Integration of All-Sky Retrievals into the GPM Combined Algorithm

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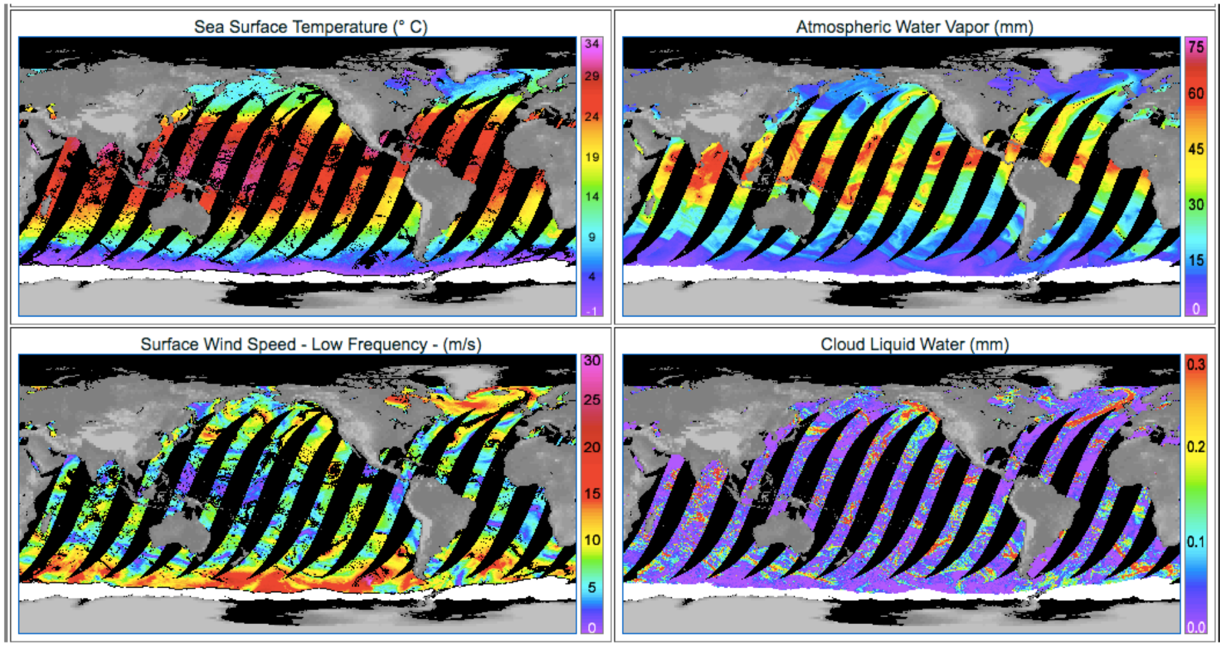
What parameters can GMI/DPR retrieve in the absence of precipitation? Within precipitation?

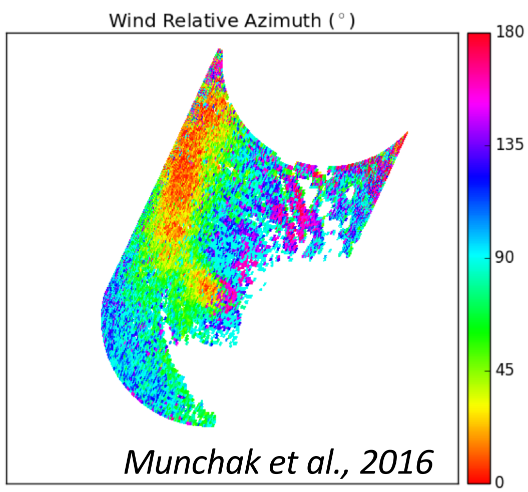
Classic ocean parameters: SST, wind speed, column water vapor, cloud water path



