Assignment 3

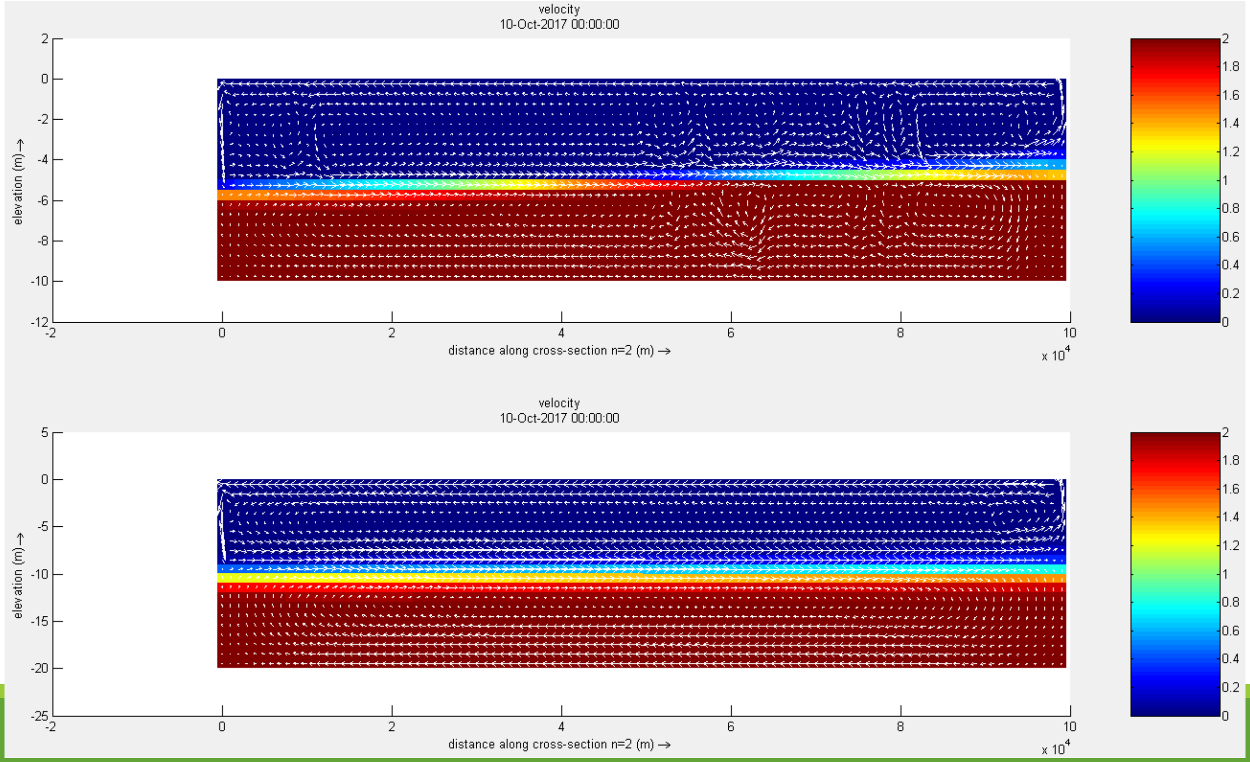
WHAT IS GOING ON?

Stable stratification?

Possible (already showed earlier)

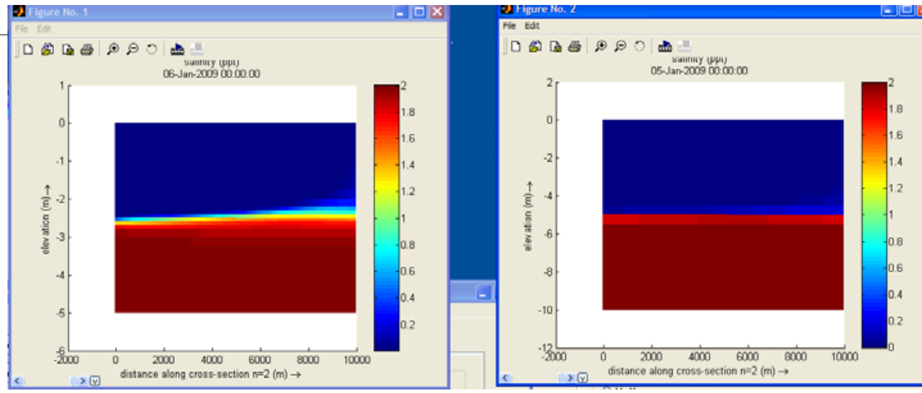
But with pycnocline driving flow?

- Realistic → increase depth

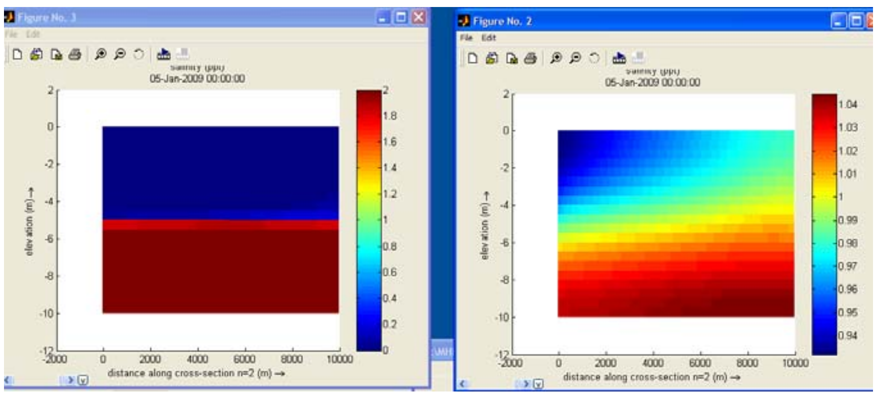


Which effect is occurring?

