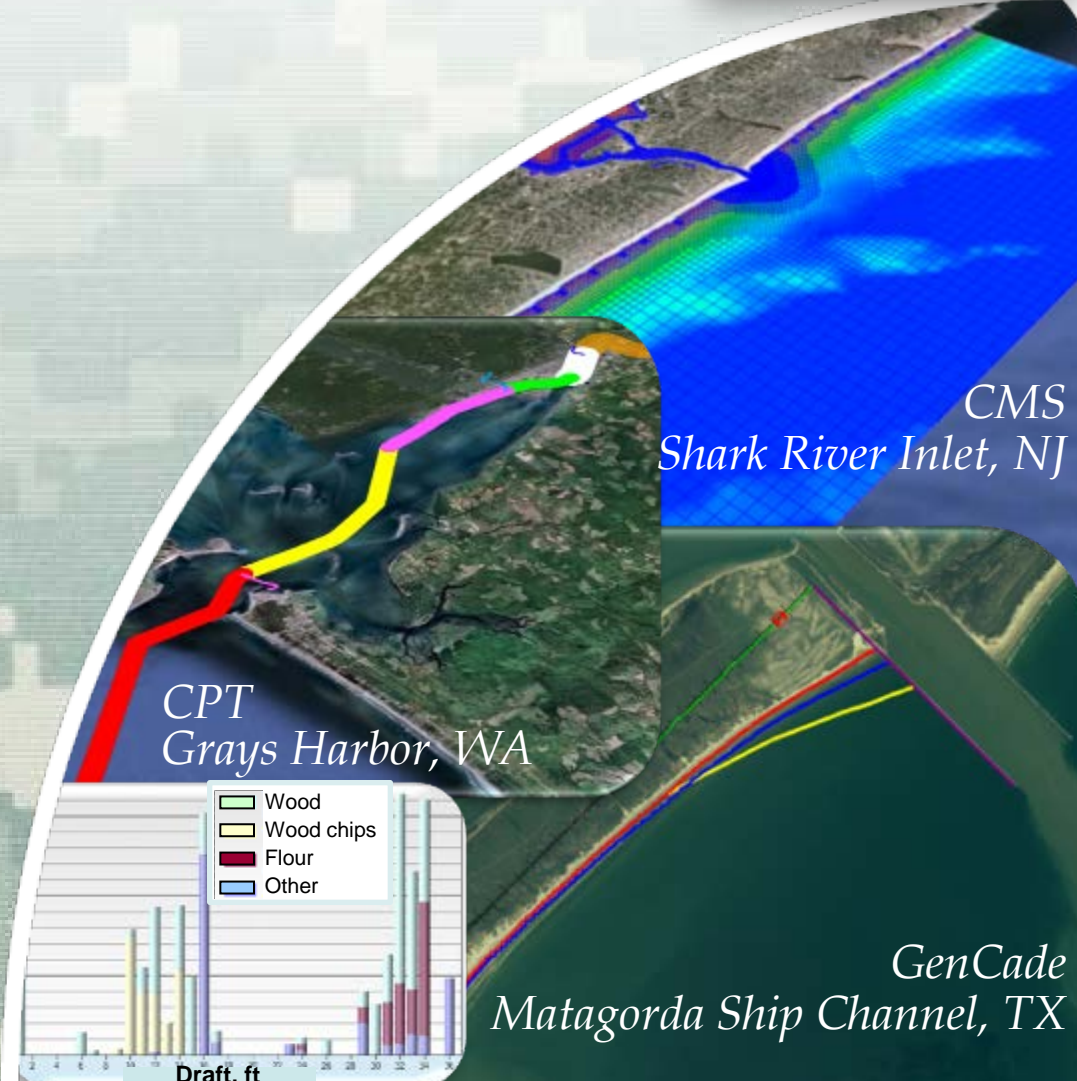


# Overview of the SMS (v11.0)

**Mitchell Brown**  
 Civil Engineering Technician  
[Mitchell.E.Brown@usace.army.mil](mailto:Mitchell.E.Brown@usace.army.mil)

March 6, 2012



US Army Corps of Engineers  
**BUILDING STRONG**





# Overview of Presentation



## Introduction to the Surface-water Modeling System (SMS v.11.0)

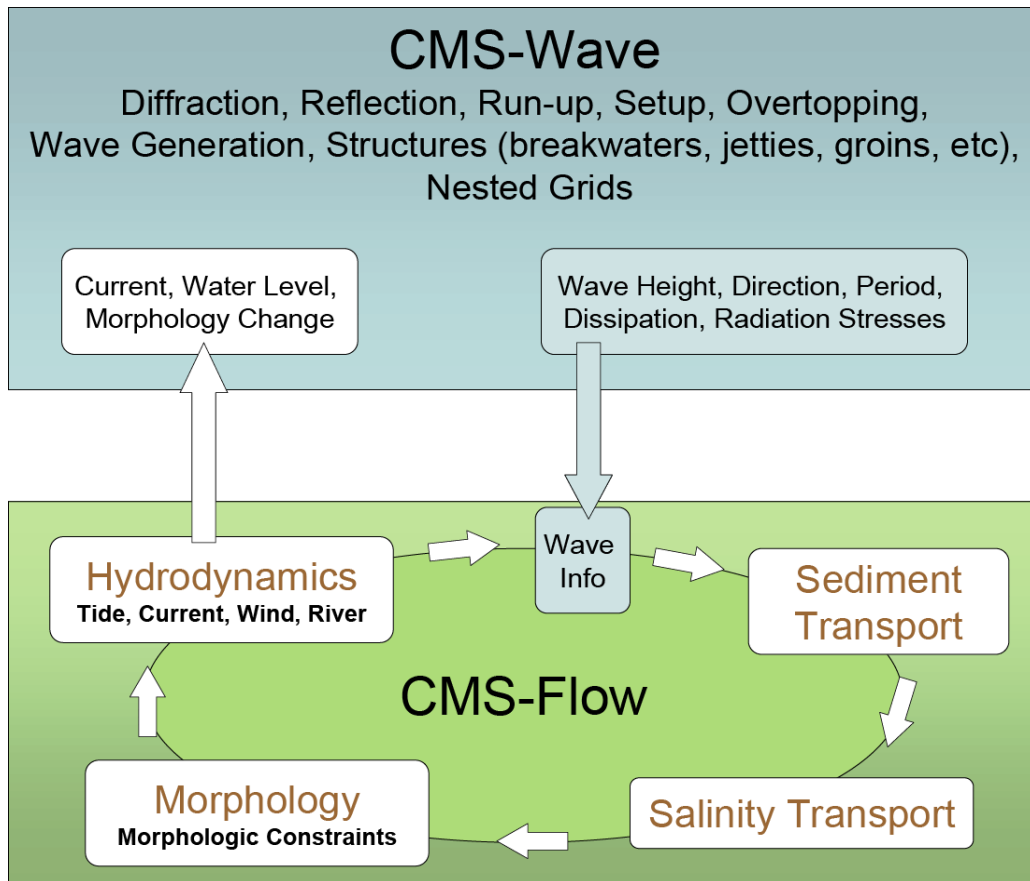
- What is it?
- Tools, Modules, Data Tree, Images, etc.
- CMS Models interface





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# CMS Overview



## Since 1997...

- 38 workshops
- Districts can independently run the CMS!

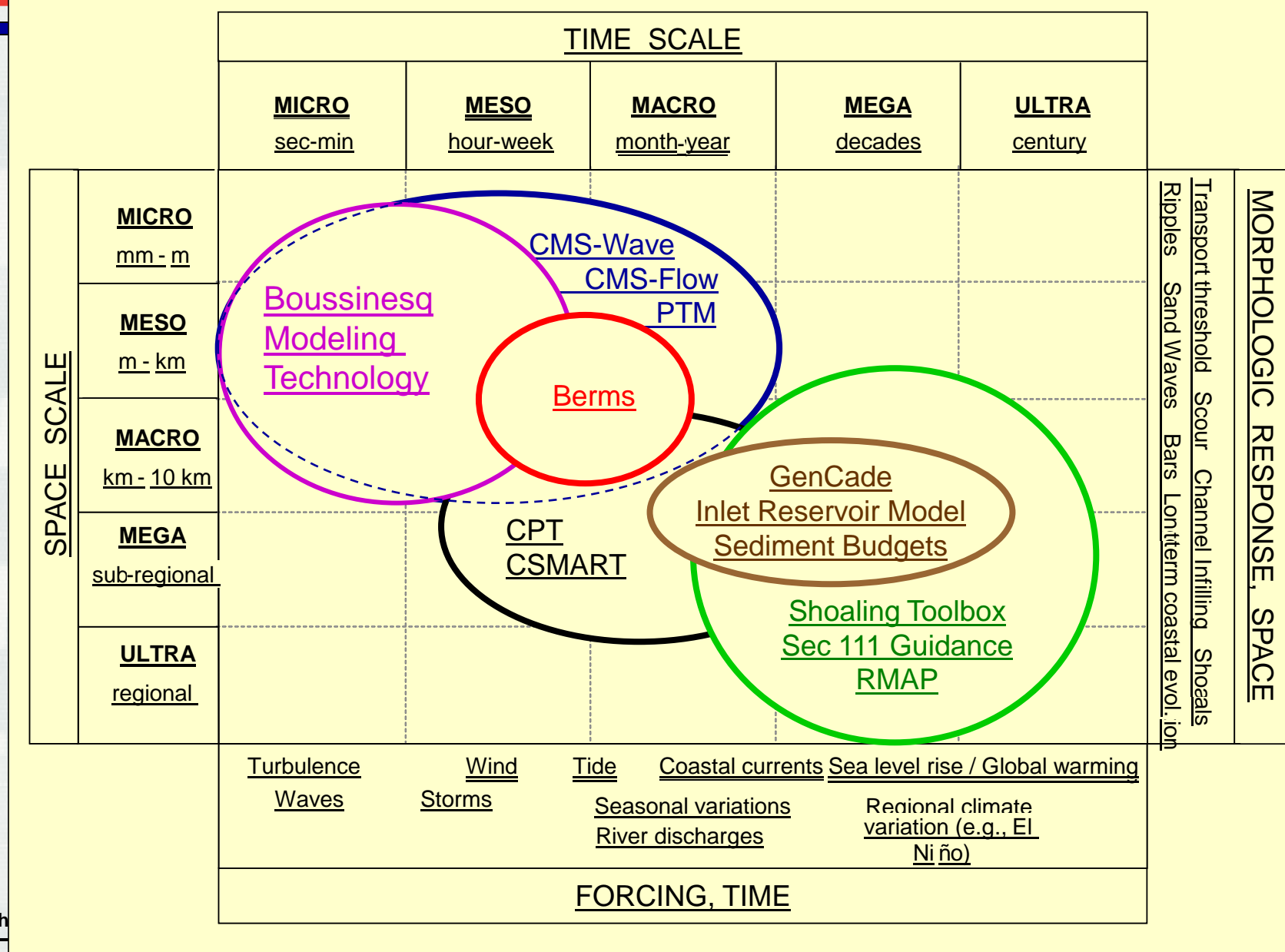
## Advantages...

