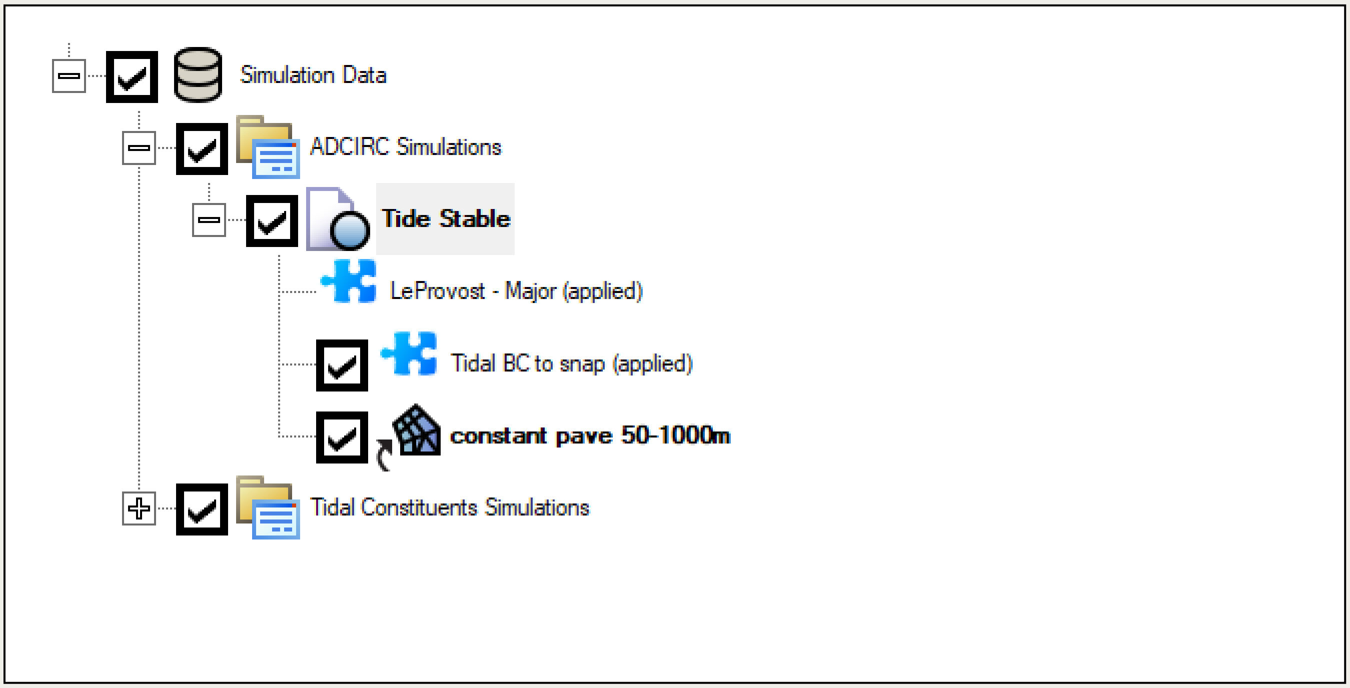
SMS 14.0 Tutorial

An ADCIRC Simulation using SMS



Objectives

This tutorial demonstrates how to assemble and run an ADCIRC simulation. It assumes all the components have been created and are ready. The steps to create these components will be the content following tutorials.

Prerequisite Tutorials

- Overview
- Map Module
- Raster

Required Components

- SMS Core

Time

- 10 minutes (plus execution time)

1 Introduction

This exercise illustrates how to assemble and execute a simulation in the Surface-water Modeling System (SMS) when all components are provided. The ADCIRC engine is used for this exercise.

This exercise utilizes data from the region around Indian River Inlet located on Delmarva Peninsula along the Maryland coast between Delaware Bay and Chesapeake Bay.

2 Getting Started

Start by importing a project file containing an existing mesh:

1. Launch the SMS application.
2. From the *Menu* bar, select the *File* | **Open…** menu item to bring up the *Open* dialog.
3. From the *Files of type* drop-down menu, select the *Project Files (*.sms)* drop-down menu item.
4. Navigate to the *Exercises/Indian River* folder.
5. Select the "IR_components.sms" file.
6. Click the **Open** button to import the project and close the *Open* dialog.

The initial project should appear similar to Figure 1.

