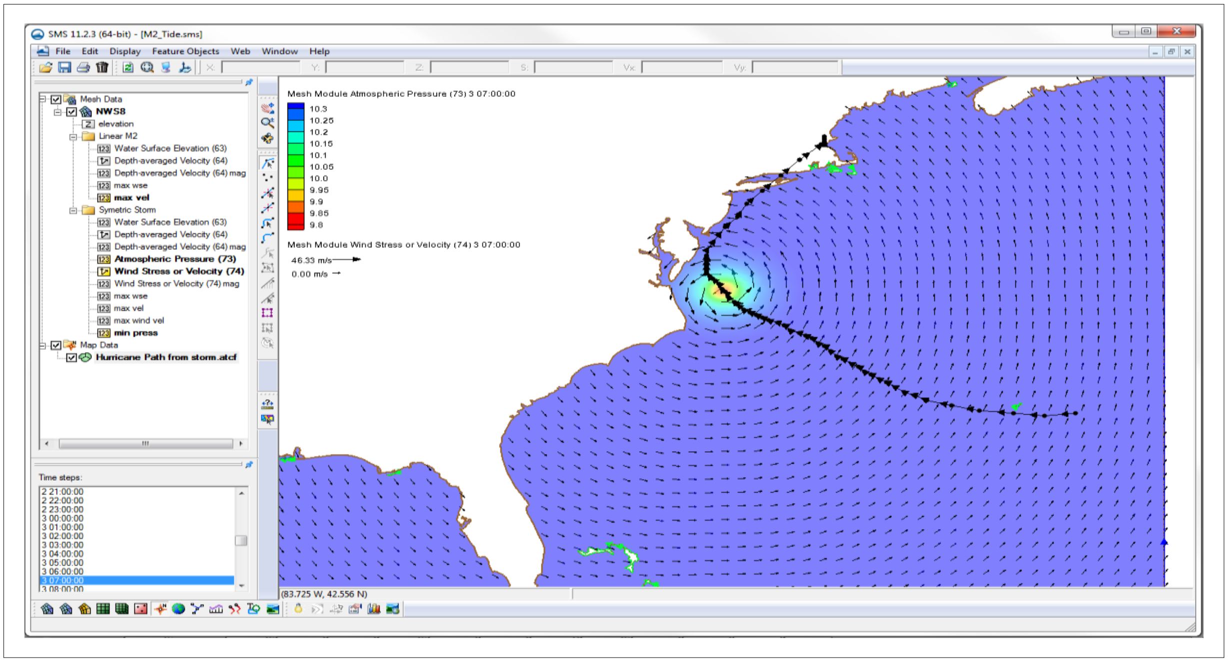
v. 12.2

SMS 12.2 Tutorial

ADCIRC – Symmetric Cyclone Simulation



Objectives

This lesson gives an overview of the ADCIRC functionality to generate the winds of a symmetric cyclonic storm (NWS = 8) and the interface to this option in the SMS. ADCIRC supports multiple wind formats and includes the two separate wind generation models which can simulate cyclonic storms. Storm definitions can be downloaded from historic databases or defined interactively.

This tutorial will teach the basic skills concerning how to use the dynamic image option.

Prerequisites

- Overview Tutorial
- ADCIRC Tutorial

Requirements

- ADCIRC Interface
- ADCIRC Model

Time

- 20–30 minutes

1 ADCIRC Symmetric Cyclonic Wind Option

The ADCIRC model includes many options for simulating wind in an analysis. The type of wind is specified as the NWS parameter in the *ADCRIC Model Control* dialog (fort.15 or control file). This document addresses the option in ADCIRC for generating a wind field representing a symmetric cyclonic storm during the ADCIRC simulation. The generated wind and pressure fields generated by ADCIRC can be exported during this type of a simulation for inspection in relation to hydraulic currents and water levels computed during the simulation.

2 The ADCIRC Simulation

To apply a cyclonic storm model in ADCIRC, an ADCIRC simulation must exist. For this example, a fairly low resolution representation of the Western North Atlantic (WNAT) is provided. The grid (fort.14 or *.grd) consists of approximately 53,000 nodes. For information on how to set up a basic ADCIRC simulation, refer to the ADCIRC modeling tutorial.

