

# Impact of the Greenland ice sheet in warmer climate as simulated with the coupled model system EC-Earth - PISM

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Ice sheet processes are often simplified in global climate models as changes in ice sheets have been assumed to occur over very long time scales compared to changes in the ocean and atmosphere. However, observations in recent years show accelerating mass loss from ice sheets that call for more comprehensive process based models to explore the role of the Greenland Ice Sheet in climate change. Here, we present a new model system, EC-Earth - PISM with an interactive Greenland Ice Sheet. The model is based on the EC-Earth v2.3 global climate model that has adjusted surface parameterization to account for melting ice, fully coupled to the Parallel Ice Sheet model PISM. The two models are directly coupled without anomaly or flux corrections. Results from simulations under pre-industrial climate conditions show that the model climate and ice sheet are stable with realistic inter-annual variability. In model runs that have been forced into a warmer climate of four times present day levels of CO<sub>2</sub> conditions, both the ocean and atmospheric circulation are affected by the new ice sheet formulation. The surface temperature is colder in the Arctic, there is significantly more winter Arctic sea ice, ocean circulation, the polar jet and polar vortex are weaker and the stratosphere is warmer. All these effects show the importance of including a dynamic ice sheet in global models for future projections.