Experimental Design for CMIP6: Aerosol, Land Use, and Future Scenarios

FINAL REPORT

on

DE-SC0012321

Period of Performance: 07/15/14-07/31/14
PI: James Arnott, Aspen Global Change Institute

Publication Date:
October 30, 2015

Table of Contents

1. Summary of Activities

The Aspen Global Change Institute hosted a technical science workshop entitled, "Experimental design for CMIP6: Aerosol, Land Use, and Future Scenarios," on August 3-8, 2014 in Aspen, CO. Claudia Tebaldi (NCAR) and Brian O'Neill (NCAR) served as co-chairs for the workshop. The Organizing committee also included Dave Lawrence (NCAR), Jean-Francois Lamarque (NCAR), George Hurtt (University of Maryland), & Detlef van Vuuren (PBL Netherlands Environmental Change). The meeting included the participation of 22 scientists representing many of the major climate modeling centers for a total of 110 participant days.

2. AGCI Workshop on CMIP6 Design

During August 3-8, 2014 AGCI hosted a workshop entitled, "Experimental Design for CMIP6: Aerosol, Land Use, and Future Scenarios," in Aspen, Colorado. By an initial review of evaluations submitted by participants, as well as through discussions with the organizers representing three of the Model Intercomparison Project (MIP) communities (i.e. LUMIP, AerChemMIP, and ScenarioMIP), we found the meeting to be a great success. The structure of the workshop allowed for both internal MIP planning and coordination as well as the development of strong interactions between the MIPs. This coordination backbone is helping to provide a firmer grasp of which science research questions to pursue in CMIP6 and is helping to develop a sense of the prioritization and timing of crucial components of the process needed in the coming years.

At the beginning of the meeting, WCRP CMIP panel chair Veronika Eyring (DLR) offered basic guidelines for what was expected in the proposal from each of the individual MIP communities. Three broad scientific questions comprised the core of the overall CMIP6 effort, which were:

1. How does the Earth system respond to forcing?
2. What are the origins and consequences of systematic model biases?

3. How can we assess future climate changes given variability, climate predictability, and uncertainties in scenarios?

These three questions provided overall guidance for the discussions within and between the three MIP communities represented at the meeting, although specific issues underneath this outline were deliberated at length. Each of the individual MIPs represented proposed the key scientific questions they sought to address during CMIP6. These included:

AerChemMIP:

- What is the role of short-lived climate forcers in the historical climate and future projections?
- How will the role of SLCFs change under climate change?
- What are the interactions between climate and air quality policies and how can that study link to health and air quality communities?
- What are the linkages between land use and atmospheric chemistry, and vice versa?
- What is the role in climate systematic biases from misrepresentation of aerosols (forcings and feedbacks)?
- What is the importance of natural aerosols, biogeochemistry couplings and other feedbacks?

LUMIP

- What are the effects of land use and land use change on climate (past-future)?
- What are the effects of climate change on land use and land use change?
- Are there regional land management strategies with promise to help mitigate and adapt to climate change?

