Hermanus Magnetic Observatory

A facility of the National Research Foundation

Magnetic Results 2009

Hermanus, Hartebeesthoek and Keetmanshoop observatories

1. INTRODUCTION

The Hermanus Magnetic Observatory (HMO) operates four permanent geomagnetic observatories in Southern Africa, namely Hermanus (HER) and Hartebeesthoek (HBK) in South Africa, and Tsumeb (TSU) and Keetmanshoop (KMH) in Namibia.

This yearbook presents the results of the magnetic measurements carried out at HER, HBK and KMH observatories during 2009. No data was recorded at TSU observatory due to technical problems.

2. DESCRIPTION OF THE OBSERVATORIES

Observatory	Geographic Coordinates		Geomagnetic Coordinates		Elevation
	Latitude	Longitude	Latitude	Longitude	m
HER	34° 25' 28" S	19° 13' 26" E	42° 41' S	83° 26' E	26
HBK	25° 52' 58" S	27° 42' 25" E	36° 14' S	95° 52' E	1555
TSU	19° 12' 08" S	17° 35' 03" E	31° 06' S	87° 29' E	1273
KMH	26° 32' 26" S	18° 06' 37" E	37° 05' S	85° 40' E	1065

Geomagnetic coordinates given are relative to a geomagnetic North Pole position of 80.0° N, 72.1° W, computed from the IGRF-11 model at the epoch 2009.5 (http://wdc.kugi.kyoto-u.ac.jp/igrf/gggm/index.html).

3. ABSOLUTE MEASUREMENTS

At each observatory, except Keetmanshoop, absolute measurements are made in a single absolute hut. At Keetmanshoop there is a pillar with weather proof material built around it to protect against wind, sun and rain. Since 1st 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. The total magnetic field intensity, F, was measured by means of an Overhauser Magnetometer. 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), a THEO 015B (at Hartebeesthoek and Tsumeb) and a single-axis fluxgate sensor mounted on top of the telescope and electronics from Bartington. At

Keetmanshoop, the DI-flux consists of a non-magnetic theodolite type 3T2KP-NM and a single-axis fluxgate sensor mounted on top of the telescope and electronics type LEMI 204. 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"
Keetmanshoop	Mark against the wall	353° 38' 30"

3.2 Overhauser Magnetometer

The OVH is a GEM Systems type GSM-19 magnetometer. The sensor is installed in an East-West direction. The Electronic unit is powered by a 12V DC power supply via a 220V UPS. The signal levels are converted via two ADAM 4541 fibre optic converters to the computer's serial port. The OVH readings are fed into the computer for processing through an RS232 serial port. The PC serves as the instrument's controller and data logger. The instrument runs continuously and obtains a reading every 5 seconds. From these readings one-minute *F* values are 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.

3.3 F pillar corrections

At Hermanus *D* and *I* are measured on pillar no. 1 in the Absolute House, and *F* is obtained from an Overhauser sensor. The suspended dIdD serves as a backup instrument for the total field F. At Hartebeesthoek, Tsumeb and Keetmanshoop *D* and *I* are measured in the so-called "Standard Huts", while *F* is obtained from an Overhauser sensor. Site differences were obtained at regular intervals at each observatory to enable the *F* measurements to be reduced to the standard pillar:

$$F_{\text{standard pillar}} = F_{\text{dIdD/OVH}} + \Delta F_{\text{pillar}}$$

Figure 1 shows the adopted values for the year.

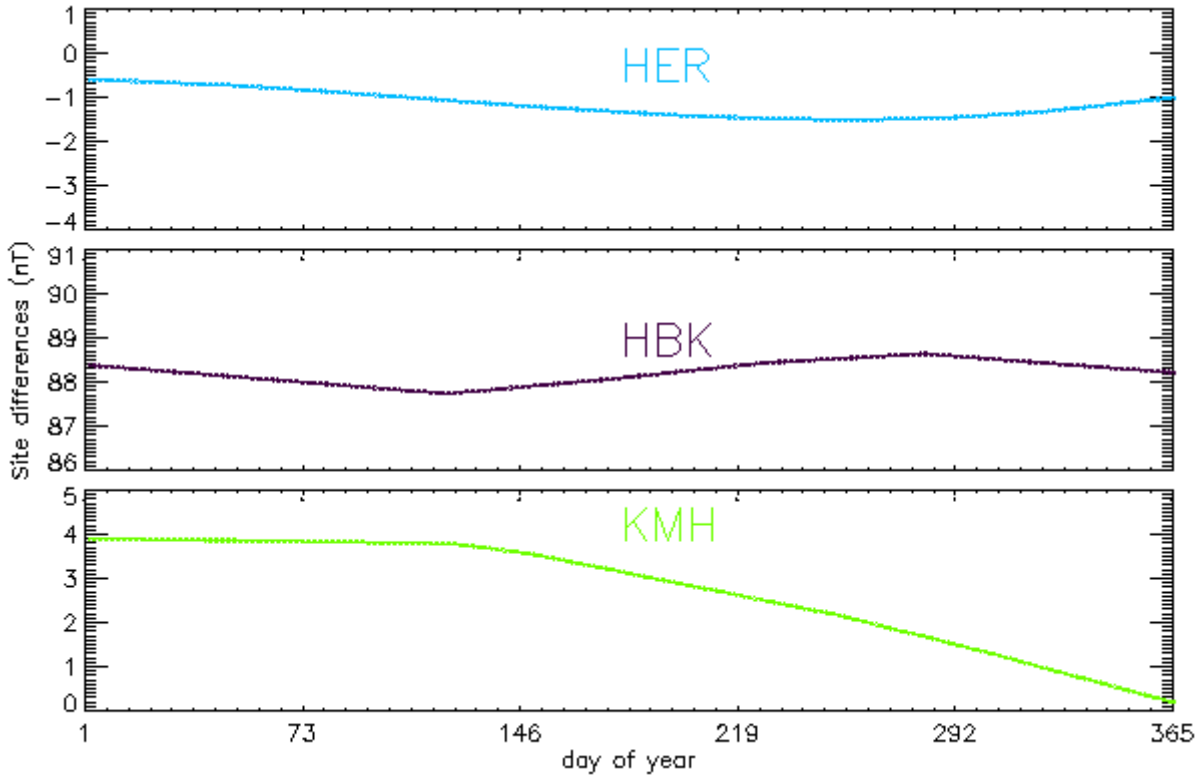

Figure 1. The adopted values of site differences (ΔF_{pillar}) at HER, HBK and KMH magnetic observatories.

4. VECTOR MAGNETOMETERS

4.1 FGE Magnetometer

A type FGE fluxgate manufactured by the Danish Meteorological Institute, Denmark is in operation at all four 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 second, but sampling is done every 5 seconds. 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 dIdD Magnetometer

The Suspended dIdD 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 *H* and *Z* 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 Loràn 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 Keetmanshoop 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. The adopted base line values were computed applying the technique of cubic spline fitting on the observed base-line values.

For Hartebeesthoek observatory, due to failure of the Fluxgate and Overhauser magnetometers there were no recorded data for the period 3 March - 30 April 2009.

For Keetmanshoop observatory, due to failure of the Fluxgate and Overhauser magnetometers there were no recorded data for the period 16 - 29 May 2009.

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 Daily mean values

Daily mean values, centred on the UT half day, are computed from the one-minute values. A value is not computed if there are more than 144 one-minute values missing.

5.5 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.

5.6 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, Edinburgh:

http://www.wdc.bgs.ac.uk/catalog/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

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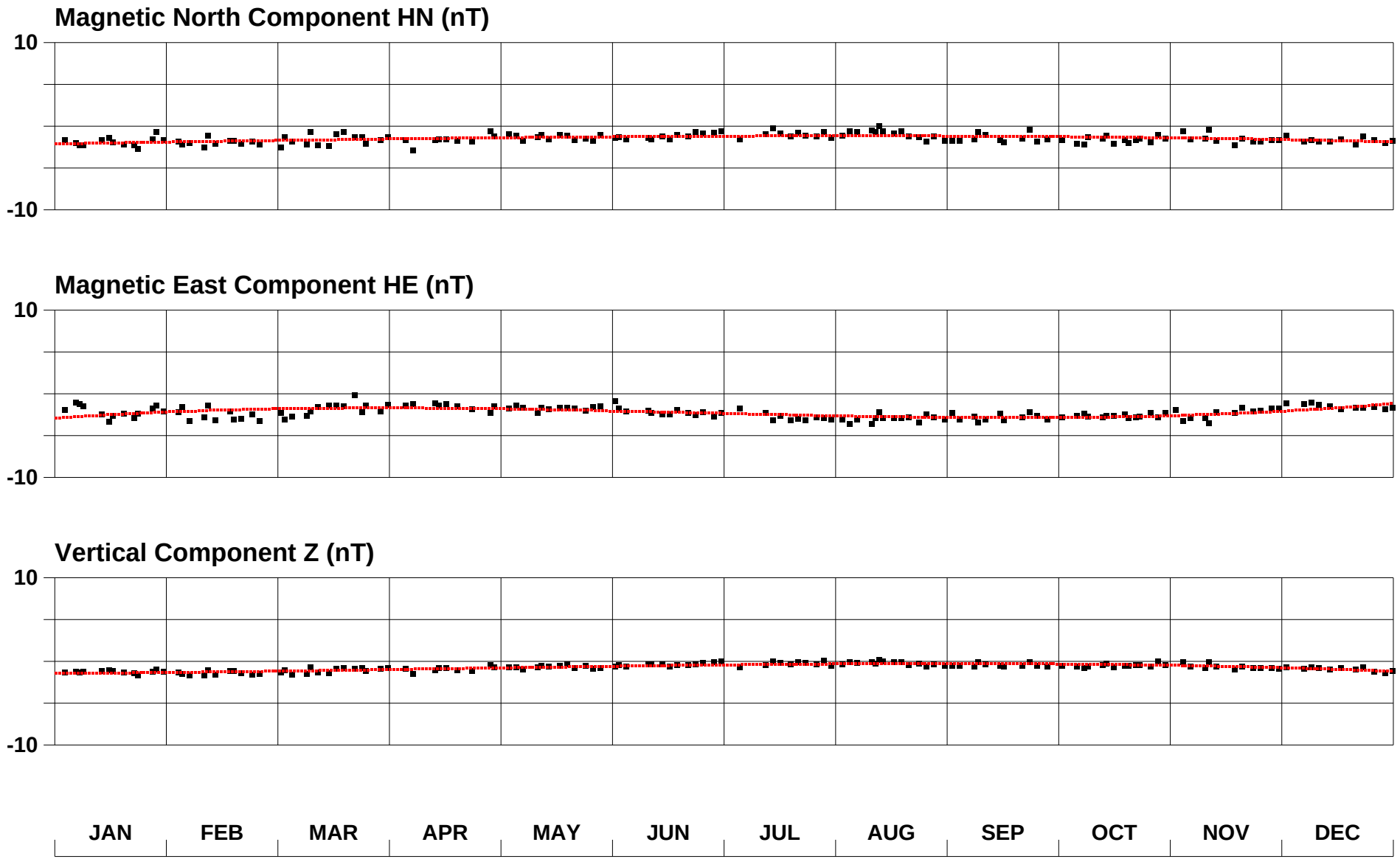
Magnetic Results 2009

