WHETHER THERE IS AN ASTROPHYSICAL SOURCE IN THE OSCILLATIONS OF GEOPHYSICAL PARAMETERS WITH A PERIOD OF 160 MINUTES?

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ABSTRACT. Oscillations with a period of 160 minutes in the ground pressure and Z-component of the geomagnetic field revealed by authors earlier are studied the regular ground measurements. For the analysis the data of five stations on the territory of Europe (Moscow, Apatity, Oulu) and Siberia (Yakutsk, Tixie) obtained in December, 2003 are used. It is shown that the specified oscillations revealed by authors earlier, are manifested in Europe and Siberia synchronously. For December, 2003 the mean amplitude of oscillations in the ground pressure accounts for 0.012±0.002 mb; in a Z-component their value is equal to 0.323±0.070 nT. Authors discuss the possible nature of pulsations.

Key words: ground pressure, geomagnetic field, oscillations with a period of 160 minutes, astrophysical source, gravitational wave.

1. Introduction and problem statement

For the first time pulsations with a period of 160-min were trusty revealed in the luminosity of the Sun as stars [Kotov et al., 1985]. Some evidences of their possible cosmological nature were obtained [Kotov, Lyuty, 1992; Kotov V. & Kotov C., 1996]. Revealing of pulsations of the Sun afterwards were confirmed by other investigators and registered as a discovery [Kotov et al., 1985]. In the scientific literature those pulsations were named as P_0-pulsations.

In the published scientific literature the appearance of 160-min pulsations in the ground pressure [Novikov et al., 1985; Karpova et al., 2002] was already noted. Those authors ascertained only the fact of their presence but without determination of their amplitudes and phases. Earlier similar pulsations were revealed in connection with the passage of interior gravitational waves (IGW) in the atmosphere [Bobova et al., 1985]. In that work the 160-min pulsations of geomagnetic AE-index were noted. Besides that publication, in [Pochtarev et al., 1983; Bobovaet al., 1990; Petrova, 1992; Petrova et al., 1999; Petrova, 2008] the connection of seismic and geomagnetic pulsations of hourly periods was noted.

Synchronous manifestations of 160-min pulsations in the ground pressure at widely separated four stations were studied by authors [Timofeev et al., 2005, 2009]. Some peculiarities of pulsations (behavior of phases and amplitudes) revealed in those works, indicated to their possible extraterrestrial (solar or galactic) origin. It has induced us to carry out the more detailed analysis of a procedure of isolation of 160-min pulsations by the ground data and also to propose one of the possible hypotheses of their origin.

2. Experimental data and their treatment

In this work the experimental data of atmospheric ground pressure and geomagnetic field have been used. The data on atmospheric pressure represents 5-min measurements obtained with digital barographs with a measurement accuracy ±0,01 mb (st. Moscow, Apatity and Oulu) and ±0,1 mb (st.Yakutsk, Tixie). The data on the geomagnetic field Z-component represents 1-min measurement obtained with digital magnetometers with the accuracy not more than 0,1 nT. Fig.1a shows the results of treatment of the 5-min values of ground pressure using a superposed epoch technique in December, 2003. The beginning of superposition on the period of 160-min (32 five-minute points) is realized from the time moment of 00:05 UT. The plots shown in Figure are for the following five stations: Tixie, Apatity, Oulu (Finland), Yakutsk and Moscow. Fig.1b presents the results of treatment of the 1-min values of the geomagnetic field Z-component for the same periods for

the stations of Oulu, Moscow, Novosibirsk, Irkutsk and Lvov from the time period of 00:01 UT. For clear evidence two 160-min periods are shown: for the ground pressure 64 five-min points in the two periods (Fig.1 *a*) and for the Z-component - 320 one-min points (Fig. 1b) are shown. The plots have been obtained from the extended set of data for the same periods as the pressure. Superpositions begin from the time period of 00:01 UT.

Beforehand the whole primary set of data has been treated as follows. First we carry out smoothing using the normal law, in which $\sigma = T/4$, where T = 180 minutes or 36 five-min points (T is a smoothing period). As a result we will obtain a trend in which all variations with a period < T = 180 min will be absent. The trend is subtracted from a primary series, i.e. we filter off all variations with a period of more than 180 minutes.

The obtained filtered off series is smoothed by the normal law with $\sigma = 10$ minutes or 2 five-minute points that corresponds to a period of smoothing T = 40 minutes. As a result, we will obtain a new series in which there will be all variations with periods of less than 40 minutes and more than 180 minutes, i.e. the band-pass filtering with a pass-band from 40 to 180 minutes is realized. In order to decrease the influence of the "penetration" variations, we will repeat the band-pass filtration with the same parameters. The necessity of double filtration is caused by very high amplitudes of "outsider pulsations" in the low-frequency range. In Fig.1a it is seen that in the ground pressure all phases obtained by the December data coincide by all stations on the whole territory of Europe and Siberia. The mean amplitude of Po-pulsations averaged by all stations, accounts for 0.012 ± 0.002 mb. In the geomagnetic field (Fig. 1b) synchronism of the change of phases by all considered stations of Europe and Siberia (Oulu, Moscow, Novosibirsk, Irkutsk, and Lvov) is also observed. The calculation errors have been determined using the techniques developed specially for estimation of results obtained using the superposed epoch technique [Jamison and Regal, 1979].

