

Overview of the SMS (v11.0), Coastal Modeling System, and User Resources



Mitchell Brown

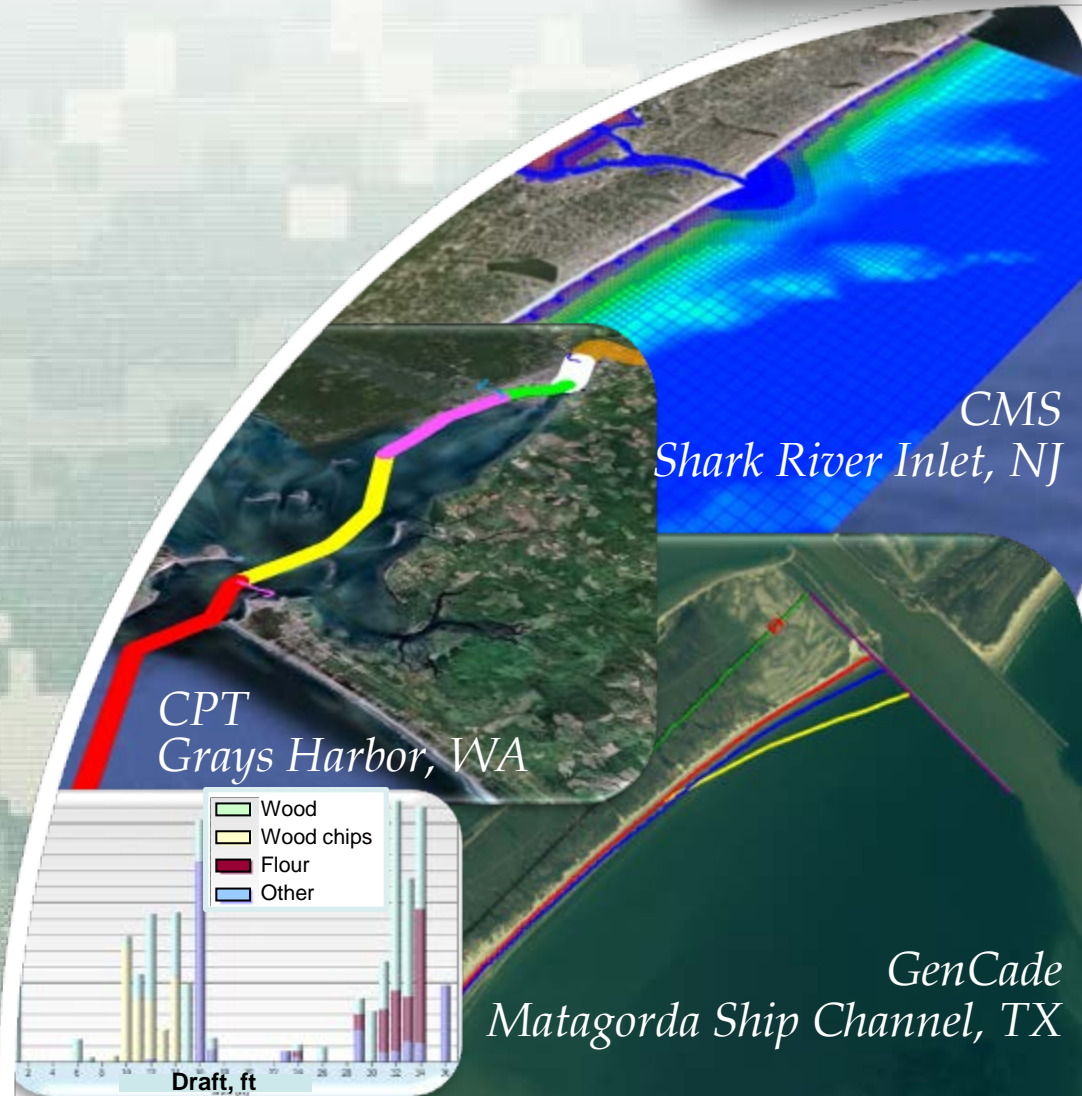
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US Army Corps of Engineers
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Overview of Presentation



- Introduction to the Coastal Modeling System (CMS)
 - CMS-Flow – Hydrodynamics, Sediment Transport, Morphology Change
 - CMS-Wave – Half-plane waves and Full-plane wind forcing.





