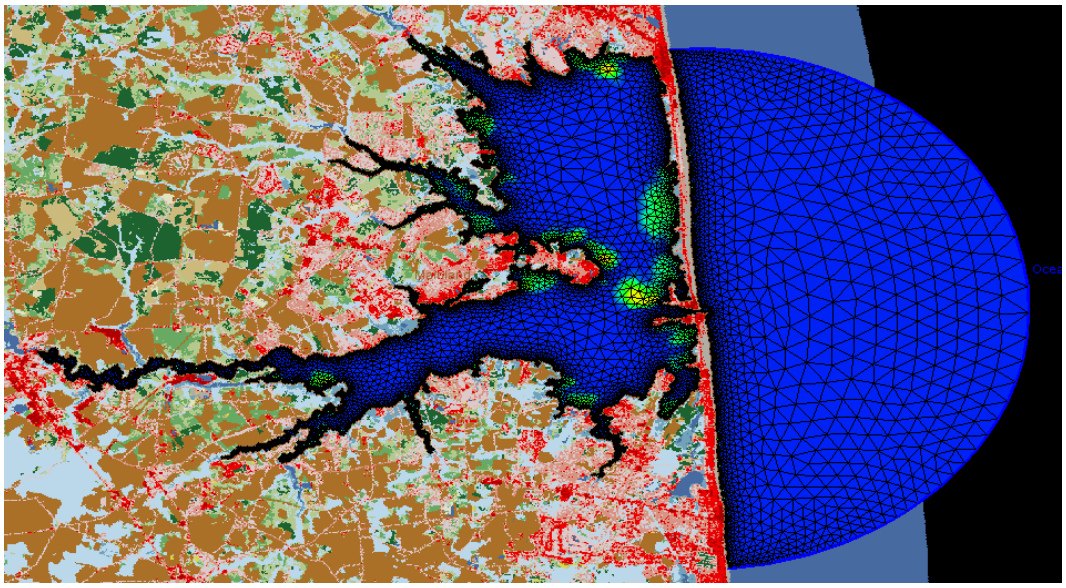
SMS 14.0 Tutorial

Nodal Attributes



Objectives

This tutorial demonstrates how to create datasets in SMS for use as nodal attributes in an ADCIRC simulation. This is referred to as “nodal attributes” in ADCIRC.

Prerequisite Tutorials

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

Required Components

- SMS Core

Time

- 10–15 minutes

AQUAVEO™

1 Introduction

This exercise illustrates how to create nodal datasets and use them an ADCIRC Simulation as nodal attributes 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 item.
3. From the *Files of type* drop-down menu, select "Project Files (*.sms)".
4. Navigate to the *Extra Exercises/Indian River* folder
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.

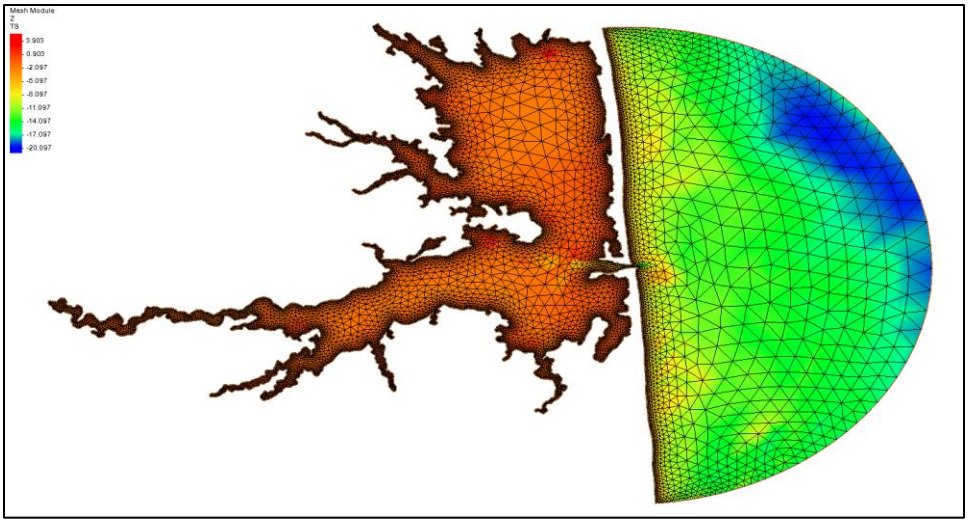


Figure 1: Initial Project

3 ADCIRC Nodal Attributes

ADCIRC makes use of a number of model parameters that can vary spatially over the domain. The representation of these attributes is achieved by specifying a values for the attribute at each node in the mesh. This is referred to as a dataset in the SMS interface.

