

Coastal Modeling System

Advanced Topics



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US Army Corps of Engineers
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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**

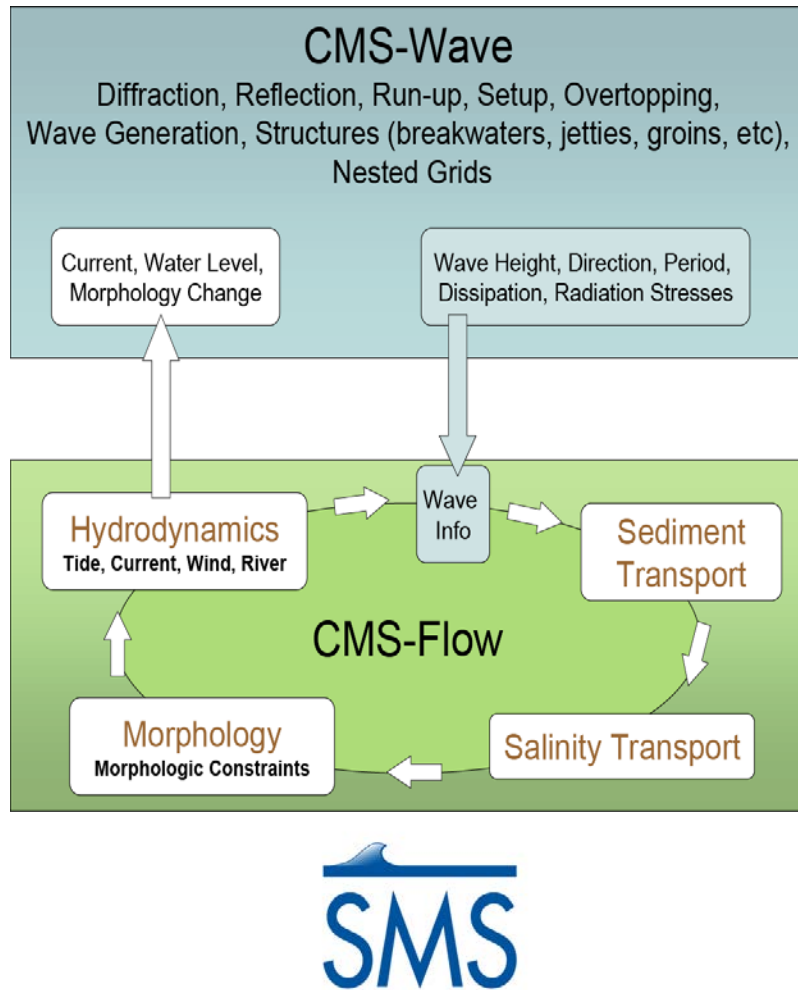
- Numerical Methods
- Advanced Output
- Scripting

▪ **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

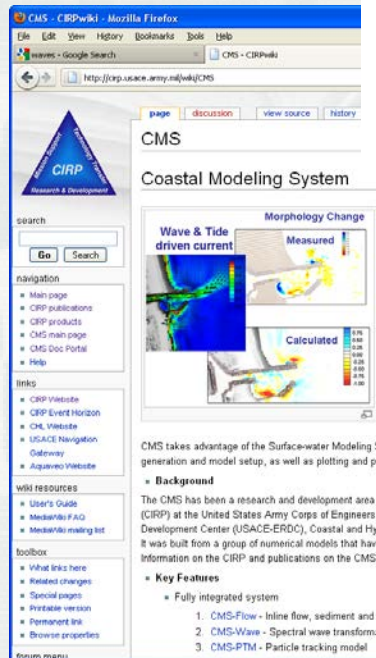
Coastal Modeling System

Coastal Modeling System Overview, background and capabilities

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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.

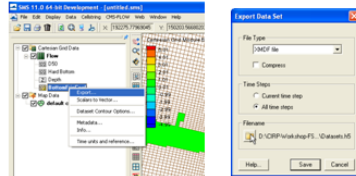


Figure 5.1.12. Manning's n contours after modifying the areas under all three bridges.

Additional Bottom Friction Cards

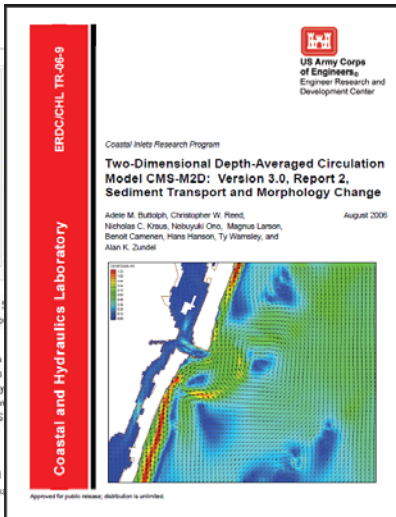
Additional advanced cards are available for setting the bottom friction to a constant for the whole grid. These cards are useful for running sensitivity analysis for a wide range of values in cases which can be approximated with a single constant bottom friction value.

