

Coastal Inlets Research Program



Julie Dean Rosati
Program Manager

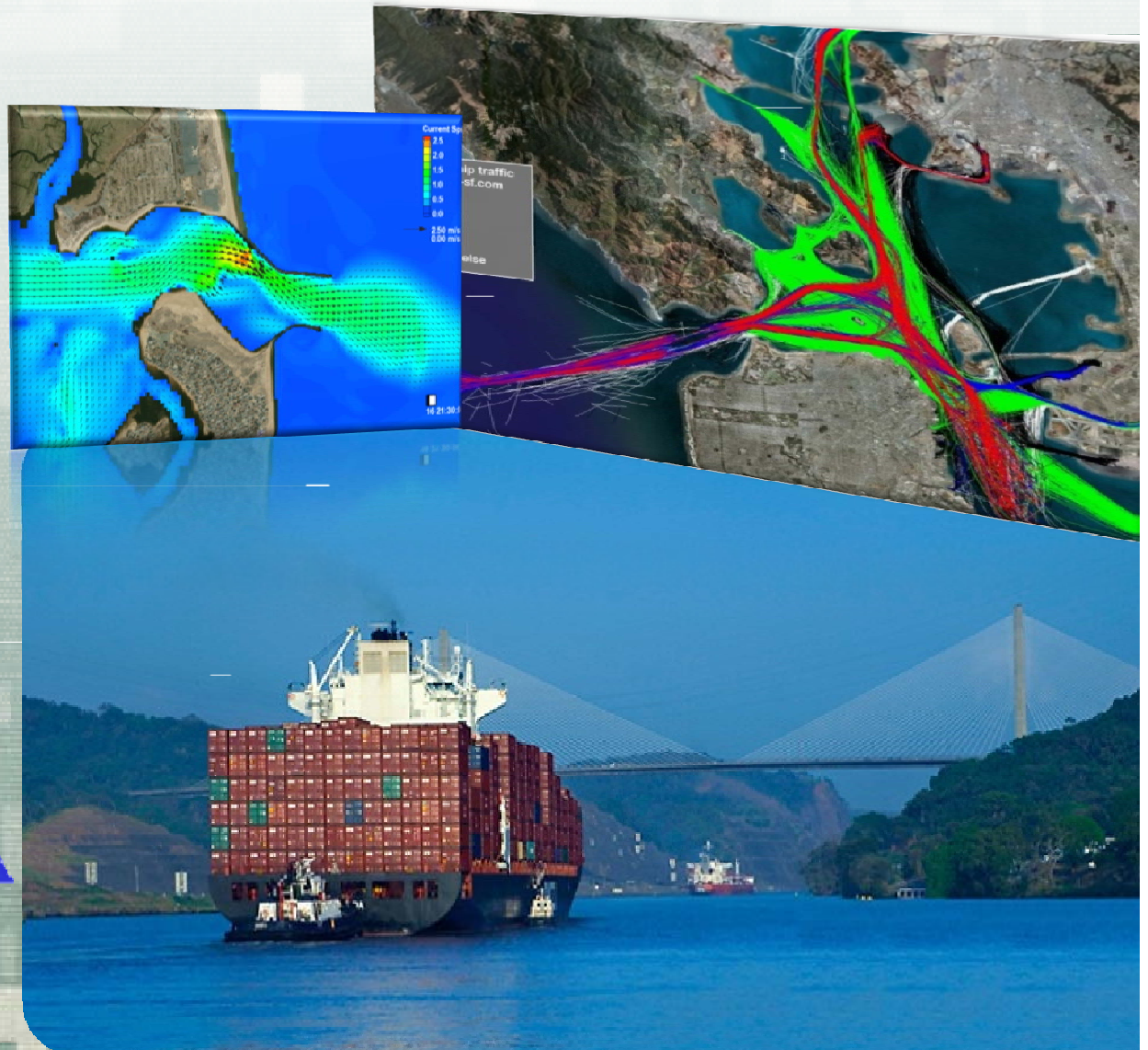
Jeff McKee
HQ Navigation
Business Line Manager

Jeff Lillycrop
Technical Director

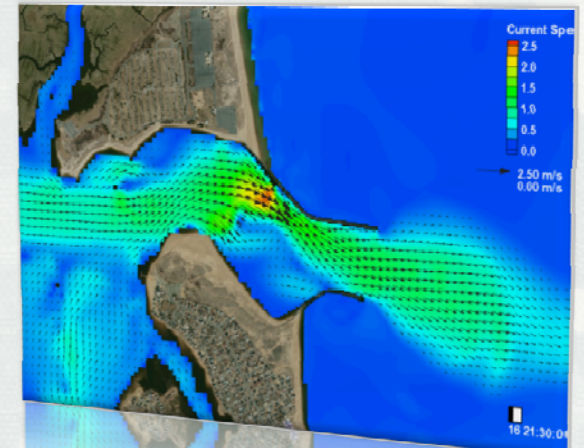
Eddie Wiggins
Associate Technical
Director



