



# Next Generation Climate Change Experiments Needed to Advance Knowledge and for Assessment of CMIP6

## **FINAL REPORT**

on

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## 1. Summary of Activities

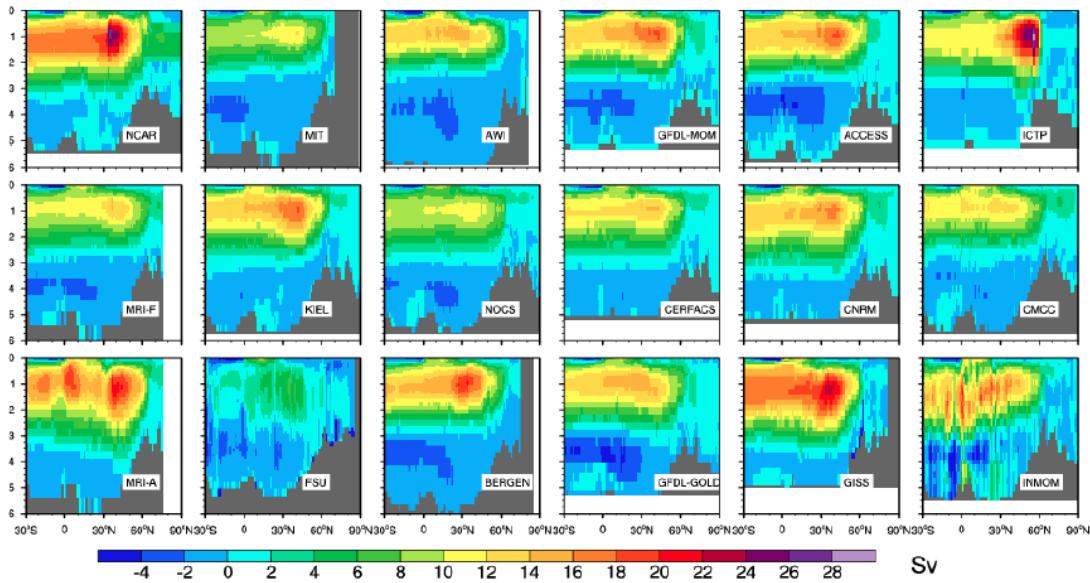
The Aspen Global Change Institute hosted a technical science workshop entitled, “Next generation climate change experiments needed to advance knowledge and for assessment of CMIP6,” on August 4-9, 2013 in Aspen, CO. Jerry Meehl (NCAR), Richard Moss (PNNL), and Karl Taylor (LLNL) served as co-chairs for the workshop which included the participation of 32 scientists representing most of the major climate modeling centers for a total of 160 participant days.

## 2. AGCI Workshop on CMIP6 Design

In August 2013, AGCI gathered a high level meeting of representatives from major climate modeling centers around the world to assess achievements and lessons learned from the most recent generation of coordinated modeling experiments known as the Coupled Model Intercomparison Project – 5 (CMIP5) as well as to scope out the science questions and coordination structure desired for the next anticipated phase of modeling experiments called CMIP6.

The workshop allowed for reflection on the coordination of the CMIP5 process as well as intercomparison of model results, such as were assessed in the most recent IPCC 5<sup>th</sup> Assessment Report, Working Group 1. For example, this slide from Masahiro Watanabe examines performance on a range of models capturing Atlantic Meridional Overturning Circulation (AMOC).

