

ANNUAL REPORT OF THE OBSERVED GEOMAGNETIC ACTIVITY AT PANAGJURISHTE OBSERVATORY FOR 2018

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Abstract. Magnetic variations show different records at each observatory. They depend mainly on the latitude of the observatory and the local time. This paper reports the definitive geomagnetic data obtained at Panagjurishte Observatory in 2018, prepared in the form of local geomagnetic indices and absolute time-series of daily mean values plots. 2018 is the penultimate year of Solar cycle 24, which is well into its decreasing phase (<https://www.swpc.noaa.gov/products/solar-cycle-progression>). It had a “double-peaked” solar maximum, with the first peak reaching a sunspot number of 99 in 2011 and the second peak in April 2014 with 101.

On the 24th of May 2018 the observatory was struck by a severe lightning storm. This damaged both systems, and they were sent out for repair. In the aftermath of this event, the observatory lost its capability to record data until the beginning of August 2018.

Calculated indices show that 2018 had 19 days with “storm”- level conditions of the geomagnetic field, but only moderate levels have been reached. The maximum K-index level reached during the period is K=6, recorded in four separate events. This weak activity is reasonable due to the fact that the sunspot numbers that year continued to decline.

Verification of data quality is performed according to “IAGA guide for magnetic measurements and observatory practice” and due to the missing data this year is labeled as “incomplete”.

Key words: PAG observatory, geomagnetic variations, geomagnetic activity, local geomagnetic indices, daily mean values, 2018.

Introduction

The Geomagnetic observatory in Panagjurishte (PAG, 24.177°EN, 42.515°N) is established in 1937 – the first on the Balkan Peninsula and unique in Bulgaria and during more than 80 years performs absolute measurements of the geomagnetic field

elements and continuous registration of their variations (Buchvarov, 2006). In 2007, the PAG observatory was equipped with digital systems for the recording of geomagnetic field elements' variations. Three different magnetometers are installed, which operate in a 24/7 regime: two tri-axial fluxgate magnetometers model FGE (DTU Space) – one of the standard type in which the three fluxgate sensors are mounted on a 12x12x12 cm³ marble cube placed on a three legged aluminum base, and a second version, in which the marble cube is suspended in two crossed phosphor-bronze strips to compensate any tilt of the sensor foundation. The third instrument is a three-axial search coil magnetometer used for studies on the longitudinal propagation of ULF signal (Chamati, 2020). It provides real time measurements at a sampling period of 0.01s which are integrated at a period of 1 s.

Thus, the observatory implemented the technical requirements and was joined to the INTERMAGNET (International Real-time Magnetic Observatory Network), which establishes a global network of cooperating digital magnetic observatories, and facilitates data exchanges and geomagnetic products in close to real time. Preliminary recorded time series and local geomagnetic K-indices are published on the NIGGG web page (http://data.niggg.bas.bg/magn_data1/dailymag_bg.php) and automatically reported to INTERMAGNET. The present paper provides definitive geomagnetic data that are checked and processed to comply with the IAGA standards for observatory practices.

Local geomagnetic indices (K , A_k , ΣK) calculated at PAG observatory.

Geomagnetic irregular variations, or so called geomagnetic disturbances, are driven by the solar wind. Globally, they are evaluated by the Kp-index which is predicted and later on determined by the world data centers (Matzka et al., 2021a). It is a 3-hour quasi-logarithmic scale developed to measure magnetic activity, ranging from 0 to 9, with 0 indicating completely quiet conditions and 9 representing extreme magnetic activity. It is intended to measure geomagnetic disturbances outside the normal diurnal quiet time variations (Sq). In order to have a somewhat consistent scale of magnetic activity between observatories at high latitudes, where field variations can be quite large in amplitude, and those at low latitudes, each observatory is assigned its own set of amplitude ranges corresponding to the various K-index levels. By definition, the K-limit scales for all observatories are proportional to the Niemeck scale (Matzka, 2021b).

The eight three-hourly K numbers (after Bartels, 1939) are calculated by a computer code (FMI method, Sucksdorff et al., 1991) from the digital recordings of the three component flux-gate variometer FGE.

