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Magnetic results for 2004

Kakadu

Charters Towers

Learmonth

Alice Springs

Gnangara

Canberra

Macquarie Island

Casey

Mawson

– and –

Australian Repeat Station Network

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SUMMARY

During 2004 Geoscience Australia operated geomagnetic observatories at **Kakadu** and **Alice Springs** in the Northern Territory, **Charters Towers** in Queensland, **Learmonth** and **Gnangara** in Western Australia, **Canberra** in the Australian Capital Territory, **Macquarie Island**, Tasmania, in the sub-Antarctic, and **Casey** and **Mawson** in the Australian Antarctic Territory.

The operations at Macquarie Island and Casey were the joint responsibility of the Australian Antarctic Division of the Commonwealth Department of the Environment and Heritage and GA. Operations at Mawson were the joint responsibility of the Australian Bureau of Meteorology of the Commonwealth Department of the Environment and Heritage and GA.

The absolute magnetometers in routine service at the Canberra Magnetic Observatory also served as the Australian Reference. The calibration of these instruments can be traced to International Standards. Absolute magnetometers at all the other Australian observatories are referenced against those at Canberra

Magnetic mean value data at resolutions of 1-minute and 1-hour were provided to the World Data Centres for Geomagnetism at Boulder, USA (WDC-A) and at Copenhagen, Denmark (WDC-C1), as well as to the INTERMAGNET program. K indices, principal magnetic storms and rapid variations were scaled with computer assistance, for the Canberra and Gnangara observatories. The scaled data were provided regularly to the International Service of Geomagnetic Indices. K indices were digitally scaled for the Mawson observatory.

K indices from Canberra contributed to the southern hemisphere Ks index and the global Kp, am and aa indices, while those from Gnangara contributed to the global am index.

Seven repeat stations were re-occupied during a field survey within continental Australia in April and May 2004.

To assist the geomagnetism program in Indonesia, data were routinely received from the Tangerang and Tondano observatories for processing. These observatories were most recently upgraded by GA's Geomagnetism personnel in 2001 under an AusAID grant that also included the purchase of instrumentation and the training of staff from Indonesia's national meteorological and geophysical organisation, Badan Meteorologi & Geofisika (BMG).

This report describes instrumentation and activities, and presents monthly and annual mean magnetic values, plots of hourly mean magnetic values and K indices at the magnetic observatories and repeat stations operated by GA during calendar year 2004.

ACRONYMS and ABBREVIATIONS

AAD	Australian Antarctic Division
ACRES	Australian Centre for Remote Sensing
ACT	Australian Capital Territory
A/D	Analogue to Digital (data conversion)
ADAM	Data acquisition module produced by Advantech Co. Ltd.
AGR	Australian Geomagnetism Report
AGRF	Australian Geomagnetic Reference Field
AGSO	Australian Geological Survey Organisation (formerly BMR)
AMO	Automatic Magnetic Observatory
AMSL	Above Mean Sea Level
ANARE	Australian National Antarctic Research Expedition
ANARESAT	ANARE satellite (communication)
ASP	- Alice Springs (Magnetic Observatory) - Atmospheric & Space Physics (a program of the AAD)
AusAID	Australian Agency for International Development
BGS	British Geological Survey (Edinburgh)
BMR	Bureau of Mineral Resources, Geology, and Geophysics (Now Geoscience Australia)
BMG	Badan Meteorologi dan Geofisika (Indonesia)
BoM	(Australian) Bureau of Meteorology
CD-ROM	Compact Disk - Read Only Memory
CNB	Canberra (Magnetic Observatory)
CODATA	Committee on Data for Science and Technology
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSY	Casey (Variation Station)
CTA	Charters Towers (Magnetic Observatory)
D	Magnetic Declination (variation)
DC	Direct Current
DEH	Department of the Environment and Heritage
DIM	Declination & Inclination Magnetometer (D,I-fluxgate magnetometer)
DMI	Danish Meteorological Institute
DOS	Disk operating system (for the PC)
DVS	Davis (Variation Station)
EDA	EDA Instruments Inc., Canada
e-mail	electronic mail
F	Total magnetic intensity
ftp	file transfer protocol
GA	Geoscience Australia
GIN	Geomagnetic Information Node
GNA	Gnangara (Magnetic Observatory)
GPS	Global Positioning System
GSM	GEM Systems magnetometer
H	Horizontal magnetic intensity
HDD	Hard disk drive (in a PC)
I	Magnetic Inclination (dip)
INTER-MAGNET	International Real-time Magnetic observatory Network
IAGA	International Association of Geomagnetism and Aeronomy
IBM	International Business Machines
IGRF	International Geomagnetic Reference Field
IGY	International Geophysical Year (1957-58)
IPGP	Institute de Physique du Globe de Paris
IPS	IPS Radio & Space Services (formerly the Ionospheric Prediction Service)
ISGI	International Service of Geomagnetic Indices
K	kennziffer (German: logarithmic index; code no.) Index of geomagnetic activity.
KDU	Kakadu, N.T. (Magnetic Observatory)
LRM	Learmonth, W.A. (Magnetic Obsv'ty)
LSO	Learmonth Solar Observatory
mA	milli-Amperes
MAW	Mawson (Magnetic Observatory)
MCQ	Macquarie Is. (Magnetic Observatory)
MGO	Mundaring Geophysical Observatory
MNS	Magnetometer Nuclear Survey (PPM)
nT	nanoTesla
N.T.	Northern Territory
OIC	Officer in Charge
PC	Personal Computer (IBM-compatible)
PGR	Proton Gyromagnetic Ratio
PPM	Proton Procession Magnetometer
PVC	poly-vinyl chloride (plastic)
PVM	Proton Vector Magnetometer
QHM	Quartz Horizontal Magnetometer
Qld.	Queensland
RCF	Ring-core fluxgate (magnetometer)
SC	Sudden (storm) commencement
sfe	Solar flare effect
ssc	Sudden storm commencement
Tas.	Tasmania
UPS	Uninterruptible Power Supply
UT/UTC	Universal Time Coordinated
W.A.	Western Australia
WDC	World Data Centre
WWW	World Wide Web (Internet)
X	North magnetic intensity
Y	East magnetic intensity
Z	Vertical magnetic intensity

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Part 2

End of Part 2

The *Australian Geomagnetism Report* has been published in electronic format since Volume 47 for calendar year 1999.

These volumes are available on Geoscience Australia's web site: http://www.ga.gov.au/

The final volume that was produced in printed format was the *Australian Geomagnetism Report 1998,* Volume 46.

Part 2

CANBERRA OBSERVATORY

The Canberra Magnetic Observatory is located in the Australian Capital Territory, approximately 30km east of the city of Canberra. The Canberra observatory is the successor to the Rossbank (1840-1854), Melbourne (1858-1919), Toolangi (1919-1979) observatory sequence of sites in south eastern Australia (McGregor, 1979; Hopgood, 1993).

Recording at the Canberra Magnetic Observatory commenced in 1978 after which it replaced Toolangi as the principal magnetic observatory in the region. A detailed history of the observatory is in *AGR 1994*.

Situated on an approximately 8 hectare site, the observatory comprises a complex of buildings and structures: a RECORDER HOUSE 60m north of the entry gate; a SECONDARY VARIOMETER HOUSE (formerly known as the (AMO or PPM) SENSOR HOUSE) 75m to its west; an ABSOLUTE HOUSE 60m NE of the RECORDER HOUSE; a COMPARISON HOUSE 10m west of the ABSOLUTE HOUSE; a VARIOMETER HOUSE 80m NW of the RECORDER HOUSE; a TEST HOUSE 220m north of the RECORDER HOUSE; and the NATIONAL MAGNETOMETER CALIBRATION FACILITY 100m SE of the RECORDER HOUSE.

Other structures on the site include a sheltered external observation site, four azimuth pillars and a seismic vault. The latter houses seismometers operated by GA's Geophysical Networks and Nuclear Monitoring groups.

Key data for Canberra Observatory:

- 3-character IAGA code: CNB
- Commenced operation: 1978
- Geographic latitude: 35° 18' 52.6" S
- Geographic longitude: 149° 21' 45.4" E
- Geomagnetic†: Lat. -42.50°; Long. 226.79°
- Lower limit for K index of 9: 450 nT
- Principal pier identification: Pier AW
- Elevation of top of Pier AW: 859 metres AMSL
- Azimuth of principal reference (NW pillar from Pier AW): 328° 37' 03"
- Distance to NW pillar: 137.3 metres
- Observers in Charge: L. Wang (GA)

† Based on the IGRF 2000.0 model updated to 2004.5

Variometers

During 2004 (since November 1995) a Narod ring-core fluxgate (RCF) variometer operated as the principal variometer at the observatory. It was located on the pier in the eastern room of the VARIOMETER HOUSE. It monitored variations in three orthogonal components of the magnetic field, and was aligned to measure the (magnetic) north-west; north-east and vertical field components, denoted A, B and Z respectively.

A GEM Systems GSM-90 Overhauser effect magnetometer (electronics no. 803810, sensor no. 81225) monitored variations in Total Intensity. Since 17 Nov 2003 this instrument has operated in the western room of the VARIOMETER HOUSE with its sensor mounted on a standard PPM tripod.

Both a LEMI and DMI (no. E0254/S0227) 3-component fluxgate variometers served as secondary instruments during 2004 should the principal variometer become unserviceable.

Damage caused to the observatory by vandals in 2004 necessitated the relocation of variometers several times during the year. The LEMI operated in the SECONDARY VARIOMETER HOUSE from the beginning of 2004 until 19 Feb. and from 17 Sep. to the end of the year. The DMI E0254 S227 operated in the NATIONAL MAGNETOMETER CALIBRATION FACILITY between 07 Apr. and 22 Sep. 2004.

The two intrusions by vandals caused damage to observatory buildings. Subsequent substantial security upgrades and building repairs that were carried out in June and July 2004 resulted in the contamination of Narod variometer data. No apparent baseline jumps occurred after these events or repair work.

The contaminated data were recovered from the backup variometers in the following UT time periods in 2004:

With DMI E0254 S0227:

June	11:	00:00 – 03:00;
	14:	22:00 – 23:30;
	17:	22:00 – 23:59;
	18:	00:18 – 01:00;
	21:	00:00 – 02:59
	28:	02:00 – 02:59
	29:	01:00 to 30 / 14:59
July	04:	00:00 – 00:59
	06:	23:00 to 09 / 05:59
	12:	04:30 – 05:29
	14:	00:00 – 05:59
	20:	00:00 – 00:59
Aug	09:	01:20 – 01:40
	25:	23:00 – 23:59

With the LEMI:

Oct	21:	01:00 – 01:59

Absolute Instruments and Corrections

Throughout 2004 absolute observations were regularly performed at Canberra with a Declination & Inclination Magnetometer (DIM) and a total field magnetometer.

The principal DIM used was an Elsec 810 (no. 200) electronics and sensor, with a Zeiss 020B (no. 353756) non-magnetic theodolite. This instrument was routinely used on ABSOLUTE HOUSE pier AW. In consideration of numerous intercomparisons between DIMs (and other magnetometers), zero corrections have been applied to absolute observations performed with the DIM Elsec 810/200; Zeiss 020B/353756.

The principal total field instrument used in 2004 was GSM90 Overhauser magnetometer with electronics no. 905926 and sensor no. 21867. (This sensor replaced no. 81241 in September 2002.) During 2004 this GSM90 magnetometer was used during regular absolute observations on pier AW in the ABSOLUTE HOUSE. Observations with this, the GSM90 reference, are used without correction.

The principal absolute magnetometers at the Canberra Magnetic Observatory also serve as the reference instruments for the Australian observatory network. Their standardizations are traceable to international standards that are regularly maintained. (See the *Reference Magnetometers* section near the beginning of this report.)

Absolute Instruments and Corrections – CNB (cont.)

During 2004 several pier difference comparisons were performed between pier AW and external GPS Station GS. The comparison results showed no evidence of magnetic contamination around the piers.

The total field intensity difference measured on 06 and 20 July 2004 using GSM90_905926 with sensor 21867 on both pier AW and Station GS, and calculated using the RCF as a base-station was:

F(AW) = F(GS) − 3.6 nT

The Declination and Inclination differences between these sites, measured using DIM E810_200/353756 on pier AW and DIM B0610h/160459 on a tripod 1.6 meter above station GS pad surface, and calculated using the RCF as a base-station, were:

D(AW) = D(GS) − 1.97' ± 0.01' (06 Jul. 2004)

D(AW) = D(GS) − 1.92' ± 0.03' (20 Jul. 2004)

I(AW) = I(GS) + 0.25' ± 0.01' (06 Jul. 2004)

I(AW) = I(GS) + 0.24' ± 0.02' (20 Jul. 2004)

Instrument corrections were not taken into account.

Baselines

The variometers remained reasonably stable throughout 2004. Over the year baselines drifted by approximately:

8 nT in X; 12 nT in Y; 3 nT in Z.

The drift patterns of three channels were very similar to those in 2002 and 2003, i.e. the Narod variometer baseline drifts appear to be seasonally dependent.

With the drift corrections applied to the baselines, the mean value and standard deviation in the difference of absolute observations from a final variometer model were:

0.0 ± 0.7 in X; 0.1 ± 0.7 in Y; 0.0 ± 0.5 in Z.

There was less than 2.0 nT variation throughout the year in the F check calculated as the difference between F measured with the fluxgate (the final variometer model with drifts applied) and the variometer PPM.

Operations

Absolute observations were performed weekly (routinely on Tuesdays) by staff of the Geomagnetism Section on a roster. The rostered duties also included the computer-assisted hand-scaling and distribution of the previous week's K indices, and overseeing the transmission of 1-minute data from CNB (and other observatories) to INTERMAGNET.

The Narod RCF variometer was situated on pier (VE) in the east room of the VARIOMETER HOUSE that, for baseline stability, was maintained at a temperature of 26.5 ± 0.5°C throughout 2004. The temperature variation of the principal variometer sensors was 25.0 ± 0.5°C. Data from the RCF were transmitted via optical fibre to the RECORDER HOUSE where they were recorded on an acquisition PC.

The GSM90 Total Intensity variometer, serving as an F-check on the vector variometer model, was located in the west room of the VARIOMETER HOUSE. It was controlled from the RECORDER HOUSE, to where its data were transmitted via optical fibre and recorded on the acquisition computer.

See the CNB *Variometers* section of this report for a description of the deployment of a LEMI and a DMI fluxgate variometer that served as secondary vector instruments.

Since the beginning of 2001, digital data were retrieved automatically every 10 minutes from the CNB observatory to GA via a real-time data link using modems and the telephone line that was established on 20 July 2000. From 23 April 2001 data telemetry was via a radio modem link.

Operations (cont.)

Once the raw data were received at GA, processing was automatically scheduled, after which processed 1-minute resolution data were provided by e-mail to ISGI, France every 10 minutes (to enable the production of a real-time aa-index) and daily to the Edinburgh INTERMAGNET GIN.

System power was backed up with a UPS with an approximately 4-hour capacity.

Significant Events in 2004

05 Feb	Termite monitoring stations deployed by Sentricon. (Report received 03 Jun., 2004)
19 Feb	Intrusion by vandals caused damage to the SECONDARY VARIOMETER HOUSE. The LEMI variometer was removed from there for security reasons.
7 Apr	DMI E0254/S0227 variometer was installed in the NATIONAL MAGNETOMETER CALIBRATION FACILITY to serve as a backup variometer.
08 Jun	Commencement of security updates and repairs to the damaged SECONDARY VARIOMETER HOUSE.
21 Jun	CPC pest control inspected the SECONDARY VARIOMETER HOUSE for termites. No further action recommended.
30 Jun	Security updates and repairs to the SECONDARY VARIOMETER HOUSE completed. Break-in by vandals occurred again at 20:30 local time.
07 Jul	Repairs to buildings damaged again by vandals commenced.
16 Jul	Repairs to damaged buildings completed.
20 Jul	GPS survey, round of angles, station differences to pier AW were carried out about station GS.
25 Aug	Two non-magnetic internal door latches were installed in the PRIMARY VARIOMETER HOUSE.
17 Sep	LEMI variometer re-installed in the SECONDARY VARIOMETER HOUSE to replace DMI E0254/S0277.
13 Oct	Windows of the COMPARISON HOUSE were discovered to have been broken by vandalism.
19 Oct	Security signage installed on doors of all buildings, front gate, around fence. Broken window of the COMPARISON HOUSE was replaced.
16 Nov	Electronics of (Australian Reference) DIM E810_200 failed. No absolute observations performed this week.
23 Nov	DIM electronics E810_215 replaced E810_200 in the routine absolute observations.
14 Dec	Installation of fibre IP hub in CONTROL HUT rack and router in green radio box. Bottom lock repaired in door and intruder alarm installed in TOP HOUSE.

Data losses in 2004

05 Mar	1040 to 06/0153 (15h 14m) All channels: Power failure
07 Apr	0140–0153 (14m) Narod channels; 0147–0153 (7m) PPM channel: Instrument installation
20 Apr	0140–0153 (14m) Narod channels;
30 Jun	0135–0141 (6m) both Narod and backup variometer data contaminated.
21 Oct.	0133–0142 (10m) PPM channel.

Variometer PPM data were contaminated during the following periods (so excluded from INTERMAGNET data files):

Data losses in 2004 – CNB (cont.)

17 Jun	2210 to 18/0130
21 Jun	0000–0100
28 Jun	0200–0300
07 Jul	0200–0300
08 Jul	0000–0530
08 Jul	2200 to 09/0100
09 Jul	0400–0430
12 Jul	0440–0520
09 Aug	0100–0200
25 Aug	2300–2359

Distribution of CNB data

K indices - weekly by e-mail

- IPS Radio & Space Services, Sydney
- British Geological Survey, Edinburgh
- International Service of Geomagnetic Indices, Paris
- Royal Observatory of Belgium, Brussels
- CLS, CNES (French Space Agency), Toulouse

Distribution of CNB data (cont.)

K indices - semi-monthly by e-mail

- Adolph-Schmidt-Observatory Niemegk, Germany

K indices with Principal Magnetic Storms and Rapid Variations - monthly by email.

- World Data Center-A, Boulder, USA
- WDC-C2, Kyoto, Japan
- Ebro Observatory, Roquetas, Spain

Preliminary Monthly Means for Project Ørsted

- Sent monthly by email to IPGP.

Preliminary 1-minute values

- Sent every 10 minutes to ISGI, France throughout 2004

1-minute and Hourly Mean Values to WDCs

- 2003: WDC-A, Boulder, USA (19 January 2004)
- 2004: WDC-A, Boulder, USA (01 August 2005; and 10 Jan. 2006)

1-minute Values for Project INTERMAGNET

- Preliminary data daily to the Edinburgh GIN by e-mail
- 2003 data sent to Paris GIN: 19 March 2004
- 2004 data sent to Paris GIN: 04 August 2005

Principal Magnetic Storms: Canberra, 2004

Commencement			SC amplitudes			Maximum 3 hr. K index		Ranges			U.T. End	
Mth.Day	Hr.Min.	Type	D(')	H(nT)	Z(nT)	Day (3 hr. periods)	K	D(')	H(nT)	Z(nT)	Day	Hr.
Jan. 22	01 36	ssc	-5.8	11	17	22(5)	7	26.2	219	78	24	03
Mar. 11	03 ··	···	··	··	··	11(6,7)	5	14.6	116	40	12	18
Apr. 05	12 ··	···	··	··	··	05(6,7)	5	15.9	135	63	06	18
Jul. 22	10 36	ssc	0.5	19	4	25(3)	7	39.8	203	144	26	09
26	22 48	ssc*	-6.1*	-58*	8*	27(3,4,5)	7	44.4	231	151	28	06
Aug. 29	10 05	ssc	0.6	14	4	30(6,7,8)	5	24.5	139	51	31	23
Nov. 07	10 52	ssc	2.0	53	13	07(7,8), 08(1,2,3)	7	44.5	387	340	08	18
09	03 ··	···	··	··	··	10(4)	8	55.2	301	220	10	21
Dec. 05	07 46	ssc*	2.2	114*	15*	05(3)	6	12.8	142	22	06	03
30	04 ··	···	··	··	··	30(3)	6	12.4	153	22	30	21

No Principal Magnetic Storms reported for Canberra in: Feb., May, Jun., Sep. or Oct., 2004

Rapid Variation Phenomena

Sudden Storm Commencements (ssc) - CNB 2004

Month & date	U.T.	Type & Quality		Chief movement (nT) H	D	Z
Jan. 22	0136	ssc	B	+11	–40	+17
Jul. 22	1036	ssc	A	+19	+4	+4
26	2248	ssc*	A	–58 *	–42 *	+8 *
Aug. 29	1005	ssc	B	+14	+4	+4
Sep. 13	2001	ssc	A	+32	+29	+4
22	0634	ssc	B	+30	+7	+2
Nov. 07	1052	ssc	A	+53	+14	+13
07	1827	ssc	A	+34	+64	+8
Dec. 05	0746	ssc*	A	+114 *	+15	+15

No *ssc* reported: Feb., Mar. – Jun. and Oct., 2004.

Solar Flare Effects (sfe) - CNB 2004

Month & date	U.T. of movement Start	Max.	End	Amplitude(nT) H	D	Z	Confir-mation
Feb. 26	0154	0202	0232	–12	–2	+2	solar
26	2213	2240	2255	+1	–7	+1	solar
Jul. 15	0132	0140	0154	+4	–1	+4	solar
16	0159	0211	0234	+4	–1	+2	solar
22	0027	0034	0045	+2	–1	–1	solar
Sep. 12	0136	0140	0143	–2	–1	+1	solar

No *sfe* reported: Jan., Mar. – Jun., Aug., Sep., Oct. – Dec. in 2004.

K indices

K indices from the Canberra Magnetic Observatory contribute to the global Kp and aa indices, the southern hemisphere Ks index, and all their derivatives.

The table on the next page shows K indices for Canberra for 2004.

From 01 December 2002 K indices for Canberra were derived using a computer assisted method developed at GA. The method, based on the IAGA accepted LRNS algorithm, is described the *Data Distribution* section near the beginning of this report. (Before this K indices were derived by the hand scaling of H and D traces on magnetograms produced from the digital data, using the method described by Mayaud (1967).)

Canberra Annual Mean Values

The table below gives annual mean values calculated using the 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 H, D, Z & F are on pages 71 & 72.

Year	Days	D		I		H	X	Y	Z	F	Elts*
		(Deg	Min)	(Deg	Min)	(nT)	(nT)	(nT)	(nT)	(nT)	
1979.5	A	12	05.6	-66	05.9	23833	23305	4993	-53778	58822	DFI
1980.5	A	12	08.6	-66	06.9	23808	23275	5009	-53767	58801	DFI
1981.5	A	12	11.2	-66	09.1	23770	23234	5018	-53771	58791	DFI
1982.5	A	12	14.0	-66	10.8	23736	23197	5030	-53769	58775	DFI
1983.5	A	12	16.6	-66	11.3	23723	23180	5044	-53756	58758	DFI
1984.5	A	12	18.4	-66	11.7	23709	23164	5054	-53741	58739	DFI
1985.5	A	12	20.7	-66	11.6	23703	23155	5067	-53726	58723	DFI
1986.5	A	12	23.2	-66	12.1	23689	23137	5081	-53716	58707	DFI
1987.5	A	12	25.5	-66	12.0	23684	23129	5096	-53699	58690	DFI
1988.5	A	12	27.6	-66	12.8	23665	23107	5106	-53690	58674	DFI
1989.5	A	12	29.0	-66	13.8	23644	23085	5111	-53683	58659	DFI
1990.5	A	12	30.7	-66	13.6	23641	23079	5121	-53667	58643	DFI
1991.5	A	12	31.8	-66	13.9	23628	23066	5126	-53652	58624	DFI
1992.5	A	12	32.4	-66	12.8	23637	23073	5132	-53625	58603	DFI
1993.5	A	12	33.0	-66	11.6	23646	23081	5138	-53597	58581	DFI
1994.5	A	12	33.5	-66	10.8	23649	23083	5142	-53571	58559	DFI
1995.5	A	12	33.8	-66	09.2	23665	23098	5148	-53540	58537	DFI
1996.5	A	12	34.2	-66	07.4	23684	23108	5154	-53507	58514	ABC
1997.5	A	12	34.2	-66	06.1	23695	23127	5157	-53476	58491	ABC
1998.5	A	12	34.2	-66	05.2	23698	23130	5157	-53444	58463	ABC
1999.5	A	12	34.1	-66	03.7	23709	23140	5159	-53403	58429	ABC
2000.5	A	12	34.2	-66	02.9	23706	23139	5160	-53367	58396	ABC
2001.5	A	12	34.7	-66	01.5	23716	23146	5164	-53327	58362	ABC
2002.5	A	12	35.1	-66	00.5	23718	23148	5168	-53291	58331	ABC
2003.5	A	12	35.5	-66	00.3	23710	23139	5169	-53264	58303	ABC
2004.5	A	12	35.5	-65	58.8	23719	23149	5171	-53225	58271	ABC
1979.5	Q	12	05.5	-66	05.3	23844	23315	4995	-53775	58824	DFI
1980.5	Q	12	08.6	-66	06.8	23813	23280	5010	-53769	58806	DFI
1981.5	Q	12	11.4	-66	08.3	23783	23246	5022	-53767	58792	DFI
1982.5	Q	12	14.1	-66	10.1	23749	23210	5033	-53766	58778	DFI
1983.5	Q	12	16.5	-66	10.7	23734	23191	5046	-53753	58760	DFI
1984.5	Q	12	18.5	-66	11.1	23719	23174	5056	-53739	58741	DFI
1985.5	Q	12	20.7	-66	11.1	23713	23164	5070	-53724	58724	DFI
1986.5	Q	12	23.2	-66	11.6	23697	23146	5083	-53714	58709	DFI
1987.5	Q	12	25.5	-66	11.6	23690	23136	5097	-53698	58691	DFI
1988.5	Q	12	27.7	-66	12.2	23675	23118	5109	-53687	58676	DFI
1989.5	Q	12	29.1	-66	13.0	23657	23098	5114	-53680	58662	DFI
1990.5	Q	12	30.8	-66	12.8	23653	23092	5125	-53663	58645	DFI
1991.5	Q	12	31.8	-66	12.9	23645	23082	5130	-53647	58627	DFI
1992.5	Q	12	32.5	-66	12.1	23649	23085	5135	-53622	58605	DFI
1993.5	Q	12	33.0	-66	11.1	23655	23090	5140	-53594	58583	DFI
1994.5	Q	12	33.6	-66	10.2	23661	23095	5145	-53568	58561	DFI
1995.5	Q	12	33.9	-66	08.7	23675	23108	5150	-53537	58538	DFI
1996.5	Q	12	34.2	-66	07.2	23689	23108	5155	-53506	58515	ABC
1997.5	Q	12	34.2	-66	05.6	23703	23135	5159	-53474	58492	ABC
1998.5	Q	12	34.3	-66	04.8	23706	23137	5159	-53443	58464	ABC
1999.5	Q	12	34.1	-66	03.2	23716	23148	5161	-53400	58430	ABC
2000.5	Q	12	34.3	-66	02.2	23718	23149	5162	-53365	58398	ABC
2001.5	Q	12	34.7	-66	00.9	23726	23156	5167	-53324	58364	ABC
2002.5	Q	12	35.1	-65	59.8	23730	23159	5171	-53289	58334	ABC
2003.5	Q	12	35.5	-65	59.5	23723	23152	5172	-53261	58306	ABC
2004.5	Q	12	35.5	-65	58.3	23728	23157	5173	-53223	58273	ABC
1979.5	D	12	5.6	-66	6.9	23816	23287	4990	-53782	58819	DFI
1980.5	D	12	8.4	-66	7.8	23792	23260	5004	-53770	58798	DFI
1981.5	D	12	11.1	-66	10.3	23750	23215	5013	-53776	58787	DFI
1982.5	D	12	13.7	-66	12.4	23710	23172	5022	-53773	58769	DFI

continued on page 73 …

K indices and Daily K sums at Canberra (K=9 limit: 450 nT) for 2004

Date	January	February	March	April	May	June	Date
01	3343 5343 28	2321 3212 16	2223 3432 21	Q 0111 2001 06	3133 2211 16	D 2243 4311 20	01
02	3322 3342 22	2233 4322 21	D 2243 3322 21	Q 0111 0000 03	1012 1111 08	2222 2332 18	02
03	3344 3233 25	3444 3332 26	1214 4312 18	D 0123 5454 24	0222 1231 13	2221 1103 12	03
04	3243 4432 25	2233 3312 19	1232 1111 12	4202 2112 14	2232 3122 17	2213 3311 16	04
05	3333 4333 25	2333 1222 18	211- ---- --	D 0111 4552 19	D 1224 2432 20	1212 2221 13	05
06	3342 2234 23	1334 3332 22	Q -111 0000 --	D 3444 4232 26	1222 2122 14	2223 2121 15	06
07	D 2354 4433 28	1123 3111 13	Q 0101 0111 05	2232 2223 18	D 2343 3321 21	2113 3221 15	07
08	Q 1112 2122 12	Q 0111 1112 08	Q 1232 0100 09	2234 3321 20	2223 3211 16	1113 1231 13	08
09	2343 3432 24	1022 3312 14	D 2323 4444 26	D 3443 2321 22	0102 3200 08	D 2134 2421 19	09
10	2443 4341 25	Q 1111 3212 12	D 2454 3223 25	1232 1123 15	1101 1111 07	2210 2031 11	10
11	2233 3421 20	D 2123 4542 23	D 2334 4553 29	2122 2211 13	2201 1133 13	2122 0210 10	11
12	Q 1211 3232 15	D 3444 3433 28	D 3433 3411 22	2232 1221 15	1331 2121 14	0210 1000 04	12
13	2222 5433 23	D 3333 4332 24	2233 4321 20	2212 2111 12	0243 2231 17	0011 0100 03	13
14	Q 3222 3232 19	2313 4422 21	2234 4331 22	2100 2101 07	1110 2100 06	1034 3221 16	14
15	1122 4434 21	D 3334 2423 24	3212 3332 19	1112 2222 13	1102 1201 08	D 2343 4321 22	15
16	D 2323 4443 25	2112 2111 11	1103 2321 13	1343 2322 20	Q 0011 1111 06	2132 2100 11	16
17	2323 3333 22	Q 0001 0202 05	1201 1021 08	1222 3221 15	Q 0001 1011 04	1112 1122 11	17
18	2331 3233 20	1111 1322 12	1322 3321 17	1232 4321 18	Q 1002 1000 04	1112 3220 12	18
19	2233 4423 23	3211 0122 12	2202 1122 12	1112 1100 07	1001 2331 11	1122 1100 08	19
20	2332 4422 22	Q 1000 1211 06	1211 2312 13	Q 1011 0001 04	D 1134 2222 17	Q 0010 0010 02	20
21	2342 4333 24	1102 3212 12	2324 4322 22	0211 1221 10	2211 2210 11	0010 1010 03	21
22	D 4456 7353 37	2112 4312 16	2232 2322 18	Q 0110 1011 05	0232 1211 12	Q 0101 0000 02	22
23	D 3345 4554 33	2112 2212 13	1121 0121 09	D 2344 4322 24	2212 3221 15	Q 0000 0000 00	23
24	2232 3322 19	2223 3333 21	Q 1200 0000 03	1124 3311 16	1133 4110 14	0120 1000 04	24
25	D 3434 4343 28	1103 1011 08	Q 0000 1222 07	2344 3211 20	1012 1100 06	Q 0000 1010 02	25
26	2323 4333 23	Q 2100 1001 05	1112 3333 17	1010 0220 06	Q 0101 1000 03	0001 2211 07	26
27	3133 3322 20	2323 2132 18	2223 3435 24	1211 0110 07	Q 1011 0000 03	Q 0000 1110 03	27
28	4322 3322 21	1343 3333 23	3433 3322 23	0010 1222 08	0011 2332 12	D 1113 2122 13	28
29	Q 2123 3113 16	D 1325 4323 23	1222 3311 15	Q 0101 0001 03	D 1124 3222 17	D 3233 3231 20	29
30	2344 3322 23		1234 4311 19	2121 1144 16	1124 2232 17	2233 3110 15	30
31	Q 1124 2111 13		1122 3232 16		D 3223 3121 17		31
Mean K-sum	**22.7**	**16.3**	**16.7**	**13.5**	**11.8**	**10.7**	

