Ice stream thermal oscillations (Robel et al. 2013)

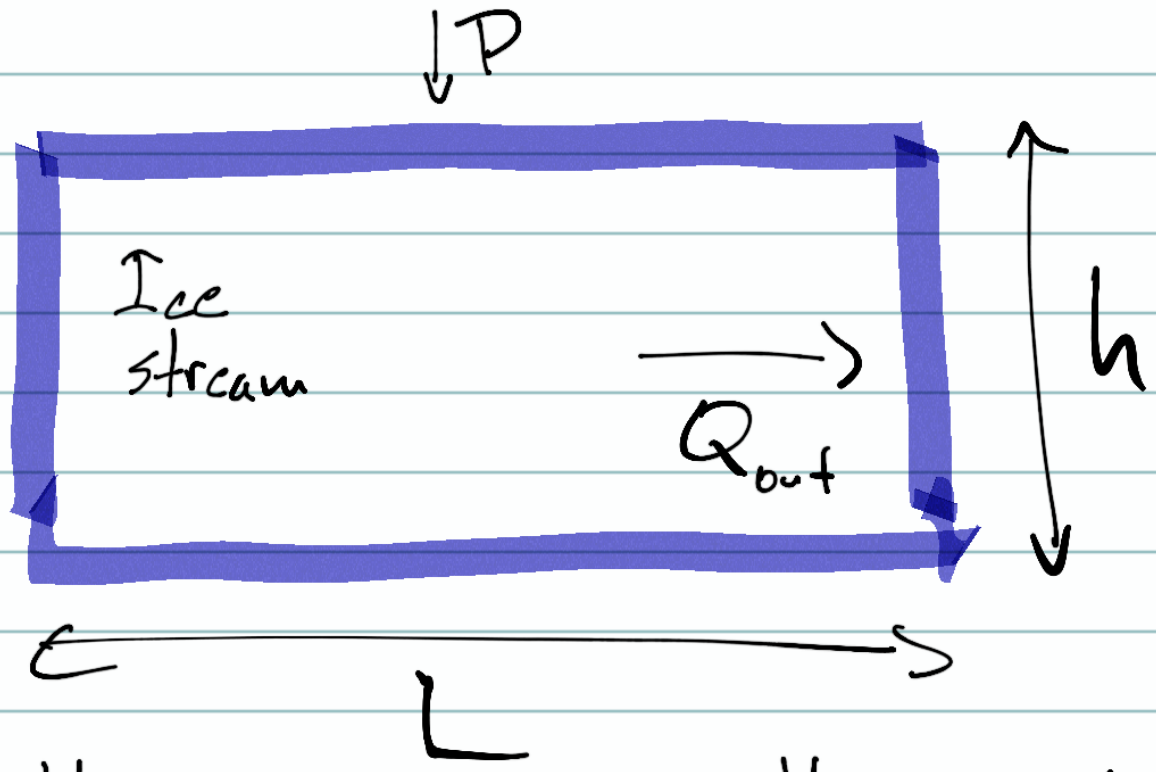
We want to know how the flow speed of an ice stream can vary over time

We need to know how

1) Driving stress: τ_d
2) Basal shear stress: τ_b

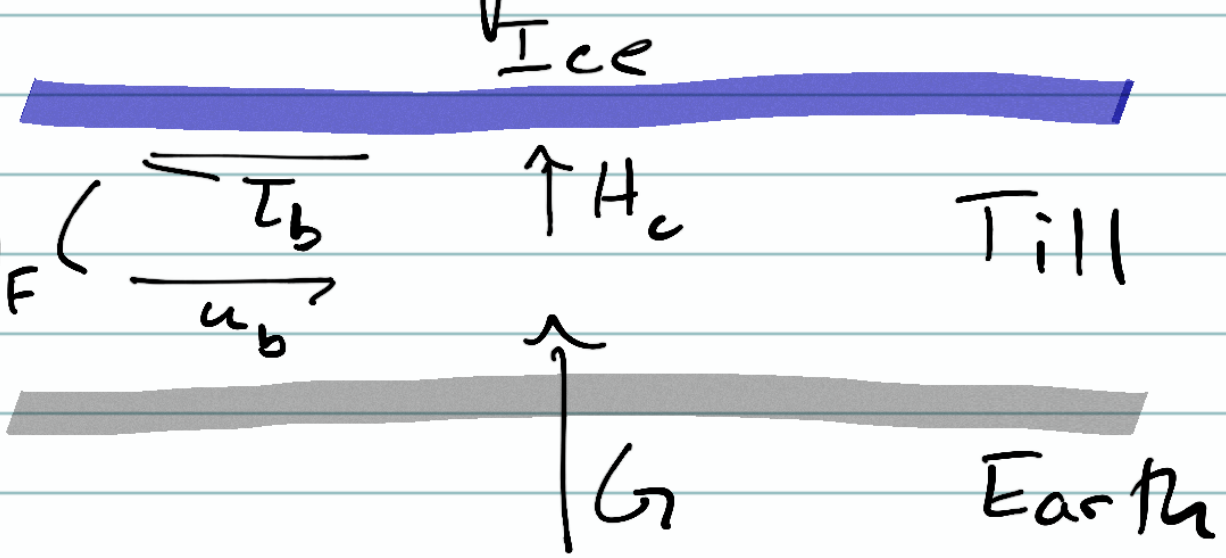
change over time

$$u = u_d W^{n+1} (\tau_d - \tau_b)^n$$



$$L\frac{dh}{dt} = PL - \underbrace{uh}_{Q} \rightarrow \frac{dh}{dt} = P - \frac{uh}{L}$$

The heat budget of the bed:



Three fluxes of heat

G: geothermal heat flux (constant)

H_c: conduction through ice thickness

H_f: internal friction at the ice-till interface

$$H_c = k \frac{T_s - T_b}{h}$$

← thicker ice reduces heat loss through ice (insulates like a blanket)

$$H_F = \tau_b u_b$$

$$\frac{dw}{dt} = \frac{1}{\rho_i L_f}\left(G_1 - k\frac{\Delta T}{h} + \bar{T}_b u_b\right)$$

$\frac{dw}{dt}$: amount (thickness) of water in fill

We have a model! (i.e. 2 yrs of my life)

$$\frac{dh}{dt} = P - \frac{uh}{L}$$

$$\frac{dw}{dt} = \frac{1}{\rho_i L_f}\left(G_1 - k\frac{\Delta T}{h} + \bar{T}_b u_b\right)$$