Precipitation Estimation Using Combined Radar and Microwave Radiometer Observations from GPM-Improvements and Initial Validation

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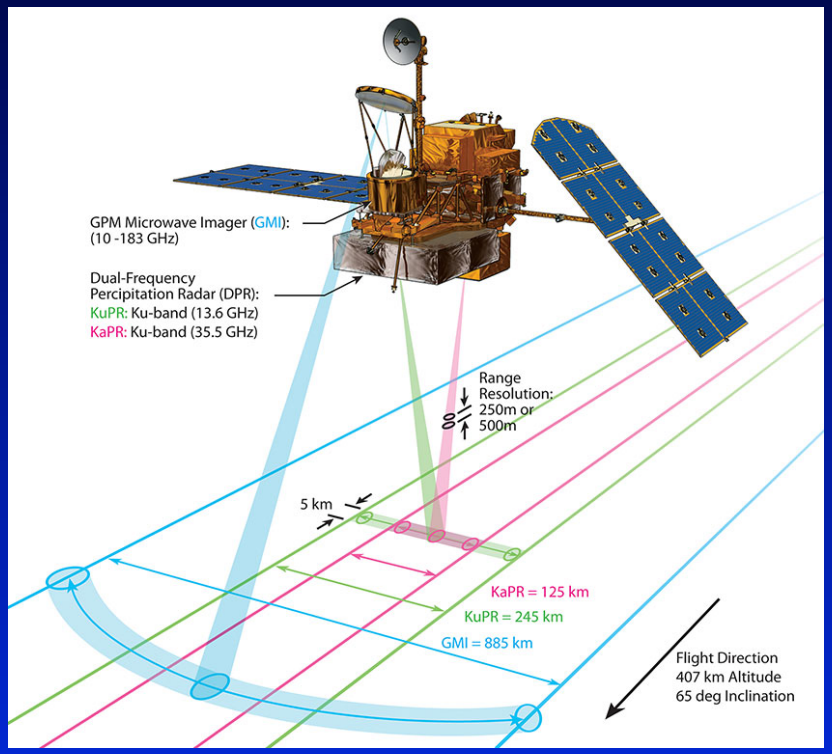
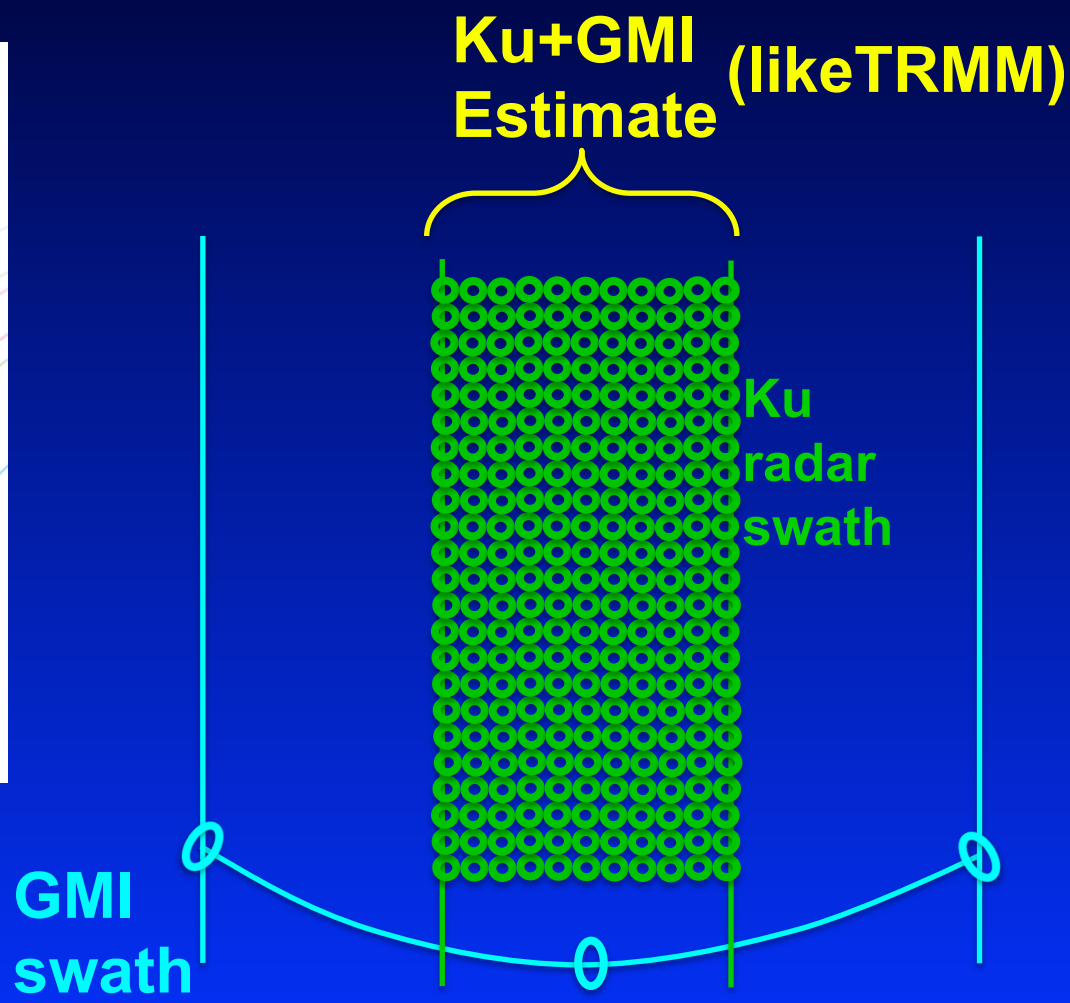
GPM Algorithm & GV Teams and Working Groups
&
GSFC Precipitation Processing System Personnel

rain estimates at pmm.nasa.gov (CMB)

Combined Radar-Radiometer Algorithm Input

- Dual-Frequency Precipitation Radar (DPR); Ku & Ka bands
- GPM Microwave Imager (GMI); 10 – 183 GHz.