Date	July	August	September	October	November	December	Date
01	1133 2211 14	3110 0012 08	1112 2211 11	0001 0111 04	1112 3200 10	2332 1211 15	01
02	1111 2321 12	0122 1001 07	1111 0200 06	2234 4311 20	Q 0012 1112 08	Q 1110 1111 07	02
03	1122 3120 12	Q 0100 0000 01	Q 1100 0100 03	1124 4322 19	1113 2233 16	Q 1111 1111 08	03
04	1113 0000 06	Q 0000 1100 02	Q 0011 1000 03	D 2322 2222 17	2321 1212 14	Q 0000 1000 01	04
05	1101 1111 07	0012 2111 08	0013 2331 13	0120 0001 04	Q 1110 0000 03	1263 2232 21	05
06	Q 1113 1000 07	2110 0011 06	D 1134 3322 19	0012 0000 03	Q 1011 1010 05	D 2333 4433 25	06
07	Q 0010 1000 02	1244 4211 19	1223 2211 14	Q 0001 2000 03	D 1214 4477 30	3222 3333 21	07
08	Q 0000 0000 00	Q 0110 0000 02	1121 3100 09	0021 2312 11	D 7776 4233 39	2222 2212 15	08
09	Q 1110 0010 04	2222 1232 16	0101 1000 03	2111 1001 07	D 3455 6576 41	1112 2122 12	09
10	0112 1210 08	D 2111 3332 16	Q 0102 0000 03	1213 2011 11	D 6678 6542 44	1232 3323 19	10
11	2113 3124 17	1123 2221 14	Q 0000 1201 04	2221 3212 15	2333 3224 22	1122 5333 20	11
12	3220 2123 15	2111 2101 09	Q 2200 1100 06	1122 1102 10	D 3454 3433 29	D 2334 3533 26	12
13	3231 2232 18	1100 2122 09	0000 0034 07	D 2433 5422 25	1123 2212 14	4332 1111 16	13
14	0121 2110 08	1222 1111 11	D 3344 4443 29	D 2334 5321 23	2121 2121 12	1233 3222 18	14
15	1001 0112 06	0100 1000 02	2213 3322 18	2113 2111 12	Q 1110 0000 03	1230 1312 13	15
16	1011 1113 09	0101 1111 06	D 2234 4322 22	1211 1001 07	1233 4422 21	1321 3334 20	16
17	4333 3111 19	1001 2441 13	D 3323 4212 20	Q 0000 0000 00	1222 1000 08	D 3432 2323 22	17
18	1121 0121 09	1232 1001 10	3213 3000 12	0000 1221 06	Q 1000 1101 04	2323 3221 18	18
19	0213 2212 13	1100 1111 06	1011 1112 08	0101 2311 09	1220 1222 12	Q 1121 1011 08	19
20	1212 2221 13	D 2224 3321 19	2143 2201 15	2331 4412 20	3334 4433 27	1111 2001 07	20
21	Q 1110 0100 04	D 2343 2222 20	1233 1111 13	2321 0011 10	3234 4322 23	2144 2323 21	21
22	1013 3345 20	2234 2311 18	D 1132 5322 19	1211 2211 11	2222 1122 14	D 2444 4222 24	22
23	D 3355 4521 28	0111 1210 07	2311 3111 13	Q 0001 1111 05	2102 1212 11	1112 2212 12	23
24	D 3333 4324 25	Q 1001 2100 05	1012 2211 10	1211 1342 15	2123 2112 14	Q 2111 1312 12	24
25	D 4576 6644 42	Q 0001 1200 04	0003 2000 05	2233 3211 17	3333 4221 21	2443 2212 20	25
26	D 5323 1127 24	0000 1101 03	0000 0011 02	Q 1100 1000 03	1121 2212 12	2332 2322 19	26
27	D 6677 7635 47	1000 1121 06	0003 2221 10	0021 2221 10	2122 3322 17	1332 1122 15	27
28	3322 3232 20	2332 0110 12	2221 0012 10	Q 1100 0111 05	1232 2322 17	2133 2343 21	28
29	1222 1100 09	0102 1122 09	1011 3212 11	0003 3332 14	3333 3333 24	2334 3312 21	29
30	1111 2112 10	D 3234 4555 31	1000 1000 02	D 3334 3312 22	3433 3333 25	D 2364 5432 29	30
31	1212 3221 14	D 3444 3332 26		D 2213 3322 18		1111 2211 10	31
Mean K-sum	**14.3**	**10.5**	**10.7**	**11.5**	**18.0**	**16.6**	

Occurrence distribution of K-indices

K-Index:	0	1	2	3	4	5	6	7	8	9	-
January	0	21	69	100	48	8	1	1	0	0	0
February	18	63	65	65	19	2	0	0	0	0	0
March	25	58	74	58	23	4	0	0	0	0	6
April	38	78	73	26	21	4	0	0	0	0	0
May	45	89	72	34	8	0	0	0	0	0	0
June	66	73	63	31	7	0	0	0	0	0	0
July	45	89	50	37	9	7	6	5	0	0	0
August	70	87	54	21	13	3	0	0	0	0	0
September	73	72	50	33	11	1	0	0	0	0	0
October	61	79	62	33	11	2	0	0	0	0	0
November	26	57	68	51	19	5	6	7	1	0	0
December	12	72	78	63	18	3	2	0	0	0	0
ANNUAL TOTAL	**479**	**838**	**778**	**552**	**207**	**39**	**15**	**13**	**1**	**0**	**6**

Monthly and Annual Mean Values

The following table gives final monthly and annual mean values of each of the magnetic elements for the year.

A value is given for means computed from all days in each month (All days), the five least disturbed of the International Quiet days (5xQ days) in each month and the five International Disturbed days (5xD days) in each month.

CANBERRA	2004	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	23147.3	5168.4	-53244.1	58287.6	23717.4	12° 35.2'	-65° 59.4'
	5xQ days	23151.4	5169.5	-53244.7	58289.9	23721.6	12° 35.2'	-65° 59.2'
	5xD days	23129.9	5162.6	-53246.9	58282.8	23699.1	12° 34.9'	-66° 00.4'
February	All days	23149.3	5169.4	-53240.4	58285.1	23719.4	12° 35.3'	-65° 59.2'
	5xQ days	23155.0	5171.5	-53237.7	58285.1	23725.5	12° 35.4'	-65° 58.8'
	5xD days	23137.2	5163.1	-53242.2	58281.4	23706.3	12° 34.8'	-65° 59.9'
March	All days	23146.7	5171.1	-53233.6	58278.0	23717.3	12° 35.6'	-65° 59.1'
	5xQ days	23160.7	5175.2	-53230.1	58280.7	23731.8	12° 35.7'	-65° 58.3'
	5xD days	23134.7	5167.8	-53236.5	58275.6	23704.9	12° 35.5'	-65° 59.9'
April	All days	23146.3	5172.8	-53230.4	58275.1	23717.3	12° 35.9'	-65° 59.1'
	5xQ days	23156.9	5175.4	-53227.8	58277.2	23728.2	12° 35.9'	-65° 58.4'
	5xD days	23137.4	5169.3	-53230.8	58271.6	23707.9	12° 35.6'	-65° 59.6'
May	All days	23152.5	5172.9	-53226.5	58274.0	23723.4	12° 35.7'	-65° 58.6'
	5xQ days	23159.1	5174.9	-53225.0	58275.4	23730.2	12° 35.8'	-65° 58.2'
	5xD days	23148.3	5171.0	-53226.4	58272.1	23718.9	12° 35.5'	-65° 58.9'
June	All days	23156.1	5173.3	-53222.4	58271.7	23726.9	12° 35.6'	-65° 58.3'
	5xQ days	23163.3	5173.3	-53220.3	58272.6	23734.0	12° 35.4'	-65° 57.9'
	5xD days	23150.2	5172.4	-53223.7	58270.5	23721.0	12° 35.7'	-65° 58.7'
July	All days	23141.2	5168.0	-53222.0	58265.0	23711.3	12° 35.3'	-65° 59.2'
	5xQ days	23162.7	5172.1	-53216.8	58269.1	23733.1	12° 35.2'	-65° 57.9'
	5xD days	23090.8	5150.6	-53230.2	58251.0	23658.3	12° 34.5'	-66° 02.2'
August	All days	23144.3	5172.2	-53223.8	58268.2	23715.2	12° 35.8'	-65° 59.0'
	5xQ days	23146.4	5172.5	-53224.1	58269.3	23717.3	12° 35.8'	-65° 58.9'
	5xD days	23128.9	5169.0	-53225.6	58263.4	23699.5	12° 35.9'	-65° 59.9'
September	All days	23150.4	5172.8	-53217.9	58265.3	23721.3	12° 35.7'	-65° 58.5'
	5xQ days	23154.2	5172.6	-53217.9	58266.7	23724.9	12° 35.6'	-65° 58.3'
	5xD days	23143.5	5172.9	-53220.0	58264.4	23714.5	12° 36.0'	-65° 59.0'
October	All days	23158.4	5172.5	-53210.6	58261.8	23729.1	12° 35.4'	-65° 57.9'
	5xQ days	23164.9	5174.8	-53208.7	58262.9	23735.9	12° 35.6'	-65° 57.5'
	5xD days	23145.7	5169.4	-53212.7	58258.4	23715.9	12° 35.4'	-65° 58.7'
November	All days	23135.5	5166.8	-53219.8	58260.6	23705.4	12° 35.3'	-65° 59.4'
	5xQ days	23153.4	5171.6	-53211.0	58260.1	23724.0	12° 35.5'	-65° 58.2'
	5xD days	23083.4	5155.1	-53236.4	58254.1	23652.1	12° 35.3'	-66° 02.7'
December	All days	23155.1	5169.7	-53210.5	58260.1	23725.2	12° 35.1'	-65° 58.1'
	5xQ days	23157.8	5172.3	-53211.0	58261.9	23728.4	12° 35.4'	-65° 58.0'
	5xD days	23153.3	5167.5	-53210.9	58259.6	23723.0	12° 34.9'	-65° 58.3'
Annual	All days	23148.6	5170.8	-53225.2	58271.0	23719.1	12° 35.5'	-65° 58.8'
Mean	5xQ days	23157.1	5173.0	-53222.9	58272.6	23727.9	12° 35.5'	-65° 58.3'
Values	5xD days	23132.0	5165.9	-53228.5	58267.1	23701.8	12° 35.3'	-65° 59.8'

(Calculated: 14:49 hrs., Wed., 11 Jan. 2006)

Hourly Mean Values

The charts on the following pages are plots of hourly mean values.

The reference levels indicated with marks on the vertical axes refer to the *all-days* mean value for the respective months. All elements in the plots are shown increasing (algebraically) towards the top of the page, with the exception of Z, which is in the opposite sense.

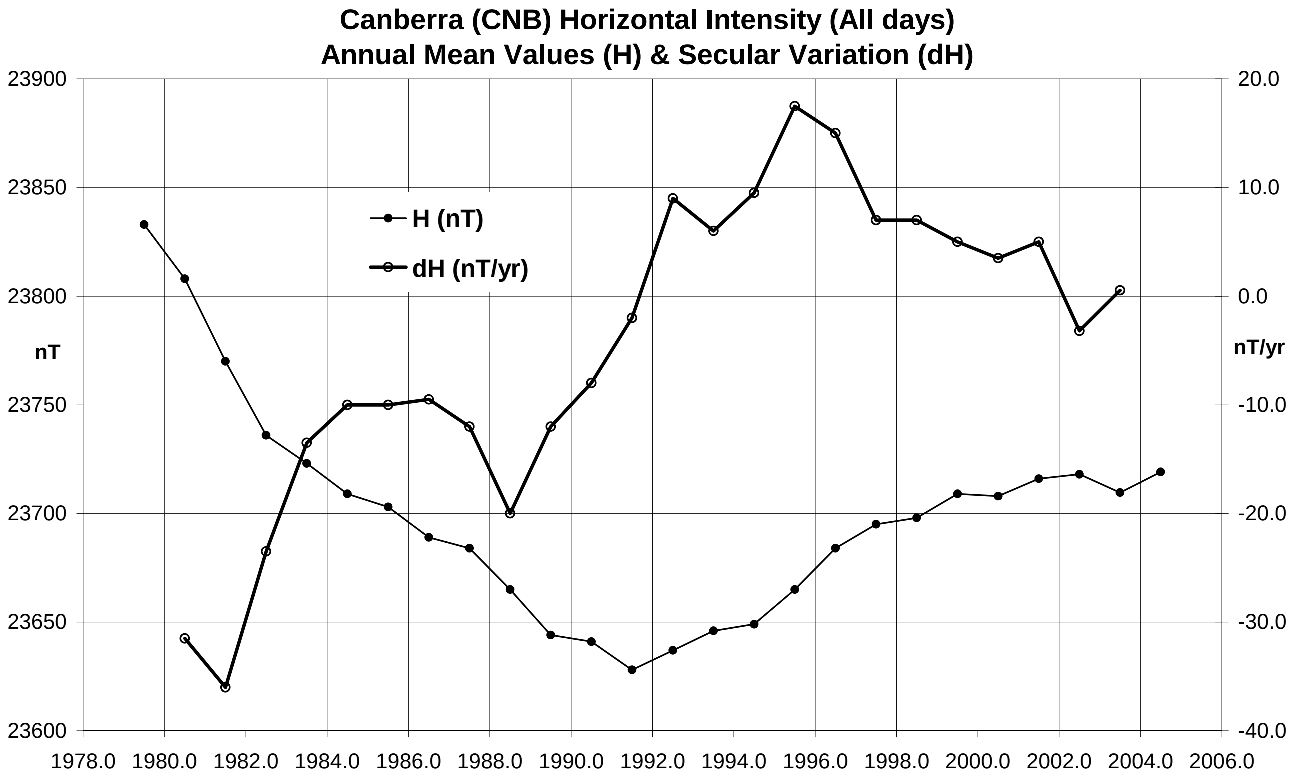
The mean value given at the top of each plot is the *all-days* annual mean value of the element.

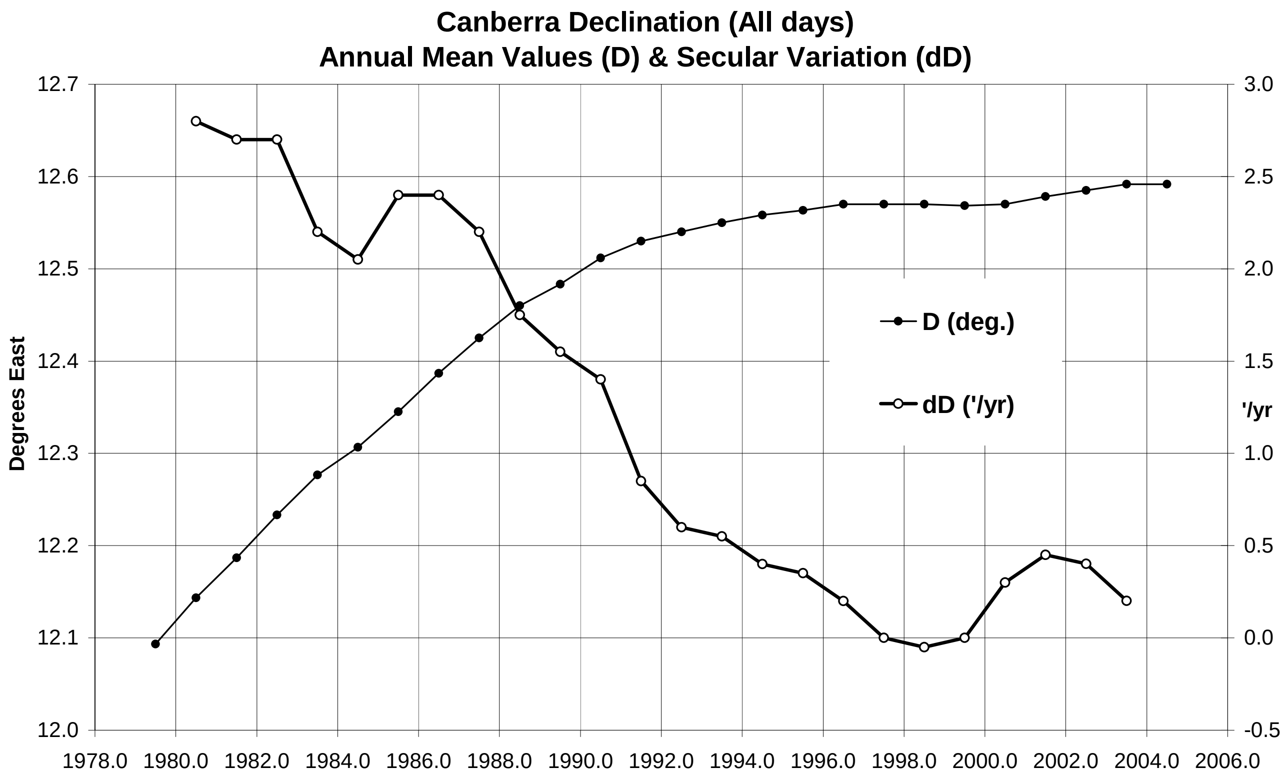
Canberra 2004 Horizontal intensity (H). Scale: 8.0 nT/mm. Mean: 23719 nT

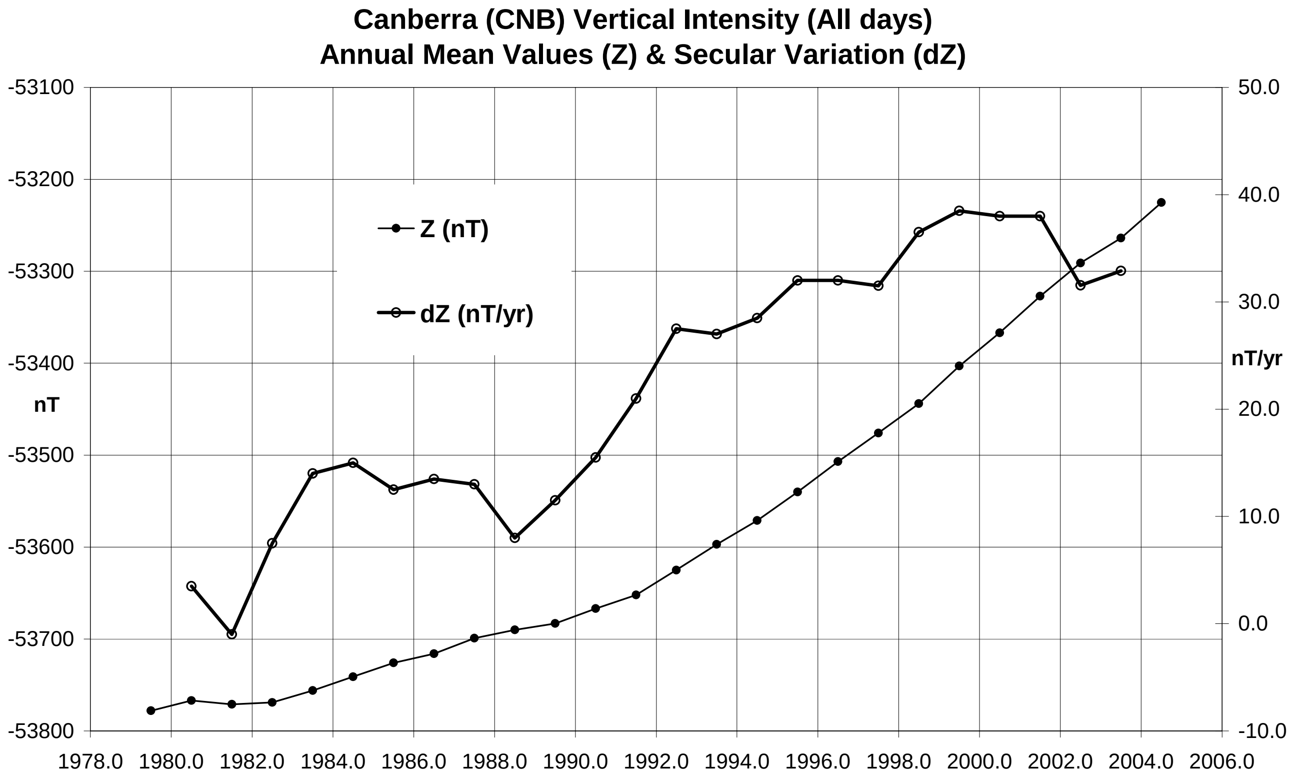
Canberra 2004 Declination (east) (D). Scale: 1.00 min/mm. Mean: 12.59 deg.

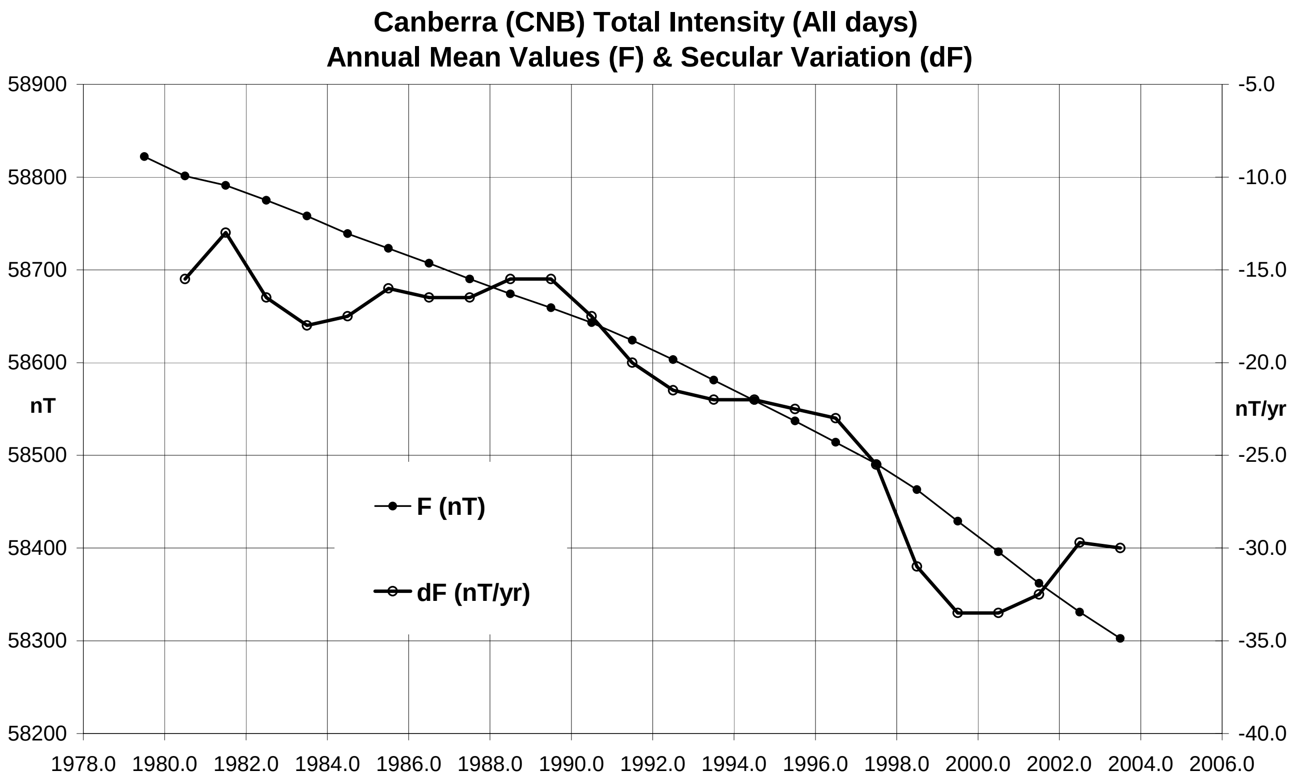
Canberra 2004 Vertical intensity (Z). Scale: 4.0 nT/mm. Mean: −53225 nT

Canberra 2004 Total intensity (F). Scale: 5.0 nT/mm. Mean: 58271 nT


Canberra (CNB) Horizontal Intensity (All days)
Annual Mean Values (H) & Secular Variation (dH)
H (nT)
dH (nT/yr)
nT
nT/yr
23900
23850
23800
23750
23700
23650
23600
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
1978.0 1980.0 1982.0 1984.0 1986.0 1988.0 1990.0 1992.0 1994.0 1996.0 1998.0 2000.0 2002.0 2004.0 2006.0


Canberra Declination (All days)
Annual Mean Values (D) & Secular Variation (dD)
D (deg.)
dD ('/yr)
Degrees East
'/yr
12.7
12.6
12.5
12.4
12.3
12.2
12.1
12.0
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
1978.0 1980.0 1982.0 1984.0 1986.0 1988.0 1990.0 1992.0 1994.0 1996.0 1998.0 2000.0 2002.0 2004.0 2006.0


Canberra (CNB) Vertical Intensity (All days)
Annual Mean Values (Z) & Secular Variation (dZ)
Z (nT)
dZ (nT/yr)
nT
nT/yr
-53100
-53200
-53300
-53400
-53500
-53600
-53700
-53800
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
1978.0
1980.0
1982.0
1984.0
1986.0
1988.0
1990.0
1992.0
1994.0
1996.0
1998.0
2000.0
2002.0
2004.0
2006.0


Canberra (CNB) Total Intensity (All days)
Annual Mean Values (F) & Secular Variation (dF)
F (nT)
dF (nT/yr)
nT
nT/yr
58900
58800
58700
58600
58500
58400
58300
58200
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
1978.0
1980.0
1982.0
1984.0
1986.0
1988.0
1990.0
1992.0
1994.0
1996.0
1998.0
2000.0
2002.0
2004.0
2006.0

Canberra Annual Mean Values (cont.)

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1983.5	D	12	16.6	-66	12.3	23706	23163	5040	-53760	58754	DFI
1984.5	D	12	18.4	-66	12.7	23691	23146	5049	-53745	58735	DFI
1985.5	D	12	20.5	-66	12.4	23690	23142	5064	-53729	58719	DFI
1986.5	D	12	23.3	-66	12.9	23675	23123	5079	-53717	58703	DFI
1987.5	D	12	25.5	-66	12.6	23674	23120	5094	-53701	58688	DFI
1988.5	D	12	27.5	-66	13.8	23647	23091	5102	-53693	58670	DFI
1989.5	D	12	29.0	-66	15.5	23615	23057	5105	-53690	58654	DFI
1990.5	D	12	30.5	-66	14.8	23619	23059	5116	-53671	58639	DFI
1991.5	D	12	31.6	-66	15.5	23600	23038	5119	-53658	58618	DFI
1992.5	D	12	32.3	-66	14.1	23615	23052	5127	-53630	58600	DFI
1993.5	D	12	33.0	-66	12.7	23628	23064	5134	-53601	58578	DFI
1994.5	D	12	33.4	-66	11.8	23633	23068	5138	-53574	58555	DFI
1995.5	D	12	33.8	-66	10.0	23652	23086	5145	-53542	58533	DFI
1996.5	D	12	34.2	-66	7.9	23676	23108	5152	-53508	58512	ABC
1997.5	D	12	34.1	-66	6.9	23683	23115	5154	-53479	58488	ABC
1998.5	D	12	34.2	-66	6.4	23678	23110	5153	-53450	58459	ABC
1999.5	D	12	34.1	-66	4.6	23692	23124	5156	-53407	58427	ABC
2000.5	D	12	34.2	-66	4.2	23685	23117	5155	-53372	58392	ABC
2001.5	D	12	34.6	-66	2.7	23695	23126	5159	-53331	58358	ABC
2002.5	D	12	35.2	-66	1.6	23700	23130	5165	-53296	58328	ABC
2003.5	D	12	35.4	-66	1.5	23688	23118	5163	-53266	58295	ABC
2004.5	D	12	35.3	-65	59.8	23702	23132	5166	-53229	58267	ABC

* Elements ABC indicates non-aligned variometer orientation

MACQUARIE ISLAND

Macquarie Island (Tasmania) is approximately 1,350 km. SSE of Hobart, about half way between Tasmania and the coast of the continent of Antarctica.

In December 1911 a magnetic station was first established at Caroline Cove at the southern end of Macquarie Island by Eric Webb. Another magnetic station, referred to as station A, was also established in 1911, on the Macquarie Island isthmus at the northern end of the island. Station A was re-occupied in 1930 by the British Australian New Zealand Antarctic Expedition (BANZARE) and again in 1948 by the first Australian National Antarctic Research Expedition (ANARE).

The Macquarie Island magnetic observatory was built at the ANARE station on the isthmus and magnetic recording has been continuous since 1952. The observatory was upgraded to produce digital data in October 1984. Data recording was upgraded to one second sampling rates in 1993. The Macquarie Island Magnetic Observatory was accepted as an INTERMAGNET Magnetic Observatory in March 2002.

