

Coastal Modeling System

Advanced Topics



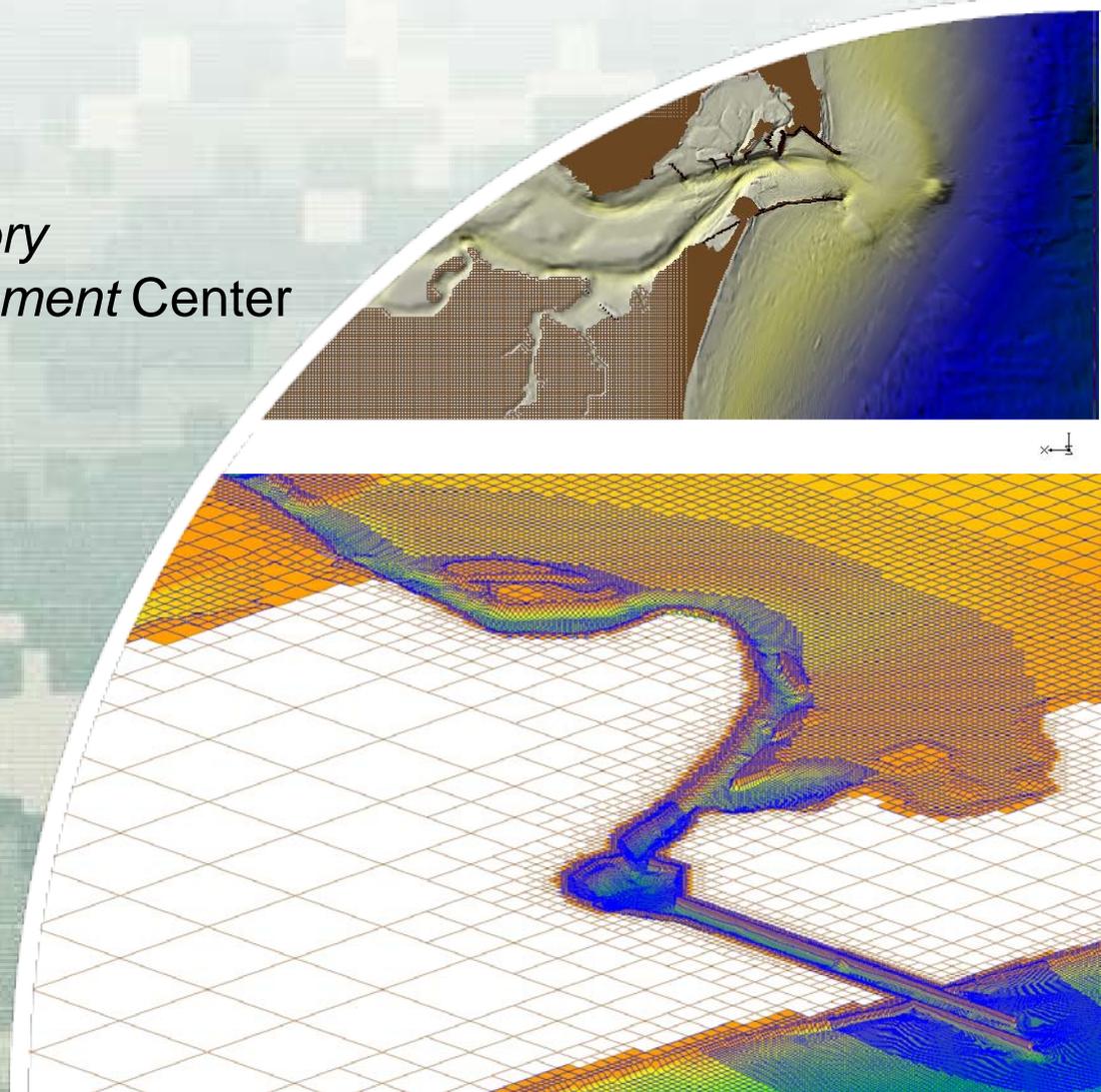
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Engineer Research and Development Center

June 18, 2012



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Report Documentation Page

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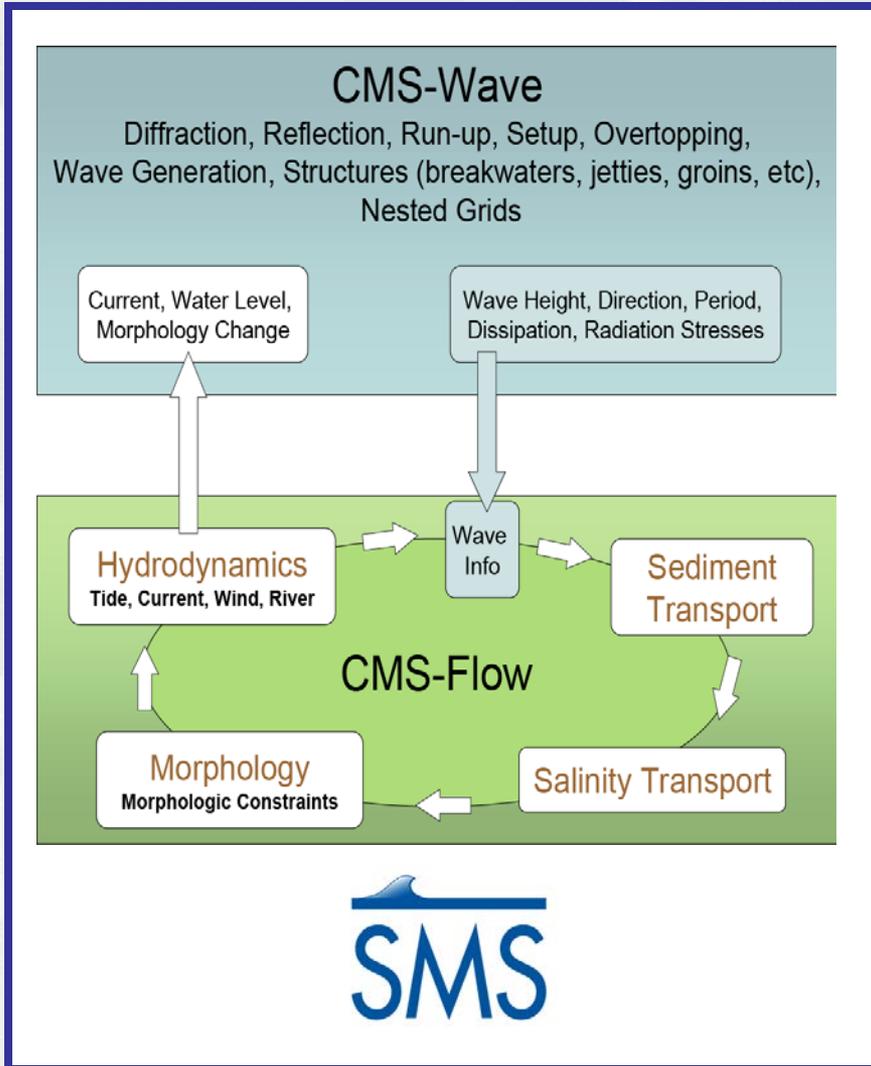
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- **18 June 2012 - Day 1**
 - Introduction to CMS (slides)
 - Overview of Documentation and Workshop Material – Read it!
 - Tips for preparing bathymetry and other scattersets
 - Tips for setting up and running
 - Hydrodynamics
- **19 June 2012 - Day 2**
 - Initial and Boundary Conditions
 - Salinity Transport
 - Surface Roller
- **20 June 2012 – Day 3**
 - Sediment Transport
- **21 June 2012 - Day 4**
 - Numerical Methods
 - Advanced Output
 - Scripting
- **22 June 2012 - Day 5**
 - Debugging and Problem solving
 - Model Calibration
 - Post-processing