The local equivalent daily amplitude index Ak [nT] is determined by converting K – indices into eight 3-hour equivalent linear amplitudes a_k , and calculating the mean value. The ranges of the individual K numbers at PAG observatory and the 3-hour equivalent amplitude a_k , which is assigned for each K value, are defined in Metodiev and Trifonova, 2019. ΣK is the daily sum of the eight K numbers.

The calculated local geomagnetic indices (K , Ak , ΣK) at PAG observatory for 2018 are presented in Table 1.

Table 1. Local geomagnetic indices (K , A_K , ΣK) calculated at PAG observatory in 2018.

Activity Indices										
Day	K								Ak [nT]	ΣK
01-Jan-18	3	3	2	3	3	2	1	2	11	19
02-Jan-18	2	1	1	1	1	2	3	1	6	12
03-Jan-18	0	1	1	2	1	1	1	1	3	8
04-Jan-18	1	1	2	1	0	1	2	1	4	9
05-Jan-18	1	2	2	2	1	1	1	3	6	13
06-Jan-18	1	1	1	1	1	0	0	1	2	6
07-Jan-18	1	1	1	1	1	1	2	1	4	9
08-Jan-18	1	2	3	2	4	3	2	2	11	19
09-Jan-18	3	2	2	2	2	2	2	2	8	17
10-Jan-18	1	1	1	2	1	1	1	0	3	8
11-Jan-18	1	1	1	1	1	0	1	1	3	7
12-Jan-18	1	1	2	1	1	2	1	1	4	10
13-Jan-18	0	1	2	2	2	2	3	3	8	15
14-Jan-18	4	3	3	2	2	2	1	2	11	19
15-Jan-18	3	2	2	1	1	3	2	2	8	16
16-Jan-18	2	1	2	2	1	1	2	2	6	13
17-Jan-18	0	1	1	1	1	0	0	1	2	5
18-Jan-18	0	1	1	1	0	1	1	1	2	6
19-Jan-18	2	2	2	1	1	1	3	3	8	15
20-Jan-18	3	2	2	2	1	2	2	1	7	15
21-Jan-18	2	1	2	3	3	2	3	3	11	19
22-Jan-18	2	2	2	2	1	3	4	3	11	19
23-Jan-18	2	2	1	2	1	1	1	0	4	10
24-Jan-18	0	0	1	1	3	3	2	4	9	14
25-Jan-18	3	2	2	2	2	3	2	2	9	18
26-Jan-18	2	2	3	1	0	1	2	3	7	14
27-Jan-18	3	2	1	2	1	2	2	2	7	15
28-Jan-18	0	1	1	1	2	1	2	3	5	11
29-Jan-18	1	1	1	2	1	1	2	1	4	10
30-Jan-18	0	2	1	1	1	0	1	0	2	6
31-Jan-18	0	0	1	2	2	2	1	3	5	11

01-Feb-18	2	0	0	1	1	1	2	2	4	9
02-Feb-18	2	1	0	1	1	1	1	0	3	7
03-Feb-18	0	1	1	1	1	1	2	2	4	9
04-Feb-18	1	1	1	1	1	1	3	1	5	10
05-Feb-18	2	2	2	2	3	3	2	1	9	17
06-Feb-18	0	1	1	2	2	1	1	3	5	11
07-Feb-18	1	1	1	1	2	1	0	1	3	8
08-Feb-18	1	1	1	1	1	0	1	3	4	9
09-Feb-18	2	2	1	0	0	0	1	3	4	9
10-Feb-18	1	2	1	2	2	2	2	1	6	13
11-Feb-18	0	1	1	1	1	2	1	0	3	7
12-Feb-18	0	1	1	2	1	0	3	1	4	9
13-Feb-18	0	1	1	1	0	0	0	2	2	5
14-Feb-18	1	1	1	0	0	0	1	3	3	7
15-Feb-18	2	1	3	2	2	5	3	3	15	21
16-Feb-18	2	2	3	2	1	2	2	3	9	17
17-Feb-18	3	3	2	2	3	2	2	3	11	20
18-Feb-18	3	2	2	2	3	4	3	3	14	22
19-Feb-18	3	3	2	2	3	3	4	3	15	23
20-Feb-18	3	0	1	1	2	1	1	0	4	9
21-Feb-18	0	0	1	2	1	1	1	1	3	7
22-Feb-18	2	1	1	2	3	3	5	4	16	21
23-Feb-18	2	3	3	4	2	2	4	3	15	23
24-Feb-18	3	2	2	2	1	1	1	2	7	14
25-Feb-18	0	1	1	1	0	3	3	2	6	11
26-Feb-18	2	1	2	1	1	2	1	4	8	14
27-Feb-18	4	4	1	3	4	2	2	1	15	21
28-Feb-18	2	2	2	2	2	2	2	2	7	16
01-Mar-18	1	1	1	1	2	1	3	3	7	13
02-Mar-18	3	0	0	0	0	0	1	2	3	6
03-Mar-18	1	0	1	2	2	1	3	3	7	13
04-Mar-18	2	2	1	1	2	2	2	1	6	13
05-Mar-18	2	1	1	1	1	2	2	1	5	11
06-Mar-18	1	1	1	1	1	2	1	1	4	9

