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SEASONAL DIFFERENCES OF ELECTRON DENSITY IN POLAR IONOSPHERE D-REGION DETERMINED BY PARTIAL REFLECTION TECHNIQUE

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Abstract. It was plotted the seasonal variations of the electron density in D-region using the data of the observatory Tumanny. In this paper some effects of the seasonal differences are discussed.

Introduction

At present time the least investigated part of the ionosphere is D-region situated at the altitude range of 50 – 90 km. This location is conditioned by a complicated photochemistry of D-region and a difficulty of the experimental determination of its parameters [Belikovich et al., 1999]. This reasons that is a drag on a progress of the D-region investigation connect with the region location in sufficiently dense layers of the atmosphere.

Among the ground-based radiophysical techniques used for D-region investigation the partial reflection technique (PRT) is more simple and informative. Using PRT the electron density can be obtained by a determination of the absorption difference along the path of the magnetoionic waves propagation [Belrose et al., 1972]. The main trouble during the analysis of backscattering consists in that the physical processes causing the observed backscattering are not enough comprehended. The absence of the correct method of the data processing and interpretation as well as the experiment expensiveness leaded to the fewness and contradictoriness of the daily, seasonal and altitude variations of the electron density. The main purpose of the work is the analysis of the electron density seasonal differences in D-region of the polar ionosphere.

Experimental results and model calculations

The daily variations of the N_e for summer, winter and autumn periods of 1999 is shown in Fig. 1. The electron density was determined by differential absorption technique, which was applied to the PGI MF radar measurements (Tumanny; 69.0° N, 35.7° E).

The points in the picture are represented the electron density for the fixed time. The solid line is the interpolar curve determined by the least square technique. For the interpolation it was used an eight power polynomial.

The figure shows an undulating variations of the electron density versus a time. These variations can be caused by the atmospheric gravity waves. The least dispersion of the points is typical for the summer data. This fact says about a strong solar influence on the lower ionosphere structure. The largest dispersion corresponds the winter data (it is the effect of a corpuscular intrusion).

It was carried out a comparison of the measured values of the electron density and estimated by the empirical PGI model of the polar ionosphere [Smirnova et al.,

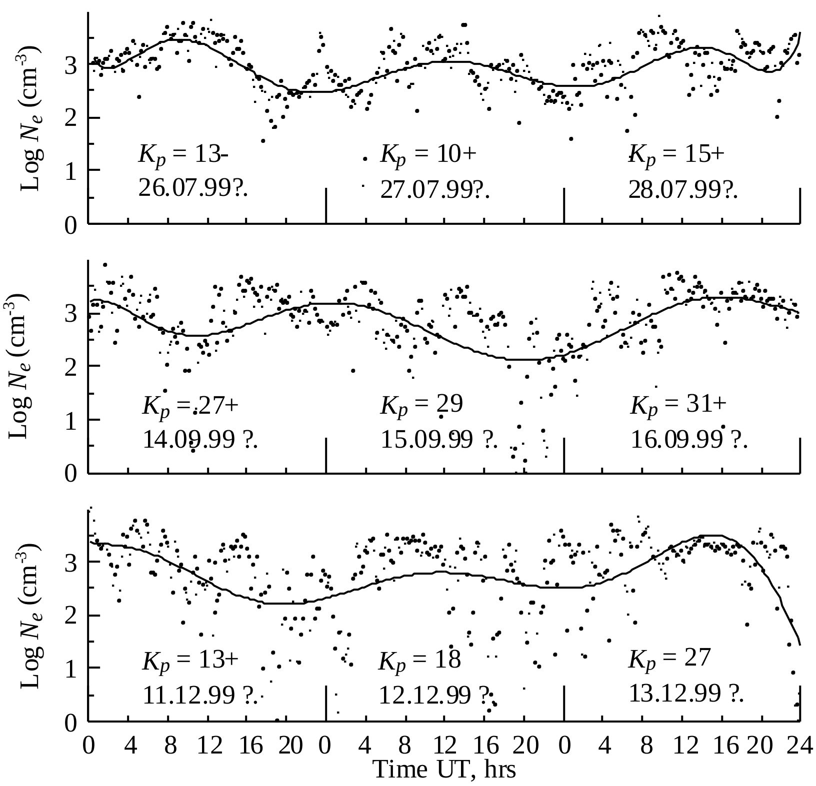

Fig. 1. The electron density variations for three days of summer, winter and autumn seasons

