ANNUAL REPORT OF THE OBSERVED GEOMAGNETIC ACTIVITY IN PANAGYURISHTE OBSERVATORY

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Abstract. Presently, in the era of Internet communication the preliminary time series (INTERMAGNET's reported data) acquired in geomagnetic observatories are available in near-real time, while the final absolute time series (definitive data) are disseminated with many months delay, being subject to many checks. This paper reports the quasi-definitive geomagnetic data obtained in Panagyurishte observatory in 2012, prepared in the form of local geomagnetic indices and absolute time-series of hourly mean values plots. Verification of data quality is performed according to "IAGA guide for magnetic measurements and observatory practice".

Key words: PAG observatory, geomagnetic variations, geomagnetic activity, hourly mean values.

Introduction

The Geomagnetic observatory in Panagyurishte (PAG) is established in 1937 – first on the Balkan Peninsula and unique in Bulgaria and during more than 75 years performs the absolute measurements of the geomagnetic field elements and continuous registration of their variations. From 2008 PAG observatory was equipped with digital systems for the recording of geomagnetic field element's variations. Thus, the observatory implement 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 facilitate 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.geophys.bas.bg/magn_data1/dailymag_bg.php) and automatically reported to INTERMAGNET. The present paper provides quasi-definitive geomagnetic data which are checked and processed to comply with the IAGA standards for observatory practices.

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

The K-index is often used as a quantitative measure of local magnetic activity. 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. 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. Thus, for example, a K-index of 5 at College (212.4°E, 64.87°N) corresponds to a lower limit of magnetic activity range of 350 nT over the 3-hour interval, while at San Juan (293.85°E, 18.117°N) this same K-index level corresponds to a lower limit of magnetic activity of 40 nT. The idea is to have K-index compensation for the influence of latitude on magnetic activity, so that a K-index of 7 at College and San Juan would represent the same magnetic storm intensity despite the actual differences in the range of magnetic fluctuation amplitudes at the two latitudes.

The ranges of the individual *K* numbers in PAG observatory (24.177°EN, 42.515°N) are defined as follows:

Deviation from the normal *Sq variation* [nT]	<5	5 -10	10 - 20	20 - 40	40 - 70	70 - 120	120 -200	200-330	330-500	> 500
K	0	1	2	3	4	5	6	7	8	9

The eight three-hourly K numbers are calculated by a computer code (FMI method) from the digital recordings of three component flux-gate variometer FGE.

Description of the geomagnetic storms and their possible effects on people and systems can be found at NOAA Space Weather Scale for Geomagnetic Storms (http://www.swpc.noaa.gov/NOAAscales/index.html#GeomagneticStorms).

A_K [nT] is the local equivalent daily amplitude index which is determined by converting K –indices into eight 3-hour equivalent linear amplitudes a_K, and calculating the mean value. The 3-hour equivalent amplitude a_K is assigned for each K value using the following table:

K	0	1	2	3	4	5	6	7	8	9
$a_{K\,[nT]}$	0	3	7	15	27	48	80	140	240	400

ΣK is the daily sum of the eight *K* numbers.

Table 1. Local geomagnetic indices (K, A_K, ΣK) calculated at PAG observatory in January 2012.

Activity indices			
PAG Observatory		January 2012	
Day	**K**	**Ak [nT]**	**ΣK**
1-Jan-12	2 1 1 1 2 2 2 1	5	12
2-Jan-12	1 1 1 1 1 1 3 2	5	11
3-Jan-12	3 3 1 1 1 2 2 1	7	14
4-Jan-12	2 1 2 2 1 0 1 1	4	10
5-Jan-12	1 1 1 1 3 2 2 2	6	13
6-Jan-12	2 1 2 2 1 2 3 3	8	16
7-Jan-12	3 2 1 1 2 2 1 3	8	15
8-Jan-12	2 1 2 2 1 1 2 2	6	13
9-Jan-12	2 2 2 2 2 3 2 2	8	17
10-Jan-12	1 1 1 2 2 1 2 1	5	11
11-Jan-12	2 2 2 2 1 1 2 2	6	14
12-Jan-12	1 2 1 1 1 2 3 3	7	14
13-Jan-12	2 2 2 0 1 1 0 1	4	9
14-Jan-12	1 0 1 1 1 0 0 1	2	5
15-Jan-12	1 1 1 1 1 1 2 3	5	11
16-Jan-12	2 1 2 3 3 3 3 2	11	19
17-Jan-12	3 2 1 2 1 1 2 1	6	13
18-Jan-12	2 1 1 2 1 1 1 1	4	10
19-Jan-12	1 1 1 0 0 1 1 1	2	6
20-Jan-12	2 2 1 1 0 1 2 1	4	10
21-Jan-12	1 2 2 2 2 2 2 2	7	15
22-Jan-12	1 2 4 4 4 4 5 5	27	29
23-Jan-12	4 3 2 1 1 0 1 2	8	14
24-Jan-12	4 2 2 2 2 4 5 4	20	25
25-Jan-12	3 3 3 4 3 2 2 2	14	22
26-Jan-12	2 1 1 2 1 3 3 2	8	15
27-Jan-12	2 1 3 1 2 2 1 1	6	13
28-Jan-12	2 2 1 1 1 1 3 3	7	14
29-Jan-12	3 2 1 1 0 2 3 3	8	15
30-Jan-12	0 0 0 1 1 4 4 4	11	14
31-Jan-12	2 1 1 0 1 0 1 1	3	7

Table 2. Local geomagnetic indices (K, A_K, ΣK) calculated at PAG observatory in February 2012.

Activity indices			
PAG Observatory		February 2012	
Day	**K**	**Ak [nT]**	**ΣK**
1-Feb-12	2 2 2 2 1 1 1 1	5	12
2-Feb-12	2 1 1 1 1 0 1 1	3	8
3-Feb-12	2 2 1 2 2 2 1 0	5	12
4-Feb-12	2 2 2 2 3 2 2 3	9	18
5-Feb-12	3 2 1 2 3 2 4 2	11	19
6-Feb-12	2 2 1 1 1 3 3 2	8	15
7-Feb-12	1 2 2 3 3 3 5 4	17	23
8-Feb-12	3 2 2 2 3 2 3 2	10	19
9-Feb-12	1 1 1 2 2 3 3 1	7	14
10-Feb-12	1 1 1 1 1 1 3 2	5	11
11-Feb-12	2 1 1 1 1 1 2 2	5	11
12-Feb-12	2 1 1 2 0 1 1 1	4	9
13-Feb-12	2 1 3 2 3 3 3 3	12	20
14-Feb-12	3 2 2 1 2 3 4 5	16	22
15-Feb-12	2 4 2 3 2 3 5 4	19	25
16-Feb-12	2 1 2 2 2 1 0 1	5	11
17-Feb-12	0 0 1 1 1 0 0 0	1	3
18-Feb-12	0 0 1 1 0 1 2 4	5	9
19-Feb-12	5 4 1 2 1 2 2 3	15	20
20-Feb-12	3 4 2 2 3 4 3 4	18	25
21-Feb-12	3 2 1 1 1 1 1 3	7	13
22-Feb-12	3 3 3 3 2 2 2 1	11	19
23-Feb-12	0 0 1 1 1 1 1 3	4	8
24-Feb-12	2 3 1 1 2 2 2 1	7	14
25-Feb-12	0 0 2 2 3 2 3 2	7	14
26-Feb-12	2 1 2 1 1 0 2 3	6	12
27-Feb-12	3 2 1 3 4 5 6 2	25	26
28-Feb-12	2 2 4 2 2 3 1 3	11	19
29-Feb-12	3 2 3 1 0 1 1 2	7	13

Table 3. Local geomagnetic indices (K, A_K, ΣK) calculated at PAG observatory in March 2012.

Activity indices			
PAG Observatory		March 2012	
Day	**K**	**Ak [nT]**	**ΣK**
1-Mar-12	1 3 3 3 2 3 5 4	18	24
2-Mar-12	3 3 2 2 2 2 2 2	9	18
3-Mar-12	2 1 1 2 1 3 1 3	7	14
4-Mar-12	3 3 3 3 2 3 4 2	15	23
5-Mar-12	3 1 2 3 1 2 3 3	10	18
6-Mar-12	3 2 2 2 2 3 3 3	11	20
7-Mar-12	3 3 4 4 5 5 5 4	32	33
8-Mar-12	2 2 3 5 4 4 4 4	23	28
9-Mar-12	4 5 6 5 5 5 3 3	41	36
10-Mar-12	4 4 2 2 2 3 4 2	16	23
11-Mar-12	2 1 1 2 2 3 3 4	11	18
12-Mar-12	3 2 2 5 5 4 4 3	24	28
13-Mar-12	4 2 1 2 2 2 2 2	9	17
14-Mar-12	2 2 1 2 2 3 2 3	9	17
15-Mar-12	3 2 1 2 5 6 5 4	29	28
16-Mar-12	3 2 2 3 3 5 5 4	23	27
17-Mar-12	4 3 3 2 3 4 5 5	25	29
18-Mar-12	4 3 2 3 2 2 3 3	14	22
19-Mar-12	2 3 2 2 3 1 3 4	12	20
20-Mar-12	1 1 2 2 1 1 2 3	6	13
21-Mar-12	1 1 2 2 2 2 3 3	8	16
22-Mar-12	1 1 1 1 1 1 3 4	8	13
23-Mar-12	2 0 1 1 1 1 2 1	4	9
24-Mar-12	1 2 3 2 2 2 3 3	10	18
25-Mar-12	2 1 2 2 2 1 1 0	5	11
26-Mar-12	1 1 2 2 1 1 1 2	5	11
27-Mar-12	2 2 2 3 3 3 4 4	15	23
28-Mar-12	5 3 2 2 3 2 3 2	15	22
29-Mar-12	0 1 0 0 1 1 2 3	4	8
30-Mar-12	3 2 2 1 1 1 0 1	5	11
31-Mar-12	1 1 2 1 2 3 3 1	7	14

Table 4. Local geomagnetic indices (K, A_K, ΣK) calculated at PAG observatory in April 2012.