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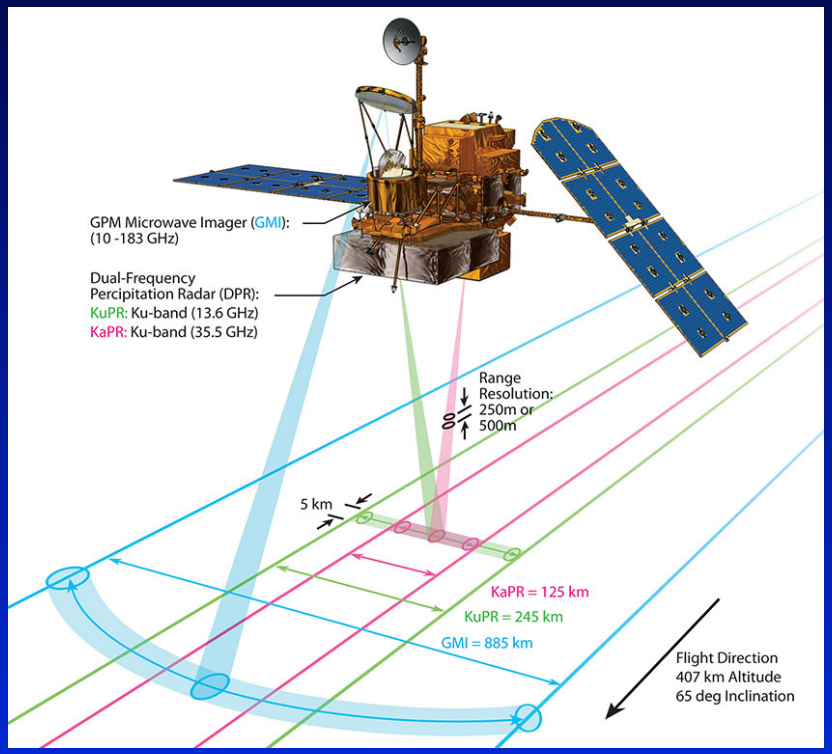
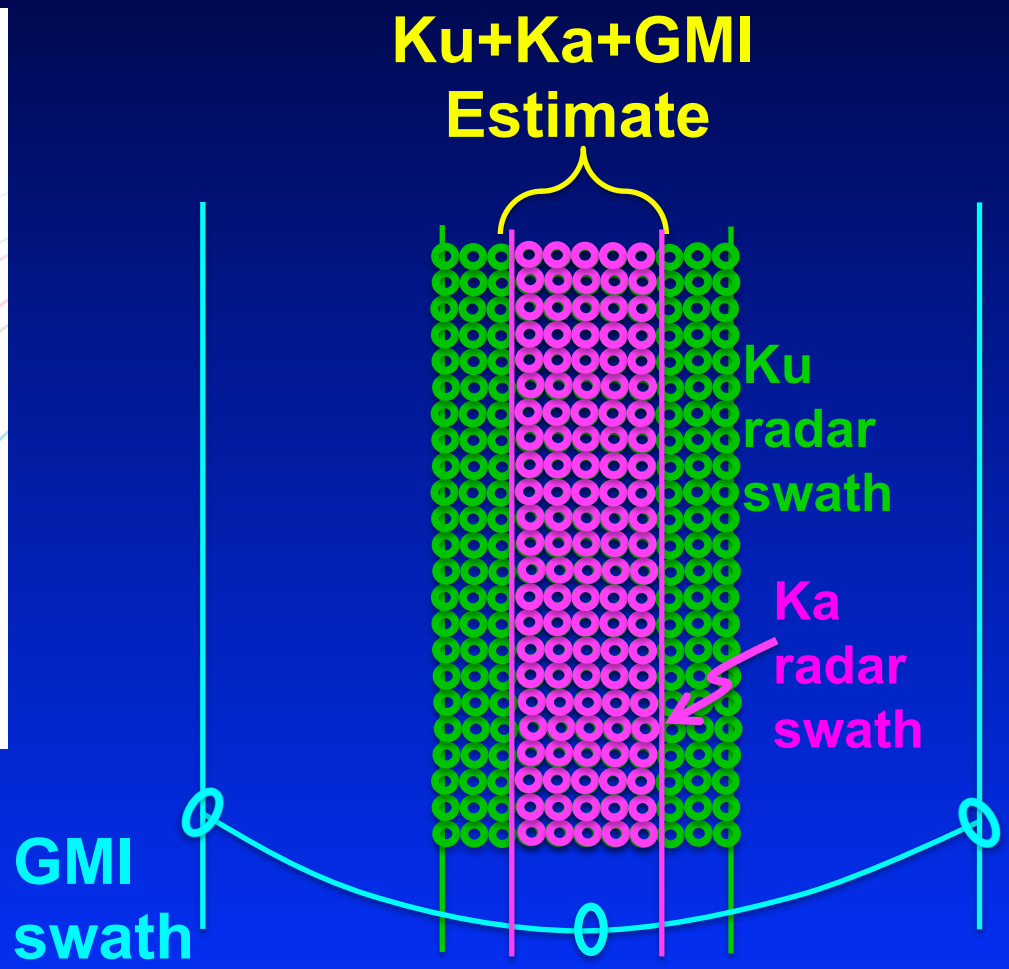
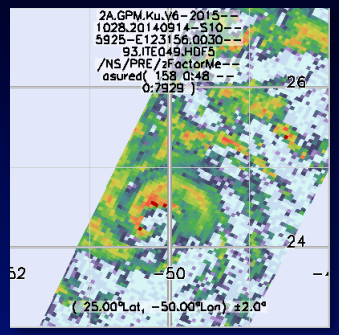




