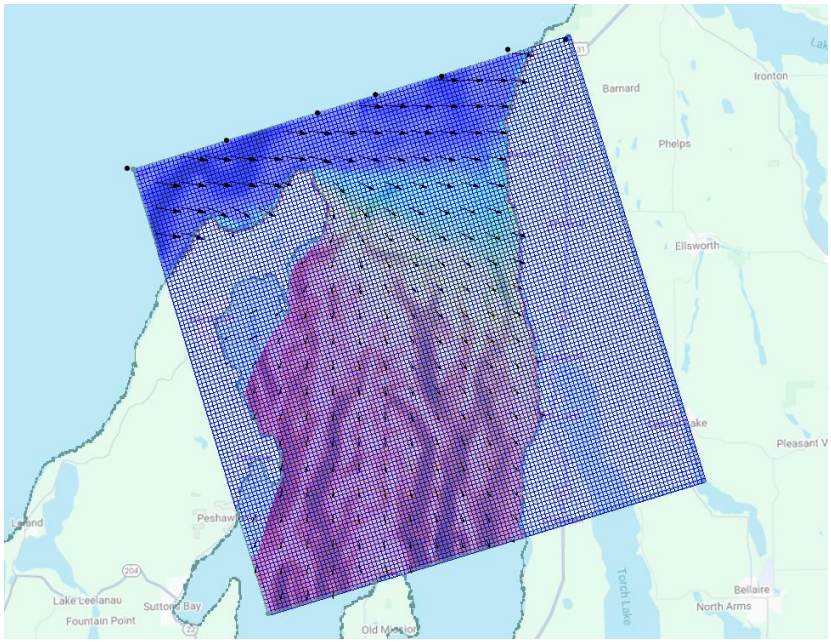
SMS 13.5 Tutorial

STWAVE Child Simulation

Setting up an STWAVE Child Simulation



Objectives

This tutorial demonstrates setting up an STWAVE simulation that uses the output from a previous simulation as input wave spectra.

Prerequisite Tutorials

- Overview
- STWAVE
- STWAVE Parent Simulation

Required Components

- SMS Core
- STWAVE Interface

Time

- 5–10 minutes

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1 Introduction

The Steady State Spectral Wave (STWAVE) numeric engine simulates the transformation of wave energy through a domain of varied bathymetry. The input wave energy may be specified at a single location along the offshore boundary or at multiple locations to provide spatially varied input. A child simulation is one that is forced by multiple spectra from a separate simulation referred to as the parent simulation.

This tutorial is a continuation of the “STWAVE Parent Simulation” tutorial.

2 Getting Started

For consistency, start by importing a project file containing the parent simulation:

1. Launch SMS and select *File* | **Open…** to bring up the *Open* dialog.
2. Select “Project Files (*.sms)” from the *Files of type* drop-down.
3. Browse to the *data files* folder for this tutorial and select “GrandTraverseBay.sms”.
4. Click **Open** to import the project and exit the *Open* dialog.

The initial project should appear similar to Figure 1. It includes:

- The output of the “STWAVE Parent Simulation” tutorial.
- A polygon defining the location of the child simulation.

This project also establishes the display (and working) projection to be UTM Zone 16.