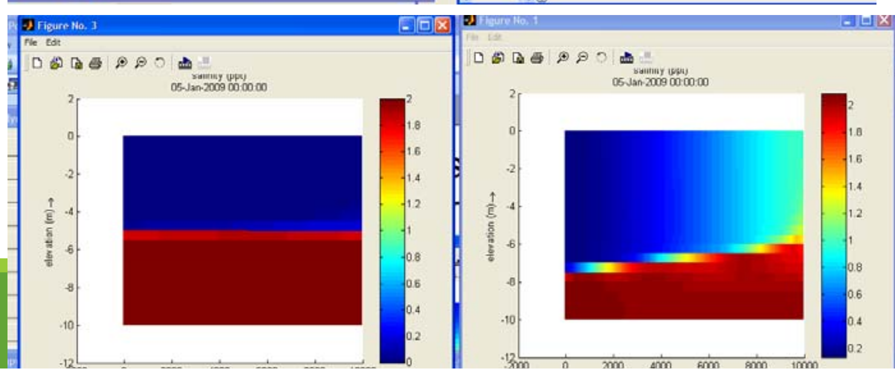
A.



B.



C.

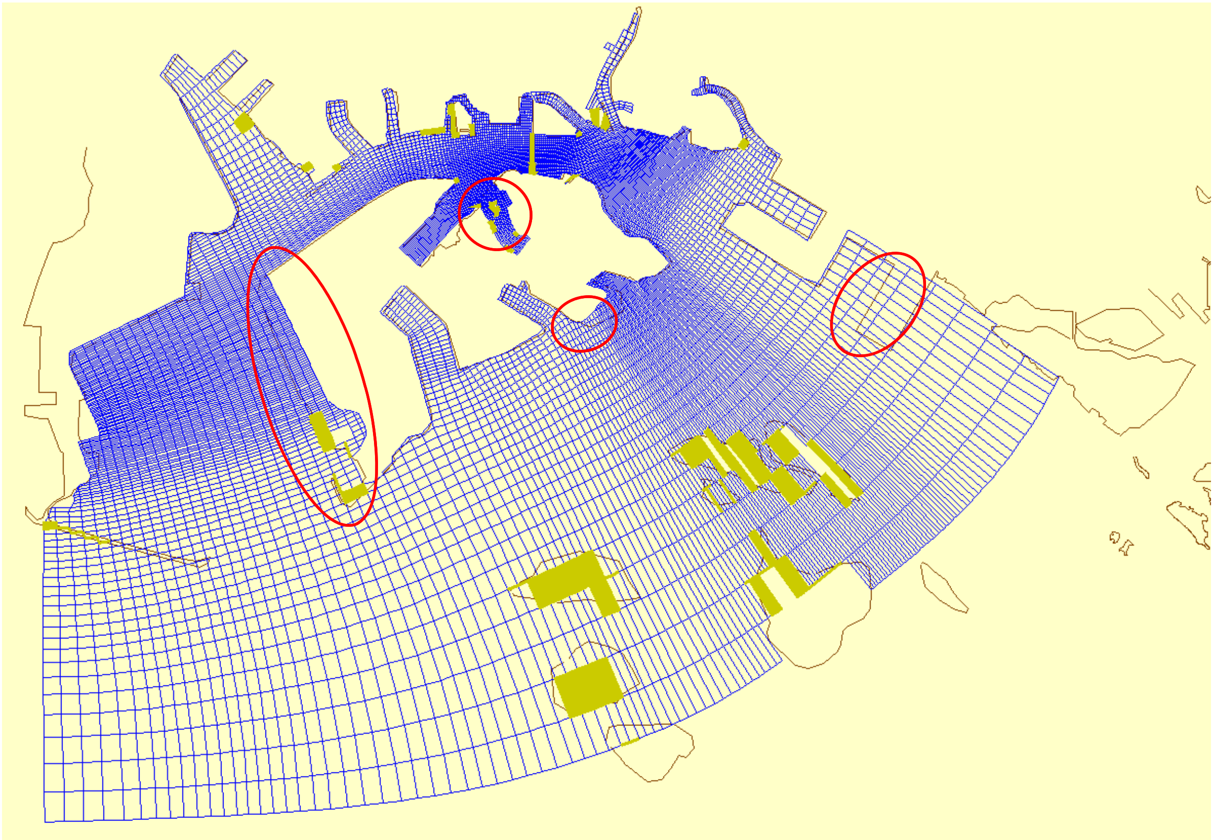


Term Project

PART 1 ISSUES

DOMAIN

Only need to add thin points / thin dams in these areas:



TIME FRAME

What was provided?

- 1 July 2017 – 30 Sept 2017

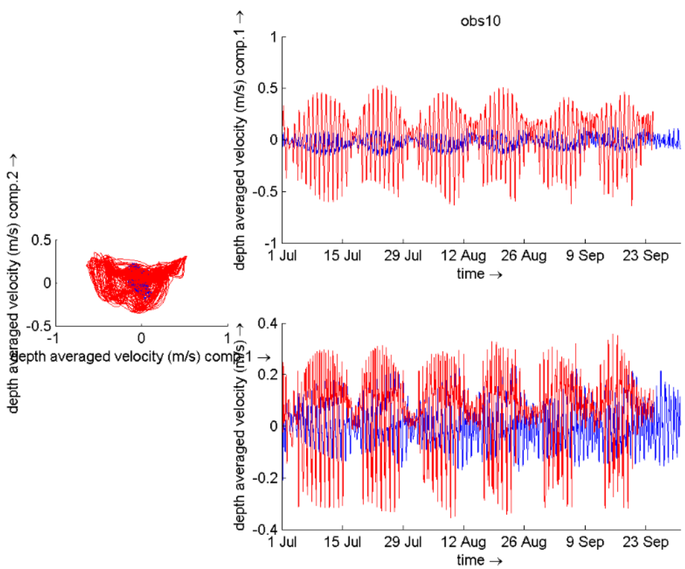
How long for verification?

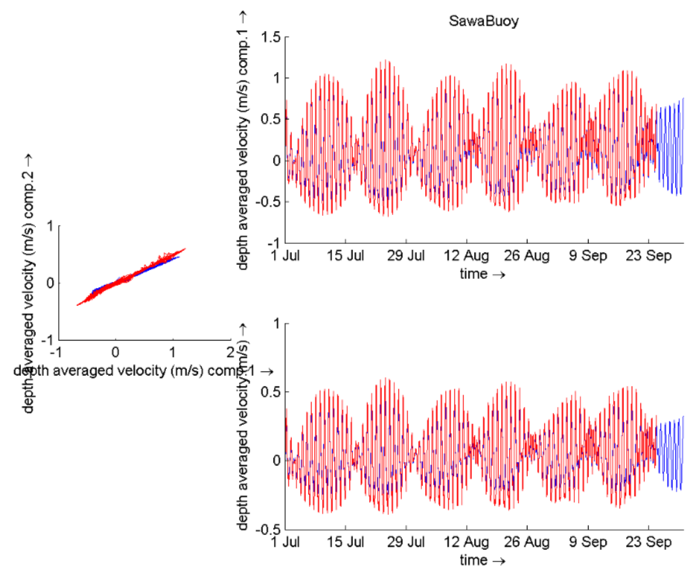
- At least one month
- And start verification after 15 July 2017.

