
The CCPP-ARM Parameterization Testbed (CAPT): Progress and Results



Presented to

ARM Science Team
Poster presentation

Presented by

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And

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CAPT = CCPP-ARM Parameterization Testbed



Organizational aspects

- ***CAPT combines the strengths of 2 programs in the Dept. of Energy Office of Science (Office of Biological and Environmental Research (BER), Climate Research Division)***
 - **CCPP** (*Climate Change Prediction Program*)–
focus on GCM climate performance
 - **ARM**
- ***CAPT fosters collaborations between GCM developers (e.g. in CCPP) and parameterization specialists (e.g. in ARM)***



Outline

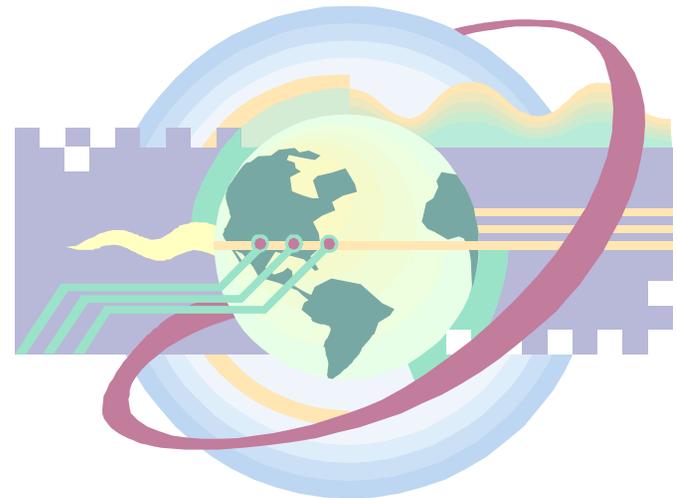


- **Review of CAPT plan**
- **Description of the CAPT methodology**
- **Examples from implementation in the Community Atmospheric Model (CAM)**
 - Identifying moisture prediction problems
 - Improving convective parameterization
- **Future plans**

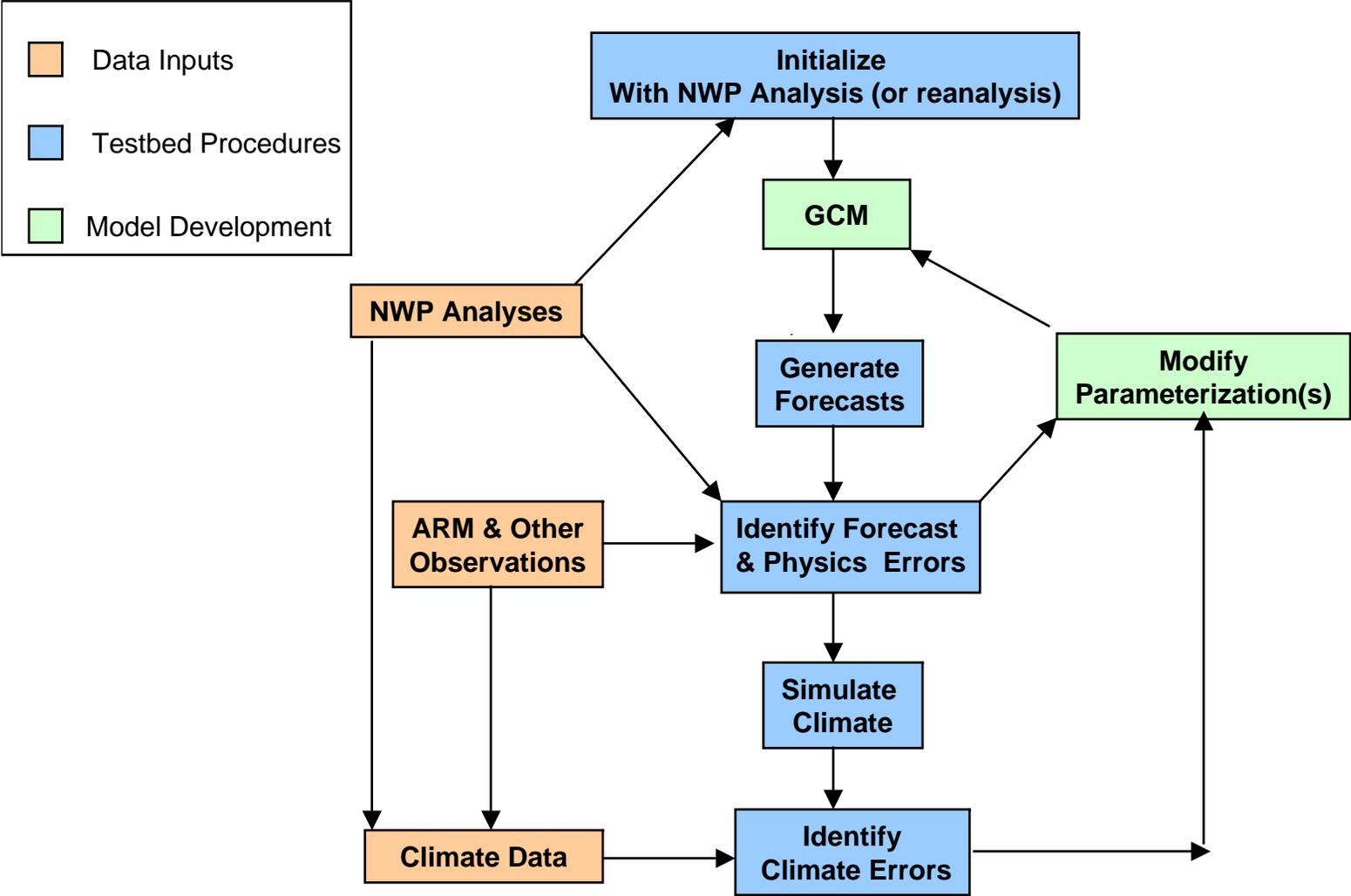
Review of our basic philosophy: implement NWP testing and improvement procedures



