

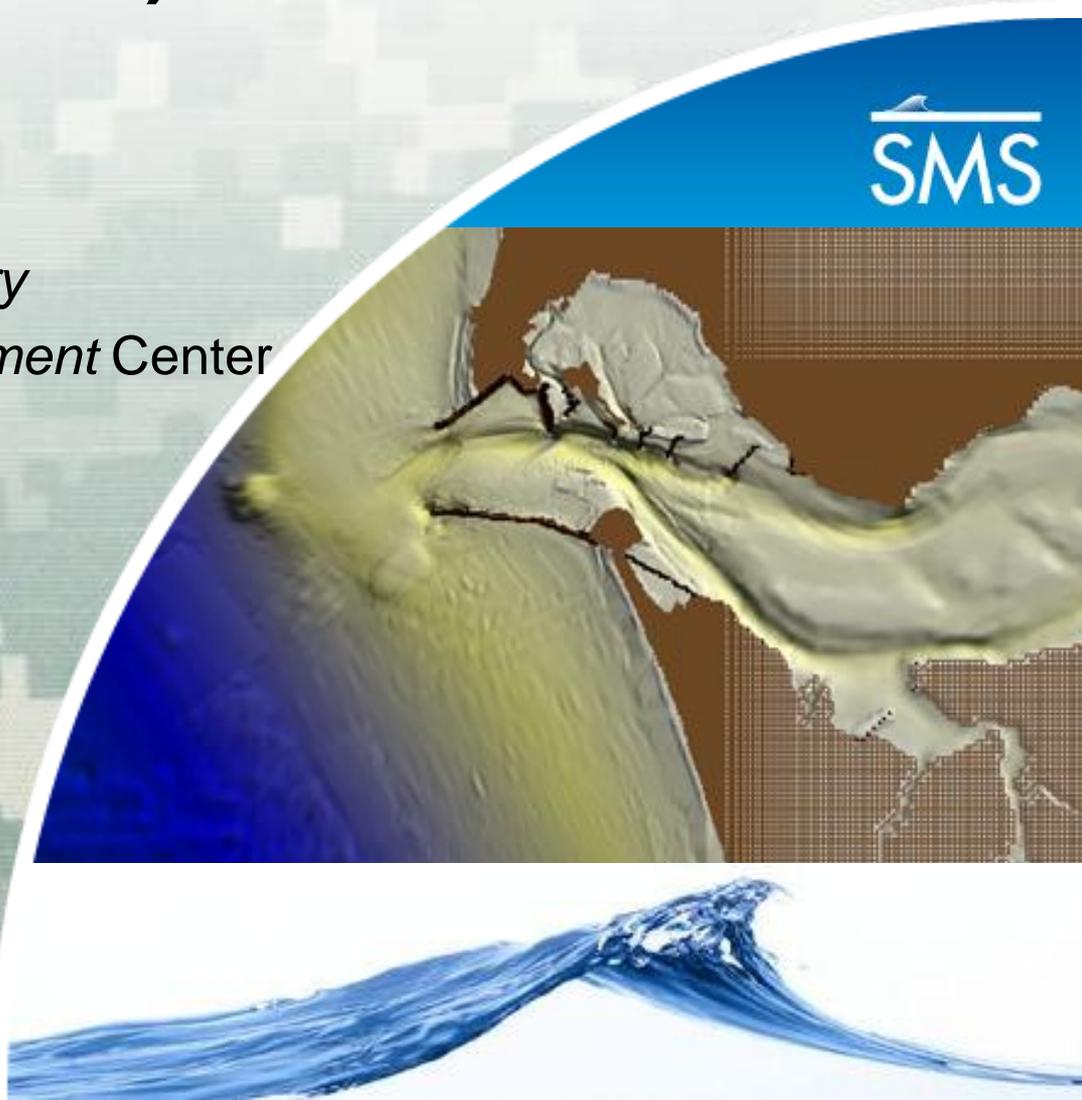
Overview of the Surface-water Modeling System (SMS) v10.1



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Engineer Research and Development Center
May 17, 2010*

SMS



US Army Corps of Engineers
BUILDING STRONG[®]



What is the SMS?



- **A Pre-Processor**
 - ▶ Organize and create input files for Corps of Engineers' Numerical Models
- **A Post-Processor (visualize results)**
 - ▶ Create plots
 - ▶ Create film loops
 - ▶ Data calculator
 - ▶ Dataset creation
- **Connect with outside tools**
 - ▶ Import/export CAD data
 - ▶ Import/export GIS data
 - ▶ Import/export tabular ASCII data
 - ▶ Import/export image data





Overview of SMS interface



The SMS interface is modular. Separate [modules](#) pertain to each data type. As the user switches from one module to another, the [menus](#) and [tools](#) change. Inside the modules, the user associates a numerical model with a mesh or grid. When that grid is active, the tools and menus for the associated model are also enabled.

The SMS screen includes several [toolbars](#), [edit fields](#), and [menus](#). Some of these change as the user switches [modules](#) or [numerical models](#). The principal components include:

- [Menu Bar](#) - Menu to issue commands. These change as the module and model change.
- [Edit Window](#) - Fields directly below the menu bar showing the coordinates and function values for selected entities.
- [Graphics Window](#) - Display panel to show the data being manipulated.
- [Project Explorer \(Data Tree\)](#) - Tree representation of data currently referenced through SMS.
- [Time Step Window](#) – Appears if transient data are available.
- [Toolbars](#) - Several toolbars can be displayed. For more information on each toolbar, see the [Toolbars](#) article.
- [Help or Status Window](#)

The toolbars, project explorer, time steps window, and edit window are dockable windows. Dockable windows may be positioned by the user.

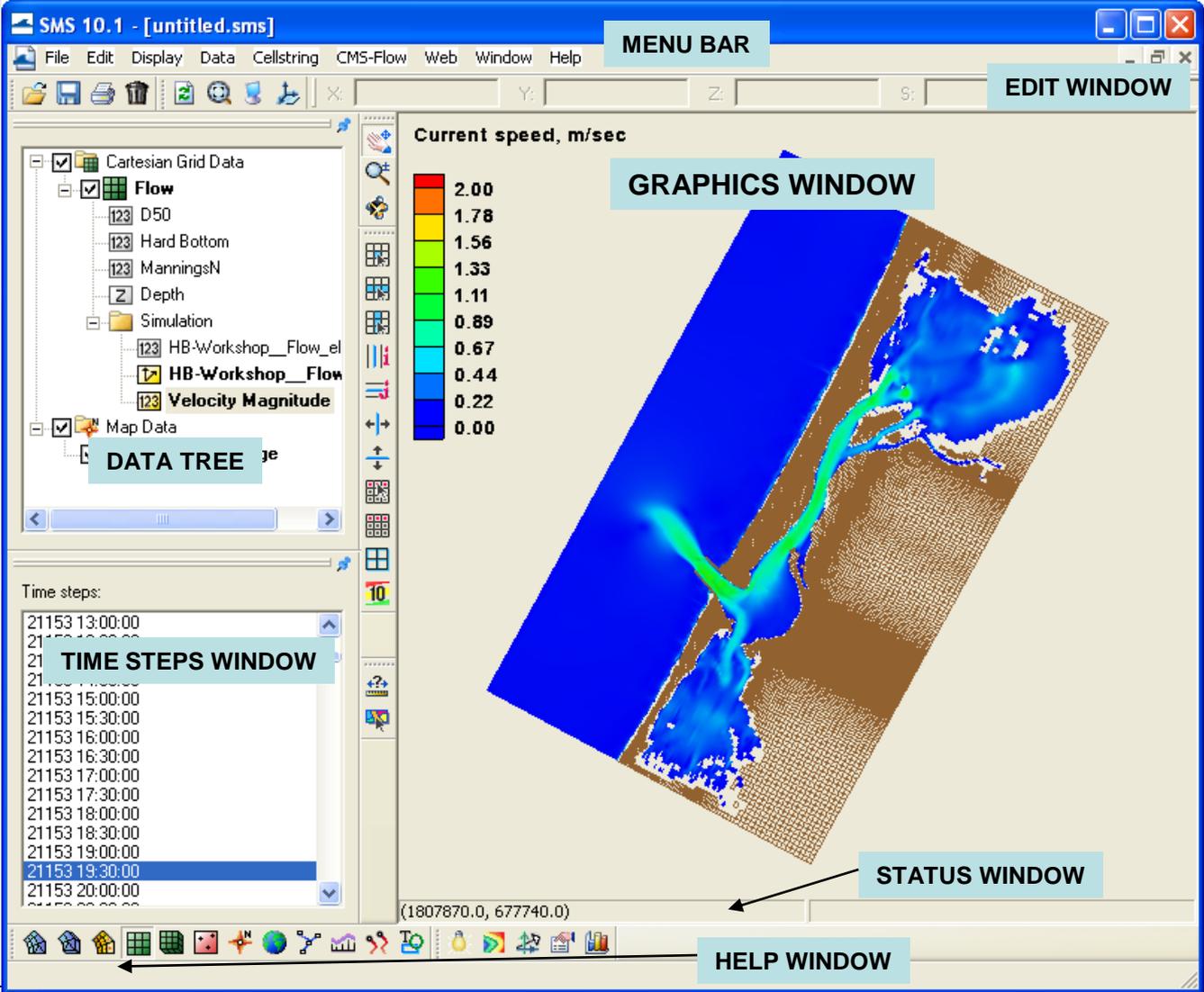


SMS Modeling Suite



The Data Tree (also referred to as the "Project Explorer") is a dockable window that appears by default on the left side of the SMS screen.

This window displays a hierarchical tree structure representing all data currently being managed in an SMS simulation.





