Resolution Dependencies of CAM Hindcasts of TWP-ICE Convection

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ARM Radiative Processes – Cloud Modeling
Working Groups' Fall Meeting
Princeton, New Jersey
November 20, 2008

LLNL-PRES-408651

Outline

- CAM version 3.6 simulations
- Precipitation and diabatic heating
- What fraction of tropical precipitation is stratiform?

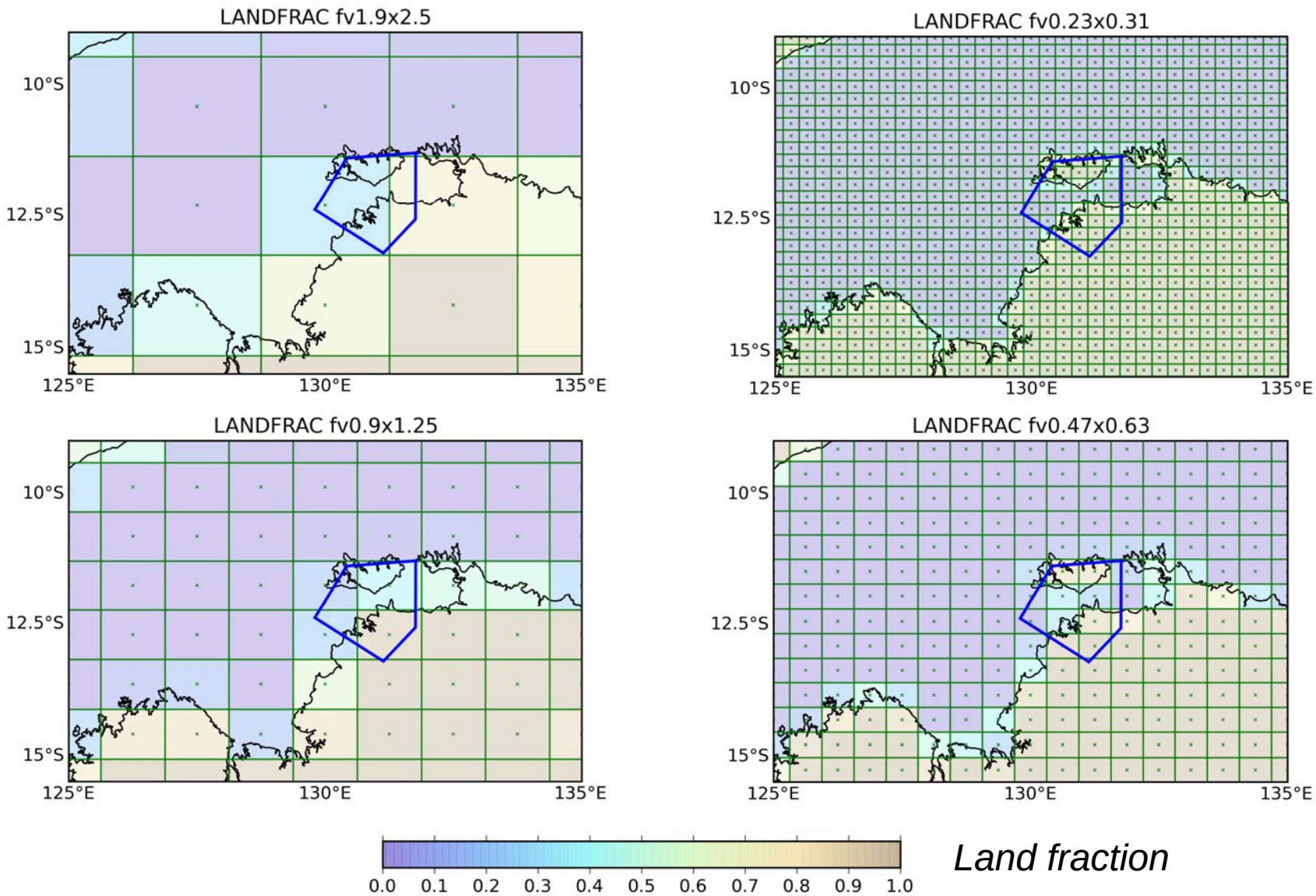
CAM version 3.6 simulations

- Physics
  - Entraining CAPE closure *(Neale et al. 2008)*
  - Morrison and Gettelman double-moment stratiform cloud microphysics *(Gettelman and Morrison 2008)*
- Resolution of the finite volume dynamical core
  - Horizontal resolutions: 2º, 1º, 0.5º, 0.25º
  - Vertical resolution: 26 Levels
