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MAGNETIC OBSERVATORIES

VOLUME 53

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Department Minister:	The Hon. Ian Macfarlane MP
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Department Secretary:	Mark Paterson

Geoscience Australia

Chief Executive Officer: Dr Neil Williams

Geospatial and Earth Monitoring Division

Chief of Division: Dr Chris Pigram

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Geomagnetism Project
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Canberra, A.C.T., 2601
AUSTRALIA

Australian Government

Geoscience Australia

Magnetic results for 2005

Kakadu

Charters Towers

Learmonth

Alice Springs

Gnangara

Canberra

Macquarie Island

Casey

Mawson

– and –

Australian Repeat Station Network

Compiled and edited by P.A. Hopgood

with contributions by

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

and N. Bartzis

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SUMMARY

During 2005 Geoscience Australia operated geomagnetic observatories at **Kakadu** and **Alice Springs** in the Northern Territory, **Charters Towers** in Queensland, **Learmonth** and **Gnangara** in Western Australia, **Canberra** in the Australian Capital Territory, **Macquarie Island**, Tasmania, in the sub-Antarctic, and **Casey** and **Mawson** in the Australian Antarctic Territory.

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

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

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

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

During a field survey in November 2005 the magnetic repeat station at Weipa in NE Australia and those at Norfolk Island and Lord Howe Island in the SW Pacific were re-occupied.

The Indonesian observatories at Tangerang and Tondano were most recently upgraded by GA's Geomagnetism personnel in 2001 under an AusAID grant that also included the purchase of instrumentation and the training of staff from Indonesia's national meteorological and geophysical organisation, Badan Meteorologi & Geofisika (BMG). To assist the geomagnetism program in Indonesia, data were routinely received from the Tondano observatory for processing. (No usable data were received from Tangerang in 2005.)

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 2005.

ACRONYMS and ABBREVIATIONS

AAD	Australian Antarctic Division
ACRES	Australian Centre for Remote Sensing
ACT	Australian Capital Territory
A/D	Analogue to Digital (data conversion)
ADAM	Data acquisition module produced by Advantech Co. Ltd.
AGR	Australian Geomagnetism Report
AGRF	Australian Geomagnetic Reference Field
AGSO	Australian Geological Survey Organisation (formerly BMR)
AMO	Automatic Magnetic Observatory
AMSL	Above Mean Sea Level
ANARE	Australian National Antarctic Research Expedition
ANARESAT	ANARE satellite (communication)
ASP	- Alice Springs (Magnetic Observatory) - Atmospheric & Space Physics (a program of the AAD)
AusAID	Australian Agency for International Development
BGS	British Geological Survey (Edinburgh)
BMR	Bureau of Mineral Resources, Geology, and Geophysics (Now Geoscience Australia)
BMG	Badan Meteorologi dan Geofisika (Indonesia)
BoM	(Australian) Bureau of Meteorology
CD-ROM	Compact Disk - Read Only Memory
CLS	Collecte Localisation Satellites
CNB	Canberra (Magnetic Observatory)
CNES	Centre National d'Etudes Spatiales
CODATA	Committee on Data for Science and Technology
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSY	Casey (Magnetic Observatory)
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)
IM	INTERMAGNET (see above)
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
SW	south-west (direction)
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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CONTENTS (continued)

Part 2

End of Part 2

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

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

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

Part 2

CANBERRA OBSERVATORY

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

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

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

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

Key data for Canberra Observatory:

- 3-character IAGA code: CNB
- Commenced operation: 1978
- Geographic latitude: 35° 18' 52.6" S
- Geographic longitude: 149° 21' 45.4" E
- Geomagnetic†: Lat. -42.51°; Long. 226.91°
- Lower limit for K index of 9: 450 nT
- Principal pier identification: Pier AW
- Elevation of top of Pier AW: 859 metres AMSL
- Azimuth of principal reference (NW pillar from Pier AW): 328° 37' 03"
- Distance to NW pillar: 137.3 metres
- Observers in Charge: L. Wang (GA)

† Based on the IGRF 2005.0 model updated to 2005.5

Variometers

During 2005 (since November 1995) a Narod ring-core fluxgate (RCF) variometer operated as the principal variometer at the observatory. It was located on the pier in the eastern room of the VARIOMETER HOUSE. It monitored variations in three orthogonal components of the magnetic field, and was aligned to measure the (magnetic) north-west; north-east and vertical field components, denoted A, B and Z respectively.

Total intensity variations were monitored throughout 2005 with a GEM Systems GSM-90 Overhauser effect magnetometer (electronics no. 803810, sensor no. 81225). It was located (since 17 Nov 2003) in the western room of the VARIOMETER HOUSE with its sensor mounted on a standard PPM tripod.

A LEMI 3-component fluxgate variometer, housed in the SECONDARY VARIOMETER HOUSE served as a backup instrument during 2005 should the principal variometer become unserviceable.

For periods in 2005 during which data were either not acquired by the primary (Narod) variometer or were contaminated, data were recovered from the backup LEMI variometer. This resulted in there being zero variometer data loss in 2005.

Data for the following intervals were acquired by the LEMI instrument:

03 Feb	0017-0025
22 Mar	0218-0306, 0413-0414, 2353-2359
30 Mar	2357 to 31/0040
22 May	0000 to 23/0026
10 Jul	0430-0440
26 Sep	0421-0435
27 Sep	0051-0220
25 Nov	1341 to 27/2124
28 Nov	0221-0514
02 Dec	1004-1005
06 Dec	1751-1752
07 Dec	2304-2315
09 Dec	1731-1732
11 Dec	0011-0012
13 Dec	0641-0642
14 Dec	1601-1602
16 Dec	1201-1202
18 Dec	0141-0142
19 Dec	1931-1932
21 Dec	0511-0512
22 Dec	0941-0942, 1012
23 Dec	2141-2142, 2334
25 Dec	1041-1042
27 Dec	0151-0152, 0358
28 Dec	2021-2022
30 Dec	0531-0532
31 Dec	2358-2359

Absolute Instruments and Corrections

Throughout 2005 absolute observations were regularly performed at Canberra with a Declination & Inclination Magnetometer (DIM) and a total field magnetometer.

At the beginning of 2005 the principal DIM in use was an Elsec 810 electronics and sensor (no. 215), with a Zeiss 020B (no. 353756) non-magnetic theodolite. (Elsec 810 sensor had been introduced on 25 November 2004 following the breakdown of the similar unit, E810_200, that had been in regular use until the previous week.) This instrument was routinely used on Pier Aw in the ABSOLUTE HOUSE. In consideration of numerous intercomparisons between DIMs (and other magnetometers), zero corrections have been applied to absolute observations performed with this instrument.

From 10 February 2005 DMI electronics and sensor no. DI0048 replaced Elsec 810_215. There was no difference between the results of the absolute observations using the two electronics units.

The principal absolute total field instrument used in 2005 was GSM90 Overhauser magnetometer with electronics no. 905926 and sensor no. 21867. Regular absolute observations with this instrument were performed on pier Aw in the ABSOLUTE HOUSE and used without correction.

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

Baselines

The variometers remained reasonably stable throughout 2005. Over the year baselines drifted by approximately:

8 nT in X; 10 nT in Y; 3 nT in Z.

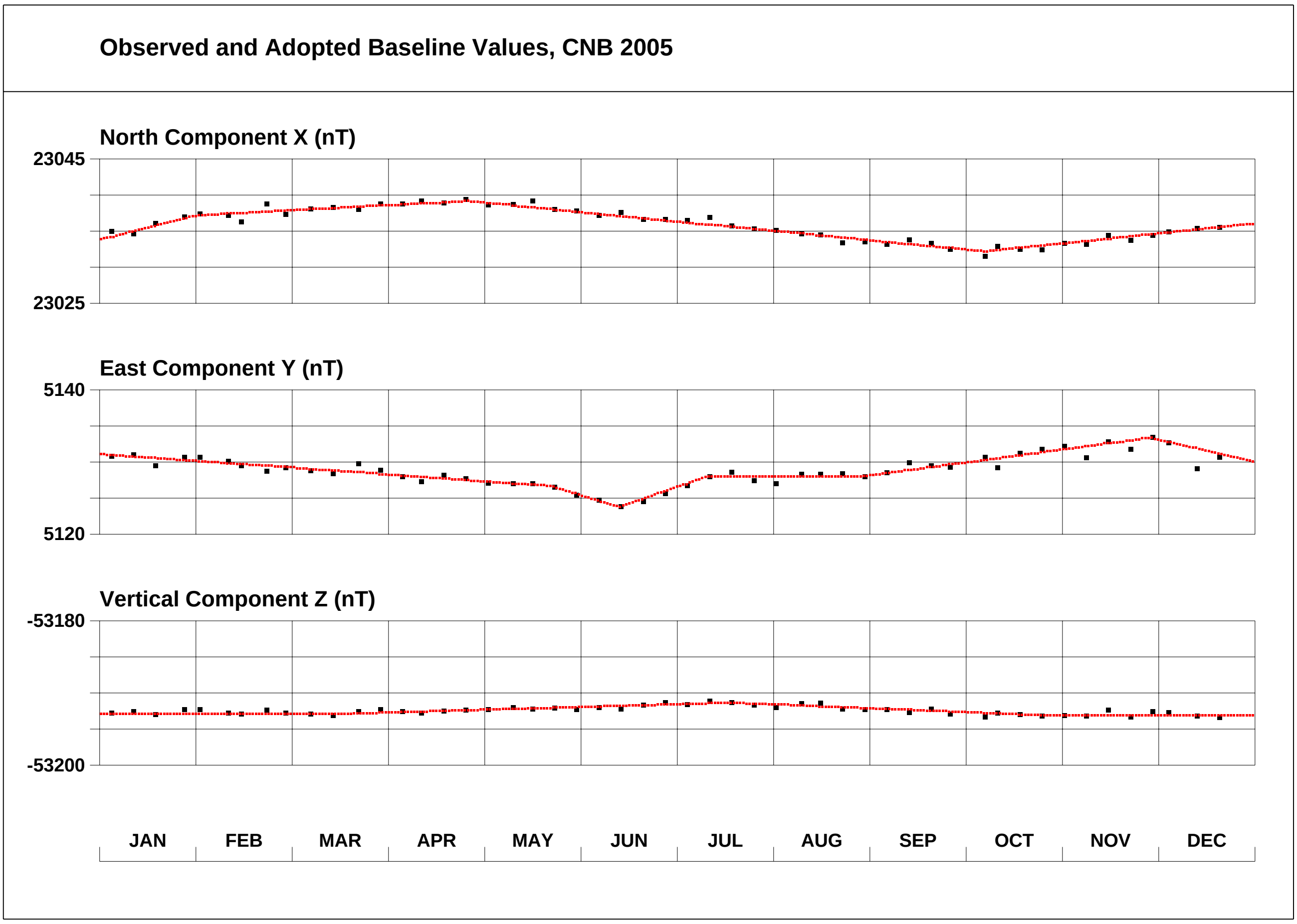
The drift patterns of three channels were very similar to those since 2002, i.e. the Narod variometer baseline drifts appear to be seasonally dependent.

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

0.0 ± 0.5 in X; 0.1 ± 0.7 in Y; 0.0 ± 0.3 in Z.

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

Observed and adopted baseline values in X, Y and Z for 2005 are shown in the following (INTERMAGNET format) chart.



Operations

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

The Narod RCF variometer was situated on pier (VE) in the east room of the VARIOMETER HOUSE, that for baseline stability, was maintained at a temperature of 26.5 ± 0.5°C throughout 2005. The temperature variation of the principal variometer sensors was 25.0 ± 0.5°C. Data from the RCF were transmitted via optical fibre to the RECORDER HOUSE where they were recorded on an acquisition PC.

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

See the Canberra *Variometers* section of this report for a description of the deployment of a LEMI variometer that served as a secondary vector instrument.

During 2005 digital data were retrieved automatically every 10 minutes from the CNB observatory to GA via a real-time data link using a radio modem link. Once received at GA, processing of the raw data was automatically scheduled, after which preliminary 1-minute resolution data were provided by e-mail to ISGI, France every 10 minutes (to enable the production of a real-time aa-index) and to the Edinburgh INTERMAGNET GIN daily until 01 September 2005 and every 10 minutes from 2320UT on that date.

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

Significant Events in 2005

17 Jan — 0730-1010UT: Temperature in VARIOMETER HOUSE changed due to mains power failure.

28 Jan — ~0015UT: New door handle installed on SECONDARY VARIOMETER HOUSE.

01 Feb — ~0320UT: Power failure.

Last absolute observation made using DIM Elsec 810 no. 215 (on Zeiss 020B 353756 theodolite).

02 Feb — Comparisons between DIM E810_215 with Zeiss 020B 353756 and B0610H with Zeiss 160459 showed that the D difference between two DIMs was stable during 2004 and 2005, and the I difference was slightly scattered, but averaging 0.0 minutes.

04 Feb — 0017-0024: Narod stalled during MagCal tests.

Variometer PPM power supply replaced.

10 Feb — DMI DI0048 electronics (with Zeiss 020B theodolite no. 353756) was introduced into the absolute observation routine.

22 Mar — RECORDER HOUSE tidied. At about 0200 the ga-cnb-mag2 NGL QNX acquisition was switched off so the DOS acquisition became unreachable.

At about 0230-0300 the ga-cnb-mag2 was installed in the VARIOMETER HOUSE and the variometer GSM90 disconnected from DOS acquisition system; read/write output of NGL connected to ga-cnb-mag2, and read only port connected to fibre optic connection to DOS. At this stage the variometer was still named "can". Unable to connect to the 192.55.112.40 ntp server, but could connect to galah as an ntp server.

At GA, variometer name changed to "cnb" and system was restarted. File names began at h0508100.cnb, although some "can" data were valid. A baseline change was expected when the QNX system was installed in VARIOMETER HOUSE. GSM90 data were not being collected.

23 Mar — Cable on GSM90 variometer power supply in the VARIOMETER HOUSE was repaired to restore F data in primary variometer. A modem was also connected to the CNB DOS acquisition (gcon CAN). Changed to QNX system.

29 Mar — DOS scheduled jobs corrected so that new GDAP was consistent with Real Time data delivery

31 Mar — Cables in VARIOMETER HOUSE re-routed. Some data loss.

05 May — It was noticed that the CN1 (LEMI) acquisition system clock had not been functioning for at least a week. The system time was corrected (by -700ms) using ntpdate (galah). Fortunately timing had been well corrected by the previous rate parameter in Gdap Clock. At 0533 Gdap Clock stopped and ntpd started. Soon thereafter there was an unsuccessful attempt to get Gdap Clock to connect to GPS. (The possibility of rectifying the lockup with a computer reset was not attempted.) Gdap Clock Test did not successfully detect interrupts.

22 May — On Monday morning (23rd LT) just before UT0 it was noticed that NGL data to QNX CNB system had stopped at 0002, though F data were still being recorded, i.e. files were transmitted without vector data. As no problems were immediately obvious a shutdown was performed at 23:57:30 (in what was an unsuccessful attempt to restore acquisition of NGL data before the next UT day). Data from the DOS system could not be retrieved - no response (although there had been a time correction not long before the attempt!) At about 00:25 on 23 May a final attempt was made to remotely fix the problem: Ceased programs GdapNGL and qtalk to NGL; but still no response. A Ctrl-C was sent and NGL restarted with normal data from then on. Reboot came back with 1 second offset, which was soon corrected by ntpd, but there was a small error for a short period. Questions arose as to why the modem was not answered by DOS, and why the NGL was not reset by GdapNGL when data stopped. Later it was possible to connect to DOS via modem to retrieve day 142 (22 May) data from DOS, to find it was missing NGL data after 00:02. A speculative explanation is that the NGL went into a non-normal-data mode spontaneously or be due to erratic data on the read rs232 line. Perhaps there was (garbled) data and hence GdapNGL never sent the reset.

02 Jun — ~0030: Variometer PPM power supply was replaced.

10 Jul — 0100-0440: Mains power was off, during which the Narod system was powered by the UPS and the LEMI was powered by a charged battery. The UPS failed for a few minutes immediately before and after the mains power was restored which resulted in a 10 minute loss of Narod data. No LEMI data were lost.

12 Jul — Absolute DIM observations using B0806H with theodolite 100856 at 00:47 were consistent but required a 0.6' correction in I. This observation was the first with the new (Pelican) plastic transit case that was inside the COMPARISON HOUSE. Later tests showed that the new transit case was not the cause: it produced a signature of about 10nT at 2m and was undetectable at 5m.

01 Sep — 2320: Transmission of near real-time CNB data to the Edinburgh INTERMAGNET GIN commenced.

06 Sep — Two sections of the Canberra Observatory boundary fence were found cut, most likely to bypass the newly locked gates and vehicle tracks were visible between them. Fortuitously the neighbouring owner/farmer was checking the fences at the time of weekly observations and discovered and fixed the problem.

26 Sep — 0821-2341: Narod variometer stopped due to a thunderstorm.

11 Oct — 0215-0235: Weed control around variometer hut.

22 Nov — Intruder alarm installed in NATIONAL MAGNETOMETER CALIBRATION FACILITY building. Keyboard video mouse (KVM) switch and flat screen also installed in this building.

25 Nov — to 27th: Narod variometer stopped (over the weekend).

28 Nov — ~0510: Switched to GdapNGL with reset tolerance set to 60 rather than 5. (It may now reset less often and give the instrument a chance to restart.) Reason for reset being required unknown.

02 Dec — ~0600: Telemetry failed during thunderstorms.

03 Dec — ~0245: The heater in SECONDARY VARIOMETER HOUSE was found fully on indicating the controller had failed.

05 Dec — ~0800: Network router and radio replaced, router from radio box relocated to top hut and fibre-optic converters installed between the router and the radio. Heater was switched off in SECONDARY VARIOMETER HOUSE and faulty heater controller removed.

06 Dec — ~2315: New temperature controller was installed in SECONDARY VARIOMETER (LEMI) HOUSE causing some contamination on CN1.

Data losses in 2005

As the LEMI vector magnetometer provided backup data to replace that from the primary Narod variometer that were either contaminated or missing, there were zero vector data loss at CNB in 2005. The table below shows the periods when total intensity variometer (PPM) data were missing in 2005:

21 Jan	2106 (1m)
04 Feb	0021-0024 (4m)
21 Mar	2349-2359 (11m)
22 Mar	0000 to 23/2237 (1d 22h 38m)
15 May	0239-0240 (2m)
22 May	2358 (1m)
02 Jun	0028 (1m), 0031-0036 (6m)
10 Jul	0431-0435 (5m), 0438-0440 (3m)
27 Sep	0219 (1m)

Principal Magnetic Storms: Canberra, 2005

Commencement				SC amplitudes			Maximum 3 hr. K index		Ranges			U.T. End	
Mth.	Day	Hr.Min.	Type	D(')	H(nT)	Z(nT)	Day (3 hr. periods)	K	D(')	H(nT)	Z(nT)	Day	Hr.
Jan.	07	12 ··	···	··	··	··	07(8), 08(1,2)	6	23	228	64	08	15
	11	21 ··	···	··	··	··	12(4,5)	5	27	103	52	13	18
	16	09 ··	···	··	··	··	18(3)	7	28	243	78	19	18
	21	16 58	ssc	7.6	161	37	21(7,8)	6	31	274	105	23	21
Apr.	04	18 ··	···	··	··	··	04(8), 05(1)	5	16	152	38	05	18
May	07	19 ··	···	··	··	··	08(5)	7	37	158	81	09	00
	15	02 34	ssc	3.6	29	15	15(3)	8	33	367	254	16	21
	20	03 ··	···	··	··	··	20(3,4)	5	13	138	53	20	21
	30	03 ··	···	··	··	··	30(5,6))	6	22	161	86	31	15
Jun.	12	06 ··	···	··	··	··	12(7,8), 13(5)	5	22	161	165	13	21
	22	22 ··	···	··	··	··	23(3,4,5)	5	19	168	165	13	21
Jul.	10	02 ··	···	··	··	··	10(4,5)	6	254	154	39	11	21
Aug.	10	06 ··	···	··	··	··	10(4)	6	15	135	41	10	21
	24	06 10	ssc	1.2	45	7	24(4,5)	7	55	332	122	26	12
	31	12 ··	···	··	··	··	31(6)	6	26	117	51	**01**	**15**
Sep.	09	14 01	ssc	1.9	64	15	11(3)	7	33	254	123	13	21
	15	09 ··	···	··	··	··	15(5,6)	6	19	149	53	16	18

There were no Principle Magnetic Storms reported for CNB in Feb., Mar., Oct., Nov. and Dec., 2005

Rapid Variation Phenomena

Sudden Storm Commencements (ssc) - CNB 2005

Month & date		U.T.	Type & Quality		Chief movement (nT) H	D	Z
Jan.	21	1658	ssc	A	+161	+53	+37
May	06	1307	ssc	A	+12	+2	+2
	15	0234	ssc	A	+29	+25	+15
Jun.	14	1832	ssc	A	+14	+14	+4
	16	0847	ssc	A	+24	+7	+6
Aug.	24	0610	ssc	A	+45	+8	+7
Sep.	08	2059	ssc	A	+9	+6	+4
	09	1401	ssc	A	+64	+13	+15

No ***ssc*** reported for CNB : Feb., Mar., Apr., Jul. Oct., Nov. and Dec. 2005.

Solar Flare Effects (sfe) - CNB 2005

Month & date		U.T. of movement Start	Max.	End	Amplitude(nT) H	D	Z	Confir-mation
Jan.	01	0027	0035	0120	7	6	11	solar
Nov.	18	0027	0032	0042	3	1	2	solar

No ***sfe*** reported for CNB in Feb., Mar., Apr., May, Jun., Jul., Aug., Sep., Oct. and Dec. in 2005.

Distribution of CNB data

K indices - weekly by e-mail

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

K indices - semi-monthly by e-mail

- GeoForschungsZentrum, Potsdam, Germany

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

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

Preliminary Monthly Means for Project Ørsted

- Sent monthly by email to IPGP.

Preliminary 1-minute values

- Sent every 10 minutes to ISGI, France throughout 2005

1-minute and Hourly Mean Values to WDCs

- 2005: WDC-A, Boulder, USA (sent in 2006)

1-minute Values for Project INTERMAGNET

- Preliminary data to the Edinburgh IM GIN by e-mail: daily until 01 September 2005 and in real-time thereafter.
- 2005 Definitive data: sent to Paris IM GIN (sent in 2006)

K indices

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

The table on the next page shows K indices for Canberra for 2005

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

Canberra Annual Mean Values

The table below gives annual mean values calculated using the monthly mean values over **All** days, the 5 International **Quiet** days and the 5 International **Disturbed** days in each month. Plots of these data with secular variation in H, D, Z & F are on pages 76 & 77.

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1979.5	A	12	05.6	-66	05.9	23833	23305	4993	-53778	58822	DFI
1980.5	A	12	08.6	-66	06.9	23808	23275	5009	-53767	58801	DFI
1981.5	A	12	11.2	-66	09.1	23770	23234	5018	-53771	58791	DFI
1982.5	A	12	14.0	-66	10.8	23736	23197	5030	-53769	58775	DFI
1983.5	A	12	16.6	-66	11.3	23723	23180	5044	-53756	58758	DFI
1984.5	A	12	18.4	-66	11.7	23709	23164	5054	-53741	58739	DFI
1985.5	A	12	20.7	-66	11.6	23703	23155	5067	-53726	58723	DFI
1986.5	A	12	23.2	-66	12.1	23689	23137	5081	-53716	58707	DFI
1987.5	A	12	25.5	-66	12.0	23684	23129	5096	-53699	58690	DFI
1988.5	A	12	27.6	-66	12.8	23665	23107	5106	-53690	58674	DFI
1989.5	A	12	29.0	-66	13.8	23644	23085	5111	-53683	58659	DFI
1990.5	A	12	30.7	-66	13.6	23641	23079	5121	-53667	58643	DFI
1991.5	A	12	31.8	-66	13.9	23628	23066	5126	-53652	58624	DFI
1992.5	A	12	32.4	-66	12.8	23637	23073	5132	-53625	58603	DFI
1993.5	A	12	33.0	-66	11.6	23646	23081	5138	-53597	58581	DFI
1994.5	A	12	33.5	-66	10.8	23649	23083	5142	-53571	58559	DFI
1995.5	A	12	33.8	-66	09.2	23665	23098	5148	-53540	58537	DFI
1996.5	A	12	34.2	-66	07.4	23684	23108	5154	-53507	58514	ABC
1997.5	A	12	34.2	-66	06.1	23695	23127	5157	-53476	58491	ABC
1998.5	A	12	34.2	-66	05.2	23698	23130	5157	-53444	58463	ABC
1999.5	A	12	34.1	-66	03.7	23709	23140	5159	-53403	58429	ABC
2000.5	A	12	34.2	-66	02.9	23706	23139	5160	-53367	58396	ABC
2001.5	A	12	34.7	-66	01.5	23716	23146	5164	-53327	58362	ABC
2002.5	A	12	35.1	-66	00.5	23718	23148	5168	-53291	58331	ABC
2003.5	A	12	35.5	-66	00.3	23710	23139	5169	-53264	58303	ABC
2004.5	A	12	35.5	-65	58.8	23719	23149	5171	-53225	58271	ABC
2005.5	A	12	35.2	-65	57.9	23720	23150	5169	-53191	58240	ABC
1979.5	Q	12	05.5	-66	05.3	23844	23315	4995	-53775	58824	DFI
1980.5	Q	12	08.6	-66	06.8	23813	23280	5010	-53769	58806	DFI
1981.5	Q	12	11.4	-66	08.3	23783	23246	5022	-53767	58792	DFI
1982.5	Q	12	14.1	-66	10.1	23749	23210	5033	-53766	58778	DFI
1983.5	Q	12	16.5	-66	10.7	23734	23191	5046	-53753	58760	DFI
1984.5	Q	12	18.5	-66	11.1	23719	23174	5056	-53739	58741	DFI
1985.5	Q	12	20.7	-66	11.1	23713	23164	5070	-53724	58724	DFI
1986.5	Q	12	23.2	-66	11.6	23697	23146	5083	-53714	58709	DFI
1987.5	Q	12	25.5	-66	11.6	23690	23136	5097	-53698	58691	DFI
1988.5	Q	12	27.7	-66	12.2	23675	23118	5109	-53687	58676	DFI
1989.5	Q	12	29.1	-66	13.0	23657	23098	5114	-53680	58662	DFI
1990.5	Q	12	30.8	-66	12.8	23653	23092	5125	-53663	58645	DFI
1991.5	Q	12	31.8	-66	12.9	23645	23082	5130	-53647	58627	DFI

continued on page 78 …

K indices and Daily K sums at Canberra (K=9 limit: 450 nT) for 2005

Date	January	February	March	April	May	June	Date
01	3223 3335 24	2112 2202 12	2234 2213 19	1221 1111 10	D 3334 4331 24	2111 2210 10	01
02	D 3443 3535 30	1111 2221 11	2233 3311 18	0001 1100 03	1211 3111 11	0002 1111 06	02
03	3234 5322 24	1242 1101 12	1110 2211 09	1211 1211 10	1123 3321 16	1121 1100 07	03
04	3332 4323 23	Q 1112 3200 10	Q 1111 1101 07	D 0222 2345 20	1100 2110 06	D 0122 2252 16	04
05	2233 3322 20	Q 0110 2001 05	1321 3323 18	D 5444 4323 29	Q 0111 1210 07	3333 2332 22	05
06	Q 1111 1121 09	1241 1223 16	D 4545 3544 34	2213 3312 17	1000 2111 06	2220 2012 11	06
07	0103 5546 24	D 2223 5353 25	D 2244 4453 28	0123 3100 10	1101 2123 11	2334 4112 20	07
08	6653 4212 29	D 3434 4443 29	D 3344 3332 25	1001 1000 03	D 4335 7642 34	1012 0000 04	08
09	Q 1214 1111 12	D 3433 4333 26	D 2333 3433 24	0000 1001 02	1121 0112 09	0000 2200 04	09
10	1221 2322 15	D 2333 4332 23	3233 3411 20	Q 0001 1001 03	1121 1111 09	Q 0001 1010 03	10
11	2332 2313 19	2224 2222 18	1222 2000 09	1102 1233 13	1023 2333 17	0001 0111 04	11
12	3445 5333 30	1100 1211 07	Q 1110 1000 04	D 3234 4433 26	1433 1322 19	D 0133 4455 25	12
13	2323 3322 20	Q 1110 0211 07	0001 0222 07	D 2344 4433 27	2343 4421 23	D 4344 5330 26	13
14	2211 1134 15	0121 1111 08	2333 5311 21	2424 4322 23	1112 1120 09	1111 0032 09	14
15	3443 3322 24	Q 1121 1002 08	1111 1001 06	2223 3322 19	D 3586 3243 34	3343 3221 21	15
16	2234 3423 23	2323 4432 23	0012 3231 12	2101 1121 09	D 2554 4421 27	D 1235 4432 24	16
17	D 3345 5645 35	2101 1203 10	2334 2422 22	1111 1000 05	2333 3222 20	2212 3321 16	17
18	D 5575 5544 40	D 4344 4511 26	1013 1233 14	1212 3211 13	1022 3300 11	1111 2011 08	18
19	D 5554 3312 28	0234 4322 20	3323 3001 15	0121 2111 09	1222 3111 13	1111 1101 07	19
20	1223 4422 20	2222 2332 18	Q 0112 2020 08	2434 4221 22	2455 3321 25	Q 0011 1000 03	20
21	D 2222 2666 28	1002 1100 05	0024 3211 13	Q 0000 0100 01	1234 4322 21	Q 0000 0000 00	21
22	4443 3333 27	0111 1222 10	Q 0110 1101 05	1100 3221 10	2123 3110 13	2112 1012 10	22
23	2332 4422 22	Q 0121 2112 10	Q 1101 2221 10	1111 1222 11	0000 2200 04	D 3355 5432 30	23
24	1212 3312 15	0122 2113 12	0101 3111 08	2212 2211 13	Q 0000 1011 03	2313 1100 11	24
25	Q 1012 2111 09	0222 2332 16	D 2343 3323 23	1222 2111 12	Q 1120 1000 05	2212 2332 17	25
26	Q 0101 2001 05	2223 3321 18	2344 4322 24	Q 0000 0001 01	Q 0000 0000 00	1212 2210 11	26
27	Q 1011 0112 07	1321 3112 14	2223 3332 20	Q 0000 1000 01	Q 0001 1000 02	Q 1000 2011 05	27
28	3111 1112 11	2223 2223 18	1210 0101 06	Q 0000 1100 02	0222 1332 15	Q 1011 1110 06	28
29	2234 3334 24		0110 0101 04	1222 3333 19	2234 2234 22	0011 1100 04	29
30	2333 3312 20		1122 1210 10	D 4433 4333 27	D 2355 6654 36	0112 1111 08	30
31	1234 4321 20		2321 1331 16		2222 3111 14		31
Mean K-sum	**21.0**	**14.9**	**14.8**	**12.3**	**15.0**	**11.6**	

