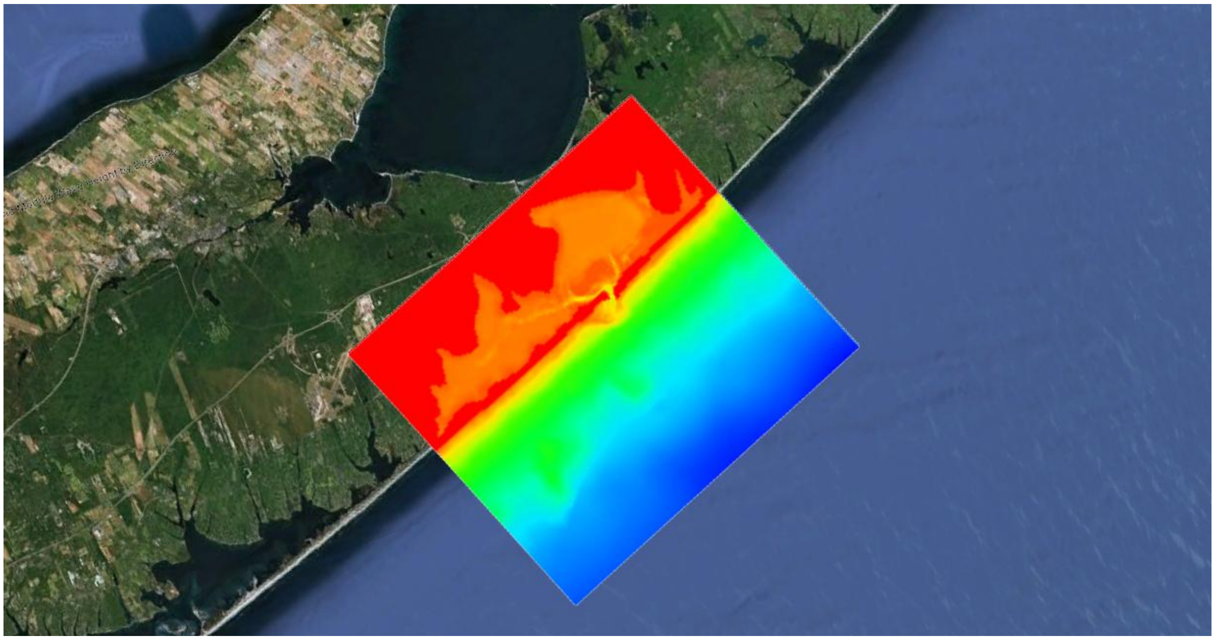
v. 11.2

SMS 11.2 Tutorial
CMS-WAVE Analysis



Objectives

This workshop gives a brief introduction to the *CMS-WAVE* interface and model. This model is similar to STWAVE and the tutorial for the models is similar. As with the STWAVE tutorial, data from the Shinnecock Inlet, Long Island, New York, is used. A *CMS-WAVE* grid will be created over a small section of the scatter set.

Prerequisites

- Overview Tutorial
- CMS-Flow Tutorial

Requirements

- CMS-WAVE
- Scatter Module
- Map Module
- Cartesian Grid Module

Time

- 45-60 minutes

1 Loading scatter set data

1.1 Reading in the scatterset data file

1. Select *File* | *Open*... and select “shinfinal.h5”. Push *Open* to read in the scatterset file.

1.2 Coordinate Conversions

First, we need to set the Display projection to a State Plane coordinate system. Then, the coordinates of the objects need to be set to geographic coordinates and reprojected to state plane coordinates for New York Long Island. To do this:

1. Select *Display* | *Projection* and make sure that *Global Projection* is toggled on. Then, click *Set Projection* and set the projection to *State Plane Coordinate System* with a zone of *New York- Long Island (FIPS 3104)*, a datum of *NAD83*, and planar units set to *Meters*. Make sure that the Vertical Units are set to *Meters* as well. Click OK twice.
2. Right-click on the scatter set and select *Projection* and toggle on *Global projection* and set the projection to *Geographic (Latitude/Longitude)* and set the datum to *NAD83*.Make sure that the vertical units are set to *Meters* as well. Click OK twice.
3. Next, right-click on the default coverage and toggle on *Global Projection*. Then select *Projection*, and set the projection to *Geographic (Latitude/Longitude)* just as you did for the scatter set.
4. Right-click on the scatter set again and select *Reproject*. Make sure that the *Current Projection* is set to *Geographic*, then set the *New Projection* to *State Plane Coordinate System*, with the datum set to *NAD83*, a zone of *New York Long Island (FIPS 3104)* and the planar units set to *Meters*. Make sure that the Vertical Units are set to *Meters* as well. Click OK.
5. Right-click on the default coverage again and select *Reproject*. Reproject the coverage to *State Plane Coordinate System* just as you did for the scatter set. Click OK when done.

