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Atmospheric Circulation in the Northern Hemisphere and Solar Activity

A. Retejum

Russian Academy of Sciences, Moscow, Russian Federation (aretejum@yandex.ru)

The studies of relationship between atmospheric circulation and solar activity began in 1940s, after the first multi-year calendar of synoptic processes had been compiled. Currently, the time-series of daily data on types of atmospheric circulation in the Northern Hemisphere spans the period between 1899 and 2005. These types were classified by B. L. Dzerdzeevskii, who divided them into four groups: zonal, disturbed zonal, meridian north, and meridian south. The tables of observations of these circulation types greatly helped to conduct statistical analysis.

The analysis of long-term trends in prevalence of various types of circulation uncovered serious changes in duration of zonal circulation during the transition from one cycle of solar activity to another. During the transitional period, the deviations from mean monthly and mean annual values increase with the rank of adjacent cycles. The greatest deviation was observed in 1923, when the number of days with zonal circulation increased three-fold. This was the year of change of Pettersson cycles, each consisting of 8 Schwabe-Wolf cycles. The deviations of comparable magnitude were observed in 1964, during the transition from one 45-year cycle to another (each consisting of 4 Schwabe-Wolf cycles).

The discovery of sudden spasmodic changes in the regimes of atmospheric circulation during the transition from one solar cycle to another draw attention to the consequences of cosmic factors. It was established that frequency of zonal and meridian north circulation groups was related to oscillations of length of day, which, in turn, depended upon velocity and density of protons in solar wind. The number of days with zonal circulation decreases as the length of day increases. The reduction of period of the Earth rotation by 1 ms is statistically associated with reduction of duration of zonal circulation by 4-5 days p.a. The duration of meridian north circulation, con-

trariwise, increases by 10 days per 1 ms of decrease of rotation period. These findings explain the character of seasonal dynamics of two major types of circulation: summer maximum of zonal circulation and winter minimum of meridian north circulation.

The author also discovered high stability of types of atmospheric circulation, which developed on particular days of synodic period of solar rotation. This stability is seen in the prevalence of zonal and meridian types during the corresponding phases of Carrington rotation, which differ in the duration of length of day and have periods of 27.3 and 13.5 days on average.

The results of this work open the way towards short-term and long-term forecasting. In particular, the available preliminary data suggest that one may expect the beginning of new phase of atmospheric circulation in the nearest future.