Objective

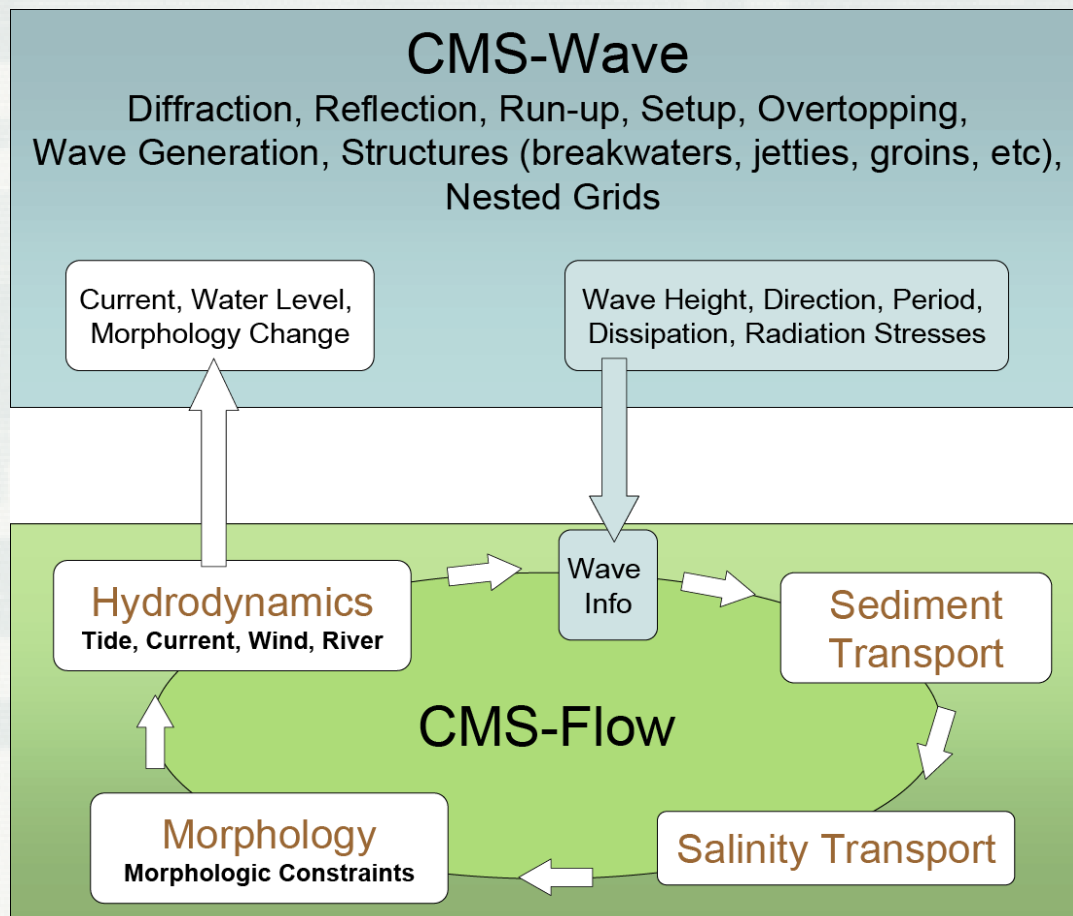


- **Deliver** to engineers' desktops **integrated** advanced models that can be used as **practical** engineering tools for **coastal** inlet and adjacent beach studies.
 - Integrated: All relevant processes, models efficiently coupled together
 - Practical: PC-based, user-friendly interface, fast, robust and accurate
 - Deliver: Manuals, tech reports, journal papers, Wiki, workshops, phone help, etc.





CMS Overview



Since 1997...

- **2 webinars**
- **38 workshops**
- Districts can independently run the CMS!

Advantages...

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



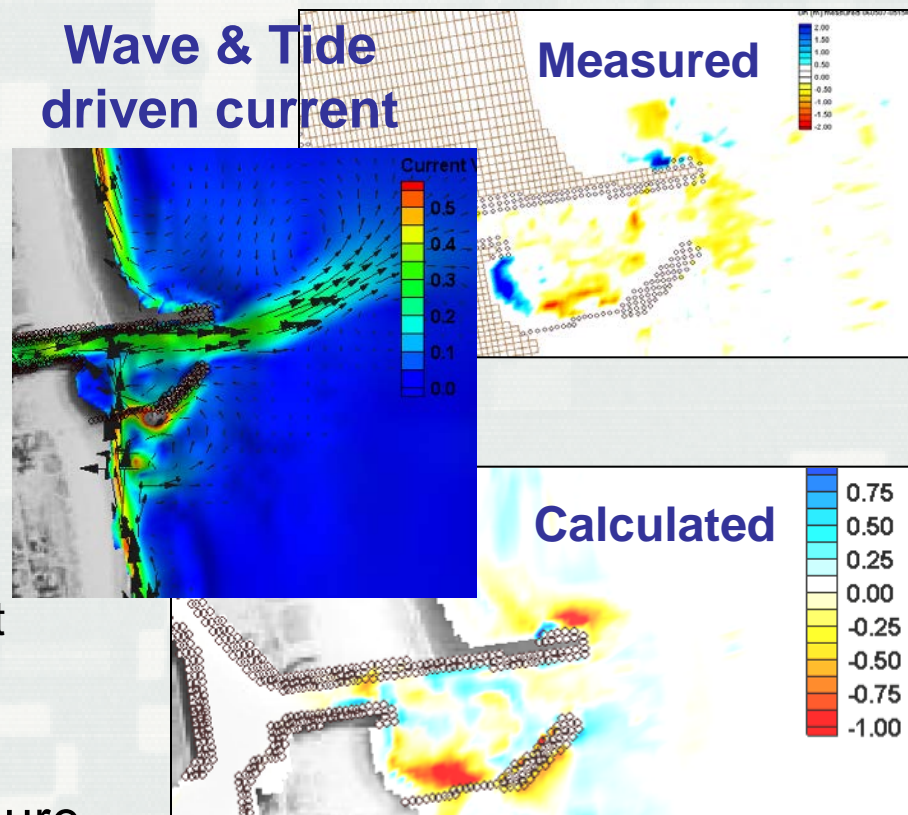


CMS-Flow Key Features



- Finite Volume Method
 - Conserves mass
 - Stable
 - Accessible
- Coupled with spectral wave model (CMS-Wave)
 - Wave-current interactions
- Inline sediment transport and morphology change
 - Non-equilibrium sediment Transport model (NET)
- Nesting capability
- WSE, river, wind/atmospheric pressure forcing
- Tidal constituent forcing (**NEW**)

