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Belsk, Hel, Hornsund, 2016

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Results of Geomagnetic Observations Belsk, Hel, Hornsund, 2016

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1. INTRODUCTION

This publication contains basic information on geomagnetic observations carried out in 2016 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 2016, 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 on the basis of model IGRF-12 from epoch 2015 (http://www.geomag.bgs.ac.uk/data_service/models_compass/coord_calc.html).

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.

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 2016 the Belsk and Hornsund observatories have been continuing the permanent observation of the Schumann resonance. Two horizontal magnetic components have been recorded at a frequency of 100 Hz. This recording was initiated in both observatories in 2004 (Neska and Satori 2006).

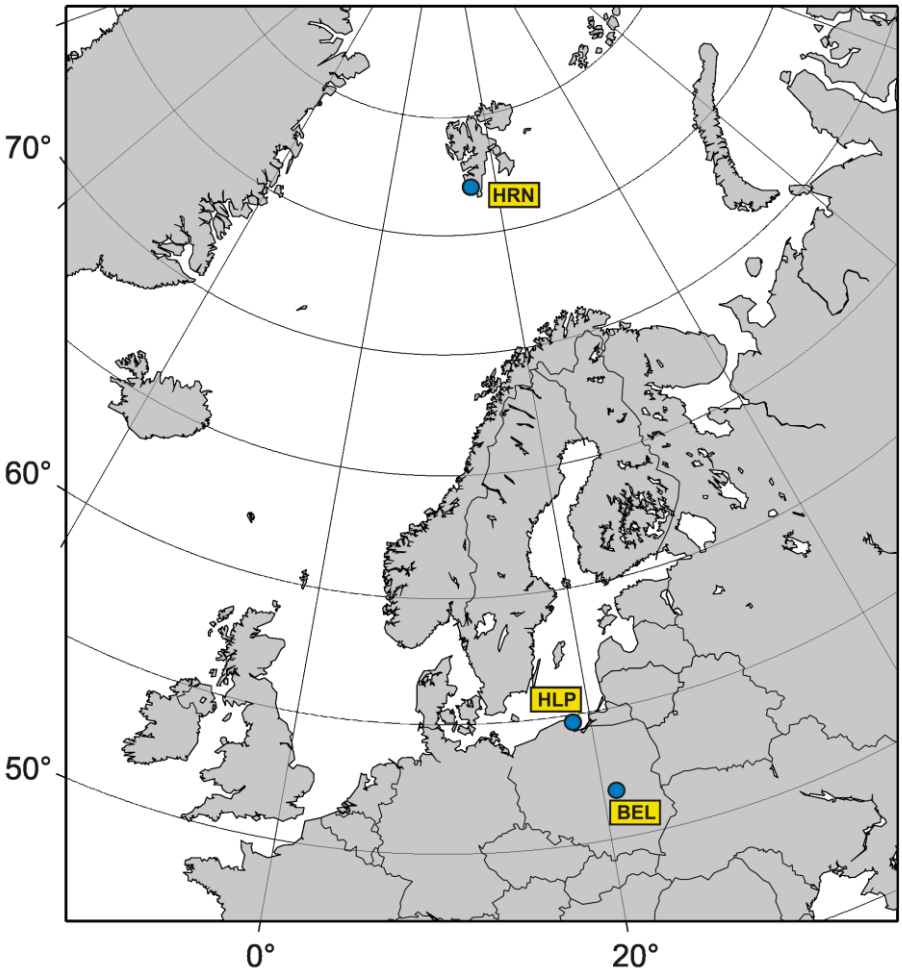

Fig. 1. Location of the Belsk, Hel, and Hornsund observatories.

Table 1

Coordinates of the Polish observatories

Observatory	Geographic coordinates		Geomagnetic coordinates		Elevation [m]
	Latitude	Longitude	Latitude	Longitude	
Belsk (BEL)	51° 50.2′ N	20° 47.3′ E	49.3° N	104.8° E	180
Hel (HLP)	54° 36.5′ N	18° 49.0′ E	52.7° N	104.3° E	1
Hornsund (HRN)	77° 00.0′ N	15° 33.0′ E	74.1° N	124.7° E	15

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.

Fig. 2. Belsk Observatory – Absolute House.

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 (Fig. 2). The Observatory is surrounded by typically agricultural regions (with fertile soil, mostly apple orchards), so the direct neighborhood is deprived of sources of major artificial geomagnetic field disturbances. It is only the electric railroad (DC powered) situated some 14 km away of the Observatory to the north that produces some small artificial magnetic disturbances, whose average level usually does not exceed 1 nT.

More information about the region in which the Observatory is located can be found on the internet pages of Grójec district (https://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.

Fig. 3. Hel Observatory – the main gate.

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 (Fig. 3).

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 Polish Polar Station Hornsund, Spitsbergen

The Polish Polar Station Hornsund (PSP Hornsund) is situated on the White Bear Bay (Isbjørnhamna) in Hornsund Fiord, Spitsbergen Island, Svalbard archipelago (Fig. 4). 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 1932-1933, they had carried out continuous recording of magnetic field and performed absolute measurements. Unfortunately, all data were destroyed during the war. In the years 1957-1958, 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.

Fig. 4. The Absolute House in Polish Polar Station Hornsund, Spitsbergen.

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. 5, 8, and 11 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 2016 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/°C,

– the magnetic sensors are located in thermostat-controlled wooden boxes where the daily temperature variations are of the order of 0.3°C.

Table 4

Mean errors of measurements of B_X, B_Y, B_Z, and B_F in 2016

Observatory	Element	Number of measurements n	Mean error m_B [nT]
Belsk	B_X	292	0.23
	B_Y	287	0.29
	B_Z	294	0.14
Hel	B_X	144	0.38
	B_Y	143	0.32
	B_Z	145	0.23
Hornsund	B_X	217	1.27
	B_Y	211	1.20
	B_Z	221	0.36

3.2 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	+/– 5000 nT	+/– 5000 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	+/– 5000 nT	+/– 5000 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. The calibration of proton magnetometers is performed according to the method described by Reda and Neska (2007).

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.

3.3 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.

3.4 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 IMFV1.23 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* (Figs. 6, 9, and 12), bases of recording sets as well as plots of *K* indices for 2016 (Figs. 7, 10, and 13) were prepared with the INTERMAGNET software imcdview.jar.

As in previous years, we include the *E* indices calculated for Belsk observatory in the present yearbook (Tables 12-15). 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).

Annual mean values for Belsk, Hel, and Hornsund are listed in Tables 6, 16, and 22, respectively. Monthly mean values of 2016 for Belsk, Hel, and Hornsund are listed in Tables 7, 17, and 23, respectively.

Three-hour-range *K* indices for Belsk are listed in Tables 8-11, for Hel in Tables 18-21, and for Hornsund in Tables 24-27.

3.5 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 Observatory

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

5. PERSONNEL TAKING PART IN THE WORK OF BELSK, HEL, AND HORNSUND OBSERVATORIES IN 2016

5.1 Belsk Observatory

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 Observatory

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

5.3 Hornsund Observatory

Mariusz Neska (head of geomagnetic observations)
Tymoteusz Salamon (observer in 1-st half-year)
Lukasz Mazurkiewicz (observer in 2-nd half-year)
Jan Reda (data processing)
Paweł Czubak (data processing)

6. TABLES AND PLOTS FOR BELSK OBSERVATORY

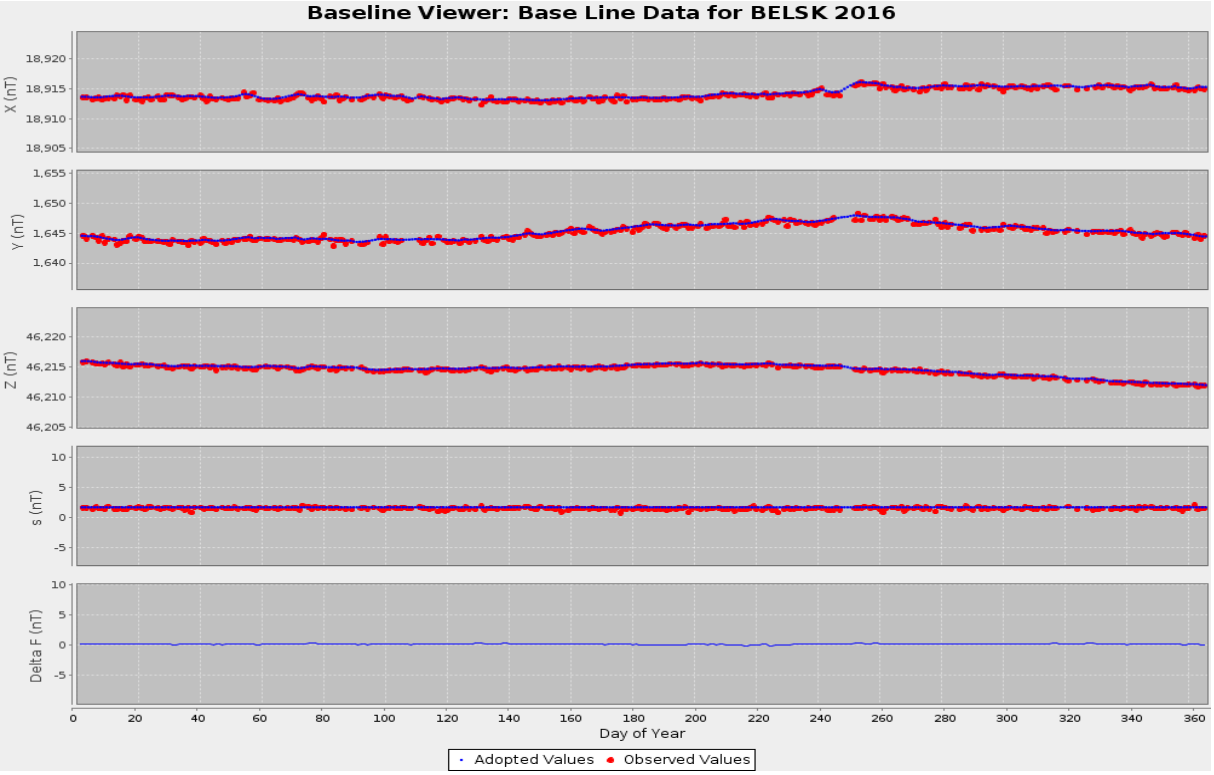

Fig. 5. Base values of set 1, Belsk 2016.

