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Modelling Jakobshavn Isbrae from 2009 to 2018

Matt Trevers¹, Tony Payne¹, Steph Cornford², and Anna Hogg

¹Centre for Polar Observation and Modelling, School of Geographical Sciences, University of Bristol, Bristol, UK
(matt.trevers@bristol.ac.uk)

²Department of Geography, Swansea University, Swansea, UK

Jakobshavn Isbrae has dramatically accelerated, thinned and retreated since the late 1990s in several stages of retreat and stagnation. Studies have indicated that the loss of buttressing due to retreat of the calving front following the disintegration of its floating ice tongue was the trigger of acceleration and thinning of the terminus, however uncertainty remains over the mechanisms controlling the timing and magnitude of the retreat.

The maximum retreat of the calving front was reached between 2013 and 2015 following the peaking of ice flow speeds in excess of 18 km yr^{-1} . Since 2016, ice flow speeds have decelerated from this peak and the terminus has experienced a modest readvance and thickening. We calculated a calving rate for the period 2009 to 2018 which shows that terminus flow speeds and calving are closely related. Until 2009 a transient loosely bonded ice tongue formed but this feature appears not to have formed from 2010 onwards.

We aim to demonstrate that the signal of thinning and retreat can be reproduced by driving the glacier with the calculated calving rate. We used the BISICLES ice sheet model to simulate the evolution of Jakobshavn Isbrae over the past decade, with the calving front driven by the calculated 2009 – 2018 calving rate. The results of these simulations show that the response of the glacier to the applied calving rate is in line with its observed evolution over this period. We also present the results of further experiments designed to examine the mechanisms and controls on the calving retreat.