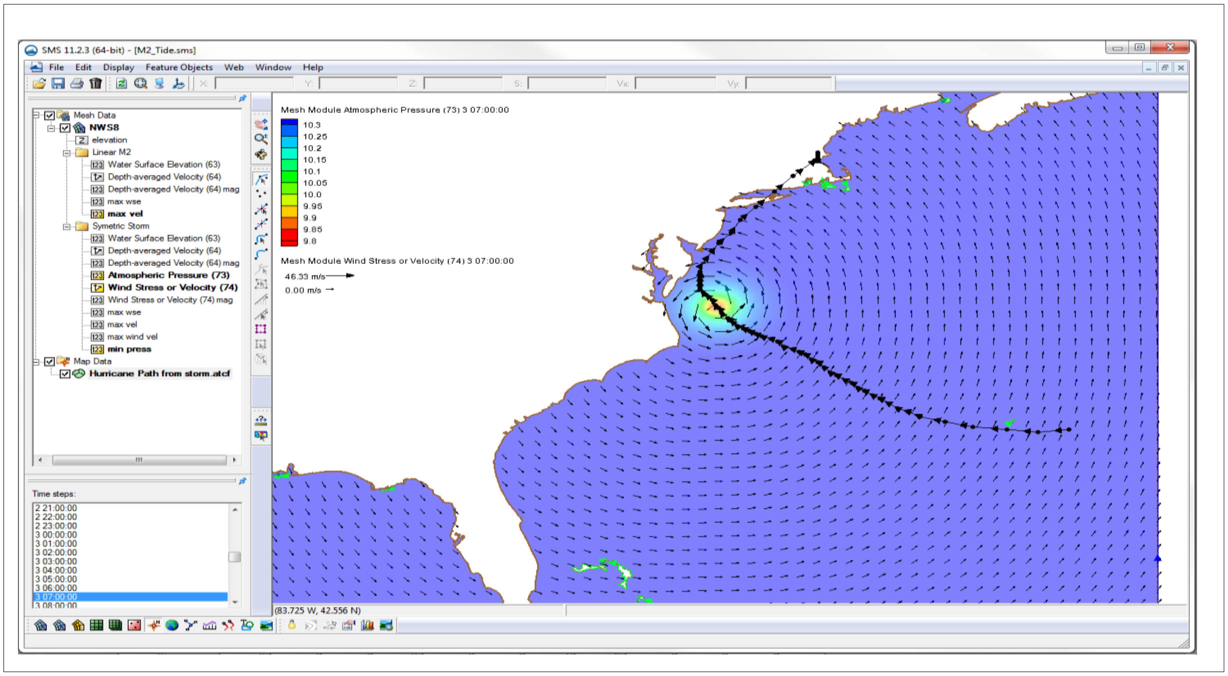
v. 12.3

SMS 12.3 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 SMS. This tutorial teaches the basic skills of how to use the dynamic image option.

Prerequisites

- Overview Tutorial
- ADCIRC Tutorial

Requirements

- ADCIRC Interface
- ADCIRC Model

Time

- 20–30 minutes

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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.

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.

2 The ADCIRC Simulation

To apply a cyclonic storm model in ADCIRC, an ADCIRC simulation must exist. For this tutorial, 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 *File* | **Delete All** to remove any existing data if SMS is already running.
2. Select *File*| **Open…** to bring up the *Open* dialog.
3. Select "Project Files (*.sms)" from the *Files of type* drop-down.
4. Browse to the *data files* folder for this tutorial and select "NWS8.sms".
5. Click **Open** to import the project and exit the *Open* dialog.

The domain should appear similar to Figure 1.

