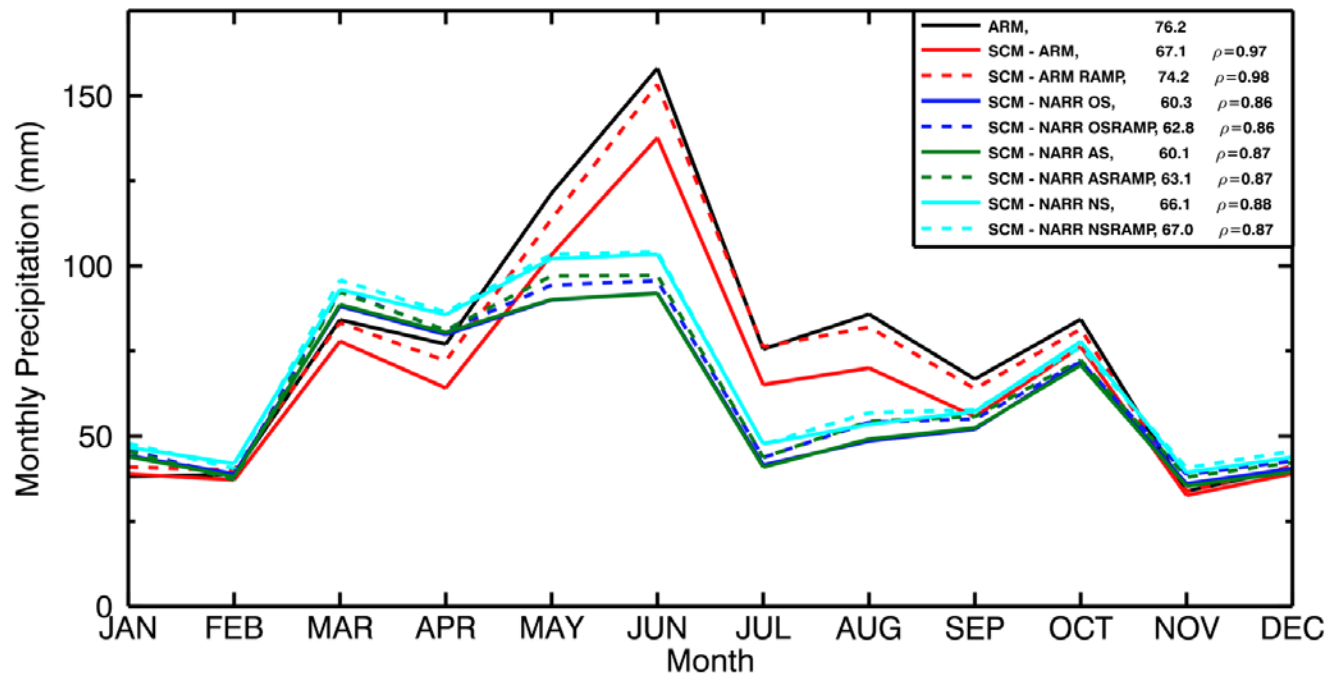


# Should Today's SCMs Convect at the SGP?

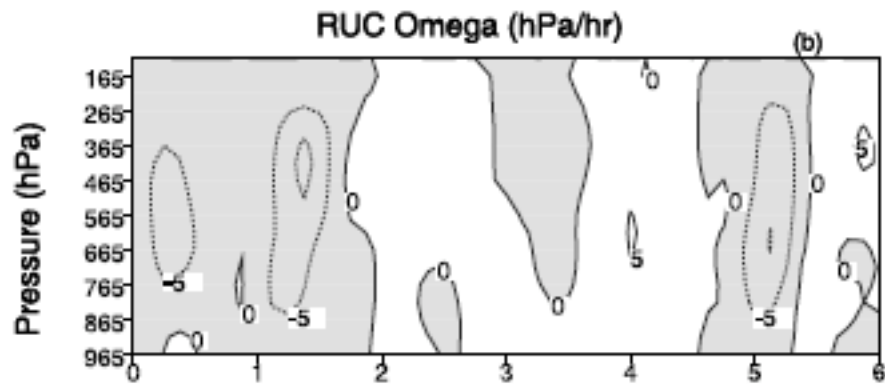
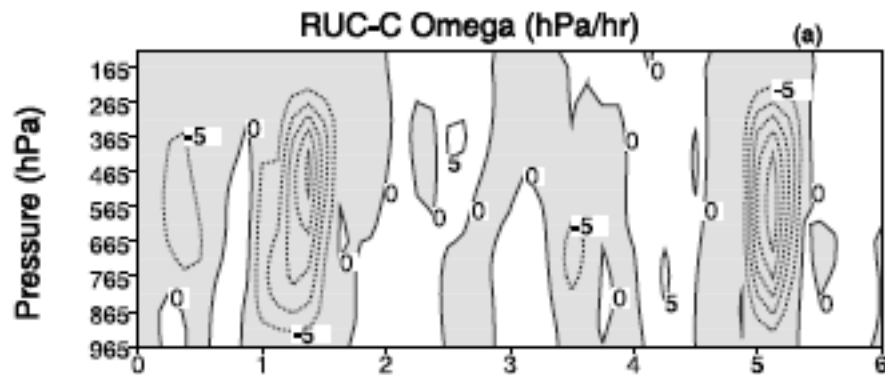
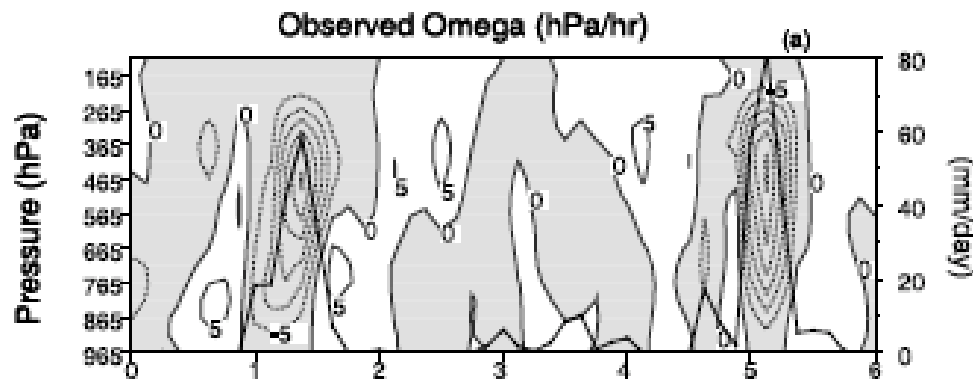
**Tony Del Genio and Audrey Wolf**  
**NASA GISS**

**FASTER