Table 6

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

to be continued

Table 6 (continuation)

Annual mean values of magnetic elements in Belsk Observatory

No.	Year	*D* [° ‘]	*H* [nT]	*Z* [nT]	*X* [nT]	*Y* [nT]	*I* [° ‘]	*F* [nT]
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
50	2015	5 48.8	19019	46495	18922	1926	67 45.1	50235
51	2016	5 57.2	19027	46538	18924	1974	67 45.8	50277

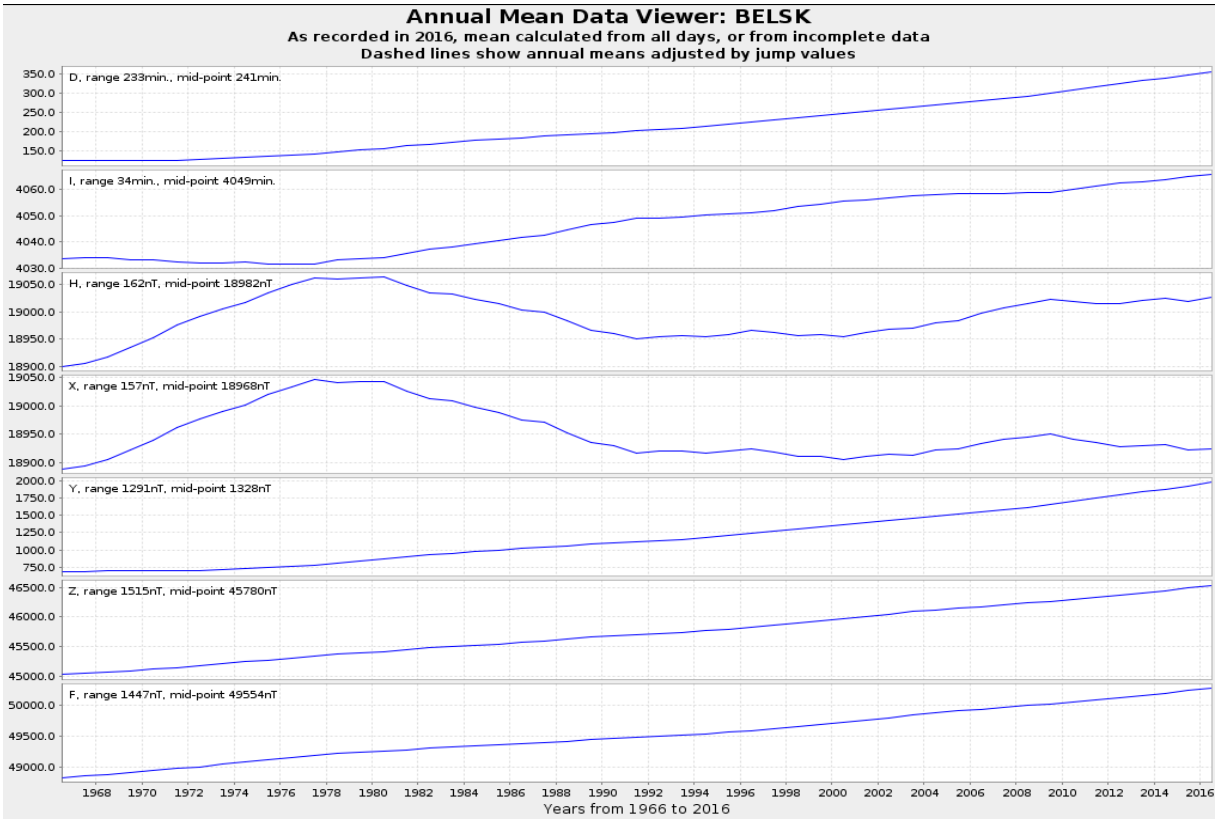

Fig. 6. Secular changes of *H*, *X*, *Y*, *Z*, *F*, *D* and *I* at Belsk.

Table 7

Monthly and yearly mean values of magnetic elements
BEL 2016

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
North component: 18500 + ... in nT													
All days	421	425	425	429	426	432	430	424	419	413	420	422	424
Quiet days	428	432	433	435	430	434	429	429	429	424	428	430	430
Disturbed days	405	410	413	419	418	430	427	416	405	392	410	412	413
East component: 1500 + ... in nT													
All days	451	455	458	462	466	470	475	479	485	490	493	496	474
Quiet days	450	452	455	461	466	469	476	478	483	486	490	494	472
Disturbed days	454	463	463	463	469	470	475	480	490	500	499	500	477
Vertical component: 46000 + ... in nT													
All days	521	520	523	524	529	532	536	543	548	556	560	562	538
Quiet days	519	520	519	523	529	531	537	541	546	553	557	559	536
Disturbed days	525	524	524	528	528	529	538	545	550	563	562	564	540

Table 8

Three-hour-range *K* indices
Belsk, January-March 2016
The limit of *K* = 9 is 450

Day	January		February		March	
	K	*SK*	*K*	*SK*	*K*	*SK*
1	5553 2122	25	3322 0000	10	3212 2223	17
2	3232 2222	18	0011 1233	11	2112 2311	13
3	1121 1324	15	3321 1111	13	2222 2112	14
4	1111 0221	9	0112 3221	12	3201 0100	7
5	0112 1232	12	3322 2242	20	0112 2011	8
6	4223 2334	23	1212 1323	15	0123 3556	25
7	3223 3341	21	2112 2422	16	4432 3445	29
8	1212 3122	14	5432 1111	18	3222 2241	18
9	1011 2211	9	2123 2123	16	1221 2222	14
10	2112 2233	16	3101 0122	10	3221 1123	15
11	2222 2354	22	2111 1334	16	1224 5344	25
12	4123 2243	21	2223 2223	18	3222 1442	20
13	4322 2231	19	2222 1111	12	0211 0101	6
14	1222 2223	16	2122 2421	16	2111 1345	18
15	2211 1222	13	2222 1125	17	4333 1264	26
16	0102 2011	7	4234 5664	34	5223 3235	25
17	0011 1111	6	5333 4355	31	4433 2433	26
18	0001 1203	7	4434 3463	31	1222 2233	17
19	4223 2211	17	3223 3452	24	2323 3432	22
20	1124 4554	26	3112 2111	12	1312 1442	18
21	4553 3555	35	1110 1133	11	2222 2222	16
22	3333 2233	22	0001 1211	6	2212 2012	12
23	2332 3322	20	2101 1124	12	2332 2223	19
24	3222 2251	19	2111 2122	12	2122 2212	14
25	0010 0000	1	3121 1112	12	2112 1211	11
26	0011 1122	8	4221 2121	15	0011 1112	7
27	1211 1100	7	0111 1111	7	3233 2433	23
28	0022 1111	8	1011 1011	6	2311 2133	16
29	0100 1101	4	2001 2102	8	3323 2322	20
30	0000 0101	2			3222 3332	20
31	2121 2335	19			3211 1111	11

Table 9

Three-hour-range *K* indices
Belsk, April-June 2016
The limit of $K = 9$ is 450

Day	April		May		June	
	K	*SK*	*K*	*SK*	*K*	*SK*
1	2000 1121	7	2223 3444	24	1111 2221	11
2	2001 3555	21	5522 3344	28	0101 1101	5
3	3222 1234	19	3222 2333	20	2000 0002	4
4	2212 2112	13	1101 1201	7	1101 1122	9
5	1011 2232	12	0112 2313	13	1224 6554	29
6	2112 2311	13	3223 3343	23	4434 4242	27
7	2022 1356	21	4222 2313	19	2113 3332	18
8	5211 1111	13	4554 5546	38	2212 3311	15
9	0001 0201	4	6233 4344	29	2111 1110	8
10	1121 2213	13	3333 3232	22	0101 2233	12
11	0001 2322	10	2211 1212	12	3222 3334	22
12	2223 3345	24	1211 1012	9	1222 3342	19
13	5334 4343	29	2122 3232	17	3322 2221	17
14	3224 3644	28	3223 3233	21	2322 2364	24
15	4201 2222	15	3322 4441	23	4134 3321	21
16	0122 2434	18	2333 4332	23	2213 3222	17
17	4332 3343	25	2233 3333	22	2222 3331	18
18	2122 1121	12	2223 3211	16	1223 3222	17
19	0100 1100	3	2122 3321	16	2221 2210	12
20	0112 1121	9	3311 1112	13	1221 2121	12
21	0112 1221	10	3343 3432	25	1111 2111	9
22	2112 4434	21	2223 3210	15	1112 3343	18
23	1212 3235	19	1212 1021	10	1311 1434	18
24	2222 3441	20	2123 2111	13	4332 3323	23
25	1122 2210	11	0111 1110	6	2221 2233	17
26	1112 2233	15	0111 1222	10	1212 2333	17
27	1222 3332	18	2212 3343	20	3231 1222	16
28	2111 2111	10	3233 2423	22	2222 3221	16
29	1101 1121	8	2112 2223	15	2111 2221	12
30	0122 2233	15	3223 2322	19	1111 1343	15
31			2222 2333	19		

Table 10

Three-hour-range *K* indices
Belsk, July-September 2016
The limit of *K* = 9 is 450

Day	July		August		September	
	K	*SK*	*K*	*SK*	*K*	*SK*
1	3223 2111	15	1100 0112	6	4333 4355	30
2	1211 2234	16	2213 4445	25	5433 5435	32
3	3222 2323	19	5444 4533	32	4534 4445	33
4	1222 1132	14	4323 3442	25	4233 3453	27
5	1111 1111	8	1344 3324	24	2332 2453	24
6	0111 1223	11	2233 3323	21	2233 3342	22
7	3323 4554	29	5222 3323	22	3322 3322	20
8	4223 4442	25	3222 3431	20	3333 2232	21
9	3333 3432	24	1323 4423	22	2111 1212	11
10	2223 4232	20	4323 3343	25	1111 0013	8
11	2213 3333	20	2112 2333	17	1001 1121	7
12	3433 3223	23	4333 2321	21	2111 2112	11
13	3222 2222	17	2111 2231	13	2111 1112	10
14	2334 2322	21	2111 2120	10	2122 3243	19
15	3333 2322	21	1111 1112	9	3111 1112	11
16	3321 3231	18	0001 2113	8	0101 1221	8
17	1111 2222	12	3311 2123	16	1002 1002	6
18	1111 1102	8	2311 2212	14	2123 2222	16
19	1101 1105	10	0111 1221	9	1122 3323	17
20	5532 3331	25	2111 1101	8	4434 2333	26
21	1023 2312	14	0121 3423	16	4223 1122	17
22	1123 3432	19	2111 1121	10	2111 1000	6
23	2231 2122	15	2203 4354	23	1111 1111	8
24	1112 2454	20	5323 3234	25	0011 2123	10
25	4323 3433	25	2122 3333	19	3413 3455	28
26	1211 1222	12	3211 1222	14	3323 3345	26
27	0101 1113	8	2213 1110	11	5444 5644	36
28	3332 3443	25	0111 0111	6	4434 4565	35
29	3333 3332	23	2012 2334	17	3344 4553	31
30	3211 1111	11	3222 3455	26	3334 3463	29
31	2001 2210	8	2111 1133	13		

