	2	3	2	3	3	3	1	1	18
16 Mar 30	2	1	1	2	3	2	2	2	15
16 Mar 31	1	2	1	2	2	1	0	1	10

Mean of K-Sum is 14.1
Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	34	75	74	50	12	3	0	0	0	0	0

7.7.5.4.4 April

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Apr 2016
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement Yr Mth Dy Hr Mn	SSC-amplitudes D(')	H(nT)	Z(nT)	Max. 3hr-K-indices Day(3Hr Periods)	K	Storm Ranges D(')	H(nT)	Z(nT)	UT End Mth Dy Hr
16 Apr 14 07 36	...			14(4,5)	5	17.9	93.0	43.5	Apr 14 23

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date Yr Mth Dy Hr Mn	Type & Quality ssc/ssc*	A,B,C	Chief movement (nT) H(x)	D(y)	Z
Nil					

```
-----------------------------------------------------------
                     S O L A R  F L A R E  E F F E C T S
-----------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_______________________________________________________________________
Nil
-----------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
----------------------------------------------------------------------------
UT-Date                 K - i n d i c e s          K-sum
16 Apr 01     1   0   0   0     0   0   1   1       3
16 Apr 02     1   0   0   0     2   5   3   3      14
16 Apr 03     1   2   2   3     1   3   1   2      15
16 Apr 04     2   2   1   1     2   0   0   1       9
16 Apr 05     0   0   0   1     3   1   2   1       8
16 Apr 06     1   0   2   3     3   2   1   0      12
16 Apr 07     0   1   2   1     1   1   4   3      13
16 Apr 08     2   2   1   1     0   0   0   0       6
16 Apr 09     0   0   0   0     0   1   0   0       1
16 Apr 10     1   1   3   3     2   0   1   2      13
16 Apr 11     0   0   0   1     1   3   2   0       7
16 Apr 12     2   2   1   2     3   4   4   3      21
16 Apr 13     3   3   4   4     4   4   3   1      26
16 Apr 14     1   2   2   5     5   4   3   2      24
16 Apr 15     2   0   0   1     1   1   1   1       7
16 Apr 16     0   0   2   4     2   4   3   3      18
16 Apr 17     2   3   2   3     3   3   2   2      20
16 Apr 18     2   1   2   2     1   0   0   0       8
16 Apr 19     0   0   0   0     1   0   0   0       1
16 Apr 20     0   0   2   3     1   0   0   0       6
16 Apr 21     0   0   1   2     0   1   1   1       6
16 Apr 22     1   1   1   1     2   3   2   2      13
16 Apr 23     1   2   1   2     3   2   2   2      15
16 Apr 24     2   1   1   1     2   4   3   1      15
16 Apr 25     1   1   1   2     1   1   1   0       8
16 Apr 26     1   0   1   2     2   1   1   2      10
16 Apr 27     1   1   3   2     3   3   2   1      16
16 Apr 28     1   0   1   2     2   0   0   0       6
16 Apr 29     0   1   0   0     0   0   0   0       1
16 Apr 30     0   2   2   2     3   3   2   2      16
Mean of K-Sum is  11.3
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           68   69   57   32   11    3    0    0    0    0    0
----------------------------------------------------------------------------
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7.7.5.4.5 May

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for May 2016
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
-------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)   Mth Dy Hr
_____________________________________________________________________________________

16 May 08 01 08    ...               8(6)              6  27.2  164.5 74.8    May 09 09
-------------------------------------------------------------------------------------
  S U D D E N  S T O R M  C O M M E N C E M E N T S
-----------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)   D(y)   Z
___________________________________________________________
Nil
-----------------------------------------------------------
                     S O L A R  F L A R E  E F F E C T S
-----------------------------------------------------------------------
Yr Mth Dy     UT of movement      Amplitude in nT    Confirmation
              Start  Max   End    H(x)  D(y)   Z
_______________________________________________________________________
Nil
```

K - I N D I C E S O F G E O M A G N E T I C A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
16 May 01	1	1	1	3	3	4	3	2	18
16 May 02	3	4	2	3	3	4	4	4	27
16 May 03	2	4	3	3	2	2	2	2	20
16 May 04	1	1	0	2	2	2	0	0	8
16 May 05	0	2	2	3	3	3	2	1	16
16 May 06	2	1	1	3	4	4	4	2	21
16 May 07	3	2	1	2	3	2	1	1	15
16 May 08	5	4	5	5	5	6	5	3	38
16 May 09	4	3	3	3	3	3	3	3	25
16 May 10	2	3	3	4	4	3	2	1	22
16 May 11	2	1	0	0	0	0	0	1	4
16 May 12	0	1	1	2	1	0	0	0	5
16 May 13	0	0	2	2	2	3	2	1	12
16 May 14	1	0	2	4	2	0	2	2	13
16 May 15	2	2	1	1	3	3	3	1	16
16 May 16	2	2	3	4	3	2	2	1	19
16 May 17	1	2	3	3	3	3	2	2	19
16 May 18	1	2	2	3	2	1	0	0	11
16 May 19	1	1	3	2	2	2	2	0	13
16 May 20	2	2	1	1	0	0	1	1	8
16 May 21	1	3	4	3	2	3	2	1	19
16 May 22	1	1	2	3	3	1	1	0	12
16 May 23	0	1	1	2	1	0	0	0	5
16 May 24	0	1	0	3	2	0	0	0	6
16 May 25	0	0	0	1	0	0	0	0	1
16 May 26	0	0	0	0	0	0	0	0	0
16 May 27	1	2	0	2	2	2	2	1	12
16 May 28	2	2	4	2	2	3	3	1	19
16 May 29	1	2	2	3	1	1	1	2	13
16 May 30	2	2	3	2	1	3	1	1	15
16 May 31	1	0	3	2	2	3	2	2	15

Mean of K-Sum is 14.4

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	49	54	72	50	17	5	1	0	0	0	0

7.7.5.4.6 June

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Jun 2016
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L M A G N E T I C S T O R M S

Commencement	SSC-amplitudes	Max. 3hr-K-indices		Storm Ranges	UT End
Yr Mth Dy Hr Mn	D(') H(nT) Z(nT)	Day(3Hr Periods)	K	D(') H(nT) Z(nT)	Mth Dy Hr

Nil

S U D D E N S T O R M C O M M E N C E M E N T S

UT Date	Type & Quality		Chief movement(nT)		
Yr Mth Dy Hr Mn	ssc/ssc*	A,B,C	H(x)	D(y)	Z
16 Jun 04 18 56	ssc	c	1.02	2.75	0.93

S O L A R F L A R E E F F E C T S

Yr Mth Dy	UT of movement			Amplitude in nT			Confirmation
	Start	Max	End	H(x)	D(y)	Z	

Nil

K - I N D I C E S O F G E O M A G N E T I C A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
16 Jun 01	1	1	1	2	2	2	1	0	10
16 Jun 02	0	0	0	1	1	0	0	0	2

16 Jun 03	0	0	0	0	0	0	0	0	0
16 Jun 04	0	0	0	0	0	0	1	1	2
16 Jun 05	1	1	3	4	4	4	3	2	22
16 Jun 06	3	4	3	5	4	3	2	1	25
16 Jun 07	1	1	1	3	1	2	3	1	13
16 Jun 08	1	2	1	3	2	1	0	0	10
16 Jun 09	1	0	0	0	1	0	1	0	3
16 Jun 10	0	0	0	1	2	1	2	0	6
16 Jun 11	2	1	2	2	2	1	1	2	13
16 Jun 12	0	1	2	2	2	2	3	1	13
16 Jun 13	2	2	1	3	2	1	1	0	12
16 Jun 14	2	1	1	1	2	2	5	3	17
16 Jun 15	3	2	2	3	3	2	1	0	16
16 Jun 16	1	0	0	2	2	1	1	1	8
16 Jun 17	1	1	2	3	3	2	2	1	15
16 Jun 18	1	2	2	2	2	1	1	1	12
16 Jun 19	1	2	1	1	1	2	0	0	8
16 Jun 20	1	2	1	1	0	0	1	1	7
16 Jun 21	0	0	0	1	1	0	0	0	2
16 Jun 22	1	0	1	1	2	3	3	2	13
16 Jun 23	1	3	1	0	0	2	2	3	12
16 Jun 24	2	2	3	2	3	2	2	2	18
16 Jun 25	2	1	1	1	1	1	2	2	11
16 Jun 26	1	0	1	3	2	3	1	2	13
16 Jun 27	3	2	3	1	1	0	1	1	12
16 Jun 28	2	2	2	2	2	2	2	0	14
16 Jun 29	1	1	1	1	0	1	1	0	6
16 Jun 30	0	0	0	1	0	1	2	2	6

Mean of K-Sum is 10.7

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	59	83	65	26	5	2	0	0	0	0	0

7.7.5.4.7 July

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Jul 2016
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement	SSC-amplitudes	Max. 3hr-K-indices		Storm Ranges	UT End
Yr Mth Dy Hr Mn	D(') H(nT) Z(nT)	Day(3Hr Periods)	K	D(') H(nT) Z(nT)	Mth Dy Hr

Nil

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date	Type & Quality		Chief movement(nT)		
Yr Mth Dy Hr Mn	ssc/ssc*	A,B,C	H(x)	D(y)	Z
16 Jul 19 23 51	ssc	a	3.76	-22.72	11.62
16 Jul 28 00 24	ssc*	b	3.96*	-4.47*	2.94*

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement			Amplitude in nT			Confirmation
	Start	Max	End	H(x)	D(y)	Z	

Nil

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
16 Jul 01	1	2	3	3	1	0	0	0	10
16 Jul 02	0	0	0	1	2	1	1	2	7
16 Jul 03	2	2	1	2	1	2	1	2	13
16 Jul 04	1	0	2	2	1	0	2	0	8
16 Jul 05	0	0	0	0	0	0	0	0	0
16 Jul 06	0	0	0	1	0	0	1	1	3
16 Jul 07	2	2	2	2	3	3	3	3	20
16 Jul 08	2	2	3	5	4	3	2	2	23

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16 Jul 09     2   1   3   3    4   3   2   1     19
16 Jul 10     2   2   2   3    3   1   1   1     15
16 Jul 11     1   1   1   2    3   2   2   1     13
16 Jul 12     1   3   4   4    3   2   2   2     21
16 Jul 13     2   2   2   2    2   2   1   1     14
16 Jul 14     2   3   3   4    2   2   2   1     19
16 Jul 15     1   3   3   3    1   2   1   1     15
16 Jul 16     2   1   1   1    3   1   1   1     11
16 Jul 17     1   1   1   2    2   1   1   1     10
16 Jul 18     1   0   1   1    0   0   0   0     3
16 Jul 19     0   0   0   0    1   2   0   3     6
16 Jul 20     3   3   3   2    2   2   1   0     16
16 Jul 21     0   0   1   1    1   1   0   1     5
16 Jul 22     0   0   2   3    2   2   3   1     13
16 Jul 23     2   2   3   2    1   0   0   0     10
16 Jul 24     1   0   1   2    1   3   4   2     14
16 Jul 25     3   3   4   5    4   3   2   1     25
16 Jul 26     0   1   0   1    3   2   0   0     7
16 Jul 27     0   0   0   0    1   0   0   0     1
16 Jul 28     1   2   3   2    2   2   3   2     17
16 Jul 29     2   3   3   3    3   3   2   1     20
16 Jul 30     2   1   1   1    0   0   1   1     7
16 Jul 31     0   0   0   1    0   2   0   0     3
Mean of K-Sum is  11.9
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           61   69   67   41   8    2    0    0    0    0    0
--------------------------------------------------------------------------
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7.7.5.4.8 August

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra              (CNB) Geomagnetic data for Aug 2016
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement      SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn   D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date           Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn   ssc/ssc* A,B,C    H(x)    D(y)    Z
_________________________________________________________
16 Aug 29 10 18   ssc      b         9.48   1.75   1.0
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy      UT of movement      Amplitude in nT    Confirmation
               Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                  K - i n d i c e s           K-sum
16 Aug 01     1   0   0   0    0   0   0   0     1
16 Aug 02     0   2   1   2    2   3   2   4     16
16 Aug 03     3   3   4   5    4   4   3   2     28
16 Aug 04     2   3   3   4    5   4   3   1     25
16 Aug 05     1   3   3   4    3   3   1   2     20
16 Aug 06     2   1   2   4    3   2   2   1     17
16 Aug 07     3   1   1   1    3   3   1   1     14
16 Aug 08     2   1   1   2    3   4   3   0     16
16 Aug 09     1   2   2   4    3   3   1   2     18
16 Aug 10     2   2   3   4    2   2   2   2     19
16 Aug 11     1   1   1   2    1   3   2   2     13
16 Aug 12     3   2   2   2    3   2   2   1     17
16 Aug 13     1   1   1   1    2   1   2   0     9
16 Aug 14     1   1   0   0    2   0   0   0     4
```

```
16 Aug 15     0   0   1   1     1   1   0   0     4
16 Aug 16     0   0   0   0     2   2   0   2     6
16 Aug 17     1   1   1   1     2   0   1   1     8
16 Aug 18     1   2   1   2     3   2   0   1     12
16 Aug 19     0   0   1   1     2   1   2   0     7
16 Aug 20     1   1   1   1     1   0   0   0     5
16 Aug 21     0   0   0   1     2   3   1   1     8
16 Aug 22     1   1   0   1     0   2   0   0     5
16 Aug 23     1   2   1   3     4   3   4   3     21
16 Aug 24     3   2   1   4     3   2   2   3     20
16 Aug 25     1   1   3   4     2   2   2   2     17
16 Aug 26     2   1   1   0     1   2   2   1     10
16 Aug 27     1   1   0   2     1   1   0   0     6
16 Aug 28     0   0   0   2     1   0   0   0     3
16 Aug 29     0   0   0   2     2   2   2   1     9
16 Aug 30     1   1   1   2     4   3   3   2     17
16 Aug 31     1   1   1   0     1   0   1   1     6
Mean of K-Sum is  12.3
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            54   79   63   34   16   2    0    0    0    0    0
--------------------------------------------------------------------------
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7.7.5.4.9 September

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GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Sep 2016
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L    M A G N E T I C    S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

16 Sep 28 09 00    ...               28(4,5)           5  13.3  107.9 34.6   Sep 28 23
16 Sep 29 00 00    ...               29(4)             6  20.2  114.5 48.1   Sep 29 18
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)    D(y)    Z
_________________________________________________________
16 Sep 17 09 26    ssc      b        8.19    2.88    2.65
---------------------------------------------------------
                      S O L A R   F L A R E   E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy     UT of movement       Amplitude in nT     Confirmation
              Start  Max    End    H(x)   D(y)    Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                 K - i n d i c e s           K-sum
16 Sep 01     2   2   4   4     4   3   4   3     26
16 Sep 02     4   5   2   4     5   4   2   3     29
16 Sep 03     2   4   5   4     5   4   3   3     30
16 Sep 04     2   2   3   4     3   4   3   3     24
16 Sep 05     2   3   3   3     2   3   3   2     21
16 Sep 06     2   2   3   2     2   2   2   2     17
16 Sep 07     3   3   1   3     3   4   2   1     20
16 Sep 08     2   2   3   4     3   2   1   2     19
16 Sep 09     1   0   0   0     1   0   1   1     4
16 Sep 10     0   2   1   0     0   0   0   1     4
16 Sep 11     0   0   0   1     3   2   1   0     7
16 Sep 12     1   2   1   1     2   1   0   0     8
16 Sep 13     0   1   1   2     1   0   0   1     6
16 Sep 14     1   1   1   2     3   2   2   2     14
16 Sep 15     1   1   1   2     1   1   0   1     8
16 Sep 16     0   0   0   1     0   2   1   0     4
16 Sep 17     1   0   0   2     1   0   0   0     4
16 Sep 18     0   0   1   3     4   3   1   1     13
16 Sep 19     0   0   2   3     3   3   2   3     16
```

16 Sep 20	3	2	3	4	1	3	1	2	19
16 Sep 21	2	2	1	3	1	0	0	1	10
16 Sep 22	1	2	1	1	0	0	0	0	5
16 Sep 23	1	2	1	1	0	1	1	1	8
16 Sep 24	1	1	1	1	1	1	1	1	8
16 Sep 25	2	3	1	3	3	2	3	3	20
16 Sep 26	1	1	2	3	4	3	3	3	20
16 Sep 27	2	2	3	5	3	4	2	3	24
16 Sep 28	3	3	2	5	5	4	3	3	28
16 Sep 29	3	4	5	6	4	4	2	2	30
16 Sep 30	2	2	3	4	3	3	3	1	21

Mean of K-Sum is 15.6

Frequency Distribution of K-Indices

K-Index :	0	1	2	3	4	5	6	7	8	9	-
	40	61	53	54	23	8	1	0	0	0	0

7.7.5.4.10 October

GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra (CNB) Geomagnetic data for Oct 2016
Location: Geographic:-35.314d 149.363d
K9 range: 450nT
Variometer: RC

P R I N C I P A L   M A G N E T I C   S T O R M S

Commencement	SSC-amplitudes	Max. 3hr-K-indices		Storm Ranges	UT End
Yr Mth Dy Hr Mn	D(') H(nT) Z(nT)	Day(3Hr Periods)	K	D(') H(nT) Z(nT)	Mth Dy Hr
16 Oct 25 06 00	...	25(5)	6	18.4 132.3 45.3	Oct 26 21

S U D D E N   S T O R M   C O M M E N C E M E N T S

UT Date	Type & Quality		Chief movement(nT)		
Yr Mth Dy Hr Mn	ssc/ssc*	A,B,C	H(x)	D(y)	Z
16 Oct 12 22 13	ssc*	a	1.32	-35.27*	14.03

S O L A R   F L A R E   E F F E C T S

Yr Mth Dy	UT of movement			Amplitude in nT			Confirmation
	Start	Max	End	H(x)	D(y)	Z	
Nil							

K - I N D I C E S   O F   G E O M A G N E T I C   A C T I V I T Y

UT-Date	K - i n d i c e s								K-sum
16 Oct 01	1	3	2	3	3	3	3	2	20
16 Oct 02	2	2	3	3	4	3	4	2	23
16 Oct 03	2	2	2	1	3	2	2	2	16
16 Oct 04	2	3	3	4	4	2	3	2	23
16 Oct 05	2	2	3	3	3	2	1	1	17
16 Oct 06	1	1	2	0	0	2	2	1	9
16 Oct 07	1	1	1	1	2	2	2	0	10
16 Oct 08	1	2	1	3	2	1	1	1	12
16 Oct 09	0	0	1	1	3	1	1	1	8
16 Oct 10	1	2	2	1	2	3	3	1	15
16 Oct 11	0	1	1	1	0	0	1	1	5
16 Oct 12	1	1	0	1	0	1	1	3	8
16 Oct 13	2	2	4	4	5	4	4	2	27
16 Oct 14	2	2	2	3	2	2	1	0	14
16 Oct 15	2	2	2	3	2	3	1	3	18
16 Oct 16	2	1	3	3	3	3	3	2	20
16 Oct 17	2	3	4	4	2	4	3	2	24
16 Oct 18	1	2	2	2	2	2	1	1	13
16 Oct 19	1	2	2	2	1	2	1	0	11
16 Oct 20	1	0	0	0	0	0	1	0	2
16 Oct 21	0	1	0	0	0	0	0	0	1
16 Oct 22	1	1	1	2	2	3	1	1	12
16 Oct 23	0	3	2	2	3	2	2	1	15
16 Oct 24	2	2	3	3	4	3	2	2	21
16 Oct 25	2	2	3	5	6	4	3	4	29
16 Oct 26	4	4	4	5	4	5	3	3	32

```
16 Oct 27      3   3   3   3     3   4   3   3      25
16 Oct 28      1   2   3   3     3   3   3   3      21
16 Oct 29      3   4   4   3     4   2   3   2      25
16 Oct 30      3   3   3   4     4   3   2   2      24
16 Oct 31      1   2   3   3     2   2   1   1      15
Mean of K-Sum is  16.6
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
           26   56   74   63   24    4    1    0    0    0    0
--------------------------------------------------------------------------
```

7.7.5.4.11 November

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Nov 2016
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L    M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement       SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges        UT End
Yr Mth Dy Hr Mn    D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date            Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn    ssc/ssc* A,B,C    H(x)    D(y)    Z
_________________________________________________________
16 Nov 05 22 26    ssc       c       2.1     6.65    1.56
16 Nov 09 06 43    ssc       a       25.57   3.46    2.49
---------------------------------------------------------
                     S O L A R  F L A R E  E F F E C T S
---------------------------------------------------------------------
Yr Mth Dy    UT of movement      Amplitude in nT    Confirmation
             Start  Max   End    H(x)  D(y)   Z
_____________________________________________________________________
Nil
---------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
--------------------------------------------------------------------------
UT-Date                  K - i n d i c e s          K-sum
16 Nov 01      1   1   2   4     3   2   2   3      18
16 Nov 02      2   1   1   2     4   3   1   2      16
16 Nov 03      1   2   4   4     3   3   2   2      21
16 Nov 04      1   1   1   1     0   0   1   0      5
16 Nov 05      1   1   0   1     0   0   0   1      4
16 Nov 06      0   1   2   2     2   1   1   2      11
16 Nov 07      1   1   2   1     1   1   0   0      7
16 Nov 08      0   0   0   1     2   0   0   0      3
16 Nov 09      0   0   3   2     2   1   1   2      11
16 Nov 10      3   3   2   3     3   5   2   3      24
16 Nov 11      2   1   1   2     2   2   2   3      15
16 Nov 12      2   4   2   5     4   3   2   3      25
16 Nov 13      2   3   2   3     3   2   3   2      20
16 Nov 14      1   1   2   3     3   3   1   2      16
16 Nov 15      1   1   1   2     3   1   0   1      10
16 Nov 16      0   1   1   0     0   0   1   1      4
16 Nov 17      0   1   1   0     0   1   1   1      5
16 Nov 18      0   0   0   1     0   2   0   0      3
16 Nov 19      0   0   0   0     1   2   1   0      4
16 Nov 20      0   0   1   2     2   1   1   1      8
16 Nov 21      1   2   2   1     2   1   2   2      13
16 Nov 22      2   2   2   3     3   3   3   3      21
16 Nov 23      2   2   2   2     2   1   1   1      13
16 Nov 24      2   2   3   3     4   3   3   3      23
16 Nov 25      3   4   3   3     4   3   3   2      25
16 Nov 26      2   2   1   3     2   2   2   1      15
16 Nov 27      2   2   2   2     3   1   1   2      15
16 Nov 28      1   1   2   2     2   2   1   2      13
16 Nov 29      1   1   0   1     2   1   1   1      8
16 Nov 30      1   1   1   0     1   1   0   0      5
Mean of K-Sum is  12.7
```

```
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            43   76   71   39   9    2    0    0    0    0    0
--------------------------------------------------------------------------
```

7.7.5.4.12 December

```
GEOSCIENCE AUSTRALIA (email: geomag@ga.gov.au)
Canberra             (CNB) Geomagnetic data for Dec 2016
Location:    Geographic:-35.314d  149.363d
K9 range:  450nT
Variometer: RC
                   P R I N C I P A L   M A G N E T I C   S T O R M S
------------------------------------------------------------------------------------
Commencement      SSC-amplitudes    Max. 3hr-K-indices   Storm Ranges       UT End
Yr Mth Dy Hr Mn   D(') H(nT) Z(nT)  Day(3Hr Periods)  K  D(')  H(nT) Z(nT)  Mth Dy Hr
____________________________________________________________________________________

Nil
------------------------------------------------------------------------------------
  S U D D E N   S T O R M   C O M M E N C E M E N T S
---------------------------------------------------------
UT Date           Type & Quality    Chief movement(nT)
Yr Mth Dy Hr Mn   ssc/ssc* A,B,C    H(x)   D(y)   Z

_________________________________________________________
16 Dec 06 07 43   ssc      c        14.84  2.5    2.04
---------------------------------------------------------
                      S O L A R  F L A R E  E F F E C T S
----------------------------------------------------------------------
Yr Mth Dy    UT of movement      Amplitude in nT    Confirmation
             Start  Max   End    H(x)  D(y)   Z

______________________________________________________________________
Nil
----------------------------------------------------------------------
     K - I N D I C E S  O F  G E O M A G N E T I C  A C T I V I T Y
---------------------------------------------------------------------------
UT-Date                K - i n d i c e s           K-sum
16 Dec 01     1   3   2   0     1   0   0   0      7
16 Dec 02     1   1   1   1     1   1   1   1      8
16 Dec 03     1   0   0   0     0   0   0   0      1
16 Dec 04     0   2   0   1     0   0   0   1      4
16 Dec 05     1   2   0   0     2   2   2   2      11
16 Dec 06     1   1   3   3     4   2   1   1      16
16 Dec 07     0   1   2   2     2   4   3   3      17
16 Dec 08     2   3   3   3     4   5   4   3      27
16 Dec 09     2   3   3   4     3   3   3   3      24
16 Dec 10     2   2   2   3     3   3   2   2      19
16 Dec 11     3   3   2   2     2   3   2   1      18
16 Dec 12     2   2   1   0     1   2   1   2      11
16 Dec 13     1   1   1   1     2   1   1   1      9
16 Dec 14     0   0   1   2     1   1   1   1      7
16 Dec 15     0   1   2   1     1   1   1   1      8
16 Dec 16     1   1   1   0     0   0   0   1      4
16 Dec 17     1   0   1   1     2   2   2   3      12
16 Dec 18     2   2   2   2     3   2   0   2      15
16 Dec 19     1   2   2   1     1   1   2   2      12
16 Dec 20     1   2   1   2     1   3   1   2      13
16 Dec 21     1   2   1   3     4   5   3   2      21
16 Dec 22     3   3   3   3     3   3   3   2      23
16 Dec 23     1   3   3   4     3   3   2   2      21
16 Dec 24     2   2   3   2     3   3   2   2      19
16 Dec 25     3   3   2   4     4   3   2   2      23
16 Dec 26     3   2   3   3     3   3   2   2      21
16 Dec 27     2   2   2   3     2   1   1   1      14
16 Dec 28     1   1   1   1     1   2   2   1      10
16 Dec 29     1   1   1   1     2   2   0   1      9
16 Dec 30     0   1   0   1     2   2   0   1      7
16 Dec 31     0   1   1   3     4   3   3   1      16
Mean of K-Sum is  13.8
Frequency Distribution of K-Indices
K-Index :   0    1    2    3    4    5    6    7    8    9    -
            34   79   71   52   10   2    0    0    0    0    0
--------------------------------------------------------------------------
```

7.8 Macquarie Island Station

7.8.1 INTERMAGNET 'readme' files

7.8.1.1 2013

```
                           MCQ
         MACQUARIE ISLAND OBSERVATORY INFORMATION 2013

  ACKNOWLEDGE- Users of the MCQ data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: MCQ
     LOCATION: Macquarie Island Station.
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 144.50 Deg.
    LONGITUDE: 158.95 Deg. E
    ELEVATION: 8 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DMI fluxgate on
               Zeiss 020B theodolite and Proton
               Precession Magnetometer (GEM GSM90)

    RECORDING
   VARIOMETER: Three component suspended DMI fluxgate
               magnetometer;
               GSM90 Total field magnetometer

  ORIENTATION: The two horizontal fluxgate channels are
               aligned equally about the magnetic meridian
               at the time of installation. The third
               fluxgate channel is vertical. (ABZ)
DYNAMIC RANGE: +/- 3200 nT
   RESOLUTION: 0.32 nT
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: Narod ring core fluxgate magnetometer
               and Elsec 820 PPM


    K-NUMBERS: None
     K9-LIMIT: 1500 nT

         GINS: Edinburgh
    SATELLITE: HTTP upload

    OBSERVERS: Greg Bird    (2013-01-01 - 2013-12-31)
               Andrew Lewis (2013-03-02 - 2013-03-08)
               Bill Jones   (2013-03-02 - 2013-03-08)


      CONTACT: Geomagnetism
               Geoscience Australia
               GPO Box 378
               Canberra, A.C.T, 2601
               Australia
```

Tel: + 61-2-6249-9111
Fax: + 61-2-6249-9969
e-mail: geomag@ga.gov.au
WWW: http://www.ga.gov.au

NOTES:

Site

Macquarie Island is approximately 1500 km southeast of Tasmania and 1300 km north of the Antarctic coast. The magnetic observatory is part of the Australian Antarctic Division research station located on the isthmus at the northern end of the island.

The observatory comprises:

* a Variometer House 100 m south of the Science building;

* an Absolute House about 30 m further south, and;

* a PPM House between the Variometer and Absolute Houses.

Power to the huts is routed underground. Data telemetry was via a wired network during 2013. The area around the observatory is used by elephant seals and other native wildlife. The Absolute and Variometer Houses are enclosed within non-magnetic protective fences.

Local meteorological conditions

The meteorological temperature at Macquarie Island during 2013 varied from a minimum -8.5C (2013-07-25) to a maximum +11.2C (2013-01-10). Daily minimum temperatures varied from -8.5C to +8.0C (average 3.1+/-2.7C); daily maximum temperatures varied from -1.9C to +11.2C (average 6.7+/-2.0C); daily temperature ranges varied from 0.2C to 11.4C (average 3.6+/-1.7C).

The daily maximum wind gust varied from 28 to 130 km/h (average 72+/-18 km/h). The maximum daily maximum wind gust was 130 km/h on 2013-03-28. The minimum daily maximum wind gust was 28 km/h on 2013-09-20.

Variometers

Two variometer systems operated at Macquarie Island throughout 2013, one is referred to as MCQ the other as MQ2. The MCQ system consisted of a Narod Geophysics Limited 3-component ring-core fluxgate and an Elsec 820 proton precession magnetometer. The MQ2 system comprised a Danish Meteorological Institute suspended 3 axis linear-core fluxgate and a GEM Systems GSM-90 total-field instrument. The details of the variometers are described in Table 2.

The MCQ fluxgate variometer electronics was situated in the ante-room of the Variometer House and the sensor was mounted on a marble base on the SE pillar of the sensor room of the Variometer House. It was oriented so that the three mutually orthogonal components recorded were of approximately equal magnitudes. At Macquarie Island the magnetic field is approximately 11d off vertical and each of the three orthogonal sensors makes an angle of approximately 55d with the magnetic vector (this orientation is referred to as ABC). The ABC tombstone sensor (9305-1) was removed on 2013-03-04 and replaced with a sensor orientated ABZ (9004-1).

The Elsec 820 total-field variometer was located on the pillar in the PPM House with the electronics console on the floor of the PPM House. The PPM House had no temperature control.

There is no heating system in the ante-room of the Variometer House. Temperature variations (daily average) in the ante-room recorded in the Narod electronics were 3.4C (2013-07-25) to 17.3C (2013-01-27). There were annual variations of about 14C. The temperature of the sensor room of the Variometer House recorded by the Narod head was 10.1C(2013-07-25) to 18.7C (2013-12-29).

The MQ2 fluxgate variometer sensor was mounted on the NE pillar of the sensor room of the Variometer House and aligned magnetic NW, NE and vertical (this orientation is referred to as ABZ). The MQ2 fluxgate electronics was mounted in an insulated box situated on the floor in the SW corner of the sensor room.

The GSM-90 total-field variometer sensor was mounted on a 22cm high stand located on the floor of the sensor room, mid-way between the NE and SE pillar. The GSM-90 electronics was located on the floor in the SW corner of the sensor room of the Variometer House.

The temperature of the sensor room of the Variometer House was controlled with a heating system. Temperature variations recorded in DMI electronics (daily average) were 18.7C (2013-07-25) to 27.3C (2013-12-29) and 12.0C (2013-07-25) to 20.2C (2013-12-29) in the DMI head through the year. There were annual variations of about 8C.

The data acquisition system was situated in the ante-room of the Variometer House. A single data-acquisition computer acquired data from both the MCQ and MQ2 variometer systems.

Until 2013-03-08 backup power was provided by two separate systems. An Uninterrupted Power Supply (UPS) located in the office powered the MCQ fluxgate variometer (Narod) and the Elsec total-field variometer. A 12 V battery box situated in the ante-room of the Variometer House powered the acquisition computer, the GPS clock, the MQ2 fluxgate variometer and the GSM-90 total-field variometer.

From 2013-03-08, power system has been upgraded. The UPS was removed and the power to all the red GPOs transferred to standard station power from GPO CB8 in the Science building Dark Room. A second 12V variometer battery box was installed in the ante-room of the Variometer House. The six-socket battery box powered the acquisition computer (ARK), DMI fluxgate, Narod Fluxgate and Garmin GPS. Two sockets remain available for use. The existing four socket battery box now powers the Elsec 820 variometer PPM and the GSM90 variometer PPM with 2 unused sockets. The existing Statronics 12V power supply for the Elsec 820 PPM was removed and the input power was re-configured with a three-pin XLR plug compatible with the variometer battery box. Voltage regulators were installed for the Narod fluxgate, DMI fluxgate and GSM90 variometer PPM to ensure a constant 12 V supply. The regulators were housed in individual boxes with 3 pin XLR sockets and three pin XLR plugs on flying leads to match the variometer battery box sockets.

Table 1. Key observatory data

IAGA code:	MCQ
Commenced operation:	1952
Geographic latitude:	54d 30' S
Geographic longitude:	158d 57' E
Geomagnetic latitude:	-59.78d
Geomagnetic longitude:	244.07d
K 9 index lower limit:	1500 nT
Principal pier:	Pier AE
Pier elevation (top):	8 m AMSL
Principal reference mark:	NMI
Reference mark azimuth:	353d 44'13"
Reference mark distance:	200 m
Observers:	G Bird (2013-01-01 - 2013-12-31) A Lewis and W Jones (2013-03-02 - 2013-03-08)

Table 2. Magnetic variometers used in 2013

3-component variometer:	Narod (MCQ) (to 2013-03-04)
Serial number:	Electronics and sensor 9305-1
Type:	ring-core fluxgate
Orientation:	A, B, C
Acquisition interval:	1 s
Resolution:	0.025 nT
3-component variometer:	Narod (MCQ) (from 2013-03-04)
Serial number:	Electronics 200907-2, sensor 9004-1
Type:	ring-core fluxgate
Orientation:	A, B, Z
Acquisition interval:	1 s
Resolution:	0.01 nT
Total-field variometer:	Elsec 820 M3 (MCQ)
Serial number:	140
Type:	Proton precession
Acquisition interval:	10 s
Resolution:	0.1 nT
3-component variometer:	DMI FGE (MQ2)
Serial number:	E0307/S0262
Type:	suspended; linear fluxgate
Orientation:	NW, NE, Z
Acquisition interval:	1 s
Resolution:	0.3 nT
A/D converter:	ADAM 4017 module (±10V)
Total-field variometer:	GEM Systems GSM 90 (MQ2)

```
Serial number:         4081418/42176
Type:                  Overhauser effect
Acquisition interval:  10 s
Resolution:            0.01 nT

Data acquisition system:Wafer 5823 QNX6.3 to 2013-03-04
                        ARK3360F QNX6.5 from 2013-03-04
Timing:                 Trimble "bluebox" GPS
                        (to 2013-03-04)
                        Garmin GPS 16 clock
                        (from 2013-03-04)
                        see errata on GPS at end
Communications:         ANARESAT
Comment
```

DMI 1-second data required de-spiking. The de-spiking parameters required a spike to exceed 0.2 nT and 10 times the average "spike-factor" of the following minute of data. Rejected data were reviewed and some of rejected data were put back. A total of 99 seconds of 1 second data was rejected during 2013 on the following dates:

Date	rejected data number due to spikes
2013-01-05	7
2013-01-12	4
2013-02-11	1
2013-03-05	43 (system upgraded in variometer room)
2013-03-06	5
2013-03-08	8
2013-03-12	1
2013-03-24	3
2013-05-21	11
2013-05-24	10
2013-08-19	3
2013-12-12	1
2013-12-13	2

Narod 1-second data required de-spiking. The de-spiking parameters required a spike to exceed 1 nT and 10 times the average "spike-factor" of the following minute of data. From 2013-01-01 to 2013-03-05, typically 20 -30 seconds data were rejected on each day. From 2013-03-05, Narod fluxgate magnetometer was upgraded, rejection rate dramatically decreased. No data were rejected on most of days from 2013-03-07. Occasionally, a few seconds data were rejected. Highest rejection rate was on 2013-08-27, 13s rejected

The Definitive 1-minute data for 2013 were derived from the DMI 3-axis linear-core fluxgate variometer and GSM-90 total-field variometer (MQ2 system). Reported data provided to INTERMAGNET in real-time during 2013 were derived from the Narod Geophysics Limited 3 component ring-core fluxgate and Elsec 820 proton magnetometer (MCQ system). Quasi-definitive 1-minute data provided to INTERMAGNET quarterly were derived from the MQ2 system. The reason for adopting the DMI and GSM-90 variometers for the quasi-definitive and definitive data is that data rejection rate of the DMI is much less than the Narod from 2013-01-01 to 2013-03-05, and the GSM90 PPM performed better than the

Elsec 820 PPM.

Table 3. Absolute magnetometers and their adopted
corrections for 2013. Corrections are applied
in the sense Standard = Instrument + correction

DI fluxgate:	DMI (Primary)
Serial number:	DI0045
Theodolite:	Zeiss 020B
Serial number:	393911
Resolution:	0.1
D correction:	0.15
I correction:	-0.10
DI fluxgate:	DMI (Secondary)
Serial number:	DI0040
Theodolite:	Zeiss 020B
Serial number:	394742
Resolution:	0.1
D correction:	0.0
I correction:	-0.10
Total-field magnetometer:	GEM Systems GSM 90 (Primary)
Serial number:	5091720/52453
Type:	Overhauser effect
Resolution:	0.01 nT
Correction:	0.0 nT
Total-field magnetometer:	Austral (Secondary)
Serial number:	525
Type:	Proton precession
Resolution:	1 nT

Variometer clock correction

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. The clock was synchronised to a GPS clock. From 2013-01-01 to 2013-12-31, the adjustments to the system clock were less than 1 ms, except the following periods
System upgrade:
2013-03-05 04:03:05.0 Adj by -48,483 ms
2013-03-05 05:07:04.0 Adj by -55 ms
2013-03-05 05:16:20.0 Adj by -159 ms
2013-03-05 06:27:30.0 Adj by 361 ms
2013-03-05 06:42:50.0 Adj by 593 ms
2013-03-05 21:11:43.0 Adj by 377 ms
2013-03-06 00:07:16.0 Adj by 540 ms
2013-03-06 00:41:08.0 Adj by 1,379 ms

GdapClock software error or GPS clock malfunction:
2013-06-08 07:43:35.1 Adj by 12,999 ms
2013-06-08 07:49:27.0 Adj by -12,999 ms
2013-09-09 08:47:04.0 Adj by -96,000 ms
2013-09-09 08:51:56.1 Adj by 95,999 ms

Absolute instruments

The principal absolute magnetometers used at Macquarie Island and their adopted corrections for 2013 are described in Table 3. The principal absolute instrument consists of DI0045/393911 and GSM-90 5091720/52453. The back-up absolute instrument consists of DI0040/394742 and Austral PPM (Aust525).

The absolute instruments at Macquarie Island were compared against the travelling reference instruments B0610H/160459 on 2013-03-06. The instrument correction for the principal absolute instrument DI0045/393911 is consistent as of 2009. therefore the adopted instrument corrections remained unchanged and have been applied to all Macquarie Island 2013 final data.

The comparison results on 2013-03-06 for the backup absolute instrument DI0040/394742 showed that inclination difference remained the same as of 2009, but there was noticeable change in declination (D) in comparison with 2009 results. D correction for DI0040/394742 will be subject to further comparisons before the new correction value being adopted.

Magnetic absolute measurements were nominally performed on a week basis in the Absolute House. DIM observations were made on the principal pier AE with a DMI Declination-Inclination magnetometer (DI0045) mounted on a Zeiss 020B (393911) theodolite.

PPM observations were performed on pier AW with a GEM Systems GSM-90 Overhauser magnetometer (5091720) with sensor 52453. A Hewlett-Packard H4300 personal digital assistant computer was used to communicate with the GSM-90 magnetometer before 2013-03-08 and then a Getac Tablet replaced the HP hand held device and used to record all observational timing and data directly to file thus replacing paper recording.

Pier differences of

X = -2.6 nT Y = +5.1 nT Z = +4.2 nT F = -4.1 nT

were applied to adjust observations performed on pier AW to be equivalent to observations on the principal pier AE.

At 2013 mean magnetic field values (X= 10787 nT, Y= 6654 nT, Z= -62890nT), the D, I and F corrections in Table 3 translate to the following corrections in X, Y and Z.

For DIM DI0045 / 393911 and GSM-90 5091720 / 52453:
X = -1.9 nT   Y = -0.5 nT   Z = -0.4O nT

For DIM DI0040 / 394742 and GSM-90 5091720 / 52453:
X = -1.6 nT   Y = -1.0 nT   Z = -0.4 nT

The principal absolute instrument parameters showed good performance during 2013. DIM DI0045/393911 fluxgate offset T0 was 5.6+/-0.5 nT; its sensor misalignment angles d and e were -1.0+/-0.2' and 0.2+/-0.1'. The standard deviation of the difference between absolute GSM-90 5091720 / 52453 and the variometer GSM-90 4081418 / 42176 during each set of 8 readings during 2013 was +/-0.5 nT excluding the period from 2013-03-05 to 2013-03-07.

Baselines

There were 52 pairs of weekly absolute observations during 2013, plus extra 5 sets during maintenance visit from 2013-03-05 to 2013-03-08. The MCQ and MQ2 variometer baselines were well controlled and cross-checked throughout 2013.

The MQ2 (DMI) baselines were quite stable during 2013 with drifts within 3 nT range in most cases, except for a few points within 4 nT range. The daily mean of the total-field difference between the DMI and GSM-90 (noted as Ef) in the Variometer House varied within 2.0 nT. The GSM-90 PPM performed satisfactorily. The F-difference (absolute F measured in the Absolute House minus F recorded in the Variometer House) in 2013 showed variations from January to November within 1.5 nT range, and 2.5 nT from November to December.

The MCQ (Narod) baselines drifted within 4 nT in X, Y and Z respectively during 2013, except a few bad points in December. The Elsec 820 PPM became unstable from 2012 mainly due to the aging of the instrument. There were a number of spikes on each day through 2013.

Final MQ2 (DMI) baselines were adopted by applying piecewise linear drifts to observed baseline residuals from the weekly absolute observations. The standard deviations of the differences between the weekly absolute observations and the final adopted variometer model and data using the DMI vector variometer were:

	stdev
X	0.6 nT
Y	0.6 nT
Z	0.7 nT
D	10"
I	02"
F	0.7nT

Variometer comparison

The 2013 definitive Macquarie Island data were compared to the Narod variometer data. Both DMI and Narod and data sets were prepared using the same methodology used to create INTERMAGNET Archive Format binary files.

The annual statistics of the 524111 available minute-differences of the two data sets (DMI -Narod) were:

	X	Y	Z
Average	-0.2	+0.3	+0.2
Std.dev	+1.4	+1.5	+0.8
Min	-22.1	-16.4	-06.2
Max	+26.1	+43.8	+20.0

The annual statistics of the 365 daily averages of the difference between the two 1-minute data sets (DMI -Narod) were:

	X	Y	Z
Average	-0.2	+0.3	+0.2
Std.dev	+1.0	+0.9	+0.6
Min	-4.2	-2.1	-1.5
Max	+1.9	+6.2	+3.0

The annual statistics of the 12 monthly averages of the difference between the two 1-minute data sets (DMI -Narod) were:

	X	Y	Z
Average	-0.2	+0.3	+0.2
Std.dev	+0.7	+0.4	+0.4
Min	-1.6	-0.2	-0.2
Max	+0.6	+0.9	+1.1

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2013 MCQ definitive data (DMI) and real time reported 1-minute data sets (Narod) (MCQ definitive (DMI) - MCQ real time (Narod)) were:

	X	Y	Z
Average	+9.4	+17.7	-9.8
Std.dev	+31.3	+68.4	+22.1
Min	-1.3	-15.5	-76.6
Max	+108.6	+233.8	+2.7

The MCQ 2013 reported real time data has relatively larger variations due to re-arrangement of instruments inside the variometer house and Narod instrument upgrade from 2013-03-04 to 2013-03-06.

Baselines were updated quarterly to produce quasi-definitive data. The annual statistics of the 12 monthly averages of the difference between the 2013 MCQ definitive data (DMI) and quasi-definitive 1-minute data sets (DMI) (MCQ definitive (DMI) - MCQ quasi-definitive (DMI)) were:

	X	Y	Z
Average	-0.2	+1.0	+0.6
Std.dev	+0.3	+0.5	+0.5
Min	-1.0	+0.4	-0.5
Max	+0.2	+2.1	+1.7

The MCQ 2013 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The magnetic observers at Macquarie Island were members of the Australian National Antarctic Research Expedition and were employed by the Australian Antarctic Division with funding support by Geoscience Australia. Their duties included maintaining the equipment, performing absolute observations to calibrate the variometers, transcribing the observations and emailing them to Geoscience Australia, maintaining the integrity of the observatory and reporting any changes to Geoscience Australia. During 2013, the role of magnetic observer was filled by the ANARE communications technical officer G. Bird.

The MCQ (Narod) vector variometer produced 8 samples per second which were filtered and outputted as 1 second data. The MQ2 (DMI) vector variometer was sampled once per second. Both the GSM-90 and Elsec 820 scalar variometers produced 10-second samples. All variometer data were recorded on an acquisition PC running QNX and the Geophysical Data Acquisition Platform (GDAP) software. Acquisition timing control was provided by a Garmin GPS clock mounted on the roof of the Variometer House.

Data were transmitted every 5 to 12 minutes to Geoscience Australia. "Reported" quality real-time 1 second and 1 minute data were provided to INTERMAGNET throughout 2013 from the MCQ variometer system. Quasi-definitive 2013 1-minute data from MQ2 were provided to INTERMAGNET quarterly. Definitive 1 minute data (and derived data products such as hourly and annual mean values) were subsequently sourced from the MQ2 system. All preliminary, quasi-definitive and final data preparation was done at Geoscience Australia.

During March 2013, Andrew Lewis and Bill Jones travelled aboard the Australian Antarctic Division (AAD) supply vessel Aurora Australis on Voyage 4 round trip (2013-02-28 2013-03-15) to Macquarie Island. They completed the following tasks:

1. Upgrade the Narod fluxgate magnetometer.
2. Upgrade the data acquisition system and GPS clock.
3. Reconfigure the variometer scalar magnetometers.
4. Reconfigure the backup power arrangements for the variometer equipment.
5. Introduce a tablet PC and GObs software for absolute observation data capture.
6. Undertake absolute instrument tests and comparisons
7. Re-measure pier differences and check azimuths.

The distribution of Macquarie Island 2013 data is described in Table 4.

Table 4. Distribution of Macquarie Island 2013 data.

Recipient	Status	Sent
1-second values		
IPSRadio and Space Services	preliminary	real time
INTERMAGNET	preliminary	hourly
WDC for Geomagnetism -Kyoto	preliminary	real time

1-minute values

INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	Quasi-definitive	Quarterly
INTERMAGNET	definitive	July 2014
WDC for Geomagnetism -Kyoto	preliminary	real time
WDC for Geomagnetism -Kyoto	preliminary	daily

Significant events

```
2013-03-05 05 - 08 March: Maintenance visit AML/WVJ
           Replace Narod (.mcq AGSO/BMR 9305-1) fluxgate;
           replace QNX6.3 Wafer 5823 acquisition computer
           with QNX6.5 ARK3360F and install new
           GARMIN GPS-16; Install second variometer battery
           box; remove LINX UPS backup power; move GSM90
           variometer sensor; install tie-down hardware on
           piers Ae, Aw and the PPM pier in the PPM hut;
           NB There was a short period during the
           maintenance visit when the mq2 data were
           recorded with the ADAM in 5V mode rather than
           10V mode.
2013-03-19 03:40 update mcq baseline file for new NGL
           variometer
2013-03-21 change permission on /usr/bin/ping from
           rwxrwxrwx to rwsrwxr-x so "acq" can run ping
2013-04-30 the front end loader was within the magnetic
           zone this morning 11:40 to 11:50 Macca time
           or 0140 (UTC) to 0150 UTC) 30/4/2013.
2013-05-24 ~01:10, DTU mag showed response to local
           earthquake; NGL mag appears to have been shaken
           and permanently changed (probably) orientation.
           01:10:09 X=10782.44, Y=6642.79, Z=-62914.86
           01:10:10 X=10780.82, Y=6659.30, Z=-62896.73
           dx =1.62, dy = -16.51, dz=-18.13
2013-05-27 absolute observations on Monday indicated NGL
           baselines changed
           Cor Var X =       0.79 nT
           Cor Var Y =     -16.15 nT
           Cor Var Z =     -18.49 nT
           No baseline change in DMI magnetometer after
           the earthquake.
2013-06-08 Curious clock corrections, either GdapClock
           software error or GPS clock malfunction.
           07:35:41.0 N Gm Adj by -485 (-7467) defer
           07:36:42.0 N Gm Adj by 1155 (-7457) defer
           07:37:43.0 N Gm Adj by 314 (-7462) defer
           07:38:41.0 N Gm Adj by 1223 (-7444) defer
           07:39:42.0 N Gm Adj by 12 (-7449) defer
           07:40:43.0 N Gm Adj by -116 (-7465) defer
           07:41:41.1 N Gm Adj by 1591 (-7437) defer
           07:43:35.1 N Gm Adj by 12999999106 (-7455) LL
           07:44:41.0 N Gm Adj by 60 (-7438) defer
           07:45:42.0 N Gm Adj by -231 (-7431) defer
           07:46:40.0 N Gm Adj by -448 (-7433) defer
           07:47:41.0 N Gm Adj by -18 (-7423) defer
           07:48:42.0 N Gm Adj by -1330 (-7442) defer
           07:49:27.0 N Gm Adj by -12999999182 (-7422) LL
           07:49:30.8 I MAG Thread watchdog action
           07:50:40.0 N Gm Adj by -1662 (-7424) defer
```

```
           07:51:41.1 N Gm Adj by -554 (-7441) defer
           07:52:42.0 N Gm Adj by 1293 (-7419) defer
           07:53:40.0 N Gm Adj by -876 (-7440) defer

2013-07-09 spikes on MCQ variometer (Narod) at around 03:27
2013-07-19 down the island for a week. Lots of variation
           this morning.
2013-07-23 GB reported that the cable/wire to the
           magnetometer (DMI) has become intermittently
           open circuit. The break appears to be where
           the cable tie tightens onto the barrel of the
           theodolite.
2013-07-31 updated mcq system (NGL) baseline by adding
           baseline jumps due to 2013-05-04 local
           earthquake.
2013-09-09 Backward time jumps
2013-11-18 JCB entered the edge of the magnetic zone today
           12.25pm till 12.40pm.
2013-12-03 First obs missing SU values. Second obs missing
           EU values but has 2 SU. Both Obs processed OK.
2013-12-05 Observer advises that huts entered 16:45 to
           17:00 Macca time for rodent detection
           appliances.



Appendix A Data losses
----------------------
Macquarie Is (MQ2) Vector data
2013-03-04    XYZ     23:59 -
2013-03-06    XYZ     - 00:41        (1483) system upgrade
2013-06-08    XYZ     07:43 - 07:44  (2) Timestamp error
2013-09-09    XYZ     08:49 - 08:52  (4) Timestamp error

Total: 1489

Macquarie Is (MQ2) scalar data

2013-02-21    F      22:30 - 22:31  (2)
2013-02-21    F      23:18 - 23:18  (1)
2013-03-04    F      23:51 -
2013-03-06    F      - 02:01        (1571) system upgrade
2013-03-06    F      02:08 - 02:08  (1)
2013-03-07    F      20:03 - 21:03  (61)
2013-03-08    F      04:58 - 05:03  (6)
2013-03-12    F      03:46 - 03:48  (3)
2013-03-12    F      03:56 - 03:59  (4)
2013-05-08    F      03:17 - 03:17  (1)
2013-07-01    F      23:56 -
2013-07-02    F      - 00:00        (5)
2013-08-20    F      03:08 - 03:11  (4)
2013-08-26    F      22:01 -
2013-08-27    F      - 01:08        (188)
2013-08-27    F      04:16 - 04:20  (5)
2013-09-09    F      08:51 - 08:51  (1)
2013-09-14    F      00:35 - 00:35  (1)
2013-10-24    F      00:51 - 00:54  (4)
2013-11-29    F      00:41 - 00:45  (5)

Total: 1863
```

Appendix B. Backup data
----
see table 2

Appendix C MCQ (Narod) data used for infill of MQ2 (DMI)
variometer during 2013.

2013-04-02 23:40:00 to 2013-04-03 02:42:00

Corrections to previous year reports

A Trible "bluebox" GPS for was used for timing correction
to the acquisition computer system from 2006 to
2013-03-05. It was incorrectly reported as a Garmin
GPS 16 in the 2006 to 2012 annual reports.

< END >

7.8.1.2 2014

MCQ
MACQUARIE ISLAND OBSERVATORY INFORMATION 2014

ACKNOWLEDGE- Users of the MCQ data should acknowledge:
-MENTS: Geoscience Australia

STATION ID: MCQ
LOCATION: Macquarie Island Station.
ORGANISATION: Geoscience Australia (GA)
CO-LATITUDE: 144.50 Deg.
LONGITUDE: 158.95 Deg. E
ELEVATION: 8 metres

ABSOLUTE
INSTRUMENTS: DI-fluxgate Magnetometer (DMI fluxgate on
Zeiss 020B theodolite and Proton
Precession Magnetometer (GEM GSM90)

RECORDING
VARIOMETER: Three component suspended DMI fluxgate
magnetometer;
GSM90 Total field magnetometer

ORIENTATION: The two horizontal fluxgate channels are
aligned equally about the magnetic meridian
at the time of installation. The third
fluxgate channel is vertical. (ABZ)
DYNAMIC RANGE: +/- 3200 nT
RESOLUTION: 0.32 nT
SAMPLING RATE: 1 second
FILTER TYPE: Intermagnet

BACKUP
VARIOMETER: Narod ring core fluxgate magnetometer
and Elsec 820 PPM

K-NUMBERS: None
K9-LIMIT: 1500 nT

GINS: Edinburgh

```
    SATELLITE: HTTP upload

    OBSERVERS: Greg Bird       (2014-01-01 - 2014-03-31)
               Ryan Jonson     (2014-04-01 - 2014-10-21)
               Scotty Hanson   (2014-10-21 - 2014-12-31)


      CONTACT: Geomagnetism
               Geoscience Australia
               GPO Box 378
               Canberra, A.C.T, 2601
               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9969
               e-mail: geomag@ga.gov.au
               WWW: http://www.ga.gov.au

NOTES:
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Macquarie Island is approximately 1500 km southeast of
Tasmania and 1300 km north of the Antarctic coast. The
magnetic observatory is part of the Australian Antarctic
Division research station located on the isthmus at the
northern end of the island.

The observatory comprises:

* a Variometer House 100 m south of the Science building;

* an Absolute House about 30 m further south, and;

* a PPM House between the Variometer and Absolute Houses.

Power to the huts is routed underground. Data telemetry was
via a wired network during 2014. The area around the
observatory is used by elephant seals and other native
wildlife. The Absolute and Variometer Houses are enclosed
within non-magnetic protective fences.

Table 1.  Key observatory data
   IAGA code:                MCQ
   Commenced operation:      1952
   Geographic latitude:      54d 30' S
   Geographic longitude:     158d 57' E
   Geomagnetic latitude:     -59.78d
   Geomagnetic longitude:    244.07d
   K 9 index lower limit:    1500 nT
   Principal pier:           Pier AE
   Pier elevation (top):     8 m AMSL
   Principal reference mark: NMI
   Reference mark azimuth:   353d 44'13"
   Reference mark distance:  200 m
   Observers:                G Bird   (2014-01-01 - 03-31)
                             R Jonson (2014-04-01 - 10-21)
                             S Hanson (2014-10-21 - 12-31)

Local meteorological conditions
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```

The meteorological temperature at Macquarie Island during 2014 varied from a minimum -3.9C (2014-05-25) to a maximum +11.2C (2014-02-19). Daily minimum temperatures varied from -3.9C to +8.2C (average 3.5+/-2.5C); daily maximum temperatures varied from +0.1C to +11.2C (average 7.0+/-1.9C); daily temperature ranges varied from 0.1C to 10.2C (average 3.5+/-1.7C).

The daily maximum wind gust varied from 20 to 154 km/h (average 74+/-19 km/h). The maximum daily maximum wind gust was 154 km/h on 2014-08-04. The minimum daily maximum wind gust was 20 km/h on 2014-02-17.

Variometers

Two variometer systems operated at Macquarie Island throughout 2014, one is referred to as MCQ the other as MQ2. The MCQ system consisted of a Narod Geophysics Limited 3-component ring-core fluxgate and an Elsec 820 proton precession magnetometer. The MQ2 system comprised a Danish Meteorological Institute suspended 3 axis linear-core fluxgate and a GEM Systems GSM90 total-field instrument. The details of the variometers are described in Table 2.

MCQ System:

The MCQ fluxgate variometer electronics was situated in the ante-room of the Variometer House and the sensor was mounted on a marble base on the SE pillar of the sensor room of the Variometer House. It was oriented so that the three mutually orthogonal components recorded were of approximately equal magnitudes. At Macquarie Island the magnetic field is approximately 11d off vertical and each of the three orthogonal sensors makes an angle of approximately 55d with the magnetic vector (this orientation is referred to as ABC). The ABC tombstone sensor (9305-1) was removed on 2013-03-04 and replaced with a sensor orientated ABZ (9004-1).

On 2014-08-25, NGL3 variometer (200907-3) replaced NGL3 variometer (200907-2) and the ABZ sensor (9004-1). The NGL3 variometer (200907-3) sensor was mounted on a ABC tombstone, thus the sensor is ABC orientated

The Elsec 820 total-field variometer was located on the pillar in the PPM House with the electronics console on the floor of the PPM House. The PPM House had no temperature control.

There is no heating system in the ante-room of the Variometer House. Temperature variations (daily average) in the ante-room recorded in the Narod electronics were 6.6C (2014-08-21) to 16.0C (2014-02-10). There were annual variations of about 9.5C. The temperature of the sensor room of the Variometer House recorded by the Narod head was 12.0C (2014-08-21) to 20.0C (2014-12-19).

MQ2 System:

The MQ2 fluxgate variometer sensor was mounted on the NE pillar of the sensor room of the Variometer House and aligned magnetic NW, NE and vertical (this orientation is referred to as ABZ). The MQ2 fluxgate electronics was mounted in an insulated box situated on the floor in the SW corner of the sensor room.

The GSM90 total-field variometer sensor was mounted on a 22cm high stand located on the floor of the sensor room, mid-way between the NE and SE pillar. The GSM90 electronics was located on the floor in the SW corner of the sensor room of the Variometer House.

The temperature of the sensor room of the Variometer House was controlled with a heating system. Temperature variations recorded in DMI electronics (daily average) were 19.9C (2014-08-21) to 27.8C (2014-02-13) and 13.6C (2014-08-21) to 20.6C (2014-02-13) in the DMI head through the year. There were annual variations of about 8C.

The data acquisition system was situated in the ante-room of the Variometer House. A single data-acquisition computer acquired data from both the MCQ and MQ2 variometer systems.

Power system was upgraded on 2013-03-08. Please refer to 2013 readme file for details.

```
 Table 2. Magnetic variometers used in 2014
   3-component variometer: Narod (MCQ) (from 2014-01-01
                                         to 2014-08-25)
   Serial number:          Electronics 200907-2,
                           sensor 9004-1
   Type:                   ring-core fluxgate
   Orientation:            A, B, Z
   Acquisition interval:   1 s
   Resolution:             0.01 nT

   3-component variometer: Narod (MCQ) (from 2014-08-25)
   Serial number:          Electronics and sensor 200907-3
   Type:                   ring-core fluxgate
   Orientation:            A, B, C
   Acquisition interval:   1 s
   Resolution:             0.025 nT

   Total-field variometer: Elsec 820 M3 (MCQ)
   Serial number:          140
   Type:                   Proton precession
   Acquisition interval:   10 s
   Resolution:             0.1 nT

   3-component variometer: DMI FGE (MQ2)
   Serial number:          E0307/S0262
   Type:                   suspended; linear fluxgate
   Orientation:            NW, NE, Z
   Acquisition interval:   1 s
   Resolution:             0.3 nT
   A/D converter:          ADAM 4017 module (±10V)
   Total-field variometer: GEM Systems GSM90 (MQ2)
   Serial number:          4081418/42176
   Type:                   Overhauser effect
   Acquisition interval:   10 s
```

Resolution:	0.01 nT

Data acquisition system:	ARK3360F QNX6.5
Timing:	Garmin GPS 16 clock
Communications:	ANARESAT
Comment	

DMI 1-second data required de-spiking. the spike filter is VectorFactor=10 and VectorNoise= 1 nT, which means a vector spike detection required a value to deviate from the local linear trend by 10 times the maximum of 1 nT, or 8/9 fractile of deviations during the following minute or so. Spikes were detected at 11:17:56 2014-09-23 and 13:58:39 2014-10-20. The detected data were reviewed, and were not rejected.

No spike filter was applied to GSM90.

Narod 1-second data were checked as a backup dataset for filling the data gaps of the DMI.

The Definitive 1-minute data for 2014 were derived from the DMI 3-axis linear-core fluxgate variometer and GSM90 total-field variometer (MQ2 system). Reported data provided to INTERMAGNET in real-time during 2014 were derived from the Narod Geophysics Limited 3 component ring-core fluxgate and Elsec 820 proton magnetometer (MCQ system). Quasi-definitive 1-minute data provided to INTERMAGNET quarterly were derived from the MQ2 system. The reason for adopting the MQ2 system for the quasi-definitive and definitive data is that the MCQ system was interrupted due to swapping Narod instruments on 2014-08-25.

Table 3. Absolute magnetometers and their adopted corrections for 2014. Corrections are applied in the sense Standard = Instrument + correction

DI fluxgate:	DMI (Primary)
Serial number:	DI0045
Theodolite:	Zeiss 020B
Serial number:	393911
Resolution:	0.1
D correction:	0.15
I correction:	-0.10
DI fluxgate:	DMI (Secondary)
Serial number:	DI0040
Theodolite:	Zeiss 020B
Serial number:	394742
Resolution:	0.1
D correction:	0.0
I correction:	-0.10
Total-field magnetometer:	GEM Systems GSM90 (Primary)
Serial number:	5091720/52453
Type:	Overhauser effect
Resolution:	0.01 nT
Correction:	0.0 nT
Total-field magnetometer:	Austral (Secondary)
Serial number:	525
Type:	Proton precession

Resolution: 1 nT

Variometer clock correction

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. The clock was synchronised to a GPS clock. From 2014-01-01 to 2014-12-31, the adjustments to the system clock were:

2014-03-02 22:31:48.1 Adj by less than 1 ms
2014-03-02 22:35:25.0 Adj by less than 1 ms
2014-05-05 00:05:09.1 Adj by less than 1 ms

System reboot
2014-07-31 01:51:51.0 Adj by -259 ms

GdapClock software error or GPS clock malfunction:
(negative time jumps)
2014-10-07 05:54:18.0 Adj by -2,999 ms
2014-10-07 06:07:24.0 Adj by 3,000, ms
2014-11-26 15:56:34.0 Adj by 13,000 ms
2014-11-26 16:04:28.0 Adj by -13,000 ms

Absolute instruments

The principal absolute magnetometers used at Macquarie Island and their adopted corrections for 2014 are described in Table 3. The principal absolute instrument consists of DI0045/393911 and GSM90 5091720/52453. The back-up absolute instrument consists of DI0040/394742 and Austral PPM (Aust525).

The absolute instruments at Macquarie Island were compared against the travelling reference instruments B0610H/160459 on 2013-03-06. There is no instrument comparison in 2014, therefore the adopted instrument corrections remained unchanged and have been applied to all Macquarie Island 2014 final data.

Magnetic absolute measurements were nominally performed on a week basis in the Absolute House. DIM observations were made on the principal pier AE with a DMI Declination-Inclination magnetometer (DI0045) mounted on a Zeiss 020B (393911) theodolite.

PPM observations were performed on pier AW with a GEM Systems GSM90 Overhauser magnetometer (5091720) with sensor 52453. A Getac Tablet was used to record all observational timing and data directly to file.

Pier differences of

X = -2.6 nT Y = +5.1 nT Z = +4.2 nT F = -4.1 nT

were applied to adjust observations performed on pier AW to be equivalent to observations on the principal pier AE.

At 2014 mean magnetic field values (X= 10780 nT, Y= 6685 nT, Z= -62865 nT), the D, I and F corrections in Table 3 translate to the following corrections in X, Y and Z.

For DIM DI0045 / 393911 and GSM90 5091720 / 52453:
X = -1.9 nT   Y = -0.5 nT   Z = -0.4 nT

For DIM DI0040 / 394742 and GSM90 5091720 / 52453:
X = -1.6 nT   Y = -1.0 nT   Z = -0.4 nT

The principal absolute instrument parameters showed good performance during 2014. DIM DI0045/393911 fluxgate offset T0 was 5.8+/-0.6 nT; its sensor misalignment angles d and e were -1.0+/-0.2' and 0.2+/-0.1'.

The standard deviation of the difference between absolute GSM90 5091720/ 52453 and the variometer GSM90 4081418 /42176 during each set of 8 readings during 2014 was +/-0.5 nT.

Baselines

There were 41 pairs of weekly absolute observations during 2014.

The MQ2 (DMI) baselines were quite stable during 2014 with drifts within -2 to +2 nT range for X and Z channels, and -2 to 5 nT for Y channel. The daily mean of the total-field difference between the DMI and GSM90 (noted as Fs - Fv) in the Variometer House varied within 2.1 nT. The F-difference (absolute F measured in the Absolute House minus F recorded in the Variometer House) in 2014 showed variations within 2.0 nT range.

Final MQ2 (DMI) baselines were adopted by applying piecewise linear drifts to observed baseline residuals from the weekly absolute observations. The standard deviations of the differences between the weekly absolute observations and the final adopted variometer model and data using the DMI vector variometer were:

	stdev
X	0.7 nT
Y	0.9 nT
Z	0.3 nT
D	13"
I	03"
F	0.8nT

Scalar data baseline jumped up 0.5 nT on 2014-07-19 due to shifting a MAGDAS instrument in the variometer house. On 2014-07-28 the GSM90 sensor cable was replaced, which caused scalar data baseline jump up 0.5 nT. Scalar data baseline was 47 nT from 2014-01-01 to 2014-07-19, then 47.5 nT to 2014-07-28, and then 48.0 nT to 2014-12-31.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2014 MCQ definitive data (DMI) and real time reported 1-minute data sets (Narod) (MCQ definitive (DMI) - MCQ real time (Narod)) were:

	X	Y	Z
Average	+1.1	+2.2	-1.1
Std.dev	+3.0	+2.4	+0.7
Min	-4.8	-1.3	-2.4
Max	+4.1	+5.2	-0.3

Baselines were updated quarterly to produce quasi-definitive data. The annual statistics of the 12 monthly averages of the difference between the 2014 MCQ definitive data (DMI) and quasi-definitive 1-minute data sets (DMI) (MCQ definitive (DMI) - MCQ quasi-definitive (DMI)) were:

	X	Y	Z
Average	-0.5	+1.2	+1.8
Std.dev	+0.8	+0.6	+0.5
Min	-1.1	+0.6	+0.7
Max	+0.9	+1.9	+2.2

The MCQ 2014 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The magnetic observers at Macquarie Island were members of the Australian National Antarctic Research Expedition and were employed by the Australian Antarctic Division with funding support by Geoscience Australia. Their duties included maintaining the equipment, performing absolute observations to calibrate the variometers, transcribing the observations and emailing them to Geoscience Australia, maintaining the integrity of the observatory and reporting any changes to Geoscience Australia. During 2014, the role of magnetic observer was filled by the ANARE communications technical officers.

The MCQ (Narod) vector variometer produced 8 samples per second which were filtered and outputted as 1 second data. The MQ2 (DMI) vector variometer was sampled once per second. Both the GSM90 and Elsec 820 scalar variometers produced 10-second samples. All variometer data were recorded on an acquisition PC running QNX and the Geophysical Data Acquisition Platform (GDAP) software. Acquisition timing control was provided by a Garmin GPS clock mounted on the roof of the Variometer House.

Data were transmitted every 5 to 12 minutes to Geoscience Australia. "Reported" quality real-time 1 second and 1 minute data were provided to INTERMAGNET throughout 2014 from the MCQ variometer system. Quasi-definitive 2014 1-minute data from MQ2 were provided to INTERMAGNET quarterly. Definitive 1 minute data (and derived data products such as hourly and annual mean values) were subsequently sourced from the MQ2 system. All preliminary, quasi-definitive and final data preparation was done at

Geoscience Australia.

The distribution of Macquarie Island 2014 data is described in Table 4.

Table 4. Distribution of Macquarie Island 2014 data.

Recipient	Status	Sent
1-second values		
IPS Radio and Space Services	preliminary	real time
INTERMAGNET	preliminary	hourly
WDC for Geomagnetism -Kyoto	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	Quasi-definitive	Quarterly
INTERMAGNET	definitive	July 2015
WDC for Geomagnetism -Kyoto	preliminary	real time
WDC for Geomagnetism -Kyoto	preliminary	daily

Significant events

2014-01-23 Equipment shipped to Kingston, Startrack #00305901. items are: Narod sensor, electronics and cable; Battery 18amp/h; 2 Pico upgrade systems; GSM90 cable; Dell Keyboard.

2014-01-24 Shipment arrives in Kingston, seen on Startrack tracking page.

2014-01-28 First SU missed.

2014-02-13 ~22:30 No E820 PPM data ~22:30 Slay and re-start GdapE820

2014-03-17 Ship is coming for resupply. Ryan J. will be the next observer. Greg will return to Australia after about 500+days in Macca.

2014-03-31 observers changeover. Greg and Ryan did two sets of obs together.

2014-04-08 send getacgga for installation on tablet PC to set time using internal GPS

2014-05-05 updated GdapClockGm
2014-05-05 00:01:41.0 N Gm Adj by -265 (-1075) defer
2014-05-05 00:04:22.7 I Gm Started
2014-05-05 00:05:09.1 N Gm Adj by -157064 (-1075) defer L
2014-05-05 00:06:41.0 N Gm Adj by 573 (-1073) defer

2014-06-10 First run of PPM measurements resulted timeout or bad readings. Final PPM readings after DI measurements are good.

2014-06-19 First run of PPM measurements resulted timeout or bad readings.
Final PPM readings after DI measurements are good. - suggested to turn the power on and let the PPM electronics warm up for a few minutes, and then take readings.

2014-06-24 Ryan advised that a plumber will enter the Magnetic quiet zone on occasion to do a physical assessment of the Seismic hut.

```
2014-06-25  accessed the Seismic Hut - 1100 hrs and
            Magnetic Quiet zone at around 0900 hrs on
            2014-06-25 local time.
2014-07-19  Moving/checking MAGDAS in variometer hut.
            Elsec 820 PPM stops delivering data
2014-07-28  Ryan changing battery in PPM variometer battery
            box and replacing GSM90 sensor cable
            GSM90 stopped 04:58:30. Both GSM90 and E820
            restarted after some intervention.
            The new sensor cable on the GSM90 has reduced
            interference on the DMI vector data but has
            not completely removed it.
2014-07-31  01:50 reboot to clear network connections
            table (netstat -a)
2014-08-25  ~01UT - 04  Replace NGL3 variometer (200907-2)
            and ABZ sensor with NGL3 variometer (200907-3)
            and ABC sensor.
2014-08-27  Range jump tests: 04:32:00 to 04:42:15 sudo
            echo -n XRANGEUP > /dev/ngl/command
            Start and finish tests with ranges 116/116/-117
2014-09-08  More range jump tests: 06:44 to 06:50 sudo
            echo -n XRANGEUP/DOWN > /dev/ngl/command
            Start and finish tests with ranges 116/115/-117
2014-09-12  First Obs with PICO on DIM. Both the primary
            and secondary DIM have been upgraded for PICO
            Need to measure scale values.
2014-10-21  The 2014-15 summer observer cannot go to MCQ.
            Ryan is training the SCTO (Scotty Hansen) to
            do the obs instead. There will now be only
            one tech on station.
2014-11-26  negative time jumps in MCQ data.

