Combining ASR obs and modeling: what can be done?

Discussion slides for the CStAT group at DOE ASR 2012 meeting

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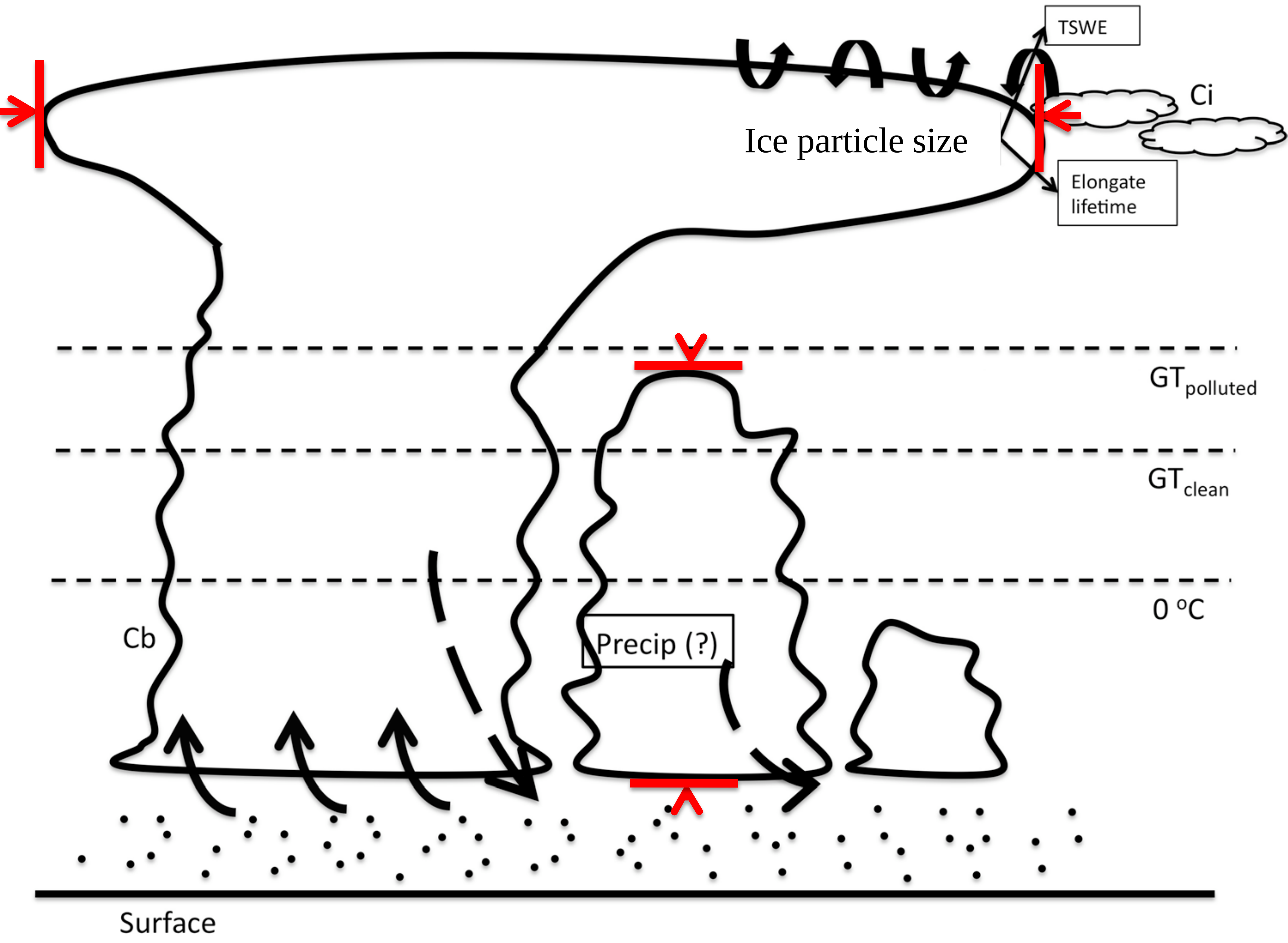
References:

Giangrande et al.(2010&2012); Varble et al.(2011a& b); Li and Schumacher(2011); Fan et al. (2010); McFarlane et al. (2008); Feng et al. (2011); Mather and McFarlane (2009); Fridlind et al. (2010); Zhu et al. (2011); Morrison et al. (2009); Grabowski and Morrison (2011); Kollias et al. (2007); Garrett et al. (2005); Tao et al. (2012); Yuan et al. (2011); Yuan and Houze (2010); Houze et al. (1980) and Houze (1970s – 2010s)...


TSWE
Ci
Ice particle size
Elongate lifetime
GT$_{polluted}$
GT$_{clean}$
0 °C
Cb
Precip (?)
Surface

Long-term and large spatial coverage

Passive and active satellite sensors from space

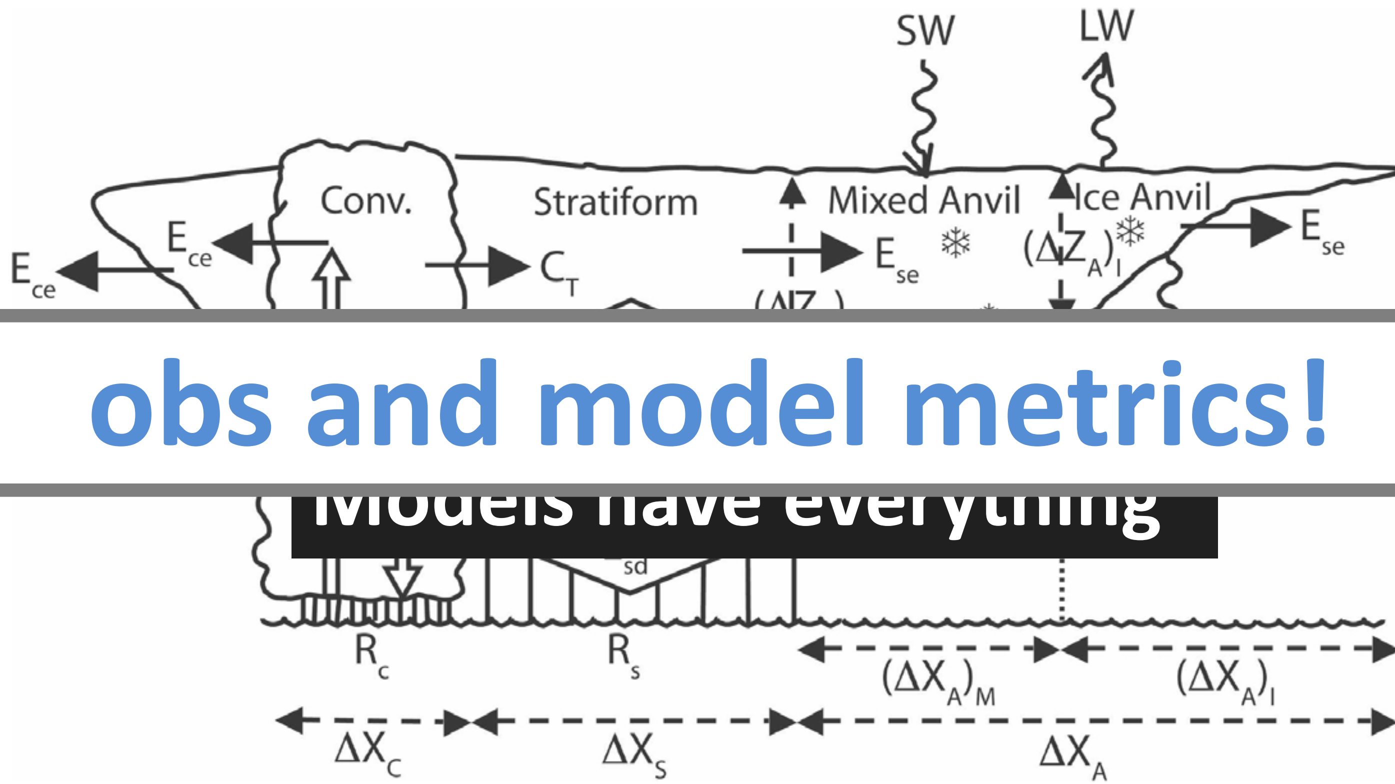


FIG. 1. Schematic vertical cross section of convective and stratiform precipitation regions and nonprecipitating anvil. This schematic was adapted from Houze et al. (1980) and has been further modified to include regions of mixed and ice anvil. Variables are defined in the text.

Fredrick and Schumacher (2008); Feng et al. (2011); Houze et al. (1980)

obs and model metrics!

Models have everything

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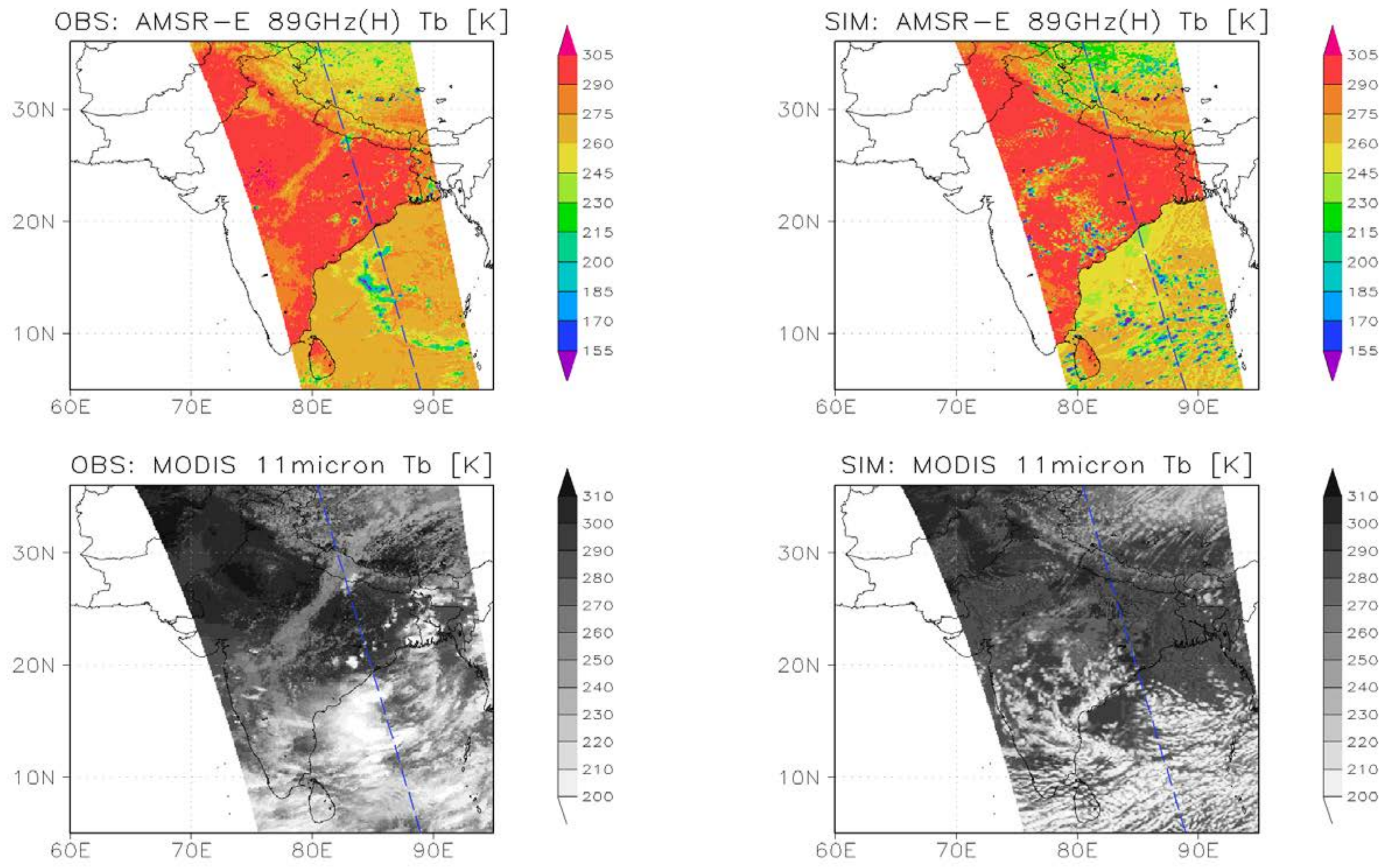
Long-term and detailed characterization

Radar, radiometer, distrometer, sondes, lidar etc at the surface

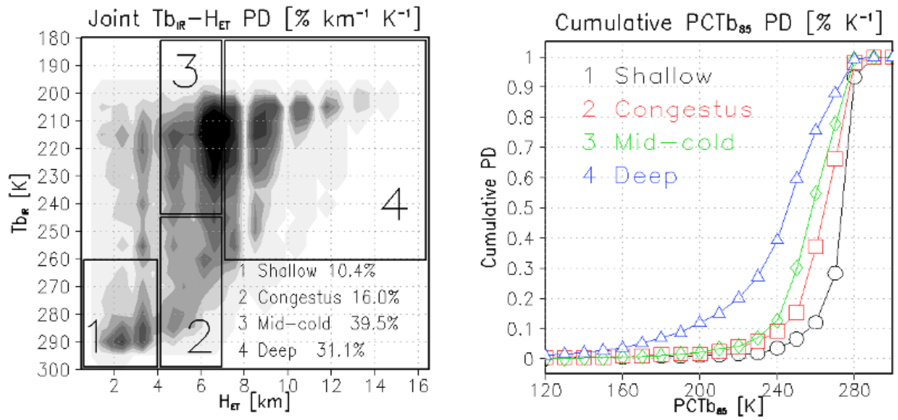
Simulated brightness temperatures with GCE model



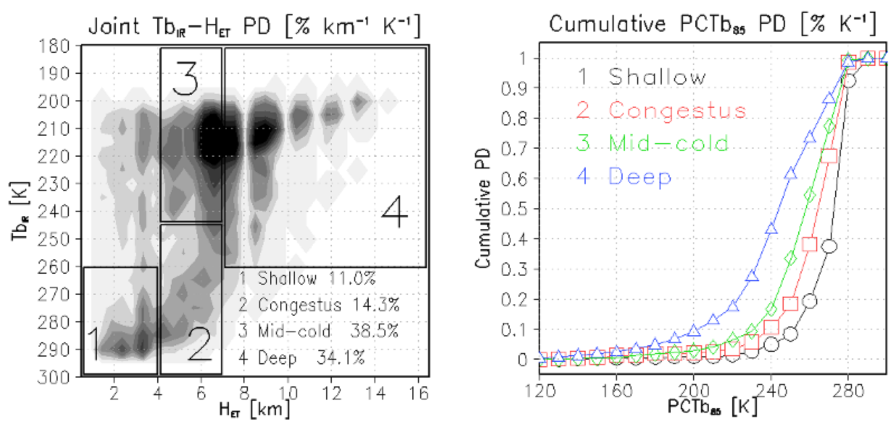
Goddard Cumulus Ensemble model with the Colorado State RAMS 2-moment microphysical scheme as passed through the Goddard Satellite Data Simulation Unit.

Simulated brightness temperatures with GCE model

High CCN (1000 cm^{-3})



Low CCN (50 cm^{-3})



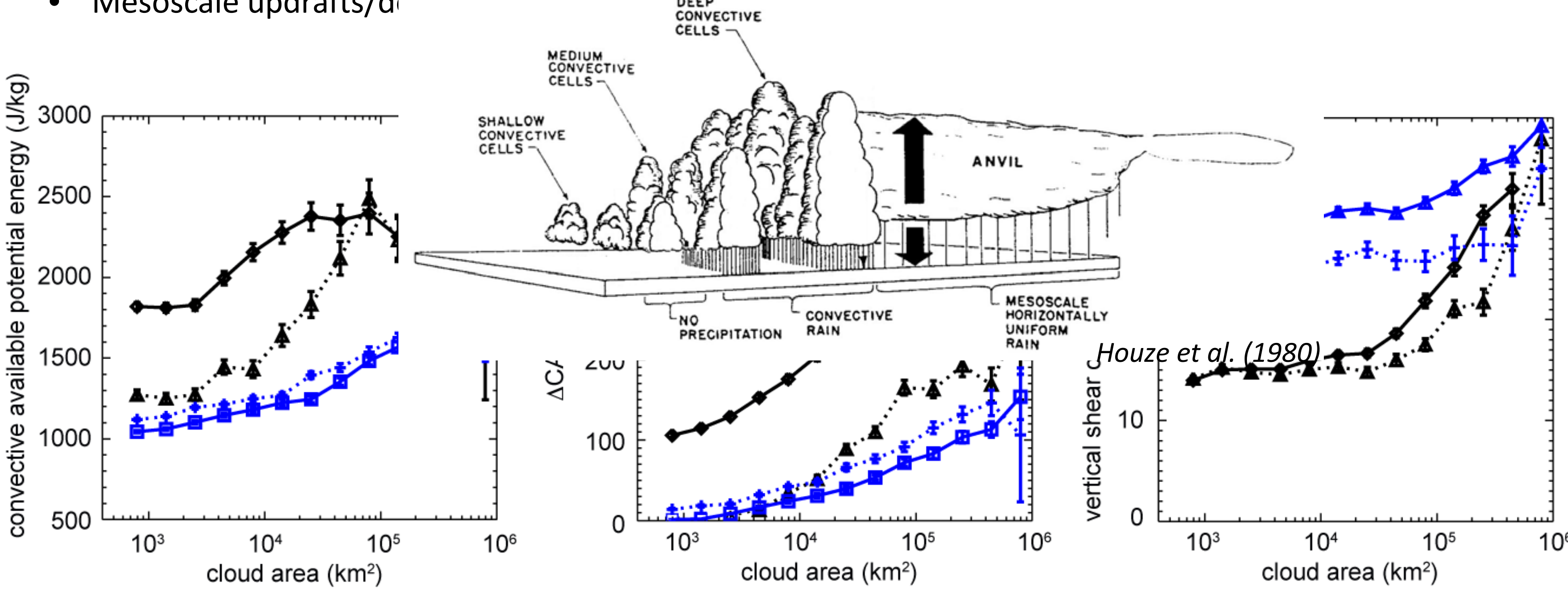
In this simulation increasing the CCN leads to a higher proportion of lower clouds, but the high clouds have lower microwave brightness temperature, indicating a higher concentration of large ice particles.

The importance of organized convection

In the tropics, cloud cover, net latent heating of the atmosphere, and net cloud radiative forcing in the atmosphere and at the surface are dominated by condensate produced in organized convective systems.

Organized convective systems rely on the interactions among:

- "Large-scale" environment (CAPE and shear)
- convective scale updrafts/downdrafts
- Mesoscale updrafts/d



Houze et al. (1980)

Observations from MODIS and a 1-deg. experimental model analysis (i.e. a satellite data assimilation product) over India and Northern Indian Ocean during summer monsoon.

Suggested approaches

1. Develop obs-based metrics for cloud life cycle and cloud macrophysical properties
2. Build statistics of these metrics and characterize meteorological regimes
3. Model-based simulator output and the same set of metric and environmental conditions
4. In-depth analysis of cases based on ground (esp. newly available radars) obs
5. Evaluate and identify critical processes and regimes from analyses of obs and model