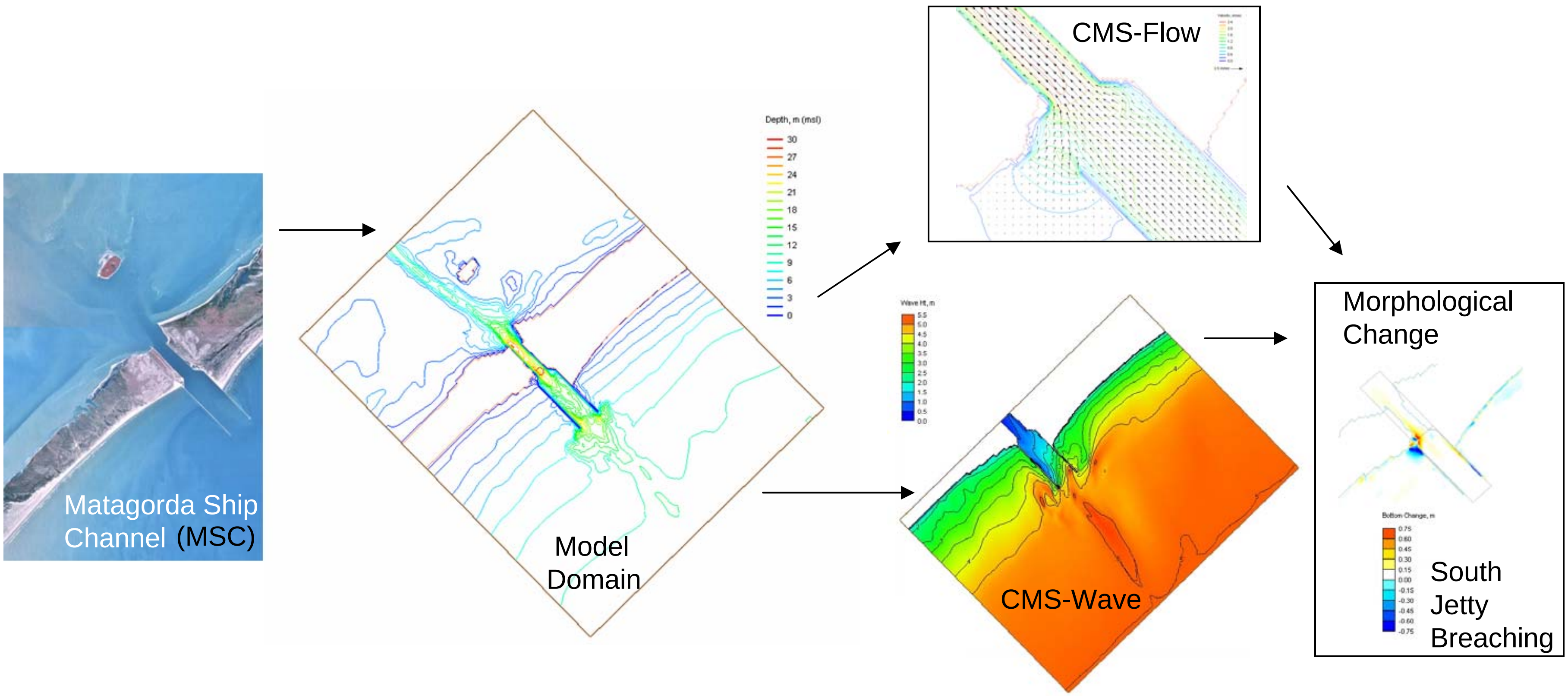
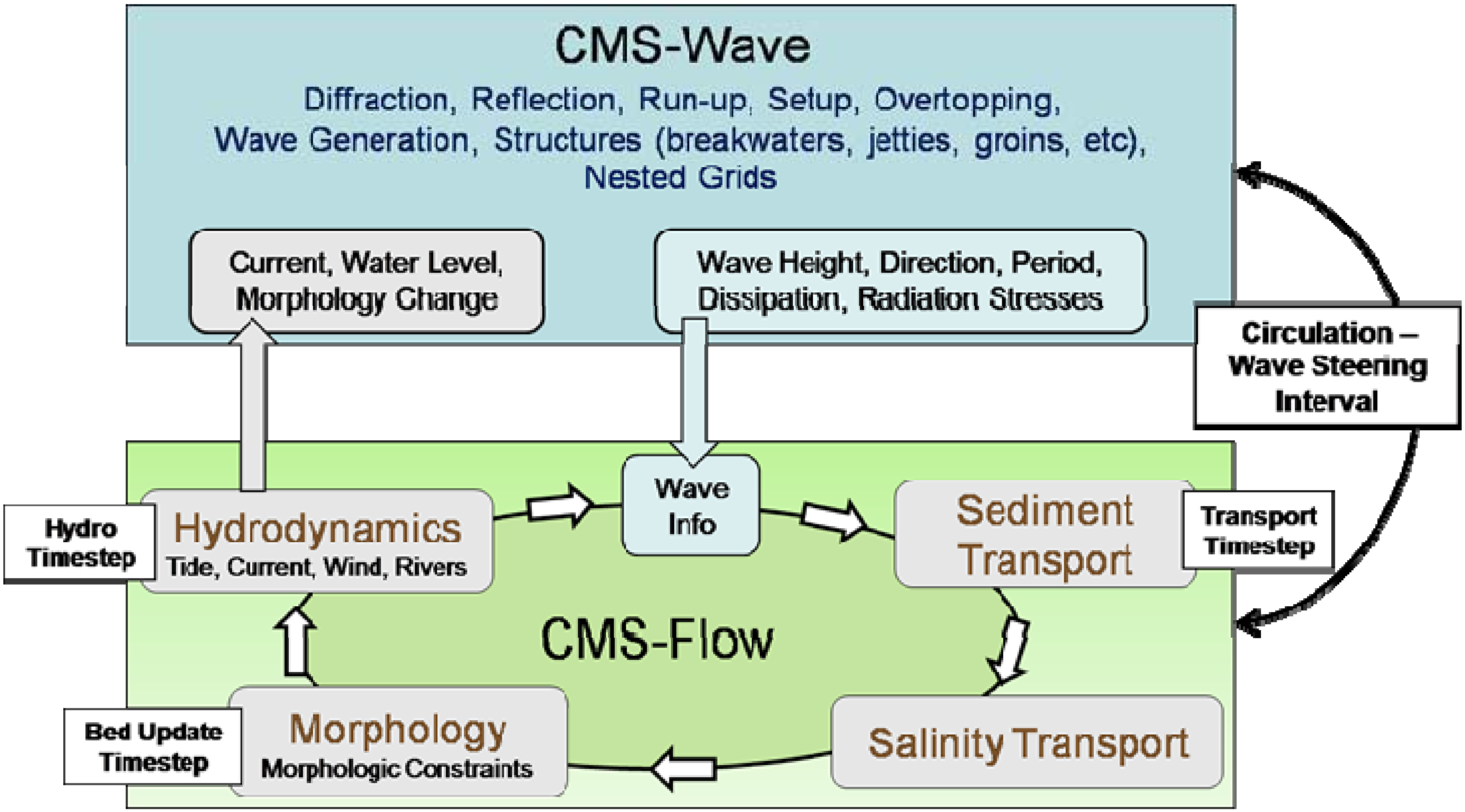
Additional information on CMS-Flow capabilities

