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FY-3G GNOS-II Topside TEC Inversion and Preliminary Accuracy Evaluation

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The Fengyun-3G (FY-3G) satellite, China's inaugural low-inclination orbit precipitation measurement satellite, was launched in April 2023. Situated at an altitude of 400 km in a non-sun-synchronous orbit, the satellite is equipped with the GNSS Occultation Sounder (GNOS-II). GNOS-II records dual-frequency signals from the BDS/GPS for precise atmospheric and ionospheric radio occultation measurements, allowing the retrieval of electron density profiles (EDP) from an altitude of 80 km to the satellite's orbit. Crucially, the FY-3G offers insights into the substantial electron density fluctuations that occur above its orbital altitude. Employing the phase-smoothing pseudorange method, our study extracts the topside Total Electron Content (TEC) from FY-3G data. We then conducted a preliminary analysis of the BDS/GPS TEC accuracy and variation characteristics as detected by the FY-3G.

We compared the topside TEC data from the FY-3G satellite with both the NeQuick2 model-derived TEC and the SWARM-measured TEC to assess discrepancies. Additionally, we analyzed the congruence between the FY-3G GPS-derived topside TEC and the BDS-derived topside TEC. The findings reveal a notable daily TEC variation consistency between FY-3G and NeQuick2, as evidenced by a correlation coefficient of 0.86. The comparison with SWARM TEC yielded an even higher correlation of 0.93. Furthermore, a high degree of agreement is observed between FY-3G GPS-derived and BDS-derived topside TEC values.

The deployment of the FY-3G satellite offers new promising data sources for ionospheric mapping and modeling. By utilizing the dual-system, topside TEC observation capabilities of FY-3G, we can analyze regions characterized by extreme ionospheric fluctuations above 400 km. Moreover, the integration of FY-3G's topside TEC with EDP below its orbit offers a ground-to-navigation-satellite TEC observational scope, akin to terrestrial observatories. The above assessments reveal that TEC variations recorded by FY-3G align with established models and satellite data, signaling its implications for both atmospheric scientific inquiry and practical meteorological operations.