  - The only physical parameters that change with resolution are the rain water autoconversion coefficient in the shallow-depth convection parameterization (Hack) and the time step

Hindcast procedure

- Three-day hindcasts are started every day at 00Z during January – February 2006
- Hindcasts are initialized with 1º resolution operational analyses of the European Centre for Medium-range Weather Forecasts
  - Variability at resolutions greater than 1º are generated by CAM
- Results are presented from hindcast day two
  - This time range is selected because day two is after the initial adjustment of the moist physics and yet the large-scale state is still close to the analysis

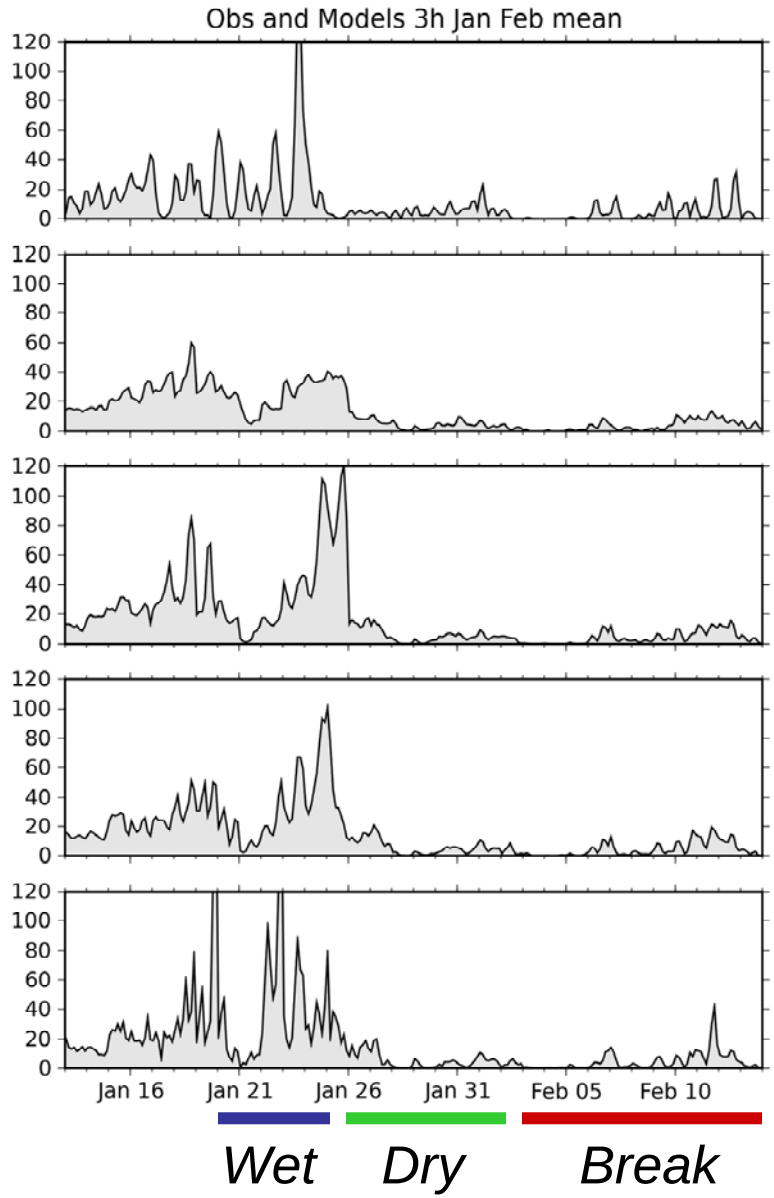
CAM grid boxes



Land fraction

TWP-ICE precipitation

- Precipitation intensity increases with resolution
- Generally good correspondence in the dependency of precipitation on convective regime



