

Impact of Greenland and Antarctic ice sheet interactions on climate sensitivity

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We use the Earth system model of intermediate complexity LOVECLIM to show the effect of coupling interactive ice sheets on the climate sensitivity of the model on a millennial time scale. We compare the response to a 2xCO₂ warming scenario between fully coupled model versions including interactive Greenland and Antarctic ice sheet models and model versions with fixed ice sheets. For this purpose an ensemble of different parameter sets have been defined for LOVECLIM, covering a wide range of the model's sensitivity to greenhouse warming, while still simulating the present-day climate and the climate evolution over the last millennium within observational uncertainties. Additional freshwater fluxes from the melting ice sheets have a mitigating effect on the model's temperature response, leading to generally lower climate sensitivities of the fully coupled model versions. The mitigation is effectuated by changes in heat exchange within the ocean and at the sea-air interface, driven by freshening of the surface ocean and amplified by sea-ice related feedbacks. The strength of the effect depends on the response of the ice sheets to the warming and on the model's climate sensitivity itself. The effect is relatively strong in model versions with higher climate sensitivity due to the relatively large polar amplification of LOVECLIM. With the ensemble approach in this study we cover a wide range of possible model responses.