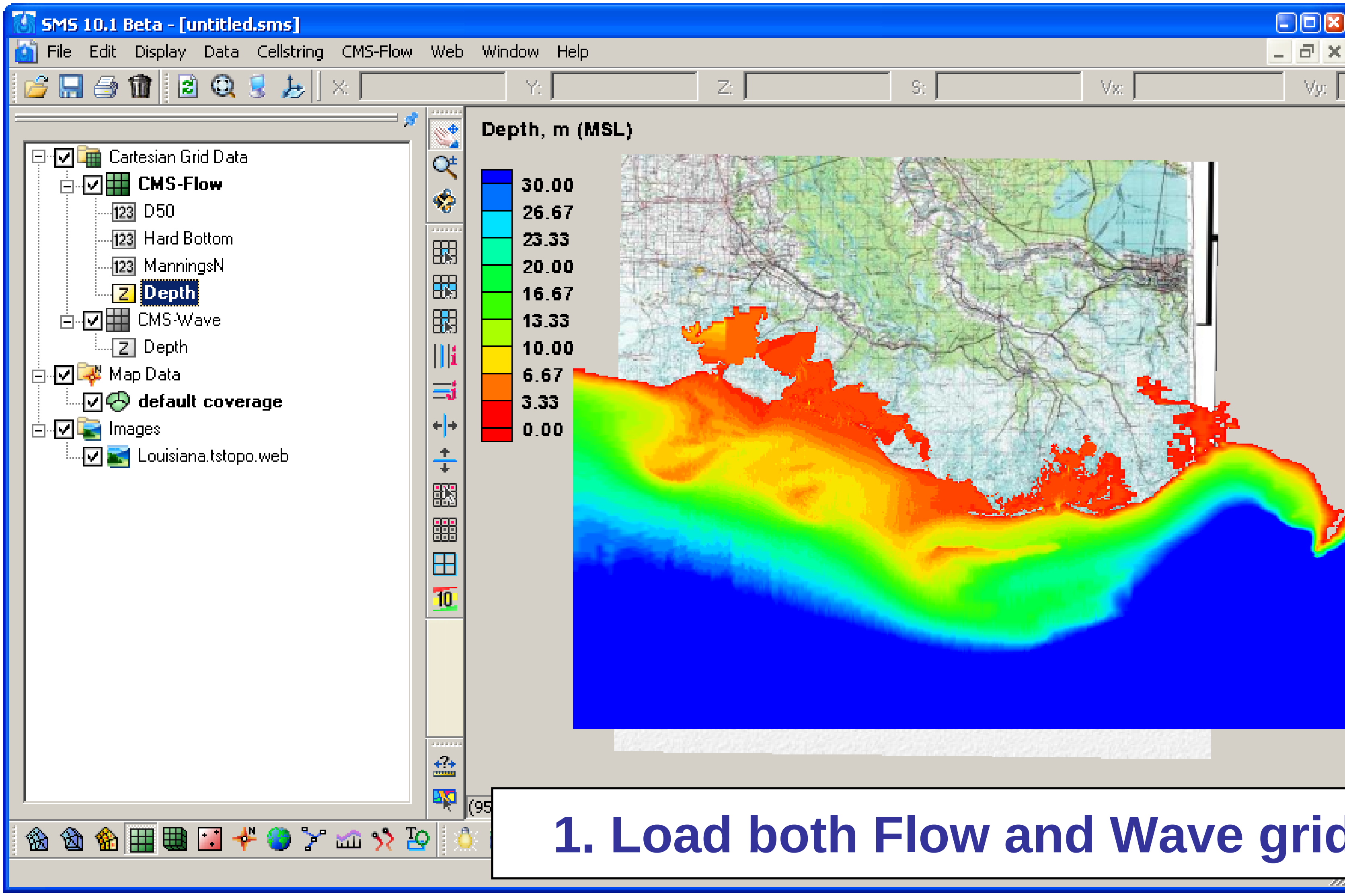
Steering Operation *CMS-Flow & CMS-Wave*



CMS-Flow and CMS-Wave Interaction (Steering)



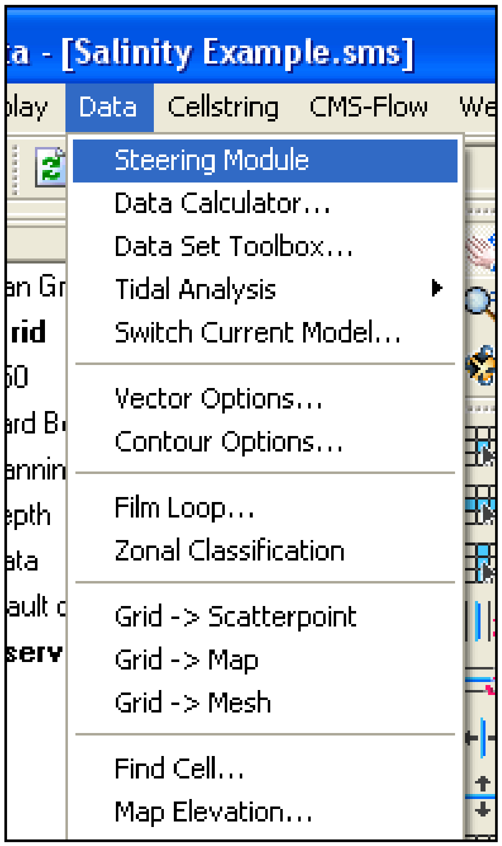
Steps for CMS-Flow/ CMS-Wave Interaction



