PUBLS. INST. GEOPHYS. POL. ACAD. SC., C-101 (408), 2009

Results of Geomagnetic Observations Belsk, Hel, Hornsund 2007

Jan REDA, Mariusz NESKA and Stanisław WÓJCIK

Institute of Geophysics, Polish Academy of Sciences
ul. Księcia Janusza 64, 01-452 Warszawa, Poland

1. INTRODUCTION

This publication contains basic information on geomagnetic observations carried out in 2007 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 2007, 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.

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.

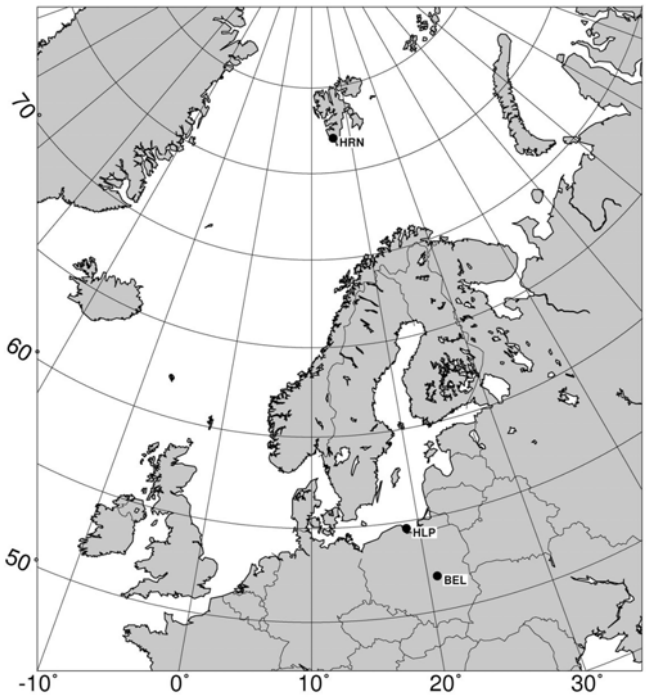

Fig. 1. Location of the Belsk, Hel and Hornsund observatories.

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

It is worth mentioning that in 2007 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.

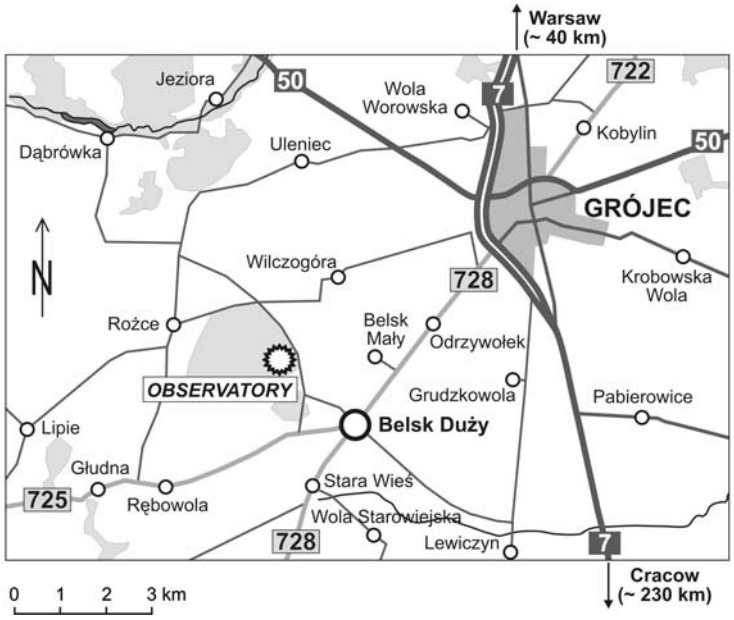

Fig. 2. Location of the Belsk Geophysical Observatory.

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.

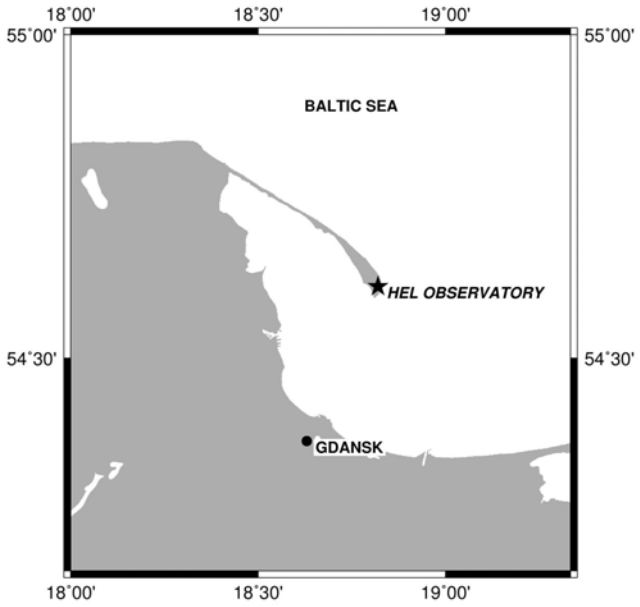

Fig. 3. Location of the Geophysical Observatory at Hel.

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

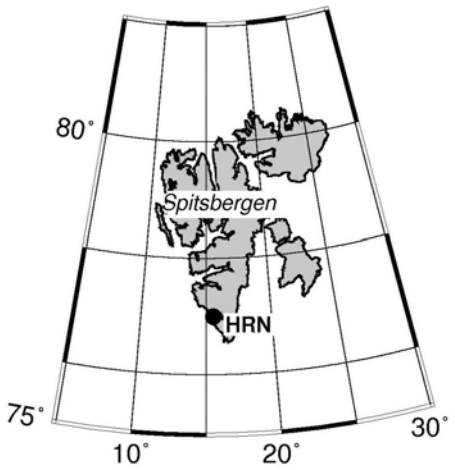

Fig. 4. Location of Polish Polar Station Hornsund.

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.

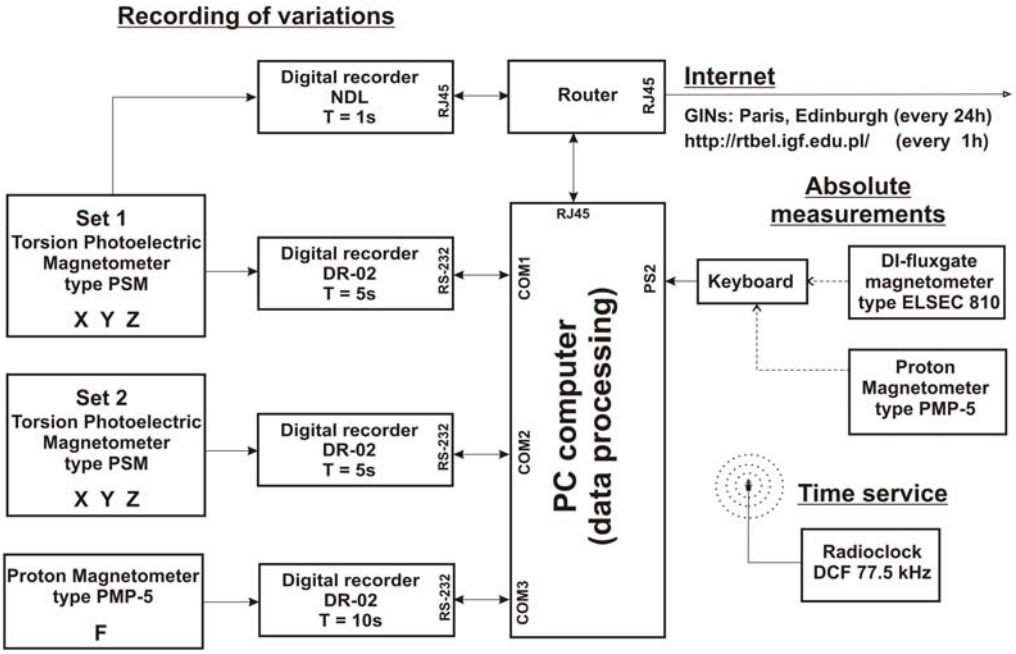

Fig. 5. Block diagram of magnetic observations system at Belsk.

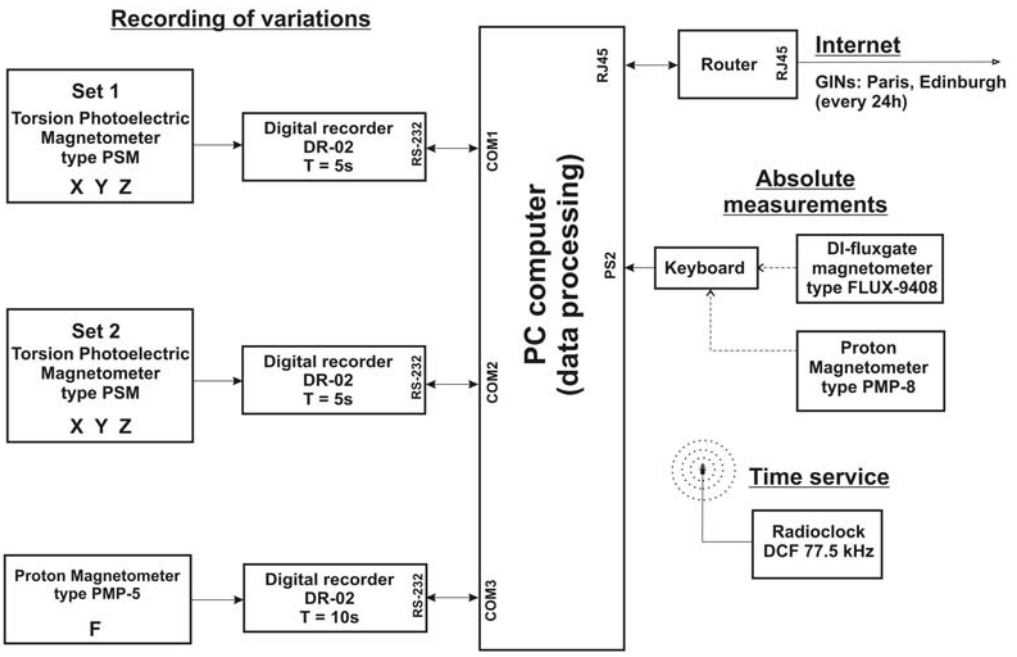

Fig. 6. Block diagram of magnetic observations system at Hel.

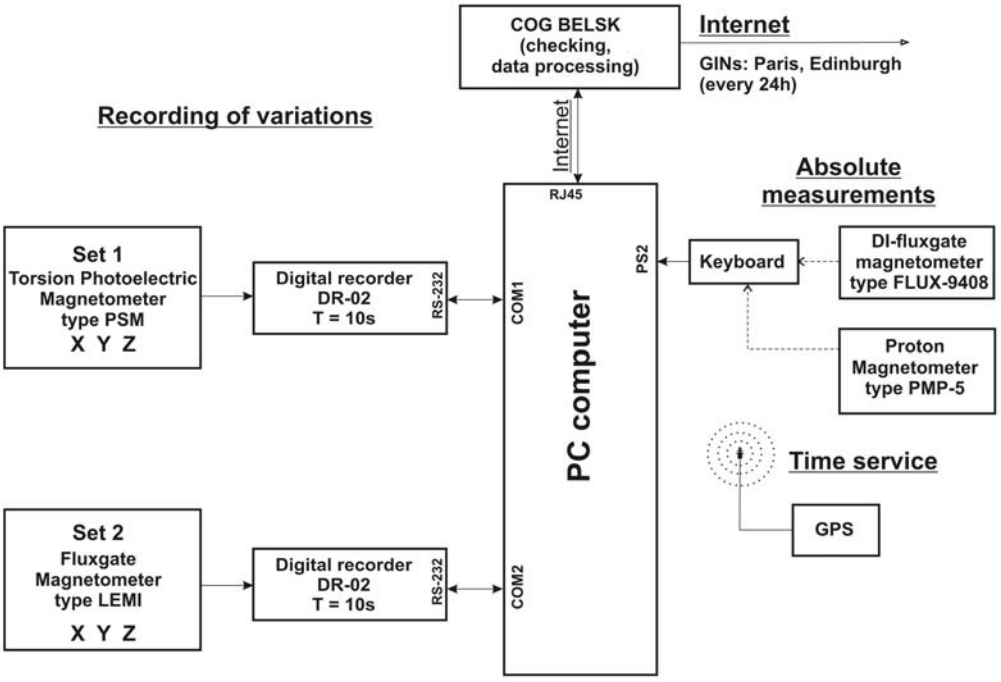

Fig. 7. Block diagram of the magnetic observations system at the Polish Polar Station Hornsund.

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], ε_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, and 25 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 2007 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 2007

Observatory	Element	Set I		Set II	
		Number of measurements [n]	Mean error [m_B]	Number of measurements [n]	Mean error [m_B]
Belsk	B_X	311	±0.5 nT	310	±0.5 nT
	B_Y	311	±0.5 nT	310	±0.6 nT
	B_Z	311	±0.3 nT	310	±0.3 nT
Hel	B_X	104	±0.5 nT	104	±0.5 nT
	B_Y	103	±0.5 nT	104	±0.6 nT
	B_Z	104	±0.3 nT	104	±0.3 nT
Hornsund	B_X	104	±1.2 nT	–	–
	B_Y	106	±1.0 nT	–	–
	B_Z	104	±0.8 nT	–	–

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.

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.

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 8511-09P	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 Producer	DR-02, DR-03 EL-LAB	DR-03 EL-LAB	DR-02 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 Producer	DR-02, DR-03 EL-LAB	DR-02 EL-LAB	DR-02 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	Institute of Geophysics PAS
	Sampling interval	10 s	10 s	–

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 0.1 nT, that of PMP-8 being 0.01 nT. 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 2007

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-Dec 31	0.0249	0.0249	0.0249
	Set II	Jan 01-Dec 31	0.0249	0.0249	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

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 and C (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 2007 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 2007 data are shown in Figs. 8 through 31 in the further part of this report.

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 data appear with one-hour delay. The Hel data are made available a few hours after the end of the day, while the delay for Hornsund is 2 days on the average. 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

Jan Reda, Mariusz Neska
Central Geophysical Observatory
05-622 Belsk
Poland
Tel.: +48 486610830 Fax: +48 486610840
E-mail: jreda@igf.edu.pl (J. Reda), nemar@igf.edu.pl (M. Neska)
http://www.igf.edu.pl/pl/obserwatoria/cog_belsk

4.2 Hel Observatory

Stanisław Wójcik
Geophysical Observatory
ul. Sosnowa 1
84-150 Hel
Poland
Tel./Fax +48 58 6750480
E-mail: hel@igf.edu.pl
http://www.igf.edu.pl

4.3 Hornsund

Mariusz Neska
Central Geophysical Observatory
05-622 Belsk
Poland
Tel.: +48 486610833 Fax: +48 486610840
E-mail: nemar@igf.edu.pl
http://hornsund.igf.edu.pl, http://www.igf.edu.pl

5. PERSONNEL TAKING PART IN THE WORK OF BELSK, HEL AND HORNSUND OBSERVATORIES IN 2007

5.1 Belsk

– Jan Reda (head of Geomagnetic Laboratory at Belsk)
– Janusz Marianiuk (consulting)
– Mariusz Neska (data processing)
– Halina Suska (data processing, observer)
– Krzysztof Kucharski (observer)
– Benedykt Pachocki (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 Modzel (observer in 1-st half-year)
– Jarosław Czyszek (observer in 1-st half-year)
– Paweł Czubak (observer in 2-nd half-year)
– Jan Reda (data processing)

References

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. (editor) (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)**, 61-67.

Technical data of PMP-8:

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

Received December 1, 2008
Accepted December 8, 2008

Tables and plots for Belsk Observatory

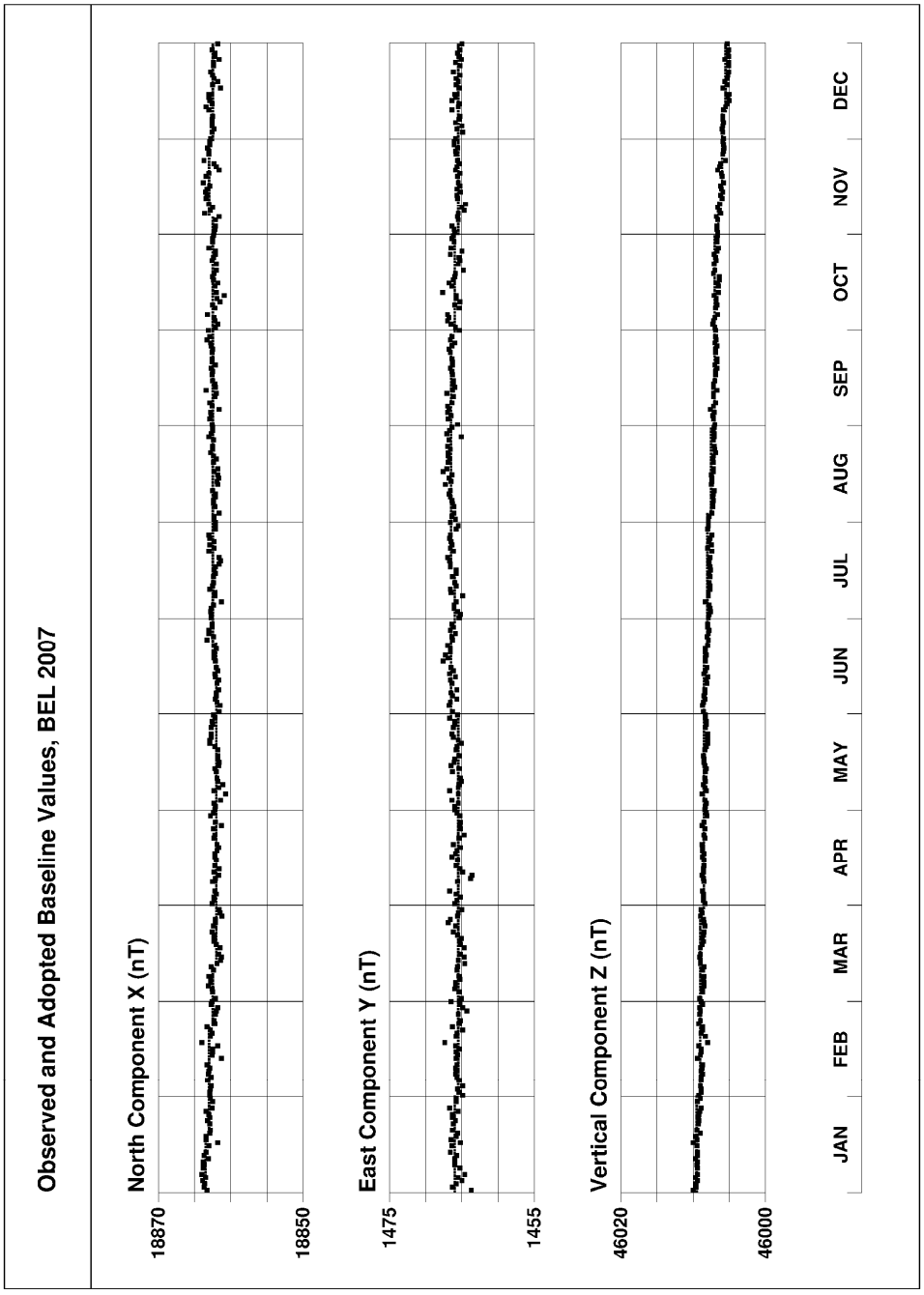

Fig. 8. Base values of set 1, Belsk 2007.

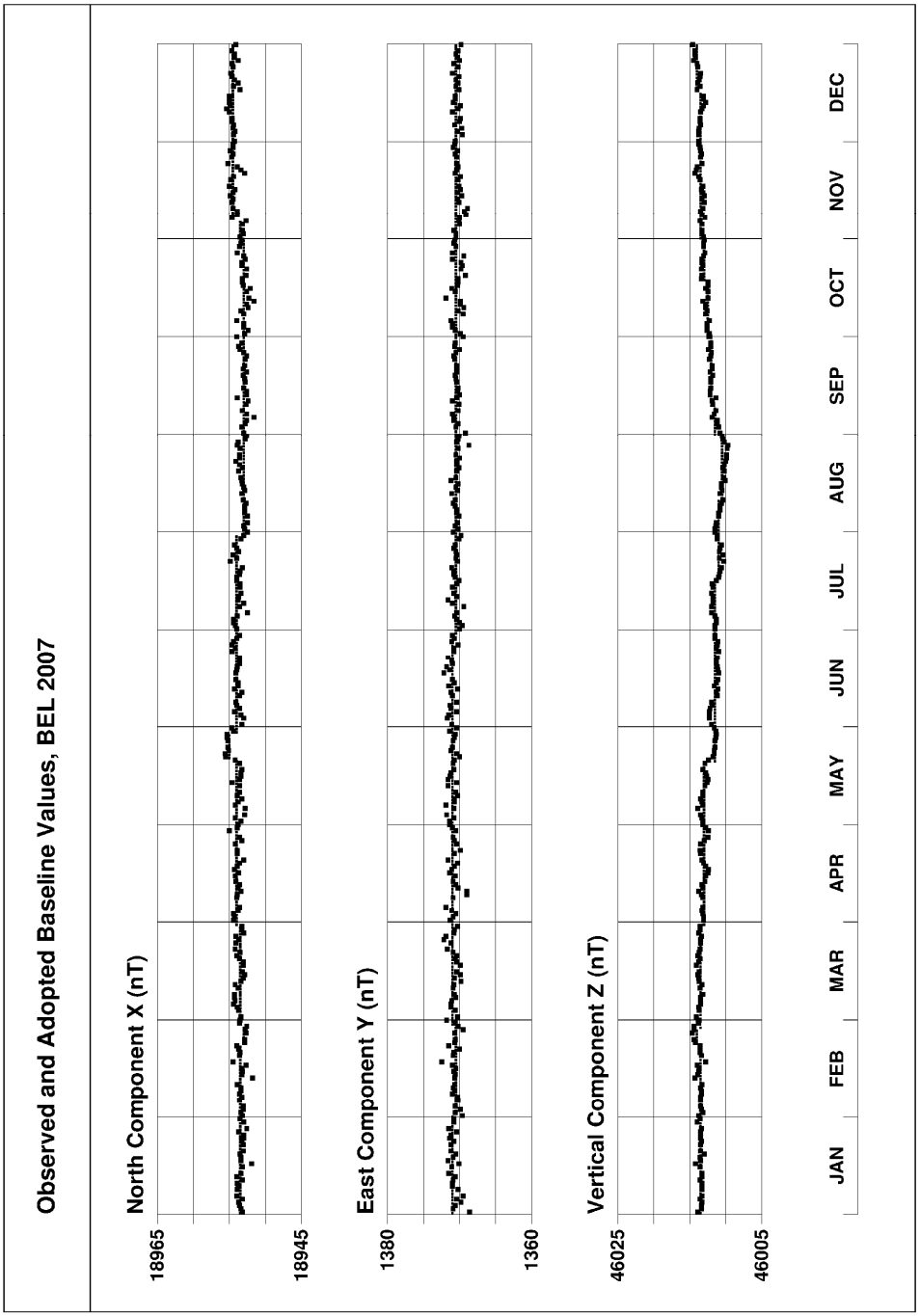

Fig. 9. Base values of set 2, Belsk 2007.

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

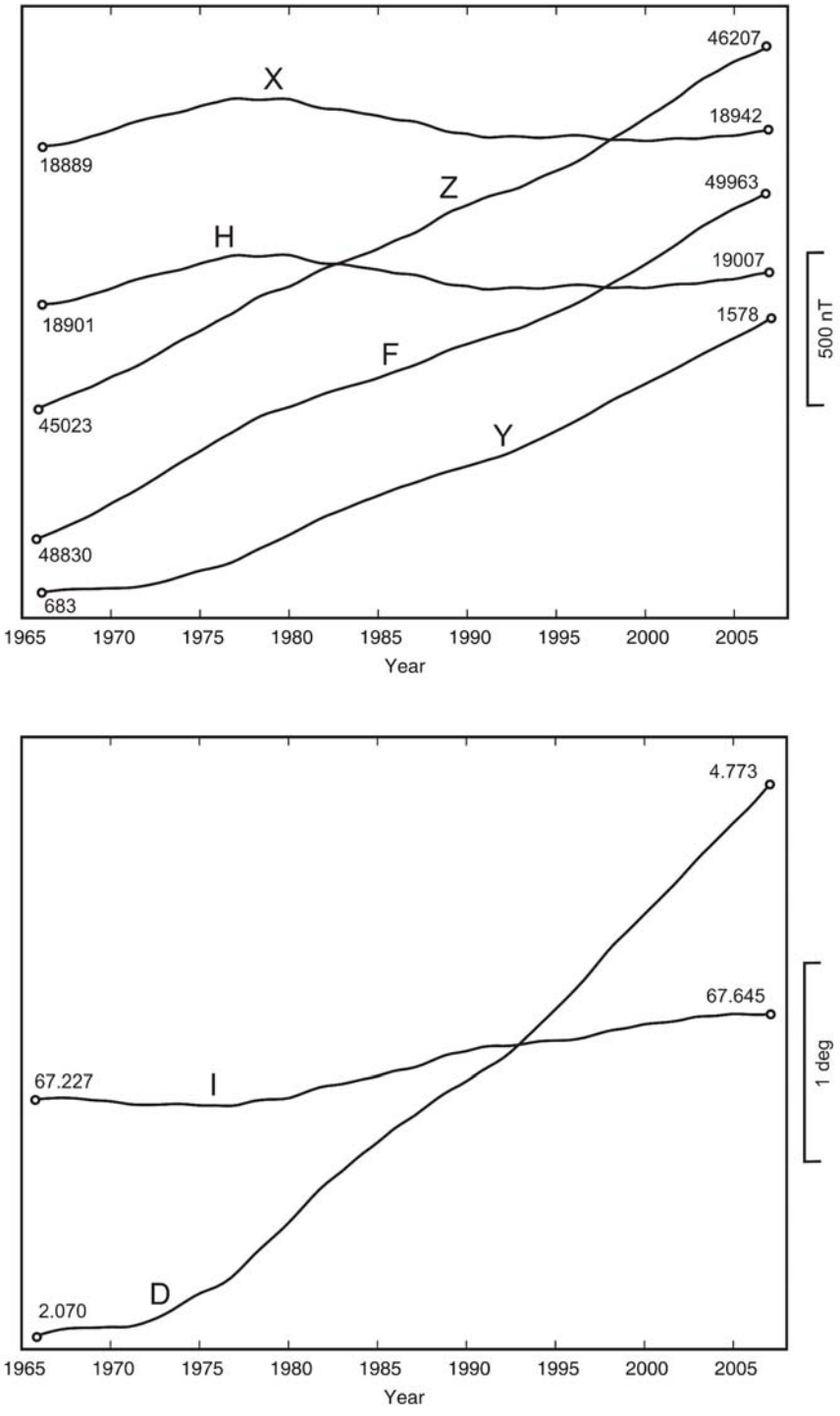

Fig. 10. Secular changes of H, X, Y, Z, F, D and I at Belsk.

MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

BELSK **2007**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
NORTH COMPONENT: 18500 + ... in nT													
All days	434	438	439	441	444	447	444	445	442	440	443	445	442
Quiet days	438	442	442	445	447	446	447	446	445	446	448	450	445
Disturbed days	427	434	434	432	439	450	443	445	437	433	431	436	437
EAST COMPONENT: 1000 + ... in nT													
All days	564	566	567	570	573	576	580	582	586	588	592	595	578
Quiet days	562	564	566	569	572	576	580	582	584	586	589	592	577
Disturbed days	568	569	570	575	577	576	580	584	588	593	598	599	581
VERTICAL COMPONENT: 46000 + ... in nT													
All days	199	199	199	199	202	204	207	209	210	215	217	220	207
Quiet days	197	198	198	198	199	203	206	208	210	213	215	218	205
Disturbed days	199	199	199	200	204	205	209	208	210	217	222	223	208

Three-hour-range K indices

Belsk, January - March, 2007

The limit of K=9 is 450

Day	January			February			March		
	K		SK	K		SK	K		SK
1	1112	4332	17	3122	2143	18	4222	3311	18
2	5323	5333	27	1121	1221	11	1121	1122	11
3	2333	4434	26	1101	1000	4	0010	0111	4
4	2333	3433	24	0011	0012	5	0111	1033	10
5	2222	3322	18	2001	2222	11	3113	2252	19
6	1211	1321	12	1222	1212	13	3423	3223	22
7	0001	1101	4	3223	2253	22	4333	3333	25
8	1100	1221	8	2322	2322	18	2111	0121	9
9	0111	1221	9	2221	1122	13	0001	1122	7
10	0222	2321	14	2111	0232	12	2111	1231	12
11	1222	2231	15	0100	0032	6	1012	2333	15
12	3001	1100	6	1012	3323	15	1213	3344	21
13	0000	0000	0	2322	2456	26	5334	4443	30
14	0011	2113	9	4233	2352	24	3323	3331	21
15	2222	5442	23	3422	2332	21	1222	2334	19
16	0411	3344	20	2121	2334	18	4211	3224	19
17	4333	3364	29	2212	3323	18	3222	1220	14
18	3333	3454	28	2012	2232	14	0012	2212	10
19	3322	3234	22	0001	1211	6	0011	1111	6
20	3222	1233	18	0011	0101	4	0000	1111	4
21	2332	2230	17	1100	0000	2	0011	1101	5
22	1011	1230	9	0000	1212	6	1111	0111	7
23	1111	0110	6	2110	0121	8	1122	3334	19
24	0001	0121	5	2011	0011	6	3323	3222	20
25	0011	0113	7	2100	1231	10	2124	3122	17
26	1111	1102	8	2322	0000	9	1112	2422	15
27	1111	1013	9	0132	1354	19	2223	2342	20
28	3201	1122	12	3443	2435	28	3212	1221	14
29	3222	6664	31				0110	0112	6
30	3433	4444	29				3112	1000	8
31	3223	3554	27				0121	2112	10

Three-hour-range K indices

Belsk, April - June, 2007

The limit of K=9 is 450

Day	April			May			June		
	K		SK	K		SK	K		SK
1	5333	4345	30	2221	1222	14	2213	1332	17
2	3433	3343	26	1110	0101	5	2223	1322	17
3	3221	1432	18	1011	2320	10	2222	3433	21
4	2312	2123	16	1001	1011	5	3212	3331	18
5	1111	1212	10	1000	1001	3	0101	1212	8
6	2110	1111	8	0000	0011	2	0201	0111	6
7	3100	0100	5	1133	4534	24	1111	1111	8
8	0011	1113	8	2333	3332	22	2322	3223	19
9	3333	1112	17	1222	3222	16	1122	2222	14
10	2102	3333	17	1011	1232	11	2223	1121	14
11	2211	1011	9	0101	2221	9	1011	0222	9
12	2222	3321	17	1112	1101	8	0111	1111	7
13	1001	0010	3	1101	0110	5	0022	1332	13
14	0111	2213	11	0112	0121	8	3334	3434	27
15	3222	2210	14	1112	2122	12	2222	2211	14
16	0010	0000	1	1111	1113	10	2312	3321	17
17	0122	3434	19	1101	2123	11	2222	3221	16
18	3311	1233	17	3244	5333	27	1112	1231	12
19	2112	1112	11	2233	3332	21	2121	2211	12
20	1101	1112	8	3212	1222	15	1111	1211	9
21	0100	0111	4	2101	1223	12	1224	4434	24
22	2213	3333	20	2122	4444	23	3223	3324	22
23	4542	1200	18	4343	4354	30	3322	2222	18
24	1112	1122	11	5332	4444	29	2222	3231	17
25	2111	3210	11	1223	3442	21	1111	2211	10
26	2111	2323	15	2323	3432	22	0211	2111	9
27	2113	2455	23	2333	3432	23	2111	1112	10
28	4334	4444	30	2212	2001	10	1101	2212	10
29	4444	3333	28	0111	2211	9	1212	2343	18
30	4332	2321	20	1111	1111	8	2211	1111	10
31				1111	1122	10			

Three-hour-range K indices

Belsk, July - September, 2007

The limit of K=9 is 450

Day	July			August			September		
	K		SK	K		SK	K		SK
1	1112	2212	12	4333	3333	25	1123	2334	19
2	1121	2100	8	2122	2211	13	5323	4343	27
3	1112	2323	15	1111	2212	11	3223	3323	21
4	3235	4431	25	0111	0101	5	2222	2122	15
5	2112	2122	13	0001	0112	5	3332	2233	21
6	1112	2331	14	1012	2346	19	3212	1335	20
7	2221	2222	15	4333	3444	28	3321	2321	17
8	2111	1110	8	2221	2112	13	2122	2231	15
9	0111	1010	5	1112	1111	9	0111	1101	6
10	0121	1124	12	1113	4543	22	1111	0110	6
11	4445	3421	27	2222	2343	20	0001	1111	5
12	2231	2221	15	2212	1111	11	1111	1001	6
13	1101	1112	8	1111	1101	7	0111	1021	7
14	2223	4563	27	1001	1113	8	2001	2332	13
15	4232	1221	17	3311	2332	18	2012	2222	13
16	1112	1121	10	2122	1121	12	1111	1210	8
17	1111	1010	6	2111	1122	11	0011	1023	8
18	1111	0100	5	2011	0110	6	3101	0110	7
19	0111	1011	6	0012	3211	10	1122	2111	11
20	0234	4314	21	1111	1112	9	0113	3344	19
21	2322	3242	20	2102	2211	11	3112	2224	17
22	1111	0210	7	0111	2221	10	3222	3343	22
23	1112	1112	10	0111	1010	5	3433	2234	24
24	0111	2101	7	0101	0110	4	4332	2322	21
25	0001	1110	4	2112	3232	16	3211	1332	16
26	0001	2433	13	2222	3443	22	1122	0021	9
27	3322	3211	17	3232	2353	23	0003	2554	19
28	1111	1113	10	3223	2222	18	4342	2355	28
29	4423	3334	26	2111	2132	13	4444	4344	31
30	3232	2321	18	1211	1021	9	3332	2242	21
31	1122	3212	14	1112	1233	14			

Three-hour-range K indices

Belsk, October - December, 2007

The limit of K=9 is 450

Day	October		November		December	
	K	SK	K	SK	K	SK
1	3222 2323	19	3111 1121	11	3111 1011	9
2	1111 0024	10	1111 1011	7	0111 0110	5
3	4332 4343	26	0001 1110	4	0000 0000	0
4	3223 2330	18	1000 1431	10	1001 1111	6
5	1212 2131	13	1111 0001	5	2111 1000	6
6	1011 1112	8	0000 1100	2	0111 2122	10
7	1111 1101	7	0001 0001	2	1110 0020	5
8	0010 0012	4	1110 1112	8	0000 0002	2
9	0111 0010	4	2111 2213	13	2101 1231	11
10	0110 0000	2	3011 2210	10	0111 2225	14
11	0000 0012	3	2111 1111	9	3322 3444	25
12	0112 1223	12	0011 1232	10	3233 2113	18
13	0011 1012	6	3222 3134	20	2211 1130	11
14	2122 1211	12	3222 3322	19	1212 1121	11
15	2111 1111	9	2111 3233	16	1111 1201	8
16	0001 1210	5	1112 2333	16	1110 0113	8
17	1000 0010	2	4221 1320	15	2233 4434	25
18	1223 2233	18	1111 1200	7	4333 3444	28
19	3323 4343	25	1010 0023	7	3222 3133	19
20	3332 1331	19	3224 6544	30	3222 3543	24
21	1121 1132	12	3324 3322	22	3222 3442	22
22	2111 1242	14	1211 1443	17	1211 3342	17
23	3212 2131	15	4322 3232	21	2222 3323	19
24	1001 1221	8	2222 2543	22	1111 0122	9
25	1013 3454	21	2233 3443	24	1010 1100	4
26	2222 3442	21	3223 2122	17	1011 1112	8
27	2323 3423	22	1211 1222	12	1211 0123	11
28	2212 3421	17	2111 1312	12	3211 1120	11
29	2111 3355	21	0001 1321	8	0001 1112	6
30	3321 2322	18	0011 1222	9	1101 1110	6
31	2111 2231	13			0001 2132	9

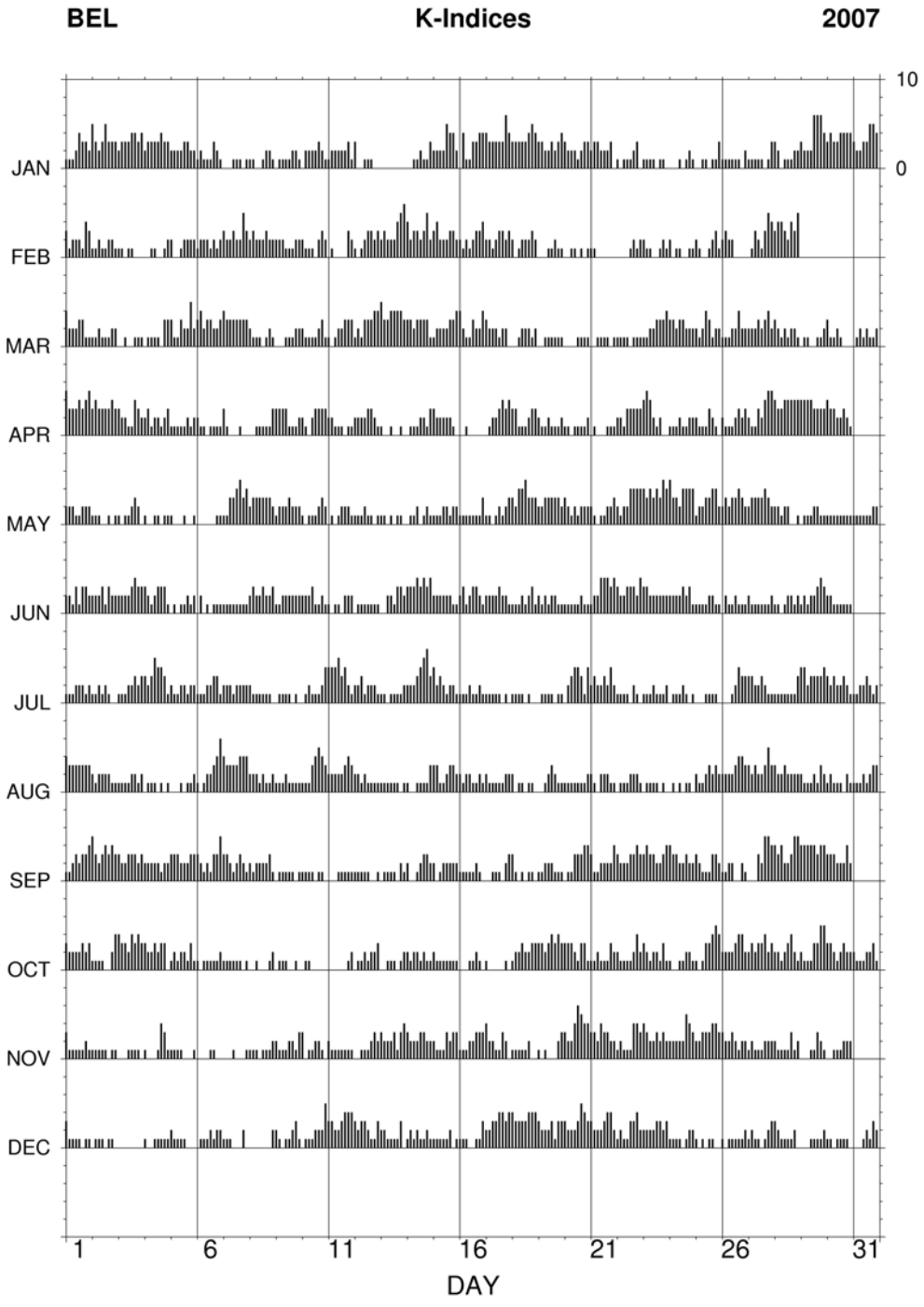

Fig. 11. K-indices in graphical form, Belsk 2007.

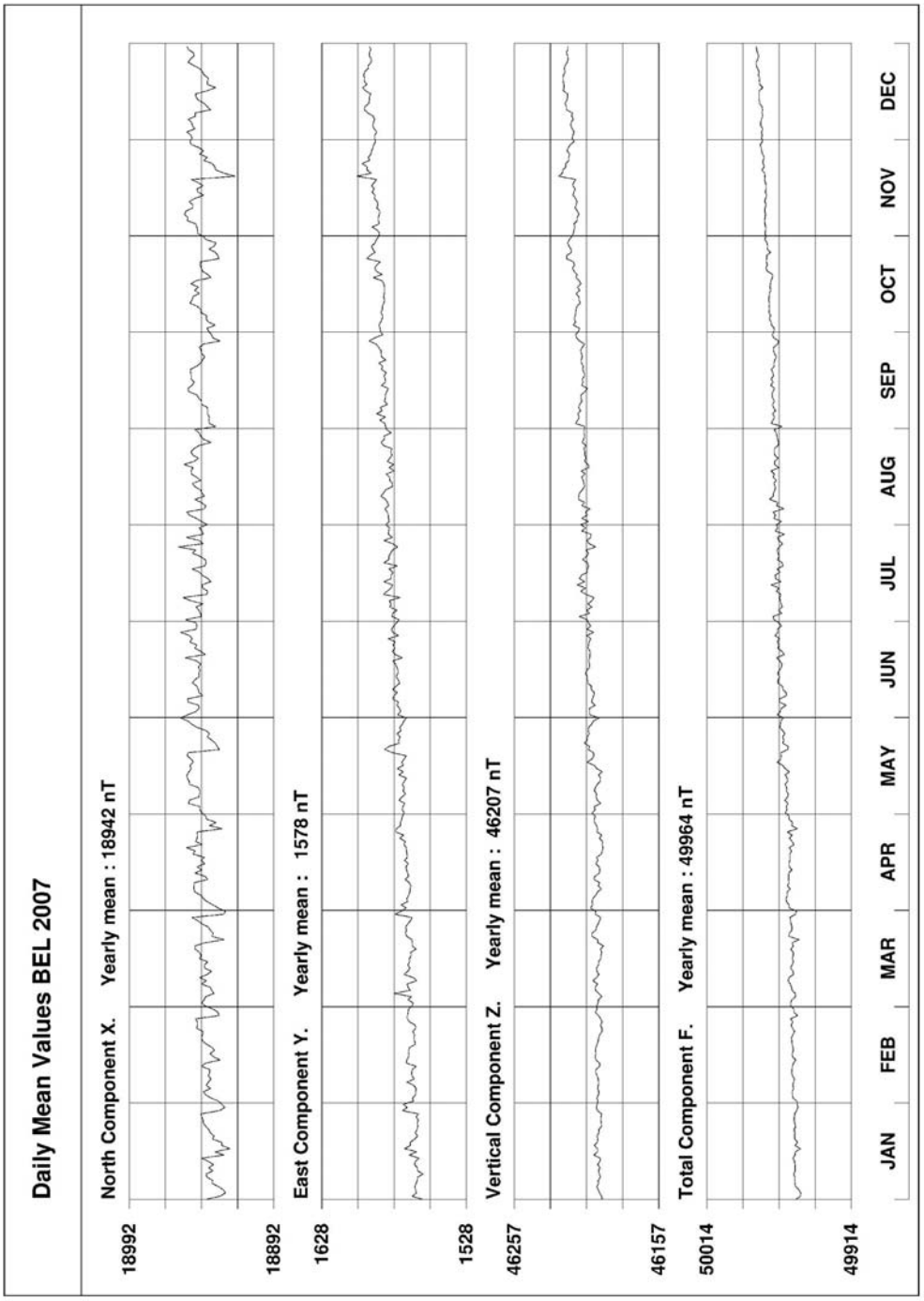

Fig. 12. Daily mean data plot for Belsk 2007.

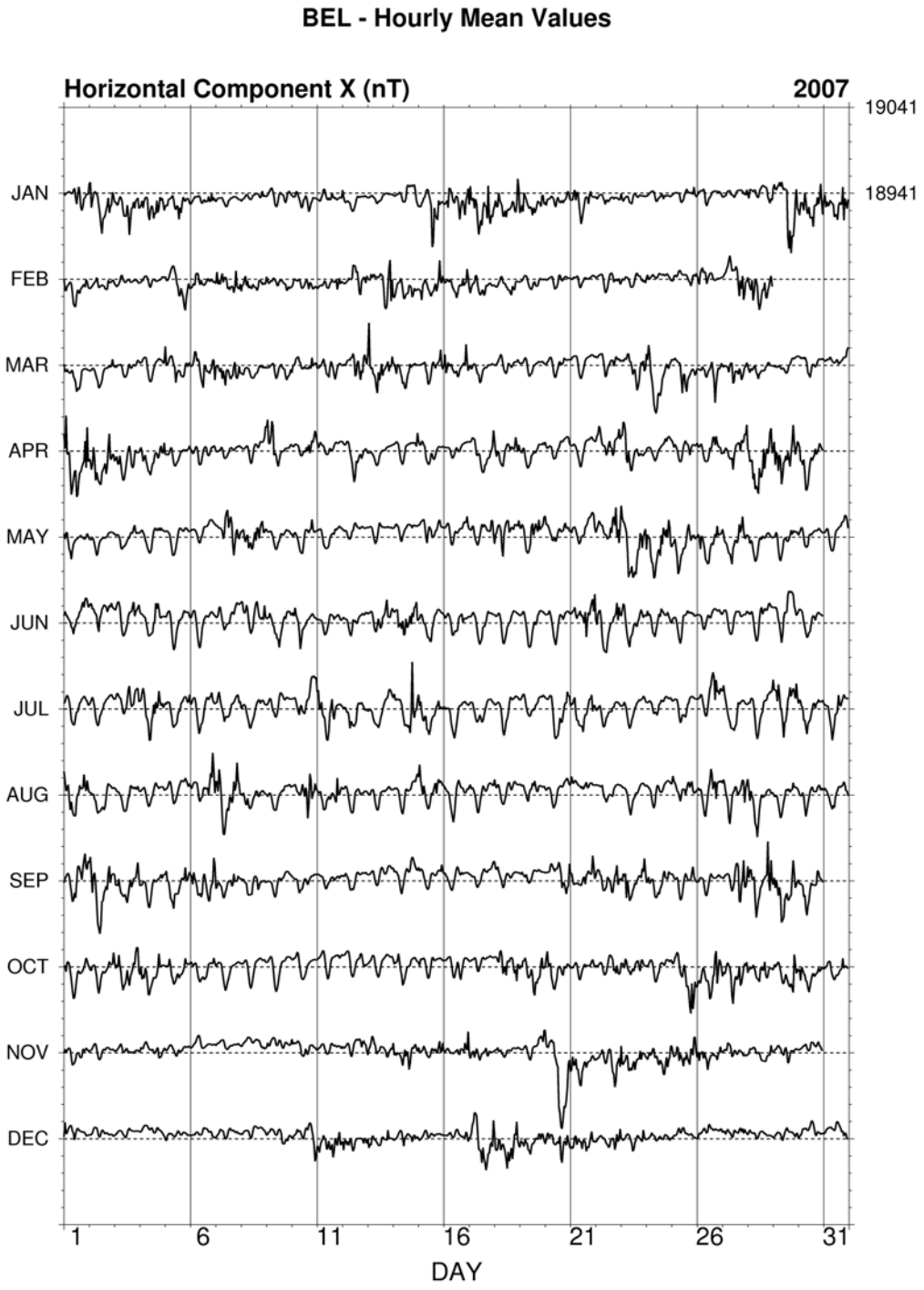

Fig. 13. Hourly mean data plot of X component for Belsk 2007.

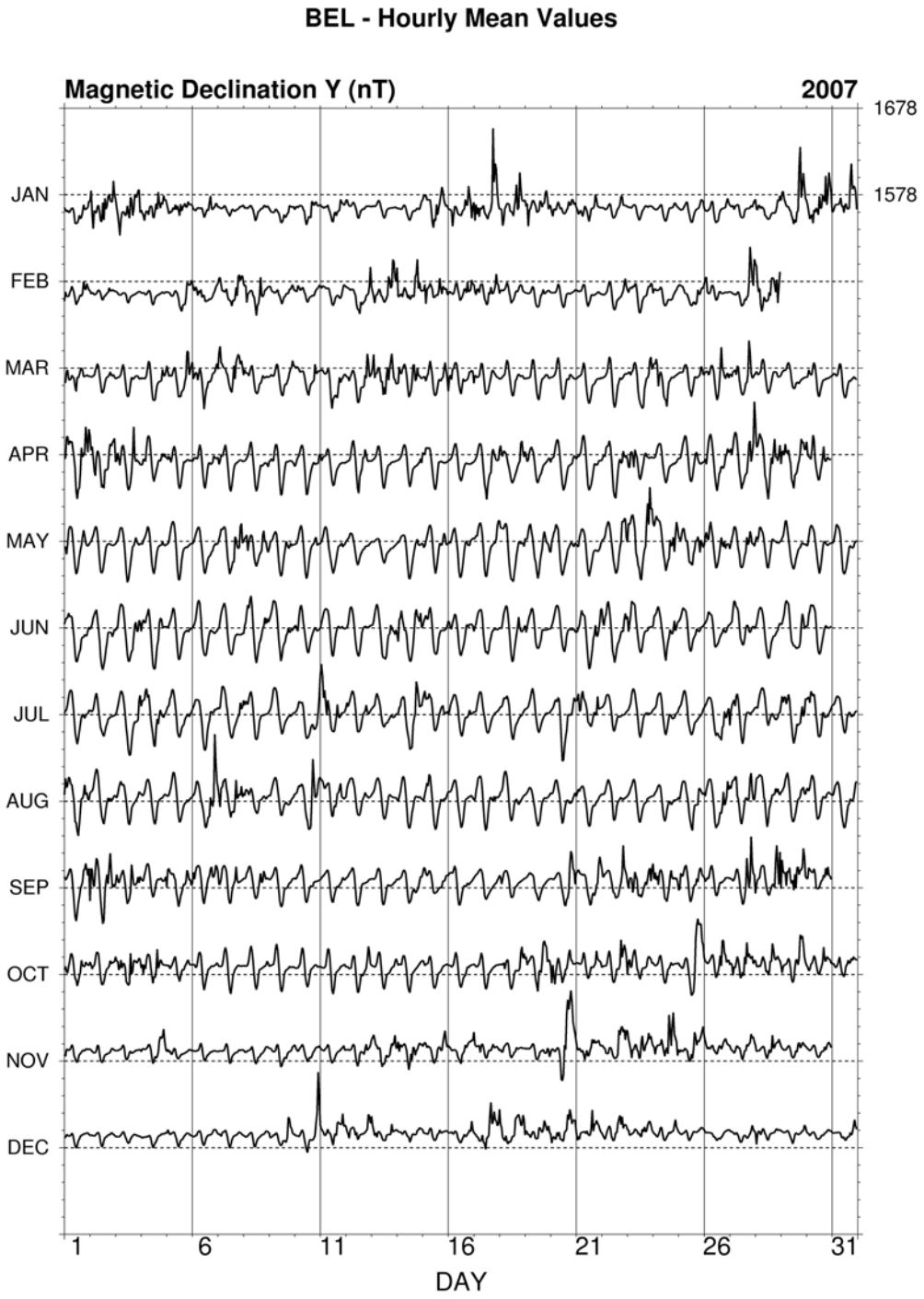

Fig. 14. Hourly mean data plot of Y component for Belsk 2007.

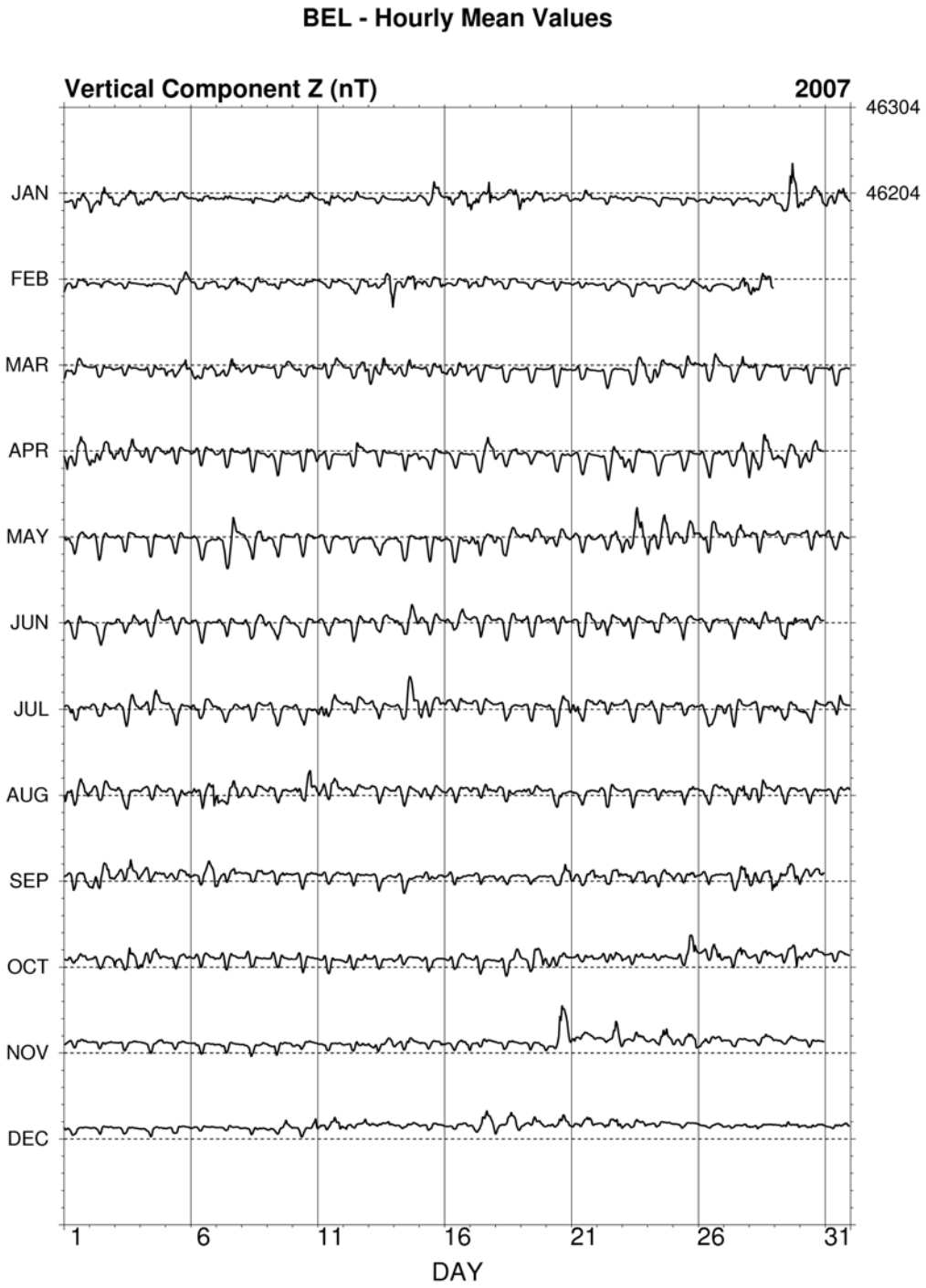

Fig. 15. Hourly mean data plot of Z component for Belsk 2007.

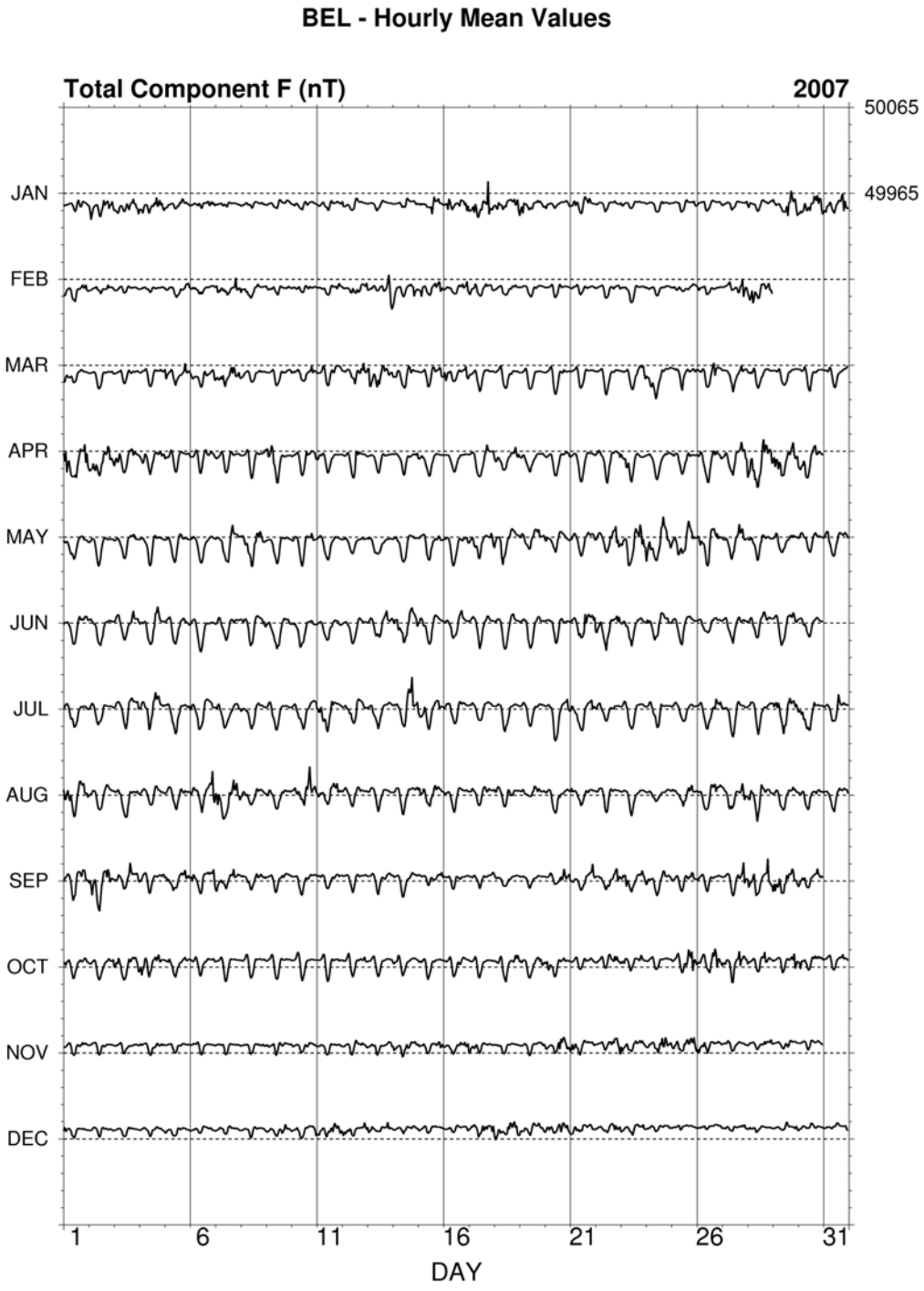

Fig. 16. Hourly mean data plot of F component for Belsk 2007.

Tables and plots for Hel Observatory

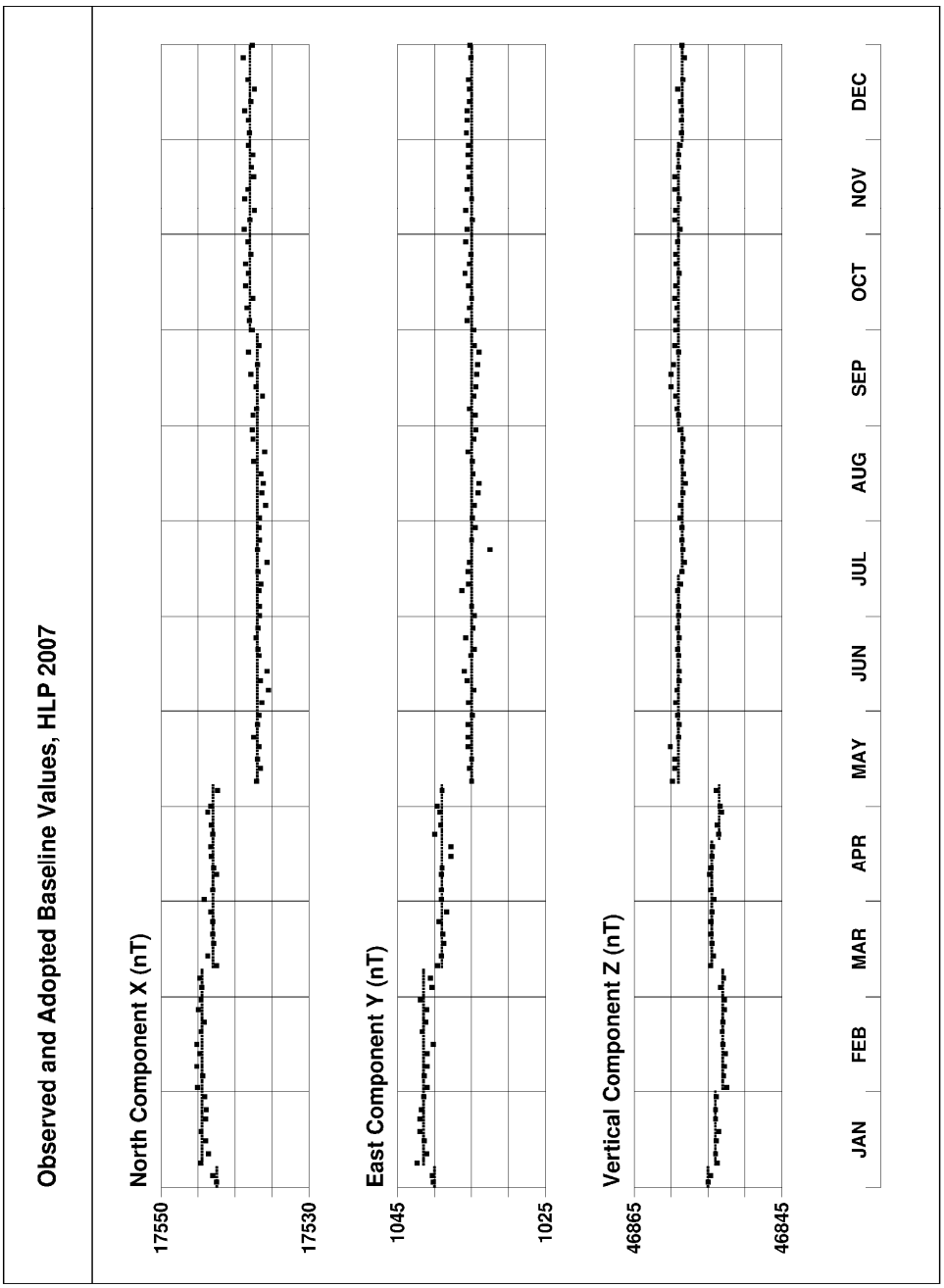

Fig. 17. Base values of set 1, Hel 2007.

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
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

No	Year	D [º ‘]	H [nT]	Z [nT]	X [nT]	Y [nT]	I [º ‘]	F [nT]
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

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

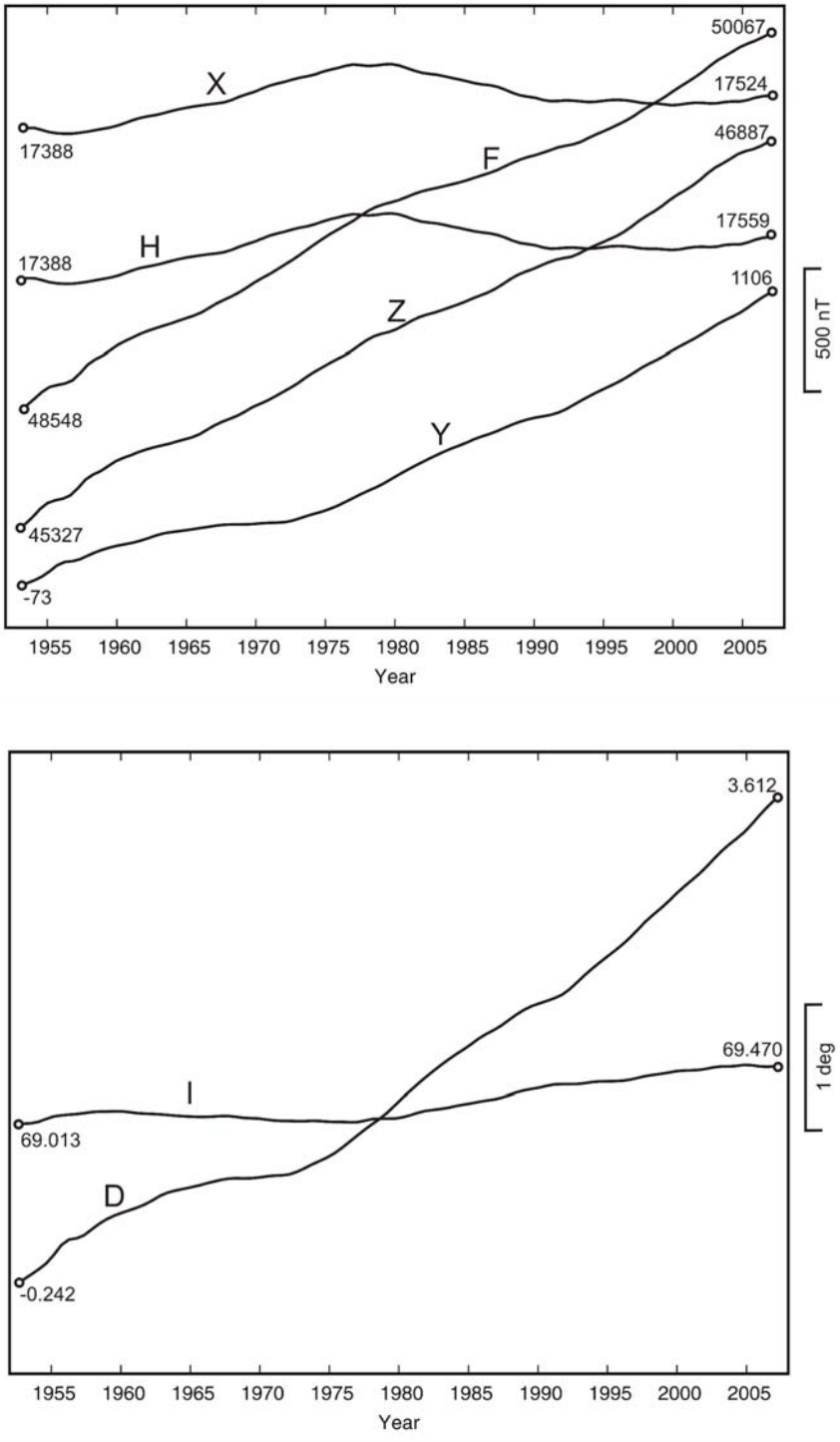

Fig. 18. Secular changes of H, X, Y, Z, F, D and I at Hel.

MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

HEL **2007**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
						NORTH COMPONENT: 17000 + ... in nT							
All days	517	521	521	522	526	530	527	527	524	522	524	525	524
Quiet days	521	525	524	526	528	528	529	529	527	527	529	530	527
Disturbed days	510	517	517	514	522	532	526	528	519	515	512	517	519
						EAST COMPONENT: 500 + ... in nT							
All days	594	596	596	598	600	602	606	609	613	616	621	624	606
Quiet days	592	594	595	597	598	602	607	608	610	614	617	621	605
Disturbed days	598	599	599	603	604	602	606	610	616	620	626	627	609
						VERTICAL COMPONENT: 46500 + ... in nT							
All days	379	379	380	381	383	385	387	388	391	396	399	401	387
Quiet days	378	378	379	380	380	384	386	388	391	394	396	399	386
Disturbed days	380	378	378	380	385	385	389	387	389	399	405	404	388

Three-hour-range K indices

Hel, January - March, 2007

The limit of K=9 is 550

Day	January		February		March	
	K	SK	K	SK	K	SK
1	1102 3332	15	3122 1133	16	4222 3311	18
2	4323 4334	26	1122 1221	12	0021 1122	9
3	2333 4433	25	1101 0000	3	0000 0101	2
4	2333 3432	23	0001 0001	2	0011 1022	7
5	2222 3222	17	2001 2222	11	3013 2153	18
6	1210 1321	11	1222 0111	10	3423 3213	21
7	0000 1000	1	3123 2253	21	4233 3333	24
8	1001 0221	7	2321 2321	16	2110 0120	7
9	0010 1121	6	2221 0122	12	0001 1122	7
10	0211 1311	10	1000 0231	7	1011 1231	10
11	1122 2121	12	0000 0022	4	1012 2323	14
12	3001 0000	4	0002 3323	13	1223 3233	19
13	0000 0000	0	2322 1355	23	4334 4443	29
14	0011 2122	9	4233 2352	24	3323 3331	21
15	2122 5341	20	3423 2332	22	1122 3334	19
16	0411 2334	18	2111 2233	15	4211 3124	18
17	4333 3353	27	2212 3223	17	3222 2220	15
18	2333 3444	26	1012 1232	12	0011 2211	8
19	2322 3224	20	0001 1201	5	0001 1101	4
20	2222 1223	16	0001 0100	2	0000 1011	3
21	2222 1230	14	1000 0000	1	0011 1100	4
22	1011 1130	8	0000 1112	5	1011 0101	5
23	1211 0100	6	2100 0021	6	1113 3324	18
24	0000 0110	2	2000 0010	3	3323 3222	20
25	0011 0112	6	1000 1121	6	2123 3122	16
26	1011 1101	6	2322 1000	10	1112 2422	15
27	1100 1013	7	0032 1344	17	2223 2242	19
28	3101 0122	10	3433 2434	26	3222 1221	15
29	3222 5564	29			0101 1112	7
30	3433 4344	28			3112 1000	8
31	3223 3553	26			0121 2112	10

Three-hour-range K indices

Hel, April - June, 2007

The limit of K=9 is 550

Day	April			May			June		
	K		SK	K		SK	K		SK
1	4433	4335	29	2221	2221	14	2113	1232	15
2	3433	3343	26	1100	1101	5	2222	1322	16
3	3221	2422	18	1011	2321	11	2222	3433	21
4	3222	2223	18	1001	1010	4	3212	3331	18
5	1111	1102	8	1000	0001	2	0001	1211	6
6	2110	1111	8	0000	0001	1	0101	1101	5
7	3100	1100	6	1033	4534	23	1101	1111	7
8	0011	1102	6	2333	3332	22	2222	3223	18
9	3233	1112	16	1222	3212	15	1122	2222	14
10	2102	3333	17	0000	1231	7	2122	2121	13
11	2211	1001	8	0001	2121	7	1001	0211	6
12	2222	4321	18	1102	0100	5	0001	1011	4
13	1011	0000	3	1101	0100	4	1022	2332	15
14	0111	2213	11	0002	0220	6	3234	3434	26
15	2122	2100	10	1012	2111	9	2222	2211	14
16	0000	1000	1	1101	1112	8	2211	3211	13
17	0122	4334	19	1111	2113	11	2122	3221	15
18	2212	1233	16	3234	5323	25	1112	1321	12
19	2111	2112	11	2233	3332	21	2111	2211	11
20	1000	1102	5	3213	1122	15	1111	1201	8
21	0100	1011	4	2101	1223	12	0124	4434	22
22	2213	3333	20	1122	4444	22	3223	3324	22
23	3442	1200	16	4343	4354	30	2322	2122	16
24	1111	1222	11	5333	4444	30	2212	3231	16
25	2111	3210	11	1223	3442	21	1001	2211	8
26	2112	2322	15	2323	3432	22	0112	2111	9
27	2113	3345	22	2223	3432	21	2111	1112	10
28	4334	4444	30	2212	2001	10	1001	2212	9
29	3343	3333	25	0001	2211	7	1212	2333	17
30	4332	3321	21	1101	1100	5	2211	1110	9
31				1111	1122	10			

Three-hour-range K indices

Hel, July - September, 2007

The limit of K=9 is 550

Day	July			August			September		
	K		SK	K		SK	K		SK
1	1112	2212	12	4233	3333	24	1123	2333	18
2	0121	2100	7	1122	2311	13	4323	4343	26
3	1112	2323	15	1111	2211	10	3223	3323	21
4	3235	4431	25	0001	1101	4	2222	2122	15
5	2112	2122	13	0001	1112	6	3333	2232	21
6	1112	2231	13	1012	2346	19	2312	1334	19
7	2111	2222	13	4333	3444	28	3322	2321	18
8	2211	1110	9	2221	2111	12	2122	2321	15
9	0101	1010	4	1111	1111	8	0011	1101	5
10	0121	1024	11	1113	5543	23	0011	1110	5
11	3444	3421	25	2222	2343	20	0001	1111	5
12	2221	2211	13	2112	2111	11	1111	0001	5
13	0110	1113	8	1001	1001	4	0001	0021	4
14	1122	4453	22	1001	1113	8	1001	2232	11
15	3232	2221	17	3312	2322	18	2012	2222	13
16	1101	1121	8	2122	1121	12	1101	1110	6
17	1011	1010	5	2001	1121	8	0001	1022	6
18	1111	0100	5	1001	1010	4	2101	1000	5
19	0001	1101	4	0002	3200	7	1122	2110	10
20	0224	5324	22	1101	1111	7	0203	3343	18
21	2322	3242	20	2002	2211	10	2111	2224	15
22	1111	0210	7	0112	2210	9	3222	3343	22
23	1112	1112	10	0001	1110	4	2333	2233	21
24	0101	2101	6	0101	0110	4	3322	3322	20
25	0001	1110	4	3103	4232	18	3212	1232	16
26	0001	2433	13	1112	3443	19	1122	0011	8
27	3221	3201	14	3232	2343	22	0003	2543	17
28	0111	1113	9	2213	2122	15	4332	2355	27
29	4323	3334	25	2111	2122	12	4344	4343	29
30	2232	2321	17	1112	1021	9	3332	2232	20
31	1122	3212	14	1112	1233	14			

Three-hour-range K indices

Hel, October - December, 2007

The limit of K=9 is 550

Day	October		November		December	
	K	SK	K	SK	K	SK
1	2212 2222	15	3111 1121	11	3001 0000	4
2	1111 0024	10	1110 0001	4	0011 0110	4
3	3322 4343	24	0000 0000	0	0000 0000	0
4	3223 3330	19	1000 1331	9	1000 0001	2
5	1212 2121	12	0111 0002	5	2010 0000	3
6	1011 1012	7	0000 1000	1	0111 2021	8
7	0011 1001	4	0000 0001	1	0100 0010	2
8	0000 0012	3	1010 1112	7	0000 0001	1
9	0000 0010	1	2101 2112	10	2100 1131	9
10	0000 0000	0	2011 1200	7	0111 2225	14
11	0000 0011	2	1011 1011	6	3222 3443	23
12	0022 1123	11	0001 0232	8	2233 1113	16
13	0001 1011	4	3222 3124	19	2211 1130	11
14	1111 1101	7	3222 2322	18	0112 1121	9
15	2001 1010	5	2111 3233	16	1002 0100	4
16	0011 1210	6	1111 2233	14	1000 0113	6
17	1000 0010	2	3121 1320	13	2233 4434	25
18	1224 2233	19	1100 0100	3	3323 3444	26
19	2323 3343	23	1000 0023	6	2222 2133	17
20	3322 1331	18	3123 5544	27	2222 3543	23
21	1121 2132	13	3323 3322	21	3232 3442	23
22	2100 1232	11	0212 1443	17	1211 3342	17
23	3211 2121	13	4222 3232	20	2122 2223	16
24	1001 1210	6	2122 2443	20	1001 0122	7
25	1013 3454	21	2232 2433	21	0000 1000	1
26	2222 3442	21	3223 1122	16	1000 0001	2
27	2323 3423	22	1211 1222	12	1111 1123	11
28	2112 2421	15	1011 1312	10	3111 1111	10
29	2111 3355	21	0001 1210	5	0000 0012	3
30	3222 1321	16	0011 1221	8	1000 1110	4
31	2111 2231	13			0001 2232	10

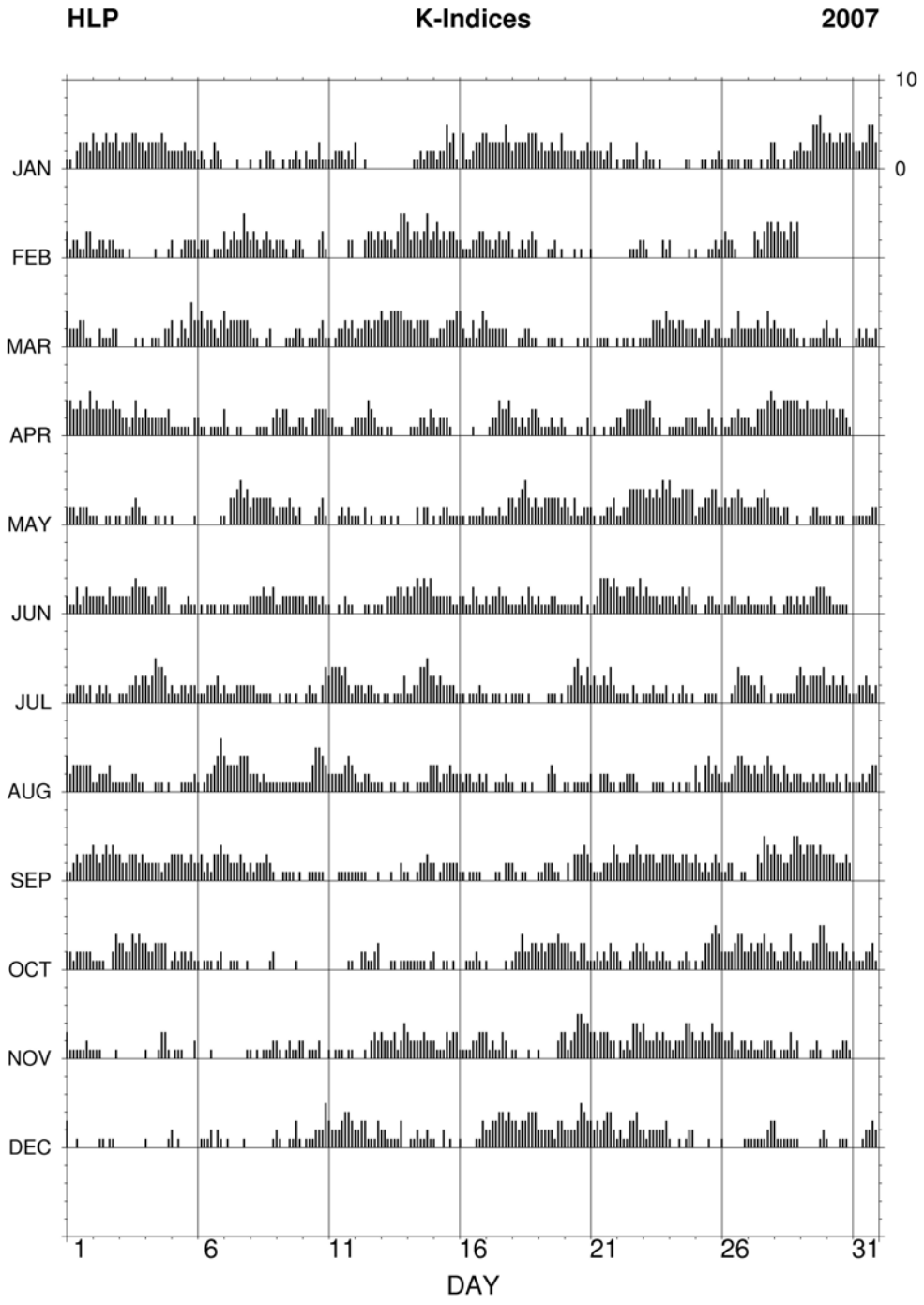

Fig. 19. K-indices in graphical form, Hel 2007.

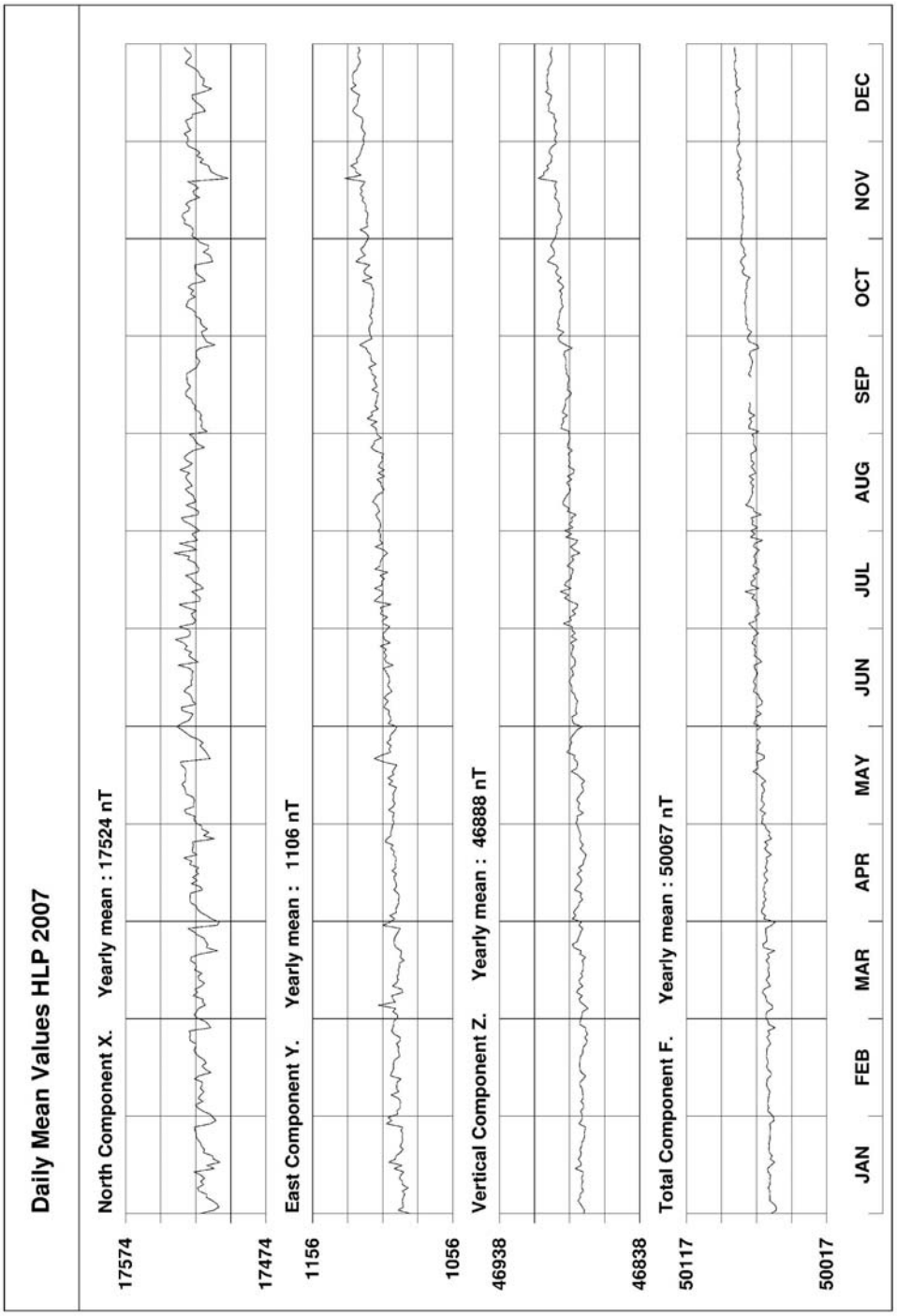

Fig. 20. Daily mean data plot for Hel 2007.

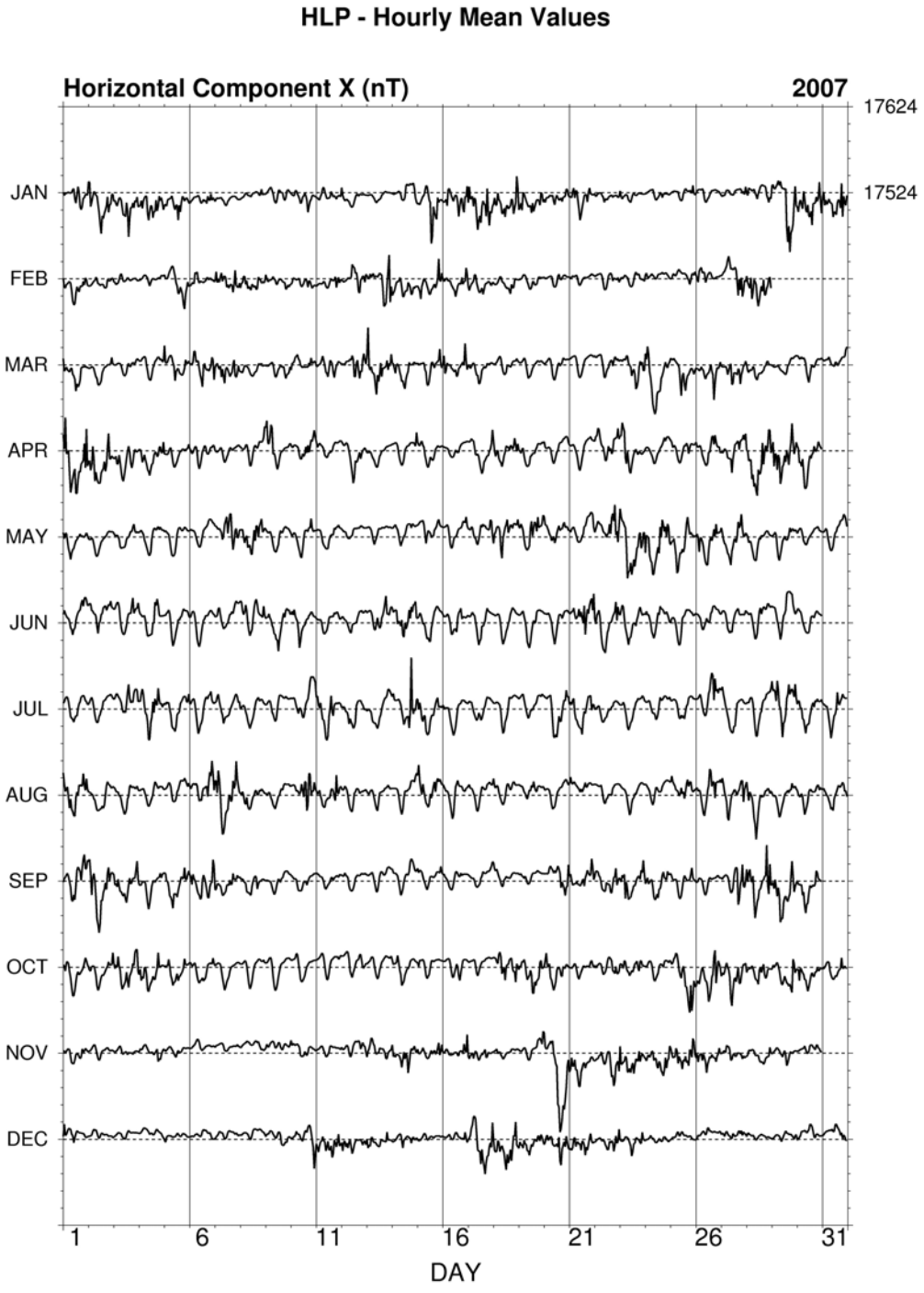

Fig. 21. Hourly mean data plot of X component for Hel 2007.

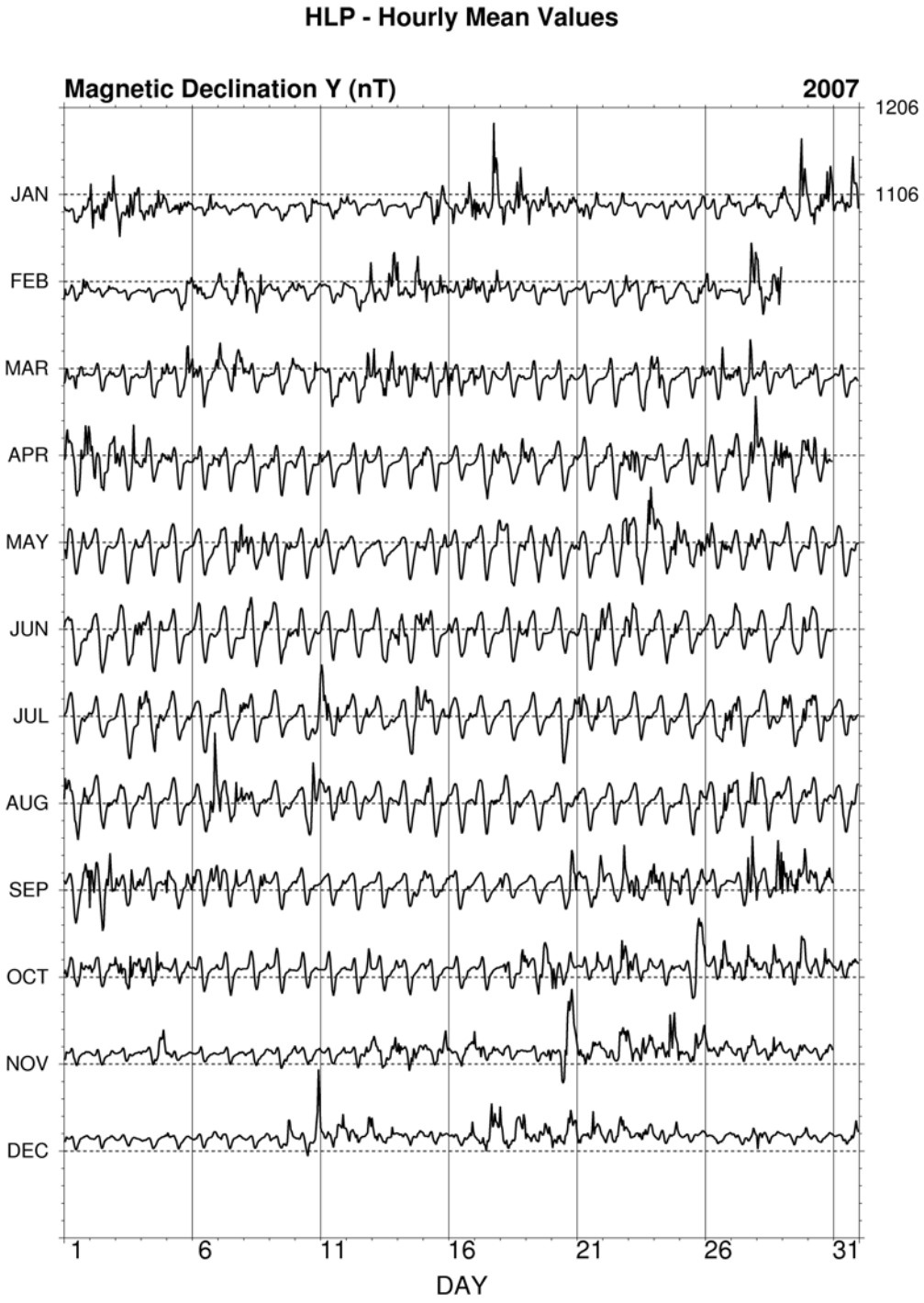

Fig. 22. Hourly mean data plot of Y component for Hel 2007.

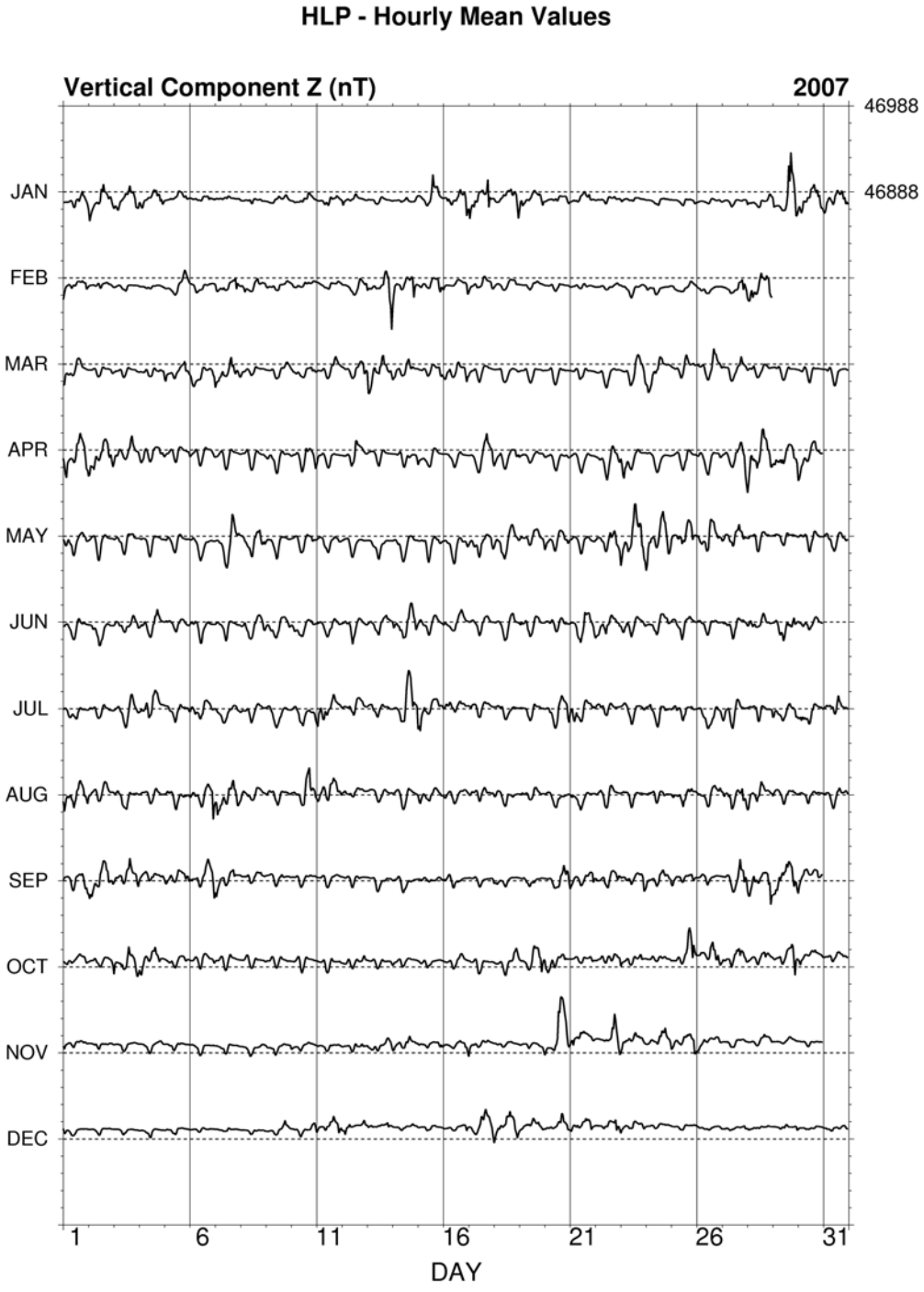

Fig. 23. Hourly mean data plot of Z component for Hel 2007.

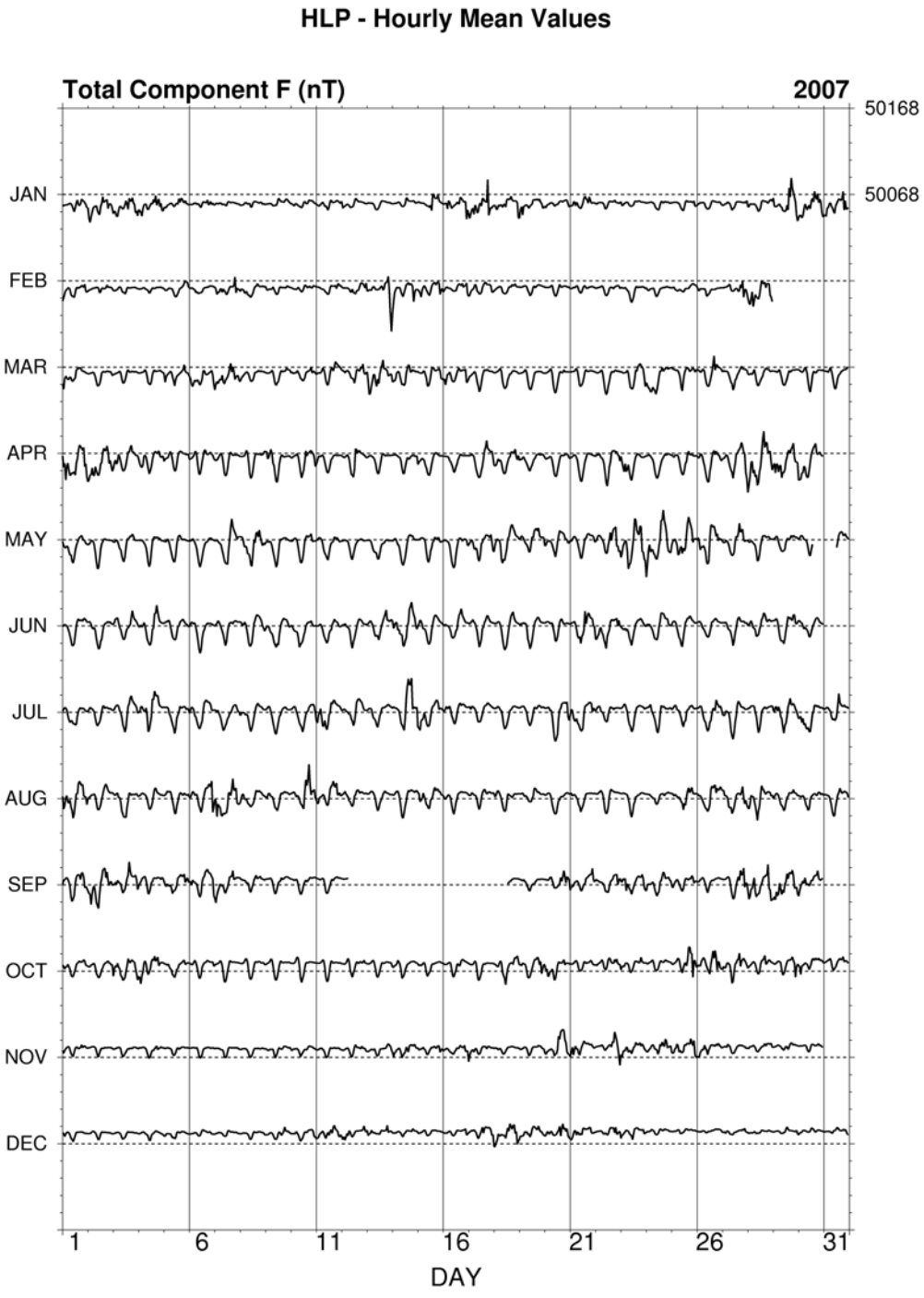

Fig. 24. Hourly mean data plot of F component for Hel 2007.

Tables and plots for Hornsund Observatory

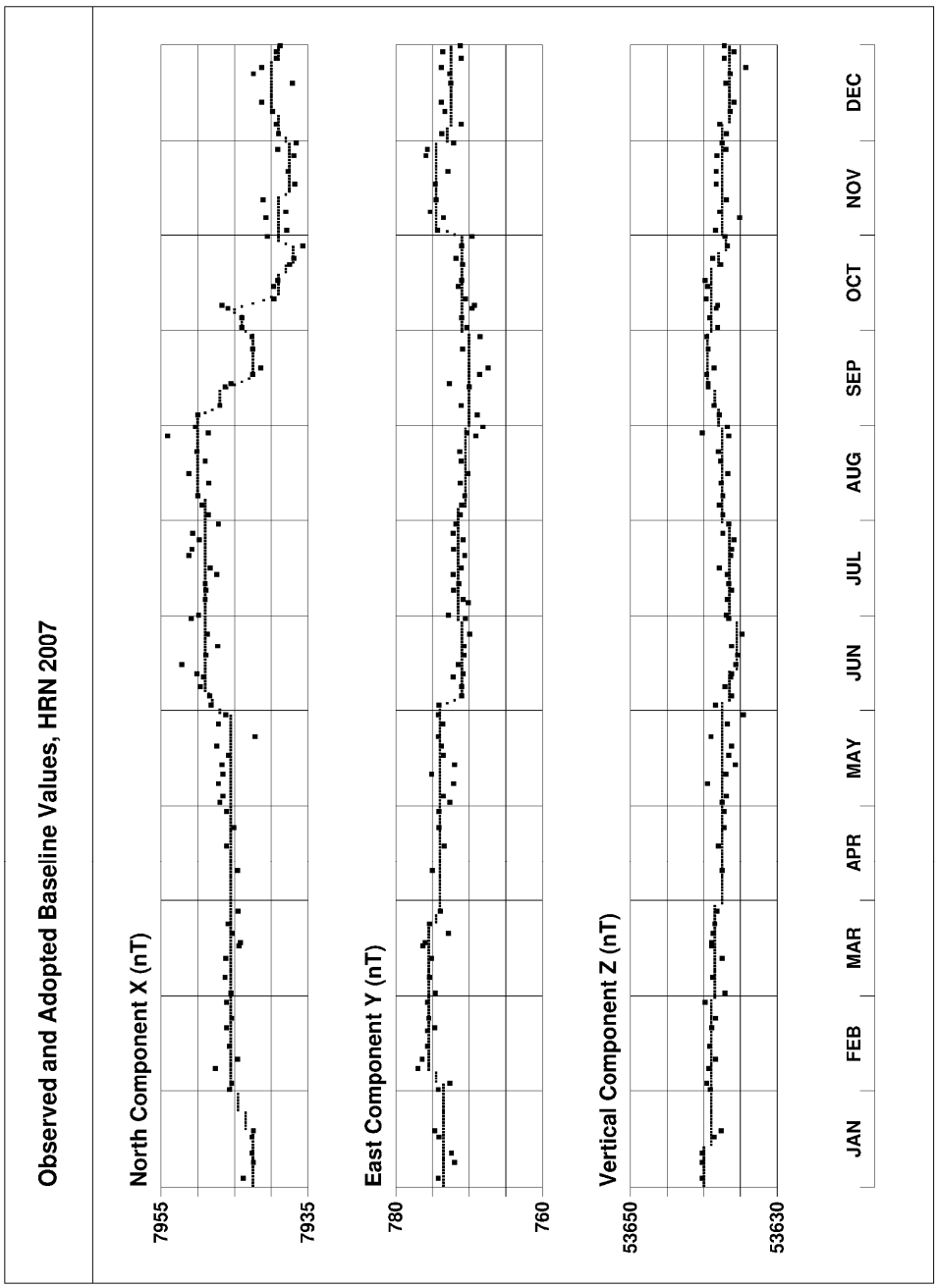

Fig. 25. Base values, Hornsund 2007.

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

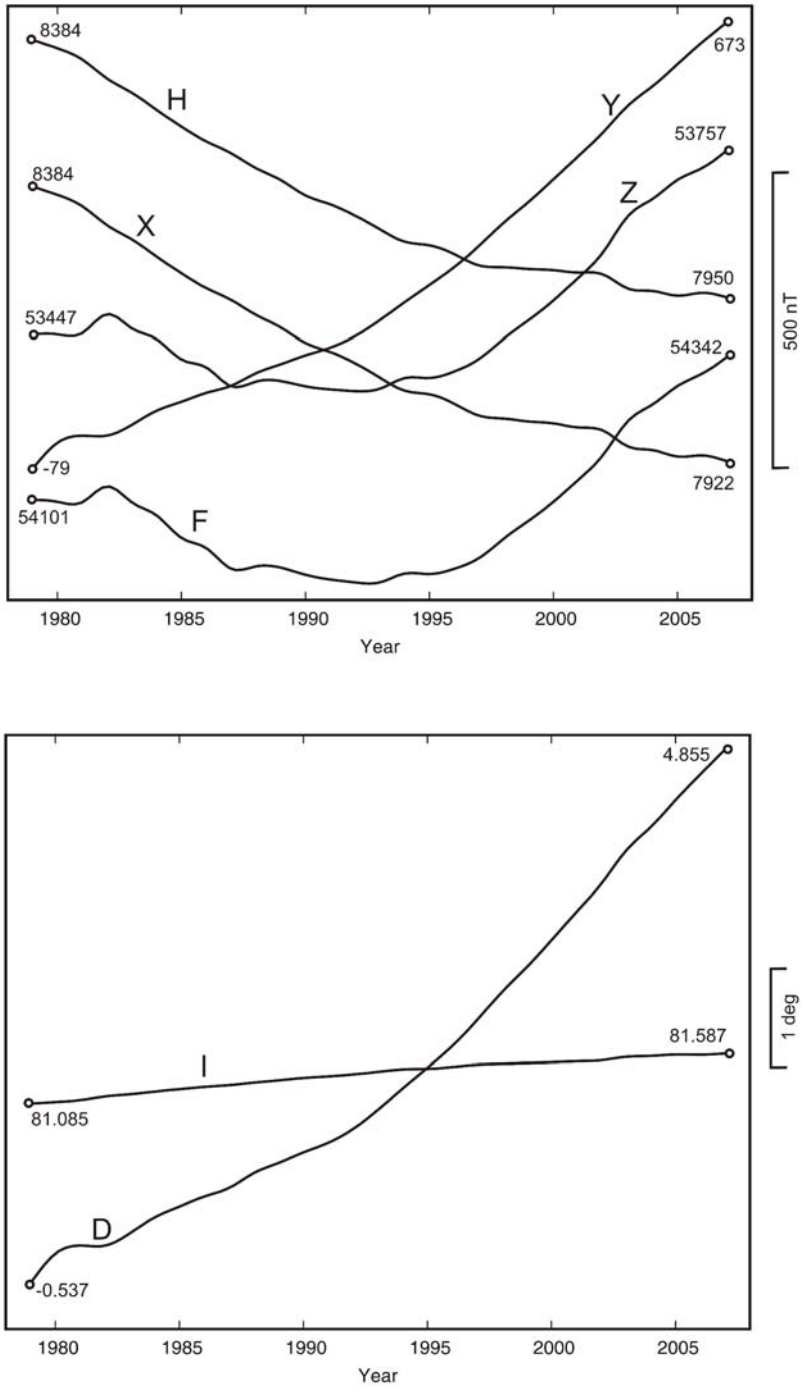

Fig. 26. Secular changes of H, X, Y, Z, F, D and I at Hornsund.

MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

HORNSUND **2007**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
							NORTH COMPONENT: 7500 + ... in nT						
All days	407	420	424	424	437	442	437	431	420	411	405	408	422
Quiet days	427	430	432	433	435	439	438	433	432	422	421	421	430
Disturbed days	369	403	399	384	425	449	433	416	405	385	371	378	401
							EAST COMPONENT: 500 + ... in nT						
All days	161	160	164	167	164	167	173	175	181	183	190	191	173
Quiet days	156	159	158	163	167	165	173	174	178	182	186	188	171
Disturbed days	171	162	180	177	167	163	173	176	188	182	199	196	178
							VERTICAL COMPONENT: 53500 + ... in nT						
All days	250	251	251	253	252	248	250	254	271	268	269	269	257
Quiet days	244	243	244	245	250	251	247	250	260	261	262	263	252
Disturbed days	274	270	267	273	257	248	235	270	293	279	287	282	270

Three-hour-range K indices

Hornsund, January – March, 2007

The limit of K=9 is 2500 nT

Day	January			February			March		
	K		SK	K		SK	K		SK
1	3113	4222	18	-343	1034	--	4443	3210	21
2	5333	5565	35	2232	2221	16	0222	1133	14
3	3343	4354	29	1122	2000	8	0121	1101	7
4	3443	4645	33	0121	0000	4	0112	2122	11
5	2343	3354	27	1112	2223	14	4232	2252	22
6	2221	1534	20	1432	1102	14	2544	4133	26
7	1110	1023	9	4333	3164	27	4333	4664	33
8	1112	0232	12	3433	2313	22	3331	2130	16
9	0210	2220	9	3333	1133	20	0111	1112	8
10	0332	2311	15	2221	1322	15	1222	2144	18
11	2232	2233	19	0000	0114	6	1224	3222	18
12	5211	0101	11	1113	3213	15	1133	3255	23
13	2000	0000	2	2233	1456	26	6343	4452	31
14	0010	1013	6	4253	3252	26	3334	4513	26
15	3333	5332	25	2343	3253	25	2333	3224	22
16	1432	3234	22	2333	3354	26	4422	3105	21
17	4343	3275	31	3423	3424	25	2433	2220	18
18	2433	3435	27	1223	2233	18	0133	2112	13
19	3432	3263	26	0122	2100	8	1222	2122	14
20	2343	2155	25	0101	1000	3	0100	1031	6
21	1343	2150	19	0110	1001	4	0112	1000	5
22	1022	2141	13	0100	0014	6	1111	1111	8
23	2433	0221	17	1210	1121	9	0122	2212	12
24	1010	0111	5	1110	0000	3	4423	3111	19
25	0112	0004	8	1101	1131	9	2224	3212	18
26	1211	1002	8	1321	0020	9	1223	2512	18
27	2111	1012	9	0122	2262	17	2323	2252	21
28	3211	0011	9	5344	3635	33	2342	2141	19
29	3233	3365	28				1221	1000	7
30	3443	3256	30				1232	1000	9
31	3343	3765	34				1331	2001	11

Three-hour-range K indices

Hornsund, April - June, 2007

The limit of K=9 is 2500

Day	April			May			June		
	K		SK	K		SK	K		SK
1	4433	3355	30	2433	2332	22	2223	1122	15
2	3534	3255	30	2311	1100	9	223-	1222	--
3	3442	2422	23	1111	2232	13	3322	2333	21
4	2333	3142	21	1101	2110	7	2323	3341	21
5	2232	1231	16	0111	1001	5	1111	2114	12
6	1112	2111	10	1100	0002	4	1301	2111	10
7	1101	2100	6	1132	4532	21	1211	1121	10
8	0011	2100	5	2334	3242	23	3321	2224	19
9	2433	2002	16	1332	3221	17	2334	3122	20
10	1212	2223	15	1011	2252	14	3423	2132	20
11	2221	1000	8	1112	2121	11	2121	0121	10
12	2323	4311	19	1122	1101	9	1211	2182	18
13	0110	0000	2	1211	1200	8	1122	1233	15
14	0211	2104	11	0112	0220	8	4344	4533	30
15	4323	1210	16	0123	2133	15	2333	2212	18
16	1011	1100	5	1212	2004	12	2423	3221	19
17	0222	2222	14	1322	2222	16	2333	3221	19
18	4332	1135	22	2244	4332	24	1223	3231	17
19	2222	2101	12	2443	3442	26	2232	2211	15
20	1211	1002	8	3233	2253	23	2221	2222	15
21	1210	0001	5	2201	1112	10	1324	4234	23
22	2322	2222	17	1223	4254	23	4343	3224	25
23	4642	2200	20	5445	3355	34	3432	2133	21
24	1212	2112	12	3444	4536	33	3333	3343	25
25	2212	4320	16	2344	3532	26	2221	2132	15
26	2322	2224	19	3434	3442	27	2212	3132	16
27	2322	3235	22	2343	3553	28	2322	2322	18
28	4344	6454	34	3323	3032	19	2212	2211	13
29	3454	4354	32	1212	2221	13	1222	3254	21
30	4454	3431	28	2312	2120	13	2221	1112	12
31				2231	1133	16			

Three-hour-range K indices

Hornsund, July - September, 2007

The limit of K=9 is 2500

Day	July			August			September		
	K		SK	K		SK	K		SK
1	1333	2212	17	5444	3353	31	2233	2263	23
2	1332	2101	13	2343	3331	22	3435	4473	33
3	1222	3323	18	1322	3212	16	2343	3425	26
4	3344	3542	28	1212	2103	12	2343	2131	19
5	2332	2144	21	0021	0112	7	2334	3242	23
6	3322	2333	21	1113	2335	19	2323	3245	24
7	2422	1144	20	3543	3554	32	2333	2533	24
8	3322	2121	16	1333	2211	16	2342	2352	23
9	1112	2110	9	2231	1213	15	0232	2101	11
10	0131	1013	10	1223	4564	27	1112	1110	8
11	3455	3221	25	3333	2542	25	0111	1232	11
12	2242	2222	18	3333	2131	19	0221	1001	7
13	1221	1212	12	1111	1121	9	0122	0002	7
14	2233	3463	26	2102	1232	13	2012	2112	11
15	5333	2241	23	2332	2211	16	2111	1123	12
16	2222	2221	15	2223	2212	16	2211	0010	7
17	2222	1121	13	2122	2124	16	0010	1003	5
18	2222	0110	10	3111	1001	8	2201	2000	7
19	0011	0010	3	1002	3110	8	0132	2000	8
20	1234	5324	24	2111	2001	8	0211	2243	15
21	3533	3232	24	2212	2210	12	2332	2215	20
22	2232	2211	15	0111	3310	10	3432	3254	26
23	1222	2112	13	0112	1111	8	3453	2215	25
24	0013	2101	8	1101	0000	3	3544	3543	31
25	1210	2110	8	2212	3221	15	2323	1154	21
26	0001	2333	12	1223	3443	22	1333	1033	17
27	3332	2210	16	4343	3263	28	0113	1454	19
28	2111	2113	12	3334	3135	25	3443	3264	29
29	3532	2324	24	2221	2143	17	3355	4365	34
30	2333	2322	20	1222	1133	15	3444	3263	29
31	1233	3222	18	0212	1214	13			

Three-hour-range K indices

Hornsund, October - December, 2007

The limit of K=9 is 2500

Day	October			November			December		
	K		SK	K		SK	K		SK
1	2424	3323	23	2222	2131	15	3211	1000	8
2	2222	2234	19	0221	1011	8	1113	0012	9
3	4433	4246	30	0212	1010	7	0000	0000	0
4	2233	3461	24	0021	1543	16	1000	1101	4
5	1433	3231	20	1232	0100	9	1111	0000	4
6	1232	2112	14	0000	1100	2	0221	2043	14
7	1223	1121	13	1111	0000	4	1211	0020	7
8	0110	1003	6	0111	0000	3	0000	0002	2
9	1201	0010	5	1111	1102	8	0200	0142	9
10	0010	0010	2	2222	2211	14	0122	2232	14
11	0000	0022	4	1213	1011	10	2343	3454	28
12	0122	1013	10	1001	0031	6	2343	2115	21
13	0011	1002	5	4332	2132	20	4323	2251	22
14	3121	2100	10	2343	3224	23	2332	1143	19
15	0111	1000	4	2322	3353	23	2113	2213	15
16	0010	1220	6	2343	2255	26	0231	0105	12
17	2100	0000	3	5333	1330	21	2443	4445	30
18	0123	2122	13	0311	0200	7	5444	3556	36
19	2443	4354	29	1010	1012	6	2443	3256	29
20	4443	1231	22	2234	4443	26	2343	3355	28
21	1232	3142	18	4433	3244	27	3444	2364	30
22	1211	1243	15	1333	2442	22	1223	3544	24
23	3223	3041	18	5343	3244	28	4343	3424	27
24	1111	1101	7	3333	2463	27	1222	1124	15
25	1124	4553	25	3444	3645	33	0111	1101	6
26	2343	2663	29	4333	2253	25	0111	1101	6
27	2333	3533	25	1322	2244	20	1221	1013	11
28	2323	3533	24	1122	2444	20	2221	1033	14
29	2222	2266	24	1112	2423	16	0022	1003	8
30	2332	1551	22	1221	1123	13	2111	1110	8
31	2233	3252	22				1111	1122	10

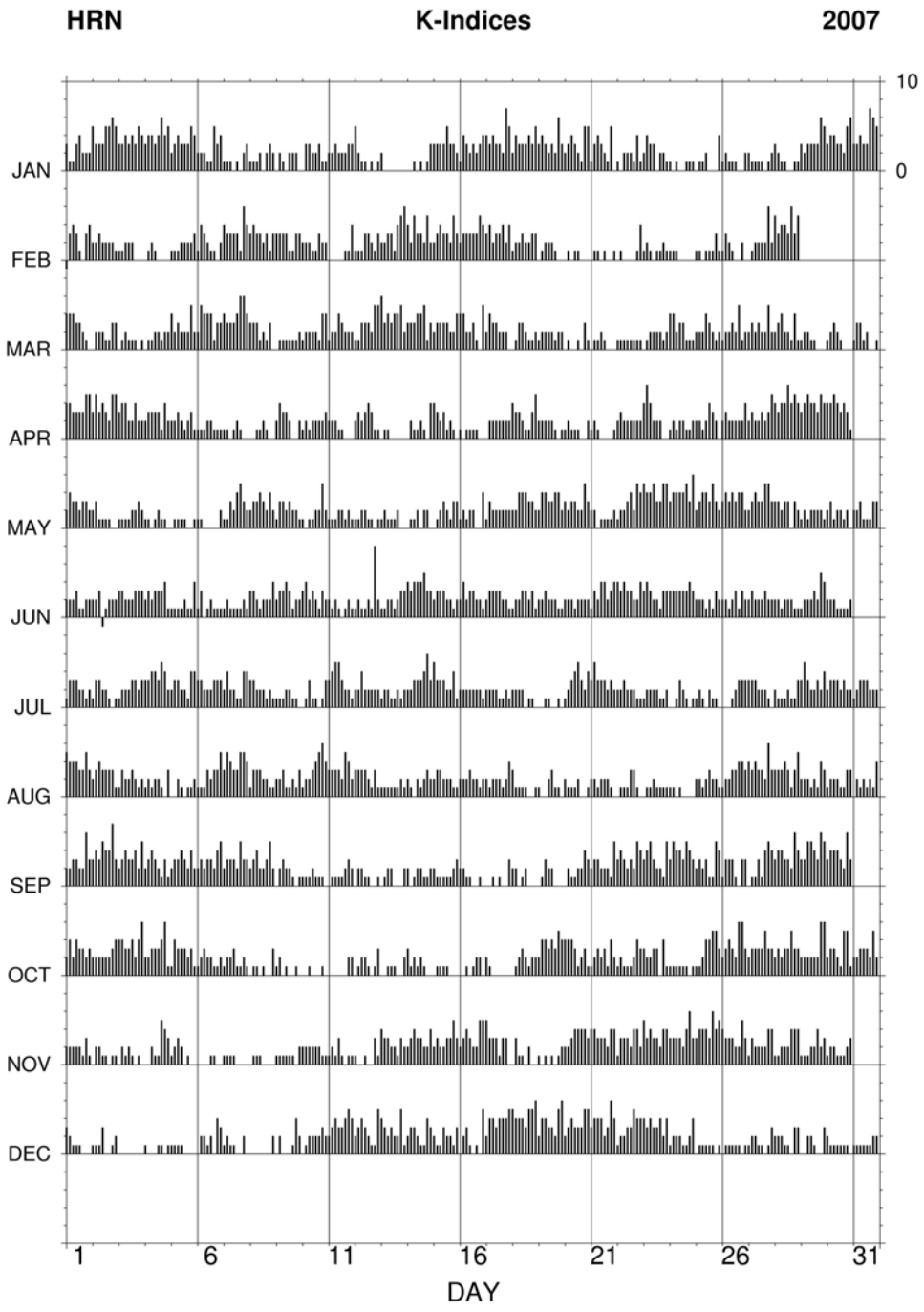

Fig. 27. K-indices in graphical form, Hornsund 2007.

