Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation Russian Academy of Sciences (IZMIRAN)

2. Completed space missions. Results obtained by Russian scientists in 2014-2015

Emperical model of the main ionospheric trough for the winter nighttime conditions

For the first time we developed an empirical model of the main ionospheric trough (MIT) for quiet (Kp=2) nighttime (18:00–06:00 LT) winter conditions in the North (Fig.1) and South (Fig.2) hemispheres for all levels of solar activity.

The model consists of two parts: 1) the MIT position model in terms of the geographical latitude and longitude; 2) the MIT shape model in terms of the latitudinal-longitudinal *foF*2 maps in the range of latitudes 45–75°N in the North hemisphere and 40–80°S in the South hemisphere. Thus, an empirical model of the quiet nighttime subauroral ionosphere was developed.

The model is based on Interkosmos-19 data for high solar activity (3500 paths) and CHAMP data (about 30 000 paths) for both high and low solar activity. *In-situ* N_e measurements at the CHAMP heights were transformed to electron density at the *F*2-layer peak height (i.e. to N_mF2 and then, to *foF*2). The accuracy of determining the trough minimum position is about of 2°. The error of *foF*2 description on the trough equatorial wall depending on the conditions under consideration is 0.2–0.4 MHz and increases up to 1.0 MHz on the polar wall. The model allows us to calculate the trough position for any level of solar activity $F_{10.7}$ from 70 to 200, *foF*2 value at one point, *foF*2 longitudinal and latitudinal variations, as well as *foF*2 spatial distribution in the range of latitudes 45–75°N in the North hemisphere and 40–80°S in the South hemisphere.

The model was used to reveal and study in detail the daily and longitudinal variations in the MIT minimum position. The longitudinal and latitudinal *foF*2 variations in the MIT region were also investigated. The accuracy of the model was tested according to the data of ground-based ionospheric stations. It was shown that the constructed model reproduces variations in the winter nighttime subauroral ionospheric structure, including variations in the MIT position and shape, much more adequately than the International Reference Ionosphere (IRI-2012).

The online version of the MIT model is available on the IZMIRAN website: http://www.izmiran.ru/ionosphere/sm-mit/.

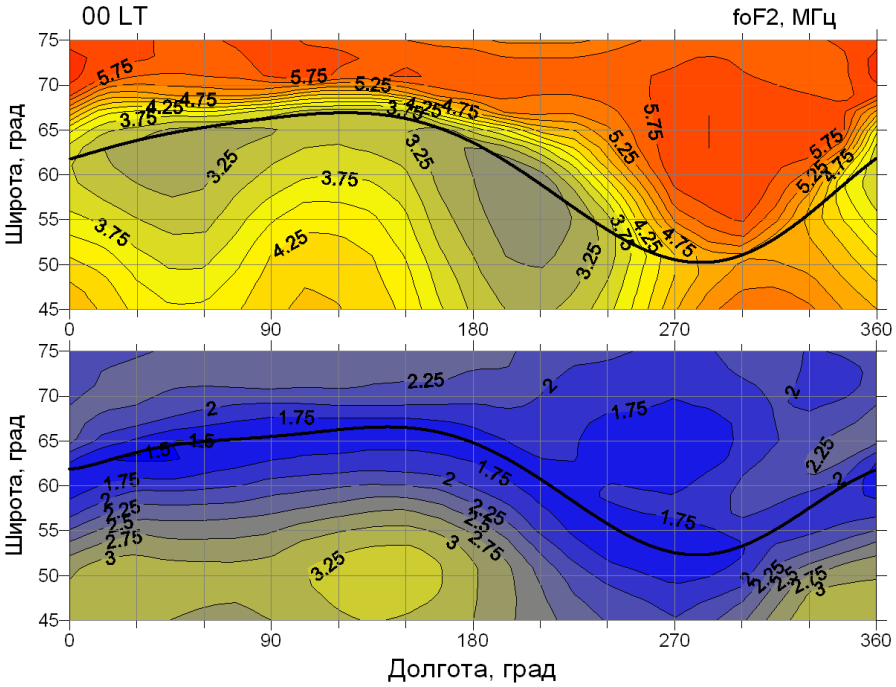

Fig.1. foF2 distribution in the main ionospheric trough in the North hemisphere at 00 LT for high (top) and low (bottom) solar activity. The curve shows the position of the trough minimum (Y - Latitude, degr.; X - Longitude, degr.).

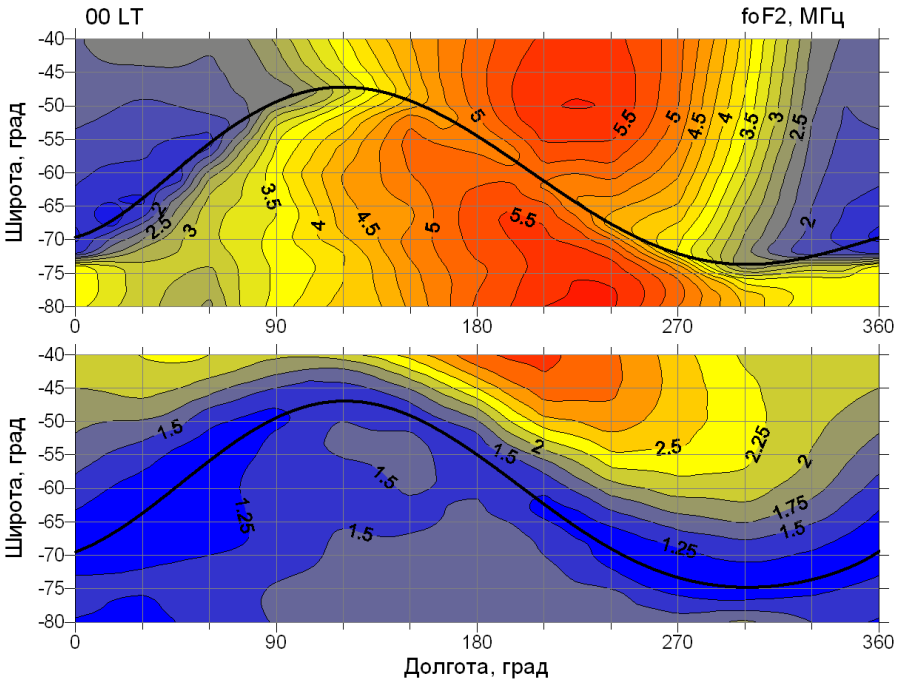

Fig.2. foF2 distribution in the main ionospheric trough in the South hemisphere at 00 LT for high (top) and low (bottom) solar activity. The curve shows the position of the trough minimum (Y - Latitude, degr.; X - Longitude, degr).

References:

A.T.Karpachev, M.V.Klimenko, V.V.Klimenko, L.V.Pustovalova. Empirical model of the main ionospheric trough for the nighttime winter conditions. Journal of Atmospheric and Solar-Terrestrial Physics (in press).