

A comparison of geophysical observations of a Greenlandic supraglacial lake drainage using commercial instruments and a low-cost experimental alternative

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Supraglacial lake drainages have the potential to be a driver of ice flow acceleration in a long-term retreat scenario of the Greenland Ice Sheet (GIS) if the hypothesized enhanced basal lubrication resulting from the supraglacial drainages is extensive enough in area and volume to affect a substantial portion of the margin of GIS. From late-May to early-August 2009, we instrumented a supraglacial lake in the vicinity of Jakobshavn Isbrae, Greenland with commercial broadband seismometers, high-frequency 3-component Y28 geophones (4.5 Hz eigenfrequency), and differential GPS stations (L1/L2 receivers). In addition to the commercial products, we also deployed a combined microphone, 3-channel seismic data (equipped with Y28 geophones for this deployment), and L1 GPS instrument, christened geoPebbles, developed at the Pennsylvania State University for approximately 1/10 of the cost a single commercial component. MODIS imagery indicates that the drainage of a supraglacial lake within 5 km of 2 stations occurred on June 17, 2009. The supraglacial lake drainage was coincident with an ~0.4 m uplift of the glacier in ~2 hours, an ~0.4 m excursion to the north in ~2 hours, and a more subtle acceleration to the west (the predominant ice flow direction in this area) followed by a gradual return to the average ice velocity preceding the supraglacial lake drainage. The seismometers also reveal ~24-36 hours of heightened seismic activity. In this first field test, the geoPebble data show good agreement with the commercial instruments and thus geoPebbles have the potential to allow more extensive GPS and seismic observations in Greenland and Antarctica. Here we present not only initial observations of a supraglacial lake drainage, but also illustrate the field potential of geoPebbles in polar research.