Table 11

Three-hour-range *K* indices
Belsk, October-December 2016
The limit of $K = 9$ is 450

Day	October		November		December	
	K	*SK*	*K*	*SK*	*K*	*SK*
1	3323 2454	26	2123 3224	19	1110 0000	3
2	3222 4353	24	5212 3325	23	0111 122	9
3	2331 2353	22	3233 3334	24	0000 0120	3
4	3423 4254	27	3111 0121	10	0100 0001	2
5	3332 2323	21	1111 0010	5	3100 1211	9
6	2110 1232	12	1111 2122	11	1112 3233	16
7	3101 1231	12	2121 1210	10	0122 2343	17
8	2322 1122	15	0011 1012	6	3333 3554	29
9	2111 3132	14	0021 2233	13	3223 3455	27
10	3321 1341	18	1222 3543	22	4323 3443	26
11	0112 1011	7	4122 2323	19	3323 3442	24
12	1111 1233	13	3233 3444	26	2111 1112	10
13	2244 4665	33	3333 3453	27	1111 1112	9
14	6433 2311	23	1222 3433	20	1112 1121	10
15	3322 2323	20	3222 3221	17	0001 1010	3
16	3123 3364	25	1111 0132	10	1000 0012	4
17	3333 2444	26	1111 0111	7	0011 2234	13
18	3232 2223	19	2010 0211	7	3211 2222	15
19	3212 1221	14	0000 0121	4	1121 1131	11
20	2010 1021	7	0011 1112	7	1111 1214	12
21	0000 0001	1	0111 1223	11	2212 4654	26
22	1011 1233	12	1122 2445	21	4433 4353	29
23	0222 1334	17	4331 1242	20	2323 3553	26
24	4322 4324	24	4232 5354	28	3222 4432	22
25	4433 7766	40	4443 5552	32	3314 4553	28
26	3435 5655	36	2222 2432	19	4223 4534	27
27	4333 3544	29	2222 2133	17	4222 3133	20
28	2232 3434	23	2111 2433	17	2201 1212	11
29	5433 3333	27	2101 1233	13	2111 2311	12
30	3332 4442	25	1111 0111	7	0110 1112	7
31	2323 2331	19			1122 3433	19

Table 12

Three-hour-range *E* indices
based on power spectrum estimation (*)
Belsk, January-March 2016

Day	January		February		March	
	E	*SE*	*E*	*SE*	*E*	*SE*
1	5554 2231	27	3312 0000	9	4212 1213	16
2	3232 3221	18	0011 1334	13	2112 2410	13
3	0121 1324	14	4421 1110	14	2222 2102	13
4	0111 0221	8	0011 3221	10	3101 0100	6
5	0001 1141	8	3222 2253	21	0012 3000	6
6	5223 2434	25	1212 1224	15	0022 2566	23
7	3224 3441	23	2012 1533	17	5432 3556	33
8	1212 4122	15	6442 1111	20	3212 3241	18
9	1011 2211	9	2013 2224	16	1211 2232	14
10	3103 2133	16	3111 0022	10	3221 1134	17
11	1222 2355	22	2122 1325	18	1224 5254	25
12	5123 2244	23	3114 3222	18	3222 1441	19
13	5422 2341	23	1232 1101	11	0111 0001	4
14	1122 2234	17	1122 2421	15	2011 1355	18
15	2211 1121	11	3232 1015	17	5343 1364	29
16	0101 1000	3	5235 5675	38	5233 3145	26
17	0011 1110	5	5343 4466	35	5434 2543	30
18	0000 1203	6	4434 3564	33	1122 2334	18
19	5223 1101	15	3224 3552	26	2333 4522	24
20	0134 4555	27	3111 1111	10	1312 1352	18
21	5444 3655	36	1110 0123	9	2122 2223	16
22	4433 2243	25	0001 1100	3	2113 1002	10
23	2332 3422	21	3101 1125	14	1342 2123	18
24	3221 2360	19	3111 2131	13	2112 2212	13
25	0000 0000	0	3111 0012	9	3112 1210	11
26	0011 1121	7	4211 1120	12	0000 0111	3
27	1111 0000	4	0111 0111	6	3233 2533	24
28	0012 1111	7	1011 1011	6	2311 1142	15
29	0000 0001	1	2001 1002	6	3233 2422	21
30	0000 0100	1			4122 4342	22
31	1121 2335	18			3211 0211	11

*) see Reda and Jankowski (2004)

Table 13

Three-hour-range *E* indices
based on power spectrum estimation (*)
Belsk, April-June 2016

Day	April		May		June	
	E	*SE*	*E*	*SE*	*E*	*SE*
1	2000 0021	5	2223 4454	26	1111 2221	11
2	2000 3555	20	5522 3455	31	0101 1000	3
3	4233 0225	21	4222 1323	19	2000 0002	4
4	2312 2112	14	1001 0201	5	0001 0122	6
5	1001 2243	13	0113 3313	15	1224 5565	30
6	2112 3311	14	3222 4454	26	4535 3242	28
7	3012 1356	21	4122 2314	19	2113 3343	20
8	6211 0010	11	5655 5556	42	2302 3200	12
9	0000 0200	2	7334 4355	34	2101 1110	7
10	1121 2103	11	3433 3233	24	0101 2243	13
11	0001 2422	11	2111 0213	11	3222 3335	23
12	2212 4456	26	1101 1012	7	1222 4343	21
13	6334 5453	33	1022 3232	15	3322 2121	16
14	3224 3644	28	3223 3134	21	2222 2364	23
15	5101 1222	14	4322 4451	25	4224 4311	21
16	0022 2544	19	2333 4321	21	1213 3222	16
17	4432 2453	27	2234 4343	25	2222 3331	18
18	2111 1011	8	2223 3211	16	1223 3232	18
19	0000 1000	1	1122 4321	16	2211 2210	11
20	0112 1011	7	3211 1002	10	1111 2111	9
21	0112 1221	10	2343 4431	24	0001 1110	4
22	2112 4425	21	2223 3210	15	0112 3353	18
23	1212 3236	20	0112 0020	6	2311 1424	18
24	1111 2441	15	2213 2011	12	4432 3323	24
25	1122 2110	10	0101 1100	4	3211 1134	16
26	0012 2233	13	0000 0212	5	1212 2444	20
27	1222 3332	18	2311 3344	21	4331 1122	17
28	2111 1011	8	3243 3433	25	2212 3220	14
29	1100 1011	5	2112 2234	17	2111 1220	10
30	0112 1223	12	4232 2312	19	0101 1343	13
31			2131 2344	20		

*) see Reda and Jankowski (2004)

Table 14

Three-hour-range *E* indices
based on power spectrum estimation (*)
Belsk, July-September 2016

Day	July		August		September	
	E	*SE*	*E*	*SE*	*E*	*SE*
1	3223 2100	13	2000 0111	5	5333 4366	33
2	0101 1234	12	2213 3435	23	6543 5535	36
3	3222 1224	18	6454 4633	35	4534 5555	36
4	2222 1131	14	4433 4542	29	5343 4564	34
5	0101 1001	4	1443 4325	26	3332 2454	26
6	0111 1124	11	3234 3323	23	2333 3352	24
7	4323 4554	30	5112 3313	19	3312 3421	19
8	4224 4451	26	4221 3530	20	3322 2342	21
9	4333 4422	25	1324 5424	25	2000 1212	8
10	2213 3232	18	5323 3443	27	1111 0014	9
11	2313 3333	21	2112 1334	17	0000 2121	6
12	4544 3234	29	5323 2321	21	2111 2002	9
13	3222 2223	18	2101 1231	11	2111 0102	8
14	2344 2332	23	2111 2010	8	2122 3253	20
15	3333 2323	22	1010 0102	5	3111 0112	10
16	4211 4131	17	0000 2214	9	0001 1121	6
17	1110 2212	10	3311 1024	15	1002 0002	5
18	0111 1101	6	2411 2112	14	2123 2222	16
19	1000 1103	6	0011 2211	8	1022 3323	16
20	6542 3321	26	3111 1001	8	5434 2432	27
21	1012 2312	12	0012 3424	16	5123 1011	14
22	1113 4442	20	2011 1132	11	2111 1000	6
23	2231 1112	13	2204 4455	26	0111 1101	6
24	1012 2555	21	6213 3225	24	0001 1124	9
25	4433 4423	27	2133 3434	23	4514 3465	32
26	1101 1222	10	3201 1233	15	3333 4445	29
27	0100 0103	5	1113 0110	8	5445 4644	36
28	3332 3453	26	0001 0010	2	5434 5675	39
29	3434 2432	25	1002 2234	14	3444 5663	35
30	3211 1111	11	3122 2555	25	4334 3463	30
31	2101 1110	7	2111 1133	13		

*) see Reda and Jankowski (2004)

Table 15

Three-hour-range *E* indices
based on power spectrum estimation (*)
Belsk, October-December 2016

