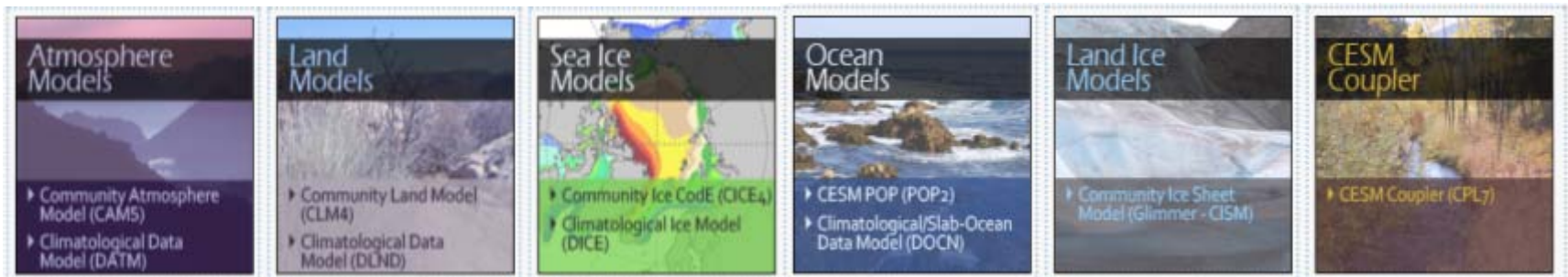


# Community Earth System Model

- April 1, 2010: **CCSM4.0 release**
  - ✓ full documentation, including User's Guide, Model Reference Documents, and experimental data
- June 25, 2010: **CESM1.0 release**
  - ✓ ocean ecosystem, interactive chemistry, WACCM, land ice, and CAM5.0 (indirect affects)

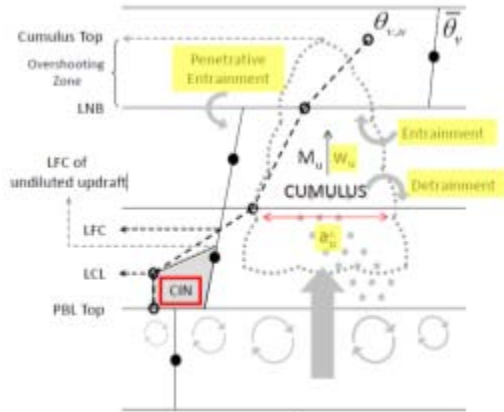


<http://www.cesm.ucar.edu/models/>

# CAM5: Physics Changes

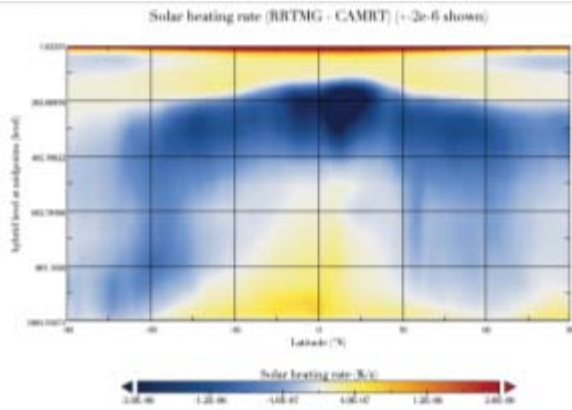
## Cloud-aerosol interaction focus

### UW PBL and shallow cumulus



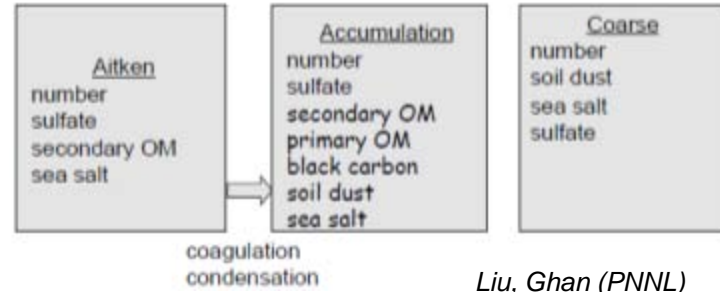
Park, Bretherton (UW)

### Rapid Radiative Transfer Model (RRTM)



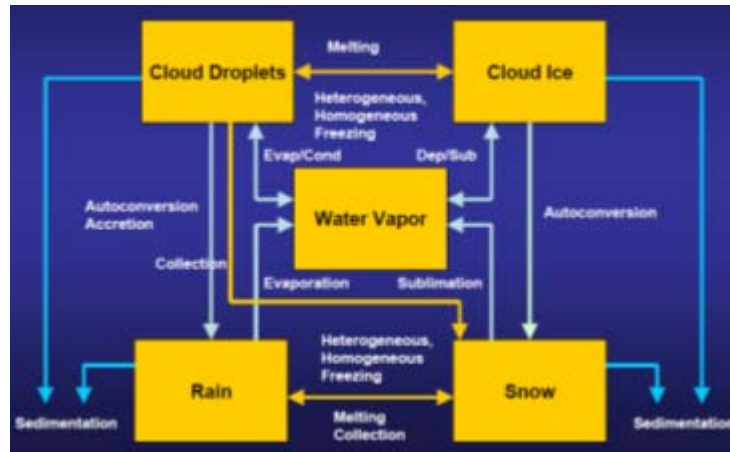
Iacono (AER), Conley (NCAR), Collins (UCB)

### 3-mode Modal Aerosol Model (MAM)

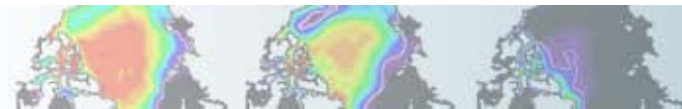


Liu, Ghan (PNNL)