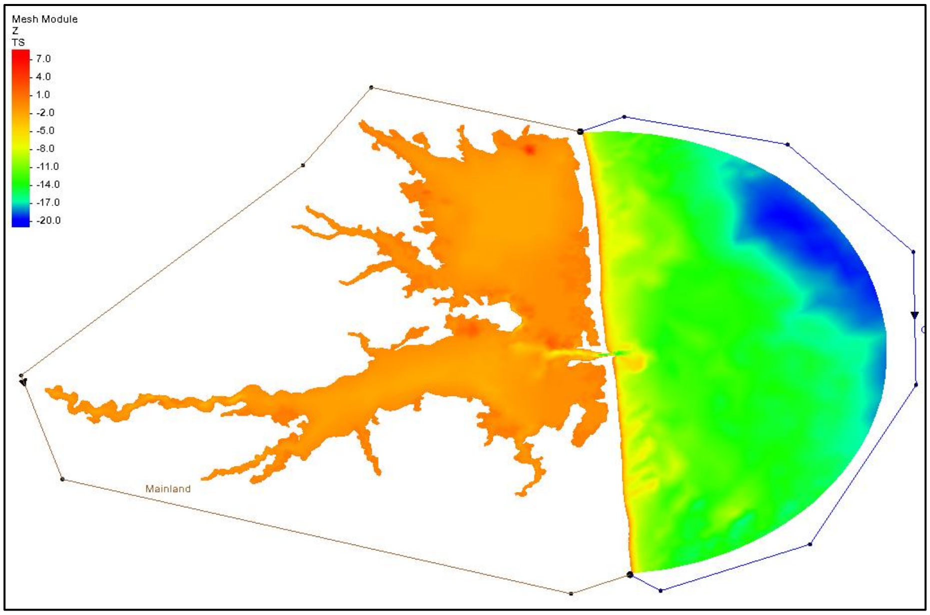


Figure 1: Initial Project

3 Defining the Simulation

SMS uses an approach referred to as "simulation-based modeling". This means that attributes and components for a numerical simulation are combined explicitly into a "simulation". A simulation is created as a separate entity in the *Project Explorer.* This allows components to be reused in multiple simulations, resulting in a more efficient process.

An ADCIRC simulation includes a mesh, boundary conditions, model parameters and potentially other components such as tides and meteorological conditions.

3.1 Creating a Simulation

To create an ADCIRC simulation:

1. In the *Project Explorer,* in a white space region, right-click to bring up the context menu.
2. Select the *New Simulation* | **ADCIRC** context menu item. This creates a new simulation named " Sim" in the *Project Explorer*.
3. On the " Sim" simulation, right-click and select the **Rename** context menu item and rename it to " Tide".

3.2 Setting Model Parameters

To set up the ADCIRC simulation parameters:

1. On the " Tide" simulation, right-click and select the **Model Control** context menu item to open the *ADCIRC Model Control* dialog.
2. Select the *General parameters* tab and enter the following parameters:

a. In the *Simulation description* section, for the *Project title,* enter “Indian River Tides 10/21/2012-10/23/2012”.

b. For the *Run ID,* enter “version 53”.

c. In the *Coordinates* section, change the *Coriolis option:* to “Variable”. This instructs ADCIRC to use the coordinates of the mesh to compute the influence of Coriolis forces.

d. Leave all the other general parameters as the default settings. Refer to the ADCIRC documentation for descriptions of each parameter.

3. Select the *Model formulation* tab and enter the following parameters:

   a. In the *Model type – IM* section, set the *Horizontal viscosity (L**2/t)* to “10.0”.

   b. In the *Nonlinear terms* section, set the *Finite amplitude terms* to be “With wetting/drying”.

   c. Specify the *Minimum depth* to be “0.05”.

   d. Specify the *Minimum vel (m/s)* to be “0.02”.

   e. Turn on the *Advective terms – NOLICA* checkbox.

   f. In the *Generalized wave continuity equation – GWCE* section, set the *Weighting factor:* to “Pure primitive equation: TAU0 specified”.

   g. For *Tau0* enter “0.001”.

   h. Set *Solver message level* to “Fatal”.

4. Select the *Timing* tab and enter the following parameters:

   a. In the *Interpolation reference date* section, double click on the date, and set the date to “10/21/2012 12:00:00 am” (0.0 hours on October 21, 2012).

This date refers to a date used by the interface to extract tidal or meteorological values from other data sources for use in a simulation.

   b. In the *Timing* section, for the *Time step (seconds),* enter “4.0”.

   c. For the *Length of run (days)* enter “3.0”.