The observatory consists of a VARIOMETER HOUSE some 100 metres south of the office in the station's Science building; an ABSOLUTE HOUSE about 30 metres further south; and a PPM VARIOMETER HOUSE between the VARIOMETER and ABSOLUTE HOUSES. During summer, the area around the huts is used by elephant seals for breeding, so all cables and power to the huts are routed underground.

Key data for Macquarie Island Observatory:

- 3-character IAGA code: MCQ
- Commenced operation: 1952
- Geographic latitude: 54° 30' S
- Geographic longitude: 158°57' E
- Geomagnetic† : Lat. -59.87°; Long. 244.01°
- Lower limit for K index of 9: 1500 nT
- Principal pier identification: Pier AE
- Elevation of top of Pier AE: 8 metres AMSL

Key data (cont.)

- Azimuth of principal reference (Pillar NMI from Pier AE): 353° 44' 13"
- Distance to Pillar NMI: ~200 metres
- Observers in Charge: H. Banon (2003/04), S. Redfern (2004/05)

† Based on the IGRF 2000.0 model updated to 2004.5

Variometers

The equipment employed to monitor magnetic variations at MCQ in 2004 included an Elsec 820M3 PPM for measuring the magnetic total intensity and a Narod 3-axis ringcore fluxgate (RCF) magnetometer. The RCF sensors, mounted on a marble '*tombstone'* base, were not aligned with either the standard field elements or cardinal points, but were oriented in such a way that the three mutually orthogonal components recorded were of approximately equal magnitudes. At Macquarie Island the magnetic field vector is approximately 11 degrees off-vertical and each ring-core sensor made an angle of approximately 55 degrees with the magnetic vector. Details of the *'tombstone'* RCF sensor base and the orientation of the sensors were given in the section on *Variometer Alignment* in *AGRs 1993-1996.*

The RCF sensors were located in the VARIOMETER HOUSE and the associated electronics were in the ante-room of that building. The VARIOMETER HOUSE temperature was controlled with a heating system. The variometer PPM sensor and electronics were situated in the PPM HOUSE, which had no temperature control. The data acquisition system and backup power were situated in the office, within the Science building.

On 19 August 2004 installation of a new DMI three axis fluxgate magnetometer commenced on the NE pillar of the VARIOMETER HOUSE. The new DMI magnetometer was in addition to the existing Narod RCF variometer on the SE pillar of the VARIOMETER HOUSE. The DMI electronics were housed in an insulated box on the floor of the VARIOMETER HOUSE.

Variometers – MCQ (cont.)

A wireless TCP/IP network link was installed to connect the VARIOMETER HOUSE to the Macquarie Island Local Area Network. An industrial PC running the QNX operating system was installed in the ante-room of the VARIOMETER HOUSE to acquire and log data from both the DMI variometer and also the Narod RCF variometer. The QNX PC was connected to the local network. A GPS clock was installed on the VARIOMETER HOUSE to provide accurate timing for the QNX data logging system.

The installation was completed on 30 August 2004. The original data logging system remained unaltered and data recorded from the Narod RCF and PPM magnetometers on the old acquisition system remained as the primary source of data throughout 2004.

Absolute Instruments and Corrections

Magnetic absolute measurements were performed in the ABSOLUTE HOUSE: on the principal pier AE with an Elsec 810 DIM (serial 214) and a Zeiss020B theodolite (serial 311847) and on pier AW with an Austral PPM (serial 525) until 17 May 2004. From 18 May a GSM90 proton magnetometer (serial 3091319 with sensor no. 01504) became the primary absolute total field magnetometer. An HP palmtop computer was used to communicate with the GSM90 magnetometer. The Austral PPM remained on-site as a back-up instrument.

The classical QHMs (serial 178, 179 on Askania circle 640616) were available as backup for use on pier AE.

A pier difference of:

$\Delta X = -2.6$nT, $\Delta Y = +5.1$nT, $\Delta Z = +4.2$nT ($\Delta F = -4.1$nT)

was applied to adjust observations performed on pier AW to be equivalent to observations on the principal Pier AE. This was adopted from pier difference absolute observations performed in 1991 and 1993 (confirmed by 2003 observations).

Instrument comparisons between the Macquarie Island absolute instruments (E810_214/311847 DIM and Austral 525) and travelling reference instruments (B0806H/100856 DIM and GSM90_003985/11690) were performed at Macquarie Island on 24 and 26 Mar 2003. GSM90_3091319 was compared to the Australian Reference at Canberra Observatory on 02 Dec 2003

The results of the instrument comparisons were:

Travelling Reference		MCQ instrument		Inst. difference
GSM90_003985	–	Austral 525 PPM	=	+0.38nT (F)
B0806H/100856	–	E810_214/311847	=	+0.19' (D)
B0806H/100856	–	E810_214/311847	=	+0.04' (I)

Comparisons between the travelling reference instruments and the Australian Reference instruments were performed on 03-04 March 2003 at CNB observatory. These comparisons resulted in the adoption of instrument differences of:

0nT, 0.0' and 0.0' in F, D, and I respectively.

Corrections to the MCQ instruments are therefore:

Australian Reference		MCQ instrument		Inst. correction
GSM90_905926*	–	Austral 525	=	+0.38nT (F)
E810_200/353756	–	E810_214/311847	=	+0.19' (D)
E810_200/353756	–	E810_214/311847	=	+0.04' (I)
GSM90_905926*	–	GSM90_3091319**	=	0.0nT (F)

* with sensor 21867 ** with sensor 01504

At the mean 2004 field values at MCQ of 10823nT, 6456nT and -63134nT in X, Y and Z respectively, the instrument corrections adopted for the absolute magnetometers used at MCQ during that year convert to the baseline corrections:

01 Jan to 18 May 2004:
$\Delta X = +0.34$ nT $\Delta Y = +1.01$ nT $\Delta Z = -0.23$ nT.

18 May to 31 Dec. 2004:
$\Delta X = +0.28$ nT $\Delta Y = +0.97$ nT $\Delta Z = +0.15$ nT.

Absolute Instruments and Corrections (cont.)

These corrections have been applied to all MCQ 2004 final data including in this report.

Baselines

The standard deviations in the difference between the weekly absolute observations and the final adopted variometer model and data were:

$\sigma_X = 1.5$ nT $\sigma_Y = 1.7$ nT $\sigma_Z = 1.2$ nT.

(In terms of the absolute observed components, they were:

$\sigma_F = 1.2$ nT $\sigma_D = 28"$ $\sigma_I = 5"$.)

The drifts applied to the X, Y, and Z baselines amounted to less than 20nT in any of these components throughout the 2004, with the Y component showing the most drift and the Z component the least drift. There were several sudden jumps in the baseline throughout 2004, the largest being 10nT in the X-component on 24 December 2004.

Throughout the year there was about 5nT variation in the difference between F measured with the fluxgate (final data model with drifts applied) and the variometer PPM.

Operations

The magnetic observers-in-charge at Macquarie Island in 2004 were supported jointly by the Australian Antarctic Division (AAD) in the Department of The Environment and Heritage and GA. They were members of the Australian National Antarctic Research Expedition (ANARE).

The duties of the magnetic observer included maintaining the equipment, performing absolute observations to calibrate the variometers, and maintaining the integrity of the observatory and reporting any changes to GA in Canberra.

During 2004, weekly absolute calibrations were performed on the observation piers in the ABSOLUTE HOUSE by the ANARE communications technical officers: the 2003/04 officer (HB) (from 27 March 2003) until 07 March 2004; and the 2004/05 officer (SR) from 08 March 2004 (until 27 March 2005).

The RCF variometer produced 8 samples per second that were averaged and output as 1-second data. The PPM variometer produced 10-second samples. The 1-second RCF data and 10-second PPM data as well as 1-minute means of both were recorded on an acquisition PC. All data were automatically transmitted daily, via a network connection routed through the Australian Antarctic Division in Hobart Tasmania, to GA where they were processed and distributed. Timing control at the observatory was provided by the Antarctic Division's GPS clock (which was also used with Atmospheric and Space Physics experiments).

During August 2004 a wireless network connection was installed to connect the VARIOMETER HOUSE to the Macquarie Island Local Area Network; a second 3-axis fluxgate variometer, a DMI suspended FGE system digitised using an ADAM4017 A/D unit, was installed in the VARIOMETER HOUSE; a computer acquisition system running the QNX6.1 operating system was also installed in the VARIOMETER HOUSE, as was a GPS clock to provide timing for the new system.

The new computer acquisition system logged data from both the new DMI variometer and the existing Narod variometer. Data from this new dual system was automatically retrieved once per day via the network connection.

The existing DOS acquisition system continued unaltered, to log the Narod RCF data and E820 PPM data as the primary system. The installation of the new system caused contamination of the data from this primary system over the period 19−30 August 2004.

Distribution of MCQ data

Preliminary Monthly Means for Project Ørsted

- Sent monthly by email to IPGP

1-minute and Hourly Mean Values to WDCs

- 2003 data: WDC-A, Boulder, USA (sent 03 Mar. 2004)
- 2004 data: WDC-A, Boulder, USA (sent 10 Jan. 2006)

1-minute Values for Project INTERMAGNET

- Preliminary data daily to the Edinburgh GIN by e-mail.
- 2003 data to the Paris GIN on 03 Mar. 2004
- 2004 data to the Paris GIN on 19 Aug. 2005

Significant Events in 2004

26 Jan. 2300 to 27/0100. Communications outage.

24 Feb. No response from DOS acquisition PC. QNX4 is operating. Acquisition PC had failed.

25 Feb 03:52:54 (according to system clock but the timing was about 40 seconds slow) Replacement PC (old MACQ V0314 PC) was installed. Clock set remotely (from GA) at 22:18:00 although it may still be a few seconds out due to communications delays.

26 Feb Local OIC set timing exactly and confirmed that one minute time marks were received. All communications to Antarctic stations were down due to fibre-optic problems in Sydney.

08 Mar First observation by 2004/05 observer (SR).

18 May First routine observations with GSM90_3091319 and 01504 using PDA for data communications. Instrument and pier comparisons performed with Austral525 and GSM90_3091319 PPMs.

21 May New QNX6 computer networked in Science Building. Test being undertaken.

23 Jun 0220 (approx): Local observer (SR) entered the VARIOMETER HUT.

07 Jul 0116–0134 and 0148–0213: Local observer (SR) in VARIOMETER HUT to prepare for new equipment installations.

08 Jul 0430–0500: Local observer (SR) in VARIOMETER HUT.

11 Jul 2316–2326: Encroachment in magnetic quiet zone.

12 Jul 0000–0010: Encroachment in magnetic quiet zone A number of sudden jumps in XYZ throughout the day.

05 Aug 0342: Clock of QNX4 OS was set.

20 Aug Installation of network link from Variometer to Communications Building

24 Aug Problems with wireless network link WaveRider radios.

25 Aug Radio link between VARIOMETER HUT and Science Building configured and working.

26 Aug Steel bolts in radio link antenna mount on VARIOMETER HOUSE replaced with non-magnetic bolts. Power point installed in the roof space for the WaveRider radio link. Observations performed after all work completed.

27 Aug Another new power point installed in VARIOMETER HUT by electrician who unknowingly tripped circuit breaker in Science Building causing the UPS to cut in. New variometer equipment installed, but sensor not yet aligned due to minor problems.

28 Aug 0003: Primary system restarted after UPS exhaused.

29 Aug 22:55:10 Primary system timing reset. Has been 5 seconds slow since restart on 28 August.

Significant Events (cont.)

31 Aug - Numerous visits into VARIOMETER HUT to get new DMI system operational.

01 Sep First absolute observation after DMI system installed.

03 Sep 0056: Gdap clock stopped and restarted as GPS clock not operating on Gdap.

11 Sep 2240 (approx.): Gdap system stopped data recording. PC is still running satisfactorily.

13 Sep 23:45 (approx.): Narod variometer connected to Gdap system. New installation photographed.

14 Sep Gdap system rebooted to restart DMI logging and start Narod logging.

21 Sep Fence at back of ABSOLUTE HUT found to have been damaged by seals.

Sep. Seals knocked open the door to the PPM HUT. The exact date is not known.

01 Oct Time on QNX4 acquisition system set. Approximately 500 1-second samples lost on primary Narod data between 1310 and 1338 (no whole minute of data was lost.)

20 Oct 0030–0545: Data (mostly F and Z) contaminated during repairs to ABSOLUTE HUT seal-fence.

21 Oct 0100–0255, 0430–0435: Repairs to ABSOLUTE HUT seal fence continued.
Work on radio link in Science building.
Gdap system rebooted.

25 Oct Experiment with absolute GSM90 PPM tuning – left it on 64μT.

08 Nov 0133: Set QNX4 OS and RT clock at (OS clock was ~7 minutes fast)

23 Nov 0600: Network outage during maintenance at AAD in Hobart.

02 Dec ~0500: Timing set by local observer after it was noted that that the DOS system was about 5 seconds slow.

24 Dec Could not communicate to QNX6 by telnet. System rebooted by local observer.

Data losses in 2004

22 Feb. 0000 to 25 / 0352 (3d 03h 53m) All data channels: Data acquisition PC failure.

07 Mar. 2201 (1 min.) F-channel only.

13 Jun 2048–2220 (1h 33m)

27 Aug. 0848 to 28 / 0003 (15h 16m) X,Y,Z channels;
0848 to 28 / 0006 (15h 19m) F channel;

28 Aug. 0008 (1 min.) F-channel.

The data (all channels) acquired over the following intervals were contaminated and so omitted from processing:

13 Jun. 2045–2245 (2h 01m) RCF failure with X,Y,Z channels all a constant non-zero value.

09 Jul. 0434–1120 (6h 47m)
2235–2245 (11 mins)

11 Jul. 1829–1850 (22 mins)

19 Aug. 2300 to 30 / 0300 (10d 04h 01m)

20 Oct. 0025–0515 (4h 51m)

21 Oct. 0145–0340 (1h 56m)

24 Dec. 0156–0157 (2 mins) RCF baseline jump.

Macquarie Island Annual Mean Values

The table below gives annual mean values calculated using the 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 H, D, Z & F are on pages 82 & 83.

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1993.5	A	29	57.2	-78	48.1	12558	10880	6270	-63428	64659	ABC
1994.5	A	30	02.2	-78	48.3	12549	10863	6281	-63404	64634	ABC
1995.5	A	30	06.6	-78	47.5	12559	10864	6300	-63376	64608	ABC
1996.5	A	30	11.0	-78	46.4	12574	10870	6322	-63353	64589	ABC
1997.5	A	30	15.4	-78	45.9	12580	10866	6339	-63336	64573	ABC
1998.5	A	30	20.0	-78	45.8	12579	10857	6353	-63320	64557	ABC
1999.5	A	30	23.6	-78	45.2	12586	10856	6367	-63294	64534	ABC
2000.5	A	30	28.4	-78	45.0	12585	10847	6382	-63268	64507	ABC
2001.5	A	30	33.5	-78	44.1	12595	10846	6404	-63231	64473	ABC
2002.5	A	30	39.1	-78	43.5	12600	10840	6424	-63198	64442	ABC
2003.5	A	30	44.6	-78	44.0	12585	10817	6433	-63174	64416	ABC
2004.5	A	30	49.0	-78	42.7	12602	10823	6456	-63134	64380	ABC
1951.5		23	50.8	-78	17.6	13383	12241	5411	-64589	65961	HDZ
1952.5		24	04.2	-78	17.8	13371	12208	5453	-64550	65920	HDZ
1953.5		24	14.6	-78	18.2	13360	12182	5486	-64533	65901	HDZ
1954.5		24	28.4	-78	18.4	13356	12156	5533	-64535	65903	HDZ
1955.5		24	42.0	-78	18.6	13350	12129	5579	-64520	65887	HDZ
1956.5		24	53.2	-78	19.3	13333	12095	5611	-64506	65870	HDZ
1957.5		25	05.7	-78	19.8	13319	12062	5649	-64482	65843	HDZ
1958.5		25	16.6	-78	20.1	13307	12033	5682	-64456	65815	HDZ
1959.5		25	26.3	-78	20.9	13288	12000	5708	-64436	65792	HDZ
1960.5		25	32.0	-78	22.0	13262	11967	5716	-64414	65765	HDZ
1961.5		25	50.0	-78	22.5	13240	11917	5769	-64359	65707	HDZ
1962.5		26	05.8	-78	23.3	13216	11869	5814	-64321	65665	HDZ
1963.5		26	08.5	-78	24.2	13193	11843	5813	-64294	65634	HDZ
1964.5		26	17.0	-78	24.7	13174	11812	5834	-64249	65586	HDZ
1965.5		26	28.6	-78	25.5	13152	11773	5864	-64214	65547	HDZ
1966.5		26	37.6	-78	26.7	13121	11729	5881	-64175	65503	HDZ
1967.5		26	46.5	-78	28.5	13084	11681	5894	-64166	65486	HDZ
1968.5		26	54.7	-78	29.7	13053	11639	5908	-64132	65447	HDZ
1969.5		27	02.3	-78	30.8	13026	11602	5921	-64099	65409	HDZ
1970.5		27	09.6	-78	32.1	12996	11563	5932	-64078	65383	HDZ
1971.5		27	13.3	-78	33.3	12963	11527	5930	-64032	65331	HDZ
1972.5		27	22.1	-78	34.4	12937	11489	5947	-64008	65302	HDZ
1973.5		27	27.6	-78	35.8	12905	11451	5951	-63985	65273	HDZ
1974.5		27	34.3	-78	37.6	12865	11404	5955	-63956	65237	HDZ
1975.5		27	43.2	-78	38.2	12847	11373	5976	-63926	65204	HDZ
1976.5		27	51.6	-78	39.1	12822	11336	5992	-63891	65165	HDZ
1977.5		27	59.8	-78	39.9	12802	11304	6010	-63861	65132	HDZ
1978.5		28	11.3	-78	41.1	12773	11258	6034	-63838	65103	HDZ
1979.5		28	19.6	-78	42.3	12745	11219	6047	-63807	65067	HDZ
1980.5		28	28.8	-78	43.0	12723	11183	6067	-63768	65025	HDZ
1981.5		28	37.5	-78	44.5	12687	11136	6078	-63735	64985	HDZ
1982.5		28	49.5	-78	45.4	12666	11097	6107	-63711	64958	HDZ
1983.5		28	54.9	-78	45.7	12652	11075	6117	-63674	64919	HDZ
1984.5		29	03.7	-78	46.1	12640	11049	6140	-63650	64893	HDZ
1985.5		29	12.0	-78	47.4	12608	11006	6151	-63619	64856	XYZ
1986.5		29	19.0	-78	47.5	12600	10986	6169	-63590	64826	XYZ
1987.5		29	26.8	-78	47.8	12593	10966	6191	-63584	64819	XYZ
1988.5		29	32.2	-78	47.8	12590	10954	6207	-63560	64795	XYZ
1989.5		29	37.8	-78	47.8	12587	10941	6223	-63552	64786	XYZ
1990.5		29	42.8	-78	48.0	12577	10923	6234	-63519	64752	XYZ
1991.5		29	47.6	-78	47.6	12578	10915	6250	-63487	64721	XYZ
1992.5		29	53.0	-78	47.5	12573	10901	6264	-63447	64681	XYZ
1993.5	Q	29	56.9	-78	47.2	12575	10896	6277	-63427	64661	ABC
1994.5	Q	30	01.5	-78	47.0	12574	10887	6292	-63403	64637	ABC
1995.5	Q	30	06.2	-78	46.5	12577	10881	6308	-63377	64613	ABC
1996.5	Q	30	10.5	-78	45.9	12585	10879	6326	-63356	64594	ABC
1997.5	Q	30	15.2	-78	45.4	12591	10876	6344	-63336	64576	ABC
1998.5	Q	30	19.7	-78	45.1	12593	10870	6359	-63321	64562	ABC
1999.5	Q	30	23.5	-78	44.6	12598	10867	6373	-63293	64535	ABC
2000.5	Q	30	28.3	-78	44.3	12598	10858	6389	-63266	64509	ABC
2001.5	Q	30	33.3	-78	43.4	12608	10857	6409	-63229	64474	ABC
2002.5	Q	30	38.9	-78	42.8	12613	10851	6429	-63196	64442	ABC
2003.5	Q	30	43.7	-78	42.6	12611	10841	6444	-63170	64417	ABC

continued on page 84 …

Monthly and Annual Mean Values

The following table gives final monthly and annual mean values of each of the magnetic elements for the year.

A value is given for means computed from all days in each month (All days), the five least disturbed of the International Quiet days (5xQ days) in each month and the five International Disturbed days (5xD days) in each month.

Macquarie Island	2004	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	10805.2	6438.8	-63147.8	64388.5	12578.2	30° 47.5'	-78° 44.1'
	5xQ days	10828.2	6448.3	-63142.9	64388.3	12602.8	30° 46.4'	-78° 42.8'
	5xD days	10765.5	6421.1	-63182.5	64414.5	12535.3	30° 49.0'	-78° 46.7'
February	All days	10819.5	6444.0	-63146.0	64389.6	12593.1	30° 46.7'	-78° 43.3'
	5xQ days	10837.5	6453.7	-63142.5	64390.0	12613.6	30° 46.4'	-78° 42.2'
	5xD days	10780.2	6423.5	-63160.0	64394.8	12549.0	30° 47.4'	-78° 45.8'
March	All days	10812.3	6445.5	-63135.2	64377.9	12587.7	30° 48.0'	-78° 43.5'
	5xQ days	10840.9	6459.4	-63139.9	64388.6	12619.4	30° 47.3'	-78° 41.9'
	5xD days	10778.5	6428.5	-63128.4	64364.0	12550.0	30° 48.8'	-78° 45.4'
April	All days	10821.3	6454.4	-63144.1	64389.0	12600.0	30° 48.9'	-78° 42.9'
	5xQ days	10837.3	6462.0	-63144.8	64393.1	12617.7	30° 48.4'	-78° 42.0'
	5xD days	10771.0	6431.2	-63136.5	64371.0	12545.0	30° 50.5'	-78° 45.7'
May	All days	10834.0	6460.9	-63135.4	64383.3	12614.3	30° 48.6'	-78° 42.1'
	5xQ days	10839.5	6464.6	-63136.5	64385.6	12620.9	30° 48.7'	-78° 41.7'
	5xD days	10826.8	6456.2	-63125.7	64372.1	12605.7	30° 48.5'	-78° 42.4'
June	All days	10840.3	6463.8	-63131.0	64380.3	12621.2	30° 48.4'	-78° 41.7'
	5xQ days	10843.6	6465.6	-63128.7	64378.7	12624.9	30° 48.3'	-78° 41.4'
	5xD days	10837.5	6461.2	-63125.2	64373.8	12617.5	30° 48.2'	-78° 41.8'
July	All days	10815.4	6451.5	-63135.9	64379.8	12593.5	30° 49.0'	-78° 43.2'
	5xQ days	10845.2	6464.4	-63132.0	64382.1	12625.6	30° 47.8'	-78° 41.4'
	5xD days	10697.0	6390.5	-63150.5	64369.3	12461.1	30° 51.4'	-78° 50.3'
August	All days	10822.6	6462.6	-63133.6	64379.7	12605.4	30° 50.6'	-78° 42.5'
	5xQ days	10832.1	6464.9	-63138.3	64386.1	12614.7	30° 49.8'	-78° 42.1'
	5xD days	10757.5	6437.5	-63124.6	64357.7	12536.7	30° 53.9'	-78° 46.0'
September	All days	10830.7	6464.0	-63133.7	64381.3	12613.0	30° 49.8'	-78° 42.1'
	5xQ days	10834.1	6463.9	-63135.2	64383.3	12615.9	30° 49.3'	-78° 42.0'
	5xD days	10811.1	6458.7	-63129.4	64373.4	12593.5	30° 51.3'	-78° 43.1'
October	All days	10831.6	6465.0	-63120.2	64368.4	12614.3	30° 49.9'	-78° 41.9'
	5xQ days	10842.4	6470.7	-63120.6	64371.1	12626.5	30° 49.7'	-78° 41.3'
	5xD days	10816.5	6456.7	-63124.4	64369.2	12597.1	30° 50.1'	-78° 42.9'
November	All days	10814.7	6457.3	-63127.8	64372.3	12596.1	30° 50.5'	-78° 43.0'
	5xQ days	10834.2	6468.3	-63123.2	64372.1	12618.2	30° 50.3'	-78° 41.7'
	5xD days	10747.9	6426.8	-63121.4	64352.4	12524.0	30° 52.9'	-78° 46.7'
December	All days	10828.0	6462.8	-63119.0	64366.4	12610.0	30° 49.9'	-78° 42.1'
	5xQ days	10839.0	6468.0	-63122.2	64371.8	12622.1	30° 49.6'	-78° 41.5'
	5xD days	10810.1	6453.7	-63127.9	64371.3	12590.1	30° 50.3'	-78° 43.3'
Annual	All days	10823.0	6455.9	-63134.2	64379.7	12602.2	30° 49.0'	-78° 42.7'
Mean	5xQ days	10837.8	6462.8	-63133.9	64382.6	12618.5	30° 48.5'	-78° 41.8'
Values	5xD days	10783.3	6437.1	-63136.4	64373.6	12558.8	30° 50.2'	-78° 45.0'

(Calculated: 15:33 hrs., Fri., 15 Apr. 2005)

Hourly Mean Values

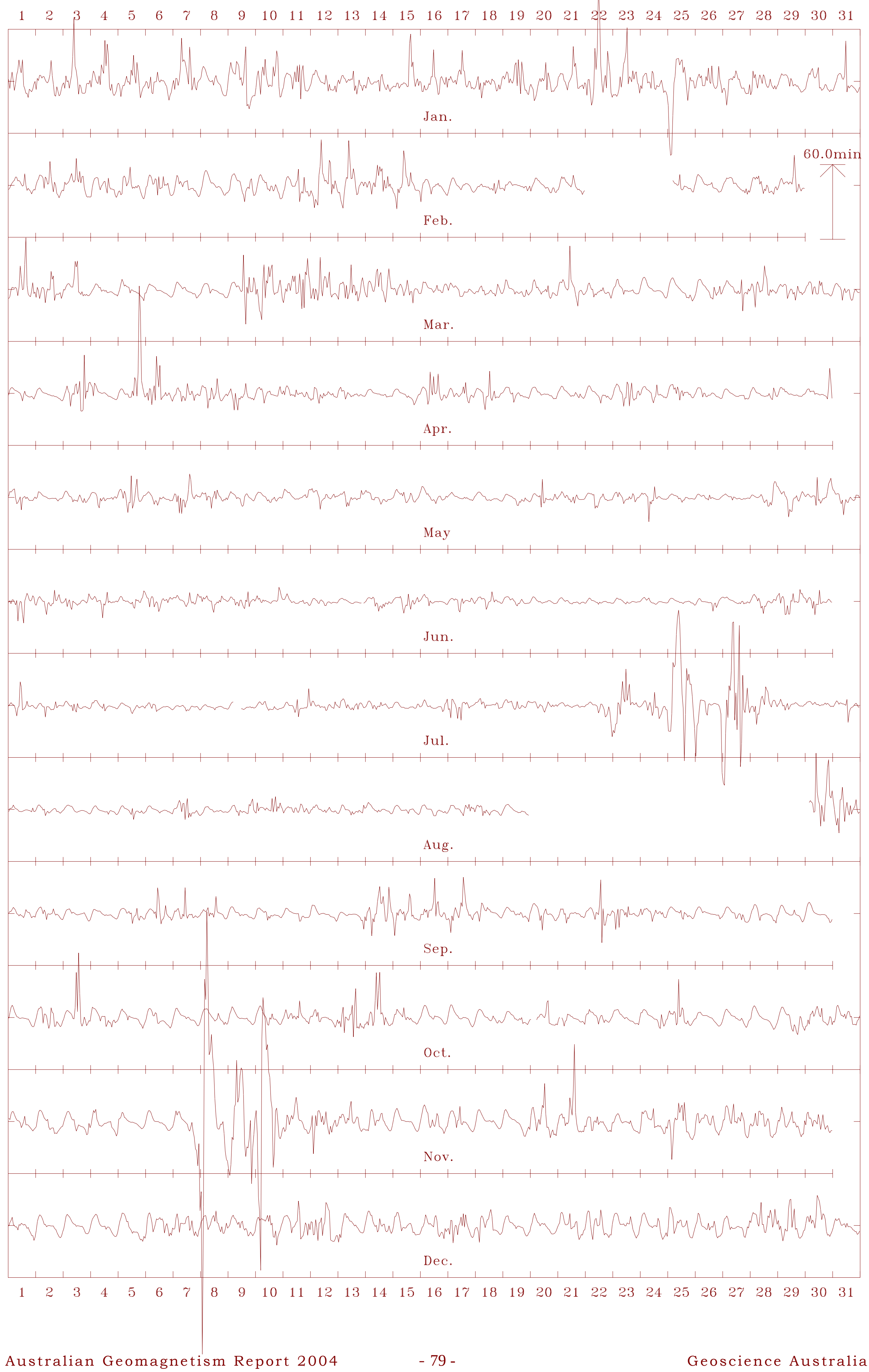
The charts on the following pages are plots of hourly mean values.

The reference levels indicated with marks on the vertical axes refer to the *all-days* mean value for the respective months. All elements in the plots are shown increasing (algebraically) towards the top of the page, with the exception of Z, which is in the opposite sense.

The mean value given at the top of each plot is the *all-days* annual mean value of the element.