Activity indices			
PAG Observatory		April 2012	
Day	**K**	**Ak [nT]**	**ΣK**
1-Apr-12	2 2 1 2 1 2 2 3	7	15
2-Apr-12	3 2 2 1 2 2 1 2	7	15
3-Apr-12	2 1 1 1 1 1 2 3	6	12
4-Apr-12	2 2 0 1 1 2 2 3	6	13
5-Apr-12	2 2 2 3 3 3 2 3	11	20
6-Apr-12	1 1 1 1 0 1 0 2	3	7
7-Apr-12	2 2 2 2 3 1 1 2	7	15
8-Apr-12	2 1 1 1 1 2 2 1	5	11
9-Apr-12	1 1 2 1 0 1 2 2	4	10
10-Apr-12	3 2 1 2 2 2 2 3	9	17
11-Apr-12	2 1 3 2 2 1 1 3	8	15
12-Apr-12	1 2 2 2 1 3 5 3	13	19
13-Apr-12	5 4 3 3 2 3 3 3	20	26
14-Apr-12	3 2 2 2 2 2 3 1	9	17
15-Apr-12	0 1 2 2 1 2 3 2	6	13
16-Apr-12	1 1 1 1 2 2 2 2	5	12
17-Apr-12	2 1 2 2 2 2 4 2	9	17
18-Apr-12	3 2 2 2 2 1 2 2	8	16
19-Apr-12	1 1 2 1 0 1 3 3	6	12
20-Apr-12	1 3 3 2 1 1 1 2	7	14
21-Apr-12	1 0 1 2 0 2 3 3	6	12
22-Apr-12	3 2 1 3 2 1 1 1	7	14
23-Apr-12	2 4 3 2 2 4 4 4	18	25
24-Apr-12	5 5 3 2 2 3 4 4	24	28
25-Apr-12	3 3 3 2 2 4 4 4	18	25
26-Apr-12	2 4 2 2 3 2 3 3	13	21
27-Apr-12	2 2 2 1 2 2 2 2	7	15
28-Apr-12	2 1 1 3 1 2 2 3	8	15
29-Apr-12	2 1 1 1 1 1 2 1	4	10
30-Apr-12	1 1 1 0 0 0 1 1	2	5

Table 5. Local geomagnetic indices (K, A_K, ΣK) calculated at PAG observatory in May 2012.

Activity indices			
PAG Observatory		May 2012	
Day	**K**	**Ak [nT]**	**ΣK**
1-May-12	0 1 1 1 1 1 1 3	4	9
2-May-12	3 1 0 1 1 0 1 3	5	10
3-May-12	2 2 2 2 2 1 2 3	8	16
4-May-12	2 2 0 1 1 2 1 1	4	10
5-May-12	0 1 1 1 1 1 1 1	3	7
6-May-12	1 2 2 2 2 1 1 0	5	11
7-May-12	1 2 1 2 2 2 1 1	5	12
8-May-12	1 2 1 1 2 3 3 4	10	17
9-May-12	4 4 3 3 4 4 5 4	27	31
10-May-12	3 3 2 2 2 2 2 4	12	20
11-May-12	3 2 2 2 1 3 2 2	9	17
12-May-12	3 1 2 2 2 2 3 3	10	18
13-May-12	3 2 2 2 2 3 3 2	10	19
14-May-12	3 2 1 1 2 1 1 1	6	12
15-May-12	2 2 2 1 1 0 0 2	4	10
16-May-12	2 1 1 2 3 2 3 4	11	18
17-May-12	2 1 1 1 1 1 2 2	5	11
18-May-12	3 2 1 2 1 2 2 2	7	15
19-May-12	2 2 2 2 2 1 2 1	6	14
20-May-12	3 4 3 2 3 2 1 1	12	19
21-May-12	0 2 1 1 0 1 4 2	6	11
22-May-12	3 4 2 2 4 4 4 4	21	27
23-May-12	3 3 3 3 2 2 2 2	11	20
24-May-12	2 2 2 2 2 2 3 2	8	17
25-May-12	2 2 1 2 2 2 2 2	7	15
26-May-12	2 1 1 1 1 1 0 0	3	7
27-May-12	1 2 1 2 0 1 1 1	4	9
28-May-12	0 2 1 1 2 3 2 2	6	13
29-May-12	1 2 0 1 2 2 2 3	6	13
30-May-12	3 3 1 2 2 2 2 1	8	16
31-May-12	3 2 3 2 2 3 3 1	11	19

Table 6. Local geomagnetic indices (K, A_K, ΣK) calculated at PAG observatory in June 2012.

Activity indices			
PAG Observatory		June 2012	
Day	**K**	**Ak [nT]**	**ΣK**
1-Jun-12	1 2 1 3 2 -1 -1 -1	4	9
2-Jun-12	-1 -1 -1 -1 -1 -1 3 4	5	7
3-Jun-12	3 2 2 3 5 4 4 2	19	25
4-Jun-12	2 3 2 4 3 3 3 4	16	24
5-Jun-12	2 3 4 3 3 3 3 4	17	25
6-Jun-12	4 3 2 3 3 3 4 2	16	24
7-Jun-12	2 2 2 2 2 2 3 2	8	17
8-Jun-12	2 2 2 3 1 1 2 1	7	14
9-Jun-12	2 2 1 2 2 2 3 2	8	16
10-Jun-12	0 1 1 2 2 2 -1 -1	3	8
11-Jun-12	-1 -1 -1 2 2 3 4 5	13	16
12-Jun-12	4 4 2 2 1 1 1 1	10	16
13-Jun-12	2 2 2 2 1 1 1 1	5	12
14-Jun-12	2 2 1 1 1 1 1 1	4	10
15-Jun-12	1 2 1 1 1 1 0 1	3	8
16-Jun-12	2 2 1 3 3 3 4 6	21	24
17-Jun-12	4 3 3 5 4 4 3 3	24	29
18-Jun-12	4 4 3 2 2 2 2 0	12	19
19-Jun-12	1 1 0 1 1 0 0 0	2	4
20-Jun-12	1 2 1 2 1 1 1 0	4	9
21-Jun-12	1 1 1 1 1 1 1 1	3	8
22-Jun-12	0 2 2 2 2 2 1 0	5	11
23-Jun-12	0 1 2 2 2 3 1 1	6	12
24-Jun-12	2 1 1 2 2 2 2 1	6	13
25-Jun-12	1 2 2 2 3 3 2 2	9	17
26-Jun-12	2 2 2 2 1 2 1 2	6	14
27-Jun-12	1 2 1 2 2 2 1 1	5	12
28-Jun-12	2 2 2 2 2 1 1 1	6	13
29-Jun-12	1 2 1 1 1 1 2 3	6	12
30-Jun-12	3 3 3 4 4 3 3 4	20	27

Table 7. Local geomagnetic indices (K, A_K, ΣK) calculated at PAG observatory in July 2012.

Activity indices			
PAG Observatory		July 2012	
Day	**K**	**Ak [nT]**	**ΣK**
1-Jul-12	3 3 3 3 3 3 3 4	17	25
2-Jul-12	3 4 3 3 4 3 3 2	17	25
3-Jul-12	2 2 3 3 2 3 2 2	10	19
4-Jul-12	3 2 1 2 2 2 1 2	7	15
5-Jul-12	3 3 2 4 4 3 3 3	17	25
6-Jul-12	2 3 2 2 3 4 4 4	17	24
7-Jul-12	2 2 2 3 2 2 3 3	10	19
8-Jul-12	2 3 2 3 3 3 2 4	14	22
9-Jul-12	5 3 3 4 4 5 3 4	28	31
10-Jul-12	3 2 3 3 2 3 3 2	12	21
11-Jul-12	2 2 3 4 2 2 2 3	12	20
12-Jul-12	3 3 3 2 2 2 1 2	10	18
13-Jul-12	1 2 1 1 1 1 1 1	4	9
14-Jul-12	1 2 1 1 2 3 5 5	17	20
15-Jul-12	4 5 5 5 3 5 6 5	45	38
16-Jul-12	4 4 3 3 3 3 2 2	16	24
17-Jul-12	3 3 3 1 1 3 2 2	10	18
18-Jul-12	2 2 1 1 1 1 2 1	5	11
19-Jul-12	1 2 2 2 2 1 1 1	5	12
20-Jul-12	1 3 2 3 2 3 3 3	12	20
21-Jul-12	2 2 2 2 2 3 3 2	9	18
22-Jul-12	2 2 3 3 1 1 2 2	8	16
23-Jul-12	2 2 2 1 3 3 3 3	11	19
24-Jul-12	2 2 2 2 2 1 2 1	6	14
25-Jul-12	2 2 2 1 1 1 1 1	5	11
26-Jul-12	1 1 1 0 1 1 0 0	2	5
27-Jul-12	1 2 2 2 1 1 1 2	5	12
28-Jul-12	1 2 2 2 2 2 4 4	12	19
29-Jul-12	2 3 2 2 1 1 1 1	6	13
30-Jul-12	2 2 2 3 3 4 4 2	14	22
31-Jul-12	2 2 1 2 2 2 1 2	6	14

Table 8. Local geomagnetic indices (K, A_K, ΣK) calculated at PAG observatory in August 2012.

Activity indices			
PAG Observatory		August 2012	
Day	**K**	**Ak [nT]**	**ΣK**
1-Aug-12	1 2 2 2 2 2 1 2	6	14
2-Aug-12	1 2 1 3 5 5 4 3	21	24
3-Aug-12	2 2 1 2 1 2 1 0	5	11
4-Aug-12	1 2 1 1 2 2 1 2	5	12
5-Aug-12	1 1 1 2 1 2 1 2	5	11
6-Aug-12	2 2 2 3 2 3 3 3	11	20
7-Aug-12	2 2 2 1 1 1 2 3	7	14
8-Aug-12	5 3 2 2 2 3 2 2	14	21
9-Aug-12	3 2 1 1 1 1 1 1	5	11
10-Aug-12	0 2 1 0 1 1 1 1	3	7
11-Aug-12	0 1 1 2 1 1 2 3	5	11
12-Aug-12	2 2 2 2 3 3 3 3	11	20
13-Aug-12	1 2 2 2 2 3 3 2	9	17
14-Aug-12	2 2 2 2 2 2 1 3	8	16
15-Aug-12	2 1 1 1 2 2 2 3	7	14
16-Aug-12	2 2 2 2 3 4 3 4	14	22
17-Aug-12	4 2 2 1 1 1 2 3	9	16
18-Aug-12	1 2 2 2 2 2 4 3	10	18
19-Aug-12	2 2 2 4 3 2 2 4	13	21
20-Aug-12	3 2 2 2 4 2 3 2	12	20
21-Aug-12	2 1 1 2 1 2 1 3	6	13
22-Aug-12	1 1 1 2 2 2 2 3	7	14
23-Aug-12	3 2 2 2 2 2 3 2	9	18
24-Aug-12	2 2 2 2 2 2 3 3	9	18
25-Aug-12	2 2 3 3 2 2 3 4	13	21
26-Aug-12	2 2 2 3 3 2 3 2	10	19
27-Aug-12	2 3 2 2 1 1 1 2	7	14
28-Aug-12	1 0 0 2 1 0 0 1	2	5
29-Aug-12	1 1 1 1 1 1 1 1	3	8
30-Aug-12	1 1 1 1 1 1 2 1	4	9
31-Aug-12	0 1 1 1 1 0 0 1	2	5

Table 9. Local geomagnetic indices (K, A_K, ΣK) calculated at PAG observatory in September 2012.

