GLOBAL ASSIMILATION OF IONOSPHERIC MEASUREMENTS (GAIM)

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The ionosphere is a highly dynamic medium that can vary significantly from day to day and from hour to hour at a given location, and these variations can have detrimental effects on military and civilian systems. In an effort to minimize or circumvent the detrimental effects, a physics-based data assimilation model of the ionosphere and neutral atmosphere is under development with funding from the Multi-Disciplinary University Research Initiative (MURI) program. Two university consortia are involved, with Utah State University (USU) and University of Southern California (USC) as the lead institutions. When completed, the GAIM model will provide specifications and forecasts on a spatial grid that can be global, regional, or local (25 km x 25 km). GAIM will use a physics-based ionosphere-plasmasphere-polar wind model and a Kalman filter as a basis for assimilating a diverse set of real-time (or near real-time) measurements. The resulting specifications and forecasts are in the form of 3-dimensional electron density distributions from 90 km to geosynchronous altitude (35,000 km). Auxiliary parameters are also available, including N_mF_2, h_mF_2, N_mE, h_mE, and slant and vertical TEC. In addition, GAIM will provide global distributions for the self-consistent ionospheric drivers (neutral winds and densities, magnetospheric and equatorial electric fields, and particle precipitation patterns), and in its specification mode, it will provide quantitative estimates for the accuracy of the reconstructed ionospheric densities.

In addition to the physics-based, Kalman filter, data assimilation model, we have also developed a Gauss-Markov Kalman filter model. For both of these models, we have assimilated several data sources, including in situ electron density measurements from the DMSP satellites, bottomside electron density profiles from the Air Force network of digisondes, GPS-TEC data from a world-wide network of more than 100 stations, GPS-TEC data from 332 stations in the CORS network (covering the U.S.), and occultation data. The presentation will first provide a brief description of the two models, and then the focus of the presentation will be on a comparison of the results from the two models and a validation with independent data sources.