Coastal Modeling System

Advanced Topics

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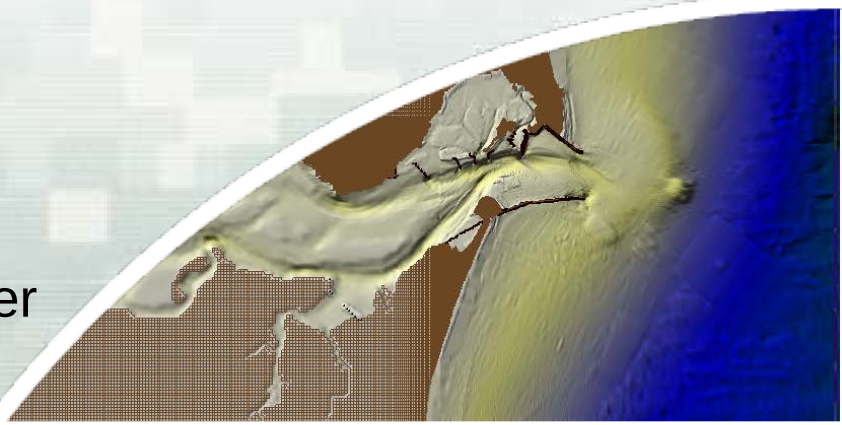
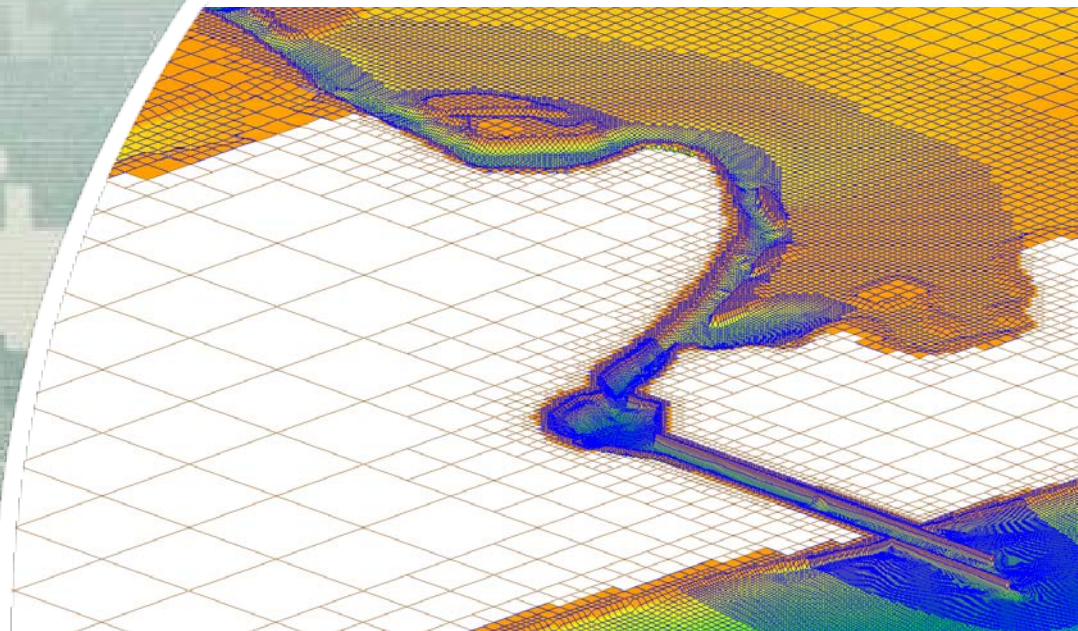
June 18, 2012





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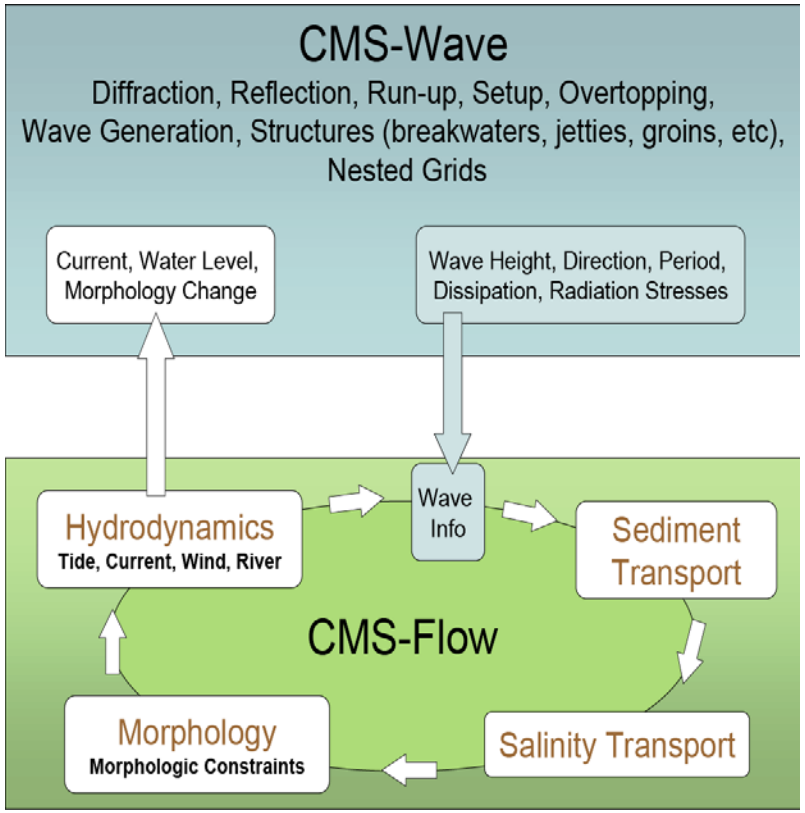
Webinar Outline

- **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 analyize 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

Coastal Modeling System (CMS)



SMS

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

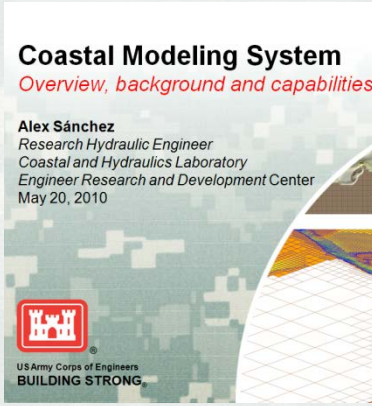
Channels: Deepening, widening, lengthening, realigning

