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## Abstract

## Full Text

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# ATMOSPHERIC PROCESSES AS A MECHANISM OF THE INFLUENCE OF SOLAR ACTIVITY ON TECTONIC PHENOMENA

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Studies of the upper layers of the atmosphere and of outer space with the aid of satellites and rockets have shown that the influence of solar activity on atmospheric processes may be exerted through solar corpuscular radiation. In this connection, the question of the links between atmospheric processes and other geophysical phenomena caused by solar activity becomes of great interest.

Earlier, the author established and statistically demonstrated ([1,2]) the influence of solar activity on seismic phenomena; moreover, it was assumed that this connection is realized through changes in the angular velocity of the Earth' s rotation ($\omega$) due to the action upon it of corpuscular solar streams. The existence of such an effect is indicated by factual data ([3,4]), from which it follows that an increase in solar activity leads to a decrease in angular velocity. Papers ([5,6]) also present data indicating the presence of a deep minimum in the course of the angular velocity in 1957–the year of maximum solar activity–although not explained by the authors of these papers.

It is assumed that the effect of solar activity on $\omega$ may occur through the interaction of the Earth' s magnetic fields and corpuscular streams ([7]). It seems to us, however, that to explain the mechanism of the influence of solar activity on $\omega$, one should proceed from the same considerations on the basis of which the annual nonuniformity of the Earth' s rotation is shown to be conditioned by seasonal changes in atmospheric circulation. For example, N. N. Pariiskii and O. S. Berliand ([8]), proceeding from the law of conservation of angular momentum,

$$L_3 = L_m + L_a = \text{const} \tag{1}$$

(and, consequently, $dL_m = -dL_a$), where $L_3, L_m, L_a$ are the angular momenta of the whole Earth, its solid body, and the atmosphere, respectively, carried out calculations of $L_a$ for various months. This led to the conclusion that the principal cause of the annual nonuniformity of the Earth' s rotation is the seasonal changes in atmospheric circulation. But since it is well known that the intensity of atmospheric circulation changes practically continuously–not only

Fig. 1

Figure 1: Fig. 1

from month to month, but also from day to day, from year to year—then, evidently, the angular velocity must also change continuously. In this connection, the possibility of an influence of solar activity on $\omega$ cannot give rise to fundamental objections, since the influence of solar activity on atmospheric processes may be regarded as established.

Recently, a number of authors have obtained data indicating almost synchronous processes in the atmosphere in connection with the passage of active solar regions through the central solar meridian ([9–11]). The author ([2]) has shown that, under analogous situations on the Sun, strong earthquakes also occur. In this connection, and proceeding from the considerations set forth, we carried out a comparison of data on earthquakes with atmospher—

processes. In doing so, we also assumed that, if the Earth enters a plasma cloud ejected by the Sun, or if the solar wind intensifies, the energy of the corpuscular flux absorbed by the Earth must affect the state of the entire atmosphere and may manifest itself in a weakening or strengthening of atmospheric circulation or in a change of its form. This, in turn, should lead to a change in the value of $L_a$ in equation (1). Such changes must obviously be planetary in character and, because of the dependence of weather on the general circulation of the atmosphere, be reflected in one way or another at any point on the globe.

The existence of such planetary atmospheric processes is quite convincingly confirmed by the data presented in Fig. 1, which gives the mean statistical curves of the distribution of the amplitudes of microseisms ($2A$) at Mirny in Antarctica relative to ($\Delta t = 0^d$) the day of maximum development of microseismic storms at Pulkovo (curve 1—48 cases for VII 1957-XII 1958, curve 2—50 cases for 1960). The maximum in Fig. 1, occurring at $\Delta t = 0^d$ with probability $> 0.99$ (for both curves), is not accidental; i.e., microseismic storms at Mirny and Pulkovo develop synchronously. It has been established, however, that microseisms are essentially dependent on the dynamic parameters of the atmosphere. At Pulkovo they are caused by the weather in the northern parts of the Atlantic ([12]), and at Mirny by the weather in the southern parts of the Atlantic and the Indian Ocean ([13]). Thus, the data presented indicate a synchronous intensification of atmospheric processes in both hemispheres.

**Fig. 1**

To find a connection between earthquakes and atmospheric processes, the method of superposed epochs was also used. In Fig. 2 are given the mean curves of the amplitudes of microseisms at Mirny in Antarctica, constructed by this method. As zero days all the strongest earthquakes with $M \geq 6.5$ were taken, regardless of the location of their epicenters (curve 1—70 cases for VII 1957-1959, curve 2—50 cases for 1960). Here the summer months, with weak microseism intensity, are omitted. For comparison, Fig. 2 (curve 3) also gives the mean curves of the modulus of the increment of the meridional baric gradient at the AT 500 level for the Atlantic for 1959-1960 (106 cases). Here the gradient was calculated as the difference between the mean height of the 500-mb surface at southern stations (44° N, 41° W, and Lajes–Azores) and northern stations (Narsarsuaq, Keflavik).

Analysis of the curves showed that the minimum at $\Delta t = 0^d$ and the maximum at $\Delta t = -(1\text{–}2)^d$, and for microseisms also at $\Delta t = +(3\text{–}6)^d$, are statistically significant (with probability $> 0.99$). That is, 1-2 days before an earthquake a strong change in the gradients in the North Atlantic and an increase of microseisms at Mirny are observed. On the day of the earthquake the values of both quantities decrease sharply. On the 3rd–6th day the intensity of the microseisms again increases. Such abrupt changes in atmospheric processes, evidently, must cause abrupt changes in angular velocity, which, as we suppose, also influence the occurrence of earthquakes. Earthquakes in this case are a kind of indicator pointing to a planetary jump in the state of the atmosphere in connection with the action of the corpuscular solar flux, and the dates of earthquakes may be regarded as certain reference days in atmospheric processes. The strength of an earthquake, apparently, will depend to some extent on the magnitude of the energy of the corpuscular flux and on the direction of the atmospheric processes. Therefore it is highly probable that, in solving the problem of earthquake prediction, the ···

besides solar data, atmospheric processes on a planetary scale should also be taken into account.

Thus, the statistical data presented, by proving the connection of earthquakes with atmospheric processes, confirm the assumption that solar activity may influence $\omega$ through atmospheric processes [14]. These data also show that rapid jumps in $\omega$, occurring over the course of days, should be observed which, under the commonly used methods of processing, cannot be identified. The data cited in the literature on changes in $\omega$, however, reflect only the total effect, which depends to a considerable extent on the direction of atmospheric processes.

The results given on the synchronism of the development of microseisms at Mirny and at Pulkovo, and consequently on the synchronism of the course of atmospheric disturbances in both hemispheres, indicate that disturbances in the atmosphere–in our case, intensifications of the intensity of atmospheric circulation–arise for planetary reasons and depend on solar activity. There is no need here to invoke changes in $\omega$ as some planetary cause. Evidently, solar corpuscular streams can influence atmospheric processes simultaneously in both the Southern and Northern Hemispheres. The manifestation in atmospheric processes of the energy arriving from the Sun by way of corpuscular streams has long been established by many authors. However, in atmospheric physics this factor has until recently been insufficiently taken into account, and in geotectonics it has not been considered at all. Neglect of this factor must evidently lead to an incomplete or erroneous interpretation of the nature of many geophysical

Fig. 2

Figure 2: Fig. 2

phenomena.

**Fig. 2**

Of course, we do not here raise the question of the fundamental causes of tectonic processes. This is only an attempt to explain the mechanism of the observed connection between seismic phenomena and solar activity.

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*Note: Figure translations are in progress. See original paper for figures.*