Focus of Workshop

- Not a hands-on tutorial (SMS experience assumed)
- Where and how to find documentation, tutorials, etc
- Theory and numerical methods
 - Model applicability
 - Knowing when and when not to use CMS before you start.
 - Interpreting results
 - So the model ran, now what?
 - Calibration
 - “To reproduce nature you must understand it.”
 - Designing cases or alternatives and making engineering decisions
 - While keeping it real.
- Tips on how to setup, run, and analyze results
 - Effectively:
 - The end result is sufficiently correct or adequate for the purposes of the project
 - Efficiently:
 - The setup process is fast and without wasted time or effort



What is the CMS?

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

Why CMS?

Operational at 10 Districts
 Validated with real applications
 Robust and user-friendly
 Practice-oriented:

1 year simulation ~ 1-3 days on PC

Types of Applications

Channels: Deepening, widening, lengthening, realigning

Jetties: Lengthening, raising, rehabbing

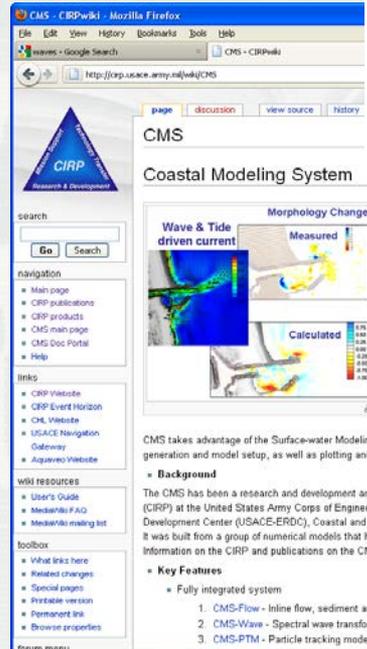
O&M: Placement areas – berms, wetlands

Processes: *Navigability* – waves and currents; *Environmental* – circulation, and sediment transport

Coastal Modeling System

Overview, background and capabilities

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The screenshot shows the CMS website interface in a Mozilla Firefox browser. The page title is 'CMS - CIRPwiki - Mozilla Firefox'. The address bar shows 'http://cirp.usace.army.mil/wiki/CMS'. The main content area displays the 'Coastal Modeling System' page, which includes a search bar, navigation links, and a description of the system. The left sidebar contains various navigation and resource links.

Exporting the bottom friction dataset

Exporting the bottom roughness (friction) datasets is useful for creating different project alternatives or when switching from different bottom roughness datasets types such as from Manning's n to Bottom Friction Coefficient and back. It is also useful for scripting multiple runs with different project alternatives.

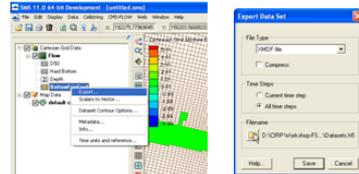


Figure 5.1.12. Manning's n contours after modifying the areas under all three bridges.

Additional Bottom Friction Cards

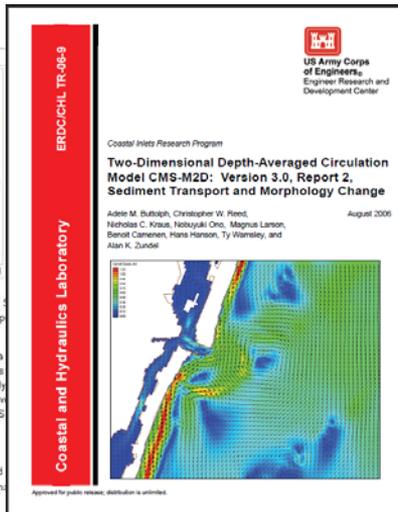
Additional advanced cards are available for setting the bottom friction to a constant for the whole grid. These cards are useful for running sensitivity analysis for a wide range of values in cases which can be approximated with a single constant bottom friction value.

Table 5.1.2. Advanced Cards: to set bottom friction dataset to a constant value

Card	Argument	Default	Range	Description	CMS Variable
MANNING_N_CONSTANT	real number	0.05	0.05 - 0.15	Specifies a constant input Manning's coefficient. Overrides any previous bottom friction cards.	MAN_N
BOTTOM_FRICTION_COEFF_CONSTANT	real number	0.05	0.05 - 0.15	Specifies a constant input Bottom Friction Coefficient. Overrides any previous bottom friction cards.	BFM
ROUGHNESS_RELIEF_CONSTANT	real number	0.05	0.05 - 0.15	Specifies a constant Roughness Relief in m . Overrides any previous bottom friction cards.	REL

5.1.2 Wall Friction

The wall friction enhances the flow drag perpendicular to any dry boundary. The wall friction may be turned On or Off in the Flow tab of the CMS-Flow Model Control!



