

Subglacial hydrology and sediment project

This project aims to investigate the delivery of sediment to the ocean through transport in the subglacial drainage system. The motivation comes from observations of sediment plumes in Greenlandic fjords, and the desire to understand what these imply for the sediment supply. As well as eroding the landscape beneath the ice sheet, the sediment supply provides nutrients that are important for marine life in the surrounding ocean.

The project will make use of a simplified version of a model that was developed to describe the formation of eskers at land-terminating glaciers, described in Hewitt and Creyts (2019). Eskers are sediment deposits that are believed to form through deposition near the mouths of subglacial channels. The model for their formation involves considering the water and sediment flow within the channel, together with the evolution of the channel's cross sectional area. A by-product of this model is that it calculates the expected discharge of both water and sediment at the glacier margin. The model will need to be adapted in various ways in order to explore the predicted sediment discharge for a Greenlandic fjord.

The model was originally written in Matlab. It has been converted to python with the help of AI, though it is not yet completely clear how well the python version will work.

To get started:

- Download code from https://github.com/ijhewitt/esker_simpler/.
- Look at and try running `esker_simpler_run_dim.m` or `esker_simpler_run_dim.py`
- Read Hewitt and Creyts (2019), and try to relate to the code to understand a bit about what is included in this model (this might not be that easy!). How do we extract the water and sediment discharge at the margin? How do we change the bed and surface topography and the forcing parameters?
- It may also be helpful to look at previous lectures on glacial hydrology, here.
- Once synthetic geometry seems clear, run the model on some Greenland geometries and meltwater inputs using flow-line data from Nanna / QGIS. What are the primary controls on the sediment discharge?

References

Hewitt, I. J. & T. T. Creyts 2019 A Model for the Formation of Eskers. *Geophysical Research Letters*, doi:10.1029/2019GL082304



Figure 1: Sediment plume in South Greenland from a drone.



Figure 2: Sediment plumes from satellite.