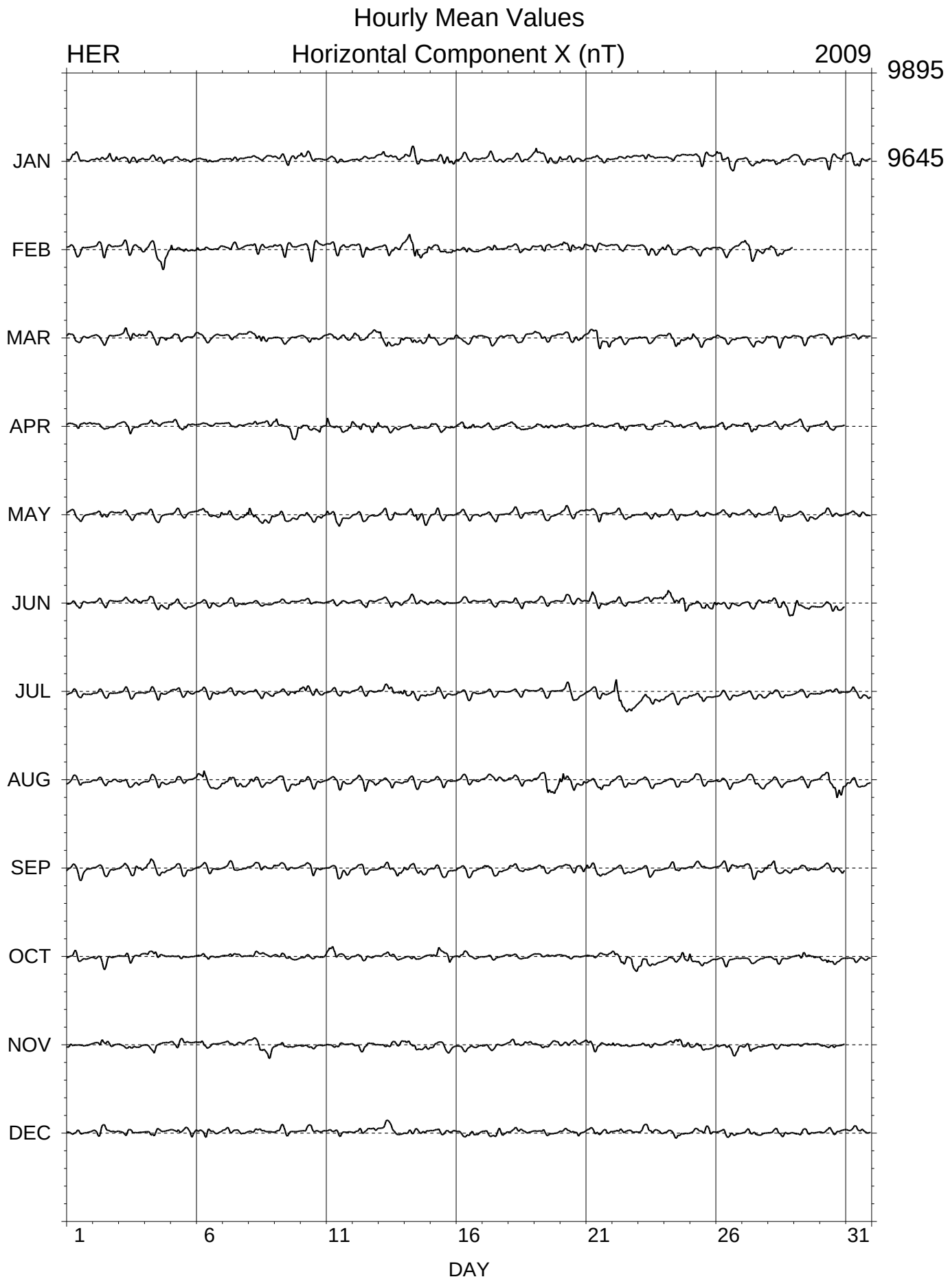
Hermanus

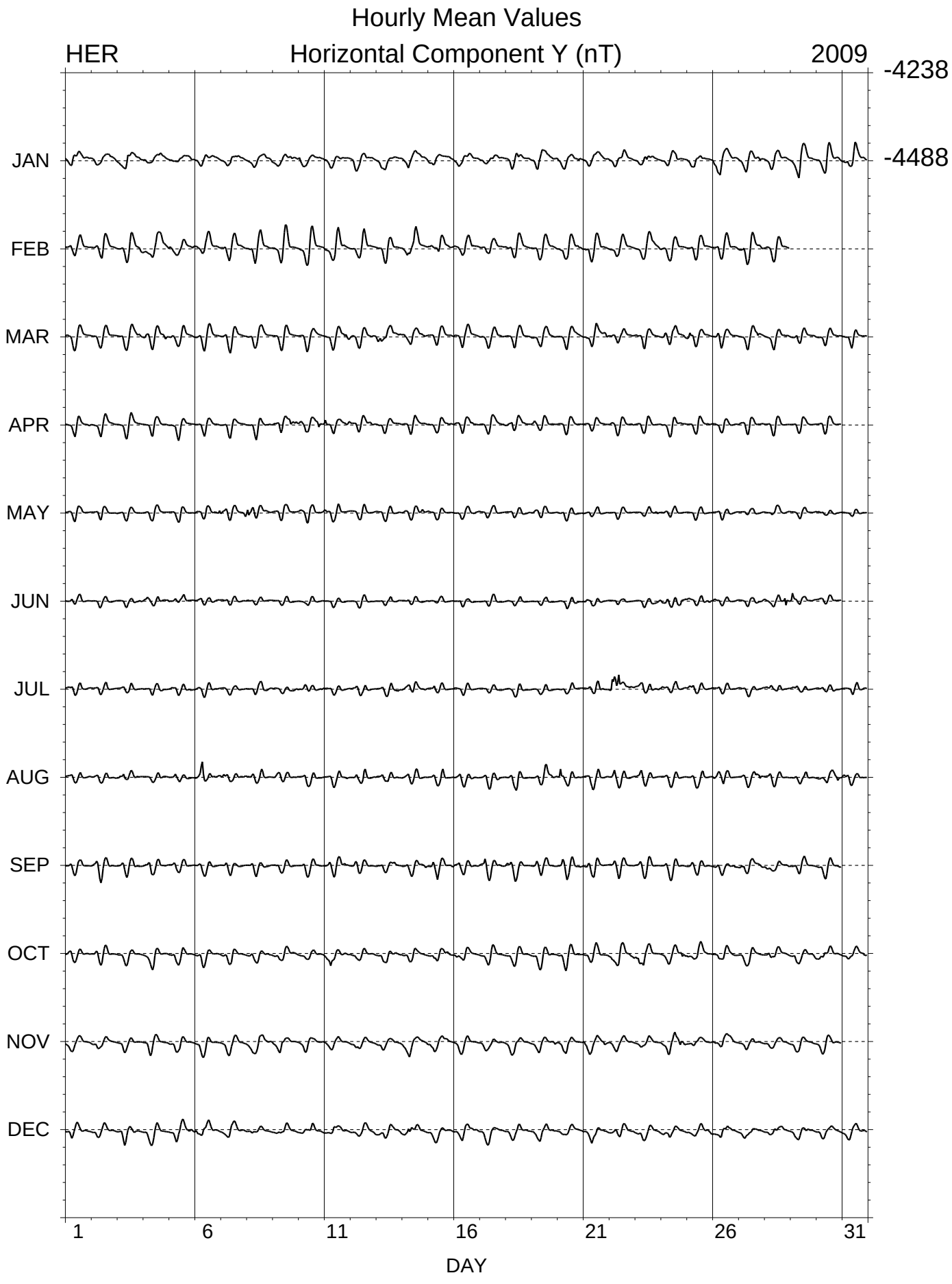
Observed and Adopted Baseline Values, HER 2009

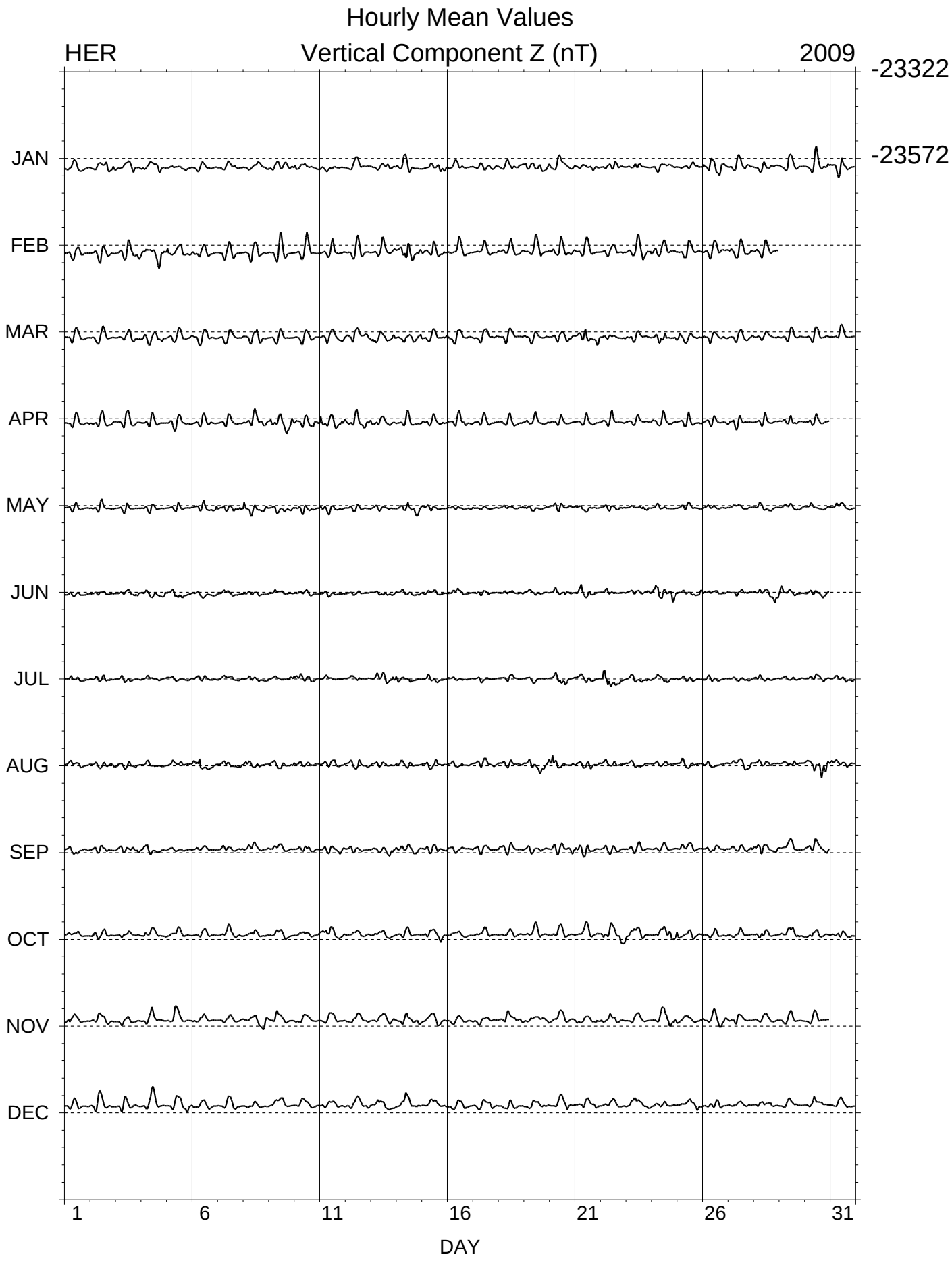
LAT: 124.425 LONG: 19.225

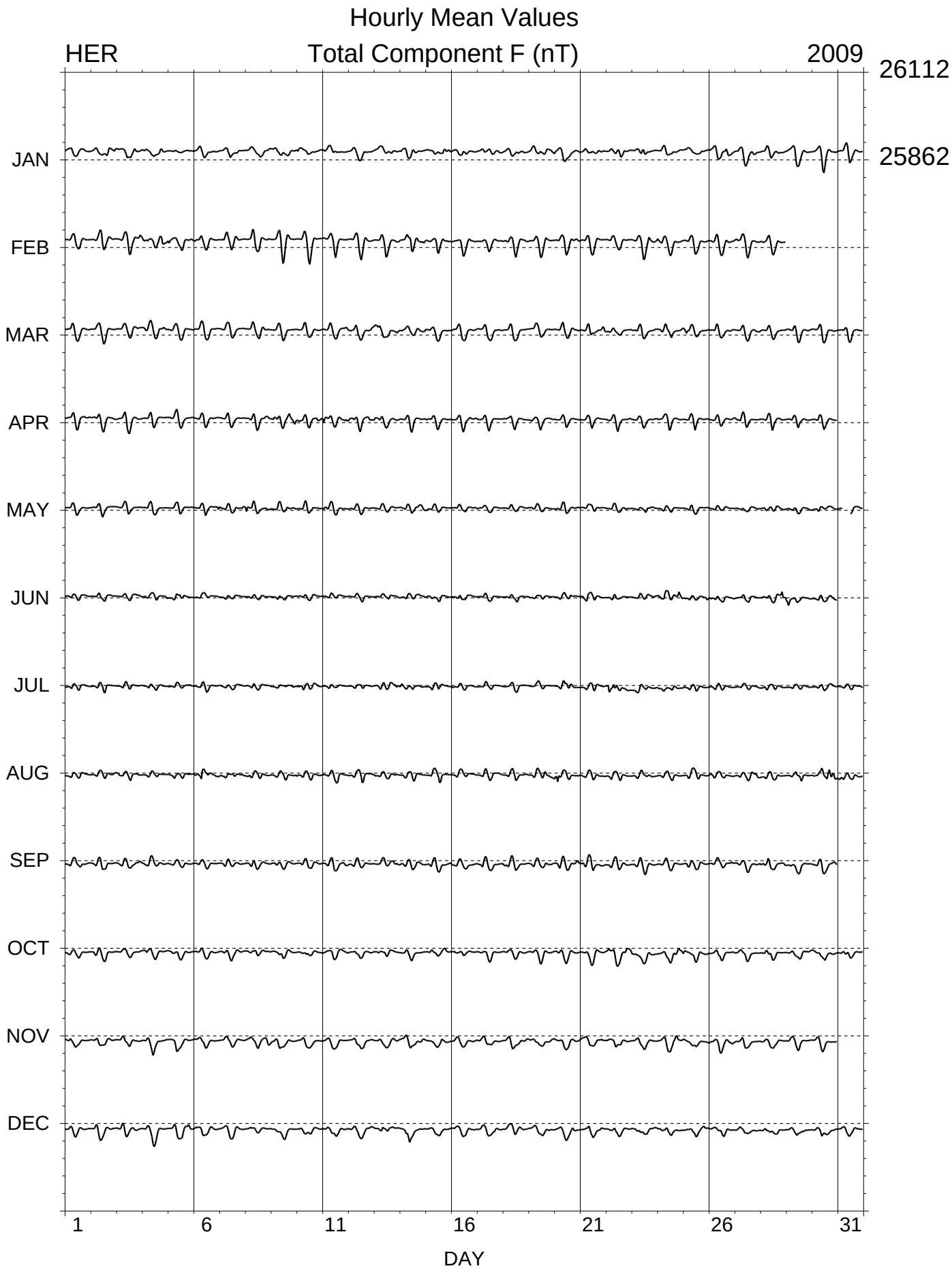
INSTITUTION: HMO INSTRUMENT: LC

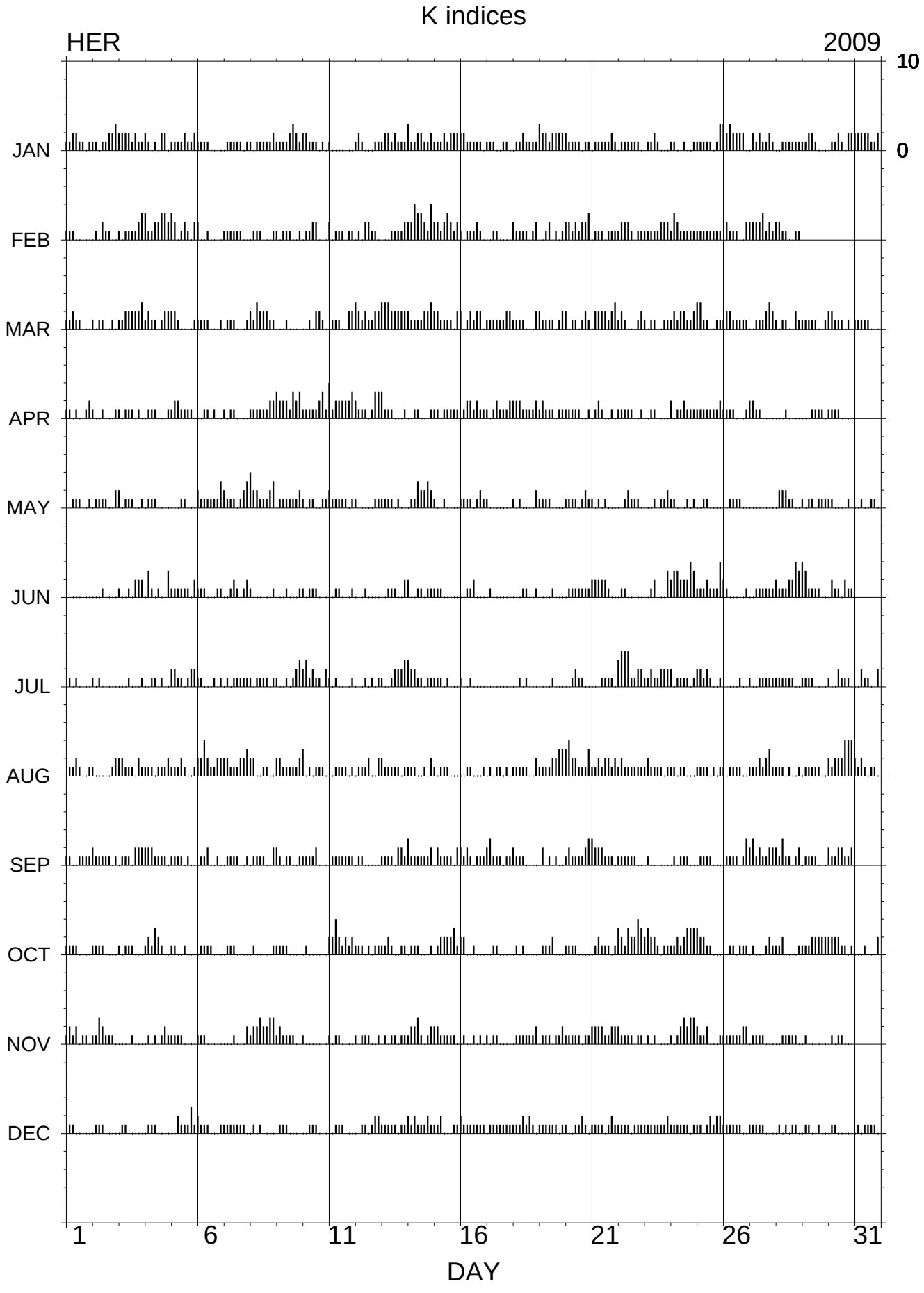



Hourly Mean Values
HER
Horizontal Component X (nT)
2009
9895
9645
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY


Hourly Mean Values
HER
Horizontal Component Y (nT)
2009
-4238
-4488
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY


Hourly Mean Values
HER
Vertical Component Z (nT)
2009
-23322
-23572
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY


Hourly Mean Values
HER
Total Component F (nT)
2009
26112
25862
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY


K indices
HER
2009
10
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY

K INDICES

HER — K9 = 300 nT — 2009

DATE	JAN	FEB	MAR	APR	MAY	JUN
01	1122 1101	1110 0000	1121 1000	1101 0012	0011 1001	0000 0000
02	1101 1223	0102 1100	1011 0010	1001 0001	0111 1002	0001 0000
03	2222 1211	1011 1123	1122 2223	1011 1010	2011 1001	1001 0222
04	2101 0220	3112 2332	1211 0122	0111 0001	0111 0000	0310 1003
05	1111 2112	3201 2102	2210 0001	1221 1110	0001 1000	1111 1102
06	1111 0000	2001 0000	1111 0001	0011 0100	2111 1113	1110 0011
07	0111 1101	1111 1100	0111 0001	1011 0000	2111 0123	0012 1012
08	1011 1112	0111 0001	2132 2211	1111 1122	4221 1123	1000 0001
09	1111 2321	1011 1001	0001 0000	3222 1323	0111 1112	0001 0001
10	2211 1010	0112 2000	0010 2210	1111 1231	1011 0011	1011 1000
11	1000 0000	2011 1011	0111 0022	4122 2223	2111 1101	0011 0001
12	1210 0011	0102 2110	3212 1122	2111 0133	1000 0011	0001 0000
13	1221 2111	0001 1112	3332 2222	3111 0001	1111 0100	0011 1002
14	3112 2112	2243 3214	2111 1223	0011 0001	0113 2232	2001 1011
15	1112 1222	2212 3212	2211 1102	1101 1111	1001 0000	1110 0000
16	2211 1110	1011 1210	2012 1220	0122 1211	1111 0121	0011 2000
17	1110 0110	0011 0000	1111 1122	1012 1112	1000 0000	0100 0000
18	0112 1111	2111 1012	1111 0002	2221 1112	1010 0002	0001 1001
19	3221 2222	0012 0101	2111 1012	1211 1011	1111 0000	0000 1000
20	2111 1011	2212 1223	2011 0121	1111 1001	1111 0121	0111 1111
21	0111 1121	0111 0111	0222 2123	0121 0010	1010 1000	2222 2100
22	0111 1110	1222 1011	1210 0012	1111 1001	0012 1110	0110 0000
23	0112 1000	1111 1222	1011 0011	0011 0000	0001 0112	0012 0003
24	1100 1001	1321 1111	1212 2112	2011 2111	1100 0101	2332 2243
25	1111 1013	1111 1111	3311 0011	1111 1112	0011 0000	1112 1114
26	3232 2220	0211 1002	1221 1111	1111 0001	0011 1100	2100 0001
27	0212 1121	2222 3121	0011 1232	2211 0000	0000 0000	0011 1111
28	0011 1111	2211 0011	1011 0021	0001 0000	0222 1100	2111 2243
29	1122 1000		1111 1001	0001 1110	1011 0111	4311 1100
30	0112 1022		2211 1010	1111 0000	1100 0010	0211 0211
31	2222 2112		1111 1000		0010 0110	

	JUL	AUG	SEP	OCT	NOV	DEC
01	0101 0000	0112 1001	1100 1111	1111 0000	1212 0110	0110 0000
02	1010 0000	1000 0012	2111 1101	1111 0000	1132 1110	0111 0000
03	0001 0001	2211 1021	0111 0222	1011 1000	0000 1000	0110 0000
04	0011 0100	1110 1112	2221 1110	1213 2100	0101 0121	0111 0000
05	2211 0122	1112 1001	1111 0100	1100 1000	1111 0000	0021 1131
06	1100 0101	2242 1122	0112 0010	0111 1000	1110 0000	2111 0001
07	0101 1111	2211 1223	0111 1001	0111 0000	0001 0002	1111 1110
08	1011 1101	2200 1100	0111 1002	0100 0001	1223 2233	0101 0000
09	1001 0123	2211 1112	2101 1001	1111 0000	1211 1100	0111 0000
10	2312 1102	3010 1110	1111 2000	0100 0000	1000 0000	0011 1000
11	1010 0001	0011 1101	0111 1111	2242 1212	1011 0000	0011 1000
12	0001 0101	0111 2002	0110 0000	1110 1011	1011 1001	0011 0122
13	1001 2223	2111 1101	1111 0221	1121 0011	0101 1011	1111 1011
14	3221 1011	1110 0102	3111 1112	0111 0001	1223 1012	2121 1121
15	1110 1000	1011 1000	0211 1102	0122 2231	2211 1110	1120 0011
16	1001 0000	0011 0001	2121 0111	2200 1000	0100 1010	2111 1111
17	0000 0000	0101 1010	2311 1011	0011 0000	1011 0000	0111 1111
18	0010 1000	1111 1002	2111 0000	0101 0000	0111 1112	1112 1210
19	0000 1000	1111 2233	0201 0100	0111 2000	0111 0112	1111 1101
20	0012 1100	3422 1113	1211 1123	1111 0000	1111 1011	1001 1210
21	0001 1110	1121 2212	3222 1110	0121 1101	2222 1122	1111 0121
22	3444 1122	1211 1111	1111 1100	3213 2243	2111 1011	1111 0111
23	1121 1222	1211 1101	0100 0000	2322 1011	0101 0000	1111 1112
24	2011 1101	1101 1000	0101 1100	1121 2333	1012 3233	1111 1101
25	2212 1001	1111 0101	0111 1000	3221 1000	2112 0001	1101 2122
26	0000 0100	1011 1100	0111 1013	0011 0111	1111 1122	1111 1100
27	1001 1111	1112 1231	2312 1122	0100 0121	0111 1000	1111 1000
28	1111 1100	1110 1001	2131 1012	1120 0001	0011 1110	0101 0110
29	1111 0000	0111 1100	0111 1000	1112 2222	0100 0000	0110 0100
30	1002 1110	2122 2444	2112 2112	2222 1101	0101 1000	0110 0000
31	0021 1002	2121 0110		0001 0002		0101 1110

HERMANUS
MEAN MONTHLY VALUES 2009

Date	D ° ,	I ° ,	H nT	X nT	Y nT	Z nT	F nT	*	ELE
JAN	-24 54.8	-65 43.2	10644	9654	-4484	-23596	25885	A	HDZF
FEB	-24 55.0	-65 43.4	10640	9649	-4483	-23590	25879	A	HDZF
MAR	-24 56.4	-65 43.5	10638	9646	-4486	-23587	25875	A	HDZF
APR	-24 56.5	-65 43.0	10639	9647	-4486	-23581	25870	A	HDZF
MAY	-24 56.7	-65 43.1	10638	9645	-4486	-23579	25868	A	HDZF
JUN	-24 57.0	-65 42.6	10640	9647	-4488	-23575	25865	A	HDZF
JUL	-24 57.7	-65 43.4	10632	9639	-4487	-23572	25859	A	HDZF
AUG	-24 58.1	-65 43.0	10634	9640	-4489	-23568	25856	A	HDZF
SEP	-24 58.2	-65 42.1	10638	9644	-4491	-23562	25852	A	HDZF
OCT	-24 58.8	-65 41.8	10638	9643	-4493	-23557	25848	A	HDZF
NOV	-24 58.8	-65 41.4	10640	9644	-4493	-23553	25845	A	HDZF
DEC	-24 58.0	-65 40.5	10645	9650	-4493	-23548	25843	A	HDZF
YEAR	-24 57.2	-65 42.6	10639	9646	-4488	-23572	25862	A	HDZF
JAN	-24 54.7	-65 43.0	10646	9656	-4484	-23596	25886	Q	HDZF
FEB	-24 54.5	-65 43.1	10643	9653	-4482	-23591	25880	Q	HDZF
MAR	-24 56.3	-65 43.2	10640	9648	-4486	-23587	25876	Q	HDZF
APR	-24 56.4	-65 42.7	10641	9649	-4487	-23581	25871	Q	HDZF
MAY	-24 56.6	-65 42.9	10639	9646	-4487	-23579	25867	Q	HDZF
JUN	-24 56.8	-65 42.5	10640	9648	-4488	-23575	25865	Q	HDZF
JUL	-24 57.8	-65 43.1	10635	9641	-4488	-23572	25860	Q	HDZF
AUG	-24 58.1	-65 42.4	10638	9644	-4491	-23567	25857	Q	HDZF
SEP	-24 57.8	-65 41.8	10639	9645	-4490	-23559	25850	Q	HDZF
OCT	-24 58.8	-65 41.6	10640	9645	-4493	-23557	25848	Q	HDZF
NOV	-24 58.9	-65 41.1	10642	9646	-4494	-23553	25846	Q	HDZF
DEC	-24 58.3	-65 40.6	10644	9649	-4494	-23548	25842	Q	HDZF
YEAR	-24 57.1	-65 42.3	10641	9647	-4489	-23572	25862	Q	HDZF
JAN	-24 54.4	-65 43.5	10642	9653	-4482	-23597	25886	D	HDZF
FEB	-24 55.5	-65 44.1	10635	9644	-4482	-23592	25878	D	HDZF
MAR	-24 56.6	-65 44.2	10633	9641	-4484	-23589	25874	D	HDZF
APR	-24 56.3	-65 43.7	10634	9643	-4484	-23583	25870	D	HDZF
MAY	-24 56.5	-65 43.5	10635	9643	-4485	-23581	25868	D	HDZF
JUN	-24 57.3	-65 42.9	10637	9644	-4488	-23575	25863	D	HDZF
JUL	-24 57.5	-65 44.2	10626	9634	-4484	-23573	25857	D	HDZF
AUG	-24 58.1	-65 43.5	10630	9637	-4487	-23570	25857	D	HDZF
SEP	-24 58.5	-65 42.4	10636	9641	-4491	-23563	25852	D	HDZF
OCT	-24 59.6	-65 42.4	10633	9638	-4493	-23557	25845	D	HDZF
NOV	-24 58.8	-65 41.6	10639	9643	-4493	-23554	25845	D	HDZF
DEC	-24 57.9	-65 40.8	10643	9649	-4492	-23549	25842	D	HDZF
YEAR	-24 57.2	-65 43.1	10635	9642	-4487	-23574	25862	D	HDZF