Breakout, ASR Science Team Meeting, 3/12/12**

# GISS Model E2 SCM, driven by ARM continuous forcing at SGP, 1999-2008 (dashed red curve)



(Kennedy (2011))

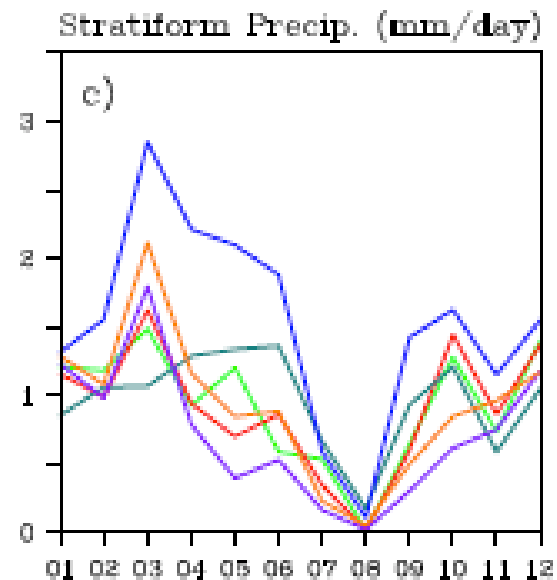
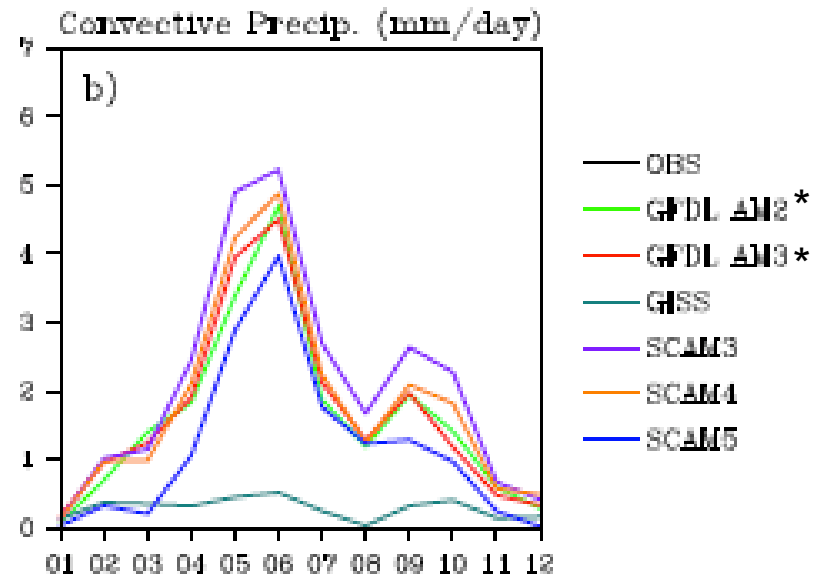
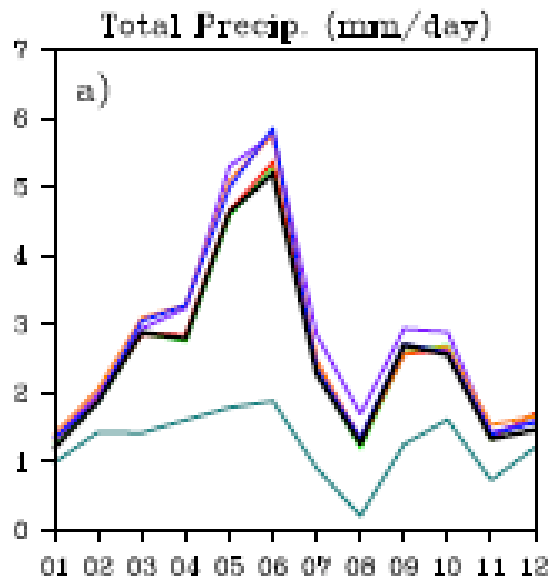