### 2-moment microphysics + ice cloud

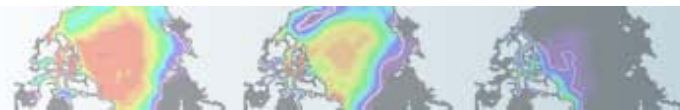


Morrison, Gettleman (NCAR)



# Status of CMIP5-IPCC: Experiments

- CAM4 released with CCSM4 on April 1<sup>st</sup> 2010
- CAM5 released with CESM1 on 25<sup>th</sup> June 2010
- fv 0.9x1.25,1.9x2.5 deg full support (science + functionality)
- fv 0.25, 0.5 functional support (no simulations)
- CMIP5 runs for IPCC Ongoing with CAM4
  - Tier 1 complete (1850, 20<sup>th</sup> C, RCPs, 1%/yr, paleo, single-forcing, 4XCO<sub>2</sub>)
  - Tier 2 and 3 (chemistry, WACCM, BGC, MOAR, CESM\_CAM5 1° ,2° )
  - CFMIP (cloud-feedback) experiments (simulator diagnostics COSP)
- Special issue papers
  - CAM4: Drafts in [March](#), revisions [April](#), submitted and data [May 1<sup>st</sup>](#)
  - CAM5: Drafts in [July](#), revisions [August](#), submitted and data [Sep 1<sup>st</sup>](#)



# Status of CAM5

## Physics

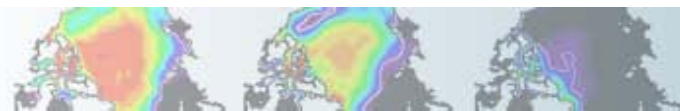
- Some answer changing bugs found since CAM5 release in June '10
- Snow (large ice) effective radius for radiation too large
- Some retuning was required (SW cloud-forcing at high latitudes)
- CN (carbon-nitrogen) turned on in the land (as in CCSM4) requires spin-up

## Experiments (Cecile's talk)

- Time devoted to 1° coupled runs on DOE-ORNL resources
- Aim to perform a significant number of CMIP5 integrations (2° also)
- Currently have +200-year control (1850)
- Running 2x20<sup>th</sup> century + SOM experiments (2XCO<sub>2</sub>, +aerosols)
- This configuration will probably constitute CAM5.1

## HOMME

- HOMME is now fully compatible with CAM5 physics
- Capability for on-the-fly re-gridding to a lat, lon grid

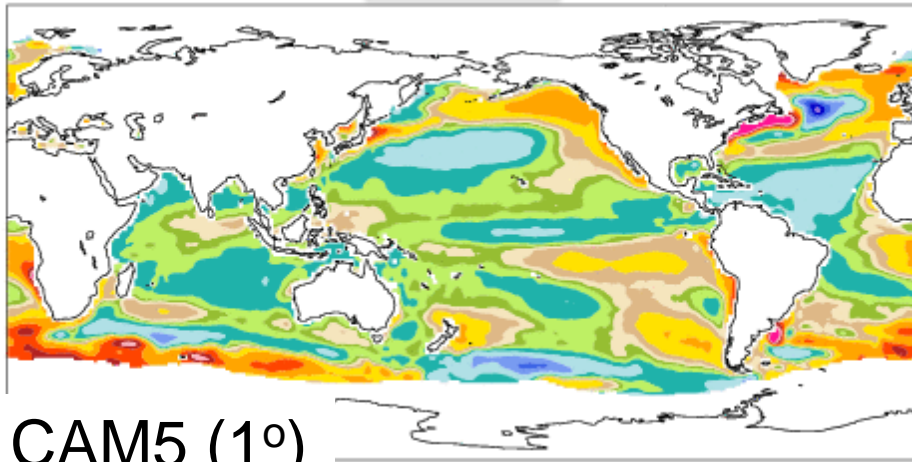




mean = -0.08

rmse = 0.95

C

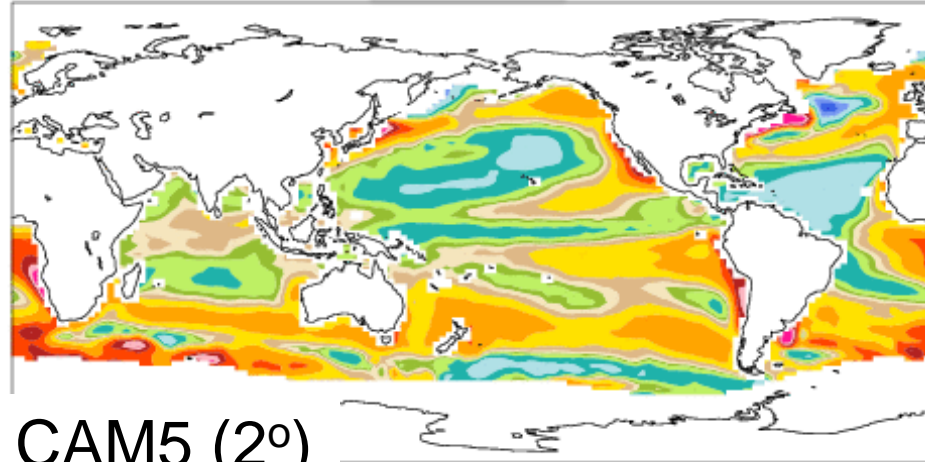


CAM5 (1°)

mean = 0.36

rmse = 1.14

C



CAM5 (2°)

