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RESULTS OF GEOMAGNETIC OBSERVATIONS BELSK, HEL, HORNSUND 2009

WARSZAWA 2010

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C-98 (394) Results of geomagnetic observations, Hel Geophysical Observatory 2005.

C-99 (398) Monographic Volume: XII IAGA Workshop on Geomagnetic Observatory Instruments, Data Acquisition and Processing, Belsk, 19-24 June 2006.

C-100 (402) Results of geomagnetic observations, Belsk, Hel, Hornsund, 2006.

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Results of Geomagnetic Observations Belsk, Hel, Hornsund, 2009

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1. INTRODUCTION

This publication contains basic information on geomagnetic observations carried out in 2009 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 2009, 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°N, 118.3°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.

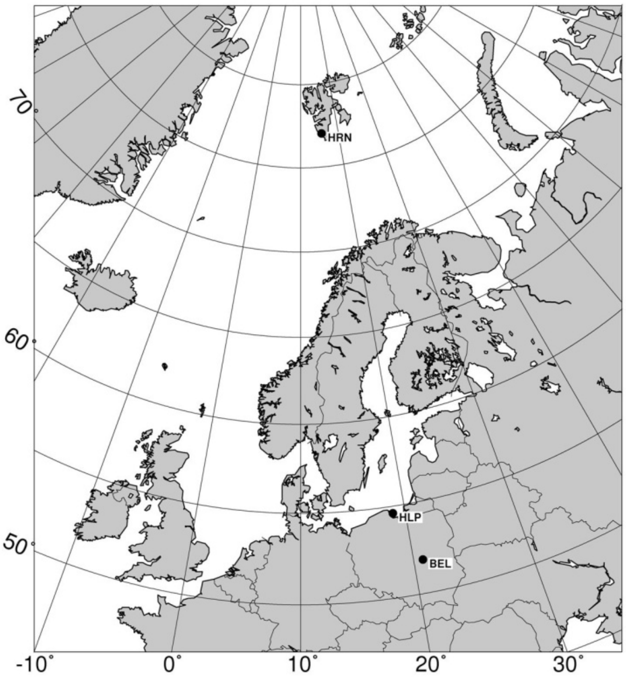

Fig. 1. Location of the Belsk, Hel and Hornsund observatories.

Table 1

Coordinates of the Polish observatories

Observatory	Geographic coordinates		Geomagnetic coordinates		Elevation
	Latitude	Longitude	Latitude	Longitude	[m]
Belsk (BEL)	51°50.1′N	20°47.3′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°00.0′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 2009 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.

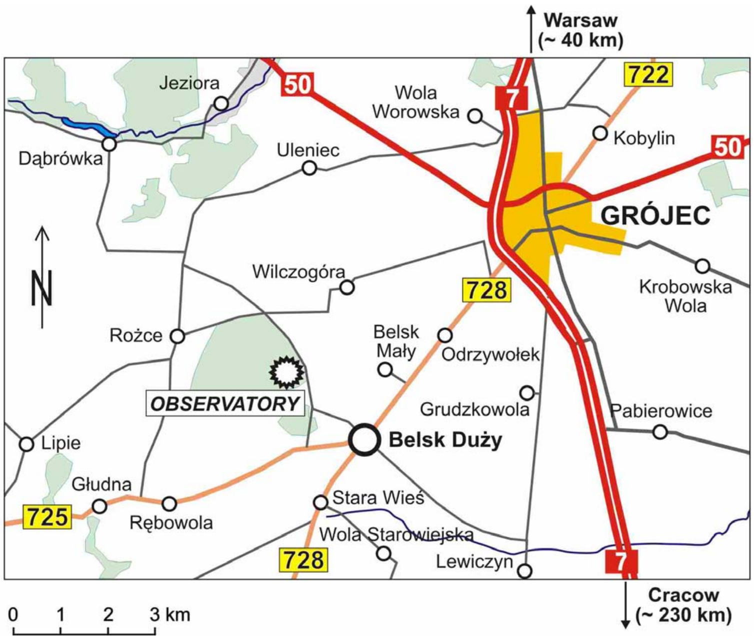

Fig. 2. Location of the Belsk Geophysical Observatory.

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/ en/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.

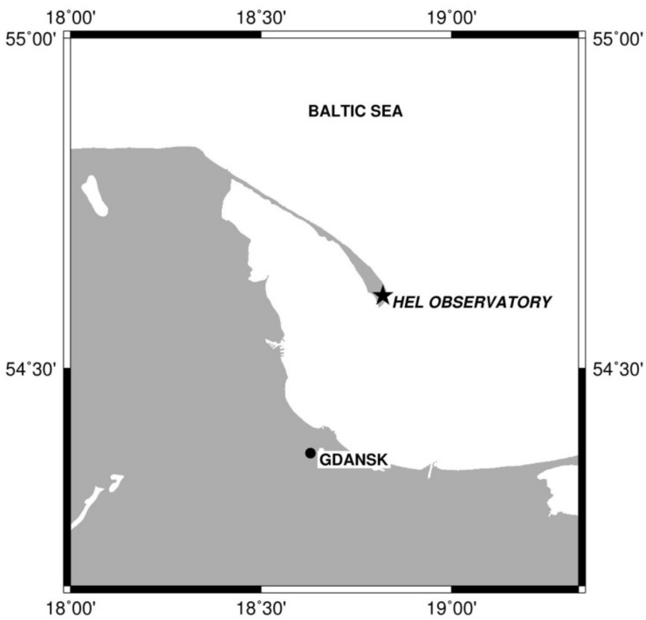

Fig. 3. Location of the Geophysical Observatory at Hel.

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.

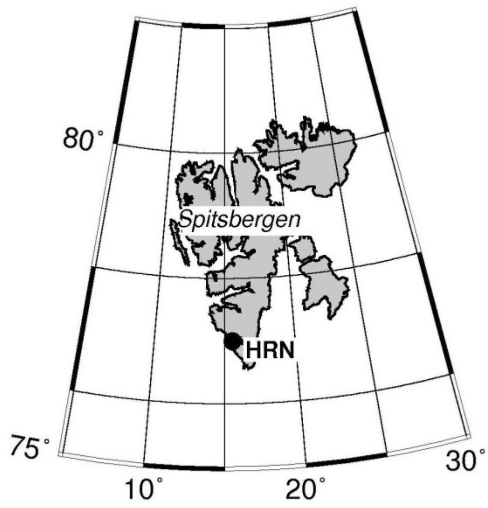

Fig. 4. Location of Polish Polar Station Hornsund.

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.

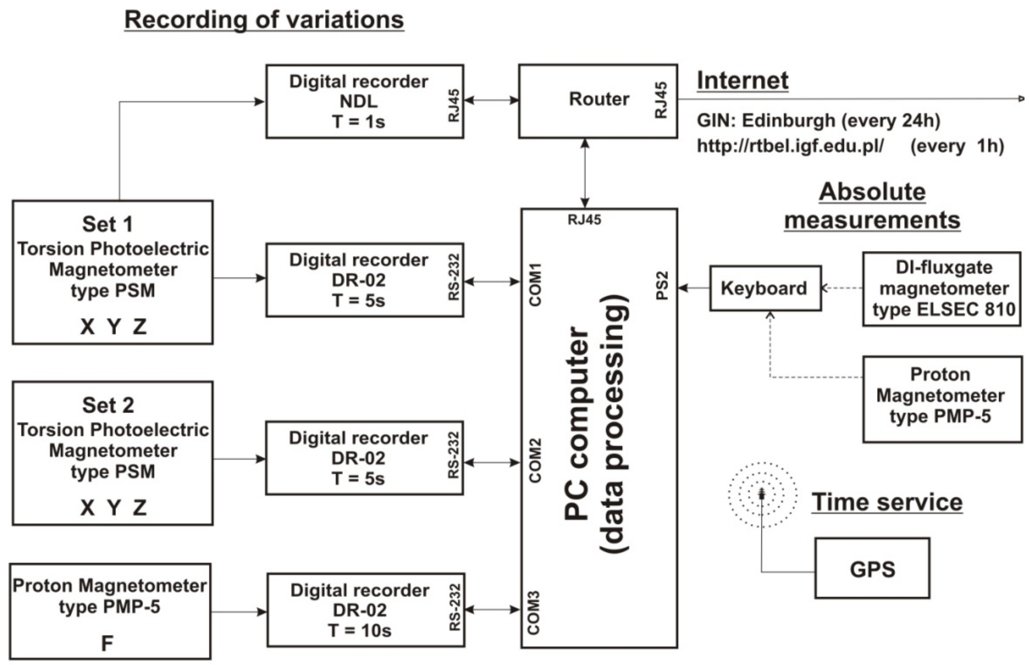

Fig. 5. Block diagram of magnetic observations system at Belsk.

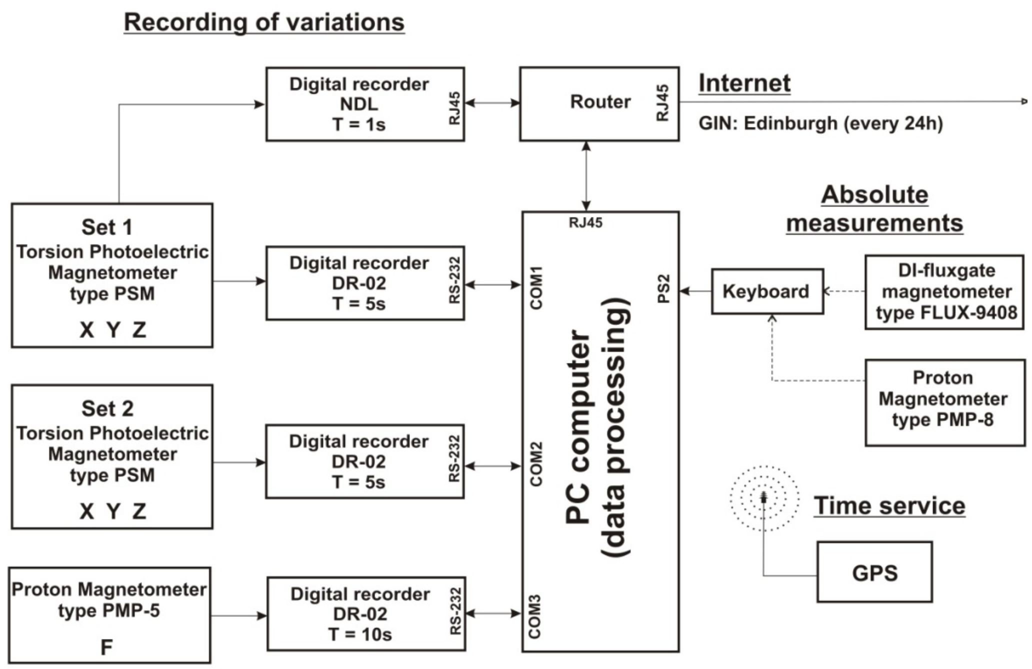

Fig. 6. Block diagram of magnetic observations system at Hel.

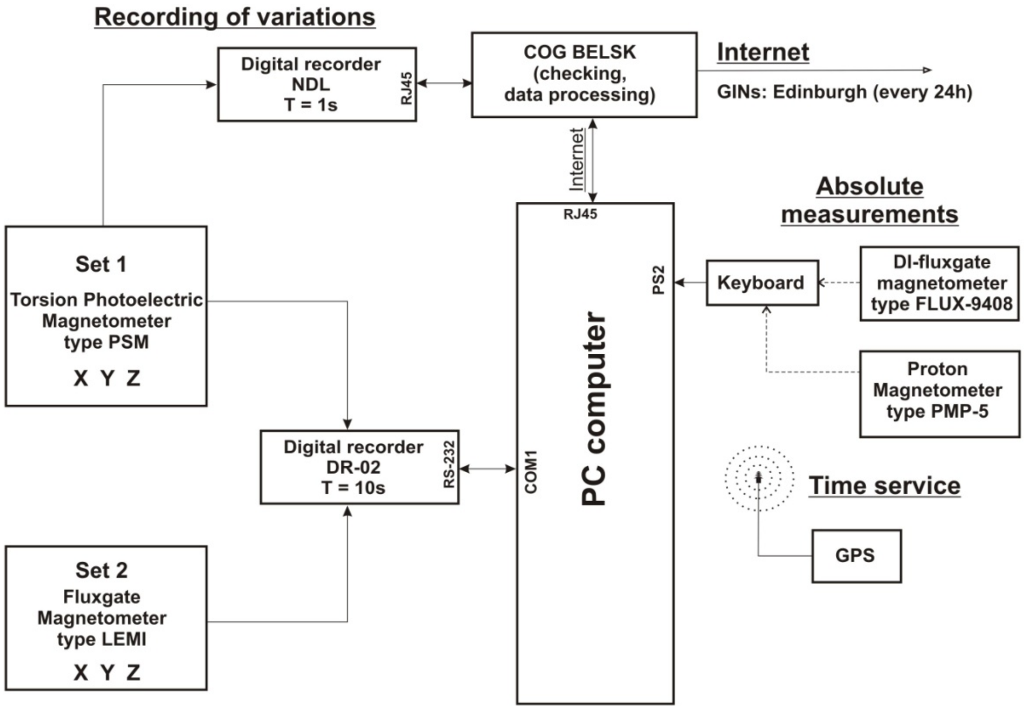

Fig. 7. Block diagram of the magnetic observations system at the Polish Polar Station Hornsund.

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 (author: S. Tomczyk) and ABS (author: M. Neska), which calculate the base values on the basis of data from the measurement protocol. The program DIFLUX is described by 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], ε_A is the scale value of the recording [nT/bit], a is the recorded instantaneous value [bits].

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

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.

Results of base determinations and the smoothed values adopted for further computations are depicted in Figs. 8, 16 and 24 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 2009 are listed in Table 4.

Table 4

Mean errors of measurements of B_X, B_Y and B_Z in 2009

Observatory	Element	Number of measurements n	Mean error m_B [nT]
Belsk	B_X B_Y B_Z	309 309 309	0.7 0.7 0.5
Hel	B_X B_Y B_Z	180 180 180	0.4 0.4 0.2
Hornsund	B_X B_Y B_Z	141 141 141	1.1 1.0 0.7

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/°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°C.

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 Kind of sensor	PSM Bobrov	PSM Bobrov	PSM Bobrov
	Type	PSM-8511-01P	PSM 8511-02P	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	DR-02, DR-03	DR-03	DR-02
	Producer	EL-LAB	EL-LAB	EL-LAB
	Sampling interval	5 s and 1 s	5 s	10 s
SET 2	Name of magnetometer Kind of sensor	PSM Bobrov	PSM Bobrov	LEMI 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	DR-02, DR-03	DR-02	DR-02
	Producer	EL-LAB	EL-LAB	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.

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.

Table 6

Scale values adopted for computations in 2009

Observatory	Period	Scale values		
		X [nT/bit]	Y [nT/bit]	Z [nT/bit]
Belsk	Jan 01 – Dec 31	0.0250	0.0249	0.0249
Hel	Jan 01 – Dec 31	0.0247	0.0247	0.0244
Hornsund	Jan 01 – Dec 31	0.149	0.151	0.149

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 (authors: M. Neska, 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 2009 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 2009 data are shown on Figs. 8-30.

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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http://www.igf.edu.pl/en/obserwatoria/cog_belsk

4.2 Hel Observatory

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4.3 Hornsund

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http://hornsund.igf.edu.pl/index_en.php
http://www.igf.edu.pl/en/zaklady_naukowe/zaklad_badan_polarnych/obserwatoria

5. PERSONNEL TAKING PART IN THE WORK OF BELSK, HEL AND HORNSUND OBSERVATORIES IN 2009

5.1 Belsk

– Jan Reda (project leader of geomagnetic observations in Belsk, Hel, Hornsund)
– Mariusz Neska (head of Geomagnetic Laboratory at Belsk)
– Paweł Czubak (data processing)
– Michał Sawicki (apparatus service)

– Krzysztof Kucharski (observer)
– Halina Suska (data processing, observer)
– 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)
– Piotr Łepkowski (observer in 1-st half-year)
– Szymon Kostka (observer in 2-nd half-year)
– Jan Reda (data processing)

Literature

Jankowski, J., and C. Sucksdorff (1996), *Guide for Magnetic Measurements and Observatory Practice*, IAGA, Warsaw, 235 pp.

Jankowski, J., J. Marianiuk, A. Ruta, C. Sucksdorff, and M. Kivinen (1984), *Long-term stability of a torque-balance variometer with photoelectric converters in observatory practice*, Geophys. Surv. **6**, 3/4, 367-380.

Jankowski, J., and J. Marianiuk (2007), *Past and present of Polish geomagnetic observatories*, Publs. Inst. Geophys. Pol. Acad. Sc. **C-99 (398)**, 20-31.

Marianiuk, J. (1977), *Photoelectric converter for recording the geomagnetic field elements: construction and principle of operation*, Publs. Inst. Geophys. Pol. Acad. Sc. **C-4 (114)**, 57-73.

Neska, M., and G. Satori (2006), *Schumann resonance observation at Polish Polar Station at Spitsbergen and in Central Geophysical Observatory in Belsk, Poland*, Przegl. Geofiz. **3-4**, 189-198 (in Polish).

Nowożyński, K., T. Ernst, and J. Jankowski (1991), *Adaptive smoothing method for computer derivation of K-indices*, Geophys. J. Int. **104**, 85-93.

Nowożyński, K., and J. Reda (2007), *Comparison of observatory data in quasi-real time*, Publs. Inst. Geophys. Pol. Acad. Sc. **C-99 (398)**, 123-127.

Reda, J., and M. Neska (2007), *Measurement session during the XII IAGA Workshop at Belsk*, Publs. Inst. Geophys. Pol. Acad. Sc. **C-99 (398)**, 7-19.

Reda, J., and J. Jankowski (2004), *Three hour activity index based on power spectra estimation*, Geophys. J. Int. **157**, 141-146.

Reda, J. (ed.) (2007), *XII IAGA Workshop on Geomagnetic Observatory Instruments, Data Acquisition and Processing, Belsk, 19-24 June 2006, Monographic Volume*, Publs. Inst. Geophys. Pol. Acad. Sc. **C-99 (398)**, 397 pp.

Tomczyk, S. (2008), *DIFLUX Software Package For Calculation Of Absolute Measurement Results*, Publs. Inst. Geophys. Pol. Acad. Sc. **C-100 (402)**.

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

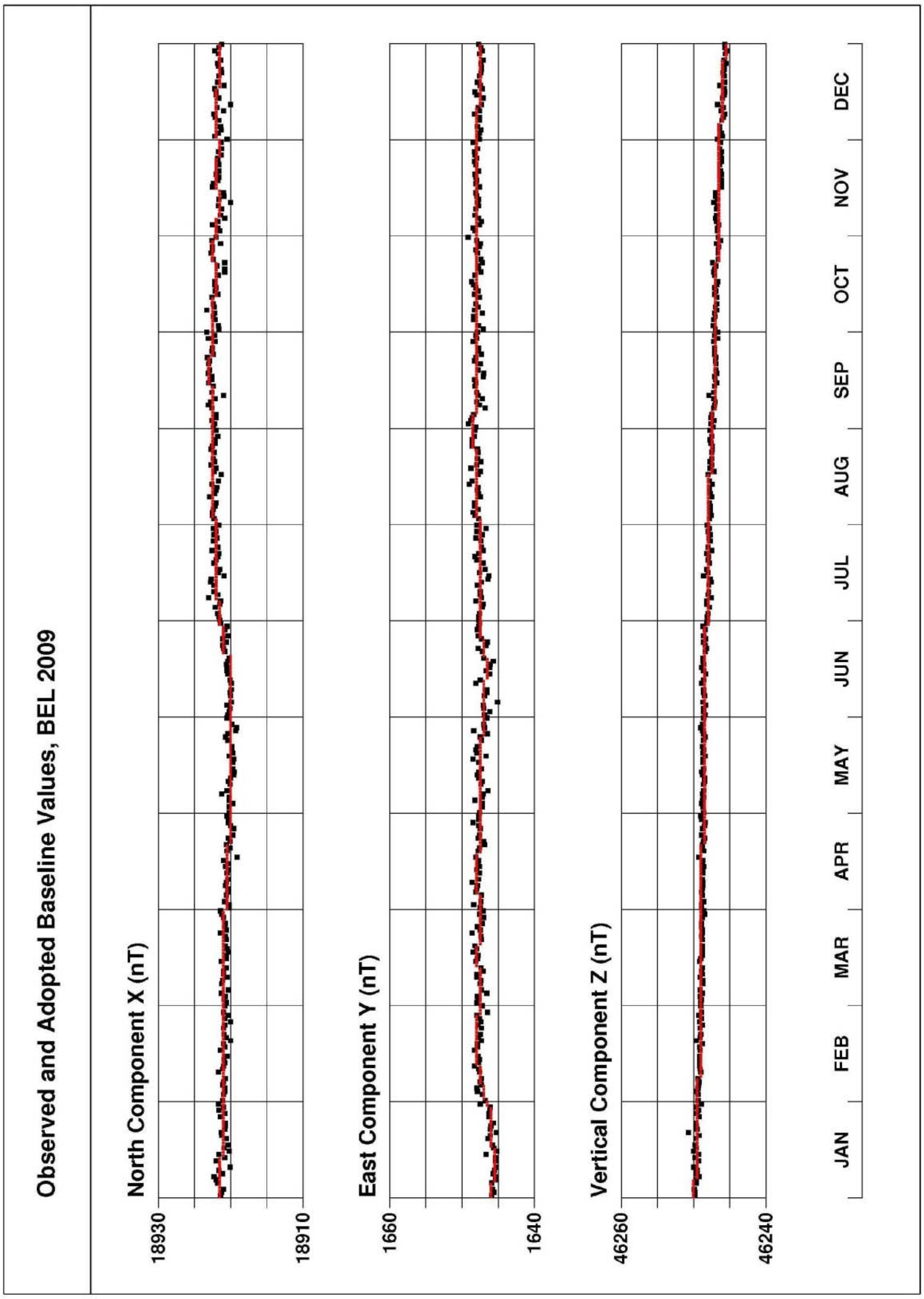

Fig. 8. Base values of set 1, Belsk 2009.

Annual mean values of magnetic elements in Belsk Observatory

No.	Year	D [° ‘]	H [nT]	Z [nT]	X [nT]	Y [nT]	I [° ‘]	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
44	2009	4 59.7	19022.2	46264.5	18949.9	1656.4	67 39.0	50022.5

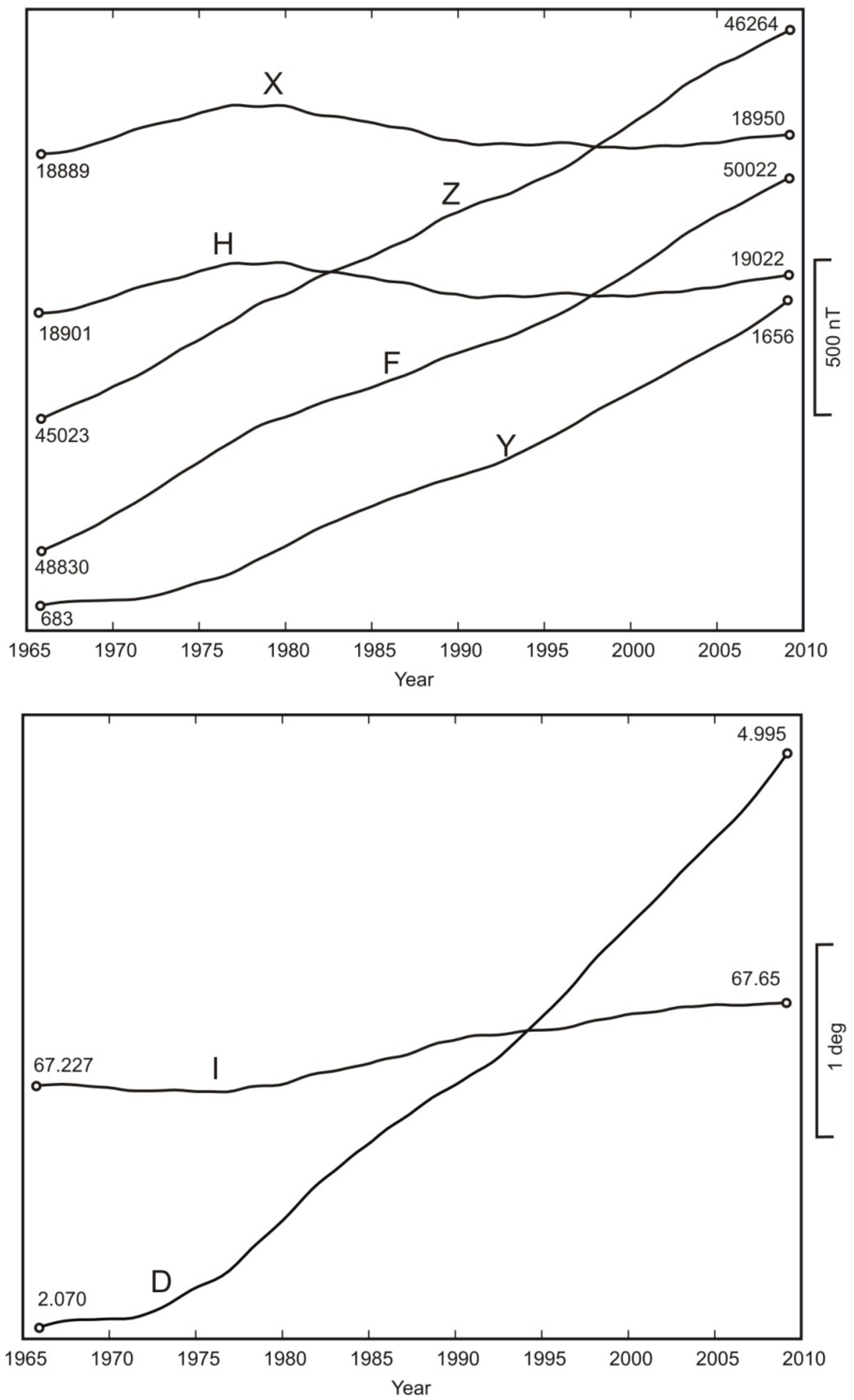

Fig. 9. Secular changes of H, X, Y, Z, F, D and I at Belsk.

MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

BEL 2009

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
				NORTH COMPONENT: 18500 + ... in nT									
All days	447	448	450	453	454	455	449	448	449	448	447	451	450
Quiet days	451	450	451	454	453	454	451	452	448	450	450	452	451
Disturbed days	445	441	446	447	454	457	447	445	447	443	445	450	447
				EAST COMPONENT: 1500 + ... in nT									
All days	136	141	144	146	150	154	159	163	165	169	173	176	156
Quiet days	136	140	143	146	151	153	159	161	165	169	173	175	156
Disturbed days	136	141	145	148	150	156	160	164	165	171	175	175	157
				VERTICAL COMPONENT: 46000 + ... in nT									
All days	253	254	254	256	257	262	266	270	271	273	277	279	264
Quiet days	252	254	253	255	257	261	266	269	272	272	277	278	264
Disturbed days	253	256	254	258	257	263	266	270	271	274	278	280	265

Three-hour-range K indices
Belsk, January - March, 2009
The limit of K = 9 is 450

Day	January K	SK	February K	SK	March K	SK
1	1222 2213	15	1111 0011	6	1111 1000	5
2	0000 1233	9	0000 0100	1	0001 0110	3
3	2323 2313	19	0000 0024	6	1022 2243	16
4	2111 1221	11	3113 3423	20	1212 2233	16
5	1111 1223	12	3111 2113	13	2211 0012	9
6	2101 1200	7	2001 0001	4	2111 1001	7
7	0110 0112	6	0100 1010	3	0001 0011	3
8	0011 2211	8	0010 0001	2	2132 3411	17
9	2111 2331	14	1000 0102	4	1001 0110	4
10	2211 0002	8	0000 1011	3	1000 2221	8
11	1001 0100	3	2111 1111	9	1111 1033	11
12	0000 0010	1	0101 1210	6	3312 1123	16
13	1120 1122	10	0000 0221	5	5333 2323	24
14	2212 3132	16	2233 4424	24	3222 2324	20
15	2111 1122	11	3312 3332	20	2322 2203	16
16	1211 1210	9	2101 1321	11	2112 1330	13
17	0011 1111	6	0000 0001	1	1111 1332	13
18	0011 1111	6	2110 1123	11	0001 1011	4
19	4121 1222	15	0000 0211	4	2111 2123	13
20	2111 1021	9	1111 1133	12	2011 1232	12
21	0001 1221	7	0001 1111	5	0122 3133	15
22	0001 1110	4	1112 2112	11	1211 0023	10
23	0011 1001	4	0001 2323	11	1110 0121	7
24	1000 0001	2	3421 1111	14	1222 3223	17
25	1000 1112	6	2111 1111	9	3322 1112	15
26	3232 3320	18	0101 1111	6	2222 2222	16
27	0101 0122	7	1223 3333	20	1001 1442	13
28	0011 1102	6	2221 0012	10	2001 1032	9
29	0121 1110	7			1011 1211	8
30	0112 0123	10			1112 2121	11
31	1122 3233	17			1112 2110	9

Three-hour-range K indices
Belsk, April - June, 2009
The limit of K = 9 is 450

Day	April K	April SK	May K	May SK	June K	June SK
1	1011 0023	8	1112 1111	9	1000 0111	4
2	1000 1111	5	0111 2112	9	0111 1111	7
3	0000 1211	5	2111 1201	9	1111 1322	12
4	0001 0001	2	1211 1100	7	1212 2112	12
5	1212 1211	11	0111 1101	6	0122 1312	12
6	1112 1210	9	2111 2233	15	1111 1121	9
7	0111 1101	6	2122 1233	16	1112 2312	13
8	0222 3232	16	4222 2233	20	1101 1111	7
9	3322 2423	21	0122 2212	12	0011 1101	5
10	2122 2242	17	1011 1111	7	2222 1210	12
11	3222 3323	20	2212 2110	11	2111 1111	9
12	2111 1133	13	0000 1111	4	1110 1100	5
13	3111 1011	9	1111 1211	9	0111 1211	8
14	1001 0111	5	1113 3332	17	2111 3222	14
15	2111 2221	12	1111 0110	6	0211 2211	10
16	1121 2322	14	1112 2121	11	0101 3220	9
17	1112 2123	13	2200 0000	4	0111 1200	6
18	2331 2222	17	1111 1112	9	0111 1212	9
19	2211 1121	11	1111 1110	7	2101 1111	8
20	2211 2211	12	1222 2232	16	0222 2222	14
21	1122 1121	11	2121 1111	10	2223 3211	16
22	1112 2012	10	0223 2321	15	1212 1210	10
23	1111 1110	7	1112 1123	12	1112 1213	12
24	3222 2221	16	1112 1211	10	2343 2352	24
25	1112 1212	11	0011 1111	6	2211 3223	16
26	1111 1001	6	1111 2110	8	1111 1111	8
27	2201 1010	7	0001 0111	4	0012 2322	12
28	0101 1111	6	0233 2210	13	2221 3443	21
29	0112 1221	10	1212 2311	13	3222 2211	15
30	1111 0100	5	1111 1121	9	1212 1221	12
31			1021 1221	10		

Three-hour-range K indices
Belsk, July - September, 2009
The limit of K = 9 is 450

Day	July K	July SK	August K	August SK	September K	September SK
1	1121 1111	9	0112 2211	10	1001 2111	7
2	1111 1111	8	1102 1113	10	2101 1211	9
3	1111 2122	11	2122 2221	14	0110 1322	10
4	1111 1211	9	1211 1221	11	2222 1221	14
5	2211 1233	15	1113 3212	14	1111 1110	7
6	1211 1112	10	2242 3222	19	0112 1121	9
7	1112 1321	12	2112 2433	18	0001 1111	5
8	2111 1211	10	1111 1211	9	1010 1112	7
9	2111 1333	15	2222 2222	16	1001 1111	6
10	2312 2322	17	2011 1221	10	1011 2110	7
11	1221 1111	10	1121 1222	12	0111 1222	10
12	1111 1101	7	1112 2112	11	0100 0111	4
13	1112 3433	18	3111 2111	11	1001 1332	11
14	3222 3212	17	1111 1102	8	3111 1222	13
15	1222 2211	13	2010 1010	5	1121 1313	13
16	1011 1110	6	1011 0001	4	2122 1121	12
17	0101 1100	4	0001 2221	8	2221 1122	13
18	0121 1110	7	0111 1122	9	1111 1000	5
19	0011 1100	4	1112 3323	16	0010 0010	2
20	1223 2310	14	3322 2223	19	0011 2123	10
21	1112 2222	13	2132 3322	18	3112 2120	12
22	3544 2232	25	1212 1121	11	1011 2111	8
23	2122 2332	17	2222 0111	11	0000 0010	1
24	2222 2311	15	1111 0100	5	0000 0110	2
25	2211 1112	11	1211 1111	9	0101 1010	4
26	1101 2110	7	2211 1111	10	0000 1123	7
27	1111 1111	8	1212 2331	15	2311 1123	14
28	1111 1201	8	1110 0111	6	2232 1123	16
29	1111 2100	7	0111 1100	5	0011 1100	4
30	1012 2321	12	2122 3554	24	2121 2122	13
31	0122 2111	10	2122 1221	13		

Three-hour-range K indices
Belsk, October - December, 2009
The limit of K = 9 is 450

Day	October K	October SK	November K	November SK	December K	December SK
1	1110 0011	5	1211 0110	7	0000 0001	1
2	1111 1010	6	0122 1100	7	0011 1001	4
3	1001 0020	4	0001 0010	2	0000 0000	0
4	1213 2111	12	0000 0111	3	0011 0000	2
5	1101 0111	6	0110 1000	3	0021 1132	10
6	0011 1001	4	0000 0000	0	3111 1011	9
7	0011 0120	5	0000 0012	3	2001 1231	10
8	0110 0012	5	2112 3332	17	0001 1001	3
9	1111 0111	7	2122 0101	9	0001 0000	1
10	0100 0010	2	1100 0011	4	0011 0110	4
11	2242 2312	18	1010 0010	3	0000 0000	0
12	0110 0011	4	0001 1012	5	0011 1121	7
13	1011 1122	9	0000 0121	4	0001 1111	5
14	0001 0011	3	1113 1113	12	2221 1111	11
15	0022 2232	13	3111 2311	13	0010 0021	4
16	2211 0000	6	0000 0020	2	1111 2211	10
17	0000 0010	1	1000 0010	2	1001 1211	7
18	0000 1110	3	0011 0101	4	0012 2210	8
19	0010 1100	3	0011 1113	8	1101 1001	5
20	1001 1000	3	2001 1111	7	1001 1210	6
21	0011 2100	5	3222 2132	17	1001 0121	6
22	3223 2244	22	2121 1321	13	0001 0122	6
23	3323 2111	16	0000 1000	1	1122 1122	12
24	1022 2353	18	0011 3443	16	1111 0001	5
25	3211 3110	12	2211 2112	12	0001 2123	9
26	1022 1232	13	2112 1221	12	2210 0211	9
27	2111 1120	9	0101 1220	7	0001 2110	5
28	1121 0111	8	0111 1211	8	0001 0110	3
29	1111 3222	13	0000 0000	0	0010 1100	3
30	3222 1121	14	0000 0000	0	0000 0001	1
31	1011 1122	9			0000 0000	0

Three-hour-range E indices
based on power spectrum estimation(*)
Belsk, January - March, 2009

Day	January K	January SE	February K	February SE	March K	March SE
1	1232 2313	17	0201 0001	4	1110 1000	4
2	0000 1234	10	0000 0100	1	0000 0000	0
3	3324 2413	22	0000 0024	6	0012 2253	15
4	2011 0311	9	4114 3433	23	1211 1244	16
5	1111 1323	13	4111 1103	12	2310 0011	8
6	2101 0200	6	3000 0001	4	2111 0001	6
7	0110 0101	4	0100 1000	2	0000 0011	2
8	0010 2211	7	0000 0000	0	2132 3411	17
9	2101 2231	12	1000 0002	3	0001 0100	2
10	3211 0001	8	0000 1010	2	0000 1220	5
11	1001 0000	2	2000 1120	6	0010 0044	9
12	0000 0000	0	0101 1200	5	4311 0123	15
13	1110 1122	9	0000 0221	5	5333 2433	26
14	2212 3132	16	2244 5425	28	3122 2334	20
15	2101 0233	12	3312 3342	21	3322 2203	17
16	2201 1110	8	1001 1321	9	3002 1220	10
17	0000 0110	2	0000 0000	0	2001 1332	12
18	0001 1110	4	2000 0123	8	0001 0011	3
19	5121 1332	18	0000 0100	1	2001 1023	9
20	2001 0031	7	1111 1143	13	2010 0222	9
21	0001 1221	7	0001 0111	4	0122 3134	16
22	0000 1110	3	0012 1011	6	1310 0023	10
23	0001 0001	2	0001 2434	14	1000 0021	4
24	0000 0000	0	2421 1110	12	1222 3223	17
25	1000 0002	3	2101 0110	6	4321 0112	14
26	4232 4420	21	0000 1111	4	2221 2122	14
27	0100 0132	7	1223 4333	21	1001 1252	12
28	0001 0002	3	2220 0013	10	1000 0031	5
29	0121 1110	7			0011 1101	5
30	0101 0022	6			1111 1131	10
31	0112 3133	14			0011 1000	3

* - see literature: Reda and Jankowski, 2004

Three-hour-range E indices
based on power spectrum estimation(*)
Belsk, April – June, 2009

Day	April K	April SE	May K	May SE	June K	June SE
1	1000 0013	5	0001 1101	4	0000 0000	0
2	0000 1110	3	0111 2112	9	0101 1111	6
3	0000 0110	2	2001 1101	6	1001 0332	10
4	0001 0000	1	0111 1000	4	1311 2112	12
5	1211 1110	8	0100 1101	4	0112 1212	10
6	0001 0200	3	2111 2234	16	1111 1111	8
7	0010 0000	1	3211 1123	14	1002 2212	10
8	0011 2232	11	5322 2223	21	1100 0100	3
9	3322 2423	21	0122 2212	12	0001 1101	4
10	2021 2251	15	1011 1121	8	1122 1200	9
11	3222 1323	18	2112 2100	9	1001 0101	4
12	2111 1133	13	0000 0101	2	0000 0000	0
13	3110 0011	7	1111 1210	8	0111 1211	8
14	0000 0001	1	0112 2332	14	2101 3222	13
15	2100 2221	10	1101 0000	3	0201 2201	8
16	0011 1313	10	1012 1121	9	0001 3120	7
17	1112 2113	12	2100 0000	3	0111 0100	4
18	1331 2212	15	1011 0013	7	0111 1211	8
19	2210 1021	9	1111 1010	6	1101 1000	4
20	2111 1210	9	1211 1231	12	0122 1221	11
21	0122 0021	8	2111 1101	8	2322 4210	16
22	1111 1002	7	0113 2320	12	0111 1100	5
23	0010 0000	1	0011 0113	7	0001 1113	7
24	2112 2221	13	1101 0211	7	3443 2352	26
25	0101 1212	8	0000 0101	2	2211 3224	17
26	0101 0001	3	1101 1110	6	2110 0011	6
27	2110 0020	6	0001 0000	1	0011 2321	10
28	0000 1020	3	0223 2210	12	2111 3454	21
29	0011 1110	5	1111 2321	12	4212 2300	14
30	1101 0100	4	1111 0120	7	1212 0221	11
31			0021 1221	9		

* - see literature: Reda and Jankowski, 2004

Three-hour-range E indices
based on power spectrum estimation(*)
Belsk, July - September, 2009

Day	July K	July SE	August K	August SE	September K	September SE
1	0111 1100	5	0112 1201	8	1000 1011	4
2	1100 0100	3	0001 1013	6	2000 0101	4
3	0001 1112	6	2121 2220	12	0000 0333	9
4	0010 1211	6	1110 1111	7	2322 1221	15
5	2111 1232	13	1113 2102	11	1110 0010	4
6	1110 0112	7	2242 3222	19	0101 1111	7
7	1102 1310	9	1112 1333	15	0000 0100	1
8	1111 1211	9	1100 1111	6	1000 0111	4
9	2011 0232	11	2222 1123	15	2001 0000	3
10	3313 2312	18	3000 0111	6	0001 1110	4
11	0211 1101	7	0010 1112	6	0001 1221	7
12	0101 1101	5	1012 2112	10	0000 0100	1
13	1111 4434	19	3111 1111	10	1001 0322	9
14	4222 3112	17	1011 0002	5	4011 1323	15
15	1211 1101	8	1010 0000	2	1121 1203	11
16	1011 1100	5	0010 0001	2	2121 0111	9
17	0000 0000	0	0001 1110	4	2321 1022	13
18	0111 1000	4	0111 1112	8	2101 1000	5
19	0010 0000	1	1012 3332	15	0000 0000	0
20	0122 2310	11	3323 2123	19	0001 1123	8
21	1102 1221	10	2031 3322	16	3113 2120	13
22	3554 1232	25	1211 1131	11	0011 1101	5
23	1122 2433	18	1211 0111	8	0000 0000	0
24	2122 2211	13	1000 0100	2	0000 0000	0
25	1211 1112	10	1101 0001	4	0001 1000	2
26	1001 1100	4	2111 0000	5	0000 1124	8
27	0111 1111	7	0111 1341	12	2312 1123	15
28	1110 1201	7	1110 0011	5	2131 1024	14
29	1101 1100	5	0111 0100	4	0001 0100	2
30	1002 2220	9	2132 3654	26	1111 2122	11
31	0022 2011	8	2111 1220	10		

* - see literature: Reda and Jankowski, 2004

Three-hour-range E indices
based on power spectrum estimation(*)
Belsk, October - December, 2009

Day	October K	October SE	November K	November SE	December K	December SE
1	1110 0000	3	0111 0100	4	0000 0000	0
2	1001 0000	2	0022 0100	5	0000 0000	0
3	1000 0010	2	0000 0010	1	0000 0000	0
4	0203 2100	8	0000 0000	0	0000 0000	0
5	1100 0101	4	0000 0000	0	0010 0142	8
6	0000 0000	0	0000 0000	0	3101 0001	6
7	0001 0120	4	0000 0003	3	2000 1130	7
8	0100 0003	4	2112 3432	18	0000 0001	1
9	0111 0111	6	2111 0000	5	0000 0000	0
10	0000 0000	0	1000 0010	2	0001 0000	1
11	2241 1212	15	1000 0000	1	0000 0000	0
12	0010 0010	2	0000 0003	3	0001 0011	3
13	1001 1022	7	0000 0021	3	0001 1011	4
14	0001 0000	1	2122 1112	12	2221 1010	9
15	0022 1131	10	3011 2411	13	0000 0021	3
16	2210 0000	5	0000 0020	2	1201 2210	9
17	0000 0000	0	1000 0000	1	0001 1110	4
18	0000 0100	1	0001 0001	2	0011 1100	4
19	0010 1100	3	0000 0013	4	1001 0000	2
20	1000 0000	1	2000 1110	5	0000 1200	3
21	0011 1000	3	4222 2133	19	1001 0021	5
22	4323 1144	22	3110 1320	11	0001 0031	5
23	3314 2111	16	0000 0000	0	0111 0022	7
24	1021 2353	17	0001 3354	16	0110 0000	2
25	3111 3100	10	2211 1012	10	0001 1033	8
26	0012 0232	10	2112 1321	13	1210 0200	6
27	2101 1020	7	0001 0000	1	0001 1100	3
28	0011 0010	3	0011 1211	7	0000 0000	0
29	0111 2133	12	0000 0000	0	0010 0000	1
30	3332 1111	15	0000 0000	0	0000 0000	0
31	0000 1122	6			0000 0000	0

* - see literature: Reda and Jankowski, 2004

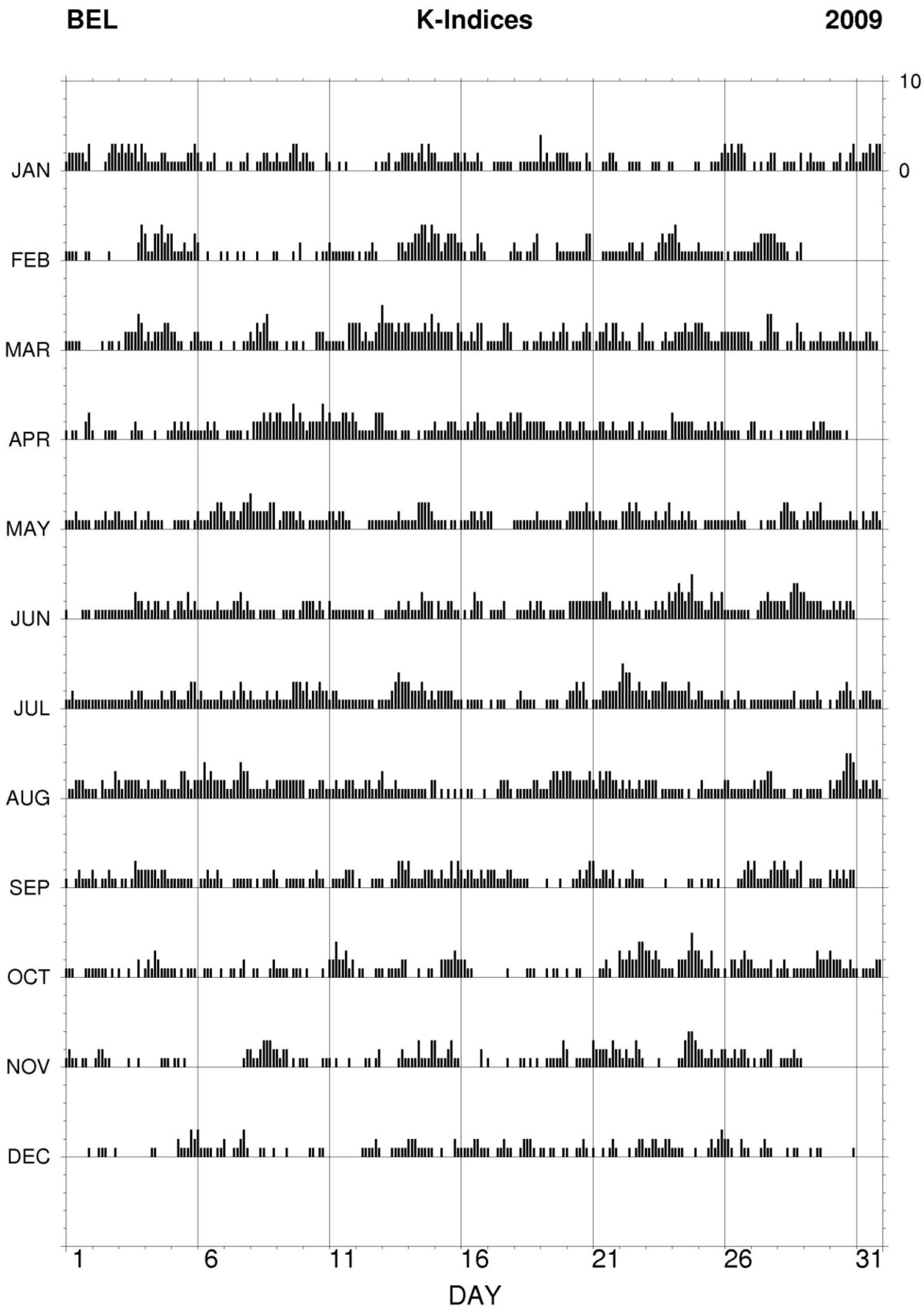

Fig. 10. K-indices in graphical form, Belsk 2009.

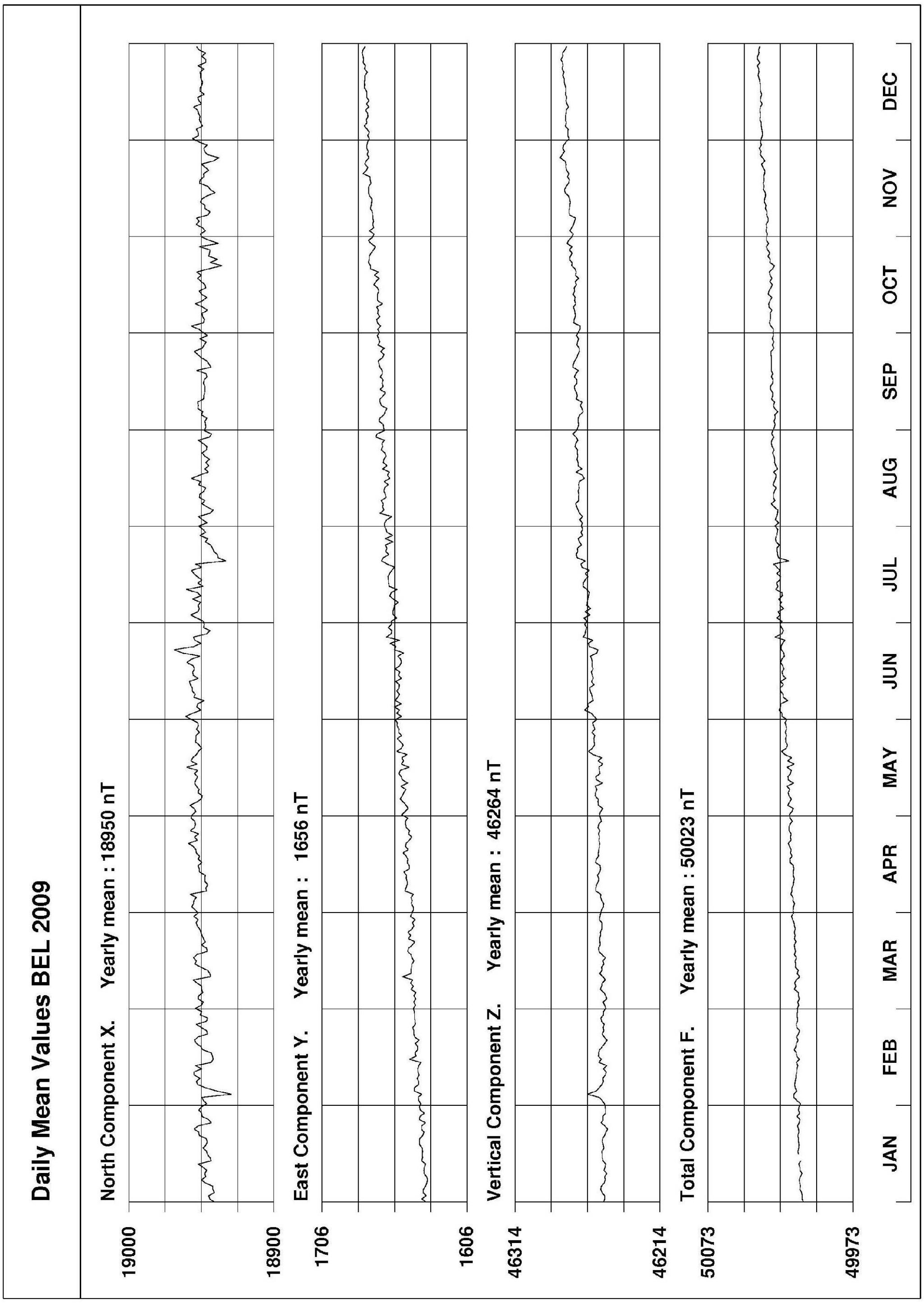

Fig. 11. Daily mean data plot for Belsk 2009.

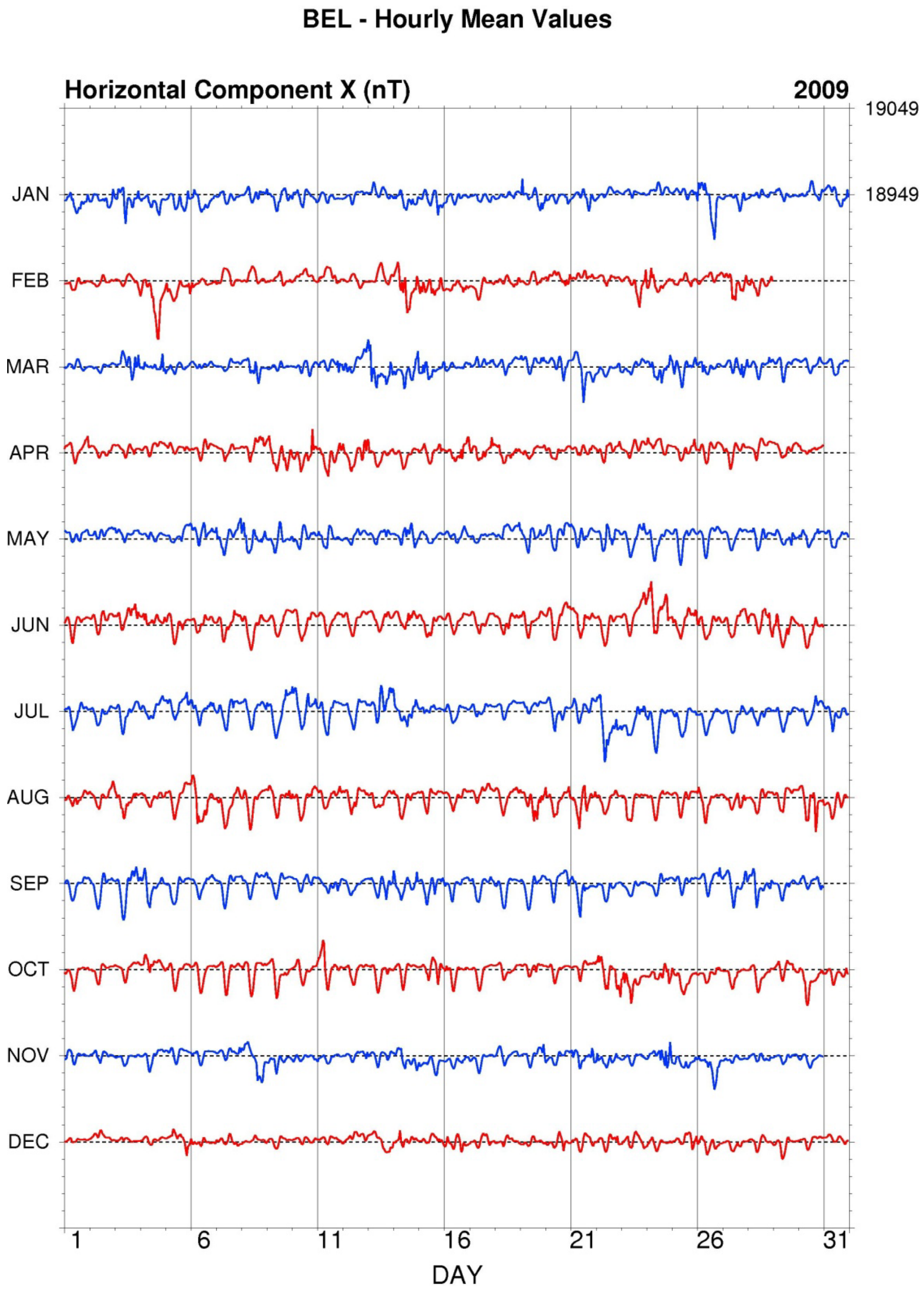

Fig. 12. Hourly mean data plot of X component for Belsk 2009.

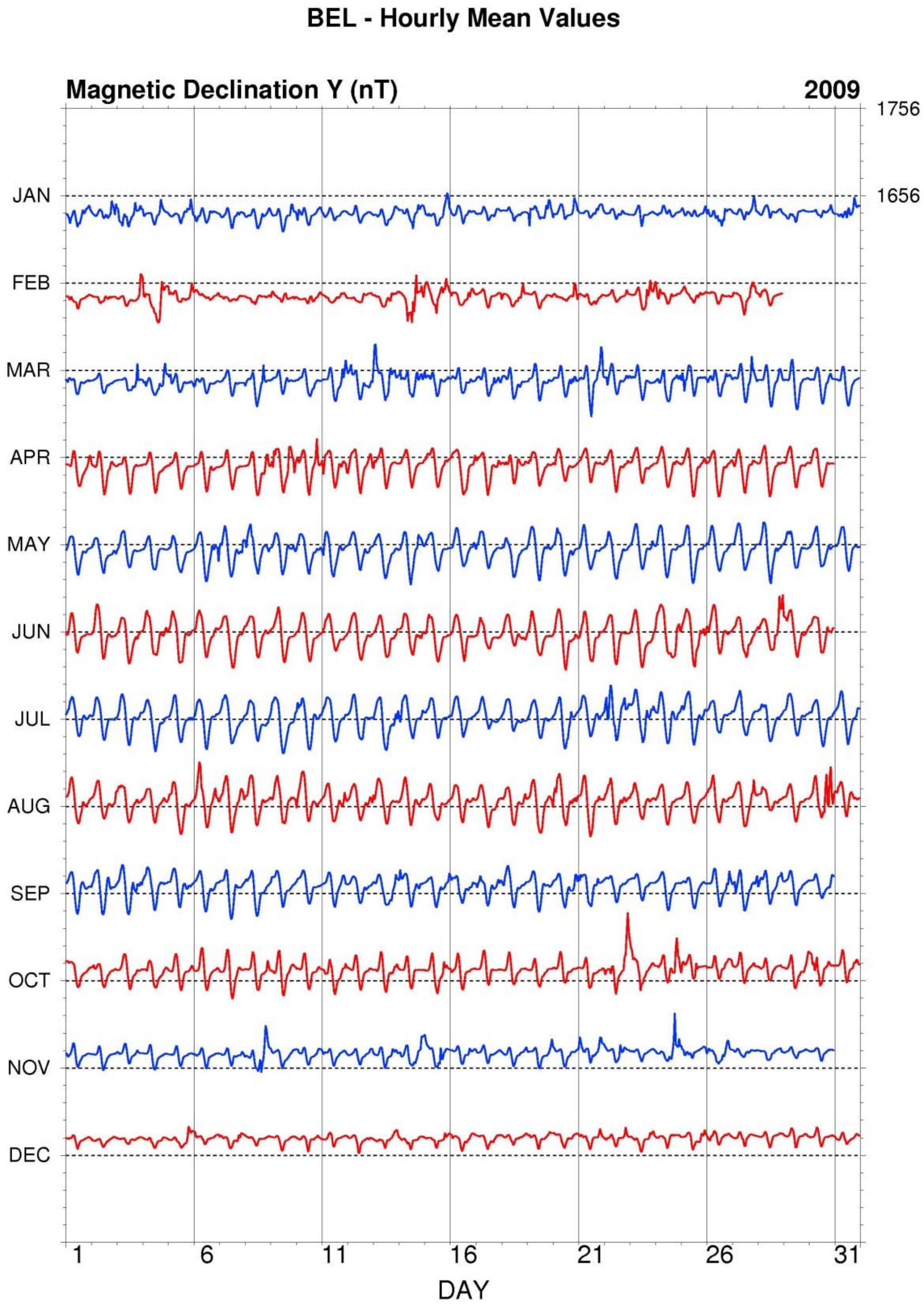

Fig. 13. Hourly mean data plot of Y component for Belsk 2009.

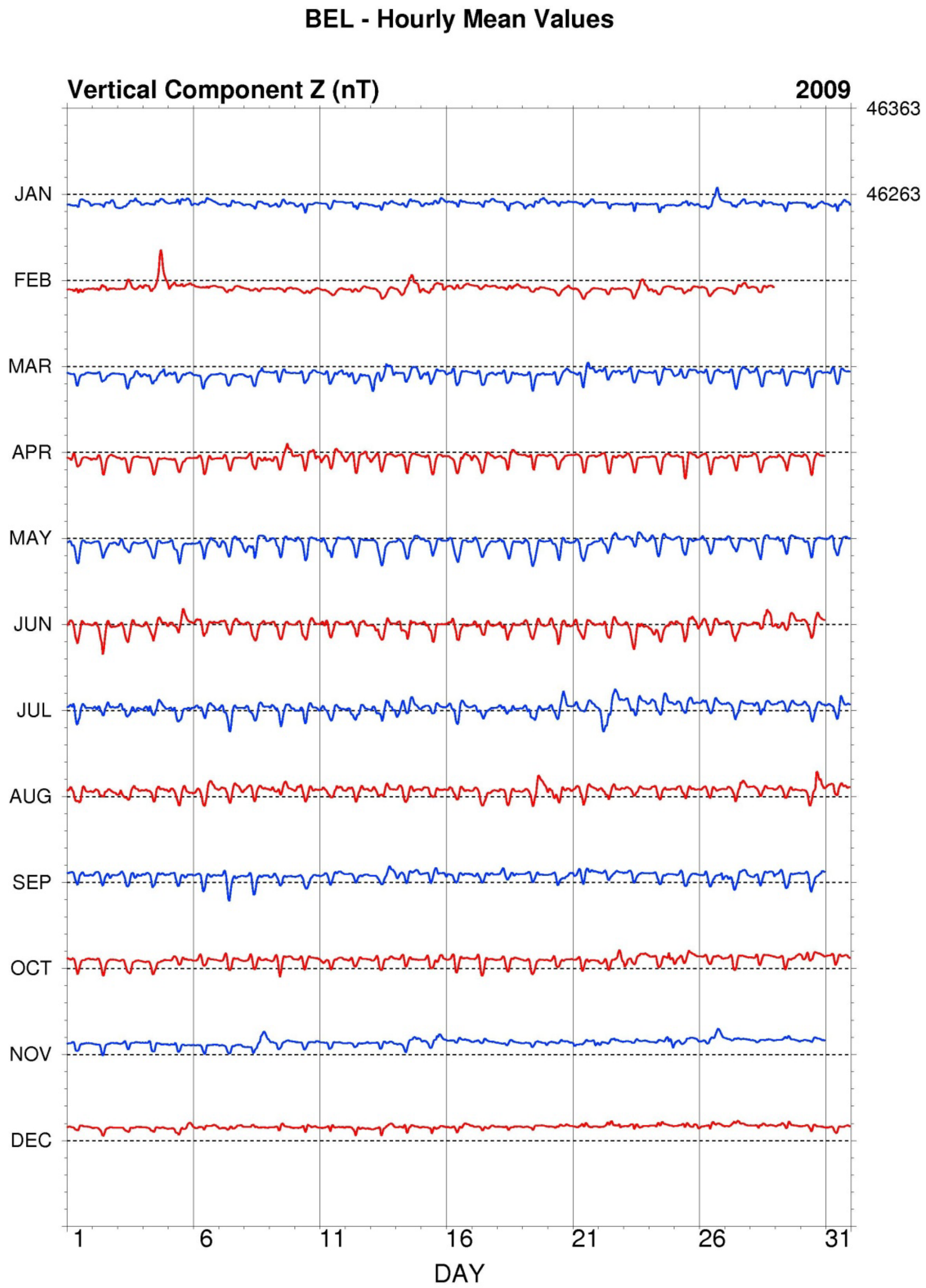

Fig. 14. Hourly mean data plot of Z component for Belsk 2009.

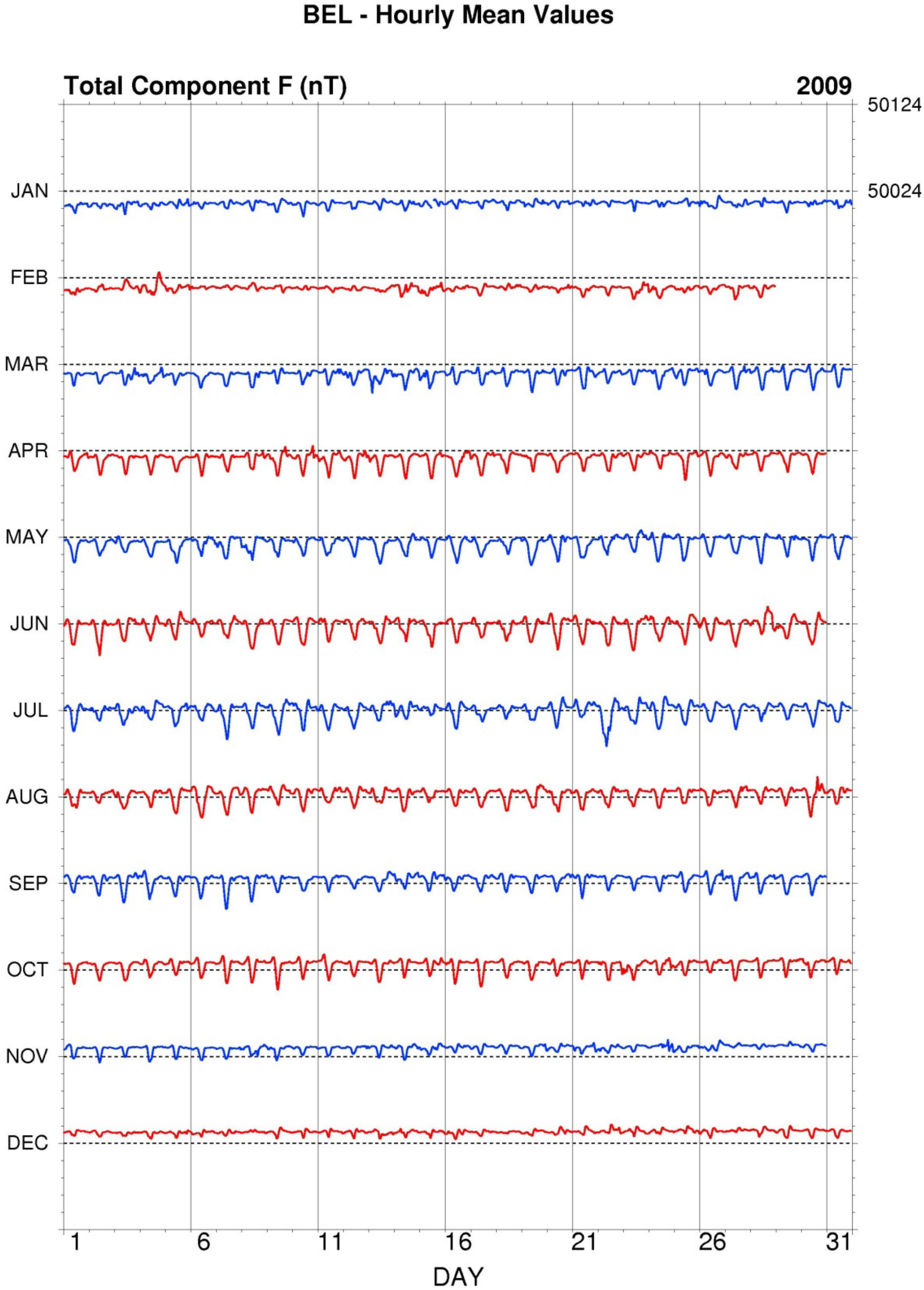

Fig. 15. Hourly mean data plot of F component for Belsk 2009.

Tables and plots for Hel observatory

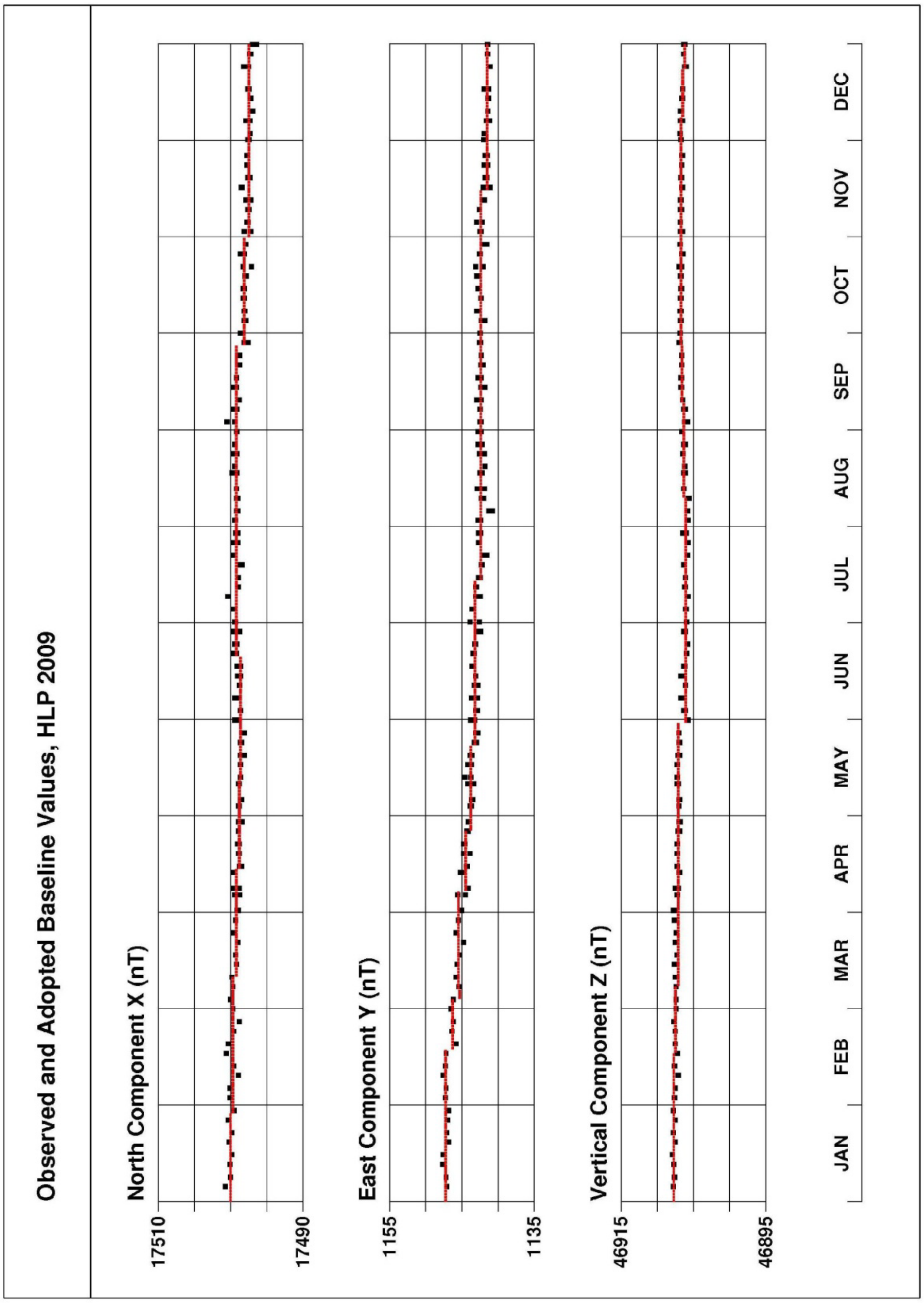

Fig. 16. Base values of set 1, Hel 2009.