To open the project:

1. Launch SMS or select the *File* | **Delete All** command to remove any existing data if SMS is already running.
2. Select the *File*| **Open** command to bring up the *Open* dialog.
3. Locate the project “NWS8.sms” in the data files folder for this tutorial and click **Open**.

SMS will open the project and display the domain as shown in Figure 1.

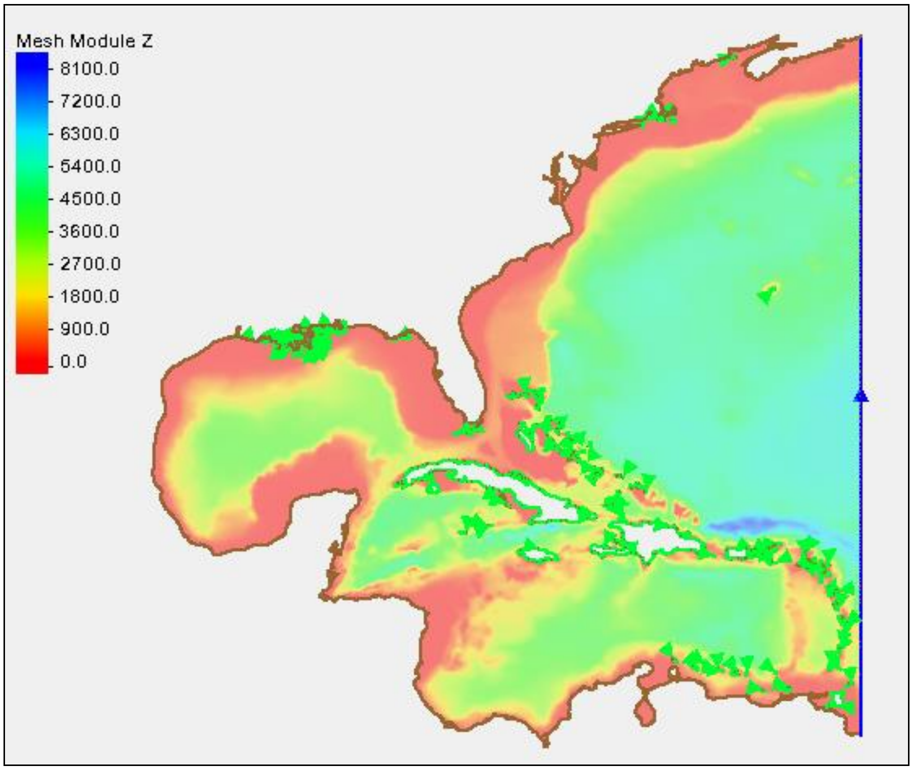


Figure 1 The NWS8 file displayed in SMS

2.1 Review of Model Parameters

It is always a good idea to be familiar with a simulation before modifying it. Since this project was provided, take a few minutes to review the characteristics of the simulation.

1. Select *Display* | **Projection...** to bring up the *Display Projection* dialog.
2. Confirm the project is working in geographic coordinates—Geographic (Latitude/Longitude), Zone NAD83, arc degrees.
    a. If this is not the projection shown, click on **Set Projection** and enter the correct projection in the dialog that follows. See the "Projections" tutorial for instruction on how to do this.

Most ADCIRC analysis runs will utilize geographic space, but often the grid is constructed in a rectilinear space and then converted to the geographic projection.

3. Click **OK** to exit the *Display Projection* dialog.
4. Activate the Mesh module and Select *ADCIRC* **| Model Control...** to bring up the *ADCIRC Model Control* dialog.

Review the selected model parameters:

5. In the *General* tab, note that the project title is "M2 Tide". This reflects that the base simulation runs a single tidal constituent. This tab also shows that the nonlinear model options (*Finite amplitude terms*, *Advective terms*, and *Time*

derivative terms) are disabled. For production runs, these terms would be enabled. They are disabled here for speed in working with the tutorial.

6. Click on the *Timing* tab. Note that the *Coldstart start time* is August 15, 2010 and the *Time step* is "20" seconds. The cold start date comes into play when using NWS = 8 because the defined storm must span the duration of the simulation. The time step can be so large because the project is only using linear terms.
7. Click on the *Wind* tab. Note that the *Wind File Type* is set to "NWS = 0 – No wind".
8. Click **OK** to exit the *ADCIRC Model Control* dialog.

