# Intercomparison of Microphysics Schemes for MC3E simulations

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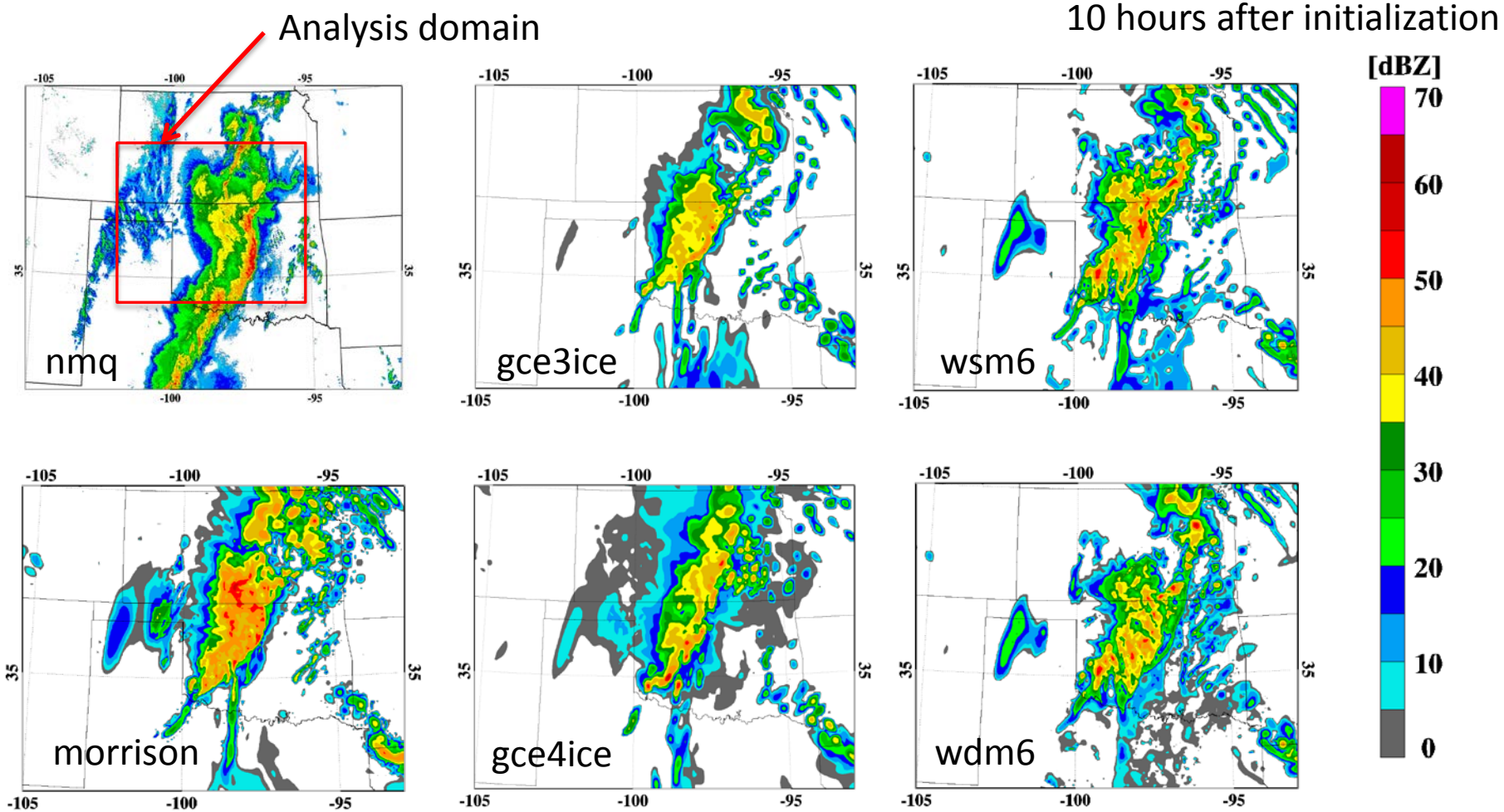
# Objectives

- Identify model deficiencies/biases.
  - Modeling frame work, microphysics, dynamical forcing, etc.
  - Convective/stratiform features, reflectivity CFADs.
- Compare of current microphysics schemes.
  - Goddard 3-ice, 4-ice, WSM6, WDM6, and Morrison
- Improve current microphysics schemes: Goddard 3-ice (Lang et al. 2011), Goddard 4-ice (Lang et al., 2013), and SBM.
  - Observations as constrain (e.g. radar, rain gauge and in-situ)