The first dataset you use in an ADCIRC simulation is the elevation (depth) of each node). ADCIRC computes water surface and velocity (varied over time) as the solution to the simulation that are also loaded into SMS and can be plotted and examined.

In practice, ADCIRC recognizes that even though the value of the parameters varies over space, many of the nodes may have the same value. Therefore, a default value can be specified and then only the non-default nodal values need to be explicitly written. This decreases the file size of the fort.13 file, which stores these parameters.

The full list of the parameters that can vary is space are detailed on the ADCIRC wiki (https://wiki.adcirc.org/Fort.13_file). Specifically, we will review three parameters:

- Manning's N
- Eddy viscosity
- Bottom friction

3.1 Land Cover Data

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 download a land use raster:

1. From the *Menu* bar, select the *File* | **Import from Web…** menu item to open the *Virtual Earth Map Locator* dialog will appear showing the area of the model domain.
2. Click the **OK** button to accept the default area and open the *Data Services Options* dialog.

Note: Data services are web sites that allow data retrieval as a service. SMS includes default specifications for a number of applicable services. For this example, we will download land cover data.

3. Select the "NLCD 2011 (US National Land Cover Database)" web service.
4. Click the **OK** button to close the *Data Services Options* dialog and open the *Save Web Services Data File(s)* dialog.
5. Browse to the working directory.
6. For the *File name,* enter "IR_NLCD".
7. Click the **OK** button to close the *Save Web Services Data File(s)* dialog and open a confirmation dialog.
8. Click the **Yes** button to confirm that a new file will be downloaded to your machine and open the *Raster Cell Size* dialog.
9. For *Enter the raster cell size (arc degrees),* enter "0.0002". (This corresponds to approximately 20 meters at the equator which is about the smallest cells in our mesh.)
10. Click the **OK** button to close the *Raster Cell Size* dialog and download the data.

The image should now appear similar to Figure 2. Each pixel of this raster is associated with a vegetation, soil or similar attribute describing how the land is used.