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	0.0	0.0 - 1.0	Specifies a constant input Manning's n coefficient. Overrides any previous bottom friction cards.	$n=0.0$
BOTTOM_FRICTION_COEFF_CONSTANT	real number	0.0	0.0 - 1.0	Specifies a constant input Bottom Friction Coefficient. Overrides any previous bottom friction cards.	$n=0.0$
ROUGHNESS_WEIGHT_CONSTANT	real number	0.0	0.0 - 1.0	Specifies a constant Roughness Weight in m^2 . Overrides any previous bottom friction cards.	$n=0.0$

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.



Availability

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

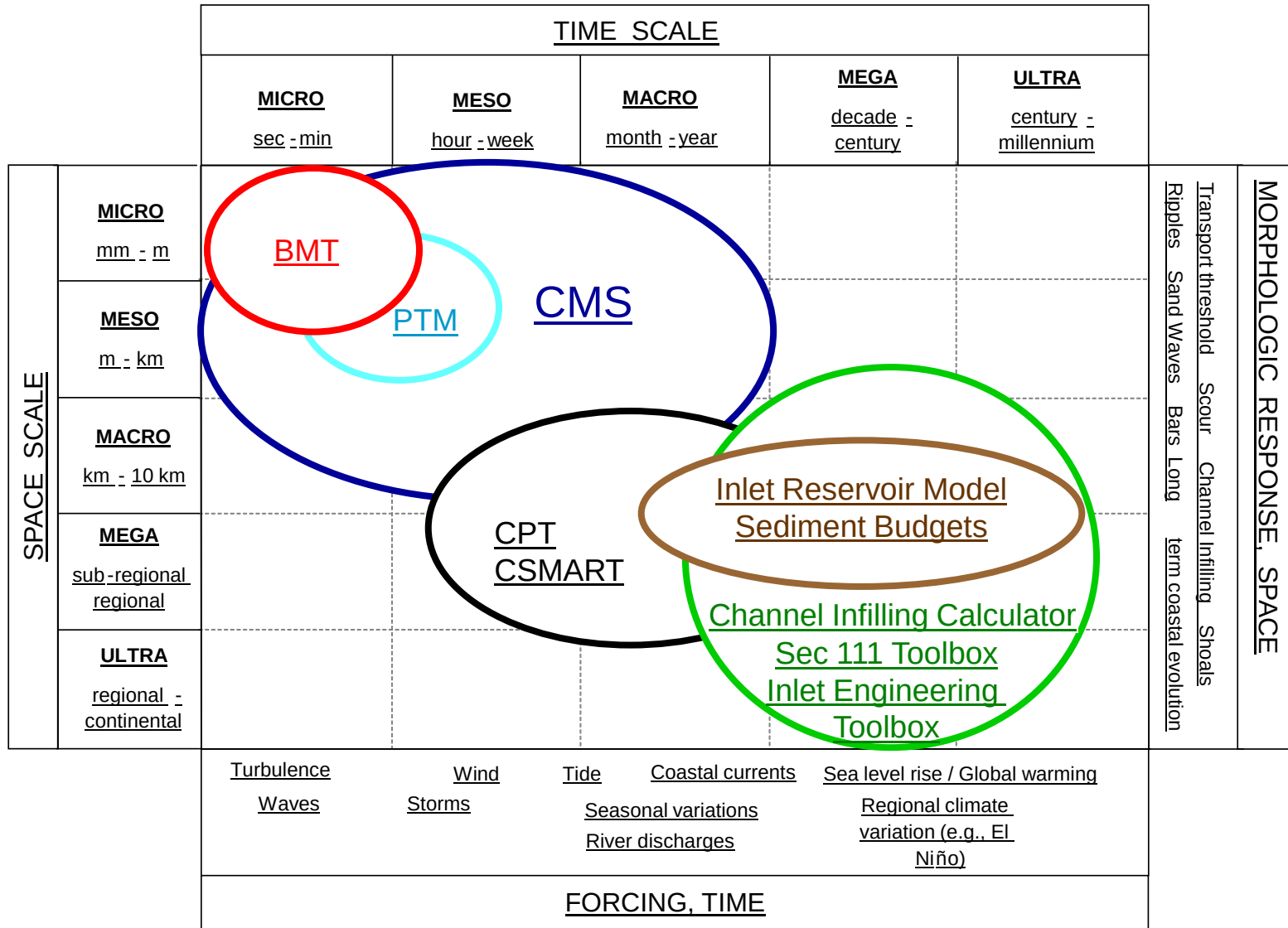
Documentation

- 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

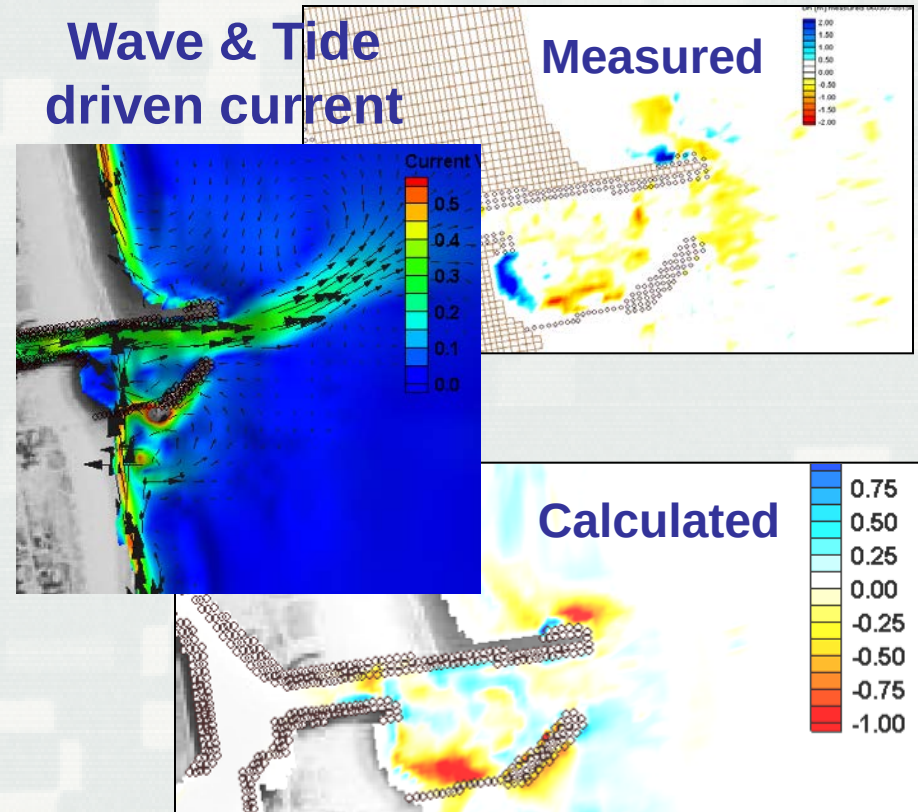
Scales of Coverage



CMS-Flow Key Features

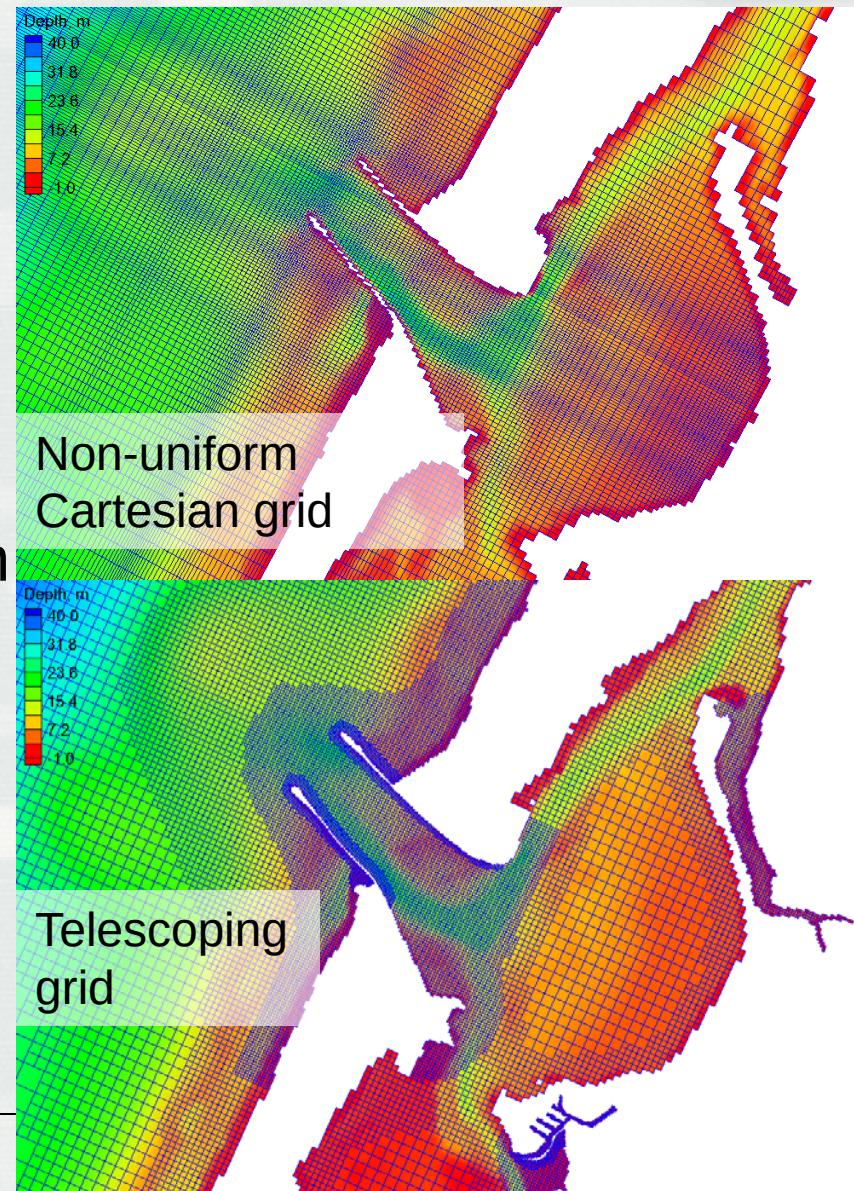
- Finite Volume Method
 - Conserves mass
 - Stable
 - Accessible
- Coupled with spectral wave model (CMS-Wave)
 - Wave-current interactions
- Inline sediment transport and morphology change
 - Non-equilibrium sediment Transport model (NET)
- Nesting capability
- Tide, river, wind, atm. pres., forcing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

