Greenland Expedition 2019: Investigating Ice Dynamics, West Greenland

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Aims

1. To construct a thermal regime of the large ice-dammed lake at Russell Glacier, West Greenland to investigate spatial and temporal variations in temperature and how this links to calving events at the ice margin.
2. To investigate exposed basal ice debris bands along the margin of the Russell and Isunguata Glaciers in order to identify their method of formation. This will help us further understand glacier dynamics.
3. To investigate how wind speed and air temperature affect variations in surface ice melt at point 660.
4. To investigate how surface debris cover contributes to surface ice melt.
5. To determine if surface debris contains biological material and whether this leads to increased surface melting

Ice-dammed Lake (Aim 1)

- To achieve Aim 1, water temperature data loggers were placed around the edge of the lake for the 18 days, as well as an air temperature logger placed near the lake.
- A remote-controlled boat, fitted with a water temperature data logger and a GPS device, was used to record water surface temperatures.
- Finally, photographs of the ice margin bordering the lake were taken every day, to assess calving events that were taking place, these can be seen in the figure below.

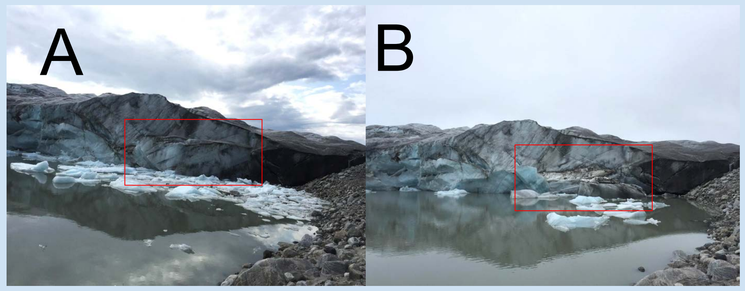


Figure 2 – The ice margin on the 29/7/19 (A) and 2/8/19 (B). The red box outlines where a large iceberg has calved off the margin.

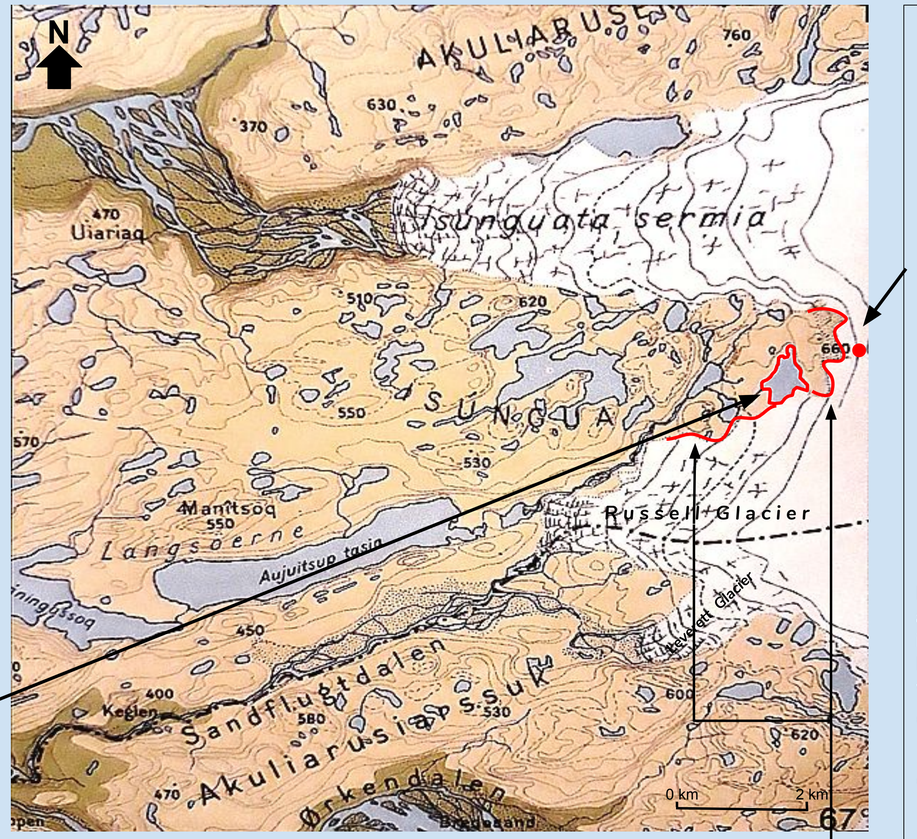


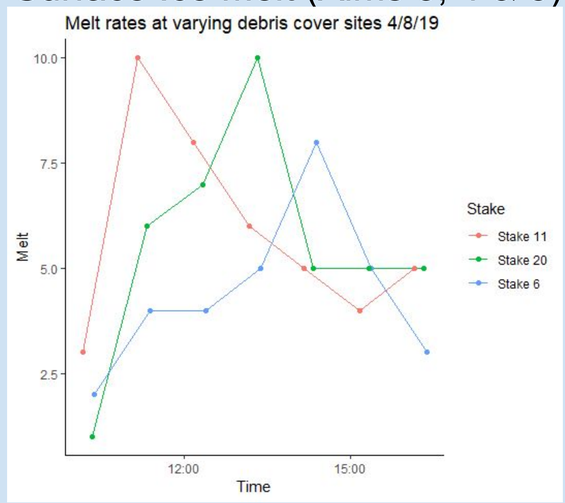
Figure 1 - Map showing field site locations for each project. These sites all surrounded the Russell Glacier in Southwest Greenland, near the town of Kangerlussuaq. (Tage Schjøtt, 2001)

Exposed Debris Bands (Aim 2)

- Debris bands within the bottom layer of the ice were identified, and samples taken from within these.
- These samples were dried and sieved to find the size distribution of sediment within them, which can show the processes affecting their formation.

Figure 3 - Debris bands at the glacier margin.

Surface Ice Melt (Aims 3, 4 & 5)



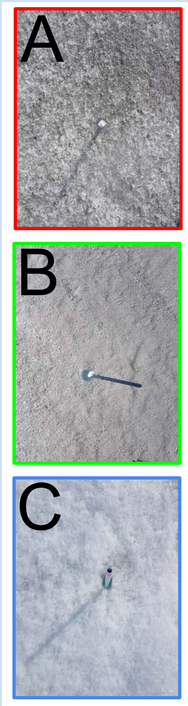


Figure 4 (above) - A graph showing the melt rates for stake 11, 20 and 6. Each stake has different surface ice properties highlighted in photos A B and C.
Figure 5 (right) - photographs of stakes 11, 20 and 6 showing the varying nature of debris cover over the research area.

- We measured surface ice melt as well as a number of factors that may influence the melt at each site.
- This included temperature, wind speed, debris cover and surface roughness.
- We will also analyse samples of surface sediment for organic matter as biological growth can increase melt.

Conclusions

1. As 2019 was the highest melt season on record for the Greenland Ice Sheet, the lake temperature was higher than expected and there was an abnormal frequency of calving events.
2. Sediment from 0-30cm was identified within debris bands, most located within clean, debris-poor ice. While some cobble sized clasts were found, the majority of sediment was below 64mm (pebbles, gravel, sand, and silt).
3. Ice melt varied considerably between the sites where data was collected. There was also considerable diurnal variations in melt as a result of changing wind speed and temperature.
4. Debris cover varied significantly between sites as well as over time. This is likely to have led to further variations in melt.