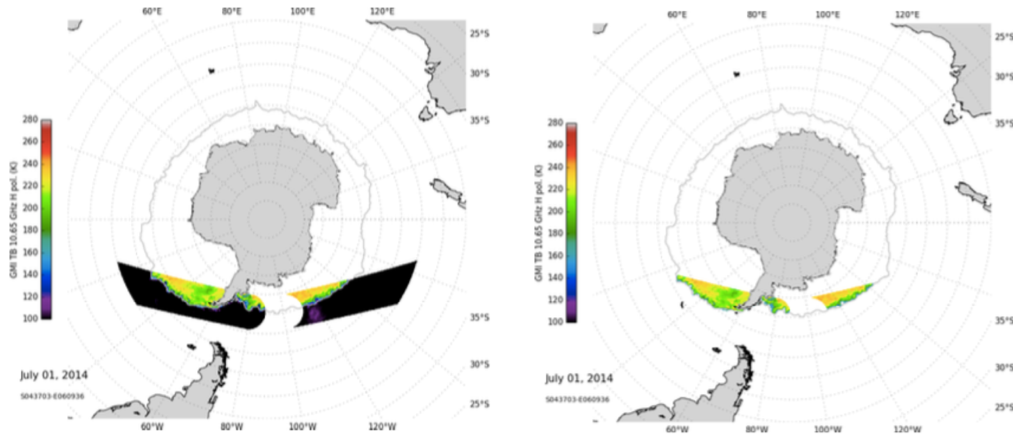
courtesy of remss.com

What parameters can GMI/DPR retrieve in the absence of precipitation? Within precipitation?

Other ocean parameters: Wind direction, temperature/water vapor profile, sea ice coverage & properties, cloud ice path



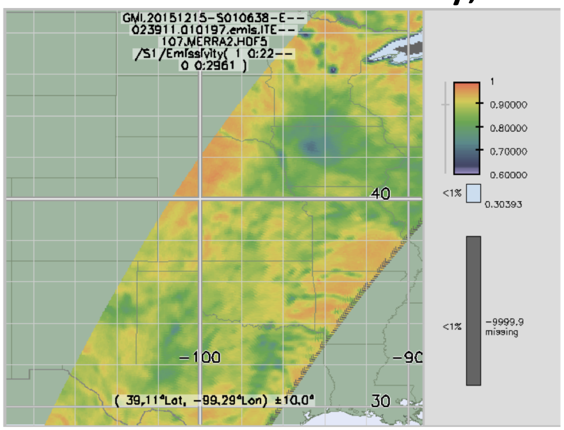
Munchak et al., 2016

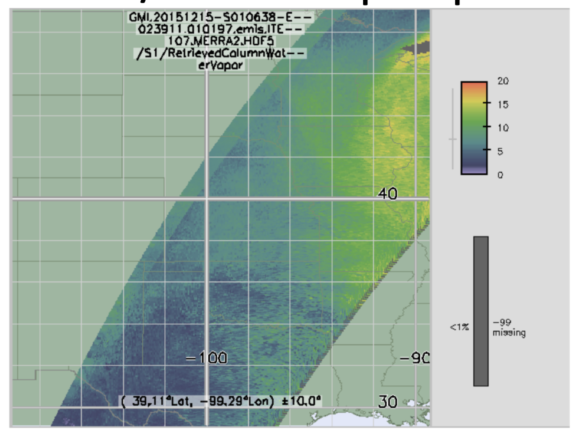


courtesy of Ludovic Brucker

What parameters can GMI/DPR retrieve in the absence of precipitation? Within precipitation?