07-Mar-18	0	0	0	1	0	1	3	1	3	6
08-Mar-18	0	1	2	1	1	0	2	1	3	8
09-Mar-18	3	2	1	2	1	2	3	4	11	18
10-Mar-18	4	3	2	1	2	2	3	3	12	20
11-Mar-18	2	1	1	0	0	1	2	1	3	8
12-Mar-18	1	0	1	1	1	1	1	1	3	7
13-Mar-18	0	0	1	1	1	1	1	1	2	6
14-Mar-18	1	1	1	1	2	4	4	3	11	17
15-Mar-18	4	2	2	2	1	4	4	3	15	22
16-Mar-18	3	3	2	3	4	4	3	4	19	26
17-Mar-18	4	2	2	2	2	2	2	4	12	20
18-Mar-18	2	1	0	2	4	4	5	6	25	24
19-Mar-18	4	3	3	1	2	2	3	4	15	22
20-Mar-18	2	2	1	1	1	1	3	2	6	13
21-Mar-18	1	1	1	1	1	1	3	2	5	11
22-Mar-18	1	2	0	0	1	2	3	3	6	12
23-Mar-18	4	2	2	3	2	2	4	4	16	23
24-Mar-18	2	2	1	2	1	3	2	3	8	16
25-Mar-18	3	3	2	3	2	3	3	5	17	24
26-Mar-18	3	2			2	3	4	4	12	18
27-Mar-18	2	2	3	2	2	2	0	1	7	14
28-Mar-18	1	1	1	1	0	1	1	1	3	7
29-Mar-18	0	1	1	2	2	2	2	2	5	12
30-Mar-18	1	2	2	2	2	2	1	1	6	13
31-Mar-18	3	2	1	2	2	2	1	1	7	14
01-Apr-18	1	1	2	2	2	2	2	2	6	14
02-Apr-18	2	1	1	1	1	2	2	2	5	12
03-Apr-18	1	2	1	1	0	1	0	1	3	7
04-Apr-18	0	0	2	2	1	2	2	2	5	11
05-Apr-18	3	2	1	1	1	3	3	2	9	16
06-Apr-18	1	1	2	2	1	2	1	1	5	11
07-Apr-18	1	1	1	1	1	2	1	2	4	10
08-Apr-18	1	1	1	1	0	1	3	3	6	11
09-Apr-18	1	1	2	2	2	3	3	5	13	19
10-Apr-18	2	3	3	3	3	3	3	4	16	24

