WACCM Discussions

Charges to WGs

- Science Targets
  - Scientific questions.
  - Development needs to reach the targets.
  - Impediments to reach the targets.
  - Metrics to assess progress toward targets.

Model Development Priorities: Categories and Relevance to Science Plan

A. Coupling across components and understanding interactions
B. New parameterizations/processes
C. High-resolution and new dynamical cores
D. Addressing biases/shortcomings
E. Software development

a) Interaction of the Carbon Cycle, Ecosystems and Climate
b) Decadal Climate Projections and Forecasts
c) Interaction of Aerosols and Climate
d) Interaction of Chemistry and Climate
e) Role of the Middle Atmosphere in Climate
f) Role of Ice Sheets, Sea Ice and Land in Abrupt Climate Change
g) Bounding Future Climate Scenarios
h) Simulating Paleoclimates
i) Role of Ocean Mesoscale Eddies in Climate
j) Interaction with Integrated Assessment Modeling
k) Interaction of terrestrial atmosphere and near space environment

Development Objectives

- WACCM5-FV and WACCM5-SE/high resolution WACCM (A/B/C for c/d/e/k). *Completed/on-going.*
- Clean up/tune/improve gravity wave routines (B/D for e/k). *On-going.*
  - Testing/tuning of GW routines for fixing "cold-pole" bias (in preparation for CCMI, among other things).
- Ionosphere module for WACCM-X (A/B/E for k). *On-going.*
- DART/WACCM (A/B? for k). *Development completed.*
- SC-WACCM testing and validation (A/B for e). *Completed.*
- WACCM diagnostics.
- WACCM-Lite (setup with coarse vertical resolution in the upper atmosphere).

Whole Atmosphere Group Science Target (1)

- Understand and quantify variability of the near space environment (stratosphere to upper thermosphere).
  - Science Questions:
    - How do lower atmosphere perturbations affect the near space environment on weather to climate scales?
    - How do lower atmosphere and solar/magnetospheric driving interact?
    - How do dynamics and chemistry interact?
  - Development needs:
    - Efficient and conservative transport scheme (CSLAM or SPELT).
    - Interactive ionosphere/plasmasphere.
    - Assimilation of both meteorological and middle upper atmosphere observations.
  - Impediments to reach the targets:
    - Biases in wind and temperature (e.g. cold pole bias).
  - Metrics to assess progress toward targets:
    - Observations of chemical species, plasma density, total electron contents, and ion drifts.

Whole Atmosphere Group Science Target (2)

- The role of lower atmosphere waves (gravity waves and tides) in ionospheric irregularities
  - Scientific questions:
    - What drives the observed large wind shears in the lower thermosphere?
    - What is the impact of gravity wave forcing on large-scale waves (tides and planetary waves)?
    - What are the wave charcteristics in ionosphere E and F region? And how do these wave interact with electrodynamics?
  - Development needs:
    - Interactive ionosphere/plasmasphere
    - High-resolution (~10km/0.1scale height)
    - Computing resources.
  - Impediments to reach the targets:
    - Parameterization of deep convection.
    - Bias in atmospheric tides (in current models).
  - Metrics to assess progress toward targets:
    - Structure, distribution and frequency of ionospheric irregularities, as compared with observations.

Whole Atmosphere Group Science Target (3)

- Volcano impact on climate
  - Science questions:
    - How does volcano aerosal form from SO2 release?
  - Development needs:
    - Modal aerosal module that takes into account the volcanic aerorsal growth process.
  - Metrics to assess progress toward targets:

CESM2-WACCM

- WACCM-SE (ne30), CAM5 physics, CSLAM transport (?), modal aerosol module with volcanic microphysics.

  - What if they can't deliver CSLAM with CAM5: WACCM5-FV or WACCM6-SE.

- WACCM-X with interactive ionospheric electrodynamics and transport.

- Options to run at ne120/ne240/0.1 scale height resolution.

Backup Slides

CESM SSC Requests

- Short-term (next year) component model development. Updated annually and part of the new CESM webpage.

- Model development processes/protocols for each working group.

- Metrics/diagnostics for model assessment (short list of primary information).

Model Development Guide Lines

1. Collaboration
2. Design Review
3. Code Base
4. Coding Guidelines
5. Testing
6. Code Review
7. Activation of New Code
8. Trunk Check-in and Documentation
9. Input Dataset

TIMELINE UNDER DEVELOPMENT -

Component	May 2013	May 2014	May 2015	May 2016
Atmosphere	CAM5.2-SE			
	WACCM5-FV WACCM4-SE			
Ocean	POP2	POP2+		
	Improved BGC	Improved BGC		
Land	CLM4.5	CLM4.5		
Sea Ice	CICE4	CICE5	CICE5	
Ice Sheet	CISM1	CISM2		

Table 1. Timeline for CESM2 development. Items shown in green shading indicate components that are scientifically supported in a fully coupled framework (meaning that they have a completed coupled control integration and have undergone model assessment). Items in blue shading are functionally supported or scientifically supported in a component-only framework. Items with no shading indicate only minimal changes from the previously released model.

Model Assessment: Atmosphere Metrics

Chemistry Metrics

Coupled Model Metrics

WACCM Metrics

- SSW frequency (North and South)
- Wind and temperature climatology of stratosphere and mesosphere (e.g. QBO, polar region, mesosphere jet reversal, mesopause height and temperature anomaly).
- Amplitudes and phases of migrating diurnal tide, semidiurnal tide, terdiurnal tide; nonmigrating diurnal eastward wavenumber 3 tide, diurnal eastward wavenumber 2, semidiurnal westward wavenumber 1.
- Stratospheric water vapor profiles and annual cycle of profiles
- Total column ozone
- Age of air in the stratosphere
- NAM/SAM
- Turbopause height
- PMC occurrence and distribution
- Upper atmosphere trend
- Vertical profiles of globally averaged O, O_2, N_2, O_3, H_2O, OH, HO_2, H, H_2, NO_x, NO_y, CO, CO_2, CH_4, O^+, NO^+, O_2^+, N^+, N_2^+, e
- Total electron density (TEC)
- F2 peak height and density

Resources

- Conception/mis-conception that WACCM development is a funded effort when applying for NSF special fund.
  - What is funded by NSF base fund.
  - What is not.