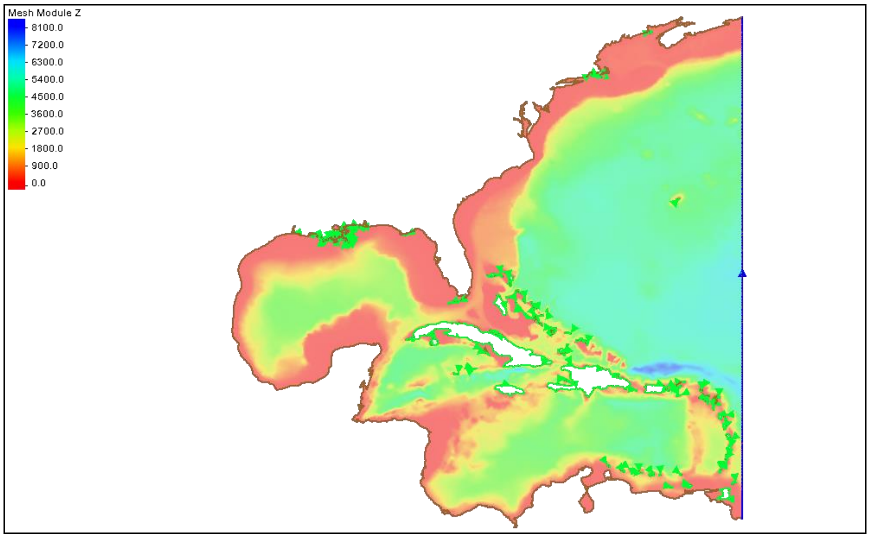

Figure 1 The NWS8 file displayed in SMS

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. In the *Horizontal* section, confirm *Global projection* is selected and the project is working in geographic coordinates: "Geographic (Latitude/Longitude), Zone NAD83, arc degrees".
3. If this is not the projection shown, click **Set Projection…** to bring up the Select Projection dialog, then select the correct projection options from the drop-downs in the dialog. See the "Projections" tutorial for instructions 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.

4. Click **OK** to exit the *Display Projection* dialog.
5. Switch to the **Mesh** module.
6. Select *ADCIRC* **| Model Control...** to bring up the *ADCIRC Model Control* dialog.

Review the selected model parameters:

7. On the *General* tab, notice that the project title is "M2 Tide".
8. Notice that the nonlinear model options (*Finite amplitude terms*, *Advective terms*, and *Time derivative terms*) are disabled.

These reflect that the base simulation runs a single tidal constituent. For production runs, the options in the *Terms* section would be enabled. They are disabled here for speed in working through the tutorial.

9. On the *Timing* tab, notice 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.

10. On the *Wind* tab, notice that the *Wind File Type* is set to “NWS = 0 – No wind”.
11. Click **OK** to exit the *ADCIRC Model Control* dialog.

2.2 No Wind Solution

A solution for the simulation as configured has been included. 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 can be viewed by opening the “nws0.h5” file included in the tutorial *data files* folder. It is not necessary to view this solution to complete this tutorial.

3 Defining the Storm

The cyclonic storm 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 imported 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[1]
- HURDAT[2]

To import the storm for this tutorial, do the following:

1. Click **Open** to bring up the *Open* dialog.
2. Select “storm.atcf” and click **Open** to import the file and exit the *Open* dialog.

SMS imports the storm data, creating a new coverage called “ storm”, and loading the storm data into the coverage. The Graphics Window should now include the storm path (Figure 2).

[1] See http://www.nrlmry.navy.mil/atcf_web/docs/database/new/database.html

[2] See http://www.nhc.noaa.gov/data/

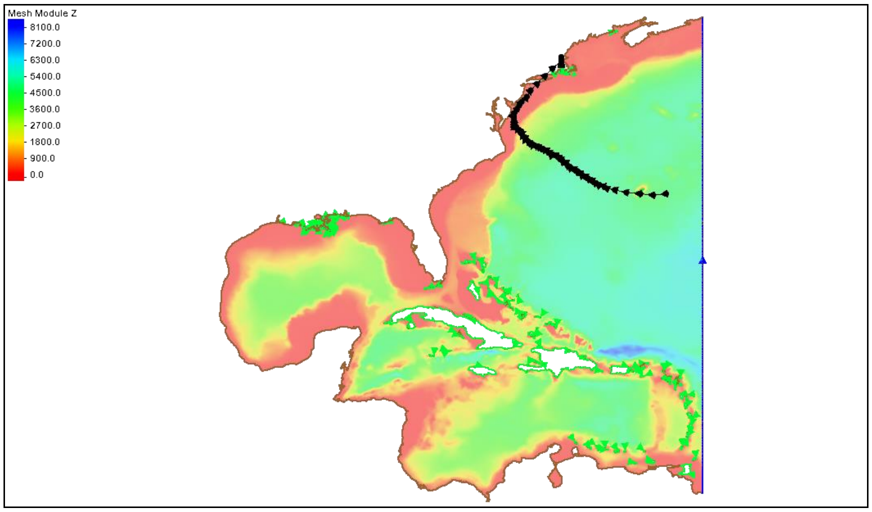

Figure 2 Storm path imported from the ATCF file

Interactive Storm

The following is given as an example of how to define a storm interactively. This section may be completed if desired, but is not necessary to complete this tutorial.

