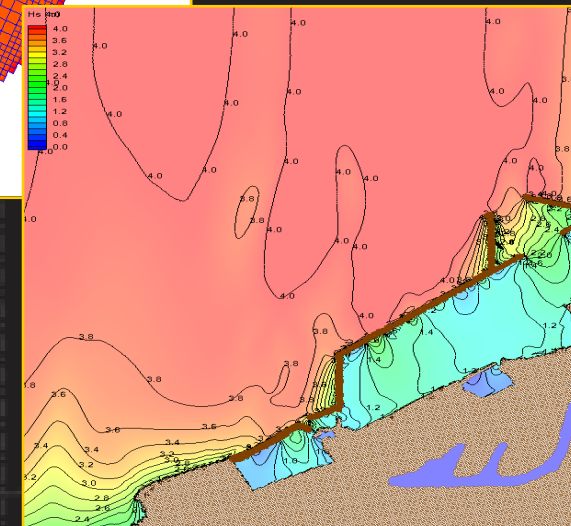
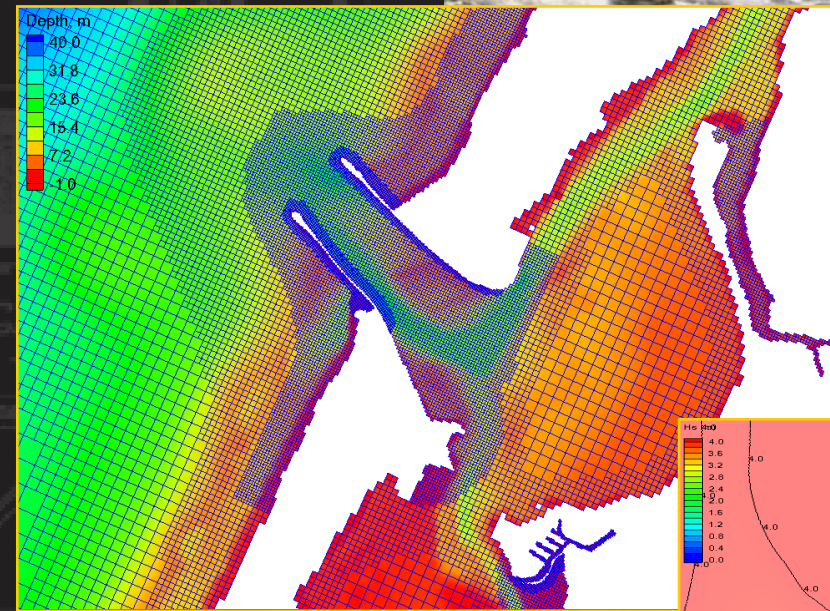


# OVERVIEW OF THE SMS (V13.3), COASTAL MODELING SYSTEM, AND USER RESOURCES

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US Army Engineer Research and Development  
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CMS Basics Webinar Series  
29 July – 02 August 2024



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CIRP



# OVERVIEW OF PRESENTATION



- Introduction to the Surface-water Modeling System (SMS v.13.3)
  - What is it?
  - Tools, Modules, Data Tree, Images, etc.
  - CMS Models interface
- Introduction to the Coastal Modeling System (CMS)
  - CMS-Flow – Hydrodynamics, Sediment Transport, Morphology Change
  - CMS-Wave – Half-plane waves and Full-plane wind forcing.



# 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



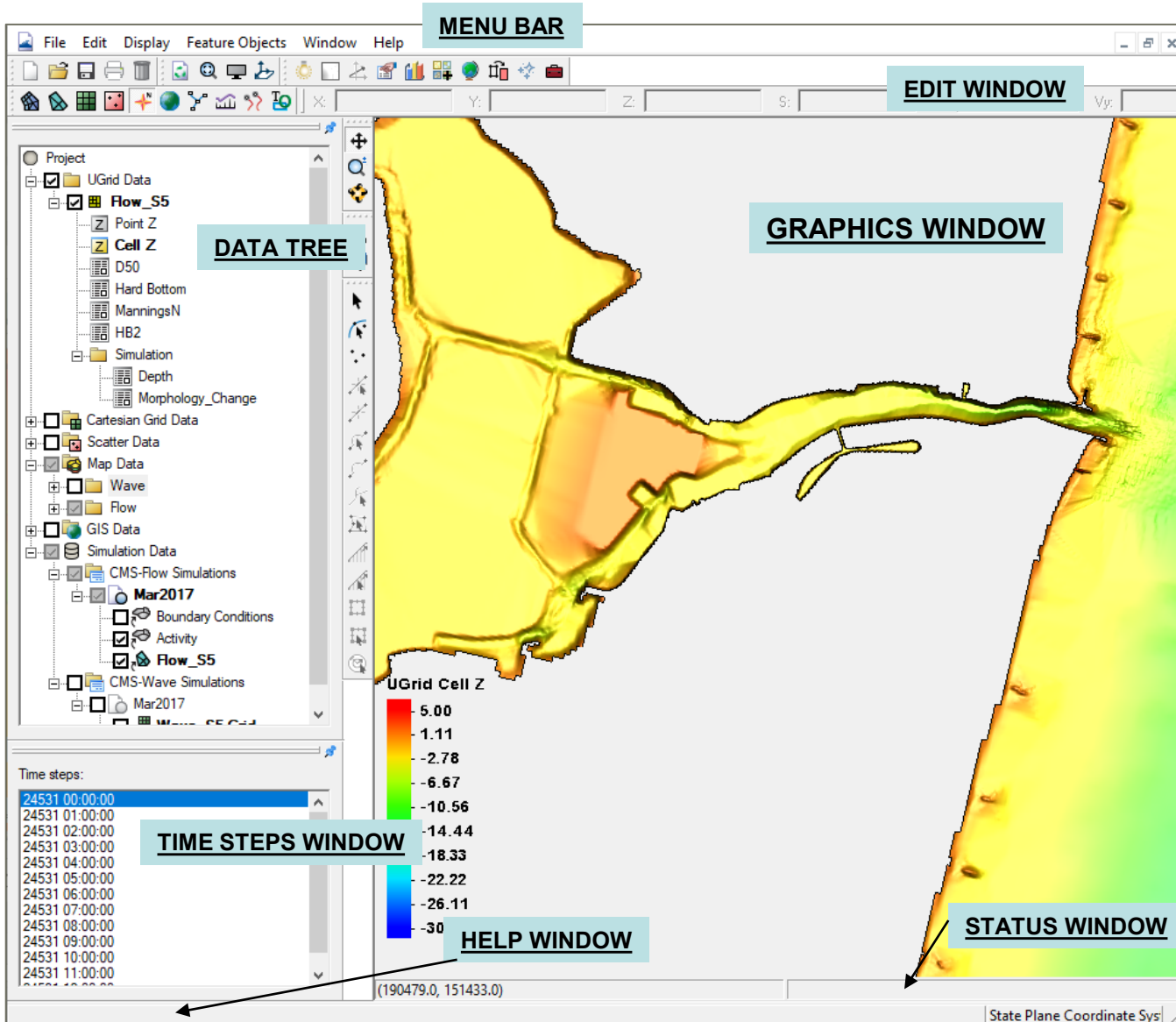


# SMS MODELING SUITE



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.











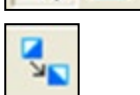
# DYNAMIC TOOLBAR













## Cartesian Grid tools

- Select Cell, Row, and Column 
- 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 Any Object 
- 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 

## UGrid Tools (for telescoping)

- Select Point 
- Select Cell 
- Create Nodestring\*\* 
- Create Cross Section\*\* 

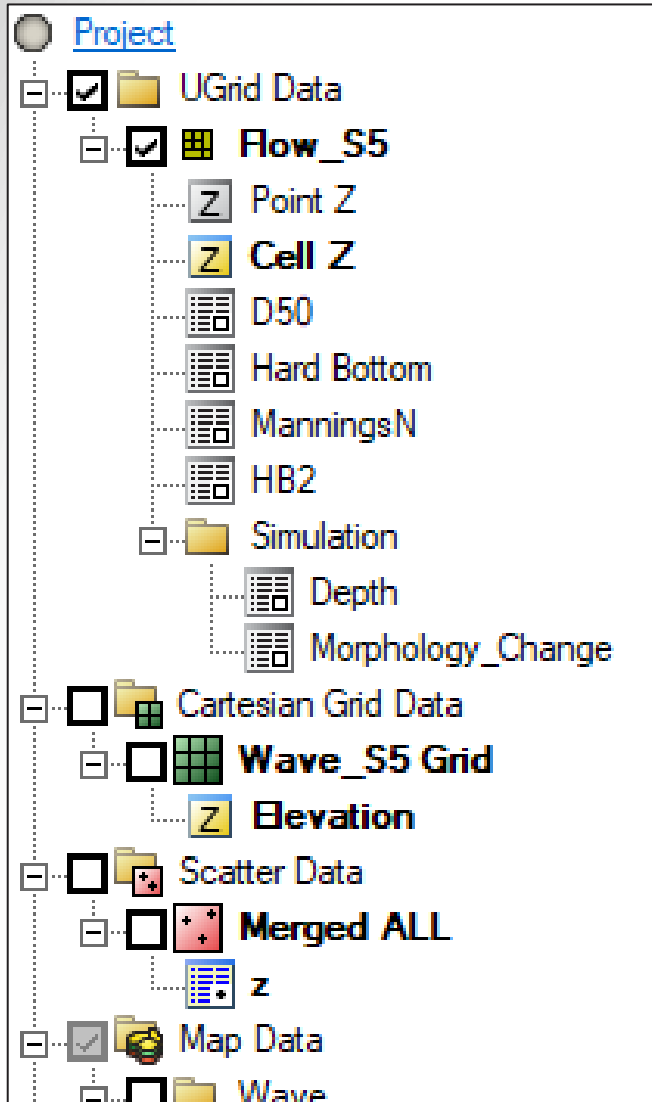
\*\* Not Presently used for CMS

**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.



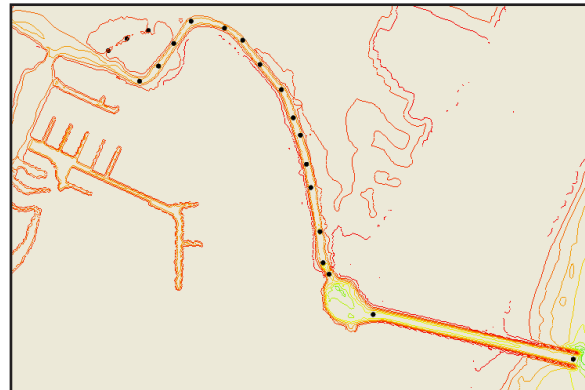
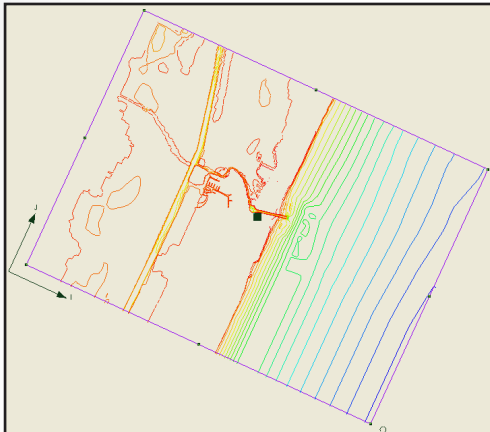
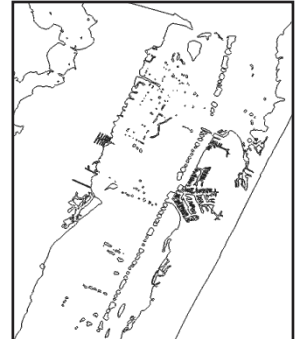
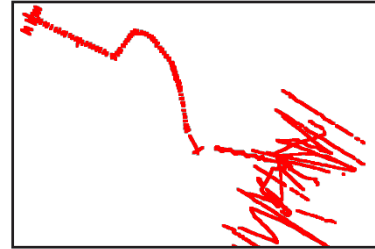
# SMS – A COMPLETE MODELING INTERFACE



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

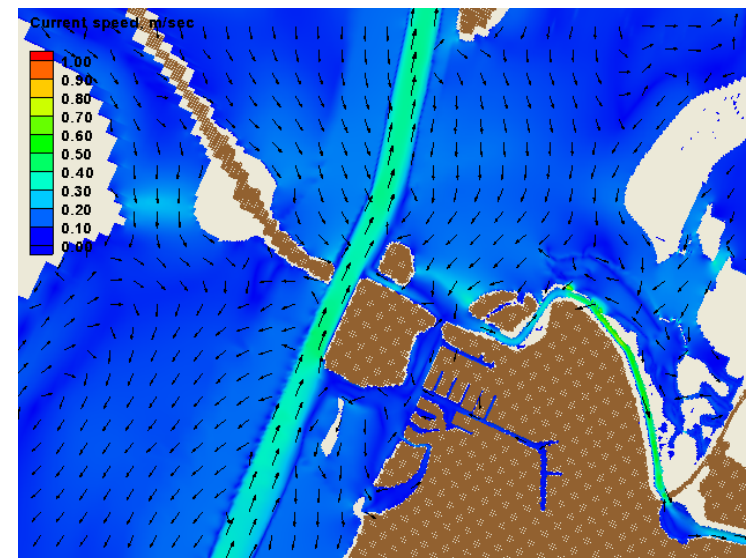


## Create Conceptual Model

- 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
Options			
Header	POINT_X	POINT_Y	POINT_Z
	621527.25184	494472.80485	-5.4
	621504.70110	494468.02136	-5.4
	621484.20043	494463.23787	-5.5
	621354.36284	494437.95371	+0.8

First 20 lines displayed.





# SCATTERED DATA (TINS)



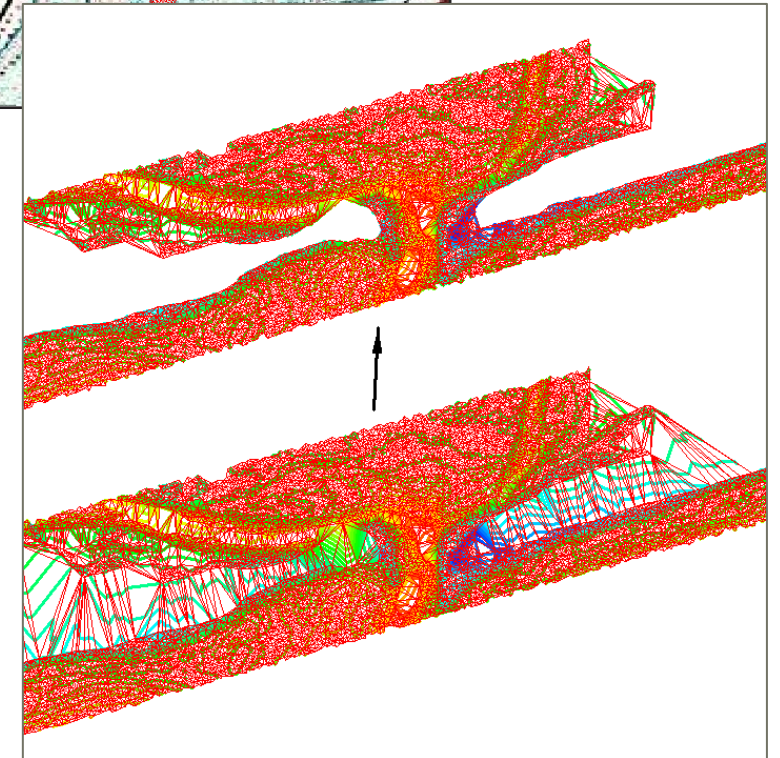
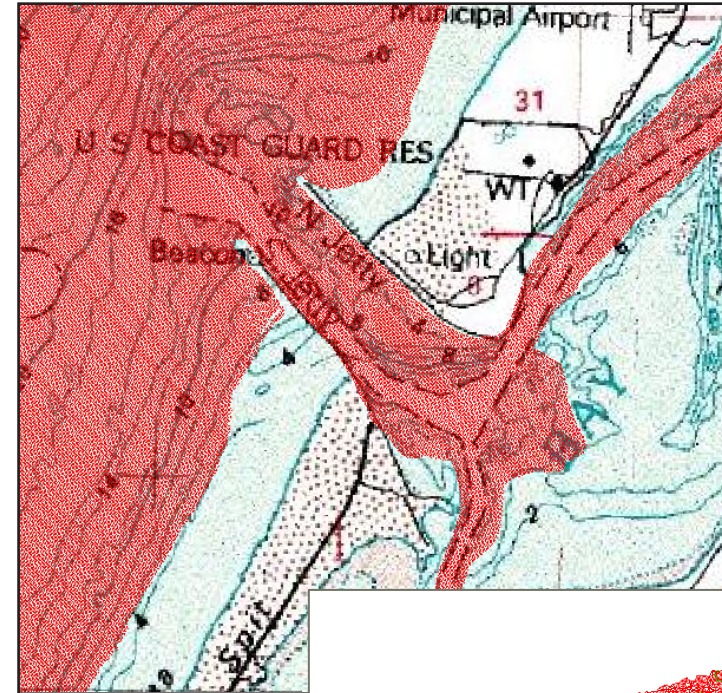
## Stores spatially varied data

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

User can delete points or triangles to change extents of a set.

