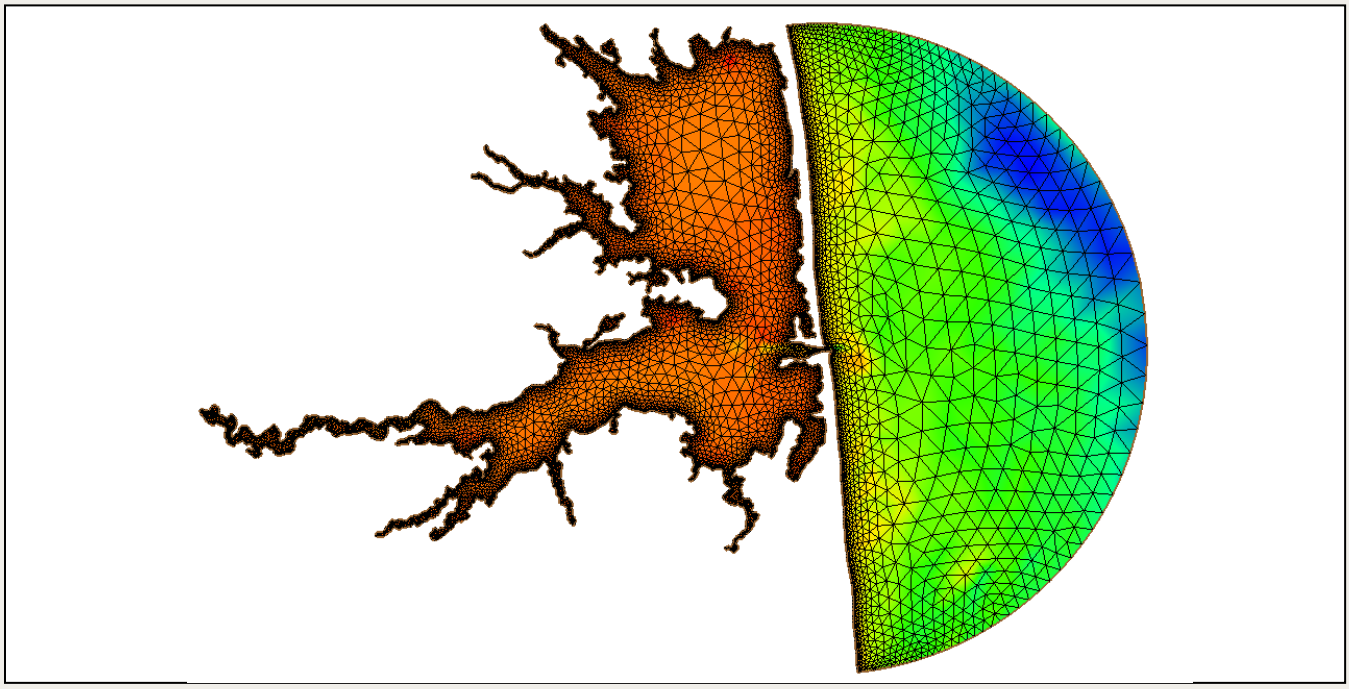
SMS 14.0 Tutorial

ADCIRC Visualization



Objectives

This tutorial demonstrates how to look at the datasets created by an ADCIRC simulation. This includes specifying contour options, vector options, display themes and an introduction to use of the dataset toolbox.

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 work with a solution from an ADCIRC Simulation in the Surface-water Modeling System (SMS).

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 a completed solution:

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

The initial project should appear similar to Figure 1.

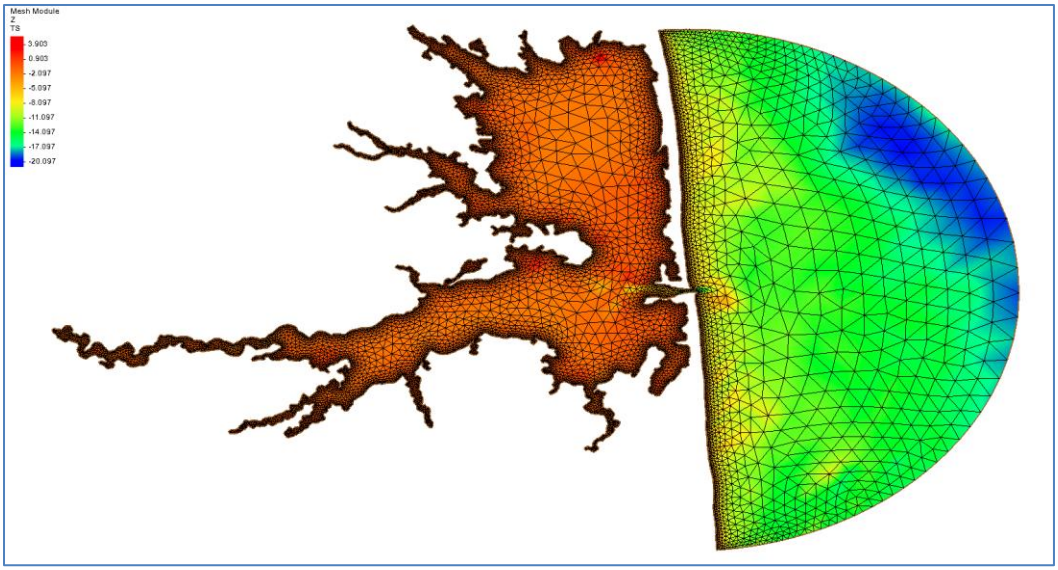

Figure 1: Initial project

3 Datasets

This project contains an ADCIRC simulation and solution datasets including the water surface and currents (velocity and direction) over time, and the extreme values of each of these quantities.

