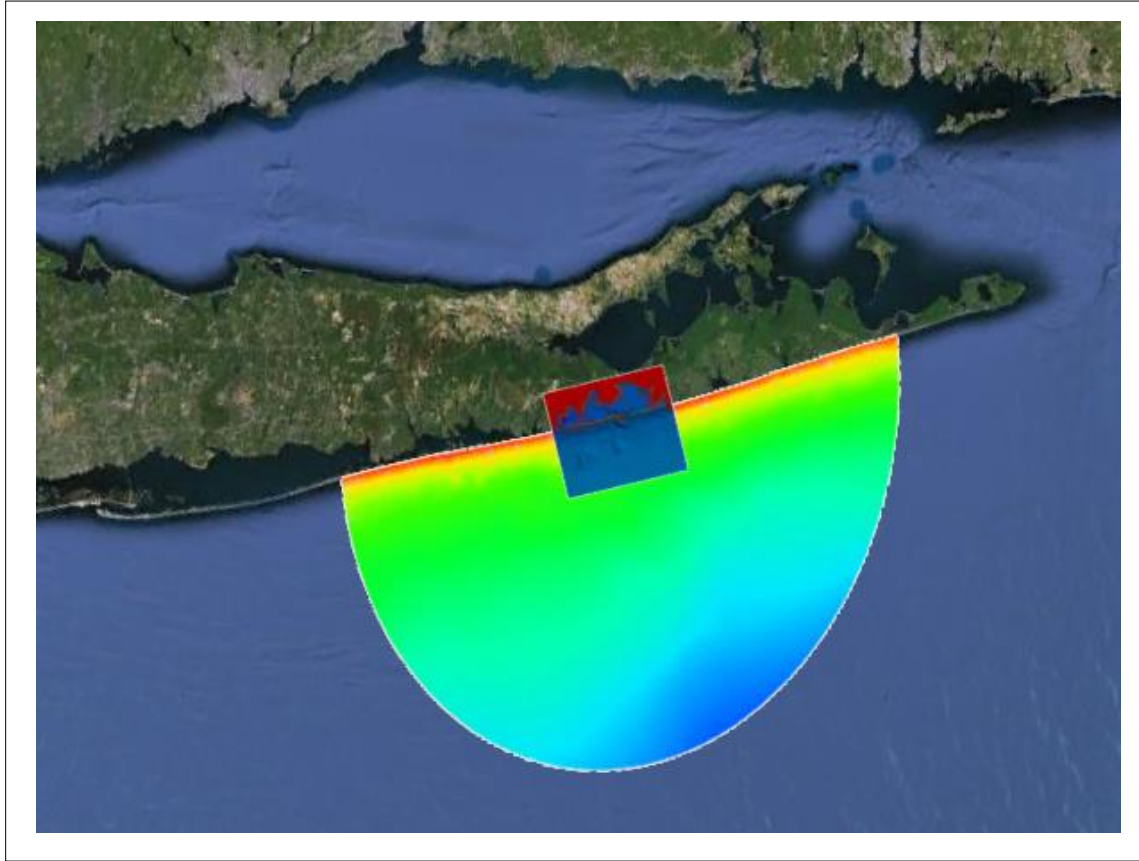


SMS 13.0 Tutorial

STWAVE Analysis



Objectives

This tutorial gives a brief introduction to the STWAVE model. A STWAVE grid will be created over a small section of scatter set data, the the model will be set up and launched.

Prerequisites

- Overview
- Map Module

Requirements

- Map Module
- STWAVE
- Cartesian Grid Module
- Scatter Module

Time

- 25–40 minutes

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1 Getting Started

This tutorial starts by using files generated with the ADCIRC model. Data from the Shinnecock Inlet, Long Island, New York, have been set up as an example. This example will use a scatter set generated in another tutorial. An grid has been created over a small section of the scatter set data.