**Wave & Tide
driven current**

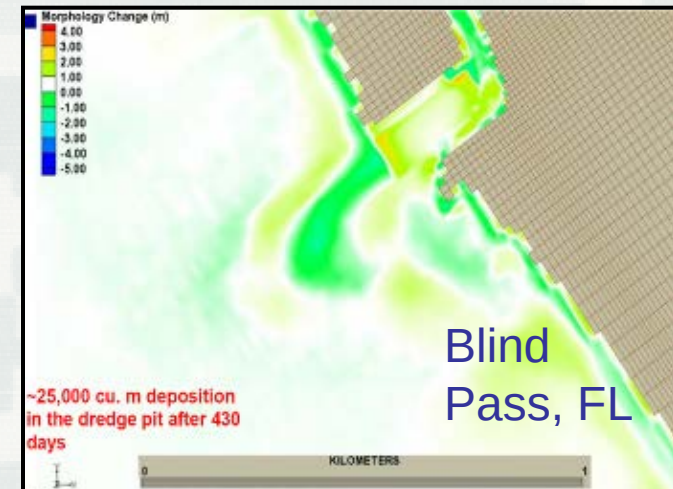
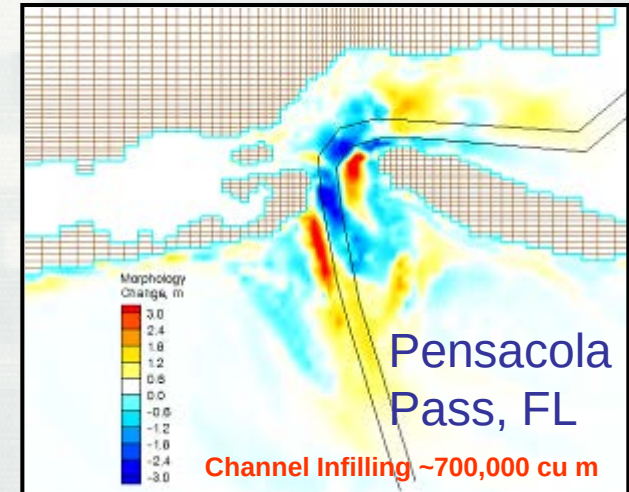


CMS-Flow Key Features

- 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

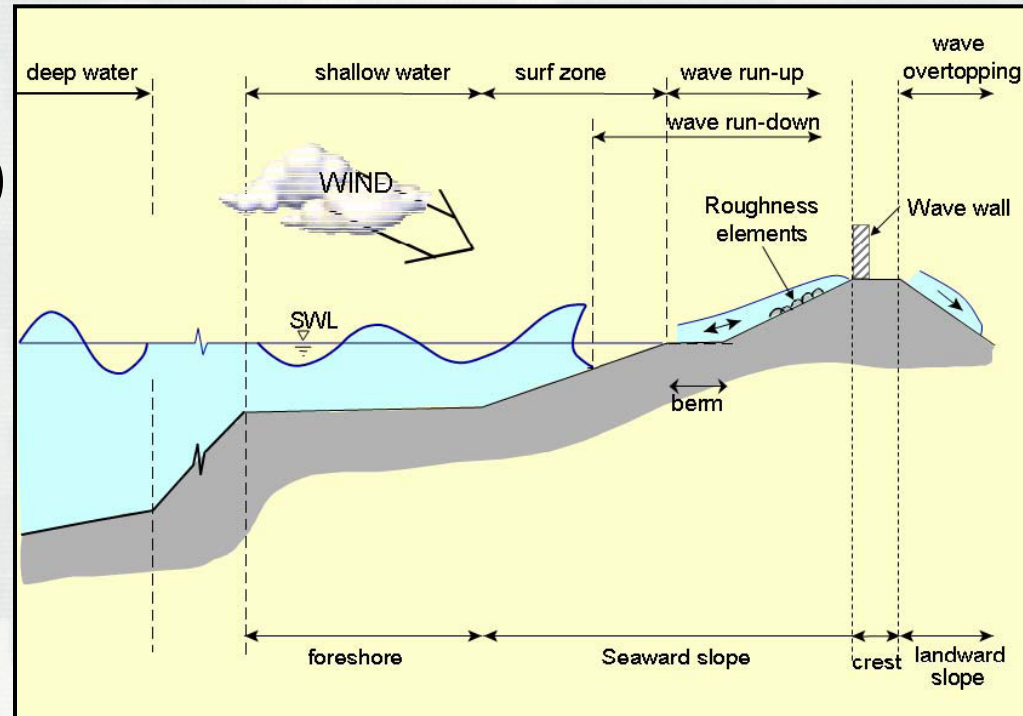


- Sediment transport models
 - Equilibrium Total Load (Exner equation)
 - Eq. Bed Load + AD Suspended Load
 - Non-Eq. (AD Total Load)
- Sediment transport formulas
 - Lund-CIRP
 - Van Rijn
 - Watanabe
 - Soulsby-van Rijn
- Hard-bottom
- Avalanching
- Bed slope influence on bed load
- Multiple-sized sed.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