- Robust
- Physics-based
- Integrated SYSTEM
- In SMS
- User-friendly

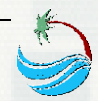




# Scales of Coverage



**MORPHOLOGIC RESPONSE, SPACE**





# 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.





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# 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.

The screenshot displays the SMS 10.1 software interface. At the top is a blue **MENU BAR** with options: File, Edit, Display, Data, Cellstring, CMS-Flow, Web, Window, Help. Below the menu bar is a toolbar with various icons. On the left side, the **DATA TREE** window shows a hierarchical structure: Cartesian Grid Data (checked), Flow (checked), D50 (123), Hard Bottom (123), ManningsN (123), Depth (Z), Simulation (unchecked), HB-Workshop\_Flow\_el (123), HB-Workshop\_Flow (123), Velocity Magnitude (123), and Map Data (checked). Below the Data Tree is the **TIME STEPS WINDOW** showing a list of time steps from 21153 13:00:00 to 21153 20:00:00, with 21153 19:30:00 selected. The main **GRAPHICS WINDOW** displays a 3D visualization of a river or inlet system with a color scale for "Current speed, m/sec" ranging from 0.00 (dark blue) to 2.00 (red). A **STATUS WINDOW** at the bottom right shows coordinates (1807870.0, 677740.0). At the bottom of the interface is a **HELP WINDOW** with various icons.





# Toolbars



## Toolbars

- Static Toolbar

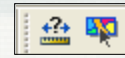


- Dynamic Toolbar

- ▶ Grid
  - ▶ CMS-Flow
  - ▶ CMS-Wave
- ▶ Scatter
- ▶ Annotation



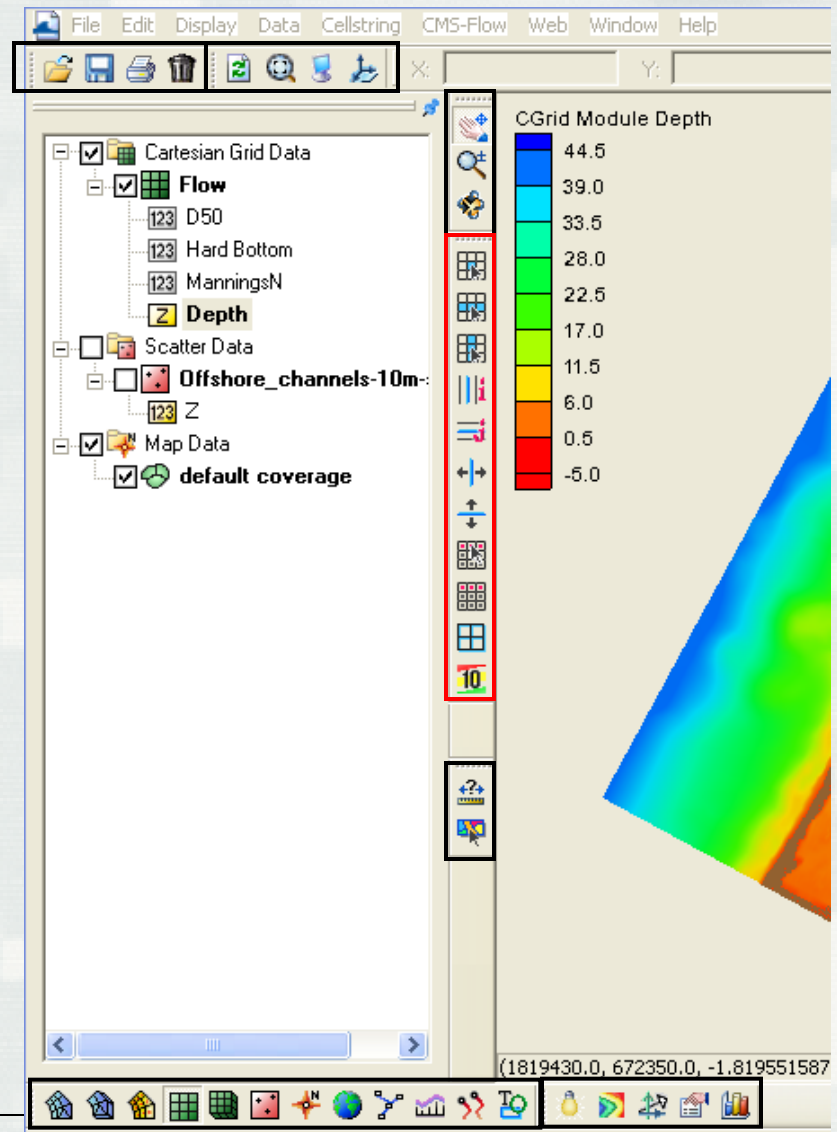
- Data Toolbar



- Optional Toolbars

- ▶ Macro
- ▶ File
- ▶ Display

- Module Toolbar







# 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

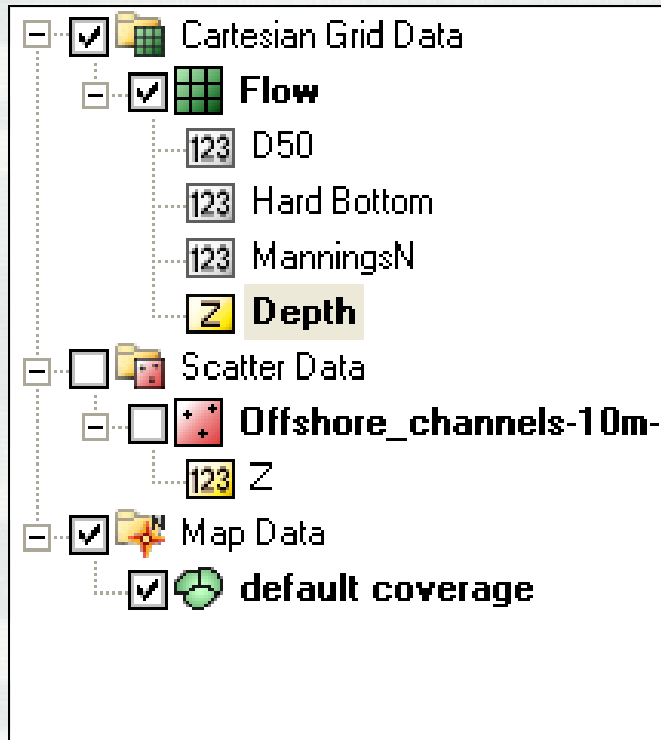
**Selection** tools usually have an arrow that points to the specific type of element.

**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.





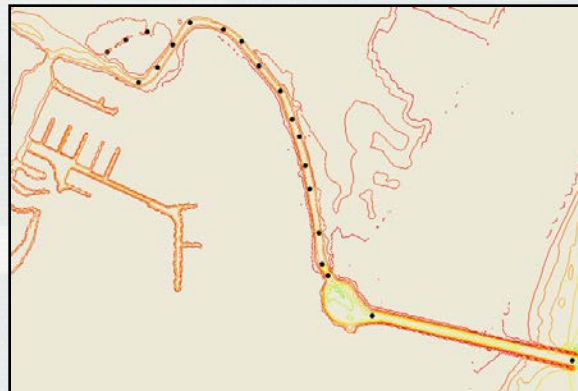
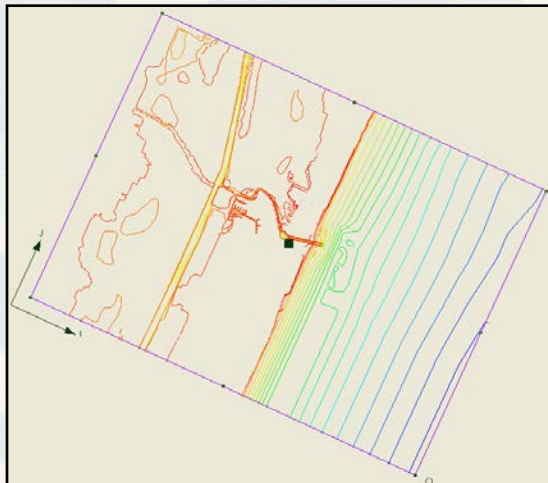
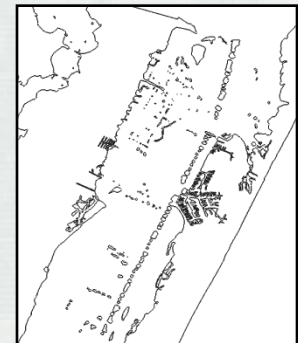
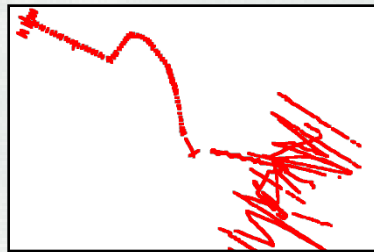
# SMS – a complete modeling interface



