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Testing the Sensitivity of the Subglacial Drainage Pattern of North East Greenland to Surface Elevation Changes

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The North East Greenland Ice Stream is one of the most striking features of the Greenland Ice Sheet. Presently the ice stream has three main outlets, two of which (Nioghalvfjerdsbræ and Zachariae Isstrøm) are currently thinning while the last (Storstrømmen) is thickening.

The ice stream initiates close to the ice divide and observations of ice velocities and radio-echo sounding data suggest the presence of subglacial water from its onset to the margin. It is well-known that subglacial water has the potential to modify and even control the flow of ice streams, and studies of subglacial processes have repeatedly shown the important role of liquid water in ice flow dynamics. On large spatial scales the pathways of the subglacial water are influenced by the surface slope. This naturally raises the question whether the thinning/thickening pattern of the glacial basin has the potential to change the subglacial water drainage pattern.

In this study we use a simple uncoupled ice flow model to investigate how surface elevation changes can change the large-scale subglacial water drainage pattern of North East Greenland. We demonstrate that variations in surface elevation of the order of 1m/yr or less can cause changes in subglacial water flux over time-scales varying from decadal to centennial to millennial. Our results emphasise the need for coupling ice flow models and subglacial processes to allow for simultaneous changes in ice flow mode and basal properties.