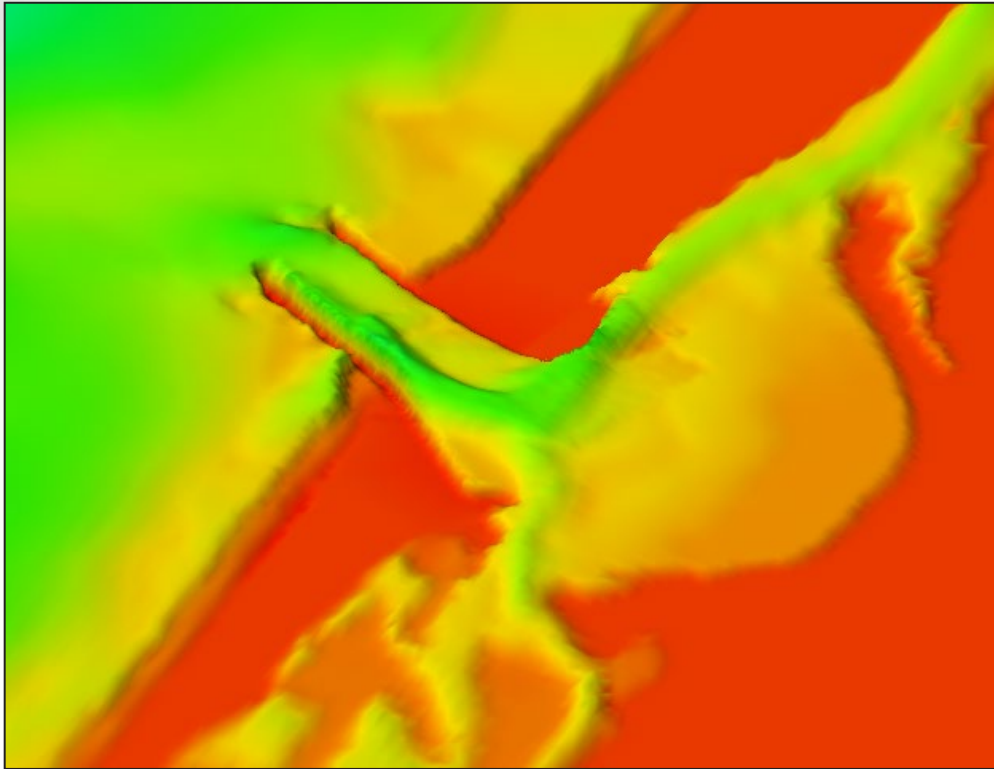
User can swap edges to alter shape of surface

- Used in linear interpolation





# VISUALIZATION OF SCATTERED DATA



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

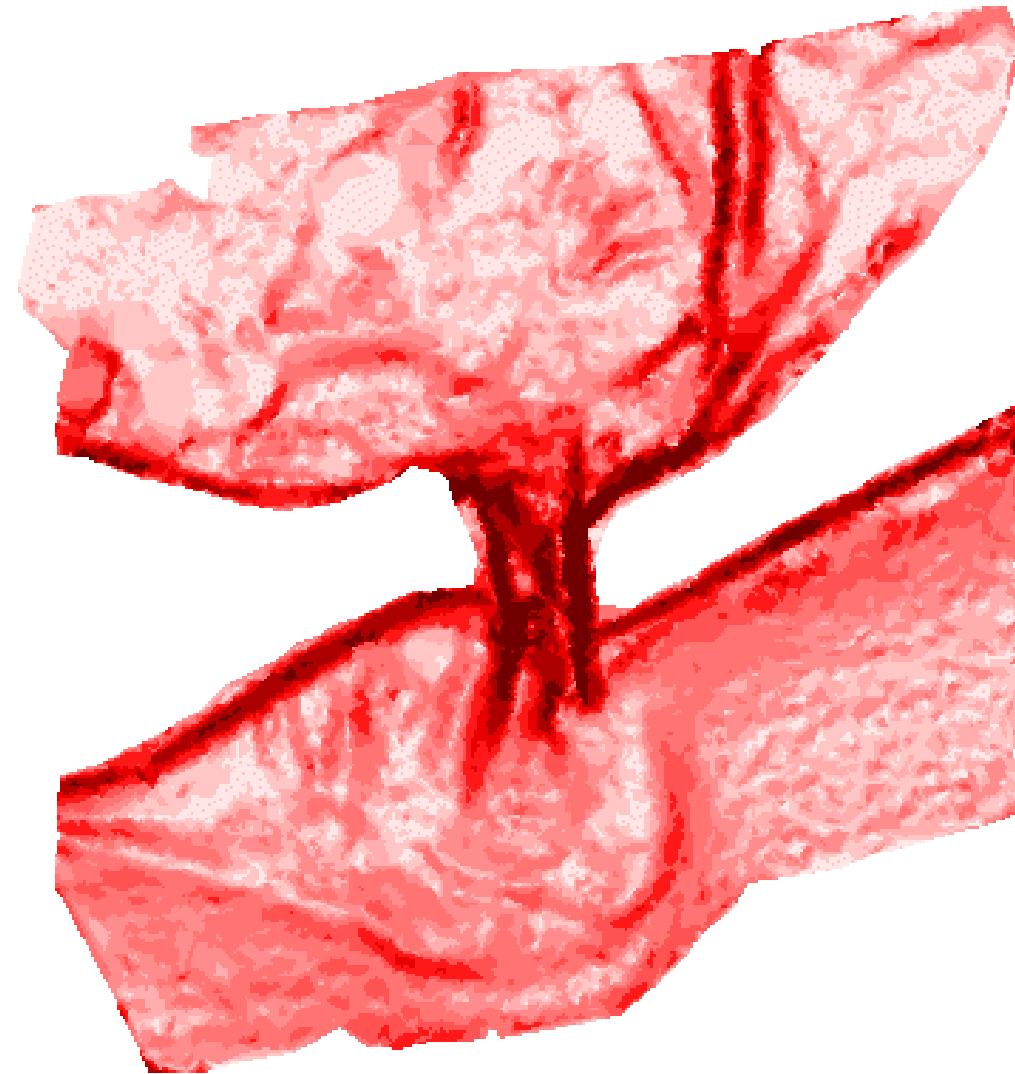
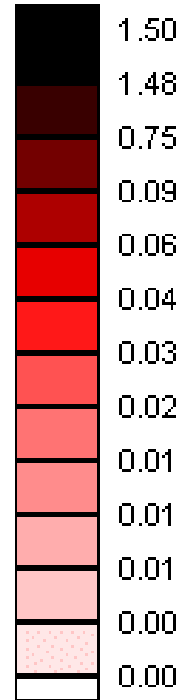
## ■ Options

