Effects of Background and Observational Error Covariance Models on Ionospheric Data Assimilation

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The data assimilation models can provide us with an inference of 3-dimensional ionospheric electron density structures from incomplete observations. We use a data assimilation model for the ionosphere that is based on the Gauss-Markov Kalman filter with the International Reference Ionosphere (IRI) as the background model to assimilate two different types of GPS observations, namely ground-based GPS data and FORMOSAT-3/COSMIC radio occultation data. Here, the satellite slant total electron contents (TEC) data are used. The error covariances for the background model and observational data play an important role in data assimilation, and this study employs two different background model error covariances: location-independent and location-dependent error covariance. While vertical and horizontal correlation structures in the location-dependent error covariance vary at each location according to the correlation estimated from empirical orthogonal functions (EOFs), correlations in the location-independent error covariance are given by the same Gaussian function regardless of locations. Observing system simulation experiments show that assimilation analyses of the electron density obtained by using the location-dependent error covariance agree better with the "truth" than ones obtained by using the location-independent error covariance.