A dataset is the name SMS users for a value that varies through space and time. ADCIRC computes datasets representing the water surface and currents in the domain. These appear in the *Project Explorer* in two places.

First, they are in a folder beneath the mesh that is the basis of the simulation.

Second, they are in a folder inside the simulation.

3.1 Setting the Time Display

An ADCIRC simulation spans a range of times. The datasets are referenced to a starting date/time specified in the simulation. SMS can display these dates relative to a user specified date/time or as explicit date/time values.

Since a project can include multiple simulations, the user must specify a reference date/time. To do this:

1. In the *Time steps* window below the *Project Explorer*, right-click on the “Time steps:” title and select **Time Settings** context menu item to open the *Time Settings* dialog.
2. In the *Time display* section of the dialog, for the *Display as* field, select the “Absolute Date/Time” drop-down menu item.
3. For the *Date Format* field, select “mmm dd.yyyy” from the drop-down menu.
4. Click the **OK** button to close the *Time Settings* dialog.
5. In the *Time steps* window, select the last time step (Oct 24, 2012 12:00 AM).

Notes: Time steps now appear in a date/time format as specified in the dialog.

The ADCIRC datasets have a reference time assigned to them. This can be viewed by right-clicking on any dataset and selecting the *Properties* command. This displays meta-data related to the dataset including number of time steps, reference time and data range among other information.

4 Contour Plots

The primary method for visualizing a dataset is to use a *contour plot* of the values over the domain. A contour plot uses a range of colors to represent a range of values.

In SMS, the user can control many options including how many contours are displayed, the range of values, the style used, and the colors used.

We will illustrate some of the contour options using the "Water Surface (eta)" dataset.

4.1 Setting Contour type and Color Palette

Contours can be displayed as lines of a filled range of colors. The user also has control of what colors should be used. To illustrate this:

1. In the *Project Explorer,* select the "Water Surface (eta)" dataset.
2. From the *Menu* bar, select the *Data* | **Contour Options…** menu item (or select the **Contour Options** macro from the *Macro* bar) to open the *Display Options* dialog.
3. From the list on the left, select the *2D Mesh* option page, then in the section on the right, select the *2D Mesh* tab.
4. In the *Contour method* section, click on the **Color Ramp…** button to bring up the *Choose color ramp* dialog.
5. From the *Aquaveo* folder, select the "Magnitude difference" palette.
6. Click the **OK** button to close the *Choose color ramp* dialog.
7. Click the **OK** button to close the *Display Options* dialog.

The display should now appear as shown in Figure 2. This color palette includes warm colors to represent higher values (flooding) and cool colors to represent lower values. The image in SMS represents the water level at the selected time of the ADCIRC simulation.

Unless specified otherwise, ADCIRC starts with a constant water level of 0.0. Throughout the simulation the water level reacts to the forcing functions. Parts of the mesh may dry out. These areas are not colored because they have no water level.

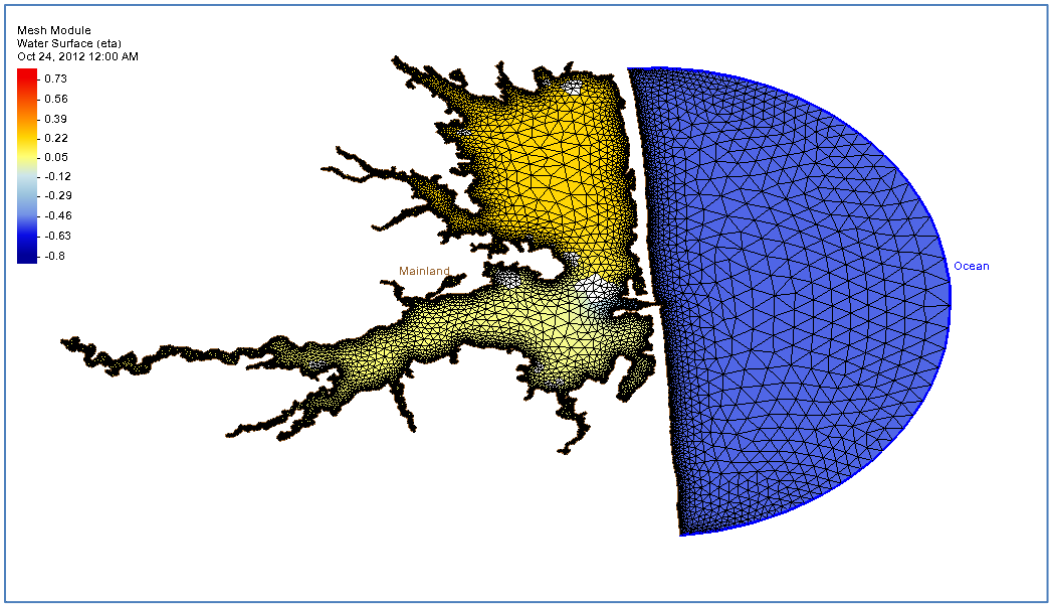

Figure 2: The water level.