Appendix A Data losses
----------------------
Macquarie Is (MQ2) Vector data
2014-07-19    XYZ     00:05 - 00:21  (17)
        checking MAGDAS in variometer hut
2014-07-31    XYZ     01:50 - 01:51  (2)
        reboot
2014-08-25    XYZ     01:30 - 04:40  (191)
        Narod System upgrade.
2014-11-26    XYZ     15:56 - 15:57  (2)
        negative time jumps
2014-11-30    XYZ     22:28 - 22:40  (13)
        baselines shifted on XYZ

Total: 225

Macquarie Is (MQ2) scalar data

2014-01-08    F      04:57 - 04:57  (1)
2014-01-14    F      03:49 - 04:01  (13)
2014-01-21    F      00:34 - 00:37  (4)
2014-01-28    F      00:09 - 00:10  (2)
2014-01-30    F      02:28 - 02:38  (11)
2014-02-03    F      22:07 - 22:10  (4)
2014-02-11    F      05:28 - 05:28  (1)
2014-02-12    F      04:33 - 04:58  (26)
2014-02-13    F      02:30 - 02:34  (5)
2014-03-31    F      21:16 - 21:21  (6)
2014-04-02    F      03:51 - 04:07  (17)
```

2014-04-02	F	21:32 - 21:33	(2)
2014-04-09	F	22:02 - 22:16	(15)
2014-04-17	F	22:39 -	
2014-04-18	F	- 00:46	(128)
2014-06-11	F	05:12 - 05:25	(14)
2014-06-22	F	01:15 - 01:27	(13)
2014-07-19	F	00:06 - 00:20	(15)
2014-07-28	F	04:55 - 06:38	(104)
2014-07-31	F	01:51 - 01:51	(1)
2014-08-25	F	01:31 - 04:39	(189)
2014-10-21	F	03:14 - 03:17	(4)
2014-11-30	F	22:29 - 22:40	(12)
2014-12-09	F	22:16 - 22:30	(15)

Total: 602

Appendix B. Backup data
----
see table 2

Appendix C MCQ (Narod) data used for infill of MQ2 (DMI) variometer during 2014.

Nil

< END >

7.8.1.3 2015

MCQ
MACQUARIE ISLAND OBSERVATORY INFORMATION 2015

```
  ACKNOWLEDGE- Users of the MCQ data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: MCQ
     LOCATION: Macquarie Island Station.
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 144.50 Deg.
    LONGITUDE: 158.95 Deg. E
    ELEVATION: 8 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DMI fluxgate on
               Zeiss 020B theodolite and Proton
               Precession Magnetometer (GEM GSM90)

    RECORDING
   VARIOMETER: Three component suspended DMI fluxgate
               magnetometer;
               GSM90 Total field magnetometer

  ORIENTATION: The two horizontal fluxgate channels are
               aligned equally about the magnetic meridian
               at the time of installation. The third
               fluxgate channel is vertical. (ABZ)
DYNAMIC RANGE: +/- 3200 nT
   RESOLUTION: 0.32 nT
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet
```

```
     BACKUP
 VARIOMETER: Narod ring core fluxgate magnetometer
             and Elsec 820 PPM

  K-NUMBERS: None
   K9-LIMIT: 1500 nT

       GINS: Edinburgh
  SATELLITE: HTTP upload

  OBSERVERS: Scotty Hanson   (2015-01-01 - 2015-04-12)
             Rich Youd       (2015-04-18 - 2015-10-28)
             Rob Bennett     (2015-11-14 - 2015-12-31)


    CONTACT: Geomagnetism
             Geoscience Australia
             GPO Box 378
             Canberra, A.C.T, 2601
             Australia

             Tel: + 61-2-6249-9111
             Fax: + 61-2-6249-9969
             e-mail: geomag@ga.gov.au
             WWW: http://www.ga.gov.au
```

NOTES:

Macquarie Island is approximately 1500 km southeast of Tasmania and 1300 km north of the Antarctic coast. The magnetic observatory is part of the Australian Antarctic Division research station located on the isthmus at the northern end of the island.

The observatory comprises:

* a Variometer House 100 m south of the Science building;

* an Absolute House about 30 m further south, and;

* a PPM House between the Variometer and Absolute Houses.

Power to the huts is routed underground. Data telemetry was via a wired network during 2015. The area around the observatory is used by elephant seals and other native wildlife. The Absolute and Variometer Houses are enclosed within non-magnetic protective fences.

Table 1. Key observatory data

IAGA code:	MCQ
Commenced operation:	1952
Geographic latitude:	54d 30' S
Geographic longitude:	158d 57' E
Geomagnetic latitude:	-59.78d
Geomagnetic longitude:	244.07d
K 9 index lower limit:	1500 nT
Principal pier:	Pier AE
Pier elevation (top):	8 m AMSL
Principal reference mark:	NMI
Reference mark azimuth:	353d 44'13"

Reference mark distance: 200 m
Observers: S Hanson (2015-01-01 - 2015-04-12)
R Youd (2015-04-18 - 2015-10-28)
R Bennett(2015-11-14 - 2015-12-31)

Local meteorological conditions

The meteorological temperature at Macquarie Island during 2015 varied from a minimum -5.4C (2015-06-12) to a maximum +11.2C (2015-02-01). Daily minimum temperatures varied from -5.4C to +8.8C (average 2.8+/-2.8C); daily maximum temperatures varied from -0.1C to +11.2C (average 6.6+/-2.2C); daily temperature ranges varied from 0.1C to 9.8C (average 3.8+/-1.6C).

The daily maximum wind gust varied from 31 to 157 km/h (average 75+/-19 km/h). The maximum daily maximum wind gust was 157 km/h on 2015-07-31. The minimum daily maximum wind gust was 31 km/h on 2015-08-31.

Daily weather observations for Macquarie Island (station ID 300004) provided by Australian Government, Bureau of Meteorology.

Variometers

Two variometer systems operated at Macquarie Island throughout 2015, one is referred to as MCQ the other as MQ2. The MCQ system consisted of a Narod Geophysics Limited 3-component ring-core fluxgate and an Elsec 820 proton precession magnetometer. The MQ2 system comprised a Danish Meteorological Institute suspended 3 axis linear-core fluxgate and a GEM Systems GSM90 total-field instrument. The details of the variometers are described in Table 2.

MCQ System:

The MCQ fluxgate variometer electronics was situated in the ante-room of the Variometer House and the sensor was mounted on a marble base on the SE pillar of the sensor room of the Variometer House. It was oriented so that the three mutually orthogonal components recorded were of approximately equal magnitudes. At Macquarie Island the magnetic field is approximately 11d off vertical and each of the three orthogonal sensors makes an angle of approximately 55d with the magnetic vector (this orientation is referred to as ABC).

The NGL3 variometer (200907-3) sensor was mounted on a ABC marble "tombstone" where the three mutually orthogonal components of the sensor produced data of approximately equal magnitude.

The Elsec 820 total-field variometer was located on the pillar in the PPM House with the electronics console on the floor of the PPM House. The PPM House had no temperature control.

There is no heating system in the ante-room of the Variometer House, but there is heating in the sensor room. Temperature variations (daily average) in the ante-room recorded in the Narod electronics were 6.7C (2015-08-19) to 16.5C (2015-01-29). There were annual variations of about 9.8C. The temperature of the sensor room of the Variometer House recorded by the Narod head was 13.8C (2015-08-19) to 20.4C (2015-01-29), an annual variations of about 6.6C.

MQ2 System:

The MQ2 fluxgate variometer sensor was mounted on the NE pillar of the sensor room of the Variometer House and aligned magnetic NW, NE and vertical (this orientation is referred to as ABZ). The MQ2 fluxgate electronics was mounted in an insulated box situated on the floor in the SW corner of the sensor room.

The GSM90 total-field variometer sensor was mounted on a 22 cm high stand located on the floor of the sensor room, mid-way between the NE and SE pillar. The GSM90 electronics was located on the floor in the SW corner of the sensor room of the Variometer House.

The temperature of the sensor room of the Variometer House was controlled with a heating system. Temperature variations recorded in DMI electronics (daily average) were 20.5C (2015-08-19) to 26.5C (2015-01-29) and 13.7C (2015-08-19) to 19.5C (2015-01-29) in the DMI head through the year.

The data acquisition system was situated in the ante-room of the Variometer House. A single data-acquisition computer acquired data from both the MCQ and MQ2 variometer systems.

Table 2. Magnetic variometers used in 2015

3-component variometer:	Narod (MCQ)
Serial number:	Electronics and sensor 200907-3
Type:	ring-core fluxgate
Orientation:	A, B, C
Acquisition interval:	1 s
Resolution:	0.01 nT
Total-field variometer:	Elsec 820 M3 (MCQ)
Serial number:	140
Type:	Proton precession
Acquisition interval:	10 s
Resolution:	0.1 nT
3-component variometer:	DMI FGE (MQ2)
Serial number:	E0307/S0262
Type:	suspended; linear fluxgate
Orientation:	NW, NE, Z
Acquisition interval:	1 s
Resolution:	0.3 nT
A/D converter:	ADAM 4017 module (±10V)
Total-field variometer:	GEM Systems GSM90 (MQ2)
Serial number:	4081418/42176
Type:	Overhauser effect
Acquisition interval:	10 s
Resolution:	0.01 nT

```
   Data acquisition system:ARK3360F QNX6.5
   Timing:                 Garmin GPS 16 clock
   Communications:         ANARESAT
```

The Definitive 1-minute data for 2015 were derived from the DMI 3-axis linear-core fluxgate variometer and GSM90 total-field variometer (MQ2 system). Reported data provided to INTERMAGNET in real-time during 2015 were derived from the Narod Geophysics Limited 3 component ring-core fluxgate and Elsec 820 proton magnetometer (MCQ system). Quasi-definitive 1-minute data provided to INTERMAGNET quarterly were derived from the MQ2 system.

No spike filtering was applied to either the DMI or the GSM90.

Variometer clock correction

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. The clock was synchronised to a GPS clock. From 2015-01-01 to 2015-12-31, the adjustments to the system clock over 10 ms were:

GdapClock software error or GPS clock malfunction:
(positive time jumps)

2015-02-02	18:28:36	15.000 s
	18:39:26	-15.000 s
2015-02-24	00:01:28	0.481 s
2015-03-07	20:41:30	9.000 s
	20:44:32	-9.000 s
2015-03-15	22:23:41	0.000 s
	22:27:41	0.001 s
2015-04-04	14:23:33	12.000 s
	14:29:29	-12.000 s
2015-07-01	00:00:40	-1.000 s
2015-08-03	06:59:49	0.550 s
2015-12-09	03:47:22	1.000 s
	03:59:20	-1.000 s

Over the periods of positive time jumps, the timestamps were adjusted manually in the definitive data set.
for example:
-9s correction was applied to the period from
2015-03-07 20:41:30.000 to 2015-03-07 20:44:32.000.
As the result of the time correction, the period is now from 2015-03-07 20:41:21.000 to 2015-03-07 20:44:23.000.

Absolute instruments

The principal absolute magnetometers used at Macquarie Island and their adopted corrections for 2015 are described in Table 3. The principal absolute instrument consists of DI0045/393911 and GSM90 5091720/52453. The back-up absolute instrument consists of DI0040/394742 and Austral PPM (Aust525).

The absolute instruments at Macquarie Island were compared against the travelling reference instruments B0610H/160459 on 2013-03-06. There is no instrument comparison in 2015, therefore the adopted instrument corrections remained unchanged and have been applied to all Macquarie Island 2015 final data.

Magnetic absolute measurements were nominally performed on a weekly basis in the Absolute House. DIM observations were made on the principal pier AE with a DMI Declination-Inclination magnetometer (DI0045) mounted on a Zeiss 020B (393911) theodolite.

PPM observations were performed on pier AW with a GEM Systems GSM90 Overhauser magnetometer (5091720) with sensor 52453. A Getac Tablet was used to record all observational timing and data directly to file.

On 2015-11-24, a fuse in GSM90_5091720 electronics blew several time after application of power. It was found the problem was due to a fault in the electronics console. A replacement GSM90 electronics and sensor was sent to the observatory on the next available re-supply voyage in April 2016. During this period, the variometer Elsec 820 PPM data was used as for absolute total field data. The scalar pier differences between Else820 and pier AW was routinely measured throughout 2014 and 2015 during absolute observations at 26.8nT.

On 2015-04-29 the tribrach on theodolite 393911 was swapped from the tribrach from the backup theodolite 394742 due to a damaged spring clip on the tricbrach securing thumbscrew.

Pier differences between AE and AW
X = -2.6 nT Y = +5.1 nT Z = +4.2 nT F = -4.1 nT
were applied to adjust observations performed on pier AW to be equivalent to observations on the principal pier AE.

At the 2015 mean magnetic field values (X= 10757 nT, Y= 6712 nT, Z= -62844 nT), the D, I and F corrections in Table 3 translate to the following corrections in X, Y and Z.

For DIM DI0045 / 393911 and GSM90 5091720 / 52453:
X = -1.8 nT   Y = -0.5 nT   Z = -0.4 nT

For DIM DI0040 / 394742 and GSM90 5091720 / 52453:
X = -1.6 nT   Y = -1.0 nT   Z = -0.4 nT

The principal absolute instrument performed well throughout the year. DIM DI0045/393911 fluxgate offset T0 was 5.8+/-0.4 nT; its sensor misalignment angles (delta and epsilon) were -1.1+/-0.2' and 0.1+/-0.2'.

The standard deviation of the difference between absolute GSM90 5091720/ 52453 and the variometer GSM90 4081418 /42176 during each set of 8 readings during 2015 was 0.4+/-0.4nT from 2015-01-01 to 2015-03-18, and then linearly drifted to 4.0nT from 2015-03-18 to 2015-12-09.

By comparing the differences of F data between magnetometers in the variometer house (DMI, Narod, GSM90 (4081418 /42176)), in the PPM house (Elsec 820), and in the absolute house (GSM90 5091720/ 52453), it was found that the linearly drift with a magnitude of 4.0nT in F between the absolute house and the variometer house from 2015-03-18 to 2015-12-09 was caused by waste materials piled up outside of 100 m magnetic quiet zone. The waste materials were added on the pile on a daily basis and it caused baseline to drift up approximately linearly. The comparison results indicate the instrument in the absolute house and the PPM house were not contaminated by the waste materials because these two houses are further from the waste material pile.

The waste materials were removed from 2015-12-09 to 2015-12-11.

Table 3. Absolute magnetometers and their adopted corrections for 2015. Corrections are applied in the sense Standard = Instrument + correction

```
   DI fluxgate:             DMI (Primary)
   Serial number:           DI0045
   Theodolite:              Zeiss 020B
   Serial number:           393911
   Resolution:              0.1
   D correction:            0.15
   I correction:            -0.10
   DI fluxgate:             DMI (Secondary)
   Serial number:           DI0040
   Theodolite:              Zeiss 020B
   Serial number:           394742
   Resolution:              0.1
   D correction:            0.0
   I correction:           -0.10
   Total-field magnetometer:GEM Systems GSM90 (Primary)
                            2015-01-01 to 2015-11-24
   Serial number:           5091720/52453
   Type:                    Overhauser effect
   Resolution:              0.01 nT
   Correction:              0.0 nT
   2015-0101 to 2015-11-24

   Total-field variometer:  Elsec 820 M3 (MCQ)
                            2015-11-24 to 2015-12-31
   Serial number:           140
   Type:                    Proton precession
   Resolution:              0.1 nT

   Total-field magnetometer:Austral (Secondary)
   Serial number:           525
   Type:                    Proton precession
   Resolution:              1 nT
```

Baselines

There were 41 pairs of weekly absolute observations during 2015. Absolute obs on 2015-03-08 were excluded due to poor quality.

The MQ2 (DMI) baseline variations can be divided into four periods:
2015-01-01 to 2015-03-18: -2 nT to 2 nT for X,Y,Z.

```
2015-03-18 to 2015-04-12: X and Y remained in -2 to 2 nT,
           but Z drifted steeply downwards to -4nT.
           It was caused by waste materials
           accumulated outside of the magnetic quiet zone.
2015-04-12 to 2015-12-09: X and Y remained in -2 to 2 nT,
           Z remained in the range -3 to -5nT.
2015-12-09 to 2015-12-11: X and Y remaineed in -2 to 2 nT,
           Z drifted steeply upward back to -2 to 2nT range
           after the waste materials being removed.
```

The MCQ (Narod) baseline variations have similar patterns as MQ2. X, Y, Z variations were within 6 nT ranges during 2015.

Final MQ2 (DMI) baselines were adopted by applying piecewise linear drifts to observed baseline residuals from the weekly absolute observations. The standard deviations of the differences between the weekly absolute observations and the final adopted variometer model and data using the DMI vector variometer were:

	stdev
X	0.4 nT
Y	0.6 nT
Z	0.2 nT
D	10"
I	01"
F	0.2nT

The GSM90 (4081418 /42176) scalar magnetometer is located in the variometer house. The Scalar magnetometer baseline remained stable during 2015-01-01 to 2015-03-18m then drifted up by 4 nT during the period of 2015-03-18 to 2015-12-11 and then down again by 4 nT as the waste materials were removed from the edge of the magnetic quiet zone. Multiple small step were applied to the scalar magnetometer baseline during 2015-03-18 to 2015-12-11.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2015 MCQ definitive data (DMI) and real time reported 1-minute data sets (Narod) (MCQ definitive (DMI) - MCQ real time (Narod)) were:

	X	Y	Z
Average	-1.8	-0.7	-2.8
Std.dev	+1.8	+2.4	+2.9
Min	-4.6	-5.0	-6.5
Max	+0.3	+2.5	+3.4

Baselines were updated quarterly to produce quasi-definitive data. The annual statistics of the 12 monthly averages of the difference between the 2015 MCQ definitive data (DMI) and quasi-definitive 1-minute data sets (DMI) (MCQ definitive (DMI) - MCQ quasi-definitive (DMI)) were:

	X	Y	Z
Average	-0.9	-0.5	-0.0
Std.dev	+0.5	+1.6	+0.9

Min	-1.6	-2.0	-1.0
Max	+0.2	+2.6	+2.0

The MCQ 2015 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

The 2015 definitive Macquarie Island data were compared to the Narod variometer data. Both DMI and Narod data sets were prepared using the same methodology used to create INTERMAGNET Archive Format binary files.
The annual statistics of the 12 monthly averages of the difference between the 2015 definitive data (DMI) and definitive 1-minute data sets (Narod)

	X	Y	Z
Average	-0.3	+0.1	+0.2
Std.dev	+0.9	+0.9	+0.2
Min	-1.6	-0.9	-0.3
Max	+1.5	+2.4	+0.6

Operations

The magnetic observers at Macquarie Island were members of the Australian National Antarctic Research Expedition and were employed by the Australian Antarctic Division with funding support by Geoscience Australia. Their duties included maintaining the equipment, performing absolute observations to calibrate the variometers, and emailing them to Geoscience Australia, maintaining the integrity of the observatory and reporting any changes to Geoscience Australia. During 2015, the role of magnetic observer was filled by the ANARE communications technical officers.

The MCQ (Narod) vector variometer produced 8 samples per second which were filtered and output as 1 second data. The MQ2 (DMI) vector variometer was sampled once per second. Both the GSM90 and Elsec 820 scalar variometers produced 10-second samples. All variometer data were recorded on an acquisition PC running QNX and the Geophysical Data Acquisition Platform (GDAP) software. Acquisition timing control was provided by a Garmin GPS clock mounted on the roof of the Variometer House.

Data were transmitted every 5 to 12 minutes to Geoscience Australia. "Reported" quality real-time 1 second and 1 minute data were provided to INTERMAGNET throughout 2015 from the MCQ variometer system. Quasi-definitive 2015 1-minute data from MQ2 were provided to INTERMAGNET quarterly. Definitive 1 minute data (and derived data products such as hourly and annual mean values) were subsequently sourced from the MQ2 system. All preliminary, quasi-definitive and final data preparation was done at Geoscience Australia.

On 2015-08-03 the data acquisition software was upgraded. The new system implements 0.4s timing offset in the NGL vector (MCQ)data, and filters the 8 sps to 1 sps and upscales 8 to 128 sps. The upgrade caused 2 minutes data loss due to rollback and reboots. From 03:21:36 2015-08-05 the data acquisition system started to run on the new program.

The distribution of Macquarie Island 2015 data is described in Table 4.

Table 4. Distribution of Macquarie Island 2015 data.

Recipient	Status	Sent
1-second values		
BoM Space Weather Services	preliminary	real time
INTERMAGNET	preliminary	hourly
WDC for Geomagnetism -Kyoto	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	Quasi-definitive	Quarterly
INTERMAGNET	definitive	July 2016
WDC for Geomagnetism -Kyoto	preliminary	real time
WDC for Geomagnetism -Kyoto	preliminary	daily

```
Significant events
-------------------
2015-01-14  Measured DI0045D 393911 # DM 201401_01
            scale value : 1.059 +/-0.02.
2015-02-02  18:28:36 : +15s positive time jump.
2015-02-23  03:45 data comms fails
            Hardware upgrade in Science Building failed.
            System  will only connect at 10Mbps at
            half duplex.
2015-02-24  00:00 reboot system - no improvement.
            Port on switch manually set to 10Mbps.
2015-03-26  Workers accessed the quiet zone yesterday
            (Thurs) between 1400-1500 local time
            (0300-0400UTC).
2015-03-28  Accessed the area with heavy machinery
            yesterday afternoon (Fri 27-03) and this
            morning (Sat).
2015-04-04  Backward time jumps in MCQ and MQ2.
2015-04-12  Last obs data from Scotty H. Rich Youd
            arrived at Macca.
2015-04-29  Problems with tribrach on Theo 393911.
            Swap the tribrach from the backup instrument
            theodolite 393911, electronics DI0045D and
            Pico 201401_01 remain in service, ie only the
            tribrach has been changed.
            First obs from Rich Youd.
2015-05-05  22:11:56 to 22:21:00 F check shows variations
            in XYZ and F. Z:22:17:30 to 17:32 chnaged
            about 1 nT.no reasons.
2015-07-06  Observer away for 8 days from tomorrow.
2015-08-03  Attempt to upgrade from GdapDeviceNGL to
            GdapDeviceNGLB and new version of MachR.
            GdapDeviceNGLB fails - roll back to
            GdapDeviceNGL after one re-boot
            MachR upgrade is successful and is now
            implemented for both mcq and mq2
            2 file sequence changes on MQ2 due to
            MachR re-start and single reboot
            3 file sequence changes on MCQ due to
            multiple MachR re-starts and single reboot.
```

```
            some of the MCQ files will only contain PPM
            data - rename to h152150c.mcq.ppmonly
2015-08-05  03:21:36 Update to GdapDeviceNGLB driver.
            No file sequence number change but gap in
            data file during the change over. A significant
            difference in new system is the implementation
            of 0.4s timing  offset in NGL data, different
            device files  (/dev/ngl/ch0 etc) filtering of
            8 sps to 1 sps and upscaling 8 to 128 sps.
2015-08-21  Observer off station from Monday 24th to Monday
            31st August.
2015-08-21  Updated Narod NGL 200907-2 (MAW system)
            baseline for realtime data delivery
2015-08-17  18:51 time jump in data file
2015-08-24  Installation work commences soon on fencing
            for LIDAR and atmospheric monitoring equipment
            near Clean-Air lab on edge of magnetic quiet
            zone.
2015-09-09  Preparing Quasi-definitive data for the Sep,
            noticed a larger F check (+/-80 nT)
            between 07:00 - 07:10 9 Sep. The larger
            variations are shown on both MCQ and MQ2 data.
2015-11-04  First absolute obs from Rob. a little higher
            chi-square in the second pair of DI and PPM.
2015-11-24  Timeout error during "tune GSM90" procedure.
            Asked Rob to check data and power cables.
2015-11-25  Found a blown 1A fuse in the GSM90_5091720.
            No short circuit after the fuse or obvious
            component damage was visible. Replaced the fuse
            and it blew again after 15-20 seconds.
            No absolute PPM on pier Aw.
2015-11-26  Fa-Fs and Fa-Fv showed that the baselines of
            Narod, DMI and GSM90 ppm in the variometer
            house jumped about 2-3 nT in Mar-Apr and then
            drifted linearly until now.
            Fa-Fv of Elsec 820 has a stable baseline
            through 2015.
            Contaminated by materials piled up adjacent
            to the Vehicle Shed within the edge of the 100m
            magnetic quiet zone boundary. The contamonation
            happened from Mar-Apr 2015.
2015-11-27  adopted Elsec 820 PPM data as Fa reading on
            pier Aw. Fa = F(Elsec 820) + 22.77 + 4.02
            where Ae - Aw  = 4.02
2015-12-01  Cor Ppm AUST_525   MCQ Aw F = -1.99
            Cor Ppm AUST_525   MCQ Aw F = -2.32
            (2013 MCQ visit GSM90_5091720/52453 - AUST_525
             = -2.4 +/- 1.4 nT)
2015-12-14  Materials within the mag quiet zone have
            been relocated over the last a few days.
            based on the difference of Elsec 820 PPM
            and GSM90 PPM, it looks the removal was carried
            out during 9 - 11 Dec.
2015-12-17  Sent a list of instruments (faulty GSM90
            and spare DIM and parts) to be retuned via V4.

Appendix A Data losses
----------------------
Macquarie Is (MQ2) Vector data

2015-02-24    XYZ     00:00 - 00:00  (1)
```

```
2015-04-23    XYZ     22:00 - 22:15  (16)
2015-08-03    XYZ     06:59 - 06:59  (1)

Total: 18 minutes

Macquarie Is (MQ2) scalar data

2015-02-23    F      22:50 - 22:55  (6)
2015-02-23    F      23:15 - 23:22  (8)
2015-02-24    F      00:00 - 00:00  (1)
2015-04-01    F      00:42 - 00:44  (3)
2015-04-23    F      22:00 -
2015-04-24    F      - 00:13        (134)
2015-05-05    F      22:12 -
2015-05-06    F      - 00:19        (128)
2015-08-03    F      06:59 - 06:59  (1)

Total: 281 minutes

Appendix B. Backup data
-----------------------
see table 2

Appendix C MCQ (Narod) data used for infill of MQ2 (DMI)
variometer during 2015.
--------------------------------------------------------
Nil

                            < END >
```

7.8.1.4 2016

```
                            MCQ
         MACQUARIE ISLAND OBSERVATORY INFORMATION 2016

  ACKNOWLEDGE- Users of the MCQ data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: MCQ
     LOCATION: Macquarie Island Station.
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 144.50 Deg.
    LONGITUDE: 158.95 Deg. E
    ELEVATION: 8 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DMI fluxgate on
               Zeiss 020B theodolite)
               GSM90 overhauser effect magnetometer

    RECORDING
   VARIOMETER: Three component suspended DMI fluxgate
               magnetometer;
               GSM90 overhauser effect magnetometer

  ORIENTATION: The two horizontal fluxgate channels are
               aligned equally about the magnetic meridian
               at the time of installation. The third
               fluxgate channel is vertical. (ABZ)
DYNAMIC RANGE: +/- 3200 nT
   RESOLUTION: 0.32 nT
```

```
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet

       BACKUP
  VARIOMETER: Narod ring core fluxgate magnetometer
              and Elsec 820 proton precession magnetometer


    K-NUMBERS: None
     K9-LIMIT: 1500 nT

         GINS: Edinburgh
    SATELLITE: HTTP upload

    OBSERVERS: R Bennett
               R Youd
               T Luttrell

      CONTACT: Geomagnetism
               Geoscience Australia
               GPO Box 378
               Canberra, A.C.T, 2601
               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9969
               e-mail: geomag@ga.gov.au
               WWW: http://www.ga.gov.au

NOTES:
------
Macquarie Island is approximately 1500 km southeast of
Tasmania and 1300 km north of the Antarctic coast. The
magnetic observatory is part of the Australian Antarctic
Division research station located on the isthmus at the
northern end of the island.

The observatory comprises:

* a Variometer House 100 m south of the Science building;

* an Absolute House about 30 m further south, and;

* a PPM House between the Variometer and Absolute Houses.

Power to the huts is routed underground. Data telemetry was
via a wired network during 2016. The area around the
observatory is used by elephant seals and other native
wildlife. The Absolute and Variometer Houses are enclosed
within non-magnetic protective fences.

Table 1.  Key observatory data
   IAGA code:                MCQ
   Commenced operation:      1952
   Geographic latitude:      54d 30' S
   Geographic longitude:     158d 57' E
   Geomagnetic latitude:     -59.78d
   Geomagnetic longitude:    244.07d
   K 9 index lower limit:    1500 nT
   Principal pier:           Pier AE
   Pier elevation (top):     8 m AMSL
```

```
   Principal reference mark: NMI
   Reference mark azimuth:   353d 44'13"
   Reference mark distance:  200 m
   Observers:           R Bennett
                        R Youd
                        T Luttrell
```

Local meteorological conditions

The meteorological temperature recorded at Macquarie during 2016 varied from a minimum of -2.9 degC (2016-08-29) to a maximum of 10.8 degC (2016-12-21). Daily minimum temperatures varied from -2.9 degC to 7.3 degC (average 3.5+/-2.0 degC); daily maximum temperatures varied from 0.8 degC to 10.8 degC (average 6.9+/-1.6 degC); daily temperature ranges varied from 0.0 degC to 8.9 degC (average 3.5+/-1.5 degC).

The daily maximum wind gust recorded varied from 19 to 137 km/h (average 71+/-20 km/h). The maximum daily maximum wind gust recorded was 137 km/h (2016-05-15). The minimum daily maximum wind gust recorded was 19 km/h (2016-11-14).

Daily weather observations for Macquarie Island (station ID 300004) provided by Australian Government, Bureau of Meteorology (http://www.bom.gov.au).

Variometers

Two variometer systems operated at Macquarie Island throughout 2016, one is referred to as MCQ, the other as MQ2. The MCQ system consisted of a Narod Geophysics Limited 3-component ring-core fluxgate and an Elsec 820 proton precession magnetometer. The MQ2 system comprised a Danish Meteorological Institute suspended 3 axis linear-core fluxgate and a GEM Systems GSM90 overhauser effect magnetometer. In this context, both the Elsec 820 and GSM 90 are referred to as total-field variometers.

The details of the variometers are described in Table 2.

MCQ System:

The MCQ fluxgate variometer electronics was situated in the ante-room of the Variometer House and the sensor was mounted on a marble base on the SE pillar of the sensor room of the Variometer House. It was oriented so that the three mutually orthogonal components recorded were of approximately equal magnitudes. At Macquarie Island the magnetic field is approximately 11d off vertical and each of the three orthogonal sensors makes an angle of approximately 55d with the magnetic vector (this orientation is referred to as ABC).

The NGL3 variometer (200907-3) sensor was mounted on a ABC marble "tombstone" where the three mutually orthogonal components of the sensor produced data of approximately equal magnitude.

The Elsec 820 total-field variometer was located on the pillar in the PPM House with the electronics console on the floor of the PPM House. The PPM House had no temperature control.

There is no heating system in the ante-room of the Variometer House, but there is heating in the sensor room. Temperature variations (daily average) in the ante-room recorded in the Narod electronics were 8.1C (2016-07-20) to 16.4C (2016-12-21). There were annual variations of about 8.3C. The temperature of the sensor room of the Variometer House recorded by the Narod head was 14.3C(2016-08-29) to 20.3C (2016-12-21), an annual variations of about 5.9C.

MQ2 System:

The MQ2 fluxgate variometer sensor was mounted on the NE pillar of the sensor room of the Variometer House and aligned magnetic NW, NE and vertical (this orientation is referred to as ABZ). The MQ2 fluxgate electronics was mounted in an insulated box situated on the floor in the SW corner of the sensor room.

The GSM90 total-field variometer sensor was mounted on a 22 cm high stand located on the floor of the sensor room, mid-way between the NE and SE pillar. The GSM90 electronics was located on the floor in the SW corner of the sensor room of the Variometer House.

The temperature of the sensor room of the Variometer House was controlled with a heating system. Temperature variations recorded in DMI electronics (daily average) were 20.6C (2016-08-29) to 26.4C (2016-12-21) with annual variation of 5.2C. DMI head temperature was from 14.3C (2016-08-29) to 19.5C (2016-12-21) with annual variations of 5.8C.

The data acquisition system was situated in the ante-room of the Variometer House. A single data-acquisition computer acquired data from both the MCQ and MQ2 variometer systems.

Table 2. Magnetic variometers used in 2016

3-component variometer:	Narod (MCQ)
Serial number:	Electronics and sensor 200907-3
Type:	ring-core fluxgate
Orientation:	A, B, C
Acquisition interval:	1 s
Resolution:	0.01 nT
Total-field variometer:	Elsec 820 M3 (MCQ)
Serial number:	140
Type:	Proton precession
Acquisition interval:	10 s
Resolution:	0.1 nT
3-component variometer:	DMI FGE (MQ2)
Serial number:	E0307/S0262
Type:	suspended; linear fluxgate

```
   Orientation:            NW, NE, Z
   Acquisition interval:   1 s
   Resolution:             0.3 nT
   A/D converter:          ADAM 4017 module (Â±10V)

   Total-field variometer: GEM Systems GSM90 (MQ2)
   Serial number:          4081418/42176
   Type:                   Overhauser effect
   Acquisition interval:   10 s
   Resolution:             0.01 nT

   Data acquisition system:ARK3360F QNX6.5
   Timing:                 Garmin GPS 16 clock
   Communications:         ANARESAT

The Definitive 1-minute data for 2016 were derived from the
DMI 3-axis linear-core fluxgate variometer and GSM90
total-field variometer (MQ2 system). Reported data provided
to INTERMAGNET in real-time during 2016 were derived from
the Narod Geophysics Limited 3 component ring-core fluxgate
and Elsec 820 total-field variometer (MCQ system).
Quasi-definitive 1-minute data provided to INTERMAGNET
quarterly were derived from the MQ2 system.

No spike filtering was applied to either the DMI or the
GSM90.

Variometer clock correction
---------------------------
Time stamps applied to the variometer data were obtained
from the acquisition computer system clock. The clock was
synchronised to a GPS clock. From 2016-01-01 to 2016-12-31,
the adjustments to the system clock over 10 ms were:

GdapClock software error or GPS clock malfunction:
(positive time jumps)

2016-01-27      19:12:23     2.000 s
                19:24:39    -2.000 s
2016-02-06      11:53:23     2.000 s
                11:59:39    -2.000 s
2016-05-31      03:23:03     1.376 s (reboot)
2016-07-26      15:49:25     4.000 s
                15:54:37    -4.000 s

Absolute instruments
--------------------
The principal absolute magnetometers used at Macquarie
Island and their adopted corrections for 2016 are described
in Table 3. The principal absolute instrument consists of
DI0045/393911 and Elsec 820/140 (2016-01-01 to
2016-03-24), and GSM90_708729/42175 (2016-04-02 to
2016-12-31). The back-up absolute instrument consists of
DI0040/394742 (2016-01-01 to 2016-03-24) and DI0022/353758
(2016-04-02 to 2016-12-31) and Austral PPM (Aust525).

As reported in 2015 readme.mcq, the variometer total-field
data from the Elsec 820 PPM continued to replace the
absolute total field data due to the faulty
GSM90_5091720 console until GSM90_708729/42175 instrument
arrived on 2016-04-02.
```

The scalar pier differences between Elsec 820 and pier AW was routinely measured throughout 2014 and 2015 during absolute observations at 26.8nT.

The primary absolute instruments (DI0045/393911, and GSM90_5091720/52453) at Macquarie Island were compared against the travelling reference instruments B0610H/160459 on 2013-03-06. On 2016-04-08 DI0045/393911 was compared with DI0022/353758 at Macquarie Observatory. The difference (DI0022/353758 - DI0045/393911) is +0.5' for D and -0.14' for I.

There is no instrument comparison in 2016 between DI0045/393911 and B0610H/160459, therefore the adopted instrument corrections remained unchanged and have been applied to all Macquarie Island 2016 final data.

The secondary DI instrument (DI0022/353758) was compared against the Australian standard instruments DI0086D/353756 at the Canberra Geomagnetic Observatory between 2015-12-07 to 2016-02-02. The adopted corrections were 0.05' for D and -0.2' for I.

The GSM90_708729 with sensor 42175 was deployed to Macquarie Island for use as the primary absolute instrument, and it was compared with Australian standard instruments (GSM90_905926 with sensor 21867) on 2015-12-22, with the adopted correction was -0.2 nT.

Magnetic absolute measurements were nominally performed on a weekly basis in the Absolute House. DIM observations were made on the principal pier AE with a DMI Declination-Inclination magnetometer (DI0045) mounted on a Zeiss 020B (393911) theodolite.

PPM observations were performed on pier AW with a GSM90 total-field variometer from 2016-04-02 to 2016-12-31.

A Getac Tablet was used to record all observational timing and data directly to file.

Pier differences between AE and AW
X = -2.6 nT Y = +5.1 nT Z = +4.2 nT F = -4.1 nT
were applied to adjust observations performed on pier AW to be equivalent to observations on the principal pier AE.

At the 2016 mean magnetic field values (X= 10747 nT, Y= 6739 nT, Z= -62814 nT), the D, I and F corrections in Table 3 translate to the following corrections in X, Y and Z.

For DIM DI0045 / 393911 and Elsec 820/140
(2016-01-01 to 2016-03-24):
X = -1.8 nT   Y = -0.5 onT   Z = -0.4 nT

For DIM DI0045 / 393911 and GSM90_708729/42175
(2016-04-02 to 2016-12-31):
X = -1.9 nT   Y = -0.5 nT   Z = -0.2 nT

Table 3. Absolute magnetometers and their adopted corrections for 2016. Corrections are applied in the sense Standard = Instrument + correction

DI fluxgate:	DMI (Primary)
Serial number:	DI0045
Theodolite:	Zeiss 020B
Serial number:	393911
Resolution:	0.1'
D correction:	0.15'
I correction:	-0.10'
DI fluxgate:	DMI (Secondary) (2016-01-01 to 2016-03-04)
Serial number:	DI0040
Theodolite:	Zeiss 020B
Serial number:	394742
Resolution:	0.1'
D correction:	0.0'
I correction:	-0.10'
DI fluxgate:	DMI (Secondary) (2016-04-02 to 2016-12-31)
Serial number:	DI0022
Theodolite:	Zeiss 020B
Serial number:	353758
Resolution:	0.1'
D correction:	0.05'
I correction:	-0.20'
Total-field variometer:	Elsec 820 M3 (MCQ) (Primary) 2016-01-01 to 2016-03-24
Serial number:	140
Type:	Proton precession
Resolution:	0.1 nT
Total-field variometer:	GEM Systems GSM90 (Primary) 2016-04-02 to 2016-12-31
Serial number:	708729/42175
Type:	Overhauser effect
Resolution:	0.01 nT
Correction:	-0.2 nT
Total-field variometer:	Austral (Secondary)
Serial number:	525
Type:	Proton precession
Resolution:	1 nT

Baselines

There were 53 weekly absolute observations during 2016. The primary absolute instrument performed well throughout the year. DIM DI0045/393911 fluxgate offset was 2.8 +/- 3.9 nT; its sensor misalignment angles (delta and epsilon) were -1.2' +/- 0.3' and -0.7' +/- 1.0'.

The standard deviation of the difference between the total-field measured in the absolute house and the total-field measured by GSM90_4081418/42176 (MQ2) in the variometer house during each set of 8 readings during 2016 was 0.4 nT. The differences are within 1 nT range except for a few sets among 53 sets.

The standard deviation of the difference of the daily average total-field between GSM90_4081418/42176 (MQ2) and Elsec 820 (MCQ) was 0.4nT during 2016. The differences of the daily average are within 2 nT showing a clear seasonal variations. Noting that the PPM House had no temperature control, the variations might be due to temperature changes in Elsec 820.

The MQ2 (DMI) baselines of X, Y and Z drifted about 4 nT, and there was not obvious baseline jumps during 2016.

The MCQ (Narod) baseline variations had similar patterns as MQ2. X, Y, Z variations were within 6 nT ranges during 2016.

Final MQ2 (DMI) baselines were adopted by applying piecewise linear drifts to observed baseline residuals from the weekly absolute observations. The standard deviations of the differences between the weekly absolute observations and the final adopted variometer model and data using the DMI vector variometer were:

	stdev
X	0.9 nT
Y	0.7 nT
Z	0.5 nT
H	0.9
D	13"
I	03"
F	0.4nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2016 MCQ definitive data (DMI) and real time reported 1-minute data sets (Narod) (MCQ definitive (DMI) - MCQ real time (Narod)) were:

	X	Y	Z
Average	-1.5	+1.3	+2.5
Std.dev	+1.0	+1.2	+1.5
Min	-2.9	-1.3	+0.3
Max	-0.3	+2.4	+4.4

Baselines were updated quarterly to produce quasi-definitive data. The annual statistics of the 12 monthly averages of the difference between the 2016 MCQ definitive data (DMI) and quasi-definitive 1-minute data sets (DMI) (MCQ definitive (DMI) - MCQ quasi-definitive (DMI)) were:

	X	Y	Z
Average	+0.3	+0.0	+0.2
Std.dev	+0.7	+0.6	+0.2
Min	-0.7	-1.0	-0.4

Max	+1.3	+0.9	+0.6

The MCQ 2016 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

The 2016 definitive Macquarie Island data were compared to the Narod variometer data. Both DMI and Narod data sets were prepared using the same methodology used to create INTERMAGNET Archive Format binary files.
The annual statistics of the 12 monthly averages of the difference between the 2016 definitive data (DMI) and definitive 1-minute data sets (Narod)

	X	Y	Z
Average	-0.8	+0.0	-0.4
Std.dev	+1.4	+0.9	+0.8
Min	-2.5	-1.2	-1.7
Max	+1.6	+2.1	+0.9

Operations

The magnetic observers at Macquarie Island were members of the Australian National Antarctic Research Expedition and were employed by the Australian Antarctic Division with funding support by Geoscience Australia. Their duties included maintaining the equipment, performing absolute observations to calibrate the variometers, and emailing them to Geoscience Australia, maintaining the integrity of the observatory and reporting any changes to Geoscience Australia. During 2016, the role of magnetic observer was filled by the ANARE communications technical officers.

The MCQ (Narod) vector variometer produced 8 samples per second (sps) which were filtered and outputted as 1 second data. The data acquisition software implements 0.4s timing offset in the NGL vector (MCQ) data, and filters the 8 sps to 1 sps and upscales 8 sps to 128 sps.

The MQ2 (DMI) vector variometer was sampled at 1 sps.

Both the GSM90 and Elsec 820 total-field variometers produced 10-second samples.

All variometer data were recorded on an acquisition PC running QNX and the Geophysical Data Acquisition Platform (GDAP) software. Acquisition timing control was provided by a Garmin GPS clock mounted on the roof of the Variometer House.

Data were transmitted every 5 to 12 minutes to Geoscience Australia. "Reported" quality real-time 1 second and 1 minute data were provided to INTERMAGNET throughout 2016 from the MCQ variometer system. Quasi-definitive 2016 1-minute data from MQ2 were provided to INTERMAGNET quarterly. Definitive 1 minute data (and derived data products such as hourly and annual mean values) were subsequently sourced from the MQ2 system. All preliminary, quasi-definitive and final data preparation was done at Geoscience Australia.

The distribution of Macquarie Island 2016 data is described in Table 4.

Table 4. Distribution of Macquarie Island 2016 data.

Recipient	Status	Sent
1-second values		
BoM Space Weather Services	preliminary	real time
INTERMAGNET	preliminary	hourly
WDC for Geomagnetism -Kyoto	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	Quasi-definitive	Quarterly
INTERMAGNET	definitive	July 2017
WDC for Geomagnetism -Kyoto	preliminary	real time
WDC for Geomagnetism -Kyoto	preliminary	daily

Significant events

2016-02-03 Sent replacement absolute PPM GSM90_708729 with sensor 42175 on AAD con note E-112275E.

2016-02-04 Sent replacement backup DIM DI0022D/353758 with Pico FJY06/156;
absolute battery box + 7AH 12V
2 x 18Ah 12V batteries on AAD con note E-112293K.
NOTE: analogue output socket from DI0022D to pico is on the side of the unit which is different from all other units

2016-02-05 Vehicles through mag zone to N of variometer hut for LIDAR Installation near Clean Air Lab
03:00 IN 05:30 OUT

2016-02-08 returned items eCon (112410C):
theodolite-394792/DI0040, PICO 201401 02 and GSM90_5091720/52453

2016-02-09 eCon (112410C) has been accepted for packing.
two items: theodolite-394792 and GSM90.

2016-02-10 01:20 possible contamination caused by LIDAR installation work. Vehicle drove passed the mag quiet zone.
Reported mag zone incursions
IN 01:00 OUT 03:30

2016-02-11 Reported mag zone incursions
IN 04:15 OUT 05:00

2016-02-22 Vehicle traffic within the Magnetic quiet zone leading up to resupply.

05/02/16	14:00-16:30
10/02/16	12:00-14:30
11/02/16	14:05-16:15
17/02/16	16:50-17:00
20/02/16	11:20-13:15
22/02/16	No time provided
23/02/16	No time provided

2016-03-04 Numerous incursions back and forth everyday through the Mag Zone this last week,
Monday 08:15 hrs through to 15:00 hrs Friday.
This next week, commencing Monday 7th will see perhaps two days only of vehicular movement and works.

2016-03-06	Numerous incursions back and forth everyday through the Mag Zone this last week, Monday 08:15 hrs through to 15:00 hrs Friday
2016-03-14	Monday 15:30 -15:40 Tuesday 08:00 - 17:15 Wednesday 07:50 - 16:30 Thursday 08:15 - 17:00 Friday 11:00 - 13:30
2016-04-02	GSM90_708729 with sensor 42175 has arrived on the station. Obs data look very good. From this week, GSM90_708729/42175 will be the absolute PPM.
2016-04-08	Comparisons of primary DI0045D/393911 and backup DI0022D/353758 were carried out. A Battery box and 2x 12v 18Ah baterries arrived on the station.
2016-04-29	Received DIM DI0040/394742 (AGSO 0029869/ 0029870) pico data logger ADC-16 201401 02 GSM90_5091720 (AGSO 0030720) and sensor 52453.
2016-05-31	03:22 reboot to clear TCP stack
2016-08-04	updated mq2 baseline file
2016-08-09	Contamination of both variometers starting around 04:08UTC. Observer confirms finish approx 05:30UTC.
2016-08-12	Observer advises that more work in the Mag quiet zone from approx 02:40UTC.
2016-08-15	Observer off station for week. 2016-08-15 to 2016-08-21. No obs completed this week.
2016-11-01	22:48 heavy machinery travelling through the mag quiet zone from 21:10 UTC. A few spikes shown on both MCQ and MQ2.
2016-11-04	Works continuing at the Clean Air Lab requiring the use of heavy machinery through the mag quiet zone.
2016-12-16	There has been fence repair works carried out over the last 2 days and today within the magnetic quiet zone at Macquarie Island.
2016-12-19	01:45 MQ2 FCheck jump/contamination. There was a power outage that may have had an impact on that area between UT 01:35 until 01:54 2016-12-19

Appendix A Data losses

Macquarie Is (MQ2) Vector data (Data loss were caused by vehicle traffic within the Magnetic quiet during resupply or work in Clean Air Lab. The data of two variometers and PPM were contaminated.)

2016-02-04	XYZ	11:46 - 11:47	(2)
2016-02-05	XYZ	03:43 - 03:43	(1)
2016-02-05	XYZ	03:52 - 03:52	(1)
2016-02-10	XYZ	01:21 - 01:21	(1)
2016-02-10	XYZ	03:42 - 03:42	(1)
2016-02-10	XYZ	03:55 - 03:55	(1)
2016-02-11	XYZ	04:25 - 04:25	(1)
2016-02-11	XYZ	04:29 - 04:29	(1)
2016-02-11	XYZ	04:42 - 04:43	(2)
2016-02-11	XYZ	04:46 - 04:47	(2)
2016-02-11	XYZ	04:50 - 04:50	(1)

2016-02-15	XYZ	03:15 - 03:15	(1)
2016-02-15	XYZ	05:14 - 05:14	(1)
2016-02-15	XYZ	13:09 - 13:10	(2)
2016-02-15	XYZ	14:20 - 14:20	(1)
2016-02-17	XYZ	13:22 - 13:22	(1)
2016-02-20	XYZ	00:27 - 00:27	(1)
2016-02-20	XYZ	00:29 - 00:29	(1)
2016-02-20	XYZ	00:35 - 00:35	(1)
2016-02-20	XYZ	00:39 - 00:39	(1)
2016-02-20	XYZ	00:41 - 00:41	(1)
2016-02-20	XYZ	01:58 - 01:58	(1)
2016-02-20	XYZ	02:17 - 02:17	(1)
2016-02-22	XYZ	06:08 - 06:08	(1)
2016-02-22	XYZ	21:02 - 21:02	(1)
2016-02-22	XYZ	22:43 - 22:43	(1)
2016-02-22	XYZ	22:45 - 22:45	(1)
2016-02-22	XYZ	22:53 - 22:53	(1)
2016-02-23	XYZ	00:00 - 00:01	(2)
2016-02-23	XYZ	00:21 - 00:21	(1)
2016-02-23	XYZ	00:26 - 00:26	(1)
2016-02-23	XYZ	02:48 - 02:53	(6)
2016-02-24	XYZ	01:11 - 01:11	(1)
2016-02-24	XYZ	01:18 - 01:18	(1)
2016-02-24	XYZ	20:48 - 20:48	(1)
2016-02-24	XYZ	21:06 - 21:06	(1)
2016-03-01	XYZ	00:32 - 00:32	(1)
2016-03-01	XYZ	01:56 - 01:56	(1)
2016-03-01	XYZ	06:08 - 06:08	(1)
2016-03-02	XYZ	01:48 - 01:48	(1)
2016-03-02	XYZ	01:50 - 01:50	(1)
2016-03-02	XYZ	01:52 - 01:52	(1)
2016-03-02	XYZ	03:53 - 03:53	(1)
2016-03-02	XYZ	04:19 - 04:19	(1)
2016-03-09	XYZ	00:30 - 00:30	(1)
2016-03-09	XYZ	02:02 - 02:02	(1)
2016-03-09	XYZ	02:25 - 02:25	(1)
2016-03-09	XYZ	03:42 - 03:42	(1)
2016-03-09	XYZ	05:17 - 05:17	(1)
2016-03-09	XYZ	21:39 - 21:39	(1)
2016-03-09	XYZ	21:45 - 21:46	(2)
2016-03-09	XYZ	21:51 - 21:51	(1)
2016-03-09	XYZ	22:03 - 22:04	(2)
2016-03-09	XYZ	22:14 - 22:15	(2)
2016-03-09	XYZ	22:26 - 22:28	(3)
2016-03-09	XYZ	22:30 - 22:30	(1)
2016-03-09	XYZ	22:32 - 22:32	(1)
2016-03-09	XYZ	22:34 - 22:34	(1)
2016-03-09	XYZ	22:54 - 22:54	(1)
2016-03-10	XYZ	00:44 - 00:44	(1)
2016-03-26	XYZ	00:22 - 00:22	(1)
2016-03-28	XYZ	21:02 - 21:05	(4)
2016-03-30	XYZ	06:57 - 07:11	(15)
2016-03-30	XYZ	22:01 - 22:01	(1)
2016-03-30	XYZ	22:24 - 22:24	(1)
2016-03-30	XYZ	22:27 - 22:27	(1)
2016-03-30	XYZ	22:33 - 22:33	(1)
2016-03-30	XYZ	22:38 - 22:38	(1)
2016-03-30	XYZ	22:43 - 22:43	(1)
2016-03-30	XYZ	22:59 - 23:00	(2)
2016-03-30	XYZ	23:06 - 23:06	(1)
2016-03-30	XYZ	23:10 - 23:10	(1)

2016-03-30	XYZ	23:17 - 23:17	(1)
2016-03-30	XYZ	23:27 - 23:27	(1)
2016-03-30	XYZ	23:38 - 23:38	(1)
2016-03-31	XYZ	02:47 - 02:47	(1)
2016-03-31	XYZ	23:31 - 23:31	(1)
2016-04-01	XYZ	03:34 - 03:34	(1)
2016-04-01	XYZ	03:41 - 03:43	(3)
2016-04-01	XYZ	22:43 - 22:43	(1)
2016-04-01	XYZ	22:48 - 22:49	(2)
2016-04-01	XYZ	22:51 - 22:51	(1)
2016-04-01	XYZ	22:55 - 22:55	(1)
2016-04-01	XYZ	22:57 - 22:57	(1)
2016-04-01	XYZ	23:04 - 23:04	(1)
2016-04-02	XYZ	03:49 - 03:49	(1)
2016-04-03	XYZ	06:50 - 06:50	(1)
2016-04-03	XYZ	06:53 - 06:54	(2)
2016-04-03	XYZ	06:56 - 06:56	(1)
2016-04-07	XYZ	02:26 - 02:27	(2)
2016-04-07	XYZ	02:42 - 02:43	(2)
2016-04-11	XYZ	04:27 - 04:27	(1)
2016-04-11	XYZ	04:31 - 04:31	(1)
2016-05-31	XYZ	03:22 - 03:22	(1)
2016-08-05	XYZ	08:57 - 08:58	(2)
2016-08-09	XYZ	03:03 - 05:28	(146)
2016-08-10	XYZ	09:59 - 10:01	(3)
2016-08-23	XYZ	12:27 - 12:29	(3)
2016-08-25	XYZ	09:18 - 09:32	(15)
2016-09-08	XYZ	21:47 - 21:48	(2)
2016-09-09	XYZ	04:18 - 04:18	(1)
2016-09-09	XYZ	17:55 - 17:55	(1)
2016-09-19	XYZ	14:02 - 14:02	(1)
2016-09-22	XYZ	02:00 - 02:00	(1)
2016-09-22	XYZ	02:07 - 02:08	(2)
2016-09-22	XYZ	02:25 - 02:25	(1)
2016-09-22	XYZ	02:27 - 02:27	(1)
2016-10-04	XYZ	10:09 - 10:10	(2)
2016-10-04	XYZ	12:49 - 12:49	(1)
2016-10-09	XYZ	12:22 - 12:23	(2)
2016-10-13	XYZ	14:57 - 14:57	(1)
2016-10-25	XYZ	10:26 - 10:26	(1)
2016-10-25	XYZ	16:33 - 16:33	(1)
2016-10-29	XYZ	08:37 - 08:37	(1)
2016-11-01	XYZ	22:49 - 22:49	(1)
2016-11-01	XYZ	22:55 - 22:55	(1)
2016-11-01	XYZ	23:08 - 23:08	(1)
2016-11-01	XYZ	23:20 - 23:20	(1)
2016-11-01	XYZ	23:31 - 23:31	(1)
2016-11-01	XYZ	23:46 - 23:46	(1)
2016-11-02	XYZ	03:22 - 03:22	(1)
2016-11-02	XYZ	04:07 - 04:07	(1)
2016-11-02	XYZ	04:10 - 04:10	(1)
2016-11-02	XYZ	04:21 - 04:21	(1)
2016-11-02	XYZ	04:23 - 04:23	(1)
2016-11-02	XYZ	04:26 - 04:27	(2)
2016-11-02	XYZ	04:29 - 04:29	(1)
2016-11-02	XYZ	04:36 - 04:36	(1)
2016-11-02	XYZ	04:40 - 04:40	(1)
2016-11-02	XYZ	05:12 - 05:12	(1)
2016-11-02	XYZ	05:16 - 05:16	(1)
2016-11-02	XYZ	21:10 - 21:11	(2)
2016-11-02	XYZ	22:03 - 22:03	(1)

2016-11-02	XYZ	22:35 - 22:35	(1)
2016-11-02	XYZ	23:16 - 23:16	(1)
2016-11-03	XYZ	09:05 - 09:06	(2)
2016-11-08	XYZ	02:10 - 02:10	(1)
2016-11-08	XYZ	02:33 - 02:33	(1)
2016-11-08	XYZ	03:18 - 03:19	(2)
2016-11-08	XYZ	03:24 - 03:24	(1)
2016-11-08	XYZ	03:34 - 03:34	(1)
2016-11-08	XYZ	03:38 - 03:38	(1)
2016-11-08	XYZ	04:51 - 04:51	(1)
2016-11-08	XYZ	21:29 - 21:29	(1)
2016-11-08	XYZ	21:36 - 21:37	(2)
2016-11-08	XYZ	21:49 - 21:51	(3)
2016-11-08	XYZ	21:55 - 21:55	(1)
2016-11-08	XYZ	22:41 - 22:42	(2)
2016-11-08	XYZ	22:57 - 22:57	(1)
2016-11-09	XYZ	02:28 - 02:28	(1)
2016-11-09	XYZ	02:37 - 02:37	(1)
2016-11-09	XYZ	02:47 - 02:47	(1)
2016-11-09	XYZ	02:52 - 02:52	(1)
2016-11-09	XYZ	20:56 - 20:56	(1)
2016-11-09	XYZ	21:05 - 21:05	(1)
2016-11-09	XYZ	21:22 - 21:22	(1)
2016-11-15	XYZ	21:53 - 21:54	(2)
2016-11-15	XYZ	22:12 - 22:12	(1)
2016-11-15	XYZ	22:26 - 22:26	(1)
2016-11-15	XYZ	22:30 - 22:31	(2)
2016-11-15	XYZ	22:40 - 22:40	(1)
2016-11-15	XYZ	22:47 - 22:49	(3)
2016-11-28	XYZ	23:49 - 23:49	(1)
2016-12-22	XYZ	10:00 - 10:00	(1)
2016-12-23	XYZ	10:21 - 10:21	(1)
2016-12-26	XYZ	02:24 - 02:29	(6)
2016-12-27	XYZ	10:32 - 10:32	(1)
2016-12-28	XYZ	15:32 - 15:41	(10)
2016-12-31	XYZ	10:16 - 10:16	(1)

Total: 402 minutes

Macquarie Is (MQ2) scalar data

2016-01-18	F	21:00 - 21:12	(13)
2016-01-29	F	03:32 - 03:40	(9)
2016-02-04	F	11:46 - 11:47	(2)
2016-02-05	F	03:52 - 03:52	(1)
2016-02-10	F	01:21 - 01:21	(1)
2016-02-11	F	04:29 - 04:29	(1)
2016-02-15	F	13:09 - 13:10	(2)
2016-02-15	F	14:20 - 14:20	(1)
2016-02-20	F	00:39 - 00:39	(1)
2016-02-20	F	02:17 - 02:17	(1)
2016-02-22	F	06:08 - 06:08	(1)
2016-02-22	F	21:02 - 21:02	(1)
2016-02-22	F	22:53 - 22:53	(1)
2016-02-23	F	00:00 - 00:00	(1)
2016-02-23	F	02:48 - 02:53	(6)
2016-03-02	F	04:19 - 04:19	(1)
2016-03-09	F	00:30 - 00:30	(1)
2016-03-09	F	02:25 - 02:25	(1)
2016-03-09	F	21:46 - 21:46	(1)

2016-03-09	F	22:04 - 22:04	(1)
2016-03-09	F	22:15 - 22:15	(1)
2016-03-09	F	22:27 - 22:27	(1)
2016-03-09	F	22:32 - 22:32	(1)
2016-03-09	F	22:54 - 22:54	(1)
2016-03-28	F	21:02 - 21:05	(4)
2016-03-30	F	06:57 - 07:10	(14)
2016-03-30	F	22:24 - 22:24	(1)
2016-03-30	F	22:27 - 22:27	(1)
2016-03-30	F	22:33 - 22:33	(1)
2016-03-30	F	23:00 - 23:00	(1)
2016-04-01	F	03:41 - 03:43	(3)
2016-04-01	F	22:49 - 22:49	(1)
2016-04-01	F	22:57 - 22:57	(1)
2016-04-02	F	03:49 - 03:49	(1)
2016-04-03	F	06:50 - 06:50	(1)
2016-04-03	F	06:53 - 06:53	(1)
2016-04-03	F	06:56 - 06:56	(1)
2016-04-07	F	02:26 - 02:27	(2)
2016-04-07	F	02:42 - 02:43	(2)
2016-04-11	F	04:27 - 04:27	(1)
2016-04-17	F	22:07 - 22:10	(4)
2016-05-27	F	05:53 - 05:53	(1)
2016-05-31	F	03:22 - 03:22	(1)
2016-07-08	F	11:42 - 11:43	(2)
2016-07-13	F	13:22 - 13:23	(2)
2016-07-15	F	09:58 - 10:03	(6)
2016-07-25	F	08:50 - 08:59	(10)
2016-07-28	F	11:31 - 11:35	(5)
2016-08-05	F	08:57 - 08:58	(2)
2016-08-09	F	03:03 - 05:28	(146)
2016-08-10	F	09:59 - 10:01	(3)
2016-08-23	F	12:28 - 12:29	(2)
2016-08-25	F	09:19 - 09:32	(14)
2016-09-08	F	21:47 - 21:47	(1)
2016-09-09	F	04:18 - 04:18	(1)
2016-09-09	F	17:55 - 17:55	(1)
2016-09-19	F	14:02 - 14:02	(1)
2016-09-22	F	02:00 - 02:00	(1)
2016-10-04	F	10:09 - 10:09	(1)
2016-10-04	F	12:49 - 12:49	(1)
2016-10-09	F	12:23 - 12:23	(1)
2016-10-13	F	14:57 - 14:57	(1)
2016-10-24	F	04:39 - 04:43	(5)
2016-10-25	F	10:26 - 10:26	(1)
2016-10-25	F	16:33 - 16:33	(1)
2016-10-29	F	08:37 - 08:37	(1)
2016-11-01	F	22:49 - 22:49	(1)
2016-11-01	F	23:08 - 23:08	(1)
2016-11-01	F	23:31 - 23:31	(1)
2016-11-01	F	23:46 - 23:46	(1)
2016-11-02	F	03:22 - 03:22	(1)
2016-11-02	F	04:07 - 04:07	(1)
2016-11-02	F	04:29 - 04:29	(1)
2016-11-02	F	05:16 - 05:16	(1)
2016-11-02	F	21:10 - 21:11	(2)
2016-11-02	F	22:03 - 22:03	(1)
2016-11-02	F	22:35 - 22:35	(1)
2016-11-02	F	23:16 - 23:16	(1)
2016-11-08	F	02:10 - 02:10	(1)
2016-11-08	F	02:33 - 02:33	(1)

```
2016-11-08    F      03:18 - 03:19  (2)
2016-11-08    F      03:24 - 03:24  (1)
2016-11-08    F      03:34 - 03:34  (1)
2016-11-08    F      03:38 - 03:38  (1)
2016-11-08    F      21:29 - 21:29  (1)
2016-11-08    F      21:36 - 21:37  (2)
2016-11-08    F      21:49 - 21:51  (3)
2016-11-08    F      21:55 - 21:55  (1)
2016-11-08    F      22:41 - 22:42  (2)
2016-11-09    F      02:28 - 02:28  (1)
2016-11-09    F      02:47 - 02:47  (1)
2016-11-09    F      02:52 - 02:52  (1)
2016-11-09    F      20:56 - 20:56  (1)
2016-11-09    F      21:05 - 21:05  (1)
2016-11-09    F      21:22 - 21:22  (1)
2016-11-15    F      22:12 - 22:12  (1)
2016-11-15    F      22:26 - 22:26  (1)
2016-11-15    F      22:31 - 22:31  (1)
2016-11-15    F      22:40 - 22:40  (1)
2016-11-15    F      22:47 - 22:48  (2)
2016-11-28    F      23:49 - 23:49  (1)
2016-12-05    F      22:56 - 22:59  (4)
2016-12-10    F      01:01 - 01:07  (7)
2016-12-19    F      01:35 - 03:56  (142)
2016-12-20    F      05:25 - 05:43  (19)
2016-12-22    F      10:00 - 10:00  (1)
2016-12-26    F      02:24 - 02:28  (5)
2016-12-27    F      10:32 - 10:32  (1)
2016-12-28    F      15:32 - 15:40  (9)
2016-12-31    F      10:16 - 10:16  (1)

Total: 533 minutes

Appendix B. Backup data
-----------------------
see table 2

Appendix C MCQ (Narod) data used for infill of MQ2 (DMI)
variometer during 2016.
---------------------------------------------------------
Nil (as both variometers were contaminated)

                            < END >
```

7.8.2 Baseline values

7.8.2.1 2013

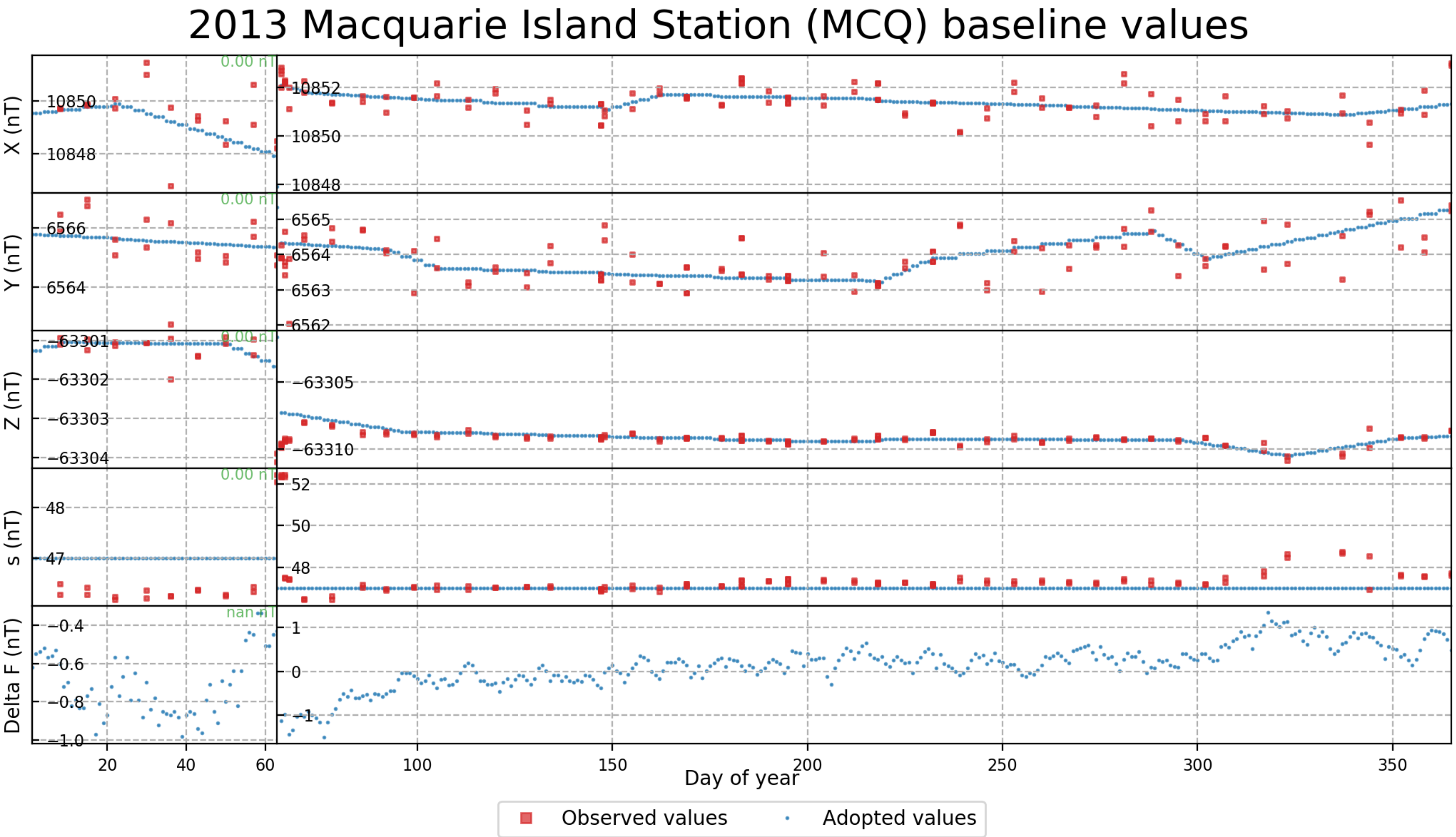

Figure 7.59 Macquarie Island Station (MCQ) baseline values for 2013. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.8.2.2 2014

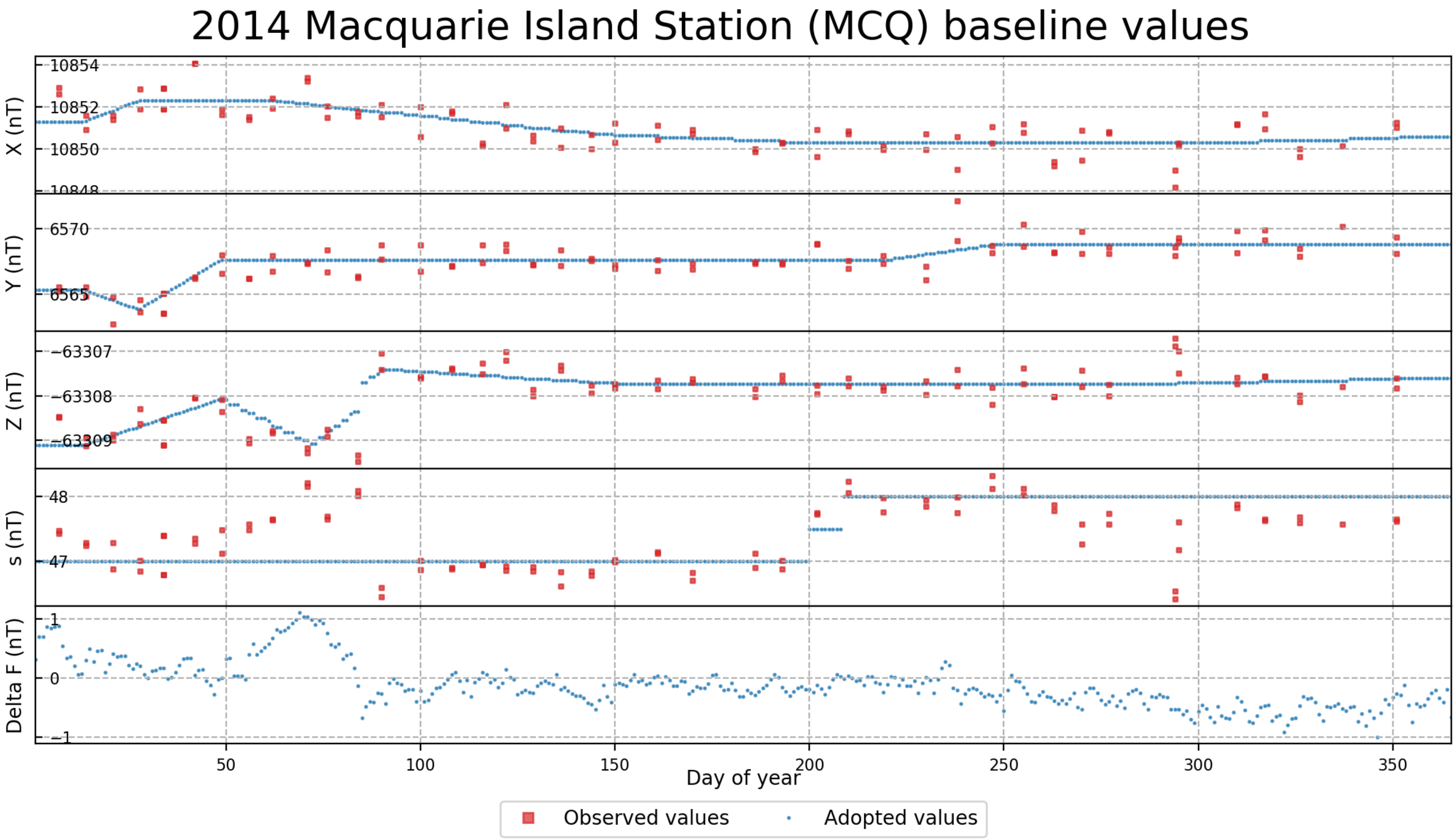

Figure 7.60 Macquarie Island Station (MCQ) baseline values for 2014. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.8.2.3 2015

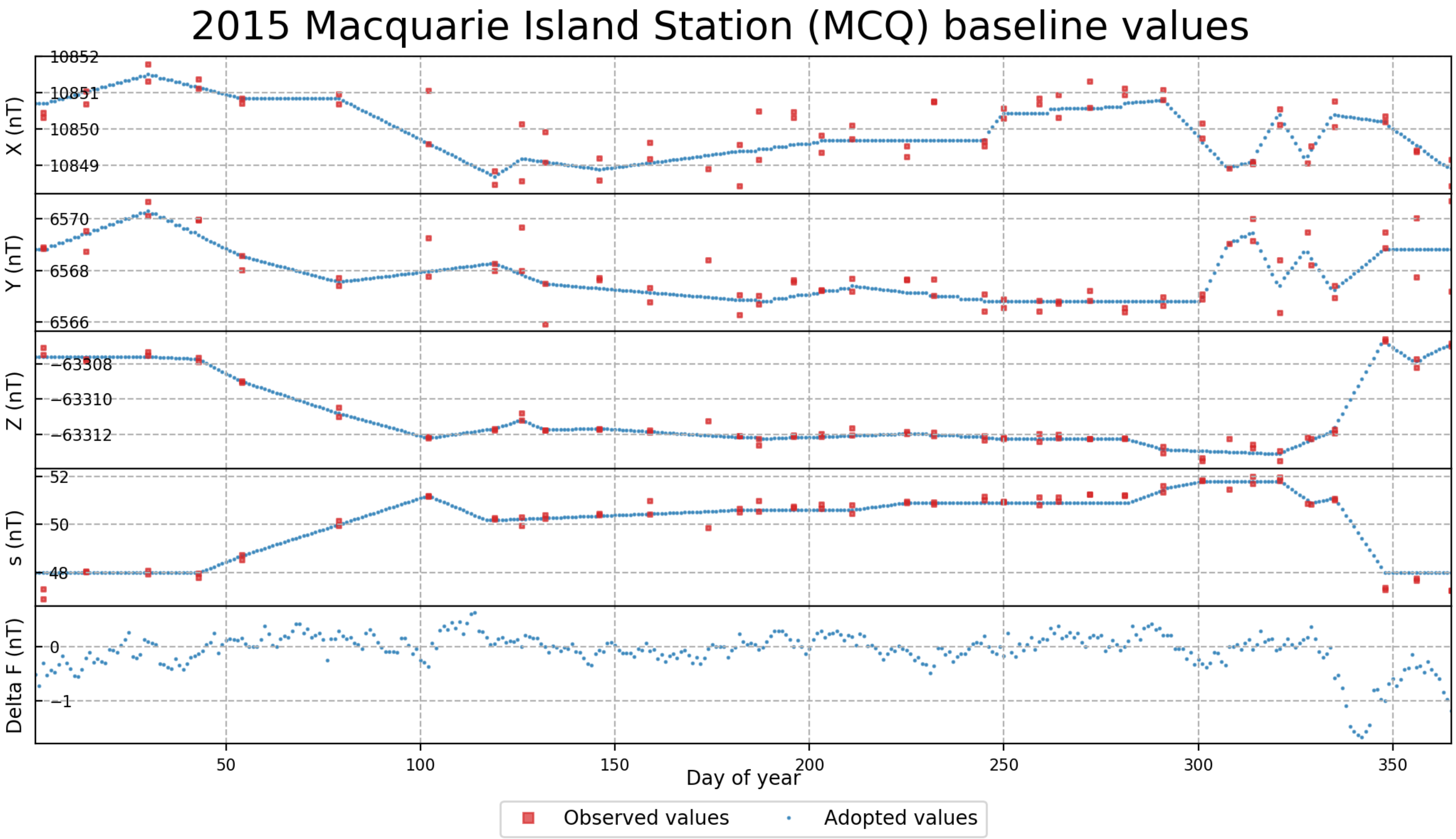

Figure 7.61 Macquarie Island Station (MCQ) baseline values for 2015. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.8.2.4 2016

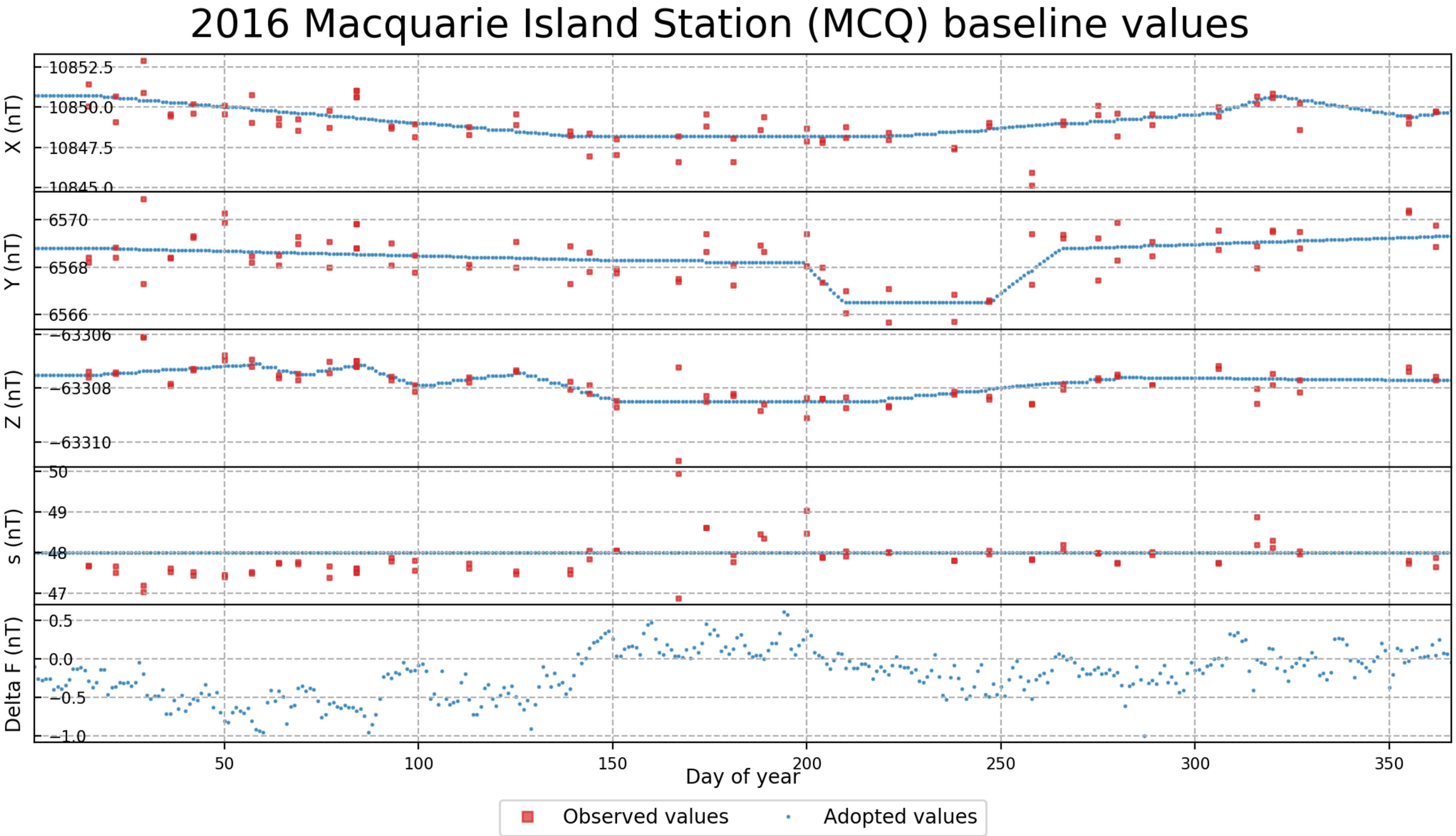

Figure 7.62 Macquarie Island Station (MCQ) baseline values for 2016. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.8.3 Annual mean values

7.8.3.1 DIH

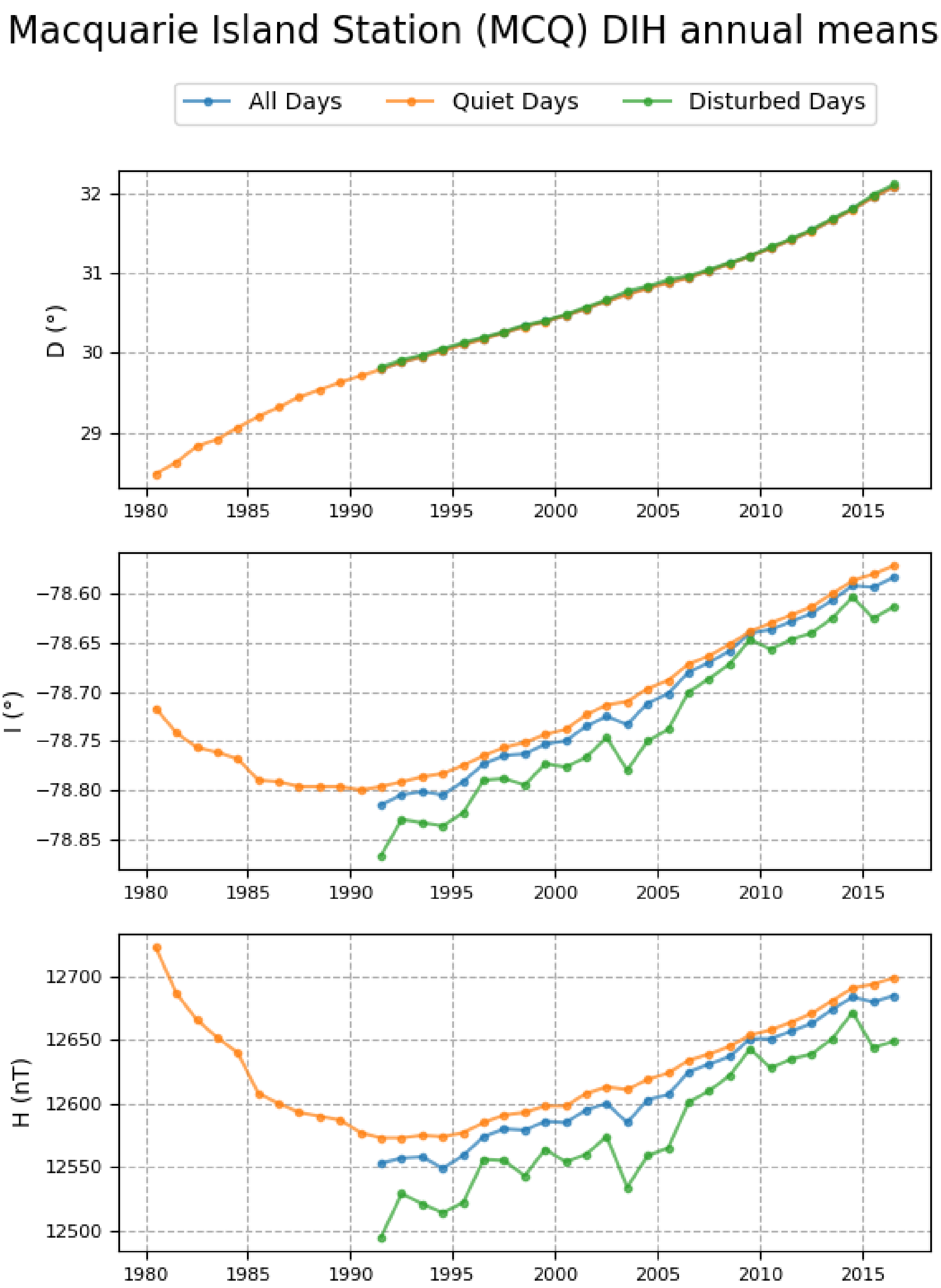

Figure 7.63 Macquarie Island Station (MCQ) annual mean values in DIH until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.8.3.2 XYZF

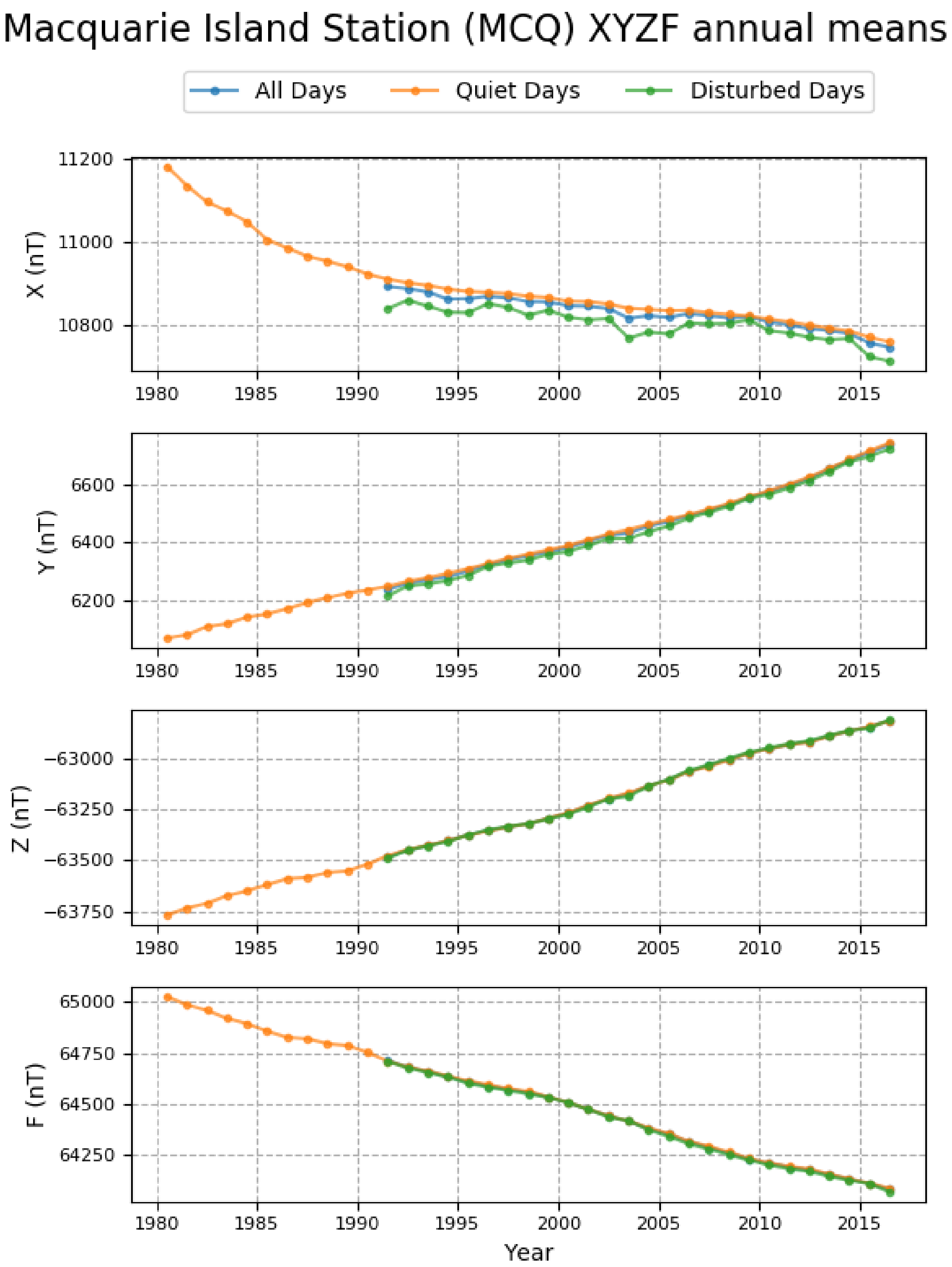

Figure 7.64 Macquarie Island Station (MCQ) annual mean values in XYZF until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.8.3.3 2016 INTERMAGNET annual mean values file