Activity indices			
PAG Observatory		September 2012	
Day	**K**	**Ak [nT]**	**ΣK**
1-Sep-12	2 1 2 2 1 2 1 2	6	13
2-Sep-12	3 2 3 2 2 3 4 4	15	23
3-Sep-12	3 3 2 3 5 5 4 4	25	29
4-Sep-12	3 2 3 2 2 3 3 3	12	21
5-Sep-12	4 4 4 4 2 3 4 3	22	28
6-Sep-12	3 3 1 1 1 3 3 2	10	17
7-Sep-12	1 2 2 1 1 2 4 4	11	17
8-Sep-12	3 1 2 2 2 2 2 1	7	15
9-Sep-12	1 1 2 2 1 1 1 2	5	11
10-Sep-12	2 2 2 0 2 1 2 0	5	11
11-Sep-12	0 1 2 1 0 0 0 1	2	5
12-Sep-12	1 1 2 2 2 1 2 2	6	13
13-Sep-12	2 2 1 1 0 2 1 1	4	10
14-Sep-12	1 2 1 1 1 2 1 3	6	12
15-Sep-12	2 2 1 2 1 2 2 3	7	15
16-Sep-12	2 2 2 2 1 1 3 1	7	14
17-Sep-12	2 1 1 1 1 1 1 1	4	9
18-Sep-12	2 3 2 2 2 2 1 1	7	15
19-Sep-12	1 2 1 2 2 4 5 5	19	22
20-Sep-12	3 2 3 2 2 2 2 2	9	18
21-Sep-12	1 1 1 2 2 2 2 1	5	12
22-Sep-12	2 1 1 2 1 1 0 2	4	10
23-Sep-12	0 1 1 0 0 0 0 0	1	2
24-Sep-12	0 1 0 1 1 1 1 1	2	6
25-Sep-12	1 0 0 1 1 1 0 0	2	4
26-Sep-12	1 1 1 1 2 1 3 3	7	13
27-Sep-12	3 2 1 1 1 1 1 1	5	11
28-Sep-12	0 1 1 1 1 1 1 0	2	6
29-Sep-12	1 1 2 1 2 1 1 1	4	10
30-Sep-12	1 1 1 3 3 3 3 4	12	19

Table 10. Local geomagnetic indices (K, A_K, ΣK) calculated at PAG observatory in October 2012.

Activity indices			
PAG Observatory		October 2012	
Day	**K**	**AK [nT]**	**ΣK**
1-Oct-12	5 4 3 2 2 2 2 1	15	21
2-Oct-12	2 1 0 2 3 2 2 2	7	14
3-Oct-12	3 2 2 2 1 1 1 1	6	13
4-Oct-12	0 1 0 0 0 0 0 0	0	1
5-Oct-12	0 1 1 1 1 2 2 3	5	11
6-Oct-12	2 1 1 2 2 2 2 2	6	14
7-Oct-12	1 2 1 1 1 1 3 3	7	13
8-Oct-12	3 3 5 5 4 3 5 4	30	32
9-Oct-12	5 5 4 4 2 2 3 5	28	30
10-Oct-12	3 2 2 3 2 4 4 3	15	23
11-Oct-12	2 2 1 2 2 2 1 2	6	14
12-Oct-12	3 3 3 2 3 3 3 2	13	22
13-Oct-12	3 4 4 4 4 6 4 4	32	33
14-Oct-12	4 2 3 3 4 3 5 4	23	28
15-Oct-12	3 2 2 2 2 1 2 2	8	16
16-Oct-12	1 1 2 2 1 2 1 2	5	12
17-Oct-12	2 1 2 1 2 1 1 3	6	13
18-Oct-12	3 1 2 2 1 1 1 2	6	13
19-Oct-12	3 2 1 1 1 0 0 0	4	8
20-Oct-12	0 0 2 2 1 0 0 0	2	5
21-Oct-12	1 2 2 1 1 1 1 1	4	10
22-Oct-12	1 1 1 1 0 1 1 1	3	7
23-Oct-12	2 2 2 2 2 2 3 1	8	16
24-Oct-12	2 1 1 1 1 1 1 1	4	9
25-Oct-12	1 1 1 2 1 0 1 2	4	9
26-Oct-12	1 1 1 1 1 2 2 2	5	11
27-Oct-12	2 0 1 1 1 1 1 1	3	8
28-Oct-12	0 1 2 2 2 1 1 0	4	9
29-Oct-12	1 0 1 0 0 0 0 2	2	4
30-Oct-12	2 1 1 1 0 0 0 1	2	6
31-Oct-12	0 0 0 1 2 3 2 3	6	11

Table 11. Local geomagnetic indices (K, A_K, ΣK) calculated at PAG observatory in November 2012.

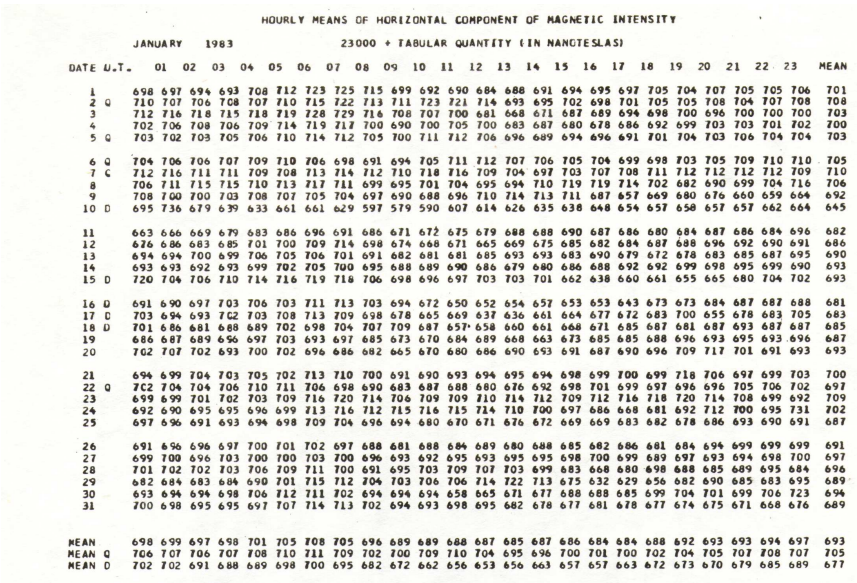
Activity indices			
PAG Observatory		November 2012	
Day	**K**	**Ak [nT]**	**ΣK**
1-Nov-12	3 2 2 3 3 4 5 4	20	26
2-Nov-12	2 3 2 2 1 1 1 2	7	14
3-Nov-12	1 1 2 1 2 1 1 1	4	10
4-Nov-12	0 1 1 1 1 1 0 0	2	5
5-Nov-12	0 0 2 2 1 2 1 1	4	9
6-Nov-12	1 1 0 1 1 2 2 2	4	10
7-Nov-12	3 3 2 1 3 4 5 4	20	25
8-Nov-12	1 1 1 1 0 0 0 2	2	6
9-Nov-12	1 1 1 0 0 0 1 0	2	4
10-Nov-12	0 0 0 0 0 0 1 3	2	4
11-Nov-12	0 0 1 1 1 1 0 1	2	5
12-Nov-12	2 1 0 1 0 2 3 5	10	14
13-Nov-12	4 4 3 3 3 3 5 4	24	29
14-Nov-12	5 5 4 3 4 2 1 2	23	26
15-Nov-12	1 0 1 2 1 1 1 2	4	9
16-Nov-12	2 1 1 1 1 3 3 3	8	15
17-Nov-12	2 2 2 3 2 2 3 3	10	19
18-Nov-12	1 1 2 1 1 2 0 3	5	11
19-Nov-12	1 1 2 2 2 2 1 2	6	13
20-Nov-12	2 2 2 2 3 3 4 3	13	21
21-Nov-12	3 2 2 2 1 2 3 1	8	16
22-Nov-12	1 1 1 1 1 0 0 1	2	6
23-Nov-12	0 0 1 1 1 1 3 4	7	11
24-Nov-12	4 3 2 2 3 3 2 2	13	21
25-Nov-12	1 2 1 1 1 2 1 2	5	11
26-Nov-12	2 2 2 2 0 1 1 1	5	11
27-Nov-12	1 1 1 1 1 1 2 1	4	9
28-Nov-12	1 1 0 0 0 0 1 2	2	5
29-Nov-12	1 0 1 2 0 2 1 1	3	8
30-Nov-12	0 1 1 1 1 1 0 1	2	6

Table 12. Local geomagnetic indices (K, A_K, ΣK) calculated at PAG observatory in December 2012.

Activity indices			
PAG Observatory		December 2012	
Day	**K**	**Ak [nT]**	**ΣK**
1-Dec-12	1 1 1 1 2 1 4 3	8	14
2-Dec-12	2 1 3 2 2 1 1 0	6	12
3-Dec-12	0 1 1 1 1 1 1 2	3	8
4-Dec-12	2 2 1 2 1 0 1 0	4	9
5-Dec-12	0 1 1 1 0 0 1 1	2	5
6-Dec-12	1 1 1 1 0 0 0 0	2	4
7-Dec-12	0 0 1 0 0 0 1 0	1	2
8-Dec-12	0 0 1 0 1 1 1 1	2	5
9-Dec-12	1 2 1 2 1 2 1 3	6	13
10-Dec-12	3 1 1 2 1 1 1 1	5	11
11-Dec-12	1 1 1 1 0 0 1 1	2	6
12-Dec-12	1 0 1 1 1 1 0 1	2	6
13-Dec-12	2 1 0 0 0 0 1 1	2	5
14-Dec-12	2 2 2 2 1 1 2 3	7	15
15-Dec-12	2 2 2 2 3 3 3 2	10	19
16-Dec-12	2 0 1 1 2 2 2 1	5	11
17-Dec-12	2 2 2 4 3 3 1 1	11	18
18-Dec-12	2 2 1 3 2 3 1 1	8	15
19-Dec-12	1 2 2 2 1 1 1 1	5	11
20-Dec-12	0 1 2 2 3 3 3 2	9	16
21-Dec-12	2 1 1 1 0 1 1 1	3	8
22-Dec-12	0 0 1 1 0 0 0 1	1	3
23-Dec-12	0 0 1 1 1 1 0 0	2	4
24-Dec-12	0 1 1 1 1 3 1 1	4	9
25-Dec-12	1 1 1 1 0 1 1 2	3	8
26-Dec-12	0 1 0 1 1 0 0 1	2	4
27-Dec-12	1 0 1 1 0 0 0 0	1	3
28-Dec-12	1 1 1 1 1 0 1 2	3	8
29-Dec-12	1 1 1 1 1 1 0 2	3	8
30-Dec-12	1 1 2 2 2 2 2 1	6	13
31-Dec-12	0 1 1 1 0 0 0 0	1	3

Quasi-definitive hourly mean values of the Declination (D), Horizontal (H), and Vertical (Z) field components.

Until the advent of digital recording systems hourly mean values (HMVs) were the primary data product from magnetic observatories. Both, the spot hourly values and the HMVs were usually compiled into monthly tables. These tables were published in observatory yearbooks as shown in Fig. 1 (see Buchvarov, 2006).