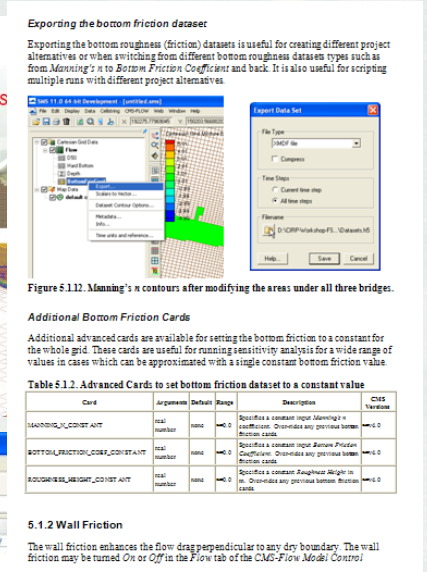
Jetties: Lengthening, raising, rehabbing

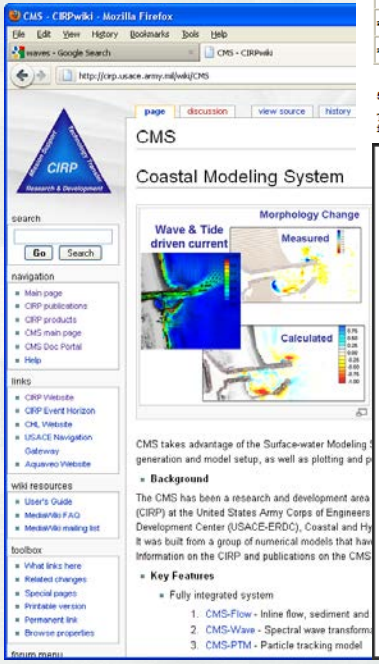
O&M: Placement areas – berms, wetlands

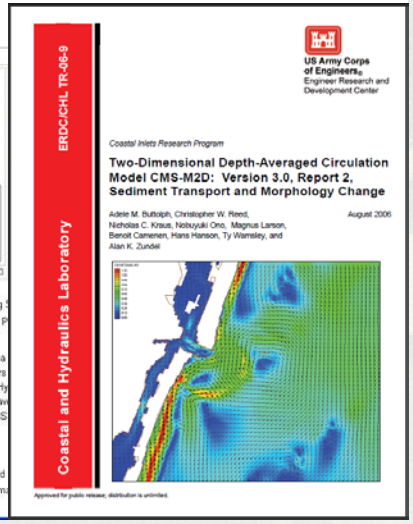
Processes: *Navigability* – waves and currents; *Environmental* – circulation, and sediment transport

Coastal Modeling System









Availability

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

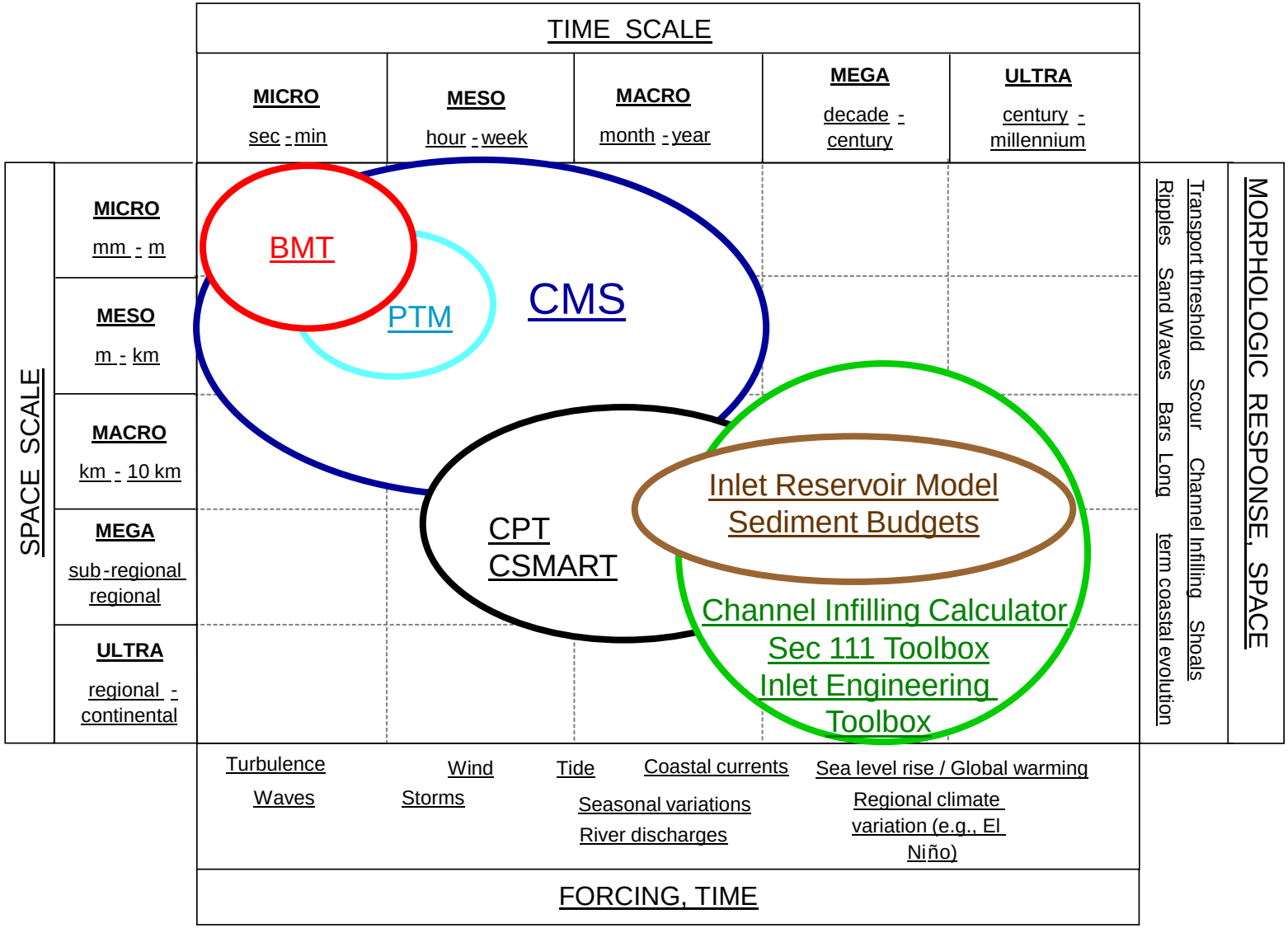
Documentation

- 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)

