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Sensitivity of the Southern Ocean circulation to enhanced regional Antarctic meltwater input

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Recent observational and modelling evidence suggests that Antarctica may be a larger source of meltwater than previously supposed. In this presentation, we use a fully coupled climate system model to assess the sensitivity of the Southern Ocean circulation to meltwater input. We present the results of a series of idealised simulations which explore the effects of increased meltwater flux from specific sectors of the West Antarctic Ice Sheet. In particular, we assess the response to physically-plausible scenarios which involve spatially and temporally variable meltwater inputs into the Ross, Weddell and Amundsen embayments. Our simulations reveal that increased freshwater input results in a rapid increase in the stratification of the upper ocean. This causes a reduction in the mixing of the cold surface waters with the underlying warmer waters, including a reduction of up to 50% in the rate of Antarctic Bottom Water formation. The reduced mixing leads to cooling at the surface, but a rapid and pervasive warming at depth. This warming is strongest at depths of between 200 and 700m, and is focused along sectors of the Antarctic ice sheets that are known to be sensitive to ocean forcing. In the Ross and Amundsen sectors, the water temperature increases by up to 1.6ºC at the depth of the grounding lines. This provides an additional feedback mechanism that may further enhance the basal melting and thermally-driven grounding line retreat of the Antarctic ice sheets during the 21st century. The rapid nature of the feedback also strengthens recent hypotheses that attribute rapid sea level rise scenarios to Antarctic sources.