

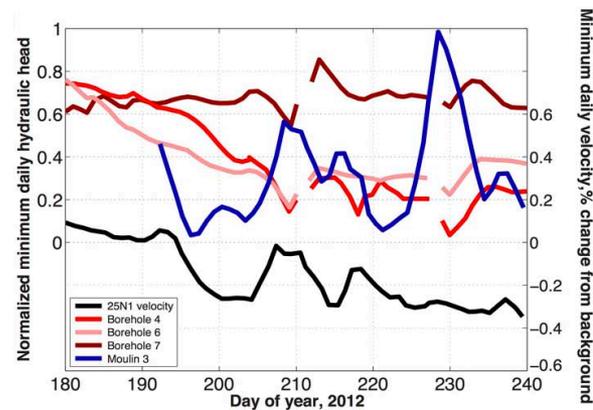
Direct observations of evolving subglacial drainage beneath the Greenland Ice Sheet

Objective

The Greenland Ice Sheet speeds up every summer as melt from the surface penetrates km-thick ice through moulin, lubricating the bed of the ice sheet. Greater melt is predicted for Greenland in the future, but its impact on ice sheet flux and associated sea level rise is uncertain; direct observations of the subglacial drainage system are lacking and its evolution over the melt season is poorly understood.

Research

- Drilled and instrumented 13 boreholes through 700 m thick ice in west Greenland.
- Performed the first analysis of Greenland ice velocity and water pressure in moulin and boreholes.
- Moulin water pressure does not lower over the latter half of the melt season, indicating a limited role of high-efficiency channels in subglacial drainage.
- Boreholes monitor a hydraulically-isolated region of the bed, but decreasing water pressure seen in some boreholes can explain the decreasing ice velocity seen over the melt season.



Borehole drill site in Greenland with moulin in foreground.

The measured late summer decrease in ice velocity (black) cannot be explained by water pressure in moulin (blue) that provide the external inputs to the basal system, but can be explained by lowering water pressure in hydraulically-isolated regions of the bed monitored by boreholes (red colors).

Impact

Our observations identify a previously unrecognized role of changes in hydraulically-isolated regions of the bed in controlling evolution of subglacial drainage over summer. Understanding this process will be crucial for predicting the effect of increasing melt on summer speed-up and associated autumn slowdown of the ice sheet into the future.

Reference: L. C. Andrews, G. A. Catania, M. J. Hoffman, J. D. Gulley, M. P. Lüthi, C. Ryser, R. L. Hawley & T. A. Neumann. 2014. Direct observations of evolving subglacial drainage beneath the Greenland Ice Sheet. *Nature*, 514, 80-83, doi:10.1038/nature13796.