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ON THE RELATIONSHIP BETWEEN THE PHASES OF 27-DAY TOTAL OZONE AND SOLAR ACTIVITY INDICES IN DIFFERENT LATITUDINAL ZONES

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The purpose of this paper is to analyse the dynamics of 27-day total ozone variations during an 11-year solar activity cycle at high and low latitudes.

The stations Churchill (58°45'N; 94°04'W), Goose-Bay (53° 19'N; 60°25'W), and Kodaikanal (10°14'N; 77°28'E) were selected for this analysis, firstly, because of the longest observation rows at these stations, covering the period from 1968 through 1985 and, secondly, due to the fact that, according to earlier sample calculations, the amplitudes of 27-day total ozone variations at high-latitude stations are the largest.

The calculations were made using a specially worked out program permitting, besides the determination of the amplitudes and phases, the observation of the coherence of phases in any time interval. To characterize solar activity, solar radio-flux at 10.7 cm was used, which according to KEATING (1978) and HEATH et al. (1971) correlated well with both the radiation at λ = 210 nm and the global ozone variations.

The results of the calculation of total ozone phases difference and those of the index $F_{10.7}$, as well as the amplitudes of the 27-day variations of these parameters are presented in Figures 1 and 2, respectively. As can be seen in Figure 1, in the periods of maximum solar activity (1968/1972 and 1978-1982), the difference between the phases varies within 5 to 6 days, while in the years of the minima it appears to have a negative value of 6 to 7 days (which corresponds to the total ozone maximum occurrence in about 20 days after the $F_{10.7}$ maximum). At Goose-Bay a somewhat lesser mean difference of phases in the years of maximum solar activity is connected with the sharp change of the phase difference in 1981, and particularly in 1969, which needs an extra detailed analysis. As can be seen in Figure 1 (c,d), the above regularities in total ozone behaviour are not observed in summer, which results also in the unchanged amplitudes of 27-day total ozone variations (Figure 2) during the transition from the minimum to the maximum of solar activity.

In winter, both at the Churchill and Goose-Bay stations we observe the growth of the amplitudes of 27-day total ozone variations in the years of active Sun, which are most pronounced in the ascending branch of 11-year solar cycle. The latitudinal change of the phases of 27-day total ozone variations in winter is shown in Figure 3 (a and b), where the 27-day variations are determined for 5-month rows of daily ozone values, separately for the winters (November through March) of 1975-1976 and 1980-1981. The shaded bands in each of the figures show the phase of the 27-day variation of $F_{10.7}$, which coincides well with the actual occurrence of the maxima in Novembers 1975 and 1980, respectively. As can be seen from Figure 3b, at mid latitudes the maximum of

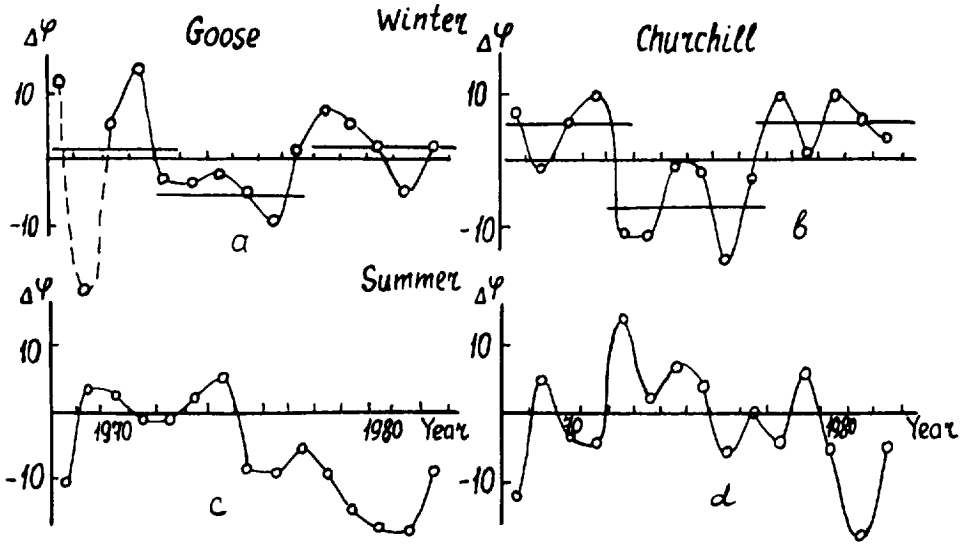

Fig.1. The differences of total ozone and $F_{10.7}$ phases in winter (a,b) and summer (c,d).