Day	October		November		December	
	E	*SE*	*E*	*SE*	*E*	*SE*
1	3422 2554	27	2113 3324	19	0000 0000	0
2	4222 5464	29	5113 4426	26	0001 1231	8
3	1331 3454	24	3223 4335	25	0000 0030	3
4	3424 4355	30	3100 0010	5	0100 0001	2
5	3432 2433	24	1000 0000	1	3100 1211	9
6	2110 0232	11	1011 1122	9	1013 4134	17
7	3101 0231	11	2111 1100	7	0121 2453	18
8	3322 1122	16	0011 1002	5	4433 4565	34
9	2111 3132	14	0021 2243	14	4224 3466	31
10	4221 1450	19	1222 3644	24	4323 3442	25
11	0011 0001	3	4112 1324	18	3413 3452	25
12	1001 0124	9	3324 4544	29	2111 0102	8
13	2244 4666	34	4324 3564	31	1101 1113	9
14	6443 2311	24	1123 4434	22	1111 0021	7
15	3223 2424	22	3222 3211	16	0000 0010	1
16	3123 3464	26	0110 0042	8	1000 0002	3
17	3334 2555	30	1100 0120	5	0001 1234	11
18	3232 2214	19	2000 0200	4	4211 2232	17
19	3111 0220	10	0000 0021	3	1211 1131	11
20	1010 0020	4	0000 1112	5	1111 1215	13
21	0000 0000	0	0101 1123	9	3113 4754	28
22	1011 1233	12	1112 3536	22	5433 4464	33
23	0222 1344	18	5321 1252	21	3334 4554	31
24	4322 5425	27	5233 6465	34	3232 5532	25
25	4534 7856	42	5553 5563	37	4314 5543	29
26	3436 5655	37	3222 2433	21	4233 4534	28
27	5433 3654	33	2222 3144	20	4222 3144	22
28	2233 4445	27	2111 2533	18	2101 0312	10
29	5534 4443	32	1000 1134	10	2101 2310	10
30	4332 5452	28	1011 0110	5	0100 1012	5
31	3322 2332	20			0112 4543	20

*) see Reda and Jankowski (2004)

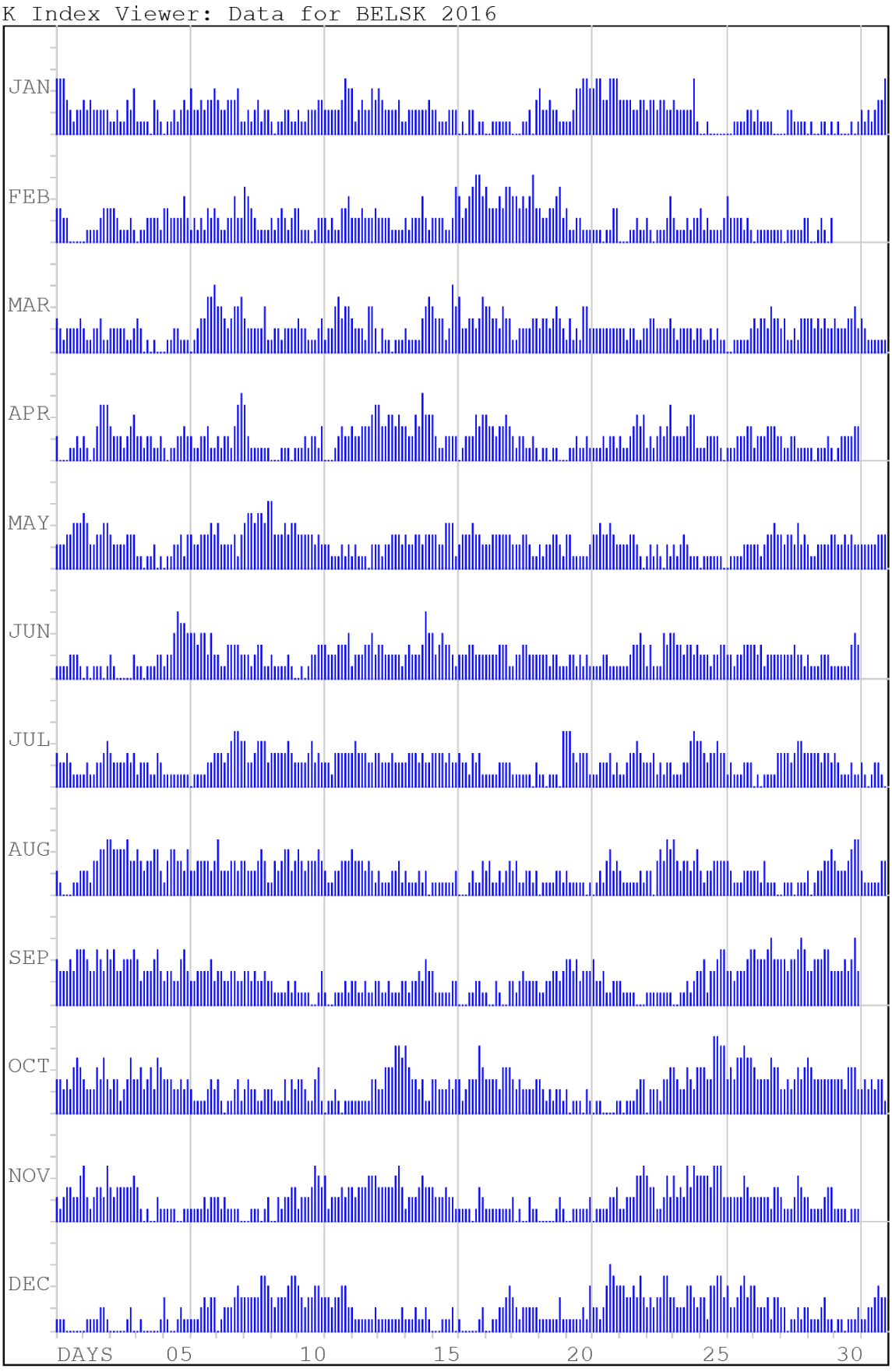

Fig. 7. *K*-indices in graphical form, Belsk 2016.

7. TABLES AND PLOTS FOR HEL OBSERVATORY

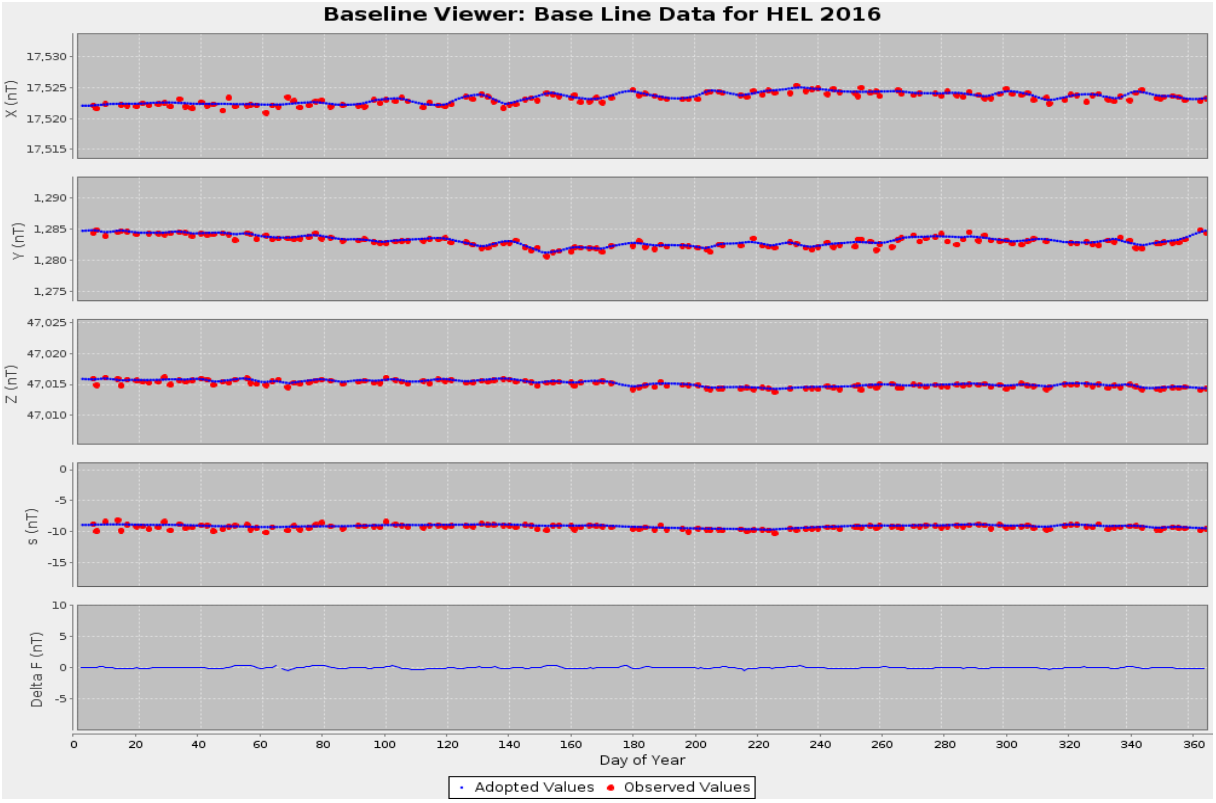

Fig. 8. Base values of set 1, Hel 2016.

Table 16

Annual mean values of magnetic elements in Hel Observatory

No.	Year	*D* [° ‘]	*H* [nT]	*Z* [nT]	*X* [nT]	*Y* [nT]	*I* [° ‘]	*F* [nT]
1	1953	-0 14.5	17388	45327	17388	-73	69 00.8	48548
2	1954	-0 10.0	17394	45374	17394	-51	69 01.5	48594
3	1955	-0 04.2	17379	45430	17379	-21	69 03.9	48640
4	1956	0 03.9	17371	45450	17371	20	69 05.0	48656
5	1957	0 05.7	17372	45475	17372	29	69 05.5	48680
6	1958	0 10.2	17380	45535	17380	52	69 06.5	48739
7	1959	0 14.7	17390	45565	17390	74	69 06.6	48771
8	1960	0 17.6	17402	45602	17402	89	69 06.8	48810
9	1961	0 19.8	17422	45625	17422	100	69 06.0	48838
10	1962	0 22.7	17438	45647	17438	115	69 05.5	48864
11	1963	0 26.5	17449	45663	17448	134	69 05.2	48883
12	1964	0 28.6	17464	45676	17463	145	69 04.6	48901
13	1965	0 30.0	17476	45692	17475	152	69 04.2	48920
14	1966	0 31.6	17485	45710	17484	161	69 04.0	48940
15	1967	0 33.3	17492	45743	17491	169	69 04.4	48973

to be continued

Table 16 (continuation)

Annual mean values of magnetic elements in Hel Observatory (continuation)

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

to be continued

Table 16 (continuation)

