

## **Hermanus Magnetic Observatory**

A facility of the National Research Foundation

**Magnetic Results 2005** 

Hermanus, Hartebeesthoek and Tsumeb observatories

#### 1. INTRODUCTION

The Hermanus Magnetic Observatory (HMO) operates three permanent geomagnetic observatories in Southern Africa, namely Hermanus, Hartebeesthoek, and Tsumeb (Namibia).

This yearbook presents the results of the magnetic measurements carried out at these observatories during 2005.

#### 2. DESCRIPTION OF THE OBSERVATORIES

The locations of the magnetic observatories are as follows:

Observatory		raphic inates	Geoma Coord	Elevation	
	Latitude	Longitude	Latitude	Longitude	m
Hermanus	34° 25' 23" S	19° 13' 33" E	42° 40' S	83° 14' E	26
Hartebeesthoek	25° 52' 58" S	27° 42' 25" E	36° 13' S	95° 38' E	1555
Tsumeb	19° 12' 08" S	17° 35' 03" E	31° 04' S	87° 17' E	1273

Geomagnetic coordinates given are relative to a geomagnetic North Pole position of 83.5° N, 119.5° W, computed from the IGRF model (degree 13) at the epoch 2005.5.

#### 3. ABSOLUTE MEASUREMENTS

At each observatory absolute measurements are made in a single absolute hut. Since 1<sup>st</sup> January 2000, absolute values of all geomagnetic elements are referred to a single standard pillar at each of the observatories. For continuity with previous data the differences between the new and old standards are quoted in the tables of annual mean values in the sense (old standard – new standard) for all elements of the geomagnetic field. Thus, annual mean values prior to 2000.5 can be referred to the new standard by adding the site difference to the old standard values.

#### 3.1 DI-Flux

Absolute observations were carried out on a regular basis at each observatory by means of a DI-flux magnetometer for measuring the angles D and I, and a Proton Precession Magnetometer (PPM) or a dldD for measuring the total magnetic field intensity, F. The absolute values H and Z were then derived from

$$H = F \cos I$$
  
 $Z = F \sin I$ 

Where H, Z and F are field values at the time of the I measurement. Baseline values  $H_o$ ,  $D_o$  and  $Z_o$  were then calculated for the vector magnetometer systems described in section 4 below.

The DI-flux consists of a ZEISS non-magnetic theodolite type THEO 010B (at Hermanus) and a THEO 015B (at Hartebeesthoek and Tsumeb) and a single-axis fluxgate sensor mounted on top of the telescope and electronics from Bartington. The DI-flux is considered to be an absolute instrument, which means that the angles

measured by the instrument do not deviate from the true values *D* and *I*. This is achieved by using an observation procedure which eliminates the unknown parameters such as sensor offset, collimation angles and theodolite errors.

The following azimuth values were used at each observatory:

Observatory	Mark	Azimuth value
Hermanus	HMO Beacon	342° 20' 26"
Hartebeesthoek	Red-white pole	357° 45' 09"
Tsumeb	Max Planck	015° 55' 06"

#### 3.2 Proton Magnetometer

The PPM is a Geometrics type G-856AX. It is installed in the electronics unit and is powered from the DC power supply 16V outlet. The PPM is triggered from the computer digital I/O and the output is obtained serially. The signal levels are converted to RS232 by a converter card in the electronics unit and fed to the computer's serial port.

The PC computer serves as the instrument controller and data logger. The PPM readings are fed into the computer for processing through an RS232 serial port.

The instrument runs continuously and obtains a reading every 5 seconds. From these readings one-minute values for F can be derived. These are calculated by the computer and are available on the screen. A graphic display of the last 24 hours recorded data is also available.

#### 3.2.1 F pillar corrections

At Hermanus D and I are measured on pillar no. 1 in the Absolute House and at Hartebeesthoek and Tsumeb D and I are measured in the so-called "Standard Huts", while F is measured by a proton precession magnetometer (PPM) some distance away for Hartebeesthoek, and for Hermanus and Tsumeb F is obtained from an Overhauser sensor which forms part of the suspended dldD vector magnetometer. Site differences were obtained at regular intervals at each observatory to enable the F measurements to be reduced to the standard pillar:

$$F_{\text{standard pillar}} = F_{\text{PPM/dIdD}} + \triangle F_{\text{pillar}}$$

The following are the adopted values for the year:

	Site differences of $\Delta F_{pillar}$									
Hermanus Hartebeesthoek Tsumeb										
Period (Day numbers)	Correction	Period (Day numbers)	Correction	Period (Day numbers)	Correction					
1 – 31	-1.1 nT	1 – 365	77.0 nT	1 – 365	18.0 nT					
32 – 59	-1.6 nT									
60 – 90	-0.9 nT									
91 –181	-1.2 nT									
182 – 212	-1.3 nT									
213 – 243	-1.0 nT									
244 – 365	-1.2 nT									

#### 4. VECTOR MAGNETOMETERS

#### 4.1 FGE Magnetometer

A type FGE fluxgate manufactured by the Danish Meteorological Institute, Denmark is in operation at all three magnetic observatories.

The sensor unit consists of three orthogonally mounted sensors on a marble cube. In order to improve long-term stability these sensors have compensation coils wound on quartz tubes in order to obtain a sensor drift of only a few nT per year. The marble cube is suspended by two strips of crossed phosphor-bronze working as a Cardan's suspension to compensate for pillar tilting which might cause baseline drift.

The sensors may be set up to record either X,Y and Z or H,D and Z components. The latter orientation has been chosen to keep the continuity of earlier recordings.

The box containing the electronics is almost magnetic free and is placed about 3 meters from the sensor. At this distance it has no effect on the recordings. Temperature outputs for the sensor and the electronics are also available. The recording rate is 1 sec. and according to INTERMAGNET specifications a numerical filter is applied in order to obtain the final minute data series.

#### Technical specifications are:

Analogue output	± 10 volt
Dynamic range	3000 nT p-p
Resolution	0.2 nT
Scale value	150 nT/volt
Misalignment of sensor axis	< 7 min of arc
Long term drift	< 3nT/year
Temperature coefficient, sensor	< 0.2 nT/°C
Temperature coefficient, electronics	< 0.1 nT/°C
Band pass	DC to 1 Hz

#### 4.2 Suspended dldD Magnetometer

The Suspended dldD is a vector magnetometer for continuous monitoring of the inclination, declination and total intensity of the Earth's magnetic field. It employs a mutually orthogonal coil system that measures one unbiased and four biased values of total magnetic fields. The axes of the coil are arranged so that the axes of the mutually orthogonal coils are themselves perpendicular to the Earth's magnetic field vector, F, in the geomagnetic horizontal and vertical planes.

Equal and opposite currents are sequentially introduced into the "Inclination" (I) coil, which is perpendicular to F. These deflection fields lie in the local geomagnetic meridian plane. The resultant deflected values of F (I+ and I-) as measured by the Overhauser magnetometer are logged. The undeflected value of F is also logged.

Then, equal and opposite currents are sequentially introduced into the "Declination" (D) coil, which is also perpendicular to F. The D deflection fields lie in the horizontal plane. The resultant deflected values of F (D+ and D-) as measured by the Overhauser magnetometer are also logged. A simple algorithm is used to determine the instantaneous angular differences between the coil axes and the direction of the earth vector, F. These angular differences are dI and dD. Adding dI and dD to baseline values of Inclination and Declination for the coil system gives the instantaneous Inclination and Declination values of F. The components F and F are computed.

GEM Systems' advanced Overhauser design employs continuous radio frequency polarization and special sensors to maximise the signal-to-noise ratio.

Technical specifications are:

Dynamic range 20,000 to 120,000 nT

Sensitivity 0.01 nT Resolution 0.01 nT Absolute accuracy 0.2 nT

Operating temperature -40°C to + 55°C
Temperature coefficient < 0.1 nT/°C
Long term drift < 2 nT/year

A cycling time of 1 sec. was used which corresponds to a reading every 5 secs. From these readings one-minute values were derived.

The data is logged by the DIMARK data acquisition system supplied by the Eötvös Lorànd Geophysical Institute, Hungary.

#### 5. PRESENTATION OF RESULTS

#### 5.1 Base-line values

The observed and adopted base-line values are shown in a graphical form. The Hartebeesthoek and Tsumeb base-line values show fluctuations different from Hermanus that can be attributed to the fact that fewer absolute observations are done at these 2 observatories. In order to improve the base-line values an analysis of the night levels of Hermanus data versus Hartebeesthoek (or Tsumeb) were done. Whenever large deviations were detected in the data, the base-line values were adjusted and new one-minute data computed. This is particularly visible in the graphs where the adopted base-line values are not representative of the observed values.

For Tsumeb observatory there are no observed base-line values for January and February. The adopted base-line values were extrapolated using the observed base-line values of the previous months. Due to failure of the fluxgate magnetometer and the PPM, there were no recorded data for the period 9 February-12 May 2005.

#### 5.2 One-minute mean values

One-minute mean values, centred on the minute, were calculated by applying the Gaussian coefficients to a series of 19 samples of 5-second data. For a filter output value to be centred on the minute; the first coefficient was applied 45 seconds before this minute and the last coefficient was applied 45 seconds after the minute.

#### 5.3 Hourly mean values

Hourly mean values, centred on the UT half hour, are computed from the one-minute values. A value is not computed if there are more than 6 one-minute values missing. The data presentation is *XYZF* rather than *HDZF* as it is more convenient for the user who is interested in certain events to compare component values.

#### 5.4 Monthly mean values

Monthly mean values are calculated from the daily mean values of H, D and Z. Monthly means are not computed if there is any missing daily value. The mean values of X,Y,F and I are calculated from the corresponding mean values of H, D and Z. Annual mean values are also calculated from the daily mean values. Monthly and annual mean values are also calculated for the five international quiet and disturbed days in each month.

#### 5.5 Mean annual values

Mean annual values since the start of each observatory are presented in a separate table. The values are centred on the middle of each year. Graphical presentations of mean annual values are also included, but only for *D*, *H*, *Z* and *F*. Site differences were taken into account when the data were plotted.

#### 6. INDICES

#### 6.1 K-indices

K-indices are only computed at the Hermanus Magnetic Observatory. The index values are determined from the *H* and *D* data. The LRNS-method is used and the K9 limit is 300nT. K-indices are sent twice a month to "Service International des Indices Geomagnetiques", Paris.

#### 6.2 am Indices

The Hermanus K-indices are also used in deriving the *am* index, a further planetary activity index.

#### 6.3 Dst indices

The Hermanus Magnetic Observatory also supplies one-minute data to the World Data Centre for Geomagnetism, Kyoto in Japan, for the generation of the Dst ring-current index, which is the most commonly used measure of geomagnetic storm intensity.

#### 7. DATA AVAILABILITY

Tables of hourly mean values of the magnetic elements are no longer published in this series of publications. Final digital one-minute values and hourly values are available through the World Data Center for Geomagnetism, Copenhagen:

http://dmiweb.dmi.dk/fsweb/projects/wdcc1/master.html

The data are also published on the annual INTERMAGNET CD-ROM. More information is available from:

