GEOSCIENCE AUSTRALIA

AUSTRALIAN GEOMAGNETISM REPORT 1999

MAGNETIC OBSERVATORIES

VOLUME 47

Department of Industry, Tourism and Resources

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Australian Geomagnetism Report 1999 - Volume 47

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AUSTRALIA

Magnetic results for 1999

Alice Springs

Canberra

Charters Towers

Gnangara

Kakadu

Learmonth

Macquarie Island

Mawson

Casey

Davis

Australian Repeat Station Network

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ISSN: 1035-1515

SUMMARY

During 1999 the Australian Geological Survey Organisation (now Geoscience Australia) operated geomagnetic observatories at Alice Springs and Kakadu in the Northern Territory, Canberra in the Australian Capital Territory, Charters Towers in Queensland, Gnangara and Learmonth in Western Australia, Macquarie Island, Tasmania, in the sub-Antarctic, and Mawson in the Australian Antarctic Territory.

Magnetic recording also took place at the stations of Casey and Davis in the Australian Antarctic Territory. These operations were the joint responsibility of the Australian Antarctic Division of the Commonwealth Department of the Environment and Heritage and GA. Casey was upgraded to magnetic observatory standard, including twice-weekly absolute observations. Davis magnetic station did not have sufficient absolute control to be considered observatory standard, so continued to be regarded as a variation station.

The magnetometers at the Canberra Magnetic Observatory are the Australian standards. The calibration of these instruments can be traced to International Standards. Absolute magnetometers at all the other Australian observatories are standardised to 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 and at Copenhagen, Denmark, as well as to INTERMAGNET. K indices, principal storms and rapid variations were hand-scaled at the Canberra and Gnangara observatories, and provided regularly to the International Service of Geomagnetic Indices. K indices were digitally scaled at the Mawson observatory.

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

A total of seven magnetic repeat stations were occupied in 1999.

The magnetic observatory at Tangerang, Indonesia was upgraded by GA's Geomagnetism group under an AusAID grant.

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 1999.

ACRONYMS and ABBREVIATIONS

AAD	Australian Antarctic Division
ACRES	Australian Centre for Remote Sensing
ACT	Australian Capital Territory
A to D	Analogue to Digital (data conversion)
ADAM	Data acquisition module produced by Advantech Co. Ltd.
AGR	Australian Geomagnetism Report
AGRF	Australian Geomagnetic Reference Field
AGSO	Australian Geological Survey Organisation (formerly BMR)
AMO	Automatic Magnetic Observatory
ANARE	Australian National Antarctic Research Expedition
ANARESAT	ANARE satellite (communication)
ASP	- Alice Springs (Magnetic Observatory) - 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)
BoM	(Australian) Bureau of Meteorology
CD-ROM	Compact Disk - Read Only Memory
CNB	Canberra (Magnetic Observatory)
CODATA	Committee on Data for Science and Technology
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSY	Casey (Variation Station)
CTA	Charters Towers (Magnetic Observatory)
D	Magnetic Declination (variation)
DC	Direct Current
DEH	Department of the Environment and Heritage
DIM	Declination & Inclination Magnetometer (D,I-fluxgate magnetometer)
DMI	Danish Meteorological Institute
DOS	Disk operating system (for the PC)
DVS	Davis (Variation Station)
EDA	EDA Instruments Inc., Canada
EDAS	Environmental Data Recording System
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
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)
PEM	Photo-Electronic Magnetometer
PGR	Proton Gyromagnetic Ratio
PPM	Proton Procession Magnetometer
PVC	poly-vinyl chloride (plastic)
PVM	Proton Vector Magnetometer
QHM	Quartz Horizontal Magnetometer
Qld.	Queensland
RCF	Ring-core fluxgate (magnetometer)
SC	Sudden (storm) commencement
sfe	Solar flare effect
ssc	Sudden storm commencement
Tas.	Tasmania
UPS	Uninterruptible Power Supply
UT/UTC	Universal Time Coordinated
W.A.	Western Australia
WDC	World Data Centre
WWW	World Wide Web (Internet)
X	North magnetic intensity
Y	East magnetic intensity
Z	Vertical magnetic intensity

CONTENTS – Part 1

CONTINUED OVERLEAF . . .

CONTENTS – Part 2

This is the first volume of the *Australian Geomagnetism Report* to be distributed in electronic format.

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

The *Australian Geomagnetism Report* will continue to be published electronically and will be available on Geoscience Australia's web site: *http://www.ga.gov.au/*

LEARMONTH OBSERVATORY

Learmonth, Western Australia, is situated on Australia's North West Cape overlooking the Exmouth Gulf to the east and Cape Range to the west. There is no town at Learmonth, only an airport and the Learmonth Solar Observatory, jointly staffed by the IPS Radio and Space Services, Department of Industry, Science & Resources and the U.S. Air Force. The nearest town is Exmouth, approximately 35km to the north. Learmonth is approximately 1100km north of the city of Perth.

The Learmonth Magnetic Observatory was established on the IPS/USAF Solar Observatory site in late November 1986 from when it has operated continuously. More details of the observatory's history are in *AGR 1994*.

The variometer sensors were housed in small underground concrete vaults located within the perimeter of the solar observatory grounds. The fluxgate sensor vault, approximately 50 metres to the east of the buildings, was set into the ground by about two-thirds of its 1m depth and had a thick concrete lid for temperature stability. Further temperature stability was gained by filling the vault with polystyrene beads and covering it with soil. A similar vault housed the proton magnetometer sensor. Sensor cables were protected by PVC conduits that ran underground from the vaults to the electronics console.

The control electronics and acquisition PC were located within the central or Radio Solar Telescope Network building of the solar observatory.

Absolute observations were performed at a site about 200 metres south of the solar observatory, situated on Royal Australian Air Force property. It consisted of a concrete observation pier within a roofed shelter with brick walls on two sides to the same height as the pier.

Key data for the observation pier of the observatory are:

- 3-character IAGA code: LRM
- Commenced operation: November 1986
- Geographic latitude: 22 13' 19" S
- Geographic longitude: 114° 06' 03" E
- Geomagnetic† latitude: -32.7°
- Geomagnetic† longitude: 186.1°
- Elevation above mean sea level (top of Pier A): 4 metres
- Lower limit for K index of 9: 300 nT.
- Azimuth of principal reference (west windsock) from Pier A: 283° 02' 18"
- Observer in Charge: M.W. McMullan (IPS)

† Based on the IGRF 1995 model.

Variometers

An EDA model FM105B 3-component fluxgate magnetometer, employed at the Learmonth observatory since its commissioning in 1986, served as the principal variometer until 0635UT on 11 February 1999. The EDA sensor head was oriented to monitor variations in the geomagnetic elements X, Y and Z.

Temperature variations within the fluxgate sensor were monitored with a Doric series 410A Trendicator digital thermometer, the sensor of which was also mounted inside the EDA sensor housing.

During February 1999, the EDA 3-axis sensor within the underground vault was damaged by water entering the vault. This necessitated the replacement of the variometer.

A Narod 3-axis ring-core fluxgate (RCF) variometer was installed on 12February 1999 and switched on at 0511UT. The sensor head was oriented to monitor variations in the magnetic north-west, magnetic north-east and vertical directions
The RCF contains its own temperature sensors so the Doric series 410A digital thermometers were decommissioned with the EDA.

During 1999 a Geometrics model 856 (no. 50708) proton precession magnetometer (PPM) measured variations in the total intensity of the magnetic field, F. This served both as a backup, should any one of the X, Y or Z variometer channels become unserviceable, and as an F-check of the variometer model.

Data Recording

Until 0635UT on 11 February 1999 data were recorded in X, Y, Z, F and temperature channels. Analogue outputs of X, Y & Z from the EDA fluxgate variometer and temperature from the Doric Trendicator were input to an EDAS-2 data logger, the digital outputs of which were recorded at 5-second intervals on the acquisition PC. 1-minute means of these data were also recorded on the acquisition PC. The digital output from the PPM was input directly to the acquisition PC each 1-minute. Timing was generated by the PC itself.

From 12 February 1999 at 0511h data were recorded digitally in 1-second intervals in X, Y, Z, and temperature. The digital output from the PPM was recorded at 10 second intervals. Both the PPM and RCF data were input directly to the PC. Timing was still generated by the acquisition PC.

The variometer and recording system was powered by 240VAC mains. The mains power was not reliable during 1999. The equipment was protected from power outages and surges by an uninterruptible power supply.

Absolute Instruments

Throughout 1999 the local observer regularly performed sets of absolute observations on the pier in the Absolute shelter using a Declination & Inclination Magnetometer (DIM) together with a PPM. The DIM comprising Bartington 010H no. 0702H fluxgate unit with Zeiss 020B theodolite no. 312714 was used together with Geometrics 856 no. 50471 PPM to perform sets of absolute observations throughout the year.

Instrument corrections

The corrections applied to the absolute magnetometers in 1999 were the same as those being applied at the end of 1998: 0.0′ and 0.0′ to D and I as measured by the DIM; and +0.4nT in F as measured by Geometrics 856 no.50471 PPM. The PPM correction comprised a +1.1nT raw difference from the Australian Standard PPM: MNS2 no.3, and a correction of -0.8nT to the latter. This resulted in baseline adjustments of:

$$\Delta X = +0.2\text{nT} \qquad \Delta Y = 0.0\text{nT} \qquad \Delta Z = -0.3\text{nT}.$$

Operations

The OIC at LRM magnetic observatory performed all routine operations at the observatory during 1999. The tasks included:

- Performance of a set of absolute observations each week;
- mailing weekly observation sheets to GA, Canberra each week.

5-second (until 11 Feb. 1999), then 1-second (from 12 Feb. 1999), and 1-minute mean raw data value files were transferred daily through modems via Telstra lines to GA in Canberra. The clocks on the acquisition PC were also regularly checked/corrected remotely from GA in Canberra.

LRM Operations (cont.)

In view of the small diurnal temperature variations within the variometer sensor vault, temperature coefficients for both the EDA and Narod fluxgate variometers were set to zero for 1999. Any temperature dependence of the variometer sensors contributed to baseline drifts over the year.

Absolute observations were processed at GA in Canberra.

During February it was found that the 3-axis fluxgate sensor pit had been flooded causing a degradation of the instrument's performance from 1018 on 05 Feb. 1999.

Significant Events 1999

Feb 05 1018 to 11/0634: EDA 3-axis fluxgate sensors were inundated and ran in a severely degraded mode (X & Y scattered, Z channel offset)

Feb 11 0635 to 12/0510: EDA switched off. PPM and acquisition systems continued running.

Feb 12 0511: Narod RCF 3-axis variometer installed in NW, NE, Z orientation.

Feb 17 First set of absolute observations performed after local observer returned from leave.

Mar 19 (approx.) New UPS installed.

Mar 21 0300: Observatory was shut-down due to tropical cyclone Vance arriving in the region.

Mar 25 Observatory re-opened after cyclone Vance.

May 31 to Jun 02 - Noise and spikes on variometer data due to proximity of a large crane to sensor vault. The crane was about 20m from the vault at times.

Jun 09 to 14th: Maintenance visit to Learmonth by staff from GA, Canberra. Instrument comparisons; total field and GPS surveys; rounds of angles; system upgrades were performed. For synchronisation of computer and RCF timing a GPS clock was installed.

LRM data loss in 1999

Jan 16 0003-0005 (3m) All channels.

Jan 21 1136 (1m) All channels.

Jan 22 0416 (1m) All channels.

Jan 25 0633-0634 (2m) All channels.

Jan 27 0231 to 28/0138 (926 mins. lost) F-channel only. PPM sampling rate reduced to 1 every 3 minutes.

Feb 02 1506, 1559 (2m): All channels.

Feb 05 0718-0719 (2m); 0756, 0802, 0852, 0917 (4m); 1131-1132 (2m): All channels.

Feb 08 2209-2210 (2m) EDA; 2210 (1m) F-channel.

Feb 11 0635 to 12/0510 (22h 36m) Fluxgate data not acquired when RCF replaced EDA.
1010-1018 (9m); 1025 (1m): F-channel.

Feb 12 0704-0707 (4m); 1535, 1605 (2m): No RCF data
0249 (1m); 0254-0353 (1h 00m); 0443-0444 (2m); 0704-0706 (3m); 1535 (1m): No PPM data

Feb 15 0303, 0309, 0841, 0911 (4m): All channels; 2354-2355 (2m) RCF; 2354 (1m) PPM.

Feb 17 1525 (1m) All channels;
1558 (1m) No RCF data

LRM data loss (cont.)

Feb 19 0033, 0126, 0328 (3m): All channels; 0034, 0329, 0413 (3m): RCF only lost.

Feb 26 2252 (1m) All channels

Mar 02 0839, 0926, 0930 (3m) All channels; 0927 (1m) RCF

Mar 03 0400, 0736, 0746 (3m): RCF lost; 0432; 0735; 1117, 1122 (4m): All channels

Mar 04 0030 (1m) All channels; 0039 (1m) No RCF data.

Mar 12 0543, 0600 (2m): All channels lost.

Mar 15 0632, 0716: All channels lost; 0634 (1m) No RCF data.

Mar 16 0934-0935 (2m) No RCF data; 0934 (1m) No F data.

Mar 20 0139 (1m) All channels lost; 0140 (1m) No RCF data

Mar 21 0418 to 25/0356 (3d 23h 39m): All channels lost when UPS exhausted after observatory power switched off (at 0300) on the arrival of tropical cyclone Vance.

Mar 25 0530 (1m) All channels lost.

Mar 26 0836 (1m) All channels lost; 0837 (1m) No RCF data

Apr 16 0004 (1m) All channels lost;
0005-0006 (2m) No RCF data

May 05 0208-0209 (2m); 0229 (1m); 2330-2331 (2m): No RCF data
0208 to 06/0034 (1day 1h 27m): No PPM data

May 06 0018 (1m); 0023 (1m): No RCF data

May 12 0728 (1m) All channels lost; 0729, 0755 (2m) No RCF data

May 14 0237, 0247, 0302, 0417 (4m): All channels; 0303 (1m) RCF channels lost.

May 22 2243 (1m) No RCF data
2243 to 26/0049 (3d 02h 07m) No PPM data: Batteries exhausted

May 26 0052-0101 (10m) No PPM data

May 29 1721, 1725, 1832, 1835 (4m): All channels lost;
1836 (1m) RCF channels only lost.

Jun 09 0834-0837 (4m) No PPM data

Jun 10 0003 (1m) All channels lost

Jun 12 0549-0733 (1h 45m) No PPM data
0613 (1m); 0733 (1m): No RCF data

Jun 14 2331 (1m) All channels lost;
2332 (1m) No PPM data

Aug 03 0126-0131 (6m) All channels lost

Distribution of LRM data during 1999

Preliminary Monthly Means for Project Ørsted

- IPGP monthly (by e-mail): None sent in 1999.

1-minute & Hourly Mean Values

- 1996, 1997, 1998: WDC-A, Boulder, USA (28 Jul. 1999)
- 1996, 1997, 1998: WDC-C1, Copenhagen,
  via Paris INTERMAGNET GIN (29 Jul. 1999)

Learmonth Annual Mean Values

The table below gives annual mean values calculated using the monthly mean values over **All** days, the 5 International **Quiet** days and the 5 International **Disturbed** days in each month. Plots of these data with secular variation in H, D, Z & F are on pages 66-67.

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

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

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

Learmonth 1999 Monthly & Annual Mean Values

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

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

Learmonth	1999	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	29685.1	60.3	-44301.8	53327.8	29685.1	+0° 07.0'	-56° 10.5'
	5xQ days	29689.0	63.0	-44298.5	53327.3	29689.0	+0° 07.3'	-56° 10.2'
	5xD days	29668.7	57.0	-44305.6	53321.9	29668.8	+0° 06.6'	-56° 11.5'
February	All days	29687.3	68.0	-44303.0	53330.1	29687.4	+0° 07.9'	-56° 10.4'
	5xQ days	29689.8	67.3	-44298.4	53327.7	29689.8	+0° 07.8'	-56° 10.1'
	5xD days	29653.3	70.5	-44314.2	53320.5	29653.4	+0° 08.2'	-56° 12.7'
March	All days	29686.2	67.3	-44301.8	53328.4	29686.3	+0° 07.8'	-56° 10.5'
	5xQ days	29695.6	66.2	-44298.8	53331.2	29695.7	+0° 07.7'	-56° 09.8'
	5xD days	29671.2	68.8	-44305.0	53322.8	29671.3	+0° 08.0'	-56° 11.4'
April	All days	29691.3	71.6	-44297.3	53327.5	29691.4	+0° 08.3'	-56° 10.0'
	5xQ days	29701.4	72.4	-44295.5	53331.7	29701.5	+0° 08.4'	-56° 09.4'
	5xD days	29671.7	74.6	-44300.1	53319.0	29671.8	+0° 08.6'	-56° 11.2'
May	All days	29698.7	75.0	-44292.2	53327.4	29698.8	+0° 08.7'	-56° 09.4'
	5xQ days	29706.3	74.5	-44291.2	53330.8	29706.4	+0° 08.6'	-56° 09.0'
	5xD days	29684.9	75.9	-44293.9	53321.2	29685.0	+0° 08.8'	-56° 10.2'
June	All days	29708.6	77.5	-44288.4	53329.8	29708.7	+0° 09.0'	-56° 08.8'
	5xQ days	29713.6	78.4	-44289.7	53333.7	29713.7	+0° 09.1'	-56° 08.6'
	5xD days	29702.3	80.1	-44289.4	53327.1	29702.4	+0° 09.3'	-56° 09.1'
July	All days	29703.3	83.9	-44285.9	53324.8	29703.5	+0° 09.7'	-56° 09.0'
	5xQ days	29712.9	83.0	-44284.8	53329.2	29713.0	+0° 09.6'	-56° 08.4'
	5xD days	29692.3	86.0	-44285.5	53318.3	29692.4	+0° 10.0'	-56° 09.5'
August	All days	29693.9	85.8	-44286.3	53319.9	29694.0	+0° 09.9'	-56° 09.5'
	5xQ days	29701.0	84.6	-44286.5	53324.0	29701.1	+0° 09.8'	-56° 09.1'
	5xD days	29670.7	87.3	-44290.6	53310.6	29670.8	+0° 10.1'	-56° 10.9'
September	All days	29687.9	87.0	-44287.8	53317.8	29688.0	+0° 10.1'	-56° 09.9'
	5xQ days	29697.5	84.7	-44286.4	53322.0	29697.7	+0° 09.8'	-56° 09.3'
	5xD days	29676.8	88.9	-44288.5	53312.2	29676.9	+0° 10.3'	-56° 10.5'
October	All days	29686.1	89.5	-44286.3	53315.6	29686.3	+0° 10.4'	-56° 09.9'
	5xQ days	29704.8	90.9	-44281.6	53322.1	29705.0	+0° 10.5'	-56° 08.7'
	5xD days	29654.1	90.6	-44289.2	53300.1	29654.2	+0° 10.5'	-56° 11.7'
November	All days	29702.3	93.2	-44286.0	53324.4	29702.4	+0° 10.8'	-56° 09.0'
	5xQ days	29715.0	95.8	-44283.0	53329.0	29715.2	+0° 11.1'	-56° 08.2'
	5xD days	29679.1	90.2	-44288.9	53313.9	29679.3	+0° 10.5'	-56° 10.4'
December	All days	29718.6	97.5	-44281.0	53329.3	29718.7	+0° 11.3'	-56° 08.0'
	5xQ days	29728.9	97.5	-44279.2	53333.5	29729.0	+0° 11.3'	-56° 07.4'
	5xD days	29696.9	97.0	-44283.0	53318.9	29697.1	+0° 11.2'	-56° 09.2'
Annual Mean Values	All days	29695.8	79.7	-44291.5	53325.2	29695.9	+0° 09.2'	-56° 09.6'
	5xQ days	29704.7	79.9	-44289.5	53328.5	29704.8	+0° 09.2'	-56° 09.0'
	5xD days	29676.8	80.6	-44294.5	53317.2	29676.9	+0° 09.3'	-56° 10.7'

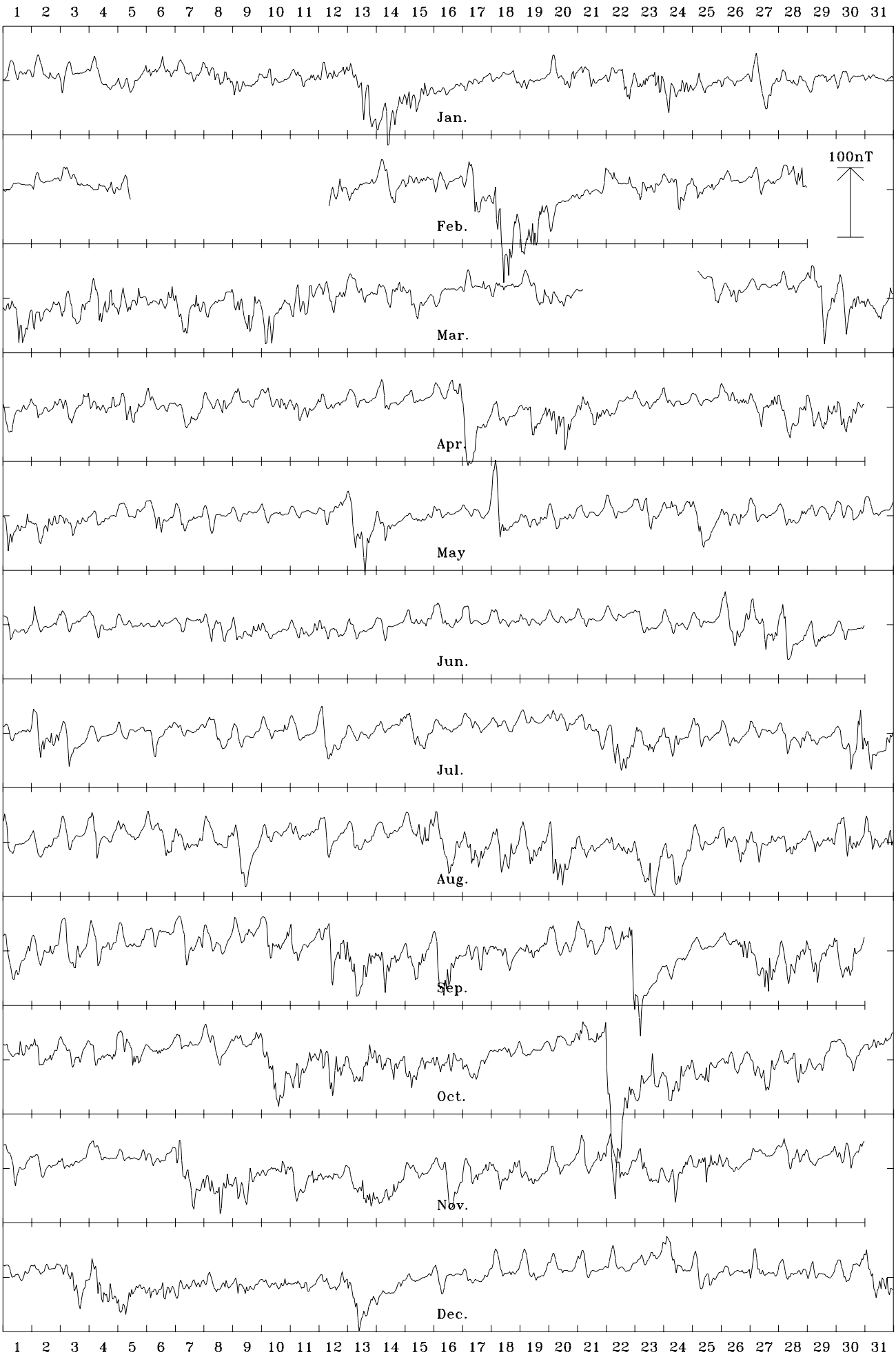
(Calculated:15:17 hrs., Sun. 10 Dec. 2000)

Hourly Mean Values

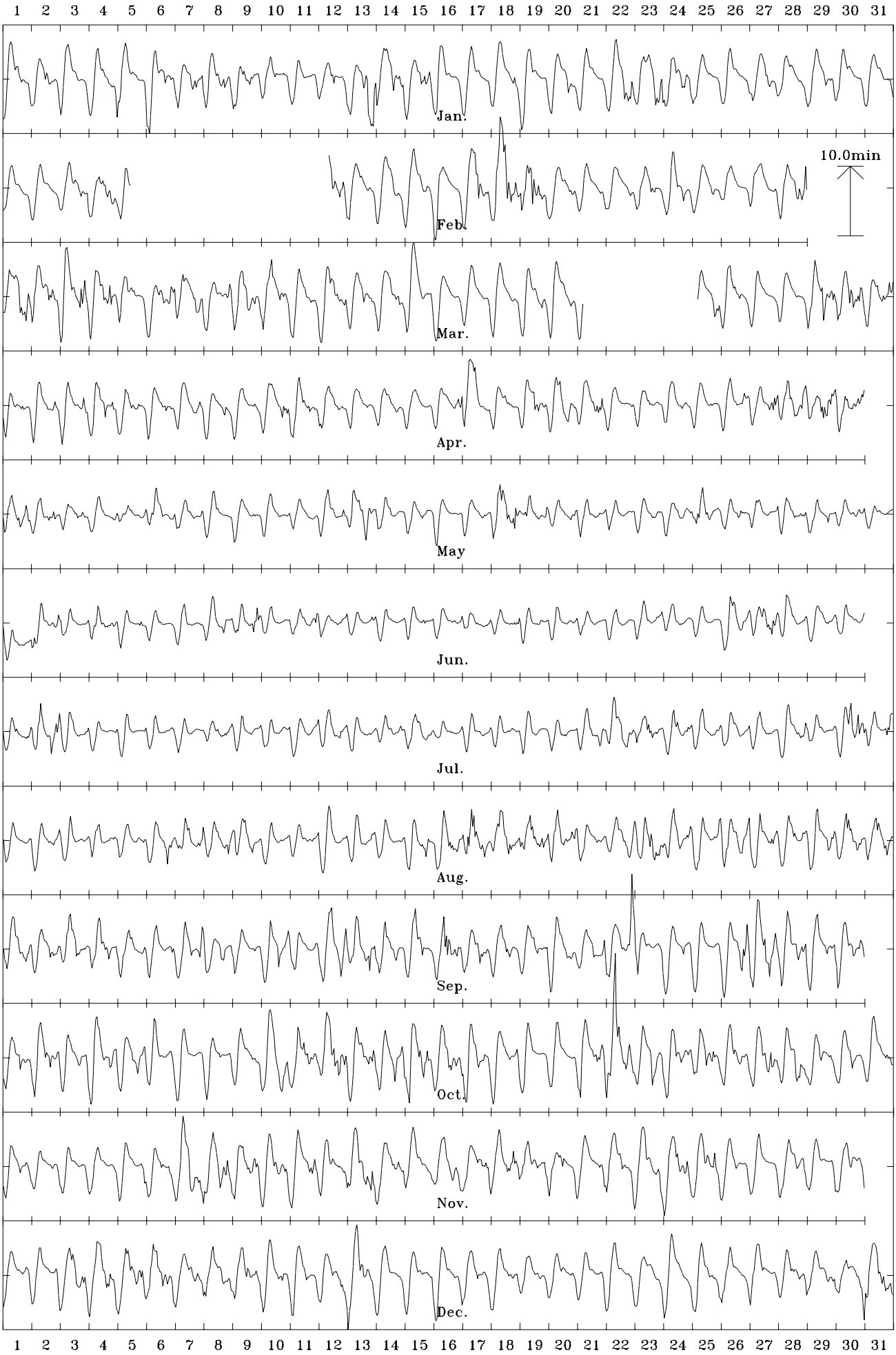
The charts on the following pages are plots of hourly mean values.