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

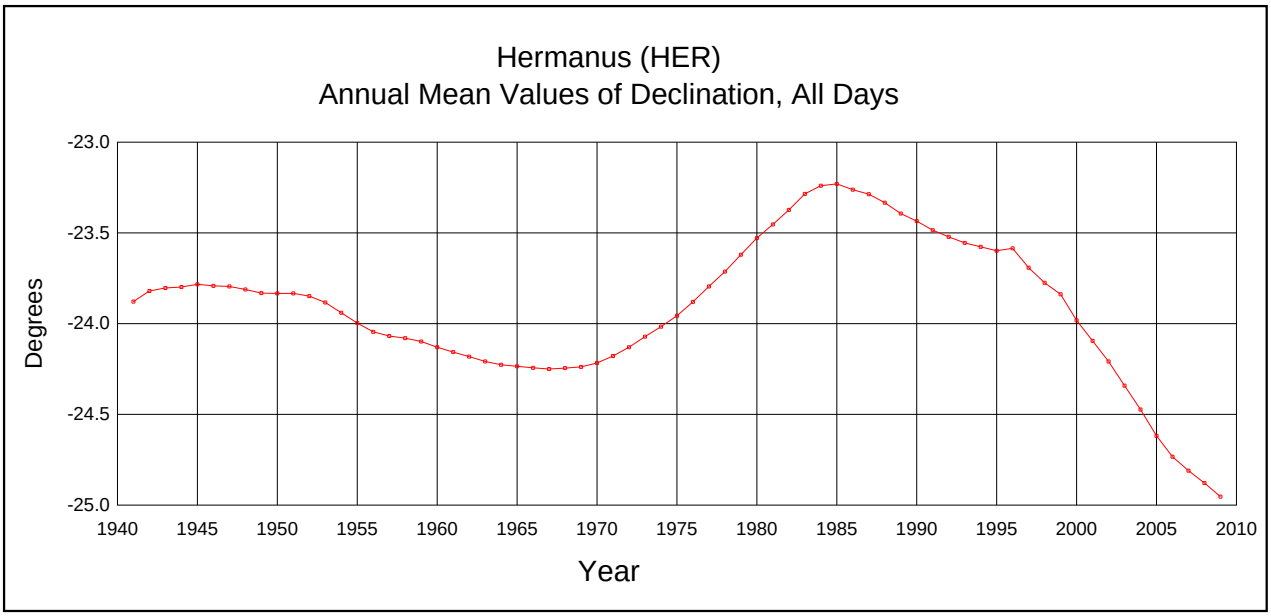
HERMANUS
MEAN ANNUAL VALUES

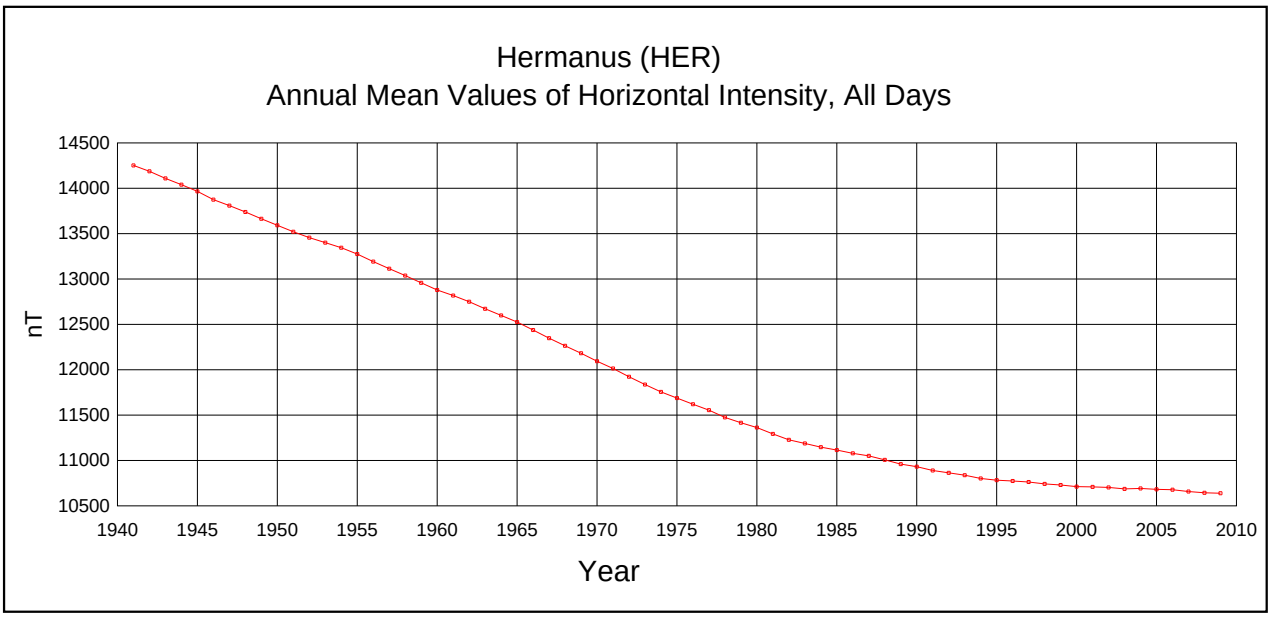
Date	°D	'	°I	'	H nT	X nT	Y nT	Z nT	F nT	*	ELE
1941.5	-23	51.6	-64	01.4	14252	13034	-5765	-29249	32537	A	DHZ
1942.5	-23	48.1	-64	03.0	14187	12980	-5724	-29153	32422	A	DHZ
1943.5	-23	47.1	-64	06.4	14109	12911	-5690	-29065	32309	A	DHZ
1944.5	-23	46.8	-64	09.1	14040	12848	-5661	-28981	32202	A	DHZ
1945.5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

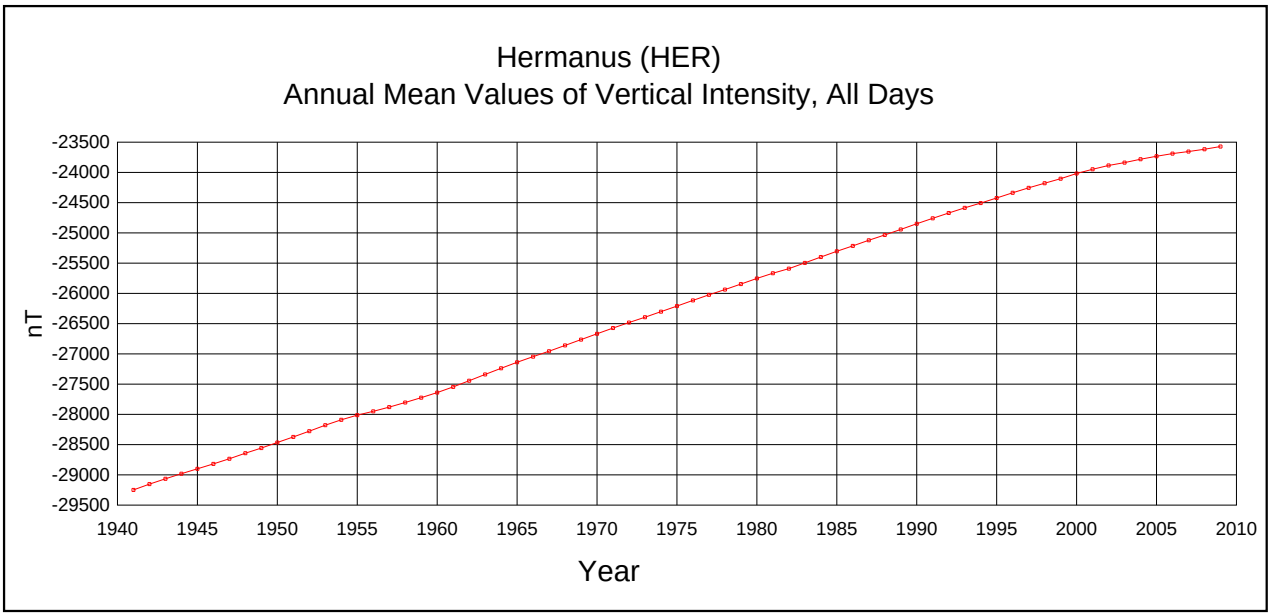
HERMANUS
MEAN ANNUAL VALUES

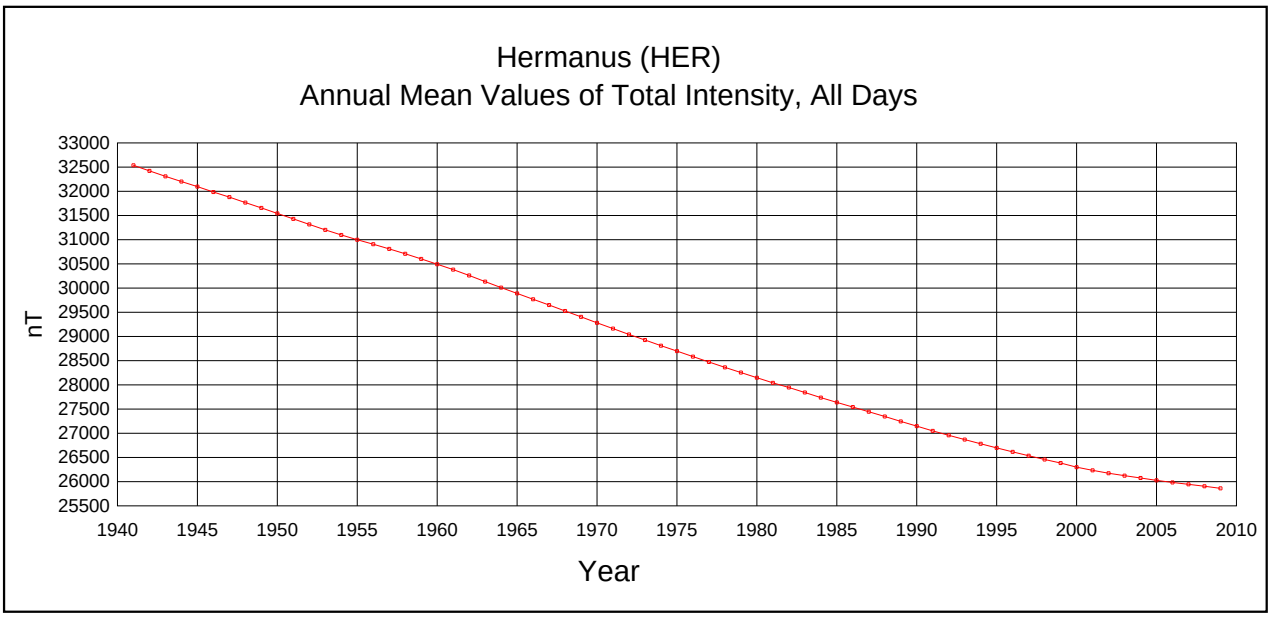
Date	° D '	° I '	H nT	X nT	Y nT	Z nT	F nT	*	ELE
1981.5	-23 26.1	-66 15.0	11293	10362	-4492	-25667	28042	A	DHZ
1982.5	-23 21.3	-66 18.6	11228	10309	-4452	-25591	27946	A	DHZ
1983.5	-23 16.0	-66 18.4	11188	10279	-4420	-25496	27843	A	DHZ
1984.5	-23 13.3	-66 18.3	11147	10244	-4395	-25399	27737	A	DHZ
1985.5	-23 12.7	-66 17.2	11115	10216	-4381	-25304	27638	A	DHZ
1986.5	-23 14.6	-66 16.8	11079	10180	-4373	-25215	27542	A	DHZ
1987.5	-23 16.1	-66 15.3	11051	10153	-4366	-25122	27445	A	DHZ
1988.5	-23 18.9	-66 15.9	11007	10109	-4357	-25034	27347	A	DHZ
1989.5	-23 22.5	-66 16.7	10960	10061	-4349	-24943	27245	A	DHZ
1990.5	-23 25.0	-66 15.2	10932	10032	-4345	-24849	27148	A	DHZ
1991.5	-23 28.0	-66 15.5	10890	9990	-4337	-24759	27049	A	DHZ
1992.5	-23 30.2	-66 14.0	10864	9963	-4333	-24671	26958	A	DHZ
1993.5	-23 32.2	-66 12.7	10838	9937	-4329	-24586	26870	A	DHZ
1994.5	-23 33.5	-66 12.8	10802	9902	-4318	-24507	26783	A	DHZ
1995.5	-23 34.8	-66 10.7	10783	9883	-4314	-24423	26698	A	DHZ
1996.5	-23 34.0	-66 07.2	10774	9876	-4308	-24337	26616	A	DHZ
1997.5	-23 40.4	-66 04.3	10763	9858	-4322	-24255	26536	A	DHZ
1998.5	-23 45.4	-66 02.7	10742	9833	-4328	-24179	26458	A	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	A	DHZ
2000.5	-23 58.9	-65 57.8	10712	9788	-4355	-24018	26299	A	DHZ
2001.5	-24 05.7	-65 54.4	10709	9776	-4372	-23948	26234	A	DHZ
2002.5	-24 12.5	-65 51.7	10703	9762	-4389	-23885	26174	A	DHZ
2003.5	-24 20.5	-65 51.1	10687	9738	-4406	-23838	26124	A	DHZ
2004.5	-24 28.4	-65 47.5	10692	9732	-4430	-23782	26076	A	DHZ
2005.5	-24 37.1	-65 46.1	10682	9712	-4450	-23733	26027	A	DHZ
2006.5	-24 44.0	-65 44.2	10678	9698	-4468	-23689	25984	A	DHZ
2007.5	-24 48.6	-65 44.7	10658	9675	-4473	-23655	25945	A	DHZ
2008.5	-24 52.7	-65 44.4	10644	9656	-4478	-23617	25905	A	DHZ
2009.5	-24 57.2	-65 42.6	10639	9646	-4488	-23572	25862	A	DHZ

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


Hermanus (HER)
Annual Mean Values of Declination, All Days
Degrees
-23.0
-23.5
-24.0
-24.5
-25.0
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year


Hermanus (HER)
Annual Mean Values of Horizontal Intensity, All Days
nT
14500
14000
13500
13000
12500
12000
11500
11000
10500
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year


Hermanus (HER)
Annual Mean Values of Vertical Intensity, All Days
nT
-23500
-24000
-24500
-25000
-25500
-26000
-26500
-27000
-27500
-28000
-28500
-29000
-29500
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year


Hermanus (HER)
Annual Mean Values of Total Intensity, All Days
nT
33000
32500
32000
31500
31000
30500
30000
29500
29000
28500
28000
27500
27000
26500
26000
25500
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

