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Potential Tipping Points of Antarctic Ice Sheet Basins

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Antarctica is losing mass in an accelerating way and these losses are considered as the major source of sea-level rise in the coming centuries. Ice-sheet mass loss is mainly triggered by the decreased buttressing from ice shelves mainly due to ice-ocean interaction. This loss could be self-sustained in potentially unstable regions where the grounded ice lies on a bedrock below sea level sloping down towards the interior of the ice sheet, leading to the so-called marine ice sheet instability (MISI).

Recent observations on accelerated grounding-line retreat and insights in modelling the West Antarctica ice sheet give evidence that MISI is already on its way. Moreover, similar topographic configurations are also observed in East Antarctica, particularly in Wilkes Land. We present an ensemble of simulations of the Antarctic ice sheet using the f.ETISh ice-sheet model to evaluate tipping points that trigger MISI by forcing the model with sub-shelf melt pulses of varying amplitude and duration. As uncertainties in ice-sheet models limit the ability to provide precise sea-level rise projections, we implement probabilistic methods to investigate the influence of several sources of uncertainty, such as basal conditions. From the uncertainty analysis, we identify confidence regions for grounded ice interpreted as regions of the Antarctic ice sheet that remain ice-covered for a given level of probability. Finally, we discuss for each Antarctic basin the total melt energy needed to reach tipping points leading to sustained MISI.