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Ice sheet - climate coupling in the GENIE earth system model: assessment and challenges

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Reduced-complexity Earth System models are a valuable counterpart to full-complexity models, especially because of their lower computational cost. Our focus here is the simulation of glacial inception and seasonal snow-cover variation, concentrating on the most recent large-scale glaciation in the Northern Hemisphere, approximately 115 kyr BP. In particular, glacial inception is difficult to simulate due to the interaction of processes on widely differing spatial and temporal scales.

For this work, we use the GENIE Earth System modelling framework. Among many components, GENIE includes a fully-dynamic atmosphere (the IGCM) and the Glimmer ice sheet model. With these components running in a coupled configuration, thousand-year simulations are entirely practical. Here, the relatively low computational cost of the GENIE model allows long model runs to be used to investigate the feedbacks important for glacial inception, and to run the ice sheet model to equilibrium.

We present the latest results from continuing work investigating the interaction between ice sheet and climate model components in GENIE. The different consequences of direct coupling and anomaly-based coupling are described, and the effects of time-accelerated coupling are explored, among other aspects of the coupling. Despite the range of techniques deployed, a believable simulation of the target inception event remains elusive. In seeking to understand this, we consider how the procedures employed to tune the atmospheric model and the glacial mass balance model may be

crucial to the outcome. Finally, we discuss how the component models might be objectively evaluated, separately and together, to determine the limits of their applicability in this context.