Response of the Antarctic ice sheet to increased sub-ice-shelf melt rates

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The Ice Sheet Model Intercomparison Project for CMIP6 (ISMIP6, Nowicki et al. 2016) 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). LARMIP (Linear Antarctic Response Model Intercomparison Project) and ABUMIP (Antarctic Buttressing Model Intercomparison Project) are initiatives within ISMIP6 to explore the sensitivity of the Antarctic ice sheet to increased basal melting rates under the ice shelves, which was identified as the process to which the ice sheet is likely most vulnerable by the SeaRISE project (Bindschadler et al. 2013, Nowicki et al. 2013). We contribute to LARMIP and ABUMIP with the ice sheet model SICOPOLIS (e.g., Greve and Blatter 2016), thus investigating the effect of the full range from moderately increased basal melting rates to extreme scenarios that melt away all floating ice rapidly. As shown in Fig. 1, over the next 200 years, the mass loss of the ice sheet (contribution to SLR) depends approximately linearly on the melting-rate increase up to ~4 m/a, while for larger melting rates, some saturation shows up (sub-linear response). An extreme scenario with 400 m/a basal melting removes almost all floating ice within a few years, which leads to contributions to SLR of ~0.7 metres after 100 years and ~1.2 metres after 200 years. The sensitivity to regionally increased basal melting rates (region definitions by LARMIP) decreases in the order Weddell > East Antarctica > Ross > Amundsen > Antarctic Peninsula.

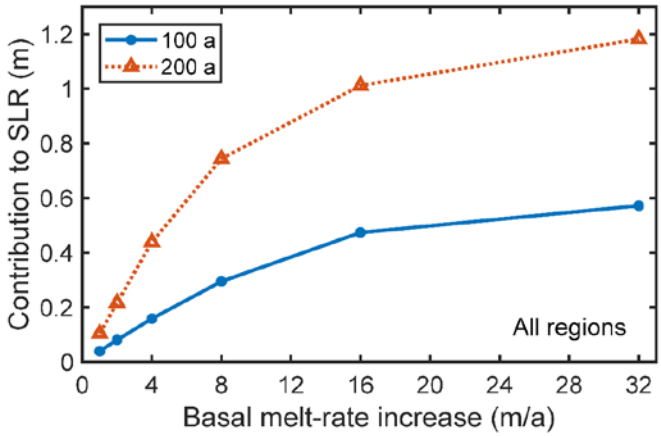

Figure 1. Simulated response of the Antarctic ice sheet to increased sub-ice-shelf melt rates ranging from 1 to 32 m/a, applied simultaneously for the floating ice all around the grounded ice sheet. The mass loss is shown in sea-level equivalents (contribution to sea level rise).

References

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