**Wave & Tide
driven current**

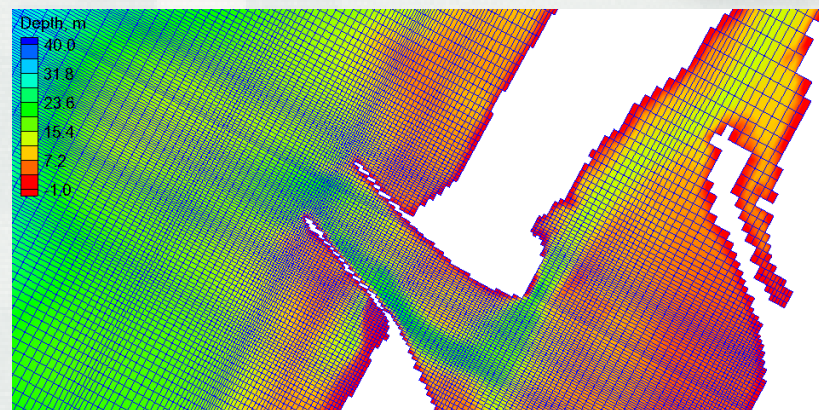




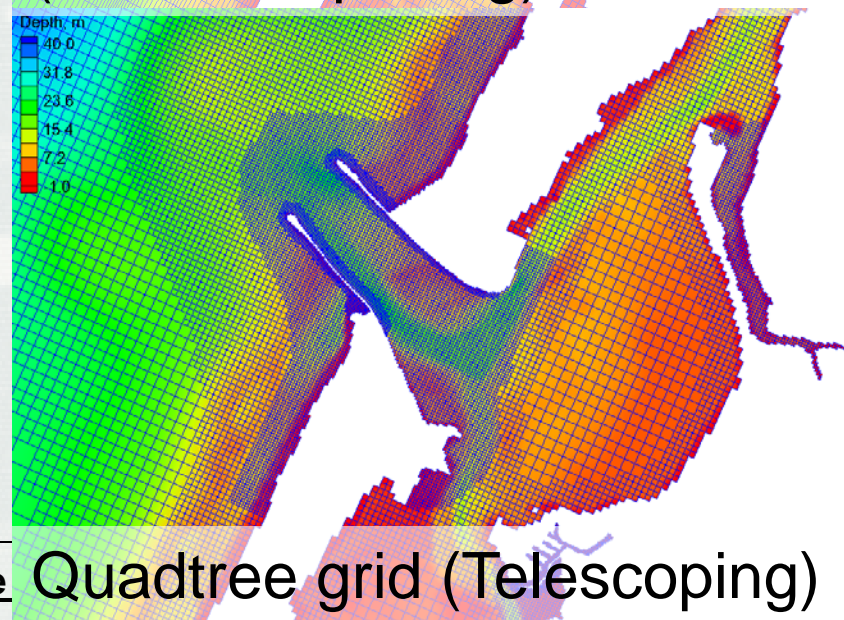
CMS-Flow Key Features



- Grid options
 - Non-uniform Cartesian grid: Easy to setup
 - Quadtree (telescoping) grid: Efficient, flexible (presently, only available for Implicit model)
- Solver options
 - Implicit: Tidal flow, long-term morphology change, parallel processing.
~5 - 30 minute time step
 - Explicit: Flooding, breaching, super-critical flow. ~1 second time step, parallel processing



Non-uniform Cartesian grid
(Variable spacing)



Quadtree grid (Telescoping)



Hydrodynamics



Included terms for the depth-averaged shallow water equations in Cartesian coordinates

Depth - averaged current velocity

Total water depth

Still water depth

Water surface elevation

Gravity

Atmospheric Pressure

Precipitation / Evaporation

Coriolis

Turbulent eddy viscosity

Bottom stress (including waves)

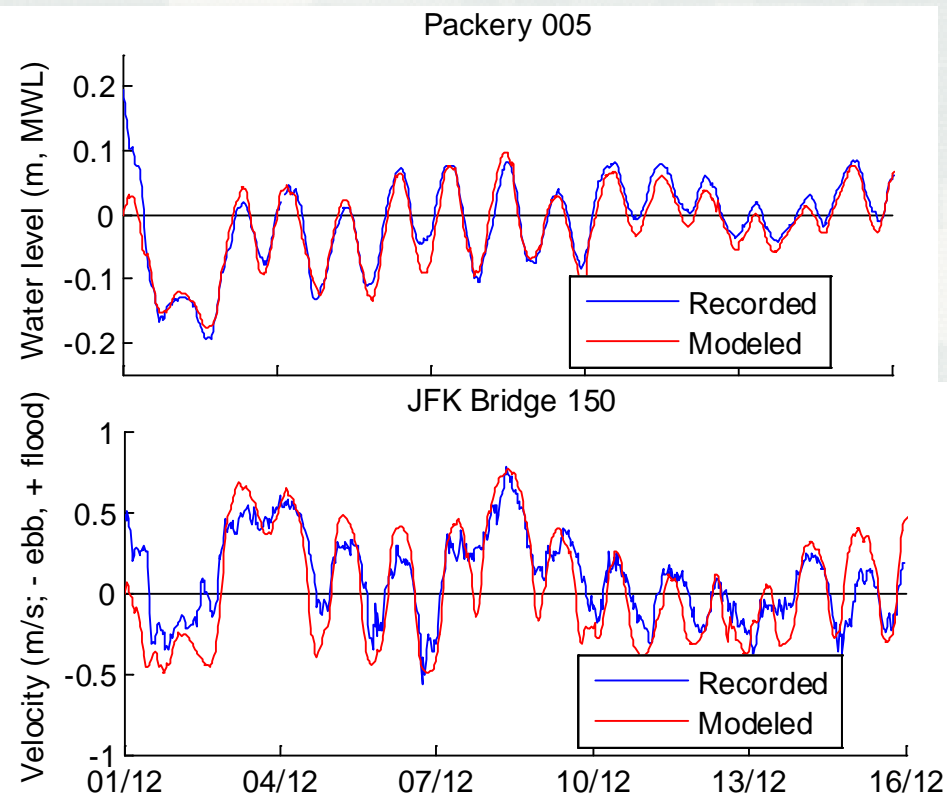
Wave stress (forcing)

