1. Objective: Validation of GPM Core Science Requirements

- DPR (GMI): quantify rain rates of 0.22 (0.20) to 110 (60) mm hr$^{-1}$ and demonstrate detection of snowfall at effective resolution(s) of 5 (15) km.
- GPM Core observatory radar estimation of $D_{0}$ to within +/- 0.5 mm
- Instantaneous rain rate estimation at 50 km resolution, bias and random error < 50% at 1 mm hr$^{-1}$ and < 25% at 10 mm hr$^{-1}$, relative to GV

2. Approaches

- CONUS: Orbit coincident gauge-adjusted radar RRs from GPM GV-specific Level-2 Multi-Radar Multi-Sensor (GV-MRMS), liquid only, "best" pixels
- Ocean: Tropical and mid-latitude orbit-coincident Dual-polar radar RR estimation from Kwajalein Atoll and Midleton Island, Alaska. (Liquid only)
- Bias, MAE/RMSE. For CONUS (ocean), MRMS (radar) matched FOVs over 50 km grid (DPR, GMI FOVs for bias with up-scaled RMSE to 50 km)
- NUFB impacts: Rain pixels fill > 80% of FOV, 50% > 0 mm/hr at 50 km; GPDR Radiometer estimate: Probability of Precipitation > 40%; 5%-95% outliers removed; error variance subtraction applied.
- Select/targeted high quality regional radar datasets (e.g., DFW CASA) for added quality checks. (not shown)

DSD - Drop Size Distribution (Mass-weighted mean diameter: $D_{0}$):
- Dual-polar radar-based retrievals of $D_{0}$ applied to ~70 radars in U.S. using GPM Validation Network software for geometric match to DPR overpasses

2BCMB MS

- DPR/GMI vs. GV comparisons
- Overarching concept: GV Radars bridge point to FOV/swath
- Gauges, disdrometers reference ground-based multi-parameter radar networks

3. Results

A) Instantaneous Rain Rate: CONUS (MRMS)

- Marine 2014-Sep. 2015
- MAE compared to GV

B) Snow Detection (Continued)

- 2A2ku NS
- 2ADPR MS
- 2ADPR NS
- 2AGPROF

B) Snow Detection (Continued)

- Ocean: Kwajalein Atoll (KWAJ) and Middleton Island AK (PAIH)

- GPM Core observatory meets L1 rain rate science requirements based on Combined and DPR radar algorithm performances

4. Summary

- DPR (GMI) appears to meet Level 1 science requirements for RR estimation (Sec. 3A) based on the strong performance of its DPR and Ku radar algorithms. V5 CBM and GPROF radiometer algorithms (e.g., over land) will improve on L1 performance.
- L1 demonstration of snow detection (Sec. 3B) over non-frozen surfaces largely verified but at unknown SWE rate threshold (likely < 0.5 – 1 mm/hr liquid equivalent). Ongoing work to improve SWE rate estimation for both satellite and GV remote sensing.
- DPR retrievals ($D_{0}$) appear to meet L1 requirements (Sec. 3C). Source(s) of small bias (nature vs. approach) under study.

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