



# Chemistry-Climate Working Group Current Status – Feb 2016

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*Chemistry-Climate Working Group Meeting – 9 Feb 2016*



# CAM-chem published versions

## CESM1.1.1 for CCMI (CAM4)

Tilmes, S., et al., Representation of the Community Earth System Model (CESM1) CAM4-chem within the Chemistry-Climate Model Initiative (CCMI), *Geosci. Model Dev. Discuss.*, doi:10.5194/gmd-2015-237, in review, 2016.

***CCMI and HTAP2 CAM-chem simulations have been posted on their respective archives, available for analysis***

## CESM1.2 (CAM4 or CAM5/MAM)

Tilmes, S., et al., Description and evaluation of tropospheric chemistry and aerosols in the Community Earth System Model (CESM1.2), *Geosci. Model Dev.*, 8, 1395-1426, doi:10.5194/gmd-8-1395-2015, 2015.

Scientifically validated release is available

<https://www2.cesm.ucar.edu/models/scientifically-supported>

- Includes updates for CCMI, MAM4, MEGAN corrections

# CAM-chem development

- CESM1.5 development versions
  - *available for developers*
  - Expanded tropospheric chemistry (“TS1” - speciated aromatics, terpenes, updated isoprene oxidation, organic nitrates)
  - New SOA-VBS framework
  - Gas and aerosol emissions from CLM fire model, with vertical distribution applied in CAM (evenly distributed to an altitude dependent on PFT)
  - Ability to read 2 emissions files (different sectors, frequency) for a single compound

