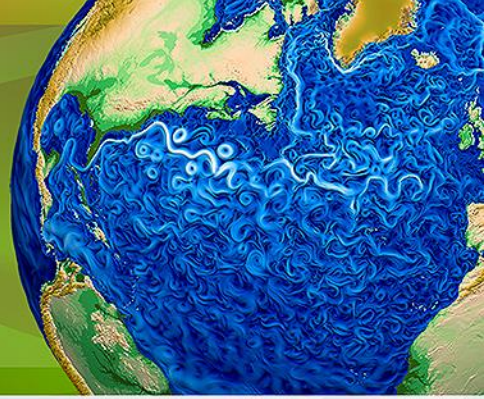
ACME
Accelerated Climate Modeling for Energy



Evaluating monsoon circulations in ACME v1 ne30 experiments

Bryce Harrop, Phil Rasch, Po-Lun Ma
Pacific Northwest National Laboratory

ACME All-Hands Meeting

June 8, 2016

Monsoons and why we care

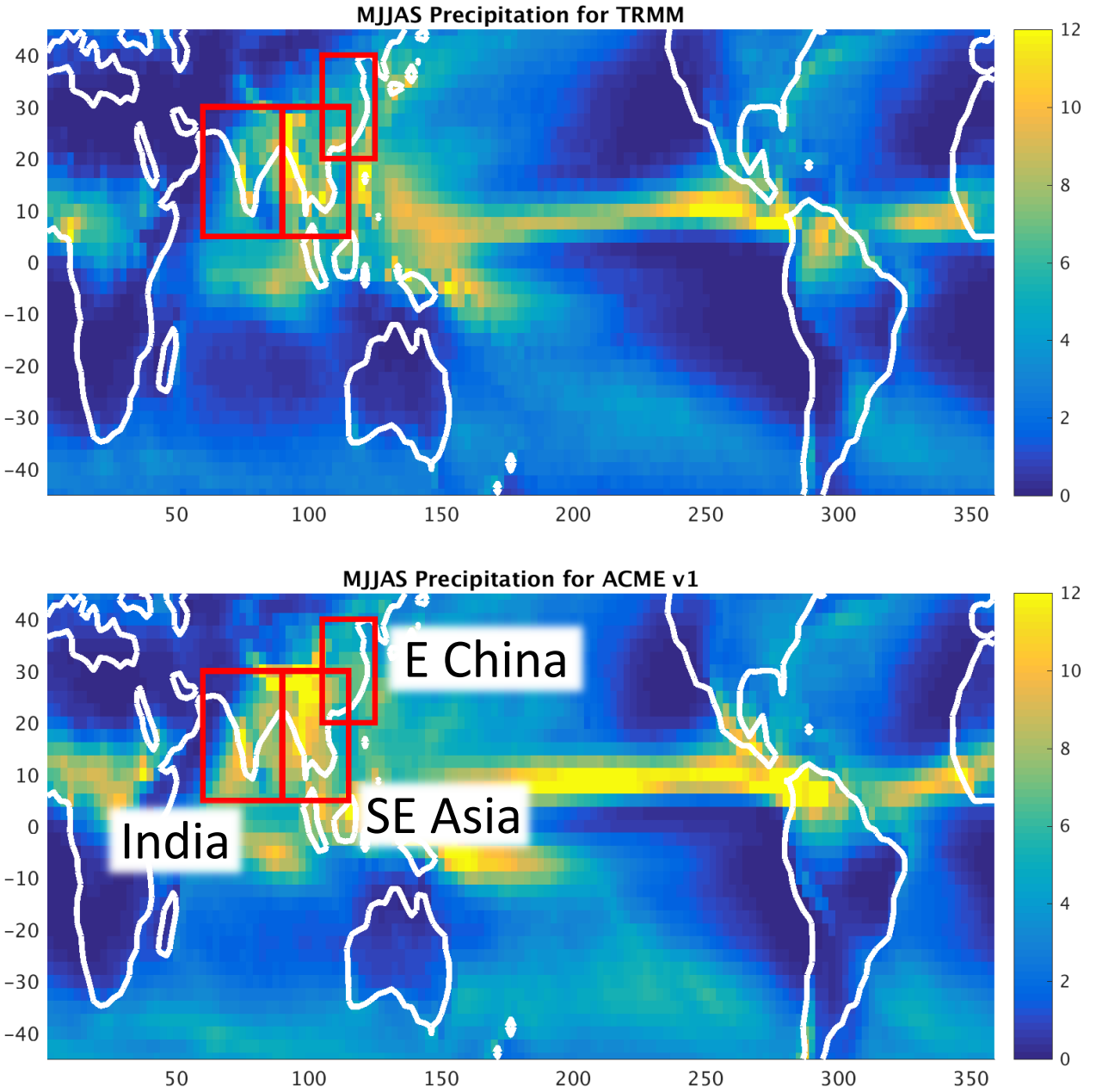
- Monsoon rainfall supplies water for over half of the world's population
- The global monsoon system is the dominant mode of seasonal variability in the Tropics
- We still lack a complete picture of the physical mechanisms responsible for the monsoon dynamics.

Questions and design

- We want to address the following questions:
  - How well does the current version 1 model simulate the monsoon globally as well as over India, SE Asia, and E China compared to observations?
  - Has monsoon simulation in ACME v1 improved relative to ACME v0 or CAM 5?
- Design
  - We have 69 ACME v1 experiments from the tuning processes (61 1-year integrations and 8 5-year integrations) – all re-gridded to a consistent 2.5°x2.5° grid.
  - Compute mean, Pattern Correlation Coefficient (PCC), and pattern RMSE for monsoon metrics between ACME v1 and observations and compare these skill scores to ACME v0 as well as CAM 5.
  - Focus on global monsoon (0-360E, 30S-30N), Indian monsoon (60-90E, 5-30N), SE Asian monsoon (90-115E, 5-30N), and E China monsoon (105-125E, 20-40N).

