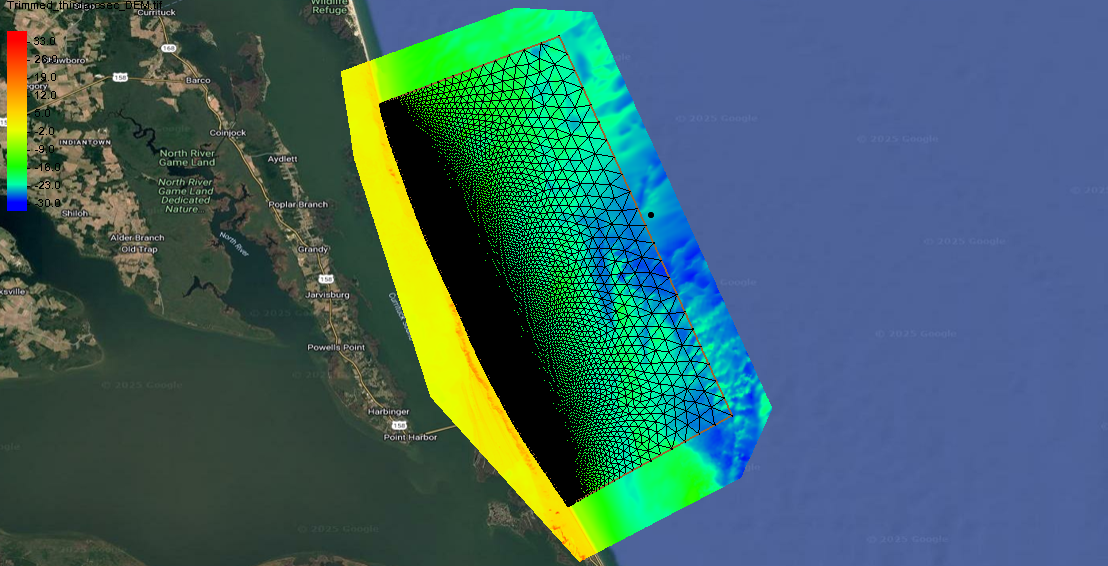
A picture containing shape

Description automatically generated



SMS 13.4

SMS 13.4 Tutorial

***WaveWatch III***

Overview of the WaveWatch III Interface in SMS

Objectives

Learn how to set up a WaveWatch III simulation and export the simulation files.

Time

* 10–20 minutes

Required Components

* SMS Core

Prerequisite Tutorials

* None

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# Introduction

This tutorial covers the steps of creating the data files for a WAVEWATCH III® (WW3) simulation in the Surface-water Modeling System (SMS). The online manual for SMS (<https://www.xmswiki.com/wiki>) includes detailed explanation of SMS.

A WW3 simulation consists of the following components:

* an unstructured grid (UGrid) or mesh of triangular cells/elements
* a wave energy spectra defined at a specified location
* a set of model parameters

This tutorial begins with some of the components having already been created. Specifically, the 2D mesh used for the simulation has already been generated. An example of how a mesh like this can be generated is found in the “Mesh Generation” tutorial.

# Getting started

Start by importing a project file containing an existing mesh:

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

The project should appear similar to Figure 1. The project contains an elevation raster, a coarse mesh covering that raster and a couple of display themes that will be used later. Refer to the display themes tutorials for more information on creating display themes.

A map of a sea

AI-generated content may be incorrect.

Figure Initial project

# Define wave spectra

In addition to a mesh, WW3 requires a set of wave conditions to be simulated.

## Define a spectral coverage

Wave conditions are represented as wave spectra, associated with a specific geographic location. SMS manages these on a spectral coverage.