C-POL Obs

2.0 º

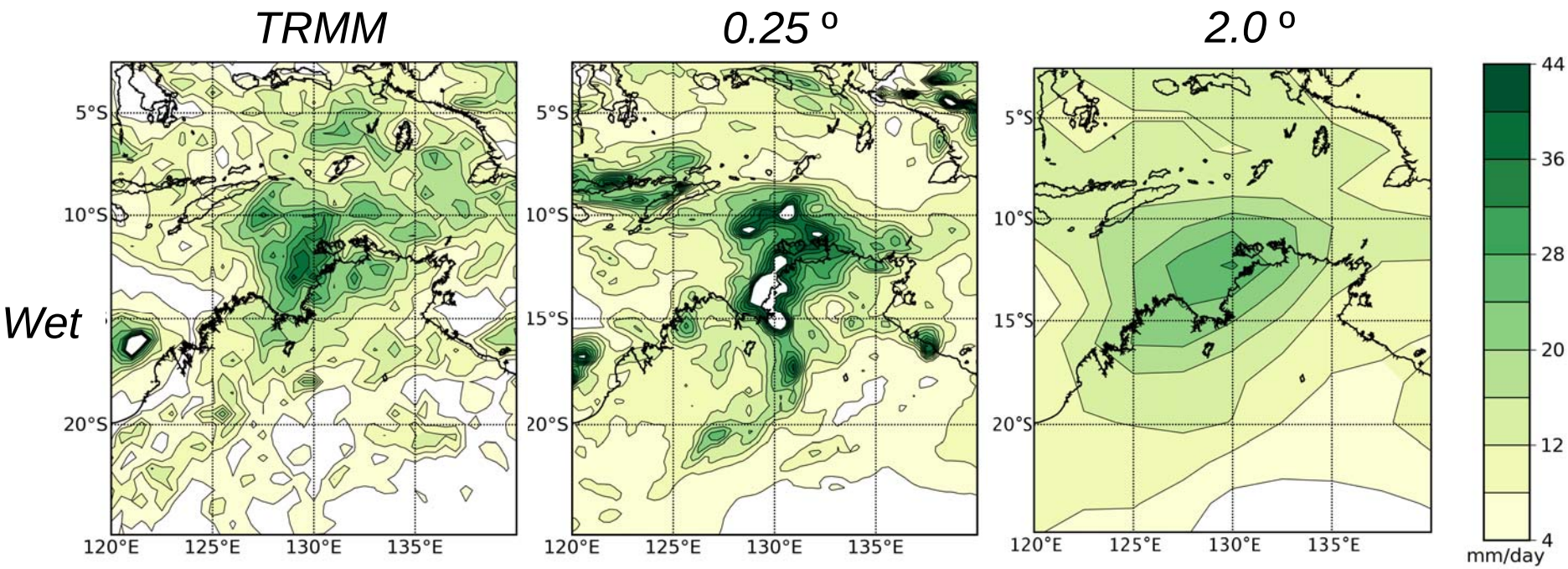
1.0 º

0.5 º

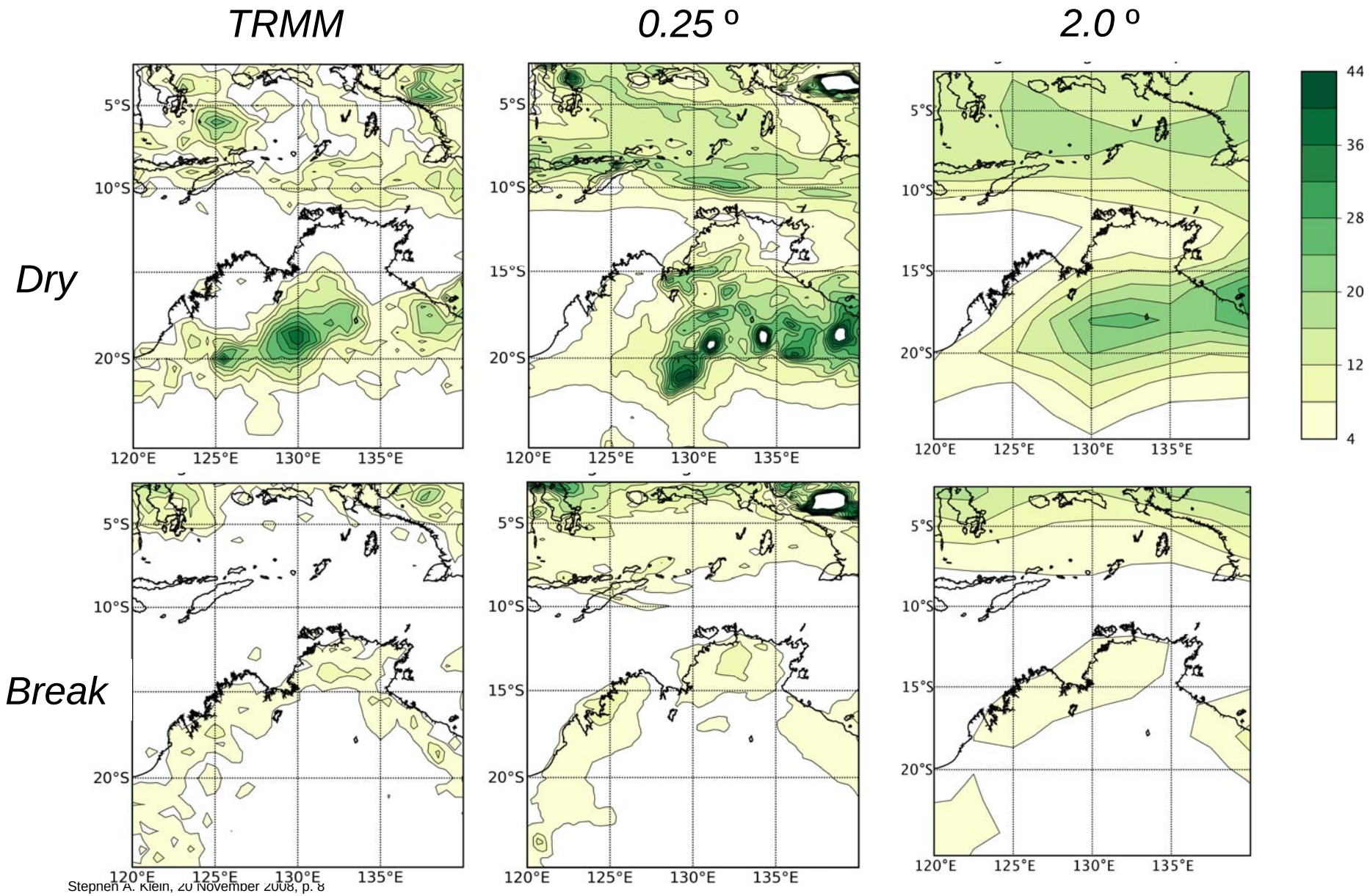
0.25 º

Regional precipitation: Wet period

- Higher resolution model produces more detail and more intense precipitation maxima

