

Modelling an ice-dammed lake project

This project aims to investigate the dynamics of subglacial floods from an ice-dammed lake. The motivation comes from the observation that retreating ice sheets and glaciers often form ice-dammed lakes that represent a potential hazard to downstream communities. The goal of the project is to use a numerical model to develop some understanding of what controls the outflow from such a lake and the magnitude of any potential floods. This is likely to depend on assumptions made about the structure of the subglacial drainage system.

The project will make use of a flow-line model for subglacial hydrology, `wyvis`. 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/wyvis/>.
- Look at `wyvis2.pdf` and try running and understanding the examples `example.m`, `example_moulin.m`, or the equivalent python scripts.
- It may also be helpful to look at previous lectures on glacial hydrology, [here](#).

The idea is to incorporate an ice-dammed lake by tricking the model into thinking the lake is a moulin. Moulins in the model have a prescribe influx (Q_m), and prescribed cross-sectional area (S_m) which means that they store a volume of water $V_m = S_m(\phi_c/\rho_w g - Z_b)$ proportional to the water pressure at their base. By making the cross-sectional area very large (i.e. the area of the lake), the moulin can therefore be thought of as a lake. Depending on the water pressure relative to the pressure in the neighbouring drainage system, water can flow from the lake into the drainage system or vice versa.

- Discuss and design some numerical experiments to introduce an ice dammed lake at a particular location on the flow line, with a certain area and water influx.
- Investigate whether the lake fills and drains steadily, or whether (and under what conditions) it fills and drains episodically. What controls this? Is it possible to say anything about the maximum flood discharge?