HOURLY MEANS OF HORIZONTAL COMPONENT OF MAGNETIC INTENSITY

JANUARY 1983 23000 + TABULAR QUANTITY (IN NANOTESLAS)

DATE	U.T.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
1		698	697	694	693	708	712	723	725	715	699	692	690	684	688	691	694	695	697	705	704	707	705	705	706	701
2	Q	710	707	706	708	707	710	715	722	713	711	723	721	714	693	695	702	698	701	705	705	708	704	707	708	708
3		712	716	718	715	718	719	728	729	716	708	707	700	681	668	671	687	689	694	698	700	696	700	700	700	703
4		702	706	708	706	709	714	719	717	700	690	700	705	700	683	687	680	678	686	692	699	703	703	701	702	700
5	Q	703	702	703	705	706	710	714	712	705	700	711	712	706	696	689	694	696	691	701	704	703	706	704	704	703
6	Q	704	706	706	707	709	710	706	698	691	694	705	711	712	707	706	705	704	699	698	703	705	709	710	710	705
7	C	712	716	711	711	709	708	713	714	712	710	718	716	709	704	697	703	707	708	711	712	712	712	712	709	710
8		706	711	715	715	710	713	717	711	699	695	701	704	695	694	710	719	719	714	702	682	690	699	704	716	706
9		708	700	700	703	708	707	705	704	697	690	688	696	710	714	713	711	687	657	669	680	676	660	659	664	692
10	D	695	736	679	639	633	661	661	629	597	579	590	607	614	626	635	638	648	654	657	658	657	657	662	664	645
11		663	666	669	679	683	686	696	691	686	671	672	675	679	688	688	690	687	686	680	684	687	686	684	696	682
12		676	686	683	685	701	700	709	714	698	674	668	671	665	669	675	685	682	684	687	688	696	692	690	691	686
13		694	694	700	699	706	705	706	701	691	682	681	681	685	693	693	683	690	679	672	678	683	685	687	695	690
14		693	693	692	693	699	702	705	700	695	688	689	690	686	679	680	686	688	692	692	699	698	695	699	690	693
15	D	720	704	706	710	714	716	719	718	706	698	696	697	703	703	701	662	638	660	661	655	665	680	704	702	693
16	D	691	690	697	703	706	703	711	713	703	694	672	650	652	654	657	653	653	643	673	673	684	687	687	688	681
17	D	703	694	693	702	703	708	713	709	698	678	665	669	637	636	661	664	677	672	683	700	655	678	683	705	683
18	D	701	686	681	688	689	702	698	704	707	709	687	657	658	660	661	668	671	685	687	681	687	693	687	687	685
19		686	687	689	656	697	703	693	697	685	673	670	684	689	668	663	673	685	685	688	696	693	695	693	696	687
20		702	707	702	693	700	702	696	686	682	665	670	680	686	690	693	691	687	690	696	709	717	701	691	693	693
21		694	699	704	703	705	702	713	710	700	691	690	693	694	695	694	698	699	700	699	718	706	697	699	703	700
22	Q	702	704	704	706	710	711	706	698	690	683	687	688	680	676	692	698	701	699	697	696	696	705	706	702	697
23		699	699	701	702	703	709	716	720	714	706	709	709	710	714	712	709	712	716	718	720	714	708	699	692	709
24		692	690	695	695	696	699	713	716	712	715	716	715	714	710	700	697	686	668	681	692	712	700	695	731	702
25		697	696	691	693	694	698	709	704	696	694	680	670	671	676	672	669	669	683	682	678	686	693	690	691	687
26		691	696	696	697	700	701	702	697	688	681	688	684	689	680	688	685	682	686	681	684	694	699	699	699	691
27		699	700	696	703	700	700	703	700	696	693	692	695	693	695	695	698	700	699	689	697	693	694	698	700	697
28		701	702	702	703	706	709	711	700	691	695	703	709	707	703	699	683	668	680	698	688	685	689	695	684	696
29		682	684	683	684	690	701	715	712	704	703	706	706	714	722	713	675	632	629	656	682	690	685	683	695	689
30		693	694	694	698	706	712	711	702	694	694	694	658	665	671	677	688	688	685	699	704	701	699	706	723	694
31		700	698	695	695	697	707	714	713	702	694	693	698	695	682	678	677	681	678	677	674	675	671	668	676	689
MEAN		698	699	697	698	701	705	708	705	696	689	689	688	687	685	687	686	684	684	688	692	693	693	694	697	693
MEAN	Q	706	707	706	707	708	710	711	709	702	700	709	710	704	695	696	700	701	700	702	704	705	707	708	707	705
MEAN	D	702	702	691	688	689	698	700	695	682	672	662	656	653	656	663	657	657	663	672	673	670	679	685	689	677

Fig. 1. Table of HMVs of Panagyurishte (PAG) observatory for the H component in January 1983

Presently, hourly mean values are based on the digital recordings of the three-component fluxgate magnetometer FGE. The baseline of this magnetometer is determined from absolute measurements with a DI-flux theodolite and an Overhauser proton magnetometer.

Before calculating the HMVs, inspection and verification of the reported data was performed. The reported data (available in near real time) are usually used in applications where the reliable representation of higher-frequency magnetic field variations is more important rather than absolute levels or secular variation. This concerns, e.g. the forecast of magnetic activity, radio-wave propagation, or space weather. In the case of reported data it is not possible to verify them prior to dissemination. Careful monitoring of the automatically transmitted data and the present-day computer technologies enable us to improve the quality of data and reduce the number of gaps in the records. After the quality control procedures have been applied to the 2012 reported data, we obtained the quasi-definitive minute mean values and calculated the HMVs.

Monthly elements' plot of the hourly mean values of the Declination (D), Horizontal (H), and Vertical (Z) field components for 2012 are shown in next figures:

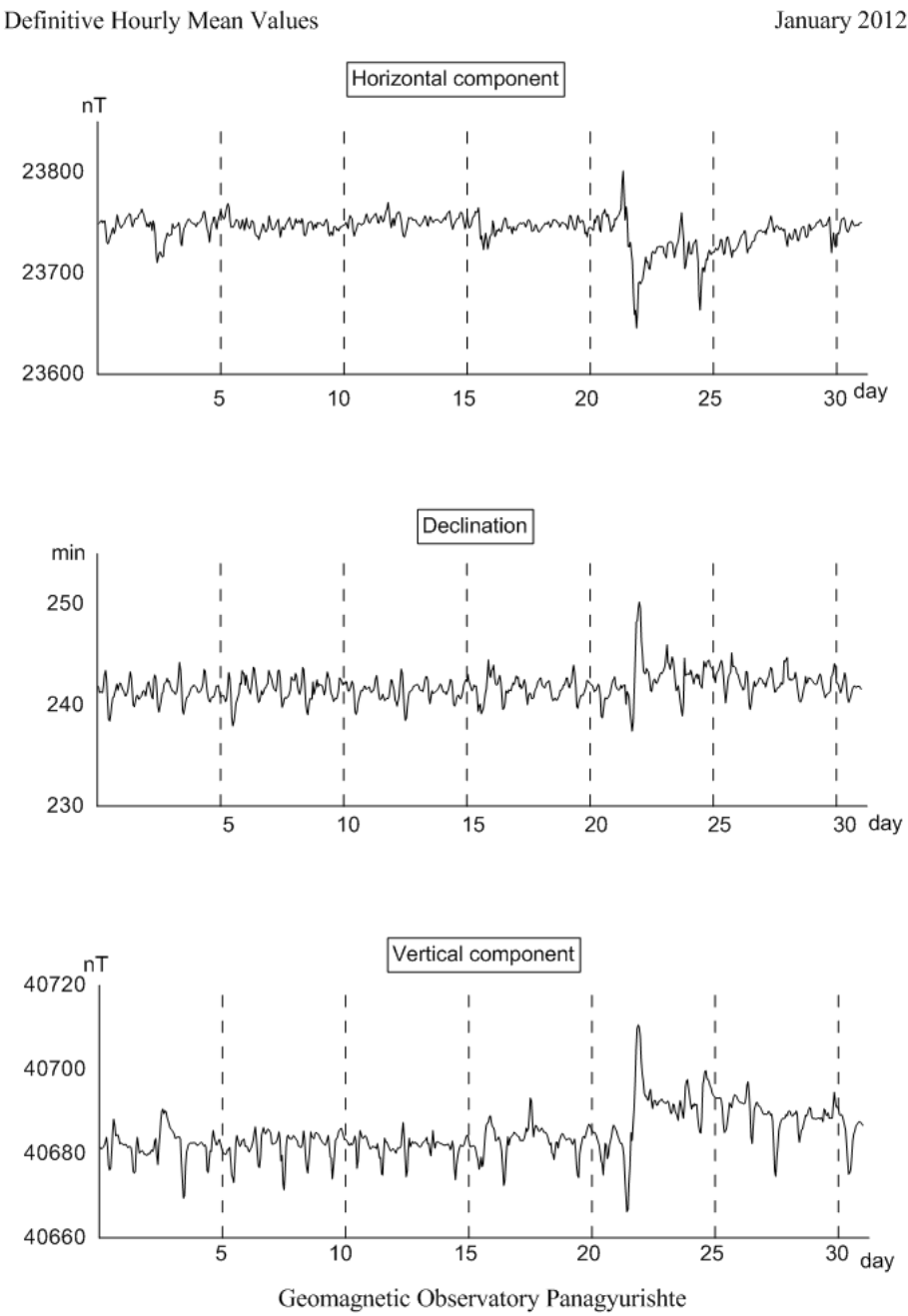


Fig. 2. Plot of the hourly mean values of the geomagnetic field components registered in PAG observatory for January 2012.

