WCRP Working Group on Coupled Models (WGCM)

Co-Chairs
Cath Senior (Met Office, UK)
Greg Flato (CCCma, Canada)
WGCM Aims

- Review and foster the development of coupled ocean-atmosphere and Earth system models
- Co-ordinate model intercomparisons to:
  - better understand natural climate variability
  - predict the climate response to natural and anthropogenic perturbations
  - assess the climate predictability at the decadal timescale

  e.g. CMIP (Coupled Model Intercomparison Project), CFMIP (Cloud Feedbacks Intercomparison Project), PMIP (Palaeoclimate Model Intercomparison Project), Transpose-AMIP (climate model used in NWP mode)

- Promote and facilitate the models evaluation and diagnosis of shortcomings, and understanding of processes and feedbacks in the climate system

Done in collaboration with many partners; WGNE (atmospheric process community), WGSIP (decadal forecasting community), many MIPs

WGCM promotes a balance between simulation – evaluation - understanding
Recent WGCM Activities

CMIP (coordinated through the CMIP panel)

• coordinated climate model experiments involving international modeling teams since 1995. Now in 6th phase (CMIP6)
• delivered better understanding of past, present and future climate change and variability in a multi-model framework.
• defined common experiment protocols, forcings and output.
• model simulations have also been regularly assessed as part of the IPCC Climate Assessments Reports and various national assessments.

WGCM Infrastructure Panel (WIP)

• manages and coordinates infrastructure development, and oversees implementation, and operations.
• maintains a website where “Position papers” and specifications for CMIP6 should be examined. 
  - https://www.earthsystemcog.org/projects/wip/
• BADC (Martin Juckes) is responsible for developing the list of variables that should be archived for each experiment in CMIP6 (the “data request”).
• PCMDI provides guidance documents for CMIP6 participants, maintains the “controlled vocabularies”, and leads the input4MIPs initiative to provide forcing datasets for CMIP6.

Grand Challenges

• WGCM provides leadership and support for 2 of the 7 WCRP grand challenges on ‘Clouds, Circulation and Climate Sensitivity’ and ‘Carbon Feedbacks in the Climate System’
• Promoted workshops engaging a wide group of scientists in the core questions.
• Many papers published
CMIP6 Organization

- **CMIP Panel** (V. Eyring (chair), S. Bony, J. Meehl, C. Senior, B. Stevens, R. Stouffer, K. Taylor) which is responsible for direct coordination of CMIP and overseeing the whole CMIP process.

- **WGCM Infrastructure Panel** (WIP, co-chairs V. Balaji & K. Taylor): Establishes standards and policies for sharing climate model output; puts the data request together technically (M. Juckes).

CMIP6 Experimental Design

Based on an extensive period (three years) of community consultation

- Meehl et al., EOS, 2014
- Finalized at WGCM-18 session (October 2014, Grainau)
- Eyring et al., CMIP6 Experimental Design and Organization, GMD, 2016
- Science Backdrop of WCRP GCs
- Experimental design based on 3 broad questions
  - How does the Earth System respond to forcing?
  - What are the origins and consequences of systematic model biases?
  - How can we assess future climate changes given climate variability, predictability and uncertainties in scenarios?
CMIP Continuity

A common suite of experiments for each phase of CMIP provides an opportunity to construct a multi-model ensemble using model output from various phases of CMIP.
CMIP: a More Continuous and Distributed Organization

(1) A handful of common experiments

DECK (entry card for CMIP)

i. AMIP simulation
   (~1979-2014)

ii. Pre-industrial control simulation

iii. 1%/yr CO2 increase

iv. Abrupt 4xCO2 run

CMIP6 Historical Simulation (entry card for CMIP6)

v. Historical simulation using CMIP6 forcings (1850-2014)

(2) Standardization, coordination, infrastructure, documentation

DECK (Diagnosis, Evaluation, and Characterization of Klima) & CMIP6 Historical Simulation to be run for each model configuration used in CMIP6-Endorsed MIPs

Eyring et al., GMD, 2016
21 CMIP6-Endorsed MIPs

- PMIP
- Paleo
- RFMIP, DAMIP, VoMIP
- Characterizing forcing
- Clouds / Circulation
- Regional phenomena
- Conservative biases
- CFMIP, DynVarMIP
- GeoMIP, ISMIP, SSMIP, SSMIP
- ISMIP, SSMIP, SSMIP
- OMIP, FAFMIP / LS3 MIP / SIMIP
- CORDEX, ViACS AB
- Impacts
- Scenarios
- ScenarioMIP
- Decadal prediction
- Geo-engineering
- Decadal prediction
- DCPP
- Decadal prediction
- GeoMIP
- Land use
- Carbon cycle
- Chemistry / Aerosols
- AerChemMIP
- Response to Forcing
- CMIP6 Experiments
- DECK
- C4MIP
- Applications under review
  - CDRMIP
  - PAMIP

Eyring et al., GMD, 2016
CMIP infrastructure coordination
CMIP6: Participating Model Groups

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New in CMIP:
2 new model groups from Germany (AWI, MESSY-Consortium)
4 new model groups from China (CAMS, CasESM, NUIST, THU)
1 new model group from Brazil (INPE)
1 new model group from India (CCCR-IITM)
1 new model group from Taiwan, China (TaiESM)
1 new model group from USA (DOE)
2 new model group from Republic of Korea (NIMS-KMA, SAM0-UNICON)
1 new model group from South Africa / Australia (CSIR-CSIRO)

⇒ 13 new model groups so far

* Other models can join providing DECK and historical simulations are submitted
CMIP6 Timeline