The image shows the cover of a report titled 'Two-Dimensional Depth-Averaged Circulation Model CMS-M2D: Version 3.0, Report 2, Sediment Transport and Morphology Change'. The cover features the ERDC/CHL logo and a map of a coastal area with a grid overlay. The report is published by the US Army Corps of Engineers, Engineer Research and Development Center.

Availability

- Comes with SMS installation package
- CIRP website (under Products)
- CMS is **Free**, interface is relatively inexpensive

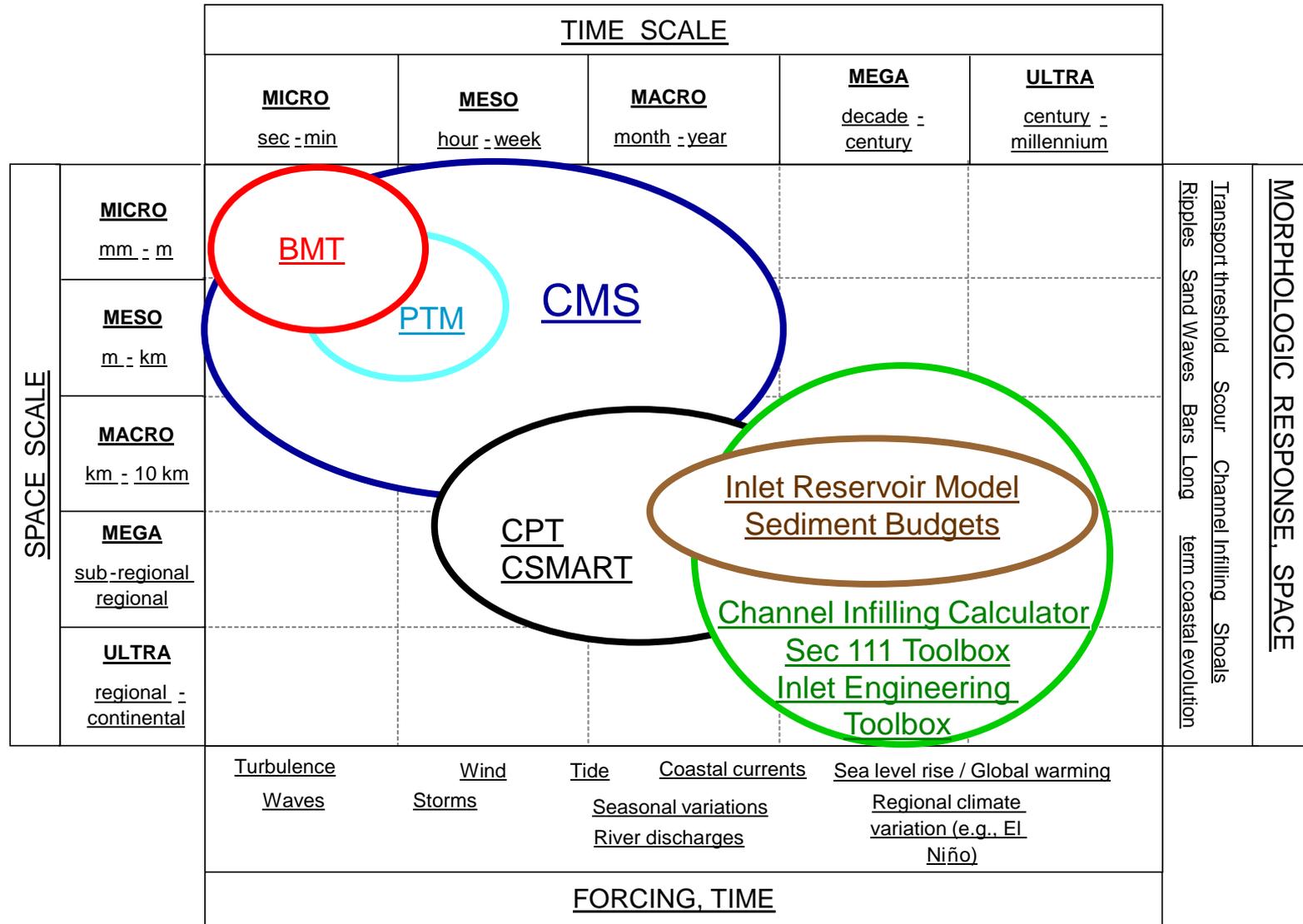
Documentation

- Several TR's, CHETN's and journal papers
- CIRP Wiki
<http://cirp.usace.army.mil/wiki/CMS>
- New Tech Report will be available later this summer

Training and Support (**Free**)

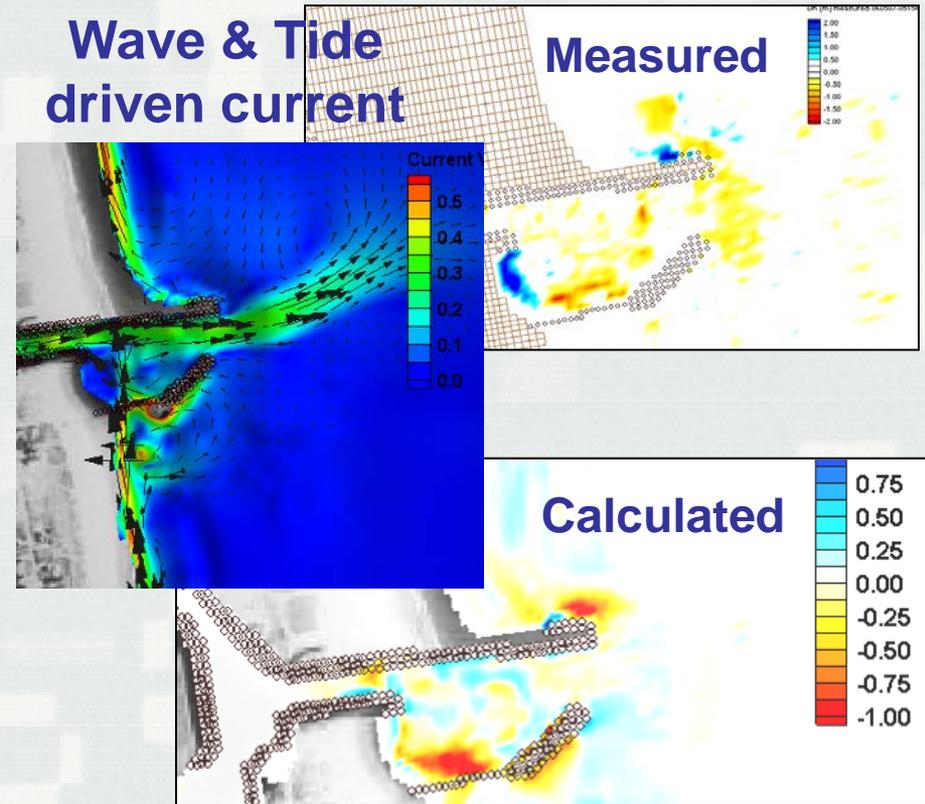
- Tech Transfer Workshops (32 since 1997)
- Additional workshops by request
- On-site training
- Seminars
- Step-by-step instructional material
- Webinars