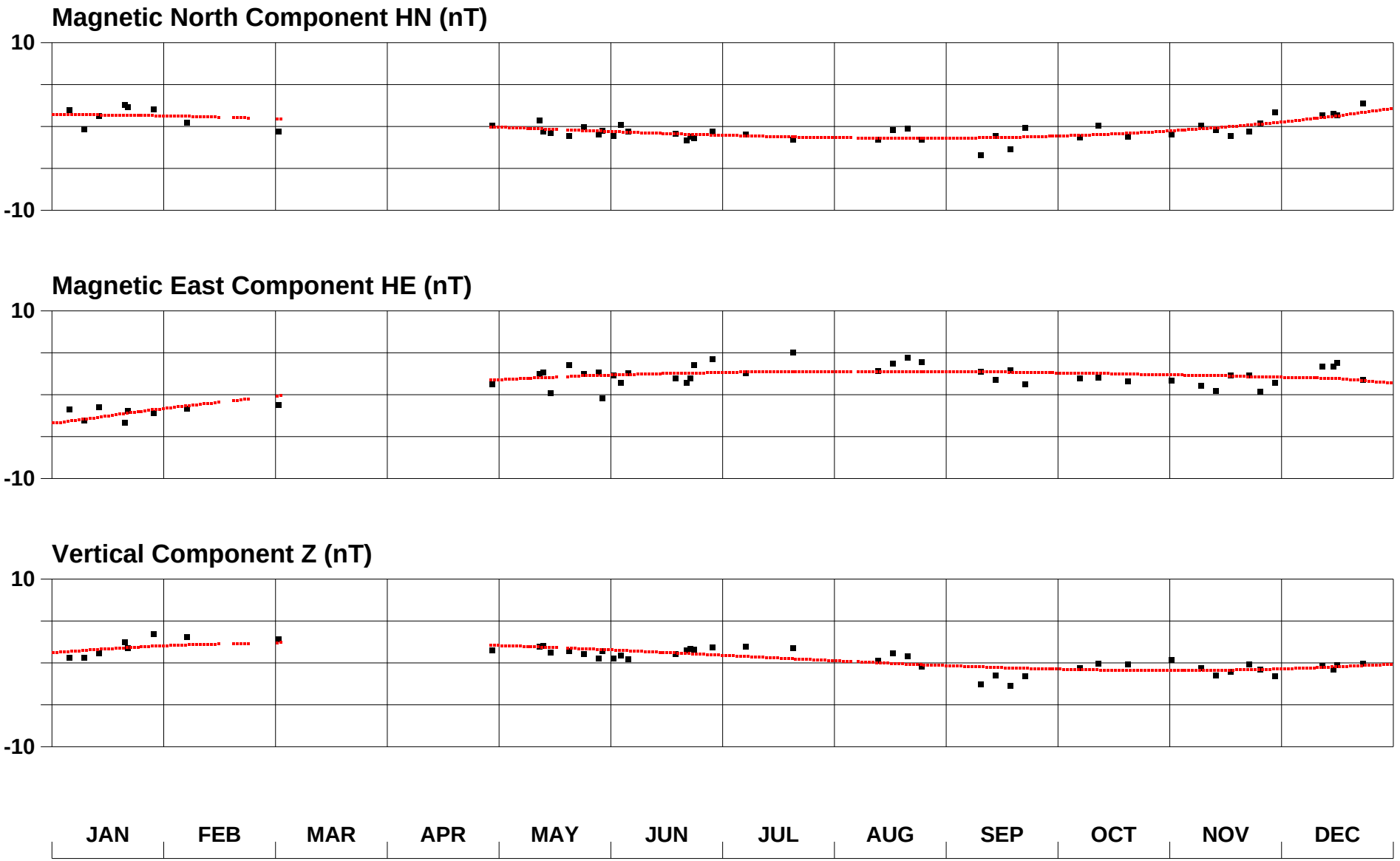
Magnetic Results 2009

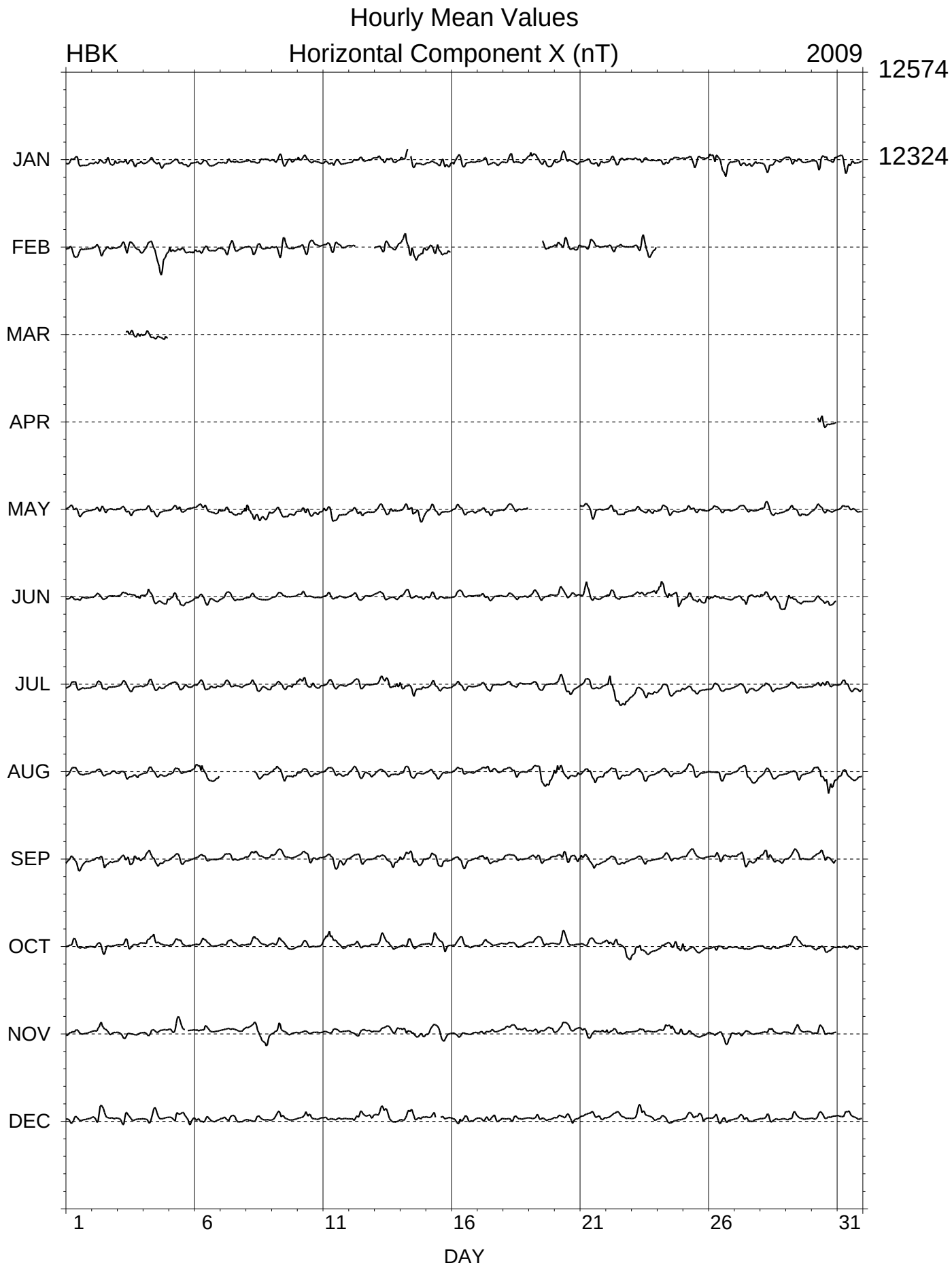
Hartebeesthoek

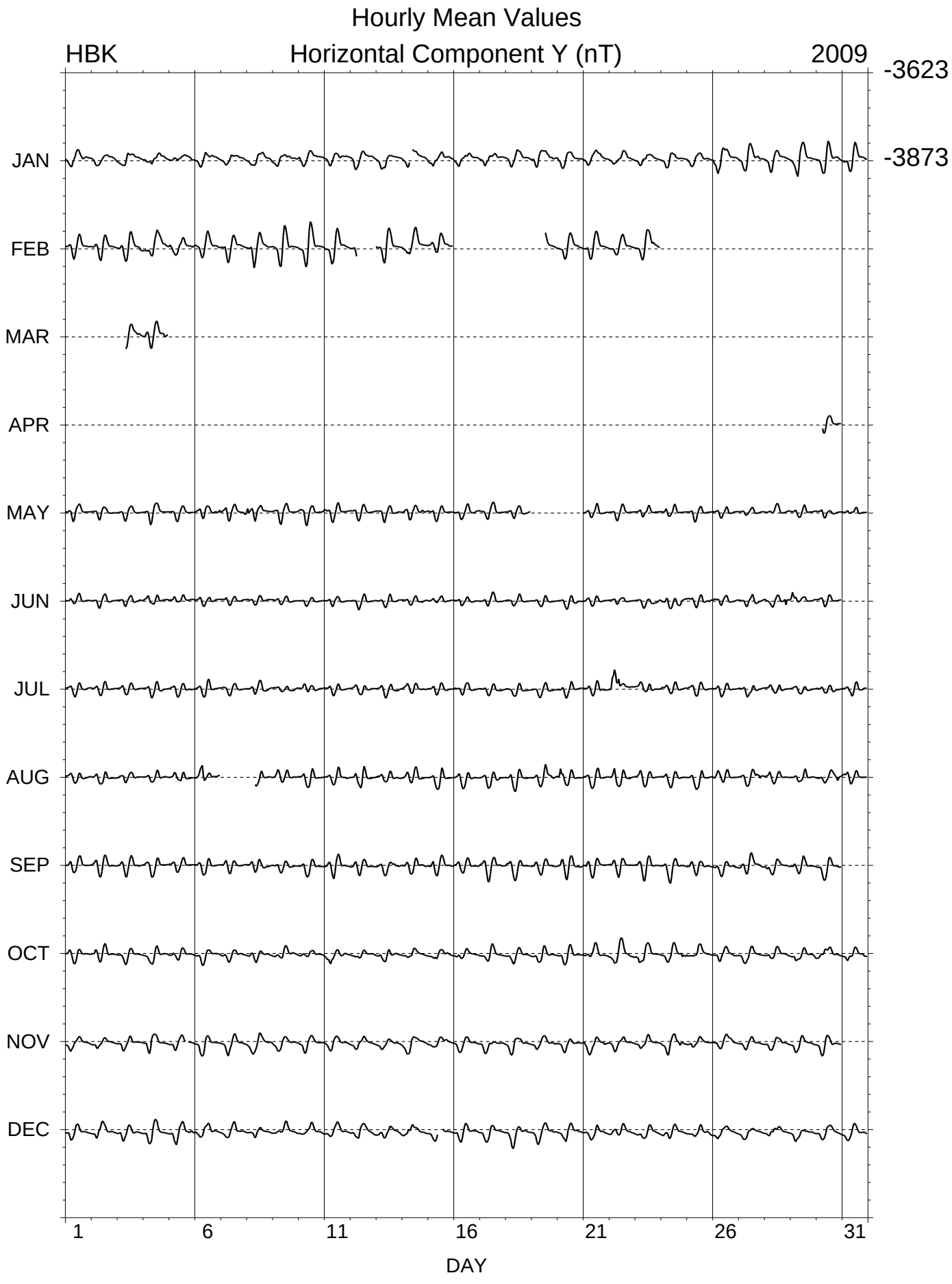
Observed and Adopted Baseline Values, HBK 2009