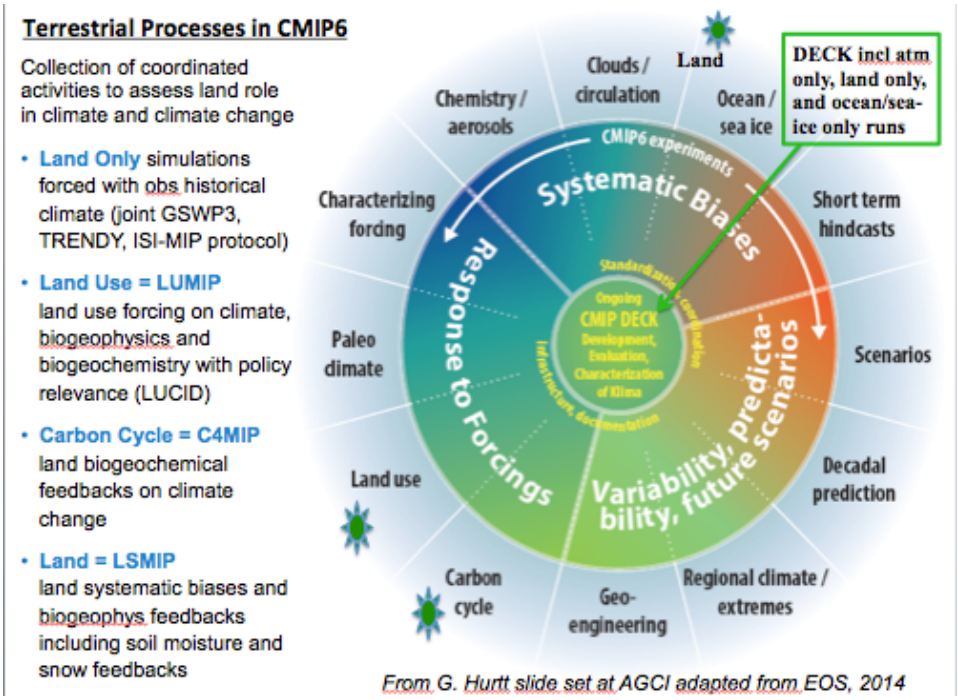
ScenarioMIP

- How does the Earth system respond to forcing, for forcing pathways relevant to IAM and IAV research communities and to policy?
- How can we assess future climate changes given uncertainties in scenarios for forcing pathways spanning a range of uncertainties in global and regional forcing relevant to IAM/IAV/policy?
- How will plausible future forcing pathways affect global and regional climate and sea level rise, climate extremes, water availability, and biospheric feedbacks, and how will these affect impacts and mitigation and adaptation possibilities?

In addition to these MIP-specific research questions, scientific and technical issues regarding the significance of changes brought about by regional forcings from both land use and air pollutants and the type of experiment that LUMIP and AerChemMIP could run in order to aid Scenario MIP to identify a set of future scenarios to propose as part of CMIP6 experimental design were discussed. Also discussed was development of a consensus on the approach(es) for the documentation of radiative forcing for all aspects (land use, short-lived climate forces, and well-mixed greenhouse gases). Considerable attention during the discussion was focused on the relationship between representative concentration pathway (RCP) scenarios run by Earth system models and shared socioeconomic pathways (SSP) run by integrated assessment models.

By the conclusion of the meeting, the individual MIP working groups were able to make substantial progress on their upcoming proposals to the CMIP panel of the WGCM (final versions were due March 2015). A draft of a timeline and distributions of responsibilities was sketched out to bring forward for approval by the CMIP Panel. In addition, a short workshop summary product was published in the 9 December 2014 edition of *Eos*.

As an example of how to integrate terrestrial processes into the overall CMIP conceptual framing, George Hurtt presented the following slide during the discussions.



From G. Hurtt slide set at AGCI adapted from EOS, 2014

3. Outcomes

A journal article summarizing the conclusions of the workshop was published in *Eos*, with the title: "Developing Climate Model Comparisons."

O'Neill, Brian C., Jean-Francois Lamarque, and David Lawrence. 2014. "Developing Climate Model Comparisons." Eos 95 (49). https://eos.org/meeting-reports/developing-climate-model-comparisons

Videorecordings of workshop presentations were taken and are to be made available on the AGCI website. The soft launch version of our new website has many of the presentations and videos. They can be viewed at https://live.agci.org/event/14s2

A public lecture in honor of Walter Orr Roberts was held during the workshop. Gerald Meehl (NCAR) presented to a standing room only audience in Aspen, Colorado. The lecture was entitled "Has Global Warming Stopped? Understanding the Ups and Downs of Climate in a Changing World," and presented recent research into the "hiatus" in temperature change observed over the past decade. The recording of Meehl's talk can be viewed at https://live.agci.org/db/lib/has-global-warming-stopped