# 1850 Coupled Experiments (1° ocean)

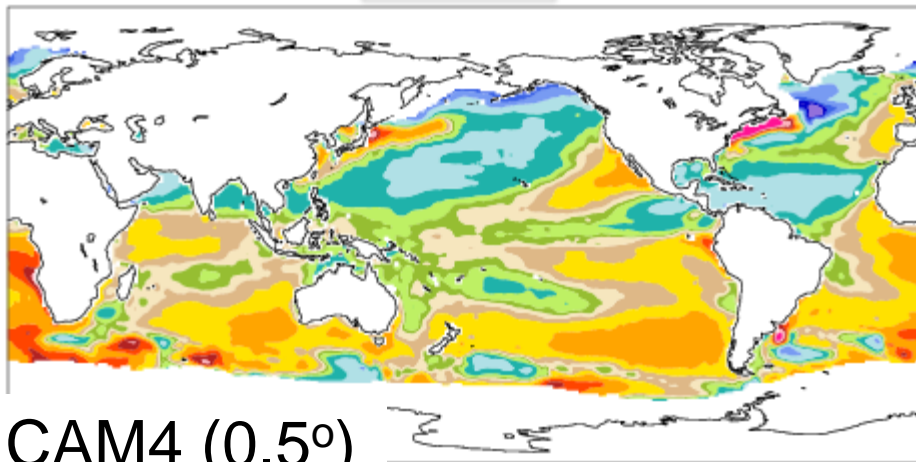
SST-bias (K)  
20-year means



mean = 0.12

rmse = 1.00

C

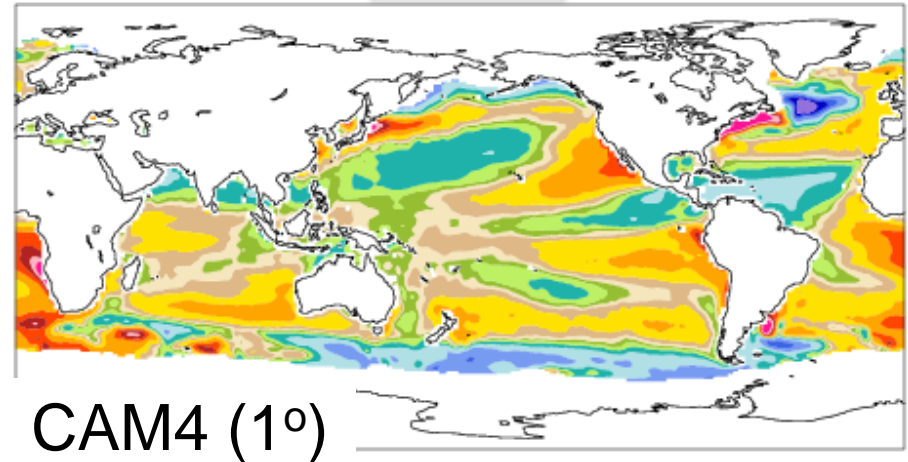


CAM4 (0.5°)

