The Role of Cloud Microphysics in the Simulation of Mesoscale Convective Systems (MCS) in the Tropical Western Pacific

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Motivation

- Tropical deep convection and related high clouds are crucial to the global radiation and water balance, yet remain a challenge for CRMs
- Physical reasons for discrepancies between different models should be understood to improve the simulation of such clouds
- Sensitivity of CRM MCS simulations to various microphysics parameterizations using a very large TWP domain size

1. Simulation details

- WRF 6-day simulations December 2003, driven by GFS
- 1725 × 1110 × 35 gp, Δx=4 km, sensitivity with 3 microphysics schemes:
  - WSM6: 1-moment scheme (Hong and Lim 2006)
  - THOM: hybrid scheme (2-moment for ice and rain)
  - MORR: 2-moment scheme (Morrison et al. 2009)

2. ISCCP Cloud Classification

- ISCCP classifications based on CTP and COT for GOES and WRF

3. MCS Statistics

- MCS identification and tracking algorithm by Boer and Ramanathan (1997) applied to GOES and simulated cloud fields:

4. MCS Microphysics

- CFADs for ice and snow mass and velocities

Summary

- Schemes that exhibit slow ice/snow sedimentation rates aloft have more numerous and larger MCSs with larger anvils
- Complex 2-moment schemes do not outperform 1-moment schemes (nucleation, sedimentation more important than size distributions)
- Limited variability among the investigated schemes in terms of surface precipitation. All exhibit overestimations of 20% (not shown)

References