To illustrate this:

1. Right-click on “File:Map Folder.svg Map Data” and select **New Coverage** to bring up the *New Coverage* dialog.
2. In the *Coverage Type* section, under *Generic* select **Spectral**.
3. For the *Coverage Name,* enter “Global\_Spectra”.
4. Click **OK** to close the *New Coverage* dialog and create the new “File:Coverage Active Icon.svg Global\_Spectra” coverage in the Project Explorer.
5. In the Project Explorer, right-click on “File:Map Folder.svg Map Data” and select **New Folder.**
6. Rename the new folder to “WW3”.
7. Drag the “File:Coverage Active Icon.svg Global\_Spectra” coverage to be under the “File:Generic Folder.svg WW3” folder.

## Define spectral point (location of the spectra)

The location associated with wave conditions is defined as a spectral point in the spectral coverage.

To illustrate this:

1. Using the **Create Feature Point** File:Create Points Tool.svg tool, create a feature point somewhere near the middle of the offshore boundary as in Figure 2.

A map of a sea

AI-generated content may be incorrect.

Figure Spectral point general location

## Define spectral grid

WW3 requires a specific type of spectral grid. This grid is created in SMS as an attribute of the spectral point.

To illustrate this:

1. Using the **Select Feature Point** File:SMS Select Node Tool.svg tool, select the newly-created point.
2. Double-click on the point to bring up the *Spectral Energy* dialog.
3. Click **Create Grid** to open the *Spectral Grid Attributes* dialog.
4. Change the *Spectral energy grid plan type* to “Global”
5. Click **OK** to close the *Spectral Grid Attributes* dialog and open the *Create Spectral Energy Grid* dialog.
6. Change the “Delta” option to “Power series”.
7. Click **OK** to close the *Create Spectral Energy Grid* dialog.

WW3 requires power series distributions for frequencies in the spectral grid. In the future, SMS will convert from other distributions to a power series.

## Set the spectral time

Wave spectra may be associated with a specific point in time. This is particularly true when using wave data from a global monitoring or simulation source such as WIS. In SMS its often recommended to set the “Zero” time for the wave spectra.

## Define spectral energy distribution

The wave spectra is composed of energy density values for each direction and frequency. These can be measured (field data), or generated from parameters. This example will generate the spectra from parameters.

To illustrate this:

Click **Spectra** button to open the *Generate Spectra* dialog.

Under *Seaward Boundary Depth*, select *Specify once for all spectra* and enter “20.0” m for the value.

Enter "0.0, 45, 1.0, 3.0, 3.3, 4" as values in the first row of the "Spectral Parameters" table.

Enter "1.0, 90, 3.0, 5.0, 3.3, 4" as values in the second row of the "Spectral Parameters" table.

Click "Generate".

Click on the spectral times to preview the energy distributions.

Click "Done".

File | Save Project. (As recommended above)

Notes:

The spectral point location would normally come from a location where spectral data is available.

Spectra from buoys or databases can be imported.

The dates associated with spectral data can be imported or specified.

The "Spectral Parameters" table can be copied/pasted from a spread sheet.

# Define boundary conditions

WW3 also requires that the attributes of the various boundaries of the domain are specified.

## Define a BC coverage

Boundary conditions are also done using a map module in SMS. To create this coverage (layer):

Right click on "Map Data" and select "New coverage".

Set the "Coverage Type" to "Models | WaveWatch3 | Boundary Conditions".

Enter a name of “BC 1” and click OK.

Drag "Boundary Conditions" coverage into the "WW3" folder.

## Define the BC arcs

Specification of boundary conditions in SMS is managed separately from the mesh. This allows the same boundary conditions to be applied to multiple meshes if desired. Arcs in a BC coverage define the location of the different types of boundaries.

To define these arcs:

Switch to the "Create Feature Arc" tool.

Click somewhere near the intersection of the coastline and the north lateral boundary.

Double click near the intersection of the north lateral boundary and the offshore boundary.

Click on the end of the arc you just created to start a new arc.

Double click near the intersection of the south lateral boundary and the offshore boundary.

Click on the end of the arc you just created to start a new arc.

