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Geoscience Australia

# AUSTRALIAN GEOMAGNETISM REPORT 2002


MAGNETIC OBSERVATORIES

VOLUME 50

**Department of Industry, Tourism and Resources**

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**Geoscience Australia**

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Chief of Division: Wally Johnson

# Australian Geomagnetism Report 2002

# Volume 50

**Geomagnetism Section**
**Geoscience Australia Earth Monitoring**
**Geoscience Australia**
**G.P.O. Box 378**
**Canberra, A.C.T., 2601**
**AUSTRALIA**

Australian Government
Geoscience Australia

# Magnetic results for 2002

**Alice Springs**

**Canberra**

**Charters Towers**

**Gnangara**

**Kakadu**

**Learmonth**

**Macquarie Island**

**Mawson**

**Casey**

**– & –**

**Australian Repeat Station Network**


Compiled and edited by P.A. Hopgood

with contributions by

A.M. Lewis, P.G. Crosthwaite, Liejun Wang

and N. Bartzis





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# SUMMARY


During 2002 Geoscience Australia operated geomagnetic observatories at **Alice Springs** and **Kakadu** in the Northern Territory, **Canberra** in the Australian Capital Territory, **Charters Towers** in Queensland, **Gnangara** and **Learmonth** in Western Australia, **Macquarie Island**, Tasmania, in the sub-Antarctic, and **Mawson** and **Casey** 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 serve as the Australian standards. The calibration of these instruments can be traced to International Standards. Absolute magnetometers at all the other Australian observatories are standardised 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 INTERMAGNET. K indices, principal magnetic storms and rapid variations were hand-scaled for the Canberra and Gnangara observatories, and provided regularly to the International Service of Geomagnetic Indices. K indices were digitally scaled at 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.

Eleven repeat stations were re-occupied in 2002 during two field surveys, the first in April-May and the second in November.

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 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 2002.

# 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 |
| ANARE | Australian National Antarctic Research Expedition |
| ANARESAT | ANARE satellite (communication) |
| ASP | - Alice Springs (Magnetic Observatory)<br>- 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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**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

## LEARMONTH OBSERVATORY

Learmonth, Western Australia, is situated on Australia's North West Cape overlooking the Exmouth Gulf to the east and Cape Range to the west. Learmonth is approximately 1100km north of the city of Perth. The nearest town is Exmouth, approximately 35km to the north. The Learmonth Geomagnetic Observatory is situated at the Learmonth Solar Observatory, jointly staffed by IPS Radio and Space Services, Department of Industry, Tourism & Resources and the U.S. Air Force. The magnetic observatory was established in late November 1986 from when it has operated continuously. More details of the observatory's history are in *AGR 1994*.

The observatory comprised:

- Two small underground vaults that housed the variometer sensors located within the perimeter of the solar observatory compound, both at approximately 40m to the east of the RSTN building.

  The principal (fluxgate sensor) vault was 0.6m x 0.6m of concrete construction with a 25mm plastic lid and was set into the ground by about two-thirds of its 1m depth. A smaller plastic subsidiary vault at a distance of approximately 3m from the principal vault housed the fluxgate electronics. A 50mm diameter PVC conduit carrying control and power cables ran underground from the subsidiary vault to the electronics console and data acquisition computer in the solar observatory Radio Solar Telescope Network (RSTN) building.

  A second (wooden) PPM sensor vault was approximately 10m north of the principal vault. A PVC conduit carried the PPM sensor head signal cable to the electronics console in the RSTN building.

  Both vaults were lined with polystyrene foam and buried beneath local sand to minimize diurnal temperature fluctuations

- A concrete absolute observation pier within a roofed shelter with brick walls on two sides to the same height as the pier. This was about 200 metres south of the solar observatory, situated on Royal Australian Air Force property. There was a safety tie down bar on the absolute pier to ensure that that the absolute instruments could not be knocked from the pier during observations.
- The control electronics, acquisition PC and UPS back-up power were located within the central or Radio Solar Telescope Network building of the solar observatory

Key data for the observation pier of the observatory are:

- 3-character IAGA code: LRM
- Commenced operation: November 1986
- Geographic latitude: 22 13' 19" S
- Geographic longitude: 114° 06' 03" E
- Geomagnetic†: Lat. -32.32°; Long. 186.31°
- Elevation above mean sea level (top of Pier A): 4 metres
- Lower limit for K index of 9: 300 nT.
- Azimuth of principal reference (west windsock) from Pier A: 283° 02' 18"
- Observers in Charge: G.A. Steward (IPS Radio & Space Services)

† Based on the IGRF 2000.0 model updated to 2002.5

### Variometers

Variations in the magnetic NW, NE and vertical components of the magnetic field were recorded at Learmonth in 2002 using a three component Danish Meteorological Institute FGE suspended three axis fluxgate (s/n E0254, S0227).
(This instrument was installed on since 12 December 2001.) The analogue data from the DMI instrument, including sensor and electronics temperatures were digitized with an ADAM 4017 8 channel 16 bit converter and recorded at 1-second intervals.

The data from the fluxgate instrument were also recorded independently by IPS for their use.

During 2002 a Geometrics model 856 (no. 50708) proton precession magnetometer (PPM) measured variations in the total intensity of the magnetic field, F. This served both as a backup, should any one of the X, Y or Z variometer channels become unserviceable, and as an F-check of the variometer model. The digital data from the variometer PPM were recorded at 10-second intervals.

The data from both the DMI fluxgate and PPM were recorded on a PC running MS-DOS-based data acquisition, control and display software. Timing was generated by the software (DOS) clock of the PC which was synchronized to 1-second pulses from a GPS clock.

The variometer and recording system was powered by 240VAC mains power. The equipment was protected from power outages and surges by an uninterruptible power supply.

### Absolute Instruments & Corrections

Throughout 2002 the local observer performed regular (approximately weekly) sets of absolute observations, on the pier (A) in the absolute shelter, using the DIM comprising Bartington 010H no. 0702H fluxgate unit with Zeiss 020B theodolite no. 312714 together with Geometrics 856 no. 50471 PPM.

The DIM absolute observations were performed using the *offset* method (see *Kakadu Observatory – Absolute Instruments & Corrections*, this report) throughout 2002.

Instrument comparisons between the LRM observatory absolute instruments (G856_50471/sensor 980801 PPM and B0702H / Zeiss 020B 312714 DIM) and the travelling standard instruments (GSM90_003985 PPM, B0806H / Zeiss 010B 100856 DIM) were performed at LRM on 18-19 June 2002.

The results of the comparisons were:

| Travelling Stndrd | | LRM instrument | | Inst. difference |
|---|---|---|---|---|
| GSM90_003985 | – | G856_50471 | = | –1.2nT (F) |
| B0806H/100856 | – | B0702H/312714 | = | –0.2' (Decl'n) |
| B0806H/100856 | – | B0702H/312714 | = | 0.0' (Incl'n) |

Comparisons between the travelling standard instruments and the Australian Standard instruments were performed on both 07 May & 16 July, 2002 at CNB observatory. These comparisons resulted in fairly unconvincing instrument differences of:

0nT, –0.1' and +0.1' in F, D, and I respectively.

Because of the uncertainties, corrections to the travelling standard instruments were all adopted as zero.

## LRM – Absolute Instruments & Corrections (cont.)

This resulted in the corrections to the LRM instruments of:

| Australian Stndrd | | LRM instrument | | Inst. correction |
|---|---|---|---|---|
| GSM90_905926 | – | G856_50471 | = | –1.2nT (F) |
| E810_200/353756 | – | B0702H/312714 | = | –0.2' (Decl'n) |
| E810_200/353756 | – | B0702H/312714 | = | 0.0' (Incl'n) |

The instrument corrections adopted for the absolute magnetometers used at LRM during 2002 convert to the baseline corrections:

$\Delta X = -0.66$ nT $\Delta Y = -1.73$ nT $\Delta Z = +1.00$ nT.

at the mean 2002 field values at LRM of 29725nT, 155nT and -44230nT in X, Y and Z respectively. These corrections have been applied to all LRM final data in this report.

## Operations

The local observer at LRM magnetic observatory was a staff member of IPS at the Learmonth Solar Observatory. During 2002 the observer performed routine tasks at the magnetic observatory that included:

- performing a set of absolute observations each week;
- mailing observation sheets to GA, Canberra each week;
- instrument checks, system re-sets etc. as required.

1-second values and 1-minute mean value data were transferred daily through modems via telephone lines to GA in Canberra. The clocks on the acquisition PC were also checked each weekday and corrected if necessary via the telephone link to GA.

The DMI variometer had accurately determined temperature coefficients.

The absolute observations were processed at GA in Canberra, where final data calibration and adoptions were made.

## Distribution of LRM data during 2002

***Preliminary Monthly Means for Project Ørsted***

- Sent monthly by email to IPGP throughout 2002

***1-minute & Hourly Mean Values***

- 2001: WDC-C1, Copenhagen, Denmark (12 Mar. 2002)
- 2001: WDC-A, Boulder, USA (02 Apr. 2002)

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

The adjustment applied to the absolute PPM used at Learmonth in 1994 was given as -1nT on page 44 in the *AGR1994*. This correction was in addition to a -1nT correction to the standard PPM (MNS2 no.3) and so should have been shown as -2nT. This results in baseline adjustments in X, Y and Z of -1.1nT, 0.0nT and +1.7nT respectively. No changes in the data presented are required as the correct adjustments were applied in their calculation.

## LRM –Significant Events 2002

| | |
|---|---|
| 01 Jan - 20 Jun | All absolute observations corrupted due to poor observing technique |
| 30 Jan | 0420: System reboot – unknown reason. |
| 31 Jan | Acquisition PC clock corrected and rate set to -18750 |
| 04 Feb | GPS system checked - LED is flashing O.K. |
| 18 Feb | About 2330 to about 19 / 0400: Unexplained data contamination and BLV problems |
| 03 Mar | 0018: System rebooted |
| 08 Mar | DIM in box fell about 30cm when handle on box broke. Stop watch ceased working: wrist watch used for timing of observations. |

## LRM – Significant Events (cont.)

| | |
|---|---|
| 10 Mar | 0605-0610: BLV jump in Y channel |
| 11 Mar | Replacement stopwatch sent.<br>0610: BLV jumps in X Y and PPM only |
| 20 Mar | ~0646-0816: Baseline jump - Van parked 20m from fluxgate inside main fence to move fuel drums for IPS generator |
| 25 Mar | 0215-0223: Jumps in X,Y,& Z baselines |
| 05 Apr | No observations this week too much sheep dung in absolute hut |
| 18 Apr | 1144: System rebooted (data loss). No PPM data after reboot |
| 10 May | PPM working again 02:45 |
| 16 May | 1200-2400: Rapid drop in electronics temperature. |
| 17 May | DIM box strap broke causing instrument to drop. |
| 18-22 June | Maintenance visit by GA officer (PGC): discovered problems with observations; carried out training; performed instrument comparisons; tested prospective sites for a replacement vault. |
| 03 Jul | Shelves for absolute instruments sent by road freight. |
| 08 Jul | A replacement 28ft radio dish (for solar observatory) arrived at RAAF base. It will be transported and installed at LRM in the next few days |
| 10 Jul | Absolute instrument shelves arrived at LRM. |
| 16 Jul | 0000-0830: Cranes replacing 28ft radio dish corrupted variometer data. |
| 17 Jul | 0000-0800: More work on radio dish corrupting data. |
| 09 Aug | 0117 and 0323: Jumps in X,Y and Z baselines |
| 08 Sep | A magnitude 7.5 earthquake occurred in New Guinea at 1844UTC producing interference on LRM data commencing about 1857 and lasting about 1 hour. (Also affected KDU and GNA - all suspended DMI systems.) Absolute observations missed |
| 08 Oct | Modem failed to answer – requested local OIC to reset the a modem reset. |
| 09 Oct | Modem found unplugged – plugged in by local OIC |
| 10 Oct | Magnitude 7.6 earthquake at 10:50:20UT in Irian Jaya affected the LRM system. |
| 03 Nov | 2138: Baseline jump in X and Y. |
| 08 Dec | 2310: System rebooted |

## LRM – Data loss in 2002

*Periods of data during which processing was inhibited on all data channels (X,Y,Z,F) due to contamination:*

| | |
|---|---|
| 18 Feb | 2330 to 19 / 0450 (05h 21m) |
| 11 Mar | 0603-0604 (2 min), 0611-0612 (2 min) |
| 20 Mar | 0646-0647 (2 min), 0815-0816 (2 min) |
| 25 Mar | 0215-0216 (2 min), 0223-0224 (2 min) |
| 16 Jul | 0000-0830 (08h 31m) |
| 17 Jul | 0000-0800 (08h 01m) |
| 09 Aug | (0117-0118 (2 min), 0323-0324 (2 min) |

*Data loss through other causes:*

| | |
|---|---|
| 02 Mar | 0016-0018 (3 mins) XYZF: System rebooted |
| 18 Apr | 1113-1144 (32 mins) XYZF: Power failure |
| 18 Apr | 1145 to 10 May / 0238 (21d 14h 54m) F channel only: PPM failure. |
| 08 Dec | 2307-2309 (3 mins) XYZF: System rebooted. |

## Learmonth 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 68-69.

| Year | Days | D (Deg | Min) | I (Deg | Min) | H (nT) | X (nT) | Y (nT) | Z (nT) | F (nT) | Elts |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1987.5 | A | -0 | 34.9 | -56 | 26.7 | 29480 | 29478 | -299 | -44446 | 53334 | DHZ(1) |
| 1988.5 | A | -0 | 33.5 | -56 | 27.0 | 29481 | 29479 | -288 | -44457 | 53344 | DHZ |
| 1989.5 | A | -0 | 34.3 | -56 | 27.1 | 29465 | 29464 | -294 | -44436 | 53317 | DHZ |
| 1990.5 | A | -0 | 28.8 | -56 | 25.4 | 29501 | 29500 | -247 | -44441 | 53342 | DHZ |
| 1991.5 | A | -0 | 26.3 | -56 | 24.5 | 29507 | 29506 | -226 | -44426 | 53333 | DHZ |
| 1992.5 | A | -0 | 23.4 | -56 | 22.6 | 29531 | 29530 | -201 | -44407 | 53330 | DHZ |
| 1993.5 | A | -0 | 18.9 | -56 | 21.2 | 29550 | 29549 | -162 | -44396 | 53331 | DHZ |
| 1994.5 | A | -0 | 15.0 | -56 | 20.5 | 29555 | 29555 | -129 | -44386 | 53326 | DHZ |
| 1995.5 | A | -0 | 10.8 | -56 | 18.2 | 29588 | 29588 | -93 | -44373 | 53333 | DHZ |
| 1996.5 | A | -0 | 06.2 | -56 | 15.5 | 29630 | 29630 | -54 | -44358 | 53344 | DHZ |
| 1997.5 | A | -0 | 01.3 | -56 | 13.3 | 29658 | 29658 | -11 | -44338 | 53343 | DHZ |
| 1998.5 | A | 0 | 04.2 | -56 | 11.6 | 29676 | 29676 | 36 | -44320 | 53338 | DHZ |
| 1999.5 | A | 0 | 09.2 | -56 | 09.6 | 29696 | 29696 | 80 | -44292 | 53325 | ABZ (2) |
| 2000.5 | A | 0 | 13.5 | -56 | 7.9 | 29707 | 29706 | 116 | -44260 | 53305 | ABZ |
| 2001.5 | A | 0 | 17.7 | -56 | 5.7 | 29724 | 29724 | 153 | -44227 | 53287 | ABZ |
| 2002.5 | A | 0 | 20.8 | -56 | 4.2 | 29734 | 29733 | 180 | -44197 | 53268 | ABZ |
| 1987.5 | Q | -0 | 34.8 | -56 | 26.3 | 29486 | 29484 | -299 | -44445 | 53336 | DHZ(1) |
| 1988.5 | Q | -0 | 33.5 | -56 | 26.3 | 29494 | 29492 | -288 | -44455 | 53349 | DHZ |
| 1989.5 | Q | -0 | 34.3 | -56 | 26.2 | 29481 | 29479 | -294 | -44433 | 53324 | DHZ |
| 1990.5 | Q | -0 | 28.7 | -56 | 24.5 | 29516 | 29515 | -246 | -44439 | 53348 | DHZ |
| 1991.5 | Q | -0 | 26.2 | -56 | 23.4 | 29527 | 29526 | -225 | -44423 | 53341 | DHZ |
| 1992.5 | Q | -0 | 23.3 | -56 | 21.7 | 29545 | 29544 | -200 | -44405 | 53336 | DHZ |
| 1993.5 | Q | -0 | 18.8 | -56 | 20.5 | 29561 | 29560 | -162 | -44394 | 53336 | DHZ |
| 1994.5 | Q | -0 | 15.0 | -56 | 19.7 | 29569 | 29569 | -129 | -44384 | 53332 | DHZ |
| 1995.5 | Q | -0 | 10.8 | -56 | 17.5 | 29600 | 29600 | -93 | -44371 | 53338 | DHZ |
| 1996.5 | Q | -0 | 06.3 | -56 | 15.2 | 29636 | 29635 | -54 | -44357 | 53346 | DHZ |
| 1997.5 | Q | -0 | 01.3 | -56 | 12.8 | 29667 | 29667 | -11 | -44338 | 53348 | DHZ |
| 1998.5 | Q | 0 | 04.1 | -56 | 11.1 | 29686 | 29686 | 35 | -44318 | 53342 | DHZ |
| 1999.5 | Q | 0 | 09.2 | -56 | 09.0 | 29705 | 29705 | 80 | -44290 | 53329 | ABZ (2) |
| 2000.5 | Q | 0 | 13.5 | -56 | 7.1 | 29719 | 29719 | 117 | -44258 | 53311 | ABZ |
| 2001.5 | Q | 0 | 17.8 | -56 | 5.0 | 29736 | 29736 | 154 | -44225 | 53293 | ABZ |
| 2002.5 | Q | 0 | 20.8 | -56 | 3.3 | 29748 | 29747 | 180 | -44195 | 53274 | ABZ |
| 1987.5 | D | -0 | 34.9 | -56 | 27.3 | 29469 | 29467 | -299 | -44448 | 53329 | DHZ(1) |
| 1988.5 | D | -0 | 33.6 | -56 | 28.2 | 29461 | 29459 | -288 | -44460 | 53335 | DHZ |
| 1989.5 | D | -0 | 34.4 | -56 | 29.0 | 29433 | 29431 | -295 | -44441 | 53303 | DHZ |
| 1990.5 | D | -0 | 29.0 | -56 | 26.7 | 29478 | 29477 | -249 | -44445 | 53332 | DHZ |
| 1991.5 | D | -0 | 26.5 | -56 | 26.5 | 29473 | 29472 | -227 | -44431 | 53318 | DHZ |
| 1992.5 | D | -0 | 23.5 | -56 | 24.1 | 29506 | 29505 | -201 | -44412 | 53320 | DHZ |
| 1993.5 | D | -0 | 18.9 | -56 | 22.3 | 29530 | 29529 | -163 | -44398 | 53322 | DHZ |
| 1994.5 | D | -0 | 14.9 | -56 | 21.6 | 29537 | 29537 | -128 | -44389 | 53318 | DHZ |
| 1995.5 | D | -0 | 10.9 | -56 | 19.1 | 29574 | 29574 | -94 | -44374 | 53326 | DHZ |
| 1996.5 | D | -0 | 06.2 | -56 | 16.0 | 29622 | 29622 | -53 | -44359 | 53340 | DHZ |
| 1997.5 | D | -0 | 01.3 | -56 | 14.2 | 29643 | 29643 | -11 | -44340 | 53336 | DHZ |
| 1998.5 | D | 0 | 04.2 | -56 | 13.0 | 29652 | 29652 | 36 | -44322 | 53326 | DHZ |
| 1999.5 | D | 0 | 09.3 | -56 | 10.7 | 29677 | 29677 | 81 | -44295 | 53317 | ABZ (2) |
| 2000.5 | D | 0 | 13.4 | -56 | 9.5 | 29679 | 29679 | 116 | -44264 | 53294 | ABZ |
| 2001.5 | D | 0 | 17.6 | -56 | 7.2 | 29699 | 29699 | 152 | -44230 | 53276 | ABZ |
| 2002.5 | D | 0 | 20.8 | -56 | 5.4 | 29712 | 29712 | 179 | -44200 | 53259 | ABZ |

Note (1): At the near zero magnetic declination at LRM the DHZ sensor orientation closely approximated an XYZ orientation.

Note (2): ABZ indicates sensor alignments in the magnetic NW, NE and vertical directions.

## Monthly & 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.

| Learmonth | 2002 | X (nT) | Y (nT) | Z (nT) | F (nT) | H (nT) | D (East) | I |
|---|---|---|---|---|---|---|---|---|
| **January** | All days | 29737.7 | 167.4 | -44210.7 | 53281.8 | 29738.2 | +0° 19.3' | -56° 04.4' |
| | 5xQ days | 29748.5 | 168.4 | -44210.1 | 53287.3 | 29749.0 | +0° 19.5' | -56° 03.8' |
| | 5xD days | 29727.0 | 166.4 | -44214.4 | 53278.8 | 29727.5 | +0° 19.2' | -56° 05.1' |
| **February** | All days | 29734.8 | 171.5 | -44206.1 | 53276.3 | 29735.3 | +0° 19.8' | -56° 04.4' |
| | 5xQ days | 29739.2 | 171.7 | -44205.3 | 53278.1 | 29739.7 | +0° 19.8' | -56° 04.1' |
| | 5xD days | 29719.1 | 170.1 | -44208.6 | 53269.7 | 29719.6 | +0° 19.7' | -56° 05.3' |
| **March** | All days | 29737.1 | 173.2 | -44200.4 | 53272.9 | 29737.6 | +0° 20.0' | -56° 04.1' |
| | 5xQ days | 29747.2 | 174.2 | -44196.6 | 53275.3 | 29747.7 | +0° 20.1' | -56° 03.4' |
| | 5xD days | 29723.7 | 173.4 | -44199.2 | 53264.5 | 29724.2 | +0° 20.1' | -56° 04.7' |
| **April** | All days | 29722.0 | 176.4 | -44200.8 | 53264.8 | 29722.5 | +0° 20.4' | -56° 04.9' |
| | 5xQ days | 29741.9 | 176.9 | -44198.4 | 53274.0 | 29742.5 | +0° 20.5' | -56° 03.7' |
| | 5xD days | 29668.4 | 176.8 | -44210.9 | 53243.3 | 29668.9 | +0° 20.5' | -56° 08.1' |
| **May** | All days | 29722.5 | 177.0 | -44199.3 | 53263.8 | 29723.0 | +0° 20.5' | -56° 04.8' |
| | 5xQ days | 29725.2 | 177.0 | -44198.6 | 53264.7 | 29725.7 | +0° 20.5' | -56° 04.6' |
| | 5xD days | 29708.1 | 175.5 | -44201.3 | 53257.5 | 29708.7 | +0° 20.3' | -56° 05.6' |
| **June** | All days | 29739.8 | 177.7 | -44194.0 | 53269.1 | 29740.4 | +0° 20.5' | -56° 03.7' |
| | 5xQ days | 29748.0 | 177.5 | -44193.3 | 53273.1 | 29748.5 | +0° 20.5' | -56° 03.2' |
| | 5xD days | 29731.0 | 178.1 | -44195.1 | 53265.1 | 29731.5 | +0° 20.6' | -56° 04.2' |
| **July** | All days | 29740.0 | 181.1 | -44191.5 | 53267.1 | 29740.5 | +0° 20.9' | -56° 03.6' |
| | 5xQ days | 29749.7 | 179.6 | -44190.4 | 53271.6 | 29750.2 | +0° 20.8' | -56° 03.0' |
| | 5xD days | 29727.9 | 182.2 | -44193.2 | 53261.8 | 29728.4 | +0° 21.1' | -56° 04.3' |
| **August** | All days | 29730.9 | 183.2 | -44192.5 | 53262.9 | 29731.5 | +0° 21.2' | -56° 04.1' |
| | 5xQ days | 29743.4 | 184.2 | -44192.3 | 53269.7 | 29744.0 | +0° 21.3' | -56° 03.4' |
| | 5xD days | 29708.4 | 185.9 | -44193.3 | 53251.0 | 29709.0 | +0° 21.5' | -56° 05.3' |
| **September** | All days | 29731.5 | 185.1 | -44191.3 | 53262.2 | 29732.1 | +0° 21.4' | -56° 04.0' |
| | 5xQ days | 29754.4 | 186.3 | -44186.9 | 53271.4 | 29755.0 | +0° 21.5' | -56° 02.6' |
| | 5xD days | 29700.6 | 184.8 | -44195.1 | 53248.2 | 29701.2 | +0° 21.4' | -56° 05.8' |
| **October** | All days | 29716.5 | 186.0 | -44197.9 | 53259.4 | 29717.1 | +0° 21.5' | -56° 05.1' |
| | 5xQ days | 29739.9 | 186.7 | -44194.1 | 53269.3 | 29740.5 | +0° 21.6' | -56° 03.7' |
| | 5xD days | 29676.1 | 184.3 | -44201.5 | 53239.8 | 29676.7 | +0° 21.3' | -56° 07.4' |
| **November** | All days | 29735.7 | 187.8 | -44193.0 | 53266.0 | 29736.3 | +0° 21.7' | -56° 03.9' |
| | 5xQ days | 29753.5 | 189.4 | -44192.1 | 53275.2 | 29754.2 | +0° 21.9' | -56° 02.9' |
| | 5xD days | 29716.3 | 185.0 | -44198.4 | 53259.7 | 29716.9 | +0° 21.4' | -56° 05.1' |
| **December** | All days | 29749.9 | 190.3 | -44188.8 | 53270.5 | 29750.5 | +0° 22.0' | -56° 03.0' |
| | 5xQ days | 29772.3 | 191.6 | -44185.6 | 53280.4 | 29772.9 | +0° 22.1' | -56° 01.6' |
| | 5xD days | 29735.6 | 189.7 | -44188.8 | 53262.5 | 29736.2 | +0° 21.9' | -56° 03.7' |
| **Annual** | All days | 29733.2 | 179.7 | -44197.2 | 53268.1 | 29733.8 | +0° 20.8' | -56° 04.2' |
| **Mean** | 5xQ days | 29746.9 | 180.3 | -44195.3 | 53274.2 | 29747.5 | +0° 20.8' | -56° 03.3' |
| **Values** | 5xD days | 29711.8 | 179.4 | -44200.0 | 53258.5 | 29712.4 | +0° 20.8' | -56° 05.4' |

(Calculated: 9:54 hrs., Thu. 17 Apr. 2003)