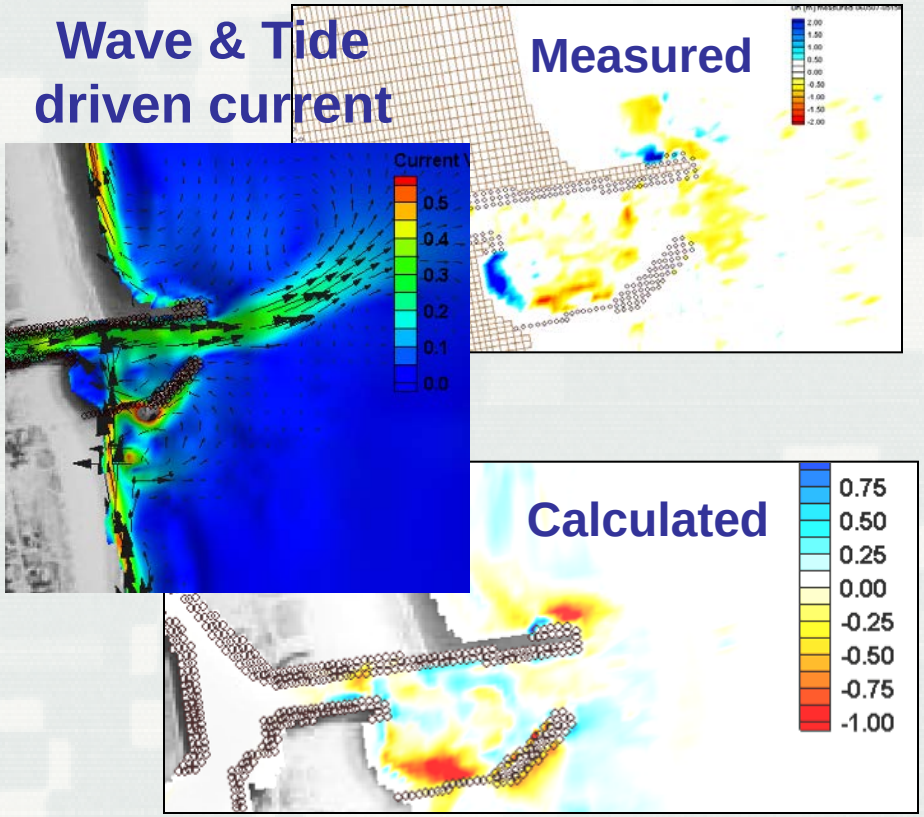
- Tech Transfer Workshops (32 since 1997)
- Additional workshops by request
- On-site training
- Seminars
- Step-by-step instructional material
- Webinars

Scales of Coverage



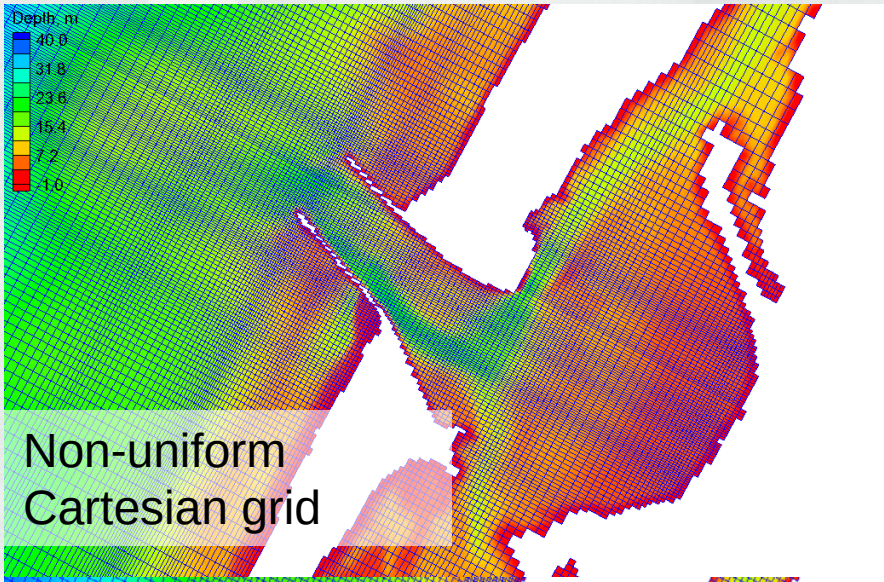
CMS-Flow Key Features

- 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)