11-Apr-18	4	2	2	1	2	1	2	2	9	16
12-Apr-18	1	2	2	2	2	2	3	3	9	17
13-Apr-18	4	1	2	1	1	1	3	4	11	17
14-Apr-18	2	1	0	2	2	2	2	2	6	13
15-Apr-18	2	1	1	1	1	1	1	3	5	11
16-Apr-18	1	1	1	1	0	0	0	2	2	6
17-Apr-18	2	1	1	0	0	1	1	2	3	8
18-Apr-18	1	1	1	2	2	3	2	1	6	13
19-Apr-18	0	0	1	2	0	1	1	1	2	6
20-Apr-18	4	3	5	5	3	4	6	4	36	34
21-Apr-18	3	2	2	2	2	4	3	2	12	20
22-Apr-18	1	1	1	1	2	1	1	1	4	9
23-Apr-18	3	1	1	1	1	1	3	3	8	14
24-Apr-18	0	1	1	2	2	2	3	2	6	13
25-Apr-18	2	2	1	1	1	0	0	2	4	9
26-Apr-18	2	1	1	1	1	1	1	2	4	10
27-Apr-18	2	1	2	2	1	3	2	2	7	15
28-Apr-18	2	1	1	1	1	1	1	0	3	8
29-Apr-18	0	1	2	2	2	2	1	1	5	11
30-Apr-18	2	2	1	1	2	2	2	0	5	12
01-May-18	0	1	1	1	1	0	1	1	2	6
02-May-18	2	2	1	2	1	1	1	1	5	11
03-May-18	1	1	1	2	1	1	2	2	5	11
04-May-18	1	0	1	1	1	1	2	2	4	9
05-May-18	1	1	2	4	4		5	5	20	22
06-May-18	5	3	3	3	3	3	4	4	22	28
07-May-18	4	3	3	2	3	3	2	3	15	23
08-May-18	2	3	2	2	2	4	4	2	13	21
09-May-18	3	2	2	2	2	2	4	3	12	20
10-May-18	3	2	2	2	2	3	2	3	10	19
11-May-18	1	3	4	1	3	2	4	4	16	22
12-May-18	2	3	1	2	1	2	2	3	8	16
13-May-18	1	2	2	2	3	3	3	3	11	19
14-May-18	1	1	1	2	1	1	1	2	4	10
15-May-18	0	2	1	1	1	2	2	2	5	11

16-May-18	0	0	0	1	1	1	2	2	3	7
17-May-18	3	2	2	3	2	2	2	3	10	19
18-May-18	2	1	1	2	1	1	1	1	4	10
19-May-18	1	1	1	1	1	1	2	1	4	9
20-May-18	1	2	1	1	1	1	0	0	3	7
21-May-18	0	1	1	1	1	0	0	1	2	5
22-May-18	0	1	1	2	2	2	2	2	5	12
23-May-18	2	3	2	3	2	2	1	2	9	17
04-Aug-18	1	2	1	1	1	1	1	1	4	9
05-Aug-18	1	2	1	2	2	2	1	2	6	13
06-Aug-18	1	2	1	1	1	1	2	1	4	10
07-Aug-18	2	3	2	2	3	2	3	2	10	19
08-Aug-18	1	1	1	2	2	2	2	1	5	12
09-Aug-18	2	1	2	2	1	1	1	1	5	11
10-Aug-18	2	2	1	1	1	2	1	1	5	11
11-Aug-18	2	2	3	2	3	2	3	4	13	21
12-Aug-18	2	1	1	2	2	2	2	2	6	14
13-Aug-18	1	1	1	2	1	1	1	2	4	10
14-Aug-18	1	0	0	2	1	1	0	1	2	6
15-Aug-18	2	1	2	3	3	3	4	3	13	21
16-Aug-18	4	2	1	3	3	2	2	2	11	19
17-Aug-18	3	3	2	2	1	1	3	4	12	19
18-Aug-18	2	3	3	2	2	3	2	2	10	19
19-Aug-18	2	2	1	1	1	3	3	3	9	16
20-Aug-18	3	3	2	2	3	3	4	2	14	22
21-Aug-18	3	1	2	2	1	1	1	2	6	13
22-Aug-18	2	1	2	1	2	2	1	3	7	14
23-Aug-18	2	1	1	0	1	1	1	2	4	9
24-Aug-18	0	1	1	2	3	1	1	1	5	10
25-Aug-18	1	2	3	3	3	2	4	4	15	22
26-Aug-18	5	6	5	4	5	5	5	3	45	38
27-Aug-18	2	2	2	3	4	5	5	3	22	26
28-Aug-18	4	2	2	2	2	1	1	1	8	15
29-Aug-18	3	2	1	1	1	2	2	2	7	14
30-Aug-18	1	1	1	1	0	0	2	3	4	9

