EVALUATION OF MODEL SIMULATED RADAR REFLECTIVITIES USING THE CPOL RADAR

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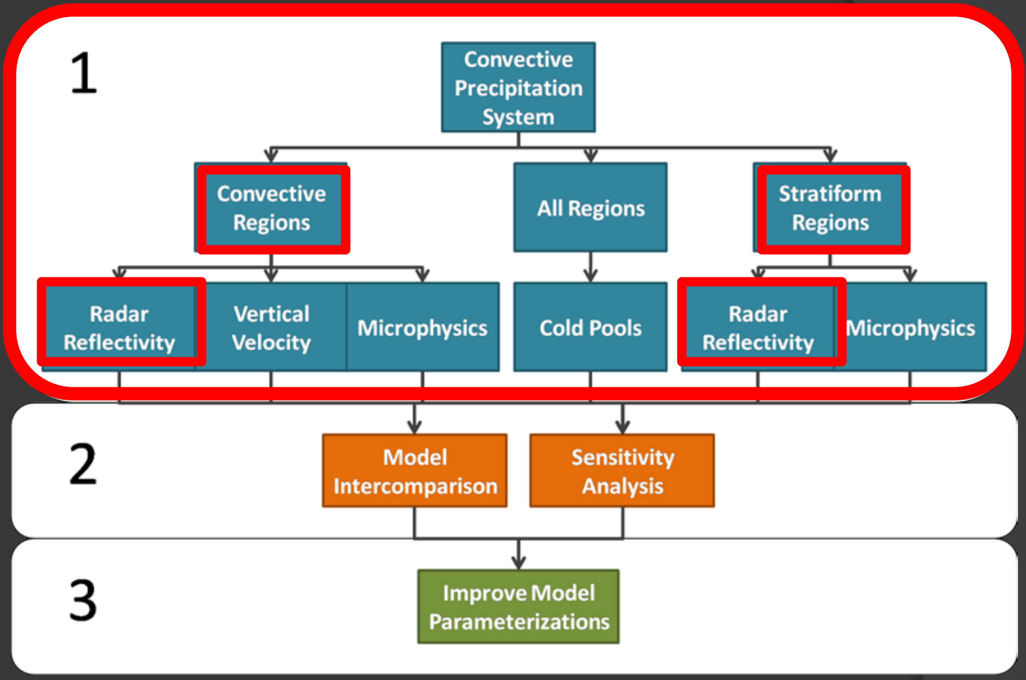
Objectives

- Use a comparison framework to improve model representation of tropical oceanic convection
- The radar reflectivity comparisons of section 1 are the focus of this talk



Outline

- CRM and LAM Intercomparison with Observations
  - The focus will be on simulated radar reflectivity compared with observed CPOL reflectivity
- Summarize ongoing work and next steps

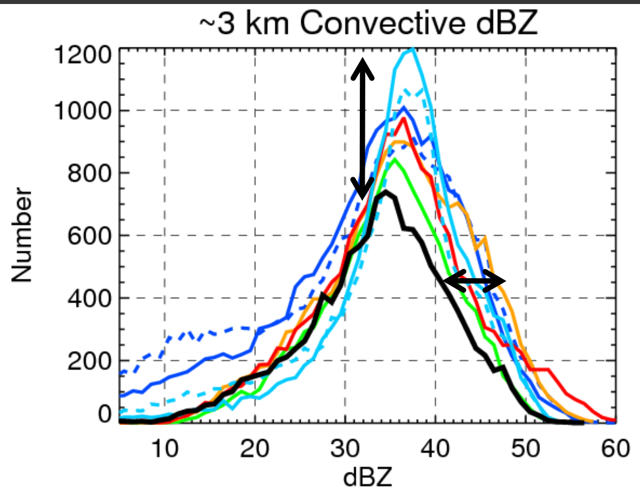
Methodology

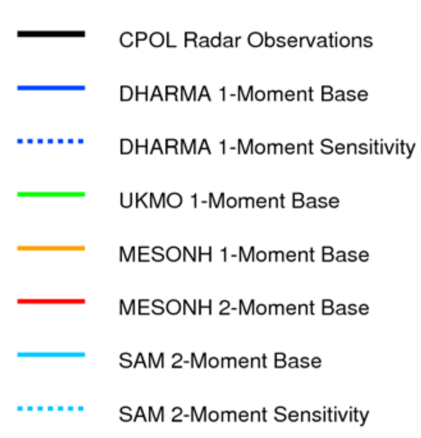
- Both CRM and LAM simulated radar reflectivity is degraded to CPOL horizontal resolution (2.5 km)
- The Steiner et al. (1999) algorithm is performed on reflectivity fields at z = 3 km to separate convective and stratiform regions
- All CRM-CPOL comparisons are confined to the pentagonal model forcing domain, whereas all LAM-CPOL comparisons are confined to the area within the CPOL 142.5 km range ring
  - Only reflectivities >= 5 dBZ are included

CRM Intercomparison

- DHARMA 1-Moment Base
- DHARMA 1-Moment Sensitivity
- UKMO 1-Moment Base
- MESO-NH 1-Moment Base
- MESO-NH 2-Moment Base
- SAM 2-Moment Base
- SAM 2-Moment Sensitivity

Convective Radar Reflectivity

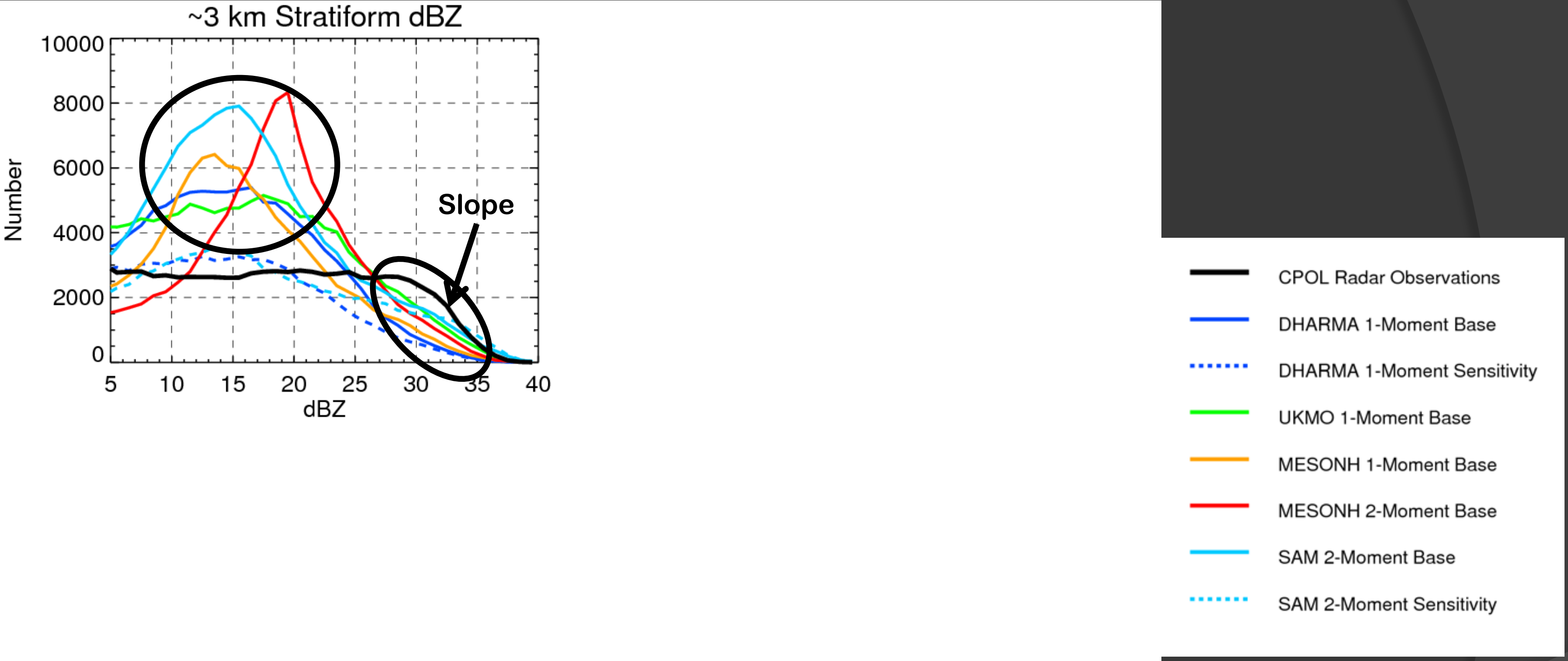




CRM Convective Summary

- Convective area is often too large, with low level dBZ skewed to higher values
- All models except Meso-NH have dBZ that is too high aloft
- Models have trouble reproducing the peaked distribution that is seen in observations aloft
- The rapid decrease in model convective dBZ near echo top is not seen in obs
  - Sign of too much graupel, not enough snow

Stratiform Radar Reflectivity



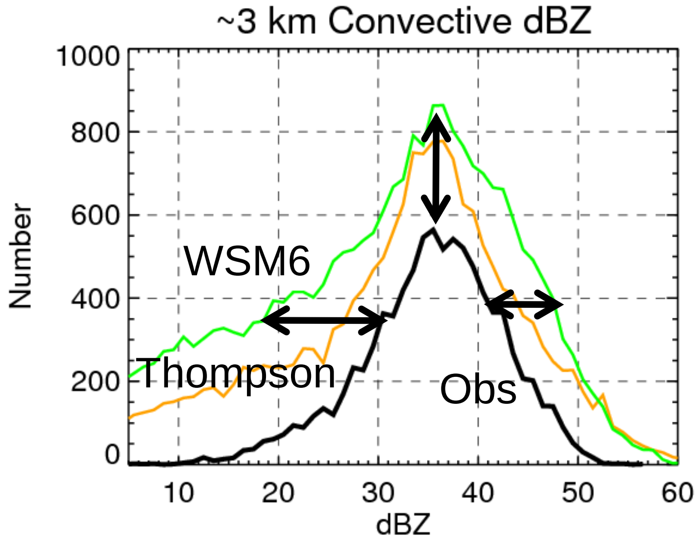
CRM Stratiform Summary

- Models have enough stratiform area but the dBZ values are too low in all but the UKMO
  - Generally not enough stratiform rain
- No model produces the observed dBZ distributions
- As with convective regions, echo tops are not high enough (these are likely related)
- Models struggle to simulate a consistent and significant increase in dBZ downward from cloud top
  - A snow aggregation issue?

LAM Intercomparison

- These simulations begin later in the active monsoon period and hence, only event C (3Z 23 Jan. to 12Z 24 Jan.) is considered
- WRF with new Thompson microphysics
- WRF with WSM6 microphysics

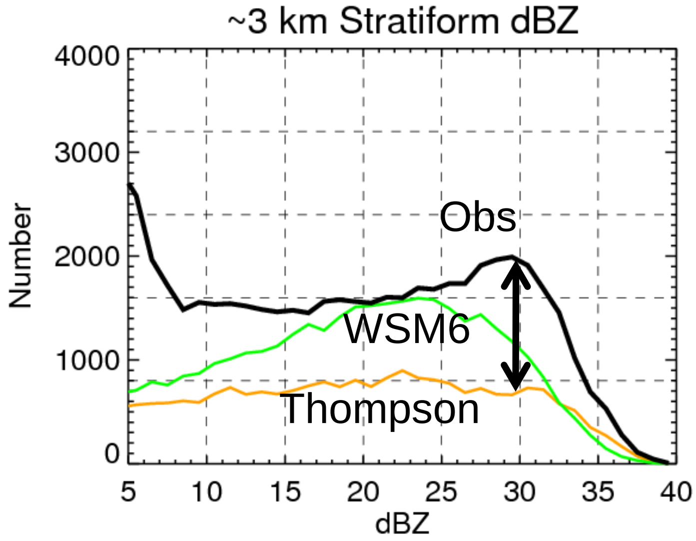
Convective Radar Reflectivity



LAM Convective Summary

- Convective area is too high, especially in the WSM6 run. Large areas of low dBZ values are especially unrealistic.
- The Thompson run keeps a peaked distribution, but at dBZ values that are too high, especially above 6 km.
- The WSM6 convective samples decrease more rapidly with height than the Thompson run, but maintain very high, unrealistic dBZ values

Stratiform Radar Reflectivity



LAM Stratiform Summary

- Low level stratiform area in both WRF runs is too low, especially in the Thompson run
- The number of Thompson stratiform samples increases with height, with gross overestimate of dBZ near 12 km
- The number of WSM6 dBZ samples drops off too quickly with height and with an unrealistic dBZ distribution, similar to CRM results

Overall Conclusions

- CRM convective dBZ is too high, especially aloft due to too much graupel
  - This does not seem to be entirely due to model updraft vertical velocity, which is not grossly different than dual Doppler retrievals
- CRM stratiform dBZ is too low throughout the troposphere
  - Could be related to insufficient advection from convective cores, insufficient in situ production of ice, and/or improper hydrometeor properties?

Overall Conclusions

- WRF simulations have vastly different dBZ distributions but both have convective dBZ too high
  - Updraft vertical velocity is very similar for both runs which suggests that this problem is due to the microphysics scheme assumptions
- The stratiform dBZ distribution at low to mid levels is better represented in the WSM6 than in most CRMs
- The Thompson run has deep stratiform regions, but the dBZ distribution is shifted far too high aloft

Future Work

- Continue to work with the dBZ output focusing on events and specific examples to check the consistency of our findings
- Obtain more dual Doppler retrievals for event C for which convection was strongest in the lobes
- Investigate whether dBZ differences are primarily due to ice water content or assumed hydrometeor properties
  - What is the reason for overproduction of graupel aloft in convective cores?
  - Are the stratiform problems due to incorrect transfer of convective elements, to poor representation of in situ microphysics, or both?

Acknowledgments

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