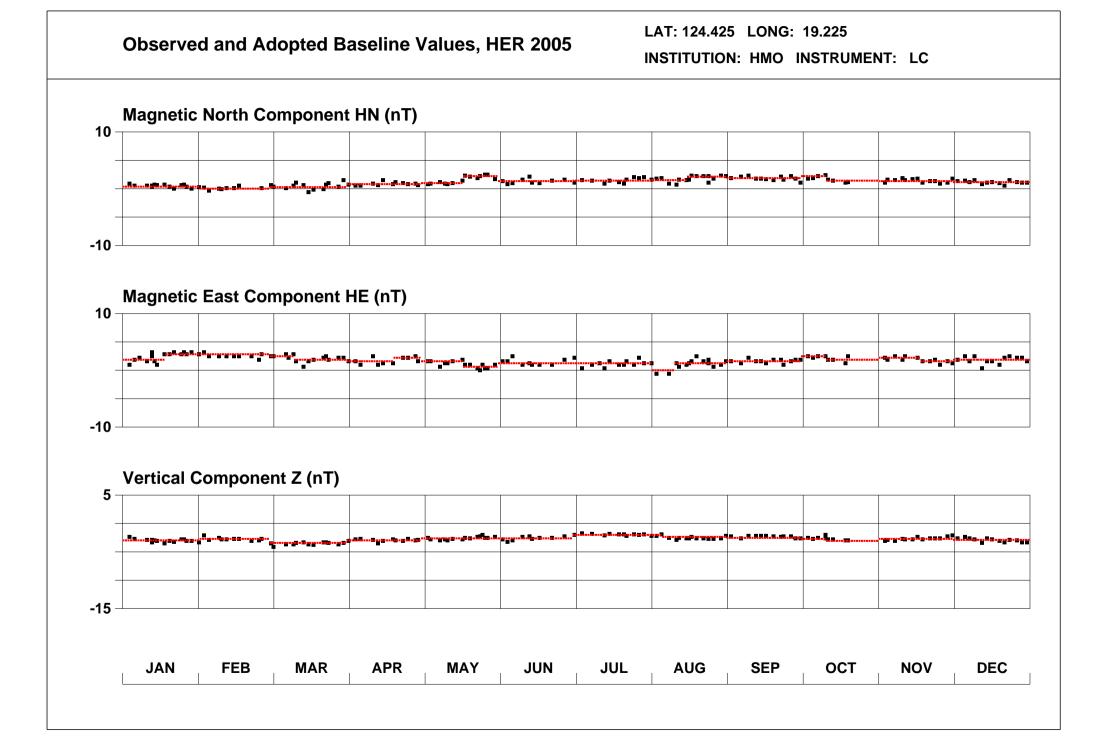
http://www.intermagnet.org

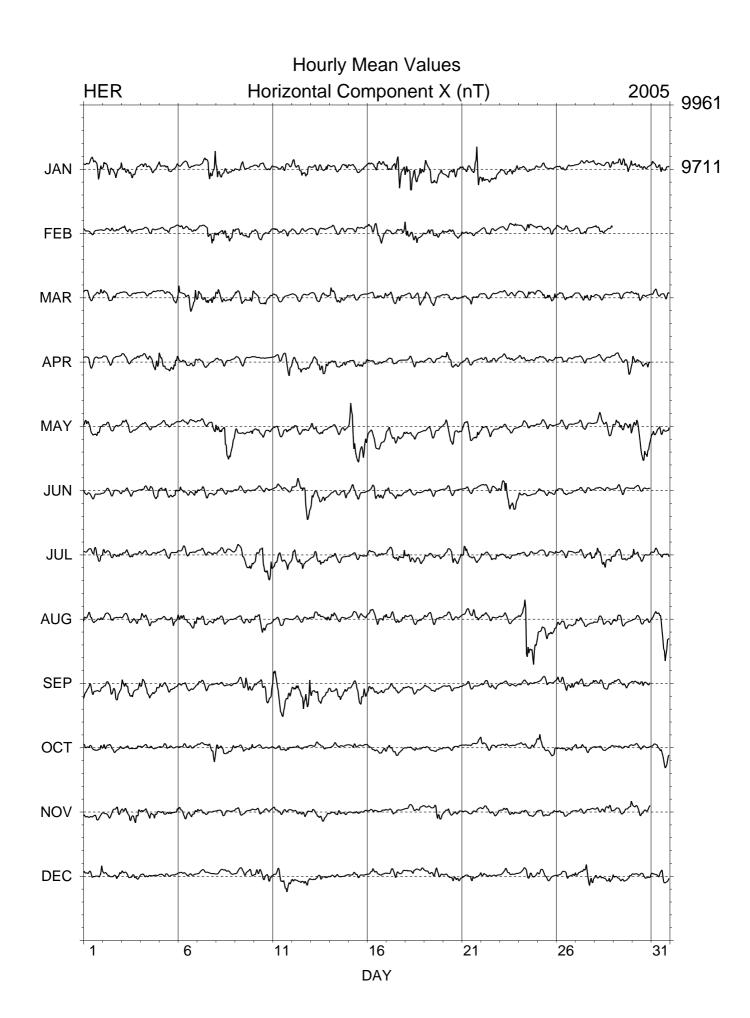
#### 8. CONTACT INFORMATION

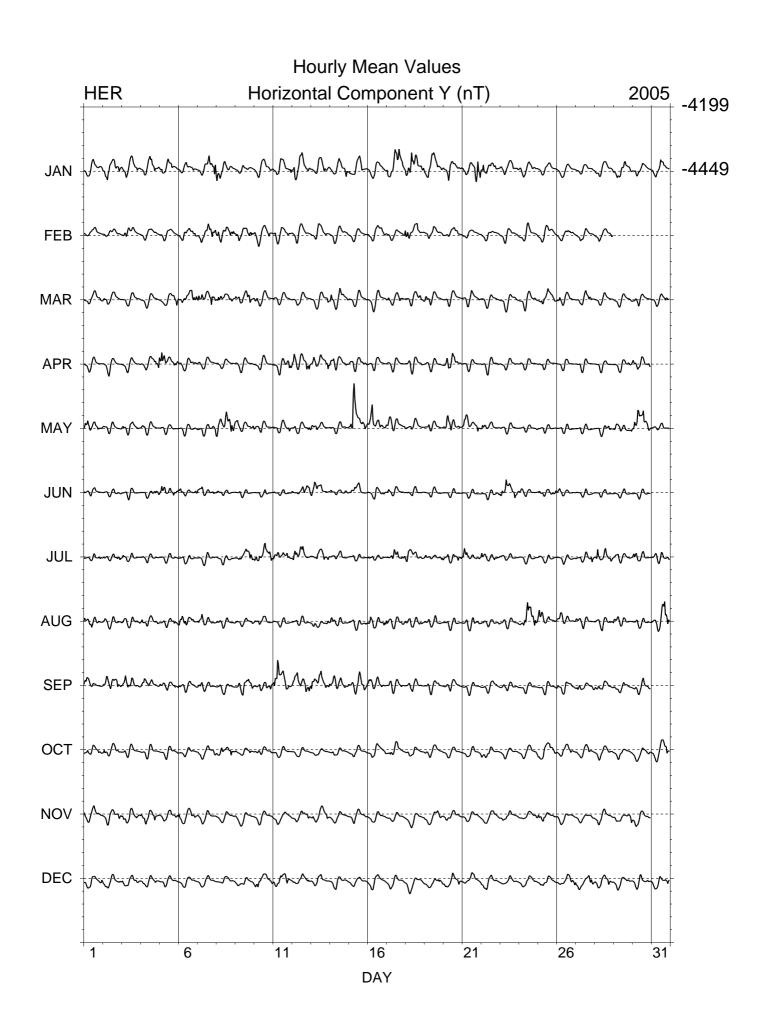
Hermanus Magnetic Observatory P.O. Box 32 Hermanus 7200 South Africa

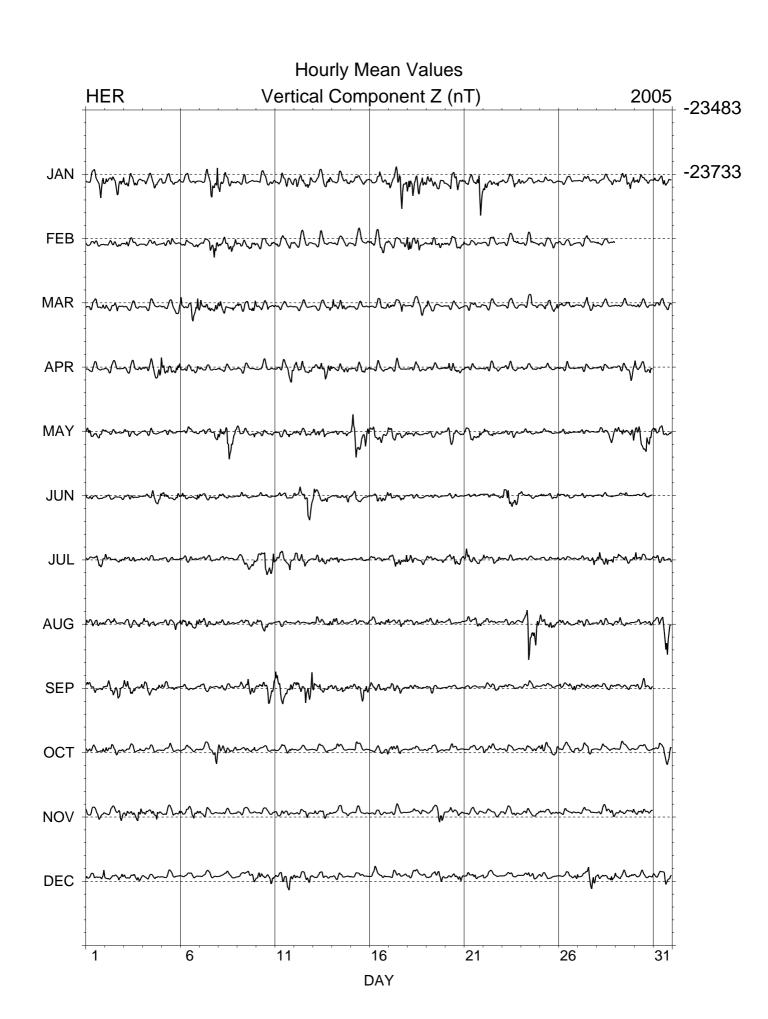
Tel. : +27 (28) 3121196
Fax. : +27 (28) 3122039
Email : info@hmo.ac.za
Internet : http://www.hmo.ac.za

