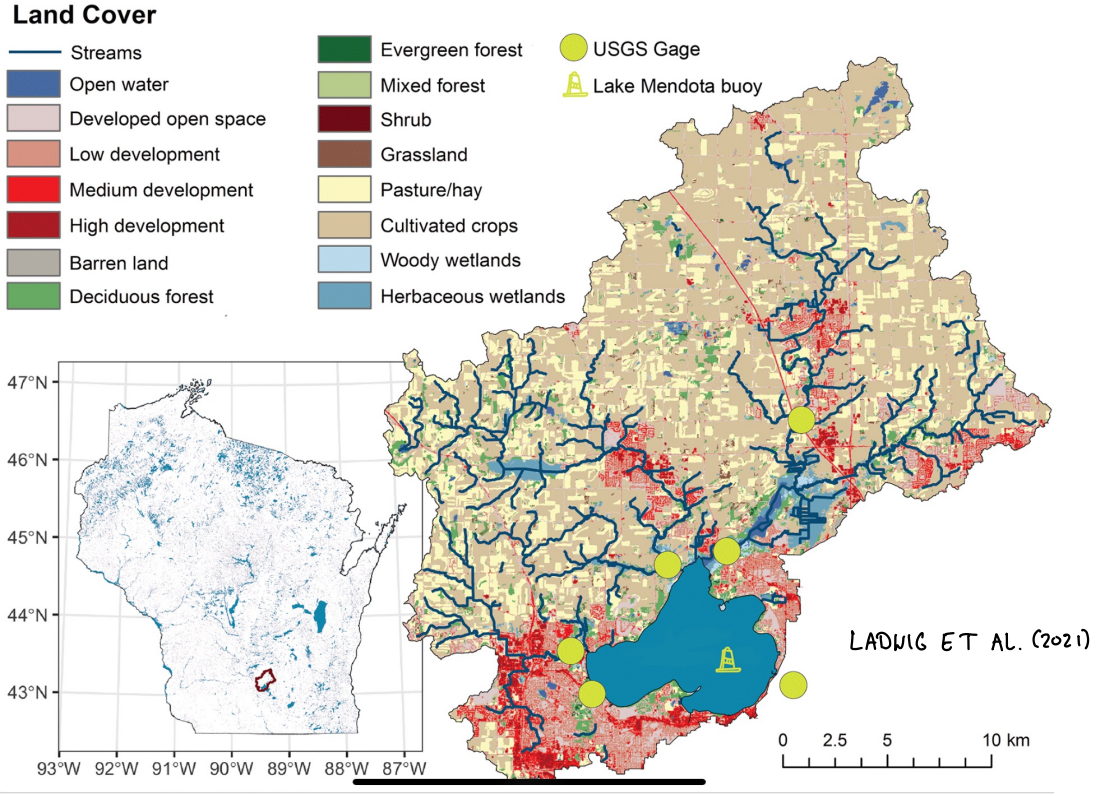
Local Lake Analysis

- model = GOTM
- GCM = GFDL-ESM
- scenario = SSP5-8.5 (2015-2100)

- Lake Mendota, Wisconsin, USA
- eutrophic
- dimictic
- about 25 m deep



Schmidt Number

Mass of the water column

$$M = \int \rho A \, dz$$

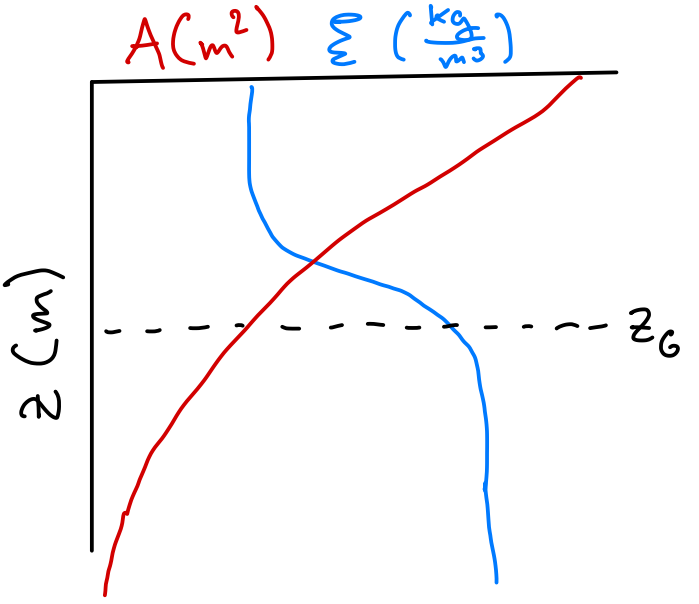
Center of mass/gravity

$$z_G = \frac{1}{\int \rho A \, dz} \int z \rho A \, dz$$

$$= \frac{1}{M} \int z \rho A \, dz$$

Mean density

$$\hat{\rho} = \frac{1}{V} \int \rho A \, dz$$



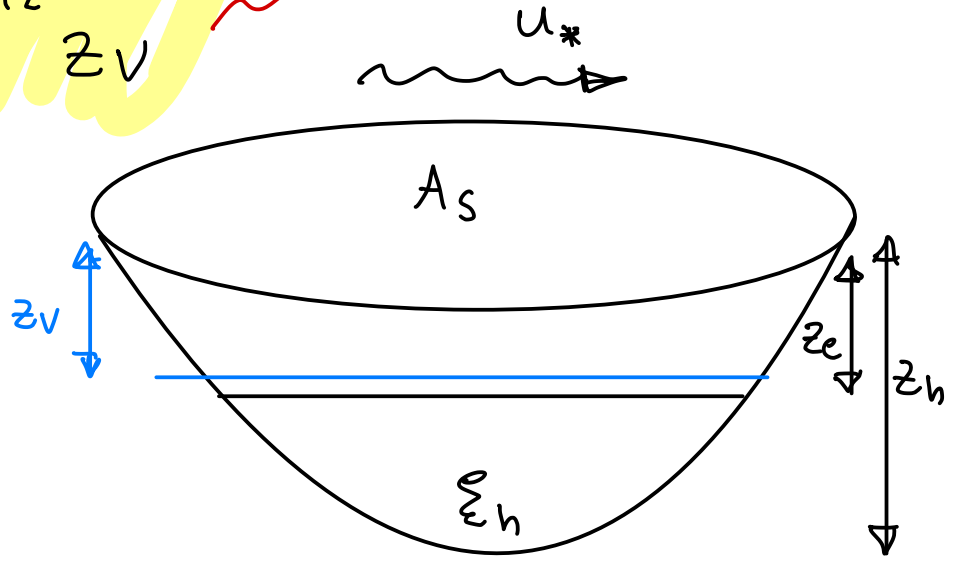
$$S_t = \frac{g}{A_0} \int (z - z_G)(\rho - \hat{\rho}) A \, dz$$

Lake Number

$$L_N = \frac{S_t \, (z_e + z_h)}{2 \xi_h u_*^2 A_S^{1/2} z_V}$$

Stabilizing forces

Mixing forces



Center of volume

$$z_V = \frac{1}{V} \int z \, A \, dz$$

Coupled Model

(1) ISIMIP temperature output as input for vertical mixing (Hondzo & Stefan, 1993)

$$K_z = a_k \left(N_z^2\right)^{-0.43} \quad \text{WITH} \quad a_k = 0.00706\, A_S^{0.56}$$

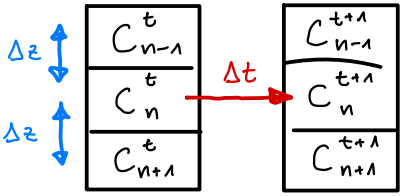
$$N_z^2 = \frac{g}{\varepsilon_z} \frac{d\varepsilon_z}{dz}$$

(2) Build our custom model

$$\frac{dC}{dt} = K \frac{d^2C}{dz^2} \xrightarrow{\text{numerics}} C_n^{t+1} = C_n^t + K\frac{\Delta t}{\Delta z^2}\left(C_{n+1}^t - 2C_n^t + C_{n-1}^t\right)$$

(FTCS)

(3) Be creative



(explicit)