Wind stress





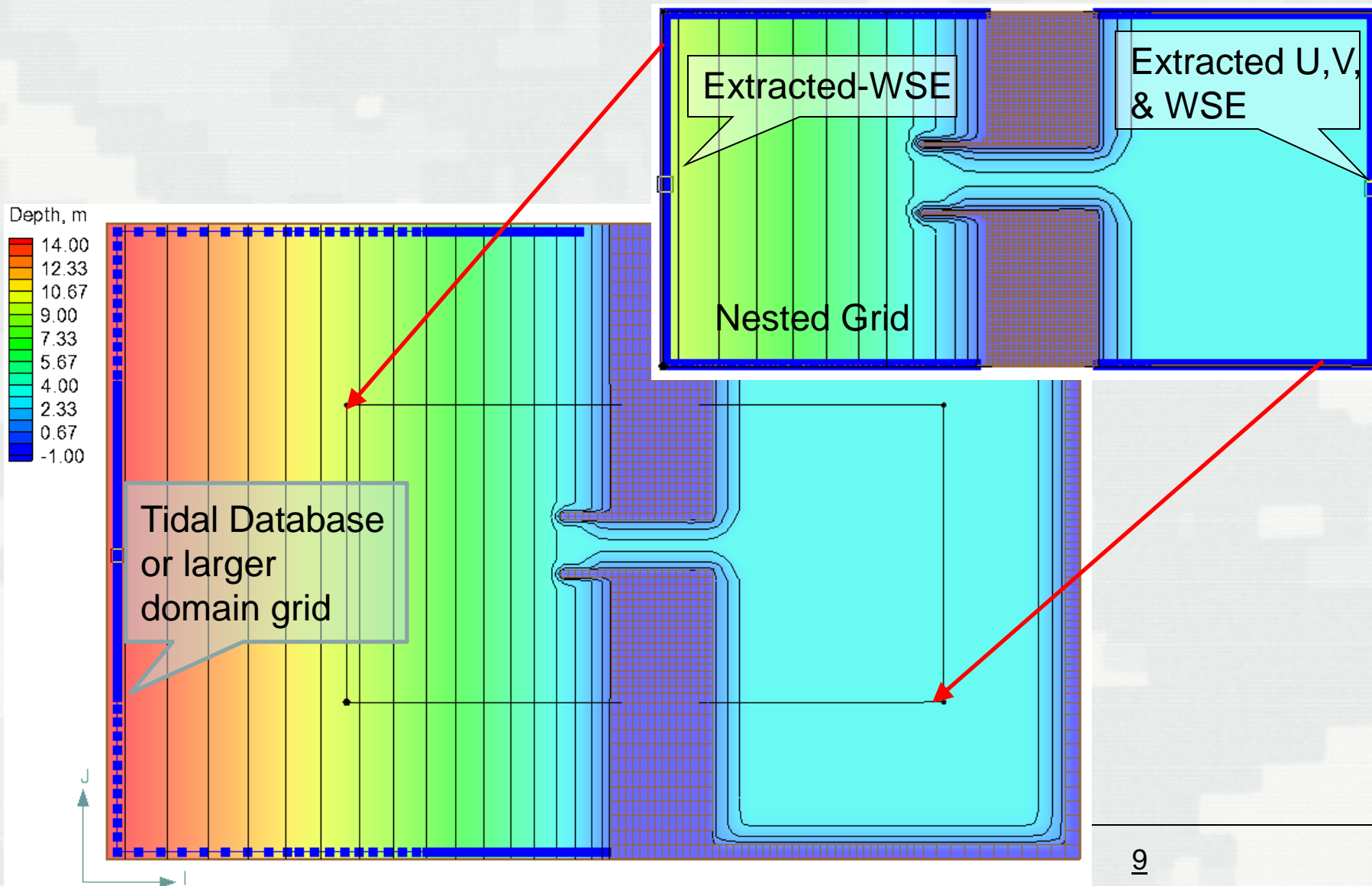
Packery Channel, TX





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Nested Grid Capability

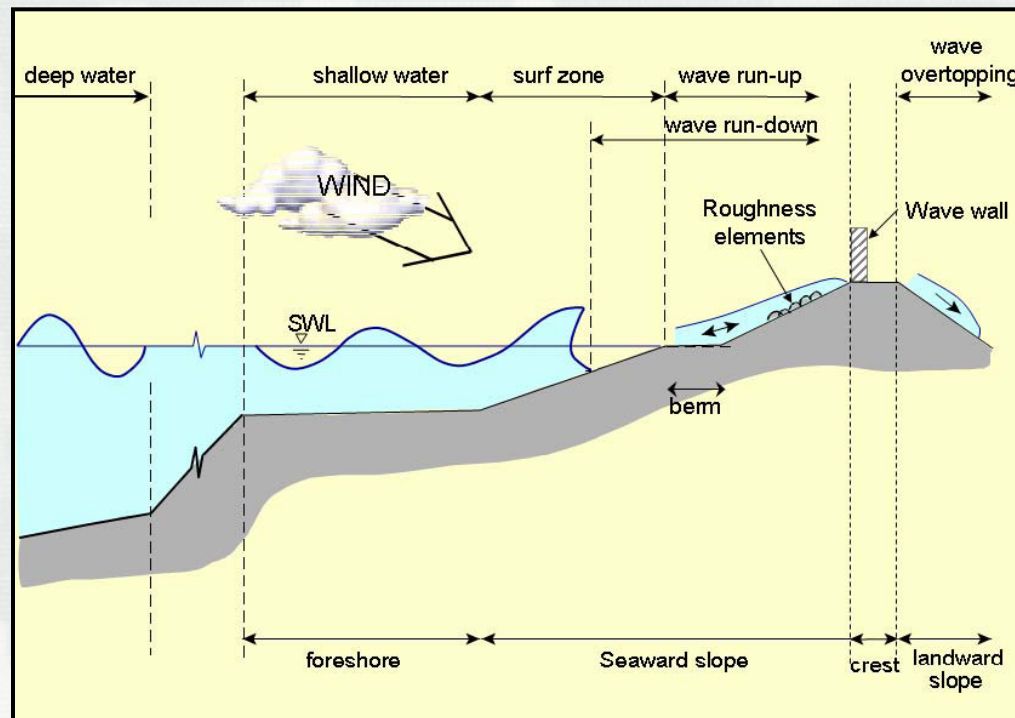




CMS-Wave: Key Features



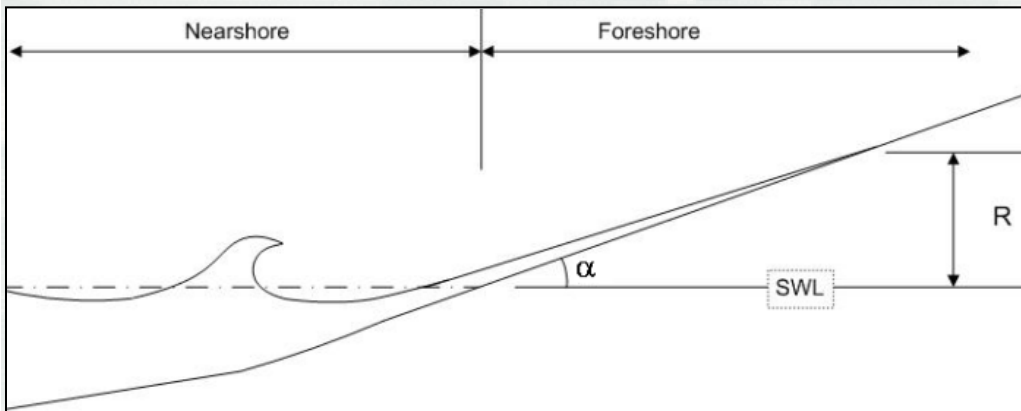
- Shoaling, refraction, diffraction, reflection
- Bottom friction
- White capping
- Wave breaking (4 options)
- Wind generation
- Wave-current, and wave-wave interactions