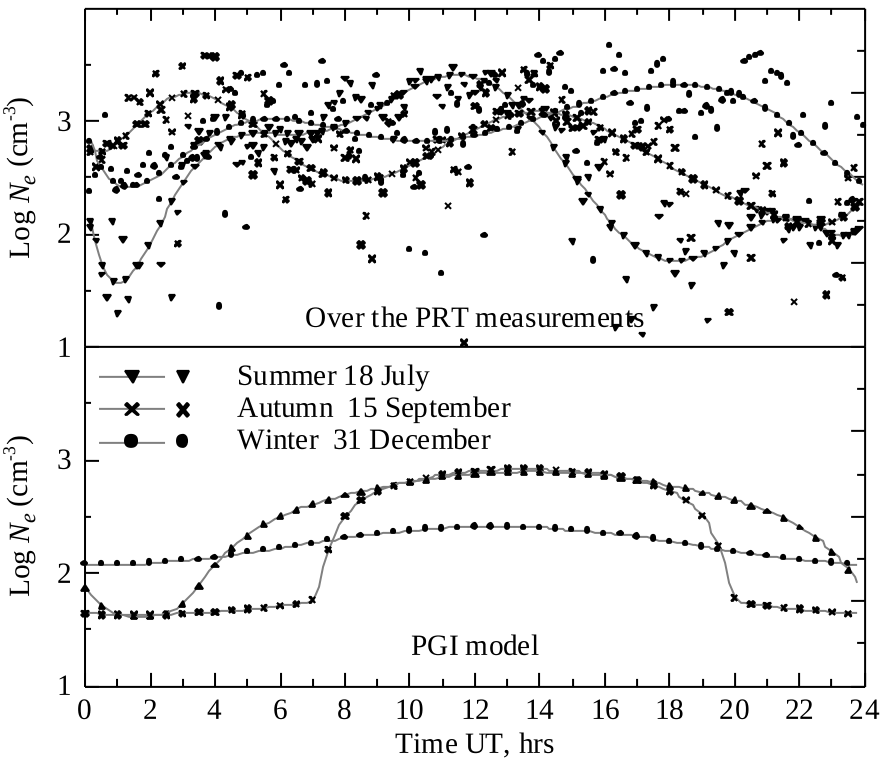

Fig. 2. Daily variations of the electron density at 85 km over the PRT measurements and PGI model

1988] (see Fig. 2). The comparison of the electron density values determined by PRT and estimated by PGI model shows a satisfactory qualitative agreement. The electron density determined from the experiments are a few times more then the model values. The model is rough and requires an improvement. It is also necessary a development of the electron density estimation technique and a work on experiment purity.

The estimation shows that the electron density is greater in a summer day than in an autumn and winter. However the greatest values of the electron density are observed in a winter evening and night. The electron density variations are not chaotic fluctuations but have a clear daily running that says about strong solar influence on the lower ionosphere structure.

In Fig. 3 the daily running of the total electron content in the ranges of 70 – 75 and 75 – 80 km is depicted. The figure clear shows effects of a sunrise and sunset. The electron density in the lowest part of the ionosphere is greater by a day than a night. During the autumn season the two maximum of the electron density are observed. So the large dispersion of their values is existed and the daily running is not appeared.

Concluding remark

Now the physics of all processes causing the Ne seasonal variations is not clear comprehended. It is supposed that the winter rise of Ne in D-region is evoked by the energy dissipation of the inner gravity waves and a penetration of the energetic corpuscles to the upper atmosphere.

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References

Belikovich V. V., Benedictov E. A., Tolmacheva A. V. Bakhmetjeva N. V. Ionosphere investigations by ATI technique. – N. Novgorod: IPFRAN, 1999. – 156 p.

Belrose J.S., Burke M.J., and Coyne T.N.R. D-region measurements with the differential-absorption, differentjal-phase partial-reflection experiments // J.Geophys. Res. – 1972. – V.77, ? 25. – P. 4829-4838.

