GEOSCIENCE AUSTRALIA

AUSTRALIAN GEOMAGNETISM REPORT 2000

MAGNETIC OBSERVATORIES

VOLUME 48

www.ga.gov.au • GEOSCIENCE AUSTRALIA • www.ga.gov.au

Department of Industry, Tourism and Resources

Minister for Industry, Tourism & Resources: The Hon. Ian Macfarlane
Parliamentary Secretary: The Hon. Warren Entsch
Department Secretary: Mark Paterson

Geoscience Australia

Chief Executive Officer: Neil Williams

Minerals & Geohazards Division

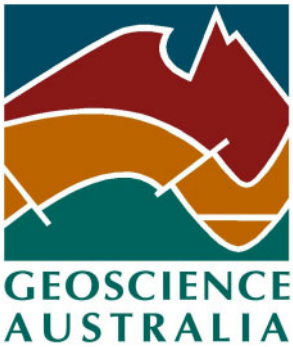
Chief of Division: Chris Pigram
Associate Chief: Wally Johnson

Australian Geomagnetism Report

2000

Volume 48

Geomagnetism Section
Integrated Geophysical Network
Geoscience Australia
G.P.O. Box 378
Canberra, A.C.T., 2601
AUSTRALIA



Magnetic results for 2000

Alice Springs

Canberra

Charters Towers

Gnangara

Kakadu

Learmonth

Macquarie Island

Mawson

Casey

Davis

Australian Repeat Station Network

Compiled by P.A. Hopgood

with contributions by

A.M. Lewis, P.G. Crosthwaite, S.D. Dennis,

Liejun Wang and H. McCreadie

ISSN: 1447-5146 (Online format)
ISSN: 1035-1515 (Printed format)

SUMMARY

During 2000 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 operated at magnetic observatory standard. 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 for the Canberra and Gnangara observatories, and provided regularly to the International Service of Geomagnetic Indices. K indices were digitally scaled at the Mawson observatory.

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

A total of eight magnetic repeat stations were occupied in 2000.

Preparations were made for further upgrades to be made to the magnetic observatory at Tangerang and the upgrade of the observatory at Manado, Indonesia by GA's Geomagnetism group under an AusAID grant. This included the purchase of instrumentation and the training of staff from Indonesia's BMG, at GA.

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 2000.

ACRONYMS and ABBREVIATIONS

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

CONTENTS

PART 1

CONTENTS Continued overleaf …

CONTENTS (continued)

This is the second volume of the *Australian Geomagnetism Report* to be made available in electronic format only.

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/*

Part 2

MACQUARIE ISLAND

Macquarie Island (Tas.) is approximately 1,350 km. SSE 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: -59.98°
- Geomagnetic† longitude: 244.14°
- 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: Perry Roberts (1999)
  Jean Osanz (2000)
  Dave Gilles (2000/01)

† Based on the IGRF 2000 model.

Observer in charge

The magnetic observers-in-charge at Macquarie Island in 2000 were supported jointly by the Antarctic Division in the Department of The Environment and Heritage, the IPS Radio and Space Services of the Department of Industry Tourism and Resources, and GA. They were members of the Australian National Antarctic Research Expedition (ANARE).

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

Jean Osanz took over absolute observations from Perry Roberts on 16 November 1999. On 8 December Dave Gillies arrived. He took over from Jean Osanz on 17 December 2000.

Variometers

The equipment employed to monitor magnetic variations at MCQ in 2000 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. The Variometer House temperature was controlled with a heating system. The Elsec 820 PPM sensor was located on the pier in the PPM House.

Macquarie Island 2000 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	2000	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	10858.2	6371.0	-63266.4	64506.9	12589.3	30° 24.2'	-78° 44.8'
	5xQ days	10869.1	6379.2	-63270.0	64513.0	12602.9	30° 24.5'	-78° 44.1'
	5xD days	10826.5	6352.2	-63255.7	64489.4	12552.6	30° 24.2'	-78° 46.6'
February	All days	10842.0	6369.7	-63276.5	64514.0	12574.7	30° 26.1'	-78° 45.6'
	5xQ days	10856.8	6379.8	-63270.7	64511.7	12592.6	30° 26.4'	-78° 44.6'
	5xD days	10805.2	6349.7	-63300.0	64529.0	12533.0	30° 26.5'	-78° 48.0'
March	All days	10849.3	6379.2	-63273.4	64513.0	12585.8	30° 27.3'	-78° 45.0'
	5xQ days	10856.3	6384.4	-63271.2	64512.5	12594.5	30° 27.5'	-78° 44.5'
	5xD days	10831.8	6365.9	-63287.4	64522.6	12564.0	30° 26.6'	-78° 46.3'
April	All days	10839.3	6376.9	-63282.2	64519.8	12576.1	30° 28.1'	-78° 45.6'
	5xQ days	10852.0	6385.4	-63276.8	64517.4	12591.2	30° 28.4'	-78° 44.8'
	5xD days	10810.5	6357.6	-63294.6	64525.4	12541.5	30° 27.6'	-78° 47.5'
May	All days	10845.9	6384.1	-63268.0	64507.6	12585.4	30° 28.9'	-78° 45.0'
	5xQ days	10858.8	6388.8	-63273.1	64515.2	12598.8	30° 28.2'	-78° 44.3'
	5xD days	10839.1	6381.1	-63252.8	64491.3	12578.0	30° 29.2'	-78° 45.2'
June	All days	10850.2	6387.5	-63265.0	64505.7	12590.7	30° 29.1'	-78° 44.7'
	5xQ days	10855.4	6387.5	-63266.7	64508.3	12595.2	30° 28.4'	-78° 44.4'
	5xD days	10821.7	6379.3	-63254.1	64489.6	12562.1	30° 31.2'	-78° 46.0'
July	All days	10838.9	6382.8	-63271.3	64509.7	12578.6	30° 29.6'	-78° 45.4'
	5xQ days	10855.6	6388.6	-63271.6	64513.2	12596.0	30° 28.6'	-78° 44.5'
	5xD days	10781.9	6363.1	-63281.2	64508.4	12519.7	30° 33.0'	-78° 48.5'
August	All days	10845.6	6388.5	-63269.5	64509.5	12587.3	30° 30.0'	-78° 44.9'
	5xQ days	10855.7	6391.8	-63269.9	64511.8	12597.7	30° 29.4'	-78° 44.3'
	5xD days	10804.3	6377.5	-63248.2	64480.8	12546.3	30° 33.3'	-78° 46.8'
September	All days	10831.7	6381.0	-63266.2	64503.2	12571.6	30° 30.2'	-78° 45.7'
	5xQ days	10857.3	6391.1	-63265.7	64508.0	12598.7	30° 29.0'	-78° 44.2'
	5xD days	10786.4	6360.6	-63282.3	64509.6	12522.3	30° 31.7'	-78° 48.4'
October	All days	10842.0	6381.9	-63270.8	64509.6	12580.9	30° 29.0'	-78° 45.2'
	5xQ days	10850.7	6391.5	-63267.4	64508.5	12593.3	30° 30.0'	-78° 44.6'
	5xD days	10805.4	6355.8	-63295.0	64525.3	12536.4	30° 27.9'	-78° 47.8'
November	All days	10851.2	6389.0	-63256.8	64498.1	12592.4	30° 29.4'	-78° 44.5'
	5xQ days	10862.3	6394.2	-63252.1	64495.8	12604.6	30° 29.0'	-78° 43.8'
	5xD days	10845.8	6383.5	-63269.8	64510.0	12585.3	30° 29.0'	-78° 45.0'
December	All days	10866.8	6396.0	-63246.3	64491.1	12609.4	30° 28.8'	-78° 43.5'
	5xQ days	10867.9	6400.2	-63241.1	64486.5	12612.5	30° 29.6'	-78° 43.3'
	5xD days	10871.1	6391.6	-63251.8	64496.8	12610.9	30° 27.2'	-78° 43.5'
Annual Mean Values	All days	10846.8	6382.3	-63267.7	64507.3	12585.2	30° 28.4'	-78° 45.0'
	5xQ days	10858.2	6388.6	-63266.4	64508.5	12598.2	30° 28.3'	-78° 44.3'
	5xD days	10819.2	6368.2	-63272.7	64506.5	12554.3	30° 28.9'	-78° 46.6'

(Calculated:15:57 hrs., Fri. 28 Jun. 2002)

Hourly Mean Values

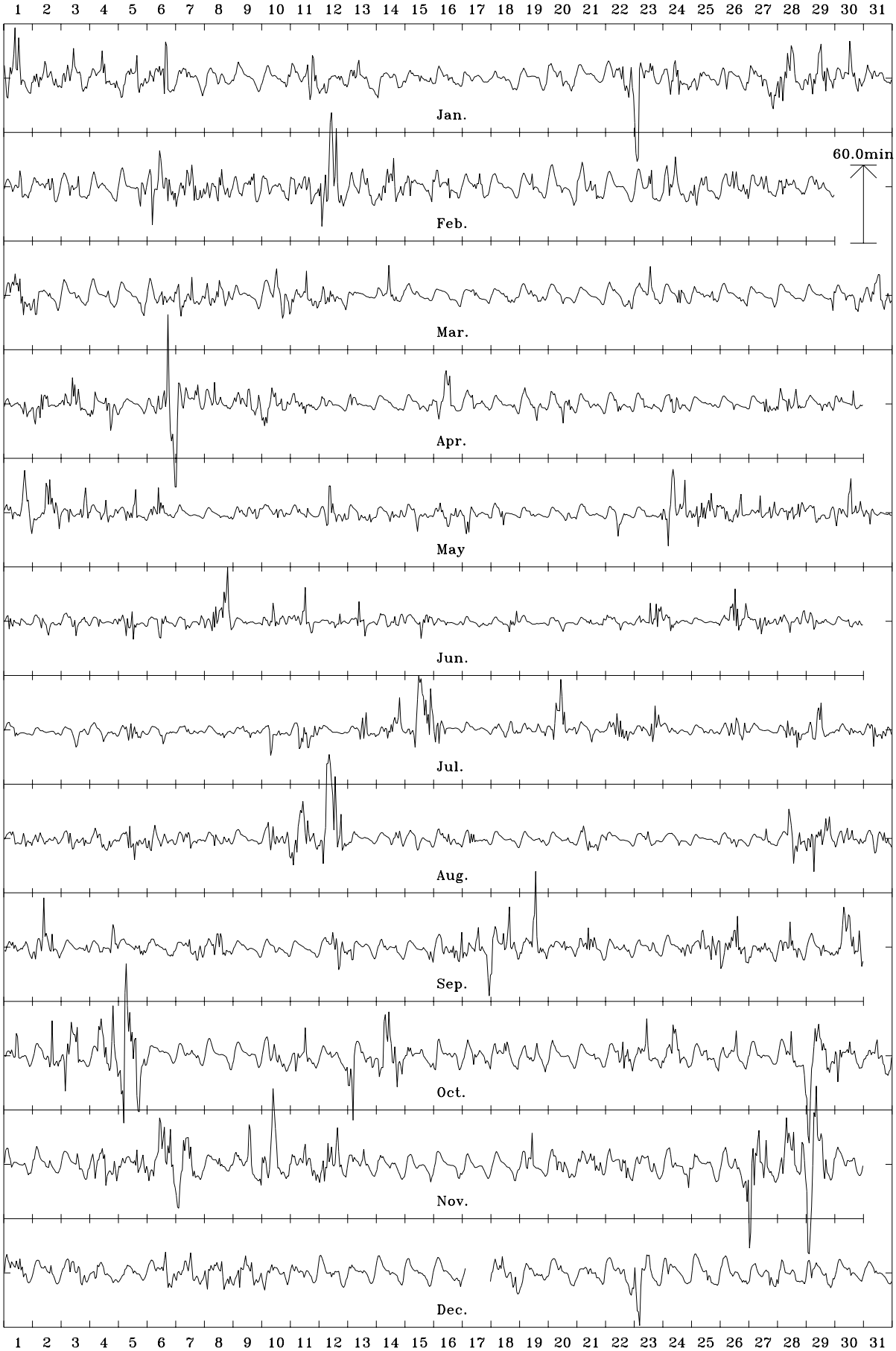
The charts on the following pages are plots of hourly mean values.

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.

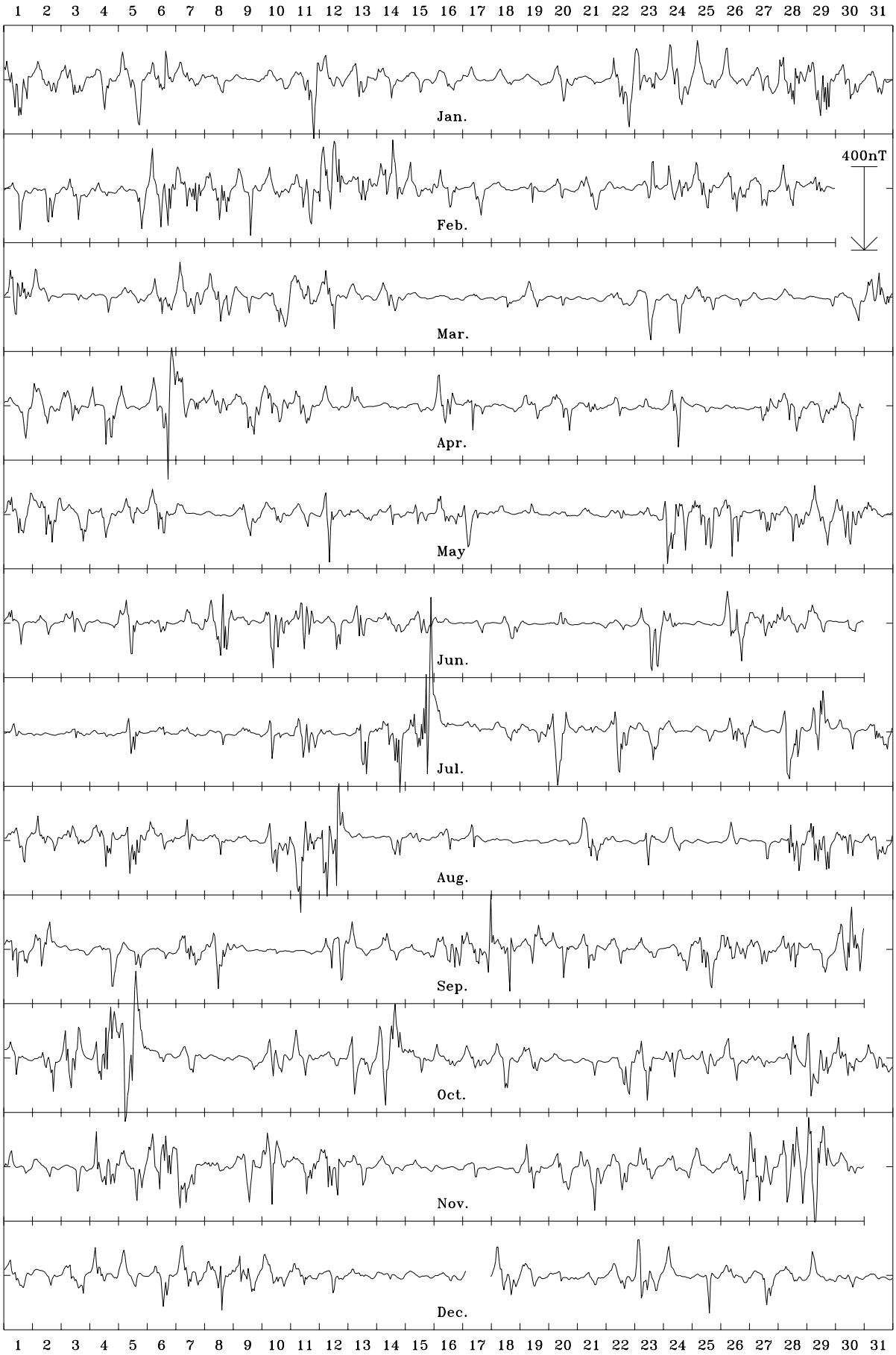
The mean value given at the top of each plot is the *all-days* annual mean value of the element.

Macquarie Is. 2000 Horizontal intensity (H). Scale: 40.0 nT/mm. Mean: 12585 nT

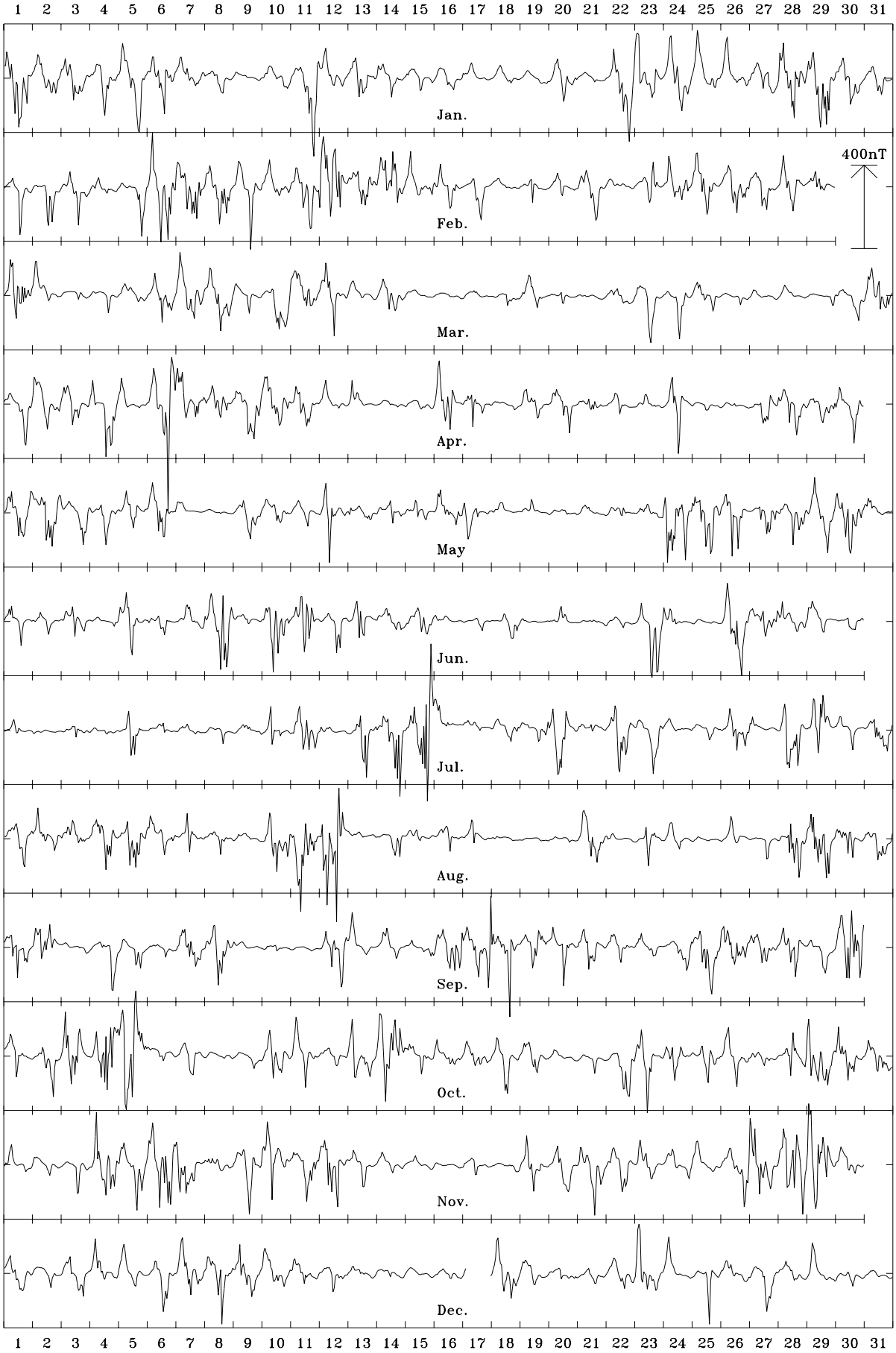
Macquarie Is. 2000 Declination (east) (D). Scale: 4.00 min/mm. Mean: 30.47 deg.

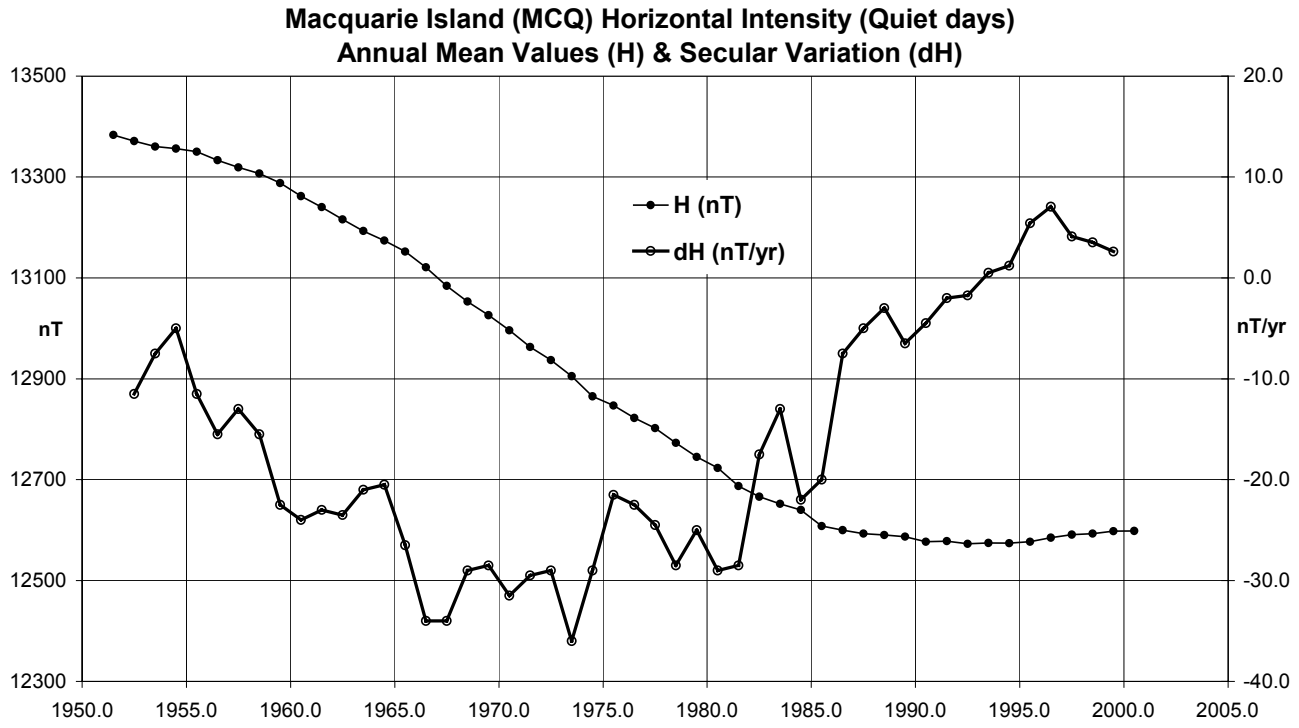


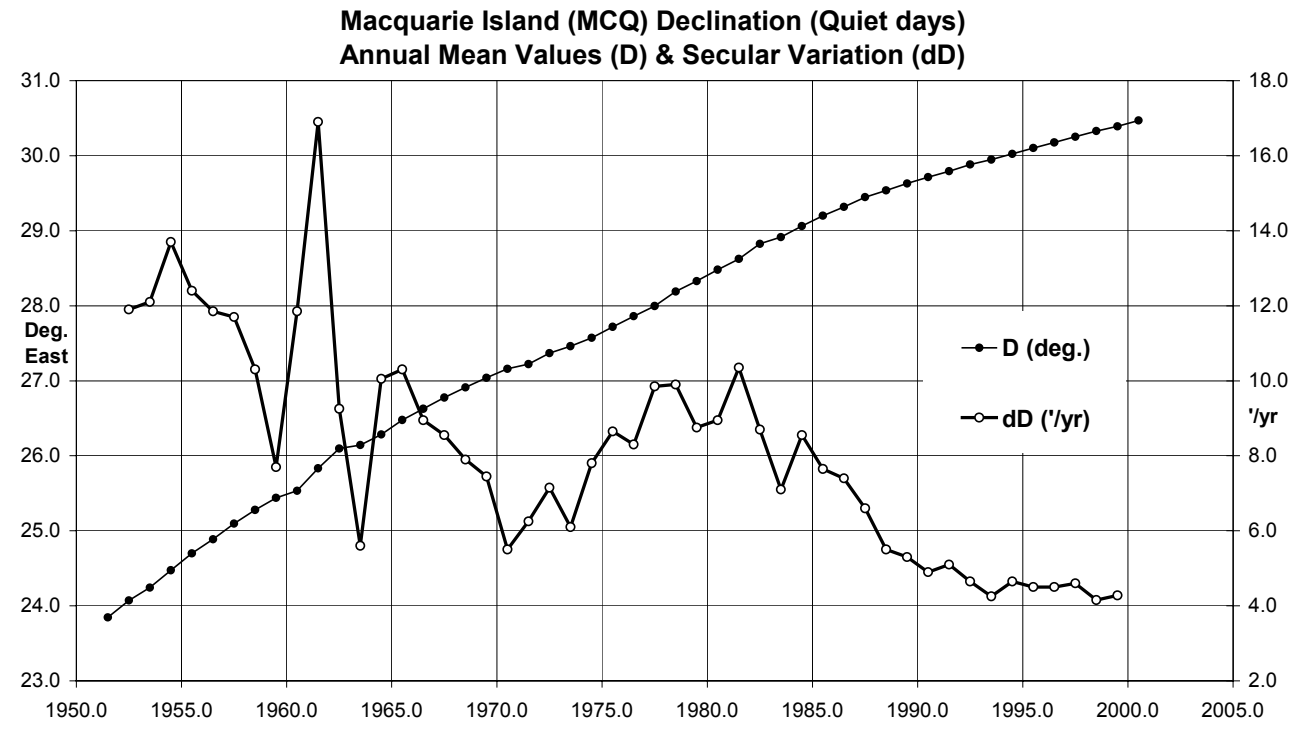
Macquarie Is. 2000 Vertical intensity (Z). Scale: 25.0 nT/mm. Mean: −63268 nT

