

Assimilation of **GPM** observations in NASA Unified WRF EDAS

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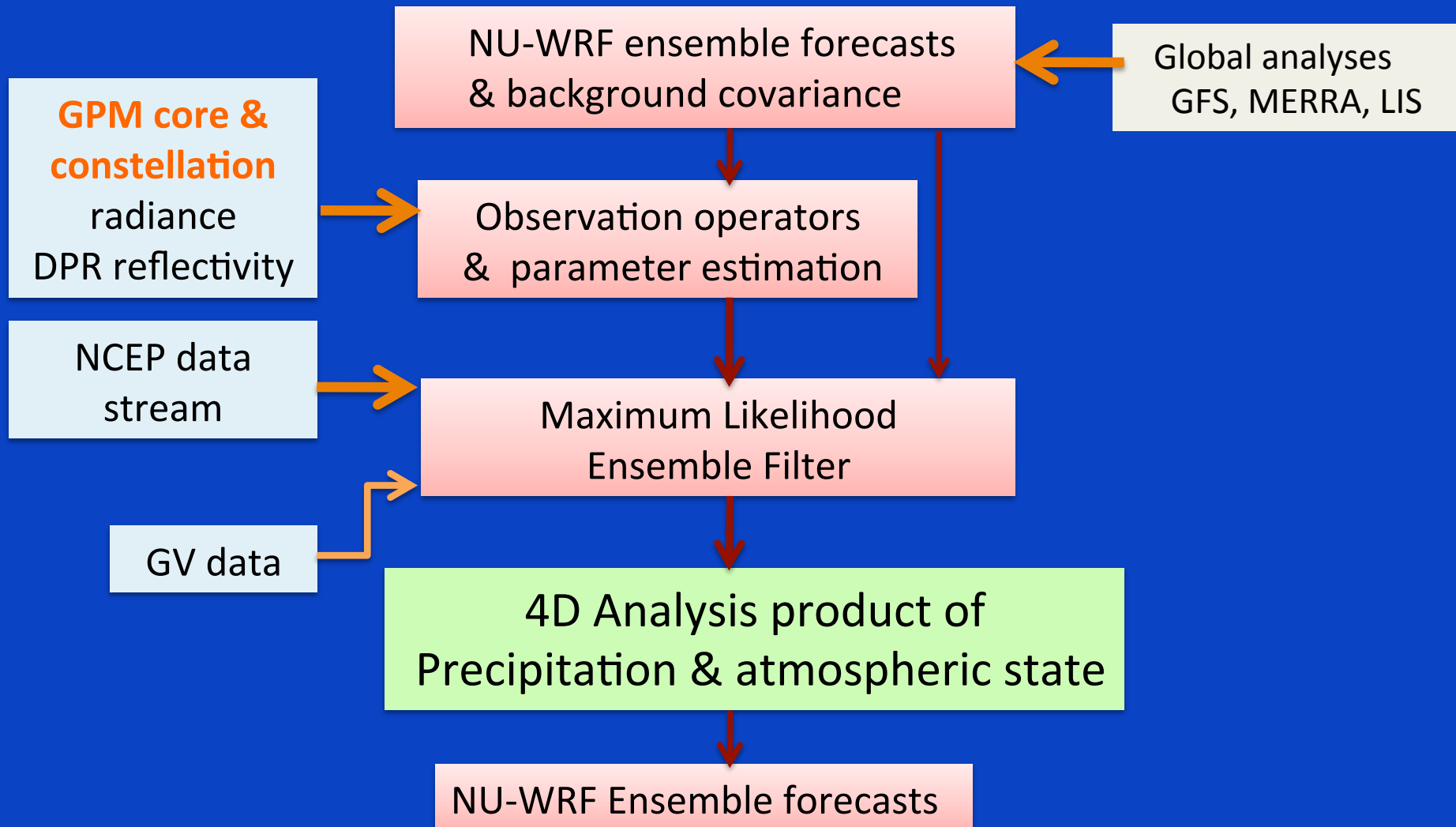
¹NASA GODDARD SPACE FLIGHT CENTER