Annual mean values of magnetic elements in Hel Observatory (continuation)

No.	Year	*D* [° ‘]	*H* [nT]	*Z* [nT]	*X* [nT]	*Y* [nT]	*I* [° ‘]	*F* [nT]
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
63	2015	4 45.5	17565	47163	17504	1457	69 34.4	50328
64	2016	4 54.7	17569	47203	17504	1504	69 35.1	50367

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

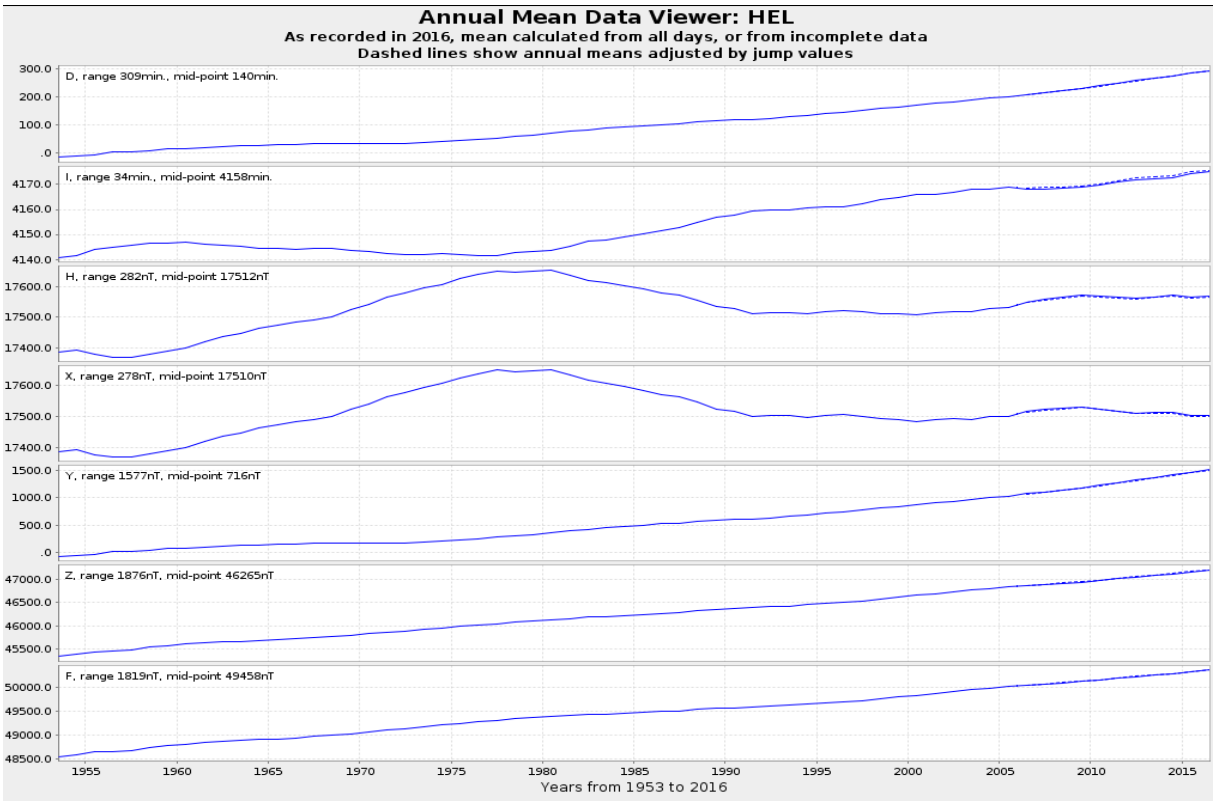

Fig. 9. Secular changes of *H*, *X*, *Y*, *Z*, *F*, *D* and *I* at Hel.

Table 17

Monthly and yearly mean values of magnetic elements
HLP 2016

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
North component: 17000 + ... in nT													
All days	502	505	506	509	507	513	510	506	499	494	500	501	504
Quiet days	508	512	513	514	510	514	519	504	498	501	506	504	508
Disturbed days	488	491	494	500	499	511	519	504	497	486	495	502	499
East component: 1000 + ... in nT													
All days	483	487	490	493	497	500	505	510	516	521	523	527	504
Quiet days	482	484	486	492	496	498	502	511	518	519	521	525	503
Disturbed days	486	496	495	494	500	500	502	511	518	525	527	528	507
Vertical component: 47000 + ... in nT													
All days	188	187	189	191	195	197	201	207	212	221	225	226	203
Quiet days	187	187	186	189	195	196	196	208	210	218	222	225	202
Disturbed days	193	190	189	194	191	194	196	208	213	223	225	227	204

Table 18

Three-hour-range *K* indices
Hel, January-March 2016
The limit of $K = 9$ is 550

Day	January		February		March	
	K	*SK*	*K*	*SK*	*K*	*SK*
1	5553 2122	25	3312 0000	9	3212 2213	16
2	3232 2222	18	0001 2223	10	2112 2311	13
3	1111 1224	13	3321 1110	12	2222 2102	13
4	1111 0221	9	0013 3221	12	3201 0100	7
5	0111 1232	11	2222 2242	18	0011 2110	6
6	4223 3334	24	1212 1223	14	0123 3555	24
7	3223 3331	20	2012 1422	14	4432 3445	29
8	1212 3121	13	5432 1110	17	3222 2231	17
9	1011 1111	7	2113 2123	15	1111 2222	12
10	2012 2233	15	2100 0122	8	3111 1123	13
11	2221 2354	21	2111 2234	16	1223 5344	24
12	3122 1233	17	2123 2223	17	3222 2441	20
13	4312 2231	18	2222 1111	12	0111 1001	5
14	1222 2223	16	1112 2421	14	2011 1344	16
15	2211 0121	10	2222 1114	15	4333 1364	27
16	0002 1011	5	4234 5564	33	5223 3134	23
17	0011 1110	5	4333 4345	29	4333 2433	25
18	0000 0203	5	4333 3453	28	1121 2233	15
19	4223 1211	16	3223 3452	24	2222 3432	20
20	0123 4554	24	3111 2111	11	1312 1342	17
21	4543 2544	31	1110 0132	9	2222 2222	16
22	3332 2242	21	0001 1111	5	2112 2012	11
23	2332 3312	19	2101 1123	11	2232 2223	18
24	3221 2251	18	2111 2021	10	2112 2212	13
25	0000 0000	0	2121 1012	10	2112 1210	10
26	0012 1121	8	3222 2120	14	0011 0111	5
27	1112 1000	6	0111 0111	6	3233 3432	23
28	0022 1111	8	1012 1012	8	2311 2132	15
29	0100 0101	3	2001 1002	6	3223 2312	18
30	0000 0101	2			3222 3242	20
31	2111 2334	17			3111 1212	12

Table 19

Three-hour-range *K* indices
Hel, April-June 2016
The limit of *K* = 9 is 550

Day	April		May		June	
	K	*SK*	*K*	*SK*	*K*	*SK*
1	2000 1021	6	2213 3444	23	1111 2221	11
2	2001 3545	20	5422 3354	28	1101 1101	6
3	3222 1234	19	3222 2323	19	1000 0001	2
4	2212 2112	13	1101 1201	7	0001 1122	7
5	0002 2132	10	0122 2312	13	1224 6554	29
6	2122 2211	13	2223 3343	22	4434 3342	27
7	2012 1255	18	4123 2313	19	2113 3332	18
8	4201 1111	11	4554 5545	37	2212 3310	14
9	0011 0101	4	6223 4344	28	1101 2210	8
10	1121 2113	12	2323 4232	21	0111 2232	12
11	0001 2312	9	2112 1212	12	3222 3324	21
12	2213 4344	23	1101 1012	7	1222 3332	18
13	5334 4342	28	1012 3232	14	2322 2221	16
14	3224 3533	25	2123 3233	19	2322 3354	24
15	4201 2222	15	3223 4441	23	3234 3321	21
16	0012 2434	16	2223 4321	19	2223 3222	18
17	3332 3343	24	2223 3333	21	1222 3331	17
18	2122 1111	11	1223 3211	15	1223 3221	16
19	0101 1100	4	2122 3321	16	1221 2210	11
20	0111 1111	7	2312 1112	13	1221 2111	11
21	0112 1221	10	2343 4322	23	1101 2110	7
22	2112 3424	19	2223 3210	15	1112 3343	18
23	1212 3234	18	0112 1020	7	1312 1424	18
24	2222 3441	20	2123 2011	12	4322 3322	21
25	1122 3210	12	0102 1100	5	2121 2223	15
26	1112 2122	12	0010 1211	6	1212 2334	18
27	1222 3332	18	2213 3333	20	3221 2122	15
28	1111 2111	9	3233 2422	21	2212 3220	14
29	1101 1011	6	2112 2223	15	1111 2221	11
30	0122 2233	15	3223 2322	19	0101 1333	12
31			2222 2333	19		

Table 20

Three-hour-range *K* indices
Hel, July-September 2016
The limit of $K = 9$ is 550

Day	July		August		September	
	K	*SK*	*K*	*SK*	*K*	*SK*
1	3222 2200	13	1000 1112	6	4333 4355	30
2	1101 2234	14	2223 4445	26	5434 4435	32
3	3222 2223	18	5444 4532	31	4434 4455	33
4	1222 1132	14	3323 3432	23	4233 3453	27
5	1111 1111	8	1334 4323	23	2332 2343	22
6	0112 2223	13	2223 3323	20	2233 3342	22
7	3323 4544	28	4222 4423	23	2222 3322	18
8	4233 4442	26	3222 3430	19	3232 2232	19
9	3333 3422	23	1323 4323	21	2110 1112	9
10	2223 4232	20	4223 3443	25	1112 0013	9
11	2223 3323	20	2112 2333	17	1001 1121	7
12	3433 3223	23	4223 2221	18	2112 3112	13
13	3222 3222	18	1111 2231	12	2111 1112	10
14	2333 2322	20	1111 3110	9	1123 3243	19
15	3333 3322	22	1011 0202	7	3212 1112	13
16	3222 3221	17	0001 2213	9	0001 1221	7
17	1111 2222	12	2212 2123	15	1002 1002	6
18	1111 1102	8	2312 2212	15	2112 2212	13
19	1101 1115	11	0011 2211	8	1023 3323	17
20	5532 3331	25	2111 1001	7	4434 2333	26
21	1023 2312	14	0012 4423	16	3222 2012	14
22	1123 3432	19	2111 1121	10	2111 2000	7
23	2232 2112	15	2103 4354	22	0121 2111	9
24	1012 2444	18	5323 3224	24	0011 2123	10
25	4323 3333	24	2122 3433	20	3414 3355	28
26	1211 1222	12	3111 2222	14	3223 3345	25
27	0101 1113	8	1112 1110	8	5434 5544	34
28	3322 3343	23	0011 1010	4	4433 4565	34
29	3333 3322	22	1023 2333	17	3344 4553	31
30	3222 1211	14	3122 4545	26	3333 3462	27
31	2101 2210	9	2111 1133	13		

