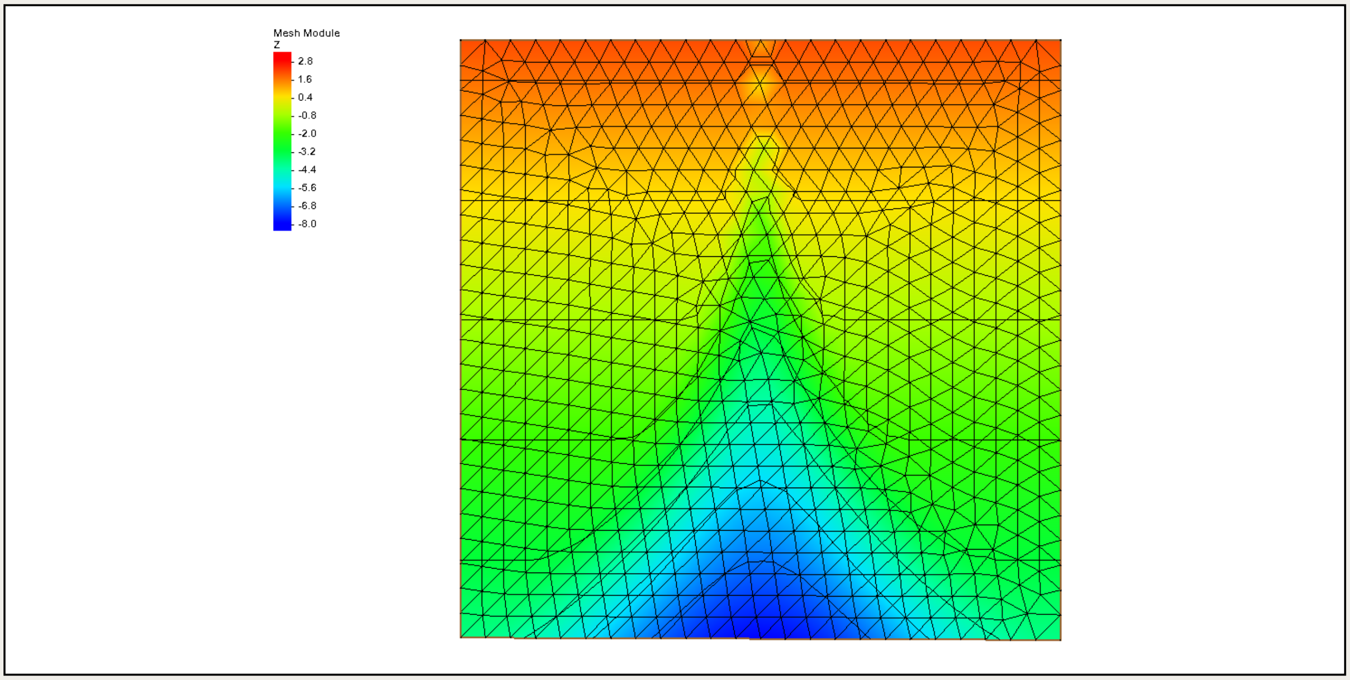
SMS 14.0 Tutorial

ADCIRC – Synthetic Channel Run Simulation – Part 1

Introduction to running an ADCIRC simulation



Objectives

This tutorial demonstrates how to set up and run an ADCIRC simulation from inside of the Surface-water Modeling System (SMS).

Prerequisite Tutorials

- Overview
- Map Module
- ADCIRC Synthetic Channel Mesh Generation Part 1

Required Components

- SMS Core
- ADCIRC Interface

Time

- 10–20 minutes

1 Introduction

This tutorial demonstrates the process of setting up and executing an ADCIRC simulation using the SMS interface. Refer to the tutorial named “SMS ADCIRC Symmetric Channel Mesh Generation – Part 1” for a description of the simulation domain, and the process of generating the computation mesh. As a brief review, the domain is illustrated in Figure 1 and the mesh is illustrated in Figure 2.

