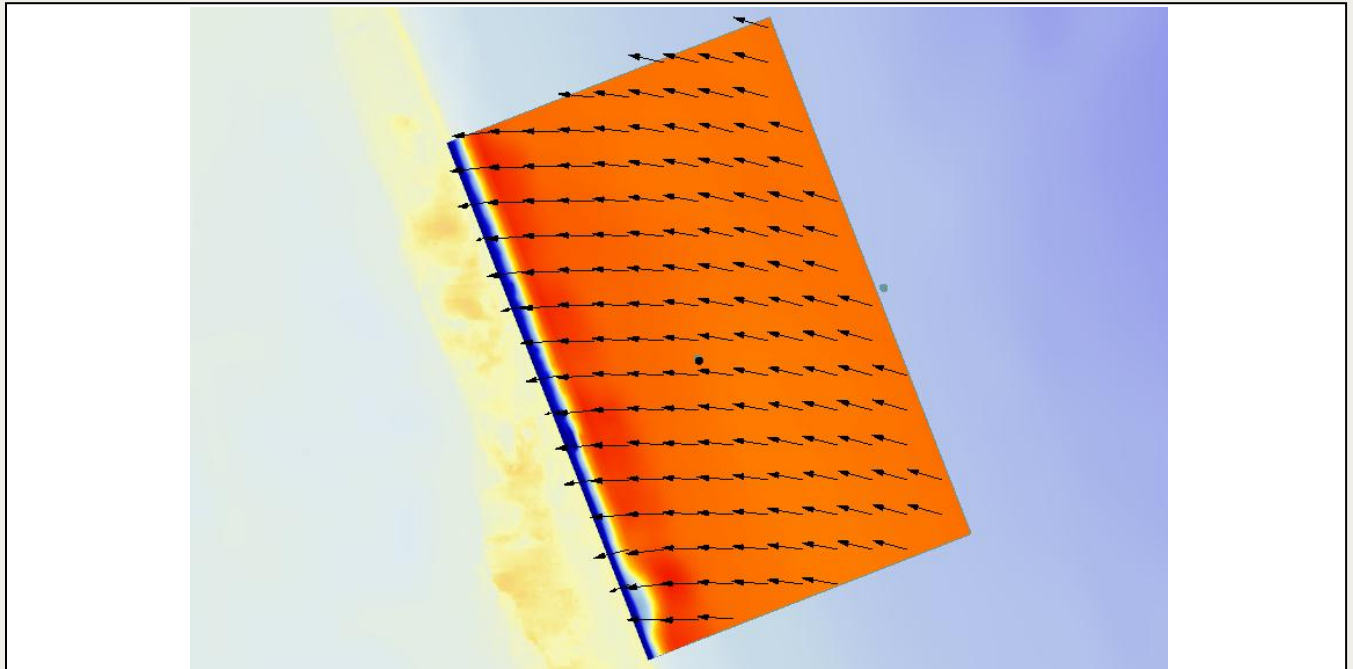




SMS 14.0 Tutorial

CMS-Wave with WIS Data

Using WIS wave data in a CMS-Wave model



Objectives

This tutorial demonstrates setting up and running a CMS-Wave simulation using WIS wave data.

Prerequisite Tutorials

- Overview
- Map Module
- WIS Portal

Required Components

- SMS Core
- CMS-Wave Model & Interface

Time

- 15–30 minutes

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1 Introduction

CMS-Wave is a part of the Coastal Modeling System which is maintained by the USACE. The model is a 2-D wave spectral transformation (phase-averaged). The term "phase-averaged" means that it neglects changes in the wave phase in calculating wave and other nearshore processes.

This model is similar to the STWAVE model which is also maintained by USACE. Differences include support for non-square and varying sized computation cells, inclusion of structures, treatment of a muddy bed, and a variety of other features.

This tutorial will demonstrate building a CMS-Wave simulation using data that was downloaded from the WIS Data Portal. See the "Retrieve Data from the WIS Portal" tutorial to see how this was done. This tutorial makes use of a location around the Currituck Sound, North Carolina in the United States.

2 Getting Started

To open the project, do the following:

1. Launch SMS, select *File* | **Open...** to bring up the *Open* dialog.
2. Browse to the *data files* folder for this tutorial and select "start.sms".
3. Click **Open** to import the project and exit the *Open* dialog.