Macquarie Is. 2004 Horizontal intensity (H). Scale: 40.0 nT/mm. Mean: 12603 nT

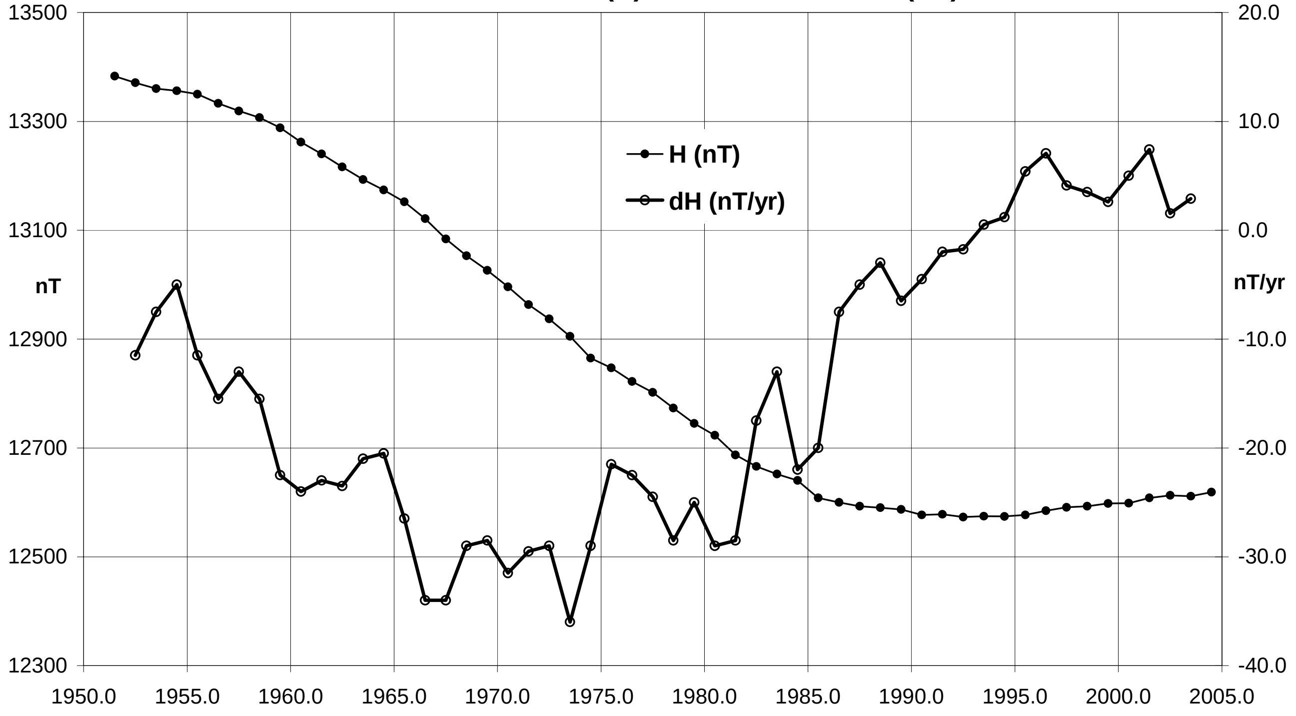
Macquarie Is. 2004 Declination (east) (D). Scale: 4.00 min/mm. Mean: 30.82 deg.



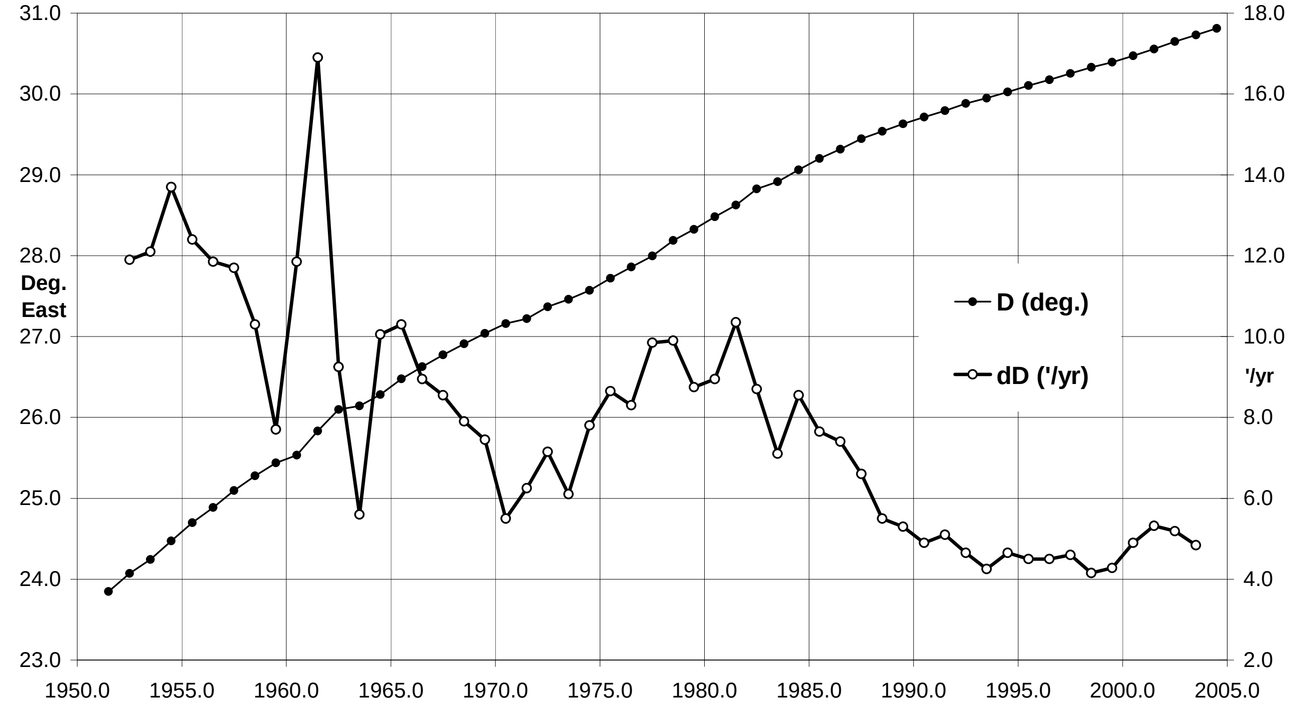
Macquarie Is. 2004 Vertical intensity (Z). Scale: 25.0 nT/mm. Mean: −63134 nT

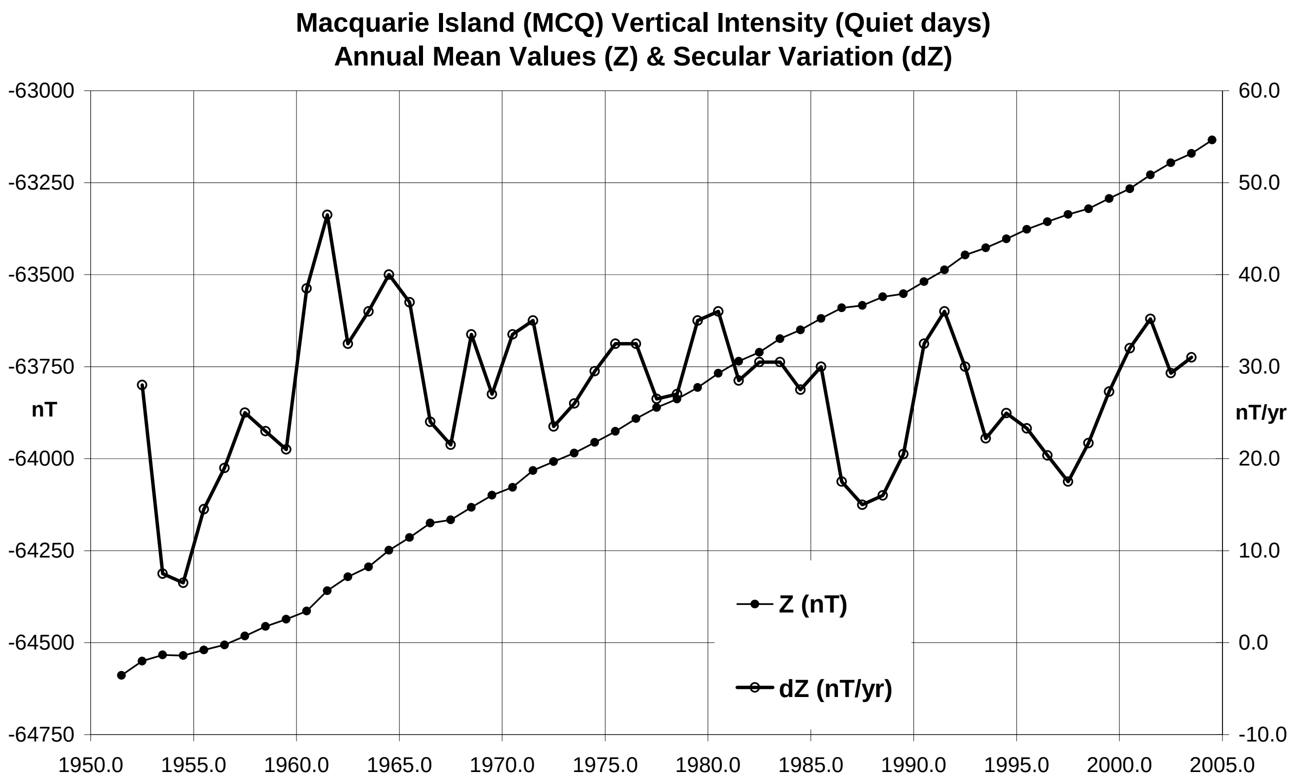
Macquarie Is. 2004 Total intensity (F). Scale: 25.0 nT/mm. Mean: 64380 nT

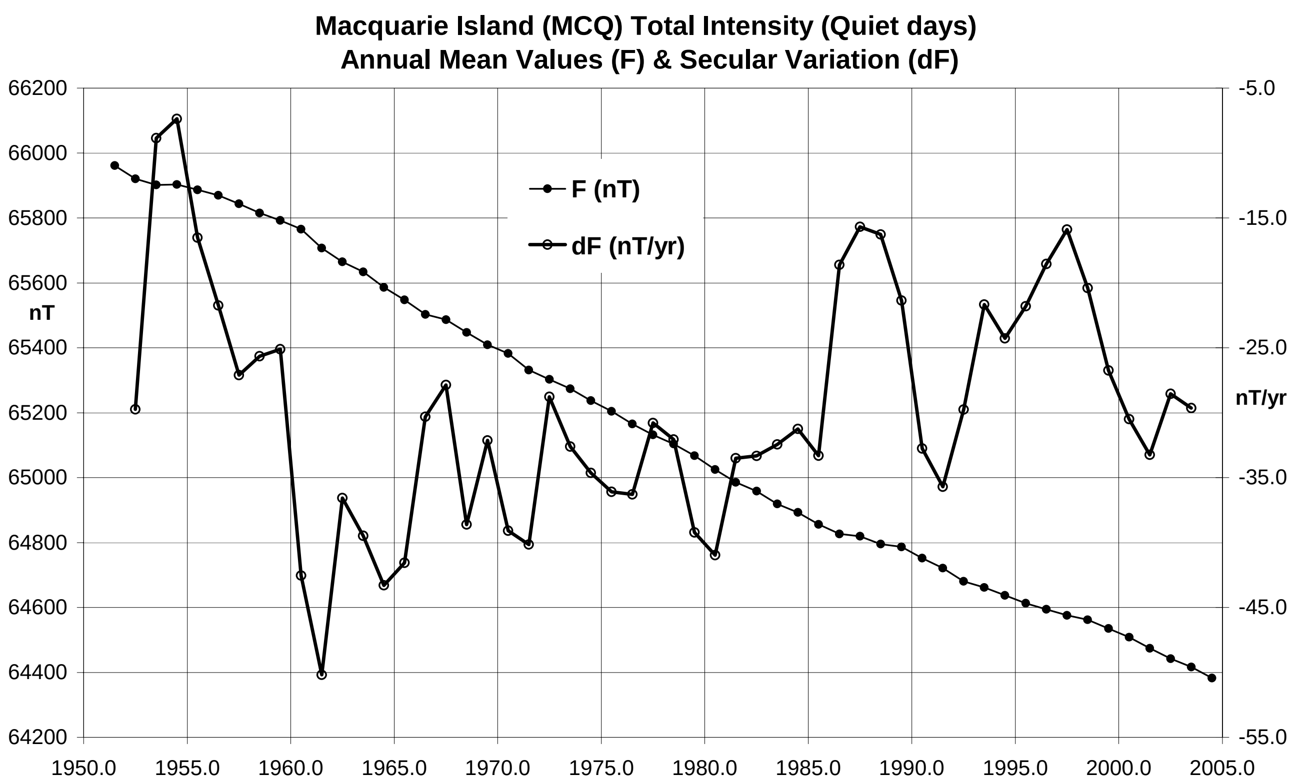
Macquarie Island (MCQ) Horizontal Intensity (Quiet days)
Annual Mean Values (H) & Secular Variation (dH)



Macquarie Island (MCQ) Declination (Quiet days)
Annual Mean Values (D) & Secular Variation (dD)




Macquarie Island (MCQ) Vertical Intensity (Quiet days)
Annual Mean Values (Z) & Secular Variation (dZ)
-63000
-63250
-63500
-63750
nT
-64000
-64250
-64500
-64750
60.0
50.0
40.0
30.0
nT/yr
20.0
10.0
0.0
-10.0
Z (nT)
dZ (nT/yr)
1950.0
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0


Macquarie Island (MCQ) Total Intensity (Quiet days)
Annual Mean Values (F) & Secular Variation (dF)
66200
66000
65800
65600
nT
65400
65200
65000
64800
64600
64400
64200
-5.0
-15.0
-25.0
nT/yr
-35.0
-45.0
-55.0
F (nT)
dF (nT/yr)
1950.0
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0

MCQ Annual Mean Values (cont.)

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
2004.5	Q	30	48.5	-78	41.8	12619	10838	6463	-63134	64383	ABC
1993.5	D	29	58.5	-78	50.0	12521	10846	6256	-63429	64654	ABC
1994.5	D	30	03.3	-78	50.2	12514	10831	6267	-63408	64632	ABC
1995.5	D	30	07.8	-78	49.4	12522	10830	6285	-63376	64601	ABC
1996.5	D	30	11.9	-78	47.4	12556	10852	6316	-63350	64583	ABC
1997.5	D	30	16.0	-78	47.3	12555	10843	6328	-63334	64566	ABC
1998.5	D	30	21.0	-78	47.7	12543	10824	6338	-63320	64550	ABC
1999.5	D	30	24.3	-78	46.4	12564	10836	6358	-63297	64532	ABC
2000.5	D	30	29.0	-78	46.7	12554	10819	6368	-63273	64507	ABC
2001.5	D	30	34.6	-78	46.0	12560	10813	6389	-63238	64473	ABC
2002.5	D	30	40.0	-78	44.8	12574	10816	6413	-63198	64437	ABC
2003.5	D	30	46.6	-78	46.8	12534	10769	6413	-63186	64418	ABC
2004.5	D	30	50.2	-78	45.0	12559	10783	6437	-63136	64374	ABC

* Elements ABC indicates non-aligned variometer orientation

CASEY OBSERVATORY

Casey is the Australian Antarctic station nearest to Australia, situated 3880km south of Perth. The magnetic ABSOLUTE HUT is about 120 metres south of the tank house, the structure of the modern Casey station nearest to it. The old Casey station, in use until the late 1980s, lies about 1km to the north-east of the present Casey.

The crystalline rocks of Casey have unusually high concentrations of magnetic minerals producing high magnetic gradients in and around the magnetic ABSOLUTE HUT.

Regular magnetic observations have been made at Casey since 1975. A variation station operated from 1988 and from 1991 to 1998 it operated as a magnetic observatory although not to a high standard. Observatory standard absolute control was achieved in 1999. A more detailed history of the Casey (and Wilkes) observatory was given in the *AGR*s 1999-2002.

Key data for Casey Station (AAT) Observatory:

- 3-character IAGA code: CSY
- Commenced operation: see above
- Geographic latitude: 66° 17' S
- Geographic longitude: 110°32' E
- Geomagnetic†: Lat. -76.33°; Long. 183.86°
- Lower limit for K index of 9: n.a.
- Principal pier identification: Pier A
- Elevation of top of Pier A: 40 metres AMSL
- Azimuth of principal reference (Pillar G11 from Pier A): 307° 41' 02"
- Distance to Pillar G11: not recorded
- Observers in Charge: M. Paterson (AAD)

† Based on the IGRF 2000.0 model updated to 2004.5

Variometers

An Antarctic Division EDA FM105B fluxgate variometer, with its data acquired by PC, operated at Casey throughout 2004. The fluxgate sensors were housed on the hill about 300m west of the Casey Science building. The sensors were aligned close to true north, true east and vertical. The temperatures were maintained at 20°C. Further description is in Crosthwaite (1999). No total field variometer operated at Casey during 2004.

Absolute Instruments and Corrections

Magnetometers used to calibrate the recording variometers at Casey were Elsec 810 DIM no. 2591 with Zeiss020B theodolite no. 356514 (owned by the Australian Antarctic Division), and Geometrics 816 no. 766 PPM, (owned by GA). A QHM and QHM circles were available as a backup in the event that one of the primary instruments became unserviceable.

For consistency with the Australian Magnetic Reference magnetometers held at Canberra, a correction of +0.7nT has been applied to the absolute PPM readings. Corrections of zero were applied to the DIM readings. These resulted in baseline corrections of:

$\Delta X = -0.01$ nT $\Delta Y = -0.10$ nT $\Delta Z = -0.69$ nT.

Because of the extreme magnetic gradients at Casey, it has been necessary to apply a correction to magnetic data from the station acquired since early 1993. QHMs were used at Casey until 1993, and DIMs since that time. The 70mm difference in sensor heights between the two instruments required the following corrections to DIM/PPM readings to produce equivalent QHM/PPM readings (with the PPM height similarly adjusted):

$\Delta D = +15.1'$ $\Delta I = +0.2'$ $\Delta F = +45$ nT

($\Delta X = +42$ nT $\Delta Y = -11.5$ nT $\Delta Z = -44$ nT)

It is desirable that a new absolute observation house and pier be located on a more suitable site. A site with gradients of about 10nT per metre was chosen during a maintenance visit by a GA officer in the 1998/99 summer (Crosthwaite 1999).

Casey Annual Mean Values

The table below gives annual mean values for Casey station. Until 1990 these were calculated using the monthly average values of regular absolute observations, denoted by AB. From 1991 they were gained using data from the AAD's fluxgate variometer that was calibrated through regular absolute observations. Until 1997 the means were calculated over the five quietest days at Mawson station, denoted QM. From 1998 monthly means were calculated over **All** days, the 5 International **Quiet** days and the 5 International **Disturbed** days in each month, denoted A, Q and D respectively.

Plots of these data with secular variation in H, D, Z & F are on the pages 91 & 92.

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts
1977.96	AB	-88	29.6	-81	38.7	9495	250	-9492	-64650	65344	DHZ
1978.5	AB	-89	4.3	-81	36.2	9518	154	-9516	-64488	65187	DHZ
1979.5	AB	-89	21.6	-81	35.7	9525	106	-9524	-64469	65169	DHZ
1980.5	AB	-89	31.5	-81	33.9	9568	79	-9568	-64528	65233	DHZ
1981.5	AB	-88	2.1	-81	32.0	9540	327	-9534	-64083	64789	DHZ
1982.5	AB	-90	10.0	-81	28.4	9650	-28	-9650	-64400	65120	DHZ
1983.5	AB	-90	32.0	-81	31.5	9585	-89	-9585	-64326	65037	DHZ
1984.5	AB	-90	50.0			9640	-140	-9639			DHZ
1985.5	AB	-90	50.0	-81	25.9	9650	-140	-9649	-64067	64790	DHZ
1986.5	AB	-90	52.9	-81	27.2	9634	-148	-9633	-64101	64821	DHZ
1987.5	AB	-91	18.6	-81	29.1	9596	-219	-9593	-64097	64811	DHZ
1988.5	AB	-91	28.4	-81	27.2	9630	-248	-9627	-64086	64805	DHZ
1989.5	AB	-90	45.5	-81	23.5	9672	-128	-9671	-63887	64615	DHZ
1990.5	AB	-91	55.0	-81	27.4	9601	-321	-9596	-63920	64637	DHZ
1991.5	QM	-92	1.2	-81	25.0	9642	-340	-9636	-63881	64605	XYZ
1992.5	QM	-92	10.0	-81	25.0	9637	-364	-9630	-63848	64571	XYZ
1993.5	QM	-92	7.3	-81	25.0	9638	-357	-9631	-63852	64576	XYZ
1994.5	QM	-92	17.1	-81	25.3	9629	-384	-9621	-63824	64547	XYZ
1995.5	QM	-92	27.5	-81	25.6	9620	-413	-9611	-63807	64528	XYZ
1996.5	QM	-92	35.4	-81	25.3	9625	-435	-9615	-63804	64526	XYZ
1997.5	QM	-92	42.1	-81	25.2	9623	-454	-9612	-63774	64496	XYZ
1998.5	Q	-92	55.4	-81	25.7	9614	-490	-9601	-63777	64497	XYZ
1999.5	Q	-93	4.9	-81	26.5	9595	-516	-9581	-63762	64480	XYZ
2000.5	Q	-93	12.9	-81	27.0	9584	-537	-9568	-63749	64465	XYZ
2001.5	Q	-93	21.6	-81	27.9	9564	-561	-9548	-63729	64443	XYZ
2002.5	Q	-93	26.1	-81	28.3	9553	-572	-9536	-63708	64421	XYZ
2003.5	Q	-93	37.5	-81	29.4	9534	-603	-9514	-63713	64422	XYZ
2004.5	Q	-93	46.5	-81	30.5	9510	-626	-9489	-63691	64397	XYZ
1998.5	A	-92	55.4	-81	25.7	9615	-490	-9602	-63785	64505	XYZ
1999.5	A	-93	4.8	-81	26.4	9599	-516	-9585	-63772	64490	XYZ
2000.5	A	-93	13.2	-81	27.0	9587	-538	-9571	-63759	64476	XYZ
2001.5	A	-93	21.6	-81	27.9	9566	-561	-9549	-63733	64447	XYZ
2002.5	A	-93	29.4	-81	28.4	9553	-582	-9535	-63719	64432	XYZ
2003.5	A	-93	39.5	-81	29.5	9535	-608	-9515	-63730	64440	XYZ
2004.5	A	-93	47.0	-81	30.4	9512	-628	-9491	-63701	64408	XYZ
1998.5	D	-92	58.2	-81	25.8	9615	-498	-9601	-63805	64526	XYZ
1999.5	D	-93	10.7	-81	26.6	9599	-532	-9583	-63796	64514	XYZ
2000.5	D	-93	13.6	-81	27.0	9588	-539	-9572	-63771	64487	XYZ
2001.5	D	-93	19.4	-81	27.8	9570	-555	-9553	-63746	64460	XYZ
2002.5	D	-93	37.4	-81	28.8	9549	-603	-9529	-63747	64458	XYZ
2003.5	D	-93	47.4	-81	30.2	9525	-629	-9503	-63764	64472	XYZ
2004.5	D	-93	47.8	-81	30.5	9513	-630	-9491	-63719	64425	XYZ

Operations

The magnetic observer-in-charge at Casey in 2004 was an officer of the Australian Antarctic Division, of the Commonwealth Department of the Environment and Heritage. He was a member of the Australian National Antarctic Research Expedition (ANARE). GA partially funded the position to enable the operation of the magnetic observatory to continue.

The magnetic observer performed approximately weekly absolute observations on the observation piers in the ABSOLUTE HOUSE to calibrate the variometers and provided regular reports to GA in Canberra.

The EDA variometer produced 1-second samples that were recorded on an AAD computer via their Analogue Data Acquisition System (ADAS). These were sent daily by ftp to GA where they were reformatted and used to produce calibrated minute, monthly and annual mean magnetic values.

There was no PPM variometer operating at Casey in 2004.

Throughout 2004 AAD performed system tests on its ADAS acquisition system daily at UT 0001, 1200−1201 and 1630−1631. This contaminated the variometer data at these times, so they have been removed from processing.

Monthly and Annual Mean Values

The following table gives final monthly and annual mean values of each of the magnetic elements for the year.

A value is given for means computed from all days in each month (All days), the five least disturbed of the International Quiet days (5xQ days) in each month and the five International Disturbed days (5xD days) in each month.

Casey Station	2004	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	-608.0	-9497.8	-63713.1	64420.3	9518.4	-93° 39.8'	-81° 30.2'
	5xQ days	-601.9	-9489.9	-63700.2	64406.2	9509.8	-93° 37.9'	-81° 30.5'
	5xD days	-588.0	-9516.5	-63698.0	64408.2	9536.5	-93° 32.3'	-81° 29.1'
February	All days	-609.9	-9502.4	-63696.5	64404.4	9522.5	-93° 40.4'	-81° 29.8'
	5xQ days	-596.4	-9506.1	-63682.5	64390.9	9525.1	-93° 35.5'	-81° 29.6'
	5xD days	-587.7	-9508.0	-63690.5	64399.2	9526.8	-93° 32.3'	-81° 29.6'
March	All days	-621.7	-9492.9	-63702.1	64408.6	9513.5	-93° 44.8'	-81° 30.4'
	5xQ days	-638.7	-9484.3	-63686.8	64392.3	9505.9	-93° 51.2'	-81° 30.6'
	5xD days	-586.9	-9487.9	-63691.8	64397.4	9506.5	-93° 32.4'	-81° 30.7'
April	All days	-627.7	-9494.4	-63701.5	64408.2	9515.2	-93° 47.0'	-81° 30.3'
	5xQ days	-648.4	-9497.6	-63708.4	64415.8	9519.8	-93° 54.3'	-81° 30.1'
	5xD days	-616.4	-9494.1	-63712.5	64419.1	9514.3	-93° 42.9'	-81° 30.4'
May	All days	-631.6	-9488.7	-63698.6	64404.6	9509.7	-93° 48.5'	-81° 30.5'
	5xQ days	-630.1	-9488.2	-63690.4	64396.3	9509.1	-93° 48.0'	-81° 30.5'
	5xD days	-636.3	-9485.1	-63703.0	64408.4	9506.5	-93° 50.3'	-81° 30.7'
June	All days	-636.0	-9484.8	-63697.4	64402.9	9506.1	-93° 50.2'	-81° 30.7'
	5xQ days	-630.1	-9482.5	-63688.1	64393.3	9503.5	-93° 48.1'	-81° 30.8'
	5xD days	-644.4	-9482.0	-63705.7	64410.8	9504.0	-93° 53.3'	-81° 30.9'
July	All days	-645.5	-9490.9	-63720.1	64426.3	9513.0	-93° 53.5'	-81° 30.5'
	5xQ days	-632.7	-9488.9	-63682.4	64388.6	9510.0	-93° 48.9'	-81° 30.4'
	5xD days	-682.0	-9481.4	-63809.0	64513.4	9506.6	-94° 07.0'	-81° 31.6'
August	All days	-640.9	-9486.8	-63708.7	64414.3	9508.5	-93° 51.9'	-81° 30.7'
	5xQ days	-642.0	-9483.9	-63704.9	64410.2	9505.6	-93° 52.4'	-81° 30.8'
	5xD days	-653.5	-9484.8	-63734.7	64440.0	9507.5	-93° 56.5'	-81° 30.9'
September	All days	-634.4	-9487.5	-63705.2	64410.9	9508.9	-93° 49.5'	-81° 30.6'
	5xQ days	-633.4	-9488.1	-63699.9	64405.8	9509.3	-93° 49.2'	-81° 30.6'
	5xD days	-650.6	-9486.6	-63741.9	64447.4	9509.3	-93° 55.4'	-81° 30.9'
October	All days	-632.4	-9489.6	-63692.1	64398.3	9510.9	-93° 48.8'	-81° 30.4'
	5xQ days	-632.6	-9490.3	-63682.3	64388.7	9511.5	-93° 48.9'	-81° 30.3'
	5xD days	-634.1	-9488.1	-63714.0	64419.9	9509.8	-93° 49.5'	-81° 30.7'
November	All days	-624.4	-9493.4	-63697.9	64404.7	9514.7	-93° 45.8'	-81° 30.3'
	5xQ days	-609.2	-9487.5	-63685.7	64391.5	9507.2	-93° 40.5'	-81° 30.6'
	5xD days	-642.7	-9497.7	-63746.8	64454.4	9521.5	-93° 52.4'	-81° 30.3'
December	All days	-618.5	-9484.4	-63683.4	64388.9	9505.1	-93° 44.0'	-81° 30.7'
	5xQ days	-618.2	-9482.4	-63679.2	64384.4	9502.7	-93° 43.9'	-81° 30.7'
	5xD days	-633.3	-9479.1	-63680.6	64385.5	9501.0	-93° 49.4'	-81° 30.9'
Annual	All days	-627.6	-9491.1	-63701.4	64407.7	9512.2	-93° 47.0'	-81° 30.4'
Mean	5xQ days	-626.2	-9489.1	-63690.9	64397.0	9510.0	-93° 46.5'	-81° 30.5'
Values	5xD days	-629.7	-9490.9	-63719.0	64425.3	9512.5	-93° 47.8'	-81° 30.5'

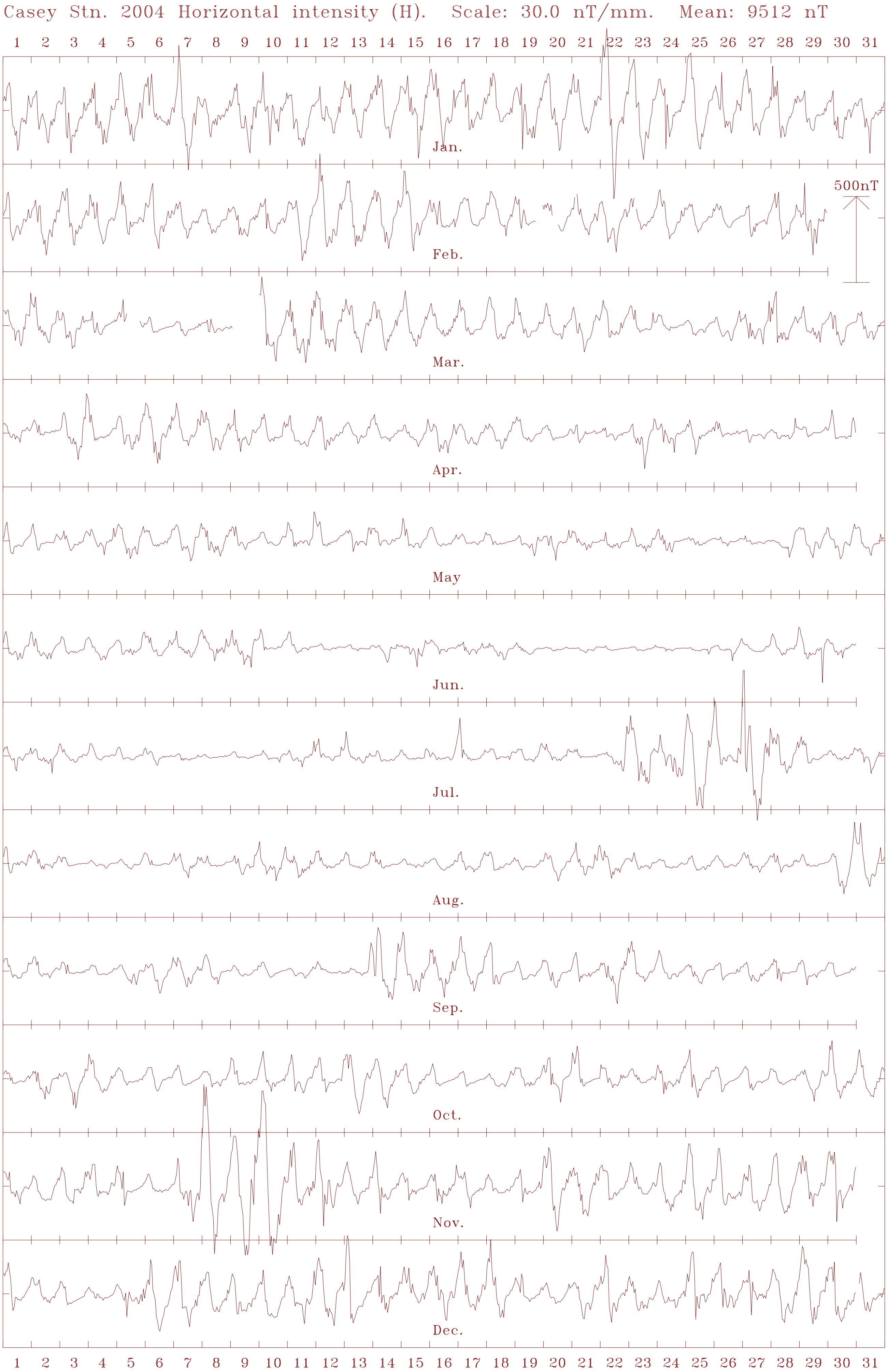
(Calculated: 13:55 hrs., Mon., 20 Feb., 2006)

Hourly Mean Values

The charts on the following pages are plots of hourly mean values.