Scales of Coverage

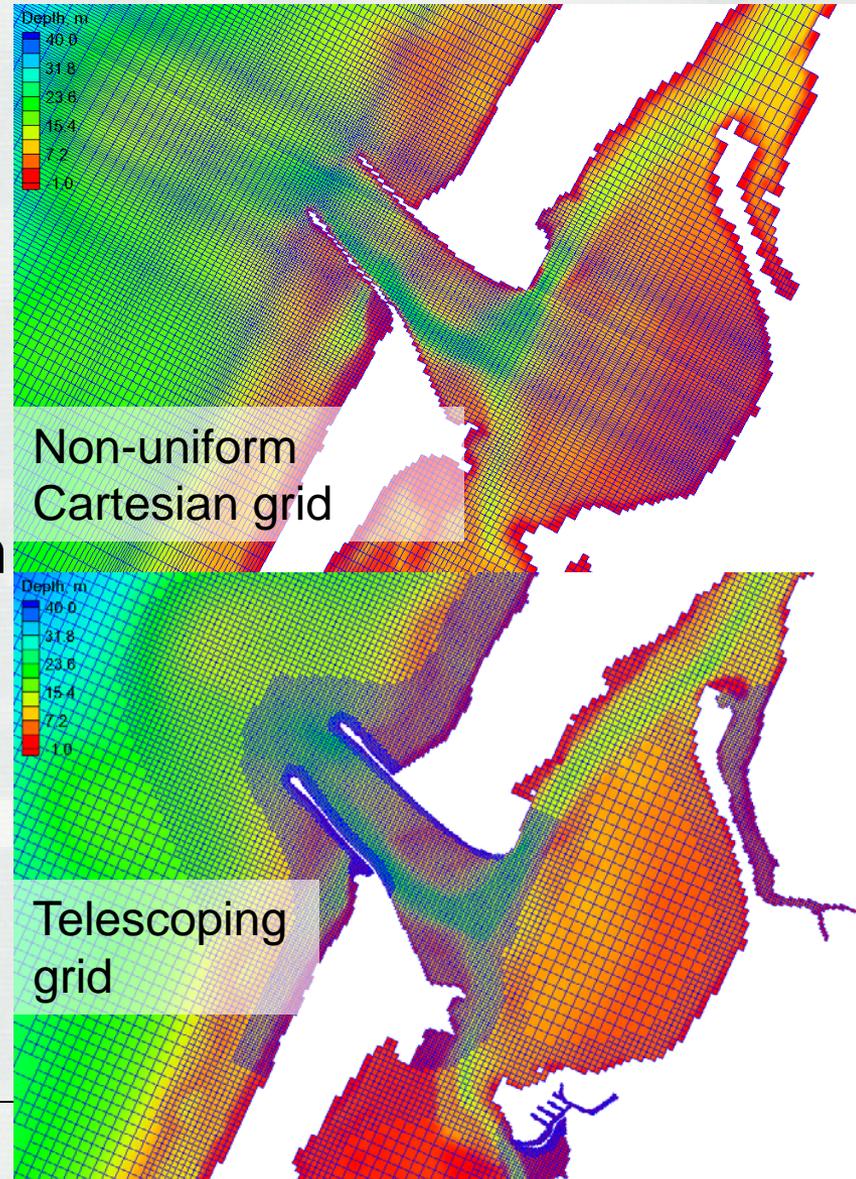


- Finite Volume Method
 - Conserves mass
 - Stable
 - Accessible
- Coupled with spectral wave model (CMS-Wave)
 - Wave-current interactions
- Inline sediment transport and morphology change
 - Non-equilibrium sediment Transport model (NET)
- Nesting capability
- Tide, river, wind, atm. pres., forcing
- Integrated Particle Tracking Model (CMS-PTM)

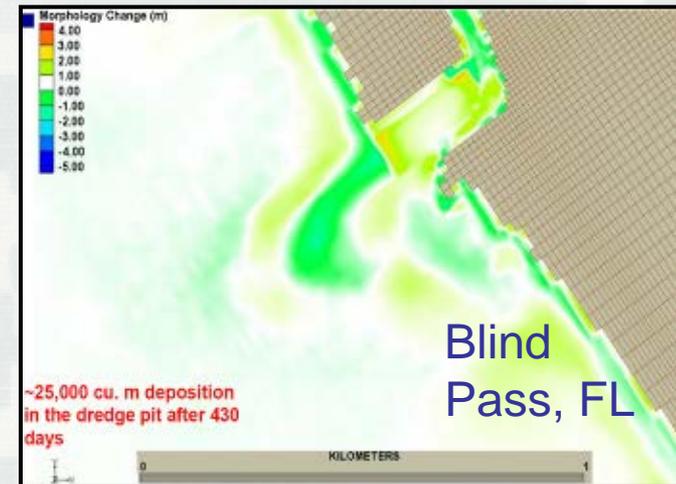
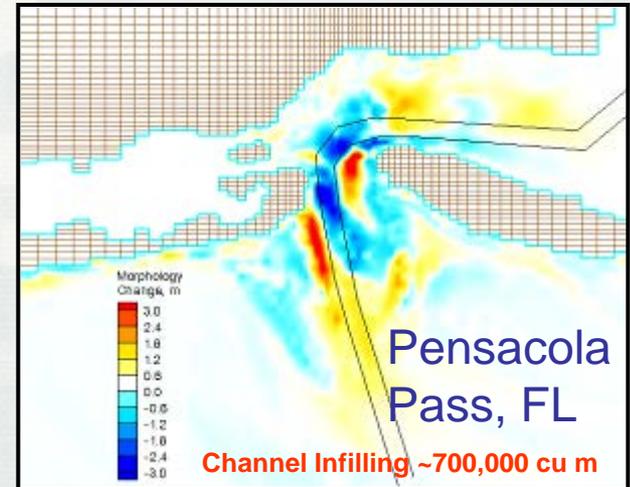
Wave & Tide
driven current