### AMOC Mean (1988-2007) in Depth Space

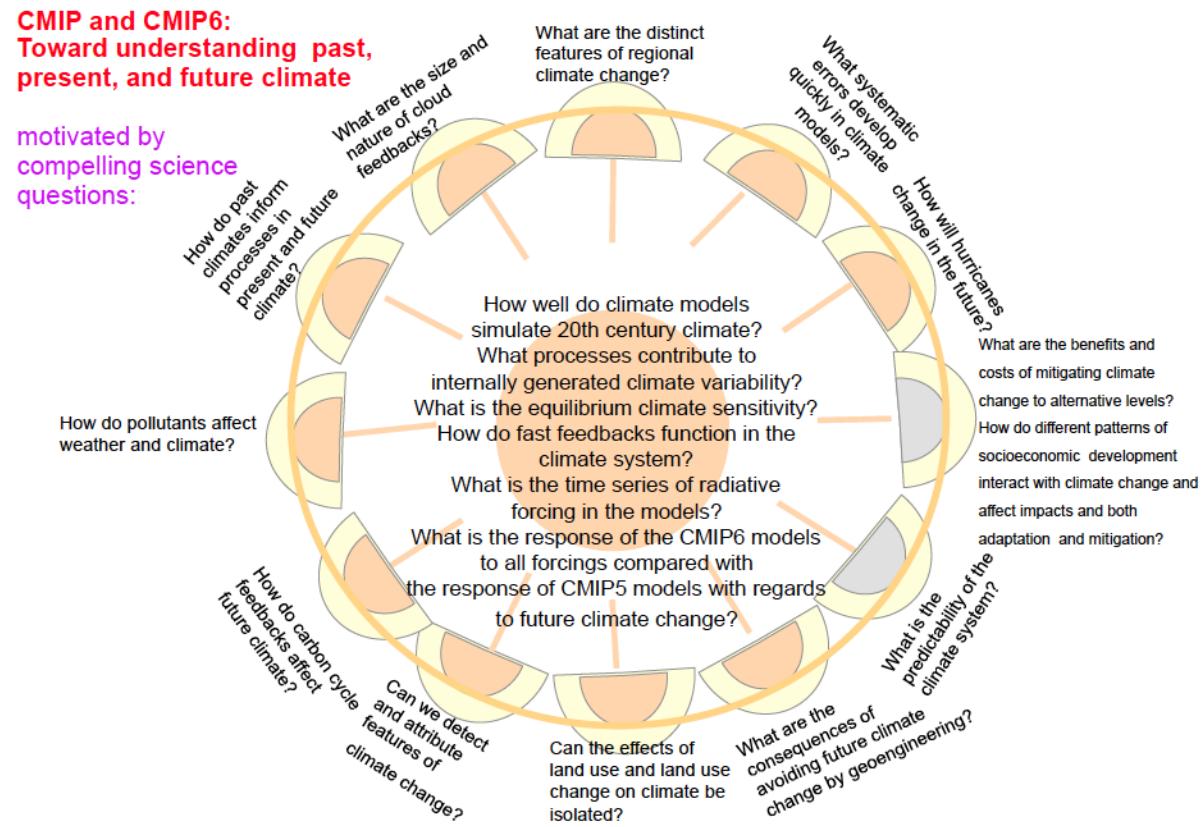


Some of the science issues that were explored at this meeting included:

- Land use –aerosols –ESM applications—interact with a couple of the Shared Socio-economic Pathways (SSPs) that show quite different outcomes from RCPs
- Reversibility or geo-engineering
- More idealized experiments, e.g. 1% runs but for other forcings, idealized aerosol, ozone, land use
- Decadal prediction and extremes
- Systematic biases
- Very high resolution time slice experiments for tropical cyclones and other aspects of storms and circulation changes
- Higher resolution coupled simulations for tropical cyclones, extremes, and circulation changes
- Coupled land ice for better estimates of global and regional sea level rise

An additional area of discussion included the selection and use of emissions scenarios that could be used for CMIP6 as well as the eventual interface of emissions scenarios with soon-to-come-online socioeconomic scenarios called Shared Socioeconomic Pathways (SSPs). One suggestion that came out of the meeting was to create a “scenario MIP” as subcomponent of CMIP6. In this way, a number of traditional scenario experiments were discussed in addition to a new approach in which non-mitigation and mitigation scenarios would be paired to provide a basis for research on impacts and damages avoided through mitigation and adaptation. Each pair (perhaps on the order of four pairs) would be run by a subset of modeling groups, with each of these groups running one pair of scenarios, though they could elect to run more if desired. An experiment design was explored to pair models and scenarios in such a way as to sample a variety of climate model characteristics for each scenario pair (e.g. climate sensitivity).

A figure below, designed and refined throughout the workshop, highlights the progression of the development of interesting science questions to the possible design of a coordinated structure for addressing those questions through the CMIP6 process.



The 2013 AGCI workshop on CMIP6 represented the culmination of a cycle (as well as a possible start to a new cycle) of interdisciplinary science workshops on coordinated Earth system modeling and related issues such as development of models for use in assessments like the IPCC.

### 3. Outcomes

A journal article summarizing the conclusions of the workshop was published in *Eos*, with the title: "Climate Model Intercomparisons: Preparing for the Next Phase."