²COLORADO STATE UNIVERSITY

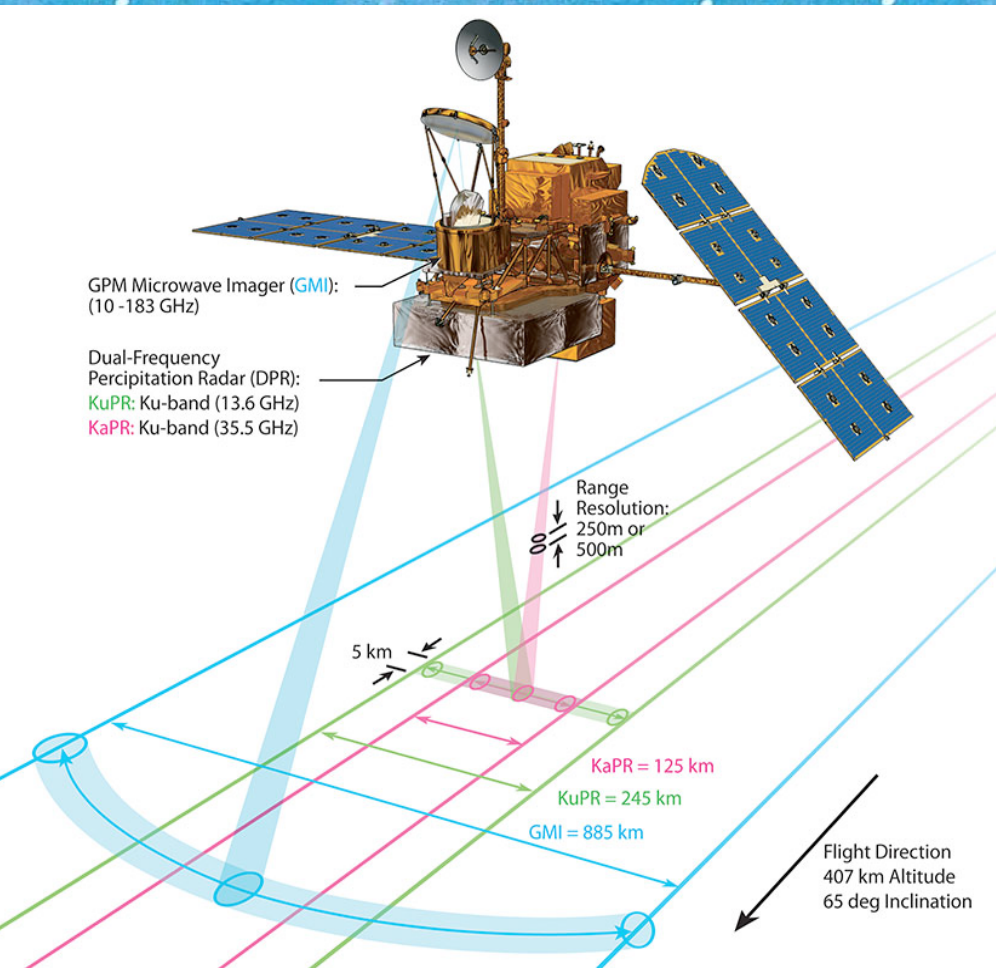
³UNIVERSITY OF CALIFORNIA, DAVIS

⁴CNRM-GAME, MÉTÉO-FRANCE AND CNRS

NASA Unified WRF Ensemble DA system



