IONOSPHERE DISTURBANCES OBSERVATIONS DURING THE PERIOD OF SOLAR ACTIVITY MAXIMUM

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ABSTRACT. Strong ionosphere disturbances dates in the first half of 2012 year are defined on the data of ionosonds network. Sporadic E_s layer appearance and strong radio wave absorption phenomena, when the reflections from ionosphere are completely absence, are studied. We show, that frequency and duration of ionosphere disturbances are increased in summer months compare to winter ones.

Key words: ionosphere, ionogram

Ionosphere observations are provided for a long time and are an actual problem. It take place mostly because of ionosphere have a significant effect on radio communications in various frequency ranges. For the radio astronomy the ionosphere has also great importance, because it can significantly distort signals from cosmic radio sources, which is received by the earth based radio telescopes. The most serious distortions are appeared during the disturbances in ionosphere. So the problem of observation and registration of ionosphere disturbances are very important.

The base instrument for ionosphere observation is the ionosphere stations (ionosonds) network, which give all ionosphere parameters in real time. Results of ionosond measures are fixed on the ionograms, which represents the dependence of signals, reflected from ionosphere from the transmitted frequency

Most ionosondes in Europe are uniting in the common system named DIAS (European Digital Upper Atmosphere Server) [1, 2]. The data, provided by this system allow to estimate enough good ionosphere conditions, and particularly, to define presence of disturbances. In this work we use data mostly from Warsaw ionosond.

Ionosphere disturbances observations are in particular interest during the solar activity maximum, because in this period the number and the intensity of ionosphere disturbances are increased as a rule. In this work we study ionosphere disturbances, which occurred in the first half of 2012 year, i.e. in the period of solar activity maximum or the period that is closely precede to it.

The ionospheres disturbances are often connect with the varying of F2 layer critical frequency over it mean value. Such disturbances can be positive (when the critical frequency increase) or negative (when the critical frequency decrease). Ionosphere disturbances caused in most times by the solar flares and their consequences [3]. After the strong solar flare the X-ray stream is appear, then it reaches Earth and caused higher ionization of ionosphere (mostly of D layer). Such disturbances named sudden ionosphere disturbances. Something later the stream of particles, mainly protons, are reaches the Earth, and they also cause higher ionization and respectively ionosphere disturbances. But such disturbances are take place only on the high latitudes.

Other type of ionosphere disturbances is caused by magnetic storms [3], which lead to electron concentration changes and so to increase of radio waves absorption.

Along with the above mentioned types of ionosphere disturbances we may consider such phenomena as an E_s sporadic layer. This layer is not regular and it can appear in any time of the day and in any time of the year. Duration of it existence is not big and can be from some minutes to some hours. However, because of high electron concentration in this layer, it can significantly influence on the radio waves spreading. Particularly, when sounding ionosphere from the Earth, it can black out higher layers. On the other side, when the radio waves come from the space, as it take place during the radio astronomy observations, they may not reach the Earth. So, sporadic layer E_s appearance can significantly influence on the radio astronomy observations, and it study is very important.

The typical example of sporadic layer E_s appearance is showed on the figure 1, where some consequent ionorams are presented. Ionograms interval is 15 minutes. Sporadic layer E_s appeared as a horizontal strait trace and reflections from higher layers are absent because of black out effect. Within near half an hour, sporadic layer E_s is disappear and ionograms becomes to its original form.

From ionograms of the first half of year 2012 there was defined all dates of sporadic layer E_s appearance and it's approximately times of appearance and durations. This data is presented in table 1.

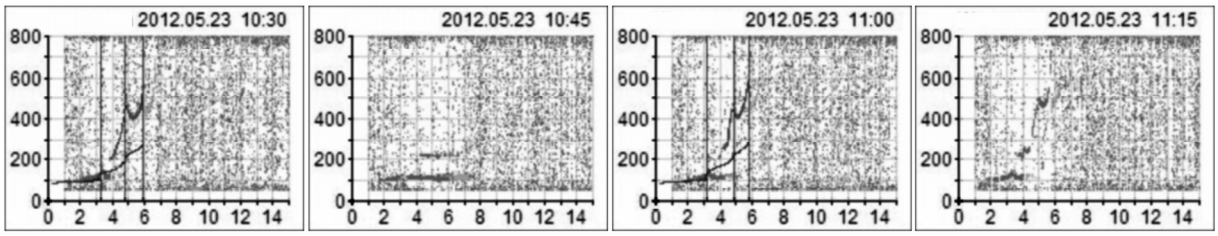

Figure 1: Ionograms 23.05.2012. Sporadic layer E_s appearance.

Table 1: Dates, time of appearance and durations of sporadic layer E_s in the first half of year 2012.

