LESSON 1

Introductory Exercise

This lesson gives an overview of using *SMS* for modeling coastal processes. The lesson uses the *Cartesian Grid Module* inside of *SMS* which contains interfaces for *STWAVE* and *M2D*. This lesson will illustrate using the *STWAVE* interface.

Concepts we will cover include the attributes of a Cartesian grid, the display options available in *SMS*, steps for setting up a model, running a model (in this case, *STWAVE*), and visualization options. Step by step instructions are provided. If you have a question, call an instructor.

1.1 Opening an STWAVE simulation

Open *SMS* and switch to the *Cartesian Grid Module* .

STWAVE is a nearshore steady state wave model which calculates wave heights periods and directions along with radiation stress gradients on a Cartesian grid. It requires bathymetry and spectral energy as input and can optionally include the effects of wind and currents.

SMS includes the option of remembering the coordinate system a numerical model is in. By default, the program assumes you are working in some local coordinate system until you tell it otherwise. *STWAVE* requires all data to be in metric units. If you open an *STWAVE* file and the current units are not metric, SMS will ask you if you want to convert the file from metric to conventional. To avoid confusion, it is easiest to tell *SMS* that you want to work in metric before loading the model. To do this:

1. Select *Edit* | *Current Coordinates*.

2. Change the horizontal units to meters and the vertical units to meters.

3. Click *OK*.

Now we are ready to open the *STWAVE* simulation. Open the file *planebeach.sim*. This is an *STWAVE* simulation file and contains links to other files that are used in *STWAVE*. The grid should be similar to the one shown in Figure 1-1.

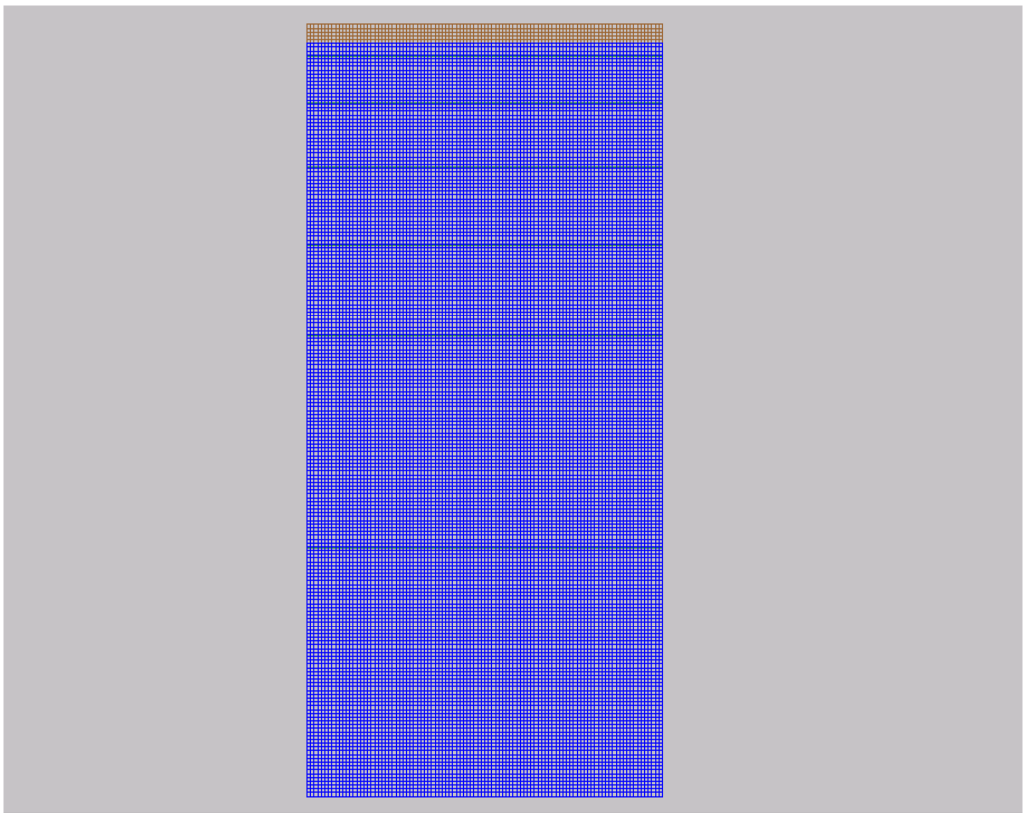


Figure 1-1 STWAVE Grid

1.2 Grid Attributes

There are several options that control what the grid looks like in *SMS*. We want to change the display options so that we can see our contours and see the orientation of our grid. To change these options:

1. Click on the *Display Options*  button in the tool window.

2. Turn off *Ocean cells* so the contours will be more visible in the ocean.

3. Turn on *Grid Boundary* so the extents of the grid are still visible.

4. Turn on the *IJ Triad*.

5. Click *OK*.

The IJ Triad tells the direction that the grid is oriented. The I direction in STWAVE corresponds with the direction wave will propagate. Therefore, the user must confirm that the I axis runs from offshore to shore. For an unrotated grid, the I direction corresponds with the X axis (to the right) and the J direction corresponds with the Y axis (to the top).

SMS provides a tool to see summary statistics about the information contained in a module. Most of the information has to do with the geometry stored in the module. To view this information, click the *Get Module Info*  macro.

The first section tells us the number of cells, rows, and columns in the grid. The second section tells us minimum and maximum depths, the orientation angle of the grid, and the s4ize of each cell. STWAVE requires constant square cells. Since we have 100 rows (cells in the J directions) and the size is 25, the grid is 2500 meters in the J direction. Click *Close* to close the information dialog.

1.3 Spectral Energy Dialog

The primary input boundary condition for the *STWAVE* model is the spectra of wave energy at the ocean boundary of the grid. These spectra may be generated in *SMS* or gathered from a buoy. This lesson uses a spectra generated from a peak wave height and direction with spreading coefficients applied.

The user must specify the wave direction for *STWAVE*. In the current version of *SMS* it is clearer to specify these spectra with reference to the grid. If the direction is specified as local, an angle of zero degrees is a wave moving in the I direction. An angle of 45 degrees indicates a wave moving in the towards shore and to the left at the same rate. To tell SMS that we will specify waves in local space:

1. Select *STWAVE | Mode Control* to bring up the model control dialog.

2. Select *Local* as the wave direction.

3. Click *OK* to exit the dialog.

Now we need to generate the spectra. The tool to do this also allows you to edit, and visualize the spectral wave energies being applied. To setup the wave energy:

1. Select *STWAVE | Spectral Energy* to bring up the spectral energy dialog.

2. Click on the *Generate Spectra Button*.

3. Change the values for the 1st spectra as follows: H = 4 m, T = 12 s, Angle = 25 deg, Gamma = 4, nn = 10, Wind Speed = 0.0, Wind Dir = 0.0, Tide Elev = 0.0.

4. Click the *Generate* button.

5. Use the Rotate Tool  to get a better view of the spectrum.

6. Click *OK* to exit the dialog.

1.4 Running STWAVE

Before running a model it is a good idea to save your data. To do this:

1. Select *STWAVE | Save STWAVE* …. This updates the files on your hard disk to reflect the changes you have made in this session.

Now, to run *STWAVE:*

1. Select *STWAVE | Run STWAVE*.

2. Make sure the model location is correct. You select the executable of *STWAVE* that you want to run. *SMS* displays the version last used. If this is not the correct version click on the file browser  icon to choose a new executable.

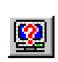
3. Click *OK*. *SMS* will now launch the *STWAVE* model. The message generated by *STWAVE* are displayed in a *DOS* prompt and you will be asked to press return when the model run is complete. For this model, the run should only take a few minutes.

When STWAVE is finished, there should be a new file *Planebeach.wav.* Open this file in *SMS* using the File menu and Open command.

1.5 Solution Visualization

SMS provides several methods for visualization of results. Contours and vector fields are the most commonly used methods. Turn on the color filled contours of the wave height function:

1. In the *Edit Window* change the *Scalar* combo-box to *Height*.

2. Click on the *Display Options*  button in the *Tool Window*.

3. Switch to the *Contours* Tab.

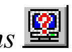
4. Switch the Contour method to *Color Fill*.

5. Click on the *Color Options* button.

6. Make sure that *Hue ramp* is selected.

7. Click *OK* in both dialogs to get back to the main *SMS* screen. The image will update to show color filled contours of the wave height.

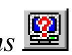
Vector fields show the currently active vector dataset. In this case the wave directions were the only vector dataset computed. Turn on the vector field display:

1. Click on the *Display Options*  button in the *Tool Window*.

2. Turn on Vectors in the Cartesian Grid tab.

3. Click *OK*.

The grid is now covered with black arrows. Since this isn't very useful we will change the vector options to something more appealing.

1. Click on the *Display Options*  button in the *Tool Window*.

2. Switch to the *Vectors* tab.

3. Under *Shaft Length* change the option to *Define Min and Max Length*.

4. Set the minimum length to 10 and the maximum length to 25.

5. Under *Arrow Placement* change the option to *Display on a Grid*.

6. Set the *x pix* and *y pix* to 30.

7. Click *OK*. The image will now show the wave height as a color, and the wave direction as an arrow, with one arrow every 30 pixels.

STWAVE also computes the change in wave period as the wave moves on shore. Change to that data set by selecting *Period* in the *Scalar* combo-box of the *Edit Window*. *STWAVE* computed that the period does not change until the wave gets very close to shore in this case. Experiment with the zoom and pan tools to view data.

1.6 Conclusion

Now you have run a numeric wave model inside of *SMS* and looked at its computed results. The rest of the week will be spent learning about several models that can be accessed from inside of *SMS*, what they do, and how they are used.