31-Aug-18	1	1	1	2	1	2	3	1	6	12
01-Sep-18	1	1	1	1	2	1	3	2	6	12
02-Sep-18	2	2	1	2	1	2	2	2	6	14
03-Sep-18	1	1	1	2	2	2	2	3	7	14
04-Sep-18	1	2	2	1	2	2	3	3	8	16
05-Sep-18	3	2	1	2	3	2	2	1	8	16
06-Sep-18	2	1	2	1	1	1	2	2	5	12
07-Sep-18	2	2	2	1	1	1	1	1	5	11
08-Sep-18	1	0	3	2	0	1	1	2	5	10
09-Sep-18	2	1	2	1	2	2	2	3	7	15
10-Sep-18	0	1	1	1	2	5	5	5	20	20
11-Sep-18	4	4	5	5	3	3	4	3	28	31
12-Sep-18	2	1	1	2	1	3	3	4	10	17
13-Sep-18	4	3	3	3	3	3	2	3	16	24
14-Sep-18	3	2	2	2	2	2	4	4	13	21
15-Sep-18	2	1	2	2	2	1	1	3	7	14
16-Sep-18	1	2	2	2	1	1	1	2	5	12
17-Sep-18	2	2	2	2	2	3	4	3	12	20
18-Sep-18	3	1	1	2	0	1	1	1	5	10
19-Sep-18	1	2	2	1	1	1	0	0	3	8
20-Sep-18	0	1	1	1	1	0	0	0	2	4
21-Sep-18	0	1	1	1	1	1	2	4	6	11
22-Sep-18	5	3	3	3	4	3	4	4	24	29
23-Sep-18	3	2	1	2	3	2	3	3	11	19
24-Sep-18	3	2	2	2	1	2	2	2	8	16
25-Sep-18	2	2	1	3	3	3	4	3	13	21
26-Sep-18	1	1	1	1	2	3	2	3	7	14
27-Sep-18	1	1	1	2	2	1	1	3	6	12
28-Sep-18	3	2	2	1	0	1	1	3	7	13
29-Sep-18	3	2	2	2	3	2	2	3	10	19
30-Sep-18	1	2	1	1	1	1	2	2	5	11
01-Oct-18	0	1	1	2	4	3	3	3	11	17
02-Oct-18	3	2	2	1	1	1	3	0	7	13
03-Oct-18	1	1	1	2	1	1	2	3	6	12
04-Oct-18	2	1	0	1	2	2	2	2	5	12

05-Oct-18	2	2	2	3	3	2	1	3	10	18
06-Oct-18	3	1	1	1	1	1	0	0	4	8
07-Oct-18	0	1	1	3	4	5	5	5	24	24
08-Oct-18	3	3	3	2	4	4	2	2	15	23
09-Oct-18	3	1	3	3	3	4	3	4	17	24
10-Oct-18	3	1	1	2	3	4	6	3	21	23
11-Oct-18	3	2	1	2	2	3	3	2	10	18
12-Oct-18	1	2	1	2	1	2	2	3	7	14
13-Oct-18	1	2	1	1	3	5	5	3	18	21
14-Oct-18	2	1	1	2	1	2	2	3	7	14
15-Oct-18	3	2	1	2	2	3	3	3	11	19
16-Oct-18	2	0	1	2	2	2	1	1	5	11
17-Oct-18	0	1	1	1	0	0	0	0	1	3
18-Oct-18	0	0	1	1	1	0	1	0	2	4
19-Oct-18	0	1	1	1	1	0	1	1	2	6
20-Oct-18	0	0	1	1	1	1	1	1	2	6
21-Oct-18	0	1	1	2	2	2	2	2	5	12
22-Oct-18	3	1	1	1	2	2	2	2	7	14
23-Oct-18	1	1	1	2	1	1	0	1	3	8
24-Oct-18	1	1	1	2	0	1	2	2	4	10
25-Oct-18	1	2	1	1	1	3	3	3	8	15
26-Oct-18	2	2	1	2	1	1	3	3	8	15
27-Oct-18	1	1	2	1	0	0	0	0	2	5
28-Oct-18	2	0	1	1	0	0	1	1	2	6
29-Oct-18	0	1	1	1	0	1	1	1	2	6
30-Oct-18	1	1	1	1	0	1	1	1	3	7
31-Oct-18	1	0	0	1	1	2	2	2	4	9
01-Nov-18	1	1	2	2	1	1	1	2	5	11
02-Nov-18	3	0	1	2	1	1	1	1	5	10
03-Nov-18	2	2	1	1	1	0	1	2	4	10
04-Nov-18	1	1	2	2	1	3	5	5	17	20
05-Nov-18	4	4	4	4	3	4	5	3	27	31
06-Nov-18	2	3	1	2	2	2	1	2	7	15