Table 21

Three-hour-range *K* indices
Hel, October-December 2016
The limit of *K* = 9 is 550

Day	October		November		December	
	K	*SK*	*K*	*SK*	*K*	*SK*
1	3323 2444	25	2112 3213	15	0010 0000	1
2	3222 3353	23	5212 3325	23	0111 1221	9
3	2231 2353	21	3233 3334	24	0000 0020	2
4	3423 4244	26	2111 0011	7	0000 0001	1
5	3332 2322	20	1011 0010	4	2000 1211	7
6	2211 1231	13	1011 2122	10	1112 3223	15
7	2101 1231	11	2111 1100	7	0121 2343	16
8	2222 1122	14	0001 1002	4	3332 3554	28
9	2111 3132	14	0022 2233	14	3223 3455	27
10	3212 1341	17	1112 3543	20	4323 3333	24
11	0012 1001	5	4122 1223	17	3322 2342	21
12	1112 1233	14	3224 3443	25	2111 1112	10
13	2244 4665	33	3333 3453	27	1111 1112	9
14	5432 2211	20	1222 3433	20	1012 1021	8
15	3222 2323	19	3221 3111	14	0001 0110	3
16	3123 3364	25	1111 0132	10	1000 0002	3
17	3233 2444	25	1101 0111	6	0001 1224	10
18	2232 1223	17	1000 0211	5	3212 2221	15
19	3112 1121	12	0000 0021	3	1110 1131	9
20	1010 1021	6	0011 1112	7	1111 1214	12
21	0000 0000	0	0111 1123	10	2212 4654	26
22	1011 1232	11	1012 2435	18	4432 3353	27
23	0221 1333	15	4321 1242	19	2323 3454	26
24	4222 3324	22	4222 5354	27	3222 3432	21
25	4433 7756	39	4443 4552	31	3313 4443	25
26	3335 4545	32	2222 2432	19	4223 4433	25
27	4333 3544	29	2222 2133	17	4222 3133	20
28	2232 3434	23	2111 2432	16	2101 1212	10
29	4433 4332	26	2111 1123	12	2101 2210	9
30	3332 4442	25	1111 0100	5	0100 1011	4
31	2223 2331	18			0112 3433	17

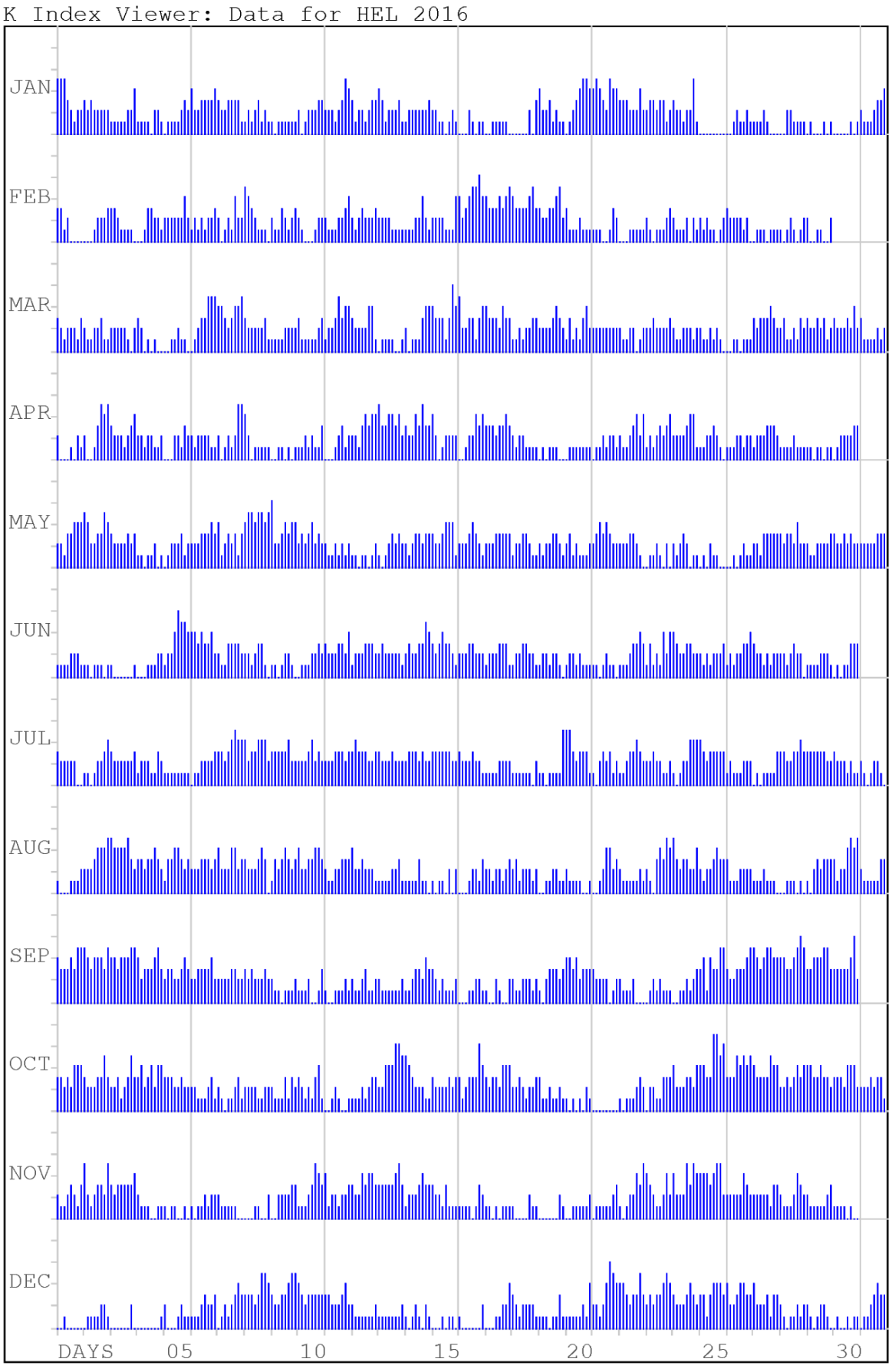

Fig. 10. K-indices in graphical form, Hel 2016.

8. TABLES AND PLOTS FOR HORNSUND OBSERVATORY

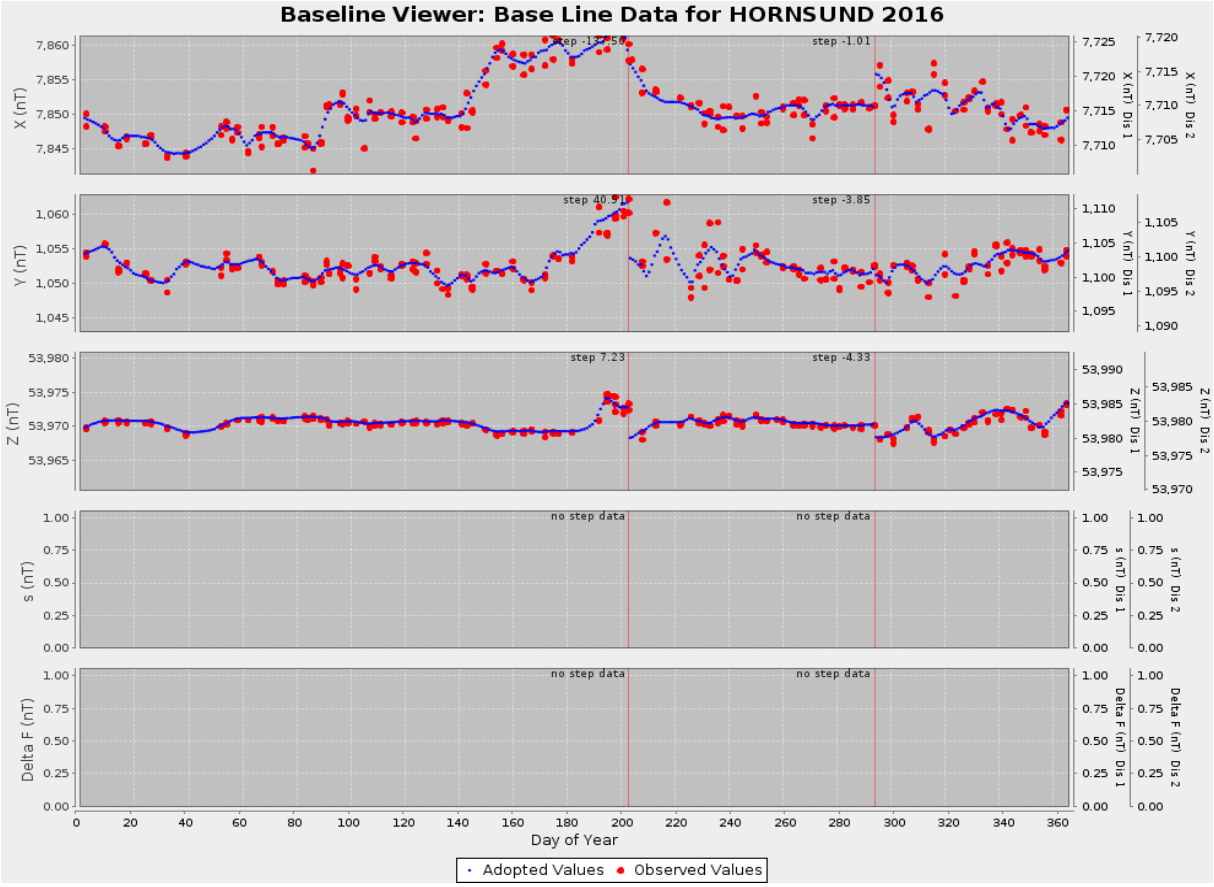

Fig. 11. Base values, Hornsund 2016.