2.2 No Wind Solution

If interested, a solution for the simulation as configured has been included. It can be viewed by opening the "nws0.h5" file included with the tutorial data files. The solution consists of water surface elevations and depth averaged velocities at hourly intervals for four days of simulation (day 1 to day 5) as specified in the *Model Control* dialog in the *Files* tab.

If desired, examine the solution just to be familiar with what ADCIRC is computing. It is not necessary to view this solution to complete this tutorial.

3 Defining the Storm

The cyclonic stor`m consists of a geometric path stored in coverage and storm parameters defined for each point on the path.

3.1 Storm Path

The storm path describes how a storm moves through space during its existence. This is the geometric definition of the storm. There are two methods of defining a storm path. It can be specified interactively, or read from a file.

For this tutorial, use a storm defined in a "Best Track" (atcf) file. File formats that may be used, and common locations to get these files include:

- ATCF (http://www.nrlmry.navy.mil/atcf_web/docs/database/new/database.html)
- HURDAT (http://www.nhc.noaa.gov/data/)

To load the storm for this tutorial:

1. Use the *File*| **Open** command to bring up the *Open* dialog.
2. Locate the project "storm.atcf" in the data files folder for this tutorial and click **Open**.

The SMS will read the storm data, create a new coverage called " storm", and load the storm data into the coverage. The SMS display will update to include the storm path as shown in Figure 2.

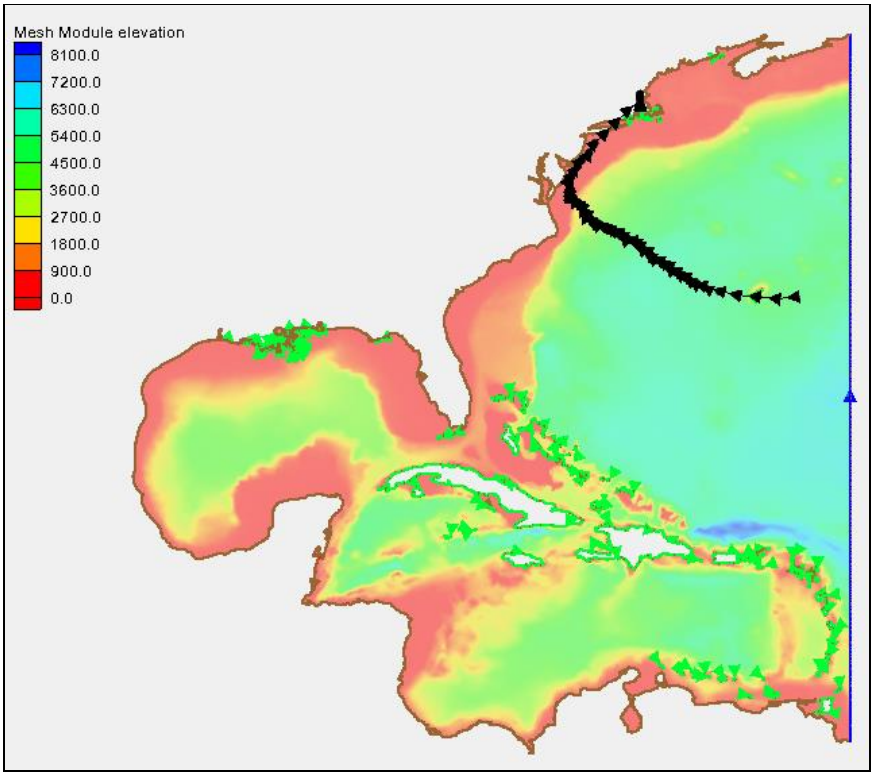


Figure 2 ATCF file loaded into SMS showing storm path

Interactive Storm

The following is given as an example of how to define a storm interactively. If uninterested in this process, skip to the next section. To create a new wind coverage:

1. Right-click on the " Map Data" entry of the Project Explorer and select **New Coverage**.
2. In the *New Coverage* dialog, set the type to "PBL/Holland" under the *Wind* type.
3. Specify a *Coverage Name* or accept the default name of "ADCIRC Wind" then click **OK**.
4. The *Storm Attributes* dialog will appear. Model and wind attributes can be specified here, but for this tutorial, accept the default settings by clicking on **OK**.

Digitizing storm path would normally be done at this point. Each point will need attributes, which would be specified as described in the next section. It's not necessary to do this at this time. This tutorial will continue to use the storm data loaded into the project previously.