Date	July	August	September	October	November	December	Date
01	1110 2432 14	2134 3321 19	2323 4012 17	2223 3322 19	2212 2321 15	D 3323 2224 21	01
02	3212 2222 16	1214 3110 13	D 1244 4443 26	D 1233 3311 17	1110 1133 11	3332 3222 20	02
03	2124 2001 12	1210 1221 10	3344 3212 22	1212 1100 08	D 3435 4332 27	3213 3232 19	03
04	1111 1100 06	2123 2211 14	3345 3331 25	0102 2110 07	D 3433 3332 24	1111 3122 12	04
05	Q 0011 1000 03	0101 1332 11	1123 2212 14	0001 1100 03	2332 3212 18	1101 0011 05	05
06	Q 0110 1210 06	D 2354 4333 27	2013 2311 13	0001 2111 06	D 3213 2322 18	Q 0211 1000 05	06
07	0101 2201 07	3233 2132 19	2113 2000 09	0113 2234 16	2121 2111 11	Q 0010 0000 01	07
08	Q 0111 1010 05	1011 2102 08	Q 0112 1211 09	D 2434 2233 23	Q 1101 0102 06	Q 0000 0001 01	08
09	D 1233 4432 22	1222 2221 14	1112 5433 20	2123 3122 16	1110 0101 05	1111 1213 11	09
10	D 2346 6444 33	2136 5310 21	2343 3554 29	2123 2102 13	Q 1130 0012 08	2421 2222 17	10
11	2244 4240 22	Q 0001 2100 04	D 6676 5443 41	2101 2211 10	1322 1211 13	D 1233 2443 22	11
12	D 3245 6420 26	Q 0101 1101 05	D 3365 5655 38	Q 0100 1001 03	1223 4212 17	2321 2322 17	12
13	D 1344 4432 25	D 2323 2122 17	D 5446 5232 31	1111 1110 07	D 1223 2322 17	1110 3112 10	13
14	1222 2200 11	2221 1011 10	2244 4321 22	Q 1100 0000 02	1213 2112 13	1221 1011 09	14
15	0011 1110 05	0101 2212 09	D 2125 6644 30	Q 0101 1001 04	1112 2101 09	Q 1212 1000 07	15
16	2221 1221 13	2313 3222 18	2345 3221 22	0212 2222 13	Q 1111 0201 07	1322 3231 17	16
17	3235 3213 22	2222 3422 19	0212 3433 18	D 1322 4310 16	Q 0011 0000 02	0103 3002 09	17
18	3353 4122 23	2233 3321 19	1223 3221 16	0111 2211 09	1111 2131 11	2112 2101 10	18
19	1111 2112 10	1113 2201 11	1111 1211 09	2112 3311 14	2211 1332 15	2122 3323 18	19
20	2224 4343 24	Q 1001 1010 04	Q 0112 2100 07	Q 0012 0000 03	1343 1211 16	D 2322 4332 21	20
21	3443 1221 20	0111 2410 10	Q 1101 2100 06	0000 0002 02	1111 1100 06	1122 3311 14	21
22	2212 3322 17	1312 3212 15	0112 2211 10	3110 1011 08	0122 2213 13	2121 0111 09	22
23	0111 1200 06	1113 3111 12	0221 1000 06	Q 1110 2110 07	2222 2111 13	Q 0010 0000 01	23
24	Q 1100 1110 05	D 2367 7554 39	Q 0000 1100 02	1000 3212 09	1223 2223 17	0112 3111 10	24
25	Q 1110 1010 05	D 4334 4431 26	Q 0113 3102 11	D 3334 2312 21	2221 2211 13	1333 3111 16	25
26	0001 0201 04	2222 0000 08	2323 4212 19	1131 2221 13	0113 2211 11	0112 2222 12	26
27	0222 2223 15	1131 1000 07	2224 2212 17	1102 3321 13	Q 0111 1111 07	D 2212 3443 21	27
28	D 2333 4323 23	Q 1001 1101 05	1222 2321 15	0113 3111 11	1123 4223 18	D 3223 3223 20	28
29	2324 2322 20	1111 1000 05	1212 3301 13	1010 0110 04	1110 0224 11	2232 2212 16	29
30	2233 1101 13	Q 1000 0021 04	0123 4312 16	0202 2112 10	D 3233 3223 21	2322 1111 13	30
31	1111 2103 10	D 1232 5654 28		D 0223 4444 23		2221 3322 17	31
Mean K-sum	**14.3**	**13.9**	**17.8**	**10.6**	**13.1**	**12.9**	

Occurrence distribution of K-indices

K-Index:	0	1	2	3	4	5	6	7	8	9	-
January	9	49	62	70	30	20	7	1	0	0	0
February	26	64	74	38	19	3	0	0	0	0	0
March	39	72	54	58	20	5	0	0	0	0	0
April	60	71	53	33	21	2	0	0	0	0	0
May	46	71	55	43	18	9	4	1	1	0	0
June	63	81	48	29	11	8	0	0	0	0	0
July	43	73	67	33	26	3	3	0	0	0	0
August	43	81	63	38	12	6	3	2	0	0	0
September	28	60	63	41	26	13	8	1	0	0	0
October	64	87	57	31	9	0	0	0	0	0	0
November	26	93	72	41	7	1	0	0	0	0	0
December	41	74	79	47	7	0	0	0	0	0	0
ANNUAL TOTAL	**488**	**876**	**747**	**502**	**206**	**70**	**25**	**5**	**1**	**0**	**0**

Monthly and Annual Mean Values

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

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

CANBERRA	2005	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	23147.3	5167.6	-53209.3	58255.7	23717.1	12° 35.1'	-65° 58.6'
	5xQ days	23155.5	5170.2	-53208.1	58258.2	23725.7	12° 35.2'	-65° 58.1'
	5xD days	23136.5	5161.4	-53213.2	58254.5	23705.3	12° 34.6'	-65° 59.3'
February	All days	23154.6	5169.3	-53201.9	58252.0	23724.6	12° 35.1'	-65° 58.0'
	5xQ days	23161.8	5172.9	-53200.2	58253.7	23732.4	12° 35.4'	-65° 57.5'
	5xD days	23141.5	5164.9	-53204.4	58248.7	23710.8	12° 34.9'	-65° 58.8'
March	All days	23151.8	5170.8	-53198.9	58248.3	23722.2	12° 35.4'	-65° 58.0'
	5xQ days	23157.1	5171.1	-53197.8	58249.5	23727.5	12° 35.3'	-65° 57.7'
	5xD days	23138.4	5168.1	-53202.7	58246.2	23708.6	12° 35.4'	-65° 58.9'
April	All days	23150.9	5171.3	-53194.0	58243.5	23721.4	12° 35.5'	-65° 58.0'
	5xQ days	23157.8	5172.0	-53191.7	58244.3	23728.4	12° 35.4'	-65° 57.5'
	5xD days	23136.9	5169.8	-53195.4	58239.2	23707.5	12° 35.7'	-65° 58.7'
May	All days	23133.1	5166.3	-53200.2	58241.7	23702.9	12° 35.3'	-65° 59.1'
	5xQ days	23155.4	5171.3	-53195.3	58246.5	23725.9	12° 35.4'	-65° 57.7'
	5xD days	23094.1	5156.2	-53209.6	58233.9	23662.7	12° 35.2'	-66° 01.5'
June	All days	23145.4	5169.0	-53195.4	58242.4	23715.5	12° 35.4'	-65° 58.3'
	5xQ days	23156.8	5169.8	-53191.6	58243.5	23726.9	12° 35.1'	-65° 57.6'
	5xD days	23131.0	5169.8	-53198.6	58239.7	23701.7	12° 35.9'	-65° 59.1'
July	All days	23146.8	5169.1	-53190.7	58238.6	23716.9	12° 35.3'	-65° 58.1'
	5xQ days	23161.0	5171.8	-53186.7	58240.9	23731.4	12° 35.2'	-65° 57.2'
	5xD days	23128.8	5163.1	-53195.4	58235.3	23698.1	12° 35.0'	-65° 59.2'
August	All days	23147.4	5168.3	-53186.6	58235.2	23717.4	12° 35.2'	-65° 58.0'
	5xQ days	23154.3	5170.4	-53186.0	58237.5	23724.5	12° 35.3'	-65° 57.6'
	5xD days	23126.1	5162.9	-53188.8	58228.2	23695.4	12° 35.1'	-65° 59.2'
September	All days	23137.3	5166.0	-53188.9	58233.0	23707.1	12° 35.2'	-65° 58.6'
	5xQ days	23151.9	5169.2	-53186.0	58236.5	23722.0	12° 35.2'	-65° 57.7'
	5xD days	23112.8	5160.6	-53194.2	58227.6	23682.0	12° 35.2'	-66° 00.1'
October	All days	23158.2	5170.0	-53178.9	58232.5	23728.3	12° 35.1'	-65° 57.2'
	5xQ days	23163.5	5171.3	-53176.9	58232.9	23733.8	12° 35.1'	-65° 56.9'
	5xD days	23149.1	5166.6	-53180.6	58230.2	23718.7	12° 34.9'	-65° 57.8'
November	All days	23160.8	5169.9	-53172.8	58228.0	23730.8	12° 35.0'	-65° 56.9'
	5xQ days	23163.1	5170.4	-53171.8	58228.0	23733.2	12° 35.0'	-65° 56.8'
	5xD days	23154.9	5168.6	-53174.7	58227.2	23724.7	12° 35.0'	-65° 57.3'
December	All days	23167.5	5169.6	-53168.0	58226.3	23737.3	12° 34.7'	-65° 56.5'
	5xQ days	23171.3	5171.2	-53169.0	58228.7	23741.3	12° 34.8'	-65° 56.3'
	5xD days	23163.3	5169.4	-53166.5	58223.2	23733.1	12° 34.8'	-65° 56.7'
Annual	All days	23150.1	5168.9	-53190.5	58239.8	23720.1	12° 35.2'	-65° 57.9'
Mean	5xQ days	23159.1	5171.0	-53188.4	58241.7	23729.4	12° 35.2'	-65° 57.4'
Values	5xD days	23134.5	5165.1	-53193.7	58236.2	23704.1	12° 35.1'	-65° 58.9'

(Calculated: 11:50 hrs., Mon., 27 Nov. 2006)

Hourly Mean Values

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

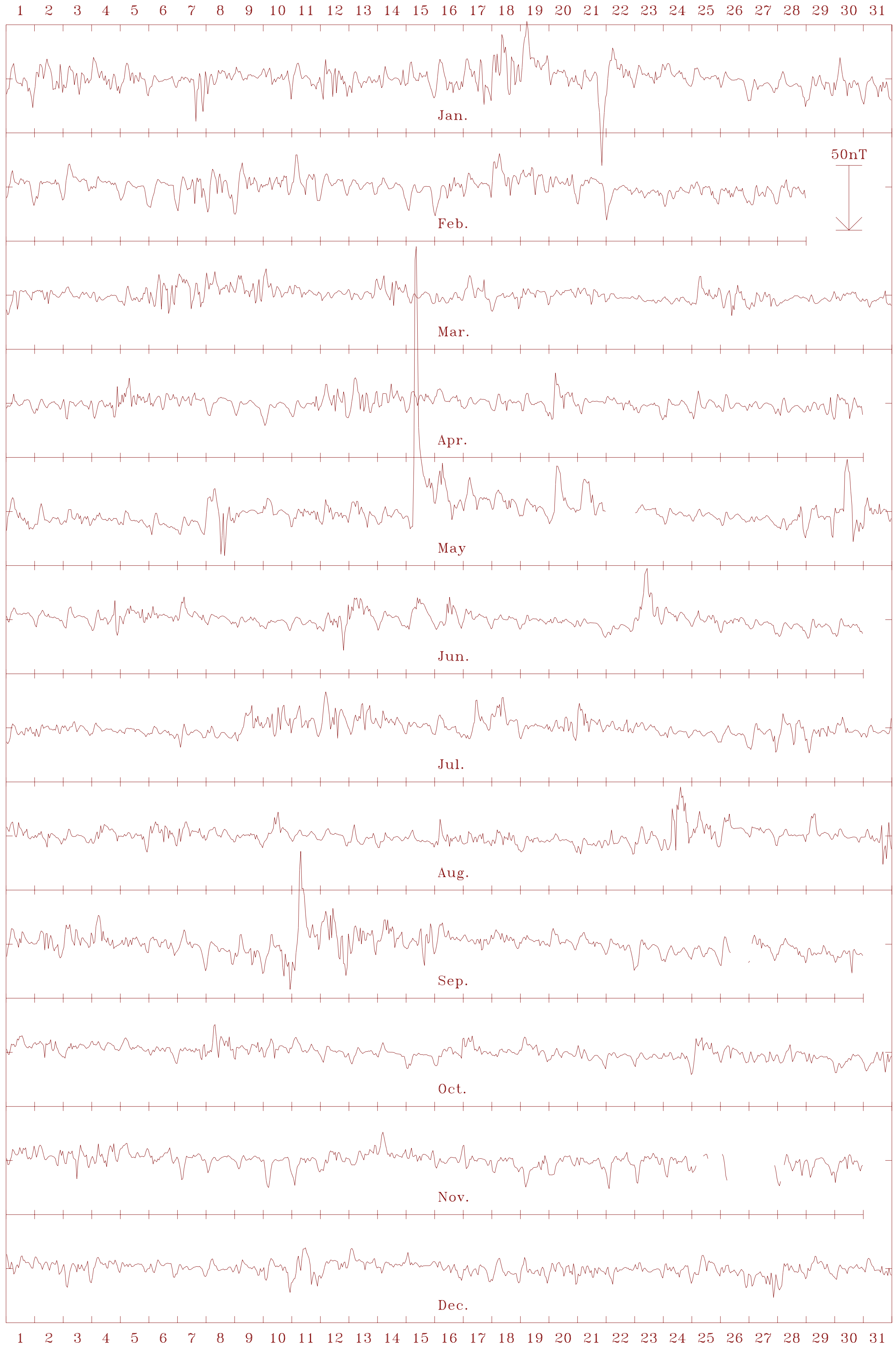
The reference levels indicated with marks on the vertical axes refer to the *all-days* mean value for the respective months. All elements in the plots are shown increasing (algebraically) towards the top of the page, with the exception of Z, which is in the opposite sense.

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

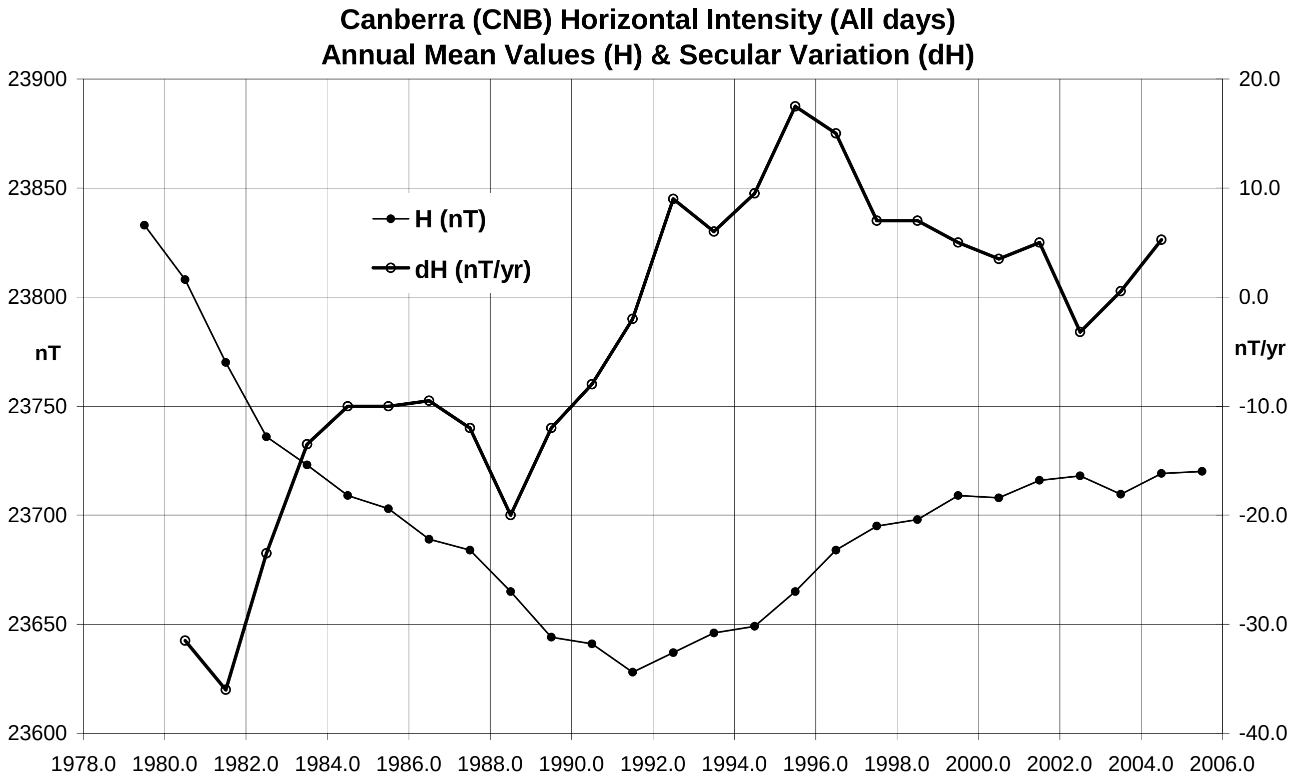
Canberra 2005 Horizontal intensity (H). Scale: 8.0 nT/mm. Mean: 23720 nT

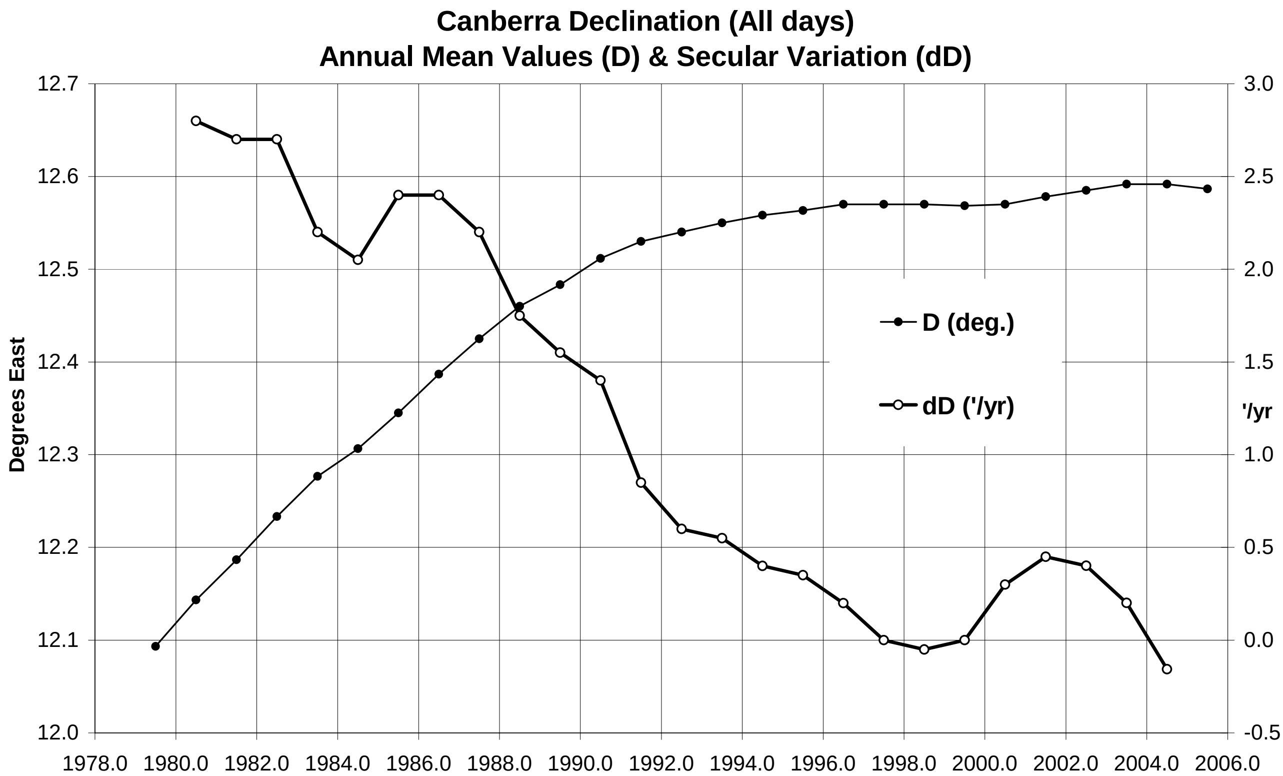
Canberra 2005 Declination (east) (D). Scale: 1.25 min/mm. Mean: 12.59 deg.

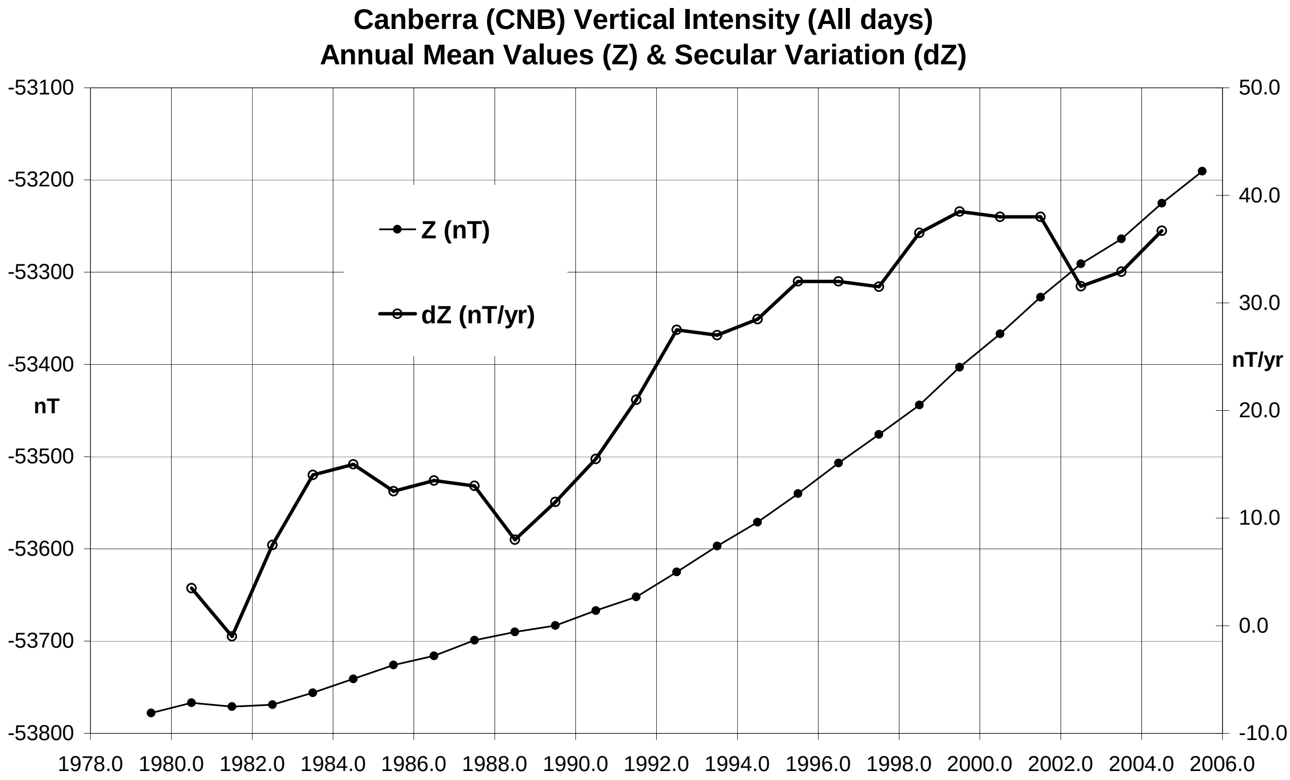
Canberra 2005 Vertical intensity (Z). Scale: 4.0 nT/mm. Mean: −53191 nT

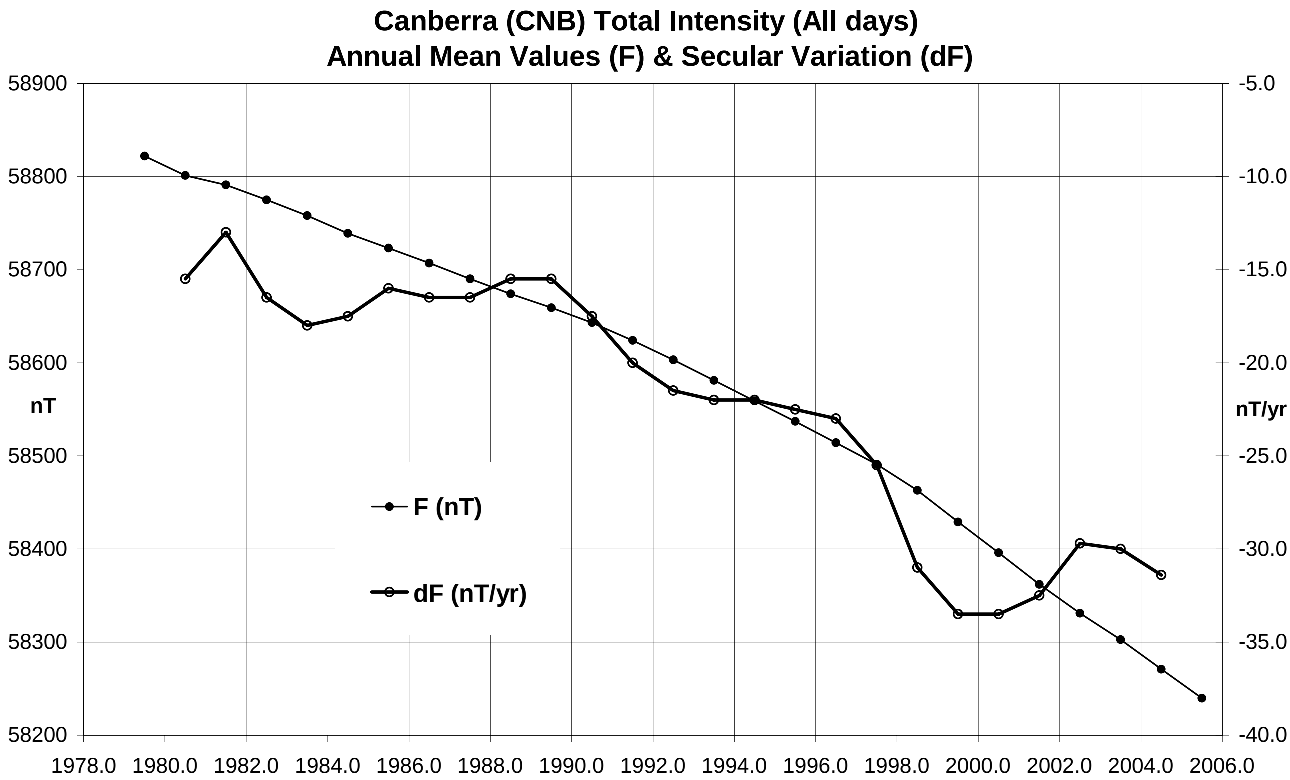


Canberra 2005 Total intensity (F). Scale: 4.0 nT/mm. Mean: 58240 nT


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


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


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


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

Canberra Annual Mean Values (cont.)

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1992.5	Q	12	32.5	-66	12.1	23649	23085	5135	-53622	58605	DFI
1993.5	Q	12	33.0	-66	11.1	23655	23090	5140	-53594	58583	DFI
1994.5	Q	12	33.6	-66	10.2	23661	23095	5145	-53568	58561	DFI
1995.5	Q	12	33.9	-66	08.7	23675	23108	5150	-53537	58538	DFI
1996.5	Q	12	34.2	-66	07.2	23689	23108	5155	-53506	58515	ABC
1997.5	Q	12	34.2	-66	05.6	23703	23135	5159	-53474	58492	ABC
1998.5	Q	12	34.3	-66	04.8	23706	23137	5159	-53443	58464	ABC
1999.5	Q	12	34.1	-66	03.2	23716	23148	5161	-53400	58430	ABC
2000.5	Q	12	34.3	-66	02.2	23718	23149	5162	-53365	58398	ABC
2001.5	Q	12	34.7	-66	00.9	23726	23156	5167	-53324	58364	ABC
2002.5	Q	12	35.1	-65	59.8	23730	23159	5171	-53289	58334	ABC
2003.5	Q	12	35.5	-65	59.5	23723	23152	5172	-53261	58306	ABC
2004.5	Q	12	35.5	-65	58.3	23728	23157	5173	-53223	58273	ABC
2005.5	Q	12	35.2	-65	57.4	23729	23159	5171	-53188	58242	ABC
1979.5	D	12	5.6	-66	6.9	23816	23287	4990	-53782	58819	DFI
1980.5	D	12	8.4	-66	7.8	23792	23260	5004	-53770	58798	DFI
1981.5	D	12	11.1	-66	10.3	23750	23215	5013	-53776	58787	DFI
1982.5	D	12	13.7	-66	12.4	23710	23172	5022	-53773	58769	DFI
1983.5	D	12	16.6	-66	12.3	23706	23163	5040	-53760	58754	DFI
1984.5	D	12	18.4	-66	12.7	23691	23146	5049	-53745	58735	DFI
1985.5	D	12	20.5	-66	12.4	23690	23142	5064	-53729	58719	DFI
1986.5	D	12	23.3	-66	12.9	23675	23123	5079	-53717	58703	DFI
1987.5	D	12	25.5	-66	12.6	23674	23120	5094	-53701	58688	DFI
1988.5	D	12	27.5	-66	13.8	23647	23091	5102	-53693	58670	DFI
1989.5	D	12	29.0	-66	15.5	23615	23057	5105	-53690	58654	DFI
1990.5	D	12	30.5	-66	14.8	23619	23059	5116	-53671	58639	DFI
1991.5	D	12	31.6	-66	15.5	23600	23038	5119	-53658	58618	DFI
1992.5	D	12	32.3	-66	14.1	23615	23052	5127	-53630	58600	DFI
1993.5	D	12	33.0	-66	12.7	23628	23064	5134	-53601	58578	DFI
1994.5	D	12	33.4	-66	11.8	23633	23068	5138	-53574	58555	DFI
1995.5	D	12	33.8	-66	10.0	23652	23086	5145	-53542	58533	DFI
1996.5	D	12	34.2	-66	7.9	23676	23108	5152	-53508	58512	ABC
1997.5	D	12	34.1	-66	6.9	23683	23115	5154	-53479	58488	ABC
1998.5	D	12	34.2	-66	6.4	23678	23110	5153	-53450	58459	ABC
1999.5	D	12	34.1	-66	4.6	23692	23124	5156	-53407	58427	ABC
2000.5	D	12	34.2	-66	4.2	23685	23117	5155	-53372	58392	ABC
2001.5	D	12	34.6	-66	2.7	23695	23126	5159	-53331	58358	ABC
2002.5	D	12	35.2	-66	1.6	23700	23130	5165	-53296	58328	ABC
2003.5	D	12	35.4	-66	1.5	23688	23118	5163	-53266	58295	ABC
2004.5	D	12	35.3	-65	59.8	23702	23132	5166	-53229	58267	ABC
2005.5	D	12	35.1	-65	58.9	23704	23135	5165	-53194	58236	ABC

* Elements ABC indicates non-aligned variometer orientation

MACQUARIE ISLAND

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

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

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

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

Key data for Macquarie Island Observatory:

- 3-character IAGA code: MCQ
- Commenced operation: 1952
- Geographic latitude: 54° 30' S
- Geographic longitude: 158°57' E
- Geomagnetic†: Lat. -59.87°; Long. 244.15°
- Lower limit for K index of 9: 1500 nT
- Principal pier identification: Pier AE
- Elevation of top of Pier AE: 8 metres AMSL

† Based on the IGRF 2005.0 model updated to 2005.5

Key data (cont.)

- Azimuth of principal reference (Pillar NMI from Pier AE): 353° 44' 13"
- Distance to Pillar NMI: ~200 metres
- Observers in Charge: S. Redfern (2004/05)
B. Copley (2005/06)

Variometers

A Narod 3-axis ringcore fluxgate (RCF) magnetometer (no. 9305-1) was the primary variometer at MCQ throughout 2005. 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 on the SE pillar 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.

A DMI FGE suspended 3-axis fluxgate magnetometer (serial nos. E290/S250) digitised using an ADAM4017 (installed in the VARIOMETER HOUSE on 19 August 2004) was used as a secondary magnetometer throughout 2005. The sensors were located on the NE pillar in the sensor room and the electronics in an insulated box on the floor. Two of the sensors were aligned horizontally in the magnetic north-west and magnetic north-east directions, with the third component aligned vertically.