Precipitation Algorithm Thumbnail Sketch

Ku reflectivity data

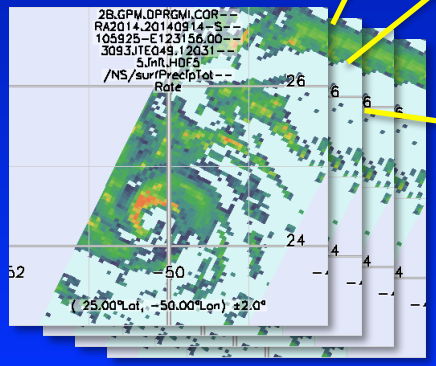


+

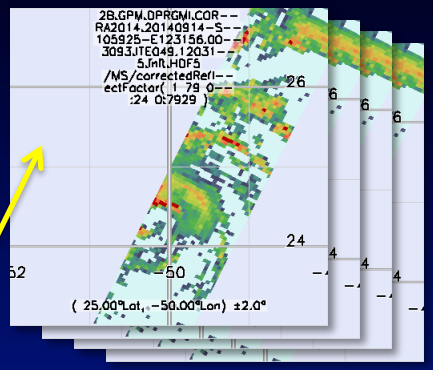
different assumptions for PSD parameters, cloud water, RH

↓

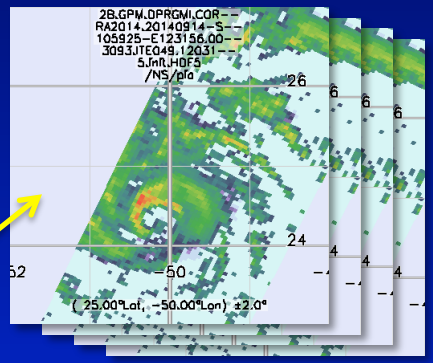
(1) Analytical solutions for initial rain rate ensemble



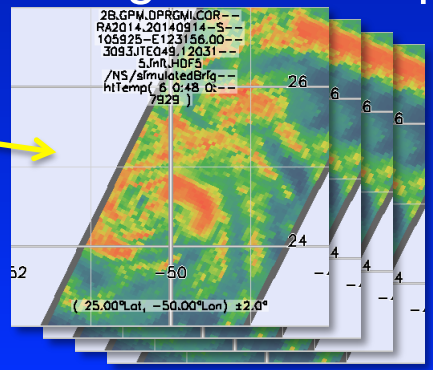
(2) Simulate Ka reflectivities



$PIA_{Ku/Ka}$, and



GMI brightness temps.



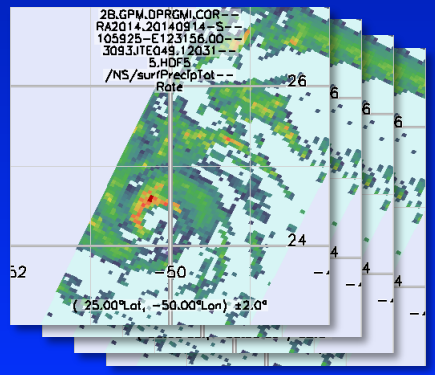
"ensemble filter" from cov{initial, simulations} and observed Ka reflect., $PIA_{Ku/Ka}$, brightness temps.

*

initial rain rate ensemble

↓

(3) Filter updates yield final rain rate ensemble



Algorithm Features

Basic algorithm framework is unchanged:
Ensemble filtering of Z_{Ku}-constrained solutions using Z_{Ka}, $PIA_{Ku;Ka}$, and GMI TB's.

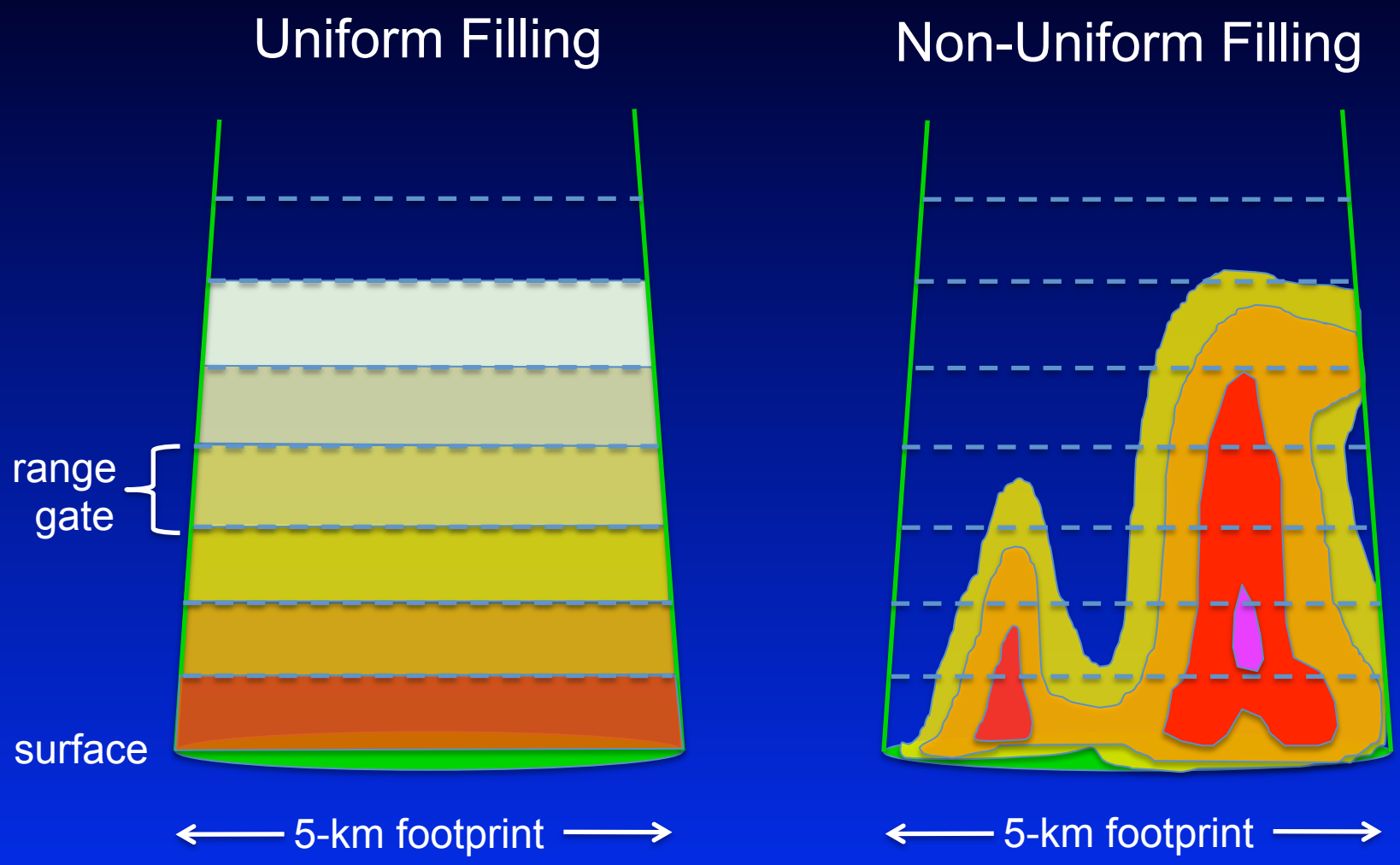
- Non-uniform "beamfilling" of precipitation within radar footprint is parameterized.

