



Hermanus Magnetic Observatory

A facility of the National Research Foundation

Magnetic Results 2004

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 2004.

2. DESCRIPTION OF THE OBSERVATORIES

The locations of the magnetic observatories are as follows:

Observatory	Geographic Coordinates		Geomagnetic Coordinates		Elevation
	Latitude	Longitude	Latitude	Longitude	m
Hermanus	34° 25' 30" S	19° 13' 30" E	42° 36' S	82° 59' E	26
Hartebeesthoek	25° 52' 58" S	27° 42' 25" E	36° 15' S	95° 29' E	1555
Tsumeb	19° 12' 08" S	17° 35' 03" E	31° 03' S	87° 00' E	1273

Geomagnetic coordinates given are relative to a geomagnetic north pole position of 82.8° N, 116.0° W, computed from the IGRF model (degree 13) at the epoch 2004.5.

3. ABSOLUTE MEASUREMENTS

At each observatory absolute measurements are made in a single absolute hut. 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 , and a Proton Precession Magnetometer (PPM) and dIdD for measuring the total magnetic field intensity, F . The absolute values H and Z were then derived from

$$\begin{aligned}H &= F \cos I \\Z &= F \sin I\end{aligned}$$

Where H , Z and F are field values at the time of the I measurement. Baseline values H_0 , D_0 and Z_0 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 the proton precession magnetometer (PPM) some distance away. The site differences have been measured which enable the F measurements to be reduced to the absolute pillar:

$$F_{\text{absolute pillar}} = F_{\text{ppm}} + \Delta F_{\text{pillar}}$$

The following are the adopted values for the year:

Site differences of ΔF_{pillar}					
Hermanus		Hartebeesthoek		Tsumeb	
Period (Day numbers)	Correction	Period (Day numbers)	Correction	Period (Day numbers)	Correction
1 – 31	22.4 nT	1 – 366	77.0 nT	1 – 366	18.0 nT
32 – 60	21.4 nT				
61 – 63	21.8 nT				
64 – 91	20.3 nT				
92 – 116	21.0 nT				
117 – 182	22.9 nT				
183 – 191	23.0 nT				
192 – 213	21.0 nT				
214 – 217(1100)	22.0 nT				
217(1101) – 244	01.3 nT				
245 – 274	01.2 nT				
275–305	01.3 nT				
306 – 366	01.1 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 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 Loránd 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 is missing data for the first 72 days. Also, no observed base-line values were available for December as no observations were done. The adopted base-line values were extrapolated using the observed base-line values of the previous months.

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

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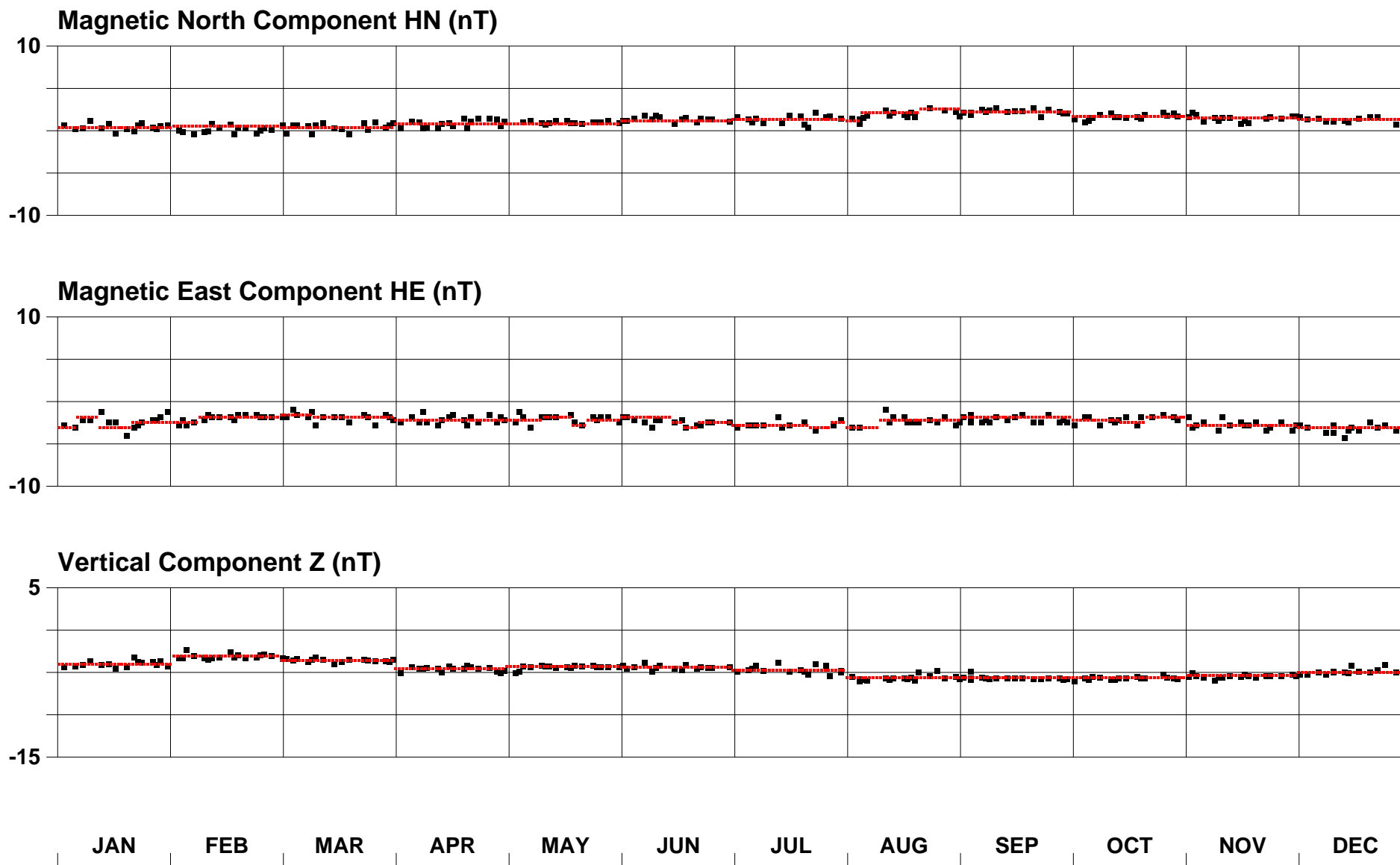
Magnetic Results 2004

Hermanus

Observed and Adopted Baseline Values, HER 2004

LAT: 124.425 LONG: 19.225

INSTITUTION: HMO INSTRUMENT: LC



Hourly Mean Values

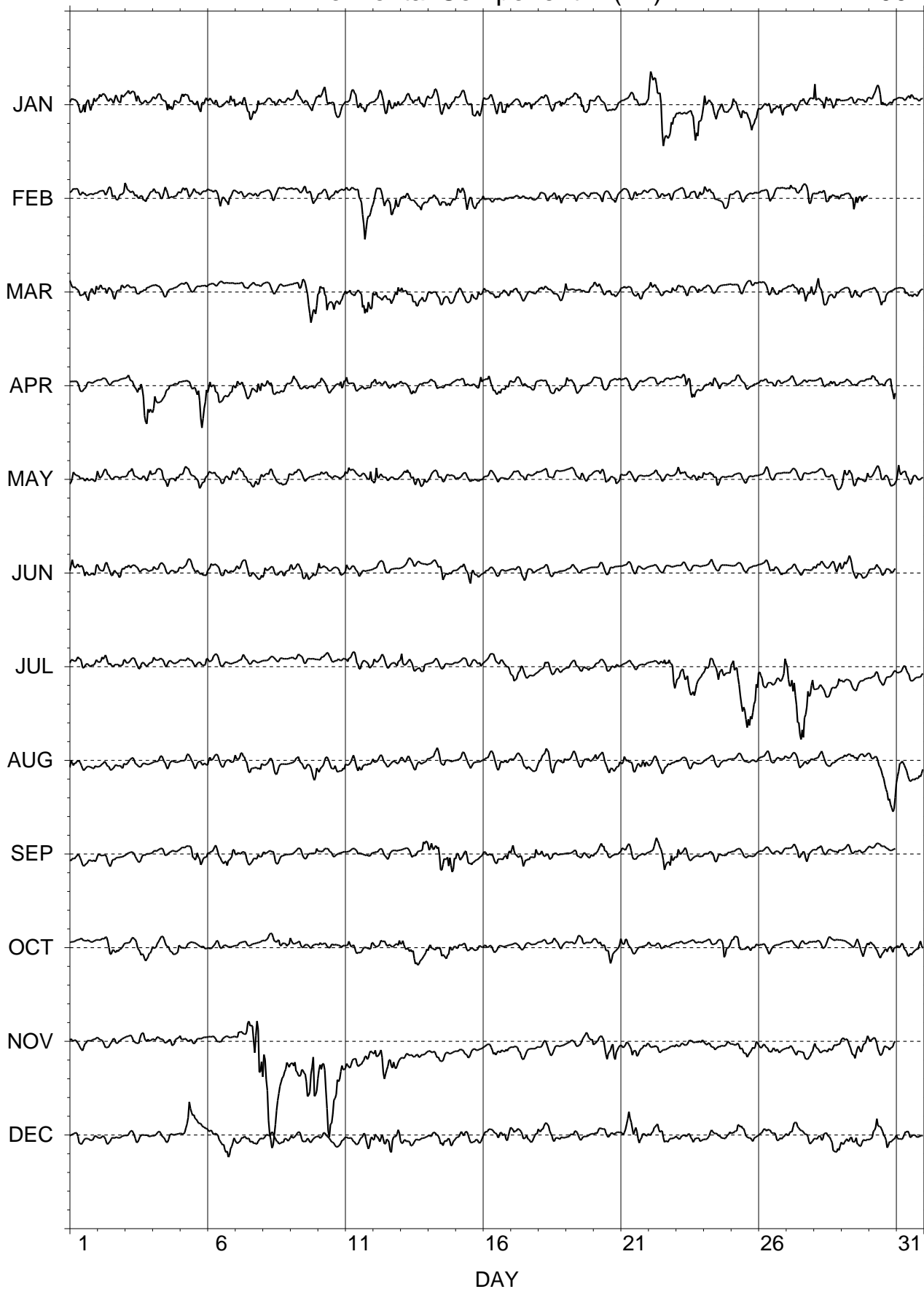
HER

Horizontal Component X (nT)

2004

9981

9731

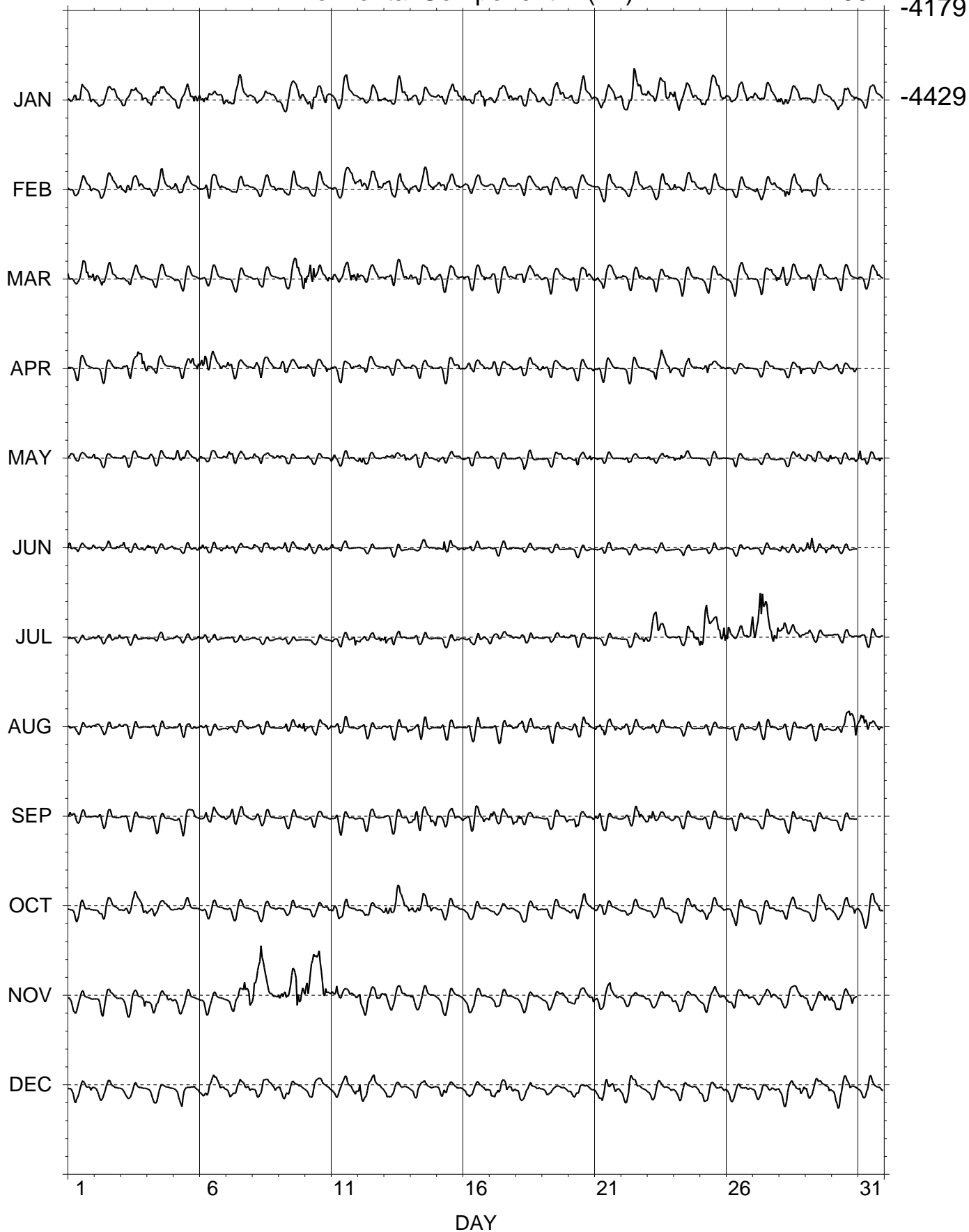


Hourly Mean Values

HER

Horizontal Component Y (nT)