Land parameters: Emissivity, temperature/water vapor profile

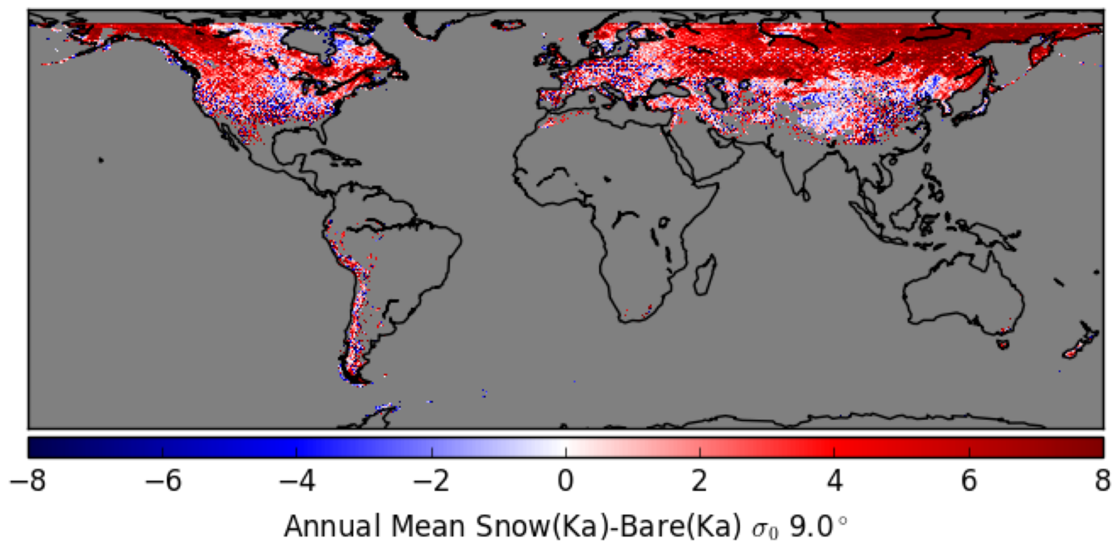




Munchak et al., 2018
In prep

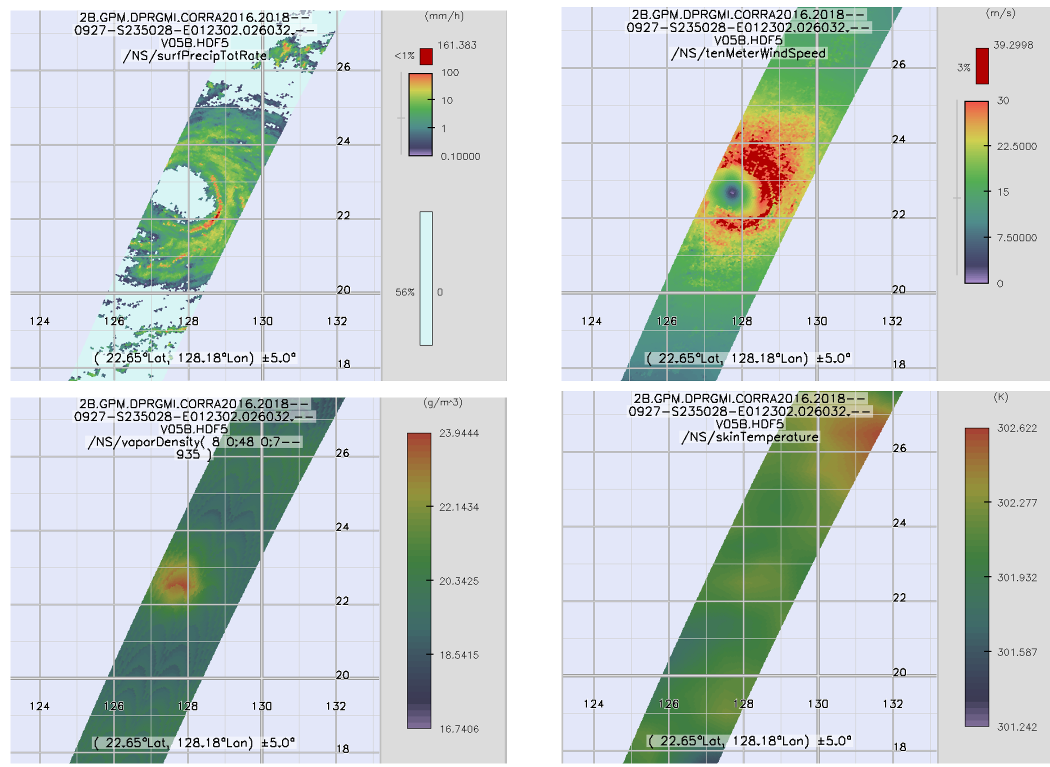
What parameters can GMI/DPR retrieve in the absence of precipitation? Within precipitation?

Potential land parameters: Cloud water path, cloud ice path, skin temperature, soil moisture, vegetation water content, **snow coverage** and properties



Current State of “Non-Rain” Parameters in Combined Algorithm

- GANAL profiles are interpolated to DPR grid (2A-ENV)
- Some parameters (surface wind, water vapor, cloud water) are retrieved within precipitation
- Others (SST, temperature, pressure) are copied directly from model
- Outside of precipitation, all model fields are simply copied



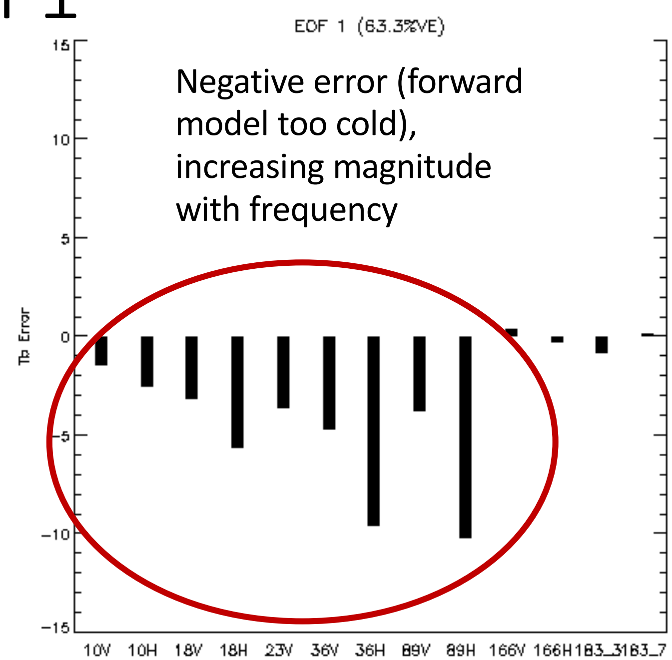
Outstanding problems

- Choice of retrieval parameters
- What background fields to use & how to represent model error
- How to interpolate into precipitation
- How to handle deconvolution

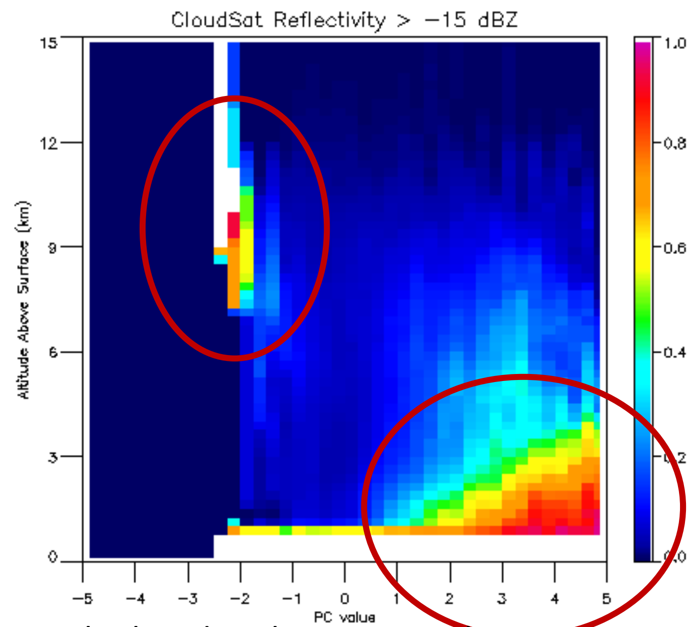
Related Issue: Light precipitation

- When non-rain retrievals fail to converge (or do converge, but with large forward model – observation error), precipitation is often present
- Look at CloudSat-GPM matchups where non-rain retrievals cost function exceeds threshold – what is causing the forward model error?

EOF analysis of high χ^2 with no DPR precip – EOF1



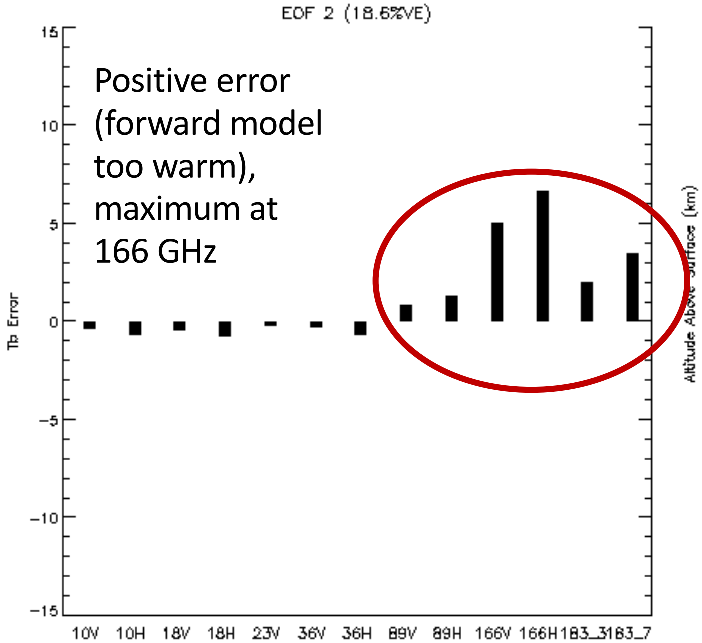
Negative error (forward model too cold), increasing magnitude with frequency



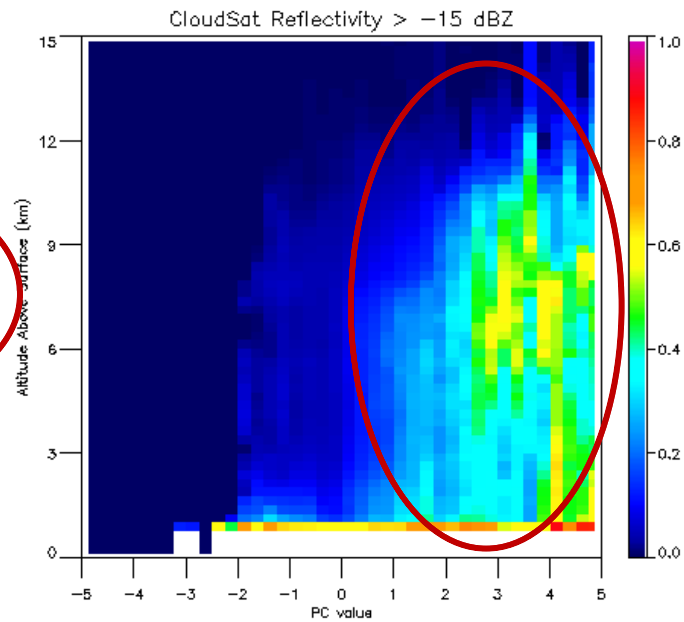
High-altitude echo associated with negative EOF values (forward model too warm) – anvil scattering?

Low-altitude echo increases in depth with increasing EOF magnitude (warm rain)

EOF analysis of high χ^2 with no DPR precip – EOF2



Positive error (forward model too warm), maximum at 166 GHz

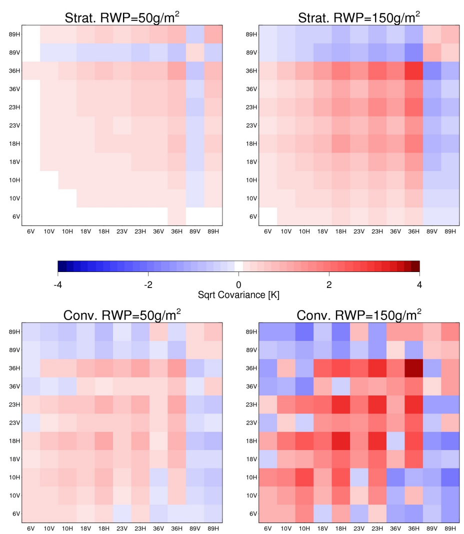


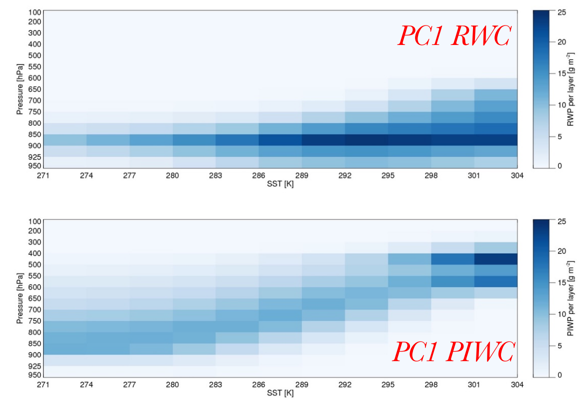
Echo probability increases with EOF magnitude; broad vertical distribution

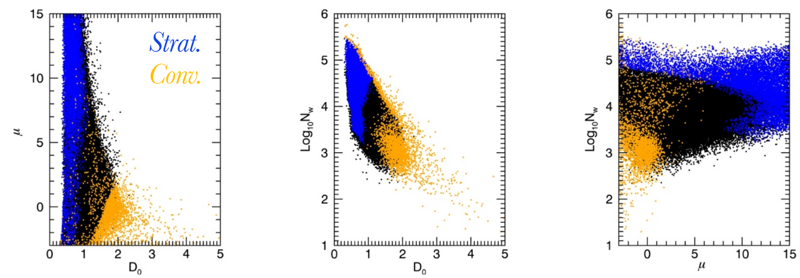
CSU 1DVAR for light precipitation

To make a full variational precipitation retrieval we need

- Vertical information (but not too much)
- Treatment of DSD variability







Measurements of DSD variability (LPVEx, OLYMPEX)

$$N(D) = N_w f(\mu)\left(\frac{D}{D_m}\right)^{\mu} e^{-(4+\mu)D/D_m}$$

From Duncan et al. (2018)

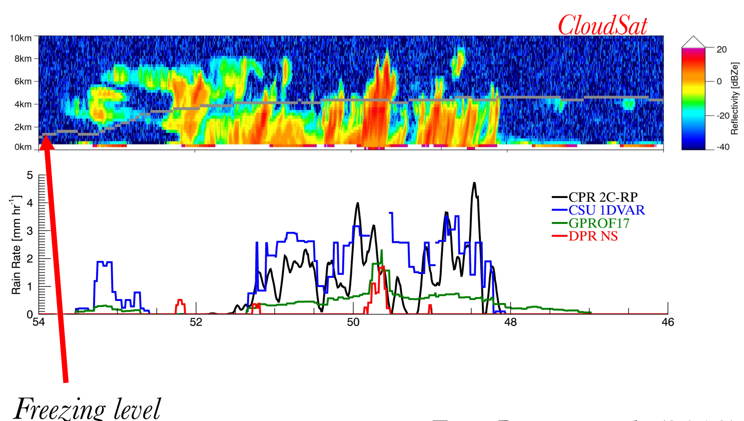
CSU 1DVAR vs. GPM & CloudSat

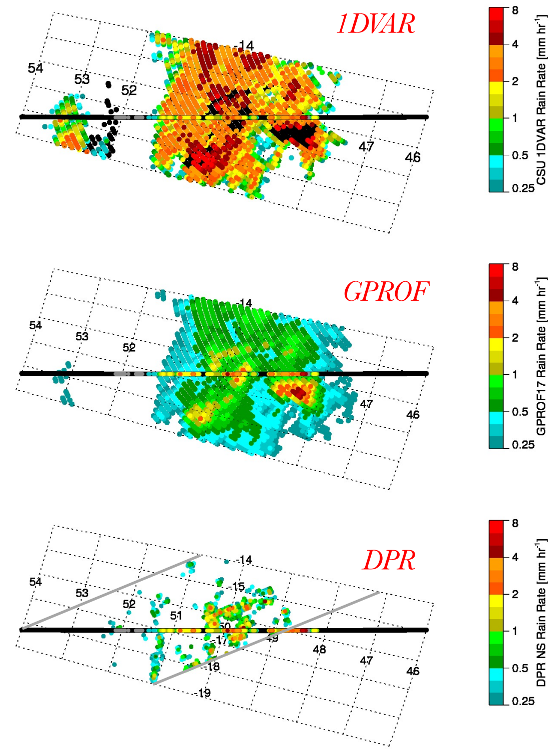
North Atlantic rain, June 1st 2015

Compare with two radars: CloudSat and DPR

CSU 1DVAR performs well *if it is warm rain*

- Since forward model is warm rain only, any pixels with significant mixed phase fail to converge





From Duncan et al. (2018)

Outlook for V07

- Top priority is to contain all necessary information for GPROF database generation in the combined algorithm output.
  - atmospheric profiles
  - surface emissivity/temperature
  - Sea ice/snow cover classification?
- Forward modeling of these fields to the GMI footprints should match GMI observations to within model error, which is scene-dependent.
- Light precipitation detection & estimation is ongoing research.
  - Evaluate frameworks for warm rain (ocean), drizzle, light snow
  - May be implemented as experimental output