Annual mean values of magnetic elements in Hel Observatory

No.	Year	D [° ‘]	H [nT]	Z [nT]	X [nT]	Y [nT]	I [° ‘]	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

No.	Year	D [º ‘]	H [nT]	Z [nT]	X [nT]	Y [nT]	I [º ‘]	F [nT]
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
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
57	2009	3 51.3	17571	46945	17531	1181	69 28.8	50126

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

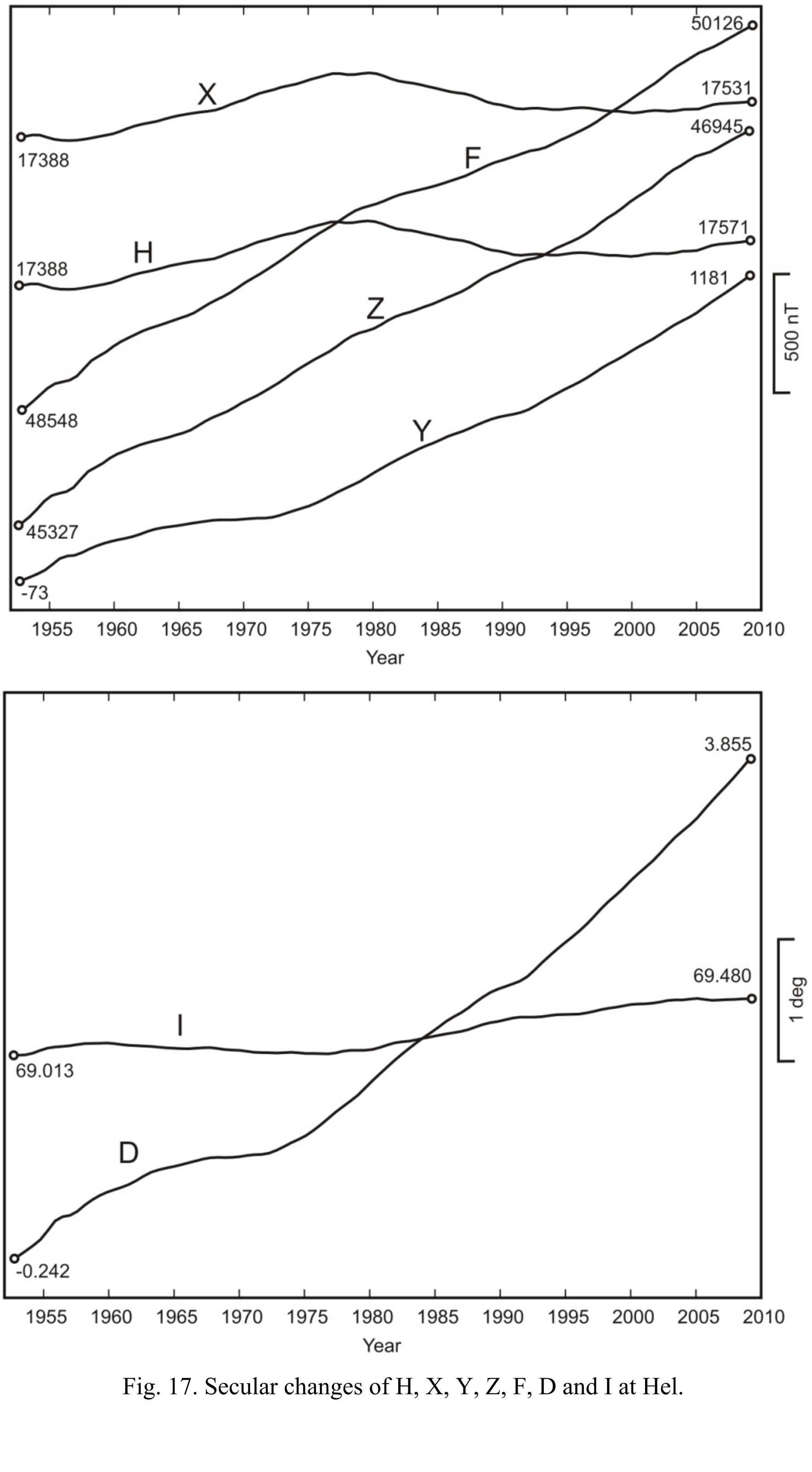

Fig. 17. Secular changes of H, X, Y, Z, F, D and I at Hel.

MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

HLP 2009

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
NORTH COMPONENT: 17000 + ... in nT													
All days	529	530	532	534	535	536	531	529	530	528	529	532	531
Quiet days	532	532	533	535	534	535	526	531	529	525	528	532	531
Disturbed days	527	524	528	529	535	538	526	528	530	530	529	532	530
EAST COMPONENT: 1000 + ... in nT													
All days	164	167	169	171	175	179	183	187	189	194	197	200	181
Quiet days	163	166	168	171	176	179	183	185	188	196	197	200	181
Disturbed days	163	167	171	172	175	182	183	187	189	194	199	201	182
VERTICAL COMPONENT: 46500 + ... in nT													
All days	434	435	435	436	438	441	446	450	451	454	458	459	445
Quiet days	433	435	434	436	438	442	446	449	452	454	458	459	445
Disturbed days	434	438	434	438	437	441	446	450	451	453	459	460	445

Three-hour-range K indices
Hel, January - March, 2009
The limit of K = 9 is 550

Day	January K	January SK	February K	February SK	March K	March SK
1	1222 2212	14	0110 0001	3	1111 1100	6
2	0100 0223	8	0000 0100	1	0001 0010	2
3	2223 2313	18	0010 0023	6	1023 2233	16
4	2101 0221	9	3113 2333	19	1212 2133	15
5	1111 1222	11	3111 2103	12	2210 0012	8
6	1101 0200	5	2001 0001	4	2101 0001	5
7	0000 0101	2	0100 1000	2	0000 0011	2
8	0001 2111	6	0000 0001	1	2123 3311	16
9	2101 2221	11	1000 0002	3	0001 1110	4
10	2211 0001	7	0000 1011	3	0000 2220	6
11	1001 0000	2	2011 1111	8	1010 1033	9
12	0000 0000	0	0101 1210	6	3212 1123	15
13	1110 1122	9	0000 0221	5	5333 2322	23
14	2112 2122	13	2133 4424	23	2122 2323	17
15	1111 0122	9	3312 3322	19	2221 2203	14
16	1201 0110	6	1101 1211	8	2012 1220	10
17	0000 0111	3	0000 0001	1	1011 1232	11
18	0001 1011	4	2000 1123	9	0001 1011	4
19	4111 1222	14	0000 0101	2	2101 2122	11
20	2110 1021	8	1100 1133	10	2011 1222	11
21	0001 1221	7	1001 1111	6	0122 2133	14
22	0000 1110	3	1112 2012	10	1221 0123	12
23	0011 1001	4	0001 2323	11	1000 0021	4
24	1000 0000	1	3321 1111	13	1222 3212	15
25	1000 1002	4	2011 1111	8	3322 1112	15
26	3232 3310	17	0101 1111	6	2222 2222	16
27	0101 0122	7	2224 4322	21	1001 1342	12
28	0000 0101	2	2221 0012	10	1001 0031	6
29	0121 2110	8			1011 1111	7
30	0101 0123	8			1112 2121	11
31	1122 3132	15			1112 2001	8

Three-hour-range K indices
Hel, April - June, 2009
The limit of K = 9 is 550

Day	April K	April SK	May K	May SK	June K	June SK
1	1011 0022	7	0012 1111	7	1000 1111	5
2	0000 2111	5	0111 2112	9	0001 2111	6
3	1001 1210	6	2011 2201	9	1002 2322	12
4	0001 1001	3	1211 1100	7	1212 2112	12
5	1222 2211	13	0021 1101	6	0112 1202	9
6	1012 1210	8	2112 2223	15	1021 1111	8
7	0021 1000	4	2111 1223	13	0103 2312	12
8	1222 3232	17	3222 2233	19	1100 1110	5
9	3322 2423	21	0112 2212	11	0011 1101	5
10	2022 2242	16	1001 1111	6	2222 2100	11
11	3222 3323	20	1111 2110	8	1101 1111	7
12	2111 1233	14	0000 0111	3	1000 1000	2
13	3111 1011	9	1111 1210	8	0111 1211	8
14	1101 0101	5	1113 3332	17	2002 3222	13
15	1111 2221	11	1001 1100	4	0111 2211	9
16	1111 2312	12	1012 2211	10	0002 3210	8
17	2112 2123	14	1100 0000	2	0101 1200	5
18	2321 2212	15	1010 1112	7	0111 1212	9
19	2211 1121	11	1111 1110	7	1100 1000	3
20	1211 2211	11	1112 2232	14	0112 2221	11
21	1122 1121	11	2121 2111	11	2222 4210	15
22	1112 2002	9	0123 2321	14	1101 1200	6
23	0110 1110	5	1002 0112	7	1112 1113	11
24	3212 3221	16	1112 1210	9	2342 2352	23
25	1112 2112	11	0011 1111	6	2212 3223	17
26	1101 0001	4	1112 2110	9	1111 1111	8
27	2201 0010	6	0001 0010	2	0012 2322	12
28	0101 2111	7	0223 3210	13	2111 3343	18
29	0012 1221	9	1112 2311	12	3222 2210	14
30	1111 0100	5	1111 1110	7	1112 1211	10
31			0021 1221	9		

Three-hour-range K indices
Hel, July - September, 2009
The limit of K = 9 is 550

Day	July K	July SK	August K	August SK	September K	September SK
1	1111 1101	7	0113 2211	11	1001 2011	6
2	1111 1110	7	1101 1112	8	2001 1101	6
3	0001 1112	6	2111 2221	12	0011 1322	10
4	1011 1211	8	1111 1221	10	2222 2221	15
5	2211 1222	13	1112 3202	12	1111 0110	6
6	1111 1111	8	2232 3222	18	0113 2111	10
7	1102 1311	10	1112 2433	17	0001 1100	3
8	1111 1211	9	1101 2211	9	1000 0111	4
9	2111 1333	15	2222 2122	15	1000 1010	3
10	2313 2312	17	2011 1221	10	1001 2110	6
11	1221 1111	10	0021 1222	10	0011 2121	8
12	1102 1101	7	1012 2112	10	0000 1101	3
13	1112 4433	19	3112 2111	12	1001 1322	10
14	4222 3212	18	1001 0102	5	3112 1212	13
15	1211 2201	10	1010 1010	4	1111 1213	11
16	1011 1100	5	0101 0001	3	2122 1111	11
17	0000 0000	0	0001 2221	8	2221 1112	12
18	0110 1000	3	0101 1111	6	1111 1000	5
19	0000 1000	1	1012 3323	15	0000 0000	0
20	1223 2310	14	3323 3123	20	0001 2223	10
21	1102 1221	10	2122 3322	17	3112 2120	12
22	2544 2232	24	1112 1121	10	1011 2101	7
23	1122 2332	16	2212 1111	11	1000 0000	1
24	2122 2311	14	1101 1100	5	0000 1110	3
25	1211 1112	10	1201 0101	6	0001 2000	3
26	1101 2100	6	2111 1110	8	0001 1123	8
27	1101 1111	7	1212 2331	15	2311 1123	14
28	1111 1201	8	1110 1011	6	2122 1123	14
29	1112 2100	8	0011 1100	4	0001 1100	3
30	0003 2321	11	2122 3544	23	2112 2122	13
31	0022 2111	9	2122 1221	13		

Three-hour-range K indices
Hel, October - December, 2009
The limit of K = 9 is 550

Day	October K	October SK	November K	November SK	December K	December SK
1	1111 0000	4	0111 0110	5	0000 0001	1
2	1001 1000	3	0021 1100	5	0000 1000	1
3	1001 1010	4	0000 0010	1	0000 0000	0
4	0213 2111	11	0000 0010	1	0000 0000	0
5	1001 1101	5	0000 1000	1	0010 1132	8
6	0011 1001	4	0000 0000	0	2111 0001	6
7	0001 0111	4	0000 0002	2	2001 1221	9
8	0000 0002	2	2113 2321	15	0000 0001	1
9	0001 0111	4	1111 0101	6	0000 0000	0
10	0000 0000	0	0000 0010	1	0001 1000	2
11	2242 2212	17	1000 0000	1	0000 0000	0
12	0010 1010	3	0000 0002	2	0001 0121	5
13	1011 1112	8	0000 0021	3	0001 1012	5
14	0001 0001	2	1113 1112	11	2221 1011	10
15	0022 2221	11	3011 1311	11	0010 0021	4
16	2110 1000	5	0000 0020	2	1111 1111	8
17	0001 0000	1	1000 0000	1	0001 1211	6
18	0000 1100	2	0001 0001	2	0012 2210	8
19	0010 2100	4	0000 0113	5	1101 0001	4
20	1000 0000	1	2001 1110	6	1001 1100	4
21	0001 2100	4	3222 1132	16	1000 0021	4
22	3213 2234	20	2121 1321	13	0000 0022	4
23	3312 2101	13	0000 0000	0	0111 1121	8
24	1021 2353	17	0001 3443	15	0110 0000	2
25	3111 2110	10	2111 1112	10	0001 2123	9
26	0011 1222	9	1112 1221	11	1110 0100	4
27	1101 1010	5	0000 0110	2	0001 1100	3
28	0011 0111	5	0011 1111	6	0001 0110	3
29	0101 2222	10	0000 0000	0	0000 0000	0
30	2222 1121	13	0000 0000	0	0000 0000	0
31	0001 1022	6			0000 0000	0

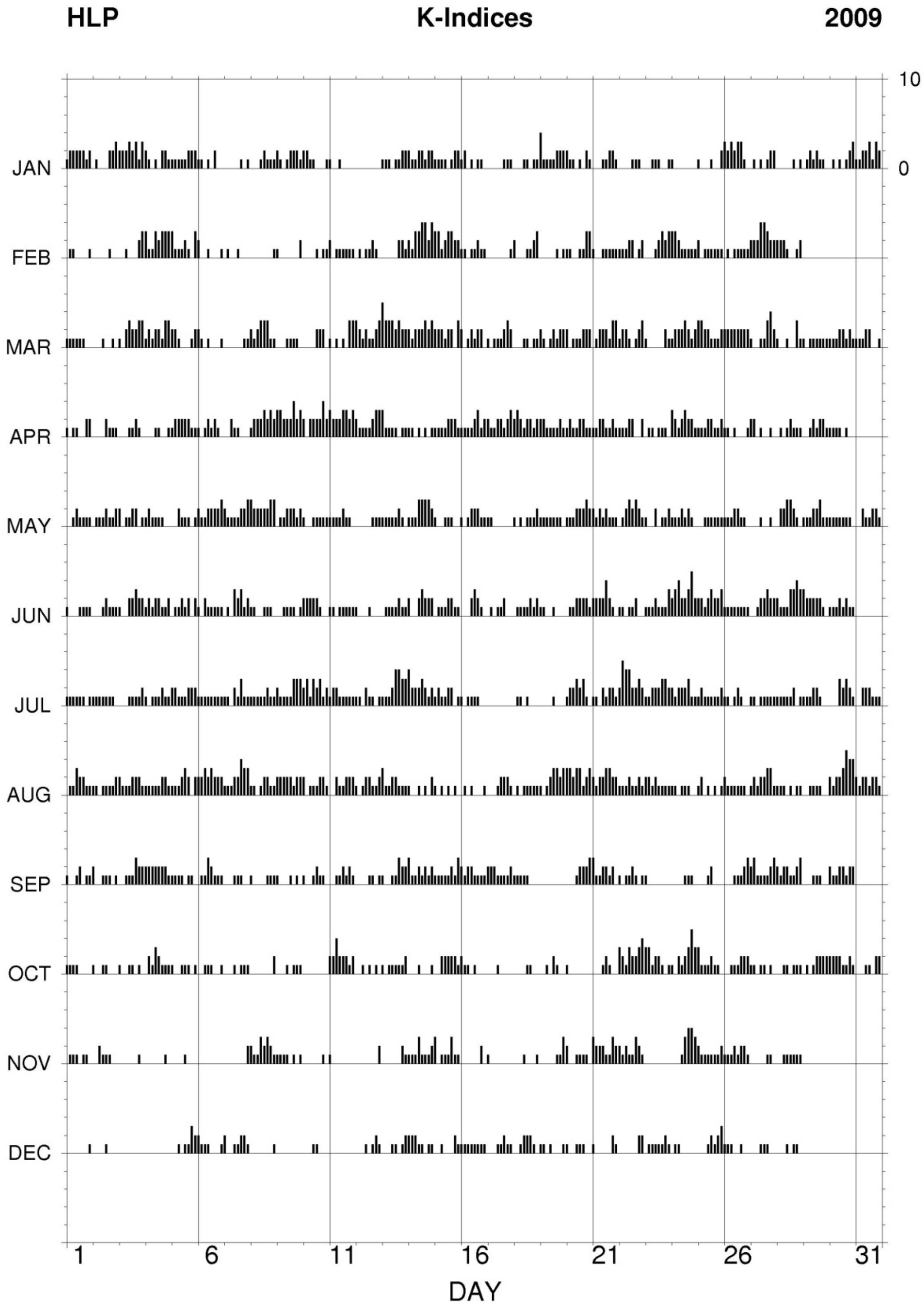

Fig. 18. K-indices in graphical form, Hel 2009.

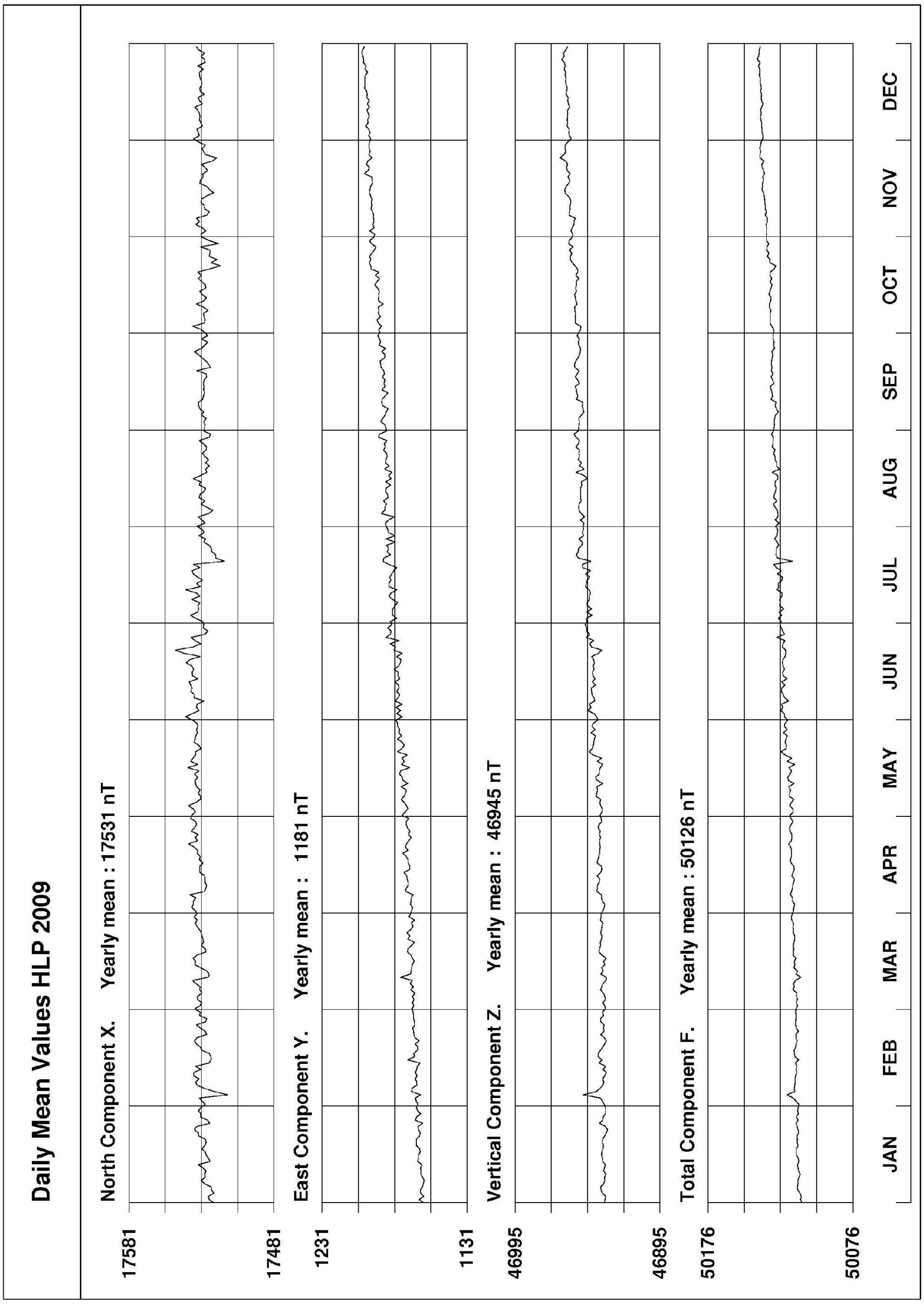

Fig. 19. Daily mean data plot for Hel 2009.

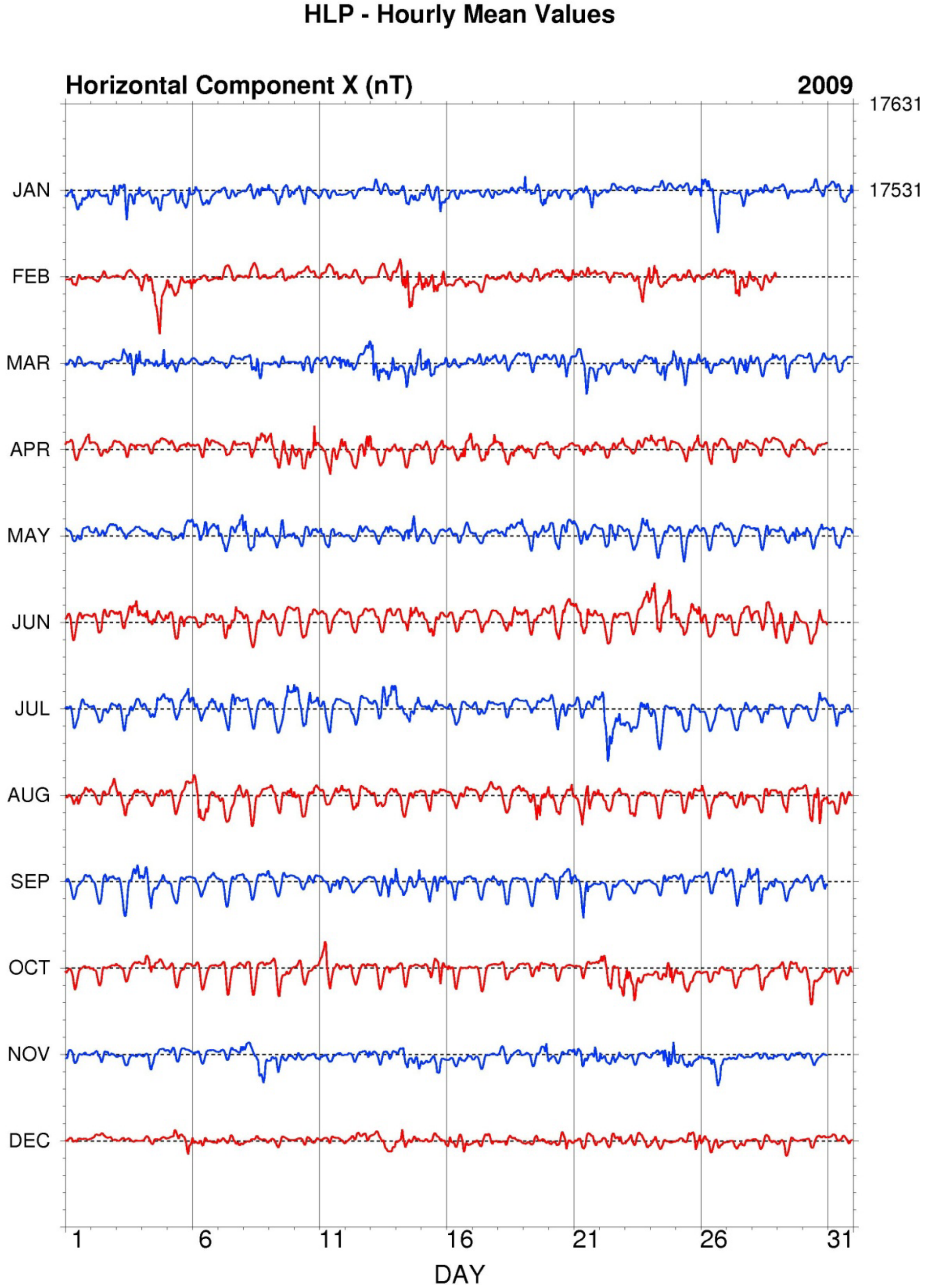

Fig. 20. Hourly mean data plot of X component for Hel 2009.

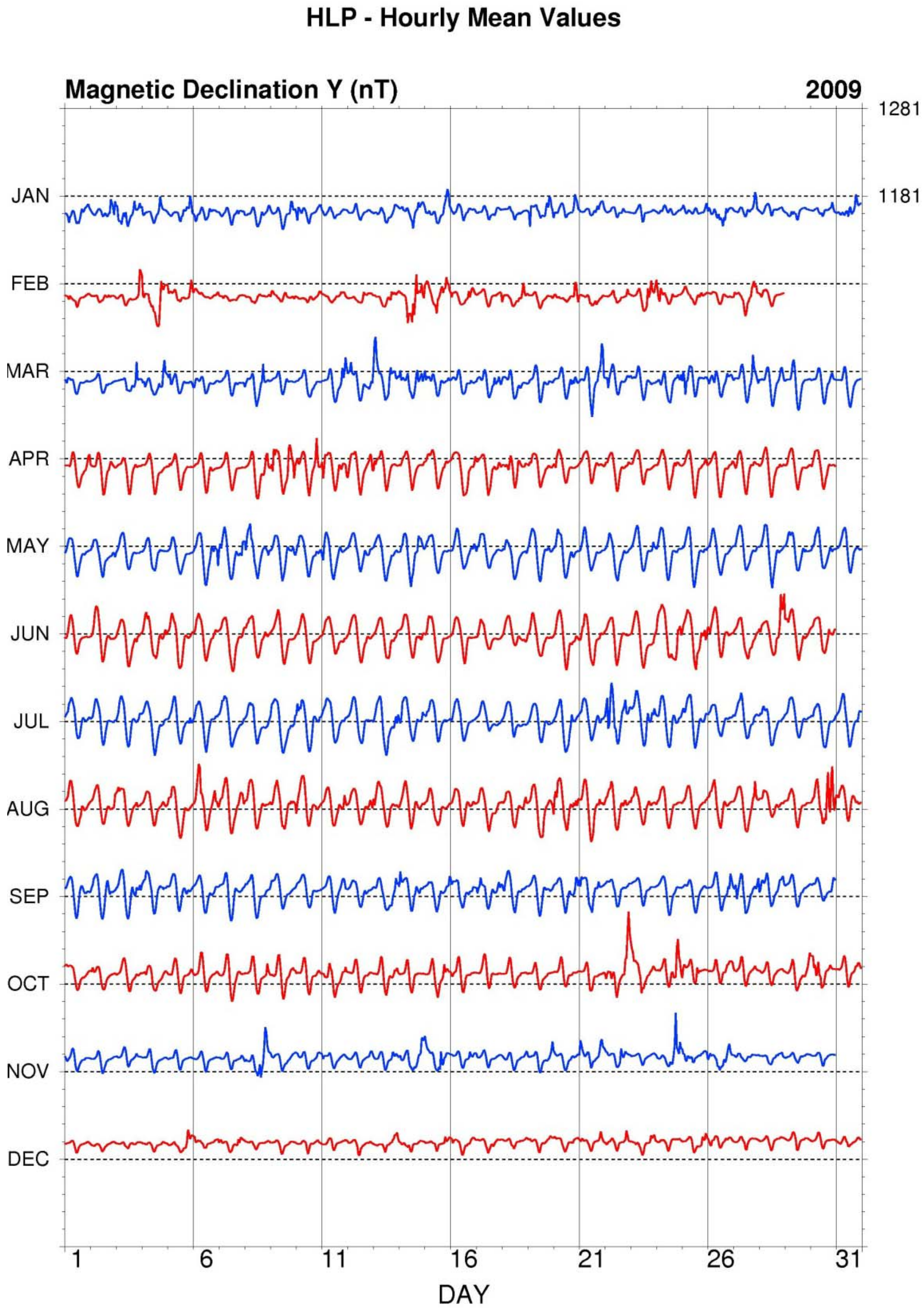

Fig. 21. Hourly mean data plot of Y component for Hel 2009.

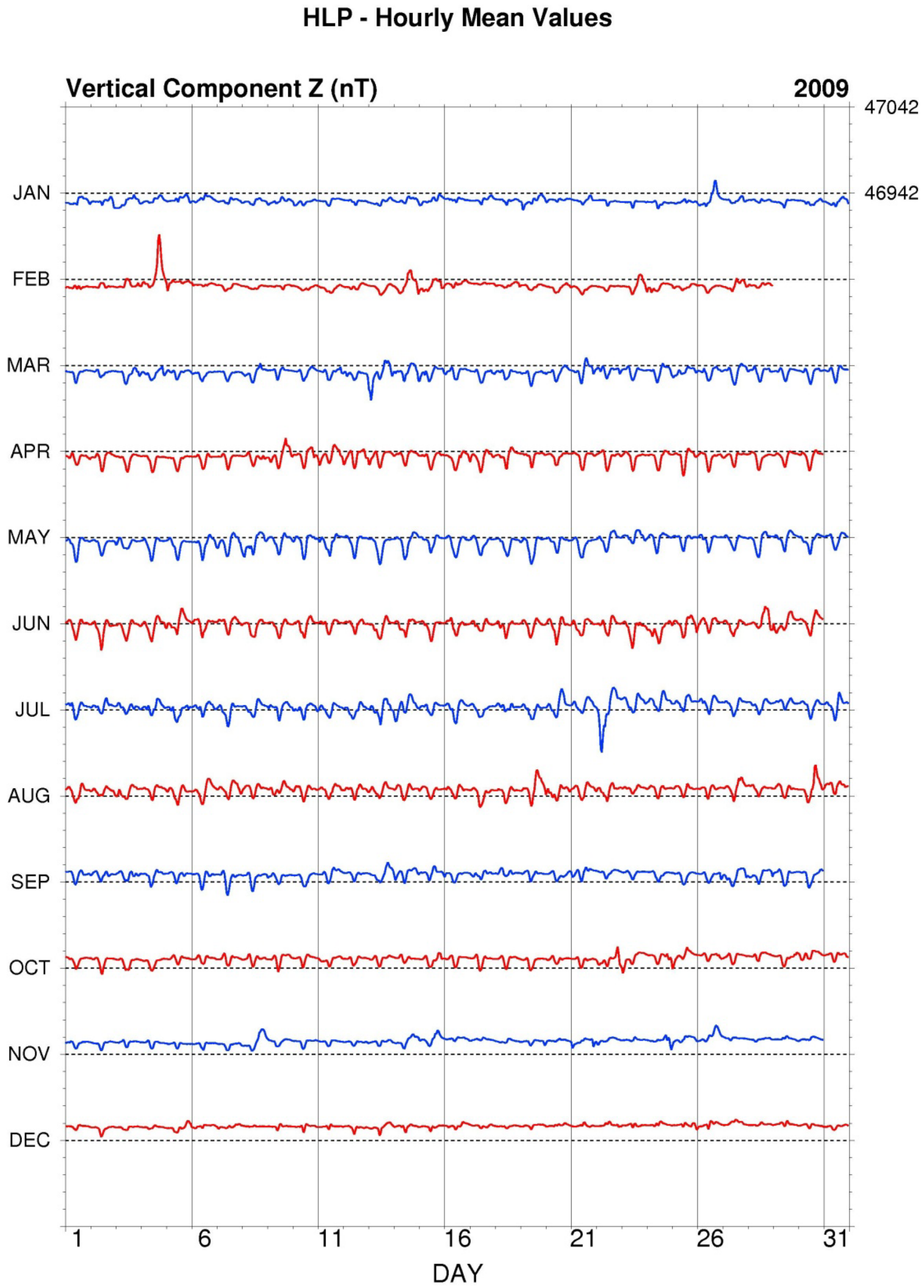

Fig. 22. Hourly mean data plot of Z component for Hel 2009.

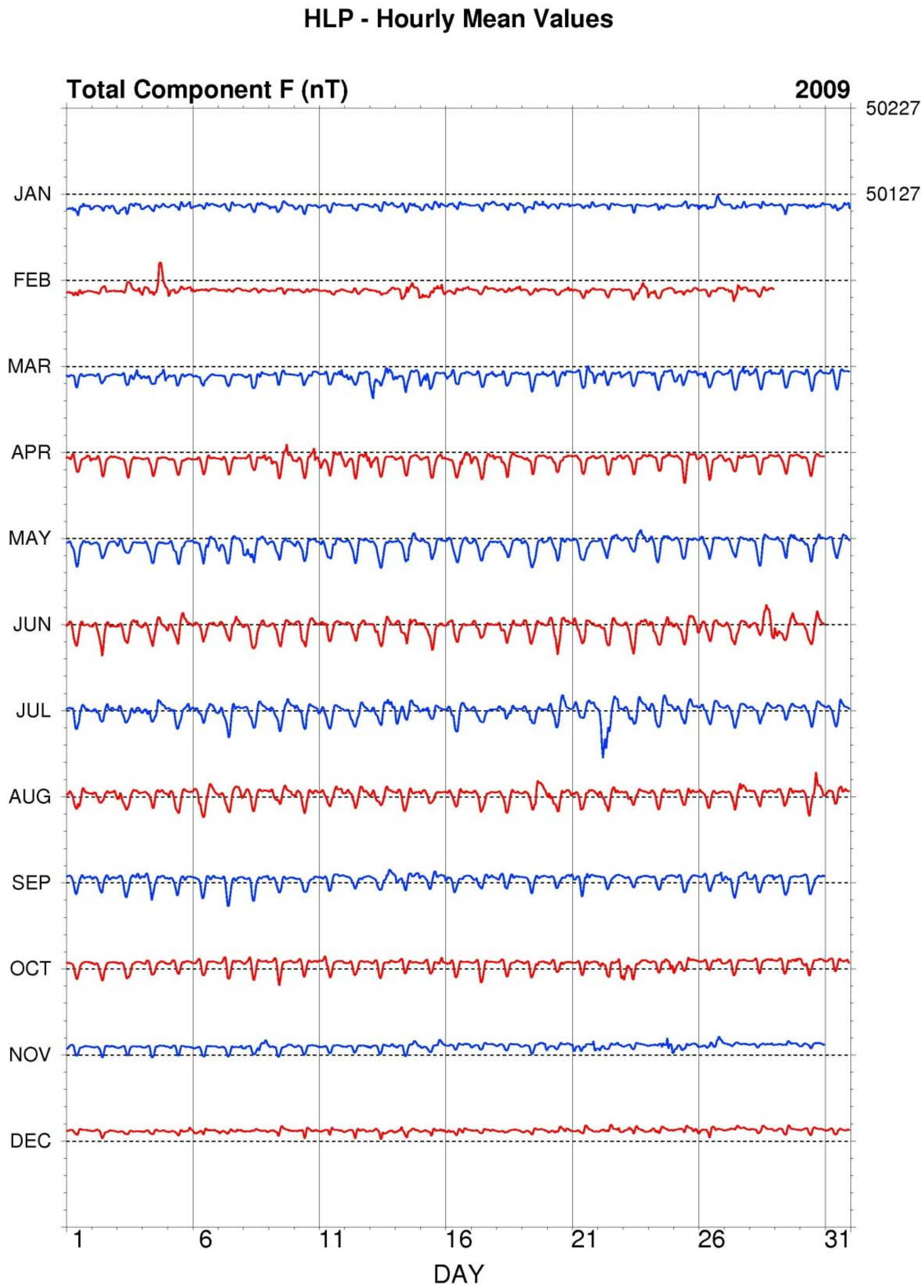

Fig. 23. Hourly mean data plot of F component for Hel 2009.

Tables and plots for Hornsund observatory

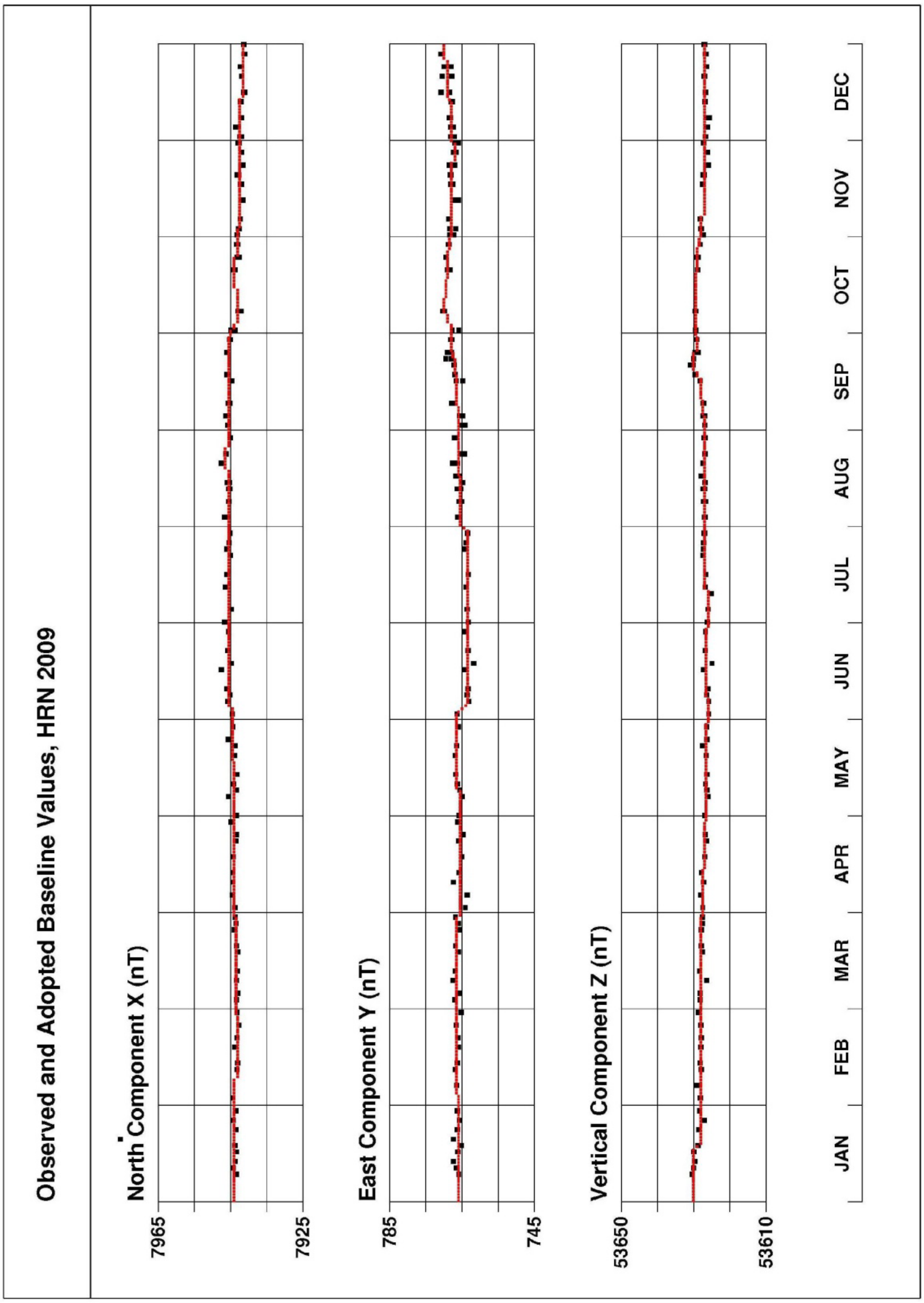

Fig. 24. Base values, Hornsund 2009.

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
2009	5 25.4	7939	53804	7903	750	81 36.4	54387

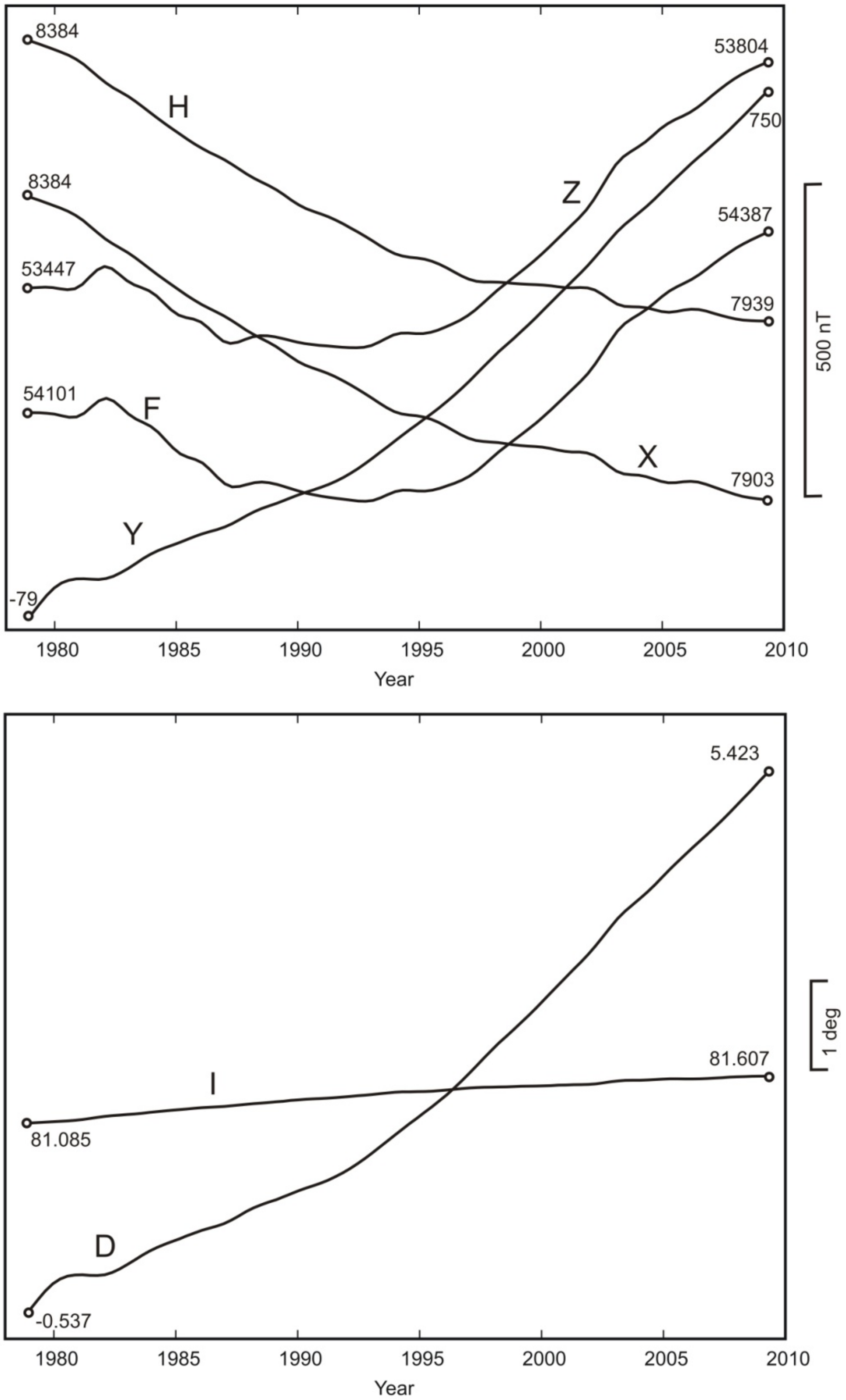

Fig. 25. Secular changes of H, X, Y, Z, F, D and I at Hornsund.

MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

HRN 2009

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
NORTH COMPONENT: 7500 + ... in nT													
All days	399	398	402	410	416	415	412	406	401	396	391	395	403
Quiet days	406	406	407	413	414	419	414	407	399	399	395	396	406
Disturbed days	387	378	390	400	416	415	408	392	397	394	379	395	396
EAST COMPONENT: 500 + ... in nT													
All days	233	236	240	239	242	244	249	256	260	266	269	271	250
Quiet days	233	234	238	237	243	247	249	255	262	265	269	272	250
Disturbed days	236	242	248	242	240	239	253	255	266	270	269	271	253
VERTICAL COMPONENT: 53500 + ... in nT													
All days	296	297	306	300	294	295	302	309	310	315	315	312	304
Quiet days	290	293	298	293	295	305	304	306	312	312	314	314	303
Disturbed days	299	298	321	307	296	292	307	301	313	327	324	314	308

Three-hour-range K indices
Hornsund, January - March, 2009
The limit of K = 9 is 2500

Day	January K	January SK	February K	February SK	March K	March SK
1	2333 2343	23	2331 0003	12	1221 2101	10
2	3201 1114	13	1001 0110	4	0101 0000	2
3	2433 3215	23	1011 0015	9	0132 2352	18
4	2222 1433	19	3222 2321	17	1222 2146	20
5	1112 2235	17	5231 2113	18	2221 0011	9
6	1322 1222	15	2111 0001	6	2223 1000	10
7	2211 1011	9	0111 1000	4	0220 0011	6
8	0002 2101	6	1011 0001	4	2233 2421	19
9	3211 2122	14	1100 0002	4	0111 1011	6
10	3222 1003	13	0100 1101	4	0010 1221	7
11	1111 0100	5	3112 2021	12	0110 0033	8
12	0000 0000	0	0201 1210	7	4422 1002	15
13	1320 1042	13	0011 1123	9	5344 2244	28
14	2222 2053	18	2234 3214	21	3333 3355	28
15	3222 1154	20	3433 3455	30	3443 3203	22
16	2321 2110	12	2212 2323	17	2233 1110	13
17	0110 1221	8	0121 0010	5	1121 2234	16
18	1111 1021	8	1221 1134	15	1202 0021	8
19	5331 1142	20	2011 1100	6	1322 1043	16
20	2212 2033	15	0222 2133	15	2010 1222	10
21	0012 1133	11	0012 1101	6	0222 2245	19
22	0221 2110	9	0112 1102	8	1322 1024	15
23	0012 1003	7	0112 3324	16	1211 0100	6
24	1110 0000	3	3522 1110	15	1332 2213	17
25	1000 2002	5	3222 1011	12	3432 1122	18
26	4233 2310	18	0222 2101	10	1332 2143	19
27	0211 0144	13	1234 3133	20	1212 2463	21
28	0011 1102	6	2343 2113	19	3011 1043	13
29	0232 2020	11			0232 1000	8
30	0123 1042	13			1322 2052	17
31	1233 3143	20			1212 2001	9

Three-hour-range K indices
Hornsund, April - June, 2009
The limit of K = 9 is 2500

Day	April K	April SK	May K	May SK	June K	June SK
1	0222 0023	11	1112 2103	11	1220 1001	7
2	1101 3211	10	1122 3002	11	0102 2111	8
3	0100 1130	6	2111 2100	8	2112 1222	13
4	0001 0000	1	1212 1100	8	1422 2223	18
5	0221 2110	9	0231 1100	8	2222 3212	16
6	0122 1100	7	1312 3322	17	1222 1112	12
7	0121 0011	6	3233 2214	20	1113 2112	12
8	0232 3143	18	5332 3222	22	1211 1011	8
9	2323 2541	22	1332 2221	16	1111 1110	7
10	2333 2251	21	2222 2122	15	1322 3210	14
11	3343 3322	23	2322 3310	16	1112 2120	10
12	2422 2154	22	1021 1211	9	1110 2111	8
13	3222 1021	13	2221 1100	9	0121 2211	10
14	1211 1122	11	1323 2242	19	2012 3232	15
15	1221 2132	14	2221 1111	11	2321 2112	14
16	2121 2213	14	1223 2141	16	0111 2110	7
17	3122 2223	17	1220 0000	5	1122 1110	9
18	2332 2221	17	1220 0022	9	1111 2222	12
19	1242 2121	15	2321 1130	13	2101 1110	7
20	1222 2121	13	2132 2111	13	0222 2122	13
21	1342 1033	17	2232 2111	14	2322 2132	17
22	1112 3002	10	0233 2331	17	1312 2211	13
23	1121 1100	7	1212 2132	14	0122 0111	8
24	1222 3332	18	2222 1132	15	2442 3232	22
25	1122 2224	16	1211 1002	8	1332 3233	20
26	1211 0001	6	2221 1131	13	2331 1001	11
27	1211 1131	11	1111 1101	7	0122 1213	12
28	1001 2230	9	1233 3110	14	2111 3543	20
29	0122 2111	10	2222 2332	18	2433 3421	22
30	1211 1100	7	2322 1131	15	2223 1423	19
31			1241 1122	14		

Three-hour-range K indices
Hornsund, July - September, 2009
The limit of K = 9 is 2500

Day	July K	July SK	August K	August SK	September K	September SK
1	1322 2211	14	2213 3211	15	1111 2011	8
2	2211 2200	10	2211 3102	12	2201 3101	10
3	1221 2113	13	2332 3220	17	1231 2234	18
4	2211 2222	14	1211 2122	12	1332 2223	18
5	2221 1143	16	3333 3101	17	1111 0110	6
6	2321 1123	15	1353 3142	22	0102 1031	8
7	2102 2221	12	2223 2333	20	0111 1231	10
8	2232 2111	14	2321 2210	13	1110 1011	6
9	3211 1232	15	2322 1012	13	1101 1000	4
10	3423 3214	22	2031 1212	12	0101 1221	8
11	2322 1121	14	0231 1222	13	0111 2321	11
12	2212 1111	11	1223 2111	13	0111 1210	7
13	1112 3323	16	2221 3123	16	0221 2231	13
14	2342 3223	21	1211 1102	9	4122 2211	15
15	2222 2200	12	2000 1110	5	1222 2213	15
16	1111 2112	10	1121 1012	9	2233 2111	15
17	1100 1100	4	1100 1112	7	1332 3134	20
18	1210 1000	5	1211 1103	10	2211 2010	9
19	0010 1110	4	1123 3332	18	0211 1000	5
20	1212 3211	13	3332 2225	22	0211 2023	11
21	1222 2332	17	23-- 3232	--	2322 2120	14
22	3345 1234	25	1213 1142	15	1112 2221	12
23	3243 3424	25	2322 2211	15	2000 0011	4
24	2243 3311	19	1222 1100	9	0000 2000	2
25	2322 2113	16	0211 1202	9	0000 1001	2
26	2122 3101	12	2222 1100	10	0000 1124	8
27	1102 2221	11	1212 2332	16	2321 2121	14
28	2212 2101	11	0121 1001	6	1131 1023	12
29	2232 3110	14	0111 1100	5	0111 1100	5
30	1202 1120	9	0243 2552	23	2212 2022	13
31	1333 3212	18	1222 2220	13		

Three-hour-range K indices
Hornsund, October - December, 2009
The limit of K = 9 is 2500

Day	October K	October SK	November K	November SK	December K	December SK
1	1221 0102	9	1222 0000	7	0000 0001	1
2	1120 1000	5	0111 1000	4	0011 1000	3
3	0010 1011	4	0000 0031	4	0000 0010	1
4	1302 2100	9	0000 0000	0	0000 0022	4
5	0111 1101	6	0011 0000	2	0010 0022	5
6	0121 1002	7	0000 0000	0	3321 0010	10
7	0000 1030	4	0000 0003	3	2212 1122	13
8	1110 0002	5	1211 2331	14	0001 0002	3
9	0111 1001	5	1221 0000	6	0000 0000	0
10	0010 0112	5	0101 0011	4	0000 0022	4
11	1233 1101	12	0011 0001	3	0000 0001	1
12	0110 1010	4	0001 0003	4	0000 1000	1
13	1111 1022	9	1000 0033	7	0110 1111	6
14	0101 0000	2	1212 1113	12	1121 0000	5
15	0023 2131	12	3122 1110	11	0000 0031	4
16	1221 0000	6	0110 0130	6	1322 1101	11
17	0000 1000	1	1001 0000	2	0111 2132	11
18	0100 0120	4	1111 0001	5	0122 2110	9
19	0010 0100	2	1111 1003	8	1101 0001	4
20	1000 0000	1	1101 1000	4	2001 1110	6
21	0010 0000	1	4322 1045	21	1100 1042	9
22	3323 2133	20	4332 2332	22	0211 0043	11
23	2323 2110	14	0110 0013	6	1123 1023	13
24	0122 1163	16	1122 2365	22	1121 0003	8
25	2332 3101	15	2221 1243	17	0102 3023	11
26	1112 2244	17	1333 2352	22	0221 0110	7
27	3212 1033	15	1111 1110	7	0122 2210	10
28	0221 1022	10	0112 1123	11	0000 0021	3
29	1211 2034	14	0020 0023	7	0000 0001	1
30	4222 2112	16	1100 0100	3	0000 0000	0
31	2012 1024	12			0100 0000	1

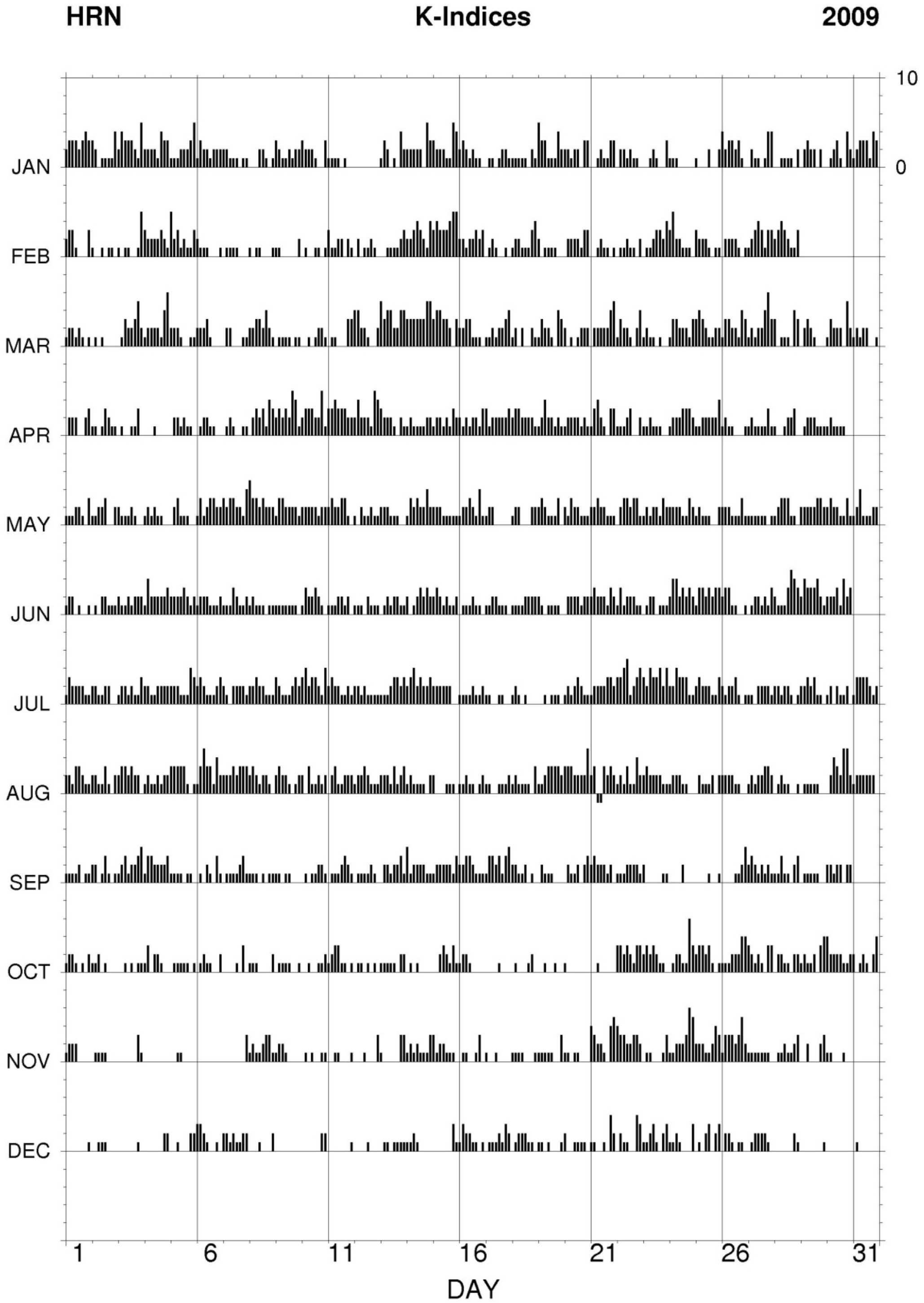

Fig. 26. K-indices in graphical form, Hornsund 2007.

