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ESS 533
Recap of May 2 lecture

We have found that the deformation rate of ice depends strongly on temperature (warmer ice deforms faster than colder ice). To better understand this effect, we need a forward model of how the temperature profile in ice evolves via advection and diffusion, and to do *that*, we need to understand conservation of energy. As we did with momentum and mass, we looked at the energy going into and out of a box. We considered advection, diffusion (via Fourier's Law for heat conduction), transient, and source terms, and derived an equation for conservation of energy:

$$\rho c \left[\frac{\partial T}{\partial t} + \vec{u} \cdot \nabla T\right] + S = \nabla \cdot \left(k \nabla \vec{T}\right)$$

We briefly discussed energy considerations for temperate vs. polar glaciers with the same basal temperature (slightly below freezing). For a temperate glacier the surface temperature is approximately freezing (i.e. warmer than the base), so there is a slight downward heat flux. For a polar glacier, the surface is well below freezing (i.e. colder than the base), so there is an upward heat flux that is large compared to the temperate case.