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



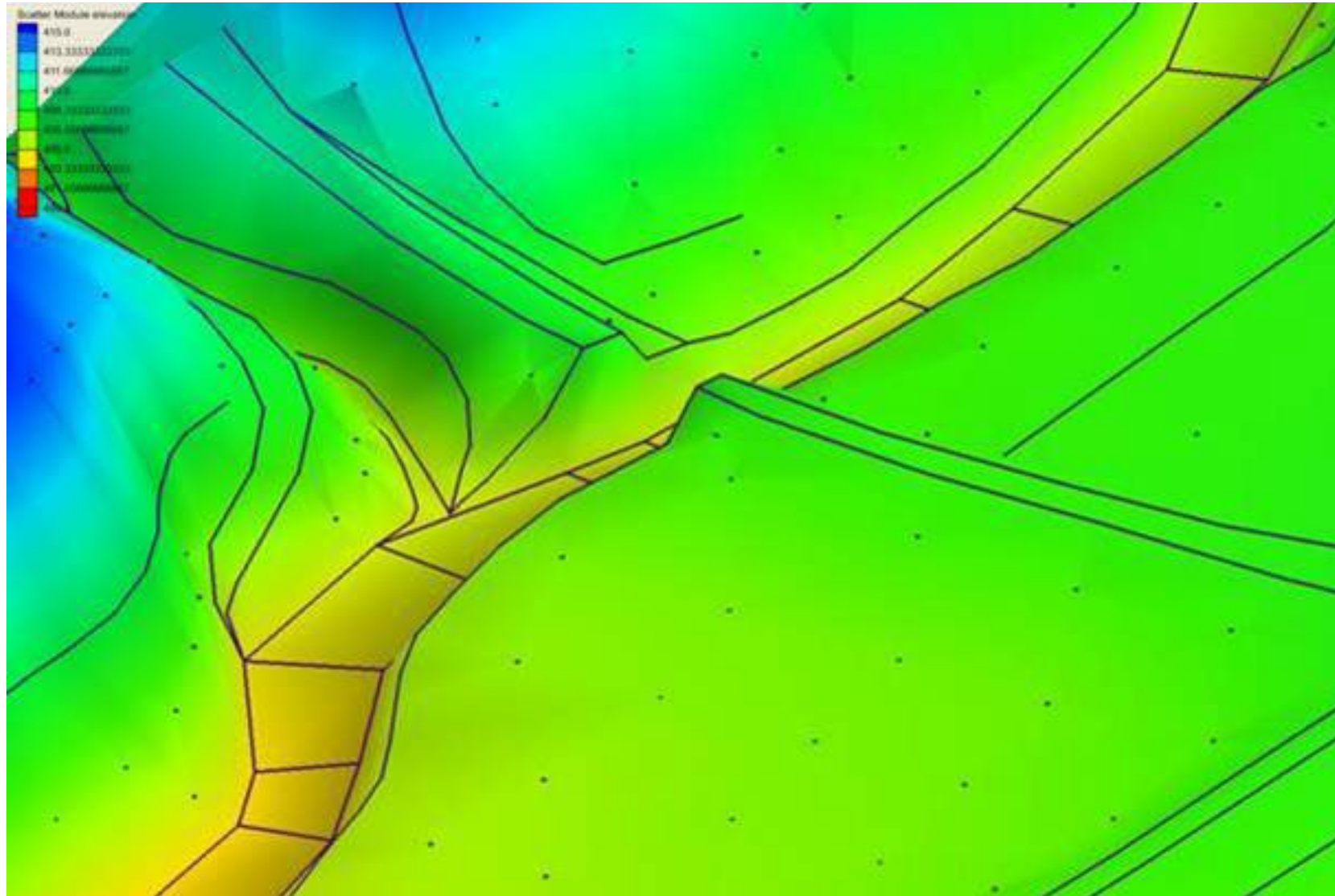
# LIDAR SURVEYS

Gradient





# BREAKLINES



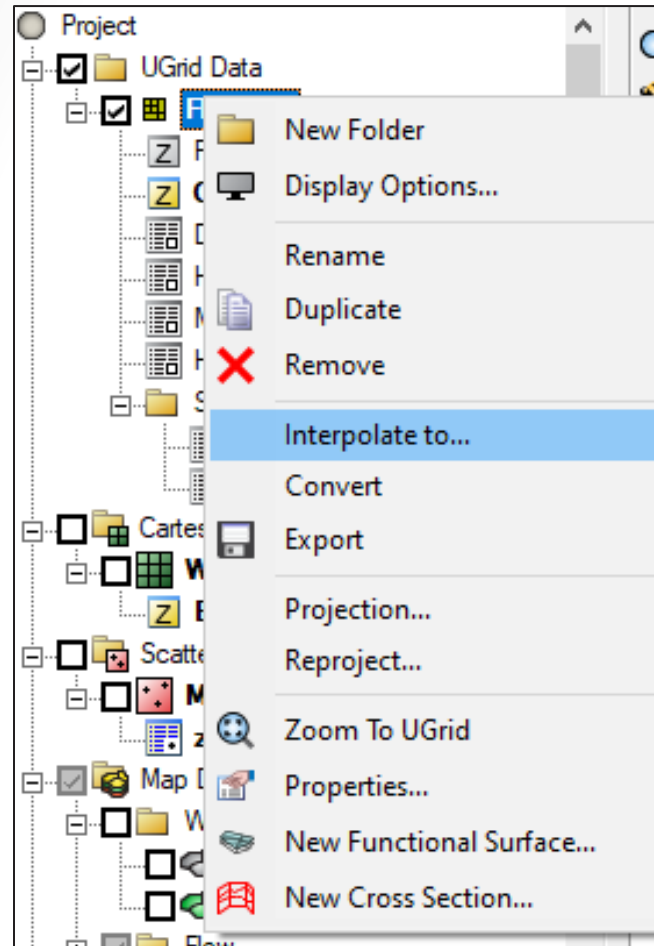


# OPERATING WITH SCATTER SETS

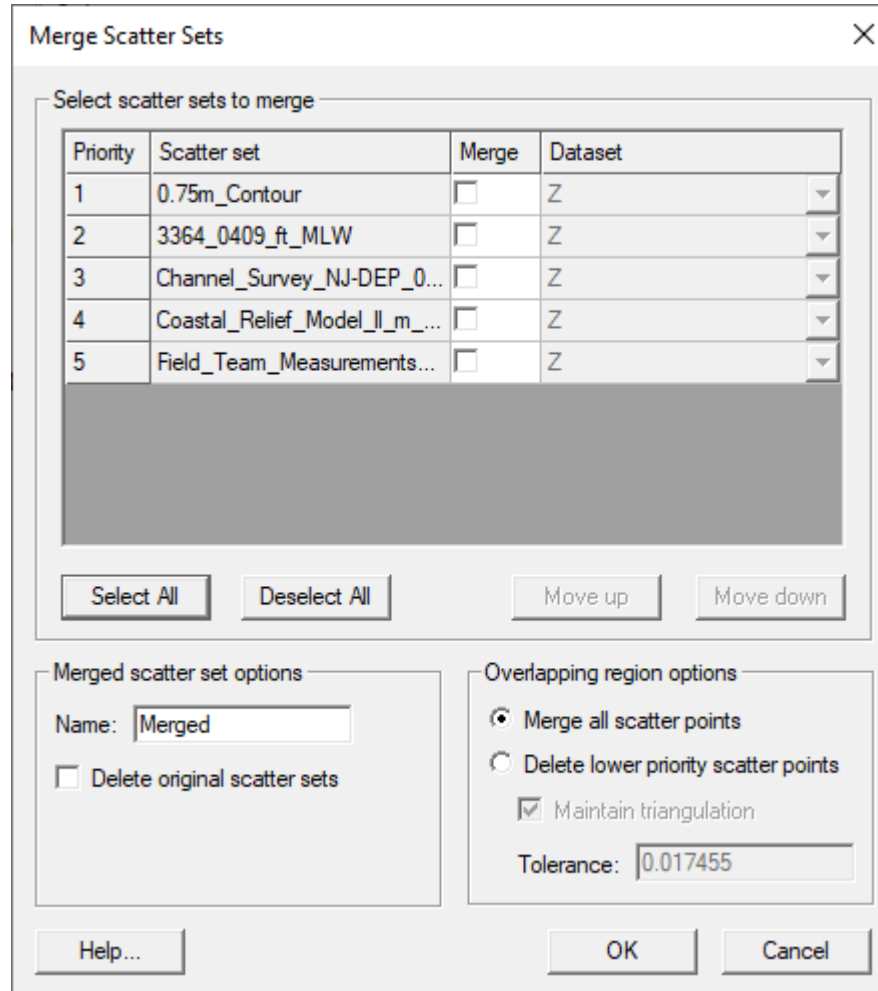
UNCLASSIFIED



## Right Click Menu



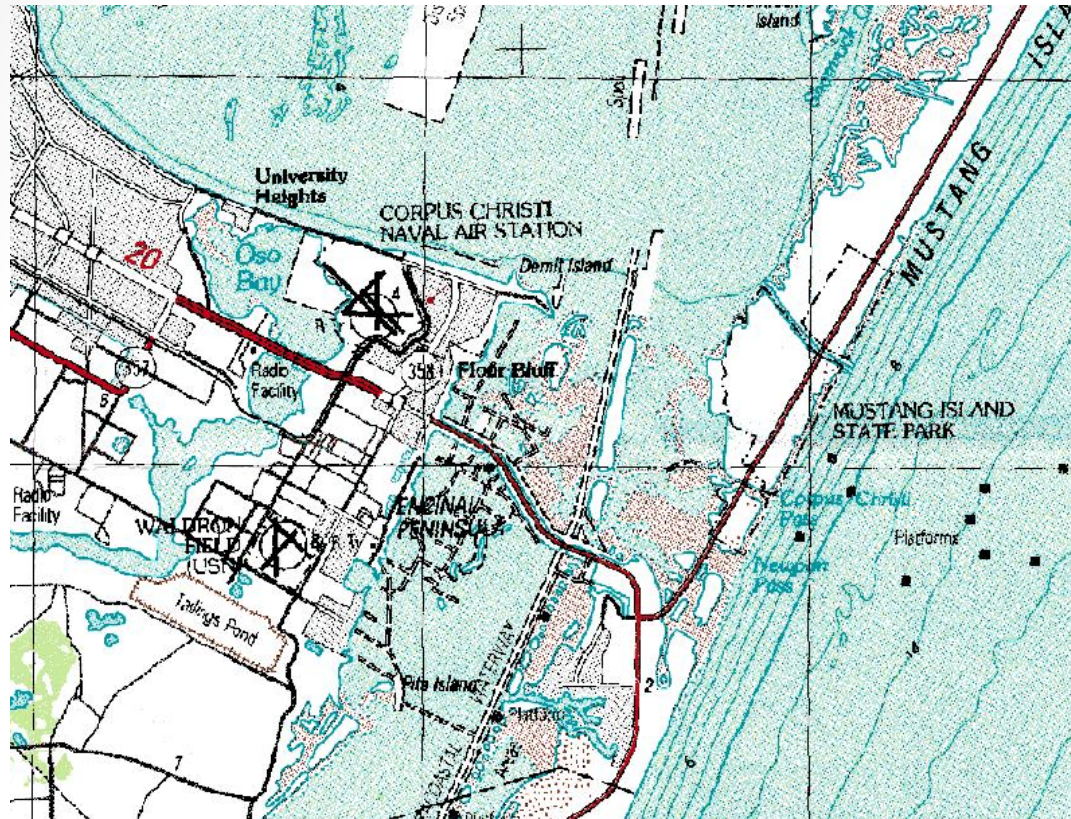
## Merge



UNCLASSIFIED



## Topo Maps



## Aerial Photos

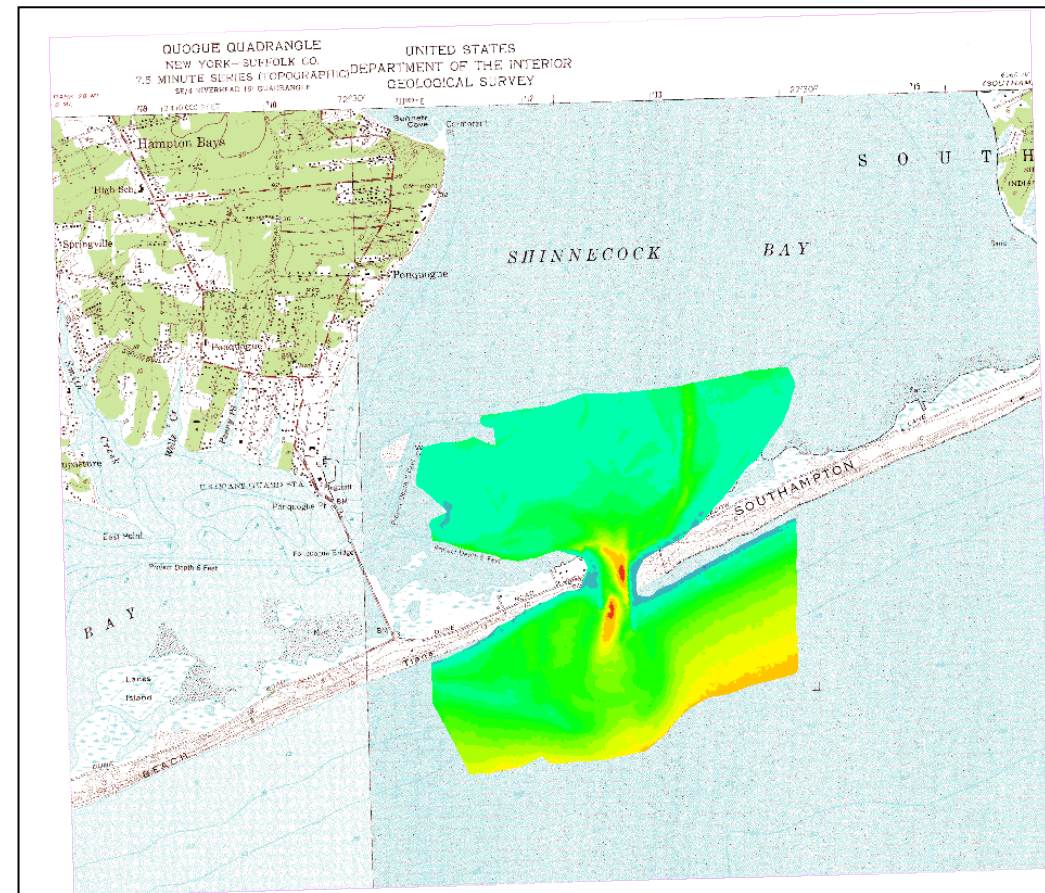
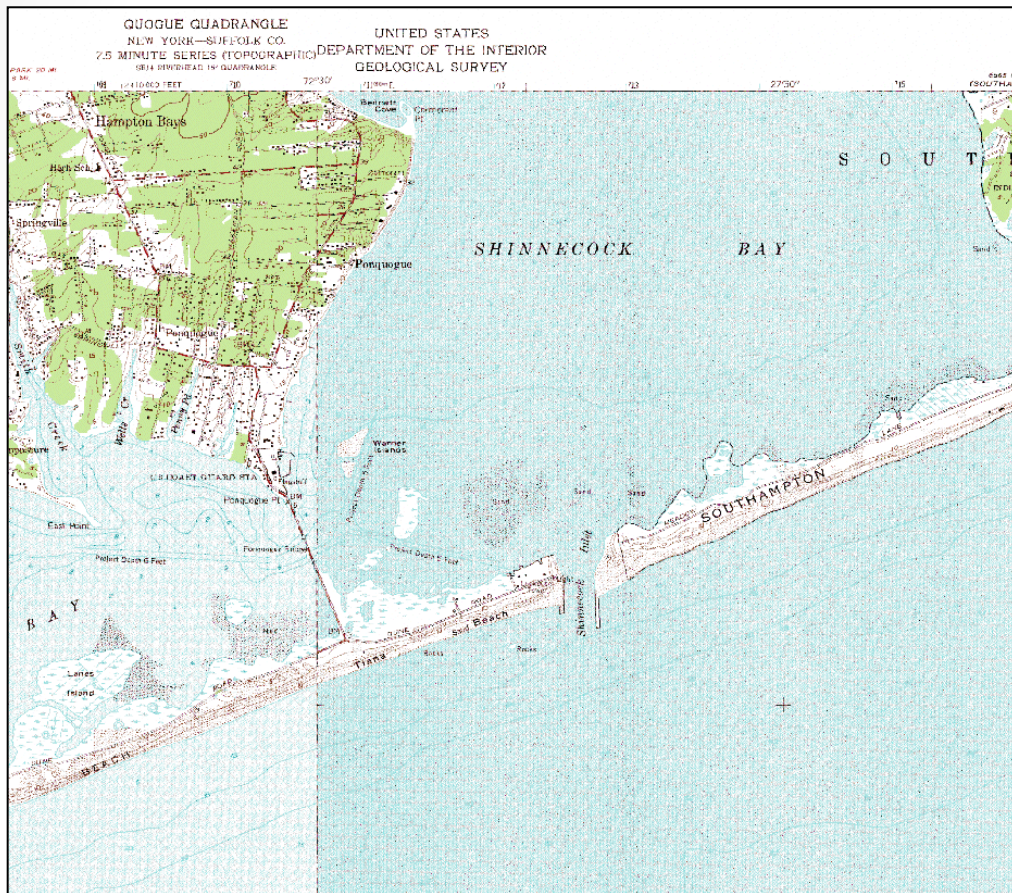




# IMAGE DATA

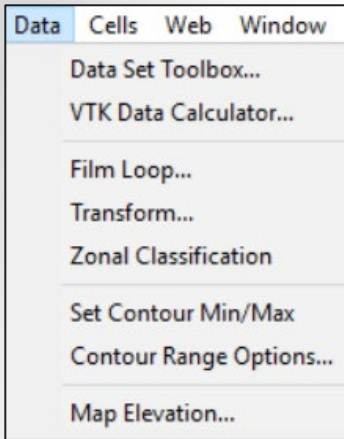


## Overlay data over images



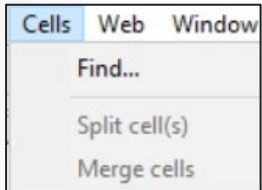


# GENERAL SMS INTERFACE: PULL-DOWN MENUS

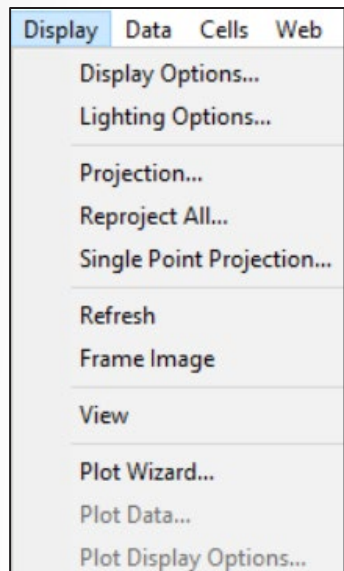


The Data pull-down menu contains many items – here are a few:

- 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
- Transform – manually changes geometry properties
- Map Elevation – Define a dataset to be the “Z” (Depth) dataset for a grid



The Cells pull-down menu contains options for finding specific cells and manipulating one or many selected cells.



The Display pull-down menu contains commands to manipulate what and how data is viewed inside the interface.

- Display Options – Affect visibility of various options
- Lighting Options – Enable and modify an “external light source”
- Projection – Set the default display projection for items loaded into SMS
- View – get information on various selections for later reproducibility.
- Plot Wizard – View loaded data in various graphical charts and plots.





# CMS-FLOW MODEL CONTROL

## PARAMETER SPECIFICATION AND FILE I/O



- Time Control
- Auxiliary Files
- Parameters
  - Wet/Dry depth
  - Flags
- Process sections to Include
  - Flow
  - Sediment Transport
  - Wind
  - Waves
  - Salinity
  - Output options

The screenshot shows the 'CMS-Flow Model Control' dialog box with the 'General' tab selected. The parameters are as follows:

- Start date/time:** 3/1/2017 12:00 AM
- Simulation duration:** 720.0 hours
- Ramp duration:** 1.0 days
- Second order skewness correction
- Hot start:**
  - Initial conditions file (File button)
  - Write single hot start output file
  - Write recurring hot start file
- Solution scheme:**
  - Implicit** (dropdown)
  - Matrix solver:** GMRES (dropdown)
- Threads:**
  - Number of threads:** 2

Buttons at the bottom: OK, Cancel, Help.



# CMS-WAVE 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

The screenshot shows the 'Model Control' dialog box with the 'Parameters' tab selected. The settings are as follows:

- CMSWAVE plane mode:** Half plane
- Source terms:** Source terms and propagation
- Current interaction:** None
- Bottom friction:** Darcy-Weisbach constant, 0.005
- Surge fields:** None
- Wind fields:** Constant value
  - Limit wave inflation for winds  $\geq 50$  m/sec
- Matrix Solver:** Gauss-Seid, Number of threads: 2

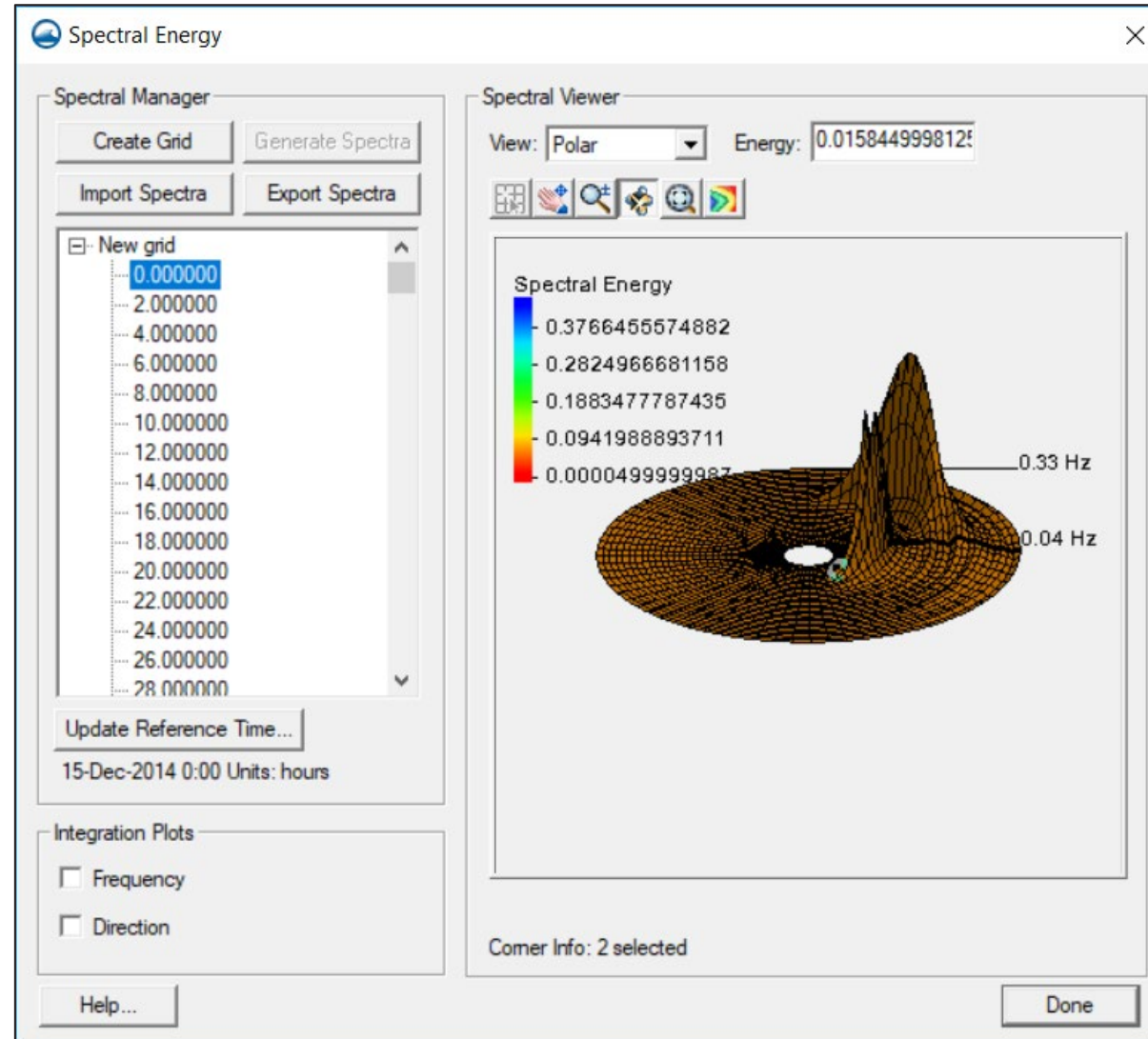
Buttons at the bottom: OK, Cancel, Help.



# 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

Seaward Boundary Depth:

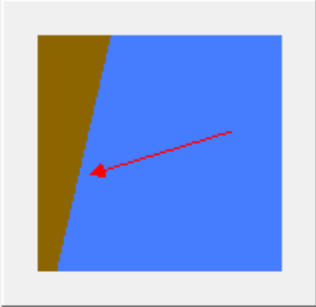
Specify once for all spectra

30.0 m

Specify for each spectrum

Angle Settings

Projection: Shore Normal



Spectral Parameters

	Time Offset (hrs)/Index	Angle (deg)	Hs (m)	Tp (s)	Gamma	nn
1	1.0	30.0	2.0	10.0	3.3	4
2						

Import Import from GenCode Export Spectral Defaults >>

Help... Generate Cancel

Select from several types of generation methods.

Observe the direction relative to the created wave grid.



# DATASET TOOLBOX



## Mathematical Operations

- Comparisons
- Data Calculator

## Spatial Operations

- Spacing
- Gradients/Derivatives
- Smoothing

## Temporal Operations

- Sample times
- Temporal derivatives

## Conversions

- Vector <-> Scalars

## Activity Mapping

- Map activity
- Value filtering

Dataset Toolbox

Tools

- Math
  - Compare datasets
  - Data Calculator
  - Angle convention
- Spatial
  - Geometry
  - Grid Spacing
- Temporal
  - Sample time steps
  - Compute derivative
  - Merge datasets
- Conversion
  - Scalar to Vector
  - Vector to Scalar
- Modification
  - Map activity
  - Filter

Compare datasets

Base

- Flow-v6-Grid (active)
  - D50
  - Hard Bottom
  - ManningsN
  - Z
  - Alt5
    - Current\_Magnitude
    - Depth
    - Morphology\_Change
    - Water\_Elevation
  - x location
  - y location

Alternate

- 2D Cartesian Grid (CMS-WAVE)
  - Wave-v6 (CMS-WAVE)
    - Depth
  - Quadtree
    - Flow-v6-Grid (active)
      - D50
      - Hard Bottom
      - ManningsN
      - Z
      - Alt5
        - Current\_Magnitude
        - Depth
        - Morphology\_Change
        - Water\_Elevation
      - x location
      - y location

Data Set Info...      Interpolation...

Value if base is inactive: 99.0      Value if alternate is inactive: -99.0

Output dataset name: new dataset      Compute

Update Available Tools      Help...      Done



# DATASET CALCULATOR



Dataset Toolbox

**Tools**

- [-] Math
  - Compare datasets
  - Data Calculator**
  - Angle convention
- [-] Spatial
  - Smooth datasets
  - Geometry
  - Grid Spacing
- [-] Temporal
  - Sample time steps
  - Merge datasets
- [-] Conversion
  - Scalar to Vector
- [-] Coastal
  - Wave Length and Celerity
  - Gravity Waves
  - Quadratic Friction
  - Mannings N
  - Chezy Friction
  - Directional Roughness
  - Canopy Coefficient
  - Primitive Weighting
- [-] Modification
  - Map activity
  - Filter

Update Available Tools

**Data Calculator**

**Data Sets**

- [-] Flow-v6-Grid
  - d1. D50
  - d2. Hard Bottom
  - d3. ManningsN
  - d4. Z
  - [-] Alt5
    - d5. Current\_Magnitude
    - d7. Depth
    - d8. Morphology\_Change
    - d9. Water\_Elevation
  - d10. x location
  - d11. y location

Add to Expression    Data Set Info...