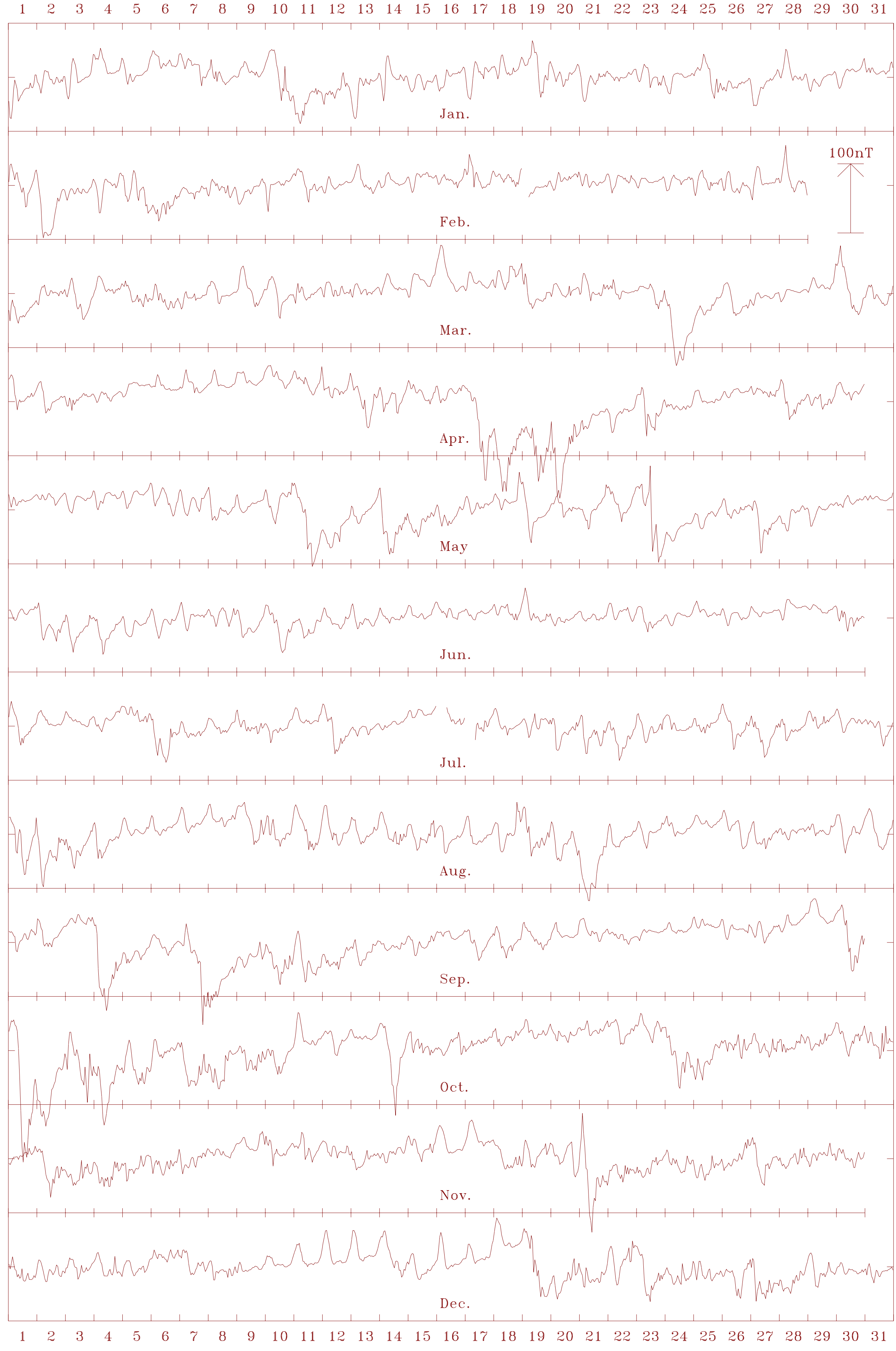
## Hourly Mean Values

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

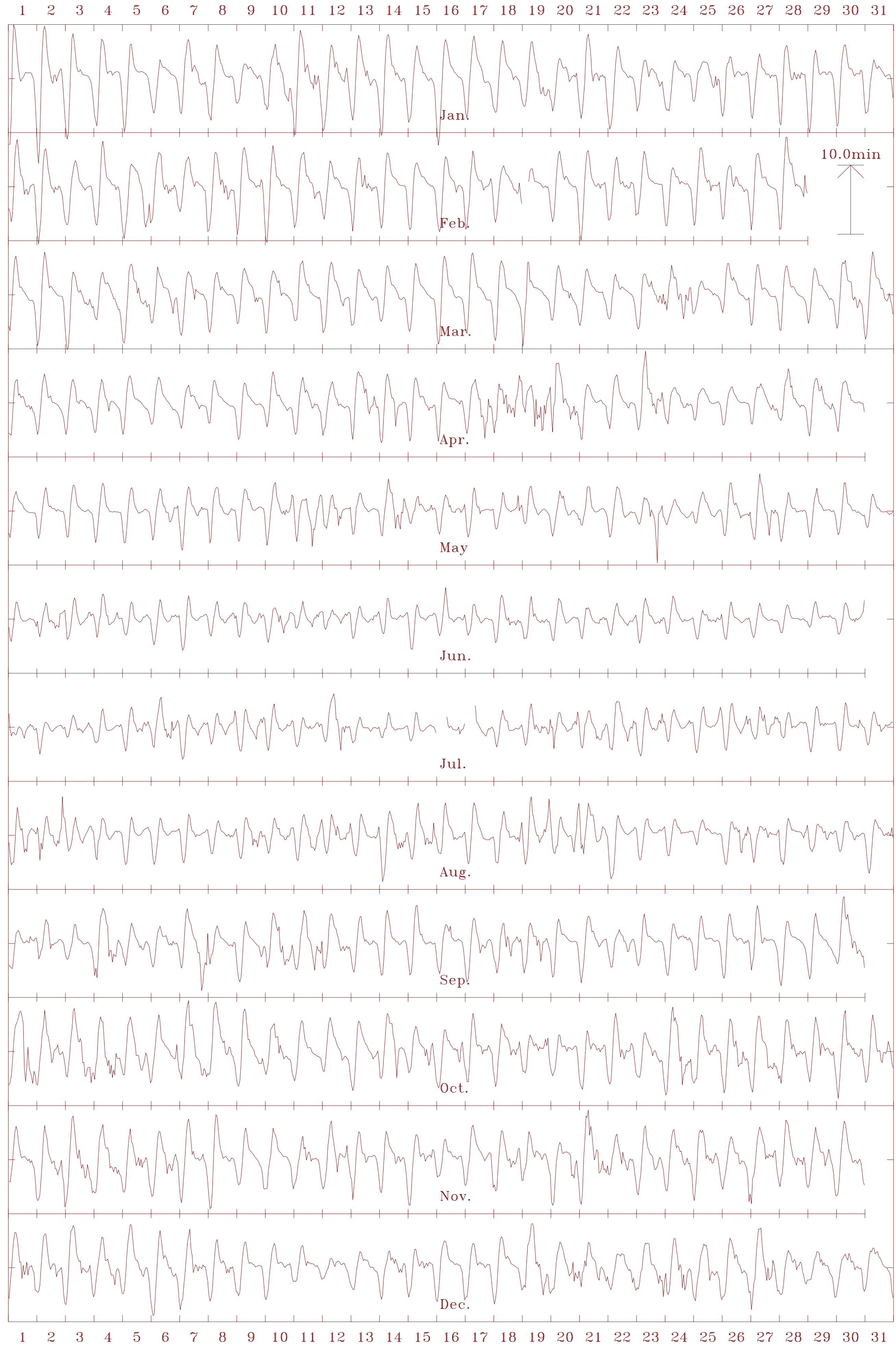
The reference levels indicated with marks on the vertical axes refer to the *all-days* mean value for the respective months. All elements in the plots are shown increasing (algebraically) towards the top of the page, with the exception of Z, which is in the opposite sense.

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

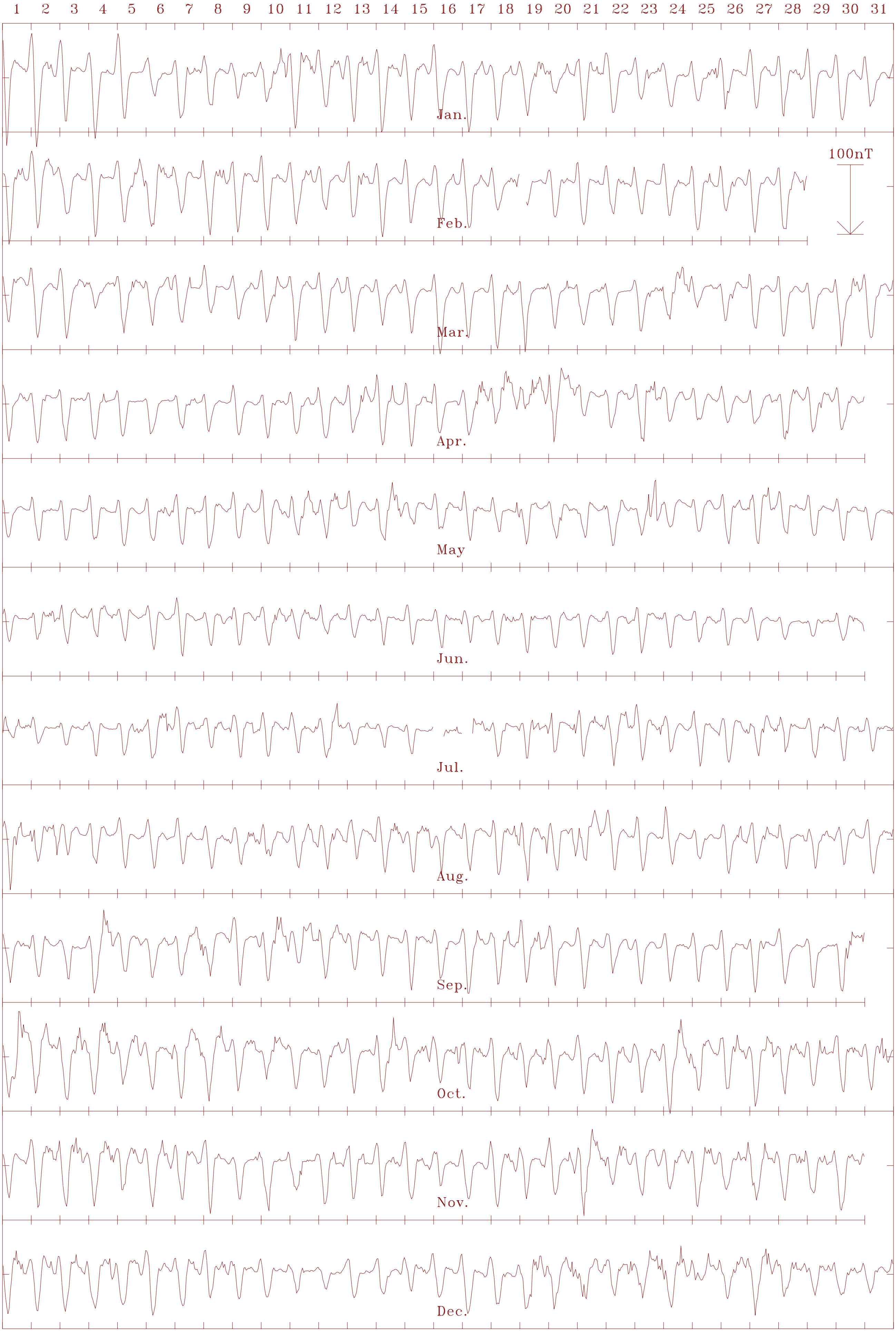
Learmonth 2002 Horizontal intensity (H). Scale: 7.5 nT/mm. Mean: 29734 nT



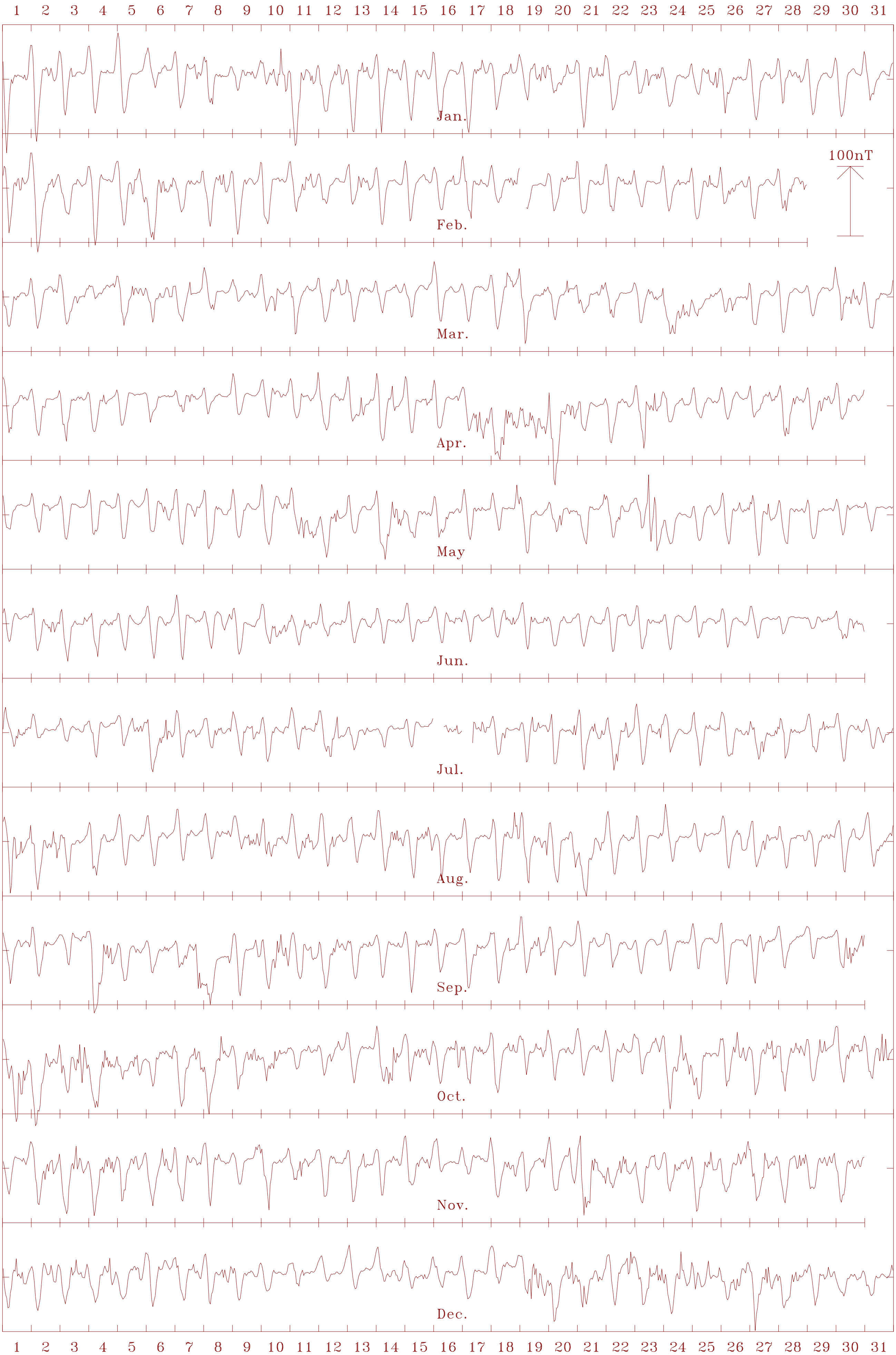
Learmonth 2002 Declination (east) (D). Scale: 0.75 min/mm. Mean: 0.35 deg.

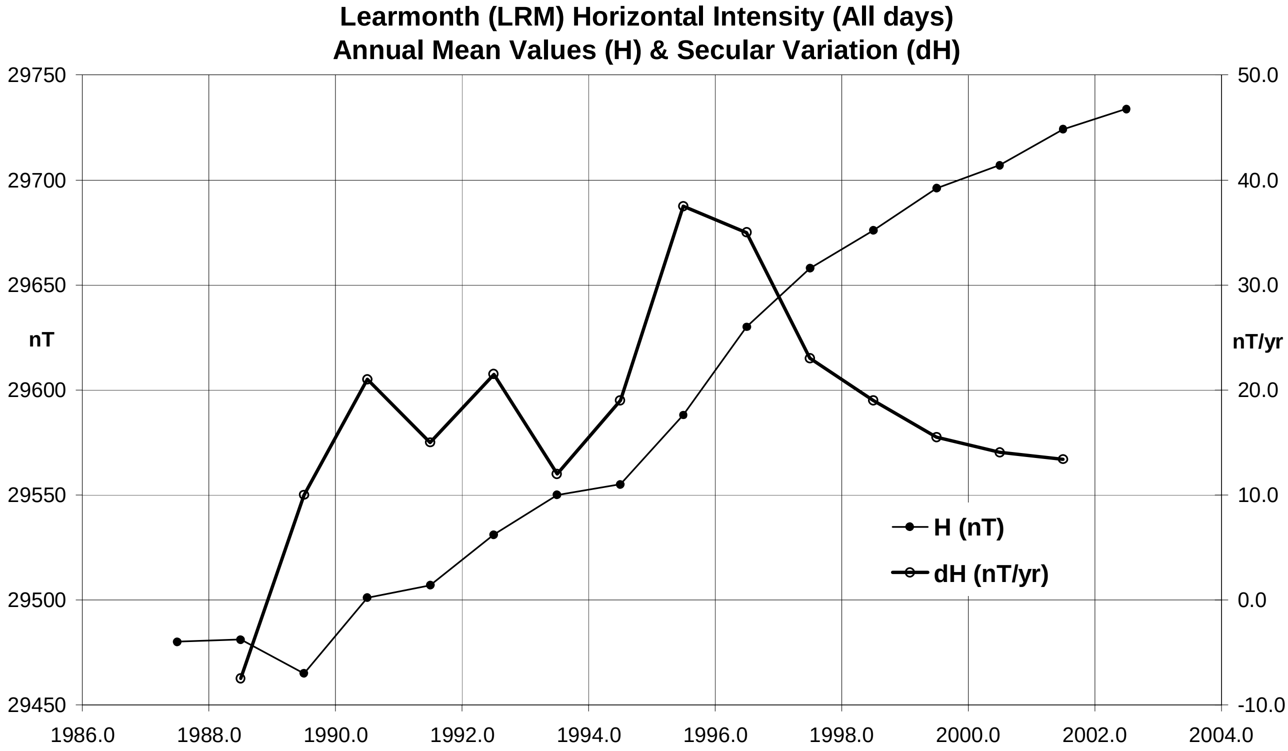


Learmonth 2002 Vertical intensity (Z). Scale: 7.5 nT/mm. Mean: -44197 nT

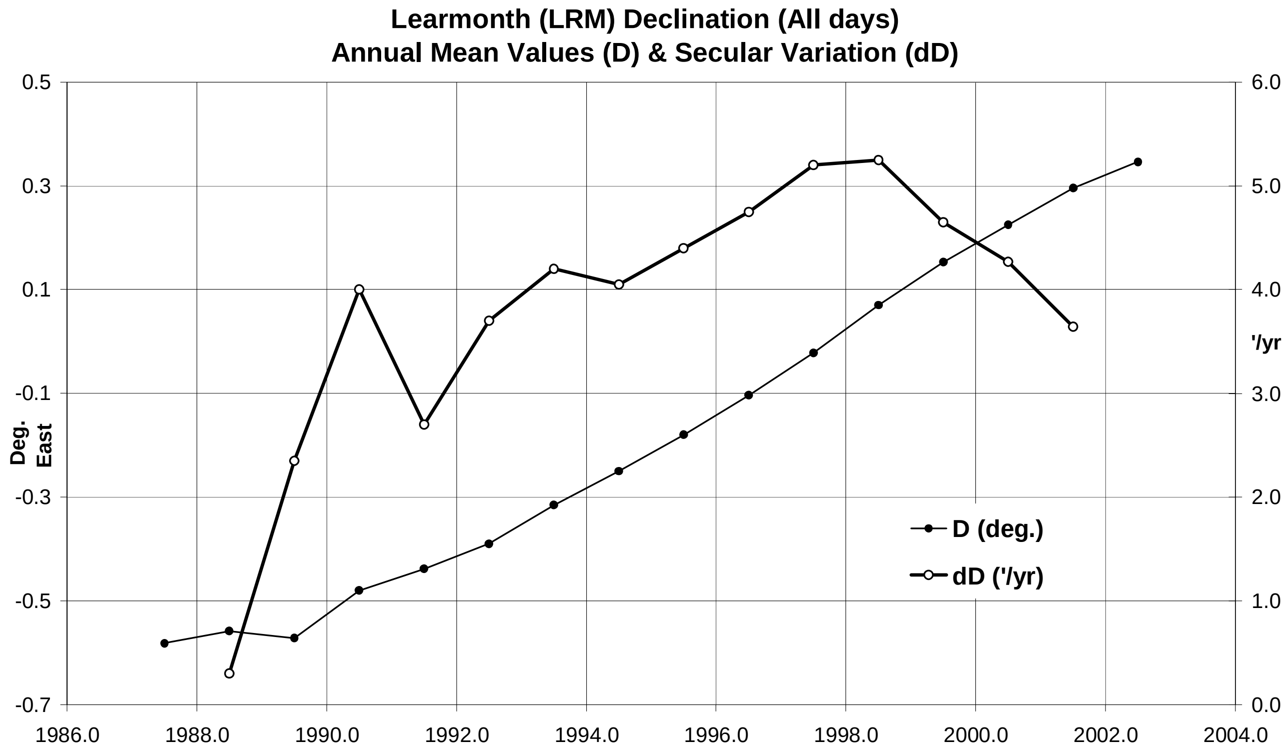


Learmonth 2002 Total intensity (F). Scale: 7.5 nT/mm. Mean: 53268 nT

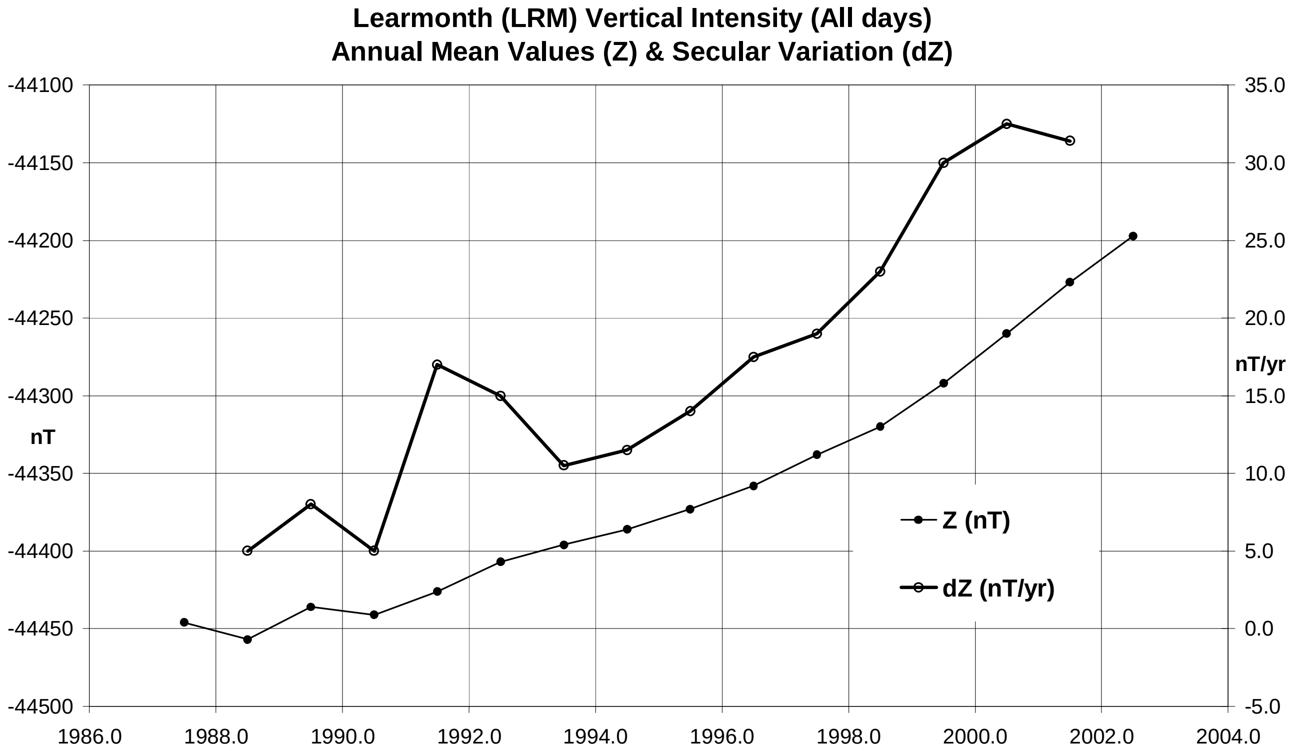




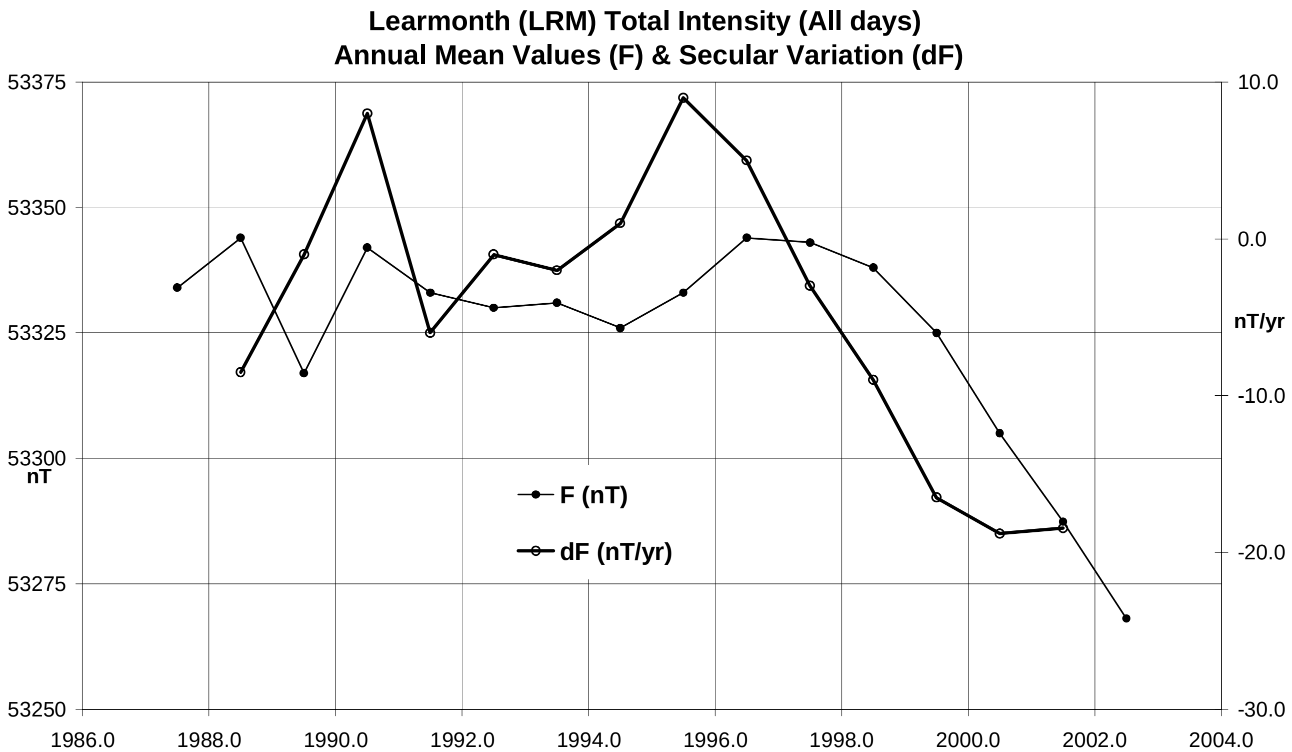
Learmonth (LRM) Horizontal Intensity (All days)
Annual Mean Values (H) & Secular Variation (dH)
nT
nT/yr
H (nT)
dH (nT/yr)
29750
29700
29650
29600
29550
29500
29450
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
1986.0
1988.0
1990.0
1992.0
1994.0
1996.0
1998.0
2000.0
2002.0
2004.0

Learmonth (LRM) Declination (All days)
Annual Mean Values (D) & Secular Variation (dD)
Deg. East
'/yr
D (deg.)
dD ('/yr)
0.5
0.3
0.1
-0.1
-0.3
-0.5
-0.7
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1986.0
1988.0
1990.0
1992.0
1994.0
1996.0
1998.0
2000.0
2002.0
2004.0



Learmonth (LRM) Vertical Intensity (All days)
Annual Mean Values (Z) & Secular Variation (dZ)
-44100
-44150
-44200
-44250
-44300
-44350
-44400
-44450
-44500
nT
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
nT/yr
1986.0
1988.0
1990.0
1992.0
1994.0
1996.0
1998.0
2000.0
2002.0
2004.0
Z (nT)
dZ (nT/yr)

Learmonth (LRM) Total Intensity (All days)
Annual Mean Values (F) & Secular Variation (dF)
53375
53350
53325
53300
53275
53250
nT
10.0
0.0
-10.0
-20.0
-30.0
nT/yr
1986.0
1988.0
1990.0
1992.0
1994.0
1996.0
1998.0
2000.0
2002.0
2004.0
F (nT)
dF (nT/yr)

# MACQUARIE ISLAND

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

A magnetic station was first established at Caroline Cove at the southern end of Macquarie Island in December 1911 by Eric Webb. Another magnetic station, referred to as station A, was established, also in 1911, on the Macquarie Island isthmus which is 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. Details of the staffing at the observatory is in *AGR* 1994. The Macquarie Island 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 the principal observation pier (AE) of the observatory are:

- 3-character IAGA code: MCQ
- Commenced operation: 1952
- Geographic latitude: 54° 30' S
- Geographic longitude: 158° 57' E
- Geomagnetic† : Lat. -59.92°; Long. 244.06°
  † Based on the IGRF 2000.0 model updated to 2002.5
- Elevation above mean sea level (top of pier): 8 metres
- Lower limit for K index of 9: 1500 nT.
- Azimuth of principal reference pillar (NMI) from pier AE: 353° 44' 13"
- Distance to Pillar NMI: ~200 metres
- Observers in Charge: Mick Eccles (2001/02)
  Peter Pokorny (2002/03)

## Variometers

The equipment employed to monitor magnetic variations at MCQ in 2002 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.