- Hogan & Battaglia model for multiple-scattering in radar simulations is utilized where needed.

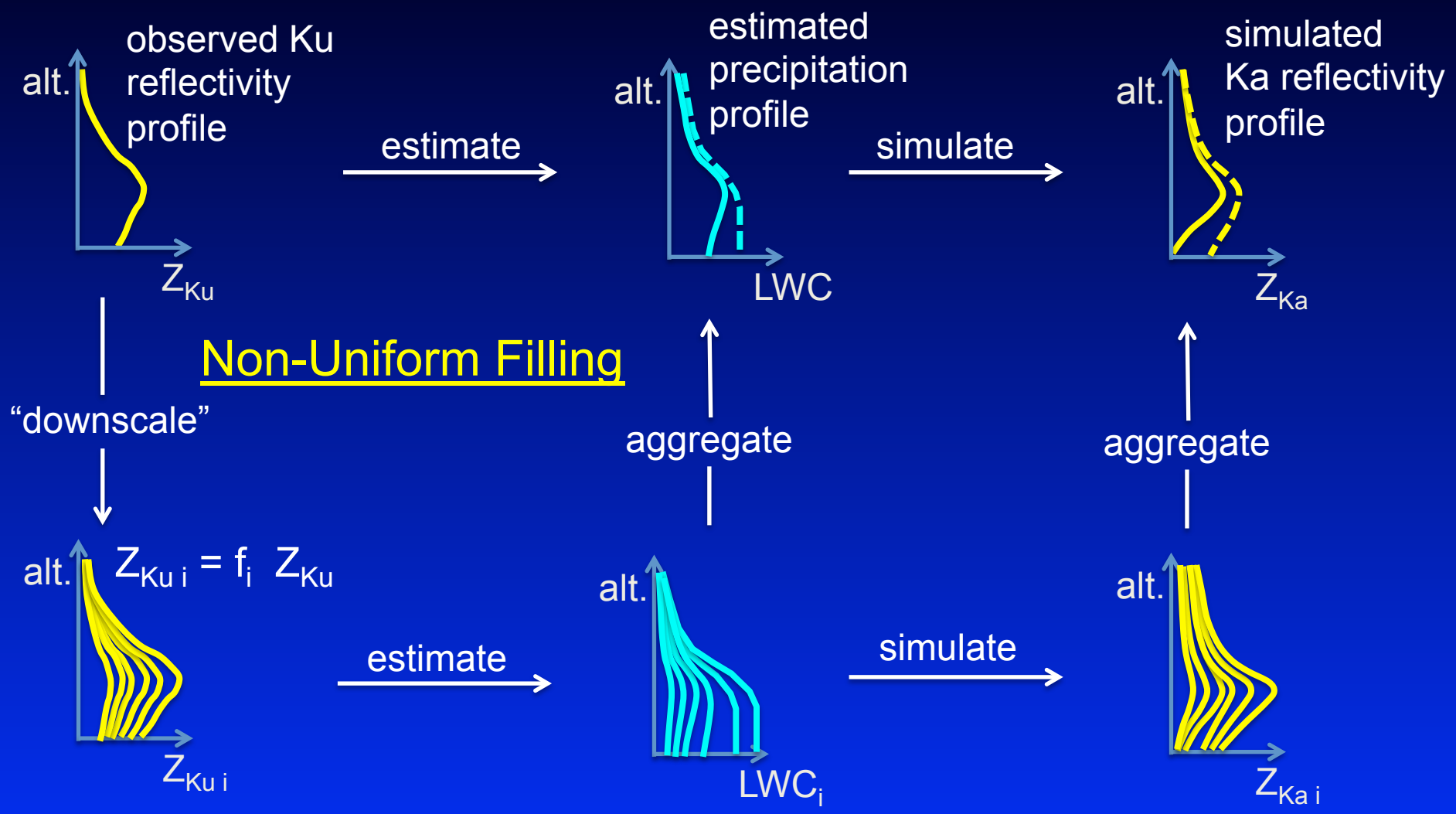
- GMI radiances are resolution-enhanced using regression-based filters.

- Option for linked radar cross-sections and microwave emissivities of earth surfaces.

