Community-Wide Model Validation Study for Systematic Assessment of Ionosphere Models

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To address challenges of assessment of modeling capabilities, the CCMC (Community Coordinated Modeling Center) initiated a series of community-wide model validation projects, such as the GEM, CEDAR and GEM-CEDAR Modeling Challenges. The CEDAR ETI (Electrodynamics Thermosphere Ionosphere) Challenge focused on the ability of ionosphere-thermosphere (IT) models to reproduce basic IT system parameters, such as electron and neutral densities, NmF2, hmF2, and TEC. Model-data time series comparisons were performed for a set of selected events with different levels of geomagnetic activity (quiet, moderate, storms). The follow-on CEDAR-GEM Challenge aims to quantify geomagnetic storm impacts on the IT system. On-going studies include quantifying the storm energy input, such as increase in auroral precipitation and Joule heating, and quantifying the storm-time variations of neutral density and TEC. The community-wide model validation activities involve international collaborations (e.g., between the CCMC and UK Met Office) to enhance the studies. In this paper, we focus on results of validation of IT models for reproducing storm impacts on TEC. In order to quantify storm impacts on TEC, we considered several parameters: TEC changes compared to quiet time (the day before storm), TEC difference between 24-hour intervals, and maximum increase/decrease during the storm. We investigated the spatial and temporal variations of the parameters during storm events (e.g., 2006 AGU storm) using ground-based GPS TEC measurements in several longitude sectors where data coverage is relatively better. The latitudinal variations were also studied. We obtained modeled TEC from various IT models. The parameters from the models were compared with each other and with the observed values. We quantified performance of the models in reproducing the TEC variations during the storm using skill scores. Model output and observational data used for the challenge will be permanently posted at the CCMC website (http://ccmc.gsfc.nasa.gov) as a resource for the space science communities to use.