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Ionospheric Storm Variability in the Empirical Canadian High Arctic Ionospheric Model (E-CHAIM)

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In this study, we explore the behaviour of the Empirical Canadian High Arctic Ionospheric Model (E-CHAIM) [Themens et al., 2017] under disturbed geomagnetic conditions within the polar cap. For this purpose, we have manually scaled several months of ionosonde data from the Canadian High Arctic Ionospheric Network (CHAIN). Using this high-quality data, we examine the behaviour of the polar cap ionosphere under disturbed geomagnetic conditions and assess the capacity of E-CHAIM to model polar cap F2-peak electron density variability on "weather-like" time scales of a few hours to several days. In so doing, we will demonstrate that, while empirical models struggle appreciably in the representation of smaller time scales (two hours or less), it is well within their capacity to capture variabilities on 2-7 day timescales using measured geomagnetic indices. We also demonstrate that in the absence of a storm-time correction, empirical models may exhibit biases in their representation of monthly median variability at high latitudes due to the dominance of negative storm responses in these regions. In F2-peak critical frequency, these monthly median biases can exceed 0.5MHz, depending on the number of storms experienced within a month.

In addition to F2-peak densities, we also examine the behaviour of other aspects of the high latitude storm-time electron density representation within E-CHAIM, including the height of the F1-layer (hmF1) and the topside scale thickness. For hmF1, we show that storm-time hmF1 variability closely matches that of the F2-peak (hmF2). In the topside, we note a significant broadening of the topside electron density profile during geomagnetic disturbances associated with the heating of the lower ionosphere.

References

Themens, D.R., P.T. Jayachandran, I. Galkin, and C. Hall (2017). The Empirical Canadian High Arctic Ionospheric Model (E-CHAIM): NmF2 and hmF2, *J. Geophys. Res. Space Physics*, doi: 10.1002/2017JA024398