Non-Uniform Precipitation Beamfilling

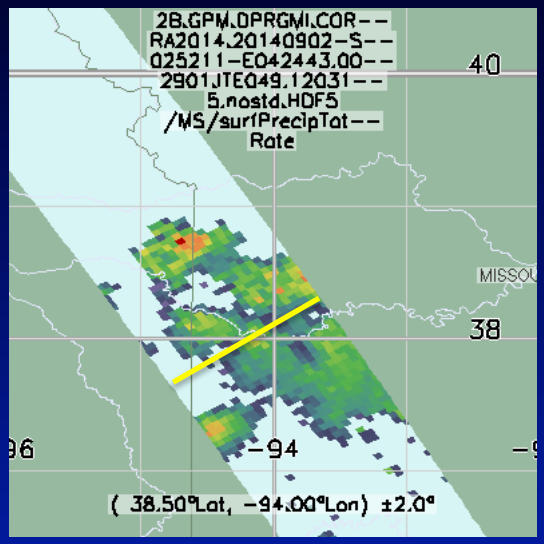


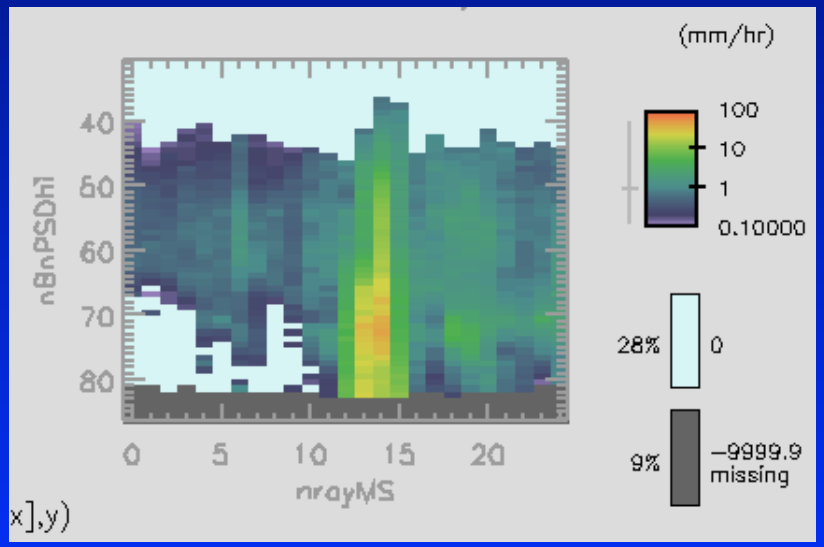
"Downscaling" to Represent Non-Uniform Beamfilling



