STRUCTURE AND VARIABILITY OF THE MAIN IONOSPHERIC TROUGH: EMPIRICAL MODELING, VALIDATION AND PHYSICAL EXPLANATION

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An empirical *foF*2 model (MIT) was constructed for the winter high-latitude ionosphere, taking into account the structure of the ionization trough. The model describes the trough position and its shape in the form of longitudinal-latitudinal *foF*2 variations in the geographic latitude range of 40-85°N and 40-85°S. The model is valid for conditions of November-February in the Northern hemisphere and May-August in the Southern hemisphere. The model describes quiet geomagnetic conditions (Kp = 0-3) at any level of solar activity in the interval of $F_{10.7}$ = 70-200 s.f.u. The model is based mainly on the measurement data of the Cosmos-900, Interkosmos-19 and CHAMP satellites. Partially, the data of the radio-occultation observations obtained in the experiments of GRACE, CHAMP and COSMIC / FORMOSAT were used. To build the MIT model, the IRI model was also used, which indirectly allowed for the data of ground-based ionospheric stations. MIT model results are compared to results of different models (IRI, E-CHAIM and model based on radio-occultation data). Results of the model, which is based on RO data agree well with MIT model results only for low solar activity. It is shown that the MIT model results are more closely to E-CHAIM and they both more adequately reproduces diurnal, longitudinal and latitudinal variations of *foF*2 than the international model of the ionosphere IRI-2012. The MIT model is available on the IZMIRAN website: http://www.izmiran.ru/ionosphere/sm-mit/.Within the framework of the model, the variations of the trough minimum position with the longitude and local time are singled out and studied in detail. We found that a magnitude of the trough position longitudinal effect for a fixed local time is greater in the daytime than in the nighttime. The magnitude and shape of the longitudinal effect is different for low and high solar activity. The Global Self-consistent Model of the Thermosphere, Ionosphere, and Protonosphere (GSM TIP) simulations demonstrate that during low solar activity, the longitudinal variations of the daytime trough position is mainly determined by longitudinal variations of the ionization function, formed due to the longitudinal variations in the solar zenith angle and the atomic oxygen density distribution. The longitudinal variations of the

nighttime trough position is formed by the longitudinal variations in ionization by precipitating auroral particles, neutral atmosphere composition, and electric field.

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