US Army Corps of Engineers
BUILDING STRONG®



- Conduct R&D to reduce O&M costs at coastal navigation projects
 - Include inlets, entrances, ports, marinas, harbors, navigation structures, channels and adjacent beaches.
- Develop tools to support O&M practice
 - Provide Districts tools for PCs to evaluate inlets, channels, structures, adjacent beaches, dredging and placement within regional systems.
- Transfer technology and products
 - Guidance documents, Workshops, models and tools, Web site, Wiki-pages, PC software, Web portals, Mobile device apps, video clips.



Program Management and Technology Transfer

Julie Rosati, Mitch Brown

Coastal Modeling System (CMS)

*Alex Sanchez
Honghai Li*



Waves at Navigation Structures

*Lihwa Lin
Zeki Demirbilek*

Geomorphic Evolution

Tanya Beck

Inlet Engineering Toolbox

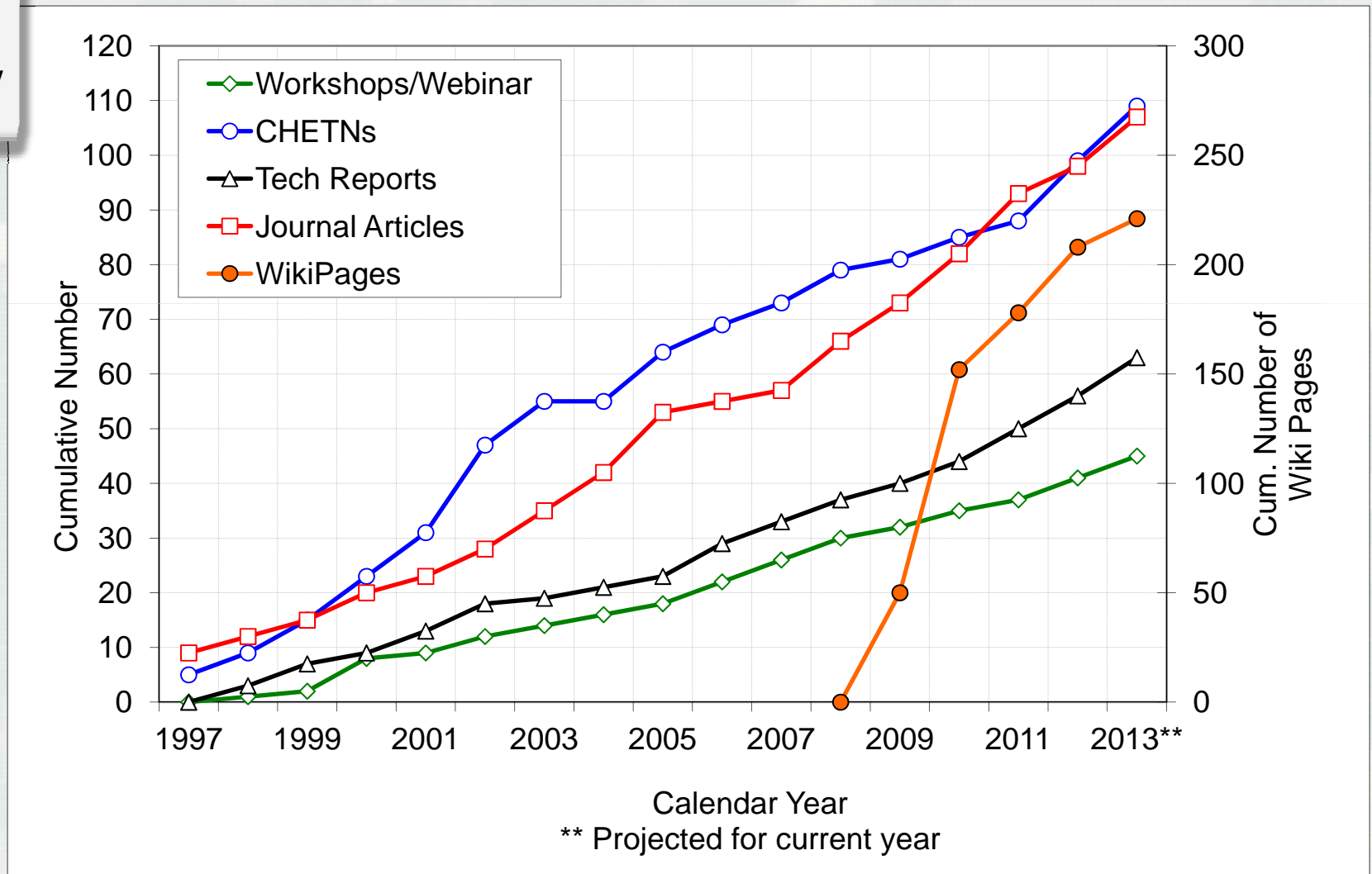
*Ashley Frey
Julie Rosati*

Coastal Navigation Portfolio Management

Ned Mitchell

CIRP Publications and Workshops

Program Management and Technology Transfer





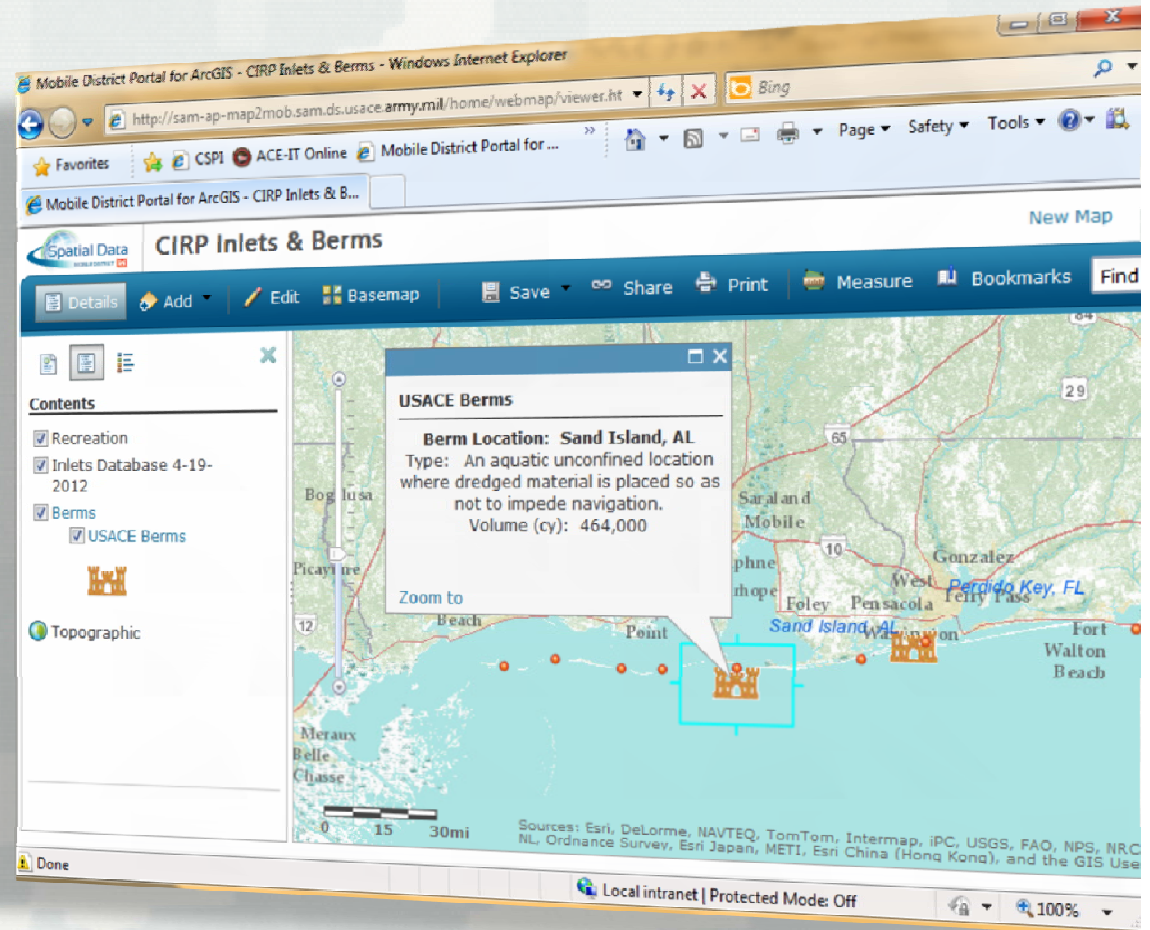
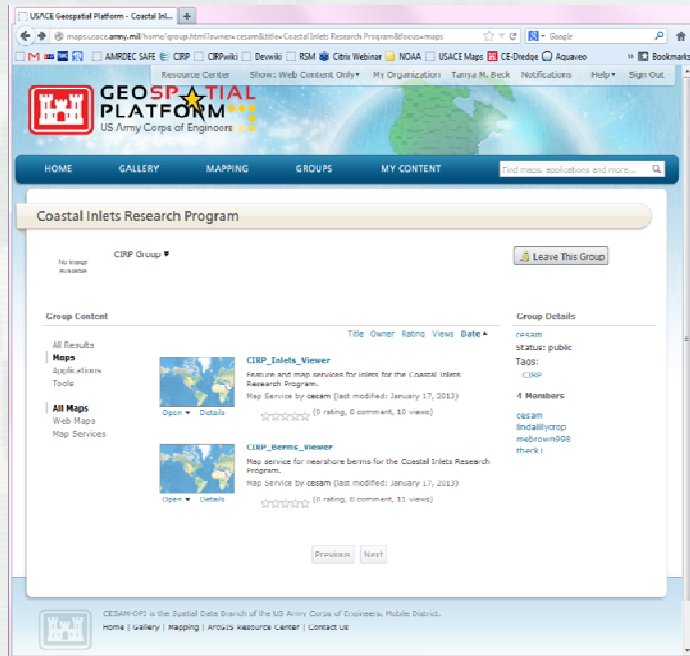
New CIRP Inlets Portal and Interactive Map of CIRP Projects



