AMWG UPDATE

THE 26th ANNUAL CESM WORKSHOP

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13 JUNE 2022

This material is based upon work supported by the National Center for Atmospheric Research, which is a major facility sponsored by the National Science Foundation under Cooperative Agreement No. 1852977.
• Development and timelines
• Vertical grid
• Physics reordering
• Topography
• Coupled results
• Survey on reducing software management burden
**CAM development**

**“CAM7” for climate**
- Vertical resolution/model top
  - L58 low top (45km) w/ simplified chemistry
  - L93 high top (85km)
- Physics
- Topography software
- Track development at: [https://github.com/NCAR/amwg_dev](https://github.com/NCAR/amwg_dev)

**Other development**
- Topography software (VR capability)
- Variable resolution
  - Tools for grid generation
  - Compsets
- Infrastructure
  - Cloud computing
  - Streamlined coupling/mediator infrastructure
- Simpler models

**Orange font indicates developments that facilitate and increase accessibility for community research using CAM**
Physics development efforts

• Physics re-ordering (A. Herrington)
• ZM for high vertical resolution (“ZM2”; R. Neale talk)
• CLUBB-EDMF (J. Teixeira talk)
• CLUBB-prognostic momentum flux (C. Zarzycki talk)
• New topography processing (P. Lauritzen poster)
• Coupling of Land and Atmospheric Subgrid Parameterizations (CLASP; N. Chaney, D. Lawrence, M. Fowler)
• Parameterization of Unified Microphysics Across Scales (PUMAS; A. Gettelman, H. Morrison, K. Thayer-Calder)
• Continued development of rigorous enthalpy/energy treatment in CAM to replace “fixer” (P. Lauritzen)
April – July 2022: First evaluation of coupled system (B1850) with SE-atmos dycore and L58 vertical grid

April – October 2022: Further development and evaluation of atmospheric physics and forcing

Late 2022: Finalize configuration of CAM for CESM2.x, i.e., decide which atmospheric physics are included, specification of boundary forcing, e.g., radiatively active tracers for L58 and L92

Short-term timeline

- “CESM2.x” slated for release in mid 2023
- CESM2.x is intended to be a viable coupled version that incorporates MOM6 + L58/L93 atmosphere
- CESM2.x is \textbf{NOT} the next CMIP model
- Possible applications: high horz. resolution, regionally-refined studies

- \textbf{Atmos physics in current evaluation}: MG2, ZM2, re-ordering, updated topo, enthalpy “fixer” for MOM6
- By late 2022 hope to incorporate PUMAS and contributions from CPTs
Vertical Resolution/Model Top

- Single L93 CMIP class model with top around 80km
  - Better resolved stratospheric dynamics including QBO
  - Full chemistry as option
- Cheaper L58 version with top around 40km
  - Optional simplified or no chemistry
- Increased PBL resolution for both

*These vertical grids are now being used for all CAM development work. Coupled evaluations have begun.*

*Thanks to Isla Simpson and Brian Medeiros for leading the vertical grid selection process*
● Free tropospheric/stratosphere resolution increased from DZ~1200m to DZ~500m.
● Two configurations L93 (top~85km) and L58 (top~45km). Identical vertical grid through mid stratosphere

- Dramatically increased PBL/lower tropospheric resolution. New lowest model level height ~20m. Previously ~60m.
- New cloud base treatment needed for ZM (R. Neale)
Vertical Resolution/Model Top (L93)

Zonally-averaged zonal wind 10-season averages

The QBO in the spectral-element dynamical core

OBS

Dz=500

ERA-I

CAM

Diff

NCAR | UCAR
Vertical Resolution/Model Top

Plots from Adam Herrington

MAGIC transect, JJA (1979-1989), CLOUD fraction

Satellite Observations (courtesy of B. Medeiros and M. Smally)

VOCALS transect, DJF (1979-1989), CLOUD fraction

CLUBB tuning exp
Physics reordering

- Main difference: CLUBB moved after coupler
- Alleviates spurious high-frequency oscillations in surface layer (already present in L32 but more pronounced with increased PBL resolution)
Old CAM6, 32L

State adjusted by each process

Adapted from Figure 7 of Wan et al. 2021 (GMD)
New "CAM-DEV", 58L etc.

Physics

Dynamics

State adjusted by each process

Adapted from Figure 7 of Wan et al. 2021 (GMD)
Impacts of re-ordering

Annual mean Shortwave Cloud Forcing

10-day timeseries (half-hourly) of 10 meter wind from 4 points in Amazon basin
Updated topography software

- Bedmachine topography replaces GMTED in Greenland and Antarctica
- Streamlined workflow using command line options. Variable resolution capabilities added
- New iterative Laplacian smoother with “no-leak” option that preserves 0m height over ocean and global topography volume.
- Updated ridge-data
- Github repository: [https://github.com/NCAR/Topo](https://github.com/NCAR/Topo) (see poster by Peter Lauritzen tomorrow)
Coupled Evaluation has begun

- **Now-July:** B1850 (pre-industrial CTL) using L58+CAM_DEV
  (reordered CAM6 physics+ZM2)+MOM6+CICE6

- **Fall 2022:** Add L93 vertical grid. Incorporate contributions from CPTs. Incorporate PUMAS microphysics. *Additional configurations: 4xCO2? LGM?*
Survey on reducing software engineering workload:

- ~40 responses received. Thank you!
- Discussion during AMWG session tomorrow
Thanks