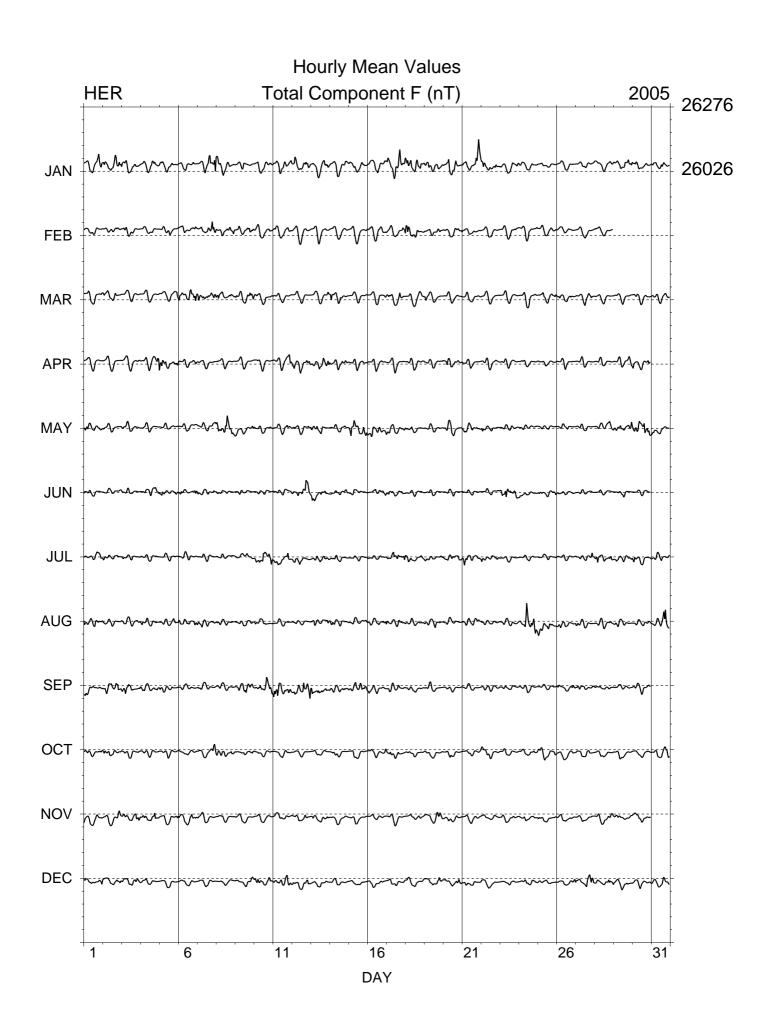
# Magnetic Results 2005 Hermanus

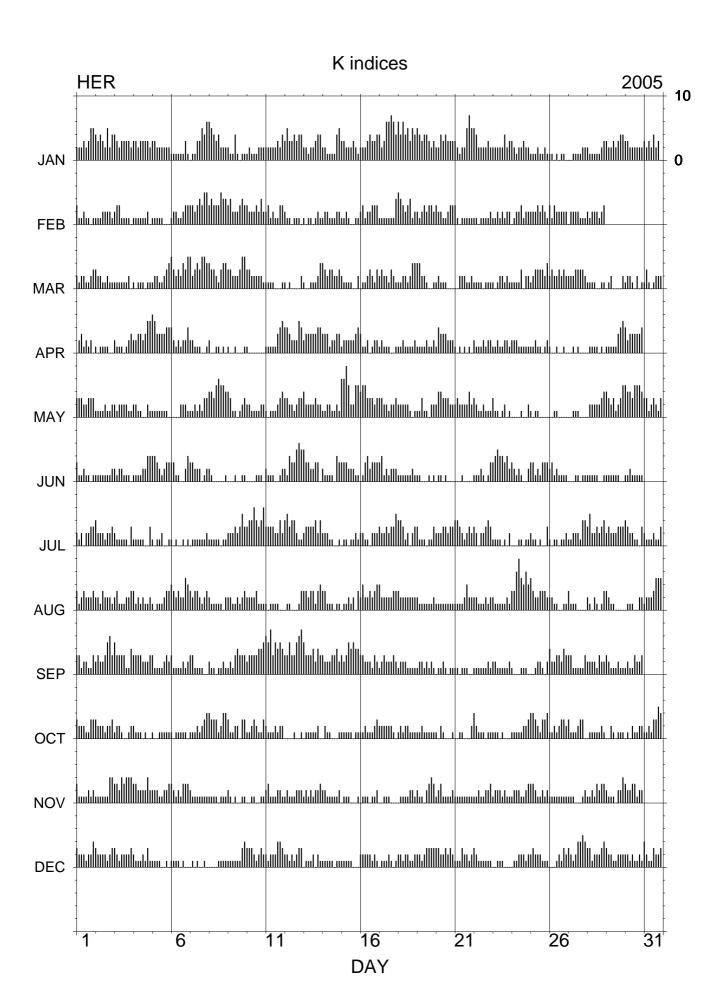












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	07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	0111 1112 1111 1011 2223 2353 3446 4346 3333 2242 4534 4211 2333 3424 2221 1001 0110 1121 2211 0222 3223 2335 4431 2023 3111 0113 2223 3233 4432 1232 3202 2343 1111 0102 0001 1011 2110 1003 1011 0112 1122 2144 3522 3234	3233 2123 2111 1102 2211 2123 2222 3111  1011 1100 0110 0013 3323 3134 3311 1011 0112 1203  2422 3234 4222 2233 3222 2222 2111 1112 1111 1111  1111 2422 2211 1212 2111 1121 3368 5464 5322 3332  2211 0011 3111 0000 2102 1013	3311 1100 2110 1121 1213 4333 2333 3445 6573 5454 3353 3567 5333 4243 3222 3342 3235 4544  3322 2132 1232 2232 1222 1111 1221 2121 0112 1011 1101 1100 1111 1121 2211 1112 1000 1110 0012 2102 4223 3243 3311 1113 2222 1322	1112 1234 4333 1244 3112 2033 1123 2113  2111 2122 0000 1001 0111 1120 0211 0001 1111 1011  1121 1123 2222 2210 1212 2111 1121 1111 1021 0001  0011 0002 4211 1011 1110 1000 1111 1223 4432 1334  1121 2332 3111 2330 0111 1121	2111 1111 1111 0111 2101 0011 0011 0011 2311 1221 1211 1222 1212 1223 2211 1112 0111 0001 0111 0112 0011 1000 0111 1221 2110 2343 1231 1112 1111 1111 1121 1223 1222 1211 1222 1123 3321 1212 1111 1111 1110 0012 1121 3233	1111 0100 0101 0010 0000 1111 1111 1134 3332 1232 2122 2443 2212 1233 0111 2021 1111 1011 1111 1000 2222 2121 0111 2101 2212 2112 2212 3333 3322 3232 1113 2212 3211 1111 0011 1000 0112 2212 2322 2111 0001 2132 3212 4454 3312 2234
	07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	0111 1112 1111 1011 2223 2353 3446 4346 3333 2242 4534 4211 2333 3424 2221 1001 0110 1121 2211 0222 3223 2335 4431 2023 3111 0113 2223 3233 4432 1232 3202 2343 1111 0102 0001 1011 2110 1003 1011 0112 1122 2144 3522 3234 2324 2333	3233 2123 2111 1102 2211 2123 2222 3111  1011 1100 0110 0013 3323 3134 3311 1011 0112 1203  2422 3234 4222 2233 3222 2222 2111 1112 1111 1111  1111 2422 2211 1212 2111 1121 3368 5464 5322 3332  2211 0011 3111 0000 2102 1013 3211 0000	3311 1100 2110 1121 1213 4333 2333 3445 6573 5454 3353 3567 5333 4243 3222 3342 3235 4544  3322 2132 1232 2232 1222 1111 1221 2121 0112 1011 1101 1100 1111 1121 2211 1112 1000 1110 0012 2102 4223 3243 3311 1113 2222 1322 3211 1211	1112 1234 4333 1244 3112 2033 1123 2113  2111 2122 0000 1001 0111 1120 0211 0001 1111 1011  1121 1123 2222 2210 1212 2111 1121 1111 1021 0001  0011 0002 4211 1011 1110 1000 1111 1223 4432 1334  1121 2332 3111 2330 0111 1121 0021 0111	2111 1111 1111 0111 2101 0011 0011 0011  2311 1221 1211 1222 1212 1223 2211 1112 0111 0001  0111 0112 0011 1000 0111 1221 2110 2343 1231 1112  1111 1111 1121 1223 1222 1211 1222 1123 3321 1212  1111 1111 1110 0012 1121 3233 2111 0224	1111 0100 0101 0010 0000 1111 1111 1134 3332 1232 2122 2443 2212 1233 0111 2021 1111 1011 1111 1000 2222 2121 0111 2101 2212 2112 2212 3333 3322 3232 1113 2212 3211 1111 0011 1000 0112 2212 2322 2111 0001 2132 3212 4454 3312 2234 3221 1222
	07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	0111 1112 1111 1011 2223 2353 3446 4346 3333 2242 4534 4211 2333 3424 2221 1001 0110 1121 2211 0222 3223 2335 4431 2023 3111 0113 2223 3233 4432 1232 3202 2343 1111 0102 0001 1011 2110 1003 1011 0112 1122 2144 3522 3234 2322 2333 4322 1103	3233 2123 2111 1102 2211 2123 2222 3111  1011 1100 0110 0013 3323 3134 3311 1011 0112 1203  2422 3234 4222 2233 3222 2222 2111 1112 1111 1111  1111 2422 2211 1212 2111 1121 3368 5464 5322 3332  2211 0011 3111 0000 2102 1013 3211 0000 0111 0022	3311 1100 2110 1121 1213 4333 2333 3445 6573 5454 3353 3567 5333 4243 3222 3342 3235 4544  3322 2132 1232 2232 1222 1111 1221 2121 0112 1011 1101 1100 1111 1121 2211 1112 1000 1110 0012 2102 4223 3243 3311 1113 2222 1322 3211 1211	1112 1234 4333 1244 3112 2033 1123 2113  2111 2122 0000 1001 0111 1120 0211 0001 1111 1011  1121 1123 2222 2210 1212 2111 1121 1111 1021 0001  0011 0002 4211 1011 1110 1000 1111 1223 4432 1334  1121 2332 3111 2330 0111 1121 0021 0111 0102 1122	2111 1111 1111 0111 2101 0011 0011 0011  2311 1221 1211 1222 1212 1223 2211 1112 0111 0001  0111 0112 0011 1000 0111 1221 2110 2343 1231 1112  1111 1111 1121 1223 1222 1211 1222 1123 3321 1212  1111 1111 1110 0012 1121 3233 2111 0224	1111 0100 0101 0010 0000 1111 1111 1134 3332 1232 2122 2443 2212 1233 0111 2021 1111 1011 1111 1000 2222 2121 0111 2101 2212 2112 2212 3333 3322 3232 1113 2212 3211 1111 0011 1000 0112 2212 2322 2111 0001 2132 3212 4454 3312 2234 3221 1222 2212 1121

### HERMANUS MEAN MONTHLY VALUES 2005

Date	0	D ,	。I	,	H nT	X nT	Y nT	Z nT	F nT	*	ELE
JAN		33.0		7.6	10681	9716	-4438	-23760	26050	А	HDZF
FEB		33.2	-65 46	5.1	10690	9723	-4442	-23750	26045	Α	HDZF
MAR		35.0		5.1	10688	9719	-4446	-23745	26039	Α	HDZF
APR		35.8		5.8	10687	9717	-4448	-23738	26032	Α	HDZF
MAY		36.8		3.3	10668	9698	-4443	-23741	26028	Α	HDZF
JUN		37.2		5.7	10678	9708	-4449	-23736	26028	Α	HDZF
JUL		37.6		5.1	10681	9709	-4451	-23731	26023	Α	$\mathtt{HDZF}$
AUG				5.1	10680	9707	-4452	-23728	26021	Α	HDZF
SEP		38.9		7.5	10668	9696	-4449	-23728	26016	Α	$\mathtt{HDZF}$
OCT	-24	39.2	-65 44	4.7	10687	9713	-4458	-23718	26014	Α	HDZF
NOV	-24	40.0	-65 44	4.4	10688	9712	-4460	-23714	26012	Α	$\mathtt{HDZF}$
DEC	-24	40.1	-65 43	3.8	10692	9716	-4462	-23712	26011	Α	$\mathtt{HDZF}$
YEAR	-24	37.1	-65 46	5.1	10682	9711	-4450	-23733	26027	A	HDZF
JAN	-24	32.8	-65 46	5.3	10691	9725	-4441	-23757	26052	Q	HDZF
FEB		32.5	-65 45	5.0	10697	9731	-4443	-23746	26044	Q	$\mathtt{HDZF}$
MAR		35.2	-65 45	5.4	10693	9723	-4449	-23744	26040	Q	HDZF
APR	-24	35.5	-65 44	4.7	10695	9725	-4451	-23735	26034	Q	HDZF
MAY	-24	36.3	-65 45	5.3	10690	9719	-4451	-23736	26032	Q	HDZF
JUN	-24	37.2	-65 45	5.3	10688	9717	-4453	-23733	26029	Q	HDZF
JUL	-24	37.5	-65 44	4.3	10694	9722	-4456	-23728	26027	Q	HDZF
AUG	-24	38.6	-65 45	5.6	10684	9711	-4455	-23727	26021	Q	HDZF
SEP	-24	39.2	-65 45	5.7	10682	9708	-4456	-23725	26019	Q	HDZF
OCT	-24	38.9	-65 44	4.0	10692	9717	-4459	-23716	26014	Q	HDZF
NOV	-24	40.0	-65 43	3.8	10692	9716	-4462	-23714	26013	Q	HDZF
DEC	-24	38.8	-65 42	2.9	10698	9723	-4461	-23710	26011	Q	HDZF
YEAR	-24	36.9	-65 44	4.9	10691	9720	-4453	-23731	26028	Q	HDZF
JAN		33.1		9.6	10669	9704	-4433	-23768	26053	D	HDZF
FEB	-24	34.2	-65 4	7.7	10679	9712	-4440	-23755	26045	D	HDZF
MAR		34.3	-65 4	7.2	10680	9713	-4441	-23750	26041	D	HDZF
APR	-24	35.7	-65 4	7.4	10674	9706	-4443	-23739	26029	D	HDZF
MAY	-24	36.8	-65 53	3.2	10632	9665	-4428	-23753	26024	D	HDZF
JUN	-24	37.4	-65 48	3.3	10668	9698	-4445	-23741	26028	D	HDZF
JUL	-24	37.8	-65 48	3.4	10664	9694	-44444	-23736	26021	D	HDZF
AUG	-24	39.6	-65 49	9.5	10655	9684	-4446	-23736	26018	D	HDZF
SEP	-24	38.3	-65 50	0.7	10644	9675	-4437	-23734	26011	D	HDZF
OCT	-24	39.2	-65 46	5.0	10677	9704	-4454	-23721	26013	D	HDZF
NOV	-24	40.3	-65 45	5.1	10683	9708	-4459	-23717	26012	D	HDZF
DEC	-24	41.1	-65 44	4.8	10686	9709	-4463	-23717	26013	D	HDZF
YEAR	-24	37.3	-65 48	3.2	10667	9698	-44444	-23739	26026	D	HDZF

\*A: All days
\*Q: Quiet days
\*D: Disturbed days
ELE: Elements recorded

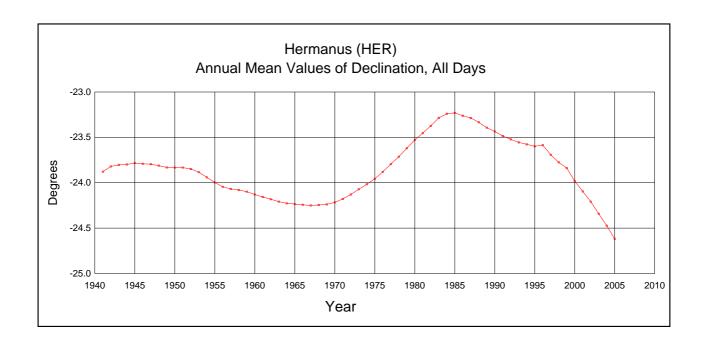
## HERMANUS MEAN ANNUAL VALUES

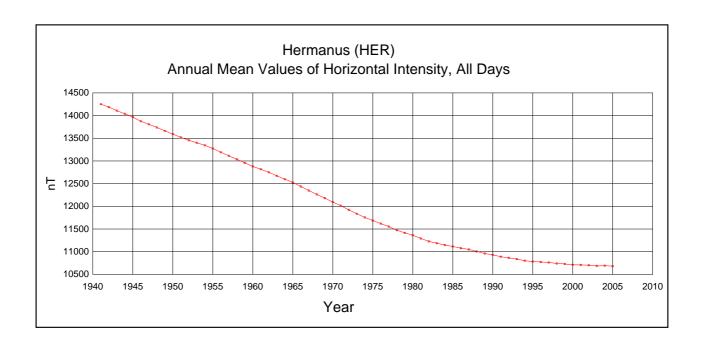
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1941.5	-23 51.6	-64 01.4	14252	13034	-5765	-29249	32537	A	DHZ
1942.5	-23 48.1	-64 03.0	14187	12980	-5724	-29153	32422	Α	DHZ
1943.5	-23 47.1	-64 06.4	14109	12911	-5690	-29065	32309	Α	DHZ
1944.5	-23 46.8	-64 09.1	14040	12848	-5661	-28981	32202	Α	DHZ
1945.5	-23 45.9	-64 12.4	13966	12782	-5628	-28900	32097	Α	DHZ
1946.5	-23 46.4	-64 17.5	13875	12697	-5594	-28819	31985	Α	DHZ
1947.5	-23 46.6	-64 19.9	13809	12637	-5567	-28734	31880	Α	DHZ
1948.5	-23 47.6	-64 22.4	13739	12571	-5543	-28642	31767	Α	DHZ
1949.5	-23 48.8	-64 25.8	13664	12501	-5517	-28557	31657	Α	DHZ
1950.5	-23 48.9	-64 28.5	13592	12435	-5488	-28465	31543	Α	DHZ
1951.5	-23 48.9	-64 31.2	13521	12370	-5460	-28373	31430	Α	DHZ
1952.5	-23 49.8	-64 33.1	13456	12309	-5436	-28278	31316	Α	DHZ
1953.5	-23 51.9	-64 33.9	13401	12255	-5422	-28179	31203	Α	DHZ
1954.5	-23 55.3	-64 35.3	13345	12199	-5411	-28090	31098	Α	DHZ
1955.5	-23 58.7	-64 38.7	13275	12130	-5395	-28013	30999	Α	DHZ
1956.5	-24 01.6	-64 44.0	13192	12049	-5372	-27950	30907	Α	DHZ
1957.5	-24 03.0	-64 48.5	13114	11976	-5344	-27880	30810	Α	DHZ
1958.5	-24 03.7	-64 52.6	13038	11905	-5316	-27804	30709	Α	DHZ
1959.5	-24 04.8	-64 56.9	12958	11830	-5287	-27724	30603	Α	DHZ
1960.5	-24 06.7	-65 01.0	12879	11755	-5261	-27640	30493	Α	DHZ
1961.5	-24 08.3	-65 02.8	12818	11697	-5242	-27546	30382	Α	DHZ
1962.5	-24 09.8	-65 04.8	12750	11633	-5219	-27444	30261	А	DHZ
1963.5	-24 11.4	-65 08.0	12672	11559	-5192	-27340	30134	А	DHZ
1964.5	-24 12.5	-65 10.6	12599	11491	-5166	-27238	30010	Α	DHZ
1965.5	-24 13.0	-65 13.5	12526	11423	-5138	-27139	29890	Α	DHZ
1966.5	-24 13.5	-65 18.2	12438	11343	-5104	-27046	29769	Α	DHZ
1967.5	-24 13.9	-65 23.3	12348	11260	-5068	-26956	29650	Α	DHZ
1968.5	-24 13.6	-65 27.6	12264	11184	-5032	-26860	29527	Α	DHZ
1969.5	-24 13.2	-65 31.6	12182	11110	-4997	-26764	29406	Α	DHZ
1970.5	-24 11.9	-65 36.3	12094	11032	-4957	-26668	29282	Α	DHZ
1971.5	-24 09.6	-65 40.3	12014	10962	-4917	-26573	29163	Α	DHZ
1972.5	-24 06.7	-65 45.7	11923	10883	-4871	-26482	29042	Α	DHZ
1973.5	-24 03.2	-65 50.7	11837	10809	-4825	-26394	28927	Α	DHZ
1974.5	-23 59.9	-65 55.0	11756	10740	-4781	-26302	28810	А	DHZ
1975.5	-23 56.3	-65 57.9	11688	10683	-4743	-26210	28698	Α	DHZ
1976.5	-23 51.7	-66 00.9	11620	10627	-4700	-26116	28584	Α	DHZ
1977.5	-23 46.6	-66 03.5	11555	10574	-4659	-26024	28473	Α	DHZ
1978.5	-23 41.7	-66 08.1	11475	10508	-4611	-25937	28362	Α	DHZ
1979.5	-23 36.1	-66 10.2	11416	10461	-4571	-25846	28255	Α	DHZ
1980.5	-23 30.6	-66 11.4	11363	10420	-4533	-25753	28148	А	DHZ

