Geophysical Research Abstracts
Vol. 20, EGU2018-14513, 2018
EGU General Assembly 2018

Response to Filchner-Ronne Ice Shelf cavity warming in a coupled ocean-ice sheet model

Sebastian Goeller (1) and Ralph Timmermann (2)

(1) Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Potsdam, Germany, (2) Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany

The ice flow at the margins of the mostly marine-based West Antarctic Ice Sheet (WAIS) is moderated by large ice shelves. Their buttressing effect significantly controls the mass balance of the WAIS and thus its contribution to global sea level rise. The stability of these ice shelves results from the balance of surface accumulation, ice flow from the adjacent ice sheet, calving and basal melting or freezing due to the ocean heat flux.

We developed the Regional Antarctic and Global Ocean model RAnGO to study the above interactions between the world ocean and the WAIS, focussing on the Filchner-Ronne Ice Shelf (FRIS) in this study. RAnGO is composed of the global Finite Element Sea ice Ocean Model (FESOM) and the three-dimensional thermomechanical finite difference ice flow model RIMBAY, where the ice flow model RIMBAY provides the ocean model FESOM with the geometry of the FRIS sub-shelf cavity and receives basal melting or freezing rates in return.

Following a complex model spin-up, we investigate the impact of the A1B warming scenario on the dynamics and mass balance of the WAIS for the next 200 years. In this scenario, model results indicate a possible redirection of a warm coastal current into the Filchner Trough and thus underneath the FRIS by the end of this century. As a consequence, our coupled modeling approach reveals not only a substantial thinning of the ice shelf but also a considerable impact on the adjacent grounded ice. In a comprehensive analysis, we compare coupled and uncoupled model runs for a 20th century forcing and the A1B warming scenario. Thus, we are able to isolate the gain of the coupling and the effects of global warming.

Our findings reveal a future grounding line retreat underneath Institute, Foundation and Support Force Ice Stream, whereas the grounding line positions at other regions of the FRIS remain stable. In particular, model results indicate an accelerated future ice flow within Institute and Support Force Ice Stream as an answer to ice shelf - ocean interactions, which will result in a rising sea level.