## 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

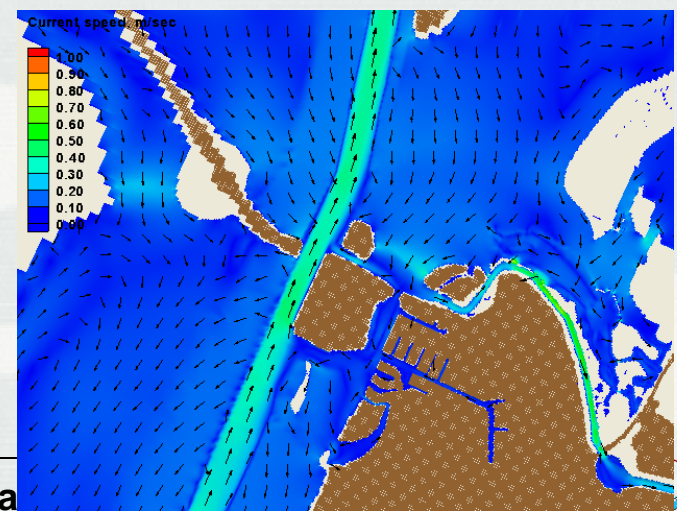


### Create Conceptual Model

- Delineate CMS model domain
- Define areas of finer resolution

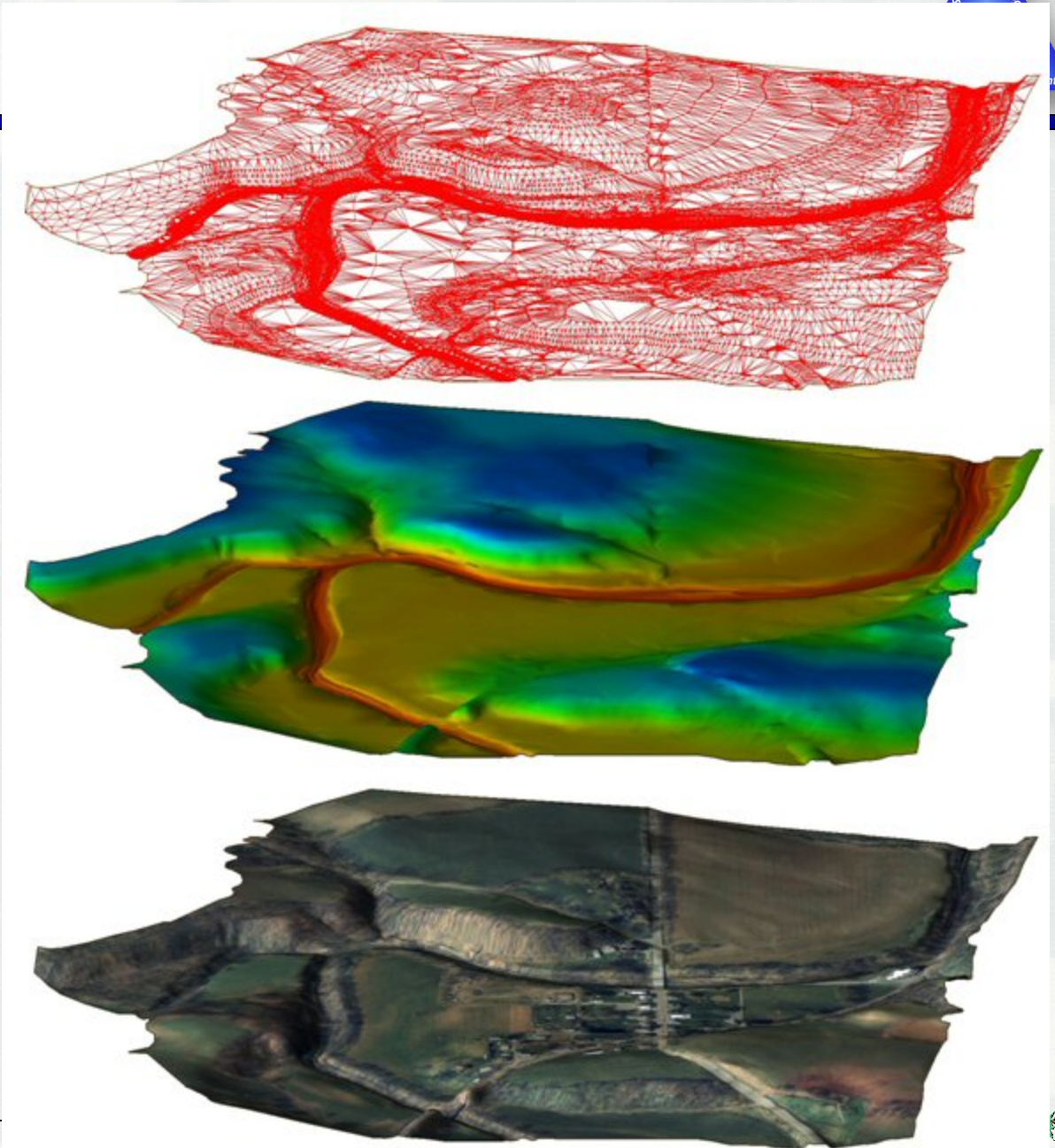
### Generate & Run CMS Models

- 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.