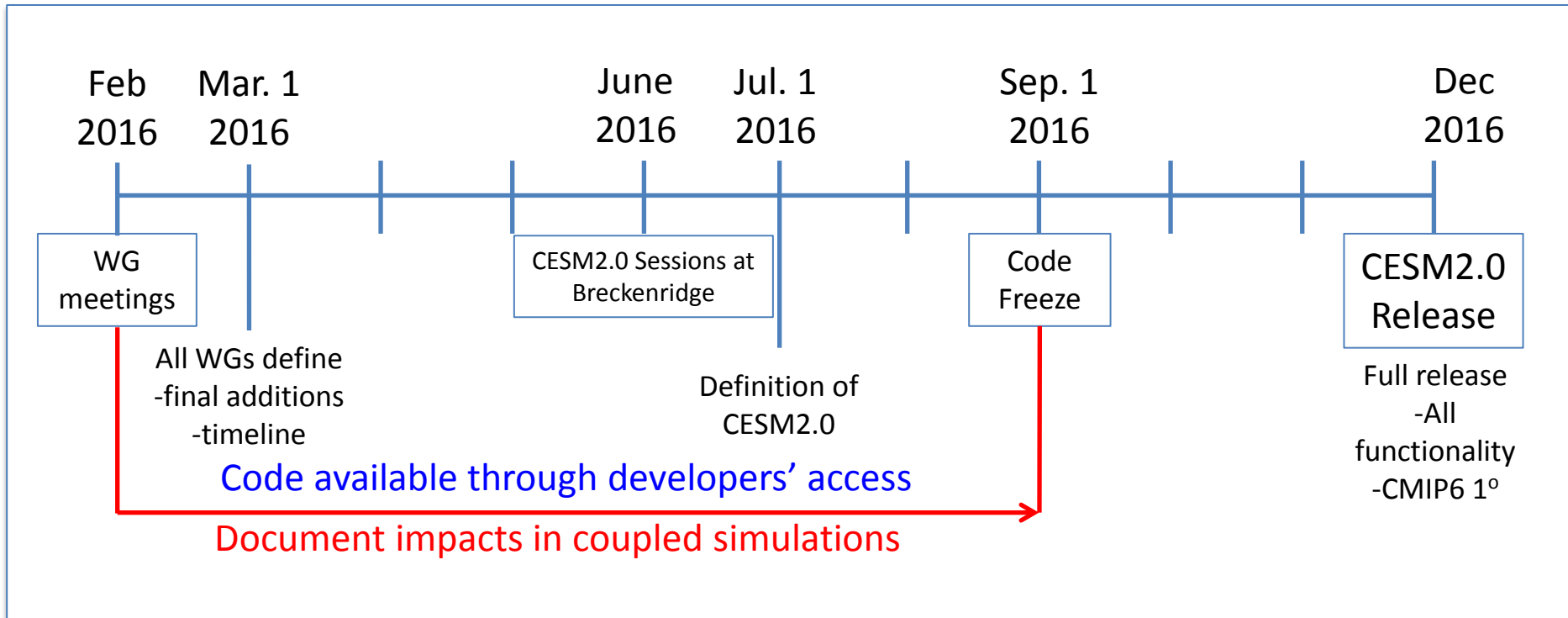
# Tropospheric Chemistry Mechanism

Improved treatment of SOA precursors:

- Speciated terpenes ( $C_{10}H_{16}$  replaced with APIN, BPIN, LIMON, MYRC, BCARY, and products) with MEGAN emissions
- Added MBO
- Replace lumped aromatic “TOLUENE” with specific BENZENE, TOLUENE, XYLENES
- Updates to isoprene oxidation scheme
- Improved treatment of organic nitrates (replace ONIT with more specific nitrates)

SOA –VBS framework uses this chemistry

# Proposed revised timeline



Pending approval by the SSC

# Plans for CESM2 (for CMIP6)

## *Code freeze Sept 1 → Release Dec 2016*

Refine and evaluate SOA-VBS implementation (including differences for low and high NO<sub>x</sub>), updated chemistry reaction rates and yields, etc.

CAM-chem additions desired, but not clear we have resources to implement:

- FAST-J/CLOUD-J (or TUV online)
- Nitrate aerosol in MAM

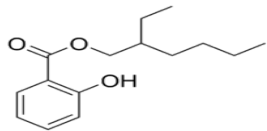
Test couplings of land, biogeochemistry and atmospheric chemistry (after CLM has been frozen)

– Including methane, biogenic VOCs, fire emissions

Test chemical representation in CAM6/CLUBB at 1-degree

# Model of Emissions of Gases and Aerosols from Nature (MEGAN) development

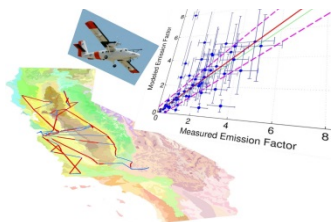
Alex Guenther: [alex.guenther@uci.edu](mailto:alex.guenther@uci.edu)



New chemical species- including ecologically relevant compounds. Will map to existing atmospheric chemical schemes.



New emission control processes including stress (ozone, temperature extremes, severe storms, insects) and microbes



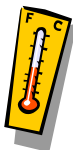
Updated emission factors based on synthesis of aircraft eddy covariance measurements, satellite data, and other observations



Approach to link MEGAN with Ecosystem Demography model



Biological particles: pollen, fungal spores, bacteria, algae, detritus



Isoprene light and temperature responses linked to CLM representation of carbon and energy fluxes

# Other development plans and wishes

- CAM-chem/DART development continues
- Does simple CAM (aerosol precursor) chemistry need improvement?
- Chemistry diagnostics package needs additional observations added
- Tim Butler – IASS/Potsdam
  - interested in downscaling CAM-Chem simulations using WRF-CHEM
  - Planning to continue development of tagged ozone
  - In cooperation with Ruediger Grote from KIT, we're also planning on implementing photosynthesis-based BVOC emissions from Grote et al, Plant, Cell, & Environment, (2014) into the CLM.



# Post CESM2 Development Plans

- Evaluate chemistry in CAM/WACCM with new dynamics (e.g., CLUBB-Deep)
- Test next generation dynamical cores: Spectral Element/CSLAM and CESM-MPAS
- Improve MEGAN biogenic emissions (in CLM) and adapt to Ecosystem Demography representation in CLM (Alex Guenther, UCI)
- Continue to improve fire emissions vertical distribution (CLM+CAM)