The Physical-Biological Model

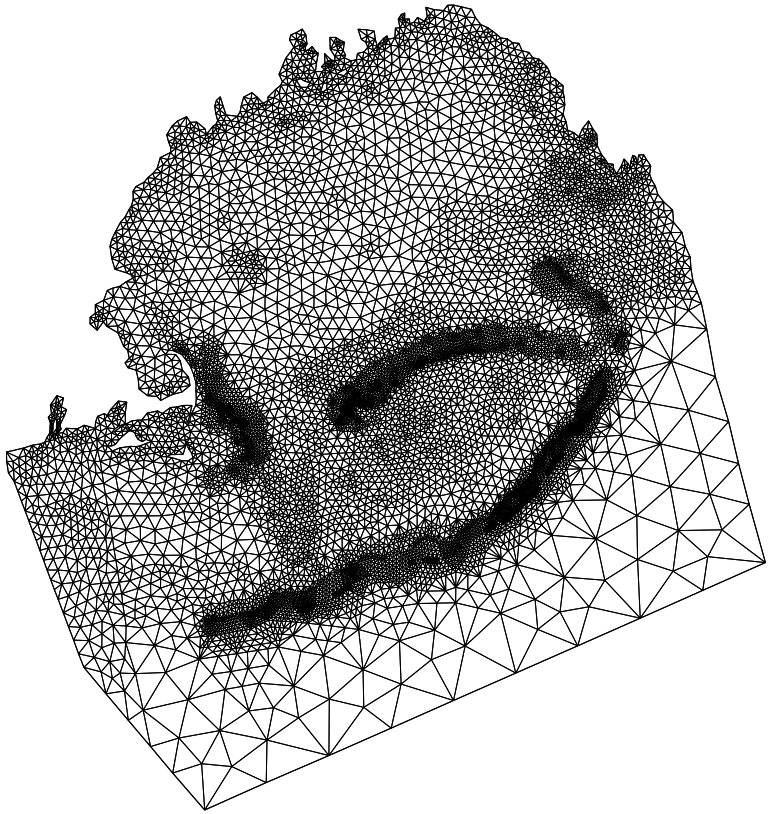
3D ADR equation for stage i:

Local Rate of Change — *Physical Transport (Advection Mixing)* — *Behaviour* — *Population Dynamics*

$$\frac{\partial C_i}{\partial t} = -\nabla\cdot(\mathbf{V}_{FLUID}C_i - \mathbf{K}\nabla C_i) - \nabla\cdot(\mathbf{V}_{BIO}C_i) + R_i$$

Stage-based population dynamics

$$R_i = d_{i-1}C_{i-1} - (d_i + m_i)C_i$$

2D Behavioural bracketing scenarios:

- Dispersal throughout water column
- Aggregation in surface (Top 25m)
  - Upwelling/Downwelling