Start with opening a project file containing a grid over the area around Shinnecock Inlet on the south shore of Long Island, New York. For convenience, projections have already been applied to the data in the project.

To open the file:

1. Select *File / Open...* to bring up the *Open* dialog.
2. Select the file “shin_start.sms” located in the data file folder for this tutorial and click **Open** to read in the project.



The project should appear containing scatter data and a Cartesian grid. The Cartesian grid contains both an elevation and velocity dataset. See the “Grid Generation” tutorial for more information on how this grid was generated.

Before continuing, save the project under a different name to preserve the original project file. To save the simulation:

1. Select *File / Save As* to open the *Save As* dialog.
2. Make sure the *Save as type* is set to “Project Files (sms),” and enter the *File name* “shin_projects”.
3. Click the **Save** button to close the *Save As* dialog and save the project.

2 Generating Spectral Energy Distribution

To generate the spectral energy distribution:

1. Right-click on “ Map Data” in the project explorer and select **New Coverage** to open the *New Coverage* dialog.
2. Select the *Coverage Type* as **Spectral**.
3. Enter a *Coverage Name* as "Spectral" then click **OK** to close the *New Coverage* dialog.
4. Using the **Create Feature Point**  tool, create a point along the middle of the bottom grid boundary as shown in the Figure 1.

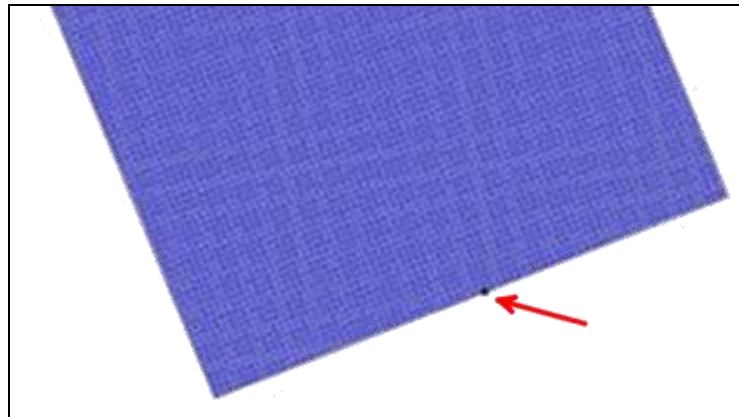



Figure 1 Spectral point location

5. Use the **Select Feature Point**  tool and double-click on the point to open the *Spectral Energy* dialog.
6. Click the **Create Grid** button to bring up the *Spectral Grid Attributes* dialog.
7. Set the *Grid angle* to “112.0” degrees. This will match the angle of the STWAVE grid.
8. Make sure that the *Spectral energy grid plane type* is set to “Local” and select **OK** to close the *Spectral Grid Attributes* dialog. The *Create Spectral Energy Grid* dialog will appear.
9. In the *Frequency Distribution* section of the dialog, change the *Number* to “40” and click **OK** to close the *Create Spectral Energy Grid* dialog.

The new spectral energy grid will appear in the *Spectral Manager* tree control.

10. Select the “Spectral Grid” to see an example displayed in the *Spectral Viewer*.
11. Click the **Generate Spectra** button to open the *Generate Spectra* dialog.
12. Enter the following parameters into the spreadsheet.

Time Offset	Angle	Hs	Tp	Gamma	nm
1	25	1	20	8	30

This tutorial assumes that the wave gauge is approximately at the offshore edge of the grid. Therefore:

13. Under the *Seaward Boundary Depth*, select *Specify once for all spectra* and enter “32” meters.

If the gauge was in deeper water, specify the actual depth of the gauge.



14. Click the **Generate** button to close the *Generate Spectra* dialog.

The new spectrum, labeled “1.00000” will appear below the grid in the *Spectral Manager* tree control. The “1.00000” represents the time offset from the reference time in hours. The reference time is displayed below the tree control.