Until 01 June in 2005 the primary total intensity variometer was an Elsec 820M3 PPM (no. 140), after which a GEM GSM90 PPM (serial no. 4081418 with sensor 42176) was used. The Elsec PPM was retained as a secondary instrument. The Elsec 820M3 sensor and electronics were situated in the PPM HOUSE (that had no temperature control), while the GEM GSM90 sensor and electronics were located in the sensor room of the VARIOMETER HOUSE.

The data acquisition system and backup power were situated in the geomagnetism office in the Science building until 01 June 2005, after which the Unix-based data acquisition system with real-time telemetry, installed in the ante-room of the variometer house during August 2004, was brought into service.

The new system comprised a wireless TCP/IP network link connecting the VARIOMETER HOUSE to the local area network. In the ante-room of the VARIOMETER HOUSE an industrial PC on the LAN and running the QNX6.1 operating system acquired and logged data from both the DMI and the Narod 3-component variometers. A GPS clock on the VARIOMETER HOUSE provided accurate timing for the QNX data logging system.

Absolute Instruments and Corrections

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

In addition to the primary absolute instruments a Danish Meteorological Institute FGE Declination and Inclination magnetometer (no. DI0045) on a Zeiss 020B theodolite (no. 393911) and the Austral PPM (no. 525) were available as back-up instruments. They were used approximately once per month.

The classical QHMs (serial 178, 179 with Askania circle 640616) were available as backup for use on pier AE (although the observer had not been trained in their use).

The pier difference, adopted from absolute observations performed in 1991 and 1993 and confirmed by observations performed in 2003, of:

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

was applied to adjust observations performed on pier AW to be equivalent to observations on the principal Pier AE.

Comparisons between the Macquarie Island primary absolute instrument DIM E810_214/311847 and the travelling reference instrument DIM B0806H/100856 were performed at Macquarie Island on 24 and 26 Mar 2003. (Details of these comparisons were given in the *AGR2004*.) The MCQ absolute total field instrument GSM90_3091319/01504 was compared to the Australian Reference at Canberra Observatory on 02 Dec 2003, and to travelling reference GSM90_5091720/52453 at Macquarie Island in 04 April 2006.

This series of instrument comparisons yielded the following instrument differences to the international reference as defined by observations at IAGA Instrument Workshops using the Australian Reference instruments:

International standard		MCQ instrument		Inst. Difference
International Standard	=	E810_214/311847	+	0.1' (D)
International Standard	=	E810_214/311847	-	0.1' (I)
International Standard	=	GSM90_3091319	+	0.0nT (F)

At the approximate mean 2005 field values at MCQ of 10820nT, 6470nT and -63100nT in X, Y and Z respectively, the instrument corrections adopted for the absolute magnetometers used at MCQ during that year convert to the baseline corrections:

$$\Delta X = -1.8 \text{ nT} \qquad \Delta Y = -0.6 \text{ nT} \qquad \Delta Z = -0.4 \text{ nT}.$$

These corrections have been applied to all MCQ 2005 final data.

Baselines

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

$$\sigma_X = 1.2 \text{ nT} \qquad \sigma_Y = 1.4 \text{ nT} \qquad \sigma_Z = 0.7 \text{ nT}.$$

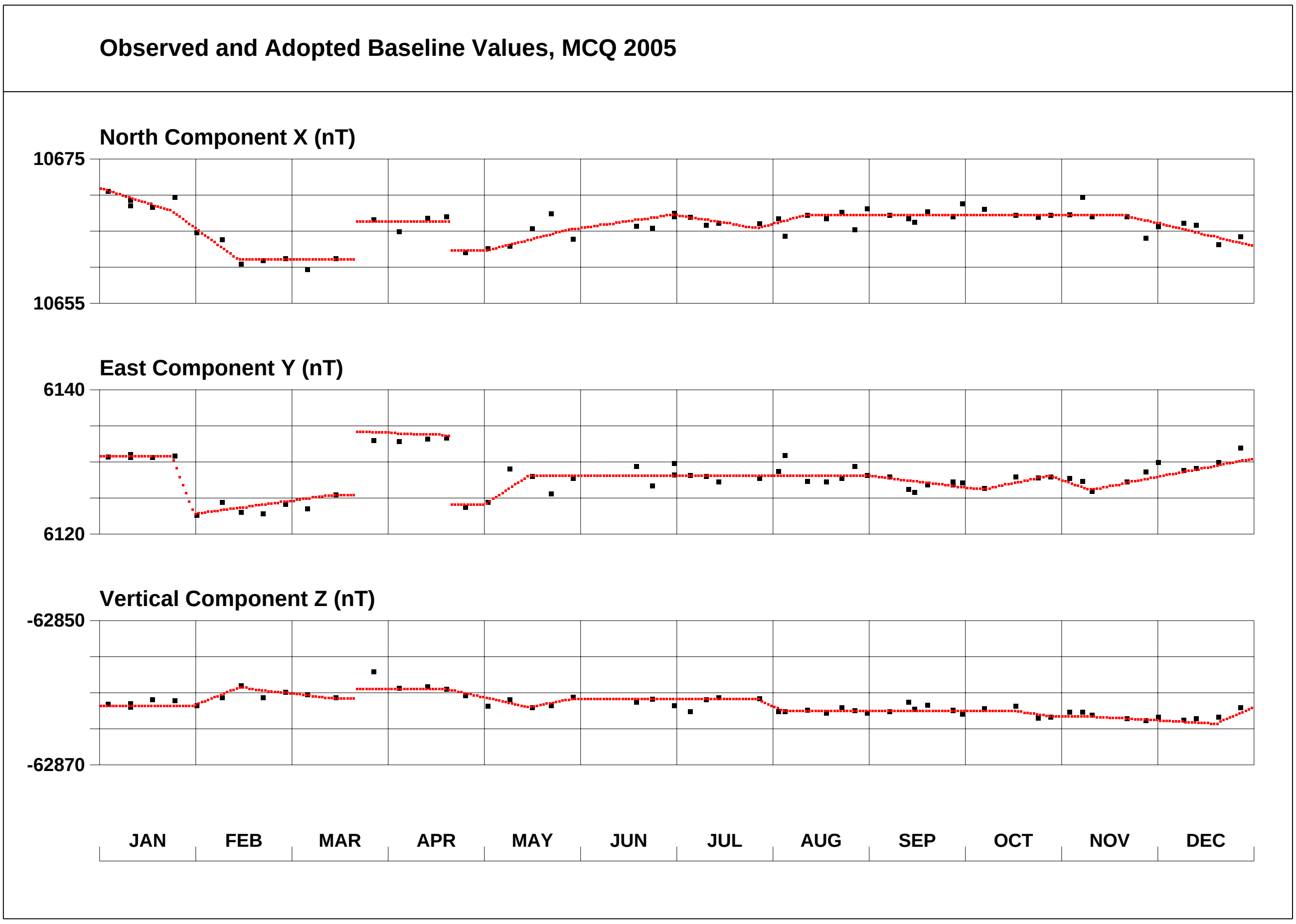
(In terms of the absolute observed components, they were:

$$\sigma_F = 1.1 \text{ nT} \qquad \sigma_D = 25'' \qquad \sigma_I = 04''.)$$

The drifts applied to the X, Y, and Z baselines amounted to less than 10nT in any of these components throughout the 2005, with the X and Y components showing the most drift. There were two sudden jumps in the baselines throughout 2005, the largest being 10 nT in the Y baseline on 21 April 2005.

Throughout 2005 there was about 3nT of variation in the difference between F measured with the vector variometer (RCF – final data model with drifts applied) and the variometer PPM.

Observed and adopted baseline values in X, Y and Z for 2005 are shown in the following (INTERMAGNET format) chart.



Operations

The magnetic observers-in-charge at Macquarie Island in 2005 were supported jointly by the Australian Antarctic Division (AAD) in the Department of The Environment and Heritage and GA. They were members of the Australian National Antarctic Research Expedition (ANARE).

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

During 2005, weekly absolute calibrations were performed on the observation piers in the ABSOLUTE HOUSE by the ANARE communications technical officers: the 2004/05 officer (SR) (from 08 March 2004) until 27 March 2005; and the 2005/06 officer (BC) from 28 March 2005 (until 06 April 2006).

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. Until 01 June in 2005 all data were automatically transmitted daily, via a network connection routed through the AAD in Hobart Tasmania, to GA where they were processed and distributed. Timing control at the observatory was provided by the AAD's GPS clock (that was also used with Atmospheric and Space Physics experiments). From 02 June 2005 the data were transmitted every 10 minutes via the network connection. Acquisition timing control was provided by a dedicated Garmin GPS clock mounted on the variometer building.

After 02 June 2005 the existing DOS acquisition system continued unaltered to log the Narod RCF data and E820 PPM data, but the primary source of data was a Unix Gdap system logging the primary Narod RCF and GSM90 and the secondary DMI fluxgate and Elsec 820M3 PPM.

Significant Events in 2005

12 Jan	0042: Time set on DOS system and some old (zip) data files deleted on QNX system.
14 Jan	No contact with MCQ caused by problems with satellite.
19 Jan	Switch to different satellite restored communications.
25 Jan	17:00 AEDT: Communications outage for an hour.
02 Feb	0030: An AAD building inspection resulted in contamination to data by a vehicle.
14 Feb	Power house maintenance caused loss of power. Data loss on all systems: 0417-2224.
15 Feb	0119: DOS time (about 2 seconds slow) was set.
17 Feb	UPS testing with multiple system reboots.
28 Mar	Changeover from 2004/05 observer (SR) to 2005/06 observer (BC).
29 Mar	Resupply voyage departs Macquarie Island.
20 Apr	~2100 and 2215: Power outages caused by Power House problems.
26 Apr	Observer off station until 02 May.
08 May	0320: GDap DMI recording stopped for unknown reasons. (The Gdap NGL still O.K).
10 May	0045: The GDap QNX6.1 was replaced by a new QNX6.3 machine. System was 4 minutes slow for first (approx) 30mins until the GPS clock was swapped to communications port /dev/ser2. Time correction of 229 seconds made at 0128. Real-time downloads of Narod data to rawhdata/mq1 directory started. Real-time downloads of DMI data to rawdata/mq2 directory started. Restarted system at 0148, and duplicated DMI to both /mag /mag2 as mcq and mq2 respectively, but only mq2 version to be downloaded. Changed DMI logging from 5V to 10V at about 0205. Askania circle removed from ABSOLUTE HUT after observations

Significant Events (cont.)

16 May GSM90 PPM installed in VARIOMETER HOUSE. Readings were bad with sensor placed on floor between NE and NW pillar. Swapped sensor cable end-for-end to ensure "MAG" is at the electronics end; moved sensor to NW pillar: good readings acquired from 05:09:30. Barcode and O-ring also installed.

02 Jun Satellite communications down for most of the day due to cable problems in Victoria.
Swapped QNX NGL/GSM90 to be primary system at 0000. Commenced real-time (every 5 minutes) downloads. Although DOS system (NGL/E820) continued running, its data were no longer retrieved automatically. QNX DMI/GSM90 running as mq2 secondary system and retrieved as 5 minutely downloads. Data from DMI system was noisy and absolutes did not track it well. QNX still recording two instances of NGL (mcq and mq1) and one of DMI (mq2).
First observation with backup DIM 393911/DI0045.

09 Jun RCF and DMI variometers started to become noisy although GSM90 remained O.K.

11 Jun Sudden jumps and increased noise in RCF data.

14 Jun ~06:45:40: Remote reboot of RCF only via DOS system, but no reduction of noise.

17 Jun Testing for mutual interference in VARIOMETER HOUSE.
00:54:01 Baseline jumps in Y and Z channels.

17 Aug Network outage due to virus problems at AAD.

18 Aug QNX4 timing was reset. No data had been transferred between DOS and QNX4 since 02 August (day 214). Manually retrieved data for 16-17 August (days 228 and 229). DOS system O.K.

01 Sep 2320: Turned on real-time delivery of MCQ data to Edinburgh INTERMAGNET GIN.

21 Oct Loaded GdapCAL onto MCQ system; checked system time and disk space; checked and set QNX4 time at 00:25 (it was 7 minutes fast); checked DOS MACQ time and disk-space.

07 Nov ~0250 (just before absolute observations): DMI suspension was wound down to experiment with data quality problems. No improvement resulted.

07 Dec 2259: QNX4.2 time set and old data files deleted from QNX and DOS systems. QNX6.3 system checked.

Data losses in 2005

02 Feb 0029-0114 (46m.) All channels: Contaminated data not processed.

14 Feb 0418-2224 (18h 07m) All channels: Power failure.

15 Feb 2218-2221 (4m) All channels;
2233 (1m) F-channel only.

16 Feb 0624-0625 (2m) All channels.

17 Feb 0627-0629 (3m), 0644 (1m) All channels: System reboots.

18 Feb 0306 (1m), 0308-0310 (3m) All channels.

21 Feb 0346 (1m), 0352-0355 (4m), 0435 (1m) All channels.

22 Mar 2248-2255 (8m) All channels: Noisy data not processed.

16 Apr 2330 (1m) F-channel only: PPM spike removed.

21 Apr 0826-2145 (3h 20m) X,Y,Z channels: Power failure.
1826-2156 (3h 31m), 2159 (1m), 2202 (1m) F-channel only

09 May 0540 (1m) F-channel only: PPM spike removed.

11 Jun 0155 to 17/0125 (5d 23h 29m) All channels: RCF failure

17 Jun 1826-2156 (3h 31m), 2159 (1m), 2202 (1m) X,Y,Z channels.
0053-0054 (2m), 0058-0103 (6m), 0120-0122 (3m) F-channel only.

07 Nov 0235--0250 (16m) All channels: Contaminated data not processed.

Distribution of MCQ data

Preliminary Monthly Means for Project Ørsted

- Sent monthly by email to IPGP

1-minute Values (IM binary format files) to WDCs

- 2005 data: WDC-A, Boulder, USA (sent 06 Nov. 2006)

1-minute Values for Project INTERMAGNET

- Preliminary data to the Edinburgh IM GIN by e-mail: daily until 01June 2005, then in real-time after that date.
- 2005 Definitive data to the Paris IM GIN on 31 Aug. 2006

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 87 & 88.

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1993.5	A	29	57.2	-78	48.1	12558	10880	6270	-63428	64659	ABC
1994.5	A	30	02.2	-78	48.3	12549	10863	6281	-63404	64634	ABC
1995.5	A	30	06.6	-78	47.5	12559	10864	6300	-63376	64608	ABC
1996.5	A	30	11.0	-78	46.4	12574	10870	6322	-63353	64589	ABC
1997.5	A	30	15.4	-78	45.9	12580	10866	6339	-63336	64573	ABC
1998.5	A	30	20.0	-78	45.8	12579	10857	6353	-63320	64557	ABC
1999.5	A	30	23.6	-78	45.2	12586	10856	6367	-63294	64534	ABC
2000.5	A	30	28.4	-78	45.0	12585	10847	6382	-63268	64507	ABC
2001.5	A	30	33.5	-78	44.1	12595	10846	6404	-63231	64473	ABC
2002.5	A	30	39.1	-78	43.5	12600	10840	6424	-63198	64442	ABC
2003.5	A	30	44.6	-78	44.0	12585	10817	6433	-63174	64416	ABC
2004.5	A	30	49.0	-78	42.7	12602	10823	6456	-63134	64380	ABC
2005.5	A	30	53.3	-78	42.1	12607	10819	6472	-63104	64352	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

continued on page 89 …

Monthly and Annual Mean Values

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

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

Macquarie Island	2005	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	10809.5	6457.4	-63116.9	64360.8	12591.5	30° 51.3'	-78° 43.1'
	5xQ days	10834.1	6471.6	-63120.7	64369.9	12619.9	30° 51.1'	-78° 41.6'
	5xD days	10770.7	6437.6	-63123.4	64359.0	12548.3	30° 52.1'	-78° 45.4'
February	All days	10820.5	6464.8	-63116.3	64362.6	12604.7	30° 51.4'	-78° 42.4'
	5xQ days	10837.2	6474.0	-63116.5	64366.5	12623.7	30° 51.2'	-78° 41.4'
	5xD days	10785.4	6446.6	-63125.1	64363.7	12565.3	30° 52.2'	-78° 44.5'
March	All days	10820.4	6470.3	-63111.3	64358.3	12607.4	30° 52.7'	-78° 42.2'
	5xQ days	10833.1	6474.9	-63111.8	64361.4	12620.7	30° 52.0'	-78° 41.5'
	5xD days	10793.7	6455.6	-63116.9	64358.0	12577.0	30° 53.1'	-78° 43.8'
April	All days	10819.8	6472.1	-63104.2	64351.3	12607.8	30° 53.2'	-78° 42.1'
	5xQ days	10833.1	6476.5	-63107.6	64357.4	12621.5	30° 52.4'	-78° 41.4'
	5xD days	10782.2	6460.4	-63092.1	64332.1	12569.7	30° 55.8'	-78° 44.0'
May	All days	10804.5	6466.5	-63114.7	64358.7	12591.9	30° 54.1'	-78° 43.0'
	5xQ days	10833.4	6477.6	-63115.1	64364.9	12622.3	30° 52.6'	-78° 41.4'
	5xD days	10695.7	6428.2	-63108.4	64330.9	12479.2	31° 00.6'	-78° 48.9'
June	All days	10828.2	6477.3	-63114.1	64363.0	12617.6	30° 53.2'	-78° 41.7'
	5xQ days	10836.5	6478.5	-63111.3	64361.7	12625.4	30° 52.4'	-78° 41.2'
	5xD days	10804.3	6480.3	-63098.0	64343.6	12598.8	30° 57.3'	-78° 42.5'
July	All days	10825.2	6475.5	-63099.3	64347.8	12614.2	30° 53.2'	-78° 41.7'
	5xQ days	10834.9	6480.4	-63098.4	64349.0	12625.0	30° 53.0'	-78° 41.1'
	5xD days	10803.2	6459.1	-63085.3	64328.9	12587.0	30° 52.5'	-78° 43.0'
August	All days	10817.0	6473.7	-63102.7	64349.6	12606.3	30° 54.0'	-78° 42.2'
	5xQ days	10830.0	6481.0	-63103.3	64353.1	12621.0	30° 53.9'	-78° 41.4'
	5xD days	10763.7	6450.9	-63099.3	64335.4	12548.9	30° 56.1'	-78° 45.1'
September	All days	10798.7	6468.5	-63108.0	64351.4	12587.9	30° 55.4'	-78° 43.2'
	5xQ days	10828.5	6479.4	-63111.1	64360.3	12619.0	30° 53.7'	-78° 41.6'
	5xD days	10732.8	6447.1	-63116.9	64347.3	12520.7	30° 59.9'	-78° 46.8'
October	All days	10825.1	6477.8	-63093.9	64342.7	12615.3	30° 53.8'	-78° 41.6'
	5xQ days	10835.6	6482.8	-63096.1	64347.1	12626.8	30° 53.5'	-78° 41.0'
	5xD days	10799.0	6465.8	-63086.7	64330.2	12586.8	30° 54.7'	-78° 43.0'
November	All days	10828.2	6478.0	-63093.7	64343.1	12618.1	30° 53.4'	-78° 41.4'
	5xQ days	10837.9	6484.4	-63096.0	64347.6	12629.6	30° 53.6'	-78° 40.9'
	5xD days	10803.8	6468.0	-63100.9	64345.2	12592.0	30° 54.5'	-78° 42.9'
December	All days	10833.0	6480.6	-63077.9	64328.6	12623.5	30° 53.3'	-78° 41.0'
	5xQ days	10842.3	6485.2	-63082.7	64335.4	12633.8	30° 53.1'	-78° 40.5'
	5xD days	10813.9	6472.6	-63072.6	64319.5	12603.0	30° 54.2'	-78° 42.0'
Annual	All days	10819.2	6471.9	-63104.4	64351.5	12607.2	30° 53.3'	-78° 42.1'
Mean	5xQ days	10834.7	6478.9	-63105.9	64356.2	12624.1	30° 52.7'	-78° 41.3'
Values	5xD days	10779.0	6456.0	-63102.1	64341.1	12564.7	30° 55.2'	-78° 44.3'

(Calculated: 12:25 hrs., Tue., 12 Dec. 2006)

Hourly Mean Values

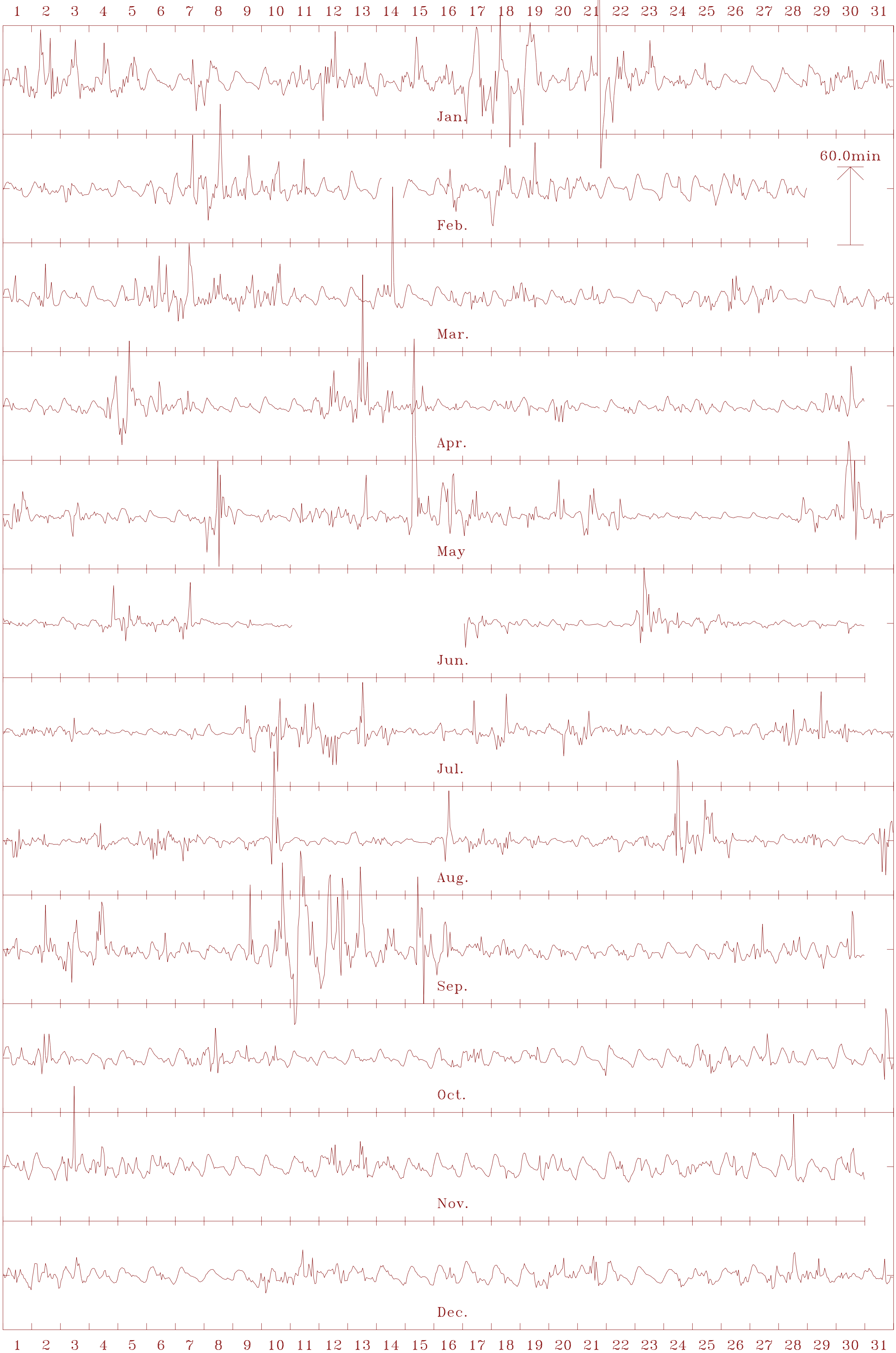
The charts on the following pages are plots of hourly mean values.

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

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

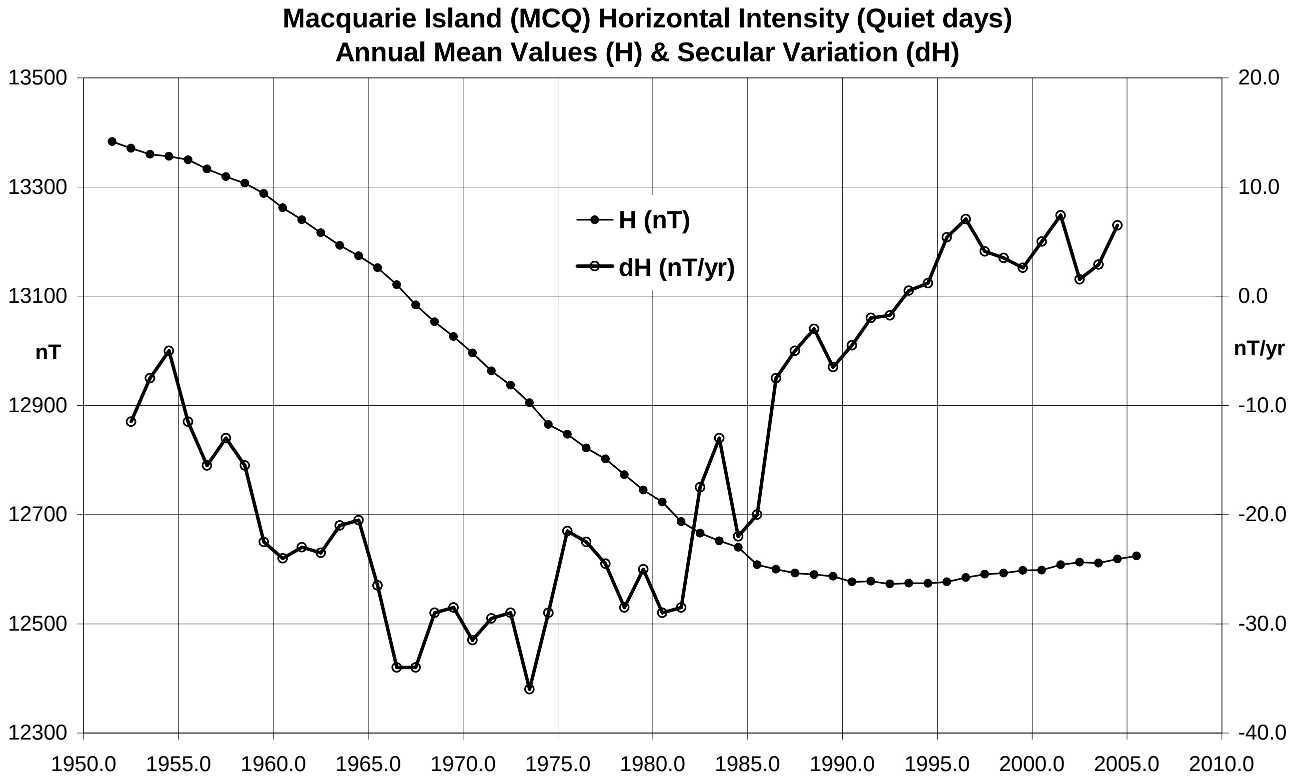
Macquarie Is. 2005 Horizontal intensity (H). Scale: 40.0 nT/mm. Mean: 12607 nT

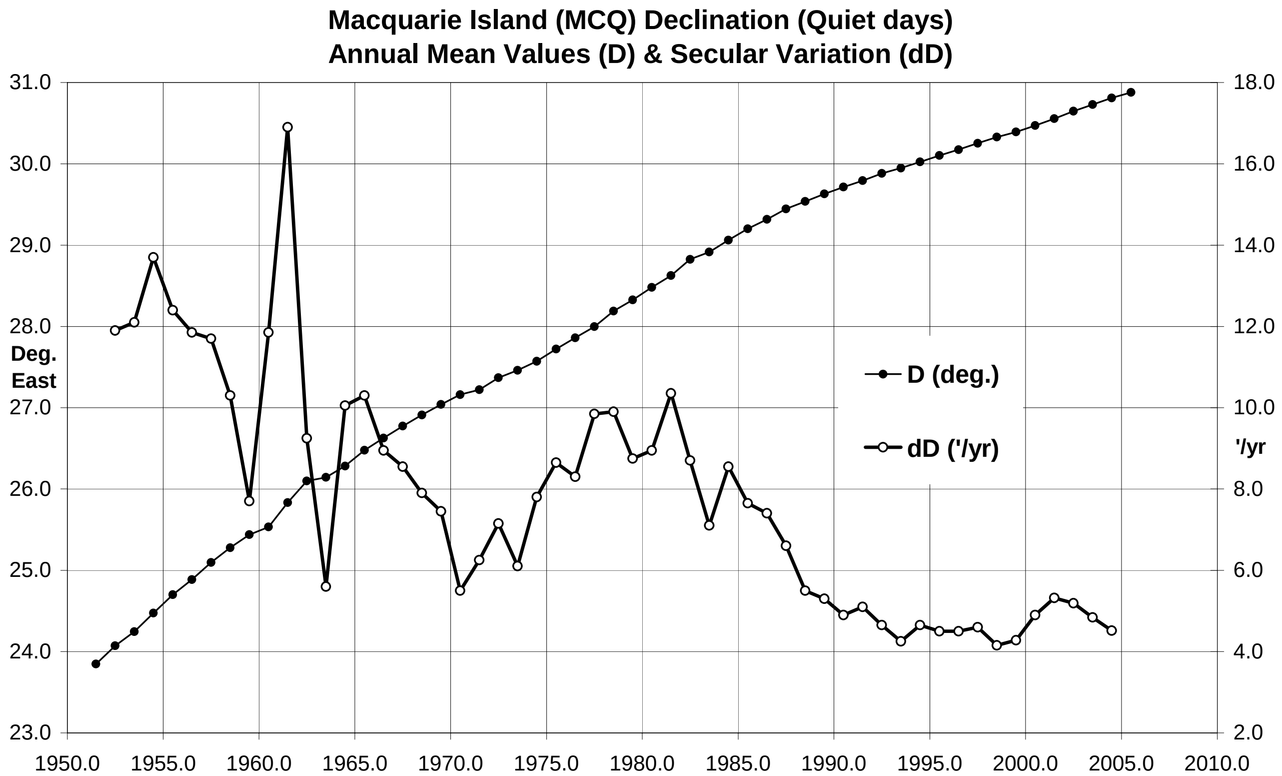
Macquarie Is. 2005 Declination (east) (D). Scale: 4.00 min/mm. Mean: 30.89 deg.

