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An adaptive-triangular fully coupled 3D ice-sheet–sea-level model

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Regional sea-level change and the deformation of the solid Earth can lead to important feedbacks on the long- and short-term evolution and stability of ice sheets. A rigorous manner of accounting for these feedbacks in model-based ice-sheet reconstructions and projections, is to establish a two-way coupling between an ice-sheet and a sea-level model. However, the individual requirements of each of these two components — such as a global, long ice sheet load history or a high ice-model resolution over critical sectors of an ice sheet — are at present not easy to combine in terms of computational feasibility. Here, we present a coupling between the ice-sheet model UFEMISM, which solves a range of approximations of the stress balance on a dynamically adaptive irregular triangular mesh, and the gravitationally self-consistent sea-level model SELEN, which incorporates the glacial isostatic adjustment for a radially symmetric, viscoelastic and rotating Earth, including coastline migration. We show global simulations over glacial cycles, including the North American, Eurasian, Greenland, and Antarctic ice sheets, and compare its performance and results against commonly used alternatives.