**Introduction & Motivation**

- NASA’s Global Precipitation Measurement (GPM) mission continues to evolve with improvements in rain drop size distribution (DSD) and rainfall algorithms.
- Given uncertainty in the DSD estimates and thus rainfall over a GPM-Dual Precipitation Radar footprint (Tokay et al., 2016), a robust ground validation analysis is crucial to understand the limitations of space based measurements and provide for improvements.
- A case study of two different rainfall GPM overpass events are analyzed from the GPM Ground Validation (GV) Precipitation Research Facility (GPF) at NASA Wallops Flight Facility (WSF) utilizing research quality polarimeter Doppler radars, disdrometers, and rain gauges.
- The goal of this study is to identify possible mismatches between GPM footprint estimates and GV measurements.

**Data & Observations**

Precipitation measuring platforms include NASA’s S-band Polarimetric Radar (NPOL), Ka/ Ku-band Dual-Polarization Dual-frequency Doppler Radar (D3R), K-band Micro Rain Radar (MRR), NOAA’s S-band Weather Surveillance Radars 1988 Doppler (WSR-88D), GPM multi-channel Microwave Imager (GMI) and Ka/Ku-band Dual-Frequency Precipitation Radar (DPR), 2-Dimensional Video Disdrometer (2DVD), Particle Size and Velocity (PARSIVEL) disdrometer, and dual tipping rain gauges.

**Two Case Studies**

Two GPM short distance (< 60 km from nadir track) overpass events over the Wallops Flight Facility are considered for this study:

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
<th>GV radars</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 May 2015</td>
<td>Enhanced Precipitation Event</td>
<td>NPOL, KDOX, KAKQ, KUMU, NPPR</td>
</tr>
<tr>
<td>28 June 2016</td>
<td>Enhanced Precipitation Event</td>
<td>NPOL, KDOX, KAKQ, KUMU, NPPR</td>
</tr>
</tbody>
</table>

**Analysis Set-Up**

The system for integrating multi-platform data to build the atmospheric column (SIMBA = see wingo et al. 2017 poster #112) framework is used to ingest precipitation measuring platform data into an atmospheric column product.

**Define Column Grid**

- Center location WFFPAD
- Vertical & horizontal Extent: 5 x 5 x 5 km
- Grid spacing: 500 m

**Select Data**

- Radars, disdrometers, gauges, GPM

**Output netCDF File**

- Column 3 grid data

**Compute Statistics**

- Average (at each layer in column)
- Bias error

\[
\text{bias} = \frac{\text{satellite} - \text{gv}}{\text{gv}}
\]

- Satellite refers to GPM (GMI or DPR) while GV refers to ground scanning/profiling radars, disdrometer, gauges, and APU's.
- Time-stamps of input data ranged from 180 to 1800 and -200 to 200 seconds of NPOL scan time (05/21-22:04:20) and (06/28-14:49:47).

**Results & Analysis**

**TABLE 1**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>21 May 2015</th>
<th>28 June 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain rate (mm/hr)</td>
<td>0.23</td>
<td>0.16</td>
</tr>
<tr>
<td>Mass-weighted mean</td>
<td>167.2</td>
<td>168.5</td>
</tr>
<tr>
<td>Normalized intercept</td>
<td>-60.6</td>
<td>-56.7</td>
</tr>
</tbody>
</table>

**Conclusions**

- GPM 2ADPR bias relative to GV is between -20 to 20% and underestimates relative to GV radars.
- GPM is positively biased relative to disdrometers, gauges, and APU's.
- The cause of the biases can be a number of reasons: differing range/height of GV radar sites, data resolution (PPI vs. APU, gauges, and 2DVD), and dual tipping rain gauges.

**Acknowledgments**

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