Geophysical Research Abstracts
Vol. 18, EGU2016-8389, 2016
EGU General Assembly 2016

A subglacial hydrological analysis of Recovery Ice Stream using GlaDS

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We use GlaDS, a 2D subglacial hydrology model, to assess subglacial drainage development in Recovery Ice Stream. Our primary aims are to a) examine the characteristics of subglacial lake growth and drainage, and b) investigate the impact of the drainage events on the dynamics of the ice stream. We first apply GlaDS to a synthetic system with one overdeepened region. The model outputs suggest that the highly constricted environment of the ice stream combined with funneling of relatively high rates of subglacial water flow from the large catchment, combine to create slow-moving high-pressure waves. The waves cause temporally varying water flow rates through the hydrological system that drives lake growth. As water builds up in the overdeepening, the hydraulic potential gradient steepens and allows greater flux out of the lake basin. Over time, this flux causes channel growth that triggers lake drainage after several years. Following lake drainage, channels again shut down. Due to the channels, high water pressures associated with lake drainage are apparent 50 km downstream of the lake rather than immediately in the vicinity of the overdeepening.

We investigate the system further by applying the hydrology model using the basal and surface topography of Recovery Ice Stream extrapolated from BEDMAP2 and mass conservation techniques. Preliminary results suggest that the subglacial water volumes and depths accumulated in the lakes are similar to those estimated through satellite-altimetry based techniques. We discuss primary water flow routes and compare the modelled lake drainage timing with ICESat surface altimetry records.