# Composited reflectivity

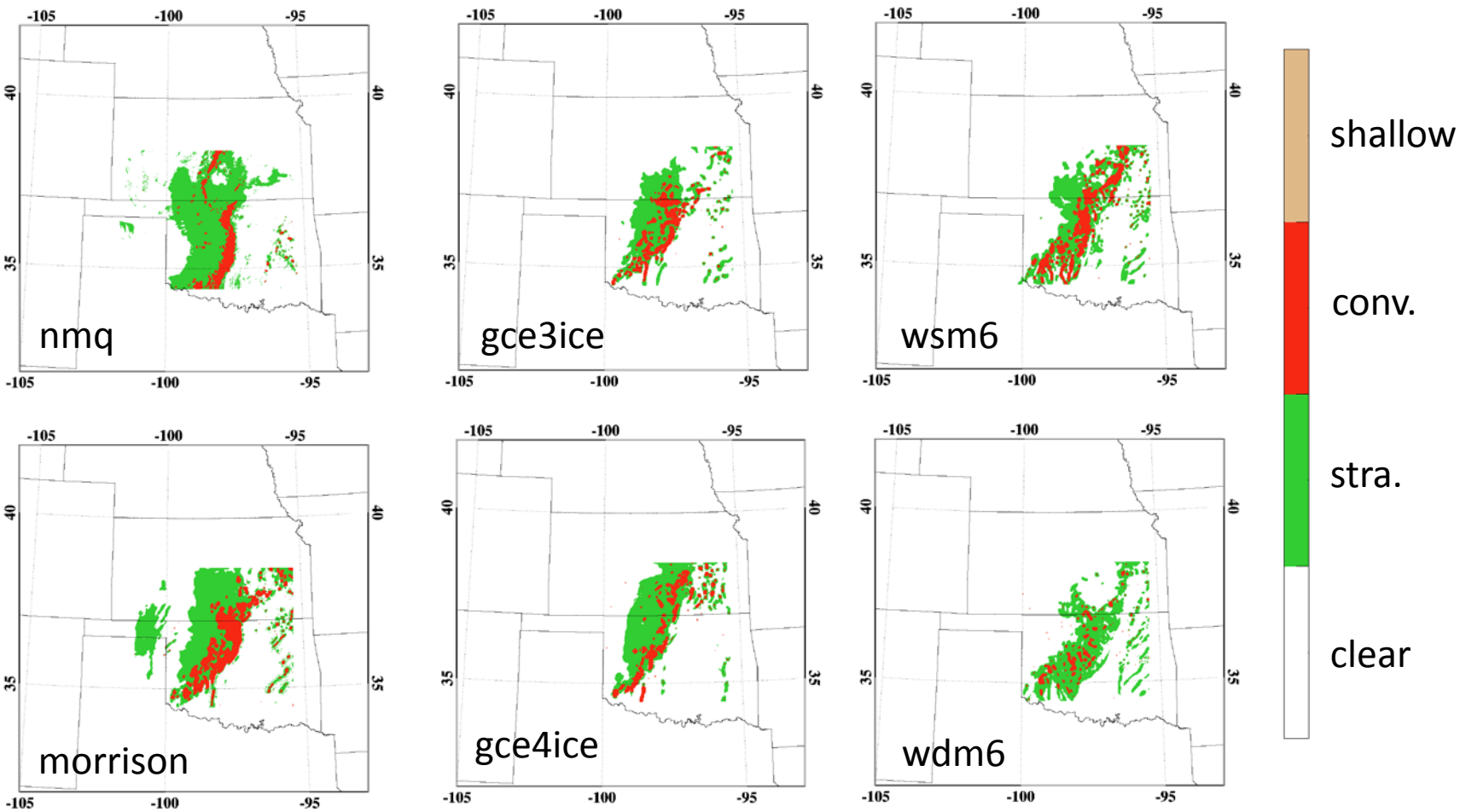
## 2011. 05. 20. 10 UTC



# Composited reflectivity

## 2011. 05. 20 10 UTC

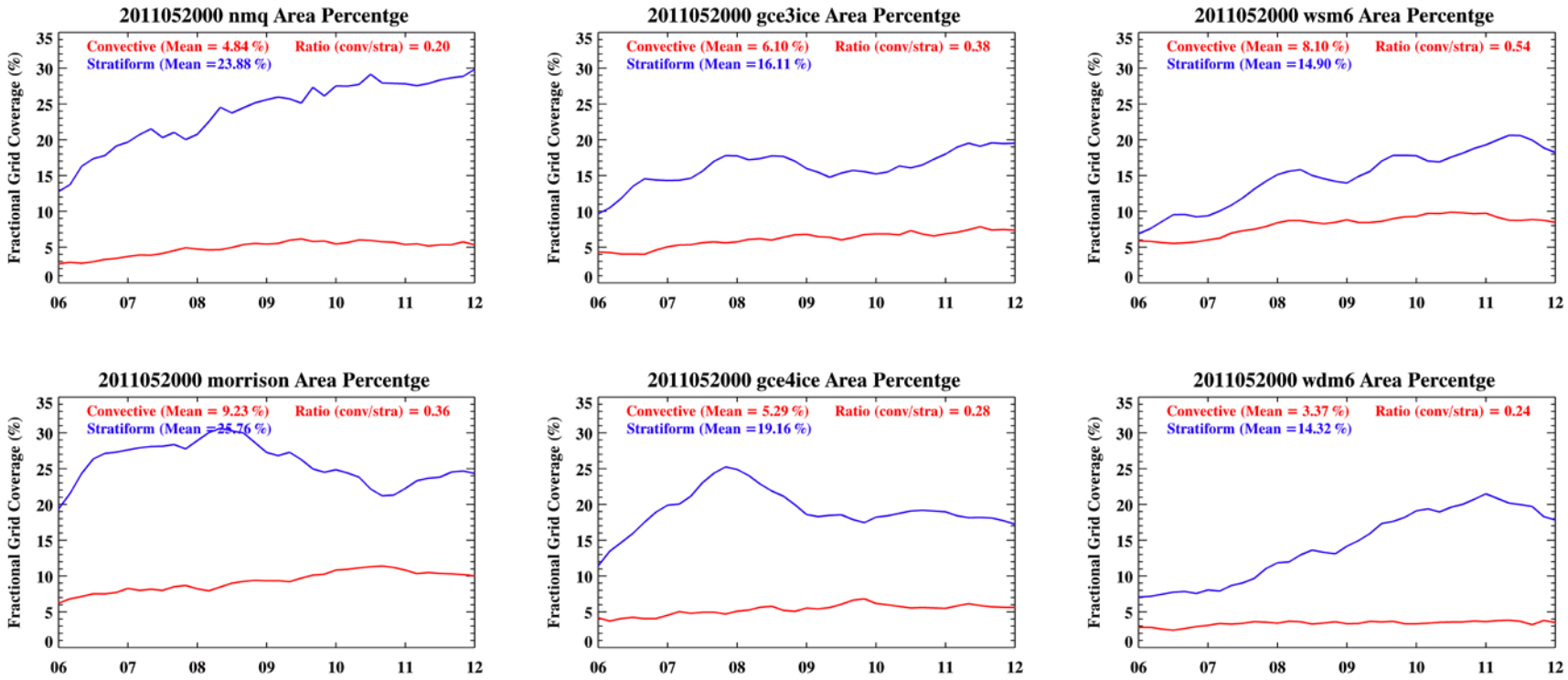
Partition scheme from Steiner et al. 1995, Feng et al. 2011