- Transmission, runup and overtopping
- Muddy bottom
- Automatic grid rotation
- Non-uniform Cartesian grid with nesting capability
- “Fast Mode”





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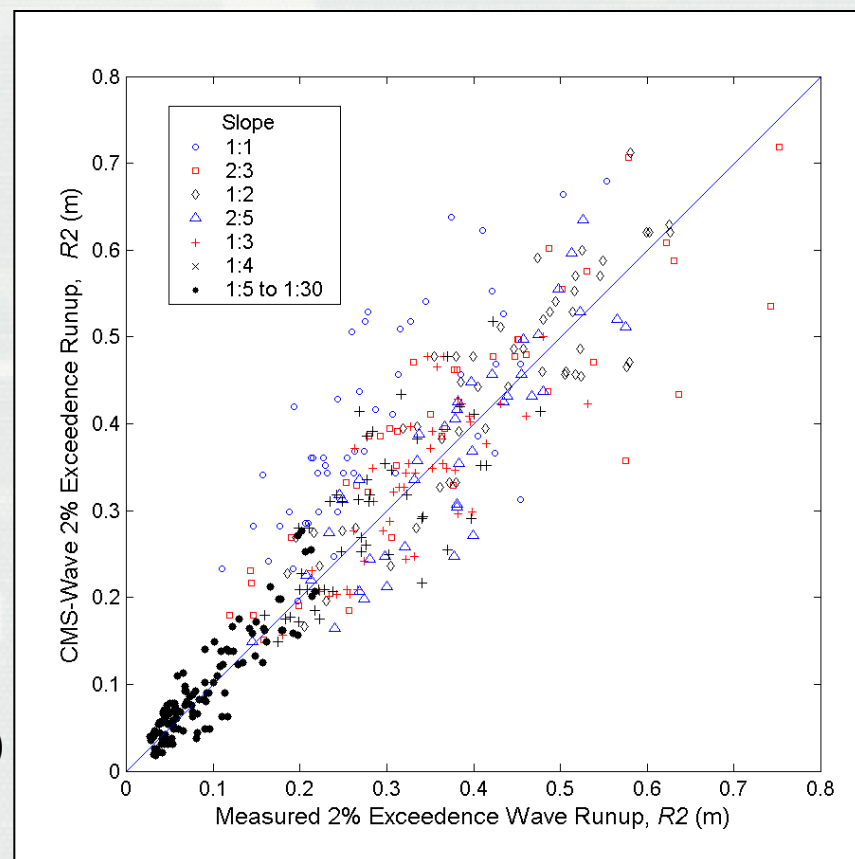
Wave Run-up



Wave run-up: rush of waves up a slope or structure

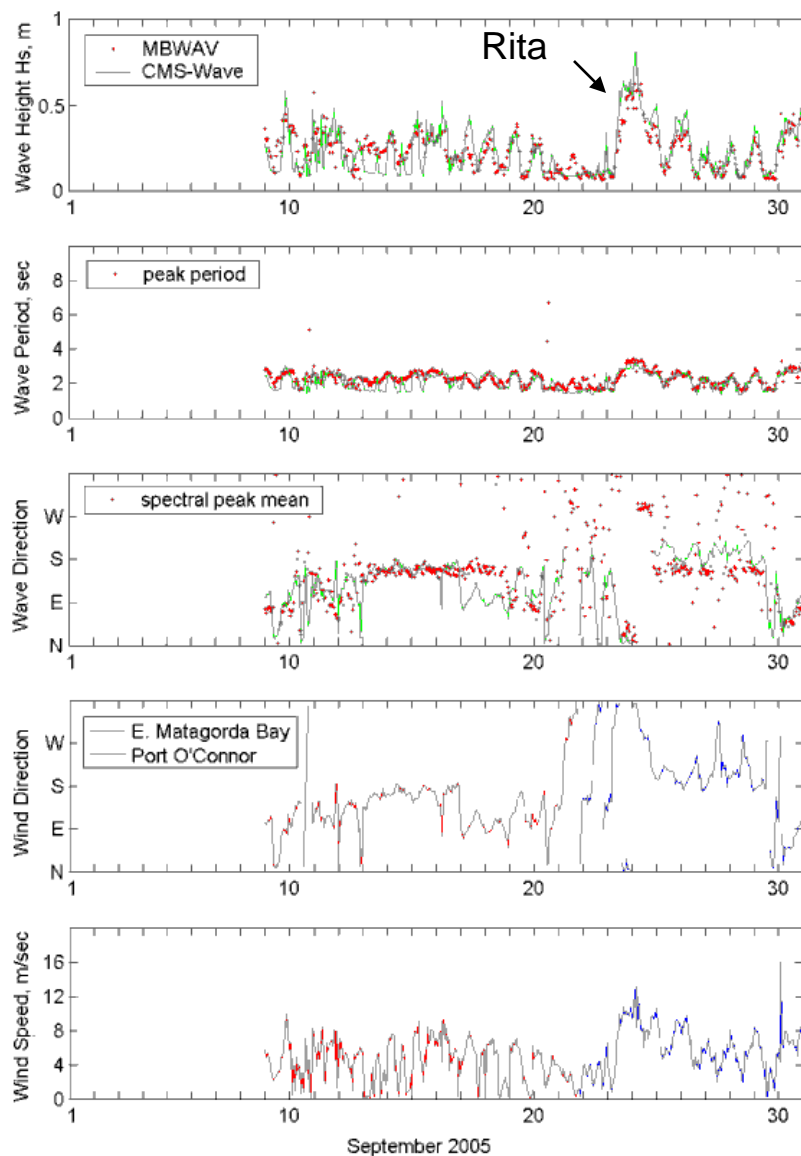
Two-percent run-up, R_2 : the vertical up-rush level exceeded by 2-percent of the larger run-up height