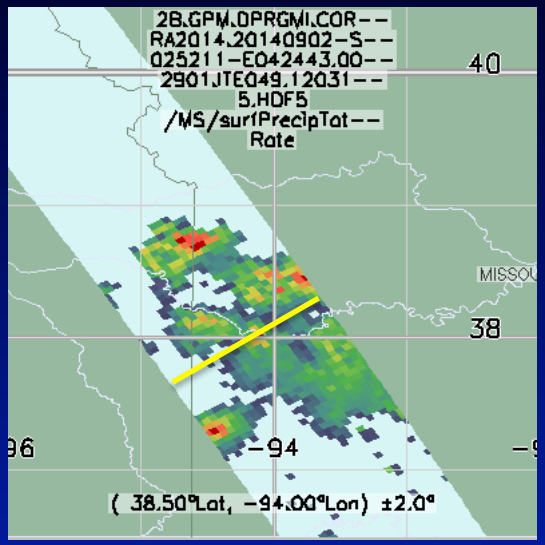
Beamfilling Application

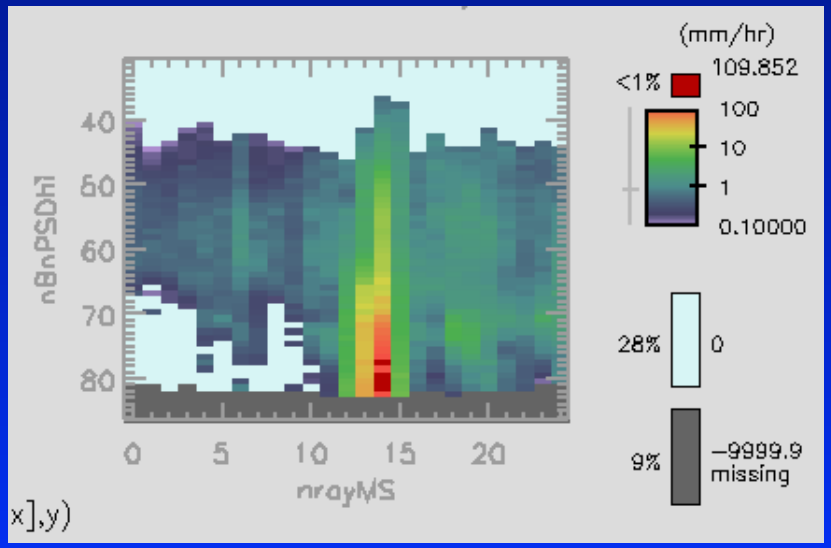
Uniform Beamfilling





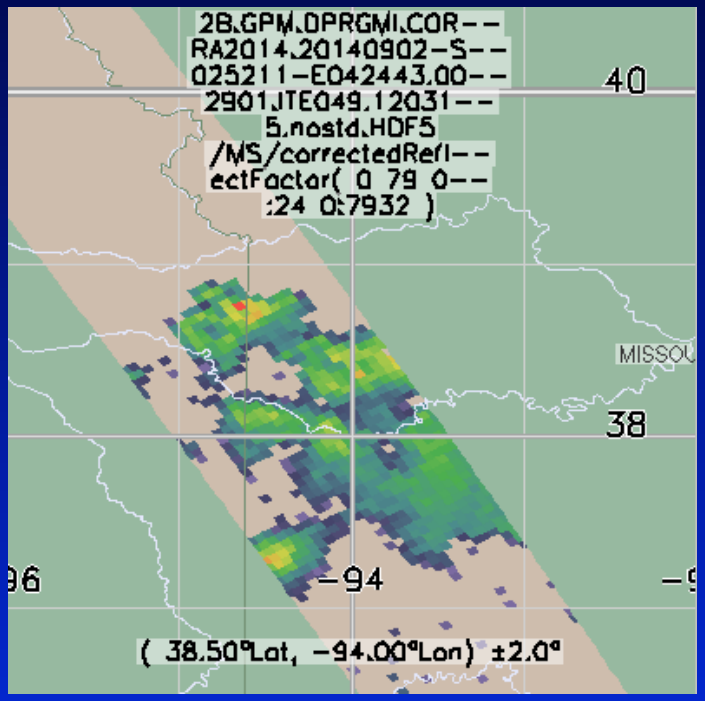
Non-Uniform Beamfilling



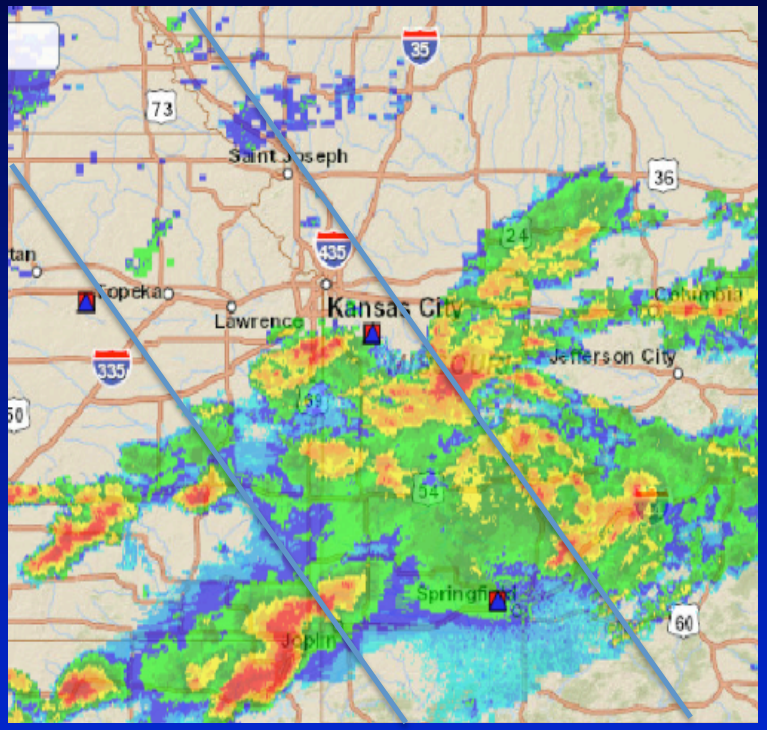


Ground Radar Comparison

Uniform: Corrected Z_{Ku}



NOAA Radar Composite



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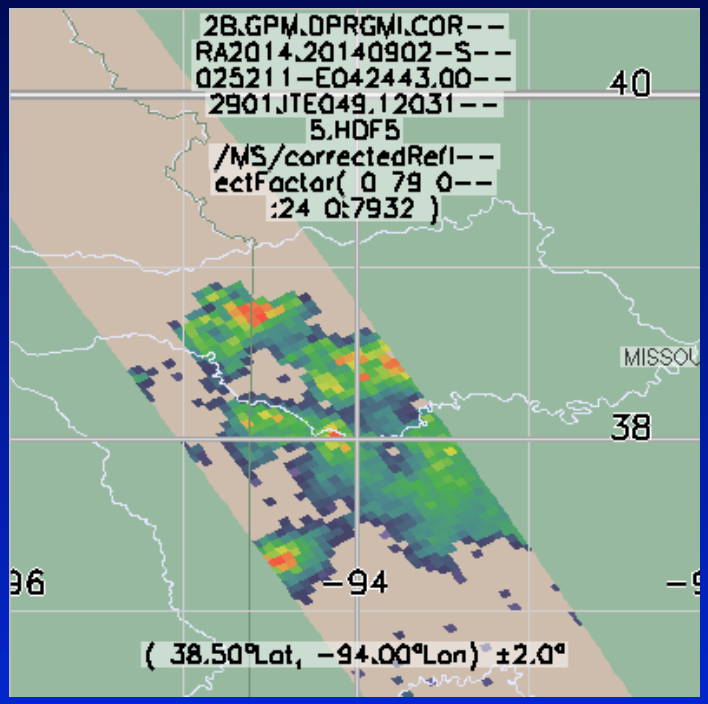

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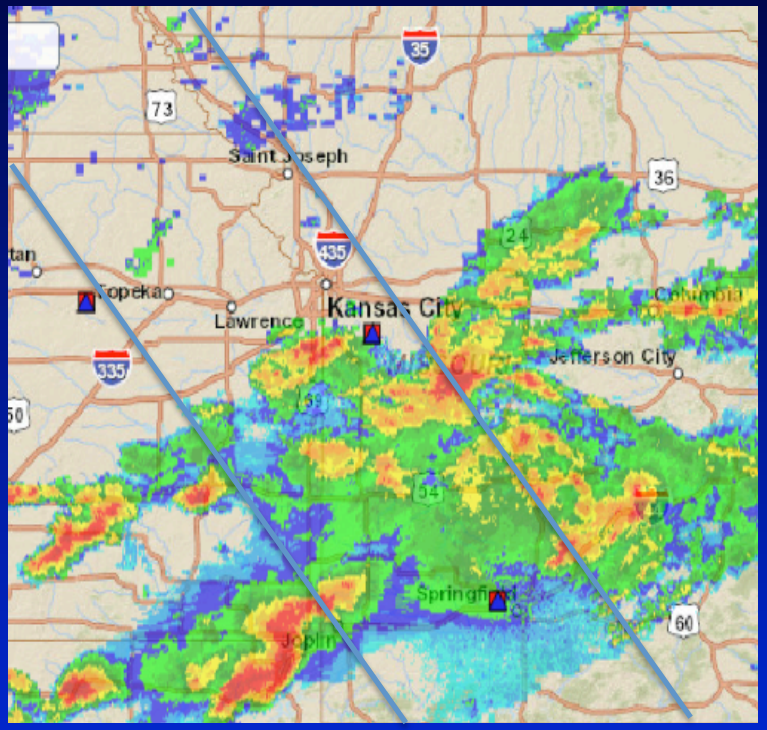
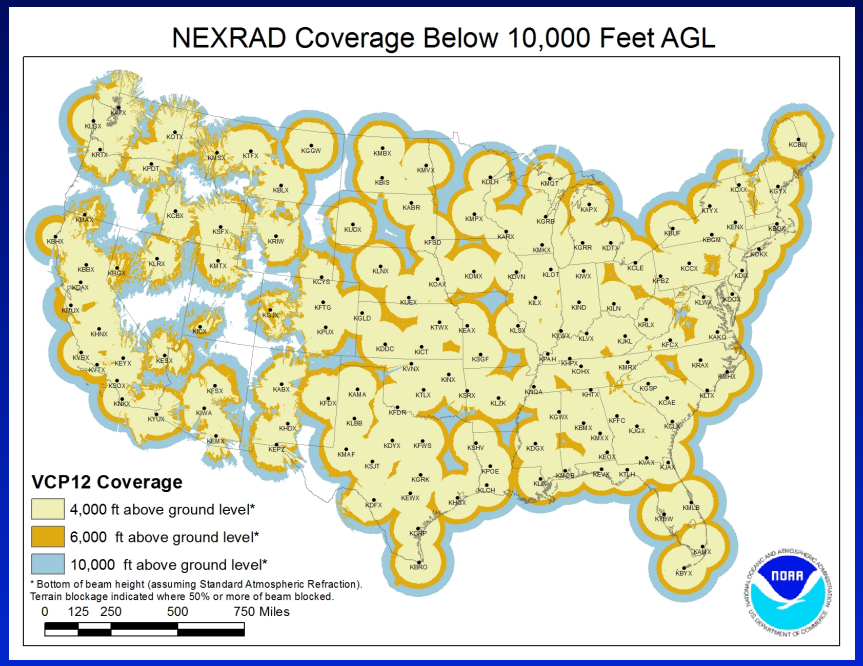
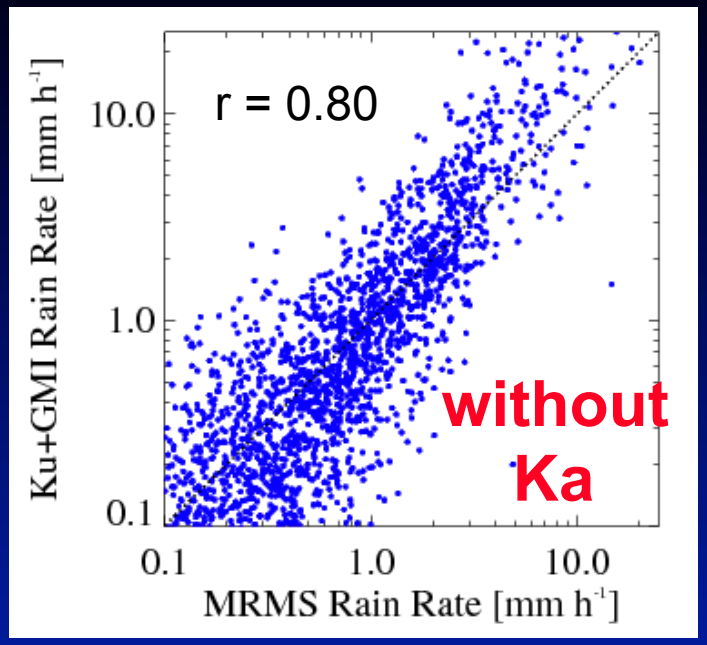
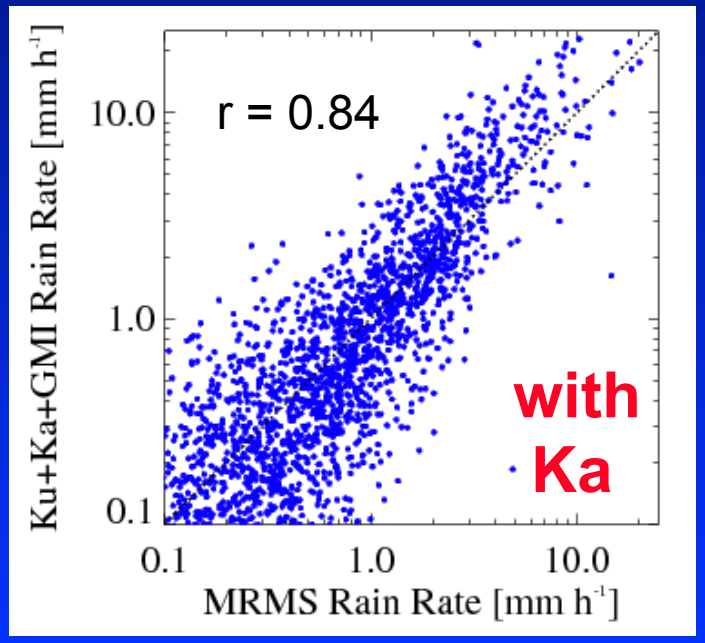


Ground Radar Comparisons- SONDJF ’14-’15

MRMS are gage-calibrated NEXRAD rain rates





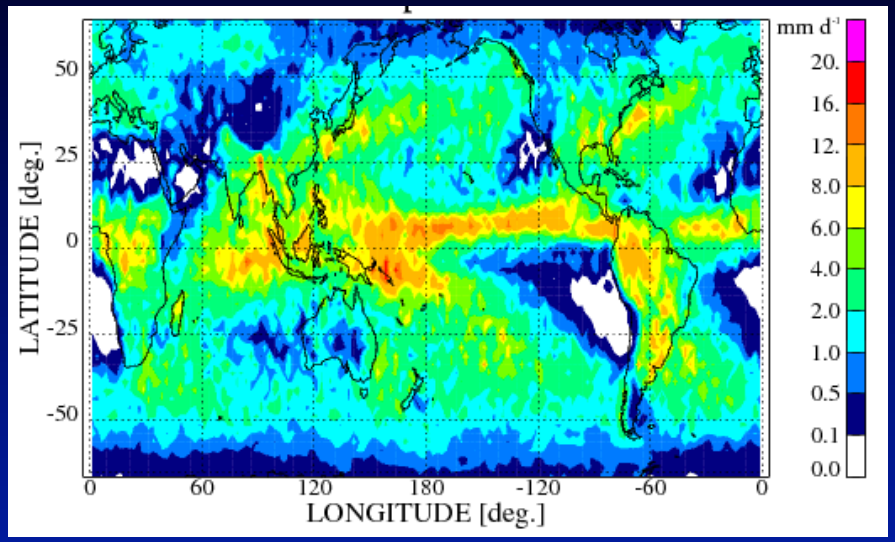


Pierre Kirstetter, Bart Kelley, Chris Kidd

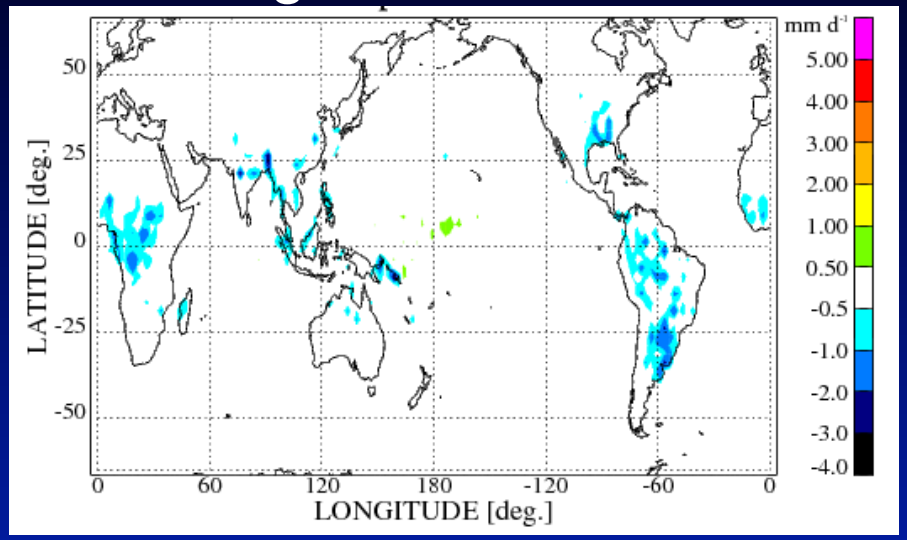
Comparison of GPM Mean Precip. vs. GPCP

Dave Bolvin

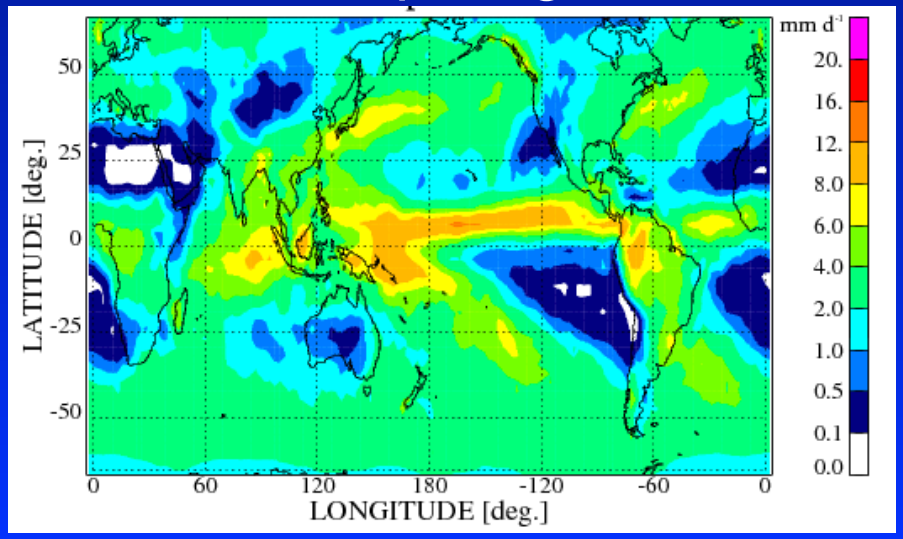
Ku+GMI Sep-Aug ’14/’15



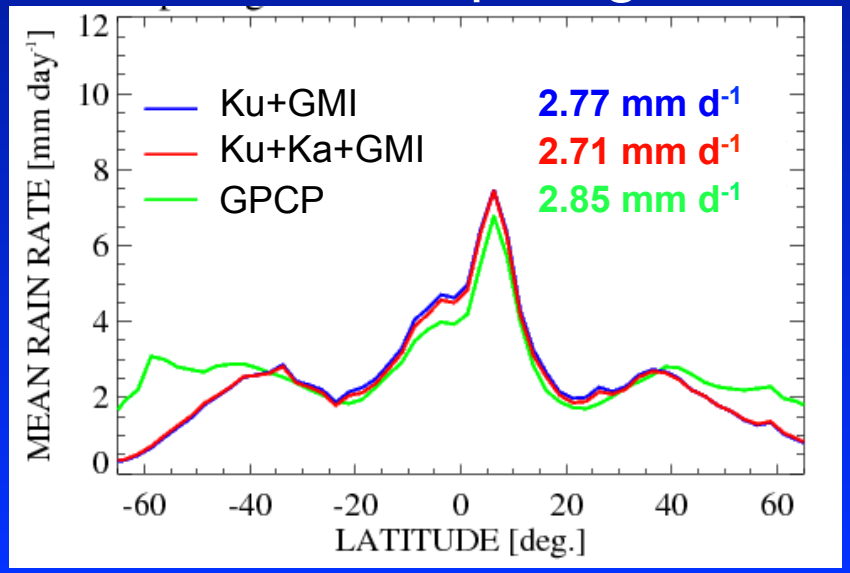
Change with Ka Added



GPCP Sep-Aug ’14/’15



Zonal Means Sep-Aug ’14/’15



Concluding Remarks

- Non-uniform beamfilling and multiple scattering are parameterized, but considerable work is still required.
- Fully implement surface model; nonspherical ice and mixed-phase particle scattering properties.
- High-latitude estimates.
- Error characterization.