INSTITUTE OF GEOPHYSICS
POLISH ACADEMY OF SCIENCES

PUBLICATIONS
OF THE INSTITUTE OF GEOPHYSICS
POLISH ACADEMY OF SCIENCES

C-108 (418)

RESULTS OF GEOMAGNETIC OBSERVATIONS
BELSK, HEL, HORNSUND
2014

WARSZAWA 2015

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WARSZAWA 2015

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Internet Edition

ISBN 978-83-88765-94-0
ISSN 2299-8020

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

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C-106 (416) (Internet Edition) Results of geomagnetic observations, Belsk, Hel, Hornsund, 2012

C-107 (417) (Internet Edition) Results of geomagnetic observations, Belsk, Hel, Hornsund, 2013

ISBN 978-83-88765-94-0

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PUBLS. INST. GEOPHYS. POL. ACAD. SC., C-108(418) (2015)

Results of Geomagnetic Observations Belsk, Hel, Hornsund, 2014

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1. INTRODUCTION

This publication contains basic information on geomagnetic observations carried out in 2014 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 2014, 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^{o}N, 118.3^{o}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 as well as by GEOMAG and LEMI flux-gate magnetometers.

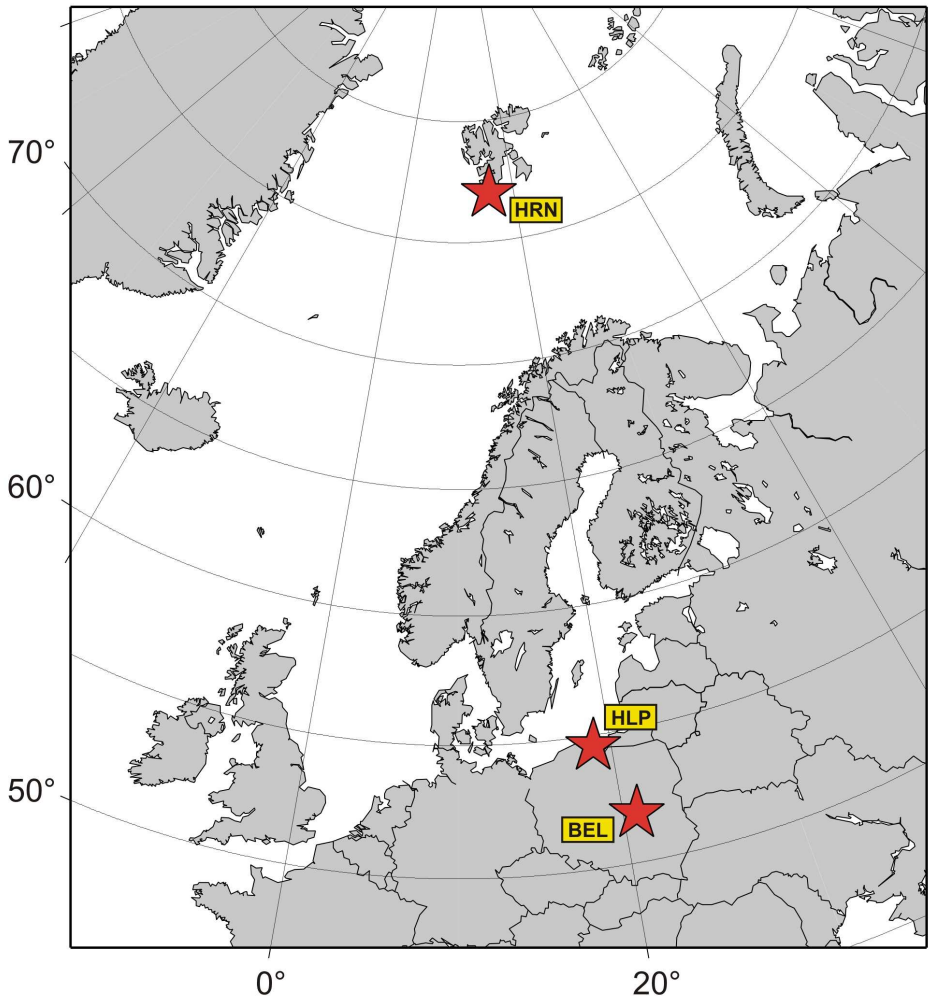

Fig. 1. Location of the Belsk, Hel and Hornsund observatories.

Table 1
Coordinates of the Polish observatories

Observatory	Geographic coordinates		Geomagnetic coordinates		Elevation
	Latitude	Longitude	Latitude	Longitude	[m]
Belsk (BEL)	51° 50.2′ N	20° 47.3′ E	49.9° N	105.1° E	180
Hel (HLP)	54° 36.5′ N	18° 49.0′ E	53.1° N	104.6° E	1
Hornsund (HRN)	77° 0.0′ N	15° 33.0′ E	73.9° N	125.3° 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, gaps in one-minute XYZ elements from Belsk and Hel are practically absent.

It is worth mentioning that in 2014 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 on the internet pages of Grójec district (http://en.wikipedia.org/wiki/Gr%C3%B3jec_County) to which the village Belsk Duży belongs. Relevant information about Belsk Observatory can be found at page http://www.igf.edu.pl/.

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://en.wikipedia.org/wiki/Hel,_Poland .

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://en.wikipedia.org/wiki/Svalbard .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)	GEOMAG 03, THEO-010B sn: 03-2012	FLUX-9408 THEO-10B sn: 160334	ELSEC 810 THEO-10B sn: 002208
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 GEOMAG 03 / THEO-010B	
Producer	GEOMAGNET, Ukraine
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 ELSEC 810 / THEO-010B	
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-010B	
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 2014 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 2014

Observatory	Element	Number of measurements n	Mean error m_B [nT]
Belsk	B_X	295	0.37
	B_Y	290	0.40
	B_Z	295	0.20
Hel	B_X	144	0.49
	B_Y	144	0.40
	B_Z	145	0.44
Hornsund	B_X	231	1.66
	B_Y	233	1.78
	B_Z	244	0.52

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 equipped with Bobrov's variometers (PSM) or flux-gate sensors (GEOMAG, LEMI) 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.

PSM magnetometers

The PSM magnetometers 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.

GEOMAG and LEMI magnetometers

The magnetometers of GEOMAG and LEMI type were designed at the GEOMAGNET company and the Lviv Centre of the Institute of Space Research, respectively, in Ukraine. They employ flux-gate sensors. 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	Geomag fluxgate
	Type	PSM-8811-01P	PSM 8511-02P	Geomag-02
	Sensor's orientation	XYZ	XYZ	XYZ
	Range	+/– 850 nT	+/– 850 nT	+/– 3200 nT
	Magnetometer's producer	Institute of Geophysics PAS	Institute of Geophysics PAS	GEOMAGNET (Ukraine)
	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	Lviv Centre of the Institute of Space Research (Ukraine)
	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

The magnetometers of type 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

NDL digital data loggers

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

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 2014 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 2014 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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http://www.igf.edu.pl/

5 PERSONNEL TAKING PART IN THE WORK OF BELSK, HEL AND HORNSUND OBSERVATORIES IN 2014

5.1 Belsk

– Jan Reda (project leader of geomagnetic observations in Belsk, Hel, Hornsund)
– Mariusz Neska (data processing)
– Paweł Czubak (data processing)
– Krzysztof Kucharski (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)
– Łukasz Mazurkiewicz (observer in 1-st half-year)
– Piotr Łepkowski (observer in 2-nd half-year)
– Jan Reda (data processing)
– Paweł Czubak (data processing)

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Received February 23, 2015

Accepted March 24, 2015

6. TABLES AND PLOTS FOR BELSK OBSERVATORY

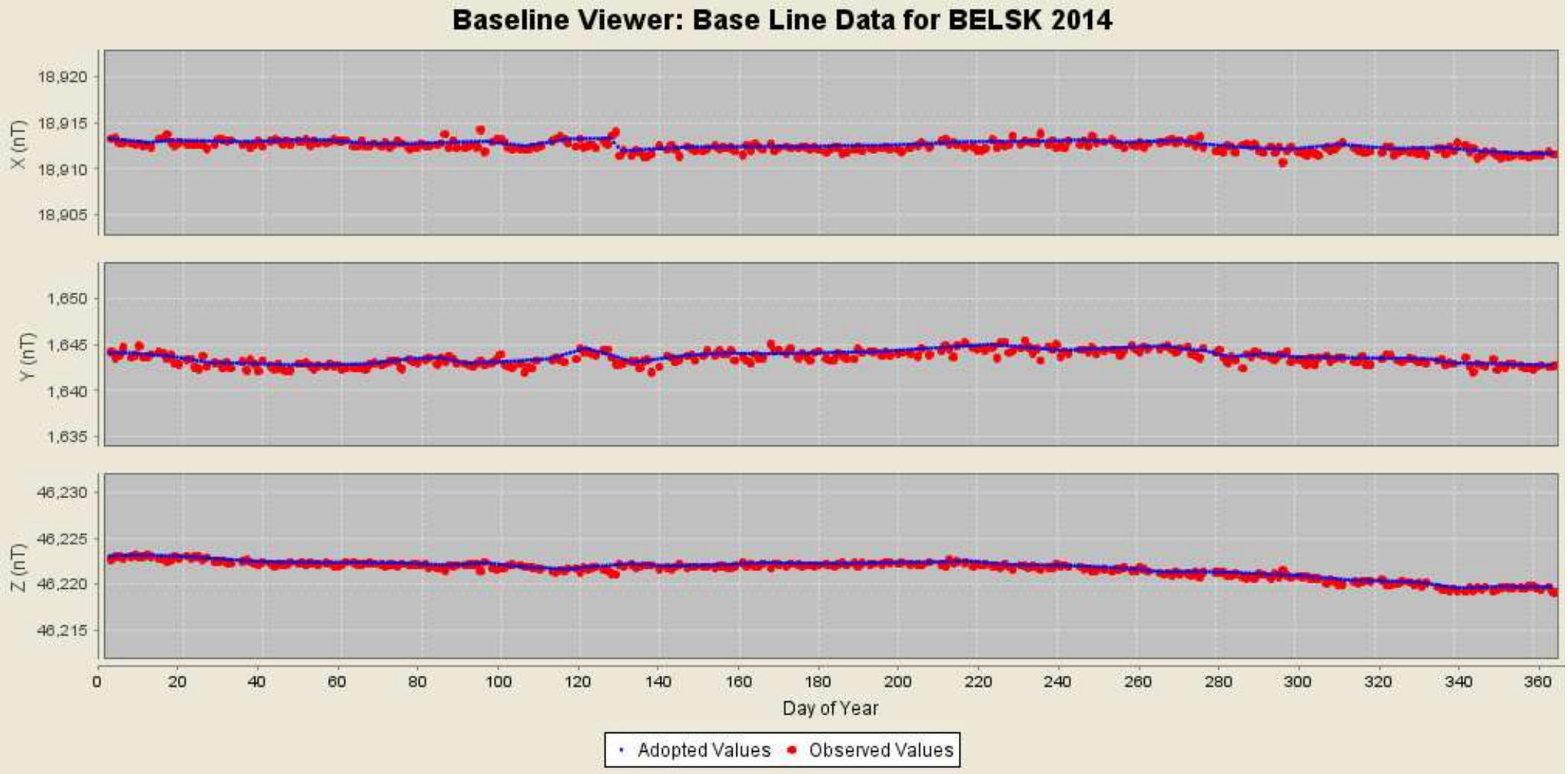

Fig. 2. Base values of set 1, Belsk 2014

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	45023	18889	683	67 13.6’	48830
2	1967	2 05.6	18906	45048	18894	691	67 14.0	48854
3	1968	2 06.2	18917	45071	18906	695	67 13.8	48880
4	1969	2 06.3	18935	45094	18923	696	6713.3	48908
5	1970	2 06.6	18953	45123	18940	698	67 13.0	48942
6	1971	2 06.6	18976	45146	18963	699	67 12.2	48972
7	1972	2 08.0	18992	45176	18978	707	67 11.9	49006
8	1973	2 10.2	19005	45211	18991	719	67 12.0	49043
9	1974	2 13.3	19016	45246	19002	737	67 12.2	49079
10	1975	2 16.4	19035	45274	19020	755	67 11.7	49112
11	1976	2 18.5	19050	45307	19034	767	67 11.7	49149
12	1977	2 22.0	19062	45337	19046	787	67 11.7	49181
13	1978	2 27.4	19059	45376	19041	817	67 13.0	49216
14	1979	2 32.3	19061	45401	19043	844	67 13.5	49240
15	1980	2 37.2	19063	45418	19043	871	67 13.9	49257
16	1981	2 42.9	19047	45449	19026	902	67 15.7	49279
17	1982	2 48.3	19035	45479	19012	931	67 17.3	49302
18	1983	2 52.4	19033	45499	19009	954	67 18.0	49319
19	1984	2 56.9	19023	45520	18998	978	67 19.2	49335
20	1985	3 00.8	19015	45542	18989	999	67 20.3	49352
21	1986	3 05.1	19003	45570	18976	1023	67 21.8	49374
22	1987	3 08.5	18999	45593	18971	1041	67 22.7	49393
23	1988	3 12.4	18983	45626	18953	1062	67 24.6	49418
24	1989	3 15.9	18966	45662	18935	1080	67 26.6	49444
25	1990	3 18.8	18962	45684	18930	1096	67 27.5	49463
26	1991	3 22.2	18951	45709	18918	1114	67 28.8	49482
27	1992	3 25.3	18954	45726	18921	1131	67 29.1	49499
28	1993	3 29.8	18956	45744	18921	1156	67 29.4	49516
29	1994	3 34.8	18954	45772	18917	1183	67 30.4	49541
30	1995	3 39.8	18959	45797	18921	1212	67 30.7	49566
31	1996	3 45.0	18966	45822	18925	1241	67 30.9	49592
32	1997	3 50.9	18963	45857	18920	1273	67 32.0	49623
33	1998	3 57.3	18956	45897	18911	1308	67 33.6	49658
34	1999	4 02.5	18958	45931	18911	1336	67 34.3	49689
35	2000	4 07.8	18955	45969	18906	1365	67 35.5	49724
36	2001	4 13.0	18962	46005	18911	1394	67 36.0	49760
37	2002	4 18.4	18969	46044	18916	1424	67 36.6	49798
38	2003	4 24.2	18970	46090	18914	1457	67 37.7	49841
39	2004	4 29.4	18980	46121	18922	1486	67 37.9	49874
40	2005	4 34.7	18984	46155	18924	1515	67 38.5	49906
41	2006	4 39.8	18997	46177	18934	1544	67 38.3	49932
42	2007	4 45.8	19007	46207	18942	1578	67 38.4	49963
43	2008	4 52.5	19014	46236	18945	1616	67 38.7	49993
44	2009	4 59.7	19022	46264	18950	1656	67 39.0	50022
45	2010	5 08.0	19018	46301	18941	1701	67 40.2	50055
46	2011	5 16.1	19015	46338	18935	1746	67 41.3	50088
47	2012	5 24.6	19014	46377	18929	1793	67 42.4	50123
48	2013	5 32.8	19020	46411	18931	1838	67 42.9	50157
49	2014	5 40.3	19025	46446	18932	1880	67 43.5	50191

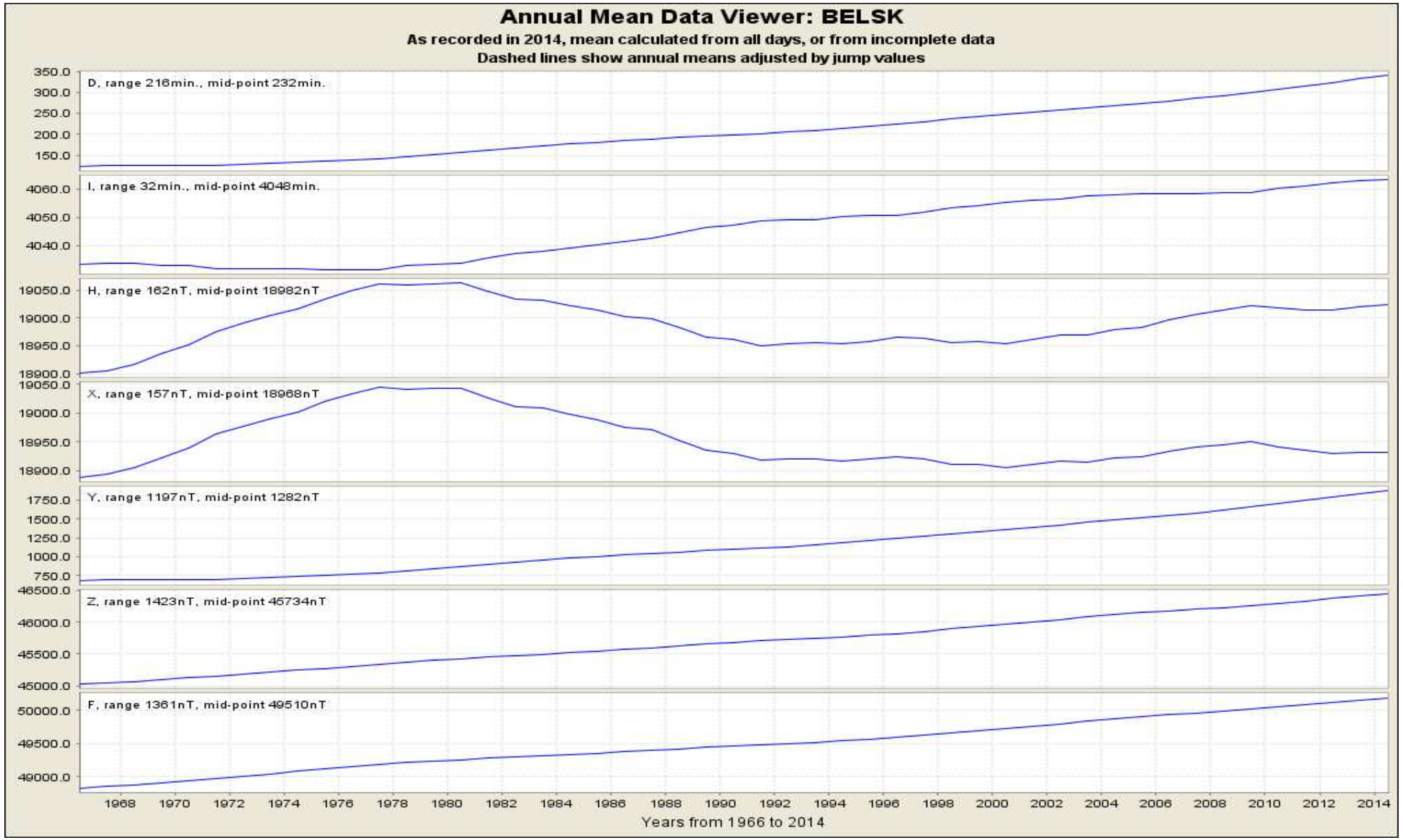

Fig. 3. Secular changes of H, X, Y, Z, F, D and I at Belsk.

MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

BEL 2014

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
NORTH COMPONENT: 18500 + ... in nT													
All days	433	426	434	434	439	442	444	436	427	423	423	420	432
Quiet days	438	436	437	436	441	441	443	441	427	433	431	424	436
Disturbed days	426	413	434	424	434	438	446	425	424	415	416	414	426
EAST COMPONENT: 1500 + ... in nT													
All days	361	367	367	371	374	377	380	383	389	392	396	400	380
Quiet days	360	363	365	370	374	376	381	382	388	389	393	399	378
Disturbed days	362	369	369	372	376	379	378	388	391	396	396	404	382
VERTICAL COMPONENT: 46000 + ... in nT													
All days	430	434	434	436	437	440	441	447	454	461	465	472	446
Quiet days	429	432	433	433	436	440	440	444	454	457	463	472	445
Disturbed days	431	436	432	441	438	440	442	455	455	465	466	474	448

Three-hour-range K indices
Belsk, January - March, 2014
The limit of K=9 is 450

Day	January			February			March		
	K		SK	K		SK	K		SK
1	1122	3334	19	0011	1123	9	2122	1133	15
2	3333	3452	26	1221	1110	9	3111	1000	7
3	2113	3231	16	2212	1112	12	2121	2002	10
4	1112	2231	13	2111	1011	8	2112	3223	16
5	1111	1100	6	1010	1112	7	1122	2233	16
6	0101	1112	7	2222	2211	14	1012	3232	14
7	1111	1323	13	1011	2335	16	0110	1111	6
8	3311	1022	13	4432	2255	27	1111	1111	8
9	3211	1132	14	4331	3353	25	1011	0121	7
10	2211	1211	11	3212	1244	19	0112	1111	8
11	0001	1132	8	2220	1124	14	0011	1111	6
12	1121	1234	15	3312	1221	15	1001	1123	9
13	2311	2101	11	0011	0000	2	4331	2111	16
14	2212	3322	17	0012	2100	6	1221	2211	12
15	1111	1111	8	0100	3334	14	2011	1121	9
16	0011	1100	4	5322	4454	29	0011	1100	4
17	0011	1113	8	1111	1133	12	0011	0102	5
18	1011	0010	4	1022	2332	15	1111	2221	11
19	0001	0010	2	4563	5333	32	2121	1111	10
20	0000	1111	4	1553	3534	29	0223	2121	13
21	3112	2222	15	3122	3323	19	2222	3322	18
22	2223	3223	19	3322	1422	19	2011	2112	10
23	3122	1122	14	2232	2444	23	1122	2132	14
24	3101	1010	7	1112	3320	13	2111	1120	9
25	2211	-224	--	0011	1113	8	1012	2144	15
26	3211	0222	13	2000	0011	4	4132	1131	16
27	0111	1113	9	1111	2455	20	1122	2220	12
28	00--	1233	--	4232	2221	18	1122	2233	16
29	1122	1222	13				3212	0003	11
30	2210	0010	6				2112	1121	11
31	0001	0001	2				0012	2230	10

Three-hour-range K indices
Belsk, April - June, 2014
The limit of K=9 is 450

Day	April		May		June	
	K	SK	K	SK	K	SK
1	0111 2222	11	2221 1111	11	1112 0211	9
2	0101 2222	10	1111 1000	5	1111 1123	11
3	1122 2122	13	0001 0333	10	3212 2221	15
4	1122 2321	14	2332 4322	21	2111 2212	12
5	1113 4323	18	1212 3332	17	1223 1223	16
6	2001 1102	7	1111 1100	6	2201 1322	13
7	3222 3422	20	0001 1112	6	2122 1533	19
8	2102 2110	9	2324 3433	24	3554 5432	31
9	0112 2221	11	3222 1101	12	1122 1131	12
10	0011 1111	6	1322 1132	15	1023 3332	17
11	0222 1225	16	4323 2223	21	2223 2311	16
12	5332 3232	23	1222 2122	14	1211 1011	8
13	3322 2242	20	1112 0111	8	1121 2221	12
14	1222 1132	14	1111 3212	12	2322 1221	15
15	1211 2121	11	1112 1221	11	1111 1110	7
16	0011 2112	8	2111 2321	13	1211 3221	13
17	3222 3431	20	2002 0111	7	2222 2234	19
18	2112 3223	16	1111 2211	10	3223 3445	26
19	4333 3342	25	0212 2212	12	2322 2232	18
20	3224 5453	28	1112 2210	10	1122 4422	18
21	3233 3422	22	1011 1111	7	1222 2101	11
22	1111 1221	10	1111 3424	17	0111 1112	8
23	1112 2232	14	3221 2445	23	0000 1113	6
24	3122 2333	19	122- 2211	--	3211 0121	11
25	2312 2332	18	2110 1210	8	1211 2313	14
26	0211 1122	10	1112 0100	6	0113 3221	13
27	1000 1113	7	0012 2221	10	1101 2221	10
28	1211 1212	11	1212 2211	12	1211 3321	14
29	0001 1013	6	1113 3221	14	3111 1133	14
30	3332 4351	24	0212 3342	17	3111 1211	11
31			1111 1210	8		

Three-hour-range K indices
Belsk, July - September, 2014
The limit of K=9 is 450

Day	July		August		September	
	K	SK	K	SK	K	SK
1	2111 1110	8	2212 3234	19	3222 3233	20
2	0221 1311	11	2223 4322	20	2222 2333	19
3	2223 2110	13	1312 1222	14	2222 1212	14
4	1112 3101	10	2322 2233	19	3222 1112	14
5	0111 0122	8	2232 3232	19	2112 2224	16
6	1102 2112	10	2222 2221	15	1232 2434	21
7	2112 3321	15	1121 2221	12	3221 1110	11
8	2222 3222	17	3323 2111	16	0111 2222	11
9	2122 2333	18	0111 1110	6	1122 2233	16
10	3221 2322	17	1012 3342	16	2012 1223	13
11	1112 2221	12	2211 2323	16	3322 1123	17
12	2222 3210	14	3122 1343	19	5322 2546	29
13	1213 1212	13	2212 2121	13	3342 3231	21
14	1122 4432	19	1111 1212	10	0011 2100	5
15	2223 3221	17	1111 1212	10	0121 1111	8
16	1121 2221	12	0001 1011	4	1222 1223	15
17	1211 2221	12	2113 3312	16	2101 1222	11
18	1111 0001	5	1121 1221	11	2111 2234	16
19	0012 1000	4	1133 2445	23	3433 3433	26
20	1110 2211	9	3122 2222	16	2212 3111	13
21	0001 2322	10	3211 2231	15	1211 1221	11
22	2111 2212	12	1200 1101	6	1122 3322	16
23	1111 1232	12	1211 1220	10	2212 2333	18
24	1123 2221	14	1001 2100	5	3324 4434	27
25	3122 1211	13	0011 1111	6	4223 2233	21
26	1222 2321	15	1002 1221	9	3222 4423	22
27	2121 1212	12	1233 3434	23	4332 2222	20
28	2233 3422	21	3433 3332	24	2113 2241	16
29	1110 1121	8	3333 2334	24	2122 2253	19
30	3111 1110	9	3323 3232	21	2323 2333	21
31	0212 2222	13	2223 3244	22		

Three-hour-range K indices
Belsk, October - December, 2014
The limit of K=9 is 450

Day	October		November		December	
	K	SK	K	SK	K	SK
1	4222 2333	21	1123 3211	14	1222 2324	18
2	2222 2323	18	2111 3331	15	3322 3342	22
3	3111 1211	11	2212 1101	10	2112 2232	15
4	1121 1022	10	1123 4466	27	3111 2324	17
5	1121 2221	12	3333 2223	21	2322 4313	20
6	2111 1014	11	1222 2124	16	2222 2343	20
7	2211 1111	10	2313 3224	20	5223 5554	31
8	1113 3223	16	2222 2214	17	3322 3543	25
9	3332 2233	21	2211 1234	16	3212 3253	21
10	3311 1222	15	3334 4532	27	3223 1121	15
11	2222 3211	15	2213 1124	16	1011 1123	10
12	0001 1121	6	4221 0113	14	3223 4344	25
13	1120 2233	14	2212 1111	11	2211 3233	17
14	1112 3555	23	3232 3243	22	2312 2342	19
15	5321 2111	16	3333 3135	24	1233 3334	22
16	2112 2214	15	4333 3434	27	1112 3223	15
17	2212 1123	14	2122 3442	20	3211 1222	14
18	3332 3534	26	3222 3312	18	1211 1322	13
19	3322 2131	17	3122 2241	17	3122 2322	17
20	3233 3544	27	3122 1342	18	3221 1213	15
21	3232 4343	24	4322 2253	23	3222 2243	20
22	3332 2531	22	3212 1244	19	5522 1412	22
23	1222 3242	18	1122 2232	15	1014 2244	18
24	3122 2321	16	2211 2322	15	4212 4444	25
25	2222 2421	17	1112 2212	12	2111 3343	18
26	3222 3331	19	1111 2002	8	3322 2253	22
27	3223 2325	22	1221 2233	16	4212 2101	13
28	3223 3332	21	0001 2211	7	2112 2242	16
29	3122 1230	14	1121 1112	10	1323 3545	26
30	0112 1122	10	1222 2332	17	3332 3232	21
31	1222 2122	14			1212 2421	15

Three-hour-range E indices
based on power spectrum estimation(*)
Belsk, January - March, 2014

Day	January		February		March	
	E	SE	E	SE	E	SE
1	1122 4434	21	0000 0124	7	2013 0034	13
2	4433 3462	29	1210 1010	6	4111 0000	7
3	2123 3241	18	2212 0101	9	3121 2001	10
4	1112 2131	12	2210 1000	6	2112 3224	17
5	0111 1000	4	0000 1001	2	1122 2233	16
6	0000 1012	4	3322 2211	16	1011 2241	12
7	1102 1434	16	001- 1335	--	0010 1111	5
8	3211 1012	11	5442 3255	30	1011 0001	4
9	3311 1042	15	4331 3364	27	1011 0011	5
10	2211 0210	9	3212 1155	20	0002 1011	5
11	0001 0041	6	1220 0014	10	0010 1011	4
12	0011 1144	12	3212 1221	14	1001 1123	9
13	3311 1001	10	0001 0000	1	4431 2111	17
14	3211 4323	19	0012 1000	4	1121 2211	11
15	1011 1101	6	0000 3334	13	2011 0130	8
16	0011 0000	2	6322 3454	29	0010 0000	1
17	0010 1103	6	1011 0034	10	0001 0103	5
18	1000 0010	2	1022 1342	15	1111 2220	10
19	0000 0000	0	5664 6323	35	2111 1111	9
20	0000 0100	1	1654 3535	32	0123 1011	9
21	4112 2322	17	4123 3323	21	2122 3322	17
22	2223 3223	19	4323 1423	22	1011 3112	10
23	3121 1033	14	2233 2455	26	1112 2132	13
24	4100 0000	5	1112 3230	13	1011 0110	5
25	2211 3224	17	0001 1104	7	1012 2144	15
26	4311 0222	15	2000 0001	3	4142 1131	17
27	0000 0113	5	1101 2556	21	0122 3110	10
28	00-- 1233	--	5232 1210	16	1112 3243	17
29	1222 1222	14			3202 0003	10
30	2210 0000	5			2112 1130	11
31	0000 0000	0			0012 3230	11

* - see literature: Reda and Jankowski, 2004

Three-hour-range E indices
based on power spectrum estimation(*)
Belsk, April – June, 2014

Day	April		May		June	
	E	SE	E	SE	E	SE
1	0011 1323	11	1211 1110	8	0012 0101	5
2	0001 3211	8	1211 1000	6	0010 0113	6
3	0112 2112	10	0000 0244	10	3212 1220	13
4	0121 2310	10	3332 4322	22	2121 2212	13
5	1013 3323	16	1322 2342	19	1213 1224	16
6	2001 1002	6	0111 0000	3	2200 1322	12
7	3121 3422	18	0000 1113	6	1122 1534	19
8	2102 2100	8	2434 3434	27	3564 5442	33
9	0011 2120	7	3222 1001	11	0122 0141	11
10	0001 0000	1	1311 1132	13	0022 4332	16
11	0122 1225	15	5323 2233	23	2223 2311	16
12	6442 3232	26	1212 2131	13	0201 0011	5
13	4333 2243	24	0111 0001	4	1121 2221	12
14	1132 0132	13	1101 3311	11	3222 1121	14
15	1211 2011	9	1112 1121	10	1011 1100	5
16	0001 1012	5	2111 2320	12	0111 2211	9
17	3221 2432	19	2002 0001	5	2222 2234	19
18	2112 4123	16	1101 2211	9	3223 2445	25
19	4323 3332	23	0211 2211	10	2323 2233	20
20	3214 5453	27	0112 2110	8	1122 3422	17
21	3333 3421	22	1000 0001	2	1212 1100	8
22	1111 1221	10	1111 3424	17	0111 1122	9
23	0012 1231	10	3221 2545	24	0000 0014	5
24	4122 3344	23	1121 2211	11	3211 0021	10
25	3202 2233	17	2110 1200	7	0111 2312	11
26	0211 1112	9	1011 0000	3	0003 3210	9
27	1000 1113	7	0001 2111	6	1001 1221	8
28	1211 1102	9	2212 2211	13	1111 3311	12
29	0001 1013	6	0113 3321	14	3101 1133	13
30	3333 4351	25	0212 4452	20	4111 2211	13
31			1111 0110	6		

* - see literature: Reda and Jankowski, 2004

Three-hour-range E indices
based on power spectrum estimation(*)
Belsk, July - September, 2014

Day	July		August		September	
	E	SE	E	SE	E	SE
1	1101 1100	5	2112 2234	17	3222 3233	20
2	0111 1311	9	3123 4412	20	2223 3324	21
3	2222 1110	11	1311 0222	12	2322 1212	15
4	1102 3100	8	3322 2244	22	3222 1112	14
5	0001 0122	6	3232 3242	21	1111 2224	14
6	1002 1102	7	2222 2220	14	1232 2424	20
7	2111 3321	14	1111 2221	11	3321 1110	12
8	2221 3322	17	4423 2100	16	0021 1211	8
9	2122 1233	16	0010 0010	2	2122 1232	15
10	3221 1311	14	1002 3242	14	3012 1223	14
11	1112 1231	12	1211 2324	16	3412 1123	17
12	2222 3110	13	3102 1454	20	5323 2557	32
13	1103 1212	11	2212 2120	12	4242 2231	20
14	1012 3432	16	0111 0113	8	0010 1100	3
15	2223 3221	17	1001 1212	8	0011 0000	2
16	1111 1221	10	0001 0001	2	1122 1234	16
17	0110 1121	7	1102 4201	11	2100 1221	9
18	1111 0000	4	0120 1221	9	1111 1234	14
19	0011 1000	3	1133 2446	24	4433 3443	28
20	0010 210-	--	3122 1123	15	2112 2111	11
21	0000 2322	9	4321 2231	18	1211 1121	10
22	3111 2212	13	1200 0001	4	1122 3322	16
23	0000 1232	8	0201 0210	6	3213 3433	22
24	0123 2221	13	0000 2000	2	4324 4545	31
25	3122 1110	11	0001 0100	2	4233 2243	23
26	1122 2221	13	0002 1111	6	2333 4433	25
27	2121 1111	10	0233 4544	25	5432 2331	23
28	2333 2422	21	3433 3433	26	2113 2241	16
29	1100 1111	6	4324 3344	27	1123 2153	18
30	3101 1100	7	4323 3241	22	3423 2333	23
31	0211 1222	11	2223 2254	22		

* - see literature: Reda and Jankowski, 2004

Three-hour-range E indices
based on power spectrum estimation(*)
Belsk, October - December, 2014

Day	October		November		December	
	E	SE	E	SE	E	SE
1	5232 2333	23	1123 3200	12	2222 2335	21
2	2223 2322	18	2101 3341	15	4322 3352	24
3	3001 0211	8	2211 1001	8	3111 1231	13
4	0121 1012	8	1023 5456	26	3111 2324	17
5	1221 1221	12	3333 3223	22	3322 4213	20
6	3101 1014	11	1222 2115	16	2123 1354	21
7	2301 0011	8	2315 2225	22	5224 5654	33
8	1113 3234	18	2112 2214	15	3233 4633	27
9	4433 2234	25	3211 1334	18	4222 4353	25
10	2411 2122	15	4334 4532	28	3222 1131	15
11	2223 3200	14	2212 1125	16	0001 0123	7
12	0001 1120	5	4221 0013	13	3123 5354	26
13	1020 1134	12	2212 1001	9	1211 3233	16
14	0112 3666	25	4231 2253	22	2312 3451	21
15	5321 2101	15	3333 3145	25	1233 4325	23
16	2102 2225	16	4433 4434	29	1102 3223	14
17	2312 1124	16	2112 4452	21	3211 1221	13
18	3333 4634	29	3221 4411	18	1210 1313	12
19	4322 2031	17	4022 2241	17	3121 1322	15
20	3243 4654	31	4123 2352	22	3111 2203	13
21	3233 5453	28	5323 2253	25	3232 3344	24
22	4233 2531	23	3212 1145	19	6622 1412	24
23	1212 3352	19	1222 3342	19	0014 2135	16
24	3122 2431	18	2111 2432	16	4112 4554	26
25	3322 2431	20	0012 2222	11	2111 4354	21
26	3333 3331	22	1101 2001	6	4322 2153	22
27	3243 1325	23	1321 2223	16	4212 2101	13
28	4223 2432	22	0001 3211	8	2112 2253	18
29	4222 1230	16	1112 1111	9	1323 4646	29
30	0112 1112	9	1222 1443	19	3332 3242	22
31	1222 2122	14			0112 2522	15

* - see literature: Reda and Jankowski, 2004

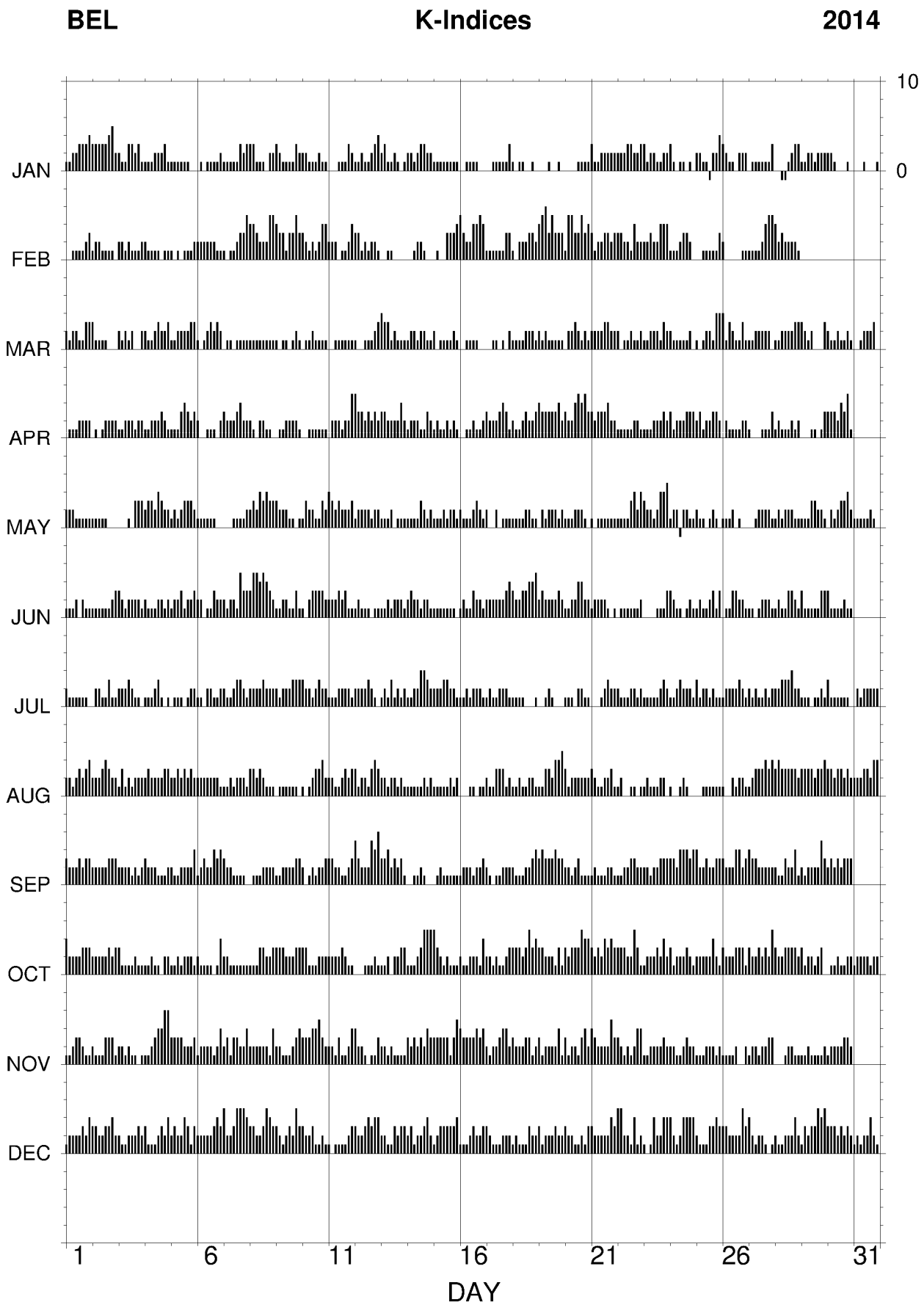

Fig. 4. K-indices in graphical form, Belsk 2014.

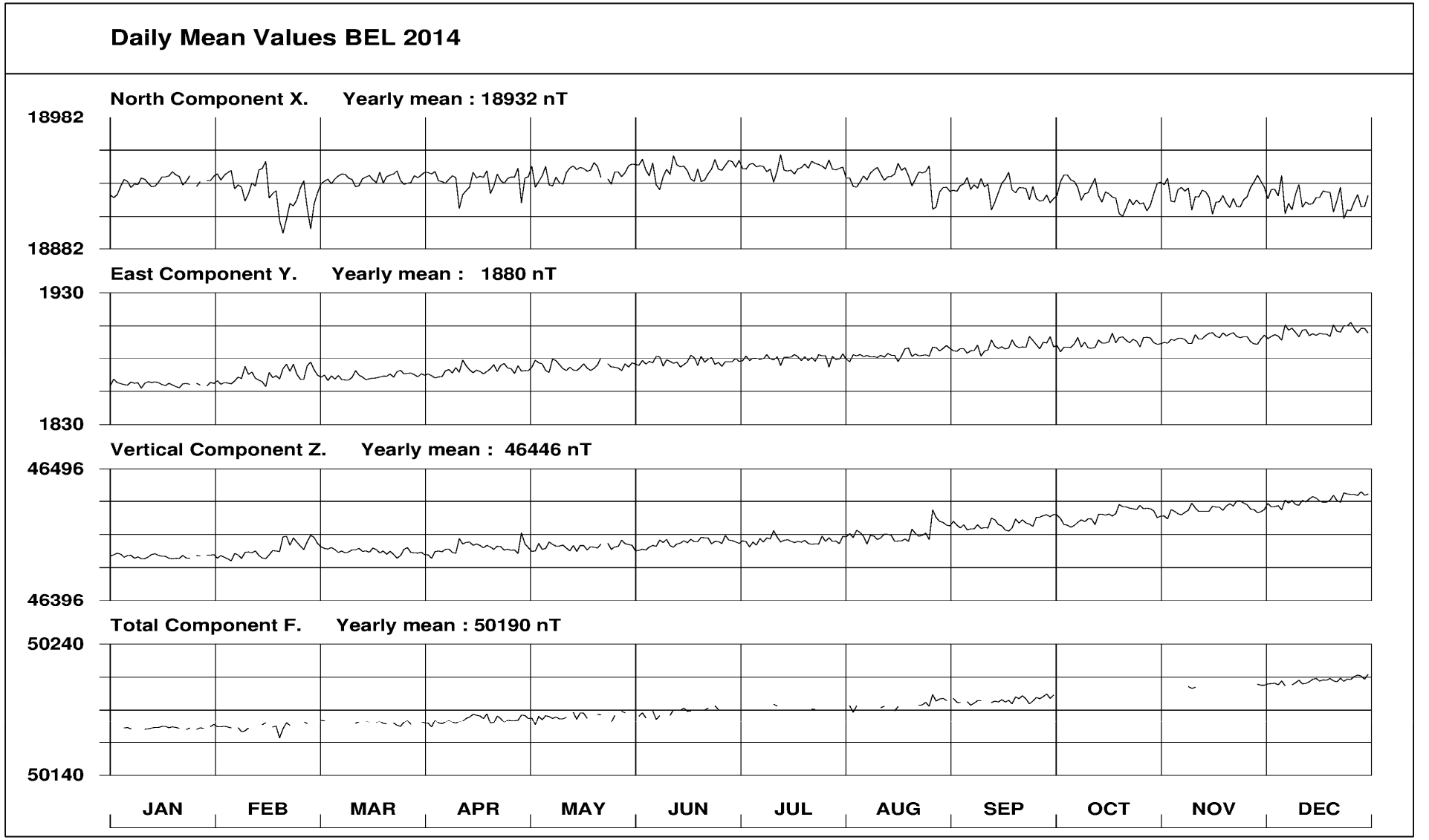

Fig. 5. Daily mean data plot for Belsk 2014.

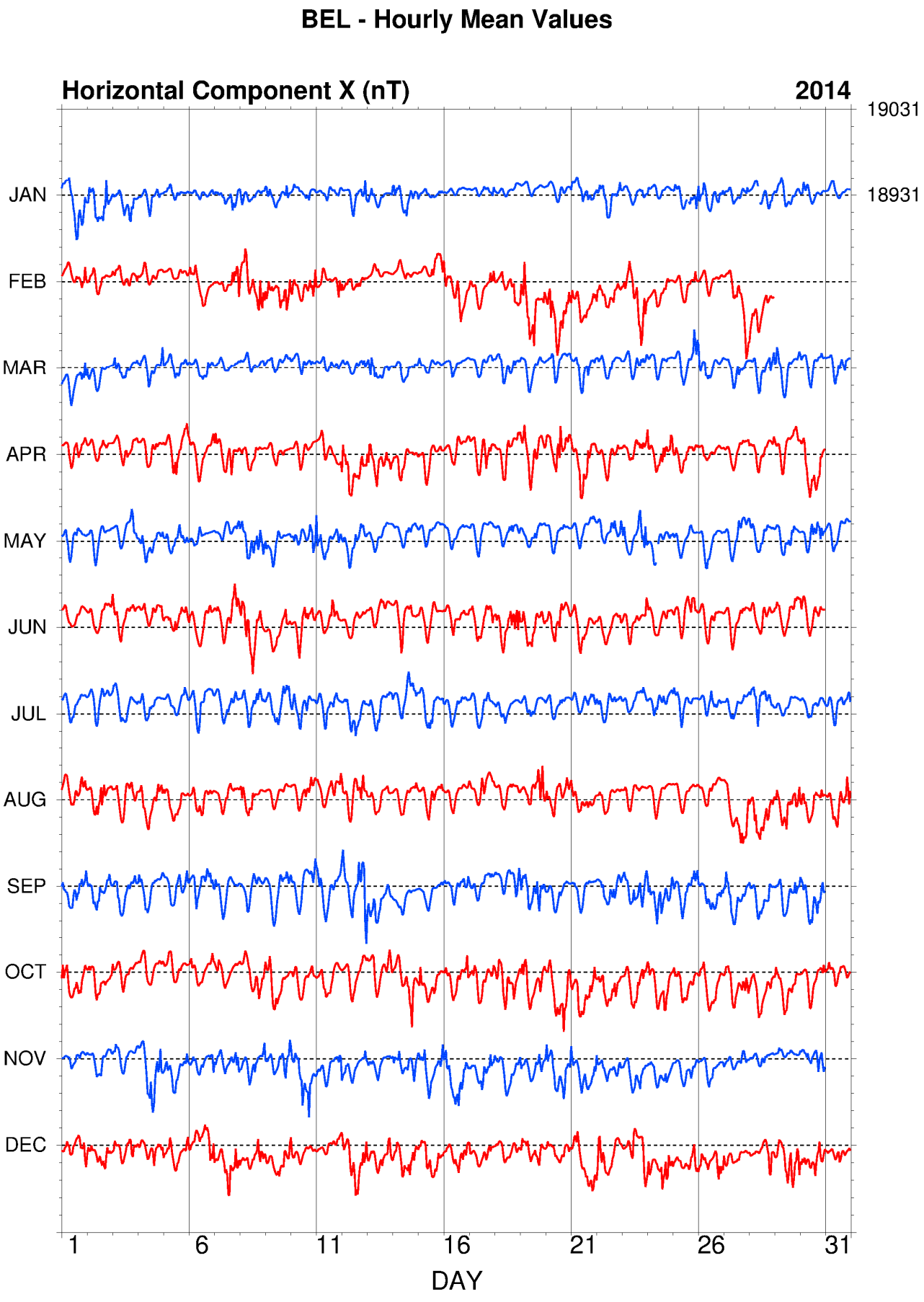

Fig. 6. Hourly mean data plot of X component for Belsk 2014.

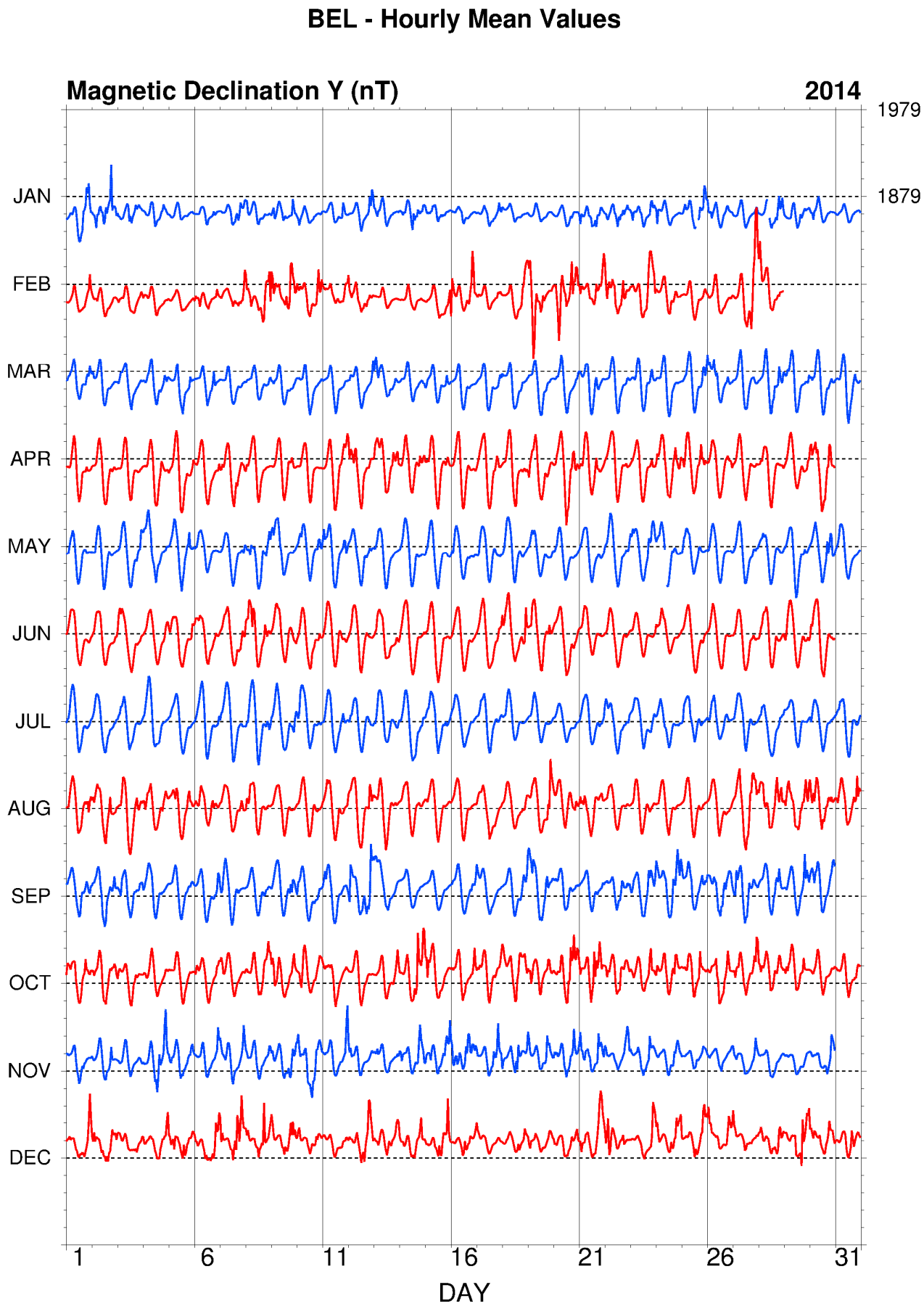

Fig. 7. Hourly mean data plot of Y component for Belsk 2014.

