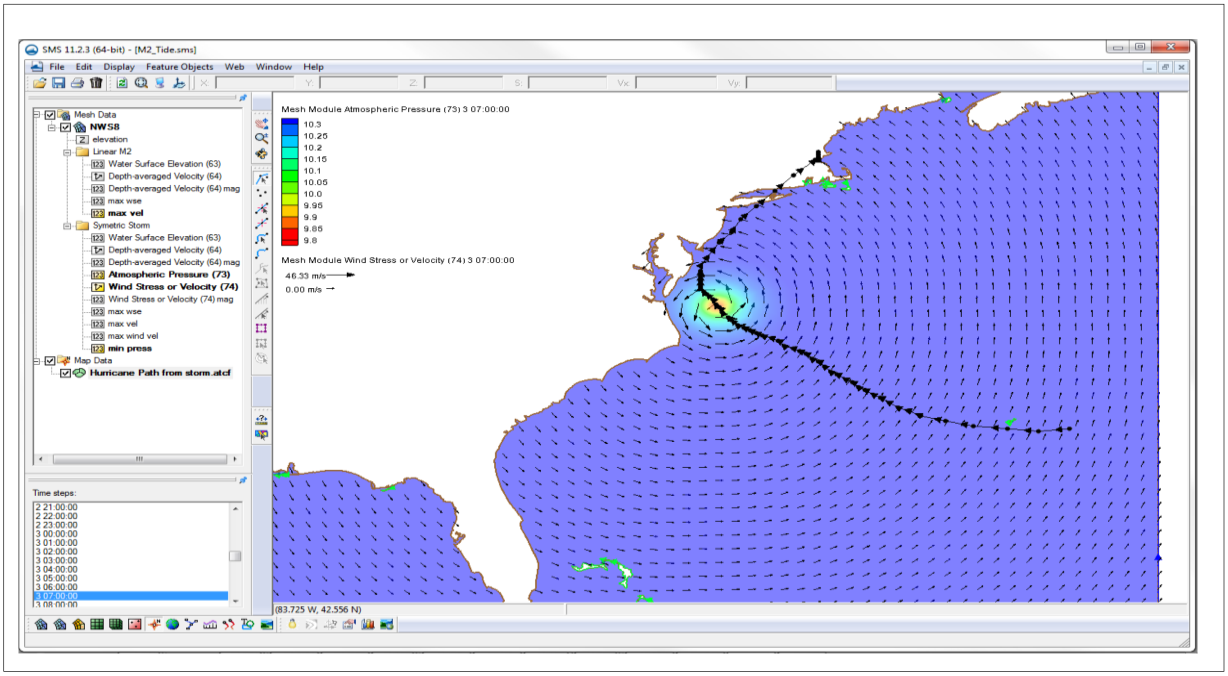
v. 13.0

SMS 13.0 Tutorial

ADCIRC – Symmetric Cyclone Simulation



Objectives

Overview the ADCIRC functionality used to generate the winds of a symmetric cyclonic storm (NWS = 8) and the interface to this option in SMS.

Prerequisites

- Overview Tutorial
- Map Module Tutorial
- ADCIRC Tutorial

Requirements

- ADCIRC Interface
- ADCIRC Model

Time

- 20–30 minutes

1 Introduction

This tutorial discusses and demonstrates the ADCIRC wind field generation option used to represent a symmetric cyclonic storm during the ADCIRC simulation. The ADCIRC model includes many options for simulating wind in an analysis. The wind and pressure fields generated by ADCIRC can be exported during this type of simulation for inspection in relation to hydraulic currents and water levels computed during the simulation.

ADCIRC supports multiple wind formats and includes two separate wind generation models which can simulate cyclonic storms. Storm definitions can be downloaded from historic databases or defined interactively.

2 Setting Up the ADCIRC Simulation

An ADCIRC simulation must exist to apply a cyclonic storm model in ADCIRC. 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.

