Using the level set method to track ice sheet boundaries

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Simulating ice-sheet volume changes requires tracking the interface of ice and its surrounding media, e.g. water, air, and sediment or rock. This can be challenging when using a _xed, or Eulerian, grid and allowing the interface to move via kinematic boundary conditions. For example, the interface may fall between grid points at a given point in time, making the application of boundary conditions less than straightforward. The level set method of Osher and Sethian (1988) o_ers an alternative approach, wherein a continuous level set function evolves within the domain via the combined kinematics of ice and its encompassing materials. Pralong and Funk (2004) applied this method to the movement of a glacier's ice/air interface, o_ering a glimpse of the potential of this method for glaciology. Here we perform a simple preliminary test of the method for a two-dimensional (owline) model of an ice shelf, comparing the results to analytic approximations of the movement of both the ice/air interface and the ice front. The ultimate goal of this work is provide a practical approach for two and three-dimensional ice-sheet models to naturally track their moving boundaries.