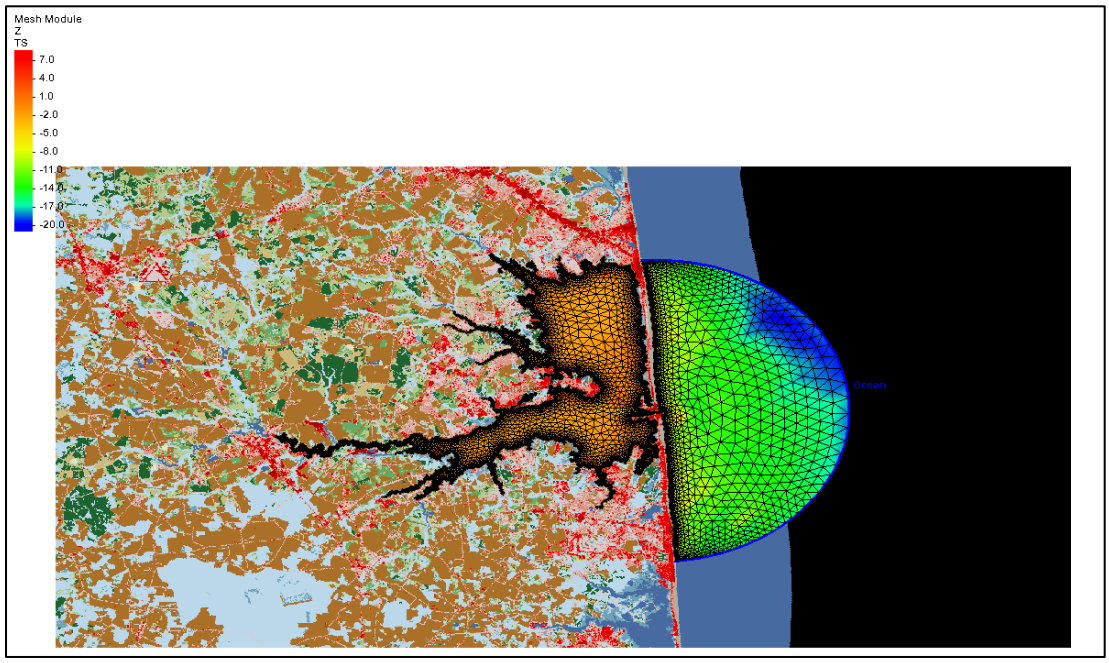


Figure 2: The NLCD Raster

3.2 Creating a Manning's N Nodal Attribute

SMS creates datasets for use as nodal attributes. The toolbox includes various specific tools for this purpose.

One type of nodal attribute is variable friction. Normally this is applied in simulations that are flooding over land but can be applied in other shallow regions. To create this dataset:

1. From the *Macro* toolbar, click on the **Toolbox** macro to open the *Toolbox (beta)* dialog.
2. Select the *Tools* tab.
3. Expand the "Datasets" folder to reveal the dataset tools.
4. Double-click on the **Manning's N from Land Use Raster** command to open the *Manning's N from Land Use Raster* tool dialog.
5. For the *Input landuse raster*, select the "GIS Data/IR_NLCD_nlcd2011.tif" coverage from the drop-down menu.
6. For the *Target grid,* select the "Mesh Data/constant pave 50-1000m" mesh from the drop-down menu. This is where the dataset will be created.
7. For the *Default Mannings N value,* enter "0.02".
8. Leave the other parameters at default.
9. Click the **OK** button to close the *Manning's N from Land Use Raster* dialog and open a status log dialog.
10. When the simulation completes, dick the **OK** button to close the status log dialog.

The image should now appear similar to Figure 3. The new “Land Use” dataset is contoured to show variable roughness. As you move the mouse cursor over the grid, the N value for the cursor location is displayed in the *Status bar,* at the bottom of the screen. Areas of shallow water are assigned a higher value.