5. Before continuing, delete the new coverage by right-clicking on the coverage and selecting **Delete**.

3.2 Storm Parameters

If the storm definition came from an external source, whether it represents an historic storm or a pure simulation, the external source will usually include the storm parameters. These consist of a starting time for the storm and the following values at each location along the storm path:

1. Select the Mesh model to make it active.
2. Select *ADCIRC* | **Model Control...** to review the selected model parameters in the *ADCIRC Model Control* dialog.
3. Review the *ADCIRC Model Control* dialog again following steps 5–7 of Section 2.1 then click **OK** to exit the dialog.

After reviewing the ADCIRC parameters, SMS provides a dialog to view and edit each of these storm parameters. To do so:

1. Select the " storm" coverage to make it active.
2. Select the **Select Feature Point** tool in toolbar.
3. Double-click on any feature node on the storm path. When doing so, SMS converts all vertices in the path to feature nodes and launches the *Storm Track Node Attributes* dialog as shown in Figure 3 below.

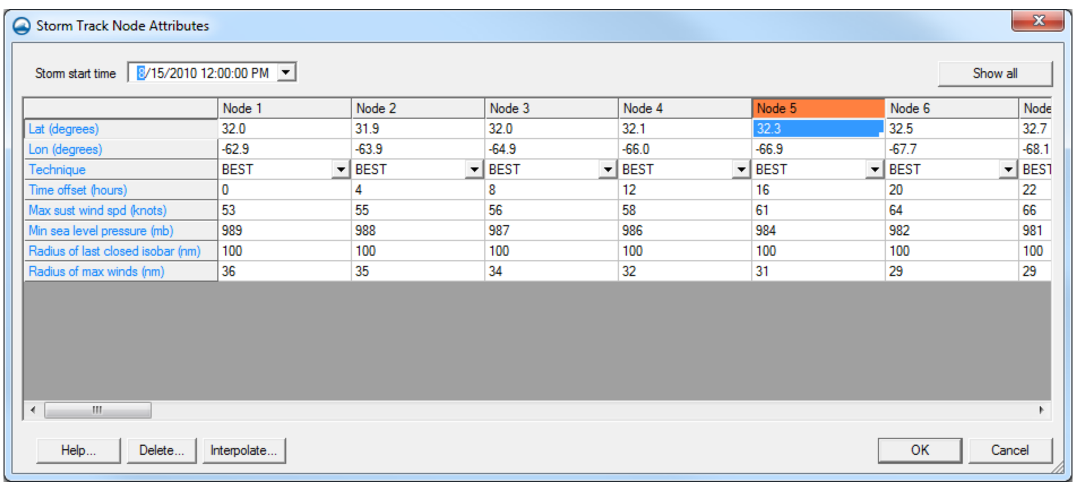


Figure 3 Storm Track Node Attributes dialog

4. Note the following fields in the *Storm Track Node Attributes* dialog:
    - *Min sea level pressure (mb) at this point:* This is another reflection of the storm strength.
    - *Radius of the last closed isobar (in nautical miles) at this point*: This defines the size of the storm's significant influence.
    - *Radius of maximum winds (in nautical miles):* This defines the size of the central portion of the storm.
5. Click **OK** to close the *Storm Track Node Attributes* dialog when done.

3.3 Setting the ADCIRC parameters for wind

With the storm track specified and the storm parameters defined, the option to have ADCIRC compute a symmetric cyclonic storm can be enabled. To do this:

1. Select the Mesh model to make it active.
2. Select *ADCIRC* | **Model Control...** to bring up the *ADCIRC Model Control* dialog.
3. In the *General* tab, change the *Project title* to "Symmetric Storm".
4. Click on the *Wind* tab and select the *NWS=8, NWS=19. NWS = 12 – Hurricane parameters* radio button.
5. On the right side of the dialog, under *Hurricane Path*, click the **Select Coverage** button. This will automatically select the "storm" coverage as there are no other available coverages of the correct type.
6. Click the **Options...** button to bring the *Storm Attributes* dialog.
7. Select *Holland Symmetrical* then click **OK** to exit the *Storm Attributes* dialog.
8. In the *Files* tab, under *Output Files Created by ADCIRC* read the column called *Unit No*. and find the numbers *73* and *74*. Check on the *Output* box for both *Unit No. 73* and *74*. These enable the output of atmospheric pressure and wind velocity respectively.
9. In the corresponding columns on the right side of the dialog specify that output for *73* and *74* should start at the end of the day 1 (*Start (day)* = "1.0") and continue through the entire simulation (*End (day)* = "5.0" or greater).
10. Set the *Frequency (min)* to be "60" to instruct ADCIRC to output wind and pressure information every hour.
11. Make certain the *Output* box is checked on for the *Unit No. 63* and *64.*
12. Click **OK** to exit the *ADCIRC Model Control* dialog.