Program Management and Technology Transfer

Geomorphic Evolution

Tools are linked to National Coastal Data Bank (NCDB) and other data resources





Workshops, Nov98-Mar13



	E & W Coasts, Nov 1998	Avalon, NJ/Redondo Beach, CA	Recent developments in CIRP: ADCIRC & STWAVE
	#1 – FSBPA, Feb 2000	Melbourne, FL	Waves, tidal hydrodynamics, tidal inlet circulation
Program Management and Technology Transfer	Feb 2001	Orlando, FL	ADCIRC, STWAVE, & ADCIRC/STWAVE linkages
	Jan 2002	Biloxi, MS	GIS for coastal and navigation projects
		Vicksburg, MS	SMS Steering Module Workshop
	Feb 2003	Ponte Vedra Beach, FL	Hydro Steering Module and sediment transport/morphology change
	May 2003	Clearwater Beach, FL	CS03 Modeling Tidal Inlets
	#5 – FSBPA, Feb 2004	New York, NY	Calculating sediment transport/morphology change
	#6 – FSBPA, Feb 2005	Dunedin, FL	Modeling sediment transport, morphological change, channel infilling
	#7 – FSBPA, Jan/Feb 2006	Sarasota, FL	Modeling of waves, circulation, sediment transp, and morph. change
	Dec 2006	Vero Beach, FL	Empirical and Numerical Techniques for Analyzing Wave Processes
	Jan 2007	Ft. Lauderdale, FL	Estuarine Design and Assessment
	#9 – FSBPA, Jun 2008	Sarasota, FL	Advanced Coastal Modeling System Workshop
	Jun 2008	Vicksburg, MS	Advanced Coastal Modeling System Workshop
	#10 – FSBPA, Jan/Feb 2009	Sarasota, FL	11th Annual FSBPA Workshop
	#11 Annual, Dec 2009	Sarasota, FL	Integrated Coastal Modeling with Applications
	May 2010	New Orleans District, LA	Advances in Decision-Support: CMS and CPT
	#12 FSBPA, Feb 2011	San Diego, CA	Modeling Inlets for Coastal Inlets
	Aug 2011	San Diego, CA	CMS&GenCode for Regional Sediment Management
	#13 NAP, Mar 2012	Philadelphia, PA	Technology Transfer Workshop/Webinar
	Jun (2)	Webinars	Two CMS Webinars
	Oct 2012	Webinar	GenCode Webinar



13 Years of Annual Workshops
40 Cumulative Workshops
DOTS one-on-one at NAB in Apr13
DOTS one-on-one at NAO FY13
WOTS (wetland) for LRB in FY13
2 Webinars (2 more planned) in FY13

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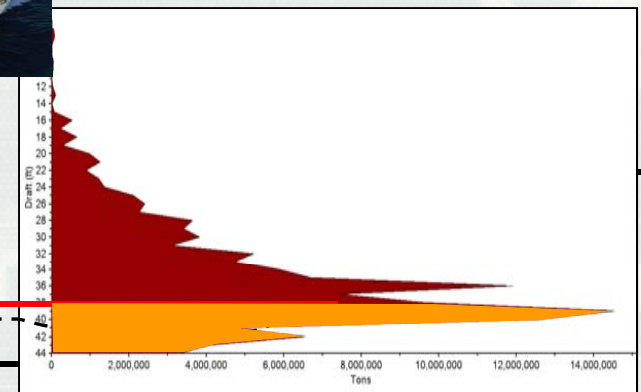
Coastal
Navigation
Portfolio
Management

Focus: develop decision-support tools that provide the USACE with objective, consistent performance metrics for inventory of coastal channels, structures, and other navigation assets.