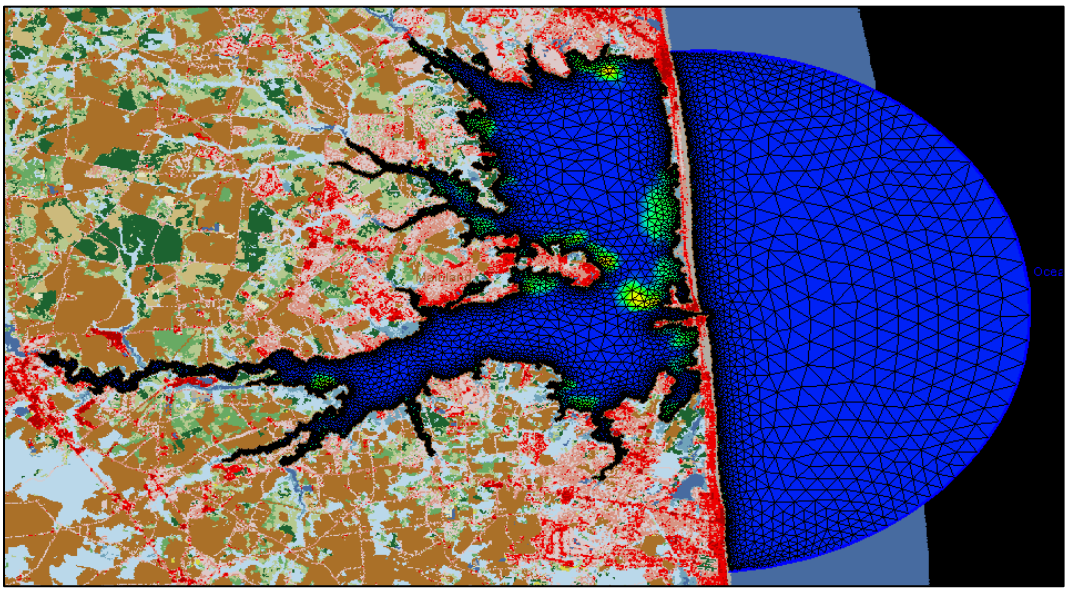


Figure 3: The Manning’s N Dataset

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_nodal_atts.sms".
4. Click the **Save** button to save the file and close the *Save As* dialog.

5 Using the Manning’s N dataset in the Simulation

Once the nodal attribute dataset exists, it can be used in the simulation by:

1. In the *Project Explorer,* in the “ Simulation Data” folder, right-click on the “ Tides” object and select the **Model Control…** context menu item to open the *ADCIRC Model Control* dialog.
2. In the *General parameters* tab, in the *Bottom stress/friction – NOLIBF* section, select the *Manning’s N nodal attribute – ManningsN* drop-down menu item.
3. Click the **Select** button to open the *Select a friction dataset* dialog.
4. Turn on the “Land Use” dataset checkbox.
5. Click the **OK** button to close the *Select a friction dataset* dialog.
6. Click the **OK** button to close the *ADCIRC Model Control* dialog.

This setting instructs SMS to add this dataset to the fort.13 file when the ADCIRC simulation is saved.

6 Creating a Primitive Weighting Nodal Attribute

Another type of nodal attribute is variable primitive weighting (Tau0). As we saw in the stability exercise, this parameter can influence ADCIRC stability. Research has shown that depth and cell size can contribute to instability related to this parameter, so the ADCIRC development team has created guidelines for spatially variable tau0 based on these parameters. To create this dataset:

1. From the *Macro* toolbar, click on the **Toolbox** macro to open the *Toolbox (beta)* dialog.
2. Select the *Tools* tab.
3. Expand the "Datasets" folder to reveal the dataset tools.
4. Double-click on the **Primitive Weighting** command to open the *Primitive Weighting* tool dialog.
5. For the *Target grid,* select the "Mesh Data/constant pave 50-1000m" mesh from the drop-down menu. This is where the dataset will be created.
6. For the *Critical average node spacing,* enter "50.0".
7. Leave the other parameters as specified.
8. Click the **OK** button to close the *Primitive Weighting* dialog and open a status log dialog.
9. When the simulation is completed, click the **OK** button to close the status log dialog.

This creates a dataset that varies from 0.02 in shallow water to 0.005 in deep water for cells with an average size greater than 50 m. For smaller cells, a tau0 of 0.03 is assigned. This dataset can also be evaluated graphically as was done for Manning's N.

7 Using the Primitive Weighting dataset in the Simulation

The primitive weighting dataset can be used in the simulation by:

1. In the *Project Explorer,* in the "Simulation Data" folder, right-click on the "Tides" object and select the **Model Control…** context menu item to open the *ADCIRC Model Control* dialog.
2. In the *Model formulation* tab, under the *Generalized wave continuity equation – GWCE* section, for the *Weighting factor,* select the "From nodal attribute: TAU0 = -3" drop-down menu item.
3. Click the **Select** button to open the *Select a TAU0 dataset* dialog.
4. Turn on the "Tau0" checkbox.
5. Press the **OK** button to close the *Select a TAU0 dataset* dialog.
6. Press the **OK** button to close the *ADCIRC Model Control* dialog.

This setting instructs SMS to add this dataset to the fort.13 file when the ADCIRC simulation is saved.

8 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_nodal_atts.sms".
4. Click the **Save** button to save the file and close the *Save As* dialog.

9 Conclusion

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

- Downloading data from web service portals.
- Using NLCD (land classification) rasters.
- Creating datasets.
- Instructing ADCIRC to use datasets as nodal attributes.

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

- Other dataset tools.
- C-Cap data instead of NLCD data.
- Other bottom friction options.
- Running ADCIRC with the changed parameters.