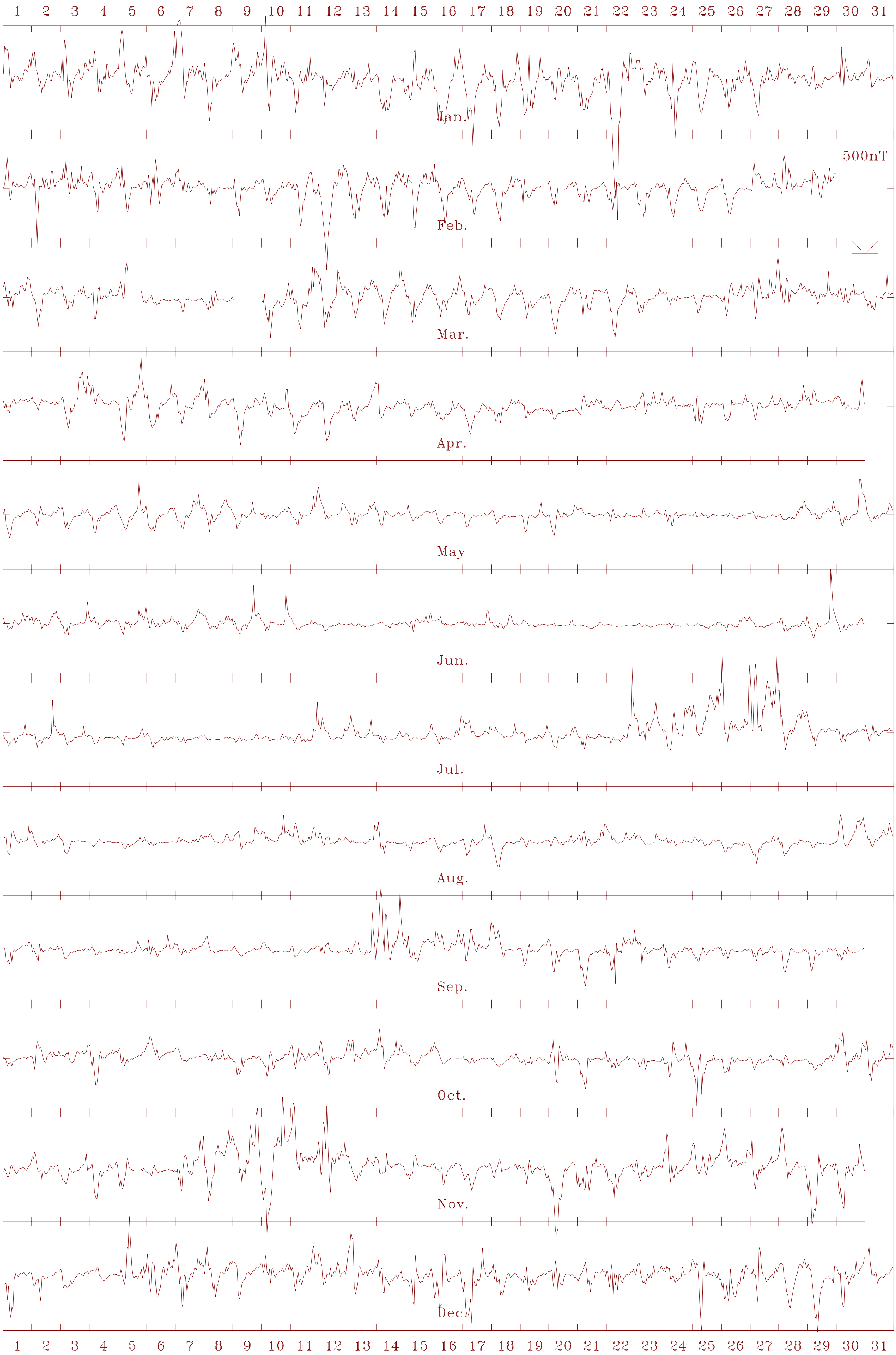
The reference levels indicated with marks on the vertical axes refer to the *all-days* mean value for the respective months. All elements in the plots are shown increasing (algebraically) towards the top of the page, with the exception of Z, which is in the opposite sense.

The mean value given at the top of each plot is the *all-days* annual mean value of the element.

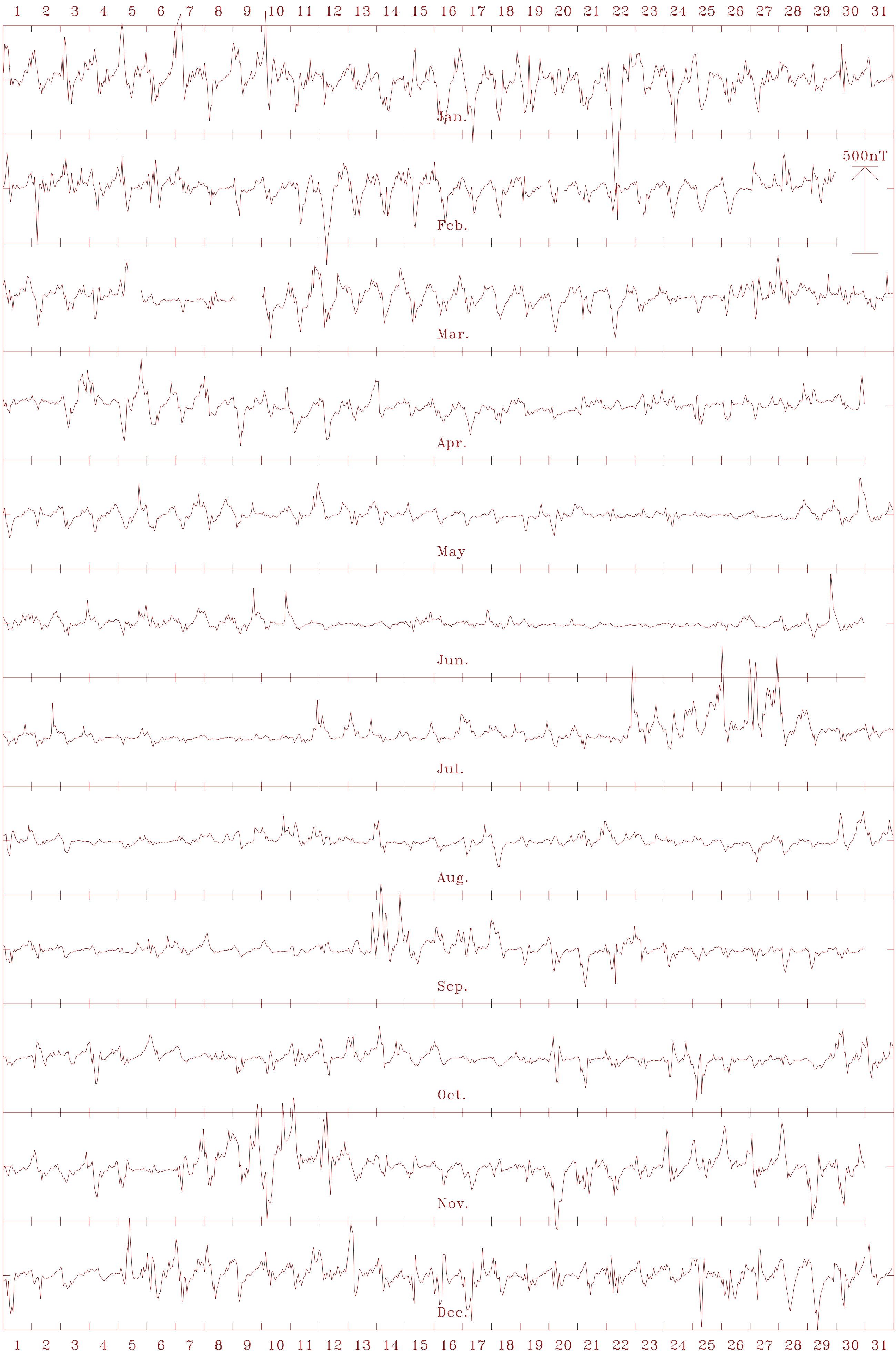

Casey Stn. 2004 Horizontal intensity (H). Scale: 30.0 nT/mm. Mean: 9512 nT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
Feb.
500nT
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

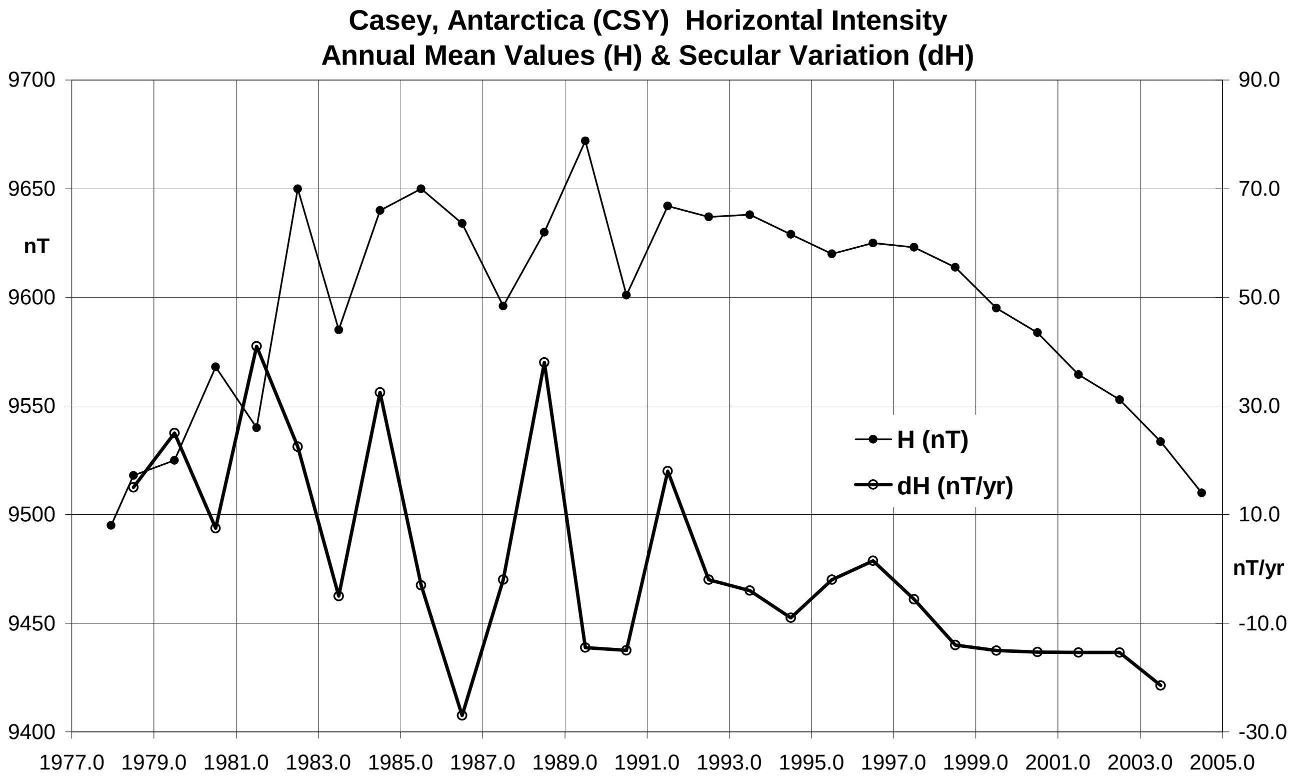
Casey Stn. 2004 Declination (east) (D). Scale: 12.0 min/mm. Mean: −93.78 deg.

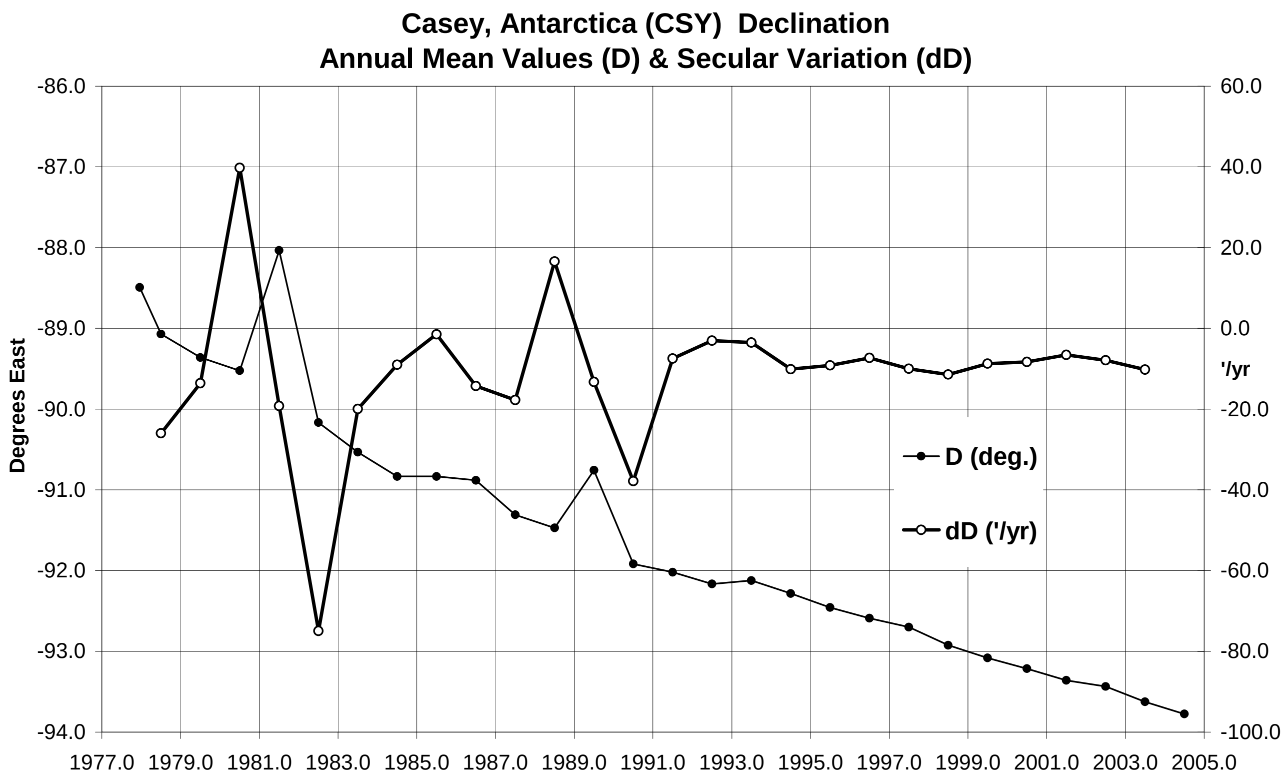
Casey Stn. 2004 Vertical intensity (Z). Scale: 30.0 nT/mm. Mean: -63701 nT

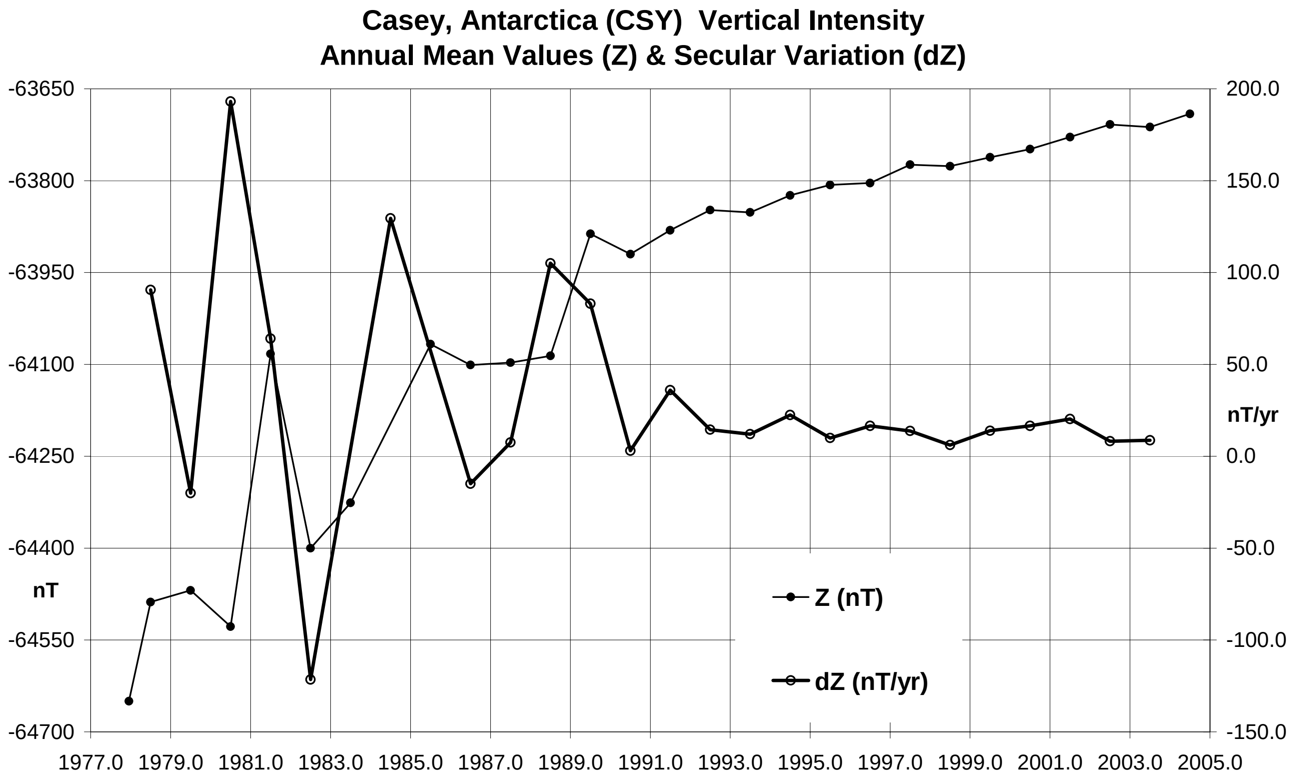


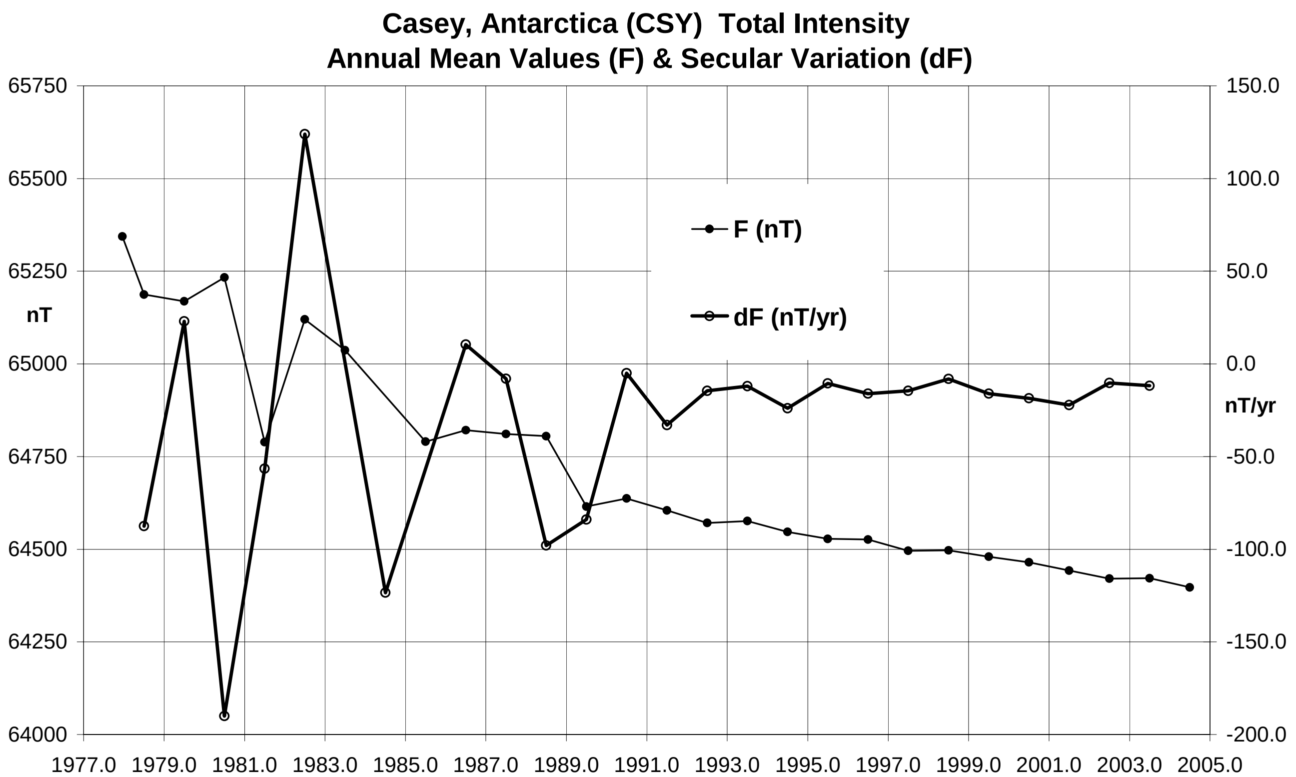
Casey Stn. 2004 Total intensity (F). Scale: 30.0 nT/mm. Mean: 64408 nT




Casey, Antarctica (CSY) Horizontal Intensity
Annual Mean Values (H) & Secular Variation (dH)
nT
nT/yr
H (nT)
dH (nT/yr)
9700
9650
9600
9550
9500
9450
9400
90.0
70.0
50.0
30.0
10.0
-10.0
-30.0
1977.0
1979.0
1981.0
1983.0
1985.0
1987.0
1989.0
1991.0
1993.0
1995.0
1997.0
1999.0
2001.0
2003.0
2005.0


Casey, Antarctica (CSY) Declination
Annual Mean Values (D) & Secular Variation (dD)
Degrees East
'/yr
D (deg.)
dD ('/yr)
-86.0
-87.0
-88.0
-89.0
-90.0
-91.0
-92.0
-93.0
-94.0
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
1977.0
1979.0
1981.0
1983.0
1985.0
1987.0
1989.0
1991.0
1993.0
1995.0
1997.0
1999.0
2001.0
2003.0
2005.0


Casey, Antarctica (CSY) Vertical Intensity
Annual Mean Values (Z) & Secular Variation (dZ)
-63650
-63800
-63950
-64100
-64250
-64400
-64550
-64700
nT
200.0
150.0
100.0
50.0
0.0
-50.0
-100.0
-150.0
nT/yr
Z (nT)
dZ (nT/yr)
1977.0 1979.0 1981.0 1983.0 1985.0 1987.0 1989.0 1991.0 1993.0 1995.0 1997.0 1999.0 2001.0 2003.0 2005.0


Casey, Antarctica (CSY) Total Intensity
Annual Mean Values (F) & Secular Variation (dF)
65750
65500
65250
65000
64750
64500
64250
64000
nT
150.0
100.0
50.0
0.0
-50.0
-100.0
-150.0
-200.0
nT/yr
F (nT)
dF (nT/yr)
1977.0 1979.0 1981.0 1983.0 1985.0 1987.0 1989.0 1991.0 1993.0 1995.0 1997.0 1999.0 2001.0 2003.0 2005.0

Significant Events in 2004 (CSY)

11 Feb — The acquisition computer required maintenance due to the detection of a computer virus. Some data loss from 11th to 24th (system calibrations). Several reboots and data loss.

05 Mar — 0800–2000: Contamination to data with a period of about 25 minutes. The station manager advised that the heating in the building that houses the variometer electronics was turned down at 0610UT. A large drift was recorded in the variometer during this period. These data were not included in final processing.

09 Mar — 0100–2340: Contamination to data with a period of about 25 minutes. These data were not included in final processing.

04 May — 0022: The station manager advised that the temperature in the building that houses the variometer electronics was increased to its normal value of approximately 20°C.

06 May — Steep drift in variometer data appears to have ceased.

10 May — ~0830: The station manager advised that the temperature in the building that houses the variometer electronics was again reduced, this time for the remainder of the winter.

31 Dec — Data missing due to a problem with AAD's GPS system.

Data losses in 2004

Short intervals of data were contaminated by daily calibration pulses automatically scheduled by AAD to occur at 0001, 1200−1201 and 1630−1631 on all days in 2004. These 5 minutes of data each day were removed from the GA data set.

There was no PPM recording variations in total intensity at Casey during 2004. The periods of data loss that follow refer to EDA fluxgate variometer data.

Jan 22 — 0431–0440 (10 min) All channels: System upgrades.

Feb 11 — 0935–1026 (52 min) All channels.

Feb 12 — 0640–0656 (17 min) All channels: System upgrades.

Feb 13 — 0155–0242 (48m); 0436–0438 (3m); 0440–0443 (4m): All channels: System upgrades.

Feb 18 — 0049–0053 (5 min) All channels: System upgrades.

Feb 19 — 0021–0023 (3m); 0031–0034 (4m); 0122–0125 (4m); 1016–1020 (5m); 1751–2315 (5h 25m) All channels: System upgrades.

Feb 20 — 0620–0625 (6m); 0749–0754 (6m); 0801–1153 (3h 53m) All channels: System upgrades.

Data losses (cont.)

Feb 21 — 0257–0304 (8m); 0308–0308 (1m); 0313–0409 (57m); 0737–0800 (24m) All channels: system upgrades.

Feb 23 — 0258–0347 (50m); 0457–0611 (1h 15m); 0657–0705 (9m); 0724–0730 (7m); 0758–0758 (1m) All channels: System upgrades.

Feb 24 — 0401–0435 (35m); 0514–0516 (3m); 0519–0521 (3m); 0524–0536 (13m); 0651–0657 (7m); 0701 (1m); 0718–0731 (14m); 2249–2250 (2m) All channels: System upgrades.

Mar 05 — 0821–1917 (10h 56m) All channels: Data contamination.

Mar 09 — 0124–2359 (22h 36m) All channels: Data contamination.

Apr 13 — 0039–0041 (3 min) All channels: System failure.

Apr 15 — 0244–0247 (4 min) All channels: System failure.

Jul 16 — 0022–0023 (2m); 0728–0729 (2m) All channels: System reboot.

Aug. 16 — 0728–0729 (2 min) All channels.

Oct 14 — 0504–0506 (3m); 0749–0750 (2m); 2256–2259 (4m) All channels: System reboot.

Oct 15 — 0014–0015 (2 min) All channels: System reboot.

Dec 31 — 0002–0209 (2h 08m) All channels: System reboot.

Distribution of CSY data

Preliminary Monthly Means for Project Ørsted

- Sent monthly by email to IPGP throughout 2004.

1-minute and Hourly Mean Values to WDCs

- 2003: WDC-A, Boulder, USA (sent 02 Sep. 2004)
- 2004: WDC-C1, Copenhagen, Denmark (sent 2 Jan 2006)
- 2004: WDC-A, Boulder, USA (sent 10 Jan. 2006)

1-minute Values for Project INTERMAGNET

- 2004: to Paris GIN (sent 22 Dec. 2005)

Enquiries for variation data from Casey for 1997 or earlier should be directed to the Atmospheric and Space Physics Section of the Australian Antarctic Division, Channel Highway, Kingston, Tasmania.

Notes and Errata (including Davis Station) (cumulative since *AGR'93*)

There was an inconsistency in the Davis magnetic H component monthly means in the *AGR1996*. Corrected values were given in the *AGR1997*.

The magnetic observatory is part of Mawson scientific research station, built on the edge of Horseshoe Harbour, MacRobertson Land , in Antarctica. It is built on bare charnockite basement rock: there is no ice or soil cover.

The magnetic observatory buildings, comprising the VARIOMETER HOUSE and the ABSOLUTE HOUSE, are situated on the south-east and inland side of the Mawson base, at the end of East Bay. They are in a magnetic quiet zone at an extremity of the Mason base.

In 1955 the Mawson observatory commenced recording magnetic variations with a three-component analogue magnetograph. The observatory has continuously recorded the geomagnetic field (and seismic activity) at Mawson since that time. In December 1985 the magnetic observatory was converted to digital recording. It is operated by Geoscience Australia as part of the Australian National Antarctic Research Expeditions (ANARE).

Further details of the observatory's history are in the *AGR 1994*.

Key data for Mawson Observatory:

- 3-character IAGA code: MAW
- Commenced operation: 1955
- Geographic latitude: 67° 36' 14" S
- Geographic longitude: 62° 52' 45" E
- Geomagnetic† : Lat. -73.08°; Long. 110.34°
- Lower limit for K index of 9: 1500 nT
- Principal pier identification: Pier A
- Elevation of top of Pier A: 12 metres AMSL
- Azimuth of principal reference (Mark BMR89/1 from Pier A): 350° 36.9'
- Distance to Mark BMR89/1: 112 metres
- Observers in Charge: R. Hegarty (2004, GA/BoM)
G. Roser (2005, GA/AAD)
- Observers in Charge:

† Based on the IGRF 2000.0 model updated to 2004.5

Variometers

A 3-axis Narod ringcore fluxgate (RCF) magnetometer and an Elsec 820M3 PPM continuously monitored variations in the Earth's magnetic field at Mawson throughout 2004. The RCF sensor was located within the sensor room of the MAW VARIOMETER HOUSE and the PPM sensor was in the recording room of the same building. This building also housed a global positioning system (GPS) clock, a data acquisition PC, a network PC, an Aironet ethernet radio link and a standby power supply.

