10.3 A RADAR-BASED EVALUATION OF GPM RETRIEVALS OF THE RAIN DROP SIZE DISTRIBUTION

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The NASA-JAXA Global Precipitation Measurement (GPM) mission makes satellite-based dual-frequency precipitation radar (e.g., DPR) estimates of the drop size distribution (DSD) in the course of estimating rain rates. Two key DSD parameters estimated include the mass-mean diameter (D_m) and the normalized intercept (N_w) of a three-parameter gamma size distribution (in DPR algorithms, mu=3). To better understand the character of the DSD and to statistically evaluate DSD retrievals by the DPR, GPM ground-validation (GV) DSD datasets build upward in scale to DPR fields of view. This scale extension relies on point measurements from disdrometers made in myriad rainfall regimes that are subsequently used to construct dual-pol radar-based retrievals of the DSD. The GV radar DSD retrievals are then applied at continental scales using 65 Validation Network (VN) WSR-88D S-band dual-pol radars and geometrically matching DPR rays and bins to WSR-88D rays and gates at DPR footprint scales.

Specific GPM science requirements mandate the retrieval of D_m to within +/- 0.5 mm of GV with no specific requirement set for N_w. Comparisons of the 2ADPR normal and matched scan version-5 (V5) products to VN-retrieved D_m values for non-partitioned precipitation types suggest the presence of a positive DPR retrieval bias relative to the VN of ˜0.2 mm with perhaps another 0.2 mm of random error. Hence, DPR D_m estimates meet the mission requirement. This is especially the case when the DPR DSD sample is considered independent of DPR algorithm-partitioning into convective (C) or stratiform (S) components. However, the satisfaction of the L1 requirement is really driven by the much larger occurrence of S-precipitation. A larger positive bias with pronounced secondary modes of disagreement is noted in C-precipitation at large DPR D_m (¿ 2-2.5 mm; especially for Ku-only retrievals) and these biases impact the relative bias observed between the DPR and VN-based rain rate estimates.

Similar comparisons between DPR and GV N_w are noisier than those of D_m. DPR V5 LOG10(N_w) estimates cluster around values of˜3.0 - 3.5 in S-rain, but exhibit more dynamic range and covariance with GV in C-precipitation. The behavior of DPR-retrieved D_m vs. N_w in C and S rain is broadly consistent with DSD-based C-S partitions in the literature, though not necessarily reflective of the full range of possible DSD precipitation values/regimes detected using disdrometers. In parallel comparisons to the GPM V5 combined radar-radiometer retrieval algorithm, the overall D_m bias behavior, not partitioned by C/S type is similar to that observed with the DPR. However, trends between combined-algorithm and GV retrievals in D_mN_w joint probability distribution space are considerably different for

both C and S precipitation relative to the GV and the DPR behavior. More recent testing of improved Nw parameterizations in the combined-algorithm suggest that better agreement will be attained in the next version of the algorithm. It is expected that improved methods of estimating the DSD for both ground and satellite-based radar retrieval algorithm approaches will result in even stronger convergence between ground and space-based estimates of the DSD and by extension, global rainfall.