Channel Portfolio Tool (CPT):

Web-based application that relates navigable depths to cargo most vulnerable to shoaling. Allows for detailed, reach-level analysis as well as regional and national summaries of the waterborne transportation systems supported by Corps navigation projects.

<https://cpt.usace.army.mil>



Coastal Structures Management, Analysis, and Ranking Tool (CSMART):

Web-based application that prioritizes coastal structures according to user-specified criteria and weightings on metrics such as condition rating, commercial tonnage, fish landings, and cruise and ferry passengers. Allows local, regional, and national queries and comparisons.

<https://itlgis01.usace.army.mil/CPT/Silverlight/CSMART>

Statements of Need

Coastal
Navigation
Portfolio
Management

Channel Portfolio Tool (CPT):

- Aligned project inventory with official CWIS codes for future merging with navigation budget data (ongoing in FY13)
- Developed CPT Optimization add-on
 - Extract waterway freight corridor information
 - Develop systems-based strategies for O&M dredge budgeting



CPT-LITE

Coastal Structures Management, Analysis, and Ranking Tool (CSMART):

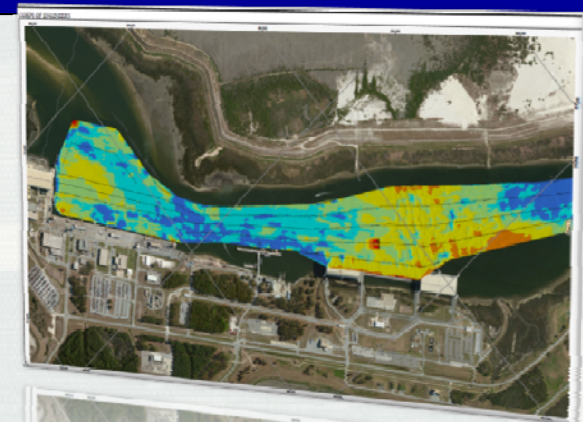
- Supported Corps Asset Management (AM) initiative and Low-Use Navigation Project PDT
- Matched AM inventory of coastal structures to Project CWIS codes
- Adapted CSMART to include physical condition ratings submitted via AM effort

		Structural Condition Rating (SCR)				
		F	D	C	B	A
Functionality Condition Rating (FCR)	F	1	2	4	5	6
	D	3	7	8	11	13
	C	9	10	14	16	18
	B	12	15	19	21	23
	A	17	20	22	24	25

Coastal
Navigation
Portfolio
Management

CPT:

- Integration with 3D Channel Framework (finally!) and Hydro Survey Tool
- Interactive charts within CPT interface
- Paper on systems-based O&M optimization to appear in *Transportation Research Record* (Mitchell, Wang, and Khodakarami; 2013)



CSMART:

- Merging CPT and CSMART
- Interface upgrades and various functionality improvements



Navigation Project Performance via AIS data archive (SON 2012-N-5)

- Paper: *AIS History and Future Improvements in Waterway Management* (Scully and Mitchell, 2013)
- Investigating new R&D applications of AIS archive as a remote sensing technology; can be cross-correlated with other data archives (tides, waves, env. monitoring, etc.)

Statements of Need

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Coastal Navigation Portfolio Management