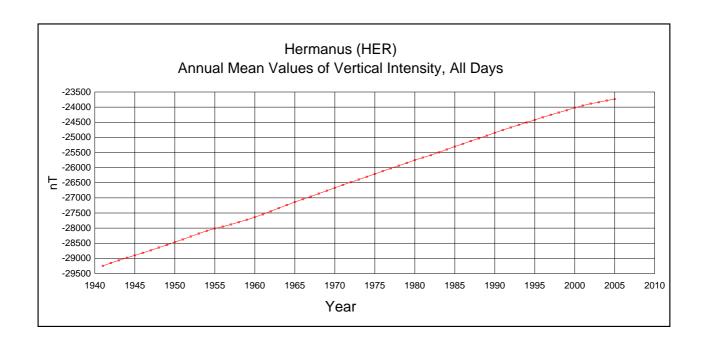
### **HERMANUS** MEAN ANNUAL VALUES

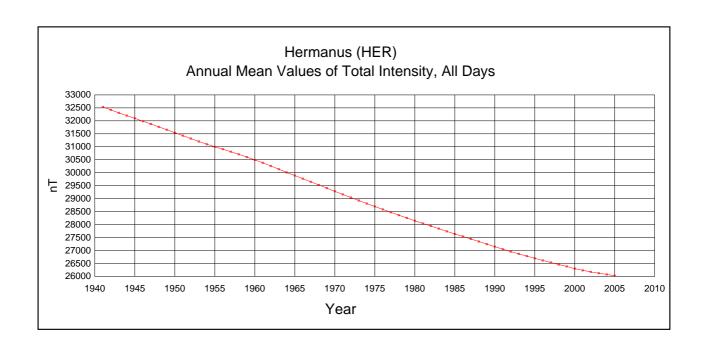
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1981.5	-23 26.1	-66 15.0	11293	10362	-4492	-25667	28042	А	DHZ
1982.5	-23 21.3	-66 18.6	11228	10309	-4452	-25591	27946	Α	DHZ
1983.5	-23 16.0	-66 18.4	11188	10279	-4420	-25496	27843	Α	DHZ
1984.5	-23 13.3	-66 18.3	11147	10244	-4395	-25399	27737	Α	DHZ
1985.5	-23 12.7	-66 17.2	11115	10216	-4381	-25304	27638	Α	DHZ
1986.5	-23 14.6	-66 16.8	11079	10180	-4373	-25215	27542	Α	DHZ
1987.5	-23 16.1	-66 15.3	11051	10153	-4366	-25122	27445	Α	DHZ
1988.5	-23 18.9	-66 15.9	11007	10109	-4357	-25034	27347	Α	DHZ
1989.5	-23 22.5	-66 16.7	10960	10061	-4349	-24943	27245	Α	DHZ
1990.5	-23 25.0	-66 15.2	10932	10032	-4345	-24849	27148	Α	DHZ
1991.5	-23 28.0	-66 15.5	10890	9990	-4337	-24759	27049	Α	DHZ
1992.5	-23 30.2	-66 14.0	10864	9963	-4333	-24671	26958	Α	DHZ
1993.5	-23 32.2	-66 12.7	10838	9937	-4329	-24586	26870	Α	DHZ
1994.5	-23 33.5	-66 12.8	10802	9902	-4318	-24507	26783	Α	DHZ
1995.5	-23 34.8	-66 10.7	10783	9883	-4314	-24423	26698	Α	DHZ
1996.5	-23 34.0	-66 07.2	10774	9876	-4308	-24337	26616	Α	DHZ
1997.5	-23 40.4	-66 04.3	10763	9858	-4322	-24255	26536	Α	DHZ
1998.5	-23 45.4	-66 02.7	10742	9833	-4328	-24179	26458	Α	DHZ
1999.0	0 1.1	0 -0.5	3	4	2	-16	4	J	DHZ
1999.5	-23 50.3	-66 00.3	10730	9815	-4337	-24104	26385	Α	DHZ
2000.5	-23 58.9	-65 57.8	10712	9788	-4355	-24018	26299	Α	DHZ
2001.5	-24 05.7	-65 54.4	10709	9776	-4372	-23948	26234	Α	DHZ
2002.5	-24 12.5	-65 51.7	10703	9762	-4389	-23885	26174	Α	DHZ
2003.5	-24 20.5	-65 51.1	10687	9738	-4406	-23838	26124	Α	DHZ
2004.5	-24 28.4	-65 47.5	10692	9732	-4430	-23782	26076	Α	DHZ
2005.5	-24 37.1	-65 46.1	10682	9712	-4450	-23733	26027	Α	DHZ

<sup>\*</sup>A: All days
\*I: Incomplete
\*J: Jump in data, jump value = old site value - new site value
ELE: Elements recorded

