PROGRESS REPORT on 2010 FIELD ACTIVITIES

Glacier Mass Balance and Pollution Studies in the Canadian High Arctic
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INTRODUCTION

Collectively, glaciers and ice caps from the Canadian Arctic represent the largest mass of ice outside of the Greenland and Antarctic Ice Sheets. Changes in the volume of these features therefore represent potentially significant impacts on global sea level rise, marine ecosystems, and ocean circulation patterns. Measurements of glacier mass balance to date reveal accelerated rates of ice loss in response to recent climate warming, particularly since the mid 1980's. In addition, levels of atmospheric pollution contained within the annual snow pack across the ice caps have provided valuable information on atmospheric trajectories and potential linkages to glacier health. The objectives of this study are to continue these long term measurements of glacier mass balance and pollution from 4 sites across the Canadian high Arctic (see Figure 1) in order to monitor the rapid environmental changes that are occurring across this region.

GLACIER MASS BALANCE

All mass balance measurements on Melville, Meighen, Agassiz, and Devon ice caps and the Grise Fiord glacier were successfully acquired. Data collected in 2010 (summarized in Table 1) give mass balance results up to September 2009. Meterological data from the automatic weather stations (AWS) on all ice caps were downloaded and reset for data acquisition over the 2010/11 balance year. Upgrades to the AWS on the Sverdrup Glacier, Devon ice cap included the installation of a remote camera and satellite up-link capabilities. These equipment provide near real time retrieval of image and meteorological data from this site, allowing for a close analysis of the relationship between ice melt and air temperature throughout the summer season.

TABLE 1.

	Long Term Net Mass Balance (Kg m^{-2})	2009 Net Mass Balance (Kg m^{-2})
Devon Ice Cap - NW	-106	-523
Meighen Ice Cap	-118	-676
Melville Ice Cap	-211	-351
Agassiz Ice Cap	-42	-52

MONITORING POLLUTION LEVELS

Contaminants records at all sites in the Canadian High Arctic have been brought to update to year 2009. In addition, a critical measurement of gamma peak in 1962/3 was carried out in the last field season. This gamma profile has allowed us to establish a reference time scale necessary to compute bulk accumulation values for the Agassiz ice cap and Mt. Oxford ice field over the past ~50 years.

Results of melting percentage measured in the past years as derived from the stratigraphic record of shallow ice cores has allowed us to update the melt layer record from the Agassiz and Devon ice caps. These results reveal an accelerated melting trend in the Canadian High Arctic and have been compiled into a manuscript submitted to the high impact journal "Nature".

VARIABILITY IN FLOW RATES OF MAJOR OUTLET GLACIERS ON THE DEVON ICE CAP

Data from 3 of the 4 differential GPS units that were deployed on the Devon ice cap in 2009 (Sverdrup, North Croker Bay, and Southeast Glaciers) were retrieved. The 4^{th} unit that was located on the South Croker Bay Glacier was lost due to excessive melt during the summer of 2009. Data from the Sverdrup and North Croker Bay glaciers show significant speed-up events during the summer months indicating a direct response of glacier flow rates, and hence calving flux, to melt water generated during the onset of summer melt. Data from all 3 sites are currently

being used to validate seasonal velocity measurements derived from RADARSAT-2 data over these glaciers.

FIELD PLANS FOR 2011

Field plans for 2011 involve measurements of glacier mass balance and pollution from the Devon, Melville, Meighen, and Agassiz ice cap sites (Figure 1). Measurements of glacier mass balance as well as Public Outreach with the students of the Umimmak School will be conducted while at Grise Fiord (Figure 1). In addition to measurements of glacier mass balance, field activities on the Devon Ice Cap will include collection of shallow ice cores, GPS, and ground penetrating radar measurements along a 50 kilometer transect in support of calibration and validation of the CryoSat-2 radar altimeter. Travel across ice caps will be performed on snowmobile with komatiq sled in tow. Accommodations will consist of small huts on Meighen and Melville ice caps, tents on Devon ice cap, and hotel in Grise Fiord.

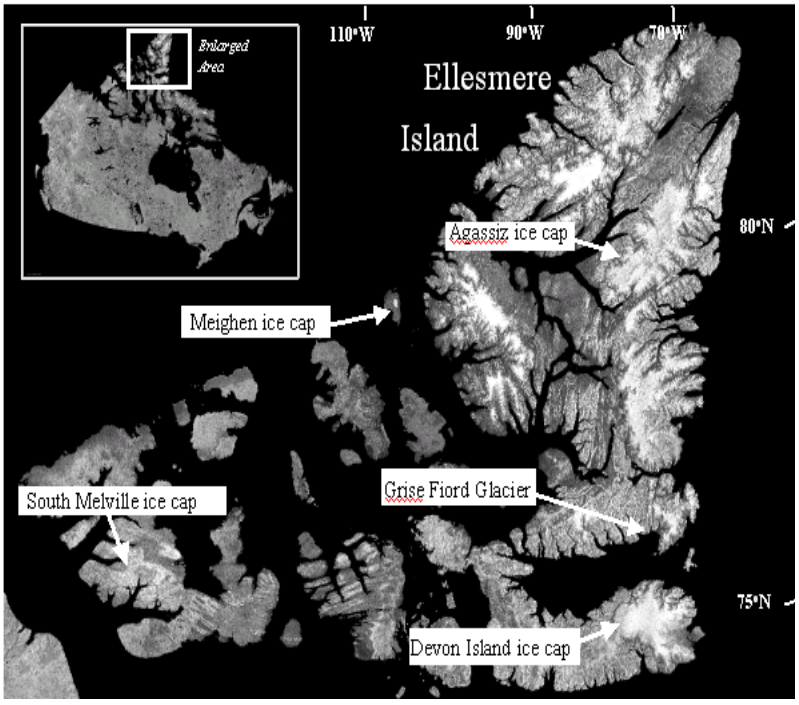

Figure 1. Location of the 2009 glacier mass balance and pollution monitoring sites across the Queen Elizabeth Islands.