- Study the progression of the model's early drift away from initialization - ***days not months***
 - Short simulations
 - Errors are likely in the parameterization of physics (not large scale motions)
 - Directly comparable to intensive observations - like ARM

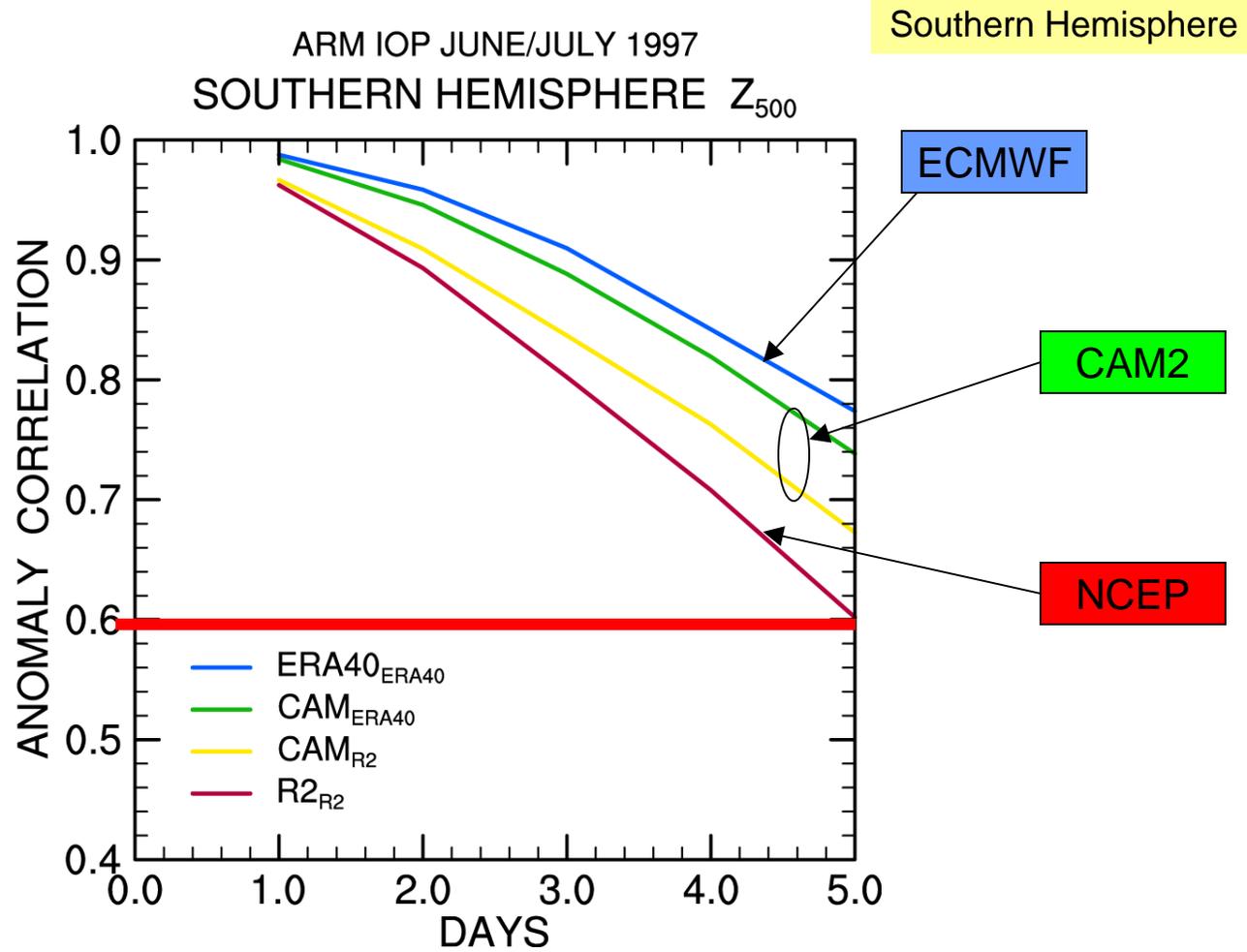


CAPT Diagnostic Protocol



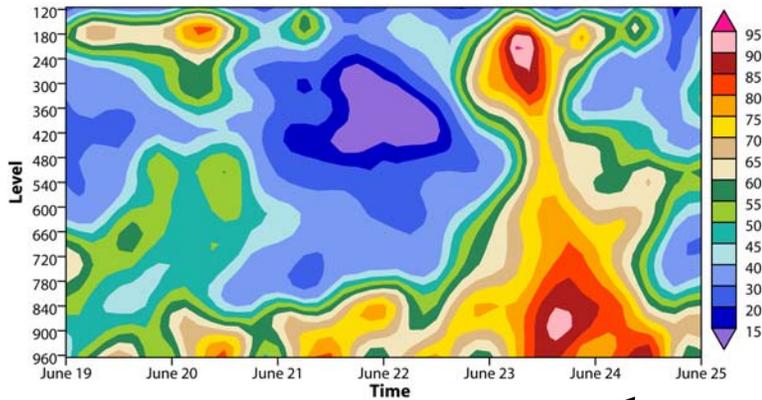
Forecasting with CAM2 - large scale dynamic features

Hemispheric-average 500mb height anomaly correlations in June/July 1997