4 Running ADCIRC with wind

To run ADCIRC with wind:

1. Save the project using the **Save As…** command.
2. In the *Save As* dialog, give the *File Name* of "symmetric_storm.sms" then click **Save**.
3. Select *ADCIRC* | **Run ADCIRC**.
4. If the *Model Checke*r dialog appears, review the errors. The current error is that there is a void in the mesh. This error can be ignored for now. Click **Run Model**.

The model wrapper will appear and the model run will start automatically. The model run may take up to 25 minutes or longer depending on the computer configuration.

5. When completed, click **Exit**.

5 Visualization of the Computed Storm

Load the solution (fort.63, fort.64, fort.73, fort.74, maxele.63, etc.).

1. Select *File* | **Open** to bring up the *Open* dialog.
2. Locate each of the following files from the NWS8 solutions folder in the symmetric_stom folder and click **Open**:
    - "fort.63"
    - "fort.64"
    - "fort.73"
    - "fort.74"
    - "maxele.63"
    - "maxvel.63"
    - "maxwvel.63"
    - "minpr.63"
    - "maxele.64"
    - "maxvel.64"
    - "maxwvel.64"
    - "minpr.64"
3. When the *Convert to XMDF* dialog appears, change dataset names if necesasry and click **OK**.
4. After loading the solution files, select *Display* | **Display Options** to bring up the *Display Options* dialog.
5. Under *2D Mesh*, turn on the *Vectors* option. Click **OK** to close the *Display Options* dialog.
6. In the Time steps window, click on each time step to see generated solutions.

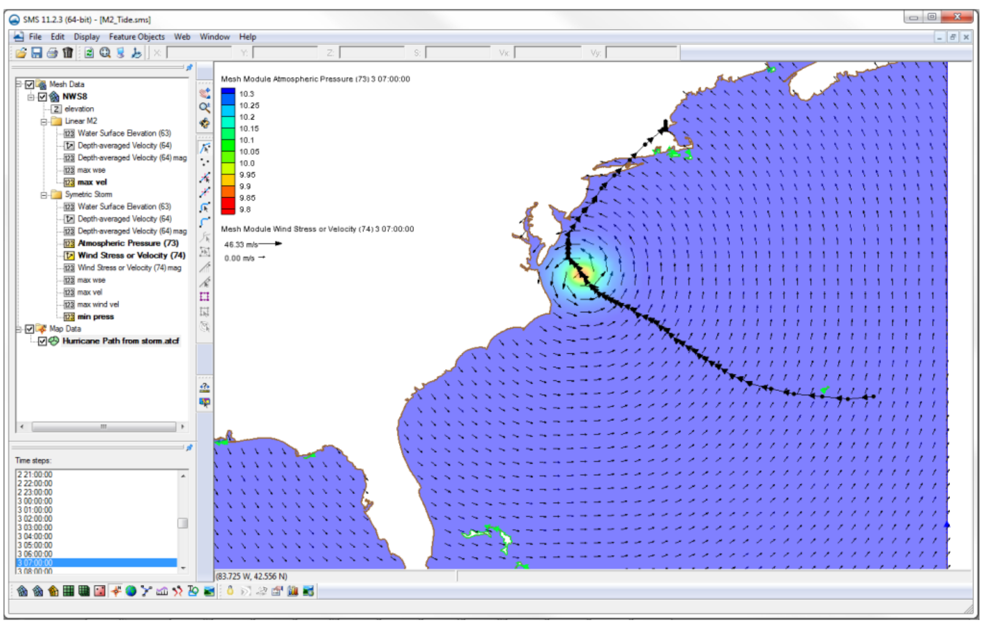


Figure 4 Symmetric cyclone visualization

6 Conclusion

This concludes the *ADCIRC Symmetric Cyclone Simulation* tutorial. If desired, continue to experiment with this part of SMS or continue on to the next tutorials.