Toolbars



Toolbars

- Static Toolbar



- Dynamic Toolbar

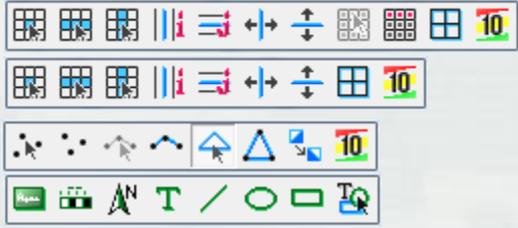
- ▶ Grid

- ▶ CMS-Flow

- ▶ CMS-Wave

- ▶ Scatter

- ▶ Annotation



- Data Toolbar



- Optional Toolbars

- ▶ Macro



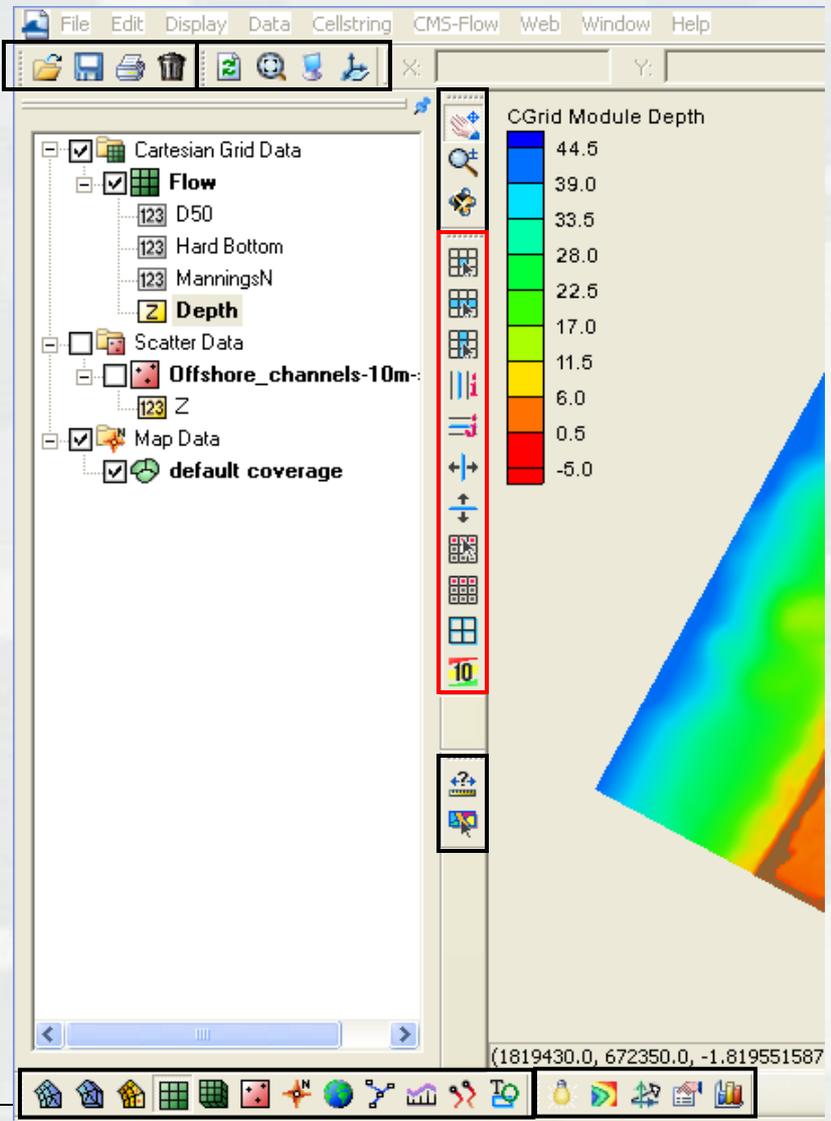
- ▶ File



- ▶ Display



- Module Toolbar





Tools



Individual Tools

- **Static Toolbar**

 Pan  Zoom  Rotate

- **Module Toolbar**

 Mesh  Cartesian Grid  Scatterpoint  Map  Particle  Annotations

- **Data Toolbar**

 Measurement Tool  Get Data Tool

- **Optional Toolbars**

- **Macro**

 Shading  Contours  Vectors  Info  Plot Wizard

- **File**

 Open  Save  Print  Delete

- **Display**

 Refresh  Frame  Display Options  Plan View



Dynamic Toolbar



Cartesian Grid tools

- Select Cell, Row, and Column
- Split Column and Row
- Move Column and Row Edges
- Select and Create Cellstrings
- Create Grid Frame
- Apply Contour Labels

Scatter Data tools

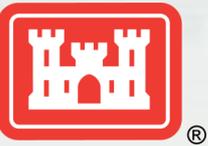
- Select and Create Point
- Select and Create Breakline
- Select and Create Triangle
- Flip Triangle Edge

Map Data Tools

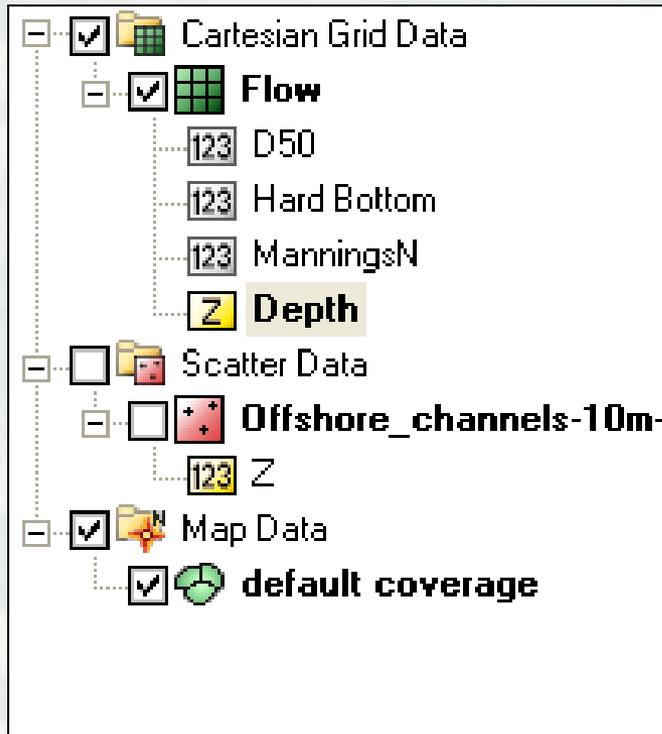
- Select Feature Node
- Create Feature Node
- Select Vertex
- Add Vertex
- Select Feature Arc
- Create Feature Arc
- Select Feature Polygon
- Create 2-d Grid Frame
- Select 2-d Grid Frame

Selection tools usually have an arrow that points to the specific type of element.

Creation tools are identical to selection tools, only they do not have the arrow.



Data Tree Components



- The Data Tree makes selection of loaded datasets easy. Simply click on a dataset to make it active, and the graphics window updates accordingly.
- There are several “right-click” options available depending on the type of dataset activated, and within which module it is located. A few of these are:
 - ▶ Basic Dataset Information
 - ▶ Dataset-specific contour options
 - ▶ Export to file
 - ▶ Metadata Information
- The display of each asset in the Data Tree can be turned off by unchecking the display box next to the dataset name.



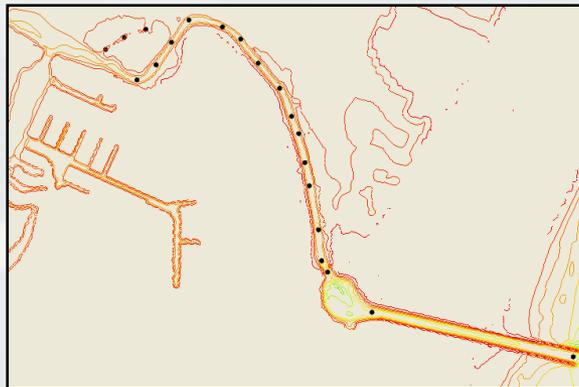
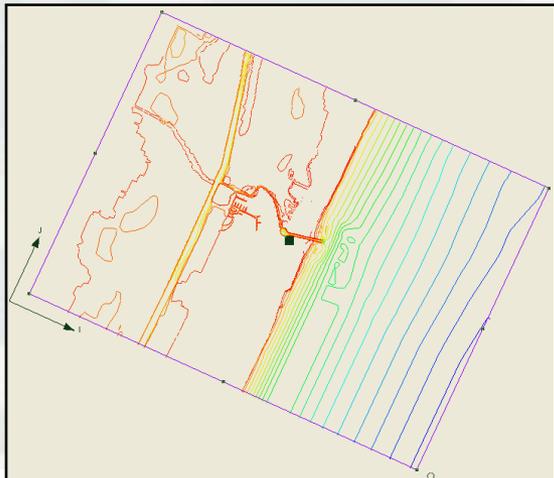
SMS – a complete modeling interface



Build a CMS model from start to finish – all within SMS

Import Background Data

- Topographic & bathymetric data – numerous formats supported
- Images – maps & aerial photos
- CAD, GIS & spreadsheet data

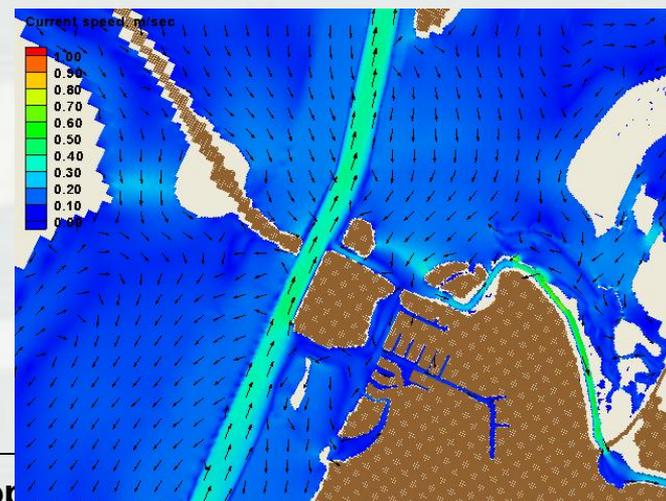


Create Conceptual Model

- Delineate CMS model domain
- Define areas of finer resolution

Generate & Run CMS Models

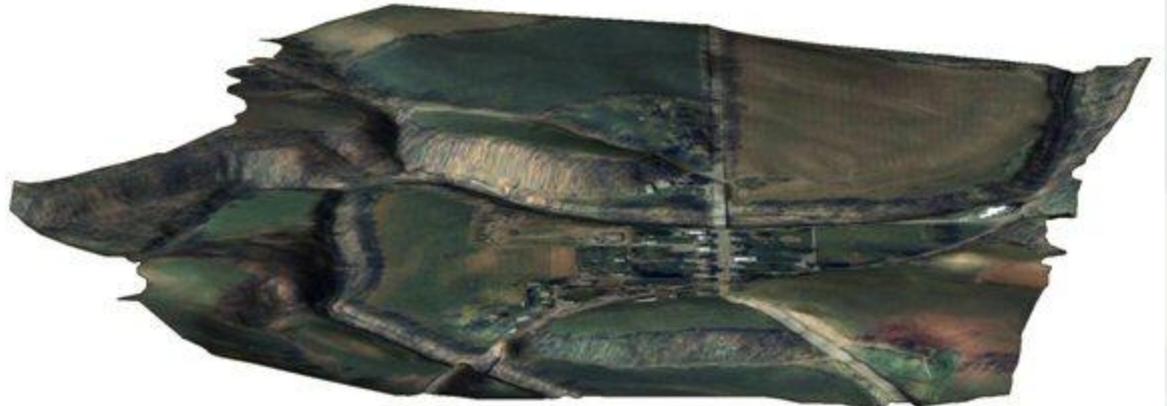
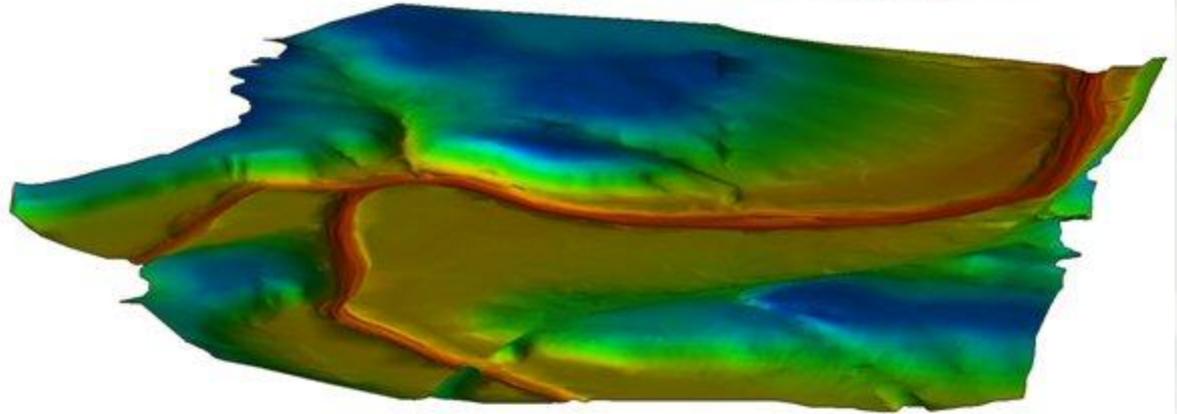
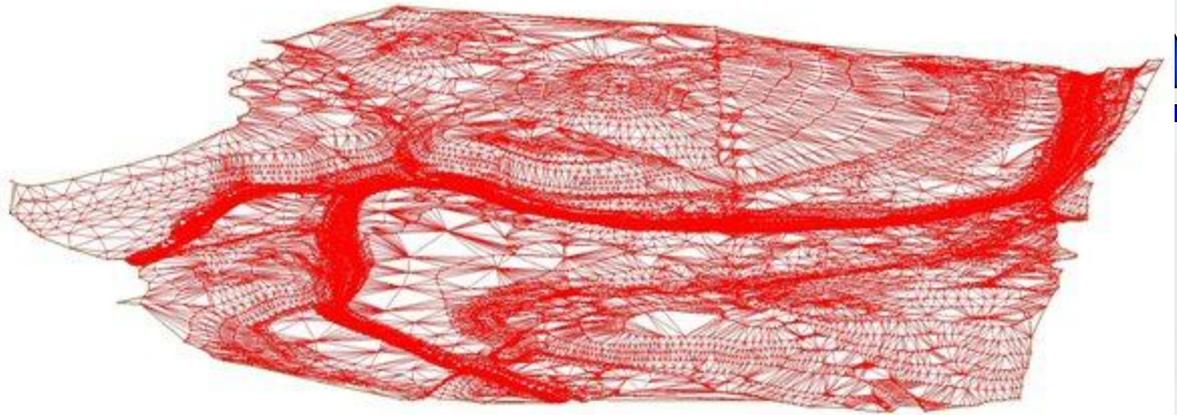
- Automatically generate grid
- Interpolate depths from background data
- Utilize built-in interfaces to define model-specific parameters and boundary conditions
- Run model and visualize results





