Evaluating the MMF Using CloudSat (and MISR)

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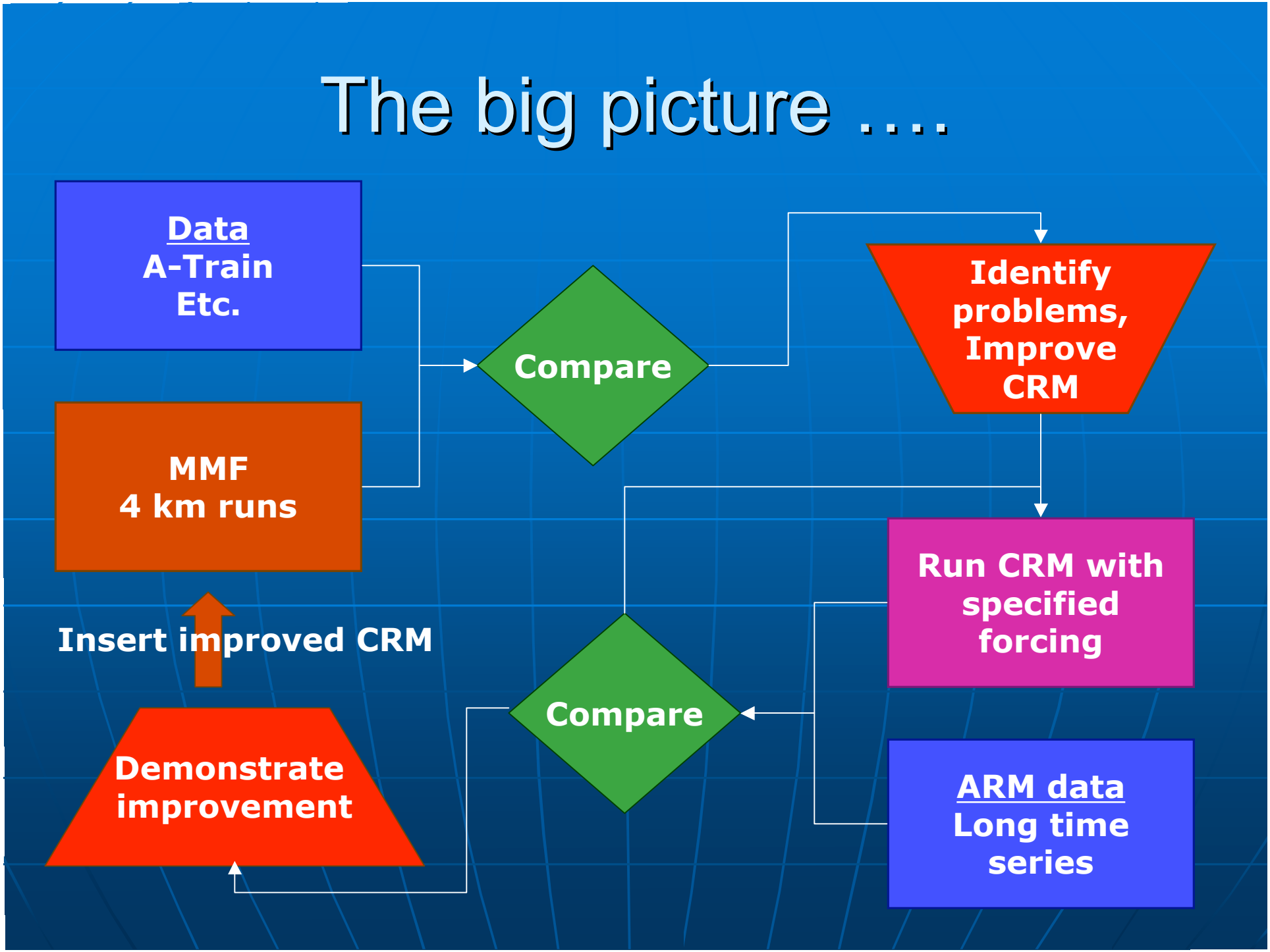
Oops: NOT an MJO talk!

The big picture ….



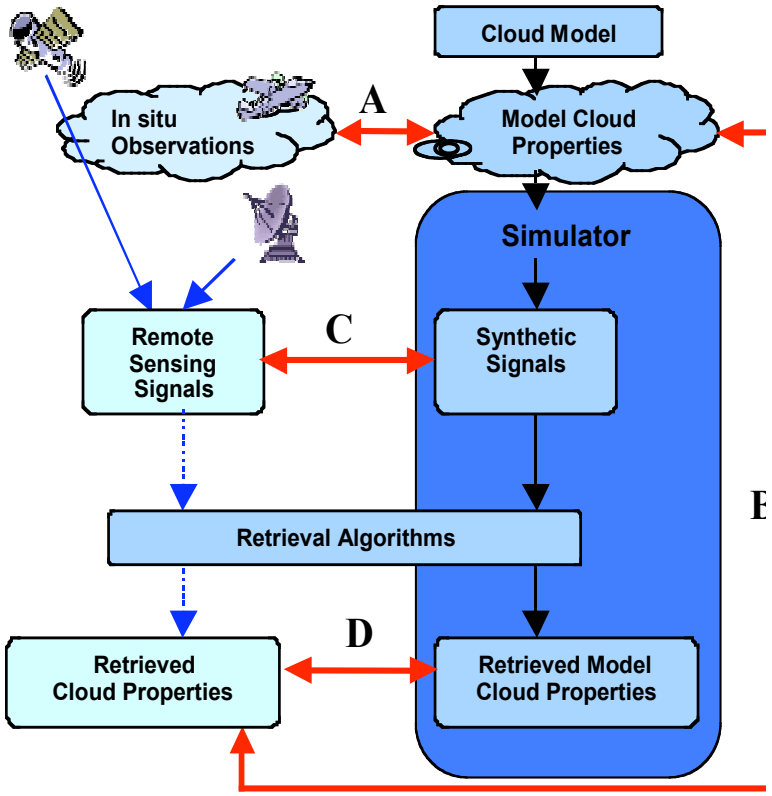
Comments

- Develop diagnostics and testing frameworks that can be re-used
- Provide a quantitative framework for analysis – moving towards scoring systems
- Reproducible results – portable data sets *and* diagnostic frameworks
- Colleagues: Steve Klein, Robert Pincus, Kuan-Man Xu and their colleagues
- Funding from DOE ARM

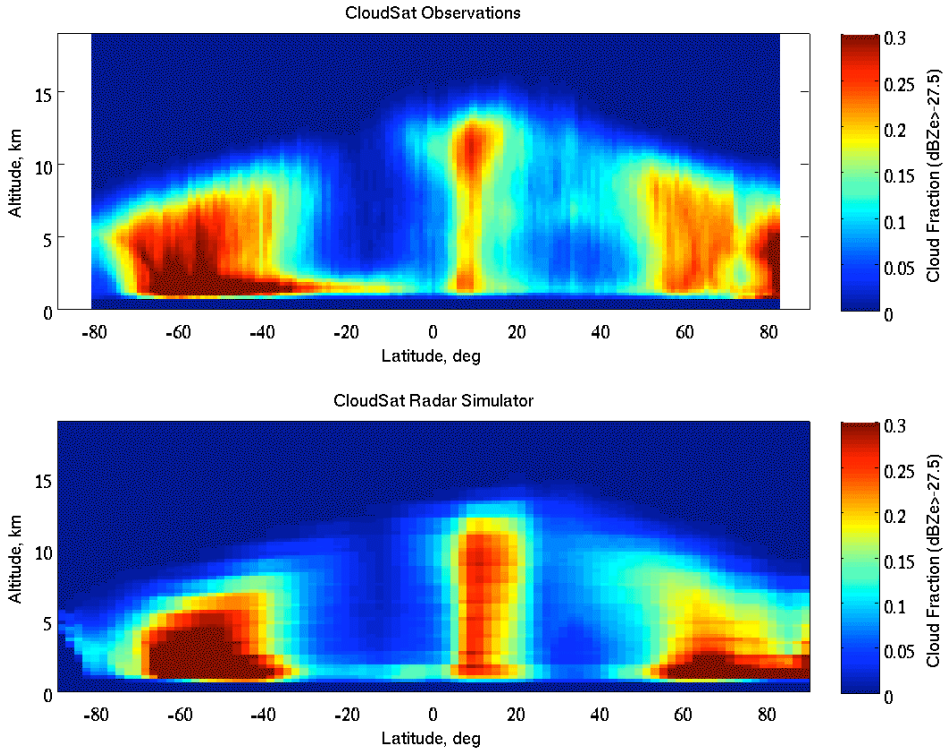
CloudSat comparison

CloudSat Instrument Simulator

MMF



August Composite



Procedure

- QuickBeam simulator
  - Takes cloud and precip mixing ratios from CRM
  - Assumes spheres with prescribed distributions and mean particle sizes for each class
  - Calculates dBZe (truncated at -27.5 dBZe for this study)
- CloudSat data from June 06 to May 07
- MMF runs
  - Observed SST
  - Averaged over 4 years from mid-1998 to mid-2002