Time (days since 2330 UTC Jun. 23, 1997)

Xie et al. (2004)

**Increase in  $\omega$  in continuous forcing is primarily due to constraint by observed precipitation...**

**So SCMs driven by constrained variational analysis are not a good test of precipitation simulation**



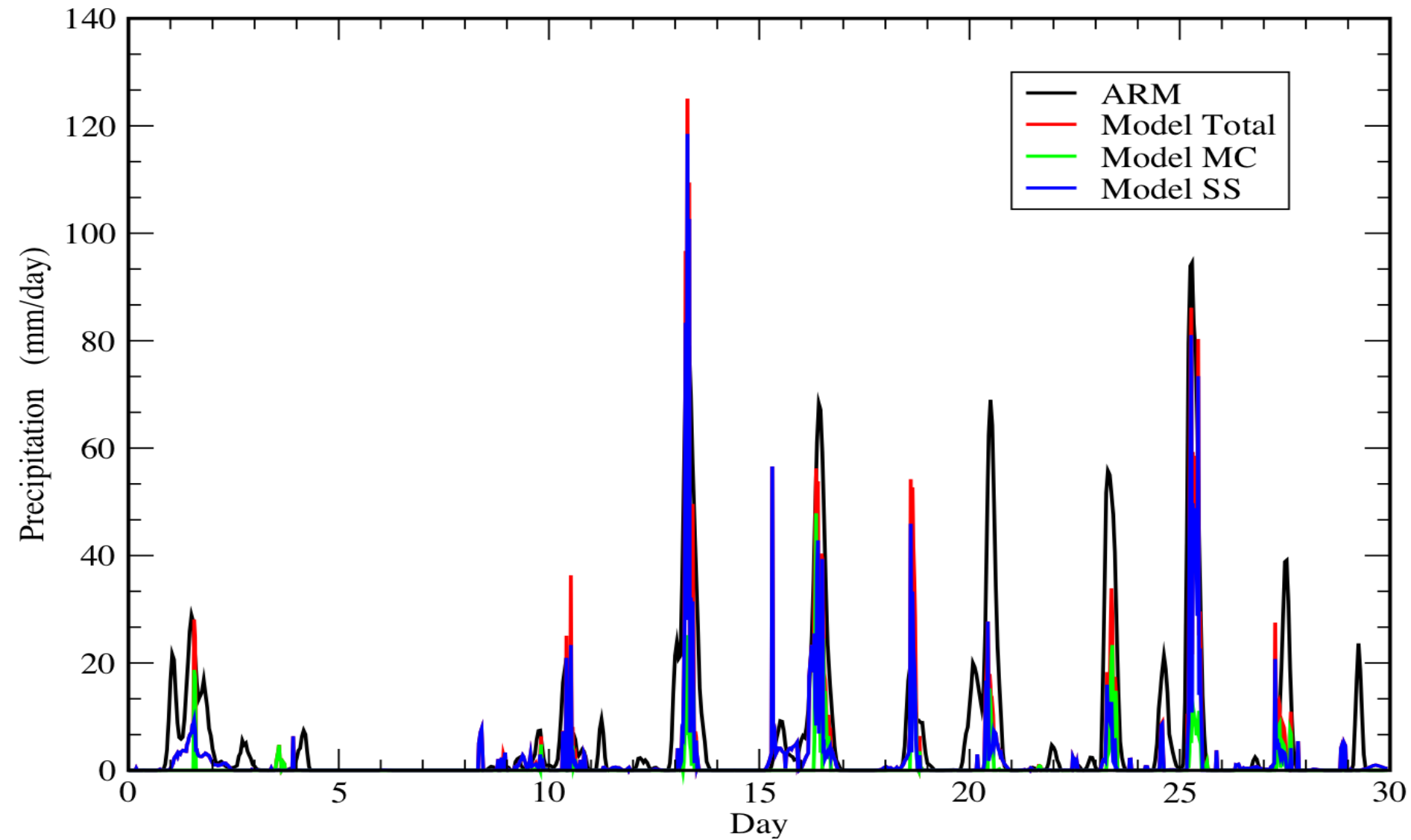
**SCMs driven by continuous forcing + 3 hr relaxation \* to observations for FASTER**