Click on various times in the *Time steps* window to see how the water level changes through the simulation. You may also use the "up" and "down" arrows to step through the times once the time step window has the focus.

Note how the water level offshore decreases as the tide goes out and the water in the bay responds, and then the tide rises, and the bay responds to that.

5 Vector Plots

SMS can also plot vector arrows representing datasets that have both direction and magnitude (vector datasets) such as the current dataset created by ADCIRC. These plots are useful for visualizing flow patterns.

To turn on the display of vectors, and illustrate some of the options:

1. From the *Menu* bar, select the *Display* | **Display Options…** menu item (or select the **Display Options** macro from the *Macro* bar) to open the *Display Options* dialog.
2. From the list on the left, select the *2D Mesh* option page, then in the section on the right, select the *2D Mesh* tab.
3. Turn the *Elements* checkbox "Off".
4. Turn the *Vectors* checkbox "On".
5. Click on the *Vectors* tab to set the options for vector display.
6. Under the *Vector Display Placement and Filter* section, from the *Display* drop-down menu, select "on a grid".
7. From the *Origin* drop-down menu, select "Relative to max elevation".
8. Under the *Arrow options* section, turn on the *Arrows follow flow path* checkbox.
9. Click the **OK** button to exit the dialog.

Now step through the timesteps again to view the flow directions. You may want to make sure that *Water Surface (eta)* is the active scalar dataset. You can also zoom into the inlet or other areas of the bay to view circulation in those areas.

6 Flow Trace Animation

SMS also includes an option to generate animations. This could be an animation of the time steps (as you have been doing manually by stepping through), or an animation of the flow field, which is referred to as a "Flow Trace" in SMS.

To generate a flow trace animation:

1. From the *Menu* bar, select the *Display* | **Display Projection…** menu item to open the *Display Projection* dialog.
2. In the *Horizontal* section, click the **Set Projection…** button to open the *Horizontal Projection* dialog.
3. From the *Recent Projections* list, select the "NAD83_District_of_Columbia_Maryland" projection. (Film Loop animations only work in rectilinear space.)
4. Click the **OK** button to close the *Horizontal Projection* dialog.
5. Click the **OK** button to close the *Display Projection* dialog.
6. From the *Menu* bar, select the *Data* | **Film Loop…** menu item to open the *Film Loop Setup – General Options* dialog.
7. In the *Select film loop Type* section, select the **Flow Trace** checkbox
8. Click the **Next** button to open the *Film Loop Setup – Time Options* dialog.
9. In the *Filmloop time* section, from the *Run Simulation* drop-down menu, select the "Oct 22, 2012 9:00 AM" drop-down menu item.
10. Select the *Specify time step size* radio button.
11. For the *Specify time step size,* enter "0.25" and from the drop-down menu, select "hours".
12. Click the **Next** button to open the *Film Loop Setup – Flow Track Options* dialog.
13. In the *Options* section, for the *Particles per object,* enter "0.25". This reduces the number of particles in the animation.
14. For the *Decay ratio,* enter "0.125". This shortens the length of the particles to further reduce clutter.
15. Click the **Next** button to open the *Film Loop Setup – Display Options* dialog. No changes need to be made for this example.
16. Click the **Finish** button to close the *Film Loop Setup – Display Options* dialog and run the command.
17. The status bar will show the progress of the command. When done the animation will be saved to the working directory, and open in the default media player.
18. Close the media viewer application when you have reviewed the animation.

SMS computes the flow trace and then launches an application to view the animation. Experiment with the *Speed* control to visualize the currents.

Notice the eddy patterns that form around the ebb shoal. Also note that the length of the particle represents relative speed of the current, however, all the velocities are exaggerated in this case. There is a parameter to slow these down as well. There is also an animation type that uses the absolute velocity in the vector dataset.

Note: SMS generates a flow trace animation for whatever is visible on the screen. If you want a flow trace of a smaller region, zoom into that region and repeat the flow trace generation process.

7 Conclusion

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

- Setting contour options.
- Setting up and using contour option display themes.
- Setting vector display options.
- Using a projection from the recent projection list.
- Generating a flow trace animation.

This is only the tip of the iceberg for visualization options in SMS. Refer to tutorials on the following subjects for more information:

- Data Visualization
  - Contour options
  - Color ramps or palettes
  - Data Calculator
  - Vector options
  - Animations
  - Functional Surface
- Dataset Toolbox
  - Math tools
  - Spatial tools
  - Temporal tools
- Datasets to Ratsers
- Multiple display theme tutorials.
- Observation Data – creating profile and section plots.

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

- Changing contour options.
- Changing vector options.
- Changing flow trace options.