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The Antarctic and Greenland response to PlioMIP2 mPWP climatic fields

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Since the pre-industrial era, global sea level has been rising along with greenhouse gas emissions. Part of the contribution to this sea-level change is the mass lost from continental ice sheets, i.e. the Greenland (GrIS) and Antarctic (AIS) ice sheets, which are shrinking at an accelerated rate. However, how they will respond to future warming is highly uncertain due to our lack of knowledge and associated uncertainty in modelling several physical processes, as well as in warming projections. A way to gain insight into future projections is to study past warm periods that are, to some extent, comparable to the present day (PD) in terms of external forcing. The mid-Pliocene warm period (mPWP, 3.3-3.0 million years ago) offers an ideal benchmark, as it is the most recent period with CO2 levels comparable to PD (350-450 ppmv), showing global mean temperatures 2.5-4.0 degrees higher. Eustatic sea-level reconstructions from that period estimate a sea level 15-20 meters higher than PD, implying ice sheets were much smaller in size. The GrIS was starting to form and the AIS was most likely constrained to land-based regions. The Pliocene Model Intercomparison Project, Phase 2 (PlioMIP2) has brought together over 15 climate outputs from 11 General Circulation models from different institutions. These models have simulated mPWP conditions under 400 ppmv of CO2 concentration over a topography generated from an updated bedrock configuration for that time period. Here we use these model outputs to force offline a higher-order ice sheet model for the Antarctic and Greenland domain. Our aim is to investigate how polar continental ice sheets respond to these different climatic fields to pinpoint their most significant climatic and topographical discrepancies. In addition, several sources of structural dependence, from different dynamic states (i.e. basal friction laws) to different initial boundary conditions (starting from no ice-sheet to the PD configuration) are investigated in this modelling framework to create a comprehensive output database for statistical analysis.