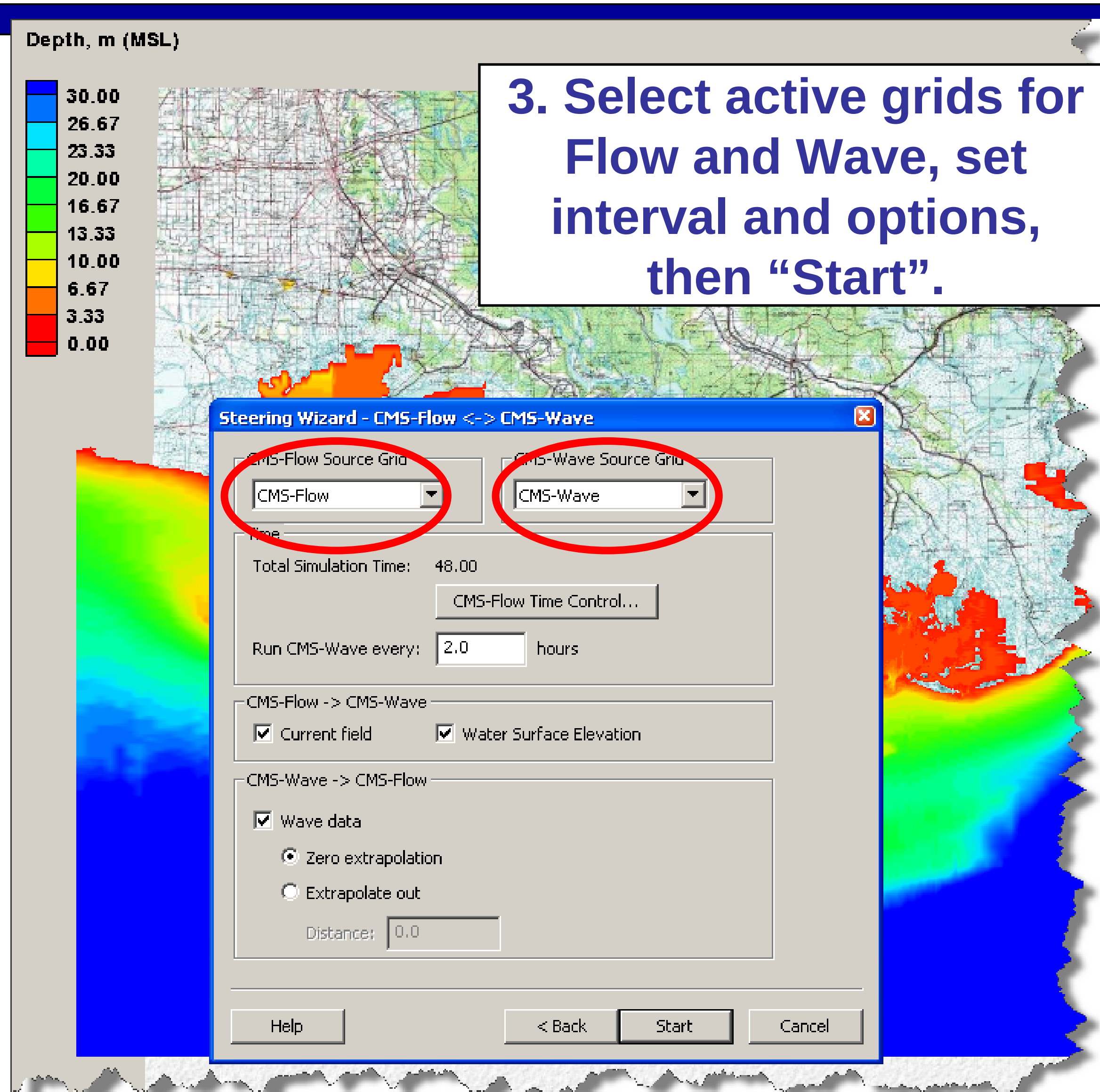
1. Load both Flow and Wave grids

Steps for CMS-Flow/ CMS-Wave Interaction

2. Choose “Steering Module” from menu

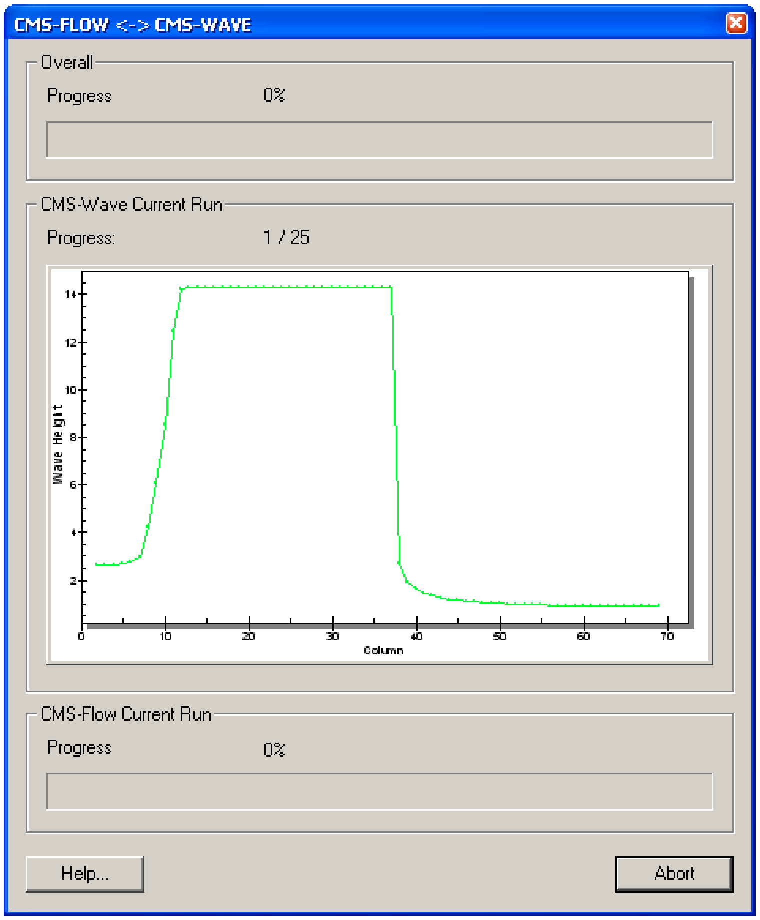


3. Select active grids for Flow and Wave, set interval and options, then “Start”.



Steps for CMS-Flow/ CMS-Wave Interaction

4. Monitor Progress



Overall Progress

Active Wave Progress / Information

Active Flow Progress

Four steps is all it takes

Additional information on CMS-Flow capabilities

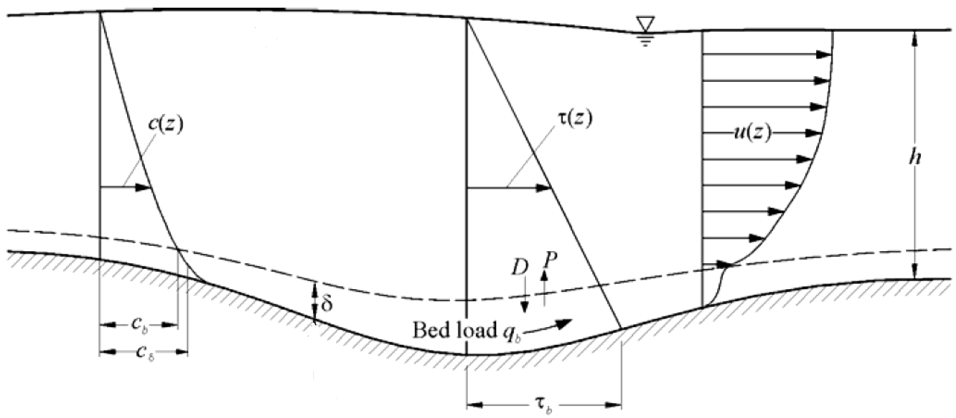
Non-Equilibrium Sediment Transport Model (NET)

NET Outline

- Introduction
  - NET Overview
  - Equilibrium vs. Non-equilibrium sediment transport
  - Advantages of Non-equilibrium
- Model Equations: A closer look at model parameters
  - Concentration capacity
  - Adaptation length
  - Bed-slope coefficient
  - Sediment diffusivity
  - Total load correction factor
- Avalanching
- Numerical implementation
- Questions

NET Overview

- 2D depth-averaged
- Features (processes)
  - Advection
  - Diffusion
  - Erosion and deposition
  - Bed-slope effects
  - Avalanching
- Definition of variables



Introduction: Equilibrium vs. Non-Equilibrium

- Equilibrium sediment transport
  - Assume local instantaneous equilibrium for bed-load transport or total-load
  - Bed change is determined by mass balance equation (Exner equation)
- Non-equilibrium sediment transport models
  - Do not assume any sediment transport load to be in equilibrium
  - Bed change is proportional to difference between local and equilibrium transport rates

Advantages of NET

- Considers temporal and spatial lags between flow and sediment transport
- Can easily handle constrained sediment loading (over- or under-loading)
- Hard-bottom problem is no problem
- Can model suspended and bed load separately or combined as bed-material or total load
- More stable than equilibrium sediment transport

Concentration Capacity

- Capacity is the concentration that would be achieved under steady-state and equilibrium conditions
- Larger scaling factors produce larger sediment loads and therefore larger morphology changes
- It is one of the most important parameters (driving force)
