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**

Rapid Radiative Transfer Model (RRTM)

3-mode Modal Aerosol Model (MAM)

2-moment microphysics + ice cloud

Liu, Ghan (PNNL)

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

Morrison, Gettleman (NCAR)
Status of CMIP5-IPCC: Experiments

- CAM4 released with CCSM4 on April 1\textsuperscript{st} 2010
- CAM5 released with CESM1 on 25\textsuperscript{th} 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\textsuperscript{th} C, RCPs, 1%/yr, paleo, single-forcing, 4XCO\textsubscript{2})
  - 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\textsuperscript{st}
  - CAM5: Drafts in July, revisions August, submitted and data Sep 1\textsuperscript{st}
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-forming 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 2x20th century + SOM experiments (2XCO₂, +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
CAM5 (1°)

1850 Coupled Experiments (1° ocean)

CAM4 (0.5°)

SST-bias (K)
20-year means

CAM4 (1°)

mean = -0.08  rmse = 0.95

mean = 0.12  rmse = 1.00

mean = 0.36  rmse = 1.14

mean = 0.18  rmse = 1.07

Community Earth System Model (CESM)
20th Century Coupled Experiments (1° ocean)

Global TS anomalies
(K, relative to 1850-1900 mean with 11-year smoothing)

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°) 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
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_{main}

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

Thanks: Gunilla Svenson
CAM4 + macro + rad (RRTM)

CAM5 + aero (MAM) + UW shallow cu + pbl (UW)

CAM4→CAM5
Cloud Feedbacks (Gettelman)

+ micro

+ macro

+ rad (RRTM)

+ aero (MAM)
\[ \alpha = \frac{\theta(\alpha) - \bar{\theta}(0)}{\sigma_\theta}, \quad \theta = q, v, w, aerosols, R^2 \]

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

UNICON (S. Park 2011)

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?