EGU21-15682
https://doi.org/10.5194/egusphere-egu21-15682
EGU General Assembly 2021

Simulating Interactive Ice Sheets in the Multi-Resolution AWI-ESM: A case study using the SCOPE Coupler

Paul Gierz[1], Lars Ackermann[1], Christian Rodehacke[1,2], Uta Krebs-Kanzow[1], Christian Stepanek[1], Dirk Barbi[1], and Gerrit Lohmann[1,3]
[1]Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Paleoclimate Dynamics, Bremerhaven, Germany
[2]Danish Meteorological Institute, Copenhagen, Denmark
[3]University of Bremen, Bremen, Germany

Interactions between the climate and the cryosphere have the potential to induce strong non-linear transitions in the Earth's climate. These interactions influence both the atmospheric circulation, by changing the ice sheet's geometry, as well as the oceanic circulation, by modification of the water mass properties. Furthermore, the waxing and waning of large continental ice sheets influences the global albedo, altering the energy balance of the Earth System and inducing climate-ice sheet feedbacks on a global scale as evident in Pleistocene glacial-interglacial cycles. To date, few fully
comprehensive models exist, that do not only contain a coupled atmosphere/land/ocean component, but also consider interactive cryosphere physics. Yet, on glacial-interglacial and tectonic time scales, as well as in the Anthropocene, ice sheets are not in equilibrium with the climate, and prescribed fixed ice sheet representations in the model can principally be only an approximation to reality. Only climate models, that contain interactive ice sheets, can produce simulations of the Earth's climate which include all feedbacks and processes related to atmosphere-land-ocean-ice interactions. Previous fully coupled models were limited either by low spatial resolution or an incomplete representation of ice sheet processes, such as iceberg calving, surface ablation processes, and ocean/ice-shelf interactions. Here, we present the newly developed AWI-Earth System Model (AWI-ESM), which tackles some of these problems. Our modelling toolbox is based on the AWI-climate model, including atmosphere and vegetation components suitable for paleoclimate studies, a multi-resolution global ocean component which can be refined to simulate regions of interest at high resolution, and an ice sheet component suitable for simulating both ice sheet and ice shelf dynamics and thermodynamics. We describe the currently implemented coupling between these components, present first results for the Mid-Holocene and Last Interglacial, and introduce further ideas for scientific applications for both future and past climate states with a focus on the Northern Hemisphere. Finally, we provide an outlook on the potential of such fully coupled Earth System models in improving representation of climate-ice sheet feedbacks in future paleoclimate studies with this model.