®

SMS – Data Processing





Import Wizard



File Import Wizard - Step 2 of 2

SMS data type:
Scatter Set

No data flag

Name:

Mapping options:
 Triangulate data Delete long triangles
Maximum edge length:
Merge duplicate points within tolerance:

File preview

Type	X	Y	Z	Scalar data	Vector X	Vector Y
Header	XYZ	(2697	points)	WSE	Velocity	Velocity
	105.074	-286.841	50.750	53.318	1.260	-0.706
	104.575	-287.898	49.607	53.368	1.308	-0.412
	104.076	-288.955	48.464	53.418	1.577	-0.712
	103.612	-290.029	48.464	53.376	2.096	-0.604

First 20 lines displayed.

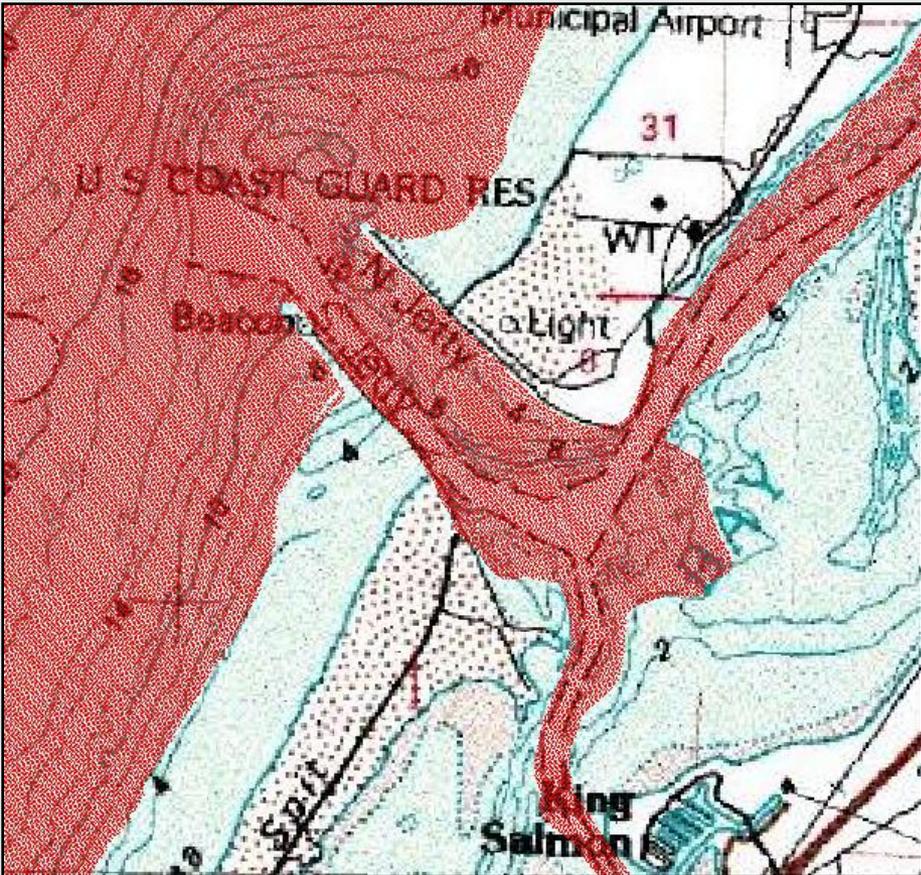


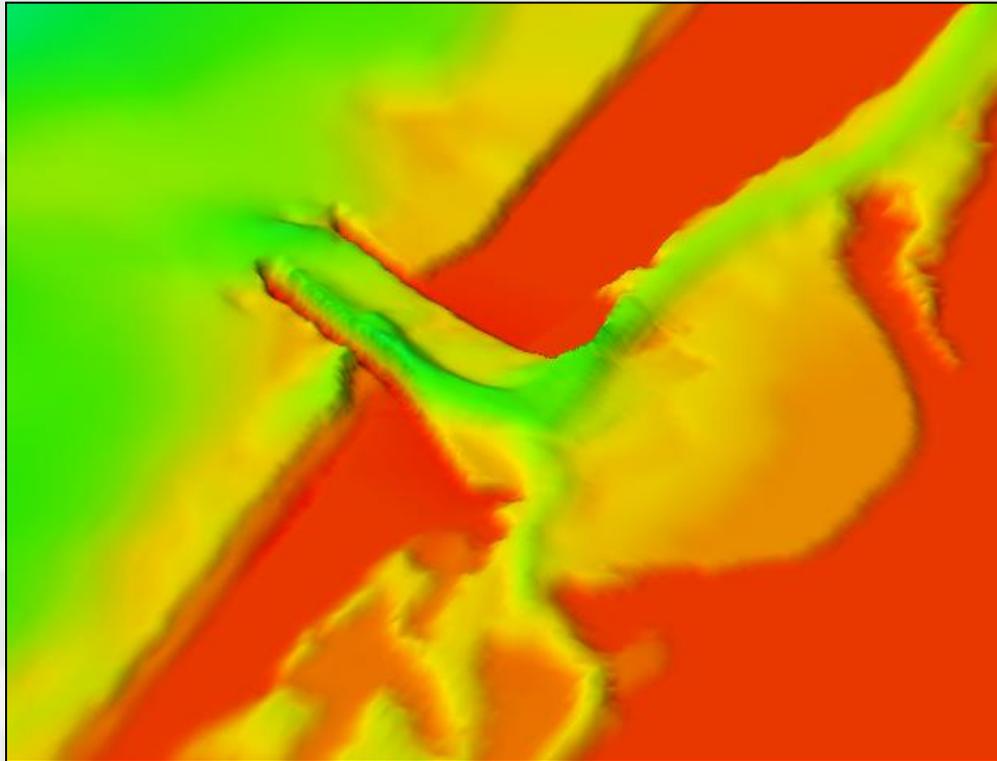
Scattered Data (TINs)



- **Stores spatially varied data**

- ▶ Bathymetric data most common
- ▶ Interpolates from one grid/mesh to another
- ▶ Allows combination of data sources
- ▶ Facilitates data thinning or filtering





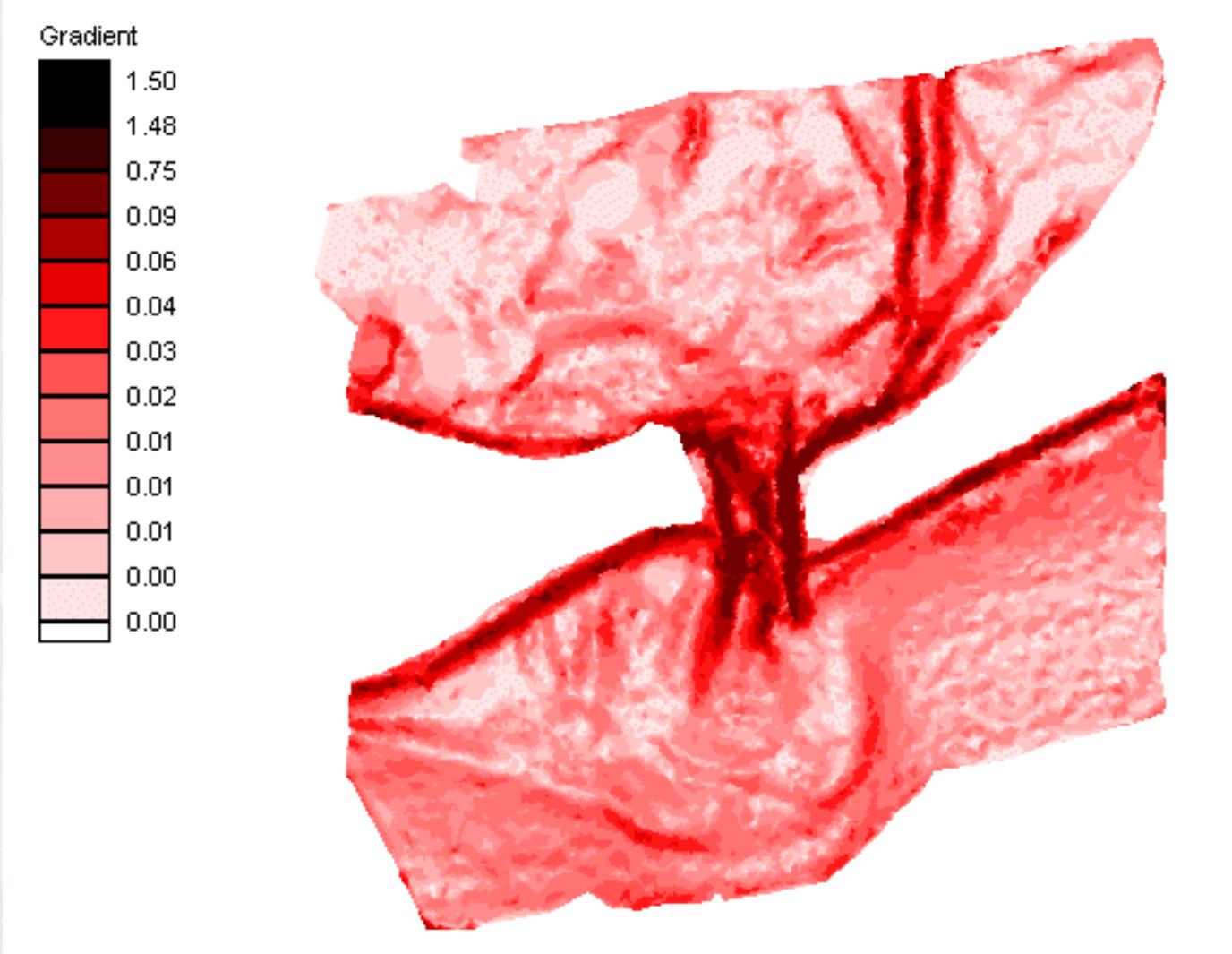
Humboldt Bay, CA
Oblique view
Z-magnification 5x

