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Oceanic an climatic consequences of a sudden large-scale West Antarctic Ice Sheet collapse

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Atmospheric warming is progressing to the point where the West Antarctic Ice Sheet (WAIS) will experience an elevated rate of discharge. The current discharge rate of WAIS is around 0.005Sv, but this rate will most likely accelerate over this century. The input of freshwater, in the form of ice, may have a profound effect on oceanic circulation systems, including potentially reducing the formation of deep water in the Southern Ocean and thus triggering or enhancing the bipolar seesaw. Using UVic – an intermediate complexity ocean-climate model – we investigate how various hosing rates from the WAIS will impact of the present and future ocean circulation and climate. These scenarios range from observed hosing rates ($\sim$0.005Sv) being applied for 100 years, to a total collapse of the WAIS over the next 100 years (the equivalent to a0.7Sv hosing). We show that even the present day observed rates can have a significant impact on the ocean and atmospheric temperatures, and that the bipolar seesaw may indeed be enhanced by the Southern Ocean hosing. Consequently, there is a speed-up of the Meridional Overturning Circulation (MOC) early on during the hosing, which leads to a warming over the North Atlantic, and a subsequent reduction in the MOC on centennial scales. The larger hosing cases show more dramatic effects with near-complete shutdowns of the MOC during the hosing. Furthermore, global warming scenarios based on the IPCC "business as usual" scenario show that the atmospheric warming will change the response of the ocean to Southern Ocean hosing and that the warming will dominate the perturbation. The potential feedback between changes in the ocean stratification in the scenarios and tidally driven abyssal mixing via tidal conversion is also explored.