Toward ionosphere forecast using COSMIC-2

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We report that assimilating ground-based and space borne GNSS observations into a coupled thermosphere-ionosphere model by using the ensemble Kalman filter (DART-TIEGCM) results in improved specification and forecast of eastward pre-reversal enhancement (PRE) electric field (E-field). Through data assimilation, not only the ionospheric plasma density, but thermospheric winds, temperature and compositions are also adjusted simultaneously according to their relationship to ionospheric plasma density. The improvement of dusk-side PRE E-field over the prior state is achieved primarily by intensification of eastward neutral wind. The improved E-field subsequently 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. The assimilative outputs are further utilized to calculate the flux tube integrated Rayleigh-Taylor instability growth rate during March 2015 for investigation of global plasma bubble occurrence. Significant improvements in the calculated growth rates could be achieved because of the improved update of zonal electric field in the data assimilation forecast. As the upcoming COSMIC-2 mission is equipped with radio occultation observations of global electron density as well as in-situ ion density and velocity measurements at low latitudes, the observations will benefit the assimilation model by providing rich data and validation of plasma bubble occurrence.