Normally, simulations last for several days up to a full lunar month, but in the interest of time this tutorial will use a much shorter duration.

   d. In the Ramp Options – NRAMP section set the Number of hyperbolic tangent spin up ramps to “1”.

   e. Under Duration (days), for the General ramp, enter “1.0”.

5. Select the *Output* tab and enter the following parameters. We will set default options that will be applied to both elevation and velocity.

   a. In the *Output files* section, on the *Default line:* row of the spreadsheet, set the *Output format* to “NetCDF”.

   b. In the *Start (days)* cell, enter “1.0”.

This skips data created during the ramp period.

   c. In the *End (days)* cell, enter “30”.

This will tell ADCIRC to create output to the end of the 3 day simulation. We've set it to the maximum duration we expect to use in this model so that if the model is run for a longer duration later output will still be written to the end of the run.

d. In the *Increment (min)* cell, enter "30.0".

6. Select the *Wind* tab and enter the following parameters:
   a. In the *NWS* section, select the "NWS=0 – No wind" drop-down item.

The *Wind* tab allows the user to specify what winds are to be used by ADCIRC. In this exercise we are not using wind.

4 Saving the Project

1. Click the **OK** button to exit the *ADCIRC Model Control* dialog.
2. From the *Menu* bar, select *File* | **Save As…** to open the *Save as* dialog to the project under a different name.
3. Navigate to the *Exercises/Indian River/work* folder.
4. For the *File name*, enter "IR_introduction.sms".
5. Click the **Save** button to save the project and close the *Save as* dialog.

5 Adding the Mesh to the Simulation

An ADCIRC simulation requires a mesh. For this exercise the mesh has been provided. To add the mesh to the simulation:

1. In the *Project Explorer,* from the top of the tree, drag the " constant pave 50-1000m" mesh down to the " Tide" simulation until a line appears below the simulation name. When the line appears, drop the mesh.

This links the mesh to the ADCIRC simulation. (Alternatively, right-click on the mesh and select "Apply to | ADCIRC Simulations -> Tide".)

2. An entry appears below the simulation that looks like the mesh. The icon includes an arrow indicating that this is not an independent mesh, but rather a link to the mesh in the *Mesh Data* section of the project.

6 Adding the Boundary Conditions to the Simulation

An ADCIRC simulation requires that the modeler define the boundary conditions for all nodes around the edge of the domain. SMS uses an ADCIRC boundary conditions coverage to store this specification. A coverage has been created for this tutorial.

When a coverage is associated with a simulation, the boundary conditions are mapped to a specific mesh. That is why the mesh was added to the simulation in the previous section. To associate the BC coverage with the simulation:

1. In the *Project Explorer,* in the " Map Data" folder, open the *ADCIRC* folder.
2. On the " Tidal BC to snap" coverage right-click to bring up the context menu and select the *Apply to* | **ADCIRC Simulations | Tide** context menu item.

3. An entry appears below the simulation labeled "Tidal BC to snap (applied)".
4. Turn off the "Mesh Data | constant pave 50-1000m" mesh checkbox.
5. Turn off the "Map Data | Tidal BC to snap" coverage checkbox.

This will leave just the applied boundary conditions visible.

6. In the *Simulation Data* folder, right-click on the "Tidal BC to snap (applied)" entry and select the **Display Options…** context menu item.
7. In the *Display Options* dialog that appears, click on the button in the *Color/style* column in the *Ocean* line of the table (it should have a thin blue line) to open the *Line Attributes* dialog.
8. In the *Line Attributes* dialog, change the *Width* variable to 3. This will make the ocean boundary thick and obviously different from the mainland boundary.
9. Click the **OK** button to close the *Line Attributes* dialog.
10. Click the **OK** button to close the *Display Options* dialog.

The display should now look similar to Figure 2. Note that SMS has snapped the approximate arcs to the exact mesh boundary.

Check to make sure that the applied ocean arc goes right up to the coast but does not wrap around to include other points on the coast.

If the snapping is not correct, you can edit the "Tidal BC to snap" coverage and reapply the boundary condition coverage to the simulation.