mean = 0.18

rmse = 1.07

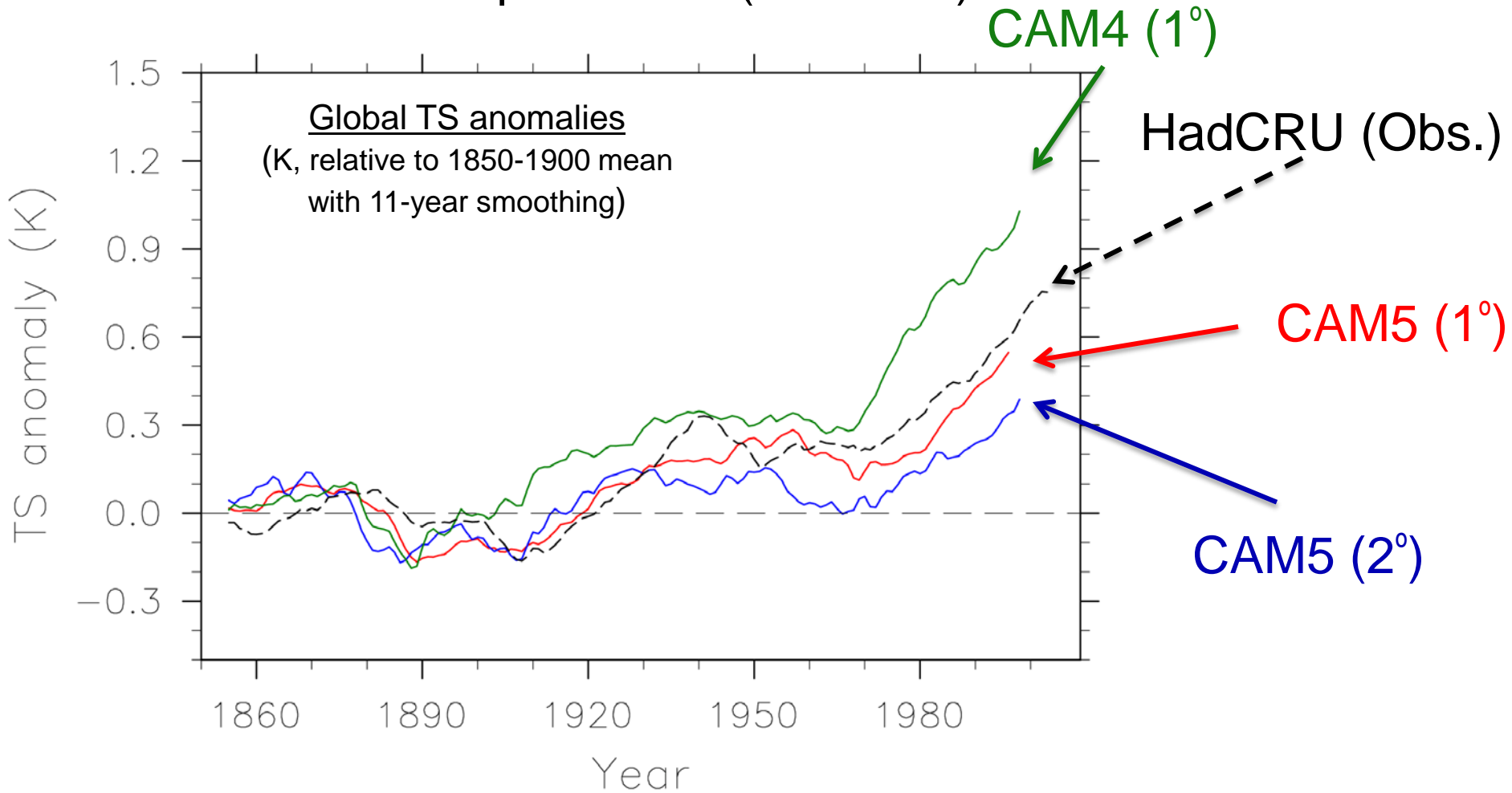
C



CAM4 (1°)



# 20<sup>th</sup> Century Coupled Experiments (1° ocean)



Thanks: Cecile Hannay

# Status of CAM5

## Aerosols

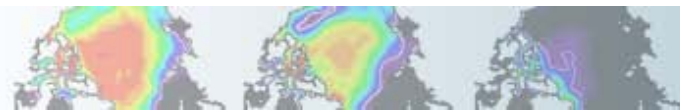
- CAM5 physics order 4-5X CAM4 -> Advecting 20+ aerosol species
- Prescribed MAM aerosol version of CAM5 imminent (2.5X CAM4)
- Version of CAM5 with prescribed aerosols from BAM (Andrew)

## High Resolution

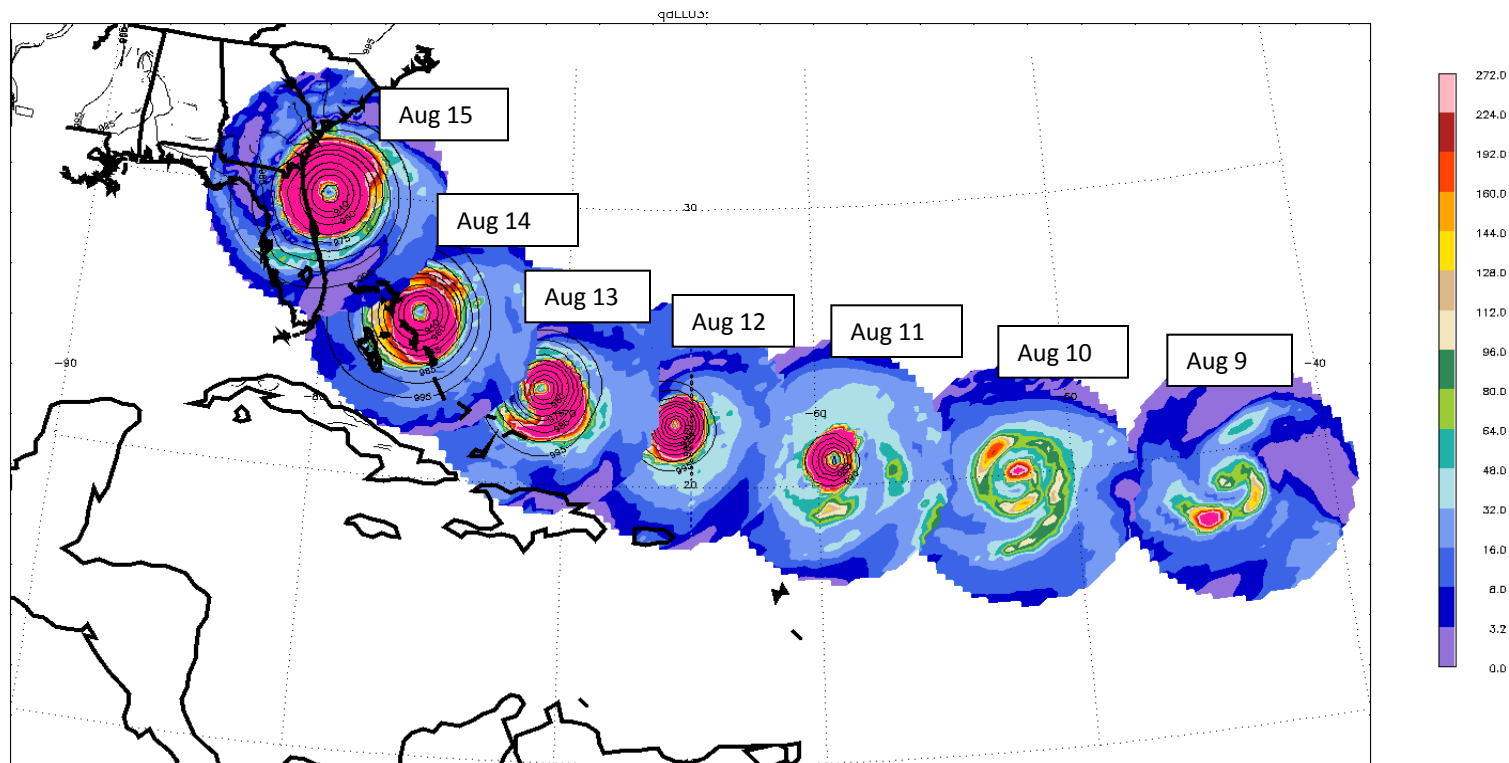
- CAM5 high resolution ( $0.25^\circ$ ) experiments; credible hurricanes
- Starting to examine how physics-dynamics interactions behave
- CAM4 time-slice experiments (DOE-ORNL): 20 years
- Prescribed AMIP SST: Present Day + future scenario (2080-2100, RCP8.5)
- HOMME activities continue for a scalable, high resolution climate runs

