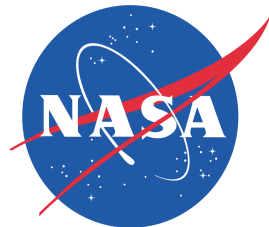


# ISMIP6: Ice Sheet Model Intercomparison Project for CMIP6

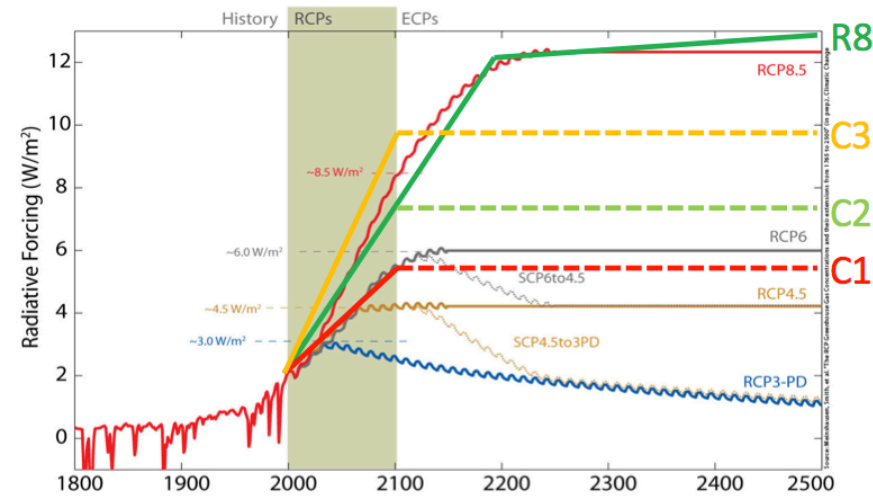
S. Nowicki

With input from the participants of the ISMIP6 workshop (July 2014)

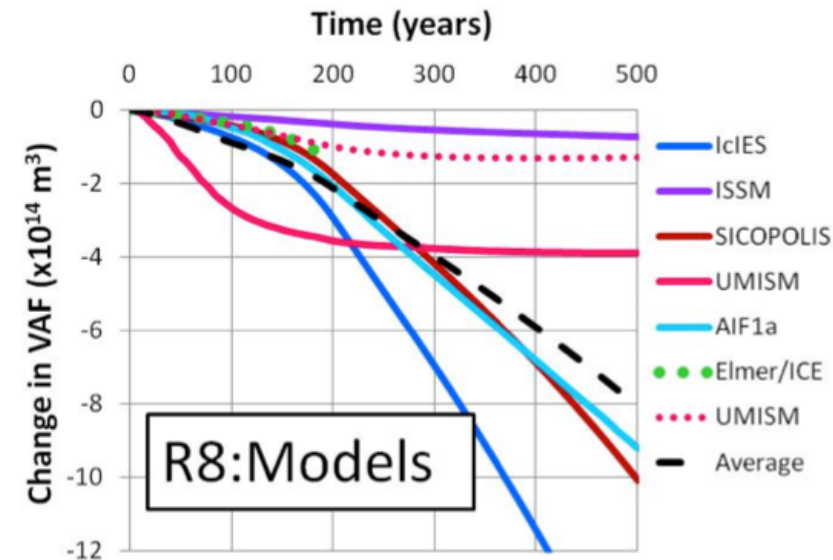


# Aims of ISMIP6 (an ice sheet MIP)

- Enable sea level projections from the Greenland and Antarctic ice sheets to become part of 'standard' CMIP/IPCC data stream.
- To link ice-sheet modelling community more tightly with CMIP community:
  - Previous use of climate projections by ice-sheet community (e.g., SeaRISE and ice2sea projects) has been *ad hoc* and out of date (e.g., use of SRES scenarios in AR5, while CMIP considered RCPs).
  - Several ESMs will have interactive ice sheet models by time of CMIP6 ( CESM, UKESM, ModelE, IPSL, MIP-I, DMI ...).
- Ice sheets highlight aspects of climate system modelling (such as polar oceans and meteorology) that are not well represented in ESMs, yet that are crucial for understanding two of the WCRP Grand Challenges: the cryosphere in a changing climate and future sea-level rise.