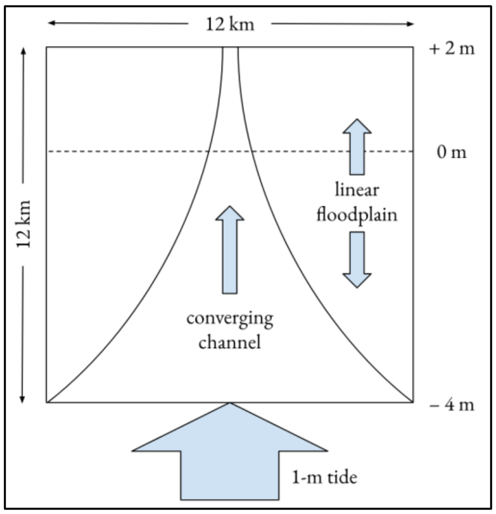


Figure 1 Doman overview

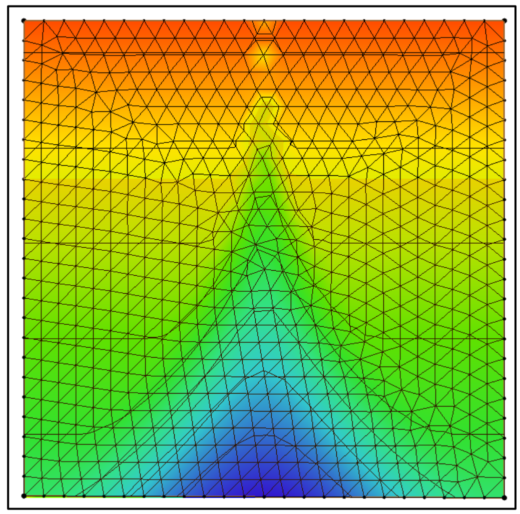


Figure 2 The mesh

2 Getting Started

Start with loading the SMS project, including the mesh:

1. Launch the **SMS** application.
2. Select *File* | **Open…** to bring up the *Open* dialog.
3. Browse to the *data files* folder for this tutorial and select “SyntheticChannelExecute.sms”.
4. Click **Open** to import the project and exit the *Open* dialog.

The display of SMS will include the elevation raster as shown in Figure 3.

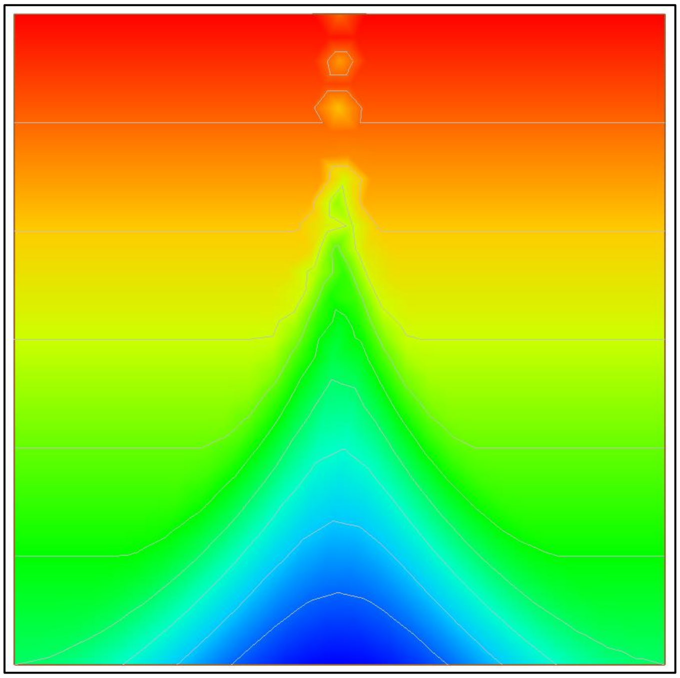


Figure 3 Starting project

3 Creating the Boundary Conditions Coverage

The mesh is one of the required components of an ADCIRC simulation. The second required component is an ADCIRC boundary condition coverage. This layer instructs ADCIRC how to handle the hydrodynamics at the four open boundaries. An idealized tidal signal will be applied at the bottom. Closed conditions with no normal flow will be applied at the other three boundaries. Flow will be allowed to slip tangentially along these boundaries, but it will not be allowed to cross them.