The project should appear similar to Figure 1. The project contains a 2D grid that was previously generated. See the "CMS-Wave Grid Generation" to tutorial to see how this grid was generated. The starting file also has some map coverages. Two of the map coverages contain spectral data that was imported from the WIS Data Portal.

Two simulations will be used in this tutorial. One simulation will make use of the spectral data that was imported from the WIS Data Portal. The other simulation will make use of spectral data that was generated in SMS using data from the WIS Data Portal.

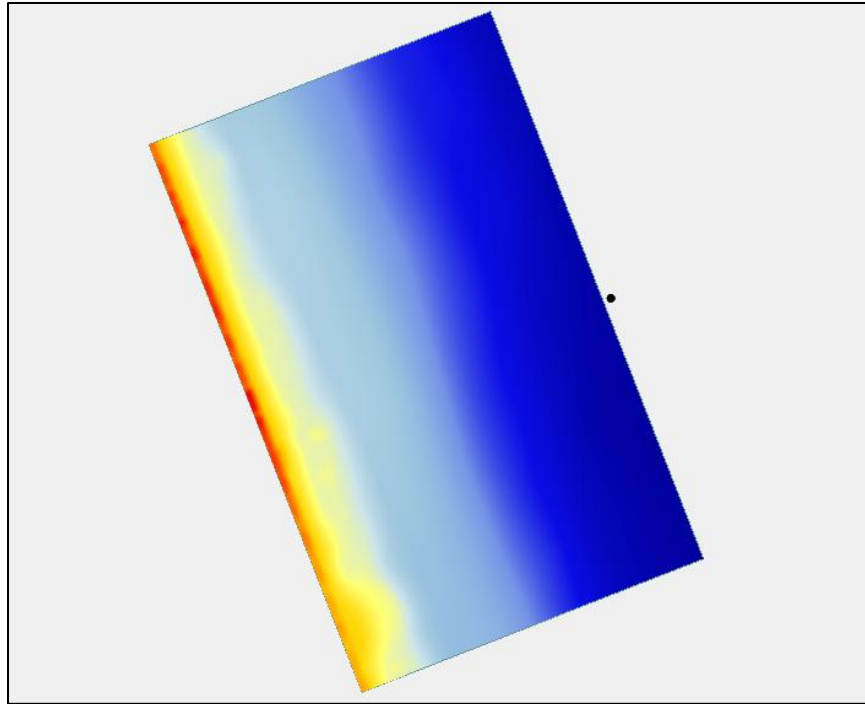


Figure 1 Initial project appearance

3 Assigning an Observation Cell

To instruct CMS-Wave to output spectra at a selected location:

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 *Models | CMS-Wave | Observation Cells*.
3. Leave the *Coverage Name* as "Observation Cells" and click **OK** to close the *New Coverage* dialog.
4. Using the **Create Feature Point** tool, create a point inside the domain as shown in the figure below.

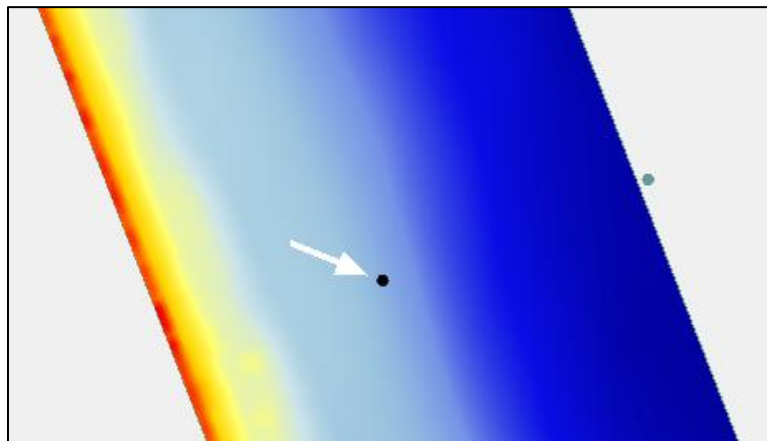


Figure 2 The observation point location.

4 Setting up the CMS-Wave Simulation

Starting in SMS 13.2, the interface for CMS-Wave 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.

4.1 Creating the simulation

To create the simulation:

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

A new  "CMS-Wave 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 "CMS-Wave-eng" for the simulation and press *Enter*.

4.2 Adding Components to the Simulation

A CMS-Wave simulation consists of a grid (basis of computations), spectral 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  "CMS-Wave 50m Grid" object and select *Apply to | CMS-Wave Simulations → CMS-Wave-eng*.

Notice the  "CMS-Wave 50m Grid" grid item has been added under the  "CMS-Wave-eng" simulation. The  "CMS-Wave 50m Grid" grid item creates a link between the simulation and the grid which tells the simulation to use the specified grid during the model run.

2. Click-and-drag the  "Observation Cells" coverage down to the  "CMS-Wave-eng" simulation.

As the cursor moves below the simulation name, a black line appears indicating this object can be added to this simulation.

3. Let go of the mouse button to drop the coverage into the simulation.

The simulation will now make use of both the geometry and the coverage.

5 Setting the Model Control

To edit the simulation parameters:

1. Right-click on the  "CMS-Wave-eng" simulation and select **Model Control...** to bring up the *Model Control* dialog.

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

5.1 Parameters

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

1. In the *Parameters* tab, Change the *Source Terms* to “Propagation Only”.
2. 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. Leave “Spectral coverage” in the *Source* combo box.
3. In the *Frequency Distribution* section, change the *Number* to “40”.
4. In the *Sides* section, click **Select...** next to “Specified spectrum” to open the *Select Spectral Coverage for Side 1* dialog.
5. Select the “ 63218_2022-01-01_2022-01-31 – ENG” coverage and click **OK** to close the *Select Spectral Coverage for Side 1* dialog.
6. In the *Case data* section, click the **Set Reference Time** button to open the *CMS-WAVE Simulation Reference Time* dialog.
7. For the *Reference time*, enter “1/1/2022 12:00:00 AM”.
8. For the *Time units*, select “hours”.
9. Click **OK** to close the *CMS-WAVE Simulation Reference Time* dialog.
10. Click the **Populate** button to automatically enter a case time.
11. 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 CMS-Wave 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 Options

The *Options* tab contains options when running CMS-Wave. These options will be left at the default values for this simulation.

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

6 Running CMS-Wave

To run CMS-Wave:

1. Right-click on the  “CMS-Wave-eng” simulation in the Project Explorer and select **Save Project, Simulation and Run**. The *Simulation Run Queue* dialog will appear.

(Note: If a message such as “CMS-Wave.exe – not found” is given, click the file browser  button to manually find the CMS-Wave executable. The default installation location for this executable is relative to the SMS installation folder “.\\python36\\Lib\\site-packages\\cmswave_exe”.)

A *Simulation Run Queue* dialog will show the progress of the CMS-Wave run.

2. When CMS-Wave finishes, select **Load Solution**.

The solution will be loaded into SMS under the  “CMS-Wave 50m Grid” object in a folder named  “CMS-Wave-eng (CMS-Wave)” and consists of datasets of wave height, wave period, wave direction, and a vector dataset to display the direction.

6.1 Visualizing the CMS-Wave Solution

To see the solution results:

1. Select *Display* | **Display Options** to bring up the *Display Options* dialog.
2. On the list on the left, select *Cartesian Grid*.
3. Turn on the *Contours* and *Vectors* options.
4. Select the *Contours* tab.
5. For the *Contour Method* select “Color fill” and set the *Transparency* to “20” percent.
6. Select the *Vectors* tab.
7. Under *Vector Display Placement and Filter*, change the *Display* to “on a grid.” Leave the spacing at “30” pixels in each direction.
8. Set the *Origin* to be “Relative to max elevation”.
9. Click on the **Options** button next to *Legend* to open the *Vector Legend Options* dialog.
10. Change the *Title* to “DS” to just show the dataset name on the legend.
11. Change the *Units* to “m” to indicate that the vector length is based on the wave height.
12. Select **OK** to exit the *Vector Legend Options* dialog.
13. Select **OK** to close the *Display Options* dialogs.
14. Select the  “Wave Direction” scalar dataset under the  “CMS-Wave 50m Grid” grid.

Note:

- The vectors display the direction of the waves. As the wave approaches the shore the wavelength shortens so the waves bend towards the shoreline.

- The scalar direction value is relative to the grid orientation as computed by CMS-Wave (0.0 are waves moving in the shore normal direction.)
15. Select the “ Wave Height” scalar dataset under the “ CMS-Wave 50m Grid” grid.

Note:

- Wave height is 1.0 meter on the offshore side of the grid as was specified in the input wave conditions.
- Wave height increases as the waves crest near the shore.
- Smaller waves penetrate through the inlet into the bay.
- This simulation is not set up to simulate reflections so only forward dispersion of the wave into the bay is represented and the waves do not penetrate to the back corners of the bay.