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

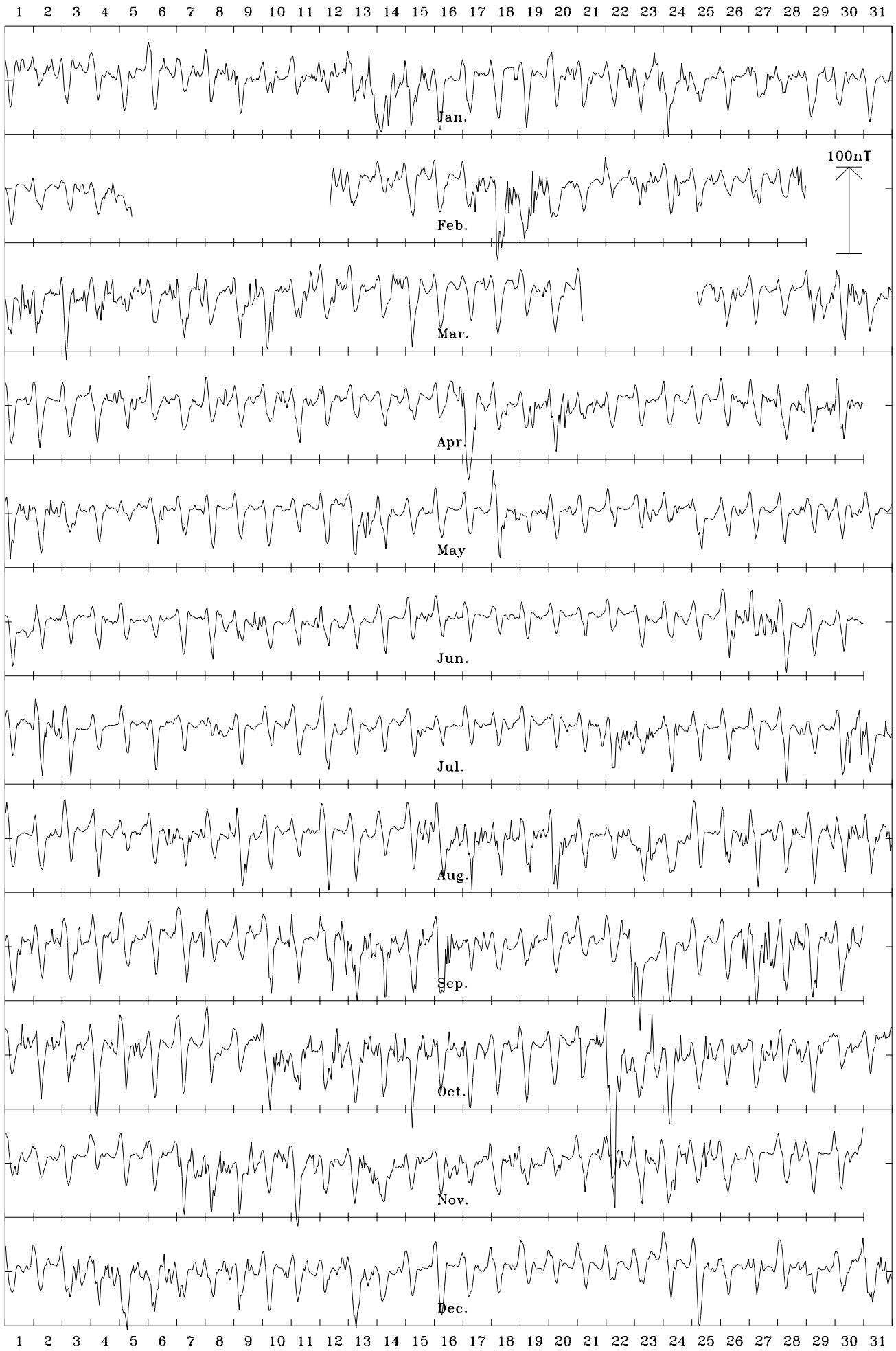
The mean value given at the top of each plot is the *all-days* annual mean value of the element.

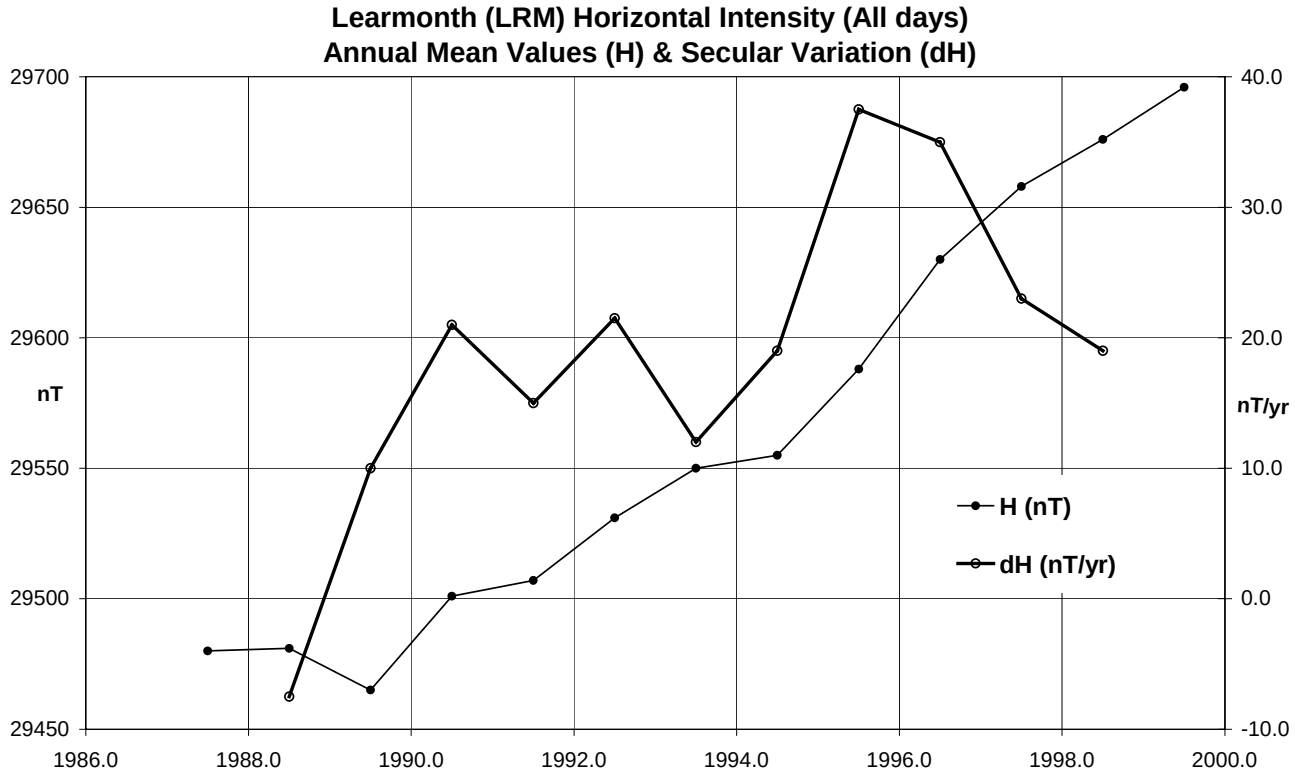

Learmonth 1999 Horizontal intensity (H). Scale: 7.5 nT/mm. Mean: 29696 nT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
100nT
Feb.
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

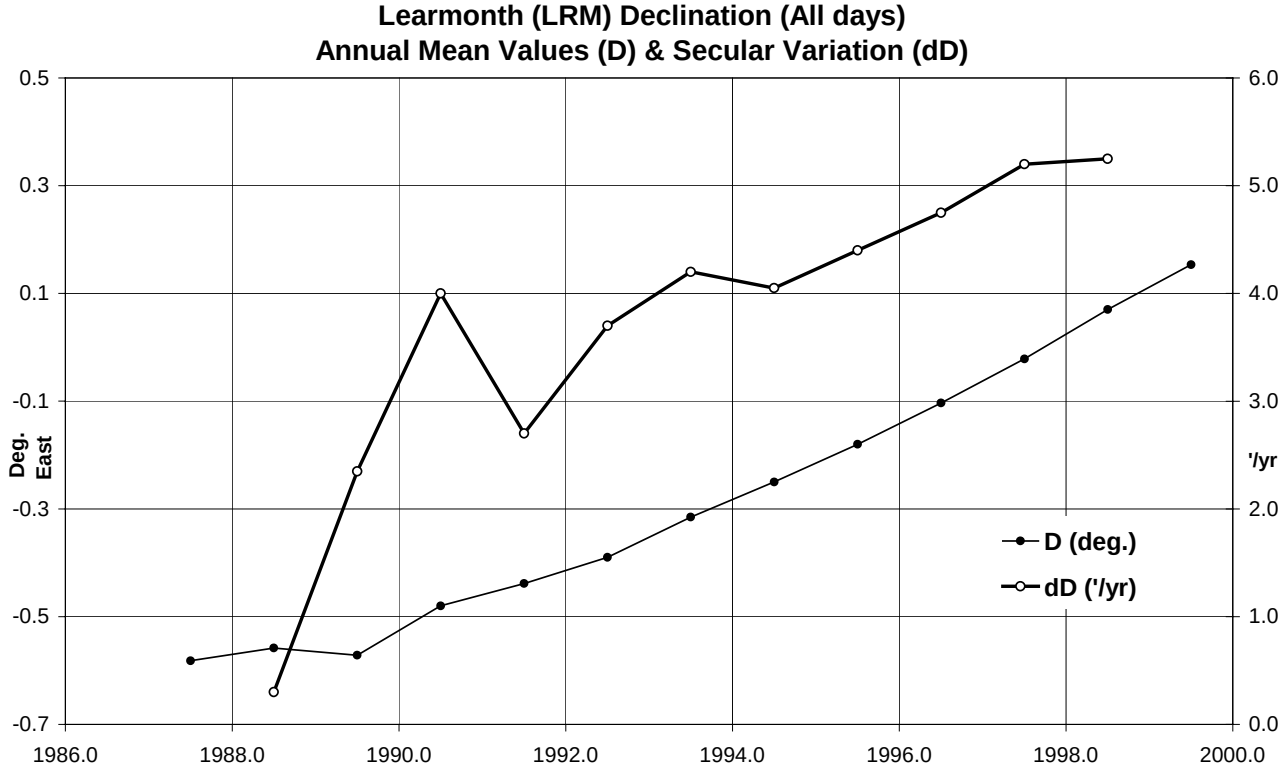
Learmonth 1999 Declination (east) (D). Scale: 0.75 min/mm. Mean: 0.15 deg.

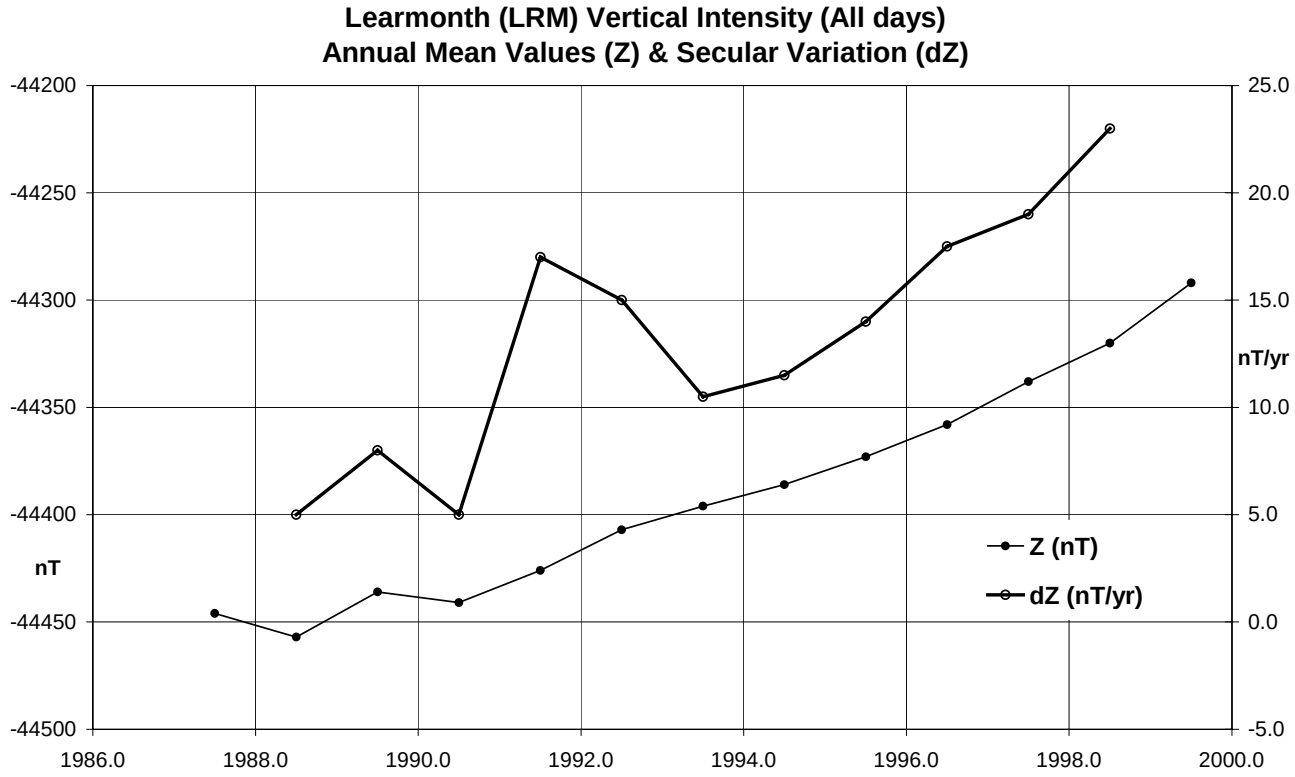


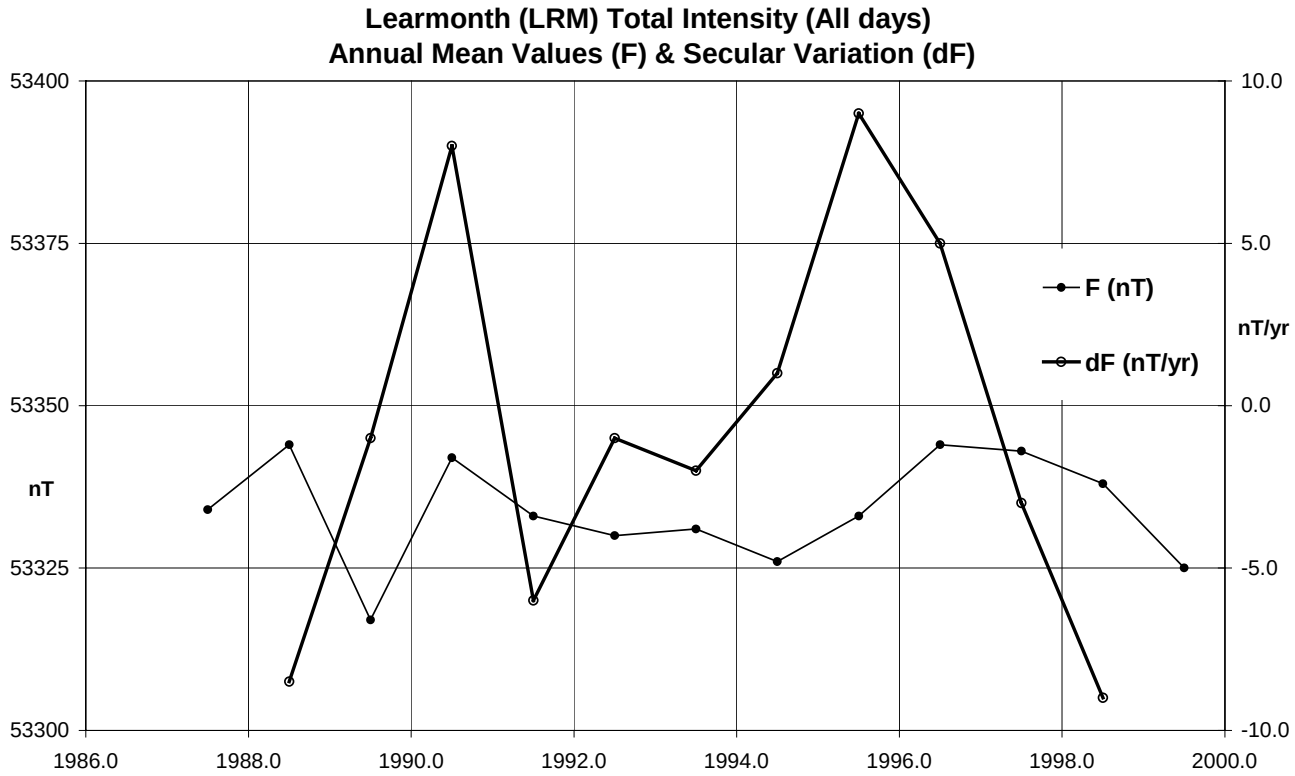

Learmonth 1999 Vertical intensity (Z). Scale: 6.0 nT/mm. Mean: −44292 nT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
100nT
Feb.
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31


Learmonth 1999 Total intensity (F). Scale: 6.0 nT/mm. Mean: 53325 nT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
100nT
Feb.
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31


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


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


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


Learmonth (LRM) Total Intensity (All days)
Annual Mean Values (F) & Secular Variation (dF)
53400
53375
53350
53325
53300
nT
10.0
5.0
0.0
-5.0
-10.0
nT/yr
1986.0
1988.0
1990.0
1992.0
1994.0
1996.0
1998.0
2000.0
F (nT)
dF (nT/yr)

MACQUARIE ISLAND

Macquarie Island (Tas.) is approximately 1100 km. south of Hobart, that locates it about half way between Tasmania and Antarctica. Magnetic recording at Macquarie Island has been continuous since 1952, becoming digital in October 1984. Details of the observatory's history are in *AGR 1994*.

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

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

- 3-character IAGA code: MCQ
- Commenced operation: 1952
- Geographic latitude: 54° 30' S
- Geographic longitude: 158° 57' E
- Geomagnetic† latitude: -60.1°
- Geomagnetic† longitude: 244.3°
- Elevation above mean sea level (top of pier): 8 metres
- Lower limit for K index of 9: 1500 nT.
- Azimuth of principal reference pillar (NMI) from pier AE: 353° 44' 13"
- Distance to Pillar NMI: ~200 metres
- Observers in Charge: Peter Jansen (1998)
  Perry Roberts (1999)
  Jean Osanz (2000)

† Based on the IGRF 1995 model.

Observer in charge

The magnetic observers-in-charge at Macquarie Island in 1999 were supported jointly by the Antarctic Division, the IPS Radio and Space Services, and GA, all of the Department of Industry Science and Resources. 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 providing regular data reports to GA headquarters in Canberra.

Perry Roberts took over absolute observations from Peter Jansen on 28 November 1998. Jean Osanz took over from Perry Roberts on 15 November 1999.

Variometers

The equipment employed to monitor magnetic variations at MCQ in 1999 included an Elsec 820M3 PPM for measuring the magnetic total intensity and a Narod 3-axis ringcore fluxgate (RCF) magnetometer. The RCF sensors, mounted on a marble '*tombstone*' base, were not aligned with either the standard field elements or cardinal points, but were oriented in such a way that the three mutually orthogonal components recorded were of approximately equal magnitudes. Details of the *'tombstone'* RCF sensor base and the orientation of the sensors were given in the section on *Variometer Alignment* in *AGRs 1993-1996*. The RCF sensors were located in the Variometer House, and the backup power supply and the acquisition computer situated in the office. The electronic console of the RCF magnetometer was situated in a small room within the Variometer House.

Absolute Instruments and Corrections

Magnetic absolute measurements were performed on Pier AW with an Austral PPM (serial 525) and on Pier AE with an Elsec 810 DIM (serial 201) with Zeiss020B (serial 311847) theodolite, while the classical QHMs (serial 177, 178, 179) were used as backup on pier AE.

For consistency with the Australian Magnetic Standard held at Canberra, a correction of +2.0nT was applied to the PPM readings, while no corrections were applied to the DIM readings. This resulted in baseline corrections in X, Y and Z of +0.3nT, +0.2nT and -2.0nT respectively (Dennis, 1998).

Operations

Twice weekly absolute calibrations were performed on the observation piers in the Absolute House.

The RCF variometer produced 8 samples/sec. that were averaged and output as 1-second data. The PPM variometer produced 10-second samples. The 1-second RCF data and 10-second PPM data as well as 1-minute means of both were recorded on an acquisition PC.

All data were automatically transmitted daily, via a network connection, to GA where they were processed. Timing was provided by the Antarctic Division's GPS clock (which was also used with Atmospheric and Space Physics experiments).

Significant Events: MCQ, 1999

The variometers ran efficiently throughout the year.

Macquarie Island Annual Mean Values

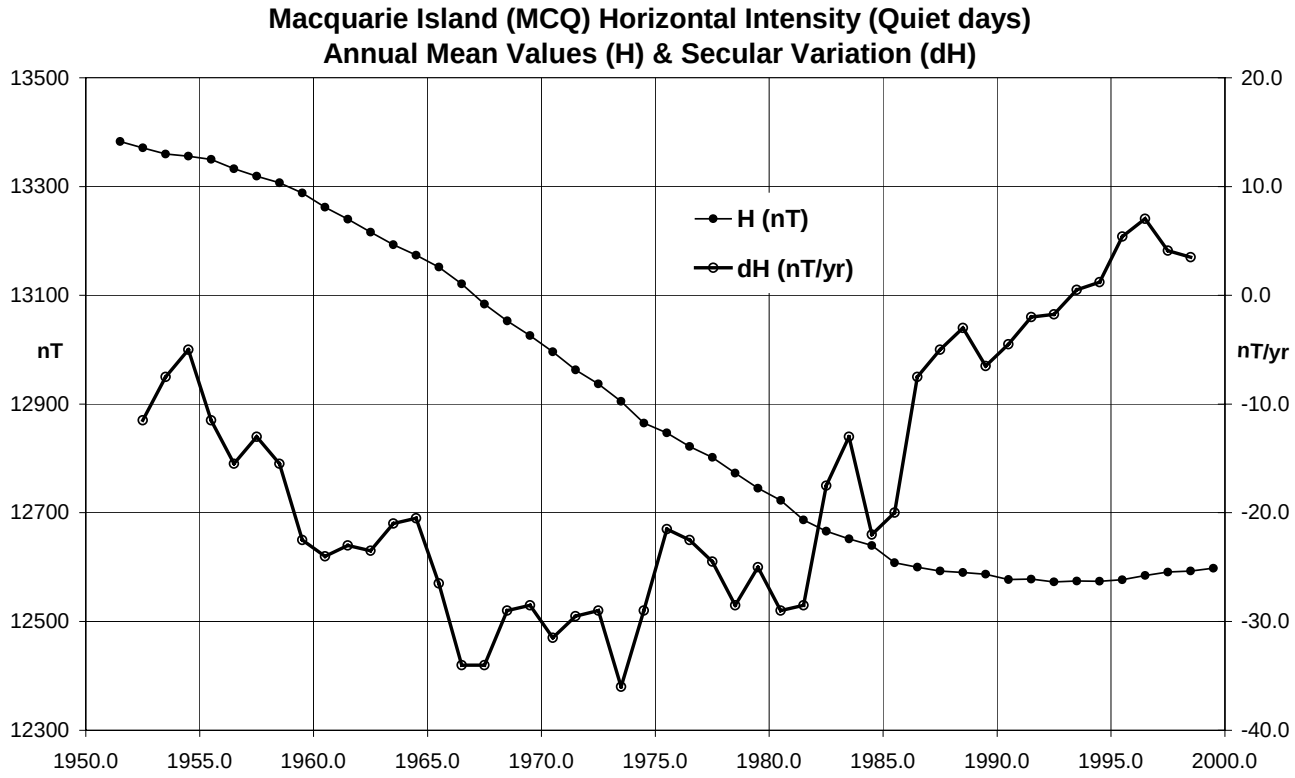
The table below gives annual mean values calculated using the monthly mean values over **All** days, the 5 International **Quiet** days and the 5 International **Disturbed** days in each month. Plots of the Quiet day mean data with secular variation in H, D, Z & F are on pages 70-71.

