Application of the ArcticDEM for detecting active subglacial lakes beneath the Greenland Ice Sheet

Jade Bowling (1,2), Amber Leeson (1), Malcolm McMillan (1), Stephen Livingstone (2), and Andrew Sole (2)

(1) Lancaster Environment Centre, Lancaster University, Lancaster United Kingdom (j.bowling@lancaster.ac.uk), (2) Department of Geography, The University of Sheffield, Sheffield, United Kingdom

Over 400 subglacial lakes have been documented beneath the Antarctic Ice Sheet, ranging from 'active' lakes which periodically fill and drain, to ancient hydrologically isolated lakes. Active subglacial lake outburst events have been associated with accelerations in local ice flow velocity. The sudden discharge of water causes the subglacial lake roof to subside, which propagates to the surface resulting in the formation of collapse basins (typically ∼50-70 m in depth). These topographic features can be detected using remote sensing techniques. In our previous work we have discovered 56 subglacial lakes beneath the Greenland Ice Sheet, increasing the total of known lakes to 60. These Greenlandic lakes, of which 4 are hydrologically-active, are distinct from their Antarctic counterparts as they are mostly distributed towards the margin of the ice sheet, and some are likely to be recharged by surface meltwater inputs.

Here, we present a new semi-automated method for detecting surface signatures of active subglacial lake drainage events in Greenland, utilising the high-resolution (2 m), high coverage ArcticDEM repeat digital surface models (2009-2016). We apply our method for identifying collapse basins to test cases to evaluate this approach and unprecedented dataset. This will ultimately allow us to examine the potential influence of drainage events on ice dynamics in future work. Improved understanding of the complex subglacial hydrological system in Greenland is crucial in order to constrain hydrological and ice dynamical models.