

Investigating potential controls on rapid surface lake drainage in West Greenland

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The controls on rapid surface lake drainage on the Greenland Ice Sheet remain uncertain, making it challenging to incorporate lake drainage into models of the ice sheet's hydrology, and so to determine the ice-dynamic impact of meltwater delivered to the ice-sheet bed. Here, we first use our Fully Automated Supraglacial lake area and volume Tracking ("FAST") algorithm to identify rapidly draining lakes within two regions of West Greenland during summer 2014. Second, we derive hydrological, morphological, glaciological and surface-mass-balance data for various factors that may influence rapid lake drainage. Third, these factors are used within Exploratory Data Analysis to examine existing hypotheses for rapid lake drainage and to consider new ones. This involves testing for statistical differences between the rapidly and non-rapidly draining lake types, as well as examining the associations between lake areas or volumes and the potential controlling factors. This study shows that the two lake types are statistically indistinguishable for almost all of the factors investigated (except lake area), indicating that they were drawn from the same population. These results therefore do not currently allow recommendation of an empirically supported, deterministic alternative to the fracture area threshold parameter for modelling rapid lake drainage within existing surface-hydrology models of the Greenland Ice Sheet.