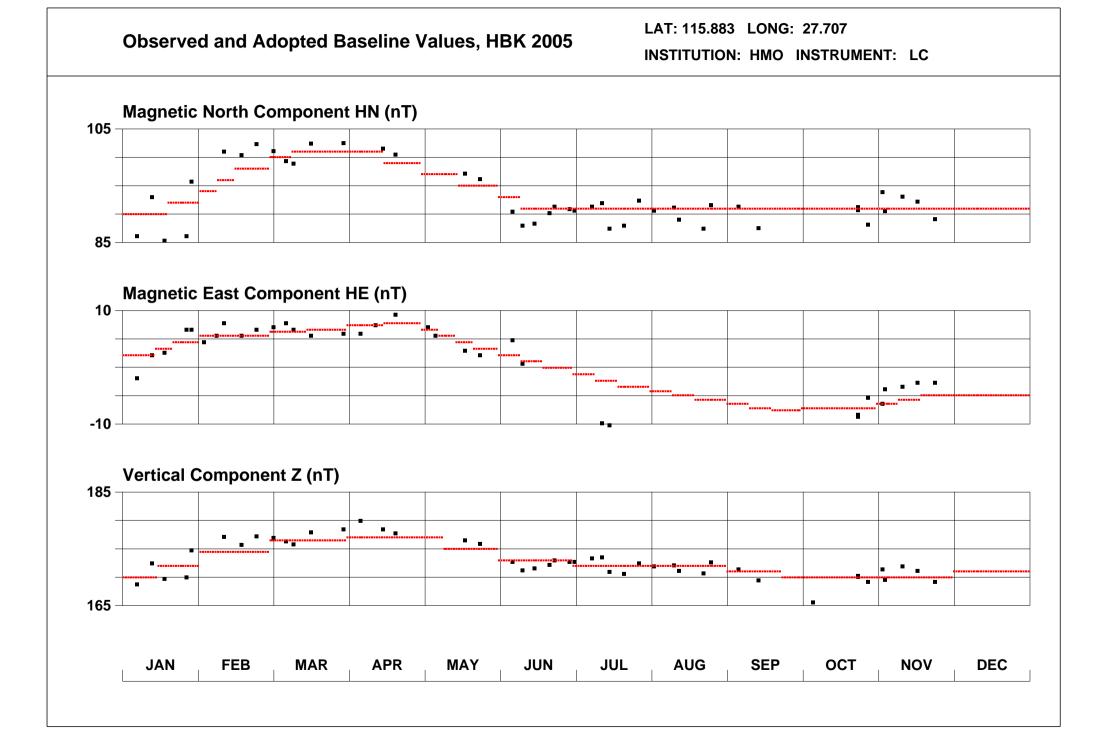


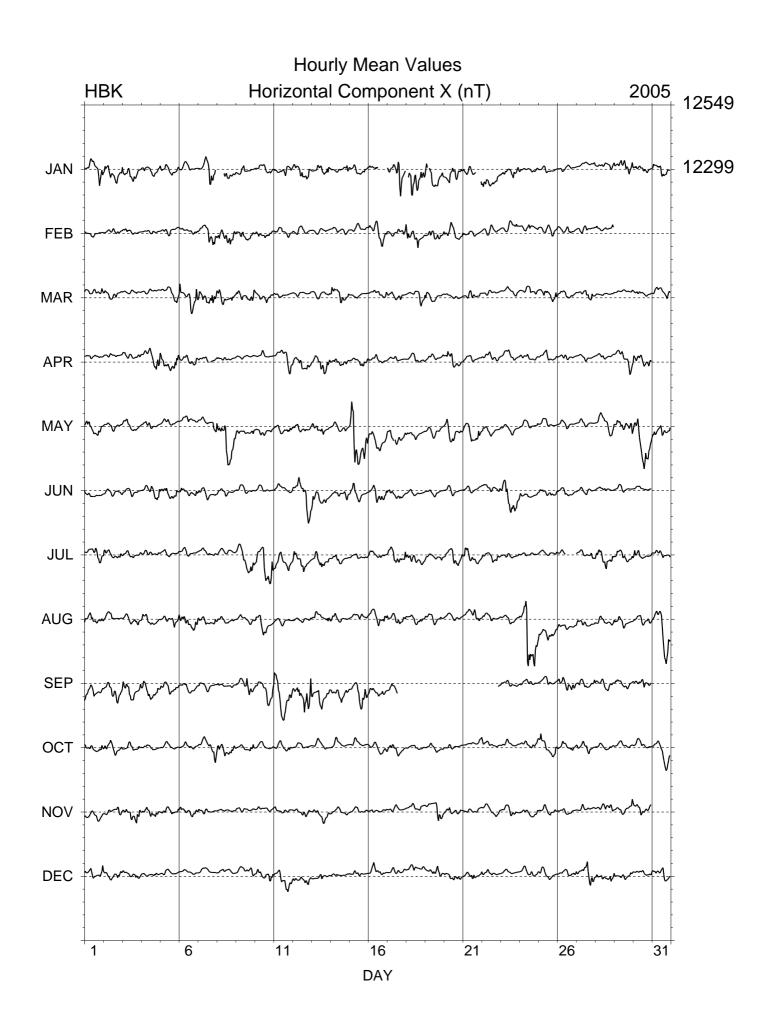


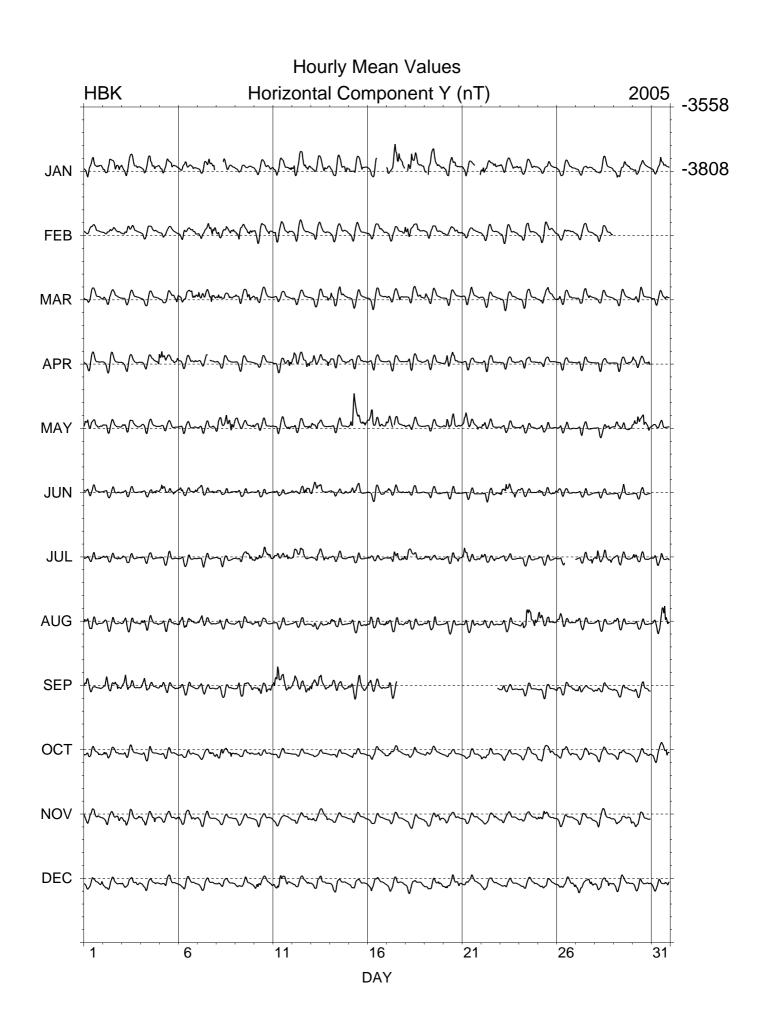


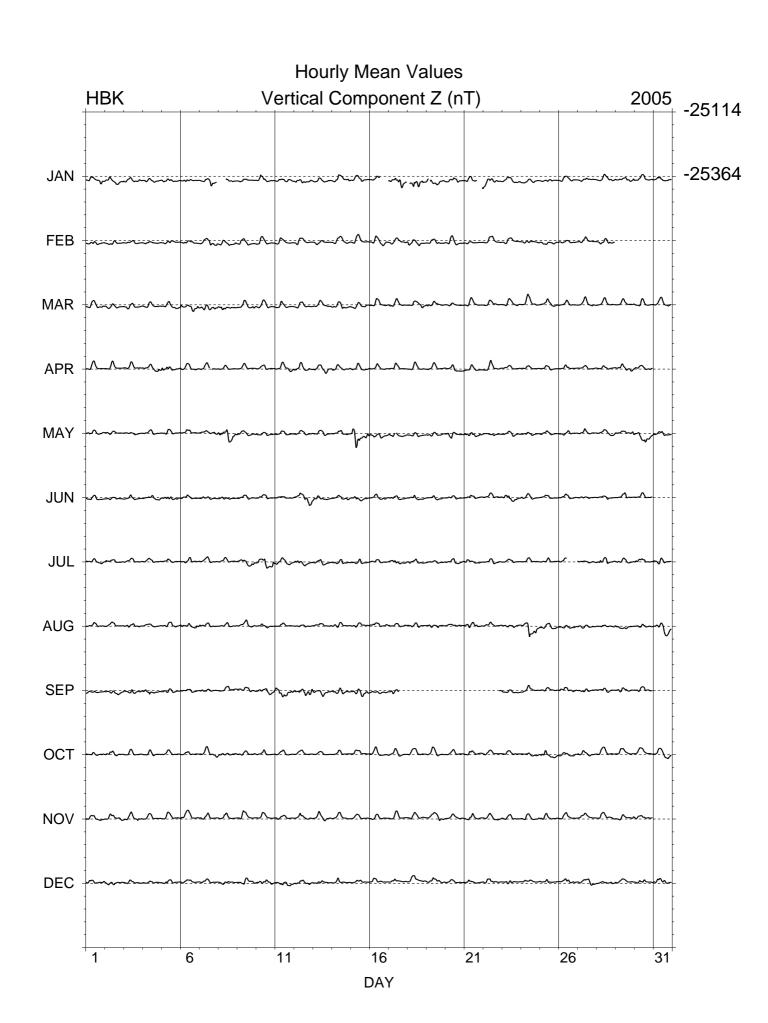


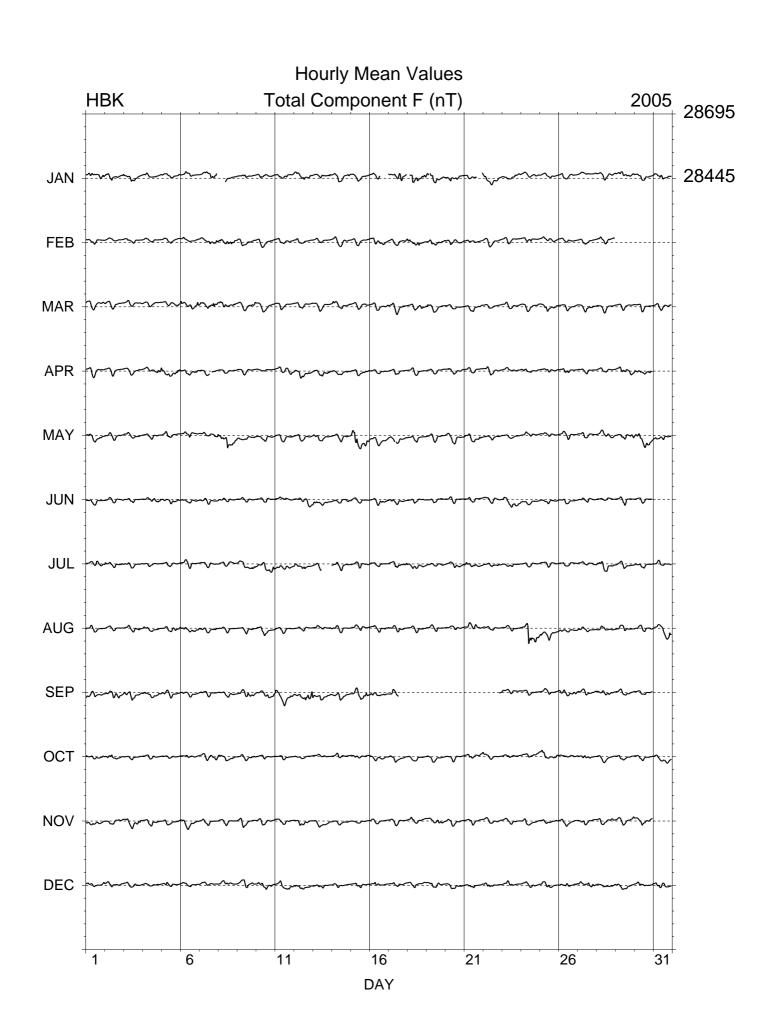
# Magnetic Results 2005 Hartebeesthoek











### HARTEBEESTHOEK MEAN MONTHLY VALUES 2005

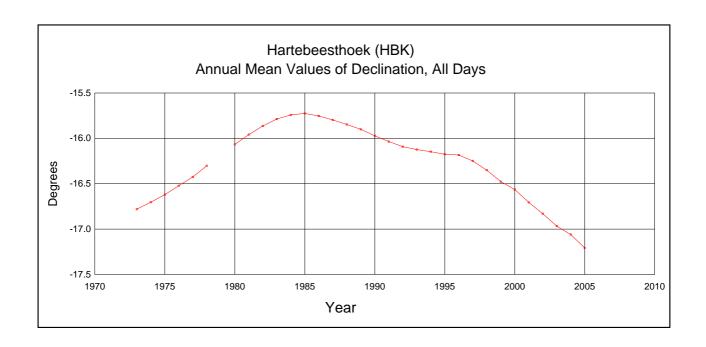
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YEAR -17 12.5 -63 04.0 12886 12310 -3812 -25363 28449 Q HD  JAN -17 07.0 -63 09.2 12849 12280 -3782 -25385 28451 D HD  FEB -17 08.2 -63 06.9 12864 12293 -3790 -25373 28448 D HD  MAR -17 08.2 -63 05.6 12876 12304 -3794 -25371 28451 D HD  APR -17 08.3 -63 05.4 12873 12301 -3793 -25362 28441 D HD  MAY -17 10.1 -63 11.7 12820 12249 -3784 -25373 28427 D HD  JUN -17 12.3 -63 07.4 12856 12281 -3803 -25366 28438 D HD  JUL -17 13.5 -63 07.7 12853 12277 -3806 -25366 28436 D HD  AUG -17 15.7 -63 08.8 12844 12265 -3811 -25368 28434 D HD  SEP -17 14.9 -63 10.2 12833 12256 -3805 -25371 28432 D HD  OCT -17 15.6 -63 05.3 12873 12293 -3820 -25362 28442 D HD  NOV -17 16.2 -63 04.4 12879 12299 -3823 -25357 28440 D HD											HDZF
JAN -17 07.0 -63 09.2 12849 12280 -3782 -25385 28451 D HD FEB -17 08.2 -63 06.9 12864 12293 -3790 -25373 28448 D HD MAR -17 08.2 -63 05.6 12876 12304 -3794 -25371 28451 D HD APR -17 08.3 -63 05.4 12873 12301 -3793 -25362 28441 D HD MAY -17 10.1 -63 11.7 12820 12249 -3784 -25373 28427 D HD JUN -17 12.3 -63 07.4 12856 12281 -3803 -25366 28438 D HD JUL -17 13.5 -63 07.7 12853 12277 -3806 -25366 28438 D HD AUG -17 15.7 -63 08.8 12844 12265 -3811 -25368 28434 D HD SEP -17 14.9 -63 10.2 12833 12256 -3805 -25371 28432 D HD OCT -17 15.6 -63 05.3 12873 12293 -3820 -25362 28442 D HD NOV -17 16.2 -63 04.4 12879 12299 -3823 -25357 28440 D HD										Q	HDZF
FEB -17 08.2 -63 06.9 12864 12293 -3790 -25373 28448 D HD MAR -17 08.2 -63 05.6 12876 12304 -3794 -25371 28451 D HD APR -17 08.3 -63 05.4 12873 12301 -3793 -25362 28441 D HD MAY -17 10.1 -63 11.7 12820 12249 -3784 -25373 28427 D HD JUN -17 12.3 -63 07.4 12856 12281 -3803 -25366 28438 D HD JUL -17 13.5 -63 07.7 12853 12277 -3806 -25366 28436 D HD AUG -17 15.7 -63 08.8 12844 12265 -3811 -25368 28434 D HD SEP -17 14.9 -63 10.2 12833 12256 -3805 -25371 28432 D HD OCT -17 15.6 -63 05.3 12873 12293 -3820 -25362 28442 D HD NOV -17 16.2 -63 04.4 12879 12299 -3823 -25357 28440 D HD	YEAR	-17	12.5	-63 04.0	12886	12310	-3812	-25363	28449	Q	HDZF
MAR -17 08.2 -63 05.6 12876 12304 -3794 -25371 28451 D HD APR -17 08.3 -63 05.4 12873 12301 -3793 -25362 28441 D HD MAY -17 10.1 -63 11.7 12820 12249 -3784 -25373 28427 D HD JUN -17 12.3 -63 07.4 12856 12281 -3803 -25366 28438 D HD JUL -17 13.5 -63 07.7 12853 12277 -3806 -25366 28436 D HD AUG -17 15.7 -63 08.8 12844 12265 -3811 -25368 28434 D HD SEP -17 14.9 -63 10.2 12833 12256 -3805 -25371 28432 D HD OCT -17 15.6 -63 05.3 12873 12293 -3820 -25362 28442 D HD NOV -17 16.2 -63 04.4 12879 12299 -3823 -25357 28440 D HD		-17								D	HDZF
APR -17 08.3 -63 05.4 12873 12301 -3793 -25362 28441 D HD MAY -17 10.1 -63 11.7 12820 12249 -3784 -25373 28427 D HD JUN -17 12.3 -63 07.4 12856 12281 -3803 -25366 28438 D HD JUL -17 13.5 -63 07.7 12853 12277 -3806 -25366 28436 D HD AUG -17 15.7 -63 08.8 12844 12265 -3811 -25368 28434 D HD SEP -17 14.9 -63 10.2 12833 12256 -3805 -25371 28432 D HD OCT -17 15.6 -63 05.3 12873 12293 -3820 -25362 28442 D HD NOV -17 16.2 -63 04.4 12879 12299 -3823 -25357 28440 D HD	FEB			-63 06.9					28448	D	HDZF
MAY -17 10.1 -63 11.7 12820 12249 -3784 -25373 28427 D HD JUN -17 12.3 -63 07.4 12856 12281 -3803 -25366 28438 D HD JUL -17 13.5 -63 07.7 12853 12277 -3806 -25366 28436 D HD AUG -17 15.7 -63 08.8 12844 12265 -3811 -25368 28434 D HD SEP -17 14.9 -63 10.2 12833 12256 -3805 -25371 28432 D HD OCT -17 15.6 -63 05.3 12873 12293 -3820 -25362 28442 D HD NOV -17 16.2 -63 04.4 12879 12299 -3823 -25357 28440 D HD	MAR								28451	D	HDZF
JUN       -17       12.3       -63       07.4       12856       12281       -3803       -25366       28438       D       HD         JUL       -17       13.5       -63       07.7       12853       12277       -3806       -25366       28436       D       HD         AUG       -17       15.7       -63       08.8       12844       12265       -3811       -25368       28434       D       HD         SEP       -17       14.9       -63       10.2       12833       12256       -3805       -25371       28432       D       HD         OCT       -17       15.6       -63       05.3       12873       12293       -3820       -25362       28442       D       HD         NOV       -17       16.2       -63       04.4       12879       12299       -3823       -25357       28440       D       HD	APR									D	HDZF
JUL       -17       13.5       -63       07.7       12853       12277       -3806       -25366       28436       D       HD         AUG       -17       15.7       -63       08.8       12844       12265       -3811       -25368       28434       D       HD         SEP       -17       14.9       -63       10.2       12833       12256       -3805       -25371       28432       D       HD         OCT       -17       15.6       -63       05.3       12873       12293       -3820       -25362       28442       D       HD         NOV       -17       16.2       -63       04.4       12879       12299       -3823       -25357       28440       D       HD	MAY	-17							28427	D	HDZF
AUG -17 15.7 -63 08.8 12844 12265 -3811 -25368 28434 D HD SEP -17 14.9 -63 10.2 12833 12256 -3805 -25371 28432 D HD OCT -17 15.6 -63 05.3 12873 12293 -3820 -25362 28442 D HD NOV -17 16.2 -63 04.4 12879 12299 -3823 -25357 28440 D HD										D	HDZF
SEP -17 14.9 -63 10.2 12833 12256 -3805 -25371 28432 D HD OCT -17 15.6 -63 05.3 12873 12293 -3820 -25362 28442 D HD NOV -17 16.2 -63 04.4 12879 12299 -3823 -25357 28440 D HD										D	HDZF
OCT -17 15.6 -63 05.3 12873 12293 -3820 -25362 28442 D HD NOV -17 16.2 -63 04.4 12879 12299 -3823 -25357 28440 D HD										D	HDZF
NOV -17 16.2 -63 04.4 12879 12299 -3823 -25357 28440 D HD										D	HDZF
									_		HDZF
											HDZF
											HDZF
YEAR -17 12.5 -63 07.2 12859 12283 -3804 -25367 28440 D HD	YEAR	-17	12.5	-63 07.2	12859	12283	-3804	-25367	28440	D	HDZF

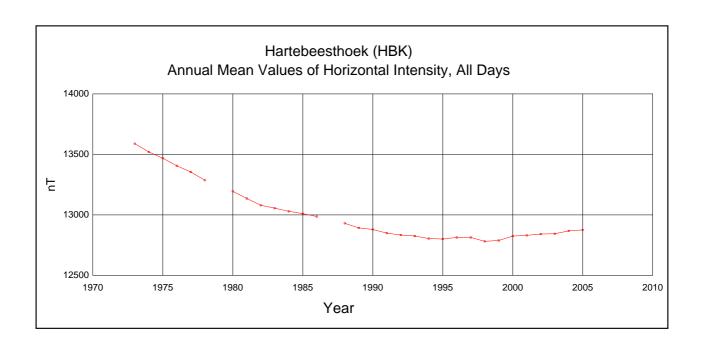
\*A: All days
\*Q: Quiet days
\*D: Disturbed days
ELE: Elements recorded

