

# **Simulating Water Mixing in a Barotropic Estuary**

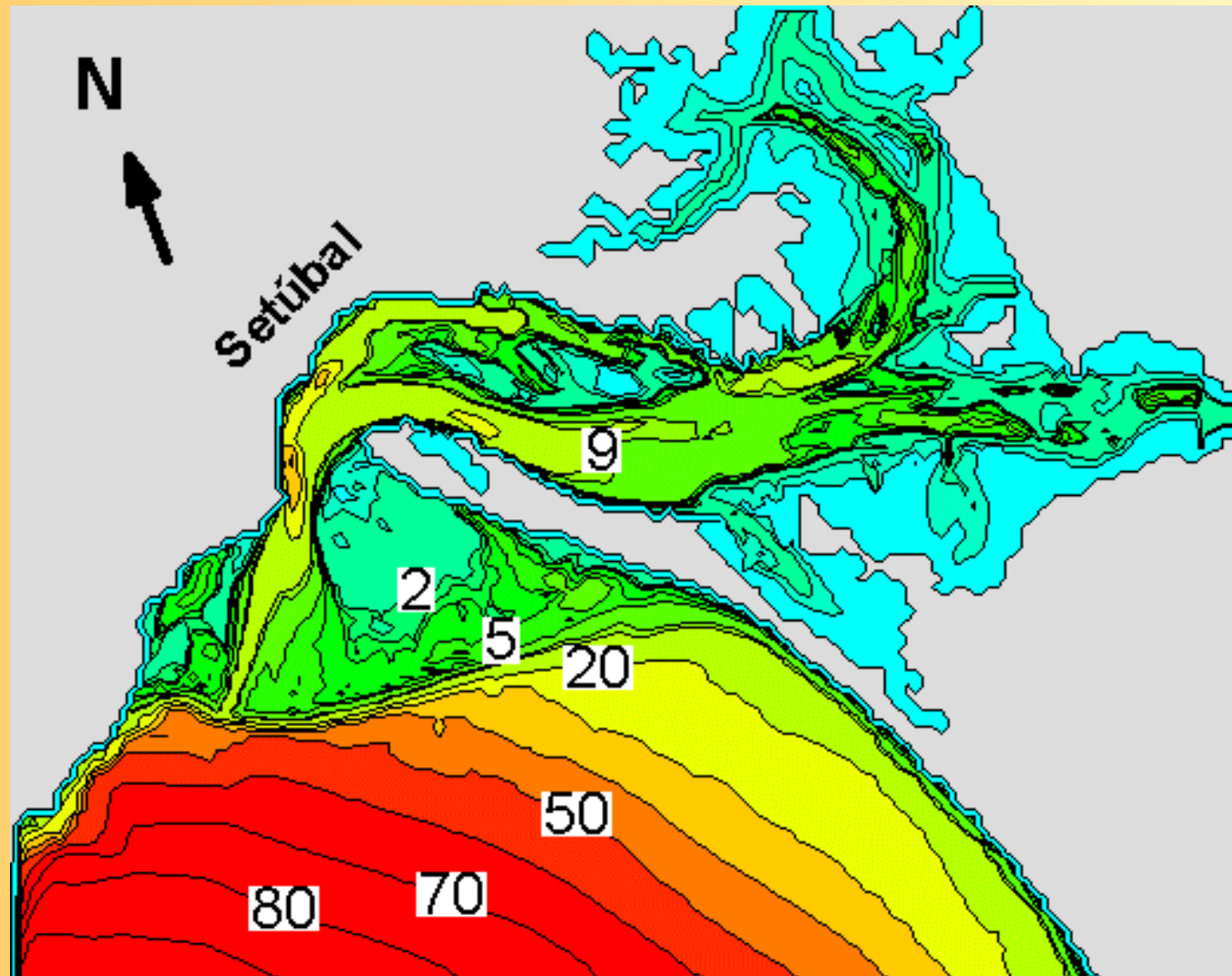
Flávio Martins, Paulo Chambel Leitão e Ramiro Neves

# Overview



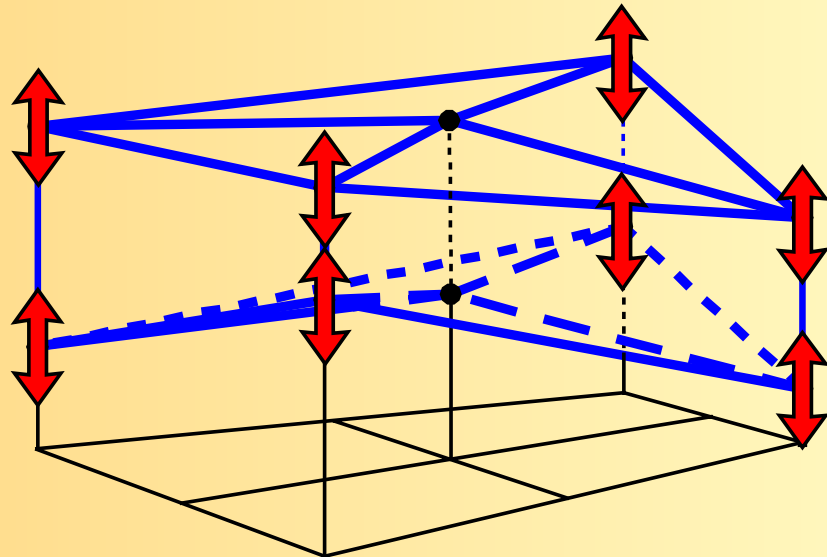
- 3D Modelling in barotropic systems ?
- The case of Sado Estuary
- Physical processes involved
- The impact in the vertical dynamic
- The conclusion: in most cases yes

