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Quantifying uncertainty in future projections of ice loss from the Filchner-Ronne basin, Antarctica

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The future of the Antarctic Ice Sheet under climate warming is one of the largest sources of uncertainty for changes in global mean sea level (GMSL). Accelerated ice loss in recent decades has been concentrated in regions where warm circumpolar deep water forces high rates of sub-shelf melt. It is unclear how ice shelves currently surrounded by cold ocean waters with low melt rates will respond to changes in ocean conditions in future. For example, previous studies have shown that if warm water were to infiltrate beneath the Filchner-Ronne ice shelf, it could drastically increase sub-shelf melt rates. However, the inland ice-sheet response to climate-ocean changes remains uncertain. Here, we set out to quantify uncertainties in projections of GMSL from the Filchner-Ronne region of Antarctica over the next two centuries. To do this we take a large random sample from a probabilistic input parameter space and evaluate these parameter sets in the ice-sheet model Úa under four RCP forcing scenarios. We then use this training sample to generate a statistical surrogate model to capture the parameter to projection relationship from our ice-sheet model. Finally, we use sensitivity analysis to identify which parameters drive the majority of uncertainty in our projections.

Our results suggest that accumulation expected with warming is capable of suppressing increases in ice discharge associated with increased ocean-driven sub-shelf melt rates. This could allow the Filcher-Ronne basin to have a negative contribution to GMSL. However, parameters controlling mass accumulation and sub-shelf melting are highly uncertain. Crucially, there is potential within our input parameter space for major collapse and retreat of ice streams feeding the Filchner-Ronne ice shelf and a positive contribution to sea level rise. Further improvements in the representation of accumulation and sub-shelf melt under climate warming in ice-sheet models will help determine the sign of GMSL projections from this region of the ice sheet.