Eyring et al., CMIP6 Experimental Design and Organization, GMD, 2016
The Grand Challenge on Clouds Circulation and Climate Sensitivity (2012-2022)
S. Bony and B. Stevens

1. Cloud Feedbacks & Climate Sensitivity
   - A strategy to narrow uncertainty in ECS (Stevens et al. 2016)
   - NARVAL2 and EUREC4A field studies (Bony & Stevens)
   - ISSI team on organization of Shallow Clouds (Pincus, Bony, Stevens Winker)
   - ECS assessment (Webb & Sherwood)
   - Aerosol forcing assessment, (Ringberg, Feb 2018, Bellouin, Quaas, Stevens & others)

2. Storm Tracks
   - 4ICESM (Hamburg, Aug 2016)
   - Targeted small workshop to develop select Grindelwald themes (2018, Caballero & Kaspi)

3. Rainbelts
   - ICTP, TRAC-MIP summer school (Jul 2018, Biasutti et al)
   - ENS-MIP?
   - A tropical response to forcing synthesis workshop/discussion in the frame of CFMIP?

4. Convective Aggregation
   - ISSI team on organization of Shallow Clouds (Pincus, Bony, Stevens Winker)
   - RCE-MIP (Wing, Reed, Satoh & Others)
   - Future of Convective Parameterization (Jakob, Siebesma)

Related Activities
- Model hierarchies workshop: Nov 2016 in Princeton, to become a regular WGCM/GC event?
- GASS conference (Feb 2018): discussion about the articulation GC / Core projects (GEWEX) / CFMIP?
- Workshop on the Challenges in modeling weather and climate in the trades (date and location TBD)
- Contribution to a H2020 Proposal
GC: Carbon Feedbacks in the Climate System

to understand how biogeochemical cycles and feedbacks control CO$_2$ concentrations and impact on the climate system

chaired by Tatiana Ilyina & Pierre Friedlingstein

Guiding questions:

1. What are the drivers of land and ocean carbon sinks?
2. What is the potential for amplification of climate change over the 21$^{\text{st}}$ century via climate-carbon cycle feedbacks?
3. How do greenhouse gases fluxes from highly vulnerable carbon reservoirs respond to changing climate (including climate extremes and abrupt changes)?

Activities:

1. GC Carbon approved by JSC, May 2016
2. Kick-off meeting Nov 2016 (Hamburg). Report on WCRP website
3. Workshop on carbon feedbacks framework and Emergent constraints, to be held in Bern, March-April 2018.
4. GC-carbon – GC-decadal discussions on decadal predictability of the carbon cycle
Future Priorities

CMIP

• Facilitating CMIP6 experiments and data exchange from modeling groups to research community and through to influencing IPCC AR6
• Routine model evaluation
• Considering design of CMIP7

Grand Challenges

• Continue to support the grand challenges on ‘Clouds, Circulation and Climate Sensitivity’ and ‘Carbon Feedbacks in the Climate System’ through to their maturity and continue to seek emerging science questions from within these communities going forward

Links to Wider modelling community

• Maintain existing strong links to process community (WGNE)
• Idealised modelling community where traceability to higher order models can be established (e.g. Princeton workshop 2016)
• Regional climate modelling and downscaling

Links to Impacts and Climate Services

• Promoting VIACS diagnostics with modelling groups
How to characterize the wide variety of models in CMIP6?
- Routine Benchmarking and Evaluation Central Part of CMIP6 -

Tools such as the community-developed Earth System Model Evaluation Tool (ESMValTool, Eyring et al., ESMValTool, GMD (2016b)) that includes other software packages such as the NCAR CVDP (Phillips et al., 2014)), and the PCMDI Metrics Package (PMP, Gleckler et al., EOS (2016)) to produce well-established analyses as soon as CMIP model output is submitted.

Broad Characterization of Model Behavior (incl. IPCC AR5 Chap 9 & 12 diagnostics in ESMValTool)

Running alongside the ESGF

Link to projections
Envisaged Workflow for Routine Evaluation in CMIP

Eyring et al., ESD (2016)
See Sarah Connors’ nice overview at:

Outline: https://www.ipcc.ch/meetings/session46/AR6_WGI_outlines_P46.pdf
Summary for Policy Makers
Technical Summary

Chapter 1: Framing, context, methods
Chapter 2: Changing state of the climate system
Chapter 3: Human influence on the climate system
Chapter 4: Future global climate: scenario-based projections and near-term information
Chapter 5: Global carbon and other biogeochemical cycles and feedbacks
Chapter 6: Short-lived climate forcers
Chapter 7: The Earth’s energy budget, climate feedbacks, and climate sensitivity
Chapter 8: Water cycle changes
Chapter 9: Ocean, cryosphere, and sea level change
Chapter 10: Linking global to regional climate change
Chapter 11: Weather and climate extreme events in a changing climate
Chapter 12: Climate change information for regional impact and for risk assessment

Annexes incl. options for a Regional Atlas and Technical Annexes
**ar6 milestones**

**IPCC call for author nominations for the Sixth Assessment Report**  
*Deadline is Friday 27th October 2017*

https://wg1.ipcc.ch/index.html#AR6Nominations

**Literature cutoff dates:**

- **SR on Global Warming of 1.5°C**  
  submission: 1 November, 2017  
  acceptance: 15 May, 2018

- **SR on Oceans, Cryosphere and Climate (Sept., 2019)**  
  submission: July (?), 2018  
  acceptance: February(?) 2019

- **SR on Land use, Desertification**  
  as above

- **WG-I (tentative)**
  
  submission: 31 January, 2020  
  acceptance: 15 October, 2020