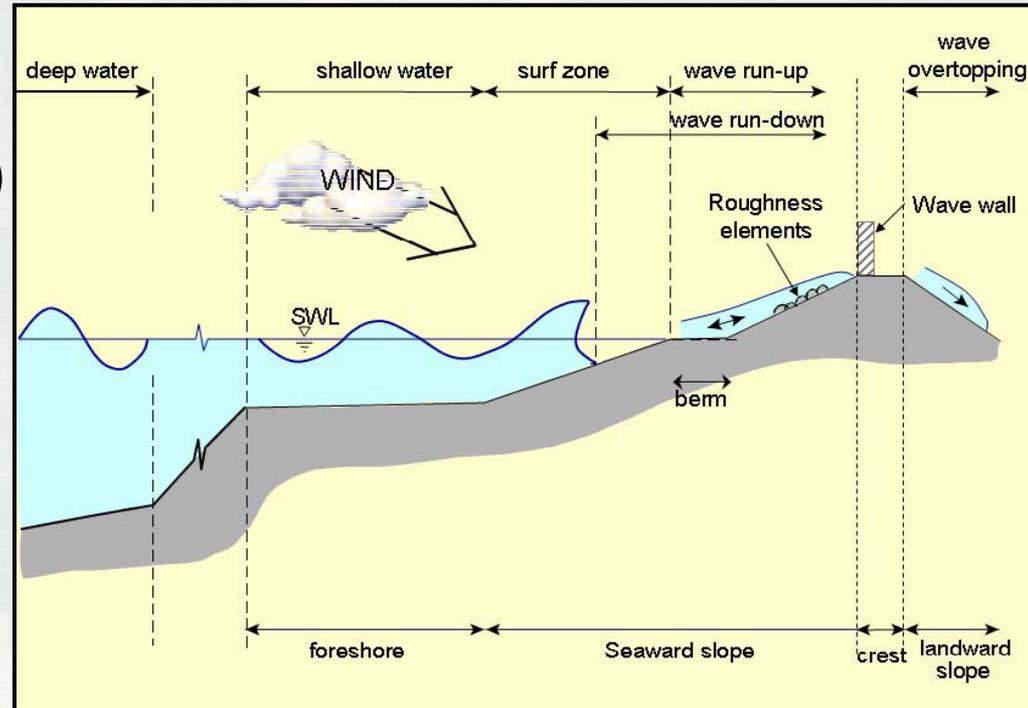
- Grid options
 - Non-uniform Cartesian grid:
Easy to setup
 - Telescoping grid:
Efficient and flexible
- Solver options
 - Implicit: Tidal flow, long-term morphology change. ~10 min time step
 - Explicit: Flooding, breaching, super-critical flow. ~ 1 sec time step
- Parallel Processing



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

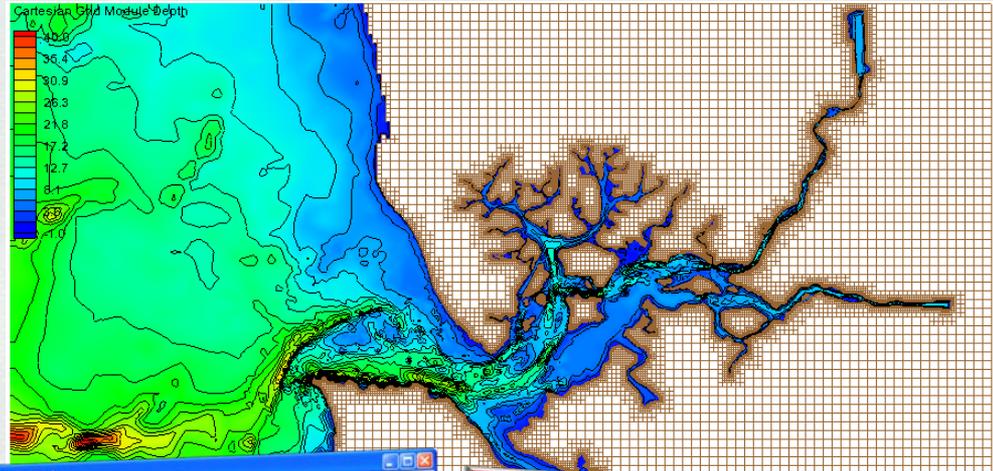


- Shoaling, refraction, diffraction, reflection
- Bottom friction
- White capping
- Wave breaking (4 options)
- Wind generation
- Wave-current, and wave-wave interactions
- Transmission, runup and overtopping
- Muddy bottom
- Automatic grid rotation
- Non-uniform Cartesian grid with nesting capability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



Recent Accomplishments

- New features
 - Telescoping grid
 - Multiple-sized sed transp
 - Surface roller
 - Wave-averaged formulation
 - Cross-shore sed transp
 - CSHORE & Lund-CIRP
- 6 Journal papers
- 5 Conference papers
- 2 V&V TR's
- 6 Wiki-TN's
- 1 PTM CHETN
- 2 CMS & 1 ADH Workshops
- Physical experiment
- R&D in graded sediments

