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Precipitation Classification and Quantification Using Dual-Polarization Observations from the NASA D3R

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The NASA dual-frequency, dual-polarization, Doppler radar (D3R) [1] was developed and deployed to support ground validation (GV) operations of the Global Precipitation Measurement (GPM) mission [2]. The D3R's primary function has been as an operational research radar enabling both engineering and atmospheric science research. It operates in the same frequencies bands, Ku- and Ka-band, as GPM's dual-frequency precipitation radar enabling direct comparisons of microphysical observations of precipitation. Over the past few years, D3R substantively participated in several national and international field experiments covering different geographic features in both winter and summer conditions. The dual-polarization observations have provided critical information in identification of different hydrometeor phases and quantification of precipitation intensity.

This paper presents the precipitation classification and quantification methodologies for the NASA D3R. In particular, a region-based hydrometeor classification approach [3] is implemented at D3R's Ku-band. Observations from GPM GV field campaigns are used for demonstration purposes. The derived hydrometeor types are cross compared with collocated S-band products and images collected by the airborne probe, which shows the great potential of using D3R to characterize differential precipitation phases. A differential phase-based rainfall algorithm is developed using in situ measurements of raindrop size distribution. The generated rainfall products are compared with ground rainfall measurements from disdrometers and rain gauges. Results show that the D3R-derived rainfall measurements agrees very well with ground observations, especially light rain that was hard to measure using traditional S- or C-band weather radars. In addition, attenuation correction for the D3R observations using polarimetric measurements is investigated to ensure data quality before quantitative applications.

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