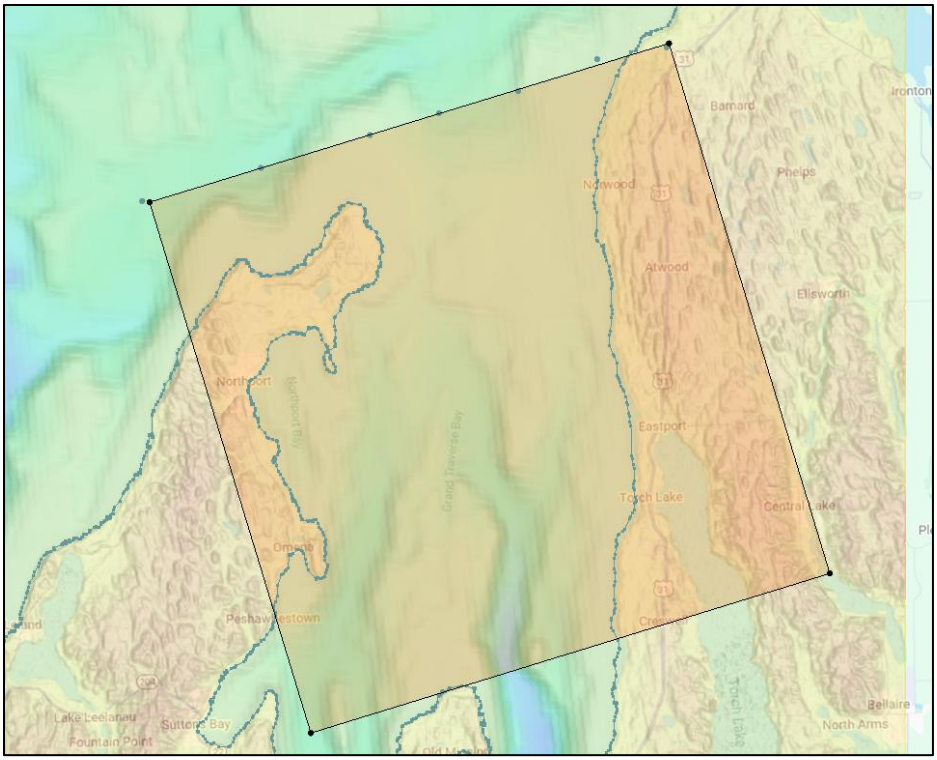

Figure 1 Initial project

3 Reviewing the Wave Spectra from the Parent Simulation

The parent simulation transformed wave spectra at its offshore location to nesting point locations in the domain, defined in the "Parent Spectral" coverage (in the *Map Data/STWAVE/Parent* folder). The transformed spectra were loaded in the "Parent - nest" coverage as part of the simulation solution. To review these spectra:

1. In the Project Explorer, expand the "STWAVE" and "Parent" folders.
2. Turn on the "Parent Spectral" coverage and make it active.
3. Right-click and select **Zoom to Coverage** to zoom to the point.
4. Using the **Select Feature Point** tool, double-click on the point in the coverage to open the *Spectral Energy* dialog.
5. Click on each of the time steps (0.0, 1.0 and 2.0 on the left side of the dialog) to review the input spectra which are displayed in the *Spectral Viewer* on the right side of the dialog.

Note that the spectra for each case indicate energy coming from a range of directions.

6. Click **Done** to close the *Spectral Energy* dialog.
7. Select the "Parent - nest" coverage to make it active then right-click and select **Zoom to Coverage** to zoom to the points.
8. Using the **Select Feature Point** tool, double-click one of the points in the coverage to open the *Spectral Energy* dialog.

9. Click on each of the time steps (on the left side of the dialog) to review the transformed spectra which are displayed in the *Spectral Viewer* on the right side of the dialog.

Note that the spectra for each case are very similar despite the variation of the input spectra reviewed in step 4 above.

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

This illustrates how the bathymetry of the domain influences the transformation of the wave energy through the domain.

4 Create the Child Grid

A child simulation in STWAVE is a simulation that uses multiple input spectra outputted by a parent simulation. Two applications of parent/child simulations include:

- Transition from coarse resolution to fine resolution.
- Change the principal wave direction.

The basis of an STWAVE analysis is bathymetry data in the form of a Cartesian grid. To create this grid for the child simulation:

1. Right-click on "Map Data" in the Project Explorer module and select **New Coverage** to open the *New Coverage* dialog.
2. Under *Coverage Type*, select **CGrid Generator**.
3. For the *Coverage Name,* enter "Child".
4. Click **OK** to close the *New Coverage* dialog.

This creates the "Child" coverage that will be used to create the grid.

5. Right-click on the "Child Domain" coverage and select **Zoom to Coverage**.
6. Select the "Child" coverage to make it active.
7. Using the **Create 2-D Grid Frame** tool, click on the upper left corner of polygons in the "Child Domain" coverage (highlighted in Figure 1). This is the offshore origin of the Cartesian grid.
8. Click on the lower left corner of the polygon. This defines the shoreward direction of the grid. This must be somewhat aligned with the principal wave direction.
9. Click on the lower right corner of the polygon to finish defining the grid frame.

The exact position of a wave grid is not important. The polygon is provided in this case for guidance and consistency. It is important that the entire grid frame should be inside the boundary of the DEM since this provides elevation data to the grid.

If desired, the grid frame can be edited graphically or explicitly using the **Select 2-D Grid Frame** tool.

10. Right-click on the "Child" coverage and select *Convert* | **Map → 2D Grid** to open the *Map → 2D Grid* dialog.
11. For the *Grid name* enter "Child".
12. In the *I Cell Options* section, set the *Cell size* to "245".
13. In the *J Cell Options* section, set the *Cell size* to "245".

14. In *Elevation options* section, set the *Source* to “Raster”.

Since there is only one raster loaded, there is no need to select the raster.

15. Click **OK** to close the *Map → 2D Grid* dialog and create the grid.

The grid will appear in the Project Explorer and the Graphics Window. This grid consists of cells that are 250 m x 250 m and have elevations extracted from the DEM.

5 Create and Assemble the STWAVE Simulation

Now to create and assemble the STWAVE simulation by completing the following:

1. Right-click on the background of the Project Explorer window and select *New Simulation* | **STWAVE** from the popup menu.
2. Right-click on the “ Sim” simulation and select **Rename**.
3. Enter “Child” as the new name.
4. Drag the “ **Child”** Cartesian grid to the “ Child” simulation to include this grid in the simulation. A line will appear under the simulation. When that line appears, let go of the mouse button to drop the grid into the simulation.
5. Right-click on the “ Parent - nest” coverage and select *Apply to…* | **STWAVE Simulations → Child**. This is the other method of linking a component to a simulation.

6 Specify STWAVE Parameters

Now to specify the STWAVE simulation parameters by doing the following:

1. Right-click on the “ Child” STWAVE simulation and select **Model Control…** to open the *Model Control* dialog.
2. Leave all parameters in the *Parameters* tab set to default values.
3. In the *Boundary control* tab:
   a. In the *Computational spectral grid* section, set *Minimum* to “0.1”. This means that only waves with period less than 10 seconds will be included in this simulation.
   b. In the *Case data* section, click on the **Populate** button. This creates a case for each of the 3 spectra that were defined in the provided spectral coverage.
4. Click **OK** to close the *Model Control* dialog.

The STWAVE simulation is now ready to run.

7 Running STWAVE

To execute the simulation:

1. Right-click on the “ Child” simulation and choose **Save Project, Simulation and Run** to save the simulation files and open the *Simulation Run Queue*.

As implied, this command actually does three things. It saves the project, exports the simulation and launches STWAVE. The *Simulation Run Queue* tracks the progress on the run.

8 Reviewing the Solution

To review the solution created by STWAVE:

1. When the simulation has finished running, click on the **Load Solution** button.
2. Turn off the "  Grand Traverse Bay.tif" DEM to simplify the display.

The solution for this simulation consists of a set of five datasets loaded onto the "  Child" Cartesian grid.

3. Right-click on the "  Child" Cartesian grid and select **Zoom to grid**.
4. Click on the "  Wave Height" dataset.

The provided project includes display templates to set the contour options for this dataset. (Refer to the "Display Themes" tutorial for more information on these themes). The Graphics Window now shows the wave heights and directions (in the form of arrows) focusing on wave heights below 0.5 meters. The colors (Figure 2) show the wave heights through Grand Traverse Bay. Note that the wave direction is too oblique to the orientation of the parent grid. This is one of the purposes of using a child simulation.

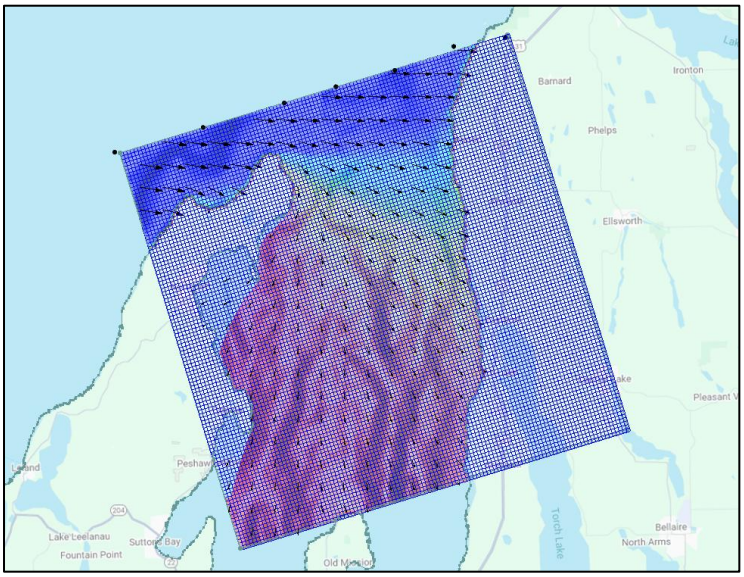

Figure 2 Wave heights and directions

9 Conclusion

This concludes the "STWAVE Child Simulation" tutorial. Features that have been described include**:**

- Creation of a Cartesian grid.
- Reviewing spectra from a parent simulation.

- Assembling and defining an STWAVE simulation.
- Reading and viewing an STWAVE simulations solution.

You may want to experiment with different grid resolutions and orientations.

The STWAVE modeling process is continued in the “STWAVE Engineering With Nature” tutorial.