To create a new wind coverage, do the following:

1. Right-click on " Map Data" in the Project Explorer and select **New Coverage** to bring up the *New Coverage* dialog.
2. In the *Coverage Type* section, select *Models* | *Wind* | **PBL/Holland**.
3. Enter any desired name as the *Coverage Name*, or accept the default name of "ADCIRC Wind".
4. Click **OK** to close the *New Coverage* dialog and bring up the *Storm Attributes* dialog.
5. Model and wind attributes can be specified here, but for this tutorial, accept the default settings by clicking **OK** to close the Storm Attributes dialog.

A new " ADCIRC Wind" coverage should appear in the Project Explorer. Digitizing a storm path would normally be done at this point. Each point needs attributes, specified as described in the next section. Because this tutorial is using the imported storm data, it is not necessary to do this at this time.

6. Right-click on " ADCIRC Wind" and select **Delete**.
7. Click **Yes** when asked to confirm deletion of the coverage.

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. Switch to the **Mesh** module.

2. Select *ADCIRC* | **Model Control...** to review the selected model parameters in the *ADCIRC Model Control* dialog.
3. Click **OK** to exit the *ADCIRC Model Control* dialog.

After reviewing the ADCIRC parameters, view and edit the storm parameters:

1. Select “ storm” to make it active.
2. Using the **Select Feature Point** tool, double-click on any feature node on the storm path to bring up the *Storm Track Node Attributes* dialog.

This causes SMS to convert to feature nodes all vertices in the storm path on the active coverage. The *Storm Track Node Attributes* dialog should appear similar to Figure 3.

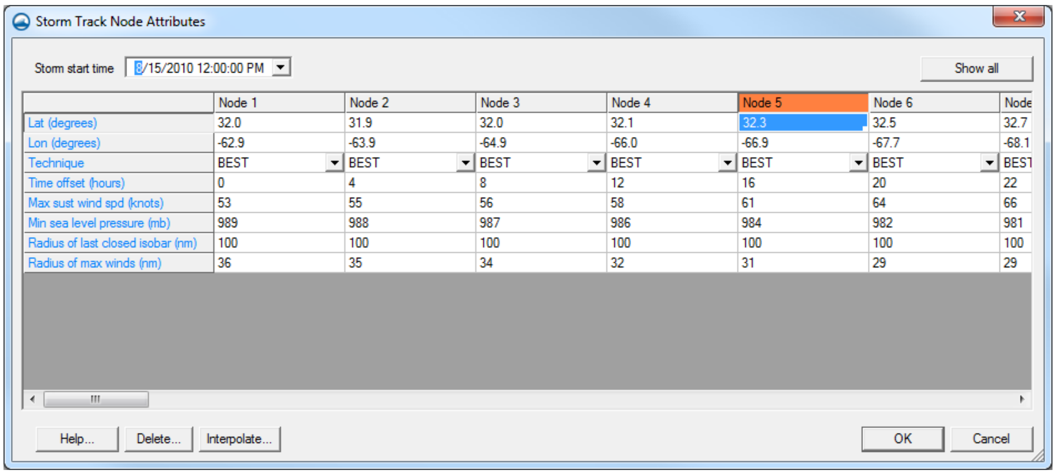

Figure 3 Storm Track Node Attributes dialog

3. Notice the following fields:
   - *Min sea level pressure (mb):* This is another reflection of the storm strength.
   - *Radius of the last closed isobar (nm)*: This defines the size of the storm's significant influence in nautical miles.
   - *Radius of max winds (nm):* This defines the size of the central portion of the storm in nautical miles.
4. Click **OK** to close the *Storm Track Node Attributes* dialog.

3.3 Setting the ADCIRC parameters for wind

After specifying the storm track and defining the storm parameters, the option to have ADCIRC compute a symmetric cyclonic storm can be enabled by doing the following:

1. Switch to the **Mesh** module and select *ADCIRC* | **Model Control...** to bring up the *ADCIRC Model Control* dialog.
2. On the *General* tab, enter “Symmetric Storm” as the *Project title*.
3. On the *Wind* tab, in the *Wind File Type* section, select *NWS=8, NWS=19. NWS = 12 – Hurricane parameters*.

4. In the *Wind File Options* section, click **Select Coverage…** to automatically select the “storm” coverage as there are no other available coverages of the correct type.

If there were multiple coverages available of the correct type, a *Select Coverage* dialog would have appeared, allowing the desired coverage to be selected.

5. Click **Options...** to bring up the *Storm Attributes* dialog.
6. In the *Wind Model* section, select *Holland Symmetrical* and click **OK** to exit the *Storm Attributes* dialog.
7. On the *Files* tab, in the *Output Files Created by ADCIRC* section, scroll down to rows *73* and 74 in the *Unit No*. column and check the boxs in the *Output* column.