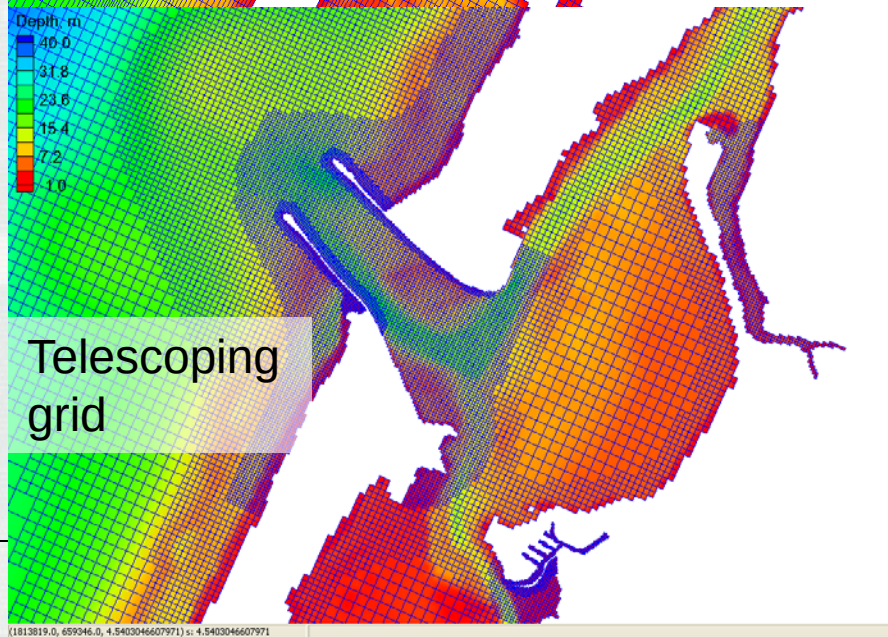


CMS-Flow Key Features

- 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



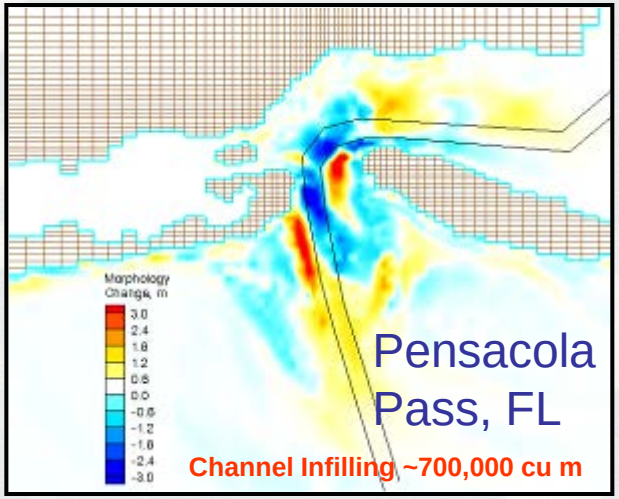
Non-uniform Cartesian grid

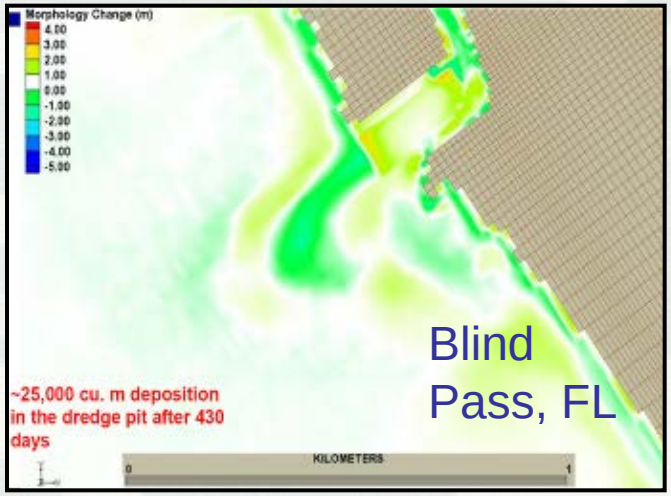


Telescoping grid

Sediment Transport: Key features

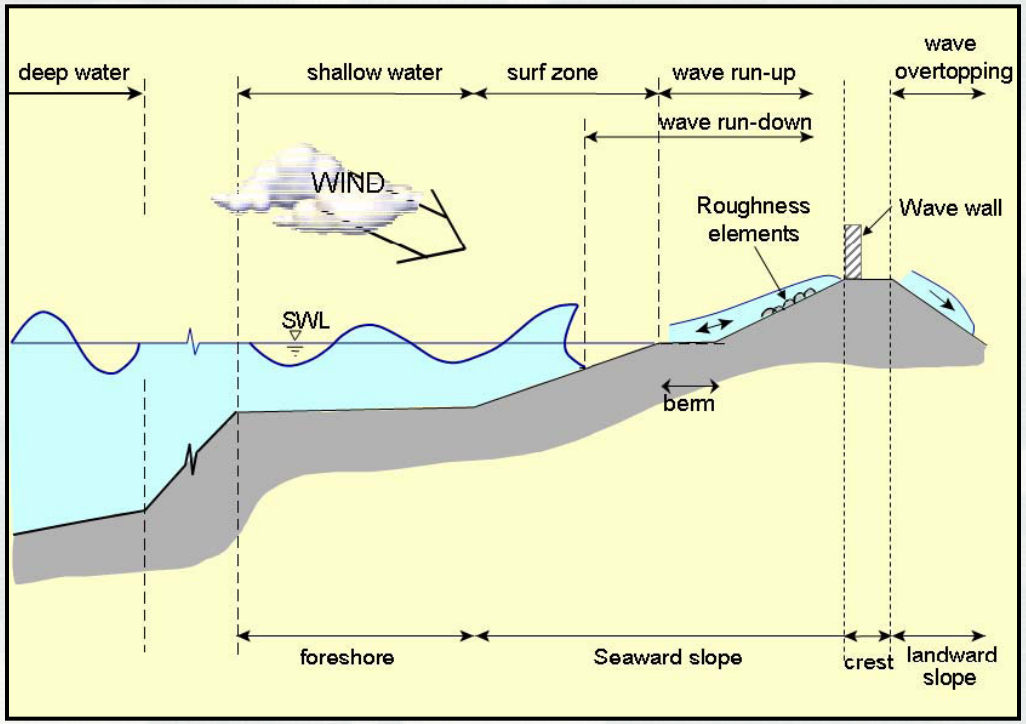
- Sediment transport models
  - Equilibrium Total Load (Exner equation)
  - Eq. Bed Load + AD Suspended Load
  - Non-Eq. (AD Total Load)
- Sediment transport formulas
  - Lund-CIRP
  - Van Rijn
  - Watanabe
  - Soulsby-van Rijn
- Hard-bottom
- Avalanching
- Bed slope influence on bed load
- Multiple-sized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





