



Modelling the behaviour of Greenland outlet glaciers; a comparison of calving criteria

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Calving is very poorly represented in current ice sheet models, however, recent rapid changes observed for several marine Greenland outlet glaciers seem to be linked to the retreat of calving fronts and indicate the importance of the calving process for ice sheet dynamics. This study investigates the use of a recently developed calving criterion (Benn et al 2007, *Annual of Glaciology* 46), that relates longitudinal strain rates to crevasse depth, for numerically modelling of calving outlet glaciers. Such a criterion has the advantage over the previously used floatation criterion that it is physically based and allows a floating tongue as observed for many of the Greenland outlet glaciers.

We include the calving criterion into a recently developed numerical flowline model for marine outlet glaciers that includes longitudinal stresses and is able to continuously follow the grounding line migration. The model is applied to Helheim Glacier, East Coast Greenland and compared to observed calving front changes. We further carry out a comparison to the earlier floatation criterion (height above buoyancy criterion). This modelling study and comparison gives us insights on the role of floating tongues to the dynamics and on how to treat calving in numerical models and therefore advances our ability to predict future ice sheet change.