Optimizing ice-sheet-shelf model performance through a skill-score study

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A fundamental requirement for an ice sheet model is to accurately reproduce the present-day conditions. The model equations, boundary conditions and forcings all contribute to the model performance. Thus choosing the best parameterisation for a given process as well as the most suitable value of its free parameters is a challenging task. Basal friction, surface mass balance and basal melting are only some examples of the various processes that must be well captured to properly simulate the past and present-day ice-sheet configuration. Here we present a skill-score study applied to a coarse-resolution three-dimensional hybrid ice-sheet-shelf model for the Greenland Ice Sheet (GrIS) including the Shallow Ice and Shallow Shelf Approximations (SIA and SSA). Particularly, we discuss the schemes used for basal sliding in transition zones, surface ablation, basal melting across the grounding line and below the ice shelves, and for glacial isostatic adjustment, as well as the eustatic sea level change signal and the spin-up procedure. The skill score is developed to incorporate multiple sources of information, from present-day geometrical constraints to available paleo records and reconstructions. By considering a broad region of the parameter phase-space, the model performance is evaluated for time periods independent from those used to constrain the model.