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Simulating the Antarctic ice sheet in the Late-Pliocene warm period: PLISMIP-ANT, an ice-sheet model intercomparison project

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In the context of future climate change, understanding the nature and behaviour of ice sheets during warm intervals in Earth history is of fundamental importance. The Late-Pliocene warm period (also known as the PRISM interval: 3.264 to 3.025 million years before present) can serve as a potential analogue for projected future climates. Although Pliocene ice locations and extents are still poorly constrained, a significant contribution to sea-level rise should be expected from both the Greenland ice sheet and the West and East Antarctic ice sheets based on palaeo sea-level reconstructions.

Here, we present results from simulations of the Antarctic ice sheet by means of an international Pliocene Ice Sheet Modeling Intercomparison Project (PLISMIP-ANT). For the experiments, ice-sheet models including the shallow ice and shelf approximations have been used to simulate the complete Antarctic domain (including grounded and floating ice). We compare the performance of six existing numerical ice-sheet models in simulating modern control and Pliocene ice sheets by a suite of four sensitivity experiments. Ice-sheet model forcing fields are taken from the HadCM3 atmosphere–ocean climate model runs for the pre-industrial and the Pliocene.

We include an overview of the different ice-sheet models used and how specific model configurations influence the resulting Pliocene Antarctic ice sheet. The six ice-sheet models simulate a comparable present-day ice sheet, although the models are setup with their own parameter settings. For the Pliocene simulations using the Bedmap1 bedrock topography, some models show a small retreat of the East Antarctic ice sheet, which is thought to have happened during the Pliocene for the Wilkes and Aurora basins. This can be ascribed to either the surface mass balance, as the HadCM3 Pliocene climate shows a significant increase over the Wilkes and Aurora basin, or the initial bedrock topography. For the latter, our simulations with the recently published Bedmap2 bedrock topography indicate a significantly larger contribution to Pliocene sea-level rise from the East Antarctic ice sheet for all six models relative to the simulations with Bedmap1.

Such multi-model comparison efforts will assist in providing potential model uncertainty when comparing reconstructions of the Antarctic ice sheet with available proxy data.