Verification Issues (1)

Correlation coefficient and Root Mean Square Error for Velocity and Water Level

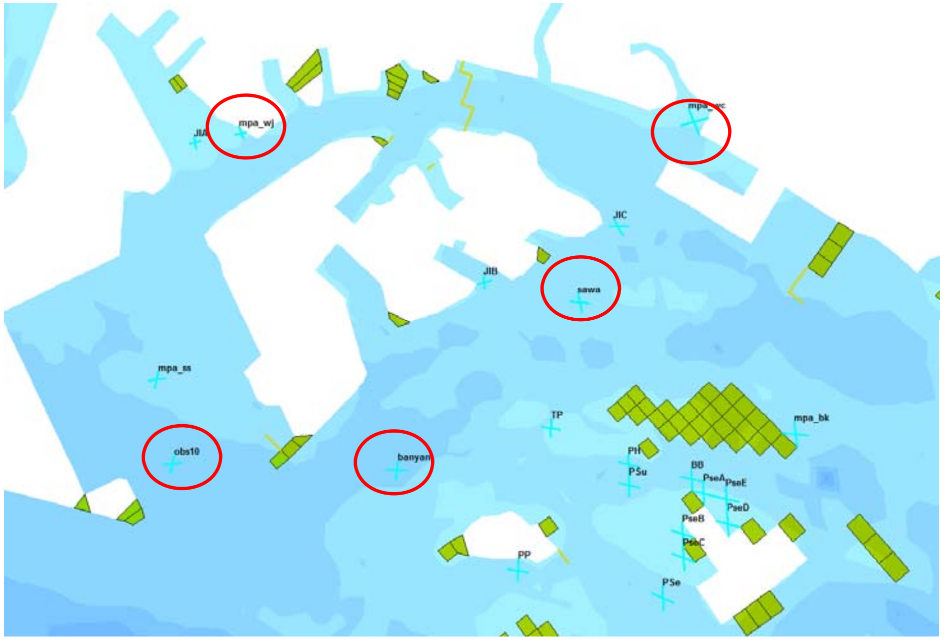
- Issues?

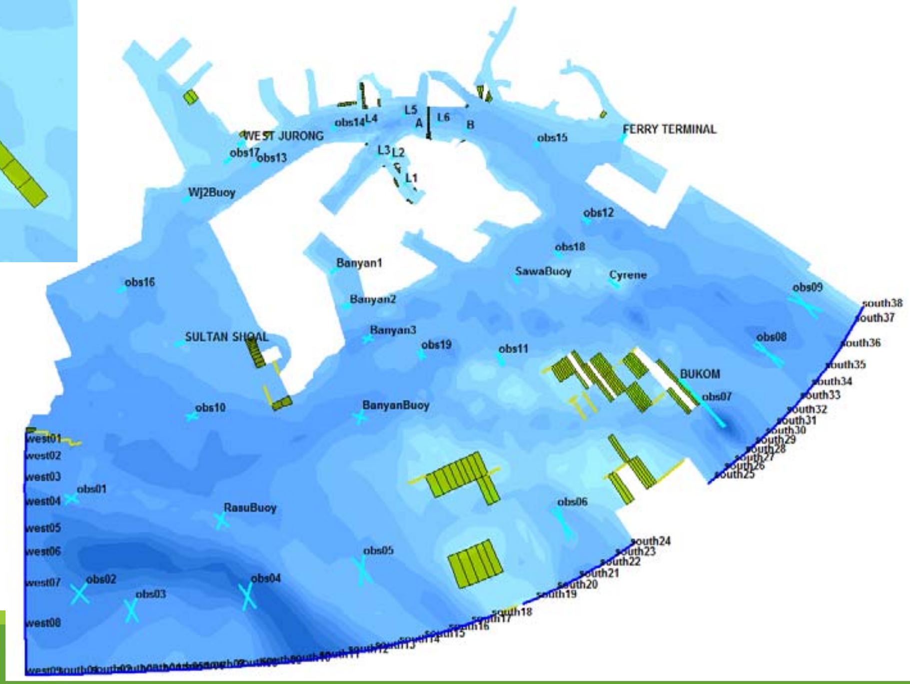




- Why?

Verification Issues (2)





What do you need for Part 1?

Amend domain appropriately (thin dams/ dry points)

Verify a 1 month simulation (after spin-up)

Run 3 different Manning's friction coefficient values to assess sensitivity of the model to friction.

Report on the correlation coefficient and RMSE and decide which of these models to take to Part 2.

Temperature Models

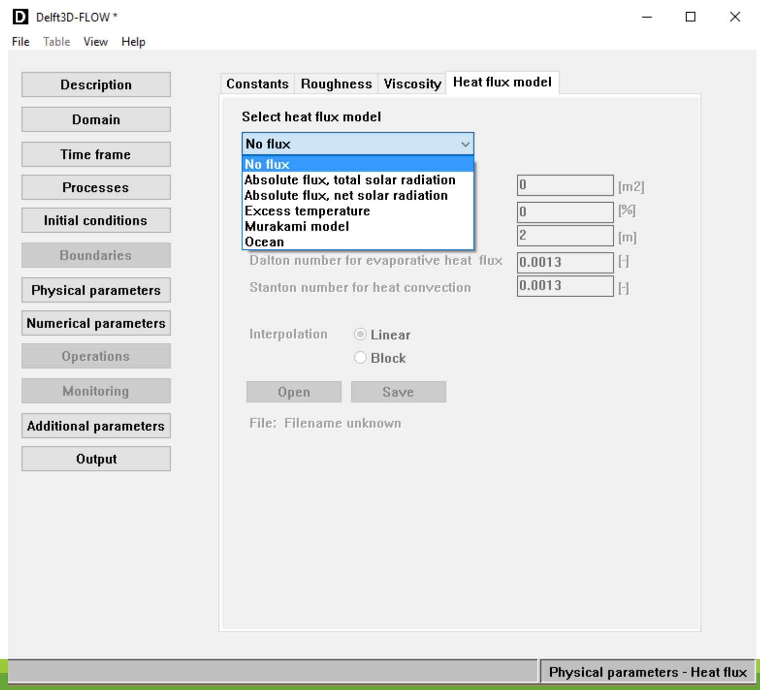
FOR YOUR TERM PROJECT ASSIGNMENT

What is the difference between temperature and salinity in Delft3D?