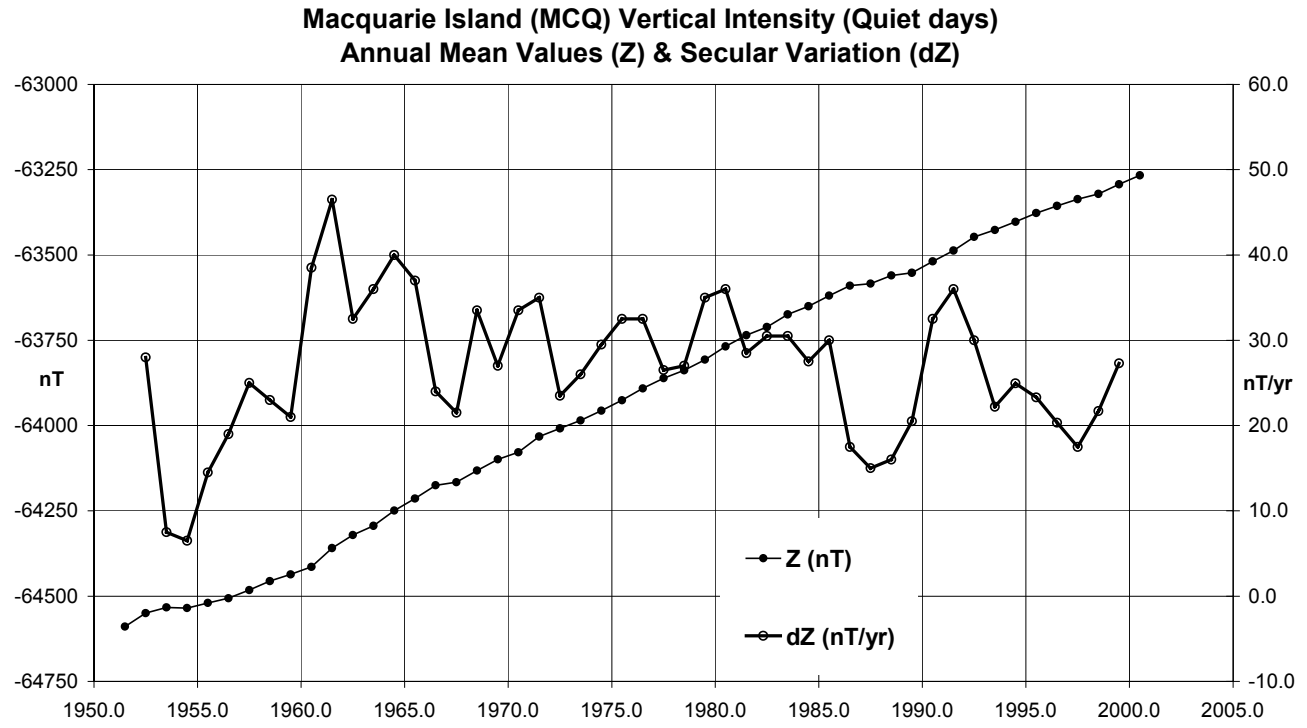


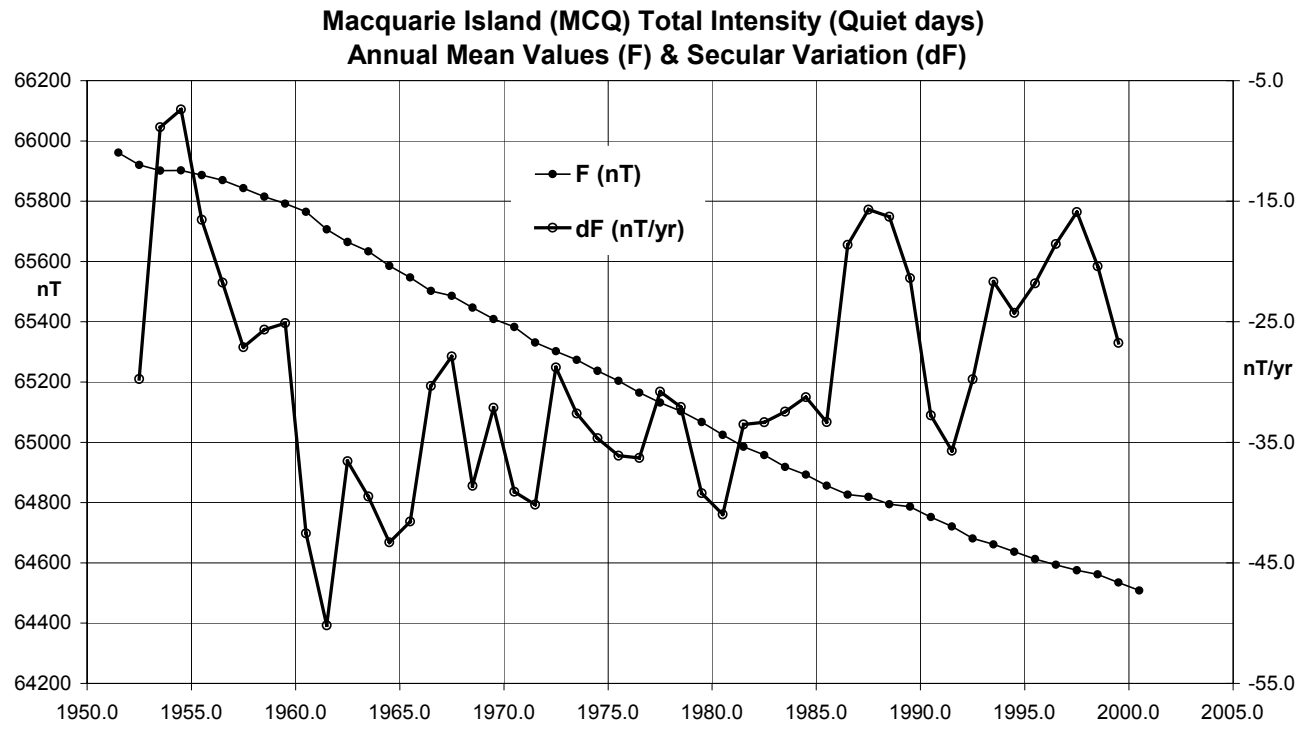
Macquarie Is. 2000 Total intensity (F). Scale: 25.0 nT/mm. Mean: 64507 nT




Macquarie Island (MCQ) Horizontal Intensity (Quiet days)
Annual Mean Values (H) & Secular Variation (dH)
H (nT)
dH (nT/yr)
nT
nT/yr
13500
13300
13100
12900
12700
12500
12300
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
1950.0
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0


Macquarie Island (MCQ) Declination (Quiet days)
Annual Mean Values (D) & Secular Variation (dD)
D (deg.)
dD ('/yr)
Deg.
East
'/yr
31.0
30.0
29.0
28.0
27.0
26.0
25.0
24.0
23.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
1950.0
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0


Macquarie Island (MCQ) Vertical Intensity (Quiet days)
Annual Mean Values (Z) & Secular Variation (dZ)
-63000
-63250
-63500
-63750
-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
2005.0


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
2005.0

MCQ - Absolute Instruments and Corrections

Magnetic absolute measurements were performed in the Absolute House, on Pier AW with an Austral PPM (serial 525) and on Pier AE with an Elsec 810 DIM (serial 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 zero 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, 2000

All 2000 The variometers ran smoothly throughout the year.

Jun-Jul The Science Building COMMS wiring was upgraded from Ethernet coaxial cables to CAT 5. This change had no effect on the GA computers.

Prior to 2000 the GA room was used almost solely as an office. During the winter of 2000 the decision was made to vacate this room and make it available to the increasing number of biologists. The move was organised as follows:

August Both filing systems were merging of into one that was located in the ASP Room.

Redundant GA equipment, principally the Seismology Helicorder, disused computers and some spare parts, were packed.

Sept. The ASP storage rack relocation into the old dark room.

The office PC was relocated of to the ASP Room.

Oct The battery room and old dark room was cleaned-up.

Packing of all redundant equipment.

Distribution of MCQ data during 2000

Preliminary Monthly Means for Project Ørsted

- 1999; Jan-Jun 2000 data to IPGP by email (sent Jul. 2000)

1-minute & Hourly Mean Values

- No data distributed in 2000.

Data losses: MCQ, 2000

Feb 25 0249 (1 min) All channels: Acquisition computer crash and re-boot.

Dec 17 0233-2248 (20h 16m) All channels: PC re-boot.

Macquarie Island Annual Mean Values

The table below gives annual mean values calculated using the monthly mean values over **All** days, the 5 International **Quiet** days and the 5 International **Disturbed** days in each month. Plots of these data with secular variation in H, D, Z & F are on pages 77-78.

Year	Days	D		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
2000.5	A	30	28.4	-78	45.0	12585	10847	6382	-63268	64507	ABC
1951.5		23	50.8	-78	17.6	13383	12241	5411	-64589	65961	HDZ
1952.5		24	04.2	-78	17.8	13371	12208	5453	-64550	65920	HDZ
1953.5		24	14.6	-78	18.2	13360	12182	5486	-64533	65901	HDZ
1954.5		24	28.4	-78	18.4	13356	12156	5533	-64535	65903	HDZ
1955.5		24	42.0	-78	18.6	13350	12129	5579	-64520	65887	HDZ
1956.5		24	53.2	-78	19.3	13333	12095	5611	-64506	65870	HDZ
1957.5		25	05.7	-78	19.8	13319	12062	5649	-64482	65843	HDZ
1958.5		25	16.6	-78	20.1	13307	12033	5682	-64456	65815	HDZ
1959.5		25	26.3	-78	20.9	13288	12000	5708	-64436	65792	HDZ
1960.5		25	32.0	-78	22.0	13262	11967	5716	-64414	65765	HDZ
1961.5		25	50.0	-78	22.5	13240	11917	5769	-64359	65707	HDZ
1962.5		26	05.8	-78	23.3	13216	11869	5814	-64321	65665	HDZ
1963.5		26	08.5	-78	24.2	13193	11843	5813	-64294	65634	HDZ
1964.5		26	17.0	-78	24.7	13174	11812	5834	-64249	65586	HDZ
1965.5		26	28.6	-78	25.5	13152	11773	5864	-64214	65547	HDZ
1966.5		26	37.6	-78	26.7	13121	11729	5881	-64175	65503	HDZ
1967.5		26	46.5	-78	28.5	13084	11681	5894	-64166	65486	HDZ
1968.5		26	54.7	-78	29.7	13053	11639	5908	-64132	65447	HDZ
1969.5		27	02.3	-78	30.8	13026	11602	5921	-64099	65409	HDZ
1970.5		27	09.6	-78	32.1	12996	11563	5932	-64078	65383	HDZ
1971.5		27	13.3	-78	33.3	12963	11527	5930	-64032	65331	HDZ
1972.5		27	22.1	-78	34.4	12937	11489	5947	-64008	65302	HDZ

continued …

MCQ - Annual Mean Values (cont.)

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
1973.5		27	27.6	-78	35.8	12905	11451	5951	-63985	65273	HDZ
1974.5		27	34.3	-78	37.6	12865	11404	5955	-63956	65237	HDZ
1975.5		27	43.2	-78	38.2	12847	11373	5976	-63926	65204	HDZ
1976.5		27	51.6	-78	39.1	12822	11336	5992	-63891	65165	HDZ
1977.5		27	59.8	-78	39.9	12802	11304	6010	-63861	65132	HDZ
1978.5		28	11.3	-78	41.1	12773	11258	6034	-63838	65103	HDZ
1979.5		28	19.6	-78	42.3	12745	11219	6047	-63807	65067	HDZ
1980.5		28	28.8	-78	43.0	12723	11183	6067	-63768	65025	HDZ
1981.5		28	37.5	-78	44.5	12687	11136	6078	-63735	64985	HDZ
1982.5		28	49.5	-78	45.4	12666	11097	6107	-63711	64958	HDZ
1983.5		28	54.9	-78	45.7	12652	11075	6117	-63674	64919	HDZ
1984.5		29	03.7	-78	46.1	12640	11049	6140	-63650	64893	HDZ
1985.5		29	12.0	-78	47.4	12608	11006	6151	-63619	64856	XYZ
1986.5		29	19.0	-78	47.5	12600	10986	6169	-63590	64826	XYZ
1987.5		29	26.8	-78	47.8	12593	10966	6191	-63584	64819	XYZ
1988.5		29	32.2	-78	47.8	12590	10954	6207	-63560	64795	XYZ
1989.5		29	37.8	-78	47.8	12587	10941	6223	-63552	64786	XYZ
1990.5		29	42.8	-78	48.0	12577	10923	6234	-63519	64752	XYZ
1991.5		29	47.6	-78	47.6	12578	10915	6250	-63487	64721	XYZ
1992.5		29	53.0	-78	47.5	12573	10901	6264	-63447	64681	XYZ
1993.5	Q	29	56.9	-78	47.2	12575	10896	6277	-63427	64661	ABC
1994.5	Q	30	01.5	-78	47.0	12574	10887	6292	-63403	64637	ABC
1995.5	Q	30	06.2	-78	46.5	12577	10881	6308	-63377	64613	ABC
1996.5	Q	30	10.5	-78	45.9	12585	10879	6326	-63356	64594	ABC
1997.5	Q	30	15.2	-78	45.4	12591	10876	6344	-63336	64576	ABC
1998.5	Q	30	19.7	-78	45.1	12593	10870	6359	-63321	64562	ABC
1999.5	Q	30	23.5	-78	44.6	12598	10867	6373	-63293	64535	ABC
2000.5	Q	30	28.3	-78	44.3	12598	10858	6389	-63266	64509	ABC
1993.5	D	29	58.5	-78	50.0	12521	10846	6256	-63429	64654	ABC
1994.5	D	30	03.3	-78	50.2	12514	10831	6267	-63408	64632	ABC
1995.5	D	30	07.8	-78	49.4	12522	10830	6285	-63376	64601	ABC
1996.5	D	30	11.9	-78	47.4	12556	10852	6316	-63350	64583	ABC
1997.5	D	30	16.0	-78	47.3	12555	10843	6328	-63334	64566	ABC
1998.5	D	30	21.0	-78	47.7	12543	10824	6338	-63320	64550	ABC
1999.5	D	30	24.3	-78	46.4	12564	10836	6358	-63297	64532	ABC
2000.5	D	30	29.0	-78	46.7	12554	10819	6368	-63273	64507	ABC

* Elements ABC indicates non-aligned variometer orientation

MAWSON OBSERVATORY

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

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

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.

The observatory has continuously recorded the geomagnetic field and seismic activity at Mawson. It is operated by Geoscience Australia as part of the Australian National Antarctic Research Expeditions (ANARE).

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

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

- 3-character IAGA code: MAW
- Geographic latitude: 67° 36' 14" S
- Geographic longitude: 62° 52' 45" E
- Geomagnetic† latitude: -73.12°
- Geomagnetic† longitude: 109.59°
- 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: Robert Sutton (1999, GA/BoM); Peter Johnson (2000, GA/BoM); Martin Purvins (2001, GA/BoM)

† Based on the IGRF 2000 model.

Observers in charge

The 2000 observer in charge of magnetic (and seismological) observatory operations was employed jointly by GA and the Bureau of Meteorology and was a member of the Australian

National Antarctic Research Expedition (ANARE). He relieved the 1999 observer on 06 January 2000, who departed Mawson on 08 January 2000.

The 2001 observer arrived at Mawson on 04 December 2000 to relieve the 2000 observer who departed on 07 December 2000.

Variometers

A 3-axis Narod ringcore fluxgate (RCF) magnetometer and an Elsec 820M3 PPM monitored magnetic variations at Mawson throughout 2000. The sensors of both these instruments were located within the sensor room of the MAW Variometer House. This building also housed a global positioning system (GPS) clock, a data acquisition PC, a network PC, and an Aironet ethernet radio link and a standby power supply. In addition, an EDA 3-component magnetometer and its associated data acquisition PC was installed in September 2000 as a standby variometer to replace the principal system should it irreparably fail.

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.

The RCF produced 8 samples/sec. that were averaged and output as 1-second data. The PPM variometer produced 10-second samples. The temperatures of the sensors and the electronics of the RCF system were monitored by its in-built dual temperature system. Temperature within the sensor room was kept close to 10°C by a fast-cycle heater.

Absolute Instruments and Corrections

Several absolute magnetometers were stored and used in the Absolute House, including the primary instruments: an Elsec model 770 PPM (serial 199) and a fluxgate theodolite magnetometer (Bartington B0766H mounted on a Zeiss 020B 313792 theodolite).

This fluxgate theodolite magnetometer arrived in January 2000 to replace the Elsec 810 (serial 213) magnetometer mounted on Zeiss 020B (serial 352229), which was forwarded to Davis DVS to replace a damaged instrument there. The Bartington MAG-01 magnetometer has a resolution of 0.1nT which is an order of magnitude more sensitive than the Elsec 810 magnetometer.

Secondary instruments were an Askania declinometer (Serial 630332), three horizontal magnetometers (QHM Serial 300, 301, and 302), and a Elsec 770 PPM (Serial 206). The declinometer and QMHs were used on Askania circle 611665.

All observations were performed on Pier A.

For standardization with the Australian Magnetic Standard held at Canberra, a correction of +2.0nT 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 +0.3nT, -0.7nT and –1.9nT respectively.

Operations

In 2000 twice-weekly absolute observations were performed by the observer in charge of the observatory on the observation pier A in the Absolute House in 2000. The absolute observations were sent to GA as well as being reduced on site.

A brief report on the operations was written by the observer before returning from Antarctica (Johnson, P., 2000). The final data for the year were reduced and analysed by GA staff.

The observer also performed preliminary data reduction at Mawson, forwarding K indices and preliminary mean quiet field values by e-mail to GA, Canberra, each month.

The observer was responsible for the continuous operation of the observatory and performed equipment maintenance as required.

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.

Data losses in 2000

Feb 26	0230 to Mar 01 / 0806 (4d 5h 36m) PPM channel: Corrupt and unreliable PPM data.
May 23	1943 to 27 / 0808 (3d 10h 25m) All channels: PC re-booted twice.
May 31	1416 to Jun 02 / 0714 (1d 16h 58m) RCF channels:
Jun 02	0713 (1 min) All channels: PC re-booted.
Sep 08	0330-1030 (7 hr): RCF channel.
Sep 08	0330 to 09 / 0735 (1d 4h 5m) PPM channel.

Mawson, Antarctica Annual Mean Values

The table below gives annual mean values calculated using the monthly mean values over **All** days, the 5 International **Quiet** days and the 5 International **Disturbed** days in each month as indicated. Plots of these data with secular variation in H, D, Z & F are on pages 89-90.

Year	Days	D (Deg	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

continued …

MAW - Annual Mean Values (cont.)

Year	Days	D (Deg	Min)	I (Deg	Min)	H (nT)	X (nT)	Y (nT)	Z (nT)	F (nT)	Elts*
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
2000.5	Q	-65	48.0	-67	49.6	18579	7616	-16946	-45585	49225	ABC
1992.5	A	-64	36.9	-68	-2.8	18499	7930	-16712	-45894	49482	XYZ
1993.5	A	-64	44.2	-68	-0.7	18506	7898	-16736	-45830	49426	ABC
1994.5	A	-64	52.9	-67	-59.4	18511	7858	-16760	-45794	49394	ABC
1995.5	A	-65	0.9	-67	56.7	18532	7828	-16798	-45741	49352	ABC
1996.5	A	-65	9.8	-67	54.5	18548	7791	-16833	-45698	49319	ABC
1997.5	A	-65	19.4	-67	53.0	18560	7749	-16865	-45670	49297	ABC
1998.5	A	-65	29.1	-67	52.4	18561	7702	-16887	-45648	49278	ABC
1999.5	A	-65	39.0	-67	51.5	18561	7653	-16910	-45618	49250	ABC
2000.5	A	-65	48.2	-67	50.6	18566	7610	-16935	-45594	49230	ABC
1992.5	D	-64	39.6	-68	-5.2	18466	7904	-16689	-45907	49482	XYZ
1993.5	D	-64	45.9	-68	-3.0	18476	7877	-16713	-45847	49430	ABC
1994.5	D	-64	55.3	-68	-1.9	18476	7831	-16734	-45804	49390	ABC
1995.5	D	-65	1.7	-67	58.8	18504	7812	-16774	-45752	49353	ABC
1996.5	D	-65	11.1	-67	56.2	18525	7775	-16814	-45707	49318	ABC
1997.5	D	-65	20.4	-67	55.0	18534	7733	-16844	-45682	49299	ABC
1998.5	D	-65	30.9	-67	54.8	18530	7680	-16864	-45665	49282	ABC
1999.5	D	-65	41.0	-67	53.9	18528	7630	-16884	-45626	49245	ABC
2000.5	D	-65	49.7	-67	52.6	18543	7593	-16917	-45614	49239	ABC

* Elements ABC indicates non-aligned variometer orientation

Distribution of MAW data during 2000

Preliminary Monthly Means for Project Ørsted

- 1999; Jan-Jun 2000 data to IPGP by email (sent Jul. 2000)

1-minute & Hourly Mean Values

- None sent in 2000.

K indices

The table on the next page shows Mawson K indices for 2000. Using the digital data, these have been derived by a computer algorithm that calculates a simple range in the X and Y magnetic components over each 3-hour UT period. The K indices were calculated from the maximum of the X and Y ranges in the usual manner. This was suitable for Mawson as the diurnal variation is small.

K indices & Daily K sums at Mawson Antarctica (K=9 limit: 1500 nT) for 2000

Date	January	February	March	April	May	June	Date
01	D 5654 4456 39	4342 4345 29	D 3655 4365 37	4332 2455 28	3552 3455 32	---- ---- --	01
02	5554 4454 36	4323 3434 26	5653 3113 27	6654 3255 36	5545 4465 38	--32 2325 --	02
03	5454 4363 34	3442 4456 32	3222 3264 24	5552 2326 30	3443 3375 32	6654 3243 33	03
04	4435 5445 34	Q 4342 3224 24	Q 3221 3212 16	D 6441 3465 33	3322 2255 24	2441 0356 25	04
05	5553 4457 38	4422 2355 27	2442 2244 24	4531 1324 23	4453 3225 28	D 6574 4223 33	05
06	4544 5645 37	D 6665 4567 45	3344 3534 29	D 4643 4678 42	6653 3245 34	4433 3311 22	06
07	5533 4354 32	D 7454 5776 45	D 5553 3464 35	D 5563 2365 35	Q 5431 1111 17	2334 3365 29	07
08	Q 4333 3321 22	5534 3564 35	D 4654 4664 39	4354 2366 33	Q 1110 1125 12	D 4667 6565 45	08
09	Q 4422 1224 21	3553 4534 32	3322 2114 18	4532 3485 34	2332 2655 28	Q 3333 2201 17	09
10	3442 2335 26	4453 3335 30	4233 3555 30	6655 3546 40	4532 2234 25	6555 4346 38	10
11	D 5434 5655 37	4664 3555 38	5543 3455 34	3443 3453 29	Q 3331 1034 18	4345 5452 32	11
12	6653 2344 33	D 7777 7535 48	D 5554 3335 33	4441 1112 18	3544 3246 31	3451 3443 27	12
13	5553 4343 32	4344 4556 35	4521 1064 23	4532 1100 16	6332 3443 28	2543 3245 28	13
14	4442 3354 29	D 5655 6665 44	4433 2255 28	Q 1221 1222 13	5422 2263 26	D 6443 3363 32	14
15	4442 3334 27	6533 3245 31	Q 4311 1222 16	1321 1155 19	5543 3233 28	4433 3465 32	15
16	4532 3344 28	4532 3445 30	Q 1221 1101 09	D 4655 4343 34	5744 3356 37	Q 4332 2114 20	16
17	Q 4432 2133 22	Q 3323 3442 24	3322 2000 12	4443 2315 26	D 7642 1165 32	Q 3211 1225 17	17
18	Q 3332 2333 22	Q 3332 1101 14	1222 2254 20	Q 3321 1135 19	4331 2123 19	2212 2556 25	18
19	4421 1344 23	Q 2323 2233 20	3443 3310 21	5632 3331 26	4323 2112 18	4410 1111 13	19
20	4444 4363 32	Q 2333 1114 18	2222 2101 12	3554 3434 31	Q 2331 2235 21	4323 2001 15	20
21	Q 3222 2112 15	4552 4533 31	2232 1112 14	4323 4354 28	Q 5442 2135 26	2212 1235 18	21
22	3554 5564 37	3322 3224 21	3333 3444 27	Q 2333 1144 21	4553 3223 27	5443 2143 26	22
23	D 5545 4424 33	2233 4522 23	5553 3433 31	2223 2222 17	D 3332 234- --	D 3551 4465 33	23
24	4465 3444 34	D 3765 4677 45	4433 4333 27	D 1664 4224 29	D ---- ---- --	6543 1135 28	24
25	4663 3454 35	4664 4356 38	3453 2341 25	Q 3222 2252 20	D ---- ---- --	Q 3341 0135 20	25
26	4552 2225 27	4454 3475 36	Q 1221 1223 14	Q 1211 1111 09	---- ---- --	D 5665 5486 45	26
27	5443 2444 30	6443 3344 31	Q 3321 1112 14	3223 3436 26	---3 3355 --	5554 4376 39	27
28	D 4654 5537 39	3744 4325 32	3431 1011 14	7544 3345 35	3552 2356 31	6652 2146 32	28
29	D 5565 5766 45	2343 3211 19	2211 1145 17	4432 2365 29	D 4552 3545 33	6553 2114 27	29
30	5663 4474 39		3322 3464 27	4421 2364 26	5464 4566 40	Q 2122 2154 19	30
31	6454 4333 32		D 5555 3444 35		3643 3--- --		31
Mean K-sum	31.3	31.1	23.6	26.8	27.4	27.5	

Date	July	August	September	October	November	December	Date
01	5442 1101 18	3343 3647 33	4453 3374 33	5553 2334 30	4342 2235 25	4333 3343 26	01
02	Q 1320 1035 15	7642 2255 33	5555 4534 36	2224 3534 25	Q 4432 3223 23	2323 3433 23	02
03	3233 3226 24	6444 3344 32	3432 1166 26	4765 5312 33	Q 3123 3334 22	3453 4343 29	03
04	5312 2233 21	6654 3665 41	3433 3375 31	D 3655 6466 41	4674 5654 41	4553 4134 29	04
05	3345 4424 29	D 5456 4556 40	3342 1455 27	D 6666 5556 45	4532 4665 35	5554 3222 28	05
06	Q 3423 2243 23	4663 4346 36	4220 2333 19	Q 5321 2021 16	D 5566 6765 46	3343 4435 29	06
07	Q 4322 1144 21	3433 3235 26	3444 3346 31	2432 3431 22	D 5777 5442 41	D 5664 4345 37	07
08	3222 2222 17	3332 2235 23	6--3 4446 --	Q 2221 1125 16	3464 4334 31	D 4554 4545 36	08
09	1233 2125 19	4222 1145 21	Q 4332 2012 17	Q 4221 2334 21	5432 5546 34	D 4565 4467 41	09
10	4563 3233 29	2664 4456 37	Q 2212 1255 20	4553 3425 31	D 5777 6443 43	D 5643 2355 33	10
11	D 3554 3356 34	D 5764 3466 41	Q 1111 2244 16	5663 3365 37	4533 4675 37	4543 2334 28	11
12	6324 1101 18	D 4955 5464 42	4543 4456 35	3222 3323 20	5554 4465 38	3443 4353 29	12
13	1235 6446 31	6643 4215 31	6542 3334 30	D 7763 2333 34	3544 4365 34	5423 2024 22	13
14	D 4554 3865 40	3222 4456 28	Q 3432 3334 25	D 5655 5766 45	4433 2224 24	Q 3232 2233 20	14
15	D 4566 7788 51	5433 2343 27	3421 1237 23	4423 4244 27	Q 4432 3153 25	Q 3422 2222 19	15
16	D 6654 5332 34	4532 2233 24	D 5333 3756 35	6433 3344 30	Q 4321 2144 21	2332 3243 22	16
17	3433 3112 20	3333 2234 23	D 4544 4449 38	6633 3264 33	Q 3433 2221 20	4444 4463 33	17
18	4542 2465 32	Q 3321 0012 12	D 6555 5545 40	3444 3336 30	2221 2264 21	5564 4343 34	18
19	5432 2335 27	Q 3111 1124 14	D 6545 5545 39	4343 3244 27	4454 3325 30	5533 3322 26	19
20	D 6764 4226 37	2111 0234 14	6633 3334 31	Q 2322 1123 16	5444 4442 31	Q 3232 2353 23	20
21	4222 2226 22	3653 3455 34	3443 3253 27	Q 4222 2131 17	5534 3454 33	3213 4324 22	21
22	4445 3454 33	Q 3211 0001 08	Q 4432 1132 20	2333 4665 32	4444 4324 29	3442 3335 27	22
23	3421 2474 27	0122 4334 19	3432 2224 22	5554 3355 35	4533 3332 26	D 5765 5434 39	23
24	Q 3431 1134 20	2553 1123 22	3322 2375 27	4434 4235 29	2433 3345 27	4642 2123 24	24
25	Q 4411 1143 19	Q 2321 0042 14	5443 3755 36	3333 4245 27	5632 2243 27	3233 5424 26	25
26	5364 3367 37	Q 5334 3112 22	5555 4356 38	4554 3355 34	3453 4575 36	4532 1355 28	26
27	5221 0025 17	3311 2143 18	4453 2445 31	4323 2324 23	D 7675 5564 45	4433 4643 31	27
28	5674 4343 36	D 3443 3555 32	4533 3434 29	4234 4435 29	5775 6565 46	4443 4323 27	28
29	6554 4335 35	D 7564 3476 42	3322 3354 25	D 6655 4455 40	D 5776 6534 43	3653 2233 27	29
30	3522 3235 25	5553 3226 31	D 5556 4677 45	5344 3333 28	3443 3335 28	Q 4333 4313 24	30
31	2533 3345 28	3444 3345 30		5534 3445 33		Q 4222 2211 16	31
Mean K-sum	27.1	27.4	29.4	29.2	32.1	27.7	

Occurrence distribution of K-indices

K-Index:	0	1	2	3	4	5	6	7	8	9	-
January	0	7	27	52	84	55	19	4	0	0	0
February	1	8	31	59	58	40	21	14	0	0	0
March	8	39	52	61	44	34	10	0	0	0	0
April	2	32	45	52	49	35	21	2	2	0	0
May	2	20	40	59	35	43	15	3	0	0	31
June	6	30	36	48	43	38	25	3	1	0	10
July	6	25	50	57	48	33	20	6	3	0	0
August	9	25	38	61	49	34	26	5	0	1	0
September	2	14	31	65	57	45	15	8	0	1	2
October	1	12	42	69	51	43	26	4	0	0	0
November	0	6	32	53	66	45	22	16	0	0	0
December	1	7	45	82	65	35	11	2	0	0	0
ANNUAL TOTAL	38	225	469	718	649	480	231	67	6	2	43

Mawson, Antarctica 2000 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 2000		X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	7653.0	-16929.6	-45604.5	49244.0	18579.2	-65° 40.5'	-67° 50.0'
	5xQ days	7651.4	-16934.6	-45603.0	49243.8	18582.9	-65° 41.1'	-67° 49.8'
	5xD days	7661.7	-16931.8	-45601.1	49243.0	18584.8	-65° 39.2'	-67° 49.6'
February	All days	7637.2	-16932.4	-45603.5	49241.5	18575.1	-65° 43.4'	-67° 50.3'
	5xQ days	7636.1	-16941.9	-45580.3	49223.0	18583.3	-65° 44.3'	-67° 49.1'
	5xD days	7633.1	-16912.4	-45618.8	49248.3	18555.4	-65° 42.5'	-67° 52.0'
March	All days	7624.7	-16933.3	-45597.2	49234.0	18570.8	-65° 45.6'	-67° 50.4'
	5xQ days	7627.6	-16945.0	-45586.6	49228.6	18582.7	-65° 45.9'	-67° 49.3'
	5xD days	7620.1	-16918.8	-45631.6	49260.2	18555.8	-65° 45.2'	-67° 52.3'
April	All days	7611.0	-16927.1	-45617.6	49248.7	18559.5	-65° 47.4'	-67° 51.7'
	5xQ days	7619.4	-16941.9	-45585.0	49224.8	18576.4	-65° 47.1'	-67° 49.7'
	5xD days	7604.2	-16912.0	-45646.8	49269.5	18543.0	-65° 47.4'	-67° 53.5'
May	All days	7605.7	-16929.5	-45593.0	49225.9	18559.5	-65° 48.5'	-67° 51.0'
	5xQ days	7611.1	-16937.0	-45583.8	49220.7	18568.6	-65° 48.1'	-67° 50.2'
	5xD days	7590.3	-16922.1	-45606.5	49233.5	18546.5	-65° 50.5'	-67° 52.2'
June	All days	7599.3	-16927.9	-45580.0	49212.3	18555.5	-65° 49.4'	-67° 50.9'
	5xQ days	7616.2	-16946.5	-45580.4	49221.6	18579.3	-65° 48.0'	-67° 49.4'
	5xD days	7567.8	-16894.6	-45573.4	49190.0	18512.3	-65° 52.3'	-67° 53.6'
July	All days	7592.4	-16932.0	-45580.1	49212.8	18556.4	-65° 50.9'	-67° 50.9'
	5xQ days	7605.9	-16943.3	-45576.1	49214.9	18572.1	-65° 49.5'	-67° 49.8'
	5xD days	7559.9	-16916.4	-45576.4	49199.2	18529.0	-65° 55.3'	-67° 52.5'
August	All days	7586.7	-16928.1	-45590.3	49220.0	18550.5	-65° 51.6'	-67° 51.5'
	5xQ days	7604.7	-16945.6	-45582.5	49221.4	18573.8	-65° 49.9'	-67° 49.8'
	5xD days	7537.8	-16891.6	-45613.5	49221.7	18497.4	-65° 57.2'	-67° 55.6'
September	All days	7591.9	-16928.6	-45595.7	49226.0	18553.1	-65° 50.7'	-67° 51.5'
	5xQ days	7600.5	-16943.4	-45583.1	49220.6	18570.1	-65° 50.4'	-67° 50.1'
	5xD days	7581.1	-16916.4	-45628.3	49250.5	18537.7	-65° 51.6'	-67° 53.4'
October	All days	7591.5	-16934.5	-45601.1	49233.0	18558.4	-65° 51.3'	-67° 51.3'
	5xQ days	7600.1	-16948.8	-45592.3	49230.9	18574.8	-65° 50.9'	-67° 50.0'
	5xD days	7566.4	-16889.1	-45643.8	49253.3	18506.9	-65° 52.1'	-67° 55.8'
November	All days	7609.4	-16952.4	-45593.7	49235.1	18582.1	-65° 49.6'	-67° 49.6'
	5xQ days	7607.6	-16959.1	-45592.9	49236.1	18587.3	-65° 50.4'	-67° 49.2'
	5xD days	7578.9	-16942.1	-45612.1	49244.3	18560.6	-65° 54.0'	-67° 51.4'
December	All days	7614.4	-16962.2	-45575.1	49221.9	18593.0	-65° 49.5'	-67° 48.4'
	5xQ days	7608.9	-16964.7	-45568.1	49215.4	18592.9	-65° 50.6'	-67° 48.2'
	5xD days	7615.6	-16958.4	-45614.0	49256.9	18590.1	-65° 49.0'	-67° 49.6'
Annual Mean Values	All days	7609.7	-16934.8	-45594.3	49229.6	18566.1	-65° 48.2'	-67° 50.6'
	5xQ days	7615.8	-16946.0	-45584.5	49225.1	18578.7	-65° 48.0'	-67° 49.6'
	5xD days	7593.1	-16917.1	-45613.9	49239.2	18543.3	-65° 49.7'	-67° 52.6'

(Calculated:14:52 hrs., Thu. 04 Jul. 2002)

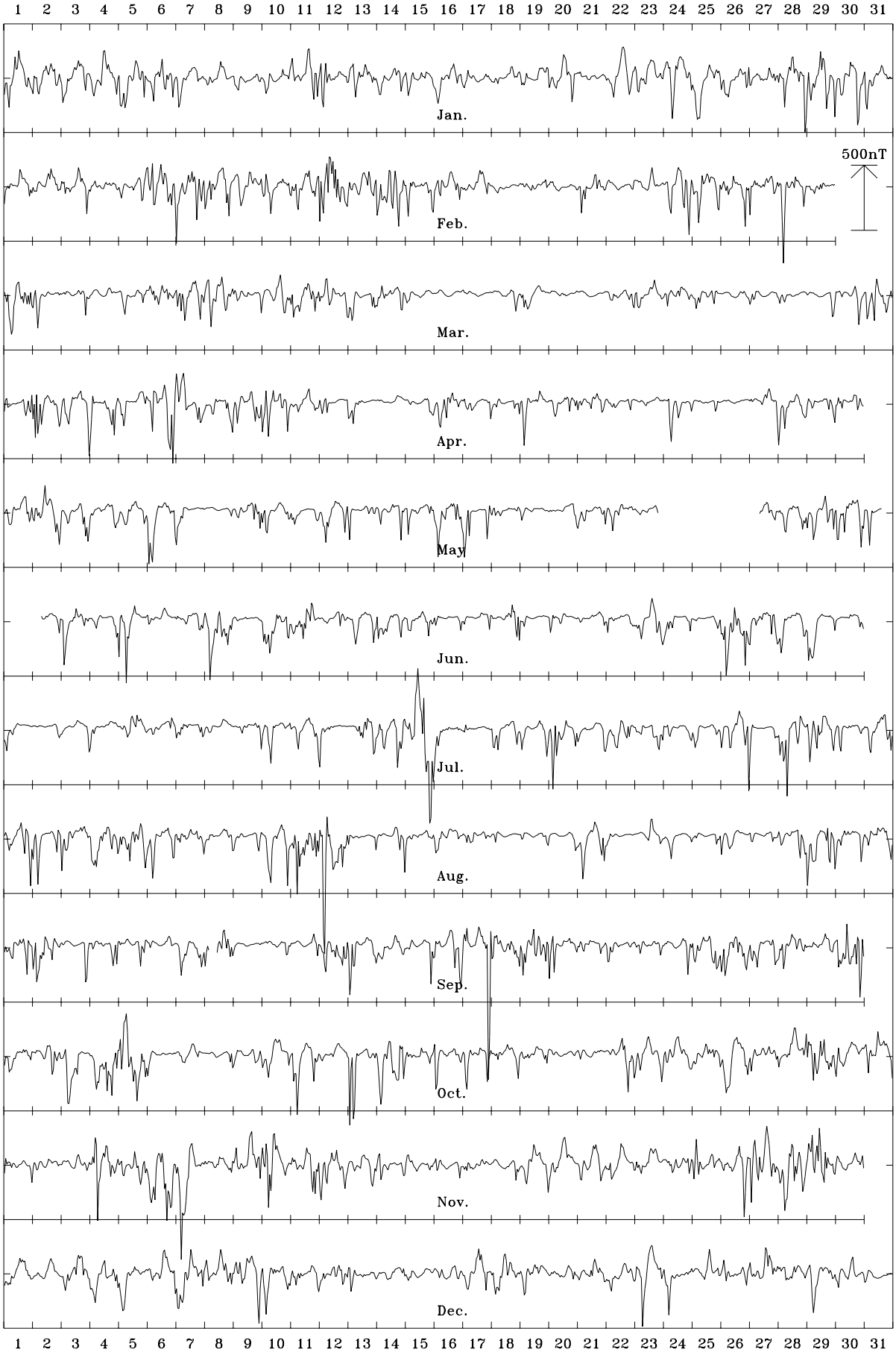
Hourly Mean Values

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.

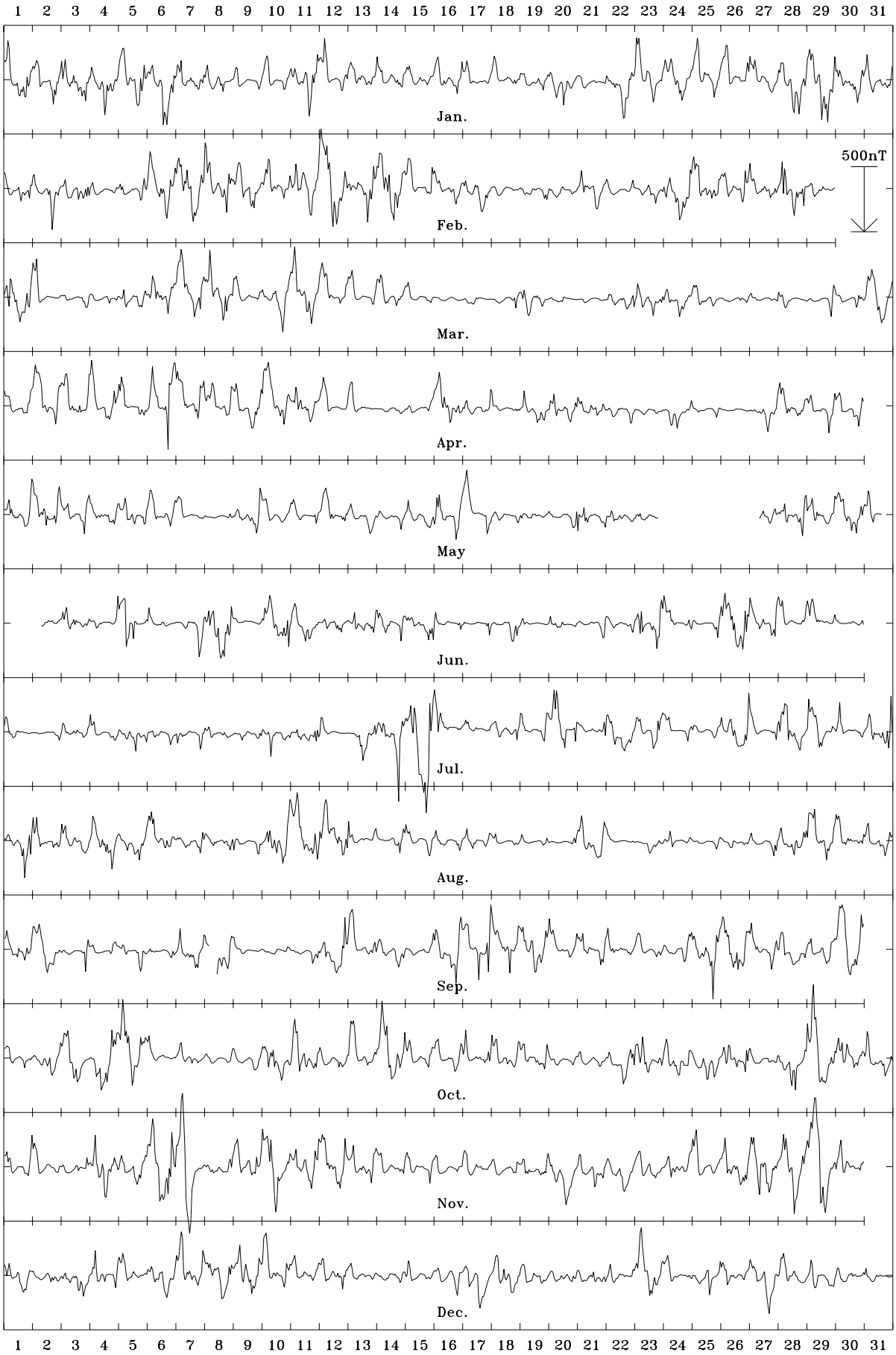
The mean value given at the top of each plot is the *all-days* annual mean value of the element.

Mawson Stn. 2000 Horizontal intensity (H). Scale: 40.0 nT/mm. Mean: 18566 nT

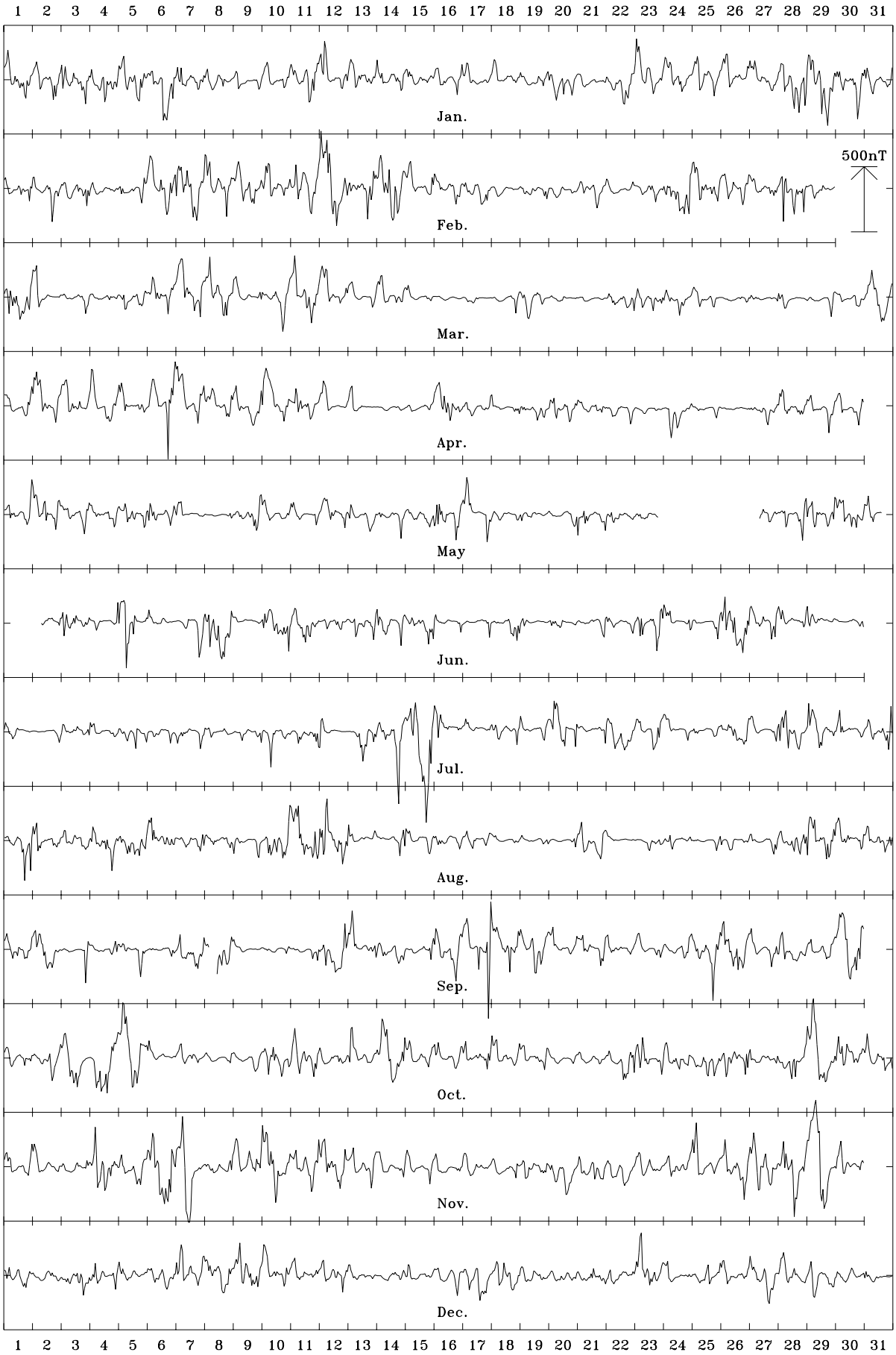


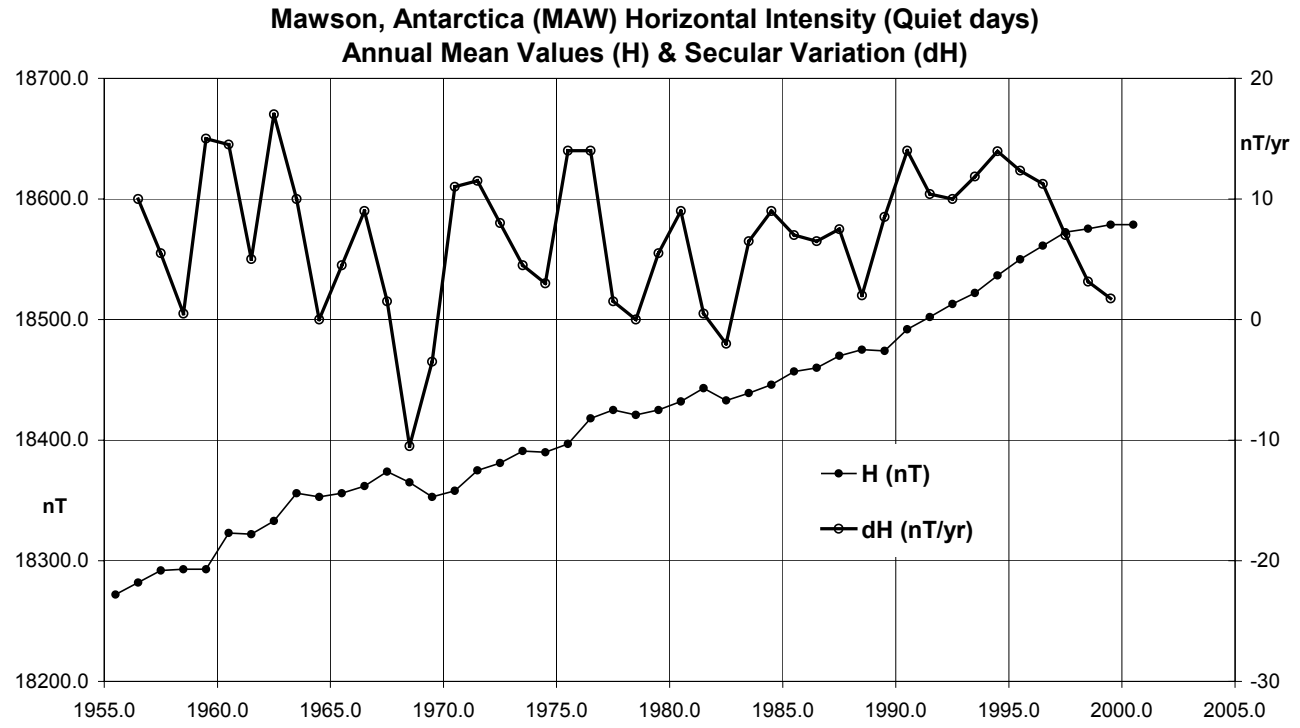
Mawson Stn. 2000 Declination (east) (D). Scale: 5.00 min/mm. Mean: −65.80 deg.

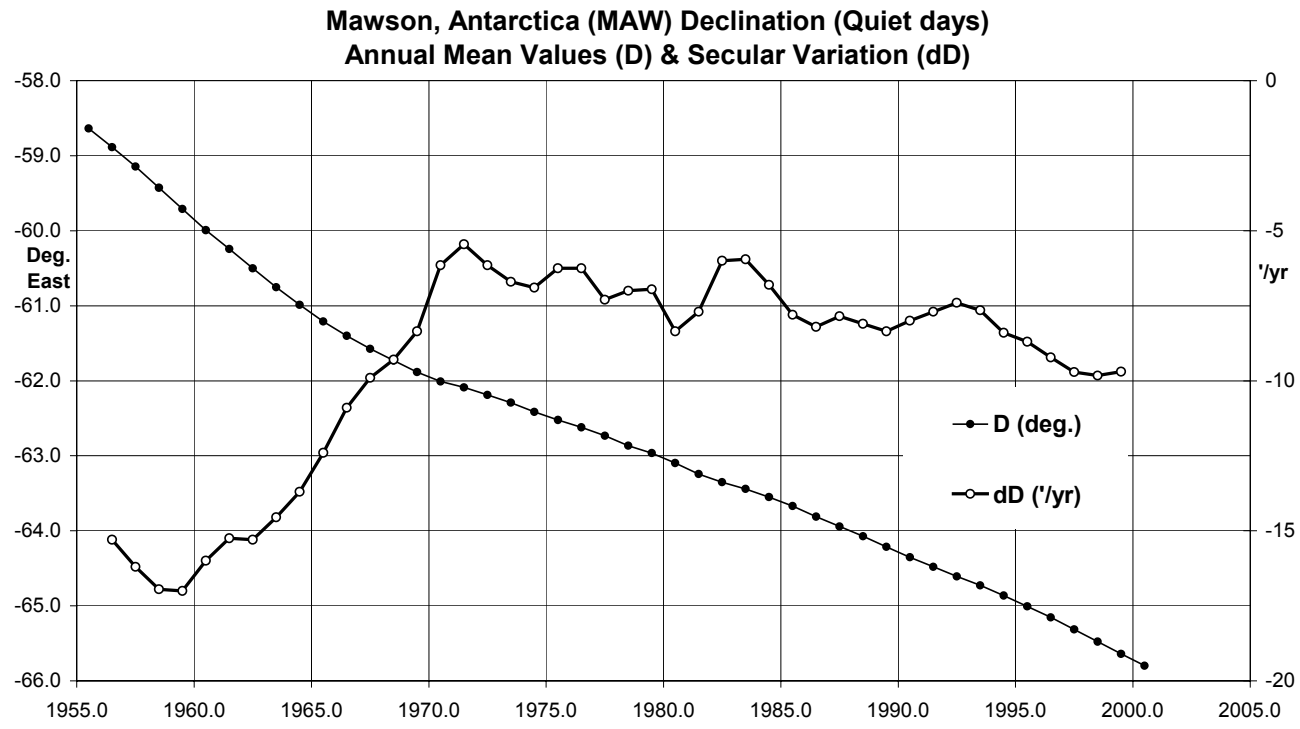
Mawson Stn. 2000 Vertical intensity (Z). Scale: 40.0 nT/mm. Mean: −45594 nT



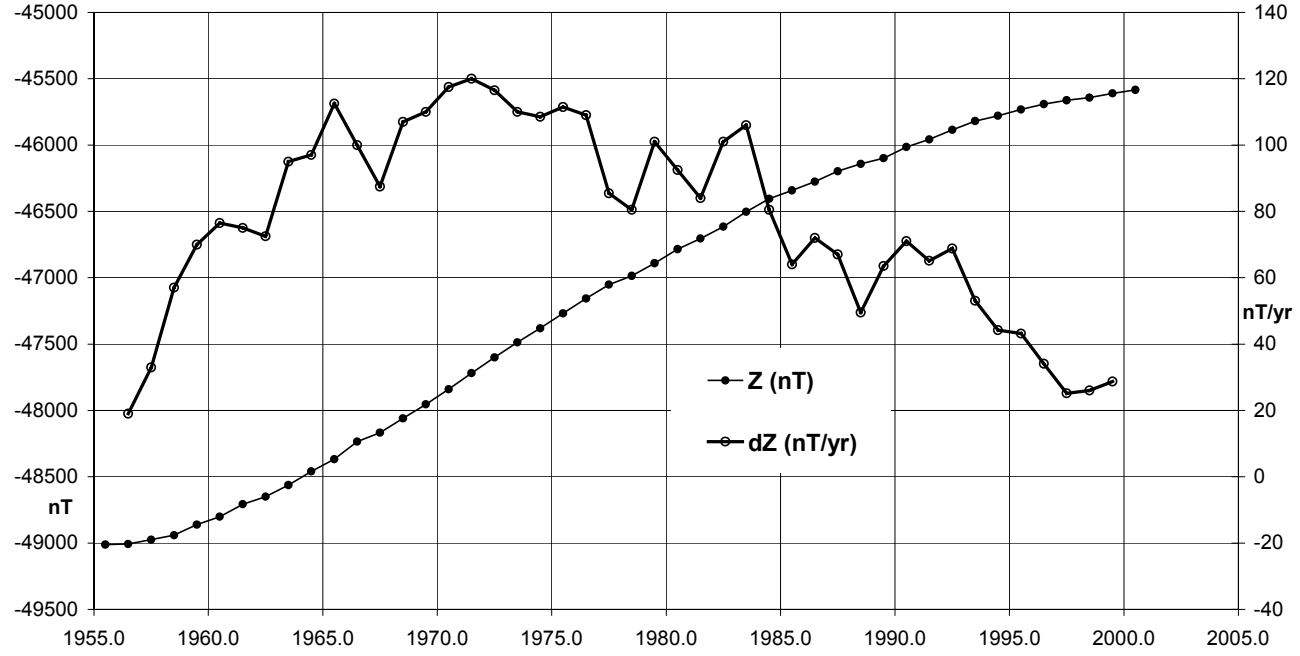
Mawson Stn. 2000 Total intensity (F). Scale: 40.0 nT/mm. Mean: 49230 nT



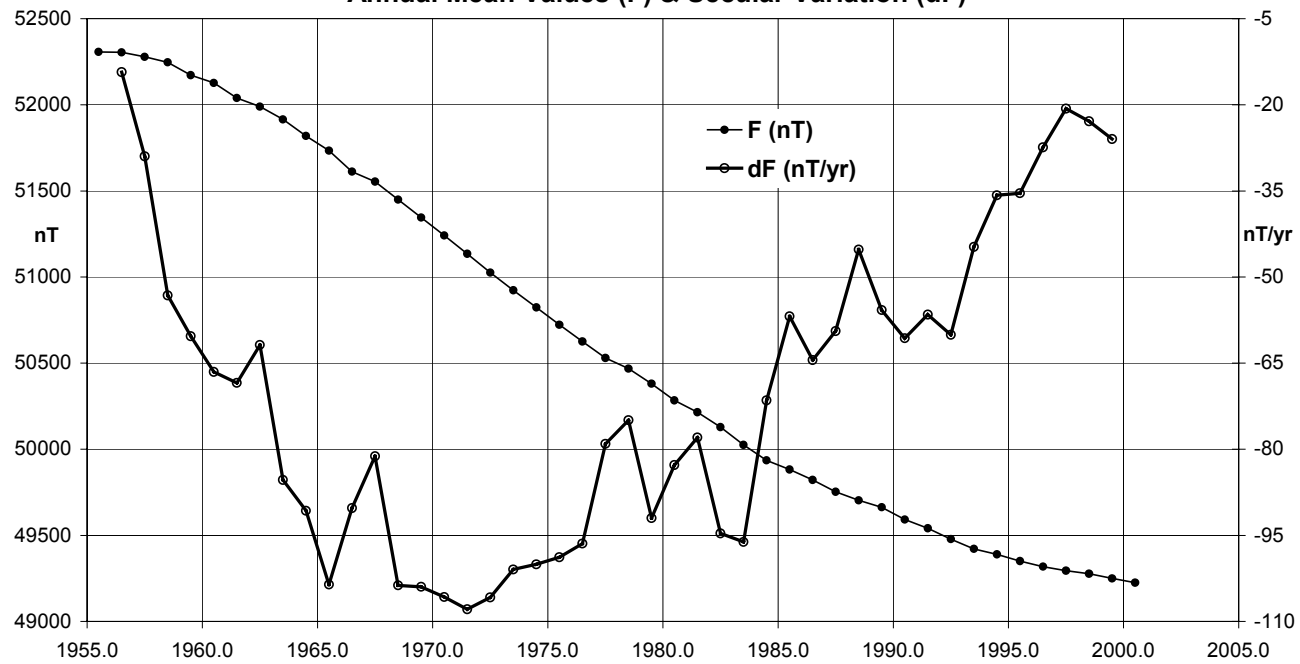

Mawson, Antarctica (MAW) Horizontal Intensity (Quiet days)
Annual Mean Values (H) & Secular Variation (dH)
18700.0
18600.0
18500.0
18400.0
18300.0
18200.0
nT
20
10
0
-10
-20
-30
nT/yr
1955.0
1960.0
1965.0
1970.0
1975.0
1980.0
1985.0
1990.0
1995.0
2000.0
2005.0
H (nT)
dH (nT/yr)


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
2005.0
D (deg.)
dD ('/yr)

Mawson, Antarctica (MAW) Vertical Intensity (Quiet days)
Annual Mean Values (Z) & Secular Variation (dZ)



Mawson, Antarctica (MAW) Total Intensity (Quiet days)
Annual Mean Values (F) & Secular Variation (dF)



MAW Significant Events 2000

Jan 07 DIM Bartington 0766H with Zeiss 313792 arrived to replace the Elsec 810 213 with Zeiss 352229 which was forwarded to Davis.

