



The impact of ice sheet dynamics on ocean circulation in a coupled Earth system model

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Coupled general circulation models of the atmosphere and the ocean, combined with models of the biosphere and the cryosphere, are the base of Earth System Models (ESMs) which are currently developed to understand the climate variations of the past and to predict future climate changes.

The COmmunity earth System MOdelS (COSMOS) initiative is a network for earth system research providing a state-of-the-art ESM. However, the model set-up generally includes over-simplified ice sheets, static in volume and shape during simulation time, and only subsequently corrected once melting (and sometimes calving) are estimated. As already criticized in the last Intergovernmental Panel on Climate Change (IPCC) report, the influence of dynamic ice sheets models, interacting with the climate components, are not taken into account.

Using a coupled setup of a three-dimensional thermomechanical ice sheet model RIMBAY and the COSMOS ESM, we investigate the influence of ice-ocean- and ice-atmosphere-interactions on the ice mass balance (with a special focus on Greenland), the Atlantic ocean circulation, and sea level change according to IPCC scenarios. RIMBAY allows for simulations of ice sheets and ice shelves, including a detailed approach to grounding lines, either within shallow-ice- and shallow-shelf-approximation, or with respect to higher-order physics. RIMBAY is forced by atmospheric COSMOS-output while melting, calving and changes in the ice orography are dynamically considered by the atmosphere and ocean modules during integration. We discuss the stability of the resulting climate, as well as the influence of increasing Greenland melt water due to global warming on the Atlantic ocean circulation.