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The FORMOSAT-7/COSMIC-2 (F7/C2) satellites have been in space for one and a half years. The primary payload is the JPL developed Tri-GNSS Radio-occultation System. Tracking data from two upward looking choke-ring antennas are used for orbit and clock determination as well as ionospheric total electron content retrieval. Two limb-viewing radio occultation antennas provide more than 4000 daily profiles of the neutral atmosphere (e.g. bending angle, refractivity, and temperature) from typically 80 km to 1 km above the Earth's surface. Secondary payloads are the Ion Velocity Meter and tri-band Radio Frequency Beacon. Over time, the satellites took turns with orbit transfers to their operational orbit configuration. Satellites not in orbit transfer are collecting radio occultation data since July 2019.

The science team put efforts on data calibration and validation in this time period, the data processing software was tuned and modified accordingly. In parallel, the engineering team loaded flight software patches to spacecraft bus and firmware updates to payload instrument to optimize the mission system. The highest count of radio occultation profiles collected to date was 5722 on April 18, 2020. The neutral atmosphere data calibration/validation effort led to the formal release of provisional products in December 2019, and validated products in March 2020. The space weather calibration/validation effort is underway. Currently, validated GPS and GLONASS absolute total electron content products are released, while GNSS scintillation and in-situ Ion Velocity Meter products are planned for release in the coming months.

The impacts of the F7/C2 data will be elaborated further in three categories: (1) improvement to numerical weather prediction; (2) space weather applications. For example, Taiwan’s Central Weather Bureau (CWB) has included the data into daily forecast operations. The case study showed the inclusion of radio occultation data can improve the tropical cyclone 120-h track forecast by 7%. Global Forecast System impact analysis performed by the Joint Center for Satellite Data Assimilation generally show positive impacts from the F7/C2 data, particularly in tropical regions. Total electron content products have been demonstrated to meet the 3 TECU accuracy requirement. National Cheng-Kung University (NCKU) has observed a small-scale solar storm in August 2019 by using FS7-TROPS products. The triggered communication and navigation disturbances are much higher than expected in the areas of central Asia and Europe. This important finding reminds scientists to watch out for small-scale solar storms.
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