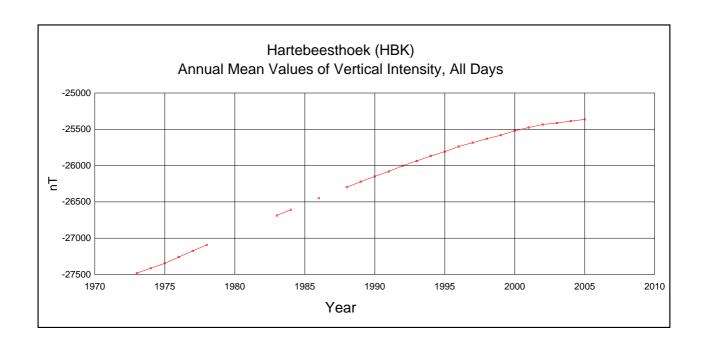
## HARTEBEESTHOEK MEAN ANNUAL VALUES

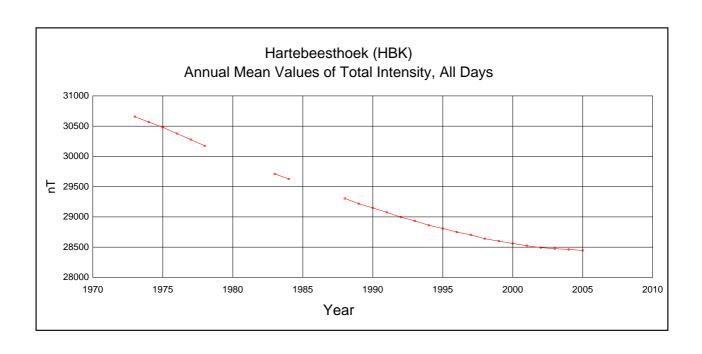
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1973.5	-16 46.6	-63 41.5	13588	13010	-3919	-27481	30657	I	DHZ
1974.5	-16 42.0	-63 45.0	13520	12950	-3885	-27414	30567	Α	DHZ
1975.5	-16 37.0	-63 46.8	13468	12905	-3852	-27346	30482	Α	DHZ
1976.5	-16 31.1	-63 49.0	13405	12852	-3811	-27260	30378	Α	DHZ
1977.5	-16 25.3	-63 49.8	13354	12810	-3775	-27174	30278	Α	DHZ
1978.5	-16 17.9	-63 52.6	13286	12752	-3729	-27092	30174	I	DHZ
1979.5	999 99.9	999 99.9	99999	99999	99999	99999	99999	I	DHZ
1980.5	-16 03.8	999 99.9	13194	12679	-3651	99999	99999	I	DHZ
1981.5	-15 57.3	999 99.9	13135	12629	-3610	99999	99999	I	DHZ
1982.5	-15 51.6	999 99.9	13079	12581	-3574	99999	99999	I	DHZ
1983.5	-15 47.0	-63 56.0	13055	12563	-3551	-26688	29711	I	DHZ
1984.5	-15 44.3	-63 54.5	13029	12541	-3534	-26608	29627	I	DHZ
1985.5	-15 43.3	999 99.9	13010	12524	-3525	99999	99999	I	DHZ
1986.5	-15 45.0	999 99.9	12986	99999	99999	-26449	99999	I	DHZ
1987.5	-15 47.6	999 99.9	99999	99999	99999	99999	99999	I	DHZ
1988.5	-15 50.6	-63 49.1	12930	12439	-3530	-26298	29305	I	DHZ
1989.5	-15 53.8	-63 49.1	12892	12396	-3531	-26222	29219	I	DHZ
1990.5	-15 58.1	-63 46.8	12879	12382	-3543	-26149	29149	I	DHZ
1991.5	-16 01.9	-63 46.5	12849	12349	-3548	-26081	29075	I	DHZ
1992.5	-16 05.3	-63 44.0	12833	12330	-3556	-26002	28997	I	DHZ
1993.5	-16 07.2	-63 41.3	12825	12321	-3560	-25936	28934	I	DHZ
1994.5	-16 08.6	-63 40.0	12804	12299	-3560	-25867	28862	I	DHZ
1995.5	-16 10.3	-63 37.3	12800	12294	-3565	-25808	28808	Α	DHZ
1996.5	-16 10.8	-63 32.1	12813	12306	-3570	-25737	28750	Α	DHZ
1997.5	-16 14.7	-63 29.3	12813	12302	-3584	-25684	28703	I	DHZ
1998.5	-16 20.8	-63 29.8	12781	12265	-3597	-25630	28640	I	DHZ
1999.5	-16 28.4	-63 26.4	12788	12263	-3626	-25582	28600	A	DHZ
2000.0	0 0.0	0 -4.8	-35	-34	11	-18	0	J	DHZ
2000.5	-16 33.8	-63 19.1	12825	12293	-3656	-25520	28561	Α	DHZ
2001.5	-16 42.3	-63 16.0	12831	12290	-3688	-25475	28524	I	DHZ
2002.5	-16 49.8	-63 12.7	12842	12292	-3718	-25434	28492	I	DHZ
2003.5	-16 58.0	-63 11.4	12844	12285	-3748	-25413	28475	Α	DHZ
2004.5	-17 03.6	-63 07.3	12868	12302	-3775	-25387	28462	I	DHZ
2005.5	-17 12.4	-63 05.2	12876	12300	-3809	-25364	28446	A	DHZ

<sup>\*</sup>A: All days
\*I: Incomplete
\*J: Jump in data, jump value = old site value - new site value
ELE: Elements recorded