# Sado Batimetry

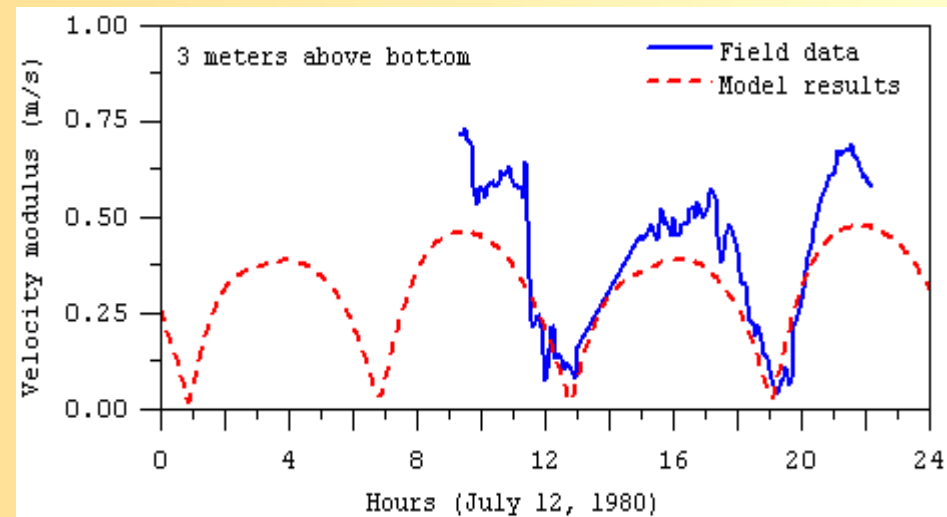
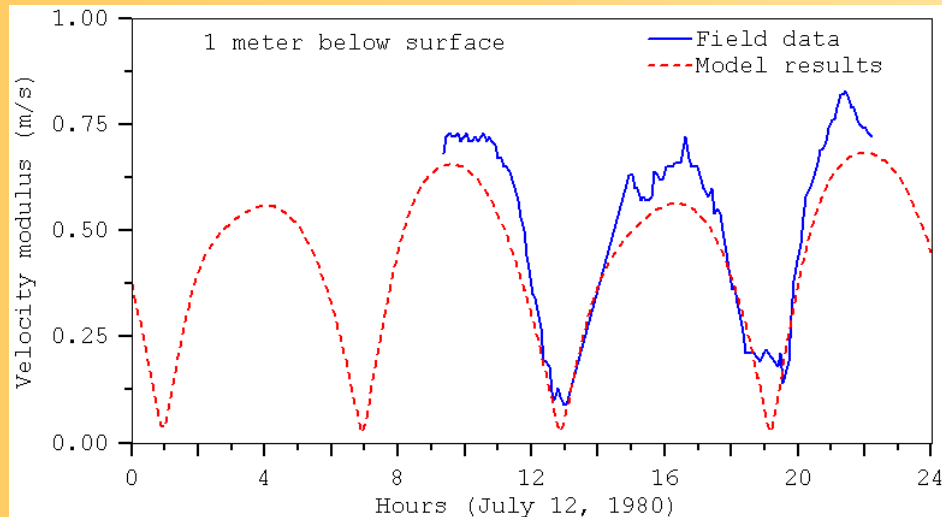
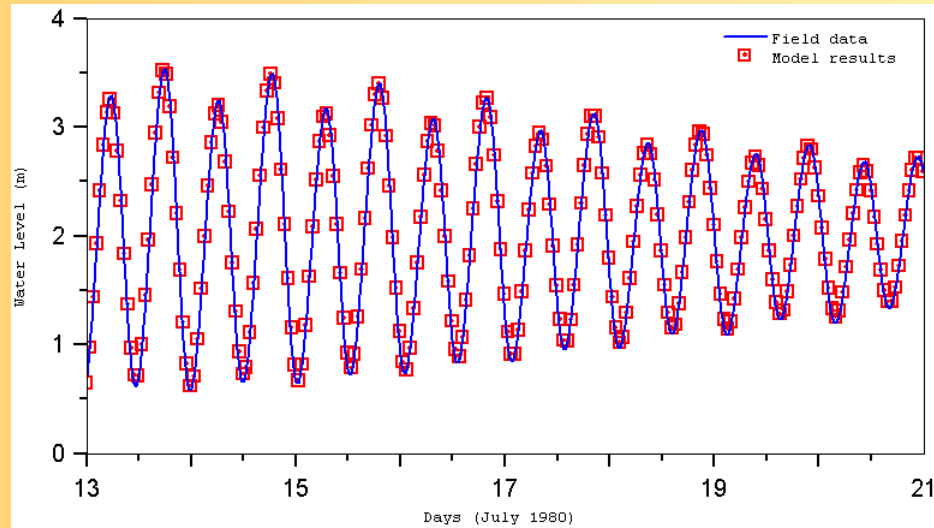


# The Mohid2000 Model

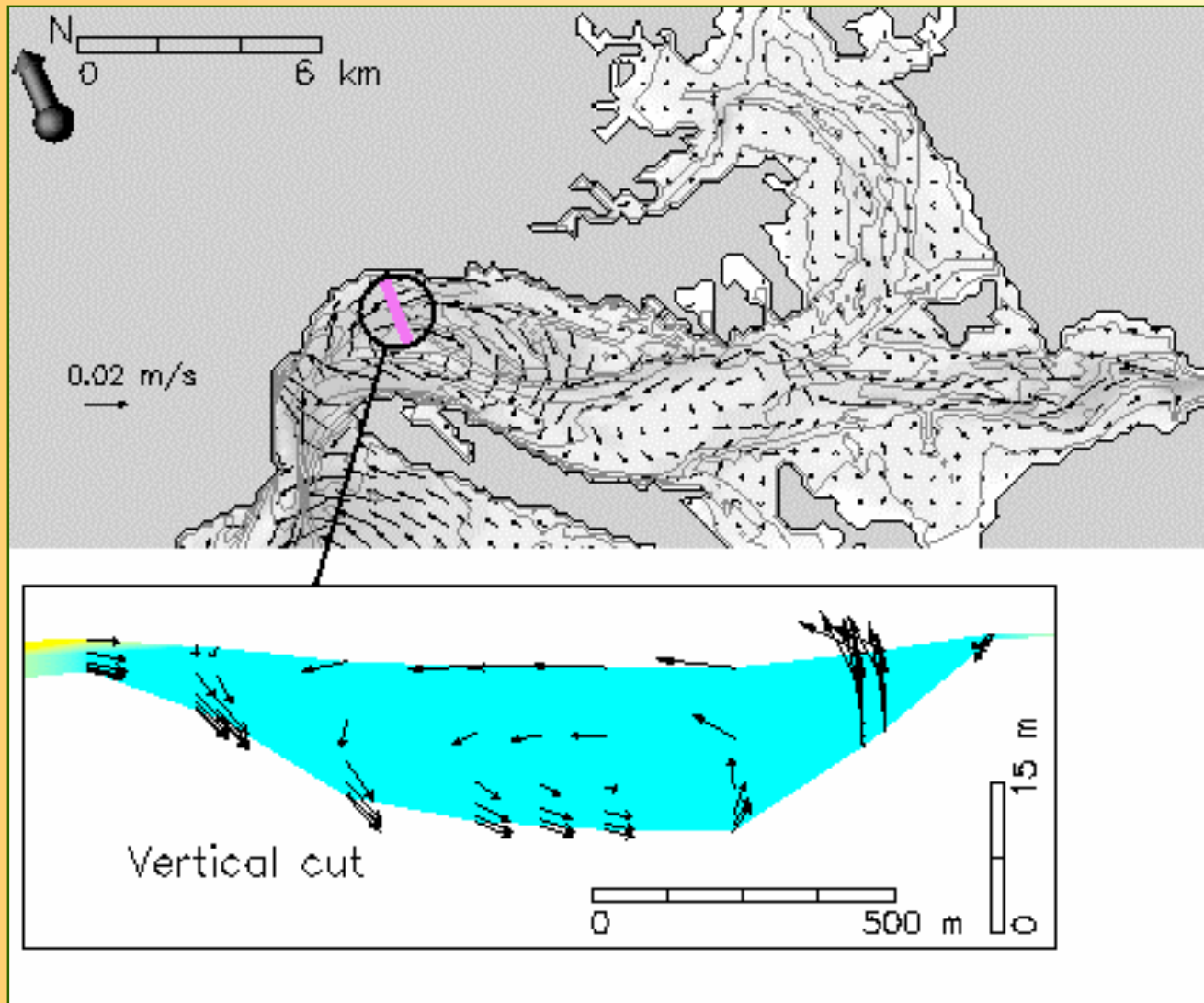
- 3D Primitive equations
- Object oriented architecture
- Eulerian and Lagrangean transport models
- Water quality and Prim. Prod. models
- Generic vertical mesh geometry