Meehl, GA, R Moss, KE Taylor, Veronika Eyring, Ronald Stouffer, Sandrine Bony, and Bjorn Stevens. 2014. "Climate Model Intercomparisons: Preparing for the Next Phase." *Eos* 95 (9): 2014–2015.  
<http://onlinelibrary.wiley.com/doi/10.1002/2014EO090001/abstract>.

Videorecordings of workshop presentations were taken and are to be made available on the AGCI website after a redevelopment of the AGCI website is complete later this year.

A public lecture in honor of Walter Orr Roberts was held during the workshop. Claudia Tebaldi (Climate Central/NCAR) and Brian O'Neill (NCAR) presented to a standing room only audience in Aspen, Colorado. The lecture was entitled "Charting a future with climate and people," and the presentation featured how climate science and social

science can be paired to better characterize the potential societal impacts of anticipated changes in climate.

## 4. Evaluation of 2013 Workshops

### ***Evaluation Results***

#### *CMIP6 Workshop*

	Poor	Fair	Good	Very Good	Excellent	Totals
Session Theme Selection	0	1	1	4	22	28
	0%	4%	4%	14%	79%	
Quality of Presentations	0	0	1	9	18	28
	0%	0%	4%	32%	64%	
Logistical Support	0	0	0	4	24	28
	0%	0%	0%	14%	86%	
Personal Value	0	0	0	7	21	28
	0%	0%	0%	25%	75%	

#### **Selected Comments from participants:**

*“Great offline opportunities to push science ahead in other research domains.”*

*“The AGCI sessions have steered climate science for 24 years.”*

*“Novel setting outdoors, relaxed atmosphere, constructive/productive environment to advance science on both technical and social levels.”*

*“Very useful in establishing and strengthening interdisciplinary connections with researchers in other fields.”*

*“AGCI is high value science for the benefit of humanity. Pure and simple.”*

### **Online Dissemination**

On our AGCI website, we 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 2013 CMIP6 Workshop Presentation and Materials (with videos forthcoming):

[http://www.agci.org/programs/past\\_scientist\\_workshops/about\\_the\\_workshop/sciSess\\_details.php?recordID=289](http://www.agci.org/programs/past_scientist_workshops/about_the_workshop/sciSess_details.php?recordID=289)

## 5. Appendix: Roster and Topical Agenda

### Roster

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## Agenda

**SUNDAY, AUGUST 4**

Arrivals in Aspen

**MONDAY, AUGUST 5**

*Continental breakfast provided at hotel beginning at 7 am.*

8:30 am Walk to ACES. Coffee & light breakfast provided at tent.  
**Meeting location:** Aspen Center for Environmental Studies  
100 Puppy Smith Street, Aspen CO

## Welcome and Introductions

9:00 am	General introductions and purpose of the meeting <b>John Katzenberger</b> <b>Jerry Meehl, Richard Moss, &amp; Karl Taylor</b>
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## CMIP5 in review

**For each speaker, specifically address:**

1. For CMIP5, what were the science questions and what was done?
2. What did we learn (scientifically and in terms of practical lessons)?
3. What science gaps and systematic model errors remain and what science questions should be addressed?
4. For CMIP6, what should be done differently?

9:30 am                   **Review of CMIP5 - Veronika Eyring & Ron Stouffer**

Results of survey: CMIP5 experiment design, emissions / forcing for historical and RCP experiments, output, model and experiment documentation, data search and support, timeline, science gaps

10:30 am                   **BREAK**

11:00 am                   Scenarios panel:  
**Richard Moss (chair), Jae Edmonds, Detlef Van Vuuren, John Weyant, Brian O'Neill**

Review EMF and previous scenarios-related workshops, what was done for CMIP5, what could be done for CMIP6

## CMIP5 experiments

12:00 noon               Panel: *Short-term experiments for CMIP5--decadal climate prediction*  
**Ben Kirtman (chair), Christophe Cassou, Gokhan Danabasoglu**

12:30 pm               **LUNCH**

### *CMIP5 experiments (cont.)*

2:00 pm               Chemistry/aerosols and ESM-carbon cycle  
**Peter Cox (chair), Pierre Friedlingstein, & Michio Kawamiya**

2:30 pm               Cloud feedbacks - **Sandrine Bony**

3:00 pm               Paleoclimate - **Bette Otto-Bliesner**

3:30 pm               **BREAK**

4:00 pm               Land use/land cover  
**George Hurtt (chair), Dave Lawrence, & Kathy Hibbard**

4:30 pm	High-resolution time slice experiments - <b>Masahiro Watanabe</b>
5:00 pm	20 <sup>th</sup> century and single forcing experiments - <b>Claudia Tebaldi</b>
5:30 pm	Adjourn