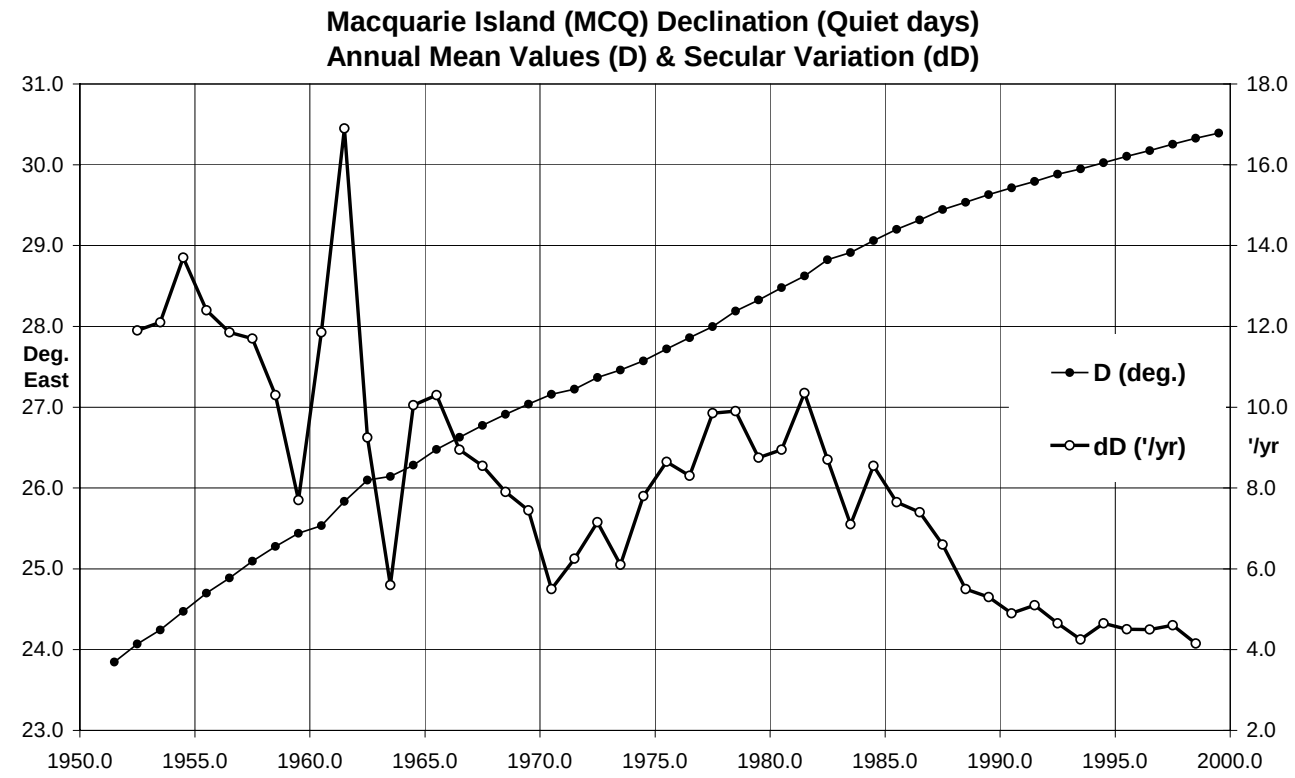
Year	Days	D		I		H	X	Y	Z	F	Elts*
		(Deg	Min)	(Deg	Min)	(nT)	(nT)	(nT)	(nT)	(nT)	
1993.5	A	29	57.2	-78	48.1	12558	10880	6270	-63428	64659	ABC
1994.5	A	30	02.2	-78	48.3	12549	10863	6281	-63404	64634	ABC
1995.5	A	30	06.6	-78	47.5	12559	10864	6300	-63376	64608	ABC
1996.5	A	30	11.0	-78	46.4	12574	10870	6322	-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

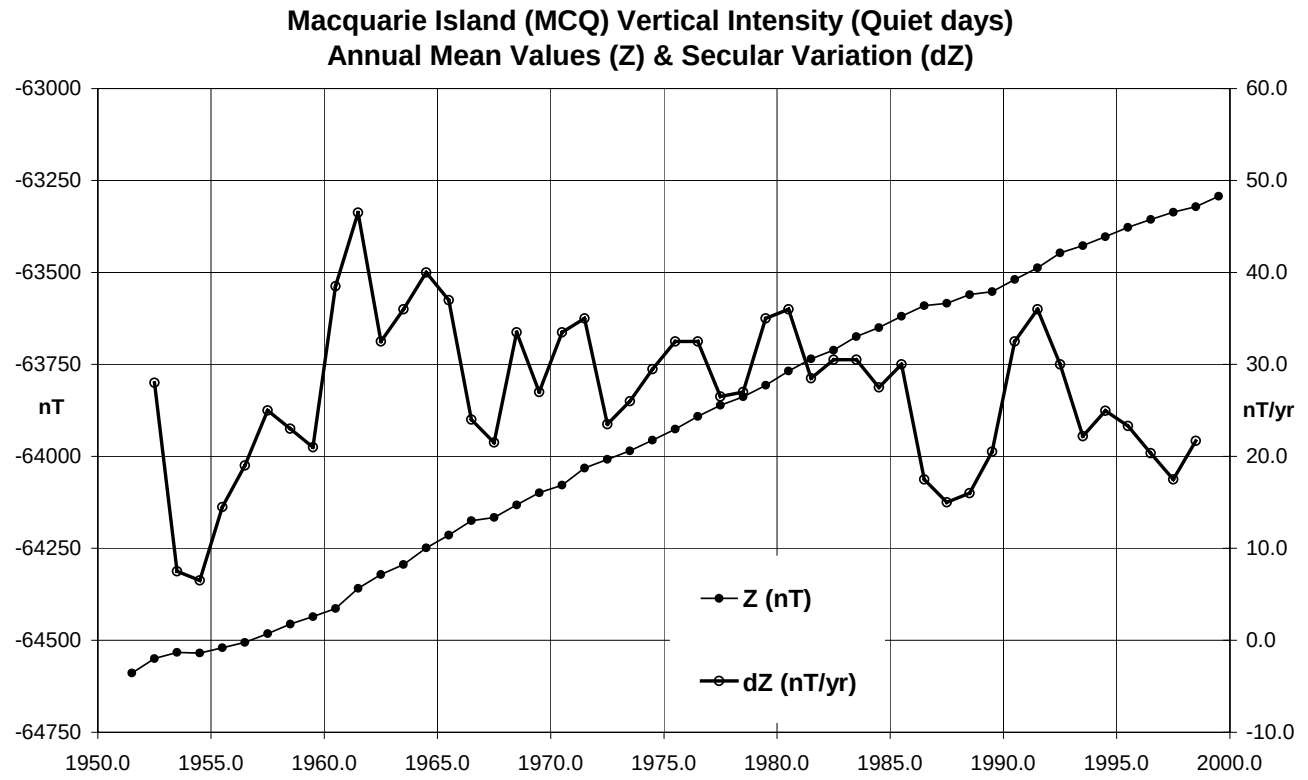
MCQ Annual Mean Values (cont.)

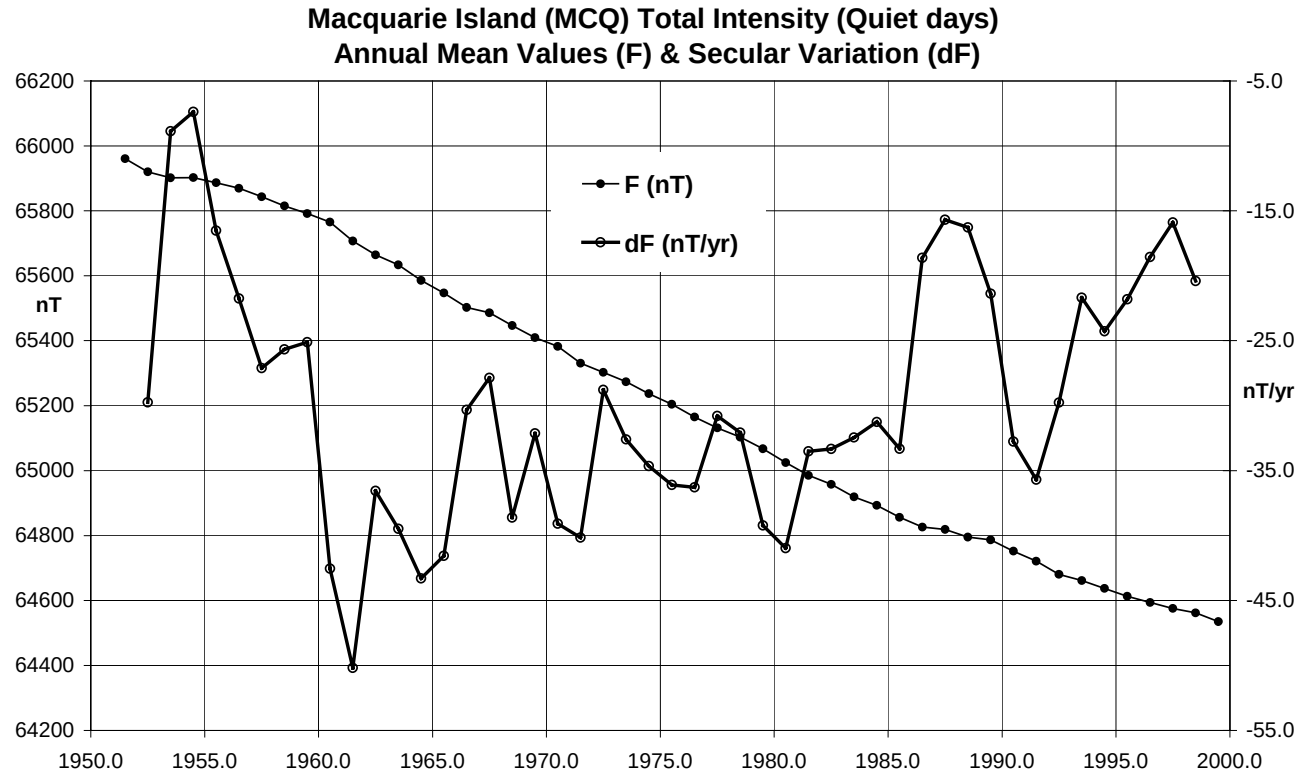
Year	Days	D (Deg	D Min)	I (Deg	I Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1951.5		23	50.8	-78	17.6	13383	12241	5411	-64589	65961	HDZ
1952.5		24	04.2	-78	17.8	13371	12208	5453	-64550	65920	HDZ
1953.5		24	14.6	-78	18.2	13360	12182	5486	-64533	65901	HDZ
1954.5		24	28.4	-78	18.4	13356	12156	5533	-64535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

* Elements ABC indicates non-aligned variometer orientation


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


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


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


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

Macquarie Island 1999 Monthly & Annual Mean Values

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

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

Macquarie Island	1999	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	10864.3	6359.0	-63303.0	64542.6	12588.5	30° 20.5'	-78° 45.2'
	5xQ days	10872.1	6367.3	-63303.3	64545.0	12599.4	30° 21.3'	-78° 44.6'
	5xD days	10826.5	6338.5	-63303.3	64534.7	12545.6	30° 20.9'	-78° 47.4'
February	All days	10858.0	6362.6	-63297.9	64536.9	12584.9	30° 22.2'	-78° 45.3'
	5xQ days	10869.7	6367.8	-63298.2	64539.6	12597.6	30° 21.8'	-78° 44.6'
	5xD days	10831.9	6358.5	-63310.2	64544.4	12560.5	30° 24.9'	-78° 46.7'
March	All days	10850.1	6360.2	-63305.2	64542.5	12576.9	30° 22.7'	-78° 45.8'
	5xQ days	10865.6	6370.2	-63302.1	64543.0	12595.2	30° 22.9'	-78° 44.8'
	5xD days	10839.3	6347.2	-63316.3	64550.5	12561.1	30° 21.1'	-78° 46.7'
April	All days	10851.8	6365.8	-63297.9	64536.1	12581.1	30° 23.8'	-78° 45.5'
	5xQ days	10865.2	6371.5	-63300.6	64541.6	12595.6	30° 23.3'	-78° 44.8'
	5xD days	10837.0	6362.5	-63290.1	64525.8	12566.7	30° 25.1'	-78° 46.2'
May	All days	10862.4	6371.5	-63296.8	64537.4	12593.2	30° 23.7'	-78° 44.9'
	5xQ days	10867.4	6373.5	-63294.6	64536.3	12598.5	30° 23.4'	-78° 44.6'
	5xD days	10850.1	6367.4	-63293.3	64531.6	12580.5	30° 24.4'	-78° 45.5'
June	All days	10868.1	6374.1	-63289.4	64531.3	12599.4	30° 23.5'	-78° 44.5'
	5xQ days	10868.7	6374.4	-63288.8	64530.9	12600.0	30° 23.5'	-78° 44.4'
	5xD days	10871.0	6374.5	-63287.3	64529.8	12602.1	30° 23.2'	-78° 44.3'
July	All days	10863.7	6375.2	-63288.8	64530.1	12596.2	30° 24.3'	-78° 44.6'
	5xQ days	10866.8	6375.7	-63289.7	64531.6	12599.1	30° 24.1'	-78° 44.5'
	5xD days	10855.5	6377.0	-63277.5	64517.9	12590.0	30° 25.9'	-78° 44.8'
August	All days	10852.1	6368.5	-63289.7	64528.5	12582.8	30° 24.4'	-78° 45.3'
	5xQ days	10861.4	6374.3	-63291.1	64531.9	12593.7	30° 24.5'	-78° 44.8'
	5xD days	10841.3	6363.1	-63300.2	64536.5	12570.8	30° 24.7'	-78° 46.1'
September	All days	10844.4	6367.4	-63291.4	64528.7	12575.6	30° 25.2'	-78° 45.7'
	5xQ days	10854.9	6373.9	-63289.4	64529.2	12588.0	30° 25.3'	-78° 45.1'
	5xD days	10808.4	6352.8	-63287.6	64517.7	12537.3	30° 26.8'	-78° 47.7'
October	All days	10834.4	6360.9	-63298.2	64533.1	12563.7	30° 25.1'	-78° 46.4'
	5xQ days	10857.8	6374.0	-63291.7	64531.9	12590.5	30° 24.9'	-78° 44.9'
	5xD days	10793.7	6339.0	-63297.7	64523.9	12517.7	30° 25.6'	-78° 48.8'
November	All days	10855.7	6367.9	-63299.9	64539.0	12585.6	30° 23.7'	-78° 45.3'
	5xQ days	10875.1	6377.0	-63294.3	64537.6	12606.9	30° 23.2'	-78° 44.1'
	5xD days	10827.9	6352.8	-63318.7	64551.6	12554.0	30° 24.1'	-78° 47.1'
December	All days	10868.3	6376.5	-63276.4	64518.9	12600.8	30° 24.0'	-78° 44.3'
	5xQ days	10875.0	6381.5	-63273.8	64517.9	12609.1	30° 24.3'	-78° 43.8'
	5xD days	10847.0	6366.7	-63283.4	64521.4	12577.6	30° 24.7'	-78° 45.5'
Annual Mean Values	All days	10856.1	6367.4	-63294.5	64533.8	12585.7	30° 23.6'	-78° 45.2'
	5xQ days	10866.6	6373.4	-63293.1	64534.7	12597.8	30° 23.5'	-78° 44.6'
	5xD days	10835.8	6358.3	-63297.1	64532.1	12563.7	30° 24.3'	-78° 46.4'

(Calculated:16:25 hrs., Tue. 18 Sep. 2001)

Hourly Mean Values

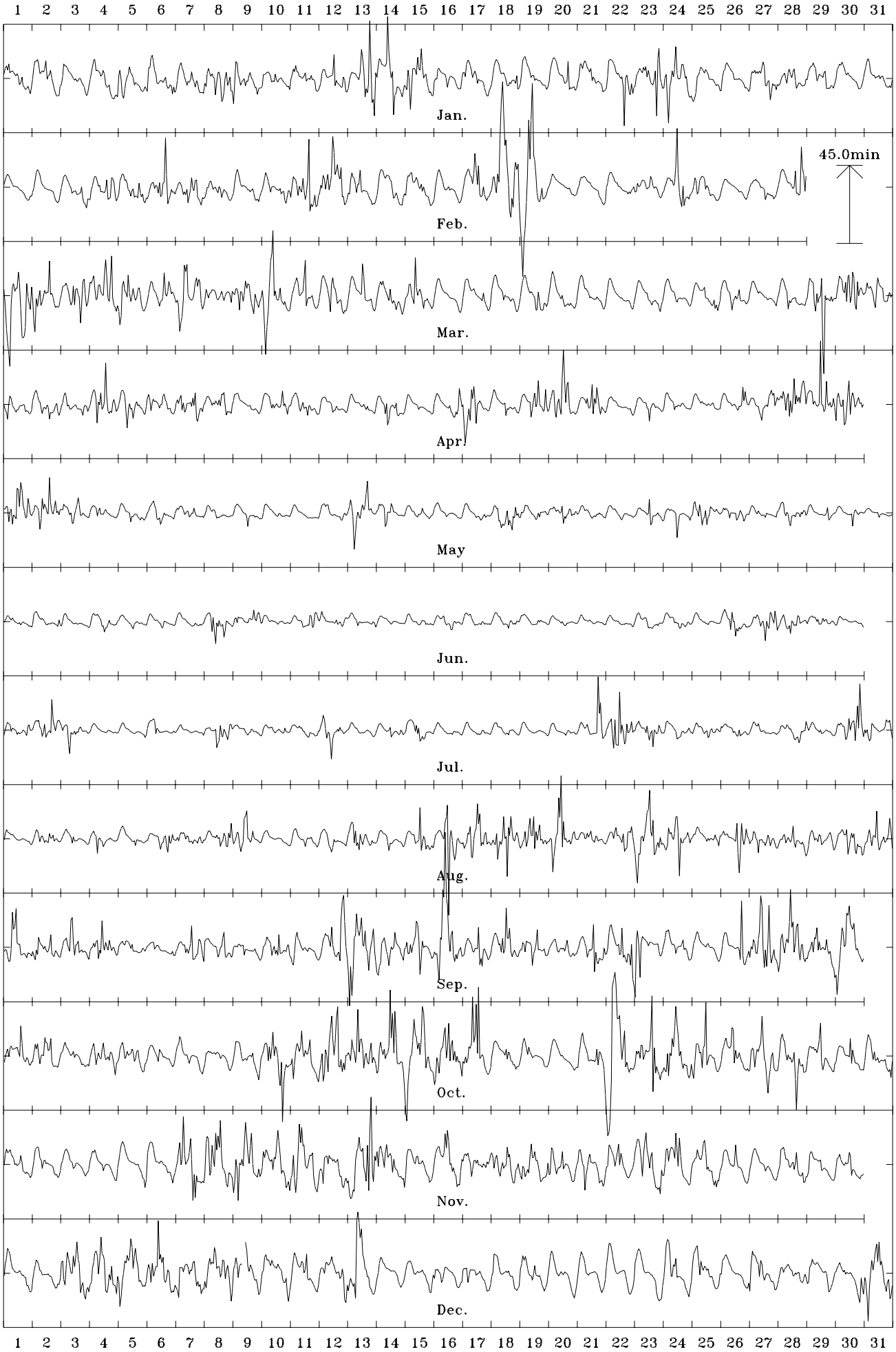
The charts on the following pages are plots of hourly mean values.

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. 1999 Horizontal intensity (H). Scale: 40.0 nT/mm. Mean: 12586 nT

Macquarie Is. 1999 Declination (east) (D). Scale: 3.00 min/mm. Mean: 30.39 deg.




Macquarie Is. 1999 Vertical intensity (Z). Scale: 25.0 nT/mm. Mean: −63295 nT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
400nT
Feb.
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Macquarie Is. 1999 Total intensity (F). Scale: 25.0 nT/mm. Mean: 64534 nT

Distribution of MCQ data during 1999

Preliminary Monthly Means for Project Ørsted

- IPGP monthly (by e-mail): Dec. 1996 – Jun. 1997.

1-minute & Hourly Mean Values

- No data distributed in 1999.

Data losses: MCQ, 1999

Feb 24 2306, 2308, 2312 (3m): Testing for year 2000 (Y2K) compliance

Dec 09 0656 (1m): Computer re-set (accidental).

Dec 09 0806-0956 (1h 51m): UPS failure.

Dec 10 0848 (1m): New UPS connected.

MAWSON OBSERVATORY

The magnetic observatory is part of Mawson scientific base, built on the edge of Horseshoe Harbour on the Mawson charnockite, in Antarctica.

The magnetic observatory buildings, comprising the Variometer House and the Absolute House, are situated on the south-east and inland side of the Mawson base, at the end of East Bay.

The Mawson magnetic observatory commenced recording magnetic variations with a three-component analogue magnetograph in 1955. In December 1985 the magnetic observatory was converted to digital recording.

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

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

- 3-character IAGA code: MAW
- Geographic latitude: 67° 36' 14" S
- Geographic longitude: 62° 52' 45" E
- Geomagnetic† latitude: -73.2°
- Geomagnetic† longitude: 108.6°
- Elevation above mean sea level (top of pier A): 12 metres
- Lower limit for K index of 9: 1500 nT.
- Azimuth of principal reference mark (89/2) from pier A: 19° 14.0'
- Distance to azimuth mark 89/2: 105 metres
- Observers in Charge: Maria de Deuge (1998, GA/BoM); Robert Sutton (1999, GA/BoM); Peter Johnson (2000, GA/BoM)

† Based on the IGRF 1995 model.

Observers in charge

The 1999 observer was employed jointly by GA and the Bureau of Meteorology and was a member of the Australian National Antarctic Research Expedition (ANARE). His duties included maintaining the equipment, performing absolute observations to calibrate the variometers and providing regular data reports to GA headquarters in Canberra.

He arrived at Mawson on 01 December 1998. The 1998 observer departed on 10 December 1998. The 2000 observer transited Macquarie Island and Davis before arriving at Mawson on 06 January 2000 to relieve the 1999 observer who departed on 08 January 2000.

Variometers

A 3-axis Narod ringcore fluxgate (RCF) magnetometer and an Elsec 820M3 PPM monitored magnetic variations at MAW throughout 1999. Sensors of both these instruments were located within the sensor room of the Variometer House. Two of the orthogonal RCF magnetometer sensors were horizontal and oriented so that they made 45 degree angles with the direction of the horizontal component of the magnetic field (ie 45° to the magnetic declination, D). The third sensor was aligned vertically, ie. parallel with the geomagnetic element Z.

MAW variometers (cont.)

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

The recorder room of the Variometer Building contained the data acquisition computers, a Doric Trendicator digital thermometer (with its sensor on a disused (PEM/Y) pier in the sensor room) and a UPS.

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, as displayed by the Doric Trendicator, was kept close to 10°C by a fast-cycle heater.

Absolute Instruments and Corrections

Magnetometers used to calibrate the recording variometers in 1999 were an Elsec 810 DIM (no. 213 with Zeiss020B theodolite 352229) and an Elsec 770 PPM (no. 199); with the QHM 300 series and another Elsec 770 PPM (no. 206) as secondary instruments. All observations were performed on Pier A.

For standardization with the Australian Magnetic Standard held at Canberra, a correction of +3.0nT has been applied to the PPM readings. Corrections of zero have been applied to the DIM readings. These resulted in baseline corrections in X, Y and Z of +0.5nT, -1.0nT and –2.8nT respectively.

Operations

The shared GA/BoM observer performed preliminary data reduction at Mawson, forwarding K indices and preliminary mean quiet field values by e-mail to GA, Canberra, every month. Twice-weekly absolute observations were performed on the observation piers in the Absolute House at Mawson in 1999. A brief report on the operations was written by the shared observer before returning from Antarctica. The final data for 1999 were reduced and analysed by GA staff.

The 1-second RCF data and 10-second PPM data as well as 1-minute means of both were recorded on an acquisition PC. A PC running QNX, also in the variometer house, automatically copied files from the acquisition PC. The QNX PC was connected to the station's radio network. The files on this PC were subsequently automatically retrieved at GA, Canberra, by ftp via the ANARE satellite communications system. A GPS clock provided system timing. Using a PC in the Science Building the data acquisition system was routinely interrogated to ensure correct operation and to check timing.

The replacement Elsec820 PPM sensor sent in the 1998-99 solved the problems of spiky data seen in previous years. This replacement, unlike its predecessors, performed well all year.

Data losses in 1999

Feb 17 0555-0555 (1m): PC re-booted while observer was working on a cable.

Feb 25 1444 to 26/0620 (15h 36m) Blizzard static.

Mar 13 0935-0935 (1 m): PC re-booted when touched – static discharge

May 11 2029-2058 (30 min), 2115-2137 (23 min) 2142-2212 (31 min), 2214-May 12 0100 (2h 47min), May 12 0103-2241 (21h 39min) Blizzard static. Two attempts at remote re-boots were unsuccessful.

May 25 0828-0937 (1h10 min): Observer was testing the temperature channel on the variometer and unwittingly interrupted acquisition

Jul 03 1154-Jul 04 0305 (15h12 min): Blizzard static

Despite special protection being in place, the major data losses were caused by blizzard static that disabled the acquisition program and/or variometers. The air at Mawson is very dry and good electrical earthing is non-existent. Sometimes the system could be restored remotely by re-booting the computer, but often, physical access was required to re-set the variometers, and for safety reasons this could only take place when the blizzards had abated. (Winds peaked at 102 knots in the February blizzard, with 30m visibility – quite unusual in summer.)

Mawson, Antarctica Annual Mean Values

The table below gives annual mean values calculated using the monthly mean values over **All** days, the 5 International **Quiet** days and the 5 International **Disturbed** days in each month as indicated.
Plots of these data with secular variation in H, D, Z & F are on pages 86-87.

Year	Days	D (Deg	D Min)	I (Deg	I Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1955.5		-58	38.1	-69	33.3	18272	9854	-15387	-49012	52307	DHZ
1956.5		-58	53.2	-69	32.5	18282	9927	-15352	-49006	52305	DHZ
1957.5		-59	8.7	-69	31.1	18292	9461	-15655	-48974	52279	DHZ
1958.5		-59	25.6	-69	30.3	18293	9538	-15610	-48940	52247	DHZ
1959.5		-59	42.6	-69	28.5	18293	9615	-15562	-48860	52172	DHZ
1960.5		-59	59.6	-69	25.2	18323	9708	-15540	-48800	52127	DHZ
1961.5		-60	14.6	-69	23.1	18322	9228	-15828	-48707	52039	DHZ
1962.5		-60	30.1	-69	21.1	18333	9305	-15796	-48650	51990	DHZ
1963.5		-60	45.2	-69	17.6	18356	9386	-15775	-48562	51915	DHZ
1964.5		-60	59.2	-69	15.4	18353	9449	-15734	-48460	51819	DHZ
1965.5		-61	12.6	-69	13.1	18356	8958	-16022	-48368	51734	DHZ
1966.5		-61	24.0	-69	9.6	18362	9014	-15997	-48235	51612	DHZ
1967.5		-61	34.4	-69	7.2	18374	9068	-15980	-48168	51553	DHZ
1968.5		-61	43.8	-69	5.2	18365	9107	-15948	-48060	51449	DHZ
1969.5		-61	53.0	-69	3.4	18353	9144	-15913	-47954	51346	DHZ
1970.5		-62	0.5	-69	0.4	18358	8621	-16208	-47840	51241	DHZ
1971.5		-62	5.3	-68	56.4	18375	8652	-16211	-47719	51135	DHZ
1972.5		-62	11.4	-68	53.1	18381	8683	-16201	-47600	51026	DHZ
1973.5		-62	17.6	-68	49.7	18391	8717	-16194	-47486	50923	DHZ
1974.5		-62	24.8	-68	47.2	18390	8750	-16175	-47380	50824	DHZ
1975.5		-62	31.4	-68	44.0	18397	8785	-16164	-47269	50723	DHZ
1976.5		-62	37.3	-68	40.0	18418	8823	-16167	-47157	50626	DHZ
1977.5		-62	43.9	-68	36.9	18425	8857	-16157	-47051	50530	DHZ
1978.5		-62	51.9	-68	35.5	18421	8893	-16132	-46986	50468	DHZ
1979.5		-62	57.9	-68	32.9	18425	8923	-16120	-46890	50380	DHZ
1980.5		-63	5.8	-68	29.8	18432	8396	-16409	-46784	50284	DHZ
1981.5		-63	14.6	-68	27.1	18443	8443	-16397	-46705	50215	DHZ
1982.5		-63	21.2	-68	25.5	18433	8470	-16372	-46616	50128	DHZ
1983.5		-63	26.6	-68	22.3	18439	8498	-16364	-46503	50025	DHZ
1984.5		-63	33.1	-68	19.3	18446	8532	-16354	-46404	49936	DHZ
1985.5		-63	40.2	-68	17.0	18457	8571	-16346	-46342	49882	DHZ
1986.5		-63	48.7	-68	15.1	18460	8613	-16328	-46276	49822	XYZ
1987.5		-63	56.6	-68	12.5	18470	8655	-16317	-46198	49753	XYZ
1988.5		-64	4.4	-68	10.7	18475	8120	-16595	-46142	49703	XYZ
1989.5		-64	12.8	-68	9.7	18474	8160	-16574	-46099	49663	XYZ
1990.5		-64	21.1	-68	6.4	18492	8208	-16570	-46015	49592	XYZ
1991.5		-64	28.8	-68	4.2	18502	8250	-16561	-45957	49542	XYZ
1992.5	Q	-64	36.5	-68	-1.7	18513	7938	-16724	-45885	49479	XYZ
1993.5	Q	-64	43.6	-67	-59.4	18522	7908	-16749	-45819	49422	ABC
1994.5	Q	-64	51.8	-67	-57.4	18537	7874	-16781	-45779	49389	ABC
1995.5	Q	-65	0.4	-67	55.3	18550	7838	-16813	-45731	49350	ABC
1996.5	Q	-65	9.2	-67	53.5	18561	7799	-16843	-45692	49318	ABC
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

MAW Annual Mean Values (cont.)