Summer (MJJAS) precip ACME v1 compared to TRMM

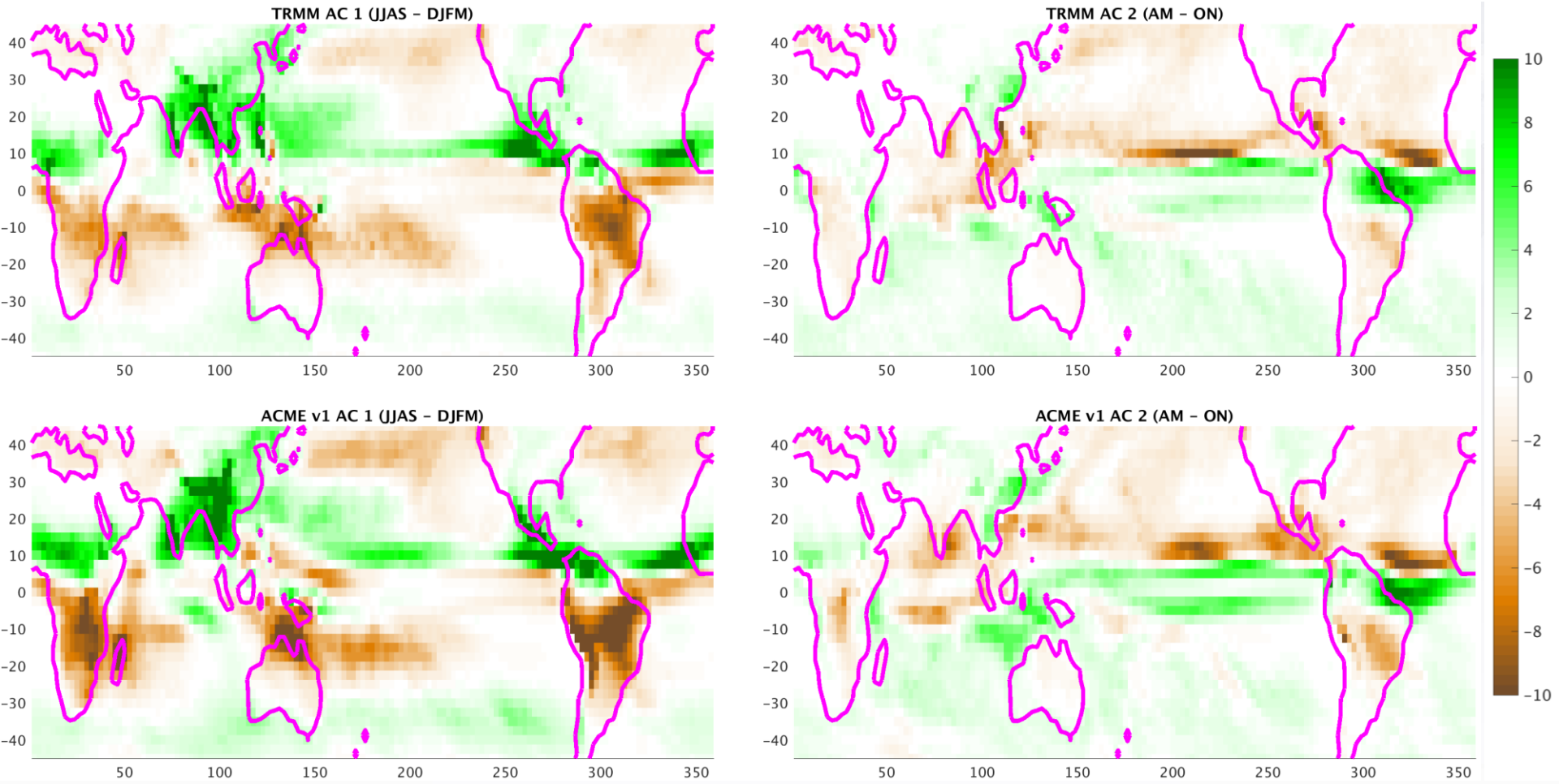
Regional boxes in red



Annual Cycles of Precipitation

AC 1 (JJAS – DJFM)

AC 2 (AM – ON)



Monsoon Precipitation Index (MPI)

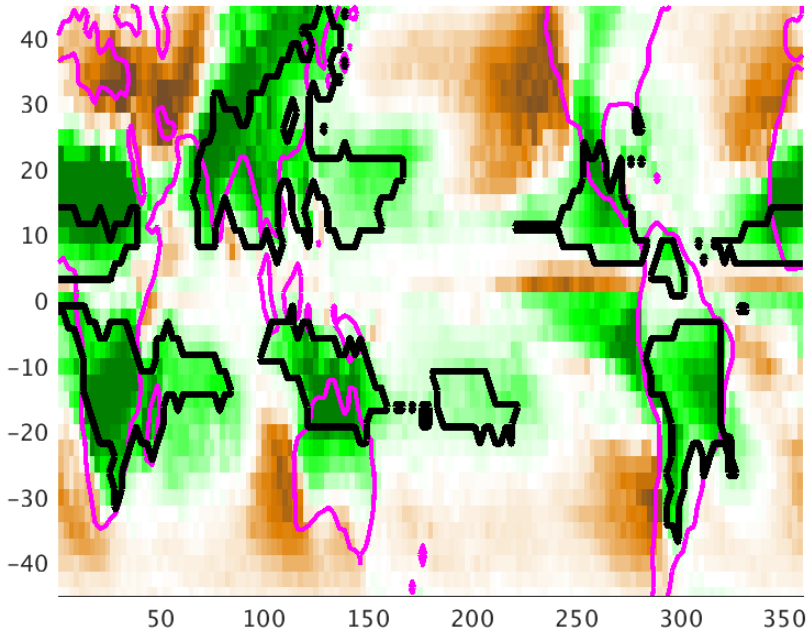
$$\text{MPI} = \frac{\text{Annual range of precipitation}}{\text{Annual mean precipitation}}$$

