GPM Version 4 Precipitation Profiles from DPR and Combined

John Kwiatkowski, George Mason University/PPS,

Acknowledgement to DPR Algorithm Development Team: Toshio Iguchi, Robert Meneghini, Takuji Kubota, Jun Awaka, Chandrasekar, V., *Shinta Seto, Minda Le, Naofumi Yoshida*

Introduction The Global Precipitation Measurement (GPM) mission core spacecraft was launched in Feb. 2014 and includes the Dual-Frequency Precipitation Radar (DPR) which consists of two radars: one operating at Ku-band (much like TRMM PR) and the other at Ka-band. The Tropical Rainfall Measurement Mission (TRMM) Precipitation Radar (PR) has provided a precipitation data record extending back to Dec. 1997 using a single frequency algorithm. This work examines the retrieved profiles of the GPM radar single and dual-frequency algorithms along with those of the Combined radar/radmiometer algorithm. In addition to precipitation rates both the radar-only and Combined algorithms attempt to estimate PSD parameters such as Nw and Dm. First looks at profiles of these parameters can illuminate algorithm differences and/or deficiencies and are a helpful diagnostic tool.

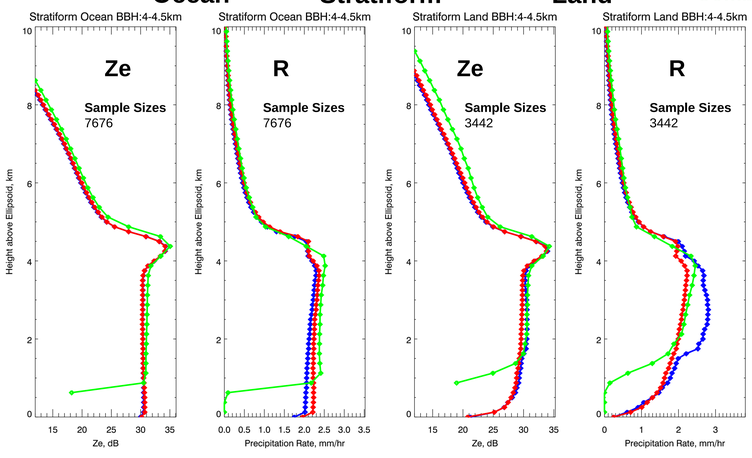
GPM DPR and Combined Average Profiles Average Corrected Reflectivity (Ze) and Precipitation Rate (R) profiles were computed from the Production Research Products for GPM DPR and GPM Combined Level-2 retrieval algorithms. (GPM V04). Average profiles are computed for all 49 angles, at each radar slant range gate for the two main precipitation classes: Stratiform and Convective. Only those cases where a clear Bright Band is detected are included in the Stratiform case. The profiles are further categorized into 14 levels; in the case of Stratiform the Height of the Bright Band is used, for Convective cases the detected Storm Height is used. September 2014 is used here as the radar antenna pattern was stabilized at that point. A previous poster compared GPM V3 profiles against the TRMM-era PR retrieval algorithm on the GPM Ku data.

Average Profiles of Corrected Reflectivity and Precipitation Rate Sept. 2014

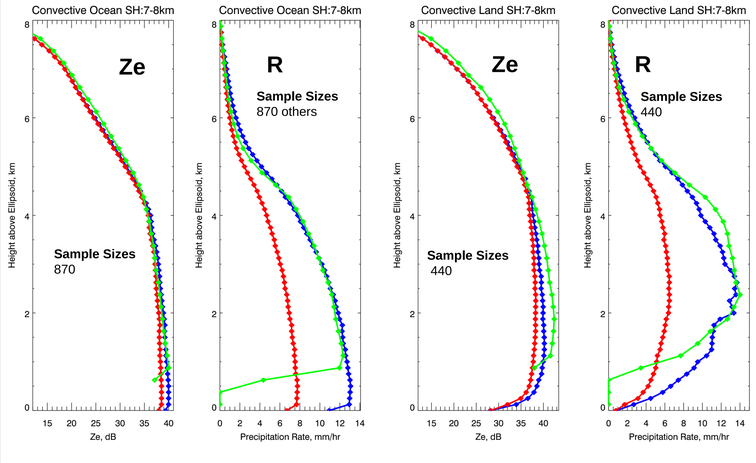
Sept. 2014. Limited to TRMM coverage area of +/37deg Latitude.
Nadir Profiles are shown.
GPM Version 4 data.

DPR Ku (2AKu)
DPR (2ADPR NS-swath)
Combined (2BCMB NS-swath)

Ocean Stratiform Land



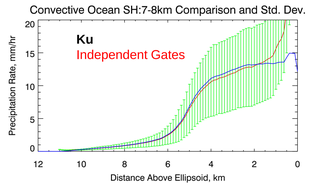
Ocean Convective Land



Aside : Profile Averaging.