2004

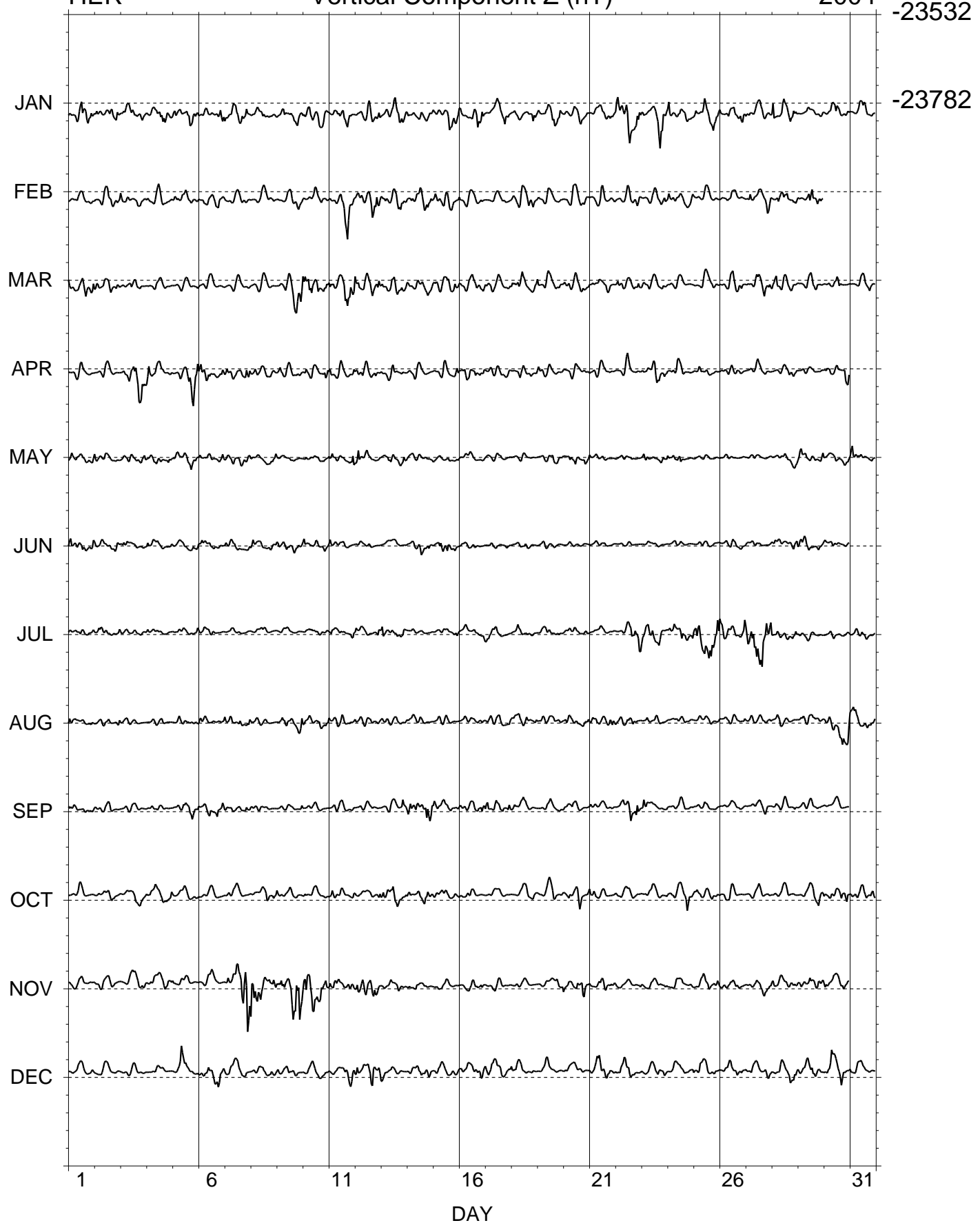


Hourly Mean Values

HER

Vertical Component Z (nT)

2004



Hourly Mean Values

HER

Total Component F (nT)