4. Evaluation of 2013 Workshops

Evaluation Results

Experimental design for CMIP6: Aerosol, land use, and future scenarios

	Poor	Fair	Good	Very Good	Excellent	Totals
Session Theme Selection	0	0	0	2	13	15
	0%	0%	0%	13%	87%	
Quality of Presentations	0	0	0	3	13	16
	0%	0%	0%	19%	81%	
Logistical Support	0	0	0	1	16	17
	0%	0%	0%	6%	94%	
Personal Value	0	0	0	1	15	16
	0%	0%	0%	6%	94%	

Selected Comments from participants:

"It is very important that the MIPS associated with CMIP6 be in close collaboration. This meeting allowed strong internal MIP planning and strong interactions among MIPs."

"Participants were top experts in their fields and on the front lines of planning for future assessments. In particular, presentations improved over the course of the week as plans were finalized."

"Very high value given the lively exchange between scientists from different communities."

"This was an excellent opportunity to collaborate with experts and ensure that my community's perspective will be represented in future CMIP6/MIP activities."

"AGCI is high value science for the benefit of humanity. Pure and simple."

Online Dissemination

On our AGCI website, are working to provide many of the videos of lectures and presentations materials from our workshops for the public. Current and future resources are accessible by the following links:

August 2014 *Experimental design for CMIP6: Aerosol, land use, and future scenarios:*

https://live.agci.org/event/14s2

5. Appendix: Roster and Topical Agenda

Roster

Almut Arneth
Karlsruhe Institute of Technology (KIT)

Katherine Calvin
Pacific Northwest National Laboratory

Bill Collins
University of Reading AC

Veronika Eyring
Deutsches Zentrum für Luft- und Raumfahrt (DLR)

George Hurtt
University of Maryland

Andrew Jones
Lawrence Berkeley National Laboratory

Jean-François Lamarque
University Corporation for Atmospheric Research

Dave Lawrence
University Corporation for Atmospheric Research

Peter Lawrence
National Center for Atmospheric Research

Gerald Meehl
National Center for Atmospheric Research

Gunnar Myhre
Center for International Climate and Environmental Research Oslo (CICERO)

Brian O'Neill
National Center for Atmospheric Research

Michael Prather
University of California Irvine

Keywan Rihai
International Institute for Applied Systems Analysis

Alex Ruane
NASA

Ben Sanderson
University Corporation for Atmospheric Research

Michael Schulz
MET

Elena Shevliakova
Princeton University

Steve Smith
Pacific Northwest National Laboratory

Claudia Tebaldi
National Center for Atmospheric Research

Detlef van Vuuren
PBL Netherlands Environmental Assessment Agency

Dan Ward
Cornell University

Agenda

Workshop 1. EXPERIMENTAL DESIGN FOR CMIP6: AEROSOL, LAND USE, AND FUTURE SCENARIOS
3 Aug 2014 – 8 Aug 2014

Agenda

SUNDAY, AUGUST 3

Arrivals in Aspen

MONDAY, AUGUST 4

9:00 am	General introductions and purpose of the meeting **John Katzenberger & James Arnott** **Claudia Tebaldi & Brian O'Neill**
9:30 am	Climate Model Intercomparison Project Phase 6 (CMIP6) – **Veronika Eyring** *CMIP timeline, role of satellite MIPs, what constitutes a CMIP experiment, expectations for MIP proposals*
10:00 am	Discussion
11:00 am	Individual MIP Meetings LUMIP: Main Tent AerChemMIP: Professor House ScenarioMIP: Red Brick Current status, plans, and implications for other MIPs
2:00 pm	ScenarioMIP **Claudia Tebaldi** or **Brian O'Neill**
2:45 pm	LUMIP **Dave Lawrence** or **George Hurtt**