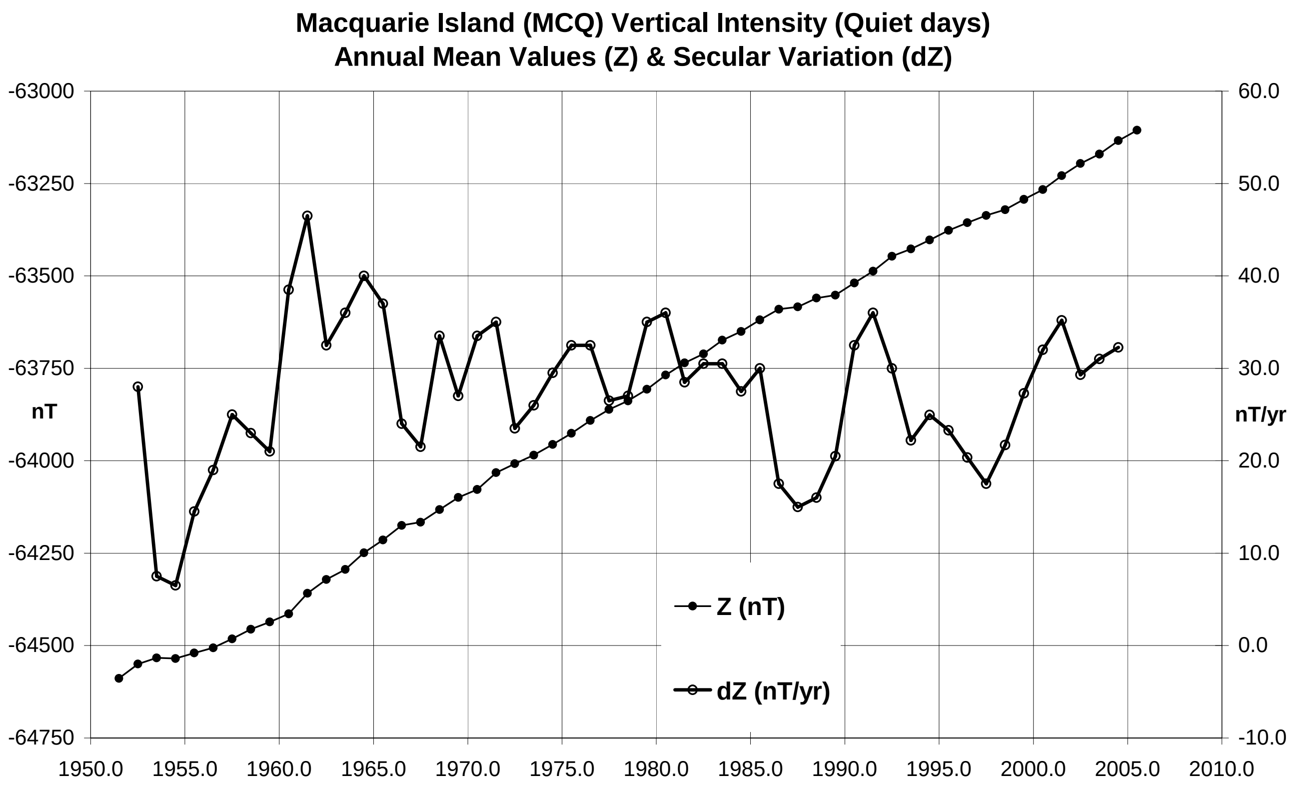


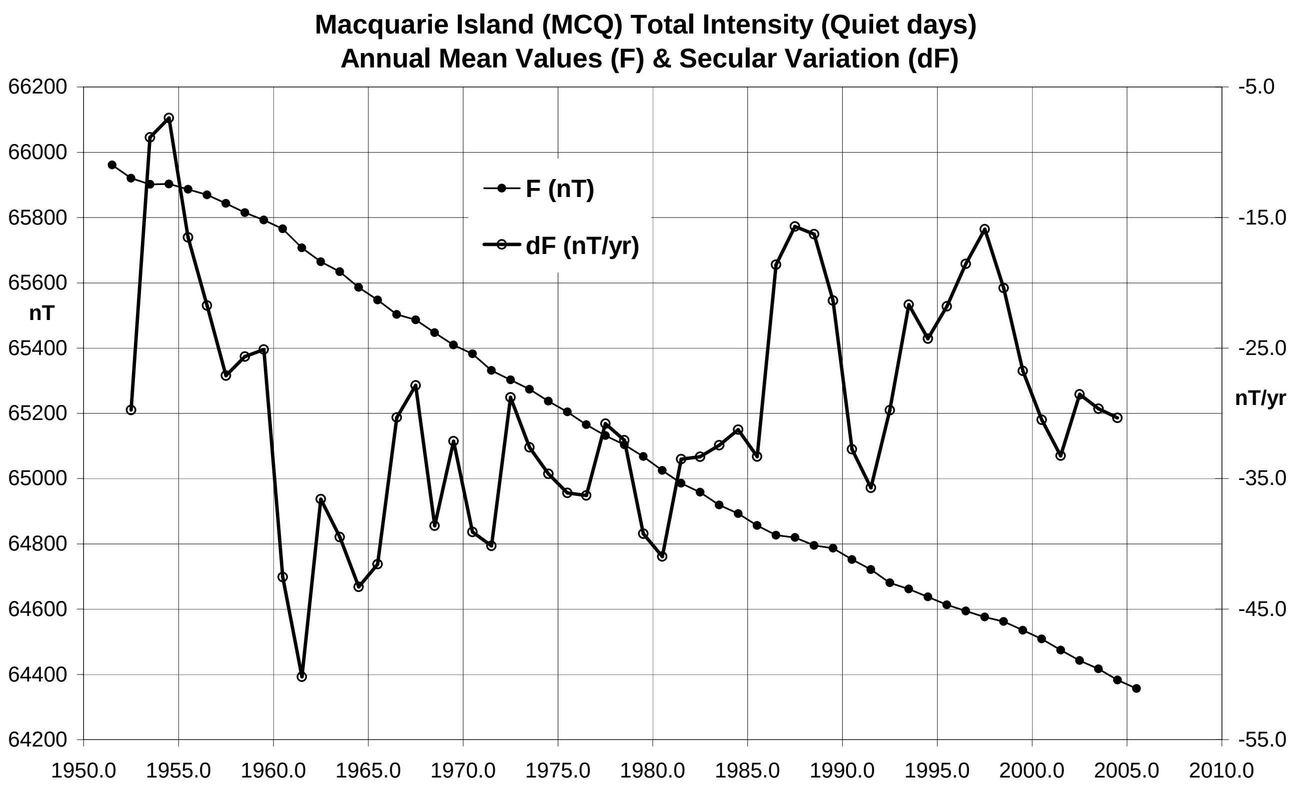
Macquarie Is. 2005 Vertical intensity (Z). Scale: 25.0 nT/mm. Mean: −63104 nT

Macquarie Is. 2005 Total intensity (F). Scale: 25.0 nT/mm. Mean: 64352 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
2010.0


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
2010.0


Macquarie Island (MCQ) Vertical Intensity (Quiet days)
Annual Mean Values (Z) & Secular Variation (dZ)
nT
nT/yr
Z (nT)
dZ (nT/yr)


Macquarie Island (MCQ) Total Intensity (Quiet days)
Annual Mean Values (F) & Secular Variation (dF)
nT
nT/yr
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*
1954.5		24	28.4	-78	18.4	13356	12156	5533	-64535	65903	HDZ
1955.5		24	42.0	-78	18.6	13350	12129	5579	-64520	65887	HDZ
1956.5		24	53.2	-78	19.3	13333	12095	5611	-64506	65870	HDZ
1957.5		25	05.7	-78	19.8	13319	12062	5649	-64482	65843	HDZ
1958.5		25	16.6	-78	20.1	13307	12033	5682	-64456	65815	HDZ
1959.5		25	26.3	-78	20.9	13288	12000	5708	-64436	65792	HDZ
1960.5		25	32.0	-78	22.0	13262	11967	5716	-64414	65765	HDZ
1961.5		25	50.0	-78	22.5	13240	11917	5769	-64359	65707	HDZ
1962.5		26	05.8	-78	23.3	13216	11869	5814	-64321	65665	HDZ
1963.5		26	08.5	-78	24.2	13193	11843	5813	-64294	65634	HDZ
1964.5		26	17.0	-78	24.7	13174	11812	5834	-64249	65586	HDZ
1965.5		26	28.6	-78	25.5	13152	11773	5864	-64214	65547	HDZ
1966.5		26	37.6	-78	26.7	13121	11729	5881	-64175	65503	HDZ
1967.5		26	46.5	-78	28.5	13084	11681	5894	-64166	65486	HDZ
1968.5		26	54.7	-78	29.7	13053	11639	5908	-64132	65447	HDZ
1969.5		27	02.3	-78	30.8	13026	11602	5921	-64099	65409	HDZ
1970.5		27	09.6	-78	32.1	12996	11563	5932	-64078	65383	HDZ
1971.5		27	13.3	-78	33.3	12963	11527	5930	-64032	65331	HDZ
1972.5		27	22.1	-78	34.4	12937	11489	5947	-64008	65302	HDZ
1973.5		27	27.6	-78	35.8	12905	11451	5951	-63985	65273	HDZ
1974.5		27	34.3	-78	37.6	12865	11404	5955	-63956	65237	HDZ
1975.5		27	43.2	-78	38.2	12847	11373	5976	-63926	65204	HDZ
1976.5		27	51.6	-78	39.1	12822	11336	5992	-63891	65165	HDZ
1977.5		27	59.8	-78	39.9	12802	11304	6010	-63861	65132	HDZ
1978.5		28	11.3	-78	41.1	12773	11258	6034	-63838	65103	HDZ
1979.5		28	19.6	-78	42.3	12745	11219	6047	-63807	65067	HDZ
1980.5		28	28.8	-78	43.0	12723	11183	6067	-63768	65025	HDZ
1981.5		28	37.5	-78	44.5	12687	11136	6078	-63735	64985	HDZ
1982.5		28	49.5	-78	45.4	12666	11097	6107	-63711	64958	HDZ
1983.5		28	54.9	-78	45.7	12652	11075	6117	-63674	64919	HDZ
1984.5		29	03.7	-78	46.1	12640	11049	6140	-63650	64893	HDZ
1985.5		29	12.0	-78	47.4	12608	11006	6151	-63619	64856	XYZ
1986.5		29	19.0	-78	47.5	12600	10986	6169	-63590	64826	XYZ
1987.5		29	26.8	-78	47.8	12593	10966	6191	-63584	64819	XYZ
1988.5		29	32.2	-78	47.8	12590	10954	6207	-63560	64795	XYZ
1989.5		29	37.8	-78	47.8	12587	10941	6223	-63552	64786	XYZ
1990.5		29	42.8	-78	48.0	12577	10923	6234	-63519	64752	XYZ
1991.5		29	47.6	-78	47.6	12578	10915	6250	-63487	64721	XYZ
1992.5		29	53.0	-78	47.5	12573	10901	6264	-63447	64681	XYZ
1993.5	Q	29	56.9	-78	47.2	12575	10896	6277	-63427	64661	ABC
1994.5	Q	30	01.5	-78	47.0	12574	10887	6292	-63403	64637	ABC
1995.5	Q	30	06.2	-78	46.5	12577	10881	6308	-63377	64613	ABC
1996.5	Q	30	10.5	-78	45.9	12585	10879	6326	-63356	64594	ABC
1997.5	Q	30	15.2	-78	45.4	12591	10876	6344	-63336	64576	ABC
1998.5	Q	30	19.7	-78	45.1	12593	10870	6359	-63321	64562	ABC
1999.5	Q	30	23.5	-78	44.6	12598	10867	6373	-63293	64535	ABC
2000.5	Q	30	28.3	-78	44.3	12598	10858	6389	-63266	64509	ABC
2001.5	Q	30	33.3	-78	43.4	12608	10857	6409	-63229	64474	ABC
2002.5	Q	30	38.9	-78	42.8	12613	10851	6429	-63196	64442	ABC
2003.5	Q	30	43.7	-78	42.6	12611	10841	6444	-63170	64417	ABC
2004.5	Q	30	48.5	-78	41.8	12619	10838	6463	-63134	64383	ABC
2005.5	Q	30	52.7	-78	41.3	12624	10835	6479	-63106	64356	ABC
1993.5	D	29	58.5	-78	50.0	12521	10846	6256	-63429	64654	ABC
1994.5	D	30	03.3	-78	50.2	12514	10831	6267	-63408	64632	ABC
1995.5	D	30	07.8	-78	49.4	12522	10830	6285	-63376	64601	ABC
1996.5	D	30	11.9	-78	47.4	12556	10852	6316	-63350	64583	ABC
1997.5	D	30	16.0	-78	47.3	12555	10843	6328	-63334	64566	ABC
1998.5	D	30	21.0	-78	47.7	12543	10824	6338	-63320	64550	ABC
1999.5	D	30	24.3	-78	46.4	12564	10836	6358	-63297	64532	ABC
2000.5	D	30	29.0	-78	46.7	12554	10819	6368	-63273	64507	ABC
2001.5	D	30	34.6	-78	46.0	12560	10813	6389	-63238	64473	ABC
2002.5	D	30	40.0	-78	44.8	12574	10816	6413	-63198	64437	ABC
2003.5	D	30	46.6	-78	46.8	12534	10769	6413	-63186	64418	ABC
2004.5	D	30	50.2	-78	45.0	12559	10783	6437	-63136	64374	ABC
2005.5	D	30	55.2	-78	44.3	12565	10779	6456	-63102	64341	ABC

* Elements ABC indicates non-aligned variometer orientation

CASEY OBSERVATORY

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

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

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

Key data for Casey Observatory:

- 3-character IAGA code: CSY
- Commenced operation: See above
- Geographic latitude: 66° 17' S
- Geographic longitude: 110°32' E
- Geomagnetic† : Lat. -76.36°; Long. 184.01°
- Lower limit for K index of 9: n.a.
- Principal pier identification: Pier A
- Elevation of top of Pier A: 40 metres AMSL
- Azimuth of principal reference (Pillar G11 from Pier A): 307° 41' 02"
- Distance to Pillar G11: 464m
- Observers in Charge: C. Clarke 2004/05
  (both of AAD) T. Taylor 2005/06

† Based on the IGRF 2005.0 model updated to 2005.5

Variometers

An Australian Antarctic Division EDA FM105B fluxgate variometer, with its data acquired by PC, operated at Casey throughout 2005. The fluxgate sensors were housed on the hill about 300m west of the Casey Science building. The sensors were aligned close to true north, true east and vertical. The temperatures were maintained at 20°C. No total intensity variometer operated at Casey during 2005.

There was no scalar (total intensity) variometer operating at Casey in 2005.

Throughout 2005 AAD performed system tests on its ADAS acquisition system daily at UT 0000, 1200 and 1630. This contaminated the variometer data at these times, which has been removed from processing

Absolute Instruments and Corrections

Absolute magnetometers used at Casey in 2005 until 13 January were Elsec 810 DIM no. 2591 with Zeiss 020B theodolite no. 356514 (owned by AAD) and Geometrics 816 PPM no. 766, (owned by GA). From 14 January 2005 the absolute magnetometers DIM DI0051 on Zeiss 020B/313888 and GEM GSM90_4081416 with sensor 42172 were used to calibrate the recording variometers. Note that only the observations from 14 January were used to calibrate the 2005 variometer data.

For consistency with the International Reference as defined by observations at IAGA Instrument Workshops via the Australian Magnetic Reference magnetometers held at Canberra, the following corrections have been applied to the absolute magnetometers used at Casey in 2005:

International standard		CSY instrument	Inst. difference
Various instruments	=	DI0051/313888	- 0.05' (Decl'n)
Various instruments	=	DI0051/313888	- 0.1' (Incl'n)
Various instruments	=	GSM90_4081416	+ 0.0nT (Total)

At the approximate mean 2005 field levels at CSY of -650nT, -9470nT and -63690nT in X, Y and Z respectively, the above instrument corrections adopted for the absolute magnetometers used at CSY during that year converted to the baseline corrections:

$\Delta X = 0.0$ nT $\quad \Delta Y = +1.9$ nT $\quad \Delta Z = -0.3$ nT.

These corrections have been applied to all CSY 2005 final data.

Observed and adopted baseline values in X, Y and Z for 2005 are shown in the following (INTERMAGNET format) chart.

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 (with the PPM height similarly adjusted):

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

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

It is desirable that a new absolute observation house and pier be located on a more suitable site. Planning for a new absolute hut and variometer system was underway throughout 2005.

Operations

The magnetic observers-in-charge at Casey during 2005 was an officer of the Australian Antarctic Division, of the Commonwealth Department of the Environment and Heritage. They were members 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 observers performed approximately weekly absolute observations on the observation pier in the ABSOLUTE HOUSE to calibrate the variometers and provided regular communication on operational matters to GA in Canberra.

The EDA vector variometer produced 1-second samples that were recorded on an AAD computer via their Analogue Data Acquisition System (ADAS). These were sent daily by ftp to GA where they were converted into GA 1-second format from which calibrated data were computed.

Distribution of CSY data

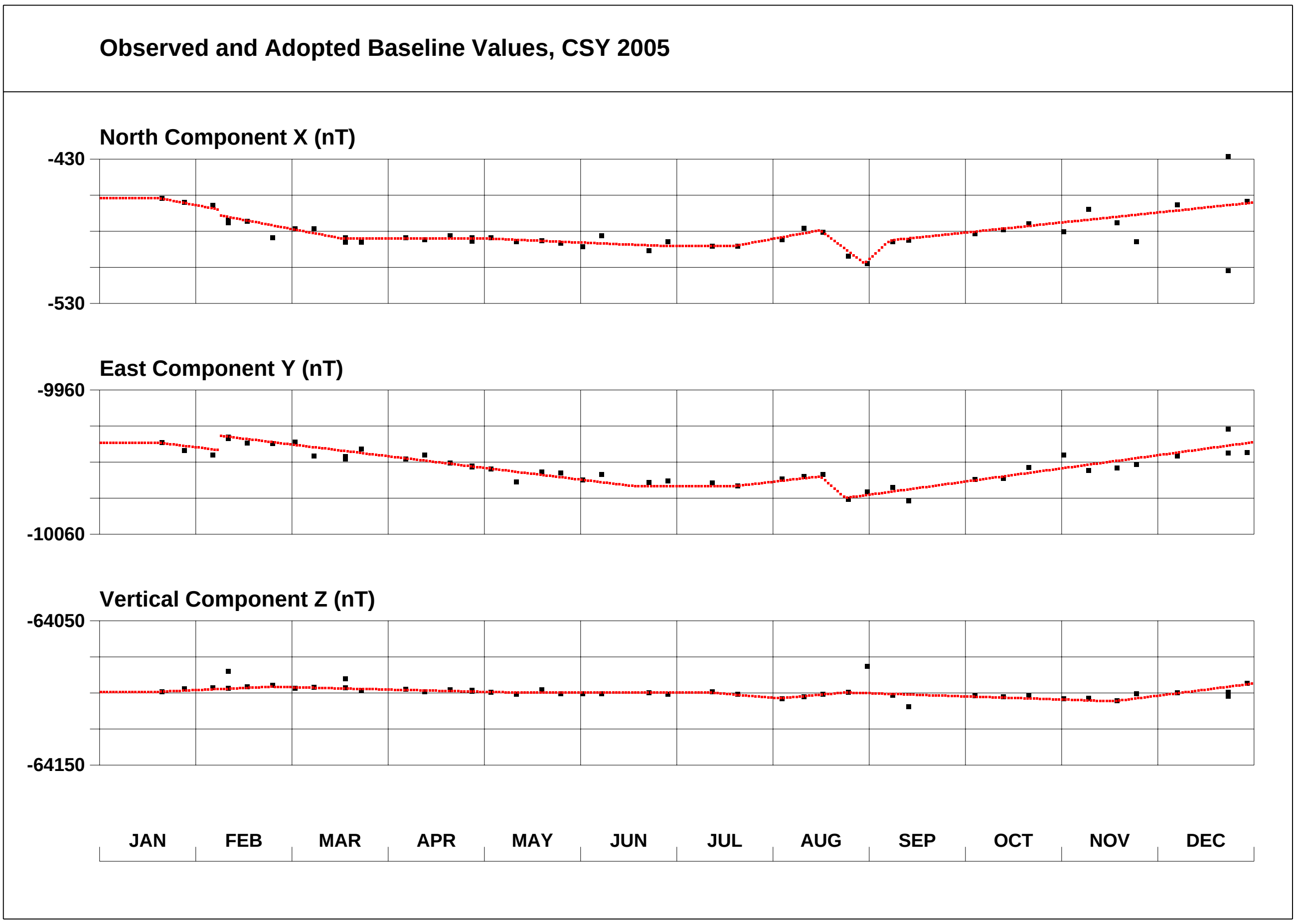
Preliminary Monthly Means for Project Ørsted

- Sent monthly by email to IPGP throughout 2005.

1-minute and Hourly Mean Values to WDCs

- 2005: WDC-A, Boulder, USA (sent 10 Jan. 2007)
- 2005: WDC-C1, Copenhagen, Den. (sent 10 Jan. 2007)

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



Significant Events in 2005

13 Jan	Final observation with DIM E810_2591 with Zeiss356514. This instrument will be returned to Hobart. Absolute instruments brought into service were DI0051/313888 and GSM90_4081416.
20 Jan	First observation with new absolute instruments GSM90_4081416 with sensor 42172 and DI0051/313888.
08 Feb	Data lost 031-0340 with possible baseline jump.
31 Aug	Absolute observation contained errors in first set and the second set had a large residual. The variometer failed during the last set of PPM readings.
Late Sep.	Severe weather at Casey prevented access to absolute hut and so no observations were performed.
Early Oct.	A five day trip to Law Dome by the OIC extended to 8 days due to severe weather: no absolute observations were performed during this period.
16 Dec	The 2006 observer (TT) took over from the 2005 observer (CC).
23 Dec	First observation by 2006 observer.
31 Dec	Data missing. Leap second caused the ADAS acquisition system to fail. Data were recovered by AAD.

Data losses in 2005

One minute intervals of data were contaminated by daily calibration pulses automatically scheduled by AAD to occur at 0000, 1200 and 1630 on all days in 2005. Data at these times each day were removed from the GA 1-second data set. As 1-minute means from Casey were calculated from 1-second data centred on the minute, adequate uncontaminated data remained to provide the 1-minute means during the calibrations.

Data losses in 2005 (cont.)

There was no PPM recording variations in total intensity at Casey during 2005. The periods of data loss that follow refer to EDA fluxgate vector (X,Y,Z) variometer data:

01 Jan	0000-0755 (07h 56m); 0821-0834 (00h 14m); 0855-0856 (00h 02m)
28 Jan	0426-0428 (3m)
08 Feb	0316-0339 (24m); 2230 to 09/0000 (01h 31m)
27 Feb	1741 to 28/0000 (06h 20m)
21 Mar	0053-0054 (2m)
18 Apr	0439-0440 (2m)
15 May	0143-0144 (2m)
20 May	0016-0026 (11m)
20 Jun	2309-2310 (2m)
06 Jul	0210-0211 (2m)
11 Jul	0053-0056 (4m)
17 Jul	2354-2357 (4m)
15 Aug	2337-2338 (2m)
16 Aug	0817-0820 (4m); 0851-0853 (3m); 0914-0917 (4m)
30 Aug	0016-0425 (04h 10m)
31 Aug	0140-0246 (01h 07m), 0354-0359 (6m), 0851-0852 (2m)
01 Sep	0338-0344 (7m)
12 Oct	0216-2212 (19h 57m)
16 Nov	2259-2308 (10m); 2310-2313 (4m)
17 Nov	1305 to 18/0000 (10h 56m)
08 Dec	1513 to 09/0000 (08h 48m)
18 Dec	1058 to 19/0000 (13h 03m)
19 Dec	0216-0221 (6m); 0324-0329 (6m)

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
2003.5	Q	-93	37.5	-81	29.4	9534	-603	-9514	-63713	64422	XYZ
2004.5	Q	-93	46.5	-81	30.5	9510	-626	-9489	-63691	64397	XYZ
2005.5	Q	-93	55.7	-81	31.3	9492	-650	-9469	-63682	64385	XYZ
1998.5	A	-92	55.4	-81	25.7	9615	-490	-9602	-63785	64505	XYZ
1999.5	A	-93	4.8	-81	26.4	9599	-516	-9585	-63772	64490	XYZ
2000.5	A	-93	13.2	-81	27.0	9587	-538	-9571	-63759	64476	XYZ
2001.5	A	-93	21.6	-81	27.9	9566	-561	-9549	-63733	64447	XYZ
2002.5	A	-93	29.4	-81	28.4	9553	-582	-9535	-63719	64432	XYZ
2003.5	A	-93	39.5	-81	29.5	9535	-608	-9515	-63730	64440	XYZ
2004.5	A	-93	47.0	-81	30.4	9512	-628	-9491	-63701	64408	XYZ
2005.5	A	-93	56.5	-81	31.4	9492	-652	-9470	-63694	64397	XYZ
1998.5	D	-92	58.2	-81	25.8	9615	-498	-9601	-63805	64526	XYZ
1999.5	D	-93	10.7	-81	26.6	9599	-532	-9583	-63796	64514	XYZ
2000.5	D	-93	13.6	-81	27.0	9588	-539	-9572	-63771	64487	XYZ
2001.5	D	-93	19.4	-81	27.8	9570	-555	-9553	-63746	64460	XYZ
2002.5	D	-93	37.4	-81	28.8	9549	-603	-9529	-63747	64458	XYZ
2003.5	D	-93	47.4	-81	30.2	9525	-629	-9503	-63764	64472	XYZ
2004.5	D	-93	47.8	-81	30.5	9513	-630	-9491	-63719	64425	XYZ
2005.5	D	-93	57.2	-81	31.5	9494	-654	-9471	-63715	64419	XYZ

Notes and Errata (including Davis Station) (cumulative since *AGR1993*)

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

Monthly and Annual Mean Values

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

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

Casey Station	2005	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	-628.6	-9480.2	-63705.3	64410.2	9502.0	-93° 47.7'	-81° 31.0'
	5xQ days	-621.8	-9482.0	-63680.3	64385.4	9502.4	-93° 45.2'	-81° 30.8'
	5xD days	-658.7	-9467.9	-63755.4	64458.6	9493.1	-93° 59.0'	-81° 31.9'
February	All days	-633.0	-9478.1	-63676.7	64381.4	9499.6	-93° 49.3'	-81° 30.9'
	5xQ days	-639.7	-9474.6	-63683.2	64387.4	9496.5	-93° 51.8'	-81° 31.1'
	5xD days	-593.8	-9497.8	-63655.3	64362.9	9516.8	-93° 34.7'	-81° 29.8'
March	All days	-642.0	-9480.3	-63687.6	64392.6	9502.2	-93° 52.5'	-81° 30.8'
	5xQ days	-637.9	-9476.4	-63679.8	64384.2	9498.0	-93° 51.1'	-81° 31.0'
	5xD days	-631.7	-9501.4	-63701.5	64409.4	9522.8	-93° 48.3'	-81° 29.9'
April	All days	-651.6	-9472.4	-63693.7	64397.5	9494.9	-93° 56.1'	-81° 31.3'
	5xQ days	-658.1	-9465.6	-63685.0	64388.0	9488.4	-93° 58.6'	-81° 31.6'
	5xD days	-652.1	-9475.7	-63713.7	64417.9	9498.3	-93° 56.2'	-81° 31.3'
May	All days	-666.6	-9469.4	-63713.6	64417.0	9493.0	-94° 01.6'	-81° 31.5'
	5xQ days	-655.1	-9469.6	-63691.2	64394.7	9492.2	-93° 57.4'	-81° 31.4'
	5xD days	-692.4	-9460.5	-63755.1	64457.1	9486.5	-94° 11.2'	-81° 32.2'
June	All days	-665.7	-9473.5	-63704.3	64408.3	9496.9	-94° 01.2'	-81° 31.3'
	5xQ days	-657.2	-9475.2	-63689.3	64393.6	9498.0	-93° 58.1'	-81° 31.1'
	5xD days	-676.3	-9469.8	-63734.6	64437.9	9494.2	-94° 05.1'	-81° 31.6'
July	All days	-661.7	-9467.5	-63700.1	64403.2	9490.7	-93° 59.9'	-81° 31.5'
	5xQ days	-652.0	-9472.5	-63681.5	64385.4	9494.9	-93° 56.2'	-81° 31.2'
	5xD days	-673.4	-9456.3	-63726.1	64427.5	9480.4	-94° 04.4'	-81° 32.3'
August	All days	-661.6	-9464.9	-63697.1	64399.9	9488.1	-93° 60.0'	-81° 31.7'
	5xQ days	-656.9	-9465.8	-63687.7	64390.6	9488.6	-93° 58.2'	-81° 31.6'
	5xD days	-673.6	-9455.2	-63734.9	64436.2	9479.8	-94° 04.6'	-81° 32.4'
September	All days	-679.3	-9464.5	-63722.2	64424.9	9489.2	-94° 06.3'	-81° 31.8'
	5xQ days	-672.2	-9465.4	-63702.9	64405.8	9489.4	-94° 03.7'	-81° 31.6'
	5xD days	-689.8	-9472.6	-63759.3	64463.2	9498.6	-94° 10.0'	-81° 31.6'
October	All days	-652.1	-9466.0	-63682.4	64385.5	9488.6	-93° 56.5'	-81° 31.5'
	5xQ days	-651.6	-9467.8	-63676.8	64380.1	9490.3	-93° 56.2'	-81° 31.4'
	5xD days	-660.7	-9457.7	-63684.6	64386.5	9481.1	-93° 59.8'	-81° 31.9'
November	All days	-645.9	-9459.1	-63674.8	64376.9	9481.5	-93° 54.4'	-81° 31.8'
	5xQ days	-655.4	-9459.9	-63670.5	64372.8	9482.7	-93° 57.8'	-81° 31.7'
	5xD days	-614.0	-9475.0	-63673.4	64377.6	9495.3	-93° 42.5'	-81° 31.1'
December	All days	-641.9	-9459.7	-63664.8	64367.1	9481.9	-93° 53.0'	-81° 31.7'
	5xQ days	-644.7	-9458.8	-63656.2	64358.4	9480.9	-93° 54.0'	-81° 31.7'
	5xD days	-633.9	-9463.0	-63687.5	64390.0	9485.0	-93° 50.0'	-81° 31.8'
Annual	All days	-652.5	-9469.6	-63693.6	64397.0	9492.4	-93° 56.5'	-81° 31.4'
Mean	5xQ days	-650.2	-9469.5	-63682.0	64385.5	9491.9	-93° 55.7'	-81° 31.3'
Values	5xD days	-654.2	-9471.1	-63715.1	64418.7	9494.3	-93° 57.2'	-81° 31.5'

(Calculated: 13:19 hrs., Wed., 20 Dec., 2006)