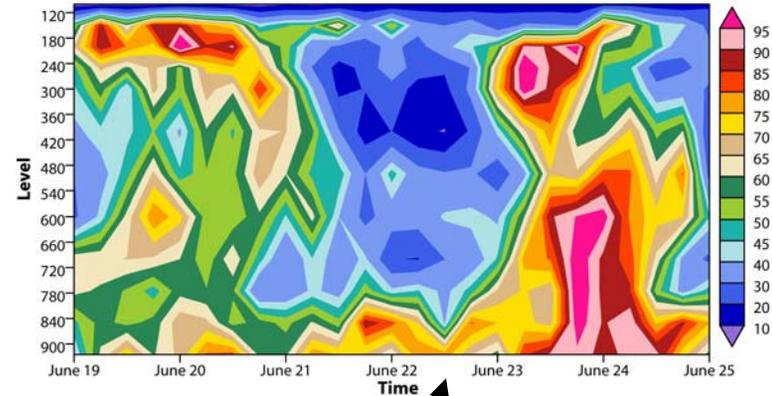


Relative humidity at ARM (SGP) is indicative of a major systematic error

ARM / SGP measurements

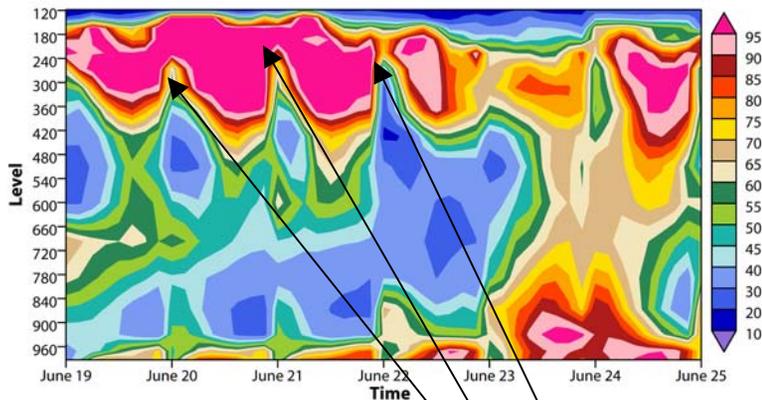


Interpolated ECMWF reanalysis



CAM2 forecasts, valid for 0-24 hours

19-24 June, 1997



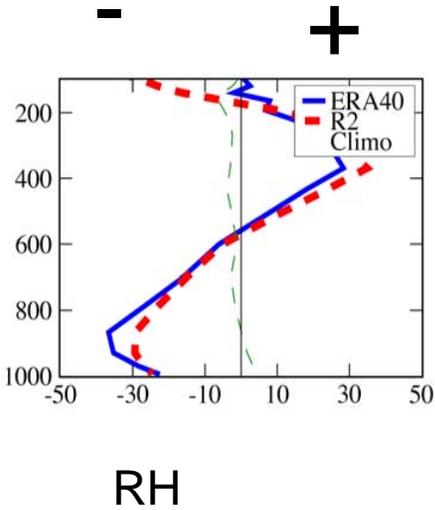
CAM2 forecasts of atmospheric moisture don't compare as favorably with observations, in particular at the ARM / SGP site.

