Ionospheric data assimilation with TIE-GCM and GPS-TEC during geomagnetic storm period

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The main purpose of this study is to investigate the latency time for the ionosphere data assimilation during the geomagnetic storm. An Ensemble Kalman Filter (EnKF) module developed by National Center for Atmospheric Research (NCAR), called as Data Assimilation Research Testbed (DART), is applied to assimilate the ionospheric electron density into a theoretical model (Thermosphere-Ionosphere-Electrodynamics General Circulation Model, TIE-GCM) with ground-based GPS total electron content (TEC) observations during the 26 September 2011 geomagnetic storm period. Effects of various assimilation time intervals, 60-, 30-, and 10-minute, on the ionospheric forecast responses are examined by their global root-mean-square errors (RMSEs) during the entire storm period. Substantial reduction of RMSEs for 10 minutes assimilation cycle suggests the ionospheric data assimilation system greatly improve the capability of model forecast during the geomagnetic storm period. Further examination shows that the neutral state variables in the assimilation model are the important factor to change the trajectory of model forecasting. However, the assimilation model with neutral state variables still needs the shorter assimilation cycle (10-minute in this study) to restrain overfitting of neutrals and lead to higher forecast accuracy during the geomagnetic storm.

Keywords: Ionospheric data assimilation, geomagnetic storm