# Model Calibration and Validation



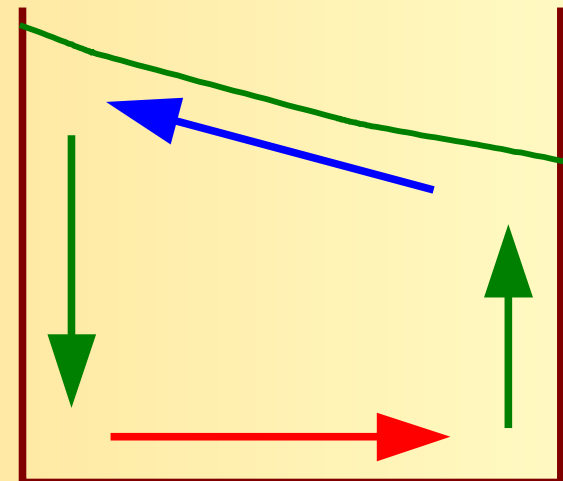
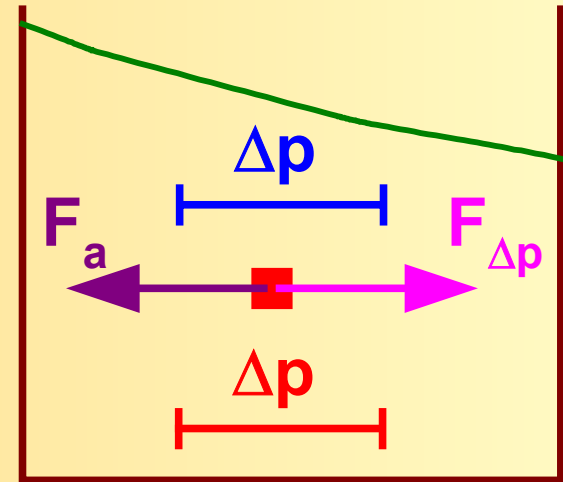
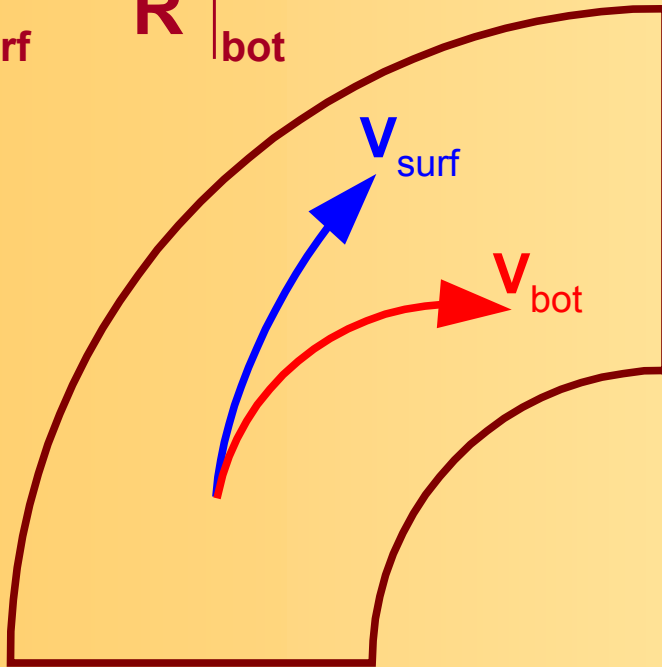
# Secondary Flows in Sado Estuary



# Some Physics...

- Secondary flows

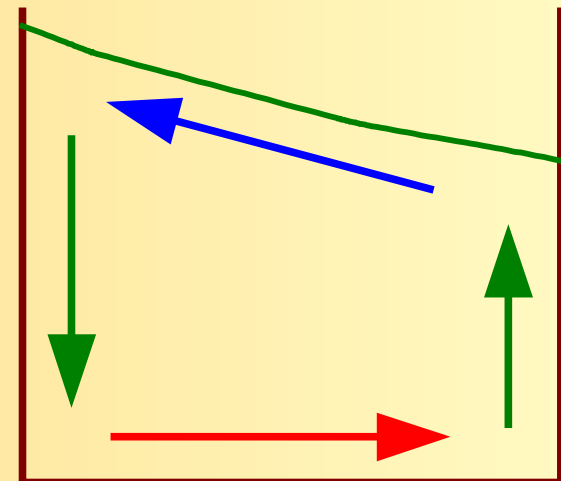
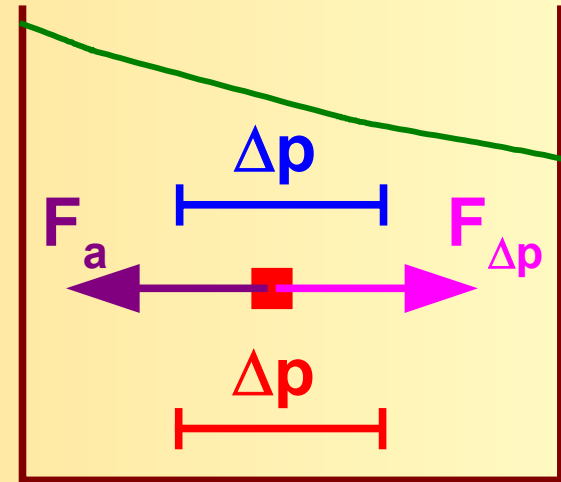
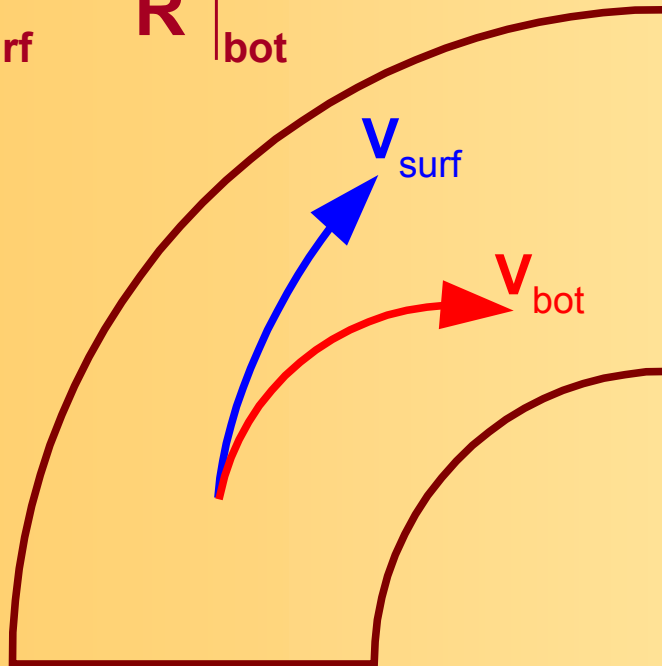
$$\frac{V^2}{R} \Big|_{\text{surf}} = \frac{V^2}{R} \Big|_{\text{bot}}$$