less organized convective line structure in simulations

# Conv. & Stra. Area Percentage

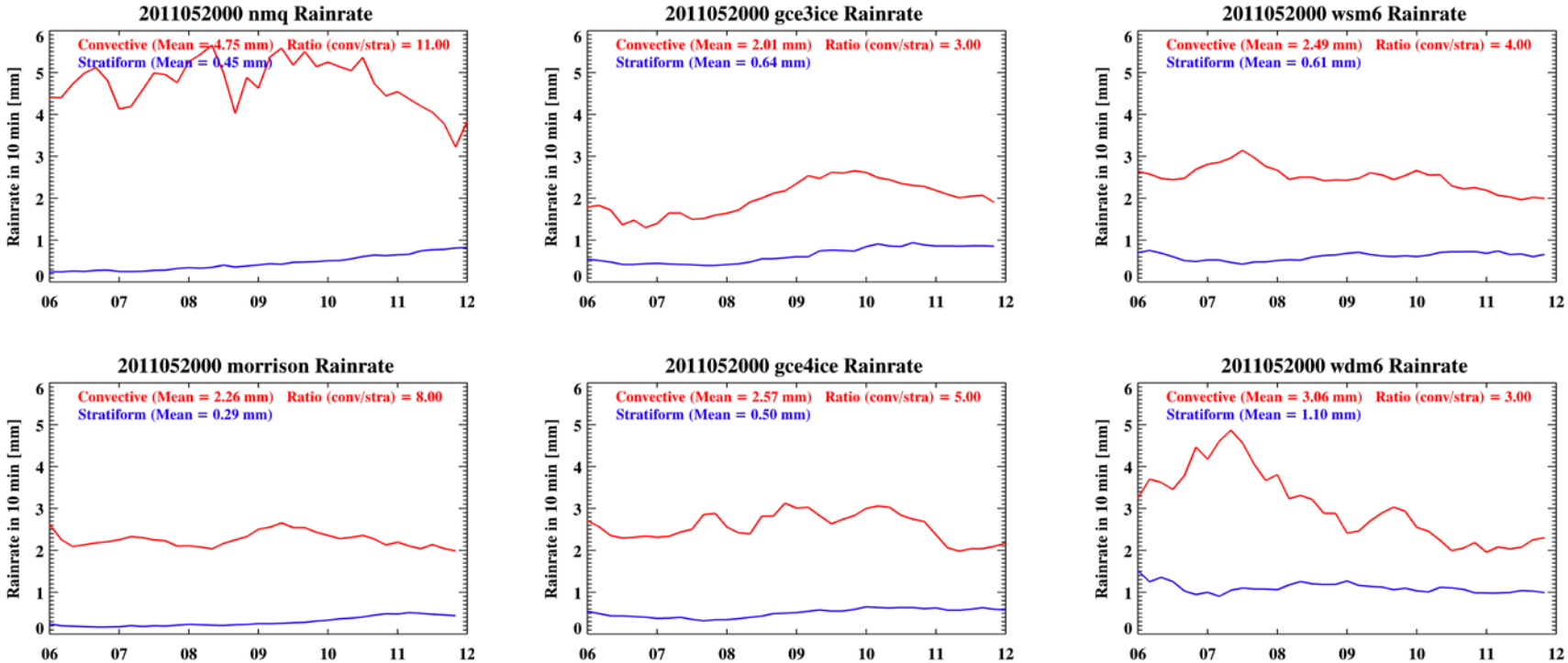
## 2011. 05. 20




- Simulations (except for WDM6) overestimate convective area
- Simulations underestimate stratiform area (except for Morrison).

2011. 05. 20

# Conv. & Stra. Rainrate

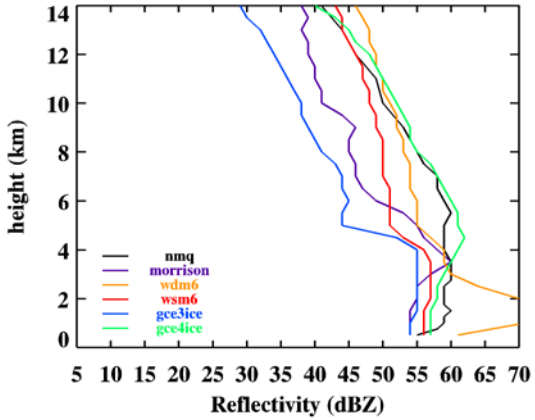


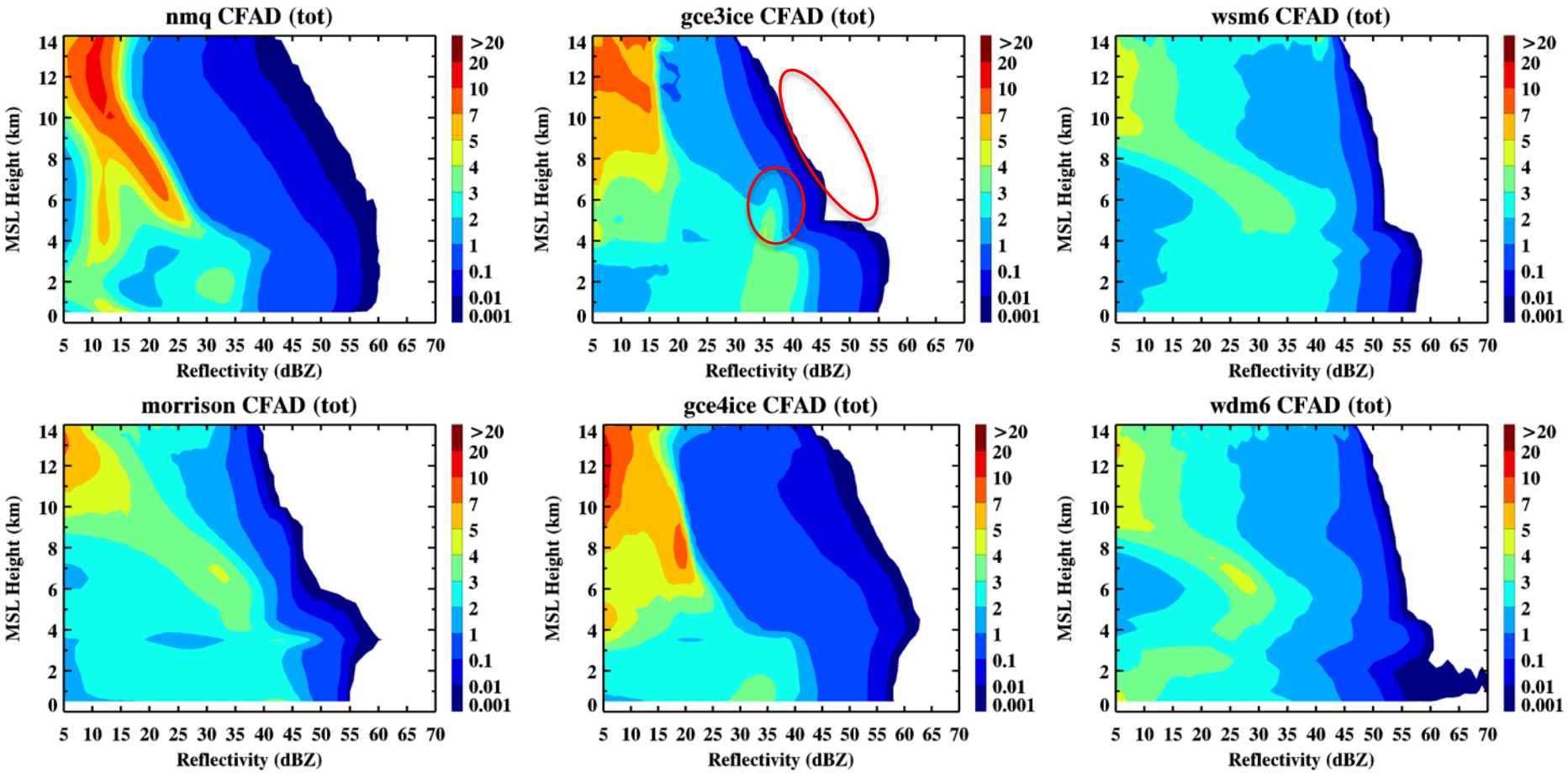

All observations and models are at 2km resolution

- High radar derived convective rain rate.
- Simulations underestimate convective Rain
- Simulations overestimate stratiform rain (except for Morrison).

2011. 05. 20

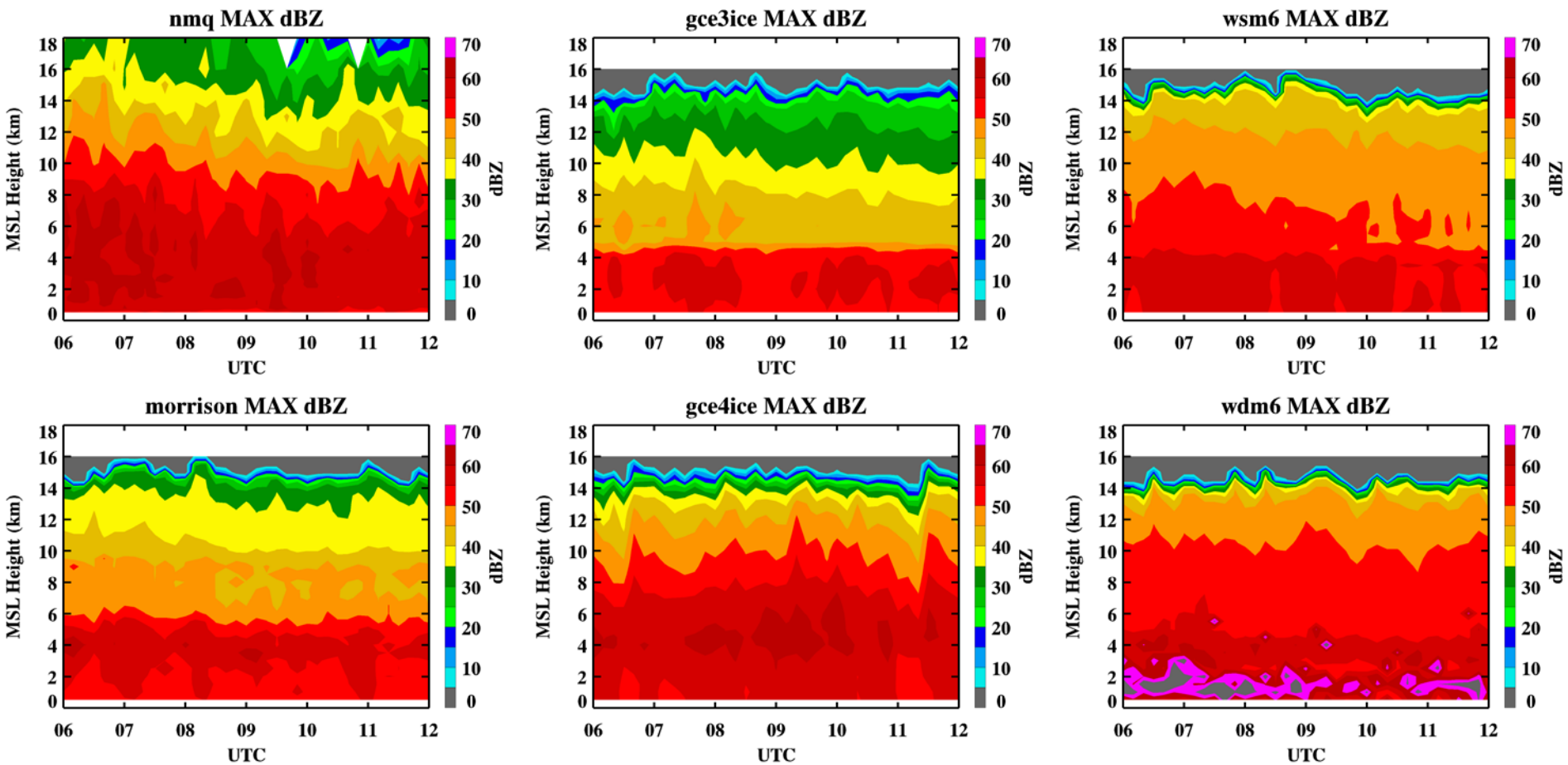
# Total CFAD



2011. 05. 20

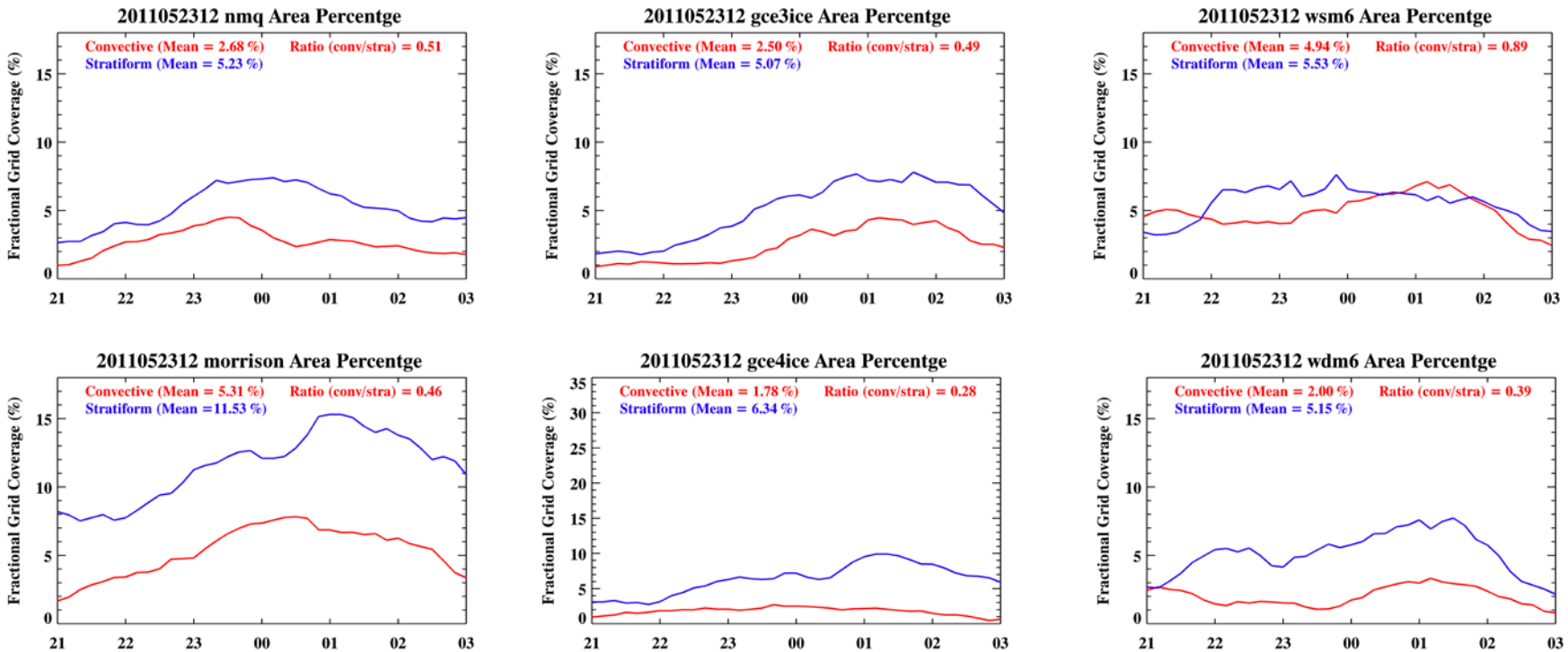
# Maximum Reflectivity (Peak in CFAD)




- Goddard 4ice produces realistic peak reflectivities.
- wdm6 large rain drops? (using NCAR WRF inline dBZ routine)

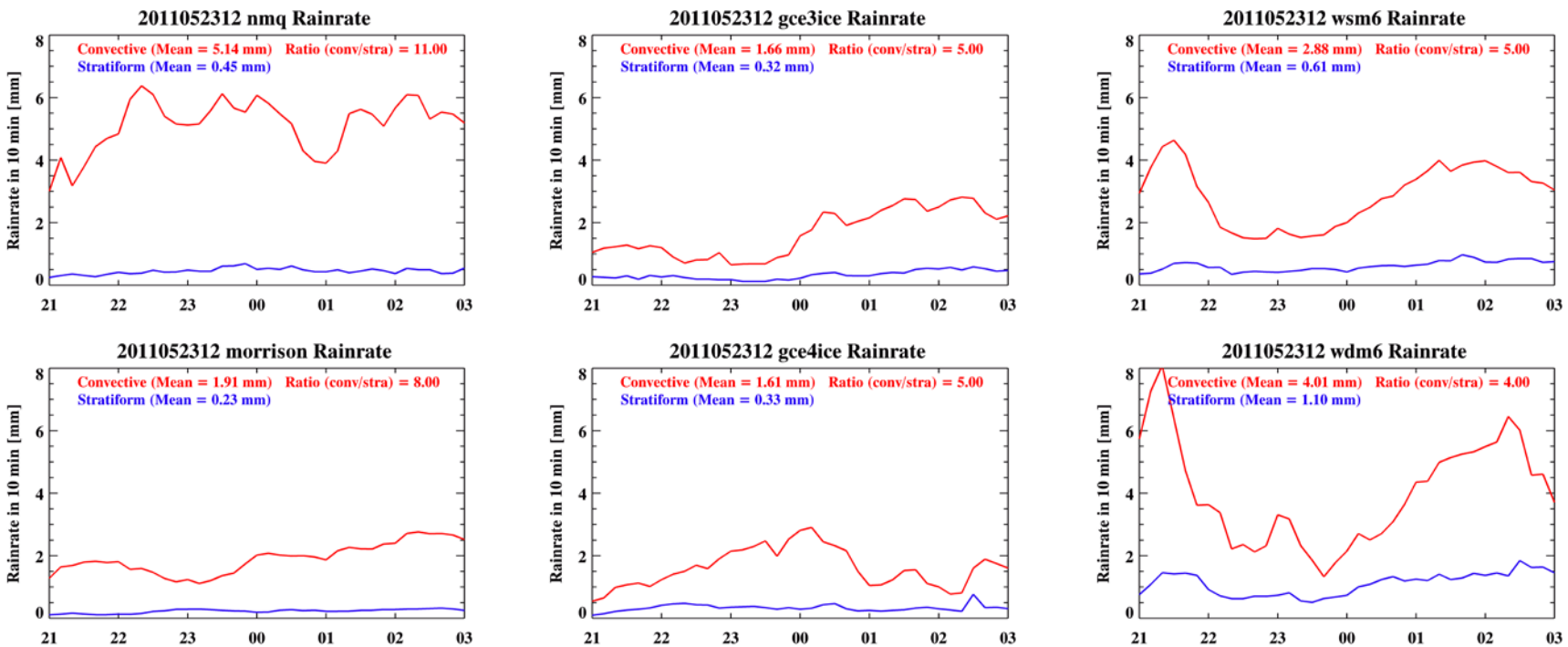
2011. 05. 23

# Conv. & Stra. Area Percentage



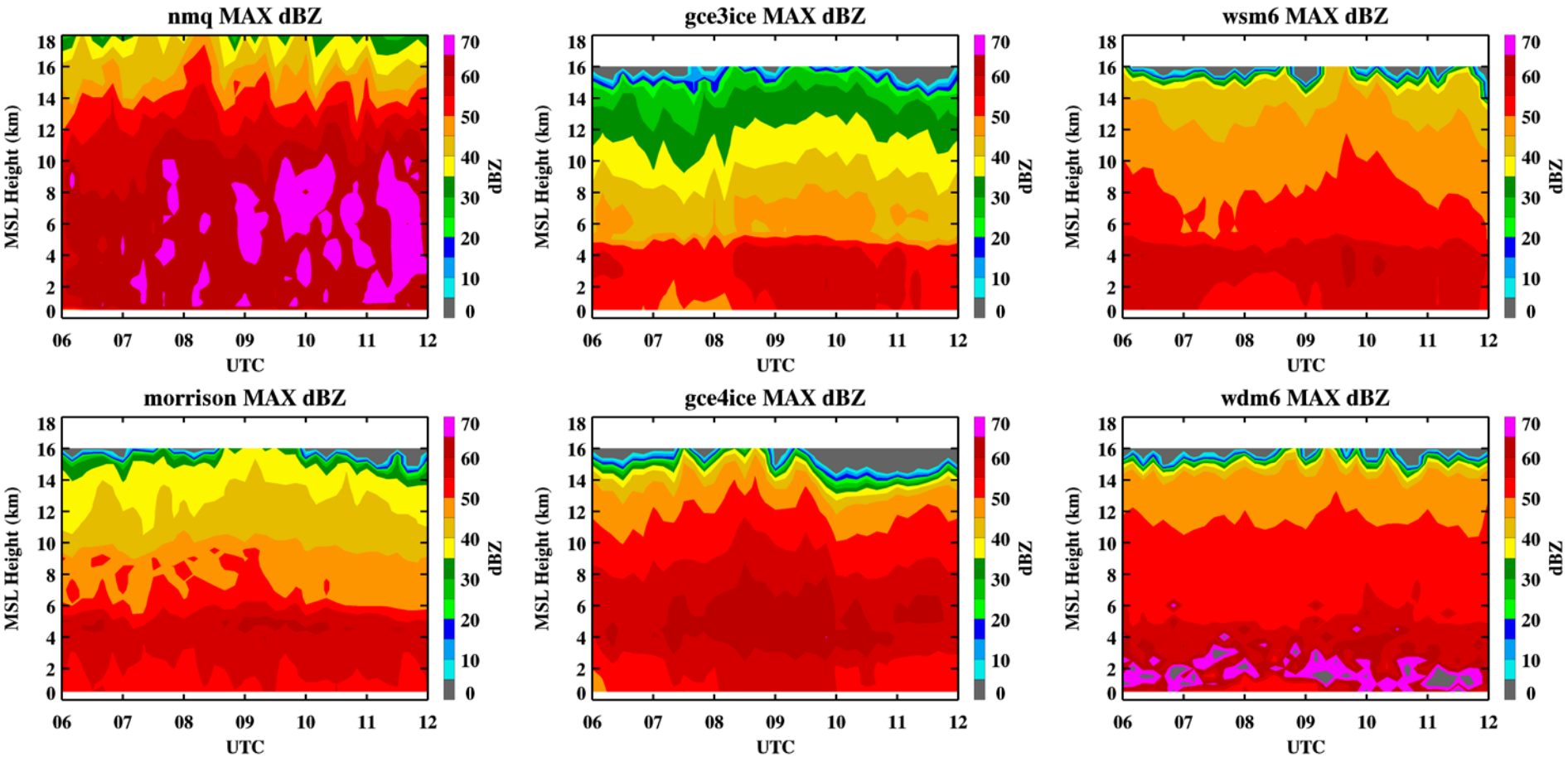
2011. 05. 23

# Conv. & Stra. Rainrate



2011. 05. 23

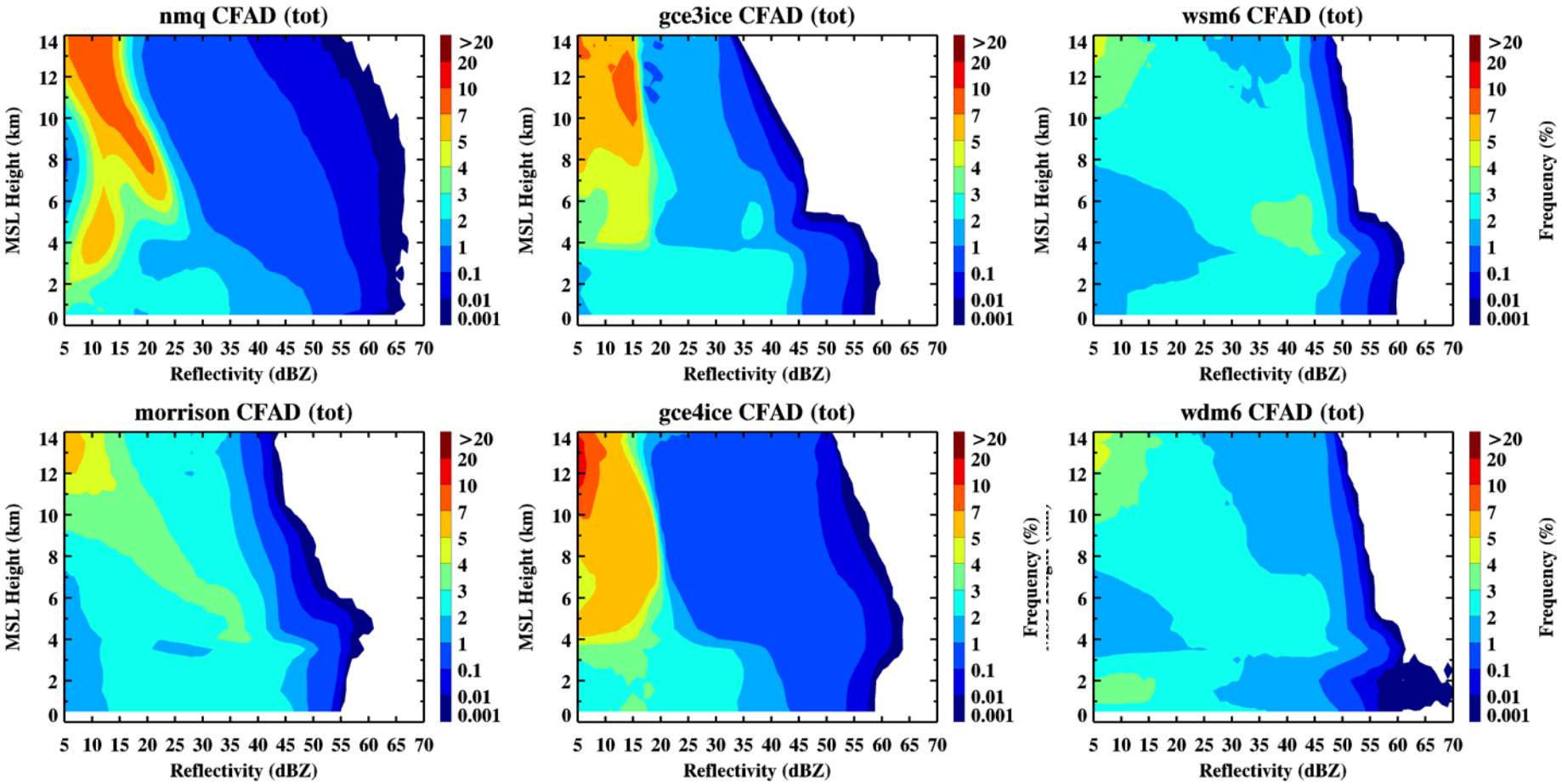
# Maximum Reflectivity




NEXRAD: convective feature
Model: stratiform feature
(wdm6 large rain drops)

2011. 05. 23

# Total CFAD



Overestimation
Slight Overestimation
Underestimation
Slight Underestimation

# Scheme Summary (0520)

- gce3ice: conv. area, stra. area, conv. rain, stra. rain.
- gce4ice: conv. area, stra. area, conv. rain, stra. rain.
- wsm6: conv. area, stra. area, conv. rain, stra. rain.
- wdm6: conv. area, stra. area, conv. rain, stra. rain.
- morrison: conv. area, stra. area, conv. rain, stra. rain.

Overestimation
Slight Overestimation
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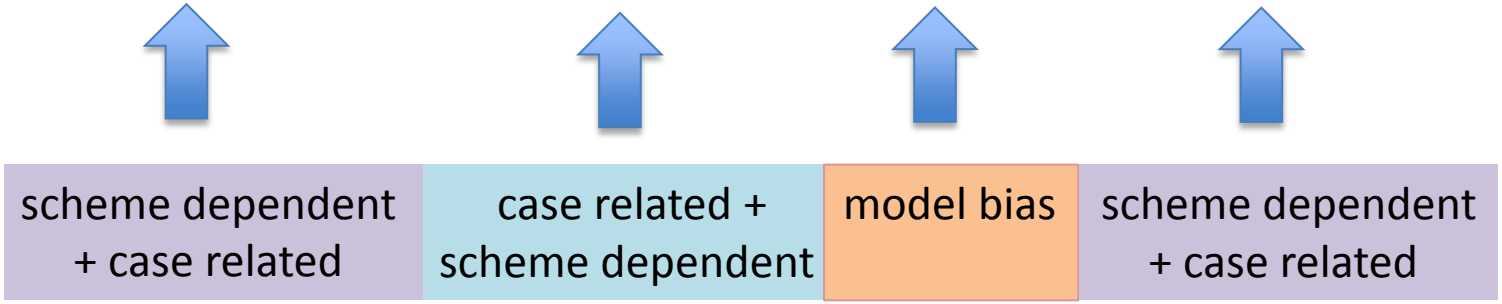
# Scheme Summary (0523)

- gce3ice: conv. area, stra. area, conv. rain, stra. rain.
- gce4ice: conv. area, stra. area, conv. rain, stra. rain.
- wsm6: conv. area, stra. area, conv. rain, stra. rain.
- wdm6: conv. area, stra. area, conv. rain, stra. rain.
- morrison: conv. area, stra. area, conv. rain, stra. rain.



# Case Summary

- Conv. & Stra. Area Percentages
  - 0520: simulations (except for WDM6) overestimate conv. area, underestimate stra. area (except for Morrison).
  - 0523:Morrison and WSM6 (WDM6 and 4ice) overestimate (underestimates) conv. area, Morrison overestimated stra. area.
- Conv. & Stra. Rain rate
  - 0520: simulations underestimate conv. rain, overestimate stra. rain (except for Morrison).
  - 0523: simulations underestimate conv. rain, WDM6 overestimate stra. rain.
- CFAD for reflectivities
  - Goddard 4ice scheme produces CFAD features closest to observations in all simulations.

- Unique CFADs characteristics (hydrometeor profiles) for individual microphysics schemes.
  - Cloud ice and snow (MMCR?)
  - Size distribution (in-situ)
- Precipitation predicability.
  - Radar-derived rain rate vs. rain gauges.