Output dataset name:

**Time Steps**

1. 0 00:00:00

Use all time steps

**Calculator**

/	(	)	min
*	ln	x^y	max
-	log	sqrt	ceil
+	1/x	abs	floor

Compute

Done



# COORDINATE PROJECTIONS



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

Display Projection

Horizontal

No projection      Units:

Global projection     

Projection name:  
NAD 1983 StatePlane New Jersey FIPS 2900 (Meters)

WKT:  
PROJCS["NAD\_1983\_StatePlane\_New\_Jersey\_FIPS\_2900",GEOGCS  
["GCS\_North\_American\_1983",DATUM  
["D\_North\_American\_1983",SPHEROID  
["GRS\_1980",6378137.0,298.257222101]],PRIMEM["Greenwich",0.0],UNIT  
["Degree",0.0174532925199433]],PROJECTION  
["Transverse\_Mercator"],PARAMETER

Vertical

Datum:       Units:



# SMS – POST PROCESSING



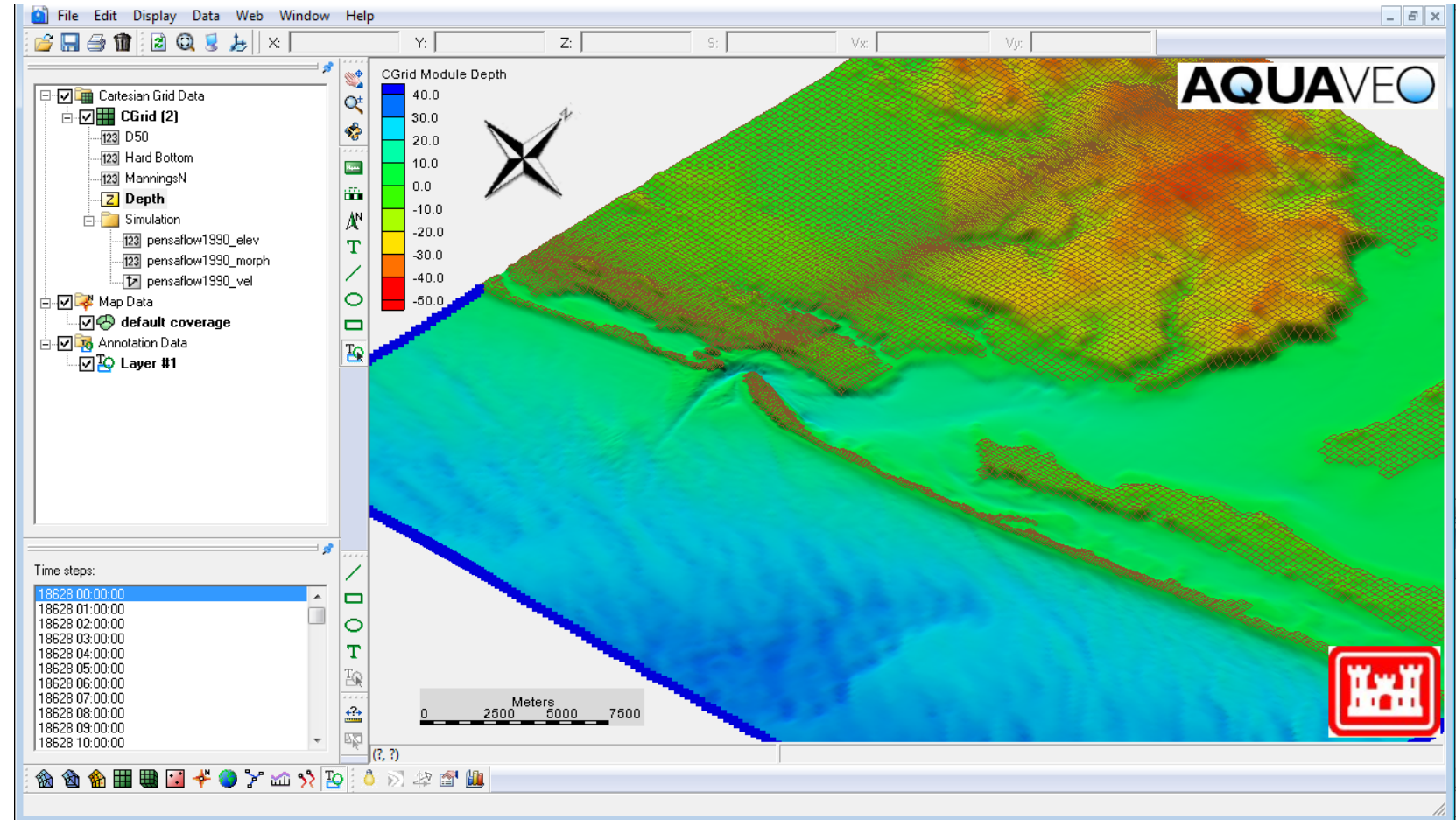
- **Annotations**
- **Graphic images**
- **Animations**
  - .mp4 film loops
  - .kmz – Google Earth Exports
- **2D Plots**
  - Time series
  - Profiles and Cross sections – both steady state and transient





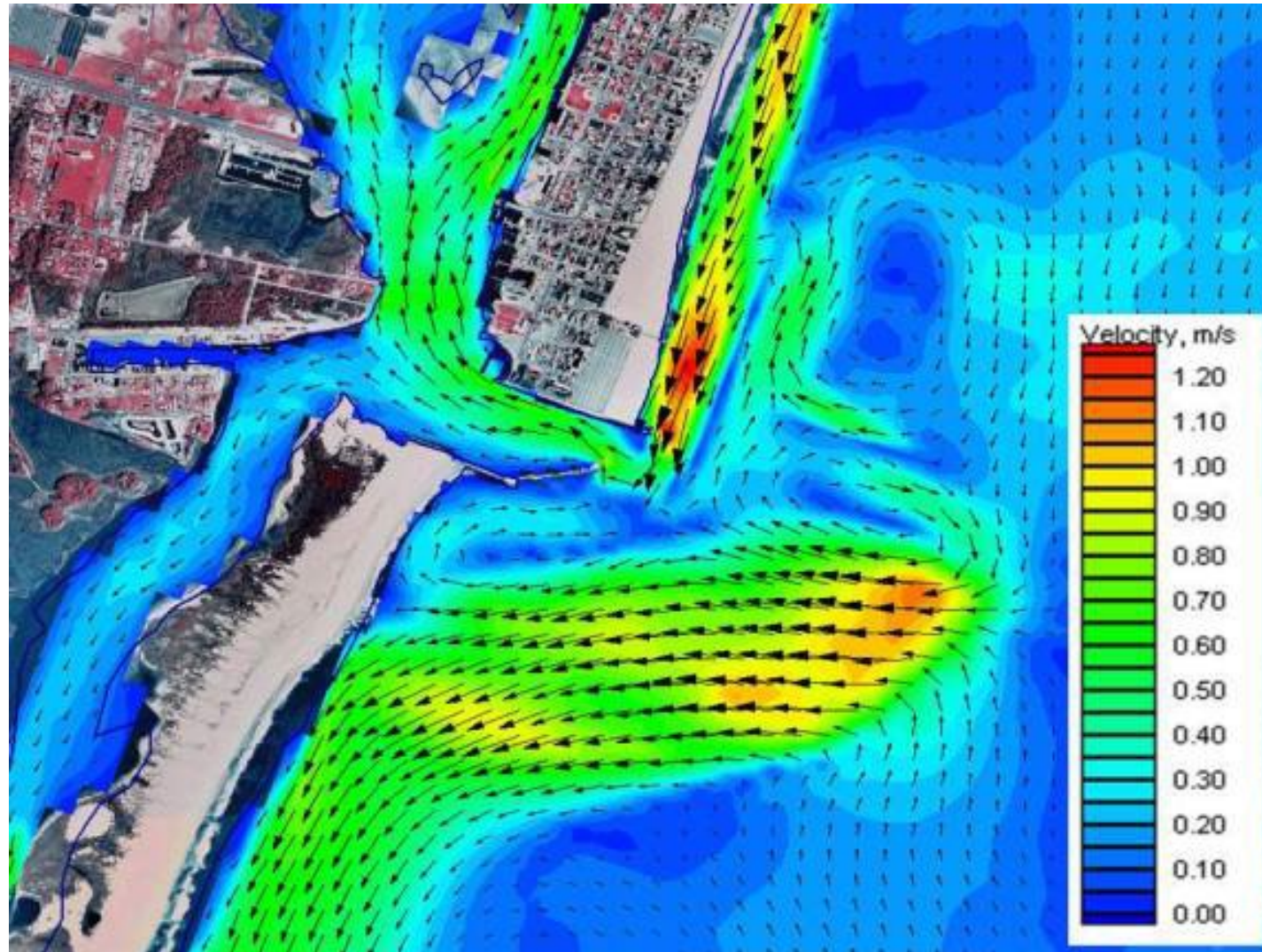
# ANNOTATION LAYERS

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





# CONTOUR/VECTOR PLOTS





# OBTAINING AND ACTIVATING SMS



<https://cirp.usace.army.mil/products/SMS.php>

## USACE District and ERDC staff –

Contact [sms@usace.army.mil](mailto:sms@usace.army.mil) and request a password for any version of SMS. If no response in one business day, contact [mitchell.e.brown@usace.army.mil](mailto:mitchell.e.brown@usace.army.mil) to facilitate.

## Others –

Visit [https://www.aquaveo.com/password\\_request](https://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.



# OVERVIEW OF PRESENTATION



- Introduction to the Surface-water Modeling System (SMS v.13.2)
  - What is it?
  - Tools, Modules, Data Tree, Images, etc.
  - CMS Models interface
- Introduction to the Coastal Modeling System (CMS)
  - CMS-Flow – Hydrodynamics, Sediment Transport, Morphology Change
  - CMS-Wave – Half-plane waves and Full-plane wind forcing.



# MISSION STATEMENT



**Deliver** to District engineer's desktops **integrated** advanced models that can be used as a **practical** engineering tool for **coastal** shoaling and erosion problems in reduction of O&M costs.

- Integrated: All relevant processes, models efficiently coupled together
- Practical: PC-based, user-friendly interface, fast, robust, and accurate
- Deliver: Manuals, tech reports, journal papers, Wiki, workshops, phone help, etc.



# COASTAL MODELING SYSTEM



## What is the CMS?

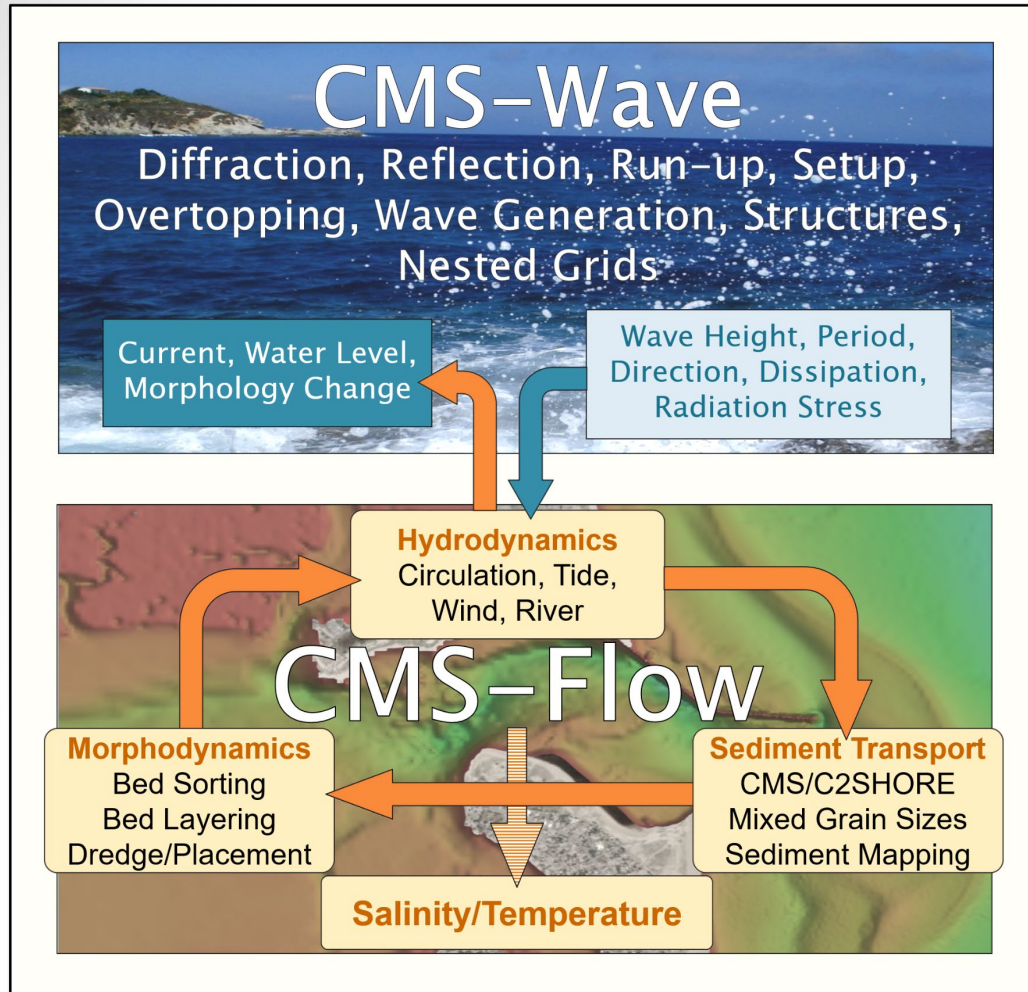
- Integrated wave, current, and morphology change model in the Surface-water Modeling System (SMS).

## Why CMS?

- Operational at ERDC, several Districts and many consulting companies
- Validated with real applications
- Robust and user-friendly
- Easy to set up and fast to get results quickly

## Types of Applications

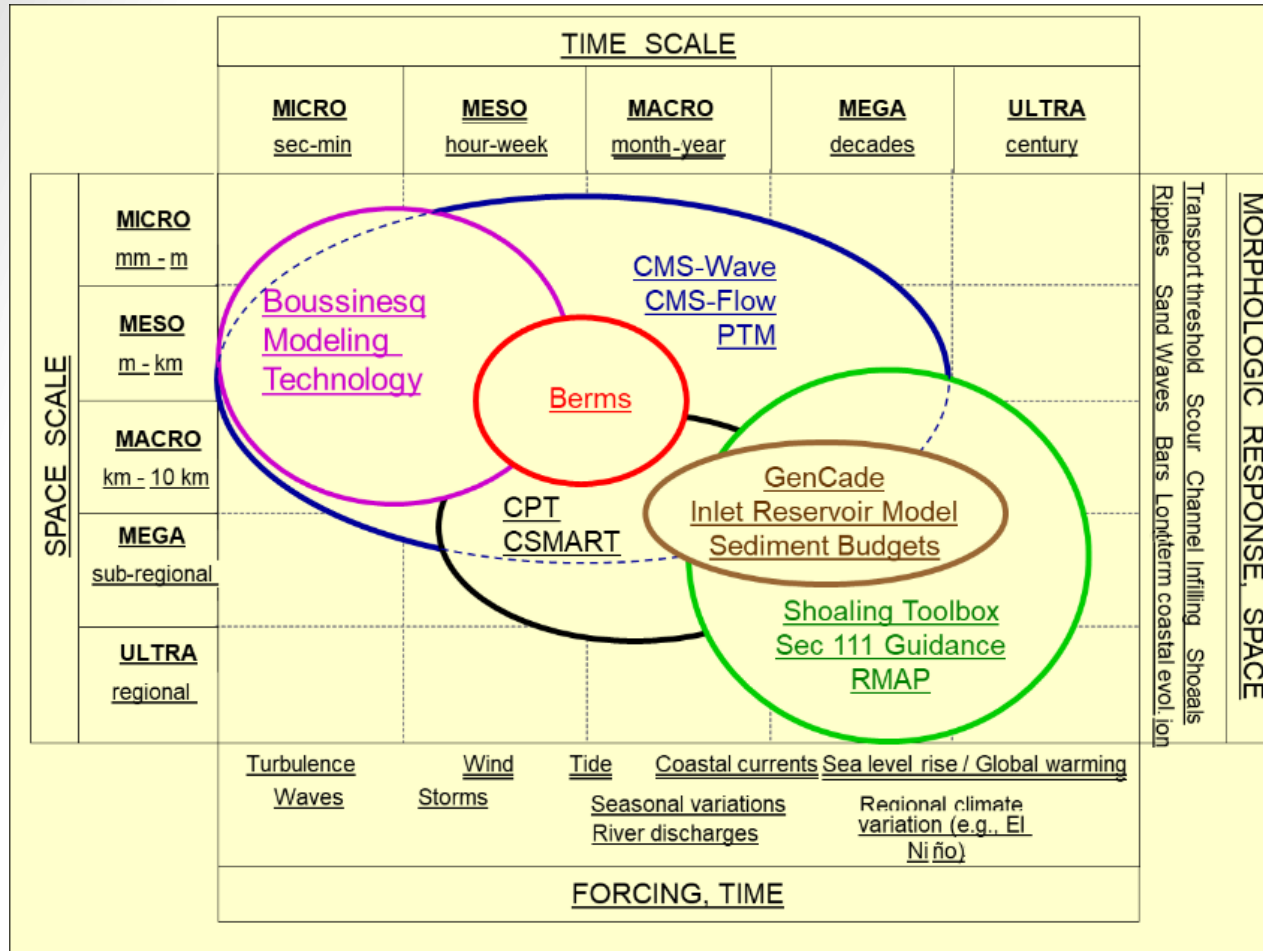
- **Channels:** Deepening, widening, lengthening, realigning
- **Jetties:** Lengthening, raising, rehabbing
- **O&M:** Placement areas – berms, wetlands
- **Processes:**  
Navigability – waves and currents;  
Environmental – circulation and sediment transport