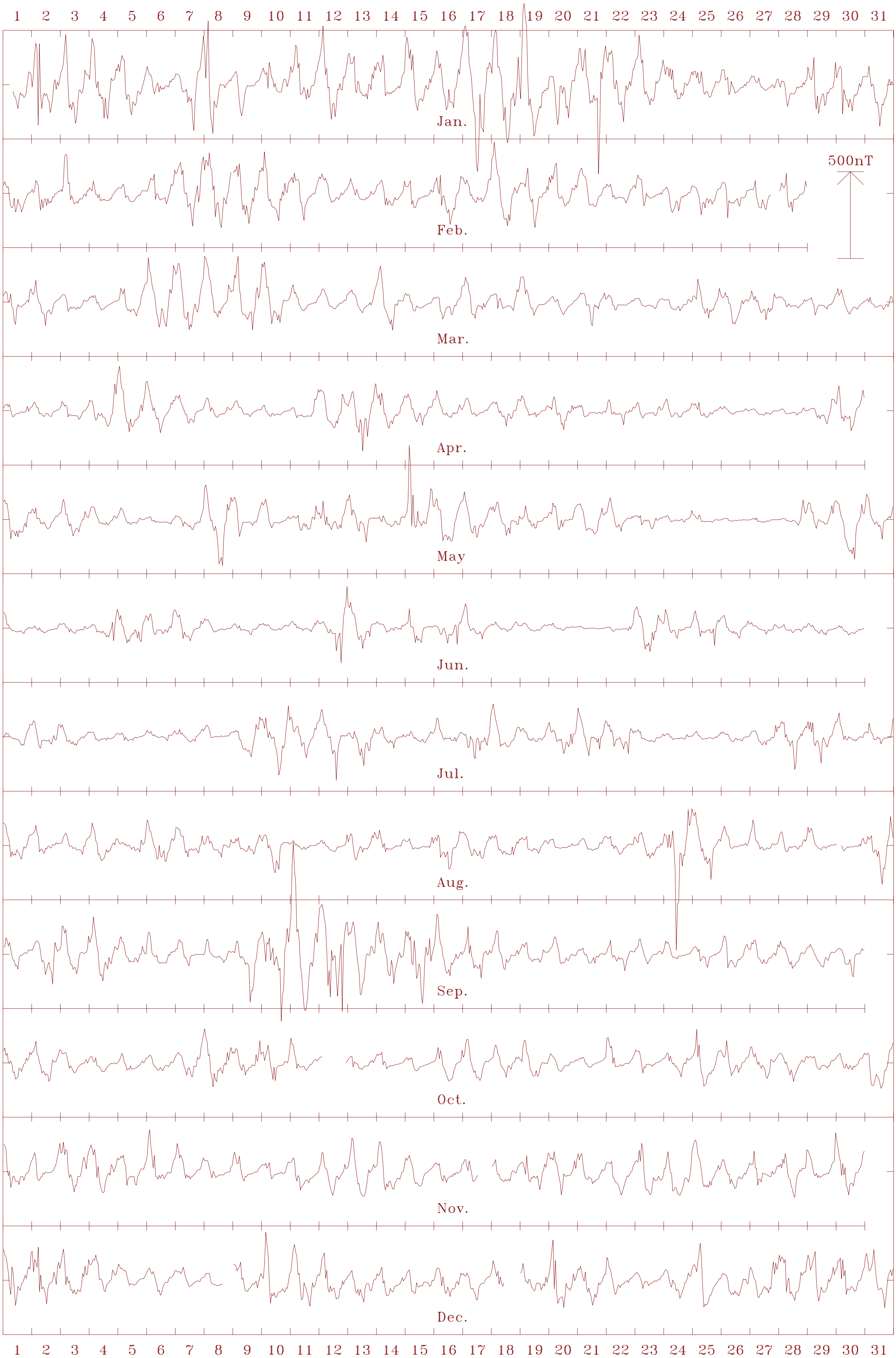
Hourly Mean Values

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

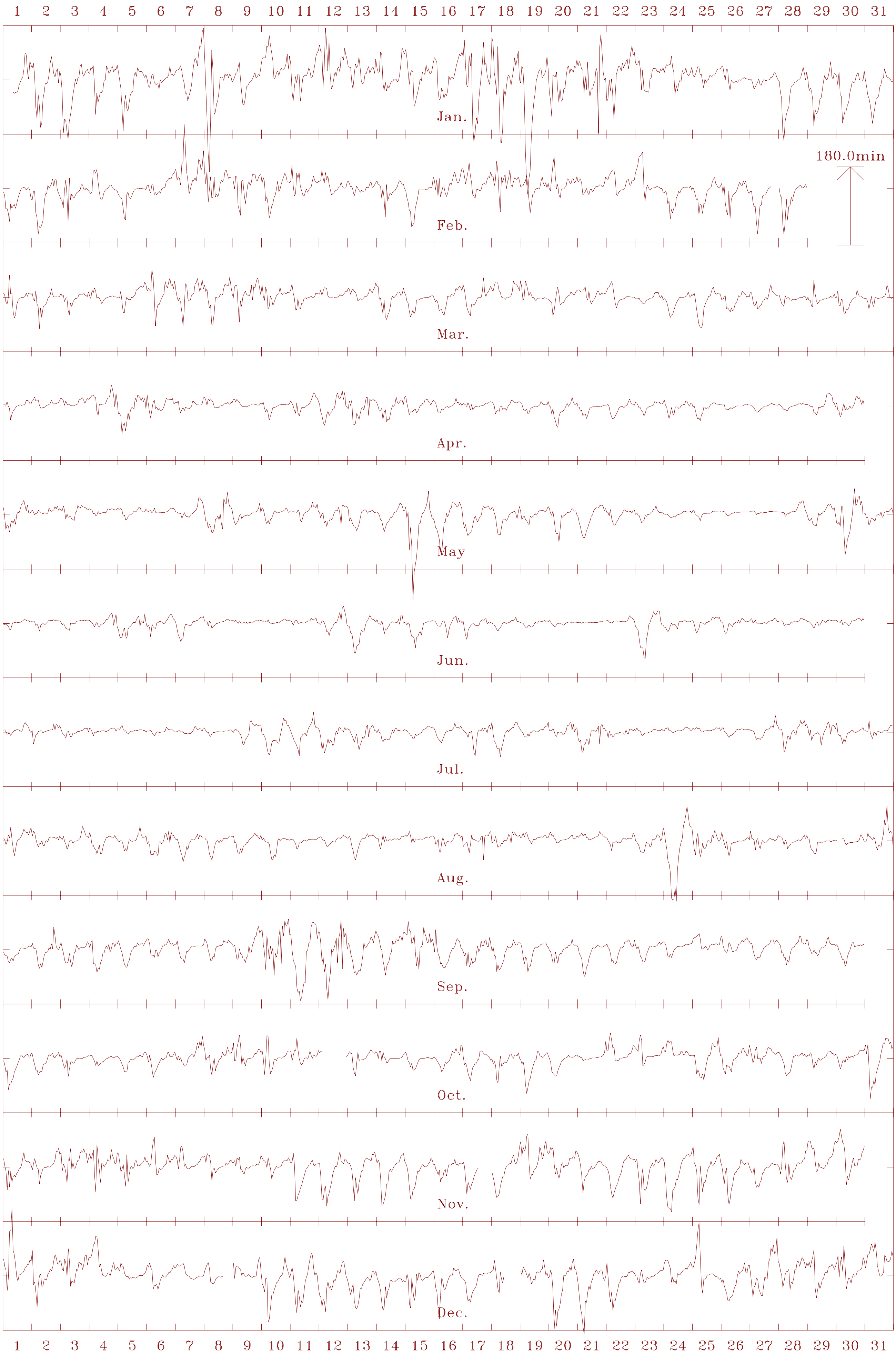
The reference levels indicated with marks on the vertical axes refer to the *all-days* mean value for the respective months. All elements in the plots are shown increasing (algebraically) towards the top of the page, with the exception of Z, which is in the opposite sense.

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

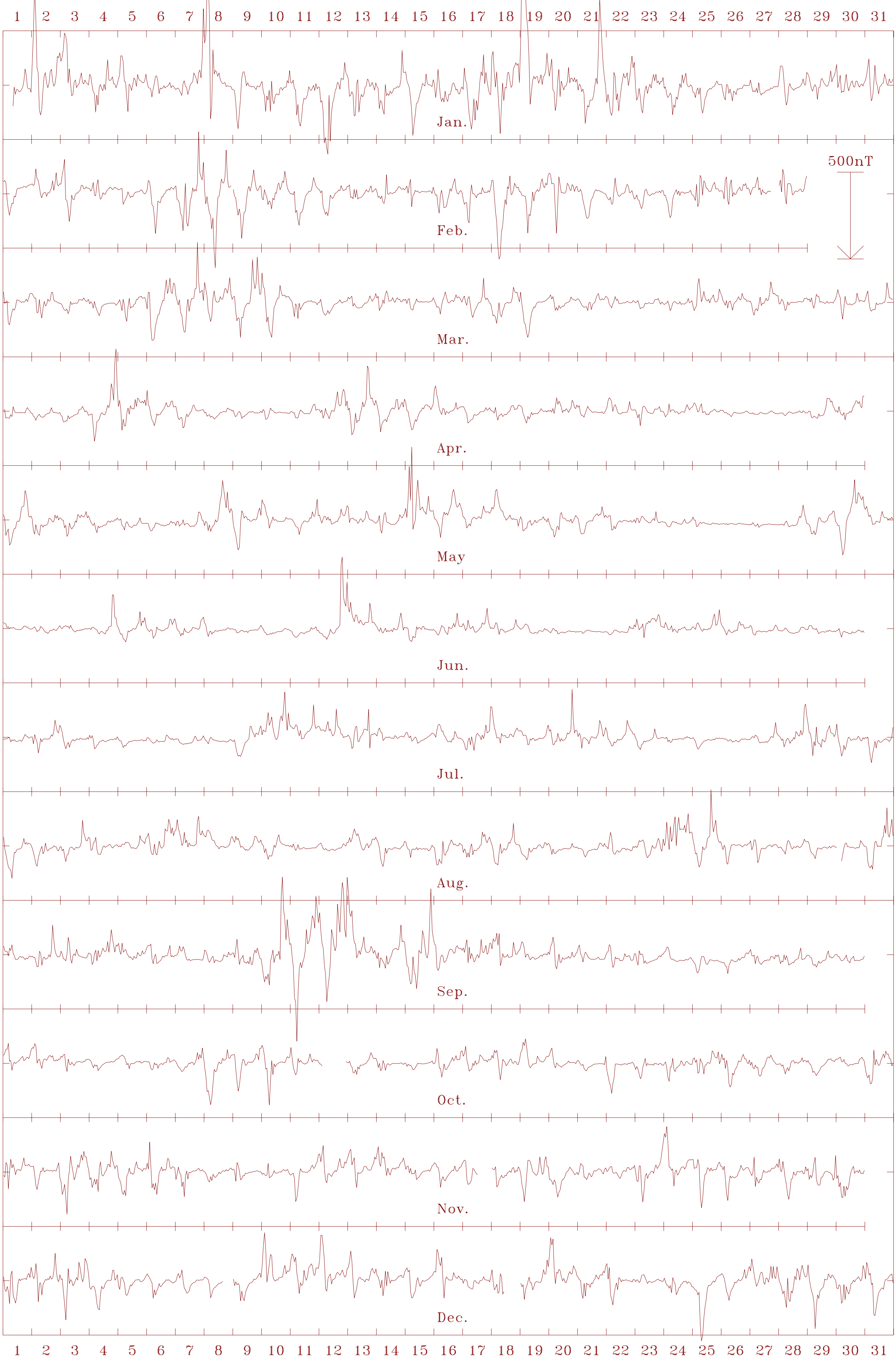
Casey Stn. 2005 Horizontal intensity (H). Scale: 30.0 nT/mm. Mean: 9492 nT



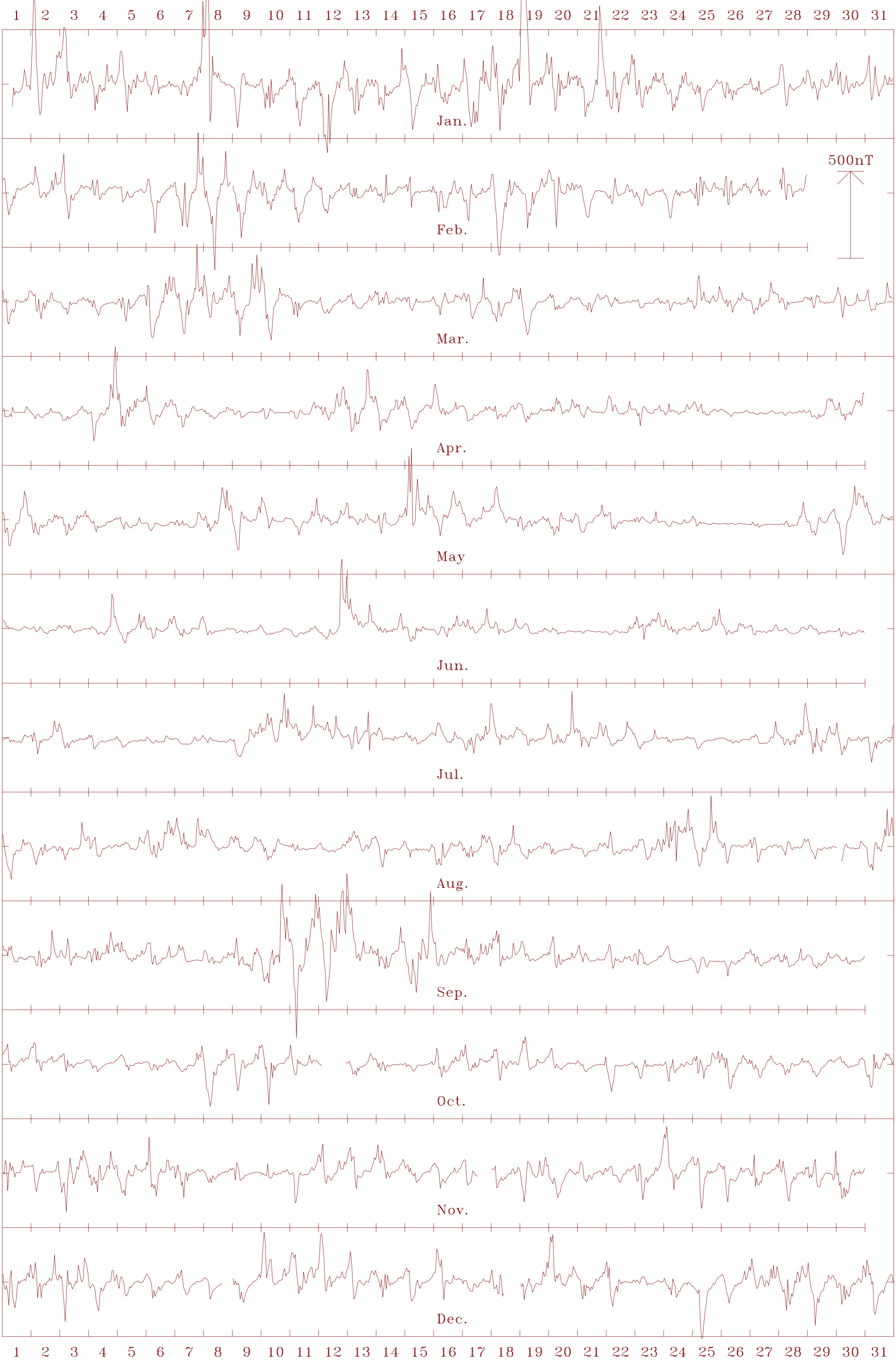
Casey Stn. 2005 Declination (east) (D). Scale: 12.0 min/mm. Mean: −93.94 deg.

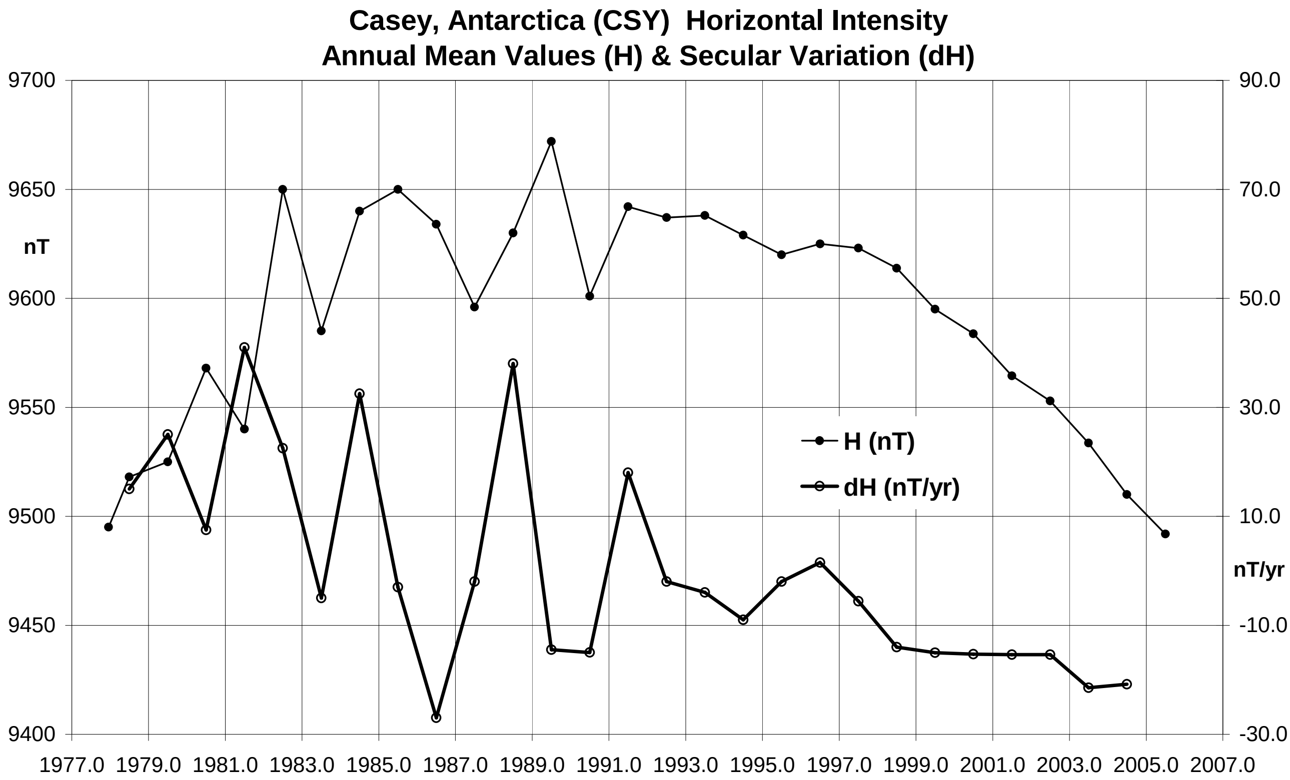


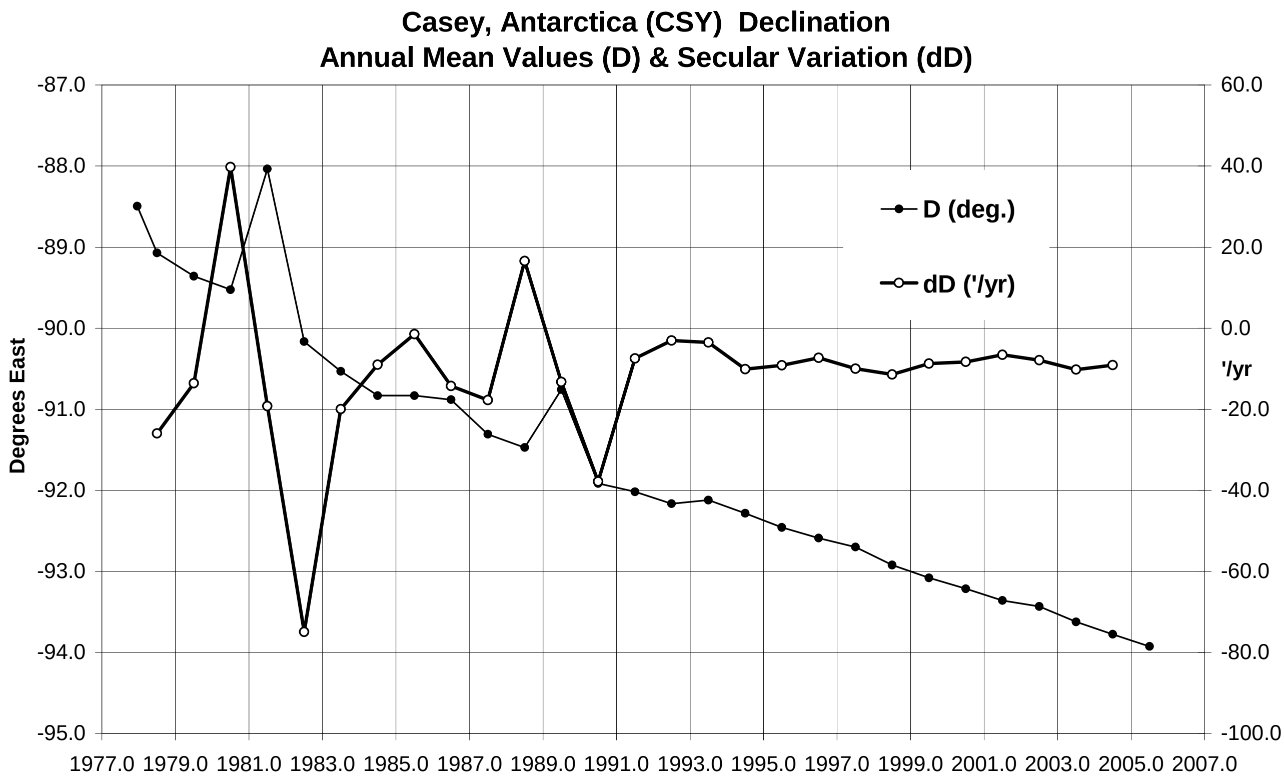
Casey Stn. 2005 Vertical intensity (Z). Scale: 30.0 nT/mm. Mean: −63694 nT

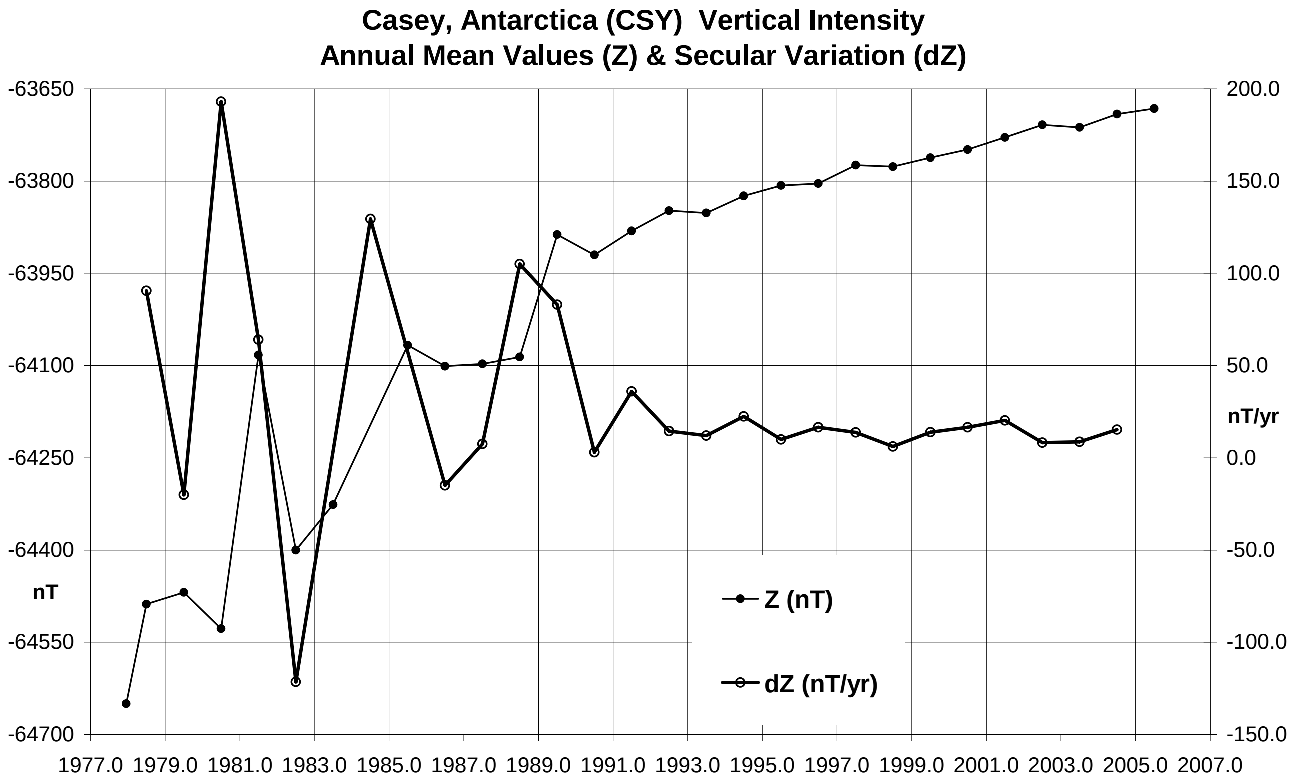


Casey Stn. 2005 Total intensity (F). Scale: 30.0 nT/mm. Mean: 64397 nT

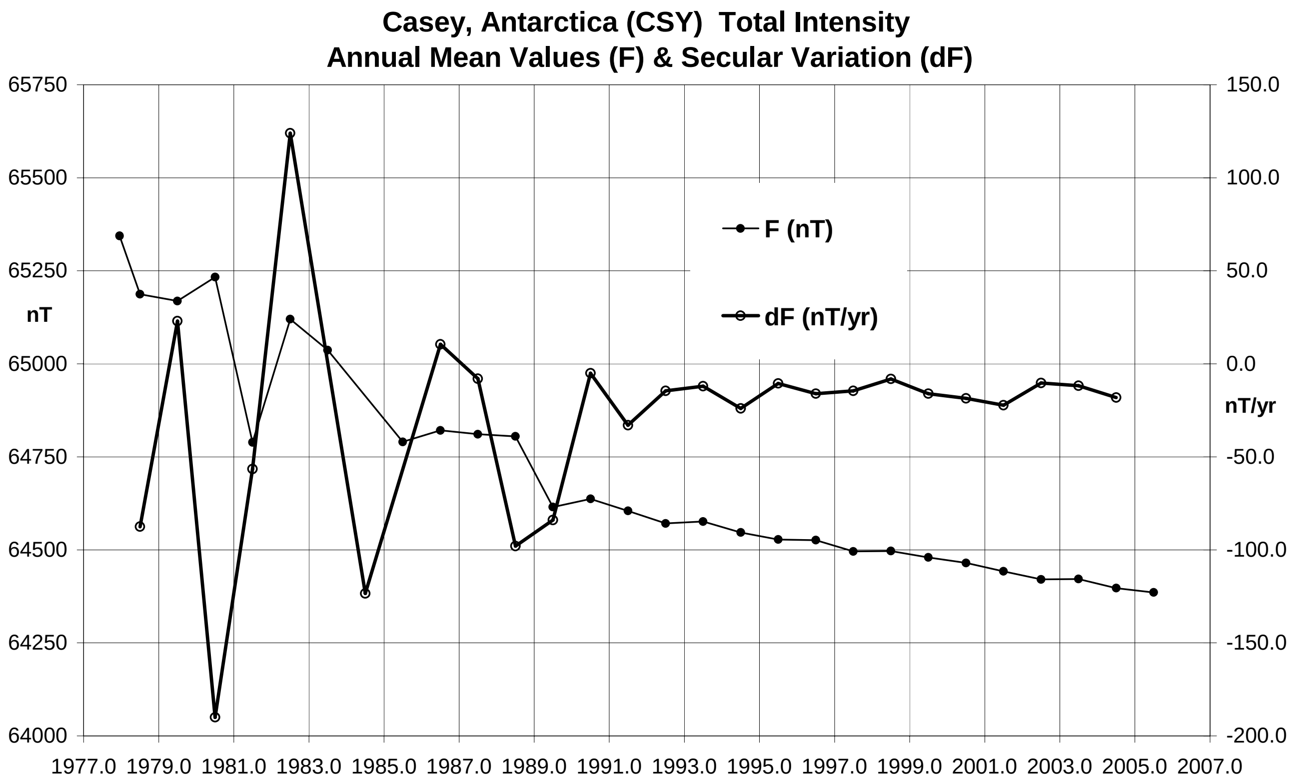



Casey, Antarctica (CSY) Horizontal Intensity
Annual Mean Values (H) & Secular Variation (dH)
nT
nT/yr
H (nT)
dH (nT/yr)
9700
9650
9600
9550
9500
9450
9400
90.0
70.0
50.0
30.0
10.0
-10.0
-30.0
1977.0 1979.0 1981.0 1983.0 1985.0 1987.0 1989.0 1991.0 1993.0 1995.0 1997.0 1999.0 2001.0 2003.0 2005.0 2007.0


Casey, Antarctica (CSY) Declination
Annual Mean Values (D) & Secular Variation (dD)
Degrees East
'/yr
D (deg.)
dD ('/yr)
-87.0
-88.0
-89.0
-90.0
-91.0
-92.0
-93.0
-94.0
-95.0
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
1977.0 1979.0 1981.0 1983.0 1985.0 1987.0 1989.0 1991.0 1993.0 1995.0 1997.0 1999.0 2001.0 2003.0 2005.0 2007.0



Casey, Antarctica (CSY) Vertical Intensity
Annual Mean Values (Z) & Secular Variation (dZ)
-63650
-63800
-63950
-64100
-64250
-64400
nT
-64550
-64700
200.0
150.0
100.0
50.0
nT/yr
0.0
-50.0
-100.0
-150.0
Z (nT)
dZ (nT/yr)
1977.0 1979.0 1981.0 1983.0 1985.0 1987.0 1989.0 1991.0 1993.0 1995.0 1997.0 1999.0 2001.0 2003.0 2005.0 2007.0



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
F (nT)
dF (nT/yr)
1977.0 1979.0 1981.0 1983.0 1985.0 1987.0 1989.0 1991.0 1993.0 1995.0 1997.0 1999.0 2001.0 2003.0 2005.0 2007.0

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 in a magnetic quiet zone on the south-east extremity of the station, at East Bay.

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

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

Key data for Mawson Observatory:

- 3-character IAGA code: MAW
- Commenced operation: 1955
- Geographic latitude: 67° 36' 14" S
- Geographic longitude: 62° 52' 45" E
- Geomagnetic† : Lat. -73.11°; Long. 110.35°
- Lower limit for K index of 9: 1500 nT
- Principal pier identification: Pier A
- Elevation of top of Pier A: 12 metres AMSL
- Azimuth of principal reference (Mark BMR89/1 from Pier A): 350° 36.9'
- Distance to Mark BMR89/1: 112 metres
- Observers in Charge: G. Roser (2004/05, GA/AAD)
  M. Leayr (2005, GA/AAD)
  D. Taylor (2006, GA/AAD)

† Based on the IGRF 2005.0 model updated to 2005.5

Variometers

A 3-axis Narod ringcore-fluxgate (RCF) magnetometer continuously monitored variations in the Earth's vector magnetic field at Mawson throughout 2005. The RCF sensor was located within the sensor (western) room of the VARIOMETER HOUSE. An Elsec 820M3 PPM was installed during most of 2005, but produced no usable total intensity data. It was replaced by a GEM systems GSM90 Overhausser magnetometer on 15 December 2005. High quality F data were available from then on. The PPM sensors were also in the sensor room. Although the Elsec PPM performed poorly, some idea of the vector variometer performance could be gained using its data: the difference between the two seemed to vary from -2.5nT to +1.0nT throughout the year. The VARIOMETER HOUSE also housed a global positioning system (GPS) clock, data acquisition computer(s), a network computer, an ethernet radio link and a standby power supply.

Two of the orthogonal RCF magnetometer sensors were horizontal and oriented so that they were each at an angle of 45 degrees to the direction of the horizontal component of the magnetic field at the time of installation. The third sensor was aligned vertically.

The RCF produced eight samples per second that were averaged and output as 1-second data by a DOS acquisition system until 15 December 2005, and filtered and output as 1-second data (on the second) by a QNX acquisition system after that date. The PPM variometers 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 maintained close to 10°C by a fast-cycle heater and displayed by a Doric Trendicator digital thermometer with its sensor on a disused (PEM/Y) pier. The recorded variometer head and electronics temperatures were about 7.1±1.1°C (8.2±0.3°C in summer and 6.4±0.8°C in winter, with a total range from 4.0°C to 9.3°C) throughout the year. The heater capacity was not sufficient to maintain 10°C in winter, and during the months April to September inclusive, 5°C would have been a better standard temperature.

An EDA 3-component fluxgate magnetometer and its associated data acquisition computer were available as a standby variometer should the principal system have failed. This system, except for the fluxgate sensor, was removed from the VARIOMETER HOUSE on 12 January 2005 in expectation of the imminent installation of a DMI variometer.

The new DMI variometer with a new variometer GSM90 and new QNX data acquisition systems were shipped to Mawson on the annual resupply vessel during 2004/05 summer. Due to an error the new equipment was mistakenly returned to Australia, where it was re-calibrated and returned to Mawson on the first available ship/intra-continental-flight of the 2005/06 summer.

The Elsec 820 F variometer performed very poorly throughout most of 2005. As its replacement GEM GSM90 was not delivered during the 2004/05 resupply, there was no useful F data until the following summer, when it was finally replaced by the GEM GSM90 on 15 December 2005.

Absolute Instruments and Corrections

The principal absolute magnetometers used to calibrate the recording variometers at Mawson in 2005 were Danish fluxgate magnetometer no. D26035 mounted on a Zeiss 020B theodolite no. 311542 and GEM model GSM90 no. 3091315 with sensor no. 91378.

Danish fluxgate magnetometer no. DI0022 mounted on a Zeiss 020B theodolite no. 353758 was used monthly as a secondary instrument during 2005. Elsec model 770 PPM no. 210 was used weekly as a secondary instrument during 2005.

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

Instrument comparisons performed at Mawson throughout 2005 indicated relative corrections to the absolute magnetometers in use at Mawson were:

F (GSM90_3091315) = F (E770_210) − 0.4 ± 0.4nT
D (D26035/311542) = D (DI0022/353758) + 0.08' ± 0.37'
I (D26035/311542) = I (DI0022/353758) + 0.10' ± 0.22'

(The DI comparisons were taken over observations from January to September 2005, rejecting some observations. The DIM DI0022/353758 was not used after October in 2005.)

