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The effects of parametric uncertainty on modeled Greenland Ice Sheet behavior

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We propagate model parametric uncertainty through an ice sheet model of Greenland, to evaluate the effects of parameter changes on reconstructions of past ice sheet size and projections of future behavior. Ice sheet models have many input parameters whose values are typically held fixed, but are poorly known. Recent work by Emma J. Stone and colleagues (The Cryosphere, v. 4, pp. 397-417, 2010) has illustrated the use of Latin hypercube sampling in evaluating the effects of parametric uncertainty on ice sheet models. In this work, the Glimmer-CISM model was run to equilibrium under the modern climatology. We have repeated this work with the SICOPOLIS ice sheet model by Ralf Greve (http://sicopolis.greveweb.net/), noting differences in the output produced by the two models. Here, we take an additional step by using a model spinup procedure that accounts for our knowledge of paleoclimate, and by forcing the spun-up model into the future. We perform a large number of model runs, each with a different set of input parameters, but the same temperature forcing time series. The forcing time series uses ice core data for the past, and a reasonable estimate of future temperature changes. We examine the range of modeled ice volumes at critical time slices in the past (such as the mid-Holocene, when the ice sheet was smaller than today) and in the future. This work helps to place error bars on ice sheet model hindcasts and projections.