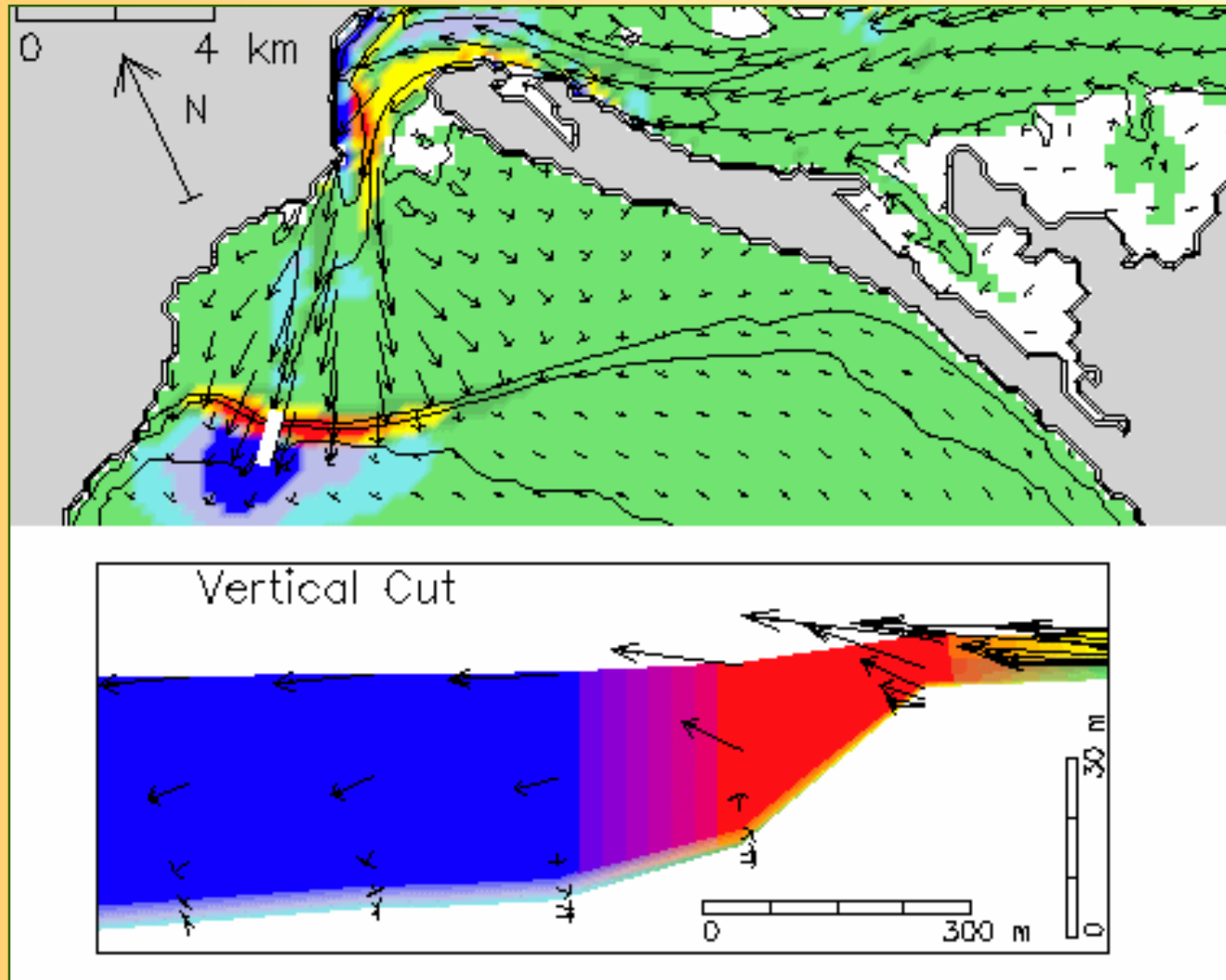
# Some Physics...