**Ahrens & Titus (1981), Mase & Iwagaki (1984)
~ 400 laboratory experiments**

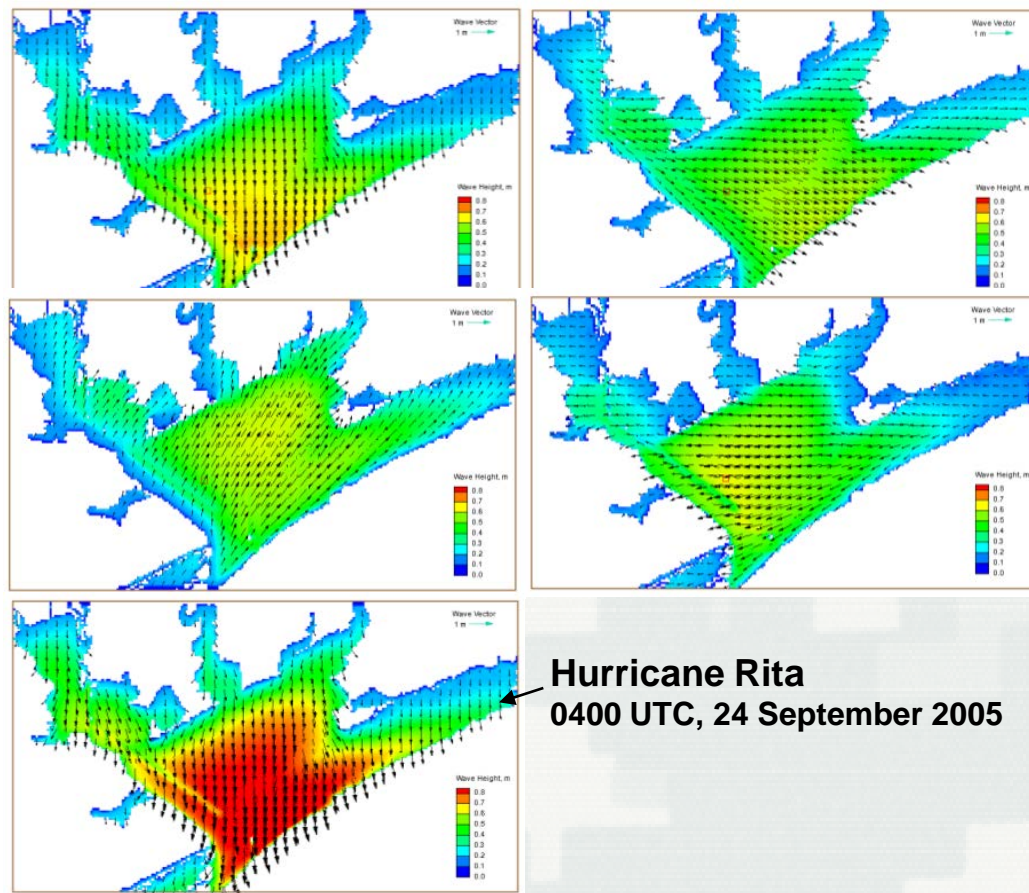




Wave Generation



Matagorda Bay, TX



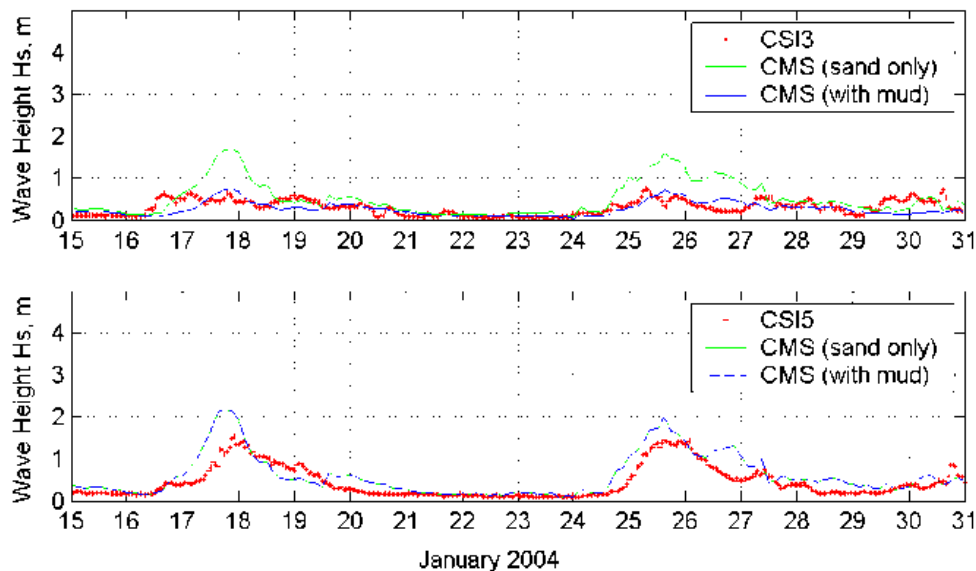
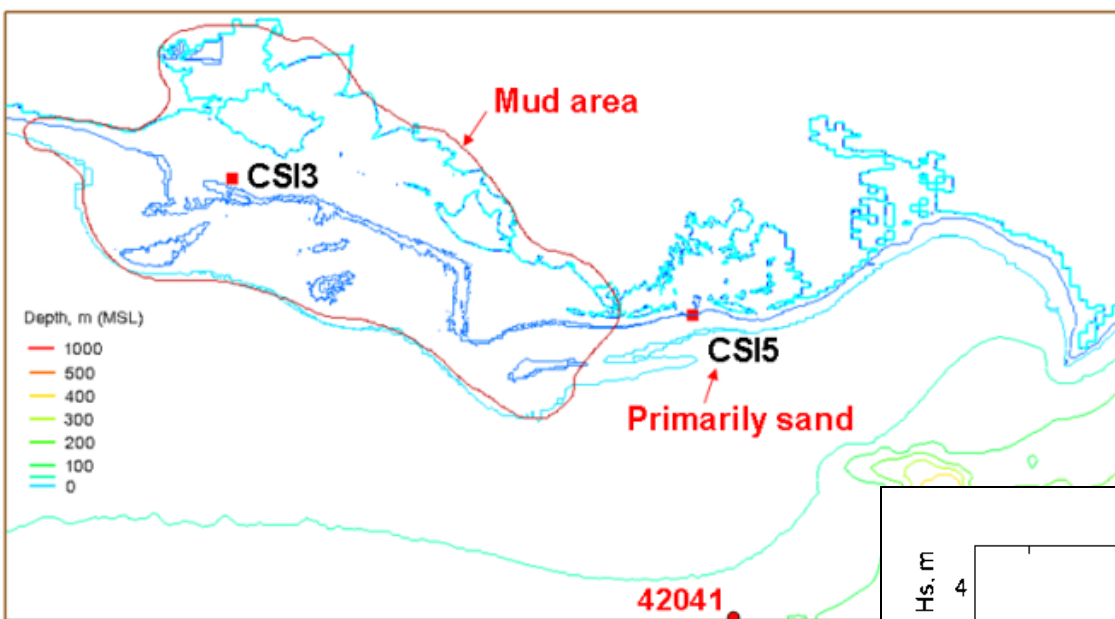
