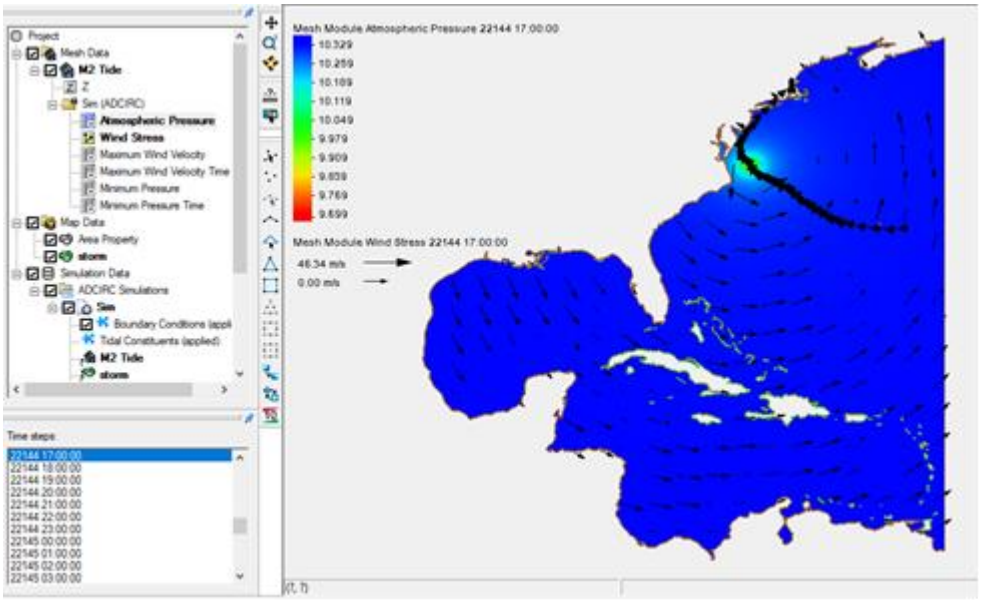
SMS 13.3 Tutorial

ADCIRC – Symmetric Cyclone Simulation

Set up an ADCIRC symmetric cyclonic storm model



Objectives

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

Prerequisite Tutorials

- Overview
- Map Module
- ADCIRC

Required Components

- SMS Core
- ADCIRC Model & Interface

Time

- 20–30 minutes

AQUAVEO™

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 “ M2 Tide” to make it active.

The domain should appear similar to Figure 1.

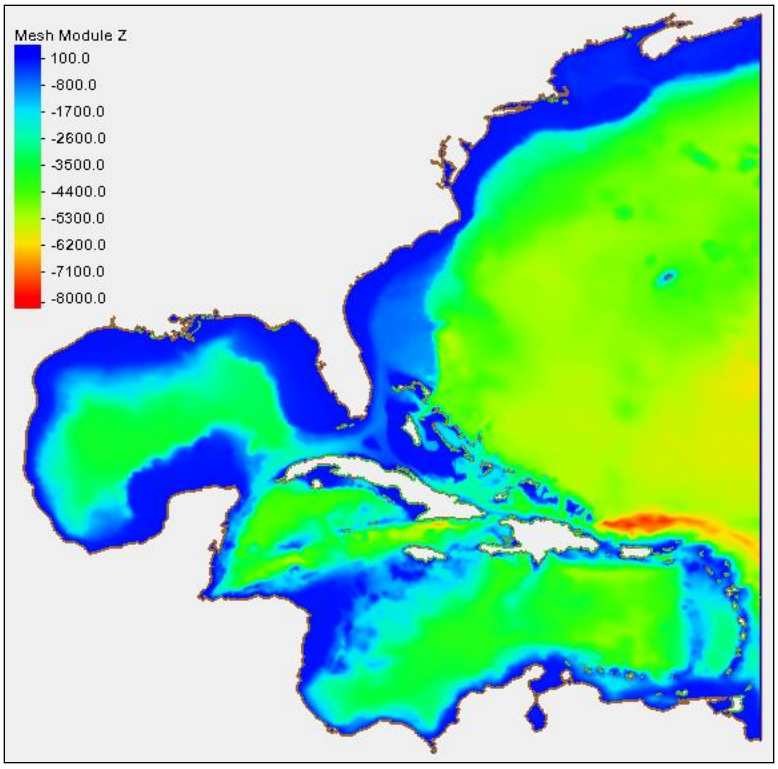


Figure 1 The NWS8 file displayed in SMS

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 "NAD83".

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 "Sim" 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 *Simulation description* section, enter "Symmetric Storm" as the *Project title*.
6. In the *Run options* section, make sure "None: cold start" is selected from the *Hot start file (initial conditions)* drop-down.
7. On the *Model formulation* tab, in the *Nonlinear terms* section, notice *Finite amplitude terms* has "None" selected from the drop-down.
8. Notice that *Advective terms-(NOLICA)* and *Time derivative terms-(NOLICAT)* are turned off.

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

9. On the *Timing* tab, in the *Interpolation reference date* section, notice that the date is set to “8/15/2010 12:00:00 pm”.
10. In the *Timing* section, notice that *Time step (seconds)* is “300.0”.

The *Interpolation reference date* is the date and time when the simulation begins. If doing a cold start, this is the cold start date. If doing a hot start, this date must match the start date and time in the hot start file.

The cold start date 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.

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

2.3 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 *Output* tab.

If desired, examine the solution just to be familiar with what ADCIRC is computing. It can be viewed by running the ADCIRC simulation with the no wind option on. 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.

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

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

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).

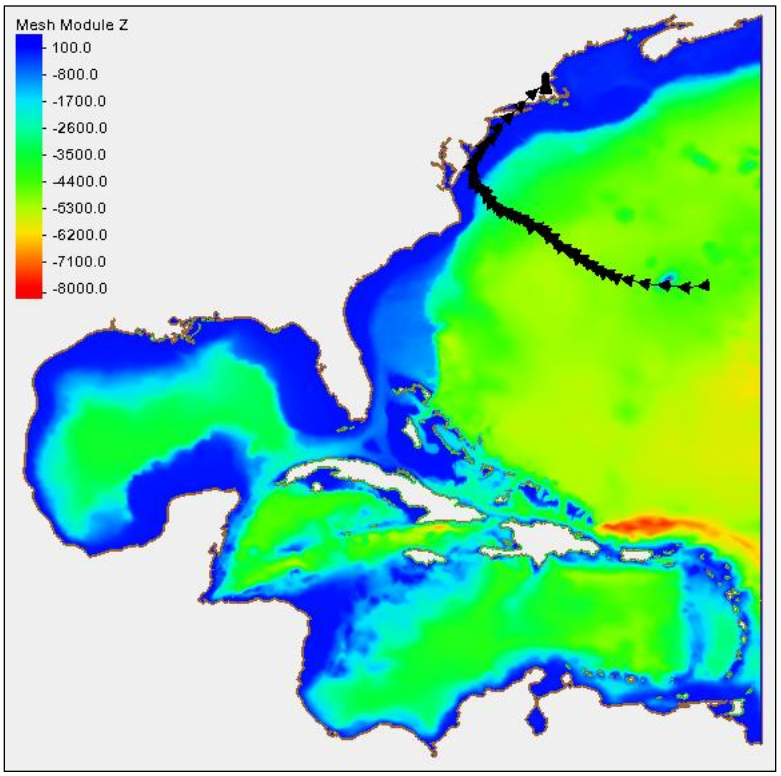


Figure 2 Storm path imported from the ATCF file

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 “Cyclonic 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 “ Cyclonic 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 "Cyclonic 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 the following values at each location along the storm path:

1. Right-click on "Sim" and select **Model Control...** to review the selected model parameters in the *ADCIRC Model Control* dialog.
2. After reviewing the information, 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 all feature nodes to vertices in the storm path on the active coverage. The *Storm Track Node Attributes* dialog should appear similar to Figure 3.

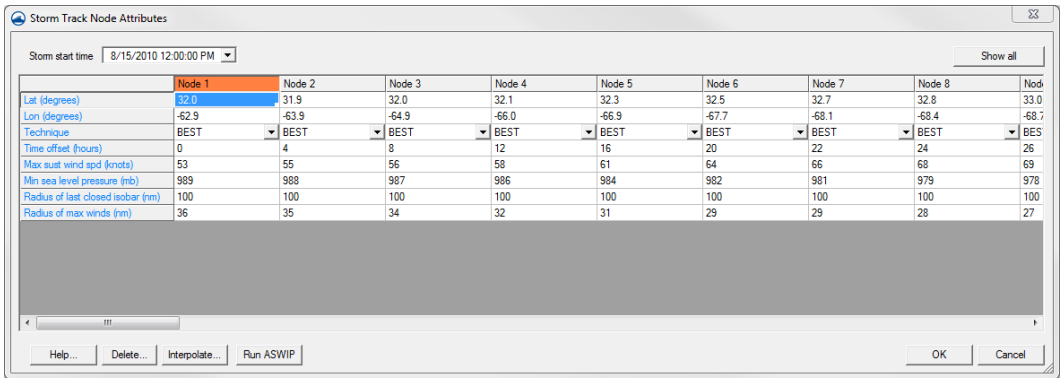


Figure 3 Storm Track Node Attributes dialog

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.