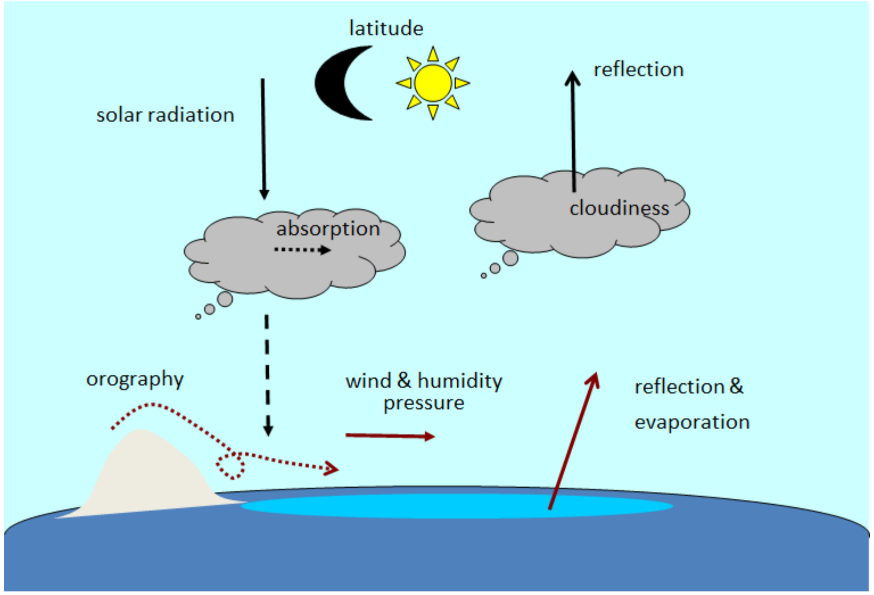
Temperature transported by computed flows (identical to salinity)

In addition:

- A temperature model which computes loss of heat to the atmosphere



Essentially the temperature model solves for these processes



The total heat flux through the free surface reads:

$$Q_{tot} = Q_{sn} + Q_{an} - Q_{br} - Q_{ev} - Q_{co},$$

with:

Q_{sn}	net incident solar radiation (short wave)
Q_{an}	net incident atmospheric radiation (long wave)
Q_{br}	back radiation (long wave)
Q_{ev}	evaporative heat flux (latent heat)
Q_{co}	convective heat flux (sensible heat).

The three general types of thermal models in Delft3D

1. No heat exchange with the atmosphere (no flux)
2. Absolute temperature model (4 types)
   - The types differ with regards to which flux is prescribed and which flux is computed
   - Most "advanced" temperature model → Ocean heat flux model which computes all fluxes based upon:
     - Angle of latitude (incoming solar radiation)
     - Cloudiness
     - Relative humidity
     - Air temperature
3. **Excess temperature model**

Excess Temperature Model

Basically excess temperature is the temperature difference between a so-called “natural background temperature” and the actual water temperature (modeled)

Based on Sweerts (1976)

Heat loss coefficient

- derived from linearization of flux exchange in total heat balance
- Only function of surface temperature and wind speed

Less suited for studies which require actual water temperature

Very well suited for studies which only are interested in the increase in temperature due to cooling water discharge→ **Which is why it is used for your term project**

Term Project

PART 2

What to do in Part 2?

Use selected model from Part 1.

Turn on temperature and wind in Processes

Add discharges A to Q from Table 1 in the appropriate location

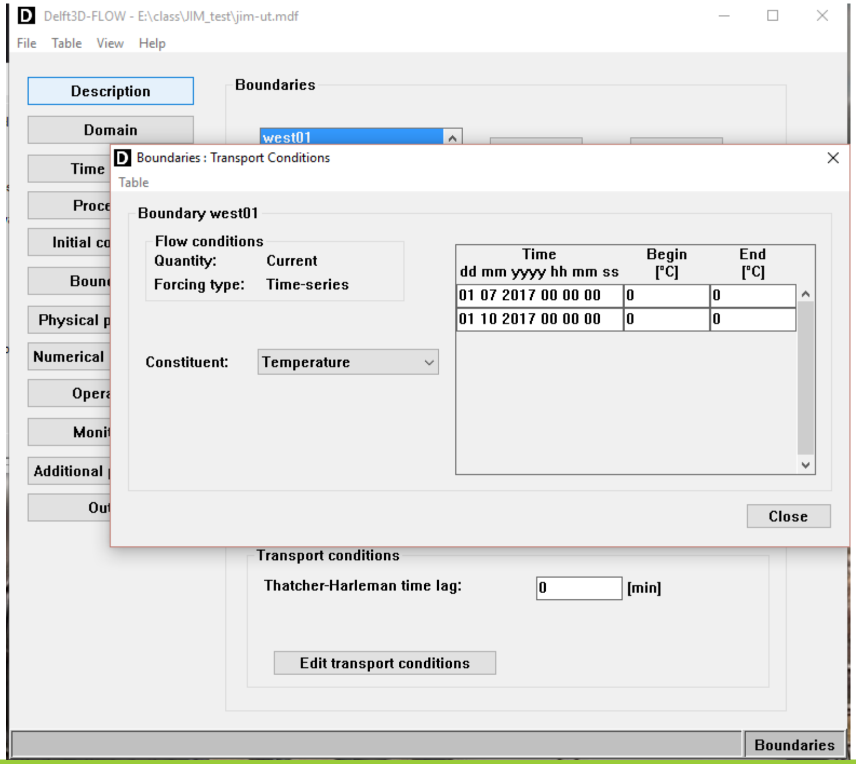
Ensure model spun-up for heat.