DATE	TIME	Duration	DATE	TIME	duration	DATE	TIME	duration
January 02	15:00	1	May 01	18:45	1	June 04	17:30	0.5
05	17:00	1	02	19:15	0.5	06	10:45	1
07	20:00	1	05	10:00	1.5	09	17:30	1
07	22:00	0.5	10	23:00	3	10	05:15	3
15	19:00	0.5	11	00:00	1	11	07:45	2
16	20:00	0.5	14	12:00	0.5	12	06:45	2
17	05:30	0.5	17	16:30	1	12	10:45	2
19	17:30	1.5	18	22:15	0.5	14	19:45	0.5
23	04:00	1	23	10:45	0.3	15	10:30	1
February 08	04:30	1	24	03:15	1.5	17	07:00	1
20	21:30	0.5	27	19:15	1	17	17:30	1
March 02	11:00	1	27	23:00	0.5	18	00:30	0.5
April 01	21:45	1	28	02:15	1	19	03:00	1
29	19:00	0.5	28	06:15	1	26	07:00	2
30	09:45	0.5	28	17:00	3	27	15:30	2.5
			28	17:00	3	28	17:00	1
			29	17:45	1	29	08:00	0.5
			29	23:15	1	29	14:30	3
			31	20:15	0.45	30	16:00	2

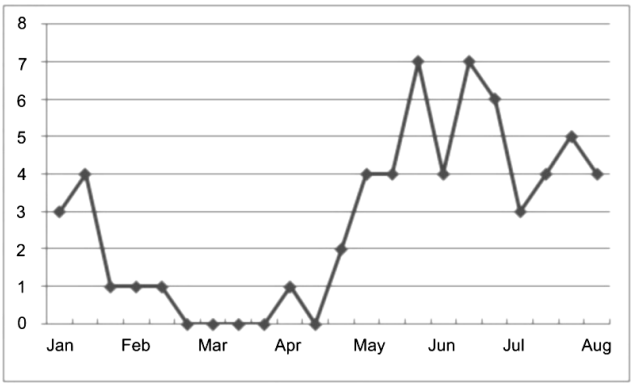

Figure 2: Sporadic layer E_s appearance frequency.

Also there was calculated approximately values of frequency of sporadic layer E_s appearance. Thees values were calculated as a ratio of number of days, when the sporadic layer E_s layer appears, to all days of observations in decade. This data is presented on figure 2. This plot shows that in summer months (beginning from May) the frequency of sporadic layer E_s appearance is significantly higher than in winter ones. Duration of sporadic layer E_s existence is also higher in summer month than in winter ones. The most notable days were July 2 and 17, when sporadic layer E_s was practically continuously exist for 10 and12 hours respectively.

When ionograms was analyzed, there was find some phenomena of strong radio wave absorption, when reflections from ionosphere are completely absent (so called black-outs). Example of such phenomena showed on figure 3. For the comparison, figure 4 show ionograms made in the same time of previous day, when the disturbance was absent. Such phenomena were observed several times during the given period.

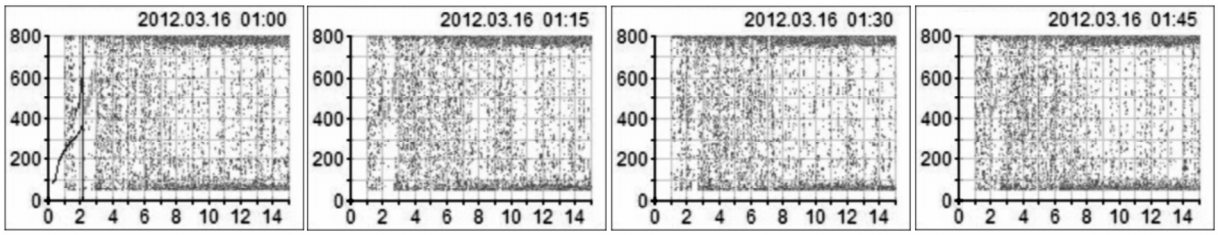

Figure 3. Ionograms 16.03.2012. Reflections from ionosphere are absent.

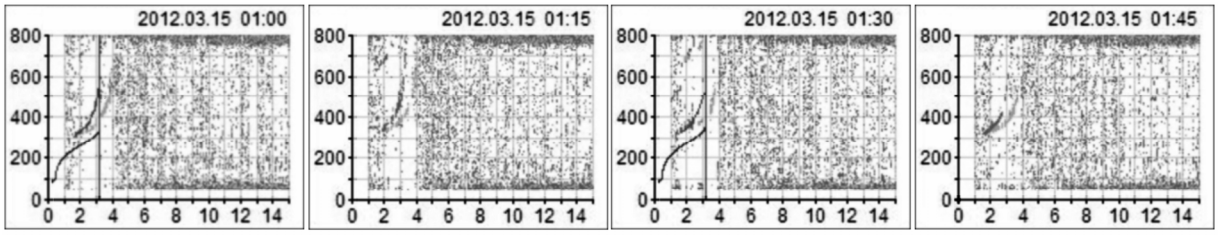

Fig.4. Ionograms 15.03.2012. Ordinary reflections from ionosphere.

The strongest effects of such type was observed on Mach 16, when reflections from ionosphere was absent for 2.5 hours, and on July 15, when reflections was absent for 2 hours. Similar phenomena were observed on January 24, April 24 and July 9, 11 and 19.

References

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