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Assessing the predictability of a coupled climate-ice sheet model system for the response of the Greenland Ice Sheet

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The wild card for reliable sea level rise prediction is the contribution of the Greenland Ice Sheet. There is an urgent need to determine the predictability of models that simulate the response of Greenland Ice Sheet to rising temperatures and the amount of freshwater flux that can be expected into the ocean. Modelling efforts have been limited by poorly known boundary and initial conditions, low resolution and lack of presentation of fast flowing ice streams. We address these limitations by building a model system consisting of a high resolution regional climate model (HIRHAM4), that has been run for the period 1950-2080 at 25 km, and Parallel Ice Sheet Model (PISM), which simulates spatially and temporally varying ice streams by combining the solutions of the Shallow Shelf and Shallow Ice Approximations. The surface mass balance is simulated with a positive-degree-day method. The important and poorly constrained model component is the past climate forcing, which serves the purpose of initializing the model by simulating the present ice sheet and observed rate of mass changes. Simulated gradients of mass loss due to warming trends of past decade and prediction for the future are presented as well as estimated sensitivities due to the various model component uncertainties.