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# Results of Geomagnetic Observations Belsk, Hel, Hornsund, 2008

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## 1. INTRODUCTION

This publication contains basic information on geomagnetic observations carried out in 2008 in three Polish geophysical observatories: Belsk (BEL), Hel (HLP), and Hornsund (HRN). All these observatories belong to the Institute of Geophysics, Polish Academy of Sciences. Observatories Belsk and Hel are located on the territory of Poland, while Hornsund is in Spitsbergen archipelago, governed by Norway.

In 2008, like in the previous years, the Belsk, Hel and Hornsund observatories have kept a close collaboration with the world network of geomagnetic observatories lNTERMAGNET. The Belsk Observatory joined INTERMAGNET in 1992, Hel in 1999, and Hornsund in 2002.

## 2. DESCRIPTION OF OBSERVATORIES

The location of observatories is shown in Fig. 1 and Table 1. The geomagnetic coordinates in Table 1 were calculated in relation to the geomagnetic pole located at 83.2$^{o}$N, 118.3$^{o}$W on the basis of model IGRF-10 from epoch 2005.

The methodology of geomagnetic observations in all the three observatories was very similar, based on the "Guide for Magnetic Measurements and Observatory Practice" (Jankowski and Sucksdorff 1996). The instruments were similar too. Absolute measurements were made with the use of DI-flux magnetometers and proton magnetometers. The magnetic field variations were measured with the use of PSM magnetometers equipped in Bobrov's quartz variometers. The spare sets are equipped in PSM magnetometers or LEMI flux-gate magnetometers.

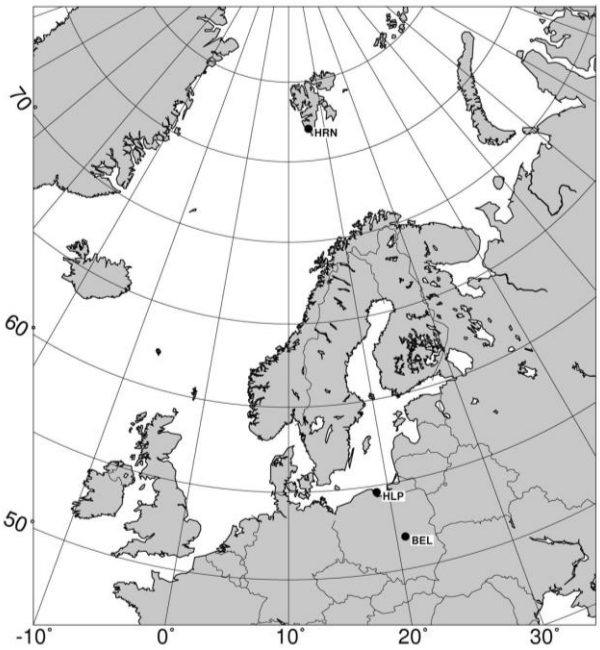


Fig. 1. Location of the Belsk, Hel and Hornsund observatories.

Table 1

Coordinates of the Polish observatories

| Observatory | Geographic coordinates | | Geomagnetic coordinates | | Elevation |
|---|---|---|---|---|---|
| | Latitude | Longitude | Latitude | Longitude | [m] |
| Belsk (BEL) | 51°50.2′ N | 20°47.5′ E | 50.2°N | 105.2° E | 180 |
| Hel (HLP) | 54°36.5′ N | 18°49.0′ E | 53.2°N | 104.6° E | 1 |
| Hornsund (HRN) | 77°0.0′ N | 15°33.0′ E | 73.9°N | 126.0° E | 15 |

Continuous recording has been made by means of microprocessor-based digital loggers DR-02 or DR-03. Owing to the recording system we use and the fact that we strictly obey the procedures relating to the so-called magnetic service, the gaps in one-minute data from Belsk and Hel are practically absent. Short gaps have only occurred in records of the Hornsund station, because the conditions prevailing there are much harder than in Poland.

It is worth mentioning that in 2008 the Belsk and Hornsund Observatories have been continuing the permanent observation of the Schumann resonance. Two horizontal magnetic components and the vertical component of the electric field have been recorded at a frequency of 100 Hz. This recording was initiated in both observatories in 2004 (Neska and Satori 2006).

## 2.1 Central Geophysical Observatory at Belsk, Central Poland

The Observatory at Belsk began continuous observations of the Earth magnetic field in 1965 (Jankowski and Marianiuk 2007). It continued the activity of the first Polish magnetic Observatory at Świder near Warsaw, working incessantly through the years 1920-1975. The magnetic observations were transferred from Świder to Belsk because of a strong increase of artificial noise from the Warsaw agglomeration, in particular due to the electric railroad passing nearby the Świder Observatory.

The Belsk Observatory is located at a distance of about 50 km south of Warsaw and about 2 km northwest of the village Belsk Duży. The premises of the Observatory, about 10 ha in area, is at the edge of the forest reserve Modrzewina, far away of people's settlements and automobile traffic. The location of the observatory in relation to the nearby towns and villages is shown in Fig. 2. The Observatory is surrounded by typically agricultural regions (with fertile soil, mostly apple orchards), so the direct neighborhood is deprived of sources of major artificial geomagnetic field disturbances. It is only the electric railroad (DC powered) situated some 14 km away of the Observatory to the north that produces some small artificial magnetic disturbances, whose average level usually does not exceed 1 nT.

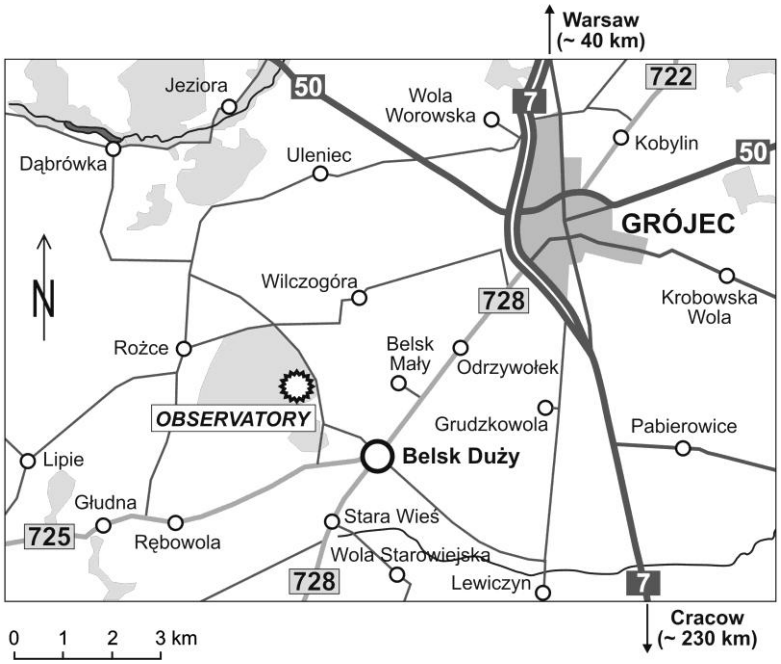


Fig. 2. Location of the Belsk Geophysical Observatory.

More information about the region in which the Observatory is located can be found, in English, Polish and German, on the internet pages of Grójec district (http://www.grojec.pl) to which the village Belsk Duży belongs. Relevant information can also be found at page of the Belsk Observatory (http://www.igf.edu.pl/pl/obserwatoria/cog_belsk).

## 2.2 Geophysical Observatory at Hel, Northern Poland

The Observatory at Hel began continuous observations of the earth magnetic field in 1932 (Jankowski and Marianiuk 2007). The observations were stopped in 1939, after the outbreak of World War II. During the war, the Observatory as well as its equipment and data were completely destroyed. After reconstruction, continuous observations at Hel were resumed in 1957.

The Hel Observatory is located in a small resort town at the end of Hel Peninsula by the Bay of Gdańsk (see Fig. 3). It is the area of Seaside Landscape Park (Nadmorski Park Krajobrazowy), weakly industrialized and urbanized. The region, surrounded by water from three sides, lacks any major artificial noise and is a good place for continuous magnetic observations.

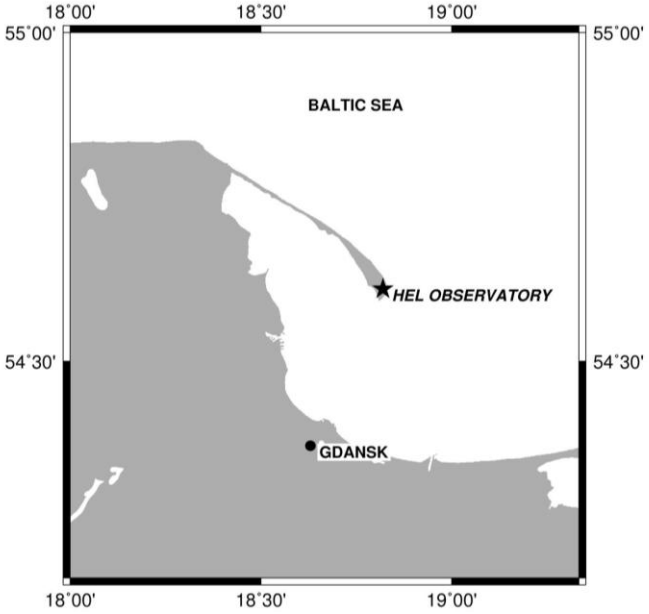


Fig. 3. Location of the Geophysical Observatory at Hel.

The observatory premises, about 4.5 ha in area, is surrounded by mixed forest (mainly pine and birch trees). Pavilions with measurement and recording instruments are located at small clearings.

More information about the town of Hel where the Observatory is located can be found at the address: http://www.hel-miasto.pl/.

## 2.3 Hornsund, Spitsbergen

The Polish Polar Station Hornsund (PSP Hornsund) is situated on the White Bear Bay (Isbjørnhamna) in Hornsund Fiord, Spitsbergen Island, Svalbard archipelago. (See Fig. 4). More information on the Svalbard Archipelago can be found at the address: http://svalbard.com.

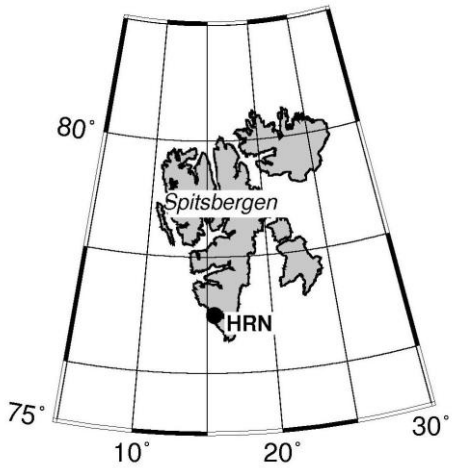


Fig. 4. Location of Polish Polar Station Hornsund.

The Hornsund station is the northernmost Polish scientific facility carrying out year-round activity. The Hornsund region is situated in a zone of strong magnetic field activity, much stronger than on the magnetic pole. Therefore, it is a very interesting place for magnetic observations.

Polish geomagnetic observations in the Arctic were initiated during the II Polar Year; a magnetic station was then established by S. Siedlecki and C. Centkiewicz on the Bear Island. In the years 1932/33, they had carried out continuous recording of magnetic field and performed absolute measurements. In the years 1957/58, in the framework of the International Geophysical Year, measurements of magnetic declination and inclination were made by J. Kowalczuk and K. Karaczun in five sites in the Hornsund Fiord region.

Since the beginning of October 1978, continuous magnetic field recording has been put into operation, and systematic absolute measurements have been implemented (Jankowski and Marianiuk 2007). Since then, PSP Hornsund has begun to fulfill all the requirements for geomagnetic observatory.

Since 1993, PSP Hornsund has been participating in the IMAGE (International Monitor for Auroral Geomagnetic Effects) project. In the framework of this project, Hornsund data are being sent to a server in Finland, once a month on the average. Since 2002, PSP Hornsund is included into the global near-real-time magnetic observatory network INTERMAGNET, sending the results, via Internet, to the GIN (Geomagnetic Information Nodes) centers in Edinburgh and Paris.

## 3. INSTRUMENTATION

### 3.1 Introduction

Simplified block diagrams of geomagnetic observations in Belsk, Hel, and Hornsund Observatories are shown in Figs. 5, 6, and 7.

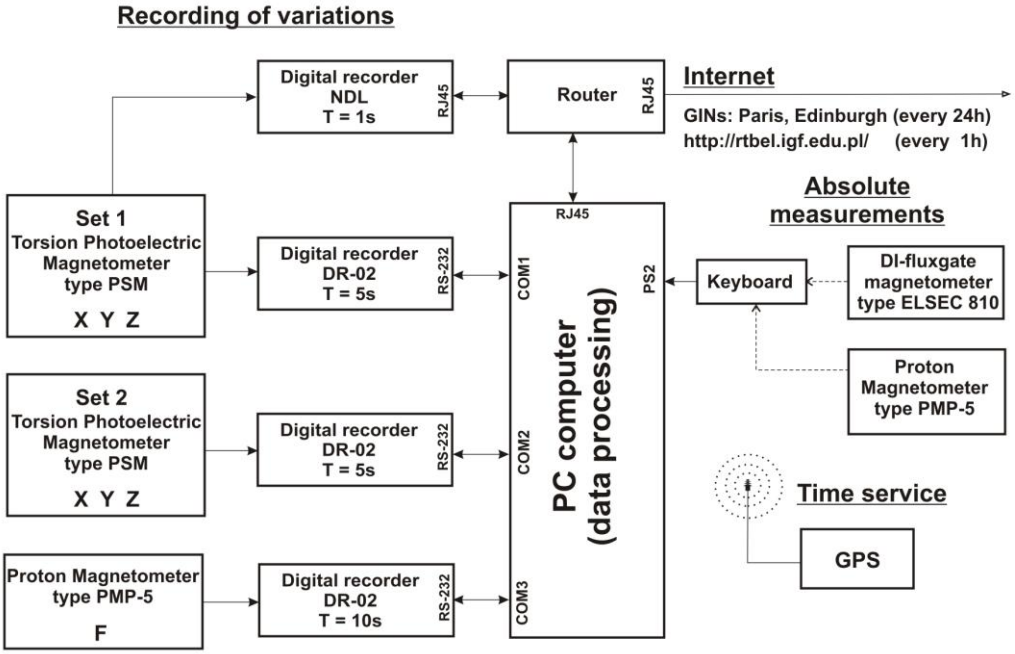


Fig. 5. Block diagram of magnetic observations system at Belsk

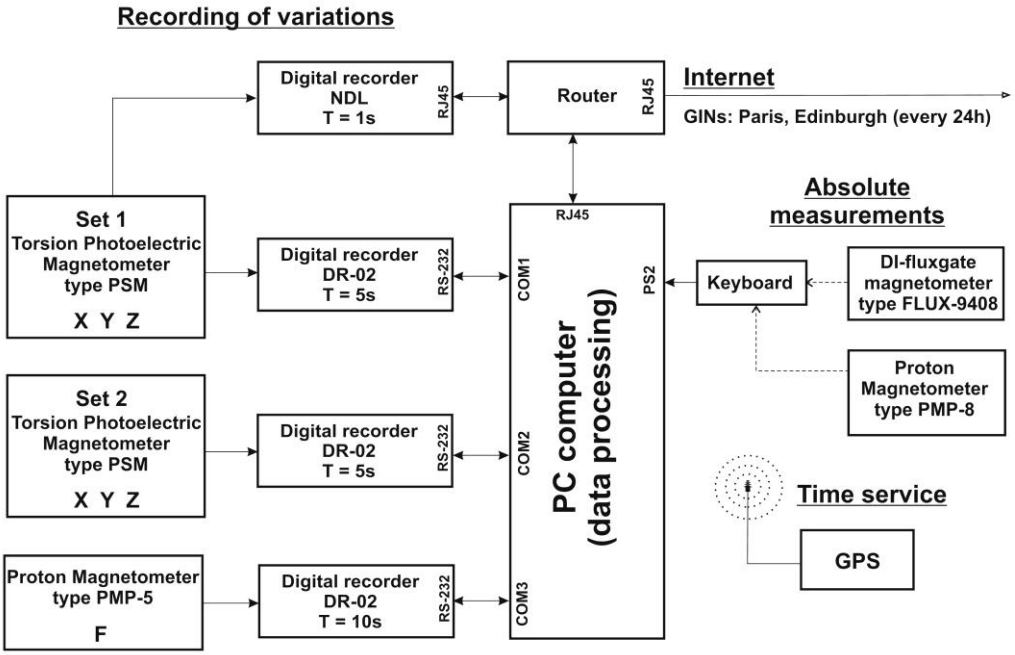


Fig. 6. Block diagram of magnetic observations system at Hel.

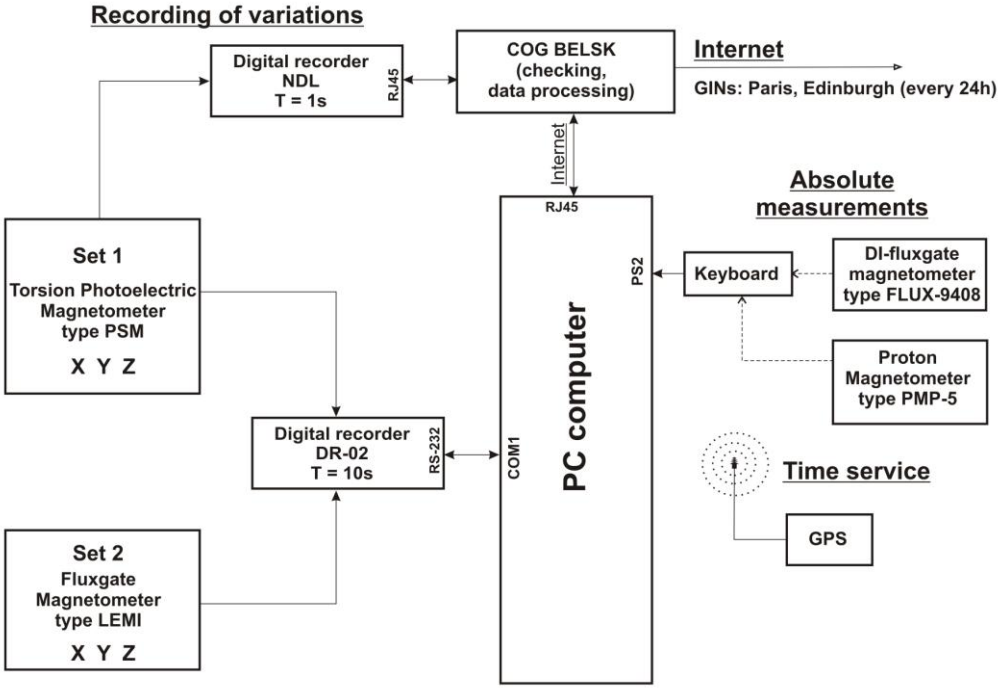


Fig. 7. Block diagram of the magnetic observations system at the Polish Polar Station Hornsund.

### 3.2 Absolute measurements

In all the three Polish observatories, the absolute measurements used for determination of bases of the recordings are performed by means of DI-flux and proton magnetometers. Di-flux magnetometers measure the absolute values of the angles of declination D and inclination I, while the proton magnetometers measure the absolute values of the total magnetic field vector F. From the measured values of F, D, and I, we can calculate all the remaining magnetic field components, H, X, Y, and Z.

The instruments for absolute measurements are listed in Table 2, and the basic parameters of the instruments in Table 3.

The results of absolute measurements are determined by means of a special computer package DIFLUX, which calculates the base values on the basis of data from the measurement protocol (Tomczyk 2008).

The bases $B_A$ of digital recording of elements X, Y and Z were calculated from the formula:

$$B_A = A - \varepsilon_A \times (a - 32768) ,$$

where A is the result of absolute measurement [nT], $\varepsilon_A$ is the scale value of the recording [nT/bit], a is the recorded instantaneous value [bits].

For the digital records with a resolution of 16 bits, the values of $2^{15} = 32768$ bits, corresponding to zero voltages on inputs of these loggers, were adopted as the base levels.

Table 2

Instruments for absolute measurements

| | Belsk | Hel | Hornsund |
|---|---|---|---|
| DI-fluxgate (fluxgate, theodolite) | ELSEC 810, THEO-10B sn: 002208 | FLUX-9408 THEO-10B sn: 160334 | FLUX-9408 THEO-10B sn: 160326 |
| Proton magnetometer | PMP-5 sn: 128 PMP-8 sn: 13/1998 | PMP-8 sn: 21/2006 | PMP-5 sn: 115 |
| Frequency of measurements | 6 per week | 2 per week | 2 per week |

Table 3

Basic parameters of the instruments for absolute measurements

Fluxgate declinometer/inclinometer ELSEC 810 / THEO-10B
Producer ..... ELSEC Oxford, UK
Mean square error of a horizontal direction ..... $\sigma_D \approx \pm 5''$
Mean square error of a zenith direction ..... $\sigma_I \approx \pm 5''$

Fluxgate declinometer/inclinometer FLUX-9408 / THEO-10B
Producer (FLUX-9408).....Institute of Geophysics Pol. Acad. Sc.
Mean square error of a horizontal direction ..... $\sigma_D \approx \pm 5''$
Mean square error of a zenith direction ..... $\sigma_I \approx \pm 5''$

Proton magnetometer model PMP-8
Producer ..... Institute of Geophysics Pol. Acad. Sc.
Resolution ..... 0.01 nT
Absolute accuracy ..... 0.2 nT

Proton magnetometer model PMP-5
Producer ..... Institute of Geophysics Pol. Acad. Sc.
Resolution ..... 0.1 nT
Absolute accuracy ..... 0.2 nT

Results of base determinations and the smoothed values adopted for further computations are depicted in Figs. 8, 9, 17, 18 and 26 in the chapters describing individual observatories.

The mean random errors of a single base measurement, $m_B$, and the number of measurements n taken in 2008 are listed in Table 4.

Thermal coefficients of magnetic sensors are not taken into account in calculations, with a view to the following facts:

- tests made every few years indicated that the coefficients are very small, less than 0.2 nT/$^{o}$C,

- the magnetic sensors are located in thermostat-controlled wooden boxes where the daily temperature variations are of the order of 0.1-0.2$^{o}$C.

Table 4

Mean errors of measurements of $B_X$, $B_Y$ and $B_Z$ in 2008

| Observatory | Element | Set I | | Set II | |
|---|---|---|---|---|---|
| | | Number of measurements [n] | Mean error [$m_B$] [nT] | Number of measurements [n] | Mean error [$m_B$] [nT] |
| Belsk | $B_X$ | 293 | 0.4 | 291 | 0.5 |
| | $B_Y$ | 293 | 0.5 | 291 | 0.5 |
| | $B_Z$ | 293 | 0.2 | 291 | 0.2 |
| Hel | $B_X$ | 101 | 0.5 | 100 | 0.6 |
| | $B_Y$ | 101 | 0.5 | 100 | 0.5 |
| | $B_Z$ | 101 | 0.3 | 100 | 0.4 |
| Hornsund | $B_X$ | 104 | 1.1 | – | – |
| | $B_Y$ | 104 | 0.9 | – | – |
| | $B_Z$ | 107 | 0.5 | – | – |

### 3.3 Recording of geomagnetic field variations

As we already mentioned, the continuous digital recordings of geomagnetic field variations in all the Polish observatories are performed by means of magnetometers PSM and digital loggers DR-02 (or DR-03). In spare sets, we use magnetometers PSM or LEMI. Both the main and spare sets record the components in the rectangular coordinate system X, Y, Z. At Belsk and Hel, continuous recording of the total magnetic field modulus F is performed as well. The basic parameters of the recording systems are listed in Table 5.

**Magnetometers PSM**

Magnetometers PSM were designed at the Institute of Geophysics PAS with the use of torsion quartz variometers of V.N. Bobrov system (Marianiuk 1977, Jankowski *et al*. 1984). In these magnetometers, the magnet's deflections in response to the magnetic field changes are transformed by means of photoelectric converters into the electric current changes. Owing to a strong negative feedback, the voltage changes on the output of the converter are in linear proportion to the magnetic field changes. The magnetometers PSM are characterized by good stability, of about 3-5 nT/year, and small noise, below 10 pT.

Table 5

Basic instruments for the magnetic field variations recording

| | | Belsk | Hel | Hornsund |
|---|---|---|---|---|
| SET 1 | Name of magnetometer<br>Kind of sensor | PSM<br>Bobrov | PSM<br>Bobrov | PSM<br>Bobrov |
| | Type | PSM-8511-01P | PSM 8511-09P | PSM-8911-05P |
| | Sensor's orientation | XYZ | XYZ | XYZ |
| | Range | +/– 850 nT | +/– 850 nT | +/– 5000 nT |
| | Magnetometer's producer | Institute of Geophysics PAS | Institute of Geophysics PAS | Institute of Geophysics PAS |
| | Digital recorder<br>Producer | DR-02, DR-03<br>EL-LAB | DR-03<br>EL-LAB | DR-02<br>EL-LAB |
| | Sampling interval | 5 s and 1 s | 5 s | 10 s |
| SET 2 | Name of magnetometer<br>Kind of sensor | PSM<br>Bobrov | PSM<br>Bobrov | LEMI<br>fluxgate |
| | Type | PSM-8511-01P | PSM 8511-03P | LEMI-003/95 |
| | Sensor's orientation | XYZ | XYZ | XYZ |
| | Range | +/– 820 nT | +/– 820 nT | +/– 10.000 nT |
| | Magnetometer's producer | Institute of Geophysics PAS | Institute of Geophysics PAS | Institute of Geophysics PAS |
| | Digital recorder<br>Producer | DR-02, DR-03<br>EL-LAB | DR-02<br>EL-LAB | DR-02<br>EL-LAB |
| | Sampling interval | 5 s and 1 s | 5 s | 10 s |
| Total field | Name of magnetometer | PMP-5 | PMP-5 | – |
| | Producer | Institute of Geophysics PAS | Institute of Geophysics PAS | – |
| | Sampling interval | 10 s | 10 s | – |

## Magnetometers LEMI

Magnetometers LEMI were designed at the Lviv Centre of the Institute of Space Research (Ukraine). They employ flux-gate sensors. These magnetometers have been successfully used as auxiliary sets. Their stability is not much less than that of PSM's, and they are also characterized by good orthogonality of sensors and relatively small self noise.

### Proton magnetometers PMP-5 and PMP-8

Magnetometers PMP-5 and PMP-8 were designed at the Institute of Geophysics PAS. These are classical proton magnetometers, in which the precession signal is forced in a cycle of proton polarization by means of direct current. The resolution of magnetometers PMP-5 is 0.1nT, that of PMP-8 being 0.01nT. The stability of both magnetometers is better than 0.3 nT/year. More information about PMP-8 magnetometer can be found on the page:

http://www.igf.edu.pl/pl/zaklady_naukowe/konstrukcji_aparatury/aparatura

### Digital loggers DR-02 and DR-03

The digital loggers were designed in the early 1990s by the enterprise EL-LAB (Poland) especially for recording the long-term slow-changing variations. These are independent instruments and their cooperation with the computer resolves itself to the read-out of data via the RS-232 interface. Model DR-03 is equipped in clock synchronized by a GPS.

## 3.4 Calibration of magnetic sensors

The verification of scale values of recording systems in all the three observatories was made by the classical electromagnetic method: electric currents were passed through calibration coils woven over variometers. The currents induce the magnetic field of precisely known intensity. The measurements are made at least few times a year.

Table 6

Scale values adopted for computations in 2008

| Observatory | Set | Period | Scale values | | |
|---|---|---|---|---|---|
| | | | X [nT/bit] | Y [nT/bit] | Z [nT/bit] |
| Belsk | Set I | Jan 01-Dec 31 | 0.0250 | 0.0249 | 0.0249 |
| | Set II | Jan 01-Dec 31 | 0.0249 | 0.0249 | 0.0249 |
| Hel | Set I | Jan 01-Feb 27 | 0.0249 | 0.0249 | 0.0249 |
| | | Feb 28-Oct 23 | 0.0254 | 0.0251 | 0.0244 |
| | | Oct 24-Dec 31 | 0.0247 | 0.0247 | 0.0245 |
| | Set II | Jan 01-Feb 27 | 0.0250 | 0.0250 | 0.0251 |
| | | Feb 28-Dec 31 | 0.0249 | 0.0250 | 0.0250 |
| Hornsund | Set I | Jan 01-Dec 31 | 0.149 | 0.151 | 0.149 |
| | Set II | Jan 01-Dec 31 | 0.307 | 0.308 | 0.307 |

The scale values of magnetometers PSM and LEMI, parameters of calibration coils of PSMs, and mutual orthogonality of sensors in PSMs and LEMIs is checked every few years in large calibration coils installed at the Belsk Observatory.

### 3.5 Data treatment

In processing the results of digital recordings we used the software packet developed for the needs of an observatory operating in the INTERMAGNET network. This software makes it possible to perform, among other things, the following operations:

- conversion of magnetic data into the INTERMAGNET text format IMFV1.22 and creation in this format of daily files containing one-minute means of X, Y, Z and F (authors: J. Reda and A. Pałka),
- automatic transmission of data, via the Internet, to the Institute of Geophysics PAS in Warsaw and data centers in Paris and Edinburgh (author: M. Neska),
- archivation of data and plotting of magnetograms (author: J. Reda),
- calculation of results of absolute measurements (author: S. Tomczyk),
- automatic calculation of geomagnetic indices K (Nowożyński *et al.* 1991). The indices are calculated with the use of ASm (Adaptive Smoothed) method, developed at the Institute of Geophysics PAS, and recommended by IAGA in 1991. The currently used program calculates the indices from one-minute means in the INTERMAGNET CD-ROM Data Format or in the IMFV1.22 format. The program for calculation of indices may be taken from the INTERMAGNET page: http://www.intermagnet.org/Software_e.html
- test printouts to check various parameters of recording adopted for calculation and a possibility of looking over current and past data curves or tables.

The diagrams illustrating the annual variations of X, Y, and Z, monthly variations of X, Y, Z and F, bases of recording sets as well as plots of K indices for 2008 were prepared with the use of program imagplot.exe provided to us by INTERMAGNET. The diagrams prepared by means of imagplot.exe and other diagrams related to 2008 data are shown in Figs. 8–32.

In the present yearbook, we include for the first time the E indices calculated for Belsk observatory. The E indices, unlike the K indices, are calculated on the basis of energy analysis. They have been described in detail by Reda and Jankowski (2004).

### 3.6 Data availability

The newest data from Belsk, Hel and Hornsund observatories can be viewed in graphic form through the WEB application

http://rtbel.igf.edu.pl

described by Nowożyński and Reda (2007).

On this page, the Belsk and Hel data appear with one-hour delay, while the delay for Hornsund is few hours. The page makes it possible to view the archival data from any observatory belonging to the INTERMAGNET network (in the form of curves on the screen). It offers also a possiblity of calculating the K indices according to the ASm method (Nowożyński *et al*. 1991) and E indices (Reda and Jankowski 2004).

The current data (of status REPORTED) from all the three observatories can be found in INTERMAGNET at the Internet address:

http://www.intermagnet.org/apps/dl_data_prel_e.php

Data from Belsk, Hel and Hornsund are also available from the WDCs. Addresses of some WDC pages with magnetic data are the following:

WDC for Geomagnetism, Edinburgh http://www.wdc.bgs.ac.uk/catalog/master.html

WDC for Geomagnetism, Kyoto http://swdc234.kugi.kyoto-u.ac.jp/

All the three observatories have in their archives the original data, whose sampling periods are listed in Table 5. For those interested, these data can be made available on request.

## 4. CONTACT PERSON, POSTAL ADDRESS, CONTACT DETAILS

### 4.1 Belsk Observatory

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### 4.2 Hel Observatory

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### 4.3 Hornsund

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http://hornsund.igf.edu.pl, http://www.igf.edu.pl

## 5. PERSONNEL TAKING PART IN THE WORK OF BELSK, HEL AND HORNSUND OBSERVATORIES IN 2008

### 5.1 Belsk

– Jan Reda (head of Geomagnetic Laboratory at Belsk to June 2008)
– Mariusz Neska (head of Geomagnetic Laboratory at Belsk since July 2008)
– Janusz Marianiuk (consulting)
– Halina Suska (data processing, observer)
– Krzysztof Kucharski (observer)
– Paweł Czubak (data processing, since October 2008)
– Józef Skowroński (observer)

### 5.2 Hel

– Stanisław Wójcik (head of Geophysical Observatory)
– Anna Wójcik (observer)
– Mariusz Neska (data processing)
– Jan Reda (data processing)

### 5.3 Hornsund

– Mariusz Neska (head of geomagnetic observations)
– Paweł Czubak (observer in 1-st half-year)
– Piotr Łepkowski (observer in 2-nd half-year)
– Jan Reda (data processing)

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Tomczyk, S. (2008), DIFLUX software package for calculation of absolute measurement results, *Publs. Inst. Geophys. Pol. Acad. Sc*. **C-100 (402)**, 61-67.

Technical data of PMP-8:

http://www.igf.edu.pl/pl/zaklady_naukowe/konstrukcji_aparatury/aparatura

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# Tables and plots for Belsk Observatory

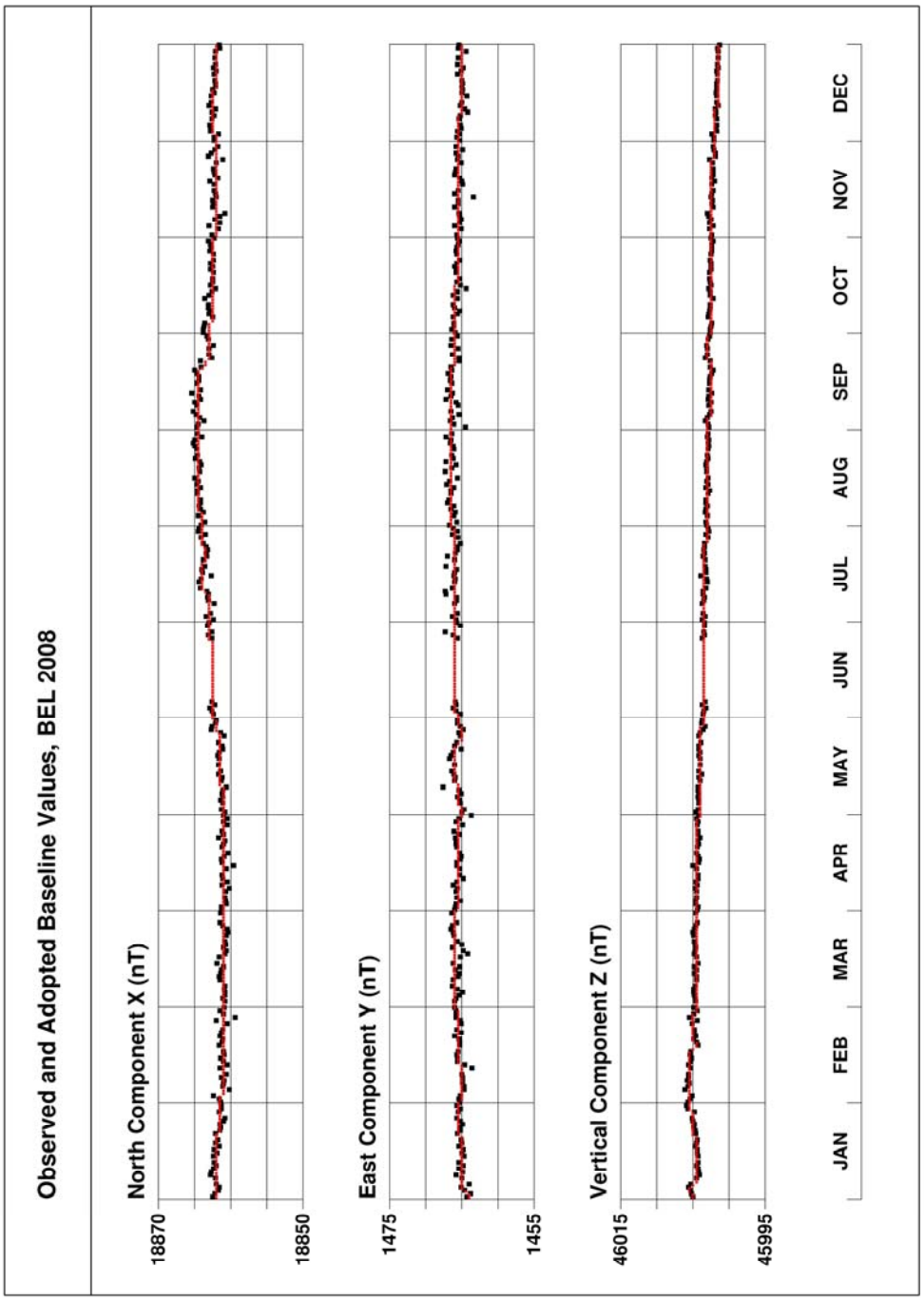


Fig. 8. Base values of set 1, Belsk 2008.

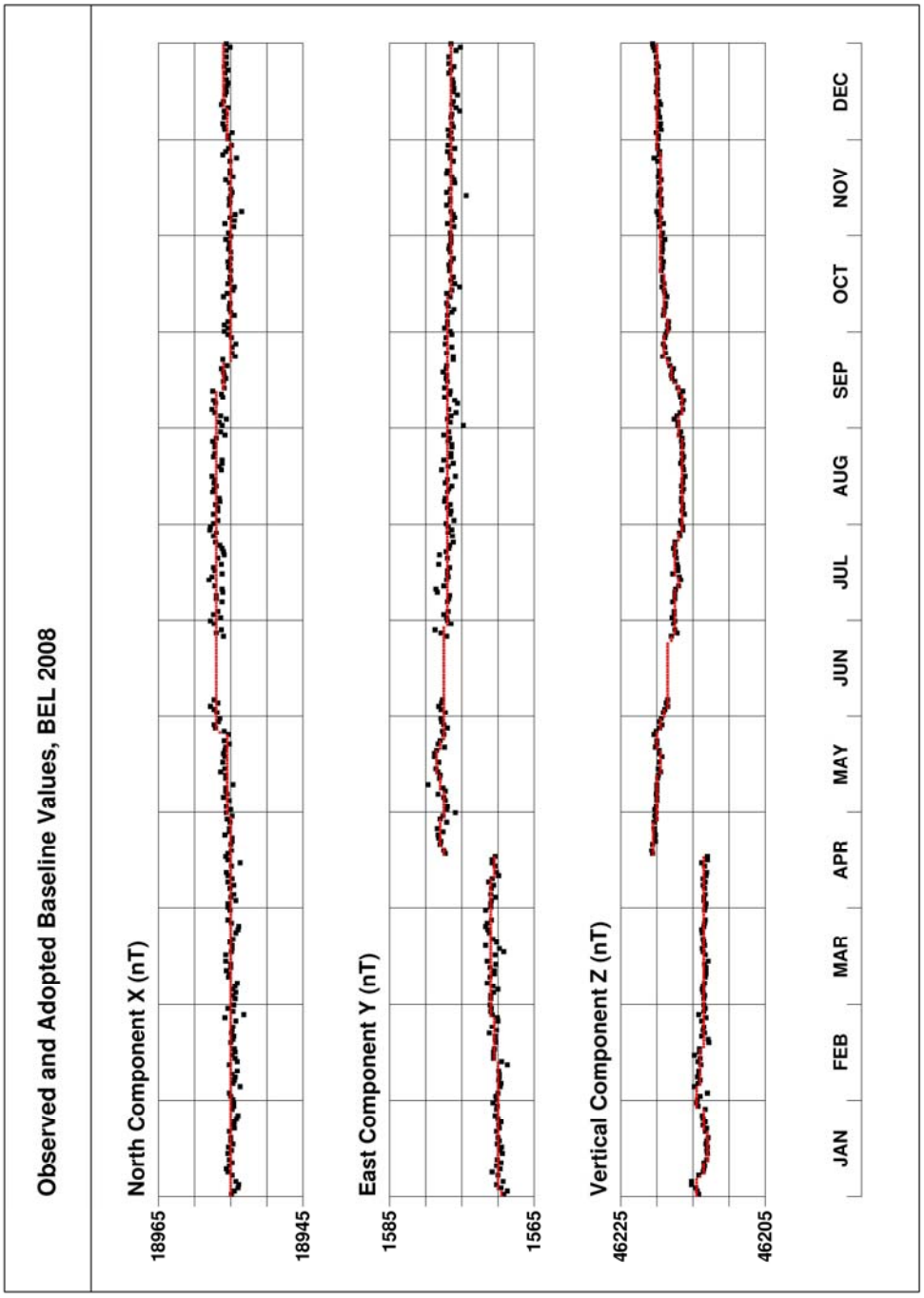


Fig. 9. Base values of set 2, Belsk 2008.

## Annual mean values of magnetic elements in Belsk Observatory

| No | Year | D [ º ‘ ] | H [ nT ] | Z [ nT ] | X [ nT ] | Y [ nT ] | I [ º ‘ ] | F [ nT ] |
|---|---|---|---|---|---|---|---|---|
| 1 | 1966 | 2 04.2 | 18901.2 | 45023.3 | 18888.9 | 682.8 | 67 13.6’ | 48829.8 |
| 2 | 1967 | 2 05.6 | 18906.2 | 45047.7 | 18893.6 | 690.7 | 67 14.0 | 48854.3 |
| 3 | 1968 | 2 06.2 | 18917.8 | 45071.3 | 18905.5 | 694.6 | 67 13.8 | 48880.5 |
| 4 | 1969 | 2 06.3 | 18935.7 | 45093.5 | 18922.9 | 695.6 | 6713.3 | 48907.9 |
| 5 | 1970 | 2 06.6 | 18953.0 | 45123.1 | 18940.2 | 697.7 | 67 13.0 | 48941.9 |
| 6 | 1971 | 2 06.6 | 18975.5 | 45146.4 | 18962.6 | 698.8 | 67 12.2 | 48972.1 |
| 7 | 1972 | 2 08.0 | 18991.6 | 45176.3 | 18978.4 | 706.7 | 67 11.9 | 49005.9 |
| 8 | 1973 | 2 10.2 | 19004.6 | 45210.8 | 18991.0 | 719.4 | 67 12.0 | 49042.8 |
| 9 | 1974 | 2 13.3 | 19016.3 | 45245.6 | 19002.0 | 737.1 | 67 12.2 | 49079.3 |
| 10 | 1975 | 2 16.4 | 19035.2 | 45273.5 | 19020.2 | 754.9 | 67 11.7 | 49112.4 |
| 11 | 1976 | 2 18.5 | 19049.7 | 45306.9 | 19034.3 | 767.3 | 67 11.7 | 49148.8 |
| 12 | 1977 | 2 22.0 | 19062.1 | 45336.6 | 19045.8 | 787.4 | 67 11.7 | 49181.0 |
| 13 | 1978 | 2 27.4 | 19058.6 | 45375.7 | 19041.1 | 817.1 | 67 13.0 | 49215.7 |
| 14 | 1979 | 2 32.3 | 19061.4 | 45401.4 | 19042.7 | 844.2 | 67 13.5 | 49240.5 |
| 15 | 1980 | 2 37.2 | 19063.2 | 45418.4 | 19043.3 | 871.2 | 67 13.9 | 49256.8 |
| 16 | 1981 | 2 42.9 | 19047.1 | 45448.9 | 19025.7 | 902.0 | 67 15.7 | 49278.7 |
| 17 | 1982 | 2 48.3 | 19034.8 | 45478.8 | 19012.0 | 931.3 | 67 17.3 | 49301.6 |
| 18 | 1983 | 2 52.4 | 19032.6 | 45498.8 | 19008.7 | 953.8 | 67 18.0 | 49319.2 |
| 19 | 1984 | 2 56.9 | 19022.8 | 45519.8 | 18997.6 | 978.4 | 67 19.2 | 49334.8 |
| 20 | 1985 | 3 00.8 | 19015.2 | 45542.0 | 18988.9 | 999.5 | 67 20.3 | 49352.3 |
| 21 | 1986 | 3 05.1 | 19003.3 | 45570.4 | 18975.8 | 1022.8 | 67 21.8 | 49373.9 |
| 22 | 1987 | 3 08.5 | 18999.1 | 45592.7 | 18970.6 | 1041.2 | 67 22.7 | 49392.9 |
| 23 | 1988 | 3 12.4 | 18983.0 | 45626.4 | 18953.3 | 1062.0 | 67 24.6 | 49417.8 |
| 24 | 1989 | 3 15.9 | 18966.2 | 45662.1 | 18935.4 | 1080.3 | 67 26.6 | 49444.3 |
| 25 | 1990 | 3 18.8 | 18961.5 | 45684.3 | 18929.8 | 1095.9 | 67 27.5 | 49463.1 |
| 26 | 1991 | 3 22.2 | 18950.8 | 45709.3 | 18918.0 | 1114.1 | 67 28.8 | 49482.0 |
| 27 | 1992 | 3 25.3 | 18954.8 | 45726.1 | 18921.0 | 1131.2 | 67 29.1 | 49499.1 |
| 28 | 1993 | 3 29.8 | 18956.4 | 45743.7 | 18921.1 | 1156.0 | 67 29.4 | 49516.0 |
| 29 | 1994 | 3 34.8 | 18953.6 | 45772.4 | 18916.6 | 1183.3 | 67 30.4 | 49541.4 |
| 30 | 1995 | 3 39.8 | 18959.3 | 45796.8 | 18920.6 | 1211.5 | 67 30.7 | 49566.2 |
| 31 | 1996 | 3 45.0 | 18965.7 | 45821.9 | 18925.1 | 1240.6 | 67 30.9 | 49591.8 |
| 32 | 1997 | 3 50.9 | 18962.8 | 45856.9 | 18920.0 | 1272.7 | 67 32.0 | 49623.0 |
| 33 | 1998 | 3 57.3 | 18955.8 | 45897.1 | 18910.6 | 1307.6 | 67 33.6 | 49657.5 |
| 34 | 1999 | 4 02.5 | 18957.8 | 45930.6 | 18910.6 | 1336.4 | 67 34.3 | 49689.2 |
| 35 | 2000 | 4 07.8 | 18955.4 | 45968.7 | 18906.2 | 1365.4 | 67 35.5 | 49723.5 |
| 36 | 2001 | 4 13.0 | 18962.4 | 46004.8 | 18911.1 | 1394.2 | 67 36.0 | 49759.6 |
| 37 | 2002 | 4 18.4 | 18969.2 | 46043.6 | 18915.6 | 1424.4 | 67 36.6 | 49798.0 |
| 38 | 2003 | 4 24.2 | 18970.2 | 46089.6 | 18914.2 | 1456.7 | 67 37.7 | 49840.9 |
| 39 | 2004 | 4 29.4 | 18980.3 | 46121.0 | 18922.0 | 1486.0 | 67 37.9 | 49873.8 |
| 40 | 2005 | 4 34.7 | 18984.3 | 46154.6 | 18923.7 | 1515.5 | 67 38.5 | 49906.4 |
| 41 | 2006 | 4 39.8 | 18996.7 | 46177.2 | 18933.8 | 1544.3 | 67 38.3 | 49932.0 |
| 42 | 2007 | 4 45.8 | 19007.4 | 46206.7 | 18941.8 | 1578.4 | 67 38.4 | 49963.4 |
| 43 | 2008 | 4 52.5 | 19014.0 | 46236.3 | 18945.2 | 1615.9 | 67 38.7 | 49993.3 |

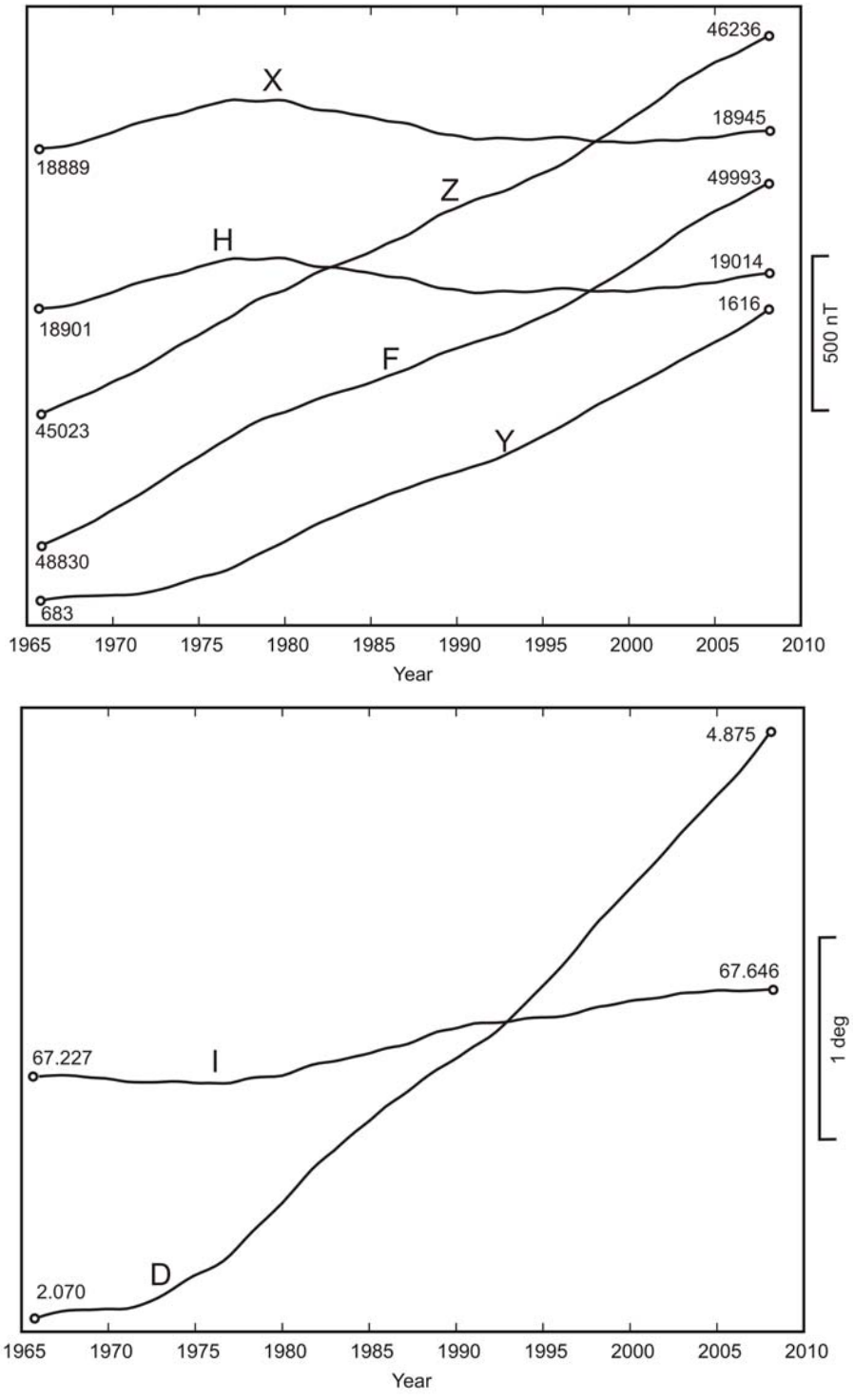


Fig. 10. Secular changes of H, X, Y, Z, F, D and I at Belsk.

## MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

**BELSK** **2008**

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | NORTH COMPONENT: 18500 + ... in nT | | | | | | | |
| All days | 443 | 440 | 438 | 442 | 450 | 450 | 450 | 448 | 446 | 443 | 446 | 447 | 445 |
| Quiet days | 450 | 447 | 445 | 444 | 454 | 452 | 451 | 450 | 447 | 448 | 448 | 450 | 449 |
| Disturbed days | 437 | 435 | 429 | 436 | 447 | 451 | 446 | 445 | 441 | 437 | 441 | 442 | 441 |
| | | | | | | EAST COMPONENT: 1500 + ... in nT | | | | | | | |
| All days | 98 | 103 | 106 | 108 | 110 | 114 | 117 | 120 | 123 | 127 | 130 | 133 | 116 |
| Quiet days | 96 | 101 | 104 | 107 | 110 | 114 | 116 | 119 | 123 | 126 | 129 | 131 | 115 |
| Disturbed days | 100 | 108 | 111 | 110 | 111 | 113 | 118 | 122 | 124 | 129 | 131 | 135 | 118 |
| | | | | | | VERTICAL COMPONENT: 46000 + ... in nT | | | | | | | |
| All days | 223 | 228 | 231 | 231 | 231 | 234 | 237 | 238 | 241 | 246 | 247 | 250 | 236 |
| Quiet days | 221 | 227 | 229 | 230 | 229 | 233 | 236 | 238 | 241 | 245 | 246 | 249 | 235 |
| Disturbed days | 223 | 228 | 231 | 233 | 232 | 233 | 238 | 239 | 241 | 247 | 247 | 250 | 237 |

**Three-hour-range K indices**

**Belsk, January - March, 2008**

**The limit of K=9 is 450**

| Day | January | | | February | | | March | | |
|---|---|---|---|---|---|---|---|---|---|
| | K | | SK | K | | SK | K | | SK |
| 1 | 2201 | 1011 | 8 | 3232 | 2455 | 26 | 5333 | 4443 | 29 |
| 2 | 0111 | 1120 | 7 | 4422 | 3343 | 25 | 2232 | 2333 | 20 |
| 3 | 0101 | 1012 | 6 | 3223 | 2453 | 24 | 1223 | 1221 | 14 |
| 4 | 0000 | 1112 | 5 | 3212 | 1234 | 18 | 2011 | 1101 | 7 |
| 5 | 2234 | 4354 | 27 | 1211 | 1210 | 9 | 2222 | 3331 | 18 |
| 6 | 3332 | 3454 | 27 | 0111 | 1232 | 11 | 1111 | 0112 | 8 |
| 7 | 3333 | 3223 | 22 | 3200 | 1223 | 13 | 2110 | 1122 | 10 |
| 8 | 2223 | 2443 | 22 | 4111 | 1232 | 15 | 0012 | 4331 | 14 |
| 9 | 3222 | 1122 | 15 | 1011 | 2123 | 11 | 3533 | 3434 | 28 |
| 10 | 2111 | 2212 | 12 | 0223 | 4545 | 25 | 3323 | 3444 | 26 |
| 11 | 2111 | 1120 | 9 | 3323 | 4433 | 25 | 2232 | 4432 | 22 |
| 12 | 0012 | 3422 | 14 | 3222 | 3333 | 21 | 3332 | 3243 | 23 |
| 13 | 3111 | 2342 | 17 | 2232 | 4432 | 22 | 2223 | 4223 | 20 |
| 14 | 3224 | 3453 | 26 | 2122 | 3143 | 18 | 3322 | 2434 | 23 |
| 15 | 2222 | 3222 | 17 | 2223 | 3332 | 20 | 4223 | 2222 | 19 |
| 16 | 2233 | 3333 | 22 | 3222 | 2230 | 16 | 2211 | 2323 | 16 |
| 17 | 3212 | 4234 | 21 | 0122 | 2113 | 12 | 2211 | 1321 | 13 |
| 18 | 3322 | 2332 | 20 | 1112 | 5434 | 21 | 3312 | 2211 | 15 |
| 19 | 1223 | 3522 | 20 | 3232 | 3332 | 21 | 0121 | 3333 | 16 |
| 20 | 1221 | 2132 | 14 | 1321 | 1201 | 11 | 2112 | 3333 | 18 |
| 21 | 1112 | 2233 | 15 | 1112 | 3331 | 15 | 2112 | 0232 | 13 |
| 22 | 1111 | 1110 | 7 | 1111 | 2111 | 9 | 2010 | 2123 | 11 |
| 23 | 0012 | 2133 | 12 | 1111 | 1232 | 12 | 3332 | 2222 | 19 |
| 24 | 1111 | 2232 | 13 | 1011 | 1222 | 10 | 1111 | 1111 | 8 |
| 25 | 3322 | 1142 | 18 | 2111 | 1110 | 8 | 1011 | 2223 | 12 |
| 26 | 3222 | 1213 | 16 | 0111 | 1122 | 9 | 1233 | 4454 | 26 |
| 27 | 1101 | 1232 | 11 | 1111 | 2352 | 16 | 4533 | 3555 | 33 |
| 28 | 1101 | 1123 | 10 | 3323 | 2555 | 28 | 4343 | 4443 | 29 |
| 29 | 1222 | 1100 | 9 | 5233 | 3655 | 32 | 2212 | 2334 | 19 |
| 30 | 1111 | 1000 | 5 | | | | 3222 | 2223 | 18 |
| 31 | 0011 | 2333 | 13 | | | | 2101 | 2121 | 10 |

**Three-hour-range K indices**

**Belsk, April - June, 2008**

**The limit of K=9 is 450**

| Day | April | | May | | June | |
|---|---|---|---|---|---|---|
| | K | SK | K | SK | K | SK |
| 1 | 1212 1110 | 9 | 1211 1334 | 16 | 2212 2421 | 16 |
| 2 | 0101 0011 | 4 | 5321 3111 | 17 | 2211 3221 | 14 |
| 3 | 2101 1201 | 8 | 3233 4233 | 23 | 0102 2322 | 12 |
| 4 | 0011 2444 | 16 | 1223 2333 | 19 | 2111 2101 | 9 |
| 5 | 2223 2534 | 23 | 2231 3442 | 21 | 1102 1210 | 8 |
| 6 | 3343 3234 | 25 | 3222 2122 | 16 | 1223 2232 | 17 |
| 7 | 3322 1443 | 22 | 2111 2222 | 13 | 2233 3233 | 21 |
| 8 | 2213 4233 | 20 | 2112 2221 | 13 | 3212 4312 | 18 |
| 9 | 3233 3233 | 22 | 1111 2112 | 10 | 2111 1021 | 9 |
| 10 | 3222 3233 | 20 | 1211 1122 | 11 | 1101 2210 | 8 |
| 11 | 3112 2211 | 13 | 2112 2121 | 12 | 1122 1011 | 9 |
| 12 | 3223 3243 | 22 | 0111 1221 | 9 | 1221 1212 | 12 |
| 13 | 2112 3421 | 16 | 2211 1220 | 11 | 1100 1120 | 6 |
| 14 | 1100 0110 | 4 | 0112 2121 | 10 | 1111 2445 | 19 |
| 15 | 0111 3223 | 13 | 0111 1121 | 8 | 4423 3324 | 25 |
| 16 | 2223 4353 | 24 | 1212 2221 | 13 | 2223 3344 | 23 |
| 17 | 3211 2321 | 15 | 1001 1101 | 5 | 2223 3322 | 19 |
| 18 | 2222 2222 | 16 | 0112 3111 | 10 | 3322 2211 | 16 |
| 19 | 2211 1223 | 14 | 2223 3331 | 19 | 1113 3222 | 15 |
| 20 | 2111 1221 | 11 | 2222 2333 | 19 | 2333 2222 | 19 |
| 21 | 1111 1211 | 9 | 3332 3322 | 21 | 1111 2212 | 11 |
| 22 | 0111 1323 | 12 | 3221 3432 | 20 | 2112 2111 | 11 |
| 23 | 3443 3434 | 28 | 2102 3233 | 16 | 2111 1110 | 8 |
| 24 | 3334 3223 | 23 | 4222 2322 | 19 | 1001 1233 | 11 |
| 25 | 2222 3232 | 18 | 2211 2212 | 13 | 3221 2333 | 19 |
| 26 | 3122 2433 | 20 | 1212 0111 | 9 | 3333 4322 | 23 |
| 27 | 2222 2322 | 17 | 1011 2222 | 11 | 3213 3321 | 18 |
| 28 | 1123 4444 | 23 | 3232 4423 | 23 | 1212 2222 | 14 |
| 29 | 3221 1121 | 13 | 2222 3432 | 20 | 2213 2223 | 17 |
| 30 | 0111 1452 | 15 | 3222 3442 | 22 | 1212 2221 | 13 |
| 31 | | | 1223 3332 | 19 | | |

**Three-hour-range K indices**

**Belsk, July - September, 2008**

**The limit of K=9 is 450**

| Day | July | | August | | September | |
|---|---|---|---|---|---|---|
| | K | SK | K | SK | K | SK |
| 1 | 2112 2111 | 11 | 1110 1222 | 10 | 1111 1111 | 8 |
| 2 | 2111 1010 | 7 | 0111 1111 | 7 | 1111 1111 | 8 |
| 3 | 1101 2211 | 9 | 1111 1222 | 11 | 1223 1334 | 19 |
| 4 | 0111 2321 | 11 | 1111 2111 | 9 | 5633 3433 | 30 |
| 5 | 2112 3333 | 18 | 1011 1110 | 6 | 2212 2123 | 15 |
| 6 | 2111 1111 | 9 | 1112 2222 | 13 | 3222 3233 | 20 |
| 7 | 1121 1102 | 9 | 1101 1222 | 10 | 3221 3241 | 18 |
| 8 | 0011 1111 | 6 | 1001 1212 | 8 | 1232 2343 | 20 |
| 9 | 0111 1111 | 7 | 3333 3445 | 28 | 1221 1113 | 12 |
| 10 | 0112 2222 | 12 | 3332 2332 | 21 | 1111 1231 | 11 |
| 11 | 2122 3223 | 17 | 2222 3212 | 16 | 0010 1112 | 6 |
| 12 | 3433 4232 | 24 | 1221 2322 | 15 | 1111 1010 | 6 |
| 13 | 2233 3432 | 22 | 2111 1211 | 10 | 0000 0001 | 1 |
| 14 | 2223 3423 | 21 | 2211 2210 | 11 | 0011 1144 | 12 |
| 15 | 3222 2222 | 17 | 2111 0110 | 7 | 3233 4433 | 25 |
| 16 | 2111 1222 | 12 | 1111 1223 | 12 | 1223 1432 | 18 |
| 17 | 2211 1220 | 11 | 3212 2212 | 15 | 3101 0011 | 7 |
| 18 | 1111 2111 | 9 | 2323 5343 | 25 | 2223 2211 | 15 |
| 19 | 1001 1101 | 5 | 3222 3331 | 19 | 0111 2231 | 11 |
| 20 | 1111 1121 | 9 | 2212 2110 | 11 | 1110 1100 | 5 |
| 21 | 1221 2222 | 14 | 1011 1121 | 8 | 1000 1112 | 6 |
| 22 | 1123 4333 | 20 | 1111 1111 | 8 | 3200 0101 | 7 |
| 23 | 3323 4333 | 24 | 1100 1111 | 6 | 2011 1111 | 8 |
| 24 | 3222 2222 | 17 | 0001 1012 | 5 | 1112 1100 | 7 |
| 25 | 1202 1101 | 8 | 1010 1001 | 4 | 1001 0133 | 9 |
| 26 | 2212 2221 | 14 | 1111 1111 | 8 | 2101 1100 | 6 |
| 27 | 0112 2124 | 13 | 2111 2011 | 9 | 0011 1232 | 10 |
| 28 | 2221 1211 | 12 | 1101 1222 | 10 | 0012 2110 | 7 |
| 29 | 0111 1212 | 9 | 1110 1211 | 8 | 0111 1111 | 7 |
| 30 | 1212 1222 | 13 | 0111 0100 | 4 | 0111 2223 | 12 |
| 31 | 1111 2211 | 10 | 0022 2232 | 13 | | |

**Three-hour-range K indices**

**Belsk, October - December, 2008**

**The limit of K=9 is 450**

| Day | October | | November | | December | |
|---|---|---|---|---|---|---|
| | K | SK | K | SK | K | SK |
| 1 | 2222 2233 | 18 | 1111 0121 | 8 | 0000 0000 | 0 |
| 2 | 3323 4343 | 25 | 0011 1012 | 6 | 0000 1000 | 1 |
| 3 | 3232 3333 | 22 | 0101 0111 | 5 | 0111 1222 | 10 |
| 4 | 2323 2213 | 18 | 1010 0001 | 3 | 2322 3312 | 18 |
| 5 | 2211 1112 | 11 | 0000 0000 | 0 | 2212 2525 | 21 |
| 6 | 1211 0101 | 7 | 0000 1010 | 2 | 3422 2432 | 22 |
| 7 | 0001 1120 | 5 | 0222 3235 | 19 | 2222 3322 | 18 |
| 8 | 1100 0001 | 3 | 3223 3232 | 20 | 1110 1231 | 10 |
| 9 | 0010 1000 | 2 | 4222 2233 | 20 | 0000 0100 | 1 |
| 10 | 0111 1103 | 8 | 1111 1210 | 8 | 0001 1222 | 8 |
| 11 | 2143 5753 | 30 | 0111 0100 | 4 | 2211 1221 | 12 |
| 12 | 4323 2324 | 23 | 1011 1111 | 7 | 1011 1112 | 8 |
| 13 | 3222 1232 | 17 | 1001 1000 | 3 | 2111 0011 | 7 |
| 14 | 1111 1221 | 10 | 0001 0111 | 4 | 1000 0000 | 1 |
| 15 | 3222 1122 | 15 | 2110 0123 | 10 | 0111 0112 | 7 |
| 16 | 1111 0111 | 7 | 3322 2133 | 19 | 1111 2133 | 13 |
| 17 | 0000 1100 | 2 | 2120 0011 | 7 | 3211 1221 | 13 |
| 18 | 0000 0011 | 2 | 1000 0110 | 3 | 0000 1121 | 5 |
| 19 | 1112 2333 | 16 | 0001 0110 | 3 | 1101 2212 | 10 |
| 20 | 1010 1122 | 8 | 0100 0022 | 5 | 1001 1110 | 5 |
| 21 | 2211 1112 | 11 | 1001 0010 | 3 | 0111 0100 | 4 |
| 22 | 0011 1233 | 11 | 0001 0011 | 3 | 0000 1432 | 10 |
| 23 | 2111 1111 | 9 | 2110 0010 | 5 | 2222 2344 | 21 |
| 24 | 0110 0000 | 2 | 0000 0013 | 4 | 2122 1332 | 16 |
| 25 | 0001 1111 | 5 | 3333 3232 | 22 | 1001 2131 | 9 |
| 26 | 0211 1201 | 8 | 3322 2233 | 20 | 1100 1122 | 8 |
| 27 | 1011 0000 | 3 | 2222 2233 | 18 | 2001 1011 | 6 |
| 28 | 0122 1222 | 12 | 1211 1123 | 12 | 2011 1111 | 8 |
| 29 | 2342 2444 | 25 | 1111 0122 | 9 | 1001 0101 | 4 |
| 30 | 3223 2543 | 24 | 1011 0210 | 6 | 0000 0011 | 2 |
| 31 | 2222 1233 | 17 | | | 3323 2232 | 20 |

**Three-hour-range E indices**

**based on power spectrum estimation(*)**

**Belsk, January - March, 2008**

| Day | January | | February | | March | |
|---|---|---|---|---|---|---|
| | K | SE | K | SE | K | SE |
| 1 | 2201 1001 | 7 | 3232 1465 | 26 | 6433 5543 | 33 |
| 2 | 0011 0120 | 5 | 4422 4354 | 28 | 2233 2334 | 22 |
| 3 | 0000 0011 | 2 | 3224 3554 | 28 | 1222 1221 | 13 |
| 4 | 0000 0012 | 3 | 3212 1223 | 16 | 2011 1000 | 5 |
| 5 | 2344 4455 | 31 | 1100 0210 | 5 | 2212 4341 | 19 |
| 6 | 4433 4554 | 32 | 0001 1242 | 10 | 1101 0112 | 7 |
| 7 | 4332 3123 | 21 | 3200 0312 | 11 | 1110 0012 | 6 |
| 8 | 2223 2544 | 24 | 4111 1122 | 13 | 0002 5341 | 15 |
| 9 | 4222 1122 | 16 | 1001 2123 | 10 | 4634 4435 | 33 |
| 10 | 2101 2212 | 11 | 0224 5655 | 29 | 4323 3455 | 29 |
| 11 | 3111 0020 | 8 | 3424 4443 | 28 | 3142 5532 | 25 |
| 12 | 0011 2433 | 14 | 3323 4443 | 26 | 3342 4153 | 25 |
| 13 | 3111 3452 | 20 | 2242 5431 | 23 | 2223 4233 | 21 |
| 14 | 4225 3564 | 31 | 2112 4153 | 19 | 2322 3544 | 25 |
| 15 | 2222 3233 | 19 | 2223 4442 | 23 | 4123 3223 | 20 |
| 16 | 2333 3433 | 24 | 2322 3140 | 17 | 2211 2213 | 14 |
| 17 | 3212 4234 | 21 | 0112 2013 | 10 | 2100 0321 | 9 |
| 18 | 3322 2443 | 23 | 1013 4444 | 21 | 2311 2210 | 12 |
| 19 | 1123 3532 | 20 | 3242 3341 | 22 | 0021 3444 | 18 |
| 20 | 1321 2033 | 15 | 1322 1301 | 13 | 2112 4333 | 19 |
| 21 | 1112 2233 | 15 | 1112 3331 | 15 | 2111 0233 | 13 |
| 22 | 1100 1110 | 5 | 1011 2000 | 5 | 2000 1014 | 8 |
| 23 | 0012 1142 | 11 | 0111 1342 | 13 | 4333 2222 | 21 |
| 24 | 1101 2241 | 12 | 1011 0123 | 9 | 0011 1110 | 5 |
| 25 | 3322 1152 | 19 | 2111 1100 | 7 | 0011 1113 | 8 |
| 26 | 4222 2203 | 17 | 0101 0122 | 7 | 2243 4465 | 30 |
| 27 | 1101 1143 | 12 | 2211 2353 | 19 | 5533 3556 | 35 |
| 28 | 0101 1024 | 9 | 4324 2666 | 33 | 5353 4444 | 32 |
| 29 | 1212 1000 | 7 | 5234 4755 | 35 | 2322 2334 | 21 |
| 30 | 1100 0000 | 2 | | | 3122 2223 | 17 |
| 31 | 0001 1344 | 13 | | | 1101 2121 | 9 |

* - see literature: Reda and Jankowski, 2004

**Three-hour-range E indices**

**based on power spectrum estimation(*)**

**Belsk, April – June, 2008**

| Day | April | | May | | June | |
|---|---|---|---|---|---|---|
| | K | SE | K | SE | K | SE |
| 1 | 1211 0100 | 6 | 1111 1235 | 15 | 2212 2432 | 18 |
| 2 | 0100 0010 | 2 | 5221 3101 | 15 | 1201 2221 | 11 |
| 3 | 1001 1100 | 4 | 3223 4243 | 23 | 0201 1222 | 10 |
| 4 | 0001 2455 | 17 | 1123 1333 | 17 | 2110 1100 | 6 |
| 5 | 1113 2635 | 22 | 2231 3443 | 22 | 0001 1200 | 4 |
| 6 | 3443 3244 | 27 | 4122 1122 | 15 | 0122 2132 | 13 |
| 7 | 4321 1544 | 24 | 2001 1122 | 9 | 2143 3343 | 23 |
| 8 | 1113 4234 | 19 | 2111 1121 | 10 | 4212 3312 | 18 |
| 9 | 3233 3233 | 22 | 1011 1011 | 6 | 2001 0021 | 6 |
| 10 | 3212 3232 | 18 | 1111 1112 | 9 | 1001 1110 | 5 |
| 11 | 3102 2301 | 12 | 1111 2120 | 9 | 1122 1000 | 7 |
| 12 | 3323 3243 | 23 | 0000 1121 | 5 | 0211 1112 | 9 |
| 13 | 1112 3531 | 17 | 2200 1220 | 9 | 0100 1110 | 4 |
| 14 | 1100 0000 | 2 | 0101 2110 | 6 | 1001 2346 | 17 |
| 15 | 0011 2224 | 12 | 0111 1011 | 6 | 4433 3324 | 26 |
| 16 | 3123 4353 | 24 | 1112 2211 | 11 | 2223 3344 | 23 |
| 17 | 4211 1210 | 12 | 1001 0000 | 2 | 3223 3432 | 22 |
| 18 | 2122 1112 | 12 | 0001 2110 | 5 | 4422 2100 | 15 |
| 19 | 2111 0224 | 13 | 3123 3331 | 19 | 1002 3222 | 12 |
| 20 | 2011 1321 | 11 | 2222 3334 | 21 | 2443 2222 | 21 |
| 21 | 1101 0110 | 5 | 4422 3322 | 22 | 1111 2112 | 10 |
| 22 | 0001 0333 | 10 | 3111 2442 | 18 | 1111 2000 | 6 |
| 23 | 3444 4544 | 32 | 2102 3243 | 17 | 2100 0000 | 3 |
| 24 | 4443 4223 | 26 | 4112 2312 | 16 | 0000 1123 | 7 |
| 25 | 2222 2232 | 17 | 2211 2212 | 13 | 4221 2433 | 21 |
| 26 | 3122 2434 | 21 | 1111 0101 | 6 | 4334 3331 | 24 |
| 27 | 2222 2311 | 15 | 0011 1223 | 10 | 4213 2411 | 18 |
| 28 | 1113 3543 | 21 | 3332 4423 | 24 | 0102 2232 | 12 |
| 29 | 3210 1121 | 11 | 2222 3432 | 20 | 2213 2234 | 19 |
| 30 | 0001 0452 | 12 | 4112 3542 | 22 | 1111 2230 | 11 |
| 31 | | | 0123 4342 | 19 | | |

* - see literature: Reda and Jankowski, 2004

**Three-hour-range E indices**

**based on power spectrum estimation(*)**

**Belsk, August - September, 2008**

| Day | July | | August | | September | |
|---|---|---|---|---|---|---|
| | K | SE | K | SE | K | SE |
| 1 | 2111 2101 | 9 | 0000 1112 | 5 | 1000 1110 | 4 |
| 2 | 2001 1010 | 5 | 0000 1011 | 3 | 0011 1101 | 5 |
| 3 | 0001 2210 | 6 | 0011 1223 | 10 | 1123 1334 | 18 |
| 4 | 0010 2211 | 7 | 1001 1111 | 6 | 6633 3533 | 32 |
| 5 | 1112 4333 | 18 | 0011 1100 | 4 | 2312 3123 | 17 |
| 6 | 2120 1010 | 7 | 1112 1222 | 12 | 4212 3243 | 21 |
| 7 | 1111 0002 | 6 | 1101 1122 | 9 | 4211 3251 | 19 |
| 8 | 0002 1111 | 6 | 0000 1202 | 5 | 1222 2453 | 21 |
| 9 | 0001 1111 | 5 | 3333 3556 | 31 | 1211 0004 | 9 |
| 10 | 0002 2112 | 8 | 4431 1432 | 22 | 1000 1130 | 6 |
| 11 | 1112 4213 | 15 | 3112 3212 | 15 | 0000 0013 | 4 |
| 12 | 3444 4332 | 27 | 1221 2312 | 14 | 1000 0000 | 1 |
| 13 | 2223 3443 | 23 | 3101 1111 | 9 | 0000 0001 | 1 |
| 14 | 2223 3423 | 21 | 3311 2110 | 12 | 0011 0144 | 11 |
| 15 | 3221 1223 | 16 | 3101 0010 | 6 | 3234 4443 | 27 |
| 16 | 1111 1222 | 11 | 0111 1124 | 11 | 1323 1432 | 19 |
| 17 | 3111 1110 | 9 | 3112 3212 | 15 | 3100 0001 | 5 |
| 18 | 0111 1110 | 6 | 2324 5453 | 28 | 2213 2211 | 14 |
| 19 | 0001 1001 | 3 | 3222 2431 | 19 | 0100 2230 | 8 |
| 20 | 1001 0021 | 5 | 2112 1100 | 8 | 1100 0100 | 3 |
| 21 | 2111 2222 | 13 | 0001 1021 | 5 | 0000 0112 | 4 |
| 22 | 0123 4434 | 21 | 1110 0100 | 4 | 3200 0100 | 6 |
| 23 | 3422 5442 | 26 | 1000 1001 | 3 | 2011 1001 | 6 |
| 24 | 4222 2221 | 17 | 0000 1002 | 3 | 0012 1000 | 4 |
| 25 | 0102 1001 | 5 | 0000 0000 | 0 | 0001 0133 | 8 |
| 26 | 2102 1221 | 11 | 0000 1110 | 3 | 2100 1000 | 4 |
| 27 | 0012 1125 | 12 | 2111 1000 | 6 | 0000 1132 | 7 |
| 28 | 2221 1100 | 9 | 0000 1112 | 5 | 0011 2100 | 5 |
| 29 | 0001 1112 | 6 | 1010 1110 | 5 | 0011 1001 | 4 |
| 30 | 1201 1121 | 9 | 0011 0000 | 2 | 0010 1223 | 9 |
| 31 | 0111 1211 | 8 | 0001 1221 | 7 | | |

* - see literature: Reda and Jankowski, 2004

**Three-hour-range E indices**

**based on power spectrum estimation(*)**

**Belsk, October - December, 2008**

| Day | October | | November | | December | |
|---|---|---|---|---|---|---|
| | K | SE | K | SE | K | SE |
| 1 | 2122 2234 | 18 | 1010 0110 | 4 | 0000 0000 | 0 |
| 2 | 3323 4343 | 25 | 0011 1012 | 6 | 0000 0000 | 0 |
| 3 | 3233 4344 | 26 | 0000 0000 | 0 | 0001 1222 | 8 |
| 4 | 2423 2203 | 18 | 1000 0000 | 1 | 1422 3312 | 18 |
| 5 | 1211 1002 | 8 | 0000 0000 | 0 | 2113 2625 | 22 |
| 6 | 0110 0000 | 2 | 0000 0020 | 2 | 4532 2532 | 26 |
| 7 | 0000 0120 | 3 | 0222 2236 | 19 | 2222 3322 | 18 |
| 8 | 1100 0000 | 2 | 4323 3242 | 23 | 0100 1230 | 7 |
| 9 | 0000 0000 | 0 | 4222 1234 | 20 | 0000 0000 | 0 |
| 10 | 0001 1103 | 6 | 2101 1200 | 7 | 0000 1221 | 6 |
| 11 | 2144 6754 | 33 | 0100 0000 | 1 | 2112 1221 | 12 |
| 12 | 5333 3424 | 27 | 1010 0012 | 5 | 1001 1111 | 6 |
| 13 | 4222 1232 | 18 | 0000 0000 | 0 | 2101 0000 | 4 |
| 14 | 1011 1221 | 9 | 0000 0100 | 1 | 1000 0000 | 1 |
| 15 | 3322 1122 | 16 | 1100 0113 | 7 | 0110 0012 | 5 |
| 16 | 1001 0010 | 3 | 3321 2013 | 15 | 0011 1244 | 13 |
| 17 | 0000 1100 | 2 | 2110 0011 | 6 | 2210 1210 | 9 |
| 18 | 0000 0010 | 1 | 0000 0000 | 0 | 0000 1121 | 5 |
| 19 | 1112 2234 | 16 | 0000 0010 | 1 | 0001 2212 | 8 |
| 20 | 1000 1122 | 7 | 0000 0012 | 3 | 0001 1100 | 3 |
| 21 | 2111 1012 | 9 | 0000 0000 | 0 | 0110 0000 | 2 |
| 22 | 0000 1343 | 11 | 0000 0000 | 0 | 0000 0432 | 9 |
| 23 | 1010 0000 | 2 | 1110 0010 | 4 | 2222 2455 | 24 |
| 24 | 0000 0000 | 0 | 0000 0001 | 1 | 2222 1332 | 17 |
| 25 | 0000 0011 | 2 | 4332 2342 | 23 | 0001 3131 | 9 |
| 26 | 0221 1202 | 10 | 3321 1234 | 19 | 1000 1011 | 4 |
| 27 | 0000 0000 | 0 | 3212 2242 | 18 | 2000 0011 | 4 |
| 28 | 0022 1221 | 10 | 1211 0124 | 12 | 2001 0000 | 3 |
| 29 | 3242 2544 | 26 | 0011 0112 | 6 | 0001 0000 | 1 |
| 30 | 3223 2543 | 24 | 1000 0200 | 3 | 0000 0011 | 2 |
| 31 | 1221 1133 | 14 | | | 3334 2342 | 24 |

* - see literature: Reda and Jankowski, 2004

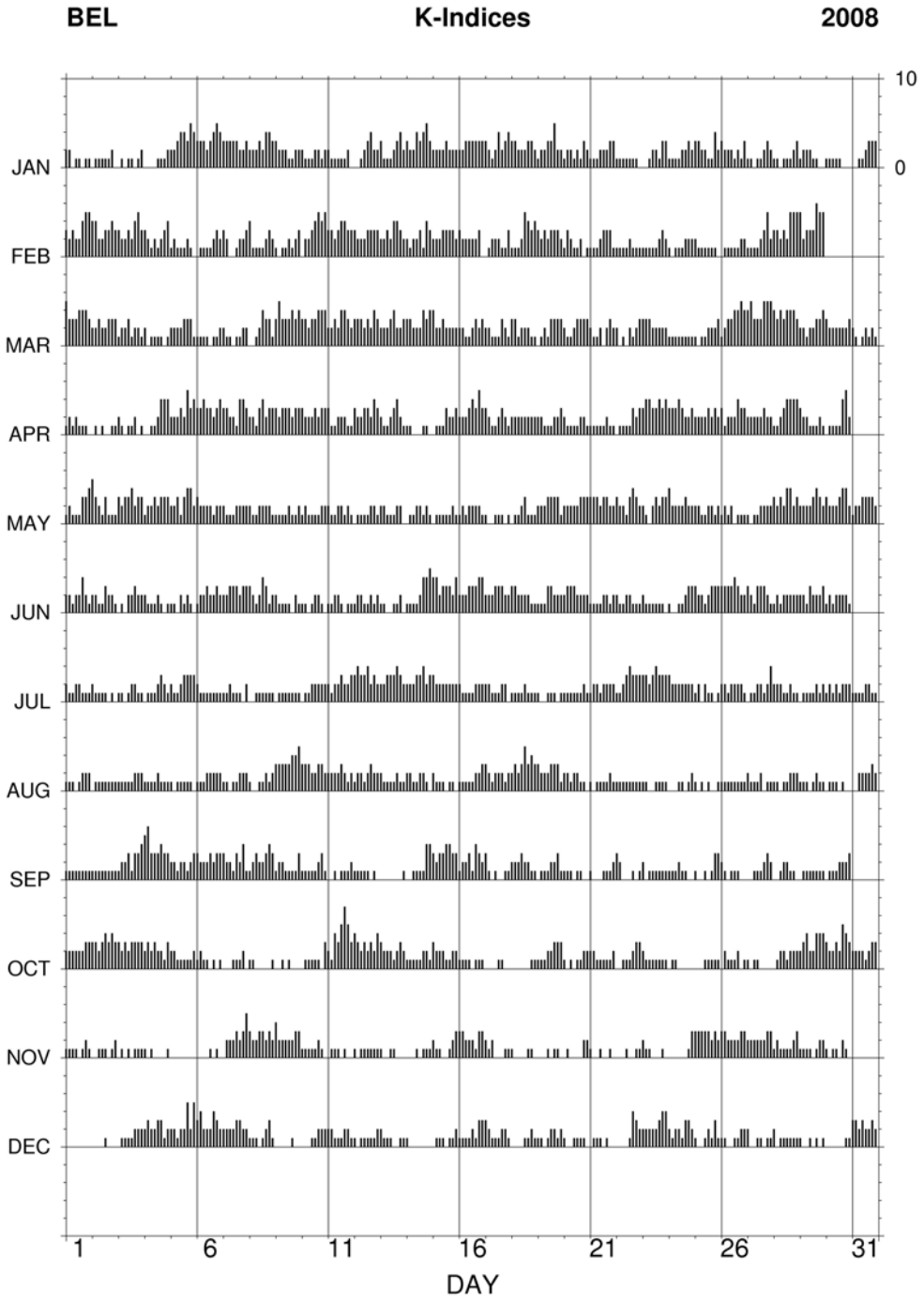


Fig. 11. K-indices in graphical form, Belsk 2008.

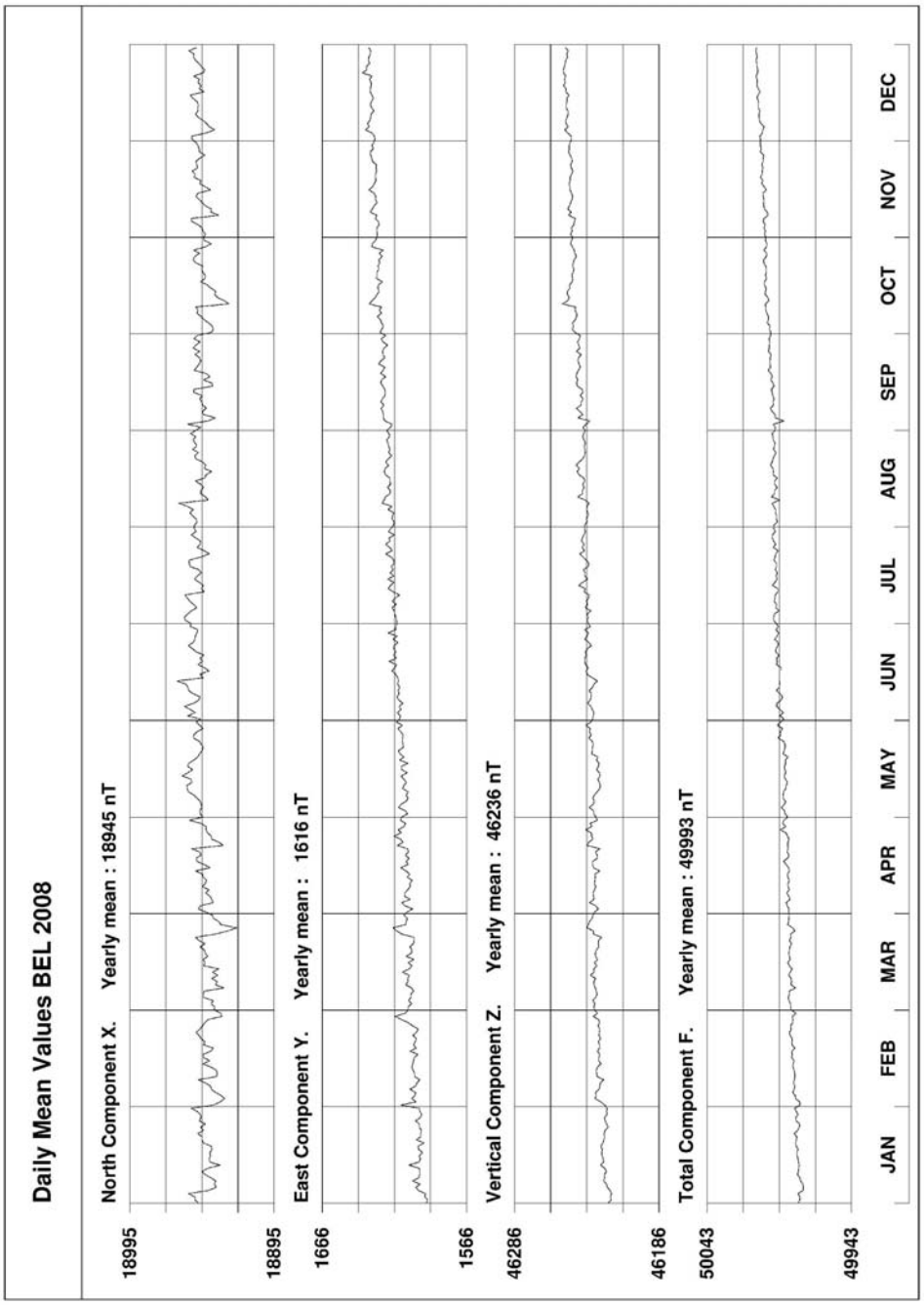


Fig. 12. Daily mean data plot for Belsk 2008.

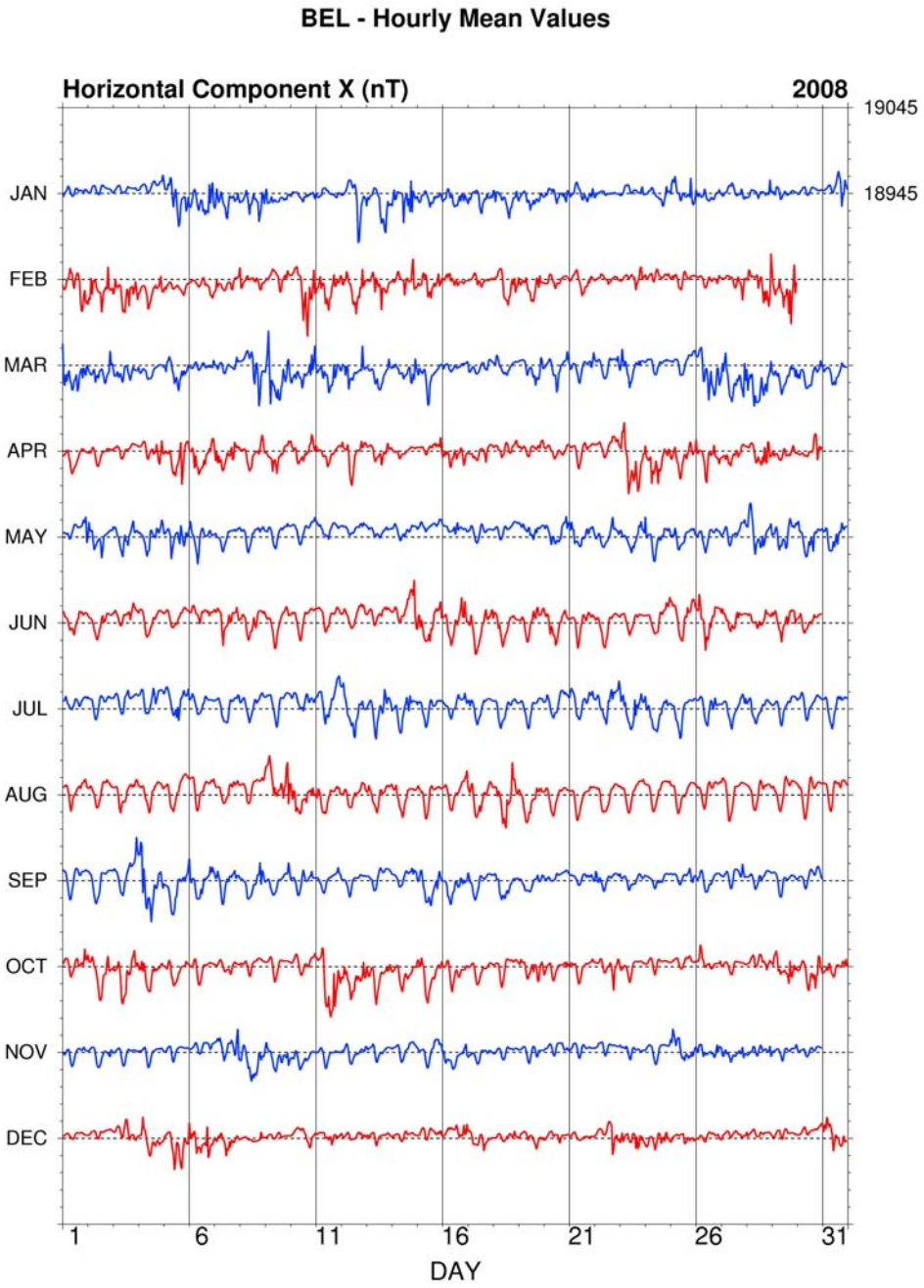


Fig. 13. Hourly mean data plot of X component for Belsk 2008.

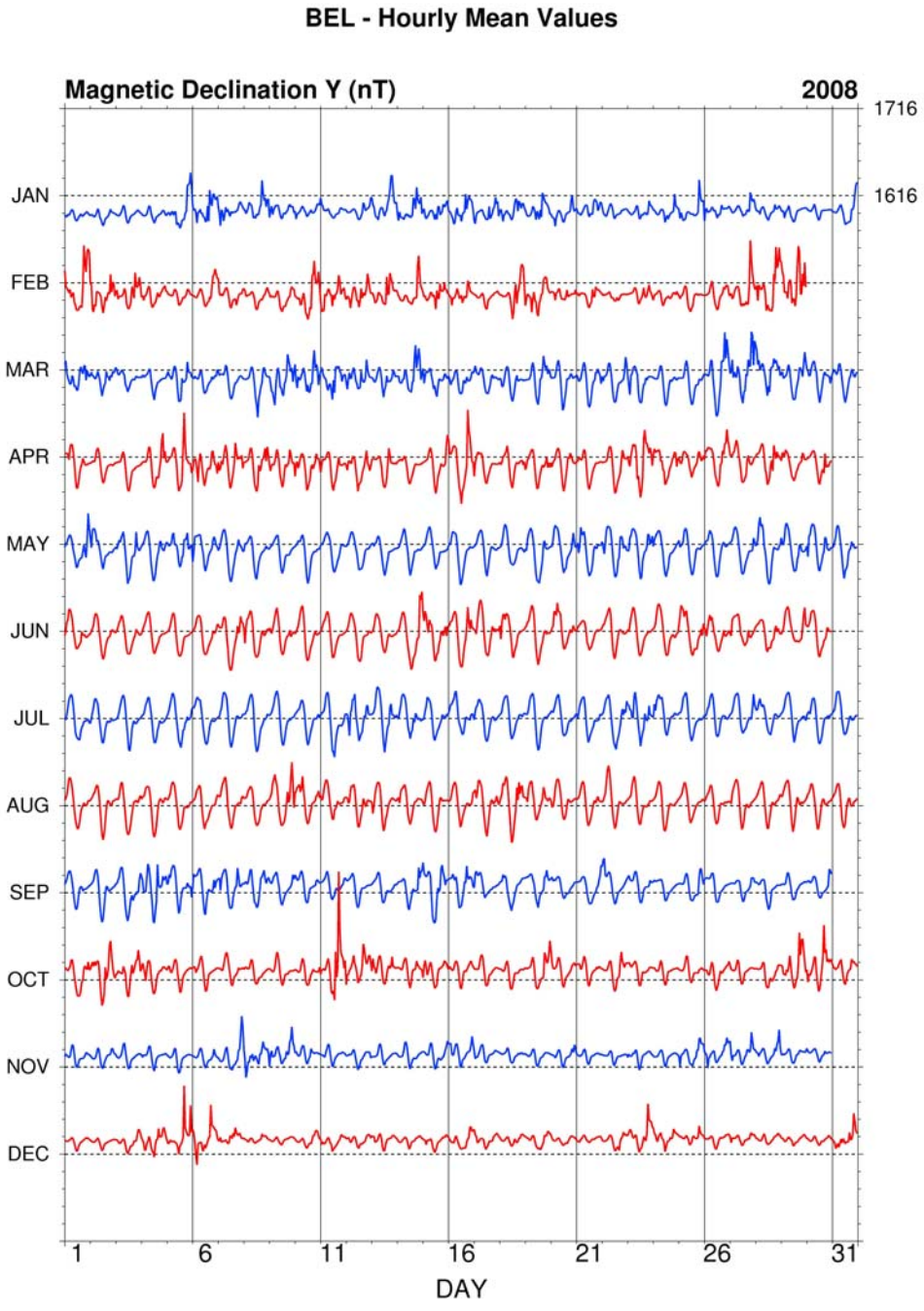


Fig. 14. Hourly mean data plot of Y component for Belsk 2008.

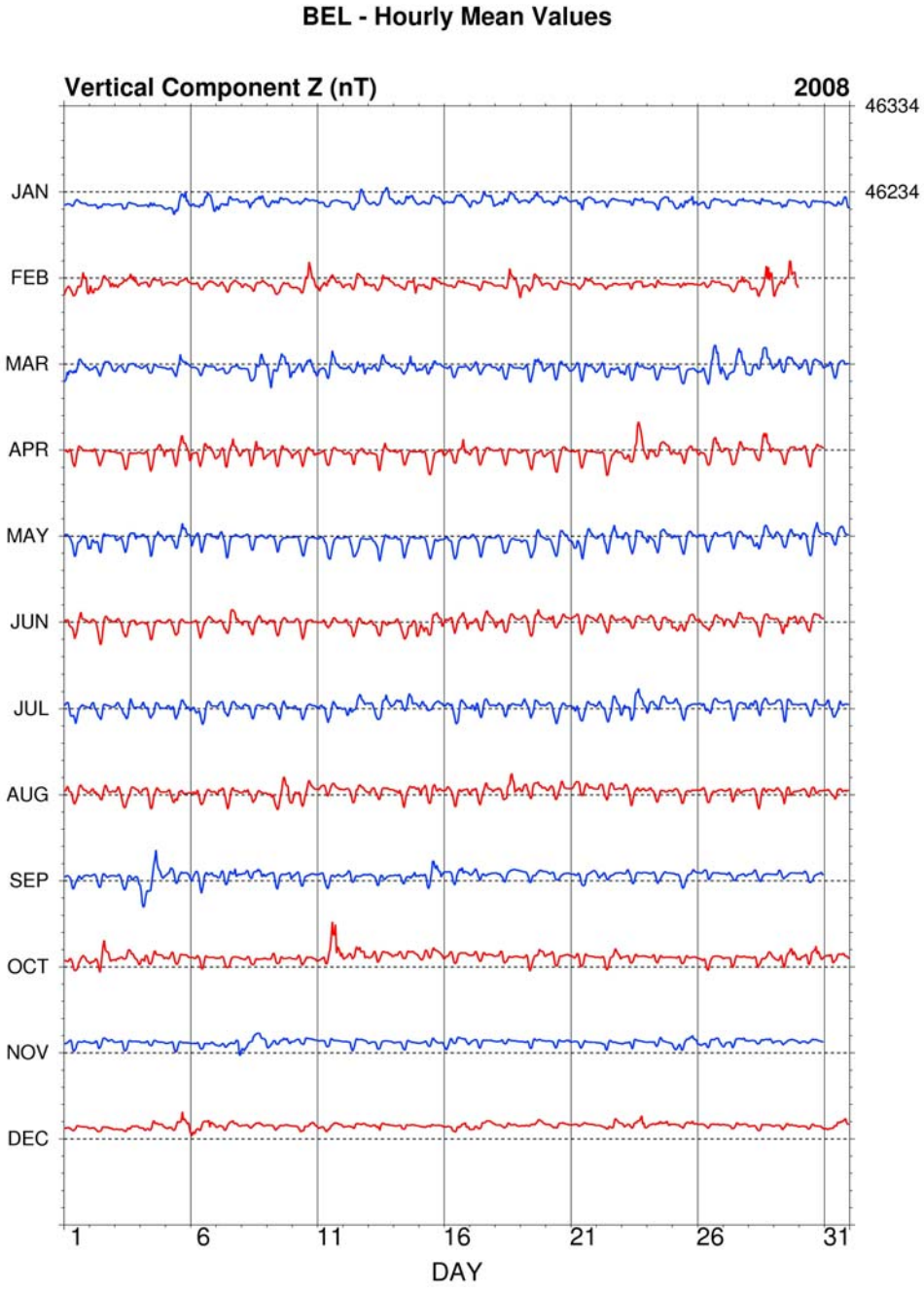


Fig. 15. Hourly mean data plot of Z component for Belsk 2008.

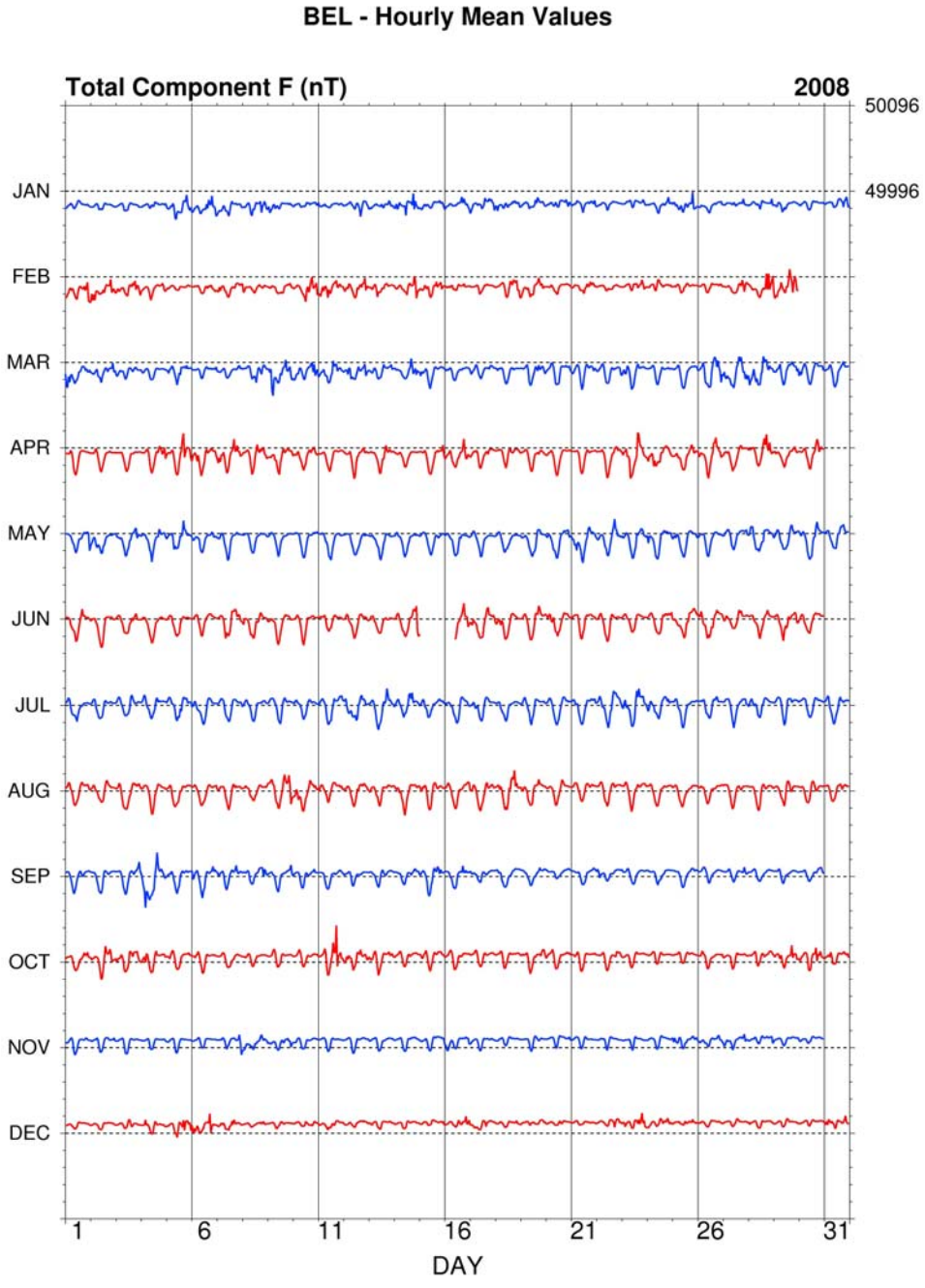


Fig. 16. Hourly mean data plot of F component for Belsk 2008.

# Tables and plots for Hel Observatory

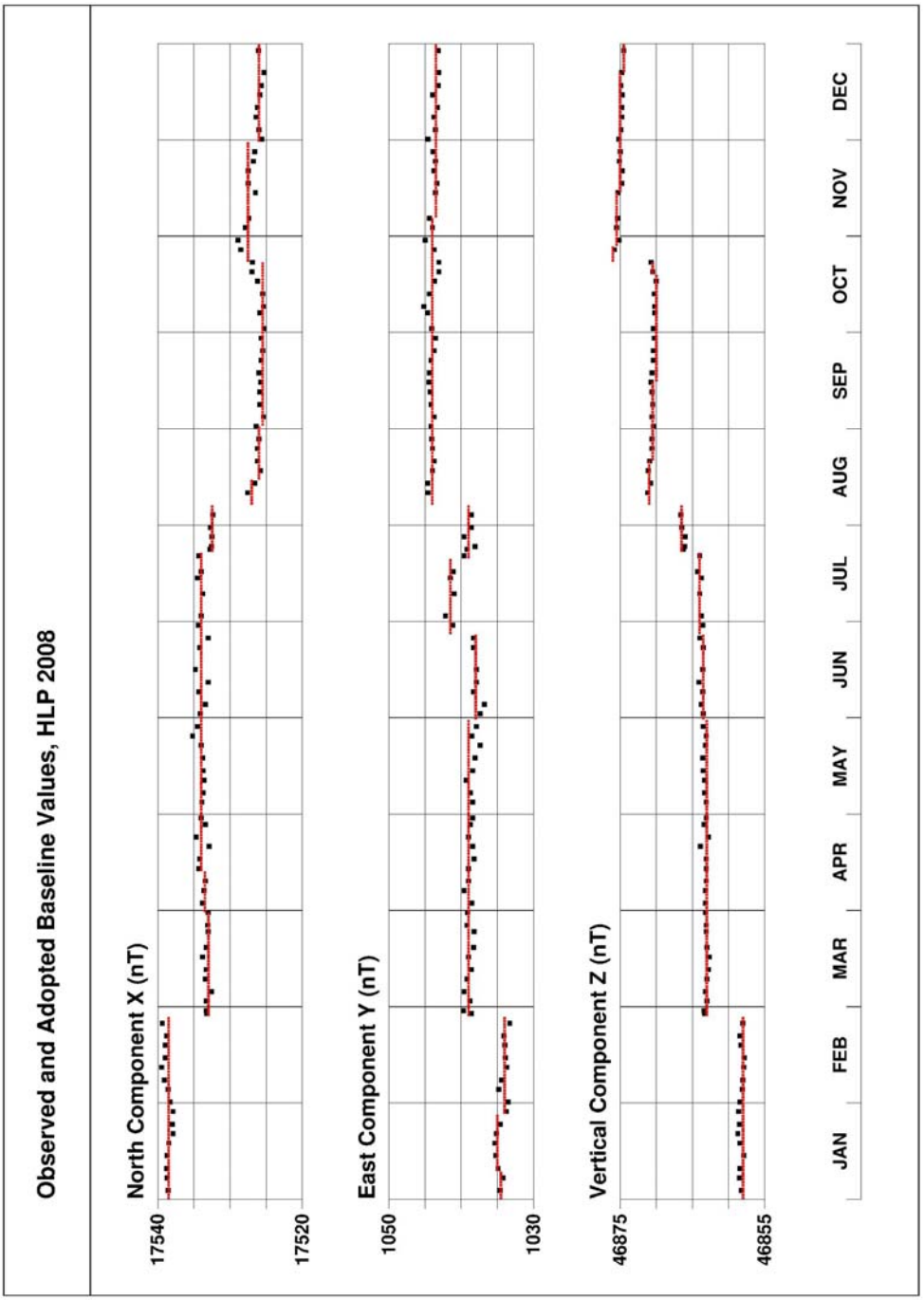


Fig. 17. Base values of set 1, Hel 2008.

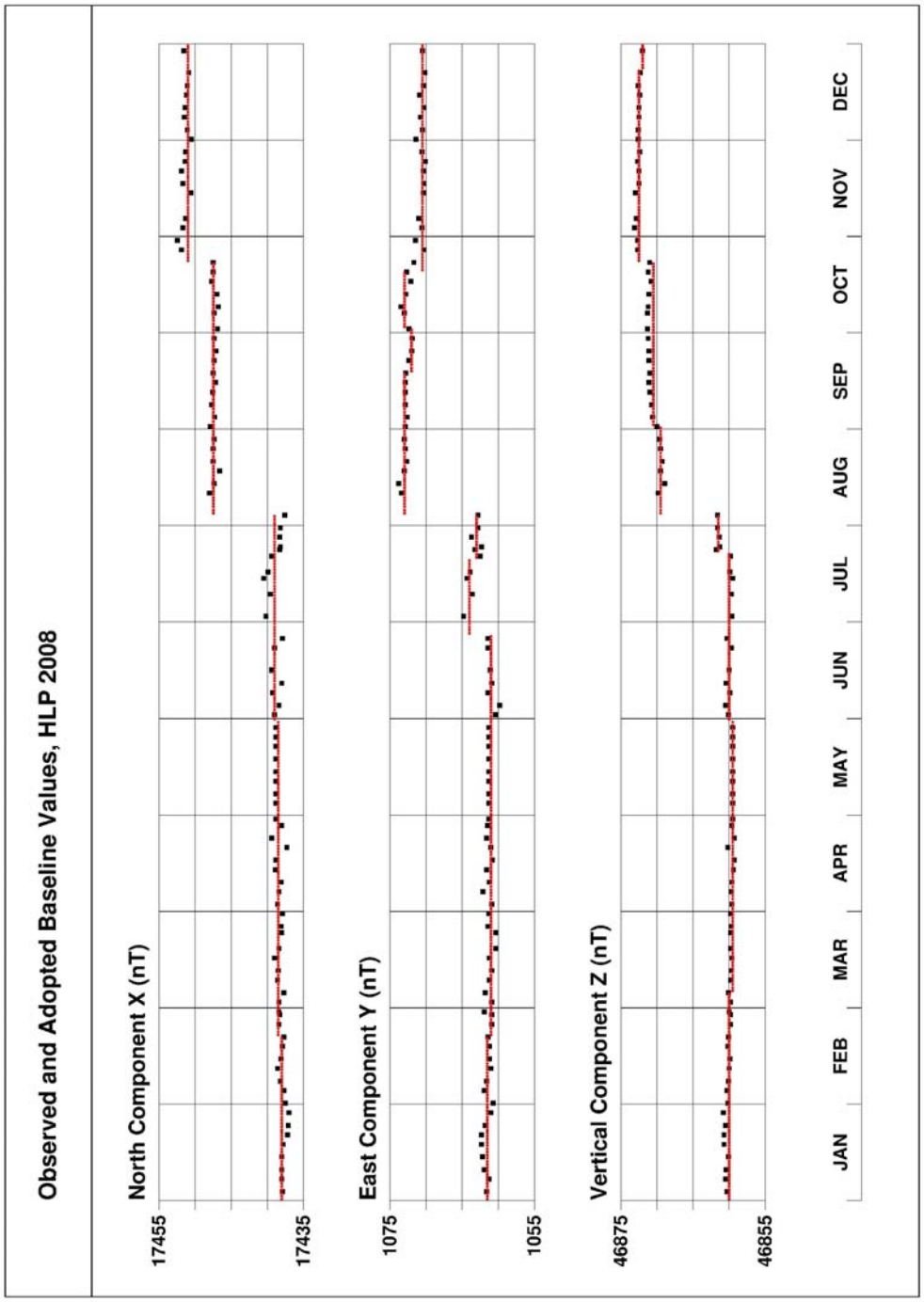


Fig. 18. Base values of set 2, Hel 2008.

## Annual mean values of magnetic elements in Hel Observatory

| No | Year | D [ º ‘ ] | H [ nT ] | Z [ nT ] | X [ nT ] | Y [ nT ] | I [ º ‘ ] | F [ nT ] |
|---|---|---|---|---|---|---|---|---|
| 1 | 1953 | -0 14.5 | 17388 | 45327 | 17388 | -73 | 69 00.8 | 48548 |
| 2 | 1954 | -0 10.0 | 17394 | 45374 | 17394 | -51 | 69 01.5 | 48594 |
| 3 | 1955 | -0 04.2 | 17379 | 45430 | 17379 | -21 | 69 03.9 | 48640 |
| 4 | 1956 | 0 03.9 | 17371 | 45450 | 17371 | 20 | 69 05.0 | 48656 |
| 5 | 1957 | 0 05.7 | 17372 | 45475 | 17372 | 29 | 69 05.5 | 48680 |
| 6 | 1958 | 0 10.2 | 17380 | 45535 | 17380 | 52 | 69 06.5 | 48739 |
| 7 | 1959 | 0 14.7 | 17390 | 45565 | 17390 | 74 | 69 06.6 | 48771 |
| 8 | 1960 | 0 17.6 | 17402 | 45602 | 17402 | 89 | 69 06.8 | 48810 |
| 9 | 1961 | 0 19.8 | 17422 | 45625 | 17422 | 100 | 69 06.0 | 48838 |
| 10 | 1962 | 0 22.7 | 17438 | 45647 | 17438 | 115 | 69 05.5 | 48864 |
| 11 | 1963 | 0 26.5 | 17449 | 45663 | 17448 | 134 | 69 05.2 | 48883 |
| 12 | 1964 | 0 28.6 | 17464 | 45676 | 17463 | 145 | 69 04.6 | 48901 |
| 13 | 1965 | 0 30.0 | 17476 | 45692 | 17475 | 152 | 69 04.2 | 48920 |
| 14 | 1966 | 0 31.6 | 17485 | 45710 | 17484 | 161 | 69 04.0 | 48940 |
| 15 | 1967 | 0 33.3 | 17492 | 45743 | 17491 | 169 | 69 04.4 | 48973 |
| 16 | 1968 | 0 34.4 | 17502 | 45769 | 17501 | 175 | 69 04.4 | 49001 |
| 17 | 1969 | 0 34.3 | 17524 | 45792 | 17523 | 175 | 69 03.5 | 49030 |
| 18 | 1970 | 0 34.8 | 17542 | 45824 | 17541 | 178 | 69 03.2 | 49067 |
| 19 | 1971 | 0 35.7 | 17565 | 45849 | 17564 | 182 | 69 02.3 | 49098 |
| 20 | 1972 | 0 36.1 | 17579 | 45880 | 17578 | 184 | 69 02.1 | 49132 |
| 21 | 1973 | 0 38.5 | 17595 | 45912 | 17594 | 197 | 69 01.9 | 49168 |
| 22 | 1974 | 0 41.9 | 17606 | 45951 | 17605 | 215 | 69 02.2 | 49208 |
| 23 | 1975 | 0 45.0 | 17625 | 45984 | 17623 | 231 | 69 01.7 | 49246 |
| 24 | 1976 | 0 49.6 | 17639 | 46015 | 17637 | 254 | 69 01.6 | 49280 |
| 25 | 1977 | 0 55.0 | 17651 | 46045 | 17649 | 282 | 69 01.5 | 49312 |
| 26 | 1978 | 1 00.2 | 17646 | 46085 | 17643 | 309 | 69 02.9 | 49349 |
| 27 | 1979 | 1 05.1 | 17651 | 46112 | 17648 | 334 | 69 03.2 | 49375 |
| 28 | 1980 | 1 11.5 | 17653 | 46127 | 17649 | 367 | 69 03.5 | 49390 |
| 29 | 1981 | 1 17.5 | 17637 | 46156 | 17632 | 398 | 69 05.2 | 49411 |
| 30 | 1982 | 1 23.4 | 17620 | 46184 | 17615 | 427 | 69 07.1 | 49431 |
| 31 | 1983 | 1 28.6 | 17614 | 46200 | 17608 | 454 | 69 07.8 | 49444 |
| 32 | 1984 | 1 33.5 | 17602 | 46219 | 17596 | 479 | 69 09.1 | 49457 |
| 33 | 1985 | 1 37.9 | 17591 | 46239 | 17584 | 501 | 69 10.3 | 49472 |
| 34 | 1986 | 1 42.7 | 17579 | 46263 | 17571 | 525 | 69 11.6 | 49490 |
| 35 | 1987 | 1 46.3 | 17572 | 46285 | 17564 | 543 | 69 12.6 | 49508 |
| 36 | 1988 | 1 51.0 | 17555 | 46318 | 17546 | 567 | 69 14.6 | 49533 |

| No | Year | D [ ° ‘ ] | H [ nT ] | Z [ nT ] | X [ nT ] | Y [ nT ] | I [ ° ‘ ] | F [ nT ] |
|---|---|---|---|---|---|---|---|---|
| 37 | 1989 | 1 55.5 | 17535 | 46352 | 17525 | 589 | 69 16.7 | 49558 |
| 38 | 1990 | 1 58.4 | 17527 | 46374 | 17516 | 604 | 69 17.8 | 49575 |
| 39 | 1991 | 2 00.6 | 17513 | 46398 | 17502 | 614 | 69 19.3 | 49593 |
| 40 | 1992 | 2 03.9 | 17515 | 46416 | 17504 | 631 | 69 19.6 | 49611 |
| 41 | 1993 | 2 10.0 | 17516 | 46428 | 17503 | 662 | 69 19.8 | 49622 |
| 42 | 1994 | 2 15.9 | 17512 | 46456 | 17498 | 692 | 69 20.7 | 49647 |
| 43 | 1995 | 2 21.3 | 17518 | 46481 | 17503 | 720 | 69 21.0 | 49672 |
| 44 | 1996 | 2 26.6 | 17523 | 46506 | 17507 | 747 | 69 21.2 | 49698 |
| 45 | 1997 | 2 32.9 | 17519 | 46539 | 17502 | 779 | 69 22.3 | 49727 |
| 46 | 1998 | 2 39.8 | 17512 | 46581 | 17493 | 814 | 69 23.8 | 49764 |
| 47 | 1999 | 2 45.4 | 17511 | 46615 | 17491 | 842 | 69 24.7 | 49796 |
| 48 | 2000 | 2 51.9 | 17507 | 46657 | 17485 | 875 | 69 25.9 | 49833 |
| 49 | 2001 | 2 57.7 | 17515 | 46692 | 17492 | 905 | 69 26.2 | 49869 |
| 50 | 2002 | 3 03.7 | 17520 | 46730 | 17495 | 936 | 69 26.9 | 49906 |
| 51 | 2003 | 3 10.8 | 17519 | 46777 | 17492 | 972 | 69 28.1 | 49950 |
| 52 | 2004 | 3 16.6 | 17529 | 46809 | 17500 | 1002 | 69 28.2 | 49983 |
| 53 | 2005 | 3 22.3 | 17531 | 46843 | 17501 | 1031 | 69 28.9 | 50016 |
| J | 2006.0 | 0 -1.5 | -2 | 9 | -2 | -8 | 0 0.6 | 7 |
| 54 | 2006 | 3 29.9 | 17550 | 46859 | 17517 | 1071 | 69 28.1 | 50038 |
| 55 | 2007 | 3 36.7 | 17559 | 46887 | 17524 | 1106 | 69 28.2 | 50067 |
| 56 | 2008 | 3 43.8 | 17564 | 46917 | 17527 | 1143 | 69 28.5 | 50097 |

Note: Since 2006 the observatory has stopped introducing the so-called historical corrections. The corrections were related, among other things, with the variable location of the instruments for absolute measurements. In the 2006.0 line we include the jump value J relating to the neglect of historical corrections. The jump values are defined as follows:

jump value J = old site value - new site value

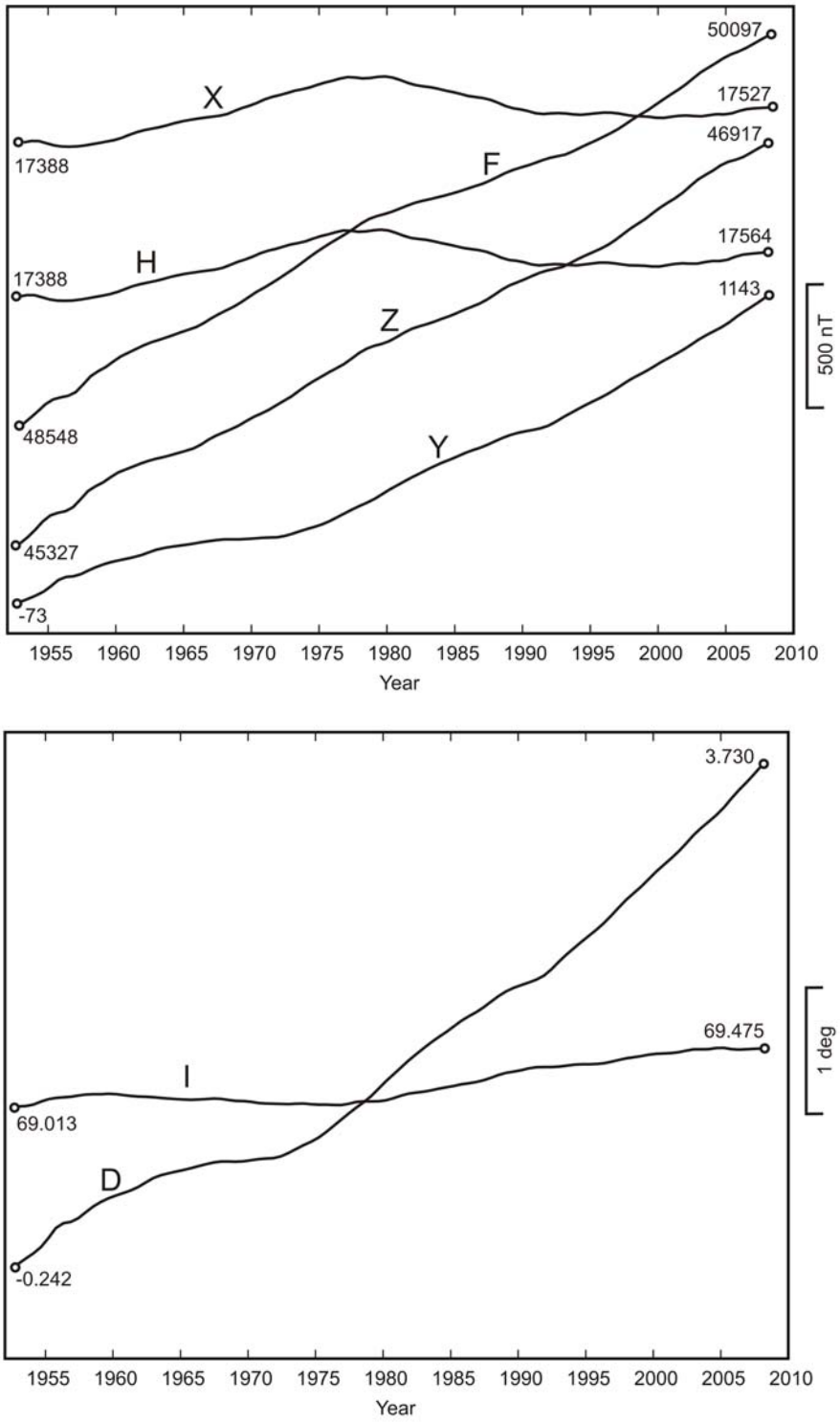


Fig. 19. Secular changes of H, X, Y, Z, F, D and I at Hel.

## MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

**HEL** **2008**

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | NORTH COMPONENT: 17000 + ... in nT | | | | | | | |
| All days | 524 | 522 | 521 | 525 | 532 | 531 | 532 | 529 | 527 | 525 | 529 | 529 | 527 |
| Quiet days | 530 | 528 | 527 | 526 | 535 | 533 | 530 | 532 | 530 | 520 | 529 | 531 | 529 |
| Disturbed days | 519 | 517 | 512 | 519 | 530 | 532 | 530 | 527 | 524 | 524 | 528 | 530 | 524 |
| | | | | | | EAST COMPONENT: 1000 + ... in nT | | | | | | | |
| All days | 127 | 131 | 133 | 135 | 136 | 140 | 144 | 146 | 150 | 154 | 157 | 161 | 143 |
| Quiet days | 124 | 128 | 130 | 134 | 136 | 139 | 142 | 146 | 150 | 157 | 158 | 160 | 142 |
| Disturbed days | 129 | 136 | 137 | 138 | 137 | 139 | 142 | 146 | 150 | 153 | 157 | 161 | 144 |
| | | | | | | VERTICAL COMPONENT: 46500 + ... in nT | | | | | | | |
| All days | 404 | 409 | 412 | 412 | 412 | 415 | 417 | 419 | 422 | 427 | 428 | 431 | 417 |
| Quiet days | 402 | 408 | 410 | 411 | 410 | 415 | 419 | 418 | 422 | 428 | 428 | 431 | 417 |
| Disturbed days | 404 | 408 | 411 | 414 | 413 | 413 | 419 | 420 | 423 | 427 | 429 | 432 | 418 |

**Three-hour-range K indices**

**Hel, January - March, 2008**

**The limit of K=9 is 550**

| Day | January | | February | | March | |
|---|---|---|---|---|---|---|
| | K | SK | K | SK | K | SK |
| 1 | 2101 1001 | 6 | 3222 1355 | 23 | 5323 4433 | 27 |
| 2 | 0000 1120 | 4 | 4322 3243 | 23 | 2222 2323 | 18 |
| 3 | 0000 0011 | 2 | 3223 2443 | 23 | 2123 1111 | 12 |
| 4 | 0000 1112 | 5 | 3212 1233 | 17 | 2011 1001 | 6 |
| 5 | 2233 3354 | 25 | 1101 1210 | 7 | 2212 3231 | 16 |
| 6 | 3332 3443 | 25 | 0011 1232 | 10 | 1111 0111 | 7 |
| 7 | 3223 3123 | 19 | 3200 0213 | 11 | 1110 0011 | 5 |
| 8 | 1222 2443 | 20 | 3111 1133 | 14 | 0013 4331 | 15 |
| 9 | 3221 1122 | 14 | 2000 2123 | 10 | 3533 3434 | 28 |
| 10 | 2111 1212 | 11 | 0223 4544 | 24 | 3223 3444 | 25 |
| 11 | 2011 0020 | 6 | 3323 3333 | 23 | 2232 4432 | 22 |
| 12 | 0001 2322 | 10 | 2222 3333 | 20 | 3332 3243 | 23 |
| 13 | 3111 2342 | 17 | 1131 4331 | 17 | 2223 3222 | 18 |
| 14 | 3224 3453 | 26 | 2122 3143 | 18 | 3322 2434 | 23 |
| 15 | 2222 3222 | 17 | 2223 3332 | 20 | 4223 3222 | 20 |
| 16 | 2233 2333 | 21 | 2222 2130 | 14 | 2111 2222 | 13 |
| 17 | 2212 3124 | 17 | 0112 2112 | 10 | 2111 1321 | 12 |
| 18 | 3332 2332 | 21 | 1012 4434 | 19 | 3311 2111 | 13 |
| 19 | 1123 2422 | 17 | 3232 3332 | 21 | 0121 3333 | 16 |
| 20 | 1221 2032 | 13 | 1311 1201 | 10 | 2112 3333 | 18 |
| 21 | 1112 1223 | 13 | 1112 2331 | 14 | 2111 0233 | 13 |
| 22 | 1110 0110 | 5 | 1011 1011 | 6 | 2001 2123 | 11 |
| 23 | 0012 1133 | 11 | 0112 1232 | 12 | 3322 2222 | 18 |
| 24 | 0111 2232 | 12 | 1011 1222 | 10 | 1111 1110 | 7 |
| 25 | 3322 1042 | 17 | 2011 0100 | 5 | 0012 2113 | 10 |
| 26 | 3121 1213 | 14 | 0111 1122 | 9 | 1133 4454 | 25 |
| 27 | 1101 1132 | 10 | 1111 2352 | 16 | 4433 3555 | 32 |
| 28 | 0111 0023 | 8 | 3323 2545 | 27 | 4343 4443 | 29 |
| 29 | 1211 1000 | 6 | 4233 3644 | 29 | 2211 2234 | 17 |
| 30 | 1100 0000 | 2 | | | 3212 2213 | 16 |
| 31 | 0001 2333 | 12 | | | 1101 2021 | 8 |

**Three-hour-range K indices**

**Hel, April - June, 2008**

**The limit of K=9 is 550**

| Day | April | | | May | | | June | | |
|---|---|---|---|---|---|---|---|---|---|
| | K | | SK | K | | SK | K | | SK |
| 1 | 1211 | 1110 | 8 | 1112 | 1234 | 15 | 2222 | 2321 | 16 |
| 2 | 0000 | 0001 | 1 | 5212 | 3101 | 15 | 2212 | 3221 | 15 |
| 3 | 2001 | 0100 | 4 | 3233 | 4232 | 22 | 1102 | 2322 | 13 |
| 4 | 0011 | 2443 | 15 | 1223 | 2333 | 19 | 2121 | 2101 | 10 |
| 5 | 2123 | 3534 | 23 | 2131 | 3432 | 19 | 1002 | 1210 | 7 |
| 6 | 3443 | 3233 | 25 | 3222 | 2121 | 15 | 1223 | 2222 | 16 |
| 7 | 3322 | 1433 | 21 | 2001 | 2222 | 11 | 2133 | 3233 | 20 |
| 8 | 2213 | 4233 | 20 | 2112 | 2111 | 11 | 3212 | 4312 | 18 |
| 9 | 2233 | 3233 | 21 | 1111 | 2111 | 9 | 1001 | 1011 | 5 |
| 10 | 3222 | 3233 | 20 | 1111 | 1122 | 10 | 1001 | 2110 | 6 |
| 11 | 3112 | 2201 | 12 | 2111 | 2121 | 11 | 1122 | 1001 | 8 |
| 12 | 3223 | 3133 | 20 | 1010 | 1211 | 7 | 1221 | 1111 | 10 |
| 13 | 1112 | 3421 | 15 | 1101 | 1220 | 8 | 1100 | 1120 | 6 |
| 14 | 1100 | 0000 | 2 | 0102 | 2110 | 7 | 1001 | 2445 | 17 |
| 15 | 0001 | 3223 | 11 | 0111 | 1111 | 7 | 3433 | 3324 | 25 |
| 16 | 2223 | 4343 | 23 | 1202 | 2221 | 12 | 2223 | 3334 | 22 |
| 17 | 3212 | 2221 | 15 | 1001 | 0100 | 3 | 2223 | 3322 | 19 |
| 18 | 2222 | 2212 | 15 | 0002 | 3111 | 8 | 3322 | 3211 | 17 |
| 19 | 2111 | 1223 | 13 | 2113 | 3321 | 16 | 1112 | 3222 | 14 |
| 20 | 2111 | 1221 | 11 | 2122 | 3333 | 19 | 2333 | 2222 | 19 |
| 21 | 1101 | 1211 | 8 | 3323 | 3222 | 20 | 1111 | 2211 | 10 |
| 22 | 0002 | 1323 | 11 | 2222 | 3432 | 20 | 2111 | 2111 | 10 |
| 23 | 3343 | 3433 | 26 | 2102 | 2233 | 15 | 2101 | 1000 | 5 |
| 24 | 3333 | 3223 | 22 | 3122 | 2312 | 16 | 1000 | 1123 | 8 |
| 25 | 2222 | 3221 | 16 | 2211 | 2211 | 12 | 3221 | 2333 | 19 |
| 26 | 3122 | 2433 | 20 | 1111 | 0111 | 7 | 3333 | 4322 | 23 |
| 27 | 2112 | 2321 | 14 | 0011 | 1112 | 7 | 3223 | 3321 | 19 |
| 28 | 1122 | 3443 | 20 | 3222 | 4323 | 21 | 1112 | 2222 | 13 |
| 29 | 2211 | 1121 | 11 | 2212 | 3332 | 18 | 2212 | 2223 | 16 |
| 30 | 0111 | 1351 | 13 | 3112 | 3442 | 20 | 1102 | 2220 | 10 |
| 31 | | | | 0223 | 3332 | 18 | | | |

**Three-hour-range K indices**

**Hel, July - September, 2008**

**The limit of K=9 is 550**

| Day | July | | | August | | | September | | |
|---|---|---|---|---|---|---|---|---|---|
| | K | | SK | K | | SK | K | | SK |
| 1 | 2112 | 3101 | 11 | 1010 | 2222 | 10 | 1000 | 2111 | 6 |
| 2 | 2001 | 1010 | 5 | 0001 | 1111 | 5 | 1112 | 1111 | 9 |
| 3 | 1001 | 2211 | 8 | 1011 | 2122 | 10 | 1223 | 2333 | 19 |
| 4 | 0001 | 2211 | 7 | 1011 | 1111 | 7 | 5533 | 3433 | 29 |
| 5 | 1223 | 3322 | 18 | 0001 | 1100 | 3 | 2212 | 2122 | 14 |
| 6 | 1111 | 1110 | 7 | 11-122 | 222 | -1 | 3222 | 3233 | 20 |
| 7 | 1111 | 0101 | 6 | 1111 | 1222 | 11 | 3122 | 3241 | 18 |
| 8 | 0001 | 1111 | 5 | 0000 | 1212 | 6 | 1232 | 2343 | 20 |
| 9 | 0111 | 1111 | 7 | 3323 | 3445 | 27 | 1211 | 1113 | 11 |
| 10 | 0002 | 2212 | 9 | 3332 | 2322 | 20 | 1111 | 1121 | 9 |
| 11 | 1122 | 3223 | 16 | 2212 | 3211 | 14 | 0000 | 1112 | 5 |
| 12 | 3433 | 4232 | 24 | 1232 | 2312 | 16 | 1000 | 0000 | 1 |
| 13 | 2233 | 3432 | 22 | 2112 | 1111 | 10 | 0000 | 0001 | 1 |
| 14 | 2223 | 3422 | 20 | 2211 | 2210 | 11 | 0011 | 1143 | 11 |
| 15 | 3222 | 2222 | 17 | 2111 | 1100 | 7 | 3233 | 3433 | 24 |
| 16 | 1111 | 2212 | 11 | 0111 | 1123 | 10 | 1222 | 1432 | 17 |
| 17 | 2211 | 1210 | 10 | 3112 | 3212 | 15 | 3101 | 1001 | 7 |
| 18 | 0101 | 1101 | 5 | 2224 | 4443 | 25 | 2212 | 1111 | 11 |
| 19 | 0001 | 1101 | 4 | 3222 | 3331 | 19 | 0111 | 1131 | 9 |
| 20 | 1001 | 1121 | 7 | 2112 | 2100 | 9 | 1100 | 1100 | 4 |
| 21 | 2111 | 2222 | 13 | 1001 | 2011 | 6 | 0000 | 0112 | 4 |
| 22 | 0123 | 4333 | 19 | 1110 | 1001 | 5 | 3100 | 0101 | 6 |
| 23 | 3322 | 4333 | 23 | 1001 | 2111 | 7 | 2011 | 1011 | 7 |
| 24 | 3222 | 2222 | 17 | 0001 | 1001 | 3 | 1002 | 1100 | 5 |
| 25 | 1112 | 1101 | 8 | 1000 | 1001 | 3 | 1001 | 0133 | 9 |
| 26 | 2112 | 2221 | 13 | 0001 | 1110 | 4 | 1101 | 1100 | 5 |
| 27 | 0012 | 2124 | 12 | 2111 | 1000 | 6 | 0000 | 1222 | 7 |
| 28 | 2222 | 1211 | 13 | 0001 | 1111 | 5 | 0012 | 2100 | 6 |
| 29 | 0101 | 1212 | 8 | 1111 | 0211 | 8 | 0111 | 1001 | 5 |
| 30 | 1212 | 1112 | 11 | 0111 | 1000 | 4 | 0011 | 2223 | 11 |
| 31 | 0111 | 2211 | 9 | 0012 | 3121 | 10 | | | |

**Three-hour-range K indices**

**Hel, October - December, 2008**

**The limit of K=9 is 550**

| Day | October | | November | | December | |
|---|---|---|---|---|---|---|
| | K | SK | K | SK | K | SK |
| 1 | 2222 2323 | 18 | 1010 0021 | 5 | 0000 0000 | 0 |
| 2 | 2223 4333 | 22 | 0011 1012 | 6 | 0000 0000 | 0 |
| 3 | 2232 3333 | 21 | 0000 0000 | 0 | 1111 1122 | 10 |
| 4 | 2323 2212 | 17 | 1000 0000 | 1 | 2322 3311 | 17 |
| 5 | 2211 1002 | 9 | 0000 0000 | 0 | 2112 2525 | 20 |
| 6 | 1111 0101 | 6 | 0000 0010 | 1 | 3322 2432 | 21 |
| 7 | 0000 1120 | 4 | 0112 2224 | 14 | 2122 2312 | 15 |
| 8 | 1100 0001 | 3 | 3223 3232 | 20 | 1100 1221 | 8 |
| 9 | 0010 0000 | 1 | 4222 1233 | 19 | 0000 0100 | 1 |
| 10 | 0002 1103 | 7 | 1111 0210 | 7 | 0001 1222 | 8 |
| 11 | 2133 5653 | 28 | 0101 0000 | 2 | 2211 1211 | 11 |
| 12 | 4322 2323 | 21 | 1010 0112 | 6 | 1001 1111 | 6 |
| 13 | 3122 1232 | 16 | 0000 0000 | 0 | 1101 0010 | 4 |
| 14 | 1011 1121 | 8 | 0000 0111 | 3 | 1000 0000 | 1 |
| 15 | 3222 1122 | 15 | 1100 0123 | 8 | 0110 0112 | 6 |
| 16 | 1011 0011 | 5 | 3222 1023 | 15 | 0011 2133 | 11 |
| 17 | 0000 1000 | 1 | 1120 0011 | 6 | 3210 1210 | 10 |
| 18 | 0000 0010 | 1 | 0000 0010 | 1 | 0000 1121 | 5 |
| 19 | 1112 2332 | 15 | 0000 0010 | 1 | 1001 1211 | 7 |
| 20 | 1000 1112 | 6 | 0100 0021 | 4 | 1000 1100 | 3 |
| 21 | 2111 1012 | 9 | 0001 0000 | 1 | 0111 0000 | 3 |
| 22 | 0001 1232 | 9 | 0000 0010 | 1 | 0000 0332 | 8 |
| 23 | 11-1-1-1110 | -1 | 2110 0010 | 5 | 2222 1344 | 20 |
| 24 | 011-11000 | -1 | 0000 0003 | 3 | 2122 2232 | 16 |
| 25 | 0001 0111 | 4 | 4332 3232 | 22 | 1001 2131 | 9 |
| 26 | 0221 1201 | 9 | 3322 2233 | 20 | 1000 0022 | 5 |
| 27 | 1001 0000 | 2 | 2112 1233 | 15 | 1000 1011 | 4 |
| 28 | 0122 1221 | 11 | 1111 0123 | 10 | 1011 0111 | 6 |
| 29 | 2332 3443 | 24 | 0111 0112 | 7 | 0001 0000 | 1 |
| 30 | 3223 2532 | 22 | 1000 0210 | 4 | 0000 0011 | 2 |
| 31 | 2221 1232 | 15 | | | 3323 2232 | 20 |

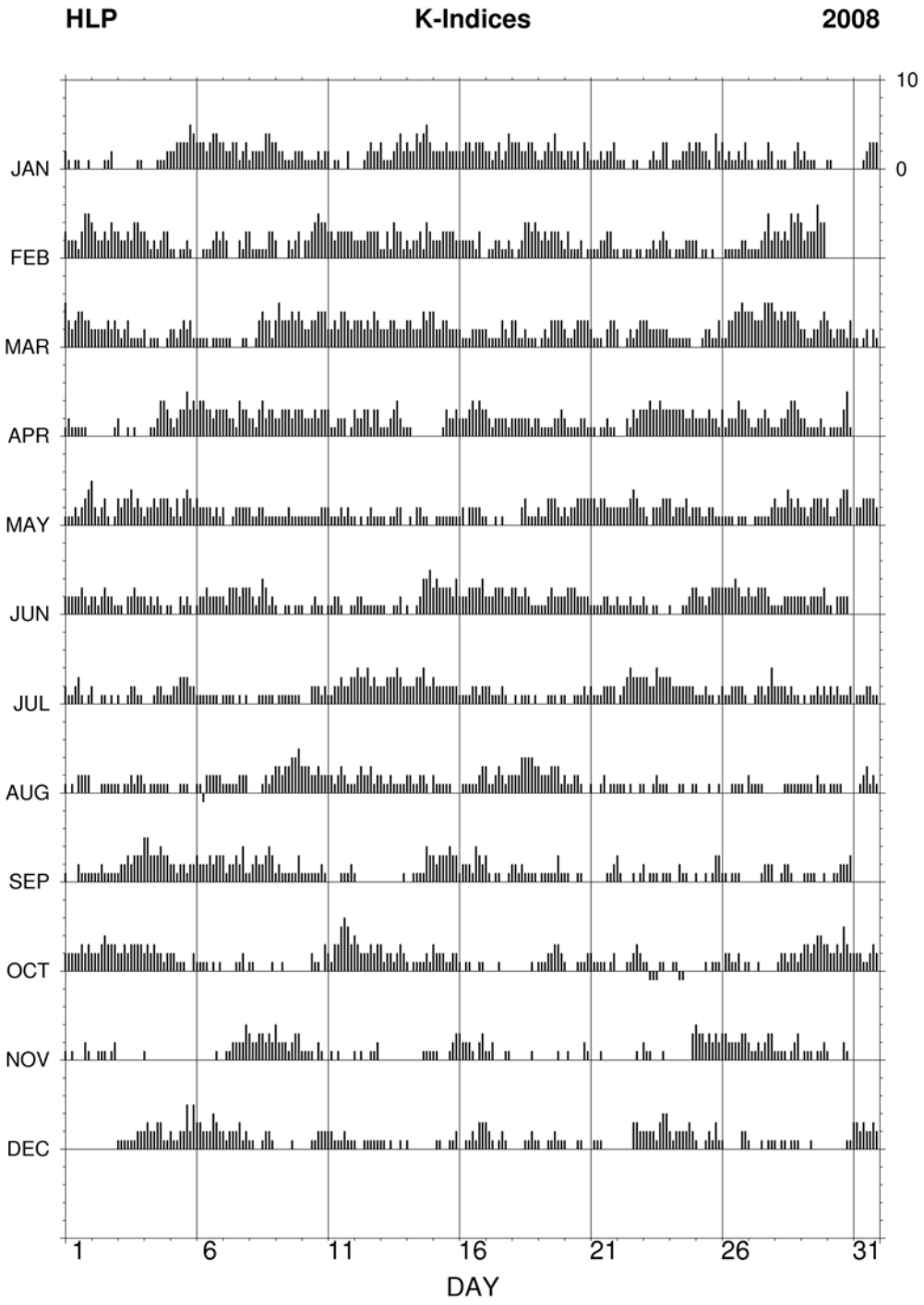


Fig. 20. K-indices in graphical form, Hel 2008.

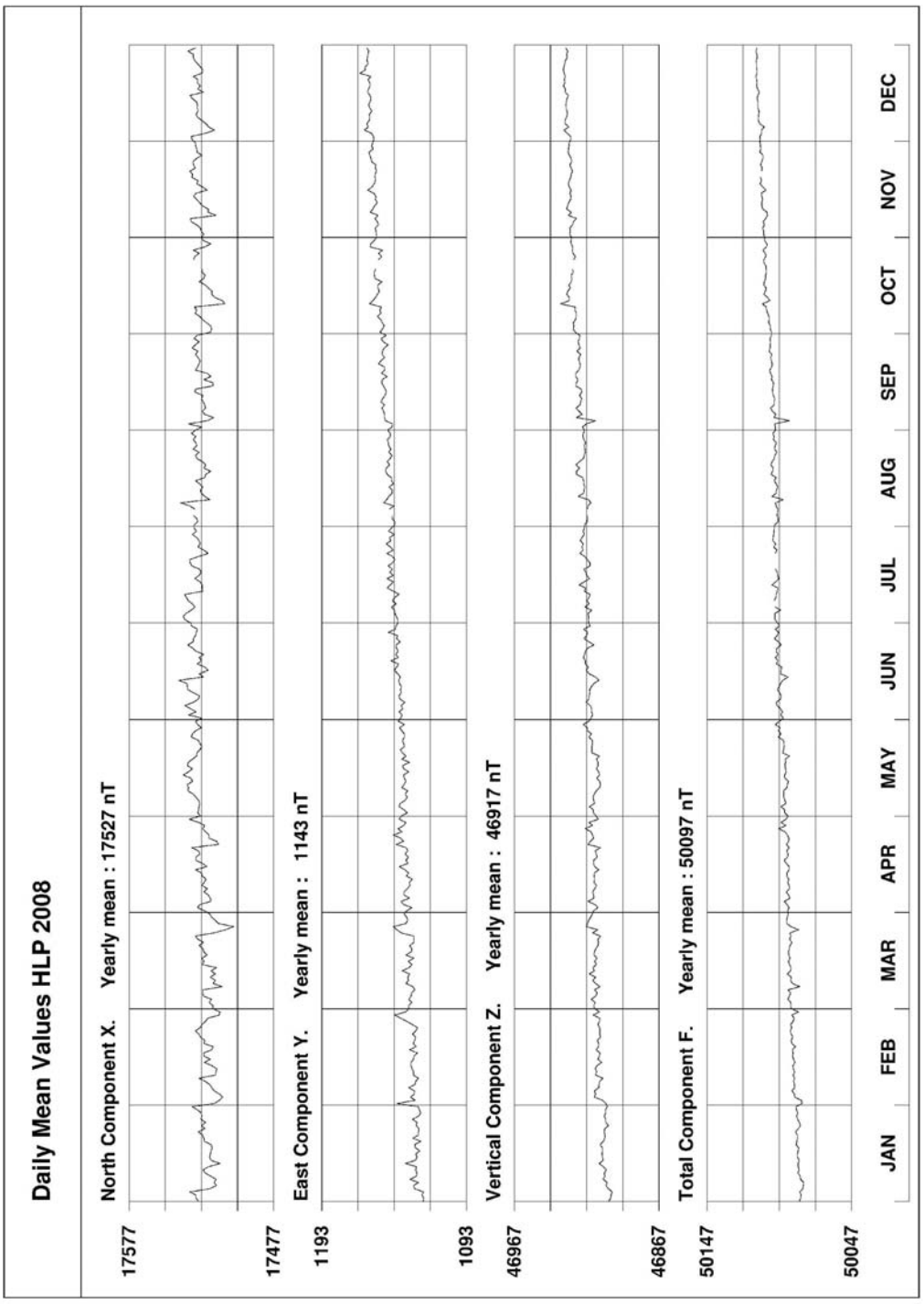


Fig. 21. Daily mean data plot for Hel 2008.

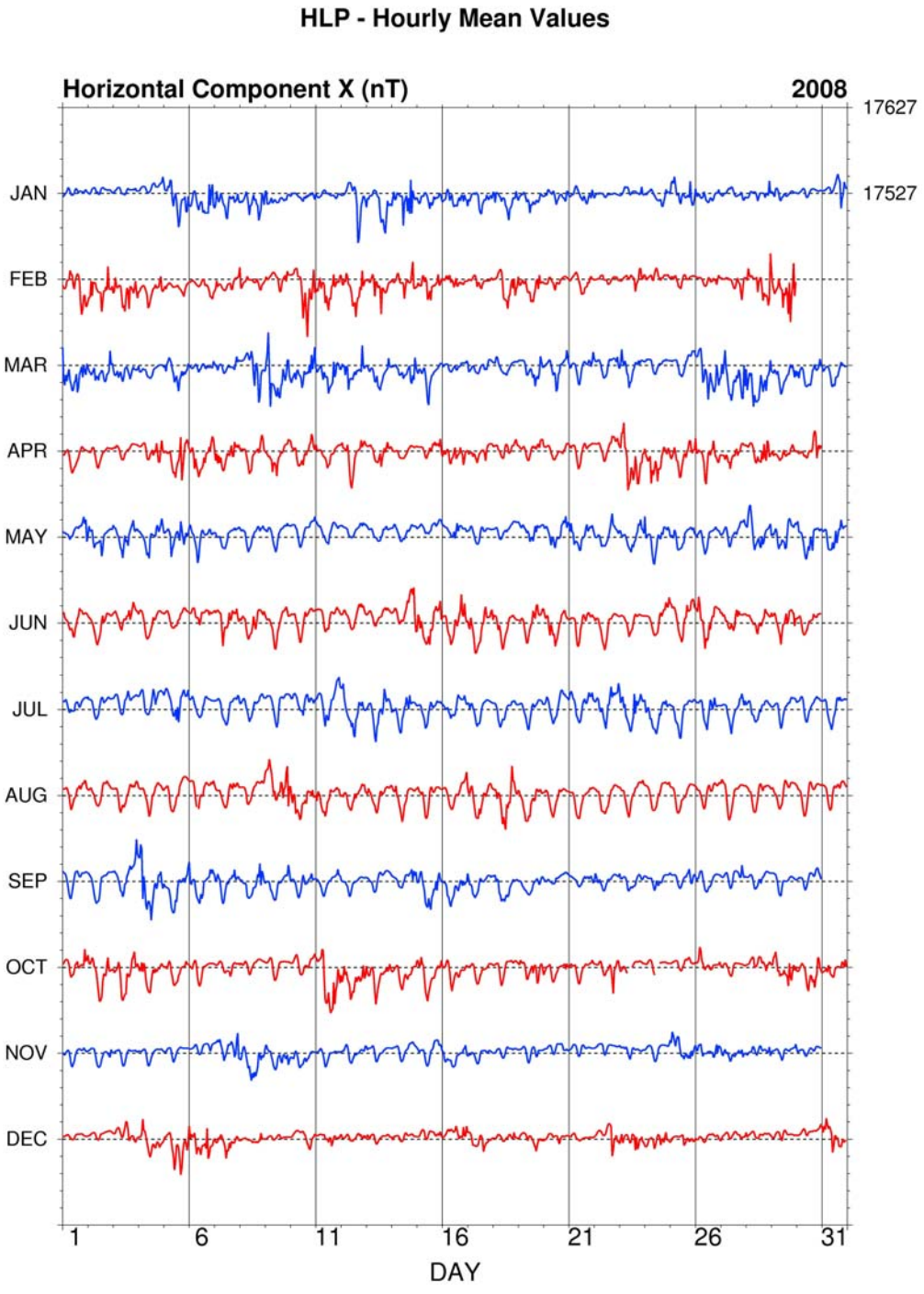


Fig. 22. Hourly mean data plot of X component for Hel 2008.

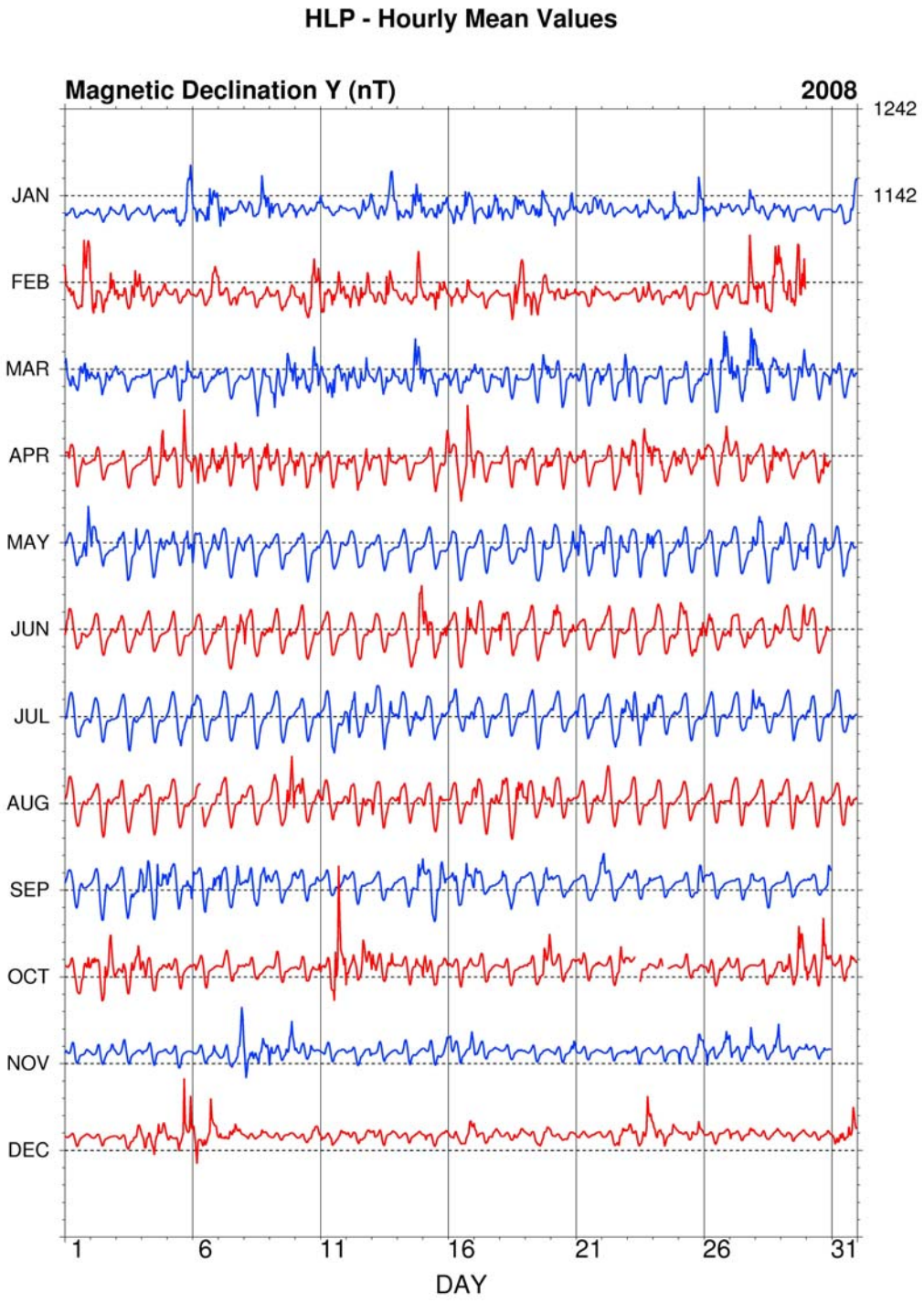


Fig. 23. Hourly mean data plot of Y component for Hel 2008.

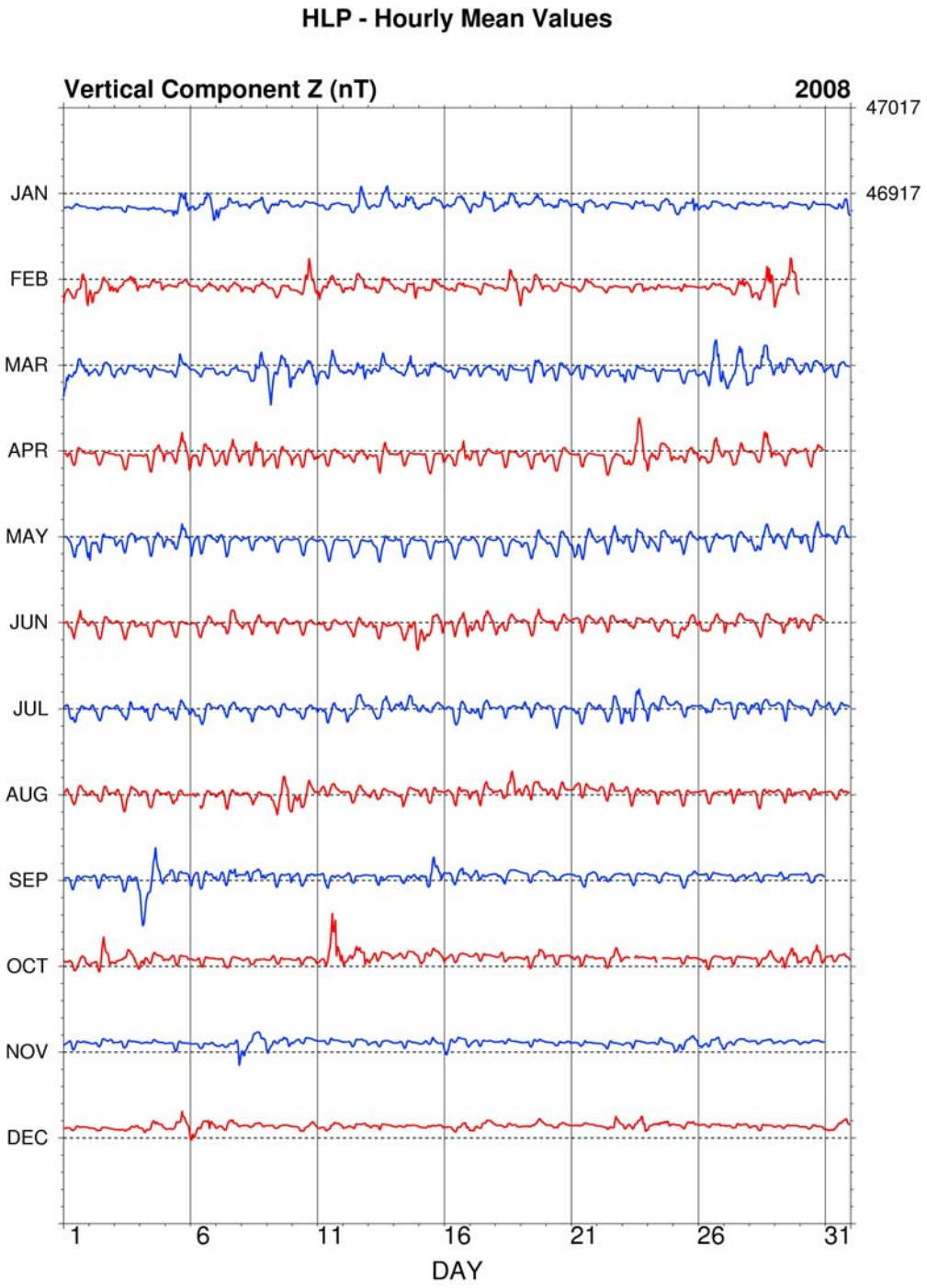


Fig. 24. Hourly mean data plot of Z component for Hel 2008.

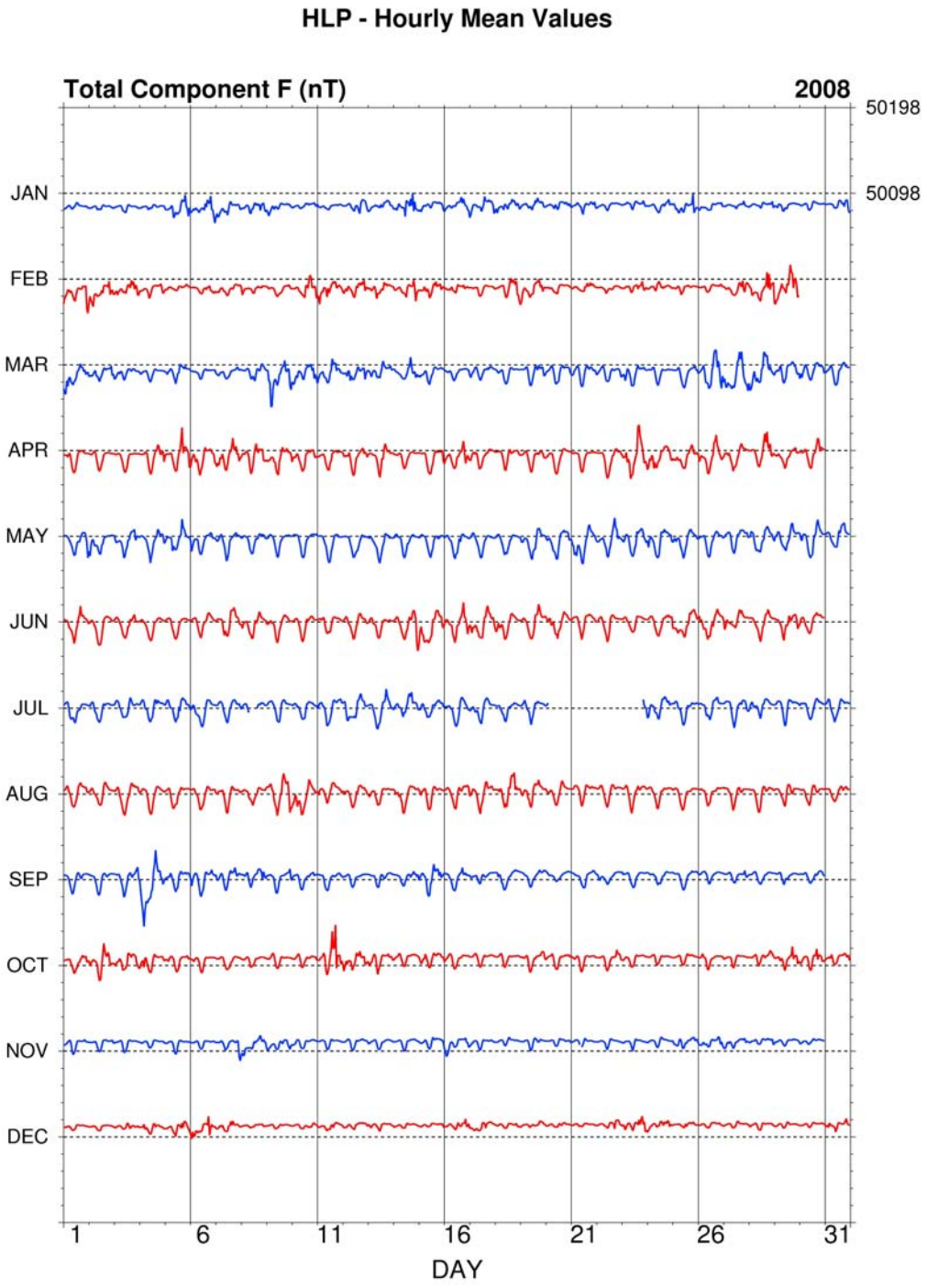


Fig. 25. Hourly mean data plot of F component for Hel 2008.

# Tables and plots for Hornsund Observatory

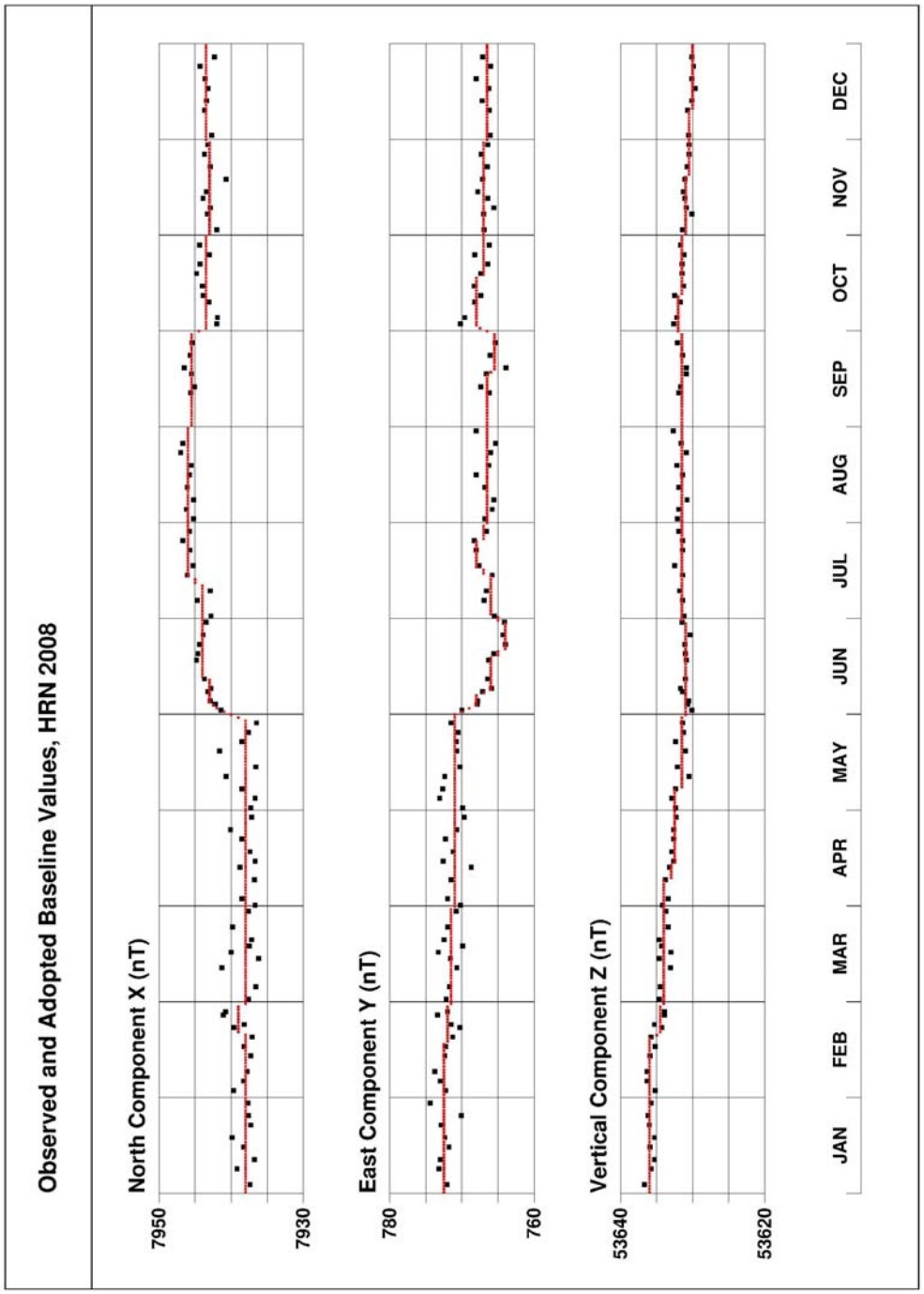


Fig. 26. Base values, Hornsund 2008.

**Annual mean values of magnetic elements in Hornsund Observatory**

| Year | D [ ° ´ ] | H [ nT ] | Z [ nT ] | X [ nT ] | Y [ nT ] | I [ ° ´ ] | F [ nT ] |
|---|---|---|---|---|---|---|---|
| 1979 | -0 32.2 | 8384 | 53447 | 8384 | -79 | 81 05.1 | 54101 |
| 1980 | -0 14.2 | 8370 | 53447 | 8370 | -35 | 81 06.0 | 54098 |
| 1981 | -0 09.3 | 8351 | 53449 | 8351 | -23 | 81 07.2 | 54097 |
| 1982 | -0 09.4 | 8319 | 53481 | 8319 | -23 | 81 09.5 | 54124 |
| 1983 | -0 02.0 | 8295 | 53457 | 8295 | -5 | 81 10.8 | 54097 |
| 1984 | 0 07.7 | 8266 | 53439 | 8266 | 19 | 81 12.4 | 54075 |
| 1985 | 0 14.3 | 8238 | 53405 | 8238 | 34 | 81 13.9 | 54037 |
| 1986 | 0 20.4 | 8213 | 53392 | 8213 | 49 | 81 15.3 | 54020 |
| 1987 | 0 25.6 | 8193 | 53360 | 8193 | 61 | 81 16.3 | 53985 |
| 1988 | 0 34.7 | 8168 | 53368 | 8168 | 82 | 81 17.9 | 53989 |
| 1989 | 0 40.8 | 8148 | 53369 | 8147 | 97 | 81 19.2 | 53987 |
| 1990 | 0 47.2 | 8122 | 53360 | 8121 | 112 | 81 20.7 | 53975 |
| 1991 | 0 53.0 | 8107 | 53355 | 8106 | 125 | 81 21.6 | 53967 |
| 1992 | 1 01.4 | 8088 | 53352 | 8087 | 144 | 81 22.8 | 53962 |
| 1993 | 1 12.9 | 8065 | 53356 | 8063 | 171 | 81 24.3 | 53962 |
| 1994 | 1 25.9 | 8044 | 53374 | 8041 | 201 | 81 25.8 | 53977 |
| 1995 | 1 38.4 | 8038 | 53374 | 8035 | 230 | 81 26.1 | 53976 |
| 1996 | 1 51.4 | 8023 | 53385 | 8019 | 260 | 81 27.2 | 53985 |
| 1997 | 2 07.2 | 8004 | 53406 | 7999 | 296 | 81 28.6 | 54003 |
| 1998 | 2 24.0 | 8001 | 53440 | 7994 | 335 | 81 29.1 | 54036 |
| 1999 | 2 39.1 | 7998 | 53471 | 7989 | 370 | 81 29.6 | 54066 |
| 2000 | 2 55.5 | 7996 | 53504 | 7986 | 408 | 81 30.0 | 54098 |
| 2001 | 3 12.4 | 7992 | 53542 | 7979 | 447 | 81 30.6 | 54135 |
| 2002 | 3 29.7 | 7989 | 53585 | 7974 | 487 | 81 31.2 | 54177 |
| 2003 | 3 49.8 | 7965 | 53646 | 7947 | 532 | 81 33.3 | 54234 |
| 2004 | 4 04.2 | 7961 | 53675 | 7941 | 565 | 81 33.8 | 54262 |
| 2005 | 4 20.5 | 7953 | 53707 | 7930 | 602 | 81 34.6 | 54293 |
| 2006 | 4 36.2 | 7958 | 53727 | 7932 | 639 | 81 34.5 | 54314 |
| 2007 | 4 51.3 | 7950 | 53757 | 7922 | 673 | 81 35.2 | 54342 |
| 2008 | 5 07.9 | 7941 | 53785 | 7909 | 710 | 81 36.1 | 54368 |

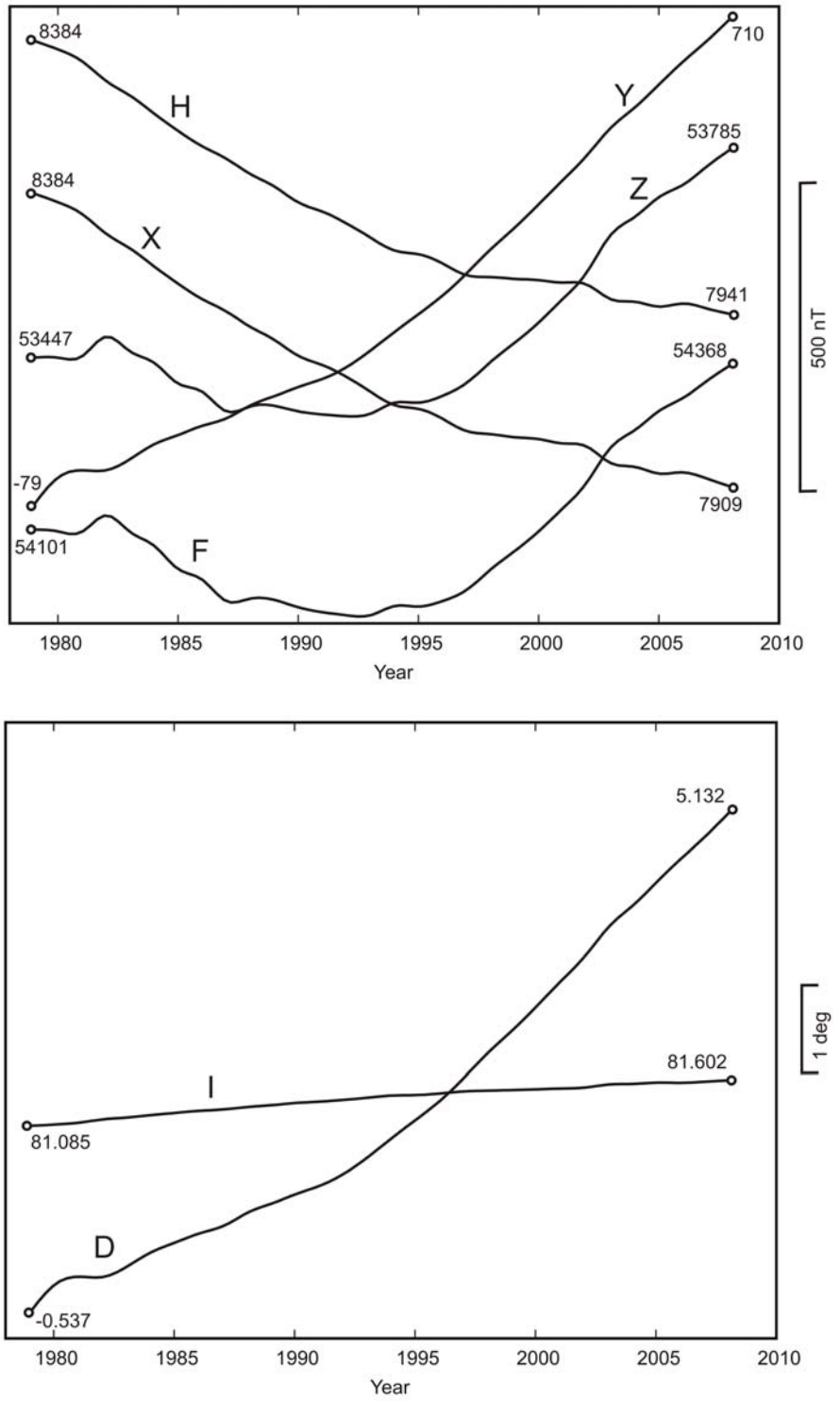


Fig. 27. Secular changes of H, X, Y, Z, F, D and I at Hornsund.

## MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

**Hornsund** **2008**

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | NORTH COMPONENT: 7500 + ... in nT | | | | | | | |
| All days | 398 | 396 | 398 | 410 | 424 | 425 | 424 | 417 | 409 | 402 | 403 | 398 | 409 |
| Quiet days | 414 | 418 | 416 | 417 | 425 | 428 | 421 | 419 | 411 | 411 | 409 | 408 | 416 |
| Disturbed days | 372 | 369 | 352 | 388 | 424 | 418 | 417 | 413 | 389 | 370 | 386 | 368 | 389 |
| | | | | | | EAST COMPONENT: 500 + ... in nT | | | | | | | |
| All days | 196 | 197 | 202 | 201 | 200 | 204 | 210 | 213 | 219 | 223 | 228 | 230 | 210 |
| Quiet days | 192 | 194 | 198 | 200 | 200 | 205 | 209 | 213 | 217 | 222 | 225 | 228 | 209 |
| Disturbed days | 202 | 196 | 218 | 213 | 197 | 202 | 214 | 215 | 222 | 227 | 236 | 237 | 215 |
| | | | | | | VERTICAL COMPONENT: 53500 + ... in nT | | | | | | | |
| All days | 279 | 282 | 290 | 286 | 277 | 283 | 275 | 281 | 292 | 293 | 294 | 293 | 285 |
| Quiet days | 269 | 271 | 281 | 285 | 274 | 276 | 284 | 278 | 282 | 287 | 286 | 289 | 280 |
| Disturbed days | 282 | 303 | 307 | 292 | 280 | 288 | 269 | 287 | 305 | 302 | 309 | 301 | 294 |

**Three-hour-range K indices**

**Hornsund, January - March, 2008**

**The limit of K=9 is 2500**

| Day | January | | | February | | | March | | |
|---|---|---|---|---|---|---|---|---|---|
| | K | | SK | K | | SK | K | | SK |
| 1 | 1221 | 2101 | 10 | 4333 | 1245 | 25 | 6554 | 3454 | 36 |
| 2 | 1210 | 0022 | 8 | 2442 | 3375 | 30 | 3343 | 3235 | 26 |
| 3 | 0101 | 0034 | 9 | 5443 | 2435 | 30 | 4333 | 2133 | 22 |
| 4 | 0001 | 0033 | 7 | 3343 | 2256 | 28 | 3132 | 2000 | 11 |
| 5 | 1233 | 3255 | 24 | 3312 | 2122 | 16 | 1333 | 4322 | 21 |
| 6 | 2442 | 3465 | 30 | 1222 | 1353 | 19 | 1232 | 1112 | 13 |
| 7 | 4443 | 3223 | 25 | 3211 | 1214 | 15 | 3121 | 1011 | 10 |
| 8 | 2343 | 2555 | 29 | 4222 | 3024 | 19 | 0012 | 4211 | 11 |
| 9 | 4333 | 1132 | 20 | 1111 | 2122 | 11 | 4533 | 3655 | 34 |
| 10 | 2222 | 1115 | 16 | 1223 | 4355 | 25 | 3453 | 3345 | 30 |
| 11 | 5222 | 1030 | 15 | 2443 | 3643 | 29 | 4343 | 4634 | 31 |
| 12 | 0023 | 1212 | 11 | 2453 | 3264 | 29 | 2453 | 3265 | 30 |
| 13 | 2322 | 2344 | 22 | 1343 | 3552 | 26 | 1454 | 4324 | 27 |
| 14 | 3464 | 3464 | 34 | 2343 | 3165 | 27 | 2443 | 3644 | 30 |
| 15 | 2443 | 3224 | 24 | 2444 | 4553 | 31 | 3354 | 3221 | 23 |
| 16 | 2464 | 3655 | 35 | 1443 | 2252 | 23 | 2422 | 3312 | 19 |
| 17 | 3333 | 3244 | 25 | 0143 | 2103 | 14 | 3311 | 2332 | 18 |
| 18 | 3553 | 3333 | 28 | 1233 | 3355 | 25 | 2322 | 3111 | 15 |
| 19 | 2353 | 3542 | 27 | 3243 | 3354 | 27 | 0332 | 3565 | 27 |
| 20 | 1443 | 2154 | 24 | 1333 | 2200 | 14 | 2223 | 3121 | 16 |
| 21 | 2233 | 2444 | 24 | 1233 | 3432 | 21 | 2222 | 1052 | 16 |
| 22 | 3222 | 2120 | 14 | 0122 | 2100 | 8 | 1212 | 2113 | 13 |
| 23 | 0122 | 3045 | 17 | 0232 | 2253 | 19 | 3433 | 2112 | 19 |
| 24 | 1322 | 2323 | 18 | 1123 | 1222 | 14 | 1312 | 1110 | 10 |
| 25 | 2442 | 1063 | 22 | 1223 | 1100 | 10 | 0112 | 2112 | 10 |
| 26 | 3243 | 2213 | 20 | 0222 | 1113 | 12 | 2234 | 3435 | 26 |
| 27 | 1311 | 1253 | 17 | 1321 | 3452 | 21 | 4644 | 3355 | 34 |
| 28 | 1222 | 1034 | 15 | 4433 | 3556 | 33 | 4444 | 5445 | 34 |
| 29 | 1223 | 2001 | 11 | 6344 | 3736 | 36 | 3333 | 4345 | 28 |
| 30 | 1111 | 1000 | 5 | | | | 3333 | 3233 | 23 |
| 31 | 0000 | 0124 | 7 | | | | 2212 | 2252 | 18 |

**Three-hour-range K indices**

**Hornsund, April - June, 2008**

**The limit of K=9 is 2500**

| Day | April | | | May | | | June | | |
|---|---|---|---|---|---|---|---|---|---|
| | K | | SK | K | | SK | K | | SK |
| 1 | 2322 | 1210 | 13 | 2232 | 2225 | 20 | 3332 | 2522 | 22 |
| 2 | 0110 | 0020 | 4 | 4332 | 3101 | 17 | 2313 | 2233 | 19 |
| 3 | 1001 | 2100 | 5 | 3224 | 4242 | 23 | 2222 | 2144 | 19 |
| 4 | 0221 | 3445 | 21 | 2333 | 3544 | 27 | 2222 | 2111 | 13 |
| 5 | 2233 | 3733 | 26 | 3342 | 3632 | 26 | 2112 | 1121 | 11 |
| 6 | 3443 | 3252 | 26 | 5333 | 3143 | 25 | 1322 | 3223 | 18 |
| 7 | 2443 | 2653 | 29 | 2222 | 2143 | 18 | 3244 | 4354 | 29 |
| 8 | 2233 | 4334 | 24 | 2343 | 1231 | 19 | 2323 | 3343 | 23 |
| 9 | 2344 | 3153 | 25 | 2222 | 3001 | 12 | 3212 | 2032 | 15 |
| 10 | 2343 | 3255 | 27 | 1331 | 2021 | 13 | 1111 | 2120 | 9 |
| 11 | 2322 | 3321 | 18 | 2231 | 1032 | 14 | 1121 | 1101 | 8 |
| 12 | 2344 | 3153 | 25 | 1121 | 1231 | 12 | 1331 | 1103 | 13 |
| 13 | 2233 | 3541 | 23 | 1311 | 1111 | 10 | 1220 | 1010 | 7 |
| 14 | 1212 | 0100 | 7 | 1122 | 2132 | 14 | 1112 | 2336 | 19 |
| 15 | 0102 | 2124 | 12 | 1210 | 2111 | 9 | 3543 | 4333 | 28 |
| 16 | 1234 | 3253 | 23 | 2313 | 2121 | 15 | 3343 | 2455 | 29 |
| 17 | 2223 | 3220 | 16 | 1001 | 1110 | 5 | 3444 | 3433 | 28 |
| 18 | 1343 | 3212 | 19 | 0111 | 2001 | 6 | 4433 | 3121 | 21 |
| 19 | 2232 | 2212 | 16 | 3222 | 3231 | 18 | 2222 | 2242 | 18 |
| 20 | 2211 | 2431 | 16 | 2322 | 3235 | 22 | 2343 | 3222 | 21 |
| 21 | 2222 | 1210 | 12 | 3333 | 3222 | 21 | 2212 | 3122 | 15 |
| 22 | 1112 | 1141 | 12 | 2433 | 3552 | 27 | 2222 | 2100 | 11 |
| 23 | 3454 | 4632 | 31 | 2112 | 4253 | 20 | 2221 | 2100 | 10 |
| 24 | 5455 | 4344 | 34 | 4343 | 3422 | 25 | 2211 | 1123 | 13 |
| 25 | 2433 | 3252 | 24 | 1322 | 3122 | 16 | 3331 | 3233 | 21 |
| 26 | 4433 | 3425 | 28 | 1222 | 1232 | 15 | 4444 | 4321 | 26 |
| 27 | 2222 | 2321 | 16 | 2112 | 2214 | 15 | 3333 | 3411 | 21 |
| 28 | 2223 | 5455 | 28 | 3443 | 3332 | 25 | 2222 | 2351 | 19 |
| 29 | 2342 | 2253 | 23 | 3233 | 3442 | 24 | 3322 | 2223 | 19 |
| 30 | 1212 | 2541 | 18 | 3323 | 4552 | 27 | 1222 | 3222 | 16 |
| 31 | | | | 1345 | 3342 | 25 | | | |

**Three-hour-range K indices**

**Hornsund, July - September, 2008**

**The limit of K=9 is 2500**

| Day | July | | | August | | | September | | |
|---|---|---|---|---|---|---|---|---|---|
| | K | | SK | K | | SK | K | | SK |
| 1 | 2233 | 2121 | 16 | 1221 | 2123 | 14 | 1120 | 2122 | 11 |
| 2 | 2212 | 2022 | 13 | 1011 | 2002 | 7 | 0111 | 2100 | 6 |
| 3 | 1111 | 2111 | 9 | 1111 | 1212 | 10 | 0333 | 2215 | 19 |
| 4 | 0101 | 2310 | 8 | 1111 | 1112 | 9 | 7753 | 3335 | 36 |
| 5 | 2233 | 3224 | 21 | 0121 | 2100 | 7 | 2323 | 2133 | 19 |
| 6 | 3222 | 2121 | 15 | 1122 | 2132 | 14 | 4322 | 3212 | 19 |
| 7 | 1221 | 0003 | 9 | 2211 | 1113 | 12 | 3333 | 3252 | 24 |
| 8 | 1001 | 1112 | 7 | 1211 | 1111 | 9 | 2343 | 2553 | 27 |
| 9 | 1111 | 2111 | 9 | 2433 | 2436 | 27 | 2433 | 2003 | 17 |
| 10 | 1113 | 2222 | 14 | 2343 | 3334 | 25 | 2221 | 1143 | 16 |
| 11 | 3222 | 3212 | 17 | 2333 | 3221 | 19 | 1210 | 0123 | 10 |
| 12 | 3545 | 3333 | 29 | 2343 | 3212 | 20 | 3110 | 1000 | 6 |
| 13 | 2333 | 3543 | 26 | 2322 | 2132 | 17 | 0010 | 0000 | 1 |
| 14 | 2344 | 3533 | 27 | 2311 | 2201 | 12 | 0112 | 1134 | 13 |
| 15 | 2333 | 3122 | 19 | 3212 | 1110 | 11 | 2344 | 4353 | 28 |
| 16 | 2332 | 1234 | 20 | 0123 | 2122 | 13 | 1333 | 2653 | 26 |
| 17 | 3322 | 1220 | 15 | 3212 | 2212 | 15 | 3311 | 0011 | 10 |
| 18 | 2322 | 2211 | 15 | 2335 | 4354 | 29 | 1232 | 3243 | 20 |
| 19 | 1101 | 1003 | 7 | 3333 | 3431 | 23 | 0121 | 2122 | 11 |
| 20 | 1111 | 2022 | 10 | 2323 | 2210 | 15 | 0221 | 1100 | 7 |
| 21 | 2223 | 3221 | 17 | 1122 | 2221 | 13 | 0001 | 1001 | 3 |
| 22 | 1233 | 4244 | 23 | 2111 | 1111 | 9 | 3311 | 1000 | 9 |
| 23 | 4443 | 5432 | 29 | 2220 | 2003 | 11 | 2212 | 2101 | 11 |
| 24 | 4332 | 3244 | 25 | 1002 | 1002 | 6 | 1212 | 2100 | 9 |
| 25 | 2322 | 2013 | 15 | 1011 | 1001 | 5 | 0001 | 1023 | 7 |
| 26 | 2222 | 2231 | 16 | 0001 | 2011 | 5 | 1311 | 2000 | 8 |
| 27 | 1112 | 2133 | 14 | 1311 | 2010 | 9 | 0020 | 1022 | 7 |
| 28 | 2333 | 2211 | 17 | 1102 | 1112 | 9 | 1122 | 2000 | 8 |
| 29 | 1221 | 1113 | 12 | 1221 | 1110 | 9 | 0222 | 2003 | 11 |
| 30 | 2322 | 1121 | 14 | 0222 | 0000 | 6 | 0120 | 2203 | 10 |
| 31 | 1112 | 2111 | 10 | 0011 | 3123 | 11 | | | |