(Hua Song)

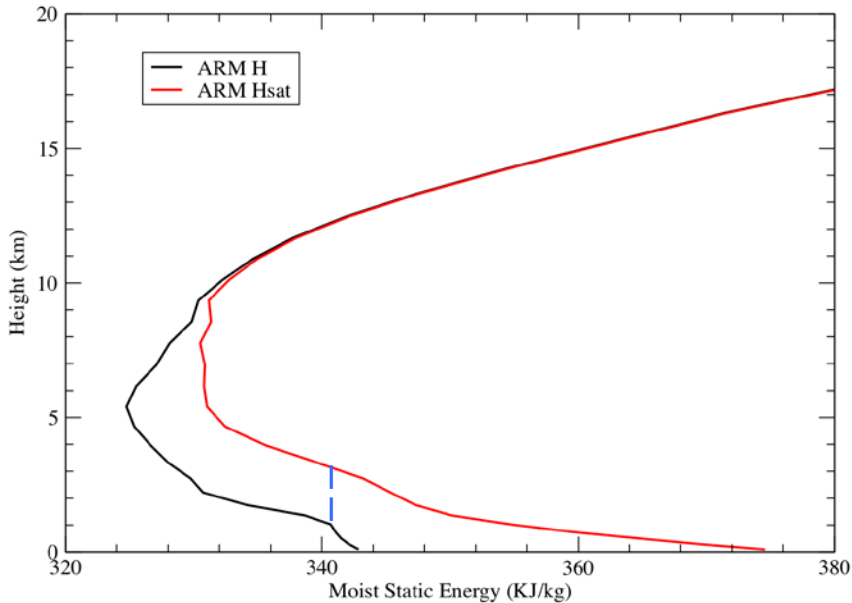
\* But not every SCM!