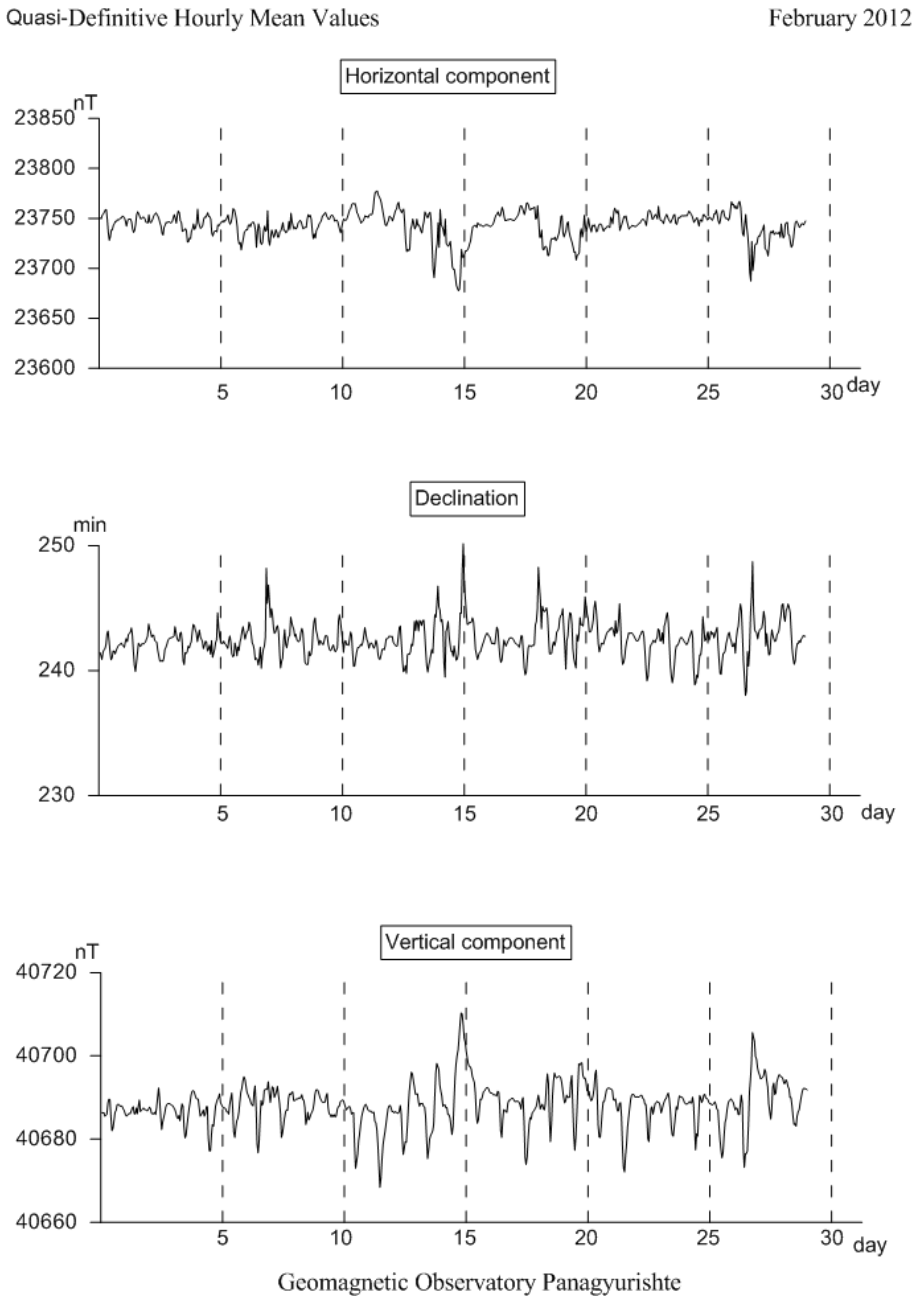


Fig. 3. Plot of the hourly mean values of the geomagnetic field components registered in PAG observatory for February 2012.

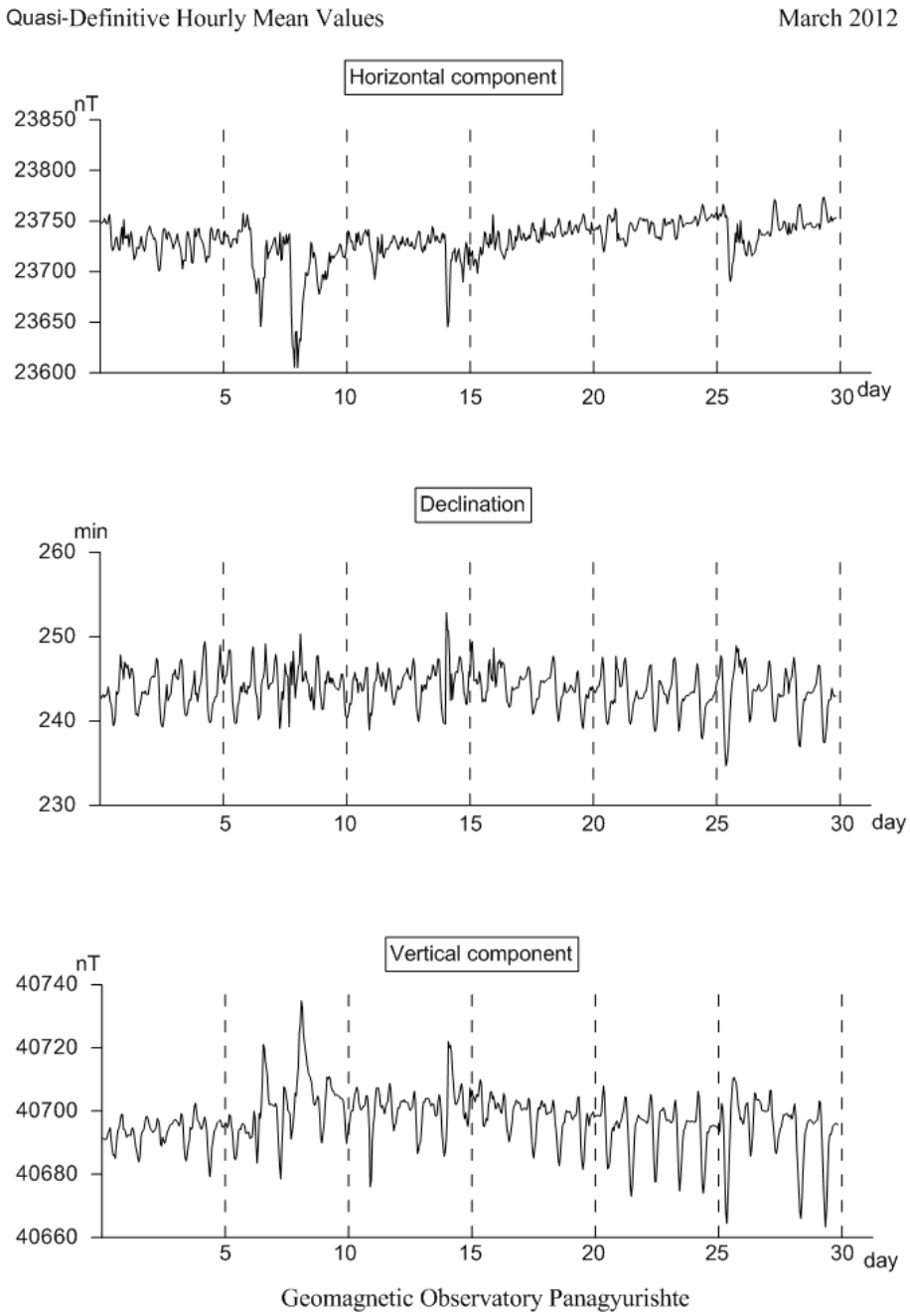


Fig. 4. Plot of the hourly mean values of the geomagnetic field components registered in PAG observatory for March 2012.

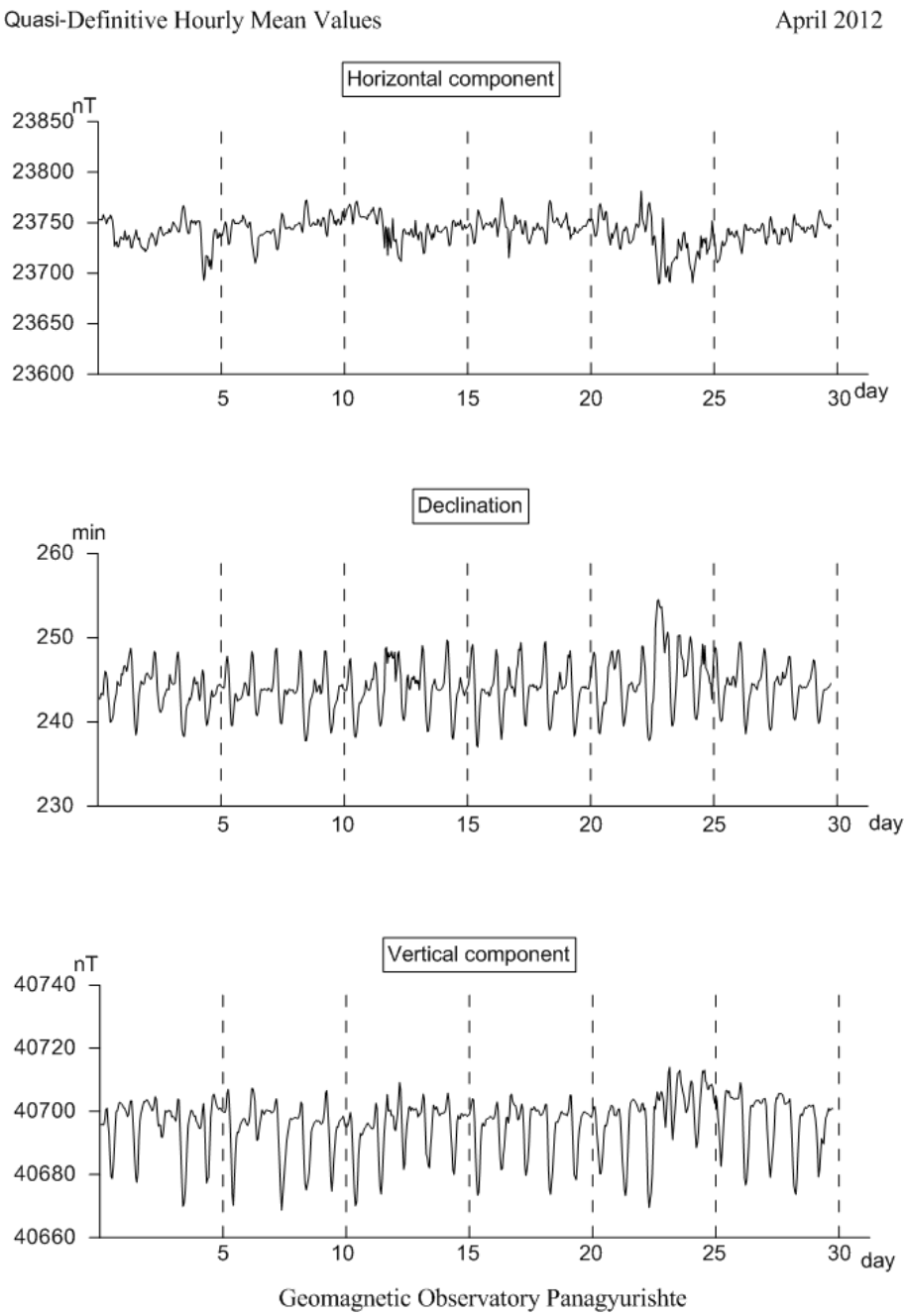


Fig. 5. Plot of the hourly mean values of the geomagnetic field components registered in PAG observatory for April 2012.

