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The long-term variations of geomagnetic disturbances reflect clearly the 11-year, 22-year, and secular (80-90 years) solar activity cycles [1]. The 22-year geomagnetic activity cycle was examined in [1-8]. The flare-generated magnetic storms typical of the 11-year cycle maxima have been shown to be developed stronger in odd cycles, wile the recurrent disturbances developing during the cycle decrease branch are stronger in even cycles. Therefore, the geomagnetic disturbances are more rightful to be associated with the 22-year cycle of the Sun's magnetic activity.

The fluctuations of the Earth's climate are also polycyclic. The cycles are of durations of **2-3** years (the quasi-biennial cycle), **4-7**, **10-12**, **20-23**, and **80-90** years [1,3,4,6-11]. Spectral analysis of a 1000-year series of the index of the deuterium-to-hydrogen content ratio in arbor rings was made in [6] (the variations of the index are proportional to the atmospheric temperature variations). The spectral analysis has made it possible to discriminate a 22.36 c 0.04-year period which is close to the 22-year solar activity cycle. The similarity of the periods tells for a relationship between weather and solar activity. The 11-year cycle, which is basic in the spot formation activity of the Sun and exhibits a very large amplitude has been shown in [3] to have a much weaker influence in the meteorological indices; its amplitude is as a rule smaller than that of the 22-23-year cycle. The direction of the Sun's general magnetic field is known to change near the 11-years solar cycle maximum, so a pronounced change in the character of the relationships may be expected during such a period. This is but one of the possible explanations for the absence of any clear 11-year cycle in the meteorological processes, compared with the 22-year cycle. It is assumed in [3] that geophysical cycles of 7-8, 12-13, 15-17, and 33-month durations can occur. Many of these cycles and shorter cycles may be related to the respective solar activity cycles, namely, the 27, 13-14, 9, or 6-7-day cycles can be found in all the meteorological indices including the various atmospheric circulation indices [1, 10]. Similar cycles are also observed in the characteristics of the Earth's magnetic field disturbance [2]. The 6- and 9-day rhythms in the Earth's atmosphere are assumed in [11] to be related to the sectorial structure of the IMF. The 9-day period corresponds to six sectors with three geoactive boundaries, while the 6-7-day cycle corresponds to eight sectors with four geoactive boundaries. Thus, the occurrence of common "solar" rhythms in the atmospheric processes and in the geomagnetic disturbances may indicate that they arise from their common solar cause associated with the sectorial structure of the IMF. Relationships of the lower atmosphere with the IMF and with the solar wind were found directly in numerous works. The sign of the correlation between solar wind velocity and atmospheric parameters (pressure, air temperature) proves to reverse when the Earth moves from one IMF sector to another. The sectorial structure of the IMF is associated with the variation of the vorticity index (defined to be an area, in km , where the circulation related to unit area reaches $20x10^{-5}$ s^{-1}) corresponding to a properly formed cyclone on the 300 and 500 mb isobaric surfaces in the northern hemisphere [7]. The winter season area of low-pressure regions of valleys in the northern hemisphere reaches its minimum a day after the Earth traversed an IMF sector boundary.

In this case, the percentage of the vorticity minimum appears to be higher in the tropospheric regions characterized by a more intensive circulation. The statistical processing of the 1952-1977 data made by the Wilkox's group [6] has shown that the dimensions of cyclonic flutes depend strongly on the IMF polarity. A decrease of the dimensions of the low-pressure flutes is greater when the field is sunward, i.e. the IMF sector is negative, whereas a decrease of the dimensions is much smaller when the field is offsun. The work emphasizes the fact that the passage through some of the sectorial boundaries is accompanied by a few-MeV proton flux observed within several days. In this case the vorticity index minimum associated with the boundaries followed by the proton fluxes is almost two times as deep as the minimum associated with the conventional boundaries. The boundaries with proton fluxes were found to be accompanied by a great increase of the IMF intensity. Using the 1968-1973 data of observations of cosmic ray intensity with the neutron supermonitor at Apatity; allowing for the IMF observation data and the data on thevorticity area in the troposphere (the VAI-index), and applying the epoch superposition method (the moment of passage through an IMF sector boundary is taken to be the zero day), it was found [10] that: (1) a passage through an IMF sector boundary gives rise to a stable affect in VAI (some 20%), whereas the effect in cosmic rays proves to be unstable, (2) an increase of the cosmic ray flux by about 0.5% within five days with a subsequent decrease by 1.0-1.5% within 3-4 days was observed in the case of 21 passages of the IMF boundary, (3) any cosmic ray effect is absent within measurement errors in case of 28 passages; (4) the cosmic ray effect does occur in case of 17 passages, but is of opposite character compared with the case (1). It has been concluded in [10] that the effect of the IMF sector boundaries on the tropospheric vorticity index cannot show itself through cosmic rays; the effect of cosmic rays on the tropospheric processes is not excluded, but it must show itself in a different manner. The effect of high-velocity fluxes on atmospheric circulation, geomagnetic activity, and galactic cosmic rays is treated in a number of works. A pronounced decrease in galactic cosmic ray intensity has been found to begin within 1-2 days before a velocity maximum occurs in the solar plasma stream and to reach its minimum on the first day. The decrease effect disappears completely on the 4th-5th day. The behavior of the geomagnetic activity index exhibits a clear maximum on the day with the plasma stream velocity maximum. The areas filled with deep cyclones in moderate latitudes are found to decrease sharply in the middle and upper troposphere of the northern hemisphere at the moment when the Earth is inside a high-velocity solar plasma stream. Similar results were obtained by Loginov [in 7] who demonstrated that an increase in solar wind velocity gives rise to a decrease of cyclonic activity in the troposphere. The latter circumstance is probably due to an intensity decrease in galactic cosmic rays which has an impact on the troposphere circulations disturbances. Indeed, this effect can be traced clearly when studying the solar flare effect on the Earth's atmosphere which results in atmospheric circulation variations in middle and high latitudes as early as within 12 hours after a flare. Attempts were make in recent years to verify the relationships between the cyclonic disturbance development, on the one hand, and the Earth's passages through the IMF boundaries, the high velocity solar wind fluxes, and solar flares, on the other hand. The relevant studies have made it possible to conclude that:

