NRI License number: 02 022 16R-M: Dynamics and Change of the Devon Ice Cap, Nunavut

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Project Location: Devon Ice Cap, Devon Island, Nunavut

Annual Report 2016

Field dates April 28-May 25, 2016

Our goal is to document and explain the dynamics and recent changes of ice caps in the Canadian Arctic, and evaluate their impact on global sea level. Fieldwork on Devon Ice Cap in 2016 involved a Postdoctoral Fellow and a PhD student. The following activities were completed:
(i) Brad Danielson (Postdoctoral Fellow) maintained and retrieved data from 3 automatic weather stations and 5 continuously recording GPS stations that are monitoring the rate of bedrock uplift rate around the ice cap. These GPS stations were installed in 2014 and 2015 on bedrock adjacent to glaciers with different flow rates to see whether uplift rates are linked to glacier dynamics. Bedrock uplift records the response of the bedrock to changes in glacier mass.
(ii) Ashley Dubnick (PhD student) collected samples of the basal ice (ice with properties that reflect interactions between the glacier and its bed) from the snow pack and 4 glaciers with different basal temperature regimes (melting vs frozen to the bed). She will investigate how the temperature of the ice at the glacier bed affects the physical properties, chemistry and microbiology of the ice.

Project Plans 2017

Field Team (2017): Martin Sharp (Professor); Ashley Dubnick (PhD Student); Luisa Fernandes (PhD Student)

Timeframe: April 2017- June 2020 (~1 month/yr in spring)

Purpose: understand how Arctic ice caps are responding to climate warming, and quantify the contribution of glacier melt in Arctic Canada to sea level change.

Goals & objectives (2017).

(1) To service and recover data from 5 GPS sensors installed on bedrock around Devon Ice cap that record vertical motion of the Earth's crust in response to changes in the ice cap's mass.

(2) To conduct ground based radar surveys and collect shallow ice cores from the upper 5-10m of the ice cap to describe the extent/thickness of ice bodies formed by refreezing of meltwater in the snow and firn. The presence of such ice bodies may increase the fraction of meltwater that runs off to the ocean since they prevent meltwater from draining into the snow and firn where it can refreeze and instead promote horizontal drainage.

Access: by Twin Otter from PCSP, Resolute Bay; Travel on ice cap (Party of 3) by skidoos and sleds, or helicopter.

Any structures that will be erected (permanent / temporary): A temporary base camp (party of 3) is established at the ice cap summit and small travel camps of 1-2 tents are used at remote sites. Camps are dismantled at the end of the field program and minimal materials (fuel/equipment/skidoos) are cache at the northern margin of the ice cap to reduce transport costs next year.

Restoration / abandonment plans: Equipment not needed for subsequent field seasons will be removed after the 2017 season. Some equipment and fuel needed for next year may be cached on the northern margin of the ice cap. All cached materials will be removed at the end of the project.

Methodology

Collection Protocol and Mechanisms:

(i*) GPS measurements*: The GPS systems consist of an antenna mast (approximately 1m high) bolted into bedrock, a Trimble Net R9 GPS sensor, batteries, and solar panels. These systems will operate year-round until they are dismantled and removed at the end of the study (approximately 4 years). We service and download them each spring.

(ii) ***Ice Coring***: A Kovacs gas-powered ice coring drill is used to recover ice cores from sites where we expect to find ice bodies in the firn. With extension rods, we can retrieve cores up to 20m deep. Cores are measured and photographed so that we have a record of the distribution and thickness of ice layers in each segment.

(iii) ***Ground Penetrating Radar (GPR):*** GPR surveys are conducted with a battery powered 500 MHz Pulse-Ekko Noggin radar system. The radar is mounted on a sled towed behind a snowmobile and connected to a continuously recording GPS unit. It is very effective at detecting ice bodies formed in the upper 10m of the ice cap where meltwater percolating down from the surface refreezes. We will conduct surveys in specific areas where remote sensing has detected ice body formation in either spring or fall.

Indicate why specific communities or individuals were selected for your research - Not applicable.

Data

- **Short term & Long term use of data.** Student theses, research publications, and public talks. Climate Change Assessment Reports (e.g. IPCC, AMAP). Data available on request to interested parties. Ultimately they will be deposited in a public data repository.

- **Other uses of data.** None

Reporting

- Results will be communicated through annual reports to the Nunavut Research Institute and Nunavut Climate Change Center, and summaries of research results to Grise Fjord and Resolute Bay communities in Inuktitut and English. NRI and NCCC will receive copies of published articles.

Will the research result in a publication? Yes – journal articles.