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

F (GSM90_3091315) = F (CNB) + 0.0 nT
D (DI0022/353758) = D (CNB) - 0.07'
I (DI0022/353758) = I (CNB) - 0.07'

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

$\Delta F = 0.0$ nT $\quad \Delta D = 0.0'$ $\quad \Delta I = 0.0'$

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

Baselines

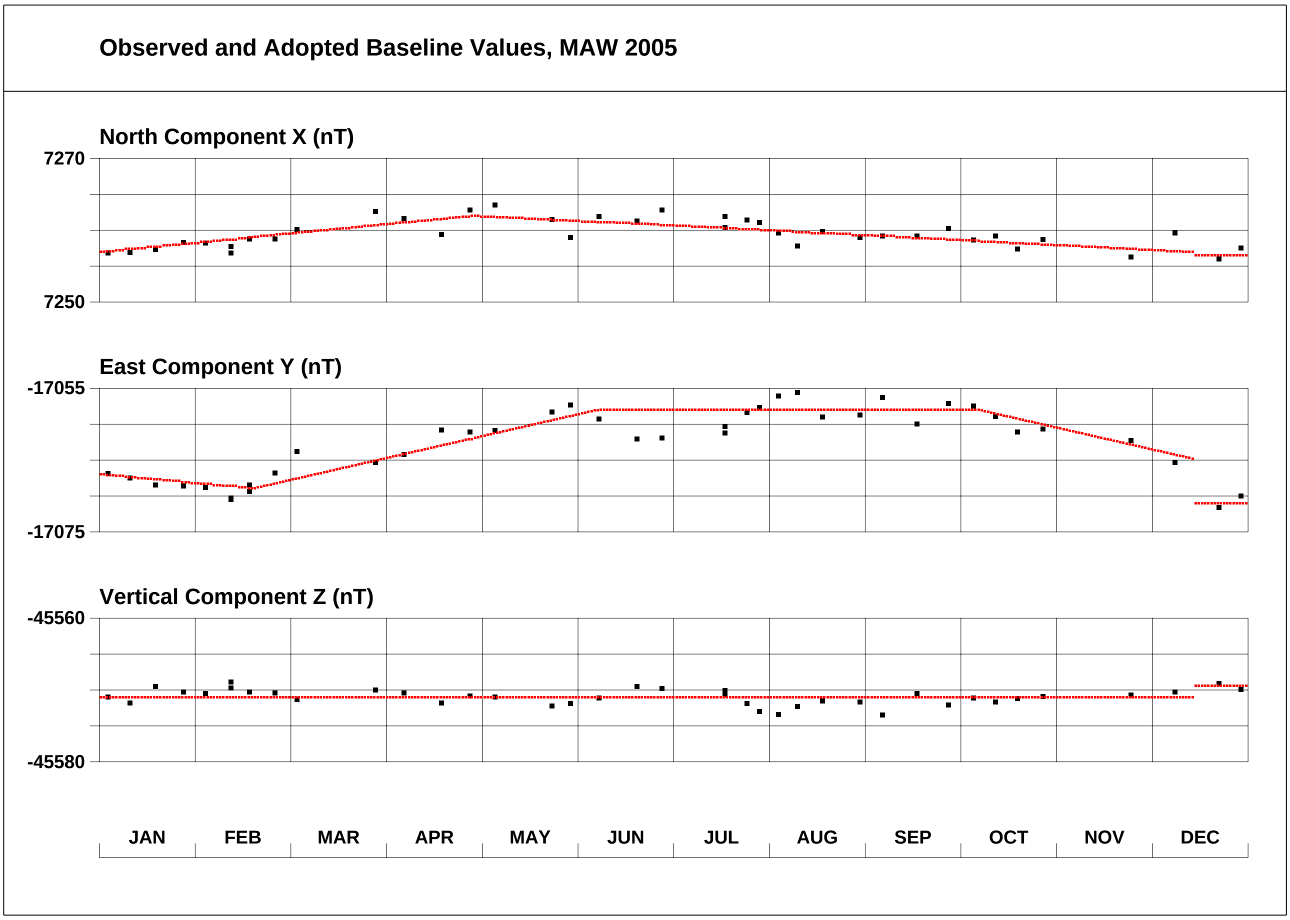
The standard deviations between the adopted variometer model and data, and the absolute observations, were:

$\sigma_X = 1.3$nT $\sigma_Y = 1.8$nT $\sigma_Z = 1.1$nT.

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

$\sigma_F = 0.9$nT $\sigma_D = 12''$ $\sigma_I = 8''$)

Observed and adopted baseline values in X, Y and Z for 2005 are shown in the following (INTERMAGNET format) chart.



Operations

The observers at Mawson observatory in 2005 were jointly employed by Geoscience Australia (GA) and the Australian Antarctic Division (AAD). They were members of the Australian National Antarctic Research Expedition (ANARE). The Mawson Station personnel change over each summer with varying periods of overlap.

The observers were responsible for the continuous operation of the observatory and performed equipment maintenance and installation as required. In 2005 the observers performed absolute observations weekly and forwarded them by e-mail to GA. During the observations the variometer system including the acquisition system timing was also checked. All data processing was performed at GA.

Until 15 December 2005 the 1-second RCF data and the 10-second PPM data, as well as 1-minute means of both, were recorded on a DOS acquisition computer 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 computer running QNX4, also in the VARIOMETER HOUSE, that was connected to the station's radio network-hub, automatically copied files from the acquisition computer each day.

The files on this computer were subsequently automatically retrieved to 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 computer in the Science Building.

From 15 December 2005 the data were recorded on a QNX6 acquisition computer which was directly connected to the station's radio network hub. Data were retrieved to GA using *rsync over ssh* every 10 minutes. The QNX6 acquisition computer used a GPS clock (both pulse-per-second and absolute-time-code) to set the system time. The clock was checked from GA occasionally to ensure it was working. If not, it was reset from GA, or if necessary the computer was re-booted.

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

In earlier years (particularly 2000) considerable effort was made to isolate the variometer system from static electricity sparks originating from the very dry blown snow during the severe blizzards that are common at Mawson. The sparks occasionally halted the acquisition computer. This seems to have improved the situation, but there were still data losses during blizzards which also delayed attention from the local observer for a few days. Blizzard was the major cause of data loss during 2005, accounting for almost all of the 1.4% data loss for the year.

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

An application for MAW to be accepted as an INTERMAGNET observatory was lodged 08 August 2005. Real-time transmission of MAW data to INTERMAGNET began on 24 November 2005. (An INTERMAGNET certificate was received on 18 January 2006.)

On 06 November 2005 external azimuth mark LEE (1,561m from Pier A) was occupied for magnetic observations by the OIC (ML). The magnetic parts of the mark were temporarily removed during the observations. The observations were at 1.6m agl (above ground level – not above mark level). Two observations were made at LEE

Operations (cont.)

and compared with the adopted baselines on Pier A. No observation was made at Pier A on that day. Both results are summarised below:

Set 1:	D at Pier A	=	D at LEE + 1.3'
	I at Pier A	=	I at LEE + 1.4'
	F at Pier A	=	F at LEE – 2.0 nT
Set 2:	D at Pier A	=	D at LEE + 1.4'
	I at Pier A	=	I at LEE + 1.4'
	F at Pier A	=	F at LEE – 2.7 nT

This compares to the results on 01 Nov 2004 (by RAH)

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

The external mark BMR89/2 was occupied on 11 February and 25 February 2005 (by GR); and 30 October 2005 (by ML):

11 Feb 2005:	D at Pier A	=	D at BMR892	- 1.5' ± 0.5’
	I at Pier A	=	I at BMR892	- 0.6' ± 0.3’
	F at Pier A	=	F at BMR892	+ 10.1 ± 1.0nT
25 Feb 2005:	D at Pier A	=	D at BMR892	- 1.2' ± 0.2’
	I at Pier A	=	I at BMR892	- 0.5' ± 0.1’
	F at Pier A	=	F at BMR892	+ 10.1 ± 0.5nT
30 Oct 2005:	D at Pier A	=	D at BMR892	- 0.1' ± 0.1’
	I at Pier A	=	I at BMR892	- 1.1' ± 0.1’
	F at Pier A	=	F at BMR892	+ 10.1 ± 0.2nT
30 Oct 2005:	D at Pier A	=	D at BMR892	- 0.5' ± 0.1’
	I at Pier A	=	I at BMR892	- 1.1' ± 0.1’
	F at Pier A	=	F at BMR892	+ 10.2 ± 0.1nT

On 11 February 2005 a round of angles was carried out (by GR) on Pier A. The conclusion was that the marks and Pier A were stable.

Also on 11 February 2005 a round of angles was carried out (by GR) on BMR89/2, providing new marks and documentation for that location.

Significant Events in 2005

Dec 07 2004	The 2004 observer (RH) handed over responsibility for absolute observations and the observatory to the 2004/05 observer (GR).
Jan 12	0730-0920: The Aironet 640-2400 Wireless LAN and external antenna were removed. Also removed were backup EDA variometer and associated computer acquisition system (except for EDA sensor) and other material. WaveRider NCL1155 Wireless LAN and new antenna **inside** the VARIOMETER HOUSE (to reduce blizzard-static problems), were installed.
Feb 11	and Feb 25: OIC (GR) performed observations on external mark BMR89/2.
Mar 07	The 2004/05 observer (GR) handed over responsibility for absolute observations and the observatory to the 2005 observer (ML).
Apr 08 & 11	The new variometer and acquisition systems dispatched to MAW were returned to GA by error.
May 13	The ABSOLUTE HOUSE was tidied up.
May 25	The DOS acquisition computer failed (possibly caused by blizzard static) and could not receive attention for some days. Restarting the computer did not fix all problems and the NGL variometer had to be powered off and on again. (5 days of data lost.)

Significant Events (cont.)

Aug 08	INTERMAGNET application for MAW submitted.
Sep 23	The new variometer and acquisition systems (returned to Australia by error) were re-dispatched to MAW after confirming the DMI FGE calibrations were unchanged.
Oct 30	Observations made on BMR892 by OIC (ML).
Nov 06	Observations made on LEE by OIC (ML).
Mid-Nov.	The 2005 observer (ML) handed over responsibility for absolute observations and the observatory to the 2006 observer (DT).
Nov 24	Transmission of MAW data to INTERMAGNET (Edinburgh GIN) via email commenced.
Dec 15	The DOS data acquisition system was disconnected and the Elsec 820 variometer PPM removed. A QNX data acquisition system and a GSM90 variometer were installed.

Data losses in 2005

Mar 22	0507–0511 (5m) Computer restart; unknown cause: all channels
May 25	(86m) Various failures; probably caused by blizzard static interference.
May 25	0619 to 30/0604 (4d 23h 46m) Probably computer failure and NGL variometer failure caused by blizzard static. All channels
Sep 11	1006–1009 (4m) Computer restart; unknown cause
Dec 14	0706–0856 (1h 51m) Data corrupted during installations
Dec 15	0719–0846 (1h 28m) Data corrupted during installations.

(Usable scalar data were only available from 0900/Dec 15)

K indices

The table on the page 104 shows Mawson K indices for 2005. Using the digital data, these have been derived by a computer-assisted scaling program using the H and D components. (See *Indices of Magnetic Disturbance* on page 1-2 of this report.) This is in contrast to recent years, when a simple range-index based on X and Y components was used.

Distribution of MAW data

Preliminary Monthly Means for Project Ørsted

- Sent monthly by e-mail to IPGP

1-minute and Hourly Mean Values to WDCs

- 2005 data: WDC-A, Boulder, USA (sent in 2006)

1-minute Values for Project INTERMAGNET

- Preliminary data to the Edinburgh IM GIN by e-mail: daily until 15 Dec. 2005, then in real-time from that date.
- 2005 Definitive data: WDC-C1, Copenhagen, Denmark (sent in 2006)

Notes and Errata (cumulative since *AGR1993)*

It was reported in *AGR1998* through to *AGR2001* that the principle azimuth mark at Mawson was BMR89/2 (at an azimuth of 19° 14.0' and distance of 105m from principle observation Pier A).

Reference to this mark actually ceased after May 1998, from when the azimuth mark BMR89/1 was principally used.

Mawson Annual Mean Values

The table below gives annual mean values calculated using the monthly mean values over **All** days, the 5 International **Quiet** days and the 5 International **Disturbed** days in each month as indicated. Plots of these data with secular variation in H, D, Z & F are on pages 110 & 111.

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1955.5		-58	38.1	-69	33.3	18272	9854	-15387	-49012	52307	DHZ
1956.5		-58	53.2	-69	32.5	18282	9927	-15352	-49006	52305	DHZ
1957.5		-59	08.7	-69	31.1	18292	9461	-15655	-48974	52279	DHZ
1958.5		-59	25.6	-69	30.3	18293	9538	-15610	-48940	52247	DHZ
1959.5		-59	42.6	-69	28.5	18293	9615	-15562	-48860	52172	DHZ
1960.5		-59	59.6	-69	25.2	18323	9708	-15540	-48800	52127	DHZ
1961.5		-60	14.6	-69	23.1	18322	9228	-15828	-48707	52039	DHZ
1962.5		-60	30.1	-69	21.1	18333	9305	-15796	-48650	51990	DHZ
1963.5		-60	45.2	-69	17.6	18356	9386	-15775	-48562	51915	DHZ
1964.5		-60	59.2	-69	15.4	18353	9449	-15734	-48460	51819	DHZ
1965.5		-61	12.6	-69	13.1	18356	8958	-16022	-48368	51734	DHZ
1966.5		-61	24.0	-69	09.6	18362	9014	-15997	-48235	51612	DHZ
1967.5		-61	34.4	-69	07.2	18374	9068	-15980	-48168	51553	DHZ
1968.5		-61	43.8	-69	05.2	18365	9107	-15948	-48060	51449	DHZ
1969.5		-61	53.0	-69	03.4	18353	9144	-15913	-47954	51346	DHZ
1970.5		-62	00.5	-69	00.4	18358	8621	-16208	-47840	51241	DHZ
1971.5		-62	05.3	-68	56.4	18375	8652	-16211	-47719	51135	DHZ
1972.5		-62	11.4	-68	53.1	18381	8683	-16201	-47600	51026	DHZ
1973.5		-62	17.6	-68	49.7	18391	8717	-16194	-47486	50923	DHZ
1974.5		-62	24.8	-68	47.2	18390	8750	-16175	-47380	50824	DHZ
1975.5		-62	31.4	-68	44.0	18397	8785	-16164	-47269	50723	DHZ
1976.5		-62	37.3	-68	40.0	18418	8823	-16167	-47157	50626	DHZ
1977.5		-62	43.9	-68	36.9	18425	8857	-16157	-47051	50530	DHZ
1978.5		-62	51.9	-68	35.5	18421	8893	-16132	-46986	50468	DHZ
1979.5		-62	57.9	-68	32.9	18425	8923	-16120	-46890	50380	DHZ
1980.5		-63	05.8	-68	29.8	18432	8396	-16409	-46784	50284	DHZ
1981.5		-63	14.6	-68	27.1	18443	8443	-16397	-46705	50215	DHZ
1982.5		-63	21.2	-68	25.5	18433	8470	-16372	-46616	50128	DHZ
1983.5		-63	26.6	-68	22.3	18439	8498	-16364	-46503	50025	DHZ
1984.5		-63	33.1	-68	19.3	18446	8532	-16354	-46404	49936	DHZ
1985.5		-63	40.2	-68	17.0	18457	8571	-16346	-46342	49882	DHZ
1986.5		-63	48.7	-68	15.1	18460	8613	-16328	-46276	49822	XYZ
1987.5		-63	56.6	-68	12.5	18470	8655	-16317	-46198	49753	XYZ
1988.5		-64	04.4	-68	10.7	18475	8120	-16595	-46142	49703	XYZ
1989.5		-64	12.8	-68	09.7	18474	8160	-16574	-46099	49663	XYZ
1990.5		-64	21.1	-68	06.4	18492	8208	-16570	-46015	49592	XYZ
1991.5		-64	28.8	-68	04.2	18502	8250	-16561	-45957	49542	XYZ
1992.5	Q	-64	36.5	-68	01.7	18513	7938	-16724	-45885	49479	XYZ
1993.5	Q	-64	43.6	-67	59.4	18522	7908	-16749	-45819	49422	ABC
1994.5	Q	-64	51.8	-67	57.4	18537	7874	-16781	-45779	49389	ABC
1995.5	Q	-65	00.4	-67	55.3	18550	7838	-16813	-45731	49350	ABC
1996.5	Q	-65	09.2	-67	53.5	18561	7799	-16843	-45692	49318	ABC
1997.5	Q	-65	18.9	-67	52.0	18572	7757	-16875	-45663	49295	ABC
1998.5	Q	-65	28.6	-67	51.3	18575	7710	-16900	-45642	49277	ABC
1999.5	Q	-65	38.5	-67	50.2	18579	7663	-16925	-45611	49250	ABC
2000.5	Q	-65	48.0	-67	49.6	18579	7616	-16946	-45585	49225	ABC
2001.5	Q	-65	56.3	-67	48.9	18577	7574	-16963	-45555	49198	ABC
2002.5	Q	-66	05.2	-67	48.2	18581	7532	-16986	-45540	49185	ABC
2003.5	Q	-66	14.7	-67	48.7	18570	7481	-16997	-45532	49174	ABC
2004.5	Q	-66	23.5	-67	48.1	18568	7436	-17014	-45503	49146	ABC
2005.5	Q	-66	32.1	-67	48.5	18556	7389	-17021	-45488	49127	ABC
1992.5	A	-64	36.9	-68	02.8	18499	7930	-16712	-45894	49482	XYZ
1993.5	A	-64	44.2	-68	00.7	18506	7898	-16736	-45830	49426	ABC
1994.5	A	-64	52.9	-67	59.4	18511	7858	-16760	-45794	49394	ABC
1995.5	A	-65	00.9	-67	56.7	18532	7828	-16798	-45741	49352	ABC
1996.5	A	-65	09.8	-67	54.5	18548	7791	-16833	-45698	49319	ABC
1997.5	A	-65	19.4	-67	53.0	18560	7749	-16865	-45670	49297	ABC
1998.5	A	-65	29.1	-67	52.4	18561	7702	-16887	-45648	49278	ABC
1999.5	A	-65	39.0	-67	51.5	18561	7653	-16910	-45618	49250	ABC
2000.5	A	-65	48.2	-67	50.6	18566	7610	-16935	-45594	49230	ABC
2001.5	A	-65	56.2	-67	49.8	18567	7571	-16953	-45565	49203	ABC
2002.5	A	-66	05.8	-67	49.3	18568	7524	-16975	-45546	49185	ABC
2003.5	A	-66	15.6	-67	50.7	18546	7466	-16976	-45546	49177	ABC
2004.5	A	-66	24.1	-67	49.6	18549	7426	-16998	-45514	49149	ABC

continued on page 112 ...

K indices and Daily K sums at Mawson Antarctica (K=9 limit: 1500 nT) for 2005

Date	January	February	March	April	May	June	Date
01	3563 3664 36	5223 3222 21	4334 2226 26	2341 1143 19	D 5654 4665 41	6333 2224 25	01
02	D 6665 4747 45	3323 3452 25	4534 3324 28	3121 1114 14	3442 3345 28	2322 2316 21	02
03	5654 5465 40	4643 2223 26	3221 1253 19	4221 2335 22	5543 3453 32	4432 3242 24	03
04	6554 5565 41	Q 2312 2224 18	Q 4111 2011 11	D 4233 3576 33	5321 1154 22	D 3333 4477 34	04
05	6545 3436 36	Q 2221 1122 13	4442 2343 26	D 7764 3577 46	Q 4322 1322 19	6554 3466 39	05
06	Q 3211 3363 22	2553 2364 30	D 7464 4678 46	6533 3366 35	2010 2123 11	5543 1156 30	06
07	1003 5558 27	D 4654 4476 40	D 6754 4777 47	5533 2323 26	3221 3266 25	5543 3137 31	07
08	6653 3332 31	D 5665 4676 45	D 7764 3685 46	5312 3243 23	D 6776 7576 51	5422 2123 21	08
09	Q 3212 1122 14	D 4765 4576 44	D 4763 3586 42	3312 0123 15	5533 2376 34	4111 2235 19	09
10	2332 3345 25	D 6655 4464 40	7554 3355 37	Q 1110 0010 04	6553 2236 32	Q 3210 0233 14	10
11	4553 3436 33	3554 3254 31	3433 1225 23	1310 2364 20	2234 3456 29	3311 1254 20	11
12	6565 4465 41	3431 2241 20	Q 3310 0235 17	D 6654 4475 41	4543 3366 34	D 3355 4586 39	12
13	4553 4765 39	Q 4420 1153 20	4101 1246 19	D 3764 4646 40	5454 4444 34	D 8665 4464 43	13
14	5663 3377 40	3532 2244 25	6643 5325 34	5544 4377 39	4343 3354 29	3243 3155 26	14
15	5565 4463 38	Q 2321 1155 20	5232 1115 20	4543 3466 35	D 8878 3368 51	4654 5322 31	15
16	6543 4454 35	3423 4655 32	2212 3245 21	5433 2355 30	D 7664 7666 48	D 2334 5345 29	16
17	D 7557 6744 45	3322 2345 24	5654 2634 35	3422 2145 23	6643 3556 38	7632 4345 34	17
18	D 7777 6557 51	D 7474 4654 41	3322 3377 30	3442 2336 27	5444 3334 30	3333 3245 25	18
19	D 8875 6545 48	2345 3454 30	6543 1124 26	3342 1223 20	3453 2232 24	3322 3322 20	19
20	3444 5566 37	5462 3465 35	Q 2311 2244 19	3764 4464 38	4565 4336 36	Q 2221 1201 11	20
21	D 5554 4775 42	5442 2235 27	3333 4244 26	Q 4221 2022 15	6664 3474 40	Q 0000 0000 00	21
22	5663 5566 42	3311 1242 17	Q 2211 1244 17	5421 3345 27	5443 3134 27	1100 0047 13	22
23	5565 4666 43	Q 4221 1011 12	Q 1110 0224 11	3322 1352 21	4221 3434 23	D 5764 4476 43	23
24	4433 4645 33	1222 3113 15	2211 2044 16	5532 2235 27	Q 4011 1125 15	6433 3115 26	24
25	Q 3322 3254 24	2333 3452 25	D 3653 3427 33	3343 3225 25	Q 43-- ---- --	6643 2566 38	25
26	Q 3322 2233 20	3333 4444 28	3454 4454 33	Q 3211 1043 15	Q ---- ---- --	5545 3245 33	26
27	Q 2211 1122 12	3442 3223 23	4354 3565 35	Q 1110 0121 07	Q ---- ---- --	Q 3111 2253 18	27
28	4332 2245 25	3343 2327 27	2331 1156 22	Q 1000 0134 09	---- ---- --	Q 1222 2134 17	28
29	5534 4357 36		2210 1226 16	1223 3465 26	---- ---- --	5232 2113 19	29
30	6644 4334 34		4443 3334 28	D 6554 4656 41	D --53 5876 --	4322 3235 24	30
31	5544 6552 36		2341 1445 24		6645 4235 35		31
Mean K-sum	**34.5**	**26.9**	**26.9**	**25.4**	**31.5**	**25.6**	

Date	July	August	September	October	November	December	Date
01	3432 2356 28	5455 4446 37	4553 3216 29	5433 3366 33	5422 3545 30	D 6544 3366 37	01
02	6543 2356 34	5543 3234 29	D 3653 4663 36	D 5534 3426 32	3420 2256 24	5454 4446 36	02
03	4444 3315 28	4542 2356 31	7664 4217 37	4432 2155 26	D 4755 4565 41	4434 3455 32	03
04	3323 2235 23	6443 3336 32	6766 4556 45	4212 2243 20	D 4644 3464 35	4332 3363 27	04
05	Q 3233 2115 20	4222 2366 27	5433 3265 31	3311 1245 20	3453 3354 30	2312 2122 15	05
06	Q 4121 1216 18	D 7544 3476 40	7533 3335 32	3212 2233 18	D 6644 4566 41	Q 1222 2224 17	06
07	3210 2345 20	6564 4256 38	4443 3001 19	2212 3346 23	6433 2244 28	Q 2101 0113 09	07
08	Q 4320 1024 16	5332 3226 26	Q 6421 2354 27	D 4564 3386 39	Q 2221 1124 15	Q 2100 0253 13	08
09	D 5334 6477 39	4433 4336 30	2422 5556 31	3433 3265 29	5222 1134 20	4311 2123 17	09
10	D 4664 4467 41	4454 4333 30	3555 5667 42	3353 2226 26	Q 2121 1254 18	5653 3365 36	10
11	5465 4475 40	Q 3132 2203 16	D 7876 6787 56	5331 2355 27	2422 2333 21	D 4554 4665 39	11
12	D 6866 6431 40	Q 3222 3226 22	D 6676 5589 52	Q 2200 1014 10	5434 4445 33	4532 3455 31	12
13	D 2445 5647 37	D 3443 3287 34	D 8656 6367 47	3312 1254 21	D 2534 4447 33	3323 3254 25	13
14	4544 3315 29	3533 2225 25	6545 4575 41	Q 2432 0002 13	5533 3255 31	2352 2121 18	14
15	3321 4366 28	2321 1226 19	D 4546 6676 44	Q 1221 1010 08	3323 3344 25	Q 2321 1113 14	15
16	6642 2333 29	3643 4346 33	6655 4465 41	2332 3456 28	Q 2212 1225 17	3523 3232 23	16
17	4335 4458 36	5544 3477 39	2533 3575 33	D 4643 4343 31	Q 4322 1002 14	2213 4213 18	17
18	7654 3267 40	4553 3656 37	4444 3344 30	2422 3243 22	2211 2532 18	3322 1121 15	18
19	4433 1226 25	4323 3145 25	5333 3354 29	4523 3344 28	3210 3566 26	2333 3466 30	19
20	5443 4356 34	Q 3100 2133 13	Q 4333 2353 26	Q 4211 0024 14	3544 2335 29	D 5633 5365 36	20
21	6773 2456 40	3121 1456 23	Q 2121 2221 13	2011 0003 07	4531 2222 21	3334 4332 25	21
22	4443 3576 36	3532 4226 27	4423 2441 24	6432 2024 23	4223 4443 26	4322 2223 20	22
23	4342 1215 22	6433 3334 29	2452 3235 26	Q 3211 1112 12	3543 3343 28	Q 2010 0011 05	23
24	Q 3123 1234 19	D 6577 6677 51	Q 3320 1022 13	2211 3343 19	4333 4445 30	2113 3243 19	24
25	Q 3220 2235 19	D 5564 4755 41	Q 2111 2212 12	D 6634 3466 38	5542 3355 32	3534 3214 25	25
26	3221 2322 17	5553 2335 31	5532 2176 31	3553 3443 30	3324 4334 26	3112 3365 24	26
27	5333 3246 29	5533 1114 23	3433 2216 24	6213 4652 29	Q 2322 1225 19	D 4211 3565 27	27
28	D 5653 4356 37	Q 5421 0146 23	4453 3445 32	2234 3454 27	3233 4325 25	D 5544 4565 38	28
29	4534 4756 38	6652 1102 23	3422 1433 22	1112 1243 15	4222 2237 24	5454 2355 33	29
30	6553 2135 30	Q 1101 0045 12	2322 3235 22	4412 2165 25	D 4545 4346 35	4543 2345 30	30
31	5433 4317 30	D 2332 5588 36		D 2322 4656 30		5332 3455 30	31
Mean K-sum	**29.7**	**29.1**	**31.6**	**23.3**	**26.5**	**24.6**	

Occurrence distribution of K-indices

K-Index:	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**-**
January	2	10	23	45	45	61	42	17	3	0	0
February	2	21	54	47	47	29	17	7	0	0	0
March	8	35	44	48	52	27	18	13	3	0	0
April	14	34	40	56	39	27	20	10	0	0	0
May	3	13	24	47	44	31	31	10	5	0	40
June	15	27	47	56	35	32	19	7	2	0	0
July	4	20	37	58	51	34	30	12	2	0	0
August	8	19	39	59	44	38	28	10	3	0	0
September	4	16	37	50	38	41	34	15	4	1	0
October	15	34	57	58	42	21	20	0	1	0	0
November	4	16	58	54	57	36	12	3	0	0	0
December	9	32	51	64	38	38	16	0	0	0	0
ANNUAL TOTAL	**88**	**277**	**511**	**642**	**532**	**415**	**287**	**104**	**23**	**1**	**40**

Monthly and Annual Mean Values

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

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

Mawson Antarctica	2005	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	7406.6	-17000.9	-45503.4	49137.3	18544.4	-66° 27.6'	-67° 49.6'
	5xQ days	7416.7	-17024.9	-45503.8	49147.3	18570.3	-66° 27.6'	-67° 48.0'
	5xD days	7370.3	-16959.3	-45472.1	49088.9	18492.3	-66° 30.8'	-67° 52.2'
February	All days	7404.7	-17011.9	-45507.0	49144.0	18553.6	-66° 28.7'	-67° 49.1'
	5xQ days	7405.9	-17019.6	-45491.7	49132.6	18561.1	-66° 29.1'	-67° 48.2'
	5xD days	7403.2	-16995.3	-45550.6	49178.5	18537.9	-66° 27.8'	-67° 51.3'
March	All days	7385.8	-16998.1	-45512.0	49141.0	18533.5	-66° 30.9'	-67° 50.6'
	5xQ days	7399.5	-17016.4	-45494.1	49132.7	18555.7	-66° 29.9'	-67° 48.7'
	5xD days	7354.5	-16948.4	-45542.7	49147.9	18475.5	-66° 32.6'	-67° 55.1'
April	All days	7382.8	-17002.1	-45503.9	49134.5	18535.9	-66° 31.7'	-67° 50.2'
	5xQ days	7400.9	-17026.1	-45486.4	49129.1	18565.1	-66° 30.4'	-67° 47.8'
	5xD days	7352.0	-16961.1	-45535.9	49145.5	18486.1	-66° 33.9'	-67° 54.3'
May	All days	7357.6	-16983.8	-45521.2	49140.4	18509.2	-66° 34.7'	-67° 52.4'
	5xQ days	7386.8	-17016.2	-45488.9	49125.9	18550.4	-66° 32.1'	-67° 48.9'
	5xD days	7292.6	-16913.4	-45567.5	49149.6	18418.9	-66° 40.6'	-67° 59.4'
June	All days	7370.5	-17000.0	-45501.4	49129.6	18529.2	-66° 33.7'	-67° 50.6'
	5xQ days	7393.8	-17022.0	-45486.5	49126.8	18558.5	-66° 31.3'	-67° 48.3'
	5xD days	7338.1	-16964.8	-45510.1	49120.9	18484.1	-66° 36.7'	-67° 53.7'
July	All days	7365.9	-16996.2	-45492.8	49119.6	18523.8	-66° 34.2'	-67° 50.7'
	5xQ days	7382.8	-17017.9	-45486.6	49123.8	18550.3	-66° 32.9'	-67° 48.8'
	5xD days	7332.5	-16965.6	-45478.4	49090.9	18482.5	-66° 37.7'	-67° 53.0'
August	All days	7360.5	-17000.2	-45491.9	49119.4	18525.3	-66° 35.4'	-67° 50.6'
	5xQ days	7376.4	-17017.9	-45489.7	49125.7	18547.8	-66° 34.0'	-67° 49.0'
	5xD days	7324.3	-16960.8	-45490.2	49098.9	18474.9	-66° 38.7'	-67° 53.8'
September	All days	7350.6	-16995.8	-45505.0	49128.6	18517.4	-66° 36.7'	-67° 51.4'
	5xQ days	7375.9	-17017.9	-45486.6	49122.8	18547.6	-66° 34.0'	-67° 49.0'
	5xD days	7285.3	-16943.6	-45561.0	49153.1	18444.0	-66° 44.1'	-67° 57.7'
October	All days	7369.8	-17013.1	-45489.7	49123.1	18540.8	-66° 34.7'	-67° 49.5'
	5xQ days	7374.6	-17023.4	-45485.1	49123.1	18552.1	-66° 34.7'	-67° 48.7'
	5xD days	7365.9	-17005.4	-45494.0	49124.0	18532.3	-66° 34.9'	-67° 50.2'
November	All days	7377.9	-17021.6	-45480.9	49119.2	18551.9	-66° 34.0'	-67° 48.6'
	5xQ days	7375.6	-17024.2	-45480.8	49119.6	18553.3	-66° 34.5'	-67° 48.5'
	5xD days	7365.5	-17005.8	-45501.6	49131.1	18532.5	-66° 34.9'	-67° 50.4'
December	All days	7379.1	-17025.9	-45481.2	49121.1	18556.3	-66° 34.1'	-67° 48.3'
	5xQ days	7376.6	-17029.5	-45473.2	49114.4	18558.5	-66° 34.8'	-67° 47.9'
	5xD days	7374.6	-17010.4	-45494.4	49127.4	18540.4	-66° 33.7'	-67° 49.6'
Annual	All days	7376.0	-17004.1	-45499.2	49129.8	18535.1	-66° 33.0'	-67° 50.1'
Mean	5xQ days	7388.8	-17021.3	-45487.8	49127.0	18555.9	-66° 32.1'	-67° 48.5'
Values	5xD days	7346.6	-16969.5	-45516.5	49129.7	18491.8	-66° 35.5'	-67° 53.4'