Two of the orthogonal RCF magnetometer sensors were horizontal and oriented so that they were each at an angle of 45 degrees to the direction of the horizontal component of the magnetic field (ie 45° to the magnetic declination, D). The third sensor was aligned vertically, ie. parallel with the geomagnetic element Z.

The RCF produced 8 samples per second that were averaged and output as 1-second data. The PPM variometer produced 10-second samples.

The temperatures of the sensors and the electronics of the RCF system were monitored by its in-built dual temperature system. Temperature within the sensor room was kept close to 10°C by a fast-cycle heater and displayed by a Doric Trendicator digital thermometer with its sensor on a disused (PEM/Y) pier. The recorded variometer head and electronics temperatures were about 6.5±1.0°C (with a total range from 4.5°C to 10°C) throughout the year.

An old EDA 3-component fluxgate magnetometer and its associated data acquisition PC were available as a standby variometer to replace the principal system should it have become unserviceable. This system, also in the VARIOMETER HOUSE, was tested during a service visit by a Geomagnetism project officer (PGC) in January 2003, but was left powered off during 2004.

The F variometer performed very poorly throughout 2004. From late July it also began to auto-trigger rather than trigger on command from the acquisition computer, causing data sequence errors. This appeared as duplicate minute-records containing a single F value and did not harm the recorded or processed 1-minute vector data, but it was a hindrance to the detection of missing data.

Absolute Instruments and Corrections

The principal absolute magnetometers used to calibrate the recording variometers at Mawson in 2004 were Danish fluxgate magnetometer no. D26035 mounted on a Zeiss 020B theodolite no. 311542 and Elsec model 770 PPM no. 210 until the end of March, then GEM model GSM90 no. 3091315 from April 2004 onwards.

Danish fluxgate magnetometer no. DI0022 mounted on a Zeiss 020B theodolite no. 353758 was used monthly as a secondary instrument from February 2004 onwards.

Elsec model 770 PPM no. 199 was used as a secondary instrument until the end of March 2004, and Elsec model 770 PPM no. 210 was used as a secondary instrument from April onwards.

All absolute observations were performed on Pier A while the azimuth mark BMR89/1 was used as the declination reference.

Instrument comparisons performed at Mawson throughout 2004 indicated relative corrections to the absolute magnetometers in use at there were:

$$F\,(E770\_210) = F\,(E770\_199) + 1.7 \pm 0.5\text{nT}$$

$$F\,(GSM90\_3091315) = F\,(E770\_210) - 0.4 \pm 0.4\text{nT}$$

$$D\,(D26035/311542) = D\,(DI0022/353758) + 0.04' \pm 0.17'$$

$$I\,(D26035/311542) = I\,(DI0022/353758) + 0.07' \pm 0.04'$$

Instrument comparisons performed at Canberra Observatory on 01-02 December 2003 indicated that the corrections to the Mawson instruments, required to align them to Australian Magnetic Reference held at the Canberra Observatory, were:

$$F\,(GSM90\_3091315) = F\,(CNB) + 0.0\text{ nT}$$

$$D\,(DI0022/353758) = D\,(CNB) - 0.07'$$

$$I\,(DI0022/353758) = I\,(CNB) - 0.07'$$

The adopted instrument corrections for PPM GSM90_3091315 and to DIM D26035/311542 are respectively:

$$\Delta F = 0.0\text{ nT} \qquad \Delta D = 0.0' \qquad \Delta I = 0.0'$$

Mawson data in this report have been adjusted to the absolute instruments GSM90_3091315 and D26035/311542 using these "zero" adopted corrections, and as a consequence no corrections have been applied to the Mawson data in this report.

According to these measurements, after the adoption of E770_210 as the standard total intensity instrument, 2003 data should have been corrected by:

$$\Delta X = -0.1\text{ nT} \qquad \Delta Y = +0.1\text{ nT} \qquad \Delta Z = +0.4\text{ nT},$$

although **no** corrections were applied to those data as the above small values exceeded the standard deviations of their estimates. This resulted in a small step in the data across the 2003/2004 boundary.

Until the end of January 2004 classical magnetometers were routinely used to maintain calibration in case of failure of the primary instruments. They included an Askania declinometer (serial 630332), three horizontal magnetometers (QHM serial 300, 301, and 302) and Askania circle 611665. With the availability of DIM and PPM backup instruments, the classical instruments were placed out of service at the end of January 2004. No data analysis of those instruments for their brief service in 2004 is included in this report.

Baselines

The standard deviations between the adopted variometer model and data, and the absolute observations, were:

σ_X = 0.8nT σ_Y = 1.2nT σ_Z = 0.8nT.

(In terms of the absolute observed components, they were:

σ_F = 0.6nT σ_D = 10" σ_I =6")

Operations

The personnel who operated the Mawson observatory in 2004 were: the 2004 observer (RH) employed jointly by Geoscience Australia (GA) and the Bureau of Meteorology (BoM) who performed absolute observations from 19 November 2003; and the 2005 observer (GR) whose position with the Australian Antarctic Division (AAD) was partially funded by GA who performed absolute observations from 7 December 2004. They were members of the Australian National Antarctic Research Expedition (ANARE). The Mawson Station personnel changeover each summer, with varying amounts of overlap.

The observers were responsible for the continuous operation of the observatory and performed equipment maintenance as required. In 2004 the observers performed absolute observations once each week and forwarded them by e-mail to GA where all data processing was performed. During the observations the variometer system was also checked.

The 1-second RCF data and the 10-second PPM data as well as 1-minute means of both were recorded on an acquisition PC in the recorder room. The computer was connected to a pulse-per-second input from a GPS clock to keep the clock rate accurate. A PC running QNX, also in the VARIOMETER HOUSE, that was connected to the station's radio network-hub, automatically copied files from the acquisition PC each day.

The files on this PC were subsequently automatically retrieved at GA, Canberra, from a secure network by ftp via the ANARE satellite communications system. To ensure correct operation and to check system timing, the data acquisition system was routinely interrogated using a PC in the Science Building.

The recorder room also housed an uninterruptible power supply for power back-up.

In earlier years (particularly 2000) considerable effort was made to isolate the variometer system from static electricity sparks originating from the very dry blown snow during the severe blizzards that are common at Mawson. The sparks occasionally halted the acquisition computer. This seems to have improved the situation, but there are still unacceptable data losses during blizzards which also delay attention from the local observer for a few days. Blizzard was the major cause of data loss during 2004, either corrupting data or the computer clock, or halting the computer outright, and accounting for almost all of the 1.2% data loss for the year.

Operations (cont.)

The daily data were processed at GA then distributed, usually within a few hours after UT0. Daily data plots were examined at GA for possible problems, which were usually quickly rectified by the local observer. The final data for the year were reduced and analysed by GA staff.

On 1 November 2004, external mark LEE (1,561m from Pier A) was occupied for magnetic observations for the first time. The magnetic parts of the mark were temporarily removed during the observations. The observations were at 1.6m agl (above ground level – not above mark level). Two observations were made at LEE and compared to baselines on Pier A at a different time of the same day. There were inconsistencies between the declination results at LEE, but the second of the two observations seemed to be more internally consistent – both results summarised below:

1st set:	D at Pier A	=	D at LEE – 1.1'
	I at Pier A	=	I at LEE + 1.6'
	F at Pier A	=	F at LEE – 1.4 nT
2nd set	D at Pier A	=	D at LEE + 4.7'
	I at Pier A	=	I at LEE + 1.6'
	F at Pier A	=	F at LEE – 1.4 nT

The external mark BMR89/2 could not be occupied during the latter stages of the 2004 observer's (RH's) term as it remained buried under snow until he departed Mawson.

On 8 March 2004, a round of angles using BMR89/1 (Ref. azimuth 350º 36.9' at Pier A) and marks A, BMR89/2, BMR85/2, and SOH gave unexpected results for A and BMR85/2. The round of angles was repeated on 26 April 2004, including the same marks and also LEE. These results were within 0.1' of the expected results, with the exception of BMR85/2 which was 0.2' lower than expected.

The conclusion was that the marks and Pier A were stable.

Data losses in 2004

Mar 08	0745−0748 (4 min) All channels: Unknown cause.
May 04	2244-to 06 / 0504 (1d 6h 21m) All channels: Blizzard.
Jun 09	1600−2047 (4h 48m) All channels: Most likely caused by blizzard.
Jul 24	2333 to 26 / 0747 (1d 08h 15m) All channels: Blizzard.
Aug 25	1338−1339 (2 min) All channels: Most likely caused by blizzard.
Aug 25	1410 to 27 / 0214 (1d 12h 05m) All channels: Blizzard.

The F variometer data from about half of all days during the year was not usable and so withheld from processing.

Mawson Annual Mean Values

The table below gives annual mean values calculated using the monthly mean values over **All** days, the 5 International **Quiet** days and the 5 International **Disturbed** days in each month as indicated. Plots of these data with secular variation in H, D, Z & F are on pages 104 & 105.

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1955.5		-58	38.1	-69	33.3	18272	9854	-15387	-49012	52307	DHZ
1956.5		-58	53.2	-69	32.5	18282	9927	-15352	-49006	52305	DHZ
1957.5		-59	08.7	-69	31.1	18292	9461	-15655	-48974	52279	DHZ
1958.5		-59	25.6	-69	30.3	18293	9538	-15610	-48940	52247	DHZ
1959.5		-59	42.6	-69	28.5	18293	9615	-15562	-48860	52172	DHZ
1960.5		-59	59.6	-69	25.2	18323	9708	-15540	-48800	52127	DHZ
1961.5		-60	14.6	-69	23.1	18322	9228	-15828	-48707	52039	DHZ
1962.5		-60	30.1	-69	21.1	18333	9305	-15796	-48650	51990	DHZ
1963.5		-60	45.2	-69	17.6	18356	9386	-15775	-48562	51915	DHZ
1964.5		-60	59.2	-69	15.4	18353	9449	-15734	-48460	51819	DHZ

continued next page …

MAW – Annual Mean Values (cont.)

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1965.5		-61	12.6	-69	13.1	18356	8958	-16022	-48368	51734	DHZ
1966.5		-61	24.0	-69	09.6	18362	9014	-15997	-48235	51612	DHZ
1967.5		-61	34.4	-69	07.2	18374	9068	-15980	-48168	51553	DHZ
1968.5		-61	43.8	-69	05.2	18365	9107	-15948	-48060	51449	DHZ
1969.5		-61	53.0	-69	03.4	18353	9144	-15913	-47954	51346	DHZ
1970.5		-62	00.5	-69	00.4	18358	8621	-16208	-47840	51241	DHZ
1971.5		-62	05.3	-68	56.4	18375	8652	-16211	-47719	51135	DHZ
1972.5		-62	11.4	-68	53.1	18381	8683	-16201	-47600	51026	DHZ
1973.5		-62	17.6	-68	49.7	18391	8717	-16194	-47486	50923	DHZ
1974.5		-62	24.8	-68	47.2	18390	8750	-16175	-47380	50824	DHZ
1975.5		-62	31.4	-68	44.0	18397	8785	-16164	-47269	50723	DHZ
1976.5		-62	37.3	-68	40.0	18418	8823	-16167	-47157	50626	DHZ
1977.5		-62	43.9	-68	36.9	18425	8857	-16157	-47051	50530	DHZ
1978.5		-62	51.9	-68	35.5	18421	8893	-16132	-46986	50468	DHZ
1979.5		-62	57.9	-68	32.9	18425	8923	-16120	-46890	50380	DHZ
1980.5		-63	05.8	-68	29.8	18432	8396	-16409	-46784	50284	DHZ
1981.5		-63	14.6	-68	27.1	18443	8443	-16397	-46705	50215	DHZ
1982.5		-63	21.2	-68	25.5	18433	8470	-16372	-46616	50128	DHZ
1983.5		-63	26.6	-68	22.3	18439	8498	-16364	-46503	50025	DHZ
1984.5		-63	33.1	-68	19.3	18446	8532	-16354	-46404	49936	DHZ
1985.5		-63	40.2	-68	17.0	18457	8571	-16346	-46342	49882	DHZ
1986.5		-63	48.7	-68	15.1	18460	8613	-16328	-46276	49822	XYZ
1987.5		-63	56.6	-68	12.5	18470	8655	-16317	-46198	49753	XYZ
1988.5		-64	04.4	-68	10.7	18475	8120	-16595	-46142	49703	XYZ
1989.5		-64	12.8	-68	09.7	18474	8160	-16574	-46099	49663	XYZ
1990.5		-64	21.1	-68	06.4	18492	8208	-16570	-46015	49592	XYZ
1991.5		-64	28.8	-68	04.2	18502	8250	-16561	-45957	49542	XYZ
1992.5	Q	-64	36.5	-68	01.7	18513	7938	-16724	-45885	49479	XYZ
1993.5	Q	-64	43.6	-67	59.4	18522	7908	-16749	-45819	49422	ABC
1994.5	Q	-64	51.8	-67	57.4	18537	7874	-16781	-45779	49389	ABC
1995.5	Q	-65	00.4	-67	55.3	18550	7838	-16813	-45731	49350	ABC
1996.5	Q	-65	09.2	-67	53.5	18561	7799	-16843	-45692	49318	ABC
1997.5	Q	-65	18.9	-67	52.0	18572	7757	-16875	-45663	49295	ABC
1998.5	Q	-65	28.6	-67	51.3	18575	7710	-16900	-45642	49277	ABC
1999.5	Q	-65	38.5	-67	50.2	18579	7663	-16925	-45611	49250	ABC
2000.5	Q	-65	48.0	-67	49.6	18579	7616	-16946	-45585	49225	ABC
2001.5	Q	-65	56.3	-67	48.9	18577	7574	-16963	-45555	49198	ABC
2002.5	Q	-66	05.2	-67	48.2	18581	7532	-16986	-45540	49185	ABC
2003.5	Q	-66	14.7	-67	48.7	18570	7481	-16997	-45532	49174	ABC
2004.5	Q	-66	23.5	-67	48.1	18568	7436	-17014	-45503	49146	ABC
1992.5	A	-64	36.9	-68	02.8	18499	7930	-16712	-45894	49482	XYZ
1993.5	A	-64	44.2	-68	00.7	18506	7898	-16736	-45830	49426	ABC
1994.5	A	-64	52.9	-67	59.4	18511	7858	-16760	-45794	49394	ABC
1995.5	A	-65	00.9	-67	56.7	18532	7828	-16798	-45741	49352	ABC
1996.5	A	-65	09.8	-67	54.5	18548	7791	-16833	-45698	49319	ABC
1997.5	A	-65	19.4	-67	53.0	18560	7749	-16865	-45670	49297	ABC
1998.5	A	-65	29.1	-67	52.4	18561	7702	-16887	-45648	49278	ABC
1999.5	A	-65	39.0	-67	51.5	18561	7653	-16910	-45618	49250	ABC
2000.5	A	-65	48.2	-67	50.6	18566	7610	-16935	-45594	49230	ABC
2001.5	A	-65	56.2	-67	49.8	18567	7571	-16953	-45565	49203	ABC
2002.5	A	-66	05.8	-67	49.3	18568	7524	-16975	-45546	49185	ABC
2003.5	A	-66	15.6	-67	50.7	18546	7466	-16976	-45546	49177	ABC
2004.5	A	-66	24.1	-67	49.6	18549	7426	-16998	-45514	49149	ABC
1992.5	D	-64	39.6	-68	05.2	18466	7904	-16689	-45907	49482	XYZ
1993.5	D	-64	45.9	-68	03.0	18476	7877	-16713	-45847	49430	ABC
1994.5	D	-64	55.3	-68	01.9	18476	7831	-16734	-45804	49390	ABC
1995.5	D	-65	01.7	-67	58.8	18504	7812	-16774	-45752	49353	ABC
1996.5	D	-65	11.1	-67	56.2	18525	7775	-16814	-45707	49318	ABC
1997.5	D	-65	20.4	-67	55.0	18534	7733	-16844	-45682	49299	ABC
1998.5	D	-65	30.9	-67	54.8	18530	7680	-16864	-45665	49282	ABC
1999.5	D	-65	41.0	-67	53.9	18528	7630	-16884	-45626	49245	ABC
2000.5	D	-65	49.7	-67	52.6	18543	7593	-16917	-45614	49239	ABC
2001.5	D	-65	56.4	-67	51.6	18547	7561	-16935	-45583	49212	ABC
2002.5	D	-66	07.6	-67	51.2	18540	7504	-16953	-45552	49180	ABC
2003.5	D	-66	17.4	-67	53.3	18510	7443	-16947	-45556	49173	ABC
2004.5	D	-66	26.0	-67	52.1	18517	7404	-16972	-45530	49152	ABC

* Elements ABC indicates non-aligned variometer orientation

Distribution of MAW data

Preliminary Monthly Means for Project Ørsted

- Sent monthly by e-mail to IPGP

1-minute and Hourly Mean Values to WDCs

- 2003 data: WDC-A, Boulder, USA (sent 19 Apr. 2004)
- 2004 data: WDC-A, Boulder, USA (sent 10 Jan. 2006)

1-minute Values for Project INTERMAGNET

- 2003 data: WDC-C1, Copenhagen, Den. (sent 19 Apr. 2004)

Significant Events in 2004

Nov 19 2003	The 2003 observer (KS) handed over responsibility for absolute observations and the observatory to the 2004 observer (RH).
Jan 26	to Jan 31: Mawson station resupply going on.
Feb 02	PPM variometer sensor no.28079910 installed, which performed poorly.
Feb 10	Installed *spare* PPM sensor in variometer (may have been E820_158 incorrectly recorded as E820_159)
Feb 11	New GSM90 installed in the ABSOLUTE HOUSE.
Feb 19	Heater removed from ABSOLUTE HOUSE for repair.
Feb 25	New DIM installed in ABSOLUTE HOUSE.
Feb 27	Repaired heater re-installed in ABSOLUTE HOUSE.
March	PDA software for running GSM90 installed and GSM90 phased in as primary absolute F reference.
Mar 08	Round of angles from Pier A measured.
Apr 05	Floppy-disc drive removed from VARIOMETER HOUSE.
Apr 26	Another round of angles from Pier A measured.
May 11	Blown light bulb removed from VARIOMETER HOUSE.
May 18	New light bulb installed in VARIOMETER HOUSE.
May 31	0530–0550: Maintenance carpenter inspected VARIOMETER HOUSE.

Significant Events (cont.)

Jun 11	Acquisition time adjusted by −1s following reboot.
Jul 26	Acquisition time adjusted by −1s following reboot. Variometer PPM began to self-trigger.
Aug 20	Connection re-seated after the acquisition PC keyboard had locked-up.
Aug 23	0808: Acquisition time adjusted by +1s.
Aug 27	Acquisition PC rebooted and time adjusted by −1s. Narod RCF magnetometer reset.
Nov 01	LEE (Lee Island marker) absolute observations made for external remote reference.
Dec 07	The 2004 observer (RH) handed over responsibility for absolute observations and the observatory to the 2005 observer (GR).

K indices

The table on the next page shows Mawson K indices for 2004. Using the digital data, these have been derived by a computer algorithm that calculates a simple range in the X and Y magnetic components over each 3-hour UT period. The K indices were calculated from the maximum of the X and Y ranges in the usual manner. This was suitable for Mawson as the diurnal variation is small.

Notes and Errata (cumulative since *AGR'93)*

In *AGR1998* through to *AGR2001* the principle azimuth mark at Mawson (MAW) was reported as being BMR89/2 at an azimuth of 19° 14.0' and distance of 105m from principle observation Pier A. This mark ceased to be used after May 1998, from when mark BMR89/1 was principally used.

K indices and Daily K sums at Mawson Antarctica (K=9 limit: 1500 nT) for 2004

Date	January	February	March	April	May	June	Date
01	5554 5456 39	4553 4355 34	5444 4776 41	Q 3221 2142 17	6544 3244 32	D 6644 3346 36	01
02	6534 4456 37	4454 4546 36	D 5454 3376 37	Q 3221 0110 10	4321 0054 19	6544 2355 34	02
03	4655 4464 38	5565 4545 39	3534 4351 28	D 3553 4656 37	2334 3255 27	4443 2226 27	03
04	5554 6564 40	6344 4346 34	2333 2333 22	5423 2312 22	3542 1166 28	5433 4244 29	04
05	6644 4776 44	5544 3333 30	5543 2204 25	D 2121 3675 27	D ---- ---- --	4431 2446 28	05
06	5563 3346 35	4664 3663 38	Q 3323 2113 18	D 5555 4266 38	--44 3256 --	4553 4265 34	06
07	D 5776 6564 46	4443 3233 26	Q 2212 2245 20	6543 2275 34	D 3554 3476 37	5432 3246 29	07
08	Q 3333 4235 26	Q 3223 2125 20	Q 2232 2212 16	5544 3366 36	4534 3355 32	5433 4252 28	08
09	4654 4564 38	2322 4355 26	D 2433 4556 32	D 3554 2365 33	4431 1214 20	D 6454 3--5 --	09
10	5454 4773 39	Q 4333 3324 25	D 6665 4267 42	3452 3276 32	3421 1155 22	6431 2065 27	10
11	3445 5645 36	D 3334 5674 35	D 5554 5676 43	5443 2465 33	6532 1157 30	6433 3112 23	11
12	Q 3322 4475 30	D 6666 4575 45	D 6555 3676 43	5553 3252 30	4732 1264 29	1222 1003 11	12
13	4443 5545 34	D 5654 4765 42	5453 4465 36	5332 2254 26	3554 2365 33	3121 1105 14	13
14	Q 5533 4444 32	5455 4675 41	5554 3475 38	4421 1125 20	3531 2114 20	3345 3343 28	14
15	5542 4765 38	D 6666 3556 43	5543 4565 37	3312 3346 25	7342 2135 27	D 2464 4366 35	15
16	D 5666 5566 45	5433 2253 27	5432 3366 32	3663 3365 35	Q 4332 1125 21	5443 2114 24	16
17	5555 3566 40	Q 4442 2244 26	4542 2245 28	4533 2244 27	Q 3311 1135 18	4443 3254 29	17
18	3463 4376 36	5532 2455 31	5452 3465 34	3552 3346 31	Q 4212 2112 15	3344 4332 26	18
19	3544 4756 38	4432 1256 27	6432 2133 24	5542 2435 30	2321 3533 22	4333 2221 20	19
20	5654 5646 41	Q 4431 2353 25	6442 2655 34	Q 4422 1125 21	D 3344 2235 26	Q 2221 2121 13	20
21	4653 4465 37	5422 4345 29	6443 3464 34	2522 1152 20	5543 2223 26	2222 2134 18	21
22	D 7777 6675 52	5433 3345 30	5443 3645 34	Q 2221 1232 15	3543 3212 23	Q 1220 0012 08	22
23	D 6655 6675 46	3433 3246 28	4442 2275 30	D 3335 4447 33	5433 2363 29	Q 2111 1114 12	23
24	6454 3356 36	5553 2555 35	Q 3311 1004 13	3343 3225 25	5455 4113 28	0121 1000 05	24
25	D 6665 5655 44	4442 2234 25	Q 3121 2231 15	3544 3255 31	4333 3222 22	Q 1101 0013 07	25
26	4544 4475 37	Q 4431 2111 17	3332 3566 31	4321 1254 22	Q 2332 2114 18	3101 1345 18	26
27	5543 4335 32	2633 2244 26	4344 4536 33	3211 0236 18	Q 3321 2223 18	Q 3221 0134 16	27
28	7664 3365 40	3674 3356 37	4754 3463 36	5121 1276 25	3222 2365 25	D 5534 2136 29	28
29	Q 3533 4235 28	D 4654 4346 36	3544 3435 31	Q 3322 1136 21	D 4643 3366 35	D 4655 3365 37	29
30	5545 4445 36		3444 5234 29	4552 2367 34	5333 3265 30	4543 3244 29	30
31	Q 3435 3223 25		3332 3462 26		D 6554 3364 36		31
Mean K-sum	**37.6**	**31.5**	**30.4**	**26.9**	**25.8**	**23.2**	

Date	July	August	September	October	November	December	Date
01	5443 3266 33	7431 1056 27	4432 2266 29	2222 1244 19	3323 3214 21	4664 3245 34	01
02	4532 2436 29	3433 1145 24	5333 1144 24	4443 3335 29	Q 4323 3332 23	Q 4331 3333 23	02
03	4332 2252 23	Q 3321 0000 09	Q 2311 1112 12	3434 4456 33	4323 2345 26	Q 3222 2234 20	03
04	5532 2225 26	Q 0131 1111 09	Q 2111 1013 10	D 6542 3455 34	3552 2355 30	Q 3121 1022 12	04
05	5422 2235 25	1222 2346 22	3222 2442 21	4332 1234 22	Q 6221 0112 15	3343 2233 23	05
06	Q 5542 2114 24	4320 1014 15	D 4344 4545 33	3333 2234 23	Q 2321 2022 14	D 4665 6465 42	06
07	Q 1321 1033 14	6654 3356 38	4453 4365 34	Q 3321 1111 13	D 4523 3566 34	5554 4456 38	07
08	Q 2200 0011 06	Q 3421 1234 20	5563 2234 30	2332 3325 23	D 9676 6366 49	4564 3435 34	08
09	Q 4420 1122 16	3453 3375 33	2211 2235 18	5321 1224 20	D 6756 5787 51	4433 3334 27	09
10	3432 1334 23	D 4322 3757 33	Q 3221 1100 10	6522 3135 27	D 7776 6766 52	4434 4434 30	10
11	3313 2247 25	2444 3266 31	Q 0010 1244 12	4542 2256 30	5666 2335 36	3442 4455 31	11
12	6543 1136 29	5432 3234 26	Q 4210 0102 10	5543 2115 26	D 6645 4665 42	D 5653 4533 34	12
13	6454 2365 35	4532 1336 27	2100 0055 13	D 5564 4465 39	4443 3233 26	6643 3322 29	13
14	2443 1125 22	4333 1104 19	D 5664 5566 43	D 5554 4565 39	5543 2223 26	3344 4333 27	14
15	4222 1265 24	2100 0023 08	6532 4545 34	3533 2355 29	Q 3331 2011 14	4442 3454 30	15
16	2222 2246 22	2211 4236 21	D 5454 4566 39	4422 1003 16	2334 4444 28	3652 4345 32	16
17	7562 2246 34	4311 2655 27	D 4554 3337 34	Q 2221 0102 10	3443 2124 23	D 4654 4556 39	17
18	4343 1244 25	4553 1015 24	6633 3102 24	2021 2254 18	Q 3221 2211 14	6554 4255 36	18
19	3333 2336 26	4211 0234 17	2121 1237 19	3322 3215 21	2422 2234 21	Q 4332 1222 19	19
20	4542 2155 28	D 5443 3446 33	4344 4314 27	3442 4425 28	4664 4354 36	4422 3245 28	20
21	Q 3320 0114 14	D 4653 2376 36	5543 2234 28	6653 2244 32	4554 4565 38	4434 3464 32	21
22	2112 4377 27	5553 3366 36	D 3443 4767 38	4422 2343 24	4553 2224 27	D 4674 4325 35	22
23	D 6775 3644 42	5542 2233 26	5553 2235 30	Q 2322 1115 17	5422 2235 25	4443 3344 29	23
24	D 4564 4536 37	Q 3221 1221 14	4523 1234 24	5332 2553 28	4433 3334 27	Q 3332 3233 22	24
25	D ---- ---- --	Q 1442 1--- --	2222 3244 21	3654 3324 30	5654 4564 39	5663 2344 33	25
26	D --34 3369 --	---- ---- --	2221 1135 17	Q 3321 2101 13	4553 3346 33	4543 3454 32	26
27	D 8787 6679 58	-231 2135 --	4221 2432 20	2121 2224 16	4453 4654 35	4552 2354 30	27
28	5553 4576 40	4333 2254 26	3532 2125 23	Q 3321 1124 17	5564 4345 36	4544 4576 39	28
29	5443 3143 27	3412 2123 18	3122 1134 17	3223 3442 23	5555 3456 38	5565 4445 38	29
30	3323 2245 24	D 4455 3767 41	4120 1043 15	D 6544 3436 35	5763 3374 38	D 4665 5545 40	30
31	3322 3334 23	D 6664 3474 40		D 3433 3476 33		5433 2334 27	31
Mean K-sum	**26.9**	**25.0**	**23.6**	**24.7**	**30.6**	**30.4**	

Occurrence distribution of K-indices

K-Index:	0	1	2	3	4	5	6	7	8	9	-
January	0	0	7	37	65	72	49	18	0	0	0
February	0	7	30	53	61	48	28	5	0	0	0
March	3	12	38	55	57	46	28	9	0	0	0
April	3	27	56	50	33	45	20	6	0	0	0
May	2	32	46	64	38	36	16	4	0	0	10
June	16	38	43	47	52	24	18	0	0	0	2
July	8	23	54	50	41	28	20	10	2	2	10
August	15	37	39	53	40	25	19	8	0	0	12
September	16	38	52	40	45	31	14	4	0	0	0
October	6	28	62	57	46	35	13	1	0	0	0
November	3	12	42	52	48	40	31	10	1	1	0
December	1	5	31	63	80	43	23	2	0	0	0
ANNUAL TOTAL	**73**	**259**	**500**	**621**	**606**	**473**	**279**	**77**	**3**	**3**	**34**

Monthly and Annual Mean Values

The following table gives final monthly and annual mean values of each of the magnetic elements for the year.

A value is given for means computed from all days in each month (All days), the five least disturbed of the International Quiet days (5xQ days) in each month and the five International Disturbed days (5xD days) in each month.