To set up this definition:

1. Right-click on the " Map Data" folder in the Project Explorer and select **New Folder**.

This creates a new folder in the " Map Data" area.

2. Enter "ADCIRC" as the name for the new folder and press *Enter*.
3. Right-click on the " Pave" coverage and select **Duplicate**.

This creates a new coverage named " Pave (2)", which is a copy of the " Pave" coverage.

4. Click and drag the new " Pave(2)" coverage into the " ADCIRC" folder.
5. Right-click on the " Pave(2)" coverage and select *Type* | *Models* | *ADCIRC* | **Boundary Conditions**.

This changes the purpose of this coverage to define ADCIRC boundary conditions.

6. Right-click on the " Pave(2)" coverage again and select **Rename**.

7. Enter the name "BC" and press *Enter*.

4 Assigning the Boundary Conditions

With the boundary condition coverage set up, the specific boundary condition types can now be assigned to specific locations. To do this:

1. In the Project Explorer, turn on the " BC" coverage to make it visible.
2. Using the **Select Feature Arc** tool, select the arc at the bottom of the domain.
3. Right-click anywhere inside the Graphics Window and select **Assign BC…** to bring up the *Assign Linear BC* dialog.
4. Change the *Linear boundary condition options* to "Ocean".
5. Click **OK** to exit the *Assign Linear BC* dialog.
6. Right-click anywhere inside the Graphics Window and select **Invert Selection.**

This will unselect the arc that was just specified as the "ocean" boundary and select the other three.

7. Right-click anywhere inside the Graphics Window and select **Assign BC…** again to bring up the *Assign Linear BC* dialog again, this time for the other arcs.
8. Change the *Linear boundary condition options* to "Mainland"
9. Leave the default "Natural" boundary.
10. Click **OK** to exit the *Assign Linear BC* dialog.
11. In the Project Explorer, turn off the " Pave" mesh (this makes the labels more obvious).

The display of SMS will now appear similar to Figure 4.

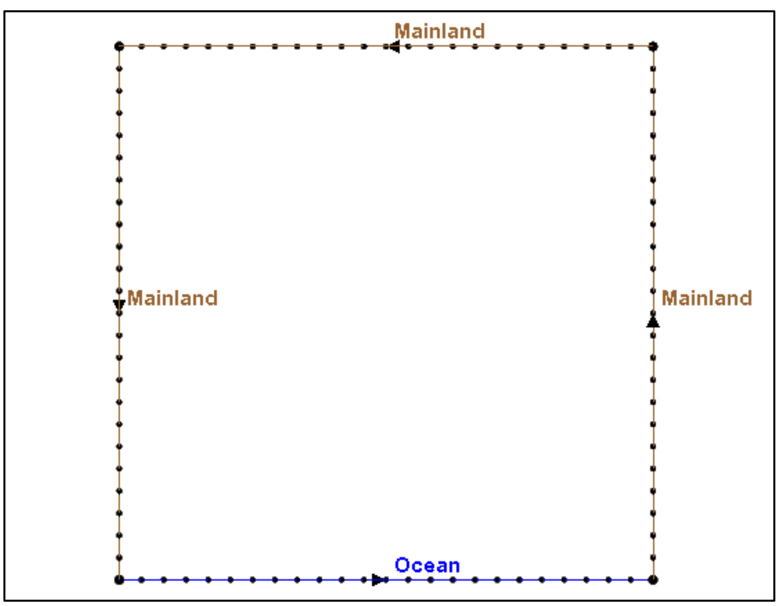


Figure 4 Arcs around the mesh in the Boundary Condition coverage

5 Specifying the Tidal Signal

With the ocean boundary defined, the next process is to define the signal that will be applied at this location. Most ADCIRC simulations would use an astronomical tide (e.g. from the moon). However, in this case, apply a simple tide using a fort.19 file. In this file, specify the water level at every node along the ocean boundary at a regular interval. ADCIRC interpolates linearly in time. This case will apply hourly water levels as shown.