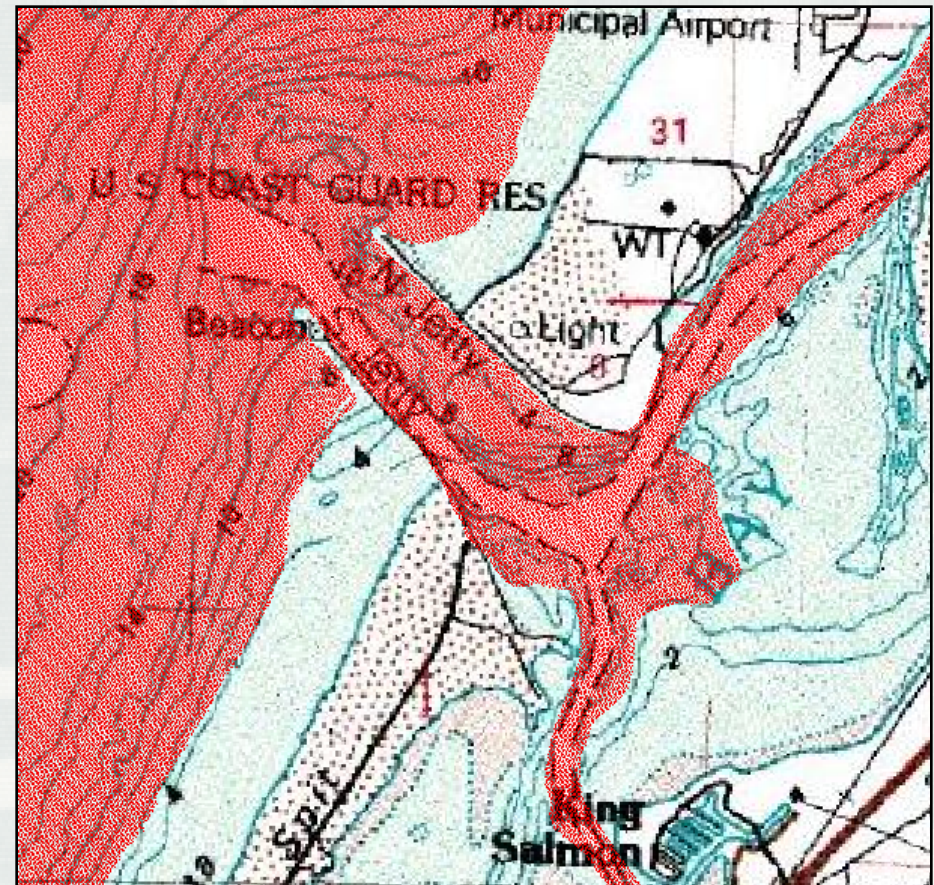


# Scattered Data (TINs)



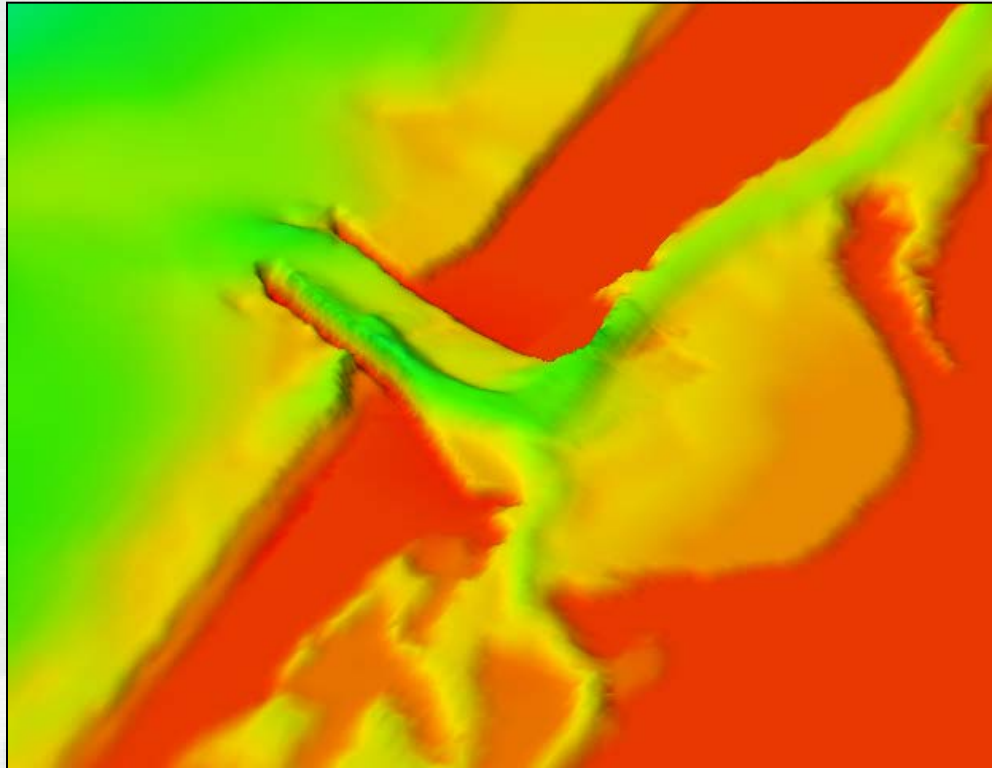
## ■ Stores spatially varied data

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





# Visualization of Scattered Data



***Humboldt Bay, CA***  
*Oblique view*  
*Z-magnification 5x*

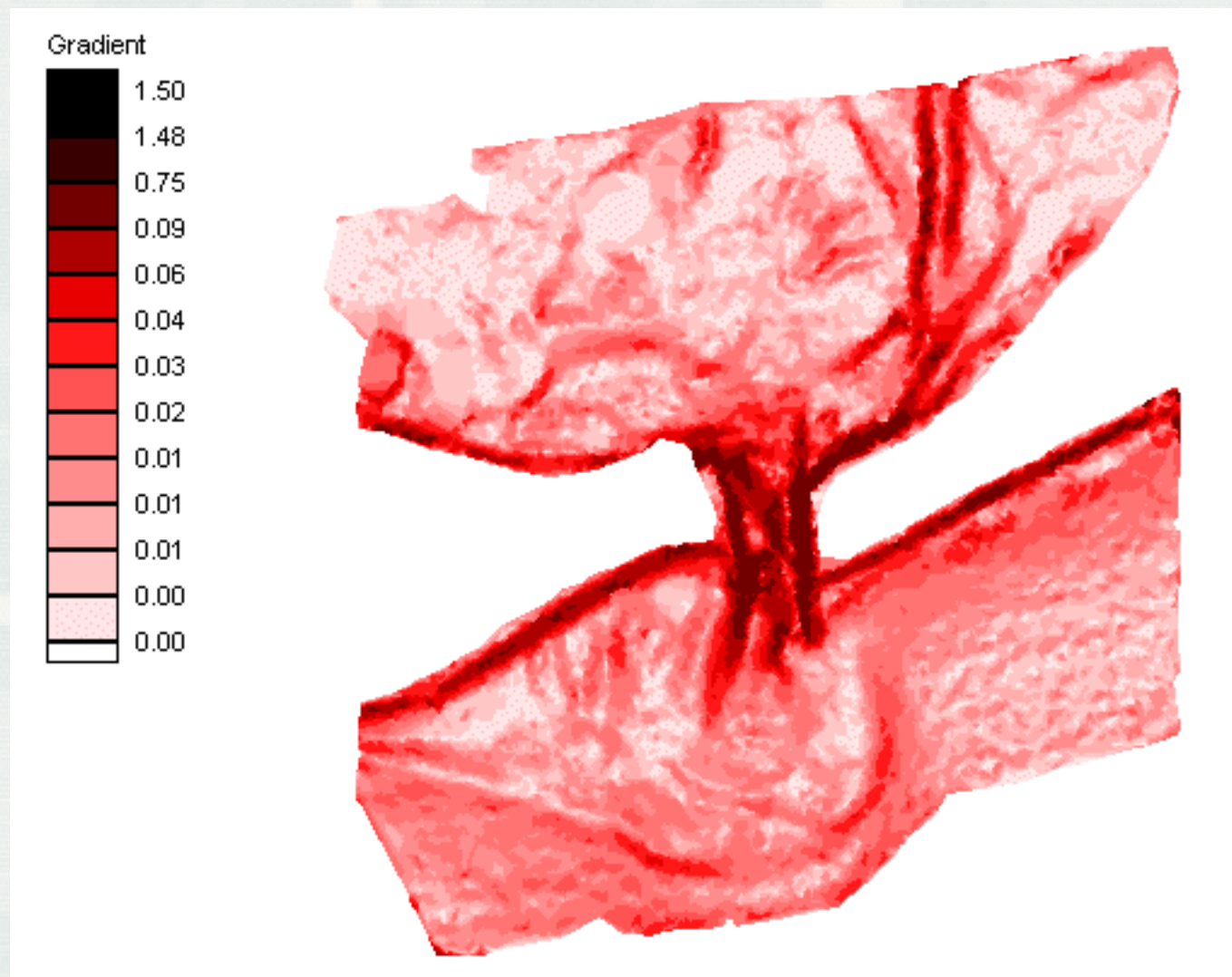
## ▪ Options

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





# Lidar Survey

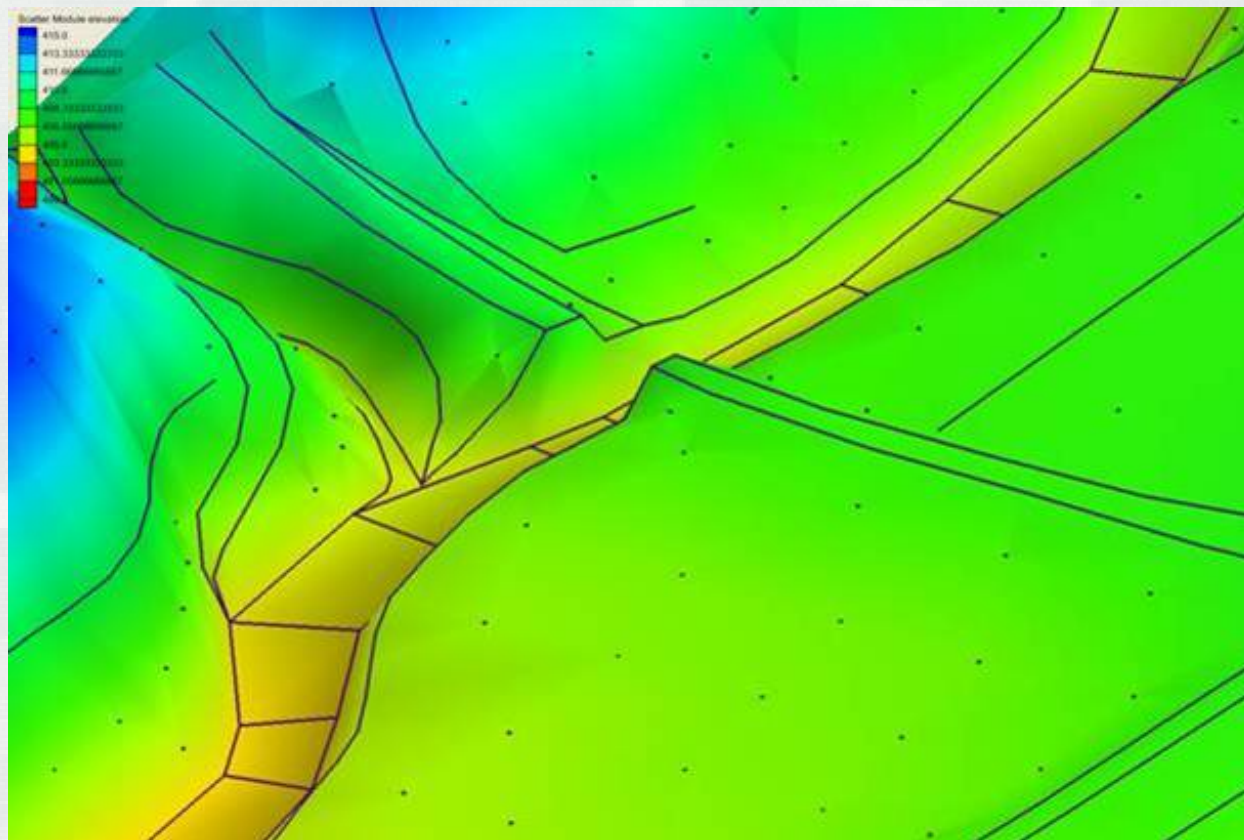






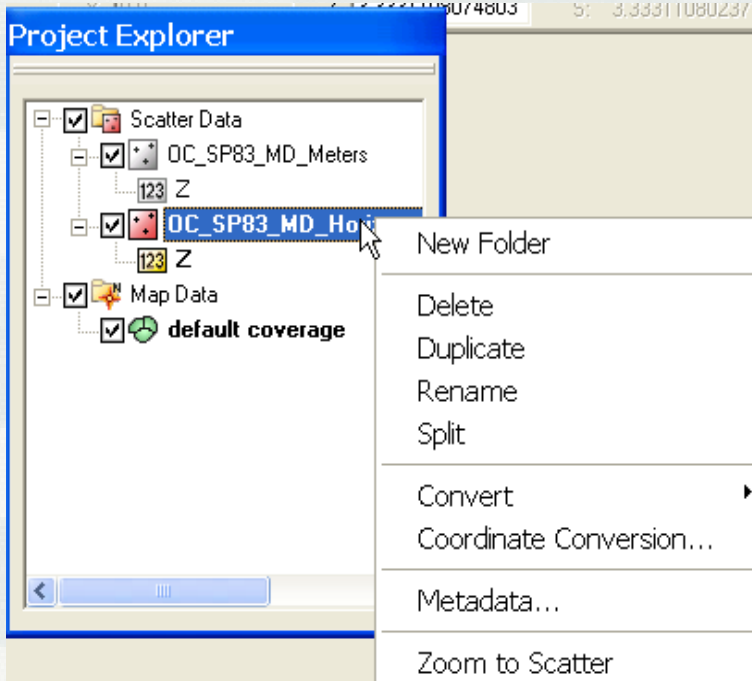
®

# Breaklines

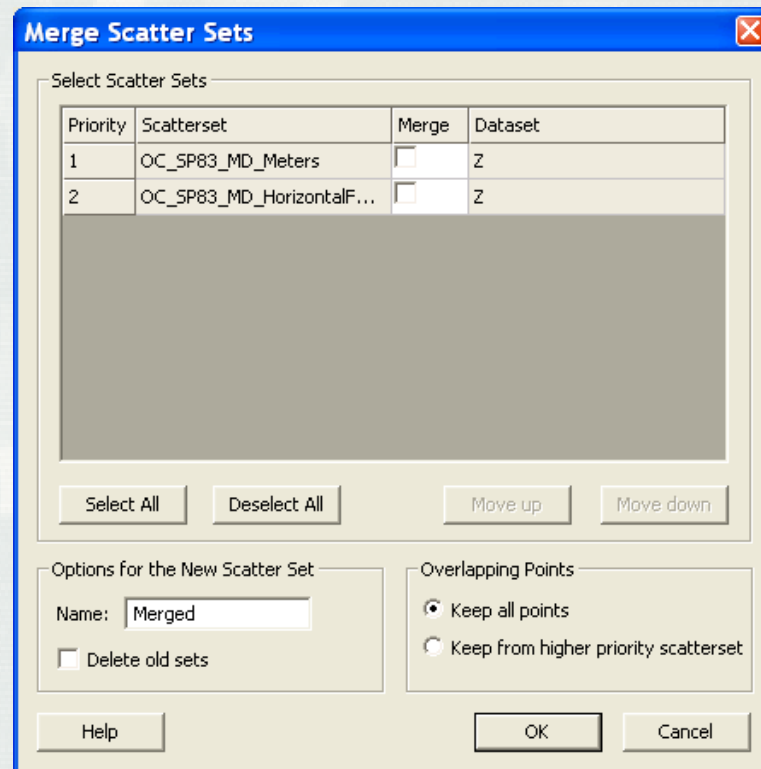


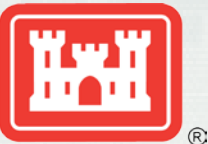


# Operating With Scatter Sets



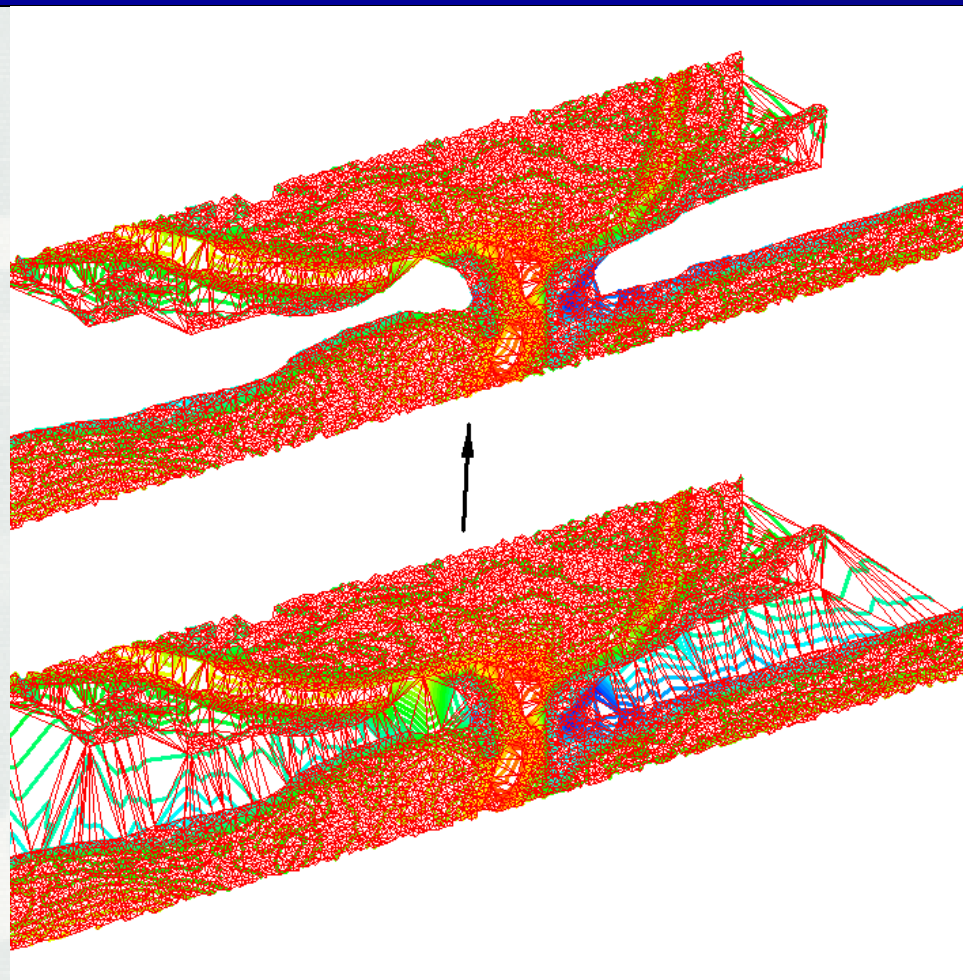
## ■ Merge





# 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**

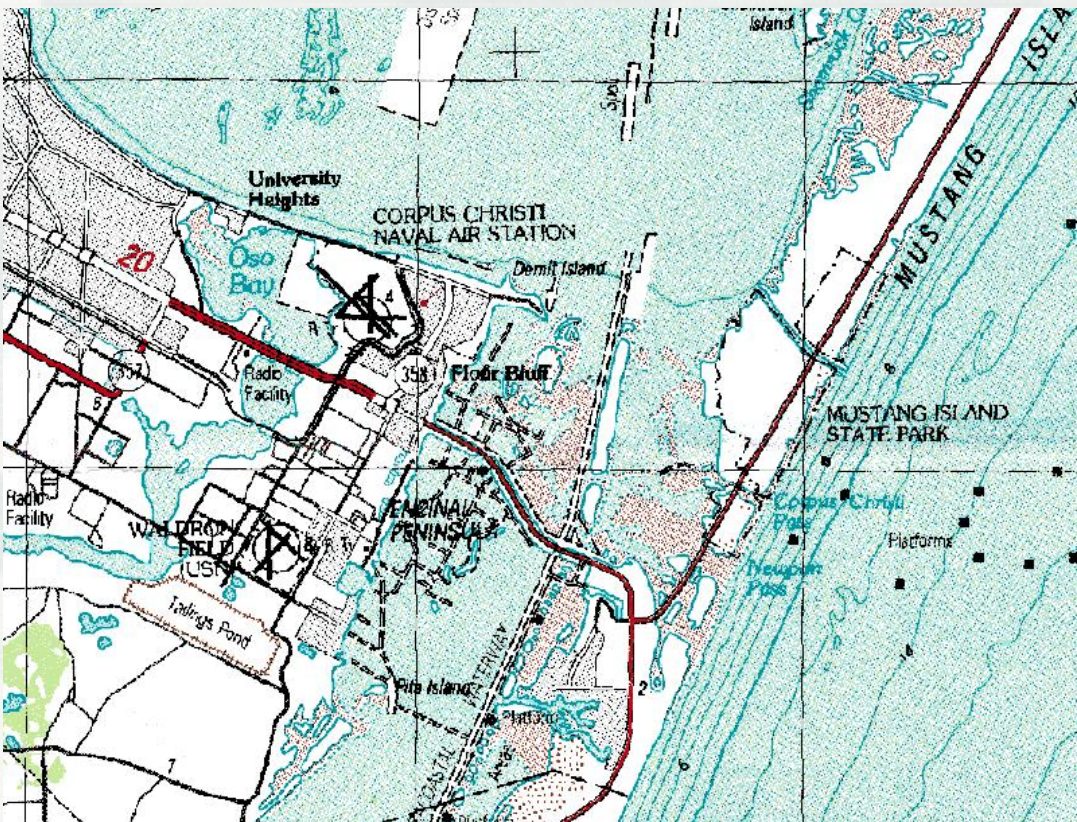




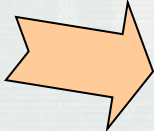
# Images



## Topo Maps



## Aerial Photos



<http://terraserver.microsoft.com>



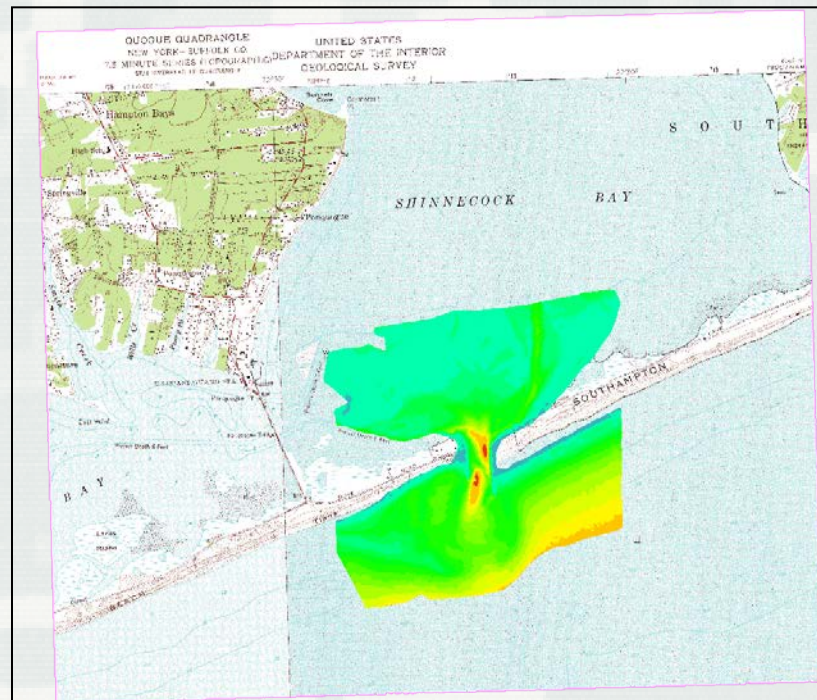
