COMPARISON OF F-REGION ELECTRON DENSITY OBSERVATIONS BY SATELLITE TOMOGRAPHY OVER KOLA PENINSULA IN JANUARY-MAY 1999 WITH MODEL STUDIES

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A comparison has been made between experimental tomographic images of the high latitude ionospheric F-region electron density and results obtained by several models of the ionosphere. A satellite tomographic campaign was arranged on the Kola Peninsula during the period January-May 1999. The receiver chain consisted of four sites covering the region from South to North within 65°-69.4° N, 31°-34.6° E. The data were converted to ionospheric electron density maps using a stochastic invertion described e.g. by Khudukon [1998]. The measurements cover the main seasons (winter, equinox and summer) as well as typical levels of solar activity (from 100 up to 200 unites of F10.7). The magnetic activity was quite low (Kp=2-3). Some days of interest have been selected for comparison of experimental and simulated results. The global theoretical model of the upper atmosphere [Namgaladze et al., 1998] as well as two empirical ionospheric models RIM-88 [Chusovitin et al.,1987] and IRI-95 [Bilitza, 1995] were applied. Simulation results obtained by the models were compared between and with the tomographic reconstructions. We studied quiet altitude-latitudinal, diurnal and seasonal variations of the F-region electron density. Solar activity was also taken into account. The analysis of the obtained results shows the following:

(a) An unexpected occurrence was that in the majority of measurement sets the results obtained by the global theoretical model of the upper atmosphere have the best agreement with the experimental data under quiet geomagnetic conditions unlike the most modern version of the empirical ionosphere model IRI-95 giving the highest divergence.

(b) Simulated daytime values of electron density agree with corresponding tomography images for all seasons of the first half of 1999 practically covering the whole range of solar activity. The agreement is so close that no correction of the solar EUV flux being used as an input parameter for the global theoretical model of the upper Earth's atmosphere is required.

(c) A necessary correction of precipitating cold electron flux intensities used in the model should be made in order to improve the agreement between measured night values of the electron density and those estimated by the theoretical model. These values have to be increased by factor 2-3 in quiet conditions. Also, a latitudinal dependence of the precipitation maximum from solar activity should be taken into account.

(d) The comparison of the experimental and simulated results shows that the simulated electron density behavior caused by all known effects (by diurnal, altitude-latitudinal, seasonal variations as well as by solar activity) is consistent with the experimental tomographic data. This indicates a good reliability of both experimental and simulated data (at least within the center of the latitudinal range under study).

This work has been supported by the Grants No.00-05-65132 and No. 00-05-65511 of the Russian Foundation for Basic Research.

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