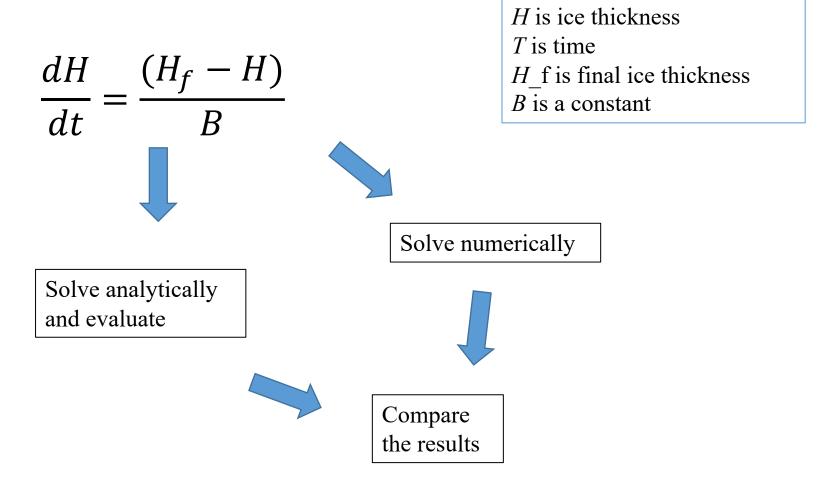
Glaciology EESCGU4220

Practical 3:

Solving equations with the finitedifference method Imagine we have a model saying how ice thickness *H* varies in time.



How to quantify the comparison? How does the comparison change with the resolution of the model? Solve analytically under the initial condition of H(t=0) = 0

$$\frac{dH}{dt} = \frac{(H_f - H)}{B}$$

$$H = H_f (1 - \exp\left(-\frac{t}{B}\right))$$

H is ice thicknessT is timeH_f is final ice thicknessB is a constant

To check this:

Sub. this back into (1)

$$\frac{dH}{dt} = H_f(\frac{1}{B}\exp\left(-\frac{t}{B}\right))$$

$$\frac{dH}{dt} = \frac{(H_f - H)}{B}$$

Today:

1. Compute H directly from the analytical solution.

$$H = H_f (1 - \exp\left(-\frac{t}{B}\right))$$

2. Compute it numerically using the finite difference approximation:

Our model equation

$$\frac{dH}{dt} = \frac{(H_f - H)}{H_f}$$

 $\frac{dH}{dt} = \frac{(H_f - H)}{B}$

Finite-difference approximation

$$\frac{dH}{dt} = \frac{H^{j+1} - H^j}{\Delta t}$$



3. Compare the two solutions, for example by plotting them on the same axes or computing the RMS mismatch. Then do this for many different values of Δt (a convergence test).