Defined by Wang & Ding, 2008

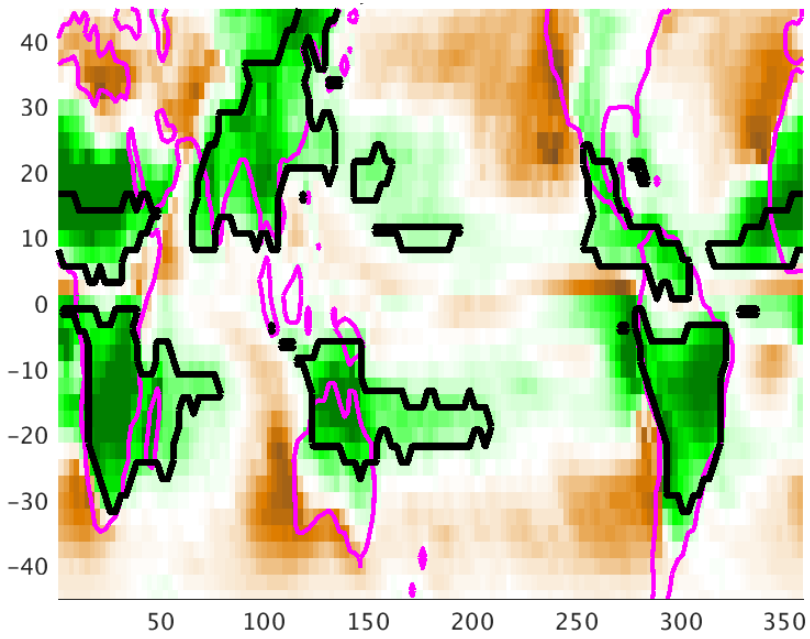
- Monsoon domain defined as MPI > 0.55 and the annual precipitation range (summer-minus-winter) > 2.5 mm/day (following Lee & Wang 2014).

Monsoon Precipitation Index (MPI)

