Recent Results from the CCPP-ARM Parameterization Testbed (CAPT *):

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*** CAPT home page: http://www-pcmdi.llnl.gov/projects/capt/**

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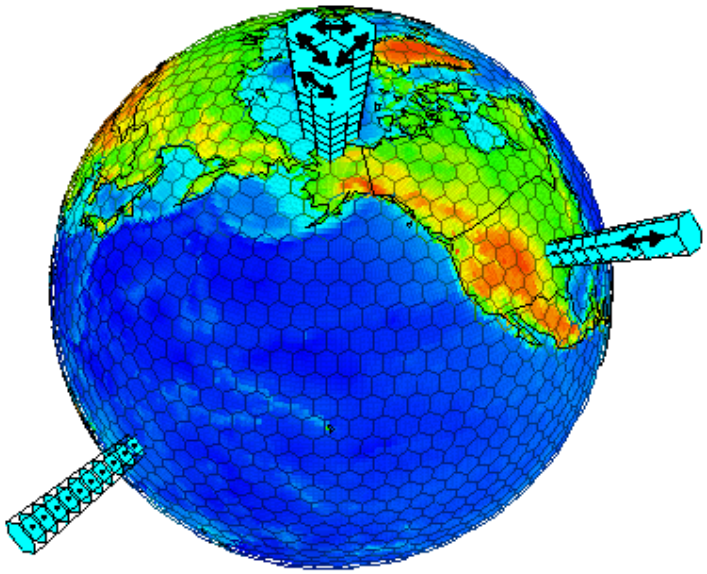
What is CAPT?

CAPT = CCPP-ARM Parameterization Testbed

- CAPT combines the strengths of 2 Dept. of Energy programs with complementary missions:
  - **CCPP (*Climate Change Prediction Program*)–**
    focus on climate GCM performance
  - **ARM (*Atmospheric Radiation Measurement*)–**
    focus on column observations of radiation/cloud processes and their parameterization
- CAPT fosters collaborations between GCM developers (e.g. in CCPP) and parameterization specialists (e.g. in ARM)



Graphic by Dave Randall

The CAPT Approach:
Evaluate Climate Model Parameterizations in Weather Forecast Mode

- Realistically initialize state variables in a climate GCM using NWP global 6-hourly analyses *remapped to the coarser model grid*.

  → make ~ 5-day weather forecasts

- Use high-frequency field observations (e.g. ARM data) to identify model forecast/physics errors

  → gain insights on parameterization deficiencies before feedbacks obscure the error sources

- Work with parameterization developers

  → test new schemes, first in forecast mode, and then in climate simulations to try to improve the model's performance

See article by Phillips et al. (December 2004 *BAMS*) for more on the CAPT philosophy and procedures:

EVALUATING PARAMETERIZATIONS IN GENERAL CIRCULATION MODELS:

Climate Simulation Meets Weather Prediction

BY THOMAS J. PHILLIPS, GERALD L. POTTER, DAVID L. WILLIAMSON, RICHARD T. CEDERWALL, JAMES S. BOYLE, MICHAEL FIORINO, JUSTIN J. HNILO, JERRY G. OLSON, SHAOCHENG XIE, AND J. JOHN YIO

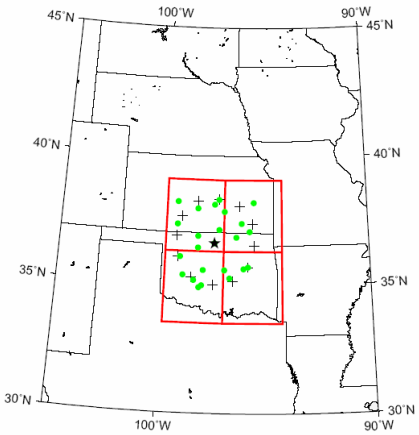
Numerical weather prediction methods show promise for improving parameterizations in climate GCMs.