2 Creating the Cartesian Grid

We will now create a Cartesian grid for running *CMS-WAVE*. The grid frame is created in the *Map* module. The *Map* module contains tools for creating GIS objects such as points, arcs, and polygons. It is also used for creating a frame, which will be filled in by a Cartesian grid.

2.1 Creating the Cartesian Grid Frame

To create the grid frame:

1. Switch to the *Map* Module.
2. Right click on *default coverage* in the *Project Explorer*, select *Type*, and select *CMS-Wave* under *Models*.
3. Select the *Create 2-D Grid Frame* tool from the *Toolbox*.
4. Zoom out a little and click out three corners of the grid in the order shown in Figure 1 to create the grid frame. The first two points you click define the i-direction, which is the direction of the incoming waves, and the last two points you click are placed on the land.

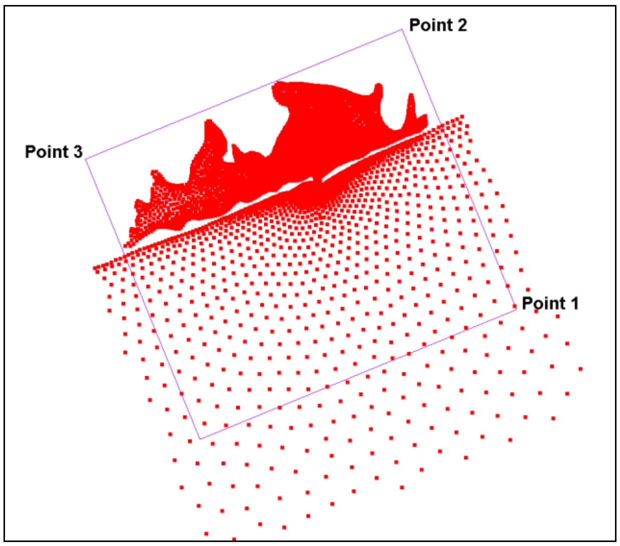


Figure 1 Creating the Cartesian Grid Frame.

5. Switch to the Select Grid Frame tool and select the box in the middle of the grid frame. The origin should be in the bottom right corner of the grid.
6. You can drag and resize the grid frame by dragging the corners or edges until the grid frame fits over the desired area. Dragging a corner or side resizes the frame. Dragging the middle point moves the entire frame. You can rotate the frame around the origin by dragging the circle located just outside the grid. You can also

type in the origin and angle in the Grid Frame dialog that opens when the grid is selected. For consistency purposes set the *Origin X* to 438,000, the *Origin Y* to 70,000, and the *Angle* to 112. You'll also want to drag the grid sides to make your grid size about 15,000 meters in the i-direction and about 17,000 meters in the j-direction (use the status portion of the *Edit Window* at the bottom of SMS to identify the grid size). These values can also be edited when generating the 2D-Grid in section 2.2.

7. Click outside the grid frame to unselect the grid and *Frame* the data on the screen when you are finished.

2.2 Mapping to the Grid

We are now ready to fill the interior of the grid. While the grid is filling, the depth and current values will be interpolated from the scatter set and mapped to each cell. To do this:

1. Go to *Feature Objects* | *Map->2D Grid*.
2. In the *Map -> 2D Grid* dialog, make sure the X, Y, and Angle values are set to 438000, 70000, and 112 respectively. Make sure the *I* value to 15000 m and the *J* value to 17000 m as well.
3. Make sure *Cell Size* is selected in the *Cell Options* and change the cell size of *I* and *J* to 100 m.
4. In the *Depth Options* section, change the source to scatter set, then select the button underneath it. This will bring up the Interpolation dialog. Choose *elevation* as the *Scatter Set to Interpolate From*. Select Single Value for the Extrapolation and change the single value to -2.0. This will make sure that areas in the Cartesian grid with no scatter data will not have any flow during simulation. It is important to do this step if elevation data for land masses is not available.
5. Click OK to exit interpolation dialog.
6. In the *Vector Options* section, select *Map Vector* and make sure that it is set as Current. Make sure the *Interpolated* option is selected and click on the Select button.
7. In the *Interpolation* dialog, select the *Depth-averaged Velocity (64)* scatterset. Make sure *Single Time Step* is selected and choose the time step corresponding to 2 hours 20 minutes (the last one).
8. Select *OK* to exit the Interpolation dialog.
9. Push *OK* to create the Cartesian grid.