15. Select the spectrum “1.00000”. The contours show the energy distribution. Select cell corners to view/edit their energies.
16. Click **Done** to exit the *Spectral Energy* dialog.

3 Assigning Monitoring Cells

To generate to assign monitoring cells to act as monitoring stations:

1. Right-click on “ Map Data” in the project explorer and select **New Coverage** to open the *New Coverage* dialog.
2. Select the *Coverage Type* as **Monitoring Cells**.
3. Enter a *Coverage Name* as “Monitoring Cells” then click **OK** to close the *New Coverage* dialog.
4. Using the **Create Feature Point**  tool, create a point anywhere in the Graphics Window.
5. With the point still selected, change the X and Y coordinates in the Edit Window to “428397” for X and “77920” for Y.
6. Repeat steps 4–5 to add two more points with the coordinates (428501,76036) and (429701,71986)



4 Setting up the STWAVE Simulation


Starting in SMS 13.0, the interface for STWAVE uses a simulation-based representation. The simulation based approach allows for reuse of grids, spectral coverages and other model components. Multiple simulations can be created in a single SMS project file.

1.1 Creating the simulation

To create the simulation:

1. Right-click in empty area of the Project Explorer and select *New Simulation* | **STWAVE**.


A new “ STWAVE Simulations” group will appear in the Project Explorer along with a new simulation named “ Sim”.




2. Right-click on the “ Sim” simulation and select **Rename**.
3. Enter the name “shin_half” for the simulation and press *Enter*.

1.2 Adding Components to the Simulation






An STWAVE simulation consists of a grid (basis of computations), spectra data, and model parameters. The components already exist in the Project Explorer, now they must be linked to the new simulation. Two methods exist to link the components. This section illustrates both.

To add the components:

1. In the Project Explorer, right-click on the “ 100m” object and select *Link to* | **STWAVE Simulations**→**shin_half**.

Notice the an “ 100m” grid item has been added under the “ shin_half” simulation. The “ 100m” grid item creates a link between the simulation and the grid which tells the simulation to use the specified grid during the model run. If multiple simulations were in the project, the same grid can be linked to more than one simulation. Any changes to the grid will automatically be updated in every simulation using that grid.

Now to add a map coverage to the simulation.

2. Click-and-drag the “ Spectral” coverage down to the “ shin_half” simulation. As the cursor moves below the simulation name, a black line appears indicating this object can be added to this simulation. Let go of the mouse button to drop the “ Spectral” coverage into the simulation.
3. Repeat step 2 to link the “ Monitoring Cells” coverage to the “ shin_half” simulation.


The simulation will now make use of both the grid geometry with the spectral and monitor cell map coverages.

5 Setting the Model Control

In the *Model Control* dialog, STWAVE inputs can be set for use in the model run. The dialog contains multiple tabs which will be discussed below.

5.1 General Parameters

The Parameters tab contains general settings for the model run. Set the following options.

1. Right-click on the “ shin_half” simulation and select **Model Control** to bring up the *Model Control* dialog.
2. In the *Parameters* tab, select “Half plane” for the *STWAVE Plane Mode*.
3. Change the *Source Terms* to “Propagation Only”.
4. Leave the other settings at their default and continue to the next section.

5.2 Boundary Control

The *Boundary Control* tab contains options for assigning spectral data for the model run.

1. Select the *Boundary Control* tab in the *Model Control* dialog.
2. Select "Spectral coverage" from the *Source* combo box.
3. In the *Frequency Distribution* section, change the *Number* to “40”.
4. In the *Sides* section, change *Side 1* to be “Specified spectrum”.
5. In the *Case data* section, click the **Insert Below** button under the table. This will add a line to the table.
6. In *Time* column of the table, enter “8/15/2018 1:00:00 am” in the first row.
7. Leave the other settings at their default and continue to the next section.

5.3 Output Control

The *Output Control* tab contains additional options for outputting results from the STWAVE model run.