Table 22

Annual mean values of magnetic elements in Hornsund Observatory

No.	Year	*D* [° ‘]	*H* [nT]	*Z* [nT]	*X* [nT]	*Y* [nT]	*I* [° ‘]	*F* [nT]
1	1979	-0 32.2	8384	53447	8384	-79	81 05.1	54101
2	1980	-0 14.2	8370	53447	8370	-35	81 06.0	54098
3	1981	-0 09.3	8351	53449	8351	-23	81 07.2	54097
4	1982	-0 09.4	8319	53481	8319	-23	81 09.5	54124
5	1983	-0 02.0	8295	53457	8295	-5	81 10.8	54097
6	1984	0 07.7	8266	53439	8266	19	81 12.4	54075
7	1985	0 14.3	8238	53405	8238	34	81 13.9	54037
8	1986	0 20.4	8213	53392	8213	49	81 15.3	54020
9	1987	0 25.6	8193	53360	8193	61	81 16.3	53985
10	1988	0 34.7	8168	53368	8168	82	81 17.9	53989
11	1989	0 40.8	8148	53369	8147	97	81 19.2	53987
12	1990	0 47.2	8122	53360	8121	112	81 20.7	53975
13	1991	0 53.0	8107	53355	8106	125	81 21.6	53967
14	1992	1 01.4	8088	53352	8087	144	81 22.8	53962
15	1993	1 12.9	8065	53356	8063	171	81 24.3	53962
16	1994	1 25.9	8044	53374	8041	201	81 25.8	53977
17	1995	1 38.4	8038	53374	8035	230	81 26.1	53976
18	1996	1 51.4	8023	53385	8019	260	81 27.2	53985
19	1997	2 07.2	8004	53406	7999	296	81 28.6	54003
20	1998	2 24.0	8001	53440	7994	335	81 29.1	54036
21	1999	2 39.1	7998	53471	7989	370	81 29.6	54066
22	2000	2 55.5	7996	53504	7986	408	81 30.0	54098
23	2001	3 12.4	7992	53542	7979	447	81 30.6	54135
24	2002	3 29.7	7989	53585	7974	487	81 31.2	54177
25	2003	3 49.8	7965	53646	7947	532	81 33.3	54234
26	2004	4 04.2	7961	53675	7941	565	81 33.8	54262
27	2005	4 20.5	7953	53707	7930	602	81 34.6	54293
28	2006	4 36.2	7958	53727	7932	639	81 34.5	54314
29	2007	4 51.3	7950	53757	7922	673	81 35.2	54342
30	2008	5 07.9	7941	53785	7909	710	81 36.1	54368
31	2009	5 25.4	7939	53804	7903	750	81 36.4	54387
32	2010	5 45.7	7928	53837	7888	796	81 37.4	54418
33	2011	6 05.8	7920	53868	7875	841	81 38.2	54447
34	2012	6 28.2	7910	53900	7860	891	81 39.1	54477
35	2013	6 50.8	7903	53920	7846	942	81 39.7	54497
36	2014	7 08.8	7895	53947	7833	982	81 40.4	54521
37	2015	7 30.6	7881	53988	7813	1030	81 41.7	54560
38	2016	7 53.5	7862	54021	7787	1079	81 43.2	54590

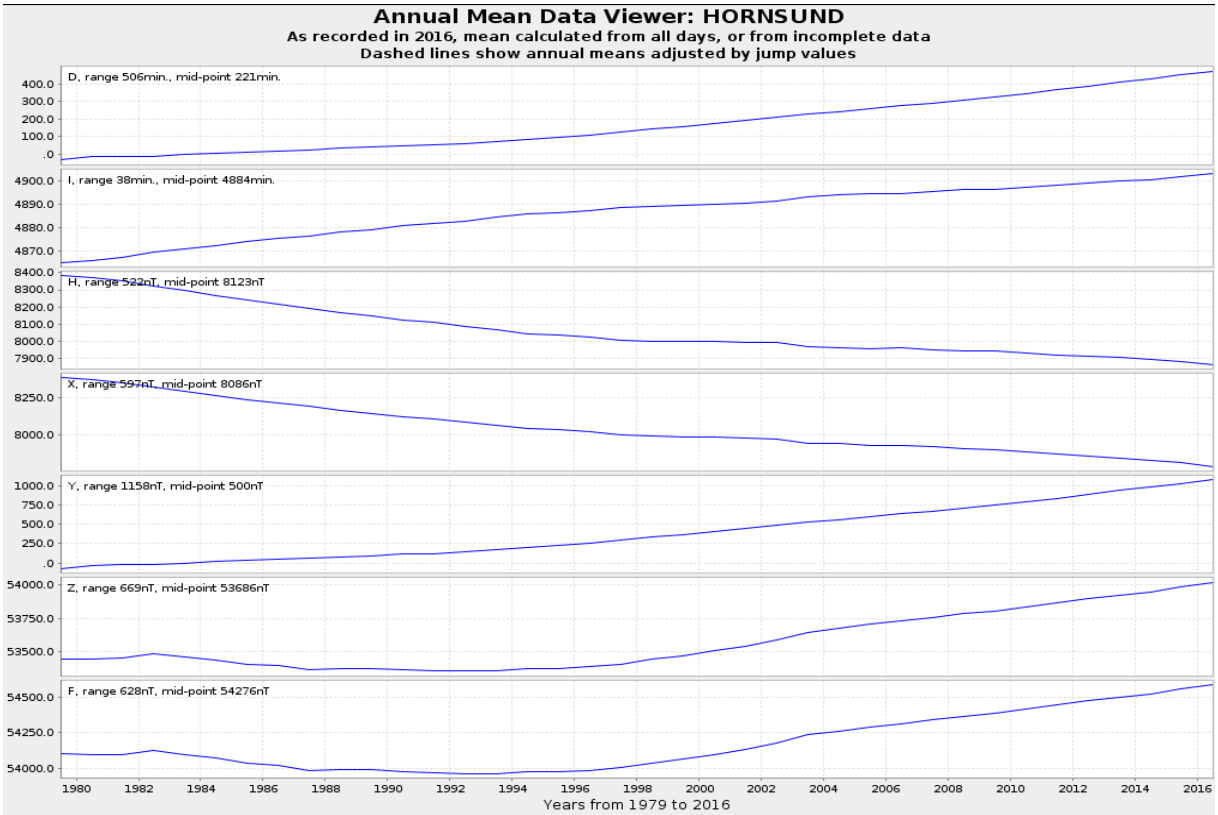

Fig. 12. Secular changes of *H*, *X*, *Y*, *Z*, *F*, *D* and *I* at Hornsund.

Table 23

Monthly and yearly mean values of magnetic elements
HRN 2016

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
North component: 7500 + ... in nT													
All days	284	283	290	298	304	312	312	300	278	266	264	258	287
Quiet days	299	301	301	306	310	303	303	301	287	288	282	279	297
Disturbed days	254	243	267	267	267	300	324	299	242	214	220	221	260
East component: 500 + ... in nT													
All days	561	561	564	563	571	570	583	583	592	598	600	607	579
Quiet days	556	559	563	567	570	572	583	583	585	592	597	603	578
Disturbed days	572	568	564	564	577	575	588	588	601	605	611	611	585
Vertical component: 53500 + ... in nT													
All days	510	512	512	504	509	508	511	515	537	549	541	541	521
Quiet days	496	504	505	510	507	505	508	513	520	526	531	531	513
Disturbed days	542	539	538	508	534	521	517	511	568	584	567	561	541

Table 24

Three-hour-range *K* indices
Hornsund, January-March 2016
The limit of $K = 9$ is 2500

Day	January		February		March	
	K	*SK*	*K*	*SK*	*K*	*SK*
1	9986 5554	51	4445 3232	27	5555 5535	38
2	6586 6455	45	2344 3445	29	6555 5533	37
3	4565 5656	42	6754 3242	33	4566 5433	36
4	4655 4446	38	3346 6444	34	6633 3431	29
5	3544 3376	35	4665 5595	45	1546 6332	30
6	9676 5546	48	3565 6567	43	2455 5889	46
7	6785 7784	52	6354 4664	38	6766 6579	52
8	4556 6556	42	8865 4332	39	7677 7576	52
9	4455 5444	35	5566 5548	44	3555 6544	37
10	5565 5497	46	7645 3444	37	6675 5345	41
11	3665 5599	48	5555 5545	39	4567 8676	49
12	8566 4487	48	6667 5544	43	5575 5795	48
13	7975 6594	52	3565 4324	32	2545 4423	29
14	3657 6559	46	3555 5755	40	4455 4459	40
15	7755 5453	41	5676 5448	45	6677 4689	53
16	3445 4233	28	7578 6998	59	9687 7477	55
17	3345 3453	30	6767 6799	57	7788 7998	63
18	2323 3544	26	7677 6697	55	3567 7646	44
19	7657 4323	37	6567 7987	55	5677 7964	51
20	3446 5556	38	5565 6434	38	3556 5684	42
21	7786 5979	58	4444 5356	35	6556 5455	41
22	5776 5459	48	3333 4433	26	3556 5334	34
23	4876 5845	47	4434 4458	36	4686 5445	42
24	5676 6594	48	5445 4343	32	4476 5434	37
25	3443 4222	24	5565 4333	34	6555 4363	37
26	1445 5426	31	6655 5333	36	2444 4333	27
27	5654 3323	31	2664 4333	31	6566 5665	45
28	4544 5344	33	3455 4444	33	4765 5465	42
29	3333 3543	27	4334 4313	25	6777 6744	48
30	2334 3333	24			6666 6777	51
31	4544 4445	34			5565 4444	37

Table 25

Three-hour-range *K* indices
Hornsund, April-June 2016
The limit of $K = 9$ is 2500