Mawson Antarctica	2004	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	7463.3	-16994.3	-45516.3	49155.4	18561.1	-66° 17.5'	-67° 48.9'
	5xQ days	7477.6	-17016.5	-45514.1	49163.2	18587.0	-66° 16.7'	-67° 47.2'
	5xD days	7432.8	-16959.9	-45540.9	49162.0	18517.6	-66° 20.1'	-67° 52.3'
February	All days	7448.4	-16992.0	-45525.2	49160.6	18552.9	-66° 19.8'	-67° 49.7'
	5xQ days	7453.3	-17003.5	-45524.5	49164.6	18565.3	-66° 19.8'	-67° 48.8'
	5xD days	7442.0	-16976.7	-45529.7	49158.6	18536.4	-66° 19.8'	-67° 50.8'
March	All days	7432.2	-16986.6	-45528.6	49159.4	18541.4	-66° 22.2'	-67° 50.5'
	5xQ days	7446.4	-17009.9	-45505.5	49148.1	18568.4	-66° 21.5'	-67° 48.1'
	5xD days	7420.2	-16960.8	-45560.9	49178.8	18513.1	-66° 22.3'	-67° 53.2'
April	All days	7426.1	-16988.7	-45520.5	49151.6	18540.8	-66° 23.4'	-67° 50.3'
	5xQ days	7439.1	-17007.8	-45505.8	49146.6	18563.5	-66° 22.6'	-67° 48.5'
	5xD days	7426.8	-16975.7	-45525.5	49152.0	18529.3	-66° 22.3'	-67° 51.2'
May	All days	7424.8	-16992.9	-45509.5	49142.8	18544.2	-66° 23.9'	-67° 49.8'
	5xQ days	7433.4	-17006.2	-45499.1	49139.0	18559.8	-66° 23.4'	-67° 48.5'
	5xD days	7416.1	-16985.4	-45512.6	49141.8	18534.0	-66° 24.8'	-67° 50.5'
June	All days	7426.1	-17001.9	-45497.0	49134.4	18553.0	-66° 24.3'	-67° 48.9'
	5xQ days	7437.0	-17014.5	-45489.2	49133.2	18568.9	-66° 23.4'	-67° 47.7'
	5xD days	7406.9	-16985.6	-45495.7	49124.8	18530.4	-66° 26.4'	-67° 50.3'
July	All days	7409.4	-16990.0	-45509.1	49139.1	18535.5	-66° 26.3'	-67° 50.4'
	5xQ days	7431.1	-17012.5	-45489.8	49132.2	18564.6	-66° 24.3'	-67° 48.0'
	5xD days	7332.5	-16908.2	-45573.7	49159.8	18430.1	-66° 33.4'	-67° 58.9'
August	All days	7412.6	-16995.7	-45510.6	49142.8	18541.9	-66° 26.2'	-67° 50.0'
	5xQ days	7426.3	-17016.4	-45505.4	49147.2	18566.3	-66° 25.4'	-67° 48.3'
	5xD days	7391.8	-16962.8	-45513.2	49130.9	18503.5	-66° 27.3'	-67° 52.5'
September	All days	7412.2	-17001.4	-45514.2	49148.1	18547.0	-66° 26.7'	-67° 49.7'
	5xQ days	7424.0	-17015.7	-45502.6	49144.1	18564.8	-66° 25.7'	-67° 48.3'
	5xD days	7390.5	-16977.2	-45513.3	49135.9	18516.2	-66° 28.6'	-67° 51.7'
October	All days	7415.2	-17004.4	-45505.5	49141.5	18550.9	-66° 26.4'	-67° 49.3'
	5xQ days	7422.9	-17017.2	-45498.0	49140.1	18565.7	-66° 26.0'	-67° 48.1'
	5xD days	7393.5	-16978.7	-45514.7	49138.1	18518.8	-66° 28.2'	-67° 51.6'
November	All days	7412.3	-17007.8	-45529.2	49164.3	18553.0	-66° 27.1'	-67° 49.8'
	5xQ days	7421.4	-17019.3	-45503.4	49145.7	18567.1	-66° 26.4'	-67° 48.2'
	5xD days	7370.7	-16973.8	-45586.9	49200.3	18505.8	-66° 31.7'	-67° 54.3'
December	All days	7423.6	-17017.6	-45506.9	49148.8	18566.4	-66° 25.9'	-67° 48.3'
	5xQ days	7420.6	-17024.5	-45503.5	49147.4	18571.5	-66° 26.9'	-67° 47.9'
	5xD days	7418.1	-17016.2	-45494.4	49135.9	18563.1	-66° 26.8'	-67° 48.2'
Annual	All days	7425.5	-16997.8	-45514.4	49149.1	18549.0	-66° 24.1'	-67° 49.6'
Mean	5xQ days	7436.1	-17013.7	-45503.4	49145.9	18567.7	-66° 23.5'	-67° 48.1'
Values	5xD days	7403.5	-16971.8	-45530.1	49151.6	18516.5	-66° 26.0'	-67° 52.1'

(Calculated: 15:51 hrs., Tue., 24 Jan., 2006)

Hourly Mean Values

The charts on the following pages are plots of hourly mean values.

The reference levels indicated with marks on the vertical axes refer to the *all-days* mean value for the respective months. All elements in the plots are shown increasing (algebraically) towards the top of the page, with the exception of Z, which is in the opposite sense.

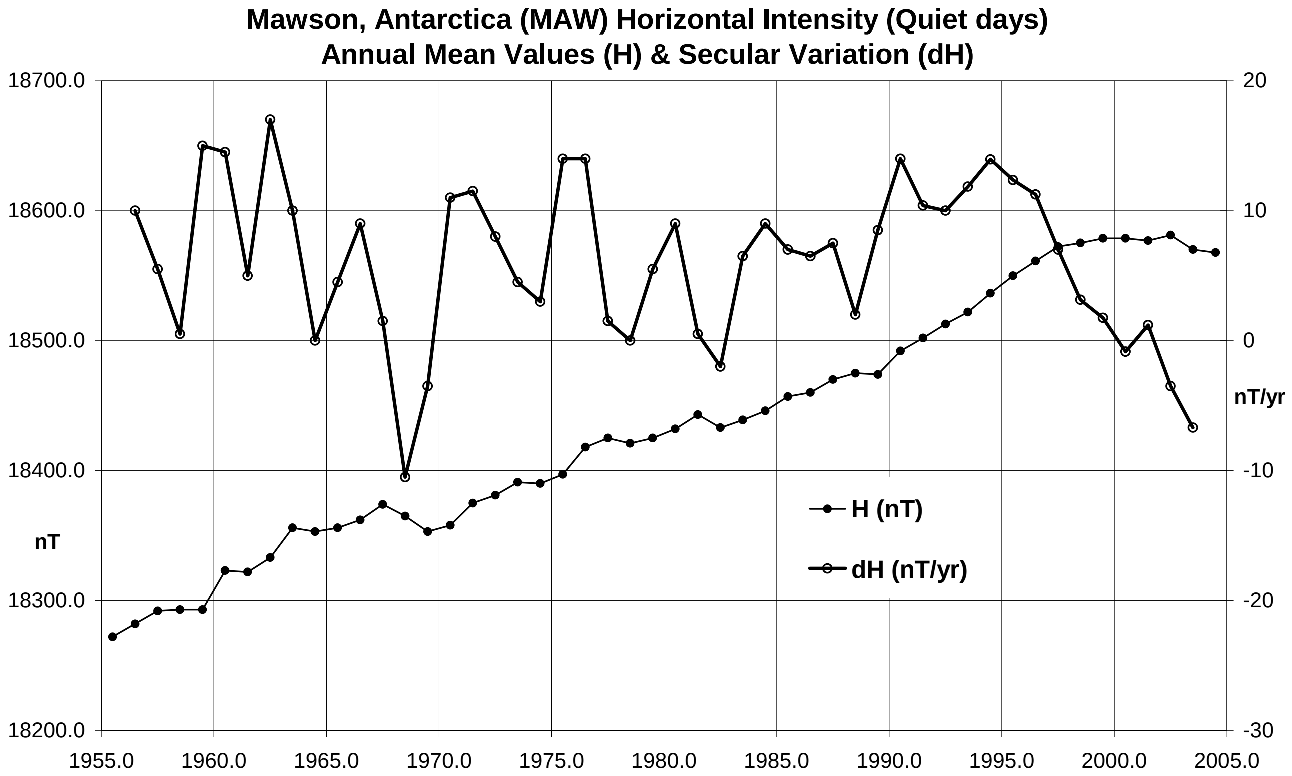
The mean value given at the top of each plot is the *all-days* annual mean value of the element.

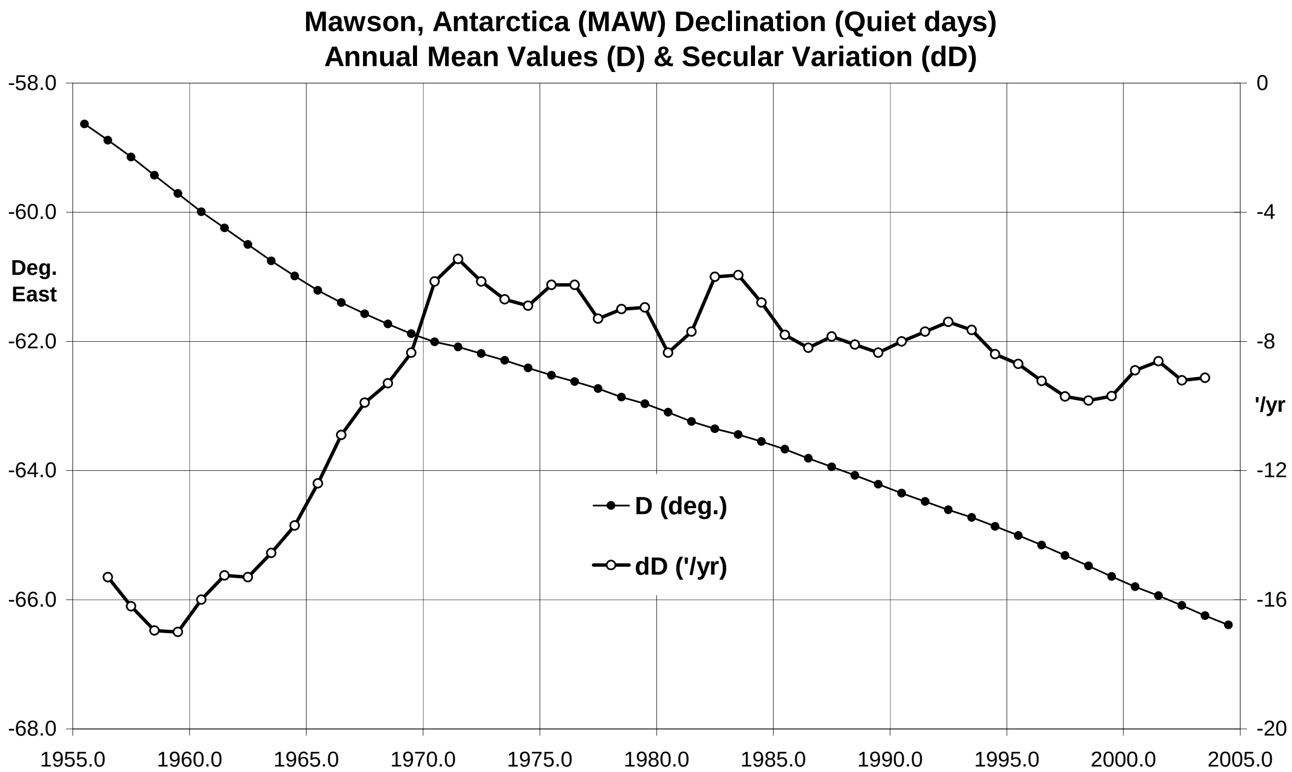
Mawson Stn. 2004 Horizontal intensity (H). Scale: 40.0 nT/mm. Mean: 18549 nT

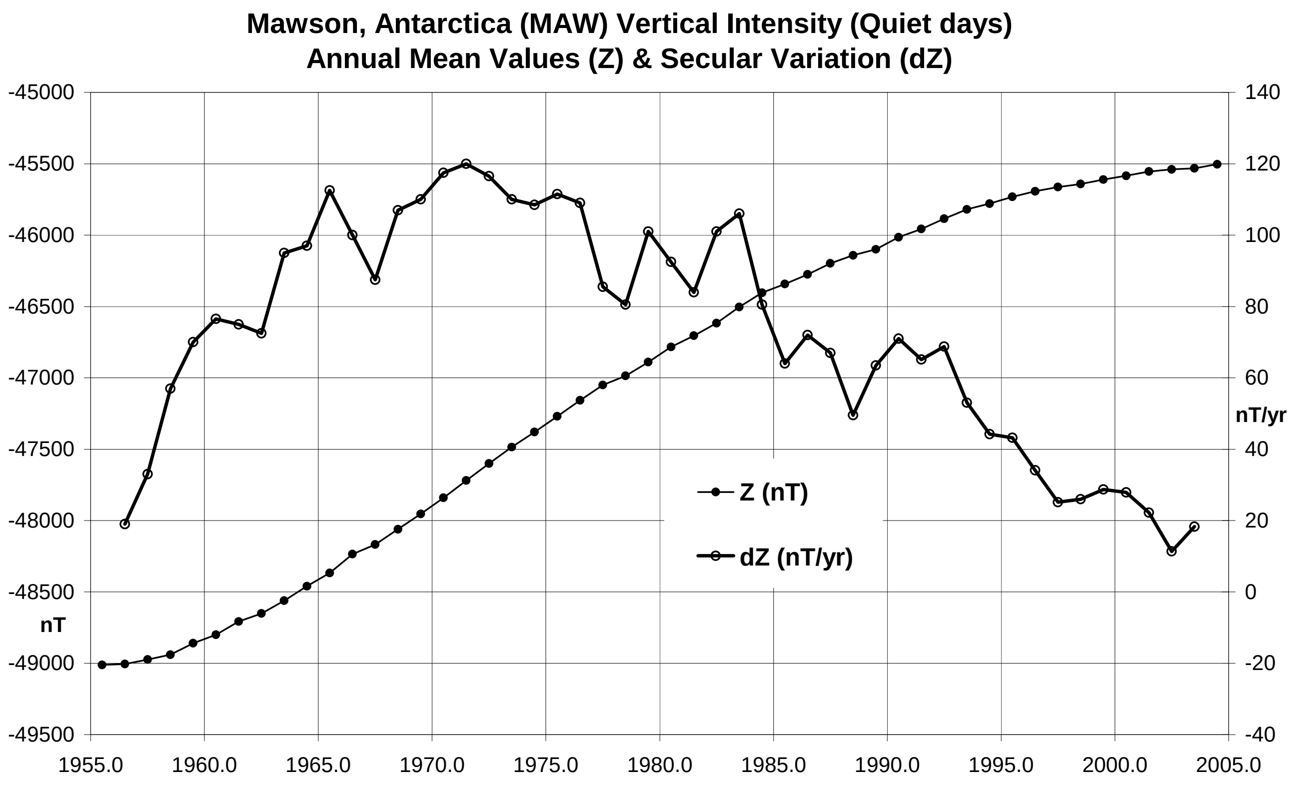
Mawson Stn. 2004 Declination (east) (D). Scale: 5.00 min/mm. Mean: −66.40 deg.

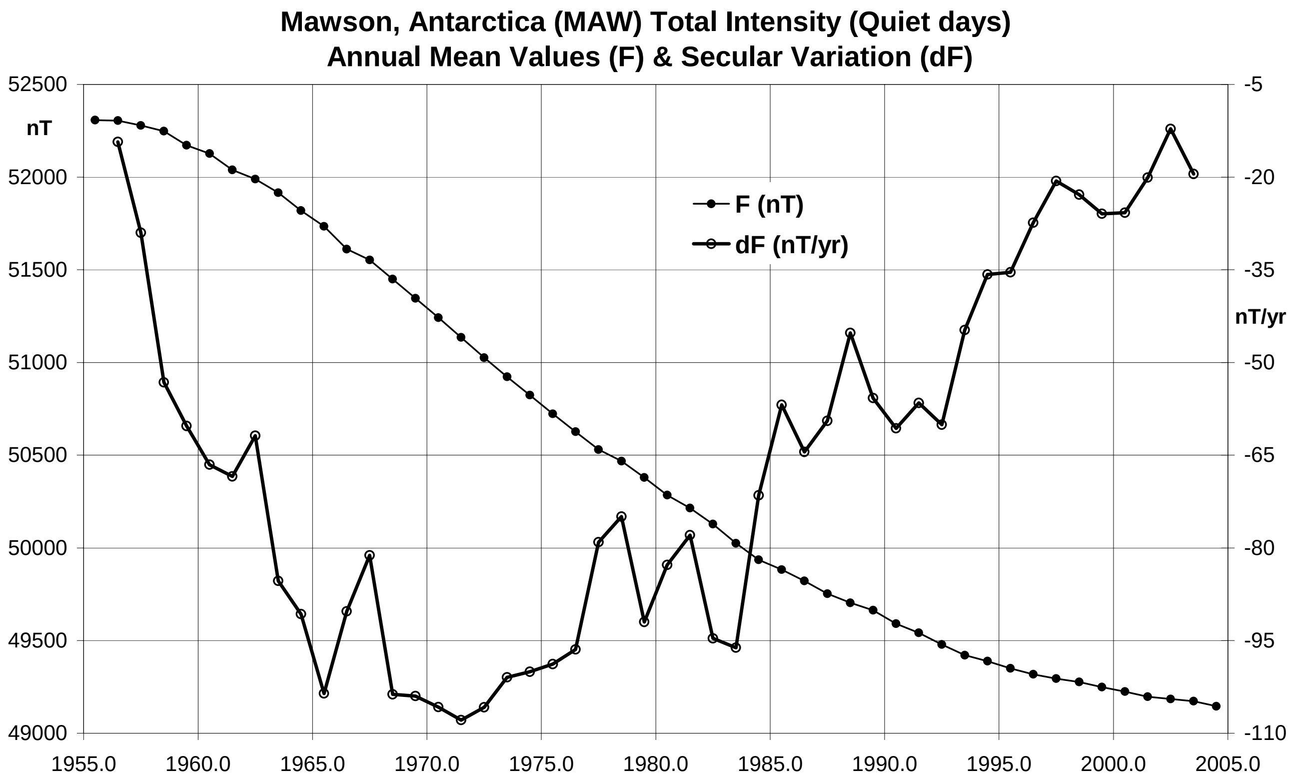
Mawson Stn. 2004 Vertical intensity (Z). Scale: 40.0 nT/mm. Mean: −45514 nT

Mawson Stn. 2004 Total intensity (F). Scale: 40.0 nT/mm. Mean: 49149 nT


Mawson, Antarctica (MAW) Horizontal Intensity (Quiet days)
Annual Mean Values (H) & Secular Variation (dH)
18700.0
18600.0
18500.0
18400.0
nT
18300.0
18200.0
20
10
0
nT/yr
-10
-20
-30
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0
H (nT)
dH (nT/yr)


Mawson, Antarctica (MAW) Declination (Quiet days)
Annual Mean Values (D) & Secular Variation (dD)
-58.0
-60.0
Deg.
East
-62.0
-64.0
-66.0
-68.0
0
-4
-8
'/yr
-12
-16
-20
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0
D (deg.)
dD ('/yr)


Mawson, Antarctica (MAW) Vertical Intensity (Quiet days)
Annual Mean Values (Z) & Secular Variation (dZ)
-45000
-45500
-46000
-46500
-47000
-47500
-48000
-48500
nT
-49000
-49500
140
120
100
80
60
nT/yr
40
20
0
-20
-40
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0
Z (nT)
dZ (nT/yr)


Mawson, Antarctica (MAW) Total Intensity (Quiet days)
Annual Mean Values (F) & Secular Variation (dF)
52500
nT
52000
51500
51000
50500
50000
49500
49000
-5
-20
-35
nT/yr
-50
-65
-80
-95
-110
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0
F (nT)
dF (nT/yr)

Summary of data loss from the Australian observatories

The table below summarizes the 2004 monthly digital data acquisition losses, in minutes per month, at the Australian observatories. The first figure refers to the principal 3-component variometers and the second figure (in parentheses) to the recording total intensity instruments. A single figure indicates the same data loss in a month for both instruments. Annual totals and percentage losses are also shown.

For details of events that resulted in loss of data, including the contamination of data subsequently excluded from processing, see the sections entitled *Significant Events* and *Data Loss* contained in the respective observatory descriptions in this report.

2004	KDU	CTA	LRM	ASP	GNA	CNB	MCQ	CSY	MAW
Jan	0 (20)	0	1,077 (27,208)	0 (44,640)	186 (8,928)	0	0	166	0 (25 days)
Feb	0	0	0	0 (41,760)	0 (,1611)	0	4,553	1,170	0 (23 days)
Mar	0	0	3	1 (40,710)	12,788 (7,541)	914	0	155	4 (23 days)
Apr	0	0	0	0	7,598 (0)	14 (8)	0	157	0 (20 days)
May	0	0	180 (867)	0 (1,181)	0	0	0	155	1,821 (27 days)
Jun	0	0	6 (8)	0	0	0	121	150	288 (17 days)
Jul	0	0	11 (1,819)	0	0	0	440	157	1,935 (16 days)
Aug	0	0 (21,866)	0	0 (3)	0	0	14,641	157	2,167 (16 days)
Sep	0	8	3 (4,921)	0	1	0	0	150	0 (3 days)
Oct	0	0	0	58 (63)	2 (37)	0 (10)	407	166	0 (5 days)
Nov	24 (191)	0	11 (4,274)	0	0	0	0	150	0 (10 days)
Dec	0	1,269 (2,457)	3 (1,221)	0	0	0	2	283	0 (12 days)
3-axis variom.	24 (0.005%)	1,277 (0.24%)	1,294 (0.25%)	58 (0.011%)	20,575 (3.90%)	928 (0.18%)	20,164 (3.83%)	3,016 (0.57%)	6,215 (1.18%)
Total field	211 (0.04%)	24,331 (4.62%)	40,321 (7.65%)	128,357 (24.3%)	18,118 (3.44%)	932 (0.18%)	20,164 (3.83%)	no PPM	197 days (53.83%)

International Quiet and Disturbed Days

2004	Quietest days 1 - 5					Quietest days 6 - 10					Most Disturbed days 1 - 5				
January	8A	29A	12A	31A	14A	21A	2A	15A	27A	11A	22	23	25	16	7
February	26	17	8	20	10	25	16A	21A	9A	7A	12	29	13	15	11
March	24	7	6	8	25	5	4	17K	19A	23A	10	11	12	9	2
April	2	1	22	20	29	27	14	26	19	13	3	6	5	9*	23*
May	26	18	17	27	16	25	9	14	10	2K	7*	29*	5*	20*	31*
June	22	23	27	20	25	12	21	13	24	19	29*	15*	1*	28*	9*
July	8	7	9	21	6	29	4	10	18	3	27	25	23	26	24
August	4	8	24	3	25	19	15	23	26	16	30	31	21*	10*	20*
September	11	10	4	12	3	30	26	25	9	27	14	17	16*	22*	6*
October	17	26	7	28	23	1	6	27	19	18	13	14	30*	31*	4*
November	6	15	18	2	5K	19	1K	17K	23	13A	10	8	9	7	12
December	4	3	19	2	24	20	23	15	14A	31A	12	6	22	30*	17*

Notes: If any of the selected quietest days were not truly quiet, they have been identified: with an A if the daily Ap index is > 6; or with a K if either one Kp index ≥ 3_o or two Kp indices ≥ 3_- occurred during the day.

If any of the 5 most disturbed days have an index Ap < 20 they are identified with an *.

International Quiet and Disturbed Day information was supplied by the International Service of Geomagnetic Indices (ISGI), International Union of Geodesy and Geophysics (IUGG), Association of Geomagnetism and Aeronomy (IAGA), edited by Institut für Geophysik, Göttingen, Germany.

GA maintains a network of fifteen repeat stations throughout mainland Australia, its offshore islands, and the south-west Pacific region. The repeat stations are usually occupied at intervals of approximately two years to determine the secular variation of the magnetic field. During each three to four day repeat station occupation, four components of the magnetic field are monitored continuously with a portable on-site 3-axis fluxgate variometer and a total field magnetometer.

During 2004 a Narod three-axis ring-core fluxgate magnetometer was used to monitor variations in three orthogonal components of the magnetic field. The digital output from this magnetometer was recorded as 1-second and 1-minute means with a portable industrial computer running an MS-DOS data acquisition system. A GEM Systems GSM90 Overhauser-effect total field magnetometer was used to monitor the total magnetic intensity. The digital output from the total field magnetometer was recorded at a sampling interval of 10 seconds.

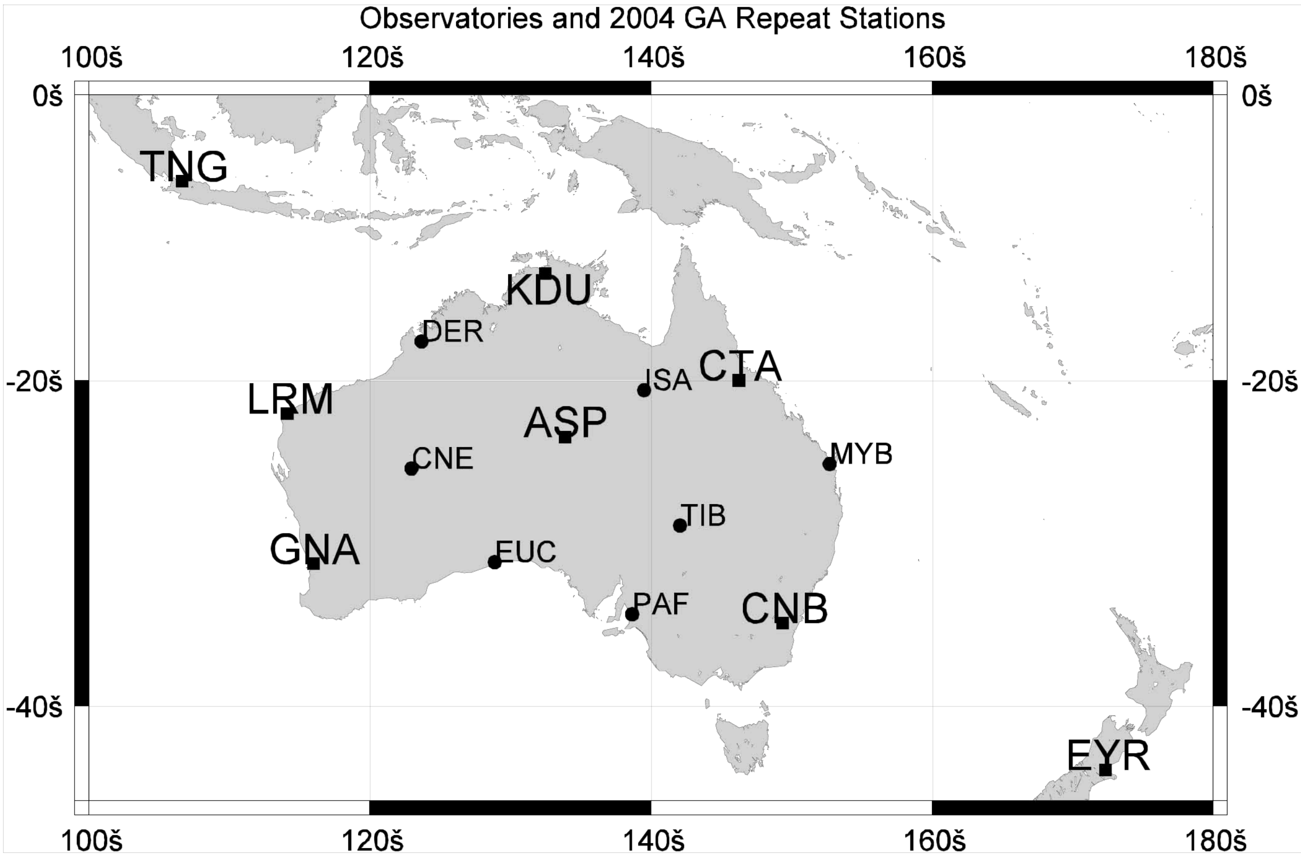
The magnetometers, acquisition and recording system were all powered by either two 12V DC batteries and solar panels or 240V AC mains power, depending on the location. Preliminary data processing and analysis was carried out on-site on a lap-top computer.

The variometer recordings were calibrated to observatory standard with a campaign of absolute magnetic observations made during each station occupation. Usually from 24 to 30 sets of absolute observations were performed on each primary repeat station. Vector field differences between the primary and secondary station at each site were also measured. Azimuths to prominent features from both primary and secondary stations were checked and total field gradient surveys around each station were undertaken.

The absolute instruments used on the repeat station surveys during 2004 were Elsec 810 DIM, no. 220 with Zeiss 020B theodolite, no. 308887, and GEM Systems GSM90 no. 810881 with sensor no. 31960. The GSM90 was also used for total field surveys around each station.

The normal or quiet level of the magnetic field at each repeat station was determined by analysing the calibrated on-site variometer record with reference to the quiet level of the magnetic field derived from a three month period of suitable magnetic observatory data.

The average annual rate of change of the field over the time between station occupations was determined by first differences between the adopted normal field values at the repeat station and the adopted normal field value from the previous occupation of the station.



The distribution of permanent magnetic observatories and repeat stations occupied in 2004

Station Occupations

Seven repeat stations were re-occupied in April/May 2004: Maryborough (MYB), Mount Isa (ISA), Derby (DER), Carnegie (CNE), Eucla (EUC), Parafield (PAF) and Tibooburra (TIB). The map above shows the location of these repeat stations and the permanent magnetic observatories in the region.

The adopted normal field values at the time of the 2004 occupations and the average secular variation over the interval between the two most recent occupations for each station are shown in the tables below. All available data from the repeat stations are plotted in the figures that follow.

