Tracking Tropical Cloud Systems – Observations for the Diagnosis of Simulations by the Weather Research and Forecasting (WRF) Model

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Summary

Metrics of tropical cloud system lifecycle are used to assess modeled microphysics.

- **Storm size is sensitive to microphysics scheme**
- **ACRF profiles of storm graupel and snow content might provide key diagnostics**

1. Tracking Mesoscale Convective Systems

Mesoscale convective systems (MCSs) are identified and tracked in the observations and simulations with the Boer and Ramanathan (1997) algorithm

MCS Definition (Laing and Fritsch, 1993):

- **Core area > 50,000 km^2 with BT < 219 K; surrounding anvil with BT < 240 K**
- **Core area plus anvil area > 100,000 km^2**

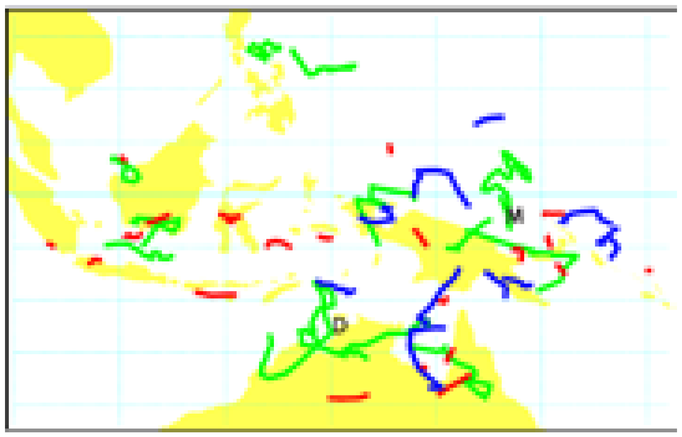
Observations

- **Track GOES-9 11 μm (Channel 4) brightness temperatures**

Weather Research and Forecasting (WRF) Simulations

- **WRF outgoing longwave radiation converted to equivalent top-of-atmosphere 11-μm brightness temperatures for tracking**

Observed MCS Tracks



Forty-nine MCS paths observed by the tracker for 26-31 December.
Colors indicate duration: t ≤ 6 hrs, 6 < t ≤ 12 hrs, t > 12 hrs.
ARM sites indicated: D = Darwin, M = Manus.

2. WRF Simulations

One-week simulations: 25 to 31 December, 2003

Domains

- **Inner: 4-km resolution, 22S-17N, 100E-162E**
- **Outer: 20-km resolution, 27S-27N, 89E-170E**

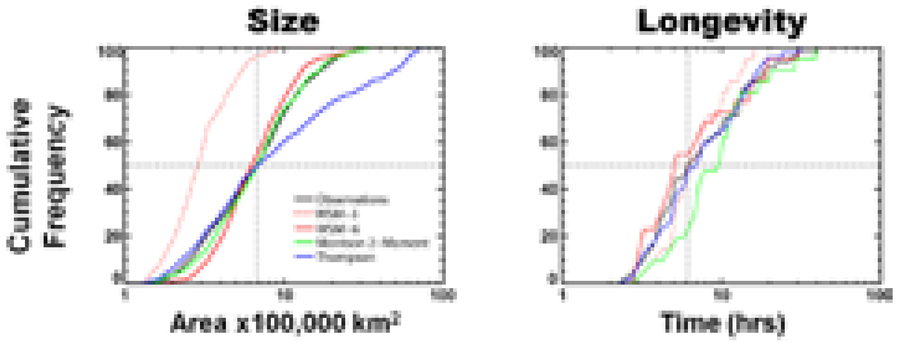
Convection

- **Inner: Explicit**
- **Outer: Kain Fritsch (new eta) each 6 mins**

3. Diagnostic Statistics

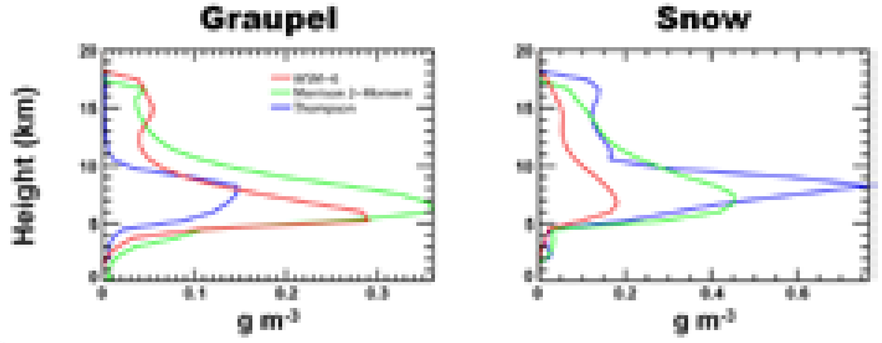
Observed and simulated MCS lifecycle statistics.

- **MCS size best simulated by the 6-class schemes**
- **Morrison 2-moment closely matches observed size**
- **Thompson closely matches MCS longevities**



Average MCS profiles for the 6-class microphysics schemes.

- **Graupel and snow profile concentrations might provide key diagnostics**
- **Cloud water and rain profiles are similar (not shown)**
- **Ice profiles different (not shown), but difficult to observe for MCSs**



References

Boer, E, and V Ramanathan, 1997: Lagrangian approach for deriving cloud characteristics from satellite observations and its implications to cloud parameterization. *J. Geophys. Res.*, 102, 21,383–21,399.

Laing, A.G., and J.M. Fritsch, 1993: Mesoscale Convective Complexes over the Indian Monsoon Region. *J. Climate*, 6, 911–919.

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