Double click near the intersection of the south lateral boundary and the coastline arc

Notes:

The arcs that were created to define the domain could also have been used rather than digitizing new arcs in the BC coverage.

## Define the BC types

Each arc in a BC coverage is assigned a type, which instructs WW3 how that boundary is to be treated.

To assign these types:

Switch to the "Select Feature Arc" tool.

Double click on the arc near the north lateral boundary.

Specify the type as "Lateral" and click "OK".

Double click on the arc near the south lateral boundary.

Specify the type as "Lateral" and click "OK".

Double click on the arc near the offshore boundary.

Specify the type as "Input" and click "OK"

File | Save Project. (As recommended above)

Notes:

The BC arcs will be snapped to the boundary later on. They just need to be close to where you want them.

# Assemble the simulation

An SMS project can include multiple WW3 simulations. Each simulation is a collection of a mesh, a spectral coverage and a boundary condition coverage, along with simulation run parameters.

## Create the simulation

The first step in defining a simulation is creating a blank simulation to hold the components. To do this:

Right click in the project explorer and select "New Simulation | WaveWatch3".

Rename the simulation to "FRF Case 1".

## Add components to the simulation

The simulation is assembled by adding components to it. To do this:

Drag the "45-1500 m Mesh" to below the simulation (black line will appear to drop).

Drag the "Global\_Spectra" coverage into the simulation .

Drag the "BC 1" coverage into the simulation.

Notes:

Components can also be added to a simulation by right clicking on the component.

You can also create an "Output points" coverage and add it to the simulation.

## Set model parameters

The run options or model parameters are assigned to the simulation. To do this:

Right click on "FRF Case 1" and select "Calculate Time Variables..." to fill in default values for timesteps.

Right click on "FRF Case 1" and select "Populate Spectra..." to fill in default values for spectral parameterization.

Right click on "FRF Case 1" and select "Model Control...".

Select the Grids entry on the left side of the dialog. The associated parameters appear on the right:

Set the "Explicit or Implicit" to "Implicit".

Click "OK" to close the Model Parameters dialog.

Select the "Output fields parameters” on the left side of the dialog.

Turn on "Water Depth [DPT]" and "Current velocity [CUR]".

Select the "Standard mean wave parameters" entry on the left side of the dialog.

Turn on "Wave height [HS]", "Peak direction [DP]", and "Peak period (from peak freq) [TP]".

Click “OK” to close the Output Field dialog.

File | Save Project. (As recommended above)

Notes:

Several "Advanced Options" appear in the dialogs used above. These options include parameters that normally will not need to be modified. Default values will be used for these parameters.

The other sessions of this training will instruct you on when the model parameters should be changed and how to determine the values.

The date/time fields should be consistent with what is specified for the spectra.

# Export the simulation files

SMS has now gathered all the information related to a WW3 simulation. We now need to tell SMS to save the input files for the analysis. To do this and review the files:

Right click on the "FRF Case 1" simulation and select "Save Simulation"

Right click on "Project" in the project explorer and select "Open Project Folder".

In the file browser, opened in the previous step, browse to "FRF\_models/WaveWatch3/FRF Case 1"

Notes:

The simulation files for executing WaveWatch3 are saved in this directory.

These files can be moved to the computation platform you will be using.

If you have a Windows version of WaveWatch3 (which we are working on), you will be able to run the simulation from inside of SMS..

Visualizing the output created by WaveWatch3 will also be available in the SMS interface.

# Conclusion

In this tutorial, we have constructed all the components of a WW3 simulation and exported the files for the analysis. We have also demonstrated the basic functionality of the SMS interface.

Other features in SMS that could be reviewed include:

Loading field data (FRF survey data).

Comparing the mesh to the original DEM

Converting mesh Z dataset to a raster.

Computing a difference raster

Interpolating datasets from one geometry to another.

Comparing datasets (dataset calculations).