  - Controls largely the magnitude and distribution of the sediment concentration field

Concentration Capacity - Continued

- Options for sediment transport capacity:
  - Lund-CIRP (ERDC/CHL CR-07-01)
    - Separate equations for suspended and bed loads
  - Van Rijn (J. Hydraulic Eng. 2007)
    - Separate equations for suspended and bed loads
  - Watanabe (Proc. Coastal Sediments 1987)
    - One equation for total load
- These equations represent the sediment transport under equilibrium conditions

Parameters

Adaptation Coefficient

- Related to how much time/distance it takes to reach equilibrium
- The larger the coefficient the more rapid the system goes into equilibrium and the larger the erosion and deposition

Bed-slope Coefficient D_s

- Bed change equation
- Method first adapted by Watanabe (1985)
- Smoothes bathymetry and Improves stability
- Related to sediment properties and flow characteristics

Sediment Diffusivity Coefficient

- Coefficient is related to the strength of horizontal mixing in a depth-averaged sense
- Directly related to eddy viscosity

Total-load Correction Factor

- Accounts for the lag between the depth-averaged sediment and flow velocities
- For total load transport

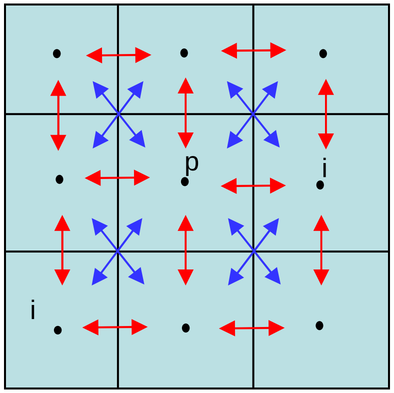
Processes

Hard-Bottom

- Concentration capacity at hard-bottom cells
  – Allows for deposition above and erosion down-to a specified depth.

Avalanching

- Two approaches available
  1. 9-point mass balance approach (Wu 2007)
     - May be used at large time intervals
     - Iterates until convergence
  2. Relaxation method (5- and 9-point)
     - Requires smaller time steps (morphologic time step)
     - No iterations
     - Very simple and stable



Numerical Methods

- Finite volume method
- Advection
  - Upwind
  - Hybrid Linear/ Parabolic Approximation (HLPA)
- Diffusion
  - Central difference
- Bed-slope term (conc.)
  - Central difference

- Boundary conditions
  - Ocean boundaries
    - Inflow: “Zero-gradient” BC
    - Outflow: Open BC
  - Land boundary
    - Zero flux BC
  - Future versions will have
    - User specified concentration (river)
    - Equilibrium BC

