Ionospheric Electron Density observed by Using the Tiny Ionospheric Photometer and GPS Occultation Experiment

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Each FORMOSAT-3/COSMIC (F3/C) satellite has a GPS Occultation Experiment (GOX) payload to operate the ionospheric radio occultation, a Tiny Ionospheric Photometer (TIP) to observe the nighttime ionospheric 135.6 nm airglow emission, and a Tri-Band Beacon (TBB) to transmit radio beacon to ground-based receiver to tomographically estimate fine structures of the satellite-to-receiver electron content. Due to its very high sensitivity ~150 counts/s/Rayleigh and rather narrow nadir pointing 3.8° circular field-of-view, the TIP provides accurate characterization of ionospheric electron density gradients. The horizontal electron density gradients from the TIP can significantly improve the accuracies in the GOX measurements and TBB tomography results. In this paper, a numerical model has been developed to estimate the conversion factor between the TIP intensity and ionospheric electron density (or total electron content, TEC) for various local times, seasons, and solar activities in the equatorial ionization area (EIA). Meanwhile, simultaneous observations in the electron density (or TEC) of the global ionospheric map (GIM) and F3/C GOX as well as the ionospheric 135.6 nm airglow emissions from the TIMED GUVI and F3/C TIP are used to validate the conversion factor. Some of the EIA features are presented by the TIP data.