Year	Days	D (Deg	D Min)	I (Deg	I Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1992.5	A	-64	36.9	-68	-2.8	18499	7930	-16712	-45894	49482	XYZ
1993.5	A	-64	44.2	-68	-0.7	18506	7898	-16736	-45830	49426	ABC
1994.5	A	-64	52.9	-67	-59.4	18511	7858	-16760	-45794	49394	ABC
1995.5	A	-65	0.9	-67	56.7	18532	7828	-16798	-45741	49352	ABC
1996.5	A	-65	9.8	-67	54.5	18548	7791	-16833	-45698	49319	ABC
1997.5	A	-65	19.4	-67	53.0	18560	7749	-16865	-45670	49297	ABC
1998.5	A	-65	29.1	-67	52.4	18561	7702	-16887	-45648	49278	ABC
1999.5	A	-65	39.0	-67	51.5	18561	7653	-16910	-45618	49250	ABC
1992.5	D	-64	39.6	-68	-5.2	18466	7904	-16689	-45907	49482	XYZ
1993.5	D	-64	45.9	-68	-3.0	18476	7877	-16713	-45847	49430	ABC
1994.5	D	-64	55.3	-68	-1.9	18476	7831	-16734	-45804	49390	ABC
1995.5	D	-65	1.7	-67	58.8	18504	7812	-16774	-45752	49353	ABC
1996.5	D	-65	11.1	-67	56.2	18525	7775	-16814	-45707	49318	ABC
1997.5	D	-65	20.4	-67	55.0	18534	7733	-16844	-45682	49299	ABC
1998.5	D	-65	30.9	-67	54.8	18530	7680	-16864	-45665	49282	ABC
1999.5	D	-65	41.0	-67	53.9	18528	7630	-16884	-45626	49245	ABC

* Elements ABC indicates non-aligned variometer orientation

MAW Significant Events 1999

(Dec 01, 1998) New observer (Robert Sutton) arrived.

(Dec 10, 1998) Out-going observer (Maria de Deuge) departed.

Mar 13 The static discharge that caused a 1 minute data loss also caused the PPM to be recorded once per minute instead of the usual 6 per minute, until remedied.

May 11 to 13: Upon tidying the PPM cable in the variometer hut the PPM began providing wildly scattered readings. This continued until the cable was restored to its original position.

May 19 Station power outage. The UPS kept the variometer and acquisition running although the PPM data were noisy.

Nov 2 to 4: Maintenance on Absolute Hut roof and Variometer hut door.

(Jan 06, 2000) New observer (Peter Johnson) arrived.

(Jan 08, 2000) Out-going observer (Robert Sutton) departed.

The following also took place at Mawson in 1999:

- A tide gauge was installed 90m ENE of the variometer hut. Three-phase power to variometer hut was re-organised. One of the 3 phases supplied the heaters in the variometer and absolute hut; another phase supplied the PC and variometers in the variometer hut; and the other phase supplied the tide gauge experiment. The electrical work was performed in January-February and November-December 1999.
- Pier differences between the principal absolute Station A and secondary Station 85/2 were determined during three successive summers. On each occasion multiple observations were performed at each station. The results below refer to the Station A – Station 85/2 (X,Y,Z in nT) difference at a sensor height above ground level of 1.60m at Station 85/2 derived through baselines:

  1998-1999: (-2, 12, -23)

  1998-1999: (0, 10, -20)

  1999-2000: (-8, 8, -21)
- For backup, an EDA fluxgate variometer was sent to Mawson in 1998-99 summer and some preparations were made to install it in August-October, however a superior instrument became available and was sent to the station in the 1999-2000 summer and subsequently installed in 2000.

Distribution of data during 1999

Preliminary Monthly Means for Project Ørsted

- IPGP monthly (by e-mail): Sep. 1994 – Dec. 1997 (amended values)

1-minute & Hourly Mean Values

- None sent in 1999.

K indices

The table on the next page shows Mawson K indices for 1999. Using the digital data, these have been derived by a computer algorithm that calculates a simple range in the X and Y magnetic components over each 3-hour UT period. The K indices are calculated from the maximum of the X and Y ranges in the usual manner. This was suitable at Mawson as the diurnal variation is small.

K indices & Daily K sums at Mawson Antarctica (K=9 limit: 1500 nT) for 1999

Date	January	February	March	April	May	June	Date
01	3433 3333 25	Q 2222 1112 13	D 4653 4564 37	6642 1343 29	D 6564 3374 38	4222 1222 17	01
02	5344 3332 27	Q 4321 1013 15	6653 4546 39	2552 3352 27	D 4453 3345 31	4323 1026 21	02
03	Q 5532 3323 26	4333 3344 27	3534 3766 37	3433 2264 27	5443 3253 29	4221 2010 12	03
04	4463 3353 31	3542 4443 29	D 4665 4776 45	6442 3265 32	2332 1225 20	4432 2226 25	04
05	4654 3324 31	5434 3455 33	6554 3533 34	5443 3343 29	3121 1235 18	4111 3245 21	05
06	4532 4454 31	4444 3564 34	5543 3456 35	3652 2334 28	4543 3214 26	2222 1100 10	06
07	3343 4444 29	4553 3545 34	D 5654 3565 39	5554 3464 36	4542 2234 26	1321 1125 16	07
08	D 5544 4555 37	4543 2232 25	4553 2457 35	3322 3634 26	3321 2144 20	D 4454 2323 27	08
09	6553 3345 34	Q 3431 2244 23	4654 4755 40	3322 2223 19	2321 2111 13	D 4452 2565 33	09
10	5434 2243 27	4552 2355 31	D 7776 2255 41	3343 3477 34	3311 1102 12	3211 0112 11	10
11	3443 2343 26	D 6553 5444 36	3544 4422 28	5642 3334 30	Q 0110 000- --	2212 2365 23	11
12	4232 3145 24	D 6555 5554 40	3434 2345 28	5322 2222 20	---- ---4 --	3421 1244 21	12
13	D 4454 5766 41	3543 3244 28	3223 3234 22	Q 1121 1114 12	D 5753 4344 35	5421 1063 22	13
14	D 4347 5446 37	3334 4432 26	4434 4345 31	3243 2332 22	5353 2125 26	Q 2221 0004 11	14
15	D 6654 4464 39	4553 4344 32	5664 3334 34	Q 3321 0111 12	4323 2254 25	1010 2224 12	15
16	4443 3223 25	3333 2111 17	Q 3232 2113 17	3322 3466 29	Q 2221 1210 11	2133 2335 22	16
17	4433 2234 25	D 4445 5335 33	2222 2232 17	D 7774 2223 34	Q 0111 1323 12	3442 2234 24	17
18	3232 3364 26	D 4868 6686 52	3433 2321 21	4313 2122 18	D 4665 4574 41	3432 1125 21	18
19	Q 4422 2123 20	D 6656 6653 43	3323 2444 25	2333 3335 25	3543 3335 29	4311 0200 11	19
20	4322 4443 26	Q 4222 2244 22	Q 4323 2350 22	D 3554 4535 34	3453 3336 30	Q 0111 0010 04	20
21	3544 4212 25	2332 1224 19	2432 2221 18	3443 3565 33	4421 1223 19	Q 0001 1034 09	21
22	5332 5655 34	4332 1154 23	Q 3211 2231 15	Q 3221 1133 16	Q 2221 1101 10	Q 1011 1004 08	22
23	D 4544 3554 34	4552 3522 28	2222 2235 20	Q 2322 3223 19	4212 3231 18	3222 2125 19	23
24	4664 4554 38	3334 4542 28	Q 3222 1113 15	5532 1122 21	2431 3223 20	3322 1242 19	24
25	5543 3344 31	2532 3--- --	3122 1454 22	Q 2121 1224 15	D 6444 4322 29	5210 0102 11	25
26	Q 4423 3124 23	Q --21 2001 --	3442 3212 21	3121 1354 20	4431 2233 22	D 5443 3344 30	26
27	5543 4332 29	3233 2255 25	Q 2322 1015 16	4344 3676 37	4441 1126 23	D 4333 4465 32	27
28	3543 4323 27	2332 3476 30	4332 2223 21	D 5554 3566 39	5342 2354 28	D 3773 2344 33	28
29	4433 3343 27		D 3553 5346 34	D 4443 4556 35	3211 1231 14	4444 3221 24	29
30	Q 4323 2213 20		5354 4465 36	D 6554 3456 38	1001 1352 13	Q 1032 0043 13	30
31	Q 3333 2322 21		4544 3377 37		Q 1200 0004 07		31
Mean K-sum	**28.9**	**28.7**	**28.5**	**26.5**	**22.2**	**18.7**	

Date	July	August	September	October	November	December	Date
01	3332 2165 25	5422 1000 14	6655 4466 42	3332 3354 26	5534 4255 33	3322 3443 24	01
02	D 4564 3454 35	Q 4342 1635 28	4553 3354 32	4554 3335 32	5442 2225 26	4332 3235 25	02
03	4363 ---- --	Q 4321 1115 18	4664 3325 33	3443 3425 28	5422 2145 25	4544 4454 34	03
04	Q -011 0032 --	4554 1223 26	5543 2444 31	3664 3445 35	Q 3522 1223 20	D 5565 5754 42	04
05	Q 0011 0025 09	5522 2123 22	Q 3542 3245 28	4443 3436 31	3321 1135 19	D 4674 4665 42	05
06	4451 0335 25	3322 2757 31	Q 3231 2243 20	Q 3333 3243 24	5333 2353 27	D 3754 5444 36	06
07	2110 0122 09	4433 2257 30	3344 3376 33	Q 3332 0123 17	D 5675 5645 43	5453 4574 37	07
08	5212 3455 27	3322 2356 26	Q 4322 2424 23	3544 4115 27	D 5554 5465 39	4444 4365 34	08
09	5221 1044 19	6564 4211 29	5332 3023 21	3332 2126 22	D 4765 5665 44	5544 3345 33	09
10	3321 1053 18	Q 1010 0125 10	4543 3366 34	D 5575 5754 43	4444 4466 36	3553 3465 34	10
11	3222 2235 21	6521 0125 22	6743 2114 28	5663 3577 42	D 5774 4556 43	4543 4312 26	11
12	5633 2254 30	3343 3136 26	D 5535 4465 37	D 5765 5576 46	4443 3564 33	3434 3465 32	12
13	3411 1143 18	5553 2245 31	D 5755 4885 47	5565 5666 44	D 5664 6566 44	D 5775 6423 39	13
14	2001 0164 14	Q 3422 2111 16	6663 3455 38	D 5564 5567 43	4443 3565 34	Q 4431 2222 20	14
15	5433 3434 29	2223 3443 23	4466 4332 32	6674 4654 42	Q 4332 3233 23	3322 2134 20	15
16	Q 3231 1114 16	5345 5476 39	D 4755 4665 42	6654 4665 42	4554 4545 36	5651 2234 28	16
17	Q 3211 1323 16	D 6754 4445 39	4553 4664 37	6664 5335 38	4344 4343 29	4543 3442 29	17
18	3222 0221 14	D 6655 4656 43	2434 4422 25	3523 3365 30	5554 3575 39	3433 3345 28	18
19	Q 4101 1000 07	6564 5567 44	4433 4235 28	Q 4442 2111 19	4553 4444 33	4434 4334 29	19
20	1110 1110 06	D 4855 4566 43	4453 3455 33	Q 3222 2131 16	5654 2214 29	3232 2224 20	20
21	D 4333 2652 28	Q 4343 3122 22	3332 3345 26	5634 2445 33	5453 2445 32	Q 3232 1232 18	21
22	D 2674 3676 41	3332 3675 32	D 4433 4358 34	D 7685 4575 47	5434 4333 29	Q 3322 2223 19	22
23	5533 4243 29	D 5654 3345 35	4663 2223 28	D 5663 6556 42	4665 4554 39	Q 3432 3323 23	23
24	6421 4275 31	D 5545 5336 36	Q 3442 1223 21	5564 4367 40	5546 4565 40	4664 3224 31	24
25	4532 2135 25	3331 1135 20	Q 3222 0113 14	6554 3641 34	3655 4455 37	4552 4323 28	25
26	4232 2225 22	4533 3466 34	2221 2547 25	3433 4354 29	Q 4433 3222 23	Q 3321 1113 15	26
27	3443 1033 21	5543 3465 35	D 4575 5676 45	5654 4754 40	Q 2232 3124 19	6433 2243 27	27
28	2233 2457 28	5443 3355 32	6554 4556 40	4443 5575 37	4543 3353 30	4542 2355 30	28
29	4232 1104 17	5333 2354 28	6554 4455 38	4454 3254 31	Q 4533 2234 26	5442 3334 28	29
30	D 5453 5475 38	3645 3756 39	7764 3366 42	Q 3433 3445 29	5554 5344 35	3553 3345 31	30
31	D 6762 2256 36	4554 3476 38		4543 2334 28		D 6755 5666 46	31
Mean K-sum	**22.6**	**29.4**	**31.9**	**33.5**	**32.2**	**29.3**	

Occurrence distribution of K-indices

K-Index:	0	1	2	3	4	5	6	7	8	9	-
January	0	5	35	79	78	36	13	2	0	0	0
February	3	15	40	52	53	39	13	1	3	0	5
March	2	15	54	58	50	39	20	10	0	0	0
April	1	24	53	68	39	30	19	6	0	0	0
May	16	46	50	53	42	23	7	3	0	0	8
June	32	46	64	36	40	14	6	2	0	0	0
July	24	42	49	47	34	28	13	6	0	0	5
August	7	23	34	53	41	54	26	9	1	0	0
September	2	7	33	52	59	45	30	9	3	0	0
October	1	10	18	57	55	57	36	13	1	0	0
November	0	7	28	44	67	67	22	5	0	0	0
December	0	9	42	67	66	41	16	7	0	0	0
ANNUAL TOTAL	88	249	500	666	624	473	221	73	8	0	18

Mawson, Antarctica 1999 Monthly & Annual Mean Values

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

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

Mawson Antarctica 1999		X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	7692.8	-16909.2	-45627.4	49264.3	18577.0	-65° 32.2'	-67° 50.8'
	5xQ days	7681.5	-16910.8	-45620.9	49257.0	18573.7	-65° 34.2'	-67° 50.8'
	5xD days	7694.1	-16895.7	-45621.7	49254.7	18565.3	-65° 31.0'	-67° 51.4'
February	All days	7675.1	-16905.7	-45620.8	49254.2	18566.5	-65° 35.0'	-67° 51.3'
	5xQ days	7685.6	-16915.7	-45620.6	49259.0	18579.8	-65° 33.9'	-67° 50.4'
	5xD days	7629.4	-16870.2	-45621.5	49236.0	18515.7	-65° 40.0'	-67° 54.6'
March	All days	7666.6	-16901.6	-45642.4	49271.5	18559.2	-65° 36.1'	-67° 52.3'
	5xQ days	7671.6	-16918.4	-45615.8	49253.3	18576.5	-65° 36.5'	-67° 50.5'
	5xD days	7655.8	-16879.9	-45689.6	49306.3	18535.1	-65° 36.2'	-67° 55.1'
April	All days	7650.3	-16898.3	-45630.0	49256.3	18549.5	-65° 38.6'	-67° 52.6'
	5xQ days	7670.2	-16923.1	-45611.3	49250.6	18580.2	-65° 37.1'	-67° 50.2'
	5xD days	7618.4	-16877.3	-45659.8	49272.0	18517.3	-65° 42.4'	-67° 55.5'
May	All days	7656.6	-16914.5	-45617.8	49251.5	18566.8	-65° 38.7'	-67° 51.2'
	5xQ days	7667.4	-16924.0	-45610.4	49249.5	18579.8	-65° 37.6'	-67° 50.2'
	5xD days	7636.7	-16897.2	-45630.9	49254.7	18542.9	-65° 40.8'	-67° 53.1'
June	All days	7660.5	-16918.4	-45596.4	49233.6	18571.9	-65° 38.4'	-67° 50.3'
	5xQ days	7665.9	-16926.1	-45598.2	49238.8	18581.2	-65° 38.0'	-67° 49.8'
	5xD days	7652.3	-16908.0	-45582.5	49216.0	18559.1	-65° 39.0'	-67° 50.8'
July	All days	7645.3	-16911.7	-45600.8	49233.1	18559.6	-65° 40.4'	-67° 51.2'
	5xQ days	7659.0	-16927.2	-45602.7	49242.2	18579.3	-65° 39.3'	-67° 50.0'
	5xD days	7620.0	-16883.5	-45600.4	49219.2	18523.6	-65° 42.6'	-67° 53.5'
August	All days	7634.0	-16902.1	-45610.7	49237.2	18546.2	-65° 41.6'	-67° 52.3'
	5xQ days	7645.6	-16920.3	-45605.2	49240.1	18567.5	-65° 41.0'	-67° 50.8'
	5xD days	7600.0	-16870.1	-45625.0	49234.5	18503.2	-65° 45.0'	-67° 55.5'
September	All days	7624.3	-16898.1	-45627.8	49250.3	18538.6	-65° 43.0'	-67° 53.3'
	5xQ days	7647.2	-16923.1	-45616.5	49251.8	18570.8	-65° 41.0'	-67° 50.9'
	5xD days	7600.8	-16870.0	-45637.8	49246.5	18503.5	-65° 44.8'	-67° 55.8'
October	All days	7628.6	-16903.8	-45632.8	49257.6	18545.6	-65° 42.7'	-67° 53.0'
	5xQ days	7642.7	-16929.7	-45616.5	49253.4	18575.0	-65° 42.2'	-67° 50.6'
	5xD days	7604.1	-16864.2	-45656.3	49262.1	18499.6	-65° 43.8'	-67° 56.5'
November	All days	7653.4	-16923.4	-45617.8	49254.2	18573.7	-65° 40.0'	-67° 50.8'
	5xQ days	7657.3	-16937.3	-45618.7	49260.3	18587.8	-65° 40.4'	-67° 49.9'
	5xD days	7623.5	-16881.3	-45622.5	49239.6	18523.2	-65° 41.8'	-67° 54.1'
December	All days	7652.6	-16933.1	-45589.1	49230.8	18582.2	-65° 40.9'	-67° 49.4'
	5xQ days	7657.4	-16942.3	-45592.8	49238.0	18592.4	-65° 40.7'	-67° 48.9'
	5xD days	7619.4	-16906.9	-45565.1	49194.8	18545.0	-65° 44.5'	-67° 51.2'
Annual Mean Values	All days	7653.4	-16910.0	-45617.8	49249.6	18561.4	-65° 39.0'	-67° 51.5'
	5xQ days	7662.6	-16924.8	-45610.8	49249.5	18578.7	-65° 38.5'	-67° 50.2'
	5xD days	7629.5	-16883.7	-45626.1	49244.7	18527.8	-65° 41.0'	-67° 53.9'

(Calculated:16:39 hrs., Thu. 18 Oct. 2001)

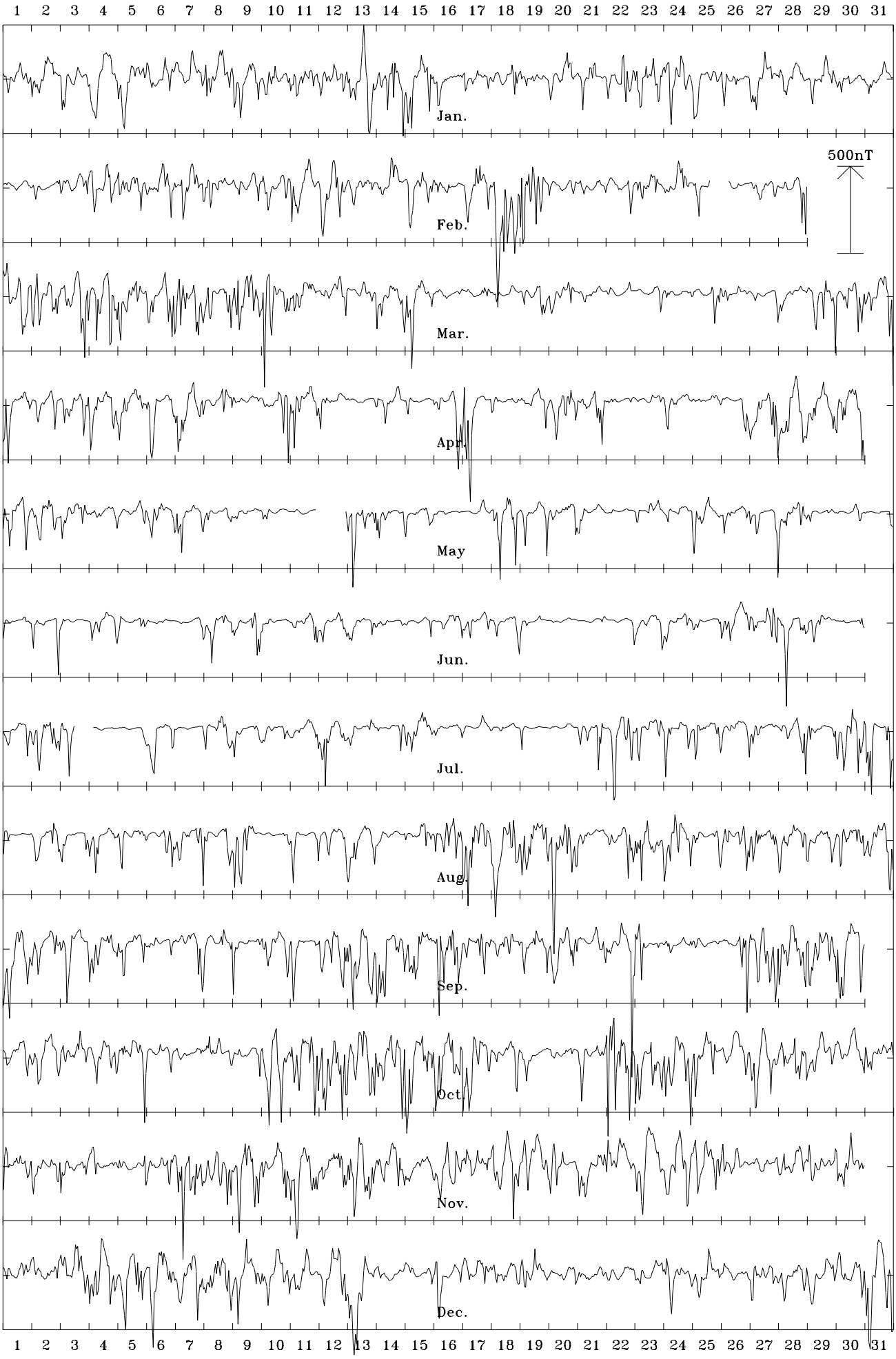
Hourly Mean Values

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

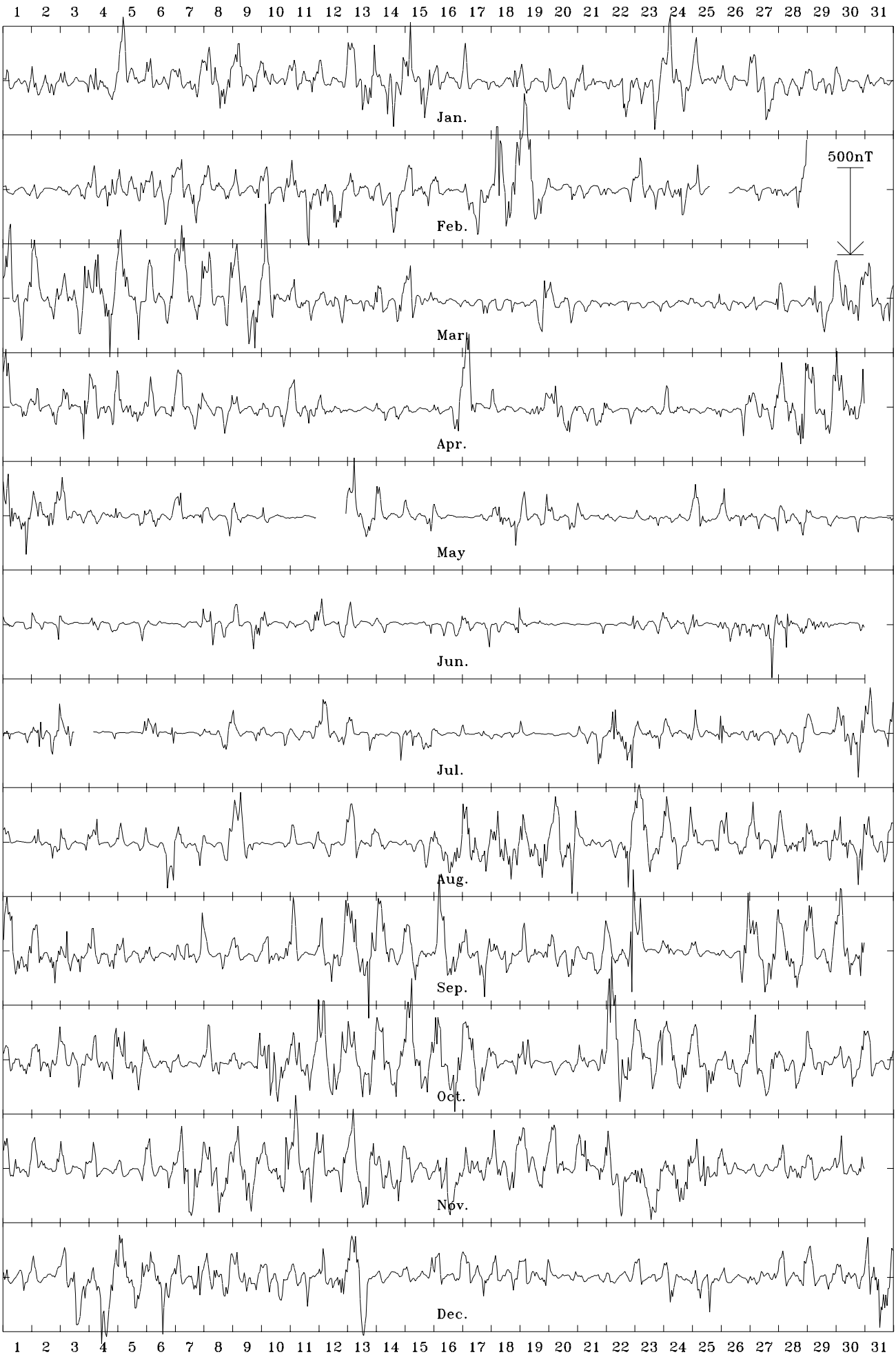
The reference levels indicated with marks on the vertical axes refer to the *all-days* mean value for the respective months. All elements in the plots are shown increasing (algebraically) towards the top of the page, with the exception of Z, which is in the opposite sense.

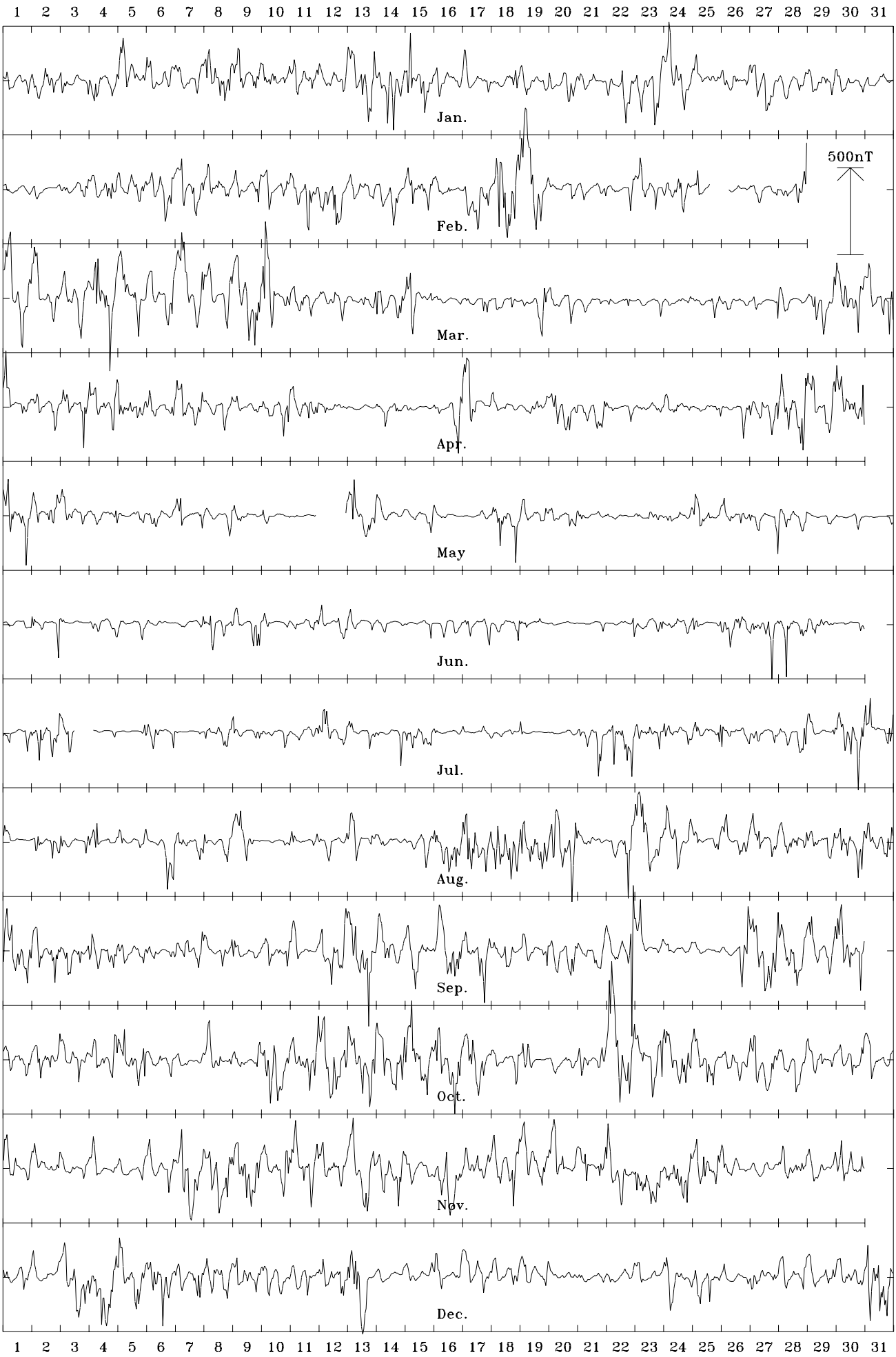
The mean value given at the top of each plot is the *all-days* annual mean value of the element.

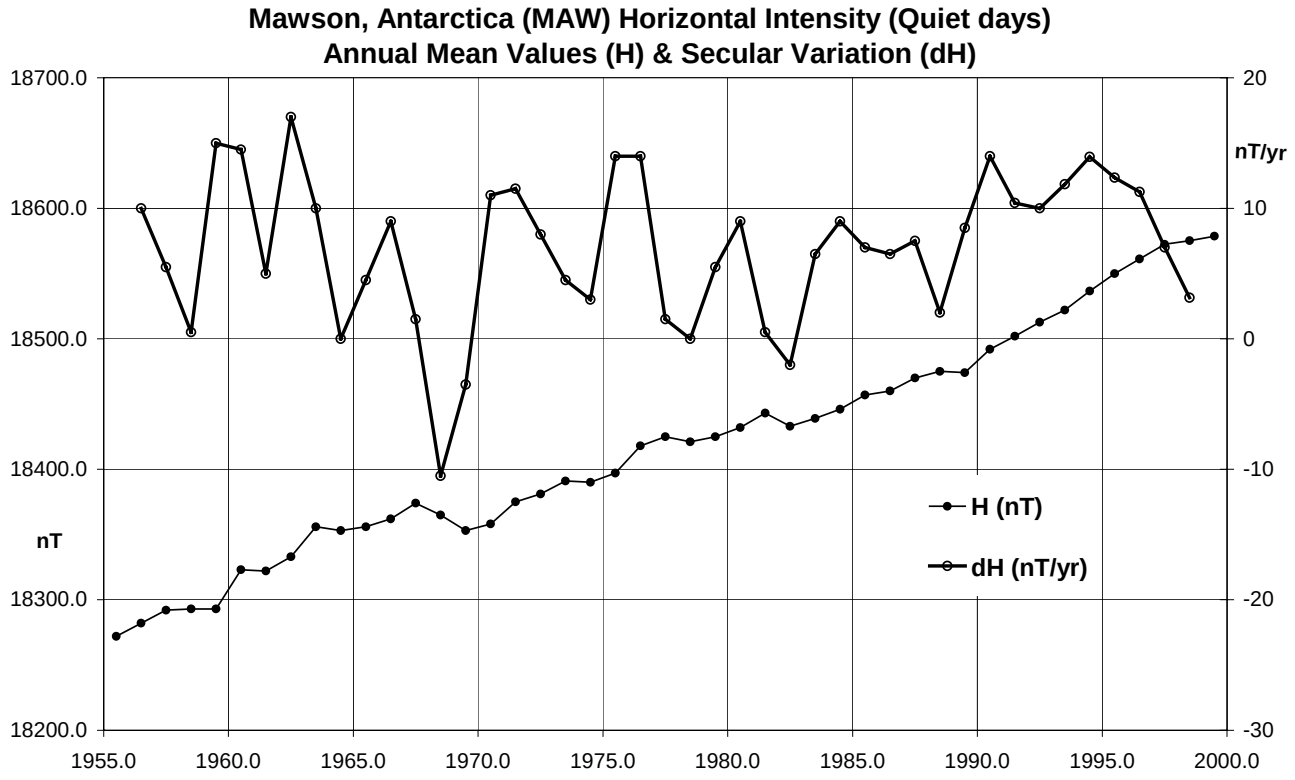
Mawson Stn. 1999 Horizontal intensity (H). Scale: 30.0 nT/mm. Mean: 18561 nT

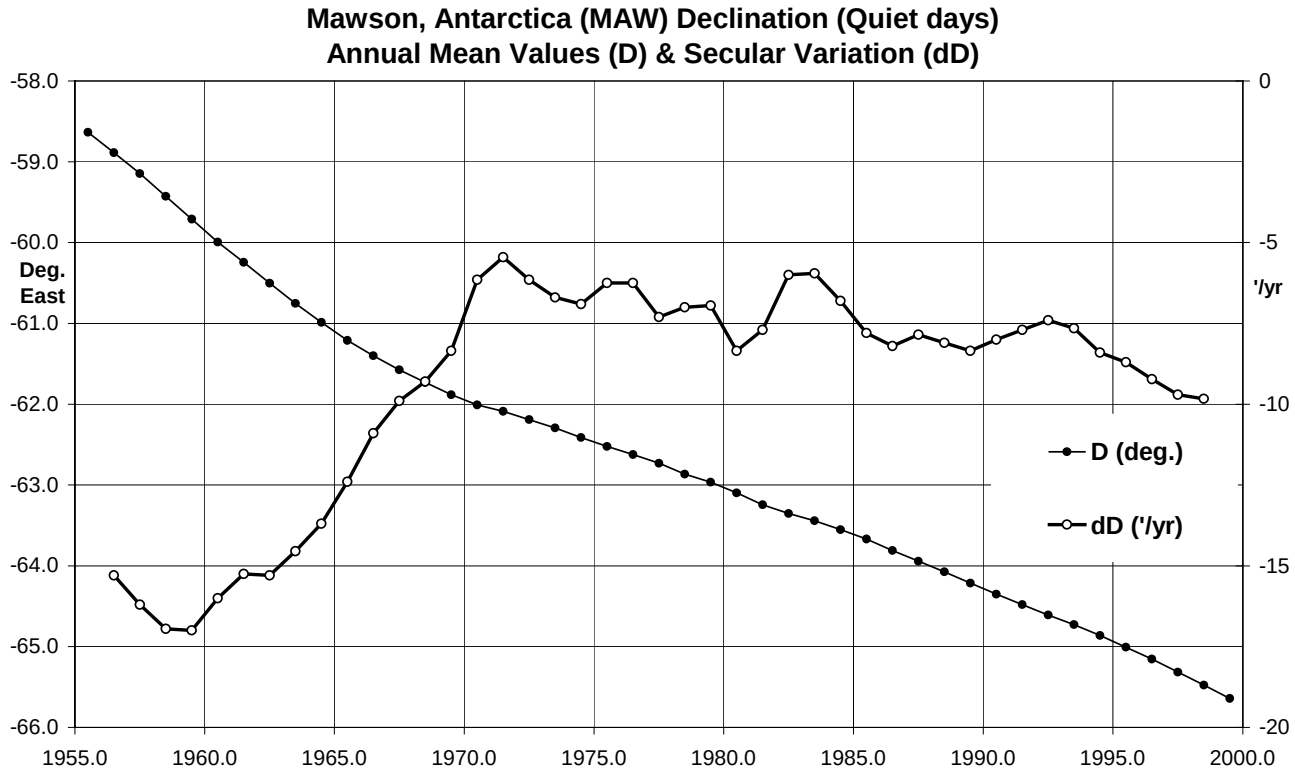


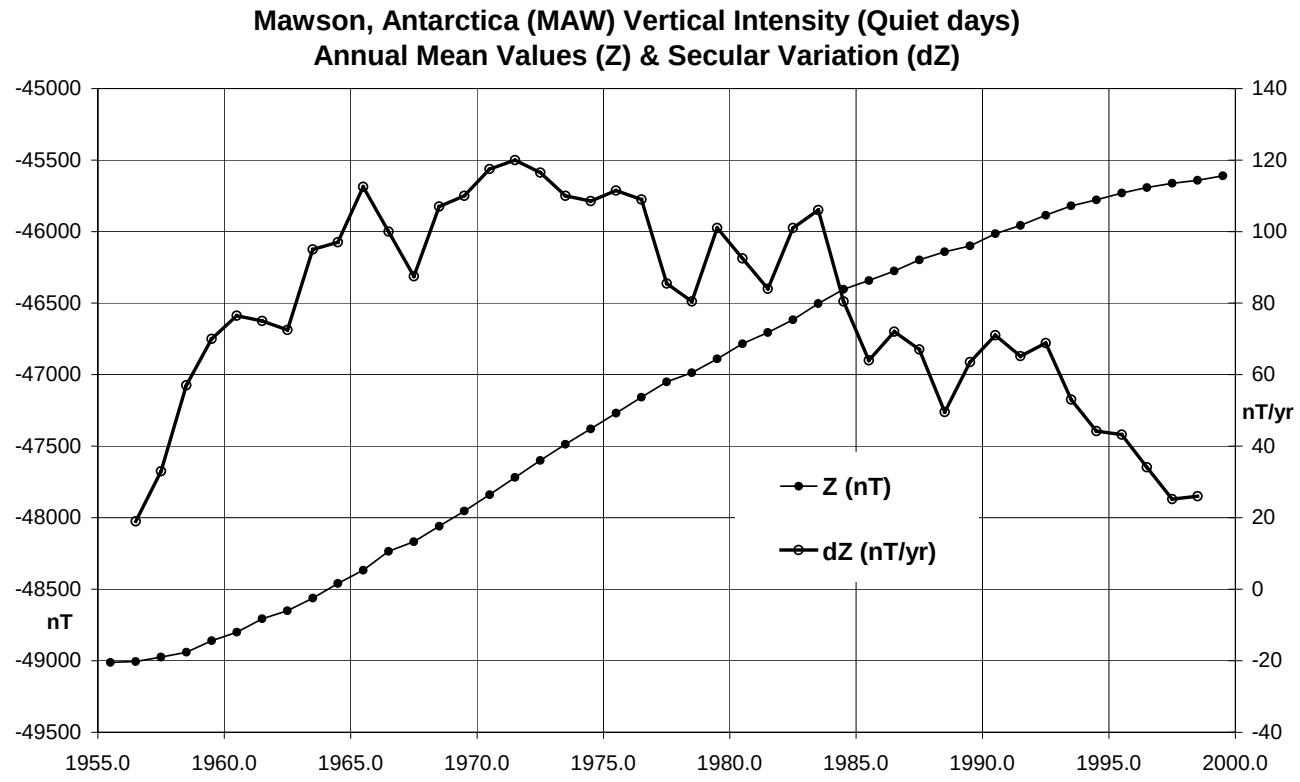
Mawson Stn. 1999 Declination (east) (D). Scale: 4.00 min/mm. Mean: −65.65 deg.

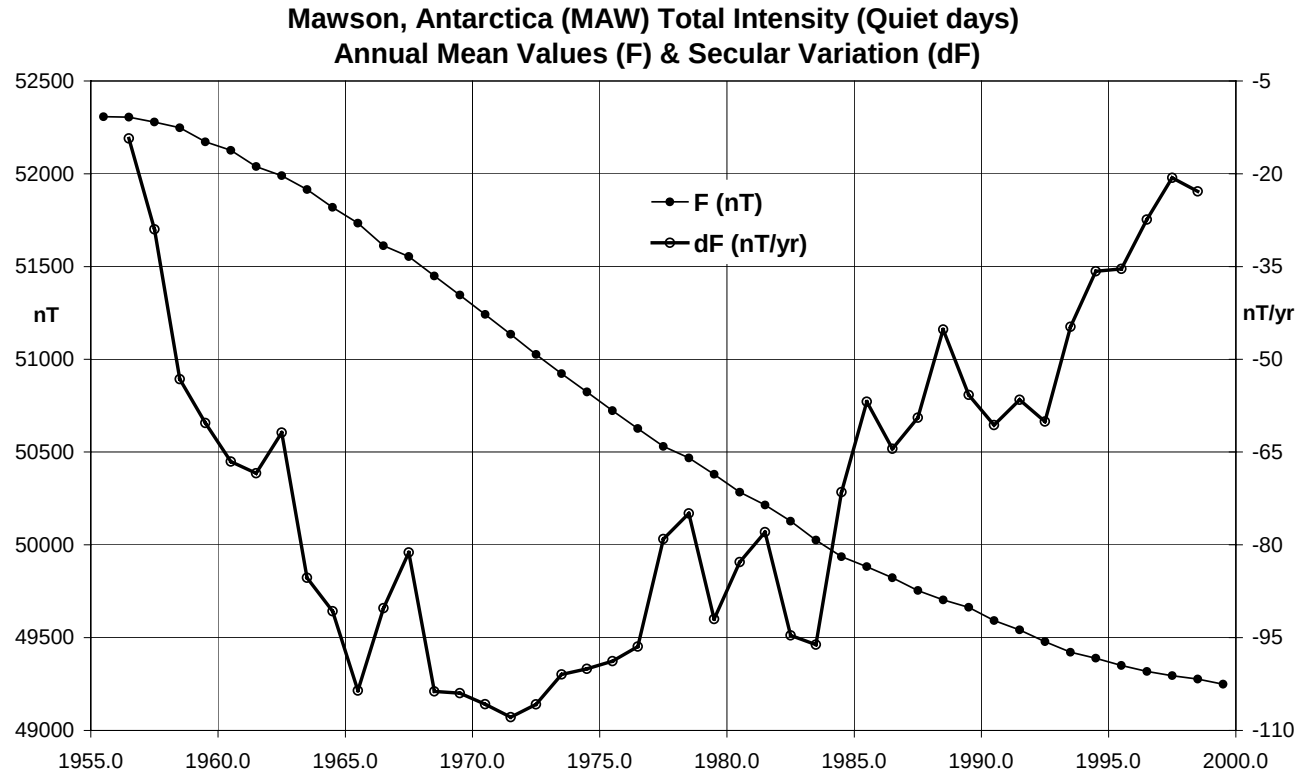

Mawson Stn. 1999 Vertical intensity (Z). Scale: 30.0 nT/mm. Mean: −45618 nT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
500nT
Feb.
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31


Mawson Stn. 1999 Total intensity (F). Scale: 30.0 nT/mm. Mean: 49250 nT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
Feb.
500nT
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.


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


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


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


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

CASEY OBSERVATORY

Casey is the closest Australian Antarctic station to the Australian mainland. The absolute hut is about 120 metres south of the tank house, the closest part of the modern station. The old Casey station, in use until the late 1980s, was about 1 km to the north-east, until it moved closer to the magnetic absolute hut.

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

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

- 3-character IAGA code: CSY
- Geographic latitude: 66° 17' S
- Geographic longitude: 110° 32' E
- Geomagnetic† latitude: -76.8°
- Geomagnetic† longitude: 183.4°
- Elevation above mean sea level (top of observation pier) 40 metres
- Azimuth of reference pillar (G11) from observation pier 307° 41' 02"
- Observer in Charge: Steven Wallace (AAD)

† Based on the IGRF 1995 model.

History

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

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

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

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

Since 1998 the calculation of monthly means has been carried out at GA using International Quiet Days.

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

GA began processing minute values from Casey in 1998 and in 1999 its operation was upgraded to full observatory status.

Full observatory operation began on 22 March, 1999.

Observer in charge

The magnetic observer-in-charge at Casey in 1999 was supported jointly by the Antarctic Division and GA from the Department of Industry Tourism and Resources. He was a member of the Australian National Antarctic Research Expedition (ANARE).

The duties of the magnetic observer included maintaining the equipment, performing twice-weekly absolute observations to calibrate the variometers and providing regular data reports to GA headquarters in Canberra.

Variometers

An Antarctic Division EDA FM105B fluxgate variometer, with the data acquired by PC, operated at Casey throughout 1999. The three fluxgates are housed in separate boxes on the hill about 300m west of the Casey Science building. And their sensors are aligned close to true north, east and vertical. The temperatures were maintained at 20 degrees C. Further description can be found in Crosthwaite (1999, in prep).

Absolute Instruments and Corrections

Magnetometers used to calibrate the recording variometers were an Elsec 810 DIM and Zeiss020B theodolite, both owned by the Antarctic Division, and a Geometrics 816 PPM, owned by GA. A QHM and QHM circles are available as a back-up.

For standardization with the Australian Magnetic Standard held at Canberra, a correction of +2.0nT has been applied to the absolute PPM readings. Corrections of zero have been applied to the DIM readings. These resulted in baseline corrections in X, Y and Z of 0nT, -0.3nT and –2.0nT respectively.

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

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

The combined corrections applied in X, Y and Z were +42nT, -11.9nT and -47nT at Casey.

Casey, Antarctica 1999 Monthly & Annual Mean Values

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

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

Casey Station	1999	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	-505.3	-9591.0	-63755.4	64474.9	9605.1	-93° 01.0'	-81° 26.0'
	5xQ days	-539.1	-9579.9	-63767.1	64485.1	9595.4	-93° 13.3'	-81° 26.6'
	5xD days	-521.6	-9577.3	-63765.6	64483.3	9593.4	-93° 07.1'	-81° 26.6'
February	All days	-510.3	-9588.5	-63768.5	64487.5	9602.7	-93° 02.8'	-81° 26.2'
	5xQ days	-514.8	-9581.2	-63757.3	64475.3	9595.2	-93° 04.6'	-81° 26.5'
	5xD days	-548.1	-9590.6	-63814.6	64534.0	9607.6	-93° 16.2'	-81° 26.3'
March	All days	-511.0	-9591.5	-63772.3	64491.7	9605.4	-93° 03.0'	-81° 26.1'
	5xQ days	-527.5	-9582.2	-63776.9	64494.9	9596.8	-93° 09.1'	-81° 26.6'
	5xD days	-492.7	-9609.0	-63756.9	64479.0	9622.0	-92° 56.1'	-81° 25.1'
April	All days	-516.5	-9584.8	-63780.0	64498.3	9598.8	-93° 05.1'	-81° 26.5'
	5xQ days	-523.5	-9575.7	-63772.8	64489.9	9590.1	-93° 07.8'	-81° 26.9'
	5xD days	-530.5	-9587.2	-63799.1	64517.7	9602.1	-93° 10.0'	-81° 26.5'
May	All days	-519.4	-9578.9	-63771.9	64489.4	9593.0	-93° 06.2'	-81° 26.7'
	5xQ days	-514.7	-9577.6	-63766.4	64483.7	9591.4	-93° 04.6'	-81° 26.8'
	5xD days	-523.5	-9571.4	-63781.3	64497.7	9585.8	-93° 07.9'	-81° 27.2'
June	All days	-521.8	-9579.4	-63767.4	64485.0	9593.6	-93° 07.1'	-81° 26.7'
	5xQ days	-518.2	-9579.0	-63759.9	64477.6	9593.0	-93° 05.8'	-81° 26.6'
	5xD days	-528.7	-9572.9	-63775.0	64491.7	9587.6	-93° 09.7'	-81° 27.0'
July	All days	-522.7	-9579.7	-63773.2	64490.8	9594.0	-93° 07.4'	-81° 26.7'
	5xQ days	-515.0	-9578.4	-63763.5	64481.0	9592.2	-93° 04.7'	-81° 26.7'
	5xD days	-532.1	-9580.7	-63799.8	64517.4	9595.6	-93° 10.7'	-81° 26.8'
August	All days	-527.9	-9579.3	-63779.9	64497.5	9594.0	-93° 09.3'	-81° 26.7'
	5xQ days	-527.3	-9579.9	-63771.2	64488.9	9594.4	-93° 09.0'	-81° 26.6'
	5xD days	-538.5	-9575.6	-63806.0	64522.8	9591.0	-93° 13.2'	-81° 27.1'
September	All days	-526.9	-9588.0	-63789.3	64508.1	9602.7	-93° 08.7'	-81° 26.3'
	5xQ days	-512.9	-9585.8	-63774.1	64492.5	9599.7	-93° 03.7'	-81° 26.4'
	5xD days	-533.5	-9582.8	-63804.6	64522.6	9598.1	-93° 11.3'	-81° 26.7'
October	All days	-525.8	-9587.1	-63792.8	64511.5	9602.0	-93° 08.4'	-81° 26.4'
	5xQ days	-524.0	-9582.2	-63756.0	64474.2	9596.7	-93° 07.9'	-81° 26.4'
	5xD days	-538.9	-9590.6	-63830.0	64549.0	9606.4	-93° 12.9'	-81° 26.5'
November	All days	-491.2	-9589.8	-63749.2	64468.5	9603.3	-92° 56.1'	-81° 26.0'
	5xQ days	-470.0	-9597.9	-63731.9	64452.4	9610.0	-92° 48.4'	-81° 25.5'
	5xD days	-525.2	-9586.2	-63810.2	64528.7	9601.6	-93° 08.2'	-81° 26.6'
December	All days	-509.6	-9579.4	-63748.6	64466.6	9593.8	-93° 02.7'	-81° 26.5'
	5xQ days	-502.8	-9570.8	-63732.4	64449.0	9584.3	-93° 00.6'	-81° 26.9'
	5xD days	-573.2	-9574.9	-63797.6	64515.0	9593.6	-93° 25.5'	-81° 26.9'
Annual Mean Values	All days	-515.7	-9584.8	-63770.7	64489.1	9599.0	-93° 04.8'	-81° 26.4'
	5xQ days	-515.8	-9580.9	-63760.8	64478.7	9594.9	-93° 04.9'	-81° 26.5'
	5xD days	-532.2	-9583.3	-63795.1	64513.2	9598.7	-93° 10.7'	-81° 26.6'

(Calculated: 08:55 hrs., Tue. 23 Oct. 2001)

Hourly Mean Values

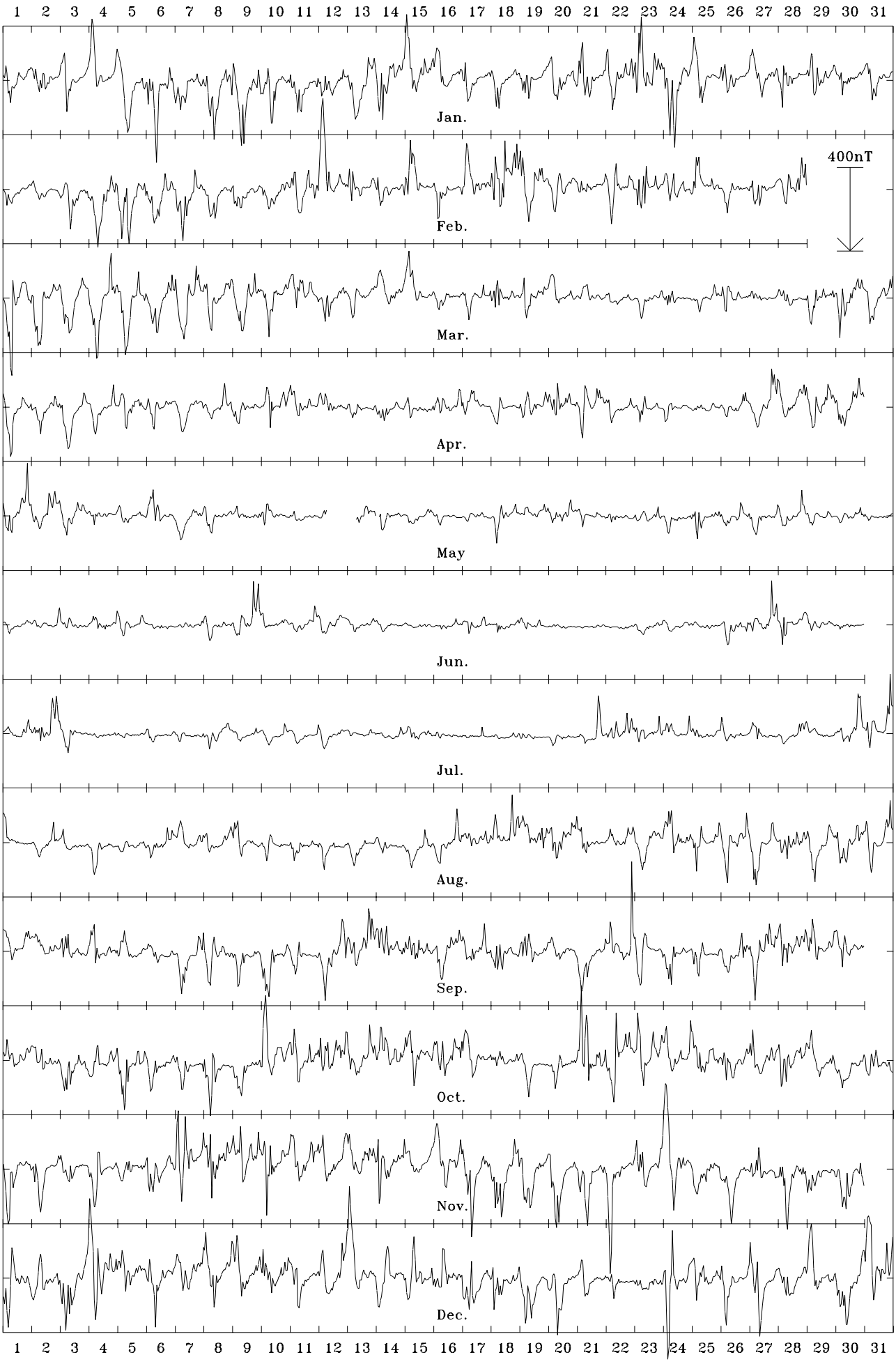
The charts on the following pages are plots of hourly mean values.

