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Hybrid GCM - ice-sheet modelling: model set-up and benchmark experiments

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Fully coupled ice-sheet-climate modelling on the geological time-scale remains beyond the capability of current computational systems. Hybrid GCM-ice-sheet modelling offers a middle ground, balancing the need to accurately capture both long-term and small-scale processes with the need to simulate long periods of time. Here we present and evaluate a model set-up that forces the ANICE ice model with output from the HadCM3 general circulation model (GCM). We address the difficulties in downscaling low-resolution GCM output to the higher-resolution grid of an ice-model, and in correcting for differences between GCM and ice model surface topography.
As a benchmark experiment to assess the validity of this model set-up, we perform a simulation of the entire last glacial cycle, 120 ky B.P. to present-day. The simulated eustatic sea-level drop at LGM amounts to 110 m, agreeing well with the consensus. The simulated ice-sheets at LGM agree well with the ICE-5G reconstruction in terms of total volume and geographical location. Modelled benthic oxygen isotope abundance and the relative contributions from global ice volume and deep water temperature agree well with available data. This means that this model set-up can be used to create time-continuous ice distribution and sea-level reconstructions for periods from the geological past of several hundreds of kiloyears in duration.