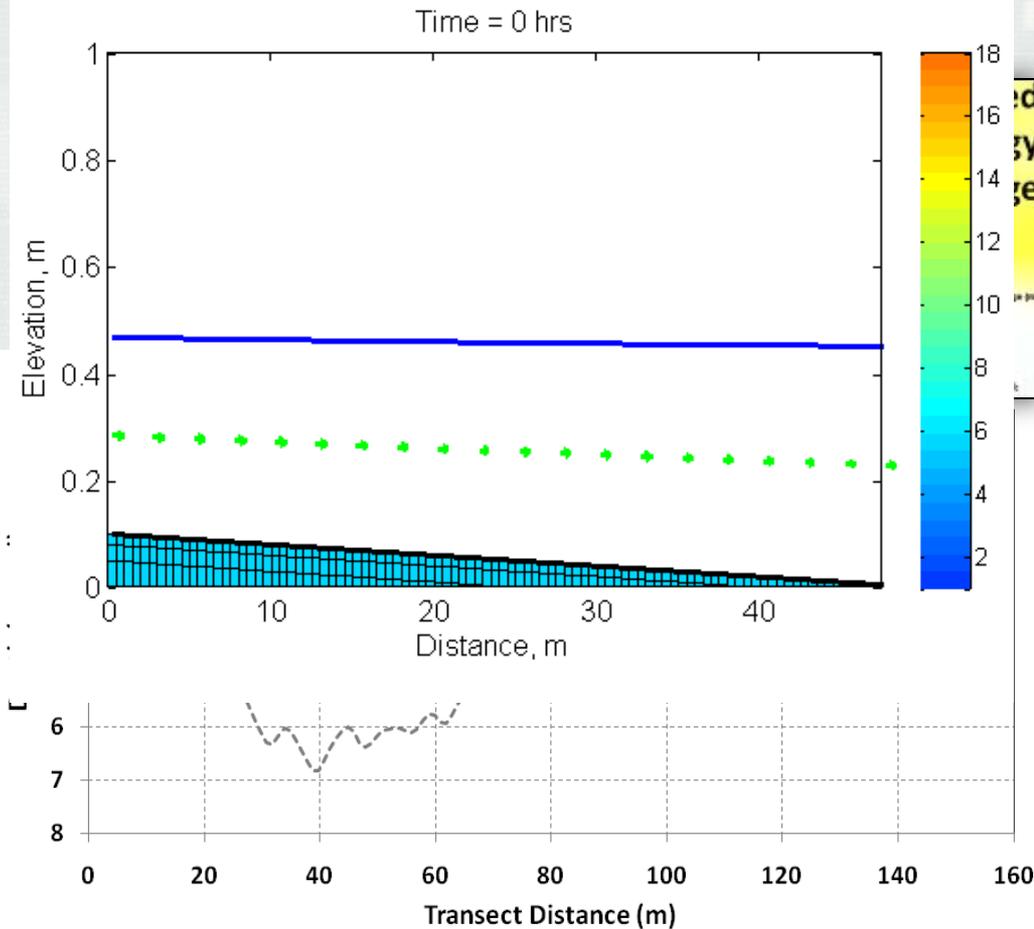


Key Features

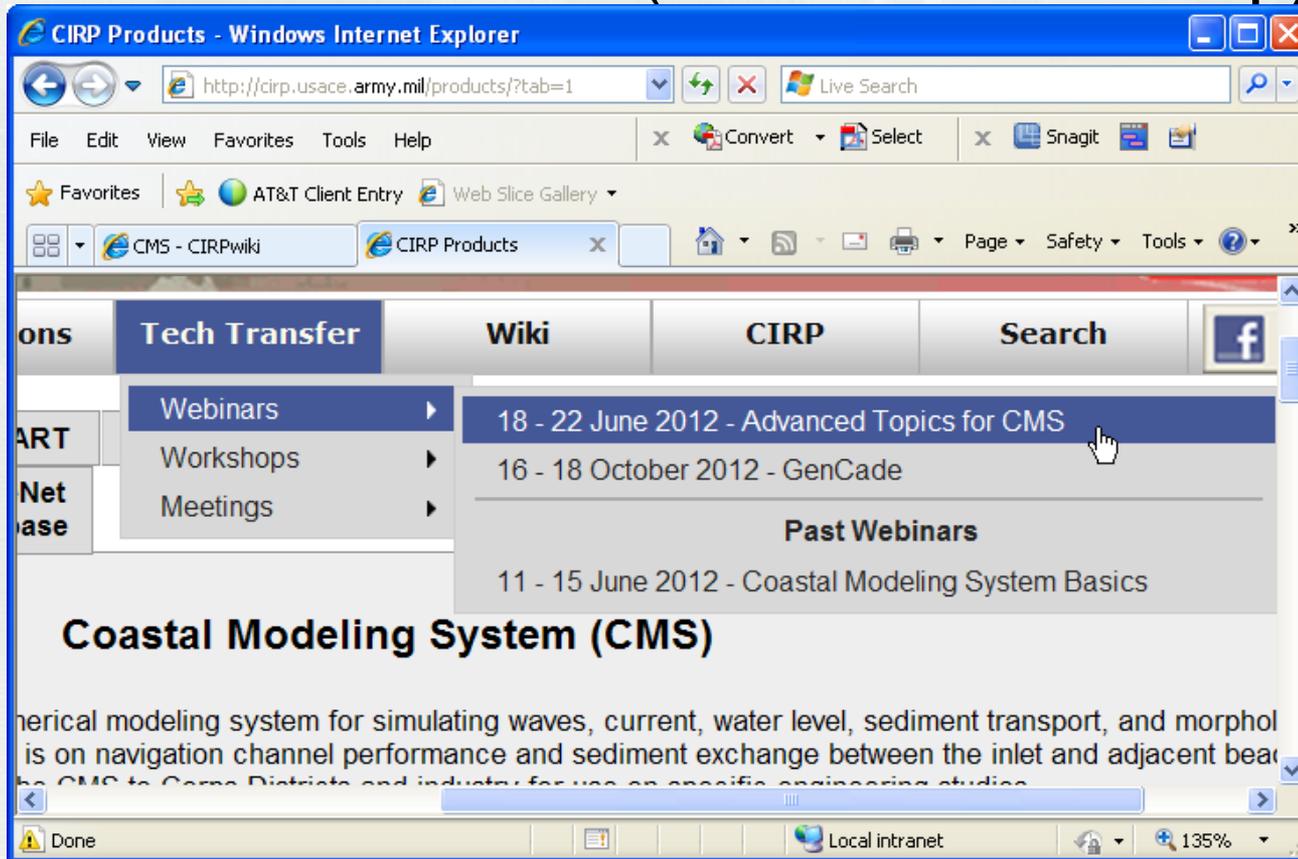
- Fully integrated system
 1. CMS-Flow - In-line flow, sediment and swivity moors
 2. CMS-Wave - Spectral wave transformation model
 3. CMS-PTM - Particle tracking model