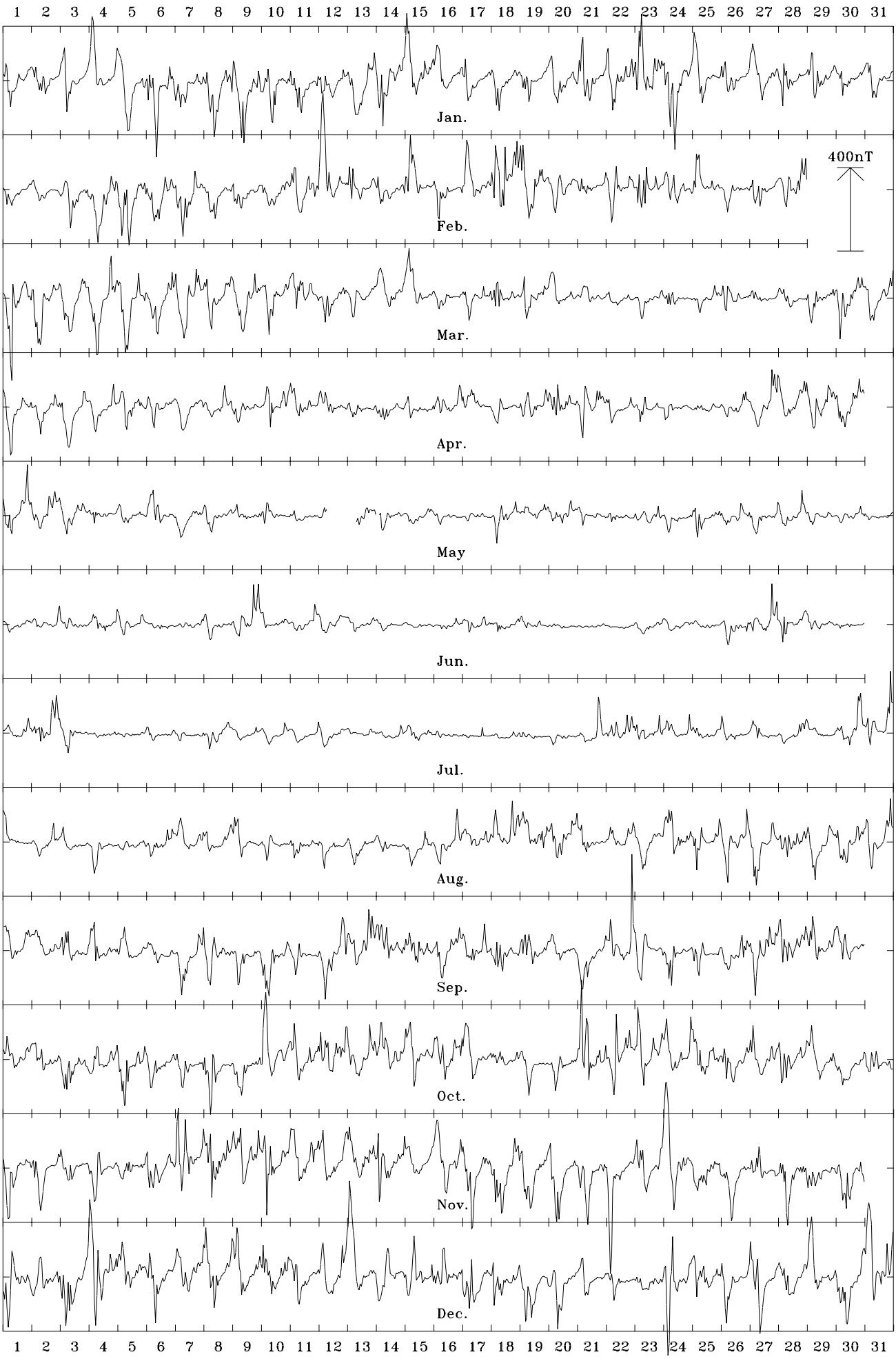
The reference levels indicated with marks on the vertical axes refer to the *all-days* mean value for the respective months. All elements in the plots are shown increasing (algebraically) towards the top of the page, with the exception of Z, which is in the opposite sense.

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

Casey Stn. 1999 Horizontal intensity (H). Scale: 25.0 nT/mm. Mean: 9599 nT


Casey Stn. 1999 Declination (east) (D). Scale: 10.0 min/mm. Mean: −93.08 deg.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
120.0min
Feb.
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31


Casey Stn. 1999 Vertical intensity (Z). Scale: 25.0 nT/mm. Mean: −63771 nT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
400nT
Feb.
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

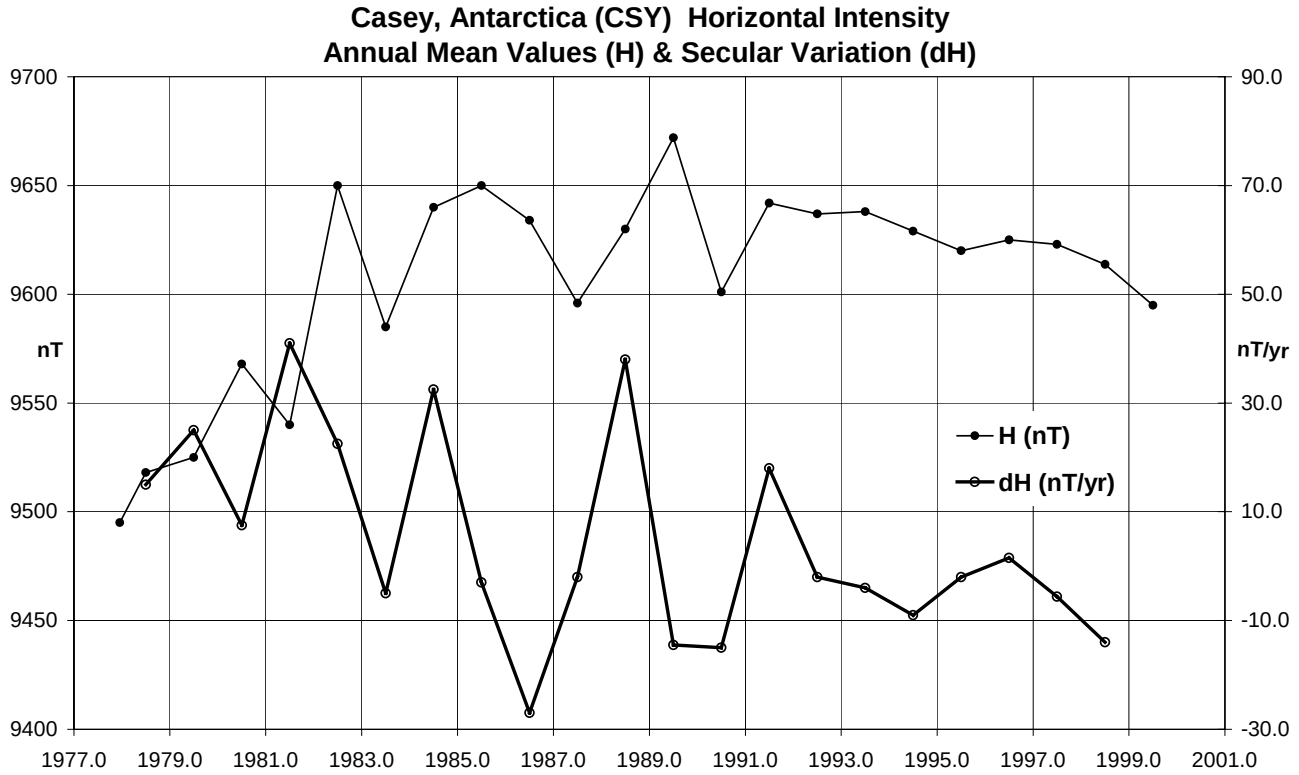

Casey Stn. 1999 Total intensity (F). Scale: 25.0 nT/mm. Mean: 64489 nT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
400nT
Feb.
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

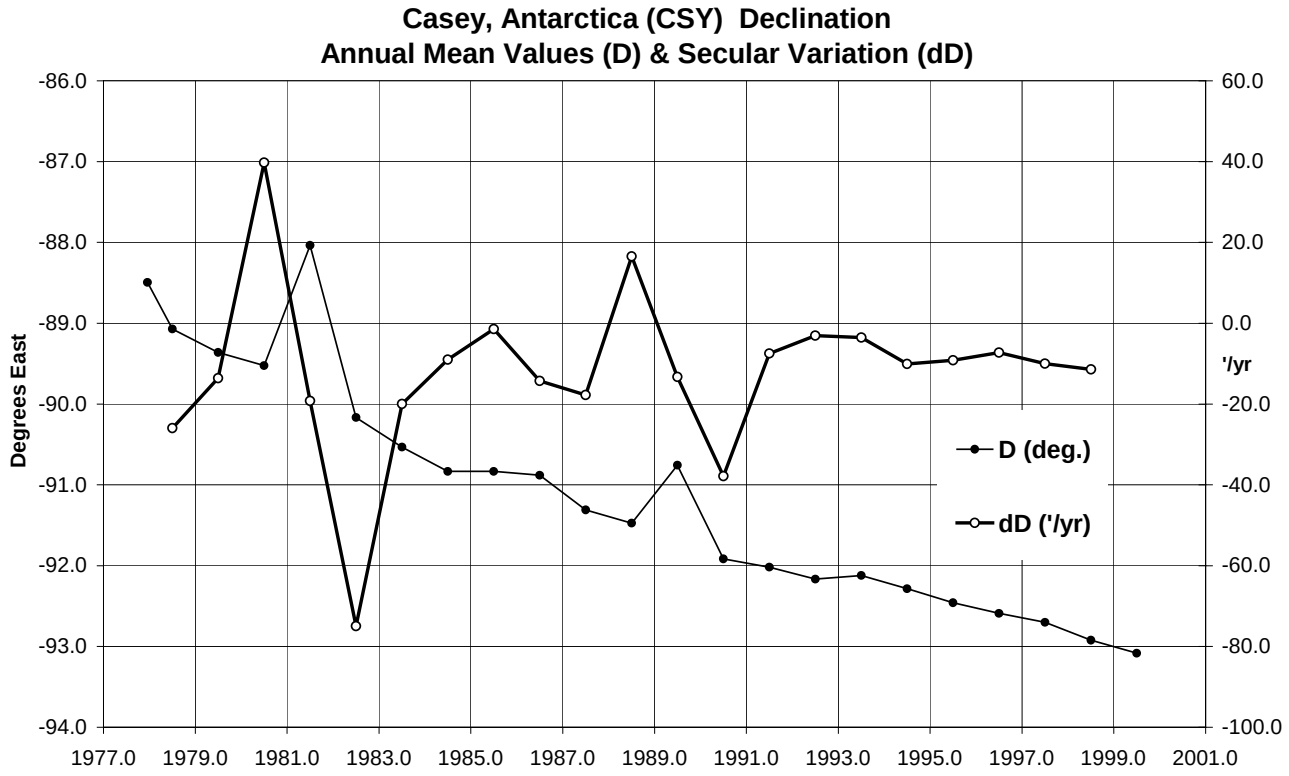
Casey Annual Mean Values

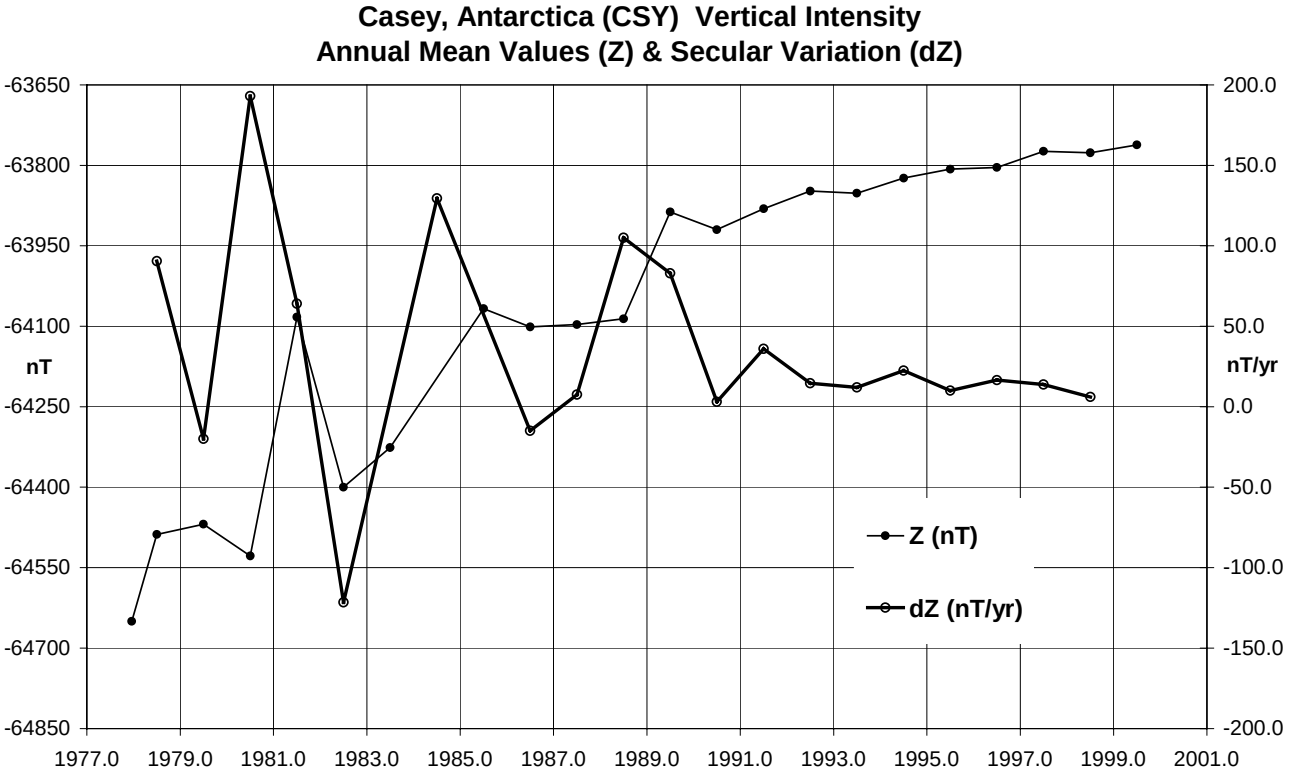
The table below gives annual mean values for Casey station. Until 1990 these were calculated using the monthly average values of regular absolute observations, denoted by A_B. From 1991 they were gained using data from the AAD's fluxgate variometer that was calibrated through regular absolute observations. Until 1997 the means were calculated over the five quietest days at Mawson station, denoted Q_M. 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.

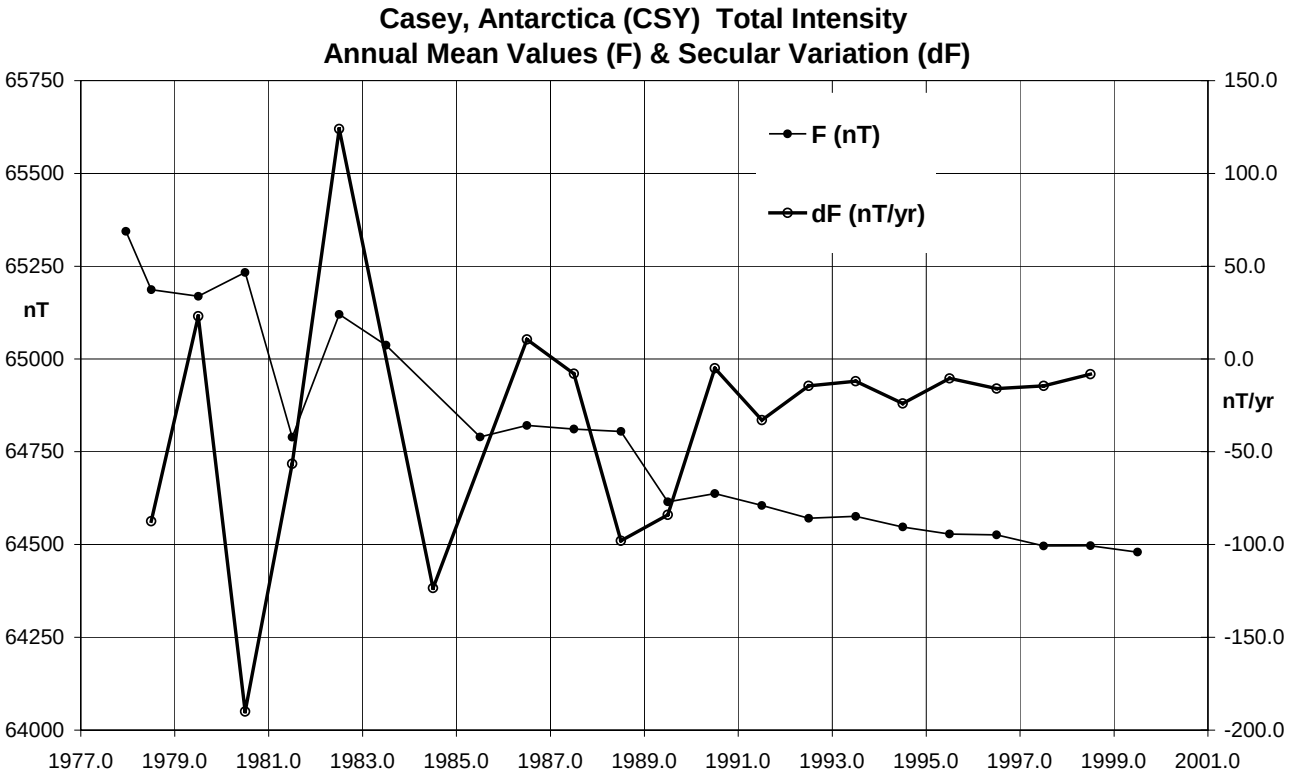
Plots of these data with secular variation in H, D, Z & F are on the pages 94-96.

Year	Days	D		I		H	X	Y	Z	F	Elts*
		(Deg	Min)	(Deg	Min)	(nT)	(nT)	(nT)	(nT)	(nT)	
1977.96	A_B	-88	29.6	-81	38.7	9495	250	-9492	-64650	65344	DHZ
1978.5	A_B	-89	4.3	-81	36.2	9518	154	-9516	-64488	65187	DHZ
1979.5	A_B	-89	21.6	-81	35.7	9525	106	-9524	-64469	65169	DHZ
1980.5	A_B	-89	31.5	-81	33.9	9568	79	-9568	-64528	65233	DHZ
1981.5	A_B	-88	2.1	-81	32.0	9540	327	-9534	-64083	64789	DHZ
1982.5	A_B	-90	10.0	-81	28.4	9650	-28	-9650	-64400	65120	DHZ
1983.5	A_B	-90	32.0	-81	31.5	9585	-89	-9585	-64326	65037	DHZ
1984.5	A_B	-90	50.0			9640	-140	-9639			DHZ
1985.5	A_B	-90	50.0	-81	25.9	9650	-140	-9649	-64067	64790	DHZ
1986.5	A_B	-90	52.9	-81	27.2	9634	-148	-9633	-64101	64821	DHZ
1987.5	A_B	-91	18.6	-81	29.1	9596	-219	-9593	-64097	64811	DHZ
1988.5	A_B	-91	28.4	-81	27.2	9630	-248	-9627	-64086	64805	DHZ
1989.5	A_B	-90	45.5	-81	23.5	9672	-128	-9671	-63887	64615	DHZ
1990.5	A_B	-91	55.0	-81	27.4	9601	-321	-9596	-63920	64637	DHZ
1991.5	Q_M	-92	1.2	-81	25.0	9642	-340	-9636	-63881	64605	XYZ
1992.5	Q_M	-92	10.0	-81	25.0	9637	-364	-9630	-63848	64571	XYZ
1993.5	Q_M	-92	7.3	-81	25.0	9638	-357	-9631	-63852	64576	XYZ
1994.5	Q_M	-92	17.1	-81	25.3	9629	-384	-9621	-63824	64547	XYZ
1995.5	Q_M	-92	27.5	-81	25.6	9620	-413	-9611	-63807	64528	XYZ
1996.5	Q_M	-92	35.4	-81	25.3	9625	-435	-9615	-63804	64526	XYZ
1997.5	Q_M	-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
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
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




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


Casey, Antarctica (CSY) Vertical Intensity
Annual Mean Values (Z) & Secular Variation (dZ)
nT
nT/yr
Z (nT)
dZ (nT/yr)
-63650
-63800
-63950
-64100
-64250
-64400
-64550
-64700
-64850
200.0
150.0
100.0
50.0
0.0
-50.0
-100.0
-150.0
-200.0
1977.0
1979.0
1981.0
1983.0
1985.0
1987.0
1989.0
1991.0
1993.0
1995.0
1997.0
1999.0
2001.0



CSY 1999 Operations

The observers at Casey were officers of the Australian Antarctic Division, of the Australian Department of the Environment and Heritage, and were members of the Australian National Antarctic Research Expedition (ANARE).

Until March 1999 two absolute observations were performed at Casey in each month. From 22 March 1999 full absolute control began that including twice-weekly absolute observations performed on the observation piers in the Absolute House.

The EDA variometer produced 1-second samples that were recorded on an AAD computer. These were sent to GA where they were converted into GA 1-second format from which calibrated minute, monthly and annual means were computed. There was no PPM variometer operating at Casey in 1999.

An officer from GA visited the station in the 1998-99 summer (07 Nov. - 09 Jan.) and, by performing absolute observations and GPS surveys, was able to identify suitable a site with relatively low magnetic gradients (about 10 nT per metre) on which to build a proposed new magnetic absolute house (Crosthwaite 1999, in preparation).

Using absolute observations and variometer data in a regression, the alignment of the fluxgate sensors was also determined during this summer visit. This showed the orientation to be several degrees different from what had earlier been believed.

Significant Events: CSY, 1999

The operation was enhanced to produce full observatory data. Absolute observations increased in frequency from two observations on one day per month to observations twice-weekly and calibrated preliminary monthly means were produced on site.

Distribution of CSY data during 1999

Preliminary Monthly Means for Project Ørsted

- IPGP monthly (by e-mail): None sent in 1999.

1-minute & Hourly Mean Values

- None sent in 1999.

Data losses: CSY, 1999

Some calibration activities for Antarctic Division caused loss of short intervals of data, as did the daily sets of calibration pulses

Jan 01	0000-0001 (2min), 0923-0924 (2min)
Jan 05	0348-0355 (8 min)
Jan 22	1146-1147 (2 min), 1519-1523 (5 min)
Jan 30	0001-0001 (1 min), 0309-0310 (2 min)
Feb 07	0001-0001 (1 min)
Feb 09	0141-0156 (16 min)
Feb 16	0001-0001 (1 min), 0040-0040 (1 min)
Feb 25	0905-0918 (14 min)
Mar 11	0051-0052 (2 min)
Apr 05	0056-0100 (5 min)
Apr 08	0718-0720 (3 min), 0725-0727 (3 min)
Apr 09	0315-0317 (3 min), 0320-0324 (5 min)
May 06	0001-0001 (1 min), 0052-0052 (1 min)
May 07	0001-0001 (1 min), 0148-0152 (5 min), 2346-2347 (1 min)
May 12	0651-2359 (17h 09)
May 13	0000-0700 (7h 01), 0904-0904 (1 min)
May 14	0001-0237 (2h 37)

CSY data losses (cont.)