## Absolute Instruments and Corrections

Magnetic absolute measurements were performed in the Absolute House: on Pier AW with an Austral PPM (serial 525) and on Pier AE with an Elsec 810 DIM (serial 214) and a Zeiss020B (serial 311847) theodolite.

The classical QHMs (serial 177‡, 178, 179 on Askania circle 640616) were available as backup for use on pier AE.

A pier difference of:

$\Delta X = -2.6nT, \quad \Delta Y = +5.1nT, \quad \Delta Z = +4.2nT$

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 and Aust.525) and travelling standard instruments (B0806H/100856 GSM90_003985/11690) were performed at Macquarie Island on 24 and 26 Mar 2003.

The results of the instrument comparisons were:

| Travelling Stndrd | | MCQ instrument | | Inst. difference |
|---|---|---|---|---|
| GSM90_003985 | – | Austral 525 | = | +0.38nT (F) |
| B0806H/100856 | – | E810_214/311847 | = | +0.19' (Decl'n) |
| B0806H/100856 | – | E810_214/311847 | = | +0.04' (Incl'n) |

Comparisons between the travelling standard instruments and the Australian Standard 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 Stndrd | | MCQ instrument | | Inst. correction |
|---|---|---|---|---|
| GSM90_905926 | – | Austral 525 | = | +0.38nT (F) |
| E810_200/353756 | – | E810_214/311847 | = | +0.19' (Decl'n) |
| E810_200/353756 | – | E810_214/311847 | = | +0.04' (Incl'n) |

The instrument corrections adopted for the absolute magnetometers used at MCQ during 2002 convert to the baseline corrections:

$\Delta X = +0.34 \text{ nT} \quad \Delta Y = +1.01 \text{ nT} \quad \Delta Z = -0.23 \text{ nT}.$

at the mean 2002 field values at MCQ of 10850nT, 6430nT and -63195nT in X, Y and Z respectively. These corrections have been applied to all MCQ final data including in this report.

‡ See *Absolute Magnetometers employed in 2002* on page 5 of this report.

## Operations

The magnetic observers-in-charge at Macquarie Island in 2002 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.

Weekly absolute calibrations were performed on the observation piers in the absolute house by the ANARE communications technical officers: Mick Eccles from the beginning of 2002 until 01 March; then Peter Pokorny from March until the end of 2002.

### MCQ – Operations (cont.)

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, to GA where they were processed and distributed. Timing was provided by the Antarctic Division's GPS clock (which was also used with Atmospheric and Space Physics experiments).

## Distribution of MCQ data during 2002

***Preliminary Monthly Means for Project Ørsted***

- Sent monthly by email to IPGP

***1-minute & Hourly Mean Values***

- 2001: WDC-A, Boulder, USA (sent 04 Jun., 2002)

***1-minute Values for Project INTERMAGNET***

- Preliminary data daily to the Edinburgh GIN by e-mail from June 2002.
- Definitive data for CD-ROM sent to the WDC-C1 for Geomagnetism, Copenhagen Denmark:
  - 2001 data sent 04 Jun. 2002

## MCQ, 2002 – Significant Events:

| | |
|---|---|
| 01 Mar | Observer change over: Peter Pokorny replaced Mick Eccles. |
| March | Macquarie Island accepted as an INTERMAGNET Magnetic Observatory. |
| 15 Mar | Unexplained baseline jump. |
| 17 Oct | & 18th: Helipad repairs, bulldozer in quiet zone |
| 21 Oct | 0538-0700 & 2127 to 22 / 0331: Squirrel AS350 helicopter operations in the quiet zone. All operations completed and equipment removed from quiet zone by 22 / 0600. |
| 09 Nov | Acquisition PC halted - access to hard disk lost |
| 11 Nov | Acquisition PC rebooted |
| 01 Dec | OIC away for 1 week so no absolute observations. |
| | 2330 to 02 / 0400: Carpenters repairing seal damage to fences within the quiet zone around micro-pulsations equipment |

## MCQ, 2002 – Data losses:

| | |
|---|---|
| 15 Mar | 0428-0429 (2 min) All channels: Data contaminated. |
| 17 Mar | 1730-1731 (2 min) All channels: Data contaminated. |
| 09 Nov | 1700 to 11 / 0329 (1d 10h 30m): PC failure |

## 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 77-78.

| 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 |
| 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 |

continued on page 79 ...

## Monthly & 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 | 2002 | X (nT) | Y (nT) | Z (nT) | F (nT) | H (nT) | D (East) | I |
|---|---|---|---|---|---|---|---|---|
| January | All days | 10859.1 | 6413.1 | -63201.6 | 64447.7 | 12611.4 | 30° 33.9' | -78° 42.9' |
| | 5xQ days | 10868.4 | 6419.6 | -63202.7 | 64450.9 | 12622.8 | 30° 34.1' | -78° 42.3' |
| | 5xD days | 10840.1 | 6398.3 | -63192.7 | 64434.3 | 12587.6 | 30° 33.1' | -78° 44.1' |
| February | All days | 10851.8 | 6417.3 | -63203.1 | 64448.3 | 12607.3 | 30° 35.9' | -78° 43.2' |
| | 5xQ days | 10855.0 | 6419.7 | -63201.3 | 64447.3 | 12611.3 | 30° 36.0' | -78° 42.9' |
| | 5xD days | 10847.9 | 6413.8 | -63211.2 | 64455.3 | 12602.2 | 30° 35.6' | -78° 43.5' |
| March | All days | 10839.0 | 6420.9 | -63204.0 | 64447.4 | 12598.2 | 30° 38.5' | -78° 43.6' |
| | 5xQ days | 10847.3 | 6428.1 | -63200.7 | 64446.2 | 12608.9 | 30° 39.1' | -78° 43.0' |
| | 5xD days | 10828.1 | 6420.2 | -63205.7 | 64447.2 | 12588.5 | 30° 39.9' | -78° 44.2' |
| April | All days | 10823.5 | 6417.0 | -63211.2 | 64451.5 | 12582.8 | 30° 39.8' | -78° 44.5' |
| | 5xQ days | 10846.3 | 6427.4 | -63206.4 | 64451.5 | 12607.7 | 30° 39.0' | -78° 43.2' |
| | 5xD days | 10730.7 | 6377.8 | -63236.3 | 64457.2 | 12483.2 | 30° 43.6' | -78° 50.0' |
| May | All days | 10837.4 | 6424.5 | -63204.6 | 64448.0 | 12598.6 | 30° 39.6' | -78° 43.6' |
| | 5xQ days | 10841.1 | 6426.6 | -63206.6 | 64450.8 | 12602.8 | 30° 39.6' | -78° 43.4' |
| | 5xD days | 10804.0 | 6408.5 | -63189.9 | 64426.5 | 12561.8 | 30° 40.5' | -78° 45.4' |
| June | All days | 10848.2 | 6429.2 | -63194.7 | 64440.6 | 12610.3 | 30° 39.2' | -78° 42.9' |
| | 5xQ days | 10852.0 | 6431.0 | -63192.6 | 64439.3 | 12614.4 | 30° 39.1' | -78° 42.7' |
| | 5xD days | 10835.8 | 6422.0 | -63188.7 | 64431.9 | 12595.9 | 30° 39.2' | -78° 43.6' |
| July | All days | 10847.5 | 6430.7 | -63189.1 | 64435.2 | 12610.4 | 30° 39.6' | -78° 42.8' |
| | 5xQ days | 10851.2 | 6431.1 | -63189.3 | 64436.0 | 12613.8 | 30° 39.2' | -78° 42.7' |
| | 5xD days | 10844.0 | 6428.7 | -63184.6 | 64429.9 | 12606.4 | 30° 39.7' | -78° 43.0' |
| August | All days | 10838.7 | 6428.3 | -63191.2 | 64435.5 | 12601.7 | 30° 40.3' | -78° 43.3' |
| | 5xQ days | 10843.6 | 6432.4 | -63192.6 | 64438.1 | 12607.9 | 30° 40.6' | -78° 43.0' |
| | 5xD days | 10836.3 | 6424.0 | -63180.2 | 64424.1 | 12597.4 | 30° 39.7' | -78° 43.4' |
| September | All days | 10831.0 | 6426.3 | -63200.7 | 64443.4 | 12594.0 | 30° 40.9' | -78° 43.8' |
| | 5xQ days | 10849.2 | 6435.4 | -63193.3 | 64440.0 | 12614.2 | 30° 40.5' | -78° 42.7' |
| | 5xD days | 10803.8 | 6413.8 | -63210.7 | 64447.7 | 12564.3 | 30° 41.8' | -78° 45.5' |
| October | All days | 10817.0 | 6418.0 | -63201.7 | 64441.3 | 12577.8 | 30° 40.9' | -78° 44.7' |
| | 5xQ days | 10837.7 | 6427.2 | -63198.3 | 64442.2 | 12600.2 | 30° 40.2' | -78° 43.5' |
| | 5xD days | 10778.5 | 6403.8 | -63192.3 | 64424.5 | 12537.6 | 30° 43.0' | -78° 46.7' |
| November | All days | 10834.4 | 6426.8 | -63193.5 | 64437.0 | 12597.2 | 30° 40.6' | -78° 43.6' |
| | 5xQ days | 10852.5 | 6434.4 | -63191.7 | 64438.9 | 12616.6 | 30° 39.8' | -78° 42.5' |
| | 5xD days | 10815.9 | 6424.4 | -63208.6 | 64448.6 | 12580.1 | 30° 42.6' | -78° 44.6' |
| December | All days | 10847.6 | 6431.5 | -63175.1 | 64421.6 | 12611.0 | 30° 39.8' | -78° 42.7' |
| | 5xQ days | 10867.2 | 6440.0 | -63171.7 | 64422.3 | 12632.1 | 30° 39.1' | -78° 41.5' |
| | 5xD days | 10824.2 | 6421.9 | -63169.2 | 64411.0 | 12586.0 | 30° 40.9' | -78° 43.9' |
| Annual | All days | 10839.6 | 6423.6 | -63197.6 | 64441.5 | 12600.0 | 30° 39.1' | -78° 43.5' |
| Mean | 5xQ days | 10851.0 | 6429.4 | -63195.6 | 64442.0 | 12612.7 | 30° 38.9' | -78° 42.8' |
| Values | 5xD days | 10815.8 | 6413.1 | -63197.5 | 64436.5 | 12574.2 | 30° 40.0' | -78° 44.8' |

(Calculated: 14:14 hrs., Wed. 07 May 2003)

## Hourly Mean Values

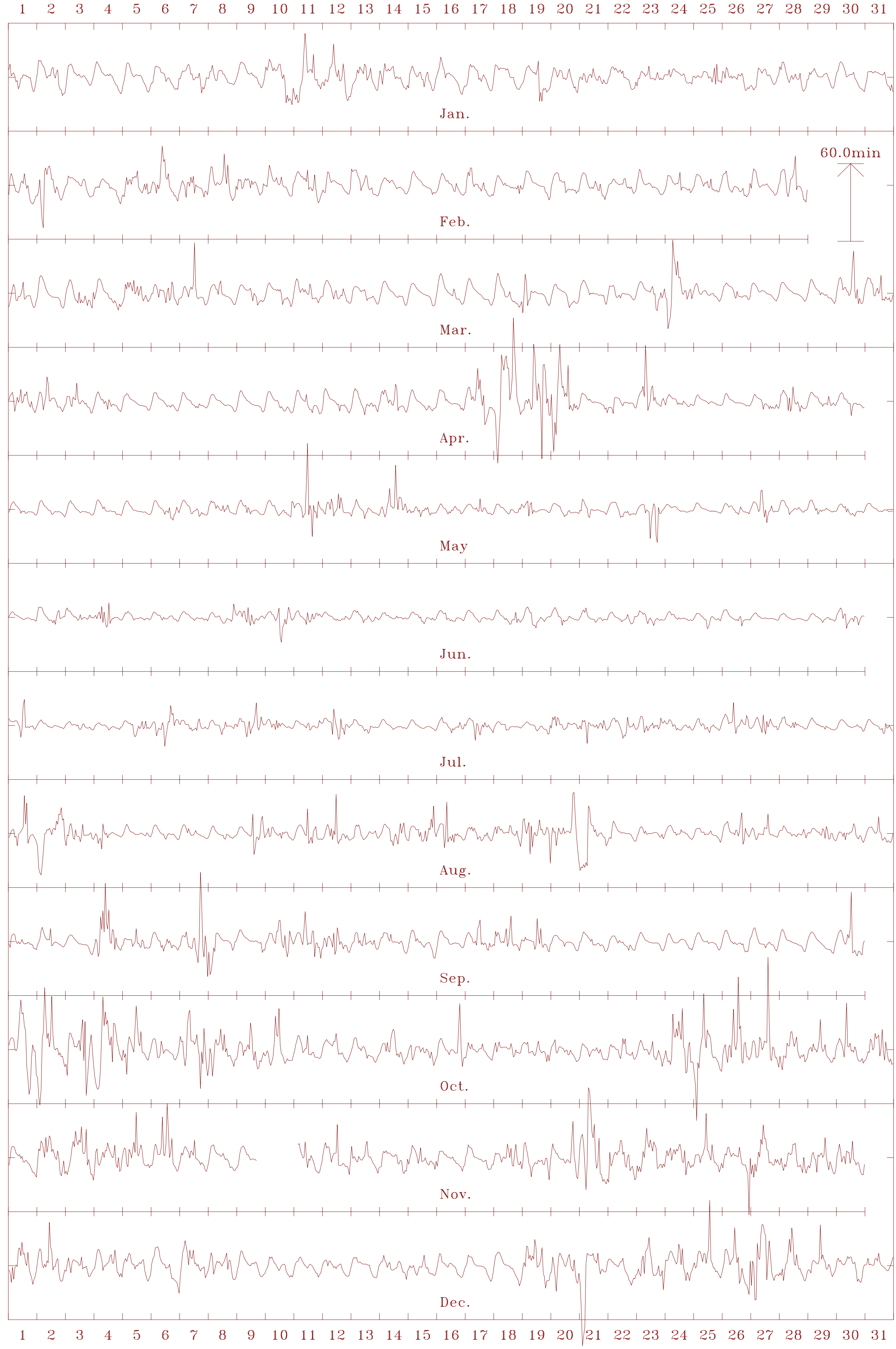
The charts on the following pages are plots of hourly mean values.

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.

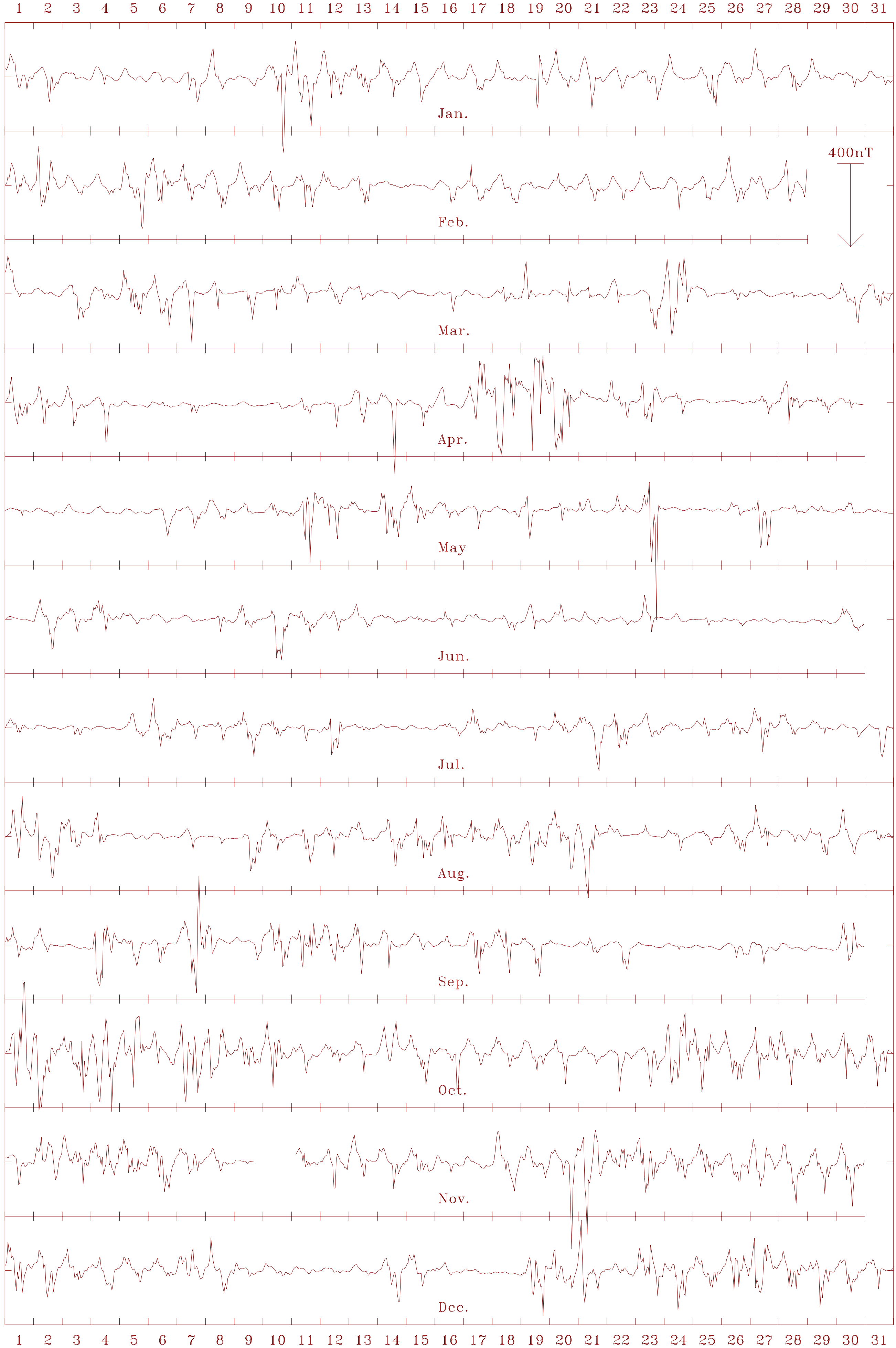
The mean value given at the top of each plot is the *all-days* annual mean value of the element.

Macquarie Is. 2002 Horizontal intensity (H). Scale: 40.0 nT/mm. Mean: 12600 nT

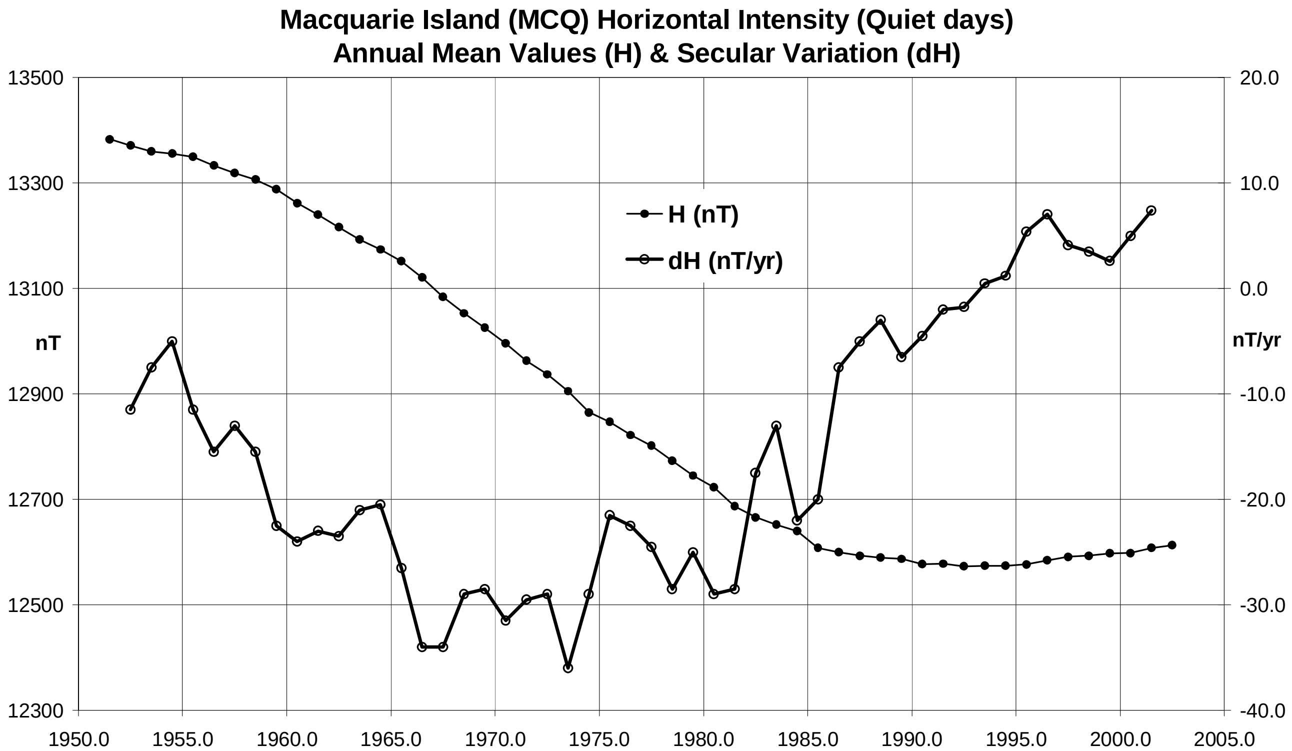
Macquarie Is. 2002 Declination (east) (D). Scale: 4.00 min/mm. Mean: 30.65 deg.

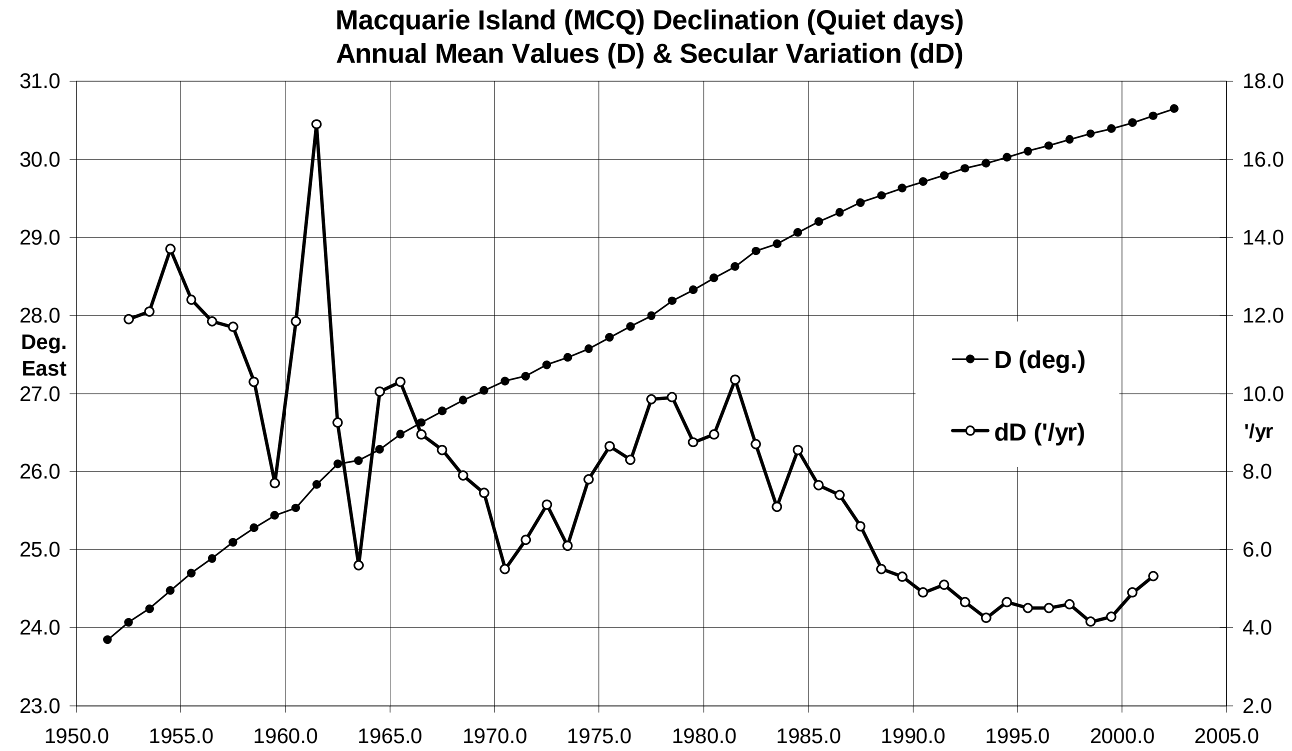


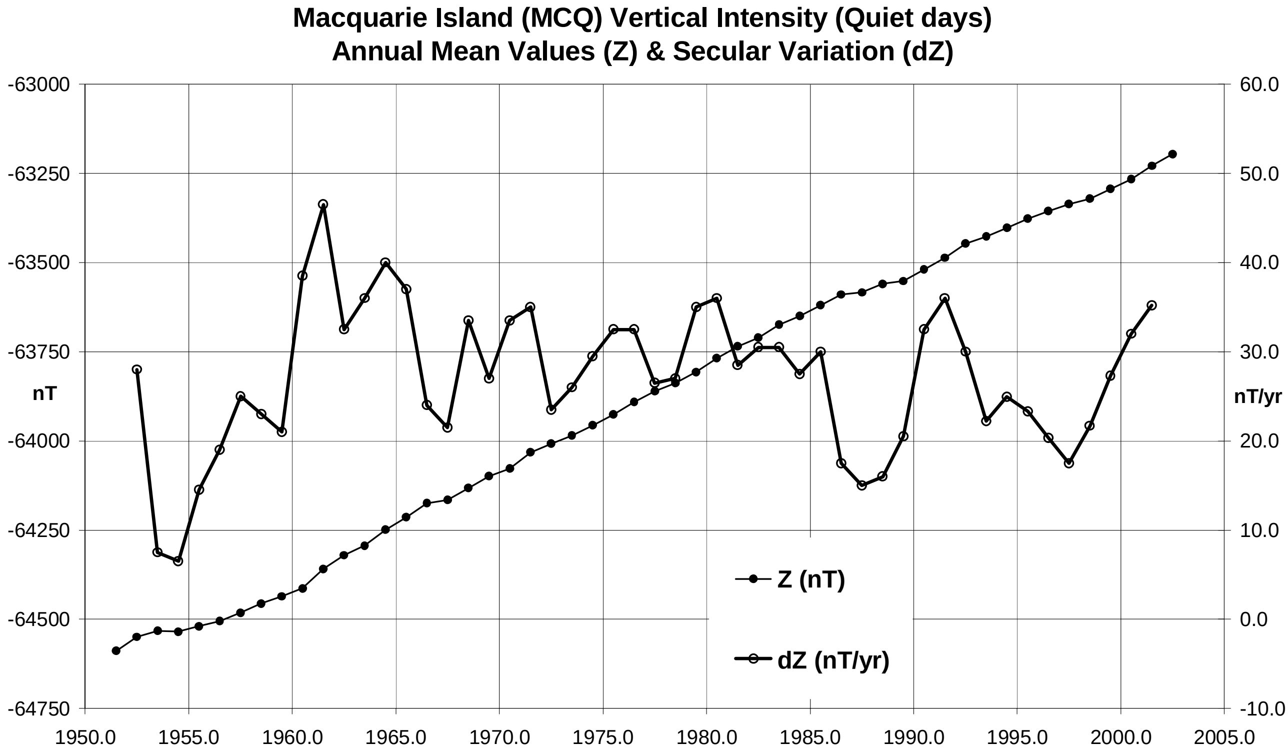
Macquarie Is. 2002 Vertical intensity (Z). Scale: 25.0 nT/mm. Mean: −63198 nT

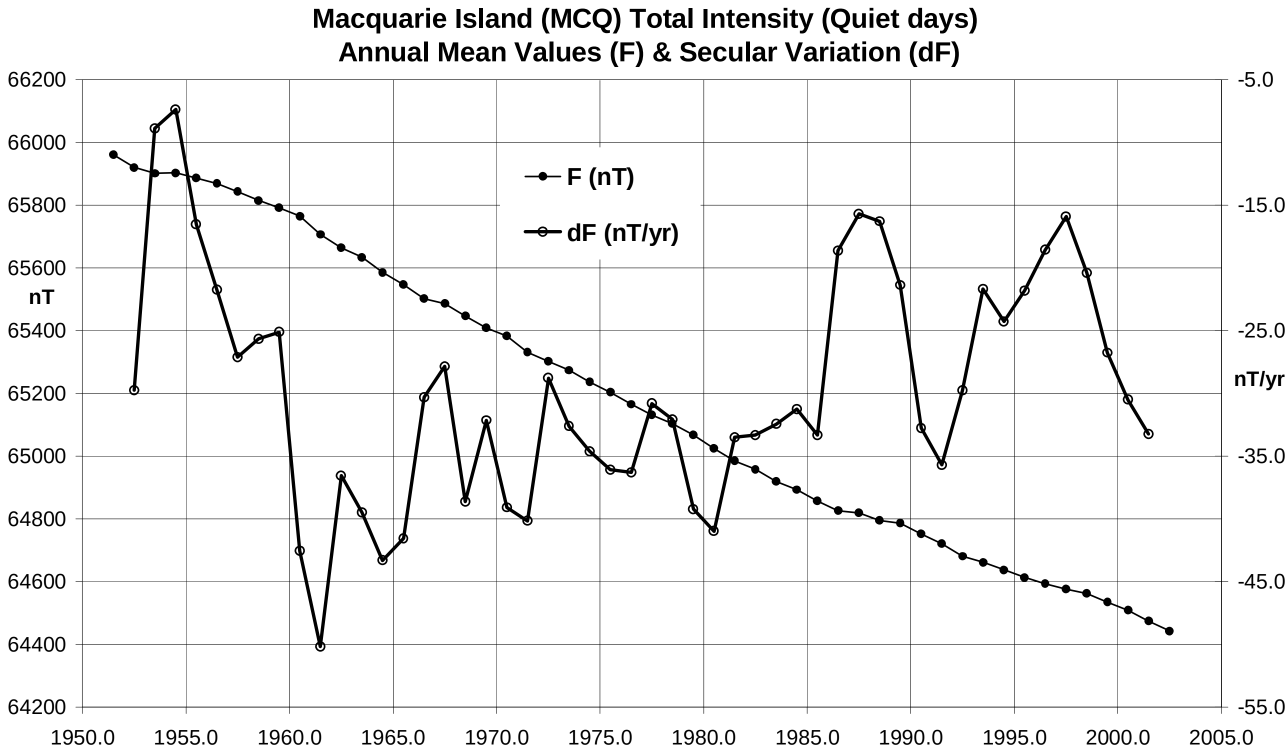


Macquarie Is. 2002 Total intensity (F). Scale: 25.0 nT/mm. Mean: 64442 nT


Macquarie Island (MCQ) Horizontal Intensity (Quiet days)
Annual Mean Values (H) & Secular Variation (dH)
H (nT)
dH (nT/yr)
nT
nT/yr
13500
13300
13100
12900
12700
12500
12300
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
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) Declination (Quiet days)
Annual Mean Values (D) & Secular Variation (dD)
D (deg.)
dD ('/yr)
Deg.
East
'/yr
31.0
30.0
29.0
28.0
27.0
26.0
25.0
24.0
23.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
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) 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
1950.0
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)


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
1950.0
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)

**MCQ – Annual Mean Values (cont.)**

| Year | Days | D (Deg | Min) | I (Deg | Min) | H (nT) | X (nT) | Y (nT) | Z (nT) | F (nT) | Elts |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

* Elements ABC indicates non-aligned variometer orientation

# MAWSON OBSERVATORY

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).

