Coastal Modeling System
Advanced Topics

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**Report Documentation Page**

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<tr>
<td>U.S. Army Corps of Engineers, U.S. Army Engineer Research and Development Center, 3909 Halls Ferry Road, Vicksburg, MS, 39180-6199</td>
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Standard Form 298 (Rev. 8-98)
Prepared by ANSI X39-18
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 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
Coastal Modeling System (CMS)

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
- 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

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FORCING, TIME

- Waves
- Storms
- Tide
- Coastal currents
- Sea level rise / Global warming
- Regional climate variation (e.g., El Niño)
- Turbulence
- Wind
- Seasonal variations
- River discharges
- Transport threshold
- Scour
- Channel Infilling
- Shoals
- Ripples
- Sand Waves
- Bars
- Long term coastal evolution

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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**
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

Pensacola Pass, FL
Channel Infilling ~700,000 cu m

Blind Pass, FL
~25,000 cu. m deposition in the dredge pit after 430 days
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/wiki/CMS
The next CIRP workshop will be in San Diego, CA, Aug 19-21, 2011. For more information, see http://cirp.usace.army.mil

60 CIRP documents published as eBooks

http://cirp.usace.army.mil
CIRP Wiki

- 183 Content Pages
- >75,000 views
- Documentation Portal
  - Technical Documents
  - User Guide, tutorials, user-interface, guidance
  - Test cases
- Forum
- Links to CIRP website, publications, products, etc

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

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

Inlet Publication Archive  
Other Publications  
Quarterly Newsletters  

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3 Conference Papers
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   3.2 Hydrodynamics
   3.3 Sediment Transport and Morphodynamics
   3.4 Applications/Projects
   3.5 Miscellaneous

4 Other References


Publications: Sediment Transport


Publications: Various

Recommended Software and Hardware

- 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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Thanks to the CIRP team and developers: