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POLISH ACADEMY OF SCIENCES

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RESULTS OF GEOMAGNETIC OBSERVATIONS BELSK, HEL, HORNSUND 2012

WARSZAWA 2013

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PUBLS. INST. GEOPHYS. POL. ACAD. SC., C-106 (416) (2013)

Results of Geomagnetic Observations
Belsk, Hel, Hornsund,
2012

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1. INTRODUCTION

This publication contains basic information on geomagnetic observations carried out in 2012 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, under Norwegian administration.

In 2012, like in the previous years, the Belsk, Hel and Hornsund observatories have kept a close collaboration with the world network of geomagnetic observatories INTERMAGNET. 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-11 from epoch 2010.

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.

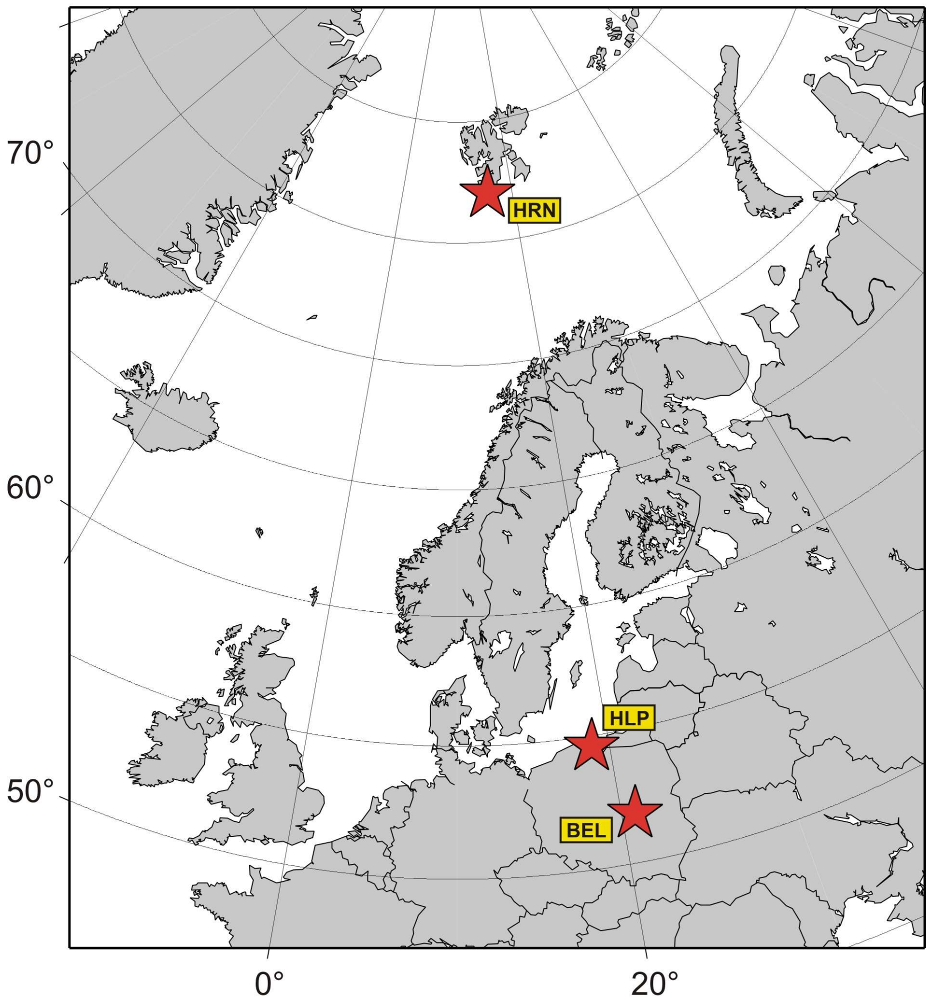

Fig. 1. Location of the Belsk, Hel and Hornsund observatories.

Table 1
Coordinates of the Polish observatories

Observatory	Geographic coordinates		Geomagnetic coordinates		Elevation
	Latitude	Longitude	Latitude	Longitude	[m]
Belsk (BEL)	51^{o} 50.2′ N	20^{o} 47.3′ E	49.9^{o} N	105.1^{o} E	180
Hel (HLP)	54^{o} 36.5′ N	18^{o} 49.0′ E	53.1^{o} N	104.6^{o} E	1
Hornsund (HRN)	77^{o} 0.0′ N	15^{o} 33.0′ E	73.9^{o} N	125.3^{o} E	15

Continuous recording has been made by means of digital loggers type NDL. 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.

It is worth mentioning that in 2012 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 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.

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 about Belsk Observatory can be found at page 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. 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.

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. More information on the Svalbard Archipelago can be found at the address: http://www.svalbard.com

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. Unfortunately, all data were destroyed during the war. 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 Finnish Meteorological Institute once a month on the average and available on http://www.geo.fmi.fi/image/request.html. 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 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 results of absolute measurements are determined by means of a special computer package ABS (author: M. Neska), which calculates the base values on the basis of data from the measurement protocol.

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

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-8 sn: 13/1998	PMP-5 sn: 160	PMP-5 sn: 115
Frequency of measurements	6 per week	3 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. 2, 10 and 18 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 2012 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 $0.3^{o}C$.

Table 4
Mean errors of measurements of B_X, B_Y and B_Z in 2012

Observatory	Element	Number of measurements n	Mean error m_B [nT]
Belsk	B_X	265	0.8
	B_Y	264	0.7
	B_Z	264	0.3
Hel	B_X	155	0.5
	B_Y	155	0.7
	B_Z	155	0.3
Hornsund	B_X	154	1.1
	B_Y	158	1.1
	B_Z	158	0.6

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 NDL 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-8811-01P	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 Producer	NDL TUS Electronics	NDL TUS Electronics	NDL TUS Electronics
	Sampling interval	1 s	1 s	1 s
SET 2	Name of magnetometer Kind of sensor	PSM Bobrov	PSM Bobrov	LEMI fluxgate
	Type	PSM-8511-06P	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	NDL TUS Electronics	NDL TUS Electronics	NDL TUS Electronics
	Sampling interval	1 s	1 s	1 s
Total field	Name of magnetometer	PMP-8	PMP-8	–
	Producer	Institute of Geophysics PAS	Institute of Geophysics PAS	–
	Sampling interval	30 s	30 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 0.1nT, 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 NDL

The NDL data logger is designed for recording of analog signals, mainly coming from geophysical phenomena detectors. The instrument is equipped with six independent measuring channels; the analog-to-digital conversion is realized using 24 bit sigma-delta converters. The GPS receiver ensures high time accuracy of recorded signals. The NDL is equipped with ftp server; this allows easy access to NDL via Internet.

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. Adopted scale values are listed in Table 6.

Table 6
Scale values adopted for computations in 2012

Observatory	Period	Scale values		
		X [nT/bit]	Y [nT/bit]	Z [nT/bit
Belsk	Jan01-Dec31	0.00000607	0.00000605	0.00000609
Hel	Jan01-Dec31	0.00000603	0.00000605	0.00000593
Hornsund	Jan01-Dec31	0.0000356	0.0000368	0.0000360

3.5 Data processing

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 (author: M. Neska),
- 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),
- archiving of data and plotting of magnetograms (authors: J. Reda, M. Neska, S.Wójcik),
- calculation of results of absolute measurements (author: M. Neska),
- 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.php
- 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 2012 were prepared with the use of programs imcdview.jar and imagplot.exe provided to us by INTERMAGNET. The diagrams prepared by means of imagplot.exe and other diagrams related to 2012 data are shown in Figs 8 .. 24.

In the present yearbook, as in previous years, we include 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 possibility 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

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 PERSONS, POSTAL ADDRESSES, CONTACT DETAILS

4.1 Belsk Observatory

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4.2 Hel Observatory

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4.3 Hornsund

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http://hornsund.igf.edu.pl/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 2012

5.1 Belsk

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

5.3 Hornsund

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

L i t e r a t u r e

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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.

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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.

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

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Technical data of PMP-8:
http://www.igf.edu.pl/pl/zaklady_naukowe/konstrukcji_aparatury/aparatura

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6. TABLES AND PLOTS FOR BELSK OBSERVATORY

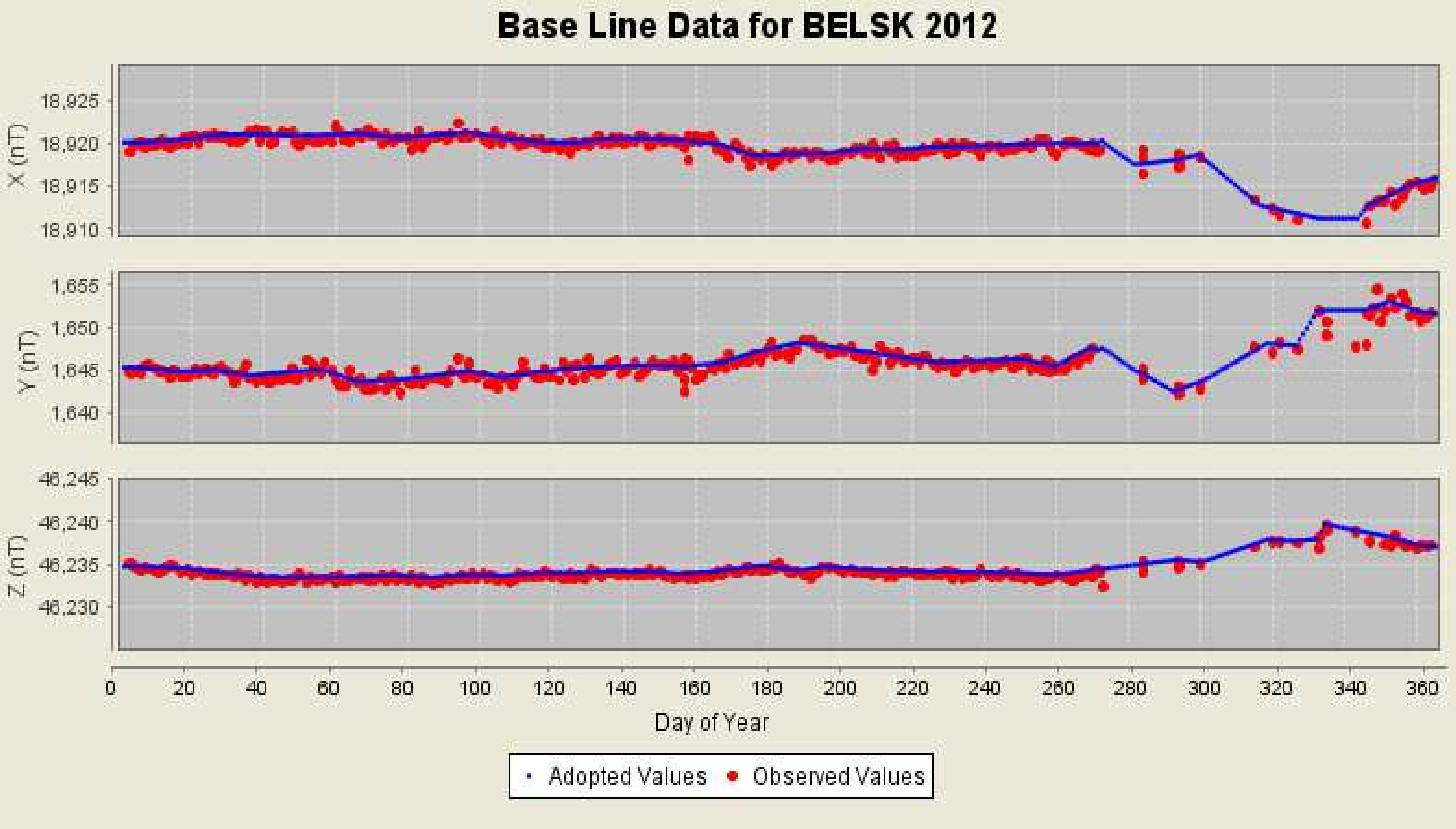


Fig. 2. Base values of set 1, Belsk 2012.

Annual mean values of magnetic elements in Belsk Observatory

No	Year	D [º ‘]	H [nT]	Z [nT]	X [nT]	Y [nT]	I [º ‘]	F [nT]
1	1966	2 04.2	18901.2	45023.3	18888.9	682.8	67 13.6’	48829.8
2	1967	2 05.6	18906.2	45047.7	18893.6	690.7	67 14.0	48854.3
3	1968	2 06.2	18917.8	45071.3	18905.5	694.6	67 13.8	48880.5
4	1969	2 06.3	18935.7	45093.5	18922.9	695.6	6713.3	48907.9
5	1970	2 06.6	18953.0	45123.1	18940.2	697.7	67 13.0	48941.9
6	1971	2 06.6	18975.5	45146.4	18962.6	698.8	67 12.2	48972.1
7	1972	2 08.0	18991.6	45176.3	18978.4	706.7	67 11.9	49005.9
8	1973	2 10.2	19004.6	45210.8	18991.0	719.4	67 12.0	49042.8
9	1974	2 13.3	19016.3	45245.6	19002.0	737.1	67 12.2	49079.3
10	1975	2 16.4	19035.2	45273.5	19020.2	754.9	67 11.7	49112.4
11	1976	2 18.5	19049.7	45306.9	19034.3	767.3	67 11.7	49148.8
12	1977	2 22.0	19062.1	45336.6	19045.8	787.4	67 11.7	49181.0
13	1978	2 27.4	19058.6	45375.7	19041.1	817.1	67 13.0	49215.7
14	1979	2 32.3	19061.4	45401.4	19042.7	844.2	67 13.5	49240.5
15	1980	2 37.2	19063.2	45418.4	19043.3	871.2	67 13.9	49256.8
16	1981	2 42.9	19047.1	45448.9	19025.7	902.0	67 15.7	49278.7
17	1982	2 48.3	19034.8	45478.8	19012.0	931.3	67 17.3	49301.6
18	1983	2 52.4	19032.6	45498.8	19008.7	953.8	67 18.0	49319.2
19	1984	2 56.9	19022.8	45519.8	18997.6	978.4	67 19.2	49334.8
20	1985	3 00.8	19015.2	45542.0	18988.9	999.5	67 20.3	49352.3
21	1986	3 05.1	19003.3	45570.4	18975.8	1022.8	67 21.8	49373.9
22	1987	3 08.5	18999.1	45592.7	18970.6	1041.2	67 22.7	49392.9
23	1988	3 12.4	18983.0	45626.4	18953.3	1062.0	67 24.6	49417.8
24	1989	3 15.9	18966.2	45662.1	18935.4	1080.3	67 26.6	49444.3
25	1990	3 18.8	18961.5	45684.3	18929.8	1095.9	67 27.5	49463.1
26	1991	3 22.2	18950.8	45709.3	18918.0	1114.1	67 28.8	49482.0
27	1992	3 25.3	18954.8	45726.1	18921.0	1131.2	67 29.1	49499.1
28	1993	3 29.8	18956.4	45743.7	18921.1	1156.0	67 29.4	49516.0
29	1994	3 34.8	18953.6	45772.4	18916.6	1183.3	67 30.4	49541.4
30	1995	3 39.8	18959.3	45796.8	18920.6	1211.5	67 30.7	49566.2
31	1996	3 45.0	18965.7	45821.9	18925.1	1240.6	67 30.9	49591.8
32	1997	3 50.9	18962.8	45856.9	18920.0	1272.7	67 32.0	49623.0
33	1998	3 57.3	18955.8	45897.1	18910.6	1307.6	67 33.6	49657.5
34	1999	4 02.5	18957.8	45930.6	18910.6	1336.4	67 34.3	49689.2
35	2000	4 07.8	18955.4	45968.7	18906.2	1365.4	67 35.5	49723.5
36	2001	4 13.0	18962.4	46004.8	18911.1	1394.2	67 36.0	49759.6
37	2002	4 18.4	18969.2	46043.6	18915.6	1424.4	67 36.6	49798.0
38	2003	4 24.2	18970.2	46089.6	18914.2	1456.7	67 37.7	49840.9
39	2004	4 29.4	18980.3	46121.0	18922.0	1486.0	67 37.9	49873.8
40	2005	4 34.7	18984.3	46154.6	18923.7	1515.5	67 38.5	49906.4
41	2006	4 39.8	18996.7	46177.2	18933.8	1544.3	67 38.3	49932.0
42	2007	4 45.8	19007.4	46206.7	18941.8	1578.4	67 38.4	49963.4
43	2008	4 52.5	19014.0	46236.3	18945.2	1615.9	67 38.7	49993.3
44	2009	4 59.7	19022.2	46264.5	18949.9	1656.4	67 39.0	50022.5
45	2010	5 08.0	19017.6	46301.3	18941.4	1701.4	67 40.2	50054.7
46	2011	5 16.1	19015.0	46338.0	18934.7	1745.7	67 41.3	50087.7
47	2012	5 24.6	19014.0	46376.7	18929.3	1792.8	67 42.4	50123.2

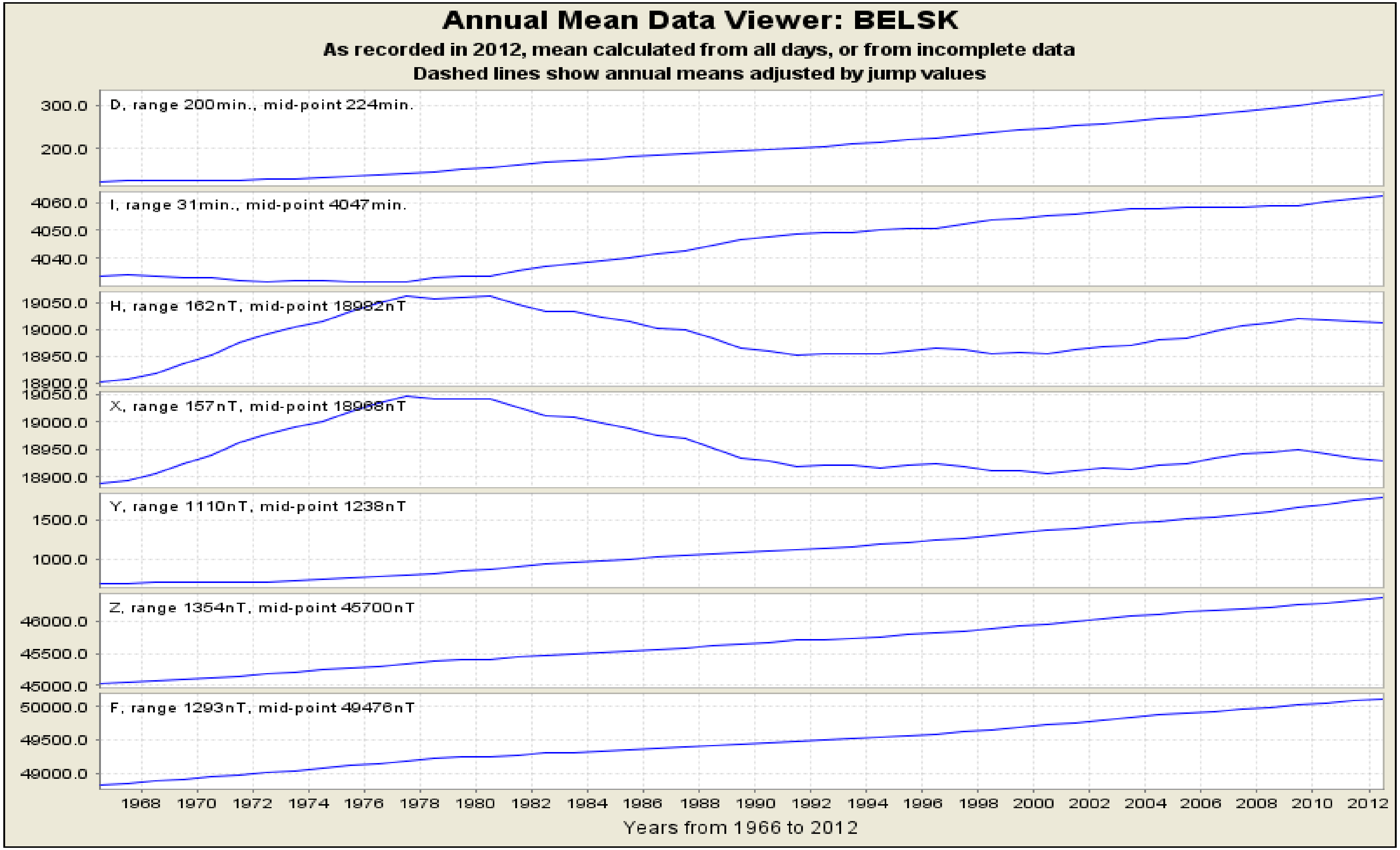


Fig. 3. Secular changes of H, X, Y, Z, F, D and I at Belsk.

MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

BEL 2012

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
NORTH COMPONENT: 18500 + ... in nT													
All days	433	433	421	429	437	433	426	433	429	418	423	436	429
Quiet days	437	437	435	434	439	428	430	437	435	428	432	438	434
Disturbed days	419	422	401	417	430	436	403	432	414	394	411	429	417
EAST COMPONENT: 1500 + ... in nT													
All days	270	275	282	285	286	291	297	297	302	306	309	312	293
Quiet days	269	274	279	282	284	294	296	297	300	304	308	311	291
Disturbed days	275	278	287	294	289	288	307	295	305	314	310	312	296
VERTICAL COMPONENT: 46000 + ... in nT													
All days	358	361	370	368	368	376	383	380	383	390	392	389	377
Quiet days	356	359	366	367	368	378	381	379	381	388	390	389	375
Disturbed days	364	364	378	368	370	381	394	381	389	392	393	391	380

Three-hour-range K indices
Belsk, January - March, 2012
The limit of K=9 is 450

Day	January K	January SK	February K	February SK	March K	March SK
1	1111 2221	11	2222 1111	12	1333 3354	25
2	1011 1132	10	1121 1111	9	3322 2233	20
3	3321 1221	15	2212 2210	12	2112 1422	15
4	2011 1011	7	2222 3233	19	3332 2342	22
5	2111 2122	12	3212 3342	20	3122 1233	17
6	2111 1233	14	2211 1331	14	3221 3334	21
7	3121 1213	14	2223 3354	24	3344 5464	33
8	1211 0131	10	4222 3242	21	2125 5444	27
9	2221 1322	15	2112 2231	14	4665 6532	37
10	1112 2131	12	1111 1132	11	5423 2442	26
11	2212 1222	14	3111 1121	11	2112 2334	18
12	1101 1233	12	2102 0212	10	2125 5443	26
13	2231 1102	12	1132 3333	19	4212 2222	17
14	1011 1001	5	3221 2345	22	2111 2322	14
15	1110 0123	9	3422 3344	25	3222 4755	30
16	2112 3232	16	2122 2111	12	4324 3544	29
17	3202 1131	13	0011 1000	3	3333 3555	30
18	2101 1212	10	0011 1124	10	4322 2333	22
19	1111 1111	8	5412 1223	20	2322 3234	21
20	1211 0230	10	3422 4433	25	1112 1133	13
21	1212 2223	15	4221 1113	15	1111 1143	13
22	1243 4345	26	3323 2220	17	1111 1135	14
23	4321 1112	15	0011 0113	7	3121 1210	11
24	4311 2553	24	1312 2210	12	2233 2332	20
25	3334 3223	23	0122 2242	15	2122 2100	10
26	2122 1332	16	2211 2123	14	1112 1111	9
27	2121 2211	12	4222 4662	28	2222 3344	22
28	2210 1133	13	2142 2313	18	5322 3232	22
29	2221 0232	14	2231 0222	14	0010 2122	8
30	0011 0343	12			3121 2101	11
31	2110 0011	6			1111 2331	13

Three-hour-range K indices
Belsk, April - June, 2012
The limit of K=9 is 450

Day	April K	April SK	May K	May SK	June K	June SK
1	2212 2223	16	0001 1113	7	1213 2322	16
2	3222 2222	17	3111 1013	11	1212 2434	19
3	2211 1113	12	2212 2223	16	2113 5541	22
4	2211 2223	15	2100 1211	8	1325 4334	25
5	2233 3423	22	1012 2101	8	2333 4434	26
6	1111 1113	10	1113 2220	12	3333 3352	25
7	2223 2212	16	0112 1210	8	2222 2332	18
8	2111 1121	10	1212 3324	18	2223 2121	15
9	1111 1123	11	4433 3454	30	1313 3232	18
10	3212 2223	17	2322 2223	18	0112 3322	14
11	1132 2113	14	3222 1422	18	2122 3445	23
12	1323 1354	22	3122 3333	20	4312 2220	16
13	5433 2333	26	3222 2333	20	2222 1221	14
14	3222 2331	18	2101 1111	8	1111 2110	8
15	0112 2131	11	1222 1102	11	0101 1111	6
16	1111 2213	12	2212 3334	20	1113 4346	23
17	2122 2332	17	1111 2121	10	4335 5443	31
18	3232 2222	18	3223 2322	19	4432 2321	21
19	1010 1133	10	2112 1221	12	0111 0111	6
20	1232 2112	14	3333 3211	19	0212 1110	8
21	2011 1234	14	0101 0142	9	0101 1111	6
22	3223 2112	16	2423 4444	27	0122 2210	10
23	1432 3444	25	3443 2222	22	0112 1321	11
24	6532 3455	33	1222 2331	16	2111 2221	12
25	4233 3453	27	2112 2311	13	2222 4422	20
26	3422 3233	22	2111 1000	6	2222 2212	15
27	2221 2222	15	1211 1201	9	1112 3322	15
28	2113 1223	15	1111 3332	15	2222 2221	15
29	2111 1120	9	1201 2223	13	1121 2222	13
30	0111 0101	5	2213 3331	18	3334 4434	28
31			3232 2341	20		

Three-hour-range K indices
Belsk, July - September, 2012
The limit of K=9 is 450

Day	July K	July SK	August K	August SK	September K	September SK
1	4334 4344	29	1111 2223	13	1232 1222	15
2	4333 4432	26	0112 5643	22	3223 2345	24
3	2222 3422	19	3222 2211	15	3323 6454	30
4	2323 3222	19	1111 2222	12	3232 2323	20
5	2224 5433	25	1112 2222	13	5443 2342	27
6	2323 3434	24	2322 3423	21	3411 1331	17
7	2221 2232	16	2112 2123	14	1222 2243	18
8	2224 3324	22	5222 2321	19	3222 2221	16
9	5434 6634	35	3211 1211	12	1112 1111	9
10	4224 3332	23	1210 1111	8	2110 2110	8
11	2233 1233	19	0111 2223	12	0011 0011	4
12	3332 2212	18	2232 2333	20	1123 2123	15
13	0111 1110	6	1222 3331	17	2211 1211	11
14	1112 3364	21	2212 2223	16	1111 1223	12
15	4555 4575	40	1122 2323	16	2221 1223	15
16	5544 4423	31	2222 3444	23	2212 1132	14
17	3432 3323	23	4221 1122	15	2102 1112	10
18	1121 1221	11	1213 2243	18	2321 2311	15
19	1122 2221	13	2224 3225	22	1211 2455	21
20	1424 3333	23	4222 4332	22	3232 2222	18
21	2222 1432	18	2122 2213	15	2122 2331	16
22	1223 2212	15	1101 3224	14	2122 1112	12
23	2312 3332	19	3222 2341	19	0000 1110	3
24	2322 3231	18	2222 2233	18	0011 1211	7
25	3122 1111	12	2222 3333	20	1111 0100	5
26	1011 2210	8	1223 4342	21	1112 2133	14
27	1212 1213	13	1222 1112	12	2221 1111	11
28	1222 3343	20	1112 1112	10	0011 0110	4
29	3222 2120	14	1222 1101	10	0121 1211	9
30	1223 3542	22	0111 1121	8	1113 3334	19
31	2111 2222	13	0011 1011	5		

Three-hour-range K indices
Belsk, October - December, 2012
The limit of K=9 is 450

Day	October K	October SK	November K	November SK	December K	December SK
1	6532 3211	23	3223 4444	26	1111 2243	15
2	2013 3212	14	2211 1212	12	2132 2110	12
3	3221 1111	12	0011 2121	8	0111 1112	8
4	1101 0100	4	0111 1110	6	2211 1010	8
5	0011 1223	10	0011 1211	7	0011 0121	6
6	2111 2223	14	1111 1221	10	0010 1000	2
7	1111 1123	11	3322 3453	25	0000 0010	1
8	4254 3264	30	1111 1003	8	0000 0011	2
9	5544 2235	30	0010 0010	2	0111 1214	11
10	3222 2443	22	0001 1023	7	2111 1111	9
11	3112 2212	14	0011 1101	5	1100 1011	5
12	3322 2432	21	2011 0225	13	0011 1102	6
13	3443 5644	33	4323 3344	26	1100 0011	4
14	4333 4355	30	6543 4212	27	1111 0023	9
15	3222 2132	17	1012 1112	9	2222 3232	18
16	1132 2211	13	1211 2342	16	2012 2332	15
17	3121 1103	12	2222 2242	18	2224 4421	21
18	2112 1221	12	1111 1203	10	2212 2302	14
19	3110 1010	7	1111 2202	10	1211 1121	10
20	0111 1011	6	2222 3353	22	0121 3322	14
21	1111 1111	8	3222 1231	16	2111 1111	9
22	1111 0111	7	1101 1012	7	0001 1101	4
23	1222 2231	15	0011 1034	10	0000 1100	2
24	2111 1110	8	5322 3322	22	0000 0311	5
25	1112 1012	9	1111 1201	8	1110 0123	9
26	1011 1222	10	2221 1111	11	1111 1001	6
27	2111 1101	8	0111 1121	8	1000 0000	1
28	0021 1121	8	0100 0022	5	0001 1012	5
29	0111 0012	6	0011 0221	7	1011 1012	7
30	2011 1011	7	0001 1111	5	1011 2221	10
31	0011 2323	12			0001 0011	3

Three-hour-range E indices
based on power spectrum estimation(*)
Belsk, January - March, 2012

Day	January E	January SE	February E	February SE	March E	March SE
1	1101 2121	9	2211 1001	8	0343 3465	28
2	0000 1122	6	1111 1001	6	4322 3233	22
3	3421 2221	17	3212 3210	14	2112 1413	15
4	3010 1011	7	2322 3333	21	3333 2252	23
5	2100 3121	10	3212 3252	20	4123 1244	21
6	1011 1143	12	1211 1441	15	4221 3234	21
7	4211 1214	16	2223 4365	27	3454 4564	35
8	1211 0131	10	4222 3251	21	2116 5445	28
9	2212 1423	17	2102 2241	14	4676 6642	41
10	1102 2231	12	1111 1042	11	5533 2442	28
11	2211 0223	13	3000 0021	6	2112 2345	20
12	1101 1133	11	2001 0112	7	2115 5354	26
13	2221 0101	9	1132 3434	21	4311 2333	20
14	1001 0000	2	3221 1336	21	3111 2423	17
15	0100 0123	7	3522 3355	28	4222 5756	33
16	2112 4242	18	2022 2000	8	5324 4655	34
17	4201 1131	13	0011 0000	2	4433 3556	33
18	3101 0111	8	0000 0115	7	4322 1233	20
19	0101 0100	3	5522 1224	23	2422 3245	24
20	2211 0130	10	3523 4444	29	1112 1133	13
21	1312 2123	15	4221 1104	15	1012 1142	12
22	0244 4455	28	3333 2110	16	0201 0046	13
23	4421 1001	13	0011 0004	6	3011 1110	8
24	4211 2454	23	1412 1210	12	2243 2332	21
25	3324 3233	23	0012 3142	13	2122 1100	9
26	2012 1432	15	2111 2024	13	1111 1101	7
27	2131 2300	12	4211 5562	26	2322 3345	24
28	3210 1143	15	2152 1214	18	6422 3141	23
29	3111 0232	13	2330 0111	11	0000 2122	7
30	0000 0454	13			4111 1100	9
31	2100 0000	3			0011 1230	8

* - see literature: Reda and Jankowski, 2004

Three-hour-range E indices
based on power spectrum estimation(*)
Belsk, April – June, 2012

Day	April E	April SE	May E	May SE	June E	June SE
1	2212 1234	17	0001 0213	7	1213 2311	14
2	4222 2222	18	2001 1014	9	1102 2435	18
3	2210 1114	12	2123 2213	16	2113 4641	22
4	2201 1224	14	2100 1200	6	1325 4344	26
5	3234 3423	24	0002 1101	5	2433 4435	28
6	1101 0003	6	1113 2120	11	4423 4352	27
7	3323 2112	17	0112 2100	7	2222 2332	18
8	2111 0120	8	0212 3224	16	2123 1020	11
9	1000 0023	6	5533 4565	36	2212 2132	15
10	3111 1223	14	2222 2224	18	0011 3313	12
11	1122 1013	11	4222 1422	19	2232 3445	25
12	1322 1364	22	4122 3233	20	5411 1220	16
13	5534 2334	29	4322 2333	22	2212 1111	11
14	4222 2331	19	3100 1111	8	1111 2100	7
15	0111 1131	9	1221 1002	9	0101 1100	4
16	1100 2203	9	2112 3335	20	0114 4446	24
17	1122 2342	17	1110 1111	7	4445 5444	34
18	3232 2233	20	3113 2322	17	5532 2321	23
19	0100 0033	7	2111 0221	10	0010 0000	1
20	1331 2111	13	3432 4211	20	0202 1110	7
21	2001 0235	13	0001 0031	5	0101 1011	5
22	3213 2111	14	2433 5454	30	0121 3200	9
23	1431 3554	26	4453 1222	23	0022 0310	8
24	7542 3355	34	1122 1321	13	1111 1211	9
25	5333 3564	32	2112 2312	14	1221 4422	18
26	3522 3243	24	2111 1000	6	2322 2202	15
27	3221 2222	16	1211 0200	7	0112 3321	13
28	1013 1323	14	0101 2332	12	1222 2111	12
29	3201 1030	10	1201 2213	12	1111 2223	13
30	0100 0001	2	2113 2331	16	3334 5445	31
31			3223 2341	20		

* - see literature: Reda and Jankowski, 2004

Three-hour-range E indices
based on power spectrum estimation(*)
Belsk, July - September, 2012

Day	July E	July SE	August E	August SE	September E	September SE
1	4334 4444	30	1112 1223	13	1122 1212	12
2	4443 5432	29	0012 6643	22	4333 2355	28
3	2222 3512	19	3221 1111	12	3424 6555	34
4	3323 3212	19	1111 2323	14	4242 2323	22
5	2224 5333	24	0012 1222	10	5453 2342	28
6	2313 3345	24	3413 2423	22	4411 1331	18
7	2221 1132	14	1112 2133	14	1322 2254	21
8	2224 3324	22	6212 2321	19	3222 2221	16
9	5444 6545	37	3212 1211	13	1012 1110	7
10	4234 3342	25	0110 1101	5	2110 2110	8
11	3333 1224	21	0000 2123	8	0000 0000	0
12	3332 2212	18	2231 2233	18	1112 2122	12
13	0101 0100	3	1122 3441	18	3211 0211	11
14	0111 3365	20	2212 2313	16	1101 1214	11
15	5565 4576	43	2022 2323	16	2221 1224	16
16	5644 4433	33	3221 3544	24	3212 1141	15
17	3542 3323	25	5221 1122	16	2101 0111	7
18	1111 1121	9	1212 2243	17	2322 2411	17
19	0112 3221	12	2314 4125	22	1211 2455	21
20	1324 3433	23	3322 4242	22	3232 2232	19
21	2222 1431	17	2112 1313	14	1122 2331	15
22	1223 1112	13	1101 3214	13	2112 0102	9
23	2212 3332	18	4222 2341	20	0000 0000	0
24	2322 3221	17	2221 3234	19	0001 1100	3
25	3122 1110	11	2223 3334	22	0011 0000	2
26	0000 2200	4	1223 4342	21	1111 2143	14
27	0112 1112	9	2322 1112	14	3111 0012	9
28	1222 3344	21	1102 1111	8	0000 0000	0
29	3222 1120	13	1111 1001	6	0021 1111	7
30	1233 4552	25	0011 1120	6	1113 3435	21
31	3111 2212	13	0001 0000	1		

* - see literature: Reda and Jankowski, 2004

Three-hour-range E indices
based on power spectrum estimation(*)
Belsk, October - December, 2012

Day	October E	October SE	November E	November SE	December E	December SE
1	5632 2211	22	3223 4555	29	0100 1153	11
2	1002 2212	10	2211 1113	12	3222 2100	12
3	3211 1111	11	0011 1121	7	0110 1212	8
4	0001 0000	1	0100 0100	2	2211 0010	7
5	0001 1214	9	0011 0211	6	0000 0011	2
6	3111 2323	16	0001 1321	8	0000 0000	0
7	0101 0033	8	3421 4553	27	0000 0010	1
8	4255 4265	33	1011 0003	6	0000 0000	0
9	6654 2236	34	0010 0000	1	0101 1224	11
10	3223 2553	25	0000 0014	5	3101 1010	7
11	3212 2202	14	0011 1100	4	2100 0000	3
12	4422 3432	24	2000 0225	11	0000 1002	3
13	4554 5745	39	5323 3455	30	1100 0001	3
14	5233 4345	29	6654 4301	29	1110 0023	8
15	4222 2032	17	1001 0112	6	3212 3332	19
16	0121 1211	9	1211 2242	15	2011 2231	12
17	3121 1104	13	1323 2243	20	2224 5411	21
18	3112 1221	13	1111 2203	11	2112 1302	12
19	3100 0000	4	1021 2202	10	1211 1110	8
20	0011 0000	2	3233 3464	28	0122 4422	17
21	1111 0000	4	3321 0231	15	3111 1111	10
22	1010 0010	3	1100 1002	5	0000 0000	0
23	1212 2230	13	0000 0035	8	0000 0200	2
24	1110 1110	6	5422 3311	21	0000 0301	4
25	1111 0012	7	0110 1201	6	1100 0112	6
26	0011 1223	10	2211 0110	8	0101 1001	4
27	3111 1000	7	0011 1031	7	1000 0000	1
28	0021 1010	5	0000 0012	3	0001 0111	4
29	0011 0002	4	0001 0221	6	0011 0002	4
30	3011 0001	6	0001 0001	2	1011 2220	9
31	0001 1323	10			0000 0001	1

* - see literature: Reda and Jankowski, 2004

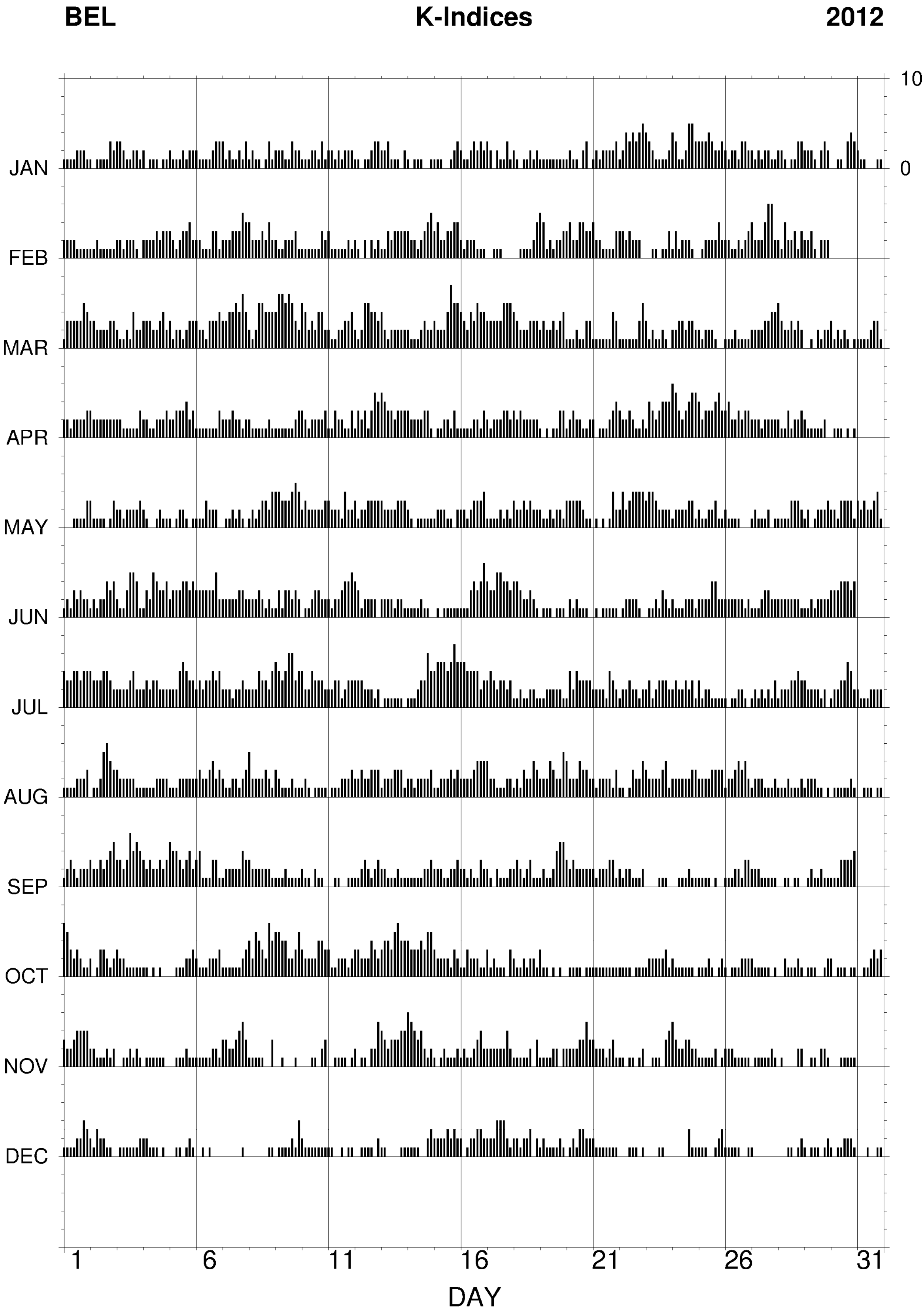


Fig. 4. K-indices in graphical form, Belsk 2012.

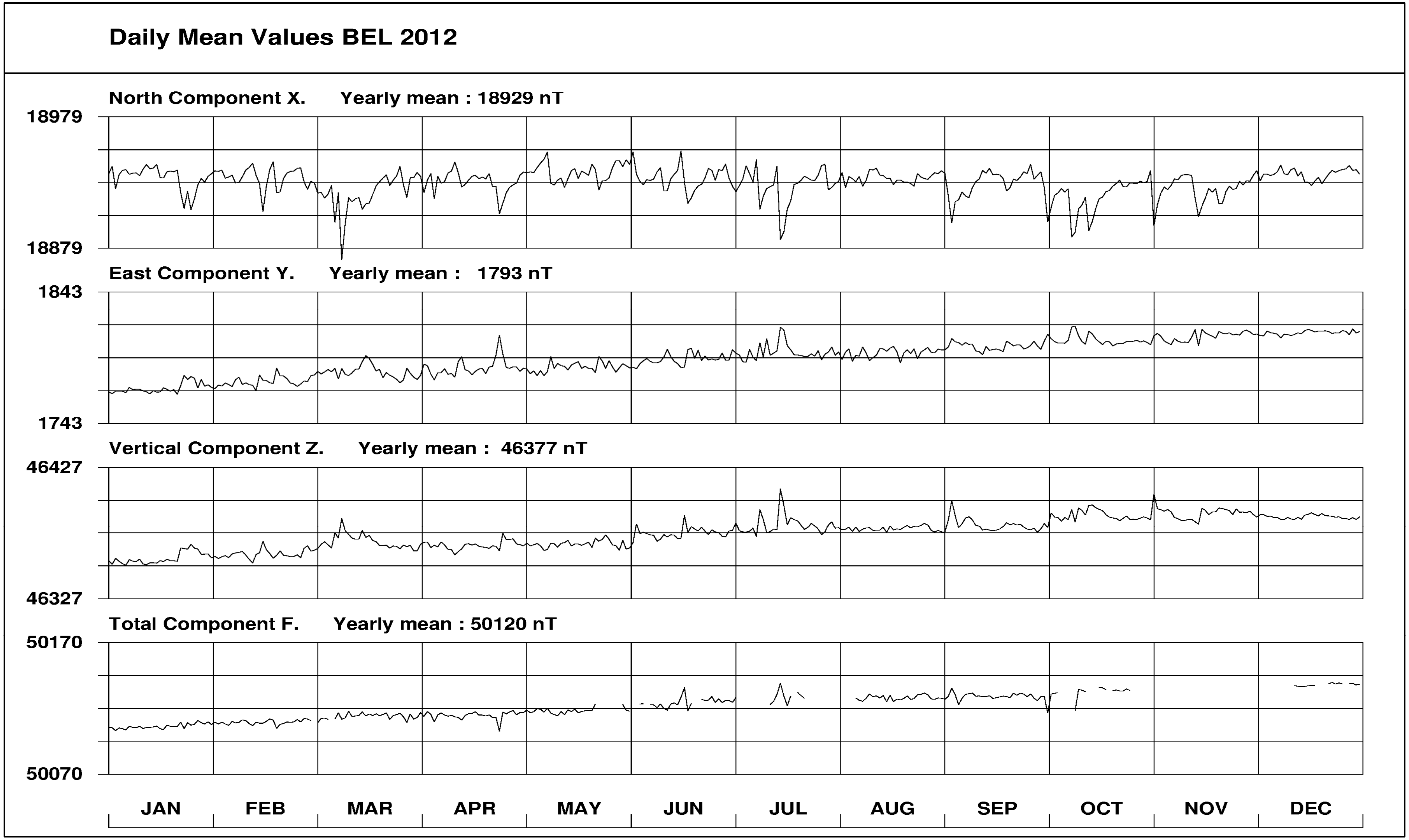


Fig. 5. Daily mean data plot for Belsk 2012.

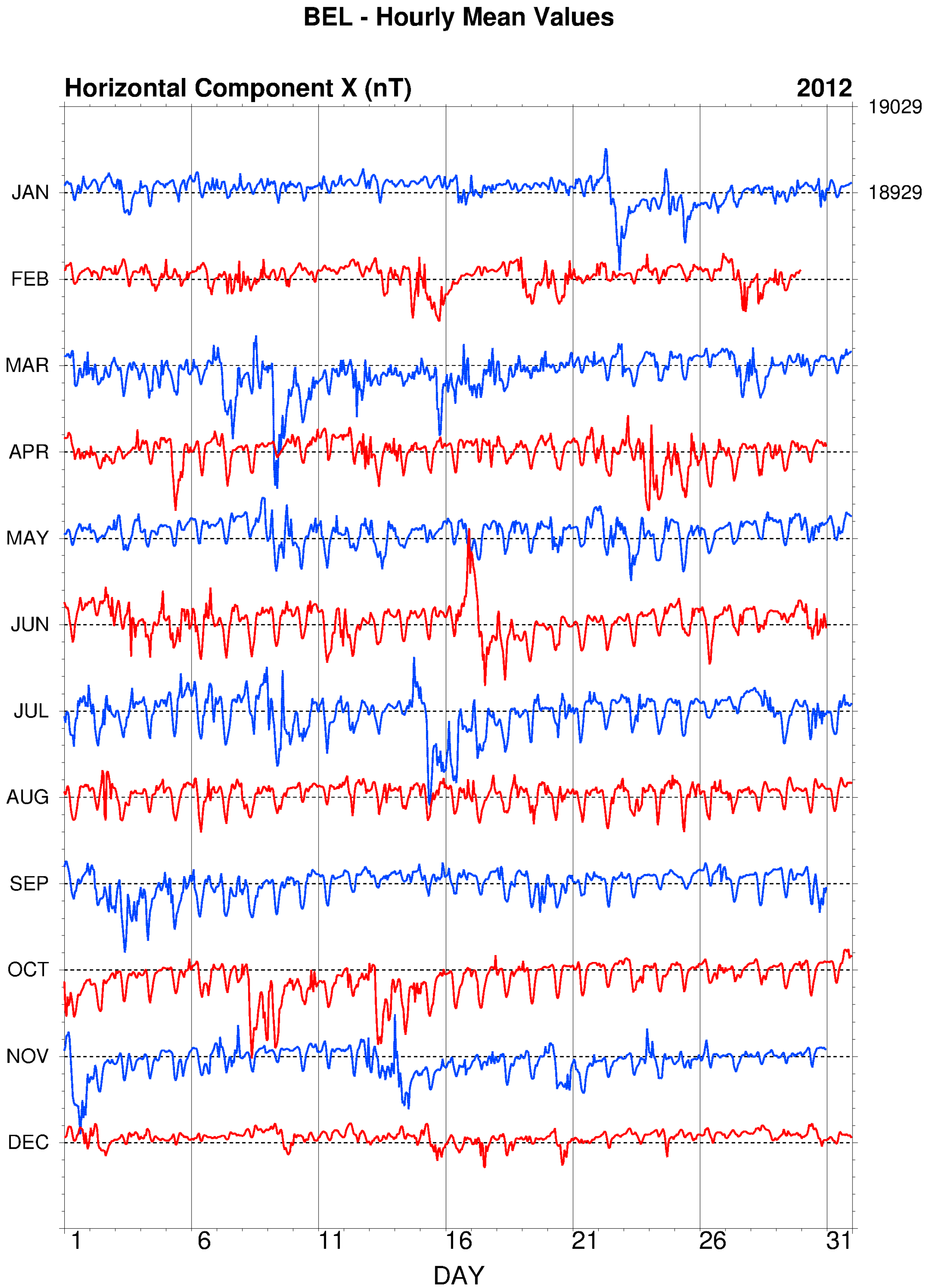


Fig. 6. Hourly mean data plot of X component for Belsk 2012.

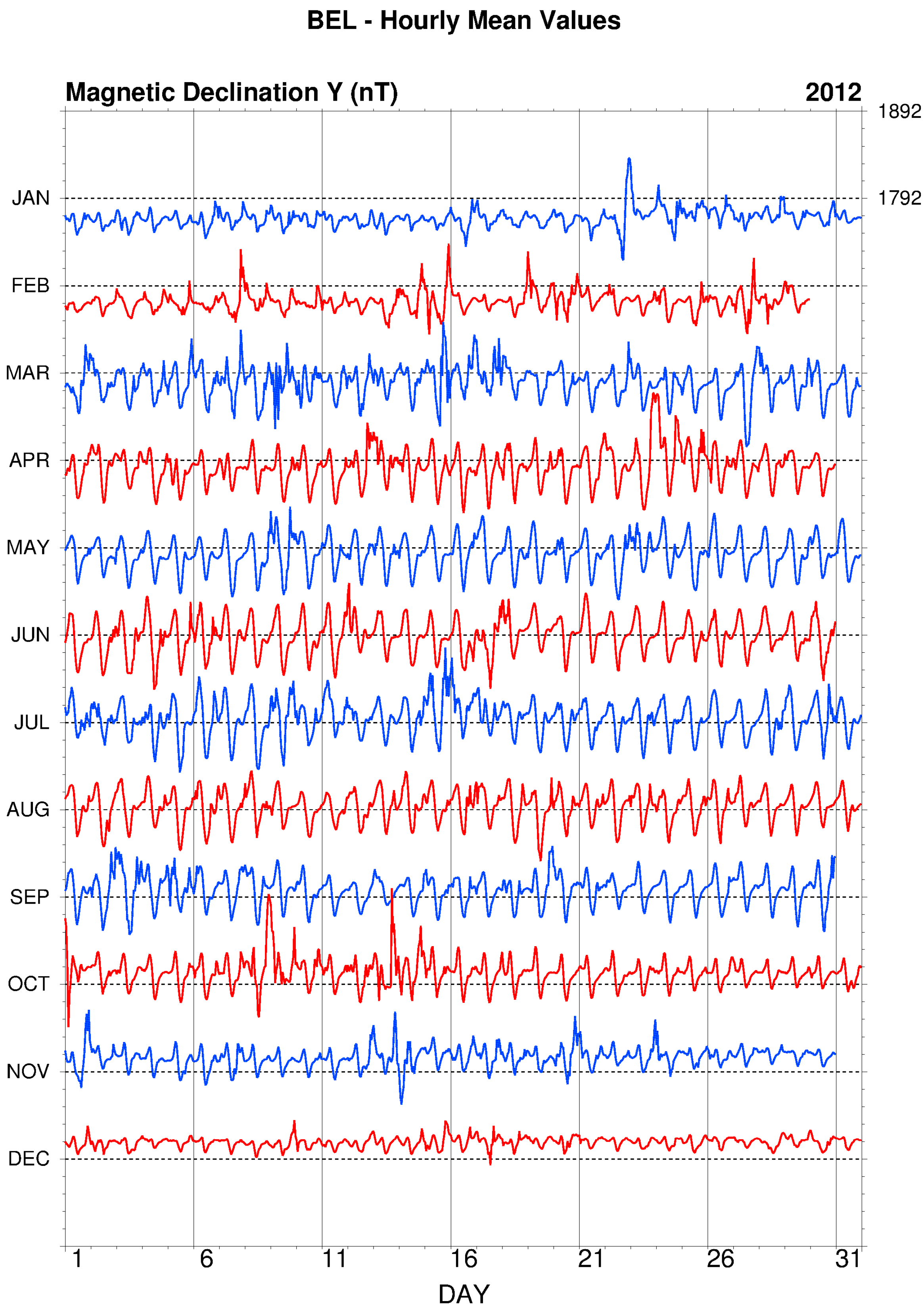


Fig. 7. Hourly mean data plot of Y component for Belsk 2012.

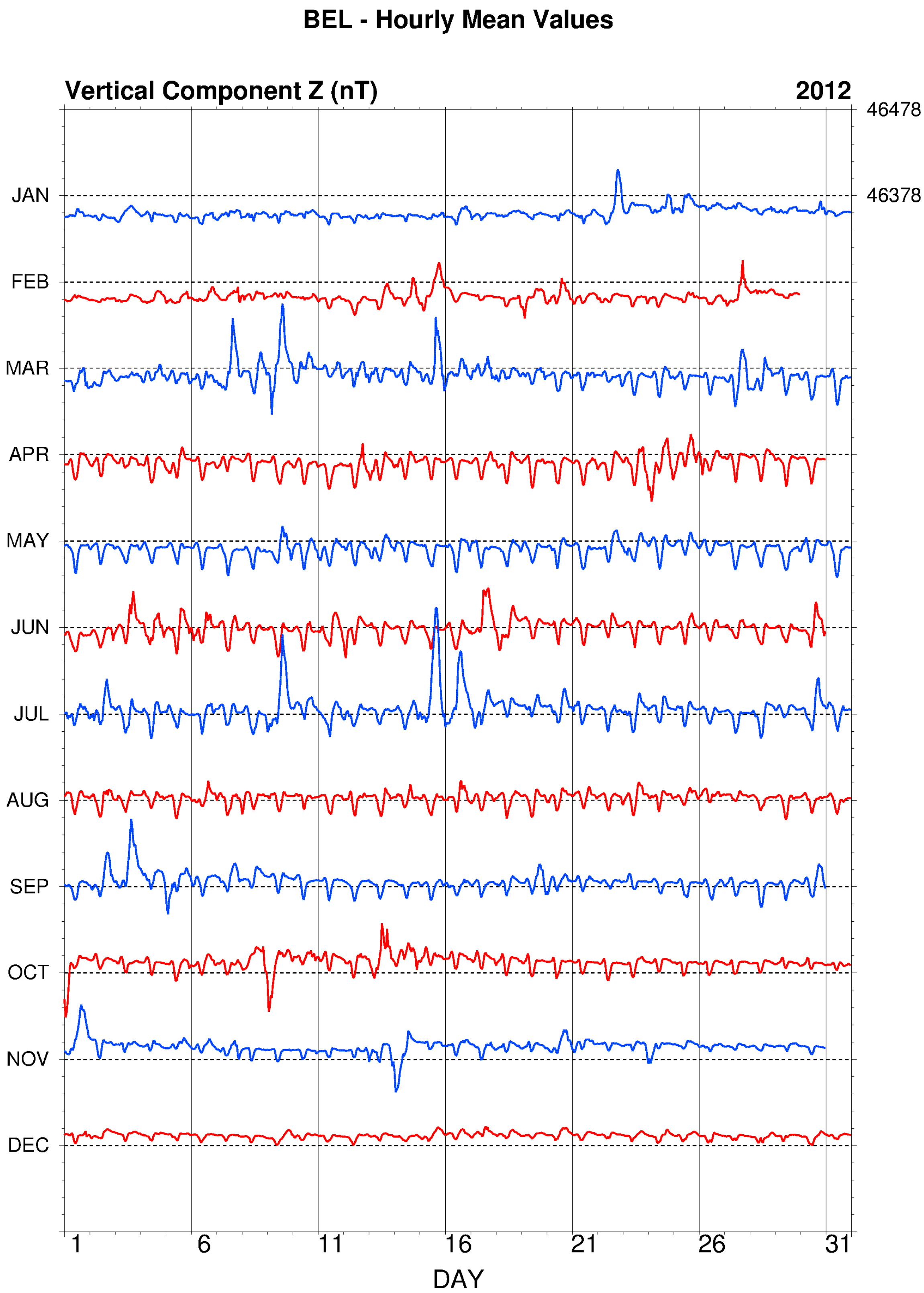


Fig. 8. Hourly mean data plot of Z component for Belsk 2012.

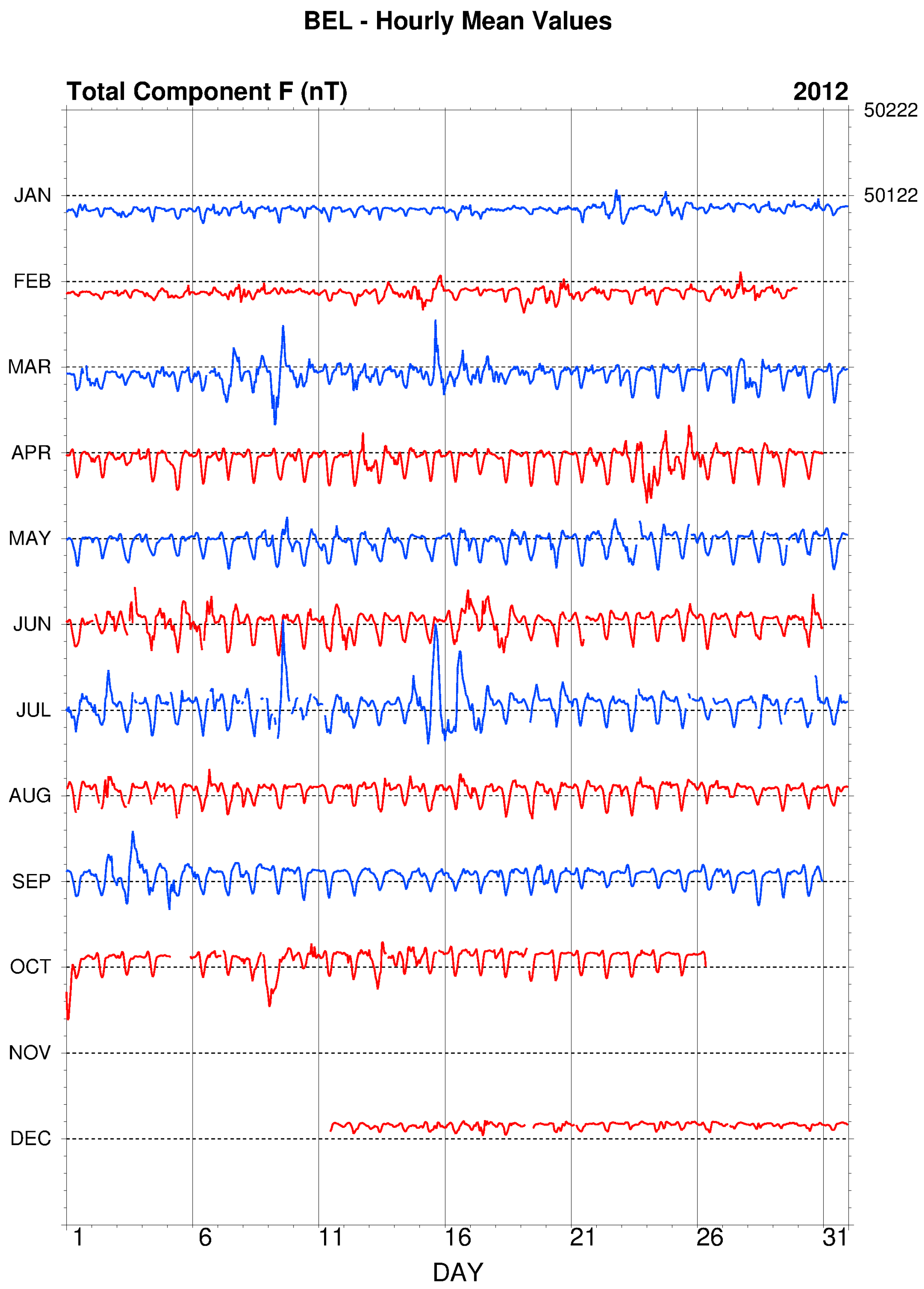


Fig. 9. Hourly mean data plot of F component for Belsk 2012.

7. TABLES AND PLOTS FOR HEL OBSERVATORY

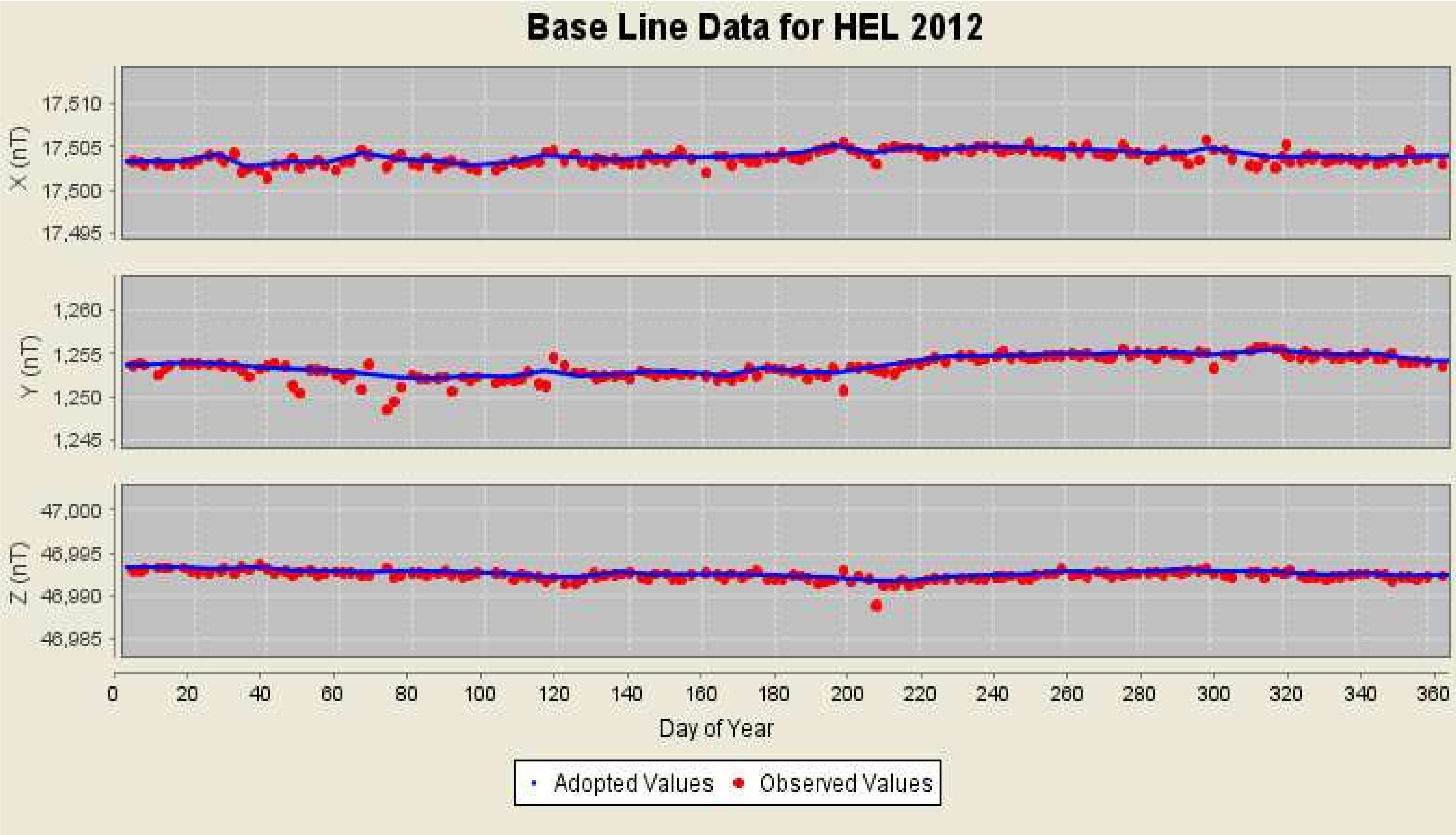


Fig. 10. Base values of set 1, Hel 2012.

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
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
58	2010	4 00.5	17568	46980	17525	1228	69 29.8	50157
59	2011	4 09.2	17564	47014	17518	1272	69 30.9	50188
60	2012	4 18.7	17562	47053	17512	1321	69 32.0	50223

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

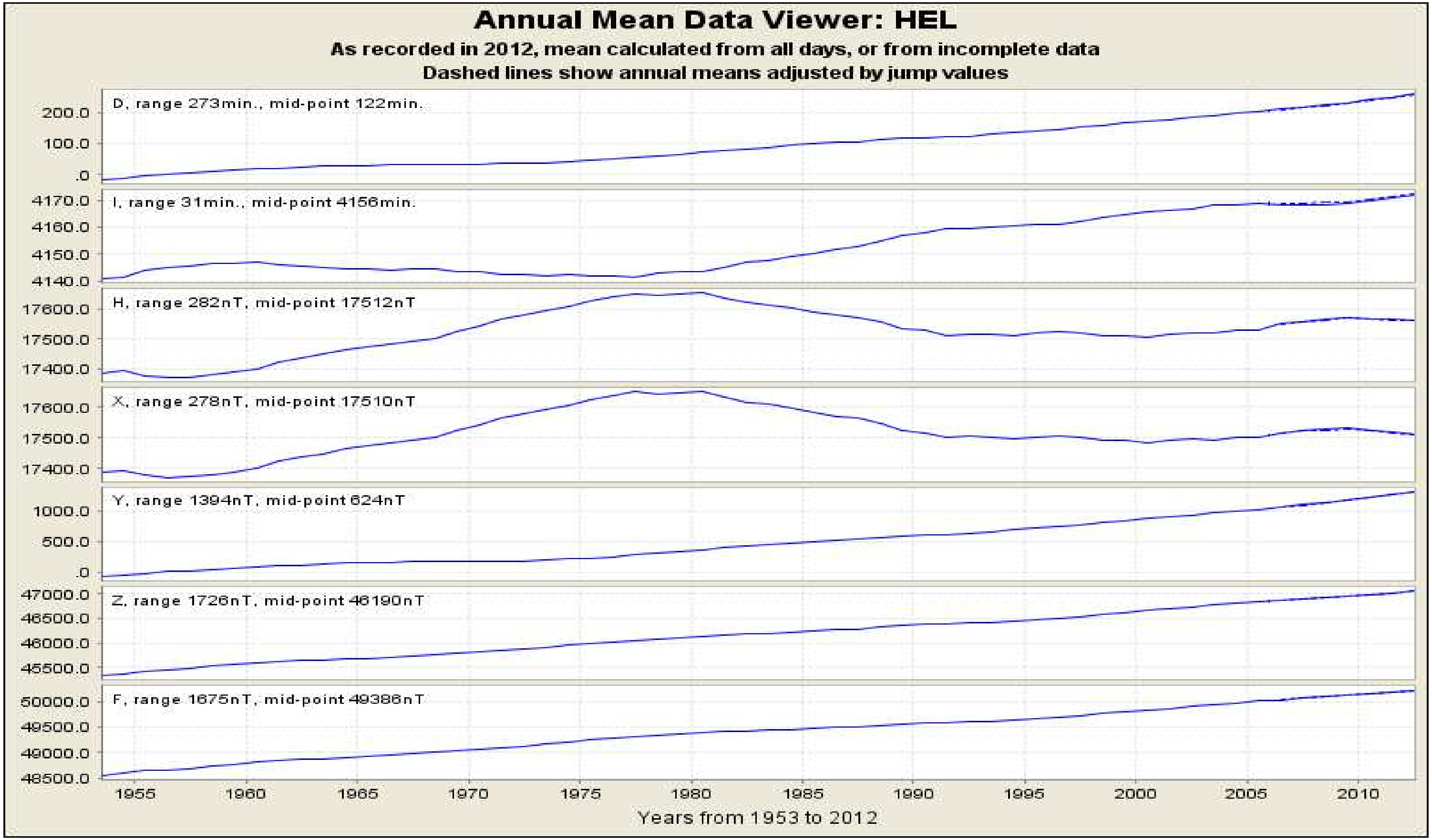


Fig. 11. Secular changes of H, X, Y, Z, F, D and I at Hel.

MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

HLP 2012

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
					NORTH COMPONENT: 17000 + ... in nT								
All days	514	514	503	511	518	516	511	516	512	502	507	518	512
Quiet days	518	517	515	514	520	511	518	516	507	508	509	521	515
Disturbed days	501	504	485	499	512	520	518	515	512	504	500	518	507
					EAST COMPONENT: 1000 + ... in nT								
All days	297	301	309	312	312	317	323	326	330	337	340	340	320
Quiet days	296	300	305	308	311	320	316	328	331	336	340	340	319
Disturbed days	302	305	314	321	315	313	316	326	331	335	338	340	321
					VERTICAL COMPONENT: 47000 + ... in nT								
All days	35	38	48	44	46	53	58	55	58	66	68	65	53
Quiet days	34	37	44	44	45	54	55	56	55	67	69	63	52
Disturbed days	42	42	56	43	46	58	55	54	58	65	66	65	54

Three-hour-range K indices
Hel, January - March, 2012
The limit of K=9 is 550

Day	January K	January SK	February K	February SK	March K	March SK
1	1111 1121	9	2221 1011	10	0233 2354	22
2	1000 1132	8	1121 1011	8	3222 2233	19
3	3311 1121	13	2212 2210	12	2112 1312	13
4	2000 1011	5	2222 3233	19	3222 2243	20
5	2101 2122	11	3112 3242	18	3122 1233	17
6	1011 1133	11	2211 1331	14	3221 3234	20
7	3111 1213	13	1122 3254	20	3344 4463	31
8	1111 1121	9	4222 3242	21	2125 5444	27
9	2111 1312	12	2102 1231	12	4666 5532	37
10	1111 2121	10	1111 1132	11	5432 2342	25
11	1211 0222	11	3101 0021	8	2112 2334	18
12	1112 1133	13	2002 1111	8	2125 4443	25
13	2231 0101	10	1122 3323	17	3211 2222	15
14	1010 0000	2	3221 2344	21	2112 2323	16
15	0100 0123	7	3422 3344	25	3222 4655	29
16	2112 3232	16	2022 2100	9	4223 3544	27
17	3201 1121	11	0011 0000	2	3333 3445	28
18	2001 0111	6	0001 0114	7	4322 2233	21
19	1001 0101	4	5412 1223	20	2322 3234	21
20	1200 0220	7	3422 4433	25	1112 1122	11
21	1211 2122	12	3222 1103	14	1101 1132	10
22	0143 4345	24	3333 2220	18	0101 1134	11
23	4321 1101	13	0011 0003	5	3021 1220	11
24	4211 2453	22	1312 2210	12	1232 3322	18
25	3333 3223	22	0022 3232	14	2112 2100	9
26	2022 2332	16	2121 2023	13	1112 1101	8
27	2122 2210	12	4212 4662	27	2222 3334	21
28	2211 1133	14	2142 2213	17	4322 2232	20
29	3221 0232	15	2231 0112	12	0000 2112	6
30	0010 0343	11			3111 2100	9
31	2111 0001	6			0011 2330	10

Three-hour-range K indices
Hel, April - June, 2012
The limit of K=9 is 550

Day	April K	April SK	May K	May SK	June K	June SK
1	2112 2223	15	0001 0113	6	1213 3322	17
2	3222 3222	18	2011 1013	9	1212 2424	18
3	2111 1123	12	2212 2213	15	2113 5541	22
4	2201 2223	14	2100 1200	6	1325 4334	25
5	2223 2323	19	0012 2101	7	2333 4334	25
6	1000 0002	3	1013 2110	9	3323 3352	24
7	2223 2112	15	0003 1200	6	2222 2332	18
8	2111 1120	9	1212 3324	18	2223 2120	14
9	1001 1022	7	4333 4454	30	1213 3232	17
10	3112 2213	15	2322 2223	18	0112 3322	14
11	1122 2113	13	3222 2422	19	1122 3345	21
12	1223 2354	22	3122 3332	19	4311 2220	15
13	5433 2323	25	3222 2232	18	2122 1211	12
14	3222 2331	18	2100 1111	7	1101 2100	6
15	0111 2131	10	1211 1102	9	0101 2101	6
16	1111 2213	12	2112 3334	19	0103 4346	21
17	2112 3332	17	1110 2121	9	4344 5444	32
18	3222 2222	17	3213 2322	18	4422 2321	20
19	0000 1132	7	2112 1211	11	0001 0000	1
20	1232 2111	13	2322 3211	16	0112 1110	7
21	1012 1233	13	0101 0142	9	0101 1110	5
22	3213 2112	15	2323 4444	26	1112 3210	11
23	1431 3444	24	3443 2222	22	0112 0310	8
24	6532 3354	31	1222 2331	16	2111 2221	12
25	4233 3453	27	2112 2311	13	2222 4312	18
26	3423 3233	23	2101 1000	5	2222 2212	15
27	2221 2222	15	0111 1200	6	1112 3322	15
28	2113 1322	15	1101 3332	14	2222 3211	15
29	2101 1120	8	1201 2223	13	1112 2222	13
30	0000 0001	1	2213 3321	17	3334 5334	28
31			3232 2341	20		

Three-hour-range K indices
Hel, July - September, 2012
The limit of K=9 is 550

Day	July K	July SK	August K	August SK	September K	September SK
1	3334 4333	26	1112 2223	14	1122 2212	13
2	3333 4432	25	0002 5643	20	3223 3345	25
3	2123 3422	19	3222 2211	15	3323 5544	29
4	2223 3212	17	1111 2222	12	3232 3323	21
5	3214 5433	25	0112 2222	12	5444 3332	28
6	2323 3434	24	2323 3423	22	3302 1331	16
7	2222 2232	17	2112 2133	15	1222 2233	17
8	2224 3323	21	5222 2321	19	3212 2221	15
9	4334 6534	32	3111 1211	11	1012 1121	9
10	3224 3332	22	0100 1111	5	2110 2110	8
11	2233 1223	18	0011 3222	11	0011 0000	2
12	3322 3312	19	1232 2333	19	1022 2113	12
13	0001 1100	3	1222 3331	17	2211 1211	11
14	0112 3355	20	1112 2213	13	1112 2213	13
15	4455 4575	39	1012 2223	13	2121 1223	14
16	5543 4422	29	2222 3434	22	2212 2131	14
17	3432 3322	22	3211 1212	13	2102 1112	10
18	1111 1221	10	1222 3233	18	2222 2311	15
19	0112 3221	12	2214 3225	21	1111 2355	19
20	1423 3333	22	3222 4332	21	3233 2222	19
21	2122 1432	17	2112 2213	14	1122 2221	13
22	1222 2212	14	1101 3223	13	2122 1112	12
23	2212 3322	17	3222 2341	19	0000 1000	1
24	2222 3231	17	2212 2233	17	0000 1211	5
25	3122 2111	13	2222 3323	19	0011 1000	3
26	0001 2100	4	1223 4342	21	1012 2132	12
27	0212 1212	11	1222 1112	12	2221 1111	11
28	1222 3343	20	1112 1011	8	0010 0000	1
29	3222 2120	14	1122 1101	9	0121 1111	8
30	1122 3542	20	0011 2121	8	1123 3334	20
31	2111 2211	11	0011 1010	4		

Three-hour-range K indices
Hel, October - December, 2012
The limit of K=9 is 550

Day	October K	October SK	November K	November SK	December K	December SK
1	6532 3211	23	3223 3444	25	0000 1143	9
2	1003 3212	12	2211 1112	11	2122 2100	10
3	2211 1111	10	0001 2111	6	0011 1112	7
4	0001 0000	1	0100 1100	3	2211 0010	7
5	0001 1223	9	0010 1211	6	0000 0011	2
6	3111 2223	15	0001 1321	8	0000 1000	1
7	0111 1023	9	3322 3443	24	0000 0010	1
8	4244 3154	27	1011 1003	7	0000 0000	0
9	5444 2235	29	0000 0000	0	0111 1113	9
10	3223 2433	22	0001 1013	6	3101 1111	9
11	3112 2212	14	0001 1101	4	1100 0011	4
12	3322 2432	21	2000 0124	9	0011 0001	3
13	3444 5634	33	5323 3344	27	1100 0011	4
14	4233 4355	29	6543 3212	26	1111 0012	7
15	4222 2132	18	1012 0112	8	2122 2232	16
16	1122 1211	11	1111 1342	14	2011 2221	11
17	2121 1103	11	1223 1242	17	2223 3311	17
18	2112 1211	11	1111 1203	10	2212 1202	12
19	2100 0000	3	1011 2202	9	1111 1121	9
20	0000 0010	1	2122 3353	21	0121 3322	14
21	1011 1110	6	2221 1231	14	2101 1011	7
22	1111 0110	6	1100 1001	4	0000 0100	1
23	1112 2230	12	0000 1034	8	0000 0110	2
24	1111 1110	7	5322 3221	20	0000 0310	4
25	1101 1011	6	1111 1201	8	1100 0113	7
26	1011 1123	10	2211 0110	8	1111 1001	6
27	2111 1000	6	0111 1120	7	1000 0000	1
28	0011 1010	4	0000 0012	3	0001 1011	4
29	0001 0002	3	0001 0211	5	1011 0002	5
30	2001 0001	4	0001 0101	3	1011 2221	10
31	0001 1323	10			0000 0000	0

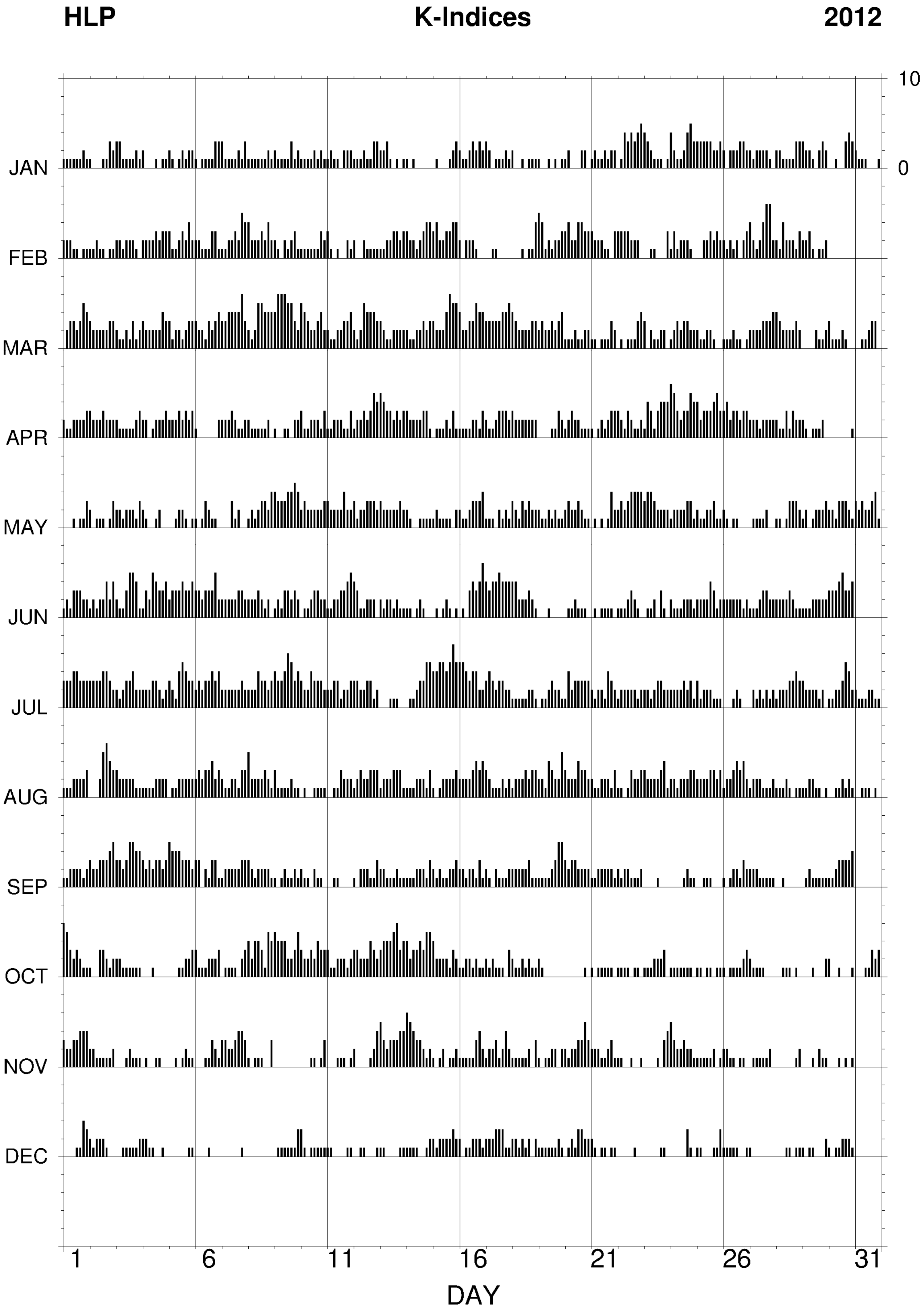


Fig. 12. K-indices in graphical form, Hel 2012.

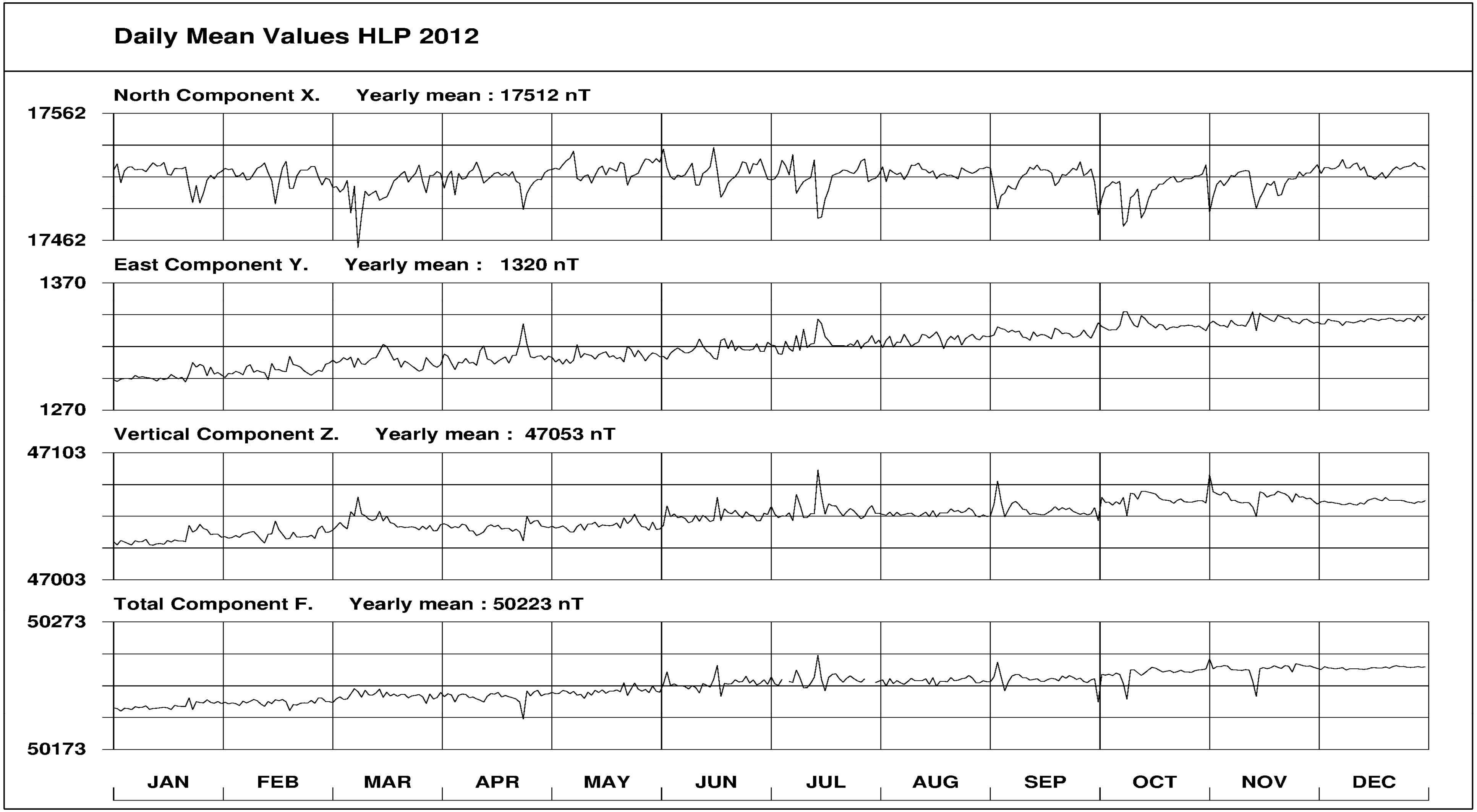


Fig. 13. Daily mean data plot for Hel 2012.

HLP - Hourly Mean Values

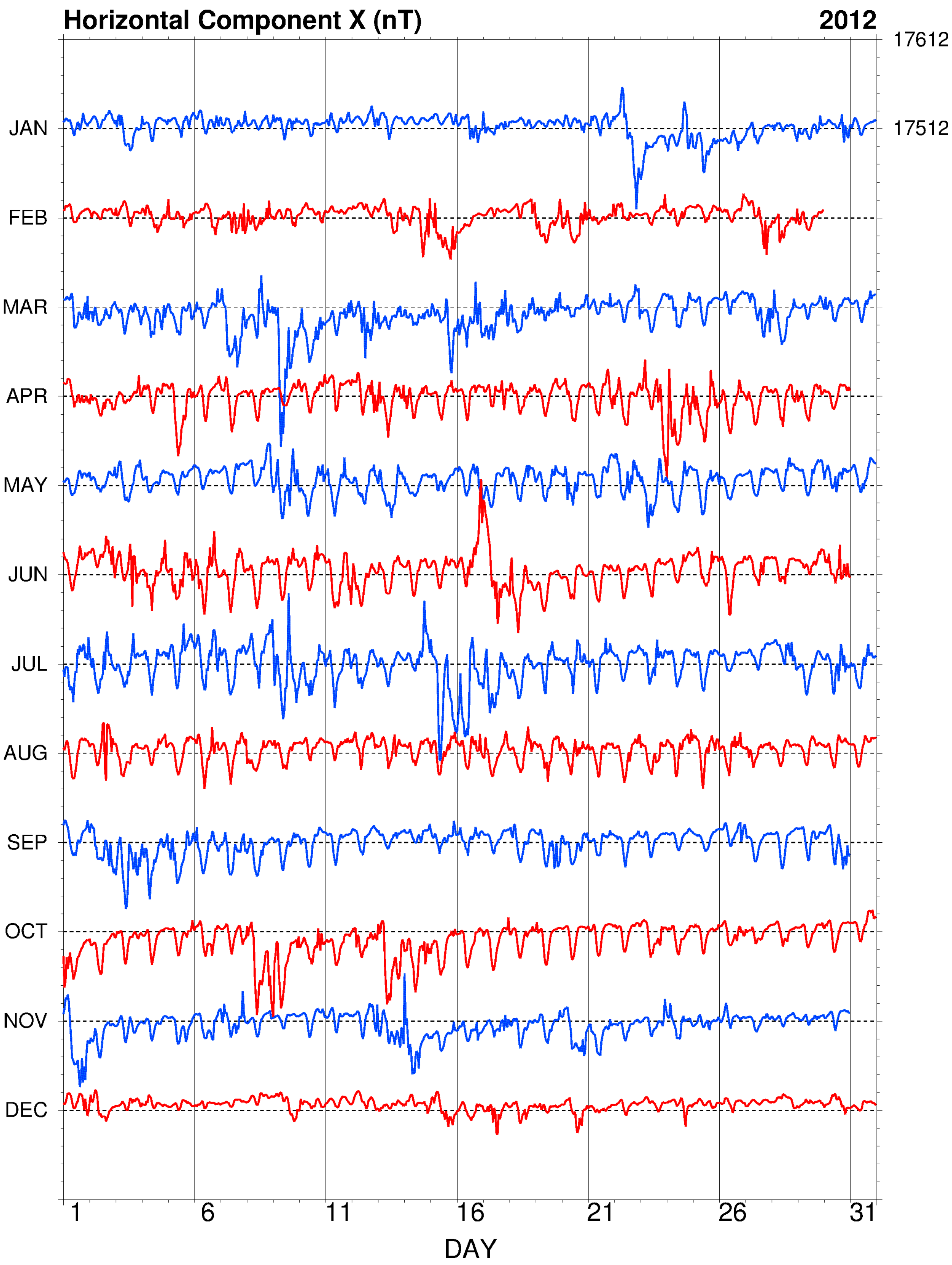


Fig. 14. Hourly mean data plot of X component for Hel 2012.

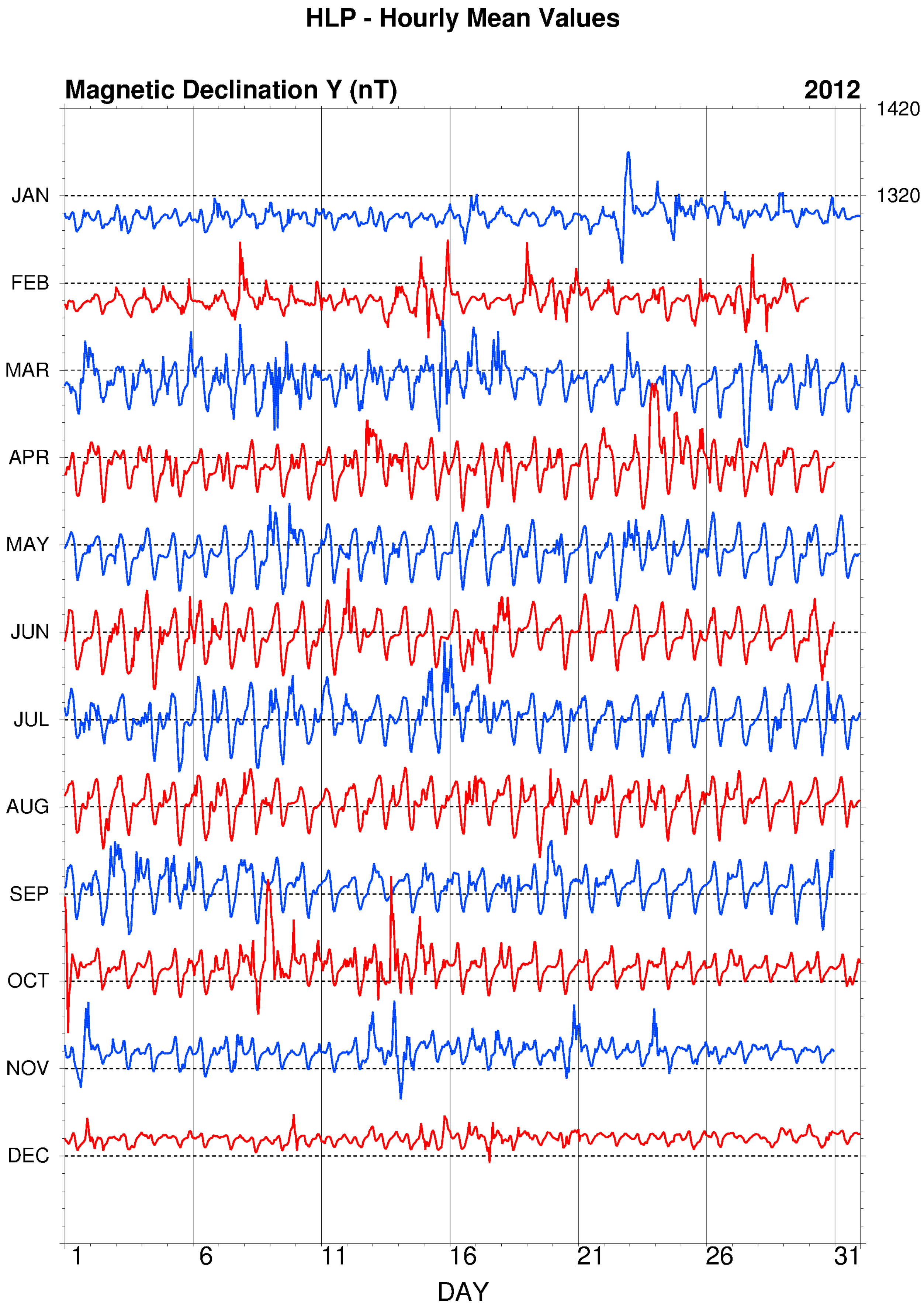


Fig. 15. Hourly mean data plot of Y component for Hel 2012.

HLP - Hourly Mean Values

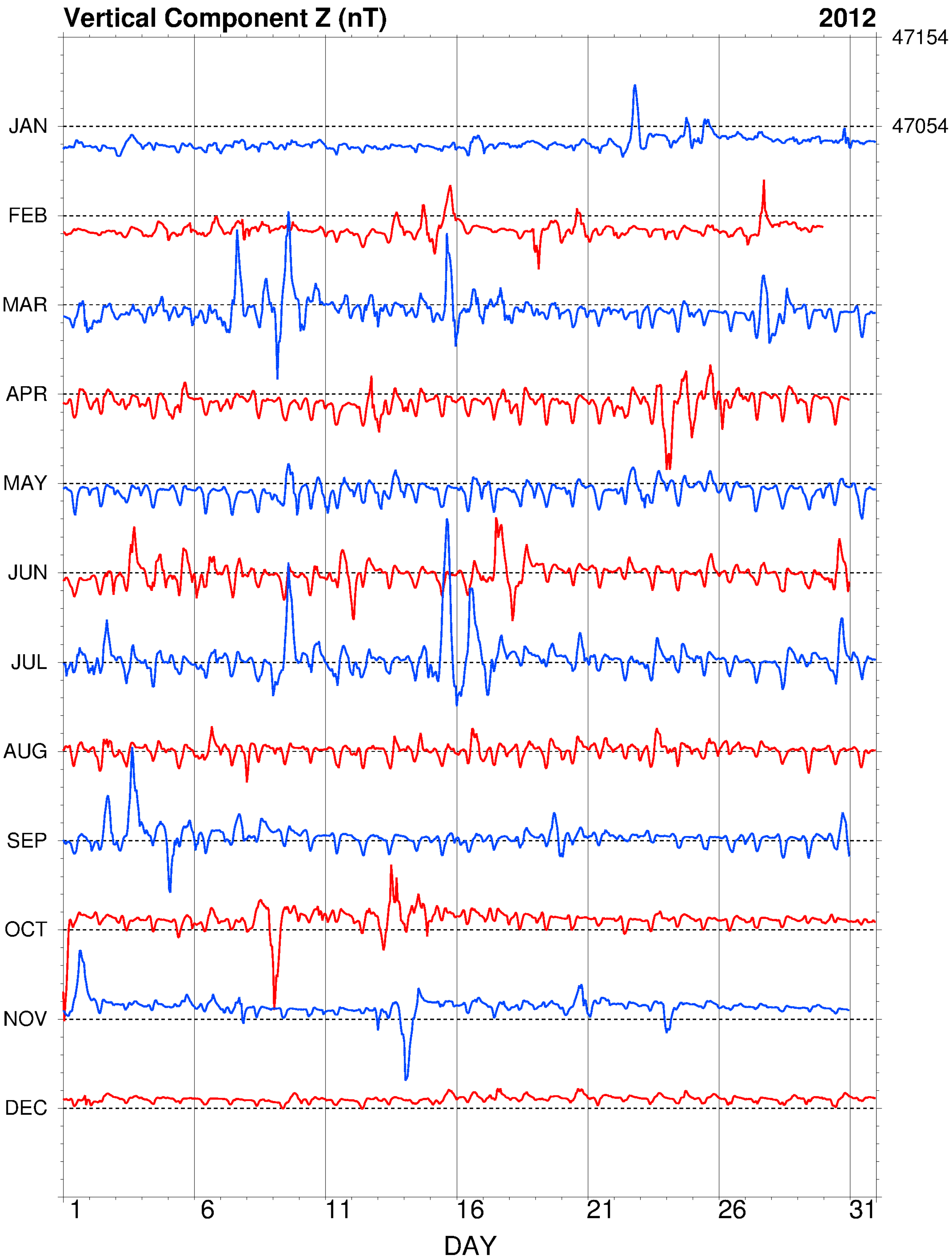


Fig. 16. Hourly mean data plot of Z component for Hel 2012.

HLP - Hourly Mean Values

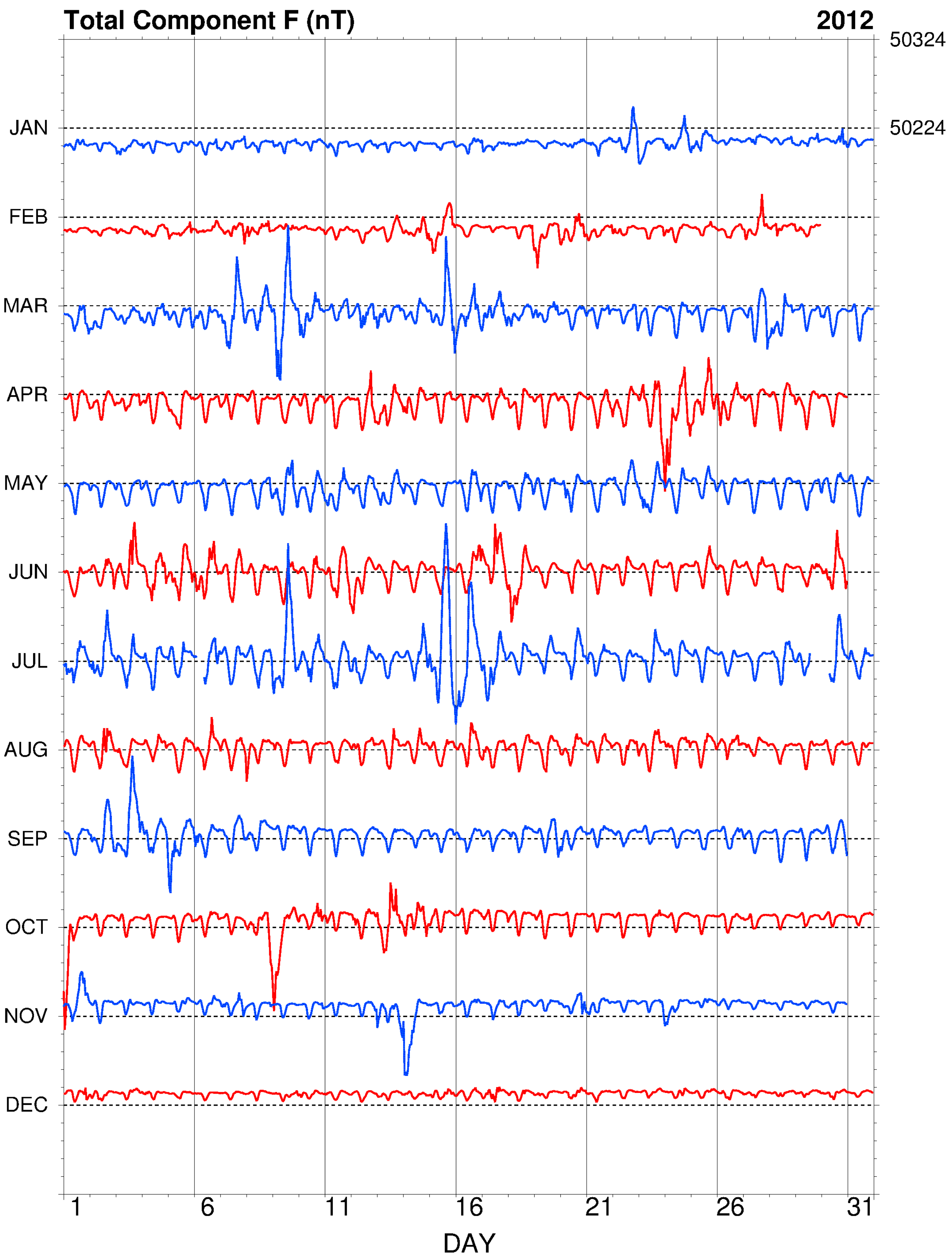


Fig. 17. Hourly mean data plot of F component for Hel 2012.

8. TABLES AND PLOTS FOR HORNSUND OBSERVATORY

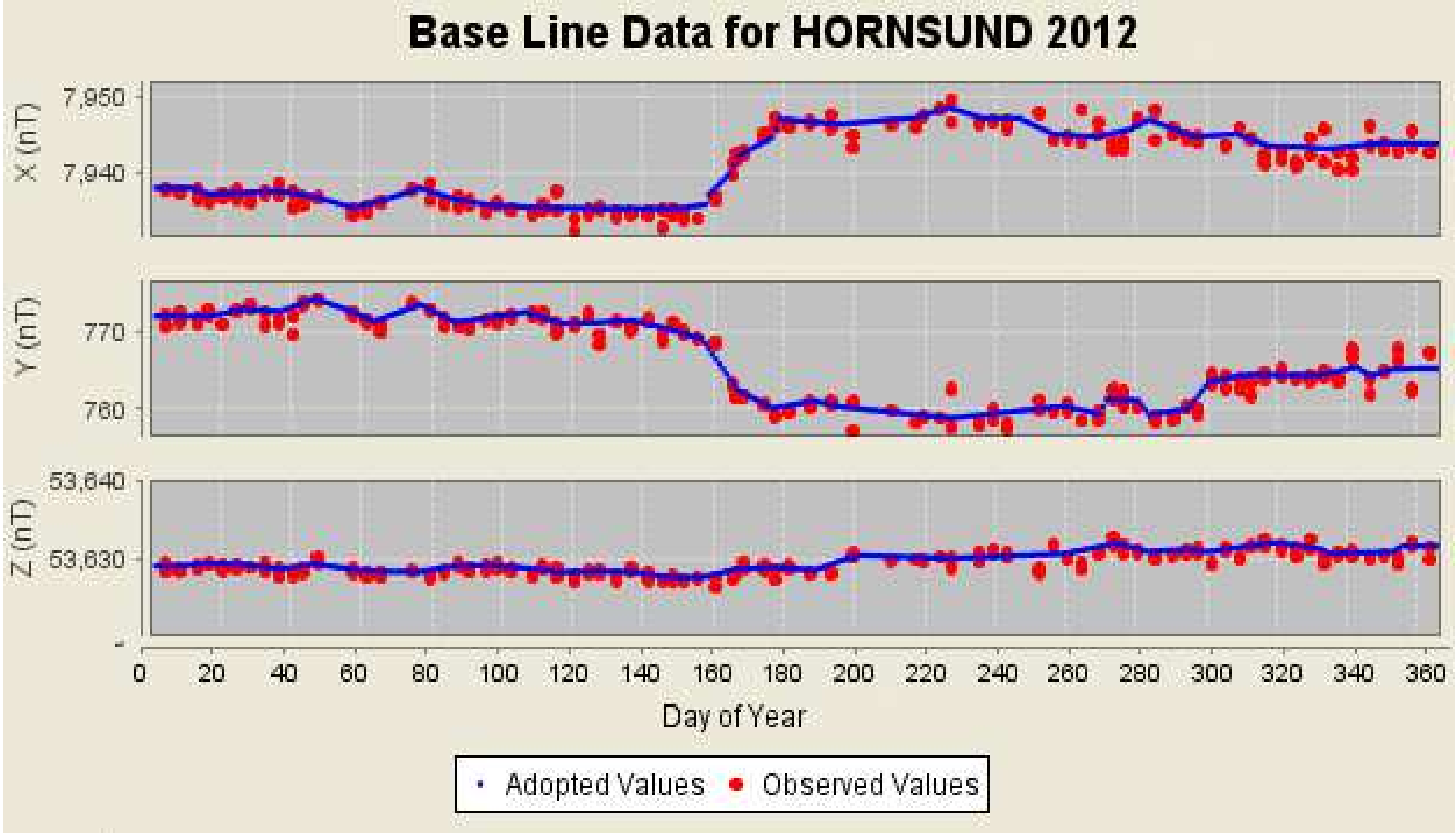


Fig. 18. Base values, Hornsund 2012.

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
2010	5 45.7	7928	53837	7888	796	81 37.4	54418
2011	6 05.8	7920	53868	7875	841	81 38.2	54447
2012	6 28.2	7910	53900	7860	891	81 39.1	54477

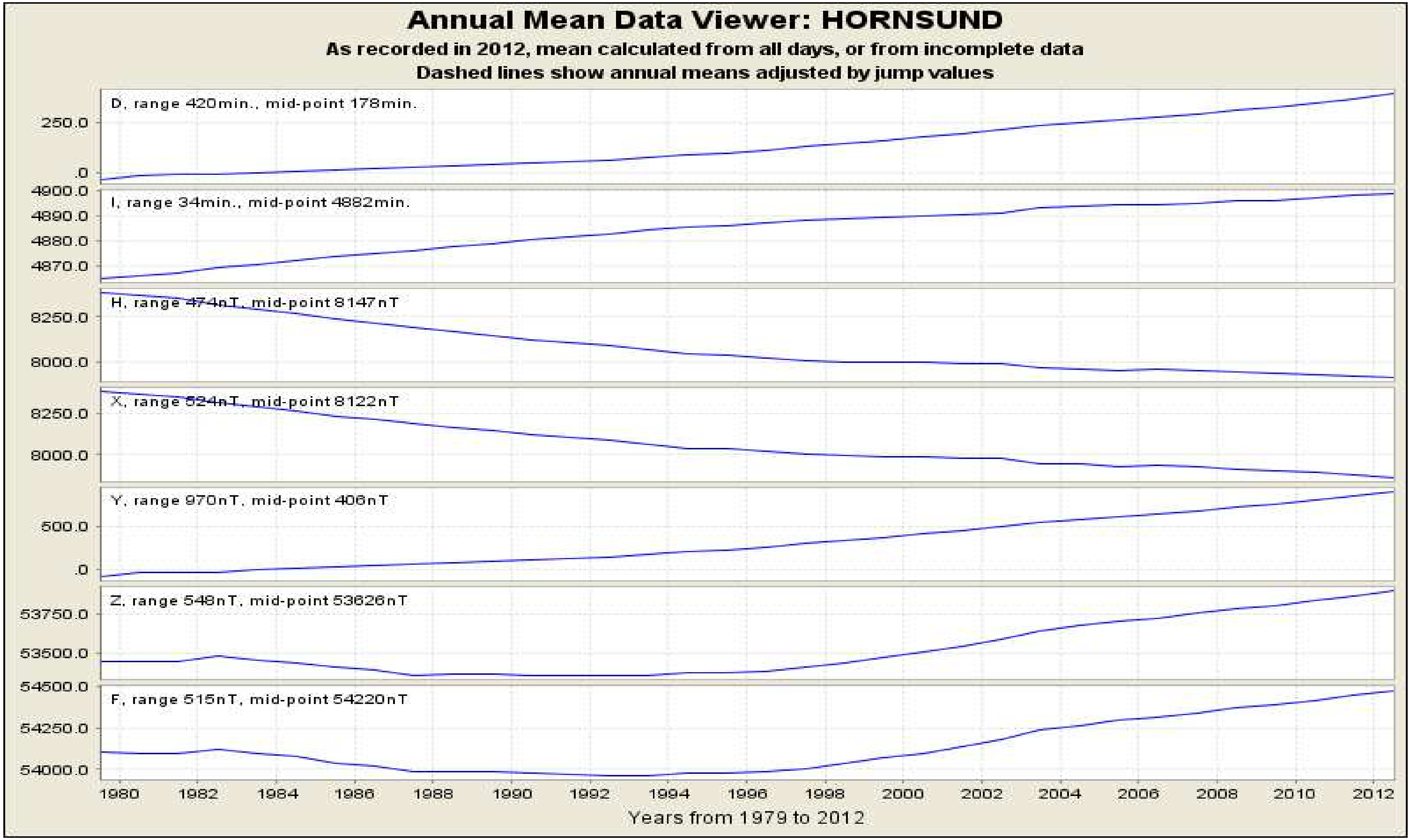


Fig. 19. Secular changes of H, X, Y, Z, F, D and I at Hornsund.

MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

HRN 2012

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
NORTH COMPONENT: 7500 + ... in nT													
All days	355	353	343	365	378	383	374	369	361	348	343	348	360
Quiet days	364	364	363	370	369	368	372	362	356	353	352	351	362
Disturbed days	340	327	314	349	351	402	320	362	386	329	319	340	345
EAST COMPONENT: 500 + ... in nT													
All days	369	375	383	378	382	384	390	392	398	411	415	416	391
Quiet days	369	373	378	379	386	391	394	396	400	409	413	415	392
Disturbed days	368	378	396	382	389	374	400	383	391	433	428	420	395
VERTICAL COMPONENT: 53500 + ... in nT													
All days	382	390	412	406	393	386	398	396	402	418	418	400	400
Quiet days	376	383	405	395	397	401	395	397	396	407	403	399	396
Disturbed days	384	408	427	430	395	363	449	375	409	464	440	400	412

Three-hour-range K indices
Hornsund, January - March, 2012
The limit of K=9 is 2500

Day	January K	January SK	February K	February SK	March K	March SK
1	3222 2253	21	1232 2010	11	1343 3355	27
2	0111 1101	6	0233 1002	11	4432 3231	22
3	3321 2211	15	3232 3200	15	4223 2623	24
4	3110 0001	6	3333 3222	21	3332 2141	19
5	2212 2023	14	2323 3224	21	2033 2224	18
6	0011 1133	10	1232 1221	14	3331 4314	22
7	4232 1125	20	124- -136	--	4335 4535	32
8	2222 1142	16	5343 2265	30	3334 5445	31
9	4222 1424	21	2212 2152	17	4655 4423	33
10	2112 2241	15	1221 3141	15	6543 3344	32
11	2432 1124	19	2222 1012	12	2223 3233	20
12	1323 2122	16	2121 1120	10	2236 5355	31
13	2331 1011	12	1232 3312	17	5223 3343	25
14	1221 0001	7	2233 2224	20	4322 3234	23
15	1310 0023	10	3312 2223	18	5333 5753	34
16	2332 2243	21	2122 3000	10	2343 3655	31
17	4321 1032	16	0121 0000	4	4254 3656	35
18	3122 2213	16	0011 1013	7	5433 3555	33
19	1222 1101	10	4322 1134	20	3333 2154	24
20	3211 0230	12	3433 3556	32	3323 2133	20
21	1321 2123	15	5433 2114	23	2112 2143	16
22	2144 4233	23	4333 2000	15	1311 0015	12
23	2331 2212	16	0012 1024	10	2021 1110	8
24	5332 3555	31	1322 2200	12	2252 2422	21
25	3454 3243	28	0232 3252	19	2233 1000	11
26	2243 3333	23	2233 3243	22	0122 2100	8
27	2242 3311	18	3222 5451	24	1223 2223	17
28	2322 2244	21	2242 2232	19	4333 2243	24
29	3232 1244	21	2341 0010	11	0010 3004	8
30	1221 1243	16			222- 0000	--
31	1211 1000	6			0010 -131	--

Three-hour-range K indices
Hornsund, April - June, 2012
The limit of K=9 is 2500

Day	April K	April SK	May K	May SK	June K	June SK
1	1322 2321	16	1112 2112	11	1313 22-1	--
2	2223 3211	16	3212 2112	14	1222 2223	16
3	2211 2125	16	3333 2102	17	3334 4443	28
4	2221 2113	14	1200 1121	8	2456 4334	31
5	3324 3201	18	0111 2111	8	2445 5434	31
6	1111 0013	8	2123 2131	15	5445 4363	34
7	3243 3102	18	1112 0110	7	2443 3242	24
8	2232 2130	15	1332 2124	18	2334 2011	16
9	0012 2122	10	4554 4454	35	2313 3113	17
10	2221 2112	13	2333 3235	24	1111 3214	14
11	1222 2003	12	5432 2431	24	2344 4333	26
12	1333 2254	23	4333 3253	26	4343 3221	22
13	6433 2454	31	4344 4332	27	2221 2222	15
14	3433 3440	24	3220 1112	12	2323 3112	17
15	0232 2241	16	2332 1011	13	1111 1111	8
16	1121 2111	10	1332 2243	20	1224 4335	24
17	2123 3232	18	3221 2111	13	3444 4333	28
18	2333 3232	21	3323 3322	21	5544 3312	27
19	1211 2111	10	2233 2221	17	1112 2211	11
20	1242 2111	14	2343 3111	18	2432 2210	16
21	1012 1143	13	1222 0011	9	2201 3112	12
22	3443 2221	21	2434 3352	26	2223 3211	16
23	1441 3332	21	3353 3442	27	1222 0221	12
24	5443 3364	32	2333 2321	19	2222 2111	13
25	3444 3564	33	1224 3313	19	2243 4222	21
26	3422 3254	25	4221 2000	11	2343 2212	19
27	2432 3122	19	1331 2100	11	2222 4322	19
28	1322 2322	17	1211 3222	14	2333 3111	17
29	3322 2033	18	2212 2213	15	1232 3143	19
30	1110 1011	6	3334 3222	22	3355 5345	33
31			3333 3231	21		

Three-hour-range K indices
Hornsund, July - September, 2012
The limit of K=9 is 2500

Day	July K	July SK	August K	August SK	September K	September SK
1	3444 4324	28	1232 3112	15	3323 3222	20
2	4444 3334	29	2122 4323	19	4334 3223	24
3	2334 4512	24	3343 2200	17	2324 4333	24
4	3643 4113	25	1232 2324	19	3443 3333	26
5	3324 4322	23	1221 2123	14	4455 3221	26
6	3433 3343	26	4423 3613	26	4422 0222	18
7	2333 2122	18	3222 3232	19	2434 3155	27
8	1324 3325	23	3323 3311	19	2334 2231	20
9	5543 5442	32	3322 2211	16	1222 2131	14
10	4445 5333	31	1210 1100	6	2320 1100	9
11	3454 2224	26	1122 2232	15	0221 1010	7
12	3353 3312	23	2331 3232	19	1312 2113	14
13	1112 1110	8	2332 3332	21	3231 2201	14
14	2233 3356	27	2333 3414	23	1221 2102	11
15	4443 -433	--	3123 2323	19	4332 2214	21
16	333- --23	--	2332 5634	28	2422 2141	18
17	5643 3423	30	4322 2244	23	1312 1011	10
18	222- 2233	--	2333 2222	19	2333 3521	22
19	2223 4221	18	2325 4113	21	1222 2434	20
20	2543 3423	26	3333 4233	24	3343 3121	20
21	2233 1221	16	2223 3334	22	2232 3421	19
22	2353 2112	19	2322 2242	19	2232 1002	12
23	2323 4322	21	2334 3332	23	0000 0000	0
24	3333 4323	24	2322 3222	18	0100 0111	4
25	3332 2221	18	2334 3232	22	1121 1000	6
26	1122 1200	9	2334 4353	27	0101 2122	9
27	1221 1111	10	1433 1114	18	2331 0011	11
28	2323 3333	22	2322 2131	16	0010 0001	2
29	3343 2121	19	1342 2102	15	0111 1111	7
30	2443 4333	26	1111 1131	10	1223 2213	16
31	2332 3211	17	0020 0000	2		

Three-hour-range K indices
Hornsund, October - December, 2012
The limit of K=9 is 2500

Day	October K	October SK	November K	November SK	December K	December SK
1	3343 2100	16	2212 1212	13	1111 1055	15
2	0002 1201	6	1211 1013	10	2222 2120	13
3	2221 1111	11	1011 1222	10	0122 1212	11
4	0200 1000	3	0111 1100	5	3232 0021	13
5	0101 2212	9	0001 1211	6	1001 0034	9
6	1222 3312	16	0112 1331	12	0100 1012	5
7	1222 1122	13	2432 2344	24	0000 1010	2
8	3223 3143	21	1112 1003	9	0000 0012	3
9	3524 2224	24	1110 2000	5	0112 1112	9
10	3333 3554	29	0001 1013	6	1211 1001	7
11	2322 3102	15	0000 1000	1	0010 0012	4
12	4443 4524	30	0110 0115	9	0002 1001	4
13	5524 5553	34	4222 3443	24	1200 0013	7
14	3343 3334	26	5423 3200	19	1100 0012	5
15	3333 2041	19	1113 1023	12	3332 3243	23
16	1352 1311	17	1321 2343	19	1222 2252	18
17	1232 2104	15	1433 3144	23	2123 3433	21
18	4222 1213	17	1321 1102	11	1232 1102	12
19	4210 2010	10	2222 2212	15	3232 2223	19
20	0001 1001	3	4421 2342	22	0323 2232	17
21	3111 0000	6	4312 2143	20	2323 2122	17
22	2210 0010	6	0221 0012	8	0211 0001	5
23	1322 2121	14	0111 1115	11	0000 2112	6
24	1220 1332	14	3332 3203	19	0111 0320	8
25	1111 1021	8	1111 1201	8	0111 0004	7
26	0121 1122	10	2332 0021	13	0222 1001	8
27	1221 1000	7	0123 1041	12	1100 0000	2
28	0111 1041	9	0110 0034	9	0111 0010	4
29	0101 0002	4	1111 0133	11	0121 1002	7
30	1101 0000	3	0121 1101	7	2022 2112	12
31	0000 1213	7			0110 0012	5

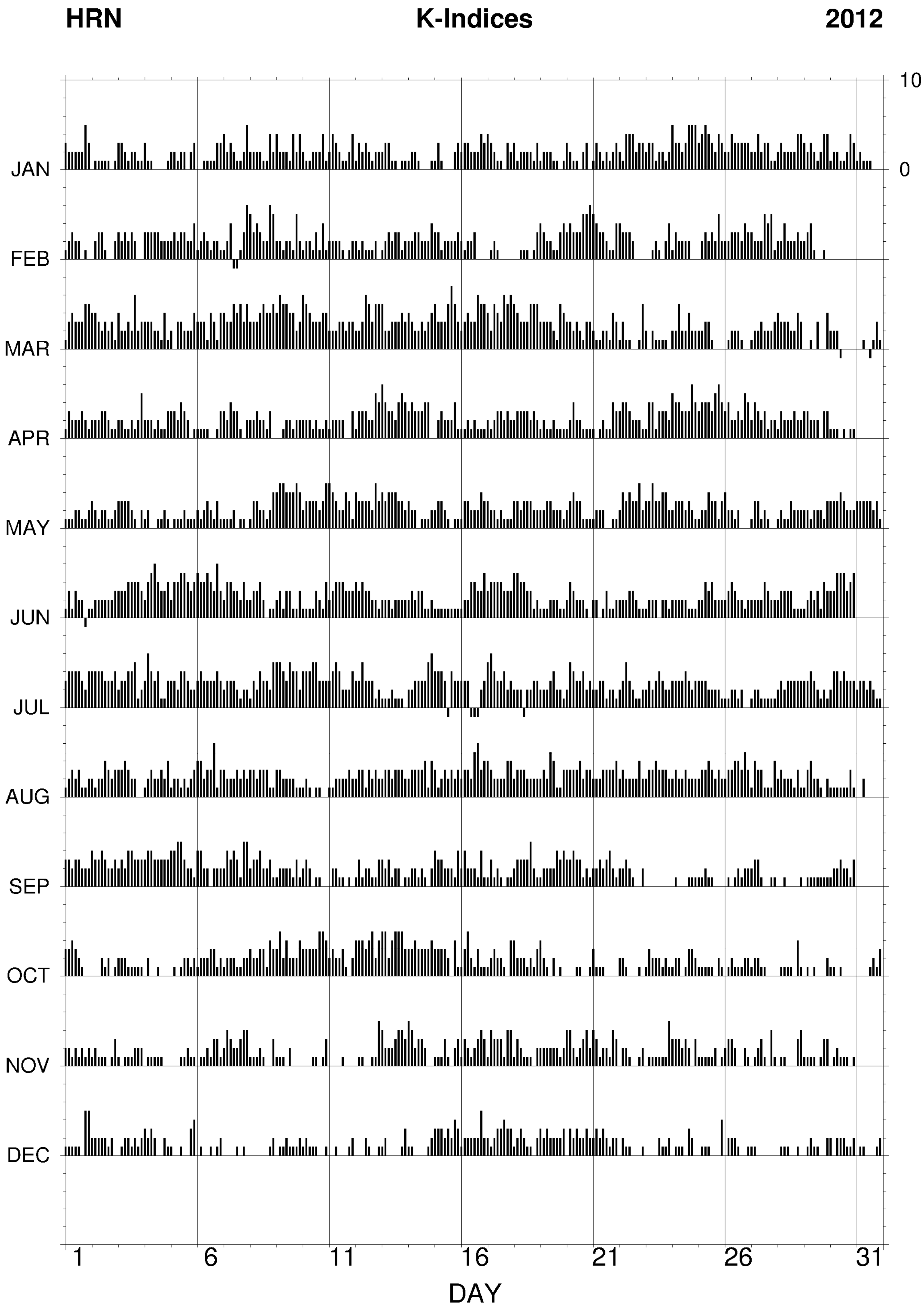


Fig. 20. K-indices in graphical form, Hornsund 2012.

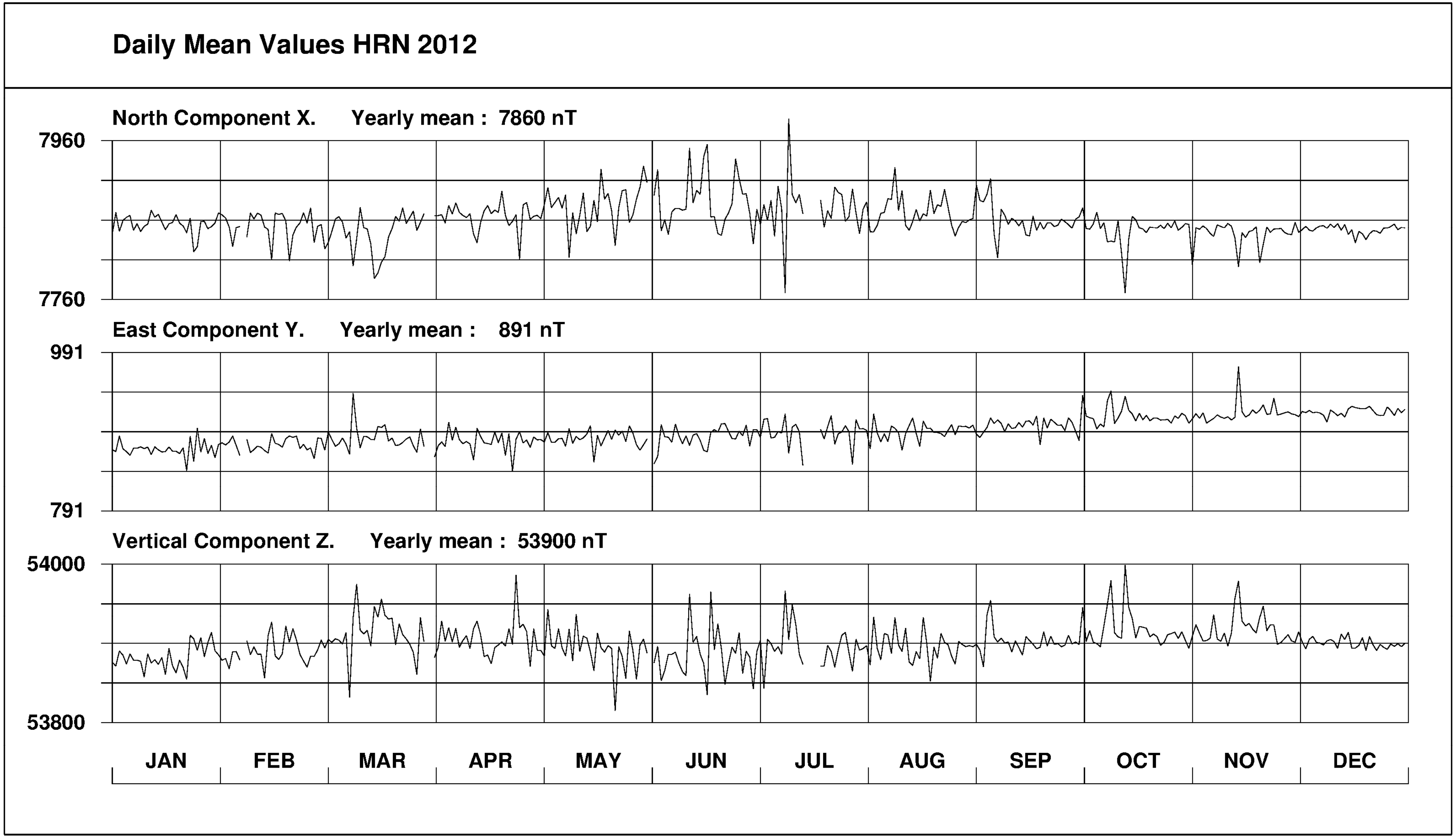


Fig. 21. Daily mean data plot for Hornsund 2012.

HRN - Hourly Mean Values

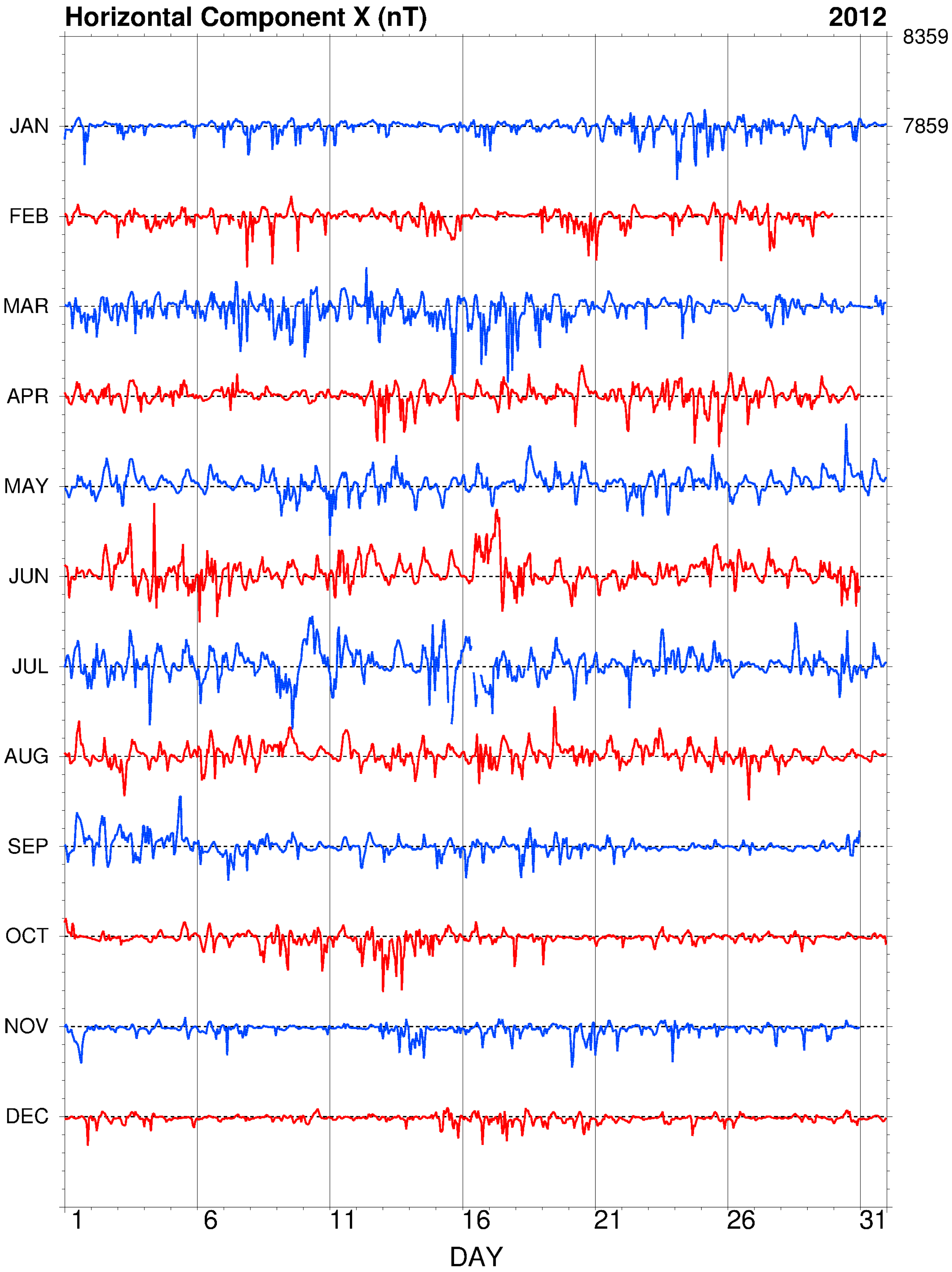


Fig. 22. Hourly mean data plot of X component for Hornsund 2012.

HRN - Hourly Mean Values

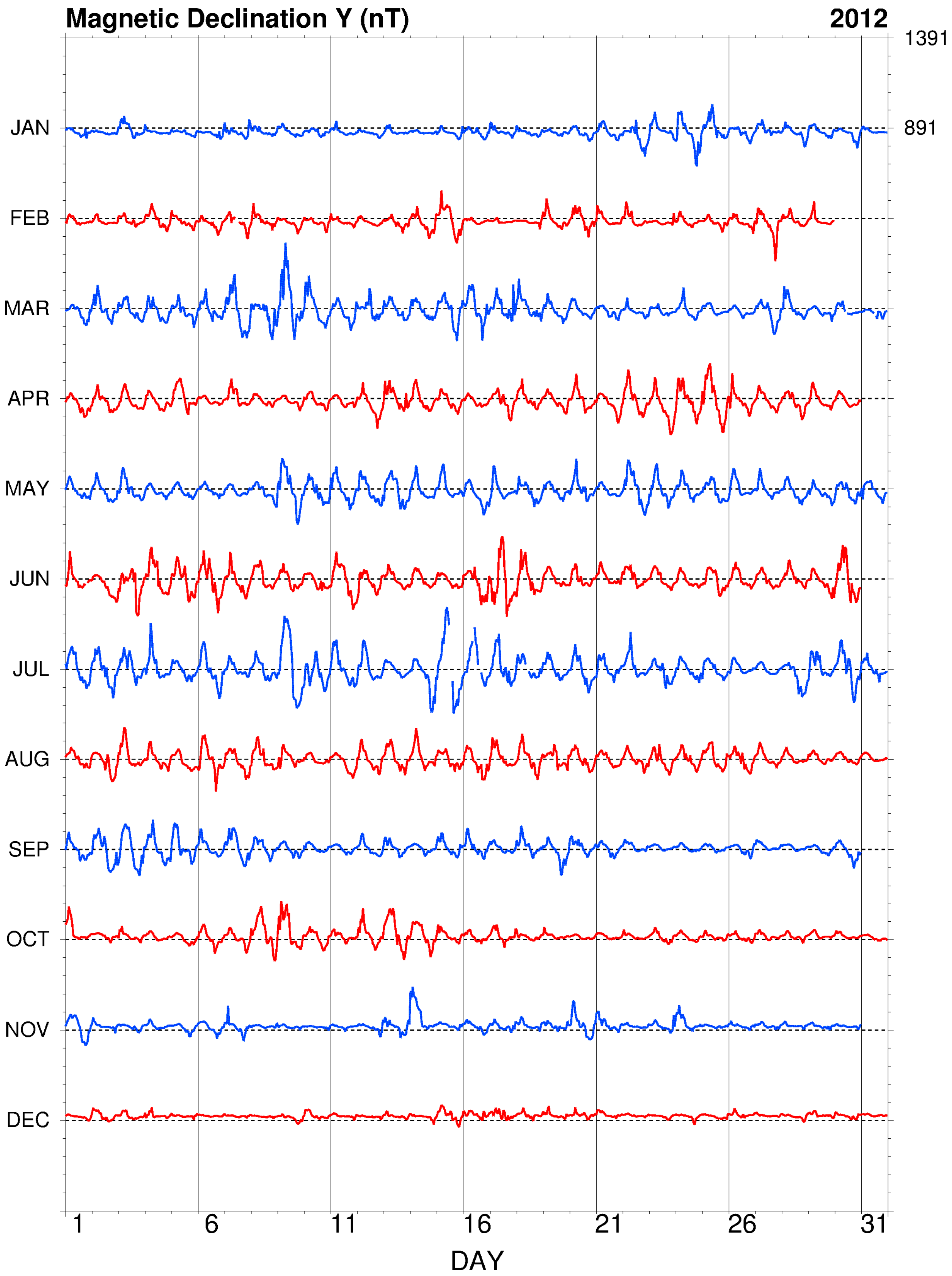


Fig. 23. Hourly mean data plot of Y component for Hornsund 2012.

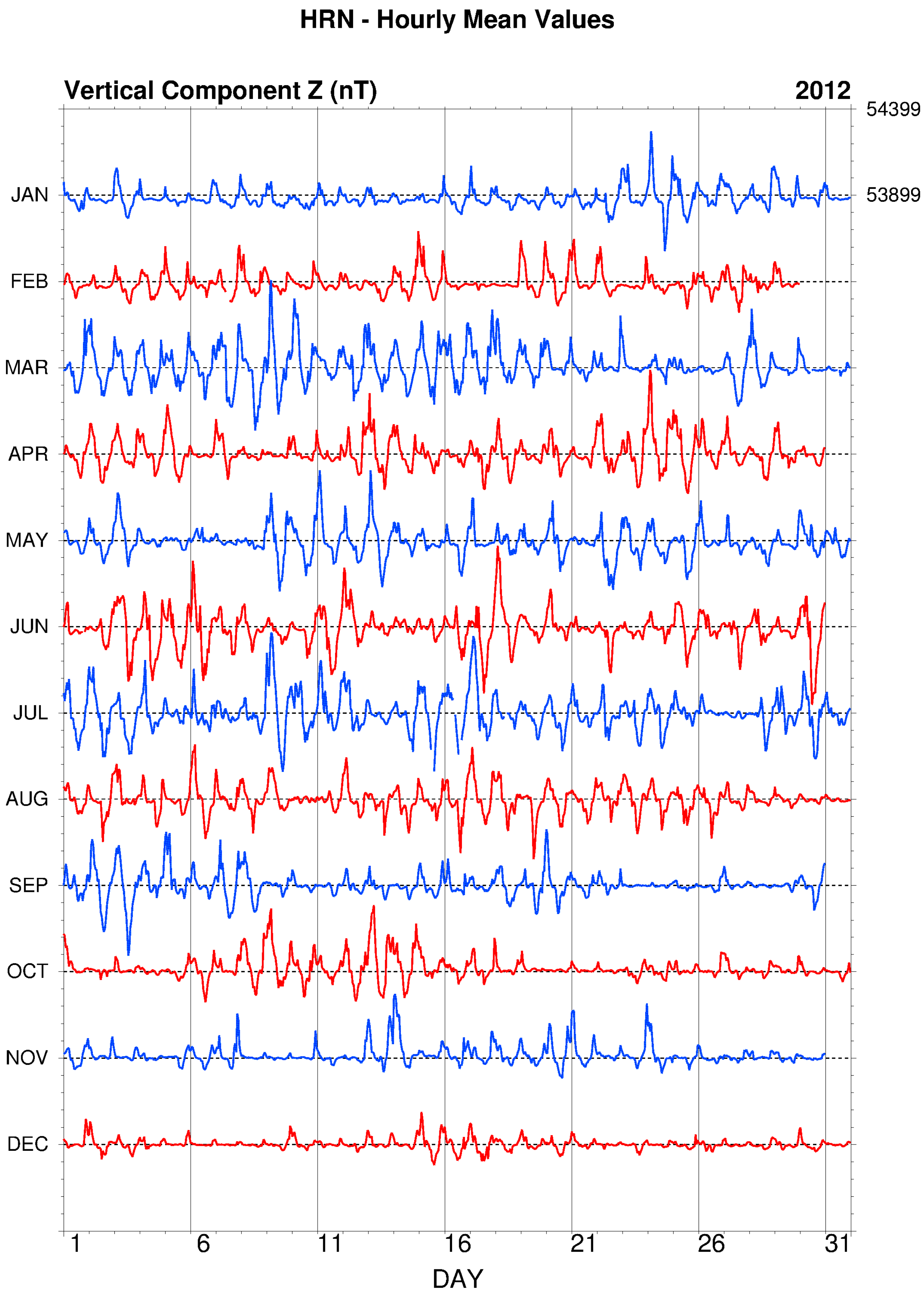
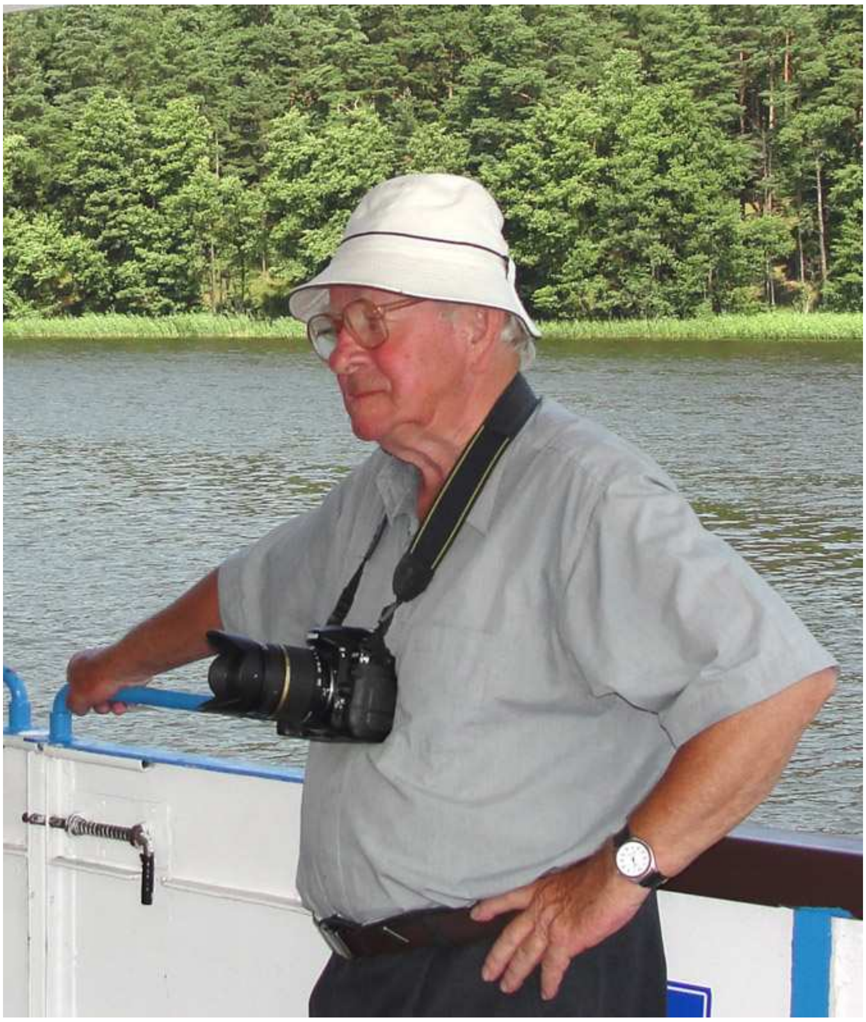


Fig. 24. Hourly mean data plot of Z component for Hornsund 2012.



DR JANUSZ MARIANIUK, 1936-2012. OBITUARY

Almost entire professional life of Janusz Marianiuk was devoted to the Earth's magnetism. Having retired some years ago, he was still very active. His employment at the Central Geophysical Observatory at Belsk covers the years 1965-2008; he has been head of the Geomagnetic Laboratory since 2001, and head of the whole Observatory in the years 2000-2006.

Janusz was born on May 31, 1936, in Zawady Duże, Brześć District (now Belarus). Having finished the elementary school in Konstantynów on Bug River, he graduated from the State Pedagogical Lycee in Leśna Podlaska. As the best student of this school he was granted a possibility of further education in Moscow, but his parents opposed to it. In 1953 the family moved to Legnica in western part of Poland. In the same year Janusz enrolled to the pedagogical branch of the Faculty of Mathematics and Physics of the University of Warsaw. After receiving his MSc. degree there, he was hired by the Department (now Institute) of Geophysics, Polish Academy of Sciences, and begun working at the first Polish Magnetic

Observatory at Świder near Warsaw. At the same time, he was teaching at the high school in Falenica.

Before the International Geophysical Year of 1957, the decision was made to move magnetic observations from Świder, contaminated by disturbances due to a nearby electric railroad, to a more suitable site. The problem was urgent, since the Świder Observatory was producing bad-quality data, and the other Polish magnetic observatory, at Hel, was destroyed during the Second World War. Hence, Poland was deprived of any good magnetic observatory. The implementation of the high standard of magnetic measurements was then the main objective of the Magnetic Laboratory at the Institute of Geophysics. This circumstance, as it turned out, strongly influenced the professional career of Janusz Marianiuk.

In 1965 Janusz moved to Belsk, where a new facility for measurement and recording of geomagnetic field was being formed. He has been associated with the Belsk Observatory through the rest of his life. Having organized the routine magnetic station, he began designing new instruments for magnetic measurements. Owing to his diligence and talent, Janusz Marianiuk became an outstanding designer of geophysical instruments. The most famous of his constructions is the portable magnetic station PSM with Bobrov's sensors. At that time it was the best magnetic instrument in the whole observatory network worldwide. He also constructed many other devices for measurement and recording of the geomagnetic field, e.g., proton vector magnetometer, stations for magnetic pulsation recording with induction sensors, magnetometer for Schumann resonance recording, telluric currents amplifiers, and digital recorders of slow-changing variations. Some of these constructions have been developed by teams, but Janusz was always playing a leading role in them. The magnetometers he constructed have been (or still are) in operation not only in Poland, but also in Finland, Hungary, Ukraine, Slovakia, Romania, and Spain. It is mainly due to Janusz Marianiuk that Polish Magnetic Observatories at Belsk, Hel and Hornsund (Spitsbergen) well satisfy all the international data accuracy criteria.

In 1988 Janusz defended his PhD thesis, dealing with digital recording of magnetic field variations at Belsk. He was an author or co-author of numerous papers and patents, listed in the bibliography presented below. His achievements were acknowledged in the well-known monograph *Geomagnetism* edited by J. A. Jacobs. In our opinion, shared by many colleagues from other countries, Janusz was one of the most outstanding designers of magnetometers over the world.

Janusz's activity was not limited to observatory measurements; he took part in many research projects. He participated in scientific expeditions to Spitsbergen and Vietnam, as well as in magnetotelluric and geomagnetic sounding campaigns in many countries: Scotland, Finland, Slovakia, and – first of all – Poland. He has frequently visited Italy and Greece, searching for electromagnetic precursors of earthquakes; he also surveyed field changes around observatories (Finland).

Janusz loved his work, and he used to express it explicitly: "I do what I love". It was obvious for all of us around him that his merits relating to the work of Magnetic Laboratory cannot be overestimated. Janusz had a rare gift of looking at problems at different levels: from general visions to tiny details. The Belsk Observatory owes him really a lot. He was a very hard-working person and a demanding boss, although most demanding from himself.

Life is not only work. Janusz was married to Barbara, whom he met at Świder. They were together through 50 years of happy marriage, and had two children, Grażyna and

Krzysztof, as well as three grandchildren. Janusz and Barbara planned to celebrate their jubilee this year.

Janusz had many non-professional passions. He loved nature, was an excellent angler, liked picking-up mashrooms. Since his young years, he has been an eager photographer, documenting various family-life and professional events (starting with the expedition to Vietnam in the 1960s).

Farewell to Janusz Marianiuk, after his successful and fulfilled life. He will be kept in memory of all who had a chance to meet him.

Jerzy Jankowski and *Jan Reda*

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