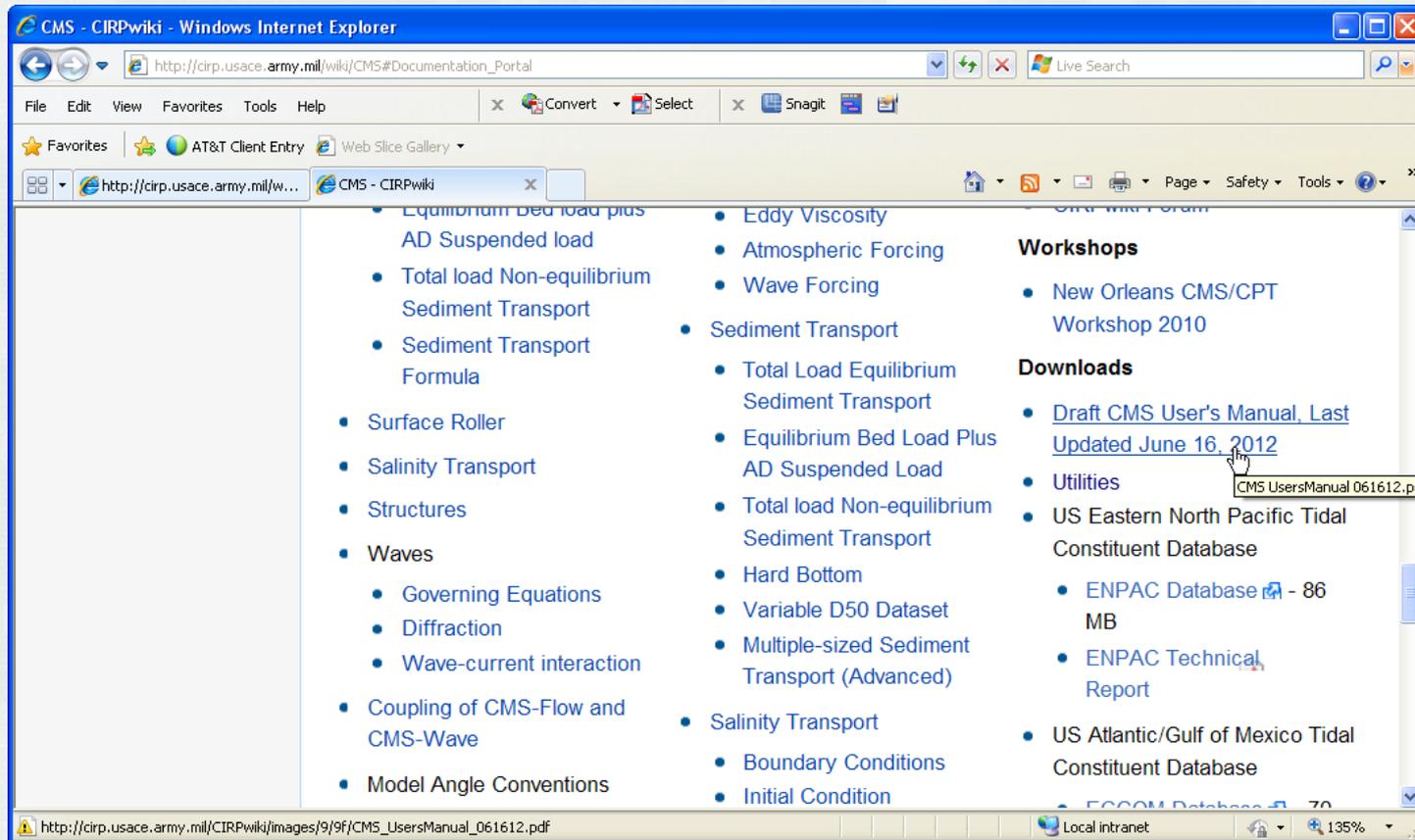
- Provides benchmark data sets and performance with which to evaluate other coastal models
- Applies unambiguous criteria in evaluation of model calculations via goodness-of-fit statistics
- Provides a go-by for applications to similar coastal projects and problems
- Identifies areas for future data collection and research
- Data and draft reports will be posted on CIRP website



- CMS-Flow data folder (same as workshop)



<http://cirp.usace.army.mil/workshops/nap12/NAP-Workshop.html>



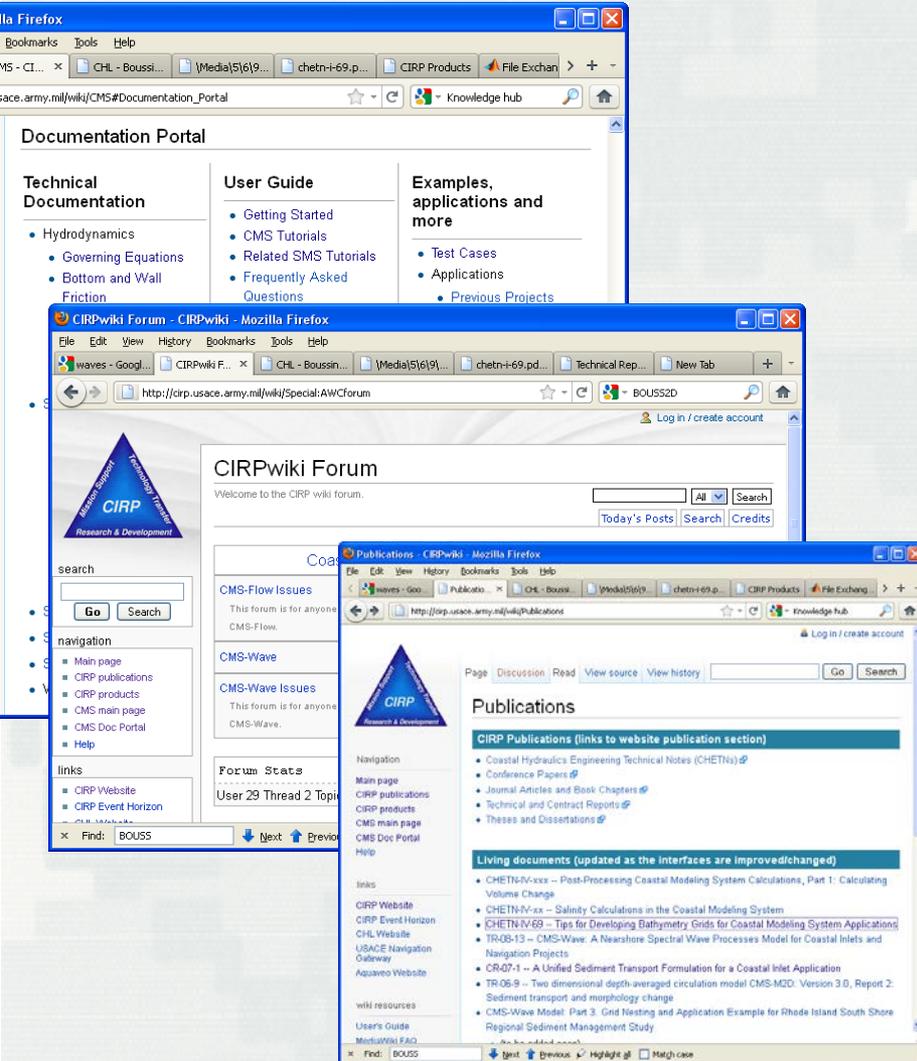
<http://cirp.usace.army.mil/wiki/CMS>

CIRP Websites

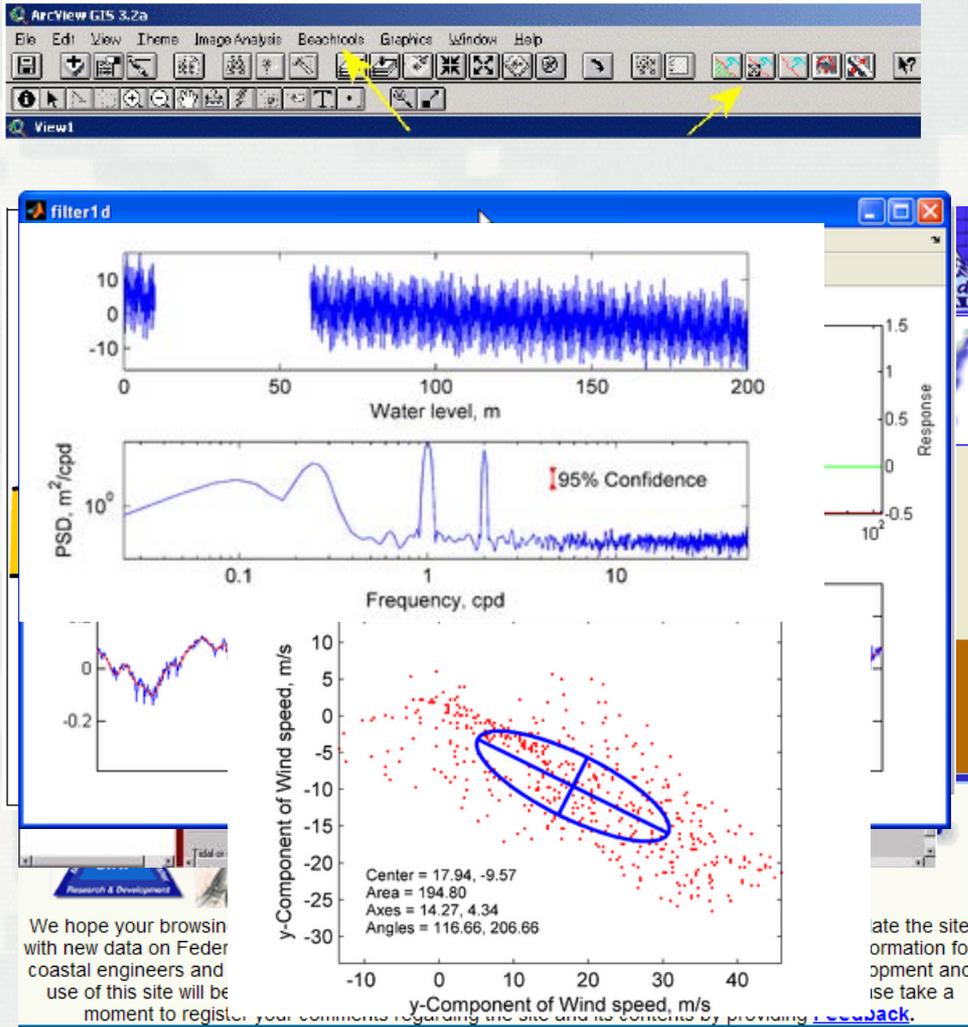


60 CIRP documents published as eBooks

- 183 Content Pages
- >75,00 views
- Documentation Portal
 - Technical Documents
 - User Guide, tutorials, user-interface, guidance
 - Test cases
- Forum
- Links to CIRP website, publications, products, etc



Other Products and Tools



- Beach Tools
- Inlets Online
- Inlet Reservoir Model
- Channel Equilibrium Area
- Tidal Analysis and Prediction Software
- Filter1D : Time Series Analysis Tool
- Utilities for pre- and post-processing, data analysis and plotting (e.g. HyPAS)
- Downloadable from CIRP website or Wiki

CIRP Publications - Windows Internet Explorer

http://cirp.usace.army.mil/pubs/

File Edit View Favorites Tools Help

AT&T Client Entry Web Slice Gallery

References - ... CIRP Publi...



Publications Tech Transfer Wiki CIRP

CIRP Publications

- [Coastal Hydraulics Technical Notes \(CHETNs\) **NEW**](#)
- [Conference Papers](#)
- [Journal Articles **NEW**](#)
- [Technical Reports **NEW**](#)
- [Theses and Dissertations](#)
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 - CHL Website
 - USACE Navigation Gateway
 - Aquaveo Website
- wiki resources
 - User's Guide
 - MediaWiki FAQ
 - MediaWiki mailing list
- Toolbox
 - What links here
 - Related changes

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Reports and Tech Notes

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- Decent text editor such as Textpad, UltraEdit, NotePad++, etc.
 - For viewing and editing large ASCII files
- HDFView
 - For viewing and editing XMDF files
- Matlab or Octave (free)
 - For pre-processing, post-processing, data analysis, and visualization.
- Excel is ok, but don't use it for everything (yes you)
- Good computing machine

Questions?

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601-634-2027

Thanks to the CIRP team and developers: