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Deglaciation of the Antarctic Ice Sheet modeled with the coupled solid Earth – ice sheet model system PISM-VILMA

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The Antarctic Ice Sheet is the largest and most uncertain potential contributor to future sea level rise. Understanding involved feedback mechanisms require physically-based models. Confidence in future projections can be improved by models that can reproduce past ice sheet changes, in particular over the last deglaciation. The complex interaction between ice, bedrock and sea level plays an important role in ice sheet instability with a large variety of characteristic response time scales dependent on the heterogeneous Earth structure underneath Antarctica and the ice sheet dynamics.

We have coupled the VIscoelastic Lithosphere and MAntle model (VILMA) to the Parallel Ice Sheet Model (PISM v2.0, www.pism.io) and ran simulations over the last two glacial cycles. In this framework, VILMA considers both viscoelastic deformations of the solid Earth by considering a three-dimensional rheology and a gravitationally self-consistent mass redistribution in the ocean by solving for the sea-level equation. PISM solves for the stress balance for a changing bed topography, which is updated in 100 years coupling intervals and which can directly affect ice sheet flow and grounding line dynamics.

Here, we show first results of coupled PISM-VILMA simulations scored against a database of geological constraints including sea level index points. We discuss sensitivities of model parameters and climatic forcing in preparation for a larger parameter ensemble study. This project is part of the German Climate Modeling Initiative PalMod.