- Secondary flows

$$\frac{V^2}{R} \Big|_{\text{surf}} = \frac{V^2}{R} \Big|_{\text{bot}}$$

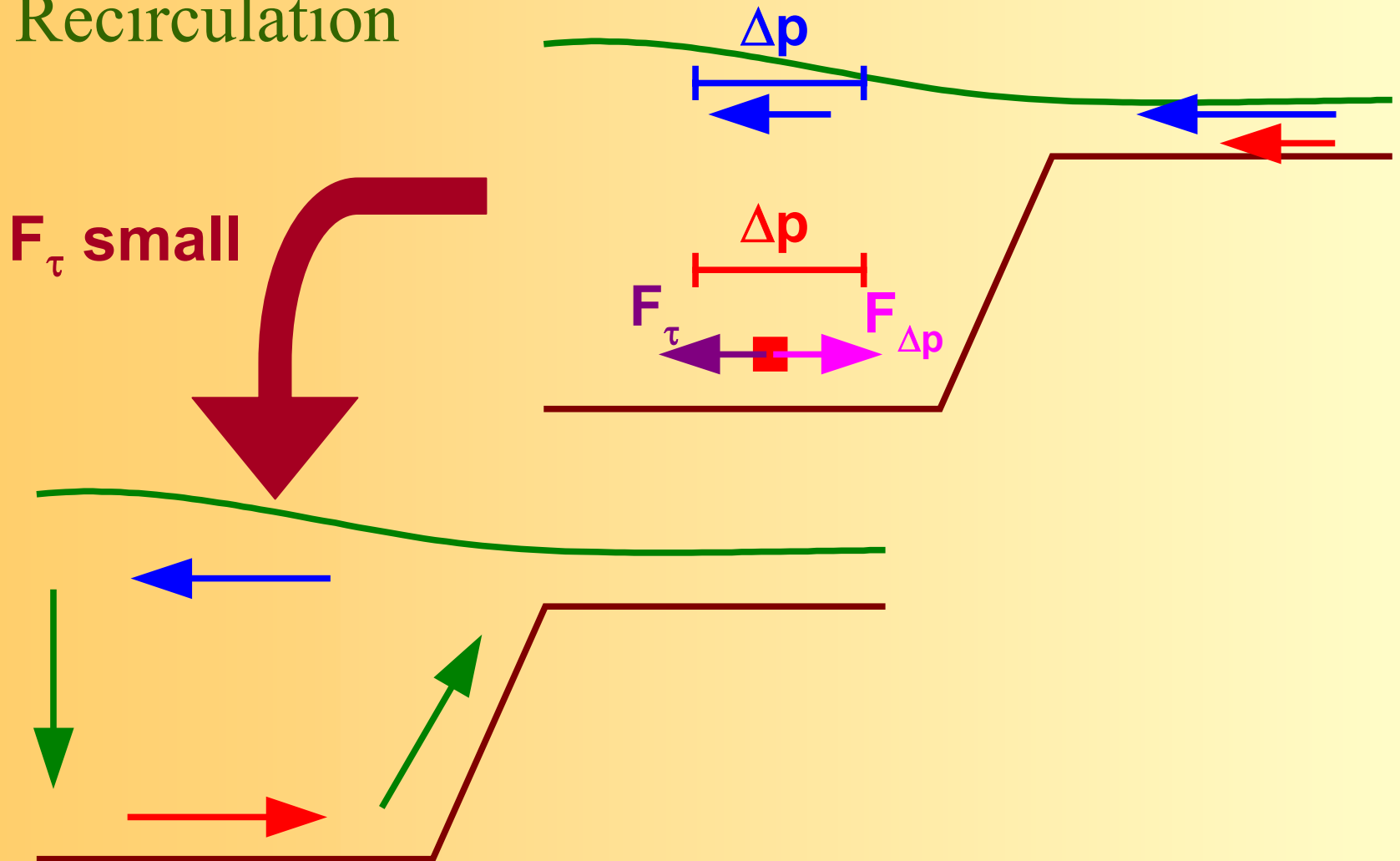


# Recirculation Flows in Sado Estuary



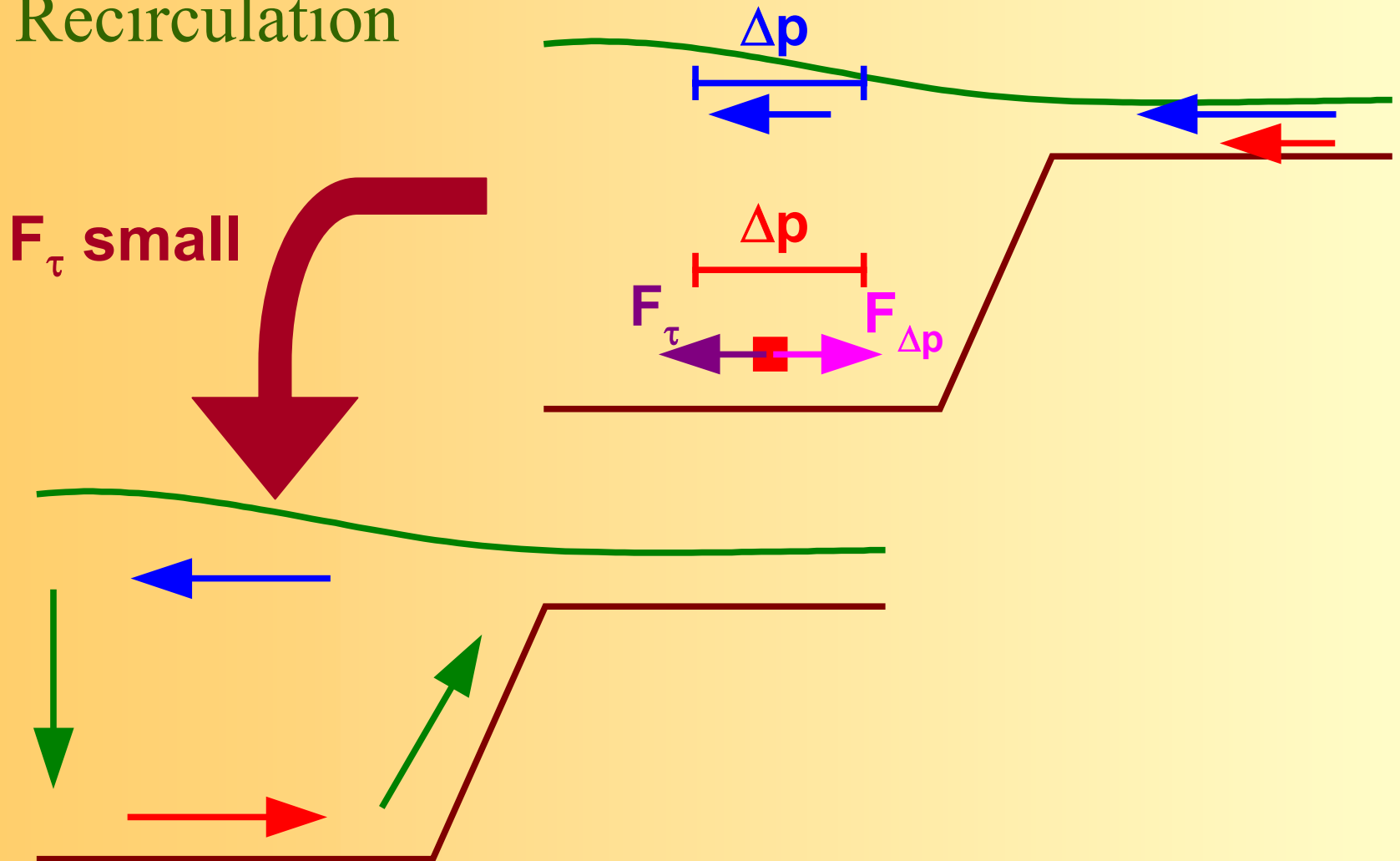
# More Physics...