# SCM SGP June 2000

Forcings with 3 Hr Relax

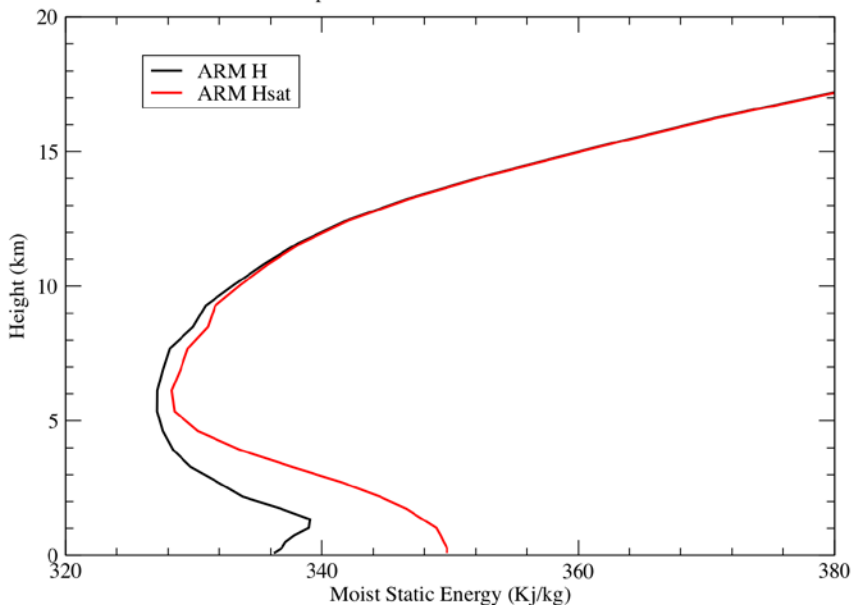


SCM SGP June 2000  
timestep 619 ARM Prep 1.32 mm/day



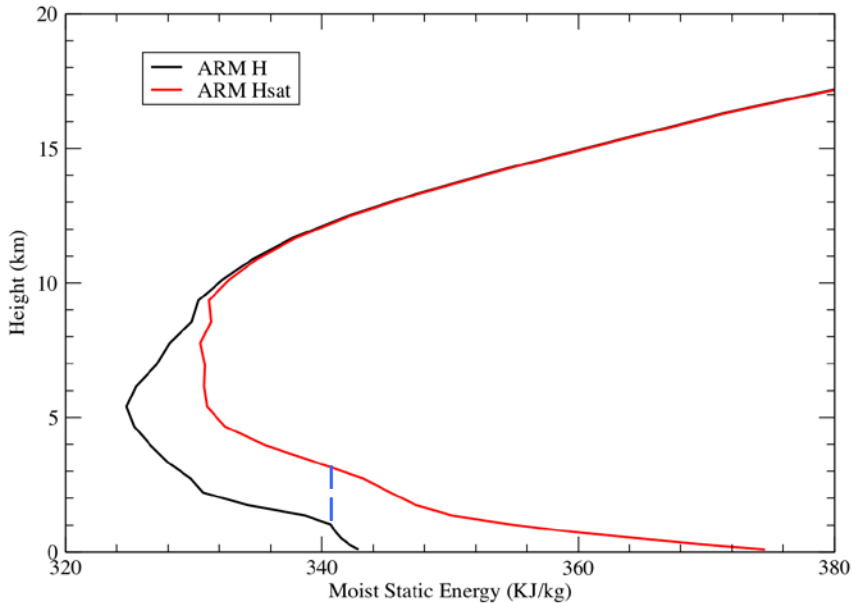
**Observed thermodynamic structure at the time precip begins...requires parcel to be lifted  $\sim 2$  km to reach LFC...requires  $w \sim 2$  m/s, larger than TKE would typically provide**

SCM SGP June 2000  
timestep 635 Prc ss 17.0 mc 1.53 ARM 54.72



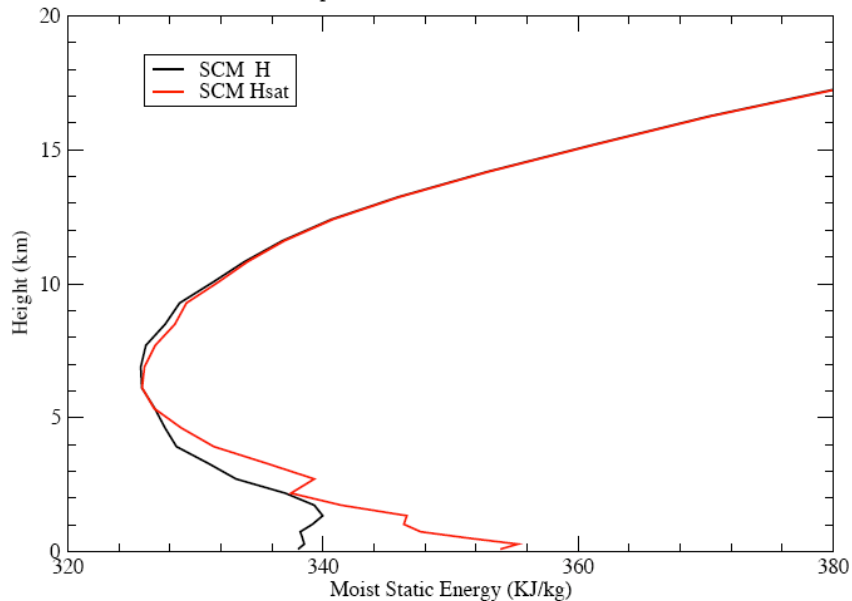
**And at the time when the SCM convective precip begins**