May 18 0001-0001 (1 min)

May 22 0208-0216 (9 min), 0315-0317 (3 min), 0319-0322 (4 min)

May 24 0333-0333 (1 min), 0657-0717 (0h 21)

Jul 19 0001-0002 (2 min)

Jul 20 0818-0847 (30 min)

Sep 29 0001-0001 (1 min), 0137-0140 (4 min)

Oct 13 0742-0742 (1 min)

Oct 14 1530-1530 (1 min)

Dec 17 0340-0349 (10 min)

Dec 28 2010-2010 (1 min), 2304-2304 (1 min)

DAVIS Variation Station

BMR/AGSO/GA and the Australian Antarctic Division have jointly carried out regular absolute measurements of the magnetic field at Davis since 1973 to provide information on the magnetic secular variation in Antarctica. The observations have been performed by Antarctic Division personnel, who were trained in the use of the instruments at GA in Canberra.

Until the Australian Antarctic Division installed EDA FM105B fluxgate variometers at Davis in January 1986 to support their Atmospheric and Space Physics research program, monthly means were calculated from absolute observations without correction for daily field variations. These data, although exhibiting scatter, enabled the estimation of the secular variation trend from year to year.

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

Since 1998 the calculation of monthly means has been carried out at GA using International Quiet Days.

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

- 3-character IAGA code: DVS
- Geographic latitude: 68° 34' 38" S
- Geographic longitude: 77° 58' 23" E
- Geomagnetic† latitude: -76.5°
- Geomagnetic† longitude: 126.6°
- Elevation above mean sea level (top of observation pier) 29 metres
- Azimuth of reference mark (PP) from observation pier 312° 00.8'
- Distance to azimuth mark PP: 80 metres
- Observer in Charge: Lloyd Symons (AAD)

Magnetometers

An EDA FM105B fluxgate variometer, with the data acquired by PC, operated at Davis. Together with the DIMs used for absolute observations, these were owned by the Australian Antarctic Division. The PPMs used for absolutes and the QHMs provided for backup were GA instruments.

Instrument Corrections

For conformity with the Australian Magnetic Standard held at Canberra, a correction of +0.0nT has been applied to the PPM readings and zero corrections have been applied to the DIM readings. Corrections of –8.0nT in H and 0′ in D were used for the QHM.

Operations

Two absolute observations were performed monthly by staff of the Australian Antarctic Division at Davis.

The observers at Davis were officers of the Australian Antarctic Division, of the Australian Department of the Environment and Heritage, and were members of the Australian National Antarctic Research Expedition (ANARE).

Two sets of absolute observations were performed on one day each month. The DIM fell from the observation pier and was seriously bent, so QHM 492 was used from 29 July 1999 for the rest of the year. (A replacement DIM was sent from Mawson the following summer.)

Distribution of data during 1999

Preliminary Monthly Means for Project Ørsted

- IPGP monthly (by e-mail): None sent in 1999

Annual & Monthly Mean Values

- None sent in 1999

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

Davis, Antarctica 1999 Monthly & Annual Mean Values

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

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

Davis Station	1999	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	3331.0	-16443.8	-51682.5	54337.7	16778.0	-78° 32.9'	-72° .9'
	5xQ days	3318.9	-16442.7	-51680.2	54334.4	16774.4	-78° 35.3'	-72° 1.1'
	5xD days	3324.6	-16428.2	-51677.1	54327.6	16761.7	-78° 33.6'	-72° 1.8'
February	All days	3316.3	-16432.0	-51688.2	54338.6	16763.5	-78° 35.4'	-72° 1.9'
	5xQ days	3323.2	-16439.9	-51680.3	54333.9	16772.5	-78° 34.3'	-72° 1.2'
	5xD days	3268.4	-16389.5	-51718.8	54352.3	16713.0	-78° 43.4'	-72° 5.5'
March	All days	3301.0	-16429.0	-51697.2	54345.4	16757.4	-78° 38.3'	-72° 2.4'
	5xQ days	3292.2	-16423.1	-51672.2	54319.2	16749.9	-78° 39.9'	-72° 2.4'
	5xD days	3318.2	-16449.2	-51726.9	54380.8	16780.7	-78° 35.7'	-72° 1.6'
April	All days	3298.7	-16422.9	-51696.8	54343.0	16750.9	-78° 38.6'	-72° 2.8'
	5xQ days	3304.8	-16429.9	-51667.1	54317.2	16759.0	-78° 37.6'	-72° 1.7'
	5xD days	3274.5	-16417.2	-51730.8	54372.2	16740.8	-78° 43.2'	-72° 4.1'
May	All days	3301.9	-16431.0	-51677.2	54327.0	16759.6	-78° 38.3'	-72° 1.9'
	5xQ days	3306.7	-16436.5	-51668.6	54320.7	16765.8	-78° 37.5'	-72° 1.3'
	5xD days	3286.5	-16422.3	-51691.0	54336.6	16748.0	-78° 41.0'	-72° 2.9'
June	All days	3298.2	-16428.9	-51668.8	54318.1	16756.7	-78° 38.9'	-72° 1.9'
	5xQ days	3303.3	-16436.7	-51662.2	54314.4	16765.4	-78° 38.2'	-72° 1.2'
	5xD days	3290.0	-16412.1	-51668.3	54312.1	16738.6	-78° 39.9'	-72° 3.0'
July	All days	3299.4	-16426.7	-51675.1	54323.5	16754.8	-78° 38.6'	-72° 2.1'
	5xQ days	3305.2	-16438.9	-51660.9	54314.0	16767.9	-78° 37.9'	-72° 1.1'
	5xD days	3279.2	-16400.8	-51697.5	54335.9	16725.6	-78° 41.6'	-72° 4.3'
August	All days	3282.6	-16418.5	-51690.9	54335.1	16743.5	-78° 41.6'	-72° 3.1'
	5xQ days	3294.5	-16432.0	-51675.8	54325.4	16759.1	-78° 39.8'	-72° 1.9'
	5xD days	3250.8	-16399.5	-51727.1	54362.0	16718.8	-78° 47.3'	-72° 5.3'
September	All days	3282.2	-16424.2	-51705.5	54350.7	16749.1	-78° 42.0'	-72° 3.1'
	5xQ days	3297.2	-16436.8	-51684.1	54335.0	16764.3	-78° 39.4'	-72° 1.7'
	5xD days	3266.7	-16401.3	-51720.6	54357.4	16723.8	-78° 44.2'	-72° 4.9'
October	All days	3281.6	-16425.7	-51706.1	54351.7	16750.5	-78° 42.1'	-72° 3.0'
	5xQ days	3289.8	-16446.3	-51680.3	54333.8	16772.2	-78° 41.3'	-72° 1.2'
	5xD days	3266.7	-16399.1	-51743.0	54378.0	16721.8	-78° 44.1'	-72° 5.4'
November	All days	3307.5	-16446.6	-51677.9	54332.8	16776.1	-78° 37.8'	-72° .9'
	5xQ days	3314.0	-16461.8	-51663.7	54324.2	16792.2	-78° 37.1'	-71° 59.7'
	5xD days	3278.8	-16399.0	-51708.3	54345.7	16724.2	-78° 41.6'	-72° 4.6'
December	All days	3288.4	-16432.6	-51650.7	54301.5	16758.7	-78° 41.1'	-72° 1.4'
	5xQ days	3291.6	-16444.6	-51644.4	54299.3	16770.8	-78° 40.9'	-72° .6'
	5xD days	3251.2	-16384.9	-51647.4	54281.9	16705.0	-78° 46.7'	-72° 4.6'
Annual Mean Values	All days	3299.1	-16430.2	-51684.7	54333.8	16758.3	-78° 38.8'	-72° 2.1'
	5xQ days	3303.4	-16439.1	-51670.0	54322.6	16767.8	-78° 38.3'	-72° 1.3'
	5xD days	3279.7	-16408.6	-51704.7	54345.2	16733.5	-78° 41.9'	-72° 4.0'

(Calculated: 11:20 hrs., Mon. 29 Oct. 2001)

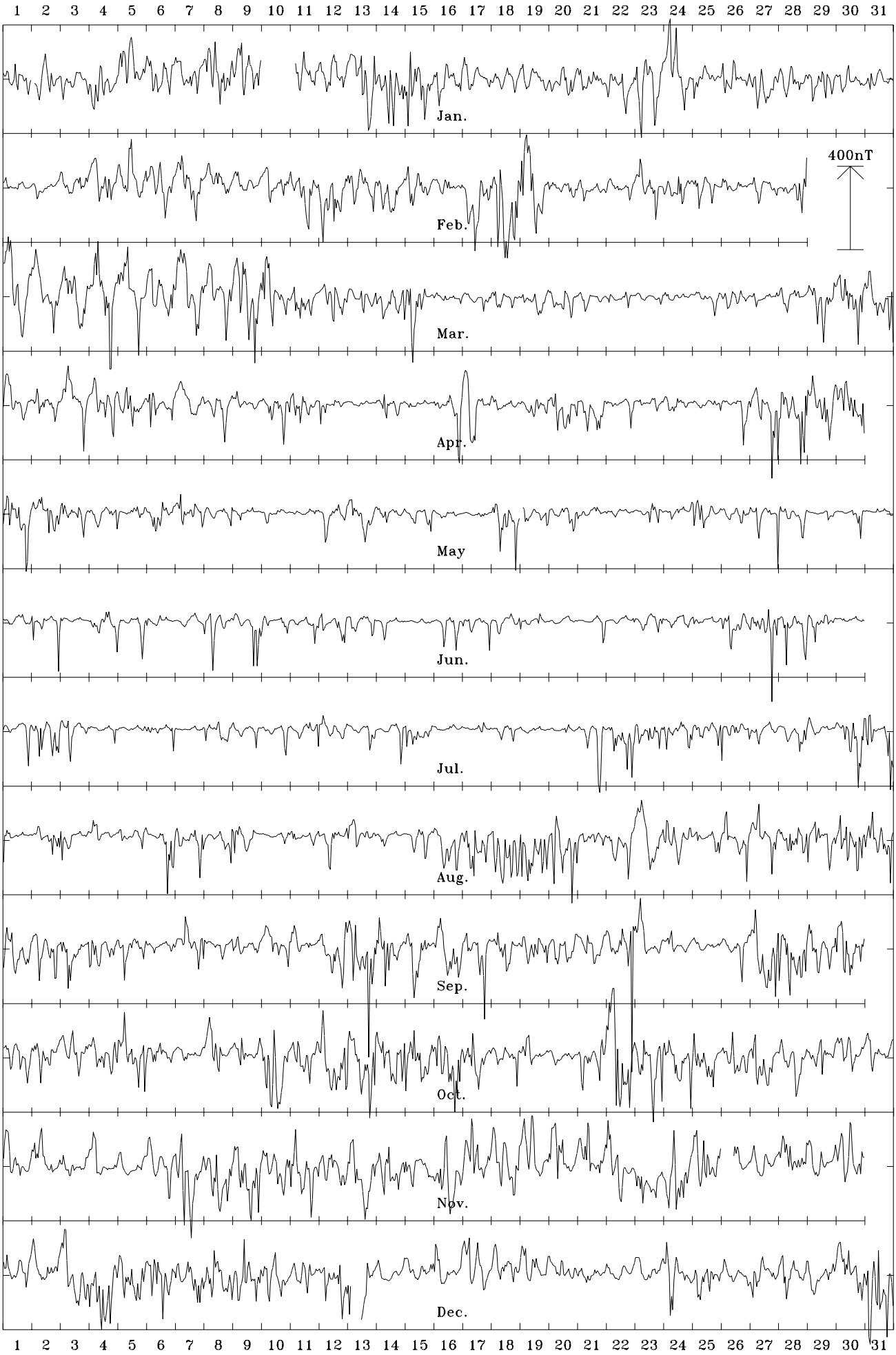
Hourly Mean Values

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

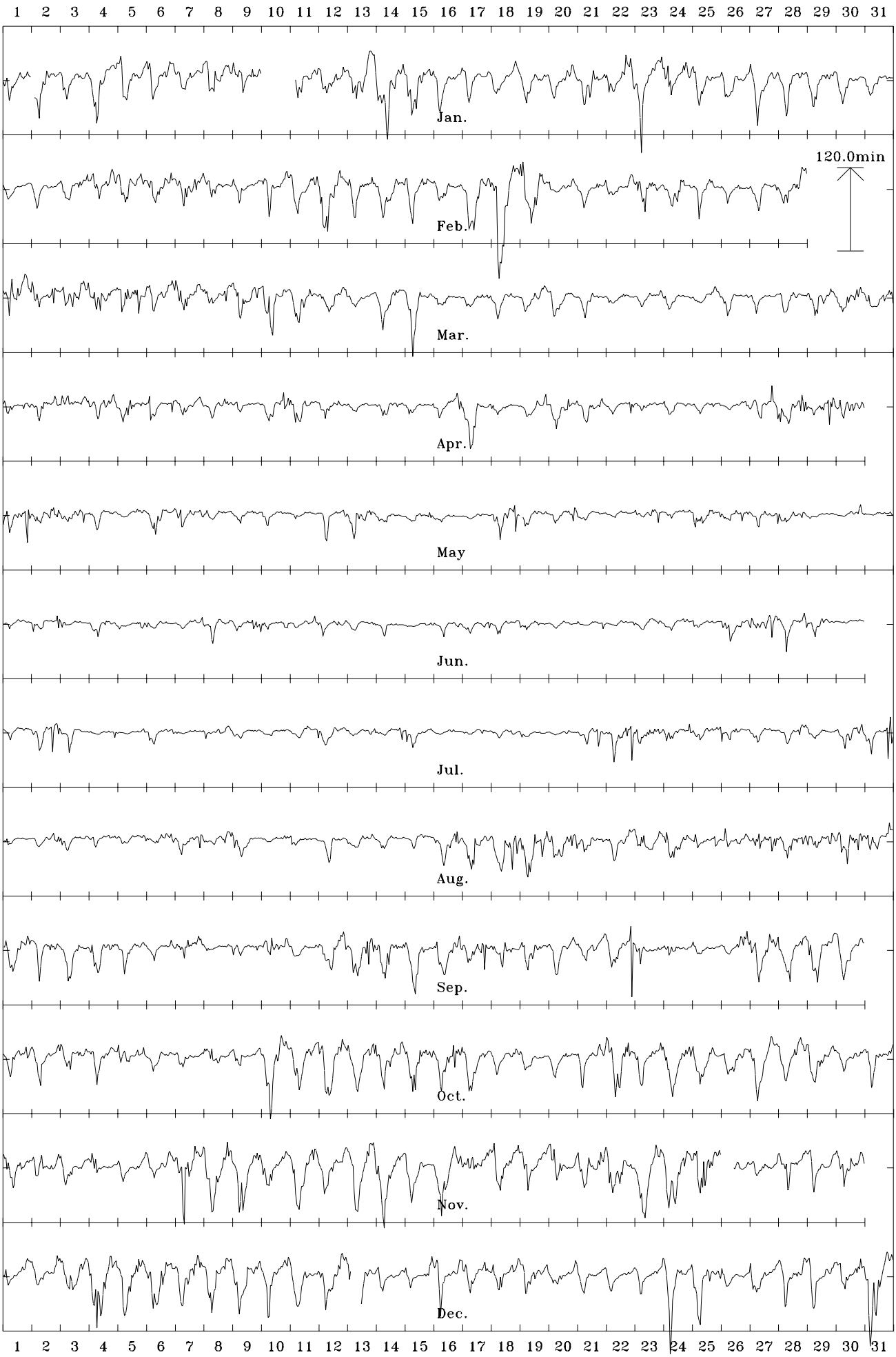
The reference levels indicated with marks on the vertical axes refer to the *all-days* mean value for the respective months. All elements in the plots are shown increasing (algebraically) towards the top of the page, with the exception of Z, which is in the opposite sense.

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

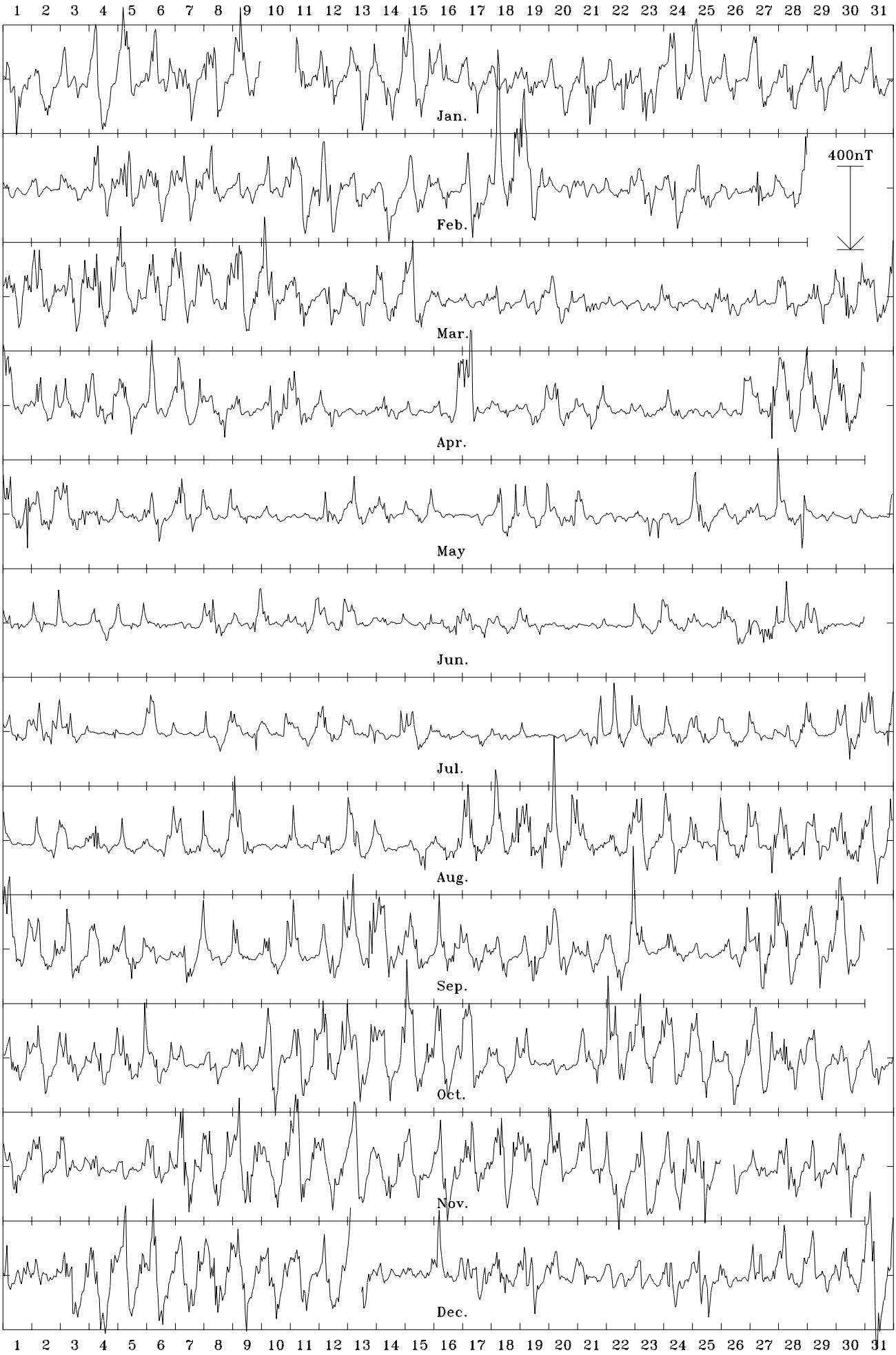
Davis Stn. 1999 Horizontal intensity (H). Scale: 25.0 nT/mm. Mean: 16758 nT



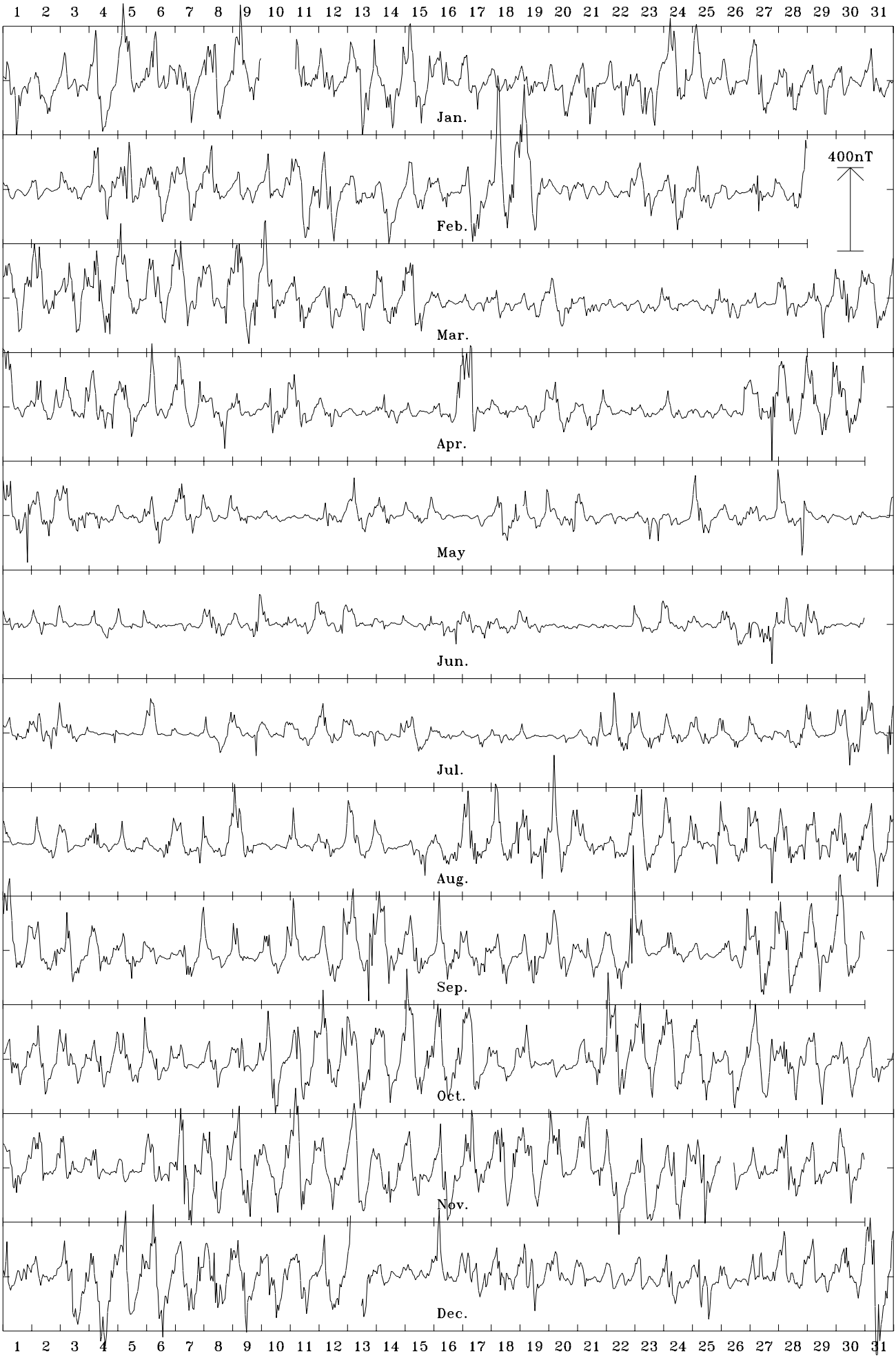
Davis Stn. 1999 Declination (east) (D). Scale: 7.50 min/mm. Mean: −78.65 deg.



