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Multi-directional ice dynamic response to slow and fast supraglacial lake drainages in Greenland.

M. Tedesco (1), M. Hoffman (2), I. Willis (3), P. Alexander (1), and A. Banwell (3)

(1) The City College of New York, CUNY, New York, 10031, USA, (2) Fluid Dynamics Group Los Alamos National Laboratory T-3, Mail Stop B216 Los Alamos, NM 87545, U.S.A. , (3) Scott Polar Research Institute, Department of Geography, University of Cambridge

During the summer of 2011 we measured the filling and draining of two supraglacial lakes in in West Greenland (49.79 W, 69.57 N), together with the level of streams flowing into the basins feeding the lakes. We also used multiple GPS to record the horizontal and vertical displacement of the ice sheet surface at five locations surrounding the lakes for a two week period (overlapping the draining of the two lakes).
In this talk we report results concerning the impact of the draining of the two lakes on the ice sheet velocity. 'Lake Half Moon', with a smaller catchment area, filled slowly at a steady rate over several days, then drained gradually over a 24 hour period as an existing moulin located outside the bottom of the lake became active; the lake level continued to drop very slowly over the remaining week as the surface stream leading from the lake to the moulin incised. 'Lake Ponting', with the larger catchment area, filled more rapidly and at an accelerating rate as depressions upstream of the lake filled with water, overflowed and delivered increasing volumes of water to the lake. Lake Ponting drained by hydrofracture following a particularly rapid rise in water level, generating a new $\sim$ 800m long extensional crevasse on the ice sheet surface. The entire $\sim$ 3 x 106 m3 lake drained within a few hours. We will show the different of the different draining mechanisms on the ice sheet velocity at different locations and distances from the lakes. The analysis of the GPS data suggest that the different styles of lake draining affect the vertical and horizontal movement of the ice sheet in different ways. The slow drainage impacted all GPS sensors in a similar way and it appears that the slow drainage event marked the point from the ice sheet velocity to go from steady relatively low values to increasing summer values. The fast draining of Lake Ponting affected the ice sheet velocity at different points in a different way, and, as expected, with a higher impact on short term velocity. We point out that this is the first time that the impact of the two types of drainage are studied using data collected from multiple GPS measurements, providing information on how ice sheet dynamics (at which distance and direction) are impacted by the drainage of surface lakes.