▪ **Options**

- ▶ Magnify in Z direction
- ▶ Oblique or plan views
- ▶ Fill with contours options
- ▶ Shading

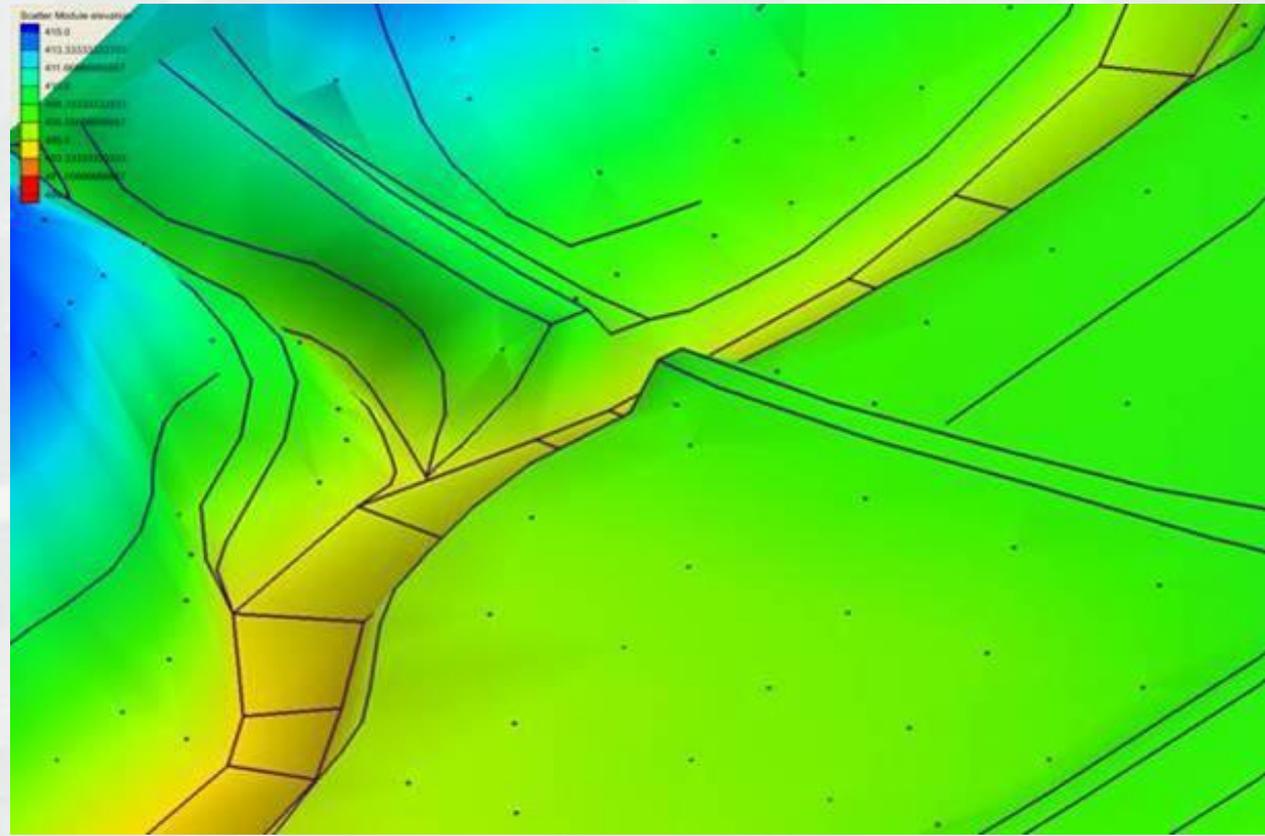


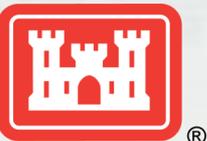
Lidar Survey



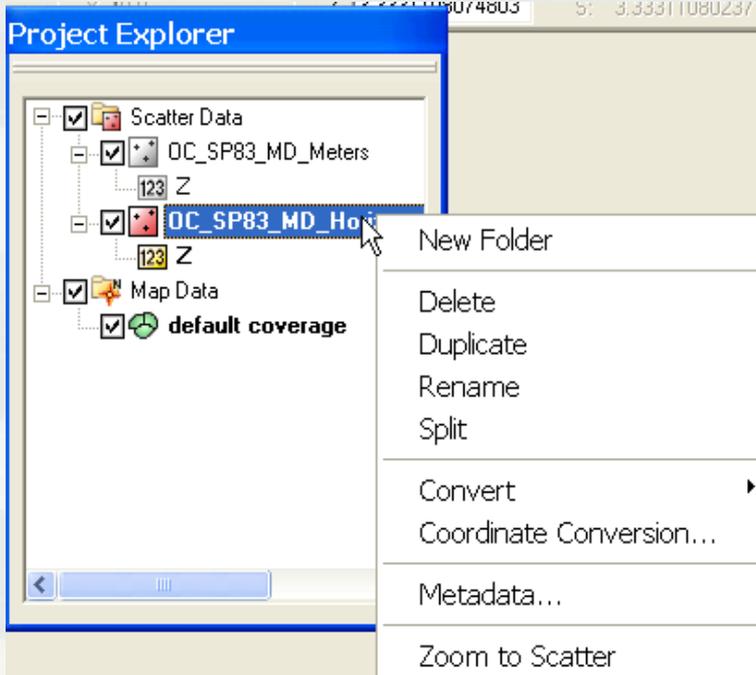


Breaklines

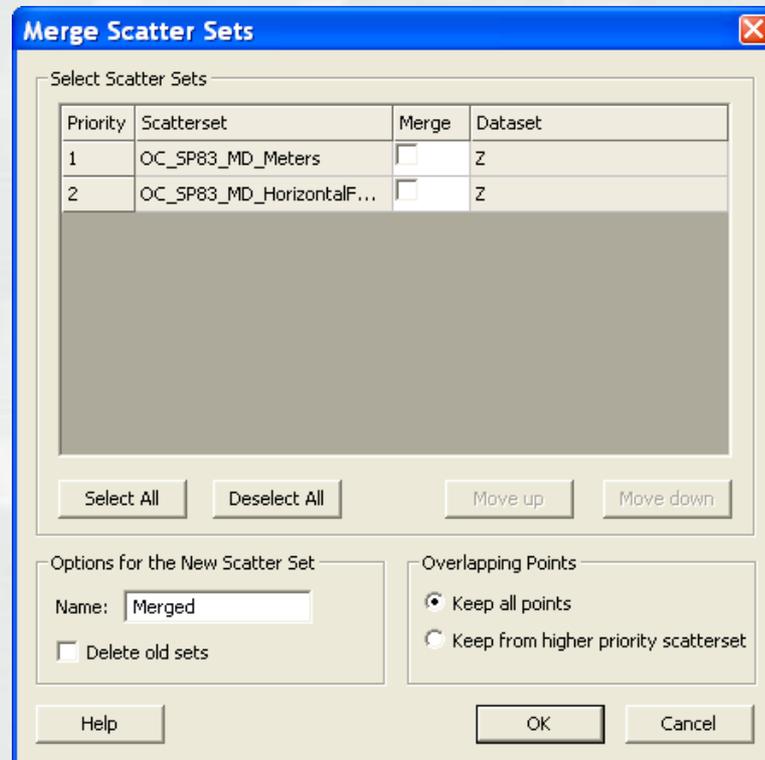




Operating With Scatter Sets



■ Merge

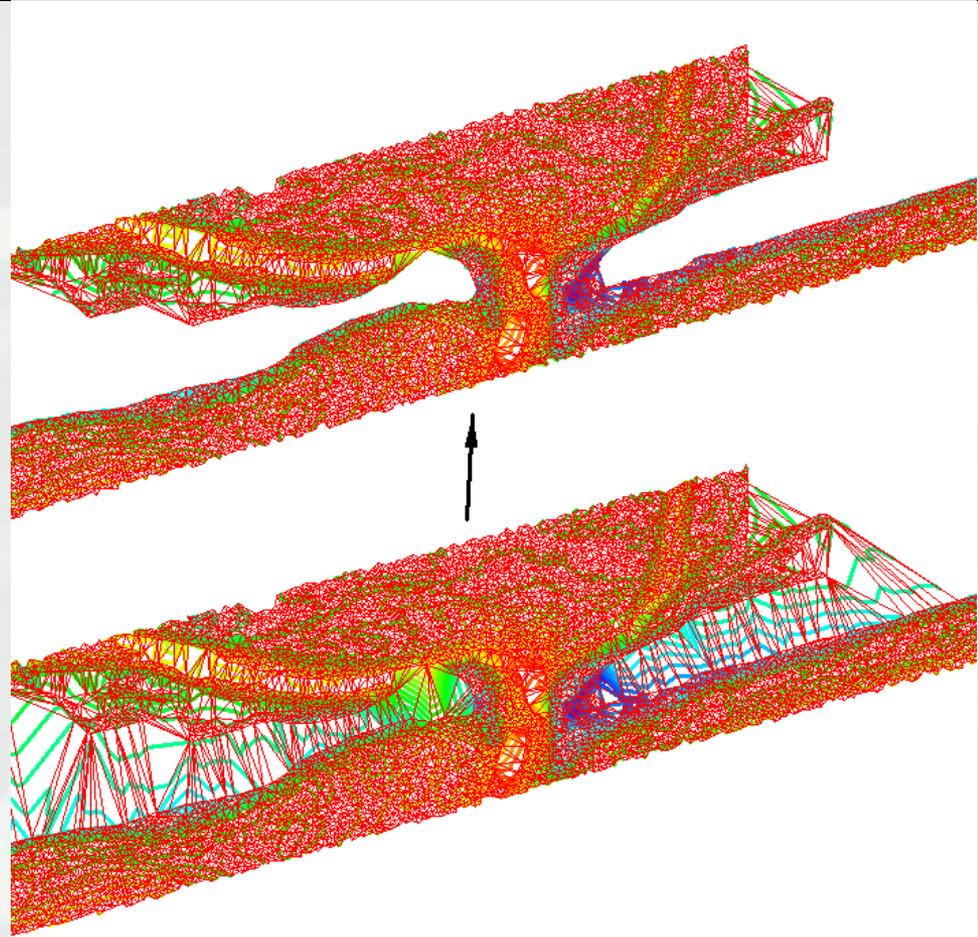




Points and Triangles



- **User can delete points or triangles to change extents of a set.**
- **User can swap edges to alter shape of surface**
 - ▶ **Used in linear interpolation**

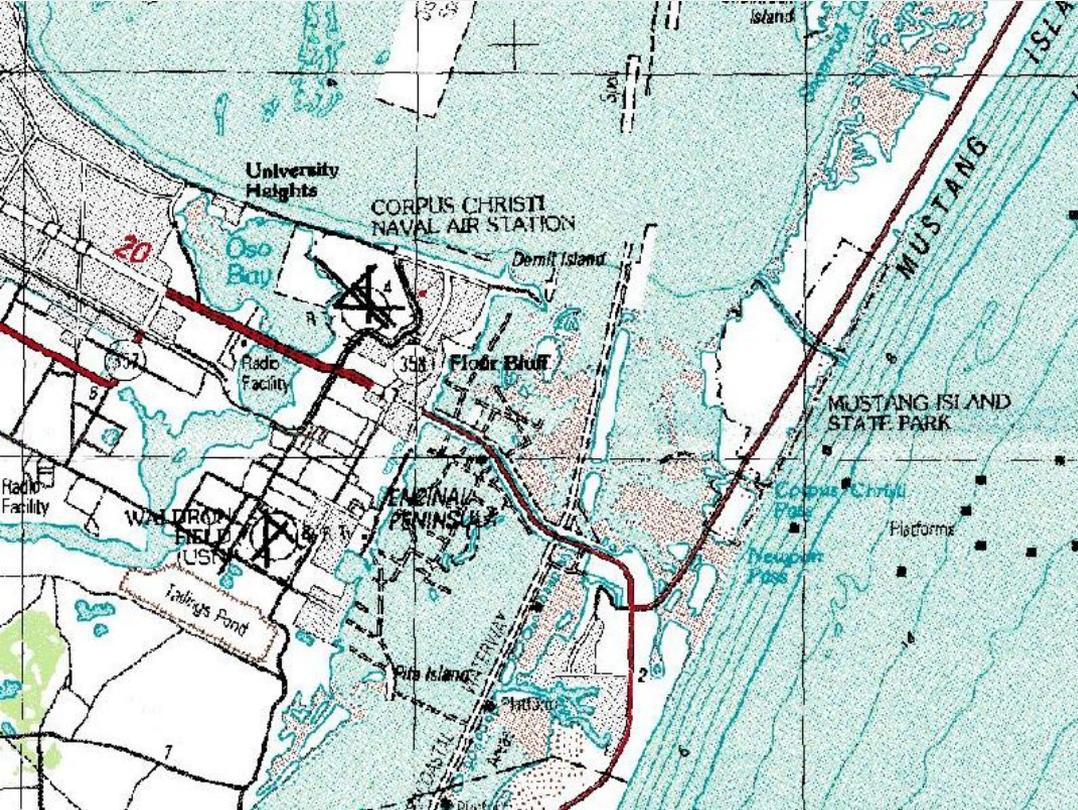




Images



Topo Maps



Aerial Photos



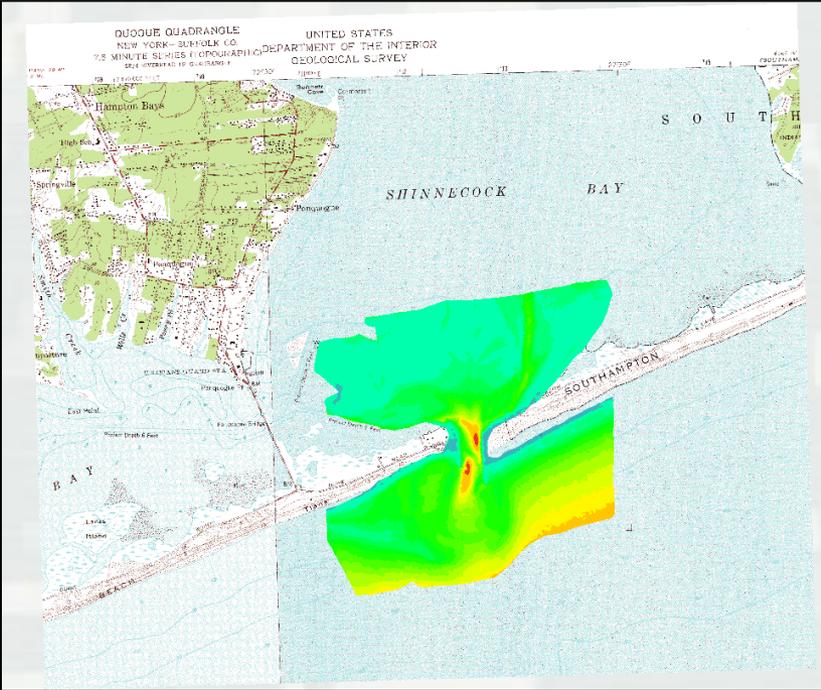
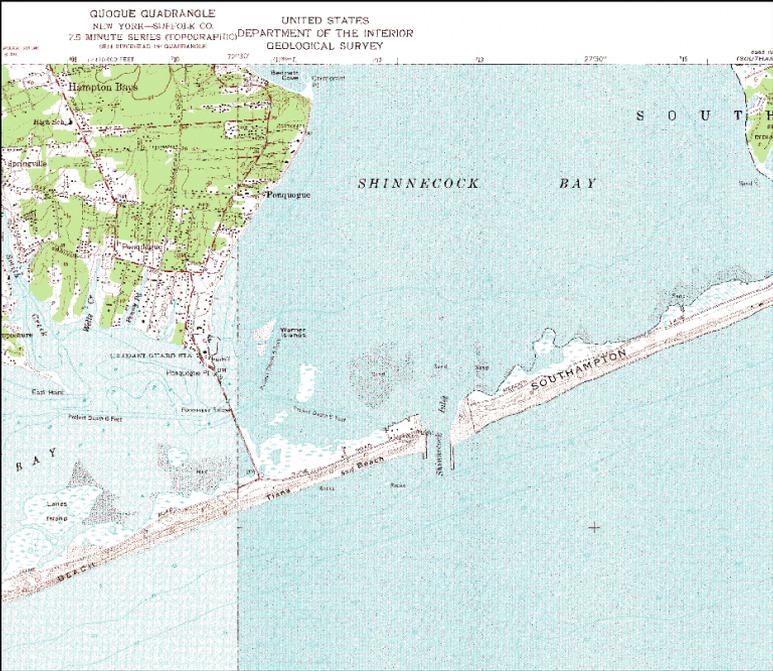
** <http://terraserver.microsoft.com>



®

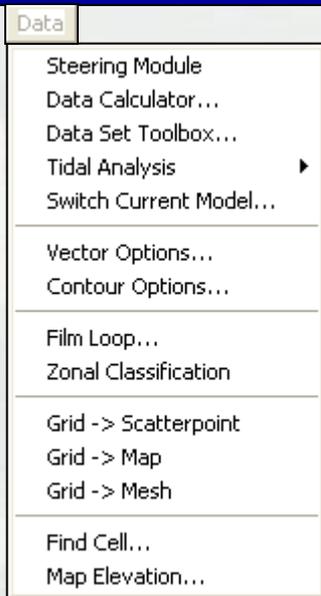


Overlay data over images





CMS-Flow Interface: Pull-down Menus

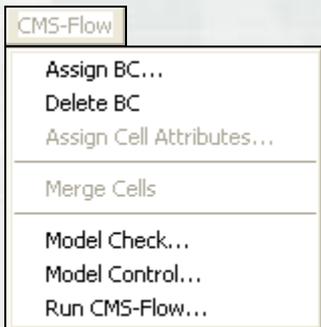


The Data pull-down menu contains many items – here are a few:

- Steering Module – Starts/controls interaction between Flow and Wave
- Data Calculator – Dataset-based functions
- Dataset Toolbox – Dataset-based operations (includes Calculator)
- Vector/Contour Options – Change appearance of data within the Graphics Window
- Film Loop – Generate animations based on loaded data/solutions
- Grid -> Scatterpoint – Convert CMS-Flow grid to Scatterpoint dataset (TIN)



The Cellstring menu contains operations for boundary condition forcing strings.



The CMS-Flow menu contains commands to operate the model.

- Assign BC – Assigns boundary condition forcing information to cellstrings
- Delete BC – Delete the forcing information from a cellstring
- Model Control – Set up the parameters and running options for the CMS-Flow simulation
- Run CMS-Flow – Start CMS-Flow based on Model Control options.



CMS-Flow Model Control

Parameter Specification and File I/O



- Time Control
- Auxiliary Files
- Parameters
 - ▶ Wet/Dry depth
 - ▶ Flags
- Calculations to Include
 - ▶ Sediment Transport
 - ▶ Wind
 - ▶ Waves
 - ▶ Salinity

CMS-Flow Model Control

Model Parameters | Transport | Tidal | Wind/Wave | Output | Cells | Advanced

Time Control

Start date: 12/01/2007

Start time: 12:00 AM

Simulation duration: 744.0 hrs

Ramp duration: 24.0 hrs

Hydrodynamic time step: 0.5 secs

Hot Start

Initial conditions file

none

Write Hot Start output file

Time to write out: 0.0 hrs

Automatic recurring Hot Start file

Interval: 0.0 hrs

Parameters

Anemometer height: 10.0 m

Depth to begin drying cells: 0.05 m

Include wall friction

Latitude throughout grid

Cell-specific latitude

Average latitude: 0.00

Momentum Equation

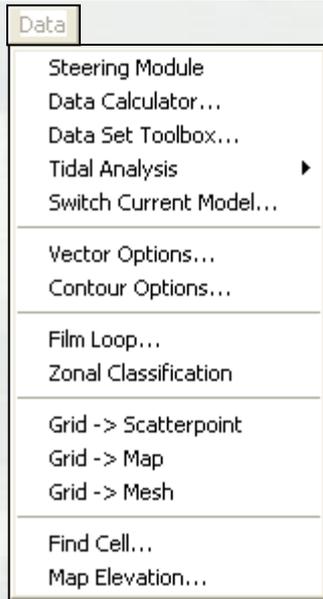
Include advective terms

Include mixing terms

Help OK Cancel



CMS-Wave Interface: Pull-down Menus

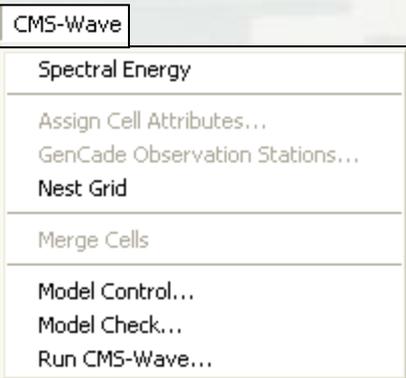


The Data are the same for both CMS-Flow and CMS-Wave.

- Steering Module – Starts/controls interaction between Flow and Wave
- Data Calculator – Dataset-based functions
- Dataset Toolbox – Dataset-based operations (includes Calculator)
- Vector/Contour Options – Change appearance of data in Graphics Window
- Film Loop – Generate animations based on loaded data/solutions
- Grid -> Scatterpoint – Convert CMS-Flow grid to Scatterpoint dataset (TIN)

The CMS-Wave menu contains commands to operate the model.

- Spectral Energy – Allows user to Create Spectral Energy forcing from wave characteristics or Import existing data from a wave gauge
- Nest Grid – Allows use of a nested (child) wave grid for better resolution in some areas
- Model Control – Set up the parameters and running options for a CMS-Wave simulation
- Model Check – Analyze present wave grid and modeling parameters for errors before run commences.
- Run CMS-Wave – Start CMS-Wave based on Model Control options.

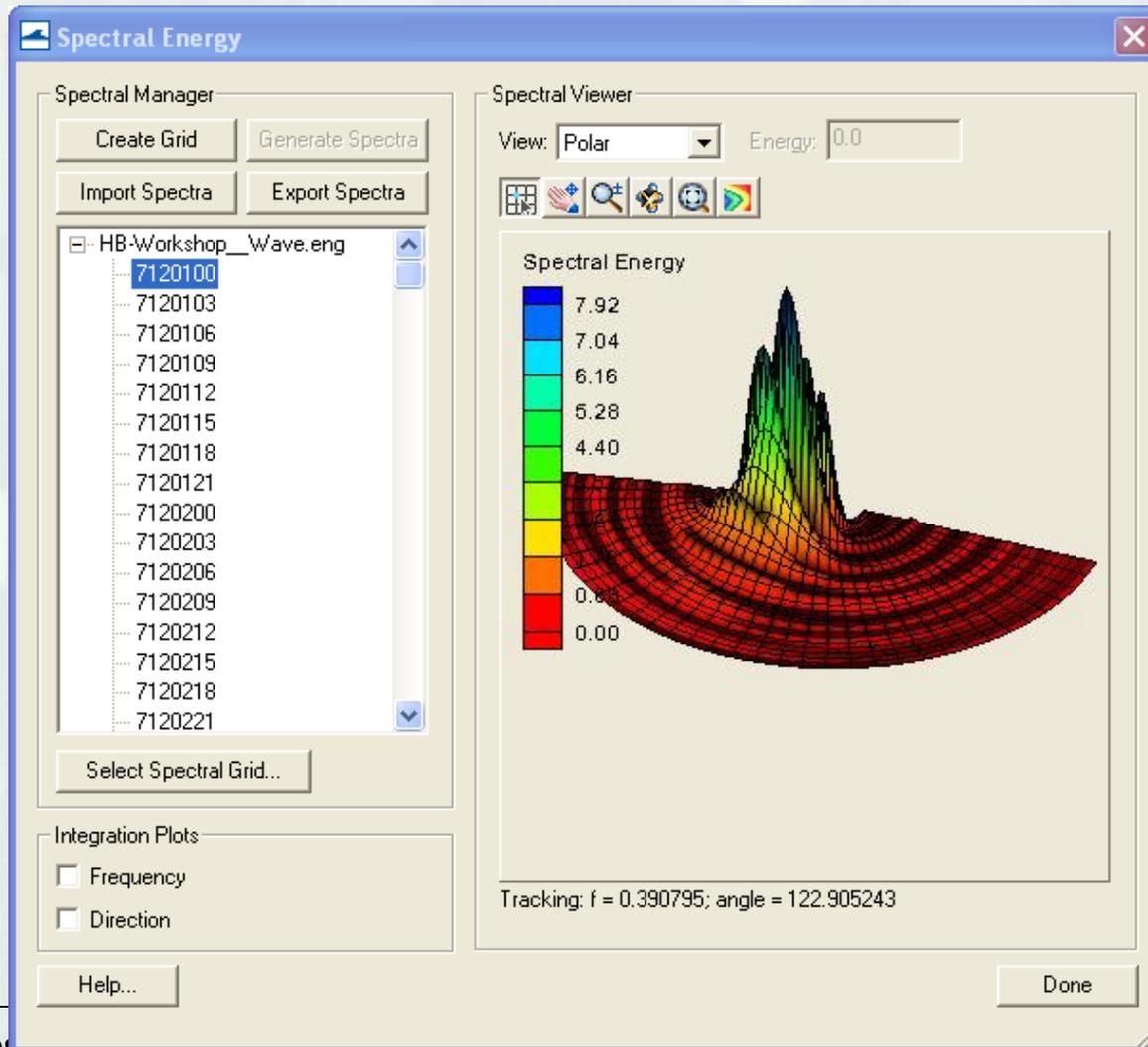




Spectral Energy menu



Example of Imported Spectra from Wave Gauge





Generate Spectra from Bulk Criteria



Generate Spectra

Parameter Settings

Generation Method: TMA (Shallow Water)

Replace Old Spectra

Directional Spreading Distribution:

Wrapped Normal

Cosine Power

Gauge Depth:

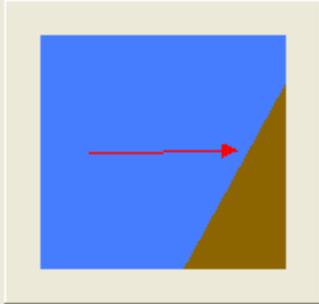
Specify once for all spectra

0.001 m

Specify for each spectrum

Angle Settings

Projection: Shore Normal



Spectral Parameters

	Index	Angle (deg)	Hs (m)	Tp (s)	Gamma	nn
1	1	30.0	2.0	10.0	3.3	4
2						

Import Import from GenCode Export Spectral Defaults >>

Help... Generate Cancel



Model Control



- Turn on Wetting & Drying of Cells
- Turn on Reflection (FWD, BWD)
- Choose Bed Friction type
- Set parameters
- Choose Output Datasets
- Choose Wave Source

CMS-Wave Model Control

Grid Definition

X origin:	1803052.5641 m	Cell size:	163.924735 m
Y origin:	656959.6380 m	Columns:	187
Angle:	331.5357 deg	Rows:	271

Settings

<input checked="" type="checkbox"/> Allow wetting and drying	<input type="checkbox"/> Bed friction	<input checked="" type="checkbox"/> Diffraction intensity: <input type="text" value="4.0"/>
<input type="checkbox"/> Forward reflection	<input checked="" type="radio"/> Spatially constant Cf: <input type="text" value="0.005"/>	<input type="checkbox"/> Currents
<input checked="" type="radio"/> Spatially constant: <input type="text" value="0.5"/>	<input type="radio"/> Spatially varied Cf: <input type="text" value="Select..."/> none selected	<input checked="" type="radio"/> Single timestep: <input type="text" value="Select..."/> none selected
<input type="radio"/> Spatially varied: <input type="text" value="Select..."/> none selected	<input type="radio"/> Spatially constant n: <input type="text" value="0.005"/>	<input type="radio"/> All timesteps: <input type="text" value="Select..."/> none selected
<input type="radio"/> Spatially varied n: <input type="text" value="Select..."/> none selected	<small>Cf = Darcy-Weisbach friction coefficient n = Manning friction coefficient</small>	
<input type="checkbox"/> Backward reflection	<input checked="" type="radio"/> Spatially constant: <input type="text" value="0.3"/>	
<input type="radio"/> Spatially varied: <input type="text" value="Select..."/> none selected		

Wave Source

<input checked="" type="radio"/> Spectra <input type="button" value="Parameters..."/>
<input type="radio"/> Wind
<input type="radio"/> Spectra and wind
<input type="radio"/> Simplified formulation

Output

<input type="checkbox"/> Radiation stresses
<input type="checkbox"/> Breaking
Function: <input type="text" value="Extended Goda"/>
<input checked="" type="radio"/> Indices
<input type="radio"/> Energy dissipation

Help...



What's New in SMS 10.1



- Dataset Toolbox
- Grid duplication/rotation tools
- Web Menu
- Spatial Data Coverages
 - ▶ Data types
 - ▶ Plot types
 - ▶ Compass plots
- Coordinate Projections
 - ▶ More projections
 - ▶ Automatic re-projection of data with projection file



Dataset Toolbox



Dataset Toolbox

Tools

- Math
 - Compare data sets
 - Data Calculator
- Temporal
 - Sample time steps
 - Compute derivative
- Conversion
 - Scalar to Vector
 - Vector to Scalar
- Modification
 - Map activity
 - Filter

Compare data sets

Base

- pensafLOW 1990 (CMS-Flow)
 - D50
 - Hard Bottom
 - ManningsN
 - Depth
 - Simulation
 - pensafLOW 1990_elev
 - pensafLOW 1990_morph

Data Set Info...

Value if base is inactive: -99.0

Alternate

- pensafLOW 1990 (CMS-Flow)
 - D50
 - Hard Bottom
 - ManningsN
 - Depth
 - Simulation
 - pensafLOW 1990_elev
 - pensafLOW 1990_morph

Data Set Info...

Value if alternate is inactive: 99.0

Output data set name: new data set

Update Available Tools

Help...

Compute

Done



Dataset Toolbox



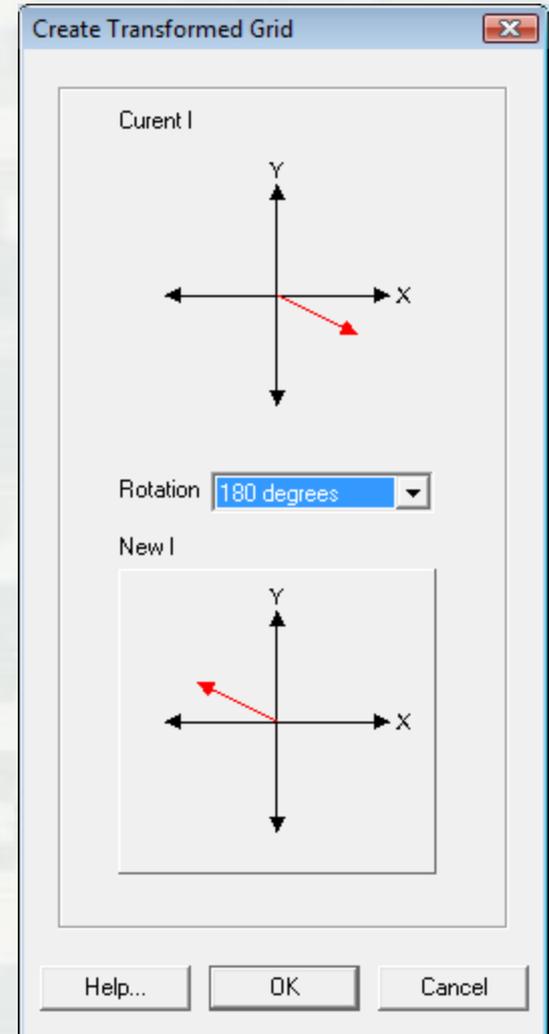
- Temporal Operations
 - ▶ Sample times
 - ▶ Temporal derivatives
- Mathematical Operations
 - ▶ Comparisons
 - ▶ Data Calculator
- Spatial Operations
 - ▶ Spacing
 - ▶ Gradients/Derivatives
 - ▶ Smoothing
- Conversions
 - ▶ Vector <-> Scalars
- Coastal Functions
 - ▶ Wavelength/Celerity
 - ▶ Courant number
- Activity Mapping
 - ▶ Map activity
 - ▶ Value filtering



Duplicate/Rotate Grid



- Accessed by Right Click on Grid in Project Explorer
 - ▶ Duplicate Flow grid for Wave model or vice-versa
 - ▶ Rotate Wave grid to appropriate orientation





- **Import data from web ...**

- ▶ Virtual Earth
- ▶ Image data
- ▶ Elevation data

- **Find Data**

- ▶ Links to useful web sites

- **Tidal Data**

- ▶ Links to coastal filtering tools

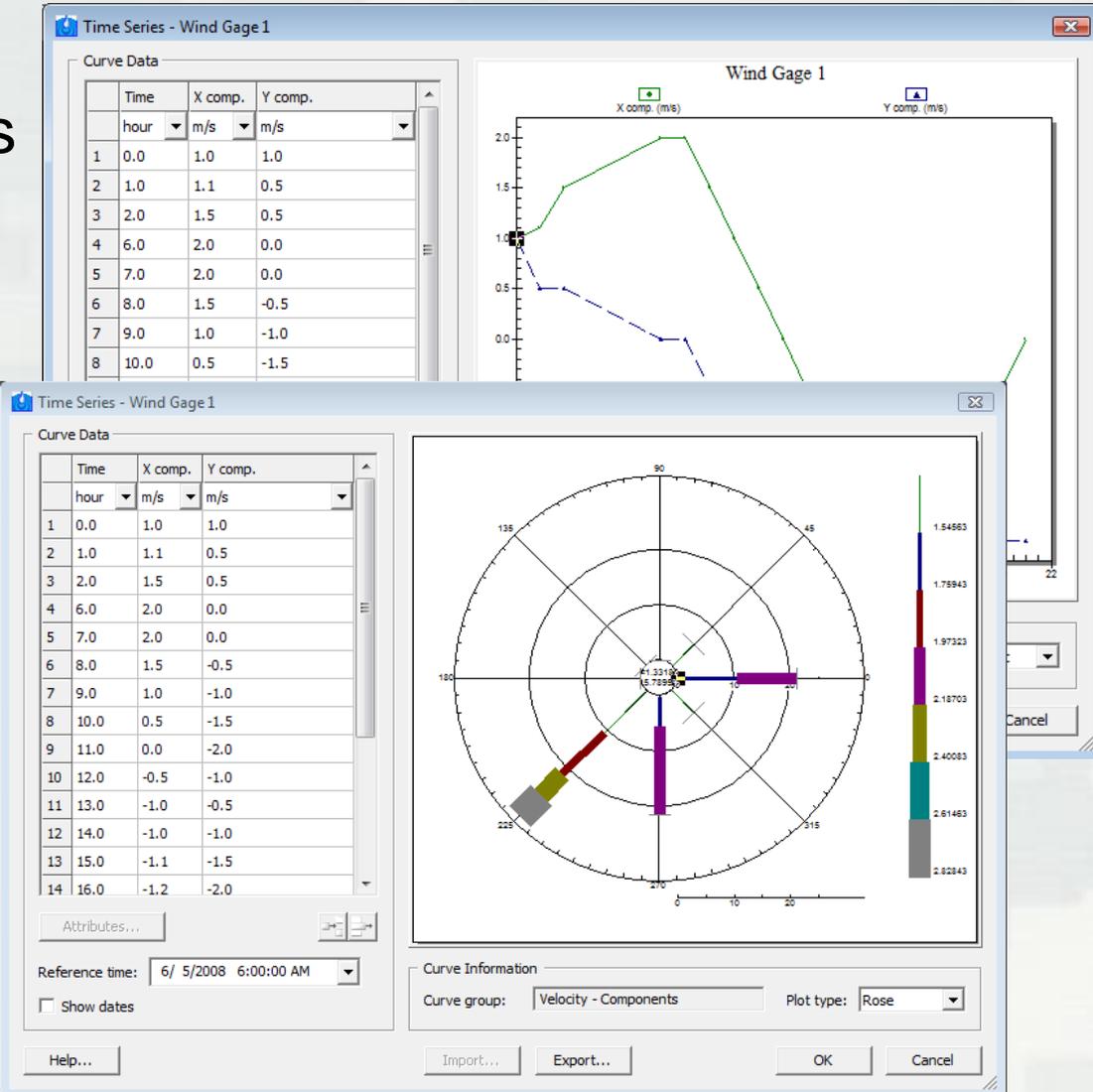




Spatial Data Coverages



- Create nodes at locations of interest (gauges)
- Associate temporal data with location
 - Scalar data
 - X/Y vector data
 - Mag/dir vector data
- Plot types
 - Scientific
 - Multi-axis
 - Rose plots





Spatial Data Coverages



Compass plot

- Displayed on graphics window
- Updates with dates
- User managed



Compass Plot Properties

Name: Wind (10m)
 Display with compass

Spatial Data

Data	Show	Color
Wind Gage 1	<input checked="" type="checkbox"/>	Red

Legend Display Options

Show legend
Location: Right
 Show min and max values
 Show one vector for each compass ring
Precision: 2

Rings

Number of rings: 3

	Percent of maximum (0 - 100)
1	33
2	66
3	100

Display Options

Compass size: 60
 Only show direction
 Show connection lines
 Filled background
Background color: [Color Picker]
 Specify min/max values for rings
Min: 0.0
Max: 1.0
Arrow style: Normal

Buttons: Help..., OK, Cancel



Coordinate Projections



- All major datums
- Project
 - ▶ Point
 - ▶ Object
 - ▶ Entire project
- Support for projection files
- Automatic detection of projections
 - ▶ Images
 - ▶ CAD
 - ▶ GIS

Reproject Current

Current projection
 Specify

Horizontal
 Local projection
Units: []
 Global projection
Set Projection

Current projection: State Plane Coordinate System

Vertical
Projection: [Local]
Units: [Meters]

Select Projection

Projection []
Load From File...
Save To File...

Projection: [State Plane Coordinate System]
Datum: [NAD83]
Planar Units: [METERS]
Zone: [Florida West (FIPS 902)]
Parameters:

Attribute	Value
STATE PLANE SCALE FACTOR	1.000000000

OK Cancel



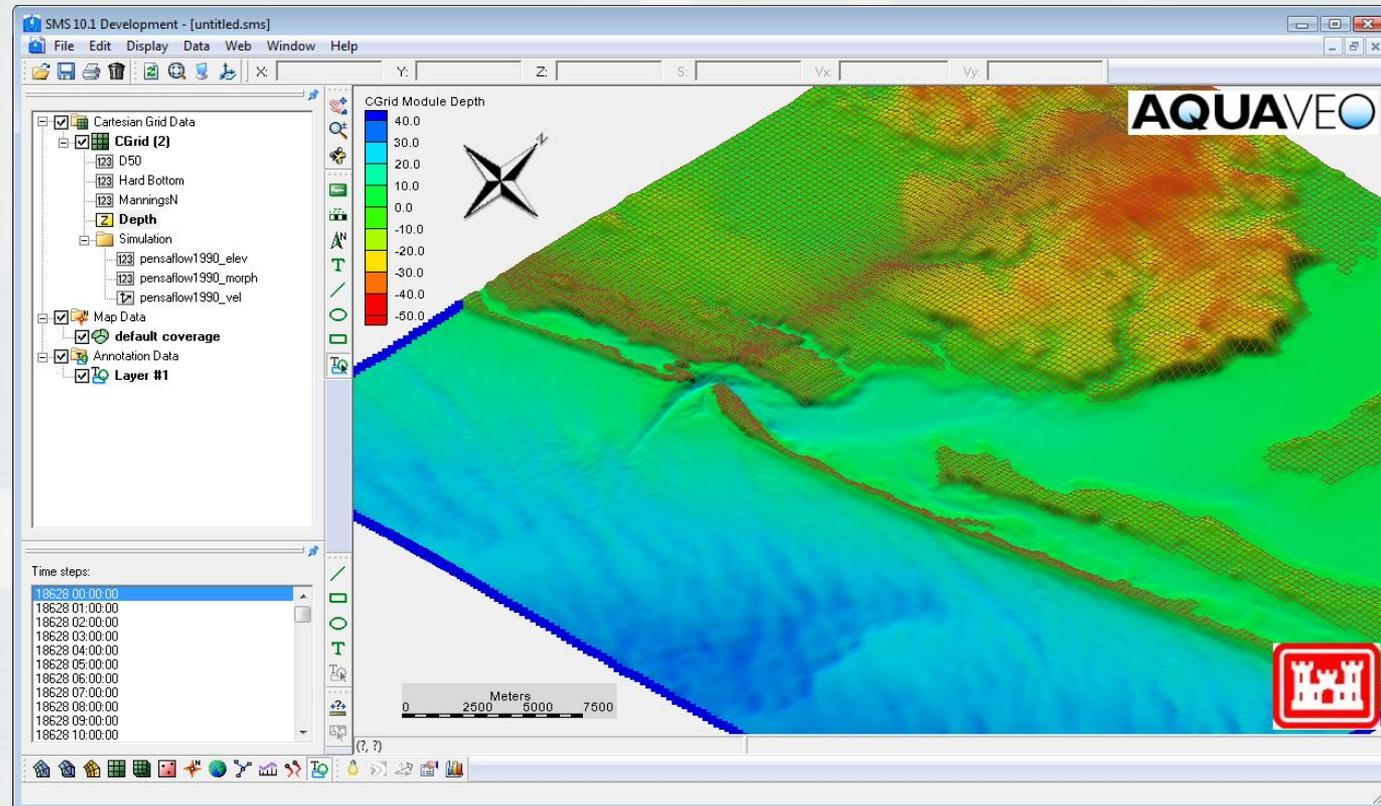
- Annotations
- Graphic images
- Animations
 - ▶ AVI filmloops
 - ▶ kmz – Google Earth Exports
- 2D Plots
 - ▶ Time series
 - ▶ Profiles and Cross sections – both steady state and transient



Annotation Layers

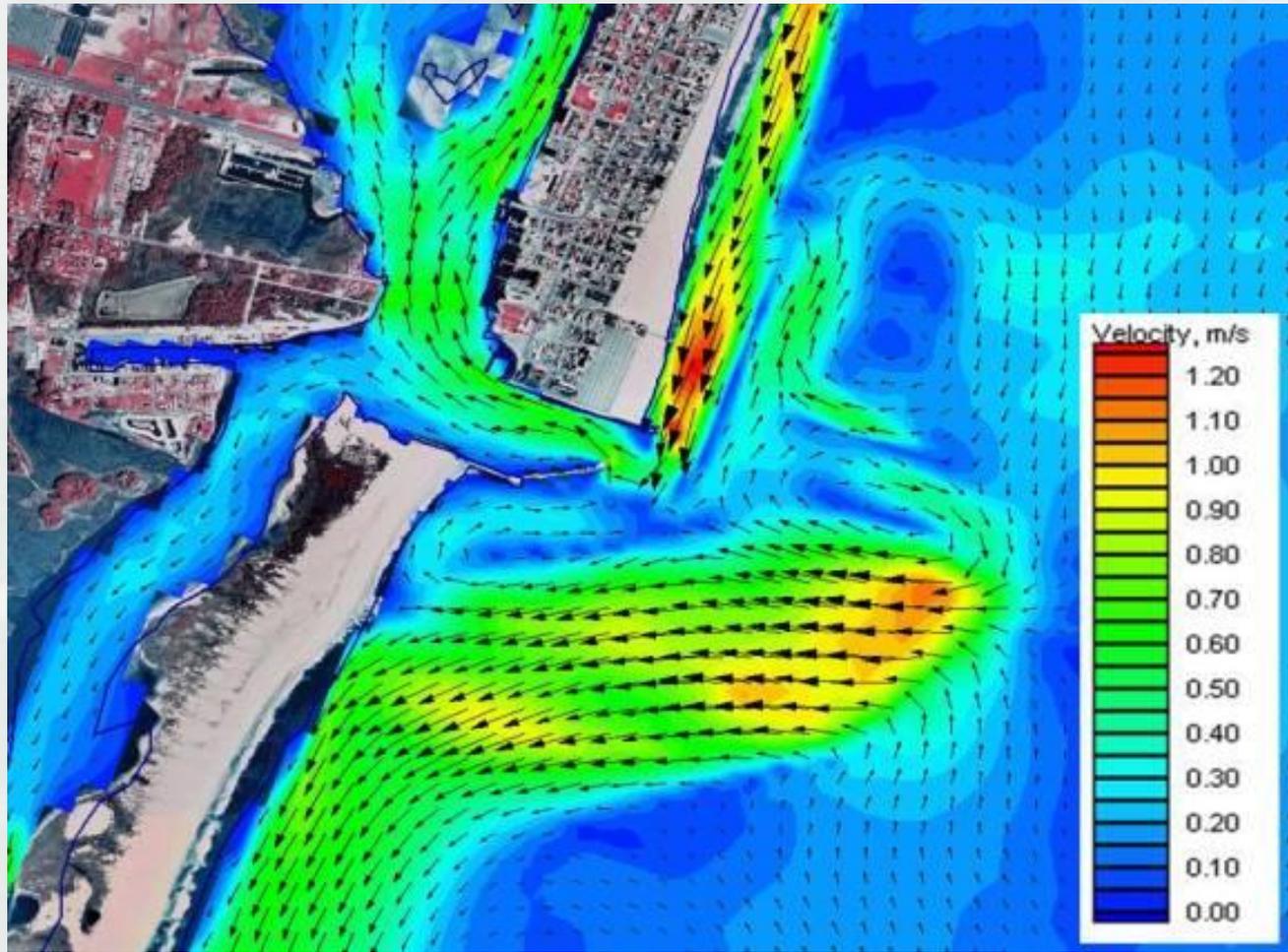


- Replaces Drawing Objects
- New Objects
 - ▶ Screen space images (logos)
 - ▶ Scale bars
 - ▶ North Arrows
- Organizes entities into layers
- Anchored in either world or screen



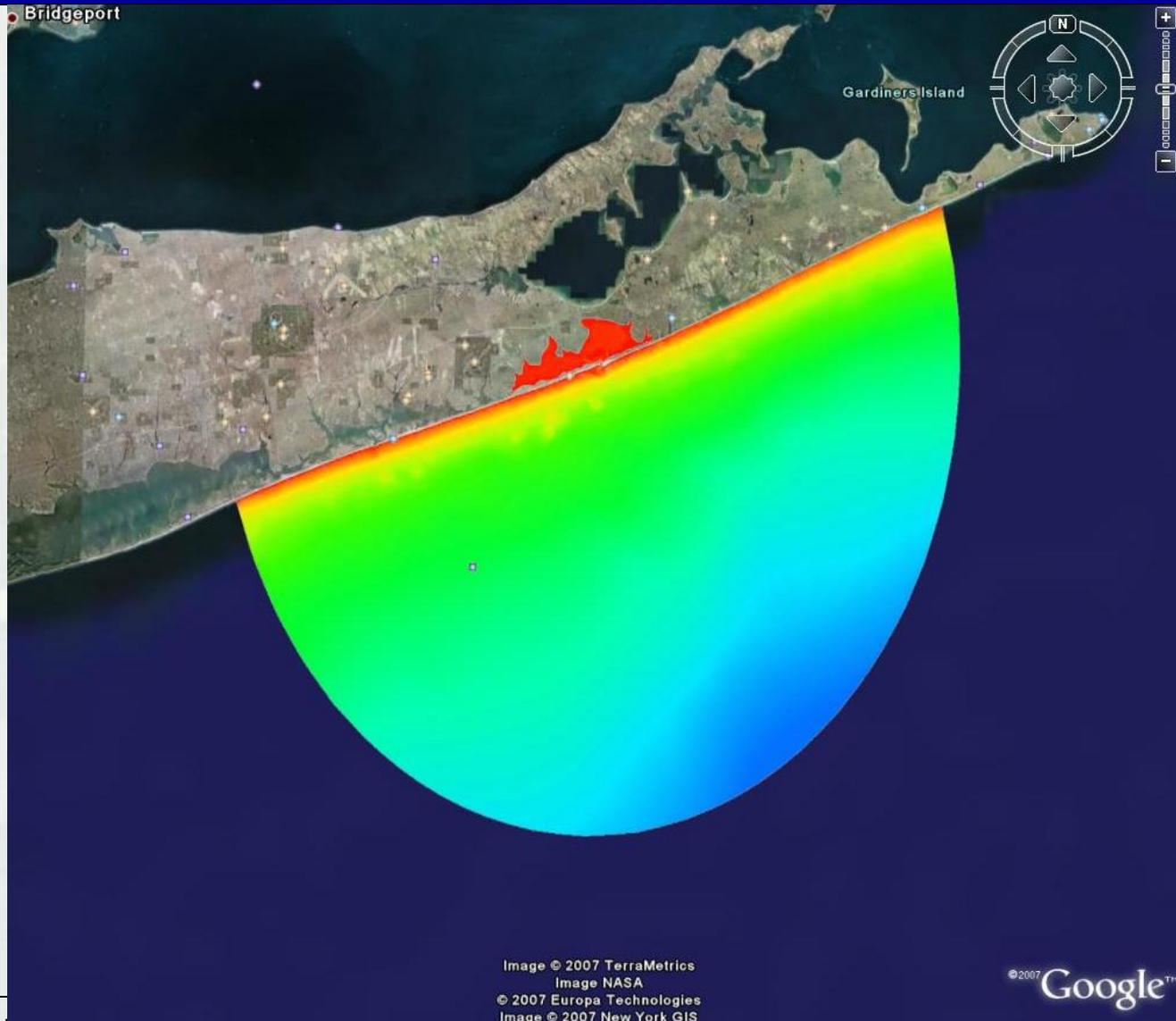


Contour/Vector Plots



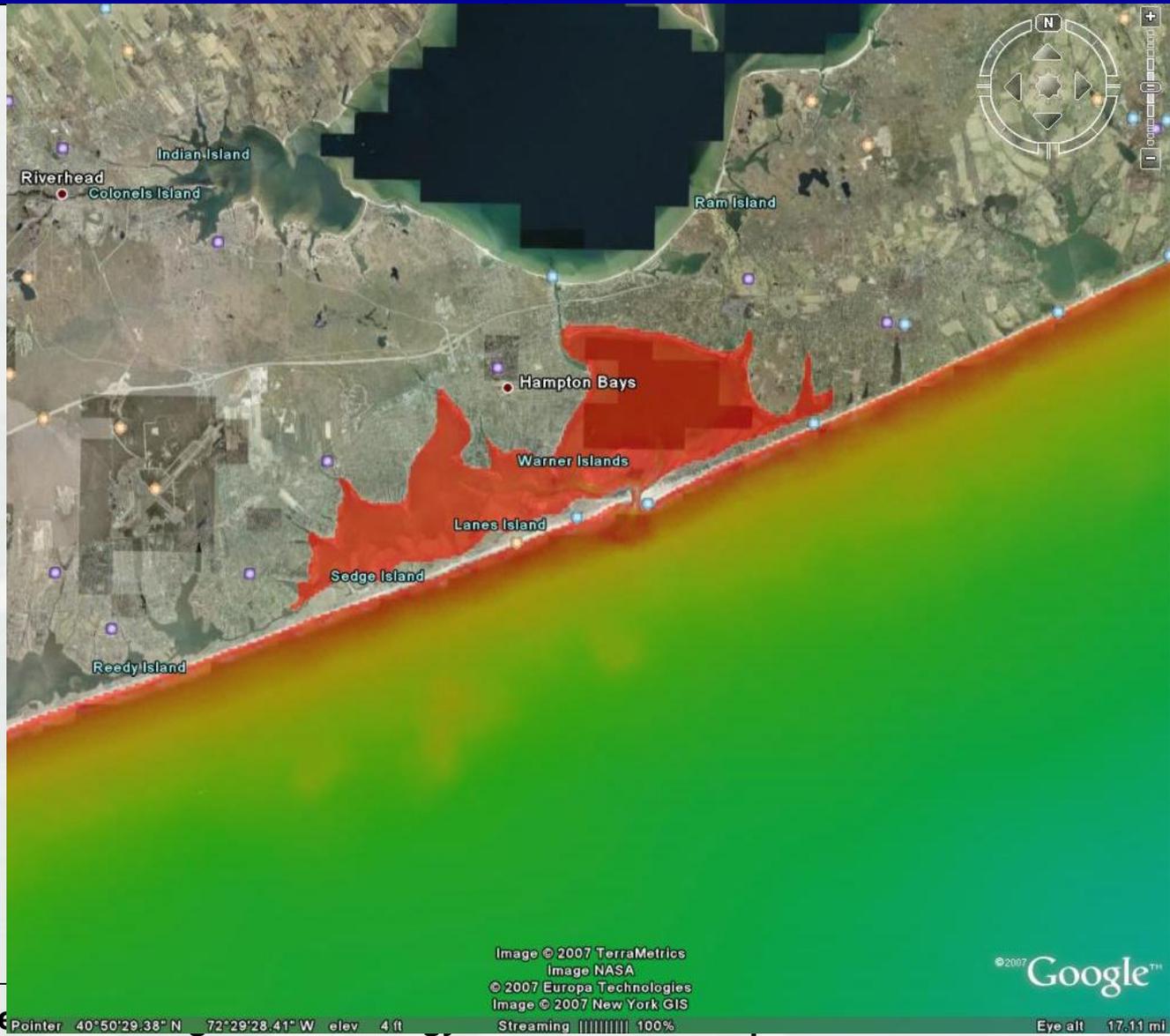


Google Overlay





Google Overlay (zoom)





Obtaining and Activating SMS



<http://cirp.usace.army.mil/products/SMS.html>

USACE –

Contact sms@erdc.usace.army.mil and request a password for SMS 10.1.

Others –

- Visit http://www.aquaveo.com/password_request for a temporary password.
- Contact Aquaveo sales at sales@aquaveo.com or call (801) 302-1400



Questions?

Mitch Brown

mitchell.e.brown@usace.army.mil

601-634-4036