Time (sec)	Water Level (m)
0	0.0000
3600	-0.2588
7200	-0.5000
10800	-0.7071
14400	-0.8660
18000	-0.9659
21600	-1.0000
25200	-0.9659
28800	-0.8660
32400	-0.7071
36000	-0.5000
39600	-0.2588
43200	0.0000
46800	0.2588
50400	0.5000
54000	0.7071
57600	0.8660
61200	0.9659
64800	1.0000
68400	0.9659
72000	0.8660
75600	0.7071
79200	0.5000
82800	0.2588
86400	0.0000

A file in Fort.19 format has been provided for this purpose. To assign it to the boundary condition coverage:

1. Right-click on the " BC" coverage and select **Forcing Options** to bring up the *Boundary Conditions Forcing Options* dialog.
2. Uncheck the *Use periodic water level forcing* option.
3. Click on the **Select** button to open a browser for selecting the fort.19 file.
4. Browse to the location of the *data files* for this tutorial.
5. Set the filter at the bottom of the browser dialog to "All files (*.*)", then select the "500m-1hr-fort.19" file.
6. Click **Open** to close the browser dialog.
7. Click **OK** to close the *Boundary Conditions Forcing Options* dialog.

It is good practice to save the SMS project often while working. Save a copy of the project to maintain the original version in case there is a need to go back.

8. Select *File* | **Save As**… to bring up the *Save As* dialog.
9. For the *File name*, enter "SyntheticChannelExecute2".
10. Click **Save** to save the project and exit the *Save As* dialog.

6 Defining the ADCIRC Simulation

With the required components for an ADCIRC simulation created, next create the simulation:

1. Right-click in the empty space in the Project Explorer and select *New Simulation* | **ADCIRC**.

A new simulation named " Sim" will be added to the Project Explorer.

2. In the Project Explorer, drag the "Pave" mesh into the " Sim" simulation.
3. Drag the " BC" coverage into the " Sim" simulation.

SMS maps the boundary conditions onto the mesh that is in the simulation when the boundary condition coverage is added to the simulation. This allows the same boundary condition coverage to be used with multiple meshes. This is limited when using a provided fort.19 file, as in this example, because the fort.19 must have the correct number of values based on the spacing of the nodes in the mesh.

There is now a simulation that includes the mesh and boundary conditions.

7 Specifying the Model Parameters

ADCIRC includes many run options specified in the form of model parameters. Default values are provided by SMS, but these may need to be overwritten. A few will be specified for this tutorial. To do this:

1. Right-click on the "Sim" simulation and select **Model Control…** to open the *ADCIRC Model Control* dialog.
2. In the *General parameters* tab, set the *Project title* to "500 m Synthetic Channel".
3. Set the *Run ID* to "1hr fort.19".

These fields can be anything. Their purpose is to document the simulation.

4. In the *Model formulation* tab, set the *Horizontal viscosity (L **2/t):* to “2.0”.
5. Change the *Finite amplitude terms* to “With wetting/drying”.
6. Set the *Minimum depth* and *Minimum vel (m/s)* parameters to “0.1”.
7. Set the *Weighting factor* to “Pure primitive equation: TAU0 specified”.
8. Set *Tau0* to “0.005”.
9. In the *Timing* tab, set the *Length of run (days):* to “1.0”.
10. In the *Output* tab, on the *Default* row, specify the *End (days)* column to “1.0”.
11. Set the *Increment (min)* column to “15.0”.

Since the *Override Default* option is not checked, these values apply to all output from ADCIRC which includes the global elevation and velocity in this case.

