Objective: Validate GPM Drop Size Distribution Retrievals is checked against individual impacts more noticeable in outer swath bias. Right, same but for D(DPR) vs. GV for MS (left) convective rain rate all DPR except when D(DPR) Kuk+Ka+GMI 3 in DPR. Left: C/S index with time from NPOL DSDs with DSD truncation of the DSD at small D. Numbers controlled DSD in Irma rainband. Right: NPOL RHIs for convective (top) and stratiform (bottom) periods. DSDs used for C/S regime partitioning, then compared to GPM DPR MS retrievals (underlying gray shade figure, courtesy Dolan et al. 2015). DPR C/S generally consistent with 2DVD partitioning. Impacts on convective rain? Consistent representation of the DSD to include small D, but rain light rain as a generalized gamma for this purpose? Yes! (see below) Broad physical consistency? Nature? DSD M4, V5 vs. GV Radar N Consistent representation of the DSD to include small D. Consistent representation of the DSD to include small D and light rain DSD retrievals satisfy basic science requirements. However some inconsistencies between GV, DPR and Combined algorithm retrievals exist in V5 that impact rain rate retrievals in products in different ways and for different precipitation types. Underlying physics of DPR DSD behavior seem consistent with GV, but Combined algorithm retrievals behave differently. Impacts to rain rate retrievals are found when filtering for precipitation type and/or DSD. Continued validation of algorithm retrievals and GV approaches is required to a) verify consistent physics; b) assure the right answer for the right reasons; and c) improve general application of algorithm approaches as it pertains to form of the DSD (e.g., gamma vs. generalized gamma vs. ?).

Drop size distributions (DSD) are critical to GPM DPR-based rainfall retrievals. NASA GPM Science Requirements stipulate that the GPM Core observatory radar estimation of D, shall be within +/- 0.5 mm of GV.

GV translates disdrometer measurements to polarimetric radar-based DSD and precipitation type retrievals (e.g., convective vs. stratiform) for coincident match-up to GPM core overpasses. How well do we meet the requirement across product versions, rain types (e.g., C/S partitioning), and rain rates (heavy, light) and is behavior physically and internally consistent?

Continental Scale comparisons confirm GPM meets basic DSD (D) science requirement, but…

2. Approach

Overarching method: Multi-regime, global disdrometer DSD “point” measurements are bridged to GPM DPR footprint/swath scales using GV dual-polarimetric radars (national network and Tier-1 research)

Nature?

Figure 5: Distribution of D (top) and N (bottom) from global 2DVD sample. Challenge for dual-freq sampling of most common Ds.

Broad physical consistency?

Figure 8: (Left) 2DVD DSDs used for C/S regime partitioning, then compared to GPM DPR MS retrievals (underlying gray shade figure, courtesy Dolan et al. 2015). DPR C/S generally consistent with 2DVD partitioning. Impacts on convective rain?

As above but for D > 2.5 mm

Consistent representation of the DSD to include small D and light rain

DPR estimators in light rain tend to underestimate (e.g., Fig. 10, bottom). The three parameter gamma does not generally fit the DSD well in light rain nor do we measure it well using the 2DVD in small drop sizes (< 0.6-0.7 mm). Use MPS + 2DVD and a generalized gamma for this purpose? Yes! (see below)

Case 1: Stratiform precipitation over Huntsville

Case 2: Tropical Cyclone Irma rainband

3. Results

Continental Scale comparisons confirm GPM meets basic DSD (D) science requirement, but…

Testing the consistency of DSD-based C/S separation in the challenging environment of OLYMPEX

Figure 12: “17 Nov. Atmo. River event. Top: 2DVD DSD with time; middle C/S Index (0 = stratiform, > 0 = convective); bottom MRR reflectivity and fall velocity.

Figure 14: DSD-based C/S is separation broadly consistent with GV radar. Left: CFDs of RHIs of C/S Index from NPOL radar. Fishery site upstream and largely in stratiform. Bishop/CRN close to mountains and under low-level convective echo. Middle: C/S index with time from NPOL DSDs with MRR trend (bottom). Right: NPOL RHIs for convective (top) and stratiform (bottom) periods. Consistent representation of the DSD to include small D and light rain

4. Summary

GPM DSD retrievals satisfy basic science requirements. However some inconsistencies between GV, DPR and Combined algorithm retrievals exist in V5 that impact rain rate retrievals in products in different ways and for different precipitation types. Underlying physics of DPR DSD behavior seem consistent with GV, but Combined algorithm retrievals behave differently. Impacts to rain rate retrievals are found when filtering for precipitation type and/or DSD. Continued validation of algorithm retrievals and GV approaches is required to a) verify consistent physics; b) assure the right answer for the right reasons; and c) improve general application of algorithm approaches as it pertains to form of the DSD (e.g., gamma vs. generalized gamma vs. ?).