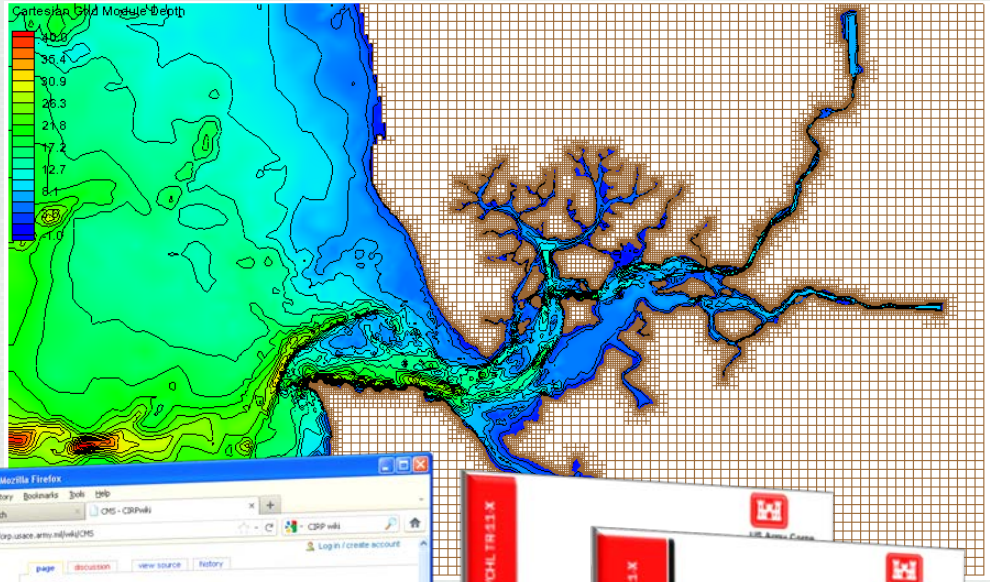
CMS-Wave: Key Features

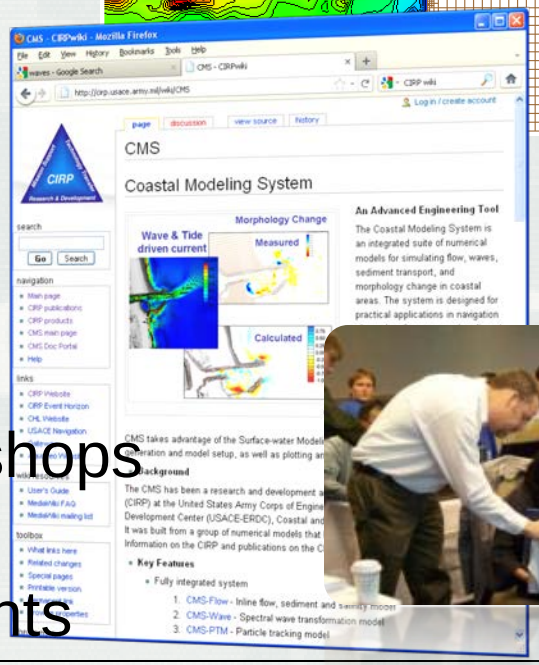
- Shoaling, refraction, diffraction, reflection
- Bottom friction
- White capping
- Wave breaking (4 options)
- Wind generation
- Wave-current, and wave-wave interactions
- Transmission, runup and overtopping
- Muddy bottom
- Automatic grid rotation
- Non-uniform Cartesian grid with nesting capability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



Recent Accomplishments

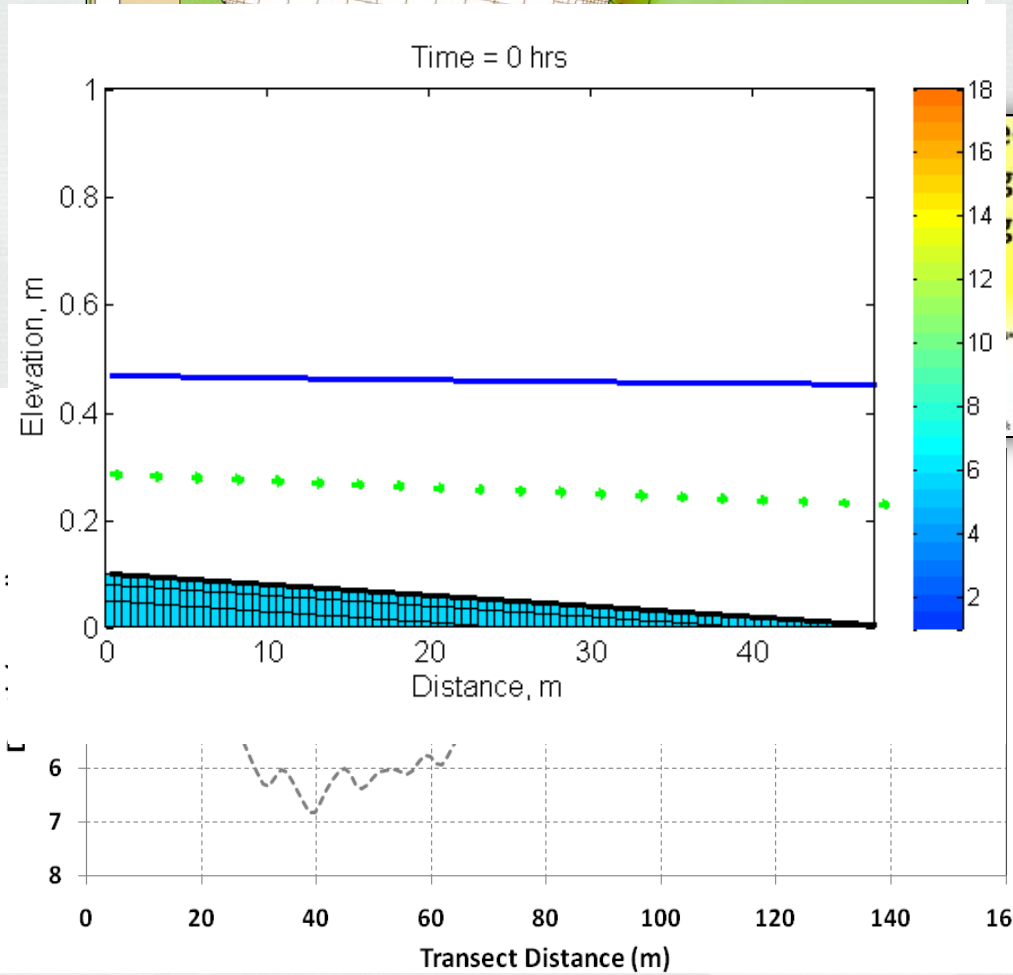
- New features
  - Telescoping grid
  - Multiple-sized sed transp
  - Surface roller
  - Wave-averaged formulation
  - Cross-shore sed transp
    - CSHORE & Lund-CIRP
- 6 Journal papers
- 5 Conference papers
- 2 V&V TR's
- 6 Wiki-TN's
- 1 PTM CHETN
- 2 CMS & 1 ADH Workshops
- Physical experiment
- R&D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