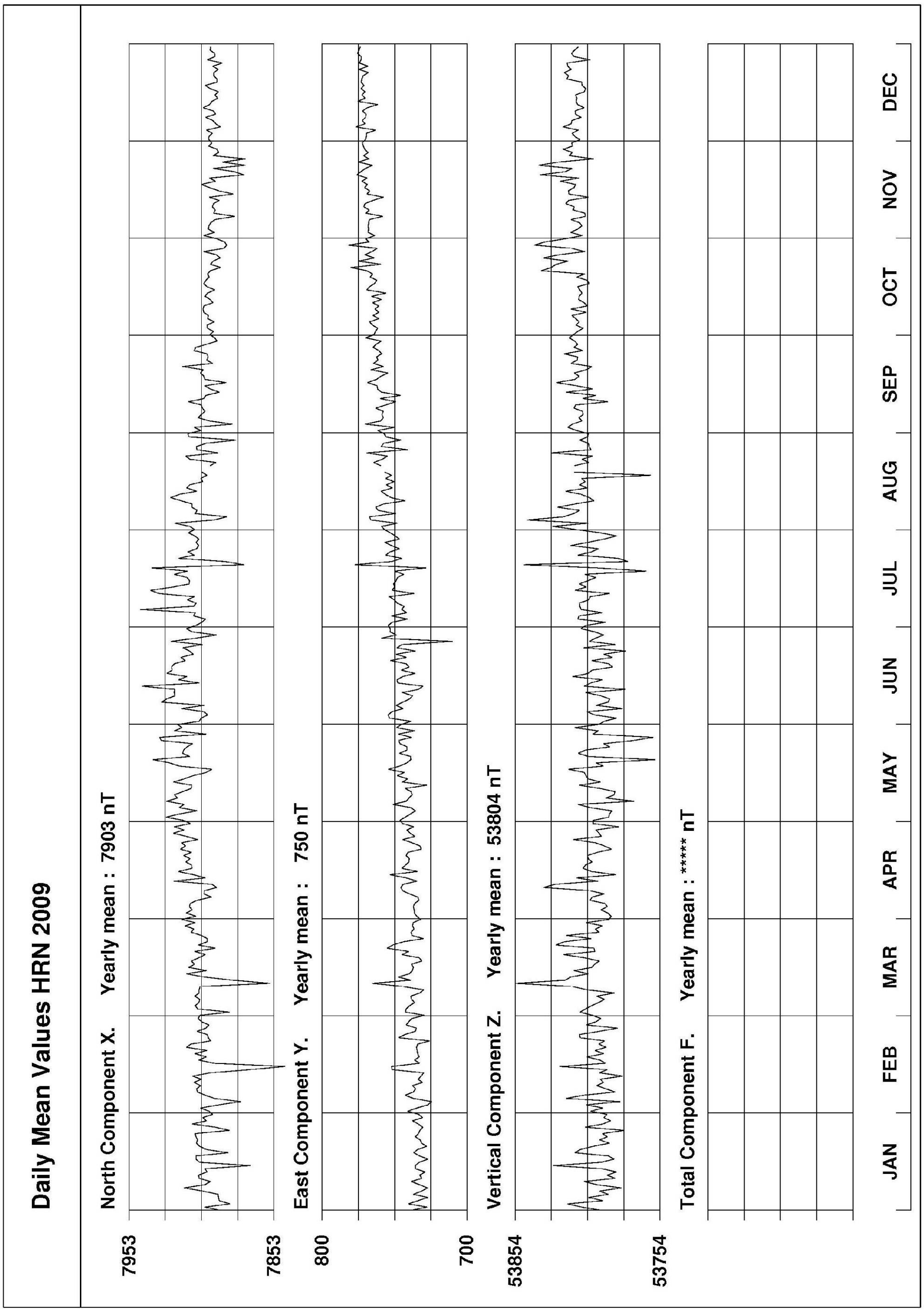

Fig. 27. Daily mean data plot for Hornsund 2009.

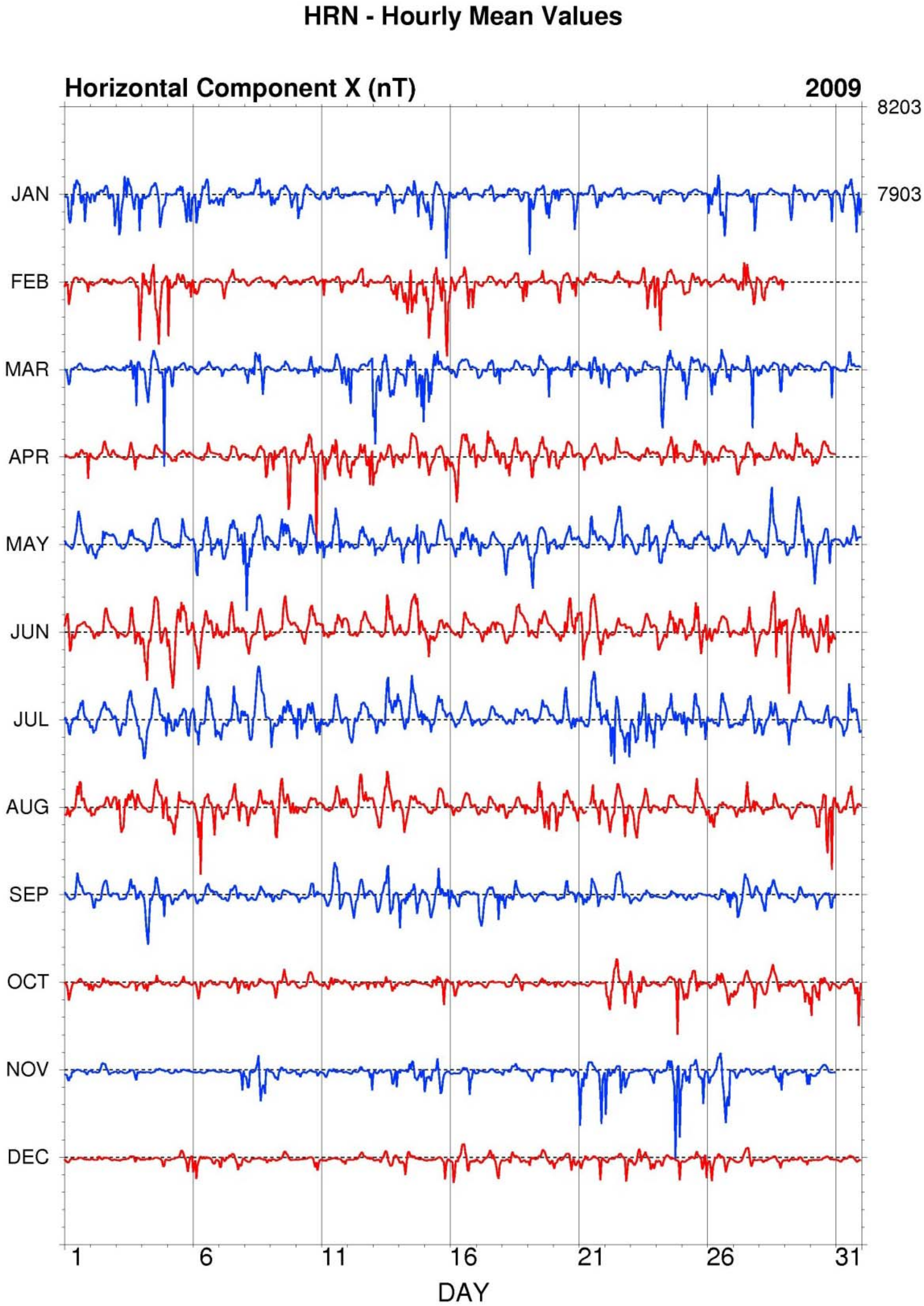

Fig. 28. Hourly mean data plot of X component for Hornsund.

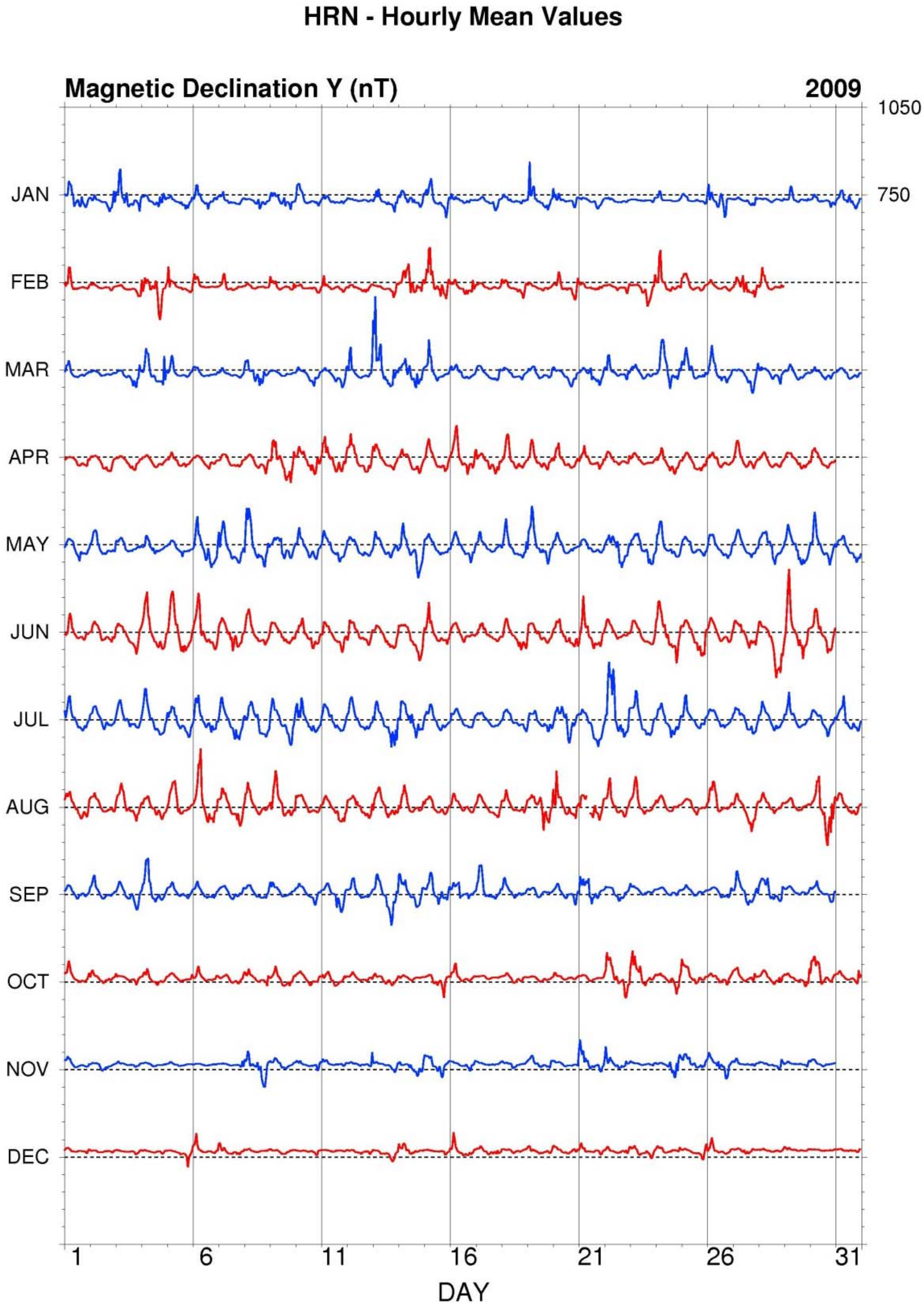

Fig. 29. Hourly mean data plot of Y component for Hornsund.

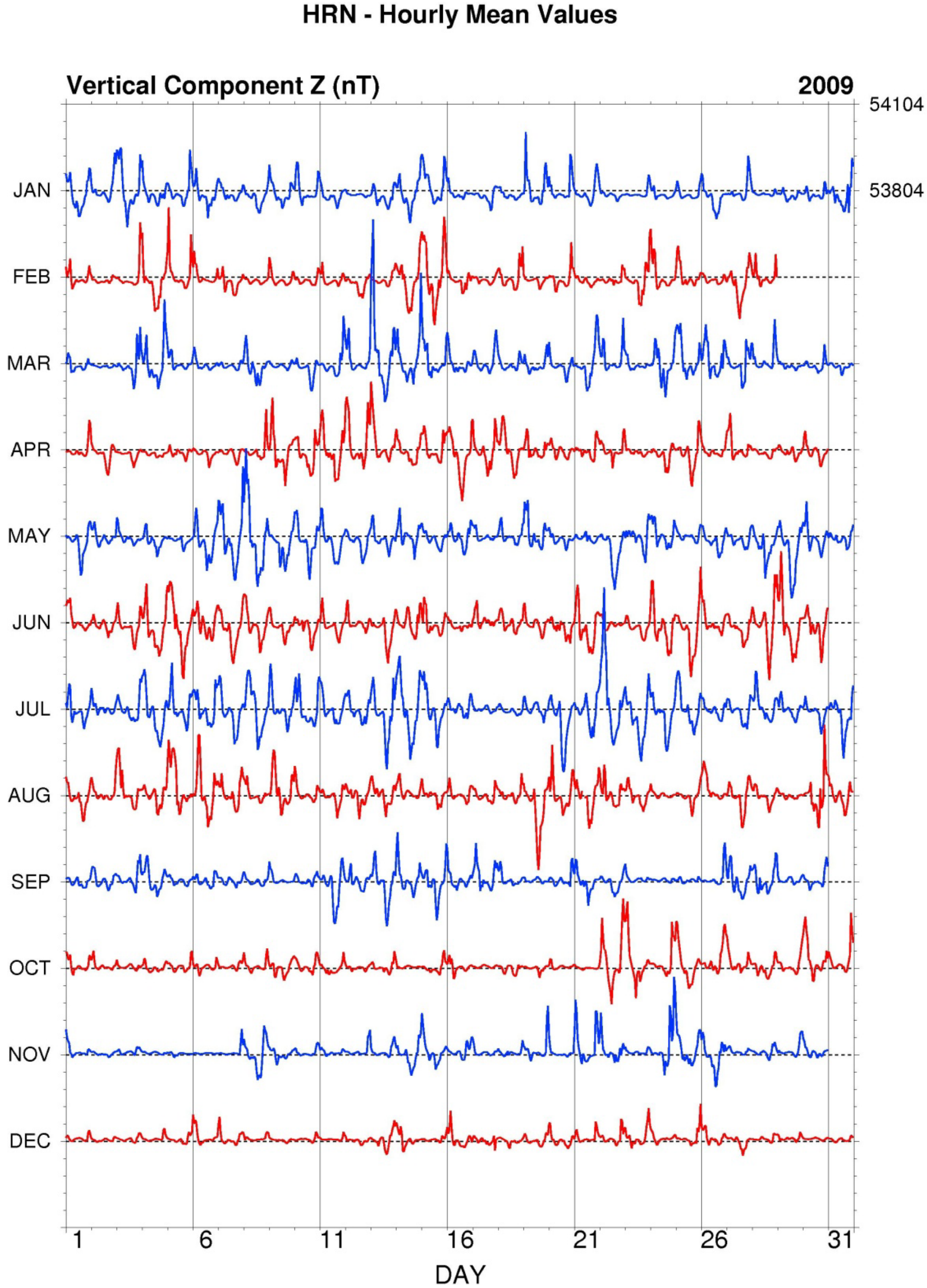

Fig. 30. Hourly mean data plot of Z component for Hornsund.