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Simulations of Dual-Frequency Radar Rainfall Retrievals

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The retrieval of raindrop size distribution (DSD) is one of the key objectives of National Aeronautics and Space Administration (NASA) Global Precipitation Measurement (GPM) Mission. The dual-frequency precipitation radar (DPR) on board GPM core satellite is the primary resource for the retrieval of DSD. The DPR operates at Ku- and Ka-band and these frequencies have different sensitivities to the precipitation at the surface. Both frequencies are subject to the attenuation but at different magnitude. The high sensitivity of Ka-band measurements intends to detect solid and/or light liquid precipitation, while Ku-band frequency will be able to measure relatively higher intensity precipitation. The data from simultaneous Ka- and Ku-band measurements will allow a more accurate estimation of the DSD. The DSD retrieval algorithm uses three-parameter gamma distribution where mass weighted diameter (Dmass), normalized intercept parameter with respect to the liquid water content, and the shape parameter will be derived from dual-frequency radar measurements. A key problem is the retrieval of three unknown with two measurements. The simulation of the dual frequency ratio (DFR), using disdrometric data collected in different field campaigns of Ground Validation (GV) program of GPM mission, can cast light on this retrieval problem. Furthermore, the use of a third and/or different wavelength in the satellite measurements can be an added value to correctly retrieve both light and heavy rain.
This study seeks relationship between the DFR and Dmass in different rain regimes. The DFR based both on Ka-/Ku-band and on frequencies other than Ka-/Ku-band is investigated. The dependence on the gamma distribution shape parameter, which is set to three in the DPR DSD retrieval algorithm, of the DFR-Dmass relationship is also analyzed.