Adopted Main Field Values at Time of Station Occupations

Station (site)	Occupation	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D	I
Maryborough (D)	2004 04 22	29237	5499	-43157	52417	29750	10º 39.1'	-55º 25.2'
Mount Isa (A)	2004 04 27	31784	3409	-39547	50851	31966	06º 07.3'	-51º 03.0'
Derby (E)	2004 05 04	33366	1563	-37287	50060	33403	02º 40.9'	-48º 08.7'
Carnegie (A)	2004 05 13	28109	1186	-47494	55202	28134	02º 24.9 '	-59º 21.5'
Eucla (D)	2004 05 17	23714	1926	-53274	58345	23792	04º 38.5 '	-65º 56.1'
Parafield (C)	2004 05 22	22831	3389	-54703	59373	23082	08º 26.6'	-67º 07.4'
Tibooburra (A)	2004 05 26	26675	4011	-49213	56121	26974	08º 33.0'	-61º 16.3'

Average Secular Variation between two most recent Occupations

Station (site)	Previous occupation	ΔX (nT/yr)	ΔY (nT/yr)	ΔZ (nT/yr)	ΔF (nT/yr)	ΔH (nT/yr)	ΔD (′/yr)	ΔI (′/yr)
Maryborough (D)	2002 05 17	-6	-2	41	-37	-6	-0.1	1.2
Mount Isa (A)	2002 05 11	4	-5	41	-30	3	-0.6	1.9
Derby (E)	2002 05 04	12	-2	38	-20	12	-0.2	2.3
Carnegie (A)	2002 05 10	13	10	41	-28	14	1.1	2.0
Eucla (D)	2002 04 21	13	11	38	-30	13	1.4	1.7
Parafield (C)	2002 04 16	6	6	32	-27	7	0.7	1.1
Tibooburra (A)	2002 04 11	1	-2	38	-33	1	-0.2	1.2

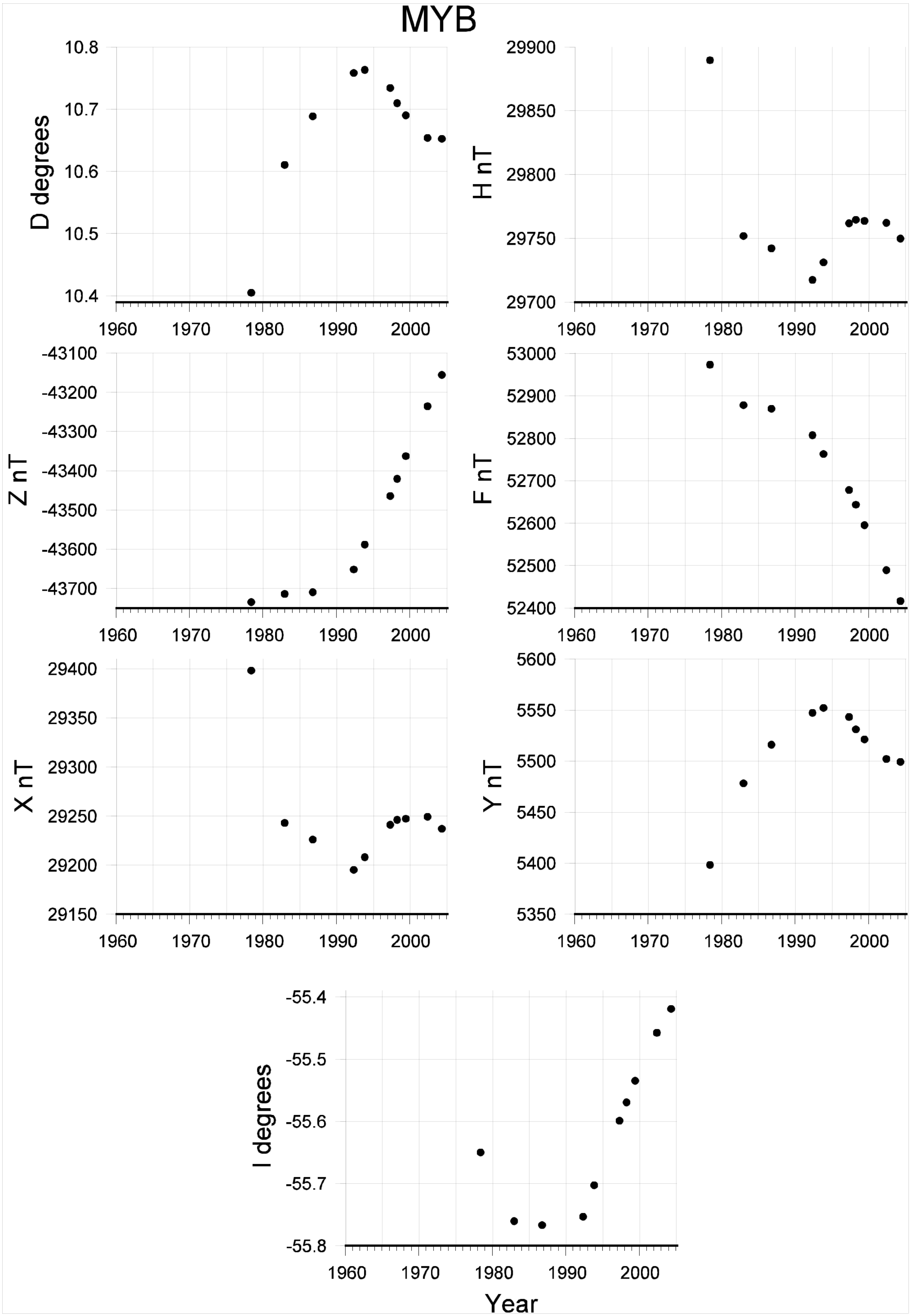
Distribution of Repeat Station data

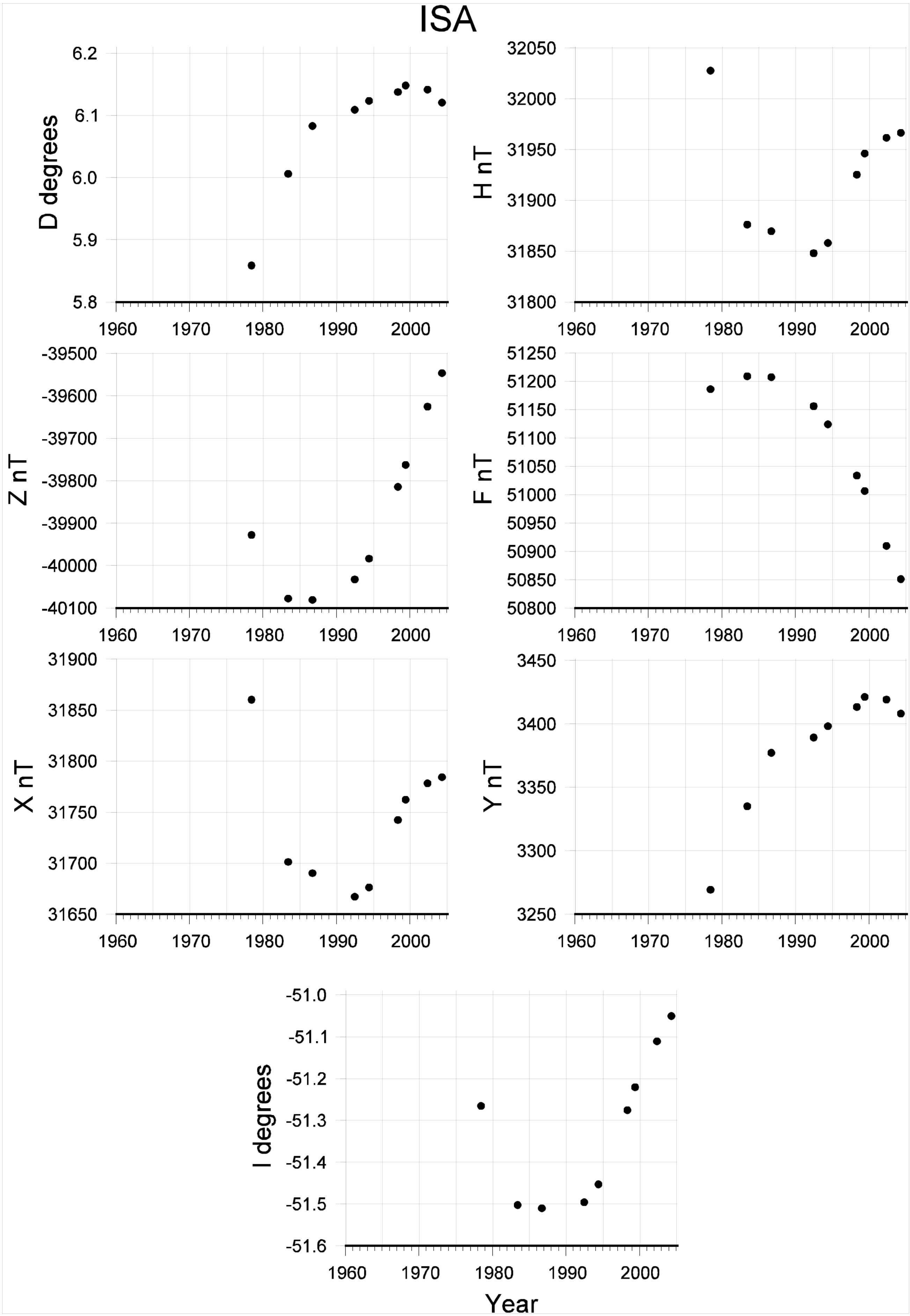
Australian Repeat Station data acquired over the 2001-2004 period were distributed to WDC-A, Boulder, USA and BGS, Edinburgh, UK on 10 Sep. 2004

Australian Geomagnetic Reference Field

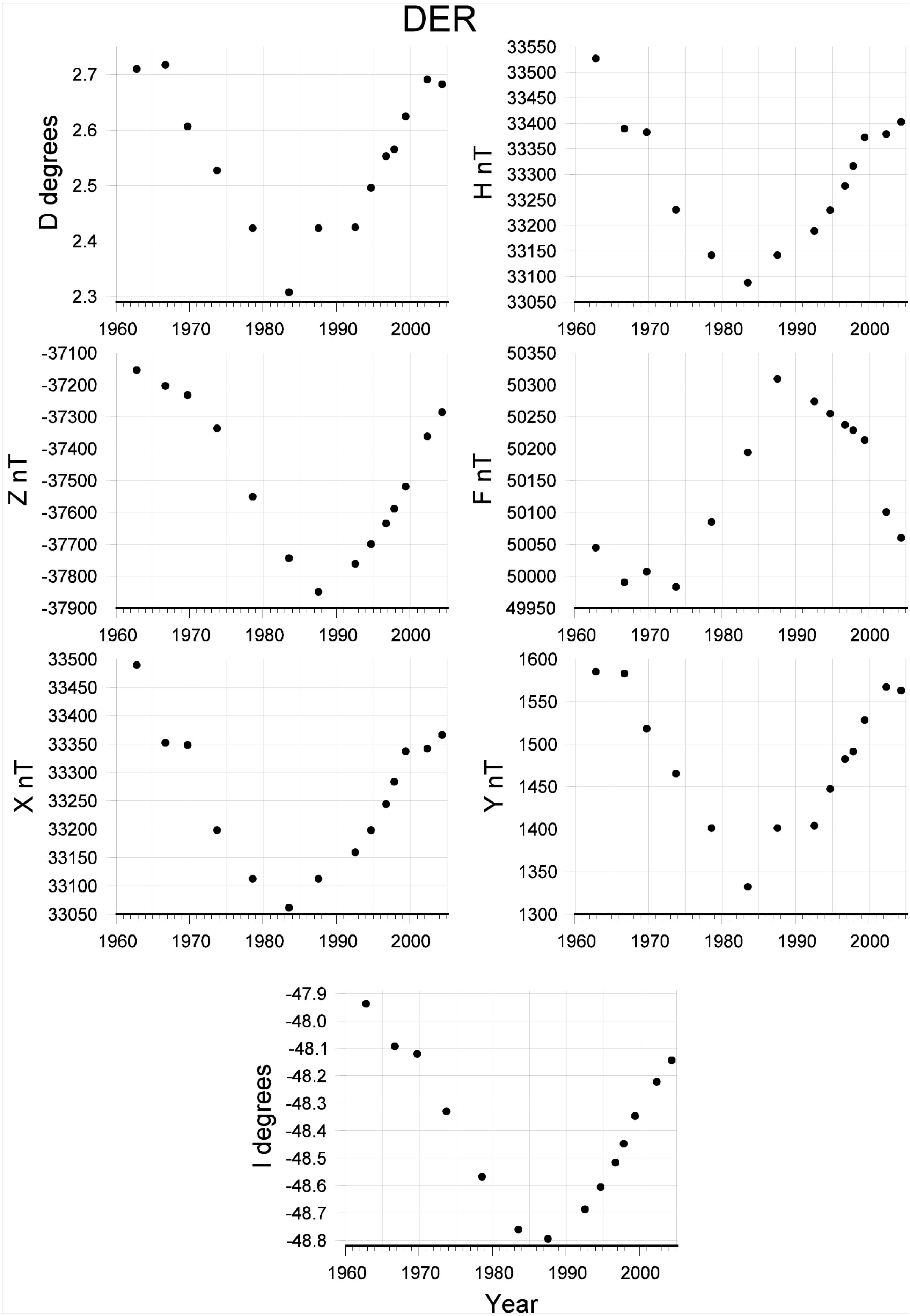
The latest revision of the Australian Geomagnetic Reference Field was for epoch 2000.0 (AGRF00) that was released in 2000 (Lewis, 2000). It is considered the best available geomagnetic field model for direction-finding applications in the Australian region. Charts in each of the magnetic elements X, Y, Z, F, H, D and I from the AGRF00 model are in the *AGR 2000*. The next AGRF model to be developed will be for 2005.0.

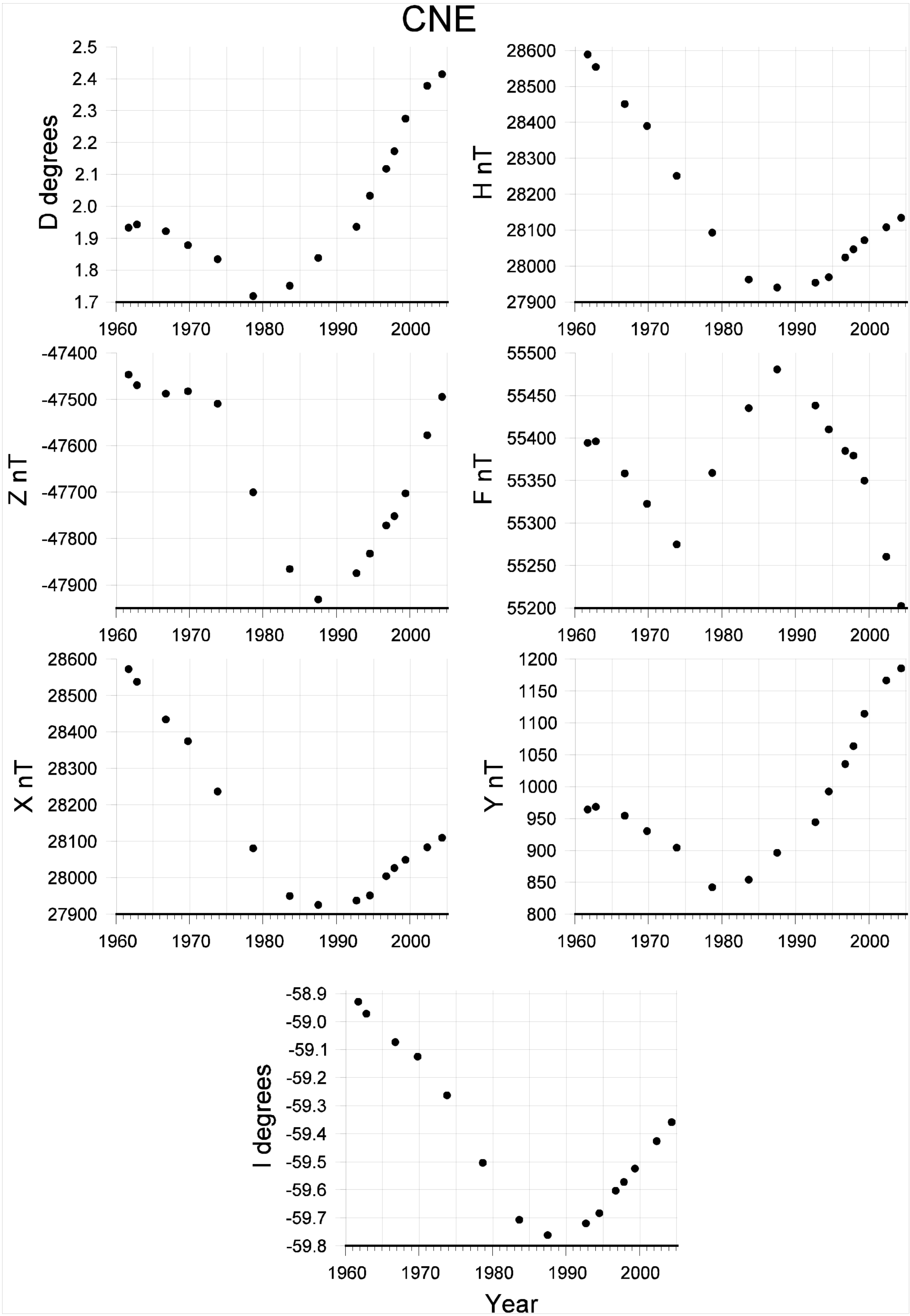
Epoch charts over the region have been produced on a regular basis since 1944. An Australian Geomagnetic Reference Field model (AGRF) has been produced every five years since 1980. These were listed in the *Charts and Models* table that appeared in *AGRs 1993-1997*.

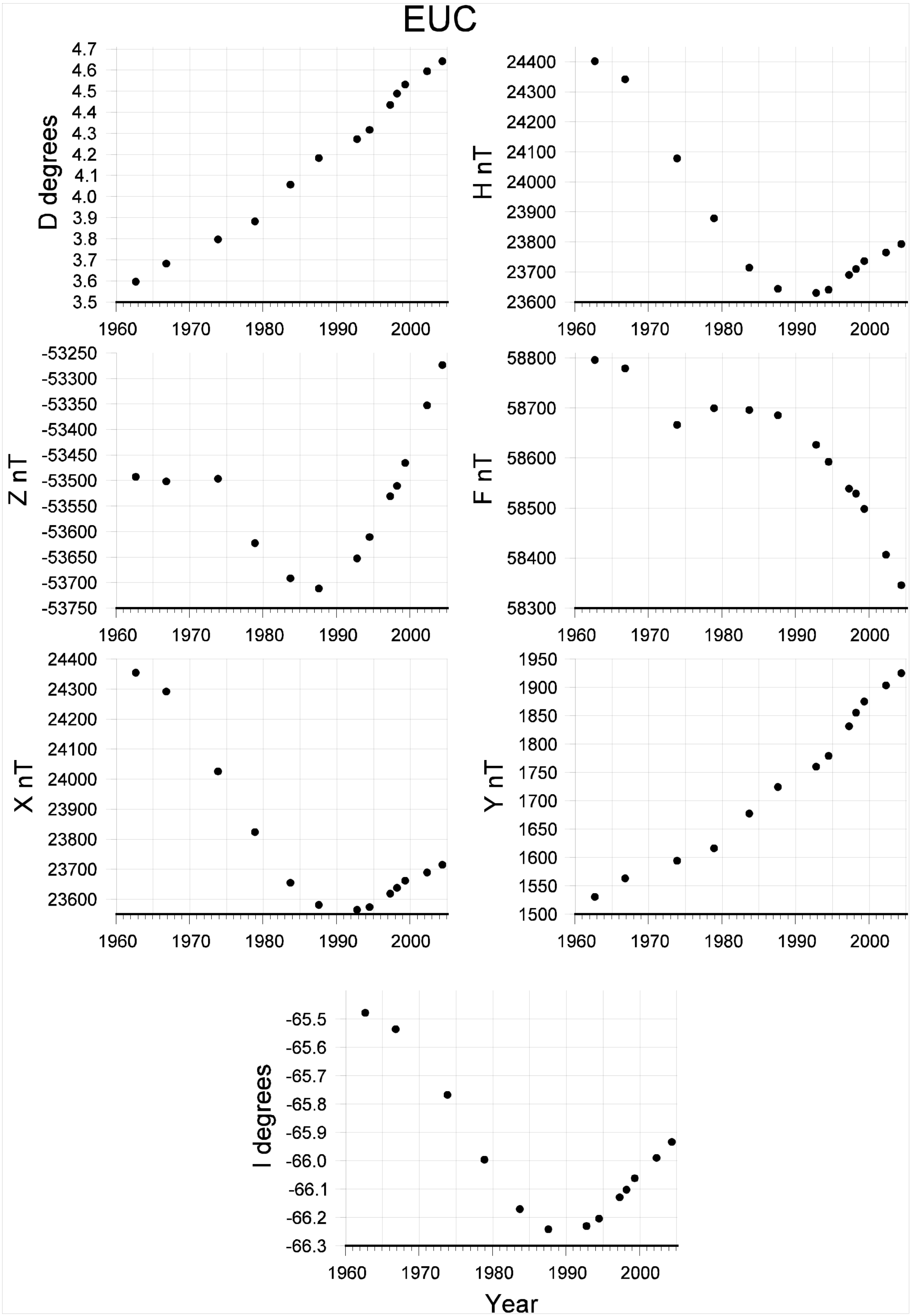

MYB
D degrees
H nT
Z nT
F nT
X nT
Y nT
I degrees
Year
1960
1970
1980
1990
2000

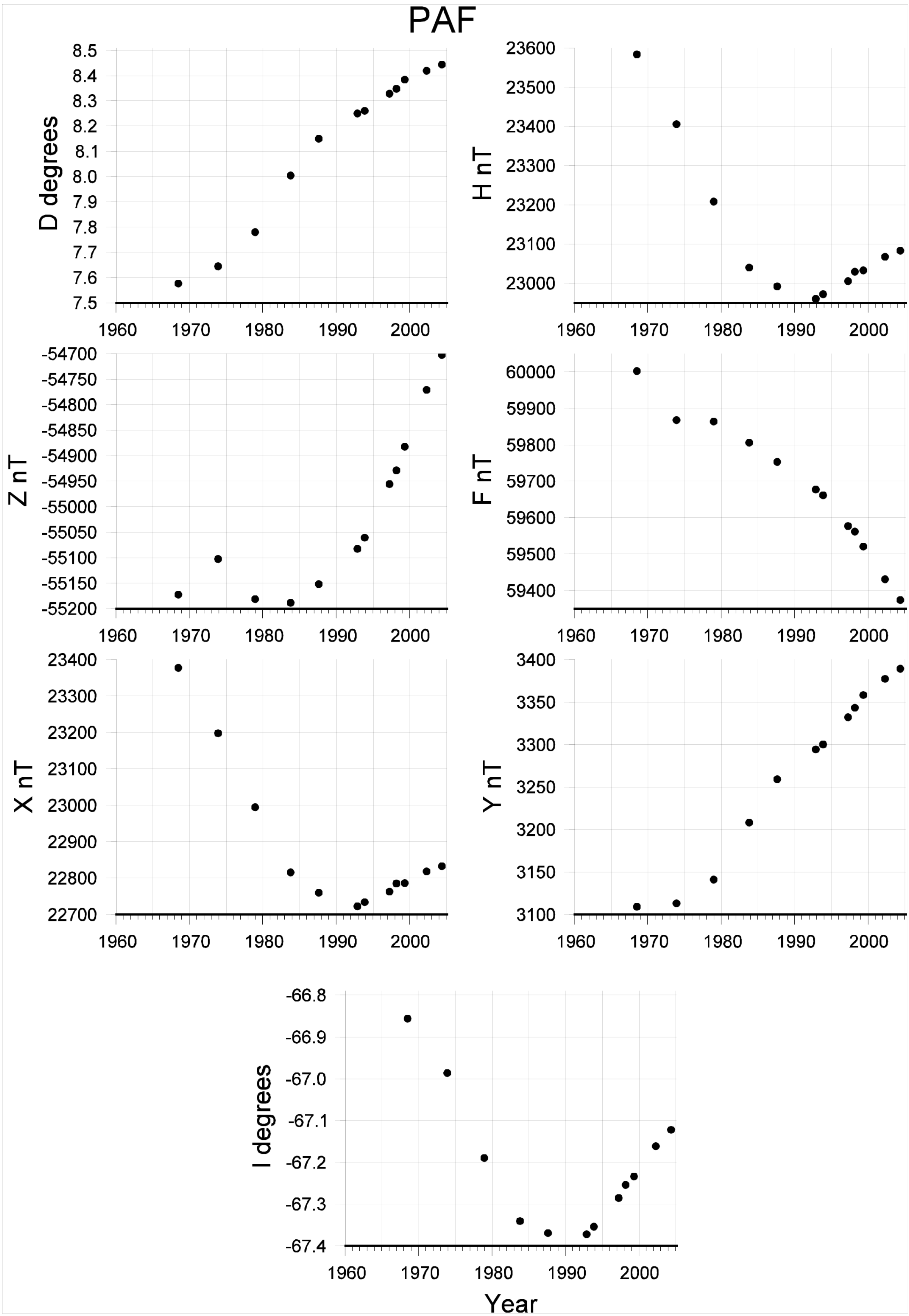


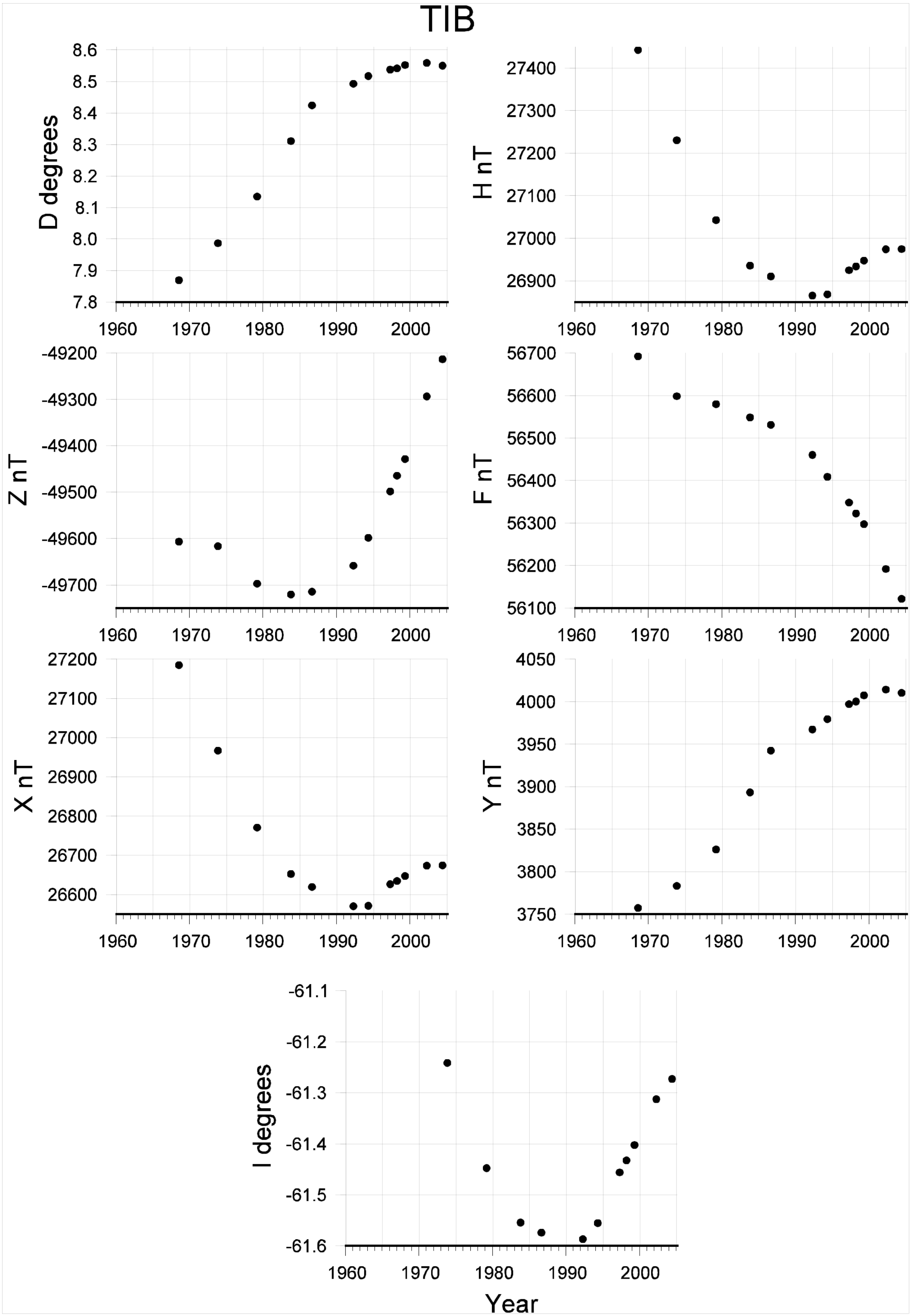
ISA
D degrees
H nT
Z nT
F nT
X nT
Y nT
I degrees
Year


DER
D degrees
H nT
Z nT
F nT
X nT
Y nT
I degrees
Year


CNE
D degrees
H nT
Z nT
F nT
X nT
Y nT
I degrees
Year


EUC
D degrees
H nT
Z nT
F nT
X nT
Y nT
I degrees
Year
1960
1970
1980
1990
2000


PAF
D degrees
H nT
Z nT
F nT
X nT
Y nT
I degrees
Year


TIB
D degrees
8.6
8.5
8.4
8.3
8.2
8.1
8.0
7.9
7.8
H nT
27400
27300
27200
27100
27000
26900
Z nT
-49200
-49300
-49400
-49500
-49600
-49700
F nT
56700
56600
56500
56400
56300
56200
56100
X nT
27200
27100
27000
26900
26800
26700
26600
Y nT
4050
4000
3950
3900
3850
3800
3750
I degrees
-61.1
-61.2
-61.3
-61.4
-61.5
-61.6
1960
1970
1980
1990
2000
Year

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Geomagnetism Staff List 2004

Name	Classification	Responsibility
Peter A. Hopgood	GA Level 6	Project Manager
Peter G. Crosthwaite	GA Level 5	Digital acquisition, system and software development and maintenance; Kakadu and Gnangara observatories
Andrew M. Lewis	GA Level 5	Repeat Station Survey; Alice Springs and Learmonth observatories
Liejun Wang	GA Level 4	Data-base development; Canberra and Charters Towers observatories
Nick Bartzis	GA Level 2	Observatories
Bruce Sibson	GA Level 3	Technical support
Owen D. McConnel	GA Level 3	Technical support, Western Australia*

* The Mundaring Geophysical Observatory was closed at the end of April 2000. Only one member of staff (ODM) remained with Geoscience Australia after that time. This officer provided technical support for the Gnangara and Learmonth magnetic observatories as well as the seismograph network in Western Australia.

Non-GA Observers/OICs

Warren Serone	ACRES (contracted by GA)	Alice Springs
Jack M. Millican	Contracted by GA	Charters Towers
Graham Steward	Learmonth Solar Observatory, IPS	Learmonth
Rory Lynch	Contracted by GA	Kakadu
Gerard (Hans) Van Reeken	Contracted by GA	Gnangara
Ray Hegarty	Technical Officer 2 (BOM & GA)	Mawson, 2004 observer
Glenn Roser	Technical Officer 2 (AAD & GA)	Mawson, 2005 observer
Henry Banon	Technical Officer 2 (AAD & GA)	Macquarie Island, 2003/04 observer
Spencer Redfern	Technical Officer 2 (AAD & GA)	Macquarie Island, 2004/05 observer
Mark Healy	Technical Officer 2 (AAD & GA)	Casey, 2004 observer
Chris Clarke	Technical Officer 2 (AAD & GA)	Casey, 2005 observer

End of Part 2