07-Nov-18	2	2	2	1	1	1	3	3	8	15
08-Nov-18	3	3	2	3	1	1	2	2	9	17
09-Nov-18	1	1	1	2	1	3	4	4	11	17
10-Nov-18	2	2	2	4	2	2	4	4	15	22
11-Nov-18	3	2	1	1	1	1	3	2	7	14
12-Nov-18	2	2	2	2	2	1	3	3	9	17
13-Nov-18	2	1	1	2	1	1	1	1	4	10
14-Nov-18	0	1	1	1	1	1	2	1	3	8
15-Nov-18	0	0	1	2	0	1	0	1	2	5
16-Nov-18	1	1	1	1	1	1	0	0	2	6
17-Nov-18	1	1	1	2	0	0	0	0	2	5
18-Nov-18	0	1	0	1	1	1	1	2	3	7
19-Nov-18	2	1	1	2	0	2	1	3	6	12
20-Nov-18	2	3	2	1	0	2	1	1	6	12
21-Nov-18	2	3	2			0	0	1	4	8
22-Nov-18	1	0	2		1	1	1	1	3	7
23-Nov-18	1	1	1	1	0	0	1	1	2	6
24-Nov-18	1	1	1	1	1	2	2	2	5	11
25-Nov-18	1	1	1	2	1	1	0	1	3	8
26-Nov-18	1	1	0	1	0	0	0	1	2	4
27-Nov-18	1	1	1	1	2	2	3	2	6	13
28-Nov-18	1	1	0	1	1	1	1	2	3	8
29-Nov-18	2	0	0	1	0	0	0	2	2	5
30-Nov-18	1	0	1	0	0	0	1	0	1	3
01-Dec-18	0	1	1	2	2	4	4	2	10	16
02-Dec-18	2	1	1	2	2	4	3	4	12	19
03-Dec-18	2	1	1	2	3	3	3	2	9	17
04-Dec-18	4	2	2	2	4	3	2	2	13	21
05-Dec-18	2	1	2	1	2	1	1	3	6	13
06-Dec-18	2	2	2	1	2	1	1	1	5	12
07-Dec-18	1	2	2	2	2	3	4	3	11	19
08-Dec-18	2	2	2	2	2	3	2	2	8	17
09-Dec-18	2	1	2	2	2	3	3	4	11	19

10-Dec-18	2	2	3	2	2	2	2	1	8	16
11-Dec-18	1	2	2	3	1	3	3	2	9	17
12-Dec-18	2	1	1	1	1	1	2	1	4	10
13-Dec-18	0	1	0	1	1	1	0	0	2	4
14-Dec-18	1	0	1	1	0	1	0	1	2	5
15-Dec-18	1	0	1	1	1	1	1	0	2	6
16-Dec-18	1	0	1	1	1	1	1	1	3	7
17-Dec-18	1	2	2	2	1	2	3	2	7	15
18-Dec-18	2	1	1	1	2	2	3	1	6	13
19-Dec-18	2	2	2	2	1	2	2	2	7	15
20-Dec-18	3	2	2	2	1	2	3	3	10	18
21-Dec-18	2	1	2	1	1	0	2	1	4	10
22-Dec-18	1	1	1	1	1	0	1	1	3	7
23-Dec-18	1	0	1	1	1	0	1	1	2	6
24-Dec-18	1	1	1	1	1	0	1	2	3	8
25-Dec-18	1	2	1	1	1	1	2	2	5	11
26-Dec-18	0	0	1	1	2	1	1	0	2	6
27-Dec-18	1	1	0	1	1	1	2	3	5	10
28-Dec-18	4	3	4	3	4	3	5	3	24	29
29-Dec-18	2	2	2	2	3	2	3	3	10	19
30-Dec-18	2	2	2	2	2	3	3	1	9	17
31-Dec-18	3	1	1	1	2	1	1	1	5	11

Geomagnetic disturbances and local K-index.

