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RESEARCH OF DEFORMATIONS OF THE LOCAL SATELLITE GEODETIC NETWORK

ИССЛЕДОВАНИЕ ДЕФОРМАЦИЙ ПО НАБЛЮДЕНИЯМ ЛОКАЛЬНОЙ СПУТНИКОВОЙ ГЕОДЕЗИЧЕСКОЙ СЕТИ

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Аннотация. Представлены результаты исследования движений и деформаций земной поверхности по спутниковым наблюдениям локальной сети.

Ключевые слова: геодинамика, мониторинг, спутниковые наблюдения, GPS.

Abstract. The results of research of motions and deformations of earthly surface are presented on the satellite supervisions of local network.

Keywords: geodynamic, monitoring, satellite supervisions, GPS.

This article is translation of the complemented material, published authors in [4].

The considered local satellite geodetic network consists of four points of the Fundamental astronomic-geodetic network and is located on a rather steady site of earth crust within the East European platform (Moscow region). The scheme of the analyzed network is resulted in the work of authors of the given article [3].

As the researches show, such territories come under the influence of remote seismic events what is possible to register by means of repeated satellite geodetic measurements which however are in their turn the subject of influence by various factors (including meteoparameters), deforming the results. In the present article the attempt is made to reveal the connection between the changes of parameters of deformations of a geodetic network and various external phenomena.

For the analysis from the archive SOPAC of International service IGS the satellite supervision from four points of the considered network for 2007 have been received. After the preprocessing the results for the equalizing and analysis of the geodynamic phenomena in a network the technique of the analysis of movements and deformations by the results of satellite measurements in the local geodetic networks has been used which was developed by V.I.Kaftan and P.A. Dokukin and described by them in [1]. Thus, the empirical material in the form of time series of vectors of displacement and parametres of deformations of the considered satellite geodetic network has been received. For the analysis of changes the component of the base lines between the points of the network, time series of seismic activity, solar activity, temperatures and pressure (tab. 1) have been used.

Table 1.

Summary table according to time series

Date	Solar activity	temperature, °	Pressure , mm.m.c	Magnitude M	Date	Solar activity	temperature, °	Pressure , mm.m.c	Magnitude M
01.Jan	757	2,3	736	5,4	10.July	727	19,7	739	5,0
11. Jan	730	8,3	734	6,0	20. July	626	18,8	746	5,4
21. Jan	685	-3,0	731	7,5	30. July	639	24,2	742	5,6
31. Jan	779	-9,8	738	6,5	09.Aug	623	21,0	755	5,6
10.Feb	665	-11,6	741	5,5	19. Aug	625	18,1	752	5,6
20. Feb	658	-12,0	745	6,7	29. Aug	639	16,2	742	5,5
02.Marc	668	0,9	742	5,4	08.Sept	608	12,0	742	5,3
12. Marc	633	2,9	754	5,8	18. Sept	604	15,7	747	5,6
22. Marc	648	12,0	756	5,9	28. Sept	607	18,6	758	7,5
01.Apr	645	7,2	757	6,2	08.Oct	611	10,0	744	5,8
11. Apr	625	5,3	749	6,0	18. Oct	609	9,8	745	5,7
21. Apr	625	4,3	736	6,2	28. Oct	599	4,9	764	5,2
01.May	789	8,3	741	5,8	07.Nov	602	-2,7	752	5,1
11. May	656	13,1	739	5,2	17. Nov	614	-3,0	742	5,9
21. May	675	26,2	753	5,0	27. Nov	626	1,0	731	6,6
31. May	690	29,8	747	5,4	07.Dec	718	1,5	749	5,9
10.June	704	16,8	746	5,2	17. Dec	692	-2,0	757	5,3
20. June	610	18,7	742	5,2	31. Dec	668	-2,8	760	5,0

To compare to time series (tab. 1) one of parametres of deformations of the considered geodetic network – dilatation (relative change of the area of the final element, in this case it is a triangle of the network) has been chosen.