Model re-initialized daily

Climate vs. forecast RH error at the SGP grid point

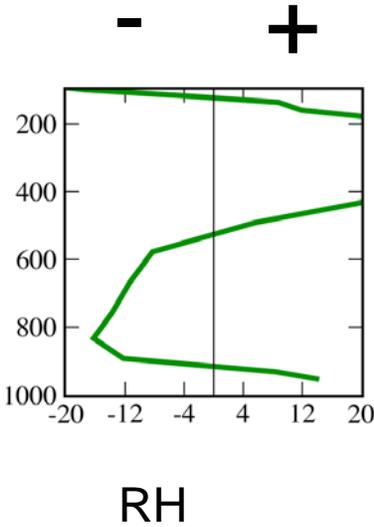


CAM2-observed ERA and R2 (climatology June)



Average of 10 years

CAM2-observed ARM (June 1997)

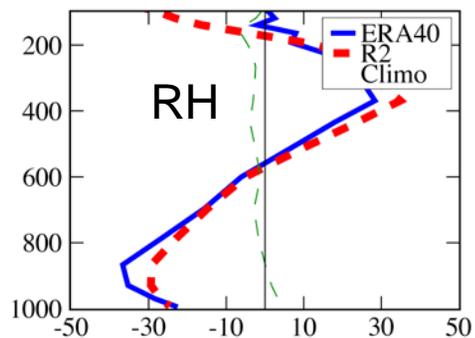
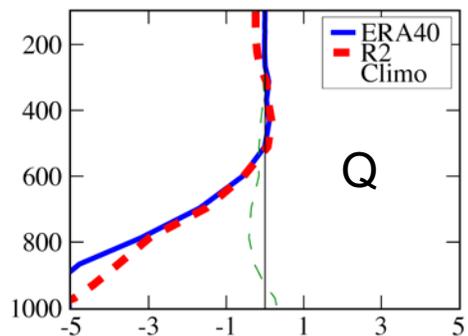
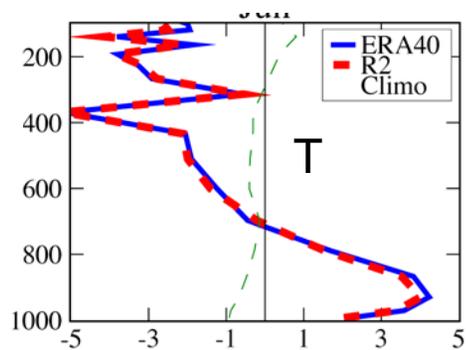


Average of 24-hour forecasts

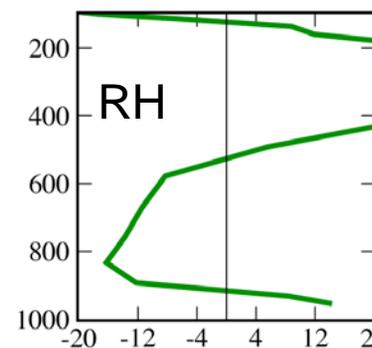
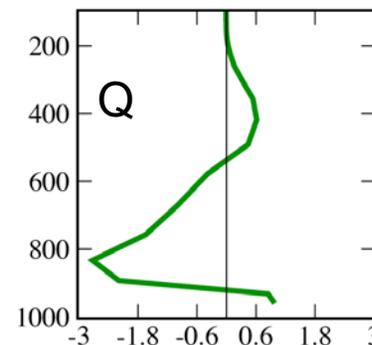
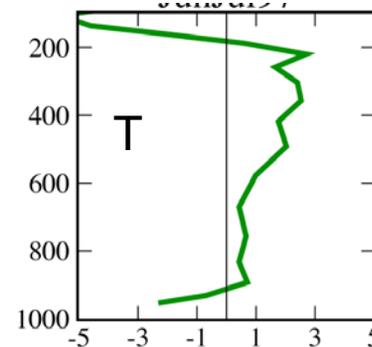
CAM2-observed ERA and R2 (climatology June)

CAM2-observed ARM (June 1997)

At the grid point
ARM site ~37N 97W



Average of 10 years



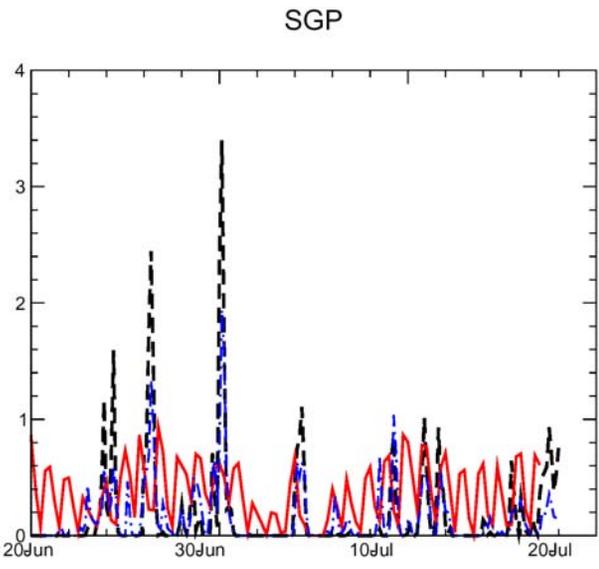
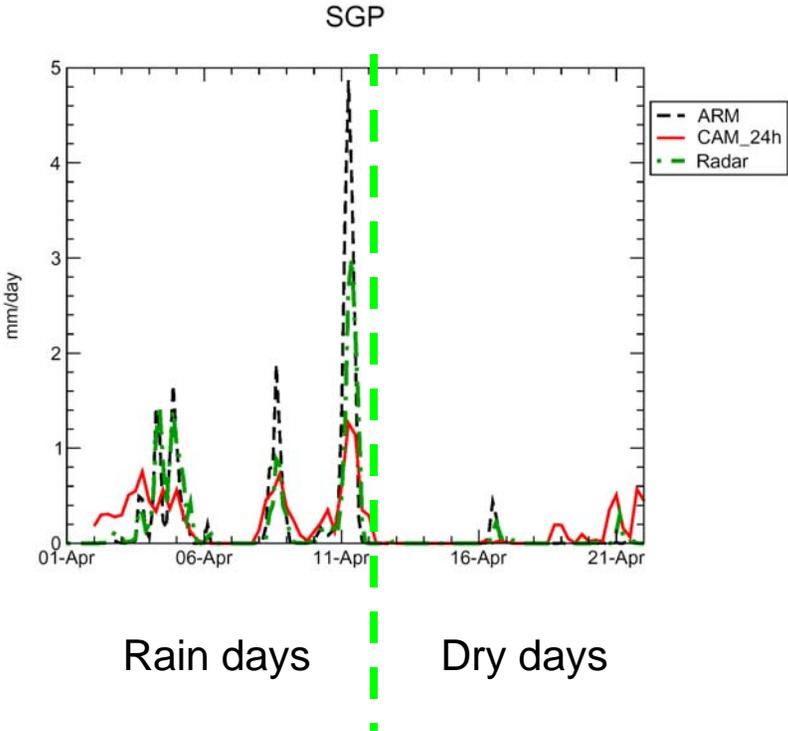
Average of 24-hour forecasts

Model produced precipitation at the SGP

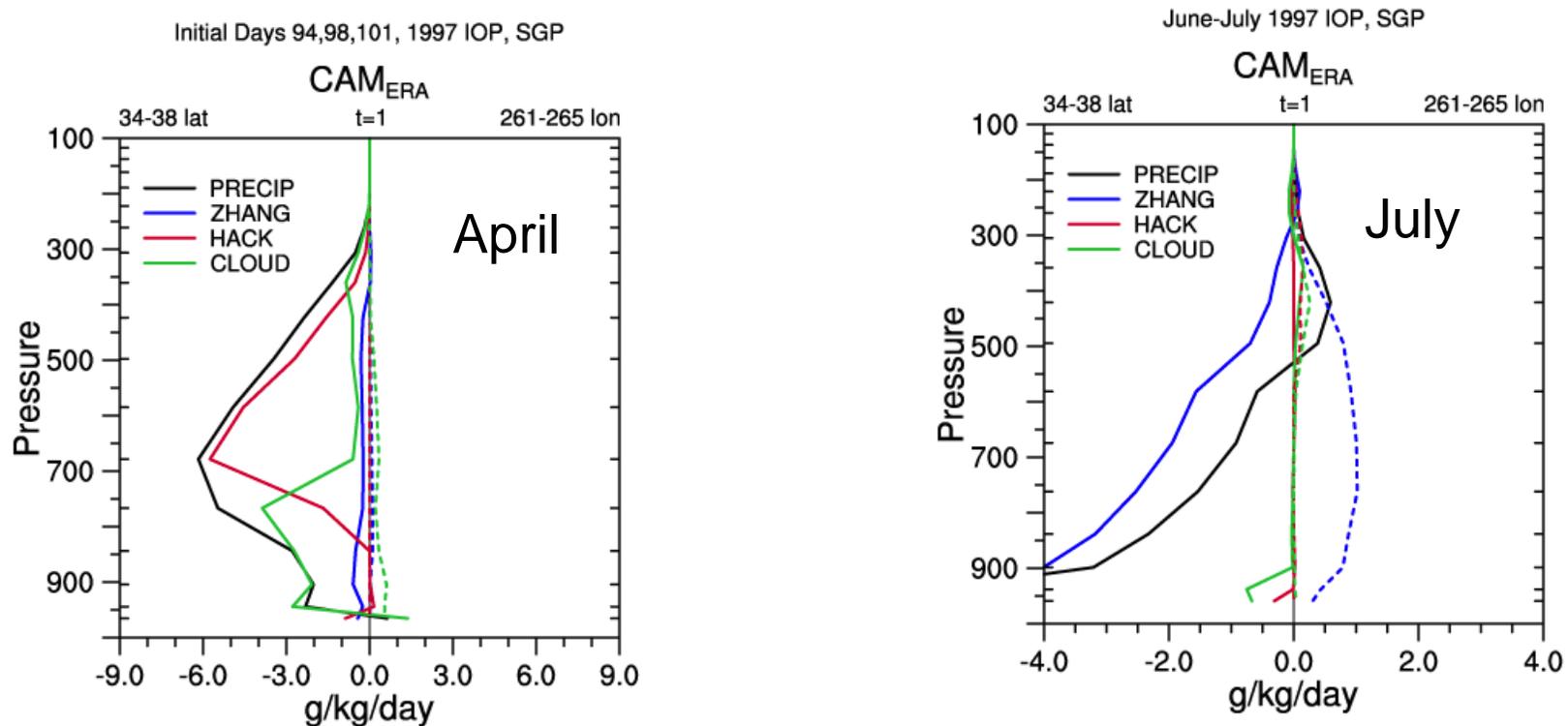


April 1997

July 1997



Components of the precipitation processes



Rain days

- Zhang convection
- Hack convection
- Prognostic cloud (replaces old grid-scale stable precip)
- Dashed is evaporation of rain for each component
- Total

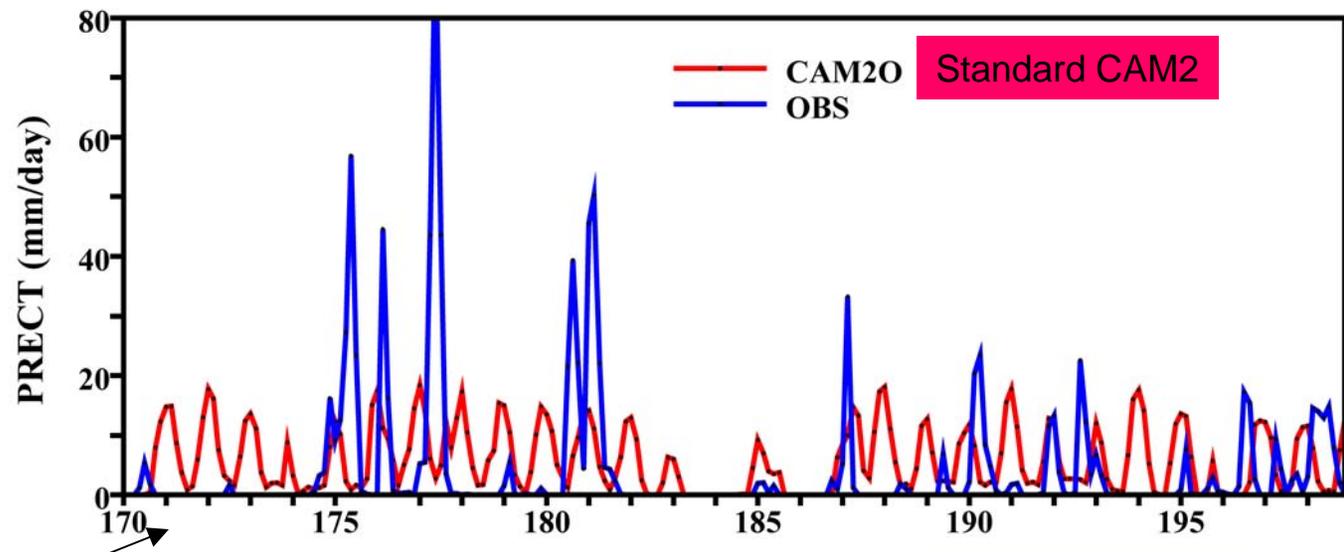
Using the CAPT framework to examine and improve parameterizations



- ***CAPT team member Shaocheng Xie has recently implemented a modified convective trigger function in the CAM2.***

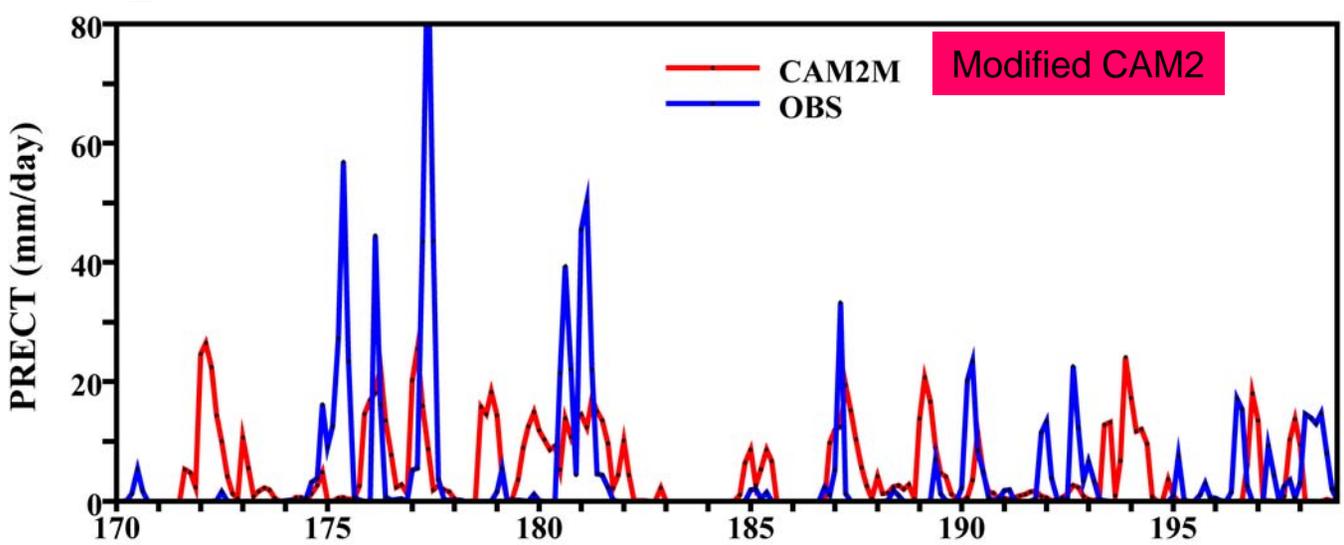
- ***A new convective trigger function (based on dynamical convective available potential energy—DCAPE) was developed to address errors-- see S. Xie and M. Zhang 2000 J. Geophys. Res., 105, 14983-14996.***

Simulated and Observed Precipitation



ARM/SGP Site

Time (Julian Days): June/July 1997



Time (Julian Days): June/July 1997

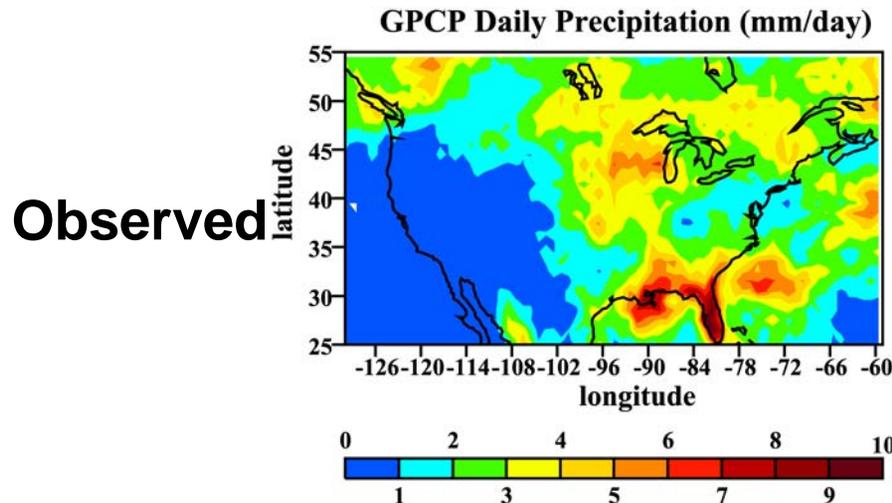
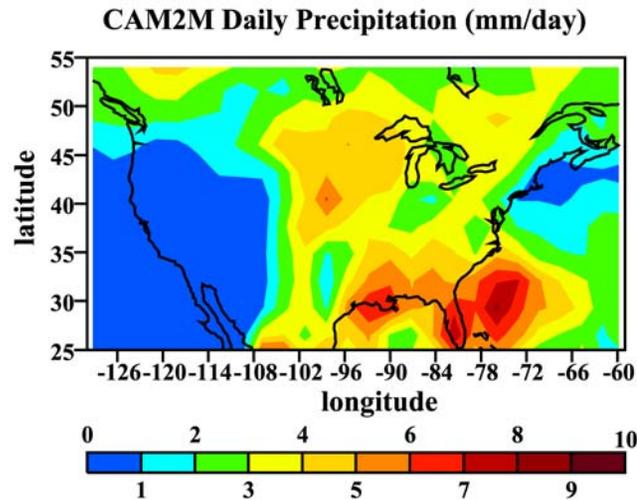
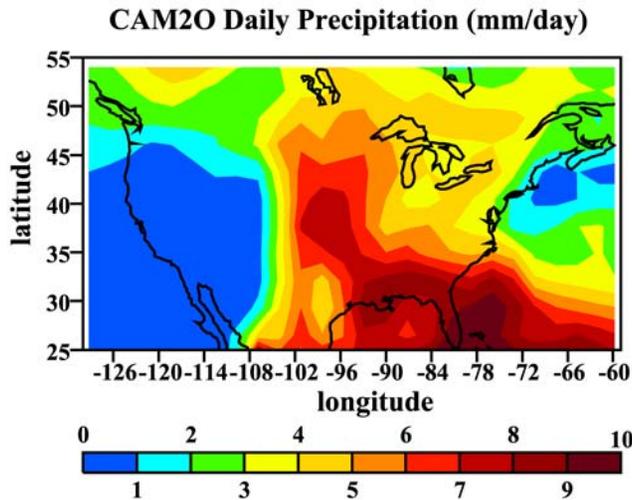
CAM2 CAPT Tests



Original

Modified trigger

Daily Precipitation Rates (mm/day)



- *The original model overestimates the observed precipitation in most parts of the United States while the excessive precipitation is clearly reduced using the new trigger*

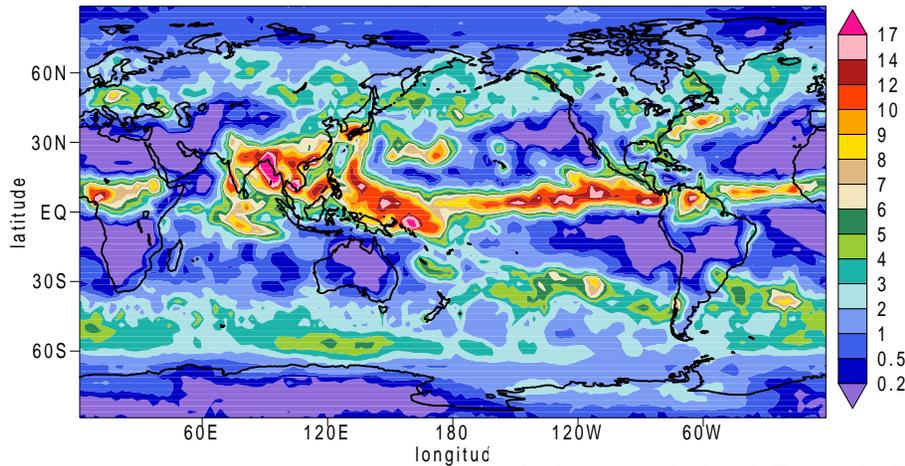
30-day ensemble mean of 0-24 hour forecasts (June 18 – July 17, 1997)

Change based on CAPT appears to improve the model climate

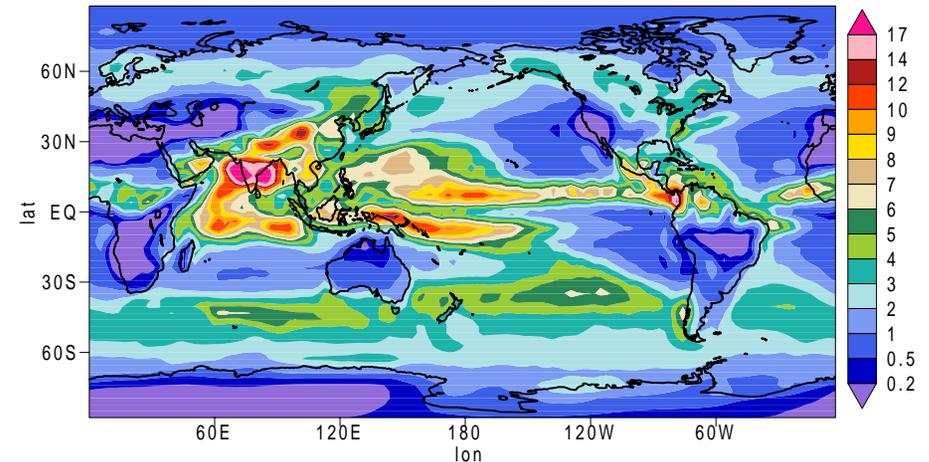


July **observed** GPCP Precipitation

pr_gpcp_
Mean 2.66518 Max 29.1919 Min 0

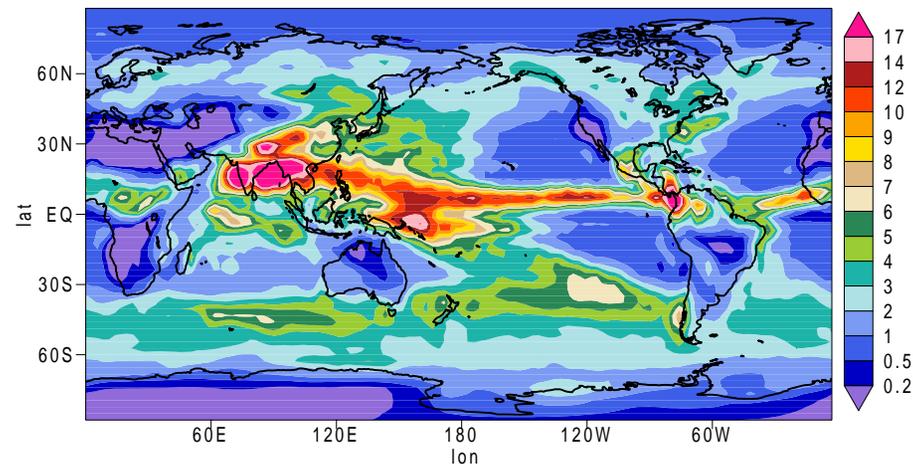


July **modeled** Precipitation in Standard CAM2



July **modeled** Precipitation in Modified CAM2

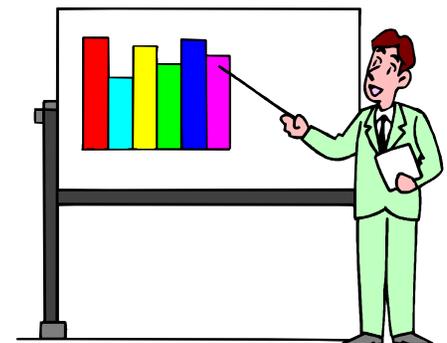
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Mean 3.04712 Max 28.0908 Min 0.00280819



Poster Summary



- **Run model in NWP forecast mode using reanalysis to initialize**
- **Analyze physical process errors and over short periods using ARM and other observational data**
- **Parameterization developers have improved the model and evaluated in CAPT**
 - **Improvement at ARM site regionally and globally**
 - **Over short periods and in climate**



CAPT Team



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As our most recent hire: Dr. Stephen Klein - GFDL

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