## Low Resolution

- Committed to FV 2.5x3.33 version CAM4 and CAM5 (high-cost, long-time)
- AMIP runs for CAM4 and in near-future CAM5



# Intense Atlantic hurricane in CAM5



Precipitation within 500 km of storm center, plotted at 0Z between Aug 9 and Aug 15, 2005

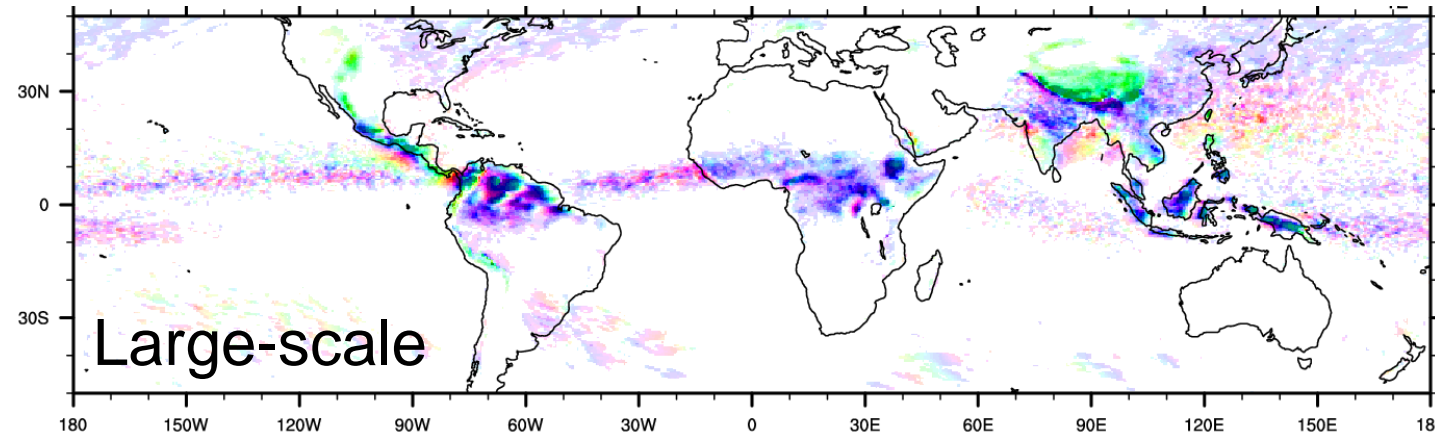
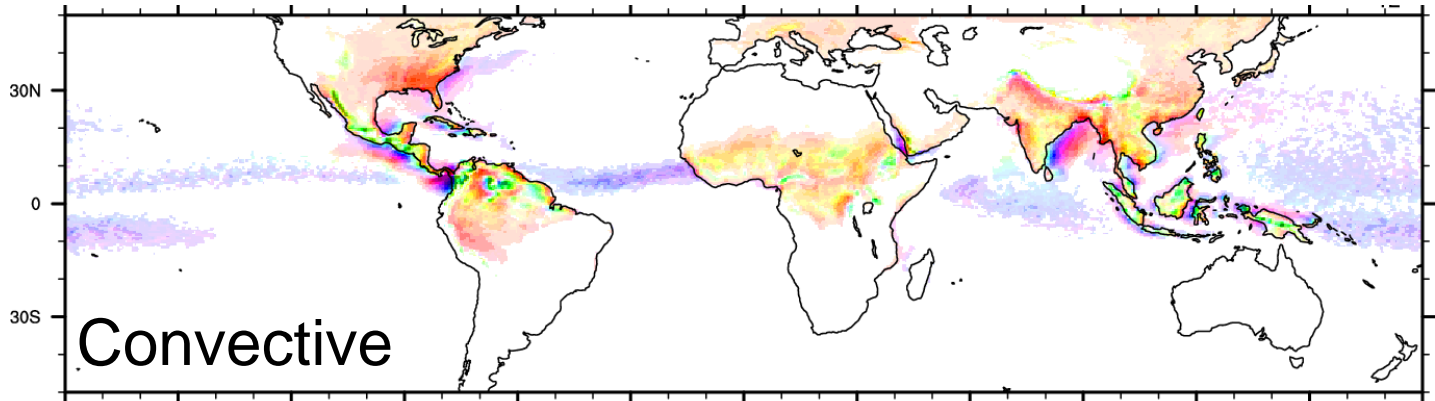
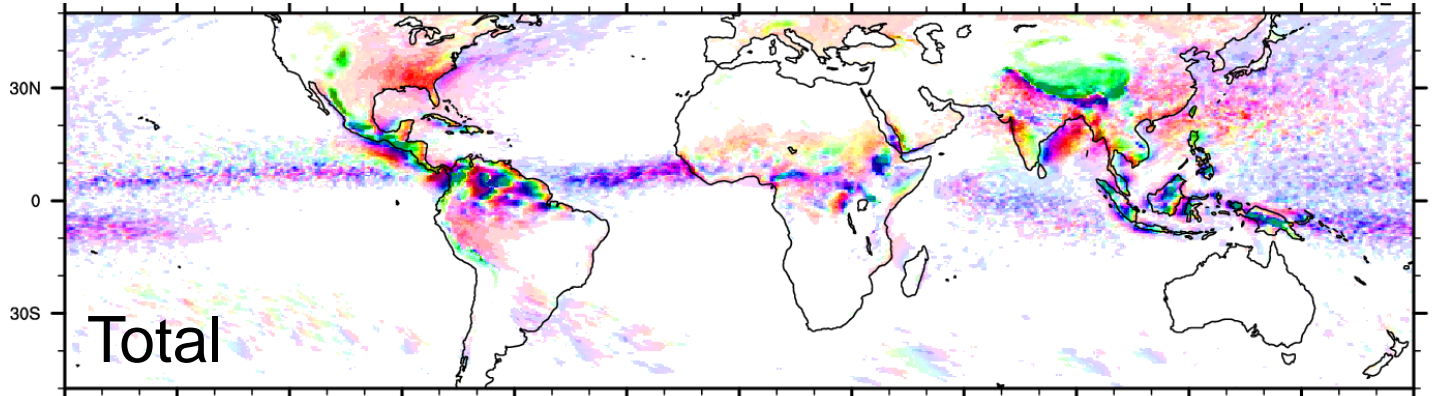
- Min pressure ~910 hPa, max winds~140 mph
- Realistic “Cape Verde” storm
- Note dry eye

Thanks: Julio Bacmeister



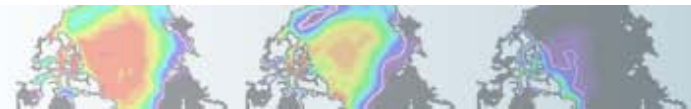
# JJA

## 0.25°



### Diurnal Cycle

(phase, hr - color)  
(magnitude - hue)



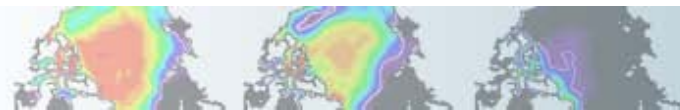
# Status of CAM5

## Validation Activities

- Climate variability, polar climate
- Boundary layer characteristics
- Climate sensitivity
- Cloud feedbacks
- Intercomparison projects (e.g., CGILS, GCSS, Transpose-AMIP, CFMIP, ACC-MIP)

## Ongoing Parameterization Development

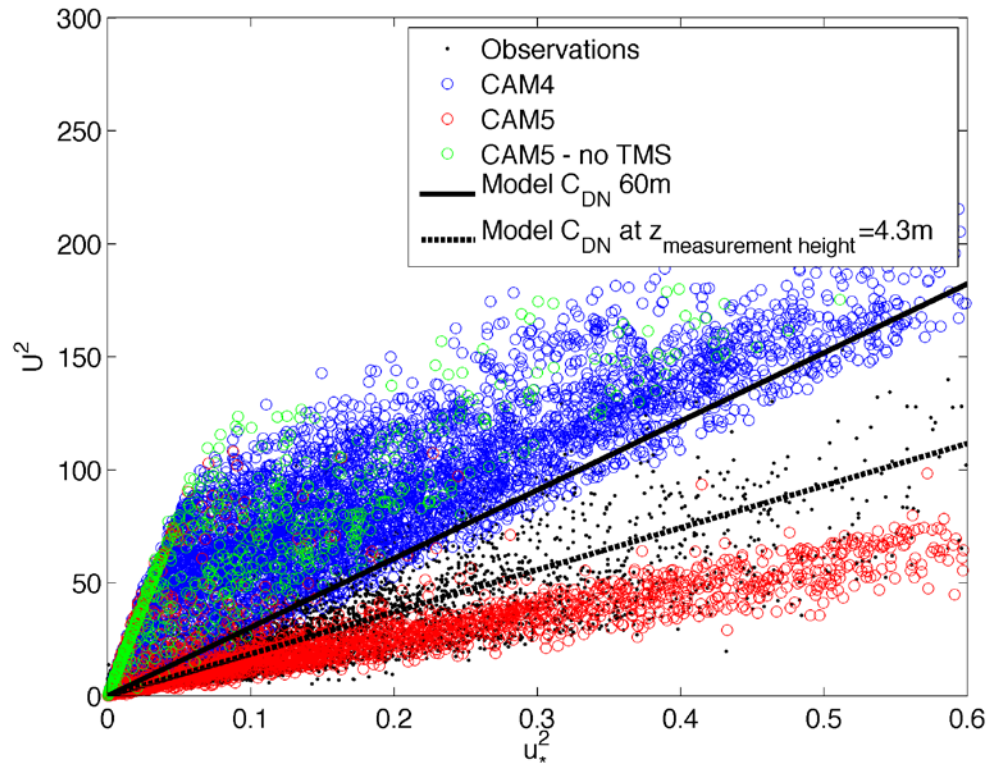
- Driven by CAM strategic plan (high-resolution, regional climate)
- Reduced NCAR core activities
- Climate Process Teams (CPT)
- EaSM (DOE/USDA/NSF)
- Unified Convection scheme
- Convection microphysics



# CAM4 vs. CAM5 PBL

## ARM SGP – wind and $u_*$

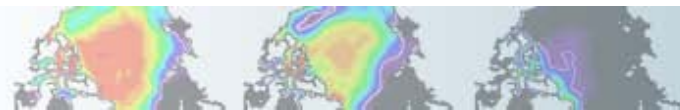
Stable regime, site: SGP<sub>M</sub>ain



- CAM4
- CAM5
- CAM5 – no tms

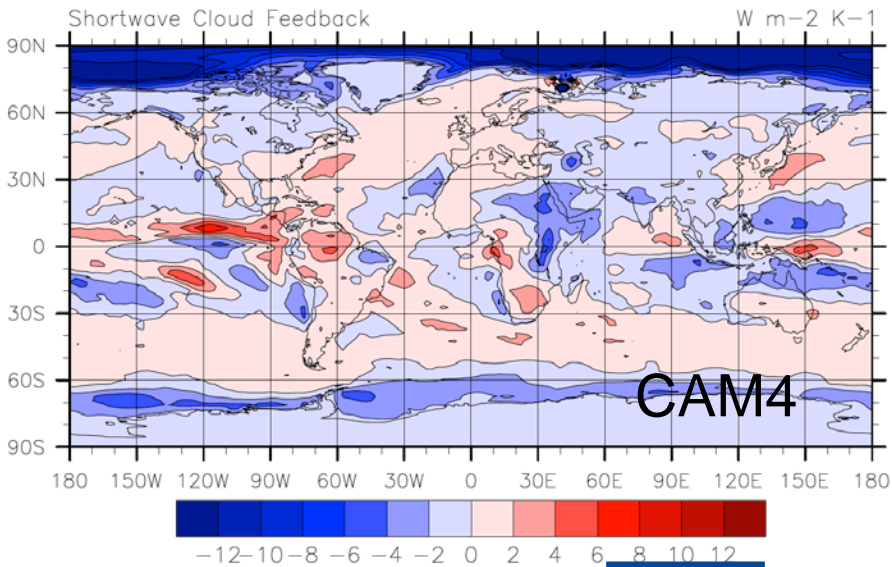
$$C_{DN} = \frac{k^2}{\ln\left(\frac{z_{ref}}{z_0}\right)^2}$$

Thanks: Gunilla Svenson

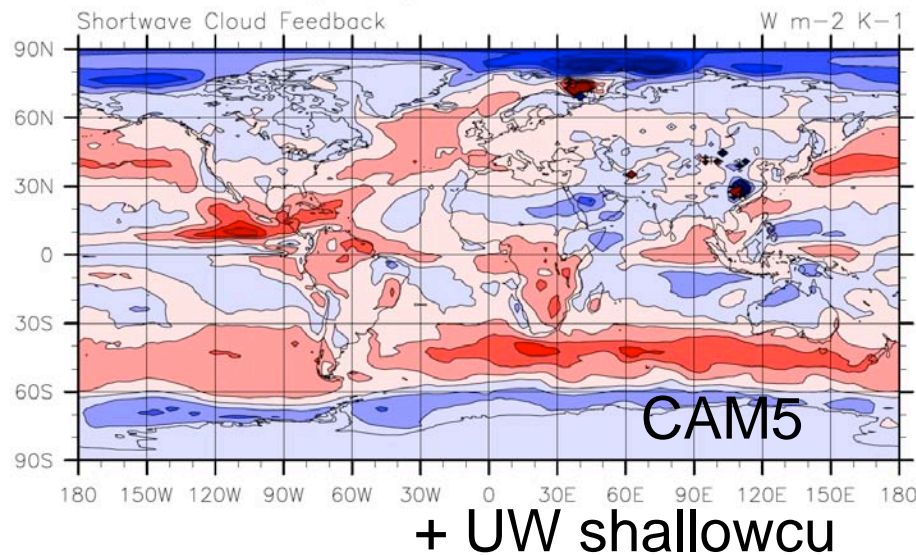




**CAM4latest\_mcess\_alb2 Shortwave Cloud Feedback**

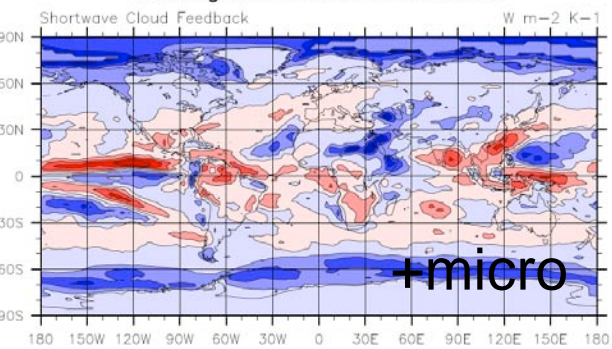


**CAM5latest\_mcess\_alb2 Shortwave Cloud Feedback**

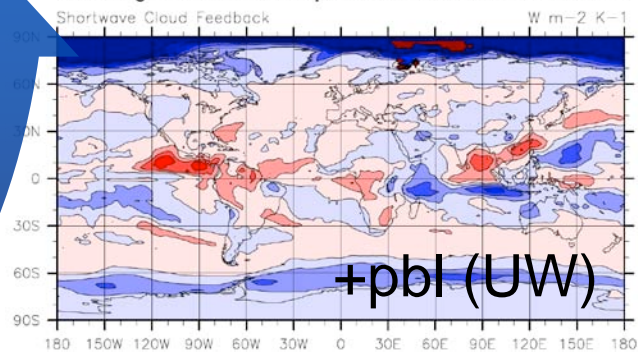


CAM4 → CAM5  
Cloud Feedbacks  
(Gettelman)

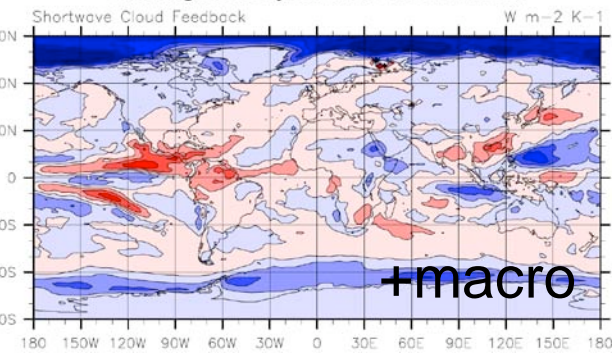
**CAM4+mg2+tune Shortwave Cloud Feedback**



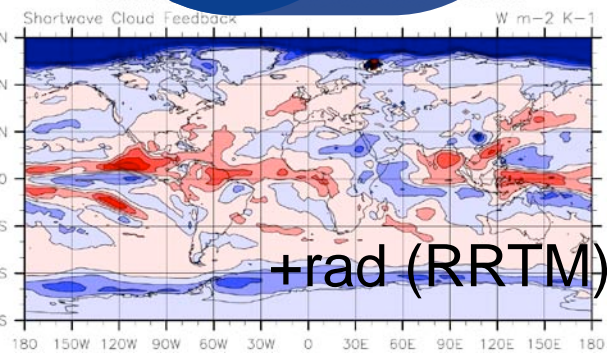
**CAM4+mg+macro+rrtm+mam+pbl+tune Shortwave Cloud Feedback**



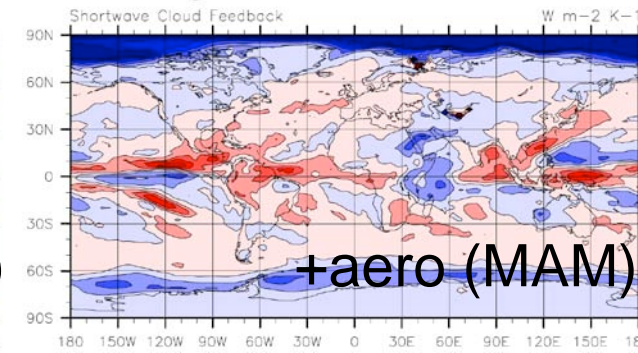
**CAM4+mg+macro10yr Shortwave Cloud Feedback**



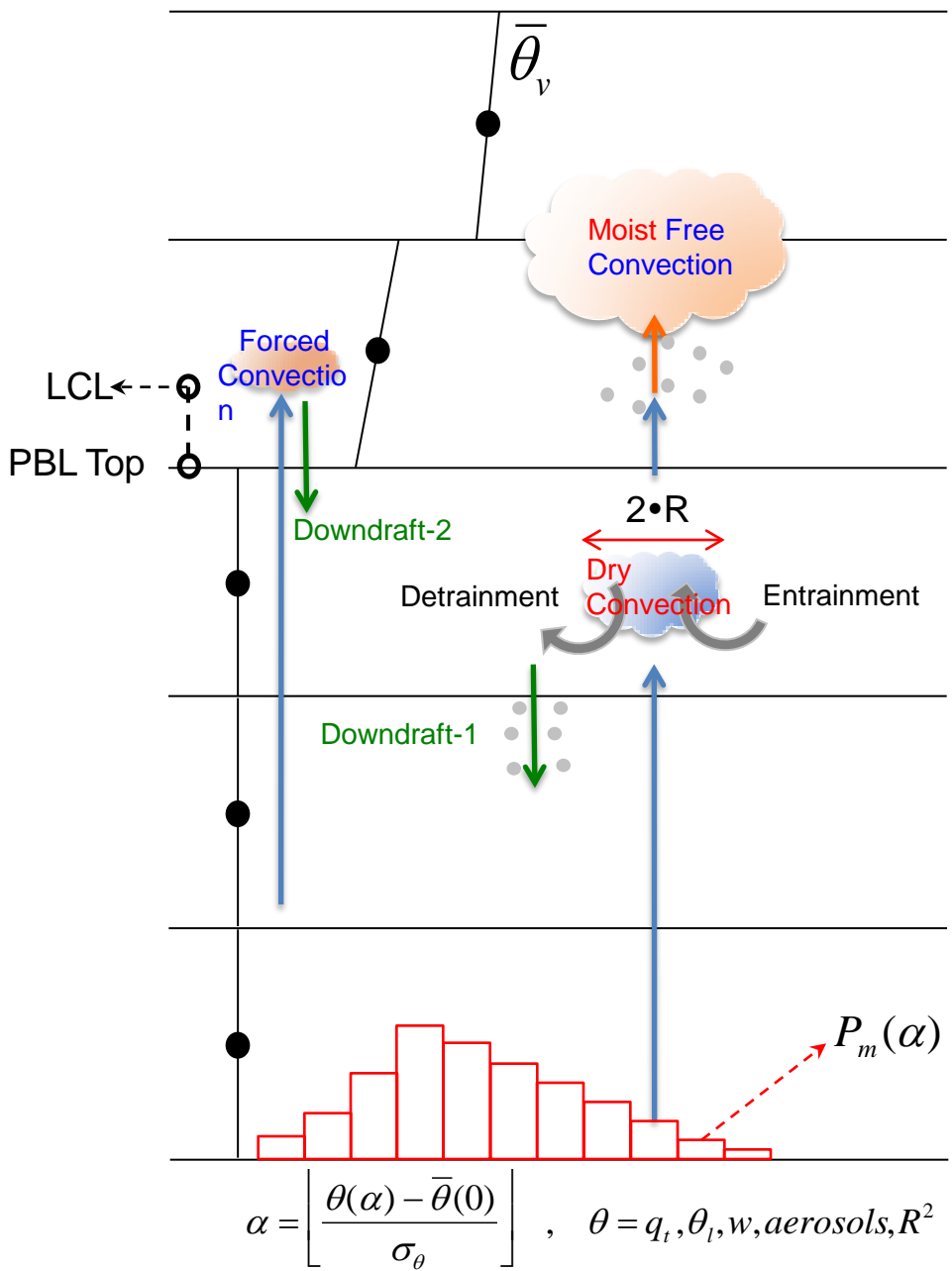
**CAM4+mg+macro+rrtm Shortwave Cloud Feedback**



**CAM4+mg+macro+rrtm+mam Shortwave Cloud Feedback**



**UNICON**  
( S. Park 2011 )



$$\frac{\pi \cdot R^2}{G} \leq a \leq 1$$

Thanks: Sungsu Park





# CAM5 Next Steps

## CAM5.1 – 2 months

- Land CN (carbon nitrogen) enable (especially for coupled runs)
- FV 1° and 2° core versions; HOMME; high and low resolution capable
- Contributions to CMIP5
- Prescribed MAM aerosols?

## CAM5.2 - ~6 months ??

- Stable, core version for other components to use for development
- Prescribed MAM aerosols, CN in land (CLM4CN)
- HOMME at 1° and 2°

## TOPICS FOR DISCUSSION

## Questions?