(1) the passages of the Earth through the IMF sector boundaries give rise to a vorticity decrease coinciding in time with geomagnetic disturbances and with a rearrangement of the cosmic ray fluctuation spectrum;

(2) vorticity increases occur after large solar flares in the 0^0-44^0E heliographic longitude interval;

(3) a strong enhancement of vorticity accompanied by powerful geomagnetic disturbances can be associated with the flares which are located in the eastern part of the solar disc, and occur by series.

Thus, we deal with complicated relationships among solar activity, geomagnetic disturbance, cosmic ray intensity, and atmospheric processes. The character of the relationships among all the relevant events may vary greatly during different periods and can be different in different regions. In someregions, especially over the northern part of the Atlantic Ocean, geomagnetic disturbances are followed by an increased variance of the near-surface pressure variability [16] which reflects the level of conversion of usefulpotential energy into kinetic energy. This circumstance must have an impact on the wind field. Indeed, the analysis of 90-year observations of near-surface pressure [16] has shown that the atmospheric instability in the moderate latitudes of the northern hemisphere (in particular over the northern part of the Atlantic Ocean) increases after strong geomagnetic disturbances (by the 2nd - 4th day). That is why the study of possible relationships between wind velocities, atmospheric vorticity, and cosmic ray fluxes in the given region, on the one hand,

and the global solar activity on the other hand becomes very important for understanding the solar-terrestrial relationships [12]. Nevertheless, it has been quite clear that the modulation of the cosmic ray flux observed on the Earth is defined by the same processes as those defining the atmospheric parameters, namely, power shock waves in interplanetary space, geomagnetic space, geomagnetic disturbances, etc. [13-16].

In [16] Pudovkin presented a general sheme of thr mechanism of action of solar activity and interplanetary medium on the state of the lower atmosphere. The practical result of Pudovkin-model [16] - variations of atmospheric pressure, the precipitation, atmospheric circulation, temperature and the atmosphere's **transparency** in the course of development of a geomagnetic disturbance.

The results of studying the cosmophysical, geophysical and meteorological processes presented a set of cause-effect relationships exists between solar activity and the rest of processes. The assumption seams to be quite realistic, therefore, that the parameters describing the atmospheric processes (in particular, the atmospheric **transparency P(t)** [8]) may be presented to be a sum of the preceding values **P(t)**, solar activity **W (t)**, geomagnetic activity $\mathbf{K_P(t)}$, and cosmic ray intensity **I(t)**, i.e. to be of the form of the self-regression model:

$$\hat{P}(t) = \sum_{i=1}^{p} \alpha_i \mathbf{P(t-i)} + \sum_{j=1}^{q} \beta_j \mathbf{W(t-j)} + \sum_{k=1}^{s} \gamma_k \mathbf{I(t-k)} + \sum_{l=1}^{m} \pi_l \mathbf{K_P(t-l)} + \xi_t \qquad (1)$$

here $P(t)$ is the predicated value of stormicity, where p, q, s, and m are the order of the model for each of the series used. The order defines "a look backwards" of each process to predict the **transparency** estimates; α, β, γ and π are the AR model parameters. In this case, as fresh data are being obtained the self-regression estimates get also renewed, thereby offering an opportunity of predicting **transparency** one step ahead. (The prediction ahead is made by seeking for the value of a future count in the form of a weighed sum p of the previous counts of **P(t)**, q counts of **W(t)**, s - **I(t)**, and m counts of $\mathbf{K_P(t)}$).
The model may be constructed in two ways:

1. The accumulated data arrays for **transparency**, solar activity, and geomagnetic activity of dimension N_O each are used to construct a matrix for the set of linear equations (1). After that, the matrix is solved to find the vectors $\{\alpha\}$, $\{\beta\}$, $\{\gamma\}$ and $\{\pi\}$. It should be taken into account in this case that the sets of the self-regression coefficients may be found in practice for any of the accumulation intervals. Some 450 equations may be obtained using the mean-monthly data for the period of 1950-1997 [17]. Correspondingly, the number of equations (ø) for mean-yearly data reduces to 47-k, where k is the highest self-regression order used; at k = 5 the number of the equations is about

20, so an attempt may be made in this case merely to solve the set (1) assuming that the noise ξ_t is minimum.

