ANALOG MODEL OF GLACIAL SURGE AFTER ICE SHELF COLLAPSE

Essig, M.H., Johnson, S.E. and Groome, W.G.

Sudden surges in glacial velocity, such as seen in the Jakobshavn Glacier in East Greenland, have been attributed to the collapse of an ice shelf, which reduces the buttressing force at the toe of the glacier. The collapse of an ice shelf can occur either by one large calving event or by several smaller calving events in rapid secession. When an ice shelf is removed suddenly or collapses, the glacier responds by increasing its velocity because the confining force of the shelf is removed and the glacier then surges. The glacier will also thin due to the rapid change in velocity at the front of the glacier which causes ice to flow out of the source area faster than it accumulates. Eventually a new ice shelf may be built by the glacier. In the case of the Jakobshavn Glacier there was a change in the velocity of the glacier in the late 1990's, which was preceded by the collapse of the ice shelf and an overall thinning of the glacier. We present an analog model using a mixture of borax, white glue, and water to test the hypothesis that major calving events can lead to glacial surge. Our results show that there is an acceleration of the model glacier after the floating part of the glacier is cut off, which simulates the collapse of an ice shelf at the toe of a valley glacier. We also found that the model glacier thinned after the buttressing lobe was cut off and that there was also a velocity gradient where the top of the glacier moved faster than the bottom of the glacier. We compare our results to velocity data from Jakobshavn and we find there are similar patterns.