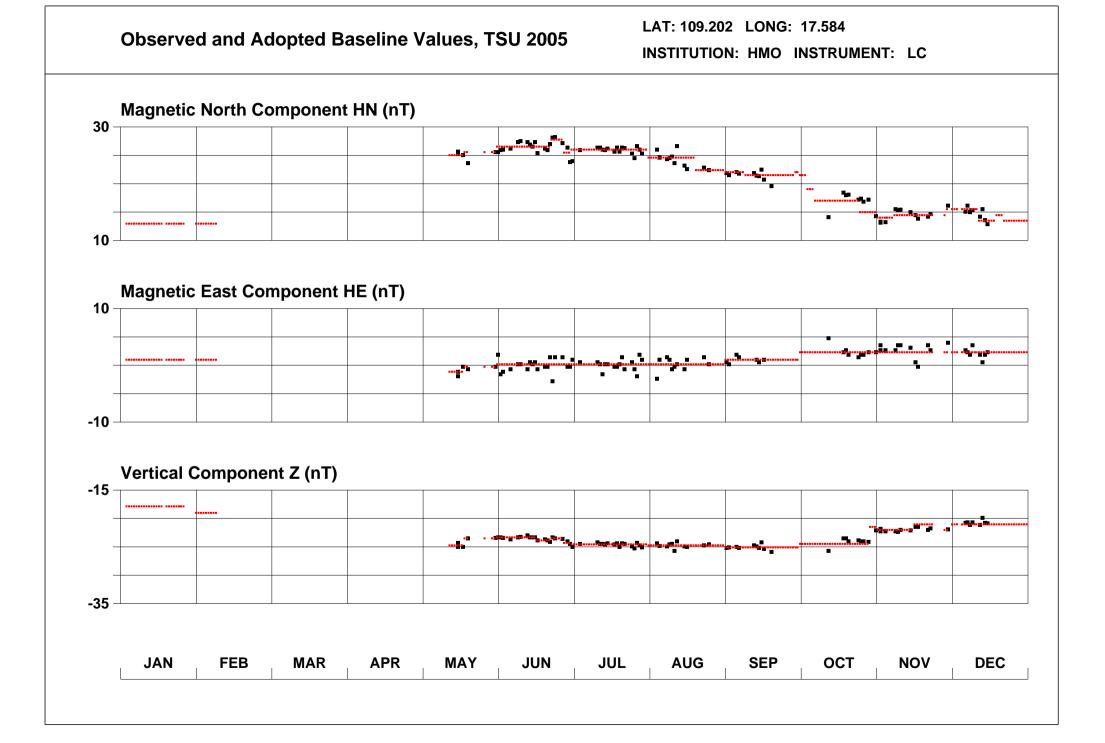


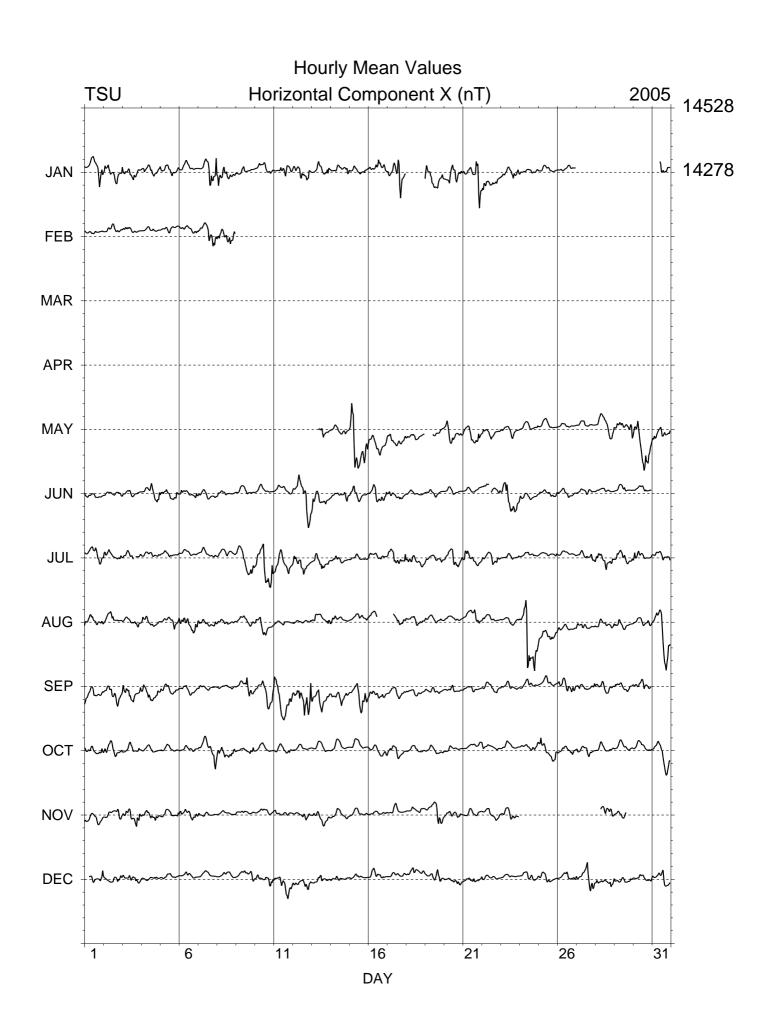


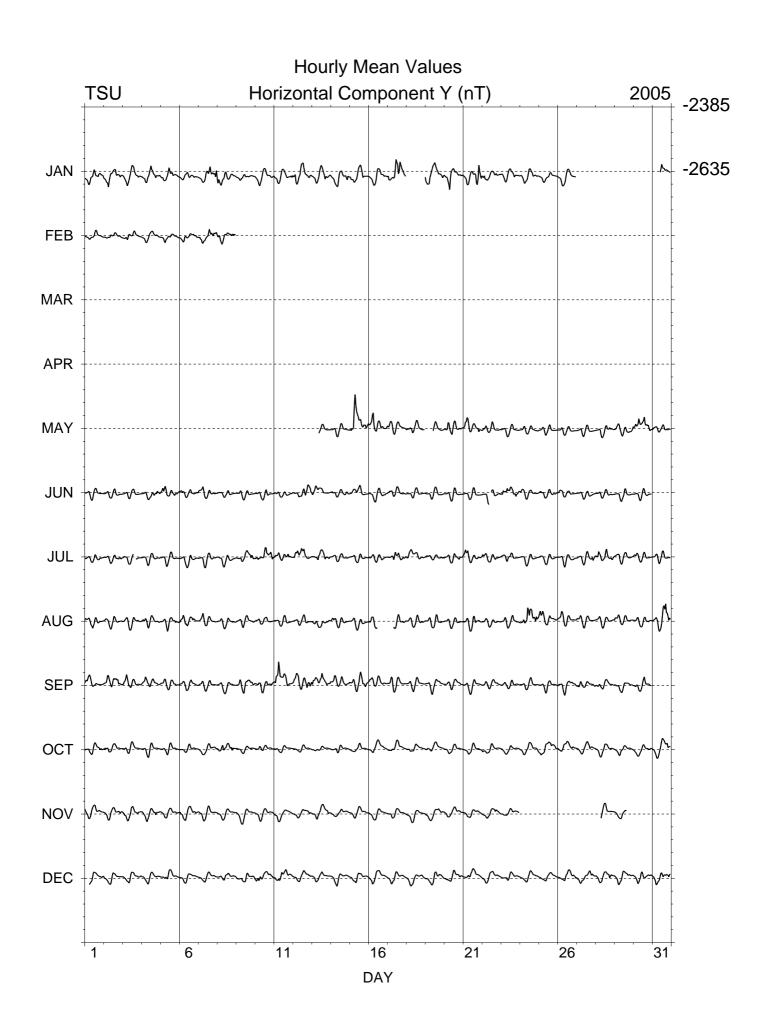


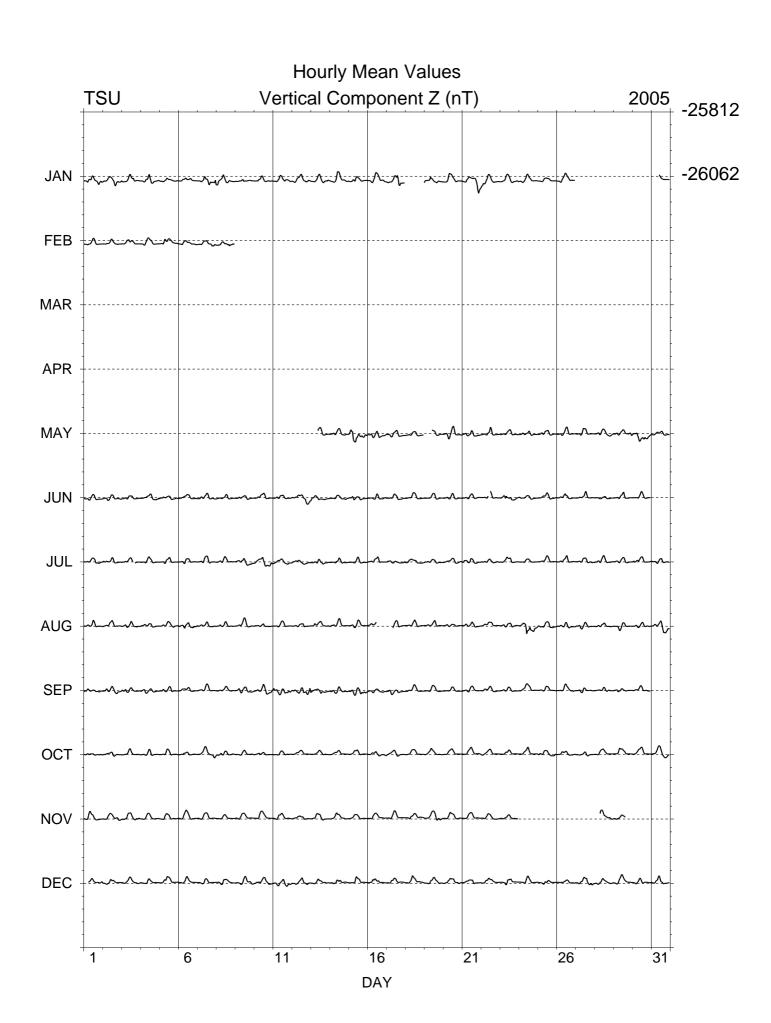


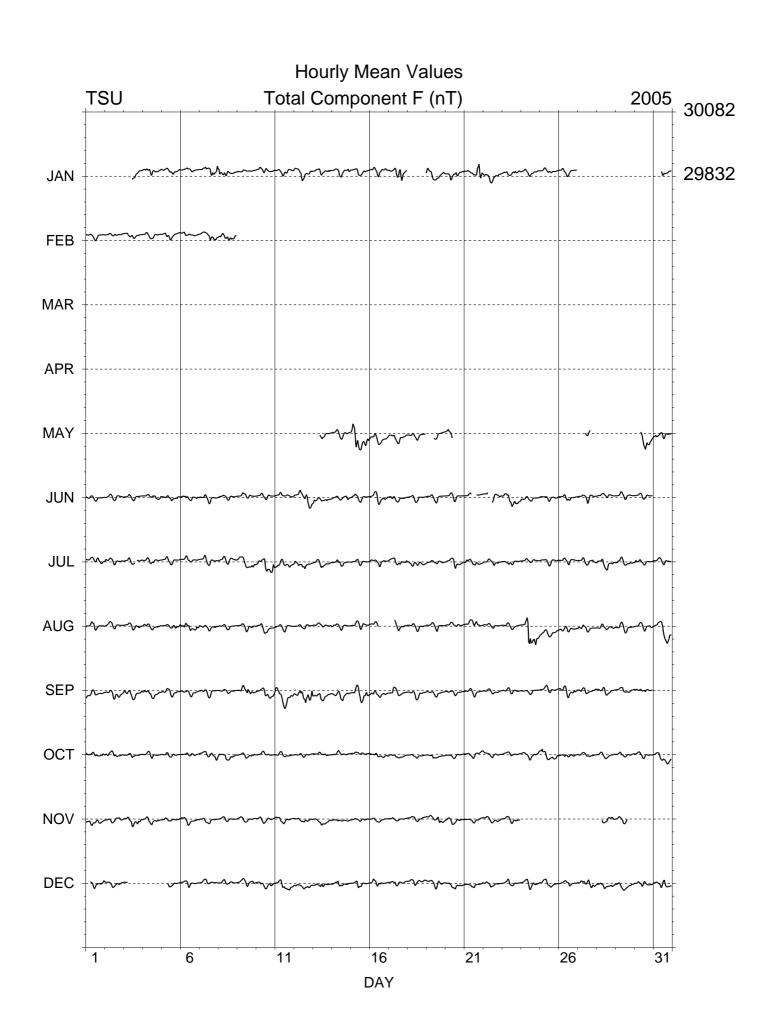
# Magnetic Results 2005 Tsumeb











## TSUMEB MEAN MONTHLY VALUES 2005

FEB	Date	0	D ,	。 I ,	H nT	X nT	Y nT	Z nT	F nT	*	ELE
MAR										А	HDZF
APR *** **** *** *** **** **** **** ****	FEB				_					A	HDZF
MAY -10 28.1 -60 54.3 14505 14263 -2635 -26065 29820 A HDZI JUN -10 28.3 -60 52.4 14522 14280 -2638 -26062 29834 A HDZI JUL -10 28.0 -60 52.4 14522 14280 -2638 -26060 29833 A HDZI AUG -10 27.5 -60 52.9 14516 14275 -2635 -26060 29830 A HDZI SEP -10 26.7 -60 54.4 14502 14262 -2629 -26062 29825 A HDZI OCT -10 26.3 -60 51.8 14525 14285 -2631 -26057 29832 A HDZI NOV -10 26.6 -60 51.9 14523 14283 -2633 -26055 29829 A HDZI DEC -10 26.0 -60 51.9 14524 14284 -2630 -26057 29831 A HDZI JAN -10 32.1 -60 51.8 14536 14291 -2658 -26062 29833 A HDZI JAN -10 32.1 -60 50.1 14548 14307 -2641 -26062 29833 A HDZI AWAR *** **** *** **** **** **** **** **										A	HDZF
JUN -10 28.3 -60 52.4 14522 14280 -2639 -26062 29834 A HDZI JUL -10 28.0 -60 52.4 14522 14280 -2638 -26060 29830 A HDZI AUG -10 27.5 -60 52.9 14516 14275 -2635 -26060 29830 A HDZI NOV -10 26.3 -60 51.9 14523 14285 -2631 -26057 29832 A HDZI NOV -10 26.6 -60 51.9 14523 14285 -2631 -26057 29832 A HDZI DEC -10 26.0 -60 51.9 14523 14284 -2630 -26055 29829 A HDZI DEC -10 27.6 -60 52.6 14519 14278 -2636 -26062 29833 A HDZI JAN -10 32.1 -60 51.8 14536 14291 -2658 -26077 29854 Q HDZI JAN -10 32.1 -60 51.8 14536 14291 -2658 -26077 29854 Q HDZI MAR *** **** *** **** **** **** **** ***	APR	***				****	****	*****	****	A	HDZF
JUL         -10         28.0         -60         52.4         14522         14280         -2638         -26060         29833         A         HDZI           AUG         -10         27.5         -60         52.9         14516         14275         -2635         -26060         29830         A         HDZI           OCT         -10         26.7         -60         54.4         14502         14262         -2629         -260657         29832         A         HDZI           NOV         -10         26.6         -60         51.9         14523         14283         -2633         -26057         29831         A         HDZI           YEAR         -10         27.6         -60         52.6         14519         14278         -2636         -26067         29831         A         HDZI           JAN         -10         32.1         -60         51.8         14536         14291         -2658         -26077         29854         Q         HDZI           JAN         -10         32.1         -60         50.1         14536         14291         -2658         -26077         29854         Q         HDZI           JAN         -10 <t< td=""><td>MAY</td><td>-</td><td>28.1</td><td></td><td></td><td></td><td>-2635</td><td></td><td></td><td>Α</td><td>HDZF</td></t<>	MAY	-	28.1				-2635			Α	HDZF
AUG -10 27.5 -60 52.9 14516 14275 -2635 -26060 29830 A HDZI SEP -10 26.7 -60 54.4 14502 14262 -2629 -26062 29825 A HDZI OCT -10 26.3 -60 51.8 14525 14285 -2631 -26057 29832 A HDZI NOV -10 26.6 -60 51.9 14523 14283 -2633 -26055 29829 A HDZI DEC -10 26.0 -60 51.9 14524 14284 -2630 -26057 29831 A HDZI YEAR -10 27.6 -60 52.6 14519 14278 -2636 -26062 29833 A HDZI JAN -10 32.1 -60 51.8 14536 14291 -2658 -26077 29854 Q HDZI MAR *** **** **** **** **** **** **** *	JUN	-10	28.3			14280	-2639	-26062	29834	Α	HDZF
SEP -10 26.7 -60 54.4 14502 14262 -2629 -26062 29825 A HDZI OCT -10 26.3 -60 51.8 14525 14285 -2631 -26057 29832 A HDZI NOV -10 26.6 -60 51.9 14523 14283 -2633 -26055 29829 A HDZI SEP -10 27.6 -60 52.6 14519 14278 -2636 -26062 29833 A HDZI JAN -10 32.1 -60 51.8 14536 14291 -2658 -26077 29854 Q HDZI JAN -10 32.1 -60 51.8 14536 14291 -2658 -26077 29854 Q HDZI MAR *** **** *** *** **** **** **** ***	JUL	-10								A	HDZF
OCT -10 26.3 -60 51.8 14525 14285 -2631 -26057 29832 A HDZI NOV -10 26.6 -60 51.9 14523 14283 -2633 -26055 29829 A HDZI DEC -10 26.0 -60 51.9 14524 14284 -2630 -26057 29831 A HDZI YEAR -10 27.6 -60 52.6 14519 14278 -2636 -26062 29833 A HDZI JAN -10 32.1 -60 51.8 14536 14291 -2658 -26077 29854 Q HDZI JAN -10 32.1 -60 50.1 14548 14307 -2641 -26069 29854 Q HDZI MAR *** **** *** *** **** **** **** ***		-10					-2635	-26060	29830	Α	HDZF
NOV -10 26.6 -60 51.9 14523 14283 -2633 -26055 29829 A HDZI DEC -10 26.0 -60 51.9 14524 14284 -2630 -26057 29831 A HDZI YEAR -10 27.6 -60 52.6 14519 14278 -2636 -26062 29833 A HDZI JAN -10 32.1 -60 51.8 14536 14291 -2658 -26077 29854 Q HDZI MAR *** *** *** *** *** *** *** *** *** *	SEP	-10	26.7					-26062		Α	HDZF
DEC -10 26.0 -60 51.9 14524 14284 -2630 -26057 29831 A HDZI YEAR -10 27.6 -60 52.6 14519 14278 -2636 -26062 29833 A HDZI JAN -10 32.1 -60 51.8 14536 14291 -2658 -26077 29854 Q HDZI MAR *** **** **** **** **** **** **** *	OCT	-10	26.3							Α	HDZF
YEAR -10 27.6 -60 52.6 14519 14278 -2636 -26062 29833 A HDZI  JAN -10 32.1 -60 51.8 14536 14291 -2658 -26077 29854 Q HDZI  FEB -10 27.5 -60 50.1 14548 14307 -2641 -26069 29854 Q HDZI  MAR *** **** *** *** **** **** **** ****	NOV	-10				14283	-2633	-26055	29829	Α	HDZF
JAN -10 32.1 -60 51.8 14536 14291 -2658 -26077 29854 Q HDZI FEB -10 27.5 -60 50.1 14548 14307 -2641 -26069 29854 Q HDZI APR *** **** **** **** **** **** **** *	DEC	-10						-26057		Α	HDZF
FEB -10 27.5 -60 50.1 14548 14307 -2641 -26069 29854 Q HDZI MAR *** **** *** *** *** **** **** ****	YEAR	-10	27.6	-60 52.6	14519	14278	-2636	-26062	29833	Α	HDZF
MAR *** **** *** *** *** **** **** ****	JAN	-10	32.1	-60 51.8	14536	14291	-2658	-26077	29854	Q	HDZF
APR *** **** *** *** **** **** **** ****	FEB	_		-60 50.1	14548	14307	-2641	-26069	29854	Q	HDZF
MAY -10 28.6 -60 51.0 14536 14294 -2643 -26062 ***** Q HDZ; JUN -10 28.6 -60 51.3 14533 14290 -2642 -26061 29839 Q HDZ; JUL -10 28.7 -60 50.8 14537 14294 -2644 -26059 29839 Q HDZ; AUG -10 27.6 -60 52.4 14521 14279 -2636 -26060 29832 Q HDZ; SEP -10 27.1 -60 52.6 14519 14278 -2634 -26059 29830 Q HDZ; OCT -10 26.3 -60 50.9 14534 14293 -2633 -26056 29835 Q HDZ; NOV -10 26.7 -60 51.1 14530 14289 -2634 -26054 29832 Q HDZ; DEC -10 25.7 -60 51.0 14532 14292 -2630 -26056 29834 Q HDZ; YEAR -10 27.8 -60 51.4 14531 14290 -2639 -26061 29837 Q HDZ; JAN -10 31.4 -60 54.6 14511 14267 -2650 -26081 29837 Q HDZ; FEB -10 28.0 -60 52.5 14528 14286 -2639 -26075 29849 D HDZ; APR *** **** *** **** **** **** ***** *****		***	****	*** ***	****		****	*****	****	Q	$\mathtt{HDZF}$
JUN -10 28.6 -60 51.3 14533 14290 -2642 -26061 29839 Q HDZI JUL -10 28.7 -60 50.8 14537 14294 -2644 -26059 29839 Q HDZI AUG -10 27.6 -60 52.4 14521 14279 -2636 -26060 29832 Q HDZI SEP -10 27.1 -60 52.6 14519 14278 -2634 -26059 29830 Q HDZI OCT -10 26.3 -60 50.9 14534 14293 -2633 -26056 29835 Q HDZI NOV -10 26.7 -60 51.1 14530 14289 -2634 -26054 29832 Q HDZI DEC -10 25.7 -60 51.0 14532 14292 -2630 -26056 29834 Q HDZI YEAR -10 27.8 -60 51.4 14531 14290 -2639 -26061 29837 Q HDZI JAN -10 31.4 -60 54.6 14511 14267 -2650 -26061 29837 Q HDZI MAR *** **** *** **** **** **** ***** *****	APR	***	****	*** ***	****	****	****	*****	****	Q	HDZF
JUL -10 28.7 -60 50.8 14537 14294 -2644 -26059 29839 Q HDZ3 AUG -10 27.6 -60 52.4 14521 14279 -2636 -26060 29832 Q HDZ3 SEP -10 27.1 -60 52.6 14519 14278 -2634 -26059 29830 Q HDZ3 OCT -10 26.3 -60 50.9 14534 14293 -2633 -26056 29835 Q HDZ3 NOV -10 26.7 -60 51.1 14530 14289 -2634 -26054 29832 Q HDZ3 DEC -10 25.7 -60 51.0 14532 14292 -2630 -26056 29834 Q HDZ3 YEAR -10 27.8 -60 51.4 14531 14290 -2639 -26061 29837 Q HDZ3 JAN -10 31.4 -60 54.6 14511 14267 -2650 -26081 29837 Q HDZ3 MAR *** **** *** *** **** **** **** ****	MAY	-10							****	Q	HDZF
AUG -10 27.6 -60 52.4 14521 14279 -2636 -26060 29832 Q HDZ3 SEP -10 27.1 -60 52.6 14519 14278 -2634 -26059 29830 Q HDZ3 OCT -10 26.3 -60 50.9 14534 14293 -2633 -26056 29835 Q HDZ3 NOV -10 26.7 -60 51.1 14530 14289 -2634 -26054 29832 Q HDZ3 DEC -10 25.7 -60 51.0 14532 14292 -2630 -26056 29834 Q HDZ3 YEAR -10 27.8 -60 51.4 14531 14290 -2639 -26061 29837 Q HDZ3 JAN -10 31.4 -60 54.6 14511 14267 -2650 -26081 29845 D HDZ3 MAR *** **** **** **** **** ***** ***** D HDZ3 APR *** **** *** **** **** ***** ***** D HDZ3 APR *** **** *** **** **** **** **** **	JUN	-10	28.6	-60 51.3	14533	14290	-2642	-26061	29839	Q	HDZF
SEP -10 27.1 -60 52.6 14519 14278 -2634 -26059 29830 Q HDZ OCT -10 26.3 -60 50.9 14534 14293 -2633 -26056 29835 Q HDZ NOV -10 26.7 -60 51.1 14530 14289 -2634 -26054 29832 Q HDZ DEC -10 25.7 -60 51.0 14532 14292 -2630 -26056 29834 Q HDZ YEAR -10 27.8 -60 51.4 14531 14290 -2639 -26061 29837 Q HDZ JAN -10 31.4 -60 54.6 14511 14267 -2650 -26081 29837 Q HDZ FEB -10 28.0 -60 52.5 14528 14286 -2639 -26075 29849 D HDZ MAR *** **** *** *** **** **** **** D HDZ APR *** **** *** *** **** **** **** ****	JUL	-10	28.7				-2644	-26059	29839	Q	$\mathtt{HDZF}$
OCT -10 26.3 -60 50.9 14534 14293 -2633 -26056 29835 Q HDZI NOV -10 26.7 -60 51.1 14530 14289 -2634 -26054 29832 Q HDZI DEC -10 25.7 -60 51.0 14532 14292 -2630 -26056 29834 Q HDZI YEAR -10 27.8 -60 51.4 14531 14290 -2639 -26061 29837 Q HDZI JAN -10 31.4 -60 54.6 14511 14267 -2650 -26081 29845 D HDZI FEB -10 28.0 -60 52.5 14528 14286 -2639 -26075 29849 D HDZI APR *** **** **** **** **** **** ***** D HDZI APR *** **** **** **** **** **** **** *	AUG	-10	27.6					-26060		Q	HDZF
NOV -10 26.7 -60 51.1 14530 14289 -2634 -26054 29832 Q HDZI DEC -10 25.7 -60 51.0 14532 14292 -2630 -26056 29834 Q HDZI YEAR -10 27.8 -60 51.4 14531 14290 -2639 -26061 29837 Q HDZI JAN -10 31.4 -60 54.6 14511 14267 -2650 -26081 29845 D HDZI FEB -10 28.0 -60 52.5 14528 14286 -2639 -26075 29849 D HDZI APR *** **** *** **** **** **** ***** *****	SEP	-10	27.1				-2634	-26059	29830	Q	HDZF
DEC -10 25.7 -60 51.0 14532 14292 -2630 -26056 29834 Q HDZI YEAR -10 27.8 -60 51.4 14531 14290 -2639 -26061 29837 Q HDZI JAN -10 31.4 -60 54.6 14511 14267 -2650 -26081 29845 D HDZI FEB -10 28.0 -60 52.5 14528 14286 -2639 -26075 29849 D HDZI APR *** **** *** *** **** **** **** ***	OCT	-10		-60 50.9	14534	14293		-26056	29835	Q	HDZF
YEAR -10 27.8 -60 51.4 14531 14290 -2639 -26061 29837 Q HDZ3  JAN -10 31.4 -60 54.6 14511 14267 -2650 -26081 29845 D HDZ3  FEB -10 28.0 -60 52.5 14528 14286 -2639 -26075 29849 D HDZ3  MAR *** **** *** *** **** **** ***** ***** D HDZ3  APR *** **** *** *** *** **** **** ***** D HDZ3  MAY -10 26.2 -60 60.0 14453 14214 -2618 -26072 29809 D HDZ3  JUN -10 28.2 -60 53.8 14509 14267 -2636 -26064 29830 D HDZ3  JUL -10 27.4 -60 54.6 14500 14259 -2632 -26063 29825 D HDZ3  AUG -10 27.4 -60 55.9 14488 14247 -2629 -26062 29819 D HDZ3  SEP -10 25.5 -60 57.4 14474 14235 -2619 -26065 29814 D HDZ3  OCT -10 26.1 -60 53.1 14513 14273 -2628 -26058 29827 D HDZ3  NOV -10 26.7 -60 52.7 14515 14275 -2631 -26056 29826 D HDZ3  DEC -10 26.3 -60 53.4 14510 14270 -2629 -26059 29826 D HDZ3	NOV	-10	26.7	-60 51.1	14530	14289	-2634	-26054	29832	Q	$\mathtt{HDZF}$
JAN -10 31.4 -60 54.6 14511 14267 -2650 -26081 29845 D HDZ1 FEB -10 28.0 -60 52.5 14528 14286 -2639 -26075 29849 D HDZ1 APR *** **** *** *** **** **** **** ****	DEC	-10		-60 51.0		_	-2630			Q	HDZF
FEB -10 28.0 -60 52.5 14528 14286 -2639 -26075 29849 D HDZI MAR *** **** *** *** *** **** **** ****	YEAR	-10	27.8	-60 51.4	14531	14290	-2639	-26061	29837	Q	HDZF
MAR *** **** *** *** *** **** **** ****	JAN	-10	31.4	-60 54.6	14511	14267	-2650	-26081	29845	D	HDZF
APR *** **** *** *** *** **** **** ****	FEB	-10	28.0	-60 52.5	14528	14286	-2639	-26075	29849	D	$\mathtt{HDZF}$
MAY -10 26.2 -60 60.0 14453 14214 -2618 -26072 29809 D HDZ3 JUN -10 28.2 -60 53.8 14509 14267 -2636 -26064 29830 D HDZ3 JUL -10 27.4 -60 54.6 14500 14259 -2632 -26063 29825 D HDZ3 AUG -10 27.4 -60 55.9 14488 14247 -2629 -26062 29819 D HDZ3 SEP -10 25.5 -60 57.4 14474 14235 -2619 -26065 29814 D HDZ3 OCT -10 26.1 -60 53.1 14513 14273 -2628 -26058 29827 D HDZ3 NOV -10 26.7 -60 52.7 14515 14275 -2631 -26056 29826 D HDZ3 DEC -10 26.3 -60 53.4 14510 14270 -2629 -26059 29826 D HDZ3	MAR									D	HDZF
JUN       -10       28.2       -60       53.8       14509       14267       -2636       -26064       29830       D       HDZ3         JUL       -10       27.4       -60       54.6       14500       14259       -2632       -26063       29825       D       HDZ3         AUG       -10       27.4       -60       55.9       14488       14247       -2629       -26062       29819       D       HDZ3         SEP       -10       25.5       -60       57.4       14474       14235       -2619       -26065       29814       D       HDZ3         OCT       -10       26.1       -60       53.1       14513       14273       -2628       -26058       29827       D       HDZ3         NOV       -10       26.7       -60       52.7       14515       14275       -2631       -26056       29826       D       HDZ3         DEC       -10       26.3       -60       53.4       14510       14270       -2629       -26059       29826       D       HDZ3	APR	***					****	****	****	D	HDZF
JUL       -10       27.4       -60       54.6       14500       14259       -2632       -26063       29825       D       HDZ3         AUG       -10       27.4       -60       55.9       14488       14247       -2629       -26062       29819       D       HDZ3         SEP       -10       25.5       -60       57.4       14474       14235       -2619       -26065       29814       D       HDZ3         OCT       -10       26.1       -60       53.1       14513       14273       -2628       -26058       29827       D       HDZ3         NOV       -10       26.7       -60       52.7       14515       14275       -2631       -26056       29826       D       HDZ3         DEC       -10       26.3       -60       53.4       14510       14270       -2629       -26059       29826       D       HDZ3	MAY	-10		-60 60.0	14453	14214		-26072	29809	D	HDZF
AUG -10 27.4 -60 55.9 14488 14247 -2629 -26062 29819 D HDZI SEP -10 25.5 -60 57.4 14474 14235 -2619 -26065 29814 D HDZI OCT -10 26.1 -60 53.1 14513 14273 -2628 -26058 29827 D HDZI NOV -10 26.7 -60 52.7 14515 14275 -2631 -26056 29826 D HDZI DEC -10 26.3 -60 53.4 14510 14270 -2629 -26059 29826 D HDZI	JUN	-10					-2636	-26064	29830	D	HDZF
SEP -10 25.5 -60 57.4 14474 14235 -2619 -26065 29814 D HDZ1 OCT -10 26.1 -60 53.1 14513 14273 -2628 -26058 29827 D HDZ1 NOV -10 26.7 -60 52.7 14515 14275 -2631 -26056 29826 D HDZ1 DEC -10 26.3 -60 53.4 14510 14270 -2629 -26059 29826 D HDZ1	JUL	-10	27.4	-60 54.6	14500	14259	-2632	-26063	29825	D	HDZF
OCT -10 26.1 -60 53.1 14513 14273 -2628 -26058 29827 D HDZI NOV -10 26.7 -60 52.7 14515 14275 -2631 -26056 29826 D HDZI DEC -10 26.3 -60 53.4 14510 14270 -2629 -26059 29826 D HDZI		-10				14247		-26062	29819	D	HDZF
NOV -10 26.7 -60 52.7 14515 14275 -2631 -26056 29826 D HDZ DEC -10 26.3 -60 53.4 14510 14270 -2629 -26059 29826 D HDZ	SEP	-10	25.5	-60 57.4		14235	-2619	-26065	29814	D	HDZF
DEC -10 26.3 -60 53.4 14510 14270 -2629 -26059 29826 D HDZ	OCT	-10				_				D	HDZF
	NOV	-10								D	HDZF
YEAR -10 27.3 -60 54.8 14500 14259 -2631 -26065 29826 D HDZ	DEC	-10	26.3	-60 53.4			-2629	-26059	29826	D	HDZF
	YEAR	-10	27.3	-60 54.8	14500	14259	-2631	-26065	29826	D	HDZF