Additional information on CMS-Flow capabilities

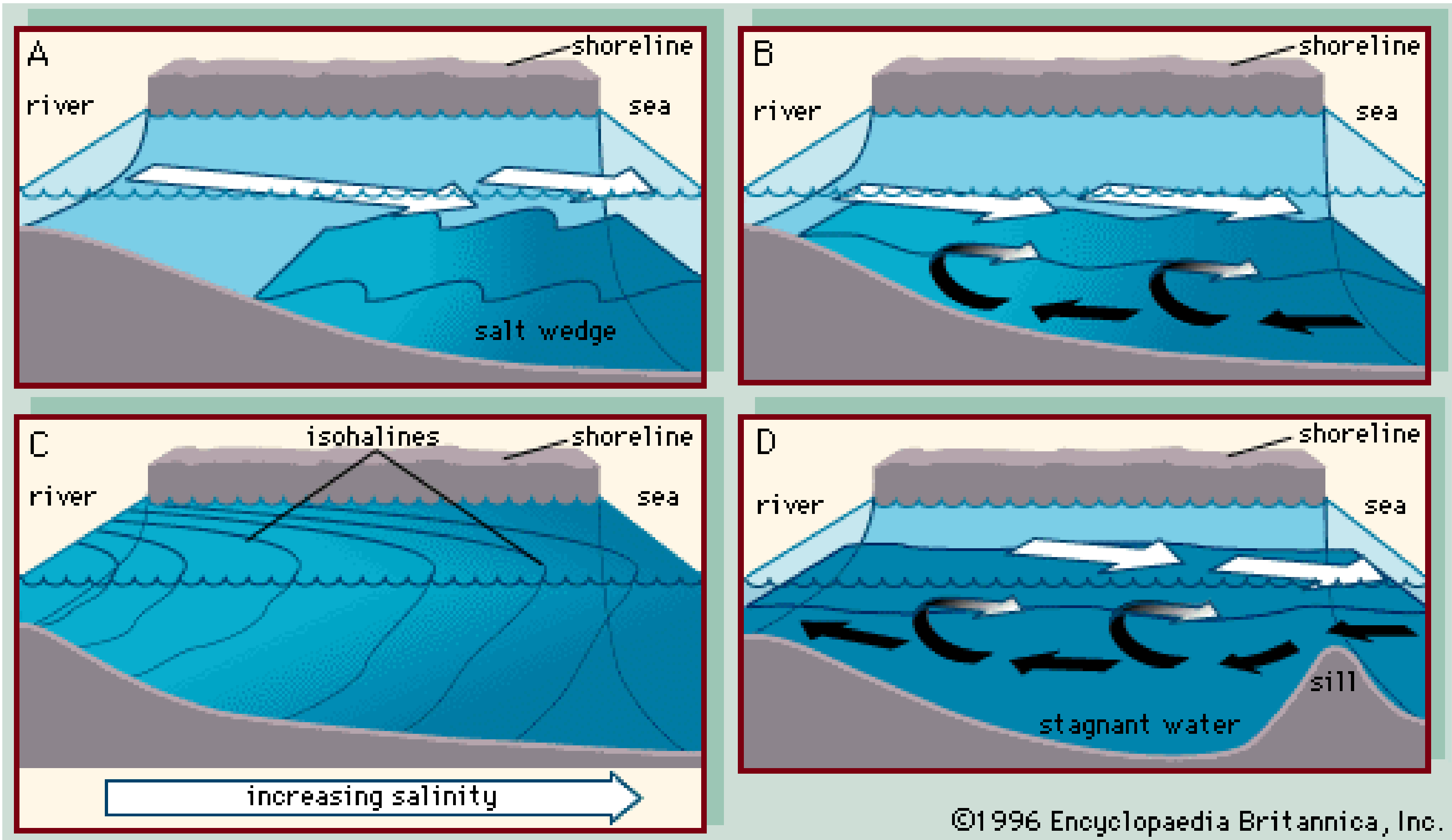
Salinity – Basic Concepts

Salinity – Basic Concepts

Salinity is the saltiness or dissolved salt content of a body of water.

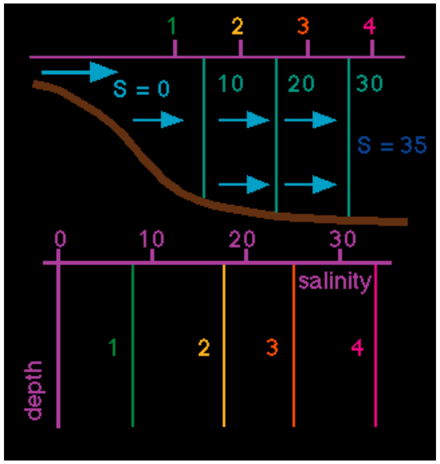
Water salinity			
Fresh	Brackish	Saline	Brine
< 0.05 %	0.05 – 3 %	3 – 5 %	> 5 %
< 0.5 ppt	0.5 – 30 ppt	30 – 50 ppt	> 50 ppt

Salinity – Basic Concepts

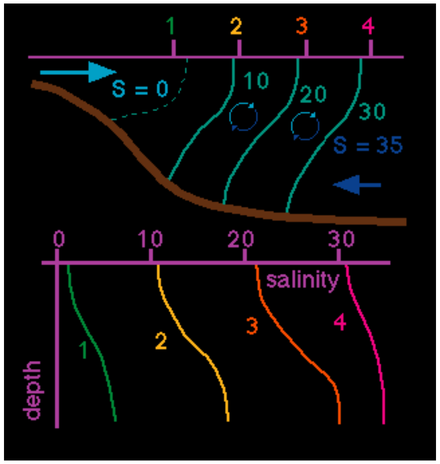


Salinity— Basic Concepts

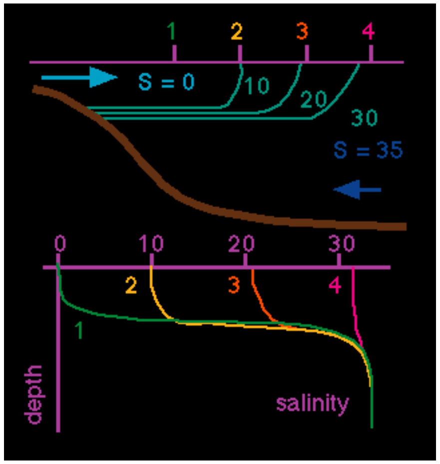
Estuary Classification



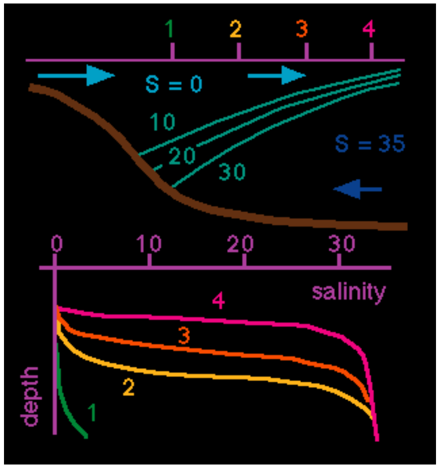
Vertically Mixed Estuary



Partially Stratified Estuary



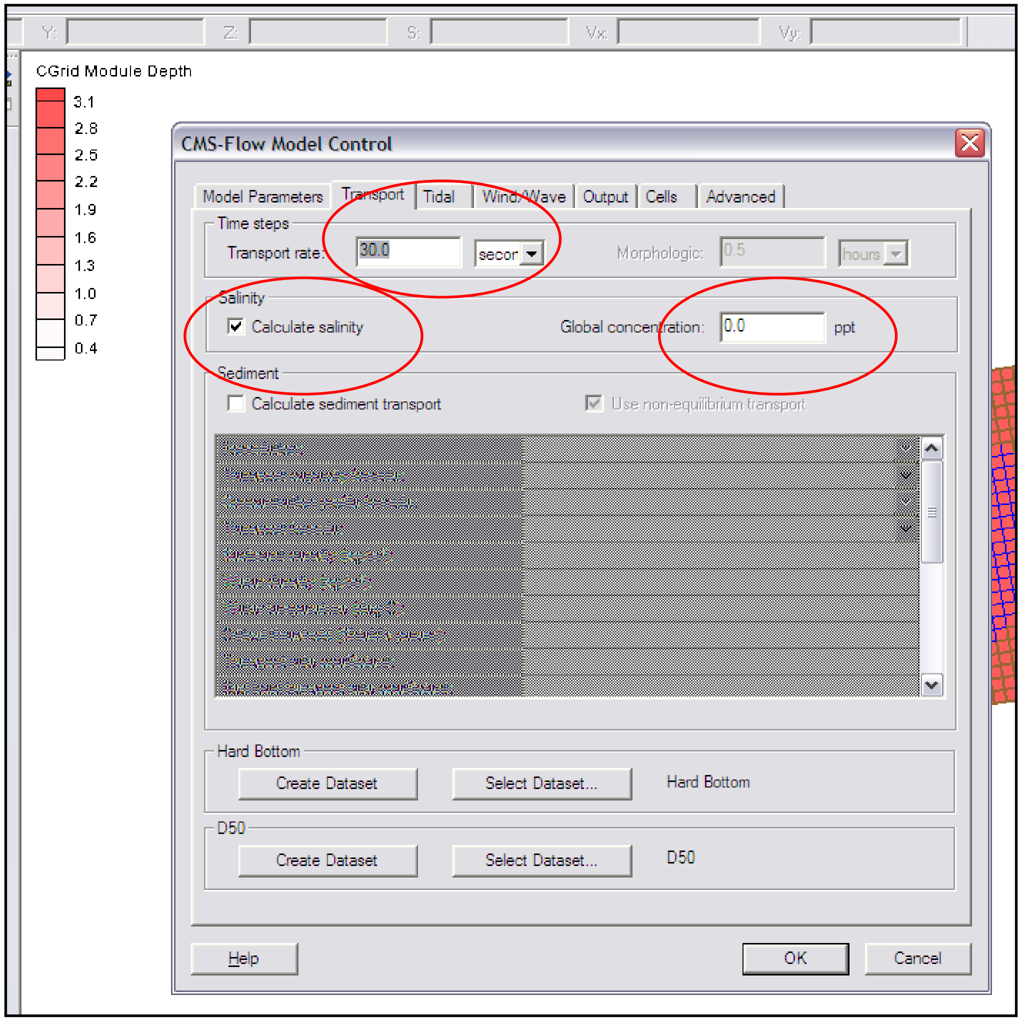
Highly Stratified Estuary



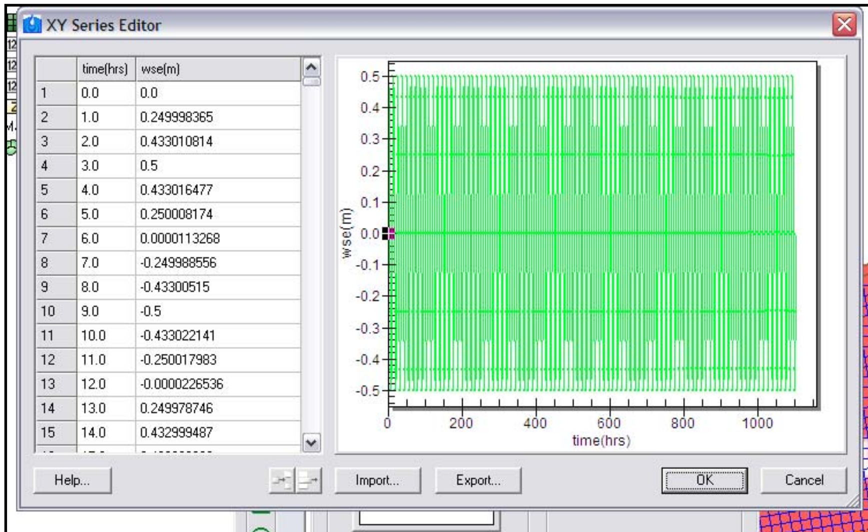