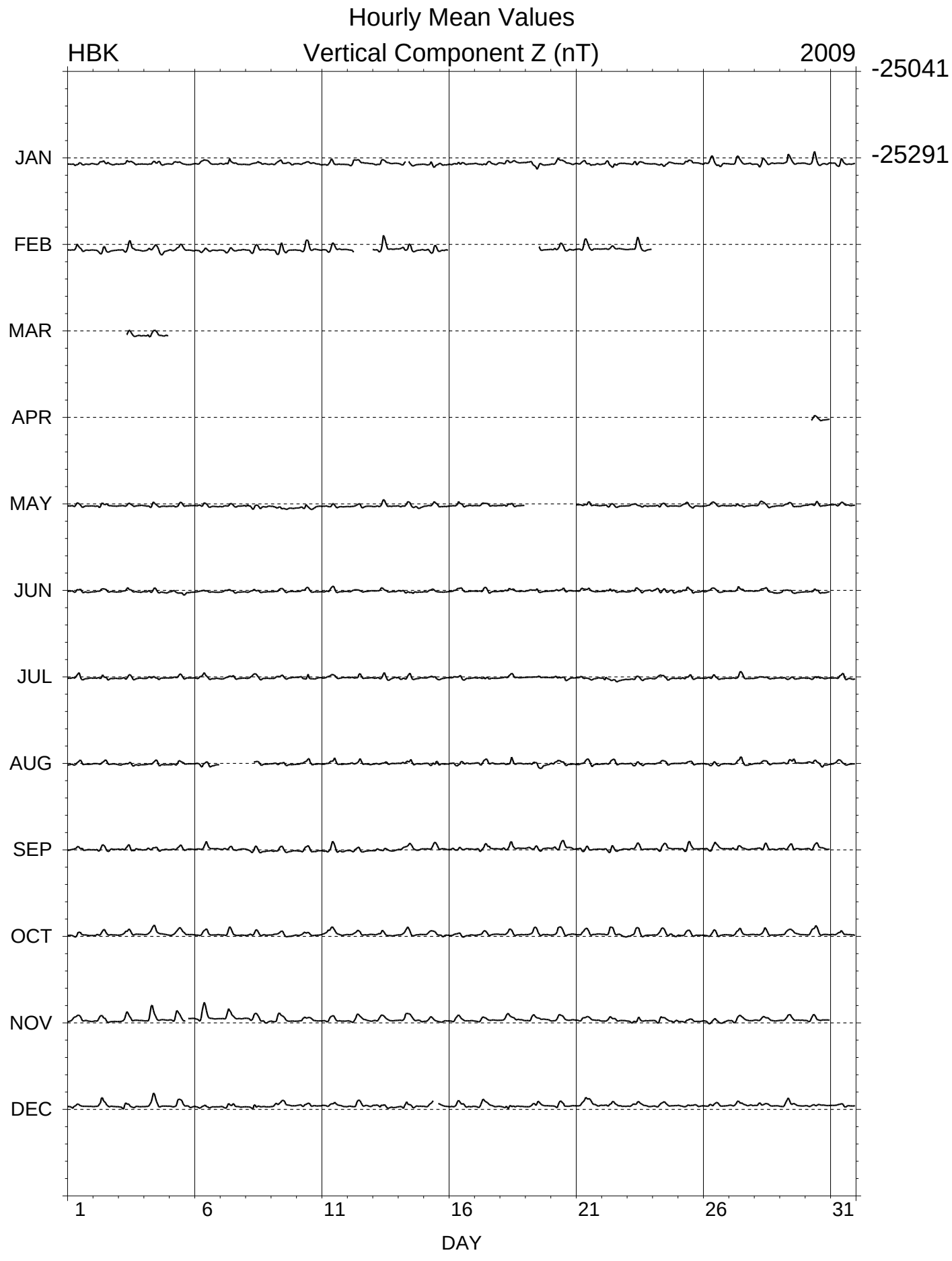
LAT: 115.883 LONG: 27.707

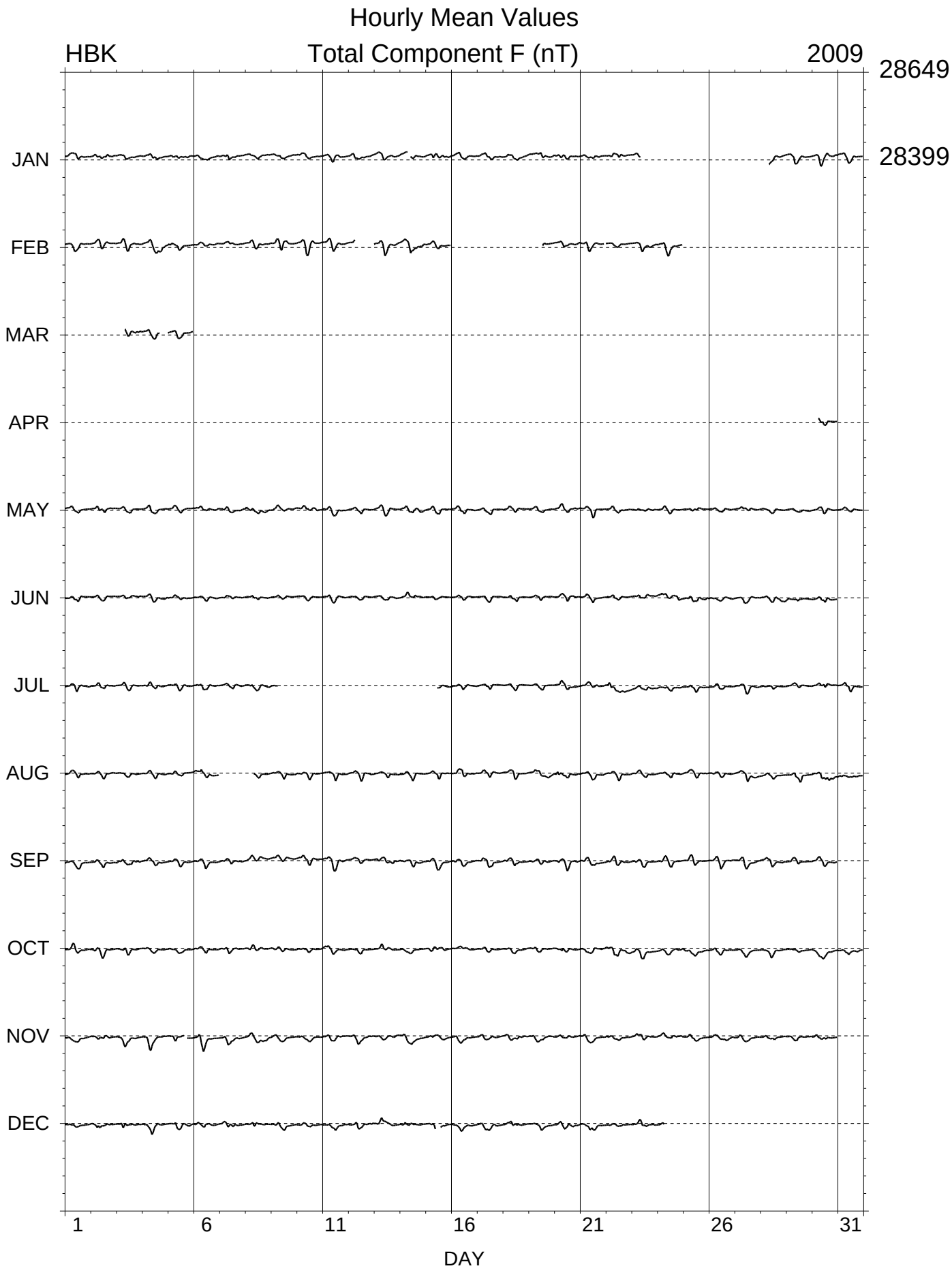
INSTITUTION: HMO INSTRUMENT: LC




Hourly Mean Values
HBK
Horizontal Component X (nT)
2009
12574
12324
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY


Hourly Mean Values
HBK
Horizontal Component Y (nT)
2009
-3623
-3873
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY


Hourly Mean Values
HBK
Vertical Component Z (nT)
2009
-25041
-25291
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY


Hourly Mean Values
HBK
Total Component F (nT)
2009
28649
28399
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY

HARTEBEESTHOEK
MEAN MONTHLY VALUES 2009

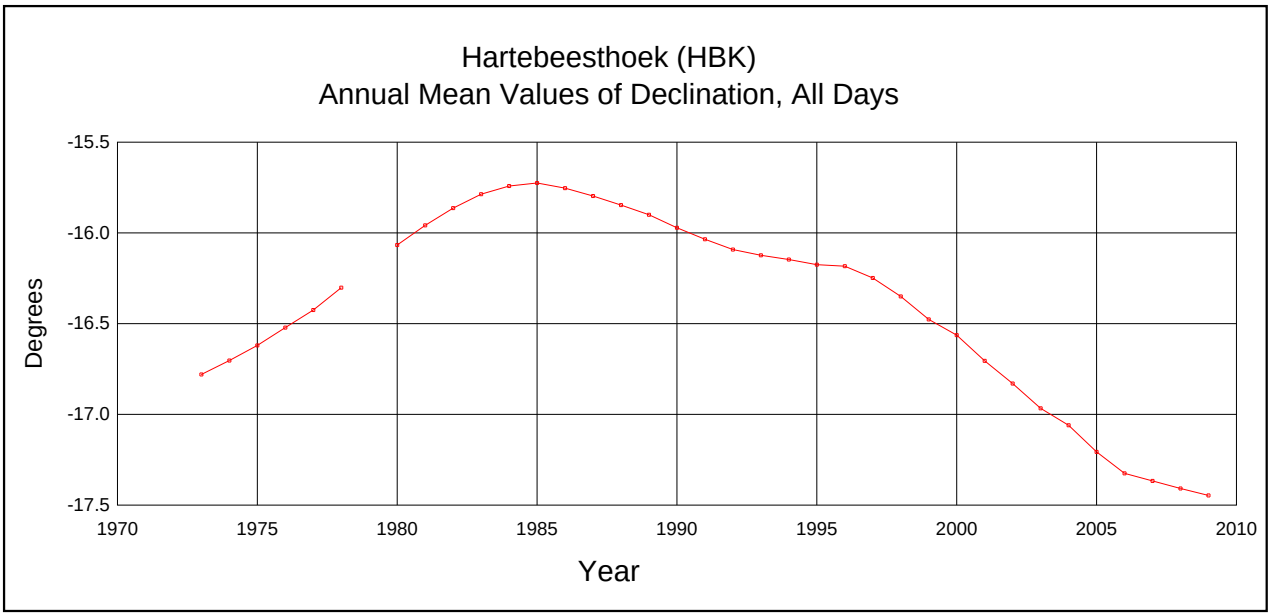
Date	° D '	° I '	H nT	X nT	Y nT	Z nT	F nT	*	ELE
JAN	-17 25.6	-62 58.2	12912	12319	-3867	-25307	28410	A	HDZF
FEB	-17 25.1	-62 57.9	12913	12321	-3865	-25305	28408	A	HDZF
MAR	-17 25.4	-62 58.0	12911	12319	-3866	-25302	28405	A	HDZF
APR	*** ****	*** ****	*****	*****	*****	******	*****	A	HDZF
MAY	-17 26.3	-62 57.3	12914	12320	-3870	-25296	28402	A	HDZF
JUN	-17 26.6	-62 56.8	12918	12324	-3872	-25293	28401	A	HDZF
JUL	-17 27.1	-62 57.5	12912	12317	-3872	-25294	28397	A	HDZF
AUG	-17 27.3	-62 57.1	12914	12319	-3874	-25291	28396	A	HDZF
SEP	-17 27.1	-62 56.2	12921	12326	-3875	-25288	28398	A	HDZF
OCT	-17 27.3	-62 55.6	12924	12329	-3876	-25284	28395	A	HDZF
NOV	-17 27.7	-62 55.1	12927	12331	-3879	-25281	28394	A	HDZF
DEC	-17 27.8	-62 54.6	12930	12335	-3880	-25279	28395	A	HDZF
YEAR	-17 26.8	-62 56.6	12919	12324	-3873	-25291	28399	A	HDZF
JAN	-17 25.5	-62 57.9	12914	12321	-3867	-25307	28411	Q	HDZF
FEB	-17 25.3	-62 57.8	12915	12323	-3867	-25306	28410	Q	HDZF
MAR	*** ****	*** ****	*****	*****	*****	******	*****	Q	HDZF
APR	*** ****	*** ****	*****	*****	*****	******	*****	Q	HDZF
MAY	-17 26.3	-62 57.1	12916	12322	-3870	-25296	28402	Q	HDZF
JUN	-17 26.4	-62 56.7	12919	12325	-3872	-25293	28401	Q	HDZF
JUL	-17 27.5	-62 57.1	12914	12319	-3874	-25293	28398	Q	HDZF
AUG	-17 27.7	-62 56.6	12918	12323	-3876	-25290	28397	Q	HDZF
SEP	-17 27.1	-62 55.7	12924	12329	-3876	-25286	28398	Q	HDZF
OCT	-17 27.1	-62 55.3	12926	12331	-3877	-25283	28396	Q	HDZF
NOV	-17 27.4	-62 54.8	12929	12333	-3878	-25279	28393	Q	HDZF
DEC	-17 27.9	-62 54.8	12929	12333	-3880	-25280	28394	Q	HDZF
YEAR	-17 26.9	-62 56.3	12921	12326	-3874	-25291	28399	Q	HDZF
JAN	-17 25.5	-62 58.4	12910	12317	-3866	-25308	28411	D	HDZF
FEB	-17 24.6	-62 59.0	12904	12312	-3861	-25307	28405	D	HDZF
MAR	*** ****	*** ****	*****	*****	*****	******	*****	D	HDZF
APR	*** ****	*** ****	*****	*****	*****	******	*****	D	HDZF
MAY	-17 26.1	-62 57.7	12911	12318	-3868	-25297	28401	D	HDZF
JUN	-17 26.7	-62 56.9	12916	12322	-3872	-25293	28399	D	HDZF
JUL	-17 26.6	-62 58.2	12905	12312	-3869	-25295	28391	D	HDZF
AUG	-17 27.3	-62 57.6	12909	12315	-3872	-25292	28395	D	HDZF
SEP	-17 27.2	-62 56.4	12918	12323	-3875	-25288	28396	D	HDZF
OCT	-17 27.5	-62 56.1	12918	12323	-3876	-25282	28391	D	HDZF
NOV	-17 27.8	-62 55.4	12925	12329	-3879	-25283	28395	D	HDZF
DEC	-17 27.8	-62 54.7	12930	12334	-3880	-25280	28395	D	HDZF
YEAR	-17 26.8	-62 57.0	12915	12321	-3872	-25292	28398	D	HDZF

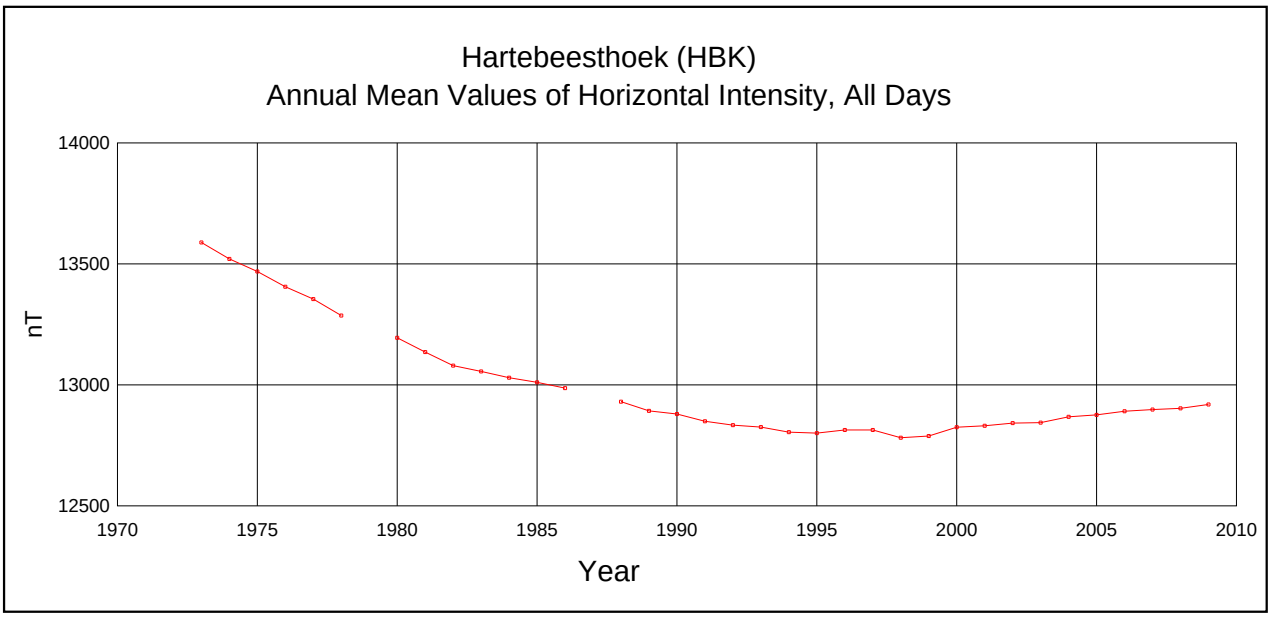
*A: All days
*Q: Quiet days
*D: Disturbed days
ELE: Elements recorded