Average profile (weighted sum) vs independent average at each bin. $i = \text{Ray} \quad j = \text{Gate/Bin}$

$$\langle R_{i,j} \rangle = \frac{\sum_{i,j} R_{i,j}}{N_{i,j}} \qquad \langle R_{i,j} \rangle = \frac{\sum_{i,j} R_{i,j}}{N_i}$$

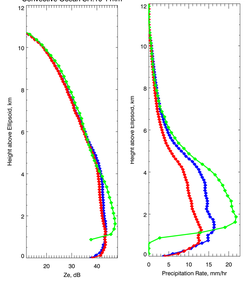


Use as a potential algorithm diagnostic tool.

- Corrected reflectivity profiles generally look very good however there are some issues near the Surface.
- Near-surface precipitation rates with GPM Ku are generally higher then DPR.
- All angles available as IDL save set.
- V05 algorithms are being tested now.

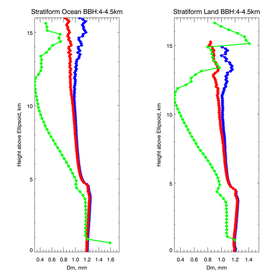
Clutter
GPM radar products have estimated data into clutter region.

Deeper Convection



First Looks at Particle Size Distribution Retrievals

Both the single and dual-frequency radar algorithms along with the Combined radar/radiometer output estimates of particle size distributions. These estimates are preliminary as the radar calibration is slated to change for Version 5 and would impact dual-frequency retrievals. However, the differences between the retrieved PSD may highlight different algorithm assumptions and retrieval issues.



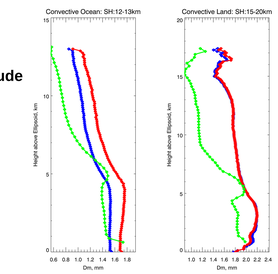
Nadir Profiles of Dm

Sept. 2014. Limited to TRMM coverage area of +/37deg Latitude

Ku – Blue
DPR – Red
Combined – Green

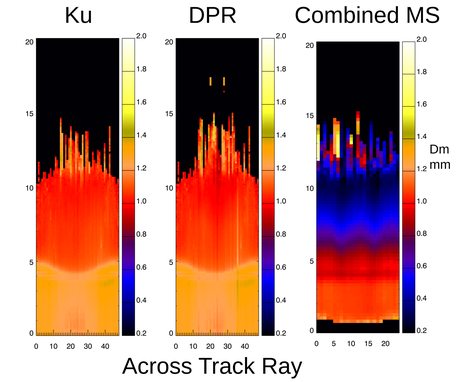
Ku/DPR assume μ = 3
Combined fixes μ = 2

Nw, is provided for all retrievals as well.



- In Stratiform precipitation and over Land for Convection Ku and DPR Dm are very similar.
- Over Ocean in Convection the DPR dual-frequency algorithm pushes Dm higher.
- Combined generally produces smaller Dm aloft.

Stratiform Land Dm

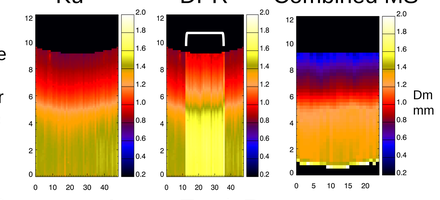


Across Track Ray

Interior rays of DPR are the dual-frequency retrieval while the outer rays are copies of the Ku single frequency retrieval.

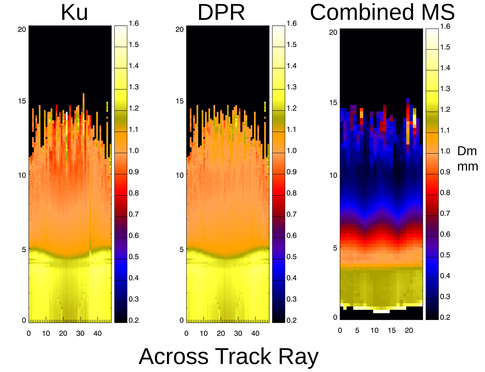
Combined MS provides retrieval for interior rays only.

Convective Ocean Dm



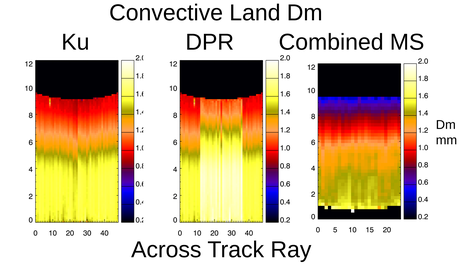
Across Track Ray

Stratiform Ocean Dm



Across Track Ray

Convective Land Dm



Across Track Ray

GPM V05 Testing at NASA Goddard / PPS

Integration and Test Environment (ITE) at PPS.

- Assist in testing modifications to GPM algorithms
- 90+ node Beowulf Cluster.
  - 32 CPUs, 256GB per node.
- Test data made available to algorithm teams by online FTP.

This work supported under NASA ROSES. Acknowledgements to: PMM, PPS, Joint DPR Team.