

PROGRESS REPORT on 2014 FIELD ACTIVITIES

Glacier Mass Balance Studies in the Canadian High Arctic

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1. INTRODUCTION

Knowledge of the mass balance of ice caps and glaciers in the Canadian high Arctic provide important insight into understanding patterns of climate change, and validating current estimates of global sea-level contributions from this region. Through continuation of the long-term time series (~50 years) of annual surface mass balance measurements for the Northwest Devon ice cap, Meighen ice cap, Melville ice cap, and Agassiz ice fields, this project contributes towards the fulfillment of NRCan's mandate and ESS strategic outcomes through activities in the ESS Climate Change Geoscience Programme (CCG) – Essential Climate Variables (ECV). Output from this project delivers towards Departmental SO #3 under the PA3.1.3 in order that *Science and knowledge are used to help Canada adapt to a changing climate – in particular, the impact of climate change on Canada's landmass is assessed, and strategies are developed to adapt to these changes*. In addition, aspects of community infrastructure and sustainable northern resource development including transportation and energy mix, will be supported by information on Cryosphere system change.

2. RESULTS

2.1 Glacier Mass Balance Measurements – Spring, 2014

All mass balance measurements on South Melville, Meighen, Agassiz (Drambuie), and Devon (NW) ice caps, and the Grise Fiord glacier were successfully acquired. Data collected in 2013-2014 give mass balance results for the 2012-2013 balance year. While the annual long-term average mass balance value for the 3 reference glaciers (Meighen, Melville, and Devon ice caps) is negative (see Table 1), Devon and Meighen ice caps experienced positive balance values of 2 and 17 cm w.e. respectively in the 2012-2013 balance year. Mass balance for the South Melville ice cap (2012-2013) of -18 cm w.e. was only slightly less negative than the long-term average of -27 cm w.e. Associated water equivalent volume change for the Devon(NW), Meighen, and South Melville ice caps was 0.04, 0.01, and -0.009 Gt respectively resulting in a net *negative* contribution to global sea-level rise from these 3 sites for the 2012-2013 balance year. Overall, glacier mass balance values in the Queen Elizabeth Islands for 2012-2013 were in sharp contrast

to the recent trend of strongly negative balance over the past 10 years reflecting the relatively cool conditions that prevailed across this region during the summer of 2013.

Table 1.

<i>Ice Cap</i>	<i>Long Term (1960-2013) Net Mass Balance (cm w.e.)</i>	<i>Net Mass Balance for 2012-2013 (cm w.e.)</i>	<i>Total Mass Change in 2012-2013 (Gt)</i>
Devon (NW)	-1.3	2	+0.04
Meighen	-1.6	17	+0.01
Melville	-27.5	-18	-0.009

2.2 CryoSat-2 Calibration and Validation - Devon ice cap

Ground surveys involving *Static GPS* data collection were conducted at Corner Reflector sites at the Cryosat summit camp Devon ice cap for validation of the ASIRAS (Cryosat-2 airborne simulator) radar altimeter. Preliminary results from this work indicates that data from the CryoSat-2 radar altimeter will contribute significantly to the Climate Change Geoscience Program (ESS) by quantifying changes in ice mass across the interior regions of the large ice caps in the QEI a seasonal basis.

2.3 Glacier Dynamics - Devon ice cap

Data from the in-situ GPS station on the Sverdrup glacier were successfully downloaded. The in-situ GPS data provides information on total mass balance of the Devon ice cap by measuring seasonal rates of ice flow to the ocean. These data also provide validation to measurements of glacier motion as monitored via satellite methods in the Glacier Velocity Mapping Program, within the Activity ‘State and Evolution of Canada’s Glaciers’, Climate Change Geoscience Program, ESS.

3. WORK PROPOSED FOR SPRING 2015

We propose to continue the glacier mass balance measurements over the Devon, Agassiz, Meighen, and Melville ice caps, and the Grise Fiord Glacier. This work involves maintenance and data retrieval from the Automatic Weather Stations (AWS), and pole measurement and replacement (or extension) as required. There are no significant changes to the work planned for 2015 relative to the activities performed in 2015.

4. LOGISTICS

Transportation to field sites will be provided by the Polar Continental Shelf Program. All work on site will be performed out of a permanent hut that exist on the Melville ice cap, tents on the Agassiz and Devon ice caps, and Meighen Ice Cap, and the Co-op Hotel while in Grise Fiord. Transportation at each site will be by snowmobile.