- Test horizontal diffusivity and impact on spread (1, 5 and 10 m2/s).
- Choose one value to be used as baseline and for impact assessment

Temperature Boundary Condition

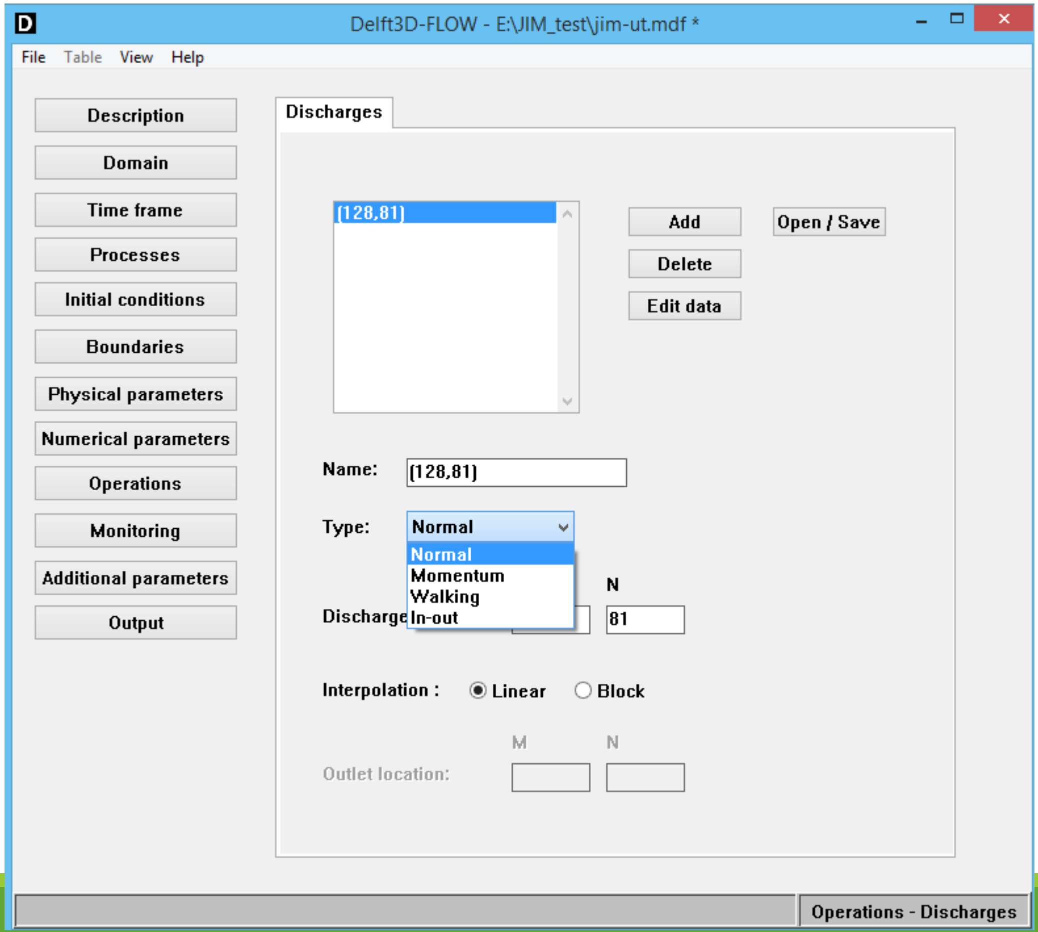
Need to set a value for temperature

