Insights into processes behind current and future sea-level rise from the Greenland Ice Sheet

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By the end of this century, the Greenland Ice Sheet will contribute roughly 1 meter of water to the global ocean. This number has substantial uncertainty, sourced from both societal unknowns (∼60 cm depending on carbon emission scheme) and unknowns in glacier processes (∼50 cm). The ISMIP6 exercise (Goelzer et al., 2020) identified the melting of ice at the surface as the main driver of ongoing and future ice sheet mass loss. This includes both the direct loss of meltwater to the ocean and its knock-on effects: meltwater that reaches the bed speeds up the flow of the ice above it, hastening the calving of icebergs into the ocean each summer. ISMIP6 also identified calving as the greatest source of uncertainty in the processes of mass balance of the Greenland Ice Sheet. This talk will address avenues for field geophysics to constrain the effect of basal water on ice flow and calving processes that occur on the Greenland Ice Sheet. These potential avenues include GNSS observations, terrestrial laser scanning, and newly applied technologies like phase-sensitive radar (ApRES) and seismoelectric methods.

In July 2022, my group will investigate the connections between surface-produced meltwater and ice dynamics in a region high on Helheim Glacier, East Greenland. I will share field plans, including deployment of a GNSS array to sense the speed at which area crevasses open, seismoelectrics to survey the englacial water table, and ApRES surveys to detect water at greater depths in the ice sheet (see Figure 1). The overall project goals are to constrain the englacial and subglacial hydrology of the area as that relates to narrowing uncertainties in the mass loss rates of the Helheim Glacier region of the Greenland Ice Sheet.

Our Helheim Glacier project contributes to EarthEd, a partnership between the University at Buffalo (UB) for K-12 teachers at underprivileged schools in the Buffalo–Niagara region. The EarthEd Institute is an intensive week-long summer training accredited for continuing education by the New York State Department of Education; there are 24 teachers enrolled for the June 2022 event. There, we present research background, tools, and results to the teachers, who then participate in hands-on research methods and plan ways to bring research to their classrooms. Next, EarthEd Outreach sends UB graduate students to area classrooms to implement these lessons and activities over the school year. This 1-to-1 pairing is mutually beneficial to the K-12 community, who learn scientific approaches directly from geology experts, and to UB graduate students, who learn pedagogical approaches from the teachers and the immersive experience itself. EarthEd program goals are to bolster the achievement of students in underprivileged schools and to encourage young people from diverse communities to consider futures in STEM at a university. Read more at the EarthEd website.

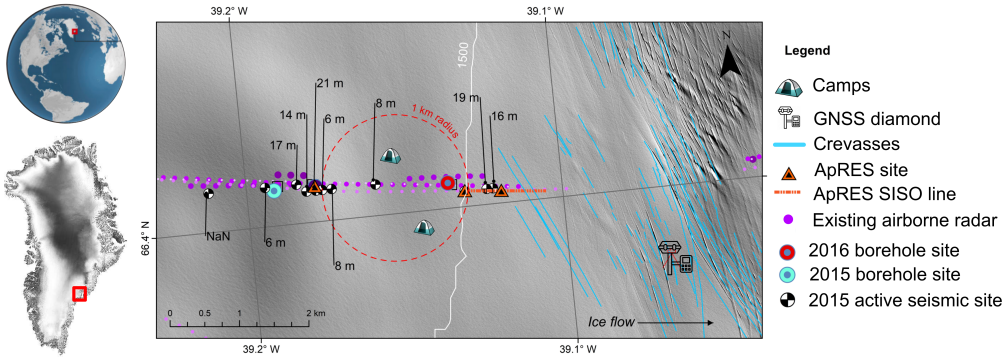

Figure 1: Our field area, with past and planned deployment sites of geophysical surveys, in the upstream reaches of Helheim Glacier on the Greenland Ice Sheet. The project's focus is on the flow of subsurface water into crevasses (blue lines in the easternmost area) and, eventually, to the glacier bed.