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1.3 PROGRESS IN D-REGION STUDIES DURING MAP

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During MAP, active studies of the ionospheric D region were performed. The most interesting and fruitful were those in which variations of D-region parameters and of the dynamical regime of the middle atmosphere were intercompared.

As a result, the general picture of the D-region behavior became much clearer than before. It appears that the D region is strongly influenced by dissipation of internal gravity waves which come from below and are destroyed at altitudes 80-100 km. This influence is much stronger in winter than in summer due to the filtering effect of the stratospheric circulation on these waves. As a result, strong day-to-day variability of the D region in winter and relative stability in summer, is now clear.

Joint consideration of simultaneous data on the D region and dynamics of the middle atmosphere allowed to formulate three main features of winter anomaly (WA) and to understand its sources. The most pronounced manifestation of WA is the existence of the so-called anomalous days which is due to two factors: enhancement of NO because of the increased turbulence, and increase of the atmospheric temperature. Both factors lead to the same result increasing the ionization rate and decreasing the effective recombination coefficient. The net change of the electron concentration may in some cases amount to two orders of magnitude.

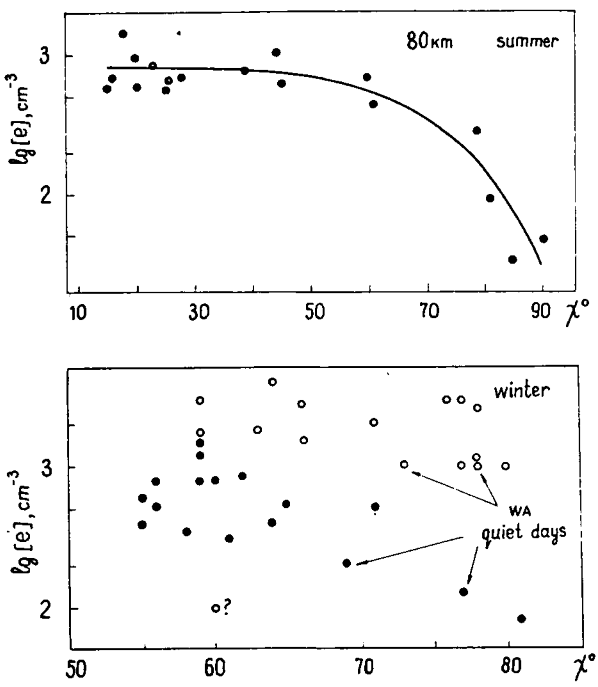

Figure 1. Electron concentrations as a function of solar zenith angle χ according to Danilov et al. [in *Spatial and Temporal Structure of the Lower Ionosphere*, 1982]. The dark points are normal days, the open ones are winter anomaly days.

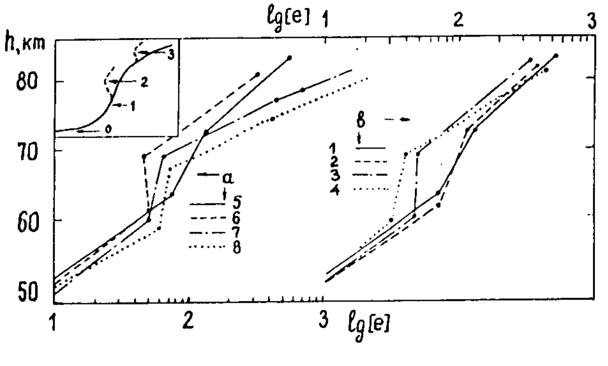

Figure 2. D-region electron profiles obtained by Pakhomov and Korneeva, [*Geomagnetism i aeronomia, 28*, No. 4, 1988] for various seasons as a result of an averaging of rocket measurements: 1 – summer; 2 – fall; 3 – spring, average; 4 – spring 1979; 5 – winter, low ionization; 6 – winter, moderate ionization; 7 – winter, high ionization.

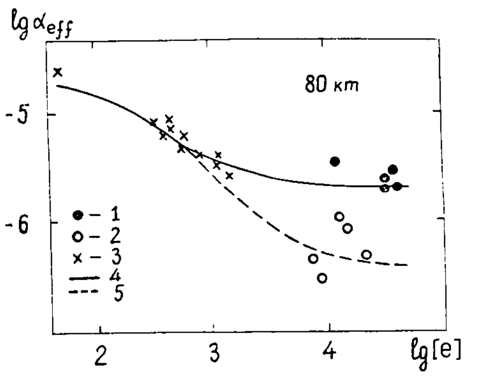

Figure 3. The effective recombination coefficient α_{eff} versus the electron concentration [e] at 80 km according to Danilov and Simonov [in *Ionosfernye issledovania*, N 34, 54, 1981]: 1– PCA, summer 1972; 2 – PCA, winter 1969; 3 – solar eclipses 1969 and 1970; 4 and 5 – theoretical curves (taking into account the dependences of α_{eff} on f^+ and f^+ on [e] and the season) for summer and winter, respectively.

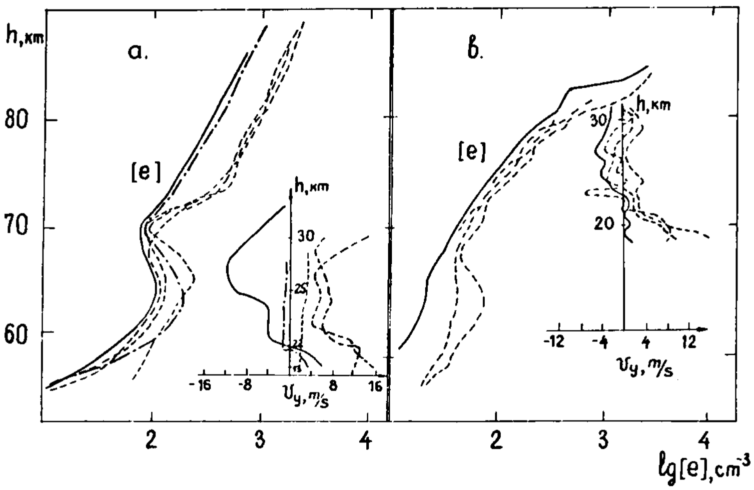

Figure 4. Profiles of the electron concentration [e] and the zonal component of the stratospheric wind V_y measured in Pittsburgh (a) and Volgograd (b) [Danilov et al., *Geomagnetism i aeronomia*, 26, 710, 1986]. The same kind of line represents the same rocket flight at which both [e] and V_y were measured.

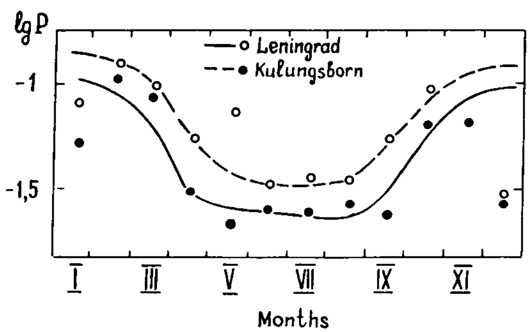

Figure 5. Seasonal variations of the fraction of time when SPA were observed [Danilov et al., *Geomagnetism i aeronomia, 27*, 536, 1987].