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Optimal Heat Flux Estimates

Temperature-chain data provide a lot of information about the physical processes occurring in lakes. These measurements characterise the thermal stratification, which has important consequences for the vertical transport of tracers. The evolution of the thermal stratification $T(z,t)$ is often modelled as a one-dimensional process obeying a diffusion equation,

$$\frac{\partial T}{\partial t} = \frac{\partial}{\partial z}\left(\kappa_e \frac{\partial T}{\partial z}\right),$$

for an eddy diffusivity κ_e, assuming a fixed cross-sectional area. The value of κ_e is estimated through an empirical formal.

We propose a new way to determine the optimal κ_e directly from the temperature profile data. Using an adjoint-loop, we can determine the best coefficient that minimizes the error between the diffusion equation and the observed data. Preliminary results show that the method is robust to low-level noise in the temperature record. Our hope is that this optimal method may help to quantify and clarify the physical processes occurring in lakes.