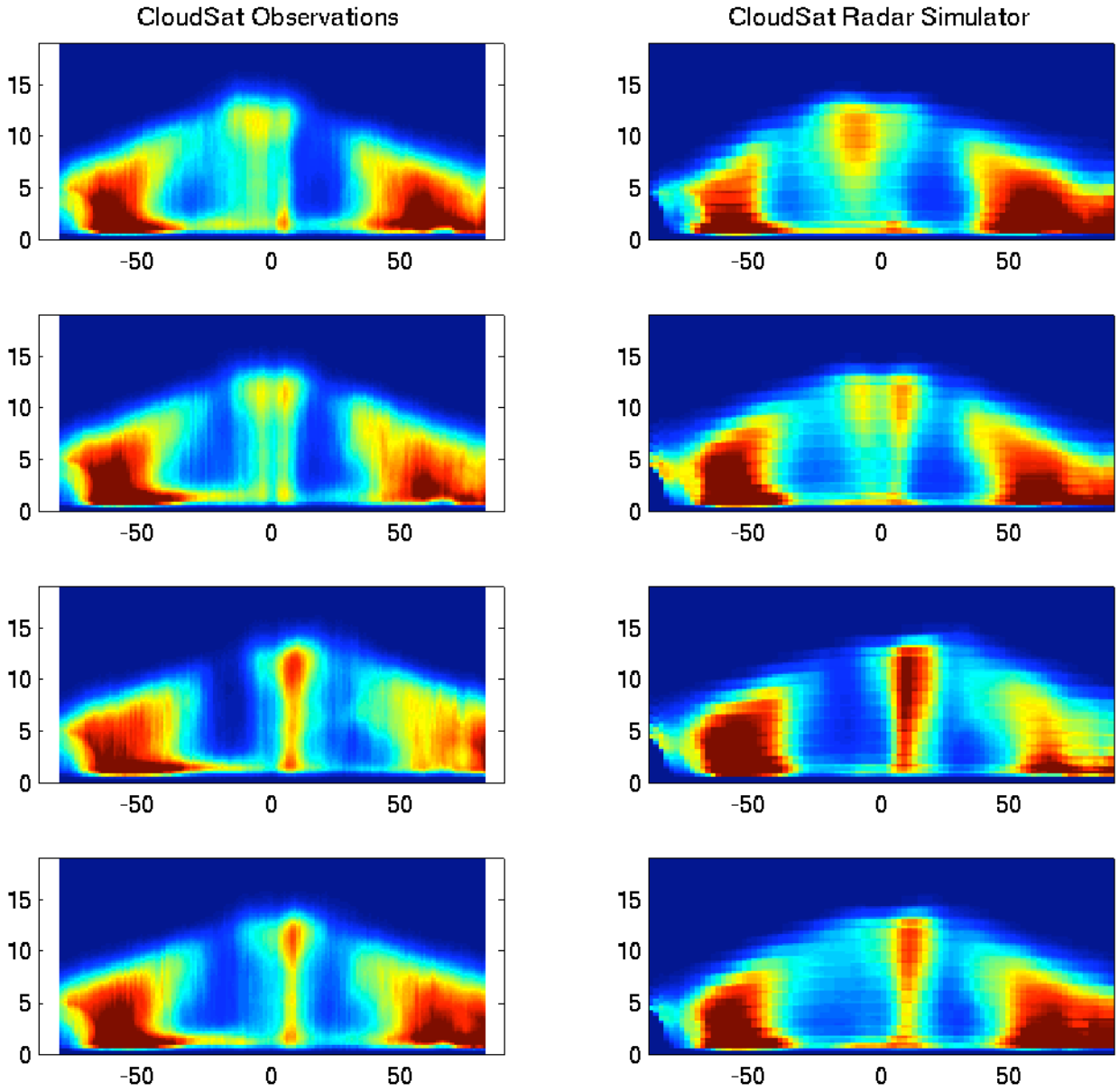
Seasonal comparison

DJF

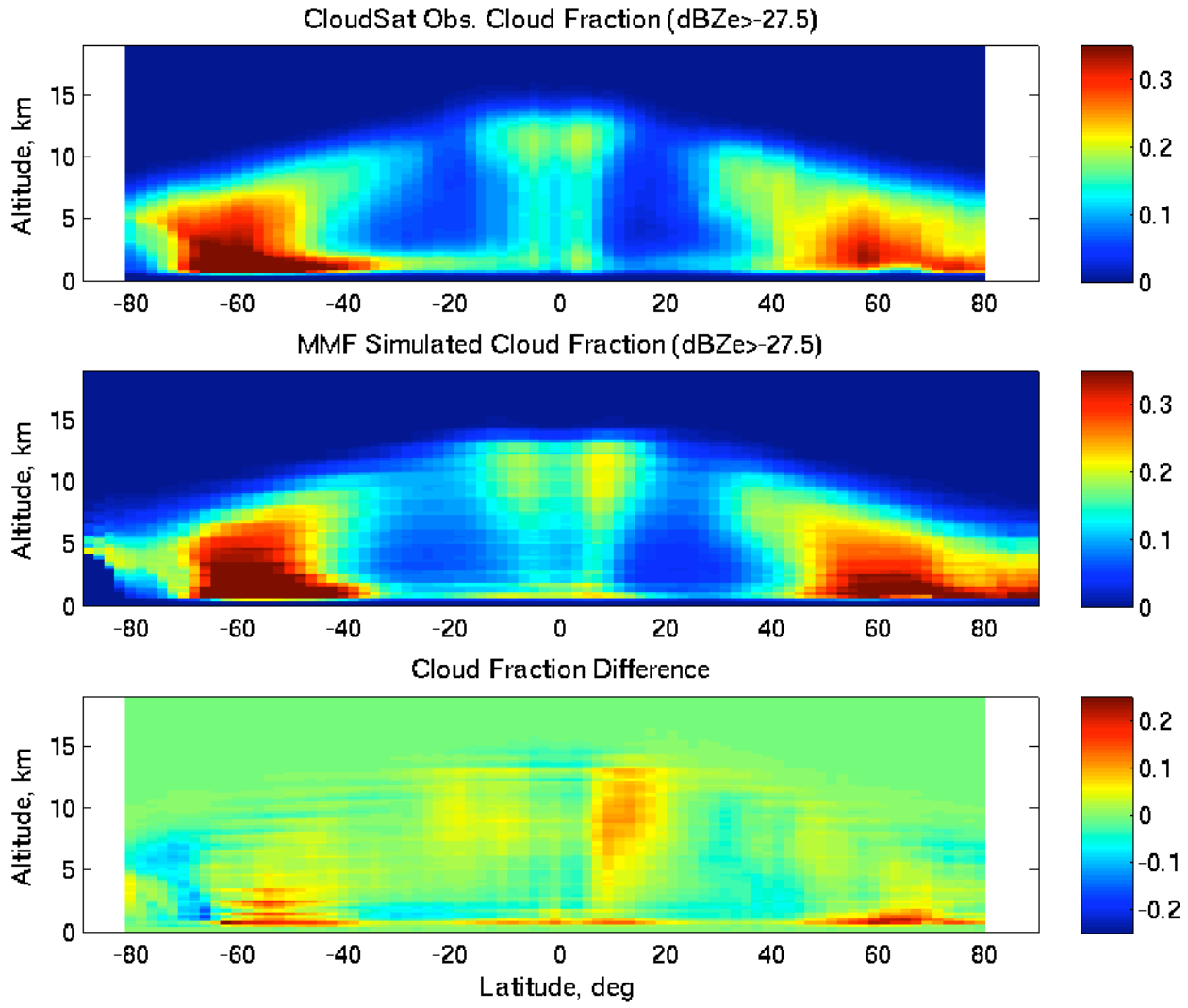
MAM

JJA