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

Key data for the principal observation pier (A) of the observatory are:

- 3-character IAGA code: MAW
- Geographic latitude: 67° 36' 14" S
- Geographic longitude: 62° 52' 45" E
- Geomagnetic†: Lat. -73.10°; Long. 110.01°
  † Based on the IGRF 2000.0 model updated to 2002.5
- Elevation above mean sea level (top of pier A): 12 metres
- Lower limit for K index of 9: 1500 nT.
- Azimuth of principal reference mark (BMR89/1) from Pier A: 350° 36.9'
- Distance to azimuth mark BMR89/1: 112 metres
- Observers in Charge: Martin Purvins (2001, GA/BoM)
  Andrew Jenner (2002, GA/BoM)
  Kerry Steinberner (2003, GA/BoM)

## Variometers

A 3-axis Narod ringcore fluxgate (RCF) magnetometer and an Elsec 820M3 PPM monitored magnetic variations at Mawson throughout 2002. 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.

## MAW – Variometers (cont.)

An EDA 3-component fluxgate magnetometer and its associated data acquisition PC were available as a standby variometer to replace the principal system should it fail. This system, also in the Variometer House, was left powered off during 2002.

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.

## Absolute Instruments and Corrections

The principal absolute magnetometers used at Mawson in 2002 were a Danish fluxgate magnetometer (D26035) mounted on a Zeiss 020B theodolite (serial 311542) and an Elsec model 770 PPM (serial 199).

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

Instrument comparisons (which were corrected to the Australian Magnetic Standard held at Canberra) performed in January 2003 indicated a correction of +1.4 ± 1.5nT for Elsec 770/199. This was consistent with the correction of +1.6nT applied in 2001. The comparisons also showed inconclusive small corrections for DIM D26035/311542 (+0.3 ± 0.3' for D, and -0.1 ± 0.1' for I).

For standardization with the Australian Magnetic Standard held at Canberra the corrections applied in 2001 have been retained for 2002 data, ie a correction of +1.6nT has been applied to the PPM readings, and corrections of zero have been applied to the DIM readings. These resulted in baseline corrections of:

$$\Delta X = +0.3 \text{ nT} \qquad \Delta Y = -0.5 \text{ nT} \qquad \Delta Z = -1.5 \text{ nT}.$$

Secondary instruments were used monthly to maintain calibration in case of failure of the primary instruments. They included an Askania declinometer (serial 630332) and three horizontal magnetometers (QHM serial 300, 301, and 302). The declinometer and QMHs were used on Askania circle 611665.

The average α-parameter and H and D corrections to make the QHMs agree with baselines determined from the primary instruments during 2002 were:

QHM300: $\alpha = +13.0\pm0.3'$ $\Delta H = -0.7\pm3.1$nT, $\Delta D = -1.5\pm1.6'$

QHM301: $\alpha = -12.4\pm0.3'$ $\Delta H = +7.2\pm1.4$nT, $\Delta D = +0.0\pm1.2'$

QHM302: $\alpha = -00.6\pm3.7'$ $\Delta H = -5.9\pm9.7$nT, $\Delta D = +0.1\pm3.8'$

(No corrections were applied to these QHM observations.

These calculations used the QHM constants

| QHM | K | $k_1$ (e-5) | $k_2$ (e-10) | α-factor | collimation |
|---|---|---|---|---|---|
| 300 | 7828.0 | 39.4 | 69.0 | 2.22e5 | 22.5' |
| 301 | 8230.5 | 39.7 | 90.0 | 0 | 72.5' |
| 302 | 7690.1 | 42.0 | 90.0 | 0 | 27.0' |

The average E-I-parameter and D correction to make the Askania declinometer agree with baselines determined from the primary instruments during 2002 were:

$$E\text{-}I = +1.4 \pm 0.4' \qquad \Delta D = -0.7 \pm 1.2'$$

## Baselines

The standard deviations between the adopted variometer model and data, and the absolute observations, were: 0.2' in D; 0.1' in I; 1.1nT in X and Y; 0.7nT in F and Z.

There were some baseline changes from 5th to 16th February 2002 not explained by the information available. At about 1040 on 5th, a new UPS was taken (and presumably installed) in the variometer hut. There were two changes to F-check, each about 50nT in the same sense (not cancelling) several minutes apart and caused mainly by change in the variometer PPM. F-check remained stable in that state until early on 6th but then started to "chatter", and then fell to near its original state. It was noticed that there was a circuit breaker flicking on and off at the time, and a new thermostat was installed to solve the problem. From then through to 16th there was a curious wave in F-check. Fortuitously, there were absolute observations near the peak and trough of the F-check wave. Some data from 5th and 6th February were rejected, but the absolute observations on the 8th and 12th February were used to correct the F-check wave thereafter.

The system failed on 6th October (blizzard static problem), and was restarted on 9th October. The baselines became erratic at about that time, but probably before 6th October. A few *apparently corrupted* absolute measurements about that time lead to poor baseline certainty between 9th September and 11th October.

There was another step up in F-check on 6th November, followed by an almost cancelling step down on 18th November, without explanation. There were adequate absolute measurements before, during, and after this period, but they did not support the F-check variability.

The variometer appeared to be less stable from September to December.

## Operations

The 2002 observers were employed jointly by Geoscience Australia (GA) and the Bureau of Meteorology (BoM) and were members of the Australian National Antarctic Research Expedition (ANARE). The Mawson Station personnel changeover each summer, with varying amounts of overlap.

The 2002 observer (AJ) arrived at MAW in January 2002 and took over the responsibility for operating the observatory on 12 February 2002. The 2001 observer (MP) departed in February 2002 after an extended changeover. The 2002 observer departed MAW in December 2002 after a brief changeover following the arrival of the 2003 observer (KS) who arrived in December 2002, and assumed responsibility for the observatory on 14 December 2002.

The observer was responsible for the continuous operation of the observatory and performed equipment maintenance as required. In 2002 the observer performed absolute observations once or twice per 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 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 that was connected to the station's radio network-hub, also in the variometer house, automatically copied files from the acquisition PC. 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.

## MAW – Operations (cont.)

In earlier years 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 occasional data losses during blizzards which also delay attention from the local observer for a few days

The daily data were processed and distributed at GA, 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.

The GA overseer for Mawson left GA in mid-2002. The annual change of local observers at Mawson, and the change of overseer at GA has left some gaps in knowledge of events during 2002, and some data has been rejected due to uncertainty in baselines – it is doubtful that this data could ever have been recovered, due to an oversight in not applying the practice to *calibrate each and every change in the variometer building before any further changes*. This occurred through inexperience and staff turnover.

## MAW 2002 – Data Loss

Feb 05 — 1030 to 06 / 0502 (18h 33m) All channels: UPS replaced – insufficient information to determine baseline changes during this period – data processing inhibited.

Apr 23 — 0604-0605 (2 min) All channels: Unknown cause.

Jul 21 — 1213 to 22 / 0619 (18h 07m) All channels: Associated with a power failure/UPS failure. Specific details are unknown.

Jul 23 — 0555 (1 min) All channels: Restart, probably to reset variometer PPM.

Oct 06 — 0006 to 09 / 0600 (3d 05h 55m) All channels: System halted most likely due to blizzard induced static discharge.

Jul 22 — 0619-Jul 23 0600 (23h 42m): F-channel only: PPM failed to restart after power outage.

*Problems in data:*

Feb 05 — 1030 to 15 / 0000 (9d 13h 31m) Poor baseline control during large baseline drifts in variometer.

Sep 09 — to Oct 11 (33 days) Poor baseline control.

## Mawson, Antarctica 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 89-90.

| 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 | 8.7 | -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 |
| 1965.5 | | -61 | 12.6 | -69 | 13.1 | 18356 | 8958 | -16022 | -48368 | 51734 | DHZ |
| 1966.5 | | -61 | 24.0 | -69 | 9.6 | 18362 | 9014 | -15997 | -48235 | 51612 | DHZ |
| 1967.5 | | -61 | 34.4 | -69 | 7.2 | 18374 | 9068 | -15980 | -48168 | 51553 | DHZ |
| 1968.5 | | -61 | 43.8 | -69 | 5.2 | 18365 | 9107 | -15948 | -48060 | 51449 | DHZ |
| 1969.5 | | -61 | 53.0 | -69 | 3.4 | 18353 | 9144 | -15913 | -47954 | 51346 | DHZ |
| 1970.5 | | -62 | 0.5 | -69 | 0.4 | 18358 | 8621 | -16208 | -47840 | 51241 | DHZ |
| 1971.5 | | -62 | 5.3 | -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 | 5.8 | -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 | 4.4 | -68 | 10.7 | 18475 | 8120 | -16595 | -46142 | 49703 | XYZ |
| 1989.5 | | -64 | 12.8 | -68 | 9.7 | 18474 | 8160 | -16574 | -46099 | 49663 | XYZ |
| 1990.5 | | -64 | 21.1 | -68 | 6.4 | 18492 | 8208 | -16570 | -46015 | 49592 | XYZ |
| 1991.5 | | -64 | 28.8 | -68 | 4.2 | 18502 | 8250 | -16561 | -45957 | 49542 | XYZ |
| 1992.5 | Q | -64 | 36.5 | -68 | -1.7 | 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 | 0.4 | -67 | 55.3 | 18550 | 7838 | -16813 | -45731 | 49350 | ABC |
| 1996.5 | Q | -65 | 9.2 | -67 | 53.5 | 18561 | 7799 | -16843 | -45692 | 49318 | ABC |

continued ...

### MAW – Annual Mean Values (cont.)

| Year | Days | D (Deg | Min) | I (Deg | Min) | H (nT) | X (nT) | Y (nT) | Z (nT) | F (nT) | Elts |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | -5.2 | -67 | -48.2 | 18581 | 7532 | -16986 | -45540 | 49185 | ABC |
| 1992.5 | A | -64 | 36.9 | -68 | -2.8 | 18499 | 7930 | -16712 | -45894 | 49482 | XYZ |
| 1993.5 | A | -64 | 44.2 | -68 | -0.7 | 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 | 0.9 | -67 | 56.7 | 18532 | 7828 | -16798 | -45741 | 49352 | ABC |
| 1996.5 | A | -65 | 9.8 | -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 | -5.8 | -67 | -49.3 | 18568 | 7524 | -16975 | -45546 | 49185 | ABC |
| 1992.5 | D | -64 | 39.6 | -68 | -5.2 | 18466 | 7904 | -16689 | -45907 | 49482 | XYZ |
| 1993.5 | D | -64 | 45.9 | -68 | -3.0 | 18476 | 7877 | -16713 | -45847 | 49430 | ABC |
| 1994.5 | D | -64 | 55.3 | -68 | -1.9 | 18476 | 7831 | -16734 | -45804 | 49390 | ABC |
| 1995.5 | D | -65 | 1.7 | -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 | -7.6 | -67 | -51.2 | 18540 | 7504 | -16953 | -45552 | 49180 | ABC |

* Elements ABC indicates non-aligned variometer orientation

## Distribution of MAW data during 2002

***Preliminary Monthly Means for Project Ørsted***

- Sent monthly by e-mail to IPGP

***1-minute & Hourly Mean Values (WDC format)***

- 2001: WDC-A, Boulder, USA (sent 23 May, 2002)

***1-minute Values (INTERMAGNET format)***

- 2001: WDC-C1, Copenhagen, Denmark (sent 23 May, 2002)

## MAW Significant Events 2002

Jan 03 Fire alarm system in variometer hut tested.

Jan 09 2002 observer (AJ) arrived at Mawson station.

Jan 11 Shovel discovered in snow drift 20m E of variometer hut.

21 Jan Unsuccessful attempt to adjust slack in DIM feet which were subsequently shortened.

24 Jan Unsuccessful attempt to adjust slack in DIM feet.

Feb 04 Site officer's inspection tour of absolute and variometer huts.

Feb 05 PPM comparisons with travelling standard. New UPS transferred to variometer hut

Feb 06 Electrician's tour of magnetic huts. Circuit breaker#7 in variometer hut flicking on/off – thermostat replaced. Power off to variometer hut, acquisition restarted at 05:01:45.

Feb 08 Heater found not to be reset after electricians replaced thermostat. Temperature 5.85°C. Adjustments made to thermostat.

Feb 09 Old UPS removed from variometer hut. Temperature 14°C, adjustments made to thermostat.

Feb 11 Temperature adjustments made to variometer.

### MAW – Significant Events (cont.)

Feb 12 Variometer power off at 1515 and 0915 local time. 2002 observer (AJ) assumed responsibility of magnetic observatory.

Feb 15 Polar Bird supply vessel arrived. Battery changed in power packs (and maybe in absolute instruments). Variometer Temperature 9.6°C.

Feb 16 Some machinery for the Prince Charles Mountains Expedition of Germany & Australia passed through the magnetic quiet zone.

Feb 19 Departure of Polar Bird.

Feb 22 Arrival of Aurora Australis.

Feb 25 Departure of Auroroa Australis.

Feb 27 Temperature adjustments.

Jul 22 UPS failed to continue operation through power outages. Apparent change in variometer characteristics at this time, or one or two weeks prior to this event.

Oct 06 Acquisition computer stopped – there was a blizzard lasting three days.

Oct 09 Acquisition computer restarted, with unexplained interruptions and effects on the data.

Dec 14 2003 observer (KS) assumed responsibility for magnetic observatory.

## K indices

The table on the next page shows Mawson K indices for 2002. 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.

## K indices & Daily K sums at Mawson Antarctica (K=9 limit: 1500 nT) for 2002

| Date | January | February | March | April | May | June | Date |
|---|---|---|---|---|---|---|---|
| 01 | 4664 4445 37 | 5654 5433 35 | 5553 2202 24 | 4563 4562 35 | Q 2321 1022 13 | Q 0111 0123 09 | 01 |
| 02 | 5544 5443 34 | D 5664 5322 33 | 3332 2223 20 | 4553 2124 26 | 3311 2201 13 | D 6542 3525 32 | 02 |
| 03 | Q 4333 3123 22 | Q 3432 2323 22 | 3334 4464 31 | 4663 2234 30 | 2431 1212 16 | 5343 3264 30 | 03 |
| 04 | Q 4433 2223 23 | 4541 2333 25 | 4343 2333 25 | 2443 2123 21 | 1321 0233 15 | D 5554 2353 32 | 04 |
| 05 | Q 4532 2122 21 | D 4443 ---- -- | D 5654 4565 40 | Q 3311 1122 14 | Q 2222 1113 14 | 5521 1154 24 | 05 |
| 06 | Q 2331 2213 17 | D --74 5553 -- | 3564 4555 37 | 1311 1224 15 | 2212 3535 23 | 3332 2234 22 | 06 |
| 07 | 3343 3443 27 | D 5455 4346 36 | 3443 3215 25 | 3222 3210 15 | 3331 2355 25 | 2221 0055 17 | 07 |
| 08 | 5463 4322 29 | 4443 3355 31 | 3334 2100 16 | Q 1122 0003 09 | 5442 2334 27 | D 0122 3256 21 | 08 |
| 09 | 2212 3333 19 | 4653 3236 32 | 2122 3531 19 | Q 3221 1101 11 | 4223 2034 20 | 4453 2364 31 | 09 |
| 10 | D 4545 5666 41 | 5452 2222 24 | 2323 3215 21 | 1222 2222 15 | D 3343 3227 27 | D 2443 4454 30 | 10 |
| 11 | D 6775 4746 46 | 4545 4335 33 | 4553 3212 25 | 3243 3224 23 | D 3235 5445 31 | 3333 2254 25 | 11 |
| 12 | D 6555 4564 40 | 5443 3215 27 | 3343 3345 28 | 5332 3222 22 | 5454 3316 31 | 5422 2235 25 | 12 |
| 13 | D 4544 4336 33 | 4433 4622 28 | 5342 3221 22 | 4543 3445 32 | 5441 3210 20 | 3543 3264 30 | 13 |
| 14 | 3443 4344 29 | Q 2332 2102 15 | Q 2223 2123 17 | 4442 4211 22 | D 3544 3465 34 | Q 4312 0134 18 | 14 |
| 15 | 3664 4345 35 | Q 1433 2222 19 | 2221 1145 18 | 2221 2335 20 | 6643 2345 33 | Q 4211 1126 18 | 15 |
| 16 | 3443 3211 21 | Q 4432 2422 23 | Q 2221 2211 13 | 3451 0055 23 | 4433 2244 26 | 3333 2225 23 | 16 |
| 17 | 4453 3335 30 | 3553 3445 32 | Q 3221 1222 15 | D 4445 6574 39 | 5122 3225 22 | 5331 1113 18 | 17 |
| 18 | 5532 3302 23 | 4442 2355 29 | 4323 5344 28 | D 6745 5746 44 | 4211 1276 24 | 1122 2453 20 | 18 |
| 19 | D 1223 4544 25 | 3332 2222 19 | D 5753 1123 27 | D 6556 5658 46 | 3452 1000 15 | 3453 2256 30 | 19 |
| 20 | 5653 3234 31 | 4343 3325 27 | 2212 2433 19 | D 8855 4555 45 | 1343 3221 19 | 5543 3114 26 | 20 |
| 21 | 5544 4343 32 | 3543 2235 27 | 3443 2243 25 | 3332 2224 21 | 6253 2102 21 | 4532 2344 27 | 21 |
| 22 | 4443 3323 26 | 4543 3254 30 | 3542 0112 18 | 6633 3434 32 | 2334 2343 24 | 3232 2346 25 | 22 |
| 23 | 5444 3364 33 | Q 3542 1223 22 | 2222 4556 28 | D 2773 3436 35 | D 3545 7746 41 | 3554 3253 30 | 23 |
| 24 | 4532 2334 26 | 4543 3133 26 | D 7644 4544 38 | 5333 2354 28 | Q 2211 0111 09 | 4342 2245 26 | 24 |
| 25 | 4533 5554 34 | 4233 3335 26 | 3522 1211 17 | Q 4222 0112 14 | Q 2100 1112 08 | 3431 3256 27 | 25 |
| 26 | 5553 3334 31 | 4443 3345 30 | 3434 3256 30 | Q 2321 0013 12 | 2232 3234 21 | 4311 2334 21 | 26 |
| 27 | 6544 2334 31 | 4332 3234 24 | Q 2332 1133 18 | 3322 3355 26 | D 5465 3435 35 | Q 3211 1100 09 | 27 |
| 28 | 4333 4334 27 | D 3664 3267 37 | Q 2311 0010 08 | 6665 3353 37 | 5543 2344 30 | Q 0010 0001 02 | 28 |
| 29 | 5533 2223 25 | | 1221 1122 12 | 3332 2356 27 | 4452 4235 29 | 3211 1145 18 | 29 |
| 30 | Q 4322 3333 23 | | D 3553 3445 32 | 3332 3322 21 | 3333 2213 20 | D 5533 3246 31 | 30 |
| 31 | 4542 1324 25 | | D 4553 3375 35 | | Q 3211 1013 12 | | 31 |
| **Mean K-sum** | **28.9** | **27.4** | **23.6** | **25.3** | **22.5** | **23.2** | |

| Date | July | August | September | October | November | December | Date |
|---|---|---|---|---|---|---|---|
| 01 | 5544 3242 29 | D 2553 4333 28 | 5441 2246 28 | D 3455 5557 39 | Q 4433 2333 25 | 5665 5545 41 | 01 |
| 02 | Q 4331 2034 20 | D 7743 3666 42 | 6443 2211 23 | D 5564 3656 40 | D 6565 5464 41 | 4554 4465 37 | 02 |
| 03 | Q 3222 1252 19 | 5553 2235 30 | 1122 1125 15 | 6544 5566 41 | D 4675 5765 45 | 4444 4354 32 | 03 |
| 04 | Q 4210 1015 14 | 4663 2111 24 | D 6675 4465 43 | D 6645 5576 44 | 4554 5646 39 | 4444 4555 35 | 04 |
| 05 | 3333 2335 25 | Q 2221 0136 17 | 3533 3331 24 | 5634 5655 39 | D 4665 4455 39 | 5433 3334 28 | 05 |
| 06 | D 6664 3668 45 | Q 3531 1024 19 | 2433 3225 24 | ---- ---- -- | 5554 4466 39 | 4433 3436 30 | 06 |
| 07 | 5443 3233 27 | Q 4331 2120 16 | D 3554 3766 39 | D ---- ---- -- | 5534 3344 31 | 4465 4455 37 | 07 |
| 08 | 5323 3226 26 | 1411 1044 16 | D 7653 0125 29 | ---- ---- -- | Q 2543 2242 24 | 4653 4545 36 | 08 |
| 09 | 6543 3344 32 | 2332 3476 30 | 3221 1265 22 | --34 4665 -- | Q 3332 2225 22 | 5332 3243 25 | 09 |
| 10 | 4443 2246 29 | 4644 3347 35 | 5454 4664 38 | 5654 4335 35 | 4573 2223 28 | 3432 2254 25 | 10 |
| 11 | 4222 1265 24 | 3442 4346 30 | D 3456 3556 37 | Q 5333 2234 25 | 3554 5334 32 | Q 3433 3223 23 | 11 |
| 12 | D 4345 4432 29 | 4543 3335 30 | 4653 3444 33 | Q 3324 3332 23 | 3445 5355 34 | Q 4433 3234 26 | 12 |
| 13 | 4535 2223 26 | 5443 3246 31 | 4664 3243 32 | Q 4442 2342 25 | 5644 4354 35 | Q 4332 2324 23 | 13 |
| 14 | Q 3212 1112 13 | 5333 4556 34 | 4543 2333 27 | 4665 4524 36 | 5542 3433 29 | 4544 3665 37 | 14 |
| 15 | Q 3111 1245 18 | 5455 4567 41 | 4322 2343 23 | 5544 3553 34 | 4543 3244 29 | 5543 4343 31 | 15 |
| 16 | 2432 2356 27 | 3563 3233 28 | 3323 2112 17 | 3333 3374 29 | Q 5432 2234 25 | 4443 3234 27 | 16 |
| 17 | D 4543 3554 33 | 2553 3346 31 | 2544 3334 28 | 5553 3245 32 | Q 6532 2334 28 | Q 4232 2223 20 | 17 |
| 18 | 4322 2101 15 | 6542 2267 34 | 6434 3334 30 | 5544 4355 35 | 5545 3555 37 | Q 3232 2222 18 | 18 |
| 19 | 2113 2335 20 | D 6774 3365 41 | 3423 3654 30 | 5553 2376 36 | 4654 3355 35 | D 4556 6563 40 | 19 |
| 20 | 7653 2377 40 | D 5652 2567 38 | Q 4321 1114 17 | 5443 4245 31 | 5543 2566 36 | D 4653 5566 40 | 20 |
| 21 | D 5752 ---- -- | D 6755 4354 39 | 3223 2322 19 | Q 3542 3255 29 | D 6787 7767 55 | 5643 4443 33 | 21 |
| 22 | --55 4446 -- | 5431 1023 19 | 4321 2445 25 | Q 5433 3353 29 | D 6545 5756 43 | 5543 4234 30 | 22 |
| 23 | 5553 3376 37 | 3332 2155 24 | Q 3221 1000 09 | 4343 3434 28 | 5554 4464 37 | D 6666 5365 43 | 23 |
| 24 | 4432 2235 25 | Q 4322 1244 22 | Q 1121 1122 11 | D 5565 6775 46 | 4555 5665 41 | D 4345 5565 37 | 24 |
| 25 | 4432 2256 28 | Q 4221 2115 18 | Q 1121 1034 13 | 6665 5556 44 | 5445 4446 36 | 5545 4463 36 | 25 |
| 26 | 4444 4365 34 | 4442 3455 31 | 4321 1245 22 | 3555 5663 38 | 5433 3336 30 | 4555 5445 37 | 26 |
| 27 | D 6543 4455 36 | 4652 3236 31 | 4322 2224 21 | 5565 5366 41 | 6764 4465 42 | D 5766 6474 45 | 27 |
| 28 | 5553 2215 28 | 3332 2145 23 | 3321 1110 12 | 5564 4354 36 | 4554 4473 36 | 3555 5654 38 | 28 |
| 29 | 2432 4223 22 | 5322 3333 24 | Q 1221 2233 16 | 4544 3256 33 | 3554 5645 37 | 5334 4445 32 | 29 |
| 30 | 3321 2363 23 | 2655 3331 28 | D 3675 5323 34 | 4574 3354 35 | 5454 4545 36 | 4343 3465 32 | 30 |
| 31 | 3312 3433 22 | 1322 2337 23 | | 6664 4554 40 | | 4444 4223 27 | 31 |
| **Mean K-sum** | **26.4** | **28.3** | **24.7** | **34.9** | **34.9** | **32.3** | |

