Examining the Mid-Latitude Ionospheric Trough with High-resolution IGS ionospheric maps

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A phenomenon known as the ionospheric mid-latitude trough is defined by a decrease in electron density in the ionosphere's F-layer near the sub-auroral zone. In this work, we use high-resolution Global Ionospheric Maps (GIMs) with a high temporal resolution of 15 minutes from the International GNSS Service (IGS) to identify and determine the features of the mid-latitude ionospheric trough. We have examined key parameters that characterize the MIT, such as the width, depth, occurrence rate, and trough minimum location. Depending on the magnetic local time, geographic distribution, seasons, and solar and geomagnetic activity conditions, including solar wind plasma speed, interplanetary magnetic field components, and geomagnetic activity indices SYM-H and Hp30 each of these MIT parameters represents morphological features of the midlatitude trough. Our research is based on a large database that we gathered by looking for troughs between 1998 and 2022, which includes two full solar cycles, such as cycles 23 and 24.

As popular 3D electron density models such as IRI, NeQuick, NEDM2020, etc. do not yet incorporate the MIT climatology and occurrence probability, the found dependencies can be used to verify existing MIT models and to create new MIT models. Including an MIT model might improve the performance of the 3D electron density models.