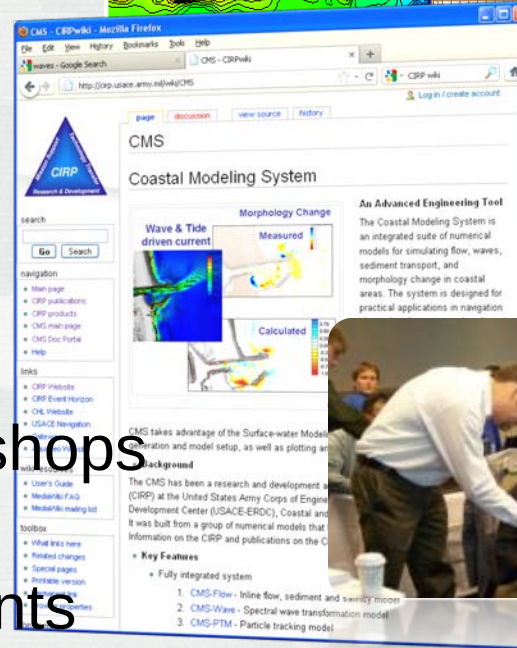
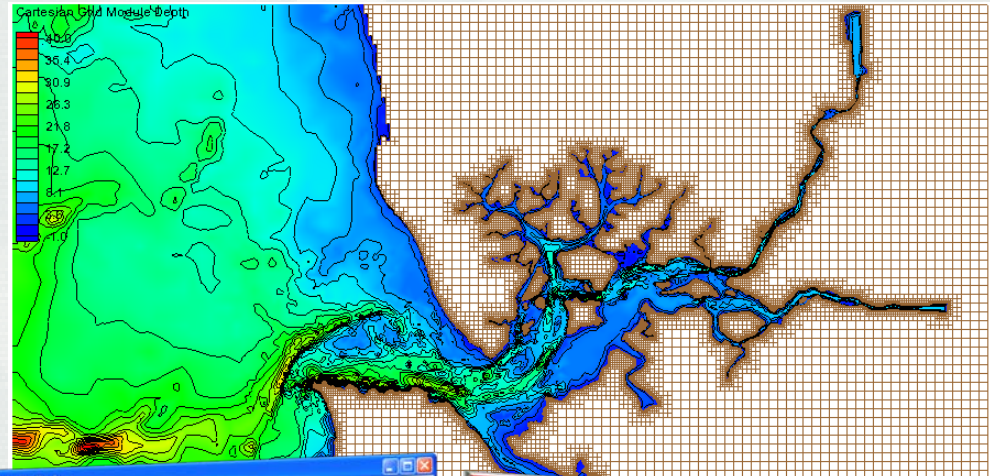
CMS-Wave: Key Features

- 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”



