URSI GASS 2023, Sapporo, Japan, 19 – 26 August 2023

Space Weather Commercial Weather Data Pilot GNSS Processing and Evaluation

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Under the National Oceanic and Atmospheric Administration (NOAA) space weather Commercial Weather Data Pilot (CWDP) program, a team from NOAA, UCAR, and several other partners is evaluating the potential to generate and utilize Global Navigation Satellite System (GNSS) space weather data products from small satellite constellations designed and operated by Spire Global and PlanetIQ. The pilot study includes a 6 month near real-time data delivery phase with near real-time processing and product delivery to study partners.

For the space weather CWDP the COSMIC Data Analysis and Archive Center (CDAAC) system is utilized to generate near real-time total electron content (TEC), electron density profile (EDP), and scintillation monitoring products. We derive absolute TEC tracks reaching from negative (minimum height of straight line 90 km) to positive elevations at the spacecraft, taking into account differential code bias and multipath calibrations. EDPs are generated using the CDAAC algorithm utilized for other satellite missions (e.g. COSMIC-1 and -2). To monitor scintillation events, high rate carrier phase and signal-to-noise ratio observations (e.g. 50 Hz or 100 Hz) are downlinked under certain conditions. The high rate observations are then used to derive scintillation amplitude and phase indices, and to attempt to geolocate ionospheric irregularity regions based on a back-propagation algorithm developed for COSMIC-2.

We present several pilot study results. First, we summarize data volumes received, latency, and products generated over the 6 month data delivery period. For TEC, we evaluate DCB stability, slant TEC distributions, and make comparisons to COSMIC-2 where the track time and observation geometry are similar. EDPs are evaluated by comparing to collocated COSMIC-2 EDPs and ionosonde observations for some cases to verify consistency, including shape and F2 layer peak height and peak electron density. For scintillation we characterize the local time and geographic locations of elevated indices, ability to geolocate the events, and discuss how mid- and high-latitude scintillation metrics differ from those derived from COSMIC-2 data.