## Occurrence distribution of K-indices

| K-Index: | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | - |
|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 1 | 9 | 33 | 78 | 70 | 38 | 16 | 3 | 0 | 0 | 0 |
| February | 1 | 6 | 45 | 66 | 52 | 36 | 10 | 2 | 0 | 0 | 6 |
| March | 7 | 33 | 64 | 63 | 37 | 34 | 7 | 3 | 0 | 0 | 0 |
| April | 10 | 26 | 59 | 56 | 33 | 31 | 17 | 5 | 3 | 0 | 0 |
| May | 13 | 40 | 59 | 59 | 38 | 27 | 8 | 4 | 0 | 0 | 0 |
| June | 14 | 36 | 49 | 57 | 38 | 36 | 10 | 0 | 0 | 0 | 0 |
| July | 4 | 21 | 53 | 59 | 46 | 36 | 17 | 5 | 1 | 0 | 6 |
| August | 5 | 23 | 41 | 64 | 41 | 39 | 24 | 11 | 0 | 0 | 0 |
| September | 6 | 37 | 51 | 56 | 43 | 24 | 19 | 4 | 0 | 0 | 0 |
| October | 0 | 0 | 14 | 48 | 48 | 72 | 33 | 7 | 0 | 0 | 26 |
| November | 0 | 0 | 20 | 41 | 66 | 72 | 29 | 11 | 1 | 0 | 0 |
| December | 0 | 0 | 26 | 56 | 80 | 57 | 27 | 2 | 0 | 0 | 0 |
| **ANNUAL TOTAL** | **61** | **231** | **514** | **703** | **592** | **502** | **217** | **57** | **5** | **0** | **38** |

## Monthly & 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 2002 | | X (nT) | Y (nT) | Z (nT) | F (nT) | H (nT) | D (East) | I |
|---|---|---|---|---|---|---|---|---|
| **January** | All days | 7574.2 | -16982.3 | -45556.0 | 49205.0 | 18594.9 | -65° 57.8' | -67° 47.8' |
| | 5xQ days | 7568.6 | -16979.3 | -45556.5 | 49203.4 | 18589.8 | -65° 58.5' | -67° 48.1' |
| | 5xD days | 7571.9 | -16965.8 | -45525.9 | 49171.1 | 18579.1 | -65° 57.0' | -67° 48.0' |
| **February** | All days | 7555.3 | -16976.1 | -45560.5 | 49204.1 | 18581.5 | -66° 00.5' | -67° 48.7' |
| | 5xQ days | 7554.6 | -16981.4 | -45551.9 | 49197.7 | 18586.0 | -66° 01.0' | -67° 48.2' |
| | 5xD days | 7555.3 | -16982.3 | -45576.4 | 49221.1 | 18587.3 | -66° 01.0' | -67° 48.8' |
| **March** | All days | 7540.2 | -16973.5 | -45543.6 | 49185.1 | 18573.0 | -66° 02.9' | -67° 48.8' |
| | 5xQ days | 7541.1 | -16985.6 | -45532.9 | 49179.5 | 18584.4 | -66° 03.6' | -67° 47.8' |
| | 5xD days | 7526.5 | -16959.1 | -45563.7 | 49196.8 | 18554.4 | -66° 04.1' | -67° 50.6' |
| **April** | All days | 7520.2 | -16966.9 | -45547.6 | 49183.6 | 18558.9 | -66° 05.8' | -67° 49.9' |
| | 5xQ days | 7534.5 | -16982.6 | -45534.4 | 49178.9 | 18579.0 | -66° 04.5' | -67° 48.2' |
| | 5xD days | 7482.9 | -16921.8 | -45583.2 | 49195.6 | 18502.8 | -66° 08.7' | -67° 54.4' |
| **May** | All days | 7520.3 | -16971.9 | -45545.8 | 49183.6 | 18563.5 | -66° 06.1' | -67° 49.5' |
| | 5xQ days | 7530.4 | -16987.9 | -45536.7 | 49182.2 | 18582.1 | -66° 05.6' | -67° 48.1' |
| | 5xD days | 7506.3 | -16947.5 | -45545.8 | 49173.1 | 18535.5 | -66° 06.7' | -67° 51.3' |
| **June** | All days | 7520.8 | -16977.6 | -45529.1 | 49170.2 | 18568.9 | -66° 06.5' | -67° 48.7' |
| | 5xQ days | 7529.2 | -16985.8 | -45529.2 | 49174.4 | 18579.8 | -66° 05.6' | -67° 48.0' |
| | 5xD days | 7503.7 | -16962.4 | -45536.1 | 49168.9 | 18548.1 | -66° 08.2' | -67° 50.3' |
| **July** | All days | 7515.3 | -16976.2 | -45527.6 | 49167.5 | 18565.4 | -66° 07.3' | -67° 48.9' |
| | 5xQ days | 7525.1 | -16983.0 | -45524.8 | 49168.7 | 18575.5 | -66° 06.1' | -67° 48.2' |
| | 5xD days | 7498.2 | -16973.4 | -45523.1 | 49159.9 | 18556.0 | -66° 10.0' | -67° 49.4' |
| **August** | All days | 7498.3 | -16961.9 | -45550.7 | 49181.4 | 18545.5 | -66° 09.1' | -67° 50.8' |
| | 5xQ days | 7513.6 | -16979.7 | -45540.8 | 49180.6 | 18567.9 | -66° 07.8' | -67° 49.1' |
| | 5xD days | 7469.0 | -16927.1 | -45595.5 | 49206.6 | 18501.9 | -66° 11.5' | -67° 54.8' |
| **September** | All days | 7501.0 | -16968.5 | -45545.8 | 49179.5 | 18552.6 | -66° 09.1' | -67° 50.2' |
| | 5xQ days | 7515.9 | -16987.1 | -45533.5 | 49176.7 | 18575.5 | -66° 08.0' | -67° 48.4' |
| | 5xD days | 7473.9 | -16936.6 | -45554.7 | 49172.8 | 18512.6 | -66° 11.4' | -67° 53.0' |
| **October** | All days | 7497.3 | -16964.0 | -45567.6 | 49197.7 | 18547.1 | -66° 09.4' | -67° 51.1' |
| | 5xQ days | 7516.1 | -16990.4 | -45545.8 | 49189.4 | 18578.7 | -66° 08.2' | -67° 48.5' |
| | 5xD days | 7461.4 | -16928.1 | -45596.7 | 49207.0 | 18499.8 | -66° 12.8' | -67° 55.0' |
| **November** | All days | 7515.0 | -16983.4 | -45552.0 | 49192.7 | 18572.0 | -66° 07.9' | -67° 49.1' |
| | 5xQ days | 7523.5 | -16991.0 | -45553.6 | 49197.9 | 18582.2 | -66° 07.0' | -67° 48.5' |
| | 5xD days | 7482.1 | -16960.9 | -45531.6 | 49161.3 | 18538.5 | -66° 11.9' | -67° 50.8' |
| **December** | All days | 7526.2 | -16995.7 | -45525.1 | 49173.6 | 18587.8 | -66° 06.9' | -67° 47.4' |
| | 5xQ days | 7528.0 | -16999.9 | -45539.9 | 49189.0 | 18592.1 | -66° 06.9' | -67° 47.5' |
| | 5xD days | 7513.3 | -16975.9 | -45485.8 | 49128.6 | 18564.6 | -66° 07.6' | -67° 47.8' |
| **Annual** | All days | 7523.7 | -16974.8 | -45546.0 | 49185.3 | 18567.6 | -66° 05.8' | -67° 49.3' |
| **Mean** | 5xQ days | 7531.7 | -16986.1 | -45540.0 | 49184.9 | 18581.1 | -66° 05.2' | -67° 48.2' |
| **Values** | 5xD days | 7503.7 | -16953.4 | -45551.6 | 49180.2 | 18540.0 | -66° 07.6' | -67° 51.2' |

(Calculated: 14:53 hrs., Thu. 24 Jun. 2004)

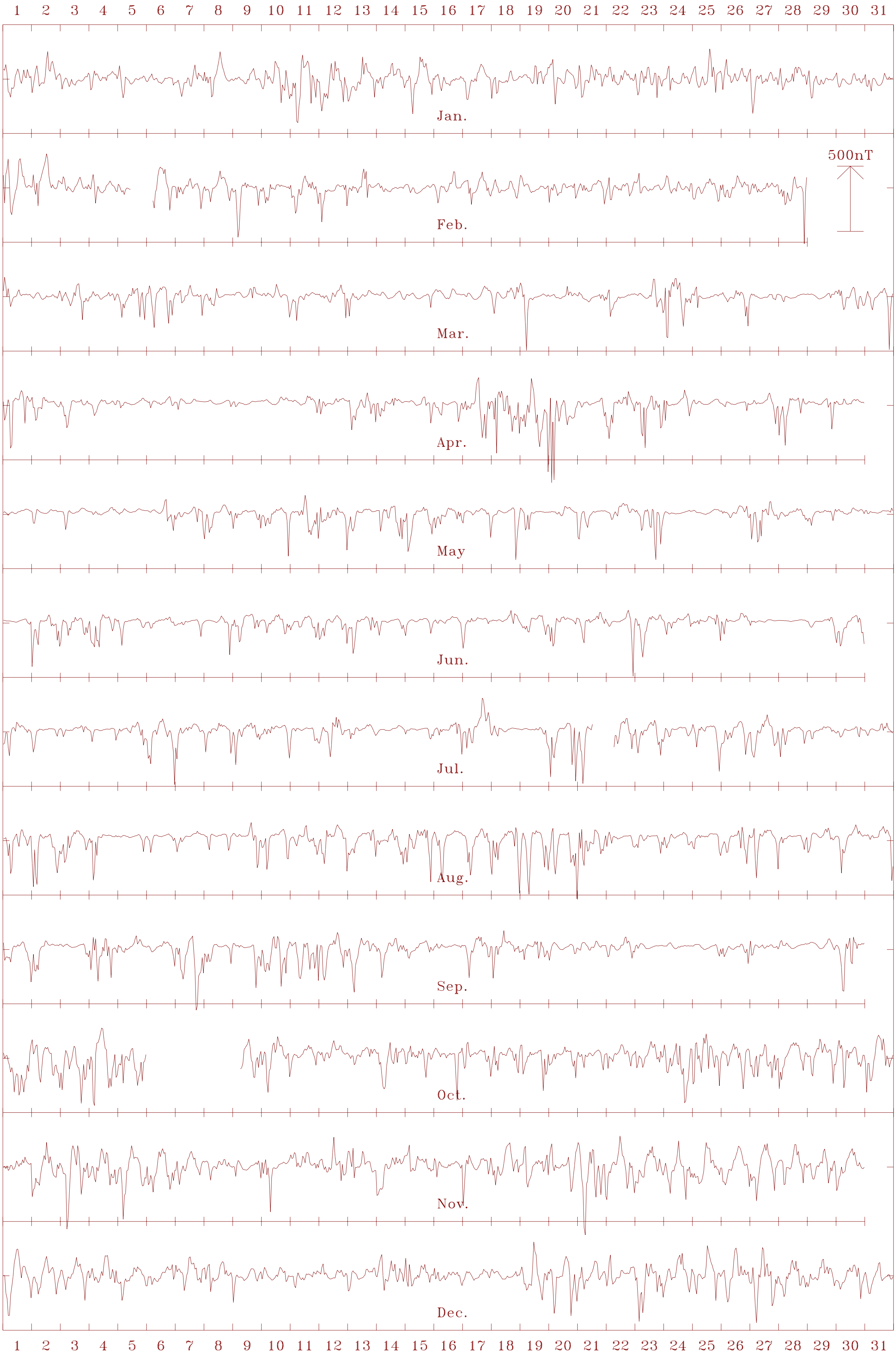
## Hourly Mean Values

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.

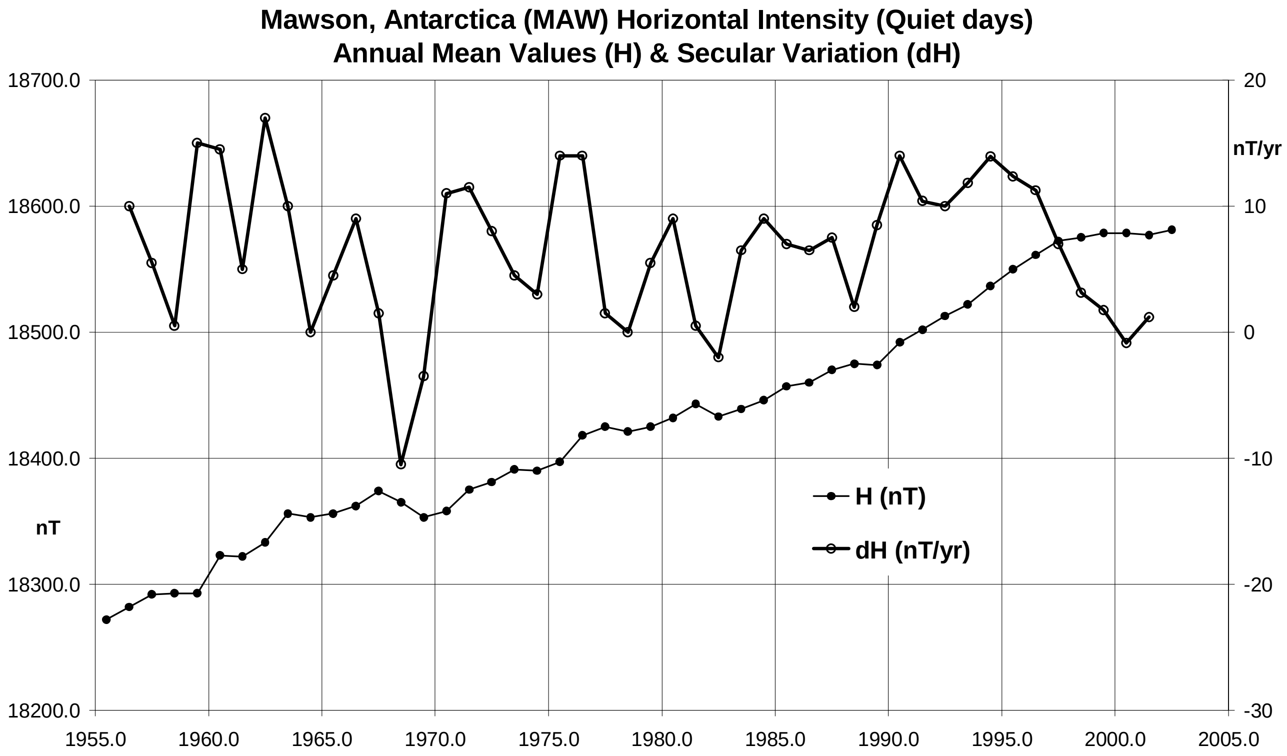
Mawson Stn. 2002 Horizontal intensity (H). Scale: 40.0 nT/mm. Mean: 18568 nT

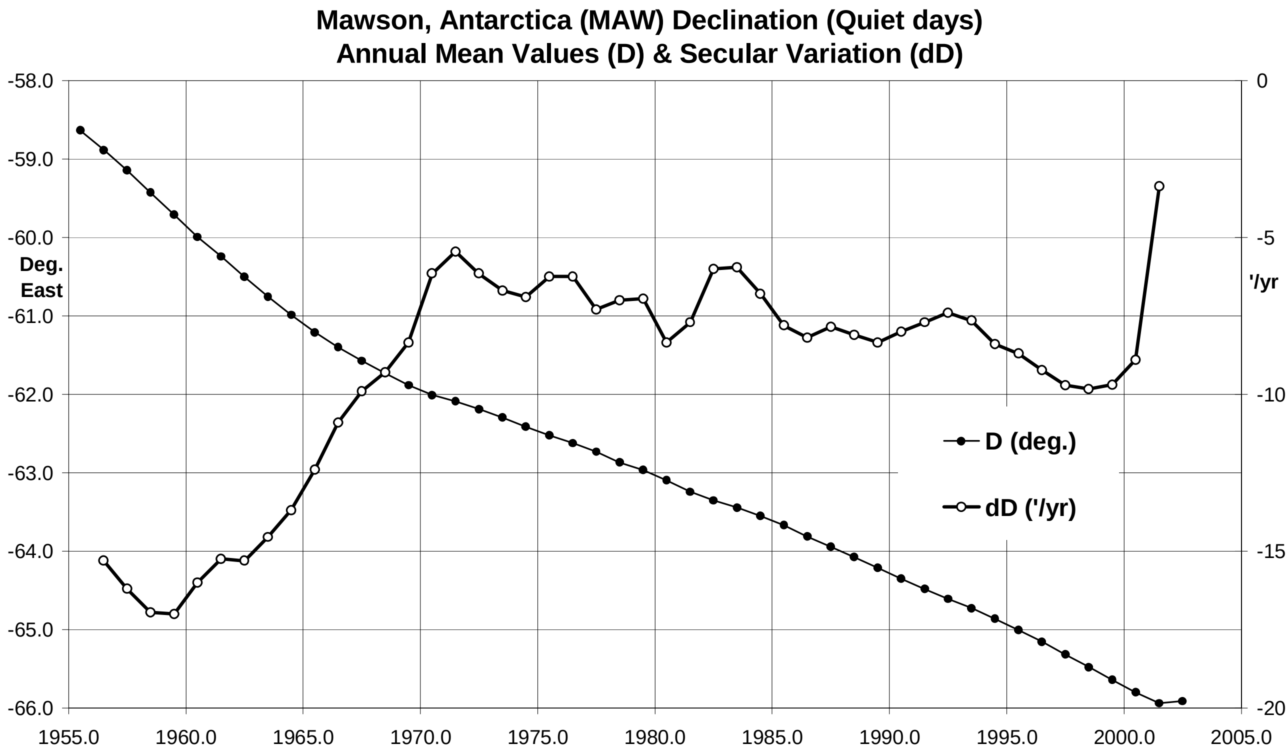


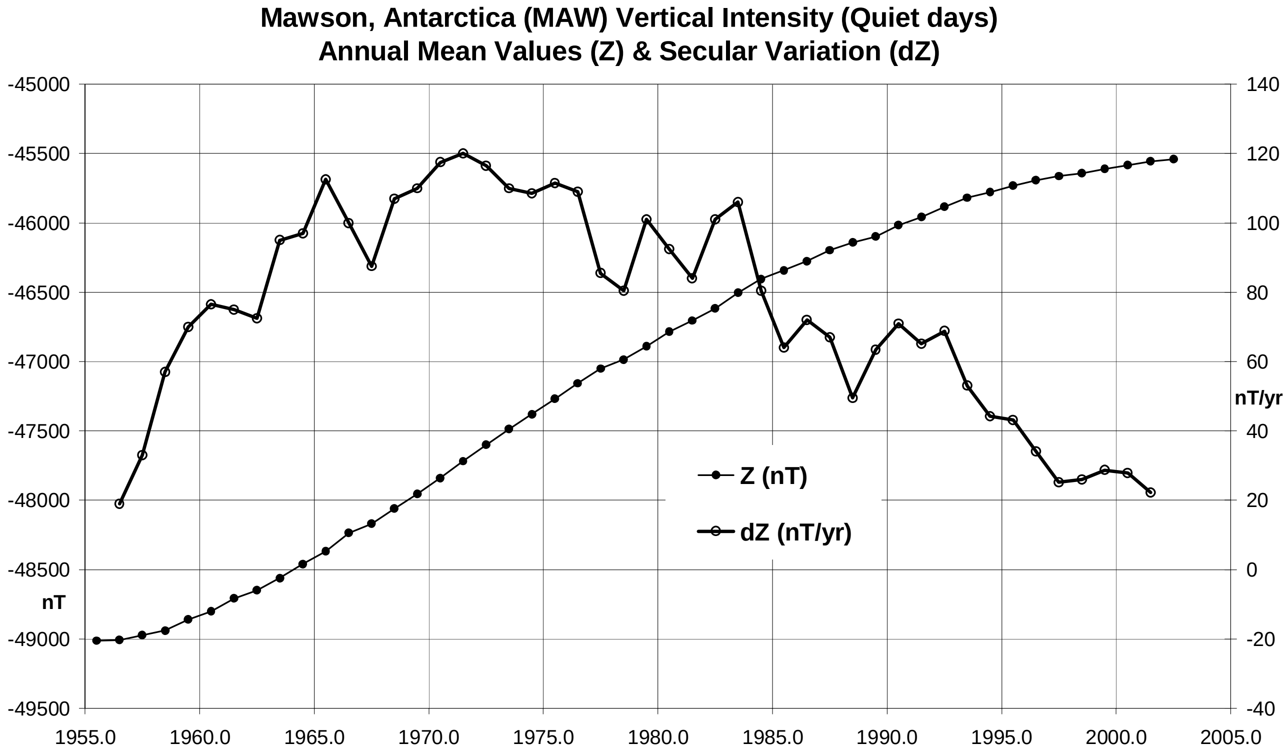
Mawson Stn. 2002 Declination (east) (D). Scale: 5.00 min/mm. Mean: -66.10 deg.

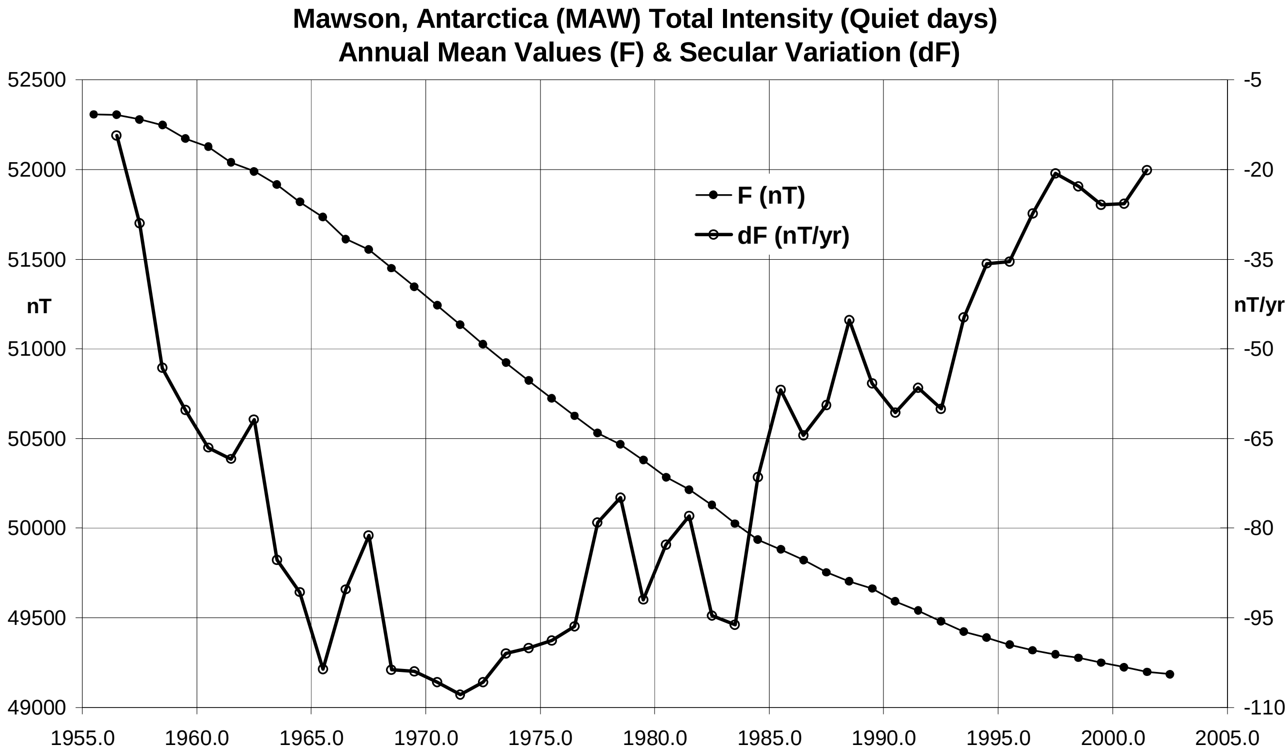
Mawson Stn. 2002 Vertical intensity (Z). Scale: 40.0 nT/mm. Mean: -45546 nT

Mawson Stn. 2002 Total intensity (F). Scale: 40.0 nT/mm. Mean: 49185 nT


Mawson, Antarctica (MAW) Horizontal Intensity (Quiet days)
Annual Mean Values (H) & Secular Variation (dH)
nT
nT/yr
H (nT)
dH (nT/yr)
18700.0
18600.0
18500.0
18400.0
18300.0
18200.0
20
10
0
-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


Mawson, Antarctica (MAW) Declination (Quiet days)
Annual Mean Values (D) & Secular Variation (dD)
Deg.
East
'/yr
D (deg.)
dD ('/yr)
-58.0
-59.0
-60.0
-61.0
-62.0
-63.0
-64.0
-65.0
-66.0
0
-5
-10
-15
-20
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0




## MAW – 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.

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 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.

The original station in the vicinity was Wilkes, established under the US Antarctic Research Program for the 1957-58 IGY, after which it was operated by ANARE. Wilkes was abandoned in 1968, having been replaced by (the old) Casey station which lies 3km across Newcomb Bay to its south west.

Key data for the principal observation pier of the Casey Station are:

- 3-character IAGA code: CSY
- Geographic latitude: 66° 17' S
- Geographic longitude: 110° 32' E
- Geomagnetic† : Lat. -76.42°; Long. 183.77°
  † Based on the IGRF 2000.0 model updated to 2002.5
- Elevation above mean sea level
  (top of observation pier) 40 metres
- Azimuth of reference pillar (G11)
  from observation pier 307° 41' 02"
- Observer in Charge: Max Paterson (AAD)

## History

A magnetic observatory was established at Wilkes (a few kilometres from where Casey now stands) by the US Antarctic Research Program for the 1957-58 IGY. It was subsequently operated by BMR and ANARE (McGregor, 2000) until the instrumentation was returned to the USA in 1968.

To provide information on the magnetic secular variation in Antarctica, BMR/ASGO/GA and the Australian Antarctic Division have jointly carried out regular absolute measurements of the magnetic field at Casey since 1975. The observations have been performed by Antarctic Division personnel, who were trained in the use of the instrumentation at GA in Canberra.

Until the Australian Antarctic Division installed an EDA FM105B fluxgate variometer in January 1988 to support their Atmospheric and Space Physics research program at Casey, monthly means were calculated from absolute observations without correction for daily field variations. These data, although exhibiting scatter, enabled the estimation of the secular variation trend from year to year at the station.

From 1991 to 1998 the digital variometer data and monthly absolute observations were made available to the GA observer at Mawson, who derived baselines and produced monthly mean values of the magnetic field (De Deuge, 1992) for Casey (and Davis). These monthly mean values, based on the five quietest days of the month (at Mawson), were provided to WDC-A. Although during this period the variometers at Casey (and Davis) were not operated to observatory standards, the monthly means derived from the variometer data were a significant improvement on those derived from the previous absolute observations only. Since 1998 the calculation of monthly means has been carried out at GA using International Quiet Days.

Until March 1999 two absolute observations were performed at Casey each month. On 22 March 1999 full absolute control began that included the performance of twice-weekly absolute observations and from when the operation was upgraded to full observatory status.

## Variometers

An Antarctic Division EDA FM105B fluxgate variometer, with the data acquired by PC, operated at Casey throughout 2002. The fluxgate sensors were housed on the hill about 300m west of the Casey Science building. Their sensors were aligned close to true north, east and vertical. The temperatures were maintained at 20°C. Further description is in Crosthwaite (1999).