CMS Framework



# WHEN IS CMS THE RIGHT TOOL?



Capability	Intended application	Presently Not available
Flow	WSE and depth-averaged currents	
Waves	Nearshore, phase-averaged	Offshore (deep water); phase-resolving
Sediment transport	Sand, multiple grain sizes; dunes via coupling with Aeolis	Fine grains (silt, mud)
Vegetation	Wave, flow drag	Sediment dynamics (under development)
Salinity, temperature	Scalar concentration advection and diffusion	Multi-phase flow; salt wedge dynamics
Speed	Desktop-friendly (hrs-days)	HPC
Grid cell size	Regional to macro (km-m)	Fine scale (cm-mm)
Numerics	Structured, non-uniform (quadtree); implicit and explicit in time	Unstructured (triangular)

# CMS-FLOW



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# CMS-FLOW: KEY FEATURES



## Finite Volume Method

- Conserves mass
- Stable

## Inline sediment transport and morphology change

- Non-equilibrium total load
- Multiple-sized transport
- Bed sorting and layering

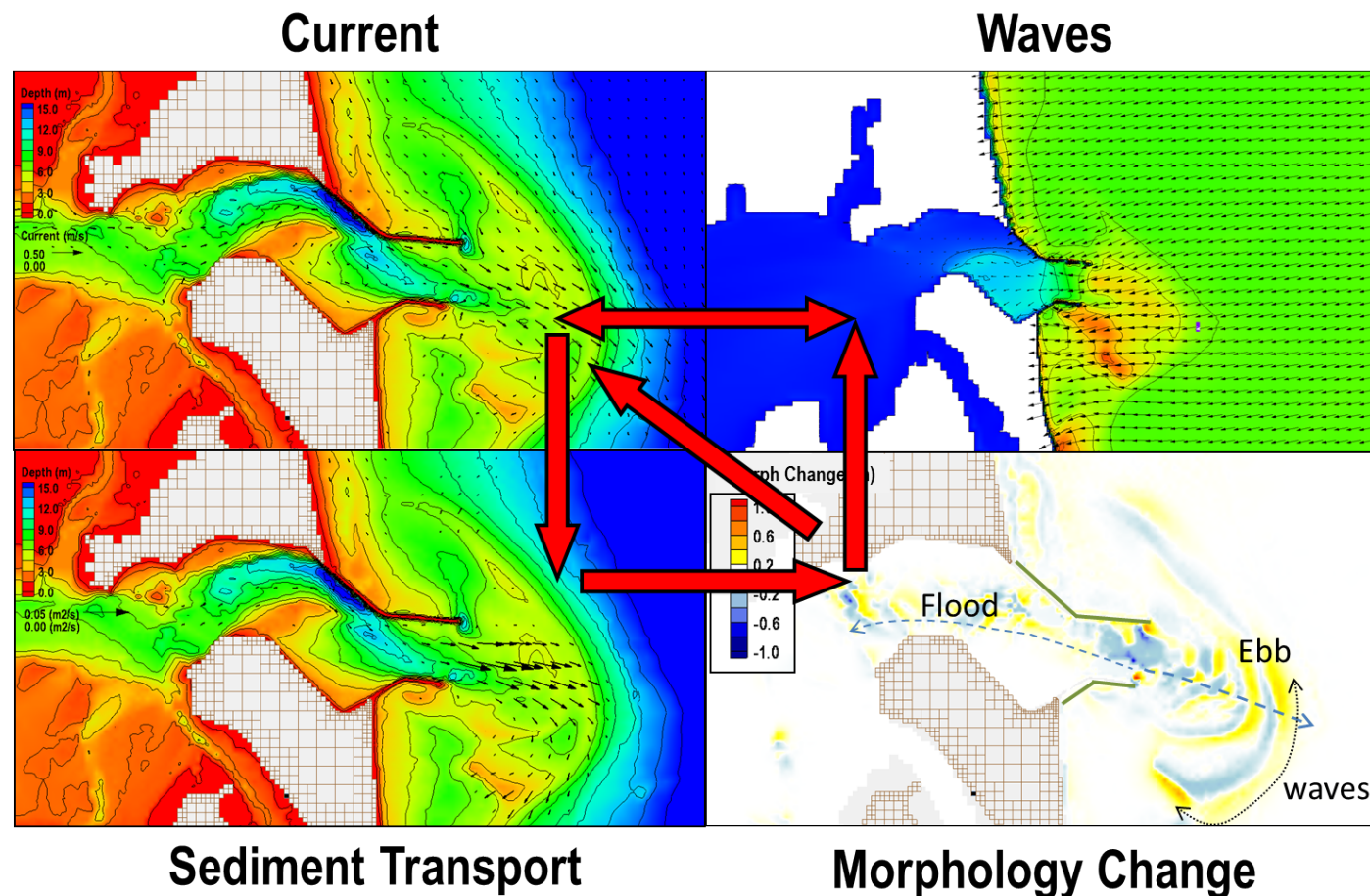
## Inline CMS-Wave model

- Wave-current interactions

## Nesting capability

## Forcing

- Tidal constituents or water level, river flux, wind, atmospheric pressure, waves, etc.





# CMS-FLOW: KEY FEATURES

## Grid options

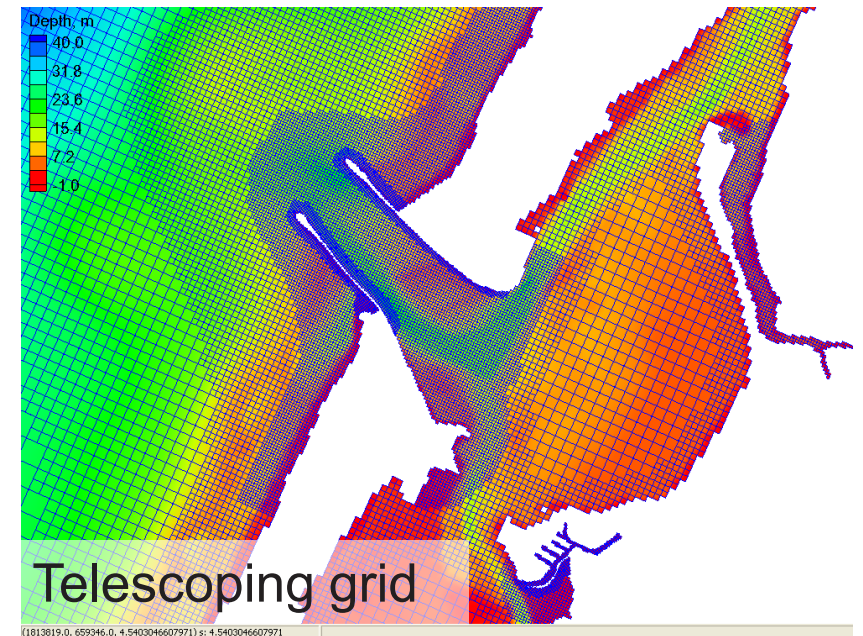
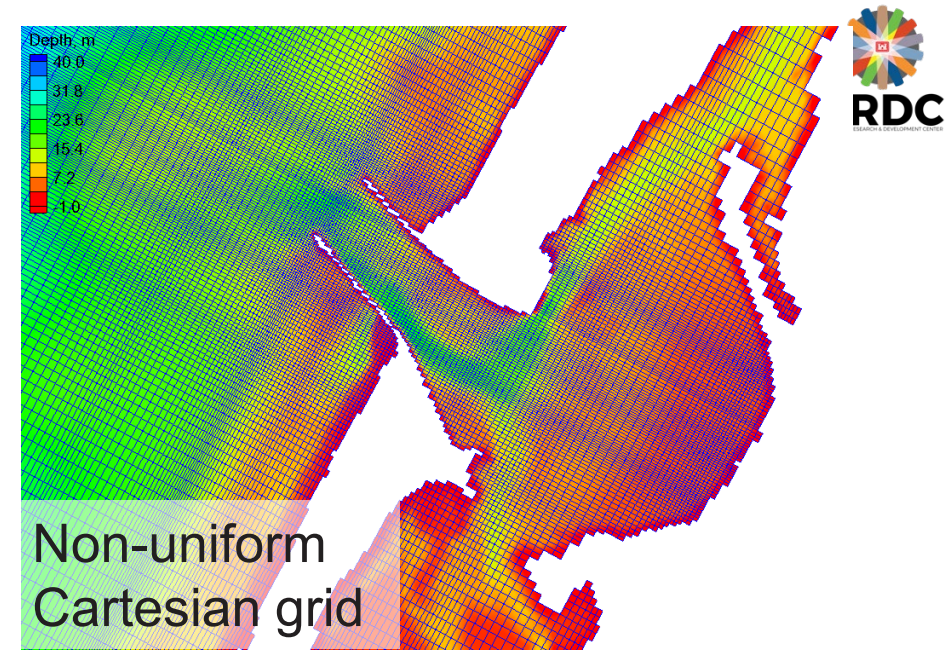
- Non-uniform Cartesian grid: Easy to setup
- Telescoping grid: Efficient, easy, flexible

## Solver options

- Implicit: Tidal flow, long-term morphology change: **~10+ min time step**
- Explicit: Flooding, breaching, super-critical flow: **~ 1 sec time step**

## Increased efficiency with OpenMP Parallel processing

- No MPI (domain decomposition) ...yet

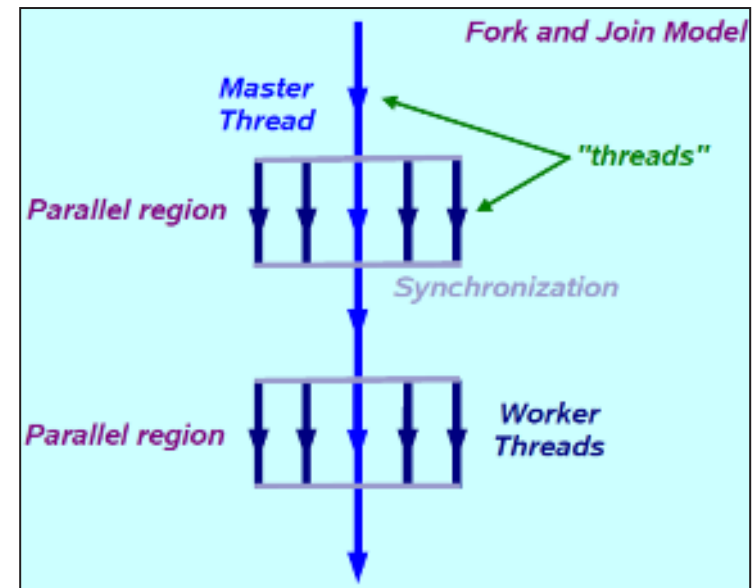




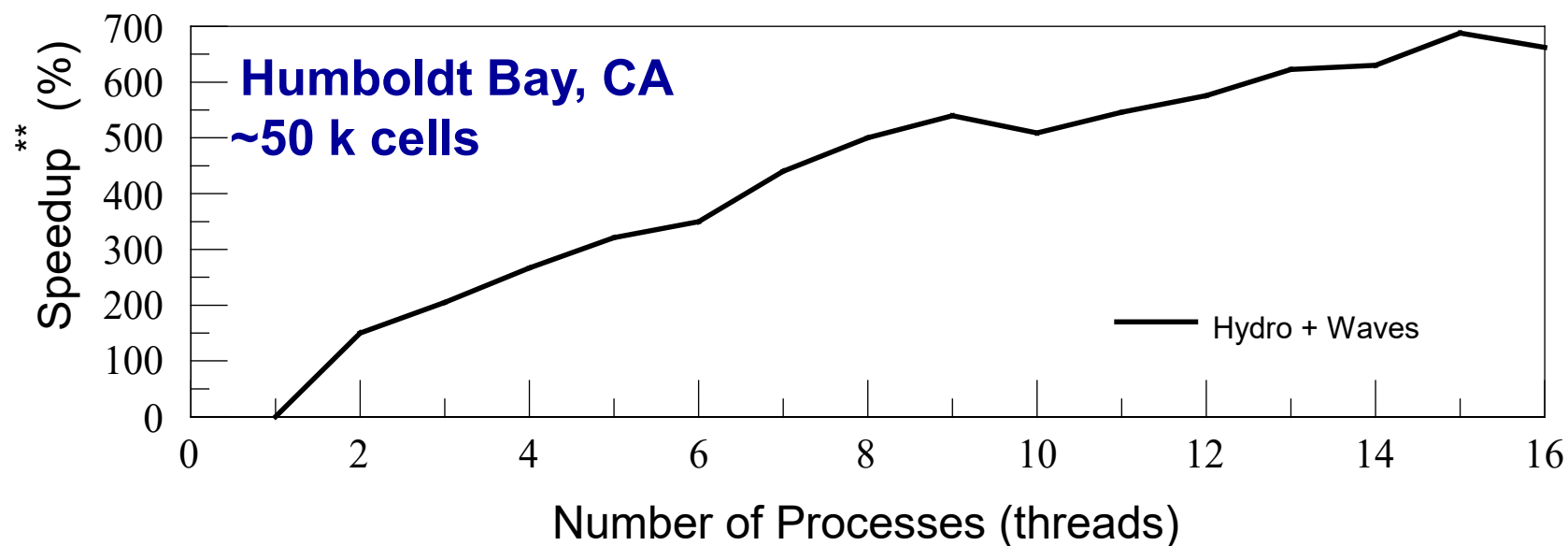
# PARALLEL PROCESSING

## ➤ CMS-Flow parallelized using OpenMP

$$\text{Speedup} = 100 \frac{\text{Serial Run time}}{\text{Parallel Run time}}$$



Speedup for CMS-Flow **Explicit** using multiple processors



For **Implicit**, using 4 processors shows best speed improvement.

Future work will include optimizing the implicit scheme for more processors.



# HYDRODYNAMICS



Conservative form of the depth-averaged shallow water equations in Cartesian coordinates

$$\frac{\partial h}{\partial t} + \frac{\partial(hU_j)}{\partial x_j} = S, \quad j = 1, 2 \quad h = \zeta + \eta$$

$$\frac{\partial(hU_i)}{\partial t} + \frac{\partial(hU_iU_j)}{\partial x_j} - \varepsilon_{ij3}f_c hU_j = -gh \frac{\partial \eta}{\partial x_j} + \frac{\partial}{\partial x_j} \left( \nu_t h \frac{\partial U_i}{\partial x_j} \right) + \frac{1}{\rho} (\tau_{Si} + \tau_{wi} - \tau_{bi})$$

$U \rightarrow$  Depth-averaged current velocity

$h \rightarrow$  Total water depth

$\zeta \rightarrow$  Still water depth

$\eta \rightarrow$  Water surface elevation

$g \rightarrow$  Total water depth

$f_c \rightarrow$  Coriolis

$\nu_t \rightarrow$  Turbulence eddy viscosity

$\tau_b \rightarrow$  Bottom stress (including waves)

$\tau_s \rightarrow$  Wave stress (forcing)

$\tau_w \rightarrow$  Wind stress



# FORCING AND BOUNDARY CONDITIONS

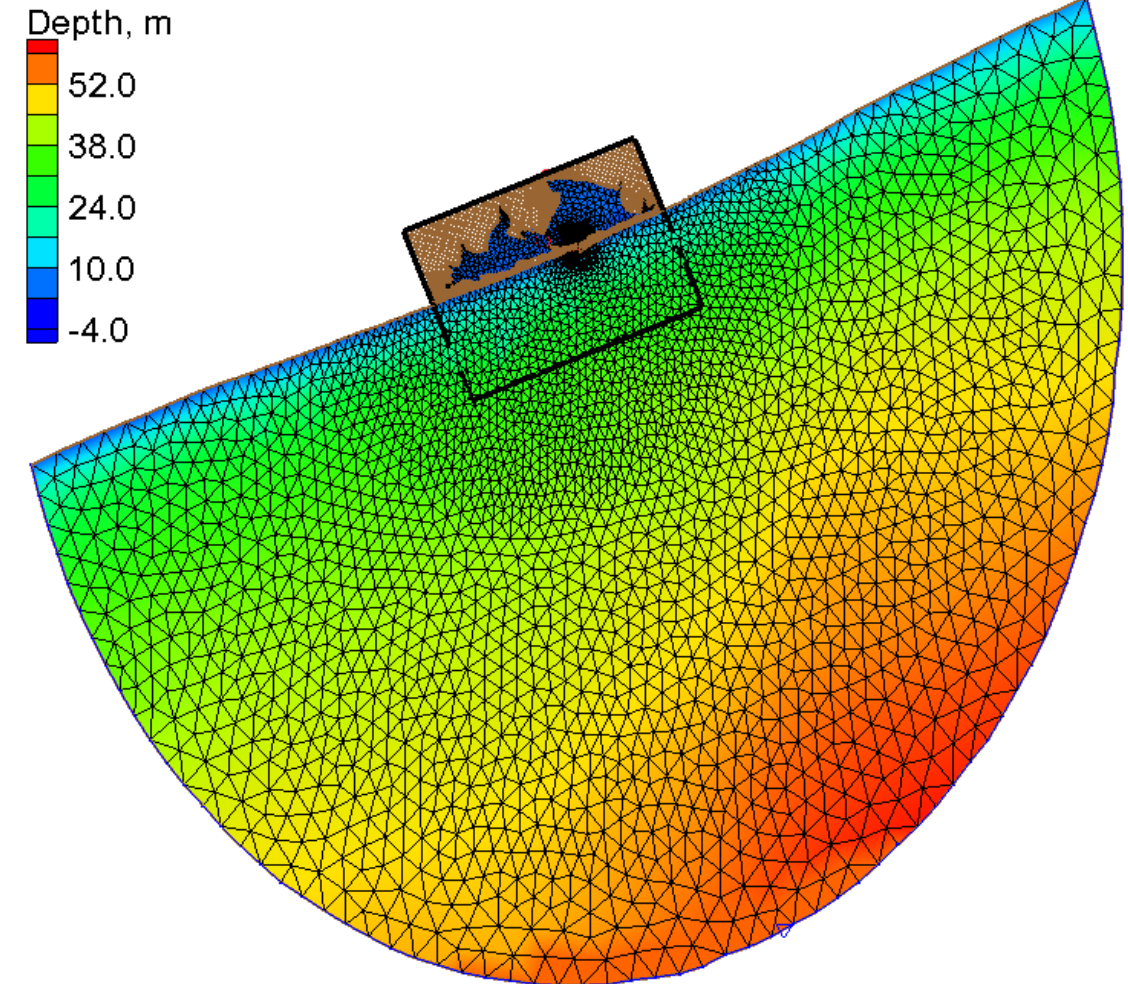


## Forcing

- Spatially constant and variable wind fields
- Atmospheric pressure gradients
- Wave and roller stresses

