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Poster

Spire Global operates more than 100 3U CubeSats in various low Earth orbits. Each satellite is equipped with a GNSS receiver capable of collecting more than 1,000 radio occultation (RO) profiles per day from GPS, GLONASS, Galileo, and QZSS constellations. Currently, Spire collects more than 12,000 profiles daily, of which approximately 10,000 result in inverted RO profiles that pass quality control (QC).

From mid-December 2020 to mid-January 2021, Spire supplied RO profiles in the first delivery order of the NOAA Commercial Weather Data Operational Buy. During the 30-day period Spire delivered 700 profiles per day derived from GPS and GLONASS transmissions. The Spire RO data were collected from 17 different satellites in a variety of orbits and characterized by a mean SNR of about 400 V/V at 1 s, median bending angle noise of about 1.4-1.5 urad, mean latency time of about 85 minutes, and close to a uniform global distribution. Before delivery to NOAA, each profile was processed in near real-time by Spire and passed internal quality control. Post-processing of each profile was performed by UCAR from raw (level 0) measurements. This is the first time Spire has had the opportunity to compare its processed RO profiles to those produced by an external processing center.

Here, we will compare the statistics of penetration depth, bending angle, and refractivity against background evaluated from ECMWF gridded analysis. We also investigate the effect of the different profile geolocation definitions. In general, we find the difference between the quality of processed profiles is small, but that UCAR's QC differs from that of Spire by rejecting some of the profiles that pass Spire QC. This type of comparison highlights differences among processing centers and helps to encourage more common and improved processing techniques by all centers.

Comparison between Spire and UCAR Processing of RO data

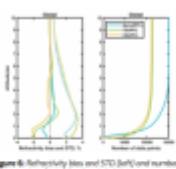


Figure 6: Refractivity bias and STD (km) vs. profile number of observations (digitized) for the global data.

In this section, we consider the statistics of the Spire refractivity data processed by the Spire Processing Center (C2) and the UCAR Processing Center (UCAR). We use the data collected between June 10, 2020, and July 10, 2020, which includes most of the data used in the previous section. The total number of the profiles is about 10000 for Spire and 10000 for C2. NCEP GPS analysis was used as a background refractivity for all three datasets.

Figure 6 shows the global refractivity bias and STD (km) and the number of data points (right y-axis). The left y-axis shows the bias in km. Spire and C2 profiles do not differ above this height. The bias is shown by solid lines, and the STD is shown by dashed lines. The lines correspond to Spire data processed by Spire, C2 data processed by Spire, and C2 data processed by UCAR. Figures 7, 8, and 9 show the same statistics for the polar, mid-latitude, and tropical regions. Spire satellite data is shown for polar region since C2 does not sample there.

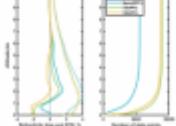


Figure 7: The same as in Figure 6 but for the polar region.

We note similar structure of the statistics of all three datasets. Negligible bias above 1-2 km, change of the bias around 10 km, and increase of the STD around 10 km. The biases compared with mid-latitude. Average values of global STD is about 3% in all datasets. Spire data shows higher STD than C2 data, which is consistent with what can be explained by the lower SNR of Spire data compared to that of C2. UCAR processing shows smaller positive bias compared to Spire and C2. The reason for the difference between Spire and UCAR processing is not completely clear, and we continue to investigate the issue.

The results presented in this section show the statistical quality of Spire-processed and UCAR-processed RO data are comparable.

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