Global P_{recipitation} M_{easurements}



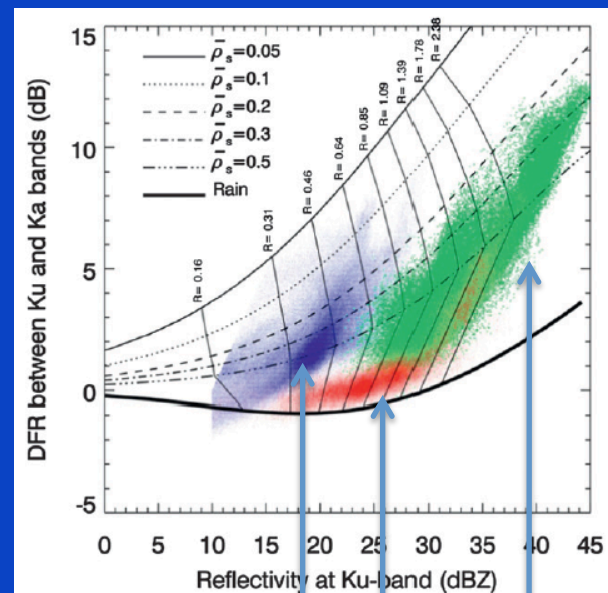
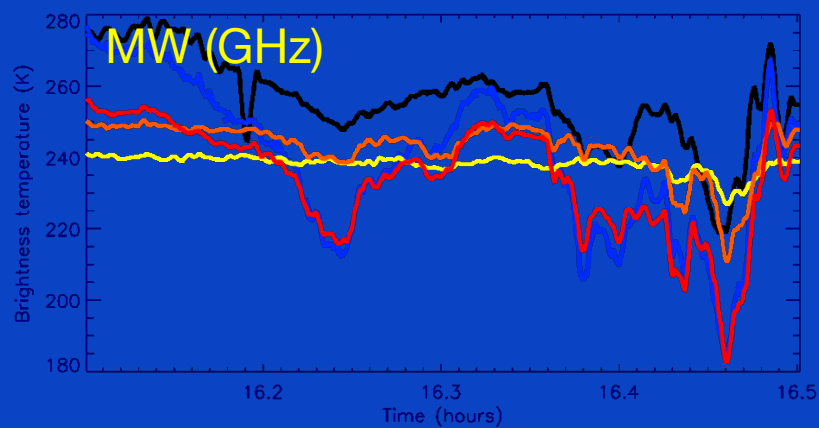
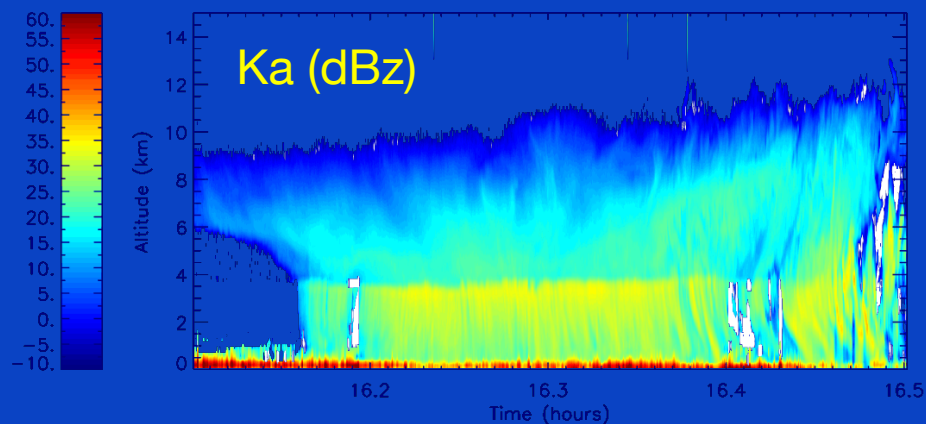
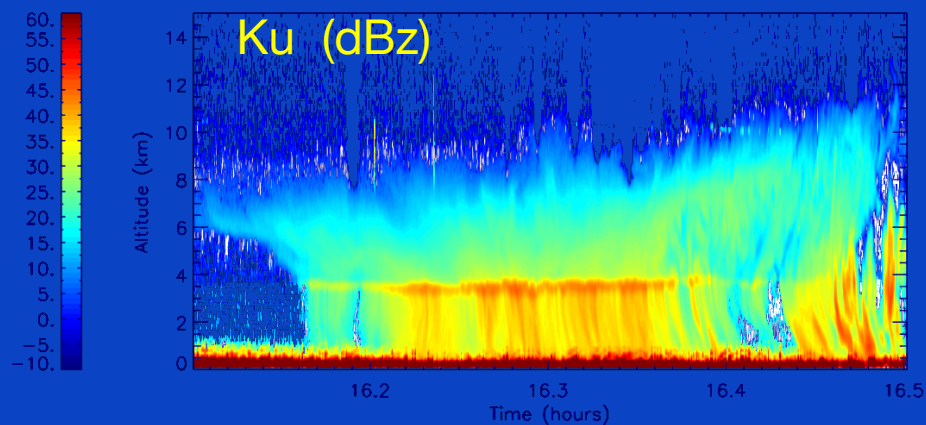
NEW!