1. Select the *Output Control* tab in the *Model Control* dialog.
2. Accept the default options and continue to the next section.



5.4 Iteration Control

The *Iteration Control* tab contains options when running in full plane mode. These options will not be used at this time.

1. Select **OK** to exit the *Model Control* dialog.

6 Running STWAVE

To run STWAVE:

1. Right-click on the “ shin_half” simulation in the Project Explorer and select **Save, Export, and Launch STWAVE**. The *Simulation Run Queue* dialog will appear.
 - If a message such as “stwave.exe – not found” is given, click the file browser  button to manually find the STWAVE executable.

A *Simulation Run Queue* dialog will show the progress of the STWAVE run. It may take a few minutes for the model run to finish.

2. When STWAVE finishes, select **Load Solution**.

The solution will be loaded into SMS. The solution will be stored in the solution file “shin_half__100m__sol.h5”. The model directory is composed of the project name (shin_half) and the grid name (100m) separated by a double underscore.

SMS has several visualization options to view the solution.

6.1 Visualizing the STWAVE Solution

To see the solution results:

1. Select *Display* | **Display Options** to bring up the *Display Options* dialog.
2. Select “Cartesian Grid” from the list on the left.
3. Turn on the *Contours* and *Vectors* options. Turn off the *Cells* option.
4. Select the *Contours* tab. For the *Contour Method* select “Color fill”. Also set the *Transparency* to “20” percent.
5. Select the *Vectors* tab. Make sure the *Shaft Length* is set to “Define min and max length” and set the *Min length* to “10” and the *Max length* to “35”.
6. Under *Vector Display Placement and Filter*, change the *Display* to “on a grid.” Leave the spacing at “30” pixels in each direction and set the *Offset* to “10”.
7. Select **OK** to exit the *Display Options* dialog.

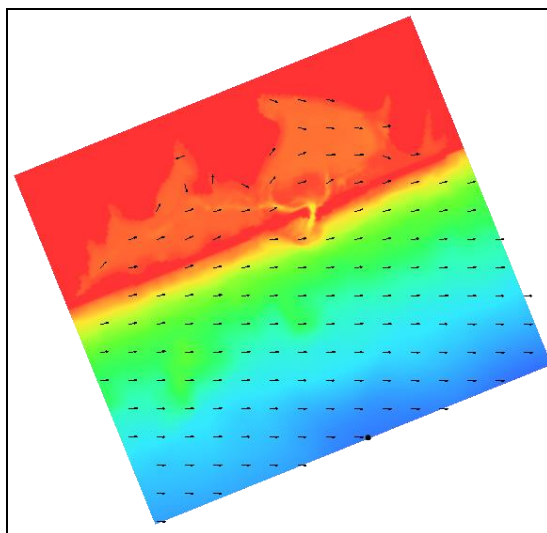




Figure 2 Depth dataset with contours and vectors turned on

8. Select the different scalar and vector datasets under the "100m" grid model in the Project Explorer to view their contours and vectors.
9. **Zoom**  into the inlet and **Pan**  along the coast to view variations.


Notice that the waves do not cover the entire bay. STWAVE is limited on how fast the waves will spread out after going through the inlet.

6.2 Visualizing the Spectral Energy

The spectral energy is recorded at each monitoring station in the grid frame and written by STWAVE to an observation file (*.obse). The observation file is automatically read in at the end of an STWAVE run. The data in this file is put into a spectral coverage. In this case the coverage is named "100m" or "100m.obse". To view the spectral energy:

1. Select the coverage "100m.obse" in the Project Explorer to make it the active coverage.

Notice that there are nodes at each of the monitoring locations.

2. To view the data in each location, double-click on the desired node using the **Select Feature Point**  tool to bring up the *Spectral Energy* dialog.