(Calculated: 12:20 hrs., Wed., 22 Nov., 2006)

Hourly Mean Values

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

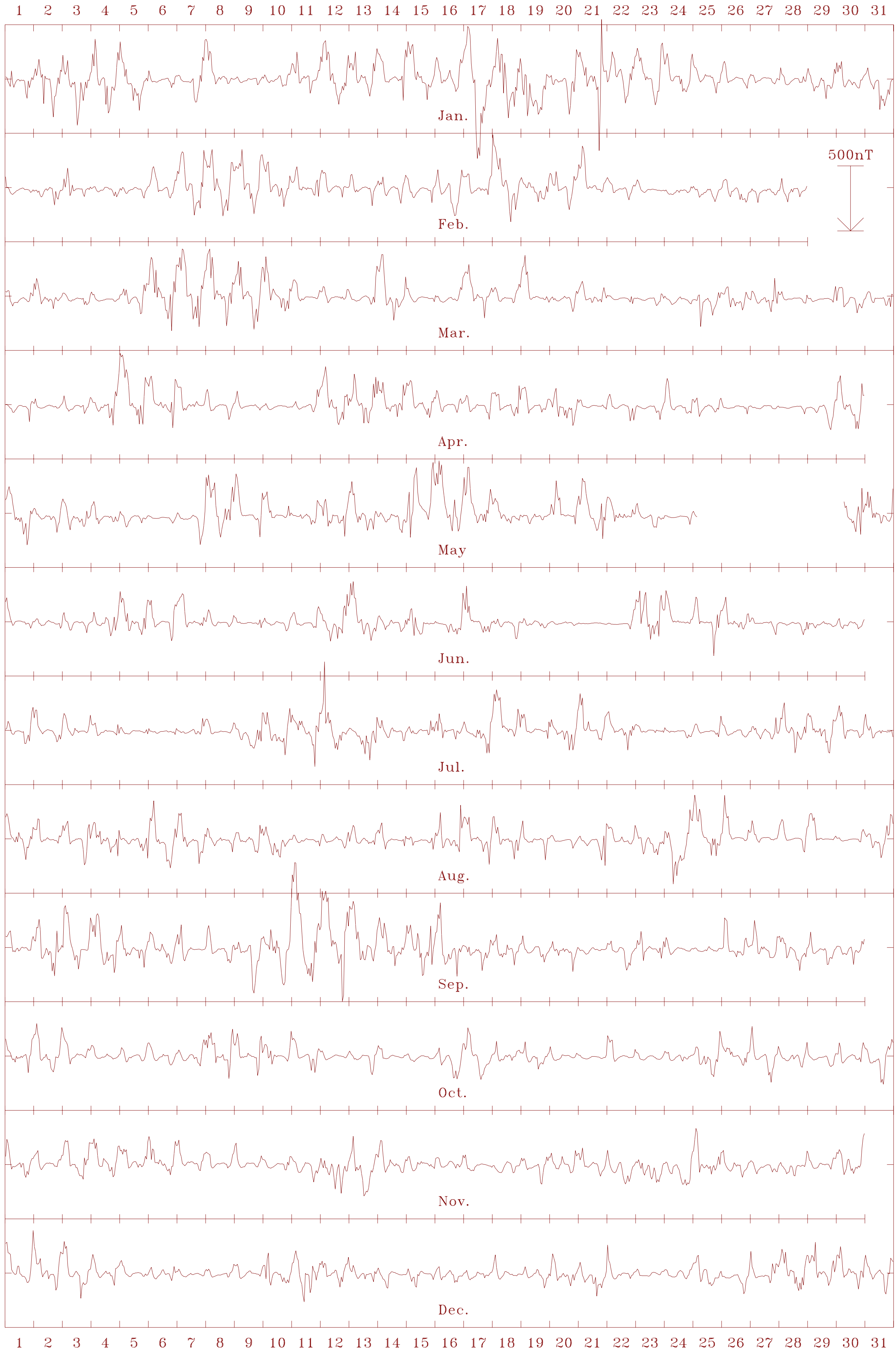
The reference levels indicated with marks on the vertical axes refer to the *all-days* mean value for the respective months. All elements in the plots are shown increasing (algebraically) towards the top of the page, with the exception of Z, which is in the opposite sense.

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

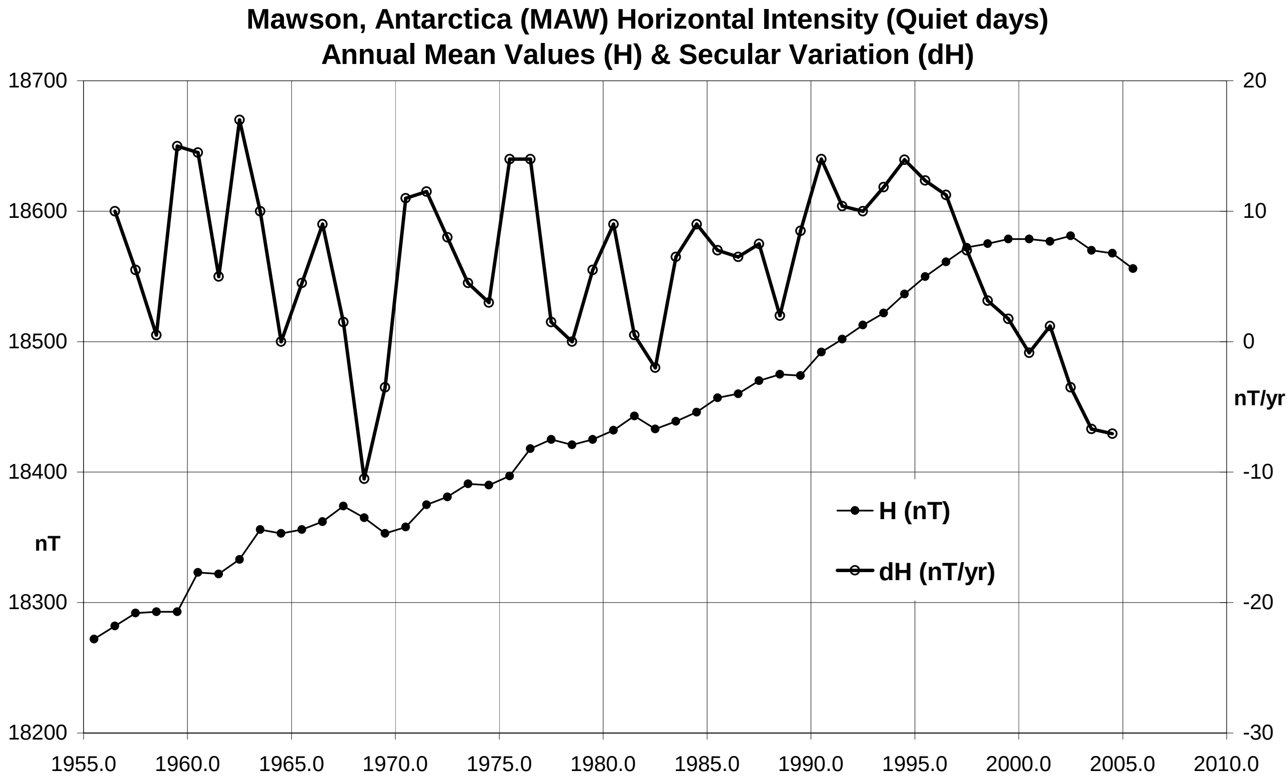
Mawson Stn. 2005 Horizontal intensity (H). Scale: 40.0 nT/mm. Mean: 18535 nT

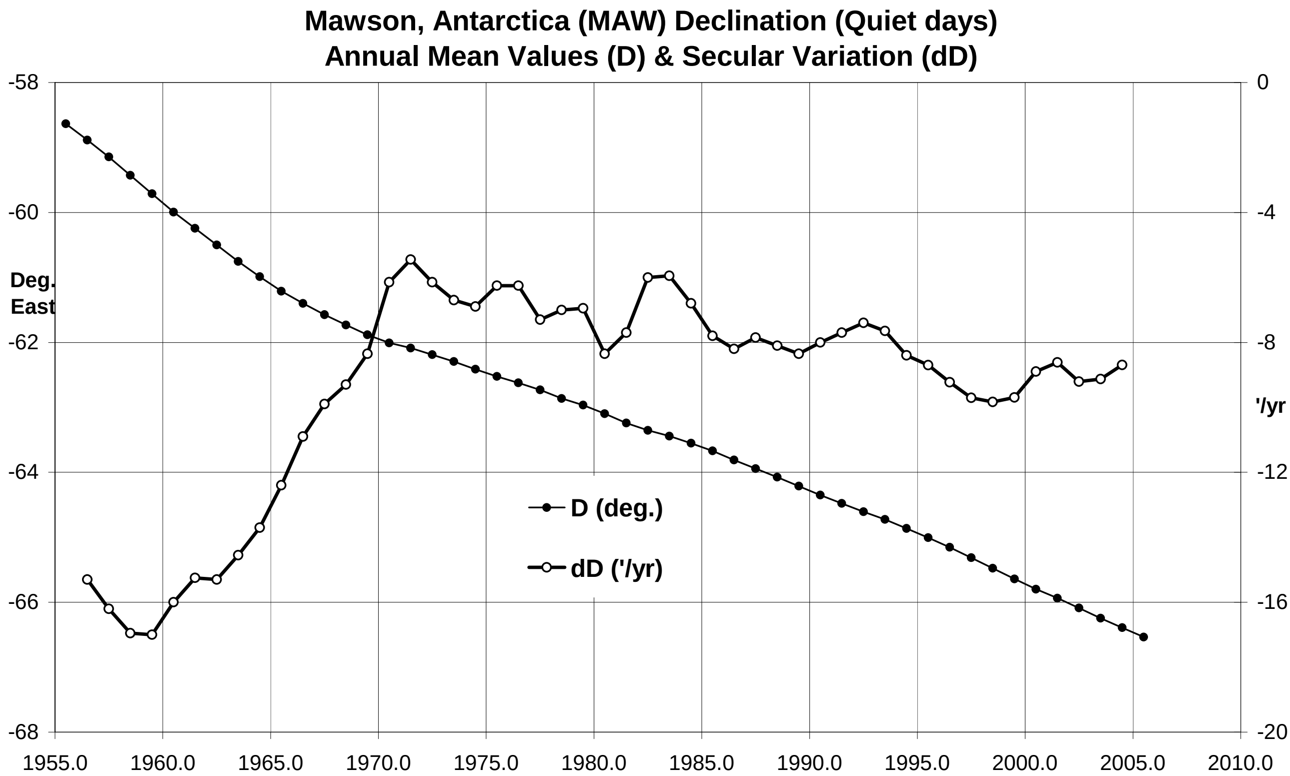
Mawson Stn. 2005 Declination (east) (D). Scale: 5.00 min/mm. Mean: −66.55 deg.

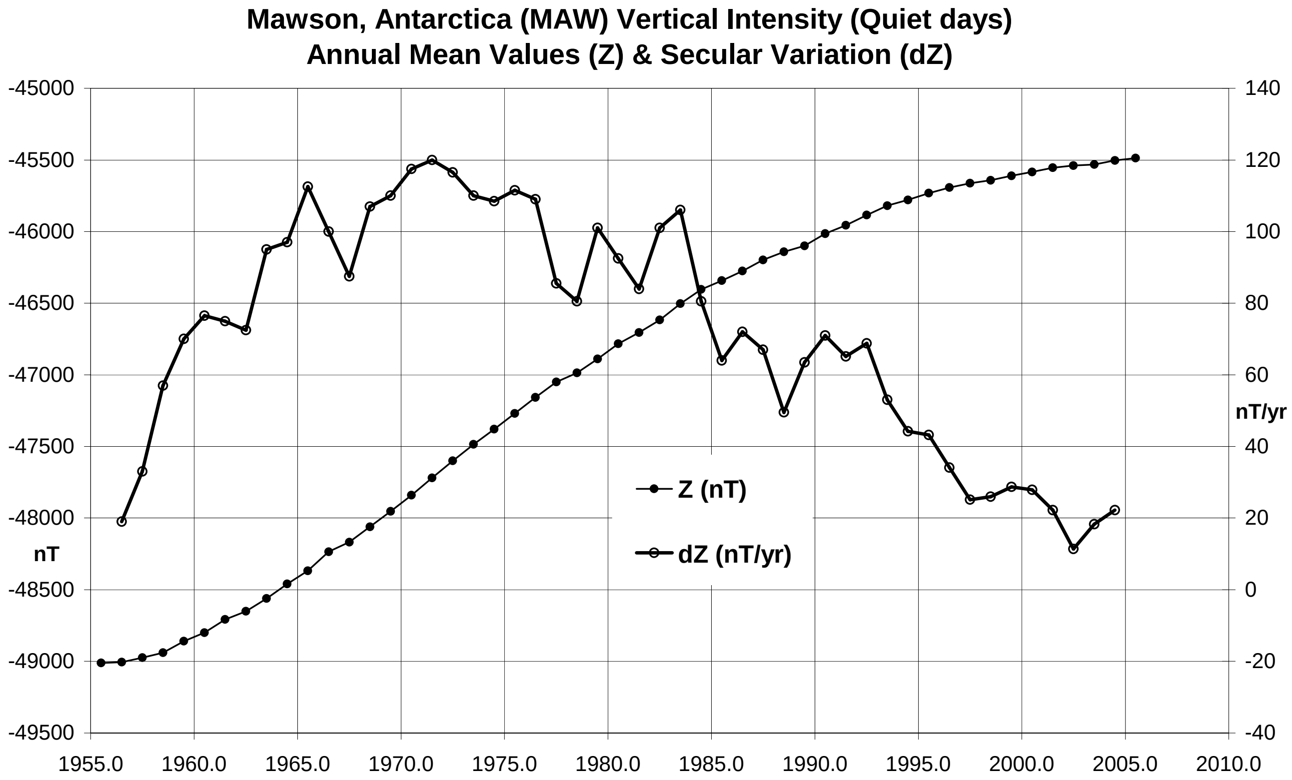
Mawson Stn. 2005 Vertical intensity (Z). Scale: 40.0 nT/mm. Mean: −45499 nT

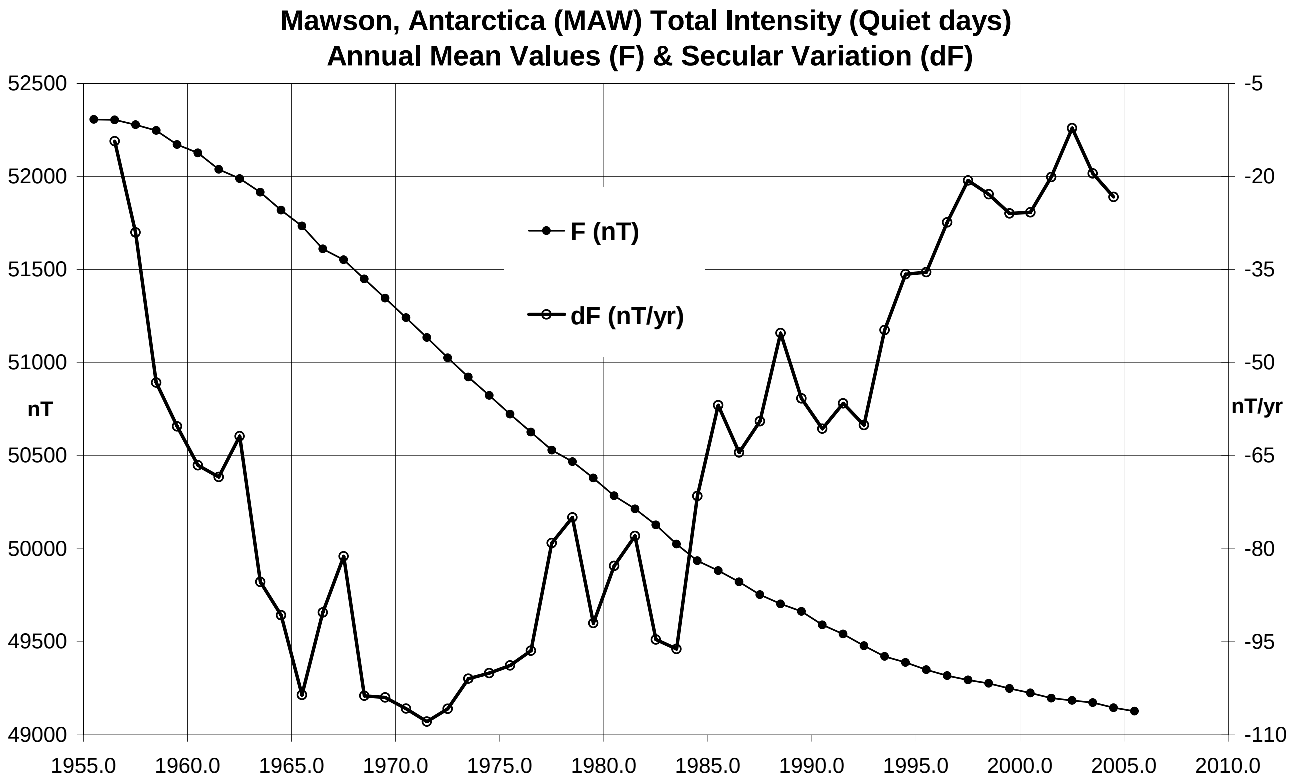


Mawson Stn. 2005 Total intensity (F). Scale: 40.0 nT/mm. Mean: 49130 nT


Mawson, Antarctica (MAW) Horizontal Intensity (Quiet days)
Annual Mean Values (H) & Secular Variation (dH)
18700
18600
18500
18400
18300
18200
nT
20
10
0
-10
-20
-30
nT/yr
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0
2010.0
H (nT)
dH (nT/yr)


Mawson, Antarctica (MAW) Declination (Quiet days)
Annual Mean Values (D) & Secular Variation (dD)
-58
-60
-62
-64
-66
-68
Deg.
East
0
-4
-8
-12
-16
-20
'/yr
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0
2010.0
D (deg.)
dD ('/yr)


Mawson, Antarctica (MAW) Vertical Intensity (Quiet days)
Annual Mean Values (Z) & Secular Variation (dZ)
Z (nT)
dZ (nT/yr)
nT
nT/yr
-45000
-45500
-46000
-46500
-47000
-47500
-48000
-48500
-49000
-49500
140
120
100
80
60
40
20
0
-20
-40
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0
2010.0


Mawson, Antarctica (MAW) Total Intensity (Quiet days)
Annual Mean Values (F) & Secular Variation (dF)
F (nT)
dF (nT/yr)
nT
nT/yr
52500
52000
51500
51000
50500
50000
49500
49000
-5
-20
-35
-50
-65
-80
-95
-110
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0
2010.0

MAW – Annual Mean Values (cont.)

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
2005.5	A	-66	33.0	-67	50.1	18535	7376	-17004	-45499	49130	ABC
1992.5	D	-64	39.6	-68	05.2	18466	7904	-16689	-45907	49482	XYZ
1993.5	D	-64	45.9	-68	03.0	18476	7877	-16713	-45847	49430	ABC
1994.5	D	-64	55.3	-68	01.9	18476	7831	-16734	-45804	49390	ABC
1995.5	D	-65	01.7	-67	58.8	18504	7812	-16774	-45752	49353	ABC
1996.5	D	-65	11.1	-67	56.2	18525	7775	-16814	-45707	49318	ABC
1997.5	D	-65	20.4	-67	55.0	18534	7733	-16844	-45682	49299	ABC
1998.5	D	-65	30.9	-67	54.8	18530	7680	-16864	-45665	49282	ABC
1999.5	D	-65	41.0	-67	53.9	18528	7630	-16884	-45626	49245	ABC
2000.5	D	-65	49.7	-67	52.6	18543	7593	-16917	-45614	49239	ABC
2001.5	D	-65	56.4	-67	51.6	18547	7561	-16935	-45583	49212	ABC
2002.5	D	-66	07.6	-67	51.2	18540	7504	-16953	-45552	49180	ABC
2003.5	D	-66	17.4	-67	53.3	18510	7443	-16947	-45556	49173	ABC
2004.5	D	-66	26.0	-67	52.1	18517	7404	-16972	-45530	49152	ABC
2005.5	D	-66	35.5	-67	53.4	18492	7347	-16970	-45517	49130	ABC

* Elements ABC indicates non-aligned variometer orientation

Summary of data loss from the Australian observatories

The table below summarizes the 2005 monthly digital data acquisition losses, in minutes per month, at the Australian observatories. The first figure refers to the principal 3-component variometers and the second figure (in parentheses) to the recording total intensity instruments. A single figure indicates the same data loss in a month for both instruments. Annual totals and percentage losses are also shown.

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

2005	KDU	CTA	LRM	ASP	GNA	CNB	MCQ	CSY	MAW
Jan	0	165 (1885)	65 (167)	0 (71)	0	0	0	495	0 (31 days)
Feb	0	9953 (52)	3 (3)	0	0	6 (3)	4553	495	0 (28 days)
Mar	0	0	1273 (4949)	0 (19,544)	9942 (18327)	16 (2654)	0	2	5 (31 days)
Apr	88	0 (89)	6 (4671)	2 (43,200)	7,532 (7534)	0	0	2	0 (30 days)
May	0	0	4 (815)	0 (32,200)	22 (513)	1462 (1)	0	13	7,272 (31 days)
Jun	0	87 (71)	81 (1762)	0	2632	0 (5)	121	2	0 (30 days)
Jul	0	0	0 (3)	0	8186 (8590)	6	440	10	0 (31 days)
Aug	0	0	0	4 (14)	213 (223)	0	14641	338	0 (31 days)
Sep	0	0	0	262 (244)	4	1006 (9)	0	7	4 (30 days)
Oct	0	1600 (2588)	0 (1)	0	1992 (2003)	0	407	1197	0 (31 days)
Nov	0	0	0 (10)	0	0	3666 (0)	0	670	0 (30 days)
Dec	0	0	0	0	0	0	2	1323	199 (14d9h)
3-axis varIom.	88 (0.017%)	11,805 (2.25%)	1,432 (0.27%)	268 (0.051%)	30,523 (5.81%)	6162 (1.17%)	20,164 (3.83%)	4,554 (0.87%)	7,480 (1.42%)
Total field	65,803 (12.5%)	4,685 (0.89%)	12,381 (2.36%)	95,281 (18.1%)	39,826 (7.58%)	2678 (0.51%)	20,164 (3.83%)	no PPM	349.38 days (95.72%)

REPEAT STATION NETWORK

GA maintains a network of fifteen repeat stations throughout mainland Australia, its offshore islands, and the south-west Pacific region. The repeat stations are usually occupied at intervals of approximately two years to determine the secular variation of the magnetic field. During each three to four day repeat station occupation, the magnetic field is monitored continuously with a portable on-site 4-component variometer system.

During 2005 a Narod three-axis ring-core fluxgate magnetometer (portable PC104 model) was used to monitor variations in three orthogonal components of the magnetic field. The digital output from this magnetometer was recorded as 1-second values with a portable industrial computer running the Geophysical Data Acquisition Platform (GDAP) on a QNX operating 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.

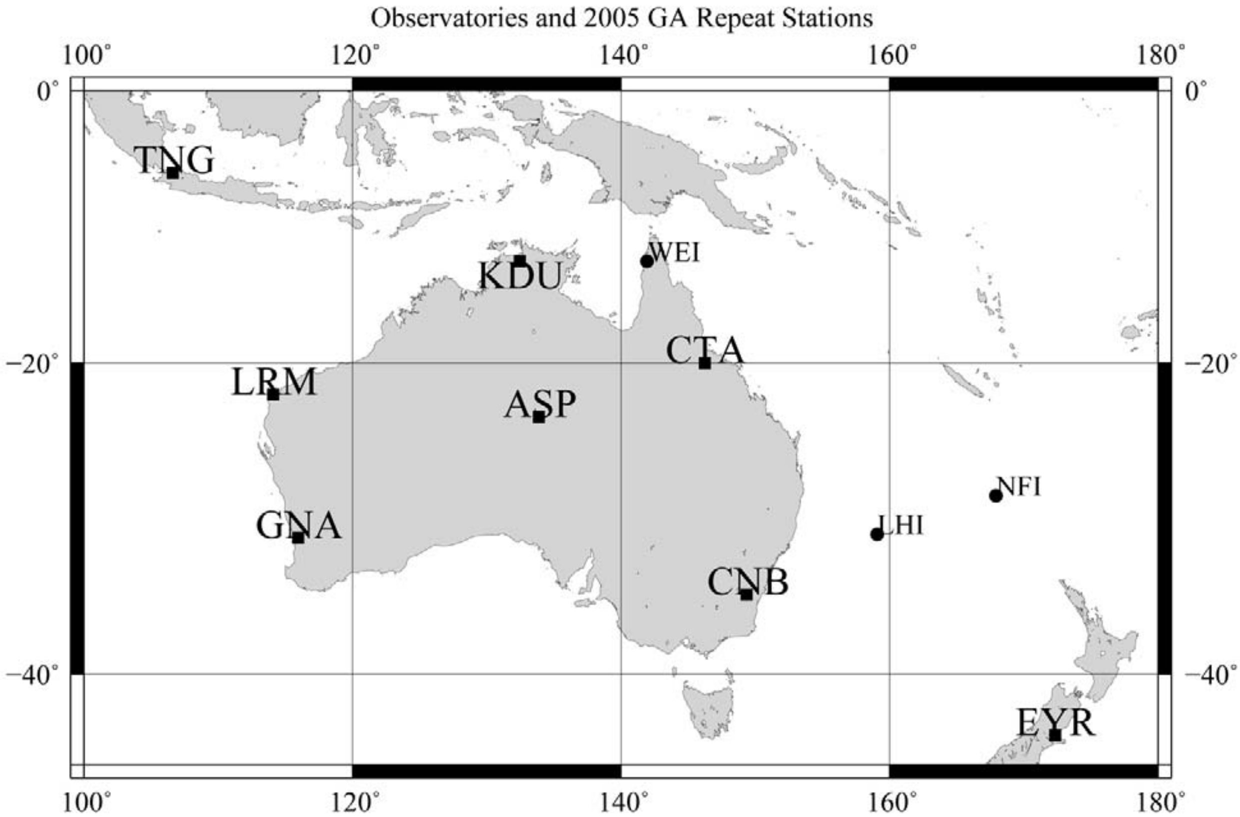
The magnetometers, acquisition and recording system were all powered by either 12V DC batteries and solar panels or 240V AC mains power, depending on the location. Preliminary data processing and analysis was carried out on-site on a lap-top computer.

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

The absolute instruments used on the repeat station surveys during 2005 were Danish Meteorological Institute DIM DI0050 with Zeiss 020B theodolite no. 308887, and GEM Systems GSM90 no. 810881 with sensor no. 31960. This GSM90 was also used for total field surveys around each station.

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

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



The distribution of permanent magnetic observatories and repeat stations occupied in 2005

Station Occupations in 2005

Three repeat stations were re-occupied in November 2005: Weipa (WEI), Norfolk Island (NFI) and Lord Howe Island (LHI). The map above shows the location of these repeat stations and the permanent magnetic observatories in the region.

The adopted normal field values at the time of the 2005 occupations and the average secular variation over the interval between the two most recent occupations for each station are shown in the tables below. All available data from the repeat stations are plotted in the figures that follow.

Adopted Main Field Values at Time of Station Occupations

Station (site)	Occupation	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D	I
Weipa (B)	2005-11-06	35446	3478	-29494	46243	35616	05º 36.2’	-39º 37.7’
Norfolk Island (B)	2005-11-10	27549	7452	-42900	51526	28539	15º 08.2’	-56º 22.0’
Lord Howe Island (D)	2005-11-27	25314	6663	-47832	54526	26176	14º 44.8’	-61º 18.6’

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)
Weipa (B)	2002-11-10	-7	-12	+38	-30	-8	-1.1	+1.8
Norfolk Island (B)	2002-11-15	-19	-11	+34	-40	-21	-0.7	+0.1
Lord Howe Island (D)	2002-11-19	-8	-7	+36	-36	-10	-0.6	+0.6

Distribution of Repeat Station data

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

Australian Geomagnetic Reference Field

The 2005 revision of the Australian Geomagnetic Reference Field (AGRF05) was released in 2005 (Lewis, 2005). It is a harmonic model of the geomagnetic field over a spherical cap shaped region of radius 28° centred on latitude 24° S and longitude 135° E. AGRF05 models the magnetic field originating from the Earth’s core and long wavelength crustal sources, and includes shorter wavelength information than global field models such as the International Geomagnetic Reference Field (IGRF). AGRF05 is considered the best available geomagnetic field model for direction-finding applications in the Australian region.

The main field model in AGRF05 is based on an extensive data set comprising vector survey data from GA’s Third Order ground survey, the U.S. Navy's Project Magnet high elevation aeromagnetic surveys, MAGSAT and Ørsted satellite data, magnetic observatory and repeat station data for the region.

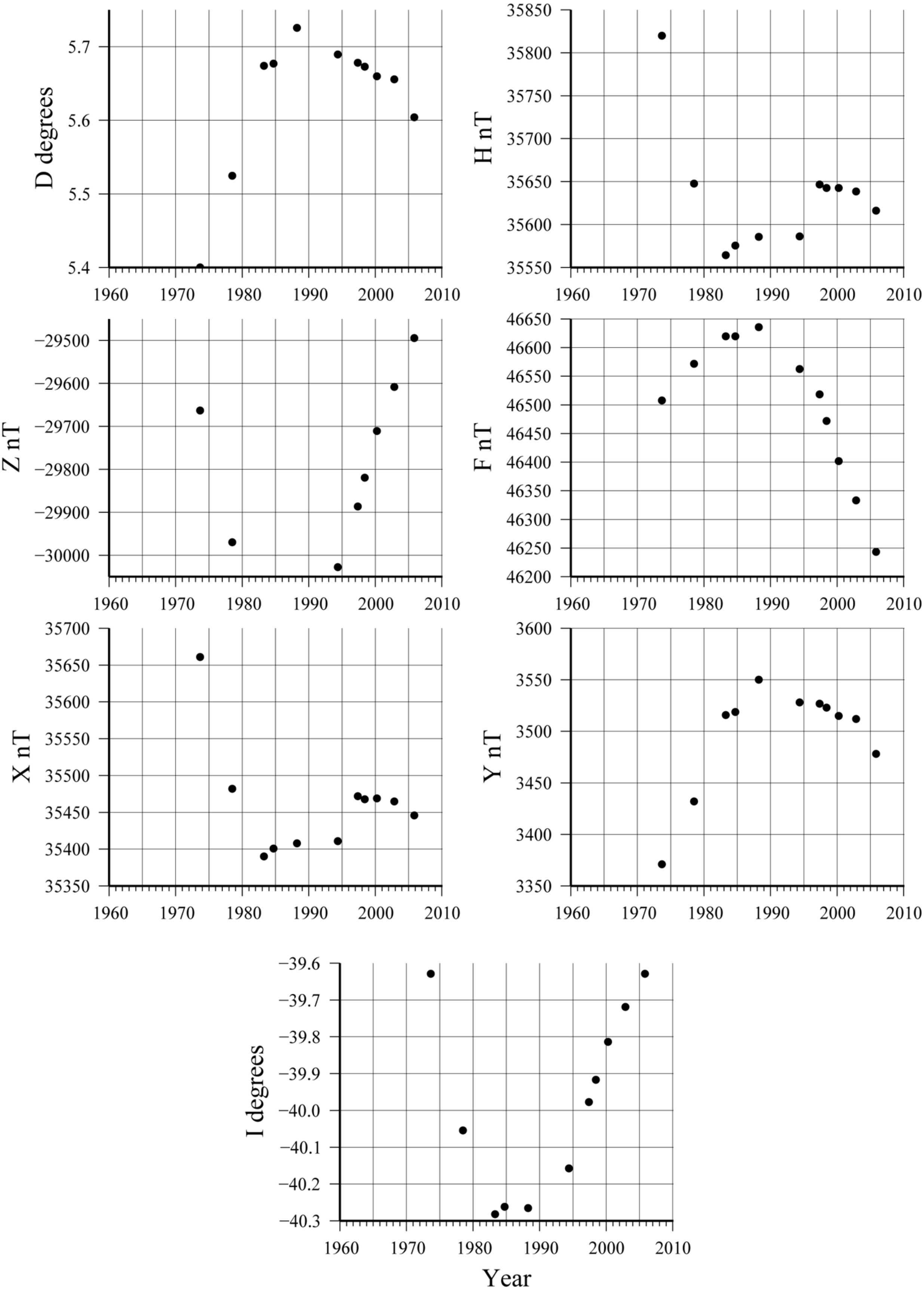
The secular variation model in AGRF05 is based on geomagnetic observatory and repeat station data.

The figures that follow show main field and secular variation contours of the geomagnetic field in the Australian region derived from the AGRF05 model at epoch 2005.0. The contours are derived from the AGRF05 model within a 24° spherical cap area. The 24° cap is considered the safe region in which AGRF is free from edge-effects. The cap outline is marked on the charts as a circular boundary. Outside this cap area the contours are derived from the IGRF-10 model at epoch 2005.0. The magnetic contours are in units of nanoTesla and nanoTesla per year for magnitude elements (X ,Y, Z, F and H) and degrees and minutes-of-arc per year for the angular elements (D and I). The main field is contoured in red while the secular variation is shown as blue contour lines.

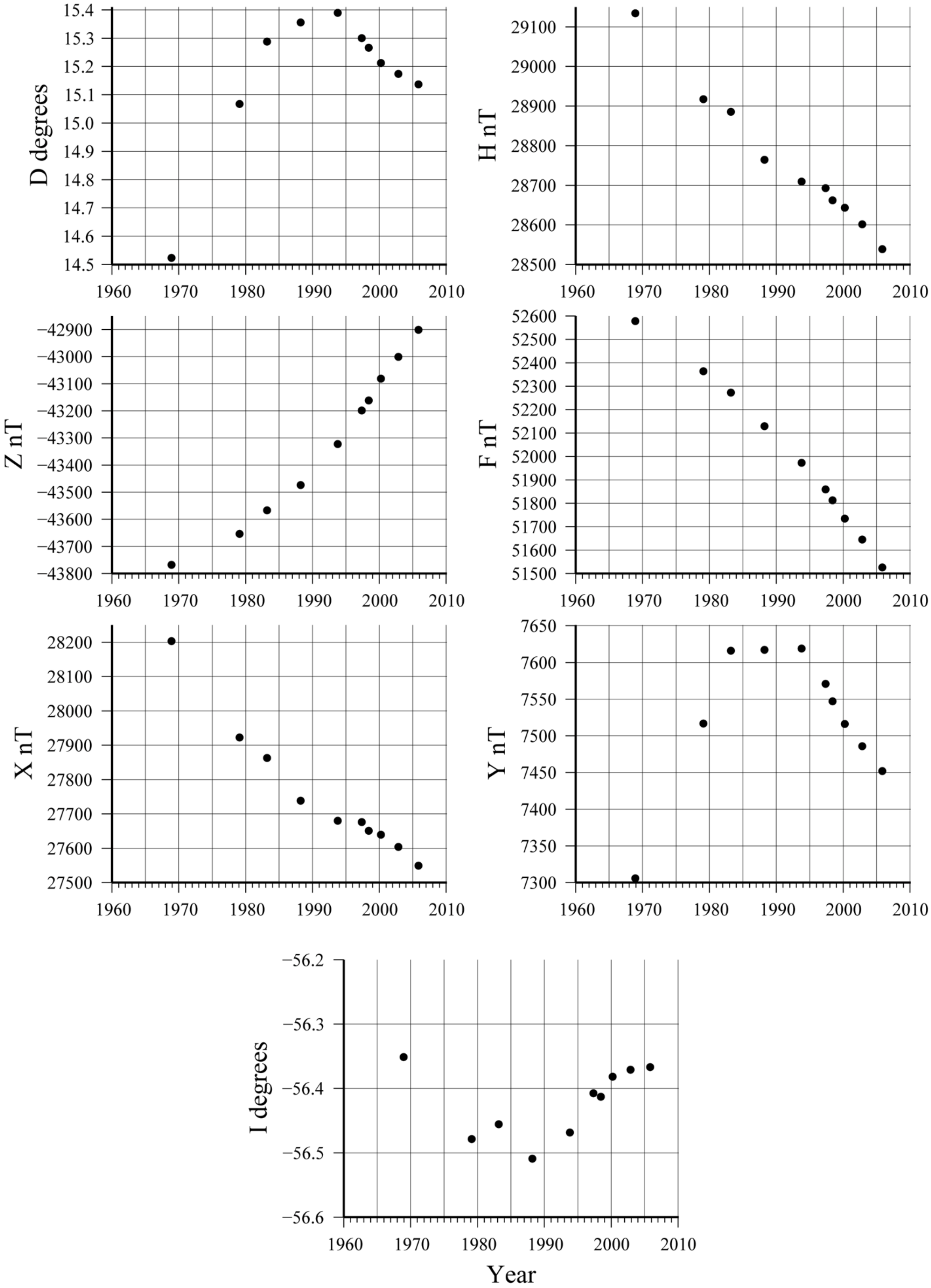
Epoch charts over the region have been produced on a regular basis since 1944. An Australian Geomagnetic Reference Field model (AGRF) has been produced every five years since 1980. These were listed in the *Charts and Models* table that appeared in *AGRs 1993-1997*.

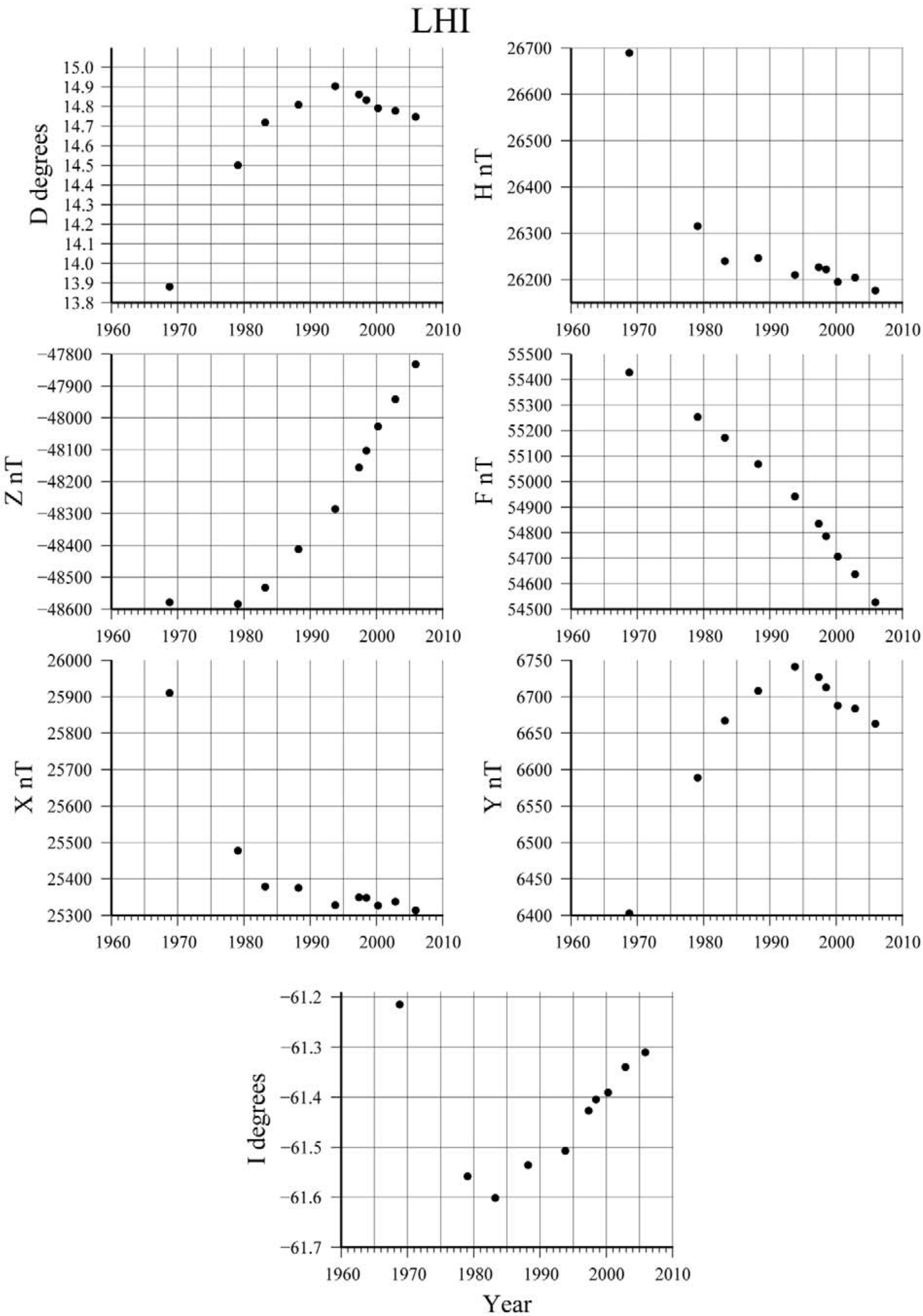
It is anticipated that the next AGRF model to be developed will be for epoch 2010.0.

WEI

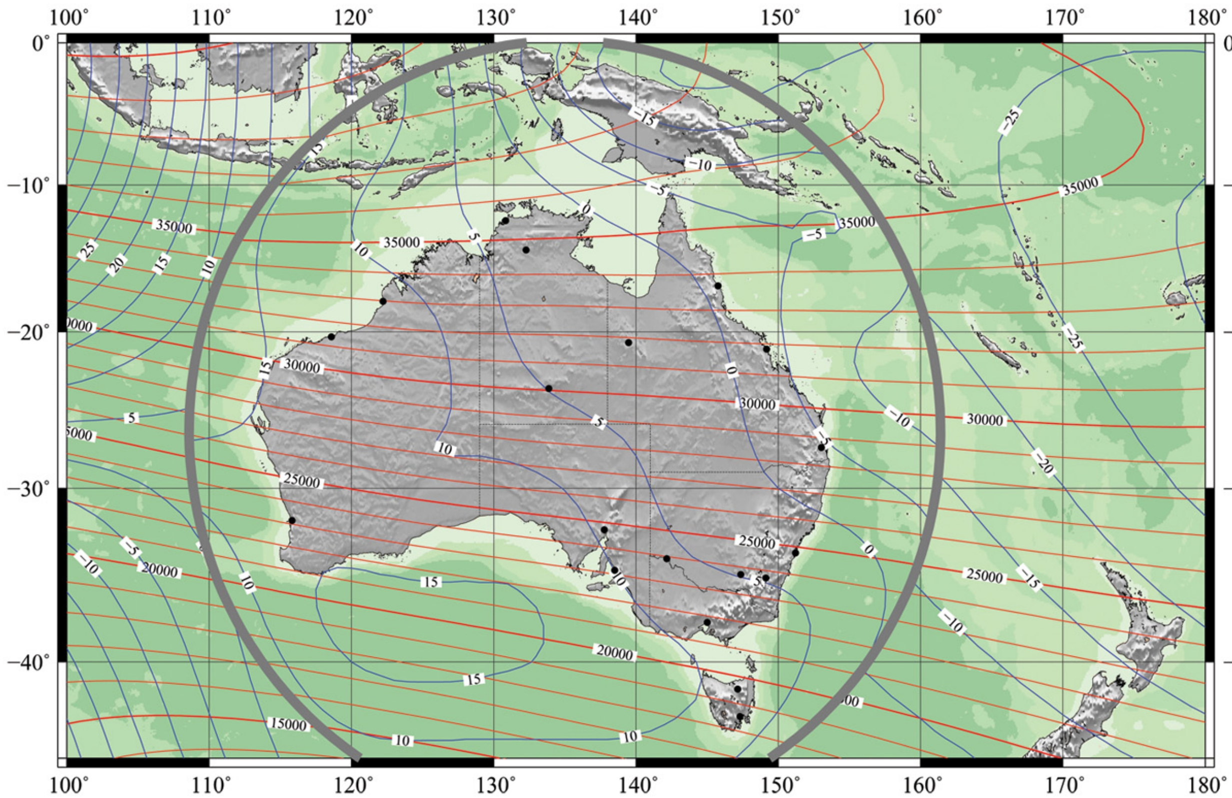

D degrees
5.4
5.5
5.6
5.7
H nT
35550
35600
35650
35700
35750
35800
35850
Z nT
−29500
−29600
−29700
−29800
−29900
−30000
F nT
46200
46250
46300
46350
46400
46450
46500
46550
46600
46650
X nT
35350
35400
35450
35500
35550
35600
35650
35700
Y nT
3350
3400
3450
3500
3550
3600
I degrees
−39.6
−39.7
−39.8
−39.9
−40.0
−40.1
−40.2
−40.3
1960
1970
1980
1990
2000
2010
Year

NFI

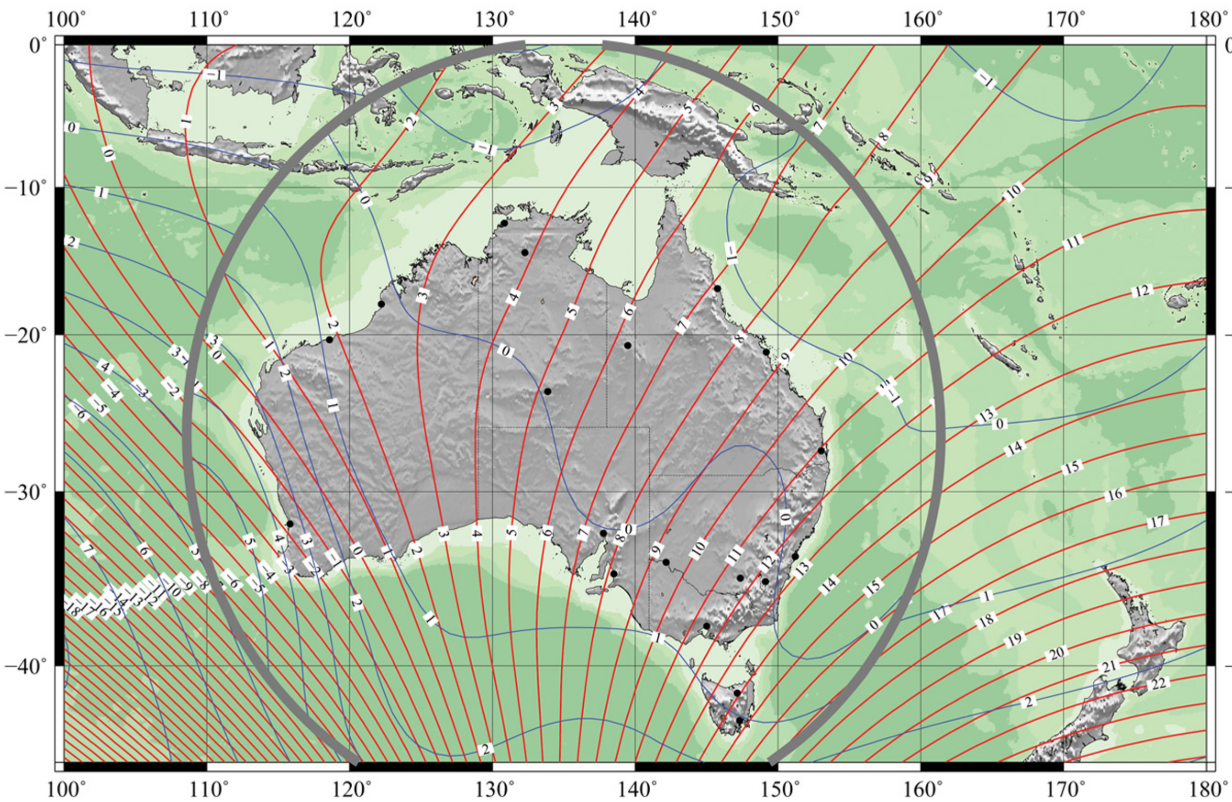



LHI
D degrees
15.0
14.9
14.8
14.7
14.6
14.5
14.4
14.3
14.2
14.1
14.0
13.9
13.8
H nT
26700
26600
26500
26400
26300
26200
Z nT
−47800
−47900
−48000
−48100
−48200
−48300
−48400
−48500
−48600
F nT
55500
55400
55300
55200
55100
55000
54900
54800
54700
54600
54500
X nT
26000
25900
25800
25700
25600
25500
25400
25300
Y nT
6750
6700
6650
6600
6550
6500
6450
6400
I degrees
−61.2
−61.3
−61.4
−61.5
−61.6
−61.7
1960
1970
1980
1990
2000
2010
Year

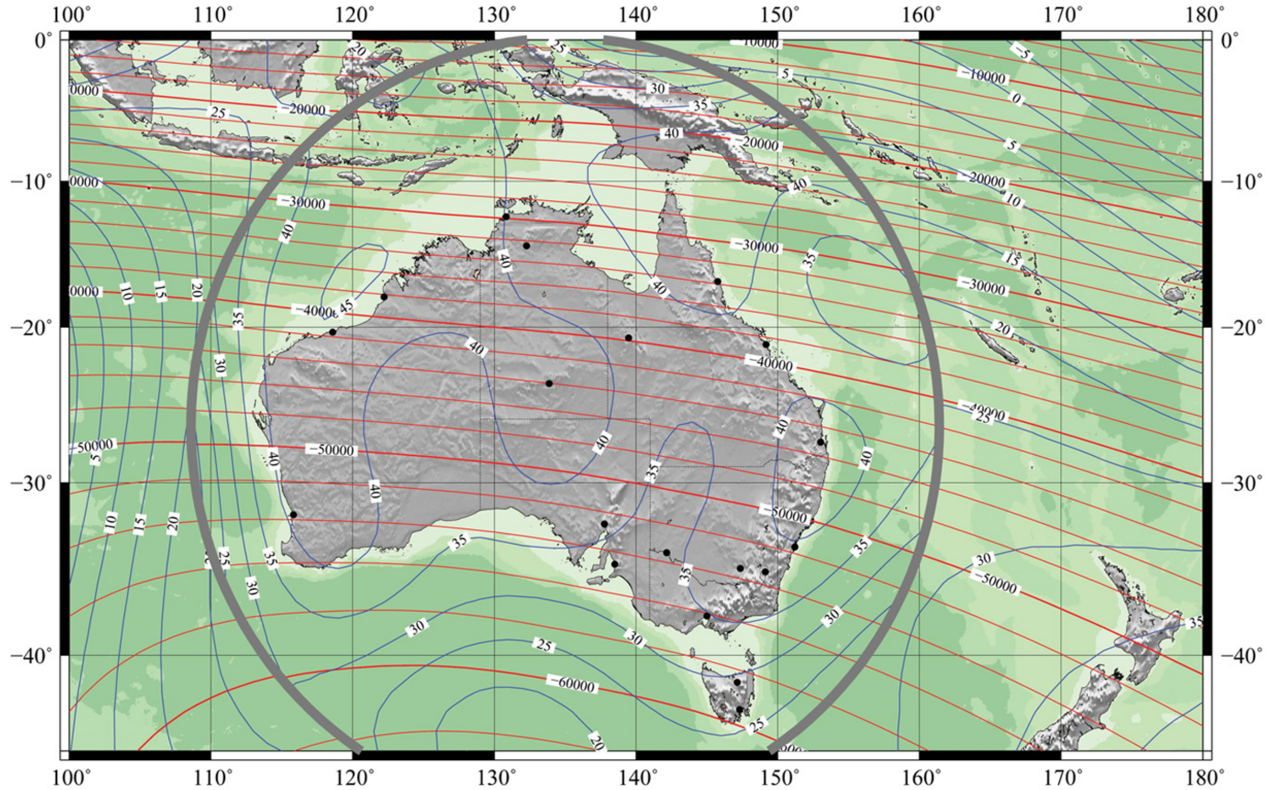
AGRF2005 Horizontal Field at Epoch 2005.0



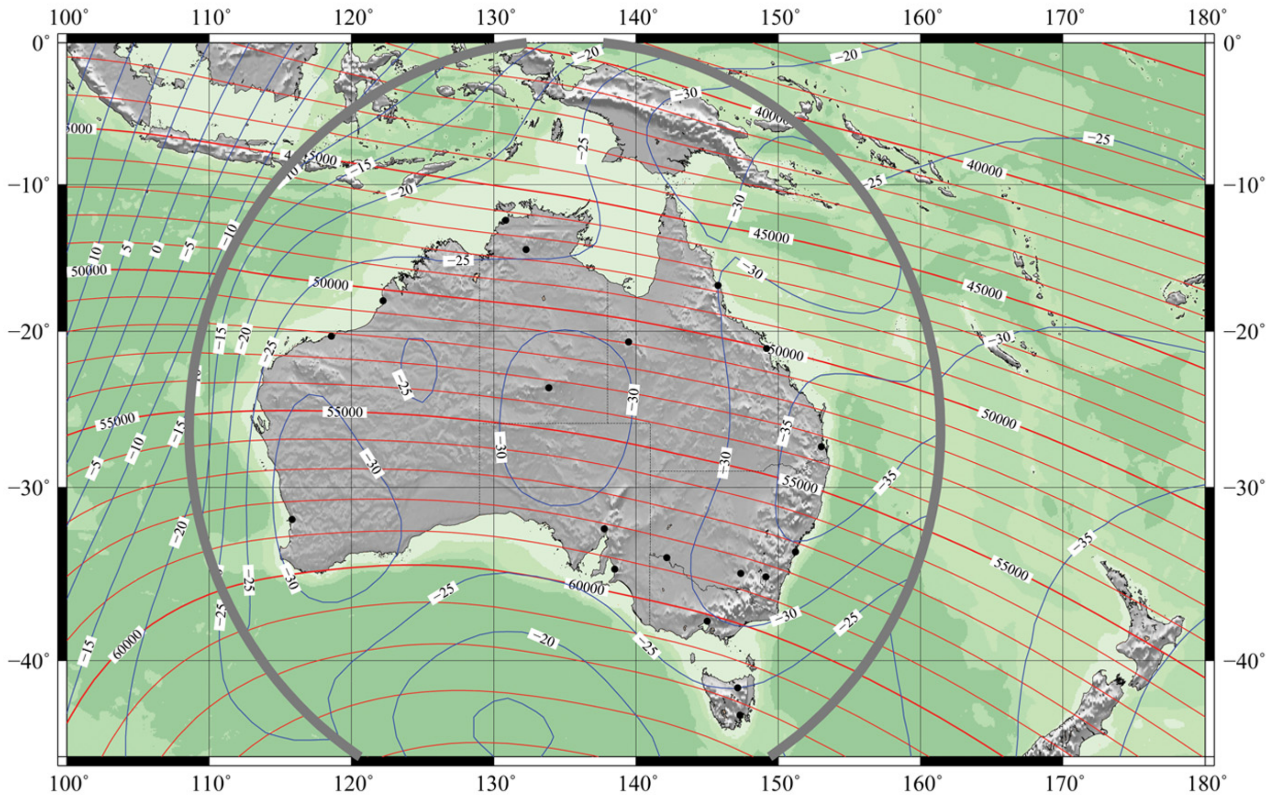
AGRF2005 Declination at Epoch 2005.0



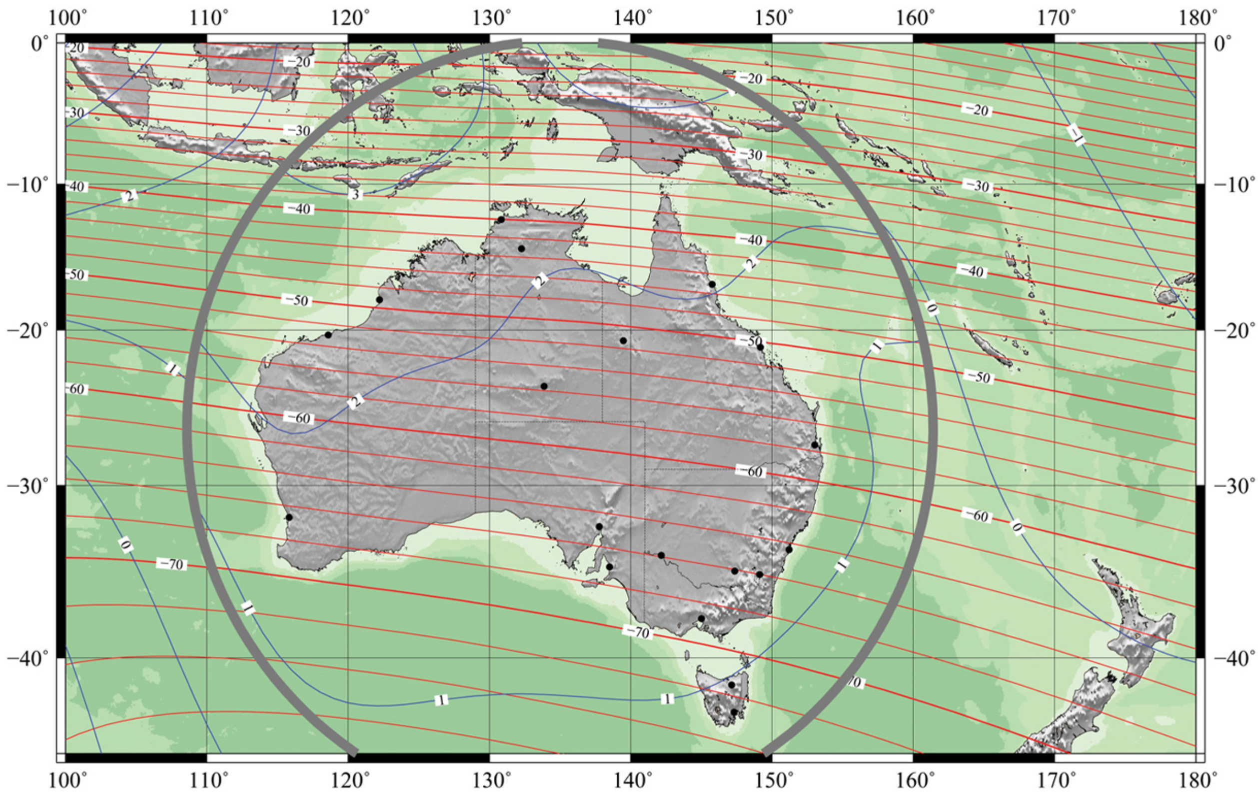
AGRF2005 Vertical Field at Epoch 2005.0



AGRF2005 Total Field at Epoch 2005.0



AGRF2005 Inclination at Epoch 2005.0



International Quiet and Disturbed Days

2005	Quietest days 1 - 5					Quietest days 6 - 10					Most Disturbed days 1 - 5				
January	26	27	25	9K	6	10	28K	24A	11A	13A	18	17	21	19	2
February	5	23	4	15	13	22	12	24K	1K	14	18	8	7	9	10
March	4	22	12	20	23	15	28	3	29	24	7	6	8	9	25
April	10	27	26	28	21	2	9	8	17	1	5	13	12	30	4
May	26	27	25	24	5	6	23	4	14	2A	30	8	15	16	1
June	21	10	20	28	27	8	19	9	11	29	23	12	13	16	4
July	6	24	5	25	8	26	4	23	15	7	10	12	13	9	28
August	11	20	30	12K	28	27	19	15K	26K	8	24	31	6	25	13*
September	24	21	20	25K	8	23K	22	19	29A	6A	11	12	15	13	2
October	15	12	23	20	14	21	5	4	29	6	8	25	31*	2*	17*
November	16	27	10	8	17	9	15	18	21	26	3	4	13*	6*	30*
December	23	7	8	6	15	5	14	18	17	24	11	28*	27	1*	20*

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

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

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

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Observatory Maintenance Reports for 2005

Gnangara Observatory Maintenance, Geomagnetism Note **2005-10** (Nick Bartzis)

Alice Springs Geomagnetic Observatory Maintenance Visit May 2005, Geomagnetism Note **2005-11** (Andrew Lewis)

Learmonth Geomagnetic Observatory Maintenance Visit June 2005, Geomagnetism Note **2005-12** (Andrew Lewis and Bruce Sibson)

Charters Towers Geomagnetic Observatory Maintenance Visit August 2005, Geomagnetism Note **2005-13** (Liejun Wang)

Alice Springs Geomagnetic Observatory Maintenance Visit September 2005, Geomagnetism Note **2005-14** (Andrew Lewis and Bruce Sibson)

Geomagnetism Staff List 2005

Name	Classification	Responsibility
Peter A. Hopgood	GA Level 6	Project Management (to June 2005)
Peter G. Crosthwaite	GA Level 5	Digital acquisition, system and software development and maintenance; Kakadu and Mawson observatories
Andrew M. Lewis	GA Level 5	Project Management (from July 2005); Repeat Station Survey; Learmonth, Alice Springs (jointly) and Macquarie Is. observatories; Australian Geomagnetic Reference Field Model.
Liejun Wang	GA Level 4	Data-base development; Canberra and Charters Towers observatories
Nick Bartzis	GA Level 2	Gnangara, Alice Springs (jointly) and Casey observatories
Bruce Sibson	GA Level 3	Technical support
Owen D. McConnel	GA Level 3	Technical support, Western Australia*

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

Non-GA Observers/OICs

Warren Serone	ACRES (contracted by GA)	Alice Springs
Jack M. Millican	Contracted by GA	Charters Towers
Graham Steward (to 01 Jul 2005)	Learmonth Solar Observatory, IPS	Learmonth
Owen Giersch (from 04 Jul 2005)	Learmonth Solar Observatory, IPS	Learmonth
Rory Lynch	Contracted by GA	Kakadu
Gerard (Hans) Van Reeken	Contracted by GA	Gnangara
Glenn Roser (to mid-March 2005)	Technical Officer (AAD & GA)	Mawson, summer 2004/05 observer
Matt Leayr (to mid November 2005)	Technical Officer (AAD & GA)	Mawson, over-wintering 2005 observer
Dominic Taylor (from mid-Nov. 2005)	Technical Officer (AAD & GA)	Mawson, over-wintering 2006 observer
Henry Banon	Technical Officer 2 (AAD & GA)	Macquarie Island, 2003/04 observer
Spencer Redfern	Technical Officer 2 (AAD & GA)	Macquarie Island, 2004/05 observer
Chris Clarke	Technical Officer 2 (AAD & GA)	Casey, 2005 observer
Tracey Taylor	Technical Officer 2 (AAD & GA)	Casey, 2006 observer

End of Part 2