## Absolute Instruments and Corrections

Magnetometers used to calibrate the recording variometers were Elsec 810 DIM no. 2591 with Zeiss020B theodolite no. 356514 owned by the Antarctic Division, and Geometrics 816 no. 1024 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 standardization with the Australian Magnetic Standard held at Canberra, a correction of +1.2nT 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  $\Delta Y =$ -0.18 nT  $\Delta Z =$ -1.19 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 of the two instruments required the following corrections to DIM/PPM readings to produce equivalent QHM/PPM readings (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 desirable that a new absolute observation hut and pier is 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 98-99.

| 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 |
| 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 |
| 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 |

## Casey Operations

The magnetic observer-in-charge at Casey in 2002 was an officer of the Australian Antarctic Division, of the 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 headquarters 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 to GA where they were converted into GA 1-second format from which calibrated minute, monthly and annual means were computed.

There was no PPM variometer operating at Casey in 2002.

## Significant Events: CSY, 2002

Nov 15 PPM head came off the wooden mounting block and fell to the floor heavily before taking the last PPM measurement.

## Distribution of CSY data during 2002

***Preliminary Monthly Means for Project Ørsted***

- Some data sent in 2002

***1-minute & Hourly Mean Values (WDC format)***

- 2001: WDC-A, Boulder, USA (sent 11 Jun. 2002)

***1-minute Values (INTERMAGNET format)***

- 2001: WDC-C1, Copenhagen, Denmark (sent 11 Jun. 2002)

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

## Monthly & 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 | 2002 | X (nT) | Y (nT) | Z (nT) | F (nT) | H (nT) | D (East) | I |
|---|---|---|---|---|---|---|---|---|
| **January** | All days | -524.4 | -9561.6 | -63682.1 | 64398.2 | 9576.7 | -93° 08.5' | -81° 26.9' |
| | 5xQ days | -494.8 | -9580.8 | -63669.2 | 64388.0 | 9593.9 | -92° 57.5' | -81° 25.9' |
| | 5xD days | -571.2 | -9536.8 | -63735.1 | 64447.5 | 9555.0 | -93° 25.5' | -81° 28.4' |
| **February** | All days | -563.5 | -9551.9 | -63698.0 | 64412.8 | 9569.1 | -93° 22.7' | -81° 27.4' |
| | 5xQ days | -568.0 | -9550.4 | -63693.3 | 64407.9 | 9567.5 | -93° 24.3' | -81° 27.4' |
| | 5xD days | -596.7 | -9551.1 | -63717.7 | 64432.6 | 9570.6 | -93° 34.5' | -81° 27.5' |
| **March** | All days | -588.2 | -9534.2 | -63716.3 | 64428.4 | 9552.7 | -93° 31.9' | -81° 28.4' |
| | 5xQ days | -602.0 | -9520.1 | -63714.6 | 64424.8 | 9539.2 | -93° 37.1' | -81° 29.1' |
| | 5xD days | -593.9 | -9542.1 | -63744.2 | 64457.4 | 9561.2 | -93° 33.8' | -81° 28.2' |
| **April** | All days | -598.5 | -9525.2 | -63732.9 | 64443.7 | 9544.2 | -93° 35.7' | -81° 29.0' |
| | 5xQ days | -597.3 | -9524.0 | -63728.7 | 64439.2 | 9542.8 | -93° 35.3' | -81° 29.0' |
| | 5xD days | -595.7 | -9517.8 | -63746.0 | 64455.6 | 9536.9 | -93° 34.9' | -81° 29.5' |
| **May** | All days | -598.9 | -9522.7 | -63733.8 | 64444.1 | 9541.6 | -93° 35.9' | -81° 29.1' |
| | 5xQ days | -599.6 | -9525.0 | -63729.9 | 64440.5 | 9543.9 | -93° 36.1' | -81° 29.0' |
| | 5xD days | -610.0 | -9513.2 | -63751.7 | 64460.5 | 9533.0 | -93° 40.1' | -81° 29.7' |
| **June** | All days | -593.3 | -9529.1 | -63722.2 | 64433.5 | 9547.6 | -93° 33.8' | -81° 28.7' |
| | 5xQ days | -589.6 | -9530.6 | -63715.7 | 64427.2 | 9548.8 | -93° 32.4' | -81° 28.6' |
| | 5xD days | -594.9 | -9528.9 | -63725.2 | 64436.5 | 9547.5 | -93° 34.3' | -81° 28.7' |
| **July** | All days | -595.1 | -9527.2 | -63722.3 | 64433.4 | 9545.8 | -93° 34.5' | -81° 28.8' |
| | 5xQ days | -589.6 | -9528.7 | -63713.2 | 64424.5 | 9546.9 | -93° 32.4' | -81° 28.7' |
| | 5xD days | -611.9 | -9518.0 | -63739.3 | 64449.0 | 9537.8 | -93° 40.7' | -81° 29.4' |
| **August** | All days | -590.0 | -9532.5 | -63730.3 | 64442.0 | 9550.9 | -93° 32.5' | -81° 28.6' |
| | 5xQ days | -570.6 | -9530.9 | -63705.6 | 64417.2 | 9548.1 | -93° 25.6' | -81° 28.6' |
| | 5xD days | -597.3 | -9548.4 | -63756.5 | 64470.4 | 9567.4 | -93° 34.8' | -81° 27.9' |
| **September** | All days | -587.4 | -9530.4 | -63731.4 | 64442.8 | 9548.8 | -93° 31.6' | -81° 28.7' |
| | 5xQ days | -578.0 | -9528.1 | -63710.3 | 64421.4 | 9545.8 | -93° 28.3' | -81° 28.7' |
| | 5xD days | -605.1 | -9528.8 | -63768.5 | 64479.5 | 9548.5 | -93° 38.0' | -81° 29.0' |
| **October** | All days | -590.1 | -9539.0 | -63741.9 | 64454.6 | 9557.8 | -93° 32.4' | -81° 28.3' |
| | 5xQ days | -589.7 | -9532.9 | -63732.4 | 64444.3 | 9551.6 | -93° 32.5' | -81° 28.6' |
| | 5xD days | -613.0 | -9540.2 | -63770.1 | 64483.0 | 9560.7 | -93° 40.6' | -81° 28.4' |
| **November** | All days | -578.7 | -9530.3 | -63724.0 | 64435.6 | 9548.9 | -93° 28.6' | -81° 28.7' |
| | 5xQ days | -568.7 | -9523.5 | -63715.7 | 64426.1 | 9541.0 | -93° 25.2' | -81° 29.0' |
| | 5xD days | -628.1 | -9522.9 | -63768.8 | 64479.3 | 9545.0 | -93° 46.2' | -81° 29.2' |
| **December** | All days | -569.4 | -9530.2 | -63697.4 | 64409.1 | 9548.3 | -93° 25.3' | -81° 28.5' |
| | 5xQ days | -517.5 | -9551.5 | -63669.9 | 64384.6 | 9565.9 | -93° 06.2' | -81° 27.3' |
| | 5xD days | -623.1 | -9503.4 | -63736.2 | 64444.3 | 9525.6 | -93° 45.1' | -81° 30.0' |
| **Annual** | All days | -581.5 | -9534.5 | -63719.4 | 64431.5 | 9552.7 | -93° 29.4' | -81° 28.4' |
| **Mean** | 5xQ days | -572.1 | -9535.5 | -63708.2 | 64420.5 | 9552.9 | -93° 26.1' | -81° 28.3' |
| **Values** | 5xD days | -603.4 | -9529.3 | -63746.6 | 64458.0 | 9549.1 | -93° 37.4' | -81° 28.8' |

(Calculated: 12:22 hrs., Thu., 01 Jul. 2004)

## 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.

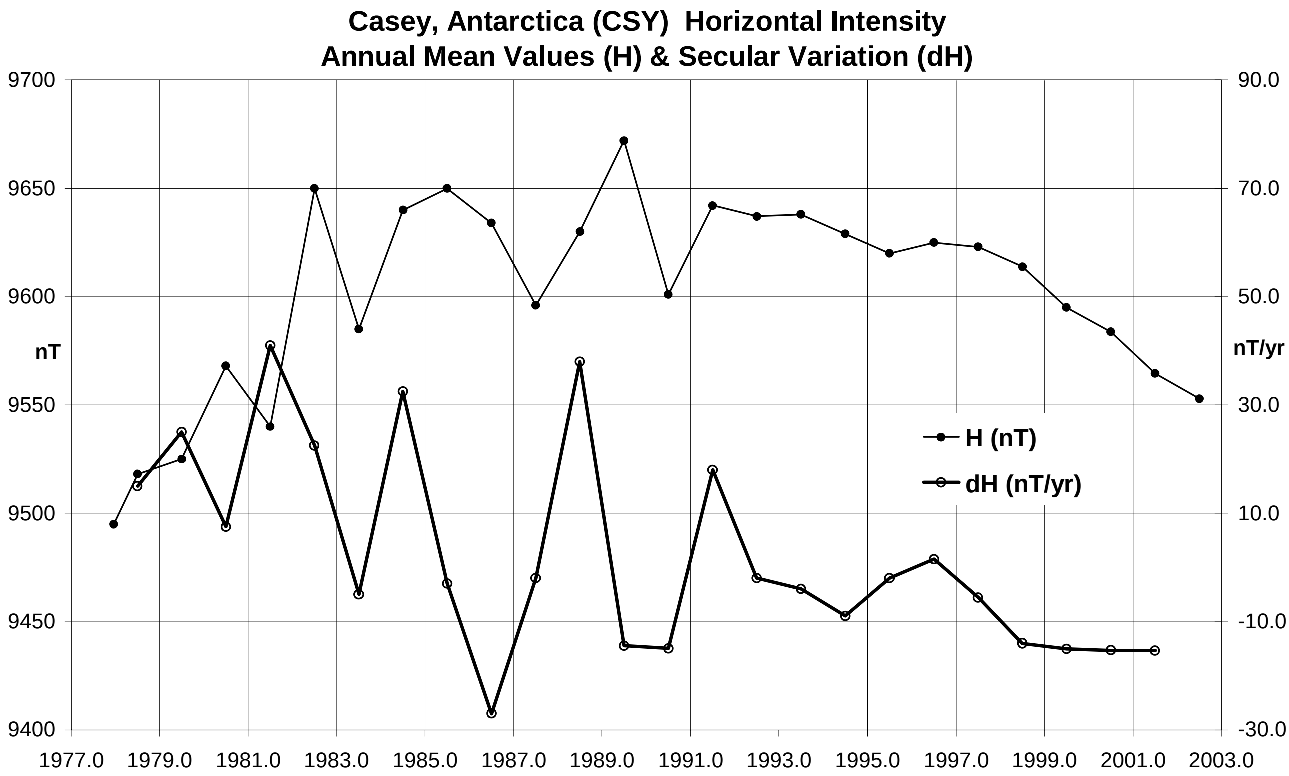
The mean value given at the top of each plot is the *all-days* annual mean value of the element.

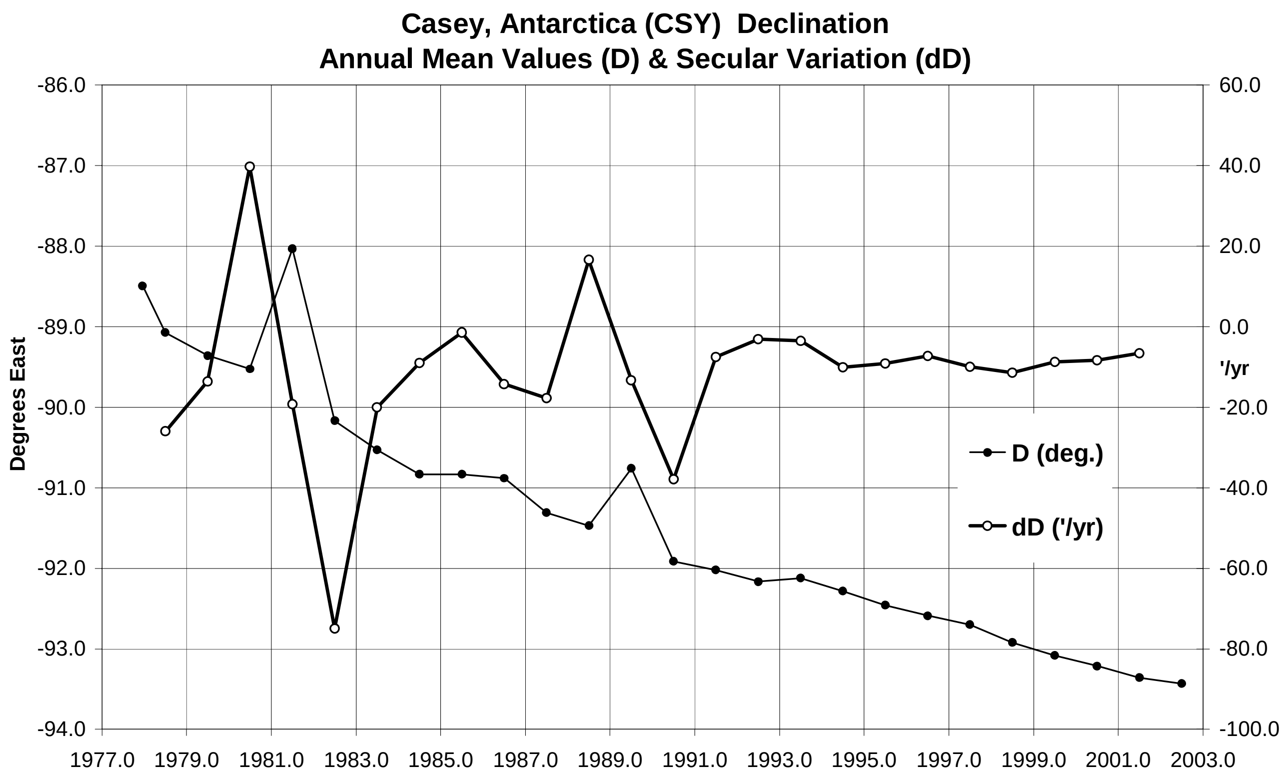
Casey Stn. 2002 Horizontal intensity (H). Scale: 25.0 nT/mm. Mean: 9553 nT

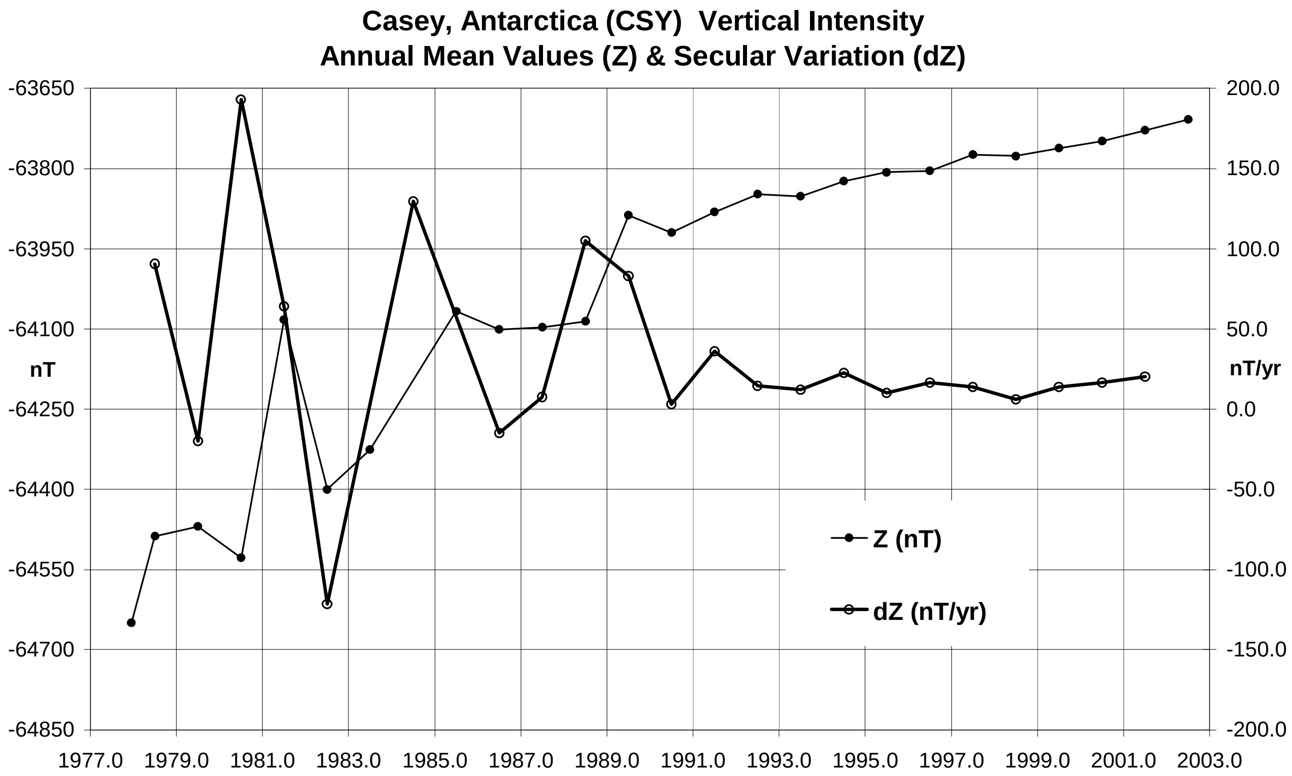
Casey Stn. 2002 Declination (east) (D). Scale: 10.0 min/mm. Mean: −93.49 deg.

Casey Stn. 2002 Vertical intensity (Z). Scale: 25.0 nT/mm. Mean: −63719 nT

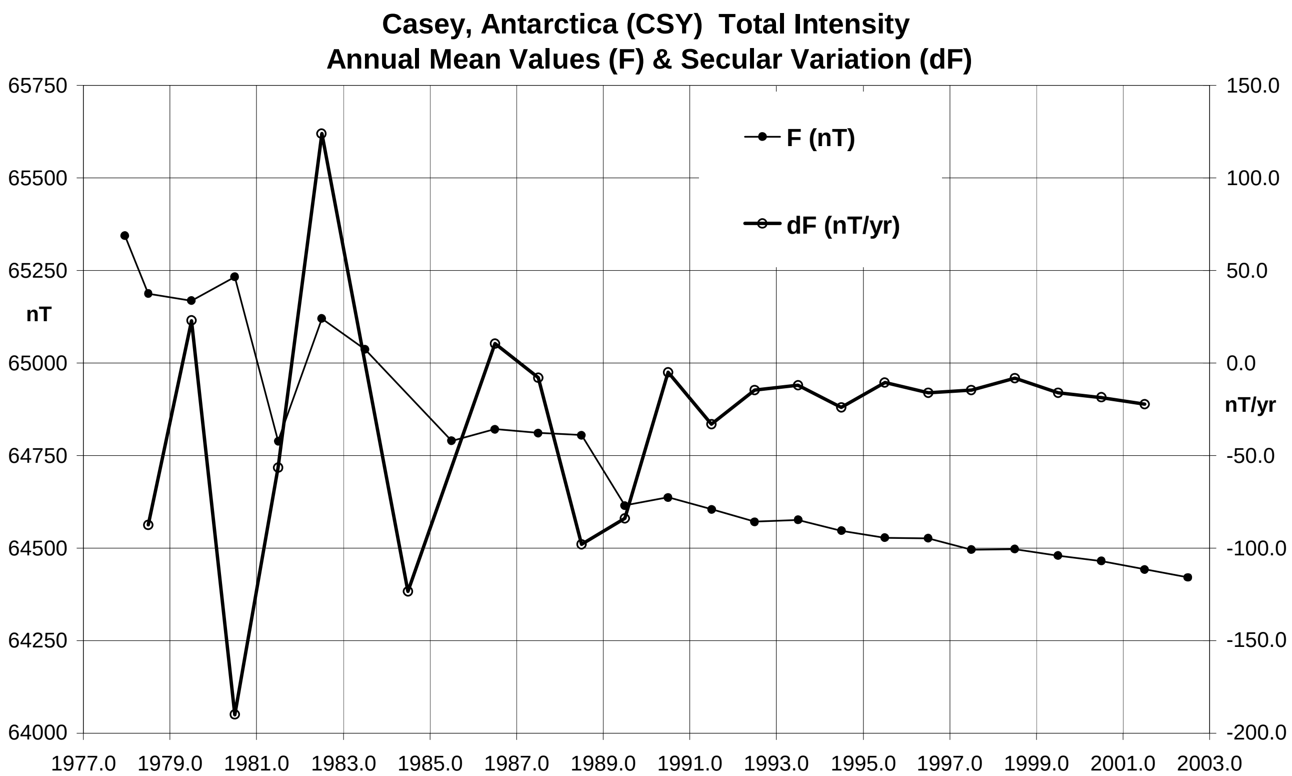
Casey Stn. 2002 Total intensity (F). Scale: 25.0 nT/mm. Mean: 64432 nT


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


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



Casey, Antarctica (CSY) Vertical Intensity
Annual Mean Values (Z) & Secular Variation (dZ)
-63650
-63800
-63950
-64100
nT
-64250
-64400
-64550
-64700
-64850
200.0
150.0
100.0
50.0
nT/yr
0.0
-50.0
-100.0
-150.0
-200.0
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
Z (nT)
dZ (nT/yr)

Casey, Antarctica (CSY) Total Intensity
Annual Mean Values (F) & Secular Variation (dF)
65750
65500
65250
nT
65000
64750
64500
64250
64000
150.0
100.0
50.0
0.0
nT/yr
-50.0
-100.0
-150.0
-200.0
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
F (nT)
dF (nT/yr)

## CSY 2002 – Data losses:

Some calibration activities for Antarctic Division caused contamination of short intervals of data, as did the daily sets of calibration pulses. As a consequence data at 0001, 1200-1201 and 1630-1631 on all days in 2002 were omitted from processing.

There was no PPM recording variations in total intensity during 2002. The periods of data loss that follow refer to EDA fluxgate variometer data.

| | |
|---|---|
| Jan 01 | 0543-0604 (22 min) |
| Jan 10 | 1617-1623 (7 min) |
| Jan 27 | 1006 to 28 / 0242 (16h 37m) |
| Feb 09 | 0500-0854 (3h 55m) |
| Feb 10 | 0229-0236 (8 min) |
| Feb 11 | 0149-0215 (27 min) |
| Mar 07 | 1206 to 12 / 0821 (4d 20h 16m) |
| Mar 13 | 1521-2323 (08h 03m) |
| Mar 13 | 2356 to 14 / 0057 (01h 02m) |
| Mar 17 | 0034-0037 (4 min) |
| Mar 20 | 2226-2244 (19 min) |
| Mar 22 | 0800 to 24 / 2324 (2d 15h 25m) |
| Mar 24 | 2335-2338 (4 min) |
| Mar 26 | 0700 to 27 / 0400 (21h 01m) |
| May 07 | 2200 to 08 / 0323 (5h 24m) |
| May 10 | 0500 to 11 / 0353 (22h 54m) |
| May 21 | 0622-0630 (9 min) |
| Dec 14 | 0402-0412 (11 min) |

## Casey & Davis Notes and Errata (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*.

## Summary of data loss in the Australian observatories in 2002

The table below summarizes the 2002 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. **The figures do not include data that have been excluded from processing such as contaminated data.**

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.

| 2002 | ASP | CNB | CTA | GNA | KDU | LRM | MAW | MCQ | CSY |
|---|---|---|---|---|---|---|---|---|---|
| **Jan** | 3 (34,967) | 0 | 1 | 0 | 6,013 (0) | 0 | 0 | 0 | 1,183 |
| **Feb** | 1373 (380) | 0 (55) | 0 | 0 | 14,705 (3) | 0 | 6 | 0 | 416 |
| **Mar** | 0 | 0 | 1 | 0 | 0 | 3 | 0 | 0 | 12,730 |
| **Apr** | 0 | 0 | 0 | 0 | 0 | 32 (18,047) | 2 | 0 | 150 |
| **May** | 0 | 0 | 0 | 4199 (4201) | 0 | 0 (13,119) | 0 | 0 | 1,856 |
| **Jun** | 0 | 1 (16) | 0 | 0 | 0 | 0 | 0 | 0 | 150 |
| **Jul** | 0 (1) | 0 | 0 | 69 | 0 | 0 | 1088 (2508) | 0 | 159 |
| **Aug** | 0 | 1 (237) | 533 (539) | 0 (3) | 0 | 0 | 0 | 0 | 155 |
| **Sep** | 0 | 0 (271) | 0 | 0 | 0 | 0 | 0 | 0 | 154 |
| **Oct** | 0 | 10 (259) | 0 | 0 | 0 | 0 | 4667 (4662) | 0 | 155 |
| **Nov** | 4 | 0 (134) | 0) | 199 | 0 | 0 | 0 | 2069 | 150 |
| **Dec** | 0 | 0 (7) | 2 (63) | 1181 | 0 | 3 | 0 | 0 | 166 |
| **3-axis variom.** | 1,380 (0.26%) | 12 (0.002%) | 537 (0.10%) | 5,648 (1.07%) | 20,718 (3.94%) | 38 (0.007%) | 5,763 (1.10%) | 2069 (0.39%) | 17,424 (3.32%) |
| **Total field** | 35,352 (6.73%) | 979 (0.19%) | 604 (0.11%) | 5,653 (1.08%) | 3 (0.001%) | 31,172 (5.93%) | 7,178 (1.37%) | 2069 (0.39%) | no PPM |

## International Quiet & Disturbed Days

| 2002 | Quietest days 1 - 5 | | | | | Quietest days 6 - 10 | | | | | Most Disturbed days 1 - 5 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 3 | 5 | 30 | 4 | 6 | 9 | 16 | 29 | 24K | 22 | 11 | 10* | 12* | 19* | 13* |
| February | 14 | 15 | 23 | 3 | 16 | 24 | 27 | 4 | 19K | 25 | 28 | 6 | 5 | 2* | 7* |
| March | 17 | 28 | 14 | 16 | 27 | 8 | 29K | 9 | 15 | 13 | 24 | 5 | 31 | 30 | 19* |
| April | 8 | 9 | 26 | 5 | 25 | 6 | 4 | 21 | 10 | 15 | 20 | 18 | 17 | 19 | 23 |
| May | 24 | 5 | 31 | 1 | 25 | 4 | 3 | 17 | 2 | 30 | 23 | 11 | 14 | 27 | 10* |
| June | 28 | 27 | 14 | 1 | 15 | 6 | 17 | 7 | 24 | 29 | 2* | 10* | 4* | 8* | 30* |
| July | 14 | 3 | 15 | 2 | 4K | 18 | 13 | 11 | 30K | 24A | 6 | 17 | 21 | 12* | 27* |
| August | 6 | 24 | 7 | 5 | 25 | 8K | 23A | 28A | 22A | 31A | 2 | 21 | 19 | 20 | 1 |
| September | 23 | 25 | 24 | 29 | 20 | 28 | 26 | 16K | 27K | 15 | 7 | 4 | 8 | 30 | 11 |
| October | 13 | 12 | 11 | 21A | 22A | 20A | 23A | 17A | 19A | 18A | 24 | 4 | 1 | 7 | 2 |
| November | 8 | 9K | 16A | 1A | 17A | 14A | 18A | 15A | 11A | 26A | 21 | 3 | 2 | 22 | 5 |
| December | 18 | 17 | 11 | 12 | 13 | 10 | 16 | 9K | 31A | 15A | 27 | 19 | 23 | 20 | 24 |

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 & 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 repeat stations throughout mainland Australia, its offshore islands, and the south-west Pacific region. The repeat stations are usually occupied at intervals of between one and two years to determine the secular variation of the magnetic field. During each three-to-four day repeat station occupation, the magnetic field is monitored continuously with a portable on-site four-component magnetic variometer.

During 2002 a Narod ring-core three-axis fluxgate magnetometer was used to monitor variations in three (nominally 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 batteries and solar panels or 240V ac mains power, depending on the location. Preliminary data processing and analysis was done on-site on a lap-top computer.