According to time series (tab. 1) the schedules have been constructed and the comparison of changes of dilatation to changes of solar activity, seismic activity, temperatures and pressure is carried out. Not to block up the article with schedules we'll present only the most characteristic cases (fig. 1) for the separate triangles of the network (triangles are numbered clockwise: (4-2-1 – №1; 2-1-3 – №2; 1-3-4 – №3; 3-4-2 – №4).

Change of the solar activity in the most cases practically doesn't influence the change of dilatation, however in a number of cases the reduction of dilatation corresponds to the positive increase of solar activity.

Analyzing the schedules, it is possible to speak about some dependence between the changes of dilatation and temperature - in certain cases schedules practically coincide, it is especially brightly expressed for all the triangles in the beginning and the end of 2007. During the period from 5/21/2007 to 6/10/2007 there was a jump of temperature from 13C ° to 28C °, at the same time dilatation in triangle №1 has increased almost in one and a half time.

In the rest period of time special changes of dilatations in triangle №1, coinciding with the sharp change of temperature is not observed. The growth of the dilatation in triangle №2 coincided with the temperature growth during the period from 5/21/2007 to 6/10/2007. For triangles №3 and №4 the similar dependence is observed.

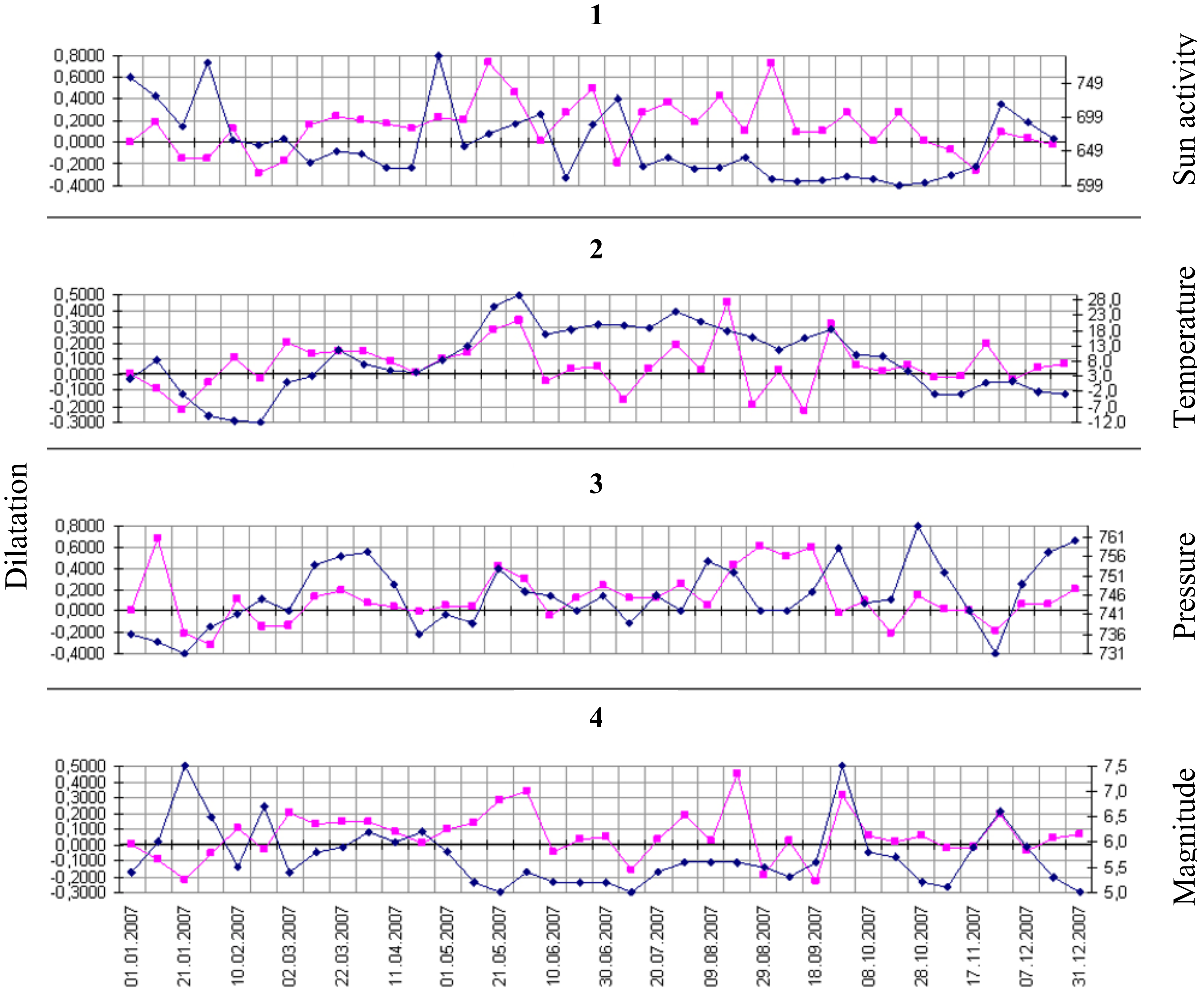

Fig. 1. Comparison of time series

In the period from 01.01.2007 to 21.01 2007 the pressure sharply went down, and in the meantime the dilatation in triangle №1 raised. From 10/20/2007 to 11/17/2007 there was a pressure jump almost on 25 millimeters of a mercury column that judging by the schedule has coincided with the change of dilatation in triangle №2. The analysis of the other schedules has shown that bigger or smaller change of pressure changes the dilatation.

The analysis of the schedules speaks about the connection of seismic activity with the change of dilatation. For example, in triangle №1 the dilatation has essentially decreased with the jump of magnitude from 10.01 2007г. to 11. 02.2007г., but from 18.09.207г. to 08.10.2007г. it has almost coincided with the magnitude jump. The same dependence is also observed in the other triangles.