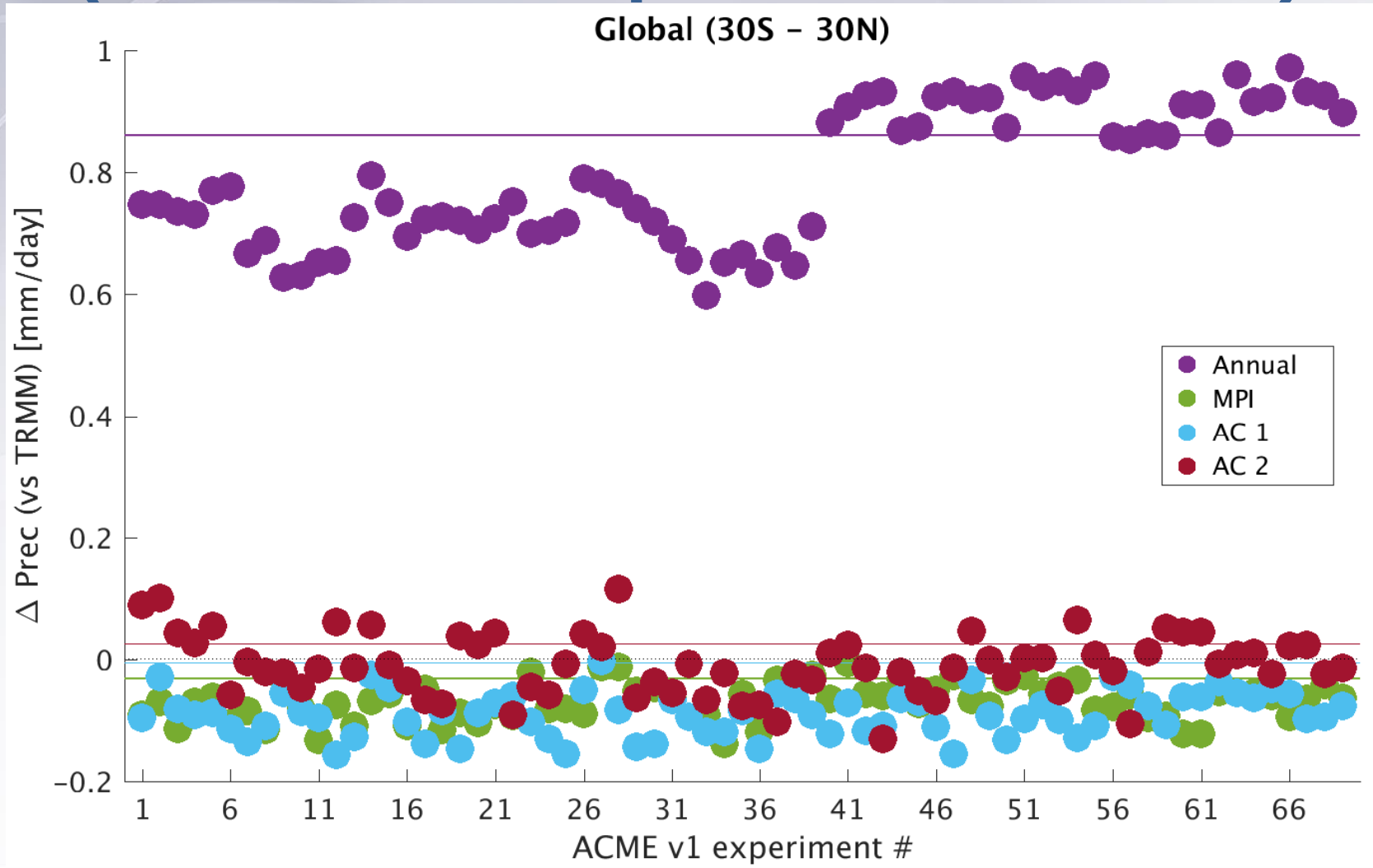
TRMM



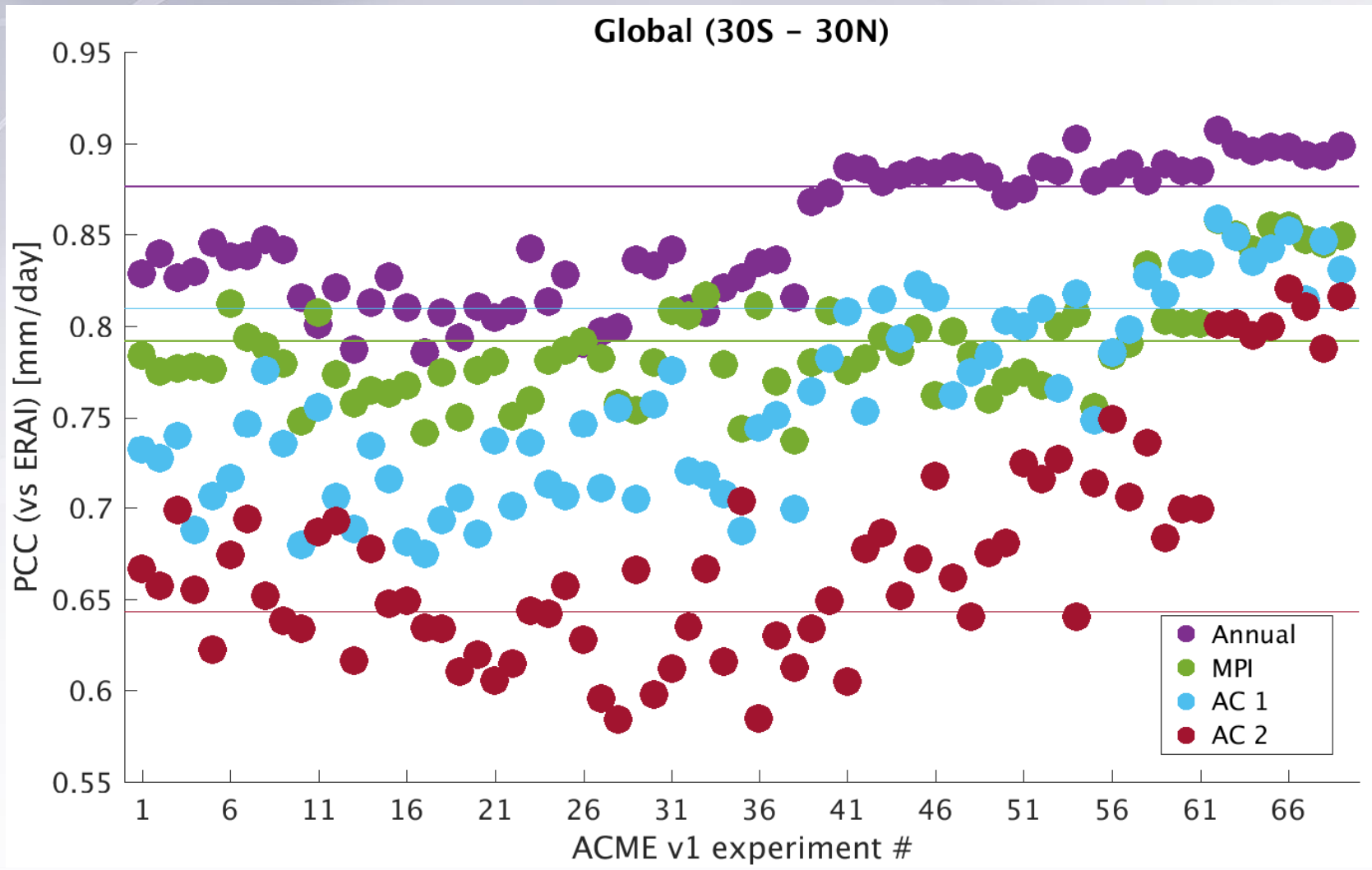
ACME v1



