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Coupled solid Earth – Antarctic ice sheet simulations with VILMA and PISM

Torsten Albrecht[1], Meike Bagge[2], Ricarda Winkelmann[1,3], and Volker Klemann[2]
[1]PIK - Potsdam Institute for Climate Impact Research, Member of the Leibniz Association, Potsdam, Germany
(torsten.albrecht@pik-potsdam.de)
[2]GFZ - Helmholtz Centre Potsdam, German Research Centre for Geosciences, Potsdam, Germany
[3]Institute of Physics and Astronomy, University of Potsdam, Potsdam, Germany

The Antarctic Ice Sheet rests on a bed that is characterized by tectonical activity and hence by a heterogeneous rheology. Spots of extremely weak lithosphere structure could have strong impacts on the Glacial Isostatic Adjustment and hence on the stability of the ice sheet, possibly also for confined glacier regions and on timescales of decades down to even years (Barletta et al., 2018).

We coupled the VIscoelastic Lithosphere and MAntle model (VILMA) to the Parallel Ice Sheet Model (PISM) and ran simulations over the last two glacial cycles. In this framework, VILMA considers both viscoelastic deformations of the solid Earth and gravitationally consistent mass redistribution in the ocean by solving for the sea-level equation (Martinec et al., 2018). In turn, PISM interprets this as a vertical shift in bed topography that directly affects the stress balance within the ice sheet and hence the grounding line dynamics at the interface of ice, ocean and bedrock.

Here we present first results of the coupled Antarctic glacial-cycle simulations and investigate technical aspects, such as optimal coupling time steps, iteration schemes and convergence, for both one-dimensional and three-dimensional Earth structures. This project is part of the German Climate Modeling Initiative, PalMod2.

References:

Barletta et al., 2018. *Observed rapid bedrock uplift in Amundsen Sea Embayment promotes ice-sheet stability*. **Science**, *360*, pp.1335-1339. DOI: 10.1126/science.aao1447

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