32nd URSI GASS, Montreal, 19-26 August 2017

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

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Extended Abstract

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 [1,2]. 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.

Using a spherical cap harmonic expansion to represent horizontal variability, a Fourier expansion in day of year to represent seasonal variations, and separation into independent UTC models, we have developed a new model of ionospheric peak height (hmF2) and bottomside electron density for the high latitude ionosphere, above 50N geomagnetic latitude. For hmF2, the choice to apply a regional modeling approach allows for increased spatial resolution over global models. Validation of the E-CHAIM hmF2 model demonstrates overall RMS errors of ~13km at each of the three test sites compared to values of 18-25km for the IRI. The majority of these improvements come from the representation in the auroral oval region, particularly during daytime and equinox periods. For the bottomside, we present a variable Chapman bottomside parameterization, where the scale heights are represented by a fourth order polynomial expansion, the coefficients of which are independently modeled using a similar approach as that used for hmF2. Together with similar quiet and storm-time models of the peak electron density (NmF2) and a topside model representation, these models make up the major elements of the Empirical Canadian High Arctic Ionospheric Model (E-CHAIM).

References

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