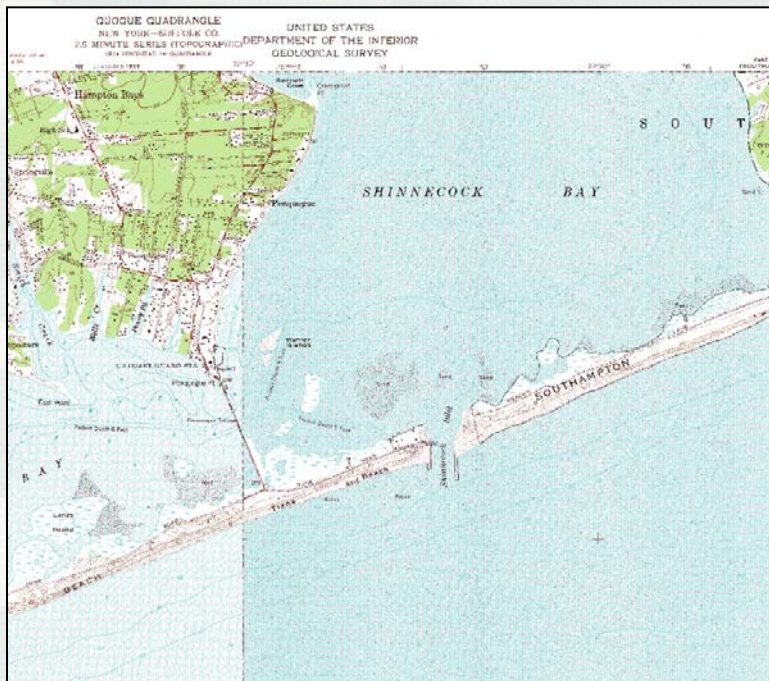


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# Image Data

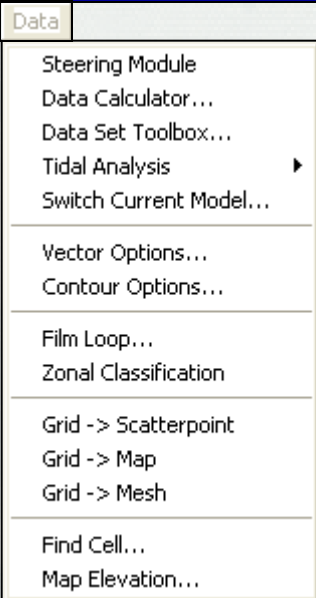


## Overlay data over images



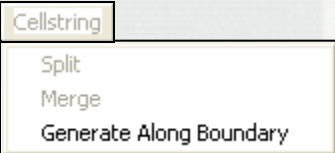


# CMS-Flow Interface: Pull-down Menus



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

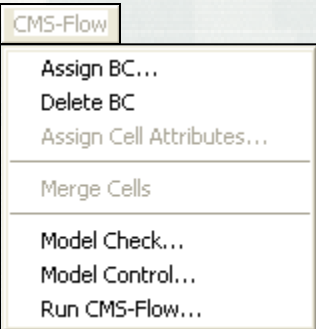
- Steering Module – Starts/controls interaction between Flow and Wave
- Data Calculator – Dataset-based functions
- Dataset Toolbox – Dataset-based operations (includes Calculator)
- Vector/Contour Options – Change appearance of data within the Graphics Window
- Film Loop – Generate animations based 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

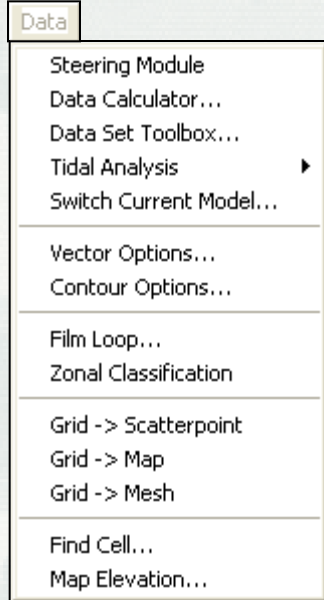
## Parameter Specification and File I/O



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



# CMS-Wave Interface: Pull-down Menus

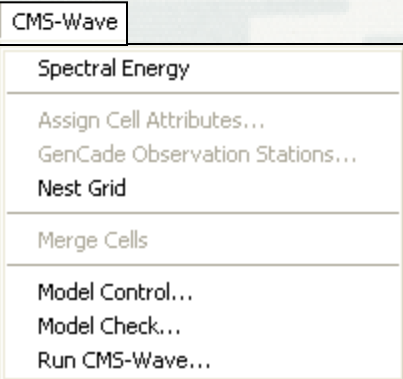


The Data are the same for both CMS-Flow and CMS-Wave.

- 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.



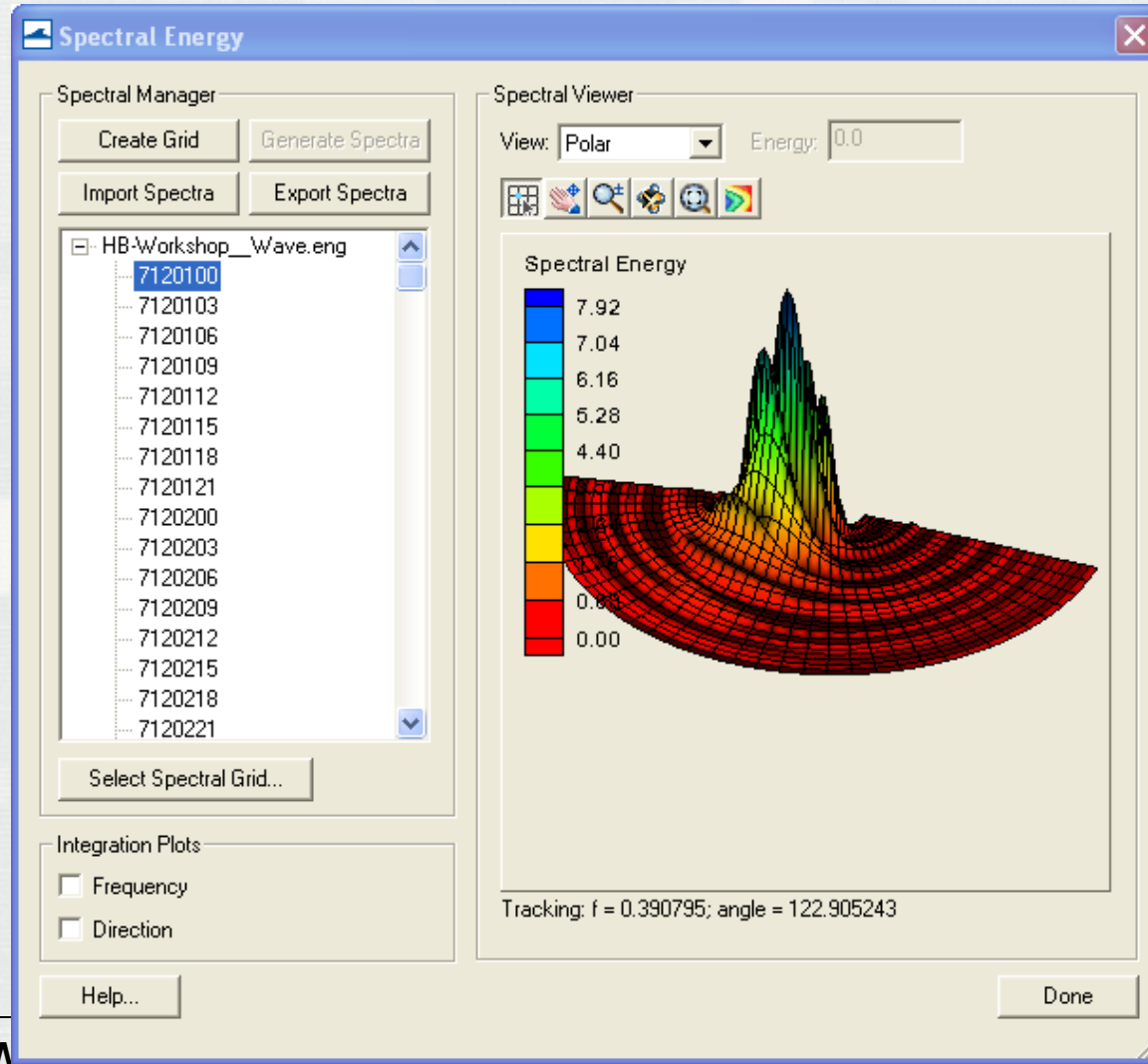




# Spectral Energy menu



## Example of Imported Spectra from Wave Gauge





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# Generate Spectra from Bulk Criteria



**Generate Spectra** [Close]

**Parameter Settings**

Generation Method: TMA (Shallow Water) [v]

Replace Old Spectra

Directional Spreading Distribution:

Wrapped Normal

Cosine Power

Gauge Depth:

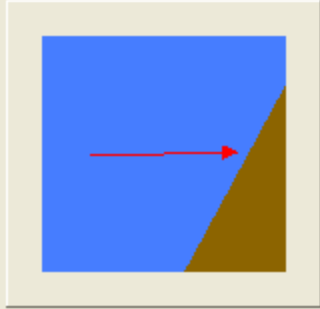
Specify once for all spectra

0.001 m

Specify for each spectrum

**Angle Settings**

Projection: Shore Normal [v]



**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**

Allow wetting and drying       Bed friction       Diffraction intensity: 4.0

Forward reflection       Spatially constant Cf: 0.005       Currents

Spatially constant: 0.5       Spatially varied Cf: Select... none selected       Single timestep: Select... none selected

Spatially varied: Select... none selected       Spatially constant n: 0.005       All timesteps: Select... none selected

Backward reflection       Spatially constant: 0.3       Spatially varied n: Select... none selected

Spatially varied: Select... none selected

Cf = Darcy-Weisbach friction coefficient  
n = Manning friction coefficient

**Wave Source**

Spectra      Parameters...  
 Wind  
 Spectra and wind  
 Simplified formulation

**Output**

Radiation stresses  
 Breaking  
Function: Extended Goda  
 Indices  
 Energy dissipation

Help...      OK      Cancel





# Recent additions to the SMS



- 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





# Web Menu



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

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

- **Find Data**

- ▶ Links to useful web sites

- **Tidal Data**

- ▶ Links to coastal filtering tools

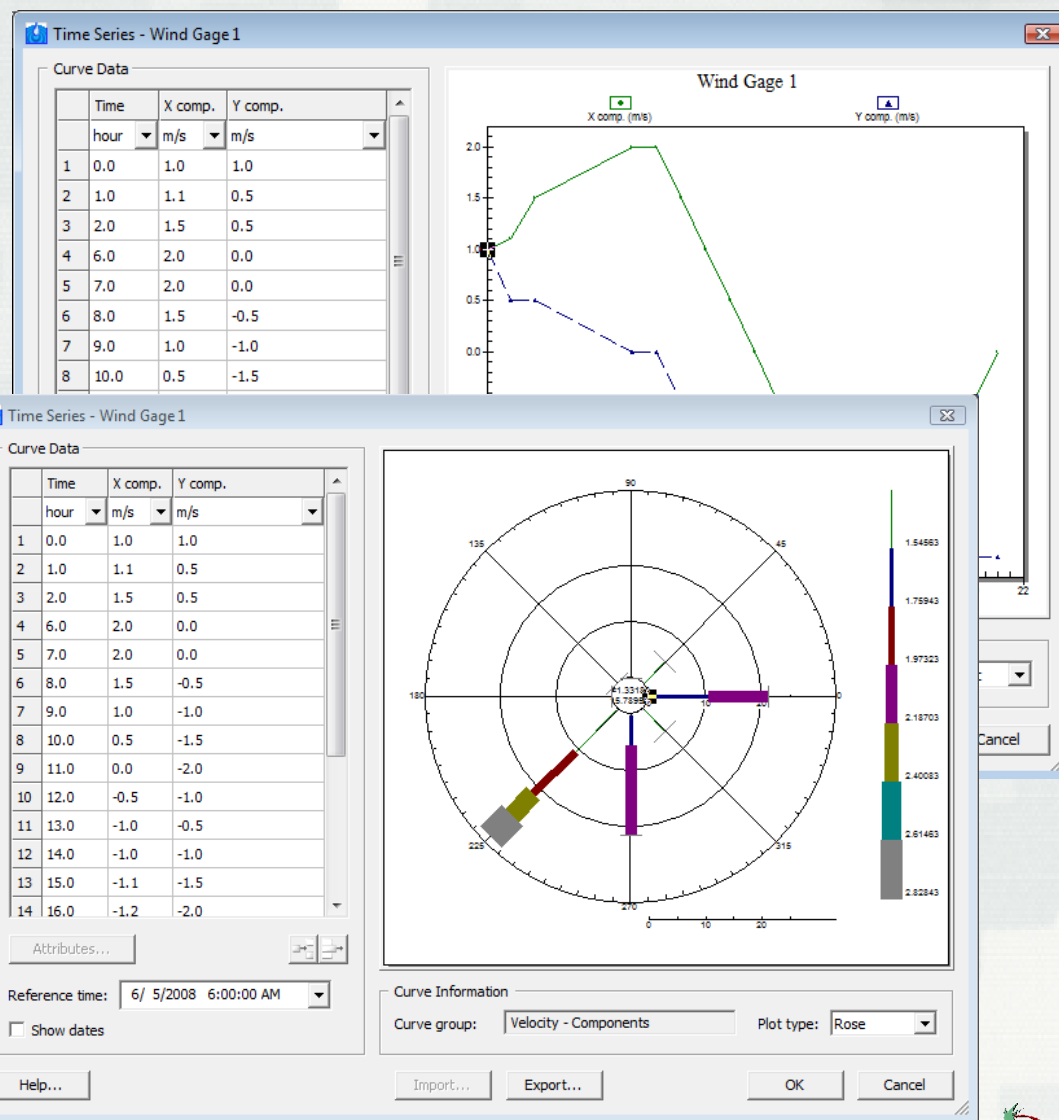




# Spatial Data Coverages



- 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





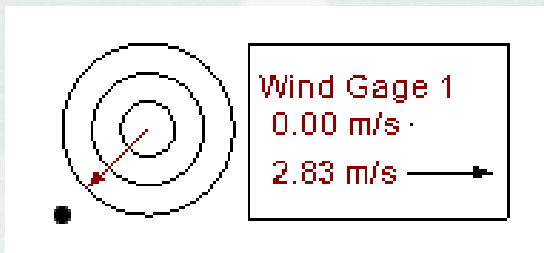


# Spatial Data Coverages



## 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 ]

New projection

Horizontal

Local projection

Units: [ ]