Jan 18 Variometer hut temperature was adjusted down from 14.73°C.

Jan 19 Variometer hut temperature was adjusted down from 11.37°C.

Feb 18 A BCF extinguisher was removed from the Variometer hut at 0908 and returned to the same (about 4m from the Variometer and PPM) position at 0923.
The effect of BCF extinguishers on the magnetic field was investigated: 1000nT at 150mm; 150nT at 450mm; 70nT at 1000mm; 3nT at 2000mm.

Feb 19 Power failure at approximately 1800 with no data loss. However at about 0800 there was a 1.5nT step down in F-check.

Mar 01 Elsec 820 no. 158 PPM head was replaced after the instrument failed.

Mar 20 PPM #199 head faulty, head #206 used instead for this observation only as head #199 was repaired.

May 23 PC failed due to static from a blizzard that developed in the evening.

May 31 Battery failure on the Bartington Mag01.

Sep 08 During the period 08-10 September work was carried out on the equipment contained in the variometer hut. The combined effect of this work should be to reduce the number of system failures due to blizzard static since the exposure of cabling and equipment has been minimised by:

- Removal of all old cabling.
- Placement of earthed copper sheet under table and placement of all cables on this.
- Cables to the RCF head, Doric temperature probe and newly installed EDA sensor head, were removed from the wall ducting.
- Cables were routed together with an earthed copper braid along the floor and taped down. A wooden cover was placed over the cable in front of the electrical cabinet to provide physical protection.
- Both computers located in the shelves of the table and the cabling tidied up.
- RCF cable recoiled in figure-8 form and replaced under the table legs as before, but now on top of the copper sheet. It is suspected the figure-8 form helps reduce the risk of longitudinally induced currents.
- PPM cable now routed so it enters the PPM from the front. Seemed to improve the signal from a 5 to a 9 as displayed on the PPM.
- GPS unit was mounted above head height on an aluminium bracket allowing the return of the broom handle to its normal function.
- EDA magnetometer installed together with its associated PC recently acquired from many sources.
- Old uninterruptible power supply (UPS) removed and replaced by a new unit.
- Magnetic fire extinguisher bottles removed from Variometer hut.
- Distance to outside influences increased from 100mm to over 1m.

Oct 20 GA office moved from the Science Building 'Wombat' which it had occupied for many years to take up residence in the ASP building 'Aeronomy'.

CASEY OBSERVATORY

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

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

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

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

- 3-character IAGA code: CSY
- Geographic latitude: 66° 17' S
- Geographic longitude: 110° 32' E
- Geomagnetic† latitude: -76.52°
- Geomagnetic† longitude: 183.65°
- 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: Michael Hyde (AAD)

† Based on the IGRF 2000 model.

History

A magnetic observatory was established at Wilkes (a few kilometres from where Casey now stands) by the US Antarctic Research Program for the 1957-58 IGY. It was subsequently operated by BMR and ANARE (McGregor, 2000) until the instrumentation was returned to the USA in 1968.
To provide information on the magnetic secular variation in Antarctica, BMR/GA and the Australian Antarctic Division have jointly carried out regular absolute measurements of the magnetic field at Casey since 1975. The observations have been performed by Antarctic Division personnel, who were trained in the use of the instrumentation at GA in Canberra.

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

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

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

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 2000 was supported jointly by the Antarctic Division, of the Department of The Environment and Heritage, and GA. 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 2000. The fluxgate sensors were housed on the hill about 300m west of the Casey Science building. Their sensors were aligned close to true north, east and vertical. The temperatures were maintained at 20°C. Further description can be found in Crosthwaite (1999).

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 were available as a backup in the event that one of the primary instruments became unserviceable.

For standardization with the Australian Magnetic Standard held at Canberra, a correction of +2.0nT was been applied to the absolute PPM readings. Corrections of zero were applied to the DIM readings. These resulted in baseline corrections in X, Y and Z of: $\Delta X = 0nT$; $\Delta Y = -0.3nT$ and $\Delta Z = -2.0nT$.

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

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

The combined corrections applied in X, Y and Z were:

$\Delta X = +42nT$ $\Delta X = -11.9nT$ $\Delta X = -47nT$

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

Casey Annual Mean Values

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

Plots of these data with secular variation in H, D, Z & F are on the pages 98-99.

Year	Days	D		I		H	X	Y	Z	F	Elts*
		(Deg	Min)	(Deg	Min)	(nT)	(nT)	(nT)	(nT)	(nT)	
1977.96	AB	-88	29.6	-81	38.7	9495	250	-9492	-64650	65344	DHZ
1978.5	AB	-89	4.3	-81	36.2	9518	154	-9516	-64488	65187	DHZ
1979.5	AB	-89	21.6	-81	35.7	9525	106	-9524	-64469	65169	DHZ
1980.5	AB	-89	31.5	-81	33.9	9568	79	-9568	-64528	65233	DHZ
1981.5	AB	-88	2.1	-81	32.0	9540	327	-9534	-64083	64789	DHZ
1982.5	AB	-90	10.0	-81	28.4	9650	-28	-9650	-64400	65120	DHZ
1983.5	AB	-90	32.0	-81	31.5	9585	-89	-9585	-64326	65037	DHZ
1984.5	AB	-90	50.0			9640	-140	-9639			DHZ
1985.5	AB	-90	50.0	-81	25.9	9650	-140	-9649	-64067	64790	DHZ
1986.5	AB	-90	52.9	-81	27.2	9634	-148	-9633	-64101	64821	DHZ
1987.5	AB	-91	18.6	-81	29.1	9596	-219	-9593	-64097	64811	DHZ
1988.5	AB	-91	28.4	-81	27.2	9630	-248	-9627	-64086	64805	DHZ
1989.5	AB	-90	45.5	-81	23.5	9672	-128	-9671	-63887	64615	DHZ
1990.5	AB	-91	55.0	-81	27.4	9601	-321	-9596	-63920	64637	DHZ
1991.5	QM	-92	1.2	-81	25.0	9642	-340	-9636	-63881	64605	XYZ
1992.5	QM	-92	10.0	-81	25.0	9637	-364	-9630	-63848	64571	XYZ
1993.5	QM	-92	7.3	-81	25.0	9638	-357	-9631	-63852	64576	XYZ
1994.5	QM	-92	17.1	-81	25.3	9629	-384	-9621	-63824	64547	XYZ
1995.5	QM	-92	27.5	-81	25.6	9620	-413	-9611	-63807	64528	XYZ
1996.5	QM	-92	35.4	-81	25.3	9625	-435	-9615	-63804	64526	XYZ
1997.5	QM	-92	42.1	-81	25.2	9623	-454	-9612	-63774	64496	XYZ
1998.5	Q	-92	55.4	-81	25.7	9614	-490	-9601	-63777	64497	XYZ
1999.5	Q	-93	4.9	-81	26.5	9595	-516	-9581	-63762	64480	XYZ
2000.5	Q	-93	12.9	-81	27.0	9584	-537	-9568	-63749	64465	XYZ
1998.5	A	-92	55.4	-81	25.7	9615	-490	-9602	-63785	64505	XYZ
1999.5	A	-93	4.8	-81	26.4	9599	-516	-9585	-63772	64490	XYZ
2000.5	A	-93	13.2	-81	27.0	9587	-538	-9571	-63759	64476	XYZ
1998.5	D	-92	58.2	-81	25.8	9615	-498	-9601	-63805	64526	XYZ
1999.5	D	-93	10.7	-81	26.6	9599	-532	-9583	-63796	64514	XYZ
2000.5	D	-93	13.6	-81	27.0	9588	-539	-9572	-63771	64487	XYZ

Casey, Antarctica 2000 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	2000	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	-503.6	-9587.3	-63740.7	64459.9	9601.4	-93° .5'	-81° 26.0'
	5xQ days	-513.8	-9579.1	-63712.7	64430.9	9593.4	-93° 4.3'	-81° 26.2'
	5xD days	-481.4	-9587.6	-63755.0	64474.0	9601.3	-92° 52.5'	-81° 26.2'
February	All days	-524.3	-9580.6	-63745.2	64463.4	9595.5	-93° 8.0'	-81° 26.4'
	5xQ days	-569.8	-9562.1	-63753.5	64469.2	9579.4	-93° 24.6'	-81° 27.3'
	5xD days	-499.8	-9589.9	-63746.2	64465.9	9604.1	-92° 59.3'	-81° 25.9'
March	All days	-532.6	-9573.8	-63749.6	64466.8	9588.9	-93° 11.1'	-81° 26.8'
	5xQ days	-532.4	-9569.9	-63749.6	64466.1	9584.7	-93° 11.1'	-81° 27.0'
	5xD days	-510.4	-9588.2	-63727.6	64447.0	9602.1	-93° 2.9'	-81° 25.9'
April	All days	-544.0	-9576.4	-63774.8	64492.1	9591.9	-93° 15.1'	-81° 26.8'
	5xQ days	-555.9	-9566.7	-63776.2	64492.1	9582.9	-93° 19.6'	-81° 27.3'
	5xD days	-537.9	-9583.2	-63773.0	64491.4	9598.6	-93° 12.8'	-81° 26.4'
May	All days	-546.2	-9571.5	-63774.8	64491.4	9587.2	-93° 16.0'	-81° 27.0'
	5xQ days	-539.9	-9572.2	-63762.6	64479.4	9587.5	-93° 13.7'	-81° 26.9'
	5xD days	-564.4	-9576.9	-63797.9	64515.3	9593.7	-93° 22.3'	-81° 26.9'
June	All days	-554.4	-9564.5	-63775.3	64490.9	9580.7	-93° 19.1'	-81° 27.4'
	5xQ days	-544.5	-9564.4	-63766.5	64482.1	9579.9	-93° 15.5'	-81° 27.4'
	5xD days	-566.6	-9557.8	-63788.3	64503.0	9575.0	-93° 23.6'	-81° 27.8'
July	All days	-562.1	-9556.4	-63774.4	64489.0	9573.2	-93° 22.1'	-81° 27.8'
	5xQ days	-547.8	-9567.1	-63759.4	64475.5	9582.8	-93° 16.6'	-81° 27.2'
	5xD days	-601.8	-9516.3	-63817.7	64526.5	9536.6	-93° 37.4'	-81° 30.1'
August	All days	-554.6	-9566.8	-63775.4	64491.4	9583.0	-93° 19.1'	-81° 27.3'
	5xQ days	-539.0	-9573.5	-63750.6	64467.7	9588.7	-93° 13.4'	-81° 26.8'
	5xD days	-582.1	-9558.6	-63815.5	64530.1	9576.7	-93° 29.1'	-81° 27.9'
September	All days	-544.3	-9566.1	-63773.2	64489.1	9581.9	-93° 15.4'	-81° 27.3'
	5xQ days	-539.3	-9566.9	-63753.4	64469.5	9582.2	-93° 13.6'	-81° 27.1'
	5xD days	-531.6	-9562.0	-63781.3	64496.5	9577.4	-93° 11.0'	-81° 27.6'
October	All days	-538.9	-9568.9	-63769.1	64485.4	9584.5	-93° 13.4'	-81° 27.1'
	5xQ days	-523.9	-9570.8	-63758.7	64475.2	9585.3	-93° 8.0'	-81° 27.0'
	5xD days	-552.3	-9571.4	-63812.1	64528.6	9588.3	-93° 18.1'	-81° 27.3'
November	All days	-518.5	-9573.8	-63734.2	64451.6	9588.8	-93° 6.1'	-81° 26.6'
	5xQ days	-501.9	-9570.2	-63729.1	64445.7	9583.5	-93° .2'	-81° 26.9'
	5xD days	-541.2	-9578.5	-63724.2	64443.0	9595.6	-93° 14.1'	-81° 26.2'
December	All days	-536.8	-9566.6	-63721.5	64438.0	9582.3	-93° 12.7'	-81° 26.9'
	5xQ days	-540.6	-9558.4	-63711.8	64427.1	9573.9	-93° 14.3'	-81° 27.3'
	5xD days	-502.9	-9590.3	-63707.4	64427.4	9604.3	-93° .2'	-81° 25.6'
Annual Mean Values	All days	-538.3	-9571.1	-63759.0	64475.8	9586.6	-93° 13.2'	-81° 27.0'
	5xQ days	-537.4	-9568.4	-63748.7	64465.0	9583.7	-93° 12.9'	-81° 27.0'
	5xD days	-539.4	-9571.7	-63770.5	64487.4	9587.8	-93° 13.6'	-81° 27.0'

(Calculated: 12:24 hrs., Fri. 16 Aug. 2002)

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.

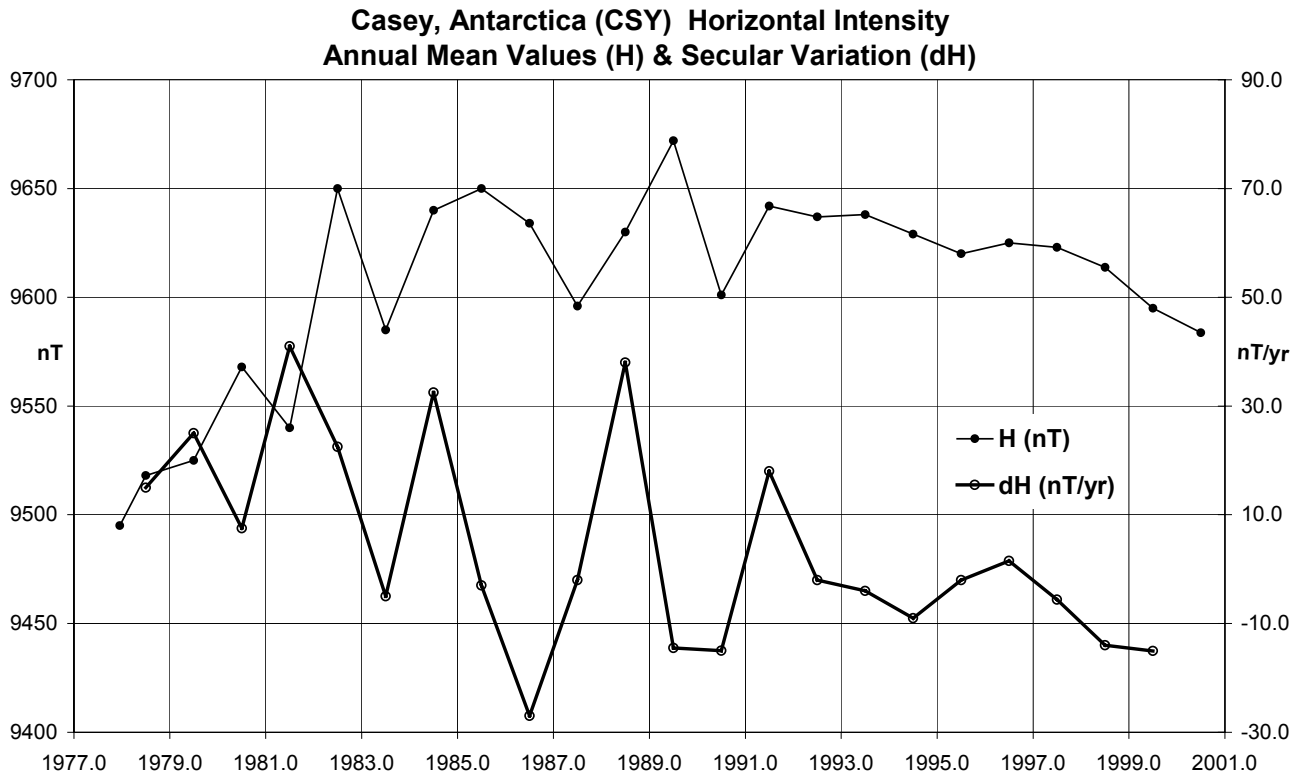
The mean value given at the top of each plot is the *all-days* annual mean value of the element.

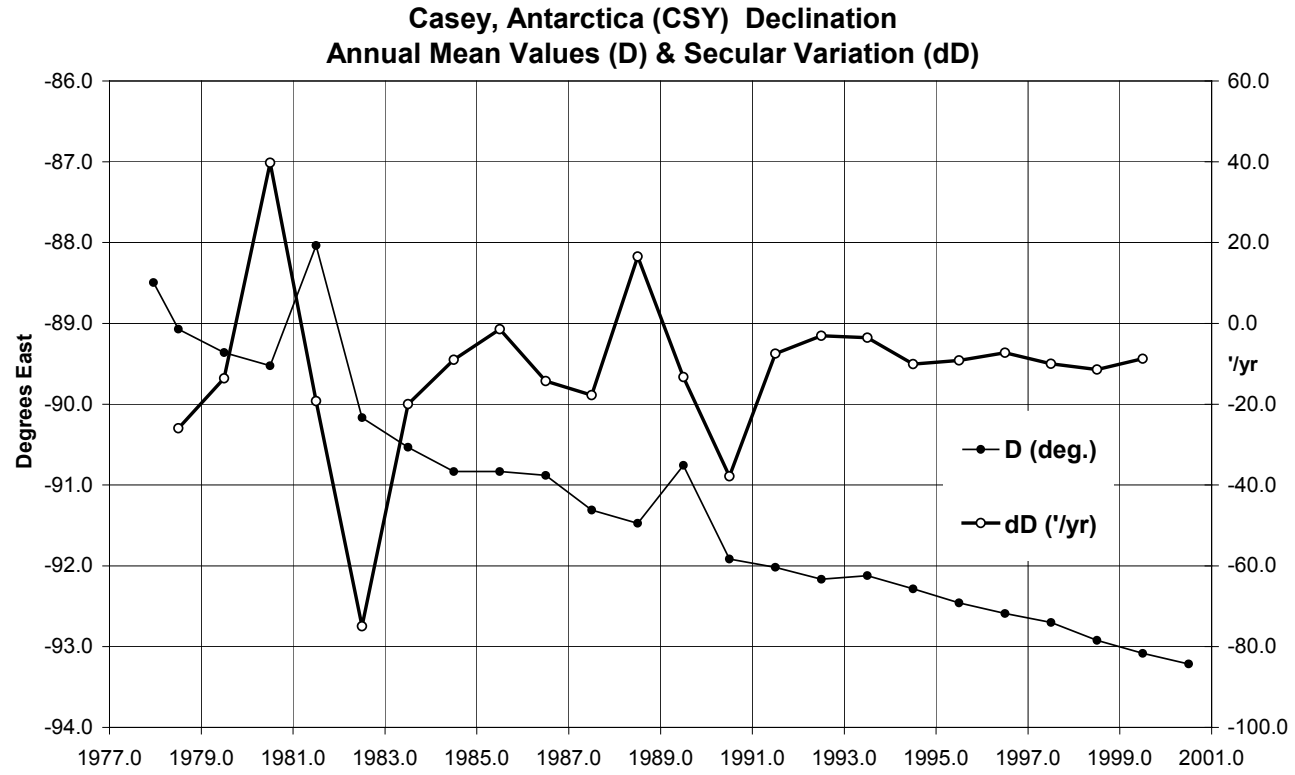

Casey Stn. 2000 Horizontal intensity (H). Scale: 25.0 nT/mm. Mean: 9587 nT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
Feb.
500nT
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

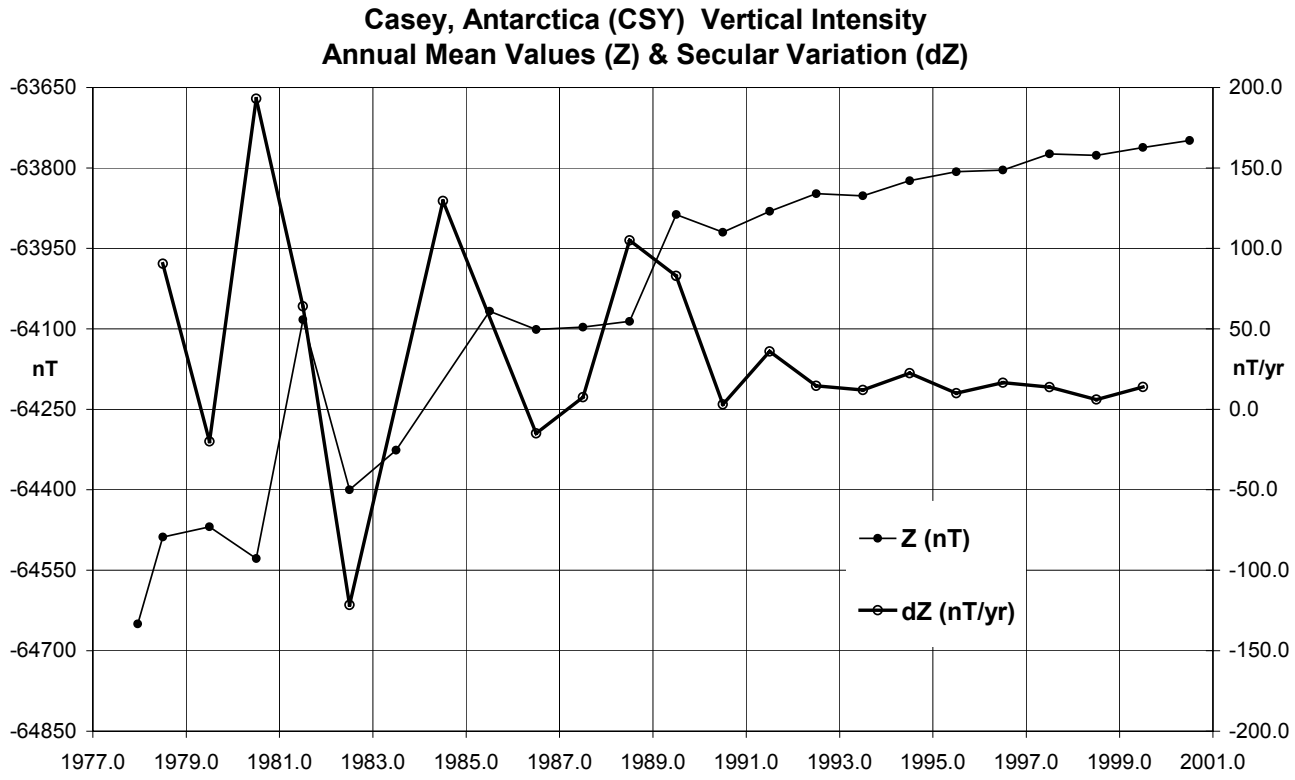
Casey Stn. 2000 Declination (east) (D). Scale: 10.0 min/mm. Mean: −93.22 deg.

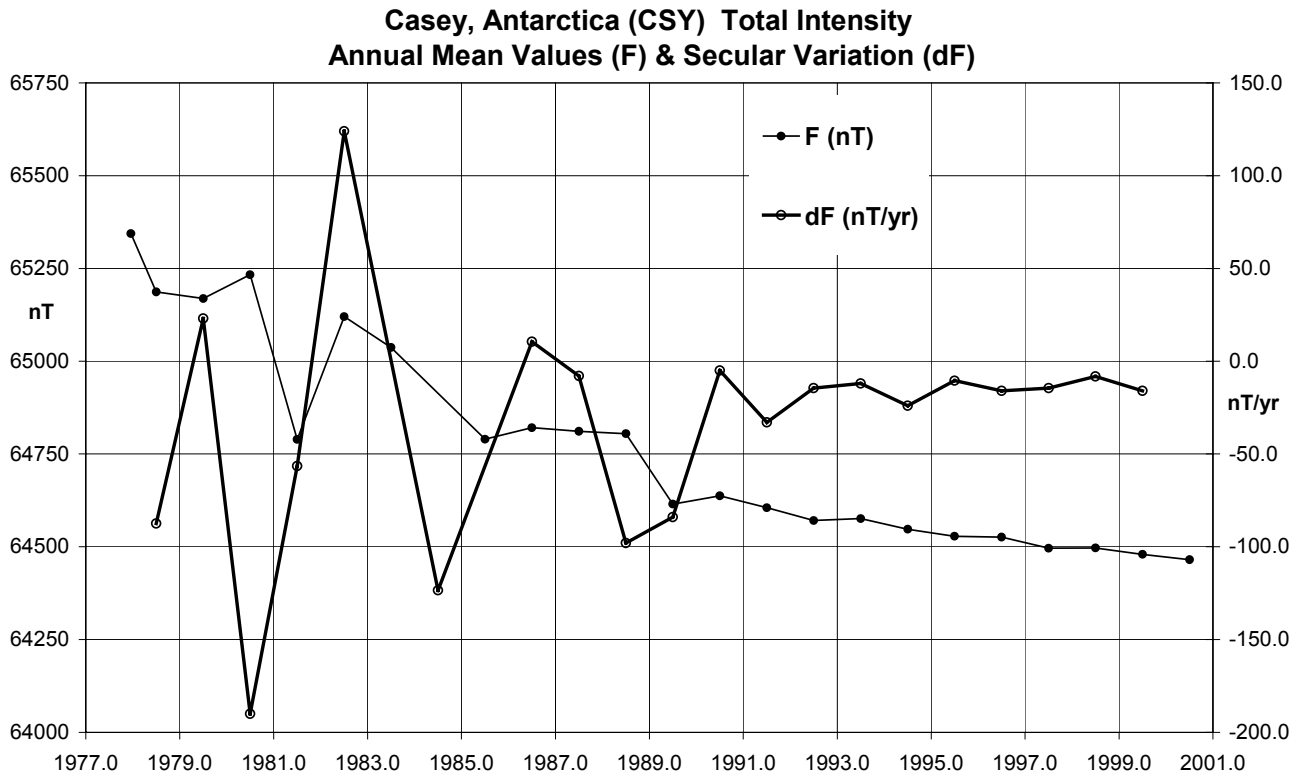

Casey Stn. 2000 Vertical intensity (Z). Scale: 25.0 nT/mm. Mean: −63759 nT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
500nT
Feb.
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31


Casey Stn. 2000 Total intensity (F). Scale: 25.0 nT/mm. Mean: 64476 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.
Mar.
500nT
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, Antarctica (CSY) Horizontal Intensity
Annual Mean Values (H) & Secular Variation (dH)
9700
9650
9600
9550
9500
9450
9400
nT
90.0
70.0
50.0
30.0
10.0
-10.0
-30.0
nT/yr
H (nT)
dH (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


Casey, Antarctica (CSY) Declination
Annual Mean Values (D) & Secular Variation (dD)
-86.0
-87.0
-88.0
-89.0
-90.0
-91.0
-92.0
-93.0
-94.0
Degrees East
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
'/yr
D (deg.)
dD ('/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


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


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

Casey 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 2000.

Significant Events: CSY, 2000

Jan 04 a GPS Truetime clock replaced the Austron clock. The GPS clock was consistent with VNG HF 16.000MHz time signals.

May Problems with the no-break power supply developed so the recording equipment was connected to unprotected power supply.

Jul 01 A replacement UPS was installed and recording was once again connected to uninterruptible power.

Distribution of CSY data during 2000

Preliminary Monthly Means for Project Ørsted

- IPGP monthly (by e-mail): None sent in 2000.

1-minute & Hourly Mean Values

- None sent in 2000.

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

Data losses: CSY, 2000

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

Jan 04 0345-0347 (3m)
Jan 08 0601-0615 (15m); 0643 (1m)
Jan 16 1114 to 17/0052 (13h 39m)
Feb 23 0022 (1m); 0138-0139 (2m)
Mar 15 2236-2359 (1h 24m)
Mar 16 0515-0536 (22m); 0611-0714 (1h 04m); 0718-0721 (4m)
Mar 17 0911 to 18/0048 (15h 38m)
Apr 04 0041-0104 (24m)
Apr 06 0801-1009 (2h 09m)
Apr 07 0153-0205 (13m)
Apr 08 0116-0177 (2m)
Apr 19 1001-1256 (2h 56m)
Apr 20 0045-0117 (33m)
May 02 0929-0943 (15m)
May 03 0901-1007 (1h 07m)
May 04 0817 (1m)
May 08 0219-0300 (42m)
May 10 0957 (1m)
May 16 0002-0049 (48m)
May 22 0524-0607 (44m)
May 24 0147-0152 (6m)
May 26 0515-0823 (3h 09m); 0848-0910 (23m); 1555-2359 (8h 05m)
May 28 2157 (1m); 2159 (1m)
May 31 0719-0721 (3m)
Jun 03 1221 (1m); 1834 to 04/0527 (10h 54m)
Jun 04 0639 (1m)
Jul 01 0017-0114 (58m)
Oct 01 0100-0103 (4m)
Dec 21 0320-0415 (56m)

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: -76.39°
- Geomagnetic† longitude: 127.67°
- 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: Darron Lehmann (AAD)

† Based on the IGRF 2000 model.

Magnetometers

An EDA FM105B fluxgate variometer, with the data acquired by PC, operated at Davis. Together with the DIMs used for absolute observations, the instruments 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.

Operations

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).

A DIM was sent (from Mawson) during the 1999/2000 summer. This instrument was used in place of the QHM 492 which had been during the second half of 1999. Two sets of absolute observations were performed on one day each month.

The absolute PPM had an IC replaced in August that was causing it to behave erratically.

Heavy machinery was used in the vicinity of the magnetic quiet zone for LIDAR installation, on 01-04, 08, 16 & 28 November 2000.

Distribution of DVS data during 2000

Preliminary Monthly Means for Project Ørsted

- IPGP monthly (by e-mail): None sent in 2000.

Annual & Monthly Mean Values

- None sent in 2000.

Inquiries for variation data from Davis should be directed to the Atmospheric and Space Physics Section of the Australian Antarctic Division, Channel Highway, Kingston, Tasmania.

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 107-108.

Year	Days	D		I		H	X	Y	Z	F	Elts*
		(Deg	Min)	(Deg	Min)	(nT)	(nT)	(nT)	(nT)	(nT)	
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
2000.5	Q	-78	47.0	-72	1.1	16765	3261	-16444	-51654	54306	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
2000.5	A	-78	47.4	-72	1.7	16759	3258	-16439	-51664	54314	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
2000.5	D	-78	48.8	-72	2.6	16751	3250	-16432	-51685	54332	XYZ

Davis, Antarctica 2000 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	2000	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D (East)	I
January	All days	3296.9	-16445.6	-51661.4	54316.1	16773.1	-78° 39.9'	-72° .8'
	5xQ days	3296.2	-16456.7	-51653.4	54311.8	16783.7	-78° 40.4'	-71° 60.0'
	5xD days	3292.4	-16435.7	-51666.4	54317.8	16762.7	-78° 40.4'	-72° 1.5'
February	All days	3286.3	-16446.0	-51662.5	54316.7	16771.3	-78° 42.0'	-72° .9'
	5xQ days	3269.1	-16437.9	-51640.9	54292.5	16759.9	-78° 45.1'	-72° 1.2'
	5xD days	3299.9	-16441.9	-51685.8	54338.5	16770.2	-78° 39.1'	-72° 1.4'
March	All days	3278.3	-16443.8	-51660.4	54313.4	16767.5	-78° 43.5'	-72° 1.1'
	5xQ days	3272.3	-16439.6	-51653.6	54305.3	16762.1	-78° 44.6'	-72° 1.3'
	5xD days	3296.3	-16465.3	-51681.7	54341.3	16792.2	-78° 40.8'	-72° .0'
April	All days	3262.2	-16438.0	-51680.8	54330.1	16758.7	-78° 46.5'	-72° 2.0'
	5xQ days	3254.7	-16432.1	-51658.6	54306.7	16751.4	-78° 47.8'	-72° 2.0'
	5xD days	3268.0	-16439.4	-51697.2	54346.6	16761.2	-78° 45.4'	-72° 2.2'
May	All days	3255.0	-16431.3	-51675.2	54322.3	16750.7	-78° 47.7'	-72° 2.4'
	5xQ days	3269.6	-16440.0	-51666.0	54317.0	16762.0	-78° 45.1'	-72° 1.5'
	5xD days	3230.4	-16418.0	-51706.2	54346.4	16732.9	-78° 52.2'	-72° 4.1'
June	All days	3236.9	-16423.4	-51668.6	54312.6	16739.5	-78° 51.0'	-72° 2.9'
	5xQ days	3254.8	-16439.6	-51654.6	54305.2	16758.7	-78° 48.1'	-72° 1.5'
	5xD days	3202.6	-16391.4	-51690.3	54321.7	16701.7	-78° 56.7'	-72° 5.6'
July	All days	3230.7	-16423.6	-51662.4	54306.4	16738.4	-78° 52.3'	-72° 2.9'
	5xQ days	3245.5	-16434.4	-51658.3	54306.6	16751.9	-78° 49.7'	-72° 2.0'
	5xD days	3194.5	-16395.6	-51662.4	54296.0	16704.3	-78° 58.5'	-72° 4.9'
August	All days	3231.8	-16427.0	-51675.3	54319.8	16742.0	-78° 52.2'	-72° 2.9'
	5xQ days	3245.5	-16442.8	-51659.5	54310.2	16760.0	-78° 50.1'	-72° 1.5'
	5xD days	3196.8	-16396.8	-51709.1	54340.9	16705.8	-78° 58.1'	-72° 5.7'
September	All days	3242.7	-16430.5	-51679.3	54325.3	16747.5	-78° 50.2'	-72° 2.7'
	5xQ days	3243.9	-16440.7	-51668.5	54318.1	16757.7	-78° 50.3'	-72° 1.8'
	5xD days	3252.9	-16434.9	-51699.1	54346.3	16753.9	-78° 48.3'	-72° 2.7'
October	All days	3251.8	-16441.4	-51672.6	54322.8	16760.1	-78° 48.8'	-72° 1.8'
	5xQ days	3256.5	-16448.1	-51666.3	54319.0	16767.4	-78° 48.1'	-72° 1.2'
	5xD days	3250.8	-16422.4	-51711.2	54353.9	16741.7	-78° 48.2'	-72° 3.6'
November	All days	3261.4	-16456.1	-51649.6	54305.9	16776.5	-78° 47.4'	-72° .3'
	5xQ days	3263.6	-16461.2	-51644.8	54302.9	16781.7	-78° 47.2'	-71° 59.9'
	5xD days	3235.4	-16460.1	-51665.5	54321.2	16776.0	-78° 52.9'	-72° .7'
December	All days	3261.3	-16457.6	-51623.6	54281.7	16777.8	-78° 47.5'	-71° 59.7'
	5xQ days	3258.4	-16457.7	-51619.9	54277.9	16777.3	-78° 48.1'	-71° 59.7'
	5xD days	3279.2	-16485.1	-51647.8	54314.1	16808.4	-78° 45.0'	-71° 58.4'
Annual Mean Values	All days	3257.9	-16438.7	-51664.3	54314.4	16758.6	-78° 47.4'	-72° 1.7'
	5xQ days	3260.8	-16444.2	-51653.7	54306.1	16764.5	-78° 47.0'	-72° 1.1'
	5xD days	3249.9	-16432.2	-51685.2	54332.1	16750.9	-78° 48.8'	-72° 2.6'

(Calculated: 12:56 hrs., Fri. 16 Aug. 2002)

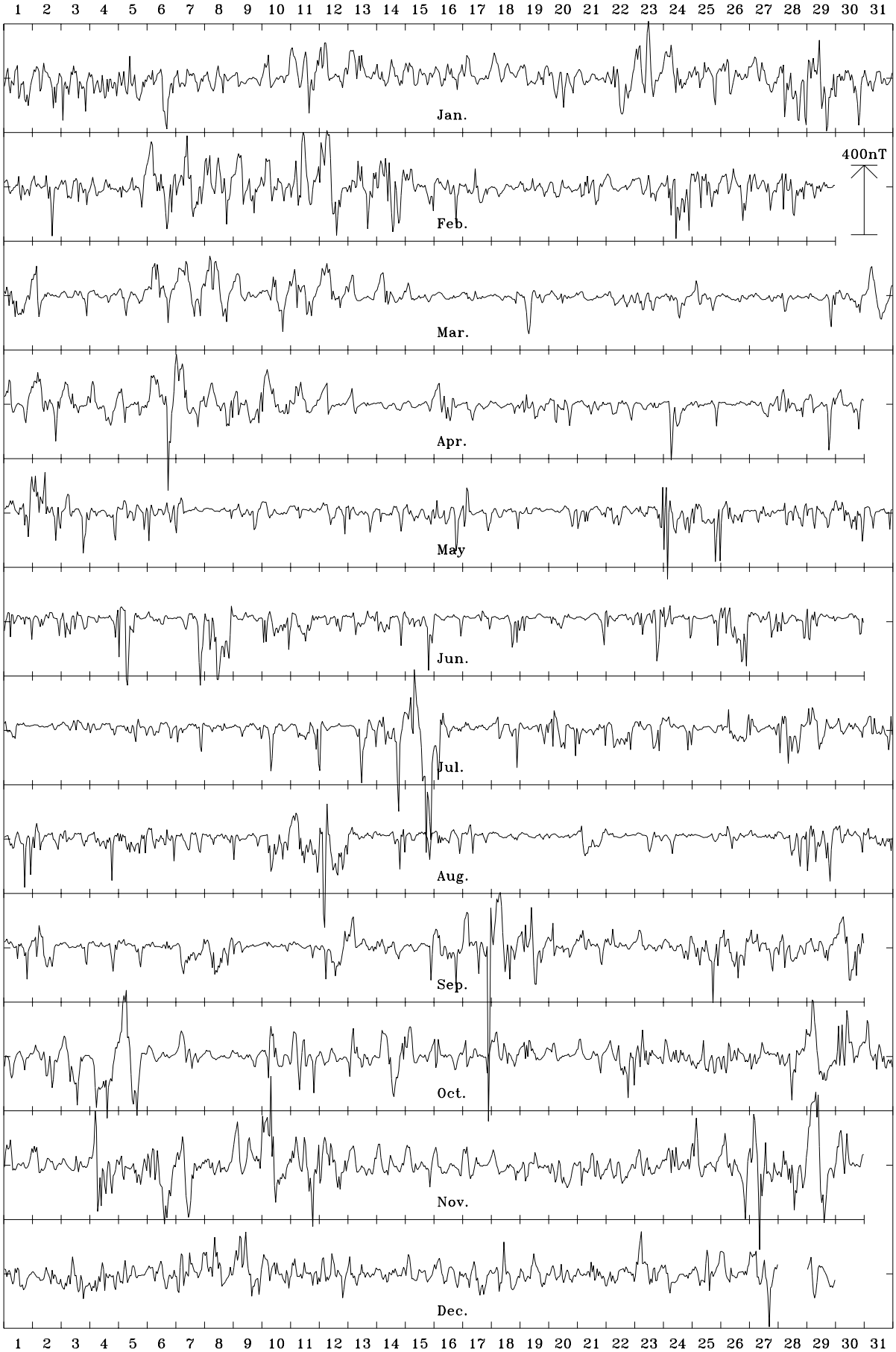
Hourly Mean Values

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

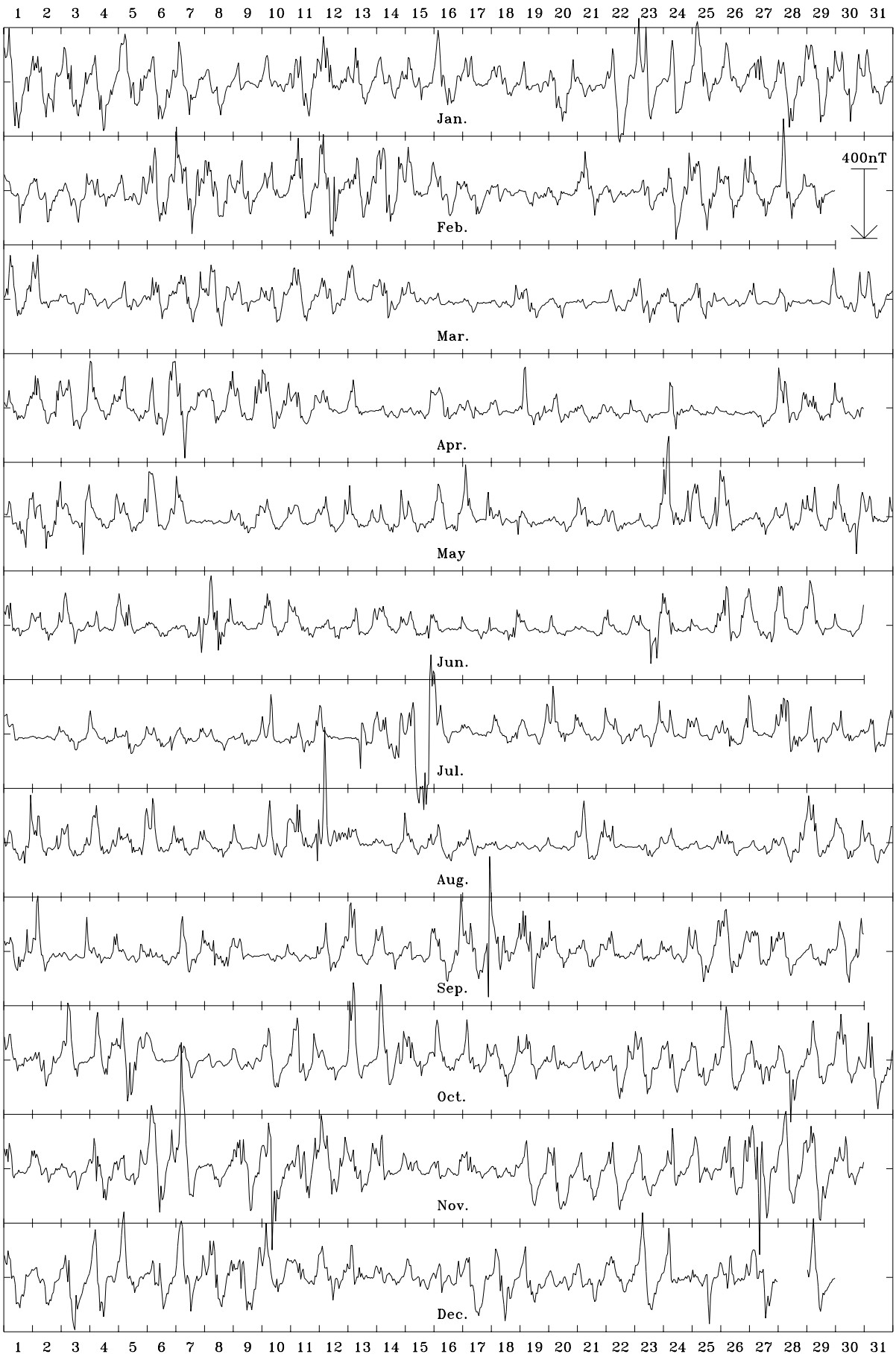
The reference levels indicated with marks on the vertical axes refer to the *all-days* mean value for the respective months. All elements in the plots are shown increasing (algebraically) towards the top of the page, with the exception of Z, which is in the opposite sense.

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

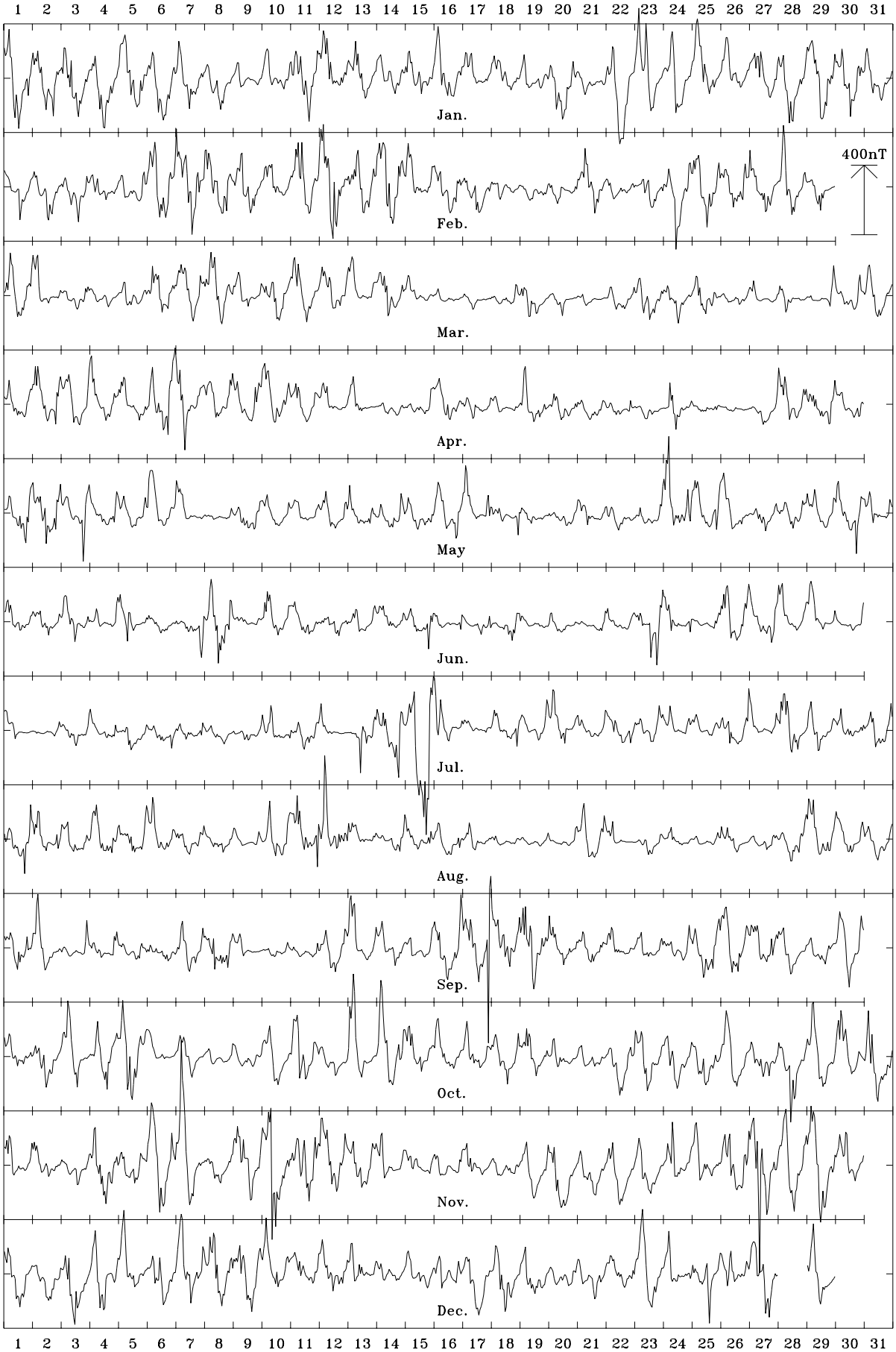
Davis Stn. 2000 Horizontal intensity (H). Scale: 30.0 nT/mm. Mean: 16759 nT

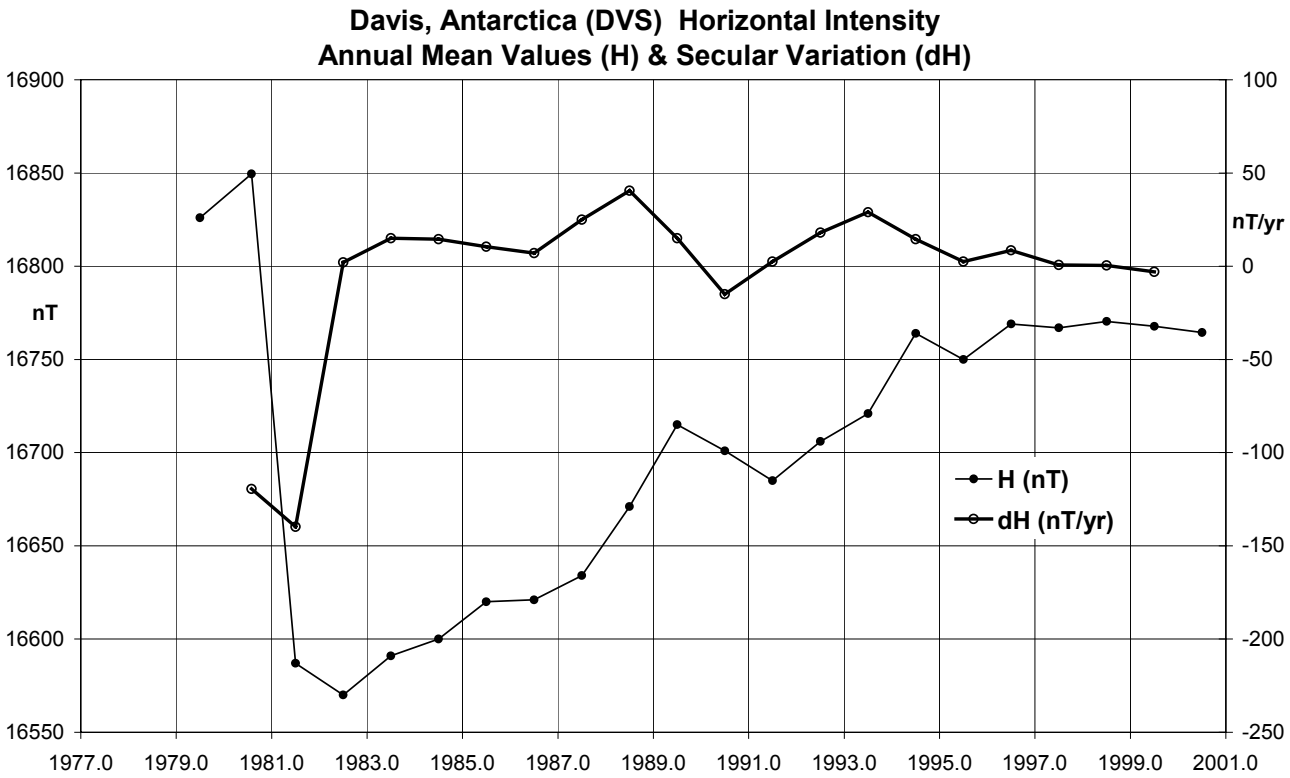


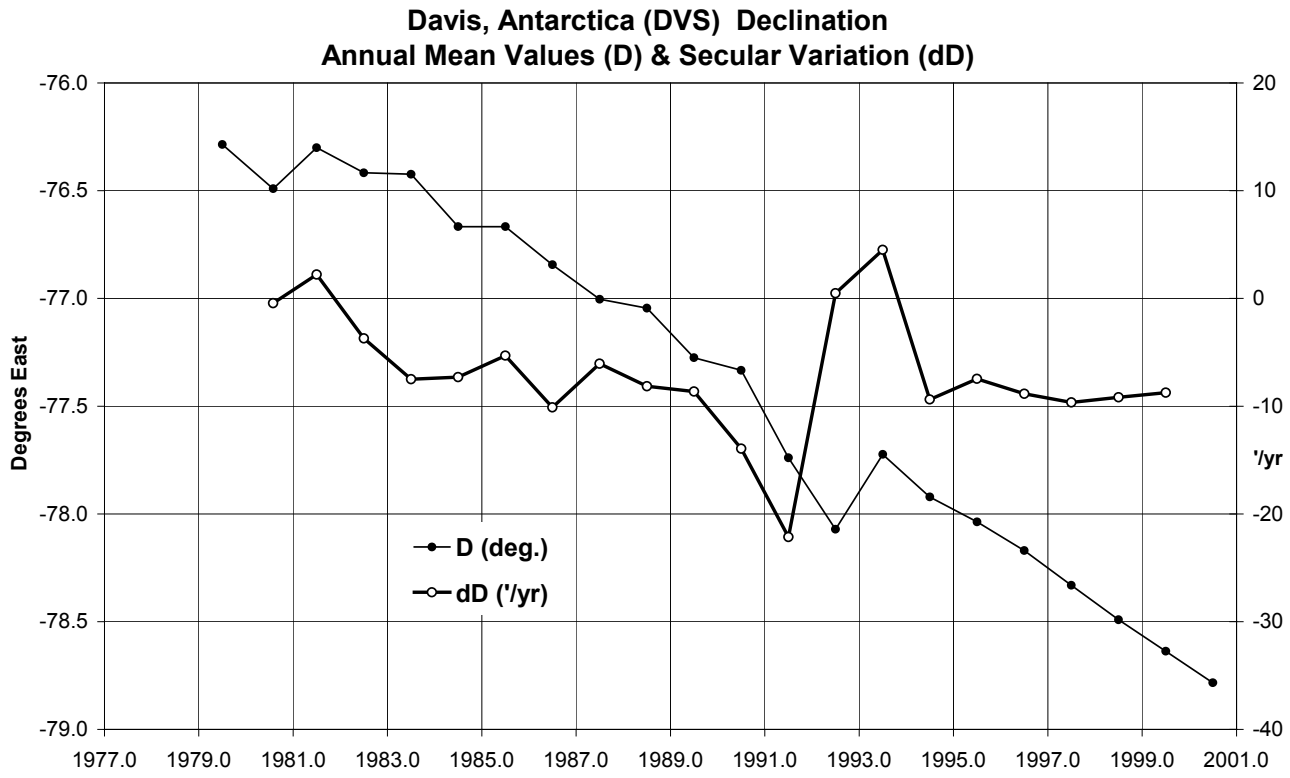
Davis Stn. 2000 Declination (east) (D). Scale: 6.00 min/mm. Mean: −78.79 deg.

