Five 20-m deep firn cores were extracted and analyzed for density and stratigraphy, two full energy balance weather stations were deployed, equipped with 16 m long thermistor strings to measure firn temperature, and over 300 km of ground penetrating radar data were collected. Preliminary firn cores analysis reveals increasing frequency and thickness of ice lenses toward lower ice-sheet elevations, in agreement with other recent work in the area. The collected data will facilitate advances in our understanding of the spatio-temporal distribution and variability of firn refreezing and its role in the surface mass balance of the Greenland Ice Sheet.

An analysis of the errors in the calculation of ice discharge through flux gates. Application to Nunavut tidewater glaciers, Canada.

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Frontal ablation of tidewater glacier, whose main components are calving and submarine melting at the glacier front, is an important mechanism of mass loss from Arctic glaciers. Frontal ablation is usually estimated calculating the ice discharge through predefined flux gates close to the glacier terminus. However, published results often lack a detailed error estimate. In the flux calculation, both errors in cross-sectional area and errors in velocity are relevant. While for estimating the errors in velocity there are well-established procedures, the calculation of the error in the cross-sectional area requires the availability of ground penetrating radar (GPR) profiles transverse to the ice-flow direction and close to the glacier terminus. Yet quite often there are only available GPR profiles collected along the centreline of glaciers, and thus it is necessary to make some assumption about the cross-sectional shape and area. In this contribution, we use GPR ice-thickness data from the IceBridge operation collected in Ellesmere and Devon Islands, Nunavut, Canada, to compare the cross-sectional areas estimated using various approaches (parabolic, quartic) with the cross-sections estimated from the observed ice thickness data. These error estimates are combined with those for ice-velocities calculated from Sentinel-1 SAR data, to get the error in ice discharge.
Our results indicate that the velocity field is the main error source for small glaciers with low velocities, while for large glaciers with high velocities the error in cross-sectional area dominates. Ice thinning or thickening between times of ice-thickness and glacier velocity measurements should be considered, as it implies systematic errors up to 8% in our case study. The U-shaped parabolic approach, with allowance for ice-thickness measurement point displaced from the glacier centerline, performs best, with small bias and admissible standard error. In general, the quartic U-shaped approach tends to overestimate the cross-sectional area, though it works best for large glaciers.

Regarding ice discharge results, we observe an increase of ice discharge from the main glaciers of the Prince of Wales Icefield (Trinity and Wykeham) from 2015 to 2016, by 5% and 20%, respectively, followed by a decrease in 2017, by 10% and 15% respectively. Belcher glacier, in the Devon Ice Cap, maintains similar discharges during 2015–2017.

The focus of this contribution was the analysis of the errors in the calculation of ice discharge through given flux gates. However, other factors might influence the approximation of the frontal ablation by the mentioned method. Among these factors are the surface mass balance between the flux gate and the calving front, the ice-thickness changes, the front position changes and the seasonal and inter-annual variations of ice velocity. The ice discharge corrections for these factors can be large and should therefore not be disregarded.

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