

Comparison of empirical models for the location of the ionospheric middle-latitude trough in the nighttime

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The middle-latitude ionization trough is a region of depleted plasma density in the ionosphere located at the equatorward edge of the auroral oval in the nighttime. Numerous studies have shown that trough locations shift equatorward under disturbed geomagnetic conditions. Many empirical models were developed to predict the trough location as a function of magnetic latitude (MLAT) and geomagnetic activity. Using the DMSP F15 data obtained in the nighttime sector of MLT = 1700-0130 hrs from February 2000 to January 2005, we identified 7735 middle-latitude troughs and statistically examined the trough location under different geomagnetic conditions. Unlike previous studies, we found that the middle-latitude trough minimum in the plasma density are distributed in a broad range of magnetic latitudes from $\sim 40^\circ\text{N}$ to $\sim 72^\circ\text{N}$ around 1700-2200 MLT in the Northern Hemisphere and from $\sim 28^\circ\text{S}$ to $\sim 76^\circ\text{S}$ around 2000-0130 MLT in the Southern Hemisphere depending on geomagnetic conditions. Trough locations at low latitudes and high latitudes, which appear under extremely disturbed ($K_p > 6$) and quiet ($K_p < 1$) geomagnetic conditions, respectively, are not well expected from previous empirical models. In this study, we develop an empirical model, in which trough locations can be expected under extreme geomagnetic conditions, and compare it with previous models.

Keywords: Ionospheric middle-latitude trough, Empirical model of the trough location