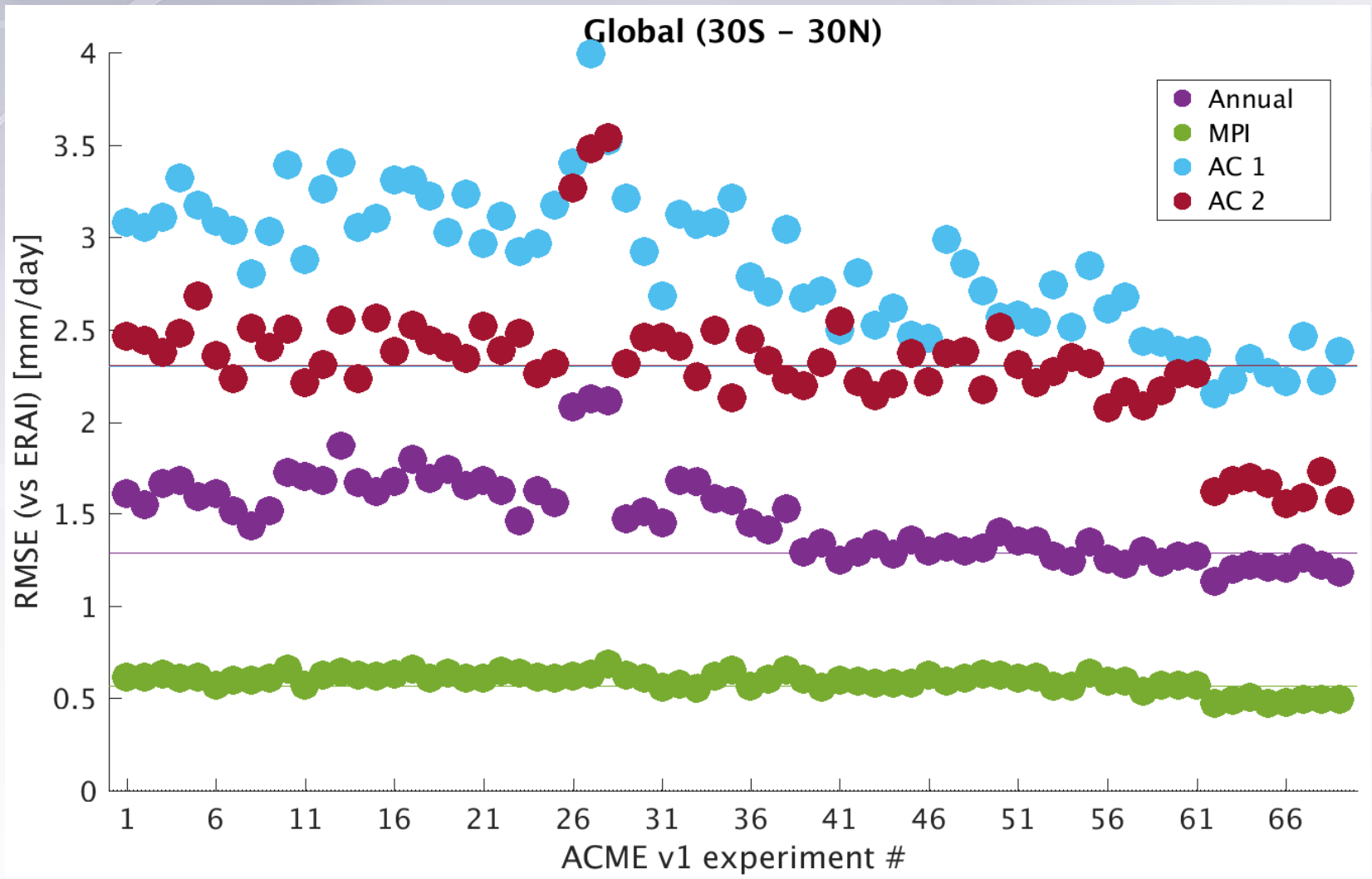
Precipitation bias over Tropics (ACME v1 compared with TRMM)