SCM SGP June 2000  
timestep 619 ARM Prep 1.32 mm/day



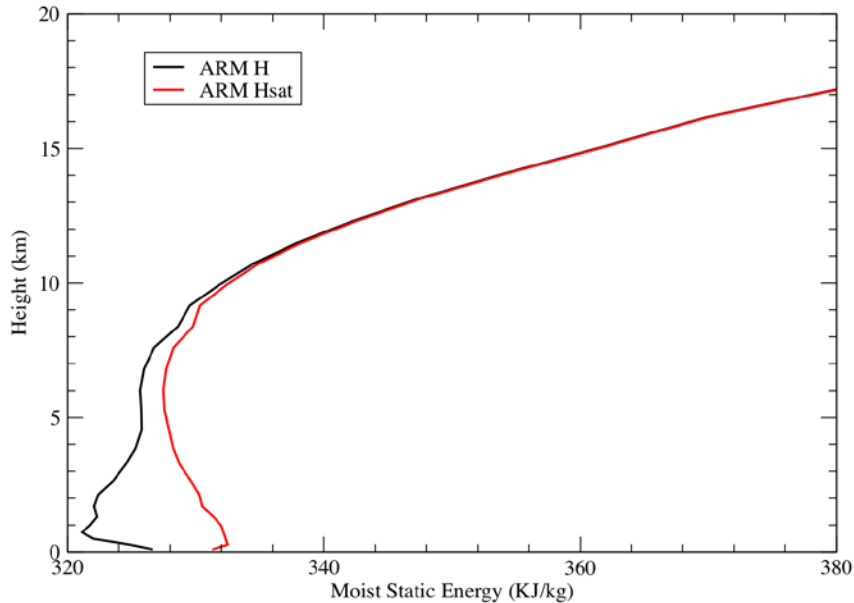
**Observed thermodynamic structure at the time precip begins...requires parcel to be lifted  $\sim 2$  km to reach LFC...requires  $w \sim 2$  m/s, larger than TKE would typically provide**

SCM SGP June 2000  
timestep 635 Prec ss 17.0 mc 1.53 ARM 54.7



**And at the time when the SCM convective precip begins**

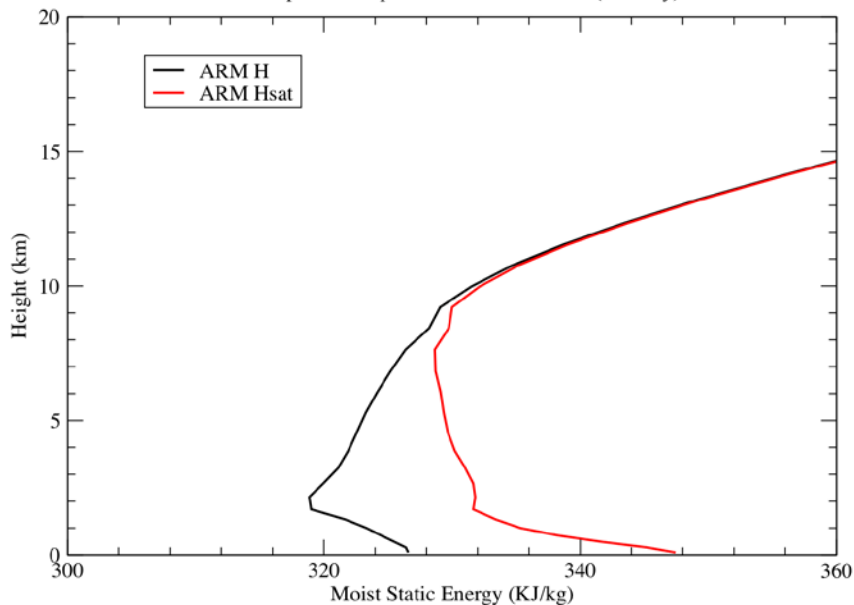
SCM SGP June 2000  
timestep 651 Prcp LS 1.5 MC 0. ARM 26.8 (mm/day)



**At time SCM (but not observed)  
precip ends...**

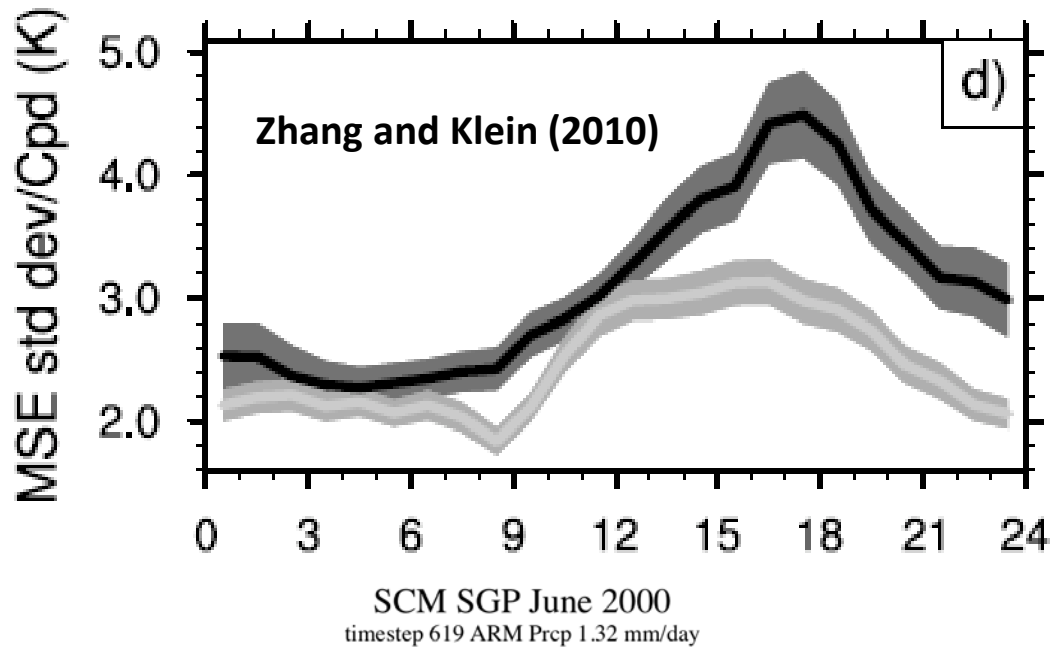
**Due to lack of mesoscale  
organization in SCMs?**

SCM SGP June 2000  
timestep 661 Prcp LS 0. MC 0. ARM 1.6 (mm/day)



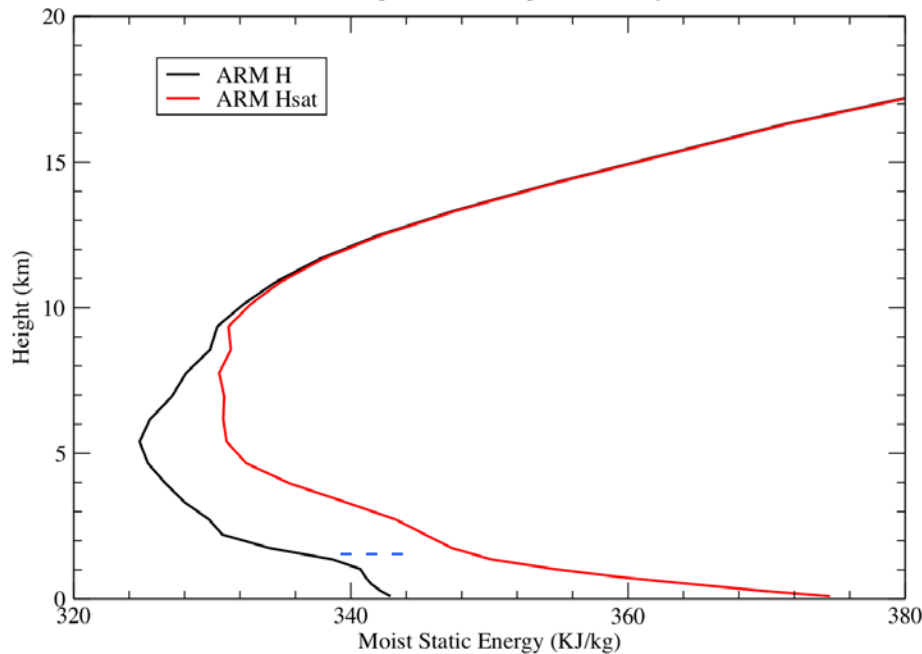
**And at time observed  
precip ends**





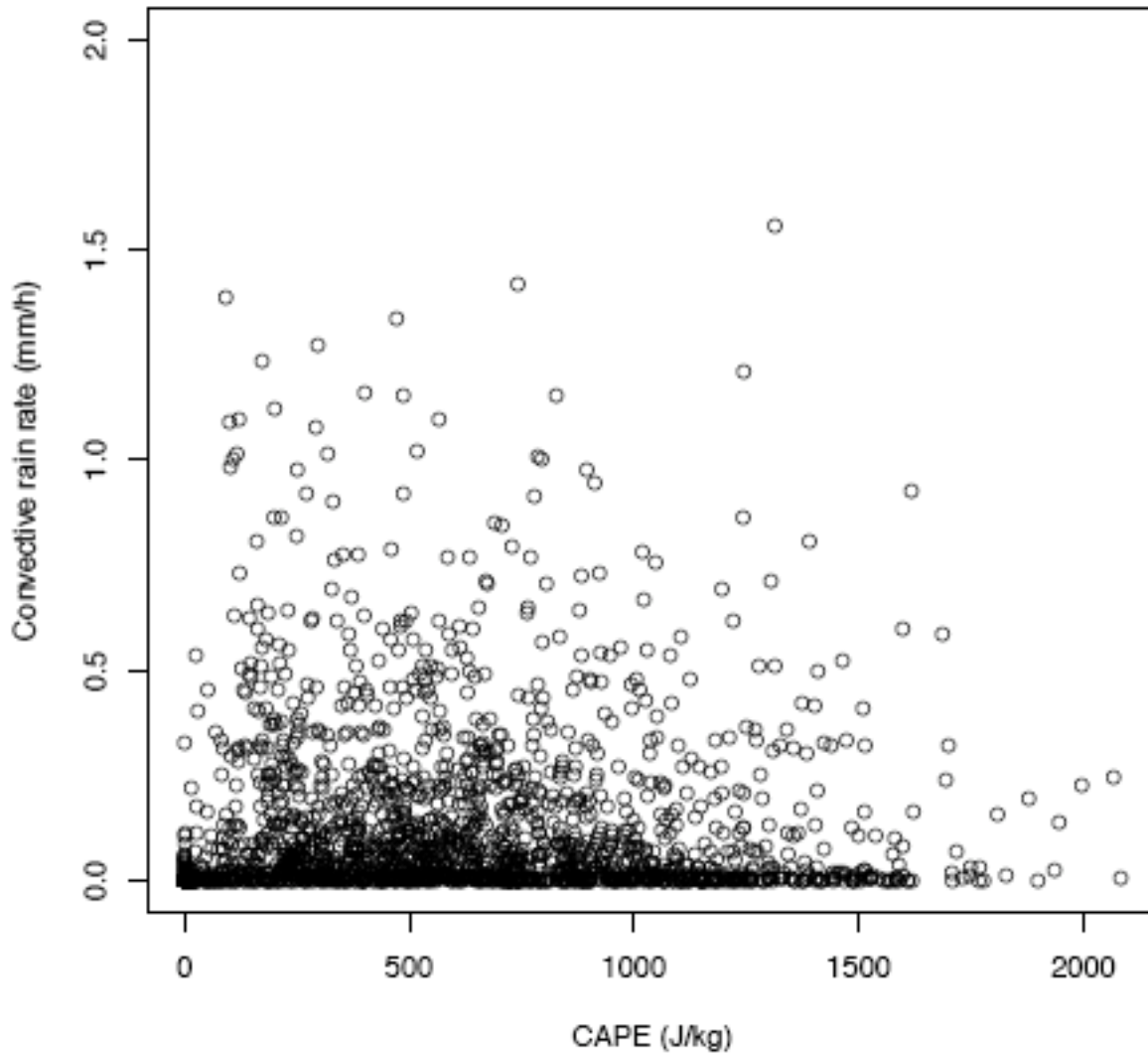
Unresolved subgrid variability, perhaps (e.g., cold pools)

But not accounted for in the current generation of cumulus parameterizations



Is “success” in producing observed precip actually an artifact of closures based on vertically integrated quantities?

# No observational support for such closures (Jakob, 2011)



# Conclusions

- **Relaxation to observations produces state with considerable CIN at time of precip onset on spatial scale of forcing**
  - **Due to propagation of systems into domain**
  - **Due to mesoscale (e.g. frontal) unresolved uplift**
- **Schemes with parcel lifting triggers should be suppressed by this until they adopt subgrid variance**
- **Schemes with integral constraint triggers (e.g., CAPE) may not...so they rain correctly for wrong reason**
- **SCMs also should not be able to sustain precip as long as observed until they adopt lagged mesoscale organization**
- **Beware beauty contests!**