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Climate Model Dependency and Understanding the Antarctic Ice Sheet during the Warm Late Pliocene

Aisling Dolan (1), Bas de Boer (1,2), Jorge Bernales (3,4), Stephen Hunter (1), and Alan Haywood (1)

(1) University of Leeds, ESSI, School of Earth and Environment, Leeds, United Kingdom (a.m.dolan@leeds.ac.uk), (2) Institute for Marine and Atmospheric Research, Utrecht, Utrecht University , (3) Freie Universitaet Berlin , (4) Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Potsdam

In the context of future climate change, understanding the nature and behaviour of ice sheets during warm intervals of Earth history is fundamentally important. A warm period in the Late Pliocene (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 and geological evidence.

Following a five year international project PLISMIP (Pliocene Ice Sheet Modeling Intercomparison Project) we present the final set of results which quantify uncertainty in climate model-based predictions of the Antarctic ice sheet. In this study we use an ensemble of climate model forcings within a multi-ice sheet model framework to assess the climate (model) dependency of large scale features of the Antarctic ice sheet. Seven coupled atmosphere-ocean climate models are used to derive surface temperature, precipitation and oceanic forcing that drive three ice sheet models (over the grounded and floating domain).

Similar to results presented over Greenland, we show that the reconstruction of the Antarctic ice sheet is sensitive to which climate model is used to provide the forcing field. Key areas of uncertainty include West Antarctica, the large subglacial basins of East Antarctica and the overall thickness of the continental interior of East Antarctica. We relate the results back to geological proxy data, such as those relating to exposure rates which provide information on potential ice sheet thickness. Finally we discuss as to whether the choice of modelling framework (i.e. climate model and ice sheet model used) or the choice of boundary conditions causes the greatest uncertainty in ice sheet reconstructions of the warm Pliocene.