Need to set Thatcher Harleman



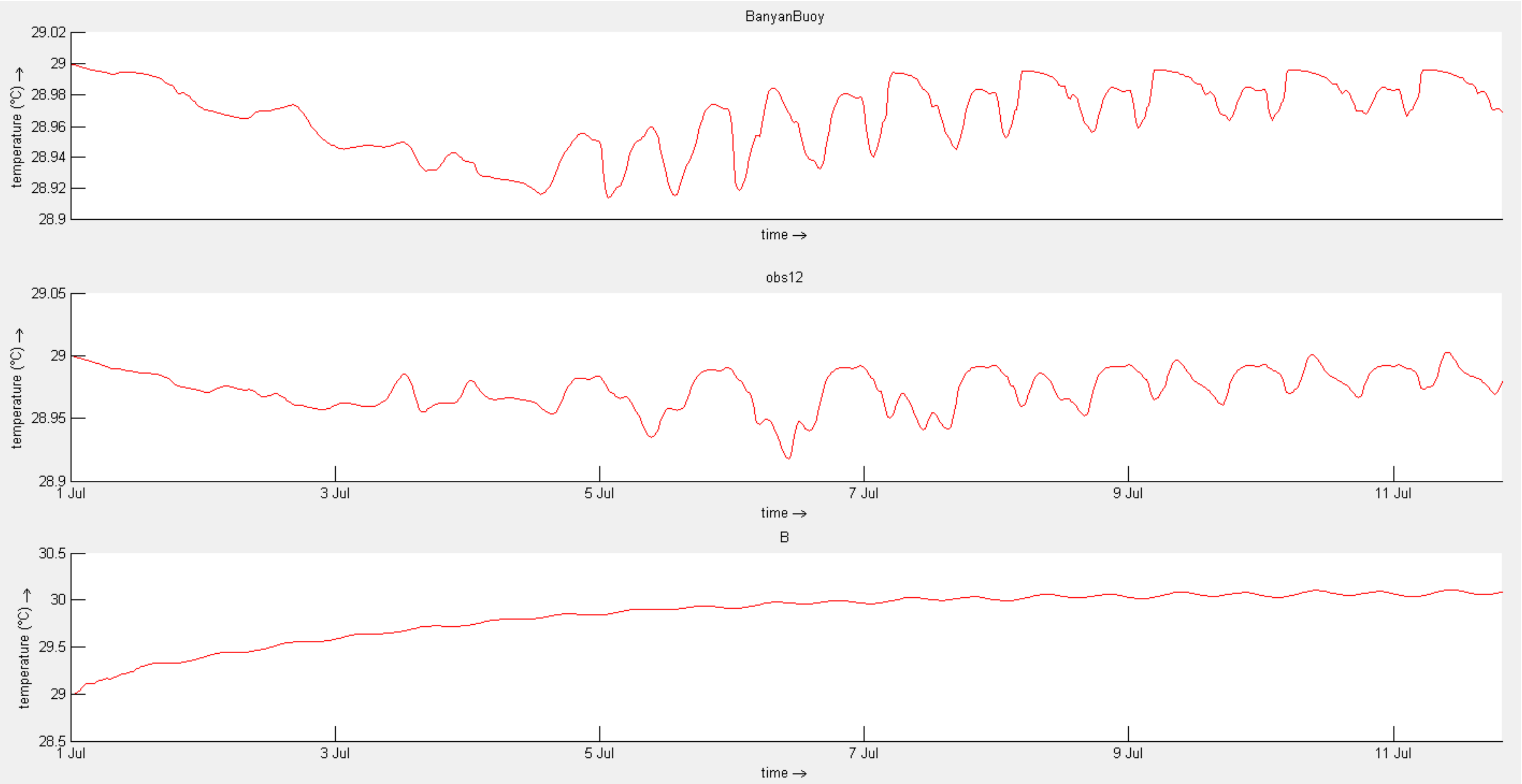
Discharge

4 methods to input

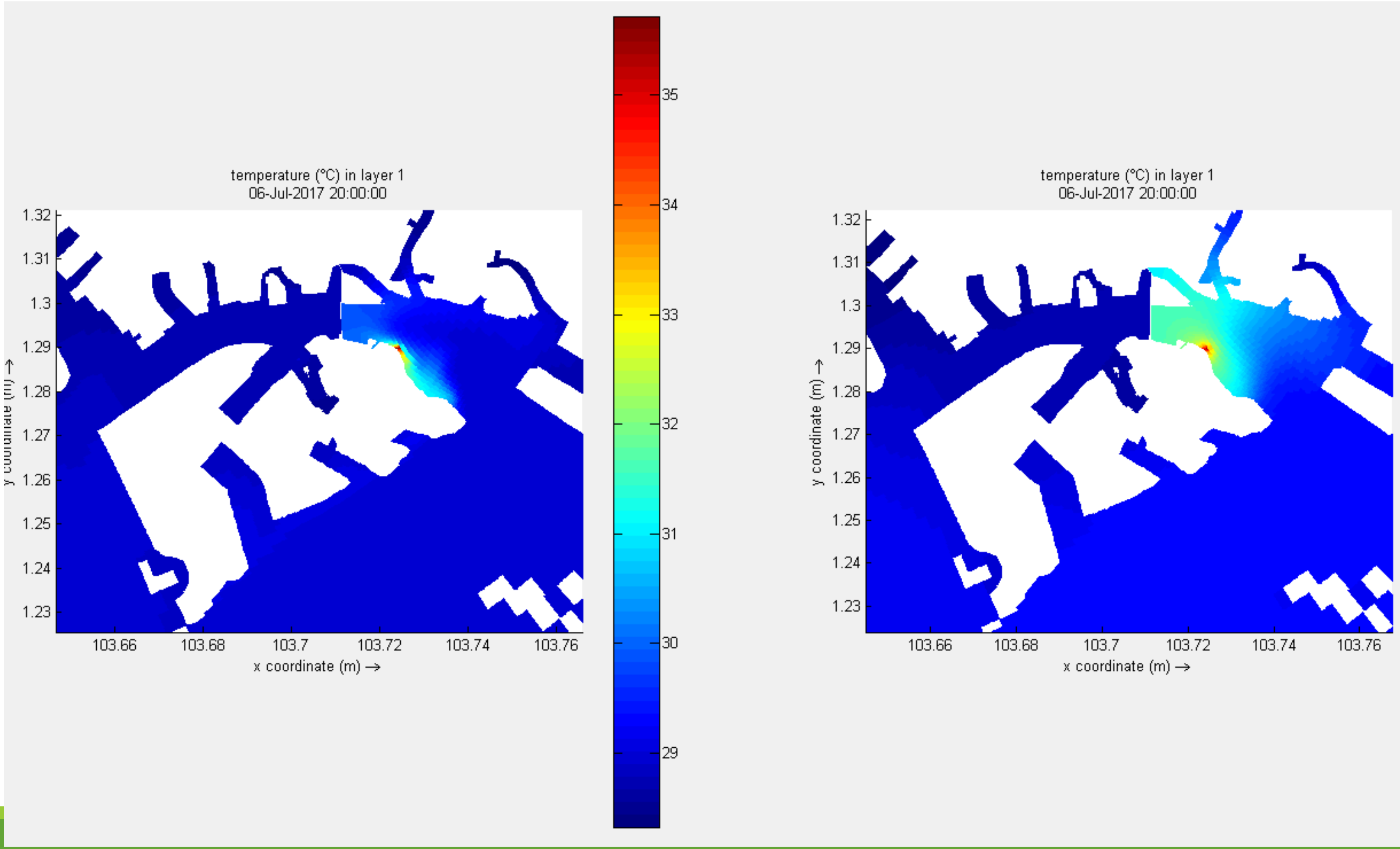


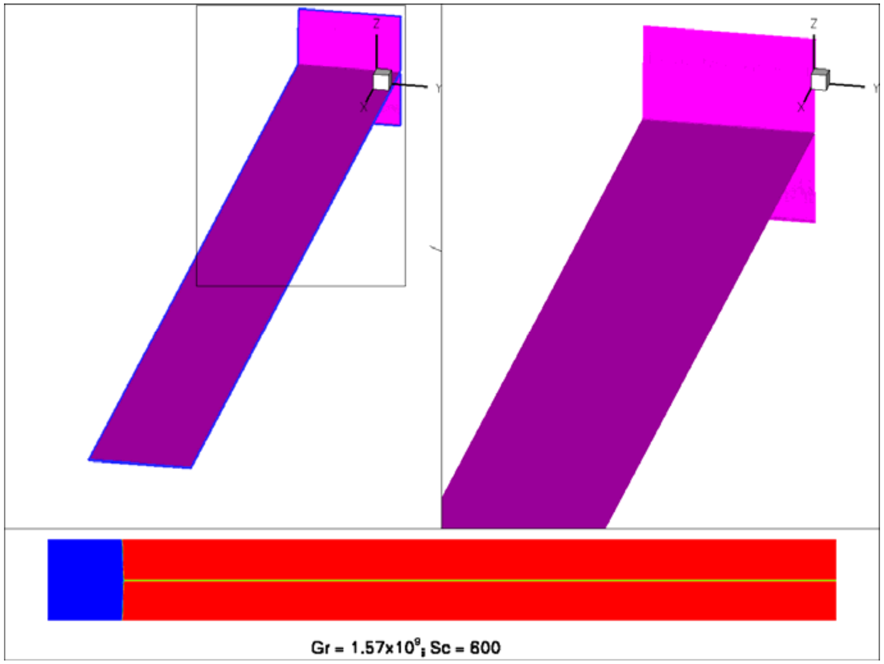
Model spun up for heat?