2004

26324

JAN

26074

FEB

MAR

APR

MAY

JUN

JUL

AUG

SEP

OCT

NOV

DEC

1

6

11

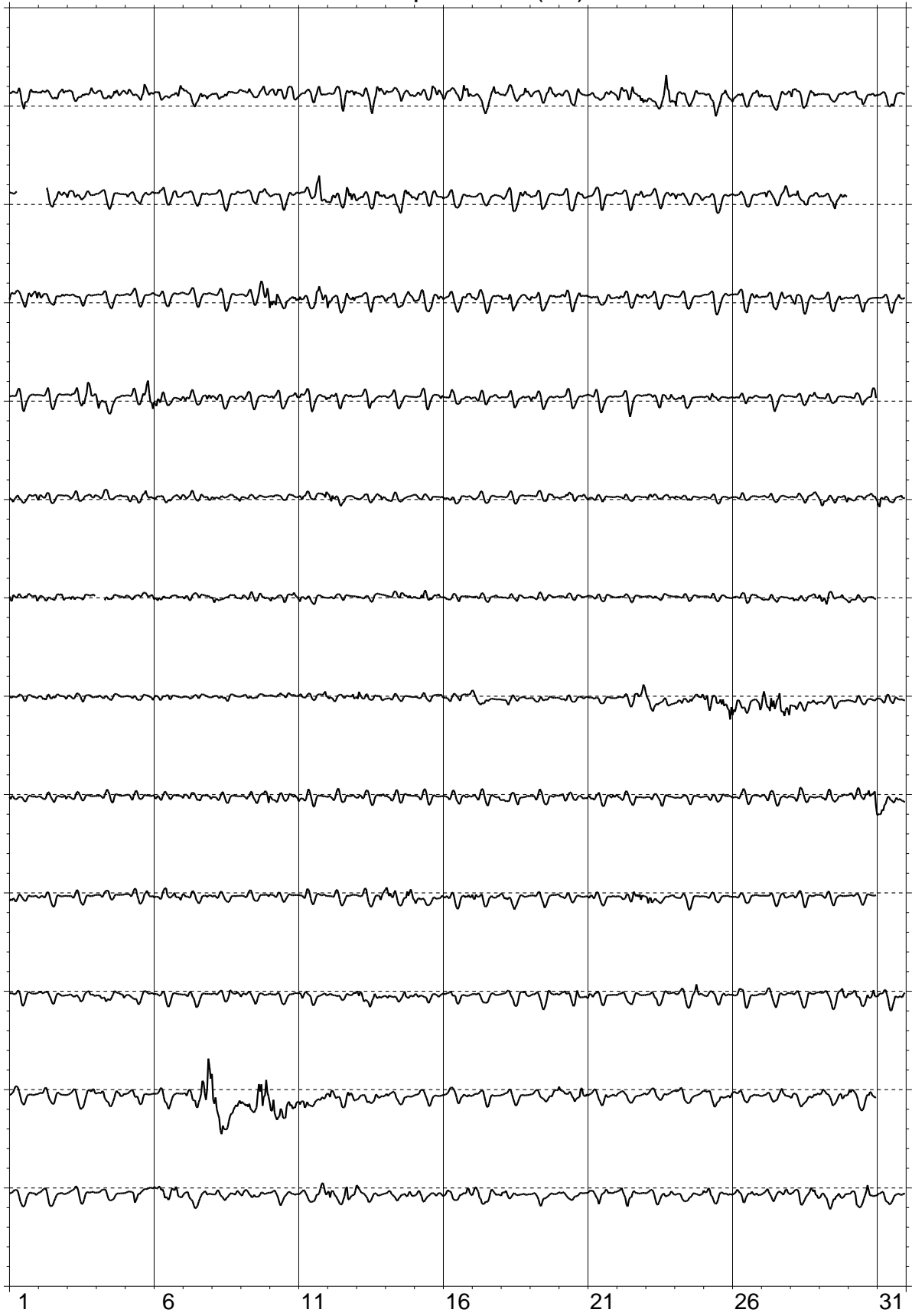
16

21

26

31

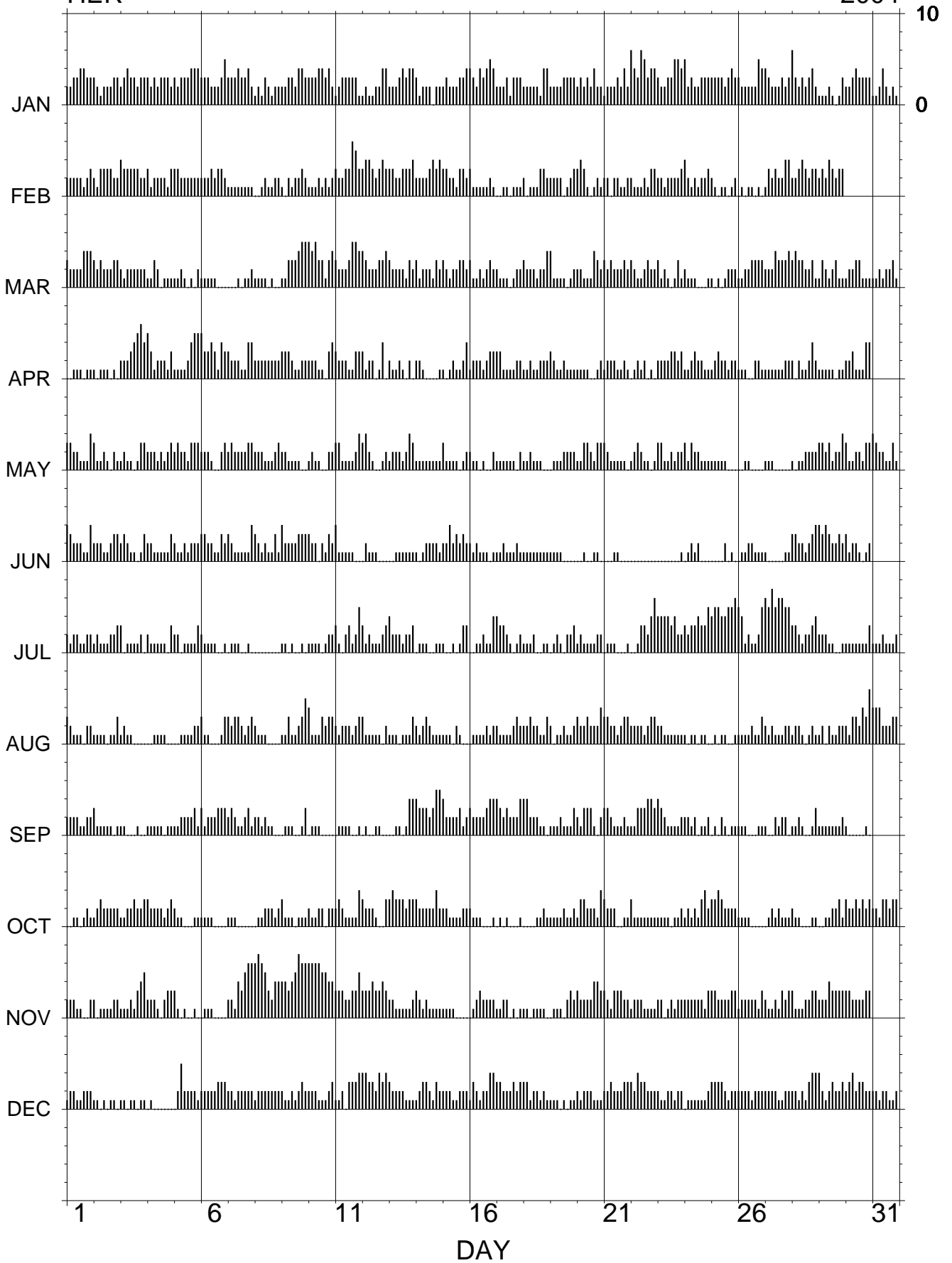
DAY



K indices

HER

2004



K INDICES
K9 = 300 NT

HER 2004

DATE	JAN	FEB	MAR	APR	MAY	JUN
01	2233 4433	2222 2123	3222 2444	0011 1011	3322 1114	4322 2114
02	3212 2233	2133 3322	3232 2233	1011 1010	3112 1021	2221 1233
03	2343 3233	4333 3322	2122 2222	2223 4564	1211 0133	2321 1013
04	3232 3332	3122 2213	1132 0111	5312 2213	2221 2123	2211 1113
05	3233 3444	3322 2222	1121 0102	1111 2455	2322 1333	2112 1222
06	3332 2235	2223 2332	1111 1000	5334 3143	2221 0023	3322 1132
07	3334 3342	1111 1111	0001 0112	3222 1144	2322 2233	3211 1114
08	1213 2122	0012 1122	1111 0100	2222 2222	2221 1123	3212 1131
09	2233 2443	1021 2232	1133 3455	3332 1122	2211 1100	4222 2333
10	3334 4342	1112 1212	5453 3134	2221 1034	1211 0022	3220 2132
11	1233 3331	3223 3653	3222 3554	3222 1133	3311 1124	4111 1100
12	1211 2244	3443 2343	4322 2334	3122 0140	3421 0012	0211 1000
13	2223 4344	3322 3334	3222 2132	2112 1020	1222 1243	0011 1111
14	3122 2022	2222 3434	3122 2132	2210 0001	1111 1111	1012 2221
15	2322 2334	3322 1332	3212 2332	1012 1124	3111 1012	2242 3232
16	4324 3454	3111 1121	3112 1232	1222 1233	2110 1002	2121 1101
17	2223 1333	0011 0111	2111 0122	3311 1122	1111 1102	1121 1121
18	2222 2144	2011 1332	3222 1224	1121 1222	1121 1100	1111 1111
19	2222 3333	2222 0123	4111 1012	3211 2111	0111 2222	1111 0000
20	2323 2422	3431 0121	2211 1432	1111 0012	1133 2133	0010 0110
21	1222 3242	2202 2112	3232 2232	1222 1121	3211 1110	0001 1000
22	6436 5344	2111 2133	3211 2322	0121 2010	1232 1101	0000 0000
23	3223 3554	2212 2223	3121 0131	2222 3323	3311 2122	0000 0001
24	5232 2333	4212 1223	2111 0001	1123 2211	3132 2111	0121 2000
25	3333 2343	2101 1012	1010 1222	1232 2122	1111 1000	0000 2010
26	3222 2254	0101 1010	1122 3333	1110 0221	0011 0000	0112 2111
27	4322 2323	1323 2244	2224 3334	1111 1122	1110 0000	1000 0011
28	6323 2342	2234 3233	3433 2231	2021 1242	1011 2222	3322 1234
29	1112 1013	2324 3233	1321 2311	1111 1011	3323 1224	4343 2232
30	2234 3333		1223 3111	2231 1144	3112 2133	3122 1012
31	1124 2121		1121 2231		4322 1131	
	JUL	AUG	SEP	OCT	NOV	DEC
01	2122 1122	3211 1022	2222 1122	0011 0121	2221 1002	1221 1222
02	1211 1223	1111 0113	3111 1101	1232 2222	2011 1122	1101 0110
03	3011 1120	1211 0000	1100 0100	1122 3223	1112 1345	1101 1011
04	2111 1103	0011 1100	1111 1011	3222 2123	2221 0233	0100 0000
05	2201 1113	0011 1122	1122 2231	2110 0011	3101 0010	0252 2221
06	2111 1001	3110 0013	3122 2333	1111 0000	0111 0000	2222 2333
07	0111 0010	3233 2123	2321 1231	1110 0000	2214 3566	2212 2222
08	0000 0000	2111 0000	2212 1100	0112 2212	6765 3244	1222 2222
09	1101 0010	1131 1235	0111 0013	3111 0111	4434 5766	2112 1232
10	1111 0122	4111 3233	0111 0000	2112 2022	6666 5544	2221 1123
11	3102 3125	2122 2123	0111 1001	2321 1114	3332 2335	1120 3334
12	3121 1123	3111 1102	0100 1100	3222 1003	3334 3343	4433 2434
13	4222 1223	1110 1113	0011 0144	3433 3233	2211 1112	3222 2111
14	0111 0011	2123 2111	4333 2355	3222 2242	3212 1111	1233 2132
15	1001 0133	1110 2100	4222 2312	2211 1122	1111 0000	2221 1222
16	0011 2114	0111 1212	3222 2344	2111 0001	0123 2222	1321 2244
17	4332 1012	2111 1232	4323 2224	0101 0001	1122 0101	3322 2323
18	1112 0011	2232 2113	4422 2110	0000 1121	1101 1110	3312 2121
19	0121 0223	2011 2112	1112 1113	1111 2112	0111 0232	1110 1011
20	1211 1122	3223 2224	2133 3102	1332 2214	3222 2443	2122 2111
21	0111 0001	3322 1233	3321 1121	3222 0011	3213 3322	2232 2233
22	0013 3246	2222 1233	1133 3443	3111 1111	1222 1111	3243 3222
23	4444 3422	2211 1111	4321 1112	1111 0112	2201 2122	2112 2122
24	3233 4335	1011 0110	2212 0112	1212 1342	2222 2213	0111 1112
25	4554 4556	0101 1001	0102 1011	3343 2222	3322 2233	3333 2122
26	5412 1125	1111 2113	1110 0011	1111 0000	1222 2213	2222 1222
27	6575 6655	2121 1122	1002 1220	0121 2111	2112 1323	2222 1122
28	3321 2234	1221 0121	1121 0013	2110 0011	3111 2233	2212 1344
29	2221 1001	1202 1122	1111 1112	0011 2231	2224 3333	4212 3223
30	1111 1113	2133 2436	1000 0010	3223 2323	3322 2233	2342 3322
31	1112 1112	4442 2233		2213 3233		2212 2112

HERMANUS

MEAN MONTHLY VALUES 2004

Date	° D ,	° I ,	H nT	X nT	Y nT	Z nT	F nT	*	ELE
JAN	-24 24.3	-65 49.4	10691	9735	-4417	-23813	26103	A	HDZFF
FEB	-24 24.3	-65 48.3	10695	9739	-4419	-23803	26095	A	HDZFF
MAR	-24 26.2	-65 48.4	10691	9733	-4423	-23795	26086	A	HDZFF
APR	-24 26.9	-65 48.1	10691	9733	-4425	-23791	26083	A	HDZFF
MAY	-24 27.1	-65 46.8	10699	9740	-4429	-23785	26080	A	HDZFF
JUN	-24 27.5	-65 46.1	10703	9742	-4431	-23779	26077	A	HDZFF
JUL	-24 28.8	-65 48.1	10686	9725	-4428	-23778	26068	A	HDZFF
AUG	-24 30.0	-65 47.9	10687	9724	-4432	-23777	26068	A	HDZFF
SEP	-24 30.1	-65 46.5	10695	9732	-4435	-23769	26064	A	HDZFF
OCT	-24 30.1	-65 45.6	10701	9737	-4438	-23765	26063	A	HDZFF
NOV	-24 33.2	-65 49.5	10670	9706	-4434	-23771	26055	A	HDZFF
DEC	-24 32.4	-65 46.3	10693	9727	-4441	-23762	26057	A	HDZFF
YEAR	-24 28.4	-65 47.6	10692	9731	-4429	-23782	26075	A	HDZFF
JAN	-24 24.0	-65 48.5	10697	9742	-4419	-23811	26104	Q	HDZFF
FEB	-24 24.3	-65 47.6	10699	9743	-4421	-23799	26093	Q	HDZFF
MAR	-24 25.1	-65 46.3	10706	9749	-4426	-23792	26090	Q	HDZFF
APR	-24 26.7	-65 46.7	10702	9742	-4429	-23788	26084	Q	HDZFF
MAY	-24 27.2	-65 45.9	10705	9745	-4431	-23782	26080	Q	HDZFF
JUN	-24 27.7	-65 45.5	10707	9746	-4434	-23777	26077	Q	HDZFF
JUL	-24 27.9	-65 45.1	10708	9747	-4435	-23772	26073	Q	HDZFF
AUG	-24 29.9	-65 47.6	10689	9727	-4432	-23776	26069	Q	HDZFF
SEP	-24 30.2	-65 46.2	10698	9734	-4437	-23771	26067	Q	HDZFF
OCT	-24 29.9	-65 44.8	10706	9742	-4439	-23762	26062	Q	HDZFF
NOV	-24 33.1	-65 46.6	10692	9725	-4443	-23765	26059	Q	HDZFF
DEC	-24 32.9	-65 46.1	10695	9728	-4443	-23761	26057	Q	HDZFF
YEAR	-24 28.2	-65 46.4	10700	9739	-4432	-23780	26076	Q	HDZFF
JAN	-24 25.5	-65 51.9	10672	9717	-4413	-23818	26099	D	HDZFF
FEB	-24 24.3	-65 50.6	10680	9725	-4413	-23810	26096	D	HDZFF
MAR	-24 26.5	-65 50.1	10679	9722	-4419	-23800	26086	D	HDZFF
APR	-24 26.9	-65 50.1	10678	9721	-4419	-23799	26085	D	HDZFF
MAY	-24 26.9	-65 47.1	10696	9737	-4427	-23784	26079	D	HDZFF
JUN	-24 27.4	-65 46.5	10700	9740	-4430	-23780	26077	D	HDZFF
JUL	-24 29.0	-65 54.3	10638	9681	-4408	-23787	26057	D	HDZFF
AUG	-24 30.7	-65 50.2	10669	9708	-4427	-23782	26066	D	HDZFF
SEP	-24 29.9	-65 47.4	10689	9726	-4432	-23772	26064	D	HDZFF
OCT	-24 30.7	-65 47.1	10689	9726	-4435	-23767	26060	D	HDZFF
NOV	-24 33.9	-65 57.3	10611	9651	-4411	-23782	26042	D	HDZFF
DEC	-24 31.9	-65 46.6	10691	9726	-4439	-23763	26057	D	HDZFF
YEAR	-24 28.7	-65 49.9	10674	9715	-4423	-23787	26072	D	HDZFF

*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

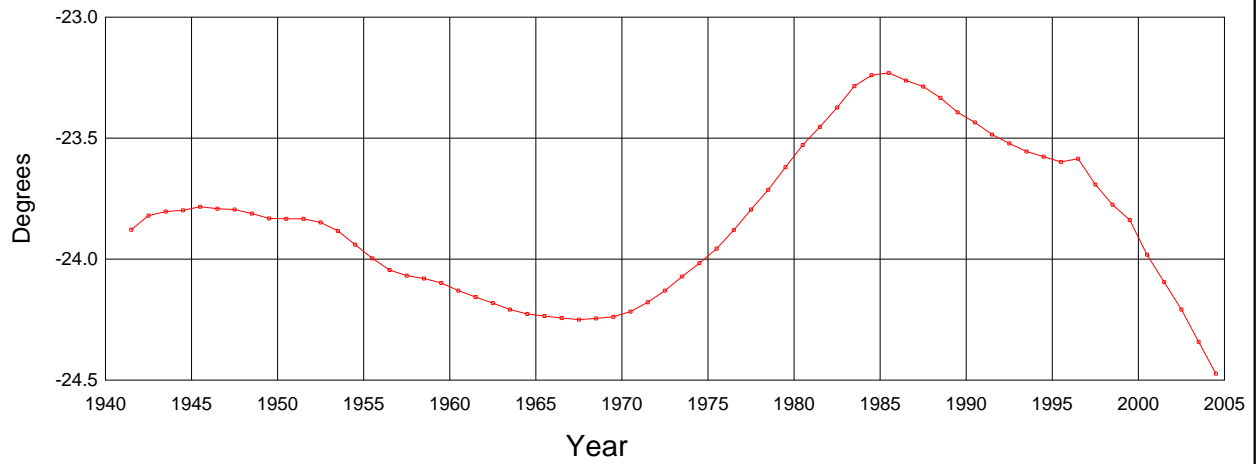
Date	° D	'	° I	'	H nT	X nT	Y nT	Z nT	F nT	*	ELE
1981.5	-23	26.1	-66	15.0	11293	10362	-4492	-25667	28042	A	DHZ
1982.5	-23	21.3	-66	18.6	11228	10309	-4452	-25591	27946	A	DHZ
1983.5	-23	16.0	-66	18.4	11188	10279	-4420	-25496	27843	A	DHZ
1984.5	-23	13.3	-66	18.3	11147	10244	-4395	-25399	27737	A	DHZ
1985.5	-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

