

The Community Active Sensor Module (CASM)

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CASM Purpose:

- Simulate active sensor platforms within the CRTM environment
- Provide a physical basis for 1-D variational retrievals via MIIDAPS
- Enhance data assimilation capabilities by providing increased access to active sensor dataset
- Foundation for observational Data Fusion activities

Status and Scope:

- Presently covers satellite-based radar simulations with path-integrated attenuation
- Work on complete integration into CRTM and MIIDAPS is ongoing
- Expected to eventually provide forward modeling capability for all space-based active microwave and lidar sensing platforms (scatterometer, altimeter, radar, lidar)

Planning Flowchart (work in progress)

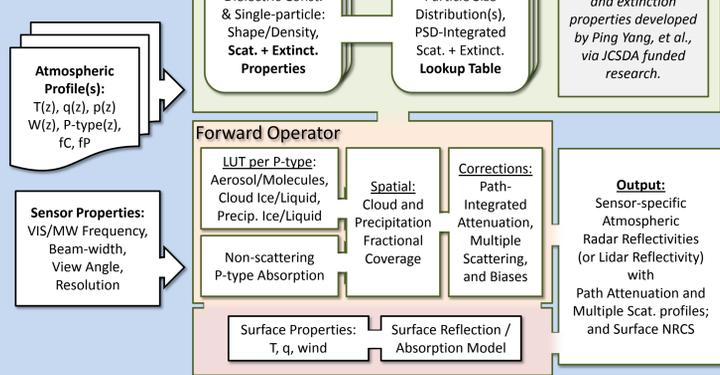
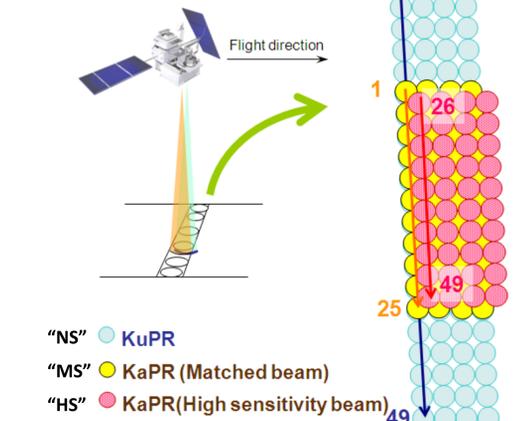
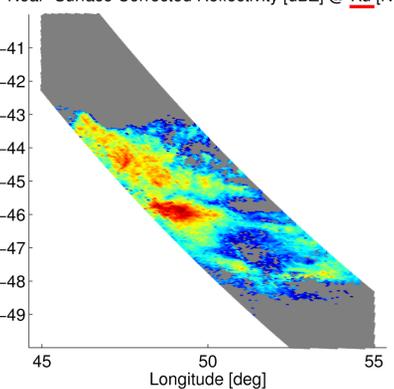


Fig 1. GPM DPR Scan Pattern



(a) DPR Observations (Ku: Level 2A) Near-Surface Corrected Reflectivity [dBZ] @ Ku [NS]



(b) DPR Observations (Ka: Level 2A) Near-Surface Corrected Reflectivity [dBZ] @ Ka [MS]

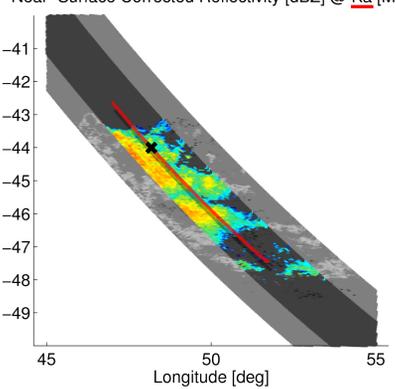
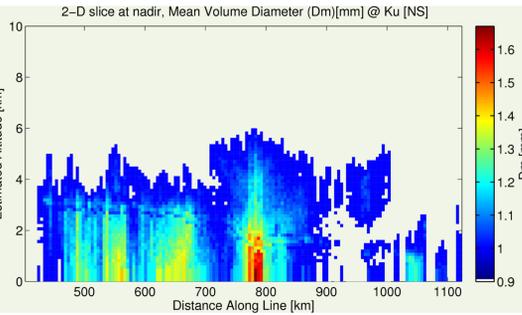


Figure 2. Near-surface Radar reflectivity observed at (a) Ku-band [NS] and (b) beam-matched Ka-band [MS], overlaid on the Ku swath (gray) [2A.GPM.Ka.V5-20140829.20151001-S005604-E022836.009030.V03B.HDF5]

(a) DPR SRT-Derived D_m [mm]



(b) DPR SRT-Derived N_w [db mm⁻¹ m⁻³]