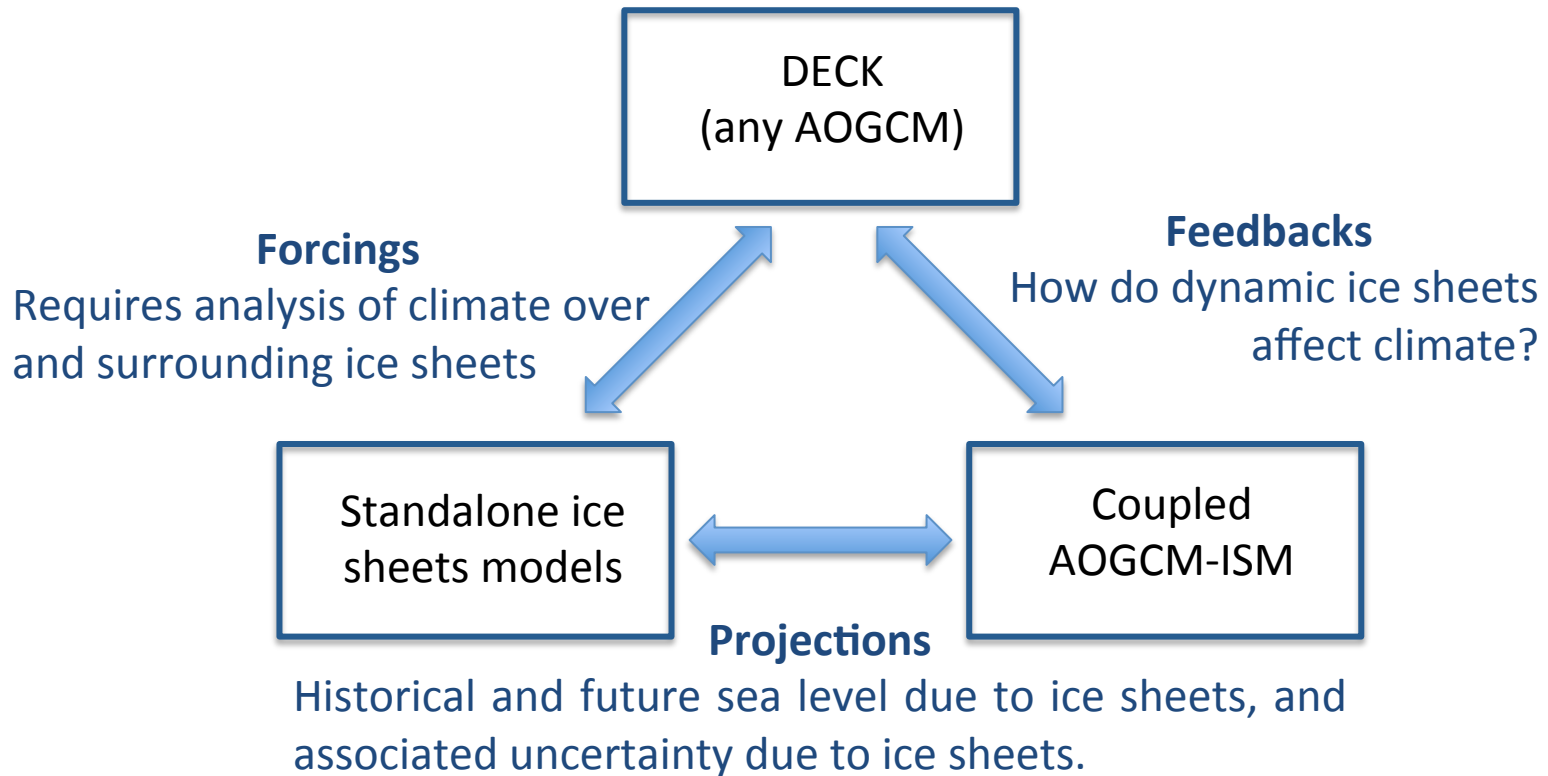


RCP considered by IPCC-AR5, and temperature profile for the SeaRISE experiments (All were based on amplifications of the A1B scenario for IPCC AR4).