In Table 2 are given days with K-indices equal to or larger than 5 which means geomagnetic storm conditions. Indices above the “threshold” value are marked in red. For 2018, there are 15 days with $K\text{-index} \geq 5$ and 4 days with $K\text{-index} \geq 6$. In addition, for the time period when the observatory was not functioning, there was one day with storm conditions, as shown by the planetary K index – Kp. According to the data for the Kp index from the World Data Center for Geomagnetism, Kyoto such a day was the 1st of June, 2018 when Kp-index=5 was obtained (<https://wdc.kugi.kyoto-u.ac.jp/kp/index.html>).

Table 2 Days with K-index ≥ 5 registered in 2018 at the Panagjurishte observatory **Error! Not a valid link.**

DD-MM-YY	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	Ak [nT]	ΣK
15-Feb-18	2	1	3	2	2	5	3	3	15	21
22-Feb-18	2	1	1	2	3	3	5	4	16	21
18-Mar-18	2	1	0	2	4	4	5	6	25	24
25-Mar-18	3	3	2	3	2	3	3	5	17	24
09-Apr-18	1	1	2	2	2	3	3	5	13	19
20-Apr-18	4	3	5	5	3	4	6	4	36	34
05-May-18	1	1	2	4	4		5	5	20	22
06-May-18	5	3	3	3	3	3	4	4	22	28
26-Aug-18	5	6	5	4	5	5	5	3	45	38
27-Aug-18	2	2	2	3	4	5	5	3	22	26
10-Sep-18	0	1	1	1	2	5	5	5	20	20
11-Sep-18	4	4	5	5	3	3	4	3	28	31
22-Sep-18	5	3	3	3	4	3	4	4	24	29
07-Oct-18	0	1	1	3	4	5	5	5	24	24
10-Oct-18	3	1	1	2	3	4	6	3	21	23
13-Oct-18	1	2	1	1	3	5	5	3	18	21
04-Nov-18	1	1	2	2	1	3	5	5	17	20
05-Nov-18	4	4	4	4	3	4	5	3	27	31
28-Dec-18	4	3	4	3	4	3	5	3	24	29

In Fig. 1, the annual mean values of D [min], I [min], H [nT], X [nT], Y [nT], Z [nT] and F [nT] registered at PAG observatory from 1948 up to 2018 are plotted. The increasing trend is maintained in an almost linear form and a constant gradient

Conclusions

Continuous registration of the geomagnetic field components gives the sum of all field contributions from internal and external (to the Earth) sources. A straightforward separation of the individual contributions is impossible, and many scientific studies deal with different aspects of this problem (Mandea nad Korte, 2010). Furthermore, there are also effects from additional sources which could influence the magnetic records such as thunderstorms (Chamati and Andonov, 2021).