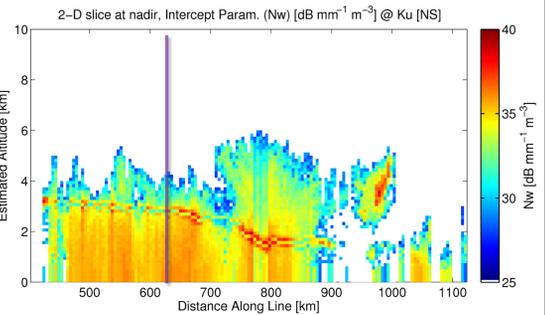
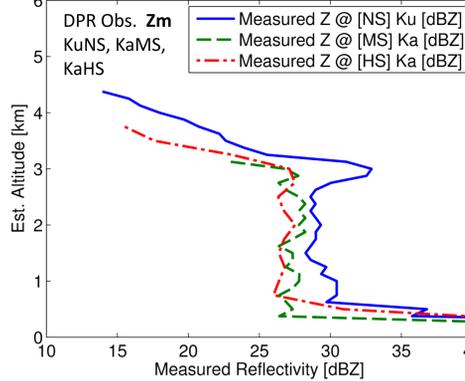
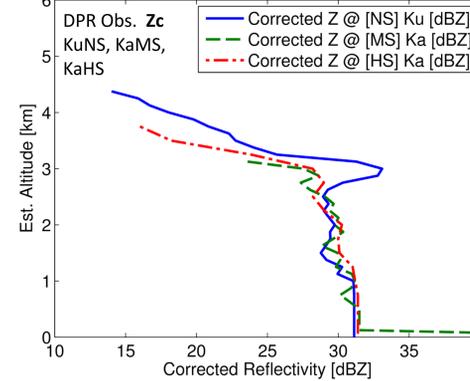


Figure 3. A 2-D vertical slice of SRT-derived DSD parameters along the red line in Fig. 2b. Panel (a) shows the median volume diameter (D_m), and (b) shows the normalized intercept parameter (N_w). Both quantities are derived from the Ku-band observations, after correcting for path-integrated attenuation, and removal of surface clutter. These parameters are used in Figures 6-11 to generate the CASM-computed radar reflectivities and attenuation.

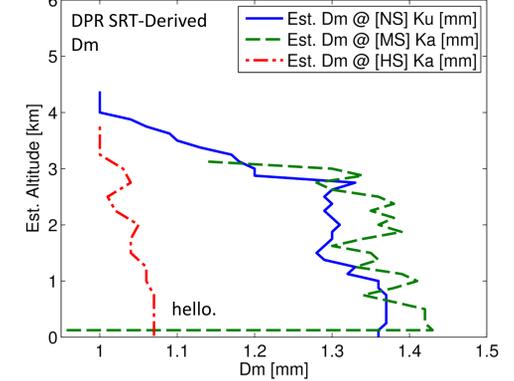
(a) Reflectivity Profiles (Z_m) [dBZ] @ Ku & Ka Band: (110)



(b) Reflectivity Profiles (Z_c) [dBZ] @ Ku & Ka Band: (110)



(a) Mean Volume Diameter (D_m) Profiles @ Ku & Ka Band: (110)



(b) Norm. Intercept Parameter (N_w) @ Ku & Ka Band: (110)

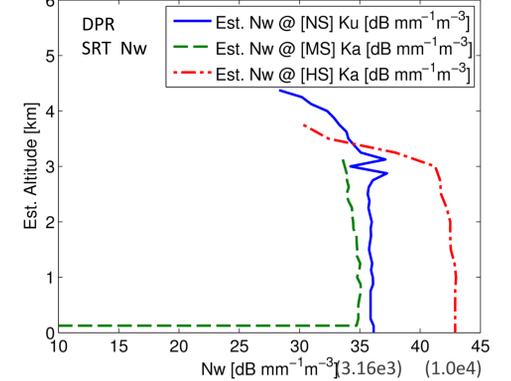


Figure 4. The X in Fig. 2b and the purple line in Fig. 3b indicates the approximate location of this vertical profile of radar reflectivities. Panel (a) shows the measured radar reflectivity, at Ku and Ka bands. Panel (b) shows the corrected reflectivities.

Figure 5. Similar to figure 4, vertical profiles of the SRT-derived DSD parameters (a) D_m and (b) are shown. The HS channel shows a significantly different D_m and N_w combination compared to the NS and MS profiles. In the remaining figures, only the NS profiles are used.

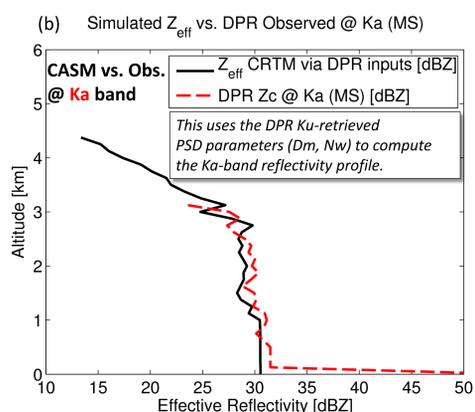
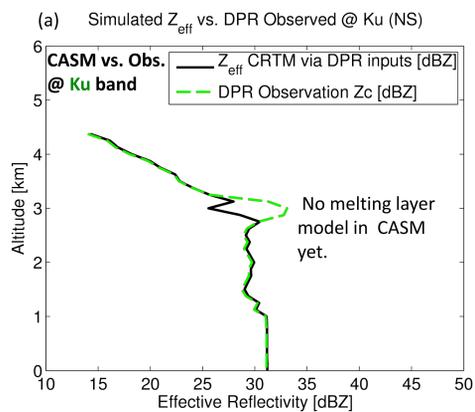
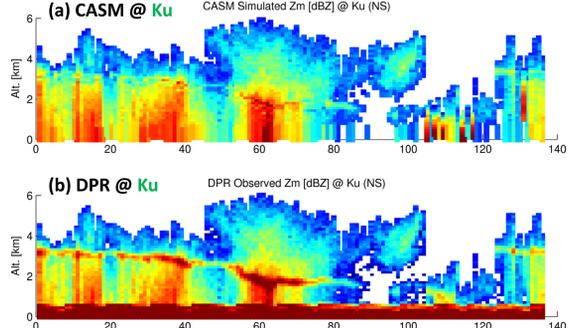


Figure 6. Vertical profile of CASM-computed radar reflectivities (black line) given the NS-derived D_m and N_w values (see Figure 5), vs. DPR observed reflectivity profiles (dashed lines). Panel (a) is Ku-band, panel (b) is Ka-band. Of note is the melting layer behavior: A melting layer model will be implemented in CASM to address deficiencies in this region.

2D-Slice (red line in figure 2b) Z_m (Measured Z) at Ku band.



2D-Slice (red line in figure 2b) Z_m (Measured Z) at Ka band.

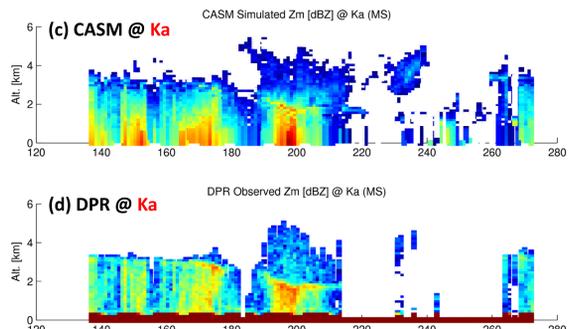
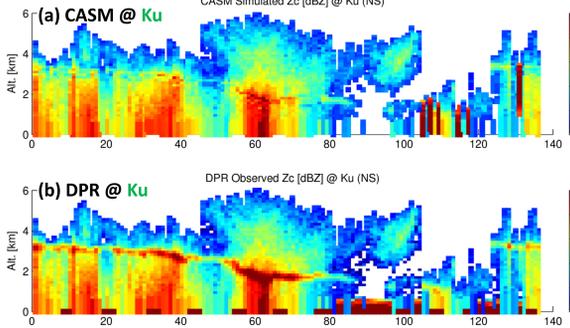


Figure 7. Measured radar reflectivities at Ku band, (a) is the CASM simulation at Ku-band, (b) is DPR observed at Ku-band. (c) and (d) are the same as (a) and (b), except at Ka-band. The path-integrated attenuation in CASM has no special tuning, and corrects attenuation from gaseous absorption and hydrometeor extinction. No water vapor information was provided in the L2A files, so I had to assume a nominal in-cloud water vapor profile.

2D-Slice (red line in figure 2b) Z_c (Corrected Z) at Ku band.



2D-Slice (red line in figure 2b) Z_c (Corrected Z) at Ka band.

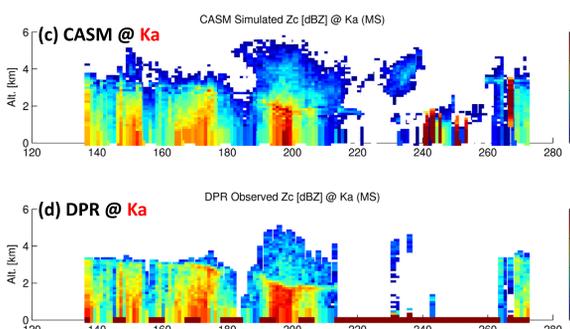


Figure 8. Attenuation-corrected radar reflectivities at Ku band: (a) is the CASM simulation at Ku-band, (b) is DPR corrected reflectivities at Ku-band. (c) and (d) are the same as (a) and (b), except at Ka-band. Note the significant attenuation corrections at Ka-band, compared with Fig. 7c. and 7d.