Hurricane Rita
0400 UTC, 24 September 2005





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Wave Dissipation over Muddy Coast

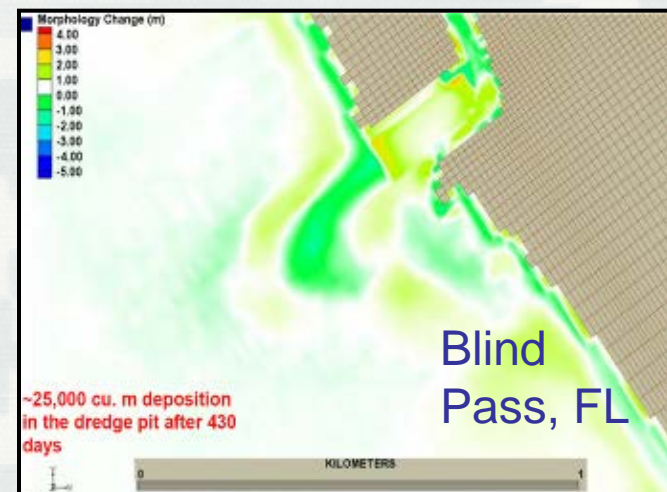
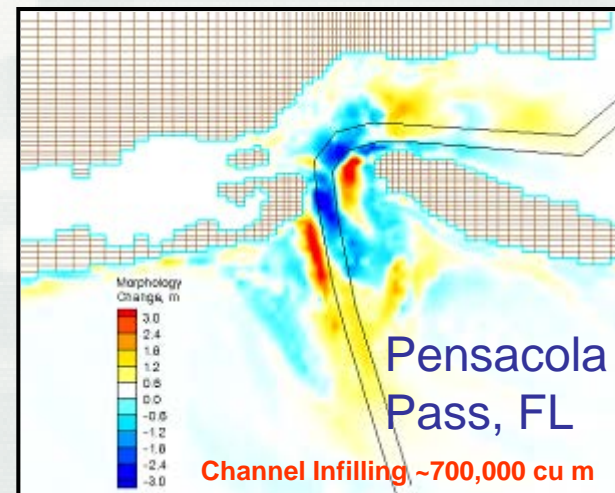