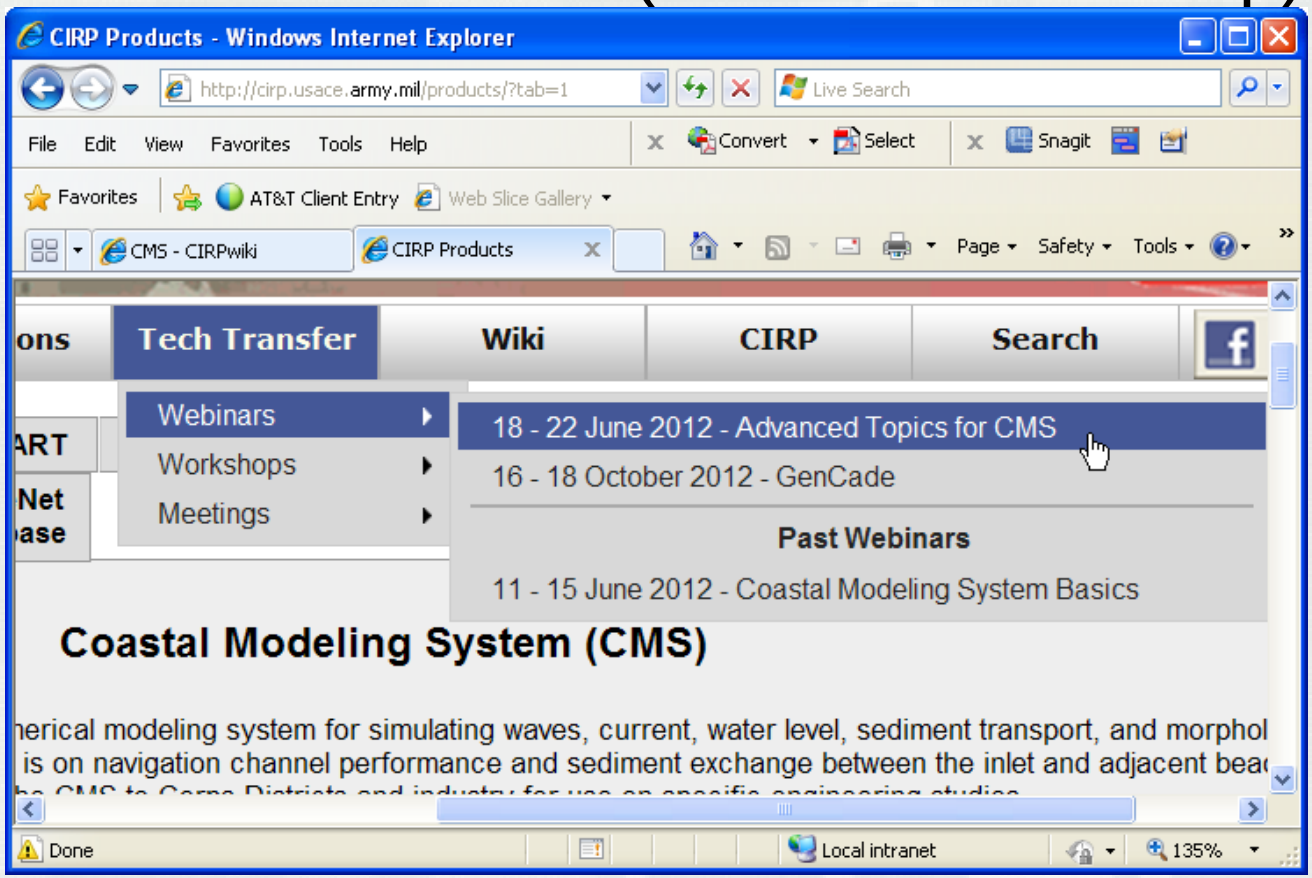
Verification and Validation Reports

- 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



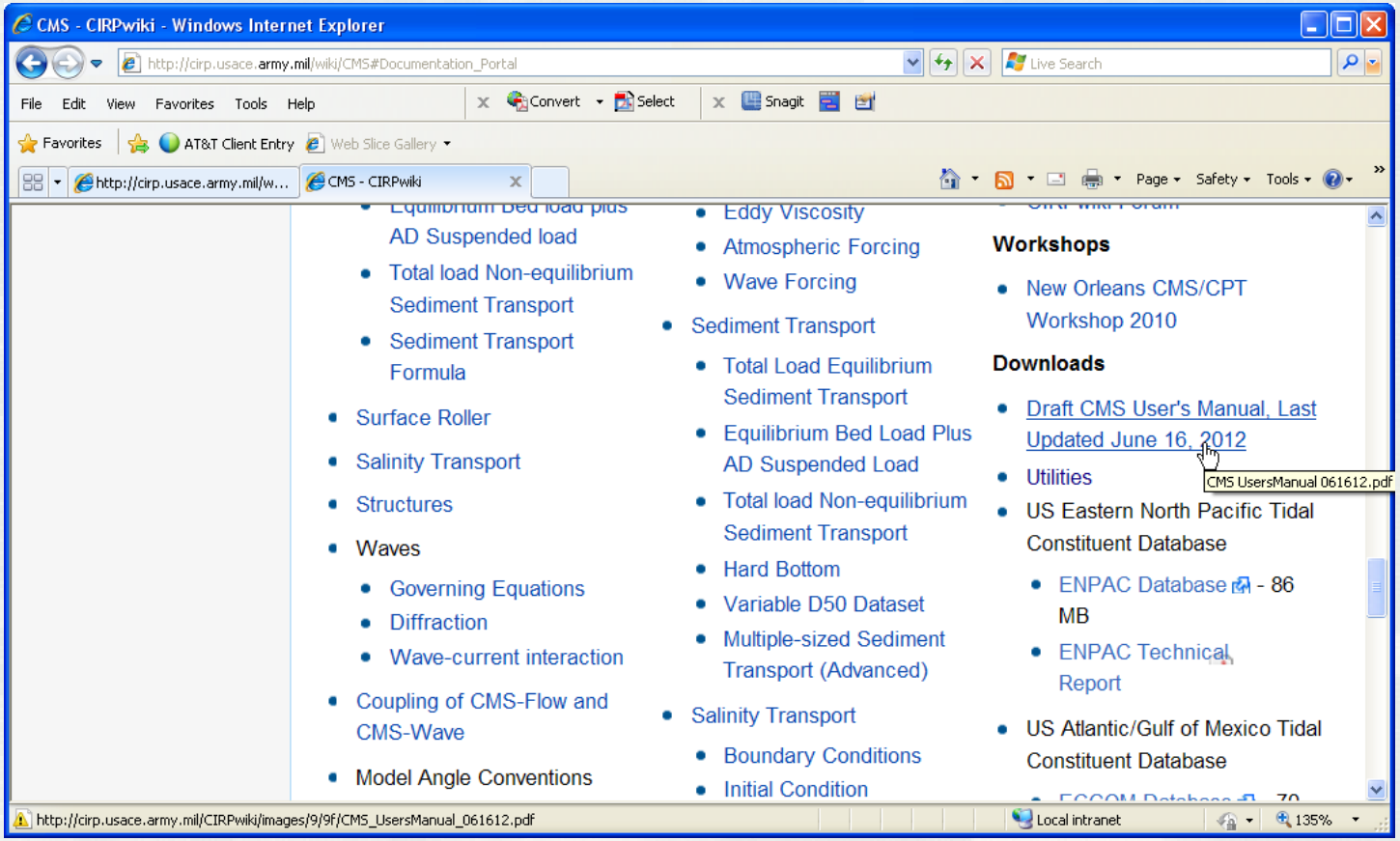