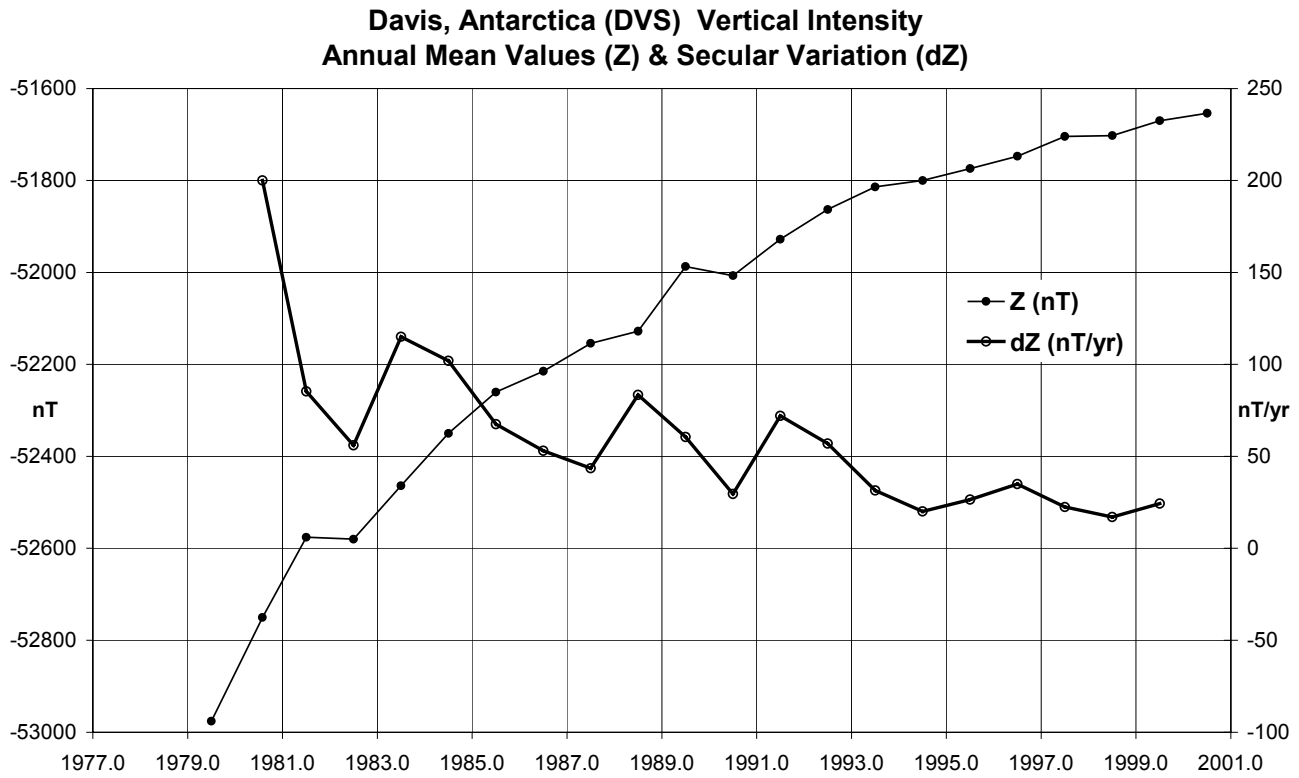

Davis Stn. 2000 Vertical intensity (Z). Scale: 30.0 nT/mm. Mean: −51664 nT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Jan.
400nT
Feb.
Mar.
Apr.
May
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

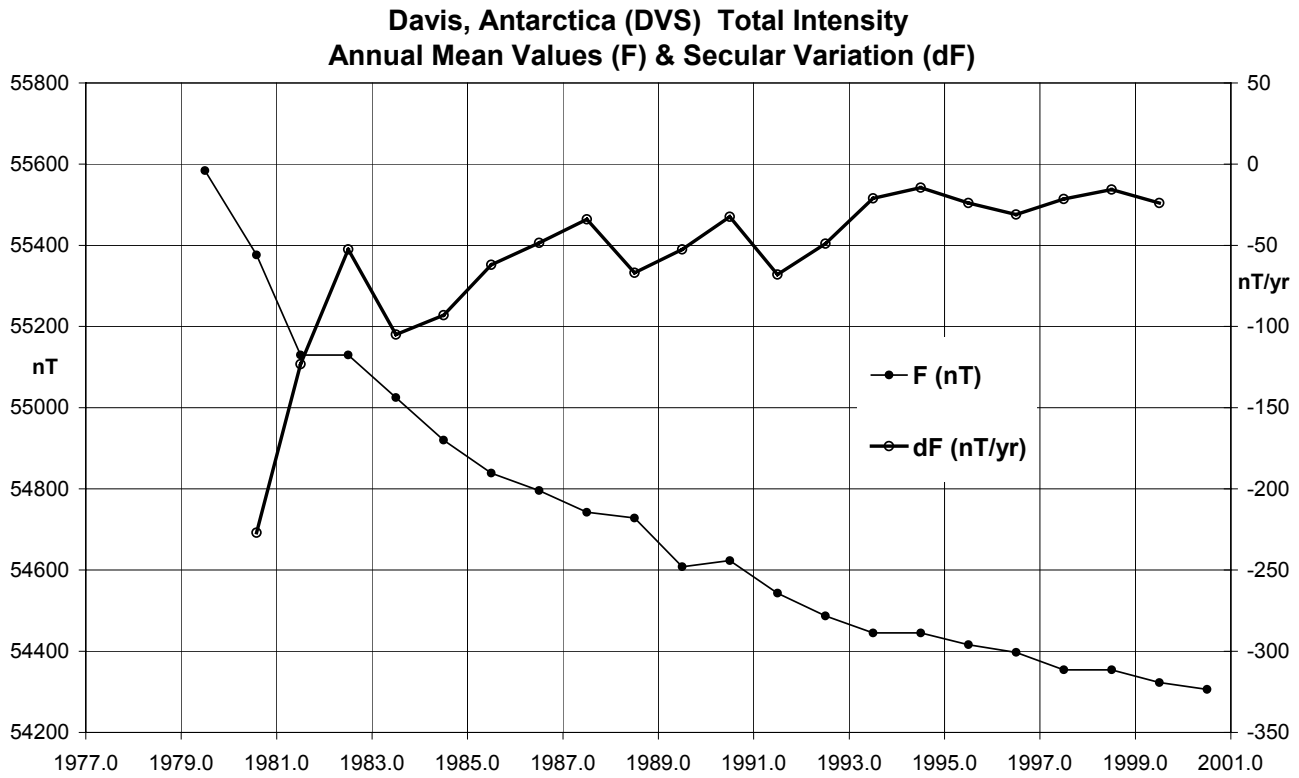
Davis Stn. 2000 Total intensity (F). Scale: 30.0 nT/mm. Mean: 54314 nT




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 2000

The table below summarizes the 2000 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.

2000	ASP	CNB	CTA	GNA	KDU	LRM	MAW	MCQ	CSY
Jan	0	1 (0)	1	29	0	0	0	0	838
Feb	0	2 (4)	0	0 (12)	6799	0	0 (5610)	1	3
Mar	0	17 (0)	0	0	801	0	0 (486)	0	1112
Apr	0	0	0	0 (2172)	15852	64	0	0	377
May	1	0	464	0	4019	1129	5589	0	926
Jun	6	0	393	0	11	19,290	1875 (1)	0	656
Jul	2	0	593	3999 (4000)	0	0	0	0	58
Aug	0	0	188 (55)	2	0	24	0	0	0
Sep	0	0	0	0	0	240	420 (1685)	0	0
Oct	0	0	40 (0)	0	17,460	0	0	0	4
Nov	0	0	6236 (15840)	18784	0	0	0	0	0
Dec	0	0	724 (6682)	5803 (5804)	0	0	0	1215 (1214)	56
3-axis variom.	9 (0.002%)	20 (0.004%)	8,639 (1.64%)	28,617 (5.43%)	44,942 (8.53%)	20,747 (3.95%)	7,884 (1.50%)	1,216 (0.23%)	4,030 (0.76%)
Total field	9 (0.002%)	4 (0.001%)	24,028 (4.56%)	30,803 (5.84%)	34,411 (6.53%)	20,747 (3.95%)	13,371 (2.54%)	1,215 (0.23%)	no PPM

2000 International Quiet & Disturbed Days

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

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 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.

A Bartington MAG-03MS100 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 a PAR24B 24 bit A/D converter and recorded as 1-second and 1-minute means with a laptop computer. A GEM Systems GSM90 overhauser effect total field magnetometer was used to monitor the total magnetic intensity. The digital output from the total field magnetometer was recorded at a sampling interval of 10 seconds.

The 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 2000 were Elsec 810 DIM, no. 220 with Zeiss 020B theodolite, no. 308887, and GEM Systems GSM90 no. 810881 with sensor no. 81301. The GSM90 was also used for GPS-positioned total field surveys around each station.

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

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

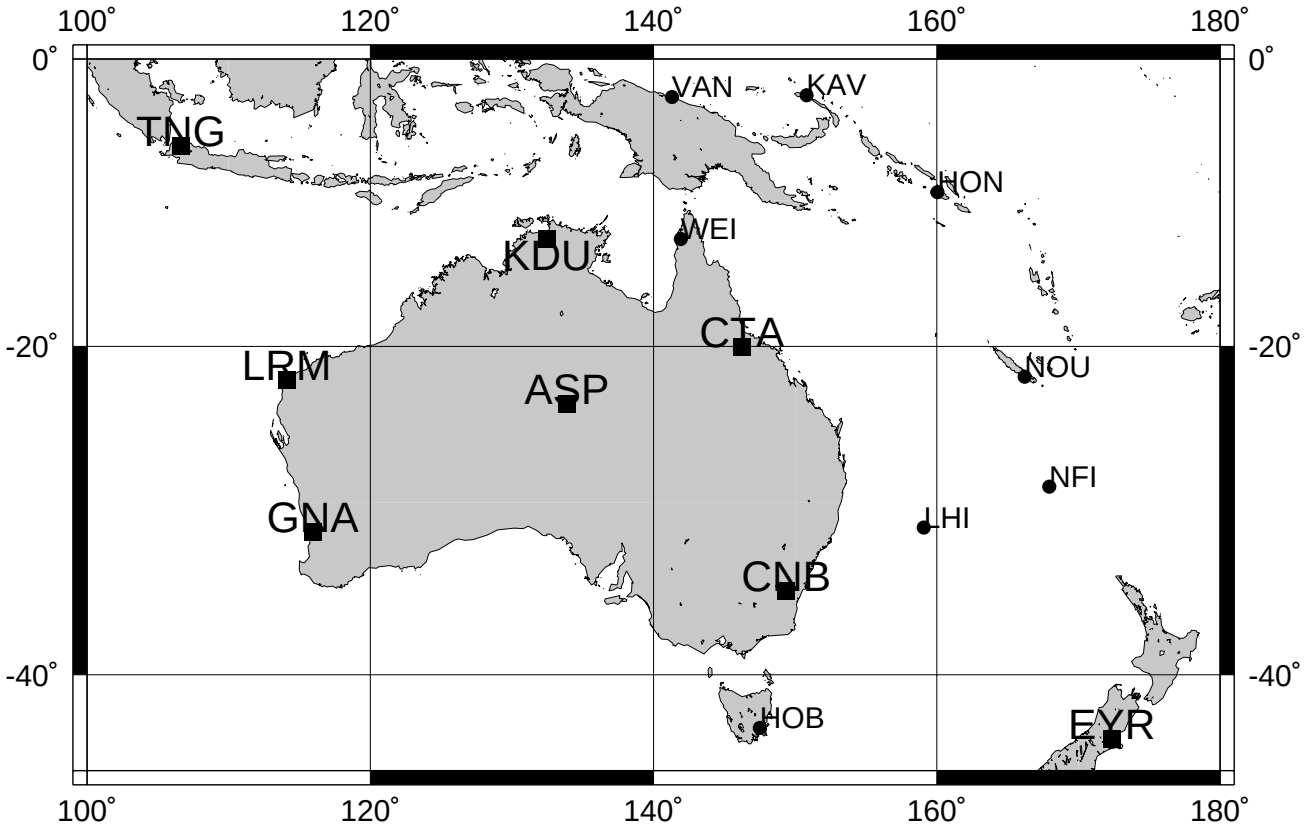
As the repeat stations are located in areas that are distant from the permanent magnetic observatories, the secular variation information gained at these sites provides valuable infill data in the areas between the permanent observatories.

Station occupations in 2000

Eight repeat stations were re-occupied in 2000 - Hobart (HOB), Norfolk Island (NFI), Weipa (WEI), Lord Howe Island (LHI), Noumea (NOU), Honiara (HON), Kavieng (KAV) and Vanimo (VAN). The figure below shows the location of these repeat stations with the permanent magnetic observatories in the region. The results of the 2000 and earlier occupations of these stations are shown in the figures that follow the text.

The adopted normal field values at the time of occupation and the average secular variation over the interval between the two most recent occupations for each station are shown in the tables below. The occupation of Vanimo was the first since 1973. The original station could not be re-located so two new stations (a (B and C) were established at Vanimo airport. Secular variation data will be available from Vanimo after the next occupation of that station.

The distribution of permanent magnetic observatories and repeat stations occupied in 2000



Adopted Main Field Values at Time of Station Occupations

Station (site)	Occupation	X (nT)	Y (nT)	Z (nT)	F (nT)	H (nT)	D	I
Hobart (H)	23–27 Mar 2000	17806	4687	-59346	62137	18412	14° 44.8′	-72° 45.8′
Norfolk Island (B)	29-31 Mar 2000	27640	7516	-43082	51735	28644	15° 12.7′	-56° 22.9′
Weipa (B)	03-06 Apr 2000	35469	3515	-29710	46402	35643	05° 39.6′	-39° 48.8′
Lord Howe Is. (D)	08-10 Apr 2000	25327	6688	-48027	54706	26195	14° 47.6′	-61° 23.5′
Noumea (B)	10-13 May 2000	31416	7065	-35689	48069	32201	12° 40.4′	-47° 56.5′
Honiara (B)	17-20 May 200	35011	5730	-20518	40983	35477	09° 17.7′	-30° 02.6′
Kavieng (C)	22-25 May 2000	36288	3997	-13446	38904	36507	06° 17.1′	-20° 13.2′
Vanimo (B)	28 May–01 Jun 00	37055	2757	-14833	40008	37157	04° 15.3′	-21° 45.7′

Average Secular Variation between two most recent Occupations

Station (site)	Previous occupation	ΔX (nT/yr)	ΔY (nT/yr)	ΔZ (nT/yr)	ΔF (nT/yr)	ΔH (nT/yr)	ΔD (′/yr)	ΔI (′/yr)
Hobart (H)	1998	14.8	8.3	38.4	-31.8	16.4	0.8	1.5
Norfolk Island (B)	1998	-6.3	-17.3	44.4	-42.8	-10.6	-1.8	1.0
Weipa (B)	1998	0.4	-4.1	59.7	-38.2	0.0	-0.4	3.4
Lord Howe Is. (D)	1998	-11.9	-13.4	42.1	-44.1	-14.9	-1.3	0.4
Noumea (B)	1997	-11.9	-28.6	39.1	-41.0	-17.9	-2.7	0.9
Honiara (B)	1997	-11.2	-34.2	49.2	-39.0	-16.6	-3.1	2.8
Kavieng (C)	1993	-1.9	-11.5	63.8	-24.9	-3.1	-1.1	5.2
*** Vanimo (B)**	-	-	-	-	-	-	-	-

* No secular variation could be calculated for Vanimo B as the 2000 occupation was the first at this station.

Australian Geomagnetic Reference Field

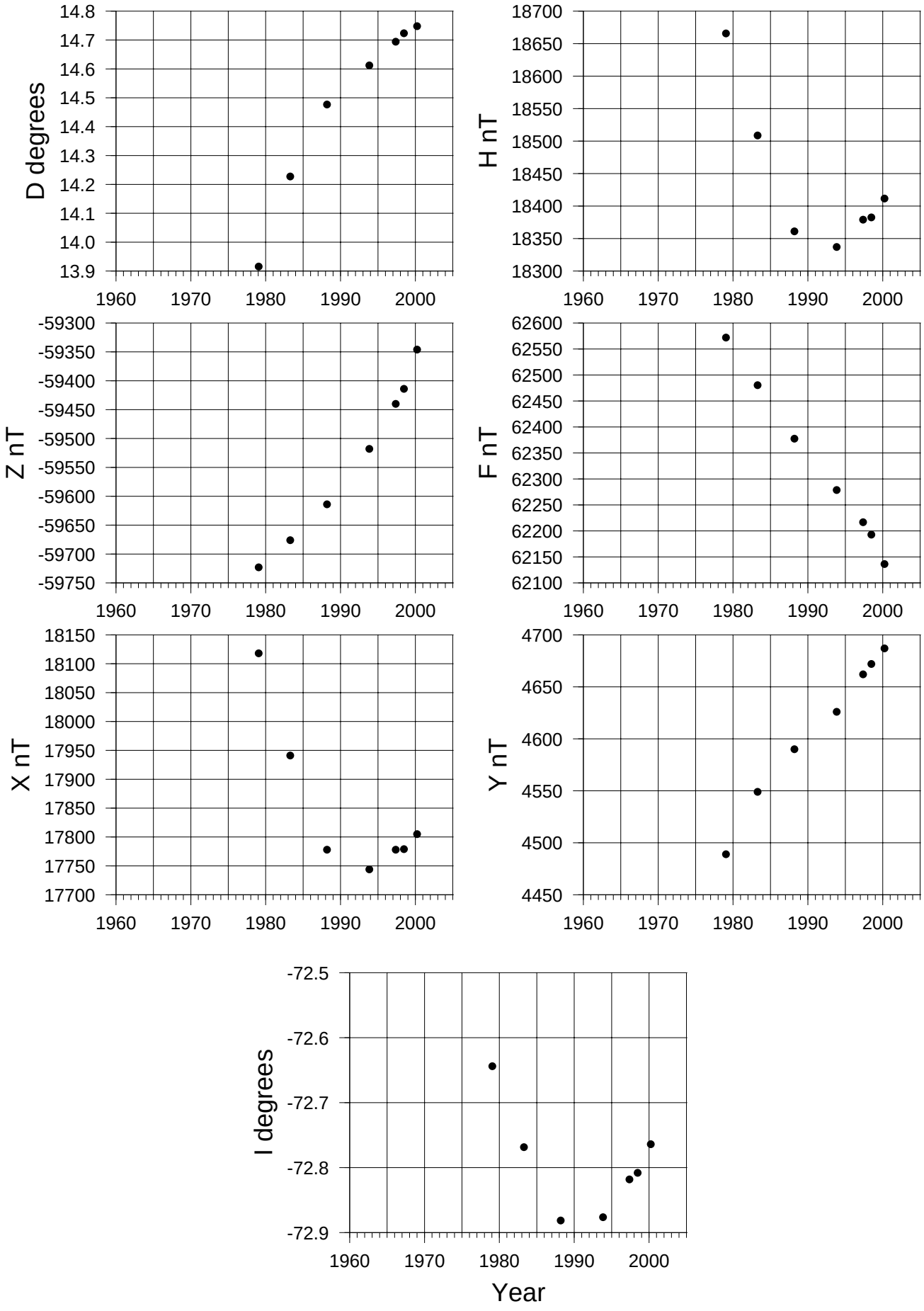
The 2000 revision of the Australian Geomagnetic Reference Field (AGRF00) was released in 2000 (Lewis, 2000). It is a harmonic model of the geomagnetic field over a spherical cap shaped region of radius 28° centred on latitude 24°S and longitude 135°E. AGRF00 models the magnetic field originating from the Earth's core and long wavelength crustal sources, and includes shorter wavelength information than global field models such as the International Geomagnetic Reference Field (IGRF). AGRF00 is considered the best available geomagnetic field model for direction-finding applications in the Australian region.

The main field model in AGRF00 is based on an extensive data set comprising all available vector survey data from the modelled area. The data includes GA's Third Order ground survey, MAGSAT satellite data, the U.S. Navy's Project Magnet high elevation aeromagnetic surveys, and magnetic observatory and repeat station data for the region. The secular variation model in AGRF00 is based on geomagnetic observatory and repeat station data.

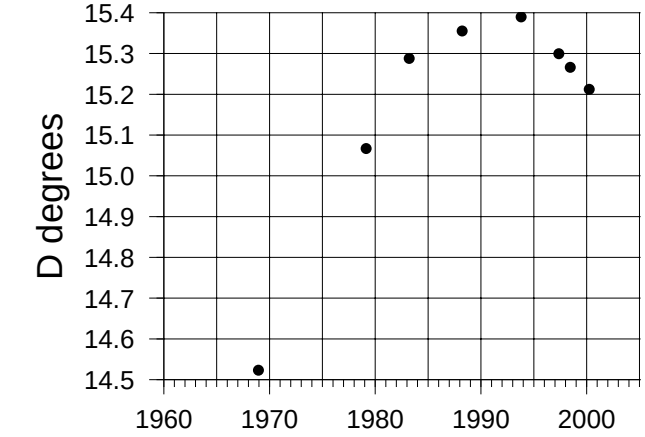
The figures that follow the individual station secular variation plots show main field and secular variation contours of the geomagnetic field in the Australian region. The contours are derived from the AGRF00 model within a 24° spherical cap area. The 24° cap is considered the safe region in which AGRF is free from edge-effects. The cap outline is marked on the charts as a circular boundary. Outside this cap area the contours are derived from the IGRF 2000 model. The magnetic contours are in units of nanoTesla and nanoTesla per year for magnitude elements (X,Y,Z,F,H) and degrees and minutes-of-arc per year for the angular elements (D,I). The main field is contoured in solid lines while the secular variation is dashed lines.

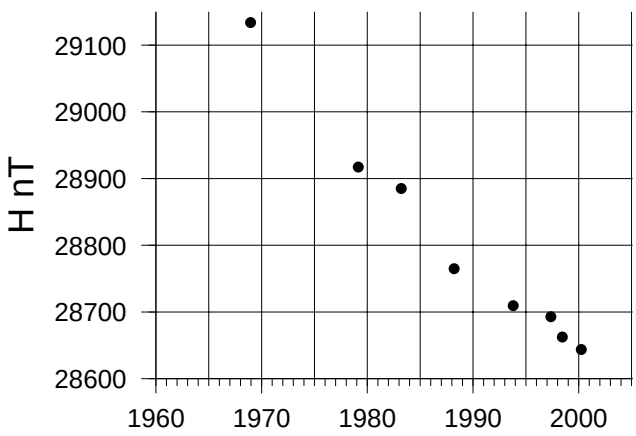
Epoch charts over the region have been produced on a regular basis since 1944. An Australian Geomagnetic Reference Field model (AGRF) has been produced every five years since 1980. These were listed in the *Charts and Models* table that appeared in *AGRs 1993-1997*.

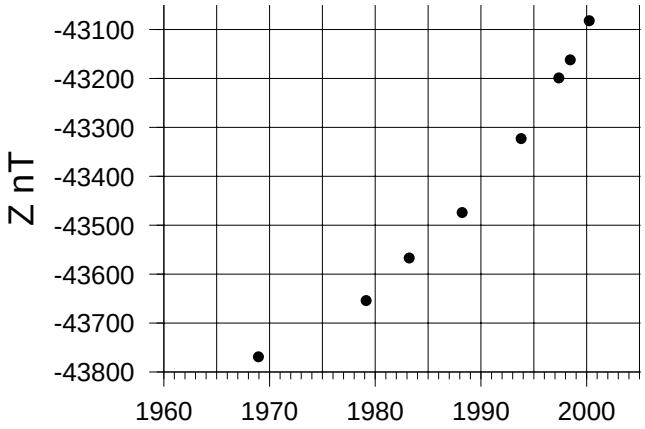
HOB

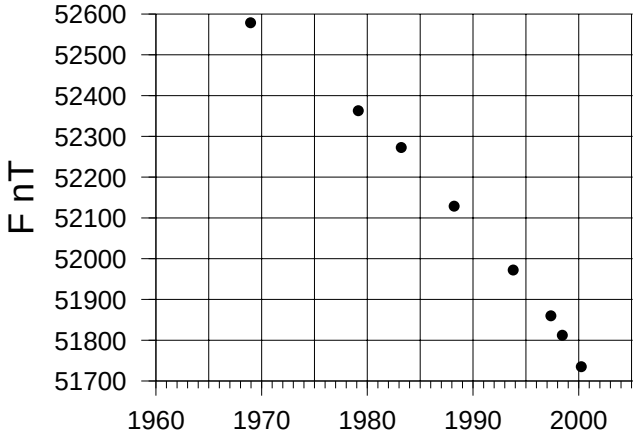

D degrees
14.8
14.7
14.6
14.5
14.4
14.3
14.2
14.1
14.0
13.9
H nT
18700
18650
18600
18550
18500
18450
18400
18350
18300
Z nT
-59300
-59350
-59400
-59450
-59500
-59550
-59600
-59650
-59700
-59750
F nT
62600
62550
62500
62450
62400
62350
62300
62250
62200
62150
62100
X nT
18150
18100
18050
18000
17950
17900
17850
17800
17750
17700
Y nT
4700
4650
4600
4550
4500
4450
I degrees
-72.5
-72.6
-72.7
-72.8
-72.9
1960
1970
1980
1990
2000
Year

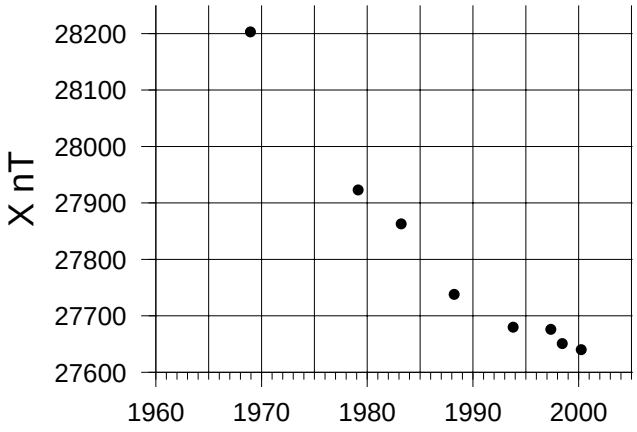
NFI

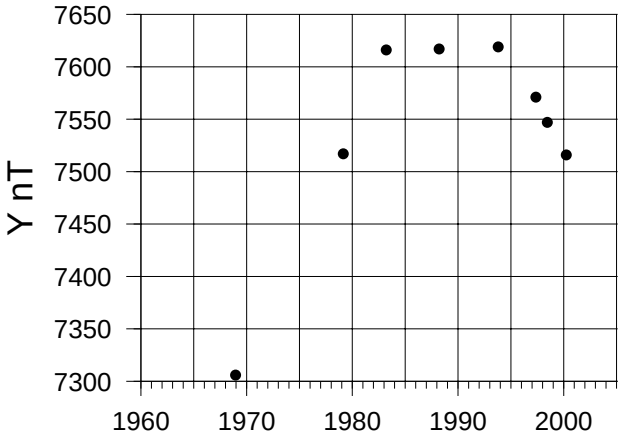

D degrees
15.4
15.3
15.2
15.1
15.0
14.9
14.8
14.7
14.6
14.5
1960
1970
1980
1990
2000

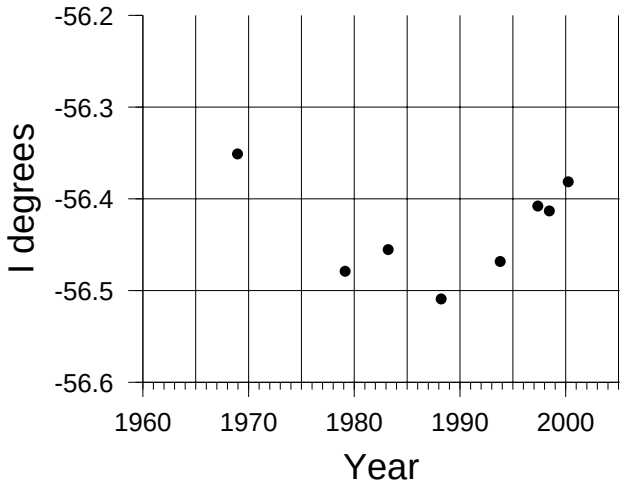

H nT
29100
29000
28900
28800
28700
28600
1960
1970
1980
1990
2000


Z nT
-43100
-43200
-43300
-43400
-43500
-43600
-43700
-43800
1960
1970
1980
1990
2000

