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Comparison of different calving laws using a level set method

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Calving is one of the most important processes that induce mass loss in Greenland and Antarctic ice shelves. These major ice discharges modify the calving front position with an impact over the whole stress regime of these glaciers. Because the calving rate depends on several physical parameters, having an empirical parameterization for simulations over long periods is a big challenge. We study the calving front position using the open-source finite element, Elmer/Ice (http://elmerice.elmerfem.org/) code. We use a time constant mesh coupled with a time-evolving signed distance to the front (level-set function Φ) that activates or masks nodes as needed. We study the front position (given as the 0 level set value) evolution by solving

$$\frac{\partial \phi}{\partial t} + w \nabla \phi = 0$$

with w=c+v, where *c* is the calving rate and v is the velocity of the ice normal to the front. By using a realistic synthetic configuration, based on the intercomparison models (MISMIP), we validate our level-set method, we study the numerical sensibility, and the impact of different calving laws reported in the literature.