- Recirculation

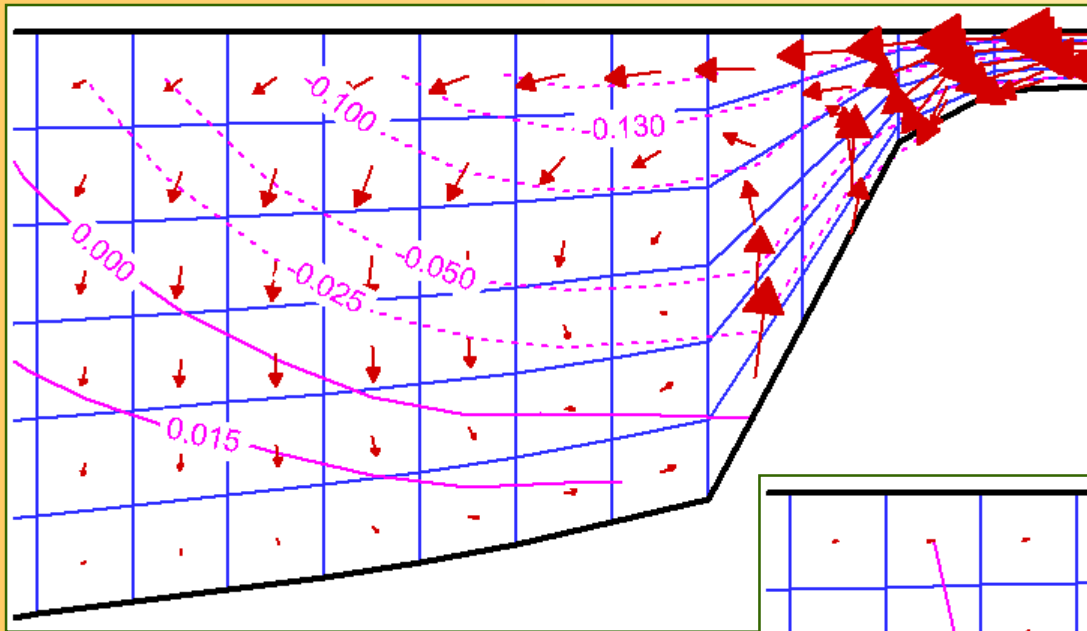


# More Physics...

- Recirculation

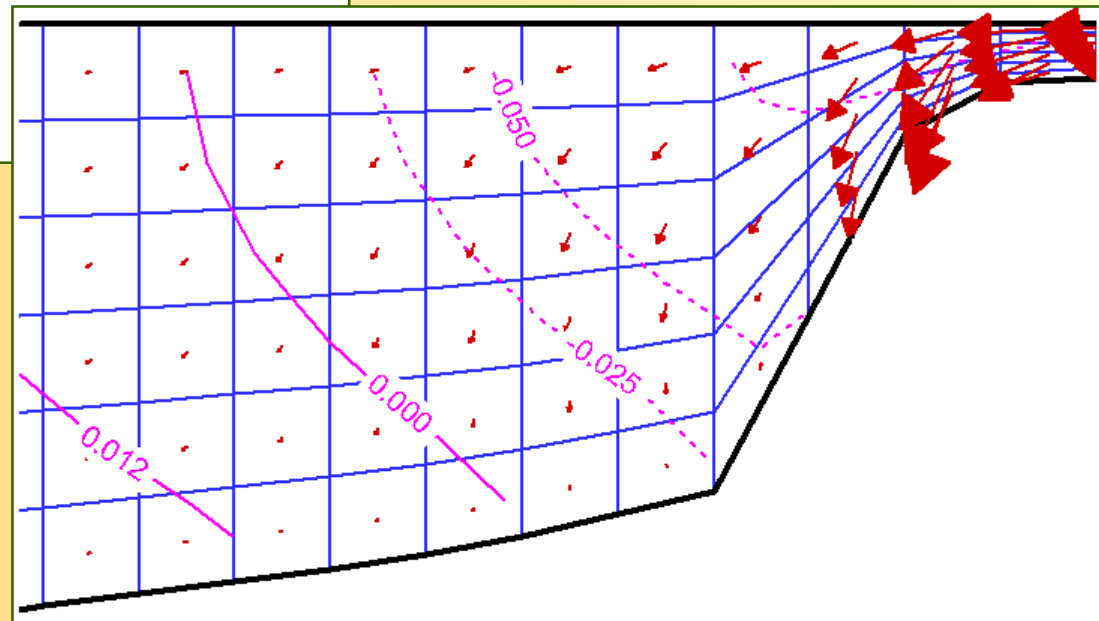


# Sensibility to Vertical Viscosity

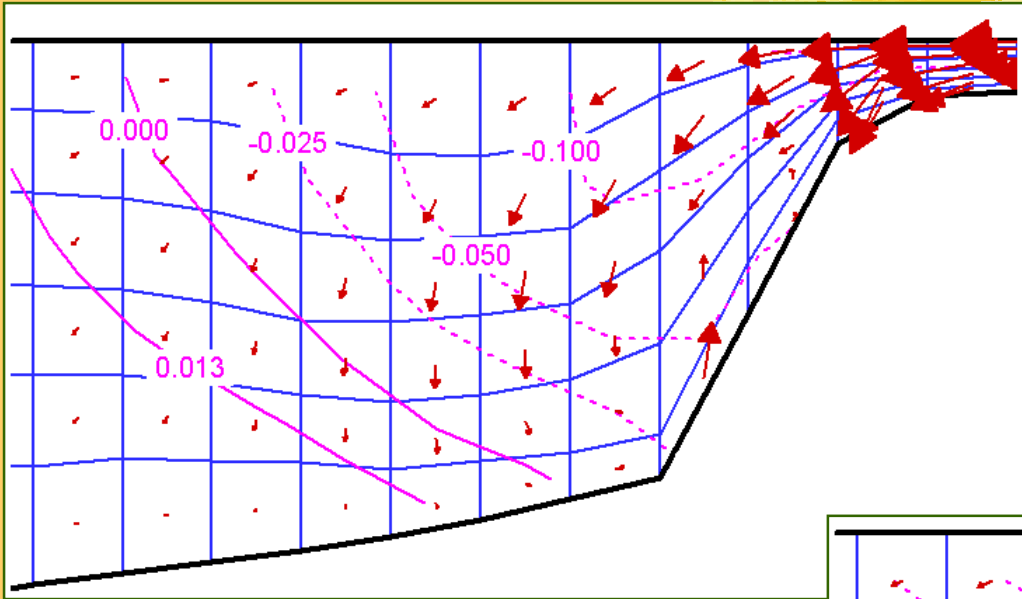


←  $\nu = 0.005 \text{ m}^2/\text{s}$

$\nu = 0.02 \text{ m}^2/\text{s}$  →

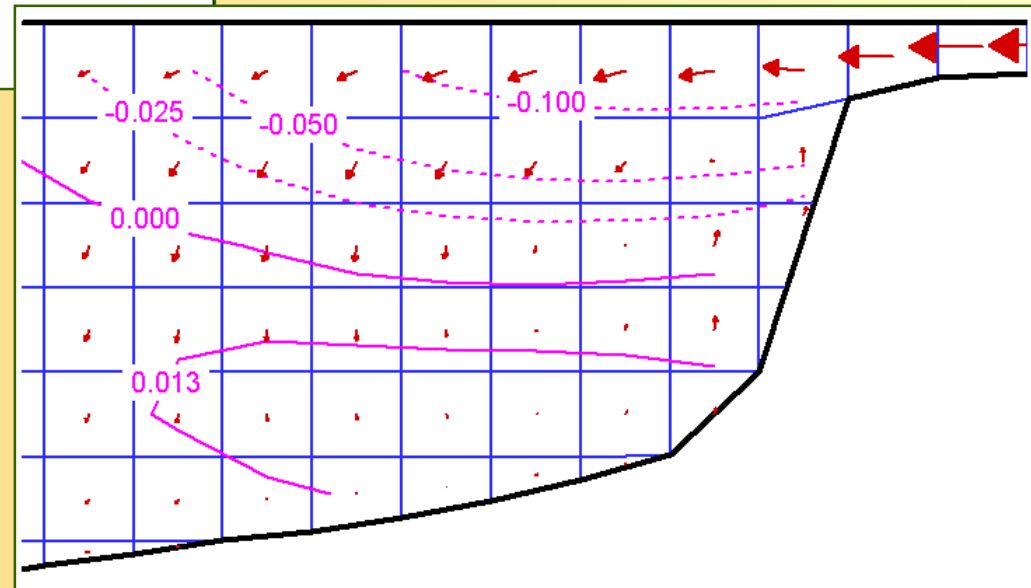


# Sensibility to Mesh Geometry

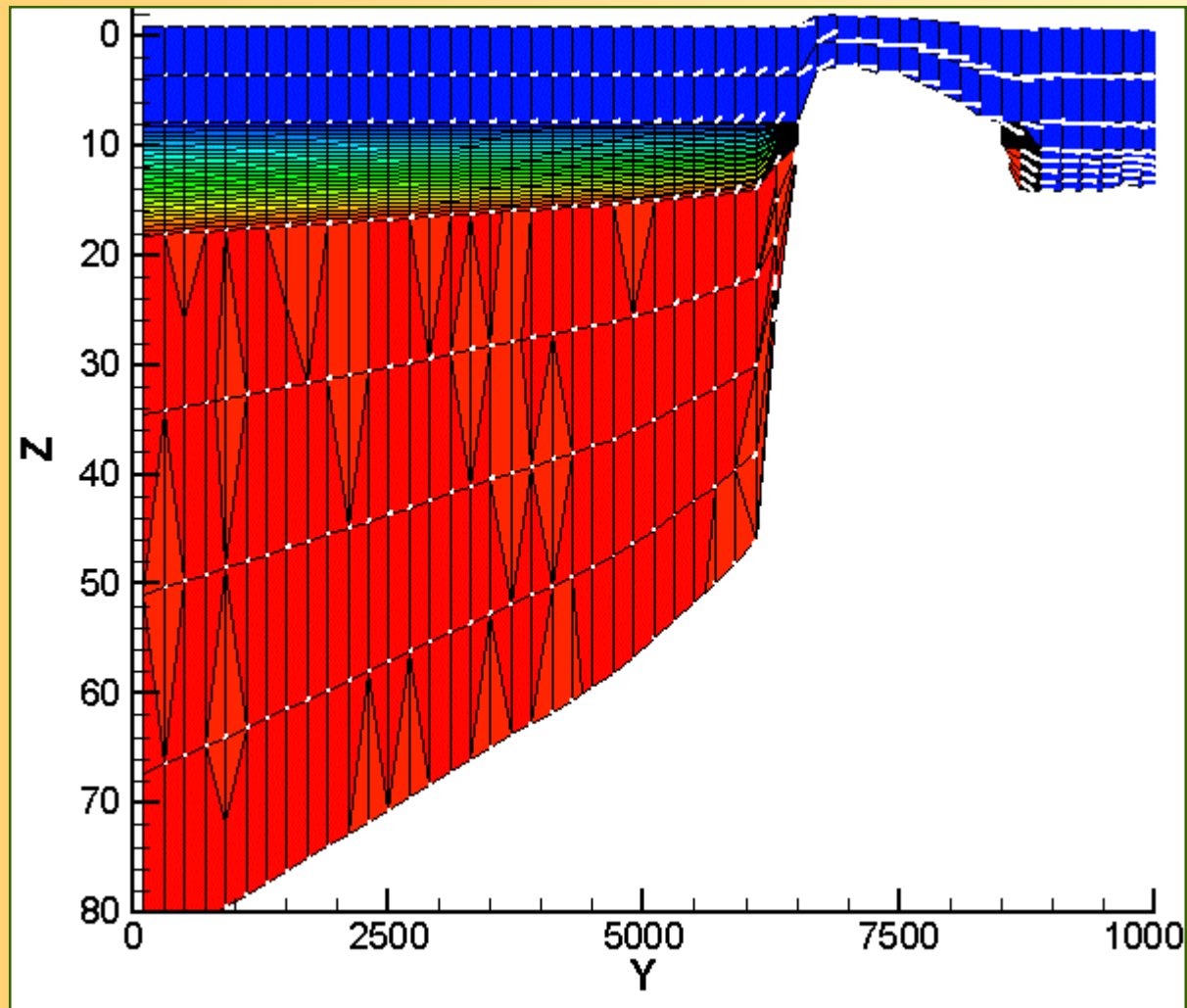


← Lagrangian Mesh

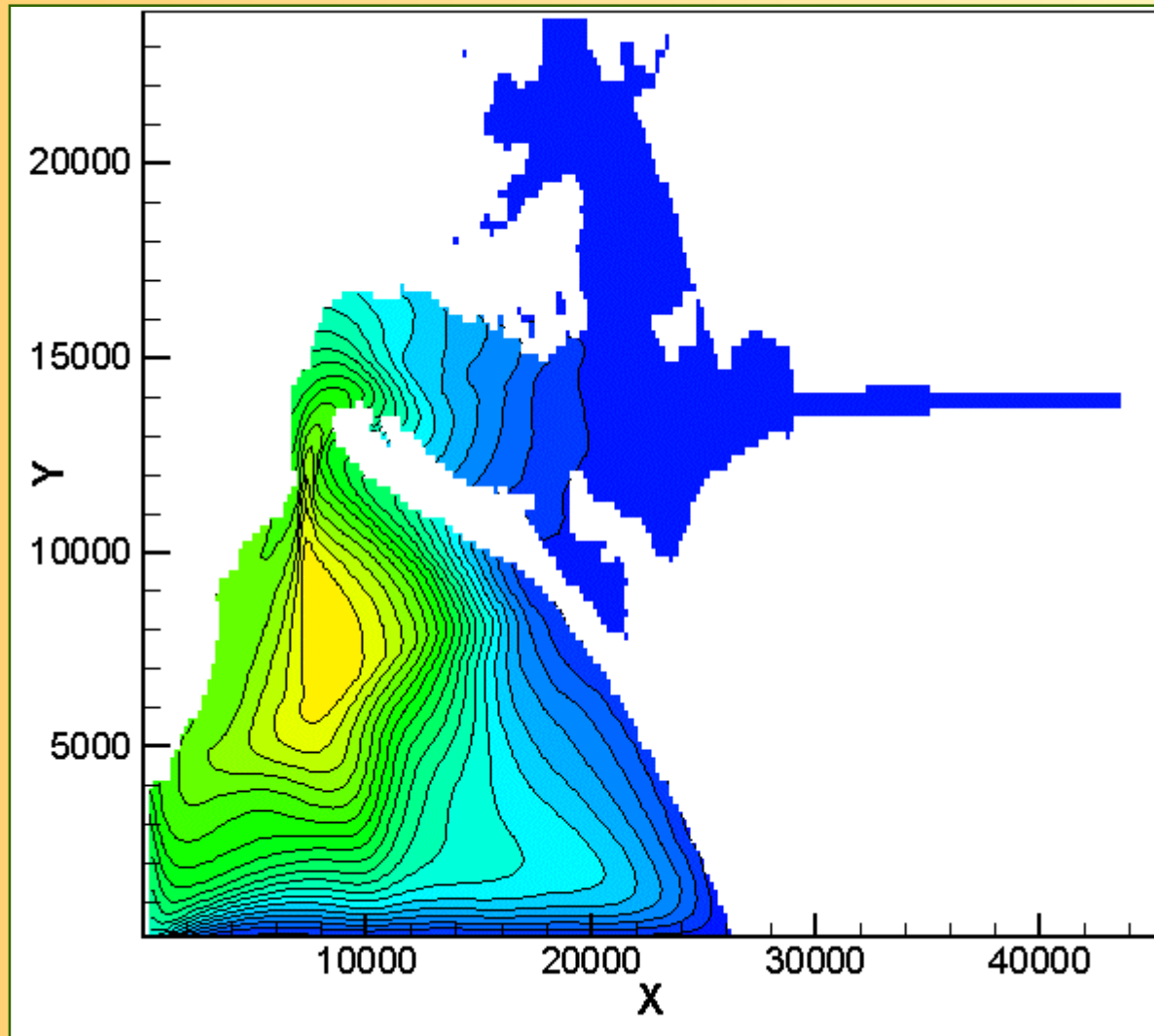
Cartesian Mesh →



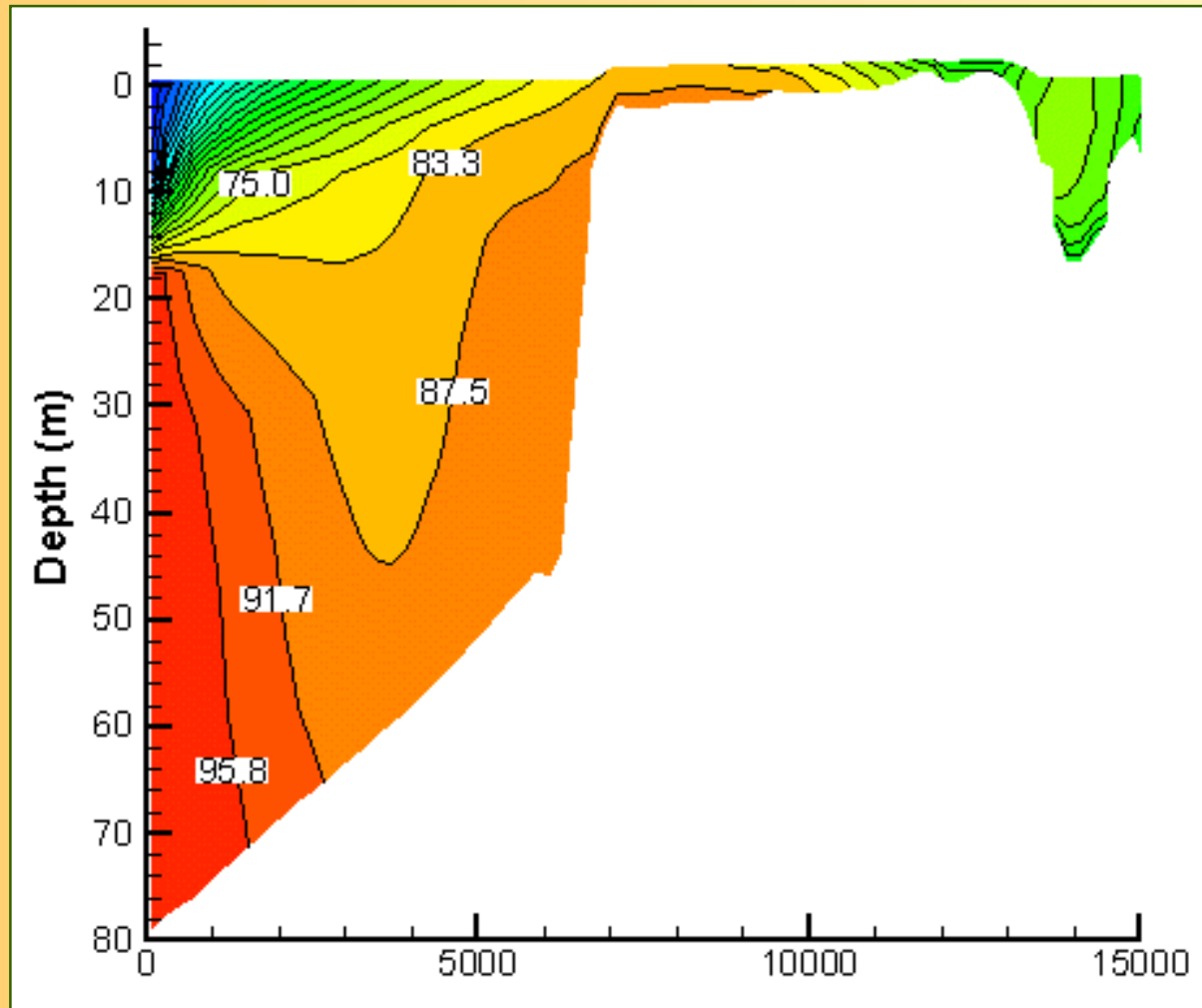
# Transport of Passive Tracers



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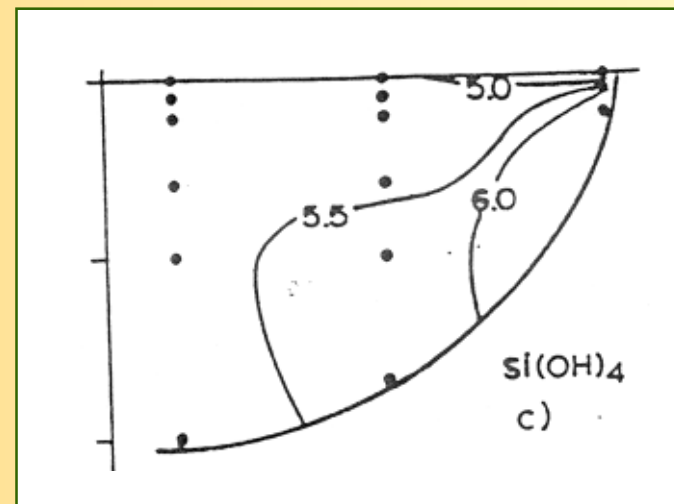
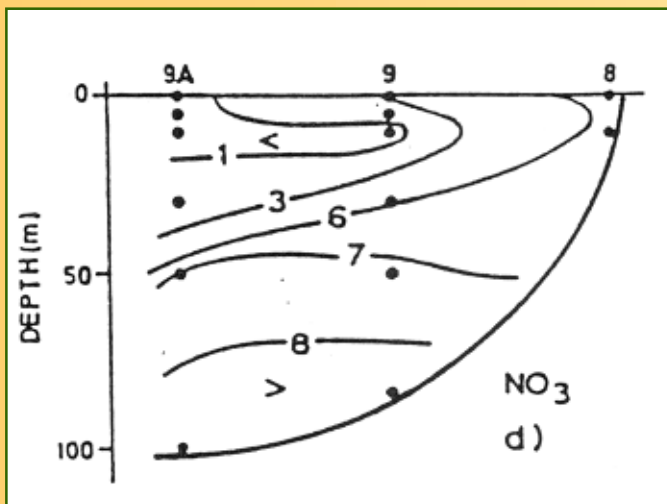
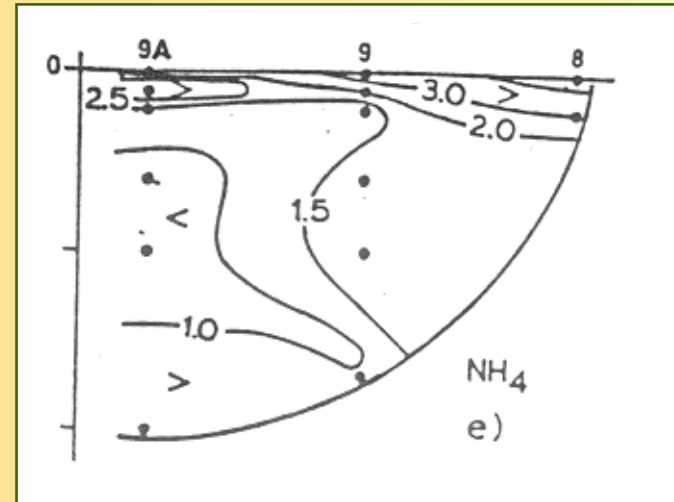
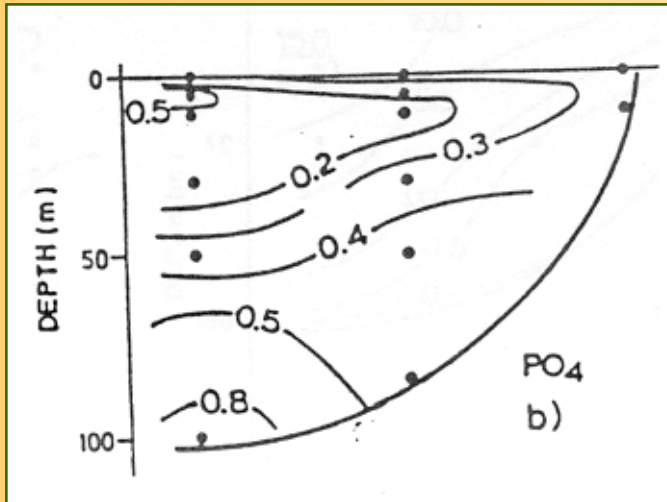


# Transport of Passive Tracers



# Nutrient Profiles

(L. Cabeçadas et. Al., 1996)



# Conclusions



- Importance of 3D barotropic flows
- High sensibility to vertical diffusion
- High sensibility to vertical discretization
- Role of 3D flows on the transport of nutrients
- Need of 3D models to simulate accurately primary production



END