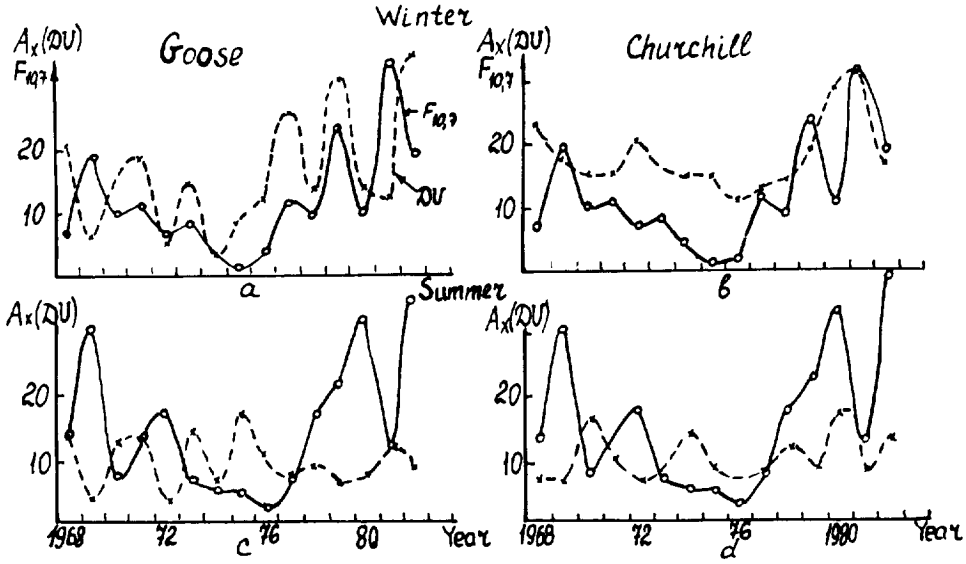

Fig.2. The amplitudes of 27-day total ozone variations in winter (a,b) and summer (c,d).

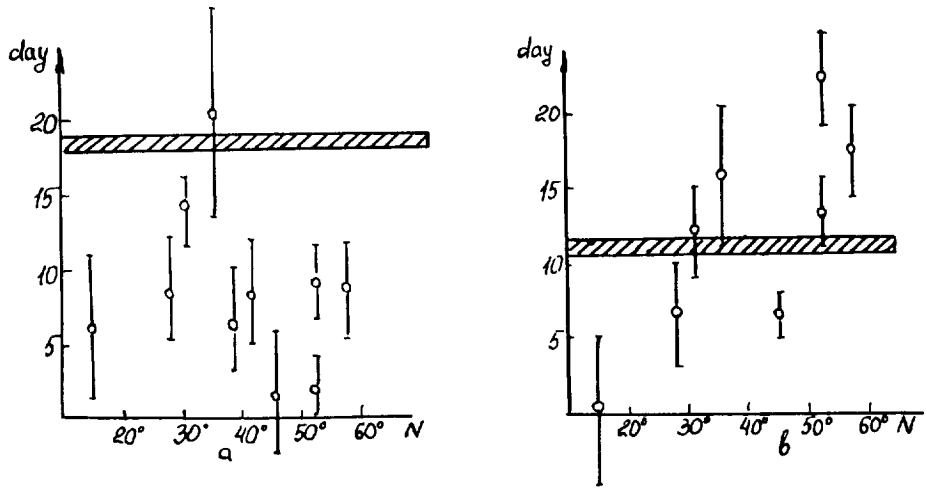

Fig.3. The latitudinal change of the phases of 27-day total ozone variations.

27-day total ozone variations immediately follows the $F_{10.7}$ maximum gradually spreading towards high and low latitudes.

In the years of minimum solar activity one fails to observe a similar relationship.

The spectral analysis of total ozone data and index $F_{10.7}$ for each of the years has shown that from year to year change not only the amplitudes of the variations observed, but also do the periods. Thus, every 4 years a sharp increase occures of the period of $F_{10.7}$ variations up to 30 days, with the following decrease down to 24-25 days. However, total ozone does not show such a periodicity. At Kodaikanal the occurrence of total ozone variations with nearly a 27-day period has an episodic character. Thus, the investigation conducted indicates the necessity of a more detailed analysis of the phenomena considered above.

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