Global Three-Dimensional Ionospheric Data Assimilation Model Using Ground-based GPS and Radio Occultation Total Electron Content

*CHIYEN LIN[1], Tomoko Matsuo[2], Jann-Yenq Liu[1], Charles Lin[3], Ho-Fang Tsai[3], Chao-Yan Chen[1]

1. Graduate Institute of Space Science, National Central University, TAIWAN, 2. Department of Aerospace Engineering Sciences, University of Colorado, Boulder, Colorado, USA, 3. Department of Earth Sciences, National Cheng Kung University, Tainan, Taiwan

In this study, an ionospheric data assimilation approach is presented based on the Gauss-Markov Kalman filter with IRI (International Reference Ionosphere) as the background model and designed to assimilate the total electron content (TEC) observed from ground-based GPS receivers and space-based radio occultation of FORMOSAT-3/COSMIC (F3/C) or FORMOSAT-7/COSMIC-2 (F7/C2). The Kalman filter consists of the forecast step according to Gauss-Markov process and the measurement update step. Observing System Simulation Experiments (OSSEs) show that the Gauss-Markov Kalman filter procedure can improve the accuracy of the data assimilation analysis over the procedure consisting of the measurement update step alone. Comparing to F3/C, the dense F7/C2 occultation observation further improves the model accuracy significantly. Validating the data assimilation results with GIMs (Global Ionosphere Maps), the vertical TECs from global ground-based GPS measurements, and the ionospheric F_2-peak height and electron density sounded by ionosondes are carried out. Both the OSSE results and the observation validations confirm that the developed data assimilation model can be used to reconstruct the three-dimensional electron density in the ionosphere satisfactorily.

Keywords: Space Weather, Data Assimilation, Radio Occultation