Check across the domain



Why test horizontal diffusivity ?





Gravity Current Flows

WHAT WE ARE ACTUALLY SEEING TODAY

So, what are gravity currents?

Flows driven by density differences

Important?

What sources exist that can cause the density differences?

-
-

What happens?

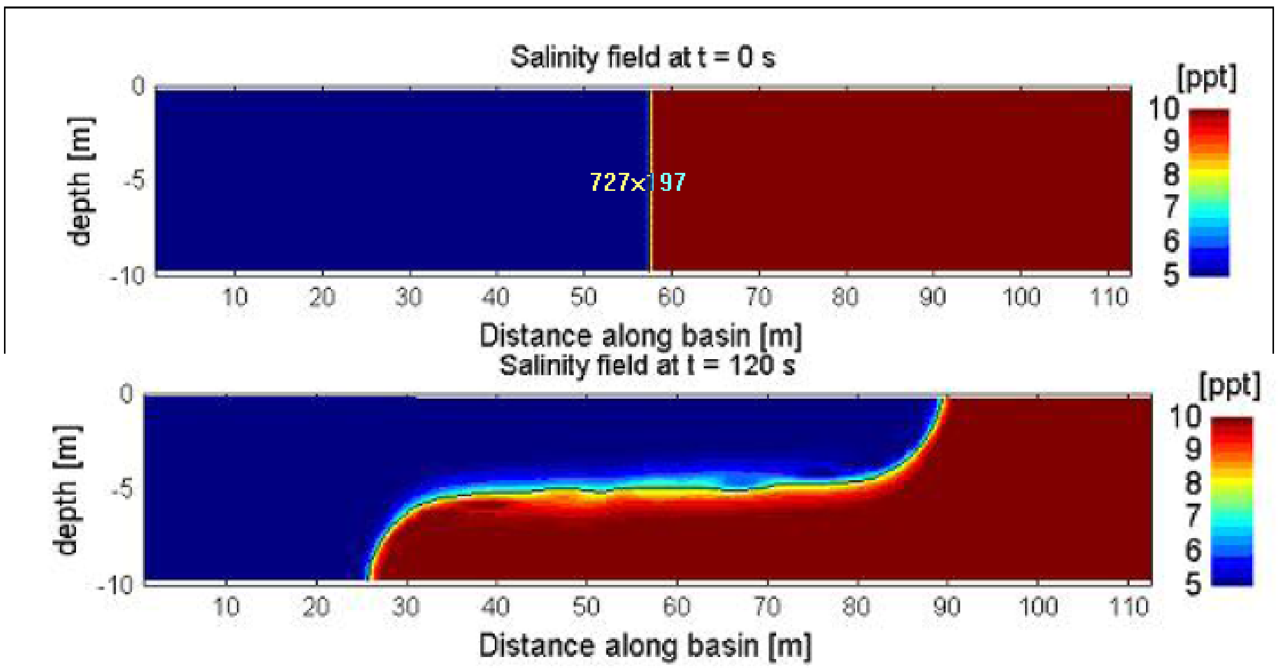
Generally these density differences will

- Drive the flow in the horizontal
- Maintain some sort of stratification which will reduce vertical exchange of ?

Salt or Heat (Temperature)?

- 1 = 0.75 kg/m3
- 5 = 1 kg/m3

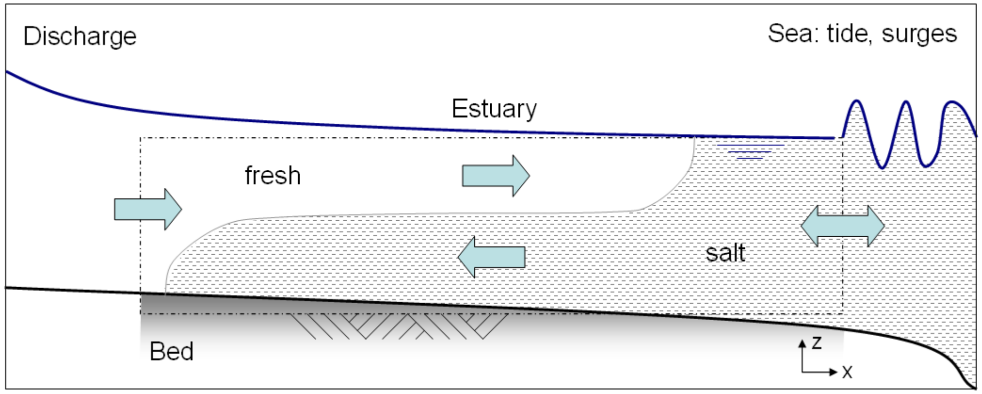
Classical Gravity Current Study



Assignment 4

Today’s assignment

1-D Estuary



- Specify a fresh river on one side, and a salty sea on the other side.
- Optionally you can use a uniform initial conditions file.
- Assess the required length of the model, and the required spin-up time, to **avoid all artificial open boundary effects**.
- What happens with the salt wedge when you increase the tidal amplitude significantly? (CE6077)

Focus of today's assignment

Domain size

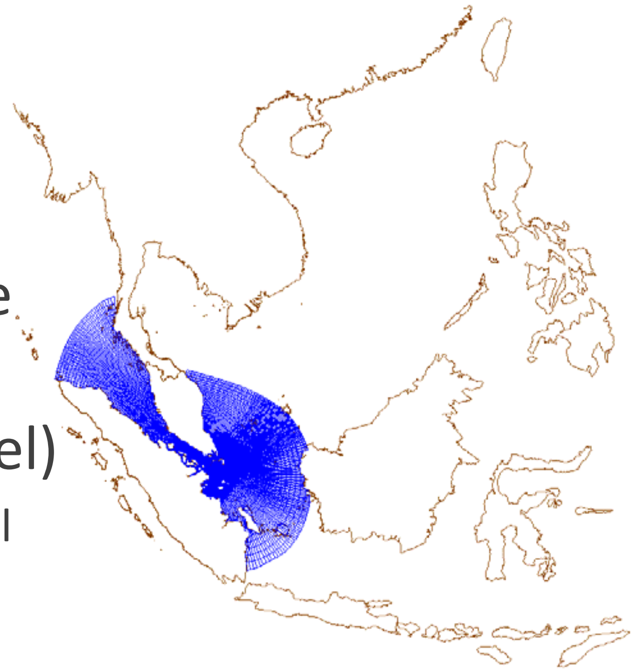
Setting up transport boundary conditions

Implications of the Thatcher-Harleman Time Lag

Reminder - Open Boundaries

What are they?

