THE USU GAIM PHYSICS-BASED DATA ASSIMILATION MODEL: RECENT DEVELOPMENTS AND RESULTS

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The ionospheric plasma distribution at low and mid latitudes is strongly driven by thermospheric and magnetospheric processes as well as by coupling processes from below. Electric fields from various sources play an important role on the morphology of the low latitude ionosphere and the neutral wind, temperature, and composition are believed to be important parameters that control the ionospheric height and density at mid latitudes. Therefore, a study of ionospheric dynamics must take into account the interaction between the different domains. As shown by meteorologists and oceanographers, a powerful way of modeling complex systems is with the use of data assimilation models. At USU, we have developed two data assimilation models with different complexity and both provide global and regional specifications of the 3-dimensional ionosphere-plasmasphere plasma densities. One of these models is a Physics-Based Kalman filter data assimilation model, which is based on a physics-based model for the ionosphere-plasmasphere system, a diverse array of data sources, and an ensemble Kalman filter data assimilation technique. This model covers the ionosphere-plasmasphere system from 90 to 30,000 km altitude and includes 6 ion species. The strength of this model is that in addition to the global and regional 3-D ionosphere electron density distribution it also self-consistently determines the corresponding ionospheric drivers, including the thermospheric neutral winds and the low-latitude electric fields. The model can assimilate a variety of different data types, including GPS/TEC from hundreds of ground-based receivers, in situ N_e from several DMSP satellites, bottomside N_e profiles from tens of ionosondes, and occultation data from the six COSMIC satellites. The model was used over several extended periods to specify the dynamics of the low- and mid-latitude ionosphere. We will present the current status of the model development and discuss the employed data assimilation technique. Recent examples of the ionosphere and driver specifications obtained from our model runs will be presented and comparisons with independent data will be shown.

Low-Latitude Ionosphere, Mid-latitude Ionosphere, Data Assimilation

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