Diagnosis of CAM2 in NWP configuration at ARM sites

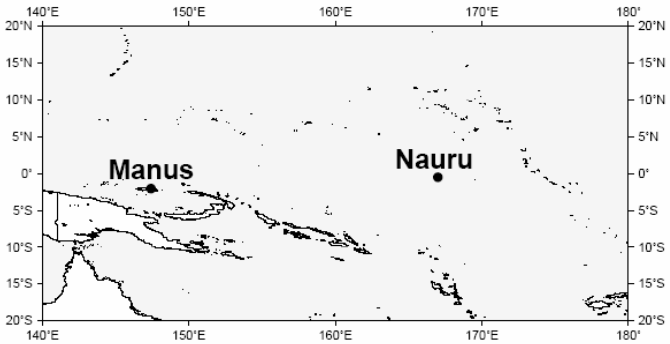
J. Boyle[1], D. Williamson[2], R. Cederwall[1], M. Fiorino[1],
J. Hnilo[1], J. Olson[2], T. Phillips[1], G. Potter[1], S. Xie[1]

Paper by Boyle et al. (2005 *JGR*, in press) elaborates on CAPT diagnosis of forecasts of version 2 of the Community Atmosphere Model (*CAM2)*

April and June/July 1997 at ARM Southern Great Plains (SGP) Site

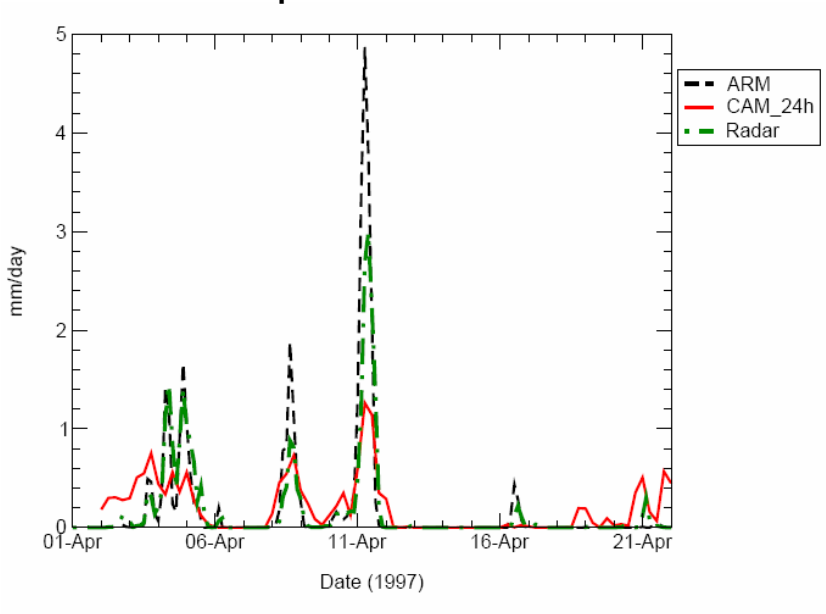


March 2000 at ARM Tropical West Pacific Sites Manus and Nauru

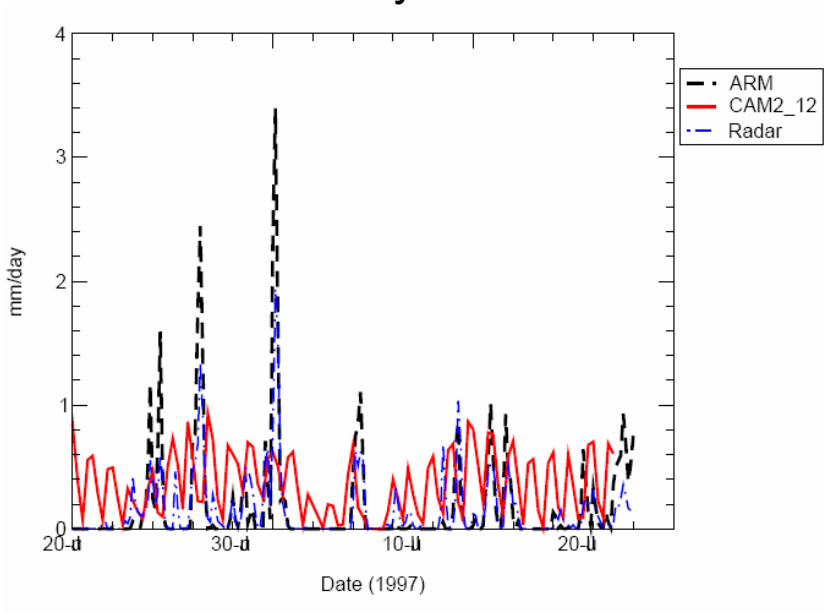


Precipitation: Observations vs. *CAM2* Forecasts at the ARM/SGP Site

April 1997

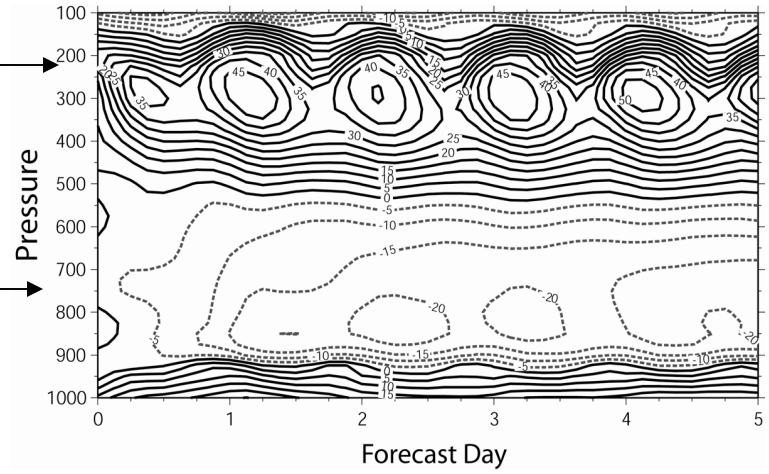


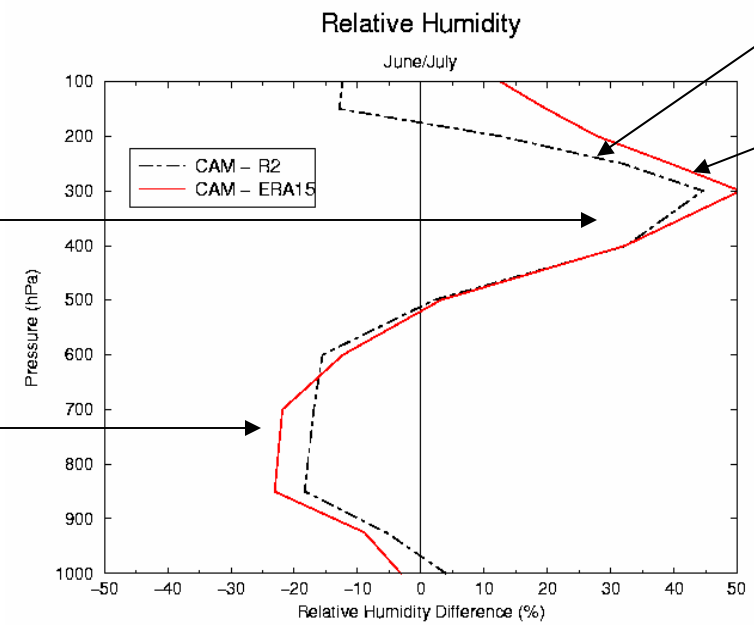
June/July 1997



CAM2 forecasts of precipitation coincide with observations in Spring (frontal precip), but not in Summer (convective precip)

At the ARM/SGP site, similar vertical error structures are seen in composited 5-day forecasts of relative humidity (RH) for June/July 1997 and in a 10-year June/July climatology :





Moisture and temperature balances
at the ARM Southern Great Plains Site
in forecasts with the CAM2

D. L. Williamson[1], J. Boyle[2], R. Cederwall[2], M. Fiorino[2],
J. Hnilo[2], J. Olson[1], T. Phillips[2], G. Potter[2] and S. C. Xie[2]

Paper by Williamson et al. (2005 *JGR*, in press) diagnoses atmospheric moisture and temperature tendencies in *CAM2* forecasts at ARM/SGP site

Atmospheric Moisture (q) Tendency Equation:

Local Tendency $\delta q/\delta t$ = Advective + Parameterization Tendencies

Constrained by realistic initialization

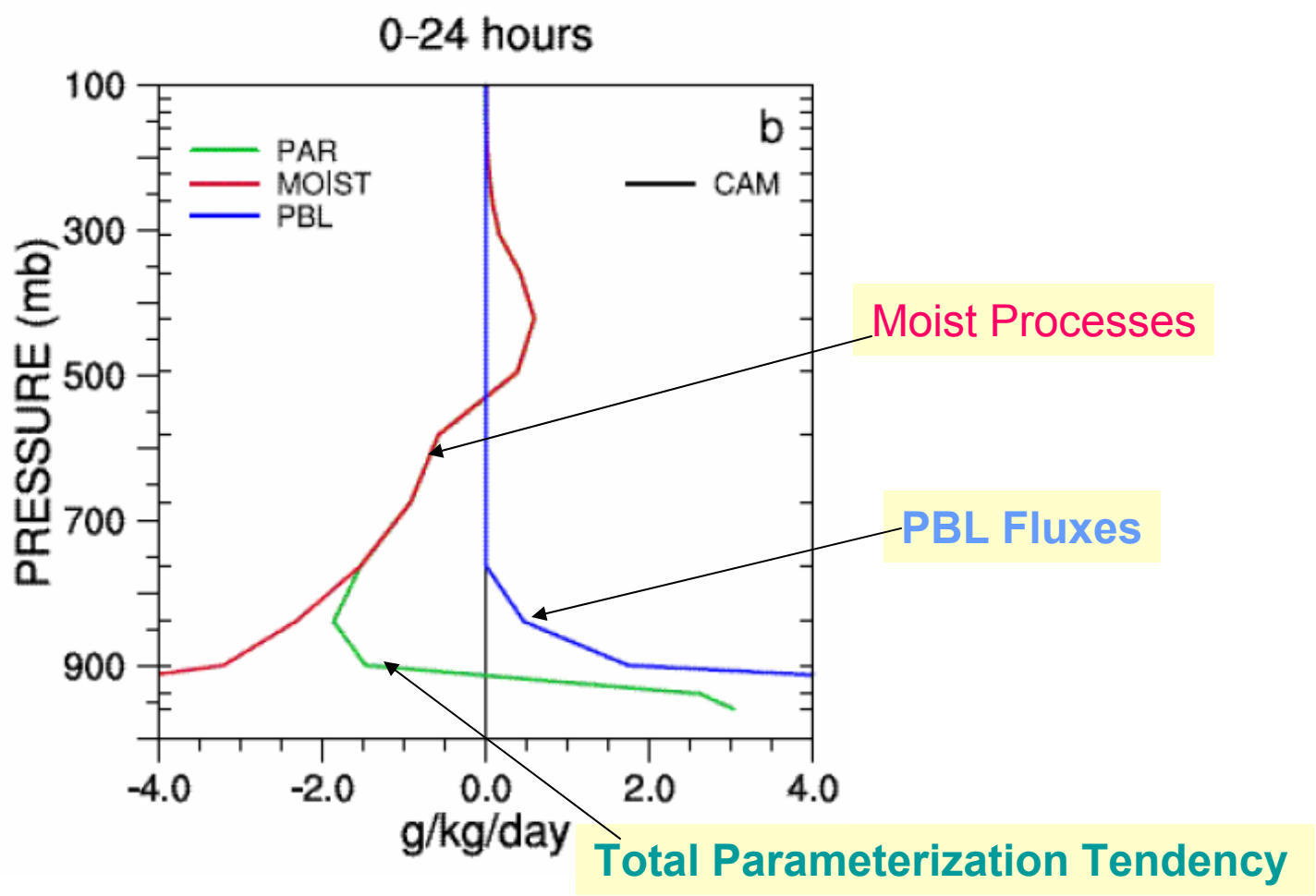
Moist Processes

PBL Moisture Fluxes

In CAM2

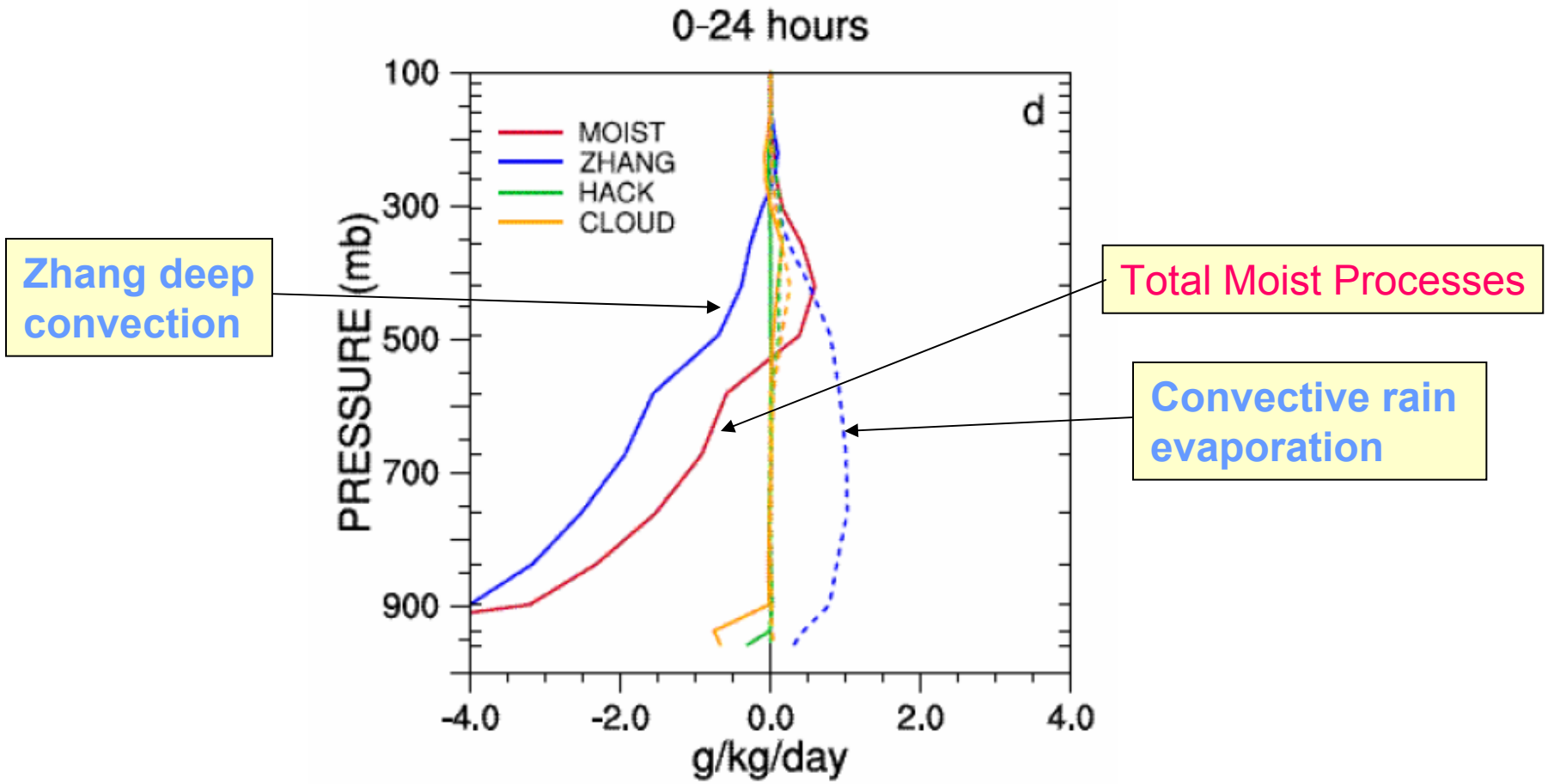
- Zhang deep convection
- Hack shallow convection
- Prognostic cloud water
- Evaporation/detrainment

CAM2 Parameterization Tendency Components in mean 24-hour forecasts during June/July 1997



Spurious lower-level drying and upper-level moistening is mainly associated with the *moist* parameterizations

CAM2 Moist Parameterization Components for June/July 1997



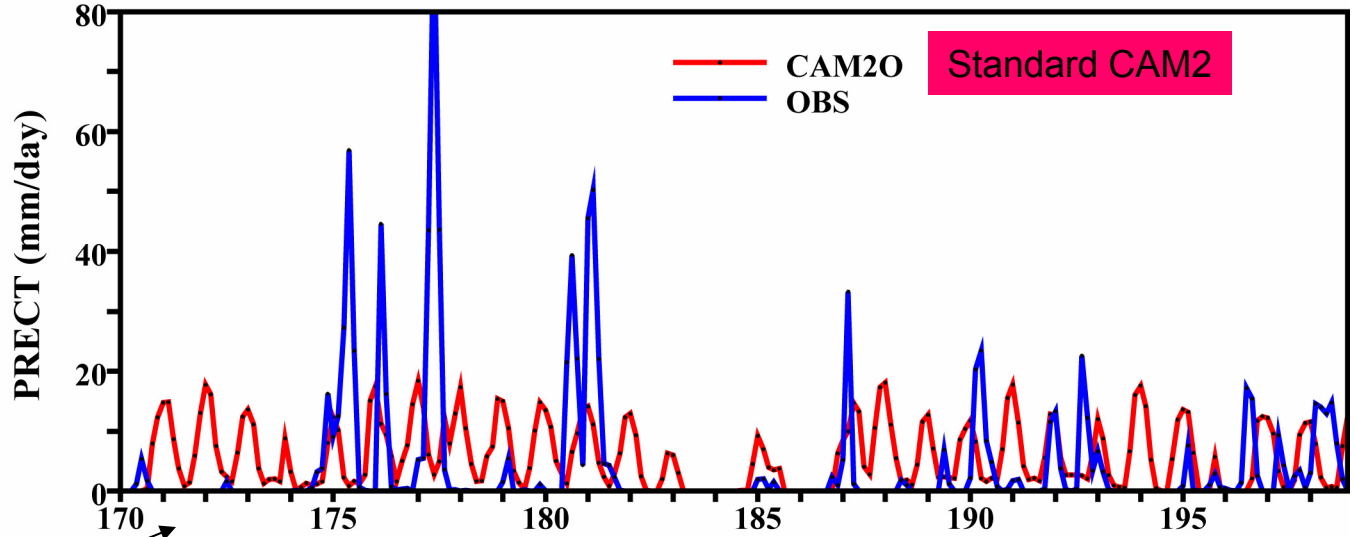
Spurious lower-level drying (and upper-level moistening) is mainly associated with the ***Zhang deep convective*** parameterization

Impact of a revised convective triggering mechanism on Community Atmosphere Model, Version 2, simulations: Results from short-range weather forecasts

Shaocheng Xie,[1] Minghua Zhang,[2] James S. Boyle,[1] Richard T. Cederwall,[1] Gerald L. Potter,[1] and Wuyin Lin[2]

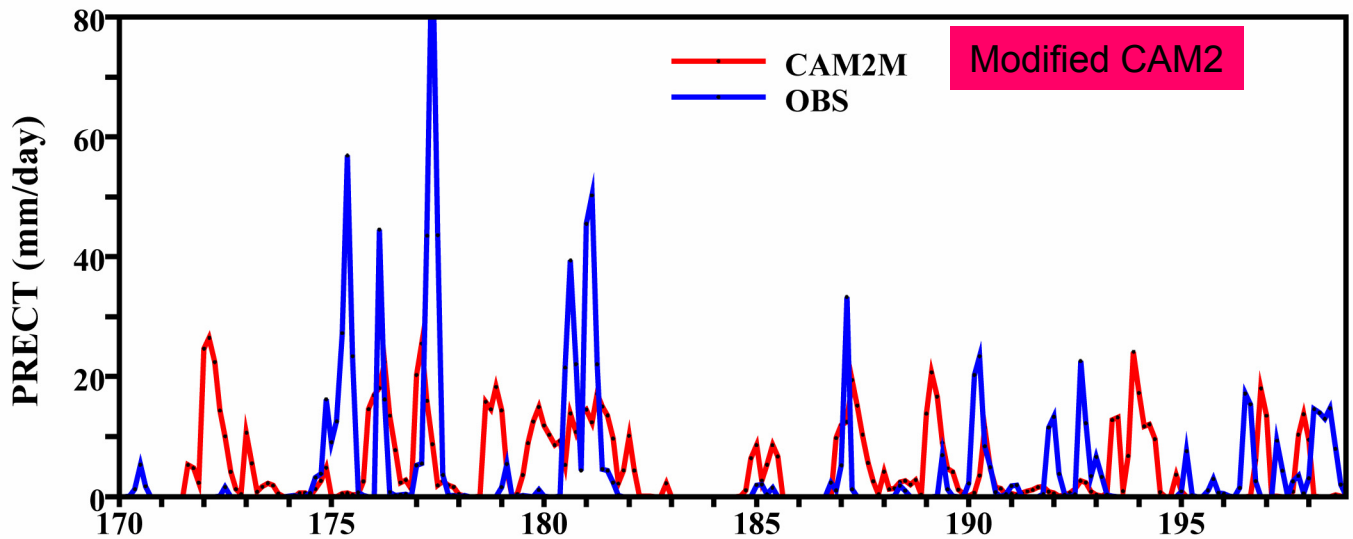
Paper by Xie et al. (2004 *JGR*, pp.14102 ff.) describes effects on *CAM2* June/July forecasts of modifying the model's ***CAPE-based convective trigger*** *criterion* to one that also requires that the dynamics be favorable for convection *(**DCAPE-based criterion**)*

Simulated and Observed Precipitation



ARM/SGP Site

Time (Julian Days): June/July 1997



Time (Julian Days): June/July 1997

CAPT Work in Progress

Generating forecasts with current *CAM3* community model

- For entire 1999-2001 period, selectively in 1997-1998
- Comparison with overlapping *CAM2* forecasts

Extending diagnosis to other observational sites

- ARM sites in Tropical West Pacific, Alaska, Australia
- *Potentially,* other (e.g. CEOP) sites

Collaborating with parameterization specialists

- Guang Zhang (UCSD)--new convection scheme
- Dave Randall et al. (CSU)--"super-parameterization"

Implementing CAPT protocol in GFDL's *AM2* model

END