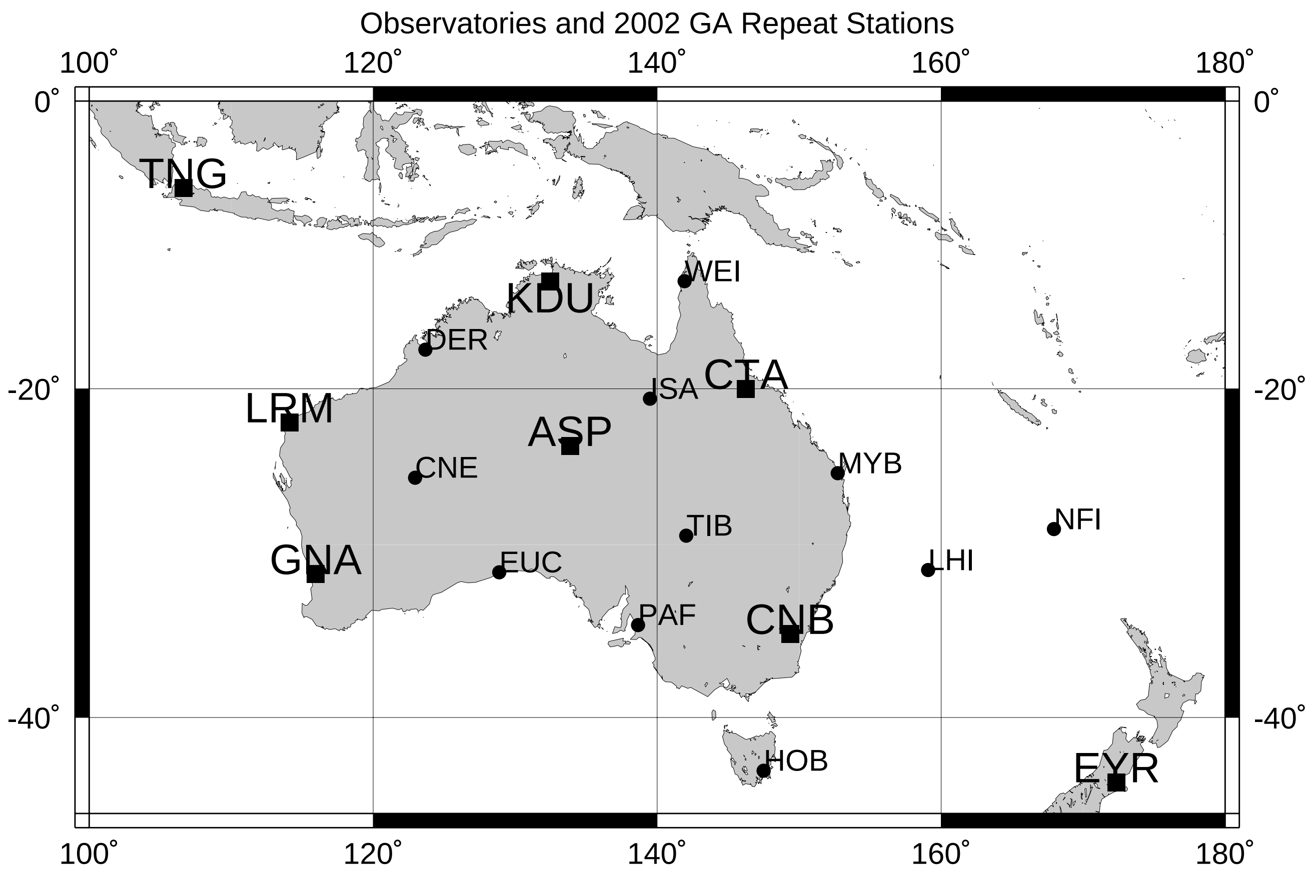
The variometer recordings were calibrated to observatory standard with a campaign of absolute magnetic observations made during each station occupation. Usually from 24 to 30 sets of absolute observations were made on each primary repeat station. Vector field differences between the primary and secondary station at each site were also measured. Azimuths 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 2002 were Elsec 810 DIM, no. 220 with Zeiss 020B theodolite, no. 308887, and GEM Systems GSM90 no. 810881 with sensor no. 81301 (TIB, PAF, EUC, CNE, DER, ISA MYB, HOB) and with sensor 81315 (WEI, NFI, LHI). 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 observatory data.

The average secular variation 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 2002**



## Station occupations in 2002

Eleven repeat stations were re-occupied in 2002 during two field surveys, the first in April-May and the second in November. Seven stations were occupied during the first survey: Tibooburra (TIB), Parafield (PAF), Eucla (EUC), Carnegie (CNE), Derby (DER), Mount Isa (ISA) and Maryborough (MYB). Four stations were occupied in the November survey: Hobart (HOB) Weipa (WEI), Norfolk Island (NFI) and Lord Howe Island (LHI).

The figure above shows the location of these repeat stations with the permanent magnetic observatories in the region. The results of the 2002 and earlier occupations of these stations are shown in the figures that follow the text.

The adopted normal field values at the time of the 2002 occupations and the average secular variation over the interval between the two most recent occupations for each station are shown in the tables below.

**Adopted Main Field Values at Time of Station Occupations**

| Station (site) | Occupation | X (nT) | Y (nT) | Z (nT) | F (nT) | H (nT) | D | I |
|---|---|---|---|---|---|---|---|---|
| **Tibooburra (A)** | 2002.04.11 | 26673 | 4014 | -49293 | 56191 | 26973 | 08º 35.5’ | -61º 18.8’ |
| **Parafield (C)** | 2002.04.16 | 22818 | 3377 | -54771 | 59430 | 23067 | 08º 25.1’ | -67º 09.7’ |
| **Eucla (D)** | 2002.04.21 | 23688 | 1903 | -53353 | 58406 | 23764 | 04º 35.6’ | -65º 59.5’ |
| **Carnegie (A)** | 2002.04.27 | 28082 | 1166 | -47578 | 55260 | 28107 | 02º 22.7’ | -59º 25.7’ |
| **Derby (E)** | 2002.05.04 | 33342 | 1566 | -37362 | 50101 | 33379 | 02º 41.4’ | -48º 13.4’ |
| **Mount Isa (A)** | 2002.05.11 | 31777 | 3419 | -39627 | 50909 | 31961 | 06º 08.5’ | -51º 06.7’ |
| **Maryborough (D)** | 2002.05.17 | 29249 | 5502 | -43236 | 52489 | 29762 | 10º 39.2’ | -55º 27.5’ |
| **Hobart (H)** | 2002.11.05 | 17813 | 4709 | -59277 | 62074 | 18425 | 14º 48.4’ | -72º 44.0’ |
| **Weipa (B)** | 2002.11.10 | 35466 | 3512 | -29608 | 46333 | 35639 | 05º 39.4’ | -39º 43.1’ |
| **Norfolk Island (B)** | 2002.11.15 | 27604 | 7486 | -43001 | 51644 | 28601 | 15º 10.4’ | -56º 22.3’ |
| **Lord Howe Is. (D)** | 2002.11.19 | 25339 | 6684 | -47941 | 54636 | 26205 | 14º 46.7’ | -61º 20.3’ |

**Average Secular Variation between two most recent Occupations**

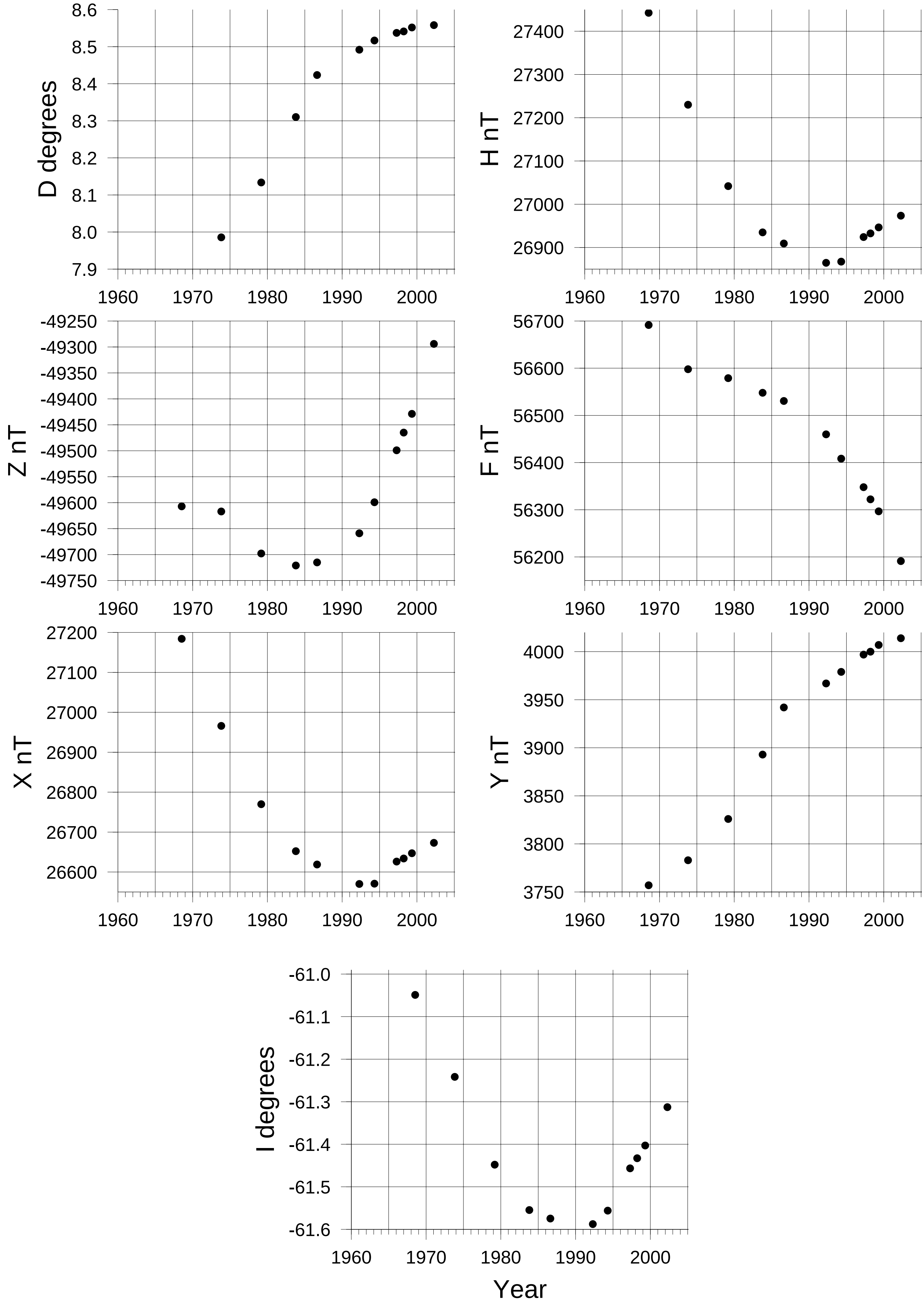
| Station (site) | Previous occupation | ΔX (nT/yr) | ΔY (nT/yr) | ΔZ (nT/yr) | ΔF (nT/yr) | ΔH (nT/yr) | ΔD (′/yr) | ΔI (′/yr) |
|---|---|---|---|---|---|---|---|---|
| **Tibooburra (A)** | 1999.04.24 | 09 | 3 | 46 | -36 | 09 | 0.2 | 1.8 |
| **Parafield (C)** | 1999.04.28 | 11 | 06 | 38 | -30 | 12 | 0.7 | 1.5 |
| **Eucla (D)** | 1999.05.04 | 09 | 9 | 37 | -30 | 10 | 1.2 | 1.4 |
| **Carnegie (A)** | 1999.05.10 | 11 | 18 | 42 | -30 | 12 | 2.1 | 2.0 |
| **Derby (E)** | 1999.05.19 | 02 | 13 | 53 | -38 | 02 | 1.3 | 2.5 |
| **Mount Isa (A)** | 1999.05.26 | 05 | -01 | 46 | -33 | 05 | -0.1 | 2.2 |
| **Maryborough (D)** | 1999.06.02 | 00 | -06 | 43 | -36 | -01 | -0.7 | 1.6 |
| **Hobart (H)** | 2000.03.25 | 03 | 08 | 27 | -24 | 05 | 1.4 | 0.7 |
| **Weipa (B)** | 2000.04.05 | -01 | -01 | 39 | -26 | -02 | -0.1 | 2.2 |
| **Norfolk Island (B)** | 2000.03.30 | -14 | -11 | 31 | -35 | -16 | -0.9 | 0.2 |
| **Lord Howe Is. (D)** | 2000.04.09 | 05 | -02 | 33 | -27 | 04 | -0.3 | 1.2 |

## Australian Geomagnetic Reference Field

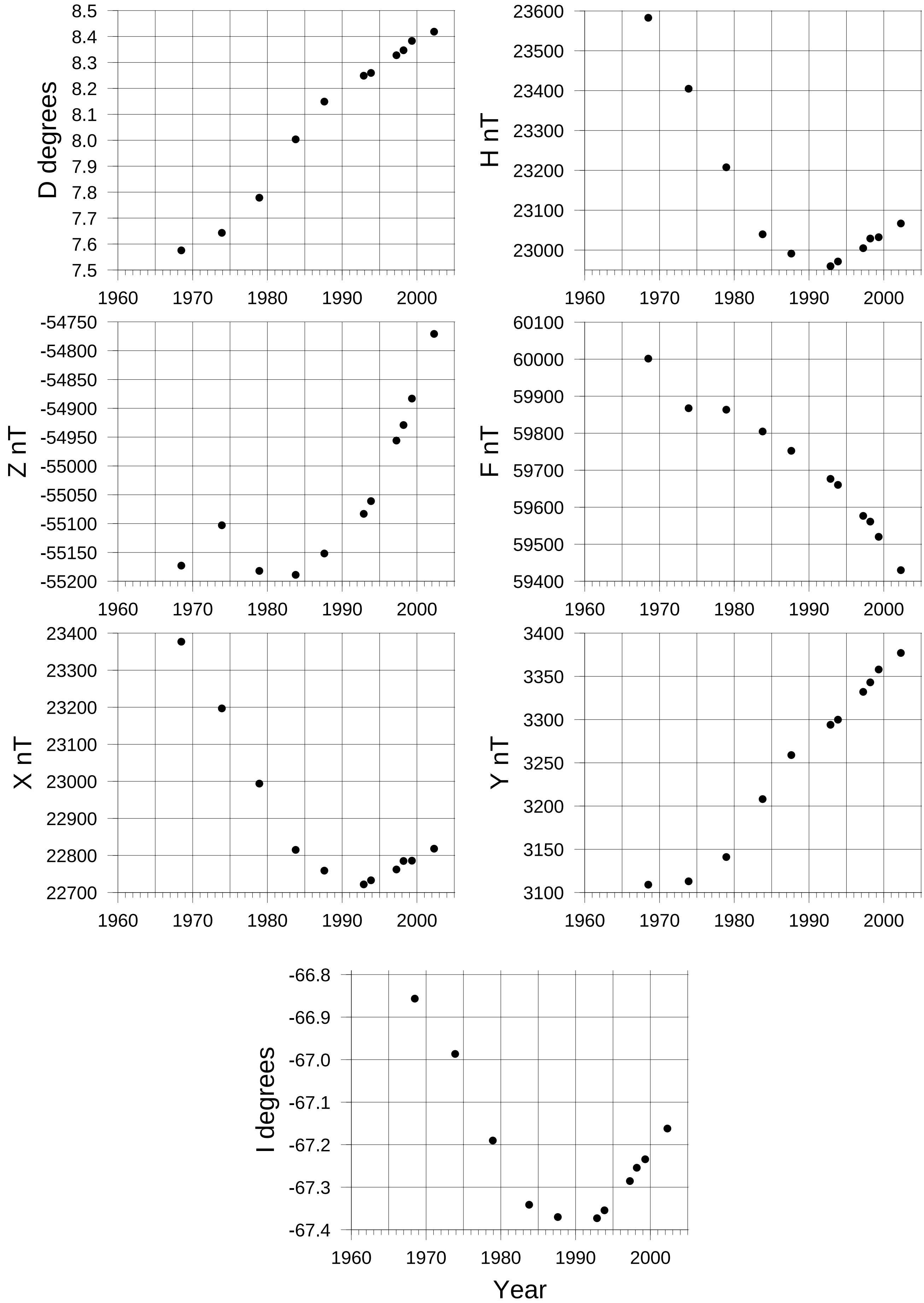
The latest revision of the Australian Geomagnetic Reference Field was for epoch 2000.0 (AGRF00) that was released in 2000 (Lewis, 2000). It is considered the best available geomagnetic field model for direction-finding applications in the Australian region. Charts in each of the magnetic elements X, Y, Z, F, H, D and I of the AGRF00 model are in the *AGR00*.

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*.

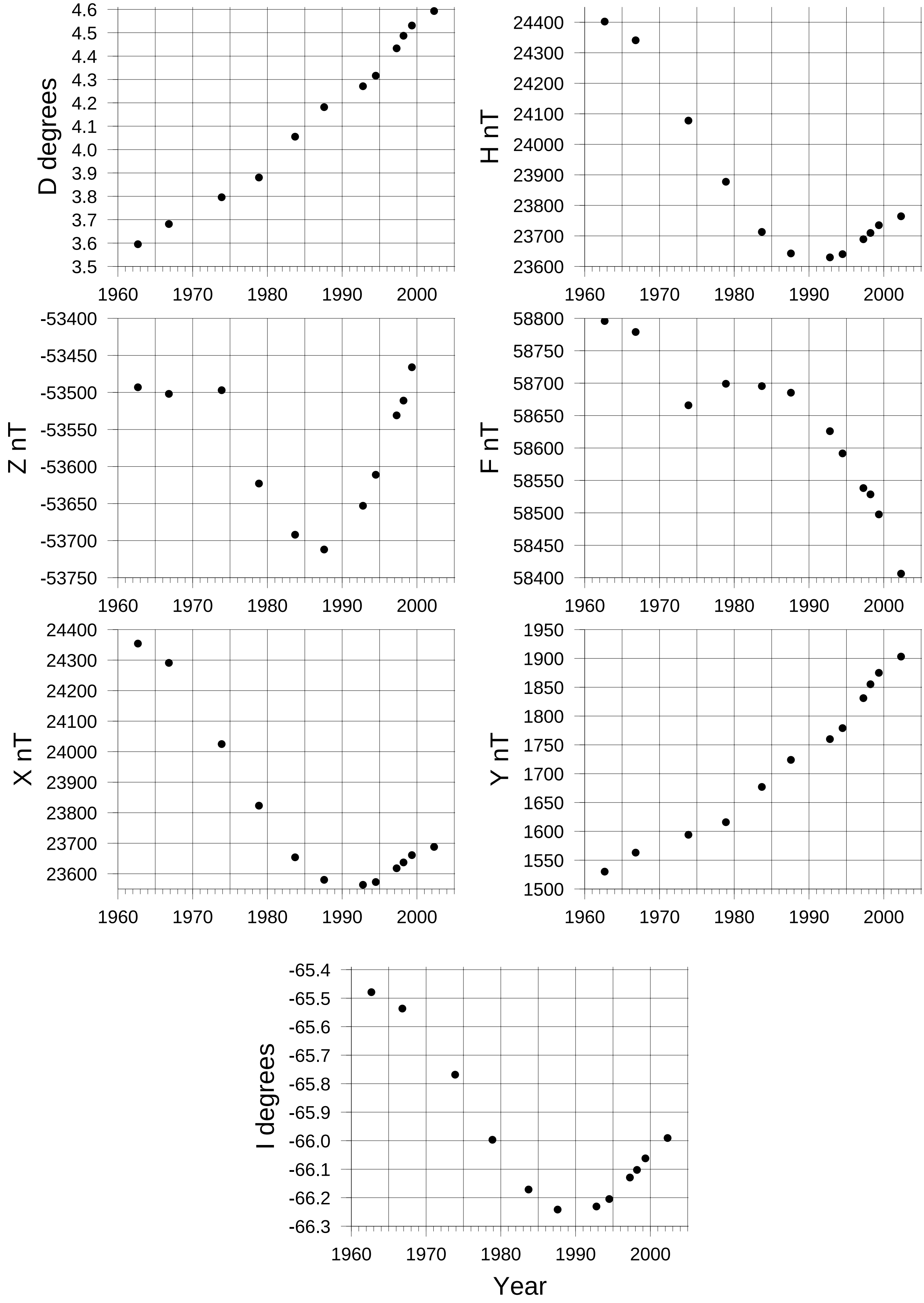
# TIB


D degrees
8.6
8.5
8.4
8.3
8.2
8.1
8.0
7.9
H nT
27400
27300
27200
27100
27000
26900
Z nT
-49250
-49300
-49350
-49400
-49450
-49500
-49550
-49600
-49650
-49700
-49750
F nT
56700
56600
56500
56400
56300
56200
X nT
27200
27100
27000
26900
26800
26700
26600
Y nT
4000
3950
3900
3850
3800
3750
I degrees
-61.0
-61.1
-61.2
-61.3
-61.4
-61.5
-61.6
1960
1970
1980
1990
2000
Year

# PAF

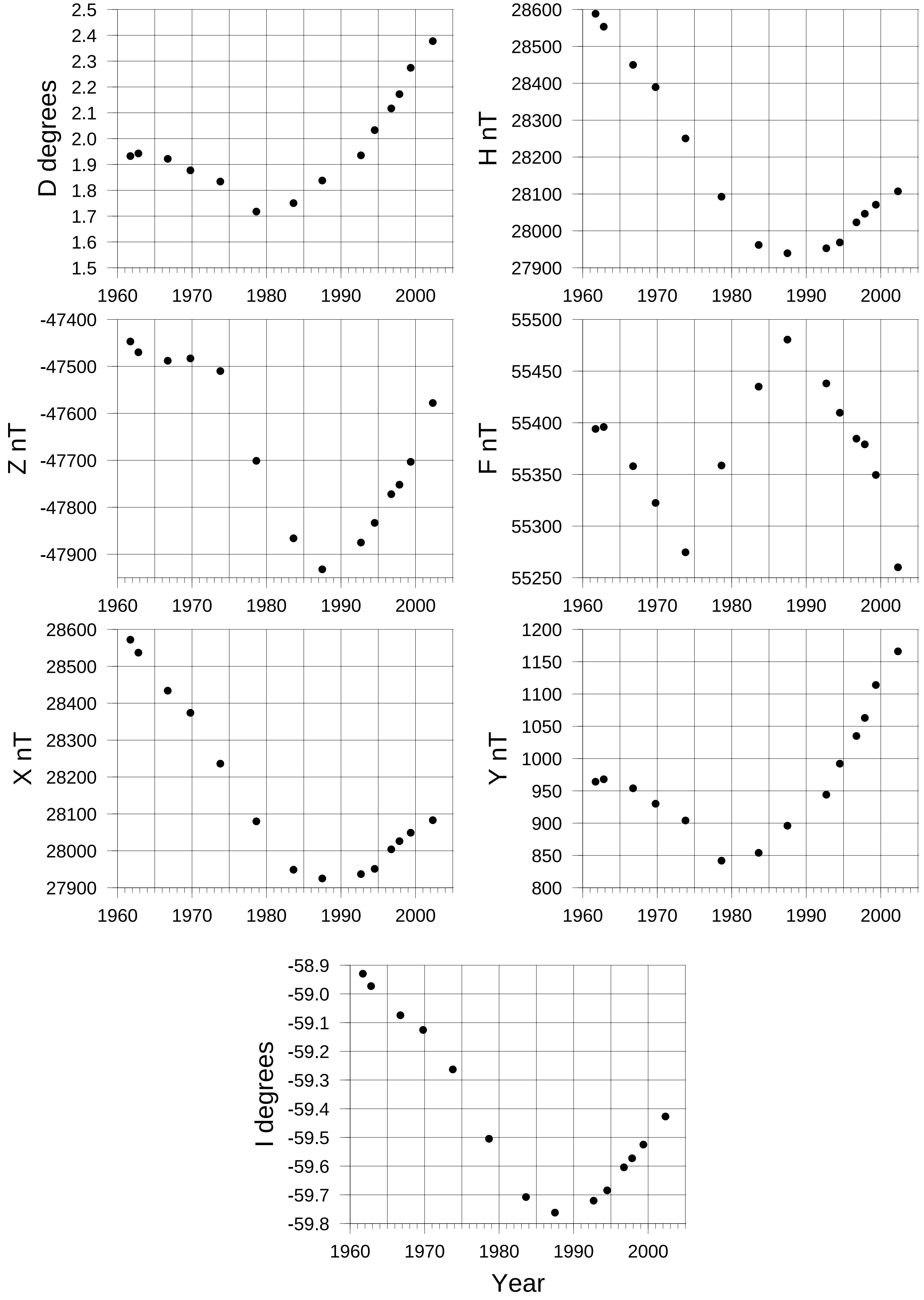


# EUC

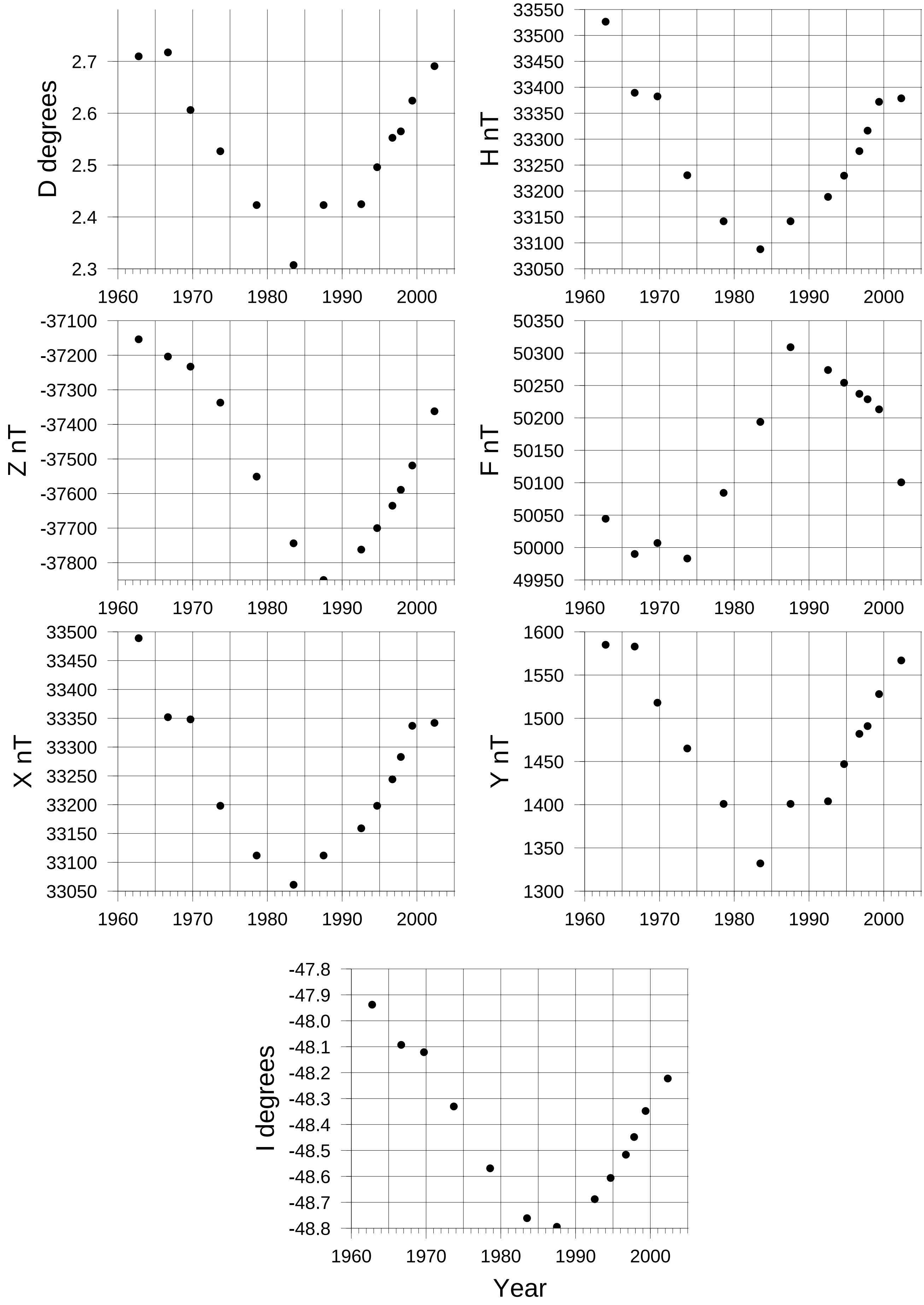


D degrees
4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5
H nT
24400 24300 24200 24100 24000 23900 23800 23700 23600
Z nT
-53400 -53450 -53500 -53550 -53600 -53650 -53700 -53750
F nT
58800 58750 58700 58650 58600 58550 58500 58450 58400
X nT
24400 24300 24200 24100 24000 23900 23800 23700 23600
Y nT
1950 1900 1850 1800 1750 1700 1650 1600 1550 1500
I degrees
-65.4 -65.5 -65.6 -65.7 -65.8 -65.9 -66.0 -66.1 -66.2 -66.3
1960 1970 1980 1990 2000
Year