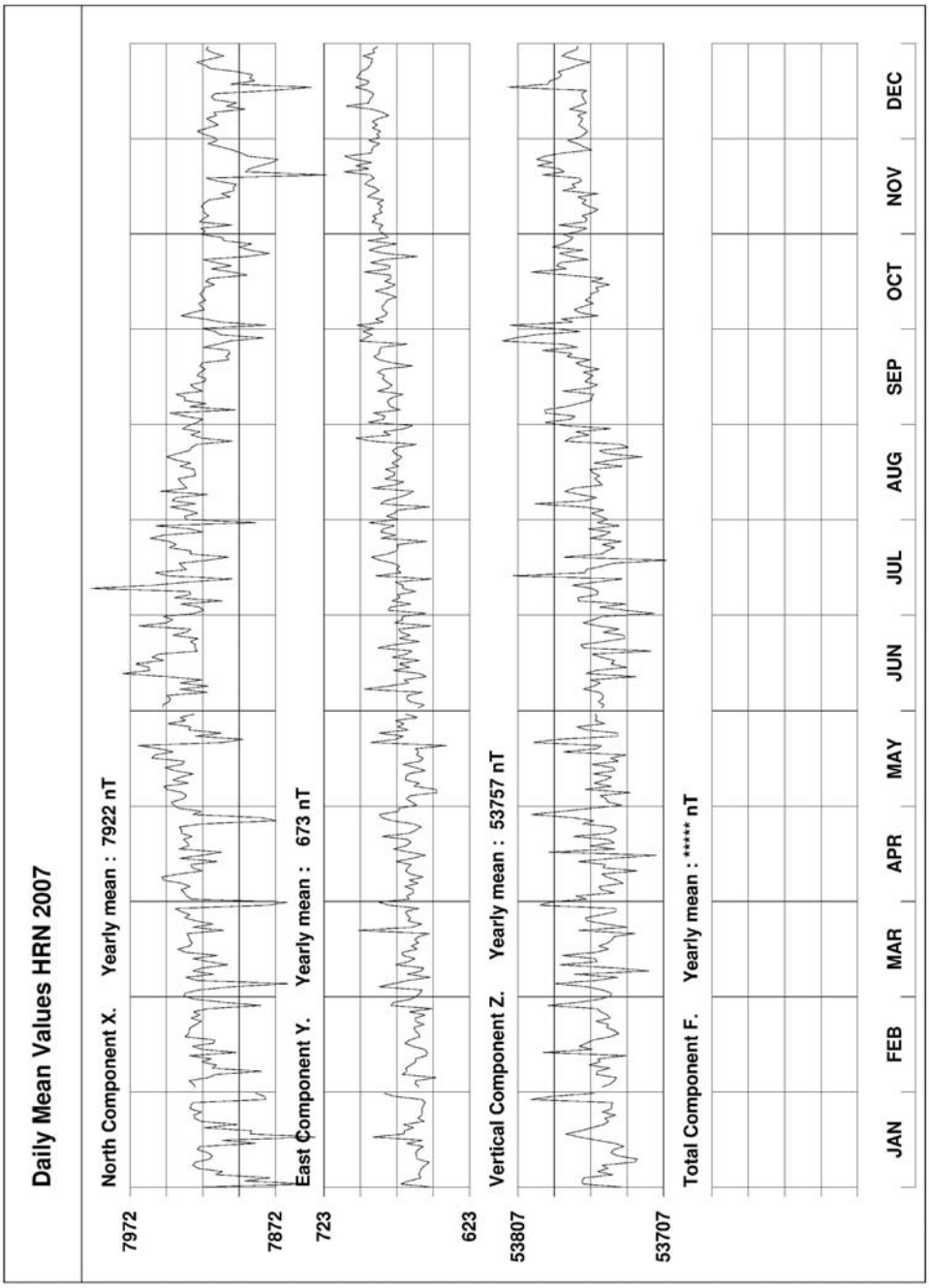

Fig. 28. Daily mean data plot for Hornsund 2007.

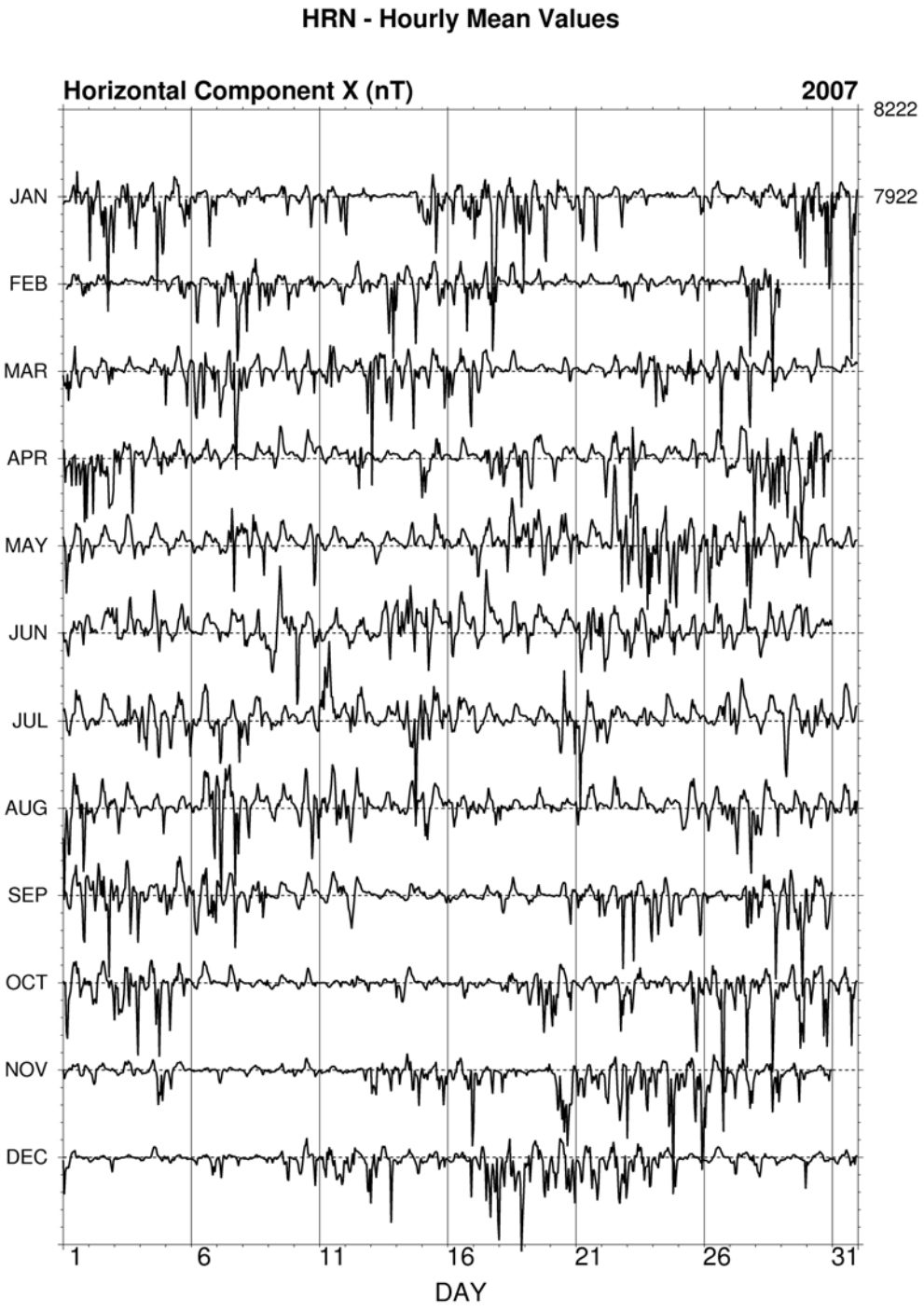

Fig. 29. Hourly mean data plot of X component for Hornsund.

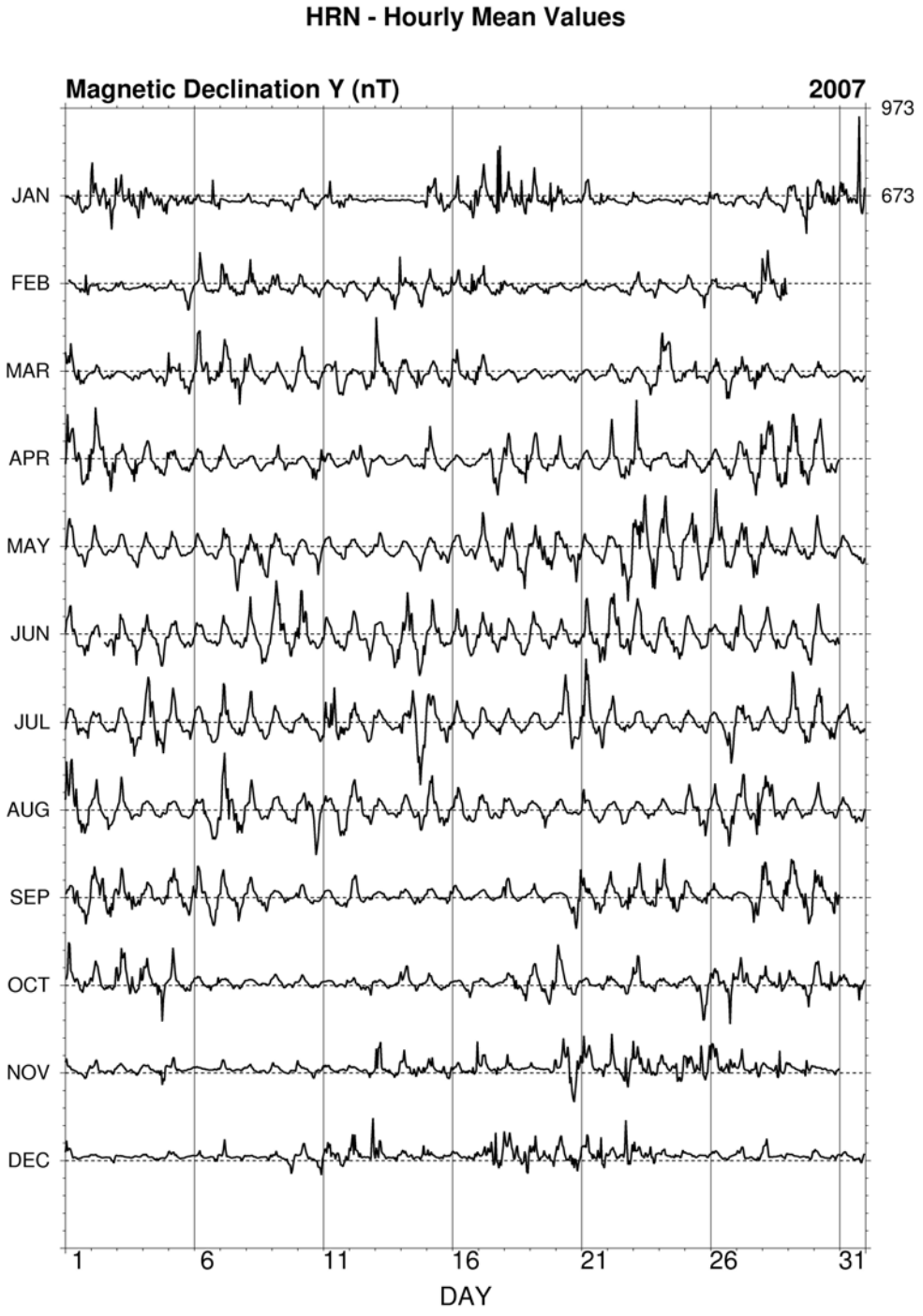

Fig. 30. Hourly mean data plot of Y component for Hornsund.

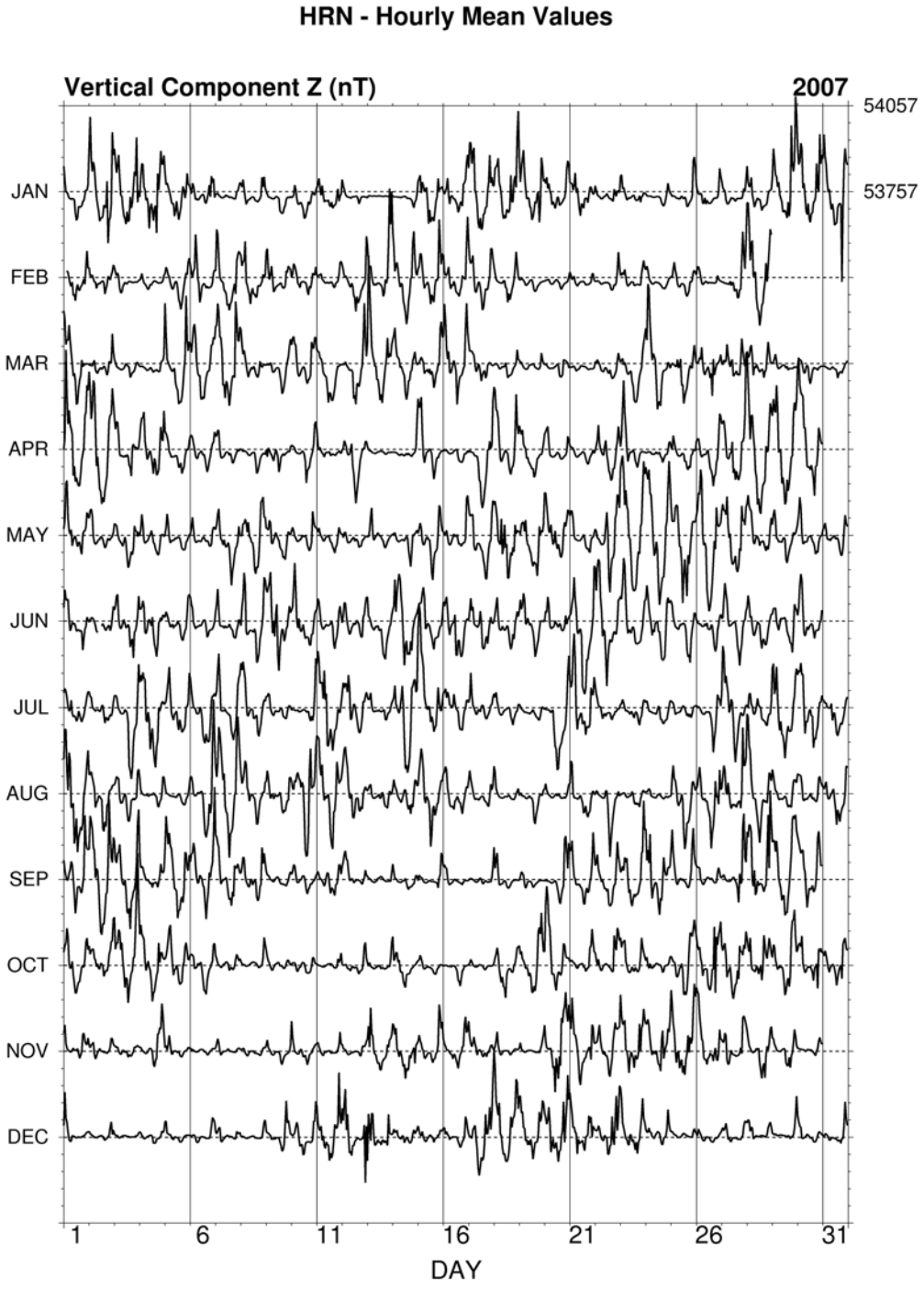

Fig. 31. Hourly mean data plot of Z component for Hornsund.

PUBLS. INST. GEOPHYS. POL. ACAD. SC., C-101 (408), 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)

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*).