



Reconciling projections of the Antarctic contribution to sea level rise

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Two recent studies of the Antarctic contribution to sea level rise this century had best estimates that differed by an order of magnitude (around 10 cm and 1 m by 2100). The first, Ritz et al. (2015), used a model calibrated with satellite data, giving a 5% probability of exceeding 30cm by 2100 for sea level rise due to Antarctic instability. The second, DeConto and Pollard (2016), used a model evaluated with reconstructions of palaeo-sea level. They did not estimate probabilities, but using a simple assumption here about the distribution shape gives up to a 5% chance of Antarctic contribution exceeding 2.3 m this century with total sea level rise approaching 3 m. If robust, this would have very substantial implications for global adaptation to climate change.

How are we to make sense of this apparent inconsistency? How much is down to the data – does the past tell us we will face widespread and rapid Antarctic ice losses in the future? How much is due to the mechanism of rapid ice loss ('cliff failure') proposed in the latter paper, or other parameterisation choices in these low resolution models (GRISLI and PISM, respectively)? How much is due to choices made in the ensemble design and calibration? How do these projections compare with high resolution, grounding line resolving models such as BISICLES? Could we reduce the huge uncertainties in the palaeo-study?

Emulation provides a powerful tool for understanding these questions and reconciling the projections. By describing the three numerical ice sheet models with statistical models, we can re-analyse the ensembles and re-do the calibrations under a common statistical framework. This reduces uncertainty in the PISM study because it allows massive sampling of the parameter space, which reduces the sensitivity to reconstructed palaeo-sea level values and also narrows the probability intervals because the simple assumption about distribution shape above is no longer needed. We present reconciled probabilistic projections for the Antarctic contribution to sea level rise from GRISLI, PISM and BISICLES this century, giving results that are meaningful and interpretable by decision-makers.