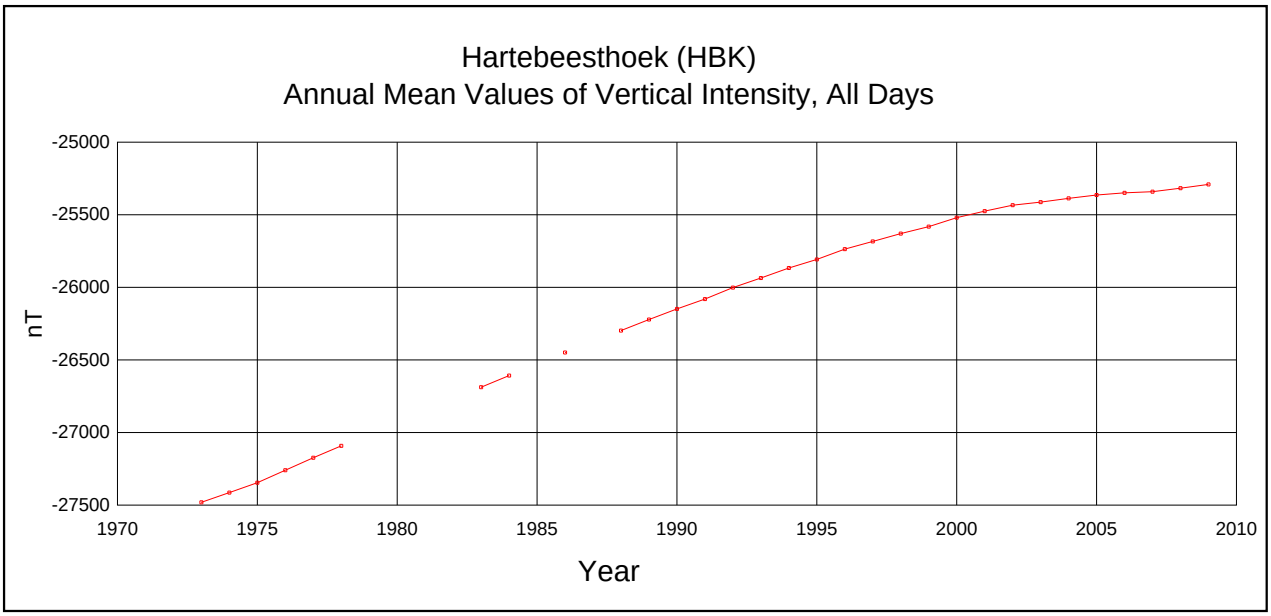
HARTEBEESTHOEK
MEAN ANNUAL VALUES

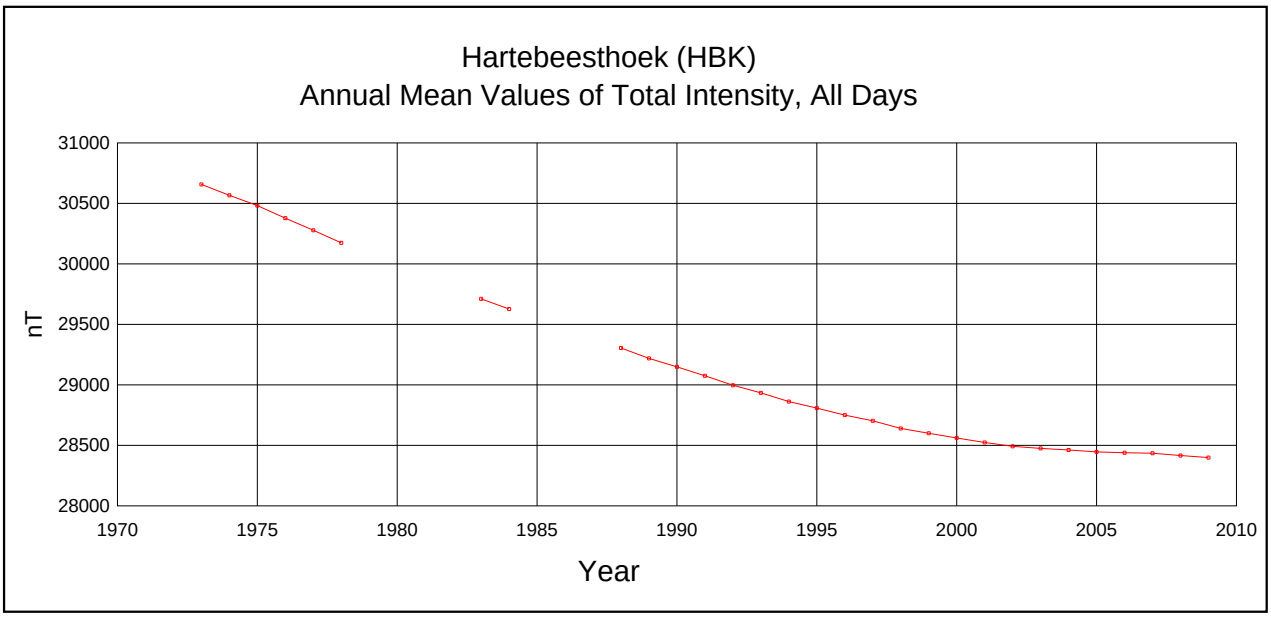
Date	°D	'	°I	'	H nT	X nT	Y nT	Z nT	F nT	*	ELE
1973.5	-16	46.6	-63	41.5	13588	13010	-3919	-27481	30657	I	DHZ
1974.5	-16	42.0	-63	45.0	13520	12950	-3885	-27414	30567	A	DHZ
1975.5	-16	37.0	-63	46.8	13468	12905	-3852	-27346	30482	A	DHZ
1976.5	-16	31.1	-63	49.0	13405	12852	-3811	-27260	30378	A	DHZ
1977.5	-16	25.3	-63	49.8	13354	12810	-3775	-27174	30278	A	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	A	DHZ
1996.5	-16	10.8	-63	32.1	12813	12306	-3570	-25737	28750	A	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	A	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	A	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
2006.5	-17	19.5	-63	02.7	12891	12306	-3839	-25349	28439	A	DHZ
2007.5	-17	22.0	-63	01.4	12898	12310	-3850	-25341	28435	I	DHZ
2008.5	-17	24.5	-62	59.6	12903	12312	-3860	-25317	28416	I	DHZ
2009.5	-17	26.8	-62	56.6	12919	12324	-3873	-25291	28399	I	DHZ

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


Hartebeesthoek (HBK)
Annual Mean Values of Declination, All Days
Degrees
-15.5
-16.0
-16.5
-17.0
-17.5
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year


Hartebeesthoek (HBK)
Annual Mean Values of Horizontal Intensity, All Days
nT
14000
13500
13000
12500
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year


Hartebeesthoek (HBK)
Annual Mean Values of Vertical Intensity, All Days
-25000
-25500
-26000
-26500
-27000
-27500
nT
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year


Hartebeesthoek (HBK)
Annual Mean Values of Total Intensity, All Days
31000
30500
30000
29500
29000
28500
28000
nT
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

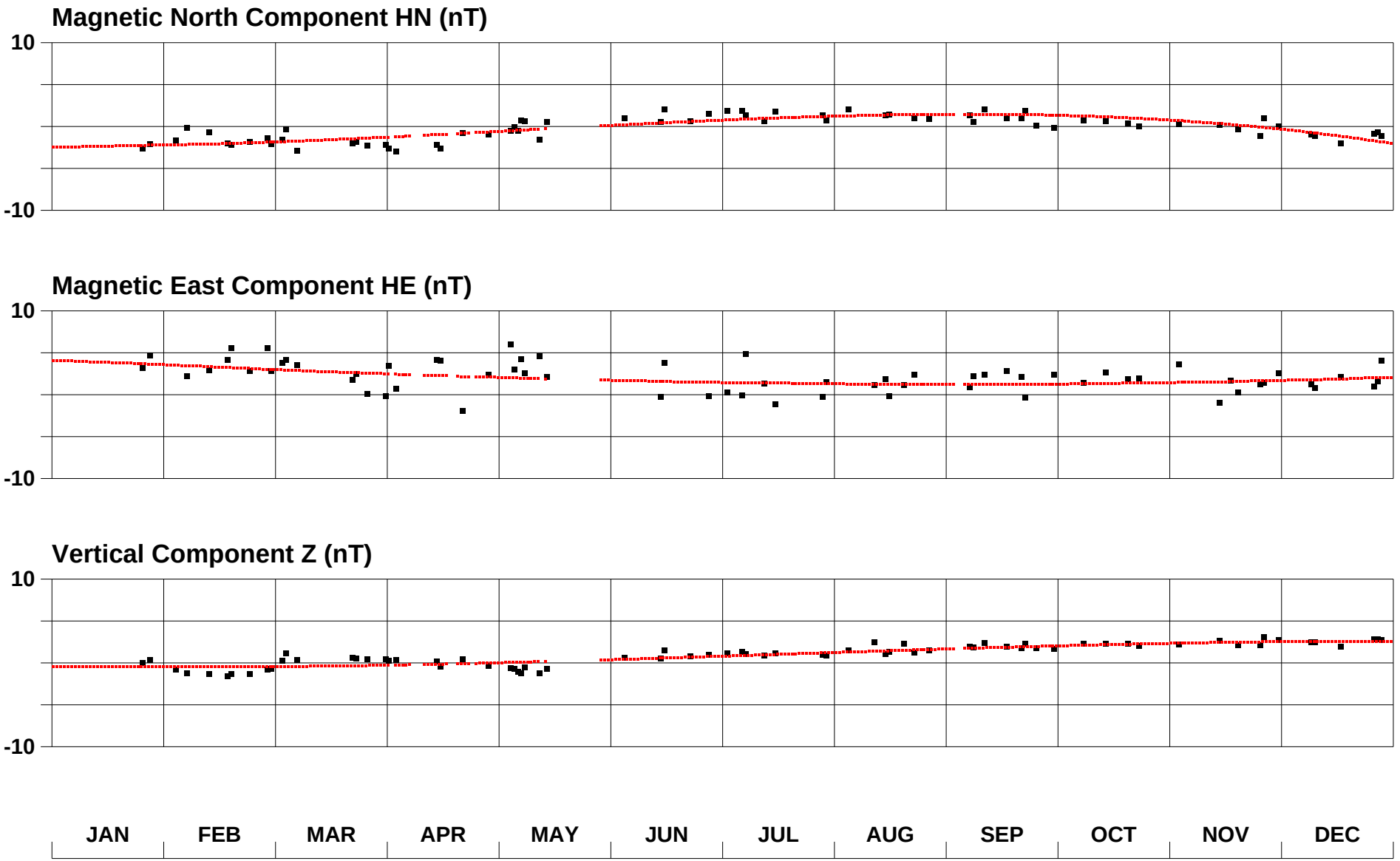
Magnetic Results 2009

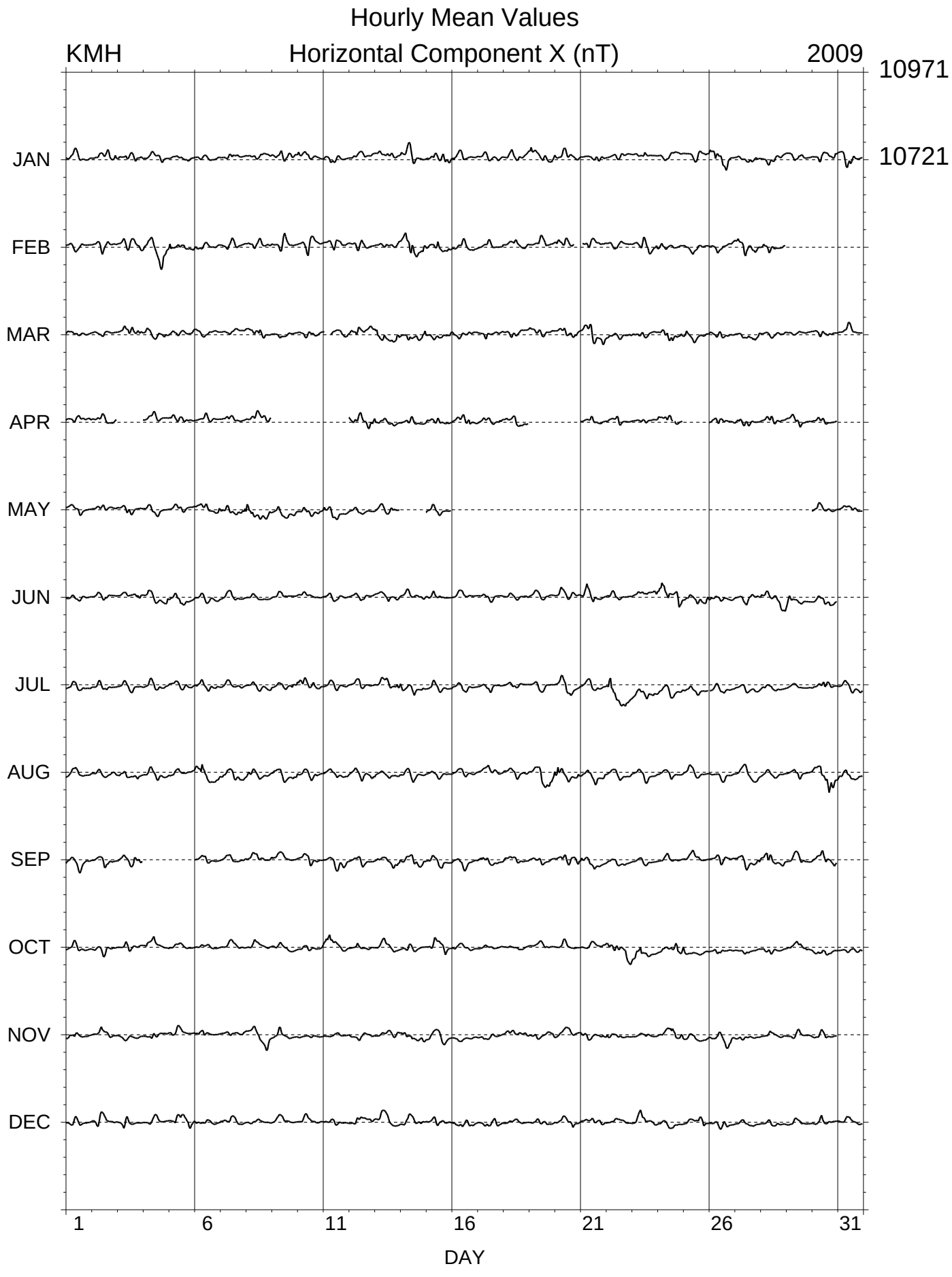
Keetmanshoop

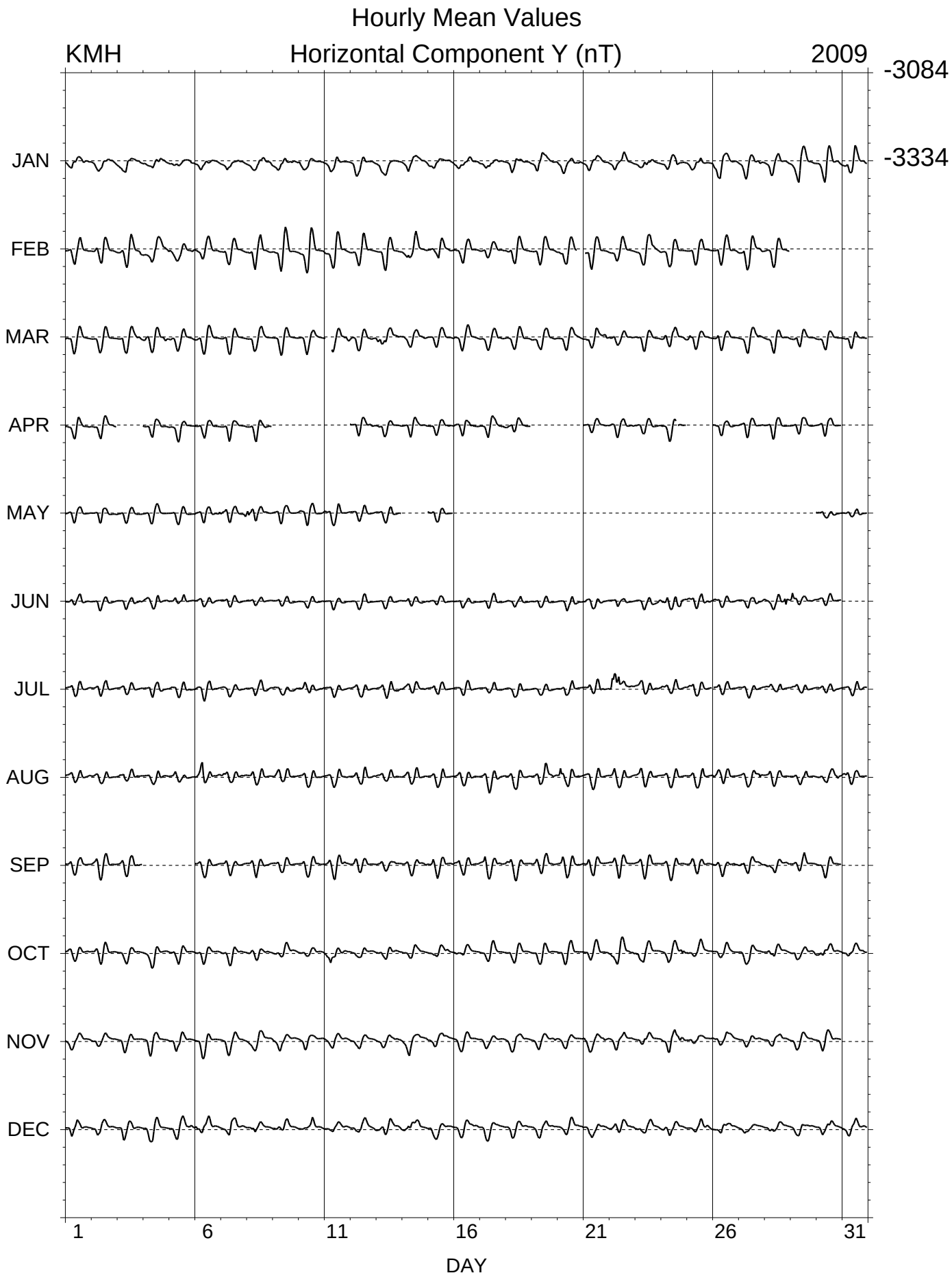
Observed and Adopted Baseline Values, KMH 2009