Day	April		May		June	
	K	*SK*	*K*	*SK*	*K*	*SK*
1	5434 4354	32	5567 8768	52	6656 6653	43
2	4333 5967	40	7876 6768	55	4645 5343	34
3	6675 4557	45	6676 5887	53	5444 3235	30
4	6555 6435	39	5555 5545	39	4443 4453	31
5	3445 5474	36	3557 6657	44	4667 7797	53
6	4556 6655	42	7667 6766	51	7797 7665	54
7	4545 4457	38	6567 6766	49	6656 6555	44
8	6634 4332	31	8998 9789	67	5656 6434	39
9	2345 4333	27	9878 8798	64	4544 6564	38
10	3675 5335	37	6677 6688	54	3655 6676	44
11	3234 5746	34	5565 6666	45	7677 6668	53
12	5656 7668	49	4545 5365	37	6576 8665	49
13	9677 8897	61	4456 5566	41	6776 5556	47
14	5768 7966	54	6567 6466	46	6775 7699	56
15	5446 6444	37	5677 8775	52	7678 6655	50
16	3357 6655	40	5778 8565	51	5666 6676	48
17	7776 6657	51	5787 7676	53	5687 7665	50
18	4555 4445	36	6887 6543	47	5677 7656	49
19	4333 6423	28	5576 6553	42	5676 6544	43
20	2676 5333	35	6766 5346	43	5564 6355	39
21	4555 5454	37	6788 7656	53	5445 7445	38
22	4455 7758	45	5667 6664	46	5656 5765	45
23	4656 7449	45	4666 5344	38	5854 6668	48
24	5676 6974	50	4567 5444	39	8777 5655	50
25	5466 7443	39	3554 5533	33	4765 5678	48
26	4556 6557	43	3344 4544	31	6557 6687	50
27	4776 6768	51	5667 7576	49	8677 5346	46
28	5566 5333	36	6786 6666	51	5666 6675	47
29	4543 5333	30	5656 5557	44	4544 5554	36
30	3545 6655	39	7767 6665	50	4544 4465	36
31			5576 6679	51		

Table 26

Three-hour-range *K* indices
Hornsund, July-September 2016
The limit of *K* = 9 is 2500

Day	July		August		September	
	K	*SK*	*K*	*SK*	*K*	*SK*
1	6666 6544	43	5443 3534	31	7767 6699	57
2	5655 5657	44	5657 6657	47	7888 8779	62
3	7776 6556	49	7888 8985	61	7888 7999	656
4	5665 5466	43	6777 8976	57	6789 7997	62
5	5654 5344	36	5689 7688	57	5687 6767	52
6	4444 5546	36	6679 7656	52	6687 6797	56
7	6787 8678	57	7665 7766	50	5786 6755	49
8	6798 8775	57	8776 6953	51	6887 6655	51
9	7687 8765	54	5878 7848	55	4645 4565	39
10	6768 8556	51	7787 6987	59	4554 4337	35
11	7778 8658	56	6666 5667	48	4444 6564	37
12	6778 6656	51	8767 6666	52	5545 5335	35
13	6766 6545	45	4555 6675	43	4654 4444	35
14	5789 7576	54	4446 6443	35	4556 6575	43
15	6778 7566	52	4464 4555	37	5565 4333	34
16	8776 6576	52	4445 6545	37	2334 4443	27
17	4667 6645	44	6766 5355	43	4335 4314	27
18	3555 5435	35	5776 5436	43	4555 6644	39
19	5534 5445	35	4355 5634	35	4376 6655	42
20	8886 765-	--	5564 4333	33	7677 6546	48
21	-444 5645	--	3345 6646	37	9766 5334	43
22	6677 7664	49	4554 5454	36	5656 5212	32
23	6677 5355	44	5647 7666	47	2464 4232	27
24	5555 6976	48	8768 7559	55	3334 4355	30
25	7776 6776	53	6678 5888	56	6856 6567	49
26	4745 5546	40	6444 5555	38	5566 6766	47
27	4433 5336	31	4565 5443	36	6677 8976	56
28	5577 5786	50	4556 5422	33	6778 8998	62
29	6977 6764	52	5456 6465	41	6787 7898	60
30	6775 5565	46	6577 7767	52	6877 7698	58
31	6545 5564	40	5555 6555	41		

Table 27

Three-hour-range *K* indices
Hornsund, October-December 2016
The limit of *K* = 9 is 2500

Day	October		November		December	
	K	*SK*	*K*	*SK*	*K*	*SK*
1	5677 7997	57	4566 5537	41	4554 3111	24
2	6677 7698	56	7556 6579	50	2565 4454	35
3	6675 6996	54	7655 5569	48	2333 2373	26
4	8787 7587	57	6554 4243	33	342- 2233	--
5	6776 6565	48	3355 2112	22	5423 3434	28
6	4665 4654	40	4344 5346	33	3545 7557	41
7	5555 5554	39	5444 4222	27	3665 6484	42
8	4765 4447	41	2344 5425	29	7776 6789	57
9	6465 5464	40	2254 5486	36	6767 7699	57
10	7656 5574	45	3455 5755	39	8876 8996	61
11	4465 4323	31	6565 4545	40	7886 6794	554
12	3545 5367	38	6678 6998	59	6565 4345	38
13	4476 7666	46	7776 6698	56	5555 5337	38
14	6576 5546	44	4676 6678	50	4557 3354	36
15	6766 5766	49	6786 6573	48	3445 3254	30
16	6686 6596	52	4665 4295	41	3334 3237	28
17	7777 5997	58	5444 3365	34	3445 5458	38
18	6887 5437	48	6444 3644	35	6765 5564	44
19	6666 6476	47	3243 3344	26	4454 5376	38
20	3353 4243	27	2353 3335	27	3554 4435	33
21	2433 4122	21	4453 5455	35	6566 6969	53
22	4444 5455	35	3455 5569	42	8767 6698	57
23	4566 5796	48	6786 5585	50	5786 7797	56
24	6666 6545	44	8655 8569	52	5666 6976	51
25	6868 9999	64	9687 7898	62	9867 6988	61
26	6888 7999	64	6565 5796	49	6777 7859	56
27	7767 6999	60	5675 5497	48	6676 6498	52
28	6676 8869	56	5555 5886	47	6545 4548	41
29	9766 7874	54	5444 5358	38	6645 6553	40
30	6787 6685	53	4545 4353	33	3444 4346	32
31	6778 5687	54			4455 6774	42

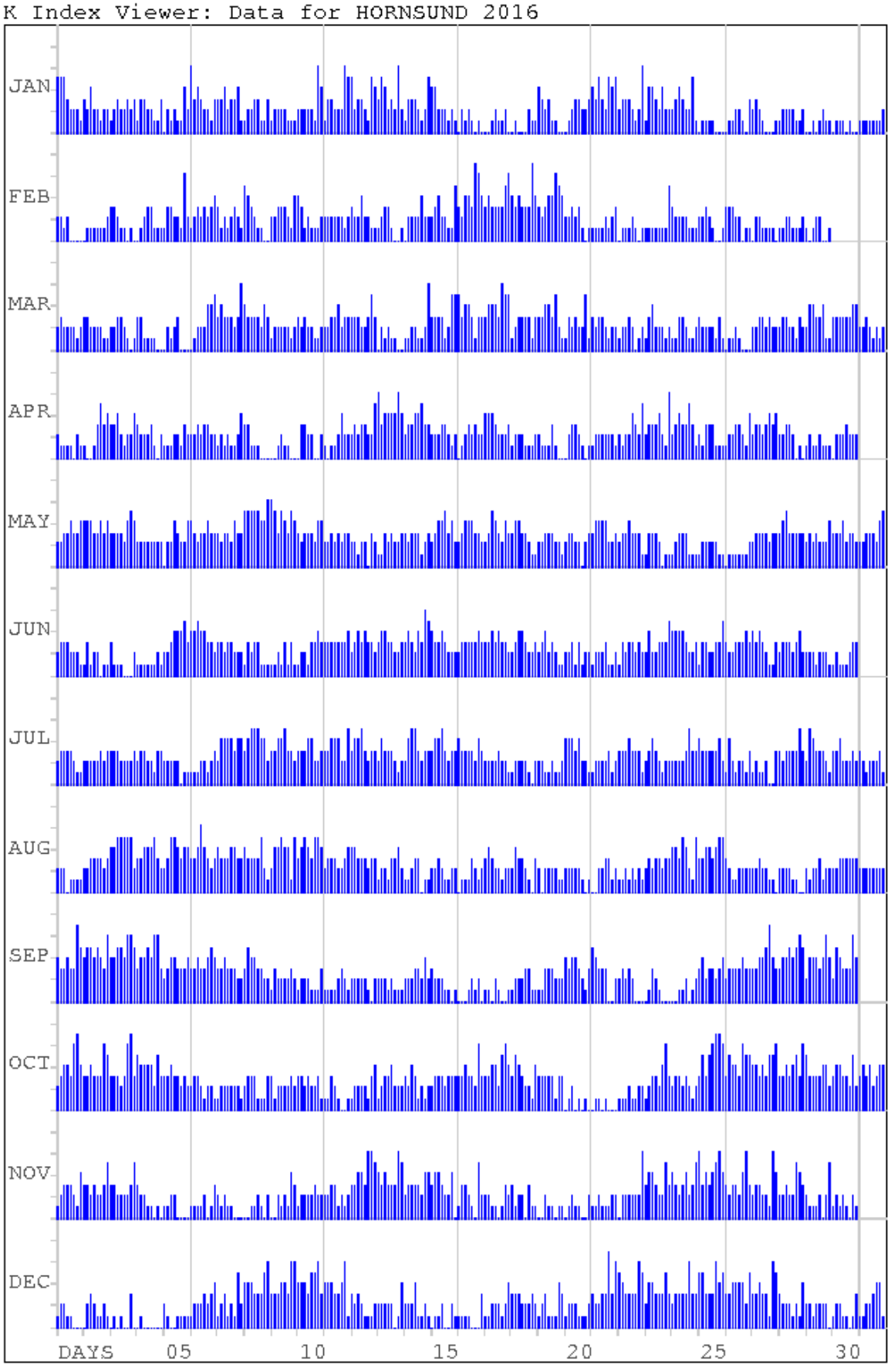

Fig. 13. K-indices in graphical form, Hornsund 2016.

References

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

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

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

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 Geophysical Observatory in Belsk, *Prz. Geofiz.* **3-4**, 189-198 (in Polish).

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.

Nowożyński, K., T. Ernst, and J. Jankowski (1991), Adaptive smoothing method for computer derivation of K-indices, *Geophys. J. Int.* **104**, 1, 85-93, DOI: 10.1111/j.1365-246X.1991.tb02495.x.

Reda, J., and J. Jankowski (2004), Three-hour activity index based on power spectra estimation, *Geophys. J. Int.* **157**, 1, 141-146, DOI: 10.1111/j.1365-246X.2004.02241.x.

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

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