Note on interpolation: It is easiest to interpolate currents when creating the 2D grid even if you won't be using currents until a later simulation. We can choose whether to use currents in the *CMS-WAVE* model control. When interpolating, you can specify a single time step or multiple steps. Single times come from any time in the data set. For multiple steps, you can specify to match all the steps from the data set, or you can specify a beginning and ending time step and a time step size.

A Cartesian grid has been created from the grid frame. To view the grid only:

1. Turn off the *Scatter Data*.
2. Frame  the display.
3. Select *Display* | *Display Options* and make sure that only contours are selected for the Cartesian grid. Switch to the Contours tab, and set the *contour method* to *color fill.* The data should look like Figure 2.

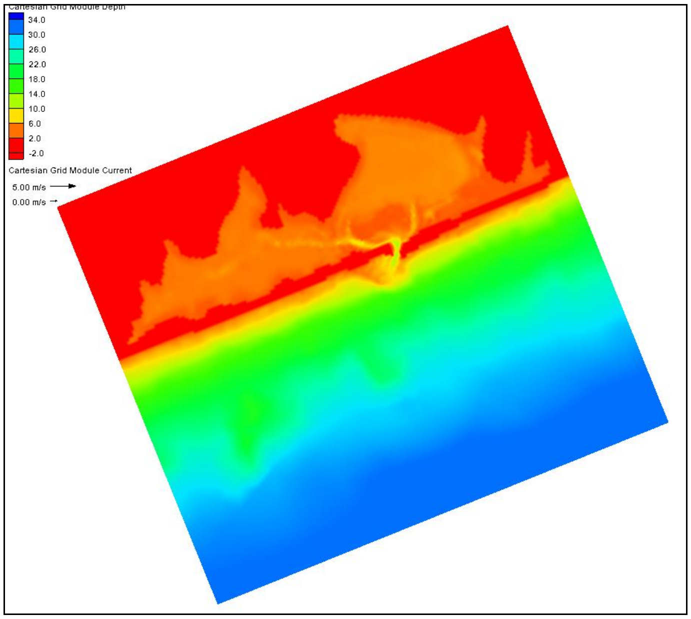


Figure 2 Cartesian Grid with Contours.

3 Editing the Grid and Running CMS-WAVE

3.1 Generating Spectral Energy Distribution

We will now generate the Spectral Energy distribution.

1. Switch to the *Cartesian Grid module* and select *CMS-WAVE | Spectral Energy*.
2. Click the *Create Grid* button to bring up the *Create Spectral Energy Grid* dialog.

Index	Angle	Hs	Tp	Gamma	nm
1	25.0	1	20	8.0	30

3. In the *Frequency Distribution* section of the dialog, change the *Number* to 40 and click *OK* to create a new spectral energy grid.
4. The new spectral energy grid will appear in the *Spectral Manager* tree control and an example will be displayed in the Spectral Viewer.
5. Click the *Generate Spectra* button.
6. In the *Generate Spectra* dialog, enter the following parameters into the spreadsheet.
7. Push the *Generate* button. The new spectrum, labeled “1,” will appear below the grid in the *Spectral Manager* tree control. Select the spectrum. The contours show the energy distribution. Select cell corners to view/edit their energies.
8. Push *Done* to exit the *Spectral Energy* dialog.

3.2 Model Control

In the Model Control, *CMS-WAVE* inputs can be set. We will view the Wind parameters:

1. Select *CMS-WAVE | Model Control*.
2. In the wave source section, make sure the source is set to *Single*, and the plane type is set to *Half plane.*
3. In the lower left corner of the dialog, click *Define Cases.*
4. In the Energy Spectra section of the *CMS-Wave Spectral Events* dialog, right click on the spectra '1' and select *Add to side 1.* Click OK twice to exit both dialogs.