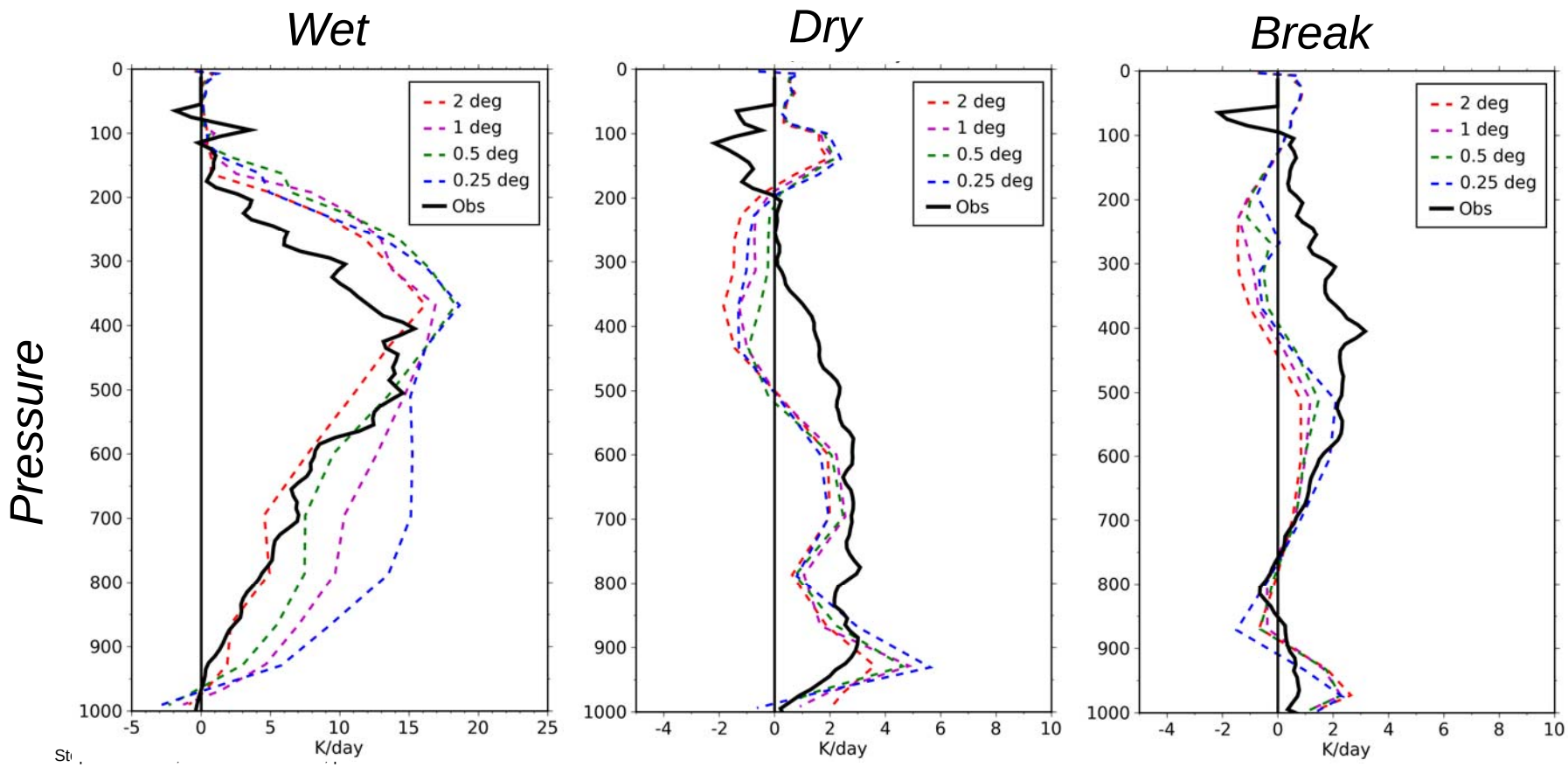


Precipitation: Dry and break periods

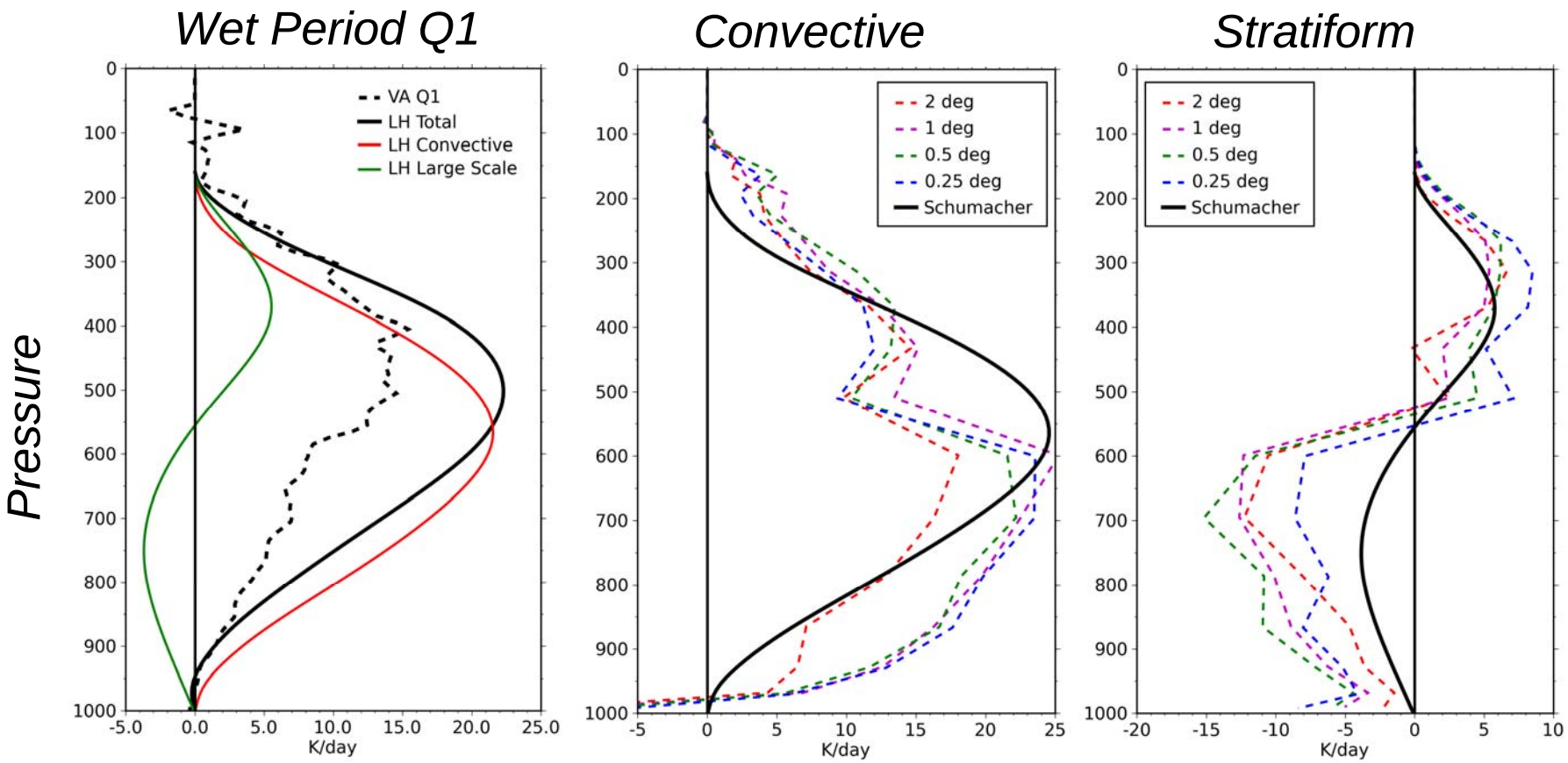


Diabatic heating: Q1

- Wet period is simulated better than others
- The change in the level of peak heating with regime is relatively well simulated



Convective vs. stratiform heating

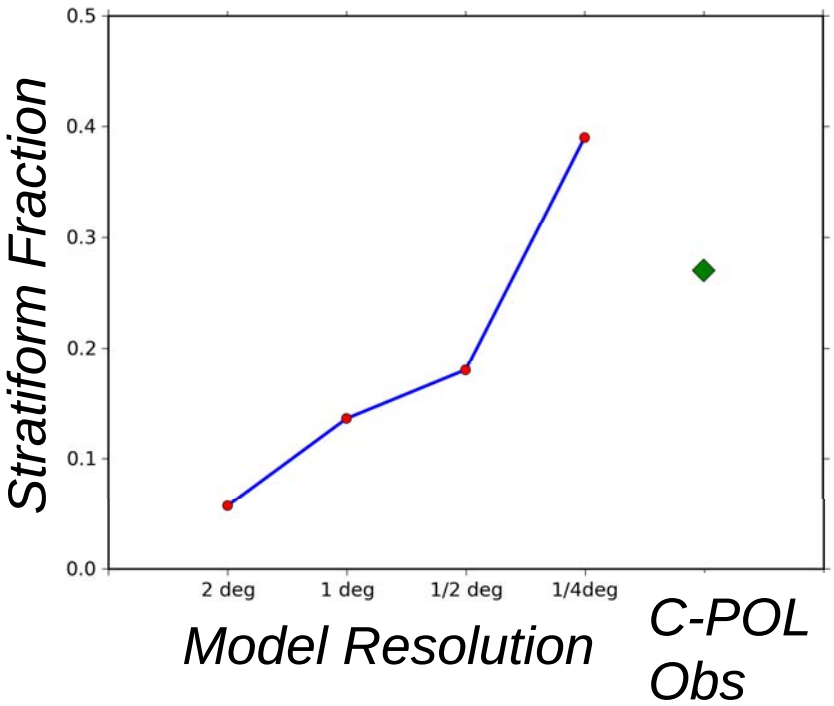


Convective – stratiform partitioning from Courtney Schumacher's analysis of C-POL radar data

Stratiform precipitation & resolution

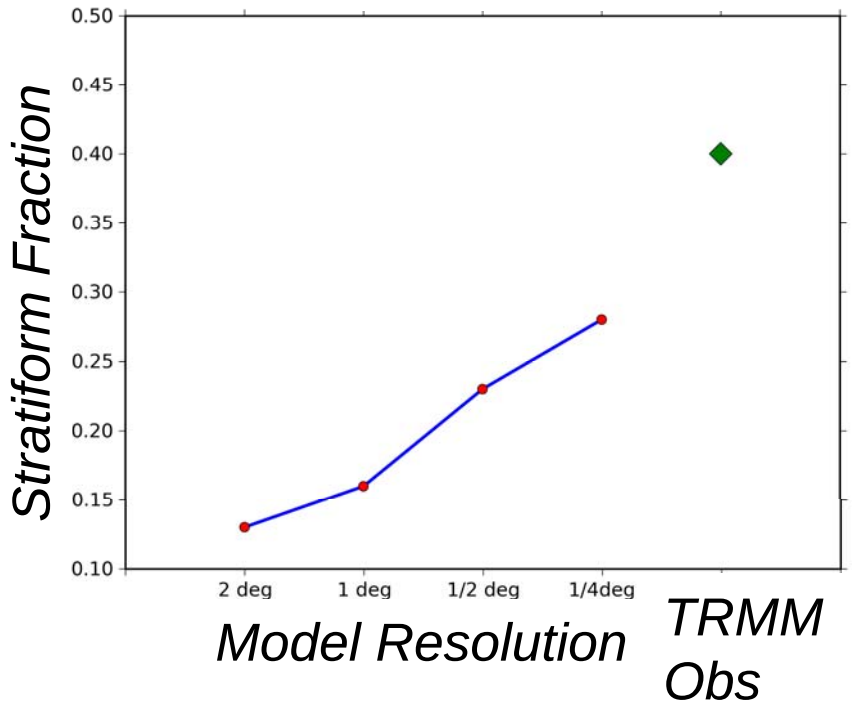
- The stratiform fraction of total precipitation increases with resolution both for the TWP-ICE wet period and in the whole tropics

TWP-ICE Wet Period



(C. Schumacher)

20 ºN – 20 ºS



(Schumacher and Houze 2003)

Conclusions

- CAM3.6's precipitation and diabatic heating respond well to the changes in convective regimes during TWP-ICE
- The model's behavior is reasonably constant across resolution which is encouraging for applications of the model
- Increased resolution reduces the biases of low-resolution models to underestimate the intensity and stratiform fraction of tropical precipitation
- Cloud and radiation simulations are also reasonably constant across resolution