EGU21-3405
https://doi.org/10.5194/egusphere-egu21-3405
EGU General Assembly 2021

Investigating the drivers of Helheim Glacier's variability from 2007 to 2020

Gong Cheng and Mathieu Morlighem
Department of Earth System Science, University of California, Irvine, CA, USA

At least half of today's mass loss of the Greenland ice sheet is due to the retreat of tidewater glaciers. For example, Helheim Glacier, in southwest Greenland, has one of the largest ice discharge records in the Greenland ice sheet during the previous decade. While there is broad agreement that the intrusion of warmer current in the Sermilik Fjord triggers the acceleration and retreat of this marine terminating glacier, other processes such as changes in basal conditions, surface mass balance or calving dynamics may have also played important roles in controlling the retreat of these glaciers. However, our understanding of these processes and their contributions to the retreat and acceleration of the glaciers remains still limited. The individual contributions of these processes have not been quantified, which makes it difficult to determine which of these processes should be included in ice sheet models to correctly capture the present and future retreat and associated mass loss of the ice sheet. Here, we simulate the dynamics of Helheim Glacier from 2007 to 2020 using the Ice-sheet and Sea-level System Model (ISSM) to investigate the model response to changes in external forcings and boundary conditions, such as basal friction, surface mass balance, ice rheology, and ice-ocean interactions at the calving front. The relative importance of each mechanism to the model is quantified within a series of perturbation experiments. We evaluate the ability of the model to match surface speed and terminus position from the observations collected during the simulation period. Preliminary results suggest that Helheim's dynamics is relatively insensitive to the choice of friction law or the surface mass balance, but that the position of the calving front and changes in basal sliding conditions are critical to explain the high variability of Helheim's surface speed. This study, as a result, can be used as a guide for model development of similar glaciers.