The display should appear like Figure 3.

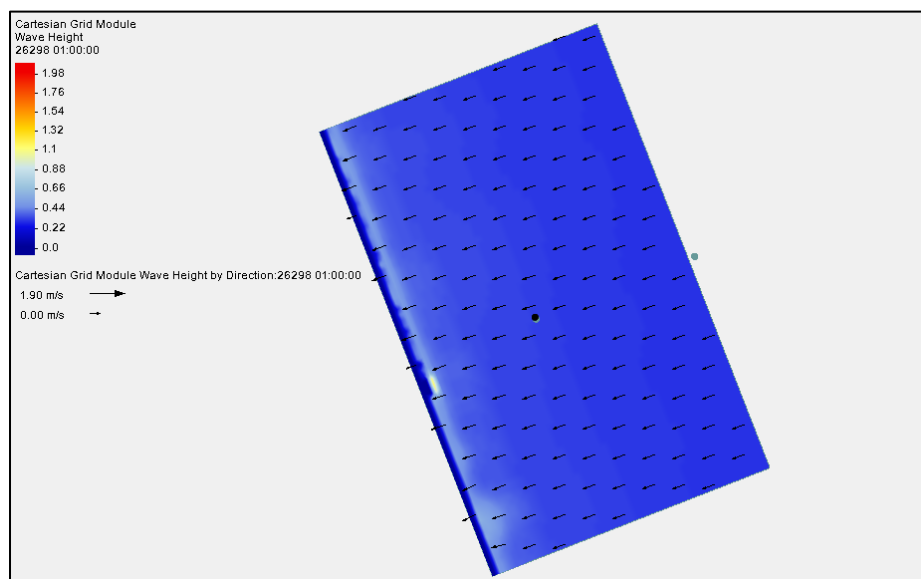


Figure 3 CMS-Wave results

6.2 Visualizing the Spectral Energy

The spectral energy is recorded at each observation cell (or nesting point) in the simulation and written by CMS-Wave to an observation file (*.obs) (or nesting (*.nst) file for nesting points). The file is automatically read in at the end of a CMS-Wave run. To view the spectral energy:

1. Select the coverage “ CMS-Wave-eng – OBSE” in the Project Explorer to make it the active coverage.

Notice that there are nodes at each of the monitoring locations specified in the “ Observation Cells” coverage.

2. Double-click on the offshore observation node using the **Select Feature Point**  tool to bring up the *Spectral Energy* dialog.

Review the spectral data.

3. Click **Done** to close the *Spectral Energy* dialog.

7 Switching Spectral Data

Now to run a CMS-Wave simulation using a different set of spectral data by doing the following:

1. Right-click on the  "CMS-Wave-eng" simulation and select **Duplicate**.
2. Right-click on the  "CMS-Wave-eng (2)" simulation and select **Rename**.
3. Enter the name "CMS-Wave-txt" for the simulation and press *Enter*.

Now to switch out the spectral data for the new simulation by doing the following:

4. Right-click on the  "CMS-Wave-txt" simulation and select **Model Control...** to bring up the *Model Control* dialog.
5. Select the *Boundary control* tab in the *Model Control* dialog.
6. In the *Sides* section, click **Select...** next to "Specified spectrum" to open the *Select Spectral Coverage for Side 1* dialog.
7. Select the  "Spectral" coverage and click **OK** to close the *Select Spectral Coverage for Side 1* dialog.
8. Select **OK** to exit the *Model Control* dialog.

The new simulation is now ready to run with the new spectral data.

9. Right-click on the  "CMS-Wave-txt" simulation in the Project Explorer and select **Save Project, Simulation and Run**. The *Simulation Run Queue* dialog will appear.
10. When CMS-Wave finishes, select **Load Solution**.

To view the spectral data:

11. Select the coverage  "CMS-Wave-txt – OBSE" in the Project Explorer to make it the active coverage.
12. Double-click on the offshore observation node using the **Select Feature Point**  tool to bring up the *Spectral Energy* dialog.

8 Conclusion

This concludes the initial "CMS-Wave with WIS Data" tutorial. The model contains many more features and capabilities that have not been explored in this document. Refer to the CMS-Wave User Manual and the SMS help file found in *Help | SMS Help...* for more information.