Ice Sheet Model Intercomparison Project for CMIP6 (ISMIP6)

- ISMIP6 is the first CMIP project focused on ice sheets.
  - *Primary goal*: To estimate past and future sea level contributions from the Greenland and Antarctic ice sheets, along with associated uncertainty
  - *Secondary goal*: To investigate feedbacks due to dynamic coupling between ice sheet and climate models, and impacts of ice sheets on the Earth system

- Includes both standalone ice sheet experiments and coupled ice sheet–climate experiments

Experimental design for ISMIP6

1. **Existing CMIP experiments** to be analyzed in terms of ice sheet forcing

2. **Standalone ice sheet experiments** based on CMIP model output to estimate past and future sea level rise, and explore uncertainty due to ice sheets

3. **Coupled AOGCM-ISM experiments** to explore impacts and feedbacks due to ice sheets

CMIP6 expts to be used by ISMIP6 (all AOGCM)

- Pre-industrial control
- AMIP
- 1% per yr CO_2 to $4xCO_2$
- Abrupt $4xCO_2$
- CMIP6 Historical Simulation
- ScenarioMIP RCP8.5/SSP5x (up to year 2300)
- Last Interglacial PMIP

Standalone ISMIP6 expts (ISM only)

- ISM control
- ISM for last few decades (AMIP)
- ISM for the historical period
- ISM forced by 1% per yr CO_2 to $4xCO_2$
- ISM for 21st / 23rd century (RCP8.5/SSP5x)
- ISM for Last Interglacial
- ISM specific experiments to explore uncertainty

New proposed ISMIP6 expts (coupled AOGCM-ISM)

- Pre-industrial control
- 1% per yr CO_2 to $4xCO_2$
- Scenario RCP8.5/SSP5x (to year 2300)

ISMIP6 participating groups

Groups participating in ISMIP6 coupled ISM–AOGCM simulations:

- Alfred Wegener Institute (Germany), **MPI-ESM/AWI-CM/PISM**[*]

- Danish Met Institute (Denmark), **EC-Earth3/PISM**

- Institute of Numerical Mathematics (Russia), **INMCM/VUB**[*]

- JAMSTEC/AORI (Japan), **MIROC/IcIES**

- Max Planck Institute (Germany), **MPI-ESM/PISM**

- Météo-France/IGE/LSCE (France), **CNRM/IPSL/Grisli/Elmer-Ice**

- NASA GISS (USA), **ModelE/PISM**

- NCAR/LANL (USA), **CESM/CISM**

- UK Met Office/U. Reading (UK), **HadGEM3/BISICLES**[*]

[*] Planning for coupled Antarctic simulations (not just Greenland)

Scenarios for coupled experiments

- **piControl** (Tier 1)

  - Same preindustrial forcing as for DECK experiments
  - Suggested to run for 500 model years to capture natural variability

- **1pctCO2** (Tier 1)

  - CO_2 concentration increases by 1%/yr until quadrupling (140 years), fixed thereafter
  - Suggested to run for 350–500 model years in total

- **ssp5-8.5** (Tier 2)

  - Similar to RCP8.5; suggested to run until 2300
  - Preceded by historical run, ~1850–2000

ISMIP6 coupled climate simulations

"The aim is to produce a realistic non-drifting coupled state."

Preindustrial AOGCM/ISM spin-up

piControl forced ISM

1pctCO2 forced ISM

ssp5-8.5 forced ISM

piControl with ISM

1pctCO2 with ISM

ssp5-8.5 with ISM

forced ISM = standalone ice sheet model forced with AOGCM output

with ISM = ice sheet model interactively coupled to AOGCM

Standard CMIP experiments (no coupled ice sheets)

- These experiments will be staged at run at NCAR
  - No extra work or computing resources from the LIWG
  - Thanks to Sheri Mickelson and others for making sure that CESM2 outputs the required fields

- Analysis
  - Jan Lenaerts and Leo van Kampenhout have offered to take the lead in analyzing and publishing results from these simulations (ice sheet climate and SMB)

Standalone ice sheet experiments

- The ISMIP6 community will draw on CMIP6 output and other expertise to develop atmosphere and ocean forcing fields.

- Experiments with CISM will be staged, run and analyzed at NCAR.
  - Computational requirements are modest compared to CESM2; can use LIWG allocation

- Bill Lipscomb and Gunter Leguy have offered to coordinate these runs, along with Heiko Goelzer (Utrecht U., ISMIP6 steering committee member)

Coupled AOGCM/ISM experiments

- These experiments will likely be staged and run at NCAR

  - CGD computing resources have been allocated for Tier 1 experiments (PI control, $1xCO_2$)

  - LIWG computing resources needed for the JG/BG spin-up and Tier 2 experiments (historical/scenario)

  - Spin-up simulation start asap (lead: Fyke/Löfverström; discussion needed!)

  - LIWG members at NCAR (Leguy, Lipscomb, Löfverström, Sacks) will take the lead in staging the runs, in consultation with other LIWG members (Fyke, Lenaerts, Vizcaino,…)

  - CGD may have some human resources to help run MIPs

- Miren Vizcaíno and her team at TU Delft will take the lead in the analysis

  - Lots of data to analyze; opportunities for others to contribute

Extra slides