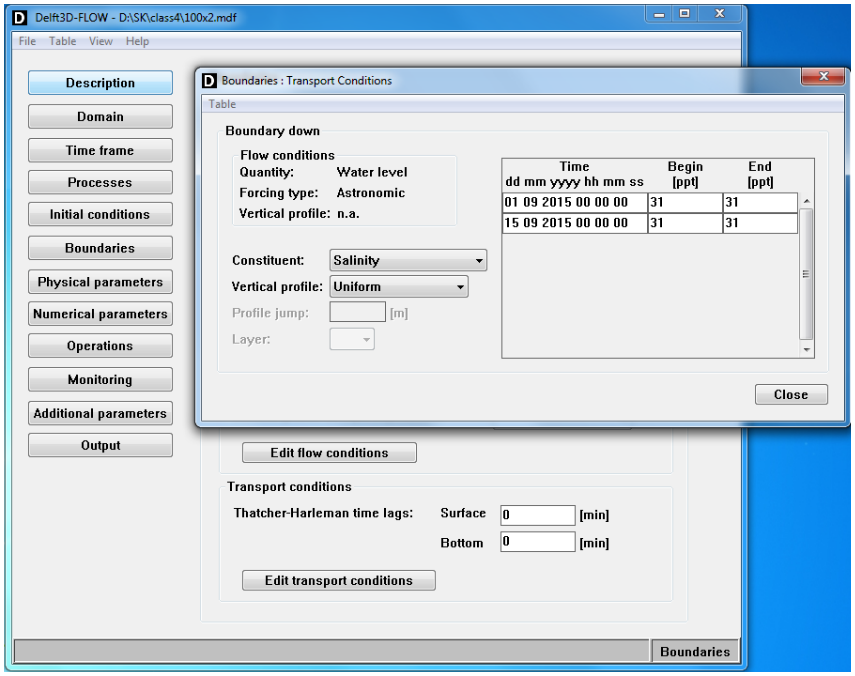
- Artificial!
- Used to restrict the model
- Therefore should be sited as far as possible from the area of interest
- Special criteria for flow (velocity, water level)
  - Should allow long waves to propagate out of the model
  - Have minimal reflection
- **What about for salinity/temperature**?
  - Where would you get the data?
  - How do you specify in coastal zones given that tides reverse flows?



How does Delft3D deal with those setup questions?

Specify concentrations (various means)

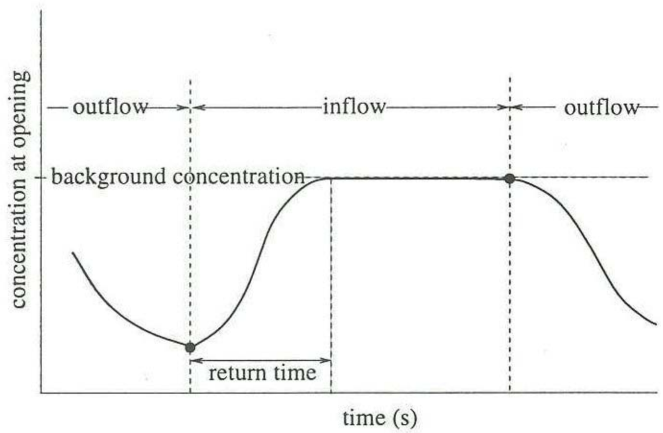
- Uniform
- Logarithmic
- Linear between surface /bed
- Step (essentially 2-layer)
- Per layer



Set-up Thatcher Harleman Time Lags(what is this?)

What are Thatcher Harleman Time lags?

- Open boundaries are artificial and particularly during tidal flows there is a strong possibility that flood values are different from ebb values for temperature / salinity
- To be able to account for this possibility a delay factor is introduced
  - Graphical interpretation



  - Mathematical description

$$C\left(t\right)=C_{out}+\frac{1}{2}(C_{bnd}-C_{out})\left(\cos\left(\pi\frac{T_{ret}-t_{out}}{T_{ret}}\right)+1\right),\qquad 0\leq t_{out}\leq T_{ret}.$$

  - What about 3D?

So how will we use Delft3D for this?

Turn on the constituent transport in the Processes section (as you have done in week 4; for this assignment → salinity)

But now instead of a closed system you have inputs from the outside world → so we have to deal with **Transport Boundary Conditions**

Setup

Create 3 grids with dx = 100 and dy = 1000
- M=100, n = 2
- M = 200, n = 2
- M = 400, n = 2

Ensure 20 layers in vertical

Ref time Jan 1; Start Nov 1; End Nov 15

Turn on salinity (not temperature) in constituents

Leave Initial Conditions as they are.

2 Open Boundaries
- Flow: (Left → Time series with Total Q : 3000 m3/s; Right → Water Level : Astronomic / S2 with H = 1.0)
- Transport: Leave Thatcher Harleman = 0 /0 on left and right. Uniform salinity of 31 on Right and Uniform salinity of 0 on Left

Setup 2

Physical parameters – just adjust viscosity/diffusivity

- Horizontal eddy viscosity 1 m2/s
- Horizontal eddy diffusivity 2.5 m2/s
- Vertical eddy viscosity 1.0x 10^{-4} m2/s
- Vertical eddy diffusivity 1.0x 10^{-6} m2/s
- Ozmidov Length Scale 1.0x 10^{-8} m

5 observation locations like Assignment 1

Output map results 90 min; History 60 min.