## **TUESDAY, AUGUST 6**

*Continental breakfast provided at hotel beginning at 7 am.*

8:30 am	Walk to ACES. Coffee and light breakfast provided at tent. <b>Meeting location:</b> Aspen Center for Environmental Studies 100 Puppy Smith Street, Aspen CO
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### **CMIP5 in review (continued)**

9:00 am	Panel: <i>The CMIP5 experience from the modeling group perspective</i> <b>Karl Taylor</b> (chair), <b>Olivier Boucher, Gokhan Danabasoglu, Wilco Hazeleger, Michio Kawamiya, Masahiro Watanabe, Colin Jones, Alessio Bellucci, Gavin Schmidt, Ron Stouffer</b>
10:30 am	BREAK
11:00 am	Panel: <i>CMIP5 issues that may impact CMIP6</i> <b>Ron Stouffer</b> (chair) IAV connections - <b>Linda Mearns</b> Hold-ups to the process - <b>Jean-Francois Lamarque</b> ESGF - <b>Karl Taylor</b> Metrics and Obs4MIPS - <b>Peter Gleckler</b> Ocean data/grids - <b>Gokhan Danabasoglu</b>
12:30 pm	LUNCH
6:00 pm	<b>Walter Orr Roberts Memorial Public Lecture</b> Extreme weather: Charting a future with climate and people Speakers: <b>Brian O'Neill &amp; Claudia Tebaldi</b>
7:00 pm	Public Reception

## **WEDNESDAY, AUGUST 7**

*Continental breakfast provided at hotel beginning at 7 am.*

8:30 am	Walk to ACES. Coffee and light breakfast provided at tent. <b>Meeting location:</b> Aspen Center for Environmental Studies 100 Puppy Smith Street, Aspen CO
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### **Formulating CMIP6**

9:00 Panel 1  
**Sandrine Bony** (chair)  
New scenario experiments - **Jae Edmonds, Detlef van Vuuren, Brian O'Neill, John Weyant**  
Idealized experiments - **Ron Stouffer**  
Aerosols - **Olivier Boucher**  
Short-lived species - **Jean-Francois Lamarque**

10:30 am BREAK

11:00 am Panel 2: **Veronika Eyring** (chair)  
Decadal climate prediction - **Ben Kirtman, Christophe Cassou, Gokhan Danabasoglu**  
IAM-ESM - **Bill Collins**  
Land use - **George Hurtt**  
GEOMIP -**Simone Tilmes**  
Transpose AMIP - **Peter Gleckler**

12:30 pm FIELD TRIP & LUNCH

5:00 pm Reception & Dialogue with ACES staff (refreshments served)  
ACES Nature Center

## THURSDAY, AUGUST 8

*Continental breakfast provided at hotel beginning at 7 am.*

8:30 am Walk to ACES. Coffee and light breakfast provided at tent.  
**Meeting location:** Aspen Center for Environmental Studies  
100 Puppy Smith Street, Aspen CO

9:00 *Discuss components for CMIP6*  
Candidates: scenario runs, idealized experiments, time slice, decadal, single  
forcings, ESM/carbon cycle, cloud feedbacks, paleo; Routine evaluation and  
benchmarking of CMIP6 models  
Discussion leads: **Veronika Eyring & Ron Stouffer**

10:30 am	BREAK
11:00 am	<p><i>Discuss management and timing of CMIP6</i>            Candidates: distributed management among communities involved, stage experiments over several years            Discussion leads: <b>Sandrine Bony &amp; Karl Taylor</b></p>
12:30 pm	<p>LUNCH            Break for afternoon</p>
6:00 pm	<p>Reception and dinner            ACES Nature Center</p>

## **FRIDAY, AUGUST 9**

*Continental breakfast provided at hotel beginning at 7 am.*

8:30 am	Walk to ACES. Coffee and light breakfast provided at tent.
9:00 am	<p><i>Synthesis: Finalize recommendation for experimental design of CMIP6</i>            Discussion leads: <b>Jerry Meehl, Richard Moss, Karl Taylor</b></p>
10:30 am	BREAK
11:00 am	<p><i>Synthesis: Finalize framework for CMIP6 and written products</i>            Discussion leads: <b>Jerry Meehl, Richard Moss, Karl Taylor</b></p>
12:30 pm	End of session

*Afternoon Departures*