CoSMIR ALONG-TRACK SCAN FOR CLOUD TOMOGRAPHY

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The Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) is a 3-year campaign in Jan-Feb 2020, 2022, and 2023, that uses a combination of airborne and ground instrumentation to observe winter storms on the East Coast of the United States. The high-altitude NASA ER-2 aircraft carries remote sensing instruments similar to spaceborne sensors that are currently used to measure clouds and precipitation, including radiometers, radars, and a lidar. The Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) is one of the sensors installed on the ER-2. CoSMIR provides measurements at nine channels covering a range from 50 to 183 GHz that are similar to the higher frequencies on the Global Precipitation Mission (GPM) Microwave Imager (GMI) (89, 165.5, and 183 GHz). CoSMIR's unique programmable scanning geometry is utilized during IMPACTS to provide both conical and along-track observations. The conical scan provides necessary horizontal imagery context while the along-track scan gives multi-angle measurements of cloud and precipitation features opening to the possibility to provide cloud tomography capabilities using passive microwave sensors.

Using a Quantile Regression Neural Network (QRNN) approach, we retrieve profiles of ice and liquid water content, along with path-integrated quantities. These retrievals are trained using radar observations.

We also developed the Bayesian Monte Carlo Integration (MCI) algorithm to retrieve microphysical quantities with uncertainty estimates. The random atmosphere/cloud cases in the retrieval database are weighted by the likelihood function measuring the disagreement between the observed and simulated brightness temperature vectors, and the retrieved quantities and uncertainty estimates are calculated by integrating over the posterior probability distribution to find the mean state and the standard deviation.

We will present observations and precipitation retrievals from the first two years of the IMPACTS campaign to show the potential of the along-track scanning for the implementation of cloud tomography using passive microwave observations.