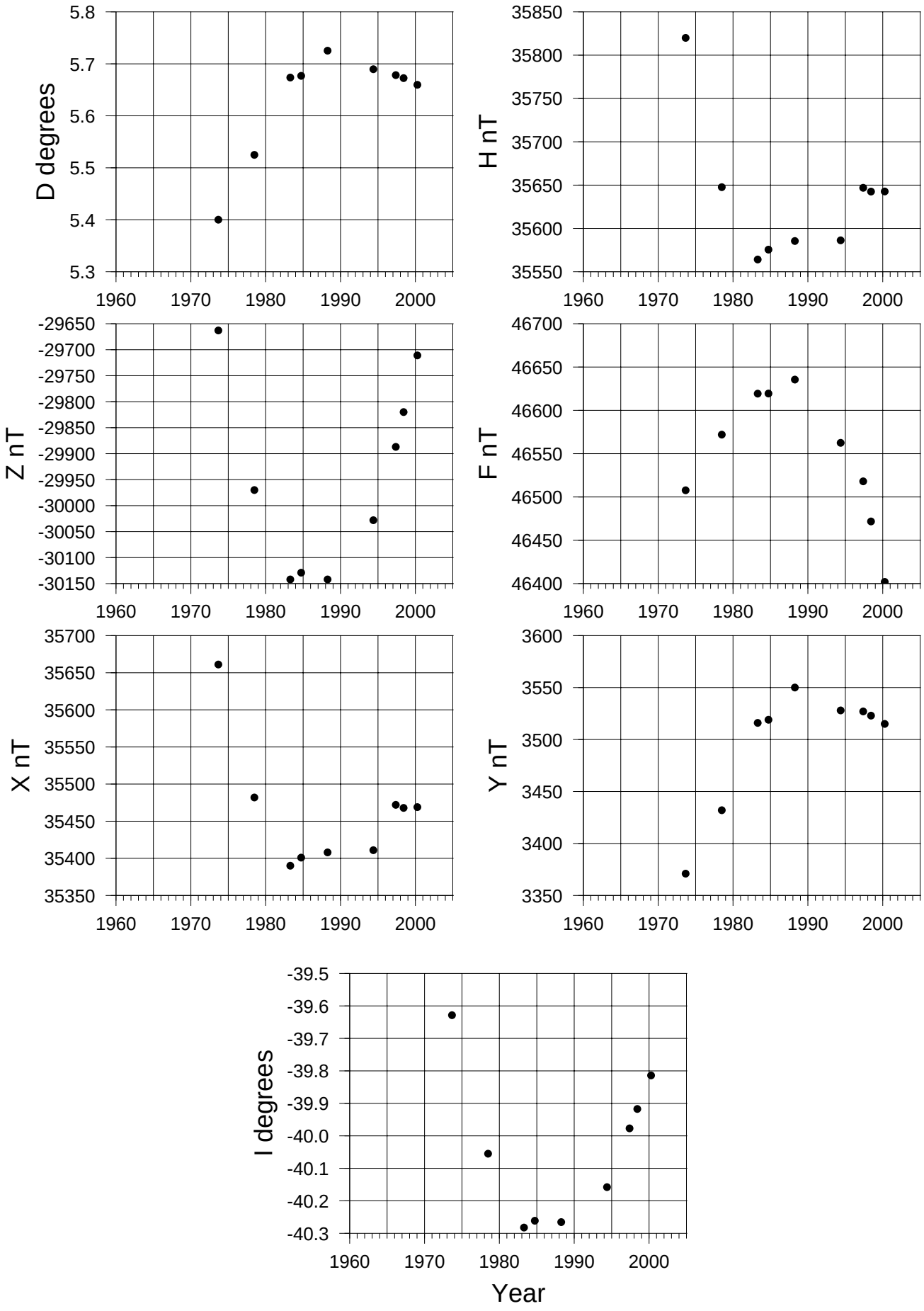

F nT
52600
52500
52400
52300
52200
52100
52000
51900
51800
51700
1960
1970
1980
1990
2000


X nT
28200
28100
28000
27900
27800
27700
27600
1960
1970
1980
1990
2000

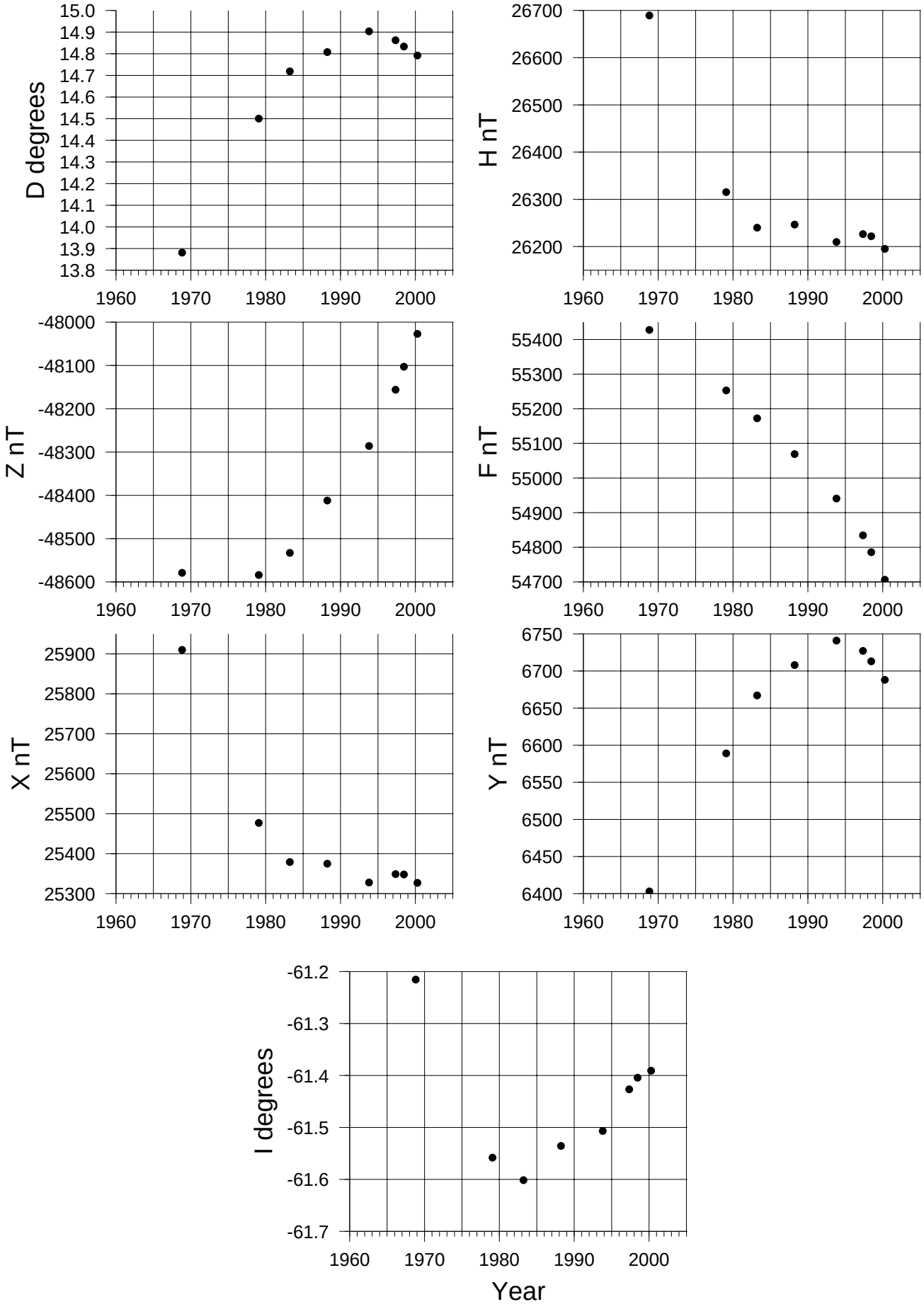

Y nT
7650
7600
7550
7500
7450
7400
7350
7300
1960
1970
1980
1990
2000


I degrees
-56.2
-56.3
-56.4
-56.5
-56.6
1960
1970
1980
1990
2000
Year

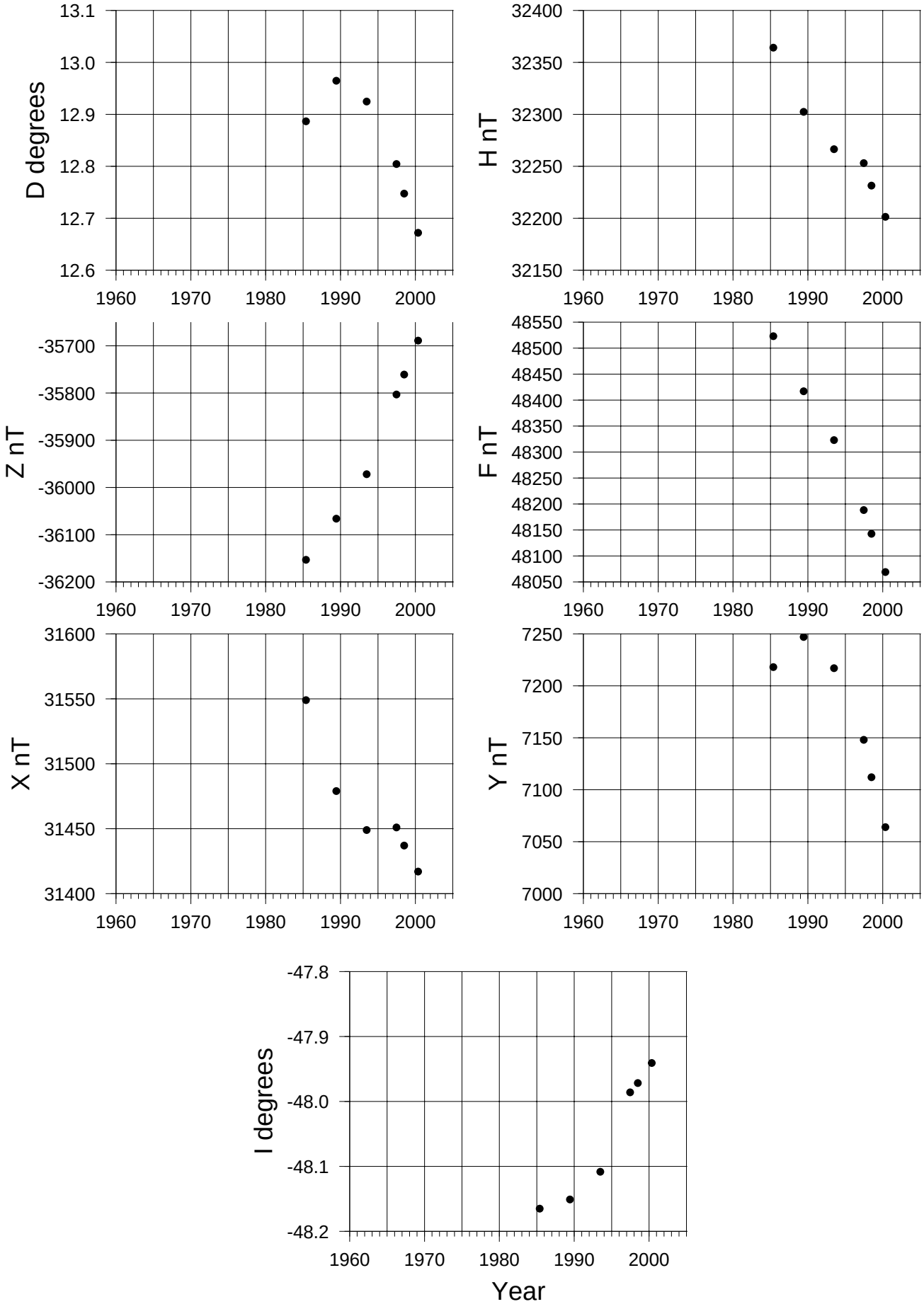
WEI


D degrees
5.8
5.7
5.6
5.5
5.4
5.3
H nT
35850
35800
35750
35700
35650
35600
35550
Z nT
-29650
-29700
-29750
-29800
-29850
-29900
-29950
-30000
-30050
-30100
-30150
F nT
46700
46650
46600
46550
46500
46450
46400
X nT
35700
35650
35600
35550
35500
35450
35400
35350
Y nT
3600
3550
3500
3450
3400
3350
I degrees
-39.5
-39.6
-39.7
-39.8
-39.9
-40.0
-40.1
-40.2
-40.3
1960
1970
1980
1990
2000
Year

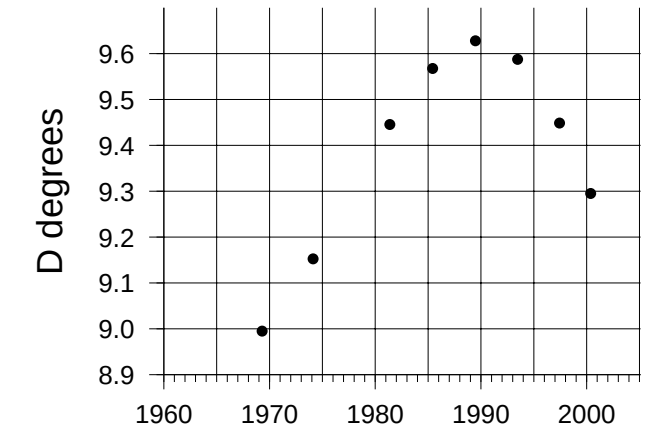
LHI

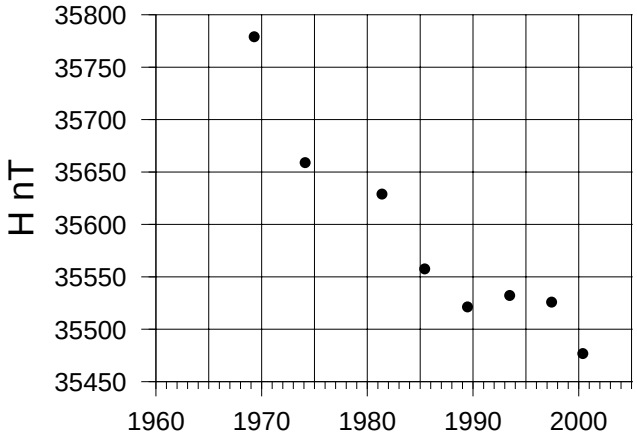

D degrees
15.0
14.9
14.8
14.7
14.6
14.5
14.4
14.3
14.2
14.1
14.0
13.9
13.8
H nT
26700
26600
26500
26400
26300
26200
Z nT
-48000
-48100
-48200
-48300
-48400
-48500
-48600
F nT
55400
55300
55200
55100
55000
54900
54800
54700
X nT
25900
25800
25700
25600
25500
25400
25300
Y nT
6750
6700
6650
6600
6550
6500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

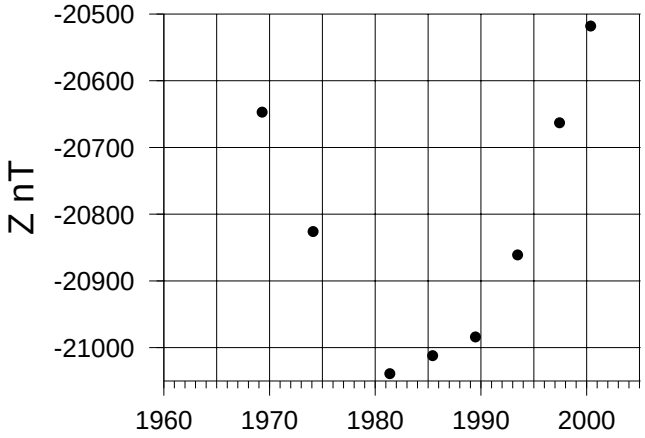
NOU

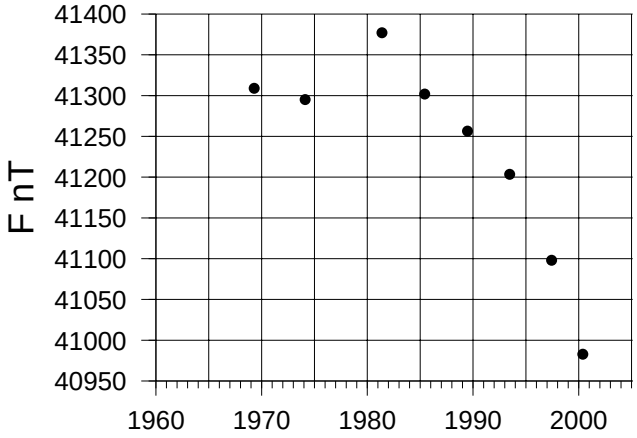

D degrees
13.1
13.0
12.9
12.8
12.7
12.6
H nT
32400
32350
32300
32250
32200
32150
Z nT
-35700
-35800
-35900
-36000
-36100
-36200
F nT
48550
48500
48450
48400
48350
48300
48250
48200
48150
48100
48050
X nT
31600
31550
31500
31450
31400
Y nT
7250
7200
7150
7100
7050
7000
I degrees
-47.8
-47.9
-48.0
-48.1
-48.2
1960
1970
1980
1990
2000
Year

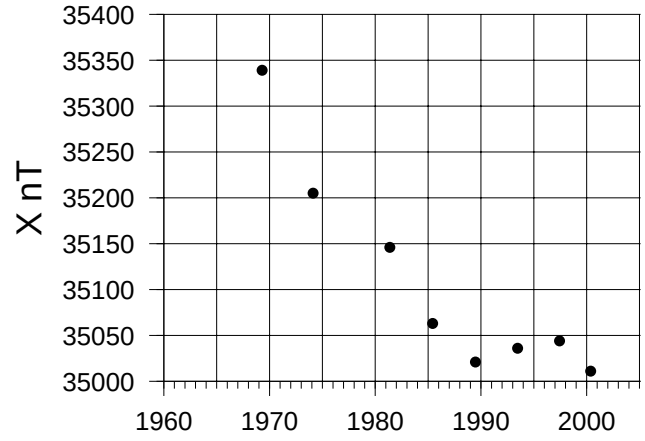
HON

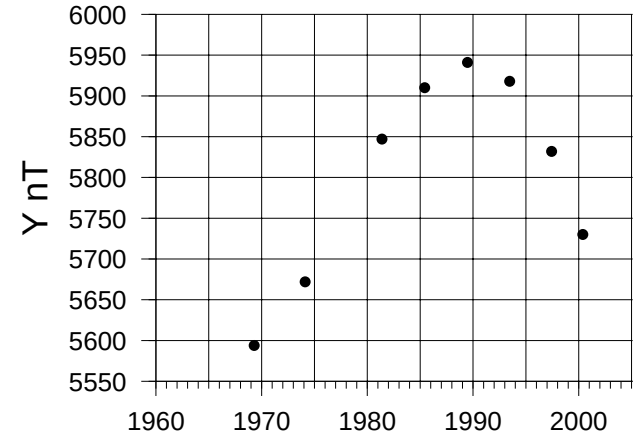

D degrees
9.6
9.5
9.4
9.3
9.2
9.1
9.0
8.9
1960
1970
1980
1990
2000

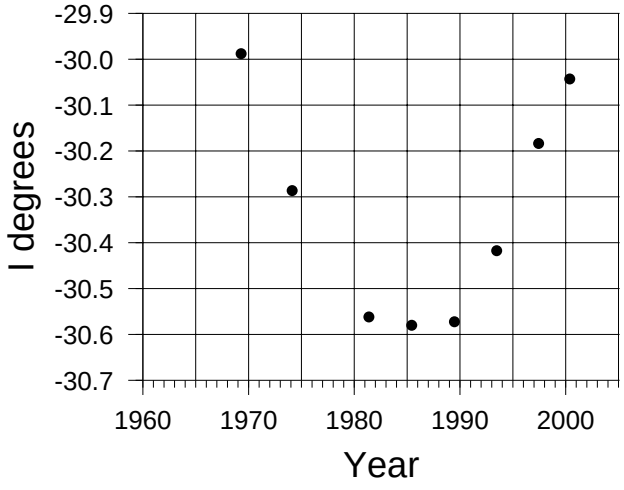

H nT
35800
35750
35700
35650
35600
35550
35500
35450
1960
1970
1980
1990
2000

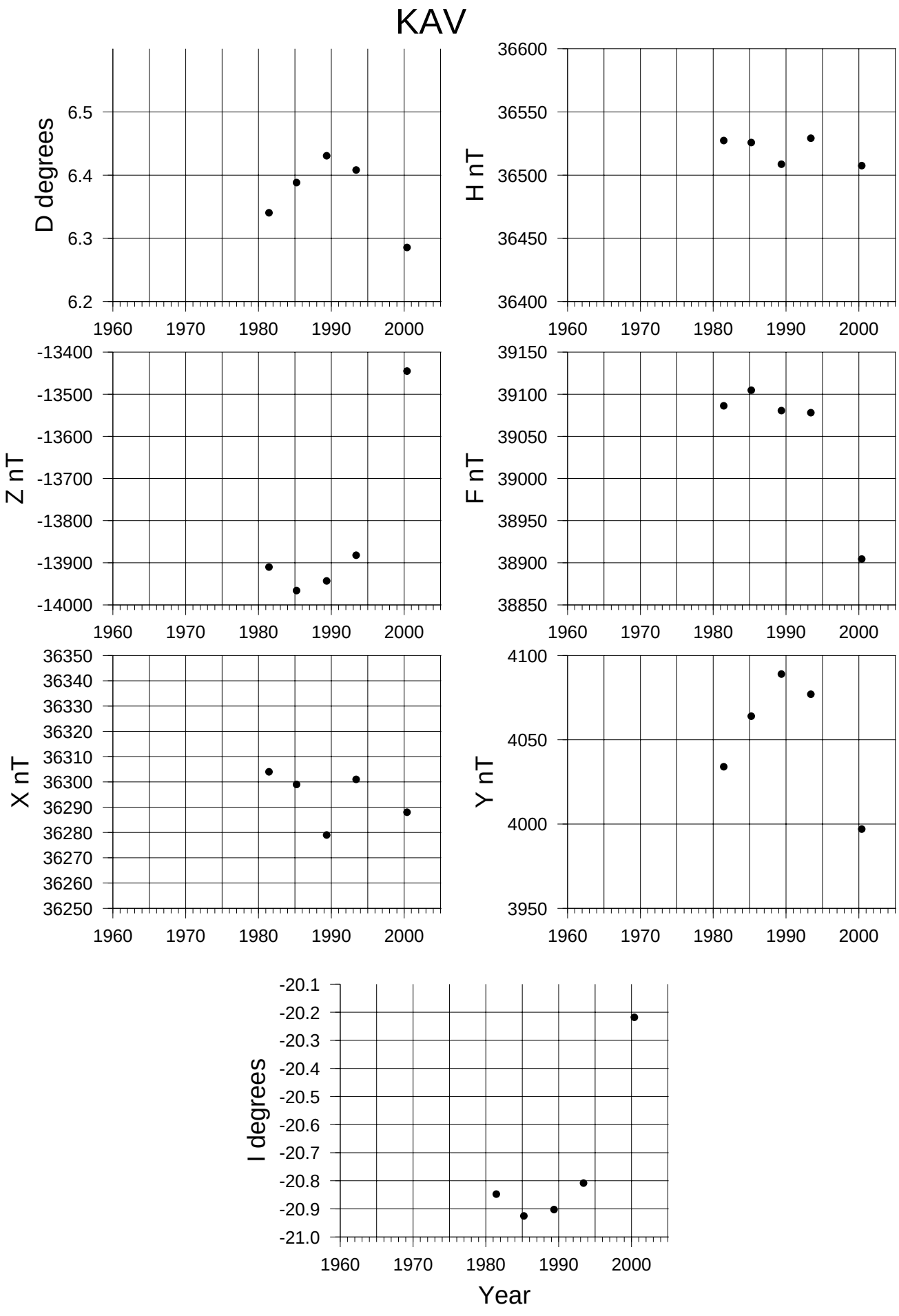

Z nT
-20500
-20600
-20700
-20800
-20900
-21000
1960
1970
1980
1990
2000

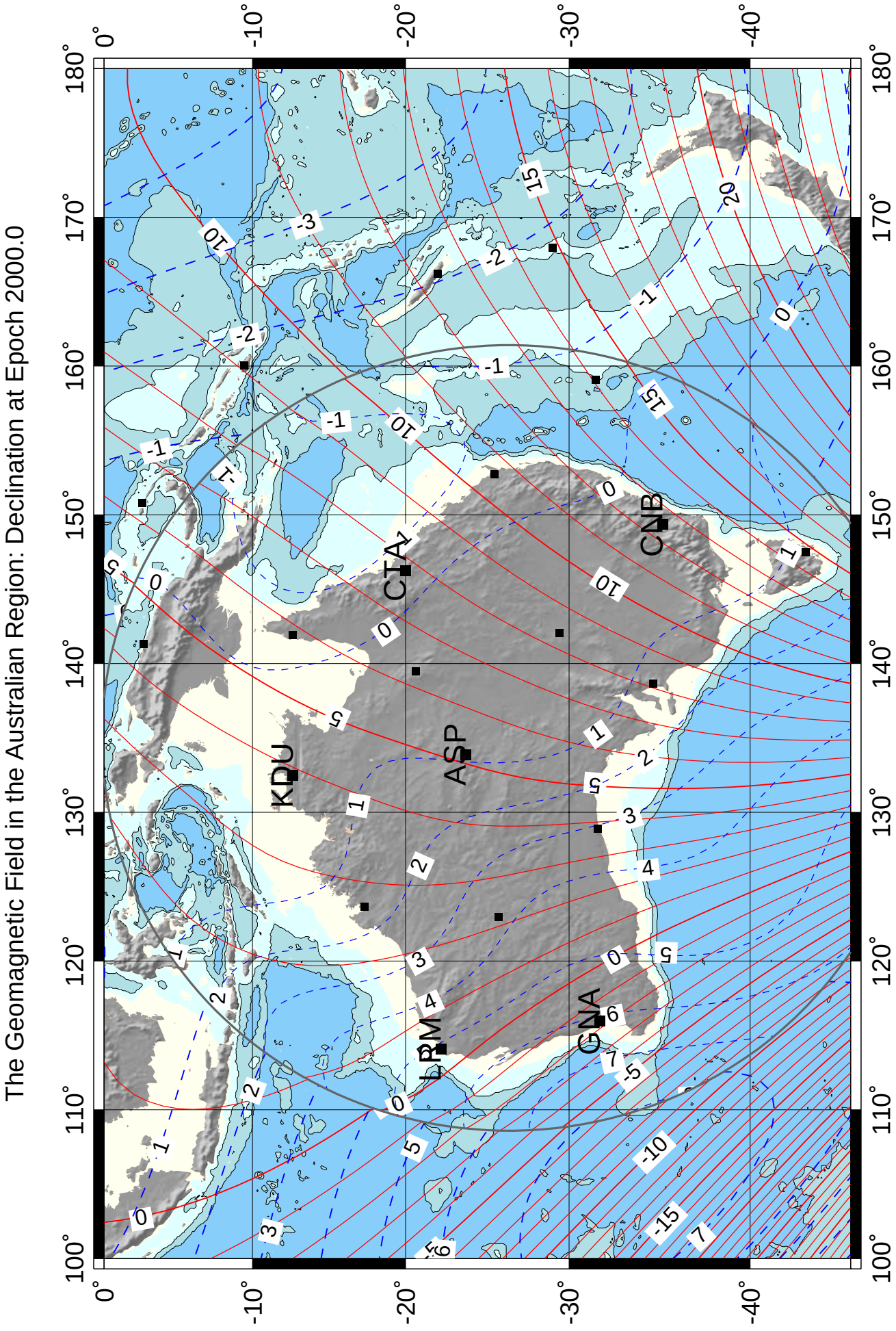

F nT
41400
41350
41300
41250
41200
41150
41100
41050
41000
40950
1960
1970
1980
1990
2000