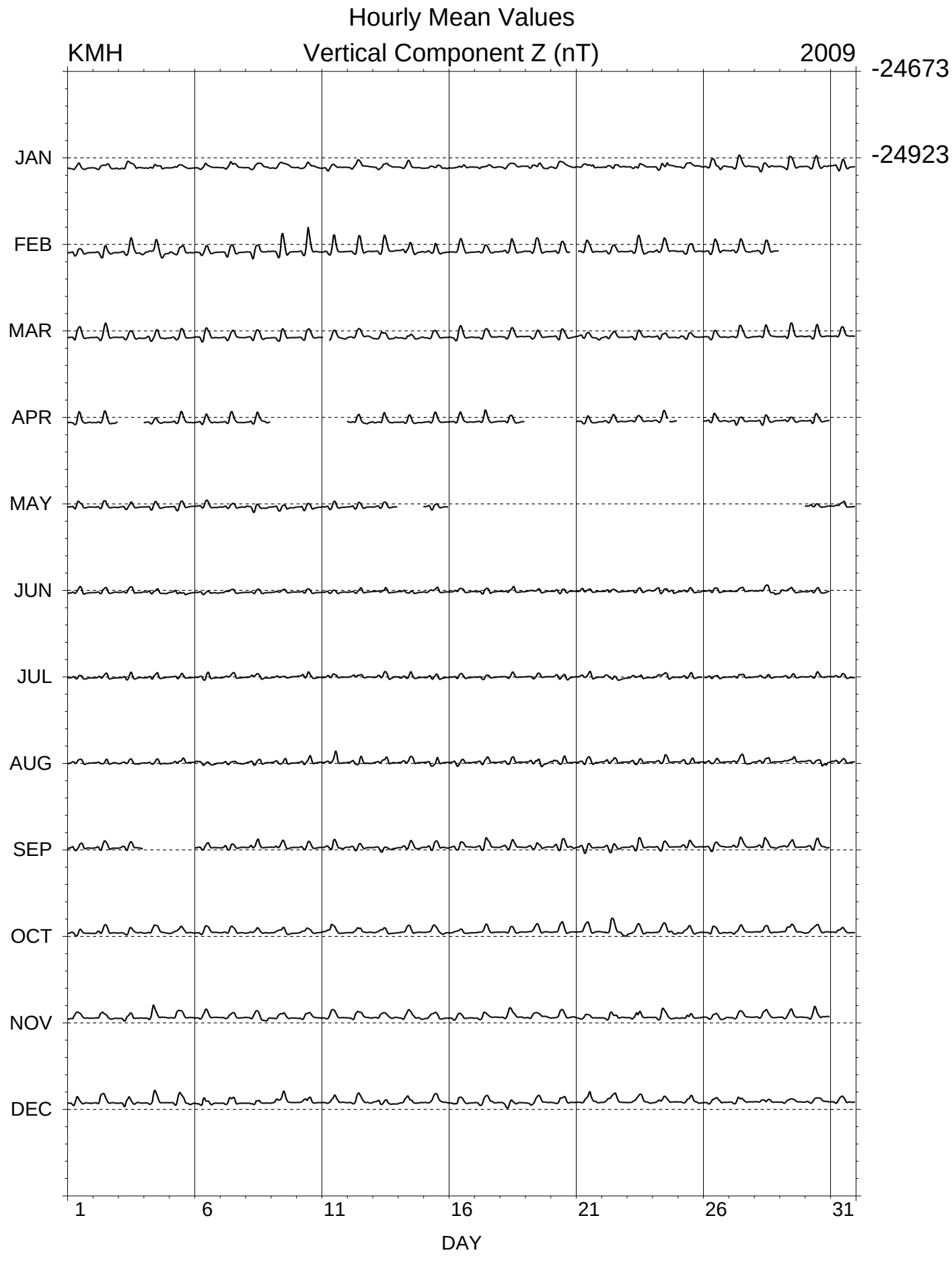
LAT: 116.541 LONG: 18.110

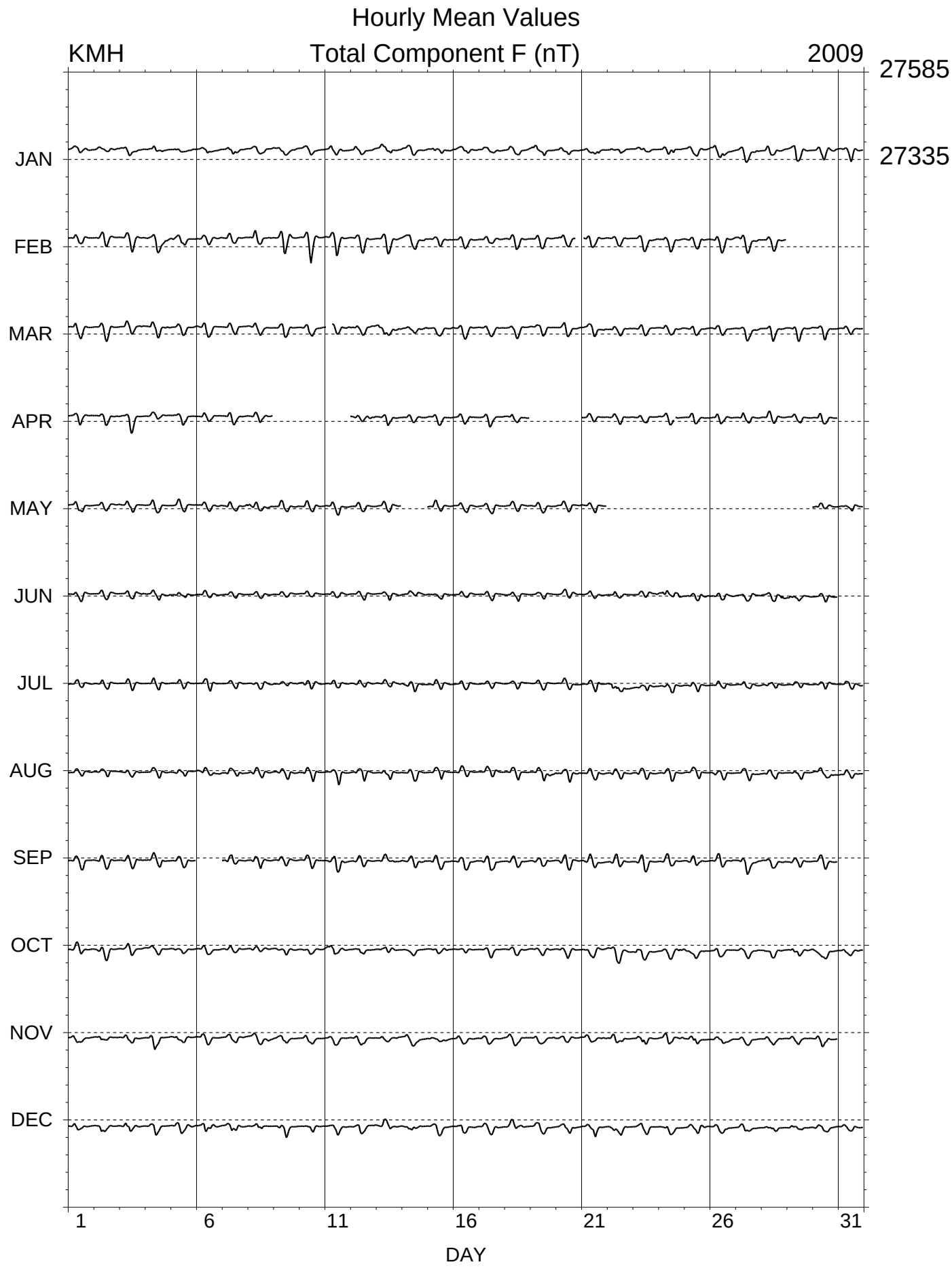
INSTITUTION: HMO INSTRUMENT: LC




Hourly Mean Values
KMH
Horizontal Component X (nT)
2009
10971
10721
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY


Hourly Mean Values
KMH
Horizontal Component Y (nT)
2009
-3084
-3334
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY


Hourly Mean Values
KMH
Vertical Component Z (nT)
2009
-24673
-24923
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY


Hourly Mean Values
KMH
Total Component F (nT)
2009
27585
27335
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1
6
11
16
21
26
31
DAY

KEETMANSHOOP
MEAN MONTHLY VALUES 2009

Date	° D '	° I '	H nT	X nT	Y nT	Z nT	F nT	*	ELE
JAN	-17 17.6	-65 45.0	11238	10730	-3341	-24948	27362	A	HDZF
FEB	-17 17.6	-65 45.1	11234	10726	-3339	-24940	27355	A	HDZF
MAR	-17 17.4	-65 45.2	11232	10724	-3338	-24938	27350	A	HDZF
APR	-17 17.0	-65 44.7	11234	10727	-3338	-24933	27346	A	HDZF
MAY	-17 17.0	-65 45.5	11227	10720	-3335	-24931	27342	A	HDZF
JUN	-17 16.7	-65 45.0	11229	10722	-3335	-24926	27339	A	HDZF
JUL	-17 16.5	-65 45.8	11220	10714	-3332	-24923	27332	A	HDZF
AUG	-17 16.4	-65 45.5	11221	10715	-3332	-24919	27329	A	HDZF
SEP	-17 16.1	-65 44.7	11225	10719	-3332	-24914	27326	A	HDZF
OCT	-17 15.7	-65 44.5	11225	10719	-3331	-24908	27320	A	HDZF
NOV	-17 15.6	-65 44.4	11224	10719	-3330	-24905	27317	A	HDZF
DEC	-17 14.5	-65 43.8	11227	10723	-3328	-24900	27314	A	HDZF
YEAR	-17 16.5	-65 44.9	11228	10721	-3334	-24923	27335	A	HDZF
JAN	-17 17.5	-65 44.8	11240	10732	-3341	-24948	27362	Q	HDZF
FEB	-17 17.2	-65 44.7	11238	10730	-3339	-24941	27357	Q	HDZF
MAR	-17 17.6	-65 44.9	11235	10727	-3340	-24938	27351	Q	HDZF
APR	-17 16.8	-65 44.5	11236	10729	-3338	-24933	27347	Q	HDZF
MAY	-17 16.9	-65 45.2	11229	10722	-3336	-24931	27342	Q	HDZF
JUN	-17 16.5	-65 44.9	11230	10723	-3335	-24927	27339	Q	HDZF
JUL	-17 16.7	-65 45.6	11222	10716	-3333	-24923	27334	Q	HDZF
AUG	-17 16.7	-65 44.9	11226	10719	-3334	-24918	27330	Q	HDZF
SEP	-17 15.4	-65 44.4	11227	10722	-3331	-24913	27325	Q	HDZF
OCT	-17 15.6	-65 44.3	11227	10721	-3331	-24908	27321	Q	HDZF
NOV	-17 15.7	-65 44.0	11227	10721	-3331	-24904	27318	Q	HDZF
DEC	-17 14.9	-65 43.9	11227	10722	-3329	-24901	27315	Q	HDZF
YEAR	-17 16.4	-65 44.7	11230	10724	-3335	-24923	27337	Q	HDZF
JAN	-17 17.2	-65 45.2	11236	10729	-3339	-24948	27361	D	HDZF
FEB	-17 17.9	-65 45.8	11228	10720	-3339	-24940	27352	D	HDZF
MAR	-17 17.4	-65 46.1	11225	10718	-3336	-24940	27349	D	HDZF
APR	-17 16.4	-65 45.1	11231	10724	-3335	-24934	27346	D	HDZF
MAY	-17 16.9	-65 45.8	11224	10717	-3334	-24931	27342	D	HDZF
JUN	-17 16.8	-65 45.2	11226	10720	-3334	-24925	27336	D	HDZF
JUL	-17 16.0	-65 46.6	11213	10708	-3328	-24923	27330	D	HDZF
AUG	-17 16.4	-65 46.1	11217	10711	-3331	-24920	27328	D	HDZF
SEP	-17 16.3	-65 45.0	11222	10716	-3332	-24912	27324	D	HDZF
OCT	-17 16.1	-65 45.1	11219	10713	-3330	-24906	27316	D	HDZF
NOV	-17 15.4	-65 44.7	11222	10717	-3329	-24906	27318	D	HDZF
DEC	-17 14.3	-65 44.0	11226	10721	-3327	-24900	27314	D	HDZF
YEAR	-17 16.4	-65 45.4	11224	10718	-3333	-24923	27334	D	HDZF

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

KEETMANSHOOP
MEAN ANNUAL VALUES

Date	°D	'	°I	'	H nT	X nT	Y nT	Z nT	F nT	*	ELE
2007.5	-17	23.3	-65	43.4	11273	10758	-3369	-24993	27417	I	DHZ
2008.5	-17	20.1	-65	45.2	11245	10735	-3351	-24966	27381	A	DHZ
2009.5	-17	16.5	-65	44.9	11228	10721	-3334	-24923	27335	I	DHZ

*A: All days
*I: Incomplete
ELE: Elements recorded