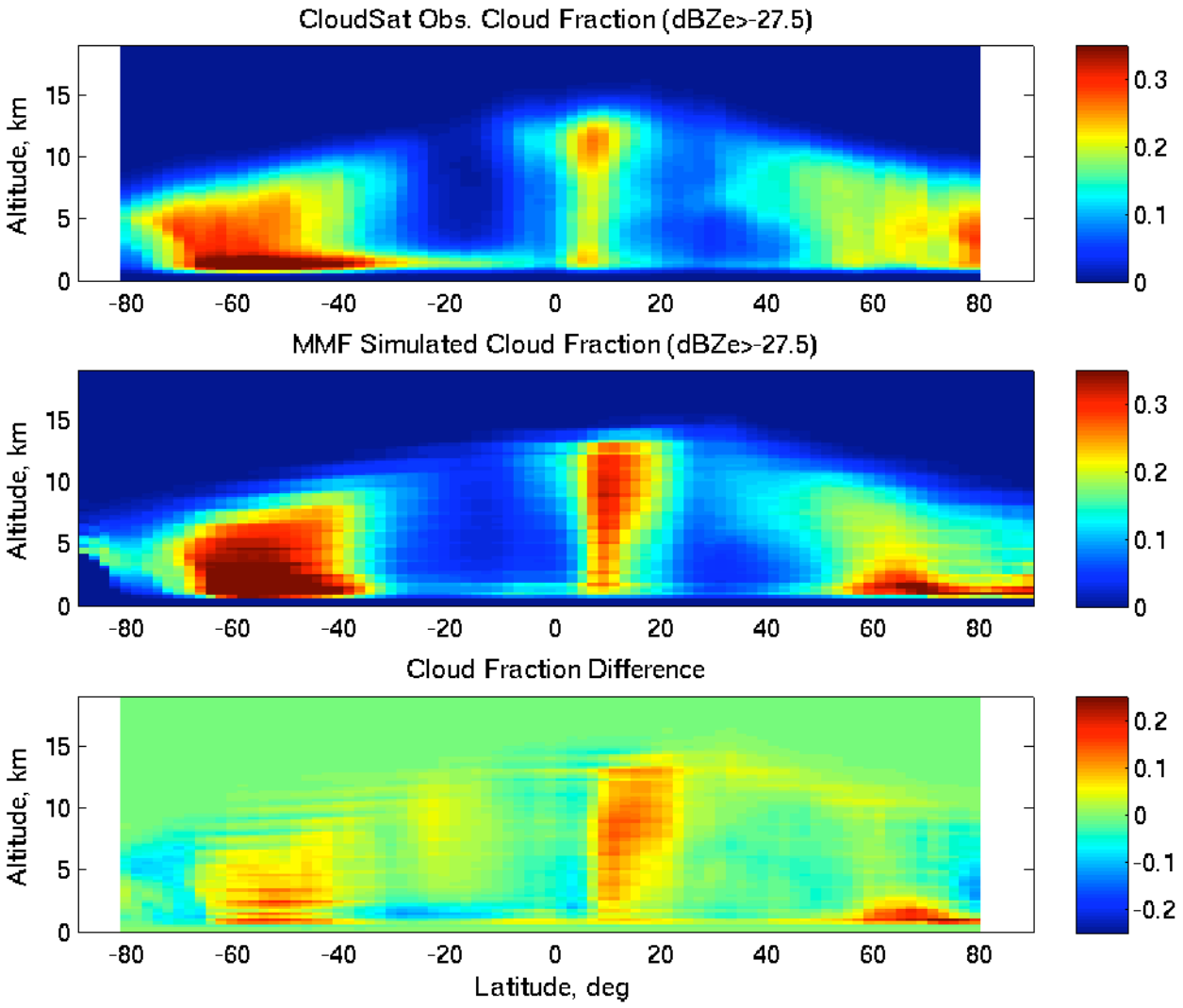
SON



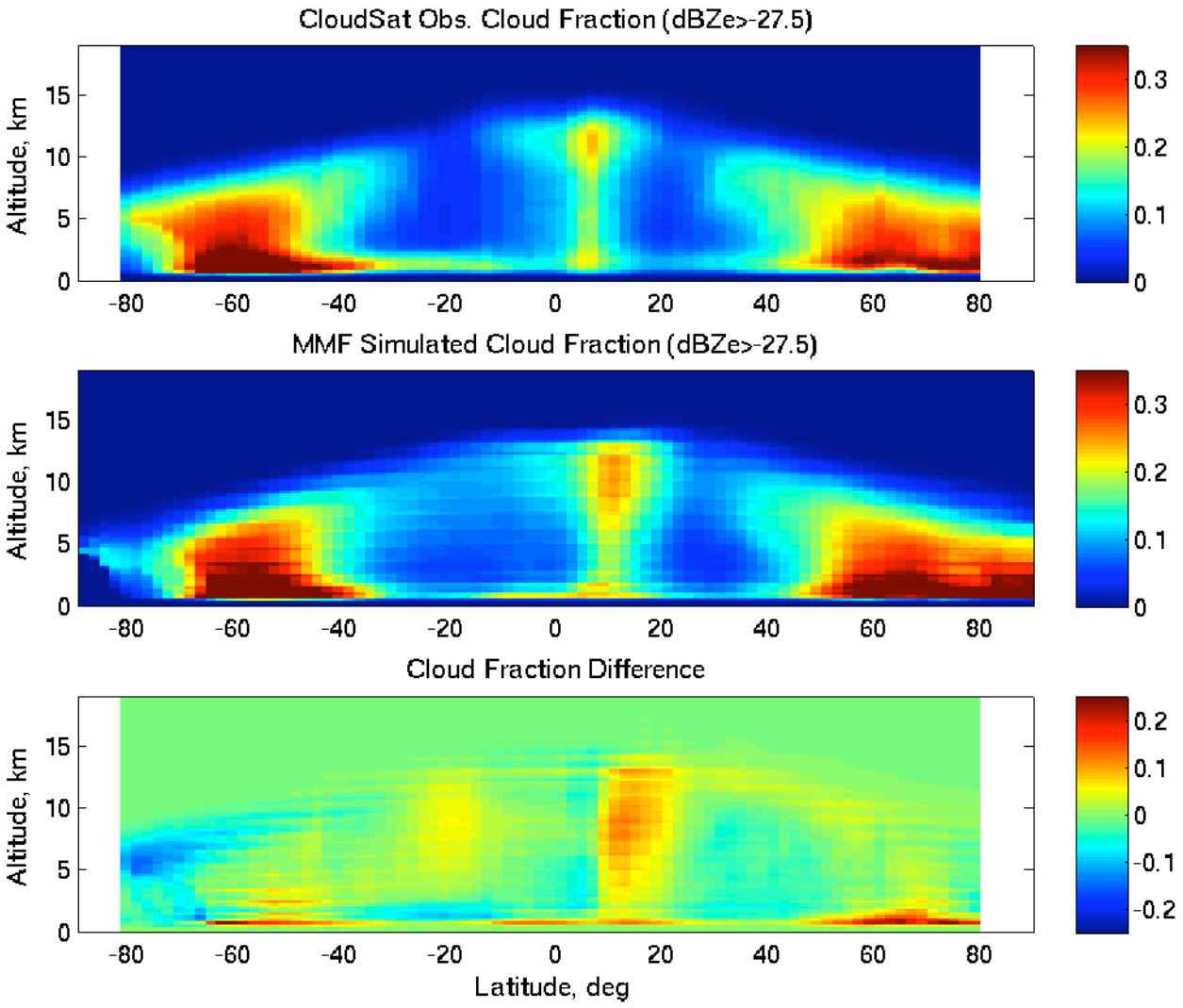
MAM (Diff = MMF – CS)



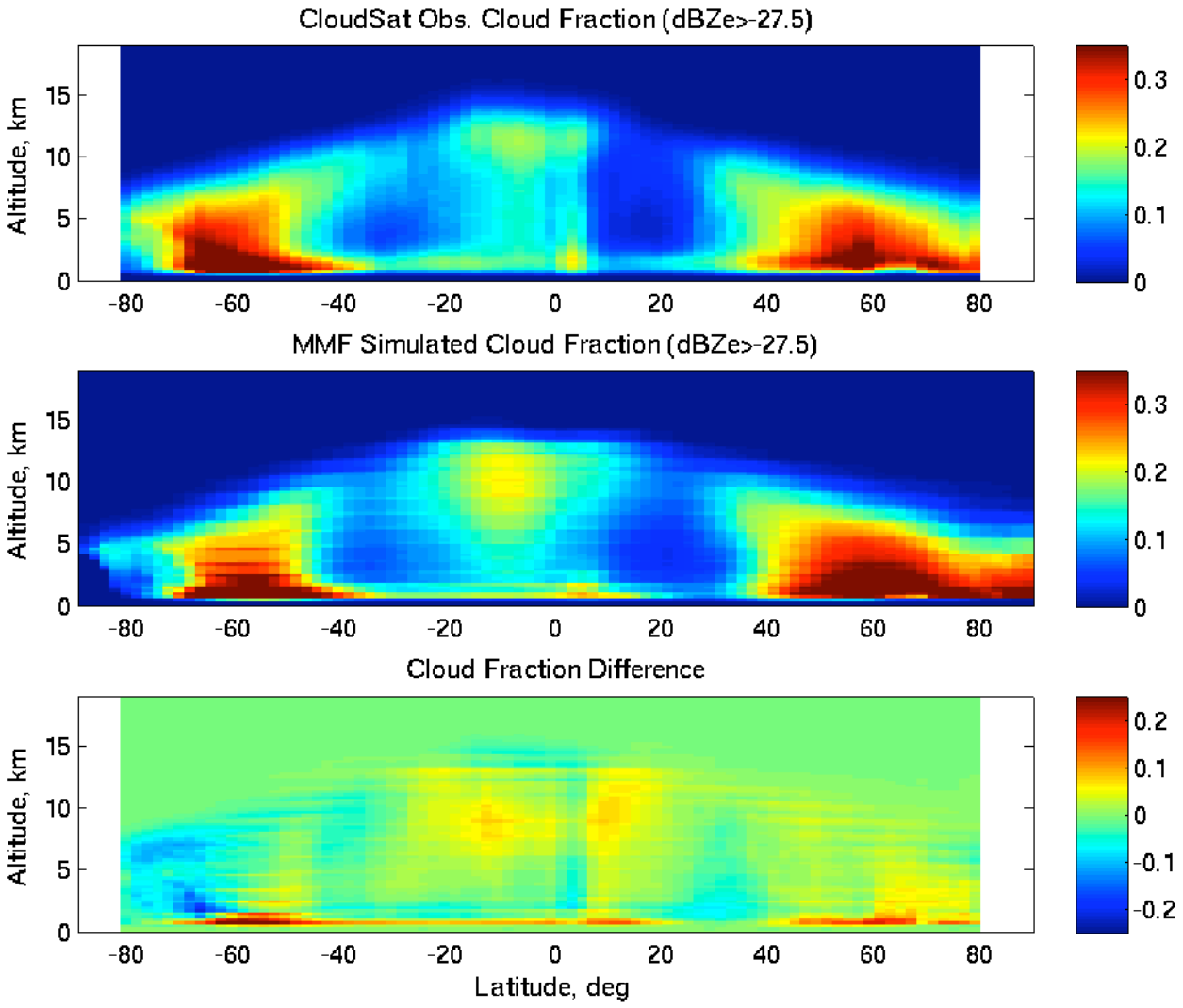
JJA (Diff = MMF – CS)



SON (Diff = MMF – CS)

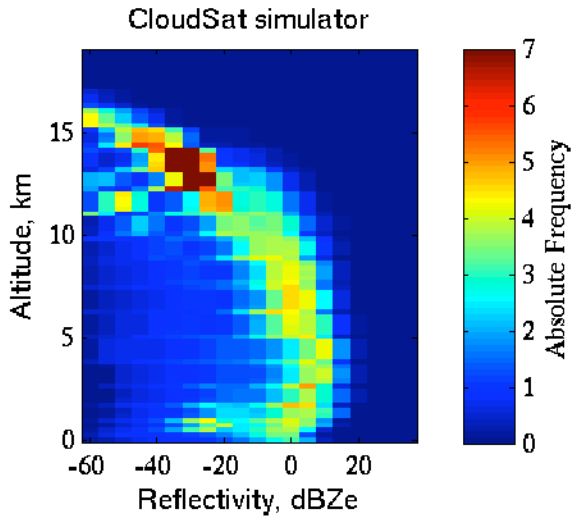


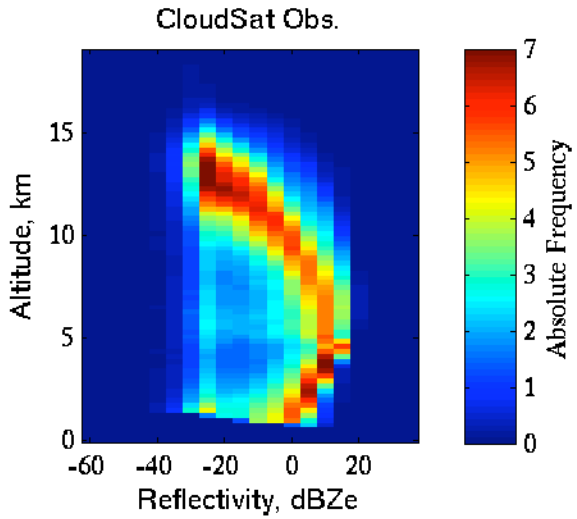
DJF (Diff = MMF – CS)

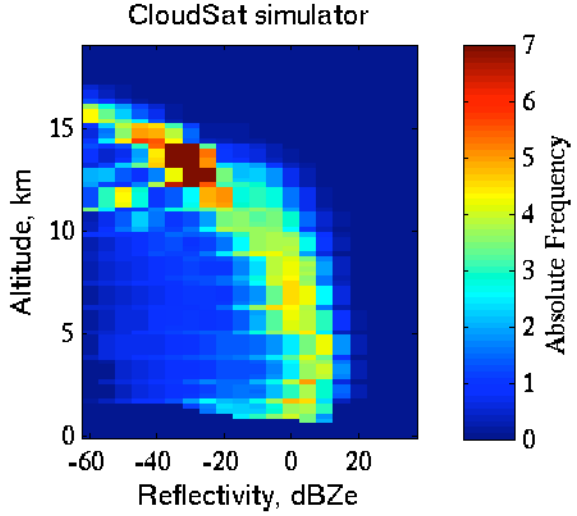


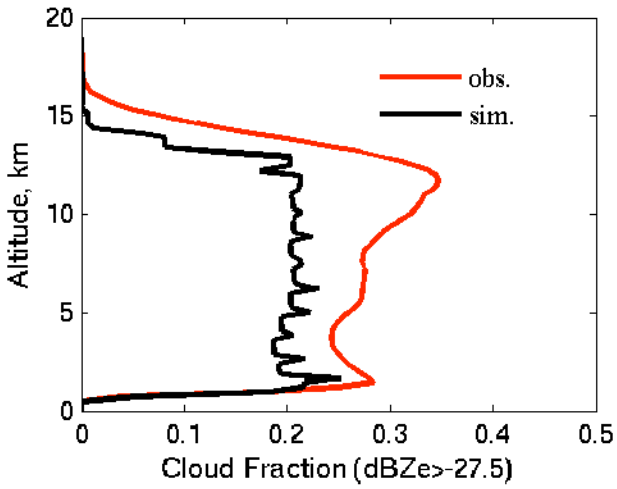
Regional comparisons

TWP - June

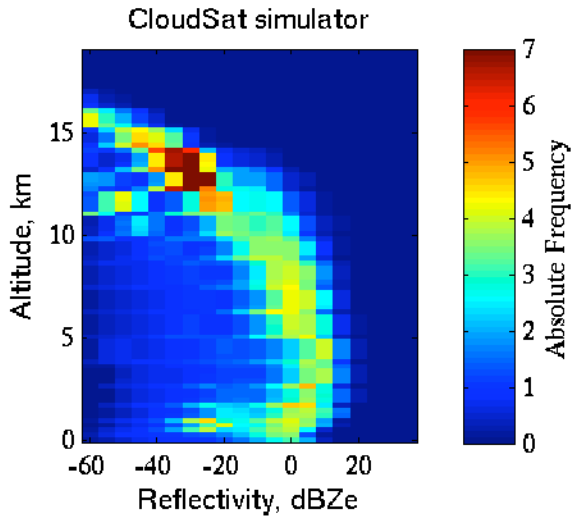

CloudSat simulator
Altitude, km
Reflectivity, dBZe
Absolute Frequency

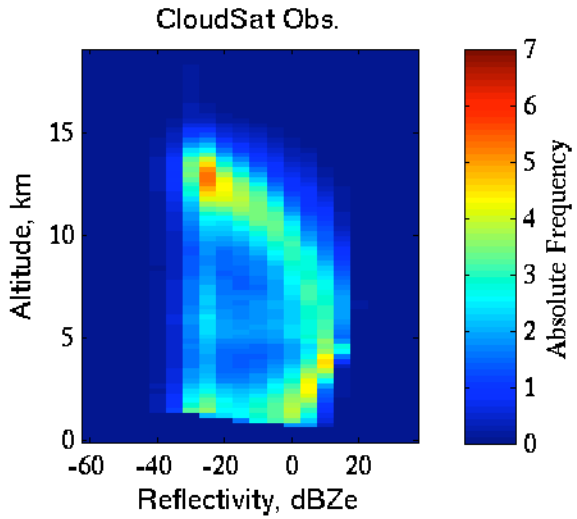

CloudSat Obs.
Altitude, km
Reflectivity, dBZe
Absolute Frequency

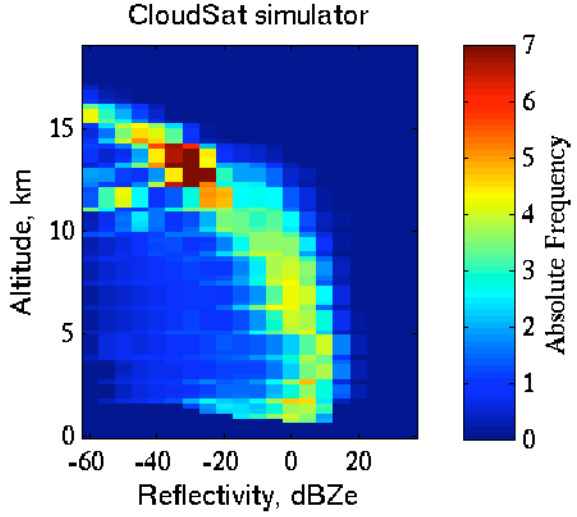

CloudSat simulator
Altitude, km
Reflectivity, dBZe
Absolute Frequency

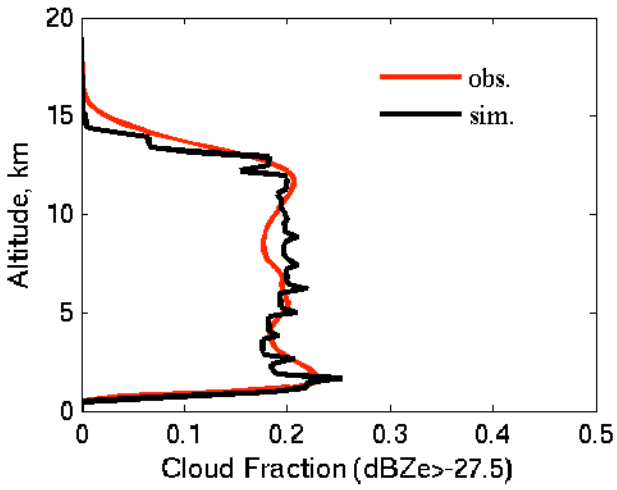

obs.
sim.
Altitude, km
Cloud Fraction (dBZe>-27.5)

TWP - July


CloudSat simulator
Altitude, km
Reflectivity, dBZe
Absolute Frequency


CloudSat Obs.
Altitude, km
Reflectivity, dBZe
Absolute Frequency


CloudSat simulator
Altitude, km
Reflectivity, dBZe
Absolute Frequency


obs.
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Altitude, km
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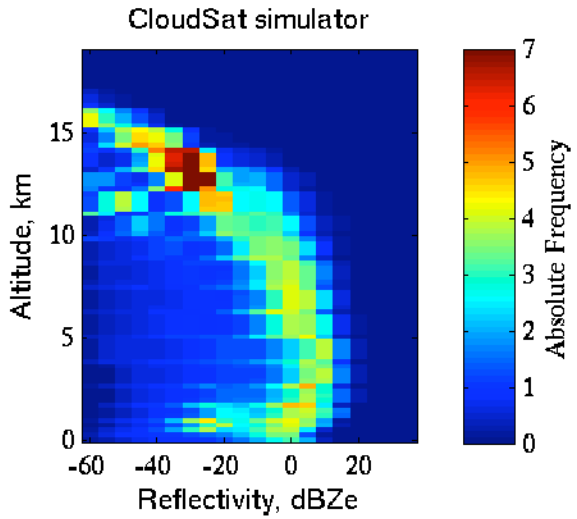
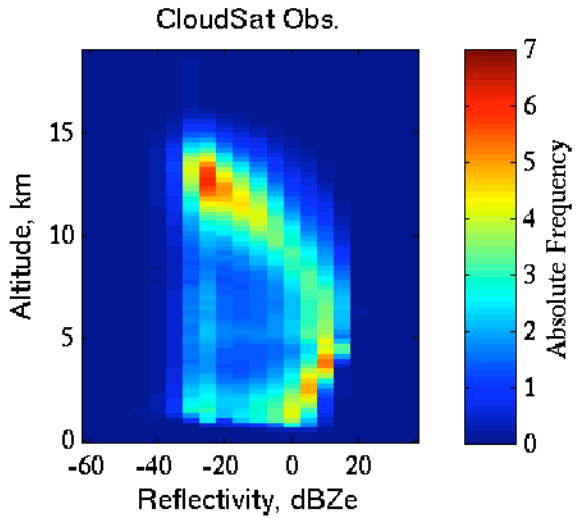
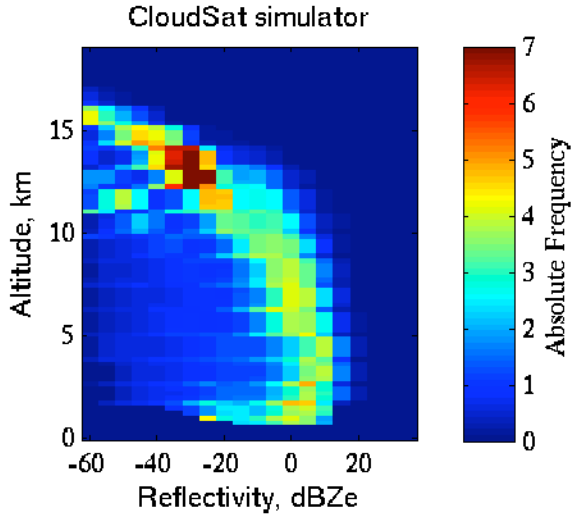
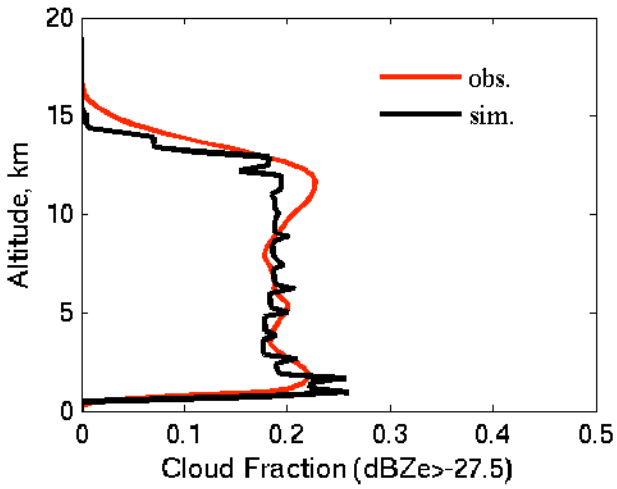
TWP - August

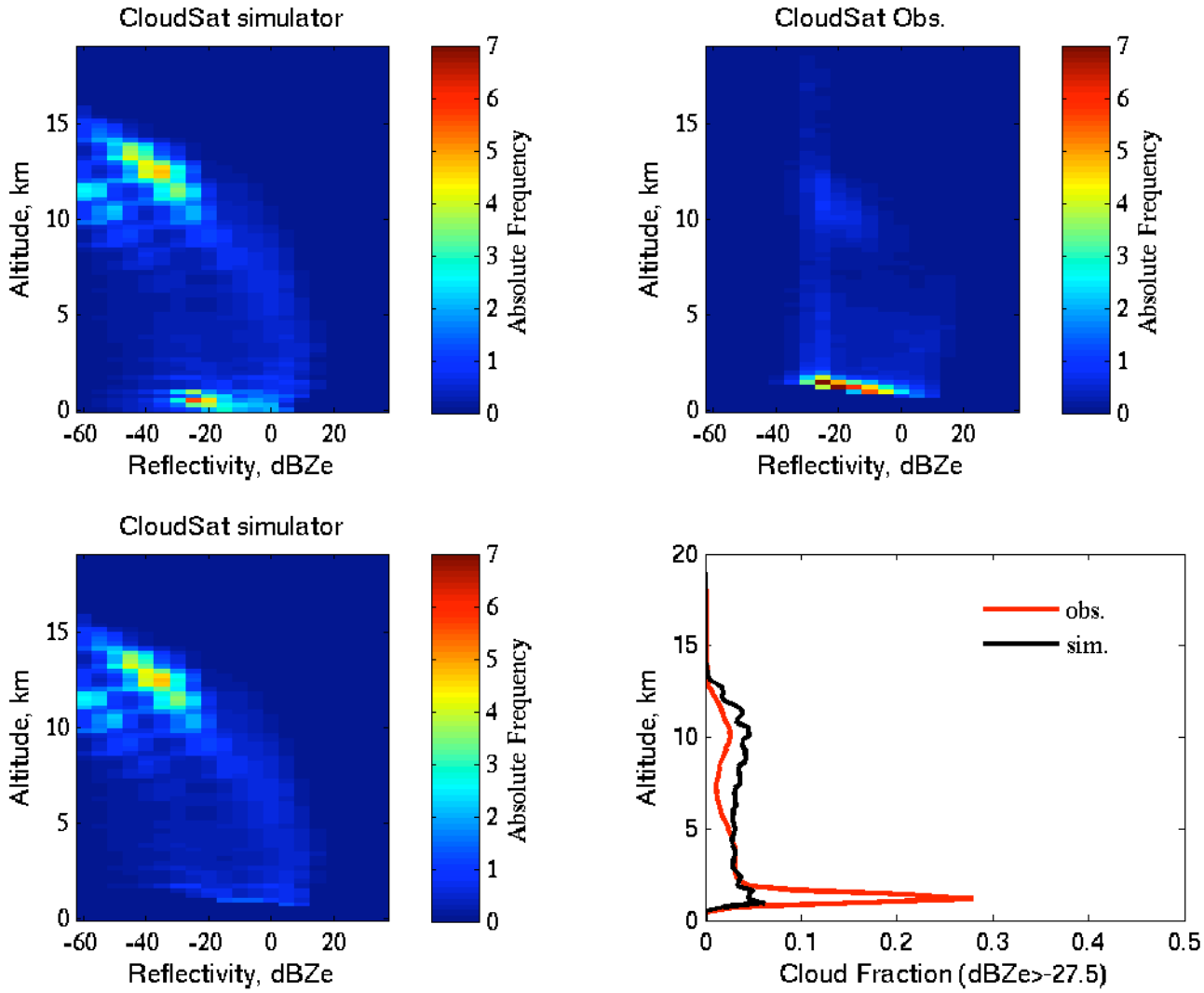

CloudSat simulator
Altitude, km
Reflectivity, dBZe
Absolute Frequency


CloudSat Obs.
Altitude, km
Reflectivity, dBZe
Absolute Frequency

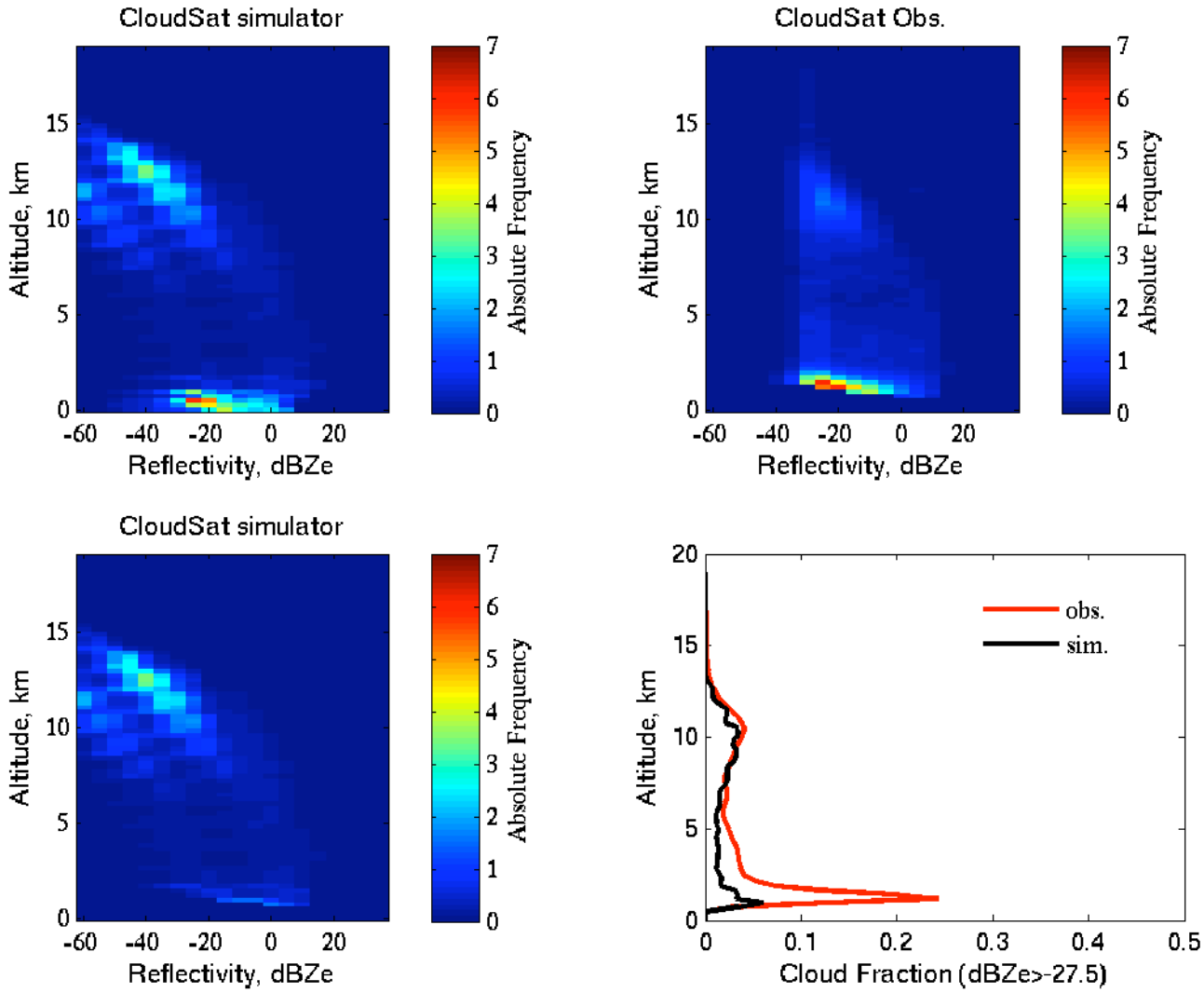

CloudSat simulator
Altitude, km
Reflectivity, dBZe
Absolute Frequency


obs.
sim.
Altitude, km
Cloud Fraction (dBZe>-27.5)

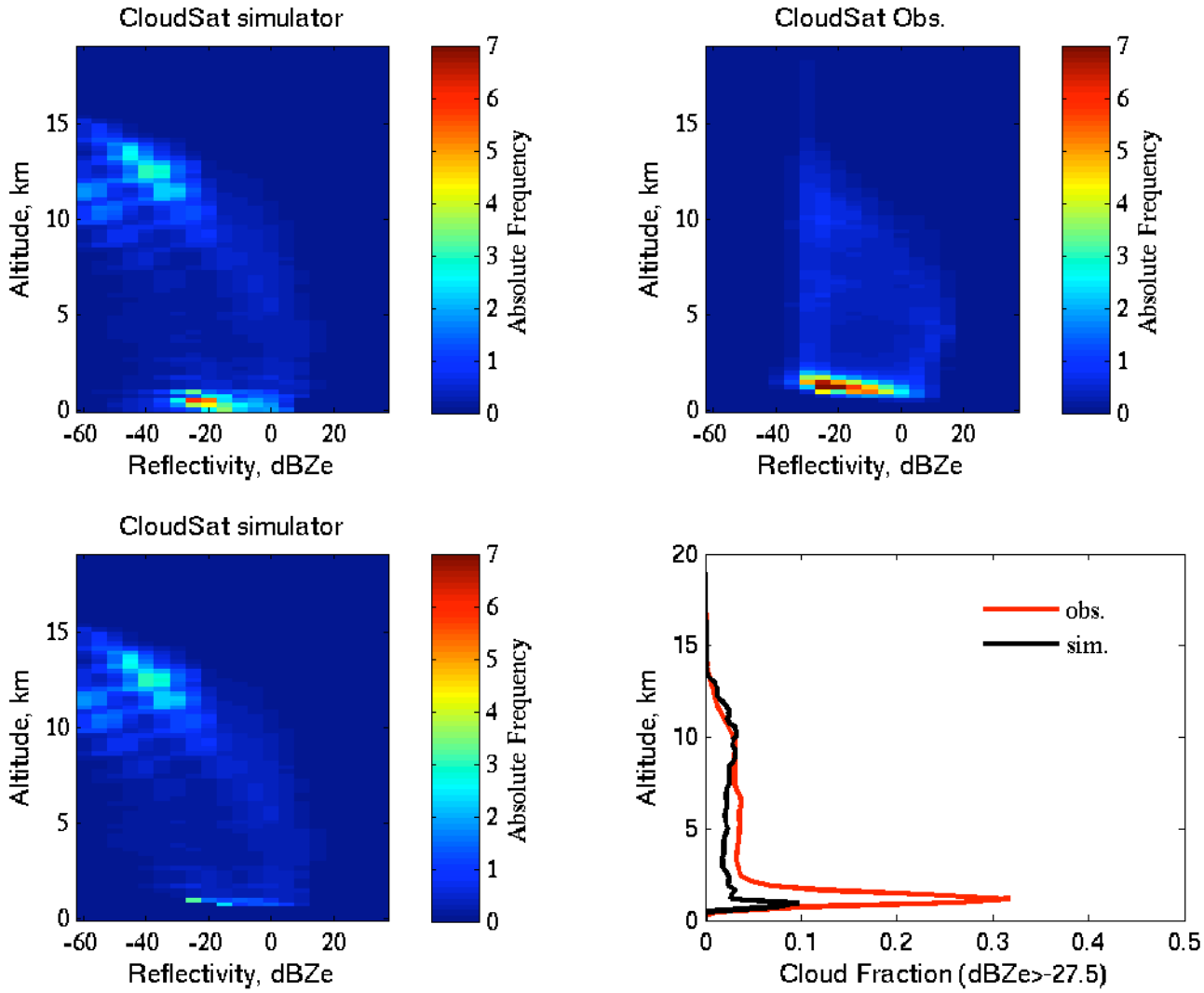
South Amer. Stratus - June



South Amer. Stratus - July



South Amer. Stratus - August



Conclusions

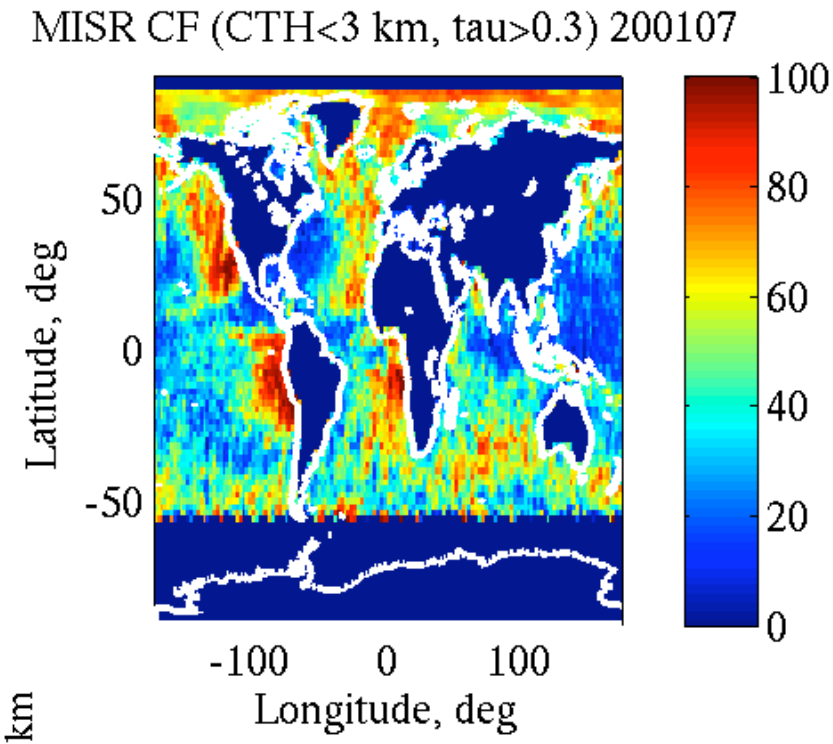
- MMF convection too active everywhere (see Yunyan's talk about timing)
- Produces too much high cloud
  - Too optically thick in convective regimes
  - Too much in non-convective regimes
- Produces too much precipitation
  - Radar reflectivity values are too high
  - Too much drizzle
- MMF has too little boundary layer cloud
- Tends to produce "stratifogulous"

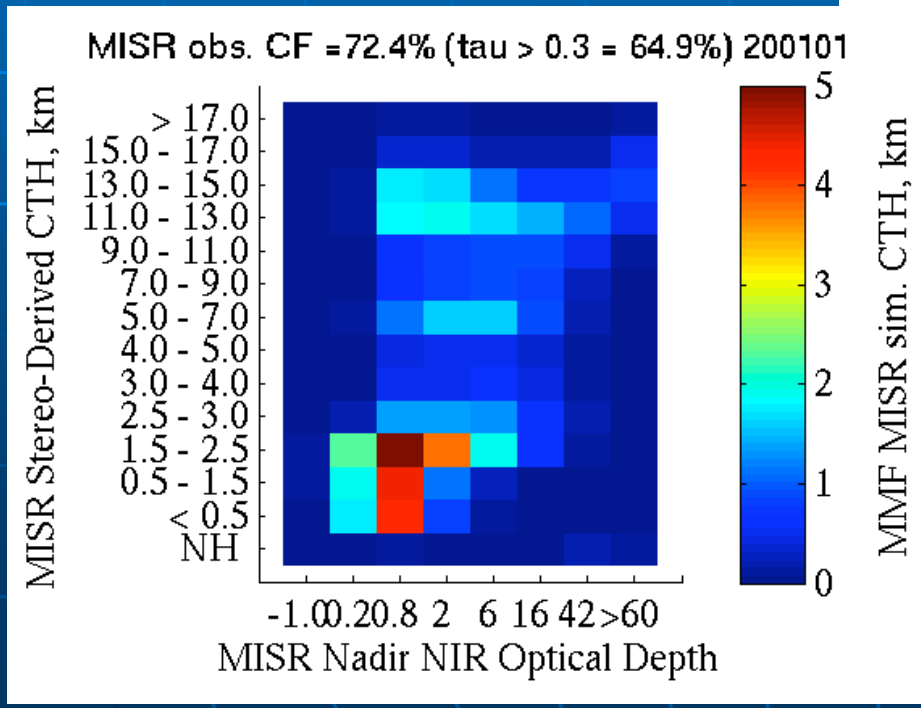
Current projects underway

- Run MMF with 1 km CRM
- CRM with higher order turbulence closure
- CRM with more vertical levels and higher resolution in boundary layer
- CRM with variable grid spacing in boundary layer
- Evaluate CloudSat heating rates using ARM heating rates

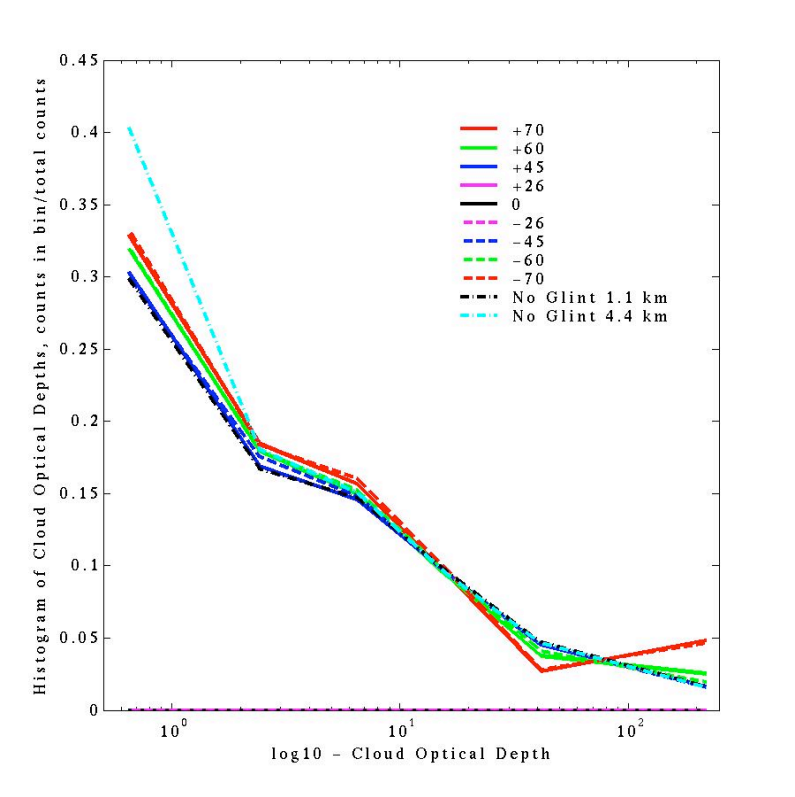
New MISR Product

The MISR project is in the process of producing global summaries of Stereo Cloud-Top-Height and 1-D Cloud-Optical-Depths (CTH-1D-OD).



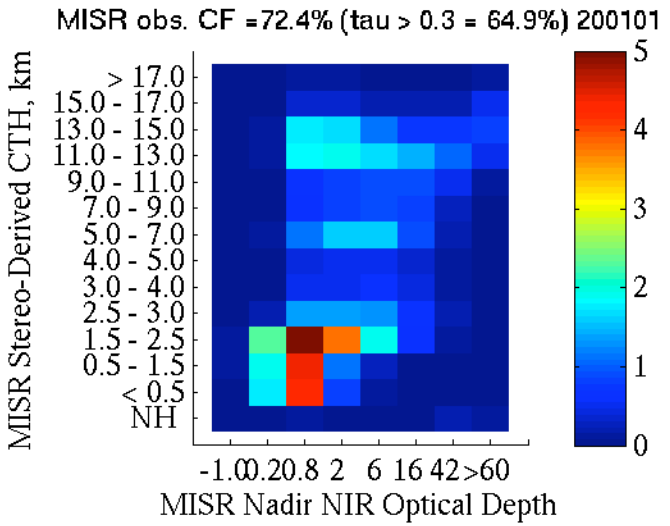


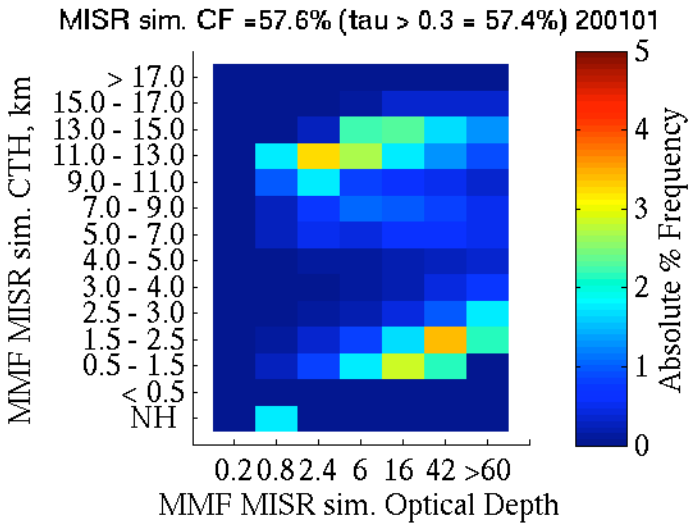
Optical Depth Retrieval

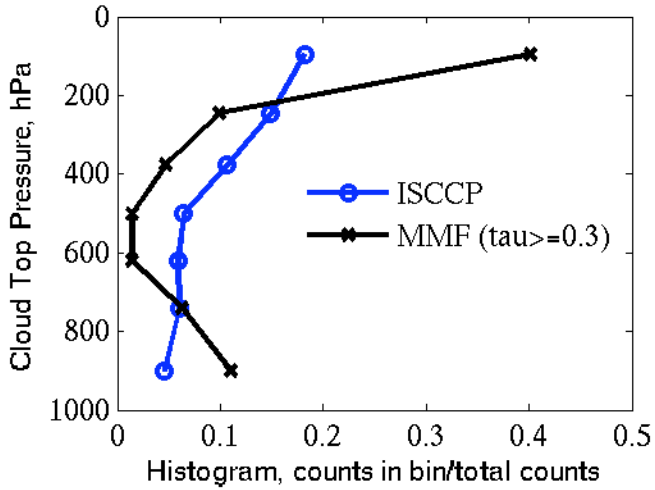


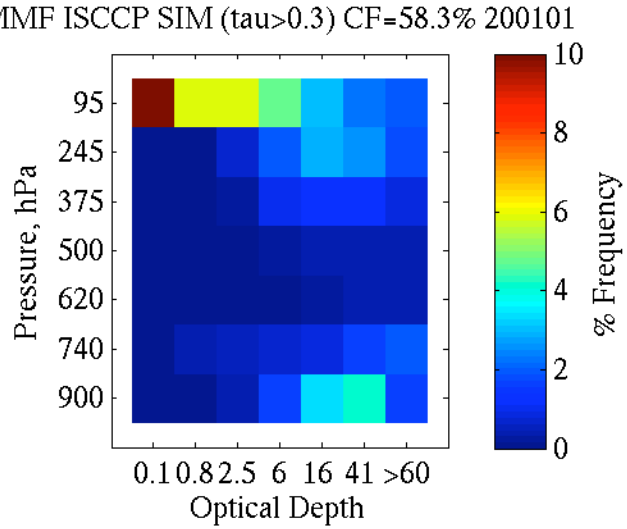
- The MISR OD retrieval similar to ISCCP => based on 1D RT
- The MISR retrieval run 9 times, once for each MISR view-angle, only over dark water surfaces
- MISR always has several sun-glint-free views
- Data product contains result for each view angle & a "best camera" result => closest camera to nadir that is free of sun glint.
- At the level of discretization being used in the CTH-OD histograms, 1D RT produces little change in OD with view-angle, except for the most oblique MISR views

Tropical Western Pacific – Jan 2001









Remarks

- Notable differences in the CTH-OD histograms being produced by the ISCCP and MISR (and MODIS) projects
- Differences have their roots in the different algorithms used both to detect clouds and to retrieve the cloud height and optical depth
- Differences tell us about the observed cloud fields
- MISR simulator can be used in concert with the ISCCP simulator designed by Steve Klein and Mark Web.
- Software available from Roger Marchand at rojmarch@u.washington.edu

Additional reading

- R. Marchand, G. G. Mace, T. P. Ackerman and G. Stephens, 2008: Hydrometeor detection using CloudSat - an earth orbiting 94 GHz cloud radar, J. Atmos. Ocean. Tech., accepted.

- R. Marchand, J. Haynes, G. G. Mace, T. P. Ackerman, G. Stephens, 2008: A comparison of CloudSat cloud radar observations with simulated cloud radar output from the Multiscale Modeling Framework global climate model, JGR, submitted.