A Comparison Framework to Evaluate TWP-ICE Cloud-resolving Simulations with Observations

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Objectives

➢Carefully compare observations with cloud-resolving and limited area model simulations of TWP-ICE tropical oceanic convection (Section 1 of the comparison framework presented here).

➢Investigate discrepancies between model output and observations via model intercomparison and sensitivity tests to determine reasons for differences (Section 2 in progress, not shown).

➢Based on section 2 findings, improve model parameterizations, especially with regard to bulk microphysics schemes in models covering all scales (Section 3).

Data and Methods

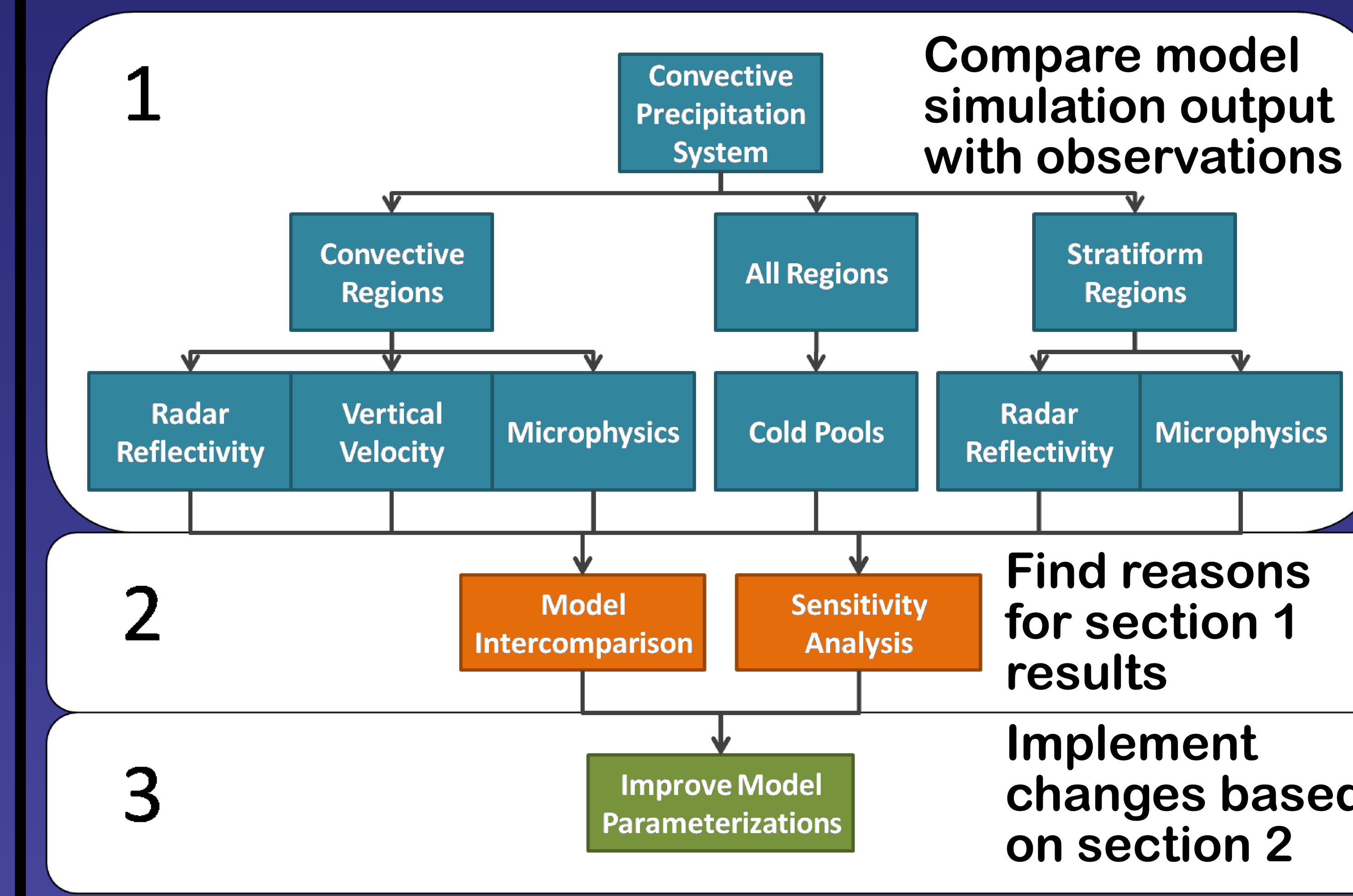
➢The primary instrument used for observational data is the C-band polarimetric Doppler radar (CPOL). It is used for radar reflectivity, dual Doppler velocity, and DSD retrievals.

➢9 model simulations produced from 4 cloud-resolving models (CRMs, periodic lateral boundary conditions) and 1 land-area model (LAM, nested with open lateral boundary conditions) are being evaluated.

➢Model output is degraded to CPOL horizontal resolution of 2.5 km. Convective and stratiform regions are identified using the Steiner et al. (1999) algorithm at the 3 km level.

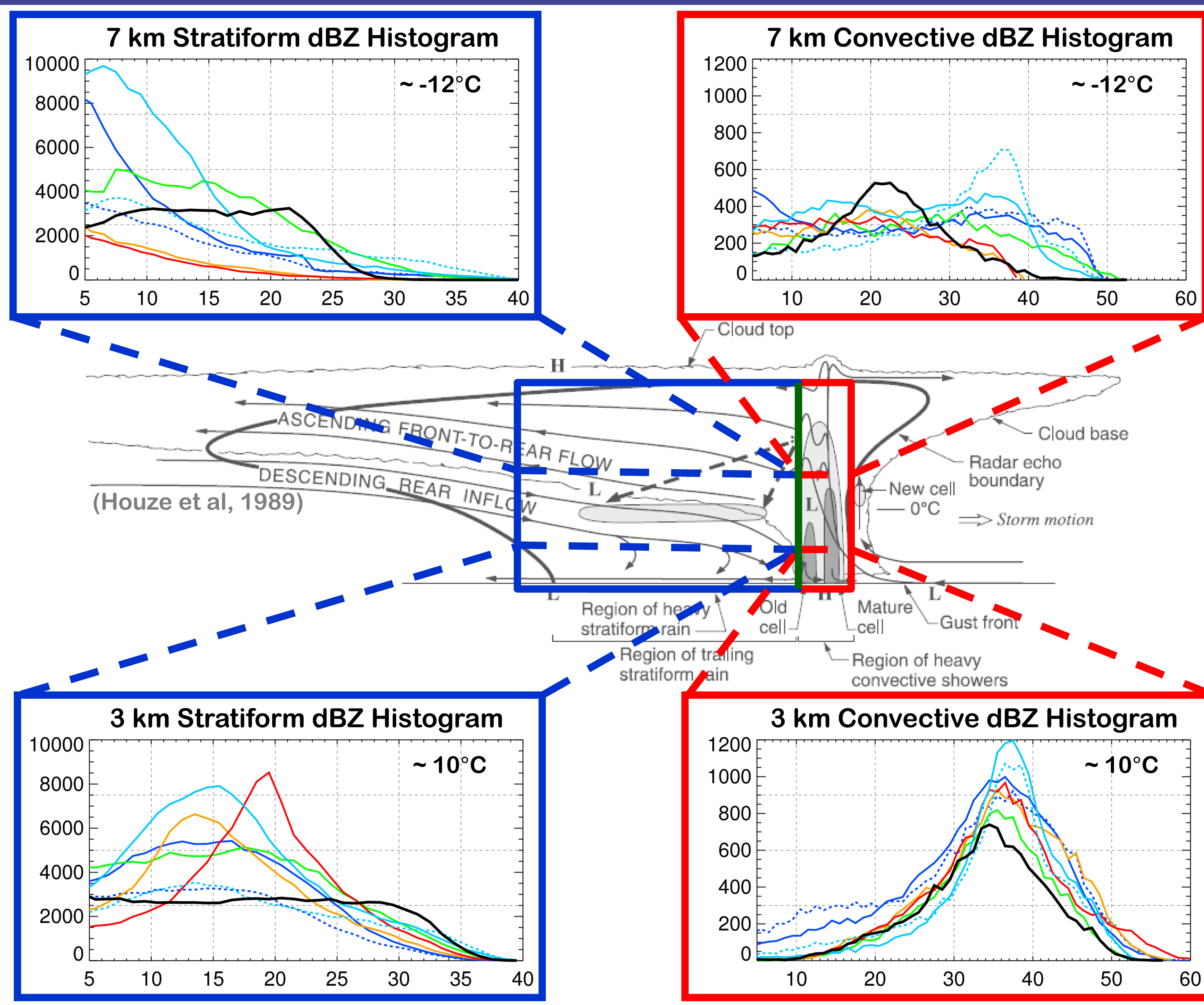
➢CPOL-CRM comparisons are performed within a pentagonal model forcing domain, whereas CPOL-LAM comparisons are performed within the 142.5 km CPOL range ring.

Comparison Framework



Convective and Stratiform Radar Reflectivity

For the active monsoon period, some stark differences are visible when comparing model with observed radar reflectivity in convective and stratiform regions at 3 and 7 km. Model updraft vertical velocity statistics are not grossly different from those observed (not shown), suggesting that the microphysics schemes are the primary reason for the differences in radar reflectivity.



Legend

- CPOL Radar Observations
- DHARMA 1-Moment Base
- DHARMA 1-Moment Sensitivity
- UKMO 1-Moment Base
- MESONH 1-Moment Base
- MESONH 2-Moment Base
- SAM 2-Moment Base
- SAM 2-Moment Sensitivity

Conclusions and Future Work

➢The comparison framework is key to organizing numerous simulations and observations into results that are applicable to improvement of the models

➢There are **some glaring differences between model simulated radar reflectivity and observations**

- ➢**CRM convective area is too high**
- ➢**CRM convective dBZ in most models is too high in the ice and mixed phase regions**
- ➢**CRM stratiform dBZ in most models is too low**
- ➢The two **WRF (LAM) simulations (not shown) have convective dBZ that is too high**, although the distributions aloft are vastly different between the WSM6 and Thompson runs
  - ➢**LAM stratiform area is far too low**, but the Thompson run has dBZ values that are far too high aloft whereas the WSM6 run is the opposite

➢Results from updraft vertical velocity comparisons suggest that **microphysics schemes are likely the primary reason** for the dBZ differences

➢The next step is to dig deeper into the various model output results in an attempt to determine the degree to which the ice water content and/or the size distribution assumptions for each ice species are causing the dBZ differences.