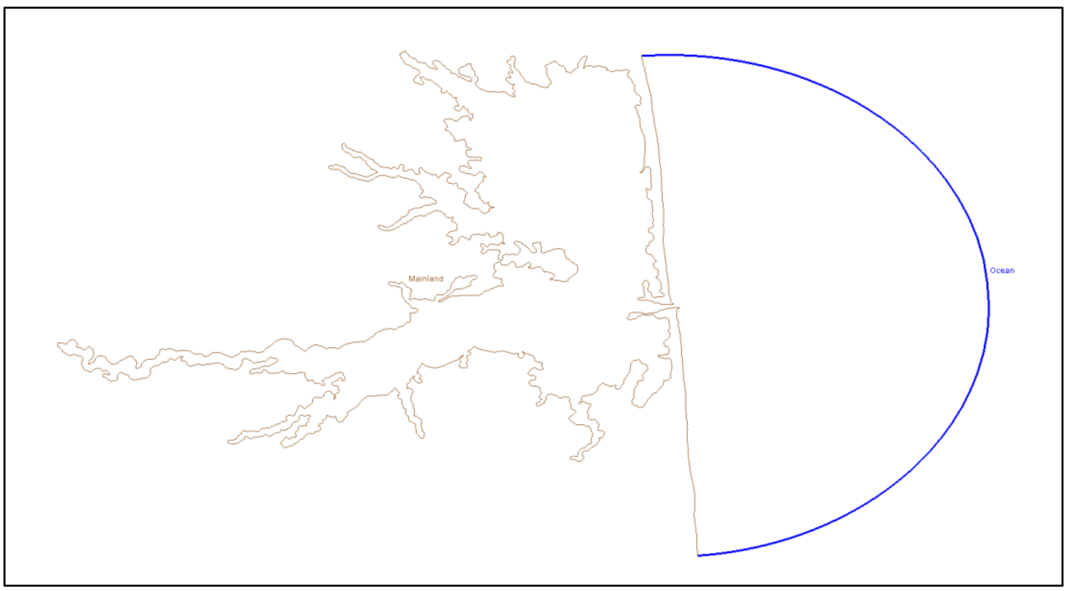


Figure 2: The Applied Ocean Boundary Condition Display

7 Applying Tidal Forcing

Many ADCIRC simulations use tidal constituents to drive water levels on ocean boundaries. The user can define which tidal constituents should be used and where the definition should come from.

A Tidal Component has been included in this project for use in this simulation.

To apply the tidal constituents that ADCIRC will use to the simulation, the boundary conditions coverage must be applied to the simulation. This is because the boundary condition coverage defines which nodal locations will have tidal forcing applied.

To apply the tidal component to the simulation:

1. In the *Project Explorer,* in the *Simulation Data* folder, right-click on the " LeProvost - Major" component to open the context menu and select the *Apply to* | **ADCIRC Simulations** → **Tide** context menu item**.**
2. A dialog appears reporting on the process of applying the tidal constituents to the simulation. If no errors are encountered, this dialog will automatically close and the " LeProvost – Major (applied)" entry appears in the simulation.
3. Right-click on the " LeProvost - Major (applied)" object in the simulation and selecting the **Tidal Constituents** context menu item brings up the ***Applied Tidal Constituents*** dialog that includes a table of constituents used in this simulation.

SMS maps all of the tides to the ocean nodes in the simulation. This extracts the constituent values from the specified database.

Each constituent and the phase/amplitude at each ocean node in the mesh can be viewed and edited here. This information will be saved in the fort.15 file for the simulation.

8 Running ADCIRC

The simulation is now ready to be run. This tutorial will use the Save Project, Simulation and Run command which does the following:

- Save all the work done so far into the SMS project files
- Export the fort.14 and fort.15 files for the " Tide" simulation into its own folder below the SMS simulation folder
- Launch the *Simulation Run Queue* and starts the " Tide" simulation. Progress of the simulation can be monitored in the Simulation Run Queue.

This run is set to simulate 3 days (518,400 seconds) of simulation with a 1.0 day (24 hour) ramp. The time step was specified as 4.0 seconds, so the simulation will include 129,600-time steps (3 days * 24 hours/day * 3600 seconds/hour * 0.25 time steps/second). Output will be saved for each point on the mesh every 30 minutes of simulation time from 12 hours to 36 hours (48 total output periods).

To start the run:

1. In the *Project Explorer,* right-click on the " Tide" simulation and select the **Save Project, Simulation and Run** context menu item to run ADCIRC.
2. The *Simulation Run Queue* dialog will open. This run should take about 10 minutes to complete.
3. When the simulation is complete, in the *Simulation Run Queue* dialog, click the **Close** button. This will load the solution in the *Project Explorer*.

9 Conclusion

This concludes the "ADCIRC Introduction" exercise. Several features have been demonstrated including:

- Creating an ADCIRC simulation and assigning run parameters.
- Assembling the components of a simulation.
- Saving and running an ADCIRC simulation.

All of the individual components will be discussed in more detail in other exercises.