The interaction between ice loss and hydrology on the Russell Glacier, West Greenland

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Introduction

The Russell Glacier is a land-terminating limb of the extensive Greenland Ice sheet. Located on the West coast of the island, the glacier lies approximately 25km north of Kangerlussuaq. Between the 4th August and the 6th September, six contrasting projects were conducted focusing on glacier hydrology, meltwater dynamics and glacial outburst floods.

Aims and Objectives

Aim: To evaluate controls of ice loss and investigate the route taken through the glacier, as well as its impacts

Objectives:

- Evaluate the impact of surface roughness on melt.
- Repeatedly survey areas with different debris characteristics in order to assess its impact on melt.
- Investigate the impact of debris on water and sediment flux in supraglacial streams.
- Evaluating diurnal variation in melt rate between a supraglacial and a proglacial stream
- Quantify ice loss into a proglacial lake.
- Assess the influence of glacier outburst floods on proglacial lake geomorphology.

Methods

Ablation rates: Ablation stakes were installed at sites with different depths/coverage of debris and different surface roughness. The stakes were surveyed regularly to identify differences in melt rates and their variation with surface debris and/or roughness.

Debris thickness/coverage: Thickness was not possible to measure, but a scale of coverage was created.

Surface roughness: Each site was repeatedly photographed and used to create surface digital elevation models (DEMs) surface using Agisoft Photoscan. Roughness was calculated, using the aerodynamic roughness length parameter (Irvine-Fynn et al., 2014).

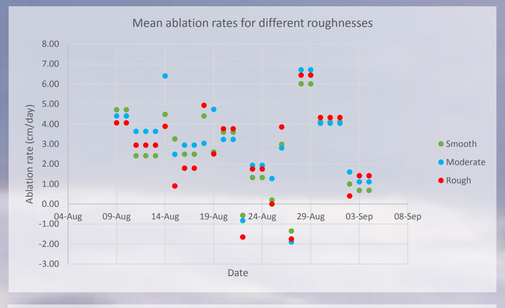
Stream velocity: This was measured at regular points along supraglacial streams that flow on bare ice and over debris cover, using salt dilution methods.

Glacial velocity: dGPS measurements were used to log the position of ablation stakes every three days.

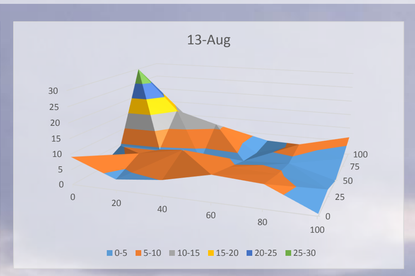
Geomorphological mapping: A geomorphological map of the sediments surrounding the proglacial lake will be compiled from GPS measurements, field sketches and photographs.

Sediment section analysis: Analysis of slackwater sediment deposits and their layers to determine how the magnitude of floods changes with relation to the slackwater deposits.

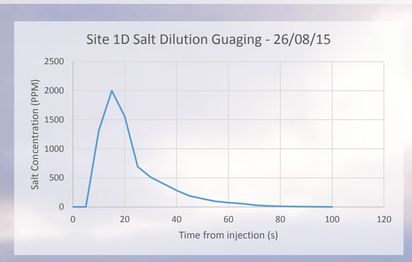
Results



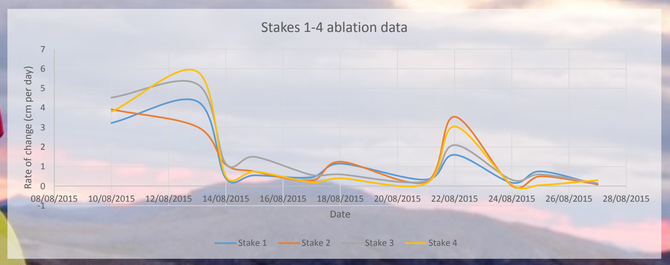
The results indicate a lot of variation in melt across surface type. Further investigation showed slightly higher ablation for rough surfaces as predicted. Rates changed dramatically from day to day demonstrating meteorological impacts.



This is an example of the graphs used to present the manual roughness measurements collected. Results show the evolution of the surface over time.



Of the two channels studied, discharge values were higher in the channel influenced by debris cover, suggesting that this channel collected more meltwater.



The ablation measurements show fluxes in the melt rates, meaning diurnal weather patterns are affect melt rates highly. The trend from the rest of the data suggests that the higher the percentage cover, the more melt occurred.

Conclusions

All the projects collected a sufficient amount of data in order to complete an undergraduate dissertation. We are still working up results, and therefore cannot conclude our project entirely, but looking at the results that we have collected, there is a link between diurnal melt rates and increased discharge on supraglacial streams; the higher the melt rates, the higher the discharge.

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