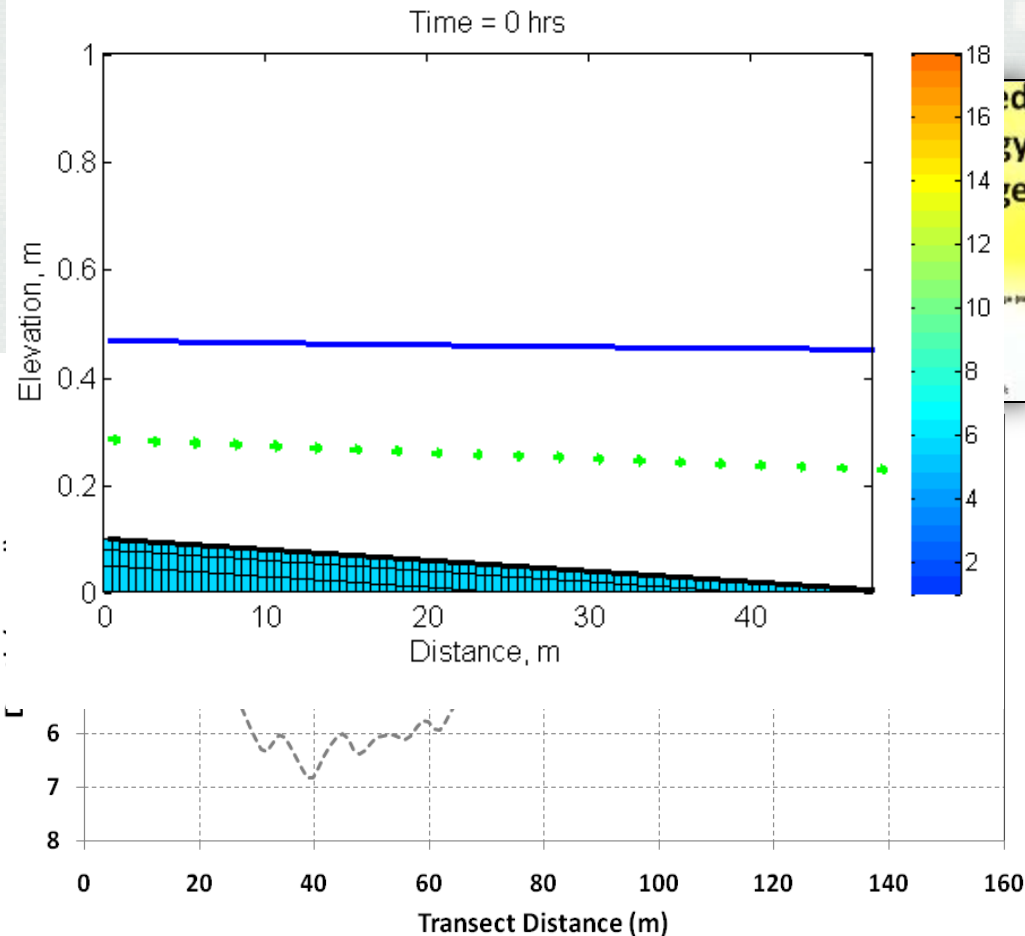
Recent Accomplishments

- 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



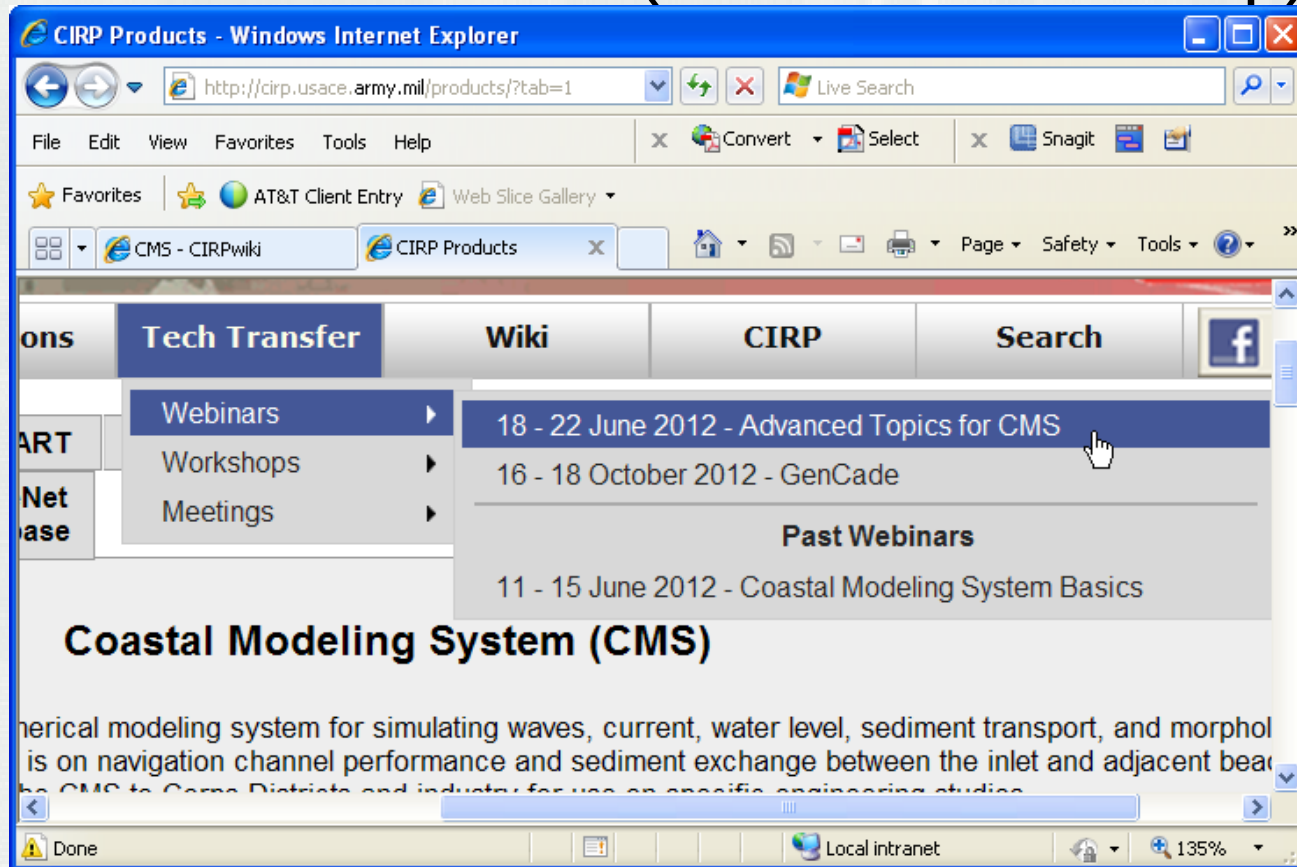
