ISMIP6 future projections for Greenland and Antarctica with the ice sheet model SICOPOLIS

Ralf Greve[1], Christopher Chambers[1], Reinhard Calov[2], Takashi Obase[3], Fuyuki Saito[4], Shun Tsutaki[5], Ayako Abe-Ouchi[3]

[1]*Institute of Low Temperature Science, Hokkaido University, Sapporo, Japan*
[2]*Potsdam Institute for Climate Impact Research (PIK), Potsdam, Germany*
[3]*Atmosphere and Ocean Research Institute, University of Tokyo, Kashiwa, Japan*
[4]*Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Yokohama, Japan*
[5]*National Institute of Polar Research (NIPR), Tokyo, Japan*

The Ice Sheet Model Intercomparison Project for CMIP6 (ISMIP6) brings together a consortium of international ice sheet and climate models to explore the contribution from the Greenland and Antarctic ice sheets to future sea level rise (SLR). Here, we use the ice sheet model SICOPOLIS (www.sicopolis.net) to carry out the ISMIP6 "standard core experiments" (and, optionally, selected extended experiments) as defined in Table 1 of tinyurl.com/ismip6-wiki-gris for Greenland and in Table 1 of tinyurl.com/ismip6-wiki-ais for Antarctica. First, paleoclimatic spin-ups for both ice sheets are conducted over the last glacial-interglacial cycle until the year 1990. In these spin-ups, we employ a nudging technique for the topography and aim at optimizing the match between simulated and observed surface velocities by adjusting the amount of basal sliding for individual drainage systems as defined by the IMBIE project (tinyurl.com/imbie-basins). Then, historical runs for both ice sheets bridge the gap between 1990 and 2015. All standard core experiments (six for Greenland, seven for Antarctica) run from 2015 until 2101 with hybrid shallow-ice-shelfy-stream dynamics for grounded ice, shallow-shelf dynamics for floating ice (Antarctica only) and horizontal resolutions of 5 km for Greenland and 8 km for Antarctica, respectively.

Results are shown in Figure 1. For Greenland, all scenarios (relative to ctrl) produce a volume loss (positive contribution to SLR) in the range of ~ 40-140 mm depending on the greenhouse gas concentration scenario (RCP8.5, 2.6) and the AOGCM used. For Antarctica, the response is non-uniform; both volume losses and gains occur. This is due to the counteracting effects of increasing ocean temperature (leading to a loss) and increasing precipitation (leading to a gain).

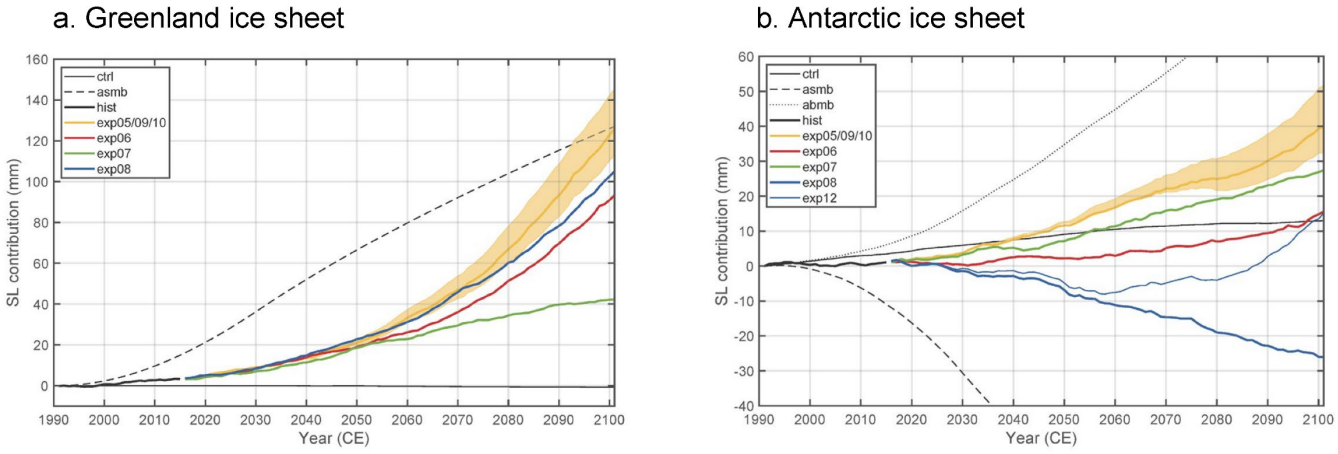

Figure 1. Simulated ice volume loss (expressed in millimetres of sea level [SL] contribution) for the Greenland (panel a) and Antarctic (panel b) ice sheets. ctrl: constant climate control run, asmb/abmb: initMIP schematic surface/basal mass balance anomaly, hist: historical run, expxx: ISMIP6 standard core experiments according to Table 1 of tinyurl.com/ismip6-wiki-gris (for Greenland) and tinyurl.com/ismip6-wiki-ais (for Antarctica), respectively.