This enables the output of atmospheric pressure and wind velocity respectively.

8. On rows 73 and 74, enter “1.0” in the *Start (day)* column and “5.0” in the *End (day)* column.

This specifies that output should start at the end of the day 1 and continue through the entire simulation for these two units.

9. Enter “60.0” in the *Frequency (min)* column on rows *73* and *74*.

This instructs ADCIRC to output wind and pressure information every hour.

10. Make sure that the box in the *Output* column is checked on rows *63/76* and *64*.
11. Click **OK** to exit the *ADCIRC Model Control* dialog.

4 Running ADCIRC with wind

To run ADCIRC with wind:

1. Select File | **Save As…** to bring up the *Save As* dialog.
2. Select “Project Files (*.sms)” from the *Save as type* drop-down.
3. Enter “symmetric_storm.sms” as the *File name*.
4. Click **Save** to save the project under the new name and close the *Save As* dialog.
5. Select *ADCIRC* | **Run ADCIRC**.
6. If the *Model Checke*r dialog appears, review the errors.

There should be an error of “small voids in mesh”. This error can be ignored for now.

7. Click **Run Model** to bring up the *ADCIRC* model wrapper dialog.

The model run will start automatically. It may take several minutes, depending on the speed and memory of the computer used.

8. When ADCIRC finishes, click **Exit** to close the *ADCIRC* model wrapper dialog.

5 Visualization of the Computed Storm

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

1. Click **Open** to bring up the *Open* dialog.
2. Browse to the *data files\symmetric_storm\ADCIRC\NWS8* folder.
3. Select "fort.63" and click **Open** to exit the *Open* dialog and bring up the *Convert to XMDF* dialog.
4. Enter any desired name in the *Dataset Name* column, or click **OK** to accept the defaults and close the *Convert to XMDF* dialog.
5. Repeat steps 1–4 for each of the following files:
   - "fort.64"
   - "fort.73"
   - "fort.74"
   - "maxele.63"
   - "maxvel.63"
   - "maxwvel.63"
   - "minpr.63"
   - "maxele.64"
   - "maxvel.64"
   - "maxwvel.64"
   - "minpr.64"
6. Click **Display Options** to bring up the *Display Options* dialog.
7. Select "2D Mesh" from the list on the left.
8. On the *2D Mesh* tab, turn on *Vectors*.
9. Click **OK** to close the *Display Options* dialog.
10. In the Time Steps window, select each time step to see generated solutions.

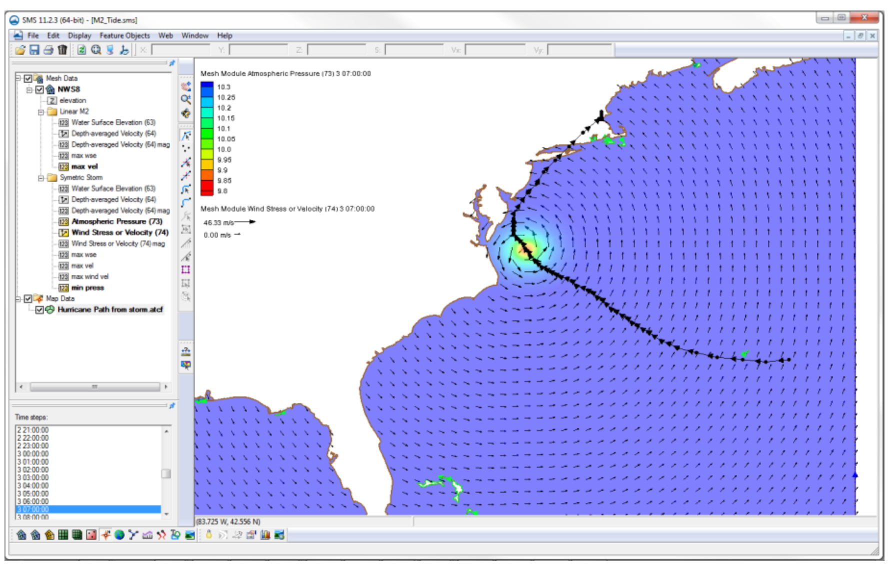

Figure 4 Symmetric cyclone visualization

6 Conclusion

This concludes the "ADCIRC Symmetric Cyclone Simulation" tutorial. Feel free to continue to experiment with this part of SMS, continue on to other tutorials, or exit the program.