Global projection

[ Set Projection ]

**Select Projection**

Projection

Projection: [ State Plane Coordinate System ] [ Load From File... ]

Datum: [ NAD83 ] [ Save To File... ]

Planar Units: [ METERS ]

Zone: [ Florida West (FIPS 902) ]

Parameters:

Attribute	Value
STATE PLANE SCALE FACTOR	1.00000000

[ OK ] [ Cancel ]



# SMS – Post Processing



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

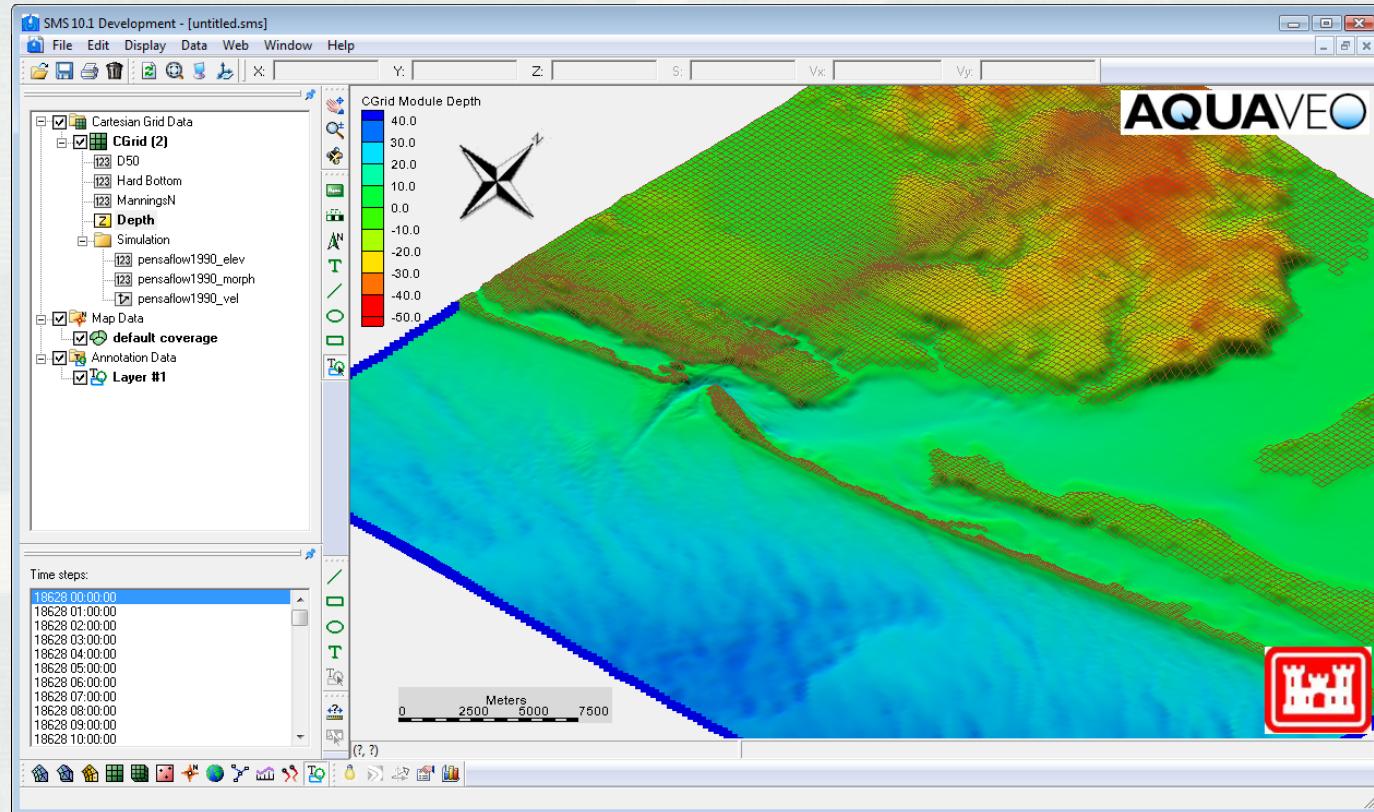




# Annotation Layers



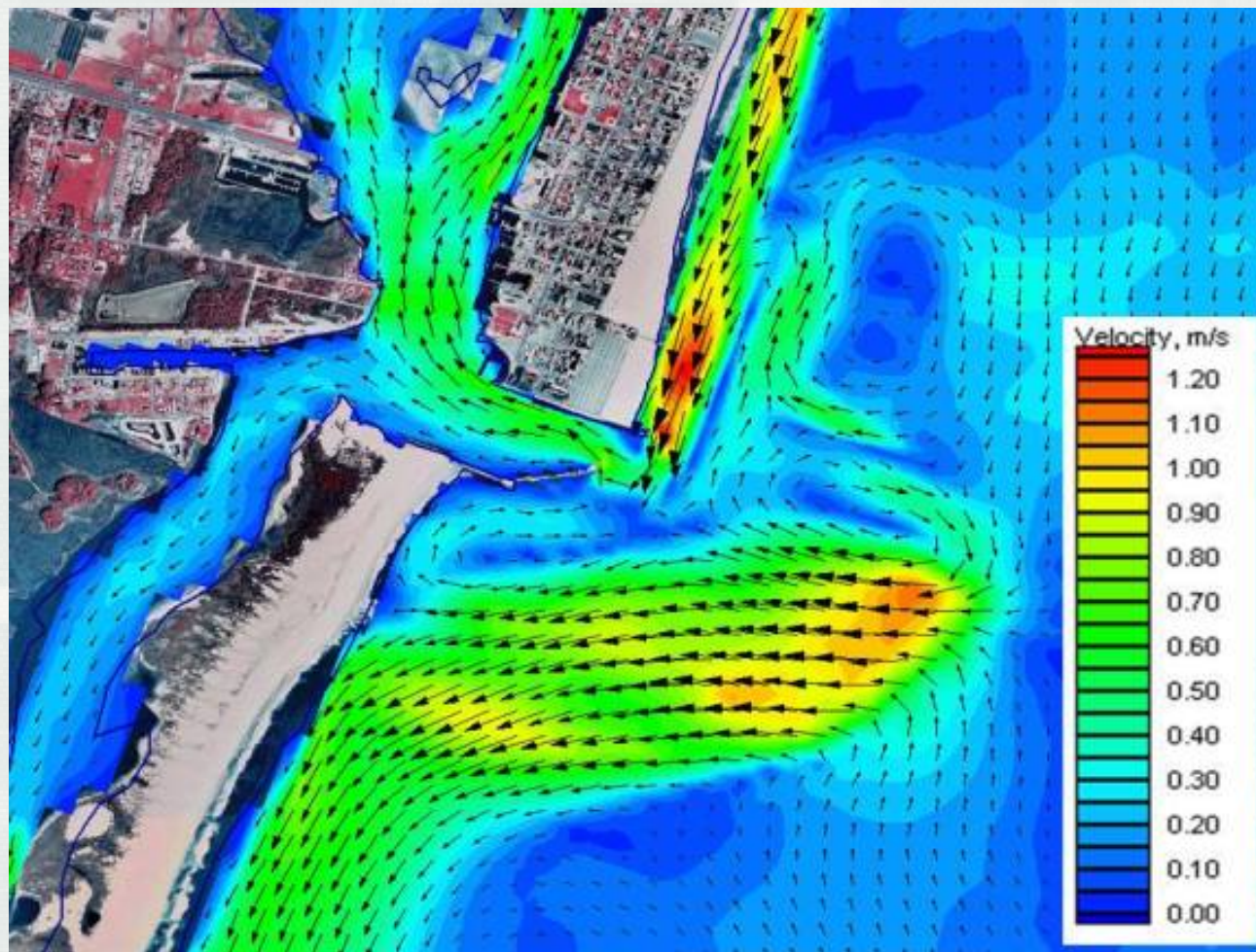
- Replaces Drawing Objects
- New Objects
  - Screen space images (logos)
  - Scale bars
  - North Arrows
- Organizes entities into layers
- Anchored in either world or screen





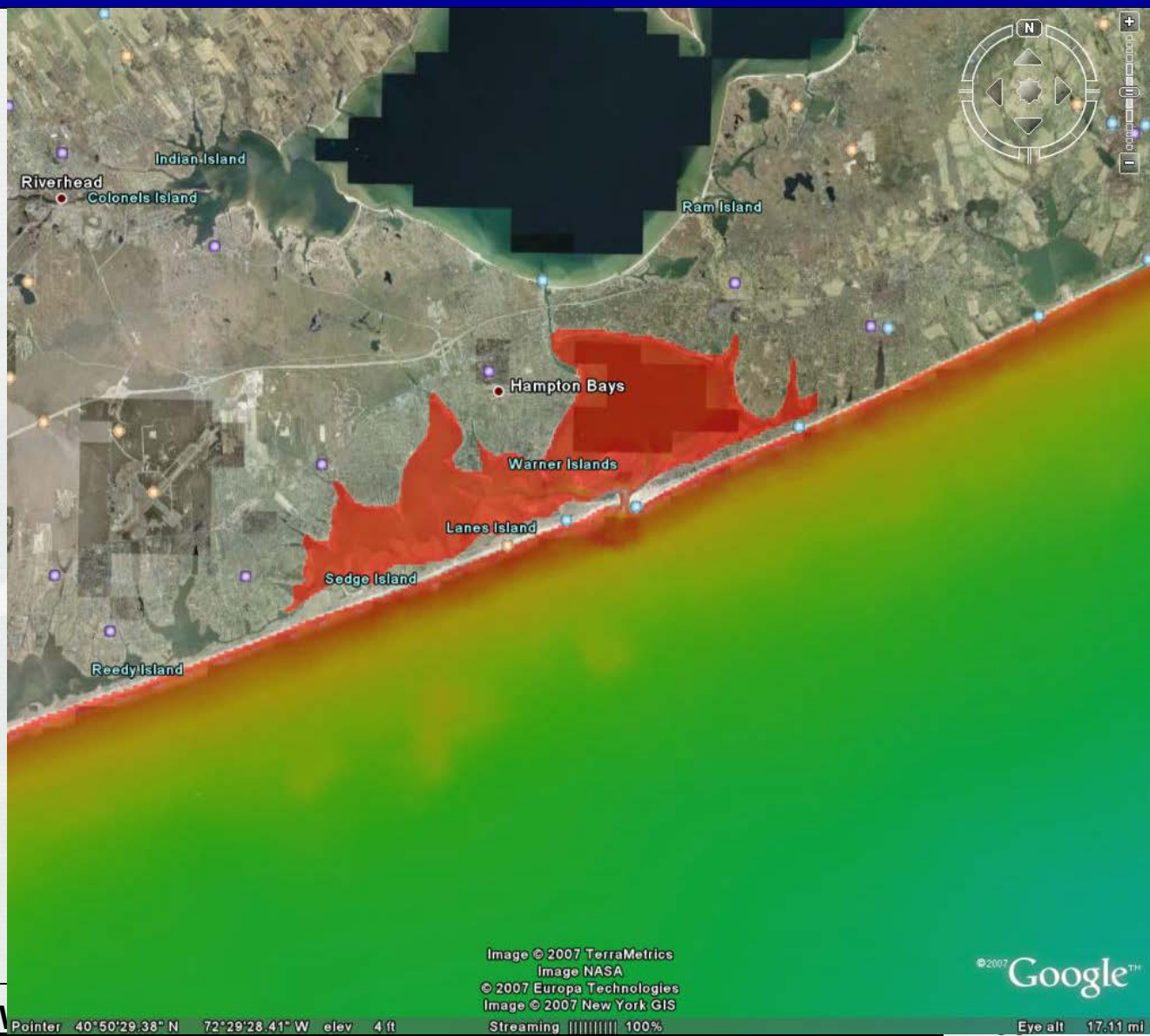
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# Contour/Vector Plots