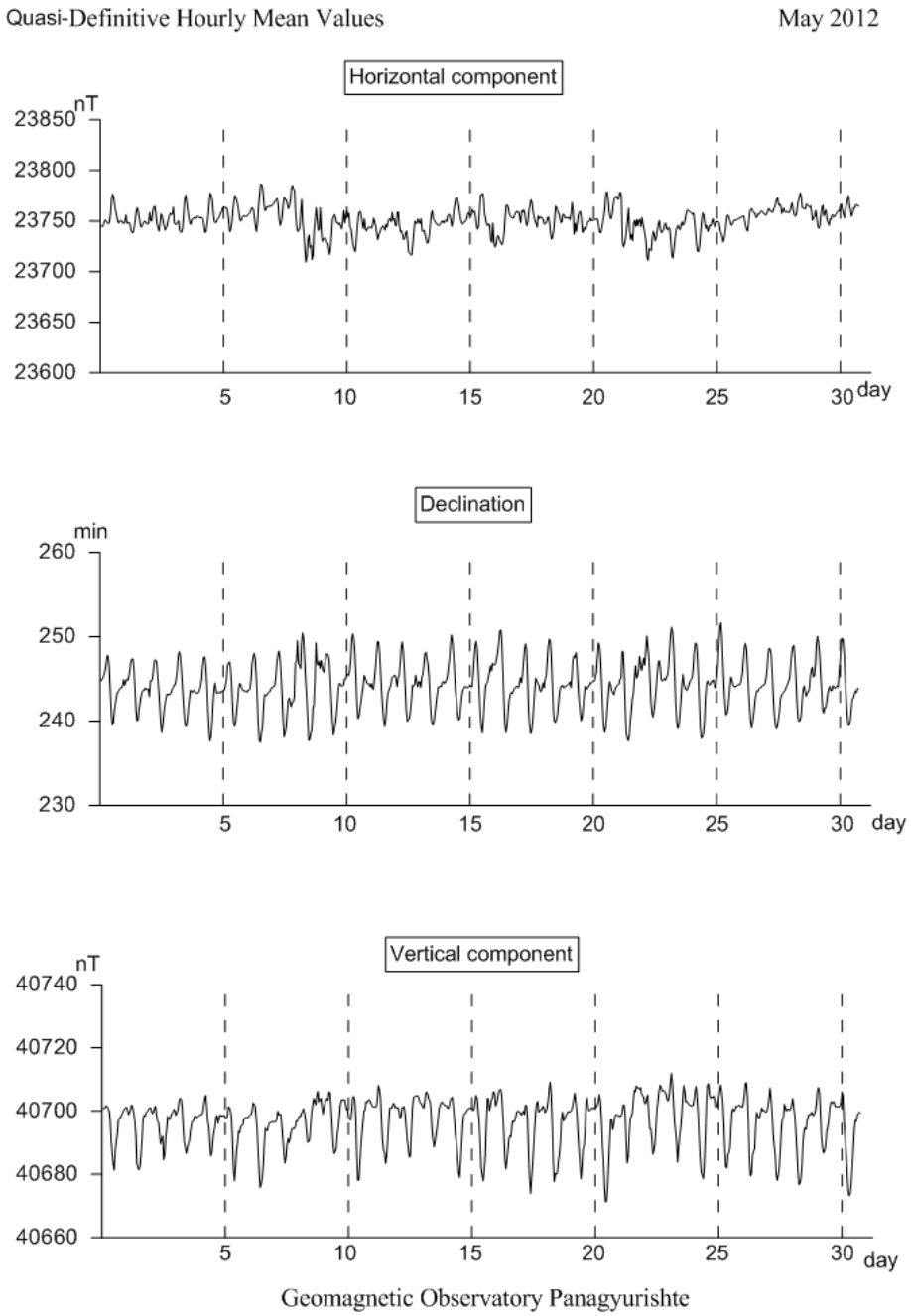


Fig. 6. Plot of the hourly mean values of the geomagnetic field components registered in PAG observatory for May 2012.

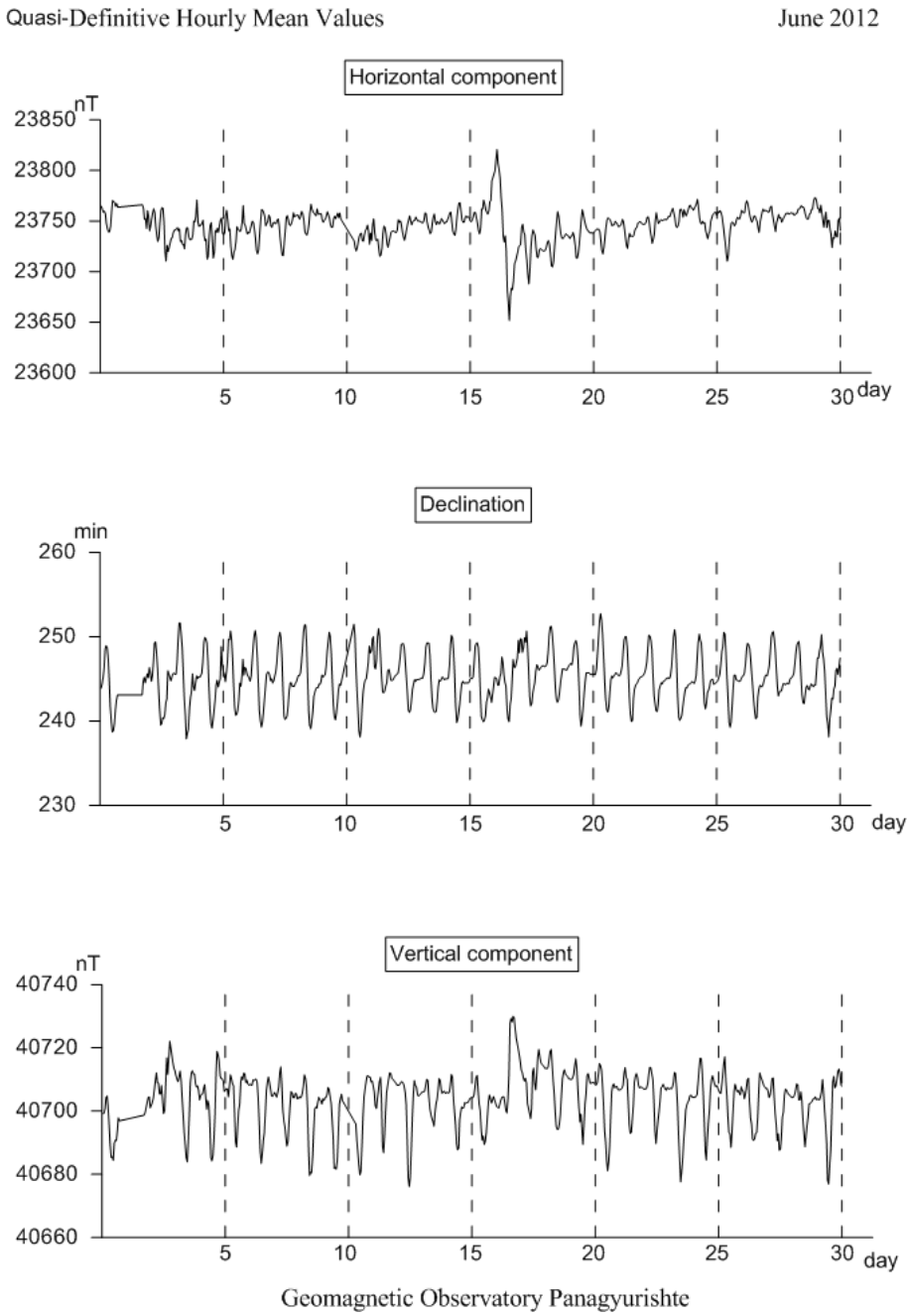


Fig. 7. Plot of the hourly mean values of the geomagnetic field components registered in PAG observatory for June 2012.

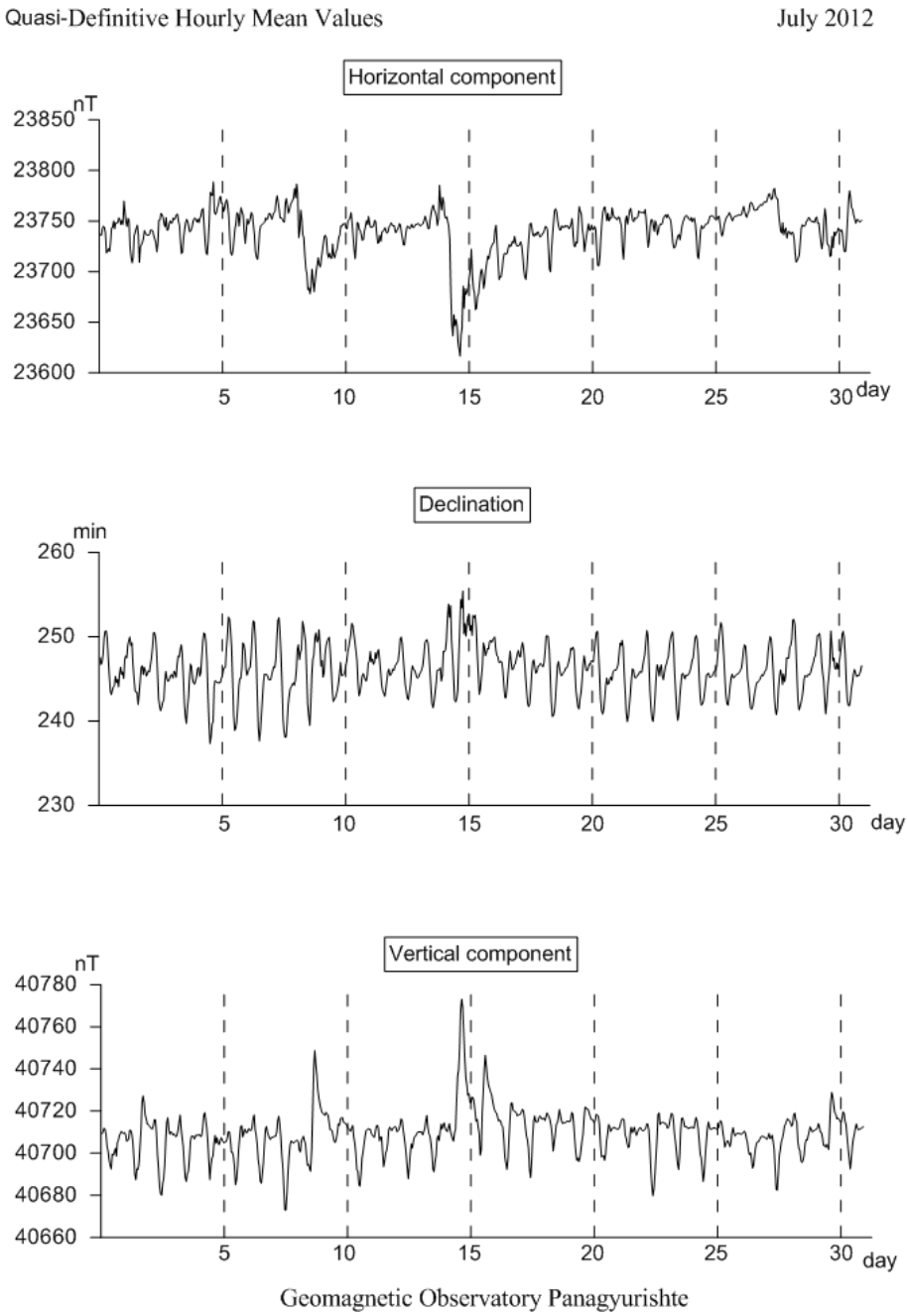


Fig. 8. Plot of the hourly mean values of the geomagnetic field components registered in PAG observatory for July 2012.