12. Click **OK** to exit the *ADCIRC Model Control* dialog.

8 Executing the Simulation

The ADCIRC simulation is ready to run. SMS will check the inputs and settings for obvious errors or missing components. SMS will display a progress window to show progress as the simulation runs. Run time depends on the size of the mesh, the duration of the simulation, the number of CPU cores and the speed of the computer being used. It can vary from minutes to hours. In this case it should take a few minutes.

To run the simulation:

1. Right click on the “Sim” simulation and select **Model Check…**.
2. If all steps have been completed correctly, a dialog should appear that states: “No model checks violated”. Click **OK** to close this message.
3. Right click on the “Sim” simulation and select **Save Project, Simulation and Run** to bring up the *Simulation Run Queue* dialog.

SMS will update the project files, export the simulation files for ADCIRC, and launch the analysis. The *Simulation Run Queue* window will appear as shown in Figure 5. This window includes a progress bar for this simulation, and an output message appears for each 1000 time steps of analysis.

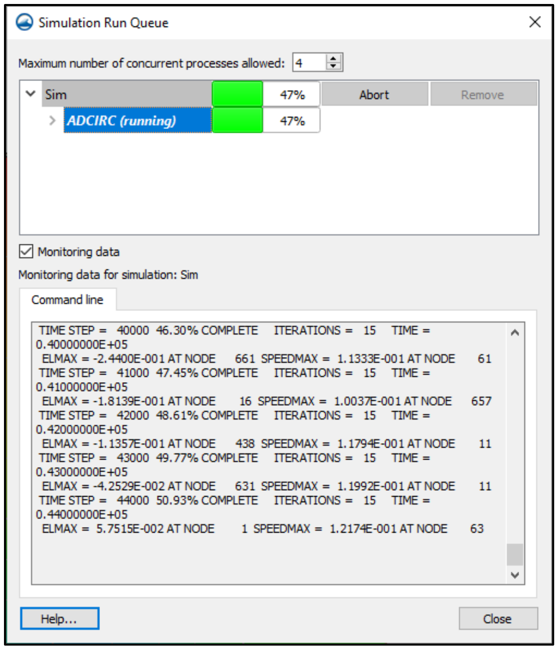


Figure 5 Simulation Run Queue during run

When the simulation is complete, the **Abort** button in the *Simulation Run Queue* changes to a **Load Solution** button (as shown in Figure 6).

4. Click the **Load Solution** button.

A new folder will appear below the mesh in the Project Explorer named " Sim (ADCIRC)". This is the solution from the ADCIRC analysis.

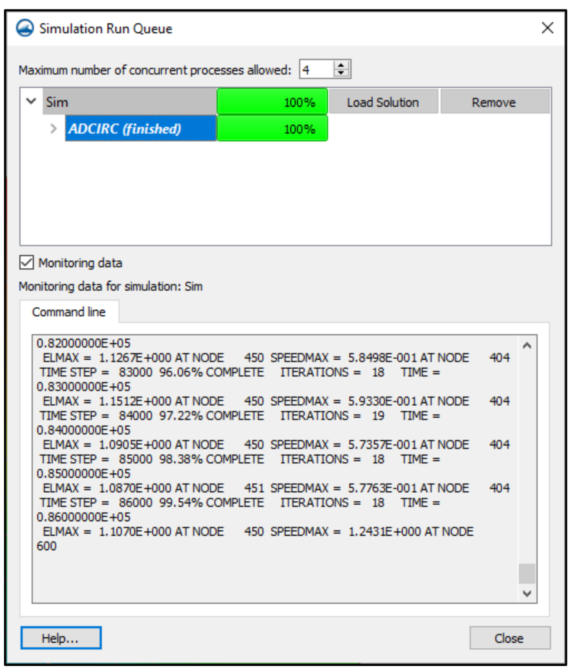


Figure 6 Simulation Run Queue when run completes

The solution includes the water surface and current velocities for each 15-minute interval in the 24 hour simulation. It also includes extreme values in the maximum speed and water surface values computed at each point in the mesh, and the time of these values in datasets is stored in the " Extremes" folder. The *Time steps* window appears at the bottom of the left panel since there are now transient datasets. Selecting a time in this window changes the active time step being viewed in the Graphics Window.

