Processing COSMIC-2 data at NOAA STAR using the Full Spectrum Inversion Method

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Radio occultation (RO) measurements provide long-term stable data with a high vertical resolution. With the SI-traceable time delay measurements, RO measurements can be used as a benchmark to calibrate other long-term satellite datasets and quantify biases for different types of radiosondes. Information obtained from Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) mission and Formosa Satellite Mission 3 (COSMIC/FORMOSAT-3), the first dedicated constellation of micro-satellites for RO measurements, have provided valuable information for climate research and weather forecasting. The follow-up mission, COSMIC-2/FORMOSAT-7 (hereafter COSMIC-2), a six-satellite constellation launched into equatorial orbit on June 25, 2019, provide the continuity of RO measurements for COSMIC and other legacy RO missions. We expect that COSMIC-2 can produce more than 4000 high-quality RO observations daily over the tropics and subtropics.

In this study, we present an independent inversion algorithm developed at NOAA Center for Satellite Applications and Research (STAR) to invert COSMIC-2 geometry and phase data to bending angle and refractivity profiles using the Full Spectrum Inversion method. We will use the FSI method to process COSMIC-2 data from October 2019 to September 2020. We will further assess the quality of FSI retrieval results by comparing them with those calculated from the European Center for Medium-Range Weather Forecasts (ECMWF) climate reanalysis version 5 (ERA5) data in the same period. We will also present the comparison results between FSI COSMIC-2 retrievals and those processed from UCAR COSMIC Analysis and Archive Center.

The COSMIC-2 provide RO measurements over the tropical and subtropical region between 45 ˚N – 45 ˚S. The measurement density is the highest in the equatorial region and decreases gradually at higher latitudes. The signal-to-noise ratio (SNR) on the COSMIC-2 L1 band ranges from 300 – 2600 v/v with a mean of 1600 v/v, which is close to twice the SNR of the legacy missions. Comparisons using COSMIC-2 data from August 28 – September 13, 2019, show that the mean biases among the UCAR, ERA5, and STAR are less than 0.1 % for both fractional bending angle and fractional refractivity. Their standard deviations are within 2.5 - 3.3 and 1.1 - 1.8 % for fractional bending angle and fractional refractivity, respectively, from the surface to 35 km altitude.