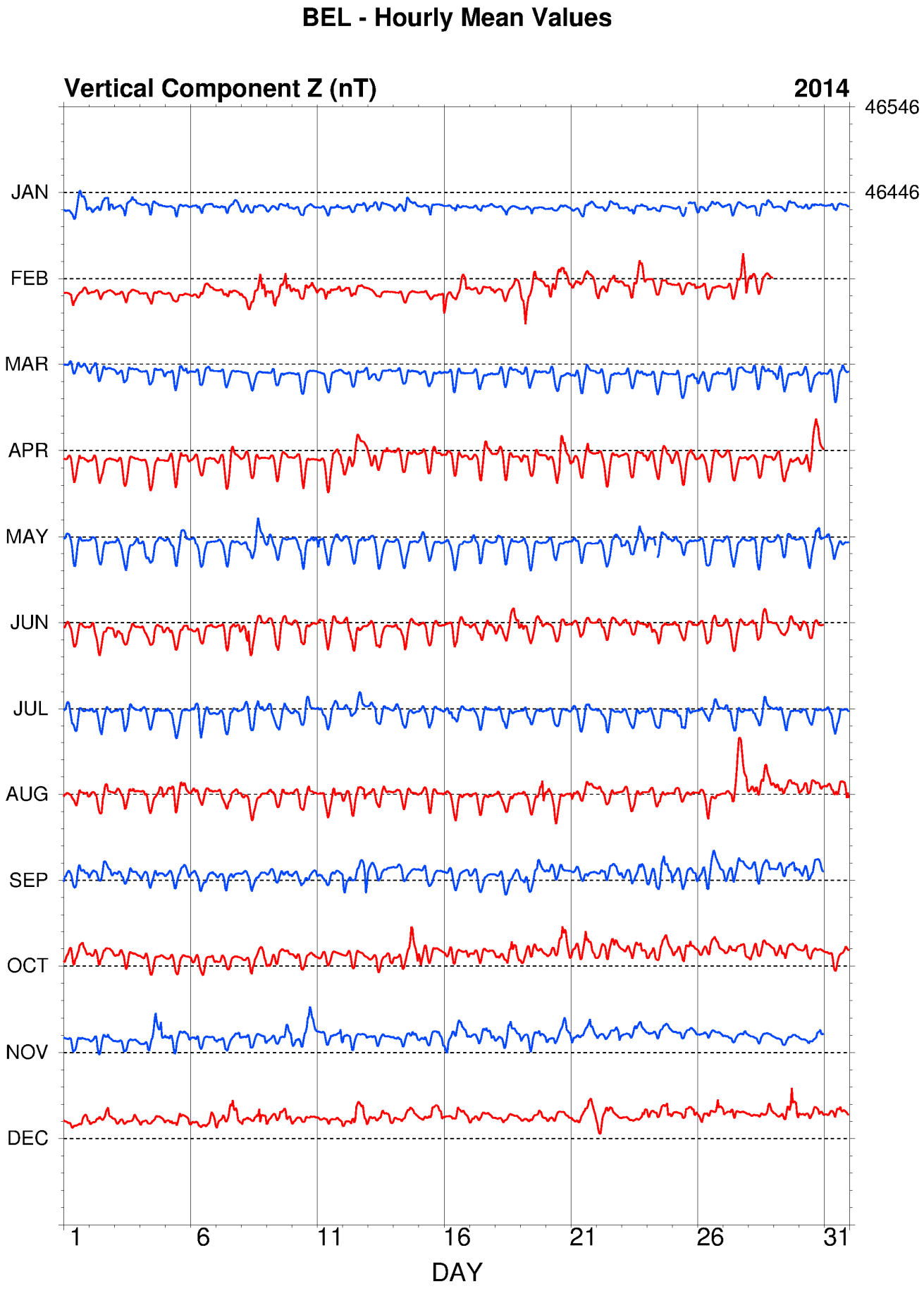

Fig. 8. Hourly mean data plot of Z component for Belsk 2014.

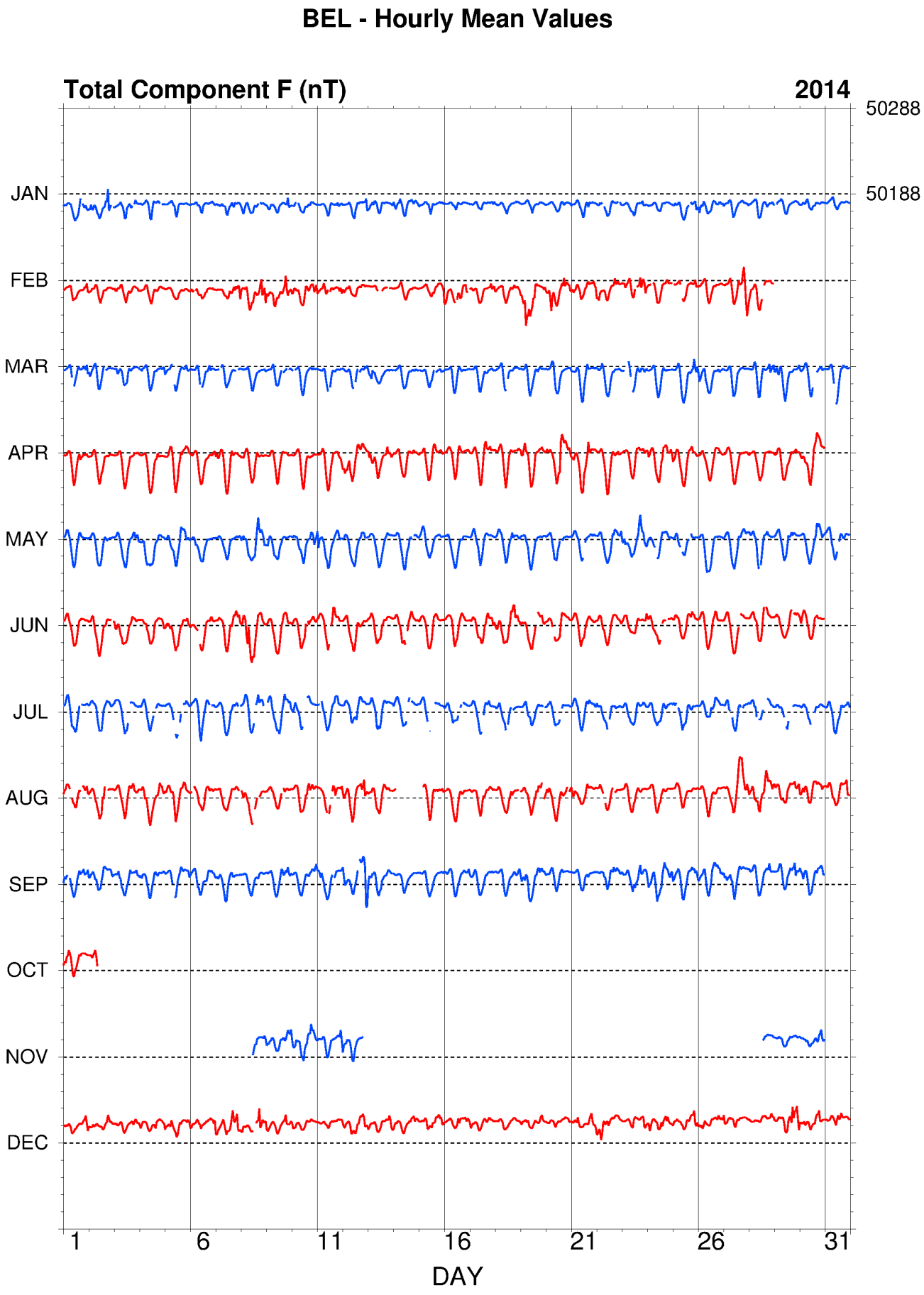

Fig. 9. Hourly mean data plot of F component for Belsk 2014.

7. TABLES AND PLOTS FOR HEL OBSERVATORY

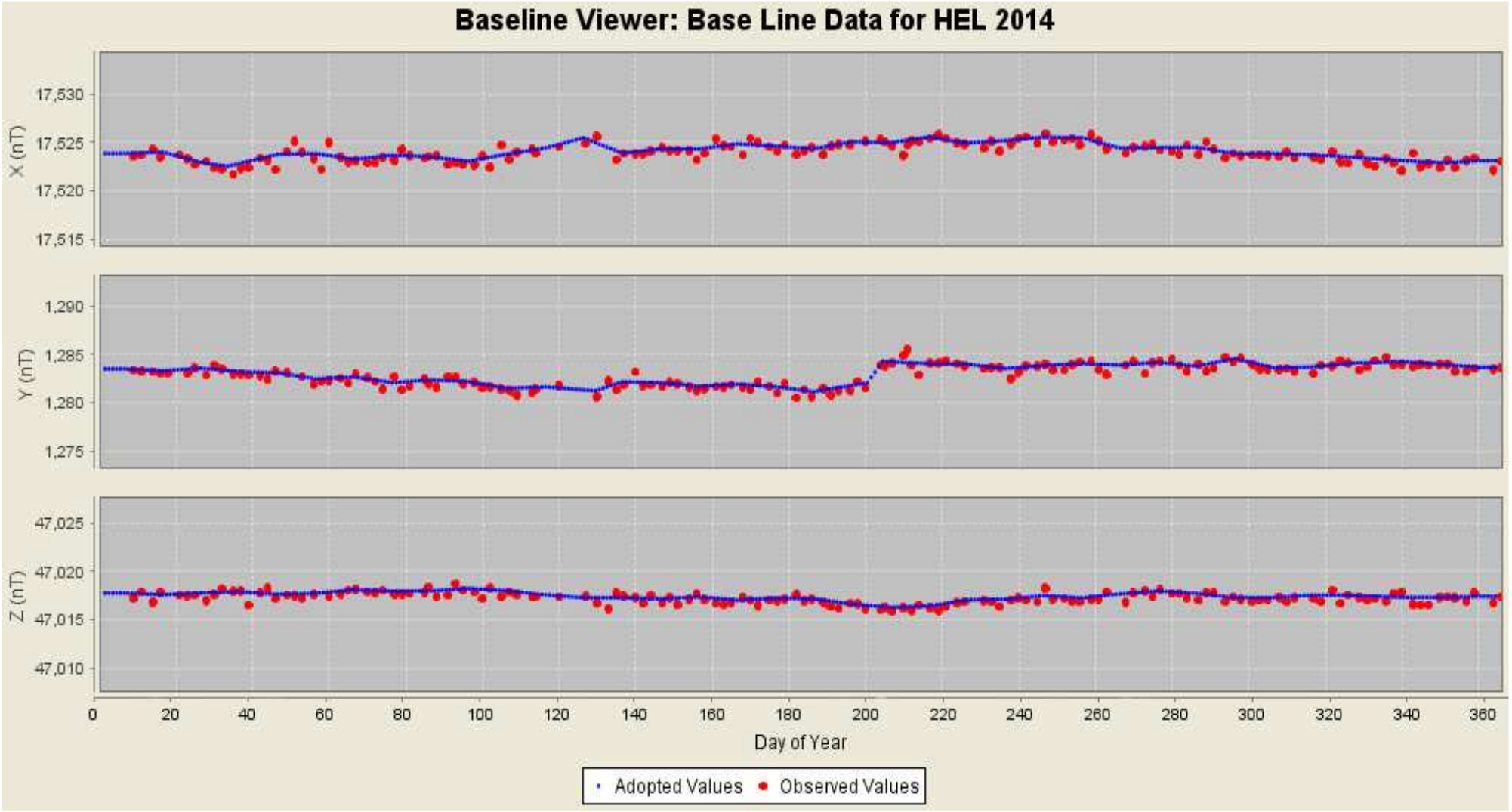

Fig. 10. Base values of set 1, Hel 2014.

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
61	2013	4 28.2	17567	47084	17513	1369	69 32.4	50254
62	2014	4 36.3	17571	47117	17514	1411	69 32.9	50286

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

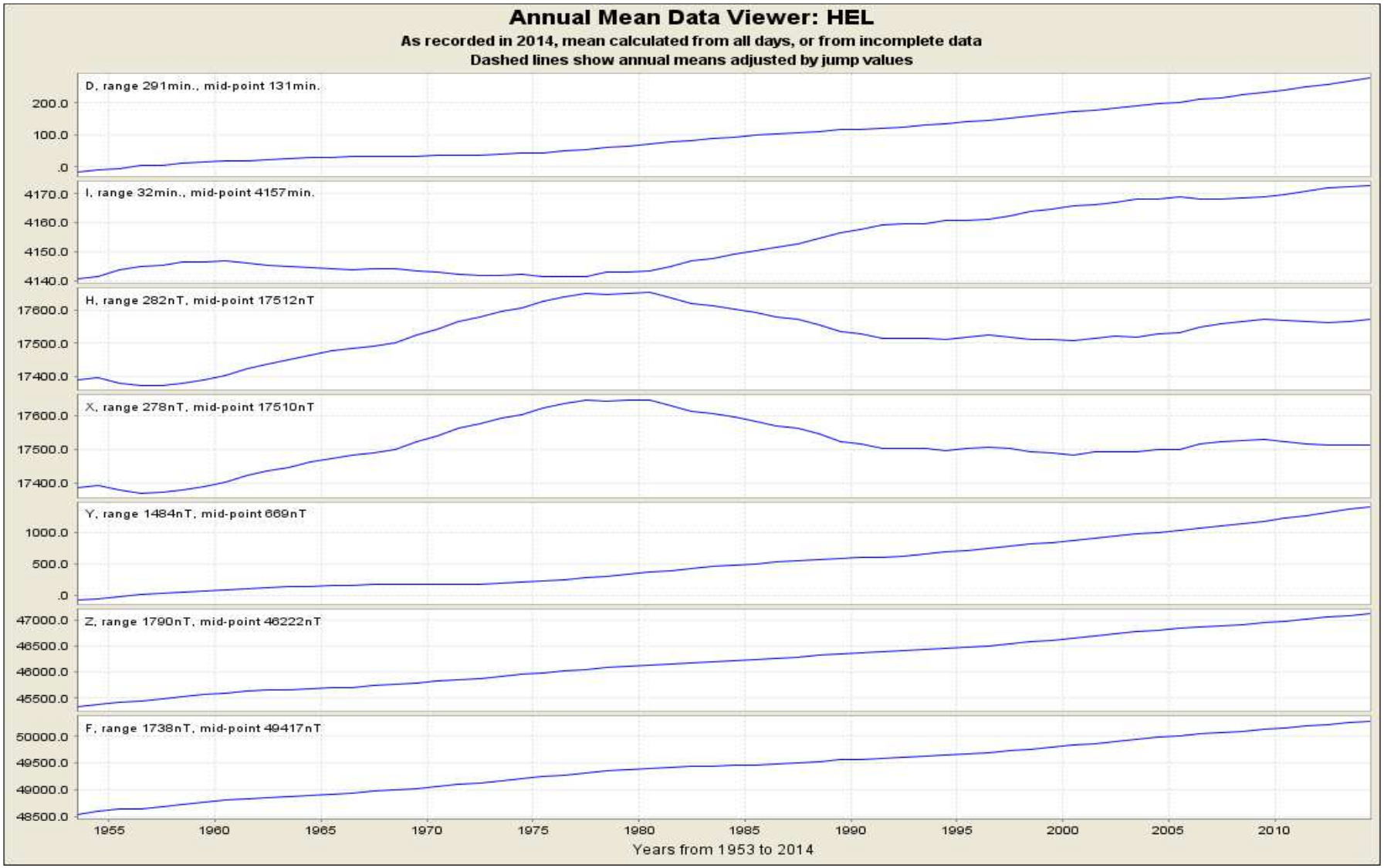

Fig. 11. Secular changes of H, X, Y, Z, F, D and I at Hel.

MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

HLP 2014

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
NORTH COMPONENT: 17000 + ... in nT													
All days	514	508	516	516	521	524	525	517	509	506	507	504	514
Quiet days	520	518	518	517	523	523	531	520	508	504	509	503	516
Disturbed days	508	495	516	507	516	520	531	516	504	504	502	506	511
EAST COMPONENT: 1000 + ... in nT													
All days	392	398	397	400	403	407	410	415	421	424	427	433	411
Quiet days	391	394	395	399	403	405	407	418	424	427	426	434	410
Disturbed days	393	400	400	401	405	409	407	415	423	424	430	431	411
VERTICAL COMPONENT: 47000 + ... in nT													
All days	101	106	106	108	108	110	111	117	125	131	136	142	117
Quiet days	101	104	106	106	107	110	111	115	125	132	134	144	116
Disturbed days	103	108	104	112	108	109	111	118	129	134	138	141	11

Three-hour-range K indices
Hel, January - March, 2014
The limit of K=9 is 550

Day	January			February			March		
	K		SK	K		SK	K		SK
1	1122	3333	18	0000	1123	7	2012	1123	12
2	3333	3452	26	1120	1110	7	3111	1000	7
3	2112	2231	14	2112	1102	10	2111	2002	9
4	1112	2221	12	2111	1001	7	2112	3213	15
5	0111	1000	4	1000	1011	4	1122	2223	15
6	0100	1112	6	2212	2211	13	1012	2231	12
7	1001	1323	11	1011	2334	15	0010	1111	5
8	2211	1012	10	4432	2344	26	1011	1101	6
9	3211	1032	13	4221	3353	23	1001	0011	4
10	2211	1211	11	2212	0144	16	1012	1011	7
11	0001	0032	6	2121	1013	11	0001	1111	5
12	1011	1133	11	3212	2211	14	1001	1123	9
13	2321	1101	11	0001	0000	1	4332	2111	17
14	2222	3322	18	0012	2100	6	1121	2211	11
15	2110	0111	7	0000	4334	14	2011	0121	8
16	0000	0000	0	5222	4454	28	0010	0000	1
17	0000	0113	5	1101	1123	10	0011	0102	5
18	1000	0010	2	1022	1232	13	1111	2221	11
19	0000	0000	0	4553	5333	31	2111	1111	9
20	0000	0101	2	1553	3424	27	0123	2121	12
21	3112	2321	15	3122	2323	18	2222	3322	18
22	2223	3223	19	3322	2322	19	2012	2112	11
23	2121	1122	12	2242	3444	25	1112	2122	12
24	3100	1000	5	1212	2220	12	2011	1110	7
25	2211	1214	14	0001	1113	7	1012	2133	13
26	3211	0222	13	1011	0001	4	3132	1121	14
27	0000	1002	3	1101	2455	19	1122	2220	12
28	0010	0232	8	4222	1221	16	1122	2132	14
29	1122	1212	12				3102	0003	9
30	2210	0000	5				2112	1221	12
31	0001	0000	1				0012	2230	10

Three-hour-range K indices
Hel, April - June, 2014
The limit of K=9 is 550

Day	April		May		June	
	K	SK	K	SK	K	SK
1	0111 2222	11	2221 1110	10	1011 1111	7
2	0001 2121	7	1101 1000	4	0111 1123	10
3	1122 2112	12	0001 0333	10	3112 2221	14
4	1122 2220	12	2322 4322	20	2111 2212	12
5	1114 3323	18	1223 3332	19	1113 1223	14
6	2000 1102	6	0111 1100	5	2210 1322	13
7	3122 3422	19	0001 1112	6	2122 2533	20
8	2102 2110	9	2334 3433	25	3565 5432	33
9	0012 2120	8	3222 1101	12	0122 1131	11
10	0010 1011	4	1211 1132	12	1023 3322	16
11	0122 1224	14	4323 2222	20	2223 3311	17
12	5332 3132	22	1222 3122	15	1211 0111	8
13	3222 2232	18	1122 1011	9	1111 2221	11
14	1121 0132	11	1101 3211	10	2322 2221	16
15	1111 1121	9	1112 1221	11	1011 1111	7
16	0001 2112	7	2111 2320	12	1111 3211	11
17	3222 3422	20	2002 1111	8	2222 2224	18
18	2112 3223	16	1111 2211	10	3223 3345	25
19	4233 3331	22	0112 2211	10	2322 2232	18
20	3224 5453	28	0112 2210	9	1122 4422	18
21	3233 3421	21	1000 1101	4	1222 2101	11
22	1112 1211	10	1111 3423	16	0111 1112	8
23	1112 2232	14	3121 2444	21	0001 1013	6
24	4123 2333	21	1121 2211	11	3211 1121	12
25	2202 2332	16	1110 1200	6	0211 3313	14
26	0111 1212	9	1111 0100	5	0013 3210	10
27	1000 2112	7	0002 2211	8	1001 2221	9
28	1112 1102	9	1102 2211	10	1112 3321	14
29	0001 1013	6	1113 3221	14	3111 1123	13
30	3332 4341	23	0113 3341	16	3111 2211	12
31			1101 1110	6		

Three-hour-range K indices
Hel, July - September, 2014
The limit of K=9 is 550

Day	July			August			September		
	K		SK	K		SK	K		SK
1	1101	1111	7	2212	3234	19	3222	3233	20
2	0221	1311	11	2123	4312	18	2223	3333	21
3	2222	1111	12	1312	1222	14	2222	2112	14
4	1112	3101	10	2322	2233	19	3222	2112	15
5	1011	1122	9	2232	3232	19	1112	2223	14
6	1002	2112	9	2212	2221	14	1222	3423	19
7	2112	3321	15	1111	2221	11	3221	1010	10
8	2112	3222	15	3313	2210	15	0121	1212	10
9	2112	1333	16	0111	1110	6	1122	2232	15
10	3222	2222	17	1012	3342	16	2012	1223	13
11	1112	2221	12	2211	2323	16	3322	2123	18
12	1222	3110	12	3122	2343	20	5322	2446	28
13	1212	1212	12	2212	2121	13	3342	3331	22
14	1012	4432	17	1112	1112	10	0011	1100	4
15	1223	3221	16	1101	1112	8	0112	1101	7
16	1111	1221	10	0000	0001	1	1222	2223	16
17	1111	1221	10	2103	3312	15	2101	1322	12
18	1101	1000	4	1121	1221	11	2112	2233	16
19	0011	1000	3	1123	2345	21	3333	3333	24
20	1010	3201	8	2122	2222	15	2212	2111	12
21	0001	2322	10	3211	2231	15	1212	2121	12
22	2111	2212	12	1201	1101	7	1122	3322	16
23	1100	1232	10	1102	1211	9	2212	3332	18
24	0113	2221	12	1001	2000	4	3324	3434	26
25	3122	2111	13	0001	1101	4	4223	3233	22
26	1122	2221	13	1001	1221	8	2222	4423	21
27	2111	1111	9	0133	3533	21	4333	2222	21
28	1232	3422	19	3433	3322	23	1113	2231	14
29	1101	1111	7	3323	3333	23	1113	2143	16
30	2101	1100	6	3223	3231	19	2323	2333	21
31	0112	2122	11	2223	3244	22			

Three-hour-range K indices
Hel, October - December, 2014
The limit of K=9 is 550

Day	October			November			December		
	K		SK	K		SK	K		SK
1	4123	2223	19	1123	3211	14	1222	2324	18
2	2222	2323	18	2101	3331	14	3321	3242	20
3	3111	1211	11	2211	1101	9	2112	2232	15
4	1121	2112	11	1123	4465	26	2111	2324	16
5	1121	2121	11	3333	2223	21	2222	3212	16
6	2111	1013	10	1222	2114	15	2122	2243	18
7	2211	1111	10	2213	2223	17	5233	5544	31
8	1123	2223	16	2222	2213	16	2322	3543	24
9	4323	2233	22	2111	1233	14	3222	3243	21
10	2310	1122	12	3234	3532	25	3223	1121	15
11	2223	3211	16	2223	2124	18	1000	0123	7
12	0001	1120	5	4221	1113	15	3122	4344	23
13	1020	2233	13	1212	1101	9	2211	2233	16
14	1112	3545	22	3231	2243	20	2212	2341	17
15	5221	2111	15	3233	3134	22	1233	3334	22
16	2112	2214	15	4333	3433	26	1102	3122	12
17	1211	1123	12	2222	3332	19	3211	1221	13
18	3332	3534	26	3221	3312	17	1110	1212	9
19	3322	2121	16	3022	2231	15	3122	1222	15
20	3233	3543	26	3122	1341	17	3111	1203	12
21	3232	4343	24	3322	2243	21	3221	2233	18
22	3232	2422	20	3212	1134	17	5521	1312	20
23	1112	2242	15	1222	2232	16	1014	2244	18
24	3122	2321	16	2111	2322	14	4212	4443	24
25	2222	2321	16	0012	2212	10	1111	3243	16
26	2223	3331	19	0111	2002	7	3322	2252	21
27	3222	2224	19	1221	2233	16	3112	2100	10
28	3223	2331	19	0001	2211	7	2111	1242	14
29	3122	1230	14	1121	1111	9	1323	3535	25
30	0112	1112	9	1212	2332	16	3332	3232	21
31	1122	2122	13				1211	2421	14

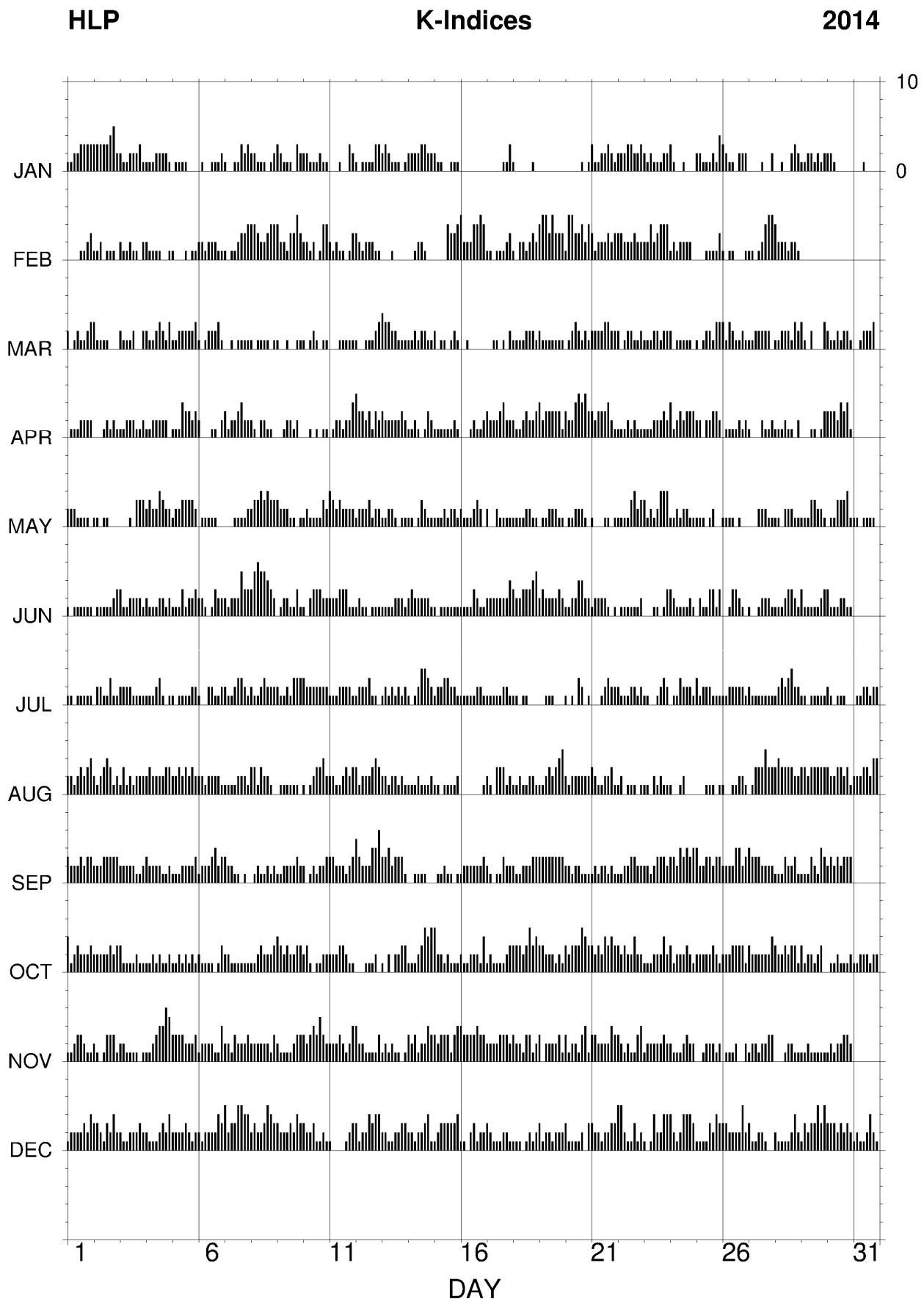

Fig. 12. K-indices in graphical form, Hel 2014.

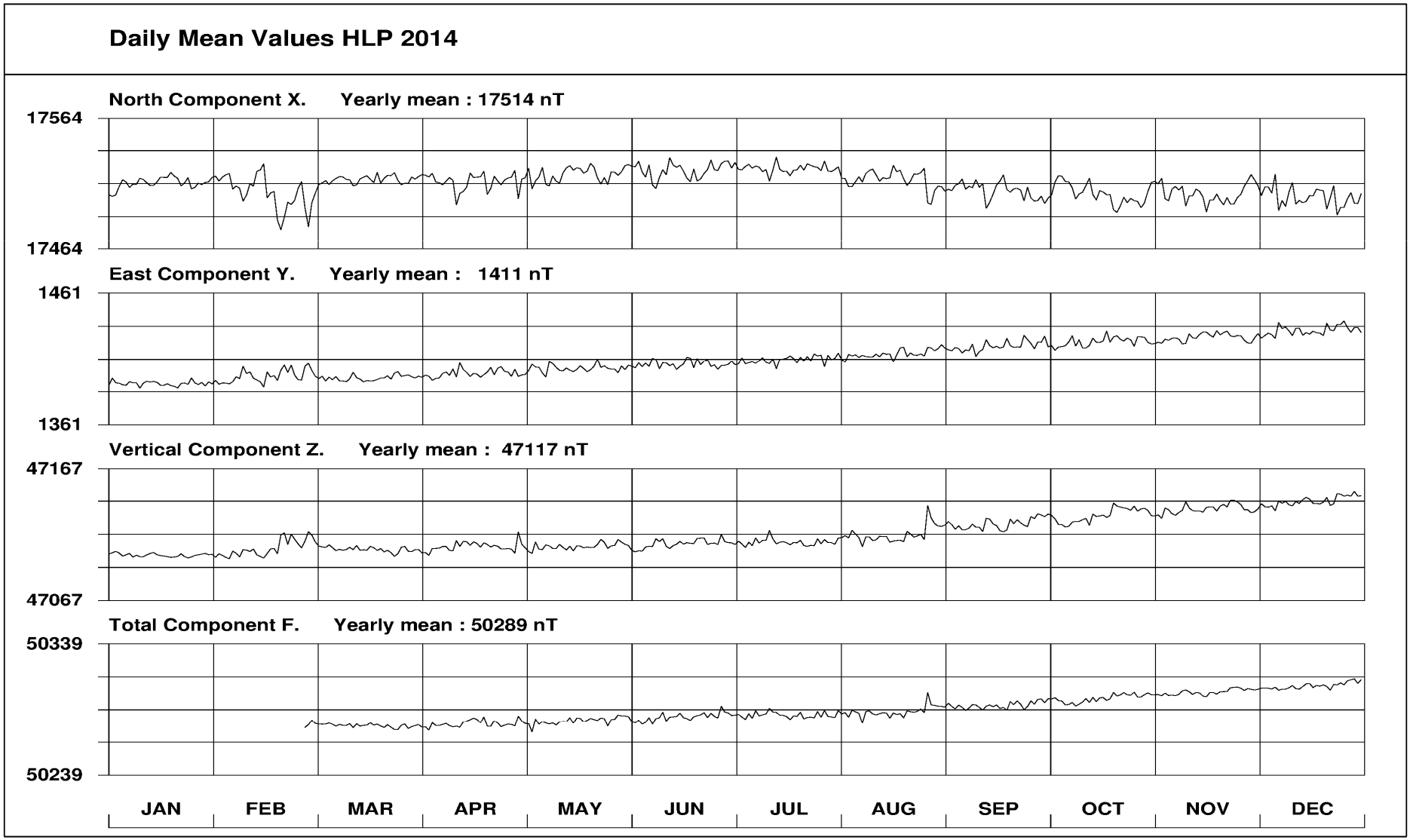

Fig. 13. Daily mean data plot for Hel 2014.