3.4 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 "Sim" and select **Model Control...** to bring up the *ADCIRC Model Control* dialog.
2. On the *Wind* tab, in the *NWS* section, select *NWS=8 – Symmetric cyclonic storm from path* from the drop-down.

A number of additional options will appear. Settings for atmospheric pressure and wind velocity output need to be defined here.

3. On the *Output* tab, on the first row, enter "1.0" as the *Start (days)*, "5.0" as the *End (days)*, and "60.0" as the *Increment (min)*.
4. For the *Global Elevation* and *Global Velocity* rows, change the *Output* column to be "Off".

This specifies that output should start at the end of day 1 and continue through the entire simulation for these two units, and it instructs ADCIRC to output wind and pressure information every hour.

5. Click **OK** to exit the *ADCIRC Model Control* dialog.
6. Right-click on "storm" and select *Apply to* | **ADCIRC Simulations** → **Sim** to link the storm track to the simulation.

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. Right-click on "Sim" and select **Save Project, Simulation, and Run** to open the *Simulation Run Queue* dialog.

There may be errors regarding datasets being outside the ADCIRC run time. These errors can be ignored for now.

6. Click **Launch** to close the *Model Checker* dialog.

The model run will start automatically. It may take several minutes, depending on the computer being used.

7. When ADCIRC finishes, click **Load Solution** to import the solution into SMS.
8. Click **Close** to exit the *Simulation Run Queue* dialog.

5 Visualization of the Computed Storm

Now review the solution files.

1. Select the "Atmospheric Pressure" dataset to make it active.
2. Click **Display Options** to bring up the *Display Options* dialog.
3. Select "2D Mesh" from the list on the left.

4. On the *2D Mesh* tab, turn on *Vectors*.
5. Switch to the *Vector* tab.
6. In the *Vector Display Placement and Filter* section, change the *Display* to “on a grid”.
7. In the *Arrow Options* section, change the *Minimum* to “25” and the *Maximum* to “50”.
8. Click **OK** to close the *Display Options* dialog.
9. In the Time Steps window, select each time step to see generated solutions.

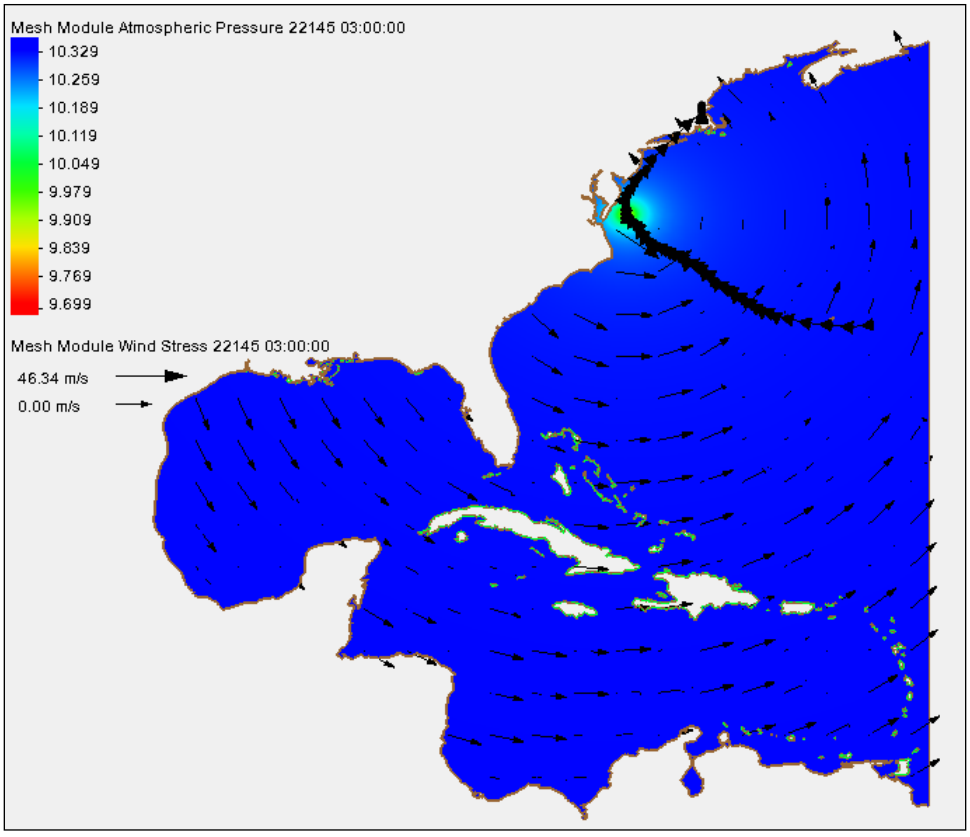


Figure 4 Symmetric cyclone visualization

6 Conclusion

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