Verification and Validation Reports

- 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



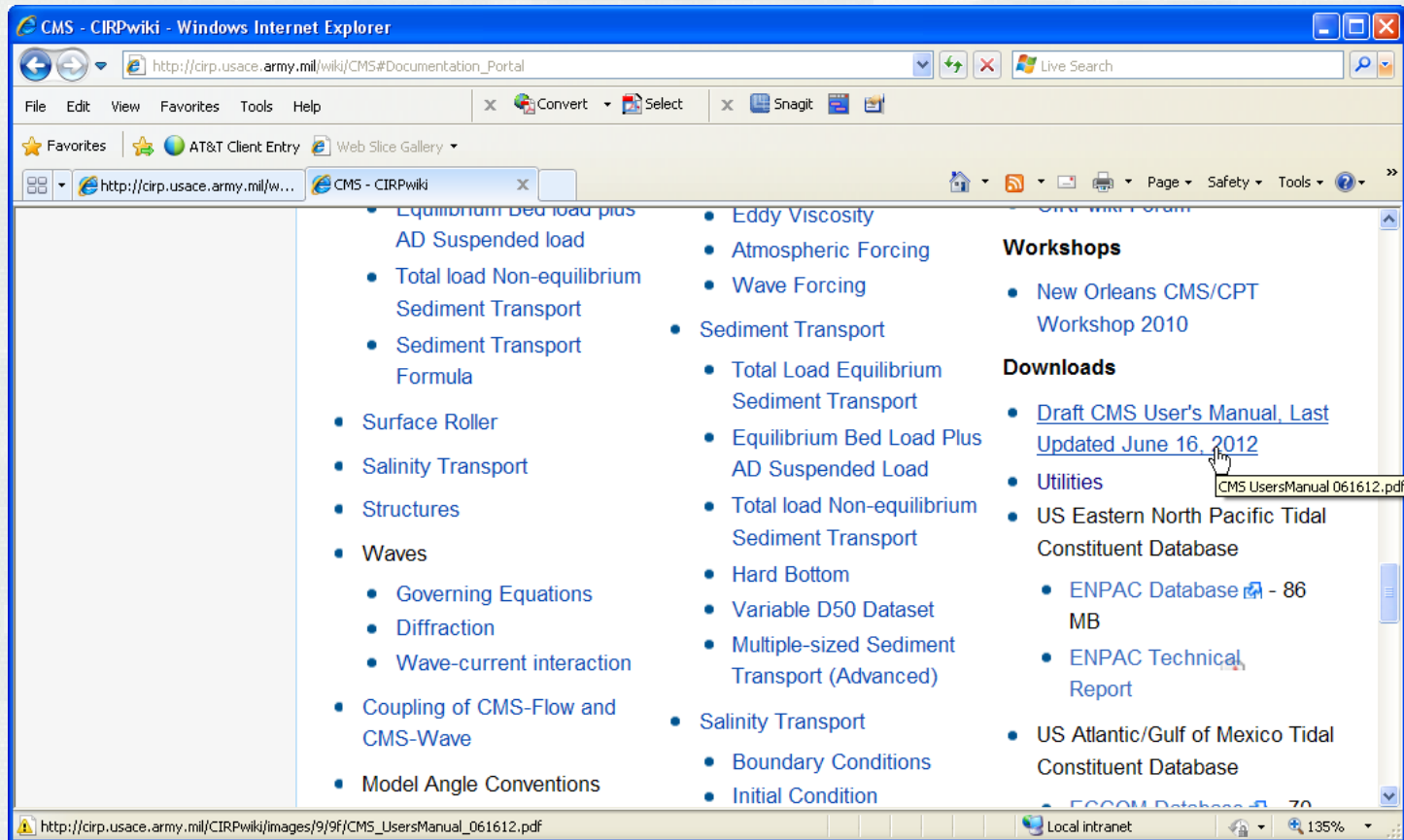
Workshop Material

- CMS-Flow data folder (same as workshop)