*A: All days

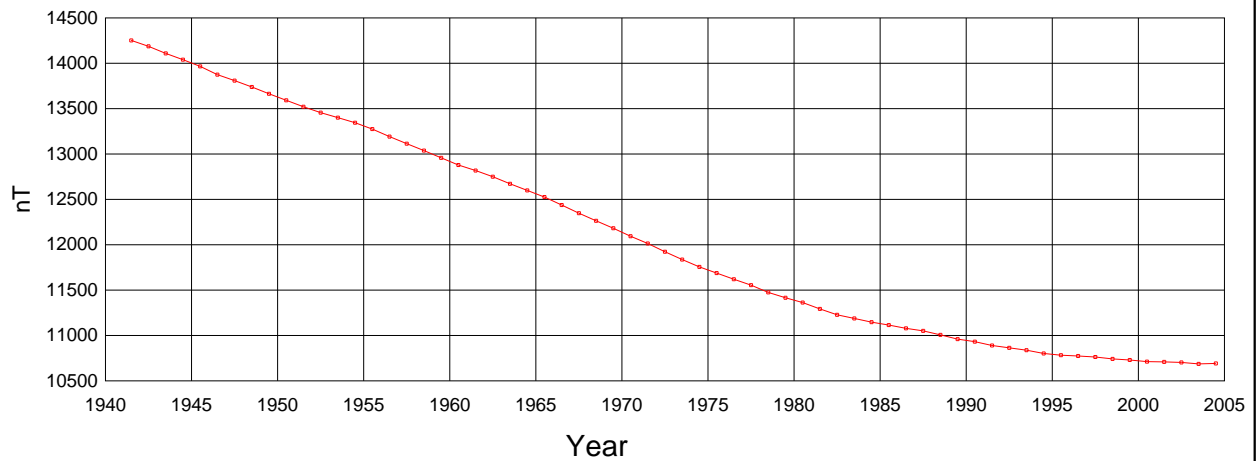
*J: Jump in data, jump value = old site value - new site value

ELE: Elements recorded

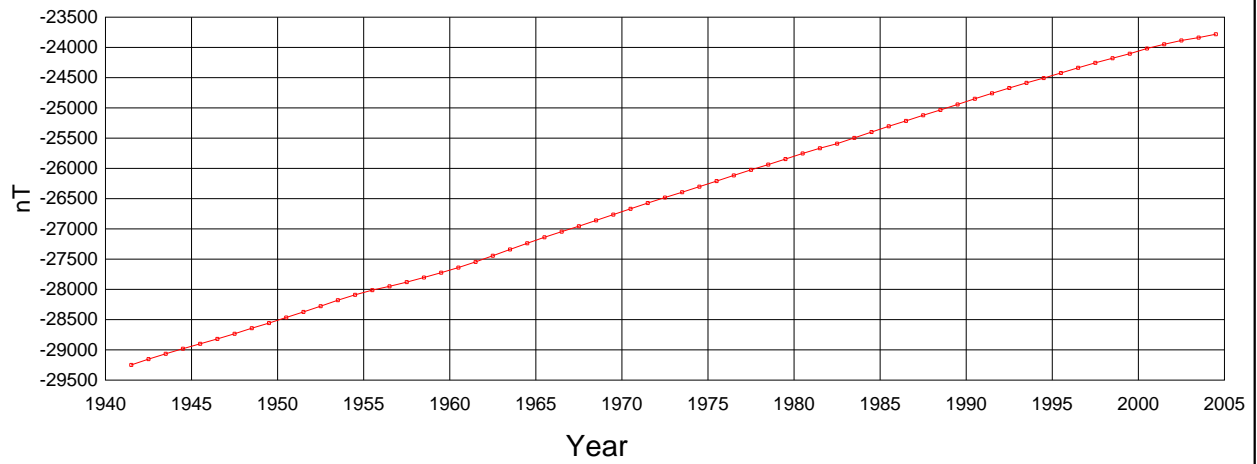
Hermanus (HER)
Annual Mean Values of Declination, All Days



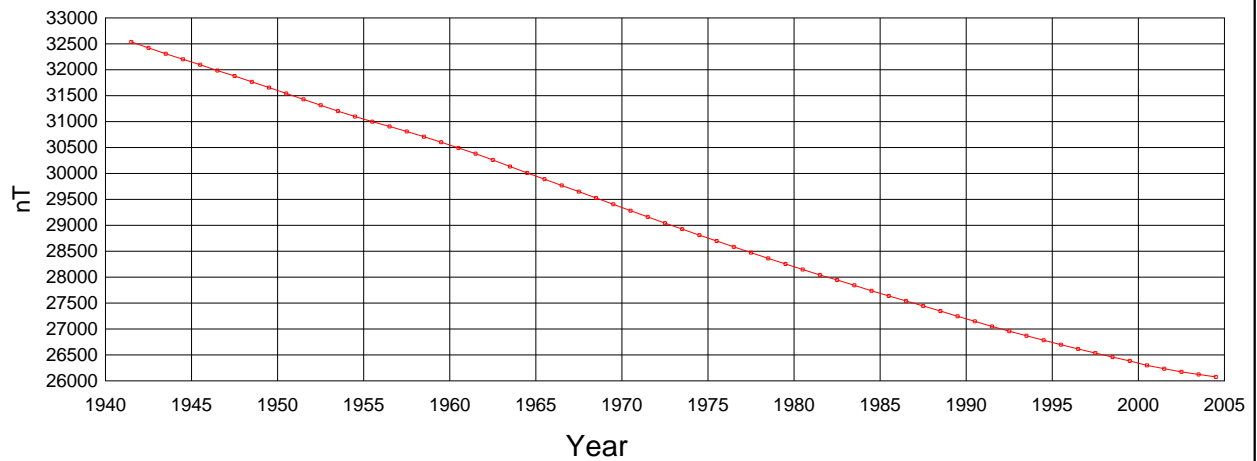
Hermanus (HER)
Annual Mean Values of Horizontal Intensity, All Days



Hermanus (HER)
Annual Mean Values of Vertical Intensity, All Days



Hermanus (HER)
Annual Mean Values of Total Intensity, All Days



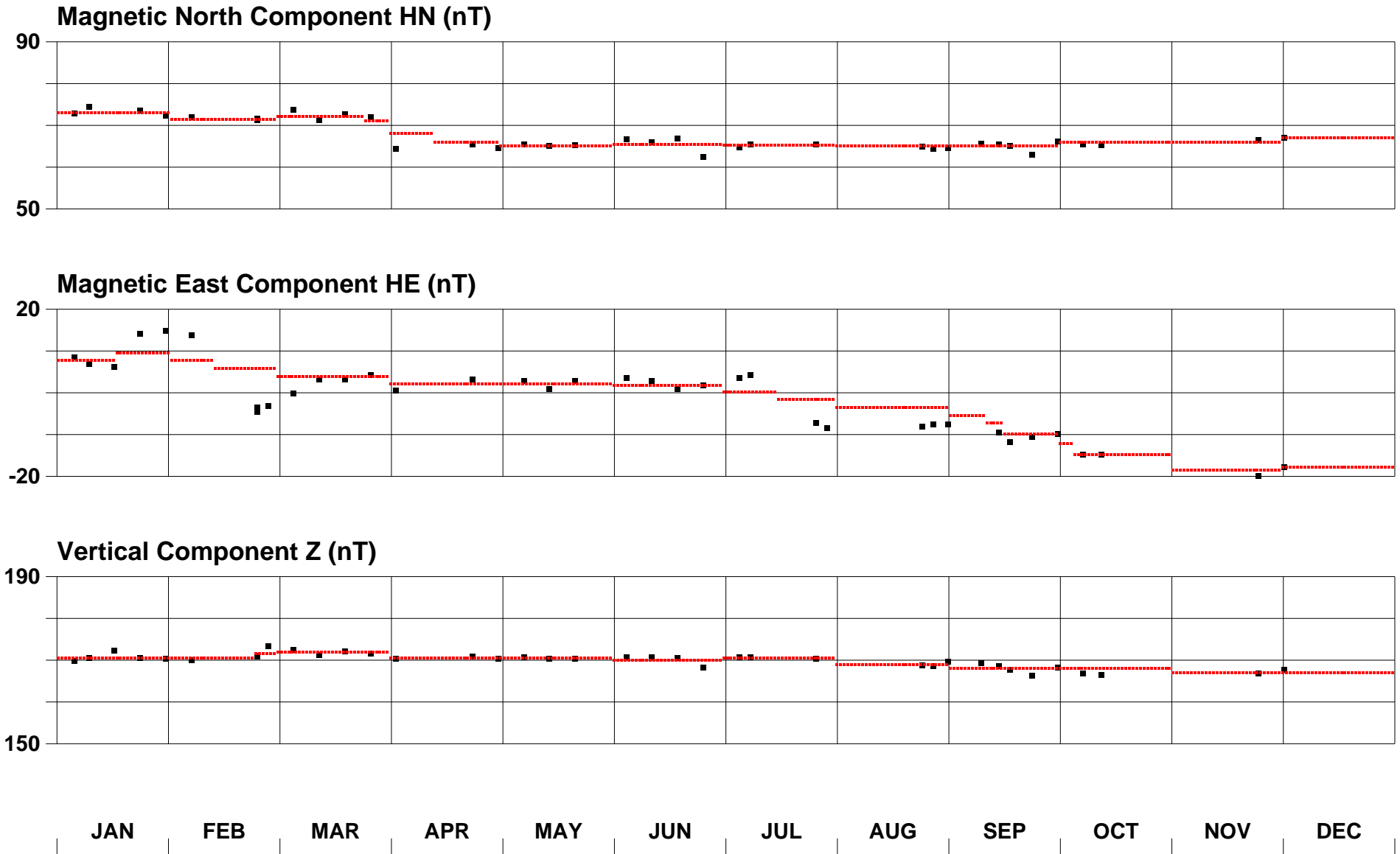
Magnetic Results 2004

Hartebeesthoek

Observed and Adopted Baseline Values, HBK 2004

LAT: 115.883 LONG: 27.707

INSTITUTION: HMO INSTRUMENT: LC

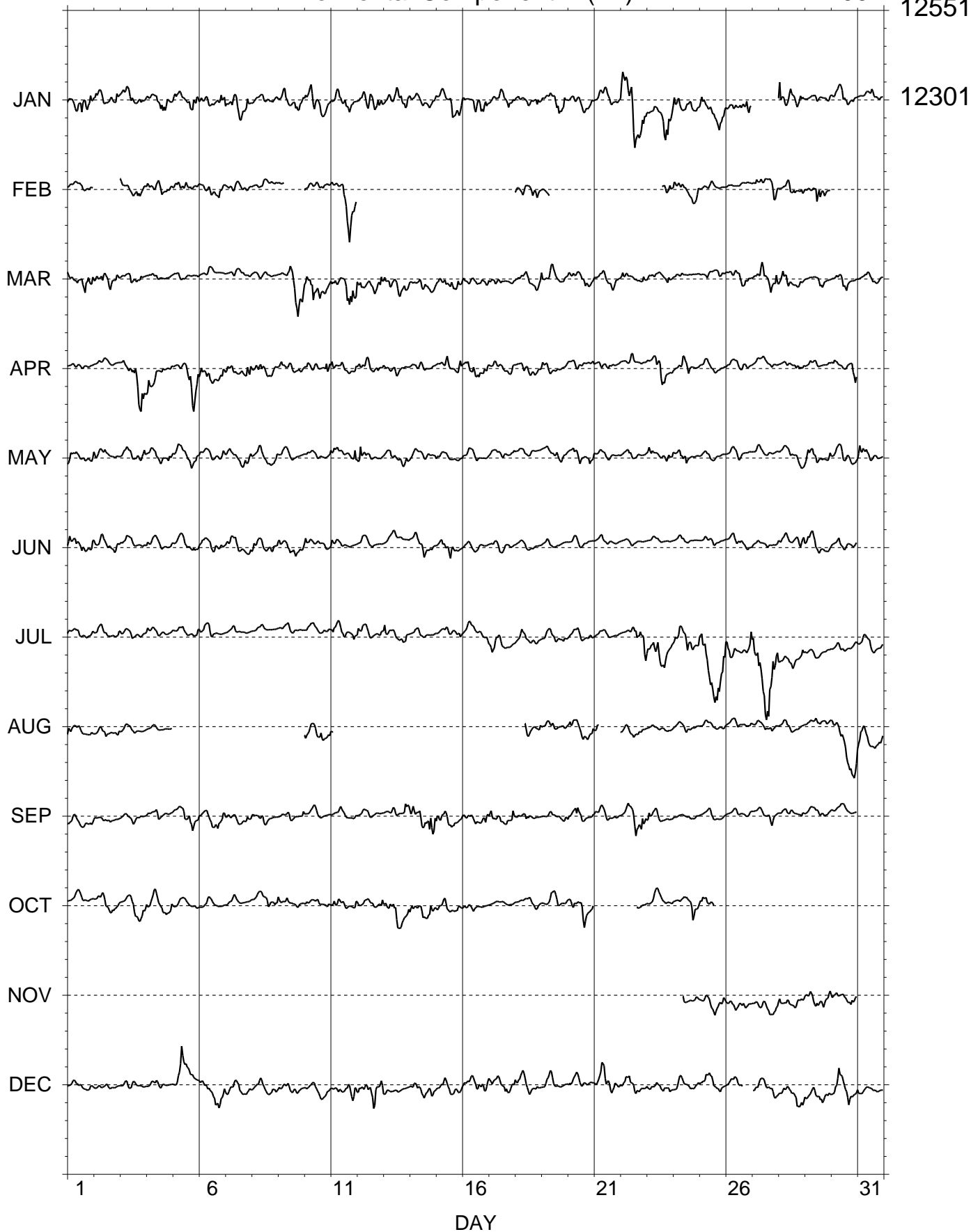


Hourly Mean Values

HBK

Horizontal Component X (nT)

2004

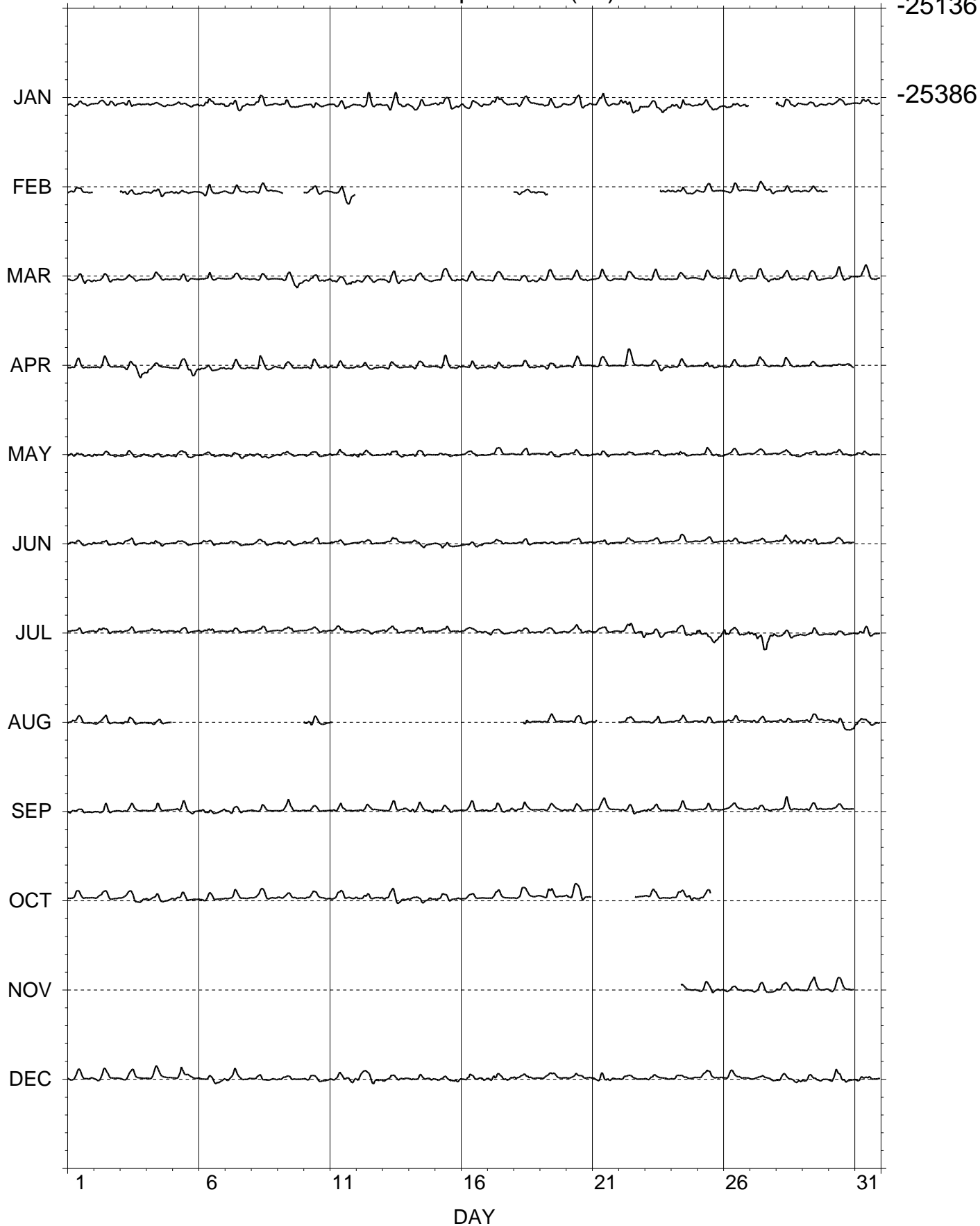


Hourly Mean Values

HBK

Vertical Component Z (nT)

2004



Hourly Mean Values

HBK

Total Component F (nT)

2004

28710

28460

JAN

FEB

MAR

APR

MAY

JUN

JUL

AUG

SEP

OCT

NOV

DEC

1

6

11

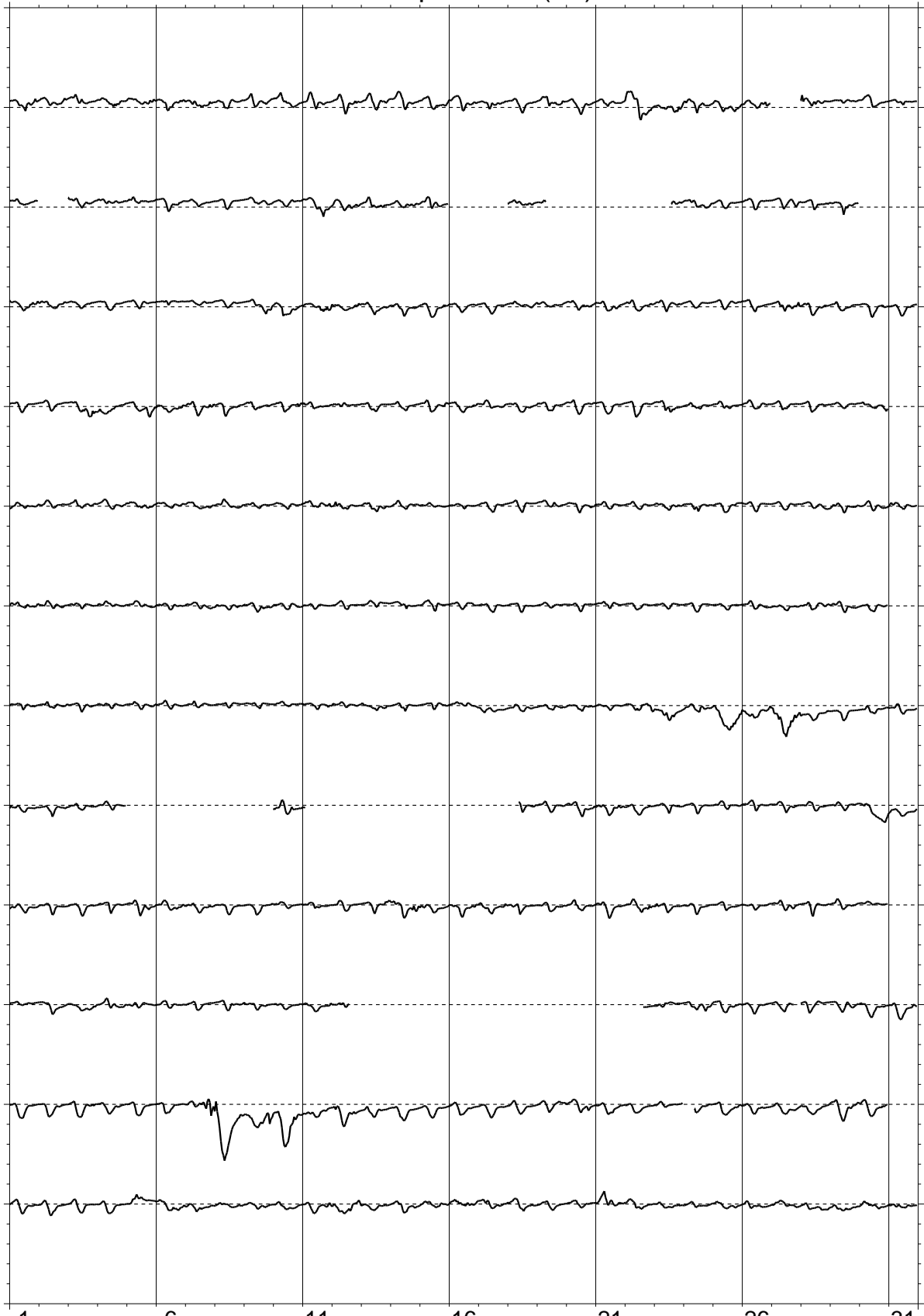
16

21

26

31

DAY



HARTEBEESTHOEK

MEAN MONTHLY VALUES 2004

Date	° D	'	° I	'	H nT	X nT	Y nT	Z nT	F nT	*	ELE
JAN	-16	59.1	-63	09.4	12857	12296	-3756	-25405	28473	A	HDZFF
FEB	-16	59.5	-63	08.0	12867	12305	-3760	-25399	28472	A	HDZFF
MAR	-17	01.5	-63	08.0	12863	12300	-3766	-25392	28465	A	HDZFF
APR	-17	01.3	-63	07.4	12867	12304	-3766	-25389	28463	A	HDZFF
MAY	-17	01.8	-63	06.5	12874	12310	-3771	-25385	28463	A	HDZFF
JUN	-17	03.0	-63	05.9	12879	12312	-3776	-25382	28462	A	HDZFF
JUL	-17	04.3	-63	07.7	12861	12295	-3776	-25382	28455	A	HDZFF
AUG	-17	06.2	-63	07.8	12861	12292	-3782	-25383	28455	A	HDZFF
SEP	-17	07.6	-63	06.4	12872	12302	-3791	-25380	28457	A	HDZFF
OCT	-17	09.4	-63	05.4	12879	12306	-3799	-25375	28458	A	HDZFF
NOV	-17	09.9	-63	08.5	12854	12281	-3793	-25382	28447	A	HDZFF
DEC	-17	10.1	-63	07.0	12868	12295	-3798	-25381	28457	A	HDZFF
YEAR	-17	04.1	-63	07.2	12868	12301	-3777	-25386	28461	A	HDZFF
JAN	-16	59.1	-63	08.4	12865	12304	-3758	-25403	28476	Q	HDZFF
FEB	-16	59.2	-63	06.9	12876	12314	-3762	-25396	28474	Q	HDZFF
MAR	-17	01.2	-63	06.2	12880	12316	-3770	-25391	28471	Q	HDZFF
APR	-17	01.2	-63	05.9	12880	12316	-3770	-25385	28465	Q	HDZFF
MAY	-17	02.1	-63	05.6	12881	12315	-3773	-25382	28464	Q	HDZFF
JUN	-17	03.1	-63	05.1	12884	12317	-3778	-25379	28462	Q	HDZFF
JUL	-17	04.0	-63	04.9	12886	12318	-3782	-25379	28463	Q	HDZFF
AUG	-17	06.0	-63	07.2	12867	12298	-3783	-25384	28459	Q	HDZFF
SEP	-17	07.4	-63	06.0	12876	12306	-3791	-25380	28459	Q	HDZFF
OCT	-17	09.1	-63	04.5	12886	12313	-3800	-25374	28460	Q	HDZFF
NOV	***	****	***	****	*****	*****	*****	*****	28452	Q	HDZFF
DEC	-17	09.6	-63	06.1	12874	12301	-3798	-25378	28456	Q	HDZFF
YEAR	-17	03.8	-63	06.1	12878	12311	-3779	-25385	28463	Q	HDZFF
JAN	-16	59.1	-63	12.0	12835	12275	-3749	-25409	28467	D	HDZFF
FEB	-17	00.5	-63	11.9	12835	12274	-3754	-25408	28468	D	HDZFF
MAR	-17	01.6	-63	09.9	12848	12285	-3762	-25397	28462	D	HDZFF
APR	-17	01.3	-63	09.3	12852	12289	-3762	-25393	28459	D	HDZFF
MAY	-17	01.6	-63	06.9	12871	12307	-3769	-25385	28462	D	HDZFF
JUN	-17	03.1	-63	06.4	12875	12309	-3775	-25383	28462	D	HDZFF
JUL	-17	03.6	-63	13.8	12809	12245	-3758	-25389	28438	D	HDZFF
AUG	-17	06.4	-63	10.3	12839	12271	-3777	-25387	28449	D	HDZFF
SEP	-17	07.4	-63	07.3	12865	12295	-3788	-25381	28455	D	HDZFF
OCT	-17	08.7	-63	07.5	12862	12290	-3791	-25380	28454	D	HDZFF
NOV	***	****	***	****	*****	*****	*****	*****	28425	D	HDZFF
DEC	-17	09.9	-63	07.4	12864	12291	-3797	-25383	28457	D	HDZFF
YEAR	-17	04.0	-63	09.2	12851	12286	-3772	-25390	28455	D	HDZFF

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

HARTEBEESTHOEK MEAN ANNUAL VALUES

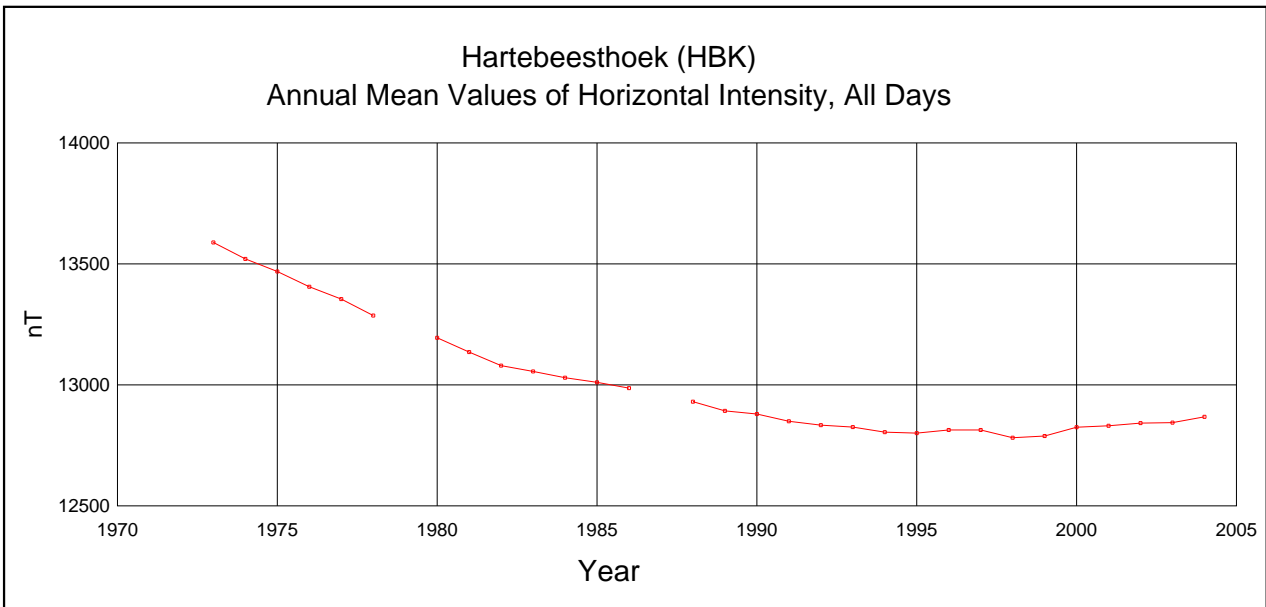
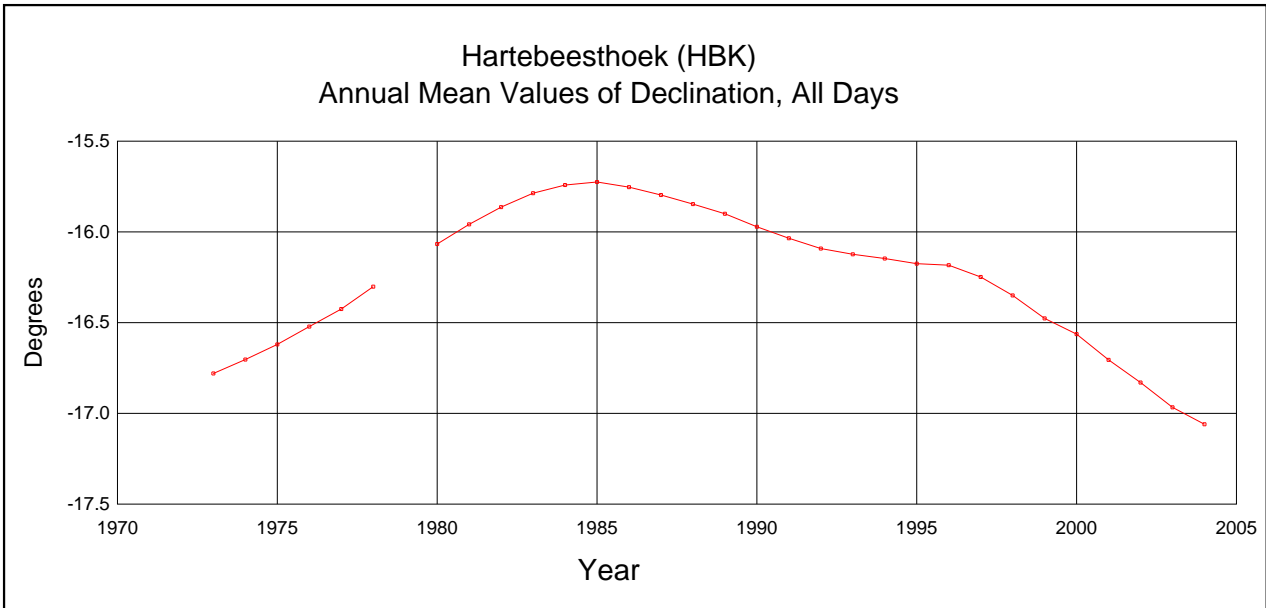
Date	° D	'	° I	'	H nT	X nT	Y nT	Z nT	F nT	*	ELE
1973.5	-16	46.6	-63	41.5	13588	13010	-3919	-27481	30657	I	DHZ
1974.5	-16	42.0	-63	45.0	13520	12950	-3885	-27414	30567	A	DHZ
1975.5	-16	37.0	-63	46.8	13468	12905	-3852	-27346	30482	A	DHZ
1976.5	-16	31.1	-63	49.0	13405	12852	-3811	-27260	30378	A	DHZ
1977.5	-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