Projection of ice volume change from the R8 SeaRISE Greenland scenario, which considered climatic, oceanic and basal lubrication forcing.

# Experimental framework for ISMIP6



Proposed to focus on following DECK experiments:

AMIP, Pre-Industrial control, 1% per year to quadrupling CO<sub>2</sub>, and RCP8.5 for future scenario, but these may change to align with CMIP6

# Experimental design for ISMIP6

## Existing DECK exp to be used by ISMIP6 (all AOGCM)

- AMIP
- Pre-industrial control
- 1% per yr CO2 to quadrupling CO2
- RCP8.5 (up to year 2300?)

## Standalone ISMIP6 exp (ISM only)

- ISM for last few decades
- ISM for 21<sup>st</sup> / 23<sup>rd</sup> century sea level forced by RCP8.5
- ISM specific experiments to explore uncertainty in sea level
- ISM forced by 1% per yr CO2 to quadrupling CO2

## New proposed ISMIP6 exp (coupled AOGCM-ISM)

- Pre-industrial control
- 1% per yr CO2 to quadrupling CO2
- RCP8.5 (up to year 2300?)



**1. Forcings**  
Requires analysis of climate over and surrounding ice sheets

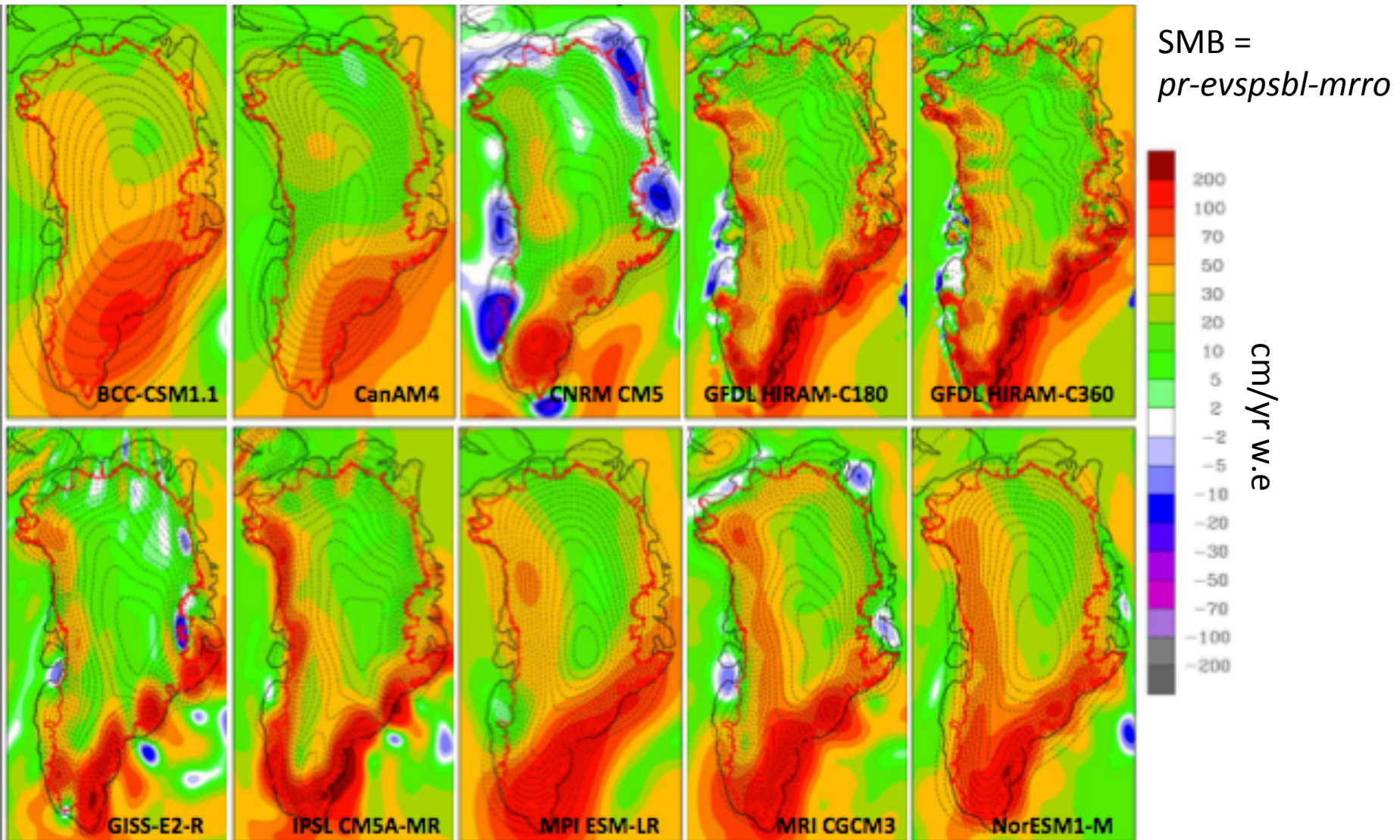


**2. Projections**  
Historical and future sea level due to ice sheets, and associated uncertainty due to ice sheets.

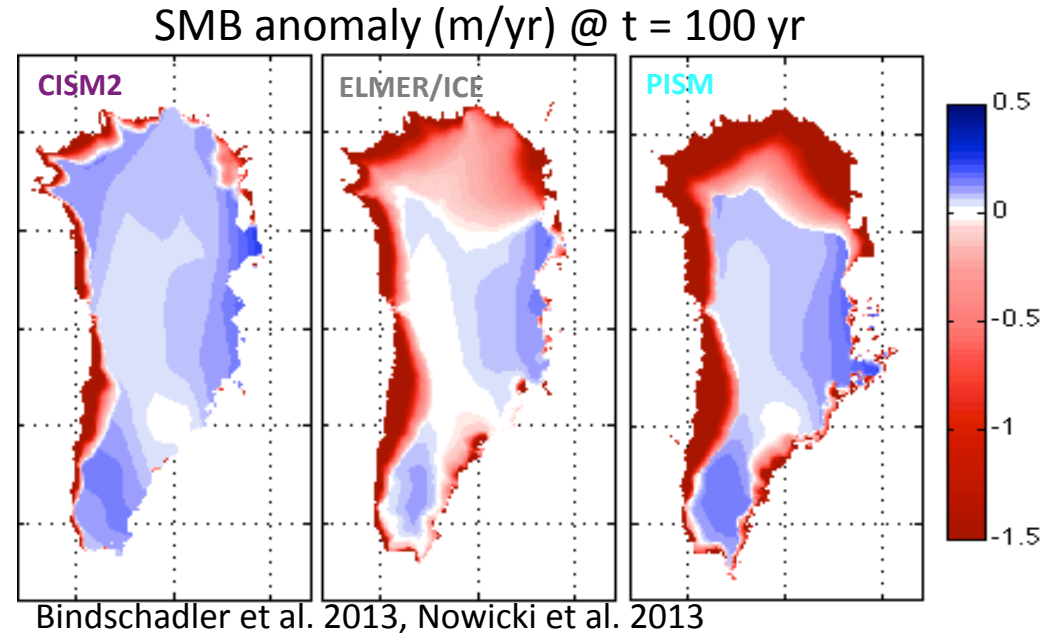
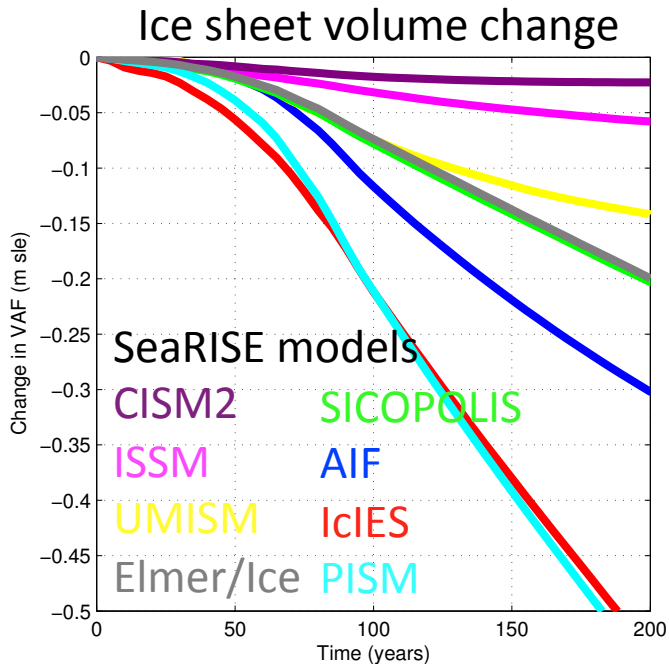


**3. Feedbacks**  
How do dynamic ice sheets affect climate?

# Evaluation of climate from DECK to derive forcing for ISM: Surface Mass Balance from CMIP5 20<sup>th</sup> Century AMIP, 1980-2008



# Sea-level projection due to the Greenland ice sheet under the A1B atmospheric forcing



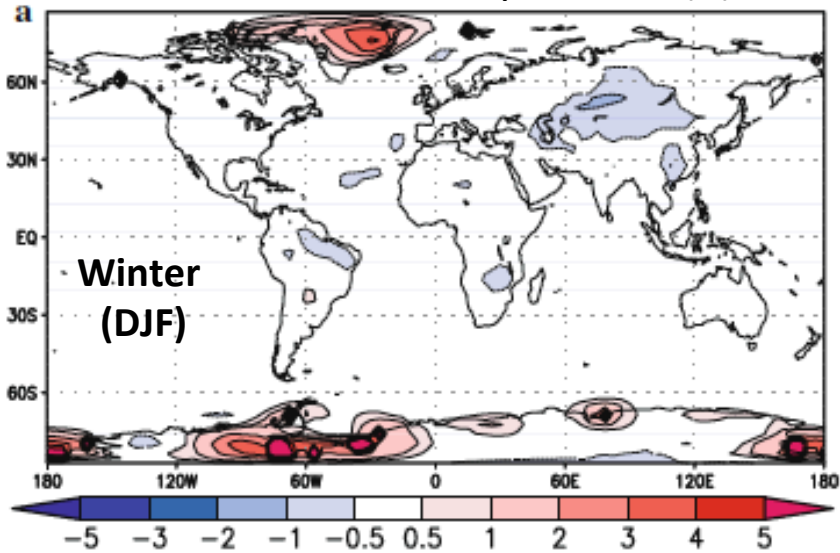
The spread in ice sheet response, and sea-level, is due to different:

- Ice sheet model physics
- Surface forcings and feedbacks, poorly known basal conditions
- Initialization / Spin-up methods

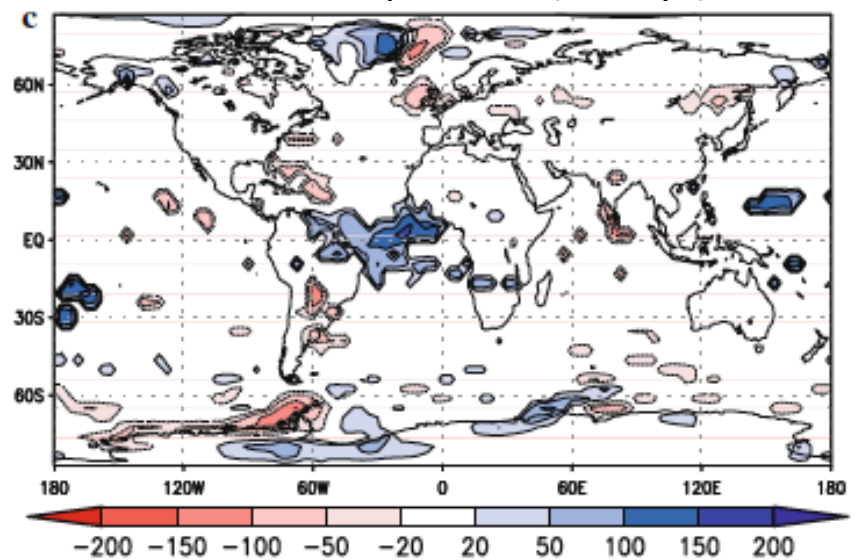
A large component of ISMIP6 will be to quantify uncertainty in SL due to ISM, based on insight gained from the ice2sea and SeaRISE efforts.