# Google Overlay (zoom)





# Obtaining and Activating SMS



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

## USACE –

Contact [sms@erdc.usace.army.mil](mailto:sms@erdc.usace.army.mil) and request a password for SMS 11.0.

## Others –

- Visit [http://www.aquaveo.com/password\\_request](http://www.aquaveo.com/password_request) for a temporary password.
- Contact Aquaveo sales at [sales@aquaveo.com](mailto:sales@aquaveo.com) or call (801) 302-1400.
- Request evaluation version from within the SMS registration form.



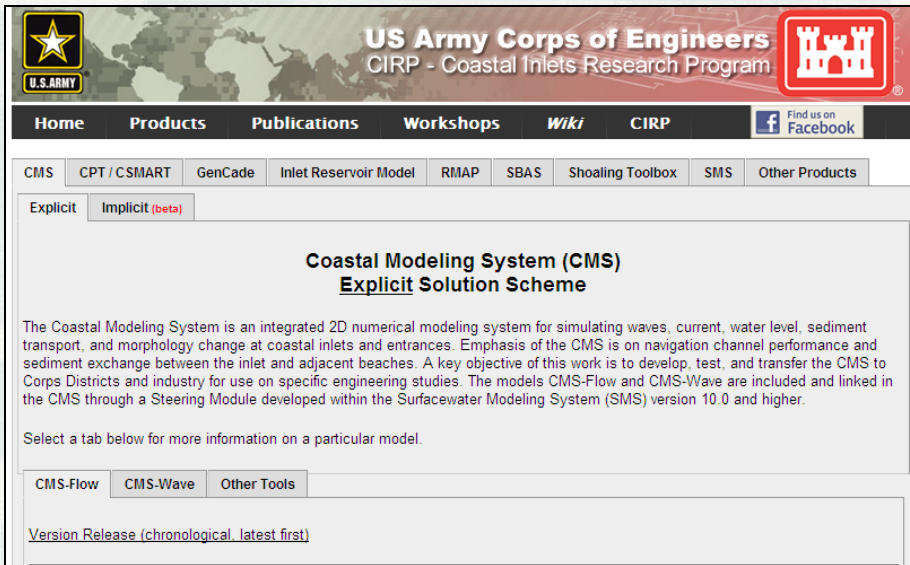


# Documentation



## ■ CIRP website

## ■ Wiki Website



**US Army Corps of Engineers**  
CIRP - Coastal Inlets Research Program

Home Products Publications Workshops Wiki CIRP Find us on Facebook

CMS CPT / CSMART GenCode Inlet Reservoir Model RMAP SBAS Shoaling Toolbox SMS Other Products

Explicit Implicit (beta)

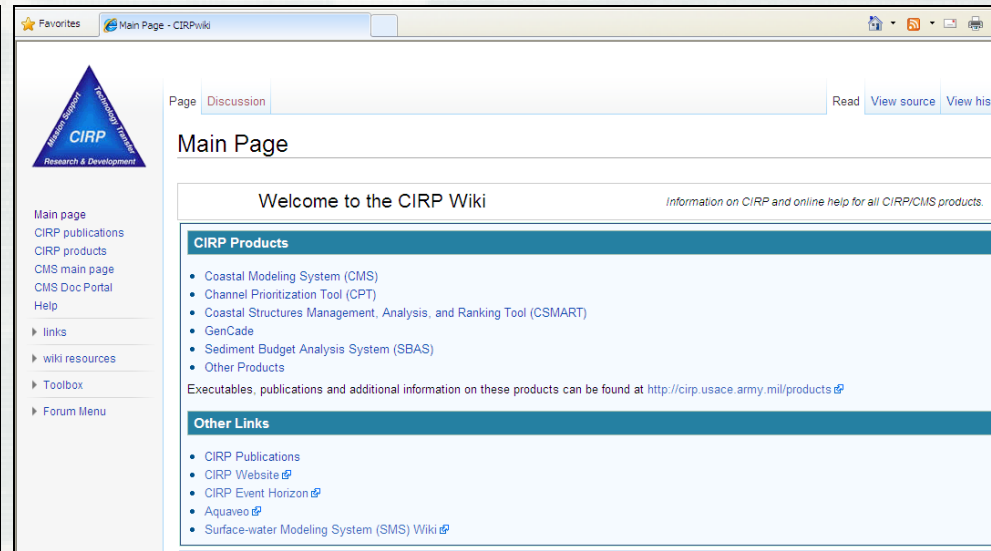
### Coastal Modeling System (CMS) Explicit Solution Scheme

The Coastal Modeling System is an integrated 2D numerical modeling system for simulating waves, current, water level, sediment transport, and morphology change at coastal inlets and entrances. Emphasis of the CMS is on navigation channel performance and sediment exchange between the inlet and adjacent beaches. A key objective of this work is to develop, test, and transfer the CMS to Corps Districts and industry for use on specific engineering studies. The models CMS-Flow and CMS-Wave are included and linked in the CMS through a Steering Module developed within the Surfacewater Modeling System (SMS) version 10.0 and higher.

Select a tab below for more information on a particular model.

CMS-Flow CMS-Wave Other Tools

Version Release (chronological, latest first)



Main Page - CIRPwiki

Page Discussion Read View source View his

## Main Page

Welcome to the CIRP Wiki Information on CIRP and online help for all CIRP/CMS products.

### CIRP Products

- Coastal Modeling System (CMS)
- Channel Prioritization Tool (CPT)
- Coastal Structures Management, Analysis, and Ranking Tool (CSMART)
- GenCode
- Sediment Budget Analysis System (SBAS)
- Other Products

Executables, publications and additional information on these products can be found at <http://cirp.usace.army.mil/products>

### Other Links

- CIRP Publications
- CIRP Website
- CIRP Event Horizon
- Aquaveo
- Surface-water Modeling System (SMS) Wiki

<http://cirp.usace.army.mil/>

<http://cirp.usace.army.mil/wiki/>





# Documentation Website



## ■ Products

- CMS
- GenCade
- Others

## ■ Publications

- Technical Reports
- CHETNS
- Journal Articles
- Others

## ■ Workshops

- Upcoming
- Recent

**US Army Corps of Engineers**  
CIRP - Coastal Inlets Research Program

Home Products Publications **Workshops** Wiki CIRP Find us on Facebook

**Upcoming Workshops**  
12th Annual Workshop: Jacksonville, FL

**Recent Workshops**  
CMS/CPT Workshop: New Orleans, LA  
13th Annual Workshop: Seattle, WA  
Hyatt New Orleans 1-day Workshop  
10th Annual Workshop: St. Pete, FL

**All Presentations/Workshops**  
Online Presentations

*The Coastal Inlets Research Program (CIRP) is pleased to celebrate our 12th Annual Technology-Transfer Workshop in conjunction with the 24th Annual National Conference on Beach Preservation Technology. The CIRP workshop will be held just prior to the FSBPA conference, from Monday, February 7th through Wednesday, February 9th (half day), 2011.*

[CIRP Workshop Information](#)

[CIRP Workshop Program](#)

[CIRP Workshop Registration](#)

[CIRP Workshop Hotel Reservations](#)

Julie Rosati and CIRP PIs



# Documentation

## Wiki



- **CMS**
  - Documentation Portal
  - Tutorials
  - Technical Info (Equations)
  - Validation Cases
- **Gencode**
  - Information
  - User Guide
- **CPT/CSMART**
  - Information and Guidance

### Channel Portfolio Tool (CPT)

POC: Dr. Kenneth Ned Mitchell  
Kenneth.n.mitchell@usace.army.mil  
601-634-2022

US Army Engineer Research and Development Center (ERDC)  
Coastal and Hydraulics Lab (CHL)

Active URL (Corps machines only): <https://itlgis01.usace.army.mil/CPTWeb/>

CPT is developmental software that is updated frequently.

### CPT general layout

#### *Setting the level of analysis (Reach, Project, District, Division)*

CPT is designed to enable analysis of commercial utilization of the Corps-maintained waterway infrastructure at a variety of coverage levels. At the most detailed level, individual channel sub-reaches may be chosen for analysis and compared to other sub-reaches in the USACE portfolio of navigation projects. However, in order to provide decision support to personnel at all levels of Corps management, CPT can also be used to analyze and compare commercial usage figures at the Project, District, and Division levels. For example, a District program manager might want to see which navigation project under his or her control handles the most exports of a particular commodity. CPT pulls from a large database that is maintained by the Corps' Waterborne Commerce Statistics Center (WCSC). Setting the desired level of analysis is done through the CPT Home screen: <https://itlgis01.usace.army.mil/CPTWeb/> . Figure 1 shows the four levels of analysis provided by CPT; the desired level is chosen by simply clicking on the respective link.





## Questions?

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