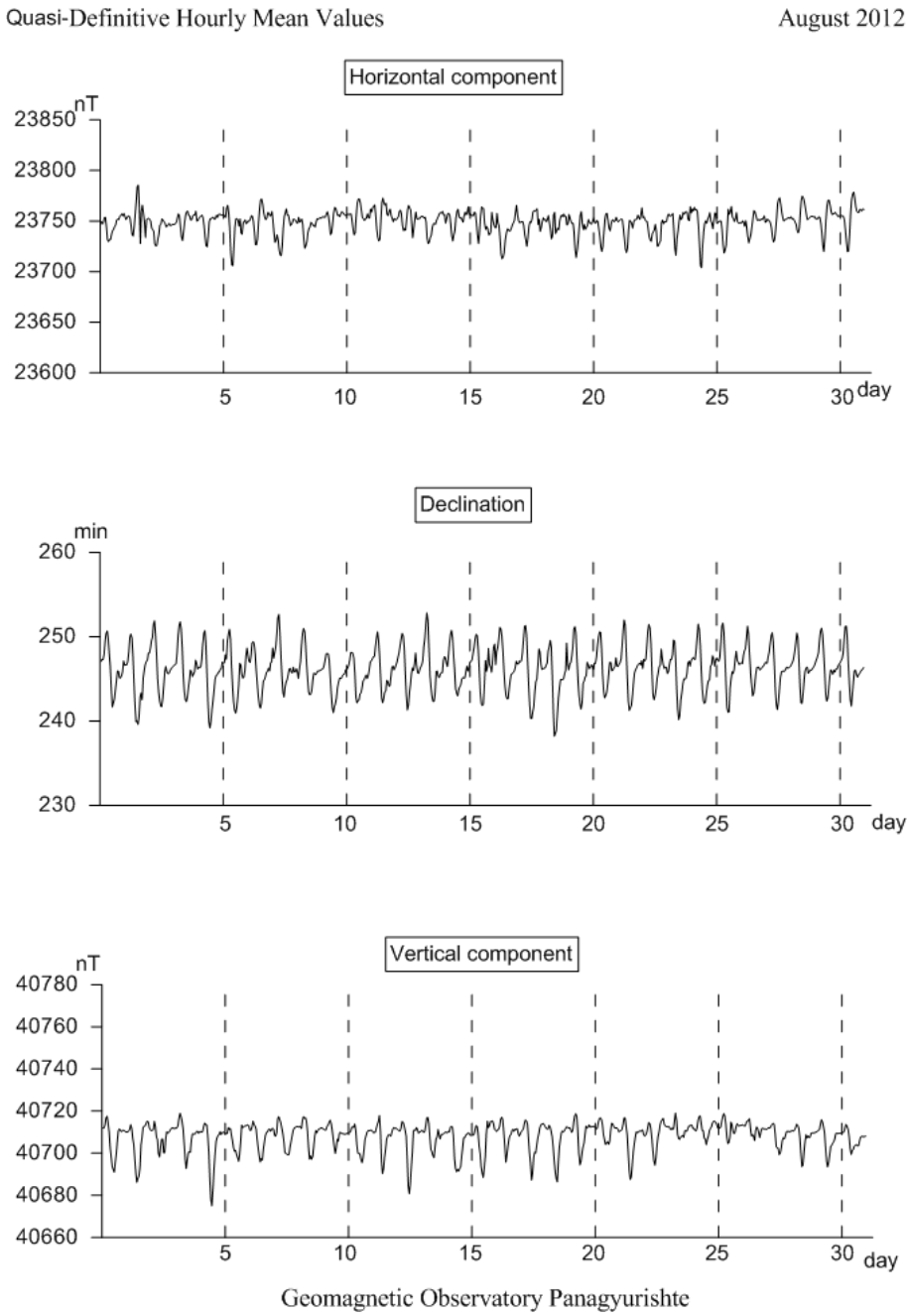


Fig. 9. Plot of the hourly mean values of the geomagnetic field components registered in PAG observatory for August 2012.

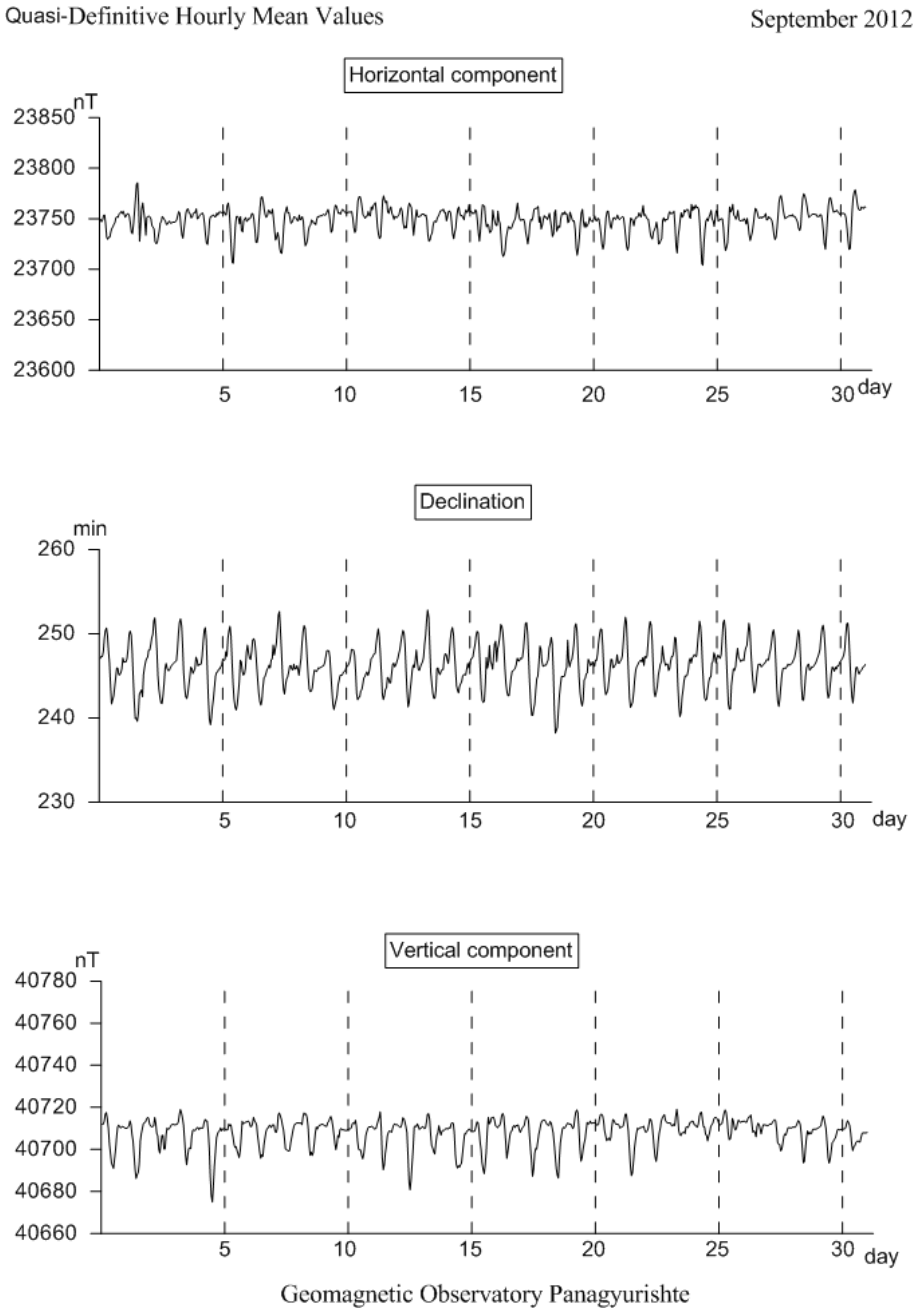


Fig. 10. Plot of the hourly mean values of the geomagnetic field components registered in PAG observatory for September 2012.

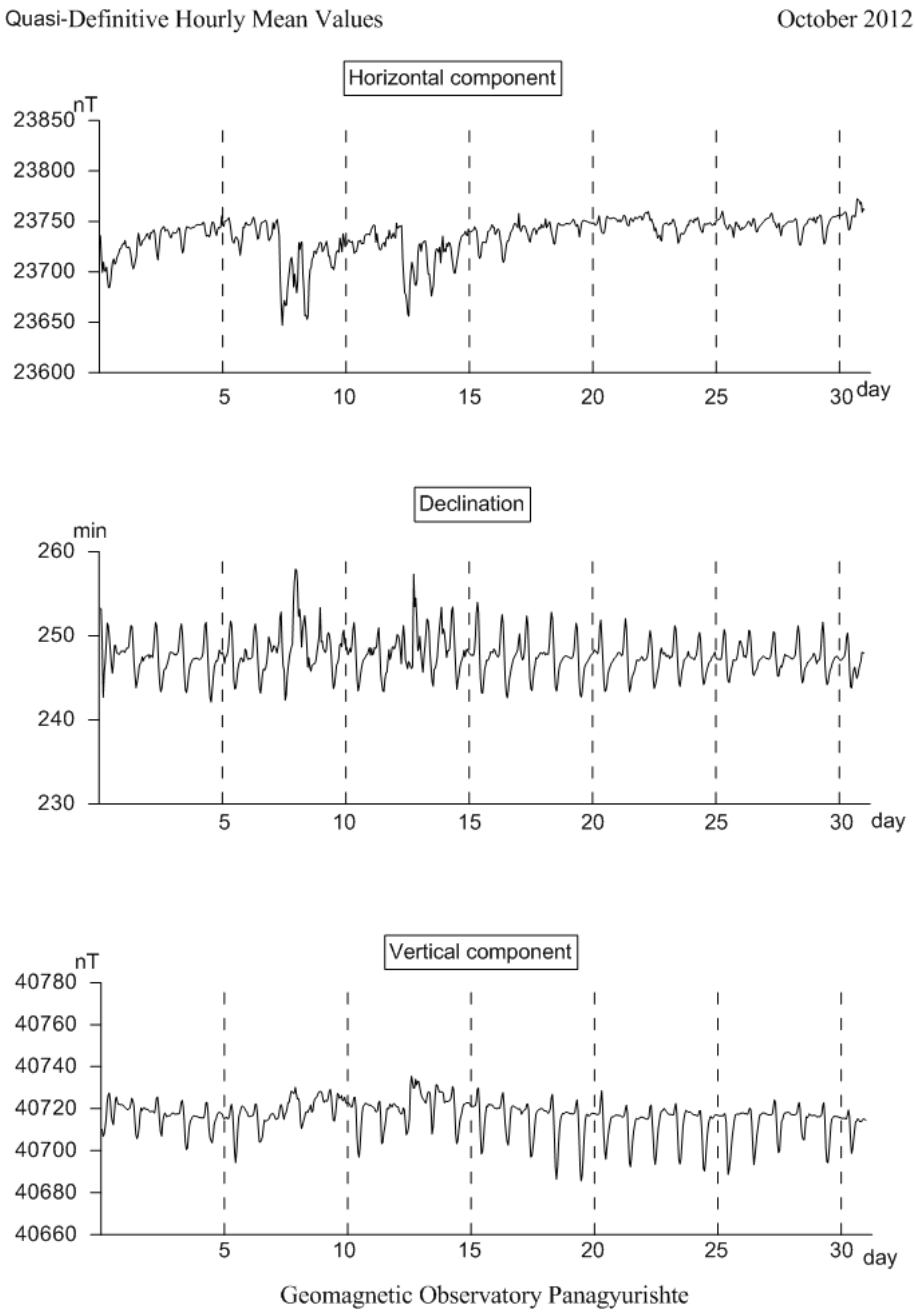


Fig. 11. Plot of the hourly mean values of the geomagnetic field components registered in PAG observatory for October 2012.