Look at the spectral energy at each monitoring station using the *Spectral Viewer*. The ocean station is not much different than the input spectral energy (labeled as *I*). The energy increases in the inlet and changes direction. The energy in the bay is very low compared to the inlet.

Also look at the spectral energies of the monitoring stations with a current. Notice that the current dampens the energy in the inlet but slightly increases the energy in the bay.


3. When finished, select **Done** to exit the *Spectral Energy* dialog.

7 Visualizing Current Effects


The next step is to see the effects when a current is added at the inlet from the receding tide. Start with creating another simulation.

1. Right-click on the “ shin_half” simulation in the Project Explorer and select **Duplicate**.
2. Right-click on the “ shin_half (2)” simulation in the Project Explorer and select **Rename**.
3. Enter “shin_curr” and press *Enter*.

Now to change the model parameters and re-run the model.

4. Right-click on the “ shin_curr” simulation and select **Model Control** to bring up the *Model Control* dialog.
5. Set the *Current interaction* to “Use dataset” then click the **Select** button to bring up a *Select Dataset* dialog.
6. Select “Velocity (64)_interp” as the vector dataset then click **OK** to close the *Select Dataset* dialog.
7. Select the *Boundary Control* tab.
8. In the *Case Data* section, click the **Insert Below** button to add a new row to the table.
9. In *Time* column of the table, enter “8/15/2018 2:00:00 am” in the second row. These will be the snaps that SMS will put the transient current dataset to.

Note on current dataset: STWAVE simulates one or more boundary condition scenarios referred to as “snaps.” In the original run, SMS used a single snap that represented a specified boundary condition. For this model run, SMS is going to run two snaps one at hour 1 and the other at hour 2. When using snaps based upon times, provide a current dataset that is transient. SMS will have STWAVE use the current dataset values for the time specified. If the snap time step is between two time steps in the current dataset, SMS will interpolate values. If the snap time step is before all time steps in the current dataset, SMS will use the values from the first time step. Similarly if the snap time step is after all time steps, SMS will use the values in the last time step. If STWAVE is not using times and is instead representing independent boundary conditions, a steady state current dataset is chosen for each snap. The surge and wind datasets work similarly.





10. Click **OK** to close the *STWAVE Model Control* dialog.
11. Right-click on the “ shin_curr” simulation in the Project Explorer and select **Save, Export, and Launch STWAVE**. The *Simulation Run Queue* dialog will appear.
12. When the model finishes running, click **Load Solution** to close the *Simulation Run Queue* dialog.

13. Select the different scalar and vector datasets of this simulation to view the contours and vectors.

If viewing the current field, notice the current is a fairly strong ebb current. Notice the difference in wave height that the current makes to the results.

8 Re-running STWAVE in Full Plane Mode

Now to see the effects of running the STWAVE module in the full-plane mode.

1. Right-click on the “ shin_half” simulation in the Project Explorer and select **Duplicate**.
2. Right-click on the “ shin_half (2)” simulation in the Project Explorer and select **Rename**.
3. Enter “shin_full” and press *Enter*.
4. Right-click on the “ shin_full” simulation and select **Model Control** to bring up the *Model Control* dialog.
5. Set the *STWAVE Plane Mode* option to *Full Plane*. Check to ensure that the *Source terms* are still set to “Propagation Only.”
6. Select **OK** to exit the *Model Control* dialog.
7. Right-click on the “ Run1” simulation in the Project Explorer and select **Save, Export, and Launch STWAVE**. The *Simulation Run Queue* dialog will appear.
8. When the model finishes running, click **Load Solution** to close the *Simulation Run Queue* dialog.

Repeat step 6.1 to visualize the STWAVE solution for the full plane option. Notice that the direction of waves in the back bay is much more varied in the full plane option.

9 Conclusion

This concludes the “STWAVE Analysis” tutorial. The model contains many more features and capabilities that have not been explored in this document. Refer to the STWAVE Users manual and SMS help file found in *Help / SMS Help...* for more information.