**Three-hour-range K indices**

**Hornsund, October - December, 2008**

**The limit of K=9 is 2500**

| Day | October | | | November | | | December | | |
|---|---|---|---|---|---|---|---|---|---|
| | K | | SK | K | | SK | K | | SK |
| 1 | 2223 | 3212 | 17 | 1222 | 0011 | 9 | 0100 | 0000 | 1 |
| 2 | 3333 | 3253 | 25 | 0121 | 2111 | 9 | 0000 | 0000 | 0 |
| 3 | 2344 | 3345 | 28 | 0212 | 0001 | 6 | 0101 | 2114 | 10 |
| 4 | 3443 | 2212 | 21 | 1100 | 0003 | 5 | 1533 | 2223 | 21 |
| 5 | 2422 | 2012 | 15 | 0000 | 0000 | 0 | 2322 | 2324 | 20 |
| 6 | 0222 | 1000 | 7 | 0000 | 0011 | 2 | 5433 | 3763 | 34 |
| 7 | 0111 | 1132 | 10 | 0222 | 2125 | 16 | 2343 | 3423 | 24 |
| 8 | 1100 | 0000 | 2 | 2434 | 3143 | 24 | 2221 | 1233 | 16 |
| 9 | 0020 | 1000 | 3 | 4323 | 3244 | 25 | 1101 | 0000 | 3 |
| 10 | 0111 | 1002 | 6 | 2222 | 1220 | 13 | 0110 | 1133 | 10 |
| 11 | 1243 | 4653 | 28 | 0201 | 0010 | 4 | 2212 | 1220 | 12 |
| 12 | 3332 | 3654 | 29 | 1111 | 1011 | 7 | 1111 | 2122 | 11 |
| 13 | 2233 | 2152 | 20 | 1000 | 0000 | 1 | 3111 | 1023 | 12 |
| 14 | 2222 | 2231 | 16 | 0110 | 0000 | 2 | 1101 | 2002 | 7 |
| 15 | 2222 | 2414 | 19 | 0210 | 0001 | 4 | 0220 | 0012 | 7 |
| 16 | 3221 | 1121 | 13 | 3332 | 1025 | 19 | 1112 | 2154 | 17 |
| 17 | 0011 | 1120 | 6 | 2241 | 1033 | 16 | 3311 | 2323 | 18 |
| 18 | 0000 | 0010 | 1 | 1100 | 0000 | 2 | 0100 | 0043 | 8 |
| 19 | 1112 | 2232 | 14 | 0010 | 0120 | 4 | 0111 | 2211 | 9 |
| 20 | 1120 | 1112 | 9 | 1200 | 0032 | 8 | 0011 | 1100 | 4 |
| 21 | 2221 | 1102 | 11 | 1110 | 0000 | 3 | 0112 | 0110 | 6 |
| 22 | 0111 | 1232 | 11 | 0000 | 0000 | 0 | 0000 | 1321 | 7 |
| 23 | 2222 | 1000 | 9 | 0121 | 0011 | 6 | 3233 | 2266 | 27 |
| 24 | 0310 | 1000 | 5 | 0000 | 0000 | 0 | 3432 | 2143 | 22 |
| 25 | 0100 | 0001 | 2 | 3333 | 2255 | 26 | 1112 | 2143 | 15 |
| 26 | 0331 | 1101 | 10 | 4533 | 2155 | 28 | 2211 | 1014 | 12 |
| 27 | 3111 | 0000 | 6 | 4333 | 2254 | 26 | 2012 | 2010 | 8 |
| 28 | 0123 | 1112 | 11 | 2222 | 2045 | 19 | 1020 | 1113 | 9 |
| 29 | 3442 | 2663 | 30 | 1231 | 1113 | 13 | 0100 | 0003 | 4 |
| 30 | 2433 | 3634 | 28 | 3112 | 0100 | 8 | 0100 | 0011 | 3 |
| 31 | 2233 | 1143 | 19 | | | | 1333 | 2254 | 23 |

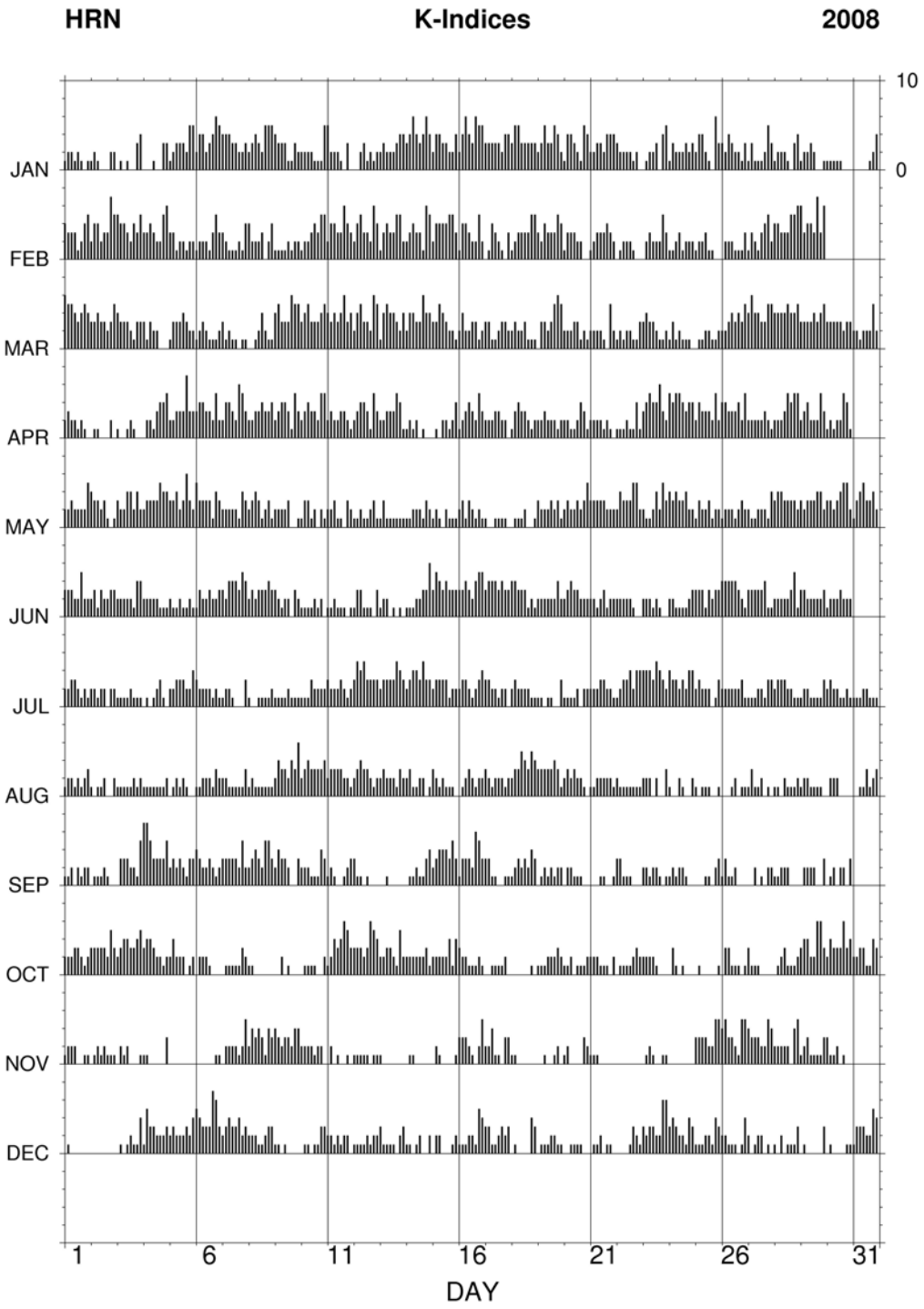


Fig. 28. K-indices in graphical form, Hornsund 2008.

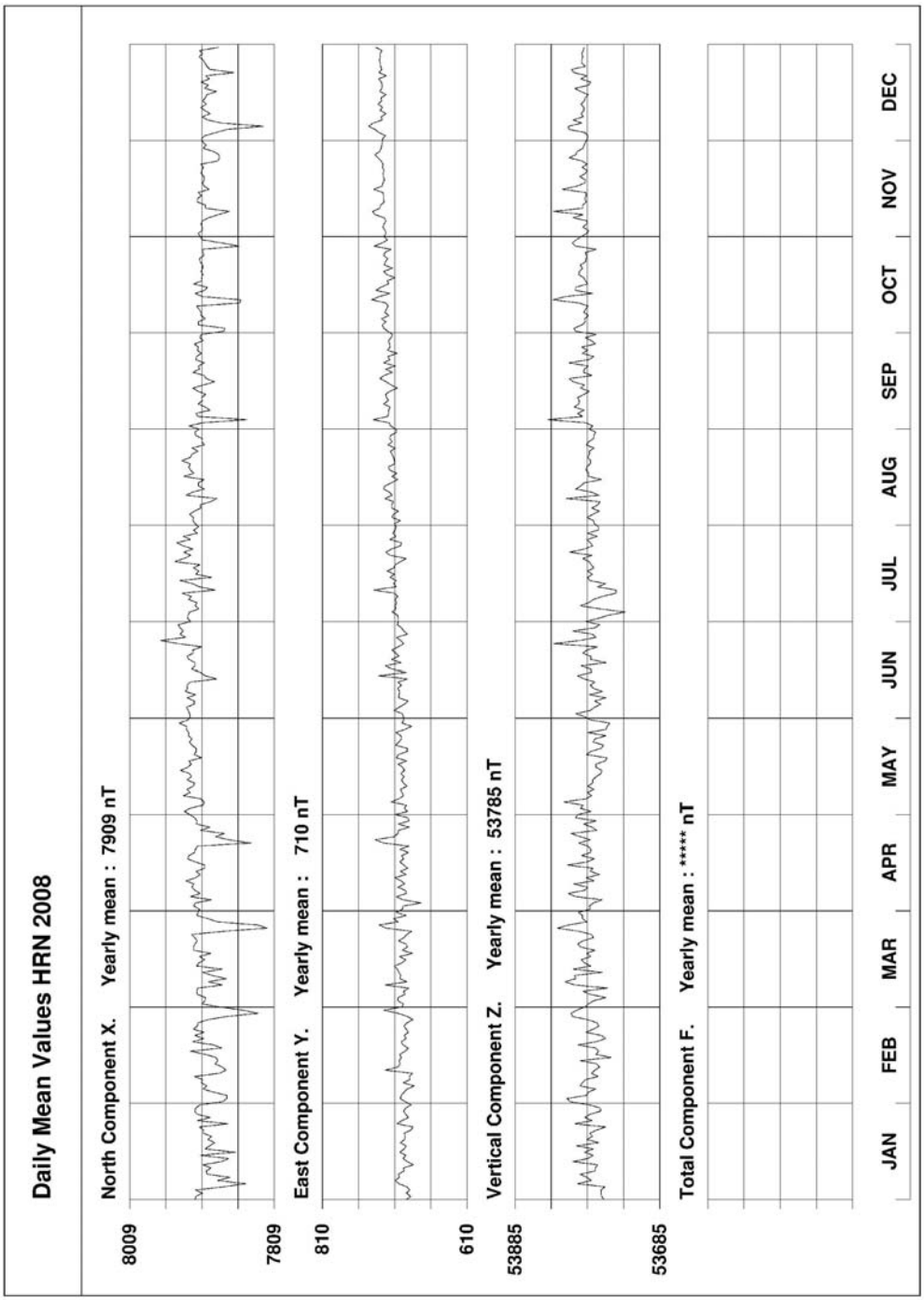


Fig. 29. Daily mean data plot for Hornsund 2008.

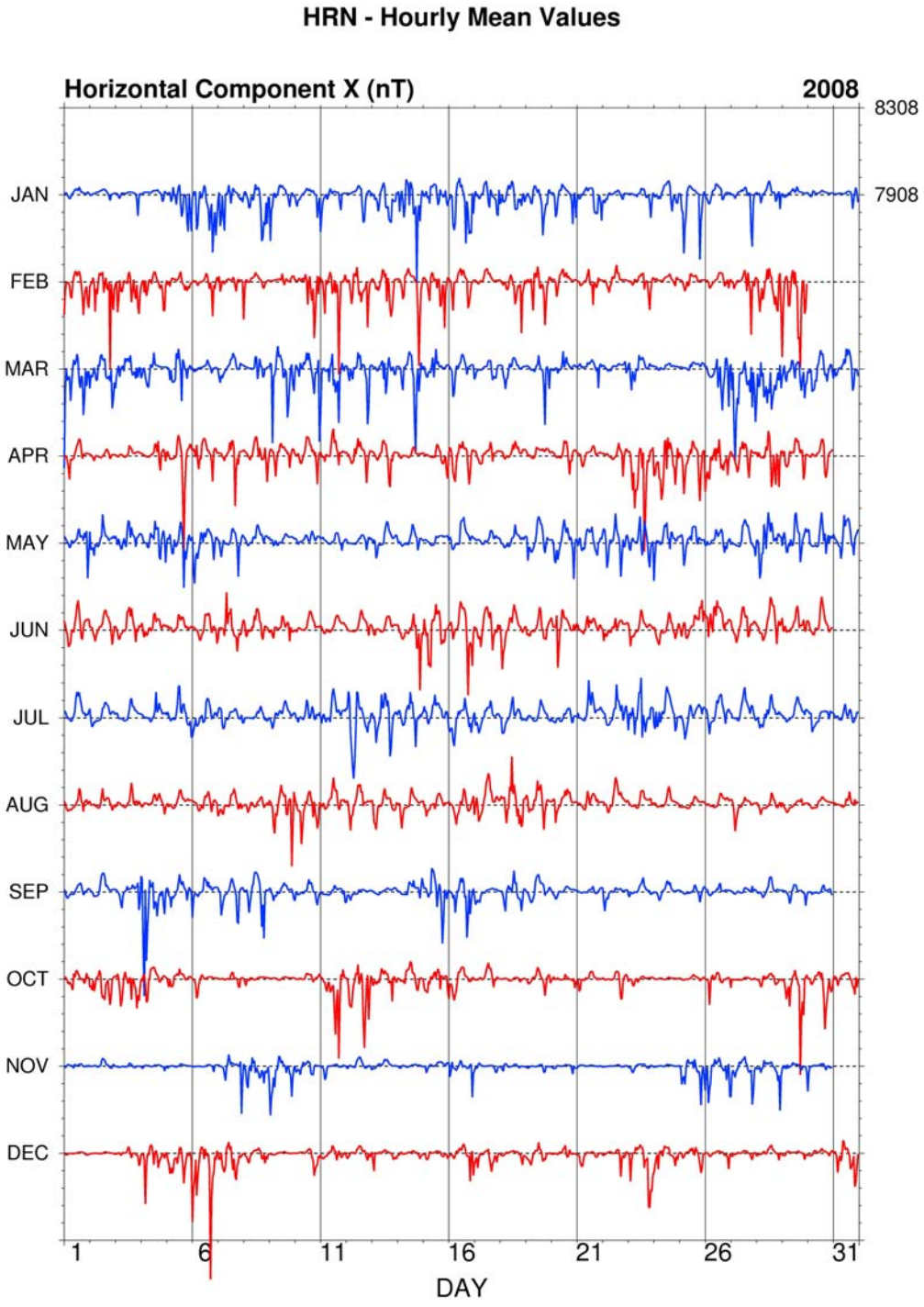


Fig. 30. Hourly mean data plot of X component for Hornsund.

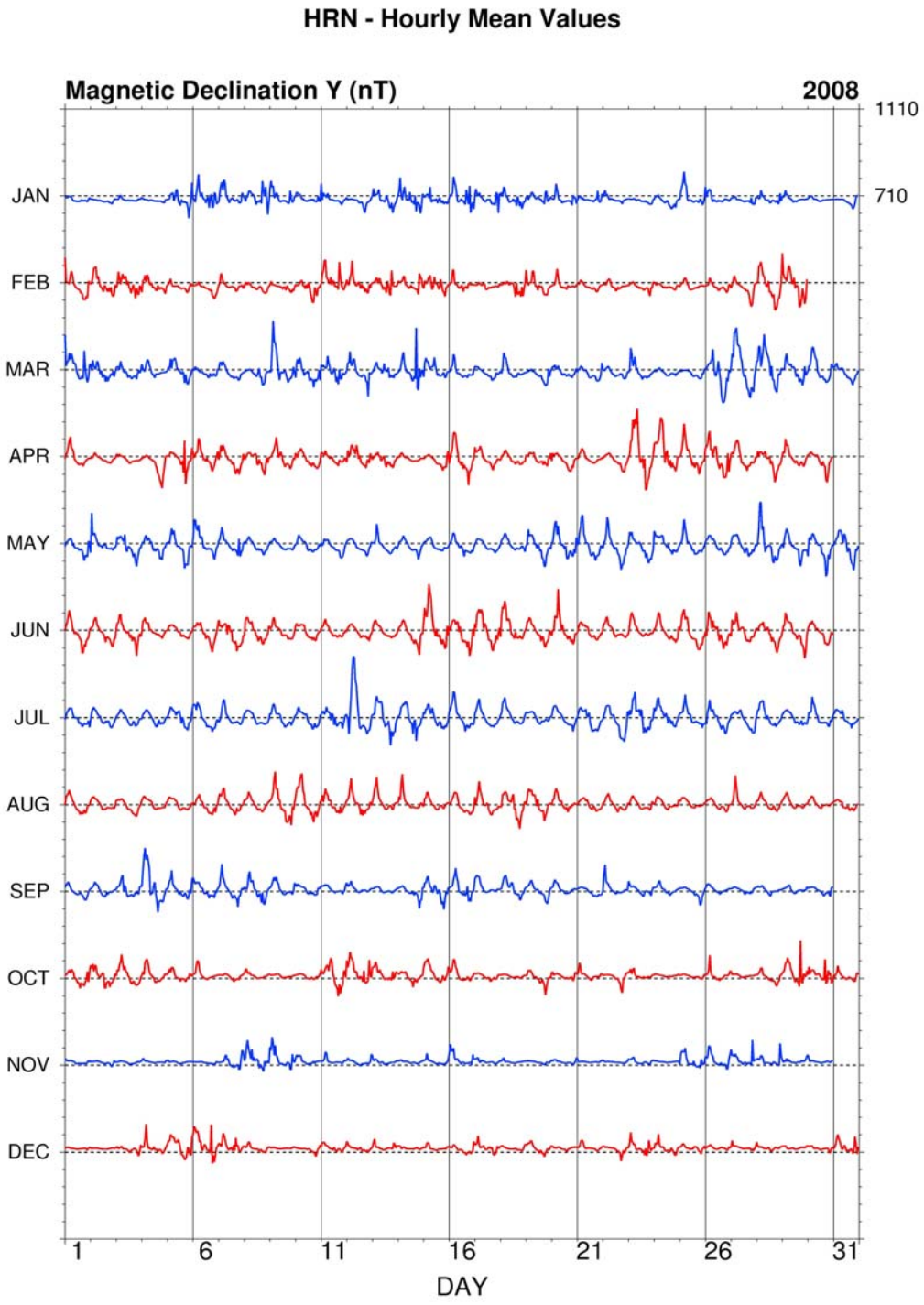


Fig. 31. Hourly mean data plot of Y component for Hornsund.

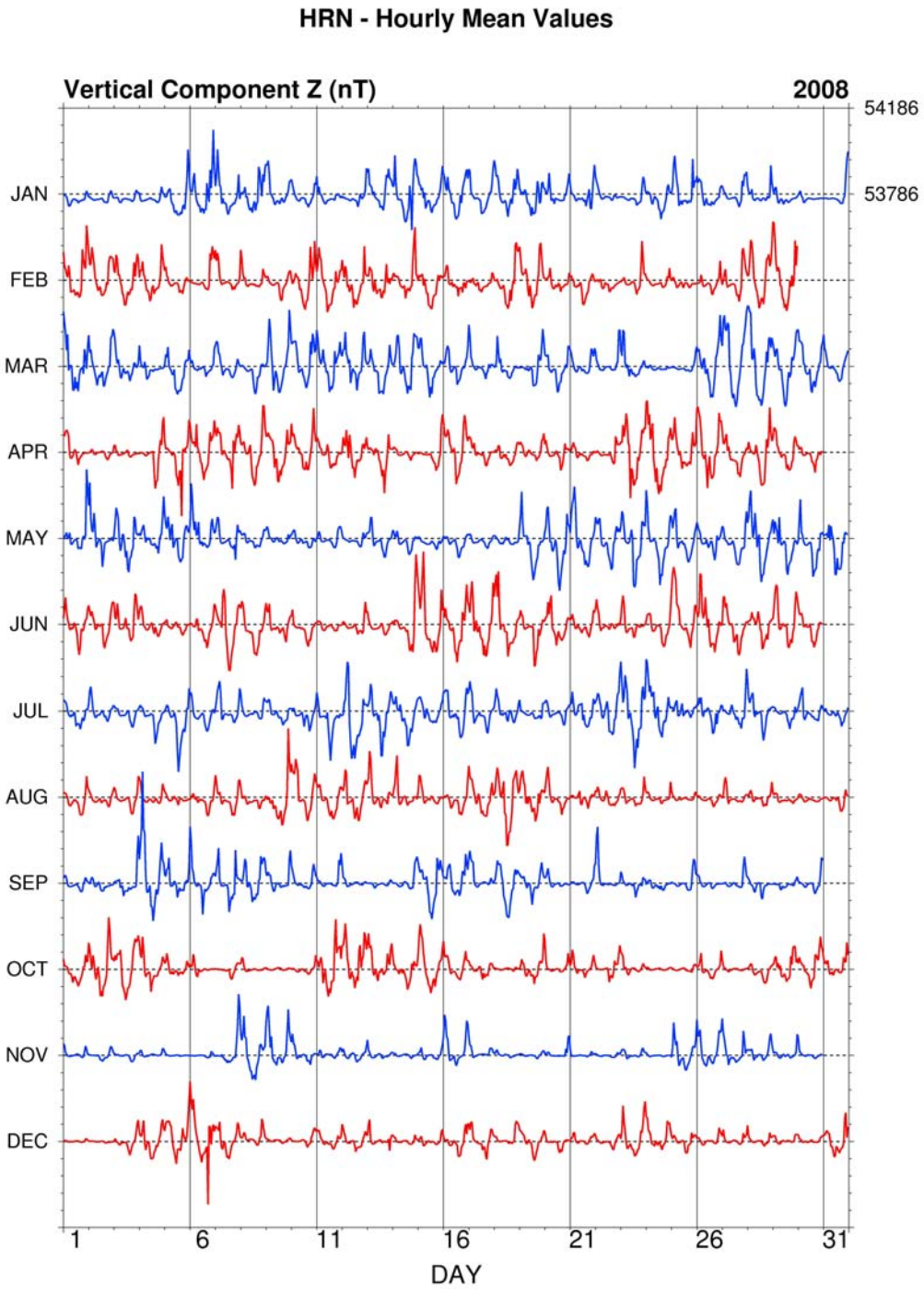


Fig. 32. Hourly mean data plot of Z component for Hornsund.

PUBLS. INST. GEOPHYS. POL. ACAD. SC., C-102 (409), 2009

# List of Yearbooks from Polish Geomagnetic Observatories

Below is the list of yearbooks with the results from the Polish geomagnetic observatories. Since the year 2006, one joint yearbook has been published in place of individual yearbooks from each observatory. The present edition is an activity report, and refers the reader to the internet where one-minute data are available. Most of the issues listed below are still available from the Institute of Geophysics.

## I. Results of Geomagnetic Observations Belsk, Hel, Hornsund (since 2006)

Published in

***Publications of the Institute of Geophysics, Pol. Acad. Sc.*:**

2006 – no C-100 (402)

2007 – no C-101 (408)

## II. Results of Geomagnetic Observations, Belsk Geophysical Observatory (1966-2005)

Published in

***Materiały i Prace Zakładu Geofizyki PAN*:**

1966 – no 20; 1967 – no 27; 1968 – no 42; 1969 – no 46;

1970 – no 50; 1971 – no 57; 1972 – no 70; 1973 – no 76;

1974 – no 88

***Publications of the Institute of Geophysics, Pol. Acad. Sc.*:**

1975 – no C-2 (107); 1976 – no C-4 (114); 1977 – no C-5 (125);

1978 – no C-8 (133); 1979 – no C-9 (139); 1980 – no C-10- (144);

1981 – no C-13 (159); 1982 – no C-17 (166); 1983 – no C-20 (180);

1984 – no C-23 (187); 1985 – no C-26 (196); 1986 – no C-29 (205);

1987 – no C-34 (218); 1988 – no C-37 (227); 1989 – no C-38 (228);

1990 – no C-40 (240); 1991 – no C-45 (250); 1992 – no C-49 (259);
1993 – no C-51 (267); 1994 – no C-55 (277); 1995 – no C-58 (287);
1996 – no C-61 (296); 1997 – no C-68 (305); 1998 – no C-70 (312);
1999 – no C-74 (318); 2000 – no C-79 (328); 2001 – no C-82 (343);
2002 – no C-85 (356); 2003 – no C-89 (368); 2004 – no C-92 (379);
2005 – no C-96 (392)

**III. Results of Geomagnetic Observations, Hel Geophysical Observatory (1958-2005)**

Published in

***Publications of the Institute of Geophysics, Pol. Acad. Sc.*:**

1958-1965 – no C-41 (241); 1966-1970 – no C-6 (127);
1971-1975 – no C-7 (128); 1976-1979 – no C-11 (154);
1980-1981 – no C-16 (165) 1982 – no C-18 (170);
1983 – no C-19 (179); 1984 – no C-24 (128); 1985 – no C-25 (195);
1986 – no C-30 (206); 1987 – no C-33 (217); 1988 – no C-36 (226);
1989 – no C-39 (239); 1990 – no C-42 (242); 1991 – no C-46 (251);
1992 – no C-50 (260); 1993 – no C-52 (268); 1994 – no C-56 (278);
1995 – no C-59 (288); 1996 – no C-62 (297); 1997 – no C-67 (304);
1998 – no C-71 (313); 1999 – no C-76 (320); 2000 – no C-81 (330);
2001 – no C-84 (345); 2002 – no C-87 (358); 2001 – no C-84 (345);
2003 – no C-91 (370); 2004 – no C-94 (381); 2005 – no C-98 (394)

**IV. Results of Geomagnetic Observations, Polish Polar Station Hornsund, Spitsbergen (1978-2005)**

Published in

***Publications of the Institute of Geophysics, Pol. Acad. Sc.*:**

1978-1979 – no C-14 (163); 1980-1981 – no C-27 (199);
1982-1983 – no C-31 (210); 1984-1985 – no C-43 (243);

1986-1987 – no C-47 (254); 1988-1989 – no C-48 (256);

1990-1991 – no C-53 (272); 1992-1993 – no C-57 (286);

1994-1995 – no C-64 (301); 1996 – no C-66 (303);

1997 – no C-69 (311); 1998 – no C-72 (315); 1999 – no C-75 (319);

2000 – no C-80 (329); 2001 – no C-83 (344); 2002 – no C-86 (357);

2003 – no C-90 (369); 2004 – no C-93 (380); 2005 – no C-97 (393)

## V. Results of Geomagnetic Observations, Polish Antarctic Station Arctowski (1978-1995)

Published in

***Publications of the Institute of Geophysics, Pol. Acad. Sc.*:**

1978-1979 – no C-21 (181); 1980-1981 – no C-22 (182);

1982-1983 – no C-28 (202); 1984-1985 – no C-32 (212);

1986-1987 – no C-35 (225); 1988-1989 – no C-44 (244);

1990-1991 – no C-54 (276); 1992-1993 – no C-60 (292);

1994-1995 – no C-63 (300)

## VI. Yearbooks from Świder Observatory (1937-1967)

*Annuaires Magnetiques* (*Roczniki magnetyczne*) for the years 1937-1967 were published in *Travaux de l'Observatoire Geophysique de St. Kalinowski a Swider* (*Prace Obserwatorium Geofizycznego im. St. Kalinowskiego w Świdrze*).

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