The ionospheric pre-reversal enhancement electric field modeling by coupled thermosphere-ionosphere data assimilation system

*Chia-Hung Chen[1], Charles Lin[1], Tomoko Matsuo[2,3], Jann-Yenq Liu[4,5]

1. Department of Earth Sciences, National Cheng Kung University, 2. Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder, Boulder, Colorado, USA, 3. Space Weather Prediction Center, National Oceanic and Atmospheric Administration, Boulder, Colorado, USA, 4. Institute of Space Science, National Central University, Chung-Li, Taiwan, 5. Center for Space and Remote Sensing Research, National Central University, Chung-Li, Taiwan

We report that assimilating total electron content (TEC) into a coupled thermosphere-ionosphere model by using the ensemble Kalman filter (EnKF) results in improved specification and forecast of eastward pre-reversal enhancement (PRE) electric field (E-field). Through data assimilation, the ionospheric plasma density, thermospheric winds, temperature and compositions are adjusted simultaneously. The improvement of dusk-side PRE E-field calculation over the prior state is achieved primarily by intensification of eastward neutral wind. The improved E-field calculation promotes a stronger plasma fountain and deepens the equatorial trough. As a result, the horizontal gradients of Pedersen conductivity and eastward wind are increased due to greater zonal electron density gradient and smaller ion drag at dusk, respectively. Such modifications provide preferable conditions and obtain a strengthened PRE magnitude closer to the observation. The adjustment of PRE E-field is enabled through self-consistent thermosphere and ionosphere coupling processes captured in the model. This study suggests that the PRE E-field that is critical in driving the evening equatorial plasma instability could be better forecasted by assimilation of TECs in the 10 minutes cycling.

Keywords: ionospheric data assimilation model, pre-reversal enhancement, electric field