## Boundary Conditions (BC)

- Closed (wall) BC
- River Flux BC
- Water level time series
- One-way nesting
- Tidal database boundary extraction
- Wind and wave-adjusted water level boundary conditions



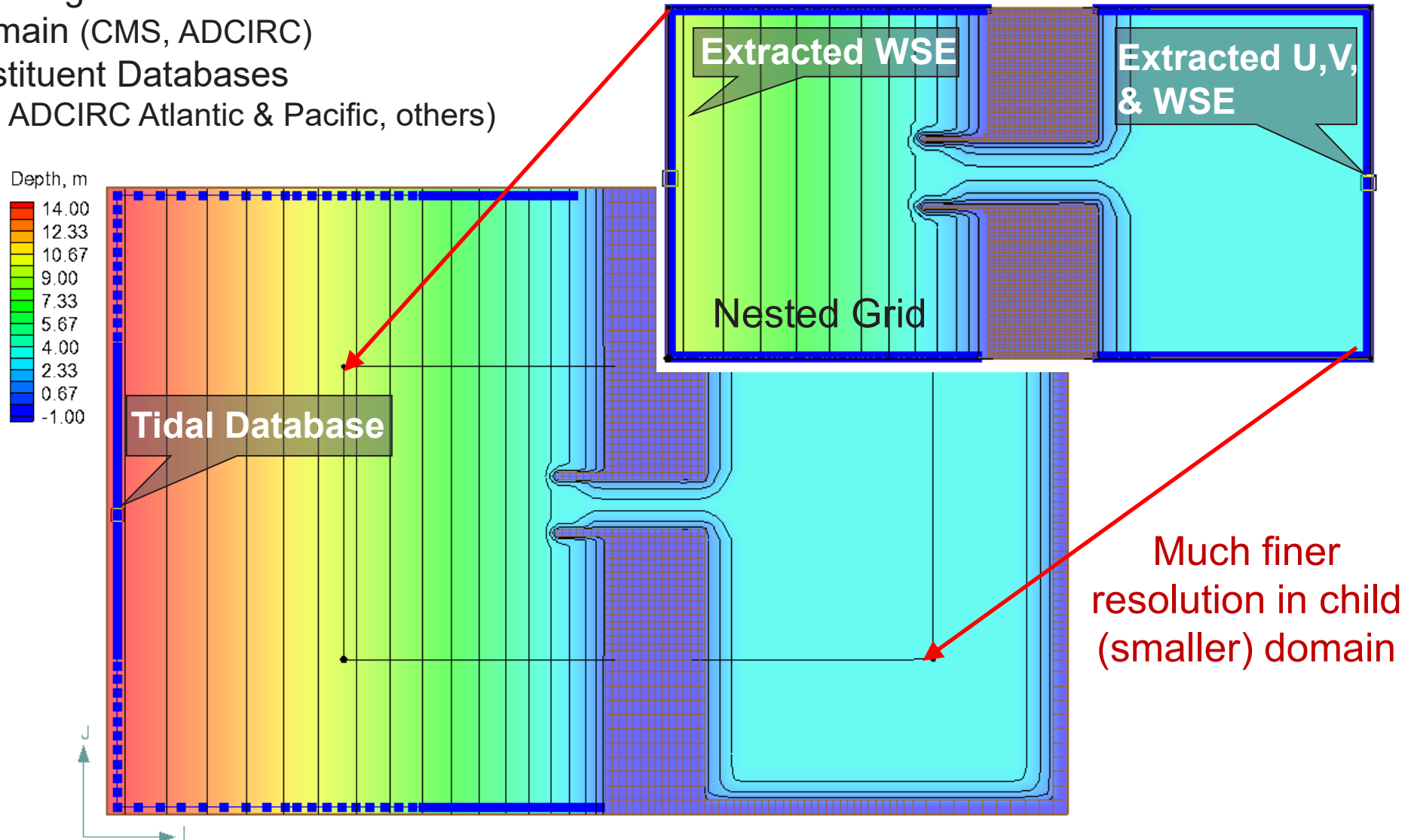


# NESTED GRID CAPABILITY



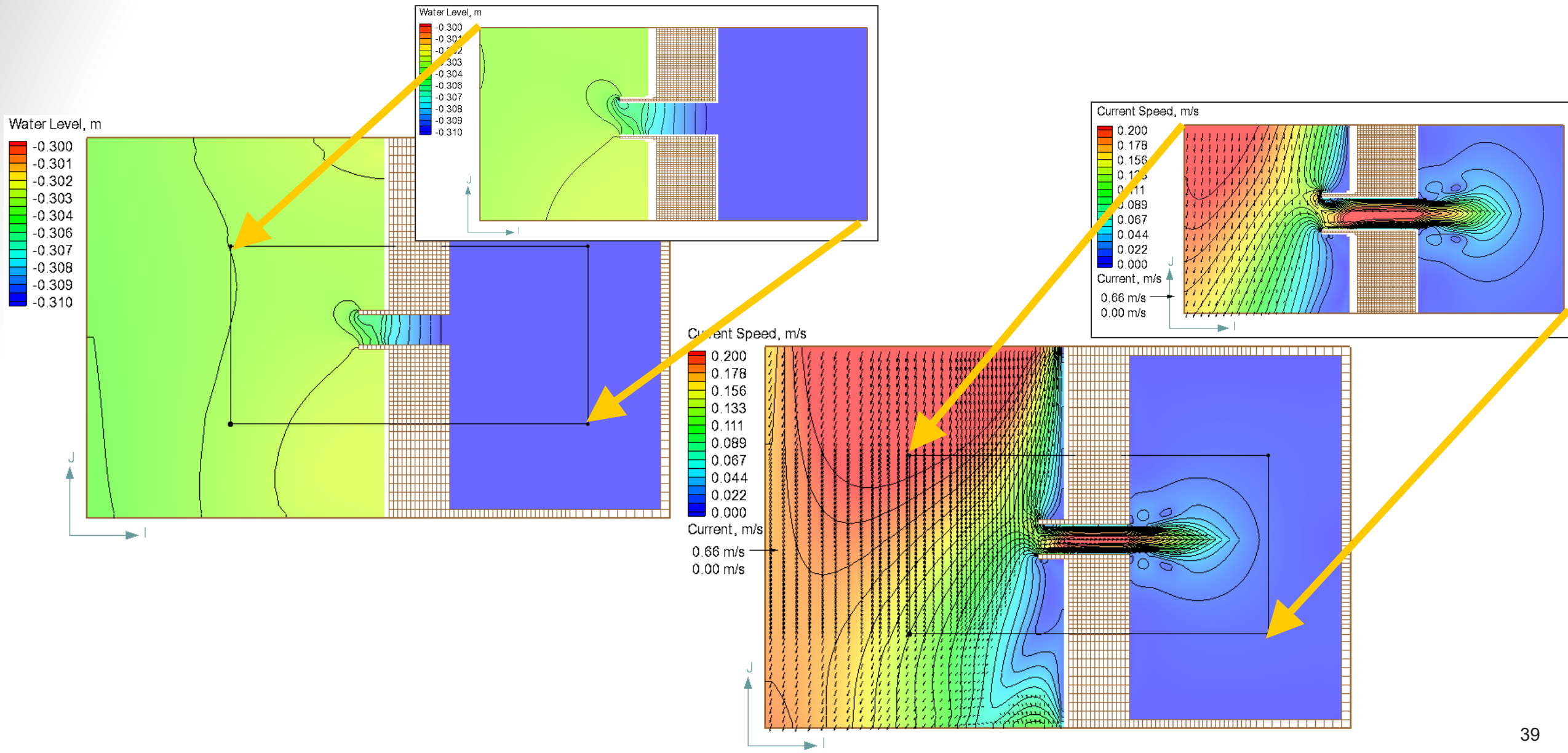
Can obtain forcing information from:

- Larger domain (CMS, ADCIRC)
- Tidal Constituent Databases (LeProvost, ADCIRC Atlantic & Pacific, others)





# NESTED GRID CAPABILITY



# CMS-WAVE



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# CMS-WAVE: GOVERNING EQUATION



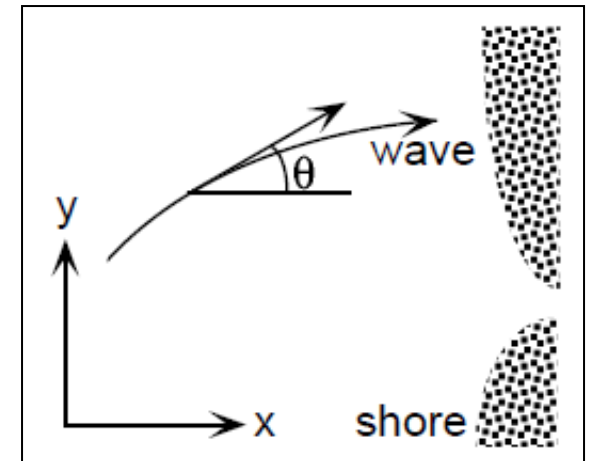
## Wave-Action Balance Equation with Diffraction

- Phase-averaged approach

Diffraction intensity factor, range of 0 – 4 (default)

$$\frac{\partial[(c_{gx} + u)A]}{\partial x} + \frac{\partial[(c_{gy} + v)A]}{\partial y} + \frac{\partial[c_{g\theta}A]}{\partial \theta} = \frac{\kappa}{2\sigma} \left\{ (cc_g \cos^2 \theta A_y)_y - \frac{1}{2} cc_g \cos^2 \theta A_{yy} \right\} + S_{in} + S_{dp}$$

where  $A = E / \sigma$  , wave-action spectrum  
and  $E = E(\sigma, \theta)$  , wave directional spectrum



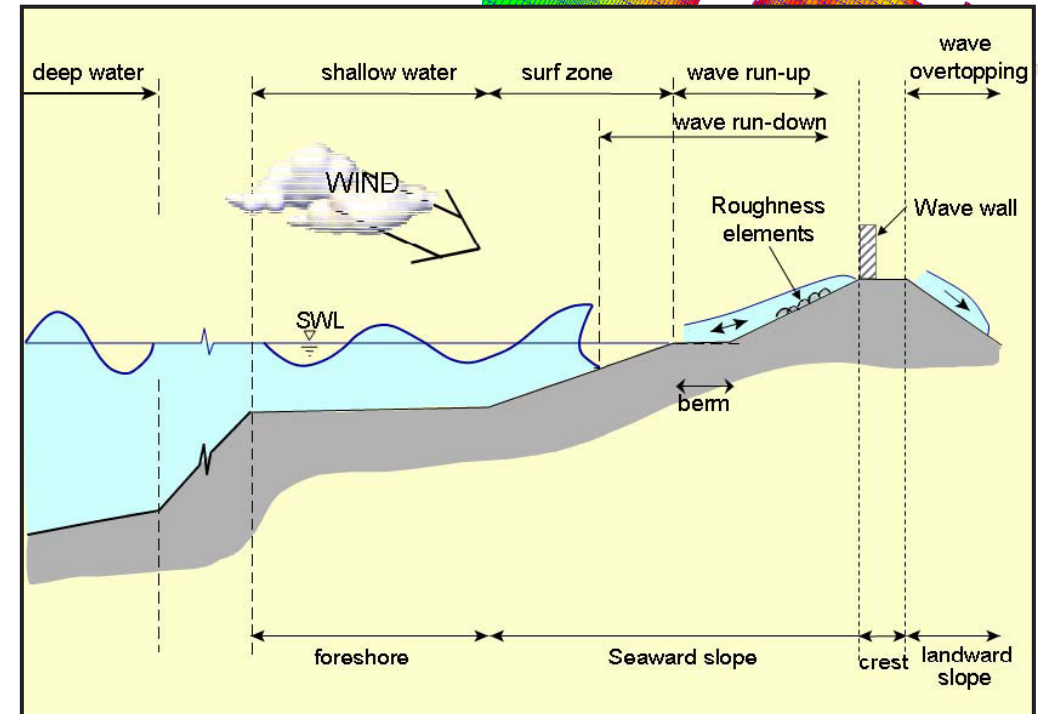
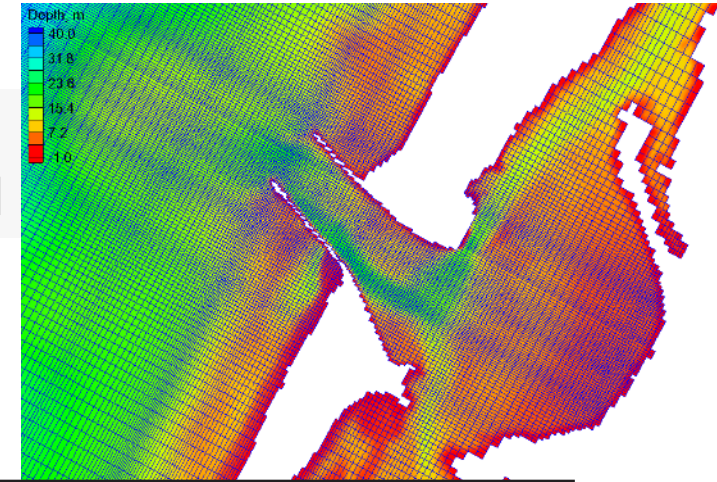


# CMS-WAVE : KEY FEATURES



- Grid options
  - Non-uniform Cartesian grid: Easy to setup
    - » Telescoping grid is **not available**
- Processes
  - Shoaling, refraction, diffraction, reflection, and bottom friction
  - White capping
  - Wave breaking (4 options)
  - Wind-wave generation, wave-current, and wave-wave interactions (e.g., reflection)
  - Wave transmission, run up, and overtopping
  - Waves over Muddy bottom
  - Simplified Formulation “Fast Mode” for non-production runs
    - Reduces run time between 5-7x
- OpenMP parallel processing