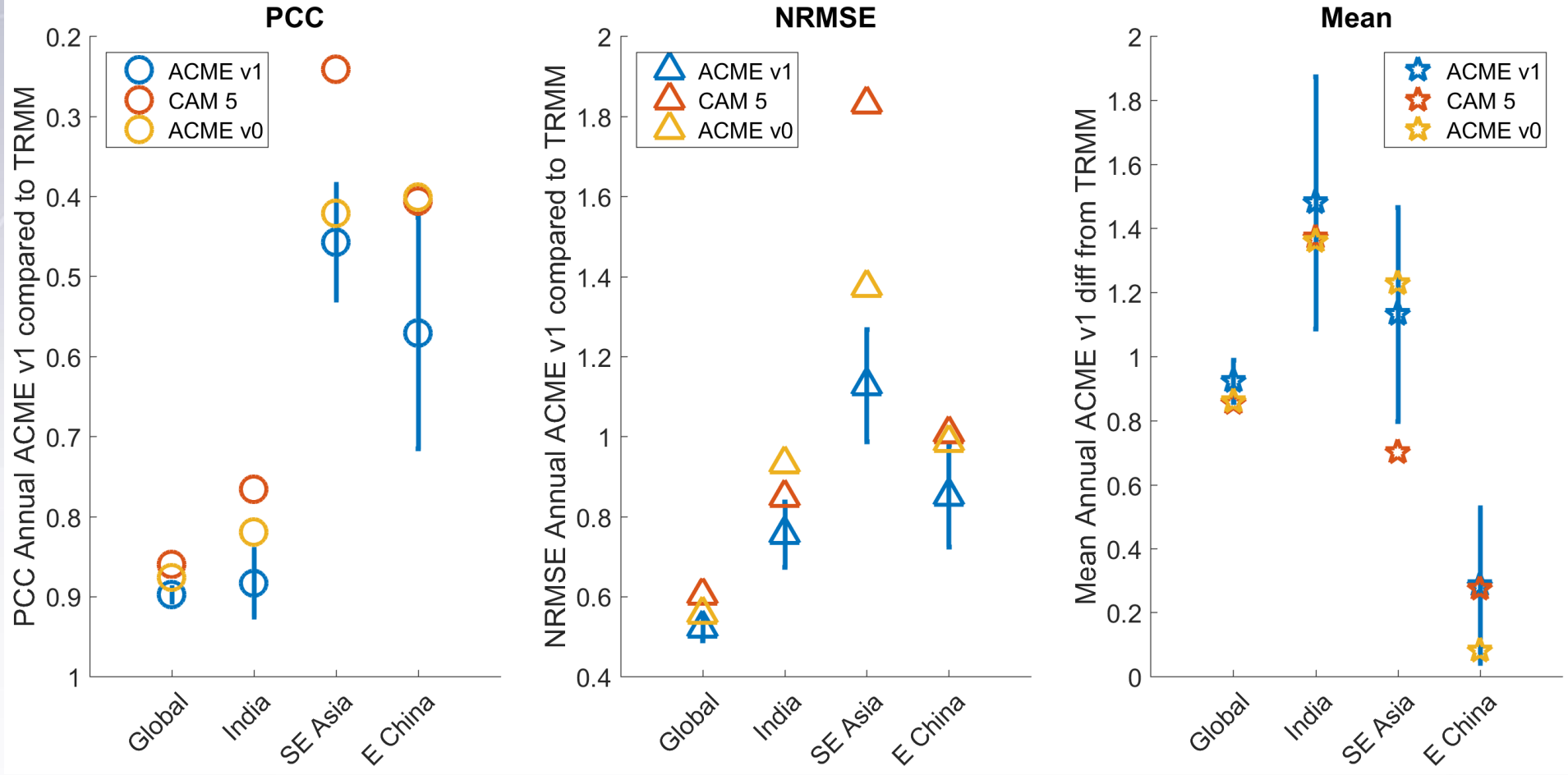
Pattern Correlation Coefficients



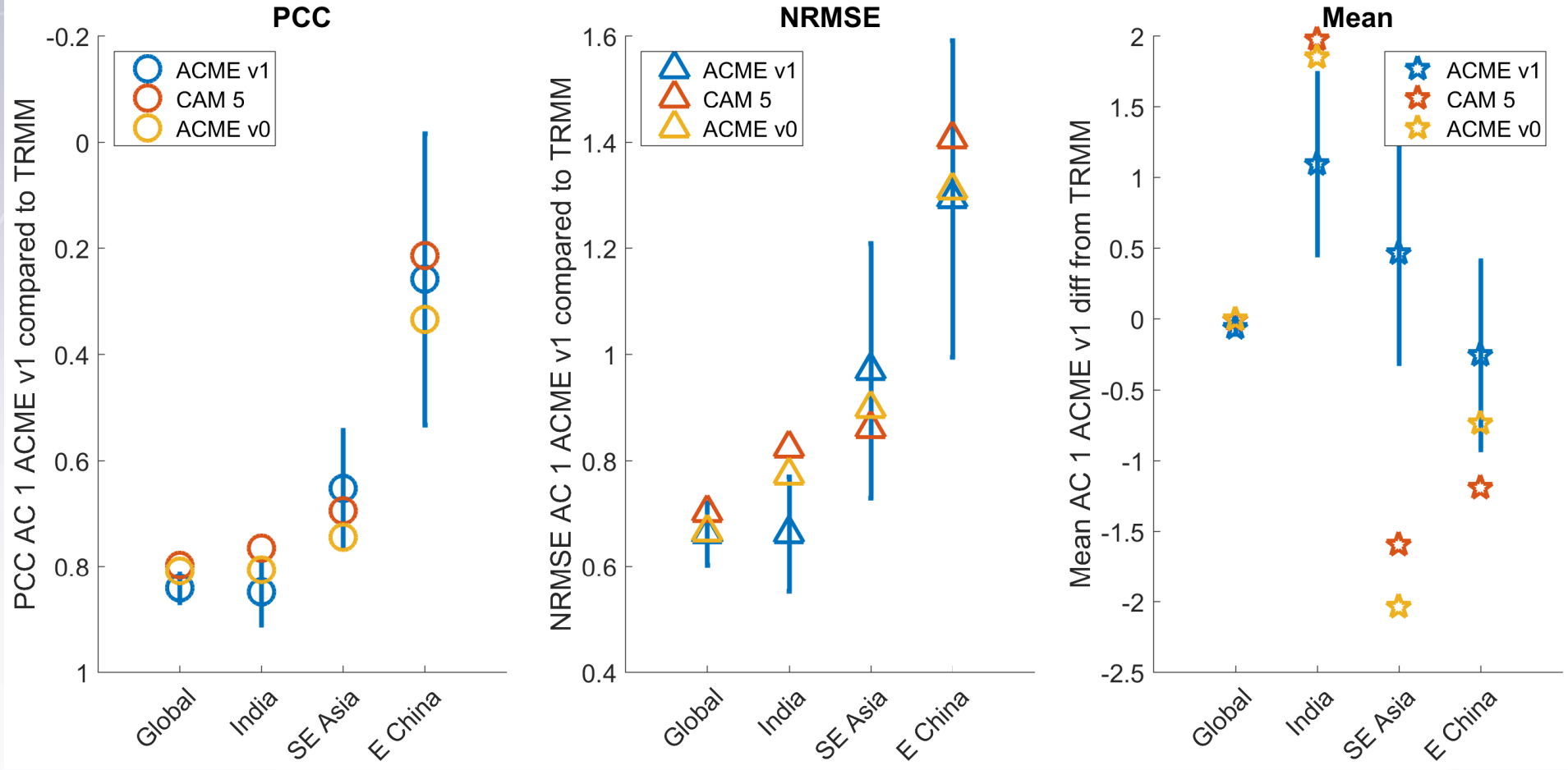
Centered pattern RMSE



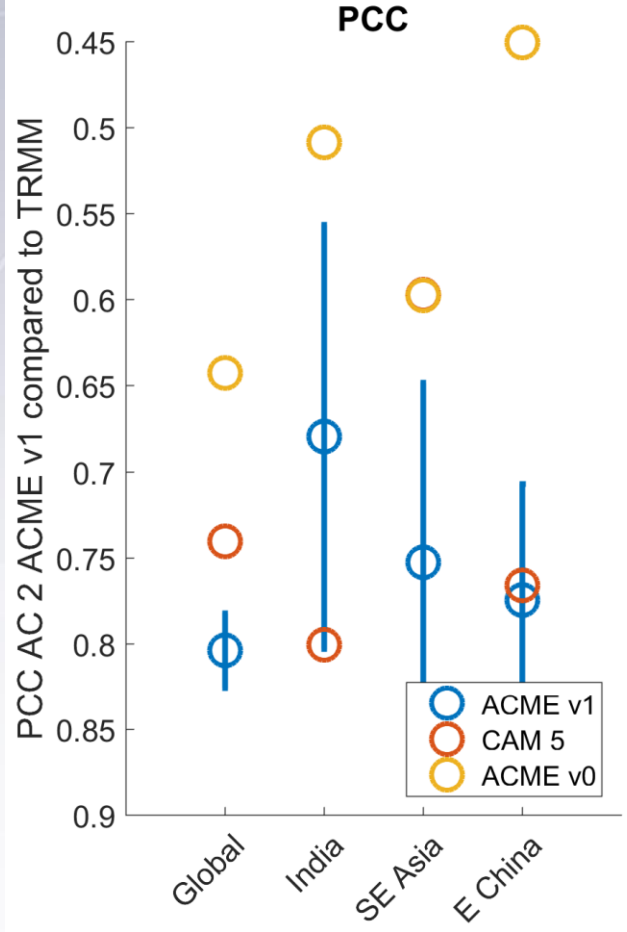
Comparing ACMEv1 to ACMEv0 & CAM
Annual mean Precipitation