# Effect of interactive ice sheets

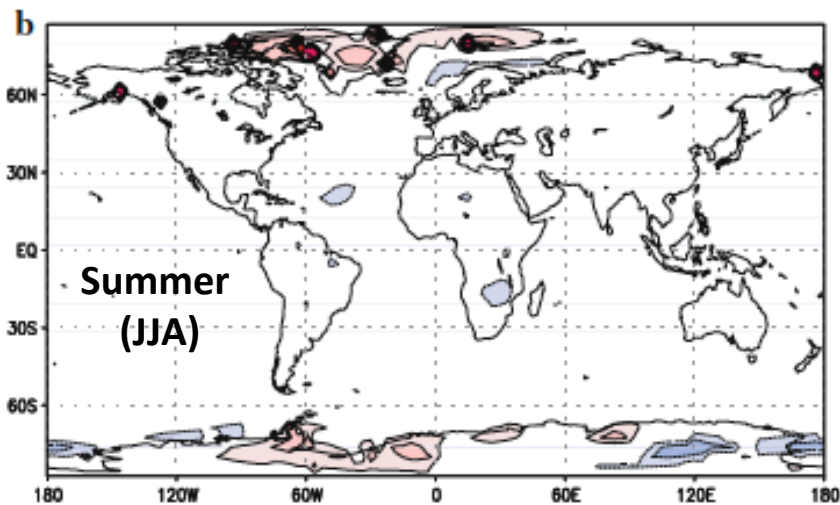
Near Surface Temperature (K)



Annual Precipitation (mm/yr)



(Viscaino et al., 2010)



Changes in atmospheric variables due to interactive ice sheets using ECHAM5/MPI-OM/SICOPOLIS in experiment 1% CO<sub>2</sub> per year until stabilization at 1120ppmv. This experiment was repeated by many groups as part as COMBINE effort.

# Potential partners and links

- CMIP and associated MIPs: Obs4MIP/ ana4MIP / PMIP
- Climate and Cryosphere (CliC) targeted activities and efforts:
  - Polar CORDEX: Coordinated Downscaling Experiments
  - WAGOM: West Antarctic Glacier Ocean Modeling
  - ESM-SnowMIP: snow models used in ESM and GCM
  - ISMASS: Ice sheet mass balance and sea level
  - new glacier effort
- Climate and Ocean: Variability, Predictability and Change (CLIVAR) efforts:
  - GRISO: Greenland Ice Sheet Ocean Interaction working group of US CLIVAR
  - Southern Ocean Region Panel of CLIVAR
- Others:
  - IMBIE: Ice sheet Mass Balance Intercomparison Exercise
  - N-SLCT: NASA Sea Level Change Team



# Summary

- ISMIP6 targets the *Cryosphere in a Changing Climate* and the *Future Sea Level* Grand Challenges of the WCRP.
- Primary goal is to provide future sea level contribution from the Greenland and Antarctic ice sheets, along with associated uncertainty. Secondary goal is to investigate feedback due to dynamic ice sheet models.
- Experiment design uses and augments the existing CMIP6 DECK experiments. Additional MIP specific experiments will be designed for ISM.
- Effort builds on the ice2sea, SeaRISE and COMBINE efforts.