Dependence of the future mass loss of the Antarctic ice sheet on climate forcing and ice-shelf disintegration

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As part of the Coupled Model Intercomparison Project Phase 6 (CMIP6), the Ice Sheet Model Intercomparison Project for CMIP6 (ISMIP6) was devised to assess the likely sea-level-rise contribution from the Antarctic and Greenland ice sheets until the year 2100. ISMIP6 used future climate scenarios as forcings for ice-sheet models developed by several international groups. Results obtained for the Antarctic ice sheet are described by Seroussi et al. (2020) and Payne et al. (2021).

Extended projections for the Antarctic ice sheet until the year 2300 have been devised to investigate the longer-term response of the ice sheet ("ISMIP6 2300 Antarctica", tinyurl.com/ismip6-ais-2300). The suite of experiments contains 14 experiments, 12 of which are for RCP8.5/SSP5-8.5 and 2 for RCP2.6/SSP1-2.6. We carried out these experiments with the ice-sheet model SICOPOLIS (www.sicopolis.net) and the same set-up as used for the original ISMIP6 experiments (Greve et al., 2020). Results are shown in Figure 1. For the control run with a constant, 1995–2014 average climate, the ice sheet is stable until the year 2300. For RCP8.5/SSP5-8.5, it suffers a severe mass loss, which amounts to ~3.1 m SLE (sea-level equivalent) for the 12-experiment mean, and > 5 m SLE for the most sensitive experiment. Most of this loss originates from West Antarctica. Ice-shelf collapse due to surface melting, parameterized explicitly in four of the experiments, increases the mass loss significantly. By contrast, the mass loss is below average for the four experiments in which the last-21st-century climate is merely repeated into the future without any further trend. For RCP2.6/SSP1-2.6, the loss is limited to a two-experiment mean of ~0.11 m SLE, demonstrating the potential of climate-change mitigation for limiting the decay of the ice sheet.

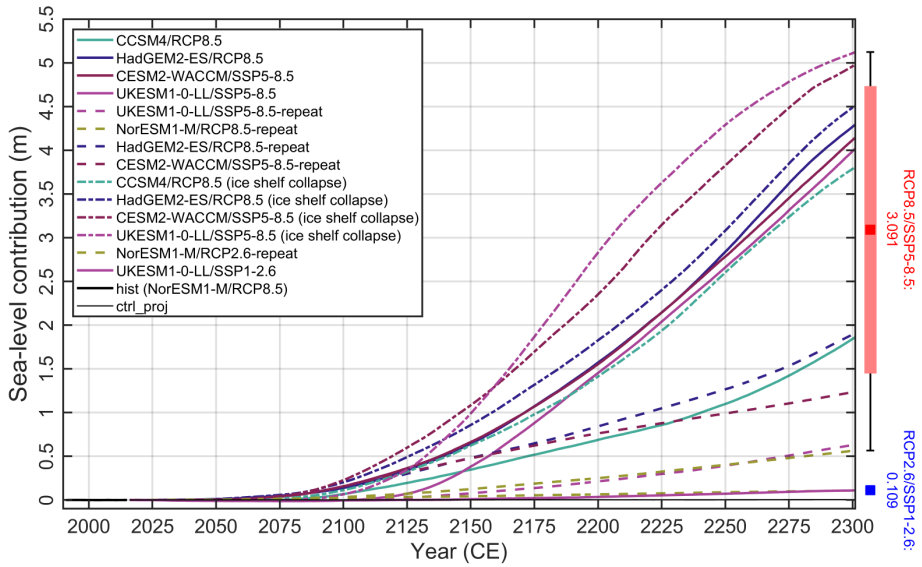

Figure 1. Historical run (hist), projection control run (ctrl_proj) and future climate experiments until the year 2300: Simulated ice mass change, counted positively for loss and expressed as sea-level contribution. The red and blue boxes to the right show the means for RCP8.5/SSP5-8.5 and RCP2.6/SSP1-2.6, respectively (RCP8.5/SSP5-8.5: also ± 1-sigma); the whiskers show the corresponding full ranges.

References

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