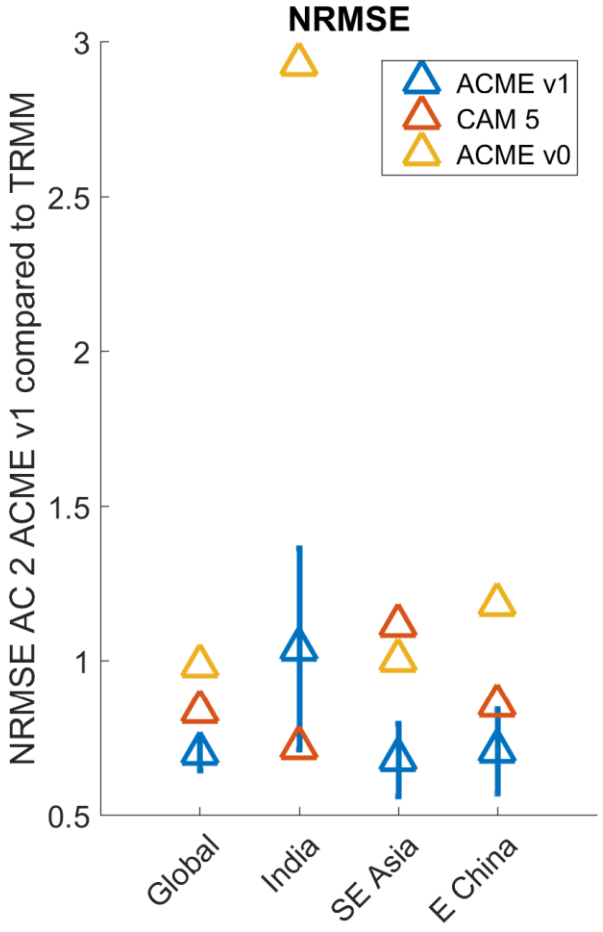


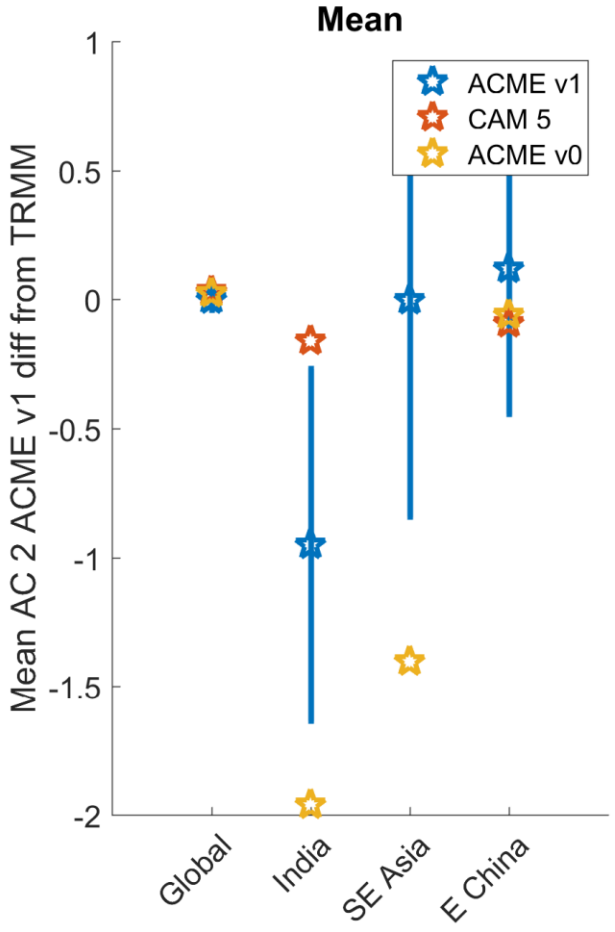
Comparing ACMEv1 to ACMEv0 & CAM Annual Cycle 1 (JJAS – DJFM)



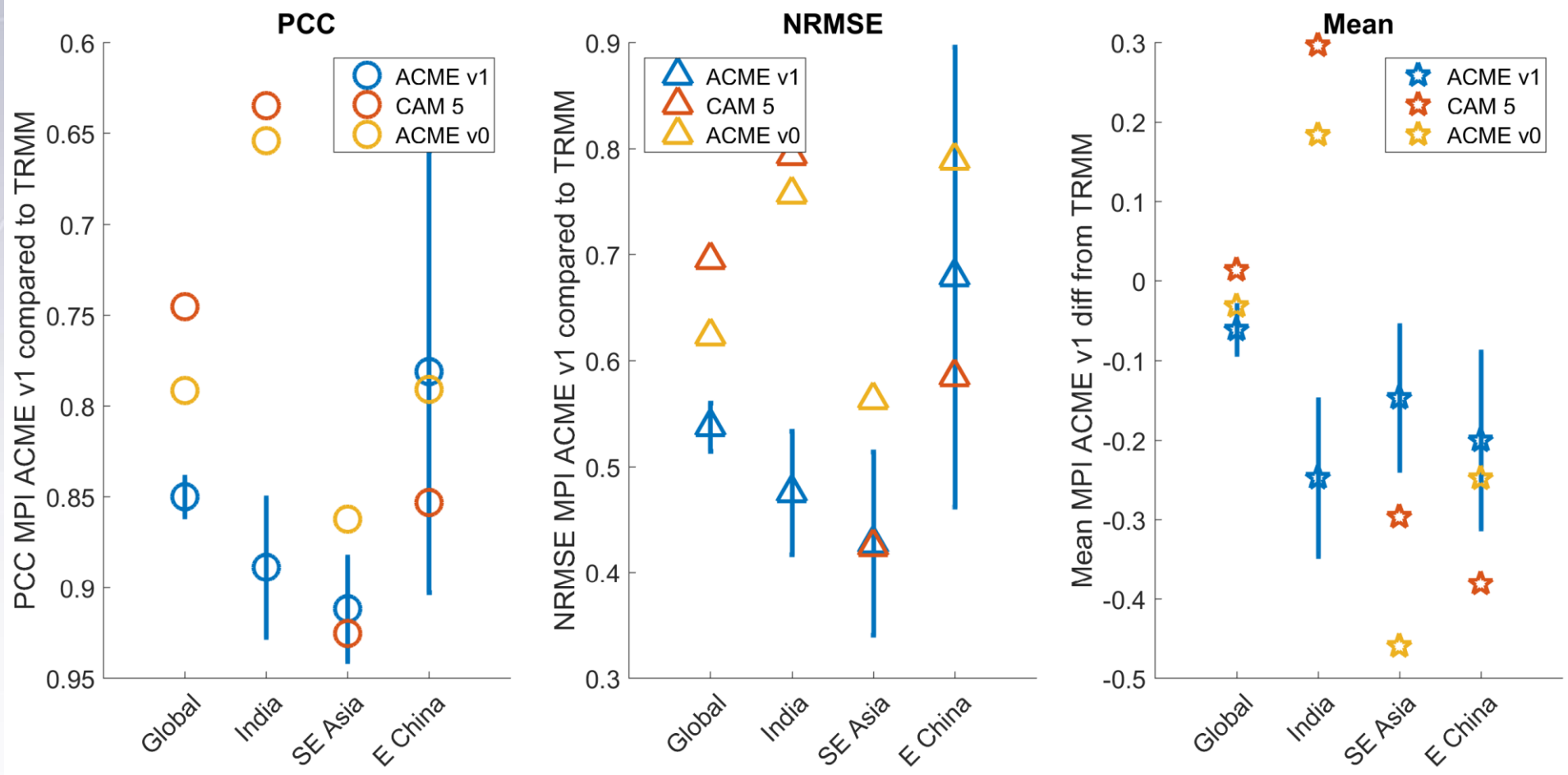
Comparing ACMEv1 to ACMEv0 & CAM Annual Cycle 2 (AM – ON)







Comparing ACMEv1 to ACMEv0 & CAM Monsoon Precipitation Index



Conclusions

- Mean precipitation biases continue to exist in ACME v1 and the most recent tuning experiments show these biases have grown larger than those present in ACME v0.
- Spatial distributions of monsoon rainfall captured by Pattern Correlation Coefficient (PCC) and pattern RMSE between ACME v1 and observations show improvements over ACME v0 for global, Indian, and SE Asian monsoon.
- ACME v1 improved compared to vanilla CAM5 in its representation of global and Indian monsoons.
- All of the above results are almost identical when using GPCP or CMAP instead of TRMM.
- The temporal variability also shows improvements in ACME v1 over ACME v0, especially in the equinoctial mode (AM – ON).

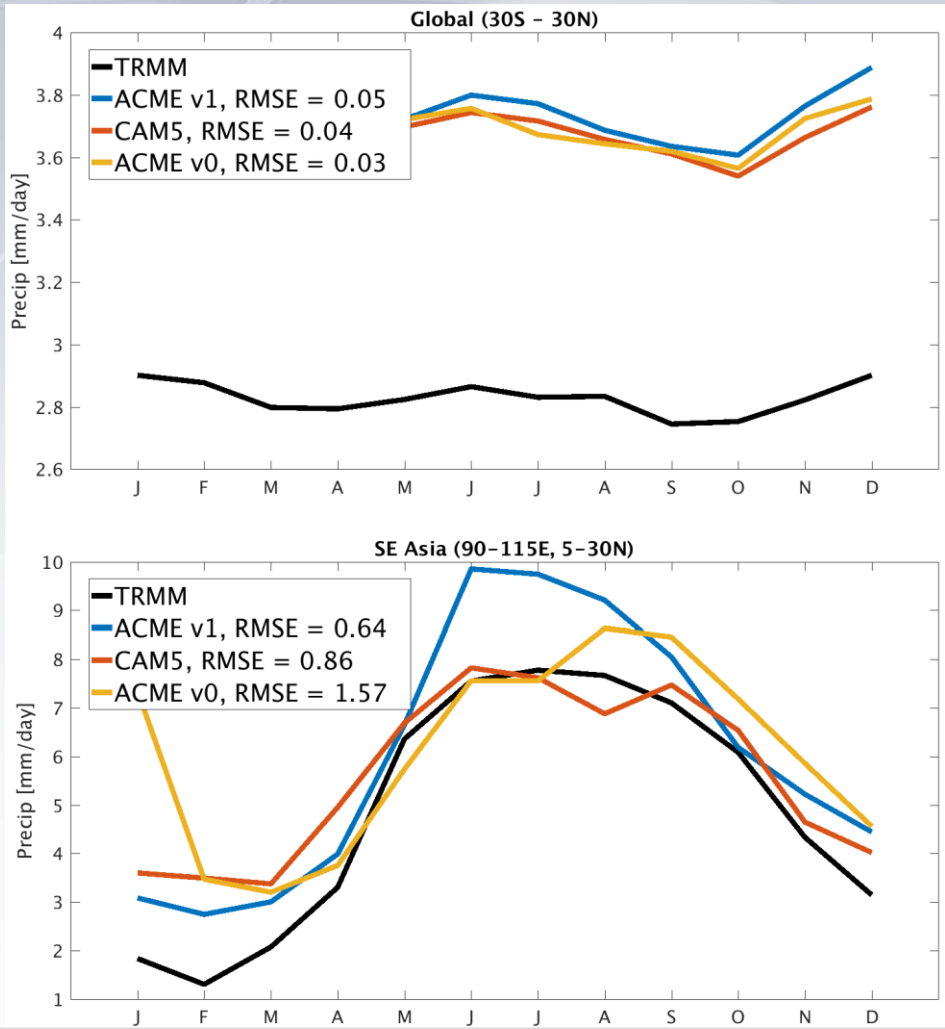
Next Steps

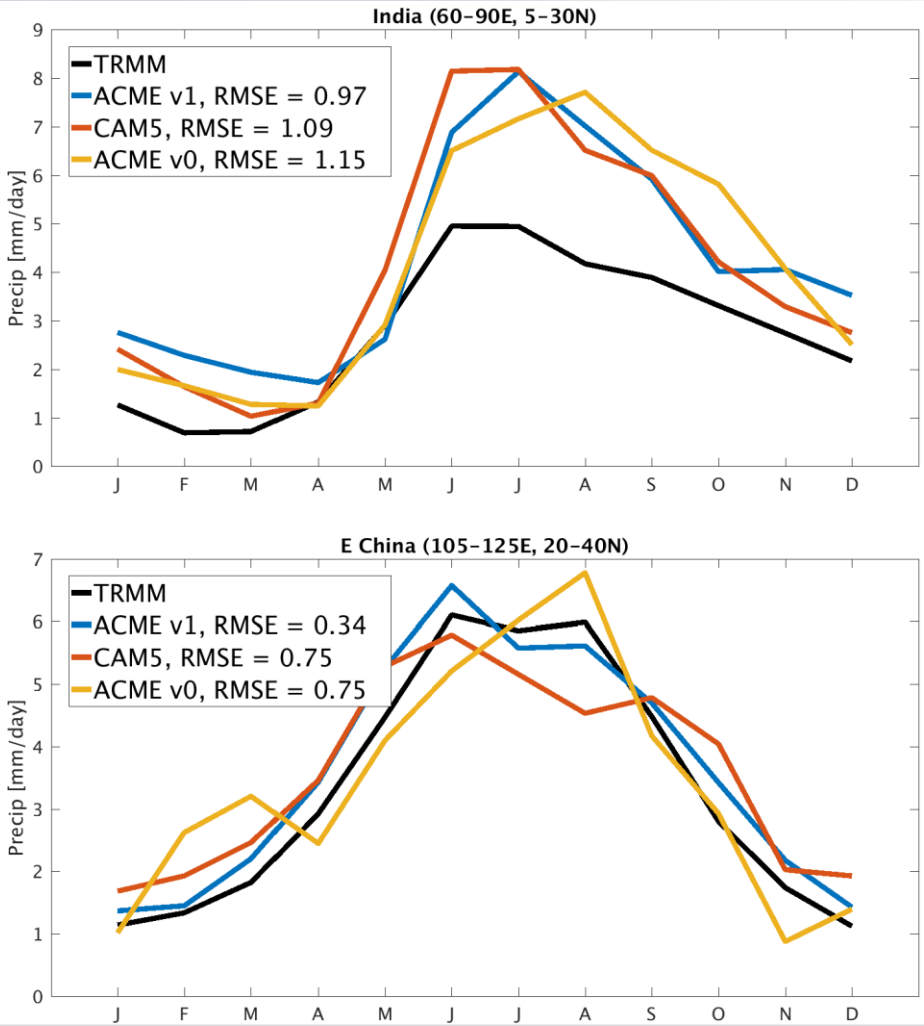
- Understanding the physical mechanisms responsible for the monsoon in ACME
- Determining what factors between ACME v1 and v0 contributed to the improvement in the Indian monsoon.
- Why has there been such little change in the SE Asian and E China monsoons?

Questions?

Extra Slides

Seasonal precipitation cycle





Summary of patterns