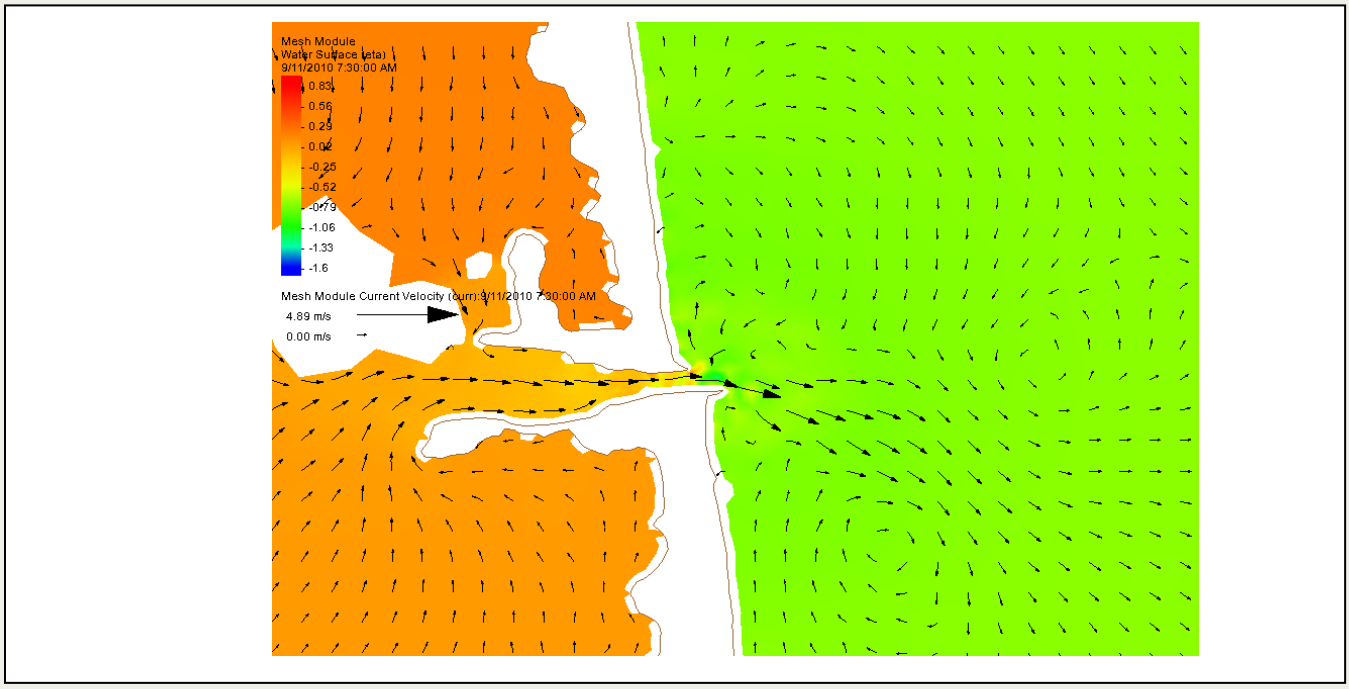
SMS 14.0 Tutorial

ADCIRC Stability



Objectives

This tutorial demonstrates how to modify an ADCIRC simulation to improve stability. This is a very complex and involved subject with many options and alternatives. This exercise demonstrates a couple of simple approaches.

Prerequisite Tutorials

- Overview
- Map Module
- Raster
- Background Data
- Simulation Domain
- Mesh Generation
- Mesh Quality

Required Components

- SMS Core

Time

- 15–20 minutes

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1 Introduction

This exercise illustrates how to modify an ADCIRC Simulation in the Surface-water Modeling System (SMS) to increase numerical stability.

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 option to bring up the *Open* dialog.
3. Navigate to the *Exercises/Indian River* folder.
4. From the *Files of type* drop-down menu, select “Project Files (*.sms)”.
5. Select the “IR_tides.sms” file.
6. Click the **Open** button to import the project and exit the *Open* dialog.

The initial project should appear similar to Figure 1.