Workshop Material

- CMS-Flow data folder (same as workshop)



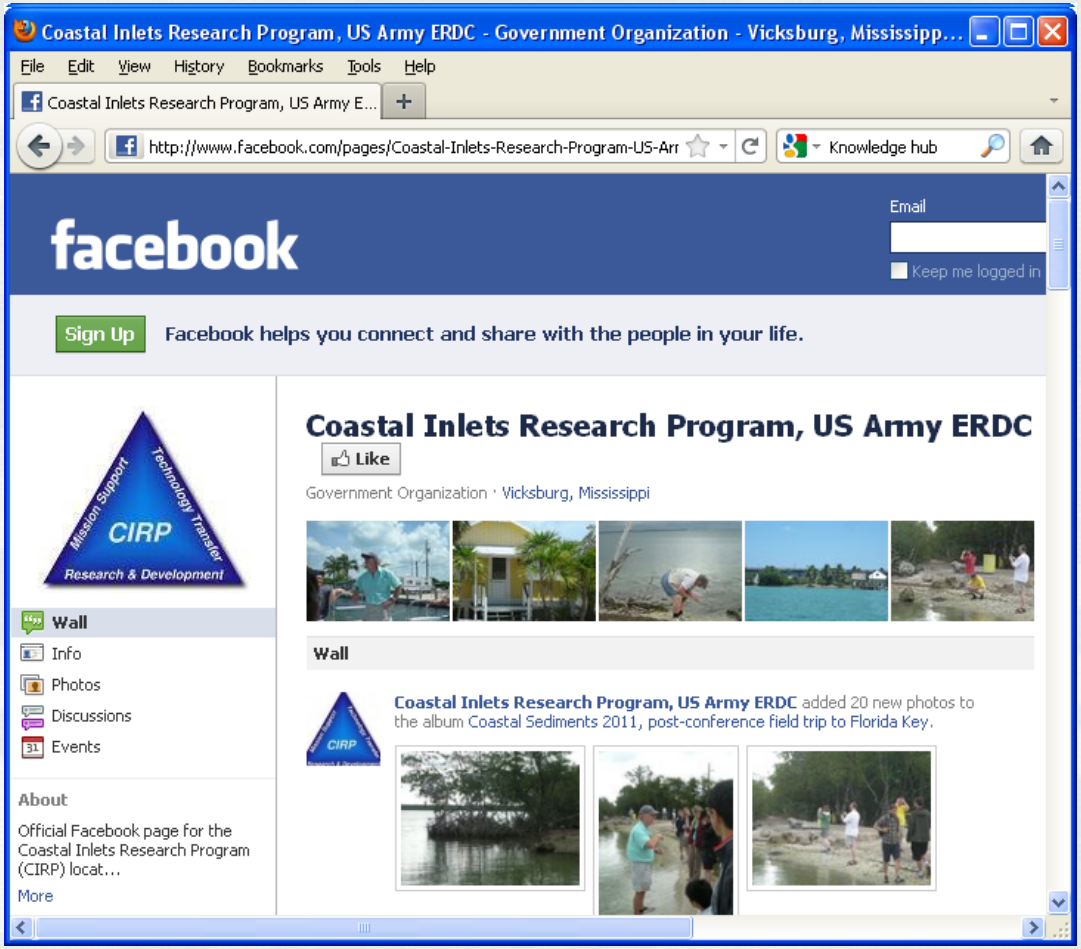
http://cirp.usace.army.mil/workshops/nap12/NAP-Workshop.html