GMI (10-183 GHz mw)

DPR (dual freq. radar)

*let it snow
let it snow
let it snow*





snow rain mixed

Assimilation of precipitation-affected radiance and reflectivity observations

$$J(x) = \frac{1}{2}(x - x_b)^T P^{-1}(x - x_b) + \frac{1}{2}(y_o - H(x))^T R^{-1}(y_o - H(x))$$



$$N(D) = N_0 e^{-\lambda D}$$

all-sky radiative transfer operator

$$\lambda = \left(\frac{N_0 \pi \rho_s}{q_s} \right)^{\frac{1}{4}}$$

$$z_e = \frac{f^4}{\pi^5 |K_w|^2} \int_0^\infty N(D) \sigma_b(D, f, T) dD$$

Assimilation of precipitation-affected radiance and reflectivity observations

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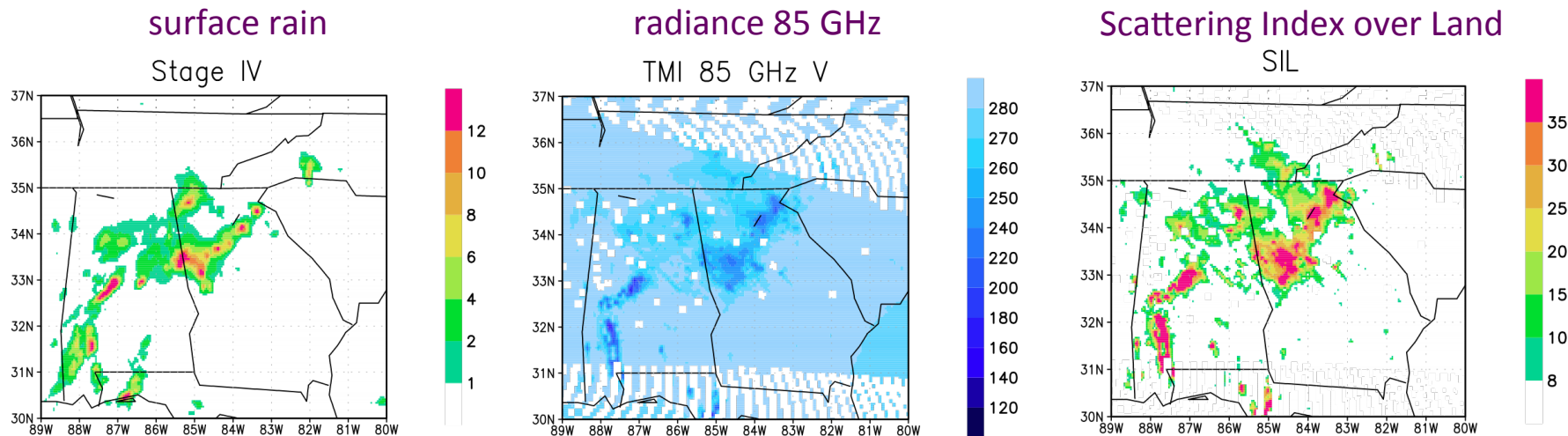
control variables include
5 hydrometeors, moisture,
temperature and wind