Smirnova N.V., Ogloblina O.F., and Vlaskov V.A. Modelling of the lower ionosphere // Pageoph. – 1988. – V.127, ? 2/3. – P. 353-379.

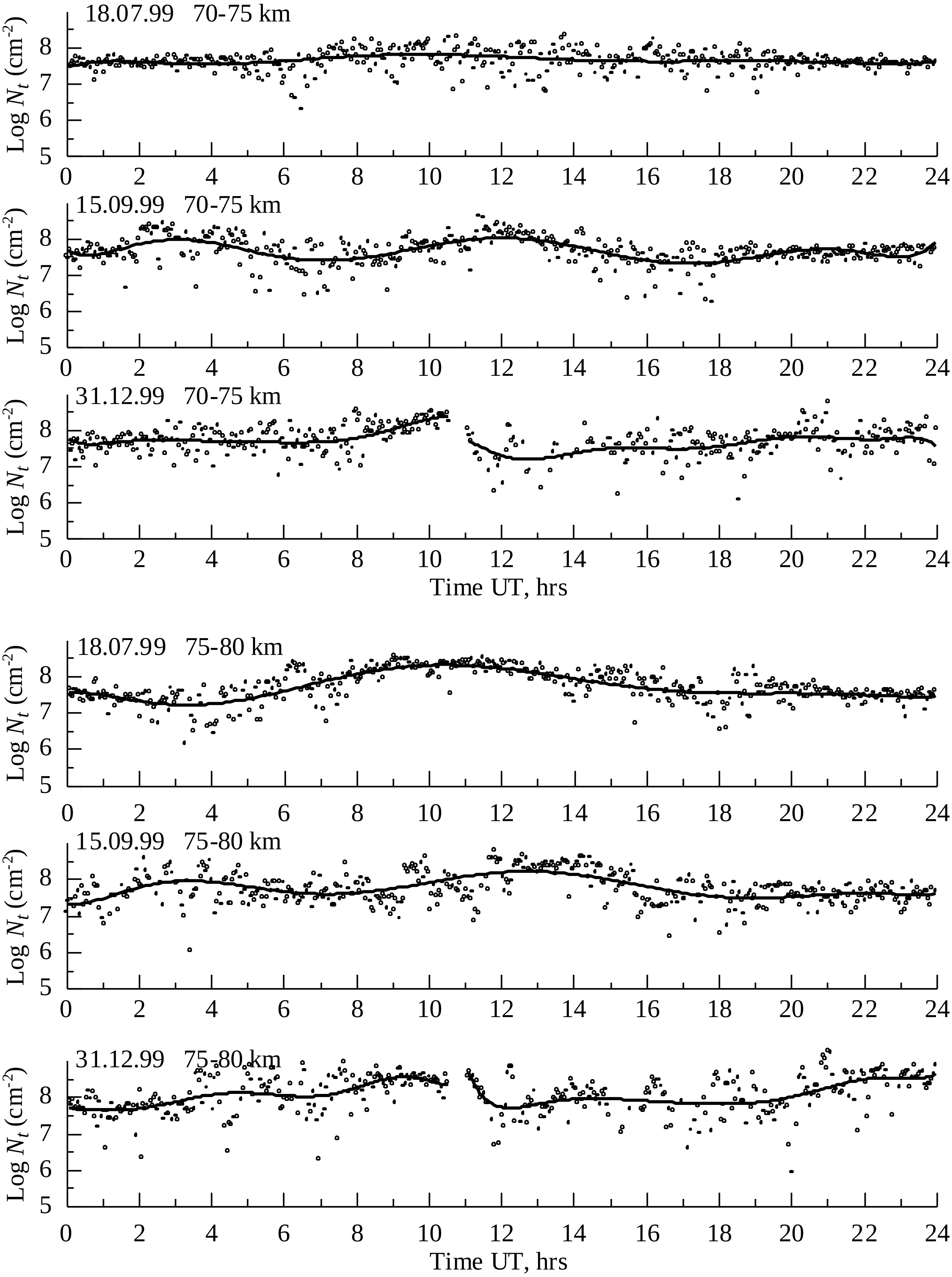

Fig. 3. The daily running of the total electron content in the region of 70 – 75 km and 75 – 80 km.