Draft CMS User Manual



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

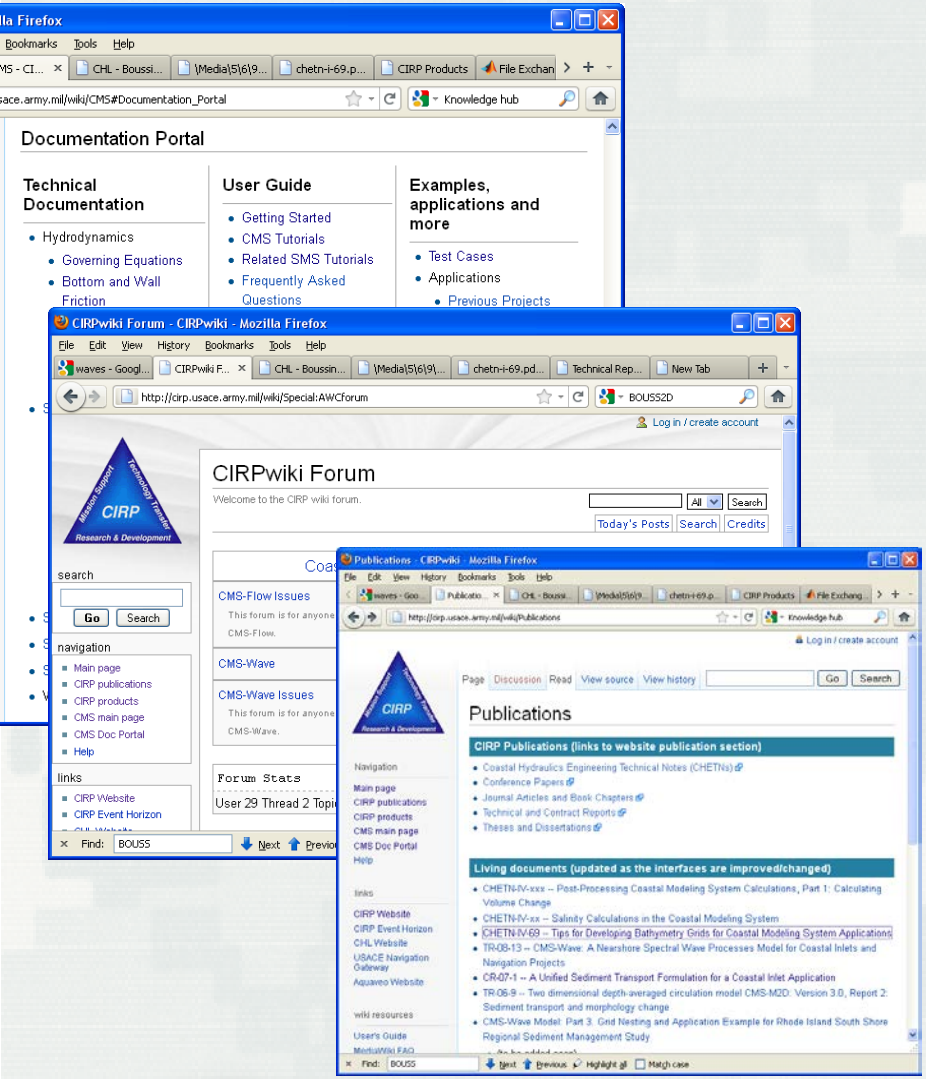
CIRP Websites



60 CIRP documents published as eBooks

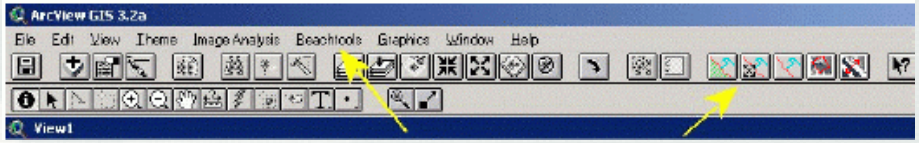
http://cirp.usace.army.mil

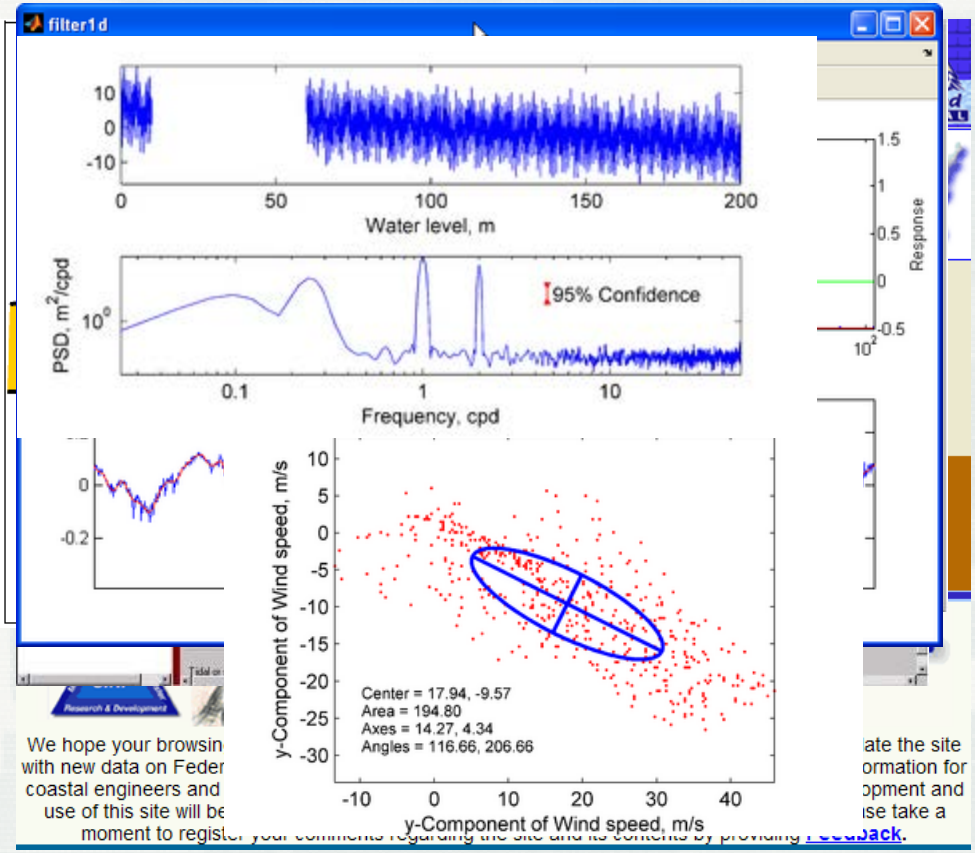
CIRP Wiki



- 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

Publications

CIRP Publications - Windows Internet Explorer

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

US Army Corps of Engin
CIRP - Coastal Inlets Research Pr

Publications | Tech Transfer | Wiki | CIRP

CIRP Publications

- Coastal Hydraulics Technical Notes (CHETNs) NEW
- Conference Papers
- Journal Articles NEW
- Technical Reports NEW
- Theses and Dissertations

- Inlet Publication Archive
- Other Publications
- Quarterly Newsletters

References - CIRPwiki - Windows Internet Explorer

http://cirp.usace.army.mil/wiki/References

Main page
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GenCade
Help

links
- CIRP Website
- CHL Website
- USACE Navigation Gateway
- Aquaveo Website

wiki resources
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- MediaWiki FAQ
- MediaWiki mailing list

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2 Journal Papers
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3 Conference Papers
- 3.1 Waves
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- 3.4 Applications/Projects
- 3.5 Miscellaneous

4 Other References

Reports and Tech Notes

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Recommended Software and Hardware

- Decent text editor such as Textpad, UtraEdit, 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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Thanks to the CIRP team and developers: