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Impact of Raindrop Size Distribution to Simulated Convective Cloud Populations during AMIE/DYNAMO

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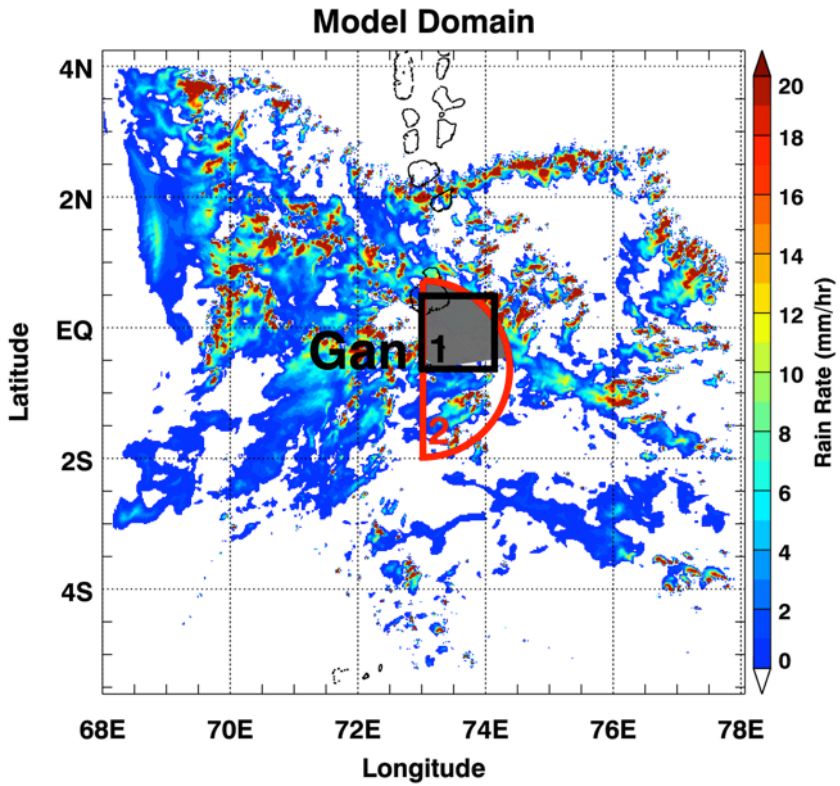
2013 ASR Fall Working Group Meeting – Radar Science Breakout

WRF Simulation & S-Pol Observation

- **WRF at 2-km resolution, no cumulus parameterization**
- **Subset results to compare with S-Pol observation**

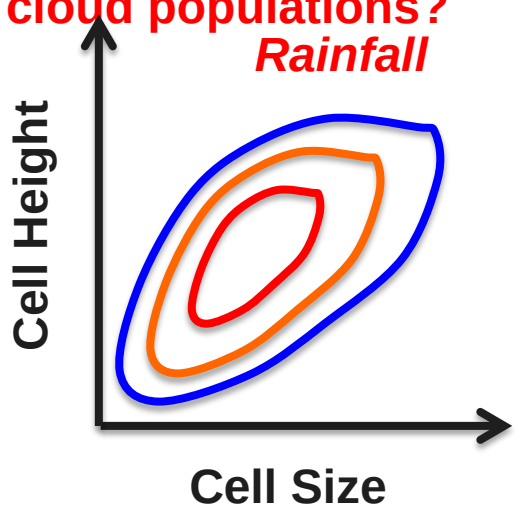


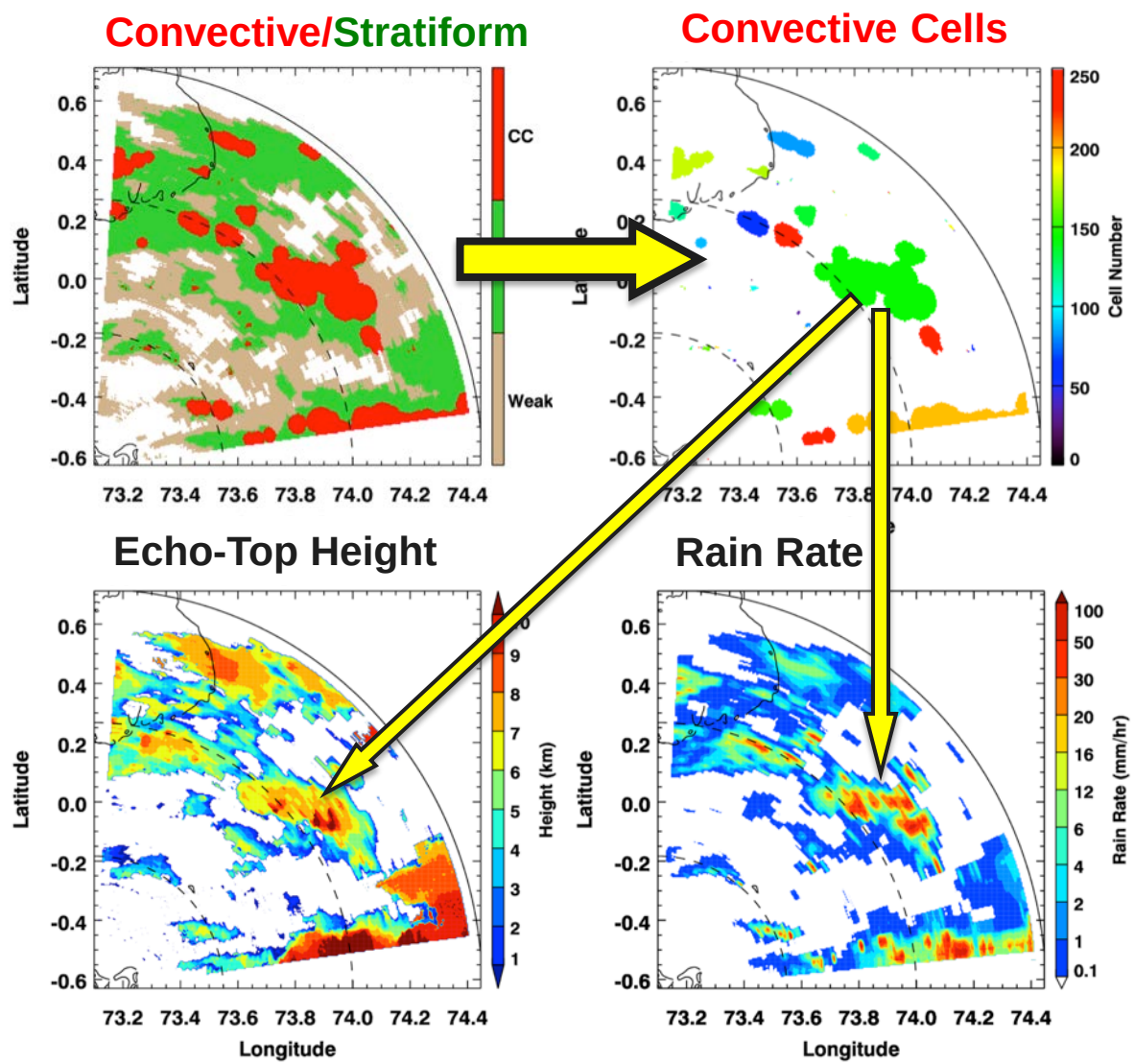
	Model Setup
Period	Nov 1 – 30, 2011
Lateral/surface forcing	ERA-I 6-hourly analysis
Land surface	NOAH
LW Radiation	RRTM
SW Radiation	Dudhia (1989)
PBL	UW scheme
Microphysics (2-moment bulk schemes)	**Goddard** **Thompson** **Milbrandt** **Morrison** **WDM6**

Use WRF 10cm radar simulator to make direct comparison with observations

Compositing Strategy

- Classify convective/stratiform based on Z_e
- Use cell size, echo-top height to construct precipitating cloud statistics (based on rain "cells")
- Fidelity of model to reproduce convective cloud populations?





Convective Cell Rain Rate

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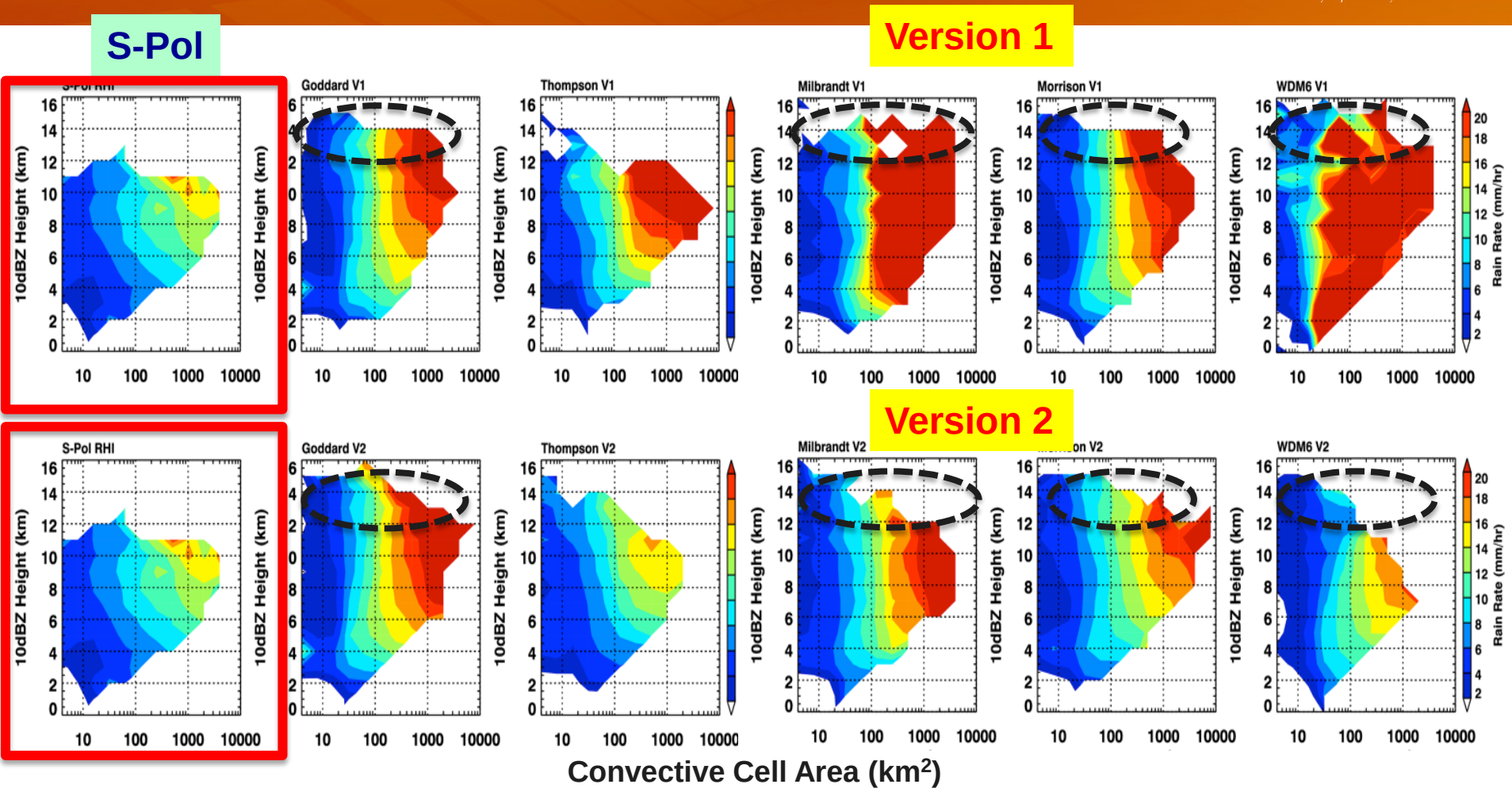
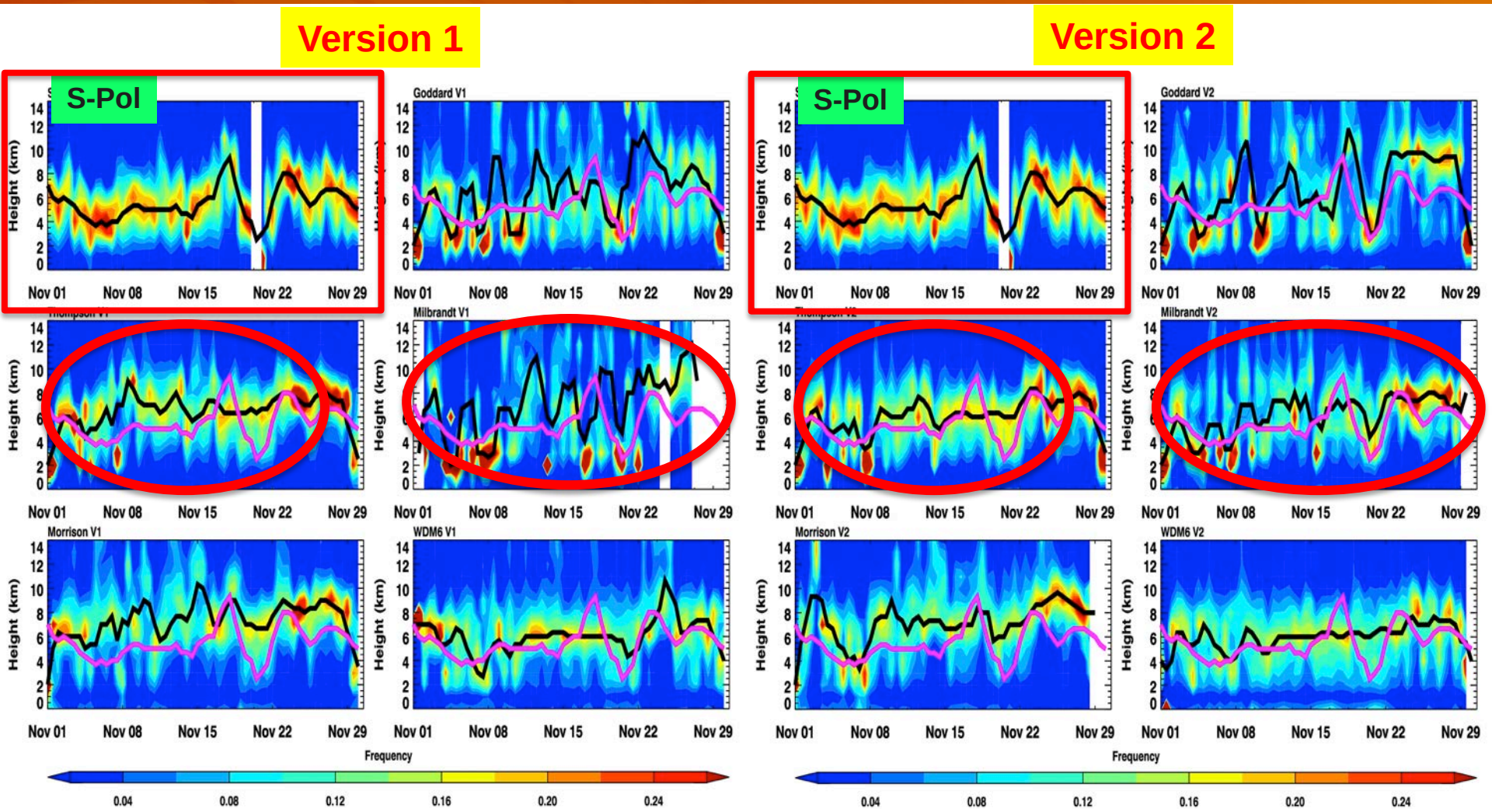


- Intense rainfall comes from large & deep convective cells
- Most schemes overestimate convective rainfall in cells > 100 km² & cell echo-top heights
- Increase raindrop break-up efficiency reduces rainfall, but not echo-top height
- Default rain drop sizes in MP are too large for this oceanic environment

Impact on Cloud Evolution



- Various degree of impacts to evolution of cloud populations
- Microphysics have important feedback to convective organization

Discussion

- CPMs can reasonably reproduces cloud populations, but very sensitive to microphysics
- While reduce raindrop size distribution seems to improve simulation, its only a "temporary fix"
- How can we better use dual-pol observations (i.e. hydrometeor ID) to constrain microphysics?
  - Current bulk microphysics lack complexity to directly simulate radar dual-pol parameters (spectral bin microphysics?)
  - Radar hydrometeor ID does not correspond to model hydrometeor mixing ratio (one volume one "most likely" hydrometeor type vs. one volume a mixture of hydrometeor types)
  - Requires open dialogs between radar experts and model developers (folks in this session!)

Backup Slides

Impact to Organization of Convection

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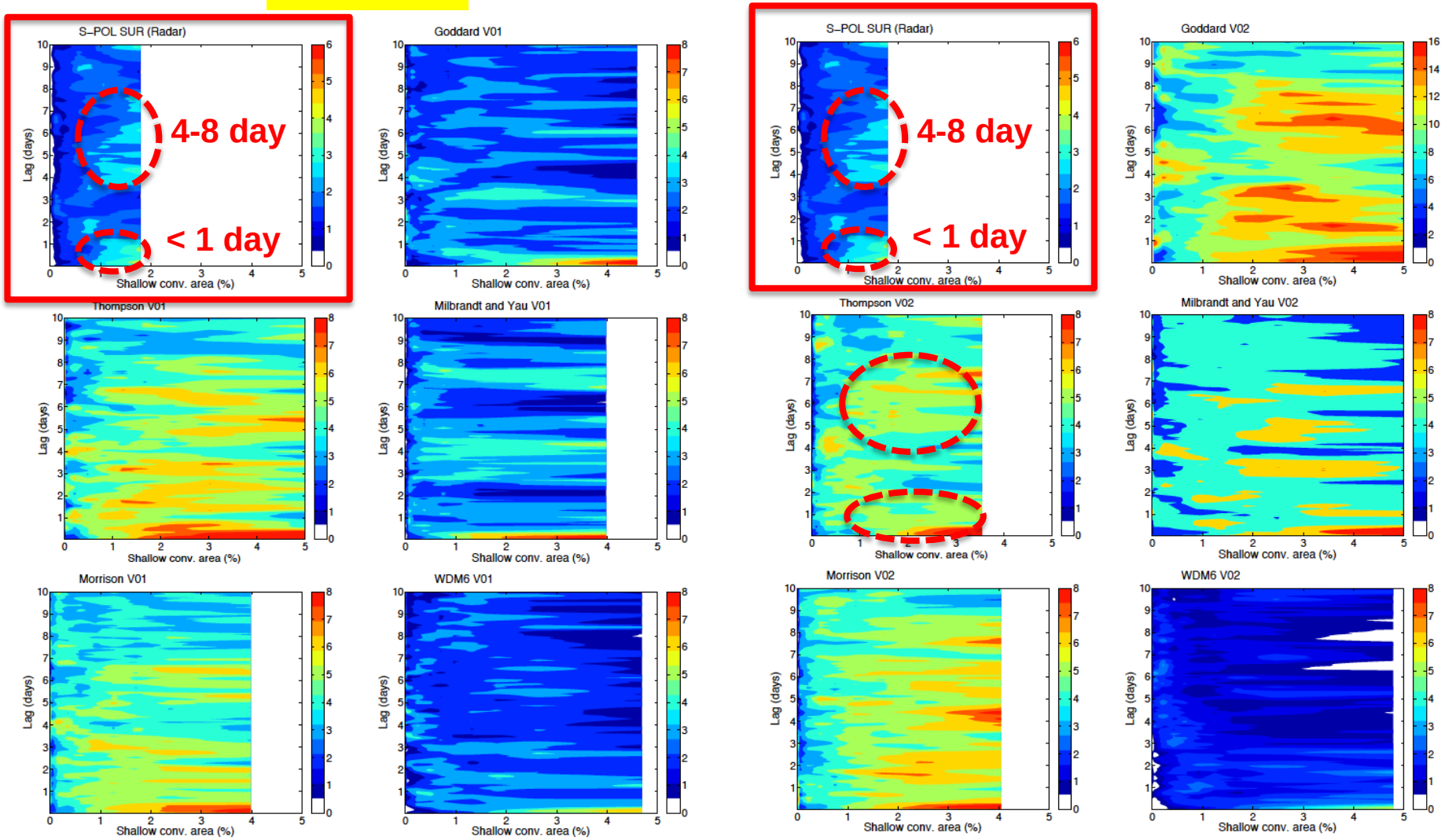
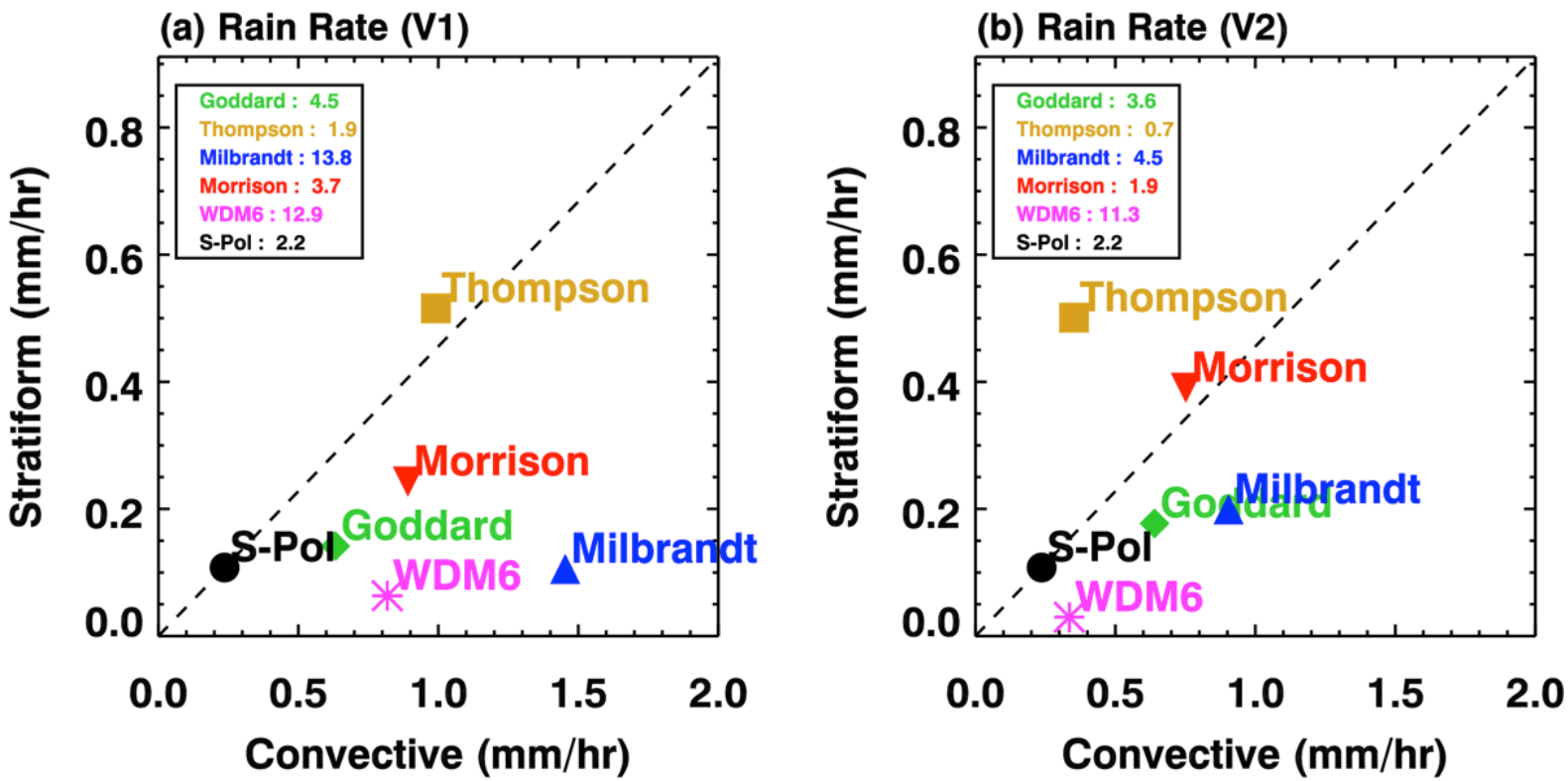
Version 1 **Version 2**



- **Microphysics impacts transition from shallow-to-deep convection**

Mean Convective/Stratiform Rainfall

- Revised versions generally reduce convective/stratiform rain ratio
- Thompson, Morrison have more robust stratiform rain than other schemes, important to MJO!



Hagos et al. (2013), *in preparation*