COMBINING GNSS-RO AND MICROWAVE SOUNDER IN JOINT RETRIEVAL OF ATMOSPHERIC TEMPERATURE AND WATER VAPOR STRUCTURES

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Global Navigation Satellite System – Radio Occultation (GNSS-RO) and passive Microwave Radiometer (MWR) are two complimentary spaceborne sounding observations for atmospheric science research. GNSS-RO provides high vertical resolution (~200m) refractivity and bending angle measurements, and the L-band signals it uses can penetrate heavy cloud cover without depending on surface emissivity. However, GNSS-RO suffers from low along-track horizontal resolution (~200km). The temperature and moisture are also coupled in the GNSS-RO retrieval process, and for decoupling the a-priori information or auxiliary observations are required. On the other hand, MWR has much better horizontal resolution (~20km). Its brightness temperature (TB) measurements in numerous frequency bands can be related to the temperature and water vapor structure in the atmospheric column. However, MWR is limited by poor vertical resolution (>2km), precipitation, and surface characteristic uncertainty over land.

In this study we present two joint retrieval approaches to combine the GNSS-RO and MWR measurements. First, an optimal estimation method, 1DVar, is implemented to combine the collocated GNSS-RO refractivity or bending angle and MWR TB observations in 1D. The GNSS-RO/MWR observations can be modeled by an Abel integral and a Radiative Transfer Model (RTM) that considers atmospheric absorption, scattering, and surface reflection and emission. By applying 1DVar to the simulated data this method is shown to reduce GNSS-RO temperature and retrieval biases at the top of PBL, and simultaneously capture the fine-scale water vapor variability that MWR cannot resolve. Results of combining the data from COSMIC-2 and Suomi-NPP missions will be demonstrated. Second, a tomographical 2D combination approach over the GNSS-RO occultation plane has been explored. The simulation results from WRF show that this new concept can better resolve the complex 2D moisture structure than what is possible from either measurement alone. The accuracy and resolution of both joint retrieval methods will be further discussed.