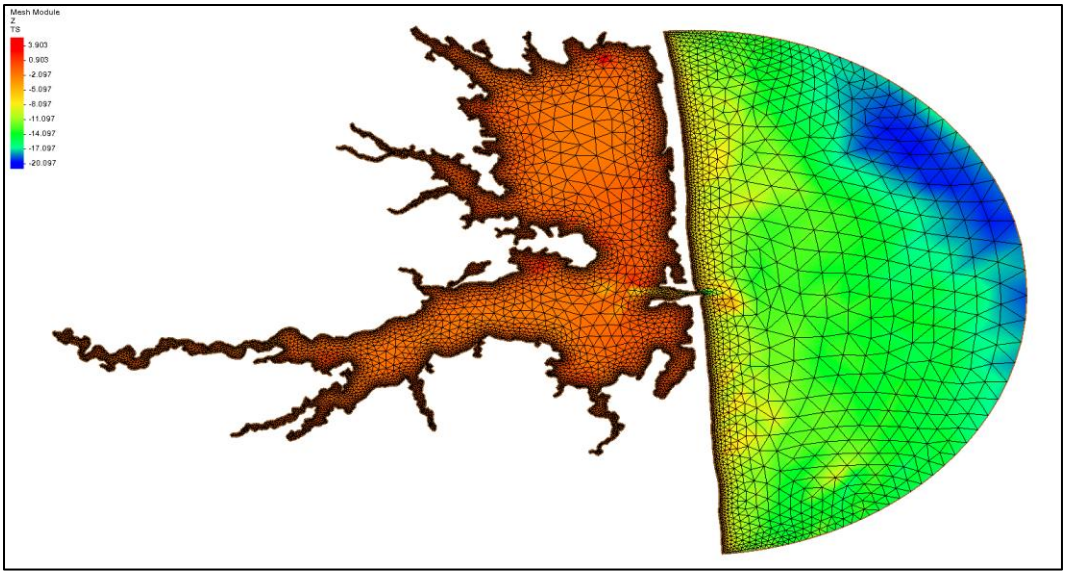

Figure 1: Initial Project

3 ADCIRC Stabilizers

The project just loaded into SMS represents a specific set of model parameters. In this case, the parameters are the defaults suggested by the ADCIRC developers. Executing ADCIRC with these parameters results in an unstable solution. The process diverges during the ramp period.

We want to evaluate the impact of changing model parameters on simulation stability. To do this we will duplicate the simulation, change a parameter and execute the modified simulation.

Specifically, we will evaluate three specific parameters, these include:

- Tau0
- Eddy viscosity
- Bottom friction

3.1 Duplicating the Simulation

The simulation in this project is almost identical to the one specified in the ADCIRC Simulation tutorial. The only difference is that the output time range has been changed to start at 1.0 days into the run rather than including the ramp period.

To create a duplicate ADCIRC simulation:

1. In the *Project Explorer*, in the "Simulation Data" folder, right-click on the "Tide" simulation and select the **Duplicate** context menu item. This creates the simulation "Tide (2)".
2. Rename the "Tide (2)" simulation to "Tide – increase tau0".
3. Repeat steps 1 and 2 renaming the new simulation to "Tide – increase viscosity".
4. Repeat steps 1 and 2 renaming the new simulation to "Tide – increase friction".

3.2 Modifying Model Parameters

To modify the ADCIRC simulation parameters:

1. In the *Project Explorer*, right-click on the "Tide – increase tau0" simulation and select the **Model Control…** context menu item to open the *ADCIRC Model Control* dialog.
2. Select the *Model formulation* tab:
    a. In the *Generalized wave continuity equation – GWCE* section, for the *Weighting factor*, select the "Pure primitive equation: TAU0 specified" drop-down menu item.
    b. For the *Tau0* value, enter "0.09" (the default value is 0.001).
    c. Click the **OK** button to exit the *ADCIRC Model Control* dialog.
3. Right-click on the "Tide – increase viscosity" simulation and select the **Model Control…** context menu item to open the *ADCIRC Model Control* dialog.
4. Select the *Model formulation* tab:
    a. In the *Model type - IM* section, for the *Horizontal viscosity (L **2/t)* value, enter "10.0" (the default value is 3.0).

b. Click the **OK** button to exit the *ADCIRC Model Control* dialog.

5. Right-click on the "Tide – increase friction" simulation and select the **Model Control…** context menu item to open the *ADCIRC Model Control* dialog.
   a. Select the *General parameters* tab:
   b. In the *Bottom stress/friction – NOLIBF* section, for the *Friction coefficient,* enter 0.03 (the default value is 0.0025.
   c. Click the **OK** button to exit the *ADCIRC Model Control* dialog.

The values specified above have been determined by trial and error for this simulation. In this simulation, when changing only Tau0 from the default value, the simulation becomes stable when the value exceeds 0.09. When changing only the eddy viscosity, the simulation is stable for values between 7.5 and 15. When changing only the bottom friction coefficient, the simulation is stable for values over 0.03.

4 Saving the Project

To save the project:

1. From the *Menu* bar, select the *File* | **Save As...** menu item to open the *Save As* dialog.
2. Navigate to the *Exercises/Indian River/work* folder.
3. For the *File name,* enter "IR_stability.sms".
4. Click the **Save** button to save the file and close the *Save As* dialog.

5 Running Multiple Simulations

The simulations are now ready to be run. To start the runs:

1. In the *Project Explorer,* right-click on the "ADCIRC Simulations" object and select the *Save Multiple Simulations and Run* context menu item tp open the *Simulations* dialog.
2. Turn off the "Tide" simulation checkbox.
3. Click the **OK** button to close the *Simulation* dialog and open the *Exporting fort.15* dialog.

This command does the following:

- Saves all the selected simulations
- Launch the *Simulation Run Queue* and starts all selected simulations. Progress of the simulations can be monitored in the Simulation Run Queue.

Depending on the site being simulated, one or more of these runs could be successful. You may also combine stabilizers to get a successful simulation.

For this specific project, increasing the eddy viscosity should result in a stable run. For other simulations, it may be an increase one of the other stabilizers. Multiple simulations runs are always needed in conjunction with calibration and/or sensitivity analysis.

Note: A 3-day simulation in a serial version of ADCIRC for this size of a mesh takes about 15-20 minutes.

6 Conclusion

This concludes the “ADCIRC Stability” exercise. Several features have been demonstrated including:

- Duplicating an ADCIRC simulation.
- Modifying parameters.
- Saving and running multiple ADCIRC simulations.

When evaluating a simulation, you may want to consider changing a combination of these parameters. No guidance is provided by the ADCIRC group at this time for which parameters should be changed and what rates of change should be considered.

If time permits, you may wish to try experimenting with:

- Further experimentation with different values of Tau0, horizontal eddy viscosity (ESLM) or bottom roughenss.
- Using Manning’s N or Chezy C instead of Cf.