2.1 Opening the Project

A base project has been created in order to save time.

1. Launch SMS, or select *File* | **New** 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.

6. Select "53K WNAT" to make it active.

The domain should appear similar to Figure 1.

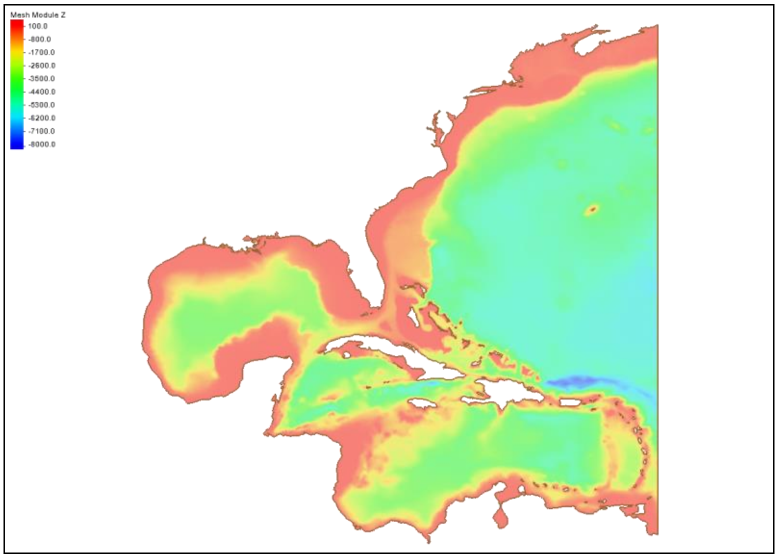


Figure 1 The NWS8 file displayed in SMS

2.2 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* | **Display Projection...** to bring up the *Display Projection* dialog.
2. In the *Horizontal* section, confirm *Global projection* is selected and the projection below is set to "GCS_North_American_1983".

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.

See the "Projections" tutorial for further instruction on setting projections.

4. Right-click on " M2 Tide" and select **Model Control…** to bring up the *ADCIRC Model Control* dialog.

Review the selected model parameters:

5. On the *General parameters* tab, in the *Run options* section, note that "None: cold start" is selected from the *Hot start file (initial conditions)* drop-down.
6. On the *Model formulation* tab, in the *Nonlinear terms* section, notice *Finite amplitude terms* has "No wetting/drying" selected and the *Advective terms (NOLICA)* and *Time derivative terms (NOLICAT)* are turned on.

If an inundation study were desired, the wetting/drying should be enabled. For any real simulation the advective and time derivative terms should be enabled. They may be disabled to enhance speed when testing the stability of a mesh.

7. On the *Timing* tab, in the *Interpolation reference date* section, notice that the date is set to “8/15/2010 12:00:00 pm”.

This is the cold start date. It is used as the reference date to extract extract tidal constituents from a tidal database. The cold start date also comes into play when using “NWS = 8 – Symmetric cyclonic storm from path” option from the drop-down in the *Option – NWS* section of the *Wind* tab. 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.

8. In the *Timing* section, notice that *Time step (seconds)* is “20.0”.
9. On the *Wind* tab, in the *Option – NWS* section, notice that the *Wind File Type* is set to “NWS = 0 – No wind”.
10. Click **OK** to exit the *ADCIRC Model Control* dialog.

2.3 No Wind Solution

A solution for the simulation as configured is included. The datasets, which are in the “ M2 Tide” folder under “ 53K WNAT”, 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 *Output* tab.

If desired, examine the solution datasets 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 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]

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

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 loads the storm data into the coverage. The Graphics Window should now include the storm path (Figure 2).

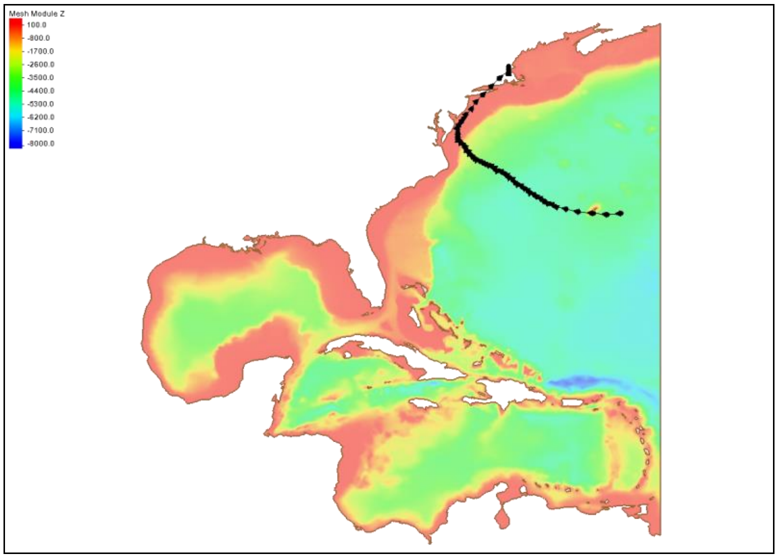

Figure 2 Storm path imported from the ATCF file

3.2 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* | **Holland/PBL**.
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.

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

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.

3.3 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 parameter values at each location along the storm path. To 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.

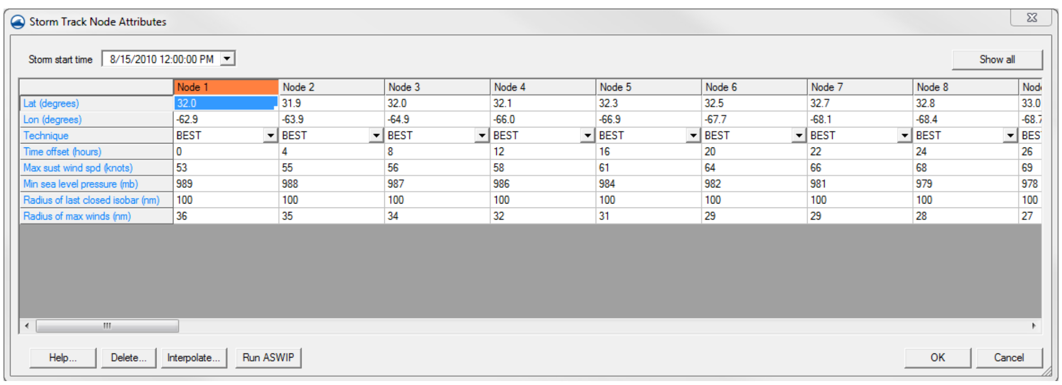

Figure 3 Storm Track Node Attributes dialog

3. Notice the following fields:
   - *Max sust wind spd (knots):* This is the principal reflection of the storm strength.
   - *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. Note that the *Storm start time* is August 15, 2010 at midnight. All simulations using this storm must start at or after that date.

5. Scroll to the far right to the last node in the storm definition (Node 56).
6. Note that the *Time offset (hours)* for this point is 120 hrs. This corresponds to August 19, 2010 at 6:00 pm. All simulations using this storm definition must end before that date/time.
7. Click **OK** to close the *Storm Track Node Attributes* dialog.