\*A: All days
\*Q: Quiet days
\*D: Disturbed days
ELE: Elements recorded

**TSUMEB** MEAN ANNUAL VALUES

Date	。D ,	。I ,	H nT	X nT	Y nT	Z nT	F nT	*	ELE
1965.5	-15 57.4	-57 18.8	17328	16660	-4764	-27004	32086	I	DHZ
1966.5	-15 53.8	-57 26.7	17245	16585	-4724	-27012	32048	I	DHZ
1967.5	-15 48.6	-57 37.3	17133	16484	-4668	-27019	31993	Α	DHZ
1968.5	-15 43.4	-57 47.5	17027	16389	-4614	-27029	31945	I	DHZ
1969.5	-15 37.4	-57 57.3	16925	16300	-4558	-27038	31899	I	DHZ
1970.5	-15 31.4	-58 05.7	16837	16222	-4509	-27045	31857	I	DHZ
1971.5	-15 23.6	-58 16.4	16728	16127	-4440	-27056	31810	Α	DHZ
1972.5	-15 15.3	-58 27.3	16617	16031	-4372	-27068	31762	Α	DHZ
1973.5	-15 06.0	-58 37.4	16510	15940	-4301	-27072	31709	Α	DHZ
1974.5	-14 57.2	-58 46.7	16409	15853	-4234	-27070	31655	I	DHZ
1975.5	-14 47.9	-58 55.2	16318	15777	-4168	-27072	31610	Α	DHZ
1976.5	-14 36.4	-59 03.3	16225	15700	-4091	-27062	31553	Α	DHZ
1977.5	-14 25.2	-59 11.2	16135	15627	-4018	-27053	31499	Α	DHZ
1978.5	-14 13.6	-59 20.6	16032	15540	-3940	-27047	31441	Α	DHZ
1979.5	-14 01.8	-59 27.2	15951	15475	-3867	-27028	31383	Α	DHZ
1980.5	-13 49.8	-59 33.6	15873	15413	-3795	-27011	31330	Α	DHZ
1981.5	-13 38.1	-59 41.5	15781	15336	-3720	-26997	31271	Α	DHZ
1982.5	-13 26.2	-59 49.2	15688	15259	-3645	-26976	31206	Α	DHZ
1983.5	-13 14.2	-59 53.4	15623	15208	-3577	-26940	31143	Α	DHZ
1984.5	-13 03.8	-59 58.0	15553	15151	-3516	-26903	31075	Α	DHZ
1985.5	-12 54.7	-60 01.6	15493	15102	-3462	-26864	31012	Α	DHZ
1986.5	-12 46.3	-60 06.0	15427	15045	-3410	-26828	30948	Α	DHZ
1987.5	-12 38.8	-60 09.0	15374	15001	-3366	-26791	30889	Α	DHZ
1988.5	-12 31.6	-60 13.4	15304	14940	-3319	-26748	30817	Α	DHZ
1989.5	-12 24.2	-60 18.6	15230	14874	-3271	-26712	30748	Α	DHZ
1990.5	*** **.*	*** **.*	****	****	****	****	****		
1991.5	*** **.*	*** **.*	****	****	****	****	****		
1992.5	999 99.9	999 99.9	99999	99999	99999	99999	99999	I	DHZ
1993.5	-11 48.4	-60 33.0	14990	14673	-3067	-26549	30488	I	DHZ
1994.5	-11 40.4	-60 36.2	14941	14632	-3023	-26520	30439	I	DHZ
1995.5	-11 30.9	-60 39.0	14889	14589	-2972	-26477	30376	I	DHZ
1996.5	-11 21.1	-60 39.7	14852	14561	-2923	-26424	30311	Α	DHZ
1997.5	-11 11.7	-60 41.1	14809	14527	-2875	-26372	30246	I	DHZ
1998.5	-11 07.0	-60 44.4	14749	14472	-2844	-26326	30176	I	DHZ
1999.5	-10 57.5	-60 45.3	14707	14439	-2796	-26267	30104	I	DHZ
2000.0	0 -2.3	0 -0.2	1	-1	-10	1	-1	J	DHZ
2000.5	-10 54.9	-60 47.8	14665	14400	-2777	-26237	30058	I	DHZ
2001.5	-10 47.4	-60 46.9	14645	14386	-2742	-26184	30001	I	DHZ
2002.5	-10 42.3	-60 48.0	14610	14356	-2714	-26141	29947	I	DHZ
2003.5	-10 38.0	-60 50.5	14571	14321	-2688	-26117	29907	I	DHZ
2004.5	-10 32.6	-60 50.2	14553	14308	-2663	-26080	29866	I	DHZ
2005.5	-10 27.7	-60 52.6	14520	14280	-2637	-26063	29835	I	DHZ

<sup>\*</sup>A: All days
\*I: Incomplete
\*J: Jump in data, jump value = old site value - new site value
ELE: Elements recorded