*A: All days

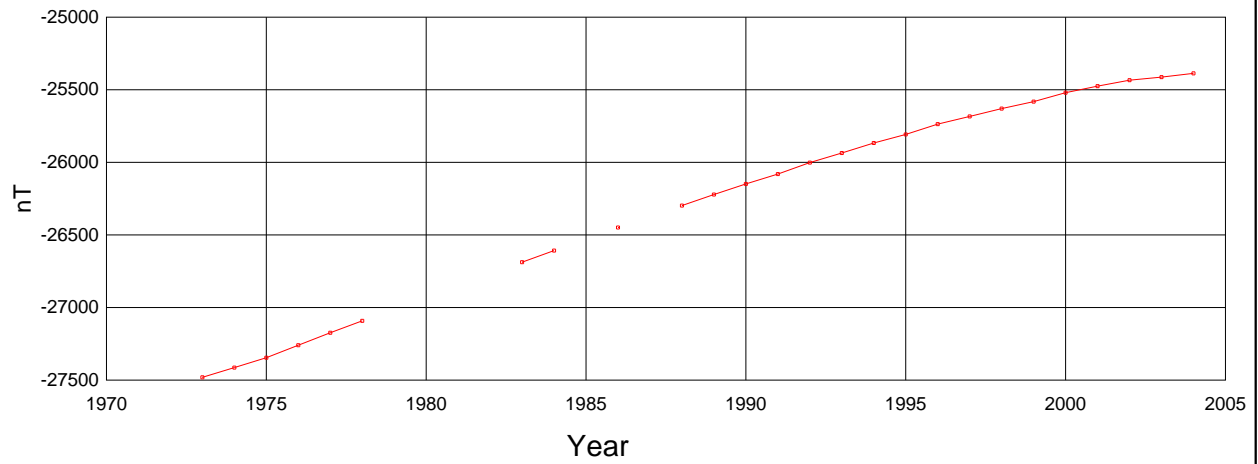
*I: Incomplete

*J: Jump in data, jump value = old site value - new site value

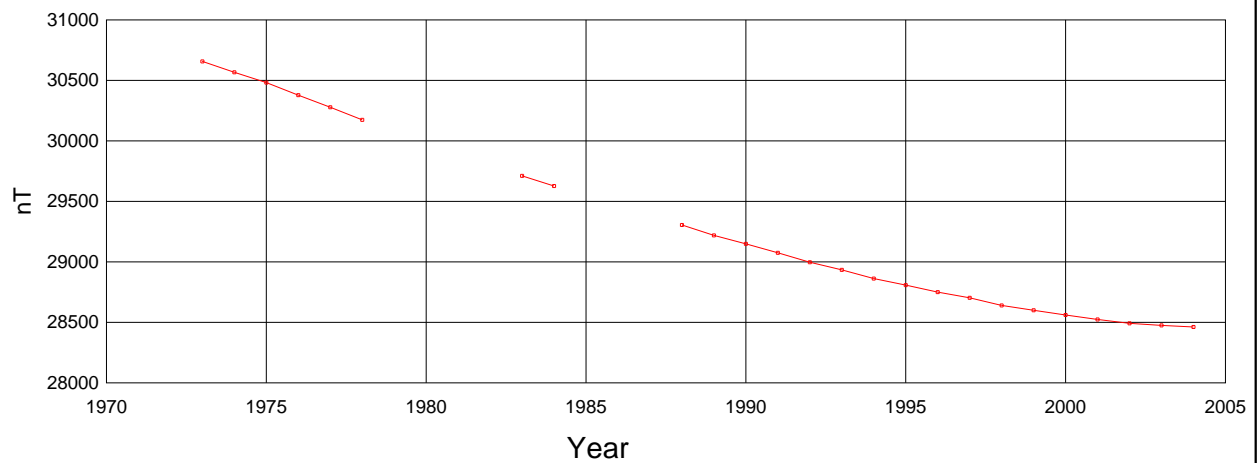
ELE: Elements recorded



Hartebeesthoek (HBK)
Annual Mean Values of Vertical Intensity, All Days



Hartebeesthoek (HBK)
Annual Mean Values of Total Intensity, All Days



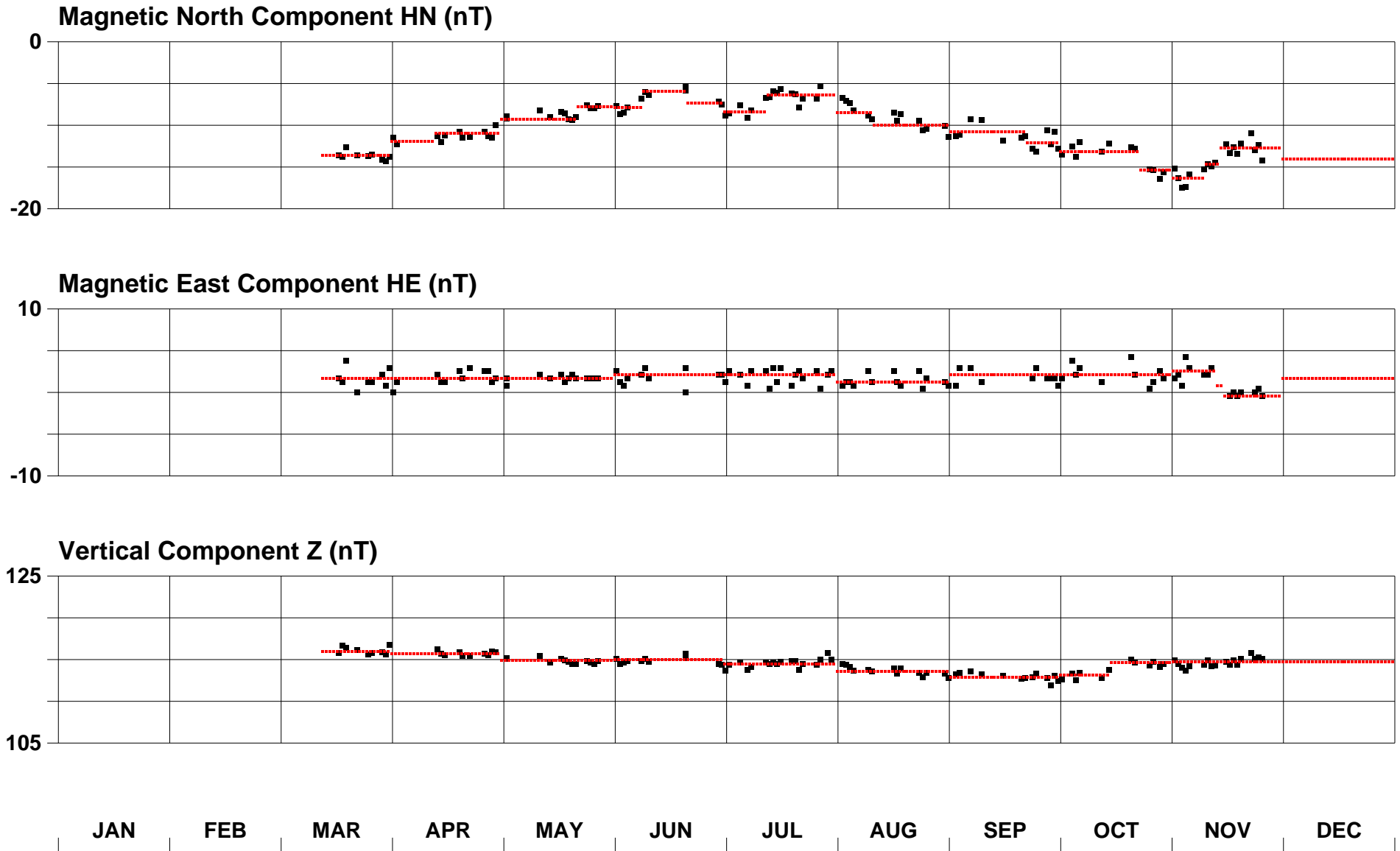
Magnetic Results 2004

Tsumeb

Observed and Adopted Baseline Values, TSU 2004

LAT: 109.202 LONG: 17.584

INSTITUTION: HMO INSTRUMENT: LC

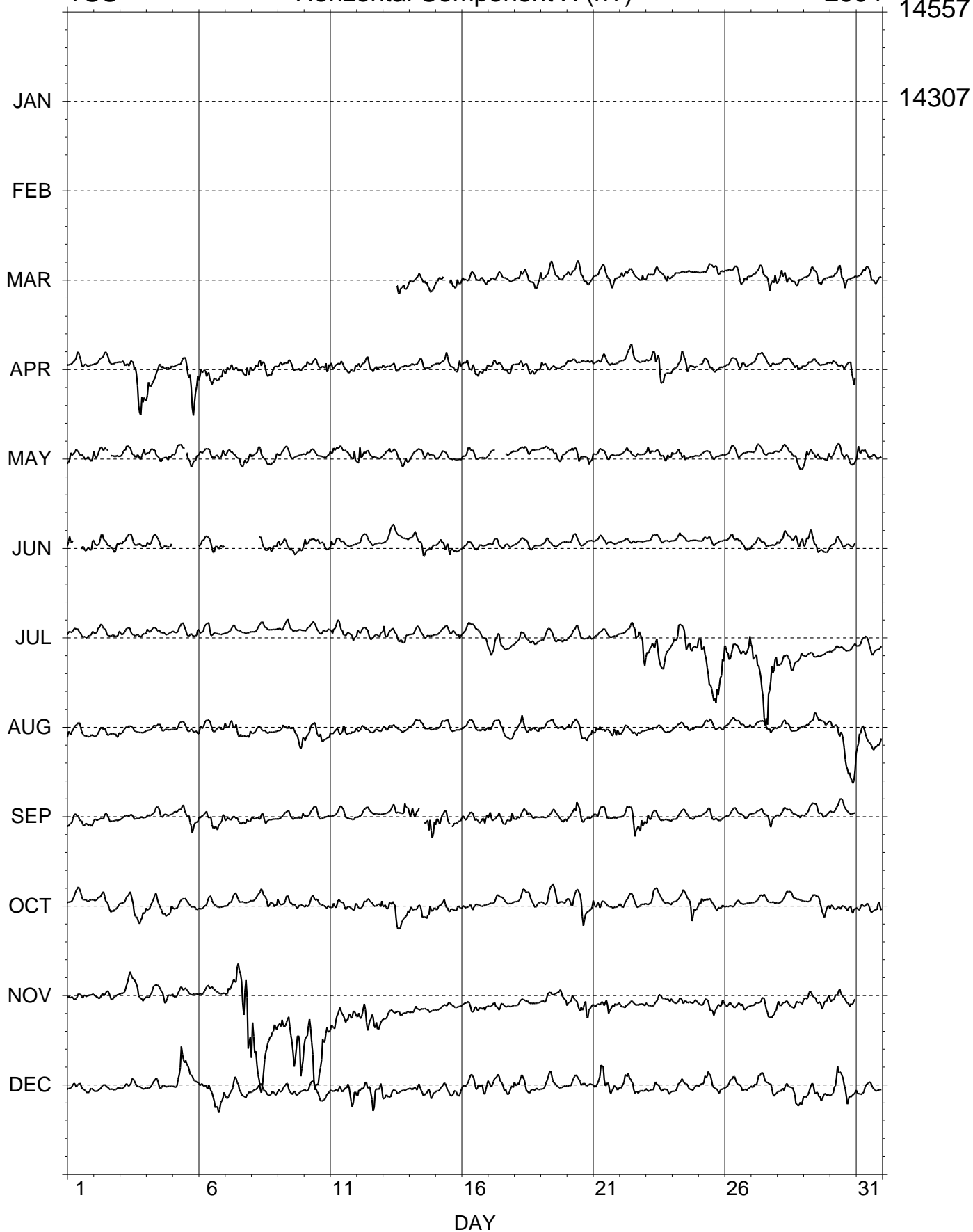


Hourly Mean Values

TSU

Horizontal Component X (nT)

2004

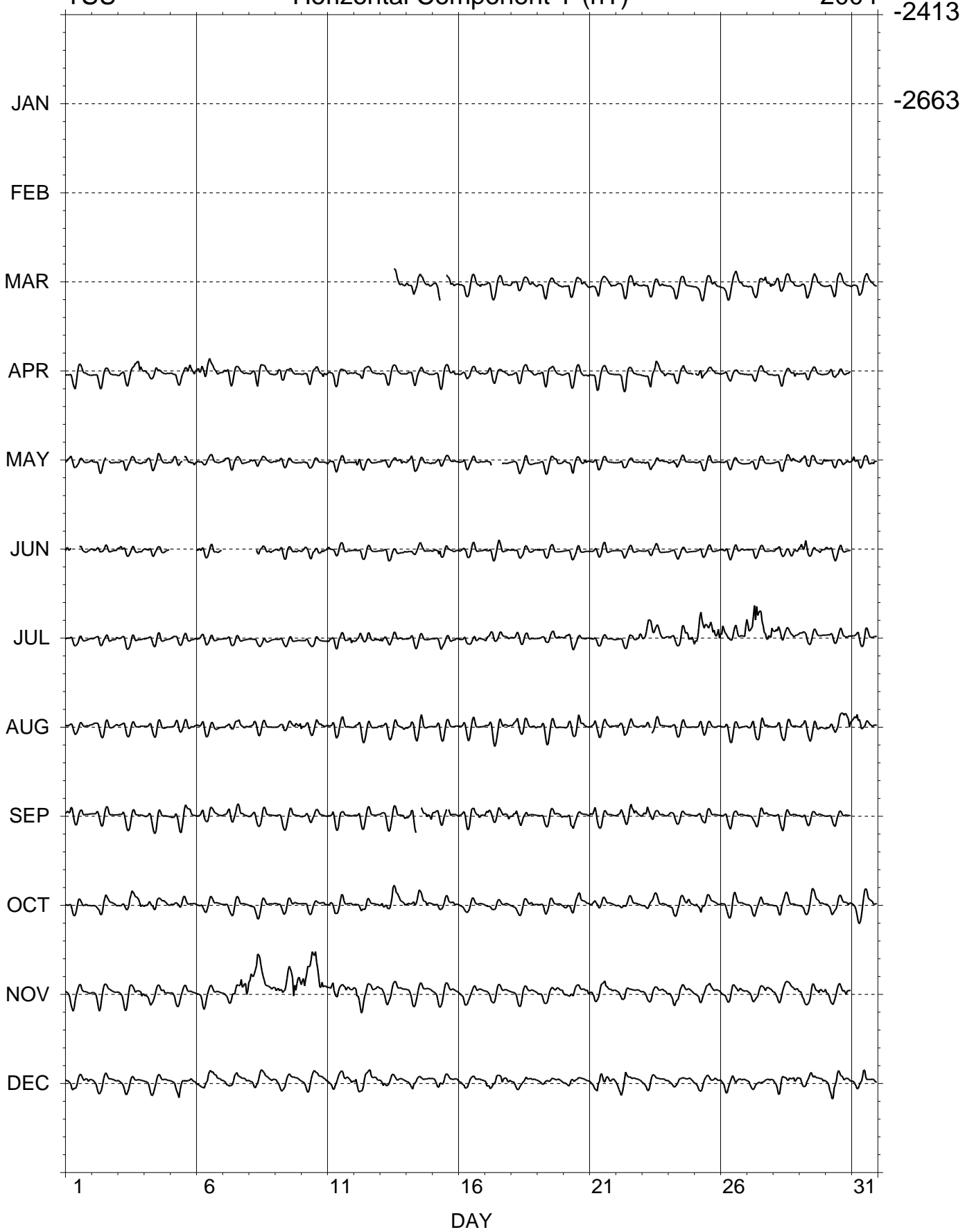


Hourly Mean Values

TSU

Horizontal Component Y (nT)

2004

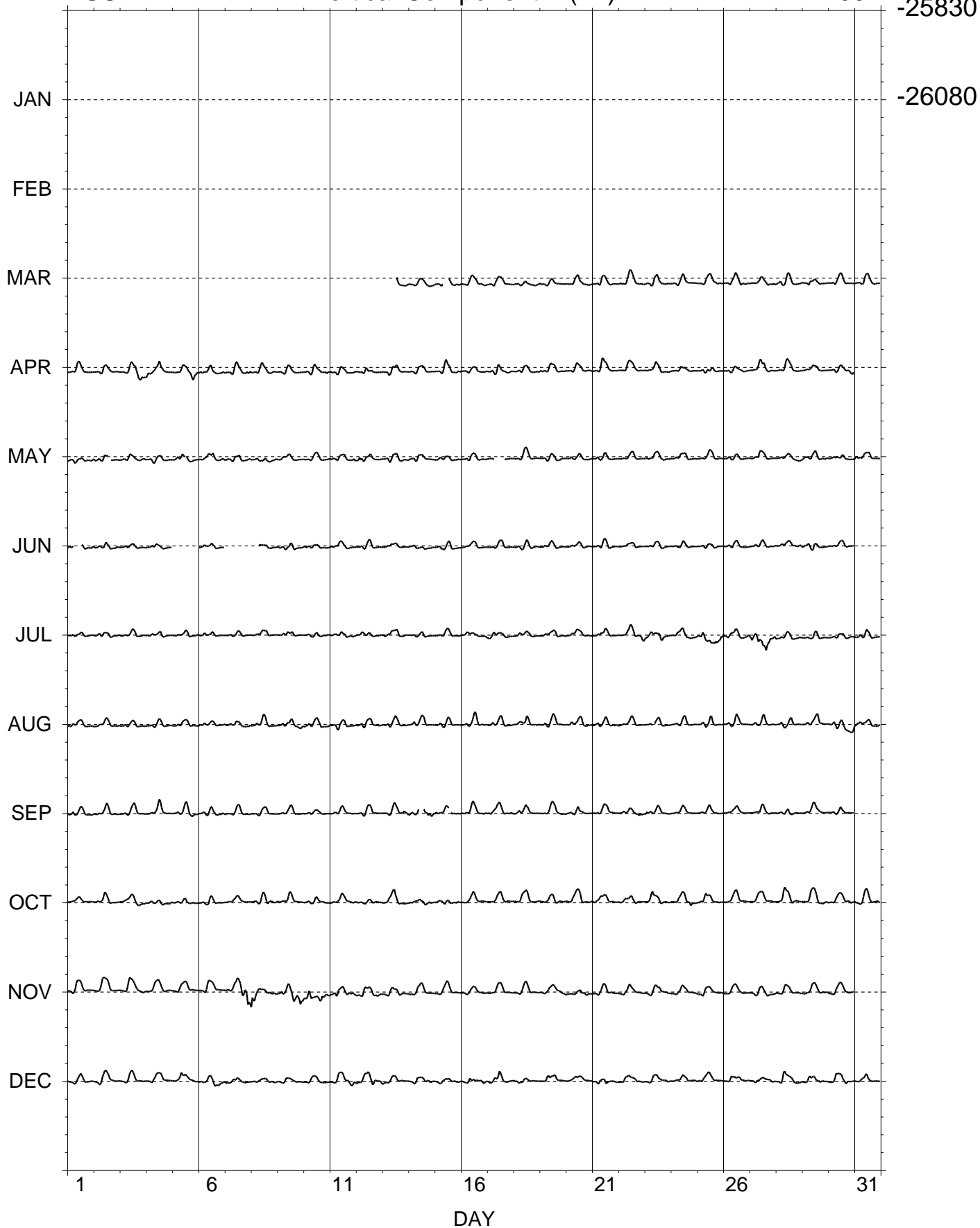


Hourly Mean Values

TSU

Vertical Component Z (nT)