9 Exploring the Results

At this point the solution created by ADCIRC can be explored by selecting datasets, selecting time steps, and experimenting with display options for the contours.

1. Select the "Water Surface (eta)" dataset and make sure the " Pave" mesh is turned on in the Project Explorer.

The SMS window should now look similar to Figure 7.

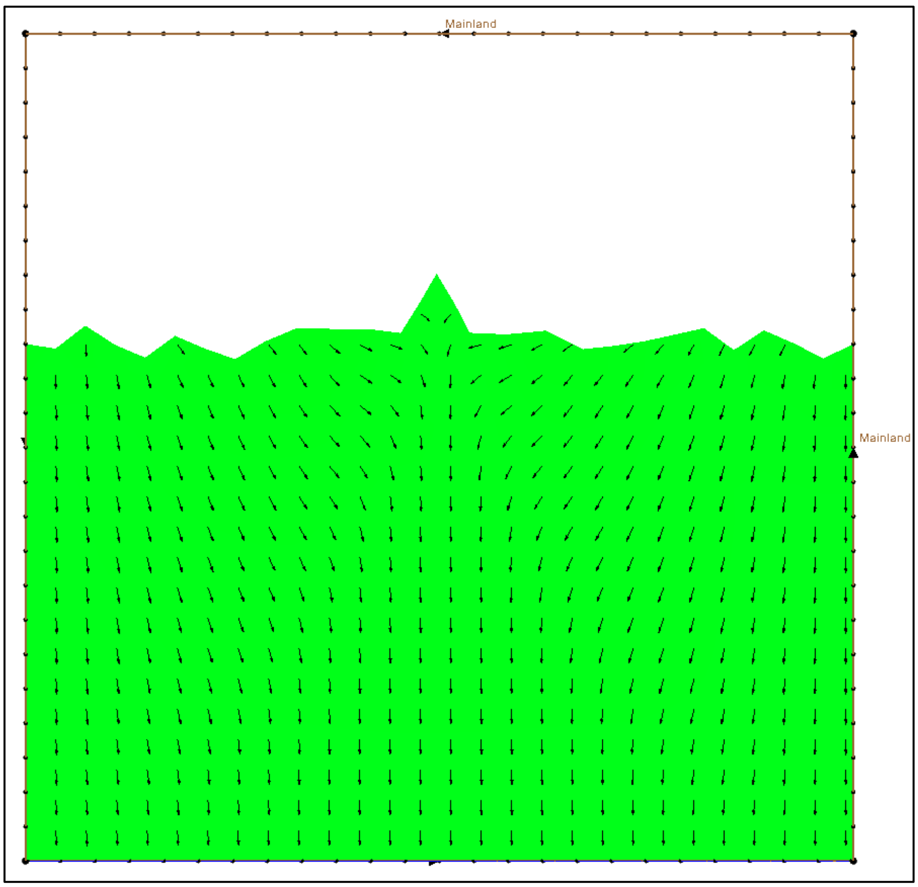


Figure 7 Water Surface Elevation computed by ADCIRC

For a more complete discussion of how the solution can be explored, see the "ADCIRC Synthetic Channel Solution – Part 1" tutorial.

10 Conclusion

This tutorial illustrated how to set up and launch an ADCIRC simulation inside of SMS. It did not make use of the parallel computation option available in ADCIRC.

A typical desktop machine can make use of multiple cores and threads to get a significant improvement in performance.

This concludes the “ADCIRC – Synthetic Channel Run Simulation – Part 1” tutorial. Topics covered in this tutorial included:

- Creation of an ADCIRC boundary conditions coverage and assignment of boundary conditions to specific locations.
- Specification of ADCIRC parameters.
- Execution of the ADCIRC simulation and loading the solution.

Additional description of the ADCIRC parameters is provided in part 2 of the tutorial.