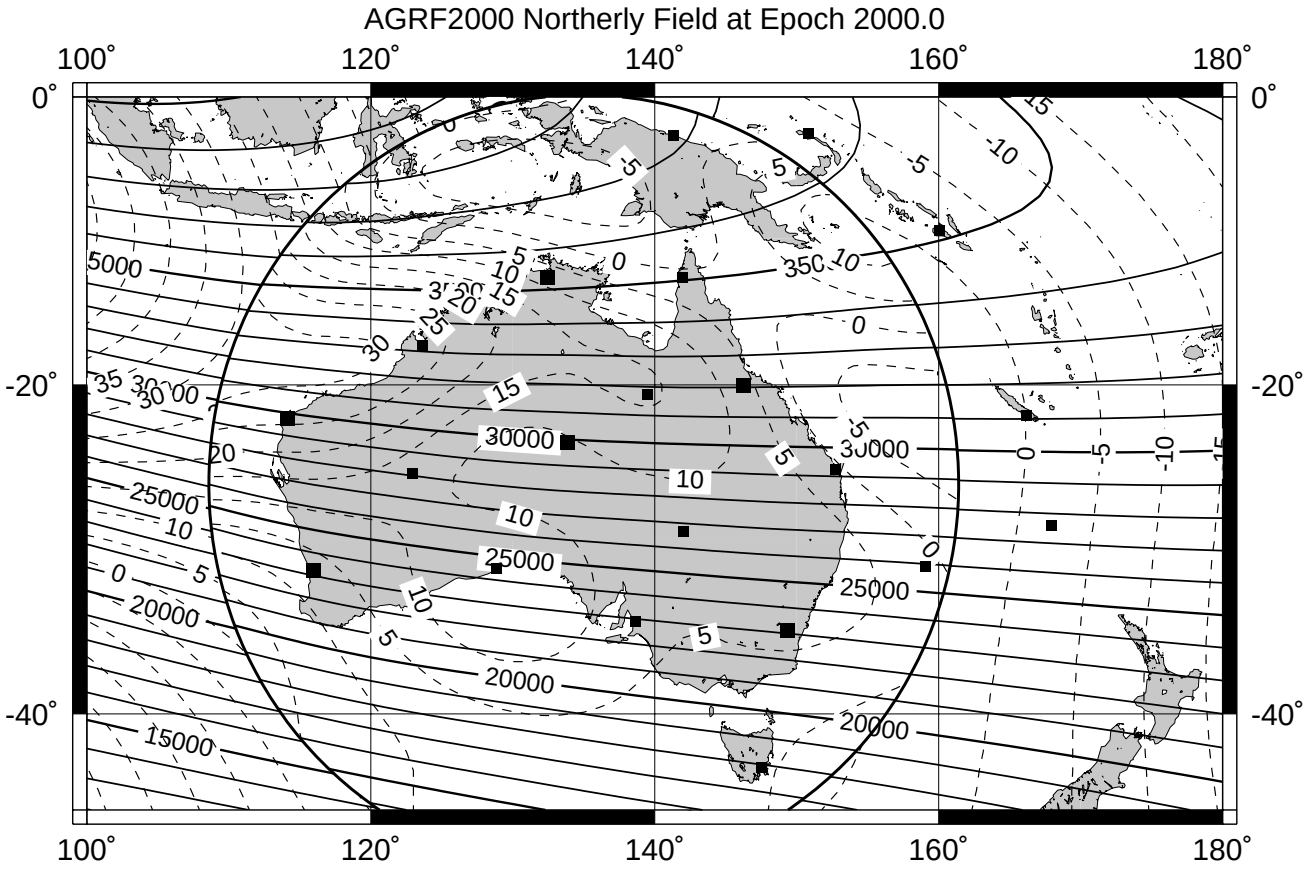

X nT
35400
35350
35300
35250
35200
35150
35100
35050
35000
1960
1970
1980
1990
2000

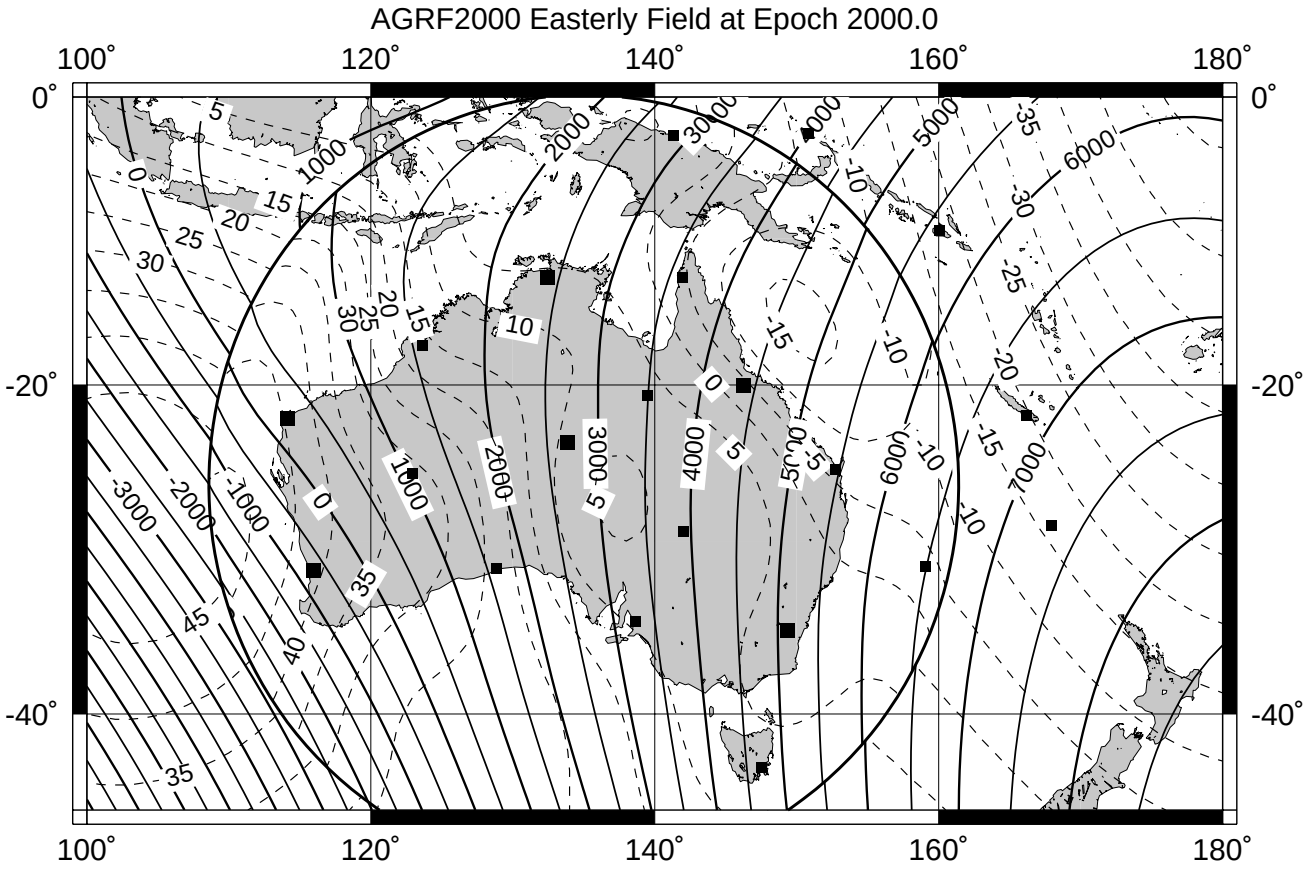

Y nT
6000
5950
5900
5850
5800
5750
5700
5650
5600
5550
1960
1970
1980
1990
2000

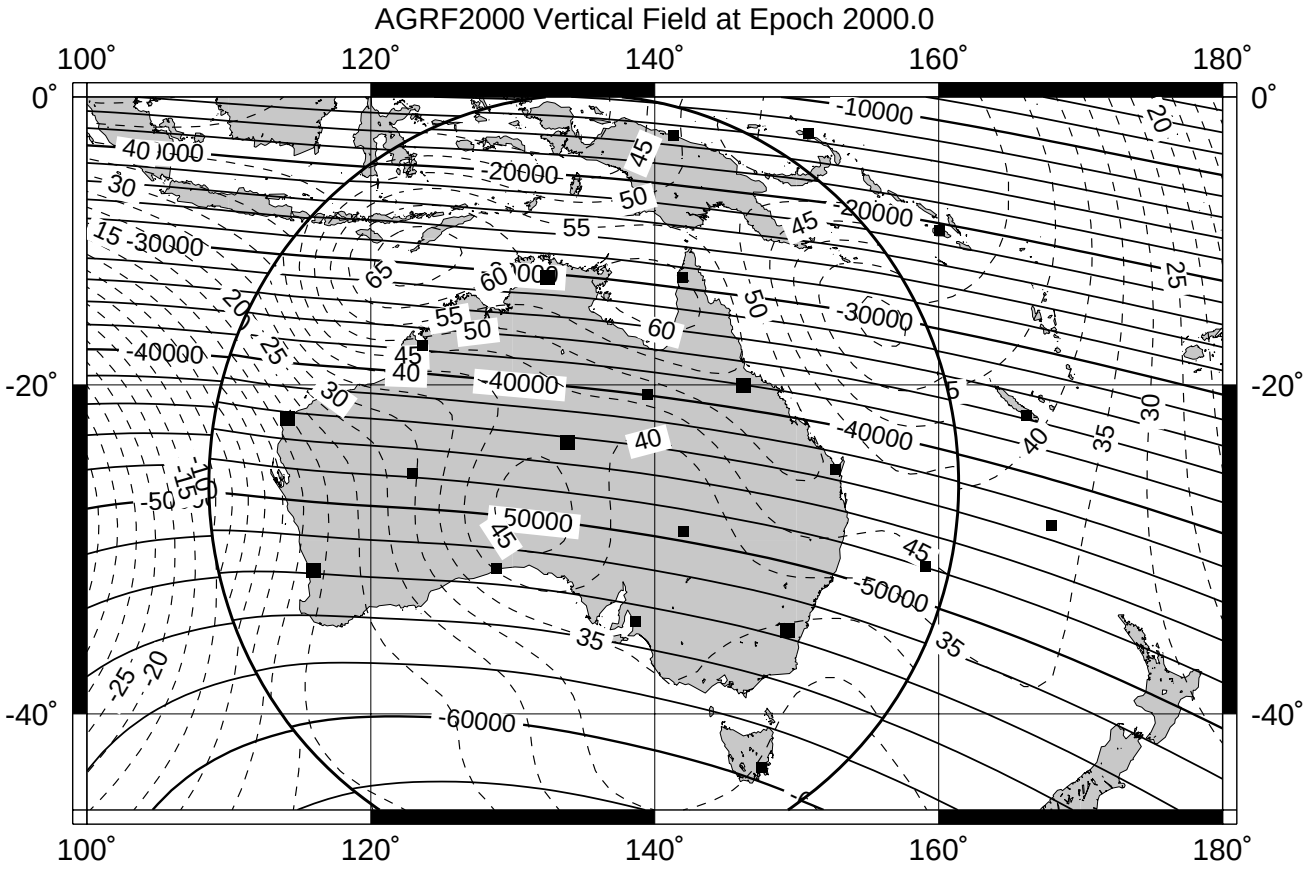

I degrees
-29.9
-30.0
-30.1
-30.2
-30.3
-30.4
-30.5
-30.6
-30.7
1960
1970
1980
1990
2000
Year

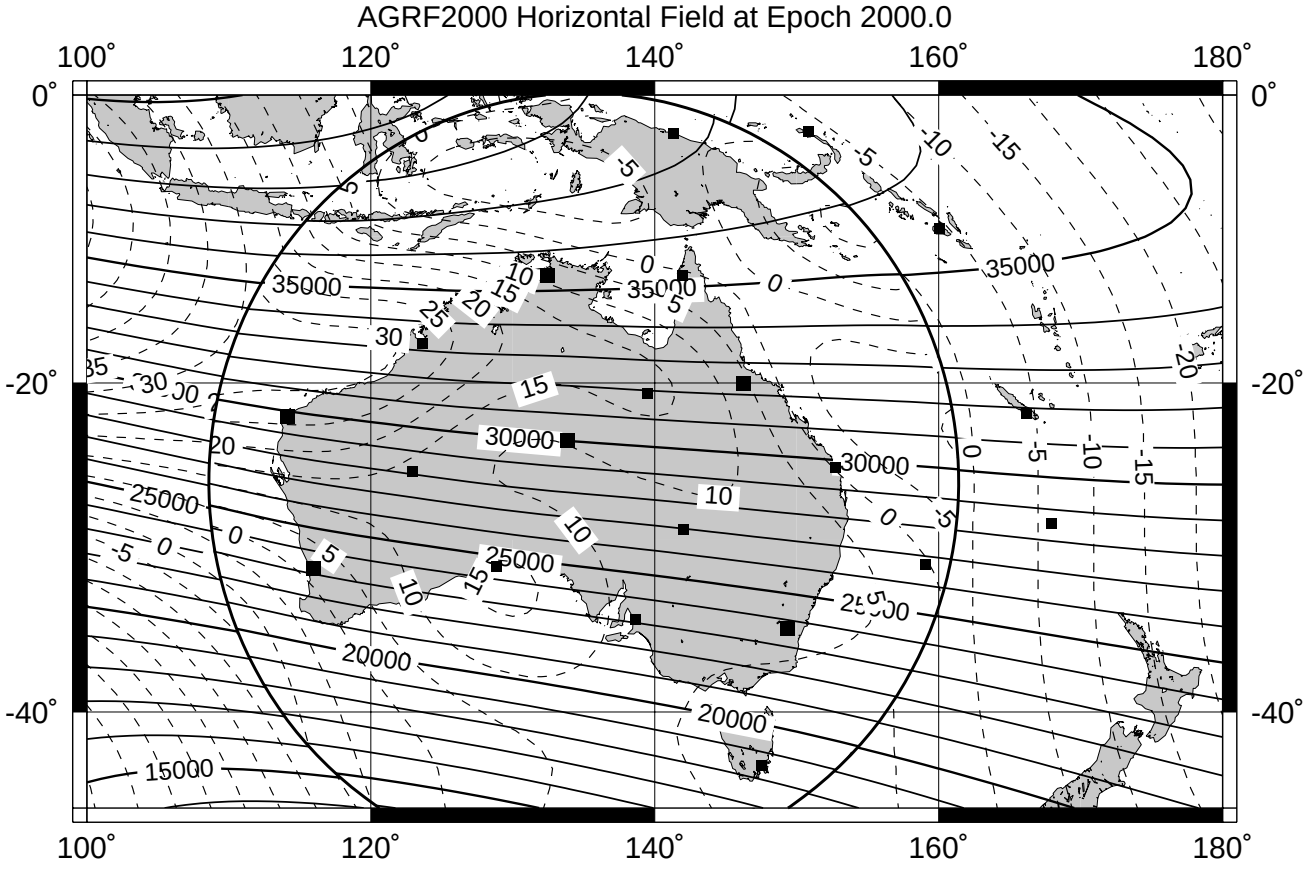

KAV
D degrees
6.5
6.4
6.3
6.2
H nT
36600
36550
36500
36450
36400
Z nT
-13400
-13500
-13600
-13700
-13800
-13900
-14000
F nT
39150
39100
39050
39000
38950
38900
38850
X nT
36350
36340
36330
36320
36310
36300
36290
36280
36270
36260
36250
Y nT
4100
4050
4000
3950
I degrees
-20.1
-20.2
-20.3
-20.4
-20.5
-20.6
-20.7
-20.8
-20.9
-21.0
1960
1970
1980
1990
2000
Year

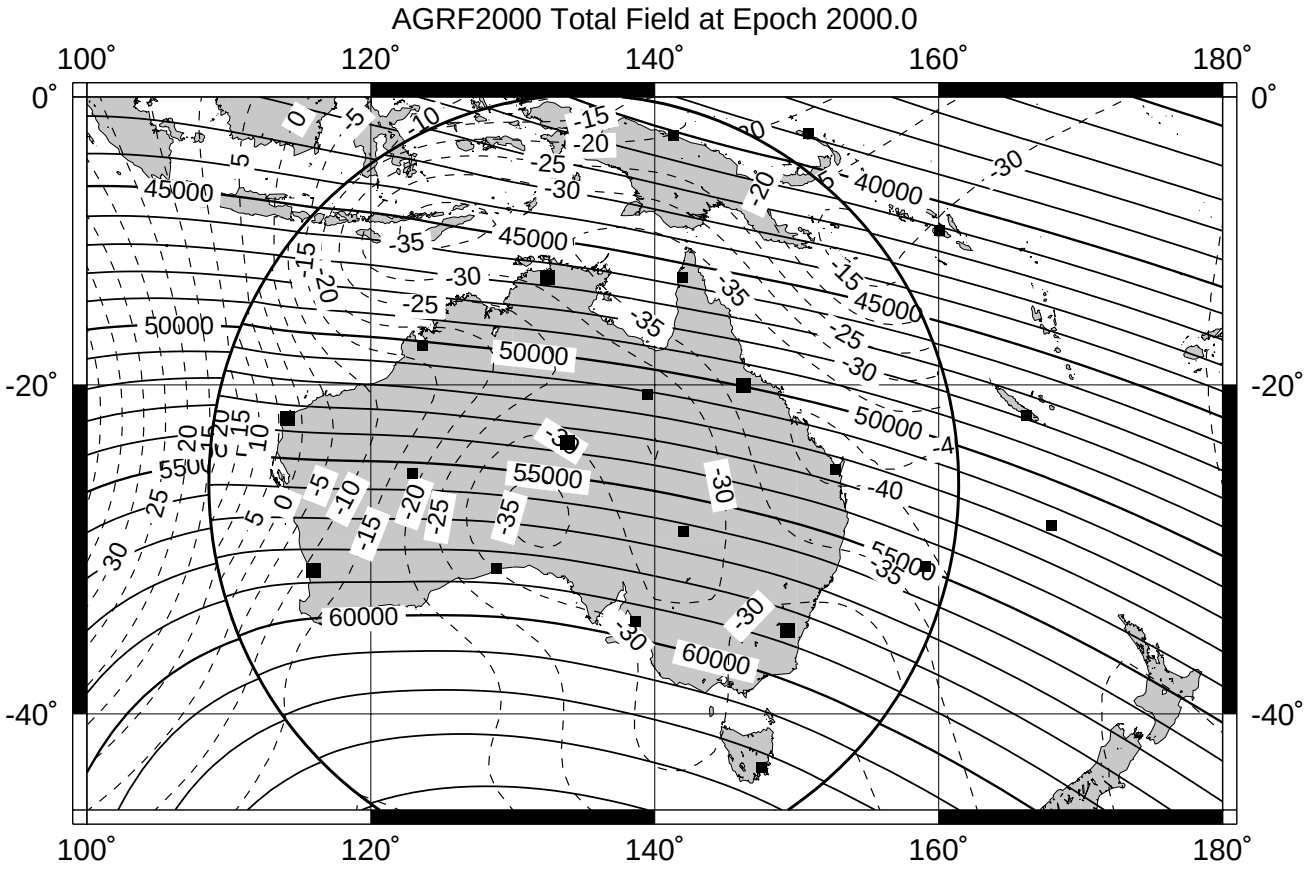

The Geomagnetic Field in the Australian Region: Declination at Epoch 2000.0
KDU
CTA
ASP
CNB
IPM
CNA
0°
-10°
-20°
-30°
-40°
100°
110°
120°
130°
140°
150°
160°
170°
180°

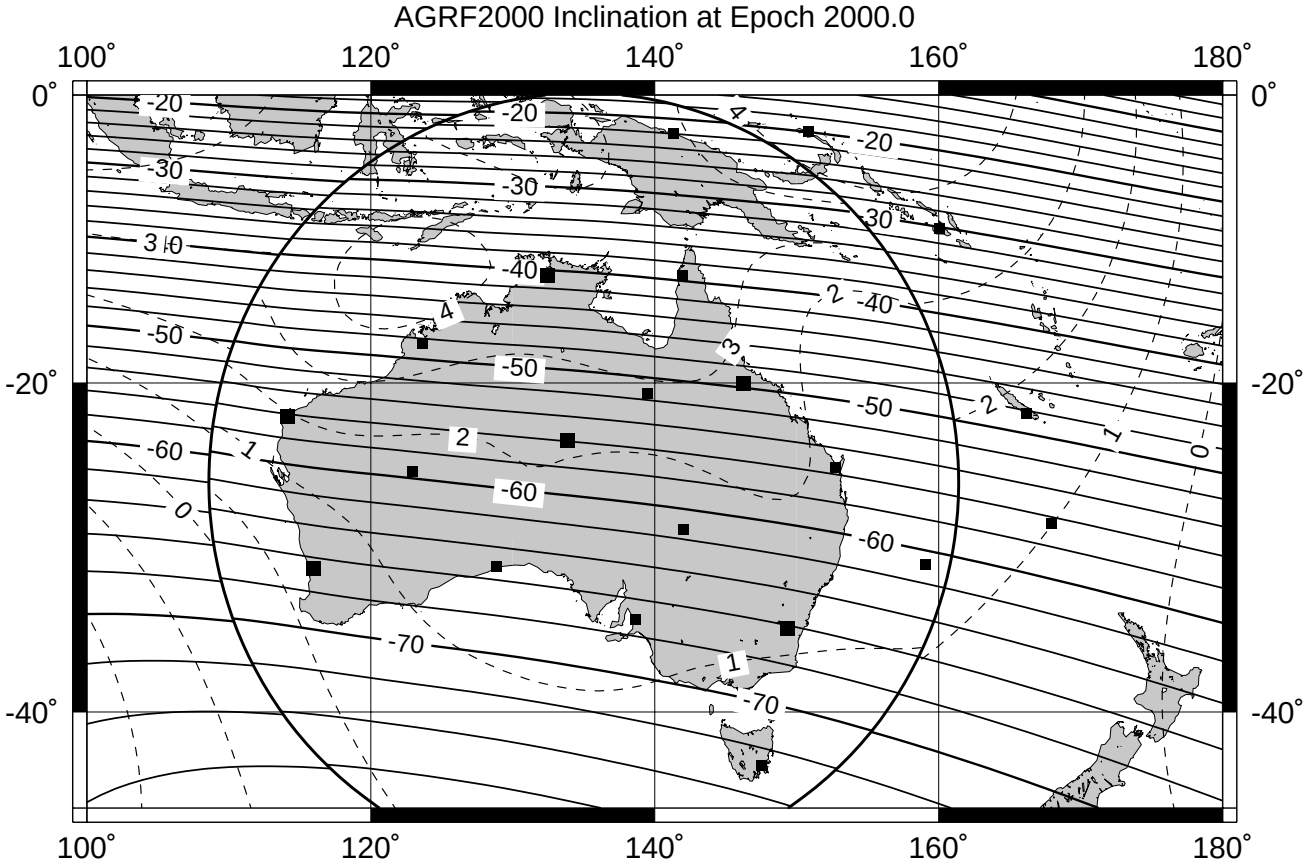

AGRF2000 Northerly Field at Epoch 2000.0
100˚
120˚
140˚
160˚
180˚
0˚
-20˚
-40˚


AGRF2000 Easterly Field at Epoch 2000.0
100˚
120˚
140˚
160˚
180˚
0˚
-20˚
-40˚


AGRF2000 Vertical Field at Epoch 2000.0
100˚
120˚
140˚
160˚
180˚
0˚
-20˚
-40˚


AGRF2000 Horizontal Field at Epoch 2000.0
100˚
120˚
140˚
160˚
180˚
0˚
-20˚
-40˚


AGRF2000 Total Field at Epoch 2000.0
100˚
120˚
140˚
160˚
180˚
0˚
-20˚
-40˚
45000
50000
55000
60000
40000


AGRF2000 Inclination at Epoch 2000.0
100˚
120˚
140˚
160˚
180˚
0˚
-20˚
-40˚

REFERENCES

'Australian Geomagnetism Report 1993', compiled by A.J. McEwin and P.A. Hopgood. *Australian Geological Survey Organisation.*

'Australian Geomagnetism Report 1994', compiled by P.A. Hopgood and A.J. McEwin. *Australian Geological Survey Organisation.*

'Australian Geomagnetism Report 1995' *to* 'Australian Geomagnetism Report 1998' , compiled by P.A. Hopgood. *Australian Geological Survey Organisation.*

Crosthwaite, P.G., 'Calibration of X, Y, Z, F type variometers' *Australian Geological Survey Organisation*, *Geomagnetism Note,* **1992/24**, 1992.

Crosthwaite, P.G. 'Using F in X, Y, Z, F type variometers' *Australian Geological Survey Organisation, Geomagnetism Note*, **1994/16**, 1994.

Crosthwaite, P.G., 'Casey Geomagnetic Observatory Visit, 1998/99 Summer', *Australian Geological Survey Organisation, Geomagnetism Note* (in preparation).

De Deuge, M.A. 'Mawson Geophysical Observatory Annual Report 1991' *Australian Geological Survey Organisation, Record*, **1992/57**, 1992.

Dennis, S.D., 'Macquarie Island Geomagnetic Observatory operational report, 1998' *Australian Geological Survey Organisation*, *Geomagnetism Note,* **1998/03**, 1998.

Hopgood, P.A. 'Australian Magnetic Observatories' *Exploration Geophysics,* **24**, 79-82, 1993

Johnson, Peter, 'Mawson Geophysical Observatory Operations, 2000' *Australian Geological Survey Organisation, Geomagnetism Note*, **2000-02**, 2000.

Lewis, A.M. 'The Geomagnetic Field in the Australian region – Epoch 2000' (chart) *Australian Geological Survey Organisation, Canberra,* 2000.

Mayaud, P.N. 'Atlas of Indices K' *IAGA Bulletin* **21**, 113pp., IUGG Publ. Office, Paris. 1967.

McCreadie, Heather '4th Australian Geomagnetism Workshop, Canberra, April 2000 - Abstracts' *Geomagnetism Notes* **2000/10**, 68pp, *Australian Geological Survey Organisation*, 2000.

McGregor, P.M. 'Australian Magnetic Observatories' *BMR Journal of Australian Geology and Geophysics*, **4**, 361-371. 1979

McGregor, Peter 'Observatory Geophysics, 1947-1998' *Aurora* (ANARE Club Journal*)*, **Vol. 19, No. 3**, 3-21, March 2000.

Seers, K.J. 'Handbook for Proton Magnetometer MNS2' *Bureau of Mineral Resources, Geology and Geophysics, Record* **1979/59**, 1979

Trigg, D.F. and R.L. Coles (editors). 'INTERMAGNET Technical Reference Manual 1994', 73pp. *INTERMAGNET*, 1994.

Geomagnetism Staff List 2000

Name	Classification	Responsibility
Charles E. Barton	Senior Principal Research Scientist	Section Head
Peter A. Hopgood	Senior Professional Officer B	Project Leader, 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	Project Leader, Repeat Station Survey, Alice Springs Observatory
Liejun Wang	Professional Officer 1	Data-base development; Canberra Observatory
Heather McCreadie	Professional Officer 1	Web development; Gnangara Observatory
Robert G. Sutton	Technical Officer 2 (on contract) (Shared by GA & BoM)	Mawson (1999 observer)
Peter Johnson	Technical Officer 2 (on contract) (Shared by GA & BoM)	Mawson (2000 observer)
Martin Purvins	Technical Officer 2 (on contract) (Shared by GA & BoM)	Mawson (2001 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)
Dave Gillies	Technical Officer 2 (Shared by AAD, GA)	Macquarie Island (2001 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	

Note: The Mundaring Geophysical Observatory was closed at the end of April 2000. Only one member of staff (ODM) remained with Geoscience Australia after that time.

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
Michael Hyde	AAD, DEH	Casey
Darron Lehmann	AAD, DEH	Davis