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

Draft CMS User Manual



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

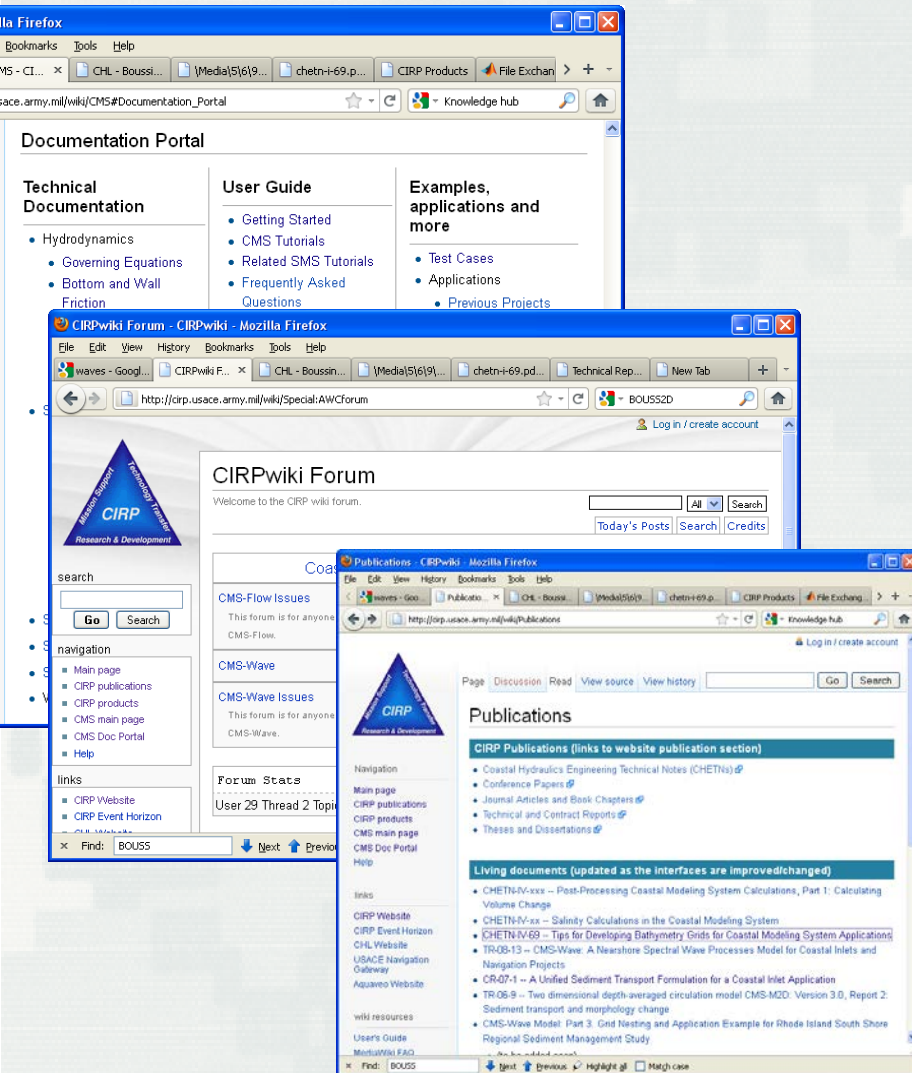
CIRP Websites



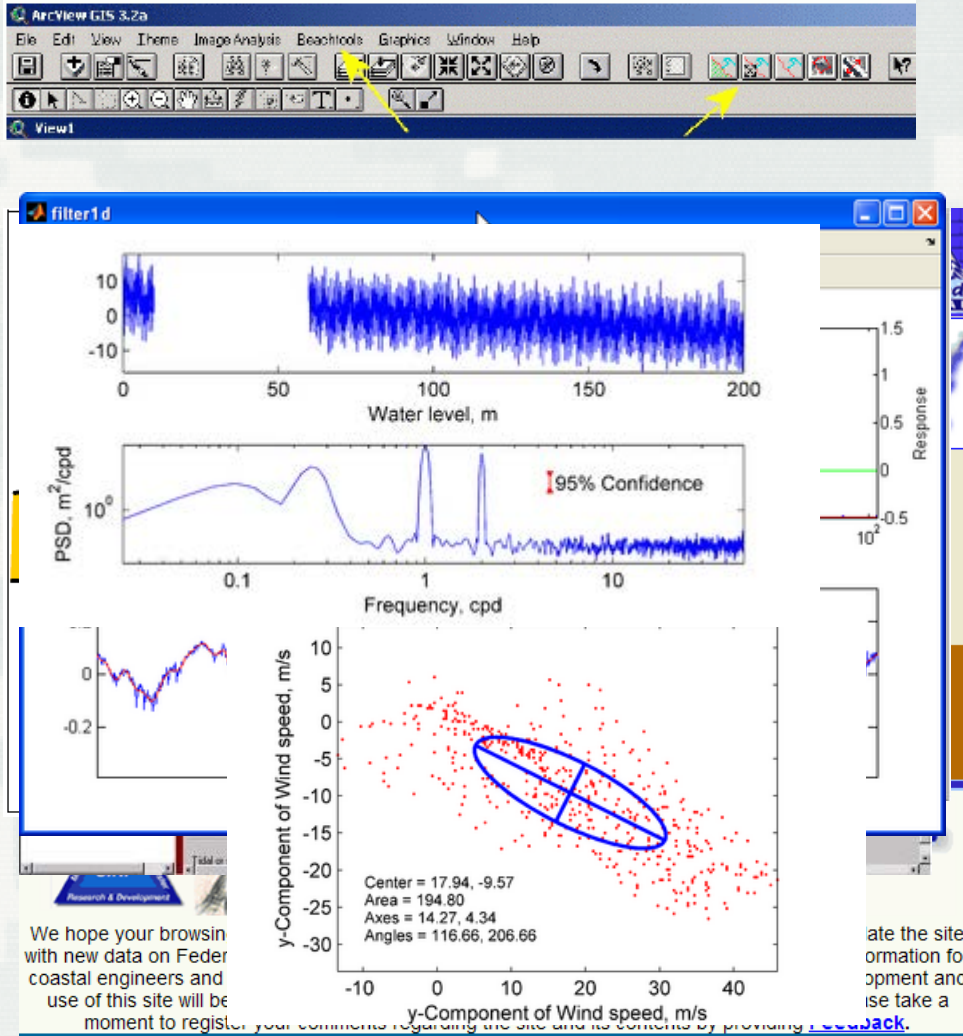
60 CIRP documents published as eBooks

CIRP Wiki

- 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/

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US Army Corps of Engineers
CIRP - Coastal Inlets Research Program

Publications Tech Transfer Wiki CIRP

CIRP Publications

[Coastal Hydraulics Technical Notes \(CHETNs\)](#) **NEW**

[Conference Papers](#)

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Main page

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links

- CIRP Website
- 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: