Atmosphere Model Changes Since Feb 2016 (CAM5.5)

• **AIM: Target Biases in Tropical Mean Climate and Variability**
  – Change: Zhang-McFarlane deep scheme (modifications to cloud top and buoyancy calculation)
  – Result: Improved tropical rainfall patterns (inc. Amazon) and MJO variability

• **AIM: Improve Surface Stress Biases (esp. Greenland)**
  – Change: Turn off Turbulent Stress (TMS), add Beljaars (ECMWF) surface drag and include anisotropic orography information
  – Result: Improved surface wind magnitudes over land and southern ocean

• **AIM: Improve precipitation processes and cloud-aerosol indirect effects**
  – Result: Reduced cloud-aerosol indirect effects. Improved LW cloud forcing

• **AIM: Reduce ice cloud and humidity biases at cold temperatures**
  – Change: Ice nucleation f(coarse sulfate), microphysics (fall velocities), bugs
  – Result: Reduced ice cloud/water/RH in upper trop+strat (tropics+S.Hem)
Improved MJO Lag-correlations (precip./U850mb, JJA)

- 20-100-day band pass filtered fields
- Lag correlation of rainfall (colors) and 850-mb zonal wind (contours) with rainfall at 90E
- Improved MJO in response to convection buoyancy change (capeten)

Obs. (TRMM/NCEP)

CAM5.5+Capeten

CAM5.5
Atmosphere Model Changes Since Feb 2016

• **Tuning**
  – CLUBB momentum mixing (precip., surface pressure)
  – Sub-cycling microphysics and CLUBB calculation
  – New solar forcing datasets (-0.3W, wavelength change)
  – Background volcanoes forcing datasets
  – Methane oxidation
  – Dust emissions
  – AMIP runs with CAM5 and CICE5
F2000 CAM5chem SOA test simulations (2deg, 10 years)

- CAM5-SOAG, 0.94 TgC/yr
- CAM5-SOAG*1.5, 1.3 TgC/yr
- VBS-SOA, 1.0 TgC/yr

New loss processes:
- Deposition of intermediates and photolysis SOA
- Changed vertical distributions

New VBS scheme for SOA results in reduced SOA near surface, more SOA in upper tropics

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VBS SOA approach results in more SOA over land, less over ocean
Increased formation over polluted regions (South East Asia)
-> Increase in AOD over East Asia, decrease over the US
WACCM Updates since February

• Fully integrated WACCM and CAM physics
  – Updated to CAM6 physics (CLUBB, MG2)
  – Update to ice nucleation: corrected stratospheric humidity, better SAD ice in polar vortex
  – Working with new momentum forcing (orographic Gravity Waves, no TMS)

• Updated Chemistry
  – Vectorized: 5-10% speedup
  – Updating photochemical rates with JPL 2015

• Further tested volcanic aerosols for CESM2
  – Prognostic aerosols may require full chemistry (i.e. prescribe in CAM and SC-WACCM). Likely need interactive OH.

• WACCM-X updated, close to version 2.0