Sediment Transport: Key features

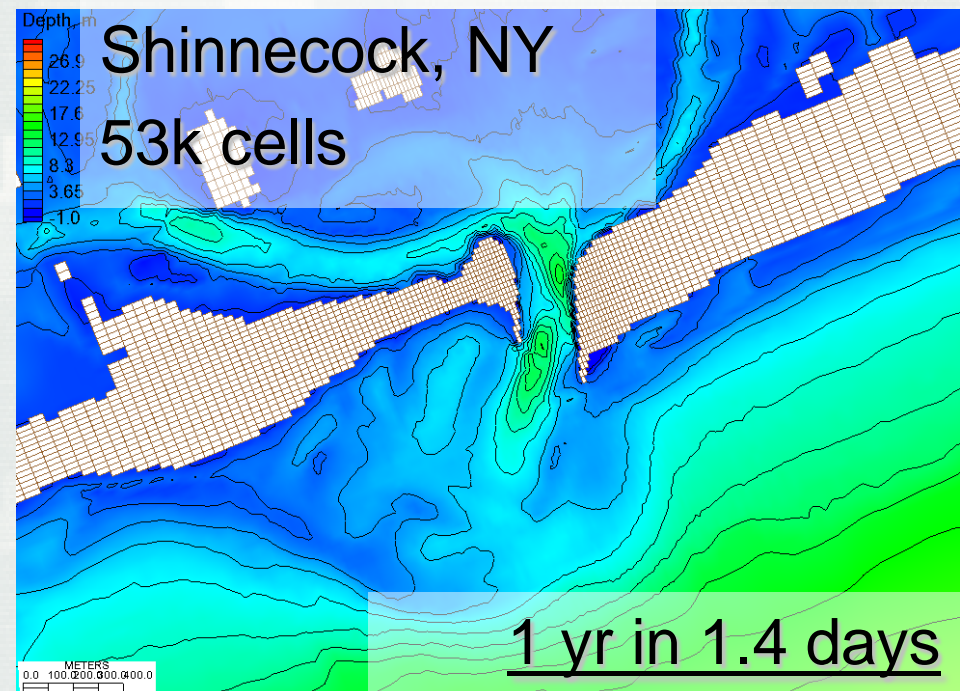
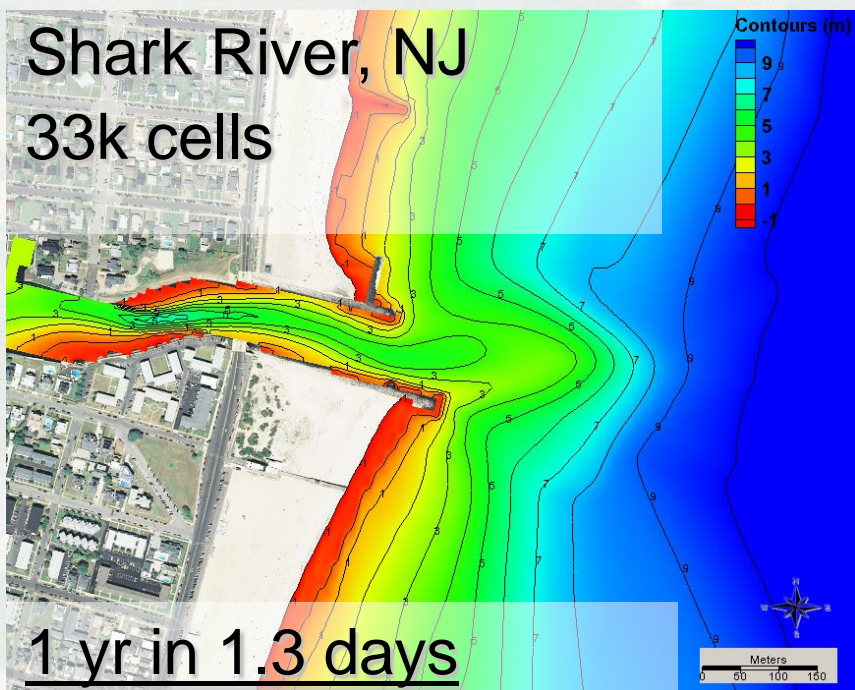


- Sediment transport models
 - Equilibrium Total Load (Exner equation)
 - Eq. Bed Load + Advection-Diffusion (AD) Suspended Load
 - Non-Eq. (AD Total Load)
- Sediment transport formulas
 - Lund-CIRP
 - Van Rijn
 - Watanabe
 - Soulsby
- Hard-bottom
- Avalanching
- Bed slope influence on bed load
- Multiple-sized sed. transport (**NEW**)

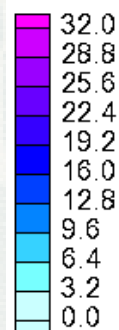




Computational Speed (Implicit)



Water Depth, m



Gironde Estuary, FR
11k cells

1 yr in 7 hrs!





Documentation



■ CIRP website

■ CIRP Wiki

US Army Corps of Engineers
CIRP - Coastal Inlets Research Program

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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)

★ Favorites Main Page - CIRPWiki

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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

■ Tech Transfer

- Upcoming
- Recent

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CIRP - Coastal Inlets Research Program

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CIRP
Research & Development

13th Annual
CIRP Technology-Transfer Workshop (#38)
6-8 March 2012
Philadelphia District
US Army Corps of Engineers

The 13th Annual Coastal Inlets Research Program (CIRP) Technology Transfer Workshop (38th overall) will be held in March 2012. The workshop will be held using facilities at the Philadelphia District. Workshop attendees will be provided Laptops or PCs with pre-loaded software, a bound notebook with presentations, and a link to download all software and data sets prior to the conference. A temporary 60-day license* for the Surface-Water Modeling System (SMS) including the Coastal Modeling System (CMS), and GenCade.

NEW - Webinar Information

Most of the Workshop will also be set up as a Webinar (call-in and connection information below). If you are interested in participating in the workshop via webinar, please email Julie.D.Rosati@usace.army.mil so we can let you know where workshop materials are posted beforehand and add your name to our list. You are welcome to participate for any portions of the workshop in which you have interest.

It is likely to be difficult for us to respond to individual off-site questions during the workshop, but we will respond to you each as time allows, so please use the webinar "participant chat" option for questions as these arise. Or, as always, feel free to email workshop instructors anytime.

Webinar access and call-in information:
Toll-Free #: 888-273-3658
Participant Code: 6760180

Webinar: <https://www.webmeeting.att.com> (Internet Explorer works best). The Meeting Number is the same at the phone number as listed above. The Participant Code is the same as above.

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Documentation Wiki



- CMS
 - Documentation Portal
 - Tutorials
 - Technical Info (Equations)
 - Validation Cases
- Gencade
 - 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.





Reports and Tech Notes

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Publications: Sediment Transport



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Questions?

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