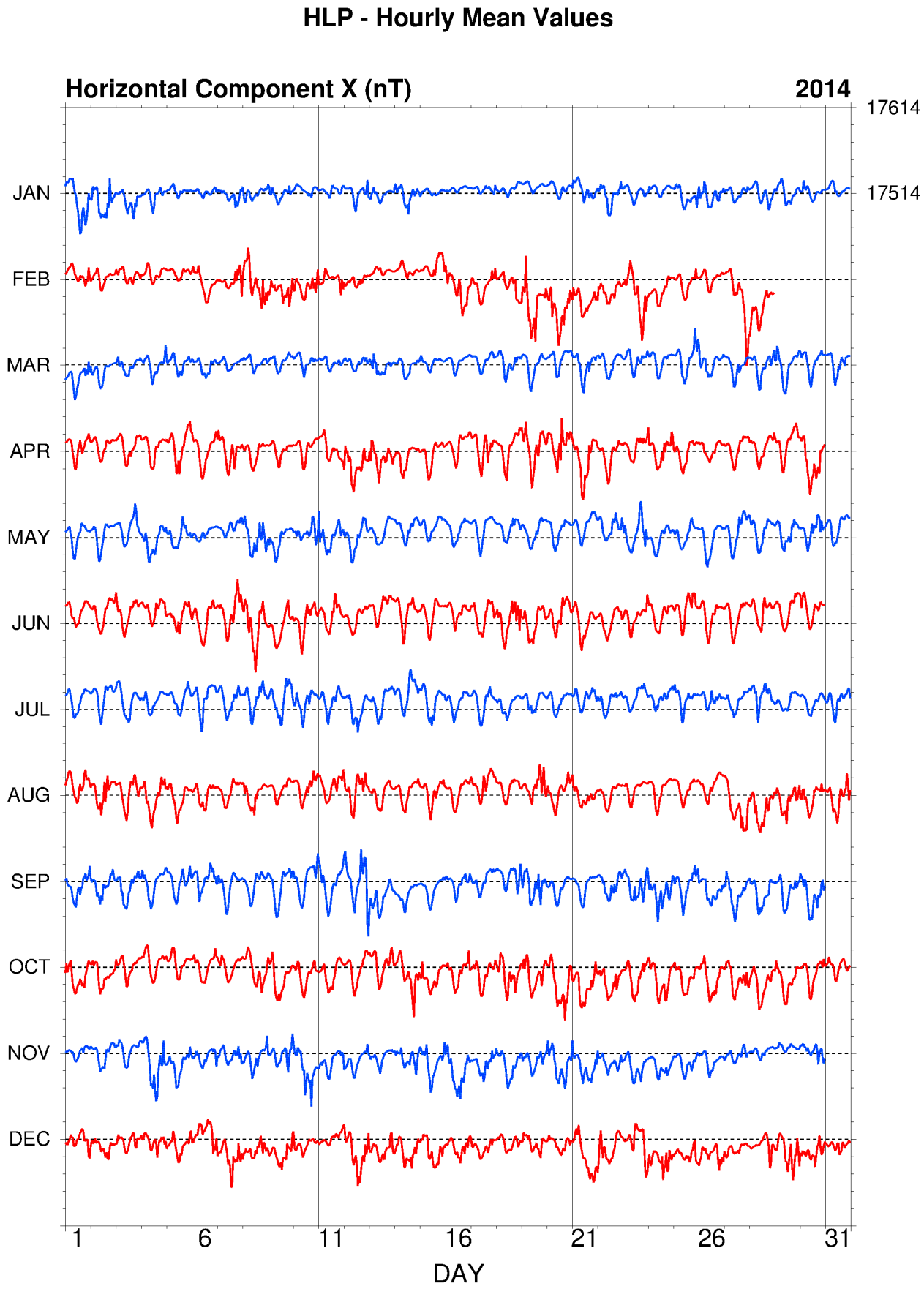

Fig. 14. Hourly mean data plot of X component for Hel 2014.

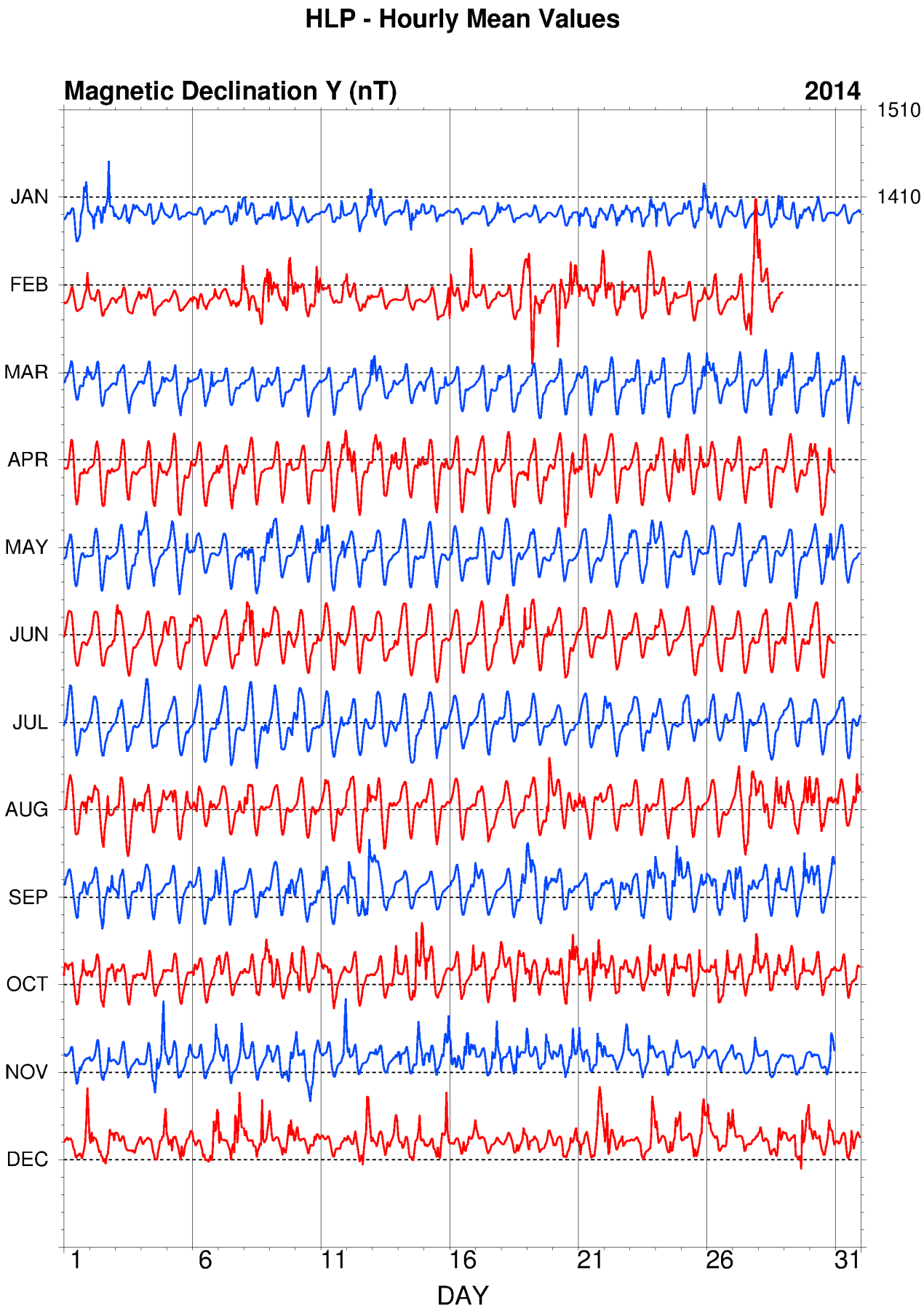

Fig. 15. Hourly mean data plot of Y component for Hel 2014.

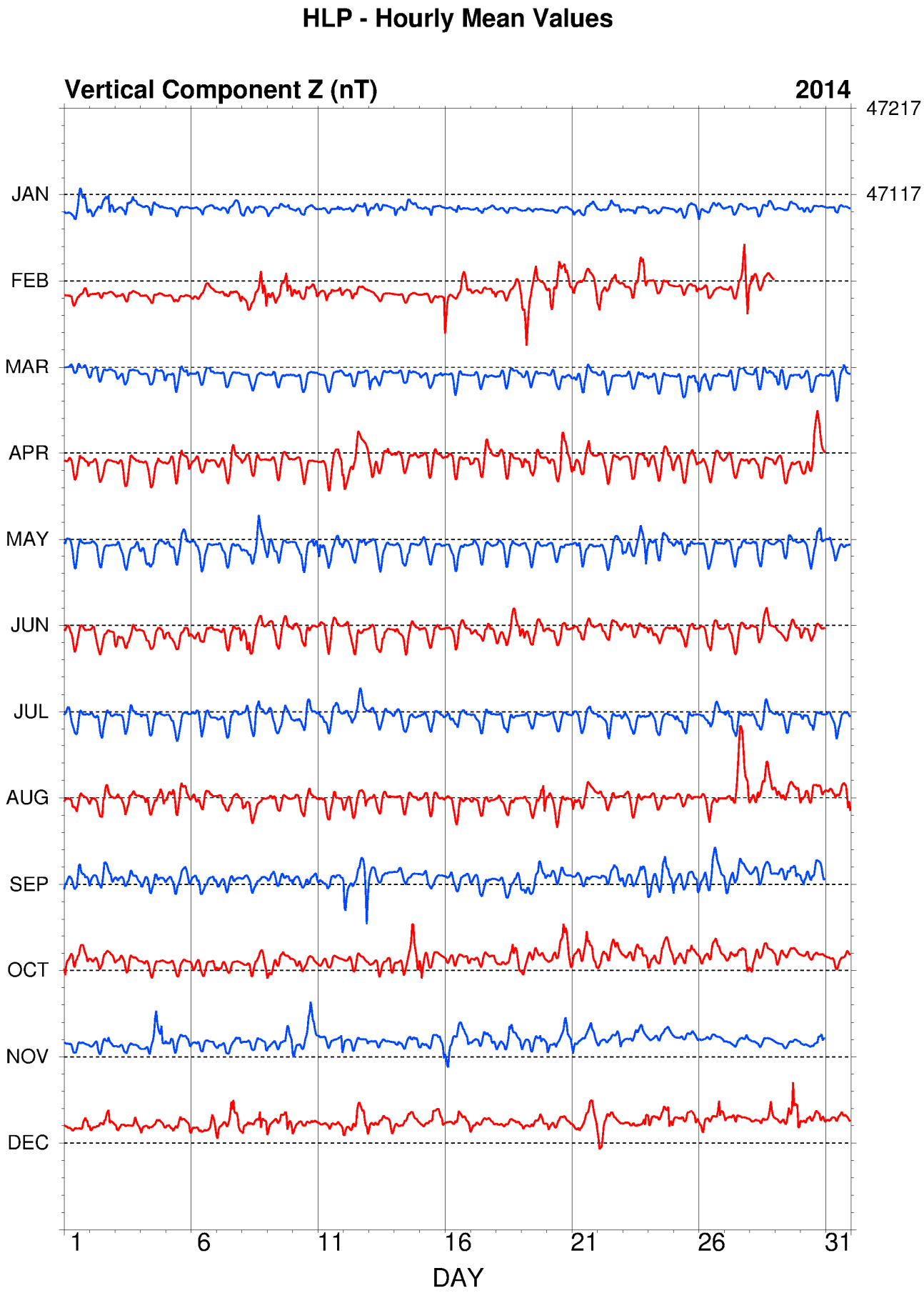

Fig. 16. Hourly mean data plot of Z component for Hel 2014.

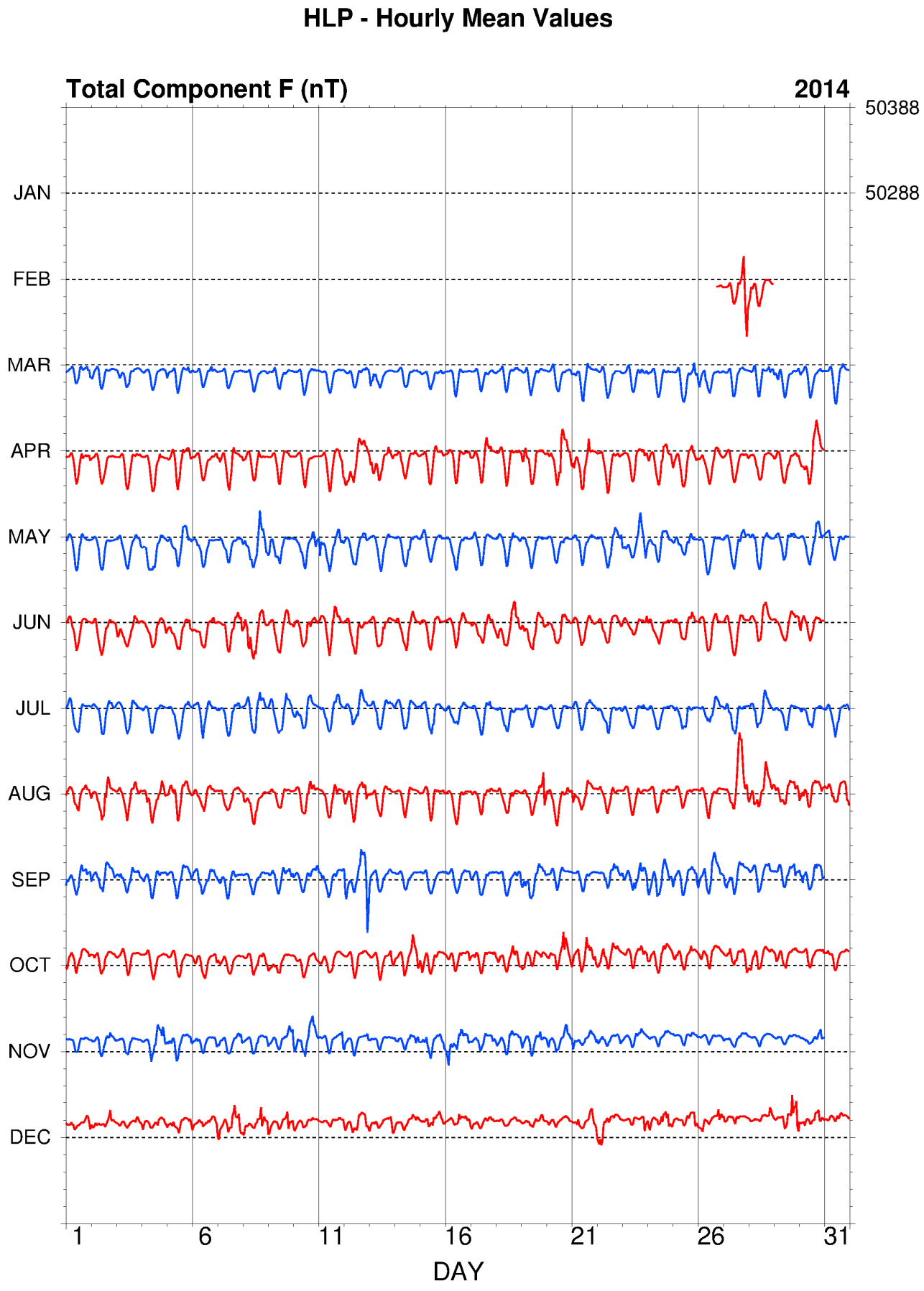

Fig. 17. Hourly mean data plot of F component for Hel 2014.

8. TABLES AND PLOTS FOR HORNSUND OBSERVATORY

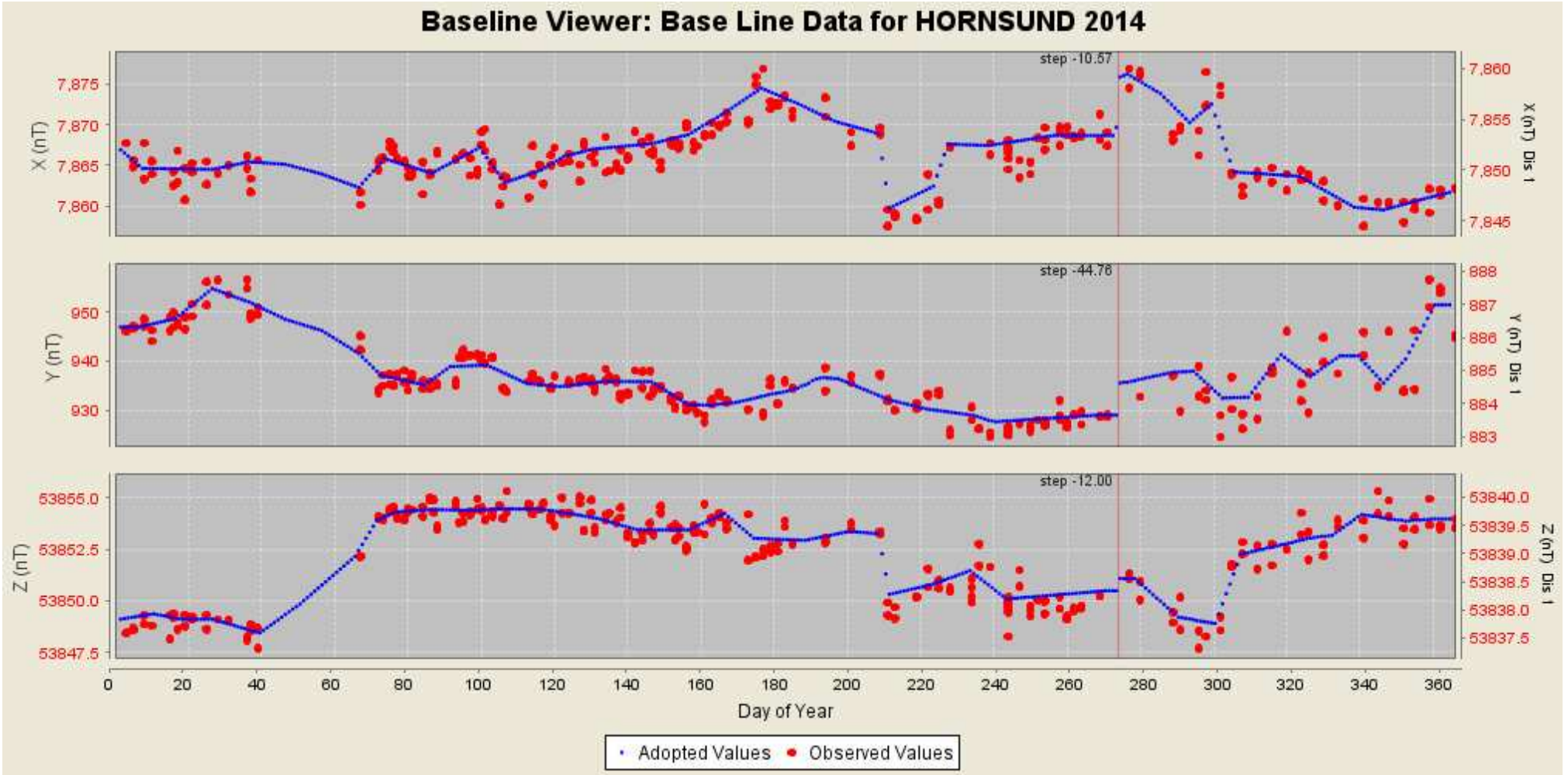

Fig. 18. Base values, Hornsund 2014.

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
2013	6 50.8	7903	53920	7846	942	81 39.7	54497
2014	7 08.8	7895	53947	7833	982	81 40.4	54521

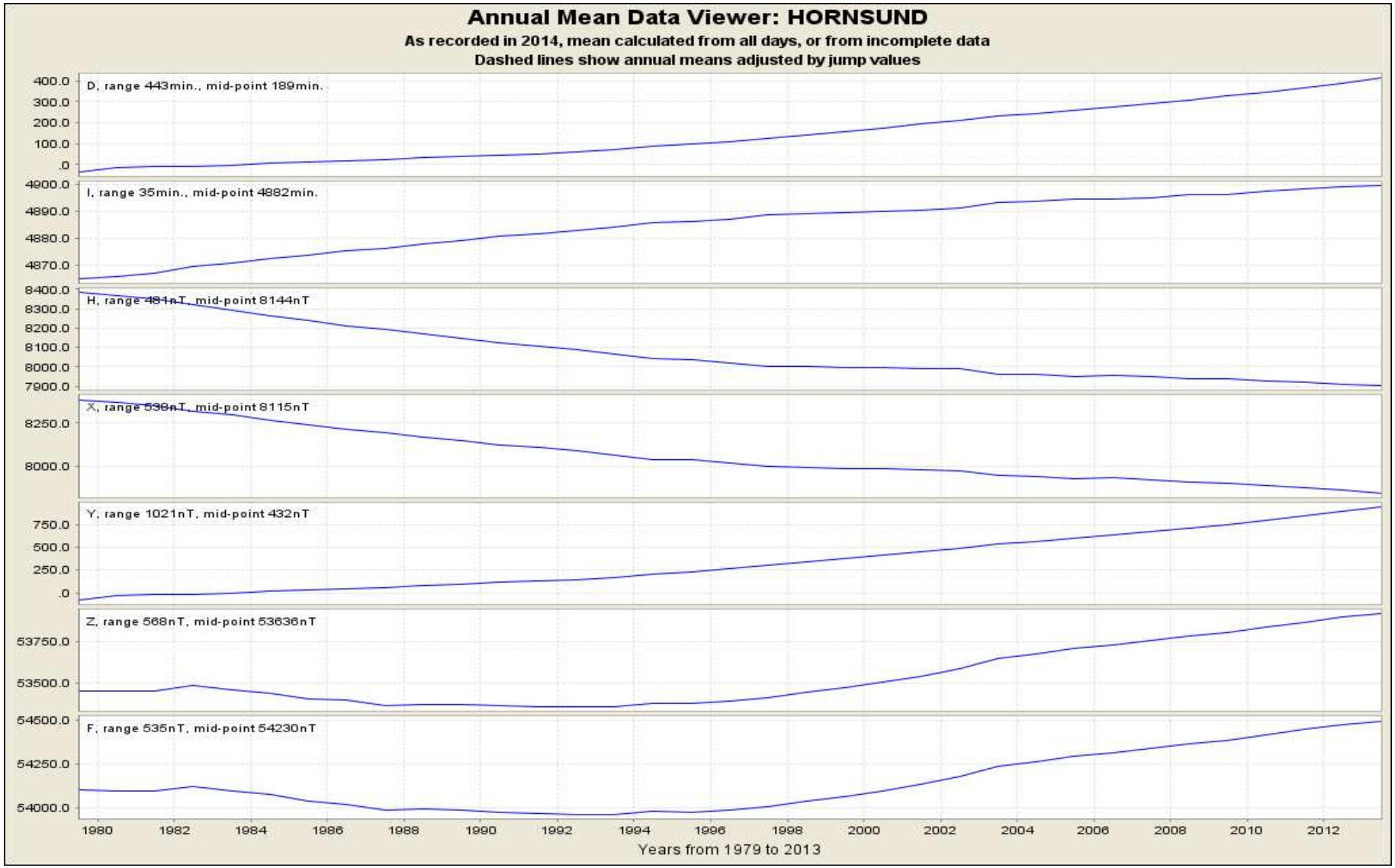

Fig. 19. Secular changes of H, X, Y, Z, F, D and I at Hornsund

MONTHLY AND YEARLY MEAN VALUES OF MAGNETIC ELEMENTS

HRN 2014

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
NORTH COMPONENT: 7500 + ... in nT													
All days	323	323	333	348	350	354	355	351	337	318	310	299	333
Quiet days	317	323	331	352	346	349	357	361	353	324	321	283	335
Disturbed days	317	334	334	343	346	348	350	348	333	321	304	308	332
EAST COMPONENT: 500 + ... in nT													
All days	478	478	468	468	467	471	475	482	490	497	502	507	482
Quiet days	484	481	472	470	471	468	476	484	485	501	499	509	483
Disturbed days	481	479	470	470	461	471	477	479	487	502	503	506	482
VERTICAL COMPONENT: 53500 + ... in nT													
All days	432	444	440	435	437	439	433	442	456	462	464	474	447
Quiet days	443	446	442	431	439	444	439	444	458	459	460	475	448
Disturbed days	433	432	438	435	441	446	440	434	451	466	471	476	447

Three-hour-range K indices
Hornsund, January - March, 2014
The limit of K=9 is 2500

Day	January		February		March	
	K	SK	K	SK	K	SK
1	1233 3222	18	0100 1114	8	1233 1023	15
2	2442 2363	26	2230 1100	9	4312 1000	11
3	2232 3131	17	2221 1100	9	3211 2001	10
4	0222 2253	18	1221 1100	8	1211 2224	15
5	0121 2000	6	0100 0011	3	2221 3143	18
6	0312 2033	14	3232 2231	18	1122 2150	14
7	2112 2433	18	0011 1232	10	1221 2000	8
8	2322 2123	17	4432 2142	22	1111 2122	11
9	4433 2153	25	2321 3264	23	0110 0001	3
10	2223 1310	14	3332 1155	23	0111 1100	5
11	1011 1152	12	3331 1012	14	0011 1110	5
12	1231 2145	19	4311 1233	18	1111 0111	7
13	2432 2101	15	1002 0000	3	3332 2110	15
14	4432 3214	23	0000 1000	1	1231 3202	14
15	2221 1121	12	0100 3212	9	2121 1124	14
16	2121 0001	7	4322 3334	24	1--- 0000	--
17	1011 1102	7	2101 1133	12	0010 0102	4
18	3100 0000	4	1122 2121	12	1222 2210	12
19	0000 0001	1	3543 5212	25	1221 1110	9
20	0001 1111	5	2444 3324	26	1132 1013	12
21	3212 2223	17	3232 3233	21	0234 2212	16
22	1322 3223	18	2422 2512	20	2212 2111	12
23	2232 2052	18	3353 2332	24	1122 2232	15
24	2211 0000	6	0122 3130	12	2132 2110	12
25	4421 1233	20	0001 1113	7	0112 2155	17
26	5431 0222	19	1030 0011	6	4342 1021	17
27	1010 1001	4	1111 2433	16	1223 3321	17
28	0010 0332	9	2443 2111	18	1112 3234	17
29	2232 1313	17			4312 2001	13
30	2410 0010	8			1213 0151	14
31	0010 0001	2			0112 2220	10

Three-hour-range K indices
Hornsund, April - June, 2014
The limit of K=9 is 2500

Day	April		May		June	
	K	SK	K	SK	K	SK
1	0121 2212	11	2332 3120	16	1122 1121	11
2	1111 2122	11	1210 1000	5	1222 1103	12
3	0221 2231	13	0001 1021	5	4212 2321	17
4	1122 2530	16	2354 3221	22	2332 2124	19
5	1224 3423	21	1343 3321	20	1224 3114	18
6	1101 2101	7	1222 1100	9	2311 1232	15
7	2232 3322	19	1121 2212	12	2332 2333	21
8	1202 3101	10	2244 3322	22	3475 4431	31
9	0132 2321	14	3233 1001	13	1353 2243	23
10	1110 1110	6	2422 2022	16	2232 4323	21
11	0222 3323	17	5334 2233	25	2333 3322	21
12	4222 3212	18	2233 2121	16	1331 0111	11
13	3233 2232	20	2232 2110	13	2222 3212	16
14	2222 1122	14	1101 3112	10	4333 2131	20
15	2221 3211	14	1223 1132	15	2123 3121	15
16	0112 2111	9	2421 3221	17	2222 3311	16
17	3232 4231	20	1222 2221	14	3333 2223	21
18	2323 2222	18	1322 2212	15	4333 2334	25
19	3444 3322	25	1222 2212	14	3333 2233	22
20	3343 4442	27	1223 3211	15	2233 4322	21
21	3344 3420	23	0121 1121	9	3332 2121	17
22	1213 2131	14	1221 2322	15	1221 2122	13
23	1232 2242	18	4331 2435	25	1111 1114	11
24	4244 3324	26	2232 3222	18	4431 1110	15
25	3322 3444	25	3331 1210	14	1222 2221	14
26	2322 3221	17	1222 1120	11	1122 3200	11
27	1121 1002	8	1012 2222	12	1101 2131	10
28	2222 1101	11	1212 2211	12	2222 4422	20
29	1001 1002	5	1215 4321	19	4222 1113	16
30	3312 3332	20	1223 3431	19	3221 2222	16
31			2221 1010	9		

Three-hour-range K indices
Hornsund, July - September, 2014
The limit of K=9 is 2500

Day	July			August			September		
	K		SK	K		SK	K		SK
1	2211	2211	12	2324	3232	21	3443	3322	24
2	1232	2211	14	2334	3423	24	3333	3323	23
3	2333	2111	16	2433	0222	18	2333	2212	18
4	2222	2000	10	2345	4233	26	3333	2102	17
5	0001	0121	5	3333	4332	24	1232	3322	18
6	1012	1012	8	2333	2444	25	1242	2312	17
7	3221	3232	18	1232	2221	15	2331	2110	13
8	2232	3323	20	3333	3100	16	0232	2211	13
9	2333	2223	20	1221	2220	12	2223	2132	17
10	3332	3212	19	1123	2332	17	1121	1112	10
11	2223	2222	17	2322	2323	19	2343	2222	20
12	2333	3322	21	4222	2254	23	5434	3556	35
13	2223	2233	19	3233	2113	18	3341	2122	18
14	3112	3324	19	1221	22-2	--	1111	1200	7
15	3233	2222	19	2121	3212	14	0122	1000	6
16	2222	1132	15	1100	0001	3	2222	2023	15
17	1322	2142	17	2102	3200	10	2211	1101	9
18	1212	1100	8	0230	2121	11	1111	1121	9
19	1011	2000	5	1133	2236	21	4343	3231	23
20	1110	2111	8	4112	2122	15	2222	3101	13
21	1011	2222	11	3223	3222	19	1331	1113	14
22	3212	2112	14	1311	2111	11	2233	2422	20
23	1210	0223	11	1222	1110	10	2323	3642	25
24	1223	2122	15	1121	1000	6	2333	3325	24
25	3333	3211	19	0001	2100	4	4333	2255	27
26	2253	4341	24	0111	1110	6	3333	3452	26
27	2332	1211	15	1223	3322	18	5543	3232	27
28	1333	3324	22	2345	3522	26	2223	2421	18
29	1111	1111	8	2234	3243	23	2332	2243	21
30	3211	1100	9	2323	4232	21	2233	2223	19
31	2222	2132	16	2334	3254	26			

Three-hour-range K indices
Hornsund, October - December, 2014
The limit of K=9 is 2500

Day	October			November			December		
	K		SK	K		SK	K		SK
1	3233	3212	19	1232	3101	13	1332	1222	16
2	2222	2331	17	2213	2221	15	2442	3243	24
3	2222	1111	12	1122	1101	9	4323	1121	17
4	0222	0002	8	1033	3334	20	2223	2135	20
5	2221	1121	12	1243	2112	16	3233	3114	20
6	2322	2004	15	1233	2104	16	3333	2225	23
7	3421	1123	17	3322	2113	17	5343	3665	35
8	1333	2332	20	2322	2114	17	4443	3731	29
9	3422	2222	19	2232	1114	16	4332	3254	26
10	2321	2122	15	4333	3321	22	4234	1132	20
11	1223	3100	12	1122	1116	15	2221	1112	12
12	0022	1020	7	3221	1014	14	2333	3354	26
13	0110	1113	8	2221	1101	10	2333	3255	26
14	1212	2225	17	3442	2152	23	1322	2253	20
15	4442	2000	16	3333	3256	28	2333	3242	22
16	1123	2115	16	4333	3634	29	1222	3214	17
17	1322	2122	15	2342	3253	24	5222	1211	16
18	4453	3732	31	2332	3321	19	0211	1213	11
19	2332	3142	20	4223	1161	20	2221	1112	12
20	2334	2624	26	5322	2132	20	2221	2212	14
21	3233	5533	27	5222	2122	18	1322	2344	21
22	4433	2533	27	3222	1015	16	6532	1321	23
23	1332	2261	20	2222	3333	20	1114	2223	16
24	4233	2432	23	1221	1211	11	2222	3334	21
25	3232	2531	21	0121	1211	9	2233	3245	24
26	1322	2122	15	0221	2111	10	2332	2133	19
27	2333	3233	22	1321	1212	13	4322	2100	14
28	2223	2522	20	0011	2202	8	2121	1443	18
29	2222	1150	15	2121	1010	8	1443	3544	28
30	0222	1111	10	2221	1242	16	2243	3262	24
31	1121	2122	12				3234	2311	19

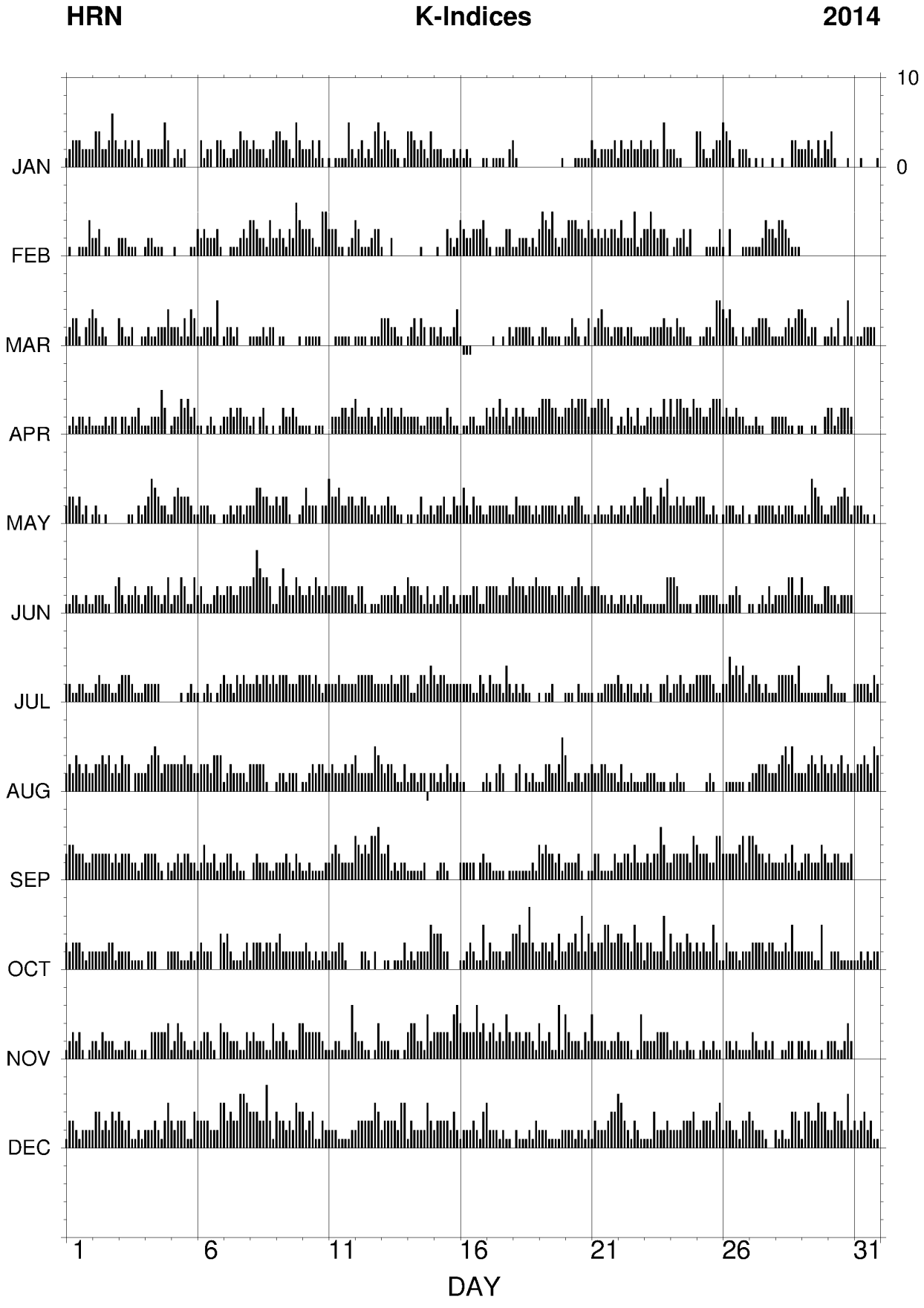

Fig. 20. K-indices in graphical form, Hornsund 2014.