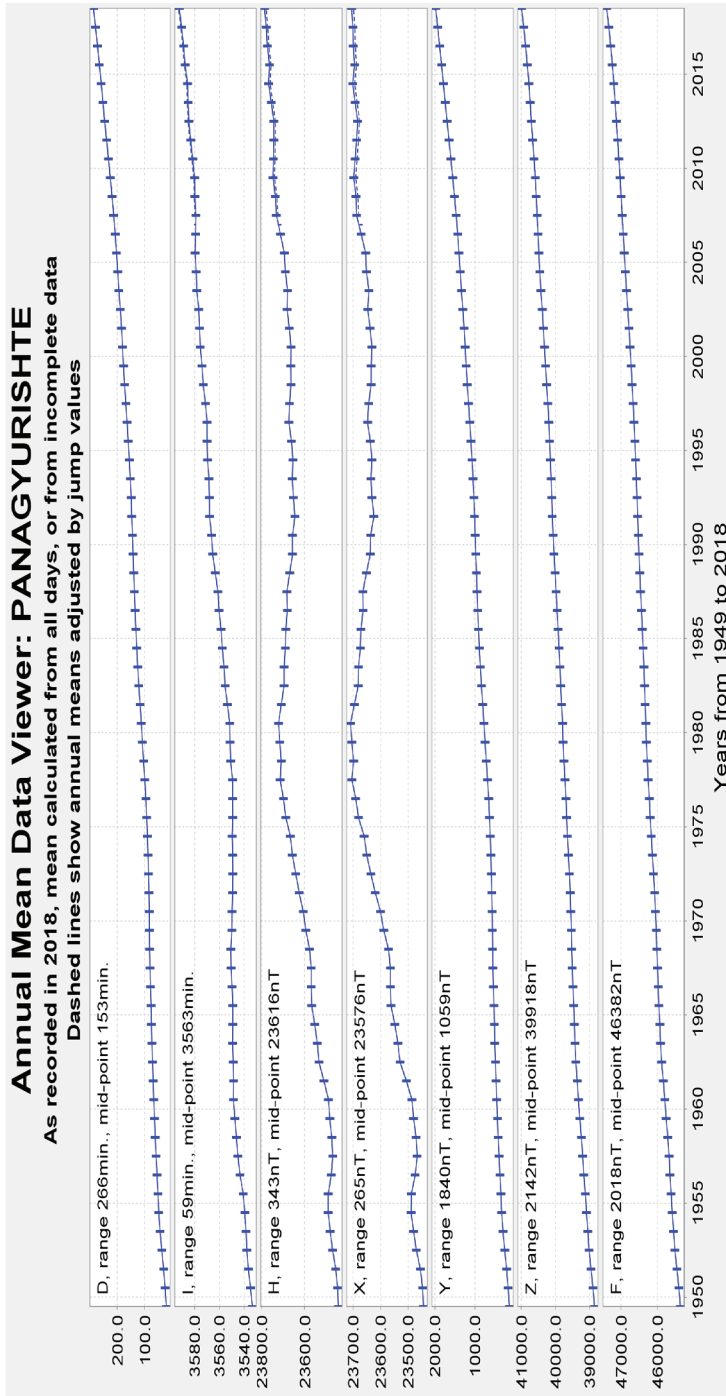


Fig. 1. Annual mean values of D [min], I [min], H [nT], X [nT], Y [nT], Z [nT] and F [nT] registered at the PAG observatory from 1948 up to 2018.

An approximate description of the strength of different external variations, however, is provided by geomagnetic indices. A quantitative measure of 2018 local geomagnetic activity in the form of a 3 hour *K*-index is published here, based upon the range of fluctuations in the PAG observatory records. Table 2 shows that the number of data values having disturbed the geomagnetic field in 2018 is decreasing to 19 (+1 for the period where the Observatory was not functioning). For comparison, in 2017, there were 50.

The most active period began on August 26 and ended on August 27. The strongest events during 2018 were on March 18 and August 26 with the largest *K*-index 6. The observed activity is quite reasonable because 2018 is already at the tail end of the 24th Solar cycle.

The data are checked and verified according to IAGA requirements (Jankowski and Sucksdorff, 1996).

The secular trend of declination (*D*), inclination (*I*), horizontal (*X* and *Y*), and vertical (*Z*) field components, as well as the total field intensity measurement at Panagjurishte observatory up to 2018, is plotted in the next figure:

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Годишен доклад за наблюдаваната геомагнитна активност в Обсерватория Панагюрище през 2018

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Резюме: Записите на магнитните вариации показват различни стойности и поведение във всяка обсерватория. Те зависят основно от географската ширина на обсерваторията и местното време.

Тази статия представя окончателните геомагнитни данни, получени в обсерватория Панагюрище през 2018 г., изготвени под формата на локални геомагнитни индекси. През 2018 г. Слънчевият цикъл 24 вече е към своя край (<https://www.swpc.noaa.gov/products/solar-cycle-progression>). Той се характеризира с двоен слънчев максимум, като при първия пик е достигнат брой на слънчевите петна 99 през 2011 г., а във втория пик през април 2014 г. броят на петната е 101.

Изчислените индекси показват, че през 2018 г. има 19 дни с условия, определящи ниво „буря“ на геомагнитното поле, но са достигнати само умерени нива. Само за четири дни, на 18 Март, 20 Април и 26 Август и 10 Октомври 2018 г. е изчислен К-индекс 6. Това е очаквано и разбираемо поради факта, че броят на слънчевите петна през тази част от Слънчевия цикъл продължава да намалява.