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Coupling the U.K. Earth System Model to dynamic models of the Greenland and Antarctic ice sheets

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In this presentation we describe how models of the Greenland and Antarctic ice sheets have been incorporated in the global U.K. Earth System model (UKESM1) with a two-way coupling that passes fluxes of energy, water and the locations of ice surfaces between the component models. Offline, file-based coupling is used throughout to pass information between the components, which is both physically appropriate and convenient within the UKESM1 structure. Ice sheet surface mass balance is computed in the land surface model using sub-gridscale multi-layer snowpacks. Icebergs calved from the ice sheets are fed into a Langrangian iceberg drift scheme in the ocean. Ice shelf basal melt is explicitly calculated in cavities resolved by the ocean model, and ice sheet and shelf geometries are kept consistent in all components. We demonstrate that our coupled model remains stable when simulating changes in ice sheet height, extent and grounding-line position of hundreds of kilometres.