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Estimating Antarctic Ice Sheet Contributions to Future Sea Level Rise Using a Coupled Climate-Ice Sheet Model

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One of the largest uncertainties in projecting future global mean sea level (GMSL) rise in response to anthropogenic global warming originates from the Antarctic ice sheet (AIS) contribution. Previous studies suggested that a potential AIS collapse due to the Marine Ice Sheet Instability (MISI) and Marine Ice Cliff Instability (MICI) may contribute up to 1m GMSL rise by the year 2100. However, these estimates were based on uncoupled ice sheet models that do not capture interactions between the AIS and the ocean and atmosphere. Here, we explore future GMSL projections using a three-dimensional coupled climate-ice sheet model (LOVECLIP) that simulates ice sheet dynamics in both hemispheres. The model was forced by increasing CO₂ concentrations following the Shared Socioeconomic Pathway (SSP) 1-1.9, 2-4.5 and 5-8.5 scenarios. Over the next 80 years, the corresponding GMSL contribution from AIS amounts to about 2cm, 8cm and 11cm, respectively. Additional sensitivity experiments show that AIS meltwater flux in response to the SSP 5-8.5 CO₂ concentrations causes subsurface Southern Ocean warming which leads to an additional 20% AIS melting and a reduction in Southern Hemispheric future warming.