departures in radiance,
reflectivity, moisture,
temperature and wind

Precipitation signals in microwave radiance over land surface

the importance of scattering signals from frozen particles

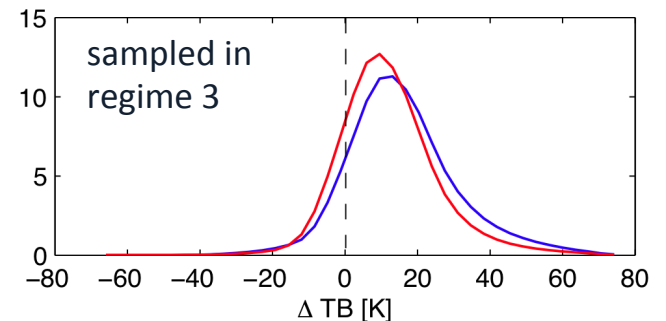
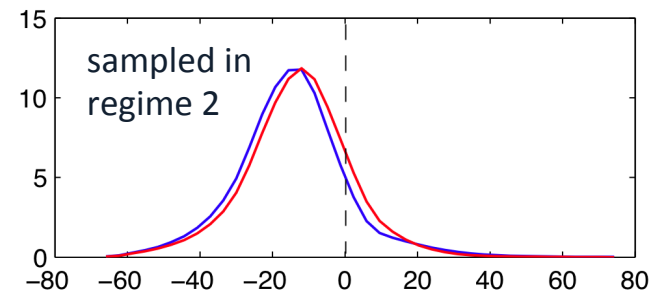
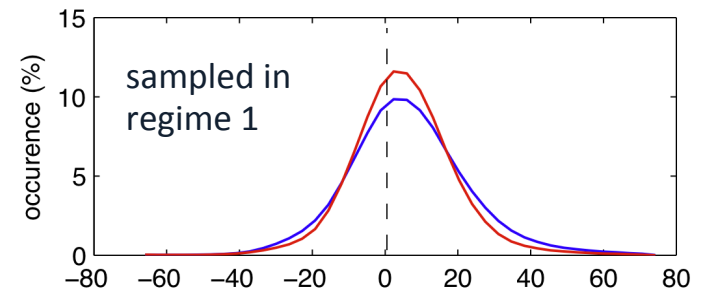
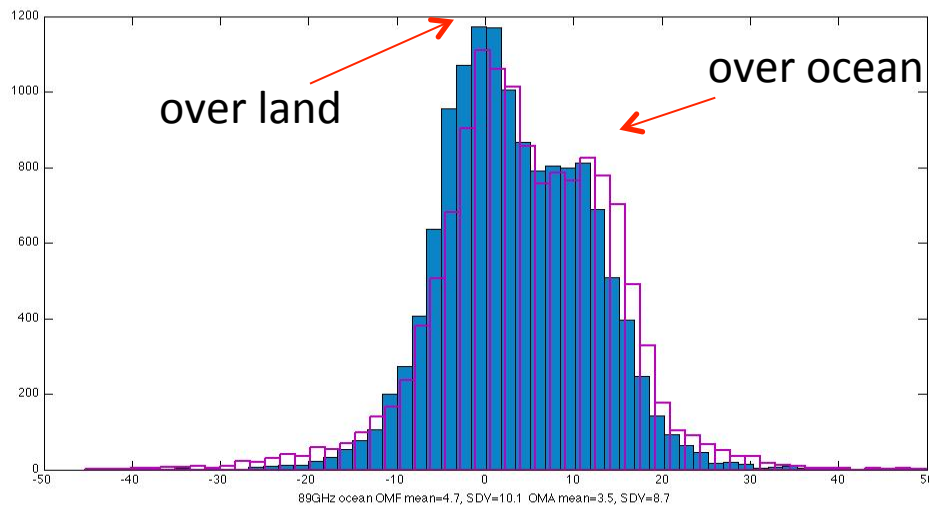


- Scattering Index over Land (SIL) is calculated from observed radiance and from the forward model simulated radiance.
- Precipitation-affected radiance is assimilated where the value of SIL exceeds 10K.

Precipitation signals in microwave radiance over land surface

the distribution of radiance departures in three regimes (discrepancies in storm intensity, location and shape)

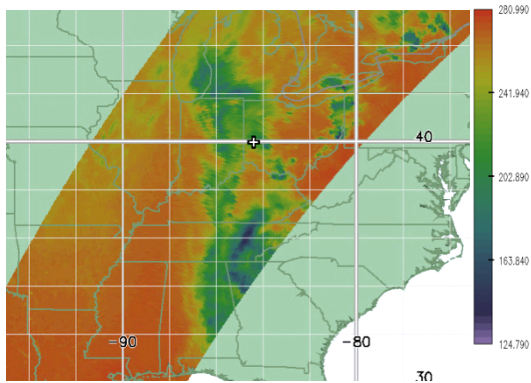
radiance departures (89GHz)



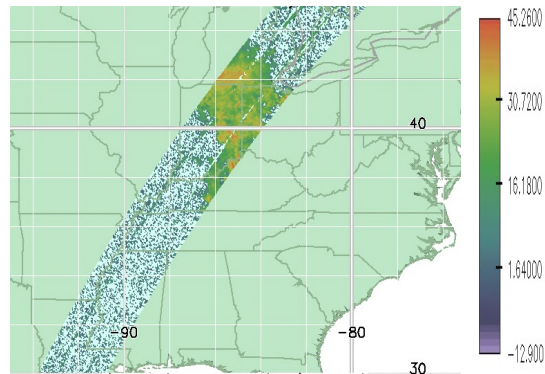
GPM data assimilation during IPHEx field campaign

Observations (2014-05-15)

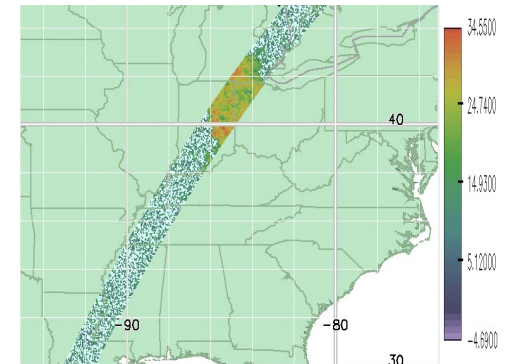
GMI 89GHz



DPR Ku



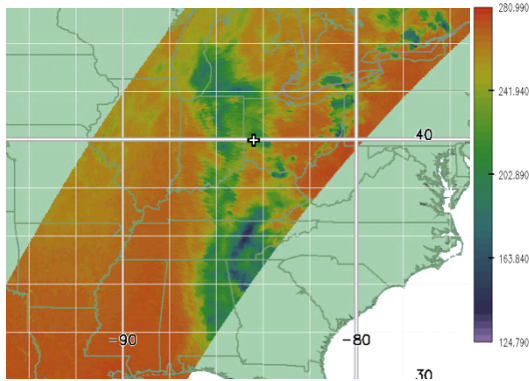
DPR Ka



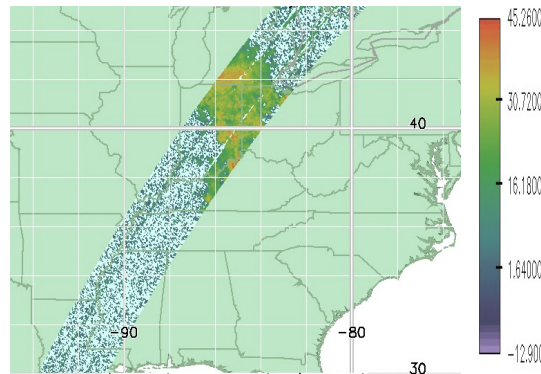
GPM data assimilation during IPHEx campaign

Observations (2014-05-15)

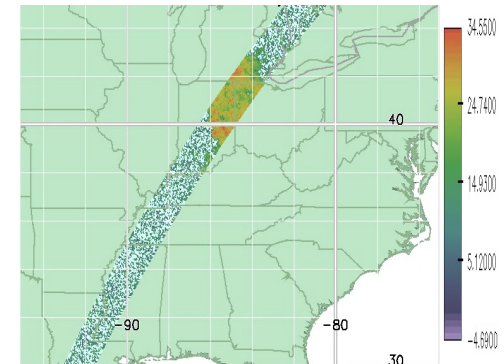
GMI 89GHz



DPR Ku

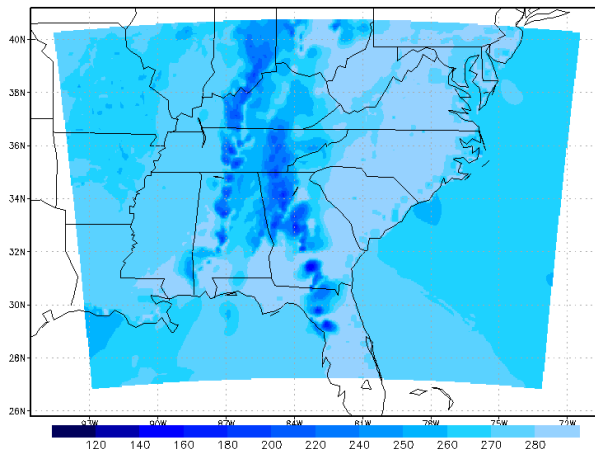


DPR Ka

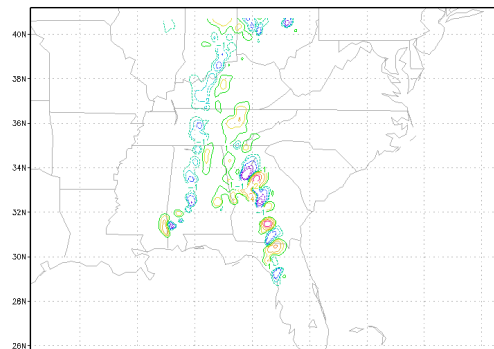


Model

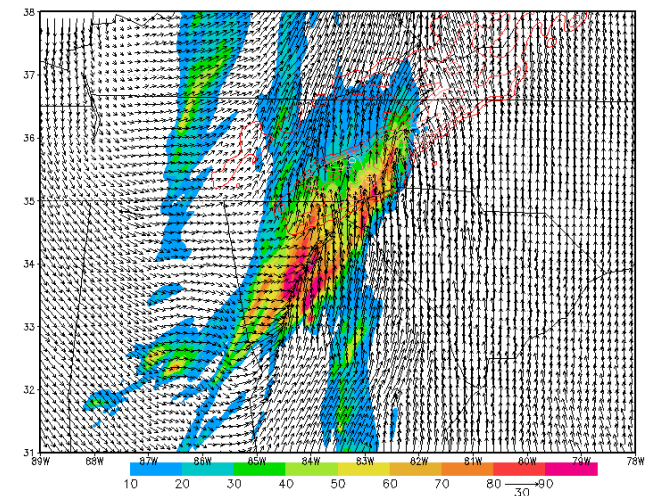
simulated radiance (0z)



hydrometeor
increments (0z)

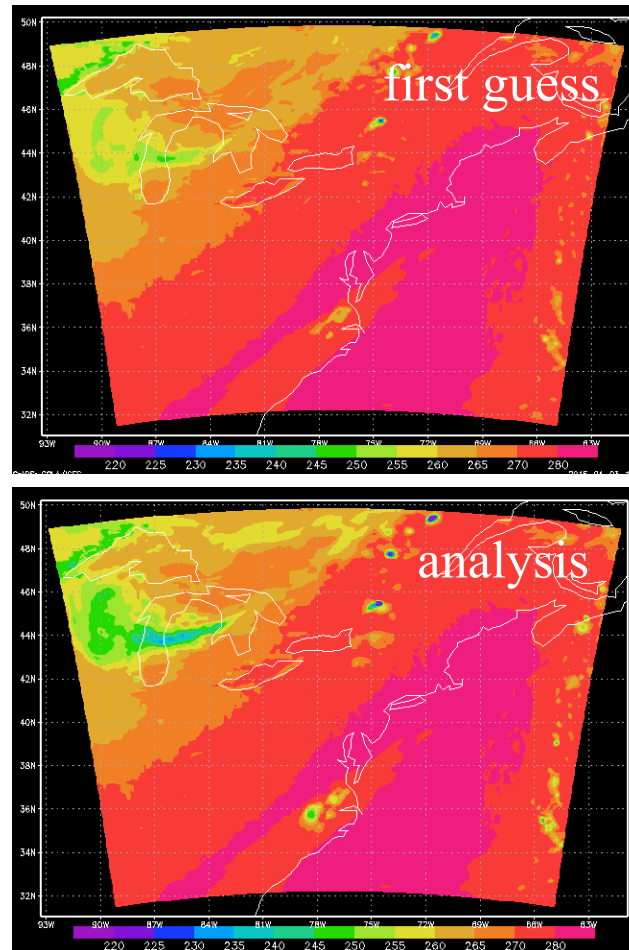
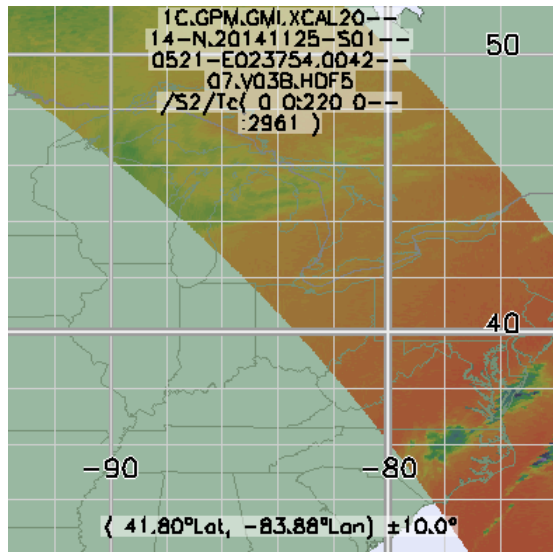


Precipitation forecast (0-6z)

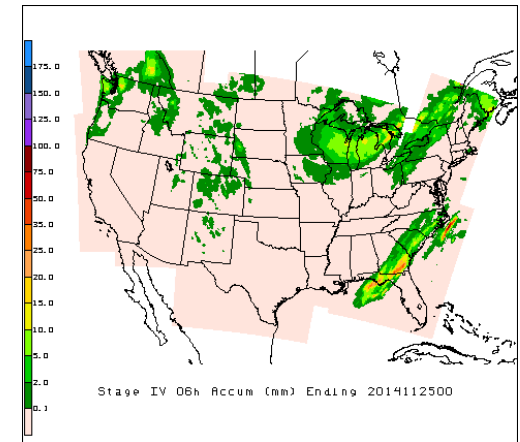


GPM data assimilation during a winter storm 2014

GMI 166GHz



Surface precipitation Stage IV



Remarks

- Why radiance
- Why ensemble scheme
- Life becomes harder when you know more