For more accurate representation of the interrelation of the considered phenomena the correlation analysis has been carried out and the known formula (1) used to calculate the factors of correlation for investigated time series:

$$r = \frac{\sum (x_{1j} - \bar{x}_1)(x_{2j} - \bar{x}_2)}{\sqrt{\sum (x_{1j} - \bar{x}_1)^2}\sqrt{\sum (x_{2j} - \bar{x}_2)^2}}, \qquad (1)$$

The correlation factors r were calculated for two compared pairs of time series, and the formula of Romanovsky [2] was used to estimate the degree of narrowness of the correlation connection.

The results of the correlation analysis are shown in tab. 2.

Table 2.

Results of the correlation analysis

Compared characteristics	Triangle 1		Triangle 2		Triangle 3		Triangle 4	
	r	**σr**	**r**	**σr**	**r**	**σr**	**r**	**σr**
Dilatation and solar activity	-0,168	± 0,162	-0,135	± 0,164	0,062	± 0,166	-0,189	± 0,161
Dilatation and temperature	0,300	± 0,152	0,508	± 0,124	0,218	± 0,159	0,639	± 0,099
Dilatation and pressure	0,356	± 0,146	0,154	± 0,163	0,215	± 0,159	0,282	± 0,153
Dilatation and earthquake magnitude	-0,035	± 0,166	-0,250	± 0,156	-0,151	± 0,163	-0,392	± 0,141

Given data in table 2. allow to conclude the following:

The factor changes in the limits from -1 to 1 that speaks about the linear connection of the considered series. In the most cases the calculated factor of correlation exceeds the value of the standard deviation that speaks about the statistical importance of correlation. The correlation connection is mostly notable in the compared series of dilatation and earthquakes energy (triangles № 1, 3, 4), dilatation and temperature (triangles № 1, 2, 4), and also dilatation and earthquakes magnitude (triangle № 4).

Despite that in no case correlation reaches 1, from the results of the analysis it is possible to draw a preliminary conclusion about the influence of the strongest seismic events (including removed), and also meteorological parameters on the results of the satellite geodetic measurements (on which basis the parameters of deformations of the terrestrial surface are calculated)

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