Davis Stn. 1999 Vertical intensity (Z). Scale: 25.0 nT/mm. Mean: −51685 nT



Davis Stn. 1999 Total intensity (F). Scale: 25.0 nT/mm. Mean: 54334 nT

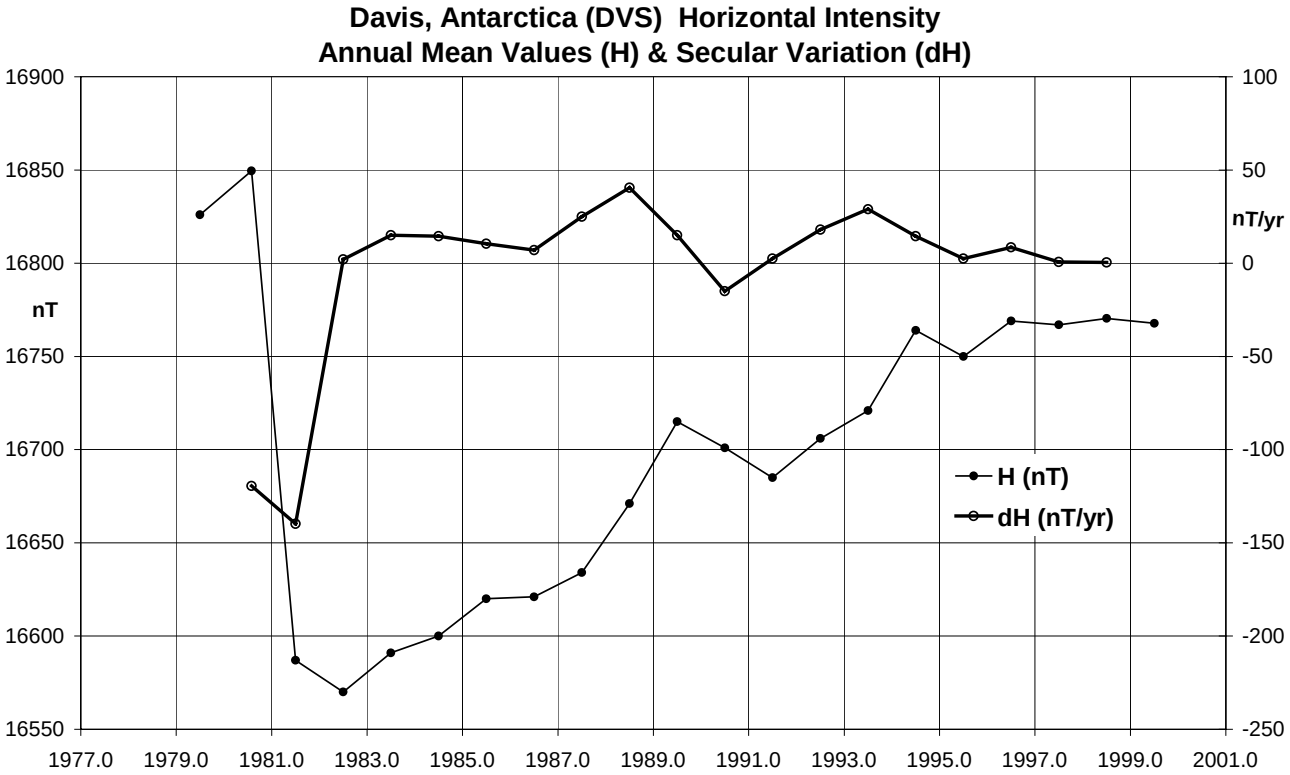


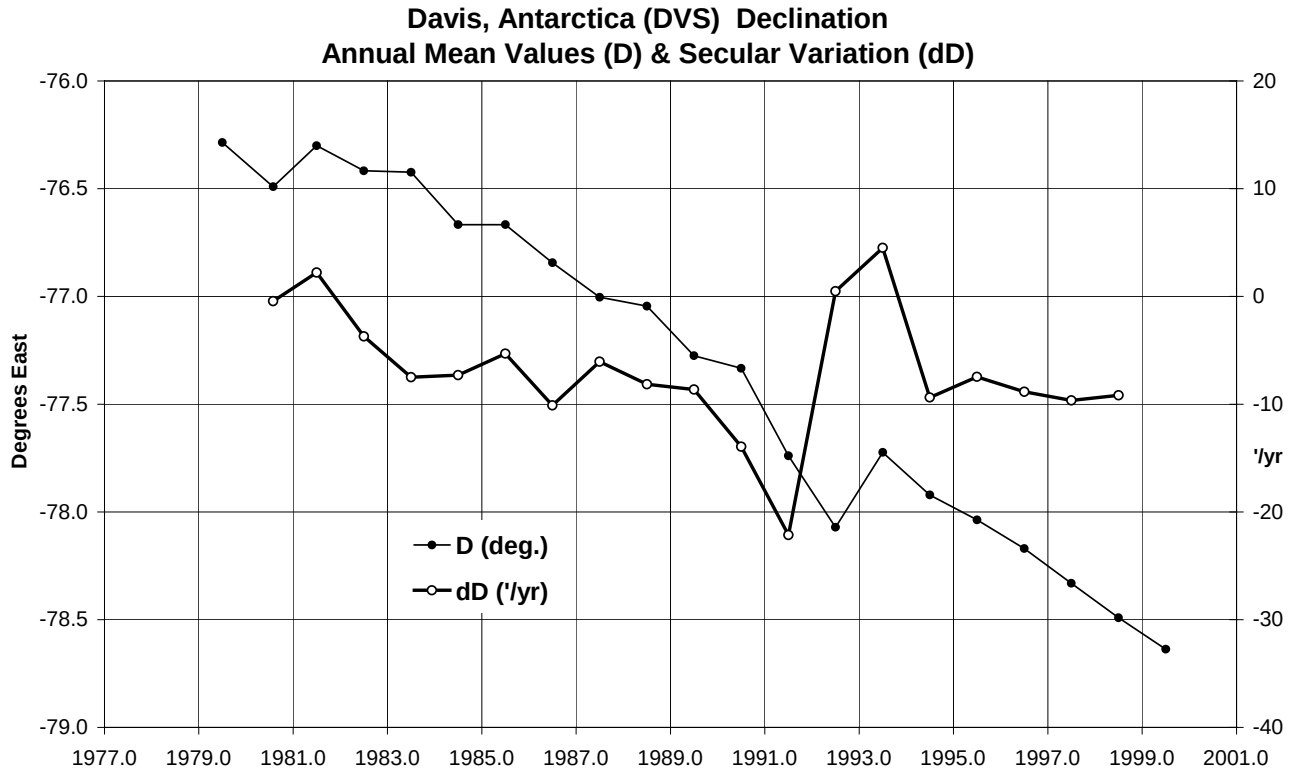
Davis Annual Mean Values

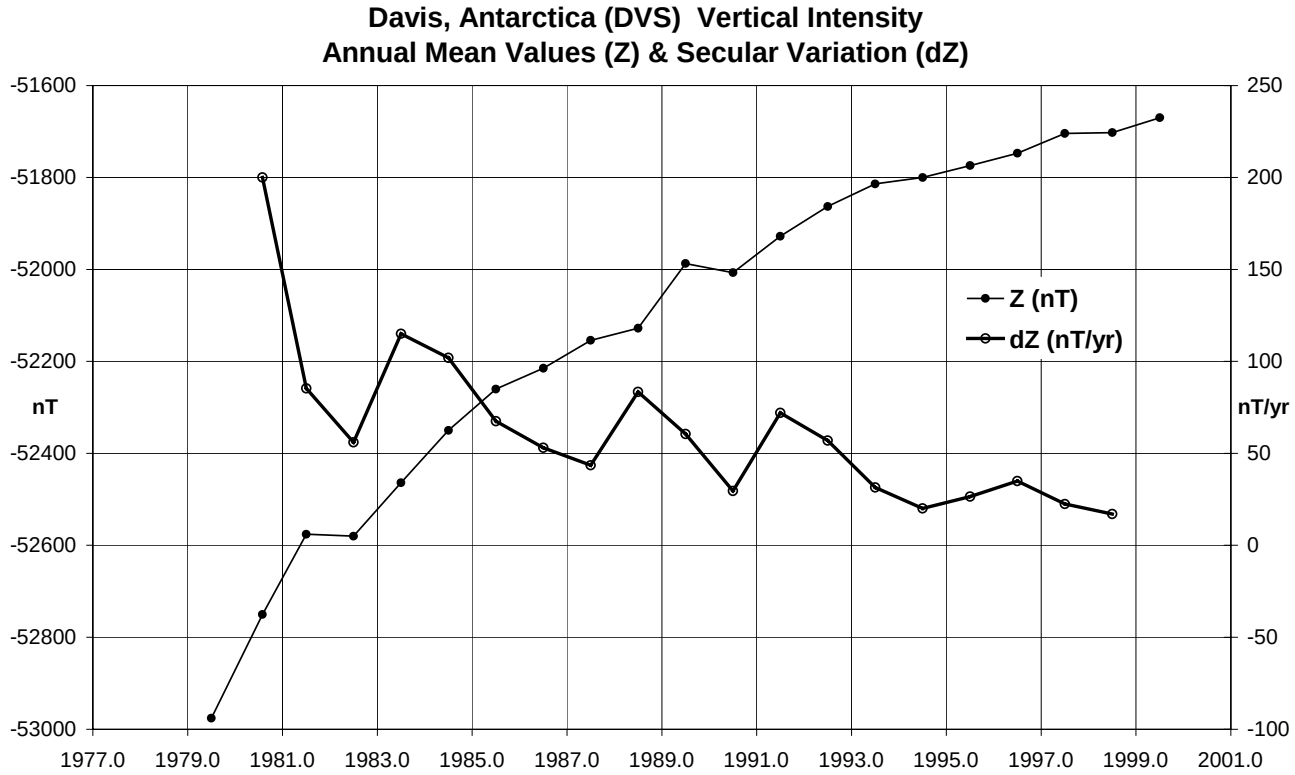
The table below gives annual mean values for Davis. Until 1990 these were calculated using the monthly average values of regular absolute observations, denoted by A_B. From 1991 they were gained using data from the AAD's fluxgate variometer that was calibrated through regular absolute observations. Until 1997 the means were calculated over the five quietest days at Mawson station, denoted Q_M. 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.

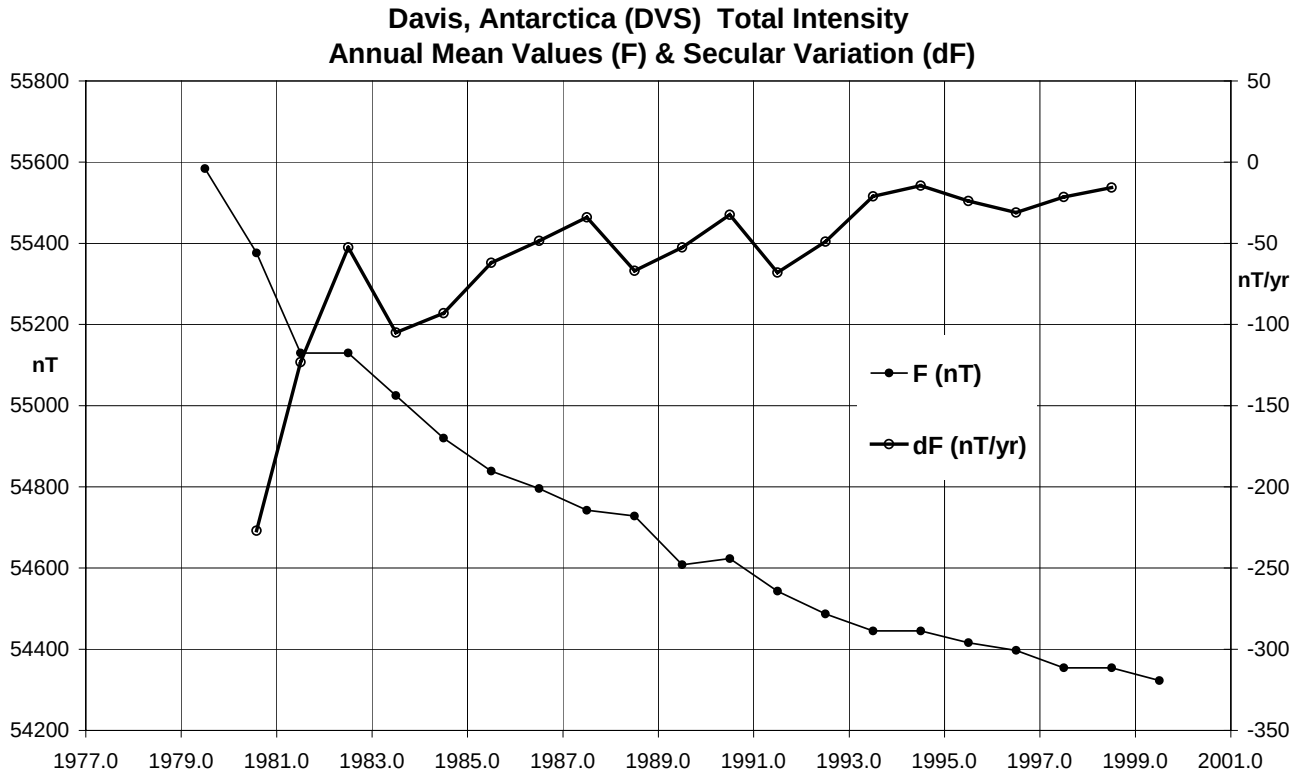
Plots of these data with secular variation in H, D, Z & F are on the pages 104-105.

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1979.5	A_B	-76	17.1	-72	22.8	16826	3989	-16346	-52976	55584	DHZ
1980.6	A_B	-76	29.5	-72	17.1	16850	3936	-16383	-52751	55377	DHZ
1981.5	A_B	-76	18.0	-72	29.4	16587	3928	-16115	-52576	55130	DHZ
1982.5	A_B	-76	25.0	-72	30.5	16570	3892	-16107	-52580	55130	DHZ
1983.5	A_B	-76	25.4	-72	27.1	16591	3895	-16127	-52464	55025	DHZ
1984.5	A_B	-76	40.0	-72	24.4	16600	3828	-16153	-52350	54920	DHZ
1985.5	A_B	-76	40.0	-72	21.5	16620	3833	-16172	-52260	54839	DHZ
1986.5	A_B	-76	50.6	-72	20.6	16621	3783	-16185	-52215	54796	DHZ
1987.5	A_B	-77	0.2	-72	18.6	16634	3741	-16208	-52154	54742	DHZ
1988.5	A_B	-77	2.7	-72	15.9	16671	3737	-16247	-52128	54728	DHZ
1989.5	A_B	-77	16.5	-72	10.6	16715	3682	-16304	-51987	54608	DHZ
1990.5	A_B	-77	20.0	-72	11.8	16701	3662	-16295	-52007	54623	DHZ
1991.5	Q_M	-77	44.4	-72	11.2	16685	3543	-16304	-51928	54543	XYZ
1992.5	Q_M	-78	4.3	-72	8.8	16706	3453	-16345	-51863	54487	XYZ
1993.5	Q_M	-77	43.4	-72	6.9	16721	3555	-16338	-51814	54445	XYZ
1994.5	Q_M	-77	55.3	-72	4.0	16764	3508	-16393	-51800	54445	XYZ
1995.5	Q_M	-78	2.2	-72	4.3	16750	3472	-16387	-51774	54416	XYZ
1996.5	Q_M	-78	10.2	-72	2.7	16769	3438	-16413	-51747	54397	XYZ
1997.5	Q_M	-78	19.9	-72	2.0	16767	3391	-16420	-51704	54354	XYZ
1998.5	Q	-78	29.5	-72	1.7	16770	3346	-16433	-51702	54354	XYZ
1999.5	Q	-78	38.3	-72	1.3	16768	3303	-16439	-51670	54323	XYZ
1998.5	A	-78	29.8	-72	2.7	16759	3342	-16422	-51715	54363	XYZ
1999.5	A	-78	38.8	-72	2.1	16758	3299	-16430	-51685	54334	XYZ
1998.5	D	-78	31.9	-72	4.5	16735	3327	-16401	-51737	54376	XYZ
1999.5	D	-78	41.9	-72	3.4	16734	3280	-16409	-51705	54345	XYZ


Davis, Antarctica (DVS) Horizontal Intensity
Annual Mean Values (H) & Secular Variation (dH)
16900
16850
16800
16750
16700
16650
16600
16550
nT
100
50
0
-50
-100
-150
-200
-250
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
H (nT)
dH (nT/yr)


Davis, Antarctica (DVS) Declination
Annual Mean Values (D) & Secular Variation (dD)
-76.0
-76.5
-77.0
-77.5
-78.0
-78.5
-79.0
Degrees East
20
10
0
-10
-20
-30
-40
'/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
D (deg.)
dD ('/yr)


Davis, Antarctica (DVS) Vertical Intensity
Annual Mean Values (Z) & Secular Variation (dZ)
-51600
-51800
-52000
-52200
-52400
-52600
-52800
-53000
nT
250
200
150
100
50
0
-50
-100
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
Z (nT)
dZ (nT/yr)


Davis, Antarctica (DVS) Total Intensity
Annual Mean Values (F) & Secular Variation (dF)
55800
55600
55400
55200
55000
54800
54600
54400
54200
nT
50
0
-50
-100
-150
-200
-250
-300
-350
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
F (nT)
dF (nT/yr)

Summary of data loss in the Australian observatories in 1999

The table below summarizes the 1999 monthly digital data acquisition losses, in minutes per month, at the Australian observatories. The first figure refers to the principal 3-component variometers and the second figure (in parentheses) to the recording total intensity instruments. A single figure indicates the same data loss in a month for both instruments. Annual totals and percentage losses are also shown. The figures do not include data that have been excluded from processing such as contaminated data.

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

1999	ASP	CNB	CTA	GNA	KDU	LRM	MAW	MCQ	CSY
Jan	0	0	627	425	8475	7 (932)	0	0	22
Feb	0 (2320))	0	1	0	1068	1390 (99)	938 (892)	3	33
Mar	0	4 (3)	5 (6)	0	227	5764 (5755)	1 (15)	0	2
Apr	0	0	0	0	0	3 (1)	0	0	19
May	0	6 (5)	0	0	0	21 (5993)	1621 (1585)	0	1664
Jun	3 (3)	1297	0	0 (5552)	0	5 (111)	0	0	0
Jul	0	4032 (4311)	0	19 (21)	0	0	912 (915)	0	32
Aug	0	7 (1955)	0	0	0	6	0	0	0
Sep	0	0 (108)	0	0	0	0	0	0	5
Oct	0	0	614	0	1023	0	0	0	2
Nov	1 (1)	2 (3)	0	1 (3)	0	0	0	0	0
Dec	0	957 (955)	0	0	0	0	0	113	12
3-axis variom.	4 (0.00%)	6,305 (1.20%)	1,247 (0.085%)	445 (0.50%)	10,793 (2.1%)	7,196 (1.37%)	3472 (0.66%)	116 (0.022%)	1791 (0.34%)
Total field	2,324 (0.44%)	8,637 (1.64%)	6,001 (1.14%)	7,978 (1.52%)	43,576 (8.3%)	12,897 (2.45%)	3407 (0.65%)	116 (0.022%)	no PPM

1999 International Quiet & Disturbed Days

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

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 one Kp index $\geq 3_0$ or two Kp indices $\geq 3_-$ occurred during the day.

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

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

REPEAT STATION NETWORK

GA maintains a network of repeat stations throughout mainland Australia, its offshore islands, and the south-west Pacific region. The distribution of permanent magnetic observatories and repeat stations occupied in 1999 is shown in the figure below. The repeat stations are occupied at intervals of between one and two years to determine the secular variation of the magnetic field.

During each four day repeat station occupation, the magnetic field is monitored continuously with a portable on-site four-component magnetic variometer.

An EDA FM105B three-axis fluxgate magnetometer was used to monitor variations in three (nominally orthogonal) components of the magnetic field. The analogue output from the fluxgate was digitised with an ADAM-4017 16 bit A to D converter and recorded as 1-second and 1-minute means with a laptop PC. A Geometrics 856 PPM was used to monitor the total magnetic intensity. The digital output from the PPM was recorded at a sampling interval of 10 seconds.

The variometer recordings were calibrated to observatory standard with a campaign of absolute magnetic observations made during each station occupation.

The absolute instruments used on the repeat station surveys during 1999 were Elsec 810 DIM, no. 220 with a Zeiss 020B theodolite, no. 308887, and Geometrics 856 PPMs nos. 50700 and 50699. A GEM GSM-90 PPM (serial number 810881) was used for GPS-positioned total field surveys around each station.

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

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

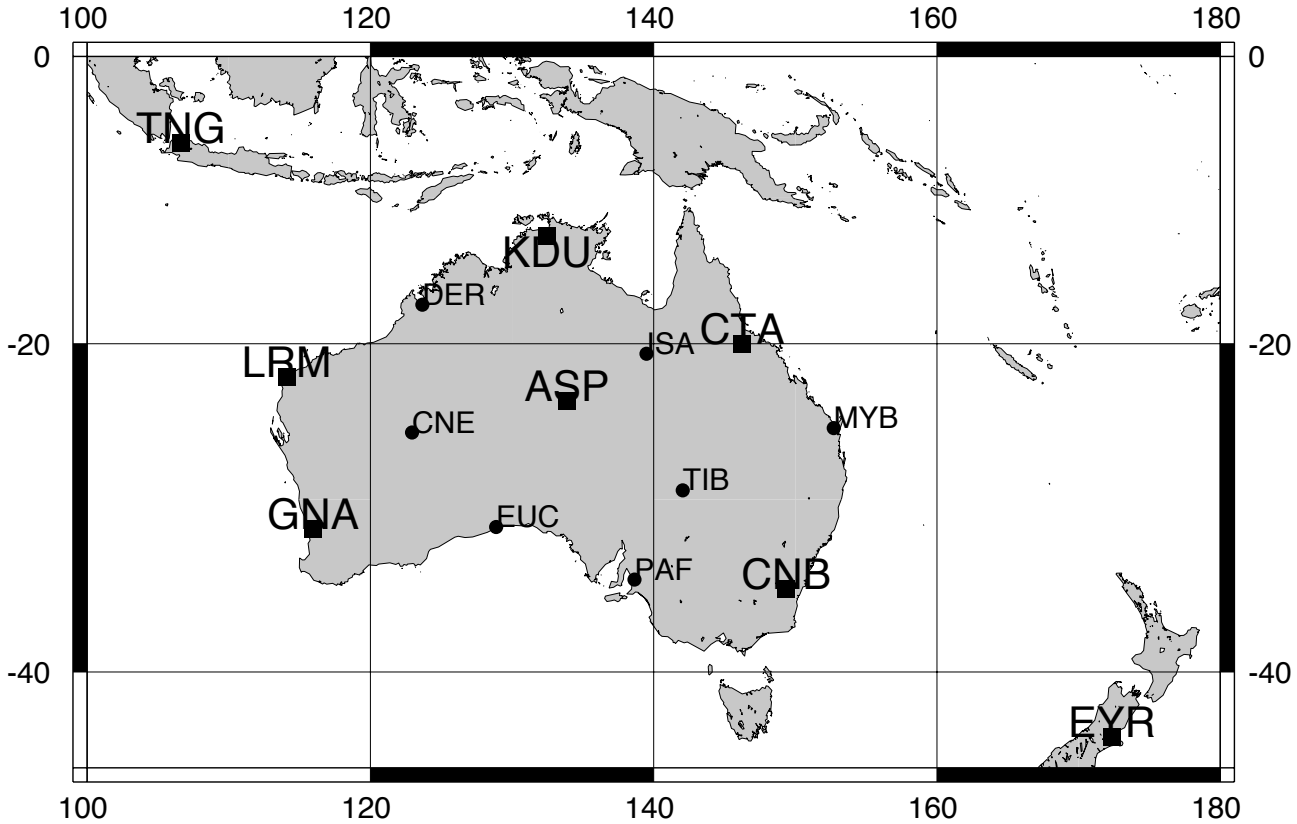
As the repeat stations are located in areas that are distant from the permanent magnetic observatories, the secular variation information gained at these sites provides valuable infill data in the areas between the permanent observatories.

Station occupations in 1999

Seven repeat stations were occupied in 1999: Tibooburra, (TIB); Parafield, (PAF); Eucla, (EUC); Carnegie, (CNE); Derby, (DER); Mt Isa, (ISA) and Maryborough, (MYB). The figure below shows the location of these repeat stations as well as the magnetic observatories in the region.

The adopted normal field values and secular variation at the time of occupation for each of these stations are shown in the tables on the following page.

The distribution of permanent magnetic observatories and repeat stations occupied in 1999



Adopted Main Field Values at Time of Station Occupations

Station (site)	Occupation	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D	I
Tibooburra (A)	24 Apr. 1999	26647	4007	-49429	56297	26947	08° 33.1′	-61° 24.1′
Parafield (A)	28 Apr. 1999	22823	3346	-54915	59562	23067	08° 20.4′	-67° 12.9′
Eucla (D)	04 May 1999	23661	1875	-53467	58498	23735	04° 31.9′	-66° 03.8′
Carnegie (A)	10 May 1999	28049	1114	-47703	55349	28071	02° 16.5′	-59° 31.5′
Derby (E)	19 May 1999	33337	1528	-37520	50213	33372	02° 37.5’	-48° 20.9′
Mt Isa (A)	26 May 1999	31763	3422	-39762	51006	31946	06° 08.9′	-51° 13.2′
Maryborough (D)	02 Jun. 1999	29248	5521	-43363	52595	29764	10° 41.4′	-55° 32.0′

Secular Variation at Time of Occupations

Station (site)	ΔX (nT/yr)	ΔY (nT/yr)	ΔZ (nT/yr)	ΔF (nT/yr)	ΔH (nT/yr)	ΔD (′/yr)	ΔI (′/yr)
Tibooburra (A)	12.1	6.6	33.2	-23.0	12.9	0.6	1.7
Parafield (A)	0.7	13.7	40.5	-36.3	2.7	2.0	1.1
Eucla (D)	20.8	17.6	39.9	-27.5	22.1	2.3	2.1
Carnegie (A)	15.3	34.1	33.2	-20.1	16.7	4.1	1.9
Derby (E)	35.2	24.0	45.3	-9.7	36.3	2.3	3.9
Mount Isa (A)	18.9	7.7	49.3	-26.1	19.6	0.6	3.1
Maryborough (D)	1.6	-8.5	49.4	-40.7	0.0	-1.0	1.8

Epoch Charts

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 are listed in the *Charts and Models* table that appeared in *AGRs 1993-1997*.

At the end of 1999 the most up to date AGRF model was that for epoch 1995.0 (Lewis and McEwin, 1996). Charts of the AGRF 1995 model for each of the magnetic elements: H, D, X, Y, Z, H, F & I are in the *AGR 1996*.

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CORRECTION

AGR98 The serial no. of the GEM Systems GSM-90 total field variometer that operated at the Canberra (CNB) observatory from 23 Oct. 1998 was incorrectly reported as no. 810881. The correct serial no. is 803810.

Geomagnetism Staff List 1999

Name	Classification	Responsibility
Charles E. Barton	Senior Principal Research Scientist	Section Head
Andrew J. McEwin	Senior Professional Officer A (until October 1999)	Geomagnetism Manager
Peter A. Hopgood	Senior Professional Officer B	Australian Observatories
Peter G. Crosthwaite	Senior Information Technology Officer C	Digital acquisition, system and software development and computer maintenance
Stewart D. Dennis	Professional Officer 2	Antarctic Observatories
Andrew M. Lewis	Professional Officer 2	Repeat station surveys, Alice Springs Observatory
Liejun Wang	Professional Officer 1 (from Feb. 1999)	Data-base development; Canberra Observatory
Heather McCreadie	Professional Officer 1 (from Mar. 1999)	Web development; Gnangara Observatory
Maria A. de Deuge	Technical Officer 2 (on contract) (Shared by GA & BoM; 21 July 1997 - Feb. 1999)	Mawson (1998 observer)
Robert G. Sutton	Technical Officer 2 (on contract) (Shared by GA & BoM)	Mawson (1999 observer)
Perry Roberts	On contract - shared between AAD, IPS and GA	Macquarie Island (1999 observer)
Jean Osanz	Technical Officer 2 (on contract) (Shared by GA, IPS & BoM)	Macquarie Island (2000 observer)
Lindsay Miller	Technical Officer 4	Technical support
Bruce Sibson	Technical Officer 3	Technical support

Mundaring Geophysical Observatory (Western Australia) staff

Edward P. Paull	Senior Professional Officer C	As well as having responsibility for the running of the Gnangara and Learmonth magnetic observatories, staff at the Mundaring Geophysical Observatory operated the seismograph network in Western Australia.
Owen D. McConnel	Technical Officer 4	
Lyn A. Van Reeken	Technical Officer 2	
Yvonne M. Moiler	Administrative Services Officer 2	

Non-GA Observers/OICs

Warren Serone	ACRES (contracted by GA)	Alice Springs
Jack M. Millican	Contracted by Queensland University	Charters Towers
Maurice McMullan	Learmonth Solar Observatory, IPS	Learmonth
Kim Stellmacher	Contracted by GA	Kakadu
Gerard (Hans) Van Reeken	Contracted by GA	Gnangara
Steven Wallace	AAD, DEH	Casey
Lloyd Symons	AAD, DEH	Davis