4:00 pm	AerChemMIP **Jean-Francois Lamarque**
4:45 pm	Concluding Discussion

TUESDAY, AUGUST 5

9:00 am	Sensitivity of climate to global or regional land use *Speakers (15 min each):* **Andy Jones** (on IAM-ESMs), **Elena Shevliakova** (on sensitivity to land use), **Peter Lawrence** (on model dependence of sensitivity to land use)
9:45 am	Discussion
11:00 am	Sensitivity to land use (continued) *Speakers (15 min each):* **Dan Ward** (on radiative forcing of land use), **Almut Arneth** (on LUC4C)
11:30 am	Discussion
1:30 pm	Sensitivity of climate to global or regional emissions of Short-lived Climate Forcers (SLCFs) *Speakers*: **Jean-Francois Lamarque, Bill Collins, Steve Smith**
3:30 pm	Scenario differences
3:30 pm	**Claudia Tebaldi** – Sensitivity of local climate outcomes to global forcing or temperature change
3:50 pm	**Alex Ruane** – Sensitivity of agricultural impacts to climate change
4:10 pm	Discussion: How different should scenarios be that are part of ScenarioMIP? What climate or impact model experiments are needed to better understand differences across scenarios?
6:00 pm	Walter Orr Roberts Memorial Public Lecture **Jerry Meehl:** *Has global warming stopped? Understanding the ups and downs of climate in a changing world.*

WEDNESDAY, AUGUST 6

9:00 am	Experimental designs for climate model experiments on the sensitivity of climate to land use and emissions of SLCFs

Moderators: **Dave Lawrence**, **Jean-Francois Lamarque**

Discussion: What climate model experiments should be carried out to investigate the sensitivity of climate to global or regional variations in land use or emissions of SLCFs? What type of experiments would be best (e.g., idealized vs. plausible)? Which scenarios should they be based on? In which MIPs should they be carried out?

11:00 am Harmonization of historical and projected future land use, and implementing IAM land use scenarios in ESMs
Speakers (15 minutes each): **George Hurtt** (on new data layers), **Kate Calvin** (on afforestation scenarios), **Peter Lawrence** (on implementing land use dataset including wood harvest)

THURSDAY, AUGUST 7

9:00 am Land use – SLCF bilateral discussion
Moderators: **Dave Lawrence**, **Jean-Francois Lamarque**
Discussion: What common issues do LUMIP and AerChemMIP face? Should experimental designs for the sensitivity of climate to land use and to SLCF emissions be parallel? Are there important interactions between land use and SLCF emissions that should be accounted for?

11:00 am Process/timeline discussion
Moderator: **Detlef van Vuuren**

Discussion: What are the proposed timelines for each MIP? Will MIPs divide activities into two phases? What information needs to be exchanged across MIPs, and when? What are the needs for coordination across MIPs?

2:00 pm Individual MIP meetings

Goals: Draft proposed MIP designs and timelines, to be presented Friday a.m. Use of this time will remain flexible to best address needs at this point of the meeting, including possible plenary discussions, or coordination across separate MIP meetings as necessary.

LUMIP: Hotel Aspen Breakfast Room
AerChem MIP: Main tent
ScenarioMIP: Red Brick

FRIDAY, AUGUST 8

9:00 am Proposed design presentations by the three MIPs
(15 minutes each with 15 minutes discussion)
9:00 am ScenarioMIP – **Detlef van Vuuren**

9:30 am	LUMIP – **Dave Lawrence**
10:00 am	AerChemMIP – **Jean-Francois Lamarque**
11:00 am	Cross-MIP coordination issues Moderator: **Brian O'Neill** Discussion: What further interactions across MIPs need to take place in order to produce MIP proposals to the CMIP panel by September? What longer-term interactions need to take place in order to exchange information on progress on areas of common interest? How should these interactions take place (identify cross-cutting working groups, further joint meetings, etc.)?
12:00 pm	Wrap-up, discussion of products, next steps Moderator: **Claudia Tebaldi** Discussion: Beyond proposals from each MIP to the CMIP panel, what meeting products should be produced (meeting report, publication on MIP designs, etc.)? How will this be accomplished? Should we be interacting with additional MIPs, and if so how?