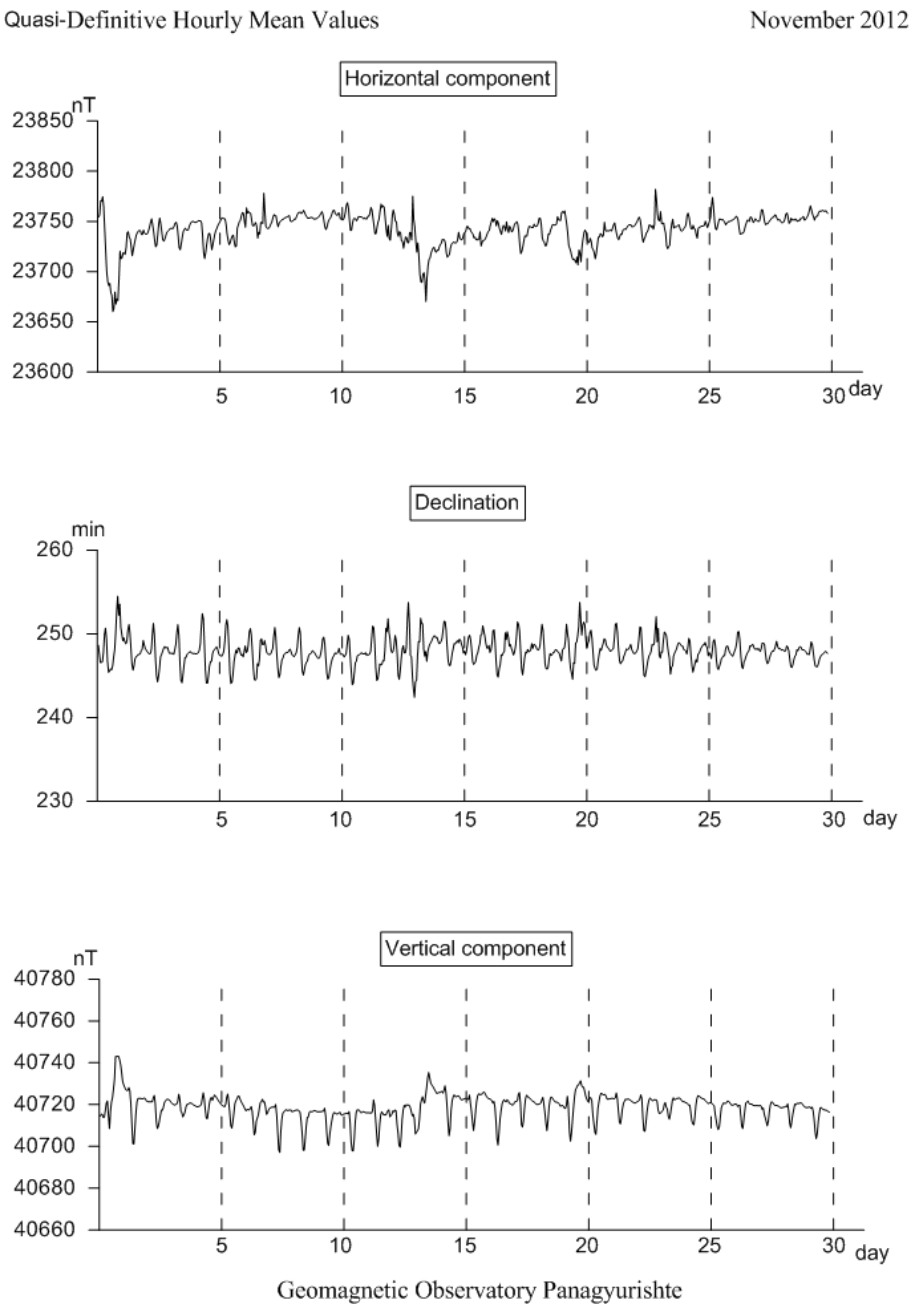


Fig. 12. Plot of the hourly mean values of the geomagnetic field components registered in PAG observatory for November 2012

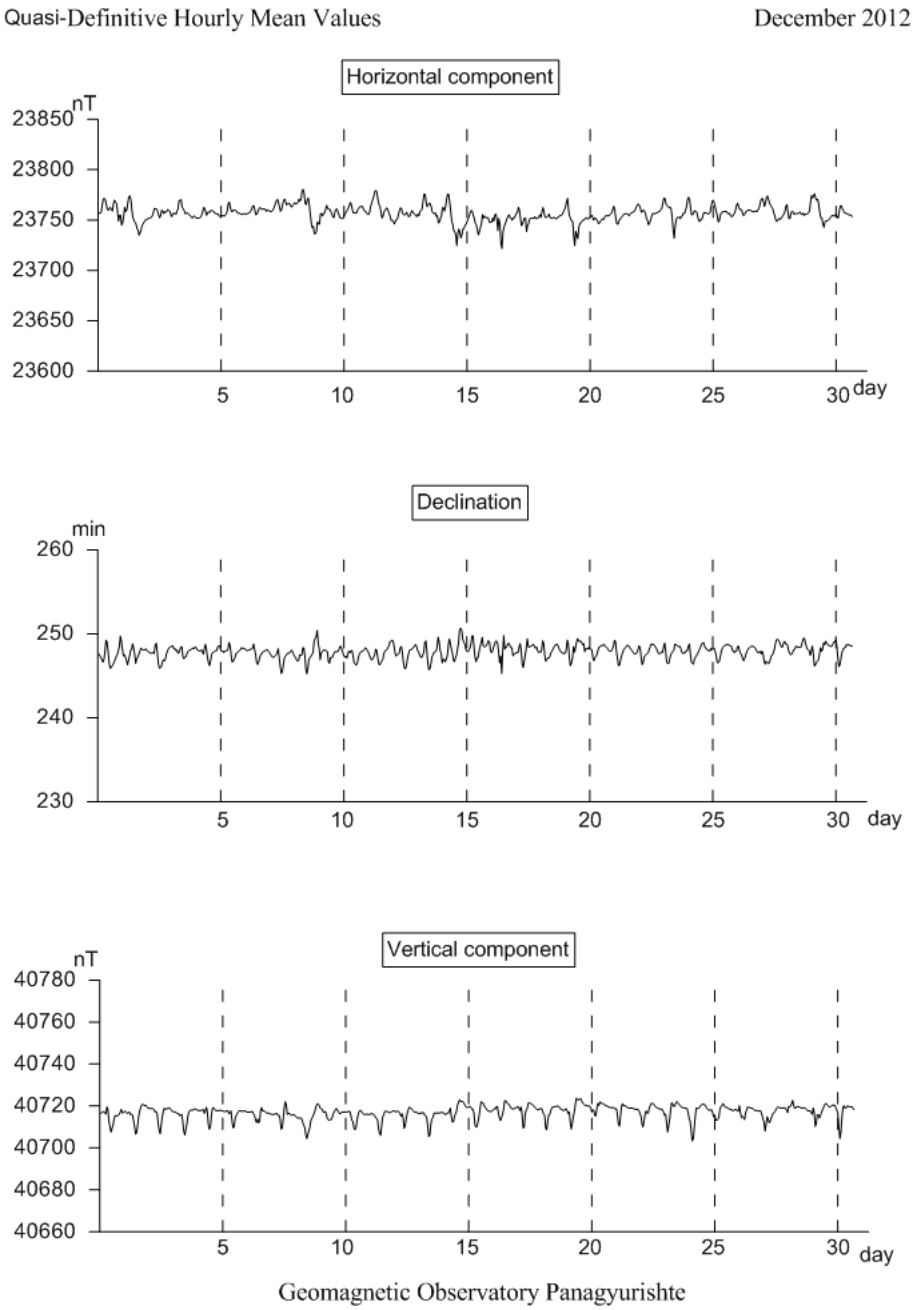


Fig. 13. Plot of the hourly mean values of the geomagnetic field components registered in PAG observatory for December 2012.

Conclusions

Continuous registration of the geomagnetic field components gives the sum of all field contributions from the sources internal and external to the Earth. A straightforward separation of the the individual contributions is impossible and many scientific studies deal with different aspects of this problem (Mandea nad Korte, 2010). Approximate description of the strength of different external variations , however, are provided by geomagnetic indices. A quantitative measure of the 2012 local geomagnetic activity in the form of 3 hour *K*-index is published here, based upon the range of fluctuations in the PAG observatory traces over 3 h. intervals. Tables shows that 2012 has relatively quiet geomagnetic field. Monthly variations of the geomagnetic field components are plotted by means of hourly mean values. Data are checked and verified according to IAGA requirements (Jankowski and Sucksdorff, 1996).

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Годишен доклад за наблюдаваната геомагнитна активност в Обсерватория Панагюрище

П. Трифонова, М. Методиев

Резюме: Понастоящем, в ерата на интернет комуникациите, записите от геомагнитните обсерватории се предоставят на заинтересованите потребители почти в реално време, докато обработените времеви серии (окончателни данни) са обект н амного проверки и се разпространяват с месеци закъснение. Настоящият доклад представя квази-окончателни геомагнитни данни, получени в Обсерватория Панагюрище през 2012 г., изготвени под формата на локални геомагнитни индекси и графики на средночасовите стойности на компонентите на магнитното поле. Верификацията на данните е извършена в съответствие с изискванията на IAGA.