2. If, however, the number of equations (1) exceeds the number of unknowns α, β, γ and π and any assumptions concerning the minimum value of ξ_t cannot be made, the solution of the set (1) reduces to solving a set of equations for the covariant functions A_{IJ}, rather than the values of solar activity, **transparency**, geomagnetic activity, and cosmic ray intensity [4]. The second way of solving the set of equations is advantageous due to the absence of the noise ξ_t because the mutual correlations of the noise with the rest parameters are zero.

Thus, by prescribing the model order *p, q, s,* and *m* for **transparency**, solar and geomagnetic activity and cosmic ray intensity, we can not only predict the mean values of **transparency** (or geomagnetic activity, f.e.) one step ahead (the value of the step is defined only by the value of data discretization δt) but also help to estimate the contribution of one or another process to the predicted **transparency**. Indeed, if the values of one of the sought parameters α, β, γ and π are small (much below the errors in measuring them), the respective process proper may be disregarded in the model. For example (f.e.), when analyzing the mean-yearly dependencies between earth's temperature and cosmic ray intensity, the values of γ were negligible compared with the errors as regards the absolute values too. A detailed analysis has shown that the W or I or K_P -index alone cannot be used to construct any prognostic model.

The values of **transparency** in 1950-1995, solar activity in 1945-1995, geomagnetic activity in 1945-1995 and cosmic ray intensity in 1960-1995 wereused to find the values of the model parameters and to estimate the values of *P(t)* in 1976 and 1977 which were compared afterwards with the real *P(t)* values in the same years. The analysis was carried out using the mean-monthly and mean-yearly values of P, W and I. It should be noted that the number of predictors (order of model) must not be very high; as shown in [4], the number of predictors must not exceed a tenth of sampling volumes because of a possible correlation among the variables and a restricted sampling. The results obtained have shown that the values of α, β, γ and π for the entire period do not vary in practice; moreover the P(t) values found for 1996 and 1997 in terms of a prognostic model with the coefficients α, β, γ and π from the [4] differ from the real *P(t)* values by less than 23% for 1-year predictions, by 37% for 2-year prediction. Thus the use of the standard **APCC-models** to develop a **transparency** prediction on the basis of the previous values of **transparency** and the observation data on solar activity, geomagnetic activity, and cosmic ray intensity is very promising. The results of have demonstrated a good agreement between the calculated and experimental *P(t)* values, so that the further development of such a model will make it possible at least to predict the mean-yearly meteorological characteristics one year ahead to within a 10% accuracy. For less accurate estimates to be obtained, the four-parametric model (α, β, γ, π and ξ_t) is quite sufficient.

Experimental results related to the action of solar and geomagnetic activity as well as other cosmophysical factors (galactic and solar cosmic rays, GCR and SCR, on the lower atmospher and meteorological and climatic parametrs, including ENSO, have been discussed in the preciding sections.

The data given and the results of the simulation the mechanism of the action of heliophysical parametrs on atmosphere ardue convincingly for the authenticity of the physical mechanism of the influence of SA on climatological and meteorological processes, whose determining element is the change in transparency of the atmosphere under the action mainly of galactic and solar cosmic ray modulated by solar and geomagnetic activity [16].

Estimates of the energetics of dynamics processes in the lower atmosphere simulated by solar and geomagnetic activity and of the additional energy entering the atmosphere upon a changes in its transpa- rency during period of the disturbances have shown that they are simular to the another, which has in [12] evidentlypermitted exibiting the physical nature of the energy source of the action of solar and geomagnetic activity on processes in the lower atmosphere.

The geomagnetic disturbances and the radiative emission of the Sun, but not the energy contained in the solar wind of liberated in the magnetosphere and ionosphere, tourn out directly to be the source. Thus, the results of analyzing the works published in recent years have demonstrated a feasible relationships of the atmospheric processes with heliophysical and geophysical events and with cosmic ray intensity. All the published results fall well within the assumption that the activity of the processes in the earth's atmosphere and magnetosphere is affected by the processes occurring on the Sun. Therefore, the processes occurring in interplanetary medium and the cosmic ray intensity observed on the Earth's surface must be allowed for when solving the problems relevant to finding the mechanisms of the large-scale atmospheric and magnetospheric processes or when making attempts to predict the processes. The first first steps in this direction have been made in the present work. The possibilities of researh on influence of the solar and geomagnetic activitys on climate and meteorological processes have not been exhaused. Those phenomena of solar-terrestrial relationships which determine the action of disturbances on the Sun and in the interplanetary medium on the climatic and meteorological conditions on Earth and on the state of the lower atmosphere are causing the most enlivened discussions at the present time.

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