Salt Wedge Estuary

Salinity setup with SMS

Salinity transport is enabled from CMS-Flow model control interface

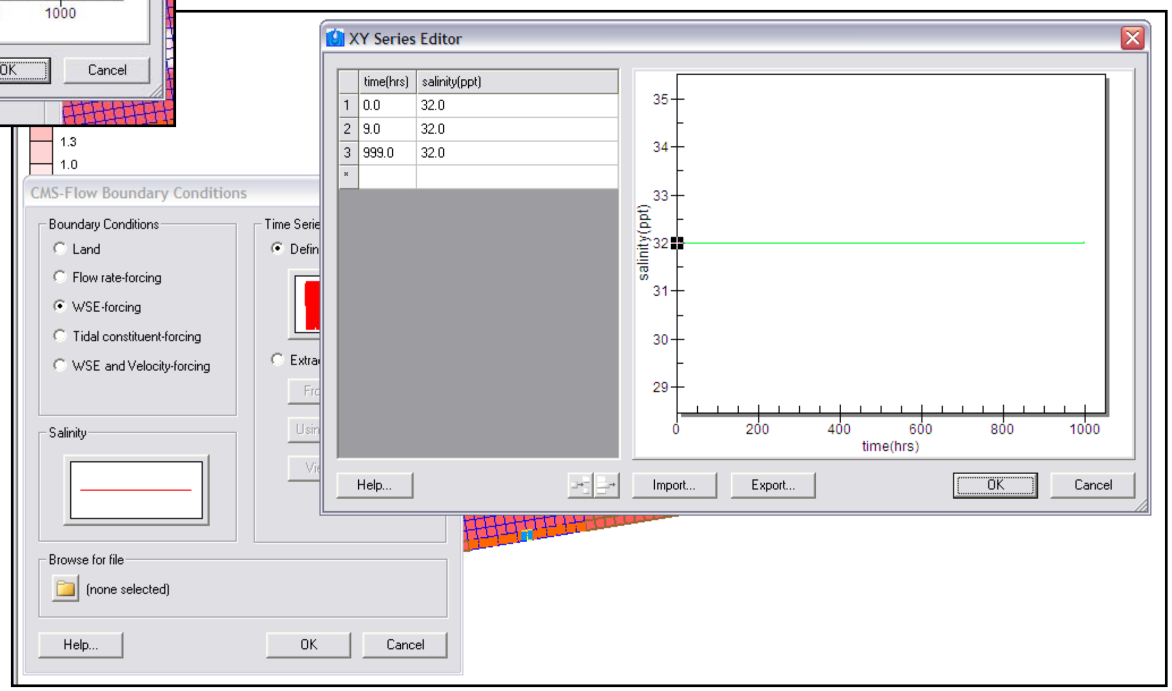


Salinity setup with SMS

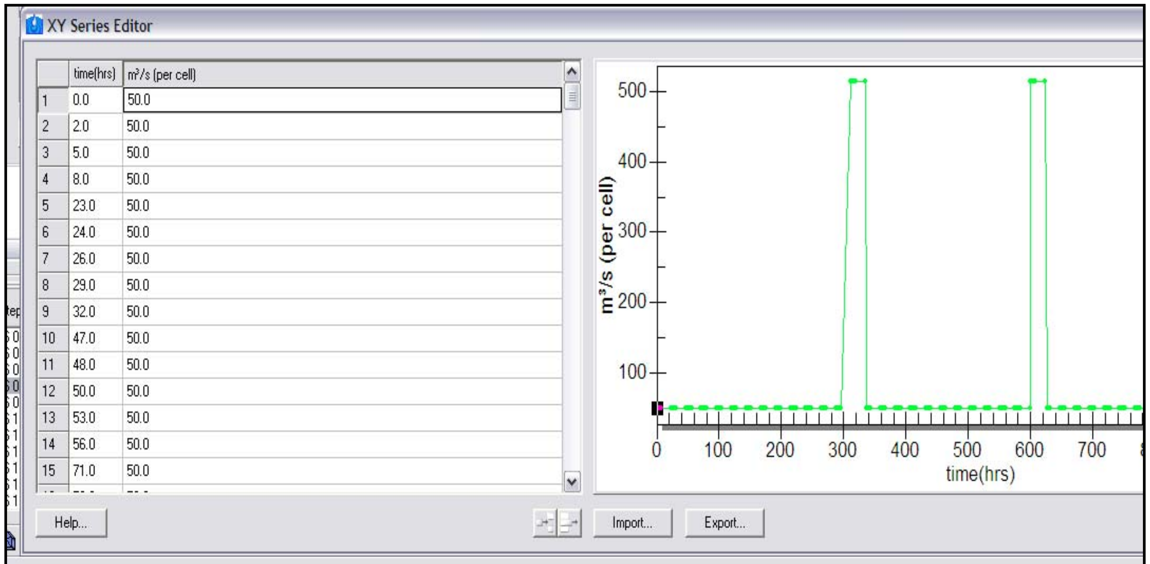


Cell strings in SMS act as boundary conditions for the SMS, containing both hydro forcing information and salinity concentration (if enabled).