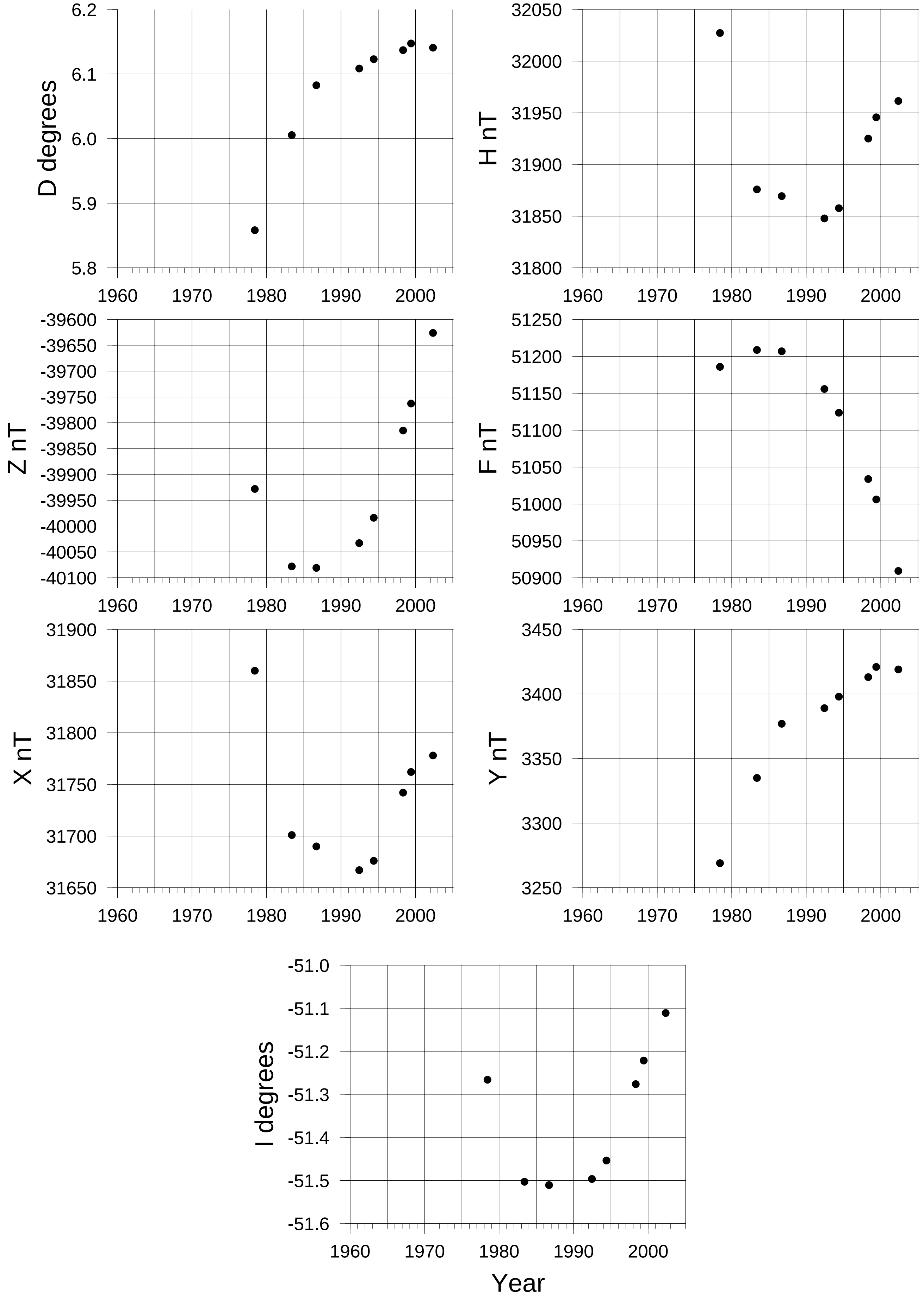
## CNE


D degrees
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
H nT
28600
28500
28400
28300
28200
28100
28000
27900
Z nT
-47400
-47500
-47600
-47700
-47800
-47900
F nT
55500
55450
55400
55350
55300
55250
X nT
28600
28500
28400
28300
28200
28100
28000
27900
Y nT
1200
1150
1100
1050
1000
950
900
850
800
I degrees
-58.9
-59.0
-59.1
-59.2
-59.3
-59.4
-59.5
-59.6
-59.7
-59.8
1960
1970
1980
1990
2000
Year

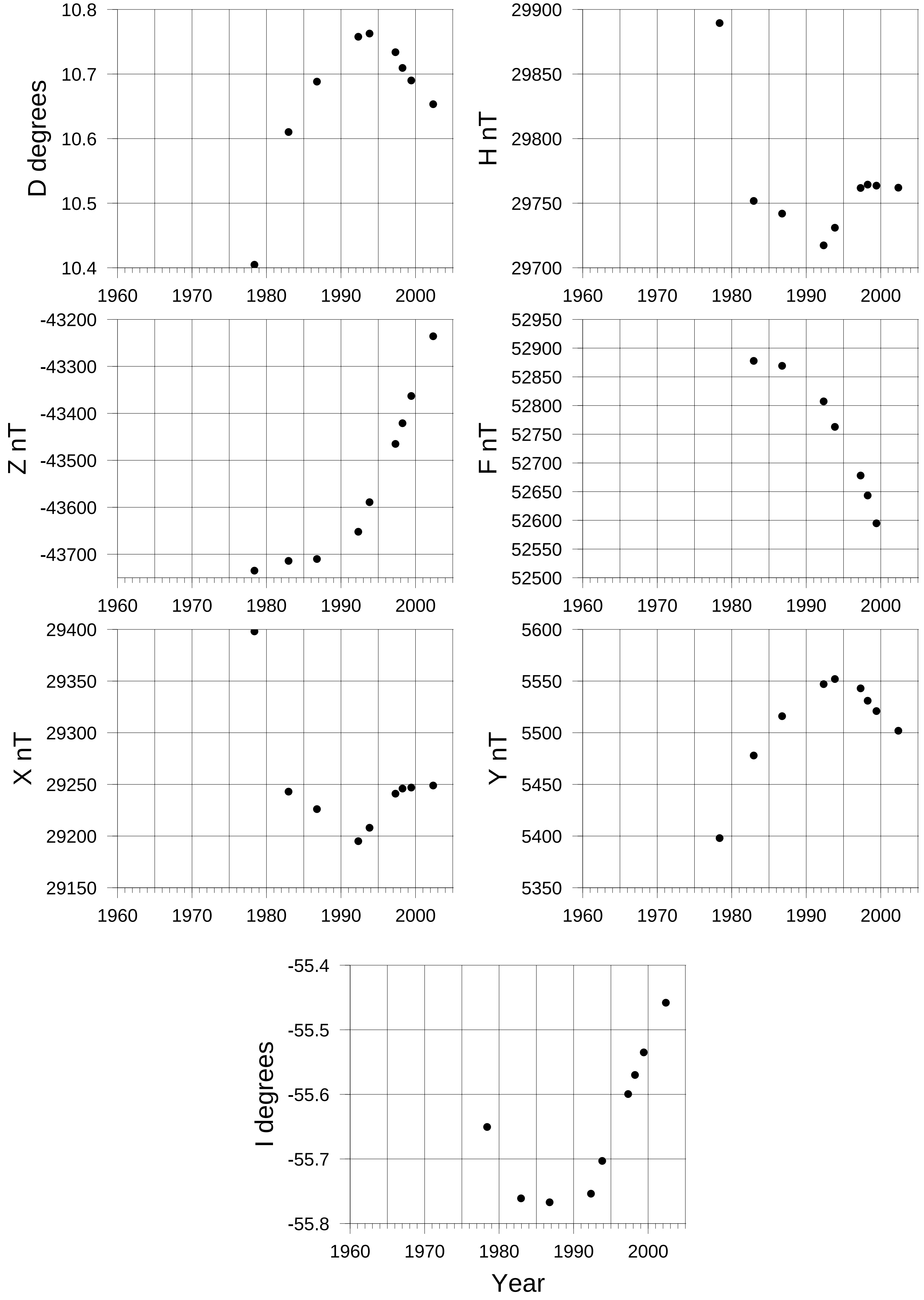
# DER


D degrees
2.3
2.4
2.5
2.6
2.7
H nT
33050
33100
33150
33200
33250
33300
33350
33400
33450
33500
33550
Z nT
-37800
-37700
-37600
-37500
-37400
-37300
-37200
-37100
F nT
49950
50000
50050
50100
50150
50200
50250
50300
50350
X nT
33050
33100
33150
33200
33250
33300
33350
33400
33450
33500
Y nT
1300
1350
1400
1450
1500
1550
1600
I degrees
-48.8
-48.7
-48.6
-48.5
-48.4
-48.3
-48.2
-48.1
-48.0
-47.9
-47.8
1960
1970
1980
1990
2000
Year

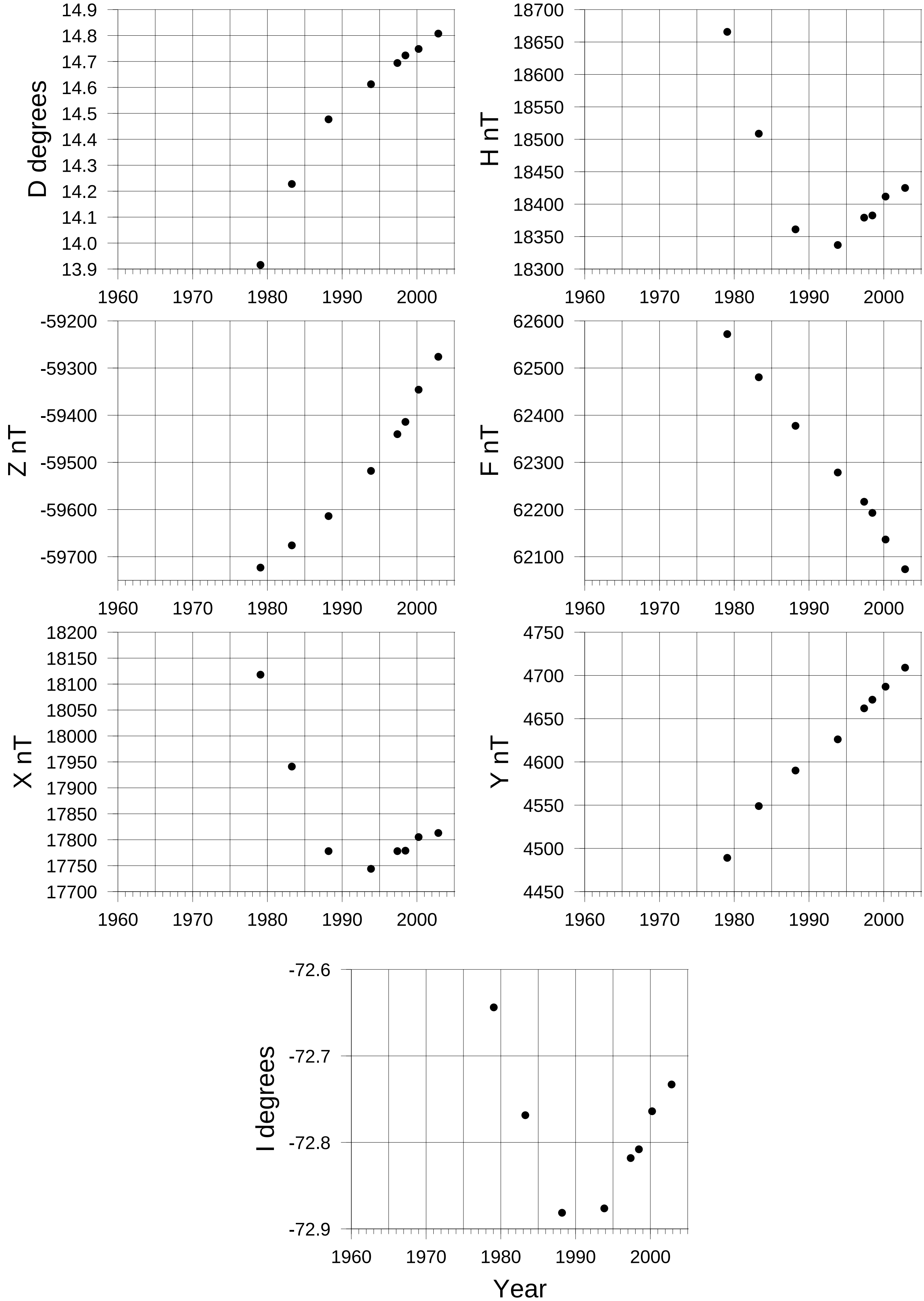
# ISA


D degrees
6.2
6.1
6.0
5.9
5.8
H nT
32050
32000
31950
31900
31850
31800
Z nT
-39600
-39650
-39700
-39750
-39800
-39850
-39900
-39950
-40000
-40050
-40100
F nT
51250
51200
51150
51100
51050
51000
50950
50900
X nT
31900
31850
31800
31750
31700
31650
Y nT
3450
3400
3350
3300
3250
I degrees
-51.0
-51.1
-51.2
-51.3
-51.4
-51.5
-51.6
1960
1970
1980
1990
2000
Year

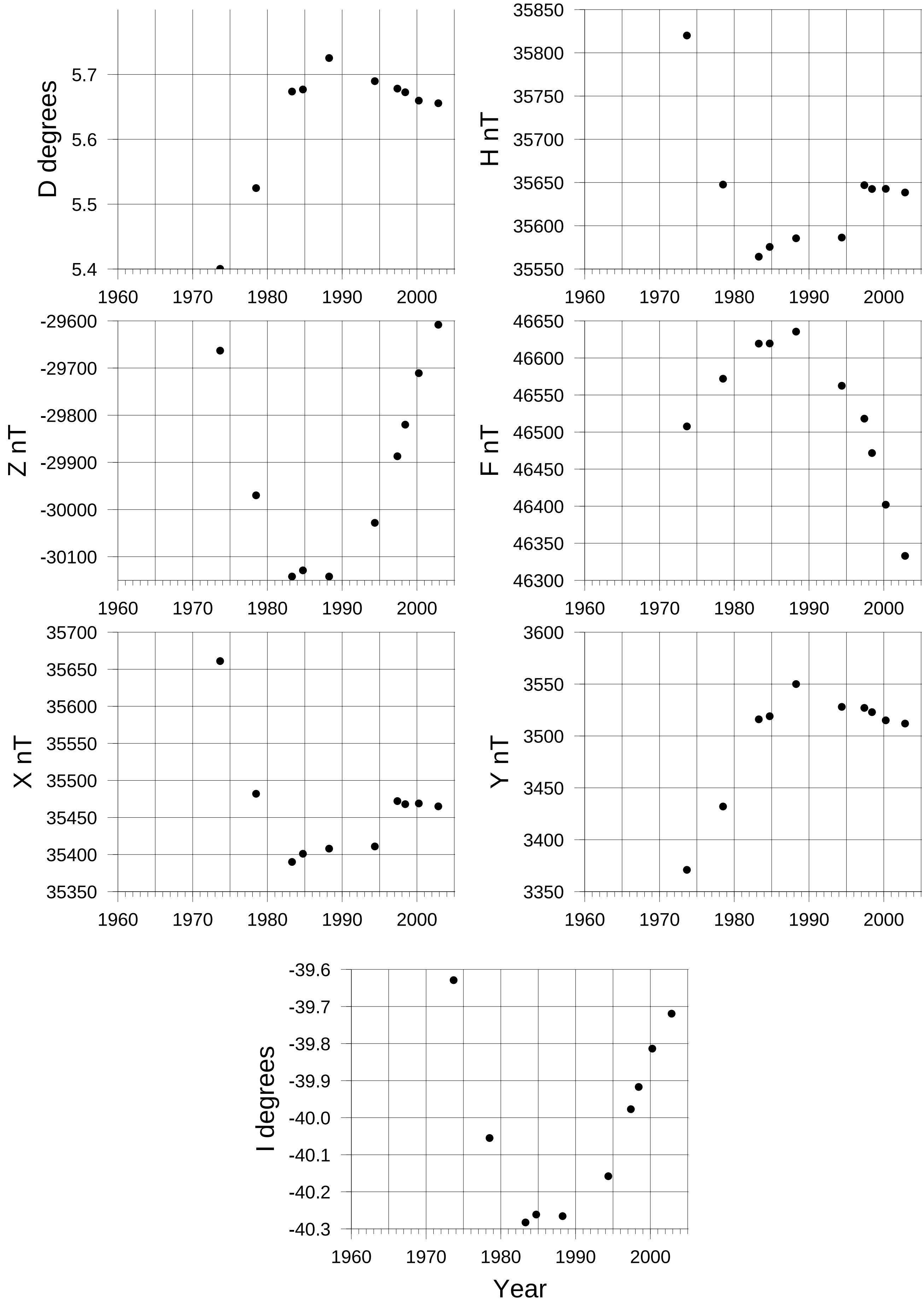
# MYB


D degrees
10.8
10.7
10.6
10.5
10.4
H nT
29900
29850
29800
29750
29700
Z nT
-43200
-43300
-43400
-43500
-43600
-43700
F nT
52950
52900
52850
52800
52750
52700
52650
52600
52550
52500
X nT
29400
29350
29300
29250
29200
29150
Y nT
5600
5550
5500
5450
5400
5350
I degrees
-55.4
-55.5
-55.6
-55.7
-55.8
1960
1970
1980
1990
2000
Year

# HOB

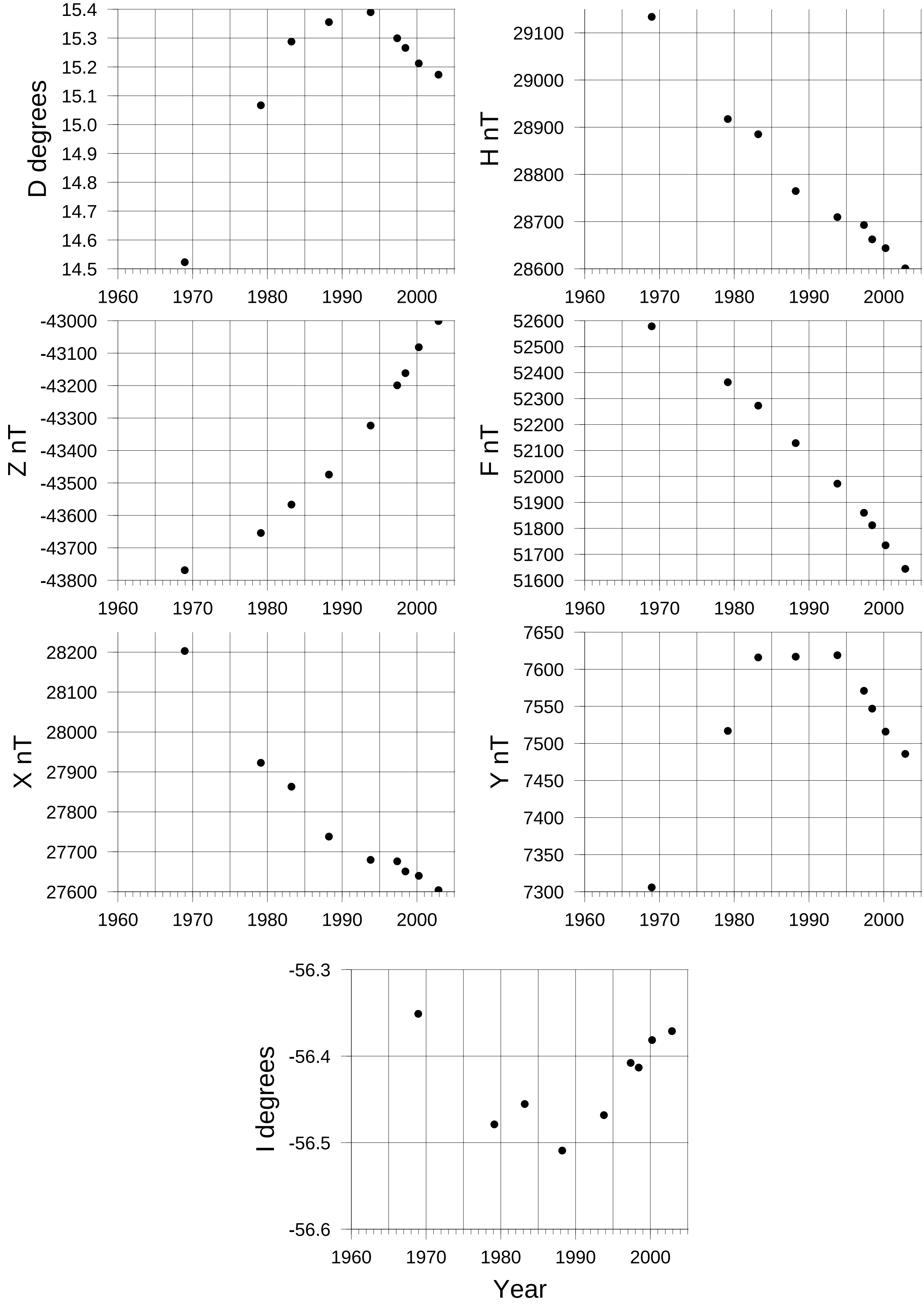

D degrees
H nT
Z nT
F nT
X nT
Y nT
I degrees
Year
1960
1970
1980
1990
2000

# WEI

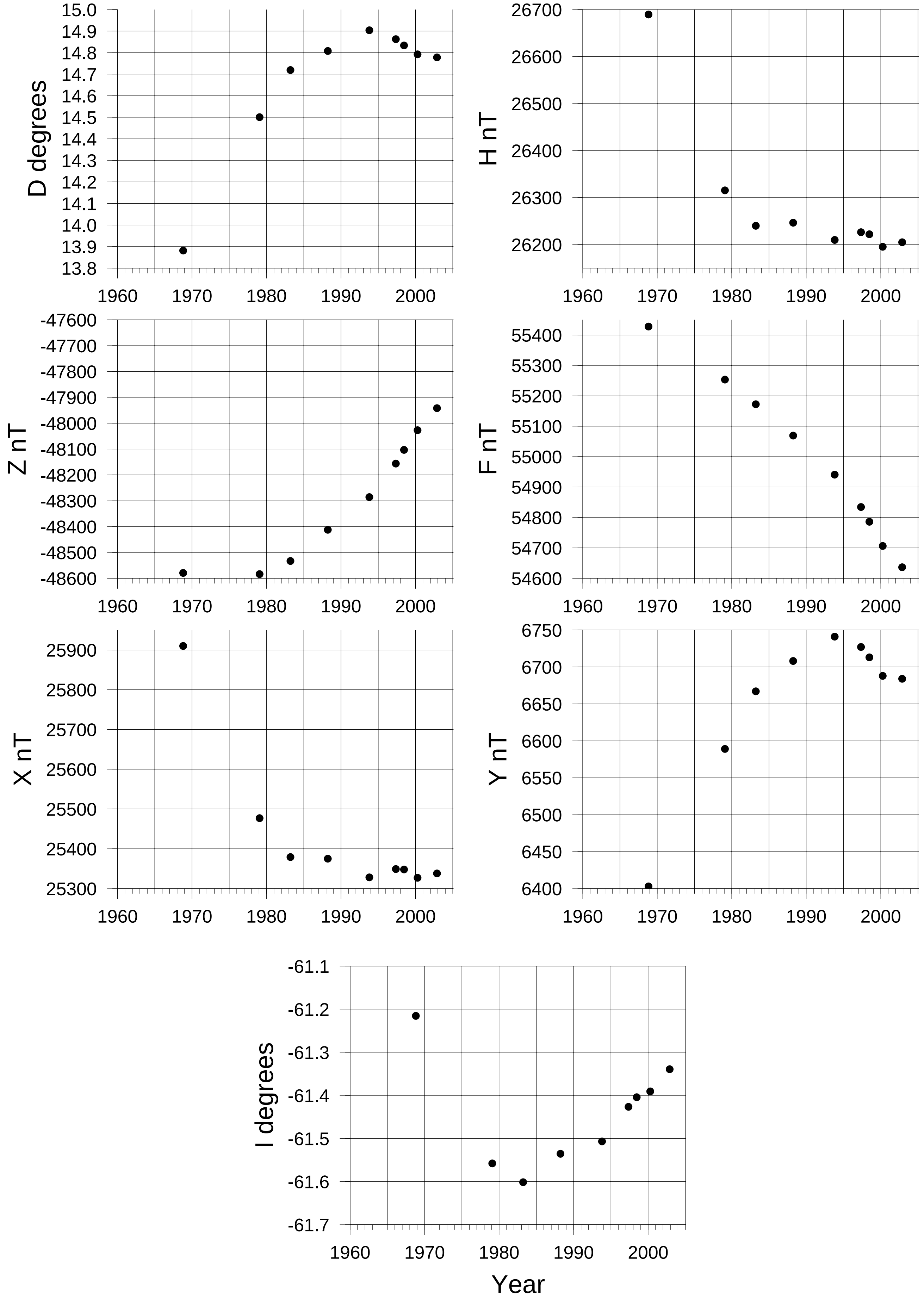


D degrees
5.7
5.6
5.5
5.4
H nT
35850
35800
35750
35700
35650
35600
35550
Z nT
-29600
-29700
-29800
-29900
-30000
-30100
F nT
46650
46600
46550
46500
46450
46400
46350
46300
X nT
35700
35650
35600
35550
35500
35450
35400
35350
Y nT
3600
3550
3500
3450
3400
3350
I degrees
-39.6
-39.7
-39.8
-39.9
-40.0
-40.1
-40.2
-40.3
1960
1970
1980
1990
2000
Year

# NFI


D degrees
15.4
15.3
15.2
15.1
15.0
14.9
14.8
14.7
14.6
14.5
H nT
29100
29000
28900
28800
28700
28600
Z nT
-43000
-43100
-43200
-43300
-43400
-43500
-43600
-43700
-43800
F nT
52600
52500
52400
52300
52200
52100
52000
51900
51800
51700
51600
X nT
28200
28100
28000
27900
27800
27700
27600
Y nT
7650
7600
7550
7500
7450
7400
7350
7300
I degrees
-56.3
-56.4
-56.5
-56.6
1960
1970
1980
1990
2000
Year

# LHI



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## Geomagnetism Staff List 2002

| Name | Classification | Responsibility |
|---|---|---|
| Charles E. Barton | GA Level 8 | Section Head |
| Peter A. Hopgood | GA Level 6 | Project Leader |
| Peter G. Crosthwaite | GA Level 5 | Digital acquisition, system and software development and maintenance; Kakadu & Gnangara observatories |
| Andrew M. Lewis | GA Level 4 | Project Leader, Repeat Station Survey, Alice Springs & Learmonth observatories |
| Liejun Wang | GA Level 3 | Data-base development; Canberra & Charters Towers observatories |
| Adrian D. Costar | GA Level 2 (to 14 June 2002) | Antarctic Observatories |
| Nick Bartzis | GA Level 2 (from 29 Oct. 2002) | 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 Queensland University | Charters Towers |
| Graham Steward | Learmonth Solar Observatory, IPS | Learmonth |
| Kim Stellmacher | Contracted by GA | Kakadu |
| Gerard (Hans) Van Reeken | Contracted by GA | Gnangara |
| Martin Purvins | Technical Officer 2 (on contract) (shared by GA & BoM) | Mawson (2001 observer) |
| Andrew Jenner | Technical Officer 2 (on contract) (shared by GA & BoM) | Mawson (2002 observer) |
| Kerry Steinberner | Technical Officer 2 (on contract) (shared by GA & BoM) | Mawson (2003 observer) |
| Mick Eccles | Technical Officer 2 (AAD) | Macquarie Island (2001/02 observer) |
| Peter Pokorny | Technical Officer 2 (AAD) | Macquarie Island (2002/03 observer) |
| Max Paterson | AAD | Casey, 2002 |

# End of Part 2