UNB Physics Department Seminar

Near-real-time data assimilation of the high latitude ionosphere

Ben Reid
UNB Physics

The high latitude ionosphere provides a challenging environment for space weather forecasting. This region of the ionosphere is very dynamic andcan cause issues with radio frequency signals that interact with it. By design, climatological models cannot adequately capture the short-term variability of the ionosphere. To be able to provide the best possible understanding of the current state of the ionosphere, it is required to augment traditional models with near-real-time data sources, primarily ionosondes and Global Navigation Satellite System (GNSS) receivers. However, these instruments are both sparsely and unevenly distributed at high latitudes, which creates challenges for traditional assimilation approaches.

To address these issues, we have developed a new, near-real-time data assimilation framework intended for the high latitude sector. This framework is built on the Empirical Canadian High Arctic Model (E-CHAIM), and uses a Kalman Filter as the basis of the assimilation. The unique parameterization of E-CHAIM allows for robust linearization and differentiation, which we exploit to greatly constrain the number of parameters in the state of the assimilation. This also allows us to avoid traditional tomographic techniques for GNSS assimilation, which can have regularization problems given the suboptimal distribution of Arctic GNSS receivers.

We present preliminary results using simulated data in order to verify the validity of this technique. We are able to demonstrate a significant improvement in the reconstructed ionospheric profile, and the vertical Total Electron Content (vTEC), when compared to the base empirical model. In addition, we are able to resolve simulated Differential Code Biases (DCBs) of the GNSS receivers, an essential capability in order to be able to use real GNSS data.

March 21, 2019, 1:15--2:15 pm in P204. Colloquium tea in P203 beforehand