2004



Hourly Mean Values

TSU

Total Component F (nT)

2004

30116

29866

JAN

FEB

MAR

APR

MAY

JUN

JUL

AUG

SEP

OCT

NOV

DEC

1

6

11

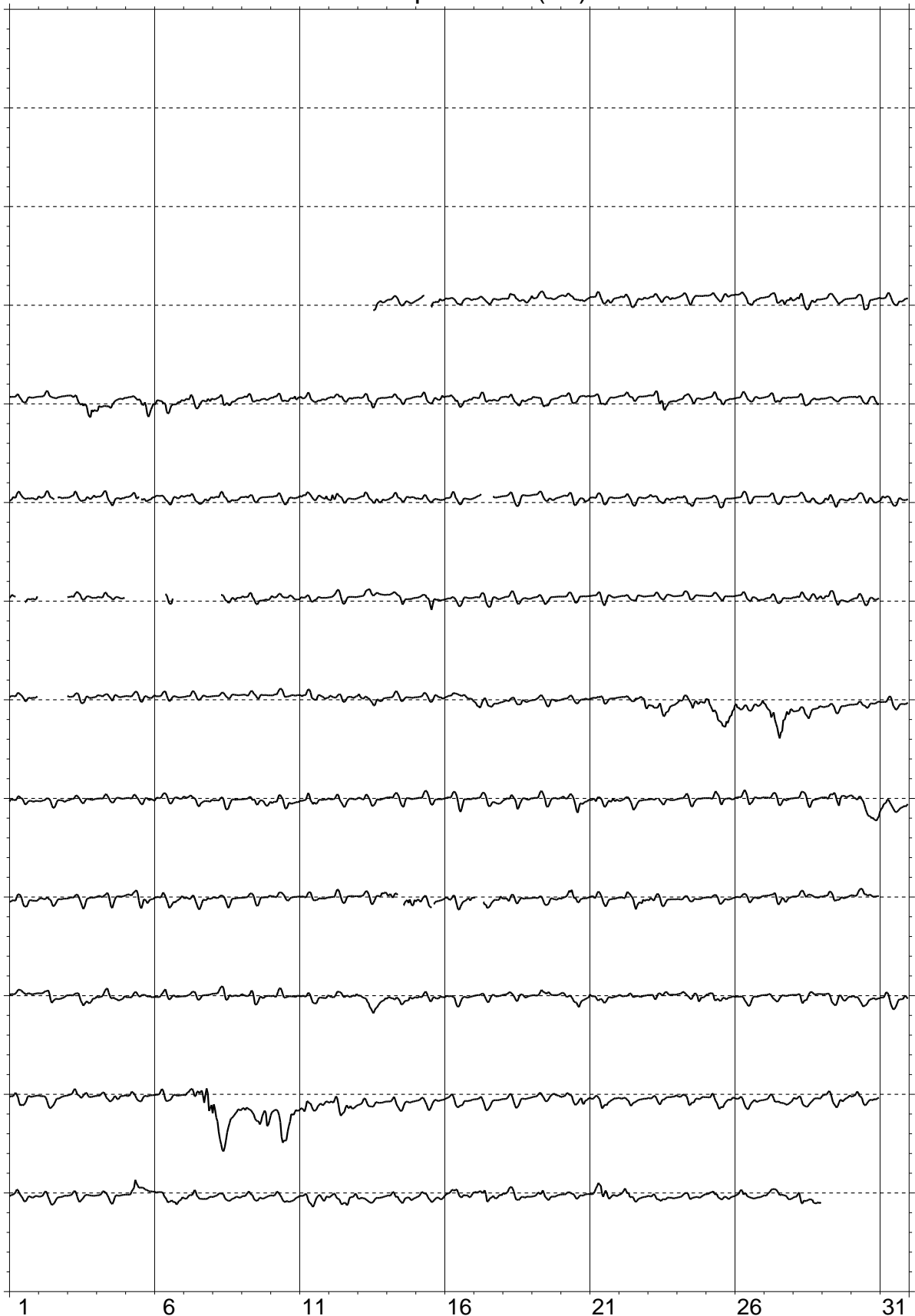
16

21

26

31

DAY



TSUMEB

MEAN MONTHLY VALUES 2004

Date	° D	'	° I	'	H nT	X nT	Y nT	Z nT	F nT	*	ELE
JAN	***	****	***	****	*****	*****	*****	*****	*****	A	HDZF
FEB	***	****	***	****	*****	*****	*****	*****	*****	A	HDZF
MAR	-10	34.2	-60	49.6	14566	14319	-2672	-26092	29882	A	HDZF
APR	-10	34.0	-60	49.6	14564	14317	-2671	-26088	29878	A	HDZF
MAY	-10	33.5	-60	49.1	14567	14321	-2669	-26085	29877	A	HDZF
JUN	-10	33.2	-60	48.6	14570	14324	-2668	-26081	29876	A	HDZF
JUL	-10	32.5	-60	50.9	14548	14302	-2662	-26081	29864	A	HDZF
AUG	-10	32.6	-60	50.9	14547	14301	-2662	-26079	29862	A	HDZF
SEP	-10	32.3	-60	49.8	14555	14310	-2662	-26076	29863	A	HDZF
OCT	-10	31.6	-60	49.3	14559	14314	-2660	-26074	29863	A	HDZF
NOV	-10	31.9	-60	53.4	14520	14276	-2654	-26078	29847	A	HDZF
DEC	-10	31.4	-60	51.0	14544	14300	-2656	-26077	29858	A	HDZF
YEAR	-10	32.6	-60	50.3	14553	14308	-2663	-26081	29866	A	HDZF
JAN	***	****	***	****	*****	*****	*****	*****	*****	Q	HDZF
FEB	***	****	***	****	*****	*****	*****	*****	*****	Q	HDZF
MAR	-10	34.5	-60	48.1	14580	14333	-2676	-26090	29888	Q	HDZF
APR	-10	34.2	-60	48.0	14579	14332	-2674	-26086	29883	Q	HDZF
MAY	-10	33.7	-60	48.3	14574	14327	-2671	-26082	29878	Q	HDZF
JUN	-10	33.1	-60	48.1	14574	14328	-2669	-26080	29877	Q	HDZF
JUL	-10	33.0	-60	48.1	14574	14328	-2669	-26078	29875	Q	HDZF
AUG	-10	32.6	-60	50.6	14550	14305	-2663	-26080	29864	Q	HDZF
SEP	-10	32.7	-60	49.4	14559	14313	-2665	-26076	29865	Q	HDZF
OCT	-10	31.3	-60	48.3	14568	14323	-2660	-26071	29865	Q	HDZF
NOV	-10	32.4	-60	50.4	14547	14302	-2661	-26072	29855	Q	HDZF
DEC	-10	31.7	-60	50.3	14550	14305	-2659	-26075	29858	Q	HDZF
YEAR	-10	32.8	-60	49.0	14564	14318	-2666	-26078	29869	Q	HDZF
JAN	***	****	***	****	*****	*****	*****	*****	*****	D	HDZF
FEB	***	****	***	****	*****	*****	*****	*****	*****	D	HDZF
MAR	***	****	***	****	*****	*****	*****	*****	*****	D	HDZF
APR	-10	33.8	-60	51.4	14548	14301	-2667	-26091	29871	D	HDZF
MAY	-10	33.2	-60	49.4	14564	14318	-2667	-26084	29875	D	HDZF
JUN	-10	33.3	-60	49.2	14565	14318	-2668	-26082	29873	D	HDZF
JUL	-10	30.7	-60	56.6	14494	14250	-2644	-26086	29842	D	HDZF
AUG	-10	32.4	-60	53.0	14526	14281	-2657	-26081	29853	D	HDZF
SEP	-10	31.9	-60	50.7	14547	14302	-2659	-26076	29859	D	HDZF
OCT	-10	31.5	-60	51.0	14543	14298	-2656	-26075	29856	D	HDZF
NOV	-10	29.8	-61	00.7	14452	14210	-2633	-26085	29821	D	HDZF
DEC	-10	31.4	-60	51.3	14542	14297	-2656	-26077	29856	D	HDZF
YEAR	-10	32.0	-60	52.7	14530	14285	-2656	-26082	29856	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	A	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	A	DHZ
1972.5	-15	15.3	-58	27.3	16617	16031	-4372	-27068	31762	A	DHZ
1973.5	-15	06.0	-58	37.4	16510	15940	-4301	-27072	31709	A	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	A	DHZ
1976.5	-14	36.4	-59	03.3	16225	15700	-4091	-27062	31553	A	DHZ
1977.5	-14	25.2	-59	11.2	16135	15627	-4018	-27053	31499	A	DHZ
1978.5	-14	13.6	-59	20.6	16032	15540	-3940	-27047	31441	A	DHZ
1979.5	-14	01.8	-59	27.2	15951	15475	-3867	-27028	31383	A	DHZ
1980.5	-13	49.8	-59	33.6	15873	15413	-3795	-27011	31330	A	DHZ
1981.5	-13	38.1	-59	41.5	15781	15336	-3720	-26997	31271	A	DHZ
1982.5	-13	26.2	-59	49.2	15688	15259	-3645	-26976	31206	A	DHZ
1983.5	-13	14.2	-59	53.4	15623	15208	-3577	-26940	31143	A	DHZ
1984.5	-13	03.8	-59	58.0	15553	15151	-3516	-26903	31075	A	DHZ
1985.5	-12	54.7	-60	01.6	15493	15102	-3462	-26864	31012	A	DHZ
1986.5	-12	46.3	-60	06.0	15427	15045	-3410	-26828	30948	A	DHZ
1987.5	-12	38.8	-60	09.0	15374	15001	-3366	-26791	30889	A	DHZ
1988.5	-12	31.6	-60	13.4	15304	14940	-3319	-26748	30817	I	DHZ
1989.5	-12	24.2	-60	18.6	15230	14874	-3271	-26712	30748	I	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	A	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

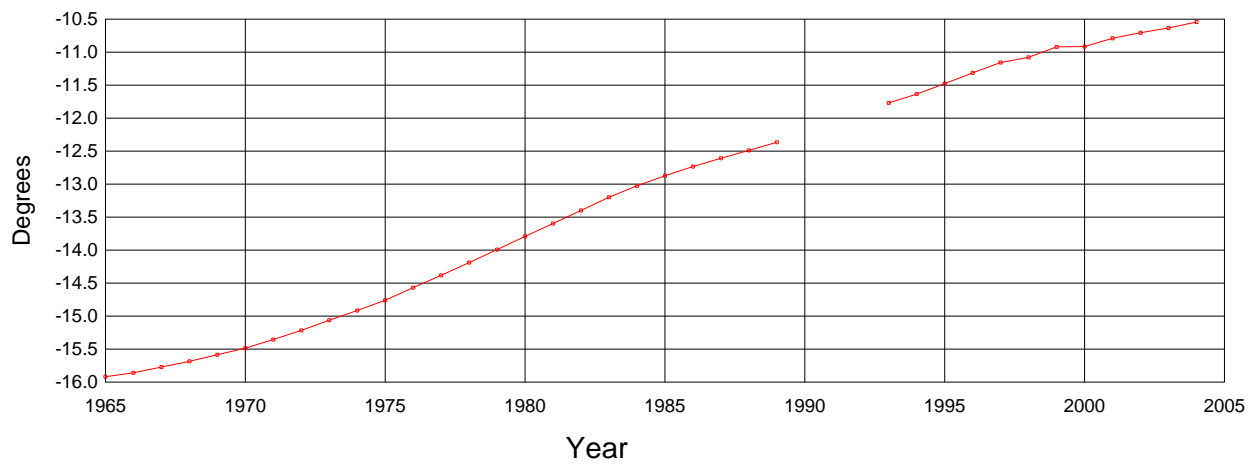
*A: All days

*I: Incomplete

*J: Jump in data, jump value = old site value - new site value

ELE: Elements recorded

Tsumeb (TSU)
Annual Mean Values of Declination, All Days



Tsumeb (TSU)
Annual Mean Values of Horizontal Intensity, All Days

