Improved Representation of Active and Passive Surface Characteristics in the GPM DPR-GMI Combined Precipitation Algorithm

PI: S. Joseph Munchak/NASA Goddard Space Flight Center

The GPM Combined Radar/Radiometer Algorithm (CORRA) is the only GPM product that makes use of both active and passive measurements to retrieve precipitation profiles, and is the product upon which the passive microwave algorithm (GPROF) and multi-satellite retrievals (IMERG) are calibrated. As a physically-based retrieval, CORRA relies on accurate forward models to simulate the GMI and DPR measurements, which are then input to an ensemble filtering technique to reduce the spread between observations and simulations. An important component of these forward models is the surface, as it affects both passive and active measurements: the surface emissivity can strongly influence the brightness temperatures, especially at low frequencies and in light precipitation where the atmosphere is optically thin. Likewise, the surface backscatter cross-section measured by the radar is attenuated by precipitation and this path-integrated attenuation (PIA) is an important constraint for the radar and combined algorithms, but requires an accurate reference value for the rain-free surface cross section. Furthermore, both the surface backscatter cross-section and surface emissivity are related to each other via the physical and electromagnetic properties of the surface.

Previously we have developed a database of non-precipitation ocean retrievals (wind, cloud liquid, and water vapor profile) and emissivity retrievals over land from GMI data. From these, we created a geophysical model function for both emissivity and surface backscatter cross-section for GMI and DPR as a function of wind speed and direction for water surfaces and empirical emissivity-backscatter relationships for land surfaces. These were demonstrated to improve precipitation retrievals over land compared to gauge-adjusted radar (MRMS) and wind speed retrievals over ocean relative to reanalysis products, and have gone into the most recent version (V5) of CORRA products.

For continuing work to go into version 6 (and beyond) of GPM products, we propose to 1) continue to improve the surface emissivity-backscatter models used in the CORRA precipitation retrieval, including developing geophysical model functions for land surfaces where possible, and 2) incorporate retrievals of the atmosphere and surface state outside of precipitation into new versions of CORRA. The latter item will serve two purposes: First, it will ensure a seamless transition of retrieved atmospheric properties (such as water vapor, cloud water, and ocean surface winds) from outside of precipitation to within precipitation, replacing the current system where reanalysis fields are copied into the product outside of precipitation. Second, it will move the generation of the emissivity database from an offline process to an online one, thereby enhancing its availability and timeliness. These improvements should greatly benefit the users of CORRA and the wider GPM community.