Ocean Boundary

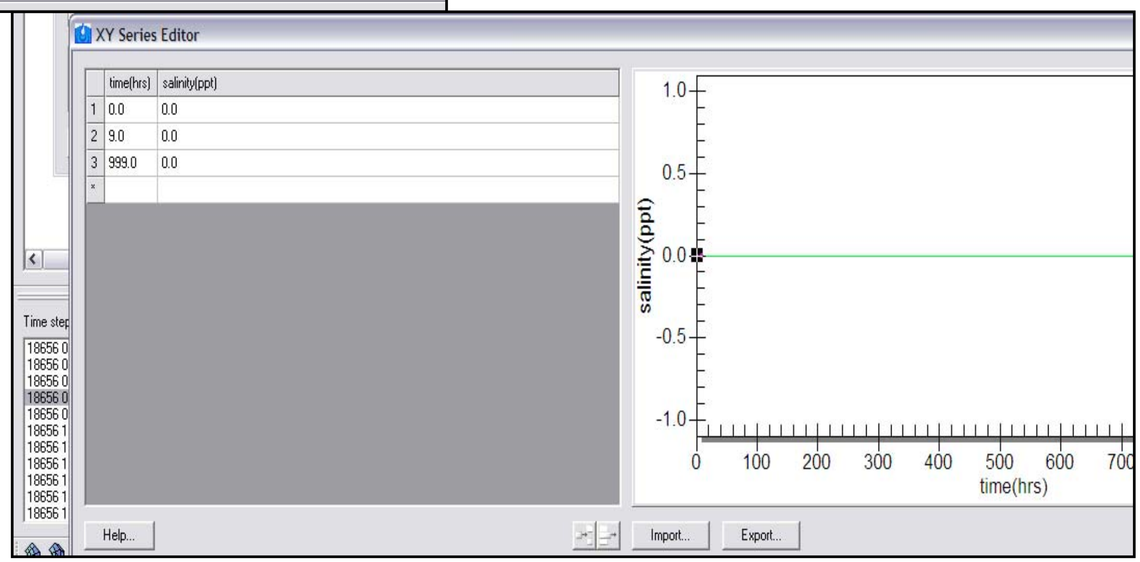


Salinity setup with SMS

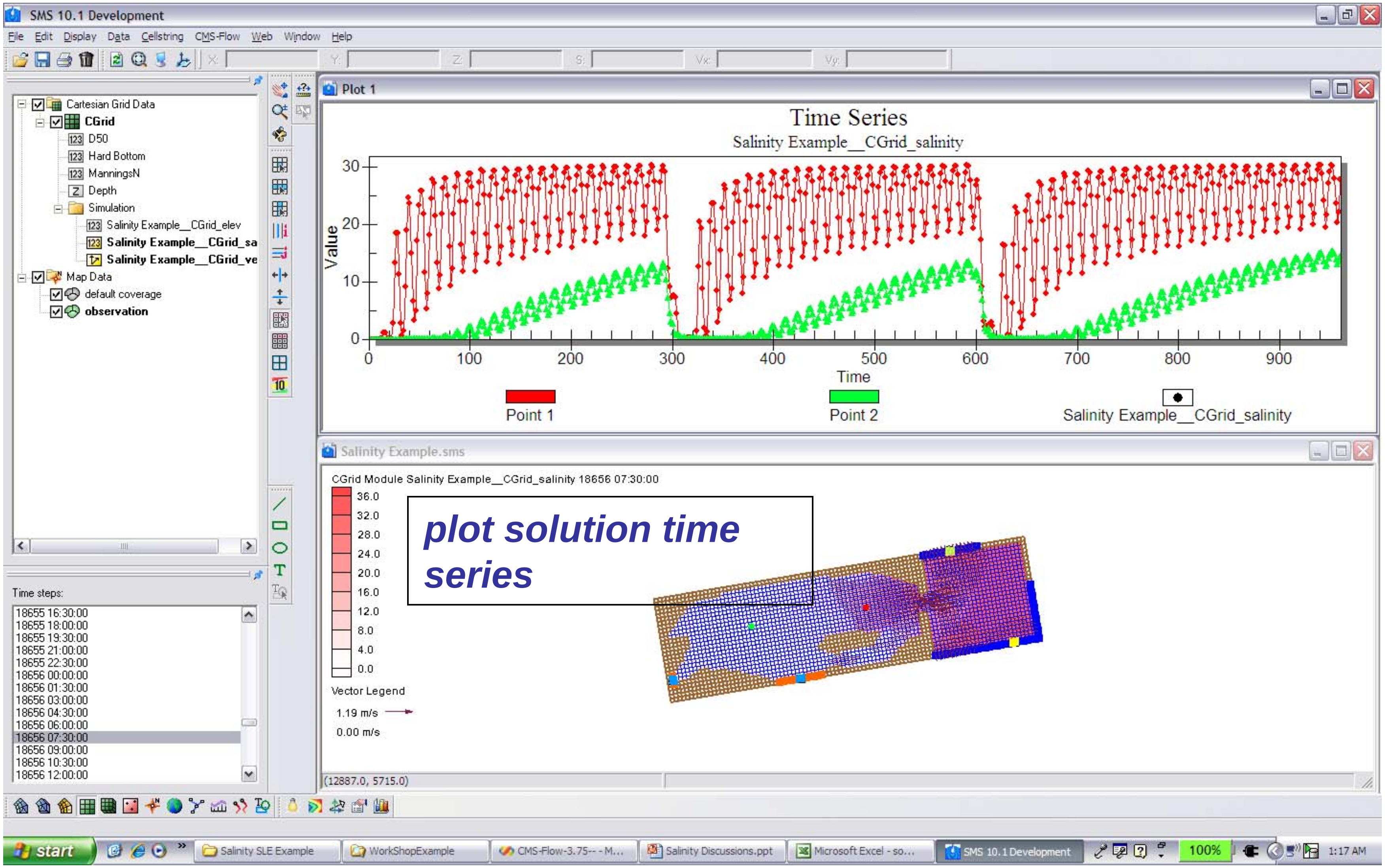


Similarly with River Flow boundaries, the cell strings hold both pieces of forcing information

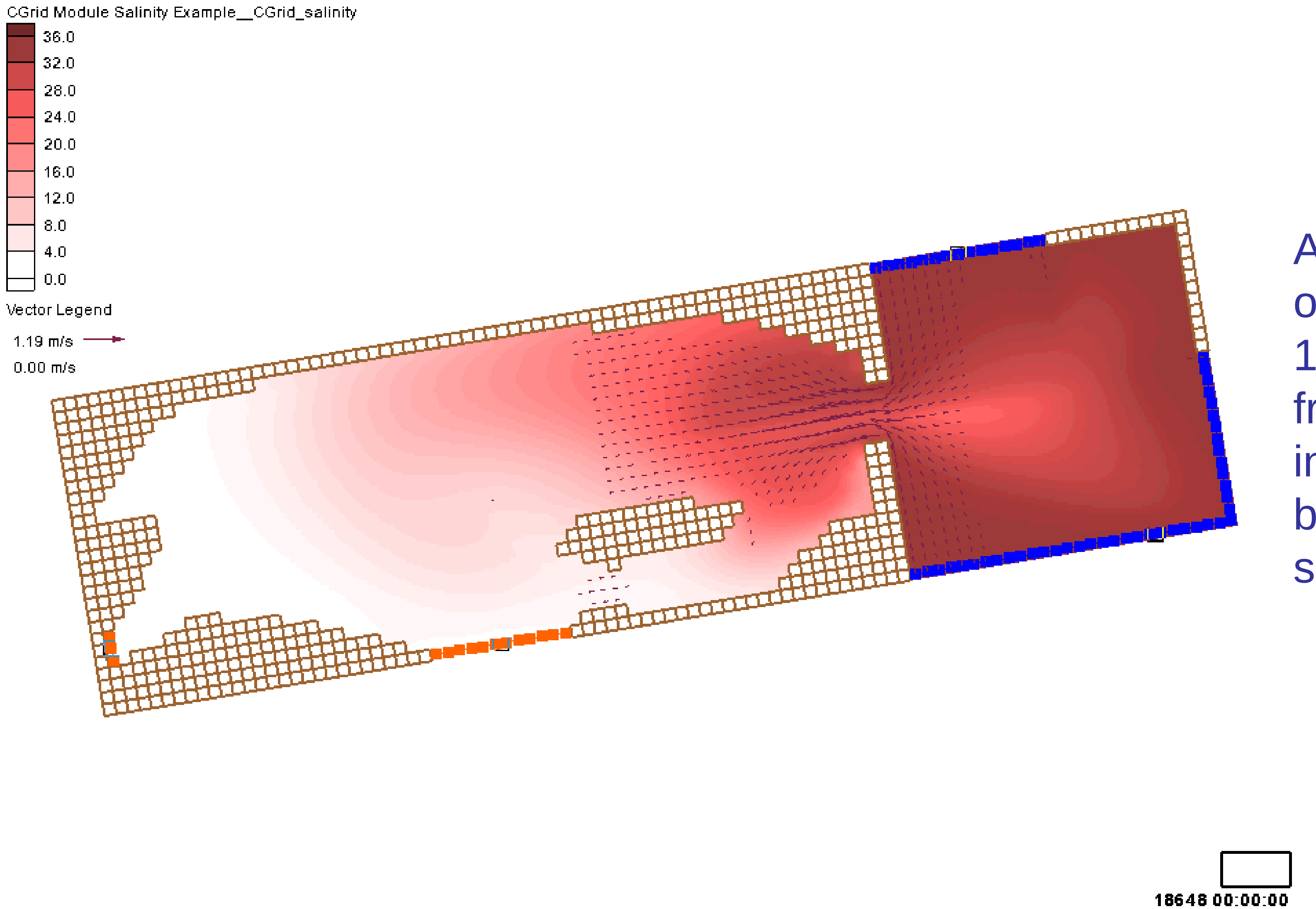
River Boundary



Salinity setup with SMS



Salinity animation



At 0000 hrs on day 18653, inflow from rivers increases, bringing 0 ppt salinity.

Future of CMS Salinity Calculation

Near-future salinity enhancements:

- Two-layer model with toggle on/off and one additional parameter
- Additional lateral diffusion options
- Intelligent initial condition (reducing ramp-up time needed)
- Separate salinity time-step (presently uses sediment transport timestep)