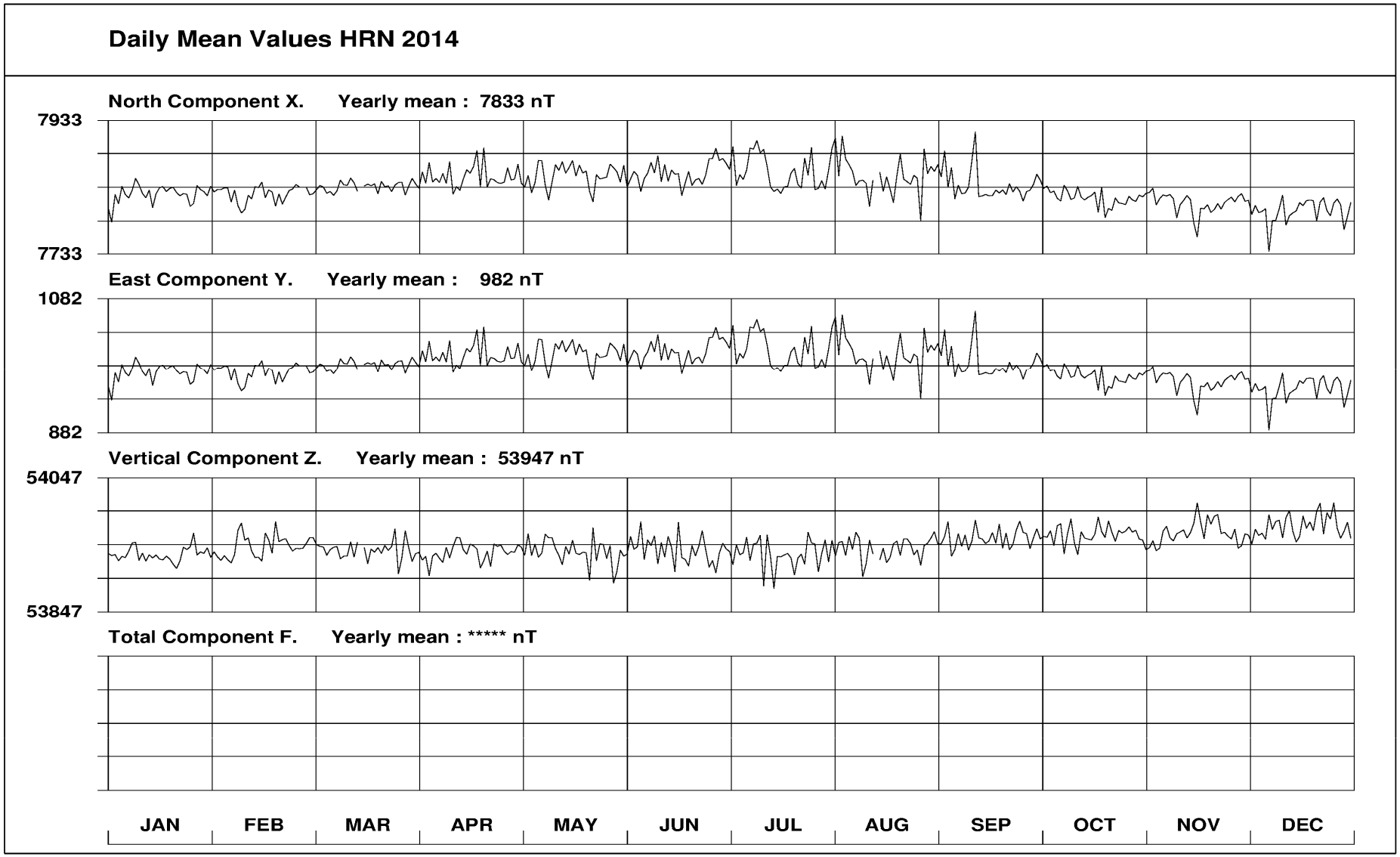

Fig. 21. Daily mean data plot for Hornsund 2014.

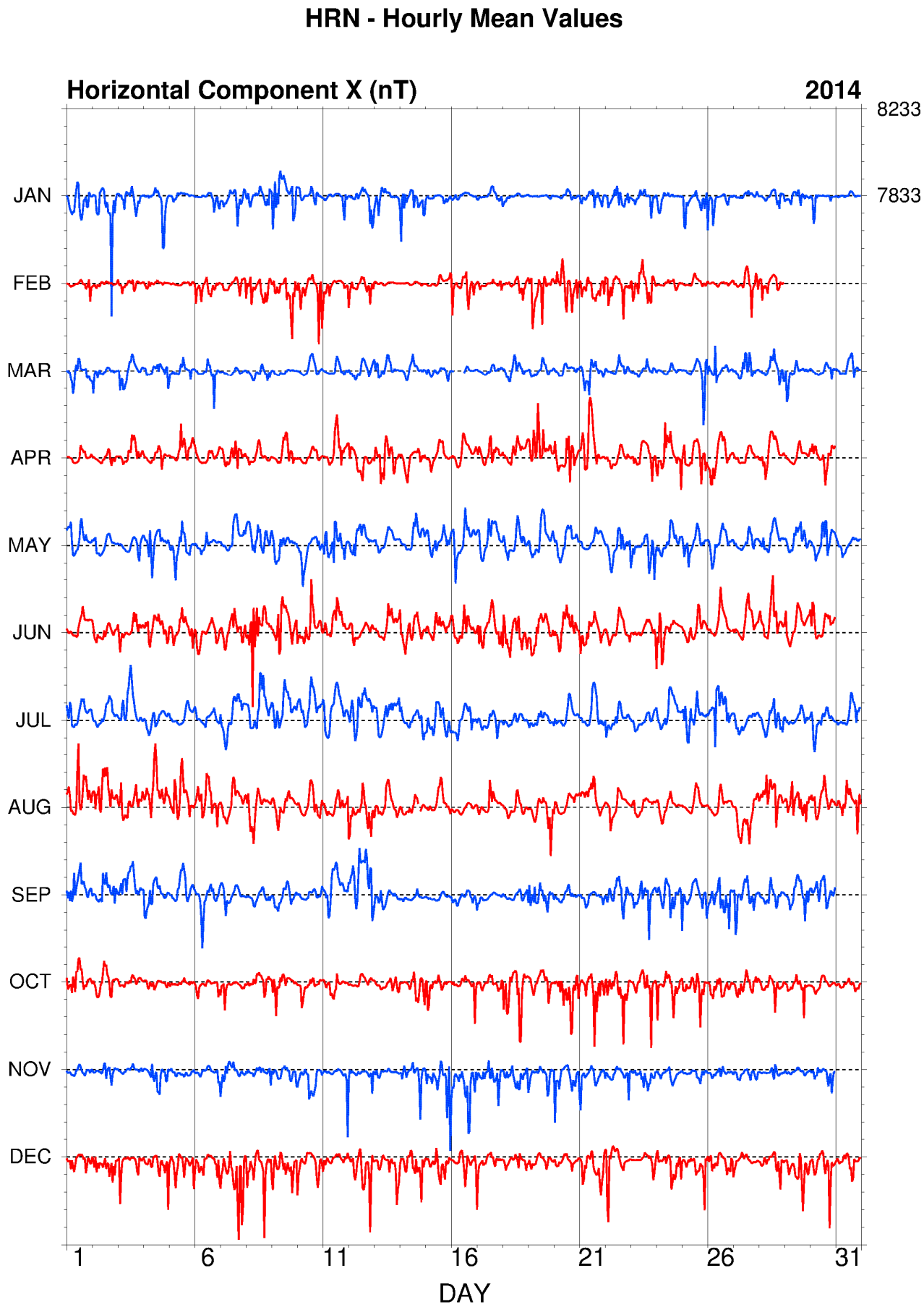

Fig. 22. Hourly mean data plot of X component for Hornsund 2014.

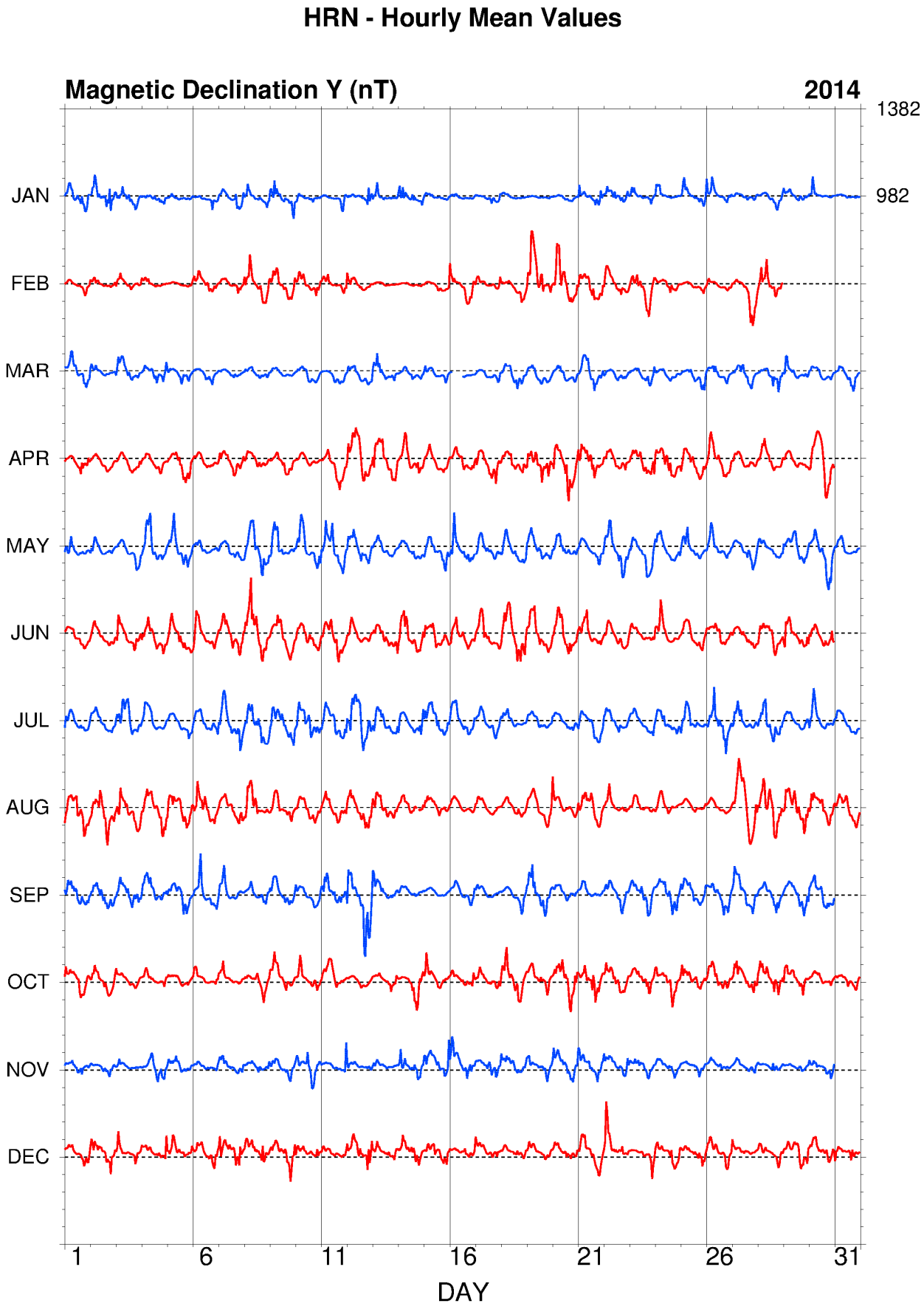

Fig. 23. Hourly mean data plot of Y component for Hornsund 2014.

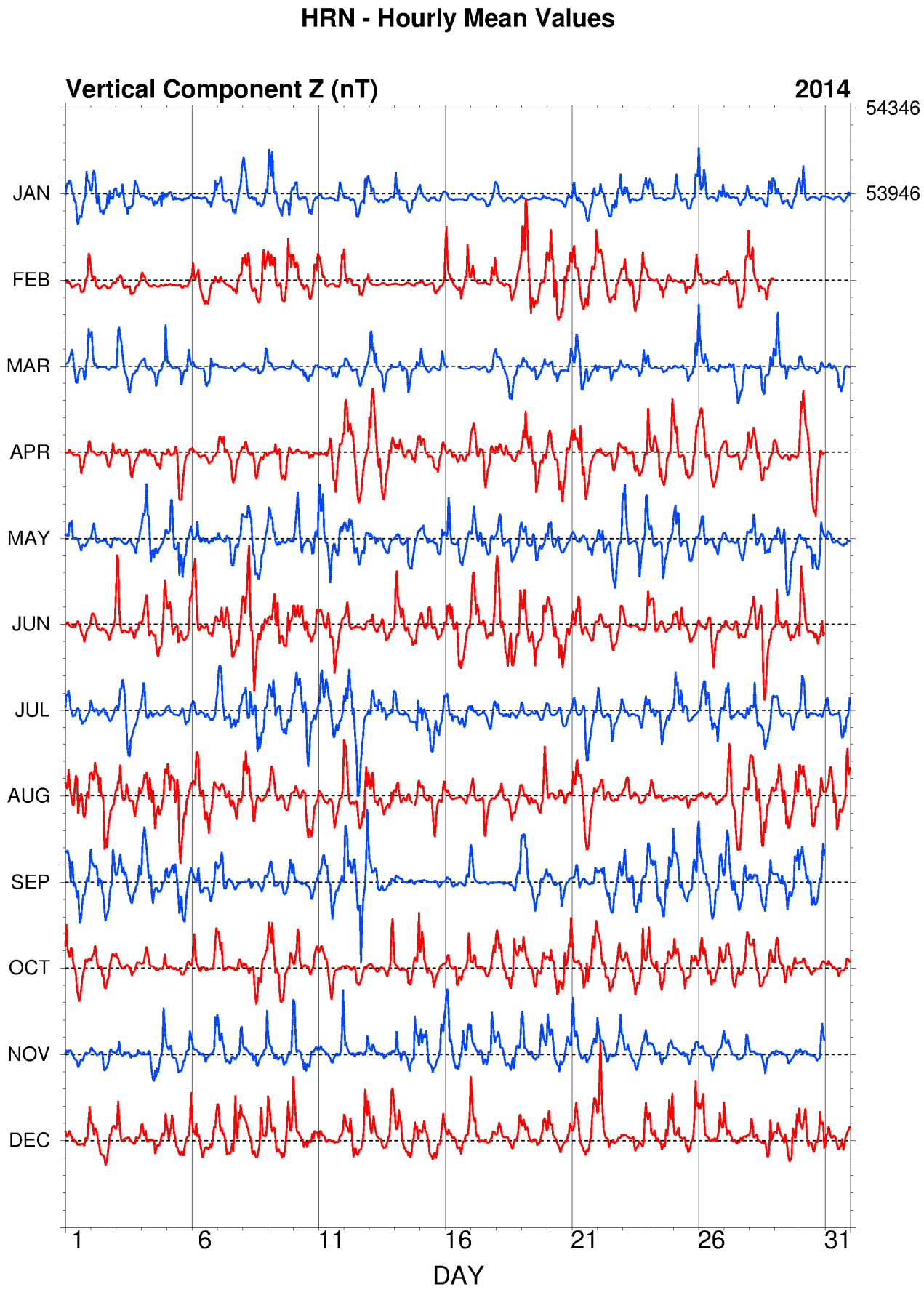

Fig. 24. Hourly mean data plot of Z component for Hornsund 2014.

C O N T E N T S