3.3 Selecting Monitoring Stations

The final step is to select cells to act as monitoring stations:

1. Select the *Select Grid Cell* tool.
2. When you select a cell, the i and j location can be seen at the bottom of the screen in the status portion of the *Edit Window*. We are going to select cells by choosing their i and j coordinates.
3. Make sure no cells are selected and choose *Data* | *Find Cell…*
4. Enter 110 for *I* and 60 for *J* and click *OK*. A cell in the bay should now be selected. You can also select cells by entering the nearest x and y values or entering the cell ID.
5. Select *CMS-WAVE* | *Assign Cell Attributes…*
6. Change the *Cell Type* to *Monitoring Station* and click *OK*.
7. Repeat steps 3 through 6 to assign a monitoring station in the inlet and the ocean. The i and j coordinates for the inlet cell are 92 and 66 respectively, and the i and j coordinates for the ocean cell are 50 and 70 respectively.

3.4 Saving the Simulation

To save the simulation:

1. Select *File* | *Save As*, make sure the *Save as type* is set to *Project Files (sms)*, and enter the file name *shin1*.
2. Click the *Save* button.

3.5 Running CMS-WAVE

To run *CMS-WAVE*:

1. Select *CMS-WAVE* | *EXPORT CMS-WAVE files*.
2. Save as *CMS-Wave*.
3. Next, select *CMS-WAVE* | *Launch CMS-Wave*.
4. If a message such as “cmswave.exe – not found” is given, click the *File Browse* button to manually find the *CMS-WAVE* executable.

5. A dialog will come up showing the progress of the *CMS-WAVE* run. To load the simulation after *CMS-WAVE* finishes, make sure that *load solutions* checkbox is on. Click *Exit* when *CMS-WAVE* finishes.

4 Post Processing

SMS provides several tools for visualizing the results of model runs.

4.1 Visualizing the CMS-WAVE Solution

To see the solution results:

1. Select *Display* | *Display Options* . Under the *Cartesian Grid* tab turn the *Contours* and *Vectors* toggles on.

2. Under the *Contours* tab for the *Contour Method* select *Color fill*.

3. Under the *Vector* tab make sure the *Shaft Length* is set to *Define min and max length* and set the *Min length* to 25 and the *Max length* to 50.

4. Under *Vector Display Placement,* change the *Vector Display Placement and Filter* to *on a grid*.

5. Push *OK* to exit the *Display Options* dialog.

6. Select the "Depth" scalar dataset of the Cartesian grid model in the *Project Explorer* to view their contours and vectors.

You'll notice that the waves do not cover the entire bay. CMS-WAVE is limited on how fast the waves will spread out after going through the inlet.

4.2 Visualizing Current Effects

We want to see the effects when a current is added at the inlet from the receding tide. To do this:

1. Select *CMS-WAVE* | *Model Control…*
2. Turn on Currents. Select Single time step and click on the Select button. Select the Current vector set.
3. Press OK to exit the Model Control dialog.
4. Save the simulation as shin_curr.sms and rerun CMS-WAVE.

5. Make sure the *Load solution* checkbox is on before closing the model wrapper. Select the different scalar and vector datasets of this simulation to view the contours and vectors. Notice the difference that the current makes to the results.

4.3 Visualizing the Spectral Energy

The spectral energy is recorded at each monitoring station in the grid frame. To view the spectral energy:

1. Select *CMSWAVE | Spectral Energy*.
2. Push the Import *Spectra button* and push the File Browser button in the Import Spectra dialog.
3. Change the Files of type to Obs Output File (*.obs) and open the *shin__default coverageGrid.obs* solution file.
4. Change the Options to Select Existing Spectral Grid and click Import.
5. Three numbers should be added to your spectral grid. Right click on each dataset and rename these to read 00500070_base, 00920066_base, and 01100060_base. These datasets refer to the ocean station, the inlet station, and the bay station respectively.
6. Repeat steps 2 through 5 to open *shin_curr_default coverageGrid.obs*. Rename these new datasets to 00500070_curr, 00920066_curr, and 01100060_curr.

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 *1*). The energy increases in the inlet and changes direction. The energy in the bay is very low compared to the inlet. You can 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. When you are done, click *Done* to exit the *Spectral Energy* dialog.