```
                           ANNUAL MEAN VALUES

                           MACQUARIE ISLAND, MCQ, ANTARCTICA

COLATITUDE: 144.50    LONGITUDE: 158.95 E    ELEVATION:   8 metres

  YEAR       D         I         H       X        Y       Z       F    * ELE Note
          Deg Min  Deg Min      nT      nT       nT      nT      nT

1991.500 029 47.7 -78 48.9  12553  10893   6237 -63482  64711 A  XYZ    3
1992.500 029 53.1 -78 48.3  12557  10888   6257 -63450  64681 A  XYZ
1993.500 029 57.2 -78 48.1  12558  10880   6270 -63428  64659 A  ABC
1994.500 030 02.2 -78 48.3  12549  10863   6281 -63404  64634 A  ABC
1995.500 030 06.6 -78 47.5  12559  10864   6300 -63376  64608 A  ABC
1996.500 030 11.0 -78 46.4  12574  10870   6322 -63353  64589 A  ABC
1997.500 030 15.4 -78 45.9  12580  10866   6339 -63336  64573 A  ABC
1998.500 030 20.0 -78 45.8  12579  10857   6353 -63320  64557 A  ABC
1999.500 030 23.6 -78 45.2  12586  10856   6367 -63294  64534 A  ABC
2000.500 030 28.4 -78 45.0  12585  10847   6382 -63268  64507 A  ABC
2001.500 030 33.5 -78 44.1  12595  10846   6404 -63231  64473 A  ABC
2002.500 030 39.1 -78 43.5  12600  10840   6424 -63198  64442 A  ABC
2003.500 030 44.5 -78 44.0  12585  10817   6433 -63174  64416 A  ABC
2004.500 030 49.1 -78 42.7  12603  10823   6456 -63134  64380 A  ABC
2005.500 030 53.3 -78 42.1  12607  10819   6472 -63104  64352 A  ABC
2006.500 030 57.0 -78 40.8  12625  10828   6493 -63063  64315 A  ABC
2007.500 031 01.9 -78 40.2  12631  10823   6511 -63035  64288 A  ABZ    4
2008.500 031 07.3 -78 39.5  12637  10818   6532 -63005  64260 A  ABZ
2009.500 031 12.9 -78 38.4  12651  10820   6556 -62973  64231 A  ABZ
2010.500 031 19.0 -78 38.2  12651  10808   6576 -62951  64210 A  ABZ
2011.500 031 25.2 -78 37.7  12657  10801   6598 -62932  64192 A  ABZ
2012.500 031 32.1 -78 37.2  12663  10792   6623 -62917  64178 A  ABZ
2013.500 031 40.1 -78 36.4  12674  10787   6654 -62890  64155 A  ABZ
2014.500 031 48.3 -78 35.5  12684  10780   6685 -62865  64132 A  ABZ
2015.500 031 57.6 -78 35.6  12680  10757   6712 -62844  64111 A  ABZ
2016.500 032  5.4 -78 35.0  12685  10747   6739 -62814  64082 A  ABZ

1980.500 028 28.8 -78 43.0  12723  11183   6067 -63768  65025 Q  HDZ    1
1981.500 028 37.5 -78 44.5  12687  11136   6078 -63735  64985 Q  HDZ
1982.500 028 49.5 -78 45.4  12666  11097   6107 -63711  64958 Q  HDZ
1983.500 028 54.9 -78 45.7  12652  11075   6117 -63674  64919 Q  HDZ
1984.500 029 03.7 -78 46.1  12640  11049   6140 -63650  64893 Q  HDZ    2
1985.500 029 12.0 -78 47.4  12608  11006   6151 -63619  64856 Q  XYZ
1986.500 029 19.0 -78 47.5  12600  10986   6169 -63590  64826 Q  XYZ
1987.500 029 26.8 -78 47.8  12593  10966   6191 -63584  64819 Q  XYZ
1988.500 029 32.2 -78 47.8  12590  10954   6207 -63560  64795 Q  XYZ
1989.500 029 37.8 -78 47.8  12587  10941   6223 -63552  64786 Q  XYZ
1990.500 029 42.8 -78 48.0  12577  10923   6234 -63519  64752 Q  XYZ
1991.500 029 47.5 -78 47.8  12573  10911   6247 -63477  64710 Q  XYZ    3
1992.500 029 53.0 -78 47.5  12573  10902   6264 -63447  64681 Q  XYZ
1993.500 029 56.9 -78 47.2  12575  10896   6277 -63427  64661 Q  ABC
1994.500 030 01.5 -78 47.0  12574  10887   6292 -63403  64637 Q  ABC
1995.500 030 06.2 -78 46.5  12577  10881   6308 -63377  64613 Q  ABC
1996.500 030 10.5 -78 45.9  12585  10879   6326 -63356  64594 Q  ABC
1997.500 030 15.2 -78 45.4  12591  10876   6344 -63336  64576 Q  ABC
1998.500 030 19.7 -78 45.1  12593  10870   6359 -63321  64562 Q  ABC
1999.500 030 23.5 -78 44.6  12598  10867   6373 -63293  64535 Q  ABC
2000.500 030 28.3 -78 44.3  12598  10858   6389 -63266  64508 Q  ABC
2001.500 030 33.3 -78 43.4  12608  10857   6409 -63229  64474 Q  ABC
2002.500 030 38.9 -78 42.8  12613  10851   6429 -63196  64442 Q  ABC
```

2003.500	030	43.7	-78	42.6	12611	10841	6444	-63170	64417	Q	ABC	
2004.500	030	48.6	-78	41.8	12619	10838	6463	-63134	64383	Q	ABC	
2005.500	030	52.7	-78	41.3	12624	10835	6479	-63106	64356	Q	ABC	
2006.500	030	56.6	-78	40.3	12634	10836	6496	-63064	64317	Q	ABC	
2007.500	031	01.8	-78	39.8	12639	10830	6515	-63038	64293	Q	ABZ	4
2008.500	031	07.1	-78	39.1	12645	10826	6535	-63008	64265	Q	ABZ	
2009.500	031	12.8	-78	38.3	12654	10822	6558	-62974	64233	Q	ABZ	
2010.500	031	18.7	-78	37.8	12658	10815	6579	-62952	64212	Q	ABZ	
2011.500	031	25.1	-78	37.3	12664	10808	6602	-62932	64194	Q	ABZ	
2012.500	031	32.0	-78	36.8	12671	10800	6627	-62920	64183	Q	ABZ	
2013.500	031	39.9	-78	36.0	12681	10793	6657	-62891	64157	Q	ABZ	
2014.500	031	48.0	-78	35.2	12691	10786	6688	-62865	64134	Q	ABZ	
2015.500	031	57.3	-78	34.8	12694	10771	6718	-62843	64112	Q	ABZ	
2016.500	032	4.9	-78	34.3	12699	10760	6745	-62816	64087	Q	ABZ	
1991.500	029	49.4	-78	52.0	12495	10840	6214	-63489	64708	D	XYZ	3
1992.500	029	54.7	-78	49.8	12529	10860	6248	-63451	64677	D	XYZ	
1993.500	029	58.5	-78	50.0	12521	10846	6256	-63429	64654	D	ABC	
1994.500	030	03.3	-78	50.2	12514	10831	6267	-63408	64632	D	ABC	
1995.500	030	07.8	-78	49.4	12522	10830	6285	-63376	64601	D	ABC	
1996.500	030	11.9	-78	47.4	12556	10852	6316	-63350	64583	D	ABC	
1997.500	030	16.0	-78	47.3	12555	10843	6328	-63334	64566	D	ABC	
1998.500	030	21.0	-78	47.7	12543	10824	6338	-63320	64550	D	ABC	
1999.500	030	24.3	-78	46.4	12564	10836	6358	-63297	64532	D	ABC	
2000.500	030	29.0	-78	46.6	12554	10819	6368	-63273	64507	D	ABC	
2001.500	030	34.6	-78	46.0	12560	10813	6389	-63238	64473	D	ABC	
2002.500	030	40.0	-78	44.8	12574	10816	6413	-63198	64437	D	ABC	
2003.500	030	46.6	-78	46.8	12534	10769	6413	-63186	64418	D	ABC	
2004.500	030	50.3	-78	45.0	12559	10783	6437	-63136	64374	D	ABC	
2005.500	030	55.2	-78	44.3	12565	10779	6456	-63102	64341	D	ABC	
2006.500	030	58.1	-78	42.0	12601	10805	6484	-63059	64305	D	ABC	
2007.500	031	02.9	-78	41.2	12610	10803	6504	-63031	64280	D	ABZ	4
2008.500	031	07.9	-78	40.3	12622	10804	6525	-62999	64251	D	ABZ	
2009.500	031	13.2	-78	38.8	12643	10813	6553	-62970	64226	D	ABZ	
2010.500	031	19.8	-78	39.4	12628	10787	6566	-62947	64201	D	ABZ	
2011.500	031	26.0	-78	38.8	12635	10781	6589	-62928	64184	D	ABZ	
2012.500	031	33.1	-78	38.4	12639	10771	6614	-62913	64170	D	ABZ	
2013.500	031	41.2	-78	37.5	12651	10765	6645	-62886	64146	D	ABZ	
2014.500	031	48.9	-78	36.2	12672	10768	6680	-62863	64127	D	ABZ	
2015.500	031	59.3	-78	37.5	12644	10724	6698	-62851	64110	D	ABZ	
2016.500	032	7.0	-78	36.8	12649	10713	6725	-62810	64071	D	ABZ	

* A = All days
* Q = 5 International Quiet days each month
* D = 5 International Disturbed days each month

ELE = Elements recorded

Notes:

1. Quiet day annual means from 1980 to 1991 are calculated using preliminary data.
   A LaCour variometer operated at MCQ from 1951 to September 1984

2. A PhotoElectronic Magnetometer (PEM) operated at MCQ from October 1984 to December 1991

3. A Narod Ring Core Fluxgate magnetometer operated as the primary variometer at MCQ from December 1991.to Dec 2006

4. A Danish Meteorological Institute suspended linear-core fluxgate

variometer operated as the primary variometer from January 2007

7.9 Mawson Station

7.9.1 INTERMAGNET 'readme' files

7.9.1.1 2013

```
                           MAW
             MAWSON OBSERVATORY INFORMATION 2013

  ACKNOWLEDGE- Users of the MAW data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: MAW
     LOCATION: Mawson Station, MacRobertson Land-Antarctica
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 157.60 Deg.
    LONGITUDE: 62.88  Deg. E
    ELEVATION: 12 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DMI on Zeiss 020B)
               and Proton Precession Magnetometer (GSM90)

    RECORDING
   VARIOMETER: Danish Meteorological Institute suspended
               fluxgate FGE Magnetometer
               GSM90 Proton Precession Magnetometer

  ORIENTATION: Two horizontal fluxgate channels are aligned
               equally about the average magnetic north at
               the time of installation.
               This orientation is referred to as ABZ.
DYNAMIC RANGE: +/-3200nT
   RESOLUTION: 0.3nT
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: Narod ringcore fluxgate (RCF) magnetometer

    K-NUMBERS: Computer-assisted scaling from preliminary
               Narod variometer data
     K9-LIMIT: 1500 nT

         GINS: Edinburgh
    SATELLITE: Http delivery.

    OBSERVERS: Darren Henderson
               Chris Stevenson
               Craig Hayhow

      CONTACT: Geomagnetism
               Geoscience Australia
               G.P.O. Box 378
               Canberra, A.C.T, 2601
               Australia

               Tel: + 61-2-6249-9111
```

Fax: + 61-2-6249-9986
e-mail: geomag@ga.gov.au
WWW: http://www.ga.gov.au

NOTES:

The magnetic observatory is part of the Mawson scientific research station in Mac Robertson Land, Antarctica. The station is on the edge of Horseshoe Harbour and built on bare charnockite basement rock - there is no ice or soil cover. The magnetic observatory comprises:
* the Variometer House, and;
* the Absolute House;

and is situated in a magnetic quiet zone at East Bay on the southeast extremity of the station.

In 1955 the Mawson observatory commenced recording magnetic variations with a 3-component analogue magnetograph. The observatory has continuously recorded the geomagnetic field at Mawson since that time. In December 1985 the magnetic observatory was converted to digital recording. It was accepted as an INTERMAGNET observatory at the start of 2006. It is operated by Geoscience Australia as part of the Australian National Antarctic Research Expeditions.

Table 10.1. Key observatory data.

```
--------------------------------
IAGA code:             MAW
Commenced operation:   1955
Geographic latitude:   67d 36' 14" S
Geographic longitude:  62d 52' 45" E
Geomagnetic latitude:  -73.05d
Geomagnetic longitude: 112.21d
K 9 index lower limit: 1500 nT
Principal pier:        Pier A
Pier elevation (top):  12 m AMSL
Principal reference mark: BMR89/1
Reference mark azimuth:   350d 36.9'
Reference mark distance:  112 m
Observers: D Henderson (- 2013-02-07)
           C Stevenson (- 2013-10-26)
           C Hayhow (- 2014-03-21)
```

Local meteorological conditions

The meteorological temperature at Mawson during 2013 varied from a minimum -32.9C (2013-08-02) to a maximum +4.7C (2013-11-11). Daily minimum temperatures varied from -32.9C to +1.0C (average -14+/-8C); daily maximum temperatures varied from -25.3C to +4.7C (average -8+/-7C); daily temperature ranges varied from 0C to 22C (average 6+/-3C).

The daily maximum wind gust varied from 19 to 194 km/h (average 83+/-30 km/h). The maximum daily maximum wind gust was 194 km/h in September. The minimum daily maximum wind gust was 19 km/h in May. Almost every day was windy due to either blizzard or katabatic conditions. There was from 0 to 17.2 (average 4.1+/-5.2) hours of sunshine per day according to the meteorological definition.

Variometers

The variometers used during 2013 are described in Table 10.2. The DMI sensor was located in the recording (eastern) room of the Variometer House. Two of the orthogonal sensors were horizontal and oriented so that they were each at an angle of 45d to the direction of the horizontal component of the magnetic field at the time of installation. The third sensor was aligned vertically. The Narod and total-field sensors were located within the sensor (western) room. Two of the Narod orthogonal sensors were horizontal and oriented so that they were each at an angle of 45d to the direction of the horizontal component of the magnetic field at the time of installation. The third sensor was aligned vertically. The Narod magnetometer produced eight samples per second that were Gaussian filtered and output as 1 second data on the second.

The NGL magnetometer was installed during a maintenance visit to Mawson in 2011 (2011-02-25 to 2011-02-28). A pulse inverter was installed between the Garmin GPS clock and the new NGL magnetometer, as the GPS produces the opposite polarity pulse to that required by the NGL.

The Overhauser magnetometer was configured for 10 second sampling.

During the 2011 maintenance visit, the DMI and NGL magnetometers were connected to independent QNX computers ga-maw-mag1 and ga-maw-mag2 respectively, each with its own battery box power and GPS clock, and sharing a screen and keyboard using a KVM switch. The GSM-90 variometer was connected to ga-maw-mag2 with the NGL magnetometer. GSM-90 data were recorded on both computers by linking it over the QNX qnet network from ga-maw-mag1 to ga-maw-mag2.

Sensor and the electronics temperatures of both fluxgate magnetometers were monitored by in-built dual temperature systems.

Temperature regulation during 2013, as in previous years, was not ideal. The heating system (a regulated heater in each sensor room) was inefficient and inadequate. Although there have been attempts to build a controlled heater for a small volume around each magnetometer sensor and each magnetometer electronics within a coarsely controlled low-temperature room environment for many of GA's observatories, there has been little progress.

The Narod sensor was more temperature stable than the Narod electronics, the DMI sensor and DMI electronics. The annual range in Narod sensor temperature (western room) was about 7C; the temperatures of the Narod electronics, DMI sensor and electronics (eastern room) were highly correlated and had a range of about 20C.

None of the equipment is well temperature-stabilised and this is probably a major factor in data quality. Temperature control of the variometers remains a priority in order to improve data quality.

The DMI variometer was used as the primary source of definitive 2013 Mawson data (with data gaps filled using Narod data where possible) delivered in 2014.

The DMI variometer was used as the primary source of quasi-definitive 2013 Mawson data delivered during 2013 and 2014.

The DMI variometer was used as the primary source of real-time 2013 Mawson data delivered during 2013.

The DMI variometer (with data gaps filled using Narod data where possible) was used as the primary source for 2013 Mawson K-indices.

No spike filtering was applied to the definitive DMI data.

Spike detection filters for Narod data required a spike to differ from the local linear trend by more than 10 times the deviation from trend during a period of 10's seconds after the data point. Almost all spike detections on the NGL data were an indication of range jumps in the variometer. It became apparent that the acquisition system was incorrectly filtering data around range jumps and inserting the spikes due to an apparent error in the Narod firmware (range jumps were indicated to occur in the second adjacent to when they actually occurred). This was not a significant problem but will require correcting in future. The NGL data were therefore spike filtered to correct the artificially generated spikes. Genuine spike detections occurred on 2013-04-02 during fire equipment testing, but these data were rejected in any case.

Experience from 2011 data processing indicated that a spike filter was not useful for the scalar data as it eliminated apparently valid data during daily auroral zone activity - no spike filter was applied to 2013 scalar data.

The DMI variometer performed satisfactorily during the year. However the QNX driver did stop several times during the year causing data losses. These were days of high winds/blizzards, and the problem appears to be caused in some way by static problems during blizzards.

The Narod variometer performed satisfactorily during the year. It did lose many samples (about 28-72 sporadically per day, average 45 per day) possibly due to data communication errors - whether this was a problem with the Narod or the computer is unknown.

The scalar GSM-90 variometer(s) performed satisfactorily throughout 2013.

Table 10.2. Magnetic variometers used in 2013. See Appendix C for a schematic of their configuration.

```
------------------------------------------------------------
3-component variometer: Narod (MAW)
Serial number:          NGL-200907-1 with BMR 9004-3
Type:                   ring-core fluxgate
Orientation:            NW, NE, Z
Acquisition interval:   1 s
Scale value:            0.01 nT / count
```

```
Period of use:            from 2011-02-26
3-component variometer: DMI FGE (MW2)
Serial number:            E0291 / S0244
Type:                     suspended linear-core fluxgate
Orientation:              NW, NE, Z
Acquisition interval:     1 s
A/D converter:            ADAM 4017 module (+/-10V)
Scale value:              0.32 nT / count
Period of use:            from 2006-05-17
Total-field variometer: GEM Systems GSM-90
Serial number:            8092902 / 83384
Type:                     Overhauser effect
Acquisition interval:     10 s
Resolution:               0.01 nT
Period of use:            from 2011-03-11
Data acquisition system:GDAP: PC-104 computer QNX6.3 OS (2)
Timing:                   Garmin GPS16 clock(2)
Communications:           ANARESAT

Variometer clock corrections
----------------------------
Time stamps applied to the variometer data were obtained
from the acquisition computer system clock. That clock was
synchronised to a GPS clock. During 2013, adjustments to the
system clock were less than 10 ms except on the following
occasions:

ga-maw-mag1 (DTU variometer)
----------------------------
2013-02-15 06:46:49 -0.170 s (after system reboot to fix
                             GdapClockGm program failure)
2013-02-25 00:05:04 +0.779 s (after system reboot to fix
                             GdapClockGm program failure)
2013-03-27 01:40:59 +0.511 s (after system reboot to fix
                             GdapClockGm program failure)
2013-09-14 07:13:08 +0.767 s (after accidental system
                             reboot to fix network problem)
(There were 32 corrections between 1 and 10ms. The rate of
the ga-maw-mag1 system clock was 15-20 x 10-6 s/s.)

ga-maw-mag2 (Narod, GSM90 variometers)
--------------------------------------
nil
(There were 0 corrections in excess 0f 0.1 ms. The rate of
the ga-maw-mag2 system clock was corrected to be mostly <1 x
10-6 s/s.)

Absolute instruments
--------------------
The principal absolute magnetometers used at Mawson and
their adopted corrections for 2013 are described in Table
10.3.

(DI0022/353758 was used until 2013-01-04. DI0132
(PIL7356)/313792 was sent to MAW 2011-12-14 and was used
from 2013-01-10.)

The DI0132/313792-derived sensor-orientation angles d and e
and the electronics offset T0 were stable through 2013.

The absolute GSM-90 appeared to perform well throughout
```

2013.

All absolute observations were performed on Pier A while the azimuth mark BMR89/1 was used as the declination reference.

Instrument corrections of zero have been adopted for all Mawson absolute instruments for 2013 as no new evidence about corrections was gathered. At the 2013 mean magnetic field values at Mawson these D, I and F corrections translate to corrections of:

DX = 0.0 nT   DY = 0.0 nT   DZ = 0.0 nT

Instrument corrections were applied while reducing absolute observations to determine baselines and, accordingly, these corrections have been applied to all Mawson 2013 final data.

Table 10.3. Absolute magnetometers and their adopted corrections for 2013. Corrections are applied in the sense Standard = Instrument + correction.

DI fluxgate:	DMI
Serial number:	DI0022
Theodolite:	Zeiss 020B
Serial number:	353758
Resolution:	0.1'
D correction:	0.0'
I correction:	0.0'
DI fluxgate:	DMI
Serial number:	DI0132
Theodolite:	Zeiss 020B
Serial number:	313792
Resolution:	0.1'
D correction:	0.0'
I correction:	0.0'
Total-field magnetometer:	GEM Systems GSM-90
Serial number:	4081417 / 42187
Type:	Overhauser effect
Resolution:	0.01 nT
Correction:	0.0 nT

Baselines

Baselines were adopted manually using a linear spline fit to baseline residuals for the Narod and DMI variometers.

The standard deviations of the differences between the adopted variometer model and data using DMI variometer (used for definitive data) and the absolute observations were:

X 0.6 nT
Y 0.5 nT
Z 0.5 nT
D 7"
I 3"
F 0.4 nT
(Using 95 observations as pairs of weekly observations.)

Observed and adopted baseline values in X, Y and Z are shown in Figure 10.1.

For comparison, the standard deviations between the adopted variometer model and data using Narod variometer, and the absolute observations, were:

X 0.8 nT
Y 0.9 nT
Z 0.5 nT
D 9"
I 4"
F 0.4 nT
(Using the same observations as used for DMI reductions.)

There were some differences between the absolute and variometer GSM-90s throughout the year. At least one was related to fire extinguisher maintenance.

Variometer comparison

The 2013 definitive Mawson data (DMI variometer) were compared to the Narod variometer data. Both DMI and Narod data sets were aligned using the same methodology using the one set of absolute observations.

The annual statistics of the 522921 available minute-differences of the two data sets (DMI - Narod) were:

	X	Y	Z
Average	-0.2	-0.2	+0.1
Std.dev	+0.8	+1.1	+0.4
Min	-7.3	-7.8	-16.3
Max	+15.7	+9.4	+8.6

The annual statistics of the 365 daily averages of the difference between the two 1-minute data sets (DMI - Narod) were:

	X	Y	Z
Average	-0.2	-0.2	+0.1
Std.dev	+0.7	+1.1	+0.4
Min	-2.4	-3.8	-0.9
Max	+2.0	+2.4	+0.9

The annual statistics of the 12 monthly averages of the difference between the two 1-minute data sets (DMI - Narod) were:

	X	Y	Z
Average	-0.2	-0.2	+0.1
Std.dev	+0.4	+0.5	+0.3
Min	-1.0	-1.1	-0.5
Max	+0.3	+0.6	+0.4

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2013 MAW definitive data and real time reported 1-minute data sets (MAW definitive - MAW real time) were:

	X	Y	Z
Average	-0.0	+0.0	+0.0

	X	Y	Z
Std.dev	+0.8	+0.5	+1.1
Min	-1.1	-0.5	-1.2
Max	+1.8	+0.8	+1.8

The MAW 2013 reported real time data are within the specification for INTERMAGNET Quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2013 MAW definitive data and quasi-definitive 1-minute data sets (MAW definitive - MAW quasi-definitive) were:

	X	Y	Z
Average	-0.4	-0.0	+0.1
Std.dev	+0.4	+0.5	+0.4
Min	-1.1	-0.6	-0.6
Max	-0.1	+0.8	+0.6

The MAW 2013 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The Mawson observer was a member of the Australian National Antarctic Research Expedition and was employed by the Australian Antarctic Division with funding support by Geoscience Australia. Mawson personnel change over each summer with varying periods of overlap. Darren Henderson, who operated the observatory for most of 2012, handed over observatory responsibilities to Chris Stevenson in February 2013, and he handed over to Craig Hayhow in October 2013.

The observer was responsible for the continuous operation of the observatory and performed equipment maintenance and installation as required. In 2013 the observers performed absolute observations weekly and forwarded them by email to Geoscience Australia. During the observations the variometer system was also checked. All data processing was performed at Geoscience Australia.

During 2013 data were recorded on two QNX acquisition computers which were connected to the station's radio network hub. Data were retrieved to Geoscience Australia using rsync over ssh every 6 minutes. (Data from the alternate variometer system were also retrieved every 6 minutes, interleaved with the primary variometer.)

Real-time data were processed automatically at Geoscience Australia then distributed, usually within a 2 to 15 minute delay.

Daily data plots were examined at Geoscience Australia for possible problems which were usually rectified quickly by the local observer. The final data for the year were reduced and analysed by Geoscience Australia staff.

For 2013 Definitive data, the INTERMAGNET filter was applied to convert 1 second vector data to 1 minute data. An INTERMAGNET filter was also applied to scalar data.

```
The distribution of Mawson 2013 data is described in Table
10.4. Data losses are identified in Table A.8.
----------------------------------------------------------

Table 10.4. Distribution of Mawson 2013 data.
--------------------------------------------
Recipient                    Status              Sent

1-second values
IPS Radio and Space Services preliminary         real time
INTERMAGNET                  preliminary         real time

1-minute values
INTERMAGNET                  preliminary         real time
INTERMAGNET                  preliminary         daily
INTERMAGNET                  quasi-definitive    monthly
                             (irregular during2013/14)
INTERMAGNET                  definitive          July 2014
WDC for Geomagnetism Kyoto   preliminary         real time

Significant events
------------------
2013-02-11 From Mawson/AAD
           Mawson Station has been experiencing a power
           since roughly Feb 11 8am GMT.
           Services will be restored as soon as possible.
           Regards Matthew Longmire
2013-02-14 GPS Clock / GdapClock in RESET mode from
           2013-02-14T23:30.
           Reboot at 2013-02-15T06:43:30
           15/02/13 06:44:18 -MachR I 0 Started
           15/02/13 06:46:49 -CLK I 0 Correction 1360910809
           852795099 C 0 s -170220591 R 0 s 17553
           15/02/13 06:47:31 -CLK I 0 Correction 1360910851
           852701355 C 0 s 22637 R 0 s 17666
2013-02-25 ga-maw-mag1/DTU GdapClock not working.
           22/02/13 14:30:01 - CLK W 0 Lost contact with
           Gm16 RESET
           Clock talking OK (qtalk) but restarting program
           didn't work. Reboot at 23:57.
           24/02/13 23:58:08 - CLK I 0 Power Up 2269583
           GdapClock still not working - wrong, eventually
           it did, but took a good 5 minutes.
           25/02/13 00:05:04 -CLK I 0 Correction 1361750704
           800873785 C 0 s  778741821 R 0 s      17679
           25/02/13 00:05:46 - CLK I 0 Correction 1361750746
           801784845 C 0 s      19266 R 0 s      17784
           Note that GM clock is Ver 2.3 (very old firmware
           needs replacement) - ACTION 2014
2013-03-01 ~06:00 interference to variometer
2013-03-04 Chippy working in mag huts - could not see
           interference
2013-03-06 Chris Stevenson taking photographs in mag huts
           - some interference
2013-03-24 DTU data stopped - slay/restarted GdapAdam and
           all was well
2013-03-26 Clock program failed RESET from 13:10
2013-03-27 Reboot at 01:35 to try and fix clock.
           Possibly not required.
           In future wait at least a few minutes after
```

```
            restarting program before reboot.
            27/03/13 01:40:59 -CLK I 0 Correction 1364348459
            530306555 C 0 s 510808782 R 0 s 16805
            27/03/13 01:41:41 -CLK I 0 Correction 1364348501
            531182685 C 0 s 16361 R 0 s 16903
2013-04-02 Fire extinguisher testing 09:-10: seems to have
            displaced F baseline mostly by a bit.
2013-04-26 GdapAdam / DTU failed at MAW 2013-04-26 ~17:,
            restarted 2013-04-27 ~00:22.
2013-04-27 Stopped again shortly after being restarted.
            Restarted GdapAdam about 05:22
2013-07-22 GdapAdam / DTU failed at MAW 2013-07-22 ~01:30:,
            restarted 2013-07-22 ~02:14. Failed again
            2013-07-22T04:35:29  restarted 2013-07-22 ~22:54
2013-09-09 Tested Pico ADC16 FJY06/139 + Fluxgate Model G
            cable + DB25M flying lead for MAW
            Put in mail this day to Peter Yates/Channel Hwy.
2013-09-14 Communications restored to MAW variometers - a
            local network problem at MAW.
            Accidental reboot of ga-maw-mag1 (DTU data)
2013-10-01 Testing Mag Building fire alarms at 11.10 UTC
            (1615 local 1/10/13) with ferrous 2.5mm Allen
            key for 3-4 minutes
2013-10-28 Possibly Chris' last observations 2013-299.
            Chris is about to depart MAW leaving Craig
            Hayhow to do the job. Chris has been training
            Craig. Craig_hay@aad.gov.au
2013-11-05 Craig's first observations. ~0.3' scatter in D,
            otherwise very good.
2013-12-05 04:08  - contamination caused by electrical
            checks in variometer hut

Table A.10. Mawson data losses.
------------------------------
Date       Interval(hh:mm) Data loss (minutes)

Vector data
2013-03-01 05:56-06:12     17
2013-03-06 11:04-11:12     9
2013-04-02 09:01-09:39     39
2013-09-14 06:31-07:15     45
2013-11-15 08:48-09:31     44
2013-12-05 04:10-04:13     4

Scalar data
2013-03-01 05:56-06:12     17
2013-03-06 11:04-11:12     9
2013-04-02 09:01-09:39     39
2013-04-26 18:23-18:23     1
2013-08-30 05:58-06:01     4
2013-09-14 06:31-07:15     45
2013-11-15 08:48-09:31     44
2013-12-05 04:10-04:13     4

Table A.12. Summary of 2013 data losses from Australian
observatories.
-------------------------------------------------------
Observatory Vector        Scalar
            (minutes) (%) (minutes) (%)
Mawson      158      0.03 163      0.03
```

```
Appendix B. Backup data
-----------------------
Table B.3. Mawson MAW (Narod) vector variometer data used
for infill of MW2 (DMI) vector variometer during 2013.
---------------------------------------------------------
Date     Interval (hh:mm)<!>Data infilled(minutes)<!>
2013-02-15 06:44-06:44 1
2013-02-24 23:58-23:58 1
2013-03-24 10:36-22:59 744
2013-03-27 01:36-01:36 1
2013-04-26 17:33
2013-04-27      -00:22 410
2013-04-27 00:53-05:19 267
2013-07-22 01:31-02:13 43
2013-07-22 04:36-22:53 1098

Appendix C. Variometer configurations
-------------------------------------

Staff
-----
Table 4. Observatory-based staff.
--------------------------------
Name Organisation/Company Observatory Period
Darren Henderson AAD Mawson to 2013-02-07
Chris Stevenson  AAD Mawson to 2013-10-26
Craig Hayhow     AAD Mawson to 2014-03-21

                    <END>
```

7.9.1.2 2014

```
                            MAW
            MAWSON OBSERVATORY INFORMATION 2014

  ACKNOWLEDGE- Users of the MAW data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: MAW
     LOCATION: Mawson Station, MacRobertson Land-Antarctica
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 157.60 Deg.
    LONGITUDE: 62.88  Deg. E
    ELEVATION: 12 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DMI on Zeiss 020B)
               and Proton Precession Magnetometer (GSM90)

    RECORDING
   VARIOMETER: Danish Meteorological Institute suspended
               fluxgate FGE Magnetometer
               GSM90 Proton Precession Magnetometer

  ORIENTATION: Two horizontal fluxgate channels are aligned
               equally about the average magnetic north at
               the time of installation.
               This orientation is referred to as ABZ.
DYNAMIC RANGE: +/-3200nT
   RESOLUTION: 0.3nT
```

```
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: Narod ringcore fluxgate (RCF) magnetometer

    K-NUMBERS: Computer-assisted scaling from preliminary
               Narod variometer data
     K9-LIMIT: 1500 nT

         GINS: Edinburgh
    SATELLITE: Http delivery.

    OBSERVERS: Craig Hayhow
               Garry Beavan

      CONTACT: Geomagnetism
               Geoscience Australia
               G.P.O. Box 378
               Canberra, A.C.T, 2601
               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9986
               e-mail: geomag@ga.gov.au
               WWW: http://www.ga.gov.au

Notes
-----

The magnetic observatory is part of the Mawson scientific
research station in Mac Robertson Land, Antarctica. The
station is on the edge of Horseshoe Harbour and built on
bare charnockite basement rock - there is no ice or soil
cover. The magnetic observatory is situated in a magnetic
quiet zone at East Bay on the southeast extremity of the
station and comprises:
* the Variometer House:
      East room - DMI sensor and electronics, and GEM
                  GSM90 electronics
      West room - Narod sensor and electronics and GEM
                  GSM90 sensor
      Centre room - acquisition PC's and electrical wooden
                  cabinet.

* the Absolute House;

In 1955 the Mawson observatory commenced recording magnetic
variations with a 3-component analogue magnetograph. The
observatory has continuously recorded the geomagnetic field
at Mawson since that time. In December 1985 the magnetic
observatory was converted to digital recording. It was
accepted as an INTERMAGNET observatory in 2006.
It is operated by Geoscience Australia as part of the
Australian National Antarctic Research Expeditions.

Table 1. Key observatory data
--------------------------------
IAGA code:             MAW
Commenced operation:   1955
Geographic latitude:   67d 36' 14" S
```

Geographic longitude: 62d 52' 45" E
Geomagnetic latitude: -73.05d
Geomagnetic longitude: 112.21d
K 9 index lower limit: 1500 nT
Principal pier: Pier A
Pier elevation (top): 12 m AMSL
Principal reference mark: BMR89/1
Reference mark azimuth: 350d 36.9'
Reference mark distance: 112 m
Observers: C Hayhow (to 2014-03-21)
           G Beavan (from 2014-03-27)

Local meteorological conditions

The meteorological temperature at Mawson during 2014 varied from a minimum -30.2 C (2014-06-12) to a maximum +8.3 C (2014-01-09). Daily minimum temperatures varied from -30.2 C to +2.0 C (average -14+/-8 C); daily maximum temperatures varied from -25.1 C to +8.3 C (average -8+/-8 C).

The daily maximum wind gust varied from 17 to 183 km/h (average 81+/-28 km/h). The maximum daily maximum wind gust was 183 km/h in May and June. The minimum daily maximum wind gust was 17 km/h in January and November. Almost every day was windy due to either blizzard or katabatic conditions.

Variometers

The variometers used during 2014 are described in Table 2. The DMI sensor was located in the recording (eastern) room of the Variometer House. Two of the orthogonal sensors were horizontal and oriented at an angle of 45d to the direction of the horizontal component of the magnetic field at the time of installation. The third sensor was aligned vertically. The Narod and total-field sensors were located within the sensor (western) room. The two horizontal Narod sensors were oriented so that they were each at an angle of 45d to the direction of the horizontal component of the magnetic field at the time of installation. The third sensor was aligned vertically. The Narod magnetometer produced eight samples per second that were Gaussian filtered to 1 second data and then output on the second

The Narod magnetometer was installed during a maintenance visit to Mawson in 2011 (2011-02-25 to 2011-02-28). A pulse inverter was installed between the Garmin GPS clock and the new Narod magnetometer, as the GPS produces the opposite polarity pulse to that required by the Narod.

The Overhauser magnetometer was configured for 10 second sampling.

During the 2011 maintenance visit, the DMI and Narod magnetometers were connected to two separate QNX/ARK 3360 industrial computers: ga-maw-mag1 and ga-maw-mag2 respectively, each with its own battery box power and GPS clock, and sharing a screen and keyboard using a KVM switch. The GSM90 variometer was connected to ga-maw-mag2 with the Narod magnetometer. GSM90 data were recorded on both computers by linking it over the QNX qnet network from ga-maw-mag1 to ga-maw-mag2.

Sensor and electronics temperatures of both fluxgate magnetometers were monitored by in-built dual temperature systems.

Temperature regulation during 2014, as in previous years, was not ideal. The heating system (a regulated heater in each sensor room) was inefficient and inadequate. Although there have been attempts to build a controlled heater for a small volume around each magnetometer sensor and each magnetometer electronics within a coarsely controlled low-temperature room environment for many of GA's observatories, there has been little progress and a new approach to solve the problem is currently under development.

The Narod sensor was more temperature stable than the Narod electronics, the DMI sensor and DMI electronics. The annual range in Narod sensor temperature (west room) was about 8 C ranging from 7.2 C to 15.3 C; the temperatures of the Narod electronics, DMI sensor and electronics (east room) were highly correlated and had a range of about 20 C.

None of the equipment is well temperature stabilised and this is probably a factor in data quality. Temperature control of the variometers remains a priority in order to improve data quality.

The DMI variometer (referred as MW2 system on table 2.) was used as the primary source for:

1. definitive 2014 Mawson data (with data gaps filled using Narod data where possible) delivered in 2015.

2. quasi-definitive 2014 Mawson data delivered during 2014 and 2015.

3. real-time 2014 Mawson data delivered during 2014.

4. Mawson K-indices 2014.

DMI vector variometer 1-second data required de-spiking. Despiking was done in raw data. A spike detection in the raw data required a value to deviate from the local linear trend by 5 times the maximum of 4 digitiser counts, or 8/9 fractile of deviations during the following minute or so.

The scalar variometer data were also despiked and a spike detection required a value to deviate from the local linear trend by 10 times the maximum of 0.1 nT, or 8/9 fractile of deviations during the following minute or so.

Both DMI and Narod variometers performed satisfactorily during the year. The QNX stopped a few times during the year causing data losses. Acquisition PCs and QNX operating system were upgraded to ARK3360F and QNX6.5 on 2014-07-25 and the system has been working all well since then.

The scalar GSM90 variometer(s) performed satisfactorily throughout 2014.

```
Table 2. Magnetic variometers used in 2014.
-----------------------------------------------------------
3-component variometer: Narod (MAW)
Serial number:          NGL-200907-1 with BMR 9004-3
Type:                   ring-core fluxgate
Orientation:            NW, NE, Z
Acquisition interval:   1 s
Scale value:            0.01 nT / count
Period of use:          from 2011-02-26
3-component variometer: DMI FGE (MW2)
Serial number:          E0291 / S0244
Type:                   suspended linear-core fluxgate
Orientation:            NW, NE, Z
Acquisition interval:   1 s
A/D converter:          ADAM 4017 module (+/-10V)
Scale value:            0.32 nT / count
Period of use:          from 2006-05-17
Total-field variometer: GEM Systems GSM90
Serial number:          8092902 / 83384
Type:                   Overhauser effect
Acquisition interval:   10 s
Resolution:             0.01 nT
Period of use:          from 2011-03-11
Data acquisition system:GDAP: PC-104 computer QNX6.3 OS (2)
Timing:                 Garmin GPS16 clock(2)
Communications:         ANARESAT
```

```
Variometer clock corrections (later)
----------------------------
```

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2014, adjustments to the system clock were less than 10 ms except on the following occasions:

```
ga-maw-mag1 (DMI variometer)
----------------------------
2014-01-03      08:44:16     0.001 s
2014-01-06      08:32:33     0.002 s
2014-01-16      23:27:04    -0.162 s
2014-01-19      13:43:05     0.002 s
2014-01-22      04:33:21     0.001 s
2014-01-23      00:01:23    -0.002 s
                15:14:05    -0.002 s
2014-01-25      10:33:11    -0.001 s
2014-01-27      22:37:04     0.004 s
2014-02-05      14:25:17    -0.001 s
2014-02-07      22:21:23    -0.002 s
2014-02-20      06:09:22     0.265 s
2014-02-27      20:23:23     0.001 s
2014-03-02      08:01:22    -0.002 s
2014-03-06      20:13:52     0.002 s
2014-03-14      01:08:07     0.026 s
2014-03-21      21:04:17    -0.001 s
2014-03-24      04:02:28     0.034 s
2014-03-26      01:09:33     0.005 s
```

```
2014-04-02      03:31:31    -0.001 s
                20:02:08     0.001 s
2014-04-07      05:11:26     0.001 s
                17:34:46    -0.001 s
2014-04-09      02:11:56     0.001 s
2014-04-14      05:46:35     0.017 s
2014-04-19      01:18:57     0.001 s
2014-05-31      22:27:08     0.001 s
2014-06-10      00:08:34    -0.003 s
2014-06-13      18:51:52     0.001 s
2014-06-15      12:41:05     0.001 s
2014-06-18      02:33:14     0.001 s
2014-06-19      18:31:53    -0.001 s
2014-06-25      19:53:30     0.001 s
2014-07-01      01:11:34     0.004 s
2014-07-02      20:45:18     0.001 s
2014-07-09      17:11:34     0.002 s
2014-07-22      19:06:06     0.001 s
2014-07-24      09:48:08   -32.496 s (PC swapped)
                10:00:43    -0.002 s
2014-07-29      06:14:55     1.561 s
2014-12-07      12:02:40     1.000 s
                12:03:40    -1.000 s

ga-maw-mag2 (Narod, GSM90 variometers)
--------------------------------------
2014-02-20      05:53:47    -0.044 s
2014-07-24      10:16:37    -9.983 s (PC swapped)
2014-07-25      08:55:31     0.521 s
                10:20:01 -335817392.696 s (error)
```

Absolute instruments

The principal absolute magnetometers used at Mawson and their adopted corrections for 2014 are described in Table 3.

The DI0132/313792-derived sensor-orientation angles and the electronics offset were stable through 2014.

The absolute GSM90 appeared to perform well throughout 2014.

All absolute observations were performed on Pier A while the azimuth mark BMR89/1 was used as the declination reference.

Instrument corrections of zero have been adopted for all Mawson absolute instruments for 2014 as no new evidence about corrections was gathered. At the 2014 mean magnetic field values at Mawson these D, I and F corrections translate to corrections of:

DX = 0.0 nT   DY = 0.0 nT   DZ = 0.0 nT

Instrument corrections were applied while reducing absolute observations to determine baselines and, accordingly, these corrections have been applied to all Mawson 2014 final data.

Table 3. Absolute magnetometers and their adopted
corrections for 2014. Corrections are applied in the sense
Standard = Instrument + correction.

```
DI fluxgate:   DMI
Serial number: DI0132
Theodolite:    Zeiss 020B
Serial number: 313792
Resolution:    0.1'
D correction:  0.0'
I correction:  0.0'
Total-field magnetometer: GEM Systems GSM90
Serial number: 4081417 / 42187
Type:          Overhauser effect
Resolution:    0.01 nT
Correction:    0.0 nT
```

Baselines

There were 45 pairs of weekly absolute observations during 2014. Poor quality absolute data on the following days were ignored:
2014-04-05 (two sets)
2015-04-11 (one set)
2014-04-19 (one set)
2014-05-08 (one set)
2014-08-30 (one set)
2014-10-24 (one set).

Baseline variations can be divided into two periods: from 2014-01-01 to 2014-07-16, and from 2014-08-07 to 2014-12-31 The offsets of the baselines between the two periods are about 7 nT in X and Y, 3 nT in Z. The baseline offsets were caused by the replacement of the two acquisition computers, and removal of some old equipment in the centre room of variometer house on 2014-07-24.

From 2014-01-01 to 2014-07-16, the adopted baselines had a range of 6 nT in X and Y, 4 nT in Z; from 2014-08-07 to 2014-12-31 the adopted baselines had a range of 5 in X and Y, and 4 nT in Z.

From 2014-07-17 to 2014-08-06 (approximately 3 weeks), there is no absolute observation data, thus drifts of XYZ were set to zero. The baseline jump on 2014-07-24 (+7.3, +7.0 and +2.5 nT in XYZ respectively) was determined by later absolute observations and also Fv-Fs.

Baselines were adopted by manual fitting of a piecewise linear spline function (with steps where required) to absolute observation residuals.

The standard deviations of the differences between the adopted variometer model and data using the DMI variometer (used for definitive data) and the absolute observations were:

X 1.2 nT
Y 1.1 nT

Z 0.6 nT
D 15"
I 4"
F 0.6 nT
(Using 83 observations as pairs of weekly observations.)

Fv-Fs variations were within a 4.0 nT range and agreed with the F-difference variation trend in 2014. F-difference is the absolute F measured on pier A during weekly observations minus Fs.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2014 MAW definitive data and real time reported 1-minute data sets (MW2 definitive - MW2 real time) were:

All months

	X	Y	Z
Average	+0.6	+1.1	+0.8
Std.dev	+2.7	+2.3	+1.6
Min	-1.4	-1.1	-2.1
Max	+8.2	+7.1	+2.8

The large ranges in XY are due to baseline jumps on 2014-07-25. The baseline jumps were corrected two weeks later when absolute observation data were processed.

Excluding Jul and Aug

	X	Y	Z
Average	-0.1	+0.4	+0.6
Std.dev	+1.3	+1.3	+1.7
Min	-1.4	-1.1	-2.1
Max	+3.0	+2.6	+2.8

The MAW 2014 reported real time data are within the specification for INTERMAGNET Quasi-definitive data excluding Jul and Aug. This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2014 MAW definitive data and quasi-definitive 1-minute data sets (MW2 definitive - MW2 quasi-definitive) were:

	X	Y	Z
Average	-0.3	+0.1	+0.5
Std.dev	+0.6	+0.6	+1.0
Min	-1.5	-0.7	-0.9
Max	+0.5	+1.2	+2.5

The MAW 2014 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The Mawson observer was a member of the Australian National Antarctic Research Expedition and was employed by the Australian Antarctic Division with funding support by Geoscience Australia. Mawson personnel change over each

summer with varying periods of overlap. Darren Henderson, who operated the observatory till 2014-03-21, handed over observatory responsibilities to Garry Beavan.

The observer was responsible for the continuous operation of the observatory and performed equipment maintenance and installation as required. In 2014 the observers performed absolute observations weekly and forwarded them by email to Geoscience Australia. During observations the variometer system was also checked. All data processing was performed at Geoscience Australia.

During 2014 data were recorded on two QNX acquisition computers which were connected to the station's radio network hub. Data were retrieved to Geoscience Australia using rsync over ssh every 6 minutes. (Data from the alternate variometer system were also retrieved every 6 minutes, interleaved with the primary variometer.)
On 2014-07-24 the acquisition computers were upgraded to ARK3360F QNX6.5.

Real-time data were processed automatically at Geoscience Australia then distributed, usually within a 2 to 15 minute delay.

Daily data plots were examined at Geoscience Australia for possible problems which were usually rectified quickly by the local observer. The final data for the year were reduced and analysed by Geoscience Australia staff.

For 2014 Definitive data, the INTERMAGNET filter was applied to convert 1 second vector data to 1 minute data. An INTERMAGNET filter was also applied to scalar data.

The distribution of Mawson 2014 data is described in Table 4. Data losses are identified in Table A.8.

Table 4. Distribution of Mawson 2014 data.

Recipient	Status	Sent
1-second values		
IPS Radio and Space Services	preliminary	real time
INTERMAGNET	preliminary	real time
WDC for Geomagnetism Kyoto	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	quasi-definitive	monthly
INTERMAGNET	definitive	July 2014
WDC for Geomagnetism Kyoto	preliminary	real time

Significant events

```
2014-01-27 restarted GdapClock ga-maw-mag1 (DTU data)
2014-02-13 ga-maw-mag1 (DTU data) GdapClock failed
           Could talk to GPS Clock even using qtalk
           Stopped clock program 2014-02-14 ~02:00 and
           clock drifted (natural rate ~ 19230)
```

```
         ga-maw-mag1 GdapAdjustClockRate 838067101 19230
2014-02-17 ga-maw-mag1 # ntpdate  147.66.40.1
         17 Feb 02:36:59 ntpdate[980971550]: adjust time
         server 147.66.40.1 offset -0.016934 sec
2014-02-18 ga-maw-mag1 # ntpdate -q 147.66.40.1
         server 147.66.40.1, stratum 2, offset -0.012271,
         delay 0.03259
         18 Feb 01:11:48 ntpdate[987226140]: adjust time
         server 147.66.40.1 offset -0.012271 sec
         ga-maw-mag1 # ntpdate  147.66.40.1
         18 Feb 01:12:00 ntpdate[987234332]: adjust time
         server 147.66.40.1 offset -0.012317 sec
         ga-maw-mag1 # ntpdate -q 147.66.40.1
         server 147.66.40.1, stratum 2, offset 0.005573,
         delay 0.03159
         18 Feb 01:12:06 ntpdate[987242524]: adjust time
         server 147.66.40.1 offset 0.005573 sec
2014-02-18 20:39 lost contact with both acquisition systems
2014-02-20 05:52;05:57 both acq computers rebooted.
         06:52 Stop and restart GdapNGL3 to get narod
         data flowing.
         GPS clocks working on both systems
2014-03-12 12/03/14 03:20:01 - CLK W 0 Lost contact with
         Gm16 RESET (DMI computer)
2014-03-23 (DMI computer)
2014-03-24 (DMI) clock stopped at 23:00 2014-03-24
2014-04-13 18:00:00 lost contact with GPS clock on
         DMI system
2014-04-14 05:43 slay and restart GdapClock
2014-04-19 Maw GdapAdam failed Friday 2014-04-18.
         restarted 2014-04-19.
2014-05-20 GdapAdam on ga-maw-mag1 failed.
         restarted 05:13 - It is probable there is a
         blizzard in progress
         Failed again 05:14:45 - restart - no luck
         23:01 stop and restart GdapAdam. again at 23:45
2014-06-10 GdapClock failed last Sunday
2014-06-22 restarted GdapAdam ~22:40 : probably stopped
         during blizzard TBC
2014-06-30 GdapClock failed
         08:40:01 - CLK W 0 Lost contact with Gm16 RESET
2014-07-01 restart GdapClock
2014-07-24 Replace both acquisition computers with
         ARK3360F QNX6.5 units.
2014-07-24 Install DC-DC converters on Narod, DMI and GSM90
         variometer, tidy up and remove old equipment.
2014-07-24 PTB on 2015-01-19 replaced the MAW reported 1
         min data with MW2 for period 06:38:00 to
         09:47:00, except for point 09:45:00 which was
         missing.
2014-07-25 Narod did not come up again after installation
         of its DC-DC converter, nor when the converter
         was removed. During a reboot Narod computer
         time set to 2025 - followed by a neg time jump
         of -10.6 years. I do not know why the machine
         booted with 2025 or changed to 2025 shortly
         after reboot.
2014-07-29 Garry Beavan and Andy Burgess have restored GA
         access to ga-maw-mag1 (DTU) but ga-maw-mag2 is
         still not reachable directly - it can be
         connected to from ga-maw-mag1.
```

```
            Narod is working again - no information about
            what happened.
            Restarted MachR on both computers to start
            recording F again - it stopped recording
            F probably after the above -10.6 year time
            correction.
2014-07-30 Retrieving Narod data files via DTU computer
            and QNET /net/ga-maw-mag2/mag.
            2014-07-29 06:14:55.1 N Gm Adj by 1561302339
            (-5471) 0 LL associated with
            /etc/system/sysinit Tue Jul 29 06:13:58 UTC 2014
            System RESTART.
2014-08-06 ~04:12 updated rc.host GdapAdjustClockRate
            parameters; followed by "L" correction.
            ga-maw-mag1 838122456 (-4500) to 838118684
            (+900), ga-maw-mag2 838115332 (-1200) to
            838114326 (-200).
2014-08-08 Difficult to produce QD data for MAW 2014-07
            for many reasons:
            Significant BL jump in DMI data but few/no
            baselines over the upgrade period.
            Apparently less severe BL jump in Narod data,
            but no Narod data for several days
            No F data for some time to check reliability
            of data. At this stage do not deliver July data
            after start of upgrade.
            Much more work needs to be done for definitive
            data to recover as much as possible.
2014-09-12 Adjusted x, y baseline. QD data for Aug 14
            uploaded to BGS. PTB
2014-10-08 Reloaded mw2 reported 1s and 1m data on
            2014-03-01 (060) into the database,
            because the existing data in the database
            contained many "zero data".
2014-10-10 First obs using Pico DI0132D 313792 FJY06/139.
            GPS time setting was not working. PC had been
            set up for time server over wifi.
2014-10-29 297 obs showing high X2 (>900) on reverse obs.
            Unknown reason, text file looks OK, data has
            processed OK apart from X2. Forward obs v.
            low X2 (~22). PTB
2014-11-14 Oct 2014 QD Processing PTB (w/ help from AML),
            changed offset & drift on Z
2014-11-26 Observer and electrician enter building
            containing variometers at ~10:35 to 10:37 for
            yearly fire alarm check.

K indices
---------
Mawson K indices for 2014 have been
derived using a computer-assisted method developed at
Geoscience Australia and based on the IAGA-accepted LRNS
algorithm. K indices were scaled from preliminary data from
the DMI variometer during 2014 (with gaps filled in with
Narod preliminary data).


Table A.10. Mawson data losses.
------------------------------
Date        Interval(hh:mm) Data loss (minutes)
```

```
Vector data : Total: 193 minutes
2014-01-27    XYZ     09:32 - 09:32  (1)
2014-01-27    XYZ     10:02 - 10:03  (2)
2014-02-20    XYZ     05:50 - 05:50  (1)
2014-05-20    XYZ     05:39 - 05:39  (1)
2014-05-20    XYZ     06:09 - 06:09  (1)
2014-05-20    XYZ     08:03 - 08:03  (1)
2014-07-25    XYZ     01:56 - 01:58  (3) PC upgrade.
2014-07-25    XYZ     06:05 - 06:09  (5)
2014-07-25    XYZ     06:45 - 06:49  (5)
2014-07-28    XYZ     09:59 - 10:02  (4)
2014-07-29    XYZ     04:06 - 04:06  (1)
2014-07-29    XYZ     06:14 - 06:14  (1)
2014-07-29    XYZ     07:25 - 09:23  (119) System stopped
2014-07-30    XYZ     05:44 - 06:26  (43)
2014-11-26    XYZ     10:33 - 10:36  (4)
2014-12-23    XYZ     11:15 - 11:15  (1)

Scalar data : Total: 13903 minutes
2014-01-01    F      13:08 - 13:08  (1)
2014-01-01    F      17:10 - 17:10  (1)
2014-01-01    F      18:01 - 18:01  (1)
2014-01-01    F      22:32 - 22:32  (1)
2014-01-02    F      05:07 - 05:07  (1)
2014-01-02    F      05:56 - 06:02  (7)
2014-01-02    F      13:37 - 13:37  (1)
2014-01-02    F      22:36 - 22:36  (1)
2014-01-02    F      23:26 - 23:27  (2)
2014-01-03    F      07:20 - 07:20  (1)
2014-01-03    F      16:28 - 16:28  (1)
2014-01-03    F      18:33 - 18:37  (5)
2014-01-03    F      21:32 - 21:33  (2)
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2014-01-10    F      02:49 - 02:51  (3)
2014-01-11    F      12:37 - 12:37  (1)
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2014-01-13	F	23:04 - 23:04	(1)
2014-01-14	F	00:51 - 00:51	(1)
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2014-01-14	F	17:02 - 17:02	(1)
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2014-01-15	F	02:33 - 02:33	(1)
2014-01-15	F	20:47 - 20:47	(1)
2014-01-15	F	20:49 - 20:49	(1)
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2014-01-16	F	00:03 - 00:03	(1)
2014-01-16	F	21:45 - 21:45	(1)
2014-01-16	F	23:49 - 23:49	(1)
2014-01-16	F	23:51 - 23:51	(1)
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2014-01-26	F	23:13 - 23:15	(3)
2014-01-26	F	23:30 - 23:30	(1)
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2014-01-27	F	00:12 - 00:12	(1)
2014-01-27	F	04:22 - 04:22	(1)
2014-01-27	F	09:30 - 10:05	(36)
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2014-01-29	F	23:47 - 23:47	(1)
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2014-01-30	F	00:31 - 00:31	(1)
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2014-01-30	F	04:05 - 04:08	(4)
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2014-02-06	F	22:25 - 22:29	(5)
2014-02-06	F	22:57 - 22:57	(1)
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2014-02-08	F	06:36 - 06:36	(1)
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2014-02-08	F	19:36 - 19:36	(1)
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2014-02-09	F	03:09 - 03:09	(1)
2014-02-09	F	03:19 - 03:19	(1)
2014-02-09	F	17:59 - 17:59	(1)
2014-02-09	F	18:42 - 18:57	(16)
2014-02-09	F	21:03 - 21:03	(1)
2014-02-10	F	02:37 - 02:42	(6)
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2014-02-11	F	13:57 - 13:57	(1)
2014-02-11	F	14:01 - 14:01	(1)
2014-02-11	F	22:13 - 22:13	(1)
2014-02-11	F	23:44 - 23:44	(1)
2014-02-12	F	03:54 - 03:54	(1)
2014-02-12	F	08:57 - 08:57	(1)
2014-02-12	F	20:10 - 20:10	(1)
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2014-02-12	F	22:44 - 22:44	(1)
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2014-02-16	F	05:29 - 05:29	(1)
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2014-02-16	F	21:41 - 21:42	(2)
2014-02-16	F	22:38 - 22:39	(2)
2014-02-16	F	22:56 - 22:56	(1)
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2014-02-17	F	23:23 - 23:23	(1)
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2014-02-18	F	00:16 - 00:16	(1)
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2014-02-18	F	09:34 - 09:49	(16)
2014-02-18	F	10:24 - 10:24	(1)
2014-02-18	F	16:58 - 16:58	(1)
2014-02-18	F	17:00 - 17:00	(1)
2014-02-18	F	20:05 - 20:05	(1)
2014-02-18	F	20:07 - 20:07	(1)
2014-02-18	F	23:09 - 23:09	(1)
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2014-02-19	F	01:33 - 01:33	(1)
2014-02-19	F	02:27 - 02:27	(1)
2014-02-19	F	02:48 - 02:50	(3)
2014-02-19	F	04:25 - 04:26	(2)
2014-02-19	F	05:39 - 05:42	(4)
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2014-02-20	F	05:50 - 05:50	(1)
2014-02-20	F	08:06 - 08:07	(2)
2014-02-20	F	10:46 - 10:46	(1)
2014-02-20	F	10:49 - 10:49	(1)
2014-02-20	F	12:46 - 12:47	(2)
2014-02-20	F	13:11 - 13:11	(1)
2014-02-20	F	17:21 - 17:21	(1)
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2014-02-20	F	19:40 - 19:40	(1)
2014-02-21	F	01:49 - 01:50	(2)

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2014-02-22	F	18:06 - 18:06	(1)
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2014-02-23	F	15:03 - 15:06	(4)
2014-02-23	F	15:11 - 15:11	(1)
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2014-02-23	F	20:30 - 20:31	(2)
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2014-02-24	F	01:07 - 01:07	(1)
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2014-02-24	F	09:25 - 09:25	(1)
2014-02-24	F	12:29 - 12:29	(1)
2014-02-24	F	12:32 - 12:32	(1)
2014-02-24	F	14:48 - 14:48	(1)
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2014-02-25	F	22:31 - 22:32	(2)
2014-02-25	F	22:40 - 22:41	(2)
2014-02-25	F	23:25 - 23:25	(1)
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2014-02-26	F	23:32 - 23:33	(2)
2014-02-27	F	00:31 - 00:34	(4)
2014-02-27	F	00:40 - 00:41	(2)
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2014-02-27	F	23:19 - 23:20	(2)
2014-02-28	F	00:02 - 00:03	(2)
2014-02-28	F	08:03 - 08:03	(1)
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2014-02-28	F	10:33 - 10:33	(1)
2014-02-28	F	12:03 - 12:03	(1)
2014-02-28	F	20:30 - 20:31	(2)
2014-02-28	F	22:13 - 22:13	(1)
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2014-03-01	F	20:23 - 20:23	(1)
2014-03-01	F	20:27 - 20:27	(1)
2014-03-01	F	20:35 - 20:36	(2)
2014-03-01	F	22:48 - 22:51	(4)
2014-03-02	F	07:06 - 07:06	(1)
2014-03-03	F	02:06 - 02:11	(6)
2014-03-03	F	06:47 - 06:50	(4)
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2014-03-04	F	00:59 - 01:00	(2)

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2014-03-05	F	00:09 - 00:13	(5)
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2014-03-05	F	20:41 - 20:42	(2)
2014-03-06	F	00:10 - 00:13	(4)
2014-03-06	F	01:06 - 01:07	(2)
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2014-03-06	F	22:11 - 22:11	(1)
2014-03-06	F	23:04 - 23:04	(1)
2014-03-07	F	19:35 - 19:36	(2)
2014-03-07	F	22:22 - 22:22	(1)
2014-03-07	F	23:28 - 23:28	(1)
2014-03-07	F	23:31 - 23:32	(2)
2014-03-08	F	23:06 - 23:07	(2)
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2014-03-09	F	23:03 - 23:04	(2)
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2014-03-11	F	21:15 - 21:15	(1)
2014-03-11	F	21:37 - 21:38	(2)
2014-03-12	F	11:35 - 11:35	(1)
2014-03-12	F	21:48 - 21:48	(1)
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2014-03-13	F	06:14 - 06:14	(1)
2014-03-13	F	21:21 - 21:21	(1)
2014-03-14	F	14:06 - 14:06	(1)
2014-03-14	F	15:25 - 15:26	(2)
2014-03-14	F	21:36 - 21:37	(2)
2014-03-14	F	21:44 - 21:44	(1)
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2014-03-15	F	14:27 - 14:27	(1)
2014-03-15	F	20:44 - 20:44	(1)
2014-03-15	F	21:18 - 21:18	(1)
2014-03-15	F	21:45 - 21:45	(1)
2014-03-16	F	23:41 - 23:41	(1)
2014-03-17	F	00:22 - 00:22	(1)
2014-03-17	F	00:26 - 00:27	(2)
2014-03-17	F	22:04 - 22:04	(1)
2014-03-17	F	22:09 - 22:09	(1)
2014-03-18	F	17:04 - 17:05	(2)
2014-03-18	F	21:06 - 21:06	(1)
2014-03-18	F	21:26 - 21:26	(1)
2014-03-18	F	22:48 - 22:48	(1)
2014-03-19	F	21:20 - 21:30	(11)
2014-03-19	F	22:39 - 22:40	(2)
2014-03-20	F	21:18 - 21:22	(5)
2014-03-20	F	23:51 - 23:52	(2)
2014-03-21	F	00:13 - 00:14	(2)
2014-03-21	F	00:44 - 00:44	(1)
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2014-03-21	F	06:28 - 06:28	(1)

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2014-03-21	F	13:06 - 13:06	(1)
2014-03-21	F	16:32 - 16:32	(1)
2014-03-21	F	18:05 - 18:05	(1)
2014-03-21	F	18:16 - 18:16	(1)
2014-03-21	F	22:47 - 22:47	(1)
2014-03-21	F	22:49 - 22:49	(1)
2014-03-22	F	23:23 - 23:23	(1)
2014-03-23	F	00:05 - 00:05	(1)
2014-03-23	F	20:13 - 20:13	(1)
2014-03-23	F	20:27 - 20:27	(1)
2014-03-23	F	20:29 - 20:29	(1)
2014-03-23	F	22:05 - 22:07	(3)
2014-03-23	F	22:48 - 22:48	(1)
2014-03-23	F	23:25 - 23:25	(1)
2014-03-23	F	23:44 - 23:44	(1)
2014-03-23	F	23:47 - 23:47	(1)
2014-03-24	F	06:29 - 06:29	(1)
2014-03-24	F	19:10 - 19:10	(1)
2014-03-24	F	21:23 - 21:24	(2)
2014-03-25	F	00:21 - 00:21	(1)
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2014-03-25	F	09:14 - 09:14	(1)
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2014-03-25	F	12:37 - 12:37	(1)
2014-03-25	F	14:47 - 14:47	(1)
2014-03-25	F	16:24 - 16:24	(1)
2014-03-25	F	20:11 - 20:11	(1)
2014-03-25	F	21:03 - 21:04	(2)
2014-03-25	F	21:59 - 21:59	(1)
2014-03-25	F	23:36 - 23:36	(1)
2014-03-26	F	07:57 - 07:57	(1)
2014-03-26	F	09:10 - 09:10	(1)
2014-03-26	F	14:14 - 14:14	(1)
2014-03-26	F	20:01 - 20:01	(1)
2014-03-27	F	08:34 - 08:35	(2)
2014-03-27	F	11:34 - 11:34	(1)
2014-03-27	F	19:35 - 19:35	(1)
2014-03-27	F	20:12 - 20:12	(1)
2014-03-27	F	20:34 - 20:34	(1)
2014-03-28	F	02:29 - 02:29	(1)
2014-03-28	F	03:36 - 03:40	(5)
2014-03-28	F	03:54 - 03:54	(1)
2014-03-29	F	01:57 - 02:00	(4)
2014-03-29	F	03:37 - 03:38	(2)
2014-03-29	F	03:55 - 03:58	(4)
2014-03-29	F	12:46 - 12:46	(1)
2014-03-30	F	01:00 - 01:00	(1)
2014-03-30	F	18:43 - 18:44	(2)
2014-03-30	F	20:30 - 20:30	(1)
2014-03-30	F	20:41 - 20:41	(1)
2014-03-30	F	21:34 - 21:35	(2)
2014-03-30	F	23:42 - 23:43	(2)
2014-03-31	F	16:37 - 16:38	(2)
2014-03-31	F	18:19 - 18:21	(3)
2014-03-31	F	18:35 - 18:35	(1)
2014-03-31	F	19:15 - 19:15	(1)
2014-03-31	F	21:05 - 21:06	(2)
2014-04-01	F	08:25 - 08:25	(1)
2014-04-01	F	12:26 - 12:26	(1)

2014-04-01	F	22:33 - 22:34	(2)
2014-04-02	F	07:44 - 07:45	(2)
2014-04-02	F	21:04 - 21:07	(4)
2014-04-02	F	21:21 - 21:21	(1)
2014-04-02	F	23:00 - 23:00	(1)
2014-04-02	F	23:03 - 23:04	(2)
2014-04-02	F	23:45 - 23:45	(1)
2014-04-03	F	18:31 - 18:31	(1)
2014-04-03	F	21:12 - 21:13	(2)
2014-04-03	F	23:06 - 23:06	(1)
2014-04-03	F	23:15 - 23:15	(1)
2014-04-03	F	23:21 - 23:22	(2)
2014-04-04	F	14:34 - 14:34	(1)
2014-04-04	F	14:36 - 14:36	(1)
2014-04-04	F	14:51 - 14:51	(1)
2014-04-04	F	17:47 - 17:50	(4)
2014-04-05	F	00:56 - 00:56	(1)
2014-04-05	F	22:30 - 22:30	(1)
2014-04-05	F	23:35 - 23:35	(1)
2014-04-06	F	06:20 - 06:20	(1)
2014-04-06	F	23:31 - 23:31	(1)
2014-04-07	F	01:10 - 01:10	(1)
2014-04-07	F	20:34 - 20:35	(2)
2014-04-07	F	21:34 - 21:35	(2)
2014-04-07	F	23:39 - 23:56	(18)
2014-04-08	F	00:48 - 00:48	(1)
2014-04-08	F	00:51 - 00:51	(1)
2014-04-08	F	22:47 - 22:47	(1)
2014-04-09	F	19:08 - 19:08	(1)
2014-04-09	F	19:51 - 19:51	(1)
2014-04-09	F	20:31 - 20:33	(3)
2014-04-11	F	08:08 - 08:09	(2)
2014-04-11	F	09:05 - 09:05	(1)
2014-04-11	F	19:46 - 19:46	(1)
2014-04-11	F	20:54 - 20:54	(1)
2014-04-11	F	21:21 - 21:21	(1)
2014-04-11	F	23:16 - 23:16	(1)
2014-04-12	F	00:19 - 00:19	(1)
2014-04-12	F	01:31 - 01:31	(1)
2014-04-12	F	10:03 - 10:03	(1)
2014-04-12	F	10:16 - 10:16	(1)
2014-04-12	F	20:23 - 20:23	(1)
2014-04-13	F	00:31 - 00:31	(1)
2014-04-13	F	00:52 - 00:53	(2)
2014-04-13	F	01:15 - 01:15	(1)
2014-04-13	F	02:08 - 02:08	(1)
2014-04-13	F	03:16 - 03:17	(2)
2014-04-13	F	10:55 - 10:55	(1)
2014-04-13	F	16:28 - 16:28	(1)
2014-04-13	F	16:42 - 16:42	(1)
2014-04-13	F	18:59 - 18:59	(1)
2014-04-13	F	19:10 - 19:10	(1)
2014-04-13	F	19:12 - 19:12	(1)
2014-04-13	F	19:14 - 19:14	(1)
2014-04-13	F	22:05 - 22:05	(1)
2014-04-13	F	22:07 - 22:07	(1)
2014-04-13	F	23:15 - 23:15	(1)
2014-04-14	F	00:15 - 00:15	(1)
2014-04-14	F	08:12 - 08:12	(1)
2014-04-14	F	20:21 - 20:21	(1)
2014-04-14	F	20:23 - 20:23	(1)

2014-04-14	F	21:32 - 21:33	(2)
2014-04-14	F	22:02 - 22:02	(1)
2014-04-15	F	08:15 - 08:15	(1)
2014-04-15	F	08:17 - 08:17	(1)
2014-04-15	F	21:23 - 21:23	(1)
2014-04-15	F	22:25 - 22:25	(1)
2014-04-16	F	22:21 - 22:21	(1)
2014-04-16	F	22:33 - 22:35	(3)
2014-04-17	F	00:54 - 00:55	(2)
2014-04-17	F	21:18 - 21:18	(1)
2014-04-18	F	01:24 - 01:24	(1)
2014-04-18	F	07:27 - 07:28	(2)
2014-04-18	F	07:30 - 07:31	(2)
2014-04-18	F	07:33 - 07:33	(1)
2014-04-18	F	08:12 -	
2014-04-19	F	- 00:24	(973)
2014-04-19	F	11:12 - 11:12	(1)
2014-04-19	F	11:40 - 11:40	(1)
2014-04-20	F	04:45 - 04:45	(1)
2014-04-20	F	12:36 - 12:36	(1)
2014-04-20	F	17:16 - 17:17	(2)
2014-04-20	F	18:54 - 18:54	(1)
2014-04-21	F	01:29 - 01:30	(2)
2014-04-21	F	05:40 - 05:40	(1)
2014-04-22	F	04:14 - 04:15	(2)
2014-04-22	F	11:06 - 11:06	(1)
2014-04-22	F	21:54 - 21:54	(1)
2014-04-22	F	21:57 - 21:58	(2)
2014-04-22	F	22:01 - 22:01	(1)
2014-04-23	F	09:16 - 09:16	(1)
2014-04-23	F	12:13 - 12:13	(1)
2014-04-23	F	17:41 - 17:41	(1)
2014-04-23	F	20:27 - 20:29	(3)
2014-04-24	F	00:01 - 00:02	(2)
2014-04-24	F	00:07 - 00:07	(1)
2014-04-24	F	00:56 - 00:56	(1)
2014-04-24	F	15:47 - 15:49	(3)
2014-04-24	F	18:36 - 18:37	(2)
2014-04-24	F	19:16 - 19:16	(1)
2014-04-24	F	20:26 - 20:28	(3)
2014-04-24	F	22:21 - 22:22	(2)
2014-04-25	F	04:55 - 04:55	(1)
2014-04-25	F	13:45 - 13:45	(1)
2014-04-25	F	18:06 - 18:06	(1)
2014-04-25	F	18:15 - 18:15	(1)
2014-04-25	F	23:21 - 23:21	(1)
2014-04-26	F	07:36 - 07:36	(1)
2014-04-26	F	13:08 - 13:08	(1)
2014-04-26	F	20:28 - 20:28	(1)
2014-04-26	F	22:29 - 22:29	(1)
2014-04-26	F	23:47 - 23:47	(1)
2014-04-27	F	22:09 - 22:09	(1)
2014-04-27	F	22:12 - 22:12	(1)
2014-04-27	F	22:19 - 22:19	(1)
2014-04-27	F	22:45 - 22:48	(4)
2014-04-28	F	03:06 - 03:06	(1)
2014-04-29	F	00:32 - 00:32	(1)
2014-04-29	F	01:18 - 01:18	(1)
2014-04-29	F	01:21 - 01:21	(1)
2014-04-29	F	20:27 - 20:28	(2)
2014-04-30	F	01:12 - 01:14	(3)

2014-04-30	F	04:16 - 04:20	(5)
2014-04-30	F	06:07 - 06:07	(1)
2014-04-30	F	06:09 - 06:09	(1)
2014-04-30	F	18:14 - 18:15	(2)
2014-04-30	F	20:25 - 20:25	(1)
2014-05-01	F	08:49 - 08:49	(1)
2014-05-03	F	20:17 - 20:17	(1)
2014-05-03	F	20:19 - 20:19	(1)
2014-05-03	F	21:23 - 21:23	(1)
2014-05-03	F	22:48 - 22:49	(2)
2014-05-04	F	05:17 - 05:18	(2)
2014-05-04	F	05:25 - 05:25	(1)
2014-05-04	F	06:41 - 06:42	(2)
2014-05-04	F	06:50 - 06:50	(1)
2014-05-04	F	10:35 - 10:35	(1)
2014-05-04	F	22:00 - 22:00	(1)
2014-05-04	F	22:12 - 22:13	(2)
2014-05-05	F	19:21 - 19:21	(1)
2014-05-07	F	01:14 - 01:14	(1)
2014-05-08	F	08:32 - 08:32	(1)
2014-05-08	F	09:12 - 09:12	(1)
2014-05-09	F	02:06 - 02:06	(1)
2014-05-09	F	05:47 - 05:47	(1)
2014-05-09	F	09:54 - 09:54	(1)
2014-05-09	F	23:22 - 23:22	(1)
2014-05-10	F	09:28 - 09:28	(1)
2014-05-10	F	23:14 - 23:14	(1)
2014-05-11	F	01:18 - 01:24	(7)
2014-05-11	F	01:31 - 01:31	(1)
2014-05-11	F	04:41 - 04:42	(2)
2014-05-11	F	08:37 - 08:37	(1)
2014-05-11	F	10:41 - 10:41	(1)
2014-05-11	F	11:19 - 11:19	(1)
2014-05-11	F	20:44 - 20:46	(3)
2014-05-11	F	22:52 - 22:55	(4)
2014-05-11	F	23:07 - 23:07	(1)
2014-05-12	F	11:37 - 11:37	(1)
2014-05-12	F	11:46 - 11:46	(1)
2014-05-12	F	14:07 - 14:07	(1)
2014-05-12	F	20:58 - 20:59	(2)
2014-05-12	F	21:06 - 21:06	(1)
2014-05-12	F	21:51 - 21:51	(1)
2014-05-12	F	22:02 - 22:03	(2)
2014-05-13	F	10:20 - 10:20	(1)
2014-05-13	F	10:30 - 10:30	(1)
2014-05-13	F	15:08 - 15:08	(1)
2014-05-13	F	22:18 - 22:18	(1)
2014-05-13	F	22:29 - 22:29	(1)
2014-05-13	F	22:58 - 22:59	(2)
2014-05-13	F	23:04 - 23:05	(2)
2014-05-13	F	23:54 - 23:56	(3)
2014-05-14	F	21:38 - 21:38	(1)
2014-05-14	F	22:01 - 22:12	(12)
2014-05-14	F	22:34 - 22:35	(2)
2014-05-15	F	11:06 - 11:06	(1)
2014-05-16	F	08:23 - 08:23	(1)
2014-05-16	F	19:44 - 19:45	(2)
2014-05-16	F	21:29 - 21:29	(1)
2014-05-16	F	21:31 - 21:31	(1)
2014-05-16	F	22:51 - 22:51	(1)
2014-05-19	F	05:11 - 05:11	(1)

2014-05-19	F	18:44 - 18:44	(1)
2014-05-19	F	18:49 - 18:49	(1)
2014-05-19	F	22:58 - 22:59	(2)
2014-05-19	F	23:07 - 23:09	(3)
2014-05-19	F	23:12 - 23:12	(1)
2014-05-19	F	23:39 - 23:39	(1)
2014-05-20	F	02:24 -	
2014-05-21	F	- 01:00	(1357)
2014-05-21	F	23:22 - 23:22	(1)
2014-05-22	F	01:03 - 01:03	(1)
2014-05-22	F	20:46 - 20:46	(1)
2014-05-22	F	21:31 - 21:31	(1)
2014-05-22	F	23:33 - 23:43	(11)
2014-05-23	F	15:49 - 15:49	(1)
2014-05-23	F	22:08 - 22:10	(3)
2014-05-23	F	22:16 - 22:16	(1)
2014-05-23	F	22:22 - 22:22	(1)
2014-05-23	F	22:40 - 22:40	(1)
2014-05-24	F	07:56 - 07:56	(1)
2014-05-24	F	16:41 - 16:41	(1)
2014-05-24	F	19:11 - 19:13	(3)
2014-05-24	F	21:59 - 21:59	(1)
2014-05-24	F	22:44 - 22:44	(1)
2014-05-24	F	22:48 - 22:48	(1)
2014-05-24	F	23:35 - 23:38	(4)
2014-05-24	F	23:54 - 23:56	(3)
2014-05-25	F	00:08 - 00:08	(1)
2014-05-25	F	08:20 - 08:20	(1)
2014-05-25	F	08:22 - 08:22	(1)
2014-05-26	F	00:39 - 00:39	(1)
2014-05-26	F	15:01 - 15:01	(1)
2014-05-26	F	21:31 - 21:31	(1)
2014-05-26	F	21:36 - 21:36	(1)
2014-05-26	F	23:35 - 23:35	(1)
2014-05-28	F	22:07 - 22:08	(2)
2014-05-28	F	23:48 - 23:50	(3)
2014-05-29	F	15:24 - 15:24	(1)
2014-05-30	F	14:04 - 14:04	(1)
2014-05-30	F	20:17 - 20:17	(1)
2014-05-30	F	20:20 - 20:21	(2)
2014-05-30	F	20:53 - 20:53	(1)
2014-05-31	F	13:11 - 13:11	(1)
2014-06-01	F	11:10 - 11:10	(1)
2014-06-01	F	21:43 - 21:44	(2)
2014-06-02	F	00:07 - 00:07	(1)
2014-06-02	F	00:20 - 00:20	(1)
2014-06-02	F	05:32 - 05:32	(1)
2014-06-02	F	21:50 - 21:50	(1)
2014-06-02	F	23:57 - 23:57	(1)
2014-06-03	F	00:31 - 00:31	(1)
2014-06-03	F	06:35 - 06:35	(1)
2014-06-03	F	07:51 - 07:51	(1)
2014-06-03	F	08:11 - 08:11	(1)
2014-06-03	F	08:39 - 08:39	(1)
2014-06-03	F	09:52 - 09:52	(1)
2014-06-03	F	09:54 - 09:54	(1)
2014-06-03	F	09:56 - 09:56	(1)
2014-06-03	F	10:09 - 10:09	(1)
2014-06-03	F	11:23 - 11:23	(1)
2014-06-03	F	18:27 - 18:27	(1)
2014-06-04	F	22:05 - 22:05	(1)

2014-06-04	F	22:50 - 22:50	(1)
2014-06-05	F	00:15 - 00:15	(1)
2014-06-05	F	01:14 - 01:14	(1)
2014-06-05	F	06:11 - 06:11	(1)
2014-06-05	F	09:03 - 09:03	(1)
2014-06-05	F	11:33 - 11:33	(1)
2014-06-05	F	21:45 - 21:52	(8)
2014-06-06	F	00:37 - 00:40	(4)
2014-06-06	F	09:18 - 09:18	(1)
2014-06-06	F	20:52 - 20:52	(1)
2014-06-06	F	21:08 - 21:08	(1)
2014-06-06	F	23:10 - 23:12	(3)
2014-06-07	F	00:56 - 00:56	(1)
2014-06-07	F	12:36 - 12:36	(1)
2014-06-07	F	16:54 - 16:54	(1)
2014-06-07	F	17:51 - 17:51	(1)
2014-06-07	F	23:09 - 23:12	(4)
2014-06-08	F	16:01 - 16:01	(1)
2014-06-08	F	18:28 - 18:28	(1)
2014-06-08	F	20:44 - 20:44	(1)
2014-06-08	F	23:28 - 23:28	(1)
2014-06-08	F	23:30 - 23:30	(1)
2014-06-09	F	08:05 - 08:06	(2)
2014-06-09	F	09:07 - 09:08	(2)
2014-06-09	F	11:10 - 11:10	(1)
2014-06-09	F	19:10 - 19:11	(2)
2014-06-09	F	19:23 - 19:23	(1)
2014-06-09	F	20:00 - 20:00	(1)
2014-06-09	F	21:07 - 21:07	(1)
2014-06-09	F	21:10 - 21:10	(1)
2014-06-09	F	23:22 - 23:22	(1)
2014-06-09	F	23:37 - 23:37	(1)
2014-06-09	F	23:54 - 23:54	(1)
2014-06-10	F	00:06 - 00:08	(3)
2014-06-10	F	05:50 - 05:50	(1)
2014-06-10	F	11:51 - 11:51	(1)
2014-06-10	F	21:55 - 21:56	(2)
2014-06-10	F	22:18 - 22:18	(1)
2014-06-10	F	22:42 - 22:42	(1)
2014-06-10	F	22:53 - 22:54	(2)
2014-06-10	F	23:10 - 23:10	(1)
2014-06-11	F	11:41 - 11:41	(1)
2014-06-12	F	11:50 - 11:50	(1)
2014-06-13	F	07:32 - 07:32	(1)
2014-06-13	F	14:37 - 14:37	(1)
2014-06-13	F	15:15 - 15:15	(1)
2014-06-13	F	16:12 - 16:13	(2)
2014-06-13	F	21:11 - 21:13	(3)
2014-06-13	F	21:38 - 21:38	(1)
2014-06-14	F	00:45 - 00:45	(1)
2014-06-14	F	00:48 - 00:48	(1)
2014-06-14	F	00:55 - 00:55	(1)
2014-06-14	F	01:00 - 01:00	(1)
2014-06-14	F	09:00 - 09:00	(1)
2014-06-14	F	10:21 - 10:21	(1)
2014-06-14	F	10:23 - 10:23	(1)
2014-06-15	F	01:57 - 01:57	(1)
2014-06-15	F	04:37 - 04:38	(2)
2014-06-16	F	07:00 - 07:00	(1)
2014-06-16	F	19:51 - 19:51	(1)
2014-06-17	F	00:23 - 00:23	(1)

2014-06-17	F	01:13 - 01:13	(1)
2014-06-17	F	18:09 - 18:09	(1)
2014-06-17	F	22:28 - 22:34	(7)
2014-06-18	F	12:26 - 12:28	(3)
2014-06-18	F	19:10 - 19:10	(1)
2014-06-18	F	19:14 - 19:15	(2)
2014-06-18	F	22:24 - 22:24	(1)
2014-06-19	F	07:29 - 07:31	(3)
2014-06-19	F	21:02 - 21:03	(2)
2014-06-19	F	21:05 - 21:06	(2)
2014-06-20	F	00:00 - 00:00	(1)
2014-06-20	F	11:13 - 11:13	(1)
2014-06-20	F	14:09 - 14:09	(1)
2014-06-20	F	15:39 - 15:39	(1)
2014-06-20	F	17:59 - 17:59	(1)
2014-06-21	F	01:06 - 01:06	(1)
2014-06-21	F	01:17 - 01:17	(1)
2014-06-21	F	21:47 - 21:47	(1)
2014-06-22	F	06:54 - 22:23	(930)
2014-06-22	F	23:03 - 23:03	(1)
2014-06-23	F	00:01 - 00:01	(1)
2014-06-23	F	00:06 - 00:06	(1)
2014-06-23	F	00:12 - 00:12	(1)
2014-06-23	F	00:14 - 00:14	(1)
2014-06-23	F	22:18 - 22:18	(1)
2014-06-23	F	22:20 - 22:20	(1)
2014-06-23	F	22:22 - 22:22	(1)
2014-06-24	F	00:13 - 00:13	(1)
2014-06-24	F	22:46 - 22:46	(1)
2014-06-24	F	22:57 - 22:57	(1)
2014-06-24	F	23:48 - 23:48	(1)
2014-06-25	F	01:56 - 01:56	(1)
2014-06-25	F	04:41 - 04:41	(1)
2014-06-25	F	17:44 - 17:44	(1)
2014-06-25	F	22:12 - 22:12	(1)
2014-06-27	F	07:59 - 08:04	(6)
2014-06-27	F	08:59 - 08:59	(1)
2014-06-28	F	02:15 - 02:15	(1)
2014-06-28	F	22:15 - 22:15	(1)
2014-06-29	F	02:08 - 02:17	(10)
2014-06-29	F	15:19 - 15:19	(1)
2014-06-29	F	15:22 - 15:22	(1)
2014-07-01	F	22:33 - 22:40	(8)
2014-07-01	F	22:49 - 22:49	(1)
2014-07-01	F	23:24 - 23:25	(2)
2014-07-01	F	23:32 - 23:32	(1)
2014-07-01	F	23:50 - 23:50	(1)
2014-07-02	F	00:42 - 00:42	(1)
2014-07-02	F	09:00 - 09:00	(1)
2014-07-02	F	21:47 - 21:47	(1)
2014-07-02	F	22:09 - 22:09	(1)
2014-07-02	F	22:11 - 22:11	(1)
2014-07-03	F	09:12 - 09:12	(1)
2014-07-04	F	00:39 - 00:39	(1)
2014-07-04	F	00:44 - 00:44	(1)
2014-07-04	F	03:46 - 03:46	(1)
2014-07-04	F	12:53 - 12:53	(1)
2014-07-04	F	22:03 - 22:03	(1)
2014-07-04	F	22:15 - 22:15	(1)
2014-07-04	F	22:23 - 22:23	(1)
2014-07-04	F	22:29 - 22:29	(1)

2014-07-04	F	23:35 - 23:36	(2)
2014-07-05	F	00:04 - 00:07	(4)
2014-07-05	F	00:09 - 00:09	(1)
2014-07-05	F	02:38 - 02:38	(1)
2014-07-05	F	02:47 - 02:48	(2)
2014-07-06	F	00:29 - 00:31	(3)
2014-07-06	F	00:34 - 00:34	(1)
2014-07-06	F	14:40 - 14:40	(1)
2014-07-06	F	22:51 - 22:51	(1)
2014-07-06	F	23:24 - 23:24	(1)
2014-07-06	F	23:34 - 23:34	(1)
2014-07-06	F	23:36 - 23:36	(1)
2014-07-07	F	10:52 - 10:52	(1)
2014-07-07	F	10:58 - 10:58	(1)
2014-07-07	F	21:45 - 21:45	(1)
2014-07-07	F	23:15 - 23:15	(1)
2014-07-08	F	01:35 - 01:35	(1)
2014-07-09	F	00:39 - 00:39	(1)
2014-07-09	F	11:54 - 11:54	(1)
2014-07-09	F	19:01 - 19:01	(1)
2014-07-09	F	22:47 - 22:48	(2)
2014-07-09	F	22:51 - 22:51	(1)
2014-07-09	F	23:16 - 23:16	(1)
2014-07-10	F	09:11 - 09:12	(2)
2014-07-10	F	16:52 - 16:52	(1)
2014-07-10	F	23:42 - 23:42	(1)
2014-07-11	F	01:53 - 01:56	(4)
2014-07-11	F	02:04 - 02:04	(1)
2014-07-11	F	19:52 - 19:52	(1)
2014-07-11	F	20:01 - 20:04	(4)
2014-07-11	F	21:59 - 21:59	(1)
2014-07-11	F	23:45 - 23:45	(1)
2014-07-12	F	00:07 - 00:08	(2)
2014-07-12	F	05:11 - 05:11	(1)
2014-07-12	F	10:10 - 10:10	(1)
2014-07-12	F	13:50 - 13:50	(1)
2014-07-12	F	15:29 - 15:29	(1)
2014-07-13	F	01:39 - 01:39	(1)
2014-07-13	F	01:55 - 01:55	(1)
2014-07-13	F	02:15 - 02:16	(2)
2014-07-13	F	11:05 - 11:05	(1)
2014-07-13	F	14:42 - 14:42	(1)
2014-07-14	F	00:06 - 00:06	(1)
2014-07-14	F	01:21 - 01:21	(1)
2014-07-14	F	08:16 - 08:16	(1)
2014-07-14	F	11:02 - 11:02	(1)
2014-07-14	F	14:33 - 14:33	(1)
2014-07-14	F	22:55 - 22:57	(3)
2014-07-15	F	13:05 - 13:05	(1)
2014-07-15	F	16:42 - 16:43	(2)
2014-07-15	F	22:46 - 22:46	(1)
2014-07-16	F	19:53 - 19:53	(1)
2014-07-16	F	20:34 - 20:34	(1)
2014-07-17	F	09:01 - 09:01	(1)
2014-07-17	F	12:55 - 12:56	(2)
2014-07-17	F	15:32 - 15:32	(1)
2014-07-17	F	15:41 - 15:41	(1)
2014-07-17	F	19:09 - 19:10	(2)
2014-07-17	F	22:11 - 22:11	(1)
2014-07-17	F	23:06 - 23:07	(2)
2014-07-18	F	10:10 - 10:10	(1)

2014-07-18	F	22:30 - 22:30	(1)
2014-07-18	F	22:52 - 22:52	(1)
2014-07-18	F	23:35 - 23:35	(1)
2014-07-19	F	00:25 - 00:25	(1)
2014-07-19	F	00:30 - 00:30	(1)
2014-07-19	F	00:39 - 00:39	(1)
2014-07-19	F	03:06 - 03:07	(2)
2014-07-19	F	22:48 - 22:48	(1)
2014-07-20	F	05:01 - 05:01	(1)
2014-07-20	F	23:17 - 23:17	(1)
2014-07-21	F	02:16 - 02:16	(1)
2014-07-21	F	20:29 - 20:29	(1)
2014-07-21	F	22:21 - 22:21	(1)
2014-07-21	F	22:38 - 22:38	(1)
2014-07-22	F	22:42 - 22:42	(1)
2014-07-22	F	23:23 - 23:23	(1)
2014-07-22	F	23:46 - 23:46	(1)
2014-07-23	F	04:15 - 04:24	(10)
2014-07-23	F	08:22 - 08:22	(1)
2014-07-23	F	08:27 - 08:27	(1)
2014-07-23	F	09:37 - 09:42	(6)
2014-07-23	F	14:32 -	
2014-07-25	F	- 08:43	(2532)
2014-07-25	F	10:15 -	
2014-07-29	F	- 07:30	(5596)
2014-07-29	F	08:46 - 09:23	(38)
2014-07-30	F	07:02 - 07:16	(15)
2014-07-31	F	22:40 - 22:43	(4)
2014-08-01	F	05:50 - 05:50	(1)
2014-08-01	F	20:42 - 20:42	(1)
2014-08-01	F	22:55 - 22:55	(1)
2014-08-02	F	08:38 - 08:38	(1)
2014-08-02	F	16:16 - 16:16	(1)
2014-08-02	F	17:25 - 17:25	(1)
2014-08-02	F	22:52 - 22:52	(1)
2014-08-02	F	23:27 - 23:29	(3)
2014-08-03	F	00:13 - 00:14	(2)
2014-08-03	F	22:05 - 22:05	(1)
2014-08-04	F	01:36 - 01:36	(1)
2014-08-04	F	11:34 - 11:35	(2)
2014-08-04	F	12:22 - 12:22	(1)
2014-08-04	F	12:52 - 12:52	(1)
2014-08-04	F	17:04 - 17:04	(1)
2014-08-04	F	22:02 - 22:05	(4)
2014-08-05	F	01:05 - 01:05	(1)
2014-08-05	F	01:07 - 01:07	(1)
2014-08-05	F	01:09 - 01:09	(1)
2014-08-05	F	07:42 - 07:44	(3)
2014-08-05	F	11:55 - 11:55	(1)
2014-08-05	F	15:44 - 15:44	(1)
2014-08-05	F	21:56 - 21:56	(1)
2014-08-05	F	23:26 - 23:26	(1)
2014-08-06	F	00:01 - 00:01	(1)
2014-08-06	F	01:36 - 01:36	(1)
2014-08-06	F	04:05 - 04:05	(1)
2014-08-06	F	13:21 - 13:21	(1)
2014-08-06	F	14:26 - 14:26	(1)
2014-08-06	F	14:35 - 14:35	(1)
2014-08-06	F	14:41 - 14:41	(1)
2014-08-06	F	20:57 - 20:58	(2)
2014-08-07	F	00:59 - 00:59	(1)

2014-08-07	F	20:57 - 20:58	(2)
2014-08-07	F	23:43 - 23:44	(2)
2014-08-08	F	00:48 - 00:55	(8)
2014-08-08	F	13:28 - 13:28	(1)
2014-08-08	F	22:21 - 22:23	(3)
2014-08-08	F	23:40 - 23:40	(1)
2014-08-09	F	22:37 - 22:37	(1)
2014-08-09	F	23:14 - 23:14	(1)
2014-08-09	F	23:20 - 23:20	(1)
2014-08-10	F	02:34 - 02:34	(1)
2014-08-10	F	20:32 - 20:32	(1)
2014-08-11	F	23:23 - 23:27	(5)
2014-08-12	F	00:28 - 00:28	(1)
2014-08-12	F	15:11 - 15:11	(1)
2014-08-12	F	18:47 - 18:47	(1)
2014-08-12	F	18:49 - 18:49	(1)
2014-08-12	F	20:36 - 20:36	(1)
2014-08-12	F	23:18 - 23:19	(2)
2014-08-12	F	23:47 - 23:47	(1)
2014-08-13	F	08:47 - 08:50	(4)
2014-08-13	F	16:41 - 16:41	(1)
2014-08-13	F	21:15 - 21:15	(1)
2014-08-13	F	21:22 - 21:22	(1)
2014-08-13	F	21:45 - 21:45	(1)
2014-08-14	F	01:39 - 01:39	(1)
2014-08-14	F	18:11 - 18:11	(1)
2014-08-14	F	21:46 - 21:54	(9)
2014-08-14	F	23:05 - 23:05	(1)
2014-08-14	F	23:07 - 23:08	(2)
2014-08-15	F	10:35 - 10:35	(1)
2014-08-15	F	13:41 - 13:41	(1)
2014-08-16	F	00:03 - 00:03	(1)
2014-08-16	F	19:26 - 19:26	(1)
2014-08-17	F	00:01 - 00:03	(3)
2014-08-17	F	00:35 - 00:35	(1)
2014-08-17	F	17:02 - 17:02	(1)
2014-08-18	F	23:53 - 23:53	(1)
2014-08-18	F	23:55 - 23:55	(1)
2014-08-19	F	17:14 - 17:14	(1)
2014-08-19	F	21:37 - 21:38	(2)
2014-08-20	F	00:24 - 00:24	(1)
2014-08-20	F	00:26 - 00:29	(4)
2014-08-20	F	02:05 - 02:05	(1)
2014-08-20	F	21:42 - 21:42	(1)
2014-08-20	F	21:59 - 21:59	(1)
2014-08-21	F	00:26 - 00:29	(4)
2014-08-21	F	02:04 - 02:04	(1)
2014-08-21	F	04:05 - 04:06	(2)
2014-08-21	F	04:09 - 04:10	(2)
2014-08-21	F	04:21 - 04:21	(1)
2014-08-21	F	21:08 - 21:08	(1)
2014-08-22	F	02:05 - 02:05	(1)
2014-08-22	F	02:22 - 02:22	(1)
2014-08-22	F	21:44 - 21:44	(1)
2014-08-22	F	22:18 - 22:18	(1)
2014-08-23	F	19:51 - 19:51	(1)
2014-08-23	F	23:16 - 23:16	(1)
2014-08-24	F	02:18 - 02:18	(1)
2014-08-24	F	13:48 - 13:49	(2)
2014-08-25	F	22:56 - 23:01	(6)
2014-08-25	F	23:41 - 23:47	(7)

2014-08-25	F	23:55 - 23:56	(2)
2014-08-26	F	00:36 - 00:36	(1)
2014-08-26	F	02:57 - 02:57	(1)
2014-08-26	F	22:36 - 22:36	(1)
2014-08-27	F	05:14 - 05:14	(1)
2014-08-27	F	15:26 - 15:26	(1)
2014-08-27	F	16:37 - 16:37	(1)
2014-08-27	F	18:55 - 18:55	(1)
2014-08-28	F	05:01 - 05:01	(1)
2014-08-28	F	13:25 - 13:25	(1)
2014-08-28	F	15:34 - 15:34	(1)
2014-08-28	F	16:46 - 16:47	(2)
2014-08-28	F	21:36 - 21:37	(2)
2014-08-28	F	22:11 - 22:11	(1)
2014-08-28	F	22:28 - 22:28	(1)
2014-08-29	F	06:11 - 06:11	(1)
2014-08-29	F	11:22 - 11:22	(1)
2014-08-29	F	20:04 - 20:06	(3)
2014-08-29	F	20:51 - 20:51	(1)
2014-08-29	F	20:53 - 20:53	(1)
2014-08-29	F	21:06 - 21:06	(1)
2014-08-29	F	23:32 - 23:32	(1)
2014-08-30	F	02:33 - 02:33	(1)
2014-08-30	F	02:37 - 02:37	(1)
2014-08-30	F	12:21 - 12:21	(1)
2014-08-30	F	14:09 - 14:09	(1)
2014-08-30	F	20:20 - 20:20	(1)
2014-08-30	F	20:56 - 20:57	(2)
2014-08-30	F	22:55 - 22:55	(1)
2014-08-30	F	22:59 - 22:59	(1)
2014-08-30	F	23:06 - 23:06	(1)
2014-08-31	F	13:09 - 13:09	(1)
2014-08-31	F	18:05 - 18:05	(1)
2014-08-31	F	20:17 - 20:17	(1)
2014-08-31	F	22:03 - 22:03	(1)
2014-08-31	F	23:48 - 23:48	(1)
2014-08-31	F	23:57 - 23:58	(2)
2014-09-01	F	00:00 - 00:00	(1)
2014-09-01	F	00:18 - 00:20	(3)
2014-09-01	F	00:34 - 00:34	(1)
2014-09-01	F	15:07 - 15:07	(1)
2014-09-01	F	18:59 - 18:59	(1)
2014-09-01	F	23:36 - 23:37	(2)
2014-09-02	F	00:05 - 00:05	(1)
2014-09-02	F	00:56 - 00:56	(1)
2014-09-02	F	16:08 - 16:08	(1)
2014-09-02	F	18:28 - 18:28	(1)
2014-09-02	F	18:51 - 18:51	(1)
2014-09-02	F	21:06 - 21:10	(5)
2014-09-02	F	23:07 - 23:07	(1)
2014-09-02	F	23:56 - 23:57	(2)
2014-09-03	F	02:28 - 02:28	(1)
2014-09-03	F	04:07 - 04:07	(1)
2014-09-03	F	12:15 - 12:15	(1)
2014-09-03	F	21:11 - 21:16	(6)
2014-09-03	F	22:22 - 22:22	(1)
2014-09-04	F	00:10 - 00:10	(1)
2014-09-04	F	10:31 - 10:31	(1)
2014-09-04	F	10:34 - 10:35	(2)
2014-09-04	F	14:17 - 14:17	(1)
2014-09-04	F	15:11 - 15:11	(1)

2014-09-04	F	18:52 - 18:52	(1)
2014-09-04	F	22:08 - 22:08	(1)
2014-09-04	F	22:20 - 22:22	(3)
2014-09-04	F	23:00 - 23:04	(5)
2014-09-04	F	23:34 - 23:36	(3)
2014-09-04	F	23:57 - 23:57	(1)
2014-09-05	F	00:04 - 00:04	(1)
2014-09-05	F	17:16 - 17:16	(1)
2014-09-05	F	22:34 - 22:46	(13)
2014-09-06	F	11:27 - 11:27	(1)
2014-09-06	F	15:33 - 15:33	(1)
2014-09-06	F	22:00 - 22:01	(2)
2014-09-06	F	22:22 - 22:22	(1)
2014-09-06	F	23:31 - 23:31	(1)
2014-09-07	F	16:56 - 16:56	(1)
2014-09-08	F	16:53 - 16:53	(1)
2014-09-08	F	22:14 - 22:14	(1)
2014-09-09	F	02:44 - 02:44	(1)
2014-09-09	F	05:30 - 05:30	(1)
2014-09-09	F	18:50 - 18:50	(1)
2014-09-09	F	22:23 - 22:33	(11)
2014-09-10	F	00:36 - 00:36	(1)
2014-09-10	F	19:57 - 19:57	(1)
2014-09-10	F	21:23 - 21:23	(1)
2014-09-11	F	06:09 - 06:09	(1)
2014-09-11	F	22:14 - 22:15	(2)
2014-09-12	F	01:56 - 01:56	(1)
2014-09-12	F	07:18 - 07:19	(2)
2014-09-12	F	07:42 - 07:42	(1)
2014-09-12	F	10:25 - 10:25	(1)
2014-09-12	F	18:18 - 18:20	(3)
2014-09-12	F	21:38 - 21:38	(1)
2014-09-12	F	21:41 - 21:41	(1)
2014-09-13	F	06:30 - 06:30	(1)
2014-09-14	F	02:45 - 02:45	(1)
2014-09-14	F	07:26 - 07:26	(1)
2014-09-14	F	08:52 - 08:52	(1)
2014-09-14	F	16:06 - 16:06	(1)
2014-09-14	F	16:57 - 16:57	(1)
2014-09-15	F	09:15 - 09:15	(1)
2014-09-15	F	22:36 - 22:36	(1)
2014-09-15	F	22:38 - 22:38	(1)
2014-09-16	F	00:46 - 00:46	(1)
2014-09-16	F	10:07 - 10:07	(1)
2014-09-16	F	12:14 - 12:14	(1)
2014-09-16	F	21:01 - 21:01	(1)
2014-09-16	F	21:26 - 21:26	(1)
2014-09-17	F	13:39 - 13:39	(1)
2014-09-17	F	15:12 - 15:13	(2)
2014-09-17	F	21:05 - 21:06	(2)
2014-09-18	F	19:02 - 19:02	(1)
2014-09-18	F	19:18 - 19:18	(1)
2014-09-18	F	22:32 - 22:32	(1)
2014-09-18	F	23:33 - 23:33	(1)
2014-09-19	F	09:09 - 09:09	(1)
2014-09-19	F	11:25 - 11:26	(2)
2014-09-19	F	11:51 - 11:51	(1)
2014-09-19	F	14:19 - 14:19	(1)
2014-09-19	F	22:43 - 22:45	(3)
2014-09-20	F	23:26 - 23:26	(1)
2014-09-21	F	09:30 - 09:30	(1)

2014-09-21	F	10:49 - 10:49	(1)
2014-09-21	F	13:57 - 13:57	(1)
2014-09-21	F	17:50 - 17:50	(1)
2014-09-21	F	17:53 - 17:53	(1)
2014-09-22	F	20:12 - 20:14	(3)
2014-09-22	F	21:34 - 21:34	(1)
2014-09-22	F	21:44 - 21:46	(3)
2014-09-22	F	22:09 - 22:14	(6)
2014-09-22	F	23:05 - 23:06	(2)
2014-09-23	F	02:04 - 02:09	(6)
2014-09-23	F	20:15 - 20:15	(1)
2014-09-23	F	20:25 - 20:25	(1)
2014-09-23	F	22:41 - 23:48	(68)
2014-09-24	F	02:14 - 02:14	(1)
2014-09-24	F	15:09 - 15:09	(1)
2014-09-24	F	16:54 - 16:55	(2)
2014-09-24	F	20:16 - 20:17	(2)
2014-09-24	F	20:43 - 20:43	(1)
2014-09-24	F	20:53 - 20:53	(1)
2014-09-24	F	21:05 - 21:05	(1)
2014-09-24	F	22:32 - 22:32	(1)
2014-09-24	F	23:59 - 23:59	(1)
2014-09-25	F	00:14 - 00:14	(1)
2014-09-25	F	05:17 - 05:17	(1)
2014-09-25	F	11:55 - 11:55	(1)
2014-09-25	F	19:28 - 19:28	(1)
2014-09-25	F	20:36 - 20:36	(1)
2014-09-25	F	20:48 - 20:48	(1)
2014-09-25	F	21:10 - 21:12	(3)
2014-09-25	F	23:15 - 23:15	(1)
2014-09-25	F	23:17 - 23:17	(1)
2014-09-25	F	23:19 - 23:19	(1)
2014-09-26	F	01:11 - 01:11	(1)
2014-09-26	F	01:14 - 01:14	(1)
2014-09-26	F	18:37 - 18:38	(2)
2014-09-26	F	18:42 - 18:42	(1)
2014-09-26	F	20:04 - 20:04	(1)
2014-09-27	F	02:39 - 02:39	(1)
2014-09-27	F	04:16 - 04:18	(3)
2014-09-27	F	04:24 - 04:24	(1)
2014-09-27	F	17:47 - 17:48	(2)
2014-09-28	F	00:30 - 00:31	(2)
2014-09-28	F	22:58 - 22:58	(1)
2014-09-28	F	23:06 - 23:07	(2)
2014-09-28	F	23:54 - 23:54	(1)
2014-09-29	F	00:13 - 00:13	(1)
2014-09-29	F	20:41 - 20:42	(2)
2014-09-30	F	00:13 - 00:13	(1)
2014-09-30	F	06:05 - 06:05	(1)
2014-09-30	F	19:27 - 19:27	(1)
2014-09-30	F	21:48 - 21:48	(1)
2014-10-01	F	00:22 - 00:22	(1)
2014-10-01	F	01:07 - 01:07	(1)
2014-10-01	F	05:32 - 05:32	(1)
2014-10-01	F	22:14 - 22:14	(1)
2014-10-01	F	22:16 - 22:16	(1)
2014-10-01	F	23:20 - 23:20	(1)
2014-10-02	F	21:25 - 21:25	(1)
2014-10-03	F	00:15 - 00:15	(1)
2014-10-03	F	00:18 - 00:18	(1)
2014-10-03	F	00:38 - 00:39	(2)

2014-10-03	F	00:41 - 00:41	(1)
2014-10-03	F	23:57 - 23:57	(1)
2014-10-04	F	08:19 - 08:20	(2)
2014-10-04	F	22:14 - 22:14	(1)
2014-10-05	F	11:20 - 11:20	(1)
2014-10-05	F	15:34 - 15:34	(1)
2014-10-05	F	19:09 - 19:09	(1)
2014-10-05	F	19:43 - 19:48	(6)
2014-10-05	F	20:22 - 20:22	(1)
2014-10-06	F	00:39 - 00:39	(1)
2014-10-06	F	04:14 - 04:14	(1)
2014-10-06	F	07:16 - 07:16	(1)
2014-10-06	F	07:22 - 07:22	(1)
2014-10-07	F	00:15 - 00:15	(1)
2014-10-07	F	06:17 - 06:17	(1)
2014-10-07	F	20:37 - 20:37	(1)
2014-10-07	F	22:22 - 22:23	(2)
2014-10-07	F	22:48 - 22:49	(2)
2014-10-08	F	20:19 - 20:19	(1)
2014-10-09	F	00:20 - 00:21	(2)
2014-10-09	F	01:06 - 01:06	(1)
2014-10-09	F	03:54 - 03:57	(4)
2014-10-09	F	08:17 - 08:17	(1)
2014-10-09	F	23:15 - 23:15	(1)
2014-10-09	F	23:40 - 23:40	(1)
2014-10-09	F	23:46 - 23:46	(1)
2014-10-10	F	04:23 - 04:24	(2)
2014-10-10	F	22:18 - 22:18	(1)
2014-10-10	F	22:27 - 22:27	(1)
2014-10-11	F	01:30 - 01:30	(1)
2014-10-11	F	01:41 - 01:41	(1)
2014-10-11	F	09:47 - 09:47	(1)
2014-10-11	F	09:59 - 09:59	(1)
2014-10-11	F	22:16 - 22:16	(1)
2014-10-12	F	22:55 - 22:55	(1)
2014-10-13	F	12:12 - 12:12	(1)
2014-10-13	F	18:22 - 18:22	(1)
2014-10-13	F	18:25 - 18:26	(2)
2014-10-13	F	19:44 - 19:44	(1)
2014-10-13	F	20:42 - 20:42	(1)
2014-10-13	F	20:49 - 20:49	(1)
2014-10-13	F	22:34 - 22:35	(2)
2014-10-13	F	22:51 - 22:51	(1)
2014-10-14	F	05:16 - 05:16	(1)
2014-10-14	F	11:01 - 11:01	(1)
2014-10-14	F	18:19 - 18:21	(3)
2014-10-14	F	18:43 - 18:43	(1)
2014-10-14	F	18:46 - 18:46	(1)
2014-10-14	F	19:02 - 19:02	(1)
2014-10-14	F	20:09 - 20:09	(1)
2014-10-14	F	22:45 - 22:45	(1)
2014-10-14	F	23:10 - 23:10	(1)
2014-10-15	F	04:18 - 04:18	(1)
2014-10-15	F	08:01 - 08:02	(2)
2014-10-15	F	10:31 - 10:31	(1)
2014-10-15	F	10:33 - 10:33	(1)
2014-10-15	F	12:55 - 12:55	(1)
2014-10-15	F	17:54 - 17:54	(1)
2014-10-16	F	19:12 - 19:12	(1)
2014-10-16	F	21:30 - 21:30	(1)
2014-10-16	F	21:54 - 21:57	(4)

2014-10-16	F	23:06 - 23:08	(3)
2014-10-16	F	23:37 - 23:37	(1)
2014-10-17	F	04:10 - 04:10	(1)
2014-10-17	F	20:49 - 20:49	(1)
2014-10-17	F	21:20 - 21:20	(1)
2014-10-17	F	22:07 - 22:07	(1)
2014-10-18	F	06:25 - 06:30	(6)
2014-10-18	F	07:55 - 07:59	(5)
2014-10-18	F	09:30 - 09:30	(1)
2014-10-18	F	18:42 - 18:42	(1)
2014-10-18	F	22:03 - 22:04	(2)
2014-10-18	F	22:58 - 22:58	(1)
2014-10-19	F	00:41 - 00:41	(1)
2014-10-19	F	00:49 - 00:49	(1)
2014-10-19	F	20:21 - 20:21	(1)
2014-10-19	F	20:23 - 20:23	(1)
2014-10-20	F	12:20 - 12:20	(1)
2014-10-20	F	16:38 - 16:39	(2)
2014-10-20	F	22:55 - 22:58	(4)
2014-10-20	F	23:08 - 23:09	(2)
2014-10-20	F	23:40 - 23:41	(2)
2014-10-20	F	23:43 - 23:43	(1)
2014-10-21	F	07:32 - 07:32	(1)
2014-10-21	F	16:33 - 16:36	(4)
2014-10-21	F	19:56 - 19:56	(1)
2014-10-21	F	20:30 - 20:30	(1)
2014-10-21	F	20:49 - 20:49	(1)
2014-10-21	F	21:00 - 21:02	(3)
2014-10-21	F	22:29 - 22:30	(2)
2014-10-22	F	15:49 - 15:49	(1)
2014-10-22	F	15:59 - 15:59	(1)
2014-10-22	F	17:04 - 17:04	(1)
2014-10-23	F	16:32 - 16:32	(1)
2014-10-24	F	00:51 - 00:52	(2)
2014-10-24	F	00:57 - 00:57	(1)
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2014-10-25	F	01:25 - 01:25	(1)
2014-10-25	F	03:58 - 03:58	(1)
2014-10-25	F	10:16 - 10:16	(1)
2014-10-25	F	21:10 - 21:12	(3)
2014-10-26	F	01:53 - 01:53	(1)
2014-10-26	F	06:43 - 06:43	(1)
2014-10-26	F	20:24 - 20:24	(1)
2014-10-26	F	21:27 - 21:28	(2)
2014-10-26	F	22:25 - 22:25	(1)
2014-10-27	F	02:19 - 02:19	(1)
2014-10-27	F	05:12 - 05:12	(1)
2014-10-27	F	15:39 - 15:39	(1)
2014-10-27	F	22:08 - 22:12	(5)
2014-10-27	F	23:30 - 23:30	(1)
2014-10-28	F	02:45 - 02:45	(1)
2014-10-28	F	15:49 - 15:49	(1)
2014-10-28	F	15:57 - 15:57	(1)
2014-10-28	F	21:47 - 21:47	(1)
2014-10-28	F	21:49 - 21:49	(1)
2014-10-28	F	23:35 - 23:35	(1)
2014-10-29	F	03:27 - 03:27	(1)
2014-10-29	F	18:17 - 18:18	(2)
2014-10-30	F	16:10 - 16:10	(1)
2014-10-30	F	22:51 - 22:53	(3)
2014-10-31	F	05:11 - 05:11	(1)

2014-10-31	F	20:32 - 20:32	(1)
2014-10-31	F	20:56 - 20:56	(1)
2014-11-01	F	07:07 - 07:10	(4)
2014-11-01	F	10:49 - 10:49	(1)
2014-11-02	F	00:21 - 00:21	(1)
2014-11-02	F	01:20 - 01:20	(1)
2014-11-02	F	01:43 - 01:43	(1)
2014-11-02	F	17:54 - 17:54	(1)
2014-11-02	F	18:30 - 18:32	(3)
2014-11-02	F	19:46 - 19:46	(1)
2014-11-03	F	07:37 - 07:37	(1)
2014-11-03	F	09:05 - 09:05	(1)
2014-11-03	F	09:07 - 09:07	(1)
2014-11-03	F	11:02 - 11:02	(1)
2014-11-03	F	11:19 - 11:20	(2)
2014-11-03	F	21:04 - 21:07	(4)
2014-11-04	F	13:54 - 13:56	(3)
2014-11-04	F	21:02 - 21:16	(15)
2014-11-04	F	23:23 - 23:23	(1)
2014-11-04	F	23:25 - 23:25	(1)
2014-11-05	F	00:08 - 00:08	(1)
2014-11-05	F	13:41 - 13:41	(1)
2014-11-05	F	22:36 - 22:38	(3)
2014-11-05	F	23:08 - 23:11	(4)
2014-11-06	F	08:39 - 08:39	(1)
2014-11-06	F	22:35 - 22:35	(1)
2014-11-06	F	22:50 - 22:50	(1)
2014-11-07	F	11:51 - 11:51	(1)
2014-11-07	F	18:17 - 18:17	(1)
2014-11-07	F	18:40 - 18:40	(1)
2014-11-07	F	23:30 - 23:30	(1)
2014-11-08	F	10:31 - 10:31	(1)
2014-11-08	F	21:19 - 21:19	(1)
2014-11-08	F	21:21 - 21:21	(1)
2014-11-08	F	22:33 - 22:33	(1)
2014-11-08	F	23:13 - 23:17	(5)
2014-11-08	F	23:34 - 23:34	(1)
2014-11-08	F	23:51 - 23:51	(1)
2014-11-09	F	14:05 - 14:05	(1)
2014-11-09	F	19:25 - 19:25	(1)
2014-11-09	F	23:33 - 23:33	(1)
2014-11-10	F	17:18 - 17:18	(1)
2014-11-11	F	18:04 - 18:04	(1)
2014-11-11	F	20:14 - 20:14	(1)
2014-11-12	F	04:50 - 04:50	(1)
2014-11-12	F	19:15 - 19:15	(1)
2014-11-12	F	22:18 - 22:21	(4)
2014-11-13	F	06:18 - 06:18	(1)
2014-11-14	F	03:42 - 03:43	(2)
2014-11-14	F	06:02 - 06:02	(1)
2014-11-14	F	08:53 - 08:53	(1)
2014-11-14	F	14:29 - 14:30	(2)
2014-11-14	F	19:42 - 19:42	(1)
2014-11-14	F	21:54 - 21:54	(1)
2014-11-14	F	22:57 - 22:57	(1)
2014-11-14	F	22:59 - 22:59	(1)
2014-11-14	F	23:24 - 23:24	(1)
2014-11-15	F	13:08 - 13:08	(1)
2014-11-15	F	17:14 - 17:14	(1)
2014-11-15	F	19:51 - 19:51	(1)
2014-11-15	F	20:29 - 20:29	(1)

2014-11-16	F	03:23 - 03:23	(1)
2014-11-16	F	06:37 - 06:38	(2)
2014-11-16	F	08:11 - 08:11	(1)
2014-11-16	F	09:27 - 09:27	(1)
2014-11-16	F	18:59 - 18:59	(1)
2014-11-16	F	19:01 - 19:01	(1)
2014-11-16	F	21:37 - 21:47	(11)
2014-11-17	F	00:16 - 00:17	(2)
2014-11-17	F	01:29 - 01:30	(2)
2014-11-17	F	15:31 - 15:31	(1)
2014-11-17	F	20:45 - 20:46	(2)
2014-11-17	F	22:28 - 22:28	(1)
2014-11-18	F	13:22 - 13:22	(1)
2014-11-18	F	18:01 - 18:01	(1)
2014-11-19	F	00:24 - 00:24	(1)
2014-11-19	F	00:30 - 00:30	(1)
2014-11-19	F	05:37 - 05:37	(1)
2014-11-19	F	09:54 - 09:54	(1)
2014-11-19	F	12:01 - 12:01	(1)
2014-11-19	F	12:24 - 12:24	(1)
2014-11-19	F	19:30 - 19:30	(1)
2014-11-19	F	20:04 - 20:04	(1)
2014-11-19	F	21:39 - 21:39	(1)
2014-11-20	F	00:49 - 00:49	(1)
2014-11-20	F	18:28 - 18:28	(1)
2014-11-20	F	18:31 - 18:31	(1)
2014-11-20	F	19:57 - 19:57	(1)
2014-11-21	F	00:38 - 00:42	(5)
2014-11-21	F	00:59 - 00:59	(1)
2014-11-21	F	01:16 - 01:16	(1)
2014-11-21	F	09:54 - 09:54	(1)
2014-11-22	F	00:17 - 00:19	(3)
2014-11-22	F	20:09 - 20:09	(1)
2014-11-22	F	21:50 - 21:53	(4)
2014-11-23	F	18:43 - 18:43	(1)
2014-11-23	F	21:51 - 21:51	(1)
2014-11-23	F	22:25 - 22:30	(6)
2014-11-23	F	22:45 - 22:45	(1)
2014-11-24	F	16:03 - 16:03	(1)
2014-11-24	F	22:17 - 22:17	(1)
2014-11-24	F	22:37 - 22:38	(2)
2014-11-24	F	22:53 - 22:53	(1)
2014-11-24	F	23:02 - 23:02	(1)
2014-11-25	F	07:11 - 07:11	(1)
2014-11-25	F	22:45 - 22:50	(6)
2014-11-26	F	02:28 - 02:28	(1)
2014-11-26	F	10:33 - 10:36	(4)
2014-11-26	F	13:20 - 13:20	(1)
2014-11-26	F	16:50 - 16:50	(1)
2014-11-27	F	00:17 - 00:17	(1)
2014-11-27	F	00:32 - 00:32	(1)
2014-11-27	F	05:53 - 05:53	(1)
2014-11-27	F	21:39 - 21:39	(1)
2014-11-29	F	09:11 - 09:11	(1)
2014-11-29	F	20:07 - 20:07	(1)
2014-11-29	F	20:24 - 20:24	(1)
2014-11-30	F	17:08 - 17:08	(1)
2014-11-30	F	17:30 - 17:30	(1)
2014-12-01	F	00:02 - 00:02	(1)
2014-12-01	F	03:51 - 03:54	(4)
2014-12-01	F	18:44 - 18:44	(1)

2014-12-01	F	22:54 - 22:54	(1)
2014-12-01	F	23:48 - 23:48	(1)
2014-12-02	F	05:12 - 05:12	(1)
2014-12-02	F	07:59 - 07:59	(1)
2014-12-02	F	09:42 - 09:42	(1)
2014-12-04	F	18:56 - 18:59	(4)
2014-12-04	F	19:30 - 19:30	(1)
2014-12-04	F	20:23 - 20:25	(3)
2014-12-04	F	23:27 - 23:38	(12)
2014-12-05	F	13:20 - 13:20	(1)
2014-12-05	F	18:30 - 18:30	(1)
2014-12-05	F	19:05 - 19:05	(1)
2014-12-05	F	23:10 - 23:11	(2)
2014-12-06	F	00:20 - 00:20	(1)
2014-12-06	F	09:26 - 09:26	(1)
2014-12-06	F	21:22 - 21:22	(1)
2014-12-06	F	23:54 - 23:54	(1)
2014-12-07	F	00:00 - 00:02	(3)
2014-12-07	F	01:47 - 01:47	(1)
2014-12-07	F	11:33 - 11:34	(2)
2014-12-07	F	12:44 - 12:46	(3)
2014-12-07	F	17:13 - 17:13	(1)
2014-12-07	F	18:03 - 18:03	(1)
2014-12-07	F	20:16 - 20:16	(1)
2014-12-07	F	22:34 - 22:34	(1)
2014-12-07	F	23:27 - 23:27	(1)
2014-12-08	F	12:55 - 12:58	(4)
2014-12-08	F	14:40 - 14:40	(1)
2014-12-08	F	18:13 - 18:13	(1)
2014-12-08	F	23:39 - 23:39	(1)
2014-12-08	F	23:41 - 23:42	(2)
2014-12-09	F	00:07 - 00:11	(5)
2014-12-09	F	12:37 - 12:41	(5)
2014-12-09	F	18:55 - 18:55	(1)
2014-12-09	F	20:17 - 20:18	(2)
2014-12-09	F	20:24 - 20:24	(1)
2014-12-09	F	21:24 - 21:24	(1)
2014-12-09	F	23:46 - 23:47	(2)
2014-12-09	F	23:49 - 23:49	(1)
2014-12-10	F	02:34 - 02:34	(1)
2014-12-10	F	19:26 - 19:26	(1)
2014-12-10	F	21:26 - 21:26	(1)
2014-12-11	F	02:12 - 02:12	(1)
2014-12-11	F	10:31 - 10:31	(1)
2014-12-11	F	10:33 - 10:33	(1)
2014-12-11	F	16:19 - 16:21	(3)
2014-12-11	F	19:20 - 19:20	(1)
2014-12-11	F	20:26 - 20:26	(1)
2014-12-11	F	21:05 - 21:05	(1)
2014-12-11	F	21:29 - 21:29	(1)
2014-12-11	F	22:02 - 22:03	(2)
2014-12-11	F	22:05 - 22:05	(1)
2014-12-11	F	22:09 - 22:09	(1)
2014-12-11	F	22:12 - 22:12	(1)
2014-12-11	F	23:34 - 23:35	(2)
2014-12-12	F	12:21 - 12:22	(2)
2014-12-12	F	14:23 - 14:23	(1)
2014-12-12	F	19:58 - 20:03	(6)
2014-12-13	F	22:39 - 22:39	(1)
2014-12-13	F	23:50 - 23:50	(1)
2014-12-14	F	14:53 - 14:53	(1)

2014-12-14	F	19:22 - 19:22	(1)
2014-12-14	F	19:49 - 19:51	(3)
2014-12-15	F	10:09 - 10:09	(1)
2014-12-15	F	22:50 - 22:50	(1)
2014-12-15	F	23:08 - 23:08	(1)
2014-12-15	F	23:40 - 23:40	(1)
2014-12-16	F	00:22 - 00:22	(1)
2014-12-16	F	19:38 - 19:39	(2)
2014-12-17	F	08:10 - 08:10	(1)
2014-12-17	F	09:45 - 09:45	(1)
2014-12-17	F	10:22 - 10:22	(1)
2014-12-17	F	17:40 - 17:40	(1)
2014-12-17	F	20:44 - 20:46	(3)
2014-12-18	F	12:30 - 12:30	(1)
2014-12-18	F	16:39 - 16:39	(1)
2014-12-18	F	20:49 - 20:49	(1)
2014-12-18	F	23:21 - 23:21	(1)
2014-12-19	F	02:23 - 02:24	(2)
2014-12-19	F	06:30 - 06:30	(1)
2014-12-19	F	15:46 - 15:46	(1)
2014-12-19	F	17:19 - 17:20	(2)
2014-12-19	F	19:21 - 19:22	(2)
2014-12-19	F	22:18 - 22:19	(2)
2014-12-20	F	02:17 - 02:24	(8)
2014-12-20	F	02:42 - 02:43	(2)
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2014-12-20	F	23:22 - 23:23	(2)
2014-12-20	F	23:26 - 23:26	(1)
2014-12-21	F	23:18 - 23:20	(3)
2014-12-22	F	05:33 - 05:35	(3)
2014-12-22	F	05:39 - 05:39	(1)
2014-12-22	F	11:36 - 11:36	(1)
2014-12-23	F	11:15 - 11:15	(1)
2014-12-23	F	11:17 - 11:17	(1)
2014-12-23	F	14:14 - 14:14	(1)
2014-12-23	F	21:24 - 21:24	(1)
2014-12-23	F	21:30 - 21:31	(2)
2014-12-24	F	02:11 - 02:11	(1)
2014-12-24	F	16:59 - 17:00	(2)
2014-12-24	F	17:41 - 17:41	(1)
2014-12-24	F	17:50 - 17:50	(1)
2014-12-24	F	17:52 - 17:52	(1)
2014-12-24	F	17:54 - 17:54	(1)
2014-12-24	F	20:12 - 20:13	(2)
2014-12-24	F	20:20 - 20:20	(1)
2014-12-24	F	20:24 - 20:24	(1)
2014-12-24	F	20:34 - 20:34	(1)
2014-12-25	F	08:57 - 08:58	(2)
2014-12-25	F	22:06 - 22:07	(2)
2014-12-26	F	00:51 - 00:51	(1)
2014-12-26	F	06:38 - 06:42	(5)
2014-12-26	F	11:09 - 11:09	(1)
2014-12-26	F	21:08 - 21:08	(1)
2014-12-26	F	21:26 - 21:26	(1)
2014-12-27	F	13:46 - 13:46	(1)
2014-12-27	F	17:01 - 17:01	(1)
2014-12-27	F	17:03 - 17:03	(1)
2014-12-27	F	22:21 - 22:21	(1)
2014-12-27	F	23:45 - 23:45	(1)
2014-12-28	F	01:54 - 01:55	(2)
2014-12-28	F	02:21 - 02:21	(1)

```
2014-12-28    F      05:49 - 05:49  (1)
2014-12-29    F      00:28 - 00:28  (1)
2014-12-29    F      16:26 - 16:26  (1)
2014-12-30    F      00:03 - 00:04  (2)
2014-12-30    F      00:11 - 00:11  (1)
2014-12-30    F      01:52 - 01:52  (1)
2014-12-30    F      18:29 - 18:29  (1)
2014-12-30    F      19:53 - 19:53  (1)
2014-12-30    F      20:00 - 20:01  (2)
2014-12-30    F      22:51 - 22:51  (1)
2014-12-31    F      08:45 - 08:45  (1)
2014-12-31    F      14:15 - 14:15  (1)
2014-12-31    F      16:04 - 16:04  (1)
2014-12-31    F      21:33 - 21:33  (1)
2014-12-31    F      23:32 - 23:33  (2)

Total: 13903

Backup data
-----------------------
Mawson MAW (Narod) vector variometer data used
for infill of MW2 (DMI) vector variometer during 2014.
---------------------------------------------------------
Date     Interval (hh:mm)
2014-04-18 08:12 - 2014-04-19 00:24
2014-05-20 02:24 - 2014-05-21 01:00
2014-06-22 06:54 - 2014-06-22 22:21
2014-06-27 07:59 - 2014-06-27 08:04
2014-07-24 00:00 - 2014-07-24 09:44


                    <END>
```

7.9.1.3 2015

```
                             MAW
            MAWSON OBSERVATORY INFORMATION 2015

  ACKNOWLEDGE- Users of the MAW data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: MAW
     LOCATION: Mawson Station, MacRobertson Land-Antarctica
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 157.60 Deg.
    LONGITUDE: 62.88  Deg. E
    ELEVATION: 12 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DMI on Zeiss 020B)
               and Proton Precession Magnetometer (GSM-90)

    RECORDING
   VARIOMETER: Danish Meteorological Institute suspended
               fluxgate FGE Magnetometer
               GSM-90 Proton Precession Magnetometer

  ORIENTATION: Two horizontal fluxgate channels are aligned
               equally about the average magnetic north at
               the time of installation.
```

```
               This orientation is referred to as ABZ.
DYNAMIC RANGE: +/-3200nT
   RESOLUTION: 0.3nT
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: Narod ringcore fluxgate (RCF) magnetometer

    K-NUMBERS: Computer-assisted scaling from preliminary
               Narod variometer data
     K9-LIMIT: 1500 nT

         GINS: Edinburgh
    SATELLITE: Http delivery

    OBSERVERS: Garry Beavan
               Trevor Crews
               Tony Harris

      CONTACT: Geomagnetism
               Geoscience Australia
               G.P.O. Box 378
               Canberra, A.C.T, 2601
               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9999
               e-mail: geomag@ga.gov.au
               WWW: http://www.ga.gov.au

Notes
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The magnetic observatory is part of the Mawson scientific
research station in Mac Robertson Land, Antarctica. The
station is on the edge of Horseshoe Harbour and built on
bare charnockite basement rock - there is no ice or soil
cover. The magnetic observatory is situated in a magnetic
quiet zone at East Bay on the southeast extremity of the
station and comprises:
* the Variometer House:
      East room - DMI sensor and electronics, and GEM
                  GSM-90 electronics
      West room - Narod sensor and electronics and GEM
                  GSM-90 sensor
      Centre room - acquisition PC's and electrical wooden
                  cabinet.

* the Absolute House;

In 1955 the Mawson observatory commenced recording magnetic
variations with a 3-component analogue magnetograph. The
observatory has continuously recorded the geomagnetic field
at Mawson since that time. In December 1985 the magnetic
observatory was converted to digital recording. It was
accepted as an INTERMAGNET observatory in 2006. It is
operated by Geoscience Australia as part of the Australian
National Antarctic Research Expeditions.
```

Table 1. Key observatory data

IAGA code:	MAW
Commenced operation:	1955
Geographic latitude:	67d 36' 14" S
Geographic longitude:	62d 52' 45" E
Geomagnetic latitude:	-73.05d
Geomagnetic longitude:	112.21d
K 9 index lower limit:	1500 nT
Principal pier:	Pier A
Pier elevation (top):	12 m AMSL
Principal reference mark:	BMR89/1
Reference mark azimuth:	350d 36.9'
Reference mark distance:	112 m
Observers:	G Beavan (until 2015-01-28)
	T Crews (from 2015-02-11)
	T Harris (from 2015-11-26)

Local meteorological conditions

The meteorological temperature at Mawson during 2015 varied from a minimum of -33.7 degC (2015-07-11) to a maximum of 8.2 degC (2015-11-11). Daily minimum temperatures varied from -33.7 degC to 0.7 degC (average -15.9+/-8.9 degC); daily maximum temperatures varied from -29.0 degC to 8.2 degC (average -9.3+/-8.5 degC); daily temperature ranges varied from 0.1 degC to 21.7 degC (average 6.6+/-3.2 degC).

The daily maximum wind gust varied from 13 to 181 km/h (average 82+/-28 km/h). The maximum daily maximum wind gust was 181 km/h on (2015-05-29). The minimum daily maximum wind gust was 13 km/h on (2015-07-06).

These conditions have been derived from data supplied by the Bureau of Meteorology (http://www.bom.gov.au).

Variometers

The variometers used during 2015 are described in Table 2.

The DMI sensor was located in the recording (eastern) room of the Variometer House. Two of the orthogonal sensors were horizontal and oriented at an angle of 45d to the direction of the horizontal component of the magnetic field at the time of installation. The third sensor was aligned vertically.

The Narod was located within the sensor (western) room along with the total field magnetometer. The two horizontal Narod sensors were oriented so that they were each at an angle of 45d to the direction of the horizontal component of the magnetic field at the time of installation. The third sensor was aligned vertically. A pulse inverter was installed between the Garmin GPS clock and the Narod magnetometer, as the GPS produces the opposite polarity pulse to that required by the Narod. The Narod magnetometer produced eight samples per second that were Gaussian filtered to 1 second data and then output on the second. The total field magnetometer was configured for 10 second sampling.

The DMI magnetometer has been selected for production of definitive data as the Narod magnetometer requires further parametric adjustment.

The DMI and Narod magnetometers were connected to two separate QNX/ARK 3360 industrial computers: ga-maw-mag1 and ga-maw-mag2 respectively, each with its own battery box power and GPS clock, and sharing a screen and keyboard using a KVM switch. The GSM-90 total field variometer was connected to ga-maw-mag2 with the Narod magnetometer. GSM-90 data were recorded on both computers by linking it over the QNX qnet network from ga-maw-mag1 to ga-maw-mag2.

Sensor and electronics temperatures of both fluxgate magnetometers were monitored by in-built dual temperature systems.

Temperature regulation during 2015, as in previous years, was not ideal and affects data quality. The heating systems (a regulated heater in each sensor room) are inefficient and inadequate. This is particularly apparent during winter storms which cause large external and corresponding internal temperature variations that are correlated to F difference (Fv - Fs) changes. As the baseline measurements are weekly at best, timing of baseline correction gradients have been derived from F difference data in conjunction with temperature data. Applied to mitigate the storm temperature effects, these have correlated well with the absolute baseline measurements.

The Narod electronics, the DMI sensor and the DMI electronics were located in the same room and showed similar temperature variances of about 26 degC, 24 degC and 24 degC respectively. The Narod sensor, located in another room, showed better temperature stability with a variance of about 8.5 degC. Improved temperature control is a priority for future upgrade or maintenance visits.

The DMI variometer (referred as MW2 system on table 2.) was used as the primary source for :

1. Definitive 2015 Mawson data delivered in 2016.
2. Quasi-definitive 2015 Mawson data delivered during 2015 and 2016.
3. Real-time 2015 Mawson data delivered during 2015.
4. Mawson K-indices 2015.

Neither DMI vector variometer 1-second data nor scalar variometer 10-second data required de-spiking except for one short period from 2015-05-28 18:00:00 to 2015-05-29 06:00:00 where all channels suffered from unknown noise. It was found the filter parameters from another site (the Kakadu thunderstorm filter) performed well in this circumstance.

The de-spiking parameters required a spike to exceed a multiple ("Factor") times a discriminating value. The discriminating value is calculated as 8/9 * 100 percentile value from a buffer of recently calculated deviations. A deviation is the minimum deviation of the point from the linear interpolations of 3 local pairs of points. The buffer is formed of recent deviations or the noise level ("Noise") whichever is greater. The spike is corrected if the three local interpolations agree to better than 9/8 * discriminating value. Otherwise the point is marked as "missing".

"Raw" prefix parameters affect raw data, non-prefix filters affect derived data and are applied after the "raw" parameters. Vector parameters affect the DMI data and scalar parameters affect the total field variometer data. More than one filter stage can be applied, these are signified by appending a number, e.g. "scalarFactor1". A parameter is turned off by setting its Factor to zero or delisting it.

The filter parameters used during this period are as follows:

```
# filter (KDU thunderstorm values)
# used for some noisy data 28-29 May 2015 only
scalarFactor=4
scalarNoise=1
scalarFactor1=9
scalarNoise1=0.1
rawVectorFactor=5
rawVectorNoise=4
vectorFactor=6
vectorNoise=0.05
```

Both DMI and Narod variometers performed satisfactorily during the year. The scalar GSM-90 variometer(s) performed satisfactorily throughout 2015 except for May when an adjustment had to be performed after data became unreliable.

The ARK3360F acquisition PCs running QNX6.5 were rebooted twice during the year causing minor data losses, otherwise the acquisition system has been working well.

Table 2. Magnetic variometers used in 2015.

3-component variometer:	Narod (MAW)
Serial number:	NGL-200907-1 with BMR 9004-3
Type:	ring-core fluxgate
Orientation:	NW, NE, Z
Acquisition interval:	1 s
Scale value:	0.01 nT / count
Period of use:	from 2011-02-26
3-component variometer:	DMI FGE (MW2)
Serial number:	E0291 / S0244
Type:	suspended linear-core fluxgate
Orientation:	NW, NE, Z
Acquisition interval:	1 s
A/D converter:	ADAM 4017 module (+/-10V)
Scale value:	0.32 nT / count
Period of use:	from 2006-05-17
Total-field variometer:	GEM Systems GSM-90
Serial number:	8092902 / 83384
Type:	Overhauser effect
Acquisition interval:	10 s

```
Resolution:              0.01 nT
Period of use:           from 2011-03-11

Data acquisition system:GDAP: ARK 3660F/QNX 6.5 (2)
Timing:                  Garmin GPS16 clock (2)
Communications:          ANARESAT

Variometer clock corrections
----------------------------
Time stamps applied to the variometer data were obtained
from the acquisition computer system clock. That clock was
synchronised to a GPS clock. During 2015, adjustments to the
system clock were less than 10 ms except on the following
occasions:

ga-maw-mag1 (DMI variometer)
----------------------------
2015-04-28      07:13:19     1.444 s   CPU reboot
2015-07-01      00:00:40    -1.000 s   leap second addition
2015-11-25      22:10:41     0.745 s   CPU reboot

ga-maw-mag2 (Narod, GSM-90 variometers)
--------------------------------------
2015-04-28      22:56:31     0.530 s   CPU reboot
2015-07-01      00:00:40    -1.000 s   leap second addition
2015-11-25      01:12:24    -0.555 s   CPU reboot


Absolute instruments
--------------------
The principal absolute magnetometers used at Mawson and
their adopted corrections for 2015 are described in Table 3.

The DI0132D/313792-derived sensor-orientation angles and the
electronics offset were stable through 2015.

The absolute GSM-90 appeared to perform well throughout
2015.

All absolute observations were performed on Pier A while the
azimuth mark BMR89/1 was used as the declination reference.

Instrument corrections of zero have been adopted for all
Mawson absolute instruments in use for 2015 as no new
evidence about corrections was gathered. At the 2015 mean
magnetic field values at Mawson these D, I and F corrections
translate to corrections of:

DX = 0.0 nT    DY = 0.0 nT    DZ = 0.0 nT

Instrument corrections were applied while reducing absolute
observations to determine baselines and, accordingly, these
corrections have been applied to all Mawson 2015 final
data.

Table 3. Absolute magnetometers and their adopted
corrections for 2015. Corrections are applied in the sense
Standard = Instrument + correction.
-----------------------------------------------------------
DI fluxgate:   DMI
Serial number: DI0132D
```

```
Theodolite:    Zeiss 020B
Serial number: 313792
A/D:           Pico FJY06/139
Resolution:    0.1'
D correction:  0.0'
I correction:  0.0'

Total-field magnetometer: GEM Systems GSM-90
Serial number: 4081417 / 42187
Type:          Overhauser effect
Resolution:    0.01 nT
Correction:    0.0 nT

DI fluxgate:   DMI (Spare instrument, unused)
Serial number: DI0133D
Theodolite:    Zeiss 020B
Serial number: 312714
A/D:           Pico GJY03/121
Resolution:    0.1'
D correction: -0.05'
I correction: -0.15'
```

Baselines

There were 52 pairs of weekly absolute observations during 2015 more-or-less evenly spaced throughout the year. 46 pairs were good, 4 sets had a single good observation and 2 sets were excluded, giving a total of 96 observations. The data sets excluded were:

2015-01-28 (one set)
2015-05-12 (one set)
2015-06-11 (both sets)
2015-06-24 (one set)
2015-11-03 (one set)
2015-11-25 (both sets).

The F difference time series (Fv - Fs) was plotted to monitor variometer baseline variations throughout 2015.

Baseline variations were mostly smooth throughout the year except for winter storm periods which showed sharp variations corresponding to storm-induced temperature variations due to the inadequate temperature control. As absolute measurements are taken weekly, the best time and drift resolution was offered by the F difference (per minute) data in conjunction with the daily temperature data. The baseline values were found to correlate well when fitted on this basis.

For 2015 the adopted baselines had a range of 3.4 nT in X and Y and 5.6 nT in Z.

Baselines were adopted by manual fitting of a piecewise linear spline function to absolute observation residuals in conjunction with the F difference and weather data where necessary.

The standard deviations of the differences between the adopted variometer model and data using the DMI variometer and 96 observations as pairs (where valid) of weekly absolute observations were:

	Mean	Std.dev
X	0.1 nT	0.6 nT
Y	0.0 nT	0.6 nT
Z	0.2 nT	0.4 nT
D	1"	7"
I	1"	2.5"
F	0.1 nT	0.3 nT

During 2015 variometer (Fv - Fs) variations were within a 2.7 nT range on a daily basis and agreed with the absolute F (measured on pier A during weekly observations) minus Fs. The minute data shows larger transient Fv Fs excursions due to large, rapid field changes at Mawson caused by real events, for example aurorae.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2015 MAW definitive data and real time reported 1-minute data sets (MW2 definitive - MW2 real time) were:

	X	Y	Z
Average	+0.8	-0.3	+2.6
Std.Dev	+1.5	+0.7	+3.7
Min	-0.9	-1.6	-1.7
Max	+3.7	+0.7	+9.3

The annual statistics of the 12 monthly averages of the difference between the 2015 MAW definitive data and quasi-definitive 1-minute data sets (MW2 definitive - MW2 quasi-definitive) were:

	X	Y	Z
Average	-0.0	+0.2	-0.1
Std.Dev	+0.3	+0.3	+0.4
Min	-0.4	-0.2	-1.2
Max	+0.6	+0.6	+0.5

The MAW 2015 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The Mawson observers were members of the Australian National Antarctic Research Expedition and were employed by the Australian Antarctic Division with funding support by Geoscience Australia. Mawson personnel change over each summer with varying periods of overlap. Garry Beavan operated the observatory until 2015-01-28. Trevor Crews operated the observatory from 2015-02-11 until 2015-11-17 plus one additional day on 2015-12-23. Tony Harris operated the observatory from 2015-11-26 on, except for 2015-12-23 (Trevor Crews).

The observer was responsible for the continuous operation of the observatory and performed equipment maintenance and installation as required. The observer also monitored for any unwanted contamination by intrusions to the quiet zone surrounding the observatory. In 2015 the observers performed absolute observations weekly and forwarded them by email to Geoscience Australia. All data processing was performed at Geoscience Australia.

During 2015 data were recorded on two QNX acquisition computers which were connected to the station's radio network hub. Data were retrieved to Geoscience Australia using rsync over ssh every 6 minutes. Data from the alternate variometer system were also retrieved every 6 minutes, interleaved with the primary variometer.

Real-time data were processed automatically at Geoscience Australia then distributed, usually within a 2 to 15 minute delay.

Daily data plots were examined at Geoscience Australia for possible problems which were usually rectified quickly by the local observer. The final data for the year were reduced and analysed by Geoscience Australia staff.

For 2015 Definitive data, the INTERMAGNET filter was applied to convert 1 second vector data to 1 minute data. An INTERMAGNET filter was also applied to scalar data.

The distribution of Mawson 2015 data is described in Table 4. Data losses are identified in Table 5.

Table 4. Distribution of Mawson 2015 data.

Recipient	Status	Sent
1-second values		
BoM Space Weather Services	preliminary	real time
INTERMAGNET	preliminary	real time
WDC for Geomagnetism Kyoto	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	quasi-definitive	monthly
INTERMAGNET	definitive	Sept 2016
WDC for Geomagnetism Kyoto	preliminary	real time

Significant events at Mawson in 2015

Taken from the Mawson information file for 2015.

2015-01-28 06:00-06:30 Fire detector inspection
2015-02-01 09:16-09:21 inspection visit to variometer building
2015-02-10 Aurora Australis arrives in Horseshoe Harbour for resupply
2015-02-12 - 2015-02-19 footprints through the quiet zone 12-18 Feb, possible interference
2015-02-18 Trevor Crews (new SCTO) takes over from Garry

	Beavan
2015-04-08	04:37 update MachR and NGL driver to GdapDeviceNGLB - Also requires stopping GdapDeviceGSM90 GdapDeviceNGLB includes 0.4 s analogue data delay
2015-04-22	negative time jump in MAW data file 05:23
2015-04-23	multiple negative time jump in MAW data file
2015-04-27	03:00 Potential for contamination as electricians undertake absolute hut building inspection
2015-04-28	27-Apr 0900-0915 local time: inspection by electricians
2015-04-28	07:12 reboot ga-maw-mag1 (DMI) to clear TCP stack of "TIME-WAIT" jobs 22:55 reboot ga-maw-mag2 (NGL) to clear TCP stack of "TIME-WAIT" jobs
2015-05-28	15: variometer PPM data becomes intermittent backward time jump in MAW data
2015-05-29	01: stop PPM, test instrument, adjust quality filter (include "345") 01:15 restart PPM backward time jump in MAW data
2015-06-21	21:23 Backward time jump in MAW data
2015-07-23	Backward time jumps
2015-07-31	Possible contamination- electrician inspecting absolute hut 31-July
2015-10-12	0600 Possible contamination- Observer enters Variometer bldg. to inspect wireless link
2015-11-25	01:11 reboot ga-maw-mag2 to clear TCP stack (NGL data) 22:09 reboot ga-maw-mag1 to clear TCP stack (DMI data) New observer Tony Harris (TNH) on site and starts obs under instruction from Trevor Crews
2015-12-08	Unknown contamination 25-Oct ~08:04:08-08:04:22 - affects MAW, MW2 and the PPM
2016-01-18	Unknown contamination 31-Dec ~14:22:58-14:24:41 - affects MAW, MW2 and the PPM
2016-02-01	Tony Harris (AAD Observer) cannot identify any possible source of contamination for 31-Dec

K indices

Mawson K indices for 2015 have been derived using a computer-assisted method developed at Geoscience Australia and based on the IAGA-accepted LRNS algorithm. K indices were scaled from preliminary data from the DMI variometer during 2015.

Table 5. Mawson data losses.

Vector data
Vector data for the year was reliable with only 34 minutes lost. The sources were service and inspections (26 min), unknown contamination (5 min) and CPU Reboots (3 min).

Date	Interval (hh:mm)	Data loss (minutes)

2015-01-28	XYZ	06:08 - 06:11	(4)	Alarm service
2015-01-28	XYZ	06:18 - 06:28	(11)	Alarm service
2015-01-28	XYZ	06:37 - 06:38	(2)	Alarm service
2015-02-01	XYZ	09:15 - 09:16	(2)	Alarm service
2015-02-08	XYZ	07:01 - 07:01	(1)	Unknown
2015-04-27	XYZ	03:08 - 03:08	(1)	Elec Inspection
2015-04-28	XYZ	07:12 - 07:12	(1)	CPU Reboot
2015-07-31	XYZ	04:12 - 04:16	(5)	Elec Inspection
2015-10-12	XYZ	05:58 - 05:58	(1)	Link Inspection
2015-10-25	XYZ	08:04 - 08:04	(1)	Unknown
2015-11-25	XYZ	22:08 - 22:09	(2)	CPU Reboot
2015-12-31	XYZ	14:23 - 14:25	(3)	Unknown

Total: 34

Scalar data

Scalar data was generally reliable for the year. Some instrument issues were encountered during May which resulted in minor data loss. Furthermore some noise occurred during and around the PPM adjustment which resulted in filtration being applied for this period and some data loss. A total of 102 minutes was lost, comprising service and inspections (33 min), PPM issues and adjustment (52 min), PPM noise post-adjustment (3 min), unknown contamination (11 min) and CPU Reboots (3 min).

Date		Interval (hh:mm)	Data loss (minutes)	
2015-01-28	F	06:08 - 06:11	(4)	Alarm service
2015-01-28	F	06:18 - 06:28	(11)	Alarm service
2015-01-28	F	06:37 - 06:38	(2)	Alarm service
2015-02-01	F	09:14 - 09:18	(5)	Alarm service
2015-02-11	F	09:44 - 09:45	(2)	Unknown
2015-03-08	F	08:44 - 08:44	(1)	Unknown
2015-04-27	F	03:06 - 03:06	(1)	Elec Inspection
2015-04-27	F	03:10 - 03:12	(3)	Elec Inspection
2015-04-28	F	07:12 - 07:12	(1)	CPU Reboot
2015-05-02	F	03:25 - 03:27	(3)	PPM Problems
2015-05-02	F	03:52 - 03:54	(3)	PPM Problems
2015-05-11	F	21:48 - 21:48	(1)	Unknown
2015-05-28	F	16:29 - 16:31	(3)	PPM Problems
2015-05-28	F	17:25 - 17:27	(3)	PPM Problems
2015-05-28	F	20:23 - 20:25	(3)	Unknown
2015-05-28	F	22:32 - 22:36	(5)	PPM Problems
2015-05-28	F	23:29 - 23:31	(3)	PPM Problems
2015-05-28	F	23:42 - 23:44	(3)	PPM Problems
2015-05-28	F	23:46 - 23:48	(3)	PPM Problems
2015-05-29	F	00:36 - 00:38	(3)	PPM Problems
2015-05-29	F	00:53 - 01:15	(23)	PPM Adjust
2015-05-29	F	01:53 - 01:53	(1)	PPM Noise
2015-05-29	F	02:37 - 02:37	(1)	PPM Noise
2015-05-29	F	05:45 - 05:45	(1)	PPM Noise
2015-07-31	F	04:12 - 04:16	(5)	Elec Inspection
2015-10-12	F	05:57 - 05:58	(2)	Link Inspection
2015-10-25	F	08:04 - 08:04	(1)	Unknown
2015-11-25	F	22:08 - 22:09	(2)	CPU Reboot
2015-12-31	F	14:23 - 14:25	(3)	Unknown

Total: 102

Mawson data loss totals.

```
------------------------
Observatory   Vector           Scalar
Mawson        34 min 0.006%    102 min 0.019%


Backup data
-----------------------
No Mawson MAW (Narod) vector variometer data was used for
infill of MW2 (DMI) vector variometer during 2015.
----------------------------------------------------------

                    <END>
```

7.9.1.4 2016

```
                              MAW
            MAWSON OBSERVATORY INFORMATION 2016

  ACKNOWLEDGE- Users of the MAW data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: MAW
     LOCATION: Mawson Station, MacRobertson Land-
               Antarctica
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 157.60 Deg.
    LONGITUDE: 62.88  Deg. E
    ELEVATION: 12 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DIM)
               and Proton Precession Magnetometer (GSM-90)

    RECORDING
   VARIOMETER: Danish Meteorological Institute suspended
               3-component fluxgate FGE Magnetometer (DMI)
               Proton Precession Magnetometer (GEM GSM-90)

  ORIENTATION: ABZ (Magnetic NW, Magnetic NE and Vertical)
DYNAMIC RANGE: +/-3200 nT
   RESOLUTION: 0.3 nT
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: Narod ringcore fluxgate (RCF) magnetometer

    K-NUMBERS: Computer-assisted scaling from preliminary
               DMI variometer data
     K9-LIMIT: 1500 nT

         GINS: Edinburgh
    SATELLITE: HTTP

    OBSERVERS: Tony Harris
               Trevor Crews

      CONTACT: Geomagnetism Project
               Geoscience Australia
```

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e-mail: geomag@ga.gov.au
www: http://www.ga.gov.au

Notes

Mawson Magnetic Observatory is part of the Mawson scientific research station in Mac Robertson Land, Antarctica. The station is on the edge of Horseshoe Harbour and built on bare charnockite basement rock - there is no ice or soil cover. The magnetic observatory is situated in a magnetic quiet zone at East Bay on the southeast extremity of the station and comprises:

```
 * a Variometer House:
      East room - DMI sensor and electronics, and GEM
                  GSM-90 electronics
      West room - Narod sensor and electronics and GEM
                  GSM-90 sensor
      Centre room - acquisition PC's and electrical wooden
                  cabinet.
```

* an Absolute House: An approximately 4 x 4 m wooden absolute hut is located 80 m south of the variometer building which houses two wooden instrument piers, one of which is used as the principal observation pier (Pier A).

In 1955 the Mawson observatory commenced recording magnetic variations with a 3-component analogue magnetograph. The observatory has continuously recorded the geomagnetic field at Mawson since that time. In December 1985 the magnetic observatory was converted to digital recording. It was accepted as an INTERMAGNET observatory in 2006. It is operated by Geoscience Australia as part of the Australian National Antarctic Research Expeditions (ANARE).

```
IAGA code:             MAW
Commenced operation:   1955
Geographic latitude:   67d 36' 14" S
Geographic longitude:  62d 52' 45" E
Geomagnetic latitude:  -73.05d
Geomagnetic longitude: 112.21d
K 9 index lower limit: 1500 nT
Principal pier:        Pier A
Pier elevation (top):  12 m AMSL
Principal reference mark: BMR89/1
Reference mark azimuth:   350d 36.9'
Reference mark distance:  112 m
Observers: T Harris
           T Crews
```

Table 1. Key observatory data

```
Local meteorological conditions
-------------------------------
The meteorological temperature recorded at Mawson during
2016 varied from a minimum of -33.5 DegC (2016-09-08) to a
maximum of 6.5 DegC (2016-12-21). Daily minimum
temperatures varied from -33.5 DegC to 1.8 DegC (average -
14.7+/-8.5 DegC); daily maximum temperatures varied from -
29.0 DegC to 6.5 DegC (average -8.4+/-8.1 DegC); daily
temperature ranges varied from 0.5 DegC to 21.1 DegC
(average 6.3+/-3.3 DegC).

The daily maximum wind gust recorded varied from 26 to
181 km/h (average 85+/-28 km/h). The maximum daily maximum
wind gust recorded was 181 km/h on (2016-02-24).
The minimum daily maximum wind gust recorded was 26 km/h
on (2016-06-24).

It should be noted maximum daily wind gusts were not
available for at least 2 days following the maximum
recorded wind gust reported here.


Variometers
-----------
The variometers used during 2016 are described in Table 2.

3-component variometer: Narod (MAW)
Serial number:          NGL-200907-1 with BMR 9004-3
Type:                   ring-core fluxgate
Orientation:            NW, NE, Z
Acquisition interval:   1 s
Scale value:            0.01 nT / count
Period of use:          from 2011-02-26

3-component variometer: DMI FGE (MW2)
Serial number:          E0291 / S0244
Type:                   suspended linear-core fluxgate
Orientation:            NW, NE, Z
Acquisition interval:   1 s
A/D converter:          ADAM 4017 module (+/-10V)
Scale value:            0.32 nT / count
Period of use:          from 2006-05-17

Total-field variometer: GEM Systems GSM-90
Serial number:          8092902 / 83384
Type:                   Overhauser effect
Acquisition interval:   10 s
Resolution:             0.01 nT
Period of use:          from 2011-03-11

Data acquisition system:GDAP: ARK 3660F/QNX 6.5 (2)
Timing:                 Garmin GPS16 clock (2)
Communications:         ANARESAT

Table 2. Magnetic variometers used in 2016.
--------

The DMI magnetometer (MW2) has been selected for
production of definitive data as the Narod magnetometer
(MAW) requires further parametric adjustment.
```

Analogue outputs from the DMI vector variometer, and the sensor and electronics temperatures, were converted to digital data using an ADAM 4017 analogue-to-digital converter. Analogue outputs from the Narod vector variometer were converted using its own proprietary electronics.

The DMI variometer sensor and electronics was located in the recording (eastern) room of the Variometer House.

The Narod variometer sensor was located within the sensor (western) room with its electronics located within the recording (eastern) room.

The total field magnetometer sensor was located within the sensor (western) room with the electronics located in the recording (eastern) room.

The DMI and Narod magnetometers were connected to two separate QNX/ARK 3360 industrial computers: ga-maw-mag1 and ga-maw-mag2 respectively, each with its own battery box power and GPS clock. Both computers shared a screen and keyboard using a KVM switch. The GSM-90 total field variometer was also connected to ga-maw-mag2. GSM-90 data were recorded on both computers by linking it over the QNX qnet network from ga-maw-mag1 to ga-maw-mag2.

Electrical power was supplied by two independent 12V battery systems, one for each vector variometer and its associated components including acquisition computer. Each battery system comprised a 12 V battery box kept charged by a battery charger which was powered by a UPS connected to the mains supply.

The data connections between the acquisition computers and the instruments were via serial cables.

Data were retrieved from both data-acquisition computers at least every 10 minutes using rsync over ssh in near real-time using the network connection supplied by ANARE.

Both the DMI and Narod vector variometers had their horizontal sensors oriented so that each sensor was at an angle of 45 Deg. to the direction of the horizontal component of the magnetic field at the time of installation. The third sensor was aligned vertically.

A pulse inverter was installed between the Garmin GPS clock and the Narod magnetometer as the GPS produces the opposite polarity pulse to that required by the Narod.

The Narod magnetometer produced eight samples per second that were Gaussian filtered to 1 second data and then output on the second.

The total field magnetometer was configured for 10 second sampling.

Sensor and electronics temperatures of both fluxgate magnetometers were monitored by in-built dual temperature systems.

Temperature regulation during 2016, as in previous years, was not ideal and affects data quality. The heating systems (a regulated heater in each sensor room) are inefficient and inadequate. This is particularly apparent during winter storms which cause large external and corresponding internal temperature variations that are correlated to F difference (Fv - Fs) changes. As the baseline measurements are weekly at best, timing of baseline correction gradients have been derived from F difference data in conjunction with temperature data. Applied to mitigate the storm temperature effects, these have correlated well with the absolute baseline measurements.

The Narod electronics, the DMI sensor and the DMI electronics were located in the recording (eastern) room and showed similar temperature variances of about 21 degC, 18 degC and 17 degC respectively. The Narod sensor, located in the western room, showed better temperature stability with a variance of about 6.6 degC. Improved temperature control is a priority for future upgrade or maintenance visits.

The annual temperature variation of 18.2 degC for the DMI vector variometer sensor converted to total variations of 3.6, 3.6 and -1.6 in the X, Y and Z channels respectively.

No temperature correction factors were available for the annual temperature variation of 17.0 degC for the DMI vector variometer electronics.

No temperature correction factors were available for the Narod variometer sensor or electronics.

The DMI variometer (referred as MW2 system on Table 2) was used as the primary source for delivery of Mawson's 2016:

1. Definitive data.
2. Quasi-definitive data.
3. Real-time data.
4. K-indices.

The ARK3360F acquisition PCs running QNX6.5 were rebooted once each during 2016 causing minor data losses, otherwise the acquisition system has been working well.

The DMI, Narod and scalar variometers performed satisfactorily during 2016 and no spike filtering was required.

Total vector variometer data loss for 2016 was 55 min minutes, broken down as follows:

* 54 min to maintenance and inspections
* 1 min to an acquisition PC restart

Vector variometer data loss events are listed in Appendix A.

The total total-field variometer loss for 2016 was 59 min, broken down as follows:

* 58 min to maintenance and inspections
* 1 min to an acquisition PC restart

Total-field variometer data loss events are listed in Appendix A.

```
Variometer clock corrections
----------------------------
```

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2016, adjustments to the system clock were less than 10 ms except on the following occasions:

```
ga-maw-mag1 (DMI variometer)
----------------------------
2016-08-24      01:27:01     1.298 s   PC restart

ga-maw-mag2 (Narod, GSM-90 variometers)
--------------------------------------
2016-08-22      03:57:42     0.509 s   PC restart
```

```
Absolute instruments
--------------------
```

The principal absolute magnetometers used at Mawson and their adopted corrections for 2016 are described in Table 3.

```
DI fluxgate:   DMI
Serial number: DI0132D
Theodolite:    Zeiss 020B
Serial number: 313792
A/D:           Pico FJY06/139
Resolution:    0.1'
D correction:  0.0'
I correction:  0.0'

Total-field magnetometer: GEM Systems GSM-90
Serial number: 4081417 / 42187
Type:          Overhauser effect
Resolution:    0.01 nT
Correction:    0.0 nT

DI fluxgate:   DMI (Spare instrument, unused)
Serial number: DI0133D
Theodolite:    Zeiss 020B
Serial number: 312714
A/D:           Pico GJY03/121
Resolution:    0.1'
D correction: -0.05'
I correction: -0.15'
```

```
Table 3.
--------
```

Absolute magnetometers and their adopted corrections for 2016. Corrections are applied in the sense Standard = Instrument + correction.

The DI0132D/313792-derived sensor-orientation-angles and the electronics offset were relatively stable until 2016-10-18 where there was a sharp change in both declination and inclination offsets. These drifted sharply over the next 2-3 weeks thereafter relaxing more slowly towards new stable levels over the remainder of 2016. The change in inclination (e) was approximately -2.4 min and the change in declination (d) was approximately -0.4 min. These changes did not seem to affect the other measurement parameters.

The absolute total field instrument (GSM-90) appeared to perform well throughout 2016.

All absolute observations were performed on Pier A while the azimuth mark BMR89/1 was used as the declination reference.

Instrument corrections of zero have been adopted for all Mawson absolute instruments in use for 2016 as no new evidence about corrections was gathered. There was no site visit during 2016 so no comparison with a travelling reference was possible.

At the 2016 mean magnetic field values at Mawson these D, I and F corrections translate to corrections of:

DX = 0.0 nT   DY = 0.0 nT   DZ = 0.0 nT

Instrument corrections were applied while reducing absolute observations to determine baselines and, accordingly, these corrections have been applied to all Mawson 2016 final data.

Baselines

There were 60 pairs of weekly absolute observations during 2016 more-or-less evenly spaced throughout the year with several 'double-ups' either for training purposes or to repeat suspicious measurements. 55 pairs were good, 2 pairs had a single good observation and 3 pairs were excluded, and another 5 single observations were excluded, giving a total of 125 observations. The data sets excluded were:

2016-03-02 (single)
2016-03-22 (single + pair)
2016-04-05 (single + pair)
2016-05-17 (single)
2016-09-14 (single)
2016-12-06 (pair)

X channel baselines drifted through 2016 within about 2.8 nT, Y channel within about 3.6 nT and Z channel within about 5.9 nT. Across the year there was no major drift trend for any channel. There were no baseline steps for 2016.

The F difference time series (Fv - Fs) was plotted to monitor variometer baseline variations throughout 2016. Baseline variations were mostly smooth throughout the year except for winter storm periods which showed sharp variations corresponding to storm-induced temperature variations due to the inadequate temperature control. As absolute measurements are taken weekly the best time and drift resolution was offered by taking the F difference (per minute) data in conjunction with the daily temperature data. The baseline values were found to correlate well when fitted on this basis.

During 2016 variometer (Fv - Fs) variations were within a 2.5 nT range on a daily basis and agreed with the absolute F (measured on pier A during weekly observations) minus Fs. The minute data shows larger transient Fv - Fs excursions due to large, rapid field changes at Mawson caused by real events, for example aurorae.

Baselines were adopted by manual fitting of a piecewise linear spline function to absolute observation residuals in conjunction with the F difference and weather data where necessary.

For 2016 the standard deviations of the weekly absolute observations from the final adopted variometer model were:

	Std.dev
X	0.7 nT
Y	0.8 nT
Z	0.3 nT
D	8.4"
I	3.0"
F	0.3 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2016 MAW definitive data and real time reported 1-minute data sets (MW2 definitive - MW2 real time) were:

	X	Y	Z
Average	-0.0	-0.2	-0.4
Std.Dev	+0.6	+0.9	+1.5
Min	-1.0	-1.6	-2.2
Max	+0.8	+1.5	+1.9

The annual statistics of the 12 monthly averages of the difference between the 2016 MAW definitive data and quasi-definitive 1-minute data sets (MW2 definitive - MW2 quasi-definitive) were:

"	X	Y	Z
Average	-0.1	-0.1	-0.0
Std.Dev	+0.3	+0.3	+0.1
Min	-0.4	-0.7	-0.3
Max	+0.5	+0.3	+0.2

The MAW 2016 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The Mawson observers were members of the Australian National Antarctic Research Expedition and were employed by the Australian Antarctic Division with funding support by Geoscience Australia. Mawson personnel change over each summer with varying periods of overlap. Trevor Crews operated the observatory until 2015-11-17 when Tony Harris took over however Trevor Crews conducted some observations on 2016-01-11 and 2016-03-02.

The observer was responsible for the continuous operation of the observatory and performed or supervised equipment maintenance and installation as required under the instruction of Geoscience Australia staff. The observer also monitored for any unwanted contamination by intrusions to the quiet zone surrounding the observatory.

There was no maintenance visit by geoscience Australia staff during 2016.

In 2016 the observers performed absolute observations weekly and forwarded them by email to Geoscience Australia. All data processing was performed at Geoscience Australia.

Real-time data were processed automatically at Geoscience Australia then distributed, usually within a 2 to 15 minute delay.

Daily data plots were examined at Geoscience Australia for possible problems which were usually rectified quickly by the local observer. The final data for the year were reduced and analysed by Geoscience Australia staff.

For 2016 Definitive data, the INTERMAGNET filter was applied to convert 1 second vector data to 1 minute data. An INTERMAGNET filter was also applied to scalar data.

Data distribution

The distribution of Mawson 2016 data is described in Table 4. Preliminary 1-minute data were also available on the GA website (http://www.ga.gov.au). Data losses are identified in Appendix A and Table A.1.

Recipient	Status	Sent
1-second values		
BoM Space Weather Services	preliminary	real time
INTERMAGNET	preliminary	real time
WDC for Geomagnetism Kyoto	preliminary	real time
1-minute values		
INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	quasi-definitive	monthly

```
INTERMAGNET                   definitive          July 2017
WDC for Geomagnetism Kyoto   preliminary         real time

Table 4. Distribution of Mawson 2016 data.
------------------------------------------


Significant events at Mawson in 2016
------------------------------------
DATE         EVENT INFORMATION
2016-01-28   Observer and an electrician entered the hut
             between 08:00 and 08:57 UTC.
             Data disturbance noticed/removed for MW2
             08:10:30-08:16:35
             08:18:39-08:19:11
             08:49:15-08:49:37
2016-02-22   00:57:30 backward time jumps MAW
2016-02-23   Data comms disruption + repair- required
             access to variometer building
             Intrusion into quiet zone inc. access to
             variometer hut
             Interference in quiet area + variometer hut
             from both comms repairs and intrusion:
             23-Feb
             MAW+MW2   ~10:13:27 - 10:15:52 MAW, MW2
                       ~10:59:55 - 11:00:20 PPM
                       ~07:41:20 - 07:42 MAW, PPM
                       ~07:51:17 - 07:51:45 MAW, PPM
             MAW       ~07:31:30
                       ~10:40:20 - 10:40:40
                       ~11:05:10 - 11:05:50 PPM
             MW2       ~10:03:37 - 10:03:45
2016-03-11   Tide gauge people intrusion to quiet zone/
             variometer hut
             02-Mar ~1300 - ~1400
             03-Mar ~1300 - ~1400
              5-Mar ~0940 - ~1040 local time (UTC +5)
2016-05-03   23-Mar - 31-Mar dip in F-check (and recovery)
             of ~2.75nT noted. ~5 days down, 2.5 days up.
             Unknown cause and in-between absolute obs but
             with one abs obs on the recovery at a
             position that matches if you fit across it!
             This does correspond to head and electronic
             temp changes during this period that are not
             evident elsewhere.
2016-04-05   Observer in variometer hut 5-April 0715-0745.
             Interference noted from approx 07:16:00 -
             07:53:20, 2 spikes near the end. Excluded
             ~0715 -0754 both MW2 and PPM.
2016-06-14   large field movements (K=9) cause
             MAW Narod variometer Z to show a jump at
             19:47:00 of ~-650nT and back again (~+650nT)
             at 19:47:16. Repaired.
2016-07-07   Backward time jumps in data (reason unknown)
2016-07-22   Incorrect power wiring of DIM noted- wired to
             +18V instead of +13.5V of old battery box, so
             not working with new battery box (+12V on
             same pin as +13.5V on old battery box).
             AML requested correction of DIM power
             connector wiring by Observer so it can use
             new battery box power supply (correct
```

	wiring). Requested inspection (and correction if necessary) of backup DIM as well. Note there could be a possible change in baseline values due to the DMI power wiring change.
2016-08-22	03:56 reboot ga-maw-mag2 (*.maw) to clear TCP stack
2016-08-23	Observer enters Variometer building ~1000. Observer + carpenter enters Absolute hut afterwards to look at repairing marker port.
2016-08-24	01:25:40 reboot ga-maw-mag1 (*.mw2) to clear TCP stack
2016-09-16	Change to absolute house- fix to marker viewing port/door. Materials checked by Observer, all OK. Obs before and after, if anything obs before NOK, after OK.
2016-10-05	Variometer bldg- fire alarm inspection 3-Oct ~06:10 - 06:18.
2016-10-12	Three backward time jumps in .maw data file (last jump at 14:29:30)
2016-10-17	17-Oct-16 18:57:22 - 18:57:30 Another range jump error in z on MAW, not correctable. Excluded 2016/10/17 18:57:24 to 2016/10/17 18:57:44
2016-10-28	3 backward time jumps in MAW data last at 08:23:30
2016-11-03	Notification from observer that heater in the absolute hut has stopped working. Observer and electrician enter absolute hut 09:40 to 10:10. Electrician to repair. Heater will be returned to absolute hut.

K indices

Mawson K indices for 2016 have been derived using a computer-assisted method developed at Geoscience Australia and based on the IAGA-accepted LRNS algorithm. K indices were scaled from preliminary data from the DMI variometer during 2016.

Appendix A. Data losses.

Vector data

Vector data for 2016 was reliable with only 55 minutes lost, comprising service and inspections (54 min) and CPU Restarts (1 min).

Date		Interval (hh:mm)	Data loss (minutes)
2016-01-28	XYZ	08:11 - 08:16	(6) Maintenance
2016-01-28	XYZ	08:19 - 08:19	(1) Maintenance
2016-02-23	XYZ	10:14 - 10:15	(2) Inspection
2016-04-05	XYZ	07:16 - 07:53	(38) Maintenance
2016-08-24	XYZ	01:26 - 01:26	(1) PC Restart
2016-10-03	XYZ	06:12 - 06:18	(7) Inspection

Total: 55

```
Scalar data
Scalar data was generally reliable for 2016 with only
59 minutes lost, comprising service and inspections
(58 min) and CPU Restarts (1 min).

Date                      Interval       Data loss
                         (hh:mm)        (minutes)
2016-01-28    F      08:12 - 08:14  (3) Maintenance
2016-01-28    F      08:16 - 08:16  (1) Maintenance
2016-01-28    F      08:19 - 08:19  (1) Maintenance
2016-01-28    F      08:49 - 08:49  (1) Maintenance
2016-02-23    F      07:42 - 07:42  (1) Inspection
2016-02-23    F      07:51 - 07:52  (2) Inspection
2016-02-23    F      10:14 - 10:16  (3) Inspection
2016-02-23    F      11:00 - 11:00  (1) Inspection
2016-04-05    F      07:16 - 07:53  (38) Maintenance
2016-08-24    F      01:26 - 01:26  (1) PC Restart
2016-10-03    F      06:12 - 06:18  (7) Inspection

Total: 59

Table A.1. Mawson data losses.
------------------------------
Observatory   Vector           Scalar
Mawson        55 min 0.010 %   59 min 0.011 %


Appendix B. Backup data
-----------------------
No Mawson MAW (Narod) vector variometer data was used for
infill of MW2 (DMI) vector variometer during 2016.

Appendix C. Data Filter Usage
-----------------------------
No data filters were applied during 2016.


                    <END>
```

7.9.2 Baseline values

7.9.2.1 2013

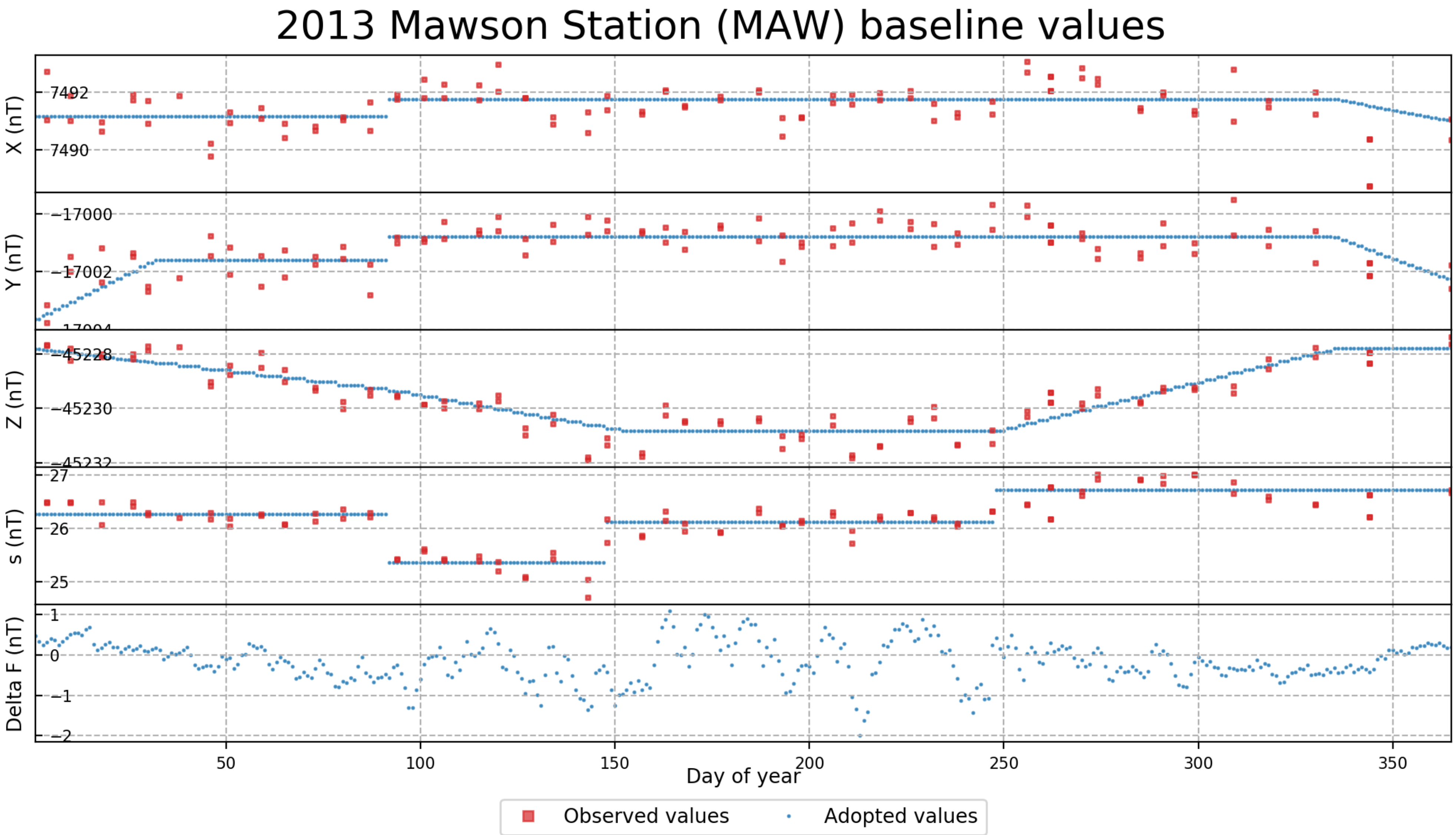

Figure 7.65 Mawson Station (MAW) baseline values for 2013. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.9.2.2 2014

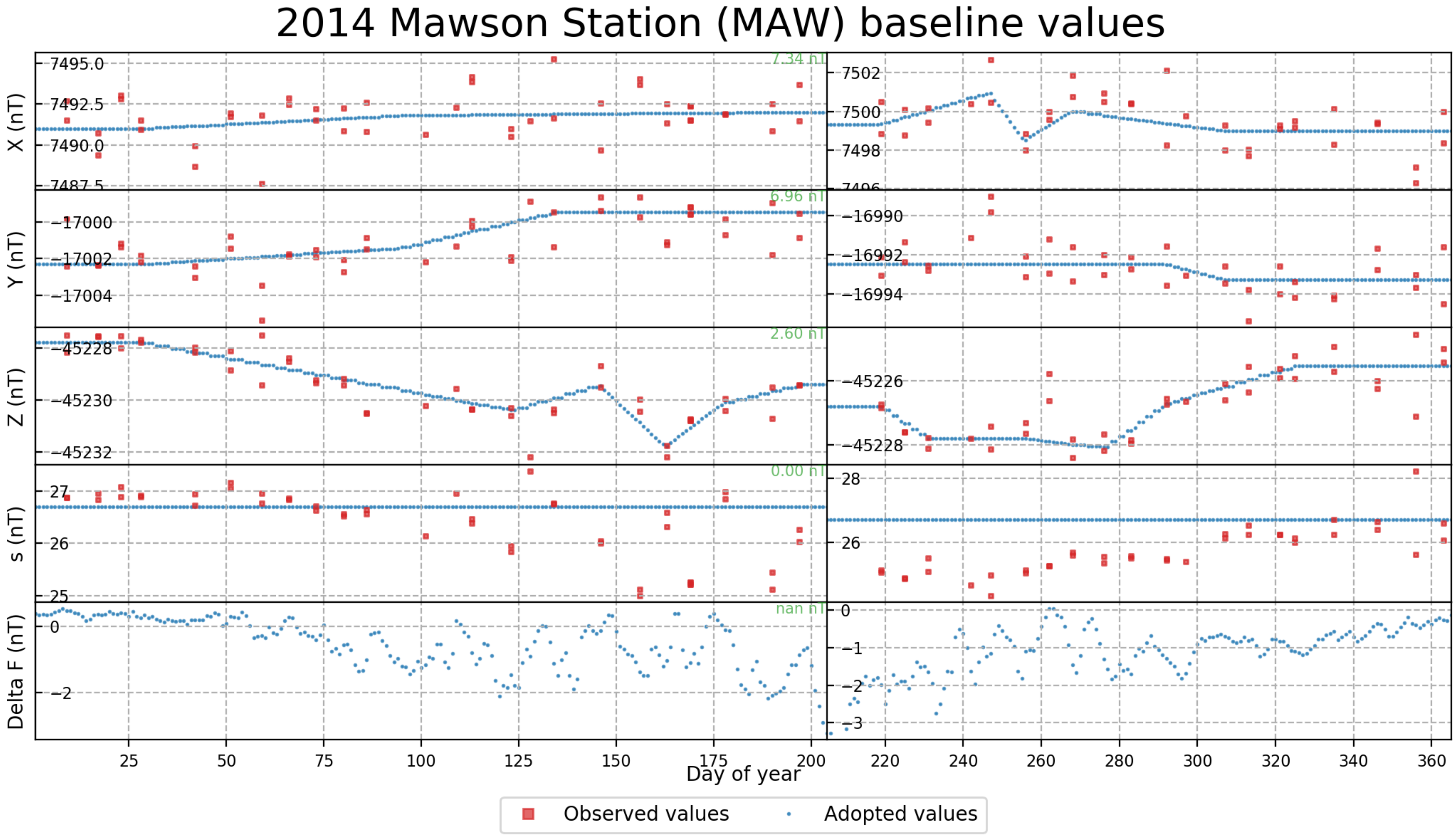

Figure 7.66 Mawson Station (MAW) baseline values for 2014. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.9.2.3 2015

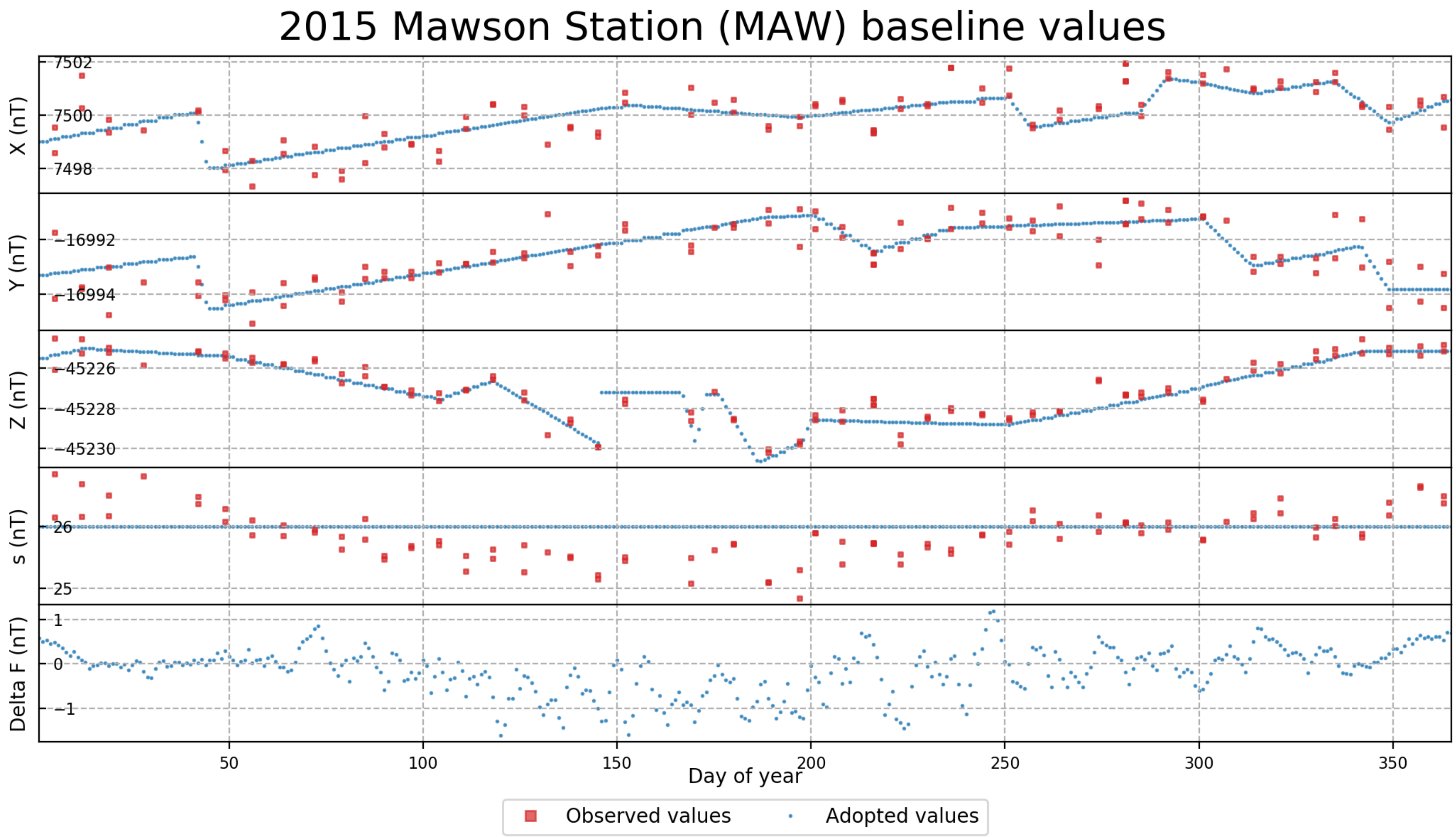

Figure 7.67 Mawson Station (MAW) baseline values for 2015. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.9.2.4 2016

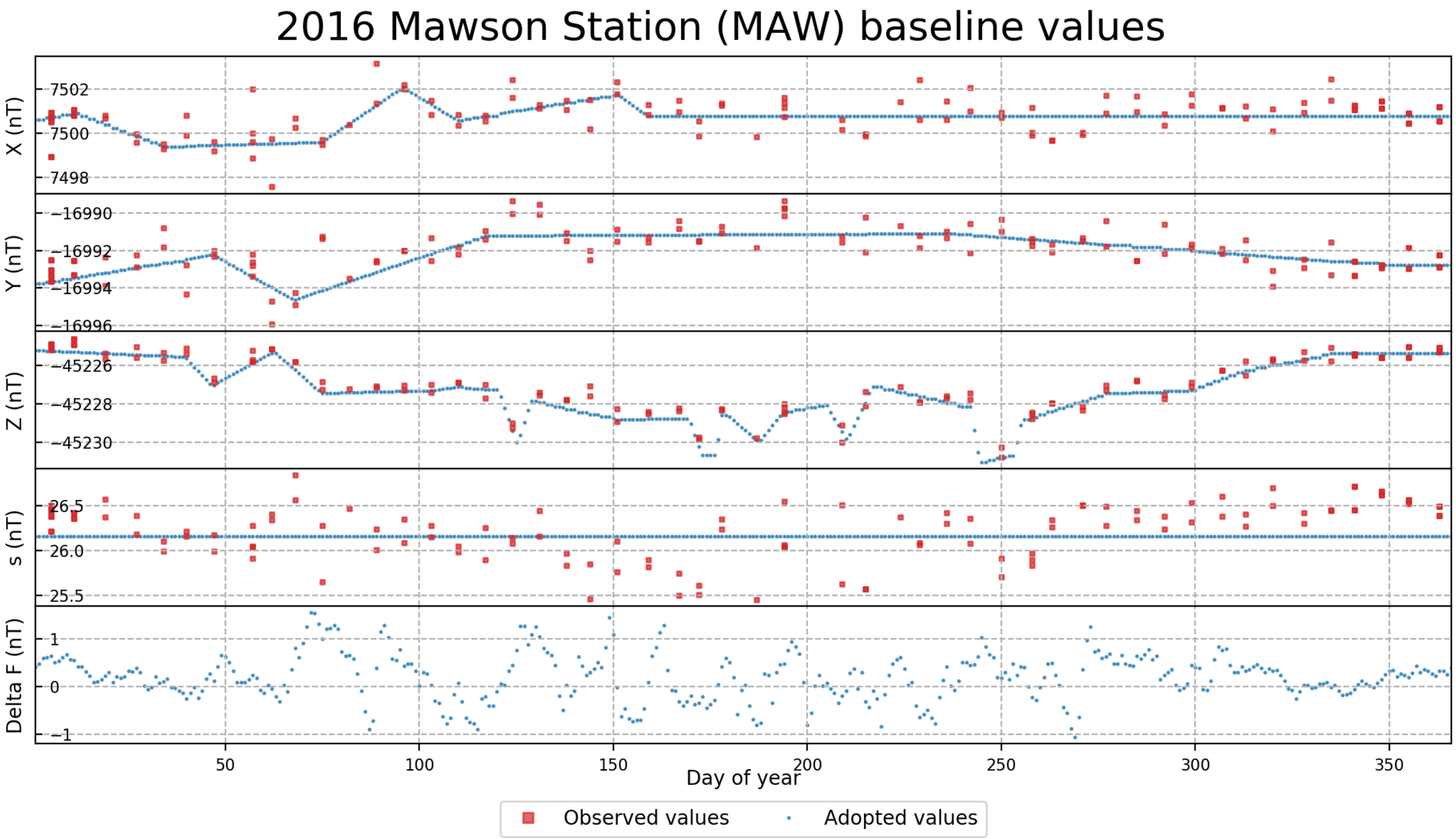

Figure 7.68 Mawson Station (MAW) baseline values for 2016. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.9.3 Annual mean values

7.9.3.1 DIH

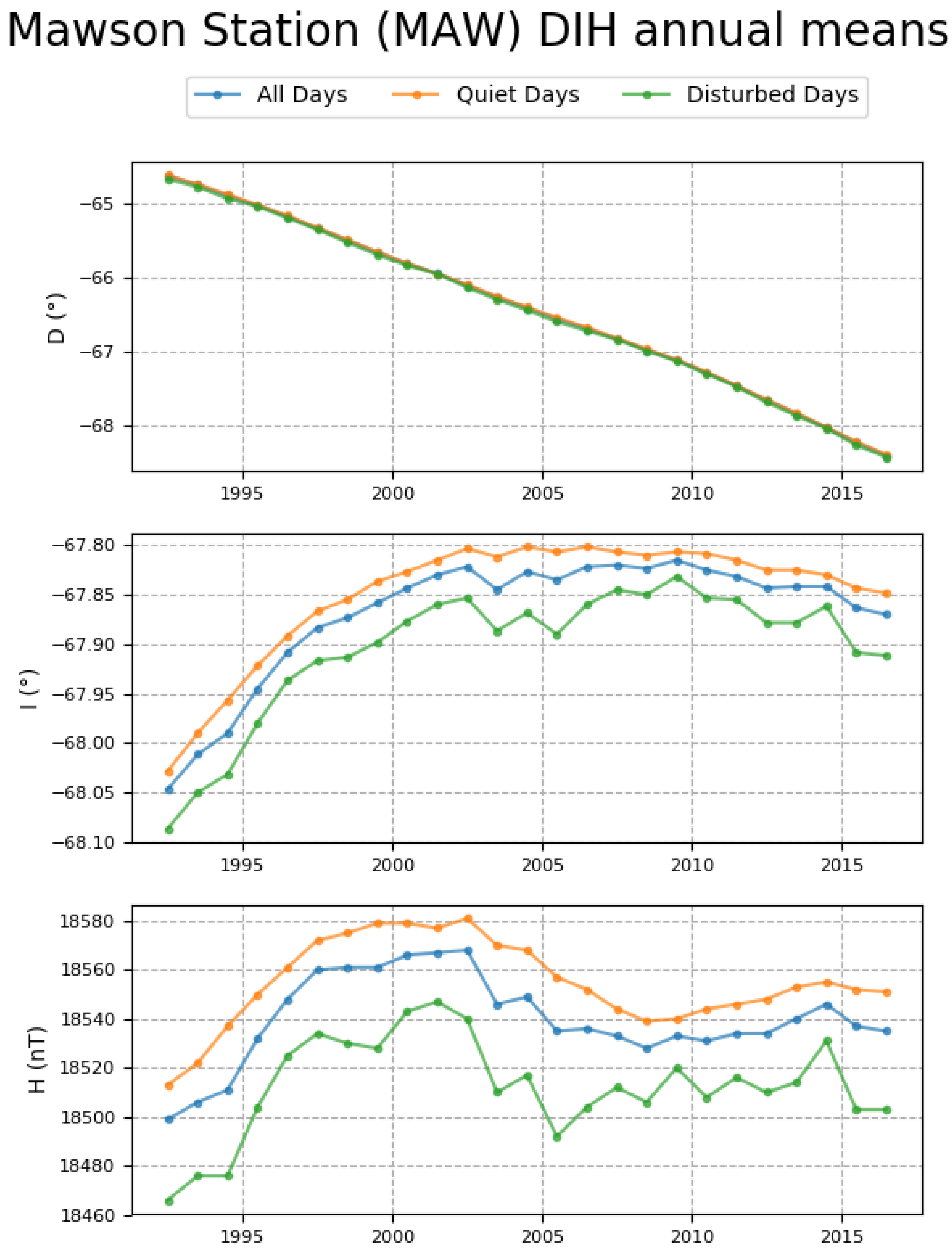

Figure 7.69 Mawson Station (MAW) annual mean values in DIH until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.9.3.2 XYZF

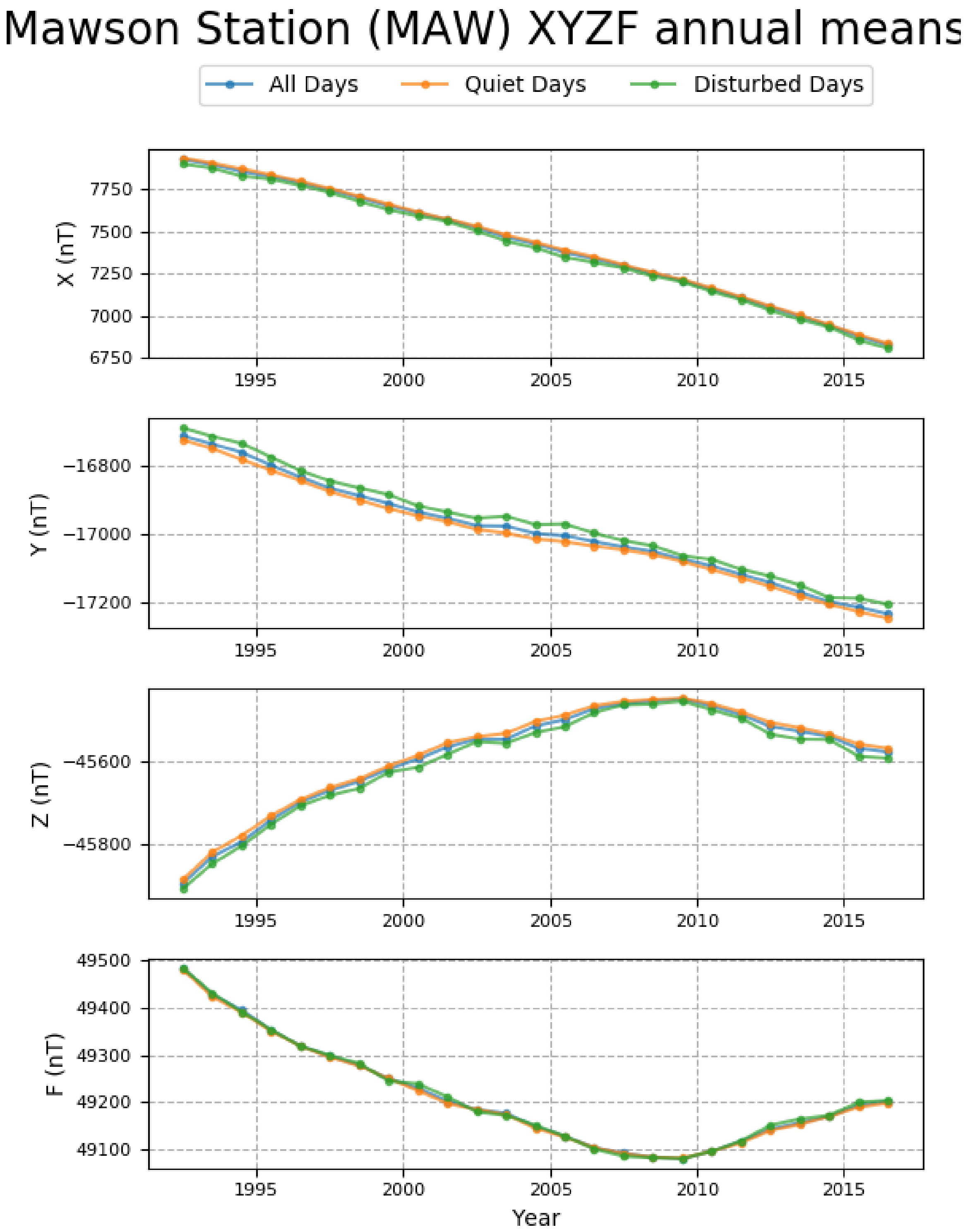

Figure 7.70 Mawson Station (MAW) annual mean values in XYZF until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.9.3.3 2016 INTERMAGNET annual mean values file

ANNUAL MEAN VALUES

MAWSON, MAW, ANTARCTICA

COLATITUDE: 157.60 LONGITUDE: 62.88 E ELEVATION: 12 m

YEAR	D Deg.	D min	I Deg.	I min	H nT	X nT	Y nT	Z nT	F nT	*	ELE	Note
1955.500	-58	38.1	-69	33.3	18272	9510	-15602	-49012	52307		DHZ	1
1956.500	-58	53.2	-69	32.5	18282	9447	-15652	-49006	52305		DHZ	
1957.500	-59	08.7	-69	31.1	18292	9381	-15703	-48974	52279		DHZ	
1958.500	-59	25.6	-69	30.3	18293	9305	-15750	-48940	52247		DHZ	
1959.500	-59	42.6	-69	28.5	18293	9227	-15796	-48860	52172		DHZ	
1960.500	-59	59.6	-69	25.2	18323	9163	-15867	-48800	52127		DHZ	
1961.500	-60	14.6	-69	23.1	18322	9094	-15906	-48707	52039		DHZ	
1962.500	-60	30.1	-69	21.1	18333	9027	-15956	-48650	51990		DHZ	
1963.500	-60	45.2	-69	17.6	18356	8968	-16016	-48562	51915		DHZ	
1964.500	-60	59.2	-69	15.4	18353	8901	-16050	-48460	51819		DHZ	
1965.500	-61	12.6	-69	13.1	18356	8840	-16087	-48368	51734		DHZ	
1966.500	-61	24.0	-69	09.6	18362	8790	-16122	-48235	51612		DHZ	
1967.500	-61	34.4	-69	07.2	18374	8747	-16159	-48168	51553		DHZ	
1968.500	-61	43.8	-69	05.2	18365	8698	-16175	-48060	51449		DHZ	
1969.500	-61	53.0	-69	03.4	18353	8649	-16187	-47954	51346		DHZ	
1970.500	-62	00.5	-69	00.4	18358	8616	-16210	-47840	51241		DHZ	
1971.500	-62	05.3	-68	56.4	18375	8602	-16237	-47719	51135		DHZ	
1972.500	-62	11.4	-68	53.1	18381	8575	-16258	-47600	51026		DHZ	
1973.500	-62	17.6	-68	49.7	18391	8551	-16282	-47486	50923		DHZ	
1974.500	-62	24.8	-68	47.2	18390	8516	-16299	-47380	50824		DHZ	
1975.500	-62	31.4	-68	44.0	18397	8488	-16322	-47269	50723		DHZ	
1976.500	-62	37.3	-68	40.0	18418	8470	-16355	-47157	50626		DHZ	
1977.500	-62	43.9	-68	36.9	18425	8442	-16377	-47051	50530		DHZ	
1978.500	-62	51.9	-68	35.5	18421	8402	-16393	-46986	50468		DHZ	
1979.500	-62	57.9	-68	32.9	18425	8375	-16412	-46890	50380		DHZ	
1980.500	-63	05.8	-68	29.8	18432	8340	-16437	-46784	50284		DHZ	
1981.500	-63	14.6	-68	27.1	18443	8303	-16468	-46705	50215		DHZ	
1982.500	-63	21.2	-68	25.5	18433	8267	-16475	-46616	50128		DHZ	
1983.500	-63	26.6	-68	22.3	18439	8244	-16494	-46503	50025		DHZ	
1984.500	-63	33.1	-68	19.3	18446	8216	-16515	-46404	49936		DHZ	
1985.500	-63	40.2	-68	17.0	18457	8186	-16542	-46342	49882		DHZ	2
1986.500	-63	48.7	-68	15.1	18460	8147	-16565	-46276	49822		XYZ	
1987.500	-63	56.6	-68	12.5	18470	8113	-16593	-46198	49753		XYZ	
1988.500	-64	04.4	-68	10.7	18475	8078	-16616	-46142	49703		XYZ	
1989.500	-64	12.8	-68	09.7	18474	8037	-16634	-46099	49663		XYZ	
1990.500	-64	21.1	-68	06.4	18492	8004	-16670	-46015	49592		XYZ	
1991.500	-64	28.8	-68	04.2	18502	7971	-16697	-45957	49542		XYZ	3
1992.500	-64	36.9	-68	02.8	18499	7930	-16712	-45894	49482	A	XYZ	4
1993.500	-64	44.2	-68	00.7	18506	7898	-16736	-45830	49426	A	XYZ	
1994.500	-64	52.9	-67	59.4	18511	7858	-16760	-45794	49394	A	XYZ	
1995.500	-65	00.9	-67	56.7	18532	7828	-16798	-45741	49352	A	XYZ	
1996.500	-65	09.8	-67	54.5	18548	7791	-16833	-45698	49319	A	XYZ	
1997.500	-65	19.4	-67	53.0	18560	7749	-16865	-45670	49297	A	XYZ	
1998.500	-65	29.1	-67	52.4	18561	7702	-16887	-45648	49278	A	XYZ	
1999.500	-65	39.0	-67	51.5	18561	7653	-16910	-45618	49250	A	XYZ	
2000.500	-65	48.2	-67	50.6	18566	7610	-16935	-45594	49230	A	XYZ	
2001.500	-65	56.2	-67	49.8	18567	7571	-16953	-45565	49203	A	XYZ	
2002.500	-66	05.8	-67	49.3	18568	7524	-16975	-45546	49185	A	ABZ	

2003.500	-66	15.6	-67	50.7	18546	7466	-16976	-45546	49177	A	ABZ	
2004.500	-66	24.1	-67	49.6	18549	7426	-16998	-45514	49149	A	ABZ	
2005.500	-66	33.0	-67	50.1	18535	7376	-17004	-45499	49129	A	ABZ	
2006.500	-66	40.8	-67	49.3	18536	7338	-17022	-45472	49105	A	ABZ	
2007.500	-66	49.2	-67	49.2	18533	7295	-17037	-45460	49093	A	ABZ	5
2008.500	-66	58.1	-67	49.4	18528	7249	-17051	-45454	49085	A	ABZ	
2009.500	-67	6.6	-67	48.9	18533	7209	-17073	-45448	49082	A	ABZ	
2010.500	-67	16.8	-67	49.5	18531	7157	-17093	-45466	49097	A	ABZ	
2011.500	-67	27.5	-67	49.9	18534	7105	-17118	-45487	49118	A	ABZ	
2012.500	-67	38.9	-67	50.6	18534	7048	-17142	-45515	49144	A	ABZ	
2013.500	-67	50.1	-67	50.5	18540	6995	-17170	-45527	49157	A	ABZ	
2014.500	-68	1.3	-67	50.5	18546	6941	-17198	-45539	49170	A	ABZ	
2015.500	-68	13.5	-67	51.8	18537	6876	-17214	-45568	49194	A	ABZ	
2016.500	-68	24.0	-67	52.2	18535	6823	-17234	-45577	49202	A	ABZ	

1992.500	-64	36.5	-68	01.7	18513	7938	-16724	-45885	49479	Q	XYZ
1993.500	-64	43.6	-67	59.4	18522	7908	-16749	-45819	49422	Q	XYZ
1994.500	-64	51.8	-67	57.4	18537	7874	-16781	-45779	49389	Q	XYZ
1995.500	-65	00.4	-67	55.3	18550	7838	-16813	-45731	49350	Q	XYZ
1996.500	-65	09.2	-67	53.5	18561	7799	-16843	-45692	49318	Q	XYZ
1997.500	-65	18.9	-67	52.0	18572	7757	-16875	-45663	49295	Q	XYZ
1998.500	-65	28.6	-67	51.3	18575	7710	-16900	-45642	49277	Q	XYZ
1999.500	-65	38.5	-67	50.2	18579	7663	-16925	-45611	49250	Q	XYZ
2000.500	-65	48.0	-67	49.6	18579	7616	-16946	-45585	49225	Q	XYZ
2001.500	-65	56.3	-67	48.9	18577	7574	-16963	-45555	49198	Q	XYZ
2002.500	-66	05.2	-67	48.2	18581	7532	-16986	-45540	49185	Q	ABZ
2003.500	-66	14.7	-67	48.7	18570	7480	-16997	-45532	49174	Q	ABZ
2004.500	-66	23.5	-67	48.1	18568	7436	-17014	-45503	49146	Q	ABZ
2005.500	-66	32.1	-67	48.4	18557	7389	-17022	-45488	49127	Q	ABZ
2006.500	-66	39.9	-67	48.1	18552	7349	-17035	-45465	49105	Q	ABZ
2007.500	-66	48.7	-67	48.4	18544	7302	-17046	-45455	49092	Q	ABZ
2008.500	-66	57.6	-67	48.6	18539	7256	-17060	-45450	49085	Q	ABZ
2009.500	-67	6.3	-67	48.4	18540	7213	-17080	-45447	49083	Q	ABZ
2010.500	-67	16.2	-67	48.5	18544	7165	-17104	-45460	49097	Q	ABZ
2011.500	-67	27.3	-67	48.9	18546	7111	-17128	-45480	49115	Q	ABZ
2012.500	-67	38.5	-67	49.5	18548	7056	-17153	-45506	49141	Q	ABZ
2013.500	-67	49.6	-67	49.5	18553	7002	-17181	-45518	49154	Q	ABZ
2014.500	-68	1.1	-67	49.8	18555	6945	-17206	-45534	49170	Q	ABZ
2015.500	-68	12.7	-67	50.6	18552	6886	-17227	-45558	49190	Q	ABZ
2016.500	-68	23.3	-67	50.9	18551	6832	-17247	-45568	49199	Q	ABZ

1992.500	-64	39.6	-68	05.2	18466	7904	-16689	-45907	49482	D	XYZ
1993.500	-64	45.9	-68	03.0	18476	7877	-16713	-45847	49430	D	XYZ
1994.500	-64	55.3	-68	01.9	18476	7831	-16734	-45804	49390	D	XYZ
1995.500	-65	01.7	-67	58.8	18504	7812	-16774	-45752	49353	D	XYZ
1996.500	-65	11.1	-67	56.2	18525	7775	-16814	-45707	49318	D	XYZ
1997.500	-65	20.4	-67	55.0	18534	7733	-16844	-45682	49299	D	XYZ
1998.500	-65	30.9	-67	54.8	18530	7680	-16864	-45665	49282	D	XYZ
1999.500	-65	41.0	-67	53.9	18528	7630	-16884	-45626	49245	D	XYZ
2000.500	-65	49.7	-67	52.6	18543	7593	-16917	-45614	49239	D	XYZ
2001.500	-65	56.4	-67	51.6	18547	7561	-16935	-45583	49212	D	XYZ
2002.500	-66	07.6	-67	51.2	18540	7504	-16953	-45552	49180	D	ABZ
2003.500	-66	17.4	-67	53.2	18510	7443	-16947	-45556	49173	D	ABZ
2004.500	-66	26.0	-67	52.1	18517	7403	-16972	-45530	49152	D	ABZ
2005.500	-66	35.4	-67	53.4	18492	7347	-16970	-45516	49129	D	ABZ
2006.500	-66	42.6	-67	51.6	18504	7316	-16997	-45482	49102	D	ABZ
2007.500	-66	50.0	-67	50.7	18512	7282	-17019	-45463	49087	D	ABZ
2008.500	-66	59.2	-67	51.0	18506	7235	-17034	-45461	49084	D	ABZ
2009.500	-67	7.3	-67	49.9	18520	7200	-17063	-45454	49082	D	ABZ
2010.500	-67	17.8	-67	51.2	18508	7143	-17074	-45475	49097	D	ABZ
2011.500	-67	28.2	-67	51.3	18516	7094	-17103	-45495	49119	D	ABZ

```
 2012.500 -67 40.8 -67 52.7  18510   7030 -17123 -45534  49152 D  ABZ
 2013.500 -67 51.8 -67 52.7  18514   6976 -17149 -45546  49165 D  ABZ
 2014.500 -68  2.0 -67 51.7  18531   6932 -17186 -45547  49173 D  ABZ
 2015.500 -68 15.7 -67 54.5  18503   6853 -17188 -45587  49200 D  ABZ
 2016.500 -68 25.5 -67 54.7  18503   6804 -17206 -45592  49204 D  ABZ

* A = All days
* Q = 5 International Quiet days each month
* D = 5 International Disturbed days each month

ELE = Elements recorded

Notes:
     1. A LaCour operated at MAW from August 1955 to November 1985.
     2. A PEM operated at MAW from December 1985 to October 1992 as
        principle instrument. The PEM continued in parallel with the
        Narod from November 1992 and into 1993.
     3. The source of annual means 1955 to 1991 in this file did not
        specify the type A, Q, or D. Examination of the data plots
        indicate that these means are most likely All Day means.
     4. A Narod RCF operated at MAW from November 1992.
     5. A Danish DMI FGE magnetometer operated at MAW since 2006
        and was the primary source of data from 2007.
```

7.9.4 K indices

7.9.4.1 2013

Table 14 Mawson Station (MAW) K index values for 2013. For each cell, 3-hourly K indices are given then the daily K sum (after the whitespace character). Dashes ('-') indicate that insufficient data were available to compute either the K indices or K sum. K indices enclosed in parentheses indicate that the K index was computed with missing data.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	32000012 08	33223315 22	65464667 44	33332235 24	55454475 39	78864355 46	44333111 20	33212211 15	55333466 35	21113235 18	54323243 26	65333212 25
02	11222223 15	56533363 34	64423366 34	43111146 21	65432264 32	66554365 40	22322202 15	13101022 10	34532331 24	99942476 50	32111115 15	21111112 10
03	32102202 12	34123223 20	55413253 28	33100124 14	22221232 16	45533456 35	32221214 17	11101115 11	21211236 18	62011321 16	43312154 23	44334445 31
04	33112013 14	22223431 19	43212024 18	53212213 19	42221546 26	64433246 32	31100111 08	22232468 29	32223145 22	21000000 03	24433544 29	54312253 25
05	22110211 10	23211110 11	53200045 19	22000024 10	45432220 22	64234125 27	55533226 31	76432456 37	21110043 12	00000002 02	44222213 20	33233233 22
06	22022342 17	21000113 08	45110002 13	42210244 19	32343235 25	55444468 40	57522456 36	54422134 25	22112364 21	02101024 10	31211244 18	23212144 19
07	32110013 11	32243223 21	12102003 09	44213210 17	44342333 26	77644322 35	53311201 16	33210032 14	34411103 17	15222334 22	44466234 33	43222144 22
08	13221225 18	45423314 26	00311043 12	01111122 09	45333335 29	14343014 20	14311133 17	31110223 13	44201331 18	12001166 17	53221112 17	77634454 40
09	44222133 21	33221123 17	53212233 21	22120014 12	32322210 15	22224543 24	02232225 18	32234244 24	23212113 15	66644323 34	46655332 34	22223434 22
10	34311033 18	33321254 23	12100125 12	01201115 11	23212112 14	55433210 23	56543357 38	43322112 18	20034465 24	66422134 28	55343566 37	34333221 21
11	22232015 17	34311145 22	53101000 10	21211215 15	12111023 11	00113325 15	46642475 38	22223204 17	21121343 17	44233244 26	46555653 39	33133124 20
12	44112122 17	41112335 20	23114014 16	53311213 19	44321112 18	33322004 17	55532256 33	21110135 14	53312215 22	21122255 20	44121100 13	22112213 14
13	43333465 31	45422247 30	33000044 14	44112125 20	11221310 11	43011112 13	55421256 30	41113334 20	53322354 27	43110044 17	12333022 16	31003212 12
14	44334344 29	55533335 32	22012321 13	54422312 23	21232323 18	32110134 15	55535466 39	54410275 28	23332133 20	24334665 33	11222244 18	56424554 35
15	34232241 21	32211255 21	34422113 20	12210014 11	11233311 15	53211104 17	56533445 35	44443315 28	21000024 09	55432227 30	54323456 32	53322423 24
16	22112236 19	22113643 22	65432334 30	30000246 15	36223356 30	30000003 06	23312553 24	57553666 43	53221133 20	65323552 31	45543222 27	35532324 27
17	54334454 32	34432562 29	43876866 48	43222100 14	44323545 30	24210015 15	01200122 08	45433324 28	25422325 25	54333443 29	34343254 28	43211242 19
18	55334325 30	22122125 17	44323123 22	32101122 12	76633255 37	34321332 21	33214573 28	53332355 29	34122346 25	21200131 10	43211211 15	34332244 25
19	52112226 21	23223435 24	43211226 21	10000004 05	53532434 29	53001153 18	24543666 36	32202234 18	64541365 34	00000222 06	12212354 20	33212444 23
20	45544222 28	43233343 25	55323436 31	00112101 06	32101255 19	54332256 30	53330123 20	31121205 15	34232116 22	00110133 09	34333221 21	45213353 26
21	43222224 21	54422255 29	77523132 30	10000100 02	43422155 26	54433247 32	21212255 20	36533436 33	43223334 24	21101100 06	13113024 15	33221112 15
22	22001013 09	55333446 33	22121255 20	33100004 11	53434445 32	55533365 35	20000124 09	65433276 36	24312112 16	01221024 12	33111134 17	22111111 10
23	24202003 13	43223356 28	42222363 24	21111126 15	46333344 30	67443557 41	43110144 18	65443365 36	33211154 20	44411000 14	34464331 28	31113123 15
24	43000002 09	33211233 18	52222231 19	56334356 35	45344366 35	45343576 37	43111153 19	43233234 24	33134433 24	22010021 08	12211111 10	10101224 11
25	23222226 21	21001105 10	22111122 12	33223465 28	76543676 44	64431346 31	23213236 22	34433345 29	43322101 16	13100014 10	13101021 09	43344331 25
26	64545466 40	22122343 19	41112010 10	47443465 37	36533765 38	21101144 14	55433346 33	44223135 24	00000012 03	30110023 10	11000112 06	23212101 12
27	54323334 27	43311013 16	24343657 34	43422335 26	55433674 37	21114355 22	54433445 32	44123466 30	20001033 09	21202021 10	20002300 07	20100012 06
28	22213345 22	23213026 19	43323435 27	31123335 21	56442223 28	44334456 33	55323136 28	64422235 28	22000032 09	22000001 05	01002113 08	21112213 13
29	33122223 18		65644765 43	62001155 20	12100002 06	66335454 36	33312222 18	22111003 10	10100025 09	22022254 19	33234362 26	43233322 22
30	12011024 11		56423265 33	54232255 28	20000021 05	53343355 31	23422244 23	31222357 25	43100023 13	23344544 29	33333355 28	22222322 17
31	31200115 13		22211265 21		12302336 20		55111243 22	63442226 29		32323235 23		43233322 22

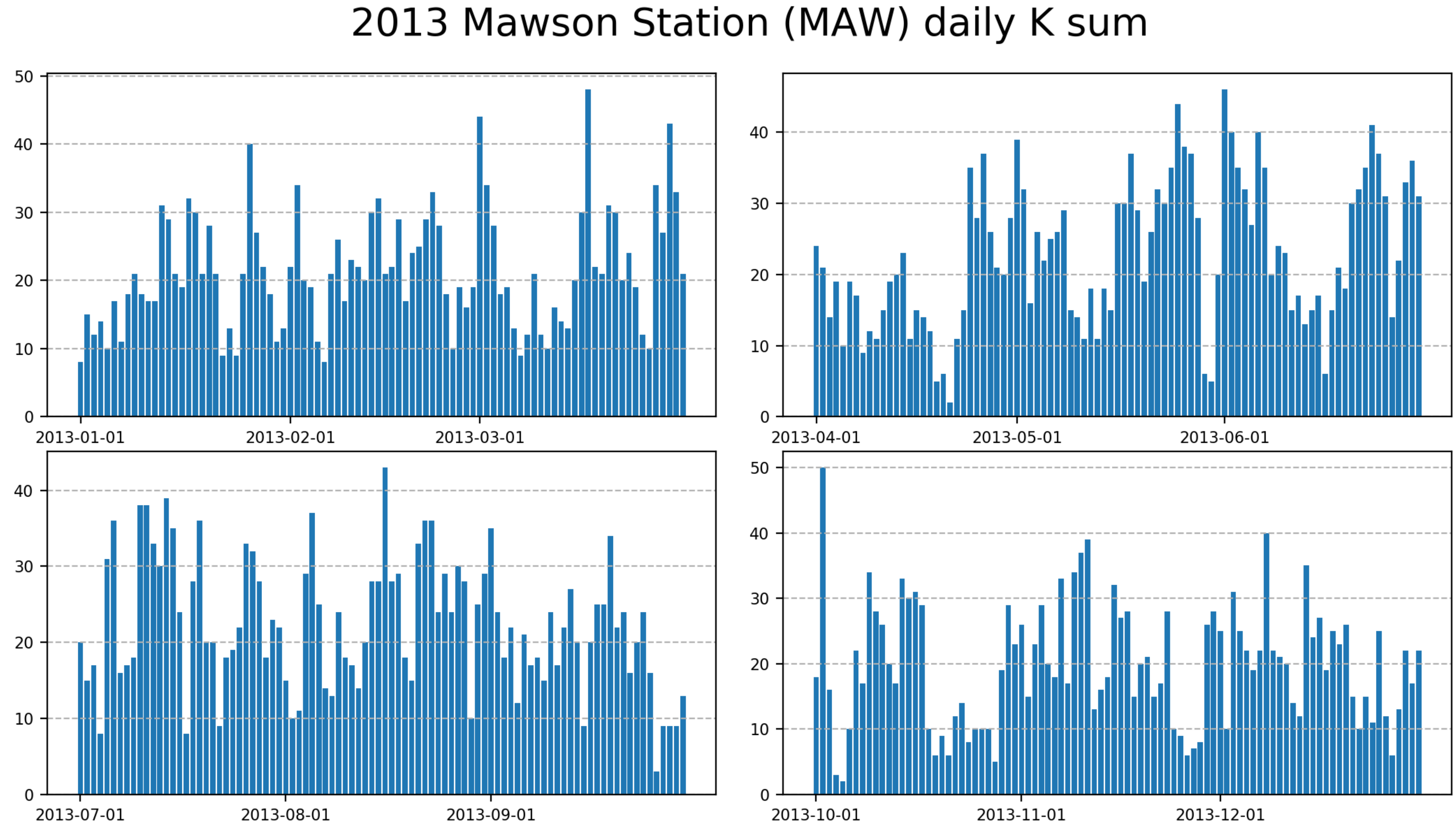

Figure 7.71 2013 Mawson Station (MAW) daily K sum.

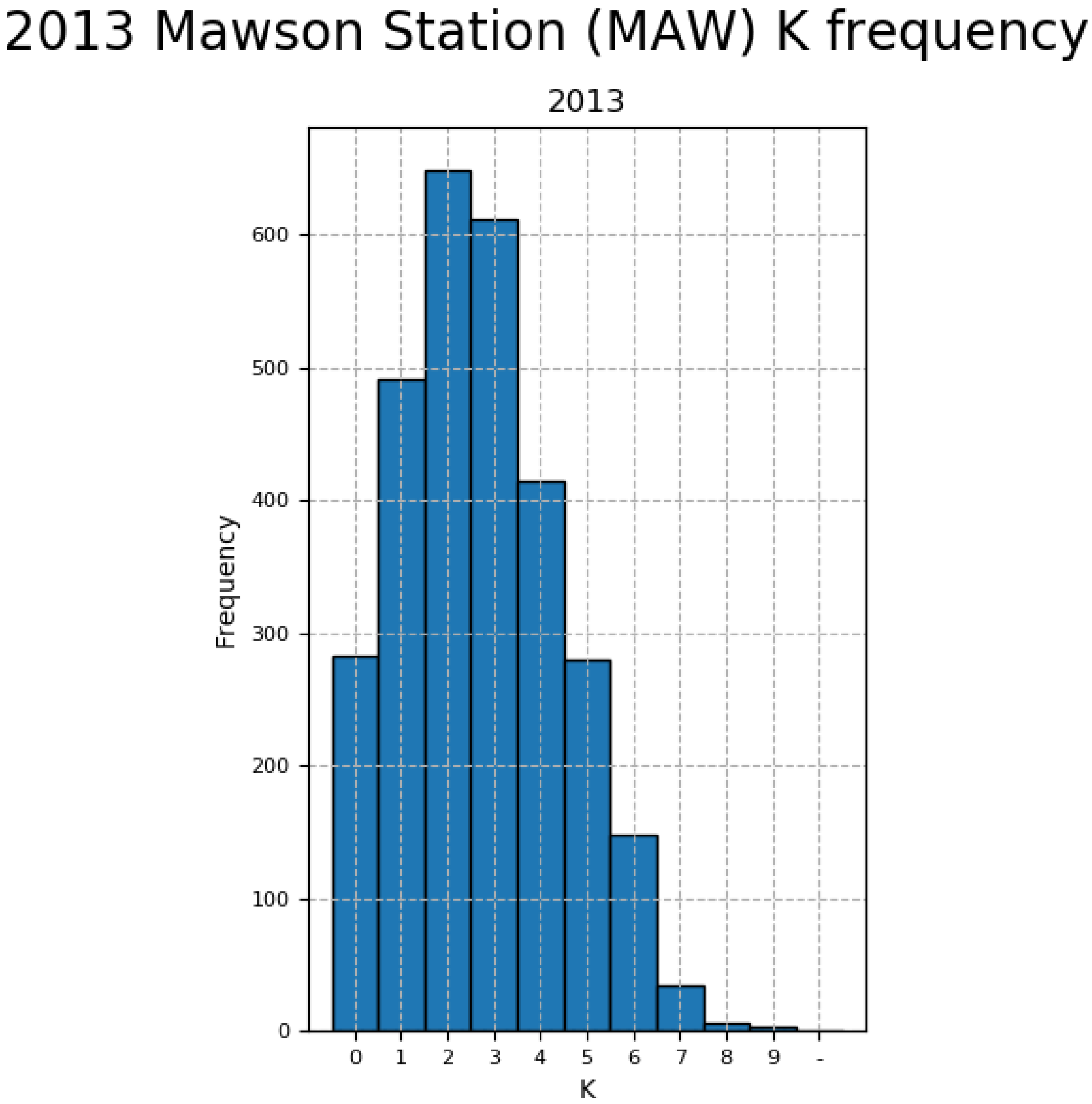

Figure 7.72 2013 Mawson Station (MAW) 3-hourly K index frequency plots.

7.9.4.2 2014

Table 15 Mawson Station (MAW) K index values for 2014. For each cell, 3-hourly K indices are given then the daily K sum (after the whitespace character). Dashes ('-') indicate that insufficient data were available to compute either the K indices or K sum. K indices enclosed in parentheses indicate that the K index was computed with missing data.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	54446444 35	32112235 19	23332255 25	12202225 16	23311011 12	00210113 08	22100114 11	33123246 24	44334335 29	53333444 29	33434222 23	45423335 29
02	55534563 36	44203233 21	53211001 13	21000244 13	23100000 06	31100005 10	12201103 10	33233535 27	44333346 30	44222355 27	33133441 22	55535464 37
03	34555462 34	34423313 23	55422105 24	22222334 20	00000055 10	52110110 11	13432001 14	25111155 21	34432215 24	32211122 14	33221012 14	55233343 28
04	33344343 27	34212212 17	33123235 22	22221432 18	56633314 31	13212146 20	42222003 15	34333257 30	54433125 27	34421114 20	32456466 36	54334345 31
05	34224212 20	23102013 12	33213355 25	32234334 24	34321353 24	33231126 21	30000003 06	33523344 27	33322335 24	33221142 18	44553236 32	44534336 32
06	22213334 20	46434333 30	41322354 24	31100003 08	12210000 06	43100153 17	30011005 10	35423355 30	33311226 21	54212025 21	34323215 23	34433456 32
07	34312434 24	43222434 24	32211113 14	43223525 26	20101135 13	23333326 25	42201144 18	32322244 22	35310111 15	45310133 20	44332333 25	56546765 44
08	44323233 24	66633473 38	31111114 13	33012112 13	35543535 33	46754324 35	21111145 16	65423112 24	13321224 18	23233343 23	33433226 26	55534655 38
09	55333244 29	45523575 36	22100014 10	11322352 19	43321001 14	12532265 26	42320216 20	22211122 13	43222244 23	66533435 35	43322356 28	54443376 36
10	44222311 19	55322256 30	32111143 16	11100010 04	35321075 26	32233225 22	44321214 21	21122233 16	50111233 16	36312254 26	54565642 37	64433233 28
11	22112162 17	34312135 22	01111233 12	02212454 20	65331253 28	24342343 25	43232255 26	22110326 17	45332223 24	34543211 23	44323236 27	43212234 21
12	23323345 25	44322334 25	53111234 20	65443355 35	34442155 28	23211000 09	25332322 22	63221366 29	74333558 38	11211232 13	55422225 27	54556455 39
13	45333213 24	00010000 01	55422222 24	66433266 36	13321012 13	11100013 07	22122125 17	44233124 23	34622222 23	22201355 20	35333223 24	45434355 33
14	54334344 30	11111101 07	32323313 20	23430255 24	11001114 09	54332241 24	30213214 16	33201014 14	22100101 07	22123556 26	55424354 32	36444363 33
15	42212233 19	21104313 15	52221044 20	34212245 23	22110131 11	31122101 11	32222134 19	43101205 16	12330012 12	75322112 23	45544256 35	35445434 32
16	23101112 11	74333445 33	21110000 05	21111213 12	44200143 18	32211221 14	32211143 17	21000005 08	33220155 21	33122236 22	65645546 41	34344335 29
17	22111234 16	44112255 24	31100115 12	44313452 26	32110010 08	43332116 23	32211244 19	41012310 12	42000211 10	35222254 25	33344464 31	54433323 27
18	34201111 13	32322355 25	32223332 20	23221123 16	33101124 15	53433366 33	21010003 07	12300134 14	21110165 17	56543644 37	43344334 28	45323324 26
19	21100212 09	58764325 40	33301134 18	44334233 26	22100225 14	35442156 30	20111002 07	32323257 27	54433443 30	54333343 28	53333353 28	53533344 30
20	21223121 14	47856535 43	23221034 17	44335665 36	22112123 14	43433222 23	20100113 08	52211034 18	43322223 21	45544746 39	55434463 34	55434324 30
21	53334433 28	53233355 29	55433334 30	54443522 29	10100012 05	32322112 16	21001243 13	65432344 31	34311114 18	43444665 36	65344434 33	46724465 38
22	44343235 28	44433434 29	32222123 17	22111244 17	41211236 20	12211036 16	52111115 17	24210023 14	34423454 29	55433654 35	44343245 29	67542323 32
23	43323233 23	54544463 35	33222155 23	22222343 20	64411567 34	20100005 08	11100155 14	13221203 14	54222555 30	34333374 30	34344454 31	31233246 24
24	44312211 18	33223221 18	41321111 14	63333366 33	33311224 19	54221114 20	33221122 16	32100000 06	45444667 40	63333664 34	44324433 27	54435665 38
25	54323335 28	21012116 14	30121256 20	44123454 27	43211223 18	33232224 21	63332102 20	00000003 03	54333266 32	54323434 28	33234323 23	44425466 35
26	56521234 28	31200012 09	63521231 23	33212254 22	33221013 15	00012100 04	34433342 26	21000012 06	54333365 32	55534342 31	34334124 24	55533353 32
27	33113325 21	34213456 28	22223331 18	32101005 12	10011044 11	10000022 05	43311111 15	14332346 26	65533342 31	54443345 32	44323333 25	54343233 27
28	22111344 18	45433332 27	22212255 21	24221125 19	22010013 09	42123321 18	34322335 25	57633536 38	44222454 27	55433553 33	33225333 24	34323354 27
29	34333334 26		66121005 21	40000014 09	11122222 13	52111215 18	22100010 06	46643366 38	33323364 27	45323342 26	33423233 23	45554646 39
30	46201110 15		43120242 18	56323253 29	12222462 21	52101002 11	53201001 12	54333253 28	56523446 35	23222243 20	44332344 27	45644564 38
31	11111001 06		12222342 18		22110000 06		31210235 17	34433367 33		34323154 25		33324433 25

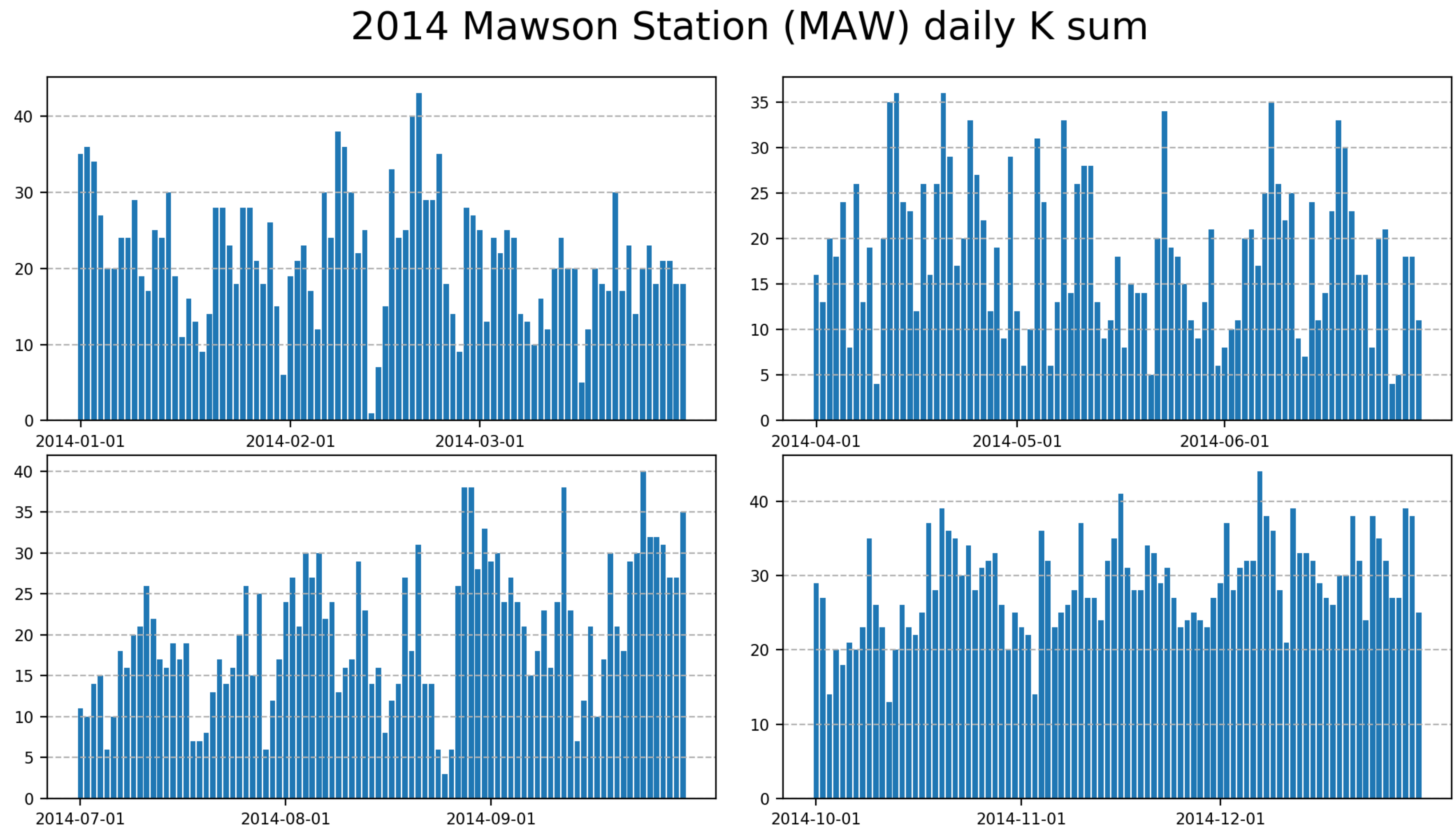

Figure 7.73 2014 Mawson Station (MAW) daily K sum.

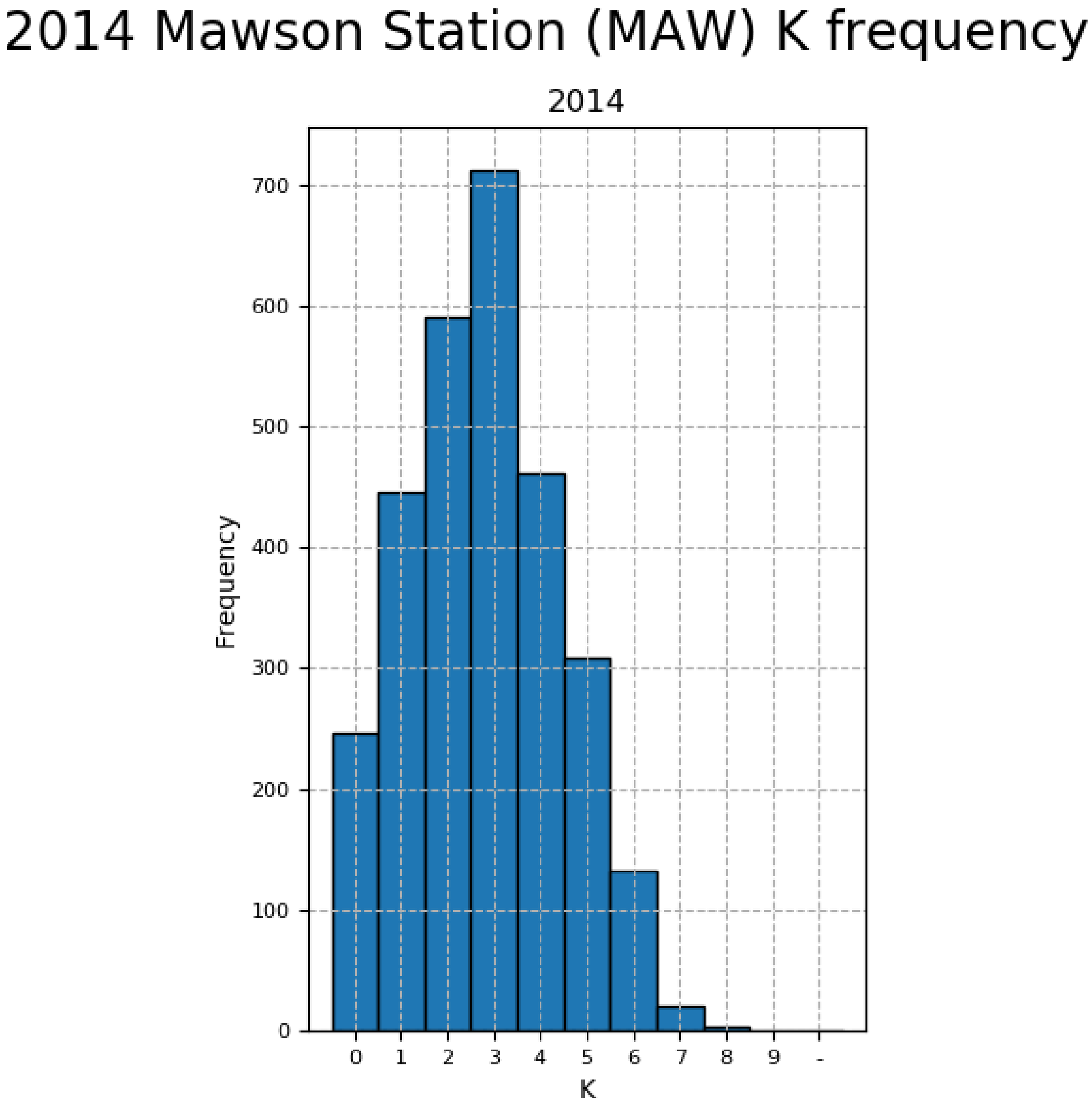

Figure 7.74 2014 Mawson Station (MAW) 3-hourly K index frequency plots.

7.9.4.3 2015

Table 16 Mawson Station (MAW) K index values for 2015. For each cell, 3-hourly K indices are given then the daily K sum (after the whitespace character). Dashes ('-') indicate that insufficient data were available to compute either the K indices or K sum. K indices enclosed in parentheses indicate that the K index was computed with missing data.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	33323235 24	55533477 39	56743366 40	12211223 14	24300112 13	44332132 22	33323212 19	44333435 29	33222216 21	33213554 26	34433342 26	44344455 33
02	44334454 31	66554574 42	66754566 45	33333356 29	33222135 21	10100000 02	11120002 07	54533324 29	53211364 25	34333455 30	12223211 14	34323354 27
03	55554231 30	56534556 39	54533365 34	33322225 22	45332231 23	01102001 05	10100100 03	34333224 24	44322344 26	44433443 29	35555665 40	23232123 18
04	24445754 35	54333445 31	34343115 24	53443353 30	33323323 22	00000000 00	01003367 20	44232246 27	65643344 35	64433447 35	47656434 39	23223234 21
05	65543355 36	25233544 28	42323242 22	24412124 20	32233235 23	00000002 02	66552246 36	33111225 18	34434665 35	45553336 34	54344656 37	33444446 32
06	45554642 35	23333211 18	24542225 26	34211134 19	54535563 36	22101103 10	66442162 31	43444356 33	34444373 32	46523466 36	54333356 32	36655465 40
07	33674334 33	23454343 28	35543666 38	34200031 13	43101212 14	12312216 18	32321125 19	34555425 33	45645577 43	57665576 47	59765653 46	55545574 40
08	55534426 34	35533354 31	33534422 26	41000154 15	54311224 22	54544657 40	32221443 21	44444264 32	85422336 33	45645677 44	32244576 33	65443326 33
09	43434335 29	43323355 28	65210111 17	33332334 24	32121225 18	45435365 35	25111124 17	26443435 31	77644577 47	35644676 41	54434556 36	44324363 29
10	45445433 32	25413235 25	33222111 15	47644366 40	33333154 25	54553345 34	32200135 16	34443234 27	33423445 28	44533445 32	55656666 45	56444565 39
11	44444224 28	35233102 19	24333442 25	56643442 34	55424465 35	46453534 34	45533356 34	54342226 28	35575737 42	56323365 33	44444664 36	55454565 39
12	34344334 28	32223344 23	25432211 20	22310154 18	34533453 30	33223322 20	45544446 36	55423456 34	44543435 32	34343756 35	32222234 20	44433455 32
13	44334344 29	21222211 13	22123221 15	35222122 19	55545767 44	43433352 27	57753475 43	45433243 28	23243655 30	36644567 41	43235456 32	43332333 24
14	53334332 26	25311101 14	34432215 24	11113536 21	35532235 28	73543225 31	63323211 21	21121144 16	34344766 37	56554354 37	44344334 29	34223457 30
15	23434311 21	23334333 24	54322332 24	33435476 35	25432132 22	33334554 30	13223236 22	53455457 38	54344436 33	44343336 30	34233323 23	65534336 35
16	35434332 27	23212235 20	35532322 25	45653686 43	53321134 22	65443433 32	54433236 30	66753555 42	34433447 32	45422211 21	44445454 34	55310112 18
17	45323125 25	34654664 38	35667587 47	57544353 36	33321230 17	45644311 28	43322123 20	46655474 41	65433117 30	54433362 30	34223343 24	22234653 27
18	23123344 22	55633466 38	66655677 48	34323375 30	22323256 25	24322423 22	21111152 14	54432234 27	55533365 35	54554655 39	35334366 33	43323234 24
19	53122234 22	55523354 32	65565346 40	54323275 31	64432321 25	53222123 20	01100001 03	76644466 43	54542015 26	22222124 17	54343222 25	33223436 26
20	33222000 12	25333114 22	65544477 42	44323222 22	34421143 22	10100003 05	11113200 09	54343326 30	55764545 41	43233436 28	33331002 15	48644744 41
21	23335654 31	44222235 24	55553323 31	34444366 34	21112134 15	12111225 15	22333244 23	24423124 22	44433222 24	33334325 26	44211132 18	44554444 34
22	56444355 36	44422233 24	34663242 30	34443236 29	42010000 07	24445686 39	22223334 21	52234354 28	34442232 24	23313254 23	34212222 18	44454355 34
23	55533322 28	44544455 35	66444326 35	35322114 21	01111114 10	87645346 43	77533256 38	44665376 41	23443552 28	53223443 26	22112022 12	45335555 35
24	34323355 28	77633326 37	33223532 23	25101222 15	34210014 15	75545333 35	43422237 27	44332333 25	24321256 25	44432254 28	10010001 03	45544344 33
25	35323235 26	33434331 24	24434344 28	10000010 02	20010000 03	34656454 37	54343245 30	23332464 27	34434125 26	43323321 21	00000000 00	34333324 25
26	55454554 37	22222124 17	43432356 30	11000001 03	43302243 21	44432215 25	63333324 27	56554666 43	32120152 16	32212202 14	10001122 07	55434356 35
27	55533355 34	21112016 14	54323314 25	20122344 18	11102235 15	43332214 22	33443235 27	68653467 45	23311124 17	23113135 19	35432233 25	44534342 29
28	54532134 27	24423455 29	13431246 24	43222212 18	44112221 17	56533353 33	44343235 28	64444546 37	41101245 18	23200100 08	23333245 25	32344224 24
29	45333374 32		46532335 31	11212225 16	22211225 17	22332114 18	23321244 21	43433355 30	55220004 18	20121125 14	33344264 29	43124344 25
30	34522374 30		34211024 17	42210042 15	22212124 16	23221255 22	33222367 28	43323154 25	10110123 09	42123525 24	43544255 32	32213325 21
31	35323345 28		22323222 18		32211232 16		55324446 33	33111134 17		32133235 22		34555565 38

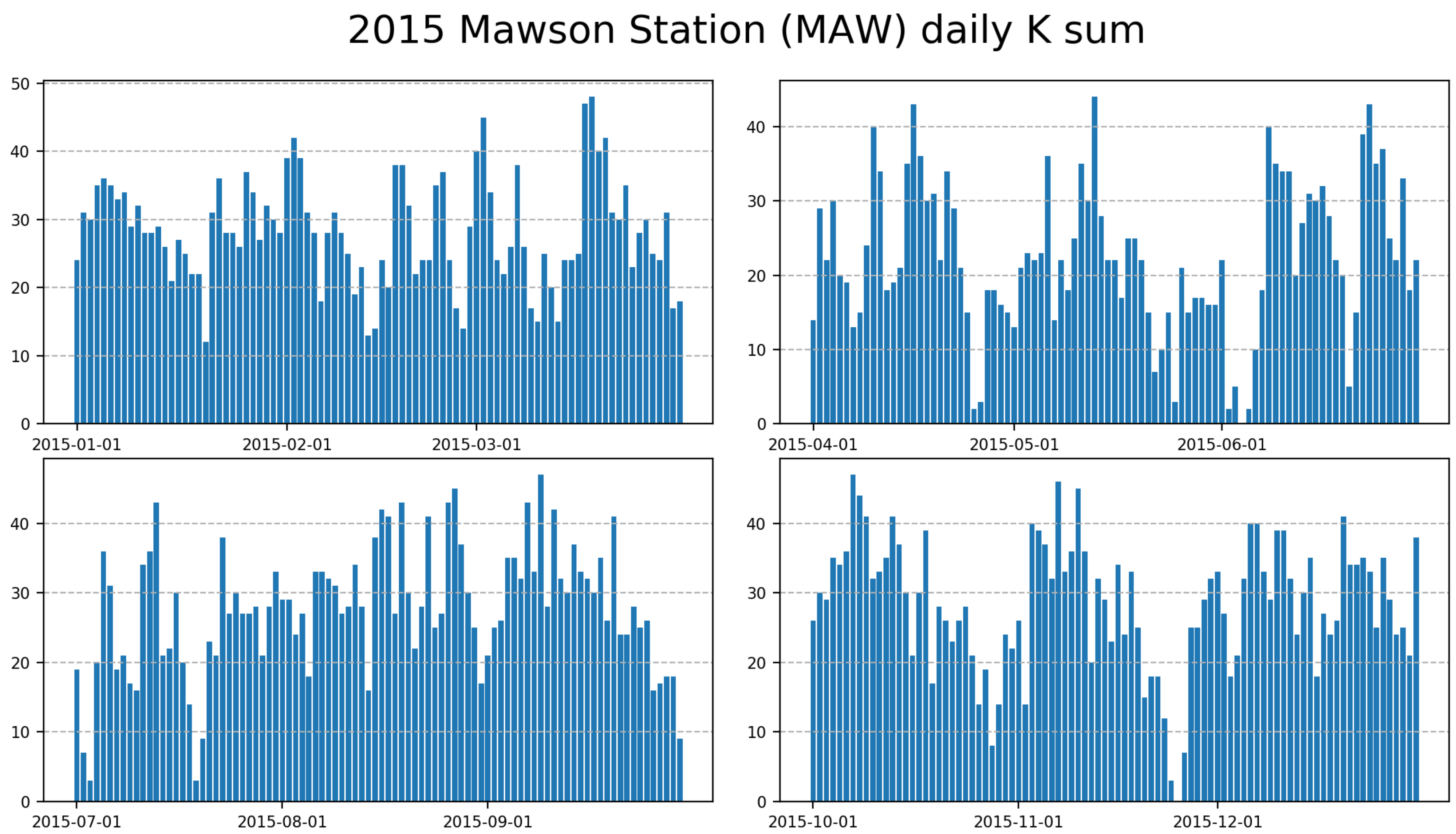

Figure 7.75 2015 Mawson Station (MAW) daily K sum.

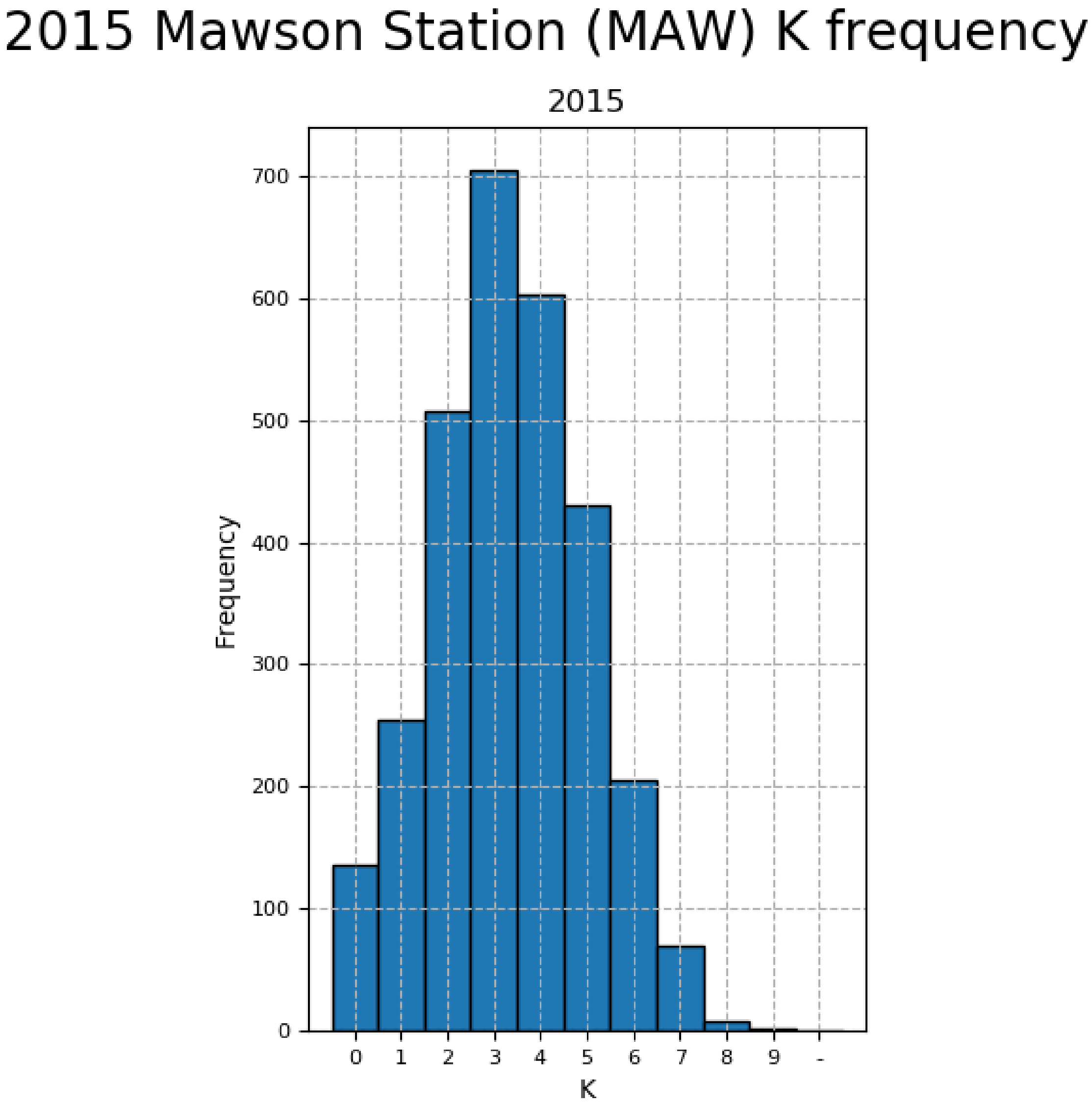

Figure 7.76 2015 Mawson Station (MAW) 3-hourly K index frequency plots.

7.9.4.4 2016

Table 17 Mawson Station (MAW) K index values for 2016. For each cell, 3-hourly K indices are given then the daily K sum (after the whitespace character). Dashes ('-') indicate that insufficient data were available to compute either the K indices or K sum. K indices enclosed in parentheses indicate that the K index was computed with missing data.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	67643343 36	46631101 22	33322215 21	41100022 10	43323456 30	34232233 22	44332223 23	32100114 12	66453487 43	35543676 39	34344425 29	33212001 12
02	55434344 32	33223325 23	53323322 23	21002655 21	55435576 40	32121024 15	24213214 19	41222326 22	56545436 38	44444365 34	53335446 33	23332232 20
03	23333435 26	45522211 22	43332114 21	44532357 33	54432446 32	41100004 10	53432256 30	56764755 45	67555667 47	34533566 35	55433447 35	21000242 11
04	24323354 26	32333212 19	53111100 12	55333034 26	22201214 14	30100123 10	34322054 23	54454665 39	66644687 47	76454366 41	54312132 21	13000013 08
05	23232333 21	44533364 32	13323233 20	33212255 23	13344325 25	33345585 36	33210045 18	35644365 36	44533445 32	56433335 32	32220011 11	44112223 19
06	64533245 32	35423335 28	12222667 28	44234355 30	43334566 34	65654474 41	11100115 10	44544356 35	44432375 32	23211344 20	41233145 23	33234435 27
07	55444344 33	33224545 28	56433766 40	32111247 21	74343335 32	43233345 27	34543365 33	53333426 29	64423424 29	33112244 20	53111202 15	34324464 30
08	44343324 27	55633223 29	54433354 31	54210003 15	78856667 53	43234301 20	54444462 33	54333632 29	55433362 31	35332345 28	32122114 16	65444577 42
09	43223323 22	43343334 27	23223325 22	11130111 09	75454477 43	43112240 17	55564433 35	23364517 31	22101235 16	42222342 21	11224375 25	34454476 37
10	43333255 28	54321145 25	54423235 28	33332004 18	56544366 39	13112253 18	34445235 30	55543376 38	43111125 18	54433563 33	33245545 31	56444543 35
11	34423555 31	34422325 25	44435335 31	30002435 17	43322245 25	54433347 33	45424456 34	33434446 31	41102354 20	22312002 12	43432345 28	46344473 35
12	64343354 32	45342343 28	44322442 25	34234566 33	42112155 21	43442334 27	66554257 40	66433233 30	33211114 16	33213245 23	55455565 40	43222324 22
13	66334452 33	33432204 21	13222204 16	75545566 43	42332253 24	45533144 29	54343136 29	22323564 27	43222225 22	35555754 39	64544475 39	34133123 20
14	33334446 30	23333544 27	43322237 26	55354666 40	54443335 31	54333398 38	54544344 33	32112123 15	43213275 27	65532323 29	23344456 31	33332231 20
15	54222234 24	44433215 26	44542386 36	63123213 21	44433353 29	54543312 27	56554326 36	42221124 18	55432115 26	45333445 31	55533333 30	22221121 13
16	33222111 15	55556876 47	75443266 37	31344566 32	25434424 28	23322233 20	54533342 29	31002235 16	10010244 12	53433387 36	43321255 25	33101114 14
17	32323331 20	55545577 43	67443575 41	56543454 36	34433355 30	34553454 33	34323223 22	34311255 24	42010005 12	55543575 39	32111243 17	22122345 21
18	21012333 15	45553476 39	33333356 29	33220112 14	36443314 28	35553244 31	22222104 15	47423125 28	42223435 25	45443226 30	33101333 17	55423333 28
19	54442312 25	53444674 37	44553654 36	22101001 07	32343331 22	44522211 21	31001115 12	21122335 19	21334423 22	53222243 23	10102133 11	34333363 28
20	34454544 33	54422224 25	34232674 31	33232013 17	34331015 20	12311013 12	65544311 29	63211104 18	54443366 35	32201042 14	12212224 16	23223325 22
21	56653576 43	24212345 23	53432334 27	23221221 15	54643323 30	11121011 08	00110105 08	20111215 13	54332114 23	12100003 07	32212334 20	43345765 37
22	44533266 33	23112224 17	34332114 21	23313436 25	34343222 23	33111334 19	44443554 33	32211255 21	43221000 12	42111255 21	33334336 28	65444455 37
23	36544434 33	53121246 24	23533225 25	34322246 26	33332133 21	35211347 26	53542025 26	34223566 31	22311000 09	22333455 27	55423353 30	55444465 37
24	54323462 29	43322234 23	52422222 21	33522542 26	43223102 17	55542335 32	53212654 28	65444327 35	11100046 13	54544435 34	65444335 34	44344555 34
25	22111001 08	54421113 21	53222133 21	22324332 21	12232001 11	34322256 27	66533455 37	53443546 34	55322246 29	54467877 48	66644574 42	53345775 39
26	12222214 16	53333123 23	11110113 09	22222236 21	10100133 09	33323356 28	23202165 21	42111255 21	64433367 36	36555765 42	35444445 33	44444645 35
27	34322113 19	24322213 19	43332434 26	24323356 28	54323356 31	64442226 30	12101016 12	34222122 18	74455854 42	66445766 44	45432355 31	44344255 31
28	32343223 22	31322124 18	25322134 22	33333111 18	54553355 35	34323242 23	55534464 36	32222210 14	45655586 44	44444576 38	33332355 27	32122245 21
29	23112224 17	30122103 12	44533335 30	22101004 10	44343246 30	42111164 20	46543465 37	32202346 22	37665576 45	76644344 38	33134235 24	43122423 21
30	22000112 08		63333363 30	32113335 21	64443234 30	11201165 17	65422235 29	55434465 36	55543375 37	35445466 37	33211123 16	33112224 18
31	33333333 24		43312214 20		34343356 31		52112223 18	32311245 21		54343344 30		33235443 27

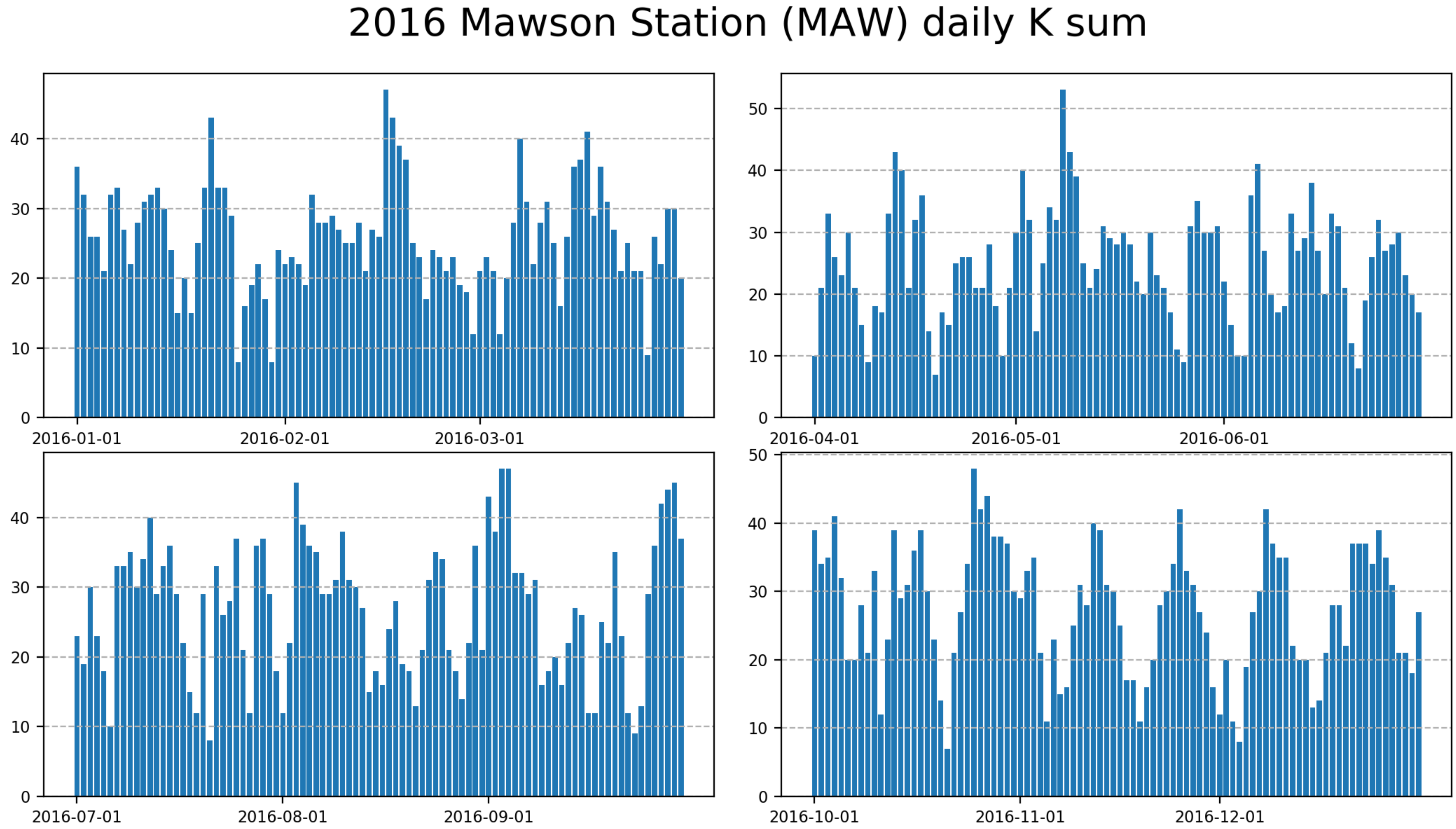

Figure 7.77 2016 Mawson Station (MAW) daily K sum.

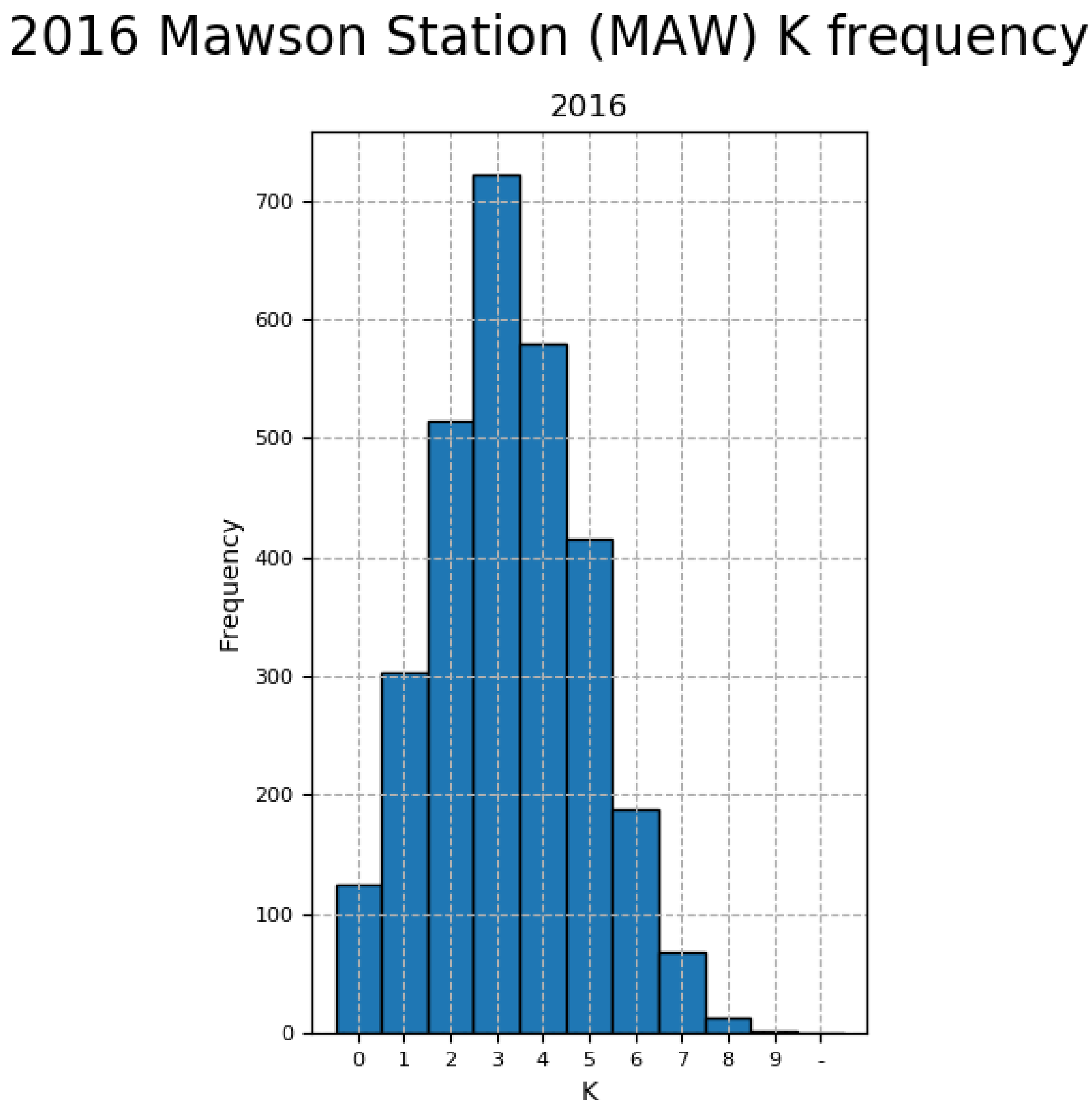

Figure 7.78 2016 Mawson Station (MAW) 3-hourly K index frequency plots.

7.10 Casey Station

7.10.1 INTERMAGNET 'readme' files

7.10.1.1 2013

```
                        CSY
           CASEY OBSERVATORY INFORMATION 2013

  ACKNOWLEDGE- Users of the CSY data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: CSY
     LOCATION: CASEY Station,
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 156.28 deg. S
    LONGITUDE: 110.53 deg. E
    ELEVATION: 40 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DMI on Zeiss 020B)
               and Proton Precession Magnetometer (GSM90)

    RECORDING
   VARIOMETER: Danish Meteorological Institute suspended
               fluxgate FGE Magnetometer
               GSM90 Proton Precession Magnetometer
               Garmin GPS16-HVS clock

  ORIENTATION: Two horizontal fluxgate channels are aligned
               equally about magnetic north at
               the time of installation.
               This orientation is referred to as ABZ.
DYNAMIC RANGE: +/-3200nT
   RESOLUTION: 0.3nT
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: No Backup Variometer

    K-NUMBERS: No scaling was performed on these data.

     K9-LIMIT: 750nT

         GINS: Edinburgh
    SATELLITE: Http delivery.

    OBSERVERS: Jukka Pirhonen
               Shane Kern (from 2013-11-19)


      CONTACT: Geomagnetism
               Geoscience Australia
               G.P.O. Box 378
               Canberra, A.C.T, 2601
               Australia
```

Tel: + 61-2-6249-9111
Fax: + 61-2-6249-9986
e-mail: geomag@ga.gov.au
WWW: http://www.ga.gov.au

NOTES:

Casey is situated on the Antarctic coast in Wilkes Land 3880 km south of Perth. It is the nearest Australian Antarctic research station to Australia. The magnetic Absolute Hut is about 120 m south of the tank house, the nearest structure of the modern Casey station. The old Casey station, in use until the late 1980s, lies about 1 km northeast of the present Casey.

Regular magnetic observations began at Casey in 1975. From 1988 a variation station operated there. From 1991 to 1998 it operated as a magnetic observatory, although not to a high standard. Observatory-standard absolute control commenced in 1999. A more detailed history of the Casey (and Wilkes) observatory is given in Hopgood (2001, 2002, 2004a, 2004b).

The magnetic observatory is part of the Casey scientific research station in Antarctica.
The magnetic observatory comprises:
* the Variometer Hut, and;
* the Absolute Hut.
The crystalline rocks of Casey have high concentrations of magnetic minerals that cause high magnetic gradients in the area. The observatory is located in one of the places of least gradient in the area but still with a higher gradient than is ideal for a magnetic observatory.

Local meteorological conditions

The meteorological temperature at Casey during 2013 varied from a minimum -32.1degC (2013-07-30) to a maximum of +6degC on one occasion (2013-01-08). Daily minimum temperatures varied from -32.1degC to +1.7degC (average -12.9degC). Daily maximum temperatures varied from -25.9degC to +6degC (average -6.2degC).

The daily maximum wind gust varied from 15 km/h to 209 km/h with a daily average wind speed of 62.7 km/h. The maximum daily maximum wind gust was 209 km/h in July. The minimum daily maximum wind gust was 15 km/h in July. Windy conditions were the norm throughout the year with the higher wind gusts being attributed to blizzards.

Variometers

The variometers used during 2014 are described in Table 2. The variometers at Casey station are housed within the Variometer Hut. The DMI variometer sensor is located in the southern corner of the hut. The GSM-90 total-field magnetometer sensor is located in the northern corner. Both sensors are mounted on marble plinths. This configuration allows for the maximum separation between the two instruments. The Variometer Hut also contains the variometer electronics mounted within non-magnetic shelves.

The instrument power supply, consisting of a 12 V battery box and charger, is also positioned within the shelves. System timing was provided by a Garmin GPS16-HVS clock mounted on the shelves. Timing corrections were applied automatically and logged. Timing corrections greater than 1 ms are listed in the Variometer clock corrections section.

The recording equipment, a QNX acquisition computer, was directly connected to the station's network hub via fibre optic cable and was located within the Variometer Hut. During the year there was only one period when contamination of the data occurred. This occurred on 2013-05-15 when the observer entered the variometer hut to measure the ambient temperature within the hut and to take photos of the acquisition system.

Table 1. Key observatory data.
IAGA code: CSY
Commenced operation: 1999
Geographic latitude: 66deg 17' S
Geographic longitude: 110deg 32' E
Geomagnetic latitude: -75.95deg
Geomagnetic longitude: 184.79deg
K 9 index lower limit: 750nT
Principal pier: Pier B
Pier elevation (top): 41 m AMSL
Principal reference mark: Trig station G11
Reference mark azimuth: 308deg 06' 00"
Reference mark distance: 464 m
Observer: J. Pirhonen
S. Kern

Table 2.
Magnetic variometers used in 2013.
3-component variometer: DMI FGE
Serial number: E0199 / S0160
Type: suspended; linear-core fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
A/D converter: ADAM 4017 module (±10V)
Scale value: 0.32 nT / count
Total-field variometer: GEM Systems GSM-90
Serial number: 4081423 / 42189
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Data acquisition system: GDAP: PC-104 computer, QNX OS
Timing: Garmin GPS 16 clock
Communications: ANARESAT

Table 3.
Absolute magnetometers and their adopted corrections for 2013. Corrections are applied in the sense
Standard = Instrument + correction.
DI fluxgate: DMI
Serial number: DI0047
Theodolite: Zeiss 020B
Serial number: 352229

Resolution: 0.1'
D correction: 0.15'
I correction: -0.20'
Total-field magnetometer: GEM Systems GSM-90
Serial number: 810881 / 31960
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT
Total-field magnetometer: Geometrics G816 (backup)
Serial number: 766
Type: Proton precession
Resolution: 1 nT
Correction: 1.5 nT

The final FCheck values for the year varied within a range of about 5 nT. The standard deviations in the 2013 weekly absolute observations from the final adopted variometer model and data were:

	stdev
X	1.6 nT
Y	1.5 nT
Z	1.5 nT
D	35.8"
I	4.3"
F	1.6 nT

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2013, adjustments to the system clock were less than 1 ms except on the following occasions:

2013-01-04	23:52:11	0.202 s	Unknown
	23:52:11	0.202 s	Unknown
2013-10-22	03:04:41	0.278 s	Reboot
2013-11-10	23:32:59	0.091 s	Reboot
2013-11-11	00:55:59	-0.052 s	Unknown

Absolute instruments

The principal absolute magnetometers used at Casey in 2013, and their adopted instrument corrections, are described in Table 3.
At the 2013 mean magnetic field values at Casey (X=-905 nT, Y=-9139 nT, Z=-63343 nT) these D, I and F corrections translate to corrections of:
dX = 0.76 nT dY = 3.6 nT dZ = -0.54 nT

Instrument corrections were applied while reducing absolute observations to determine baselines and accordingly have been applied to all Casey 2013 final data.

Baselines

The sensor and electronics were located in the Variometer Hut and were subject to the same thermal conditions. As such, independent temperature effects were unable to be determined. For 2013 the two temperature coefficients were combined into one value and used as the coefficient for the sensor. The coefficient for the electronics was set to zero.

The final baseline parameters for the variometer were completed by manually fitting a piece-wise linear function to the absolute observations. This function included drifts or jumps, when required, to obtain a good fit to the weekly absolute observation baseline residuals. Baseline drifts in all three channels increases over the period day 93 to 198. Scatter in the baseline residuals was also increased over this period. Baselines were adopted to corrected for the drift but Fcheck (Fv -Fs) data showed the corrections forced an excursion into the Fcheck data. In the absence of alternate evidence baselines were adopted using the absolute observations in preference to the Fv -Fs data.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2013 CSY definitive data and real time reported 1-minute data sets
(CSY definitive - CSY real time) were:

	X	Y	Z
Average	+1.3	-0.4	+0.3
Std.dev	+1.0	+1.0	+1.3
Min	-0.6	-2.1	-1.0
Max	+2.6	+1.2	+3.1

The CSY 2013 reported real time data are within the specification for INTERMAGNET Quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.
The annual statistics of the 12 monthly averages of the difference between the 2013 CSY definitive data and quasi-definitive 1-minute data sets
(CSY definitive - CSY quasi-definitive) were:

	X	Y	Z
Average	+0.4	+0.2	-0.1
Std.dev	+0.6	+0.6	+1.0
Min	-1.7	-1.0	-2.2
Max	+0.4	+1.5	+2.1

The CSY 2013 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The Casey observer was a member of the Australian National Antarctic Research Expedition and was employed by the Australian Antarctic Division with funding support by Geoscience Australia.
The observer was responsible for the continuous operation of the observatory and performed equipment maintenance and installation as required. The observer performed weekly absolute observations and forwarded them by e-mail to Geoscience Australia. During the observations the variometer system was also checked. All data processing was performed at Geoscience Australia.

During 2013, data were recorded on a QNX acquisition computer which was directly connected to the station's network hub. Data were retrieved to Geoscience Australia using rsync over ssh at least every 10 minutes. Real-time data were processed automatically at Geoscience Australia then distributed, usually within a 2 to 15 minute delay.

The QNX acquisition computer used a GPS clock (both pulse-per-second and absolute-time-code) to set the system time. The clock was checked from Geoscience Australia regularly to ensure it was working. If not, it was reset remotely or, if necessary, the computer was re-booted.

The distribution of Casey 2013 data is described in Table 4. Data losses are identified below.

Table 4. Distribution of Casey 2013 data.

```
1-second values
IPS            preliminary  real time
INTERMAGNET    preliminary  hourly

1-minute values
INTERMAGNET    preliminary  real time
INTERMAGNET    preliminary  daily
INTERMAGNET    Quasi-
               definitive   monthly
INTERMAGNET    definitive   July 2014
WDC for Geomagnetism
               preliminary  real time
WDC for Geomagnetism
               preliminary  daily
```

Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au)

```
Significant events
------------------
2013-03-30  Z channel drifts cause fcheck 3h to increase in
            value. Not sure why but need to investigate for
            definitive data. Apply drift for QD.
2013-05-15  01:30 XYZF contamination for about 10 minutes.
            Observer in variometer hut checking temperature
            and photos of inside.
2013-10-21  15:45 Lost contact with GPS clock
2013-10-22  02:35 Stop and restart clock driver 02:47 Stop
            and restart clock driver again
            03:03 Reboot 03:04:41 - CLK I 0 Correction
            1382411081 345722665 C 0 s  278057468 R 0
             s -41784
            03:05:23 - CLK I 0 Correction 1382411123
            343582181 C 0 s     -32429 R 0 s     -41429
2013-11-08  01:21 Lost contact with GPS clock
2013-11-10  22:38 Stop and restart clock driver 22:49
            Reboot - comes good after about 30 mins
            23:32:59 - CLK I 0 Correction 1384126379
            51308950 C 0 s 90812652 R 0 s     -41732
            23:33:41 - CLK I 0 Correction 1384126421
```

```
            49171460 C 0 s -45964 R 0 s     -42329

Data Losses for 2013
--------------------
Variometer data XYZ:
2013-01-04    XYZ     23:50 - 23:51  (2)
2013-05-15    XYZ     01:22 - 01:38  (17)
2013-10-22    XYZ     03:02 - 03:04  (3)
2013-11-06    XYZ     23:59 -
2013-11-07    XYZ     - 00:01        (3)
2013-11-10    XYZ     22:48 - 22:49  (2)
2013-12-01    XYZ     04:35 - 04:36  (2)
2013-12-30    XYZ     07:57 - 07:58  (2)
2013-12-31    XYZ     07:15 - 07:16  (2)

Total: 33

Scalar Data F:
2013-01-04    F      23:51 - 23:51  (1)
2013-05-15    F      01:23 - 01:37  (15)
2013-10-22    F      03:03 - 03:03  (1)
2013-11-10    F      22:49 - 22:49  (1)

Total: 18

Annual mean values
------------------
The annual mean values for Casey are set out in
the yearmean file.

Indices
-------

No magnetic indices are routinely calculated for the
Casey station observatory.

                             < END >
```

7.10.1.2 2014

```
                           CSY
            CASEY OBSERVATORY INFORMATION 2014

  ACKNOWLEDGE- Users of the CSY data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: CSY
     LOCATION: CASEY Station,
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 156.28 deg
    LONGITUDE: 110.53 deg. E
    ELEVATION: 40 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DMI on Zeiss 020B)
               and Proton Precession Magnetometer (GSM-90)

    RECORDING
   VARIOMETER: Danish Meteorological Institute suspended
               fluxgate FGE Magnetometer
```

```
                GSM-90 Proton Precession Magnetometer
                Garmin GPS16-HVS clock

   ORIENTATION: Two horizontal fluxgate channels are aligned
                equally about magnetic north at
                the time of installation.
                This orientation is referred to as ABZ.
 DYNAMIC RANGE: +/-3200 nT
    RESOLUTION: 0.3 nT
 SAMPLING RATE: 1 second
   FILTER TYPE: Intermagnet

        BACKUP
    VARIOMETER: No backup variometer

     K-NUMBERS: No scaling was performed on these data.

      K9-LIMIT: 750 nT

          GINS: Edinburgh
     SATELLITE: Http delivery.

     OBSERVERS: Shane Kern
                Doug McVeigh (from 2014-12-10)

       CONTACT: Geomagnetism
                Geoscience Australia
                G.P.O. Box 378
                Canberra, A.C.T, 2601
                Australia

                Tel: + 61-2-6249-9111
                Fax: + 61-2-6249-9969
                e-mail: geomag@ga.gov.au
                WWW: http://www.ga.gov.au

NOTES:
Casey is situated on the Antarctic coast in Wilkes Land
3880 km south of Perth. It is the nearest Australian
Antarctic research station to Australia. The magnetic
Absolute Hut is about 120 m south of the tank house, the
nearest structure of the modern Casey station. The old
Casey station, in use until the late 1980s, lies about 1 km
northeast of the present Casey station.

Regular magnetic observations began at Casey in 1975. From
1988 a variation station operated there. From 1991 to 1998
it operated as a magnetic observatory, although not to a
high standard. Observatory-standard absolute control
commenced in 1999. A more detailed history of the Casey
(and Wilkes) observatory is given in Hopgood
(2001, 2002, 2004a, 2004b).

The magnetic observatory is part of the Casey scientific
research station in Antarctica.
The magnetic observatory comprises:
* the Variometer Hut, and;
* the Absolute Hut.

The crystalline rocks of Casey have high concentrations of
magnetic minerals that cause high magnetic gradients in the
```

area. The observatory is located in one of the places of least gradient in the area but still with a higher gradient than is ideal for a magnetic observatory.

Table 1. Key observatory data.
IAGA code: CSY
Commenced operation: 1999
Geographic latitude: 66 deg 17' S
Geographic longitude: 110 deg 32' E
Geomagnetic latitude: -75.95 deg
Geomagnetic longitude: 184.79 deg
K 9 index lower limit: 750 nT
Principal pier: Pier B
Pier elevation (top): 40 m AMSL
Principal reference mark: Trig station G11
Reference mark azimuth: 308 deg 06' 00"
Reference mark distance: 464 m
Observer: S. Kern
D. McVeigh

Local meteorological conditions

The meteorological temperature at Casey during 2014 varied from a minimum -32.8 deg C (2014-06-10) to a maximum of +7 deg C on (2014-01-09). Daily minimum temperatures varied from -32.8 deg C to +2.3 deg C (average -13.3 deg C). Daily maximum temperatures varied from -27.0 deg C to +7 deg C (average -6.6 deg C).

The daily maximum wind gust varied from 15 km/h in January to 231 km/h in September with a daily average wind speed of 69.2 km/h. Windy conditions were the norm throughout the year with the higher wind gusts being attributed to blizzards.

Variometers

The variometers used during 2014 are listed in Table 2.

The variometers at Casey station are housed within the variometer hut. The DMI variometer sensor is located in the southern corner of the hut. The GSM-90 total-field magnetometer sensor is located in the northern corner. Both sensors are mounted on marble plinths. This configuration allows for the maximum separation between the two instruments. The variometer hut also contains the variometer electronics mounted within non-magnetic shelves. The instrument power supply, consisting of a 12 V observatory backup battery box and charger, is also positioned within the shelves. System timing was provided by a Garmin GPS16-HVS clock mounted on the shelves. Timing corrections were applied automatically and logged. Timing corrections greater than 1 ms are listed in the variometer clock corrections section.

The recording equipment, a QNX acquisition computer, was directly connected to the station's network via fibre optic cable and was located within the variometer hut.

During the year there were five periods where data was lost. The first occurred in late June when a circuit breaker on the station power supply tripped. The observatory battery backup continued to supply power to the acquisition system for several hours until exhausted The battery in the observatory battery backup was also replaced this time.

The next interruption to data occurred in early July (2014-07-08) when the acquisition system was upgraded. A new ARK3360 industrial computer running QNX 6.5 operating system replaced the existing PC-104 computer and QNX operating system.

On two occasions over a two day period, corrupted data was recorded by the DMI variometer. The first of these occurred in August and the second occurred in September. The corrupted data were excluded from the 2014 definitive data.

The last interruption to data occurred in late November (2014-11-25) when the circuit breaker on the power supply tripped again.

Table 2.
Magnetic variometers used in 2014.
3-component variometer: DMI FGE
Serial number: E0199 / S0160
Type: suspended; linear-core fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
A/D converter: ADAM 4017 module (±10V)
Scale value: 0.32 nT / count
Total-field variometer: GEM Systems GSM-90
Serial number: 4081423 / 42189
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Data acquisition system: GDAP: PC-104 computer, QNX OS
(till 2014-07-08)
ARK3360/QNX6.5
(from 2014-07-08)
Timing: Garmin GPS 16 clock
Communications: ANARESAT

Table 3.
Absolute magnetometers and their adopted corrections for 2014. Corrections are applied in the sense
Standard = Instrument + correction.
DI fluxgate: DMI
Serial number: DI0047
Theodolite: Zeiss 020B
Serial number: 352229
Resolution: 0.1'
D correction: 0.15'
I correction: -0.20'
Total-field magnetometer: GEM Systems GSM-90
Serial number: 810881 / 31960
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT
Total-field magnetometer: Geometrics G816 (backup)
Serial number: 766

```
Type: Proton precession
Resolution: 1 nT
Correction: 1.5 nT

Variometer clock corrections
----------------------------
Time stamps applied to the variometer data were obtained
from the acquisition computer system clock. That clock was
synchronised to a GPS clock. During 2014, adjustments to
the system clock were less than 1 ms except on the
following occasions:
2014-06-02      02:15:52    -0.009 s    Unknown
2014-07-08      01:50:46  -301.688 s    Replacement
                01:57:22    -1.000 s    of computer
                03:13:34    -0.050 s
                03:40:40    -0.024 s
2014-11-25      01:10:40    -0.101 s    Power failure
                02:53:09    -0.038 s

Absolute instruments
--------------------
The principal absolute magnetometers used at Casey in 2014,
and their adopted instrument corrections, are listed in
Table 3.
At the 2014 mean magnetic field values at Casey
(X=-938 nT, Y=-9102 nT, Z=-63365 nT) these D, I and F
corrections translate to corrections of:
dX = 0.77 nT  dY = 3.63 nT  dZ = -0.53 nT

Instrument corrections were applied while reducing absolute
observations to determine baselines and accordingly have
been applied to all Casey 2014 final data.

Baselines
---------
The sensor and electronics were located in the variometer
hut and were subject to the same thermal conditions. As
such, independent temperature effects were unable to be
determined. For 2014 temperature corrections were
applied using the sensor temperature only.

The final baseline parameters for the variometer were
completed by manually fitting a piece-wise linear function
to the absolute observations. This function included drifts
or jumps, when required. The baseline drifted in all three
channels over the course of the year.
Scatter in the baseline residuals throughout the year had a
a range of 5.4 nT. An adjustment to the scalar baseline was
made at the start of the year to force Fv - Fs average
to zero.

The final Fv-Fs values for the year varied from -0.9 nT to
1.0 nT. The standard deviations in the 2014 weekly
absolute observations from the final adopted variometer
model and data were:

X   1.2 nT
Y   1.3 nT
Z   0.6 nT
D   27"
I   4"
```

F   0.6 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2014 CSY definitive data and real time reported 1-minute data sets
(CSY definitive - CSY real time) were:

	X	Y	Z
Average	+0.4	+0.1	-0.1
Std.dev	1.4	1.8	1.0
Min	-2.6	-2.3	-1.2
Max	+2.4	+3.4	+2.4

The CSY 2014 reported real time data are within the specification for INTERMAGNET Quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.
The annual statistics of the 12 monthly averages of the difference between the 2014 CSY definitive data and quasi-definitive 1-minute data sets
(CSY definitive - CSY quasi-definitive) were:

	X	Y	Z
Average	+0.3	-0.1	+0.1
Std.dev	1.0	1.1	0.8
Min	-0.9	-1.5	-1.2
Max	+2.4	+2.4	+1.7

The CSY 2014 quasi-definitive data are within the specification for INTERMAGNET Quasi-definitive data.

Operations

The Casey observer was a member of the Australian National Antarctic Research Expedition and was employed by the Australian Antarctic Division with funding support by Geoscience Australia.

The observer was responsible for the continuous operation of the observatory and performed equipment maintenance and installation as required. The observer performed weekly absolute observations and forwarded them by e-mail to Geoscience Australia. Periodic visits the variometer hut were also made to check on the variometer system.
All data processing was performed at Geoscience Australia.

Data were retrieved using rsync over ssh at least every 10 minutes. Real-time data were processed automatically at Geoscience Australia and distributed, usually within a 2 to 15 minute delay.

The GPS clock was checked from Geoscience Australia regularly to ensure it was working. If not, it was reset remotely or, if necessary, the computer was re-booted.

As previously stated, an interruption in data retrieval occurred in late June (2014-06-30). During this time the temperature in the variometer hut dropped below -10 deg C as the heaters require mains power. The data from this period was excluded for the 2014 definitive data.

On 2014-12-05 the observer and a tradesman entered the variometer hut to assess installation of an electrical conduit to the absolute hut. Ten minutes of data were contamination and were excluded from the 2014 definitive data. The installation of the electrical conduit occurred in early 2015 and will be reported with the 2015 definitive data.

The distribution of Casey 2014 data is described in Table 4. Data losses are identified below.

Table 4. Distribution of Casey 2014 data.

1-second values		
IPS	preliminary	real time
INTERMAGNET	preliminary	hourly
1-minute values		
INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	Quasi-definitive	monthly
INTERMAGNET	definitive	July 2015
WDC for Geomagnetism, Kyoto	preliminary	real time
WDC for Geomagnetism, Kyoto	preliminary	daily

Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au)

Significant events

```
2014-01-15  Silica gel into window of absolute hut and
            sealed with tape. Acq computers arrived on
            shipment.
2014-03-14  A tradie and SK visited the hut today
            between 2:30 and 3:30 UTC time to investigate
            what can be done about the window and leaking
            roof.
2014-05-06  02:58:30 to 02:58:46 data missing. No reason
            for this. Investigate reason. SK reports that
            blackouts have occurred at the station. request
            SK to check battery for install date.
2014-06-02  Clock problems
            02/06/14 02:09:37 - CLK W 0 Lost contact with
            Gm16 RESET
            02/06/14 02:09:38 - CLK I 0 Power Up 4672249
            02/06/14 02:14:28 - CLK I 0 Started
            02/06/14 02:14:28 - CLK I 0 Power Up 4672250
            02/06/14 02:15:06 - CLK W 0 UTC inconsistent
            1401675306 0 17552294 385194869 1401675306
            80276172 17552294 385194869
            02/06/14 02:15:52 - CLK I 0 Correction
            1401675352 694004669 C 0 s   -9316893
            R 0 s     -42131
            02/06/14 02:16:34 - CLK I 0 Power Down 4672250
            1 0 -366
            02/06/14 02:16:34 - CLK I 0 Correction
```

1401675394 682491967 C 0 s -366 R 0 s -42050
02/06/14 02:16:34 - CLK I 0 Power Up 4672251

2014-06-18 Updated K9 index value from 1500 nT to 750 nT on advice from ISGI-Michel Menvielle.
This will apply from 2013 data onwards.
SK advises that high winds and small window of daylight hamper collection of obs for this week. Will attempt again next day.

2014-06-30 Data stops at 10:37 UTC. Check system remotely, not able to communicate with computer. Circuit breaker had tripped in Mabel. Battery is completely flat. Need to enter variometer to disconnect computer to allow battery to charge. Take opportunity to replace battery in box.

2014-07-01 Data begins to flow at 06:08:10 UTC.
Contamination evident.
All Time Corrections lost before this time.
GdapClock not working.

2014-07-04 GdapClock or qtalk cannot talk to GPS clock.
SK check connections -all were OK.
ga-csy-mag2 # ntpdate ntp
4 July 05:12:18 ntpdate[19869725]: step time server 147.66.24.1 offset 0.645312 sec
ga-csy-mag2 # ntpdate -d ntp
4 July 05:12:23 ntpdate[19877917]: ntpdate 4.1.1@1.786 Mon Mar 24 04:53:20 EST 2003 (2)
4 July 05:12:23 ntpdate[19877917]: adjust time server 147.66.24.1 offset 0.000084 sec

2014-07-05 ~23:30, added "ntpdate ntp" to RtcUpdate until GPS clock problem resolved.
Added touch /tmp/cron.log to EndDay cron job.
Added "147.66.24.10 ntp" to hosts in place of 147.66.24.1

2014-07-08 ~01:00-02:00 SK replaced the computer (now 147.66.24.131 QNX6.5) and the GPS clock sent down last summer. Upgraded the GdapClockGm (installed version didn't work well).
~23:50 adjusted clock rate to 838106259 using -10000 for trial
Noted shift in scalar F with change of computer.

2014-07-09 Changed Gsm.cfg to longpolarise=false and trigger=3.0 (from 2.5)to adjust F to near 10s mark. I FORGOT to save the CheckTimeCorrections.log file, however there is a save just a few days before, and during the time between there was no GPS clock. Hourly "ntpdate ntp" was used instead as noted above, and whenever I (PGC) checked, the corrections were small - within 10ms, I think even less than 1ms.

2014-08-18 Contamination in data, source unknown. Data excluded. 12:36:51 to 12:40:20

2014-08-27 Contamination in vector data 00:33:29 to 00:36:10 UTC, unknown cause, blizzard occurring at same time so probably not anybody outside.

2014-09-17 Fv-Fs steps

2014-09-18 Fv-Fs steps

2014-11-24 Computer stops at 21:40:29. AC circuit to variometer had tripped. Need to wait for summer so that electricians can test circuit for

```
          leakage.
2014-11-25 Computer restarts at 01:08:56.
2014-12-05 Variometer hut entered between 21:44:05 and
           21:52:57 to assess access for work associated
           with new conduit between variometer and absolute
           huts.
2014-12-17 Absolute PPM second obs, possible timing issue.
           Adjusted by 2 minutes.


Data Losses for 2014
--------------------
Variometer data XYZ:
2014-01-20    XYZ     00:54 - 00:54  (1)
2014-02-12    XYZ     03:54 - 03:54  (1)
2014-02-19    XYZ     03:48 - 03:48  (1)
2014-05-06    XYZ     02:59 - 02:59  (1)
2014-05-08    XYZ     01:11 - 01:11  (1)
2014-05-14    XYZ     16:54 - 16:54  (1)
2014-06-30    XYZ     06:00 -
2014-07-01    XYZ           - 12:00 (1801)
2014-07-08    XYZ     00:00 - 04:22  (263)
2014-08-18    XYZ     12:37 - 12:40  (4)
2014-08-20    XYZ     16:34 -
2014-08-21    XYZ           - 19:45 (1632)
2014-08-22    XYZ     16:48 - 16:52  (5)
2014-08-23    XYZ     03:57 - 04:01  (5)
2014-08-27    XYZ     00:34 - 00:36  (3)
2014-09-15    XYZ     03:02 - 03:20  (19)
2014-09-17    XYZ     09:25 -
2014-09-18    XYZ           - 22:50 (2246)
2014-11-24    XYZ     21:41 -
2014-11-25    XYZ           - 09:11 (691)
2014-12-05    XYZ     21:44 - 21:53  (10)

Total: 6685

Scalar Data F:
2014-01-02    F      18:57 - 19:17  (21)
2014-01-03    F      07:54 - 07:54  (1)
2014-01-12    F      07:36 - 07:36  (1)
2014-01-20    F      16:44 - 16:44  (1)
2014-01-23    F      09:00 - 09:01  (2)
2014-02-11    F      06:28 - 06:29  (2)
2014-02-14    F      06:04 - 06:04  (1)
2014-02-18    F      07:20 - 07:20  (1)
2014-02-20    F      11:44 - 11:44  (1)
2014-02-23    F      07:01 - 07:09  (9)
2014-03-02    F      08:09 - 08:10  (2)
2014-03-07    F      06:54 - 06:55  (2)
2014-04-20    F      07:31 - 07:35  (5)
2014-04-21    F      09:19 - 09:19  (1)
2014-05-24    F      07:30 - 07:30  (1)
2014-06-08    F      07:26 - 07:31  (6)
2014-06-08    F      08:35 - 08:36  (2)
2014-06-10    F      06:18 - 06:20  (3)
2014-06-11    F      09:18 - 09:18  (1)
2014-06-11    F      15:49 - 15:58  (10)
2014-06-11    F      16:24 - 16:26  (3)
2014-06-11    F      16:36 - 16:44  (9)
2014-06-20    F      16:09 - 16:43  (35)
```

```
2014-06-30    F      06:01 - 14:38  (518)
2014-06-30    F      14:40 -
2014-07-01    F            - 11:59 (1280)
2014-07-04    F      04:23 - 04:23  (1)
2014-07-04    F      04:25 - 04:25  (1)
2014-07-04    F      04:28 - 04:30  (3)
2014-07-04    F      06:49 - 06:50  (2)
2014-07-04    F      06:55 - 06:55  (1)
2014-07-08    F      00:00 - 04:21  (262)
2014-07-09    F      00:07 - 00:07  (1)
2014-07-15    F      13:41 - 13:41  (1)
2014-07-25    F      06:23 - 06:24  (2)
2014-08-13    F      07:05 - 07:07  (3)
2014-08-20    F      16:34 -
2014-08-21    F            - 19:44 (1631)
2014-08-22    F      16:48 - 16:51  (4)
2014-08-23    F      03:57 - 04:01  (5)
2014-08-27    F      00:34 - 00:36  (3)
2014-09-06    F      18:48 - 18:48  (1)
2014-09-08    F      08:59 - 08:59  (1)
2014-09-09    F      08:02 - 08:03  (2)
2014-09-14    F      03:01 - 03:01  (1)
2014-09-17    F      09:25 -
2014-09-18    F            - 22:50 (2246)
2014-09-24    F      05:27 - 05:27  (1)
2014-09-25    F      05:15 - 05:17  (3)
2014-09-26    F      04:21 - 04:22  (2)
2014-09-27    F      09:00 - 09:04  (5)
2014-10-02    F      06:32 - 06:33  (2)
2014-10-08    F      05:58 - 05:58  (1)
2014-10-17    F      07:58 - 07:58  (1)
2014-10-22    F      02:12 - 02:13  (2)
2014-10-24    F      07:44 - 07:44  (1)
2014-10-28    F      03:32 - 03:33  (2)
2014-11-06    F      09:51 - 09:51  (1)
2014-11-12    F      05:48 - 05:49  (2)
2014-11-13    F      05:37 - 05:39  (3)
2014-11-15    F      08:42 - 08:42  (1)
2014-11-15    F      23:32 - 23:33  (2)
2014-11-16    F      07:53 - 07:54  (2)
2014-11-19    F      07:59 - 07:59  (1)
2014-11-20    F      08:00 - 08:00  (1)
2014-11-21    F      02:38 - 02:40  (3)
2014-11-21    F      03:43 - 03:43  (1)
2014-11-21    F      07:31 - 07:31  (1)
2014-11-21    F      08:09 - 08:10  (2)
2014-11-23    F      06:26 - 06:27  (2)
2014-11-24    F      21:41 -
2014-11-25    F            - 09:11 (691)
2014-11-25    F      10:13 - 10:15  (3)
2014-11-30    F      08:28 - 08:30  (3)
2014-12-02    F      03:32 - 03:32  (1)
2014-12-02    F      08:28 - 08:29  (2)
2014-12-03    F      19:06 - 19:07  (2)
2014-12-03    F      20:13 - 20:14  (2)
2014-12-05    F      21:46 - 21:46  (1)
2014-12-05    F      21:51 - 21:51  (1)
2014-12-07    F      10:05 - 10:05  (1)
2014-12-07    F      17:08 - 17:09  (2)
2014-12-08    F      13:52 - 13:52  (1)
2014-12-12    F      05:07 - 05:10  (4)
```

```
2014-12-12    F      05:31 - 05:31   (1)
2014-12-13    F      06:00 - 06:03   (4)
2014-12-15    F      06:01 - 06:01   (1)
2014-12-15    F      09:13 - 09:13   (1)
2014-12-17    F      05:20 - 05:23   (4)
2014-12-20    F      08:28 - 08:30   (3)
2014-12-23    F      11:15 - 11:16   (2)
2014-12-27    F      04:16 - 04:17   (2)
2014-12-30    F      12:13 - 12:15   (3)

Total: 6866


Annual mean values
------------------
The annual mean values for Casey are set out in
the yearmean file.

Indices
-------
On 2014-06-18 the K9 value for Casey was updated from
1500 nT to 750 nT on advice from Dr. Menvielle from ISGI.
K indices are not routinely scaled from the Casey data.

                             < END >
```

7.10.1.3 2015

```
                           CSY
            CASEY OBSERVATORY INFORMATION 2015

  ACKNOWLEDGE- Users of the CSY data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: CSY
     LOCATION: Casey Station
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 156.28 deg
    LONGITUDE: 110.53 deg. E
    ELEVATION: 40 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DMI on Zeiss 020B)
               and Proton Precession Magnetometer (GSM-90)

    RECORDING
   VARIOMETER: Danish Meteorological Institute suspended
               fluxgate FGE, 3 component magnetometer
               GSM-90 Proton Precession magnetometer

  ORIENTATION: Two horizontal fluxgate channels are aligned
               equally about magnetic north at
               the time of installation.
               This orientation is referred to as ABZ.
DYNAMIC RANGE: +/-3200 nT
   RESOLUTION: 0.3 nT
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet

       BACKUP
```

```
   VARIOMETER: None

    K-NUMBERS: None

     K9-LIMIT: 750 nT

         GINS: Edinburgh
    SATELLITE: HTTP delivery.

    OBSERVERS: Doug McVeigh
               Andy Burgess (from 2015-12-14)

      CONTACT: Geomagnetism
               Geoscience Australia
               G.P.O. Box 378
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               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9971
               e-mail: geomag@ga.gov.au
               WWW: http://www.ga.gov.au
```

NOTES:
Casey is situated on the Antarctic coast in Wilkes Land 3880 km south of Perth. It is the nearest Australian Antarctic research station to Australia. The magnetic Absolute Hut is about 120 m south of the tank house, the nearest structure of the modern Casey station. The old Casey station, in use until the late 1980s, lies about 1 km northeast of the present Casey station.

Regular magnetic observations began at Casey in 1975. From 1988 a variation station operated there. From 1991 to 1998 it operated as a magnetic observatory, although not to a high standard. Observatory-standard absolute control commenced in 1999.

The magnetic observatory is part of the Casey scientific research station in Antarctica.
The magnetic observatory comprises:
* the Variometer Hut, and;
* the Absolute Hut.

The crystalline rocks of Casey have high concentrations of magnetic minerals that cause high magnetic gradients in the area. The observatory is located in one of the places of least gradient in the area but still with a higher gradient than is ideal for a magnetic observatory.

Table 1. Key observatory data.
IAGA code: CSY
Commenced operation: 1999
Geographic latitude: 66 deg 17' S
Geographic longitude: 110 deg 32' E
Geomagnetic latitude: -75.95 deg
Geomagnetic longitude: 184.79 deg
K 9 index lower limit: 750 nT
Principal pier: Pier B
Pier elevation (top): 40 m AMSL
Principal reference mark: Trig station G11

Reference mark azimuth: 308 deg 06' 00"
Reference mark distance: 464 m
Observer: D. McVeigh
A. Burgess

Local meteorological conditions

The meteorological temperature at Casey during 2015 varied from a minimum -33.2 deg C (2015-05-29) to a maximum of +5.2 deg C on (2015-01-22, 2015-12-29). Daily minimum temperatures varied from -33.2 deg C to +0 deg C (average -13.6 +/- 9 deg C). Daily maximum temperatures varied from -28.4 deg C to +5.2 deg C (average -6.5 +/- 7 deg C).

The daily maximum wind gust varied from 17 km/h to 207 km/h (average 62.0 +/- 39 km/h). The maximum daily maximum wind gust was 207 km/h in August. The minimum daily maximum wind gust was 17 km/h in May. Windy conditions were the norm throughout the year with the higher wind gusts being attributed to blizzards. There was from 0 to 14.4 hours (average 3.1 +/- 4) of sunshine according to the meteorological definition.

All weather data was provided by the
Australian Government - Bureau of Meteorology.

Variometers

The variometers used during 2015 are listed in Table 2.

The variometers at Casey station are housed within the variometer hut. The DMI variometer sensor is located in the southern corner of the hut. The GSM-90 total-field magnetometer sensor is located in the northern corner. Both sensors are mounted on marble plinths. This configuration allows for the maximum separation between the two instruments. The variometer hut also contains the variometer electronics mounted within non-magnetic shelves. The instrument power supply, consisting of a 12 V observatory backup battery box and charger, is also positioned within the shelves. System timing was provided by a Garmin GPS16-HVS clock mounted on the shelves. Timing corrections were applied automatically and logged. Timing corrections greater than 1 ms are listed in the variometer clock corrections section.

The recording equipment, a QNX acquisition computer, was directly connected to the station's network via fibre optic cable and was located within the variometer hut.

Periods of corrupted vector variometer data have been excluded throughout the 2015 definitive data. The most significant of these occurred on 2015-07-16, 2015-08-23 and across 2015-09-25 and 2015-09-26 with a full list under Data Losses for 2015. The cause of the corruption has not been identified.

Other periods of contamination occurred throughout 2015 when officers from AAD would enter the variometer hut from time to time. A more detailed description is contained in Operations. These data have been excluded from the 2015 definitive data.

For the 2015 definitive data the vector data were not automatically spike filtered. Any spikes were removed by excluding vector data where appropriate.

The raw 10-second scalar variometer data were automatically despiked throughout the year. A spike detection required a value to deviate from the local linear trend by 10 times the maximum of 0.1 nT, or 8/9 fractile of deviations during the following minute.

Spikes were noted in Fv-Fs, these were investigated in both the vector and scalar data. No problems were noted in these data when the spikes occurred, but they were associated with active field periods. As these spikes occur over several minutes during these active periods, a difference occurs between the timing resolution of 1 second vector data and the linear interpolation of the 10 second scalar data. Scalar data has only been excluded when these spikes exceeded +/- 5 nT.

Table 2.
Magnetic variometers used in 2015.
3-component variometer: DMI FGE
Serial number: E0199 / S0160
Type: suspended; linear-core fluxgate
Orientation: NW, NE, Z
Acquisition interval: 1 s
A/D converter: ADAM 4017 module (±10V)
Scale value: 0.32 nT / count
Period of use: 2015-01-01 to 2015-12-31

Total-field variometer: GEM Systems GSM-90
Serial number: 4081423 / 42189
Type: Overhauser effect
Acquisition interval: 10 s
Resolution: 0.01 nT
Period of use: 2015-01-01 to 2015-12-31

Data acquisition system: GDAP: ARK3360/QNX6.5
Timing: Garmin GPS 16 clock
Communications: ANARESAT

Table 3.
Absolute magnetometers and their adopted corrections for 2015. Corrections are applied in the sense
Standard = Instrument + correction.
DI fluxgate: DMI
Serial number: DI0047
Theodolite: Zeiss 020B
Serial number: 352229
Resolution: 0.1'
D correction: 0.15'
I correction: -0.20'

Total-field magnetometer: GEM Systems GSM-90
Serial number: 810881 / 31960
Type: Overhauser effect
Resolution: 0.01 nT
Correction: 0.0 nT

Total-field magnetometer: Geometrics G816 (backup)
Serial number: 766
Type: Proton precession
Resolution: 1 nT
Correction: 1.5 nT

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2015, adjustments to the system clock were less than 1 ms except on the following occasions:

2015-03-07	05:08:22	-0.016 s	Abs hut comms install
2015-05-29	14:06:52	-0.210 s	Unknown
2015-07-01	00:00:40	-1.000 s	Leap second correction
2015-07-20	08:25:40	-0.006 s	Station power outage
	13:38:54	-0.086 s	
2015-11-25	22:15:41	0.454 s	Reboot of computer

Absolute instruments

The principal absolute magnetometers used at Casey in 2015, and their adopted instrument corrections, are listed in Table 3.
At the 2015 mean magnetic field values at Casey (X=-977 nT, Y=-9120 nT, Z=-63393 nT) these D, I and F corrections translate to corrections of:
dX = 0.79 nT dY = 3.62 nT dZ = -0.53 nT

Instrument corrections were applied whilst reducing absolute observations to determine baselines and have been applied to all Casey 2015 final data.

Baselines

The sensor and electronics were located in the variometer hut and were subject to the same thermal conditions. As such, independent temperature effects were unable to be determined. For 2015 temperature corrections were applied using the sensor temperature only.

The final baseline parameters for the variometer were completed by manually fitting a piece-wise linear function to the absolute observations. This function included drifts or jumps, when required. The baseline drifted in all three channels over the course of the year.
Scatter in the baseline residuals throughout the year had a a range of 5.4 nT.

The final Fv-Fs values for the year varied from -1.0 nT to 1.9 nT. The standard deviations in the 2015 weekly absolute observations from the final adopted variometer model and data were:

X	1.9 nT
Y	1.6 nT
Z	0.8 nT
D	43"

I   5"
F   0.7 nT

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2015 CSY definitive data and real time reported 1-minute data sets
(CSY definitive - CSY real time) were:

	X	Y	Z
Average	+0.4	+0.7	-0.5
Std.dev	2.0	1.5	0.8
Min	-3.9	-2.9	-1.6
Max	+3.1	+2.6	+0.8

The CSY 2015 reported real time data are within the specification for INTERMAGNET quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2015 CSY definitive data and quasi-definitive 1-minute data sets
(CSY definitive - CSY quasi-definitive) were:

	X	Y	Z
Average	+0.1	+0.6	0.1
Std.dev	1.0	1.4	1.1
Min	-1.8	-1.5	-2.6
Max	+1.8	+2.6	+1.7

The CSY 2015 quasi-definitive data are within the specification for INTERMAGNET quasi-definitive data.

Operations

The Casey observer was a member of the Australian National Antarctic Research Expedition and was employed by the Australian Antarctic Division with funding support by Geoscience Australia.

The observer was responsible for the continuous operation of the observatory and performed equipment maintenance and installation as required. The observer performed weekly absolute observations and forwarded them by e-mail to Geoscience Australia. Periodic visits to the variometer hut were also made to check on the variometer system.
All data processing was performed at Geoscience Australia.

Data were retrieved using rsync over ssh at least every 10 minutes. Real-time data were processed automatically at Geoscience Australia and distributed, usually within a 2 to 15 minute delay.

The GPS clock was checked from Geoscience Australia regularly to ensure it was working. If not, it was reset remotely or, if necessary, the computer was re-booted.

During training conducted in late 2014, the observer was asked to asses the potential of establishing a serial communications link between the absolute and variometer huts. This assessment was conducted in late December 2014 with the serial communications link installed in early March (2015-03-07). The link allows scalar measurements to be recorded simultaneously at both the absolute and variometer huts. These data were used to calculate the vector difference between the absolute pier and the vector pier.

On April 2015-04-08, an electrician entered the variometer hut for the yearly inspection. These data have been excluded from the 2015 definitive data.

On July 2015-07-20 there was a station wide power outage. This caused contamination to the vector variometer data but not to the scalar variometer data. These data have been excluded from the 2015 definitive data.

The distribution of Casey 2015 data is described in Table 4. Data losses are identified below.

Table 4. Distribution of Casey 2015 data.

1-second values		
BoM SWS	preliminary	real time
INTERMAGNET	preliminary	hourly
1-minute values		
INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily
INTERMAGNET	quasi-definitive	monthly
INTERMAGNET	definitive	July 2016
WDC for Geomagnetism, Kyoto	preliminary	real time
WDC for Geomagnetism, Kyoto	preliminary	daily

Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au)

Significant events

2015-01-07	Observer enters variometer hut between ~00:20 and 00:30 UTC.
2015-01-20	AAD officer enters mag area 01:00 to 01:30 UTC to take photos of absolute shelter.
2015-02-05	Incursion into mag quiet zone at around 23:00.
2015-02-20	Contamination of data 03:41:06 to 03:46:08. Cause was not determined.
2015-03-01	Start logging of scalar data from instrument on absolute pier via serial cable between absolute and variometer hut.
2015-03-07	Serial cable confirmed to be operational by GA staff. AAD officer enters variometer hut at around 05UT for about 1 hour, some data contamination. Finalise installation and general tidy up of variometer hut.
2015-04-08	ADD officer entered variometer hut at 00:07:00 for inspection.
2015-04-30	05:25 (approx) stop data logging processes for

```
            scalar data in absolute hut as the instrument
            is no longer installed on the absolute pier.
2015-07-20  Contamination in XYZ but not PPM.
            07:35:31-08:06:16 and 09:21:32-09:23:29.
            Station suffered power outage ~06:58:00 to
            09:00:00.
2015-08-11  Data excluded 20:19:36 to 20:35:59,
            20:42:17 to 20:43:20. Problem with XY.
2015-08-12  Data excluded 8:22:09 to 18:31:56.
            Problem with XY.
2015-09-29  Plumbing work outside the magnetic quiet zone.
2015-11-25  22:13 reboot computer to clear TCP stack.

Annual mean values
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The annual mean values for Casey are set out in
the yearmean file.

Indices
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On 2014-06-18 the K9 value for Casey was updated from
1500 nT to 750 nT on advice from Dr. Menvielle from ISGI.
K indices are not routinely scaled from the Casey data.

Data Losses for 2015
--------------------
Variometer data XYZ:
2015-02-20    XYZ     03:41 - 04:42  (62)
2015-03-07    XYZ     03:11 - 04:20  (70)
2015-05-28    XYZ     13:35 - 13:37  (3)
2015-07-16    XYZ     09:47 - 16:53  (427)
2015-07-19    XYZ     19:29 - 19:59  (31)
2015-07-20    XYZ     07:36 - 08:06  (31)
2015-07-20    XYZ     09:22 - 09:23  (2)
2015-07-27    XYZ     23:56 - 23:59  (4)
2015-08-06    XYZ     09:16 - 09:16  (1)
2015-08-06    XYZ     09:58 - 10:02  (5)
2015-08-11    XYZ     20:20 - 20:36  (17)
2015-08-11    XYZ     20:43 - 20:43  (1)
2015-08-12    XYZ     18:22 - 18:32  (11)
2015-08-23    XYZ     03:32 - 16:55  (804)
2015-08-23    XYZ     19:33 - 19:44  (12)
2015-09-06    XYZ     23:56 - 23:59  (4)
2015-09-18    XYZ     13:20 - 13:36  (17)
2015-09-18    XYZ     14:53 - 15:12  (20)
2015-09-18    XYZ     16:06 - 16:45  (40)
2015-09-18    XYZ     18:12 - 18:12  (1)
2015-09-20    XYZ     02:41 - 03:20  (40)
2015-09-20    XYZ     07:06 - 08:27  (82)
2015-09-25    XYZ     20:34 -
2015-09-26    XYZ     - 03:48        (435)
2015-10-08    XYZ     23:56 - 23:59  (4)
2015-10-17    XYZ     23:56 - 23:59  (4)
2015-11-25    XYZ     22:13 - 22:13  (1)

Total: 2129

Scalar Data F:
2015-01-01    F      04:32 - 04:32  (1)
2015-01-01    F      07:01 - 07:01  (1)
2015-01-01    F      09:11 - 09:11  (1)
```

2015-01-01	F	09:33 - 09:33	(1)
2015-01-01	F	13:54 - 13:54	(1)
2015-01-01	F	17:22 - 17:22	(1)
2015-01-01	F	17:52 - 17:52	(1)
2015-01-02	F	09:31 - 09:31	(1)
2015-01-02	F	15:54 - 15:54	(1)
2015-01-03	F	05:36 - 05:36	(1)
2015-01-03	F	07:57 - 07:57	(1)
2015-01-03	F	09:00 - 09:00	(1)
2015-01-03	F	09:46 - 09:46	(1)
2015-01-04	F	03:30 - 03:30	(1)
2015-01-04	F	09:45 - 09:45	(1)
2015-01-05	F	13:49 - 13:49	(1)
2015-01-06	F	07:00 - 07:00	(1)
2015-01-06	F	08:47 - 08:47	(1)
2015-01-06	F	19:18 - 19:19	(2)
2015-01-07	F	00:21 - 00:24	(4)
2015-01-07	F	08:34 - 08:34	(1)
2015-01-07	F	09:22 - 09:22	(1)
2015-01-08	F	09:04 - 09:04	(1)
2015-01-08	F	09:55 - 09:55	(1)
2015-01-08	F	10:10 - 10:10	(1)
2015-01-09	F	00:53 - 00:54	(2)
2015-01-09	F	08:27 - 08:28	(2)
2015-01-09	F	08:35 - 08:35	(1)
2015-01-09	F	09:23 - 09:24	(2)
2015-01-09	F	14:24 - 14:24	(1)
2015-01-09	F	16:29 - 16:29	(1)
2015-01-11	F	05:39 - 05:39	(1)
2015-01-11	F	09:54 - 09:54	(1)
2015-01-11	F	10:10 - 10:10	(1)
2015-01-11	F	11:03 - 11:03	(1)
2015-01-11	F	14:26 - 14:26	(1)
2015-01-12	F	07:31 - 07:31	(1)
2015-01-12	F	09:34 - 09:34	(1)
2015-01-12	F	16:06 - 16:06	(1)
2015-01-13	F	03:29 - 03:29	(1)
2015-01-13	F	07:49 - 07:50	(2)
2015-01-13	F	07:59 - 07:59	(1)
2015-01-13	F	10:11 - 10:11	(1)
2015-01-13	F	10:14 - 10:14	(1)
2015-01-13	F	14:13 - 14:13	(1)
2015-01-13	F	14:16 - 14:17	(2)
2015-01-13	F	18:11 - 18:11	(1)
2015-01-14	F	07:19 - 07:20	(2)
2015-01-14	F	07:23 - 07:23	(1)
2015-01-15	F	07:07 - 07:09	(3)
2015-01-15	F	07:21 - 07:21	(1)
2015-01-15	F	11:37 - 11:37	(1)
2015-01-16	F	09:31 - 09:31	(1)
2015-01-17	F	07:45 - 07:46	(2)
2015-01-17	F	11:12 - 11:12	(1)
2015-01-17	F	11:39 - 11:39	(1)
2015-01-17	F	12:13 - 12:14	(2)
2015-01-18	F	04:03 - 04:03	(1)
2015-01-18	F	04:34 - 04:34	(1)
2015-01-18	F	09:18 - 09:18	(1)
2015-01-19	F	00:00 - 00:01	(2)
2015-01-19	F	07:21 - 07:21	(1)
2015-01-19	F	09:07 - 09:07	(1)
2015-01-19	F	18:47 - 18:47	(1)

2015-01-20	F	06:03 - 06:03	(1)
2015-01-20	F	07:35 - 07:35	(1)
2015-01-20	F	09:50 - 09:50	(1)
2015-01-21	F	07:48 - 07:49	(2)
2015-01-21	F	10:17 - 10:17	(1)
2015-01-21	F	10:21 - 10:21	(1)
2015-01-22	F	02:35 - 02:35	(1)
2015-01-22	F	09:01 - 09:01	(1)
2015-01-24	F	09:58 - 09:58	(1)
2015-01-26	F	08:34 - 08:34	(1)
2015-01-27	F	03:18 - 03:18	(1)
2015-01-27	F	15:46 - 15:46	(1)
2015-01-28	F	05:09 - 05:09	(1)
2015-01-28	F	10:15 - 10:15	(1)
2015-01-29	F	10:55 - 10:56	(2)
2015-01-29	F	21:21 - 21:21	(1)
2015-01-30	F	06:04 - 06:05	(2)
2015-01-30	F	09:25 - 09:25	(1)
2015-01-30	F	10:49 - 10:49	(1)
2015-01-31	F	09:39 - 09:39	(1)
2015-01-31	F	09:41 - 09:41	(1)
2015-02-01	F	08:49 - 08:49	(1)
2015-02-01	F	09:58 - 09:58	(1)
2015-02-02	F	05:52 - 05:52	(1)
2015-02-02	F	05:57 - 05:58	(2)
2015-02-02	F	06:08 - 06:08	(1)
2015-02-02	F	07:43 - 07:45	(3)
2015-02-02	F	09:33 - 09:33	(1)
2015-02-02	F	10:05 - 10:05	(1)
2015-02-02	F	11:59 - 11:59	(1)
2015-02-02	F	16:28 - 16:28	(1)
2015-02-03	F	03:51 - 03:51	(1)
2015-02-03	F	07:47 - 07:47	(1)
2015-02-04	F	01:53 - 01:53	(1)
2015-02-04	F	08:50 - 08:52	(3)
2015-02-04	F	10:08 - 10:08	(1)
2015-02-04	F	13:20 - 13:20	(1)
2015-02-04	F	13:43 - 13:44	(2)
2015-02-04	F	16:51 - 16:51	(1)
2015-02-04	F	16:56 - 16:57	(2)
2015-02-05	F	07:36 - 07:36	(1)
2015-02-05	F	13:03 - 13:03	(1)
2015-02-05	F	18:02 - 18:02	(1)
2015-02-05	F	19:41 - 19:41	(1)
2015-02-07	F	06:25 - 06:25	(1)
2015-02-08	F	04:07 - 04:07	(1)
2015-02-08	F	04:35 - 04:35	(1)
2015-02-08	F	04:41 - 04:41	(1)
2015-02-08	F	09:14 - 09:14	(1)
2015-02-08	F	10:50 - 10:50	(1)
2015-02-09	F	08:32 - 08:32	(1)
2015-02-09	F	09:28 - 09:28	(1)
2015-02-09	F	21:58 - 21:58	(1)
2015-02-11	F	05:50 - 05:52	(3)
2015-02-11	F	07:12 - 07:12	(1)
2015-02-11	F	07:33 - 07:33	(1)
2015-02-12	F	04:48 - 04:48	(1)
2015-02-13	F	07:35 - 07:35	(1)
2015-02-13	F	07:44 - 07:44	(1)
2015-02-14	F	09:19 - 09:19	(1)
2015-02-15	F	01:01 - 01:01	(1)

2015-02-15	F	03:49 - 03:49	(1)
2015-02-16	F	10:17 - 10:17	(1)
2015-02-16	F	21:39 - 21:39	(1)
2015-02-17	F	05:08 - 05:08	(1)
2015-02-17	F	07:52 - 07:53	(2)
2015-02-18	F	05:17 - 05:17	(1)
2015-02-18	F	06:59 - 06:59	(1)
2015-02-18	F	13:39 - 13:39	(1)
2015-02-18	F	16:20 - 16:20	(1)
2015-02-19	F	03:45 - 03:45	(1)
2015-02-19	F	06:22 - 06:23	(2)
2015-02-19	F	06:40 - 06:40	(1)
2015-02-19	F	09:56 - 09:56	(1)
2015-02-19	F	12:13 - 12:13	(1)
2015-02-19	F	16:08 - 16:08	(1)
2015-02-19	F	22:53 - 22:53	(1)
2015-02-19	F	23:54 - 23:54	(1)
2015-02-20	F	03:41 - 03:46	(6)
2015-02-20	F	04:05 - 04:05	(1)
2015-02-20	F	04:08 - 04:11	(4)
2015-02-20	F	09:55 - 09:55	(1)
2015-02-21	F	08:31 - 08:31	(1)
2015-02-22	F	17:25 - 17:25	(1)
2015-02-23	F	05:21 - 05:21	(1)
2015-02-23	F	05:42 - 05:42	(1)
2015-02-23	F	07:06 - 07:06	(1)
2015-02-23	F	08:30 - 08:30	(1)
2015-02-24	F	04:48 - 04:48	(1)
2015-02-24	F	05:01 - 05:01	(1)
2015-02-24	F	09:03 - 09:03	(1)
2015-02-24	F	11:06 - 11:06	(1)
2015-02-25	F	04:04 - 04:05	(2)
2015-02-25	F	11:06 - 11:06	(1)
2015-02-26	F	09:02 - 09:02	(1)
2015-02-26	F	17:39 - 17:39	(1)
2015-02-26	F	21:17 - 21:17	(1)
2015-02-27	F	07:35 - 07:35	(1)
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2015-02-28	F	06:23 - 06:23	(1)
2015-02-28	F	07:12 - 07:12	(1)
2015-02-28	F	09:00 - 09:00	(1)
2015-03-01	F	04:30 - 04:30	(1)
2015-03-01	F	04:54 - 04:54	(1)
2015-03-01	F	08:32 - 08:33	(2)
2015-03-01	F	09:24 - 09:24	(1)
2015-03-01	F	10:26 - 10:26	(1)
2015-03-01	F	16:46 - 16:46	(1)
2015-03-01	F	16:50 - 16:50	(1)
2015-03-01	F	17:15 - 17:16	(2)
2015-03-01	F	17:57 - 17:57	(1)
2015-03-01	F	21:09 - 21:09	(1)
2015-03-01	F	23:02 - 23:02	(1)
2015-03-02	F	06:50 - 06:50	(1)
2015-03-02	F	07:43 - 07:44	(2)
2015-03-02	F	08:19 - 08:19	(1)
2015-03-02	F	15:47 - 15:47	(1)
2015-03-02	F	15:51 - 15:51	(1)
2015-03-02	F	16:18 - 16:18	(1)
2015-03-02	F	18:35 - 18:35	(1)
2015-03-03	F	07:29 - 07:29	(1)
2015-03-03	F	12:40 - 12:40	(1)

2015-03-03	F	19:13 - 19:13	(1)
2015-03-03	F	22:42 - 22:42	(1)
2015-03-04	F	02:49 - 02:49	(1)
2015-03-04	F	05:32 - 05:32	(1)
2015-03-04	F	10:48 - 10:48	(1)
2015-03-05	F	08:26 - 08:26	(1)
2015-03-05	F	12:02 - 12:02	(1)
2015-03-05	F	16:37 - 16:37	(1)
2015-03-06	F	05:36 - 05:36	(1)
2015-03-06	F	05:47 - 05:47	(1)
2015-03-06	F	08:09 - 08:09	(1)
2015-03-06	F	08:11 - 08:12	(2)
2015-03-06	F	16:56 - 16:56	(1)
2015-03-06	F	17:59 - 18:00	(2)
2015-03-06	F	18:36 - 18:36	(1)
2015-03-07	F	03:19 - 04:58	(100)
2015-03-07	F	10:11 - 10:11	(1)
2015-03-07	F	11:07 - 11:07	(1)
2015-03-07	F	11:09 - 11:10	(2)
2015-03-08	F	06:56 - 06:57	(2)
2015-03-08	F	07:34 - 07:35	(2)
2015-03-08	F	08:02 - 08:03	(2)
2015-03-08	F	09:26 - 09:26	(1)
2015-03-08	F	10:50 - 10:50	(1)
2015-03-08	F	15:03 - 15:03	(1)
2015-03-08	F	15:35 - 15:35	(1)
2015-03-08	F	15:37 - 15:37	(1)
2015-03-08	F	16:18 - 16:18	(1)
2015-03-08	F	16:26 - 16:26	(1)
2015-03-09	F	10:14 - 10:14	(1)
2015-03-09	F	11:04 - 11:04	(1)
2015-03-10	F	07:24 - 07:24	(1)
2015-03-11	F	05:13 - 05:13	(1)
2015-03-11	F	11:19 - 11:19	(1)
2015-03-11	F	11:22 - 11:22	(1)
2015-03-11	F	16:26 - 16:26	(1)
2015-03-12	F	06:53 - 06:53	(1)
2015-03-12	F	07:42 - 07:42	(1)
2015-03-14	F	07:37 - 07:37	(1)
2015-03-14	F	17:32 - 17:32	(1)
2015-03-15	F	18:33 - 18:33	(1)
2015-03-16	F	06:11 - 06:11	(1)
2015-03-16	F	10:29 - 10:29	(1)
2015-03-16	F	10:50 - 10:50	(1)
2015-03-17	F	04:45 - 04:46	(2)
2015-03-17	F	06:09 - 06:10	(2)
2015-03-17	F	07:16 - 07:16	(1)
2015-03-17	F	07:41 - 07:43	(3)
2015-03-17	F	07:45 - 07:45	(1)
2015-03-17	F	15:25 - 15:25	(1)
2015-03-17	F	18:39 - 18:39	(1)
2015-03-17	F	22:08 - 22:08	(1)
2015-03-18	F	07:42 - 07:42	(1)
2015-03-18	F	15:10 - 15:12	(3)
2015-03-18	F	15:14 - 15:14	(1)
2015-03-18	F	23:23 - 23:23	(1)
2015-03-18	F	23:25 - 23:25	(1)
2015-03-19	F	06:22 - 06:22	(1)
2015-03-19	F	06:40 - 06:41	(2)
2015-03-19	F	06:43 - 06:43	(1)
2015-03-20	F	05:32 - 05:32	(1)

2015-03-20	F	05:34 - 05:34	(1)
2015-03-20	F	07:48 - 07:48	(1)
2015-03-20	F	09:41 - 09:41	(1)
2015-03-20	F	13:23 - 13:23	(1)
2015-03-20	F	17:12 - 17:12	(1)
2015-03-20	F	17:14 - 17:14	(1)
2015-03-21	F	06:26 - 06:26	(1)
2015-03-21	F	06:29 - 06:29	(1)
2015-03-21	F	08:58 - 08:58	(1)
2015-03-21	F	09:07 - 09:07	(1)
2015-03-21	F	09:47 - 09:47	(1)
2015-03-21	F	14:04 - 14:04	(1)
2015-03-21	F	18:41 - 18:41	(1)
2015-03-22	F	05:29 - 05:29	(1)
2015-03-22	F	09:01 - 09:01	(1)
2015-03-22	F	11:22 - 11:22	(1)
2015-03-22	F	11:45 - 11:45	(1)
2015-03-23	F	07:12 - 07:12	(1)
2015-03-23	F	09:47 - 09:47	(1)
2015-03-23	F	15:15 - 15:15	(1)
2015-03-23	F	16:14 - 16:14	(1)
2015-03-23	F	21:55 - 21:55	(1)
2015-03-24	F	14:07 - 14:08	(2)
2015-03-25	F	07:53 - 07:54	(2)
2015-03-25	F	09:43 - 09:44	(2)
2015-03-25	F	10:59 - 10:59	(1)
2015-03-25	F	14:31 - 14:31	(1)
2015-03-26	F	07:05 - 07:05	(1)
2015-03-26	F	14:03 - 14:03	(1)
2015-03-26	F	17:32 - 17:32	(1)
2015-03-26	F	20:25 - 20:25	(1)
2015-03-27	F	14:33 - 14:33	(1)
2015-03-28	F	19:08 - 19:08	(1)
2015-03-29	F	03:41 - 03:41	(1)
2015-03-30	F	06:08 - 06:08	(1)
2015-03-30	F	07:07 - 07:07	(1)
2015-03-30	F	07:49 - 07:49	(1)
2015-03-30	F	22:22 - 22:22	(1)
2015-03-31	F	08:34 - 08:34	(1)
2015-04-02	F	08:11 - 08:11	(1)
2015-04-02	F	18:57 - 18:57	(1)
2015-04-02	F	19:00 - 19:00	(1)
2015-04-02	F	20:27 - 20:27	(1)
2015-04-02	F	20:29 - 20:29	(1)
2015-04-03	F	04:41 - 04:41	(1)
2015-04-03	F	15:33 - 15:33	(1)
2015-04-03	F	22:21 - 22:21	(1)
2015-04-04	F	16:12 - 16:13	(2)
2015-04-04	F	16:22 - 16:22	(1)
2015-04-04	F	16:56 - 16:56	(1)
2015-04-05	F	16:36 - 16:36	(1)
2015-04-06	F	07:26 - 07:26	(1)
2015-04-08	F	00:07 - 07:50	(464)
2015-04-09	F	06:38 - 06:38	(1)
2015-04-10	F	06:26 - 06:26	(1)
2015-04-10	F	08:24 - 08:24	(1)
2015-04-10	F	12:45 - 12:45	(1)
2015-04-11	F	04:58 - 04:58	(1)
2015-04-11	F	07:08 - 07:08	(1)
2015-04-12	F	06:01 - 06:01	(1)
2015-04-12	F	08:18 - 08:18	(1)

2015-04-12	F	08:21 - 08:21	(1)
2015-04-15	F	19:35 - 19:35	(1)
2015-04-15	F	20:03 - 20:04	(2)
2015-04-16	F	03:27 - 03:27	(1)
2015-04-16	F	09:32 - 09:32	(1)
2015-04-17	F	03:41 - 03:41	(1)
2015-04-17	F	07:37 - 07:37	(1)
2015-04-17	F	07:46 - 07:46	(1)
2015-04-17	F	07:49 - 07:49	(1)
2015-04-17	F	09:14 - 09:14	(1)
2015-04-17	F	09:19 - 09:19	(1)
2015-04-17	F	15:56 - 15:56	(1)
2015-04-17	F	19:58 - 19:58	(1)
2015-04-18	F	04:46 - 04:46	(1)
2015-04-18	F	18:03 - 18:03	(1)
2015-04-18	F	18:08 - 18:08	(1)
2015-04-19	F	05:20 - 05:20	(1)
2015-04-19	F	08:47 - 08:47	(1)
2015-04-19	F	15:51 - 15:51	(1)
2015-04-19	F	18:37 - 18:37	(1)
2015-04-20	F	08:38 - 08:38	(1)
2015-04-20	F	17:56 - 17:56	(1)
2015-04-20	F	20:53 - 20:56	(4)
2015-04-21	F	06:28 - 06:28	(1)
2015-04-21	F	06:46 - 06:46	(1)
2015-04-21	F	09:27 - 09:27	(1)
2015-04-21	F	12:07 - 12:07	(1)
2015-04-21	F	12:23 - 12:23	(1)
2015-04-21	F	18:19 - 18:19	(1)
2015-04-22	F	03:14 - 03:14	(1)
2015-04-22	F	03:16 - 03:17	(2)
2015-04-22	F	07:49 - 07:49	(1)
2015-04-22	F	08:08 - 08:08	(1)
2015-04-22	F	15:41 - 15:41	(1)
2015-04-23	F	04:03 - 04:03	(1)
2015-04-23	F	06:34 - 06:34	(1)
2015-04-27	F	08:35 - 08:35	(1)
2015-04-27	F	08:37 - 08:37	(1)
2015-05-01	F	08:46 - 08:46	(1)
2015-05-01	F	10:06 - 10:06	(1)
2015-05-02	F	07:51 - 07:51	(1)
2015-05-03	F	07:35 - 07:35	(1)
2015-05-06	F	04:59 - 04:59	(1)
2015-05-10	F	08:14 - 08:15	(2)
2015-05-12	F	06:31 - 06:31	(1)
2015-05-12	F	06:57 - 06:57	(1)
2015-05-12	F	07:49 - 07:49	(1)
2015-05-12	F	09:25 - 09:25	(1)
2015-05-12	F	09:39 - 09:40	(2)
2015-05-13	F	04:21 - 04:21	(1)
2015-05-13	F	11:10 - 11:10	(1)
2015-05-13	F	11:31 - 11:31	(1)
2015-05-13	F	14:48 - 14:48	(1)
2015-05-13	F	18:18 - 18:19	(2)
2015-05-13	F	18:29 - 18:30	(2)
2015-05-13	F	18:42 - 18:42	(1)
2015-05-13	F	18:44 - 18:44	(1)
2015-05-13	F	19:29 - 19:29	(1)
2015-05-13	F	19:31 - 19:31	(1)
2015-05-13	F	19:36 - 19:37	(2)
2015-05-14	F	06:24 - 06:24	(1)

2015-05-14	F	07:46 - 07:46	(1)
2015-05-14	F	14:57 - 14:57	(1)
2015-05-14	F	22:05 - 22:05	(1)
2015-05-14	F	22:09 - 22:10	(2)
2015-05-14	F	22:13 - 22:13	(1)
2015-05-15	F	11:35 - 11:37	(3)
2015-05-15	F	19:29 - 19:29	(1)
2015-05-16	F	18:00 - 18:00	(1)
2015-05-17	F	05:22 - 05:23	(2)
2015-05-17	F	08:53 - 08:53	(1)
2015-05-17	F	16:42 - 16:42	(1)
2015-05-19	F	08:51 - 08:51	(1)
2015-05-19	F	08:53 - 08:53	(1)
2015-05-19	F	09:51 - 09:52	(2)
2015-05-19	F	18:17 - 18:17	(1)
2015-05-20	F	00:41 - 00:41	(1)
2015-05-20	F	06:05 - 06:05	(1)
2015-05-20	F	07:39 - 07:39	(1)
2015-05-28	F	13:35 - 13:37	(3)
2015-05-28	F	13:53 - 13:53	(1)
2015-05-29	F	00:40 - 00:40	(1)
2015-05-29	F	00:46 - 00:46	(1)
2015-05-29	F	08:03 - 08:03	(1)
2015-05-29	F	18:19 - 18:19	(1)
2015-06-01	F	20:56 - 20:58	(3)
2015-06-06	F	06:02 - 06:02	(1)
2015-06-08	F	03:56 - 03:56	(1)
2015-06-08	F	06:53 - 06:53	(1)
2015-06-08	F	12:23 - 12:23	(1)
2015-06-09	F	07:47 - 07:47	(1)
2015-06-09	F	08:44 - 08:44	(1)
2015-06-09	F	17:30 - 17:30	(1)
2015-06-09	F	17:36 - 17:36	(1)
2015-06-09	F	20:05 - 20:05	(1)
2015-06-10	F	05:49 - 05:49	(1)
2015-06-10	F	07:28 - 07:28	(1)
2015-06-10	F	12:46 - 12:46	(1)
2015-06-10	F	14:00 - 14:00	(1)
2015-06-10	F	16:51 - 16:51	(1)
2015-06-10	F	18:34 - 18:34	(1)
2015-06-10	F	18:36 - 18:36	(1)
2015-06-10	F	18:41 - 18:41	(1)
2015-06-11	F	08:19 - 08:19	(1)
2015-06-12	F	14:26 - 14:26	(1)
2015-06-12	F	17:33 - 17:34	(2)
2015-06-12	F	17:42 - 17:42	(1)
2015-06-12	F	18:43 - 18:43	(1)
2015-06-13	F	09:24 - 09:24	(1)
2015-06-14	F	01:38 - 01:38	(1)
2015-06-14	F	01:40 - 01:41	(2)
2015-06-14	F	01:46 - 01:47	(2)
2015-06-14	F	08:22 - 08:22	(1)
2015-06-15	F	14:30 - 14:30	(1)
2015-06-15	F	14:33 - 14:33	(1)
2015-06-15	F	16:24 - 16:24	(1)
2015-06-15	F	18:26 - 18:26	(1)
2015-06-16	F	06:32 - 06:32	(1)
2015-06-16	F	06:36 - 06:36	(1)
2015-06-16	F	08:38 - 08:38	(1)
2015-06-17	F	05:54 - 05:54	(1)
2015-06-19	F	05:46 - 05:46	(1)

2015-06-19	F	21:26 - 21:26	(1)
2015-06-21	F	18:29 - 18:29	(1)
2015-06-22	F	17:04 - 17:04	(1)
2015-06-22	F	20:16 - 20:16	(1)
2015-06-22	F	20:19 - 20:20	(2)
2015-06-22	F	20:40 - 20:40	(1)
2015-06-23	F	07:24 - 07:24	(1)
2015-06-23	F	07:30 - 07:30	(1)
2015-06-23	F	07:33 - 07:33	(1)
2015-06-23	F	08:27 - 08:27	(1)
2015-06-23	F	09:07 - 09:07	(1)
2015-06-23	F	15:07 - 15:07	(1)
2015-06-24	F	17:50 - 17:50	(1)
2015-06-25	F	13:54 - 13:54	(1)
2015-06-25	F	18:55 - 18:55	(1)
2015-06-26	F	07:56 - 07:56	(1)
2015-06-26	F	16:28 - 16:28	(1)
2015-06-26	F	16:56 - 16:56	(1)
2015-06-26	F	18:58 - 18:59	(2)
2015-06-27	F	01:07 - 01:07	(1)
2015-06-27	F	10:03 - 10:03	(1)
2015-06-28	F	19:11 - 19:11	(1)
2015-06-29	F	04:52 - 04:52	(1)
2015-06-29	F	11:33 - 11:34	(2)
2015-06-30	F	18:17 - 18:18	(2)
2015-07-01	F	07:31 - 07:31	(1)
2015-07-01	F	08:17 - 08:17	(1)
2015-07-01	F	14:49 - 14:49	(1)
2015-07-02	F	08:45 - 08:45	(1)
2015-07-03	F	07:57 - 07:57	(1)
2015-07-04	F	16:34 - 16:34	(1)
2015-07-06	F	04:03 - 04:03	(1)
2015-07-06	F	07:19 - 07:19	(1)
2015-07-07	F	05:41 - 05:41	(1)
2015-07-07	F	18:56 - 18:56	(1)
2015-07-09	F	05:00 - 05:00	(1)
2015-07-09	F	14:02 - 14:02	(1)
2015-07-09	F	17:56 - 17:56	(1)
2015-07-09	F	20:57 - 20:57	(1)
2015-07-10	F	07:23 - 07:23	(1)
2015-07-10	F	23:27 - 23:27	(1)
2015-07-10	F	23:46 - 23:46	(1)
2015-07-11	F	06:03 - 06:03	(1)
2015-07-11	F	07:48 - 07:48	(1)
2015-07-11	F	11:05 - 11:05	(1)
2015-07-11	F	11:20 - 11:21	(2)
2015-07-11	F	20:57 - 20:58	(2)
2015-07-11	F	21:32 - 21:32	(1)
2015-07-12	F	05:22 - 05:22	(1)
2015-07-12	F	08:55 - 08:55	(1)
2015-07-12	F	17:58 - 17:58	(1)
2015-07-12	F	20:49 - 20:49	(1)
2015-07-12	F	22:03 - 22:03	(1)
2015-07-12	F	23:22 - 23:22	(1)
2015-07-13	F	19:45 - 19:45	(1)
2015-07-13	F	19:48 - 19:49	(2)
2015-07-14	F	06:28 - 06:28	(1)
2015-07-16	F	05:25 - 05:25	(1)
2015-07-16	F	09:00 - 09:00	(1)
2015-07-17	F	06:52 - 06:52	(1)
2015-07-20	F	06:38 - 06:38	(1)

2015-07-21	F	08:24 - 08:24	(1)
2015-07-22	F	06:36 - 06:36	(1)
2015-07-22	F	07:14 - 07:14	(1)
2015-07-22	F	08:46 - 08:46	(1)
2015-07-22	F	17:42 - 17:42	(1)
2015-07-24	F	05:36 - 05:36	(1)
2015-07-24	F	07:47 - 07:47	(1)
2015-07-24	F	08:39 - 08:39	(1)
2015-07-24	F	08:43 - 08:43	(1)
2015-07-26	F	08:46 - 08:46	(1)
2015-07-27	F	15:41 - 15:41	(1)
2015-07-27	F	16:33 - 16:33	(1)
2015-07-27	F	16:55 - 16:55	(1)
2015-07-27	F	23:56 - 23:59	(4)
2015-07-28	F	07:28 - 07:29	(2)
2015-07-28	F	12:43 - 12:43	(1)
2015-07-28	F	18:06 - 18:06	(1)
2015-07-29	F	03:49 - 03:49	(1)
2015-07-29	F	09:47 - 09:48	(2)
2015-07-29	F	14:41 - 14:41	(1)
2015-07-30	F	20:07 - 20:07	(1)
2015-07-31	F	04:39 - 04:39	(1)
2015-07-31	F	07:01 - 07:01	(1)
2015-07-31	F	14:42 - 14:42	(1)
2015-08-01	F	07:58 - 07:59	(2)
2015-08-01	F	18:54 - 18:54	(1)
2015-08-02	F	10:58 - 10:58	(1)
2015-08-02	F	11:34 - 11:35	(2)
2015-08-02	F	14:24 - 14:24	(1)
2015-08-02	F	17:41 - 17:41	(1)
2015-08-02	F	18:08 - 18:08	(1)
2015-08-03	F	05:59 - 05:59	(1)
2015-08-03	F	09:05 - 09:05	(1)
2015-08-03	F	11:34 - 11:35	(2)
2015-08-04	F	05:46 - 05:46	(1)
2015-08-04	F	19:12 - 19:12	(1)
2015-08-04	F	19:19 - 19:19	(1)
2015-08-05	F	07:46 - 07:46	(1)
2015-08-05	F	09:20 - 09:20	(1)
2015-08-05	F	16:47 - 16:47	(1)
2015-08-06	F	16:56 - 16:56	(1)
2015-08-06	F	18:56 - 18:56	(1)
2015-08-06	F	19:17 - 19:18	(2)
2015-08-07	F	06:23 - 06:23	(1)
2015-08-07	F	10:56 - 10:56	(1)
2015-08-07	F	14:41 - 14:41	(1)
2015-08-07	F	14:45 - 14:46	(2)
2015-08-07	F	14:48 - 14:49	(2)
2015-08-08	F	03:08 - 03:08	(1)
2015-08-08	F	21:31 - 21:32	(2)
2015-08-08	F	21:38 - 21:38	(1)
2015-08-09	F	06:57 - 06:57	(1)
2015-08-09	F	07:36 - 07:36	(1)
2015-08-09	F	09:20 - 09:20	(1)
2015-08-09	F	13:29 - 13:29	(1)
2015-08-10	F	05:47 - 05:47	(1)
2015-08-10	F	13:51 - 13:52	(2)
2015-08-10	F	13:59 - 13:59	(1)
2015-08-11	F	08:56 - 08:56	(1)
2015-08-12	F	07:30 - 07:30	(1)
2015-08-12	F	07:35 - 07:35	(1)

2015-08-12	F	15:47 - 15:47	(1)
2015-08-13	F	18:20 - 18:20	(1)
2015-08-14	F	07:59 - 07:59	(1)
2015-08-14	F	08:01 - 08:01	(1)
2015-08-15	F	01:40 - 01:40	(1)
2015-08-15	F	08:29 - 08:30	(2)
2015-08-15	F	09:07 - 09:07	(1)
2015-08-15	F	14:56 - 14:56	(1)
2015-08-15	F	16:29 - 16:29	(1)
2015-08-16	F	19:04 - 19:04	(1)
2015-08-17	F	07:01 - 07:01	(1)
2015-08-17	F	07:44 - 07:45	(2)
2015-08-17	F	09:32 - 09:32	(1)
2015-08-17	F	15:36 - 15:36	(1)
2015-08-17	F	19:03 - 19:03	(1)
2015-08-17	F	21:19 - 21:19	(1)
2015-08-18	F	03:50 - 03:50	(1)
2015-08-18	F	10:41 - 10:41	(1)
2015-08-20	F	09:01 - 09:01	(1)
2015-08-20	F	12:25 - 12:25	(1)
2015-08-22	F	08:05 - 08:05	(1)
2015-08-22	F	19:48 - 19:48	(1)
2015-08-23	F	08:31 - 08:31	(1)
2015-08-23	F	08:34 - 08:35	(2)
2015-08-23	F	08:56 - 08:56	(1)
2015-08-23	F	09:38 - 09:38	(1)
2015-08-23	F	20:28 - 20:28	(1)
2015-08-23	F	20:38 - 20:38	(1)
2015-08-24	F	08:40 - 08:41	(2)
2015-08-24	F	09:49 - 09:49	(1)
2015-08-24	F	13:42 - 13:42	(1)
2015-08-24	F	18:50 - 18:50	(1)
2015-08-25	F	08:18 - 08:18	(1)
2015-08-26	F	12:59 - 12:59	(1)
2015-08-26	F	17:24 - 17:25	(2)
2015-08-27	F	06:50 - 06:50	(1)
2015-08-27	F	07:16 - 07:17	(2)
2015-08-27	F	07:19 - 07:19	(1)
2015-08-28	F	19:38 - 19:39	(2)
2015-08-29	F	04:49 - 04:51	(3)
2015-08-29	F	10:15 - 10:15	(1)
2015-08-29	F	18:13 - 18:14	(2)
2015-09-01	F	04:24 - 04:24	(1)
2015-09-01	F	06:52 - 06:52	(1)
2015-09-01	F	08:43 - 08:43	(1)
2015-09-01	F	11:59 - 11:59	(1)
2015-09-02	F	05:44 - 05:44	(1)
2015-09-02	F	19:41 - 19:41	(1)
2015-09-03	F	07:30 - 07:30	(1)
2015-09-03	F	17:06 - 17:06	(1)
2015-09-04	F	08:05 - 08:05	(1)
2015-09-04	F	08:45 - 08:45	(1)
2015-09-04	F	21:18 - 21:18	(1)
2015-09-05	F	04:55 - 04:56	(2)
2015-09-05	F	05:40 - 05:40	(1)
2015-09-05	F	09:42 - 09:42	(1)
2015-09-05	F	14:16 - 14:16	(1)
2015-09-05	F	19:44 - 19:44	(1)
2015-09-06	F	14:37 - 14:37	(1)
2015-09-06	F	23:56 - 23:59	(4)
2015-09-07	F	05:28 - 05:28	(1)

2015-09-07	F	17:15 - 17:16	(2)
2015-09-09	F	03:57 - 03:57	(1)
2015-09-09	F	06:58 - 06:58	(1)
2015-09-10	F	16:38 - 16:38	(1)
2015-09-10	F	18:59 - 18:59	(1)
2015-09-11	F	03:16 - 03:17	(2)
2015-09-11	F	07:40 - 07:40	(1)
2015-09-11	F	10:14 - 10:15	(2)
2015-09-11	F	17:05 - 17:05	(1)
2015-09-11	F	20:25 - 20:25	(1)
2015-09-12	F	06:37 - 06:37	(1)
2015-09-12	F	07:19 - 07:19	(1)
2015-09-12	F	13:50 - 13:50	(1)
2015-09-12	F	16:43 - 16:43	(1)
2015-09-13	F	03:20 - 03:20	(1)
2015-09-13	F	04:05 - 04:05	(1)
2015-09-13	F	09:27 - 09:27	(1)
2015-09-14	F	04:23 - 04:23	(1)
2015-09-14	F	07:41 - 07:41	(1)
2015-09-14	F	13:54 - 13:54	(1)
2015-09-14	F	18:04 - 18:04	(1)
2015-09-15	F	21:46 - 21:46	(1)
2015-09-16	F	06:17 - 06:17	(1)
2015-09-16	F	12:04 - 12:05	(2)
2015-09-16	F	18:09 - 18:09	(1)
2015-09-16	F	19:37 - 19:37	(1)
2015-09-18	F	17:22 - 17:22	(1)
2015-09-20	F	06:04 - 06:04	(1)
2015-09-20	F	06:33 - 06:33	(1)
2015-09-20	F	07:46 - 07:47	(2)
2015-09-20	F	08:40 - 08:40	(1)
2015-09-20	F	09:25 - 09:25	(1)
2015-09-20	F	09:29 - 09:29	(1)
2015-09-20	F	10:21 - 10:21	(1)
2015-09-20	F	16:26 - 16:26	(1)
2015-09-21	F	10:29 - 10:29	(1)
2015-09-21	F	17:54 - 17:54	(1)
2015-09-22	F	05:49 - 05:49	(1)
2015-09-22	F	08:18 - 08:18	(1)
2015-09-22	F	14:05 - 14:05	(1)
2015-09-22	F	14:52 - 14:52	(1)
2015-09-22	F	15:58 - 15:58	(1)
2015-09-22	F	20:19 - 20:19	(1)
2015-09-23	F	07:35 - 07:35	(1)
2015-09-23	F	07:37 - 07:37	(1)
2015-09-23	F	11:15 - 11:15	(1)
2015-09-23	F	14:48 - 14:48	(1)
2015-09-23	F	23:02 - 23:02	(1)
2015-09-24	F	04:13 - 04:13	(1)
2015-09-24	F	08:26 - 08:26	(1)
2015-09-26	F	16:45 - 16:45	(1)
2015-09-27	F	07:12 - 07:12	(1)
2015-09-28	F	08:45 - 08:45	(1)
2015-09-28	F	08:53 - 08:53	(1)
2015-09-29	F	08:23 - 08:23	(1)
2015-10-01	F	04:21 - 04:21	(1)
2015-10-01	F	09:32 - 09:32	(1)
2015-10-02	F	06:16 - 06:16	(1)
2015-10-02	F	19:48 - 19:48	(1)
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2015-10-04	F	03:43 - 03:44	(2)

2015-10-04	F	06:13 - 06:13	(1)
2015-10-05	F	05:08 - 05:08	(1)
2015-10-05	F	07:15 - 07:15	(1)
2015-10-05	F	14:08 - 14:08	(1)
2015-10-05	F	14:11 - 14:11	(1)
2015-10-05	F	15:01 - 15:01	(1)
2015-10-06	F	13:08 - 13:08	(1)
2015-10-06	F	15:37 - 15:37	(1)
2015-10-06	F	23:06 - 23:06	(1)
2015-10-07	F	04:04 - 04:04	(1)
2015-10-07	F	18:56 - 18:56	(1)
2015-10-07	F	19:55 - 19:55	(1)
2015-10-08	F	04:18 - 04:18	(1)
2015-10-08	F	08:36 - 08:36	(1)
2015-10-08	F	09:43 - 09:43	(1)
2015-10-08	F	12:53 - 12:53	(1)
2015-10-08	F	20:00 - 20:00	(1)
2015-10-08	F	23:56 - 23:59	(4)
2015-10-09	F	05:54 - 05:54	(1)
2015-10-09	F	13:18 - 13:18	(1)
2015-10-10	F	06:32 - 06:32	(1)
2015-10-10	F	15:42 - 15:42	(1)
2015-10-11	F	07:49 - 07:49	(1)
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2015-10-12	F	11:08 - 11:08	(1)
2015-10-12	F	17:20 - 17:20	(1)
2015-10-12	F	17:30 - 17:30	(1)
2015-10-13	F	08:00 - 08:00	(1)
2015-10-14	F	10:49 - 10:49	(1)
2015-10-14	F	12:25 - 12:25	(1)
2015-10-14	F	17:43 - 17:43	(1)
2015-10-14	F	19:09 - 19:09	(1)
2015-10-16	F	16:07 - 16:07	(1)
2015-10-16	F	23:33 - 23:34	(2)
2015-10-17	F	08:05 - 08:05	(1)
2015-10-17	F	08:19 - 08:19	(1)
2015-10-17	F	09:16 - 09:17	(2)
2015-10-17	F	23:56 - 23:59	(4)
2015-10-18	F	07:10 - 07:10	(1)
2015-10-19	F	09:53 - 09:53	(1)
2015-10-19	F	19:08 - 19:08	(1)
2015-10-20	F	05:49 - 05:49	(1)
2015-10-20	F	19:41 - 19:41	(1)
2015-10-21	F	03:25 - 03:25	(1)
2015-10-21	F	09:08 - 09:09	(2)
2015-10-21	F	10:30 - 10:30	(1)
2015-10-21	F	10:38 - 10:38	(1)
2015-10-21	F	13:44 - 13:44	(1)
2015-10-22	F	08:19 - 08:19	(1)
2015-10-22	F	08:21 - 08:21	(1)
2015-10-22	F	18:37 - 18:37	(1)
2015-10-23	F	08:51 - 08:52	(2)
2015-10-24	F	19:33 - 19:34	(2)
2015-10-25	F	02:02 - 02:02	(1)
2015-10-25	F	02:27 - 02:27	(1)
2015-10-25	F	02:53 - 02:53	(1)
2015-10-26	F	02:20 - 02:20	(1)
2015-10-30	F	02:37 - 02:37	(1)
2015-10-30	F	15:39 - 15:39	(1)

2015-10-30	F	22:34 - 22:34	(1)
2015-10-31	F	05:16 - 05:16	(1)
2015-10-31	F	07:12 - 07:12	(1)
2015-11-01	F	05:39 - 05:39	(1)
2015-11-02	F	05:32 - 05:32	(1)
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2015-11-03	F	19:18 - 19:19	(2)
2015-11-04	F	04:37 - 04:37	(1)
2015-11-04	F	05:06 - 05:06	(1)
2015-11-04	F	06:21 - 06:21	(1)
2015-11-04	F	07:56 - 07:56	(1)
2015-11-04	F	08:20 - 08:20	(1)
2015-11-05	F	04:56 - 04:56	(1)
2015-11-05	F	05:29 - 05:29	(1)
2015-11-05	F	07:25 - 07:25	(1)
2015-11-05	F	07:34 - 07:34	(1)
2015-11-05	F	14:01 - 14:01	(1)
2015-11-06	F	09:43 - 09:43	(1)
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2015-11-07	F	10:54 - 10:54	(1)
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2015-11-09	F	07:58 - 07:58	(1)
2015-11-10	F	03:53 - 03:54	(2)
2015-11-10	F	04:04 - 04:04	(1)
2015-11-10	F	04:08 - 04:08	(1)
2015-11-10	F	06:59 - 06:59	(1)
2015-11-10	F	07:34 - 07:34	(1)
2015-11-10	F	09:23 - 09:24	(2)
2015-11-10	F	09:57 - 09:57	(1)
2015-11-10	F	16:58 - 16:58	(1)
2015-11-10	F	18:02 - 18:02	(1)
2015-11-10	F	19:15 - 19:15	(1)
2015-11-10	F	19:22 - 19:22	(1)
2015-11-11	F	06:43 - 06:43	(1)
2015-11-11	F	08:22 - 08:22	(1)
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2015-11-11	F	16:00 - 16:00	(1)
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2015-11-14	F	11:19 - 11:19	(1)
2015-11-15	F	06:36 - 06:36	(1)
2015-11-15	F	08:28 - 08:28	(1)
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2015-11-16	F	06:05 - 06:05	(1)
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2015-11-17	F	08:48 - 08:48	(1)
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2015-11-19	F	09:43 - 09:43	(1)
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2015-11-20	F	09:25 - 09:25	(1)
2015-11-21	F	23:30 - 23:30	(1)

2015-11-23	F	08:32 - 08:32	(1)
2015-11-23	F	08:44 - 08:44	(1)
2015-11-23	F	08:46 - 08:46	(1)
2015-11-23	F	09:26 - 09:26	(1)
2015-11-25	F	22:13 - 22:13	(1)
2015-11-27	F	10:47 - 10:47	(1)
2015-11-28	F	21:11 - 21:11	(1)
2015-11-28	F	22:09 - 22:10	(2)
2015-11-29	F	05:52 - 05:52	(1)
2015-11-29	F	09:16 - 09:16	(1)
2015-11-29	F	21:02 - 21:02	(1)
2015-11-30	F	03:10 - 03:11	(2)
2015-11-30	F	03:43 - 03:43	(1)
2015-11-30	F	05:54 - 05:54	(1)
2015-11-30	F	17:41 - 17:41	(1)
2015-12-01	F	09:42 - 09:42	(1)
2015-12-01	F	10:26 - 10:26	(1)
2015-12-04	F	08:32 - 08:32	(1)
2015-12-04	F	08:57 - 08:57	(1)
2015-12-05	F	05:27 - 05:27	(1)
2015-12-05	F	08:44 - 08:44	(1)
2015-12-05	F	09:18 - 09:18	(1)
2015-12-06	F	07:06 - 07:06	(1)
2015-12-06	F	10:32 - 10:33	(2)
2015-12-06	F	16:30 - 16:30	(1)
2015-12-06	F	21:39 - 21:39	(1)
2015-12-07	F	07:46 - 07:46	(1)
2015-12-07	F	17:55 - 17:55	(1)
2015-12-08	F	09:24 - 09:24	(1)
2015-12-08	F	09:42 - 09:42	(1)
2015-12-09	F	12:06 - 12:06	(1)
2015-12-09	F	20:14 - 20:14	(1)
2015-12-09	F	20:49 - 20:49	(1)
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2015-12-10	F	08:24 - 08:24	(1)
2015-12-10	F	16:59 - 16:59	(1)
2015-12-11	F	08:43 - 08:43	(1)
2015-12-11	F	08:58 - 08:58	(1)
2015-12-11	F	09:12 - 09:13	(2)
2015-12-11	F	09:29 - 09:29	(1)
2015-12-11	F	16:10 - 16:10	(1)
2015-12-11	F	16:46 - 16:46	(1)
2015-12-12	F	05:28 - 05:28	(1)
2015-12-12	F	08:29 - 08:29	(1)
2015-12-12	F	11:45 - 11:45	(1)
2015-12-12	F	16:19 - 16:19	(1)
2015-12-12	F	16:21 - 16:21	(1)
2015-12-12	F	16:57 - 16:57	(1)
2015-12-12	F	22:03 - 22:03	(1)
2015-12-13	F	10:56 - 10:56	(1)
2015-12-13	F	13:44 - 13:44	(1)
2015-12-13	F	14:39 - 14:39	(1)
2015-12-13	F	20:53 - 20:53	(1)
2015-12-14	F	13:21 - 13:21	(1)
2015-12-14	F	16:17 - 16:17	(1)
2015-12-14	F	16:22 - 16:24	(3)
2015-12-15	F	08:55 - 08:55	(1)
2015-12-15	F	16:35 - 16:35	(1)
2015-12-16	F	03:33 - 03:33	(1)
2015-12-16	F	05:23 - 05:23	(1)
2015-12-16	F	12:27 - 12:27	(1)

2015-12-18	F	07:15 - 07:15	(1)
2015-12-18	F	07:28 - 07:28	(1)
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2015-12-20	F	03:39 - 03:39	(1)
2015-12-20	F	05:06 - 05:06	(1)
2015-12-20	F	05:29 - 05:29	(1)
2015-12-20	F	06:11 - 06:11	(1)
2015-12-20	F	06:15 - 06:15	(1)
2015-12-20	F	06:23 - 06:23	(1)
2015-12-20	F	09:20 - 09:20	(1)
2015-12-20	F	09:39 - 09:39	(1)
2015-12-20	F	20:36 - 20:36	(1)
2015-12-20	F	21:59 - 21:59	(1)
2015-12-20	F	22:45 - 22:45	(1)
2015-12-21	F	03:54 - 03:54	(1)
2015-12-21	F	18:55 - 18:55	(1)
2015-12-22	F	00:58 - 00:58	(1)
2015-12-22	F	03:10 - 03:10	(1)
2015-12-22	F	07:12 - 07:14	(3)
2015-12-22	F	09:55 - 09:55	(1)
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2015-12-22	F	11:17 - 11:17	(1)
2015-12-22	F	11:20 - 11:20	(1)
2015-12-22	F	12:15 - 12:15	(1)
2015-12-23	F	04:32 - 04:32	(1)
2015-12-23	F	08:45 - 08:45	(1)
2015-12-23	F	19:03 - 19:03	(1)
2015-12-24	F	06:41 - 06:42	(2)
2015-12-24	F	08:54 - 08:55	(2)
2015-12-24	F	10:08 - 10:08	(1)
2015-12-24	F	23:26 - 23:26	(1)
2015-12-25	F	04:04 - 04:04	(1)
2015-12-25	F	13:51 - 13:51	(1)
2015-12-25	F	17:19 - 17:19	(1)
2015-12-26	F	06:46 - 06:46	(1)
2015-12-26	F	11:33 - 11:34	(2)
2015-12-26	F	19:30 - 19:30	(1)
2015-12-27	F	14:15 - 14:16	(2)
2015-12-28	F	05:29 - 05:29	(1)
2015-12-28	F	08:07 - 08:07	(1)
2015-12-28	F	10:39 - 10:39	(1)
2015-12-28	F	15:05 - 15:05	(1)
2015-12-29	F	09:48 - 09:48	(1)
2015-12-29	F	14:55 - 14:55	(1)
2015-12-29	F	15:13 - 15:13	(1)
2015-12-30	F	07:59 - 08:00	(2)
2015-12-30	F	08:52 - 08:53	(2)
2015-12-30	F	08:57 - 08:57	(1)
2015-12-30	F	09:48 - 09:49	(2)
2015-12-31	F	05:48 - 05:48	(1)
2015-12-31	F	06:24 - 06:24	(1)
2015-12-31	F	06:57 - 06:57	(1)
2015-12-31	F	21:36 - 21:36	(1)

Total: 1629

< END >

7.10.1.4 2016

```
                        CSY
         CASEY OBSERVATORY INFORMATION 2016

  ACKNOWLEDGE- Users of the CSY data should acknowledge:
       -MENTS: Geoscience Australia

   STATION ID: CSY
     LOCATION: Casey Station, Antarctica
 ORGANISATION: Geoscience Australia (GA)
  CO-LATITUDE: 156.28 deg
    LONGITUDE: 110.53 deg. E
    ELEVATION: 40 metres

     ABSOLUTE
  INSTRUMENTS: DI-fluxgate Magnetometer (DMI on Zeiss 020B)
               and Proton Precession Magnetometer (GSM-90)

    RECORDING
   VARIOMETER: Danish Meteorological Institute suspended
               fluxgate FGE, 3 component magnetometer
               GSM-90 Proton Precession magnetometer

  ORIENTATION: Two horizontal fluxgate channels are aligned
               equally about magnetic north at
               the time of installation.
               This orientation is referred to as ABZ.
DYNAMIC RANGE: +/-3200 nT
   RESOLUTION: 0.3 nT
SAMPLING RATE: 1 second
  FILTER TYPE: Intermagnet

       BACKUP
   VARIOMETER: None

    K-NUMBERS: None

     K9-LIMIT: 750 nT

        GINS: Edinburgh
    SATELLITE: HTTP delivery.

    OBSERVERS: A. Burgess (until 2016-11-08)
               C. Chilcott(from 2016-11-08)

      CONTACT: Geomagnetism
               Geoscience Australia
               G.P.O. Box 378
               Canberra, A.C.T, 2601
               Australia

               Tel: + 61-2-6249-9111
               Fax: + 61-2-6249-9971
               e-mail: geomag@ga.gov.au
               WWW: http://www.ga.gov.au

NOTES:
Casey is situated on the Antarctic coast in Wilkes Land
3880 km south of Perth. It is the nearest Australian
Antarctic research station to Australia. The magnetic
```

Absolute Hut is about 120 m south of the tank house, the nearest structure of the modern Casey station. The old Casey station, in use until the late 1980s, lies about 1 km northeast of the present Casey station.

Regular magnetic observations began at Casey in 1975. From 1988 a variation station operated there. From 1991 to 1998 it operated as a magnetic observatory, although not to a high standard. Observatory-standard absolute control commenced in 1999.

The magnetic observatory is part of the Casey scientific research station in Antarctica.
The magnetic observatory comprises:
* the Variometer Hut, and;
* the Absolute Hut.

The crystalline rocks of Casey have high concentrations of magnetic minerals that cause high magnetic gradients in the area. The location of the observatory is in one of the places of least gradient in the area, but still with a higher gradient than is ideal for a magnetic observatory.

Table 1. Key observatory data.
IAGA code: CSY
Commenced operation: 1999
Geographic latitude: 66 deg 17' S
Geographic longitude: 110 deg 32' E
Geomagnetic latitude: -75.95 deg
Geomagnetic longitude: 184.79 deg
K 9 index lower limit: 750 nT
Principal pier: Pier B
Pier elevation (top): 40 m AMSL
Principal reference mark: Trig station G11
Reference mark azimuth: 308 deg 06' 00"
Reference mark distance: 464 m
Observer: A. Burgess
          C. Chilcott

Local meteorological conditions

The meteorological temperature at Casey during 2016 varied from a minimum -34.2 deg C (2016-07-11) to a maximum of +5.9 deg C on (2016-12-25). Daily minimum temperatures varied from -34.2 deg C to -0.1 deg C (average -12.5 +/- 8 deg C). Daily maximum temperatures varied from -26.9 deg C to +5.9 deg C (average -5.9 +/- 7 deg C).

The daily maximum wind gust varied from 19 km/h to 248 km/h (average 64.6 +/- 43 km/h). The maximum daily maximum wind gust was 248 km/h in July. The minimum daily maximum wind gust was 19 km/h in January and November. Windy conditions were the norm throughout the year with the higher wind gusts being attributed to blizzards. There was from 0 to 16.5 hours (average 2.7 +/- 4) of sunshine according to the meteorological definition.

All weather data was provided by the
Australian Government - Bureau of Meteorology.

Variometers

The variometers used during 2016 are listed in Table 2.

The variometers at Casey station are housed within the variometer hut. The DMI vector variometer sensor is located in the southern corner of the hut. The GSM90 scalar magnetometer sensor is located in the northern corner. Both sensors are mounted on marble plinths. This configuration allows for the maximum separation between the two instruments. The variometer hut also contains the variometer electronics mounted within non-magnetic shelves. The instrument power supply, consisting of a 12 V variometer backup battery system, is also positioned within the shelves. System timing was provided by a Garmin GPS16-HVS clock mounted on the shelves. Timing corrections were applied automatically and logged. Timing corrections greater than 1 ms are listed in the variometer clock corrections section.

The recording equipment, a QNX acquisition computer, was directly connected to the station's network via fibre optic cable and was located within the variometer hut.

Periods of corrupted vector variometer data have been excluded throughout the 2016 definitive data. The most significant of these occurred on the 2016-07-30 when nearly 4 hours were deleted. There also numerous periods of corrupted data lasting up to 1 minute that were also deleted. All deleted data are listed in the appendix as Data Losses for 2016.

For the 2016 definitive data both the vector data and scalar were not automatically spike filtered. Any spikes were removed by excluding vector data where appropriate.

Spikes were noted in Fv-Fs, these were investigated in both the vector and scalar data. No problems were noted in these data when the spikes occurred, but they were associated with active field periods. As these spikes occur over several minutes during these active periods, a difference occurs between the timing resolution of 1 second vector data and the linear interpolation of the 10 second scalar data. Scalar data has only been excluded when these spikes exceeded +/- 5 nT.

Table 2.
Magnetic variometers used in 2016.

3-component vector variometer:	DMI FGE
Serial number:	E0199 / S0160
Type:	suspended; linear-core fluxgate
Orientation:	NW, NE, Z
Acquisition interval:	1 s
A/D converter:	ADAM 4017 module (±10V)
Scale value:	0.32 nT / count
Period of use:	2016-01-01 to 2016-12-31
Scalar variometer:	GEM Systems GSM90
Serial number:	4081423 / 42189
Type:	Overhauser effect
Acquisition interval:	10 s

```
Resolution:                 0.01 nT
Period of use:              2016-01-01 to 2016-12-31

Data acquisition system:    GDAP; ARK3360/QNX6.5
Timing:                     Garmin GPS 16 clock
Communications:             ANARESAT
```

Variometer clock corrections

Time stamps applied to the variometer data were obtained from the acquisition computer system clock. That clock was synchronised to a GPS clock. During 2016, adjustments to the system clock were less than 1 ms except on the following occasions:

```
2016-05-12      03:15:42     1.467 s Restart after battery
                                     replacement
                03:20:54    -0.009 s Adjustment after
                                     restart
2016-12-07      21:19:01     0.782 s Unknown
```

Absolute instruments

The principal absolute magnetometers used at Casey in 2016, and their adopted instrument corrections, are listed in Table 3.
At the 2016 mean magnetic field values at Casey (X=-1008 nT, Y=-9039 nT, Z=-63407 nT) these D, I and F corrections translate to corrections of:
dX = 0.8 nT dY = 3.62 nT dZ = -0.53 nT

Instrument corrections were applied whilst reducing absolute observations to determine baselines and have been applied to all Casey 2016 final data.

Table 3.
Absolute magnetometers and their adopted corrections for 2016. Corrections are applied in the sense
Standard = Instrument + correction.

```
DI fluxgate:   DMI
Serial number: DI0047
Theodolite:    Zeiss 020B
Serial number: 352229
Resolution:    0.1'
D correction:  0.15'
I correction: -0.20'

Scalar magnetometer: GEM Systems GSM90
Serial number:       810881 / 31960
Type:                Overhauser effect
Resolution:          0.01 nT
Correction:          0.0 nT

Scalar magnetometer: Geometrics G816 (backup)
Serial number:       766
Type:                Proton precession
Resolution:          1 nT
Correction:          1.5 nT
```

Baselines

The sensor and electronics were located in the variometer hut and were subject to the same thermal conditions. As such, independent temperature effects were unable to be determined. For 2016 temperature corrections were applied using the sensor temperature only.

The final baseline parameters for the variometer were completed by manually fitting a piece-wise linear function to 54 pairs of absolute observations. This function included drifts or jumps, when required. The baseline drifted in all three channels over the course of the year. Scatter in the baseline residuals throughout the year had a a range of 5.4 nT. Any outliers were then removed from the final data.

The final daily average of Fv-Fs for the year varied from -2.3 nT to 1.3 nT. The standard deviations in the 2016 weekly absolute observations from the final adopted variometer model and data were:

X	1.1 nT
Y	1.1 nT
Z	0.4 nT
D	25.9"
I	3.4"
F	0.4 nT

Late on day 170 (2016-06-18T20:41), several small jumps occurred in the Y and Z channels. Baseline jumps have been applied to the baseline file to correct these jumps.

Real-time, Quasi-definitive and Definitive data comparison

The annual statistics of the 12 monthly averages of the difference between the 2016 CSY definitive data and real time reported 1-minute data sets
(CSY definitive - CSY real time) were:

	X	Y	Z
Average	-0.6	0.4	0.1
Std.dev	1.3	0.4	0.1
Min	-2.4	-1.5	-1.4
Max	2.0	2.8	1.2

The CSY 2016 reported real time data are within the specification for INTERMAGNET quasi-definitive data. This was in part due to keeping baselines updated to produce quasi-definitive data.

The annual statistics of the 12 monthly averages of the difference between the 2016 CSY definitive data and quasi-definitive 1-minute data sets
(CSY definitive - CSY quasi-definitive) were:

	X	Y	Z
Average	-0.5	0.5	0.2
Std.dev	1.3	1.2	0.5
Min	-1.9	-1.2	-0.8
Max	3.1	2.5	0.9

The CSY 2016 quasi-definitive data are within
the specification for INTERMAGNET quasi-definitive data.

Operations

The Casey observer was a member of the Australian National Antarctic Research Expedition and was employed by the Australian Antarctic Division with funding support by Geoscience Australia.

The observer was responsible for the continuous operation of the observatory and performed equipment maintenance and installation as required. The observer performed weekly absolute observations and forwarded them by e-mail to Geoscience Australia. Periodic visits to the variometer hut were also made to check on the variometer system.
All data processing was performed at Geoscience Australia.

Magnetic time-series data were transferred to Geoscience Australia in Canberra every 5 minutes via ANARESAT. The QNX 6.5 acquisition computer used a GPS clock (both pulse-per-second and absolute-time-code) to set the system time. Timing and clock operation was monitored via daily state-of-health messages.

In February (2016-02-05) the older absolute battery box was replaced. The older box required 2x7amp/hour batteries. The newer absolute battery boxes have been re-designed and only require 1x7amp/hour battery.

In May (2016-05-12) the battery in the variometer battery box was replaced. This required the acquisition computer to be shutdown for 24 minutes. The data during this time was lost.

In August (2016-08-09) the observer entered the variometer hut to take photos of the fibre optics box. This was to enable planning of upgrade work to the fibre-optics network at the station. Seven minutes of data was contaminated and has been excluded from the definitive data.

Also in August (2016-08-27) 36 minutes of contamination of the data occurred. The cause was not determined. These data have also been excluded from the 2016 definitive data.

In early November, the expeditioner change-over occurred, including the magnetic observer.

The distribution of Casey 2016 data is described in Table 4. Data losses are identified below.

Table 4. Distribution of Casey 2016 data.

1-second values

BoM SWS	preliminary	real time
INTERMAGNET	preliminary	hourly

1-minute values

INTERMAGNET	preliminary	real time
INTERMAGNET	preliminary	daily

```
INTERMAGNET    quasi-
               definitive   monthly
INTERMAGNET    definitive   July 2017
WDC for Geomagnetism, Kyoto
               preliminary  real time
WDC for Geomagnetism, Kyoto
               preliminary  daily
```

Preliminary 1-minute data were also available on the GA web (http://www.ga.gov.au)

Significant events

```
2016-01-31  18:00 telemetry stops - problem at AAD end.
2016-02-05  New absolute battery box enters service.
2016-05-12  18amp/h battery in variometer replaced.
            Computer stopped 02:59:29. Restarted at
            03:13:42. Some contamination before and after.
2016-07-28  Weekly obs showed that corrections made in
            previous month for QD data affect the
            residuals. This was corrected.
2016-08-09  Contamination in variometer data.
            03:55:33 - 04:02:36. Confirmed by observer.
            Observer entered to take photos of fibre optics
            box as fibre optics is be upgraded from metal
            connectors to fused connector.
2016-08-27  XY contamination. Data excluded.
            21:22:39~21:58:18
2016-11-02  New observer assumes obs responsibilities.
```

Annual mean values

The annual mean values for Casey are set out in the yearmean file.

Indices

On 2014-06-18 the K9 value for Casey was updated from 1500 nT to 750 nT on advice from Dr. Menvielle from ISGI. K indices are not routinely scaled from the Casey data.

Data Losses for 2016

```
Variometer data XYZ:
2016-05-12    XYZ     02:56 - 03:19  (24)
2016-06-15    XYZ     05:34 - 08:30  (177)
2016-06-17    XYZ     03:00 - 10:38  (459)
2016-07-30    XYZ     03:00 - 03:00  (1)
2016-07-30    XYZ     03:48 - 03:48  (1)
2016-07-30    XYZ     05:45 - 09:13  (209)
2016-07-30    XYZ     20:41 - 20:49  (9)
2016-07-30    XYZ     21:47 - 21:47  (1)
2016-07-31    XYZ     11:13 - 11:15  (3)
2016-08-09    XYZ     03:56 - 04:02  (7)
2016-08-27    XYZ     21:23 - 21:58  (36)
2016-09-10    XYZ     17:22 - 17:23  (2)
2016-12-07    XYZ     21:16 - 21:18  (3)
2016-12-09    XYZ     04:02 - 04:08  (7)
```

Total: 939 (0.7 days)

```
Scalar Data F:
2016-05-12    F      02:56 - 03:19  (24)
2016-08-09    F      03:57 - 04:01  (5)
2016-12-07    F      21:17 - 21:18  (2)
2016-12-09    F      04:02 - 04:08  (7)

Total: 38 (0.03 days)
                             < END >
```

7.10.2 Baseline values

7.10.2.1 2013

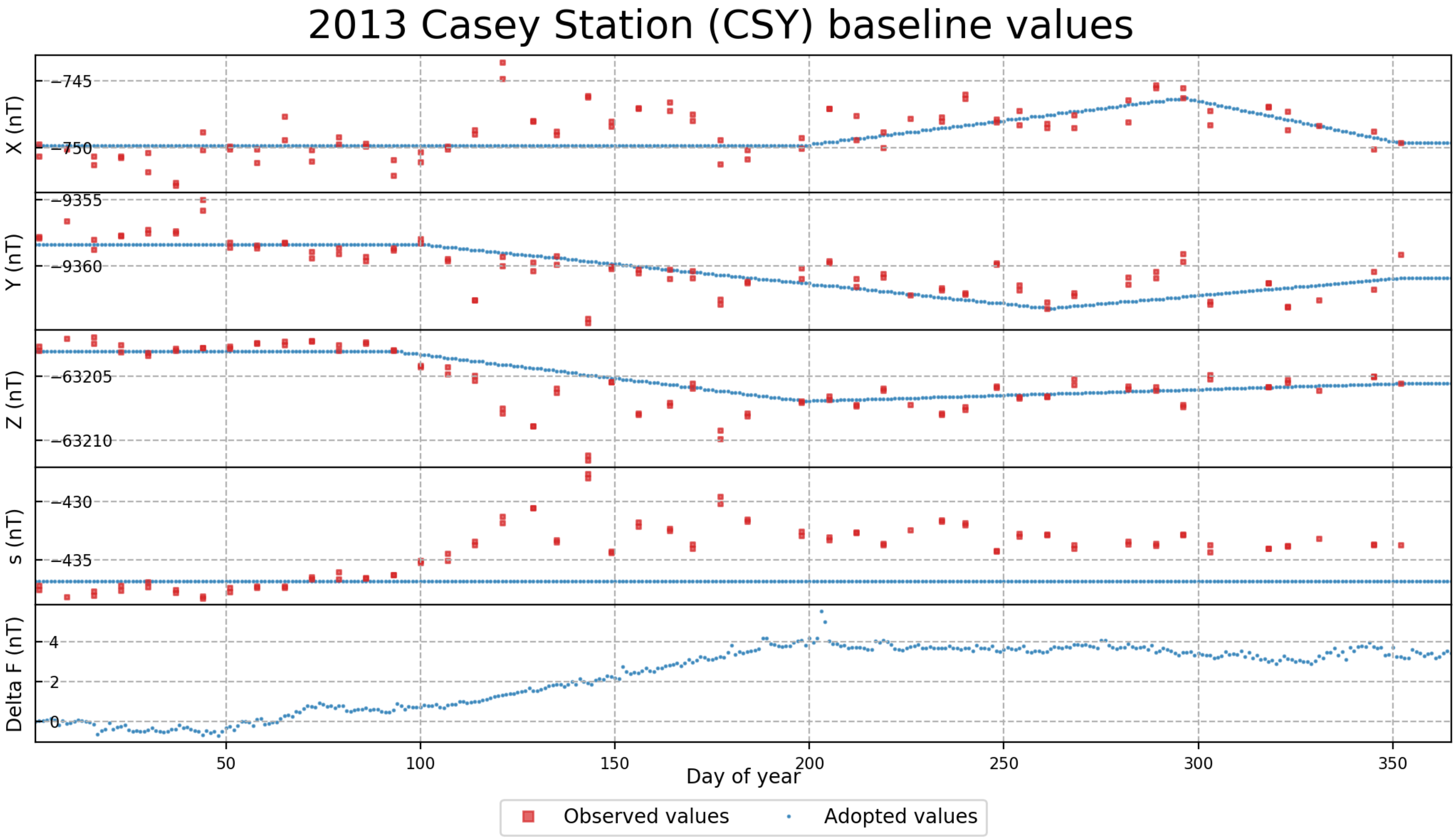

Figure 7.79 Casey Station (CSY) baseline values for 2013. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.10.2.2 2014

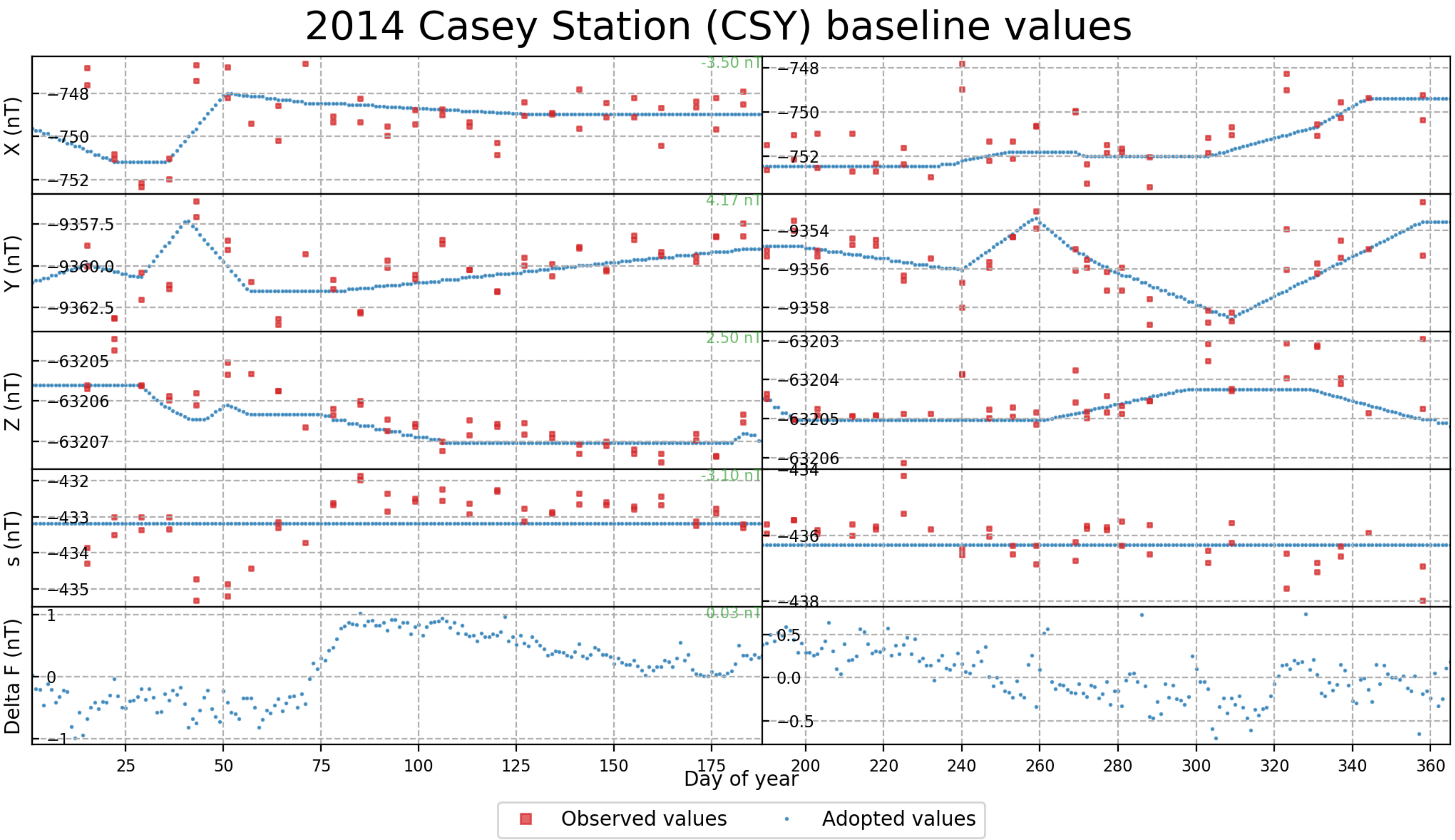

Figure 7.80 Casey Station (CSY) baseline values for 2014. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.10.2.3 2015

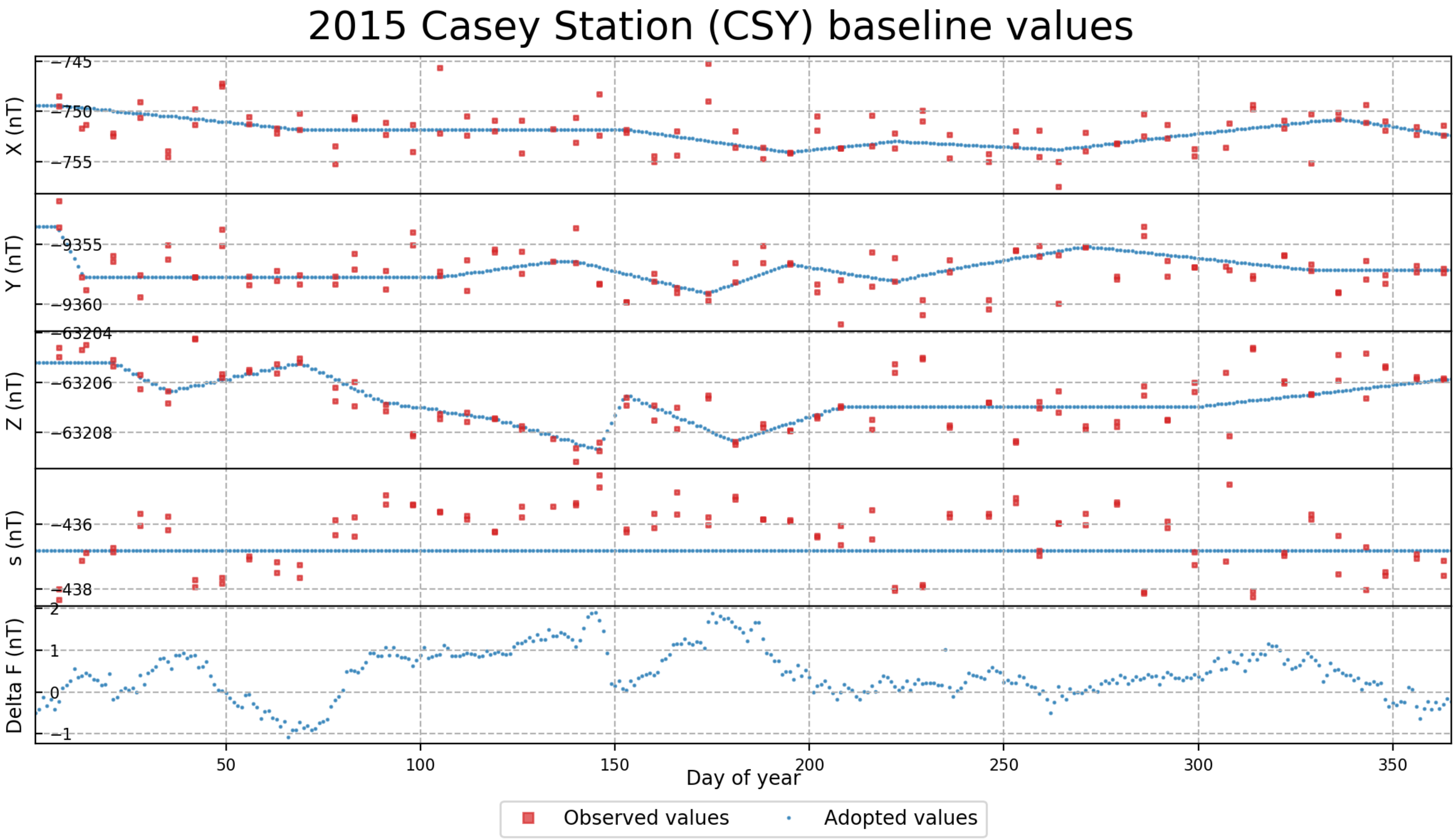

Figure 7.81 Casey Station (CSY) baseline values for 2015. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.10.2.4 2016

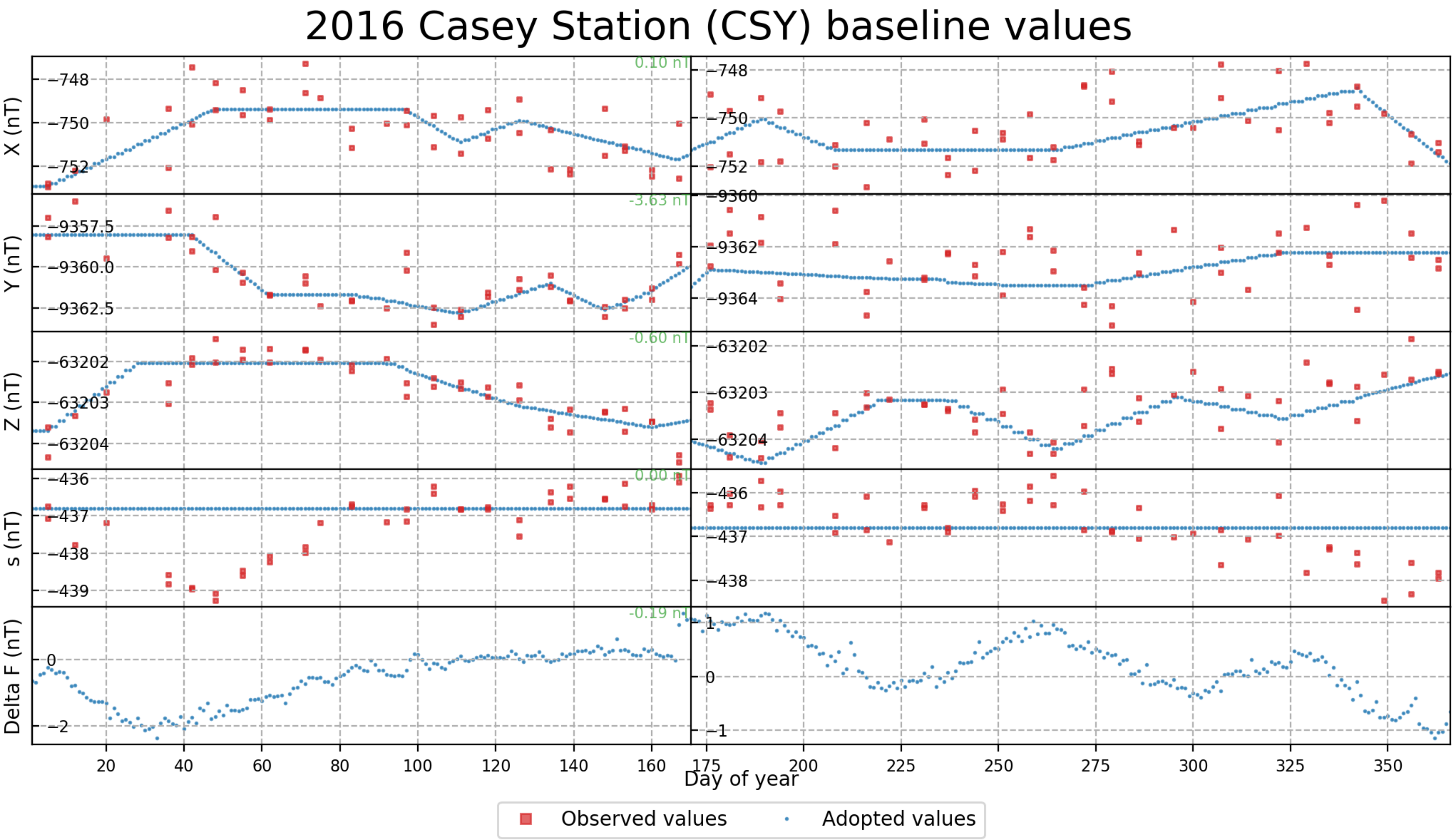

Figure 7.82 Casey Station (CSY) baseline values for 2016. Plots were generated from the appropriate IBFV2.00 INTERMAGNET Baseline Format file and were rendered similarly to the Imcdview application's baseline viewer (green text indicates a jump in baseline values).

7.10.3 Annual mean values

7.10.3.1 DIH

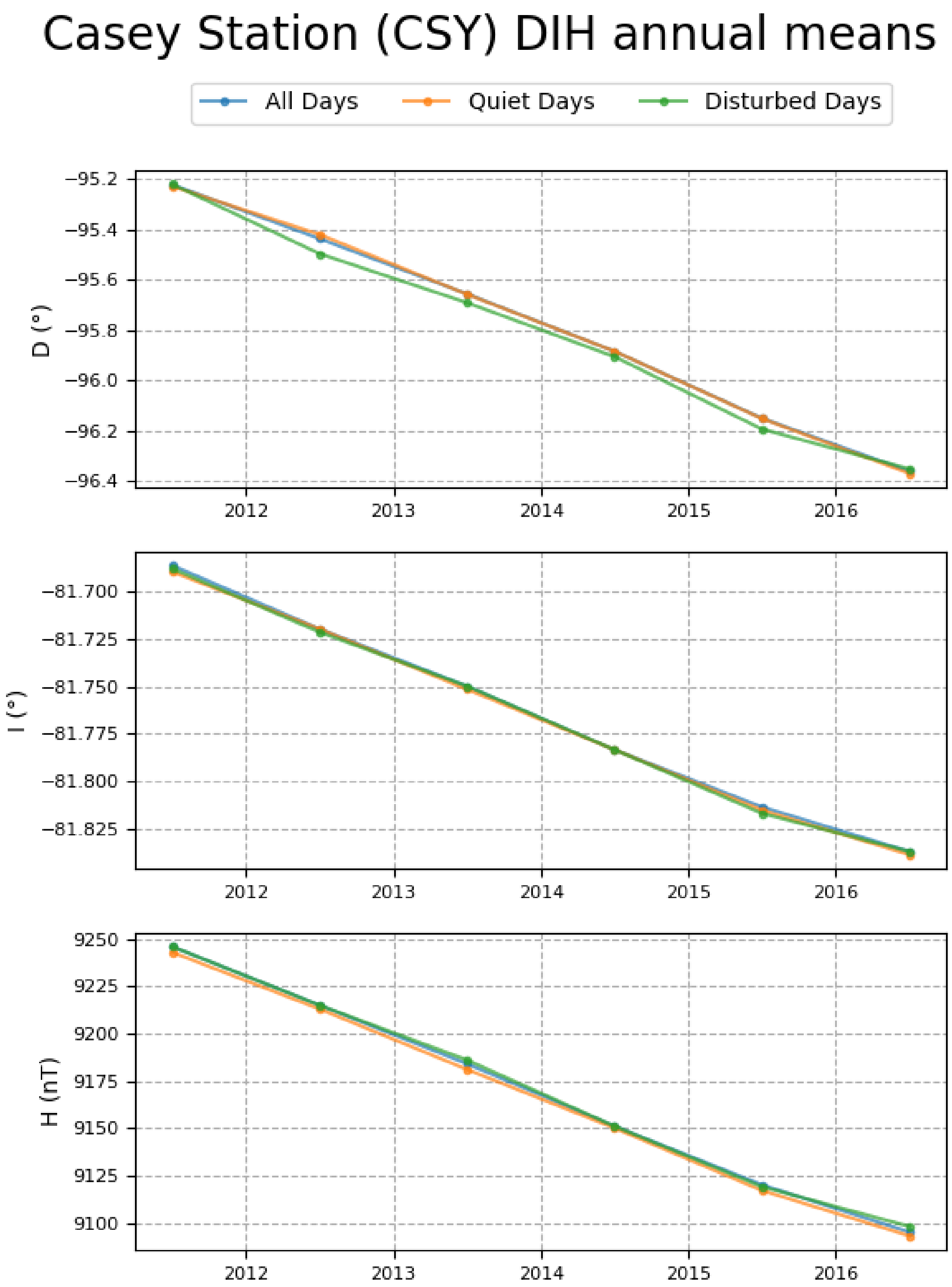

Figure 7.83 Casey Station (CSY) annual mean values in DIH until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.10.3.2 XYZF

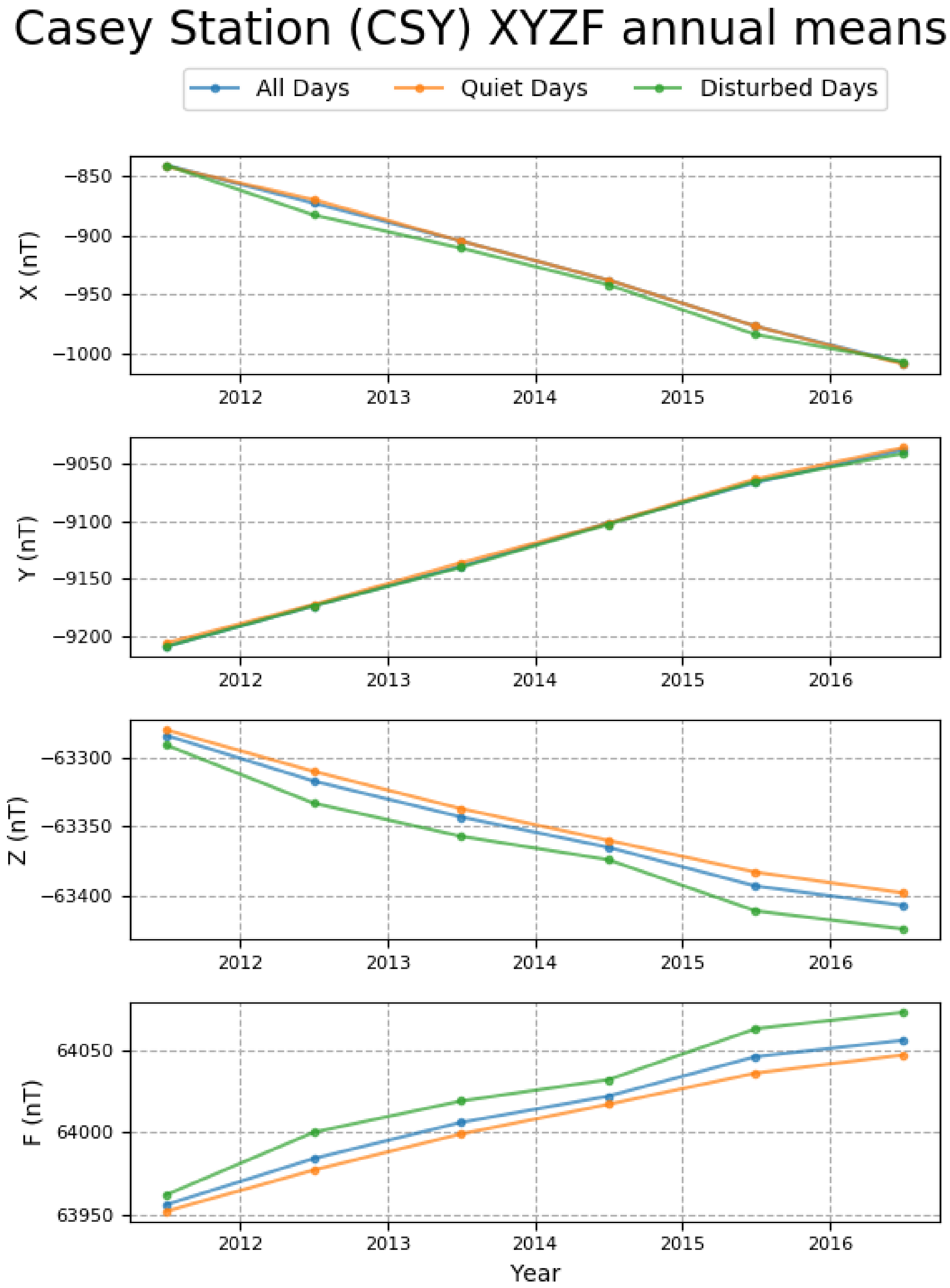

Figure 7.84 Casey Station (CSY) annual mean values in XYZF until 2016. Plots were generated from the appropriate IYFV1.01 INTERMAGNET CD-ROM/DVD Format For Yearmean File.

7.10.3.3 2016 INTERMAGNET annual mean values file

ANNUAL MEAN VALUES
CASEY, CSY, ANTARCTICA

COLATITUDE: 156.28 LONGITUDE: 110.53 E ELEVATION: 40 m

YEAR	D Deg. min	I Deg. min	H nT	X nT	Y nT	Z nT	F nT	*	ELE	Note
2011.500	-95 13.3	-81 41.2	9246	-841	-9208	-63284	63956	A	ABZ	1
2012.500	-95 26.2	-81 43.2	9215	-873	-9173	-63317	63984	A	ABZ	
2013.500	-95 39.4	-81 45.0	9184	-905	-9139	-63343	64006	A	ABZ	
2014.500	-95 53.1	-81 47.0	9151	-938	-9102	-63365	64022	A	ABZ	
2015.500	-96 09.1	-81 48.8	9120	-977	-9067	-63393	64046	A	ABZ	
2016.500	-96 21.8	-81 50.2	9095	-1008	-9039	-63407	64056	A	ABZ	
2011.500	-95 13.7	-81 41.4	9243	-842	-9205	-63280	63952	Q	ABZ	1
2012.500	-95 25.2	-81 43.2	9213	-870	-9172	-63310	63977	Q	ABZ	
2013.500	-95 39.5	-81 45.1	9181	-905	-9136	-63337	63999	Q	ABZ	
2014.500	-95 53.1	-81 47.0	9150	-938	-9102	-63360	64017	Q	ABZ	
2015.500	-96 09.2	-81 48.9	9117	-977	-9064	-63383	64036	Q	ABZ	
2016.500	-96 22.3	-81 50.3	9093	-1009	-9037	-63398	64047	Q	ABZ	
2011.500	-95 13.2	-81 41.3	9246	-841	-9208	-63291	63962	D	ABZ	1
2012.500	-95 29.8	-81 43.3	9215	-883	-9173	-63333	64000	D	ABZ	
2013.500	-95 41.5	-81 45.0	9186	-911	-9140	-63357	64019	D	ABZ	
2014.500	-95 54.4	-81 47.0	9151	-942	-9103	-63374	64032	D	ABZ	
2015.500	-96 11.7	-81 49.0	9119	-984	-9066	-63411	64063	D	ABZ	
2016.500	-96 21.2	-81 50.2	9098	-1007	-9042	-63424	64073	D	ABZ	

* A = All days
* Q = 5 International Quiet days each month
* D = 5 International Disturbed days each month

ELE = Elements recorded

Notes: 1. Annual means prior to 2011 will be provided later.

8 Repeat stations

For the interval 2013–2016 repeat stations were occupied in 2013 and 2014. The locations of these repeat stations are listed in Table 4 and shown in Figure 3.1.

Sections 8.1, 8.2 and 8.3 present the normal field values, annual change estimates and plots of past normal field values for the repeat station sites occupied in 2013 and 2014, respectively. Instrumentation, occupation and data processing details are listed in Sections 8.4, 8.5 and 8.6, respectively. The IAGA survey file for 2010.0 to 2014.2 which was submitted to World Data Center for Geomagnetism (Edinburgh) on 2014-06-26 is reproduced in Section 8.7.

8.1 Normal field values

Table 18 Normal field values for repeat station sites occupied during 2013 and 2014.

	Mid-date	D (°)	I (°)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)
WEI	2013.3917	+05.299	−39.460	35580	35428	3286	−29288	46084
HOB	2013.4055	+14.939	−72.609	18488	17863	4766	−59028	61856
LHI	2013.4357	+14.693	−61.272	26115	25261	6624	−47644	54332
NOU	2014.1753	+12.478	−47.933	31940	31186	6901	−35390	47672
NFI	2014.1946	+15.336	−56.458	28355	27345	7499	−42772	51317
KAV	2014.411	+05.785	−20.010	36360	36175	3665	−13241	38696
VAN	2014.4247	+03.737	−21.468	37034	36955	2414	−14565	39795

8.2 Annual change estimates

Table 19 Annual change estimates for repeat station sites occupied during 2013 and 2014.

	Current mid-date	Previous mid-date	D (°/year)	I (°/year)	H (nT/year)	X (nT/year)	Y (nT/year)	Z (nT/year)	F (nT/year)
WEI	2013.3917	2009.2301	−00.046	+00.019	−04	−01	−29	+23	−18
HOB	2013.4055	2009.3917	+00.017	+00.010	+07	+06	+07	+14	−11
LHI	2013.4357	2009.4219	−00.009	+00.001	−08	−07	−06	+17	−19
NOU	2014.1753	2007.4302	−00.008	−00.004	−17	−16	−08	+14	−22
NFI	2014.1946	2009.2109	+00.008	−00.002	−14	−15	+00	+18	−23
KAV	2014.411	2007.4137	−00.041	−00.000	−07	−05	−27	+03	−08
VAN	2014.4247	2007.3972	−00.055	+00.018	−02	+00	−36	+14	−07

8.3 Adopted normal field values

8.3.1 Weipa

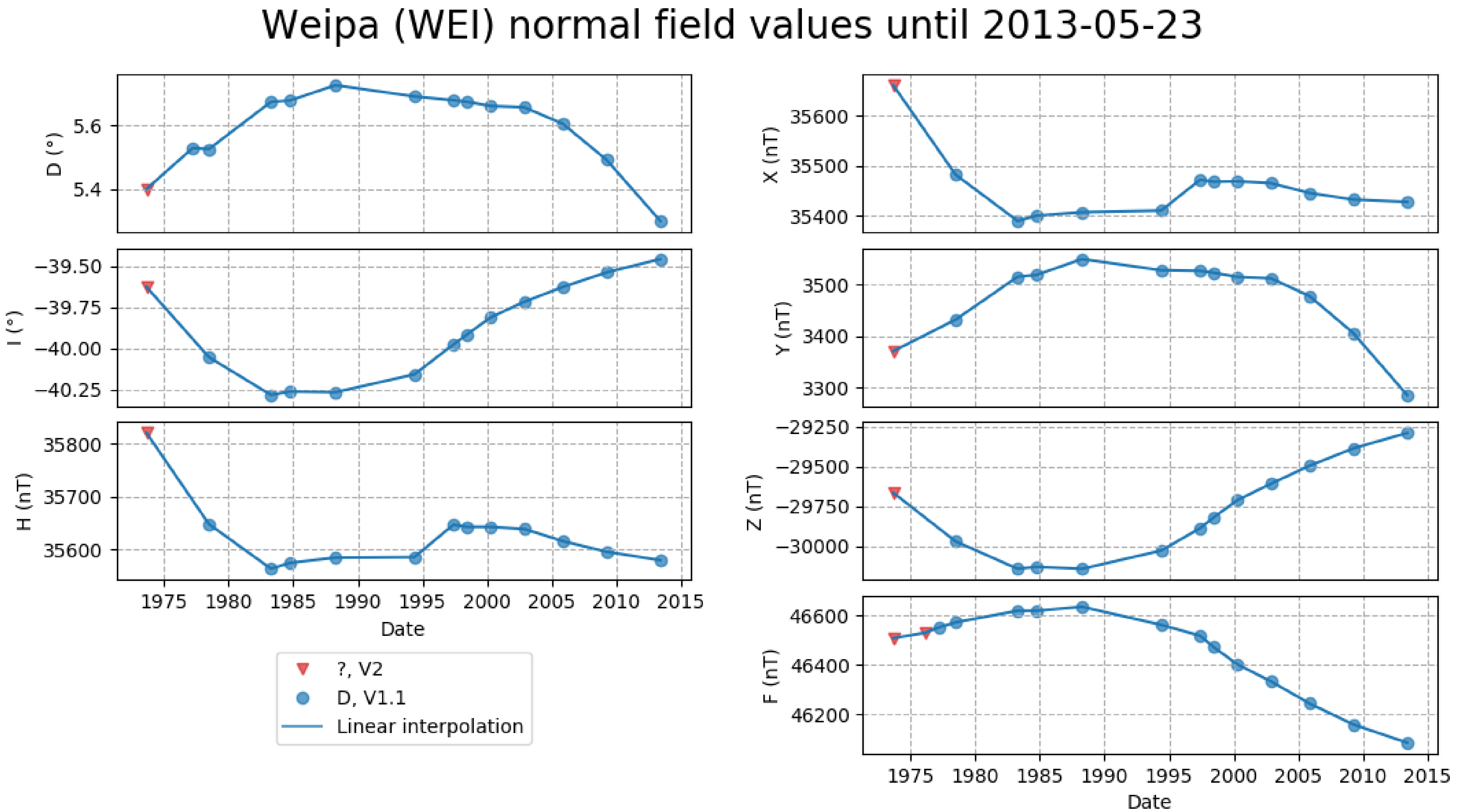

Figure 8.1 Weipa (WEI) normal field values until 2013-05-23. Refer to Newitt, Barton & Bitterly 1996, ch. 8 for meaning of legend entries.

8.3.2 Hobart

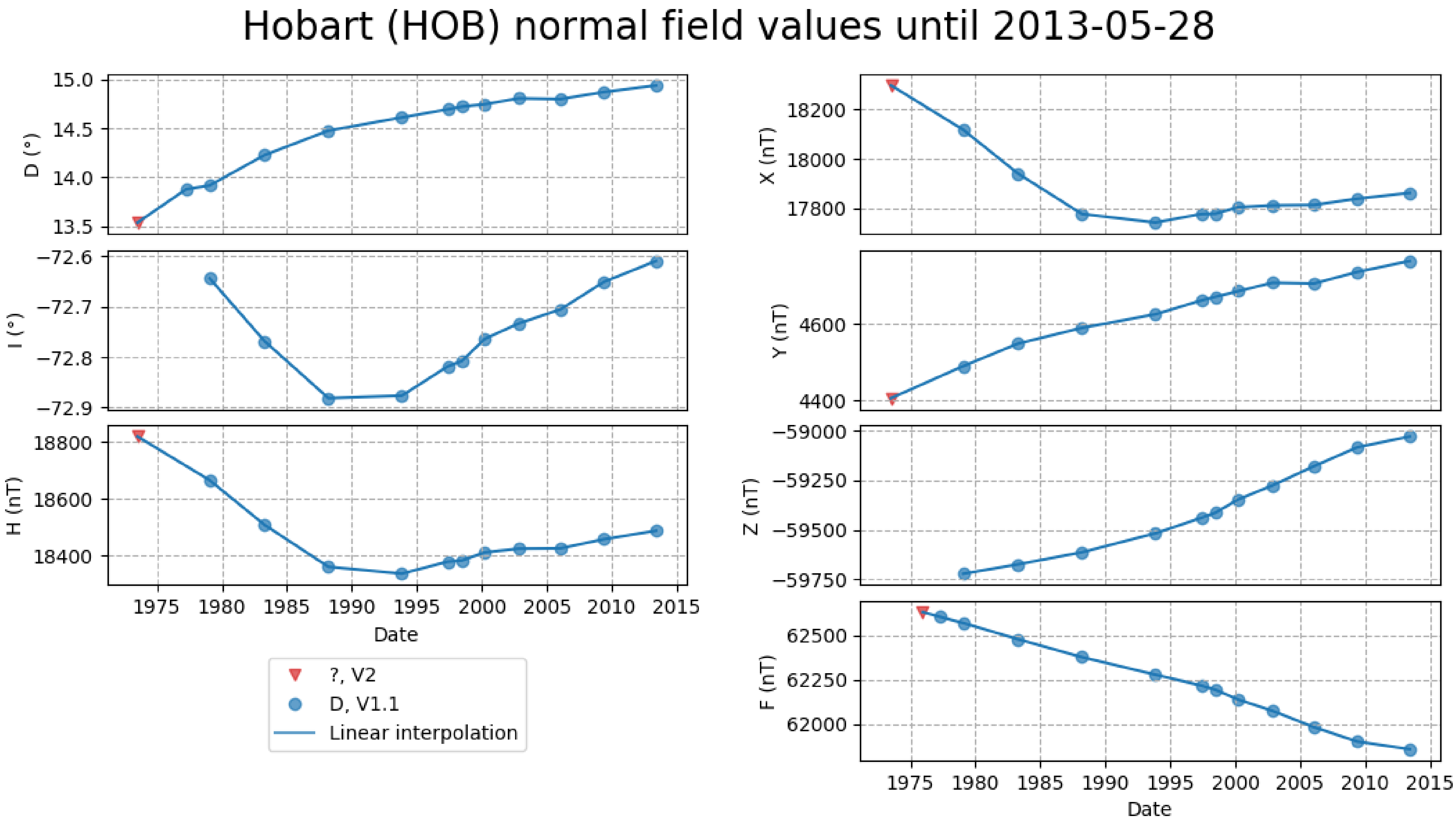

Figure 8.2 Hobart (HOB) normal field values until 2013-05-28. Refer to Newitt, Barton & Bitterly 1996, ch. 8 for meaning of legend entries.

8.3.3 Lord Howe Island

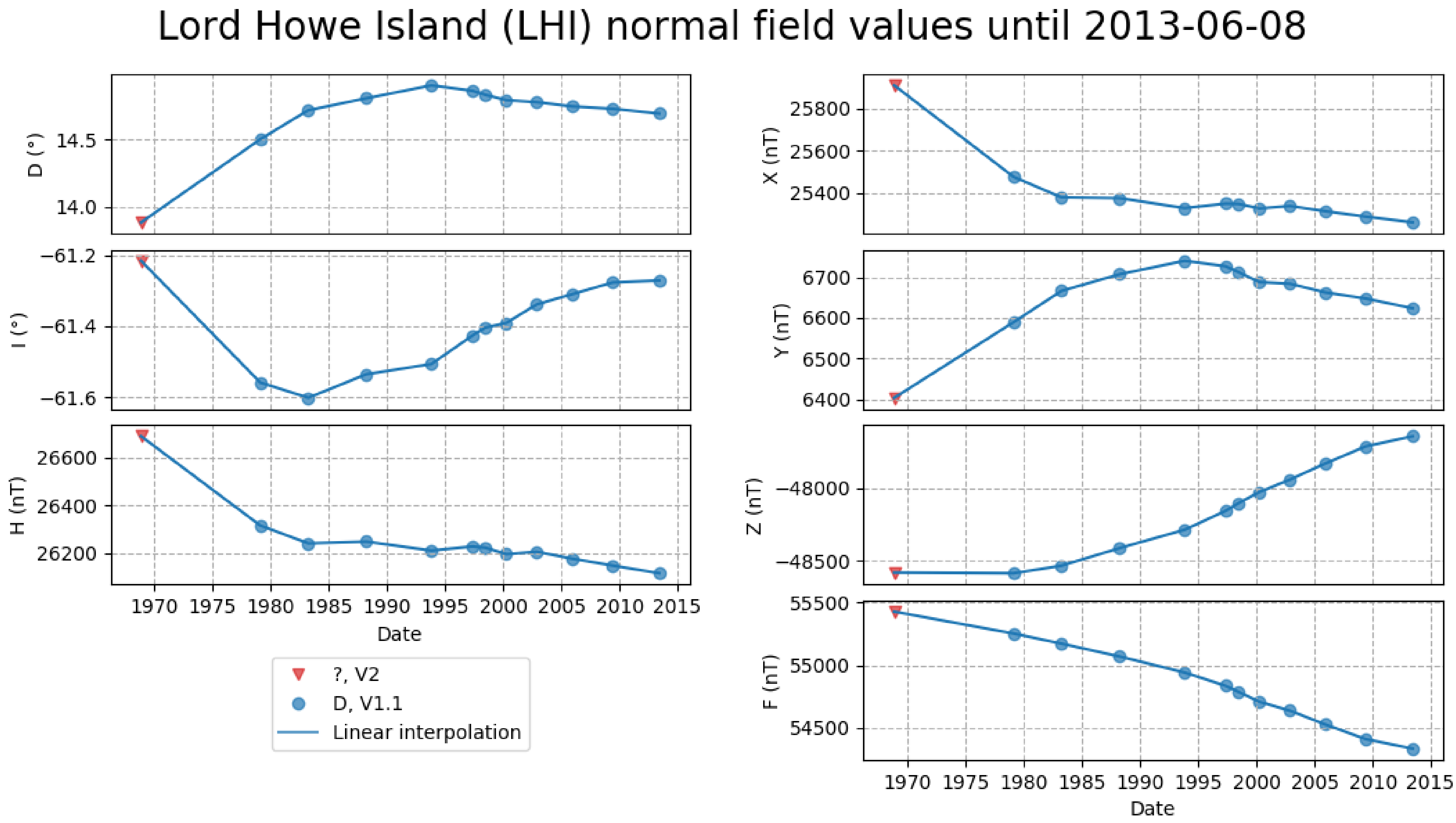

Figure 8.3 Lord Howe Island (LHI) normal field values until 2013-06-08. Refer to Newitt, Barton & Bitterly 1996, ch. 8 for meaning of legend entries.

8.3.4 Nouméa

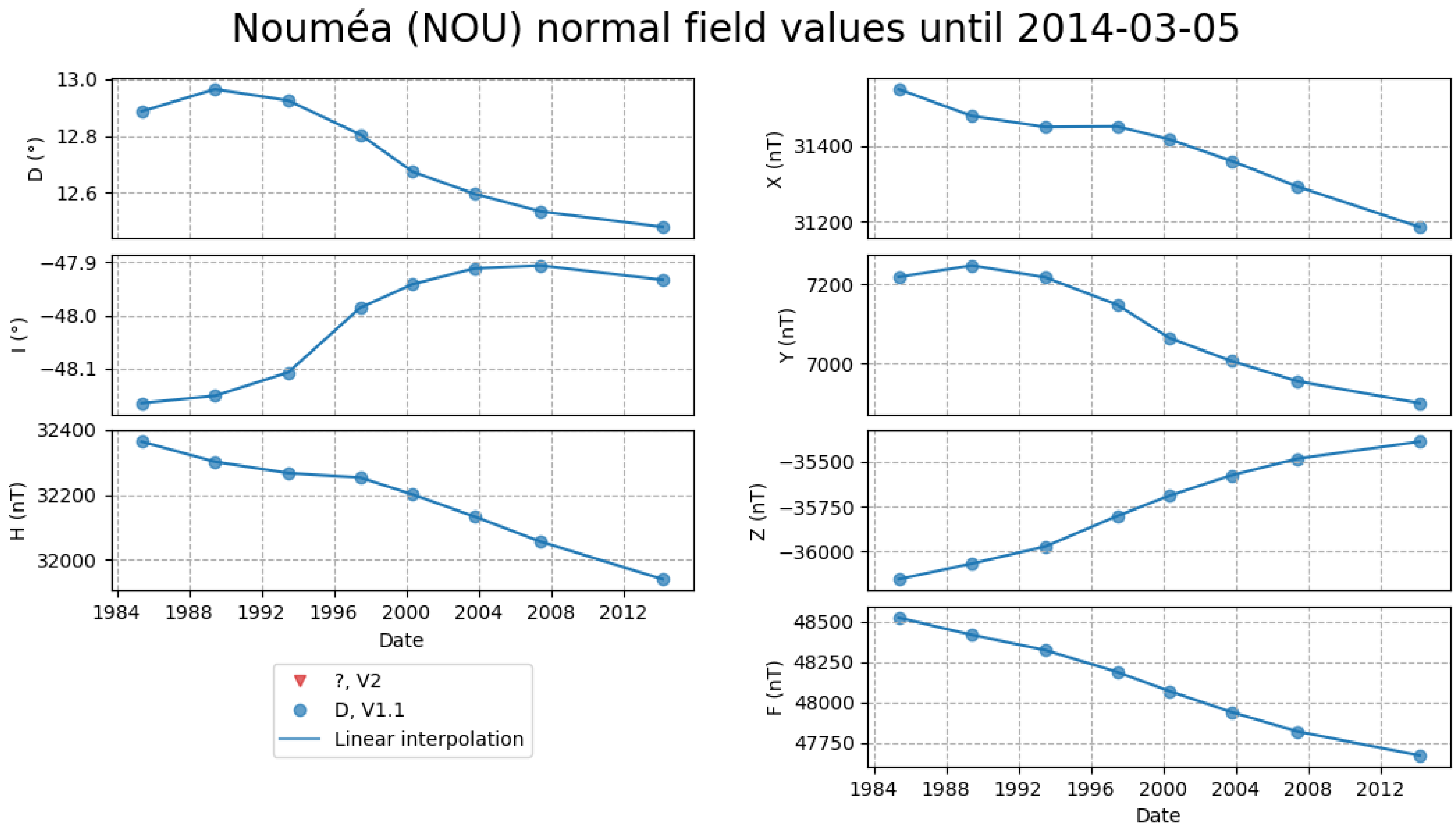

Figure 8.4 Nouméa (NOU) normal field values until 2014-03-05. Refer to Newitt, Barton & Bitterly 1996, ch. 8 for meaning of legend entries.

8.3.5 Norfolk Island

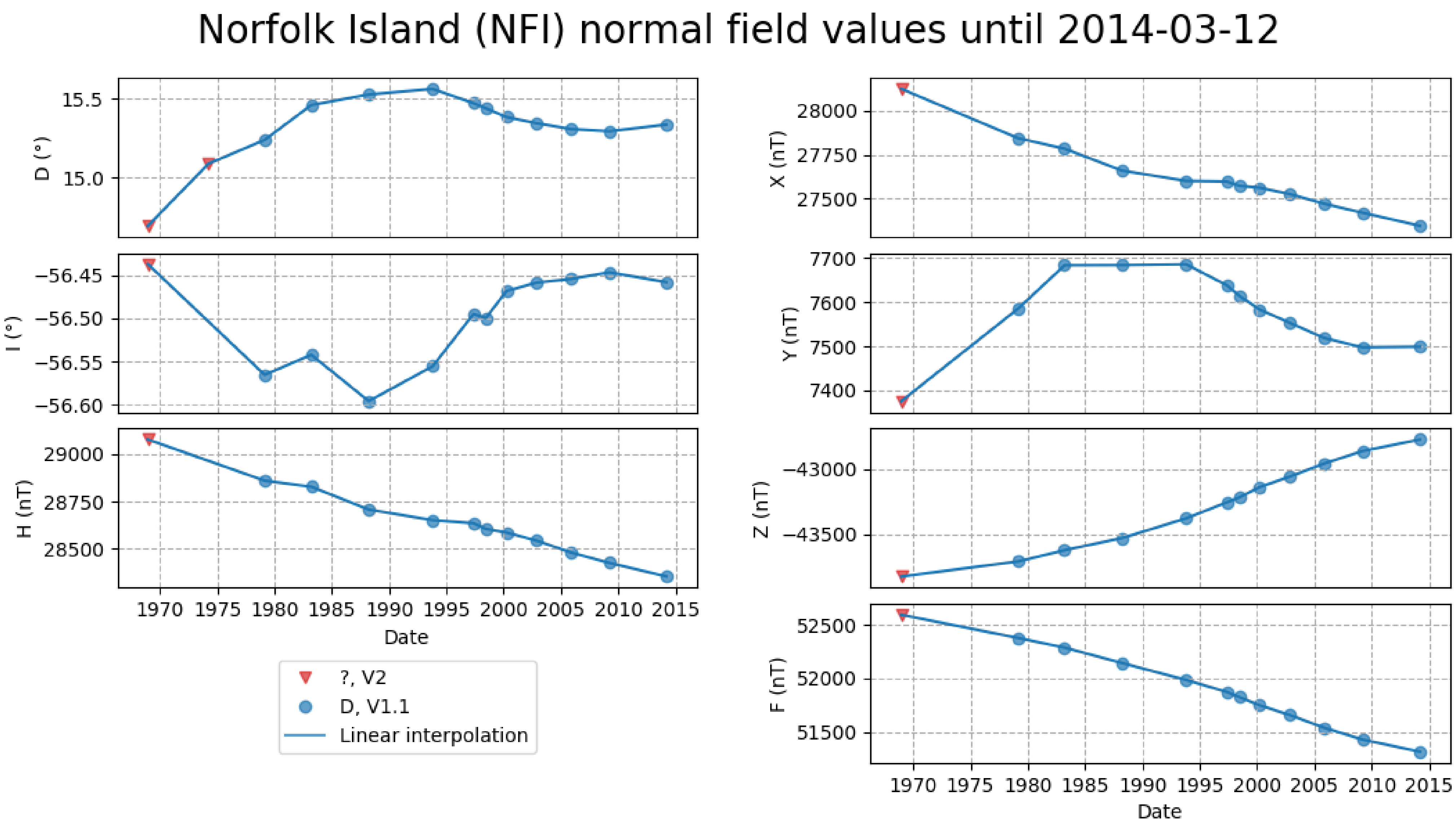

Figure 8.5 Norfolk Island (NFI) normal field values until 2014-03-12. Refer to Newitt, Barton & Bitterly 1996, ch. 8 for meaning of legend entries.

8.3.6 Kavieng

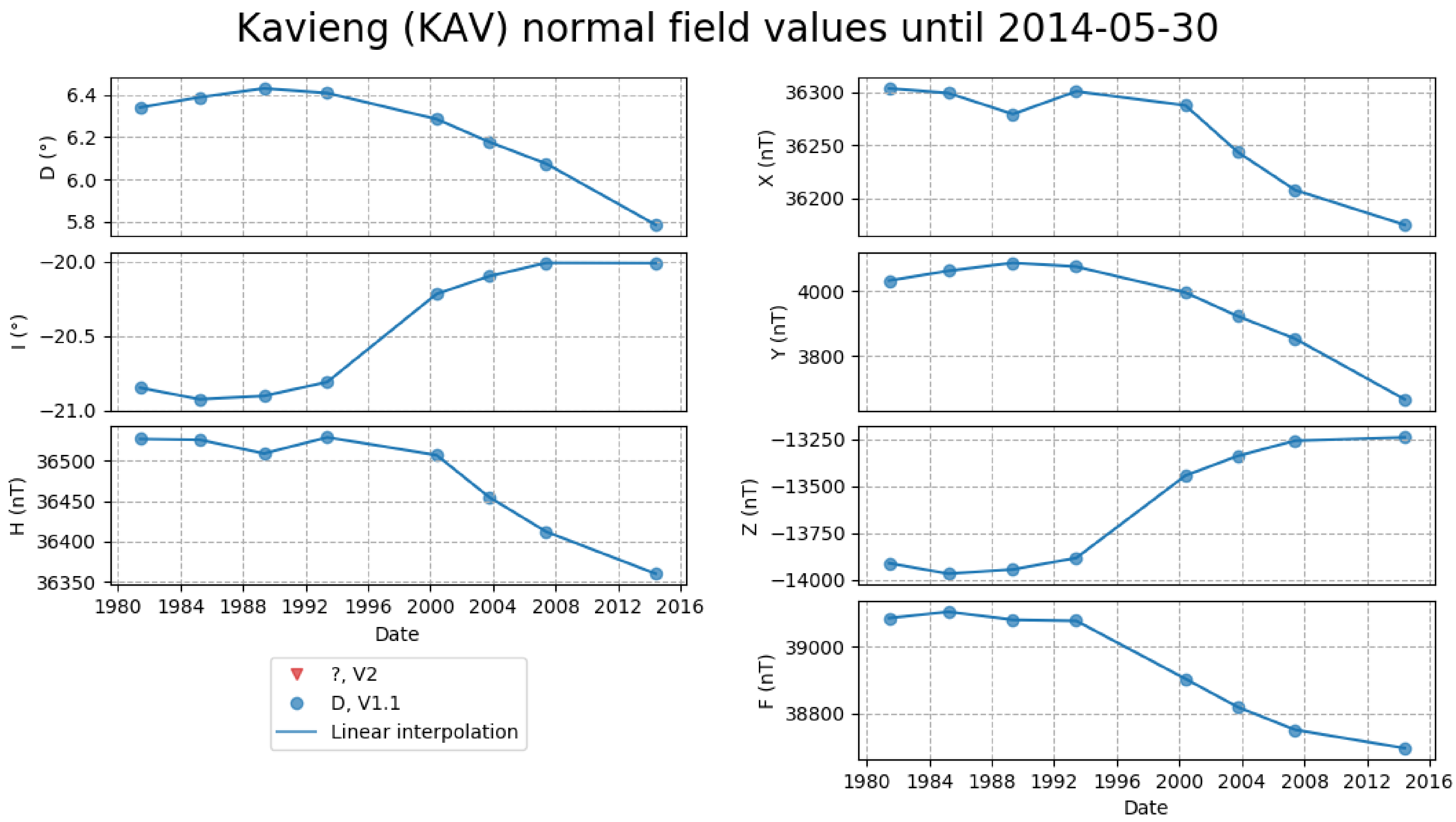

Figure 8.6 Kavieng (KAV) normal field values until 2014-05-30. Refer to Newitt, Barton & Bitterly 1996, ch. 8 for meaning of legend entries.

8.3.7 Vanimo

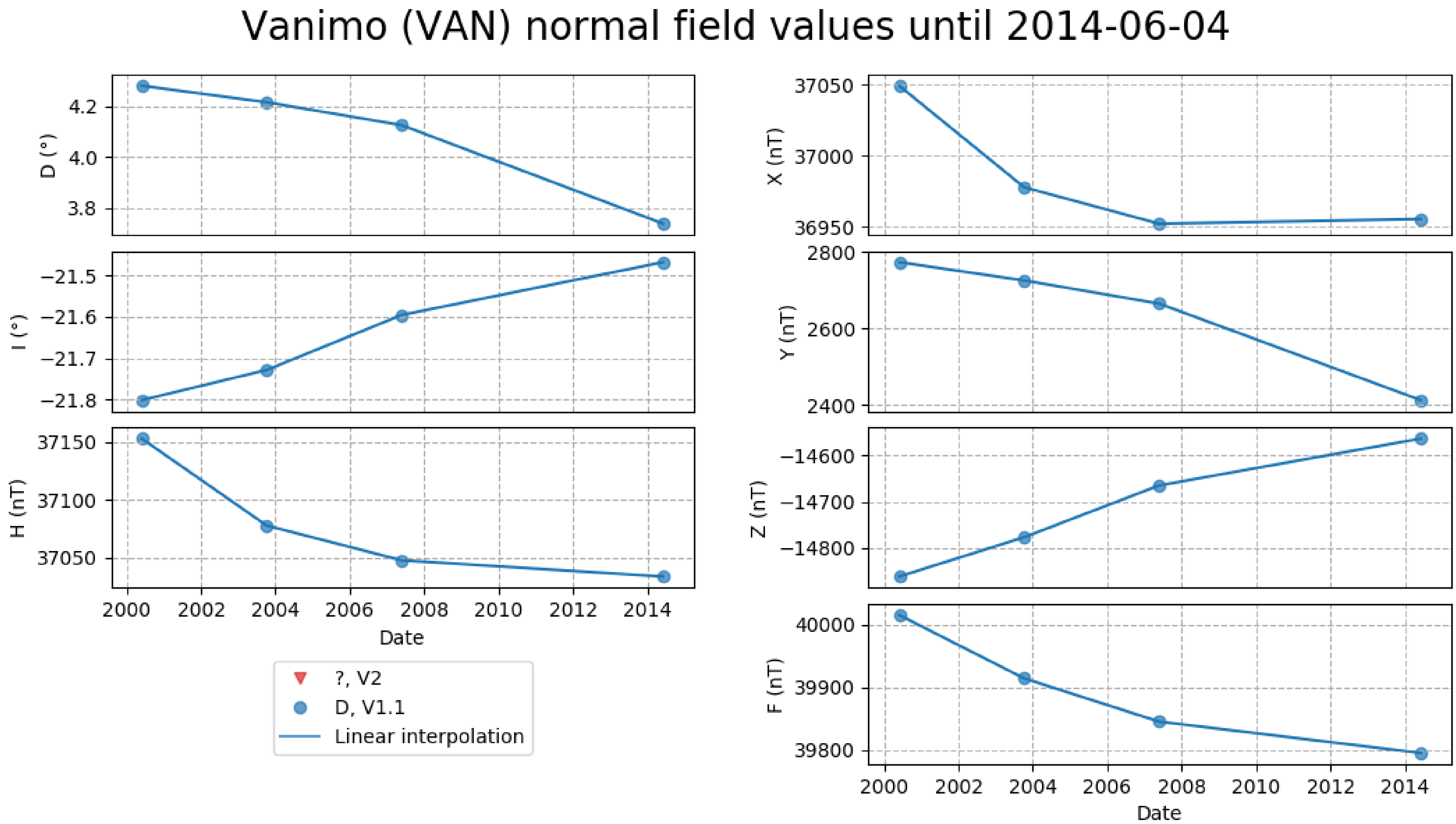

Figure 8.7 Vanimo (VAN) normal field values until 2014-06-04. Refer to Newitt, Barton & Bitterly 1996, ch. 8 for meaning of legend entries.

8.4 Instrumentation

Table 20 Instrumentation details for repeat station surveys in 2013 and 2014. Instrument corrections were determined by comparisons to reference instruments made at CNB before and after each leg of the survey.

Vector variometer	Model	NGL
	Serial number	9004-4
	Type	3-channel, non-suspended, ring-core fluxgate magnetometer
	Orientation	NW, NE, Z
	Acquisition interval	1 s
	A/D converter	Integrated
Scalar variometer	Model	Geometrics G856
	Serial number	277000/090201
	Type	PPM
	Fluid	Kerosene
	Acquisition interval	60 s
	Resolution	0.1 nT
Variometer DAQ	Hardware	x86 SBC
	OS	QNX Neutrino
	Application/system	GDAP
	Timing	Garmin GPS-16HVS receiver
DIM	Fluxgate magnetometer	DMI
	Fluxgate serial	DI0050
	Theodolite	Zeiss 020B
	Theodolite serial	308887
	Theodolite resolution	0.1′
	D correction	0.0′
	I correction	0.0′
Absolute scalar magnetometer	Model	Geometrics G856
	Serial number	50708/28079912
	Type	PPM
	Fluid	Kerosene
	Acquisition interval	10 s
	Resolution	0.1 nT
	Correction	0.0 nT
Absolute DAQ	Hardware	x86 handheld
	OS	Windows 7
	Application/system	GObs
	Timing	Integrated GNSS receiver

8.5 Occupation details

The fluxgate variometer sensor was aligned with the two horizontal channels equally distributed about the horizontal component of the magnetic field at the time of setup. The third channel was aligned vertically using the circular level built into the sensor housing. The sensor was covered with a thermally insulated non-magnetic box which was protected from direct sun and rain with a tent fly. The variometer PPM was set up on a non-magnetic pole secured with guy ropes and the sensor was protected from the weather with a plastic bag. Both sensors were usually set up at the full extent of their 20 m cables from the data acquisition system. The variometer control electronics and data acquisition and recording system was set up in various configurations depending upon the circumstances, often in a small tent but sometimes in a suitable building at the location. The variometer system was usually set up within a kilometre or so of the repeat stations and preferably within the security of the airport grounds, but this was not always possible and on occasion it was set up in magnetic quiet locations near accommodation or other suitable locations.

Absolute observations of DIF were made at the primary repeat station at the beginning and end of each occupation day using a DIM and absolute scalar magnetometer. The zero method of DIM observation (Kerridge 1988) was generally used. Total field observations at the primary repeat station were usually done on an auxiliary pier located several metres from the primary repeat station. The scalar pier difference between the primary station and the auxiliary pier was measured and applied to observational data. Observations were done at a standard height of 1.60 m above the repeat station plaque. An observation shelter (a tent fly with wooden or aluminium poles) was usually used to protect instruments and observers from the sun and weather during observations. A set of magnetic observations was also made on each secondary station to measure vector station differences.

Preliminary data processing and quality checks were undertaken at the end of each day.

8.6 Data processing

Final data were prepared at the conclusion of each survey through a comprehensive reanalysis of all observations and variometer data using standard GA geomagnetic observatory methods and software.

Normal (undisturbed local midnight quiet values) of the magnetic field at each primary repeat station were adopted by analysing the final vector time-series data with reference to several months of suitable permanent geomagnetic observatory data. The observatory data were used to derive an activity correction to the repeat station data to account for the difference between the local midnight levels of the magnetic field at the time of the repeat station occupation and the local midnight levels of the field during geomagnetic quiet times.

8.7 IAGA survey file

```
Geoscience Australia                              REV: 2014-06-26
Repeat Station Survey Data - 2010.0 to 2014.2

Sent WDC for Geomagnetism - Edinburgh (wdcgeomag@bgs.ac.uk) 2014-06-26

----------------------------------------------------------------------------
This file contains data from magnetic repeat stations in the Geoscience Australia
network occupied in the period 2010.0 to 2014.2
The Geoscience Australia repeat station network covers continental Australia and
surrounding islands, Papua New Guinea and some SW Pacific islands.

The data in this file is formatted according to IAGA specifications:

*Station_name latitude longitude elevation year_established
reduction elements class date elt1 elt2 elt3 SVepoch delt1 delt2 delt3

Where:
reduction=reduction class
elements=magnetic field elements reported
class=class of occupation
date=date of occupation
eltN=value of magnetic field element
SVepoch=epoch of secular variation
deltN=value of secular variation of magnetic element

Elements reported in this file are D=declination, H=horizontal, Z=vertical
Magnitude elements are reported in nanoTesla, angular elements in decimal
degrees. (declination positive east, vertical field positive down)
Secular variation in nT/year and decimal degrees/year.
Latitude and longitude  are measured on WGS84 datum and expressed in
decimal degrees, latitude negative south of equator, longitude positive
east of Greenwich. Elevations are relative to Mean Sea Level and
expressed in metres. NOTE: Previously submitted data may have latitude and
longitude measured on the Australian Geodetic Datum 1984, so station locations
may differ from locations for the same station in previously reported
data.

Mid-date of occupation (date) is entered as yyyymmdd
Secular variation epoch (SVEpoch) is expressed as decimal years and is also the mid date of the
three-day station occupation.

For further details on the format of data in this file see "Guide for Magnetic Repeat Station Surveys",
1996,L.R.Newitt, C.E. Barton and J.Bitterly, IAGA Working Group V-8,
chapter 8 "Reporting Procedures"

Contact:
-------
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Geoscience Australia
GPO Box 378
Canberra ACT 2601
Australia
Tel: + 61 2 6249 9111
Fax  + 61 2 6249 9969
e-mail geomag@ga.gov.au
------------------------------------------------------------------------------
*Carnegie_A           -25.801   122.948   452  1961
D DHZ V1.1 20120501  02.242 28296 -47096 2012.333  -0.035  30  48
*Derby_E              -17.369   123.666   006  1987
D DHZ V1.1 20120508  02.435 33491 -36838 2012.352  -0.045  20  59
*Eucla_D              -31.678   128.879   086  1983
D DHZ V1.1 20120424  04.482 23942 -52975 2012.314  -0.030  28  34
*Hobart_H             -42.833   147.512   005  1988                  (elevation approximate)
D DHZ V1.1 20130528  14.939 18488 -59028 2013.406   0.017  08  14
*Lord_Howe_Island_D   -31.541   159.079   002  1983
D DHZ V1.1 20130608  14.693 26115 -47644 2013.436  -0.008 -08  17
*Maryborough_D        -25.519   152.713   010  1983
D DHZ V1.1 20120522  10.465 29703 -42925 2012.391  -0.027 -03  25
*Mount_Isa_C          -20.664   139.489   339  1977
D DHZ V1.1 20120516  05.889 31959 -39265 2012.374  -0.040  05  34
*Norfolk_Island_C     -29.043   167.938   112  1968
D DHZ V1.1 20140312  15.336 28355 -42772 2014.195  -0.008 -14  18
*Noumea_B             -22.007   166.201   025  1985
D DHZ V1.1 20140305  12.478 31940 -35390  2014.175 -0.008 -17  14
*Parafield_C          -34.797   138.627   011  1997
D DHZ V1.1 20120419  08.327 23173 -54469 2012.300  -0.018  16  24
*Tibooburra_A         -29.451   142.058   174  1973
D DHZ V1.1 20120414  08.396 27003 -48964 2012.287  -0.028  06  27
*Weipa_B              -12.678   141.924   018  1969
D DHZ V1.1 20130523  05.299 35580 -29288 2013.392  -0.047 -04  23
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10 List of shortened forms

Table 21 List of shortened forms.

AAD	Australian Antarctic Division
ADC	Analog-to-digital converter
ADSL	Asymmetric digital subscriber line
AGRF	Australian Geomagnetic Reference Field
AGSO	Australian Geological Survey Organisation (Geoscience Australia predecessor)
AIGO	Australian International Gravitational Observatory
AM	Arithmetic mean
AMSL	Above mean sea level
ANARE	Australian National Antarctic Research Expedition
APS	Australian Public Service
ATWS	Australian Tsunami Warning System
BGS	British Geological Survey
BMR	Bureau of Mineral Resources, Geology and Geophysics (Geoscience Australia predecessor)
BOM	Bureau of Meteorology
BRM	Baseline reference measurements
BUC	Block upconverter
CAT	Centre for Appropriate Technology Limited
CF	CompactFlash
CLS	Collecte Localisation Satellites
CNES	Centre national d'études spatiales
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTBT	Comprehensive Nuclear-Test-Ban Treaty
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
DAF	Data Acquisition Facility
DAQ	Data acquisition
DI-flux/DIM	Declination-Inclination Fluxgate Magnetometer
DMI	Danish Meteorological Institute
DSL	Digital subscriber line
EDA	EDA Instruments Inc.
ETH Zürich	Eidgenössische Technische Hochschule Zürich
FTP	File Transfer Protocol
GA	Geoscience Australia
GDAP	Geophysical Data Application Platform
GFZ	GeoForschungsZentrum

GIN	Geomagnetic Information Node
GNSS	Global navigation satellite system
GPS	Global Positioning System
HTTP	Hypertext Transfer Protocol
IAGA	International Association of Geomagnetism and Aeronomy
IATME	International Association of Terrestrial Magnetism and Electricity
IGRF	International Geomagnetic Reference Field
IMO	INTERMAGNET Magnetic Observatory
INTERMAGNET	International Real-time Magnetic Observatory Network
IP	Internet Protocol
IPS	IPS Radio and Space Services
ISGI	International Service of Geomagnetic Indices
ISO	International Organization for Standardization
LAN	Local area network
LEMI	LEMI LLC.
LIDAR	Light Detection and Ranging
LRNS	Linear-phase, robust, non-linear smoothing
LSO	Learmonth Solar Observatory
LTE	Long-Term Evolution
NGDC	National Geophysical Data Center
NGL	Narod Geophysics Ltd.
NMEA	National Marine Electronics Association
NOAA	National Oceanic and Atmospheric Administration
NTP	Network Time Protocol
OS	Operating system
PC	Personal computer
PDA	Personal digital assistant
PIR	Passive infrared
PPM	Proton precession magnetometer
PPS	Pulse per second
RAAF	Royal Australian Air Force
RCD	Residual-current device
RM	Reference measurements
ROA	Round of angles
ROB	Royal Observatory of Belgium
RSTN	Radio Solar Telescope Network
RTOS	Real-time operating system
SBC	Single-board computer
SCTO	Supervising Communications Technical Officer

SD	Standard deviation
SFE	Solar flare effect
SFTP	Secure File Transfer Protocol
SI	International System of Units
SOH	State of health
sps	Samples per second
SSC	Sudden storm commencement
SSH	Secure Shell
SWPC	Space Weather Prediction Center
TAMS	Territory and Municipal Services
TSIP	Trimble Standard Interface Protocol
UPS	Uninterruptible power supply
USAAF	United States Army Air Forces
UTC	Coordinated Universal Time
VGA	Video Graphics Array
VPN	Virtual private network
VSAT	Very small aperture terminal
WASSA	Western Australia Space Situational Awareness
WDC-STP	World Data Center for Solar-Terrestrial Physics
WHS	Workplace health and safety