Non-uniform  
Cartesian grid





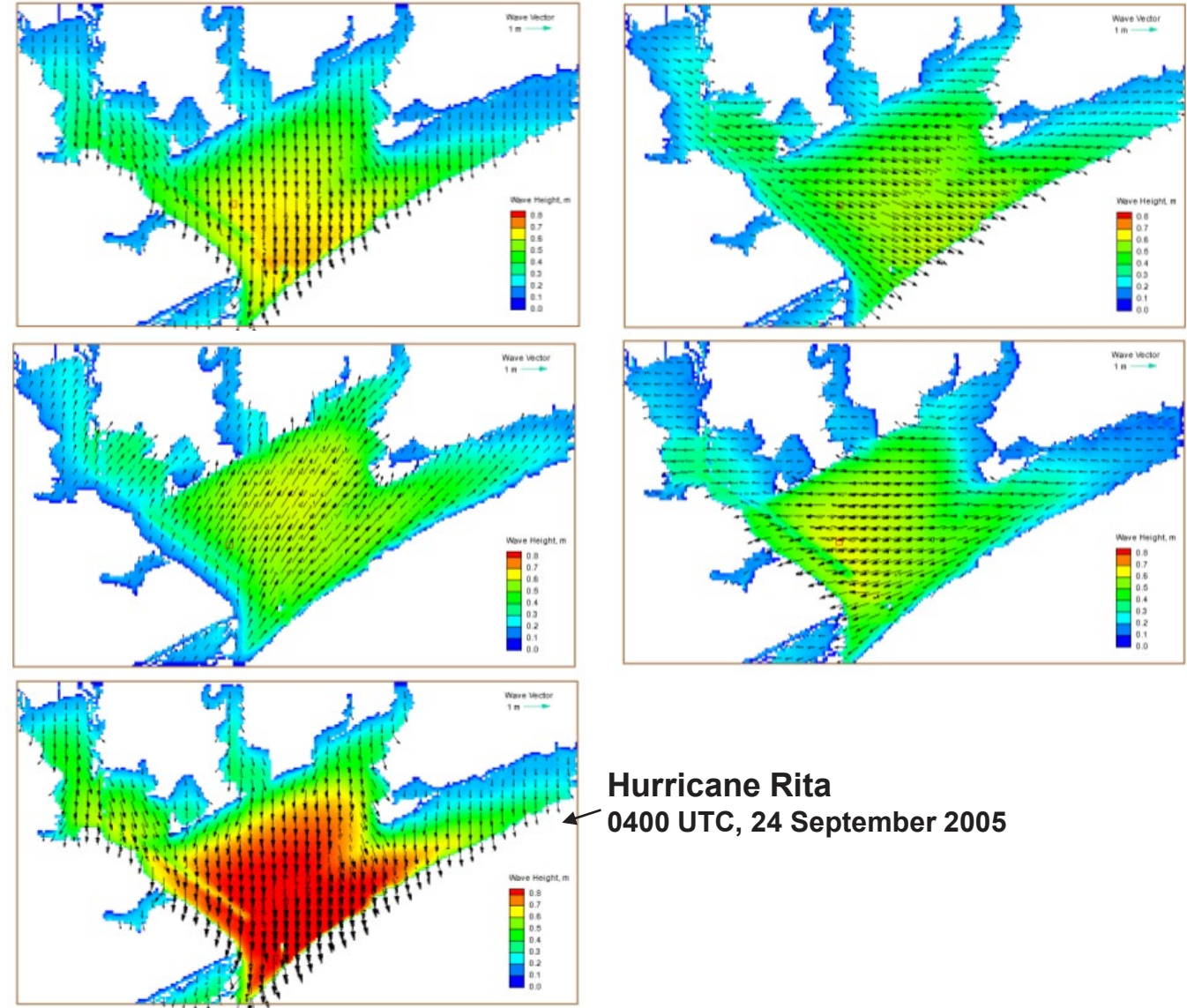
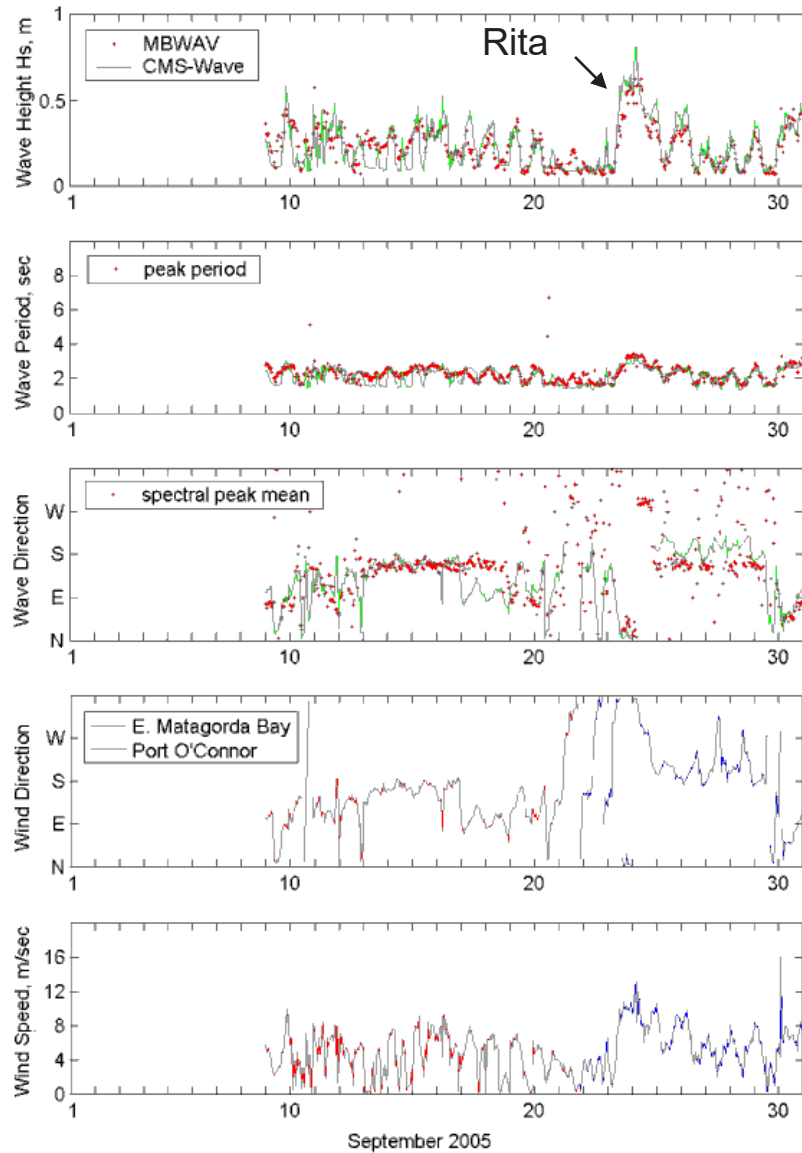
# CMS-WAVE CAPABILITY



CMS-Wave representation of key processes		
Capability	CMS-Wave	
Spectrum transformation	Directional	
Refraction & shoaling	Represented	
Depth-limited wave breaking	Choice among four formulas	
Roller	Represented	
Structures {	<b>Diffraction</b>	<b>Theory</b>
	<b>Reflection</b>	<b>Represented</b>
	<b>Transmission</b>	<b>Formulas</b>
	<b>Run-up and setup</b>	<b>Theory</b>
Wave-current interaction	Theory	
Wave-wave interaction	Theory	
Wind input	Theory	
White capping	Theory	
Bottom friction	Theory	



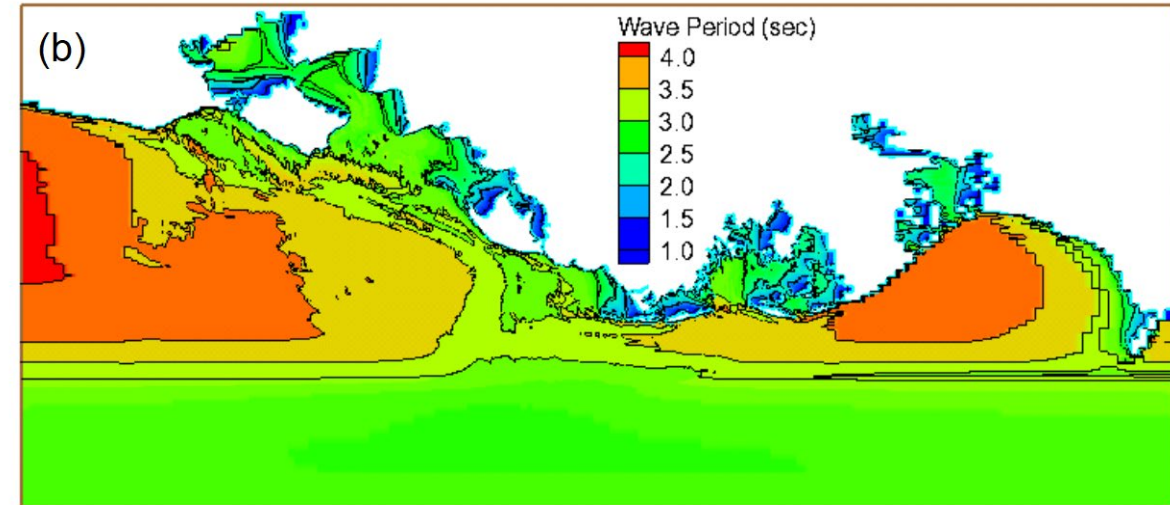
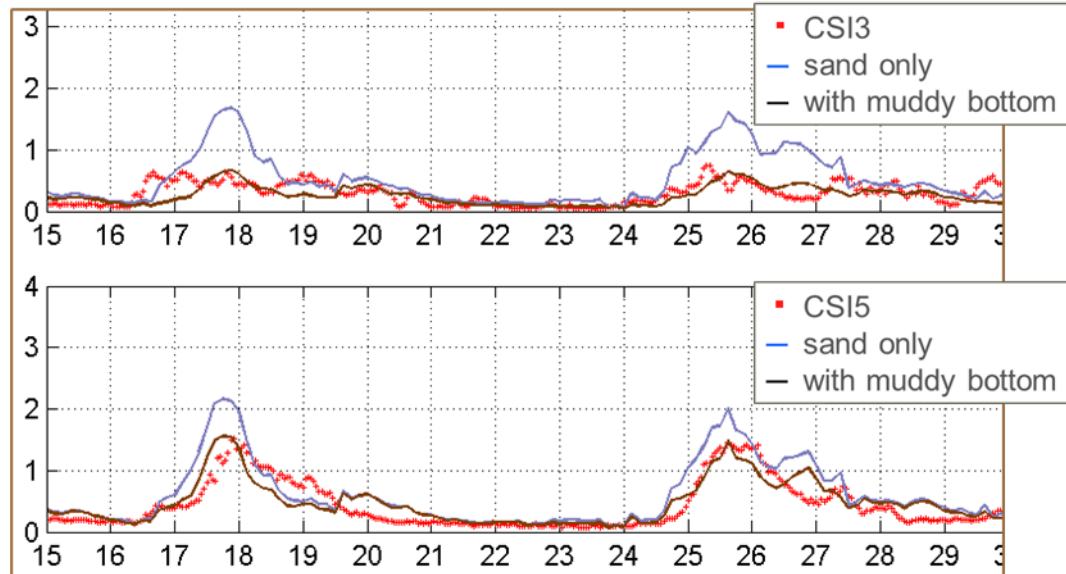
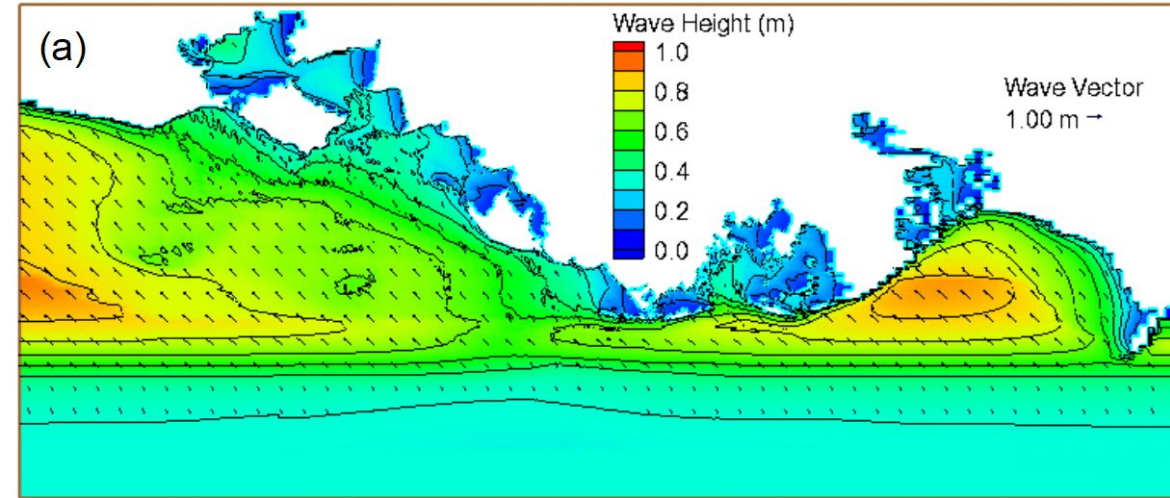
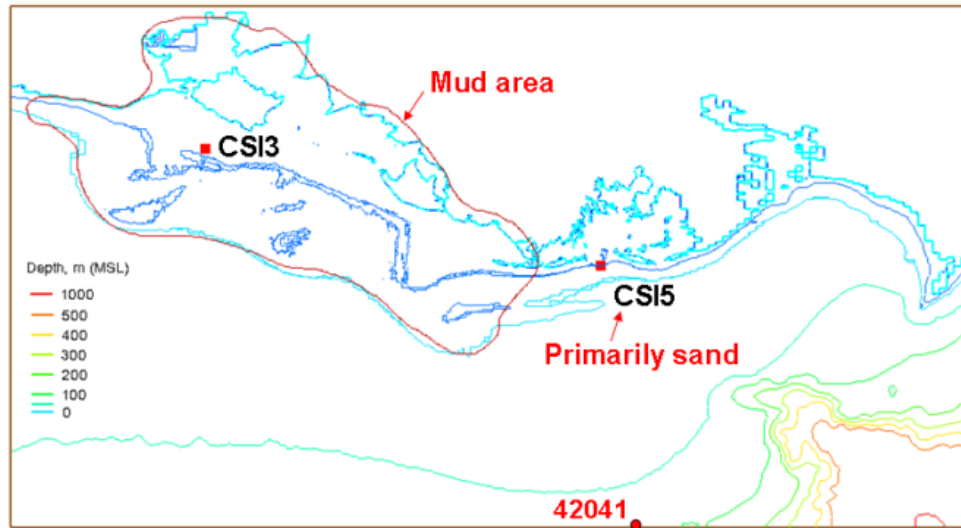
# WAVE GENERATION AT MATAGORDA BAY, TX



**Hurricane Rita**  
0400 UTC, 24 September 2005



# WAVES OVER MUDDY BOTTOM

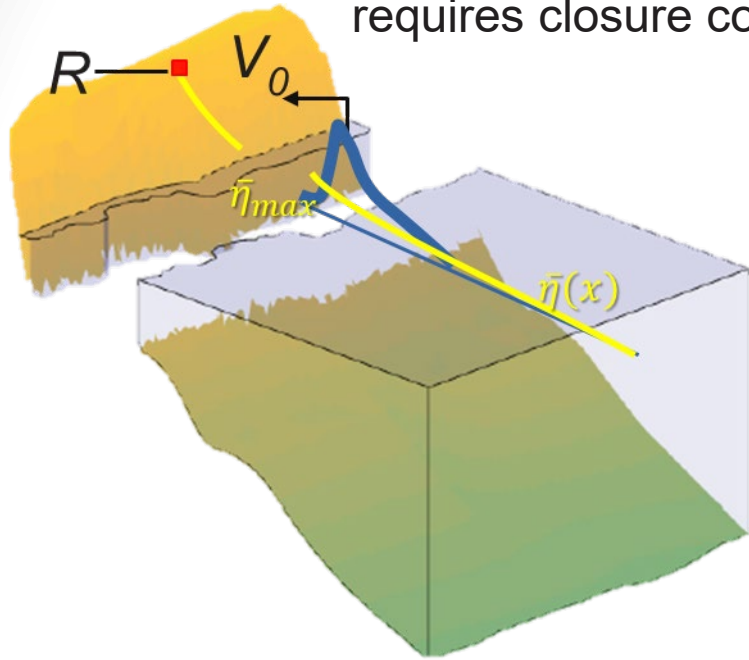




# WAVE RUN UP

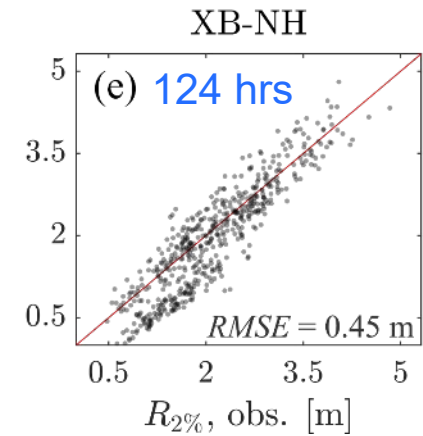
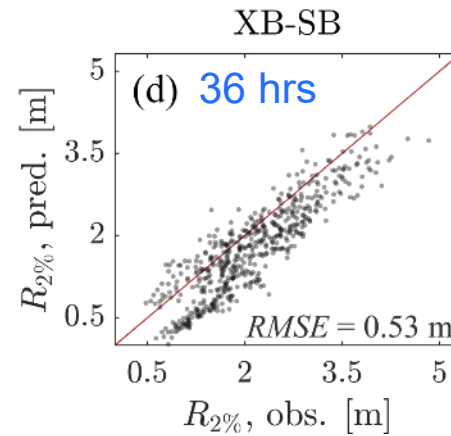
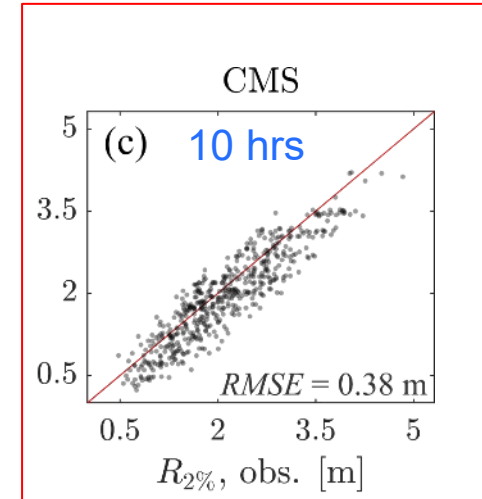
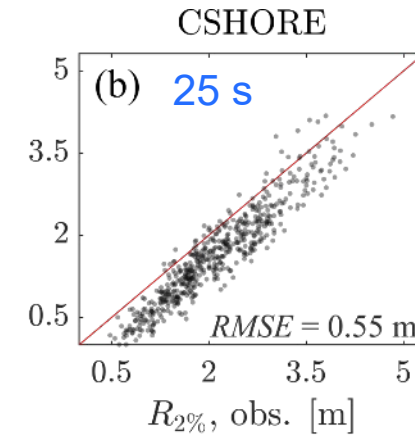
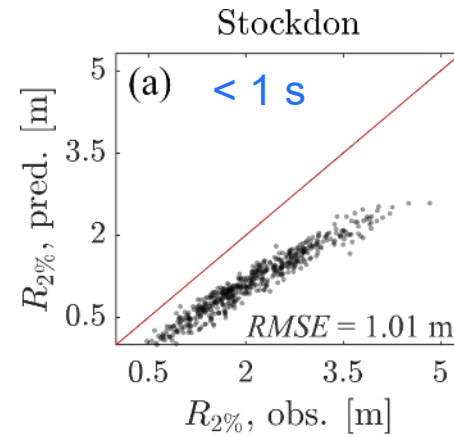


