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The Empirical Canadian High Arctic Ionospheric Model (E-CHAIM): NmF2 and hmF2 specification

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It is well known that the International Reference Ionosphere (IRI) suffers reduced accuracy in its representation of monthly median ionospheric electron density at high latitudes (Themens et al. 2014, Themens et al. 2016). These inaccuracies are believed to stem from a historical lack of data from these regions. Now, roughly thirty and forty years after the development of the original URSI and CCIR foF2 maps, respectively, there exists a much larger dataset of high latitude observations of ionospheric electron density. These new measurements come in the form of new ionosonde deployments, such as those of the Canadian High Arctic Ionospheric Network, the CHAMP, GRACE, and COSMIC radio occultation missions, and the construction of the Poker Flat, Resolute, and EISCAT Incoherent Scatter Radar systems. These new datasets afford an opportunity to revise the IRI's representation of the high latitude ionosphere.

For this purpose, we here introduce the Empirical Canadian High Arctic Ionospheric Model (E-CHAIM), which incorporates all of the above datasets, as well as the older observation records, into a new climatological representation of the high latitude ionosphere. In this presentation, we introduce the NmF2 and hmF2 portions of the model, focusing on both climatological and storm-time representations, and present a validation of the new model with respect to ionosonde observations from four high latitude stations. A comparison with respect to IRI performance is also presented, where we see improvements by up to 70% in the representation of peak electron density through using the new E-CHAIM model. In terms of RMS errors, the E-CHAIM model is shown to represent a near-universal improvement over the IRI, sometimes by more than 1 MHz in foF2. For peak height, the E-CHAIM model demonstrates overall RMS errors of ∼13km at each test site compared to values of 18-35km for the IRI, depending on location.

Themens, D.R., P. T. Jayachandran, et al. (2014). J. Geophys. Res. Space Physics, 119, 6689–6703, doi:10.1002/2014JA020052.
Themens, D.R., and P.T. Jayachandran (2016). J. Geophys. Res. Space Physics, 121, doi:10.1002/2016JA022664.