3.4 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. Right-click on " M2 Tide" and select **Duplicate** to create a simulation that will include the storm.
2. Right-click on " M2 Tide (2)" and select **Rename.** Change the simulation name to "NWS8".
3. Right-click on " storm" and select **Link > ADCIRC Simulations -> NWS8** to associate this storm with the new simulation.
4. Right-click on " NWS8" and select **Model Control...** to bring up the *ADCIRC Model Control* dialog.
5. On the *General parameters* tab, in the *Simulation description* section, enter "Symmetric storm" as the *Project title*.
6. On the *Wind* tab, in the *Option - NWS* section, select *NWS=8 – Symetric cyclonic storm from path* from the drop-down.
7. Uncheck the *Use existing wind file* toggle. With the " storm" linked to the simulation SMS will create the wind file.
8. On the *Output* tab, in the *Meteorological* subsection of the *Global output* section, select "ASCII" from the *Output format* drop-down.
9. Enter "1.0" as the *Start (days)*, "5.0" as the *End (days)*, and "60.0" as the *Increment (min)*. This specifies that output should start at the end of the day 1 and continue through the entire simulation, and it instructs ADCIRC to output wind and pressure information every hour
10. Click **OK** to exit the *ADCIRC Model Control* dialog.

4 Running ADCIRC with Wind

To run ADCIRC with wind:

1. Right-click on " NWS8" and select **Save, Export, and Launch ADCIRC**.

The model run will start automatically. On a typical PC running the serial version of ADCIRC this simulation will take around 30 minutes. The parallel version could be used to speed up execution.

2. When ADCIRC finishes, click **Load Solution** to import the solution into SMS. (If you do not wish to wait for the model to run to complete, the **Abort** button can be used to terminate the simulation. In this case, open the NWS8.h5 solution file.)
3. Click **Close** to exit the *Simulation Run Queue* dialog.

5 Visualization of the Computed Storm

The solution for this simulation includes meteorological data in addition to the hydraulic data from the base M2 Tide simulation. These data sets can be investigated in the same fashion. For example:

1. Select the *Wind Stress* vector data set and the *Minimum Pressure* scalar dataset. Depending on the active time step, the display should appear similar to Figure 4.

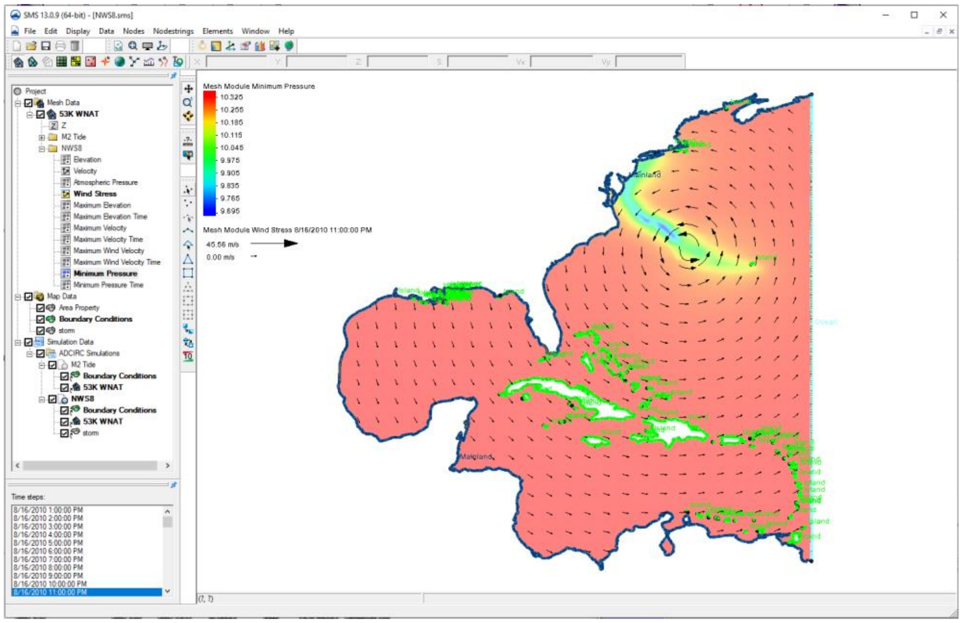

Figure 4 Symmetric cyclone visualization

6 Conclusion

This concludes the "ADCIRC – Symmetric Cyclone Simulation" tutorial. Feel free to continue experimenting in SMS, or exit the program.