Bore-type **swash** solution  
requires closure coefficient  $A_0$



$$\frac{\partial M}{\partial x} = \frac{\partial}{\partial x} \{A_0 g h^2\} = -g \bar{h} \frac{\partial z_b}{\partial x} - c_f \overline{|U|U}$$

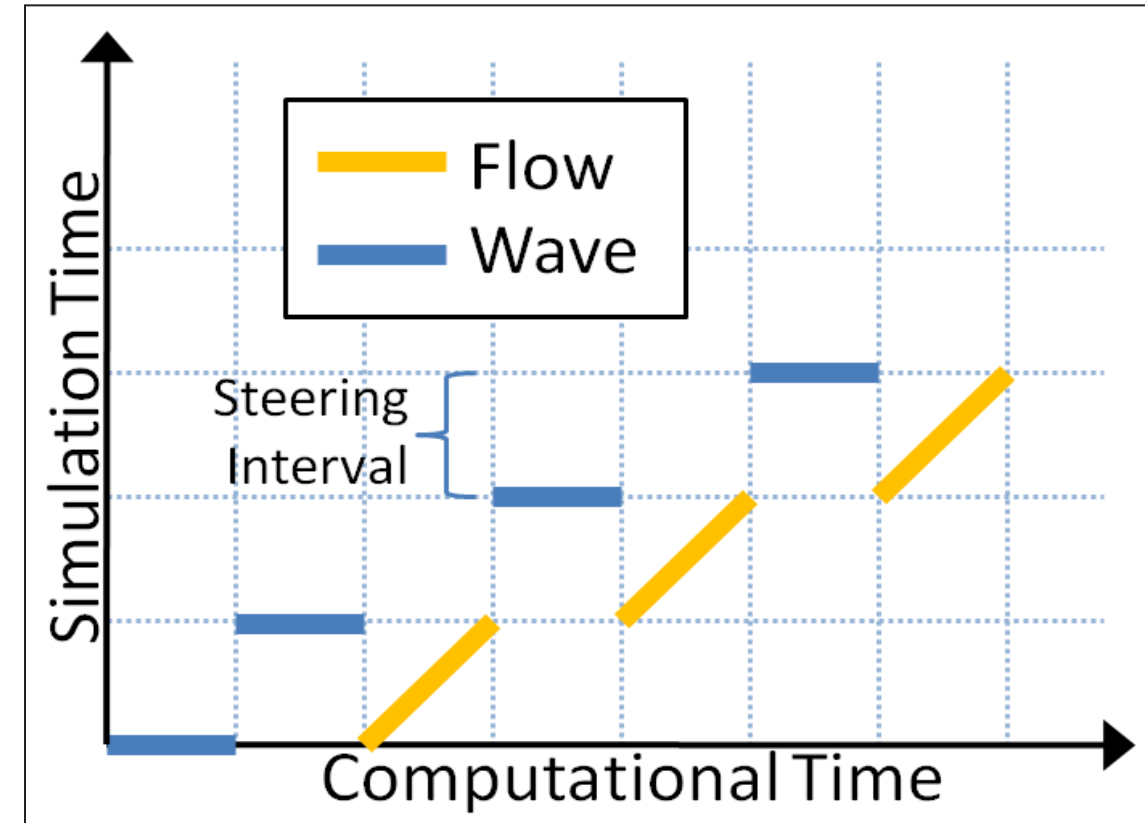
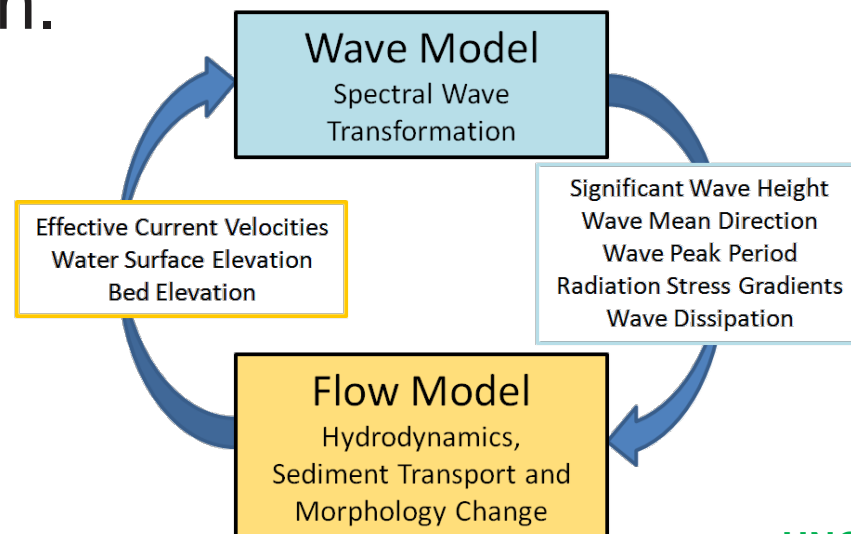
$$M \cong A_0 g \bar{h}^2$$





# COUPLING BETWEEN FLOW AND WAVES

- Steering process
  - Roller included in wave model
  - Sediment transport and morphology change included in flow model
- Separate** Flow and Wave grids with the **same** or **different** domain definition.



Adjustments to future water levels made with astronomical tide estimates to reduce the effect of a time lag in response.

# SEDIMENT TRANSPORT



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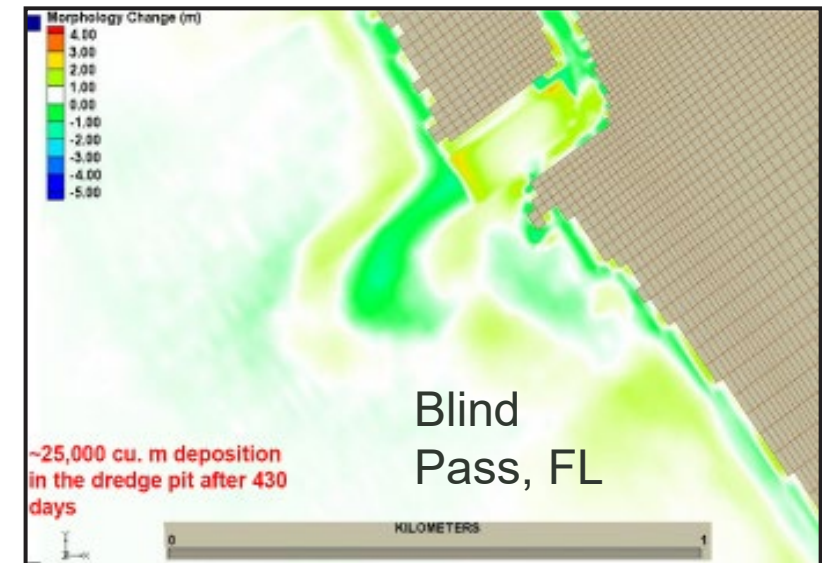
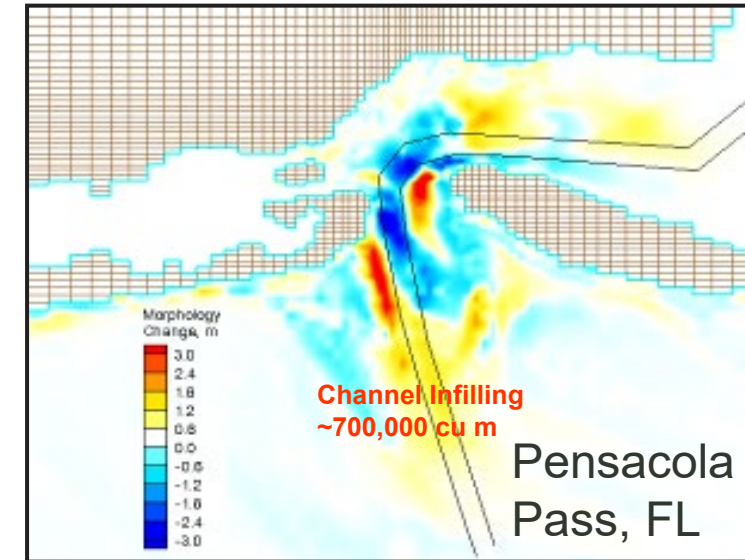


# SEDIMENT TRANSPORT: KEY FEATURES

- Choice of morphology model
  - a) Non-equilibrium total load (AD + total load)
  - b) Equilibrium (i.e., Exner's equation)
  - c) Eq. bedload and Advection-Diffusion (AD) suspended load

Available for Explicit only and no longer recommended\*\*

- Choice of sediment transport formulation
  - Lund-CIRP (2006)
  - van Rijn (1984, 2007)
  - Watanabe (1987)
  - Soulsby-van Rijn (1997)
  - C2SHORE (available in SMS 13.2+)
- Hard bottom (non-erodible layer)
- Avalanching due to slope
- Bed slope influence on bed load
- Multiple-sized sediment transport





# COASTAL MODELING SYSTEM



## Documentation

- Several TR's, CHETN's and journal papers
  - <https://cirp.usace.army.mil/pubs/>
- CIRP Wiki
  - <https://cirpwiki.info/wiki/CMS>

*We're growing!*

New information on CMS related to the source code, compiling, installing is being added to:  
<https://cms2d.readthedocs.io>

The screenshot displays the 'Coastal Modeling System' documentation page. The page header includes the CMS logo and a search bar. The main content area is titled 'Coastal Modeling System' and provides a detailed description of the system's capabilities and its integration with the Surface-water Modeling System (SMS) interface. A 'User Documentation' section lists various topics, including 'What's New', which features a list of recent updates:

- Background
- Key Features
- System Components
  - CMS-Flow
  - CMS-Wave
- Installation and Usage
  - Windows
  - Linux
- Running CMS
- What's New
  - v5.3.7 (19 October 2023)
  - v5.3.6 (26 September 2023)
  - v5.3.5 (8 September 2023)
  - v5.3.4 (16 May 2023)
  - v5.3.3 (7 April 2023)
  - v5.3.2 (11 August 2022)
  - v5.3.1 (7 July 2022)
  - v5.3.0 (16 May 2022)



# DOCUMENTATION - WEBSITE (<https://cirp.usace.army.mil>)



## Products

- CMS
- GenCade
- Others

## Publications

- Technical Reports
- CHETNS
- Journal Articles
- Others

## Tech Transfer

- Webinars
- Workshops
- Video Clips

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

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Brochures  
Posters

Dallas, TX  
August 30-31, 2016

- » 18 November 2020 - GenCade/SBAS Demonstration
- » -----
- » 16-20 September 2019 - CMS Advanced Topics with SMS 13.0
- » 06-10 May 2019 - CMS Basics with SMS 13.0
- » 19-22 April 2016 - WaveNet and TideNet
- » 04 December 2013 - PTM with CMS Webinar
- » 25 July 2013 - Sediment Budget Calculator
- » 11-15 June 2012 - Coastal Modeling System Basics
- » 18-22 June 2012 - Advanced CMS
- » 16-18 October 2012 - GenCade

Tuesday, March 6th	Wednesday, March 7th
<p style="text-align: center;"><b>CPT</b> <u>User's Manual (DRAFT)</u></p> <ul style="list-style-type: none"> <li>• Introduction to CPT Capabilities</li> <li>• Selecting Locations</li> <li>• Filters and Selections</li> <li>• Shoaling Scenario Queries</li> <li>• Map Outputs to Google Earth</li> <li>• Dredging Work Package Formulation</li> </ul>	<p style="text-align: center;"><b>AISAP</b></p> <ul style="list-style-type: none"> <li>• AIS Data Background</li> <li>• AISAP Introduction</li> <li>• First Login and Data Acquisition via AISAP</li> <li>• Creating Projects and AOIs in AISAP</li> <li>• Analysis Capabilities in AISAP</li> </ul>



# DOCUMENTATION - WIKI (<https://cirpwiki.info/wiki/CMS>)



## CMS

- Documentation Portal
- Tutorials
- Technical Info (Equations)
- Validation Cases

### Rubble Mound Tests

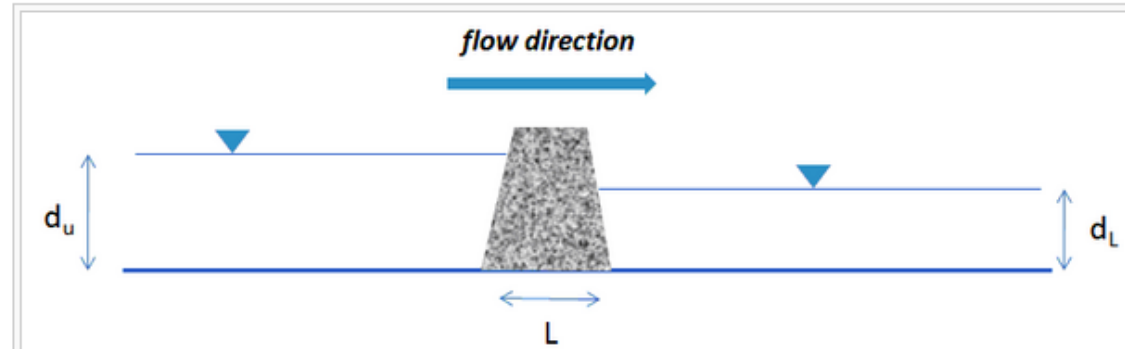


Figure 1. Schematic of the model configuration for validation and numerical grid independence test.

A model test case was developed to both verify the model code and to determine the sensitivity to the grid resolution used to represent the rubble mound. A schematic of the test case is shown in Figure 1. Water levels are held constant at the upstream and downstream values, creating the gradient across the rubble mound. The gradient creates a flow that is dependent on  $\Delta h$ ,  $L$  and the resistance parameters  $a$  and  $b$ . Five CMS grids were constructed to represent the test case, each using a different number of cells to represent the rubble mound. For each grid scenario, a simulation was made sufficiently long to reach steady conditions. Then the flow rate through the mound was compared to an analytical solution. Analytical solutions can be readily obtained from the resistance formula for the test case configuration if either  $a$  or  $b$  is set to zero.

$$q_x = \begin{cases} \frac{h_u^2 - h_L^2}{2La}, b=0 \\ \frac{\sqrt{h_u^3 - h_L^3}}{3Lb}, a=0 \end{cases} \quad (1)$$

The results for the 5 test grids are shown in Table 1 for  $b=0$ , and in table 2 for  $a=0$ . For all of the simulations,  $d_u$  was set to 2.0 m,  $d_L$  was set to 1.5 m,  $L \sim 16$  m and the values for  $a$  and  $b$  were 1.0 and 1.0. The total

## 2. Salinity Calculation at Humboldt Bay, CA

In this section, the salinity



# DOCUMENTATION – OPEN-SOURCE (CMS2D.READTHEDOCS.IO)

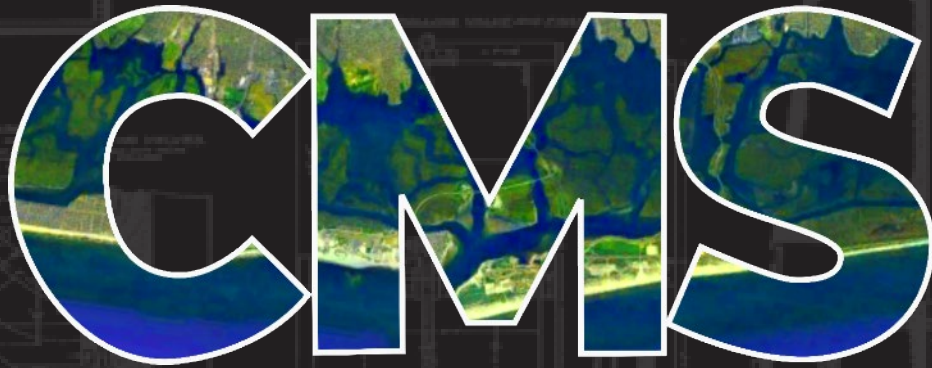


## CMS

- Background
- Installation and Usage
- Compiling on Windows and Linux (no HPC yet)
- What's New
- Links to Repository

The screenshot shows the CMS documentation website. The left sidebar contains a navigation menu with the following items: USER DOCUMENTATION: Background, Key Features, System Components, Installation and Usage, Running CMS, What's New, v5.3.7 (19 October 2023), v5.3.6 (26 September 2023), v5.3.5 (8 September 2023), v5.3.4 (16 May 2023), v5.3.3 (7 April 2023), v5.3.2 (11 August 2022), v5.3.1 (7 July 2022), v5.3.0 (16 May 2022), and Previous changes. The main content area displays the 'What's New' page for version 5.3.7 (19 October 2023). The page is titled 'What's New' and lists 'Improvements' and 'Bug fixes' for this version. The 'Improvements' section includes: 'Began adding CF Compliant naming for HDF5 solution datasets (not yet implemented)' and 'Incremented CMS-Wave version number to 3.3. The code was modified in 2021 but the number remained the same.' The 'Bug fixes' section includes: 'Tidal boundary conditions where an offset was used. The offset was being applied twice which doubled the effect.' Below this, the 'Documentation' section lists: 'Began adding new user documentation' and 'First version available as Open Source.' The next version listed is v5.3.6 (26 September 2023), with 'Improvements' including: 'Minor fixes and diagnostic output improvements for Rubble Mound Jetties with SMS 13.3+'. The 'Bug fixes' section for v5.3.6 includes: 'Incorporate updates for explicit issues (Reed)'. The final version listed is v5.3.5 (8 September 2023).

# CONNECT WITH US



## CMS Team

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**Scan for a brief survey!**

***Help inform feature development and Technology Transfer***



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