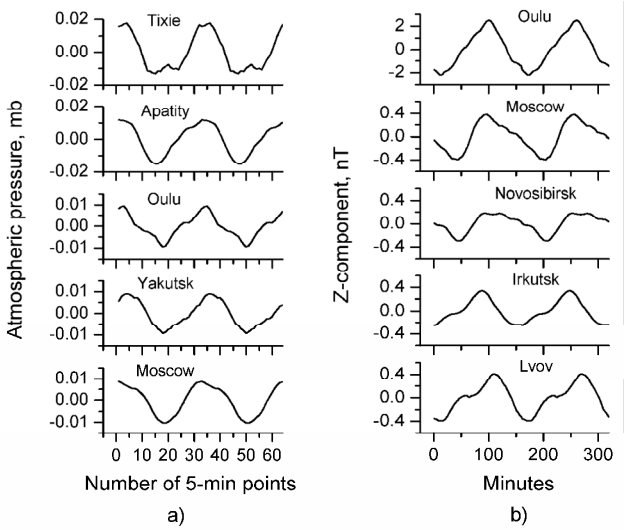

Fig.1. Phases of manifestation of 160-min pulsations in the ground pressure (a) and in the magnetic field Z-component (b). The mean temporal course of amplitudes in December 2003 in the ground pressure and in the Z-component on the territory of Europe and Siberia is shown.

3. The analysis of experimental data

The examination conducted by us testifies to the presence of synchronous oscillations in the ground atmospheric pressure and geomagnetic field. As it has been already noted in Introduction, the occurrence of pulsations of hourly periods in the ground pressure and geomagnetic field was also revealed earlier by various researchers. In this case various mechanisms capable to explain the observable synchronism of pulsations were offered. Let us consider some mechanisms in more details.

1. In [Karpova et al., 2002] the occurrence of 160-minute pulsations in the ground pressure manifested together with other periods was noted. It was noticed that they were manifested in connection with the passage of atmospheric internal gravitational waves (IGW) [Bobova et al., 1985]. The initial phases of IGW are distributed at the Earth's surface by various time zones not synchronously (i.e., their phases will not have coincidences). In our studies [Timofeev et al., 2005, 2009] at the considered stations of Europe and Siberia the synchronism of phases in the variations of both the ground pressure, and Z-components of geomagnetic field was observed. Thus, it is impossible to explain the observational facts marked by us at the expense of IGW.

2. In [Pochtarev et al., 1983; Bobova et al., 1990; Petrova , 1992; Petrova et al., 1999; Petrova, 2008] it was shown that seismic oscillations of the Earth can excite atmospheric waves which, in their turn, can affect auroral currents. In those works the fact of excitation in the atmosphere and AE-index of oscillations with the periods of seismic gravitational oscillations of the Earth was observationally established. However, it is necessary to note that in those works the synchronism of manifestation of seismic gravitational waves and pulsations of AE-index was obtained only by the coincidence of characteristics of power spectra but not phase pulsations. Besides, the presence of similar pulsations in the AE-index testifies to the presence of such pulsations in the high-latitude auroral field. In our case the effect of pulsations coinciding in phase was observed both at high and middle latitudes. Thus, this mechanism cannot describe the observational facts obtained by us completely.

3. Probably that it would be possible to explain the facts marked by us most completely by the presence of gravitational waves predicted by the Einstein's relativity theory. Recently the first observational instructions on a possibility of existence of such waves from remote astrophysical objects have been appeared (see, for example, [Hermes et al., 2012]). The presence of gravitational wave with the period P_0 would lead to synchronous squeezing and rarefaction of whole volume of the Earth and its atmosphere. In this case the pulsations of atmospheric pressure registered in any point on the globe, would coincide in phase, as was observed fact.

In the case of magnetic field we deal with the response to such actions in the current systems which are located at great depths in the Earth's core. Mechanisms of formation of such response are caused by periodic squeezings of the globe by the gravitational wave field. Under the influence of squeezing (pressure) a material resistance R (electrical resistance of iron-nickel core of the Earth) increases

[Zinoviev, 1952], hence, the currents in the core of the Earth decreases. It leads to some reduction of the Earth's magnetic field. Thus, pulsations of the Earth's geomagnetic field registered in any point on the globe would coincide in phase that also has been marked by us by data on GMF (Z-component).

4. Conclusions

1. By the data of observations at the stations of Europe and Siberia the existence of synchronous pulsations in phase with a period of 160-minutes in the ground atmospheric pressure and Z-component GMF is shown.

2. The nature of the revealed synchronous oscillations in the atmospheric pressure and GMF remains unclear. Apparently, the obtained facts can get the fullest explanation within the framework of a hypothesis on the existence of a gravitational wave with a period P_0 according to predictions of a general Einstein's relativity theory and recent astrophysical observations.

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