Ned Mitchell

Coastal Modeling System

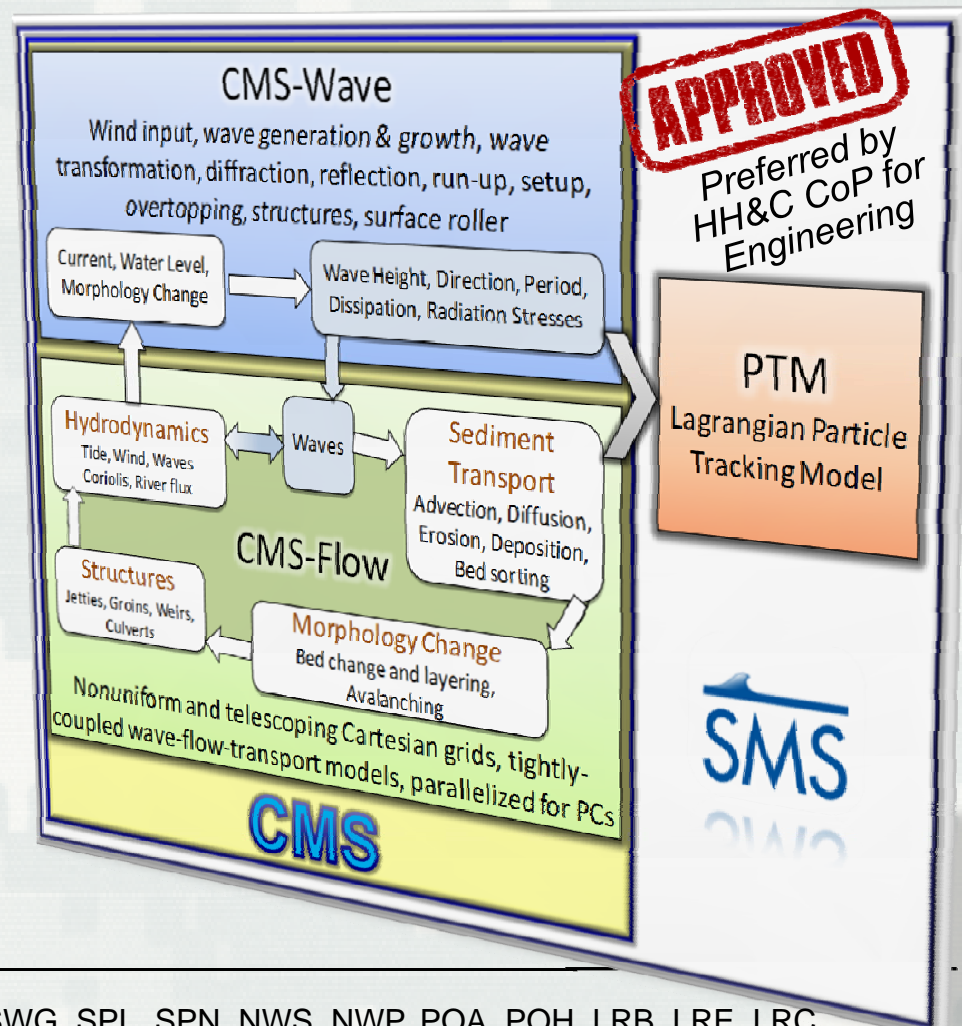
Focus: Develop, advance, and transfer an integrated wave, current, and sediment transport model for **District use** in O&M applications

Coastal Modeling System:

- PC-based
- Verified and validated with hydrodynamic (20 cases) and sediment transport (10 cases) tests
- Focus on channel shoaling, inlet short- and mid-term morphology change
- Operational at 17 Districts*

Statements of Need

Need long-term morphologic evolution predictors
Tracking Number 2008-N-6



Coastal Modeling System



Structures in CMS

Tidal gates



Permeable rubble mound breakwaters and jetties

Dana Point Harbor, CA

Low-crested weirs



Rudee Inlet, VA

Culverts



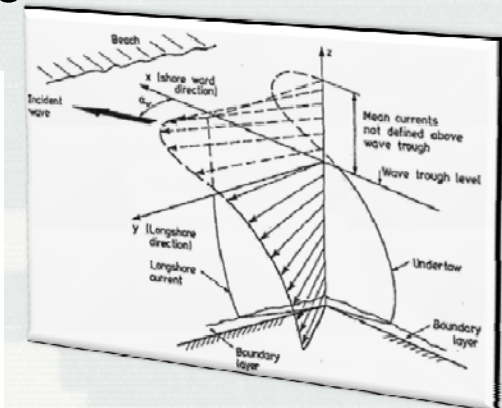
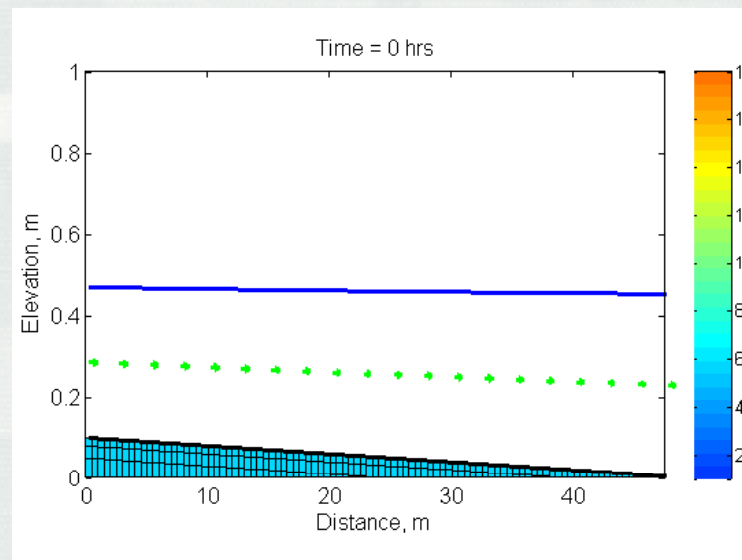
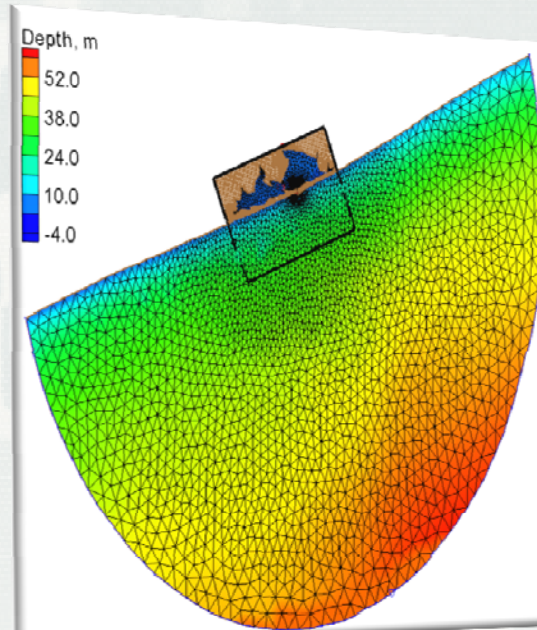
APPROVED
Preferred by
HH&C CoP for
Engineering

Coastal Modeling System

FY12 Accomplishments

Coastal
Modeling
System

- Multiple-sized sediment transport and bed layering
- Quasi-3D wave-averaged formulation
 - *Better representation of cross-shore momentum and sediment dispersion, especially significant for nearshore*
- Automated Nesting Boundary Extraction
- Automated Tidal Database Boundary
- Horizontal Coordinate Projection Conversions

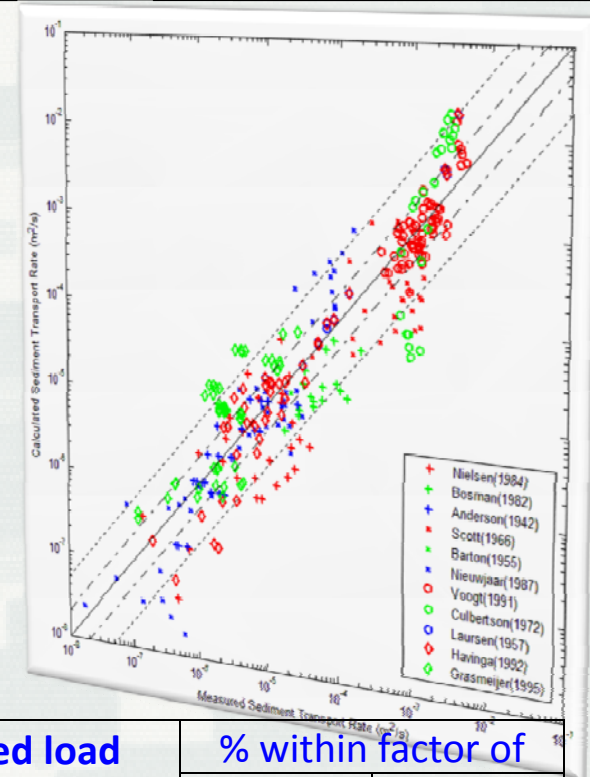


Coastal Modeling System

FY12: Improved Sediment Transport

Coastal Modeling System

- Largest source of error in modeling
- Existing formula designed for
 - Graded sediments under currents only (e.g. Wu et al. 2000) or
 - Sorted sediments under waves and currents (e.g. Lund-CIRP)
- Database being compiled
- Lab experiments
- Work benefits CIRP, DOER, RSM, +



Bed load Transport Formula	% within factor of	
	2	5
Bailard and Inman (1981)	47	70
Dibajnia and Watanabe (1992)	41	72
Ribberink (1998)	32	52
Lund-CIRP (2007)	46	74
Wu et al. (2011)	55	86

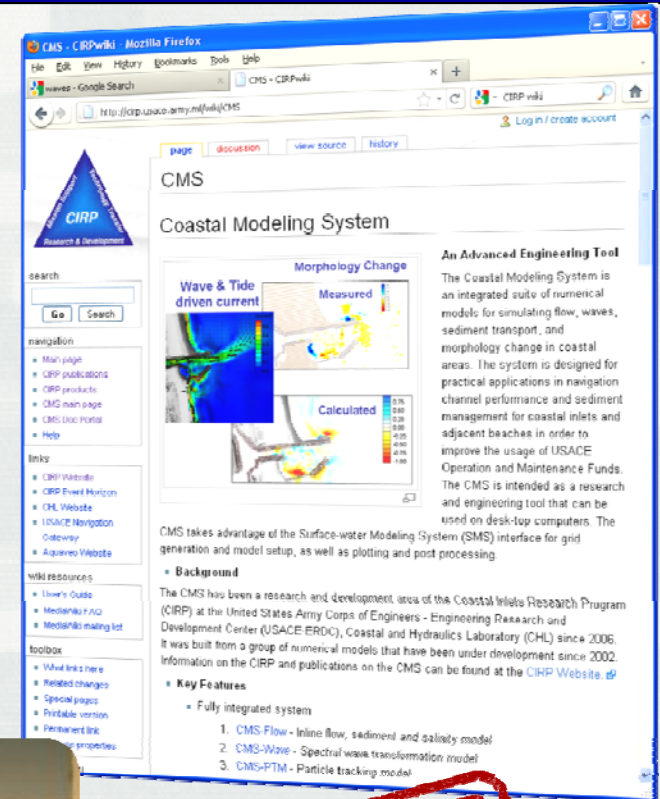
Suspended load Transport Formula	% within factor of	
	2	5
Bijker (1968)	23	52
Bailard (1968)	30	65
van Rijn (1989)	32	52
Lund-CIRP (2007)	33	65
Wu et al. (2011)	48	83

Coastal Modeling System

FY12 Technology Transfer

Coastal Modeling System

- 2 Webinars
 - Beginners (10 hrs)
 - Advanced (5 hrs)
- 1 Journal paper
 - (Norfolk, VA)
- 2 Book Chapters
 - Sediment transport theory, and applications
- 5 Conference papers
- 2 V&V TR's
- 5 CHETN's



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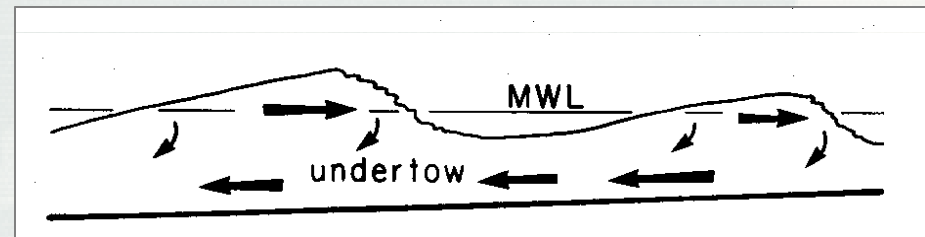
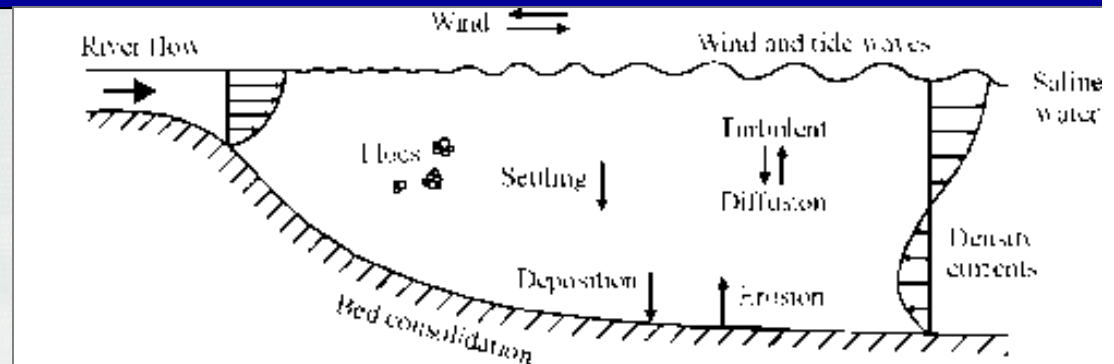
Coastal Modeling System

FY13 Plans

Coastal Modeling System

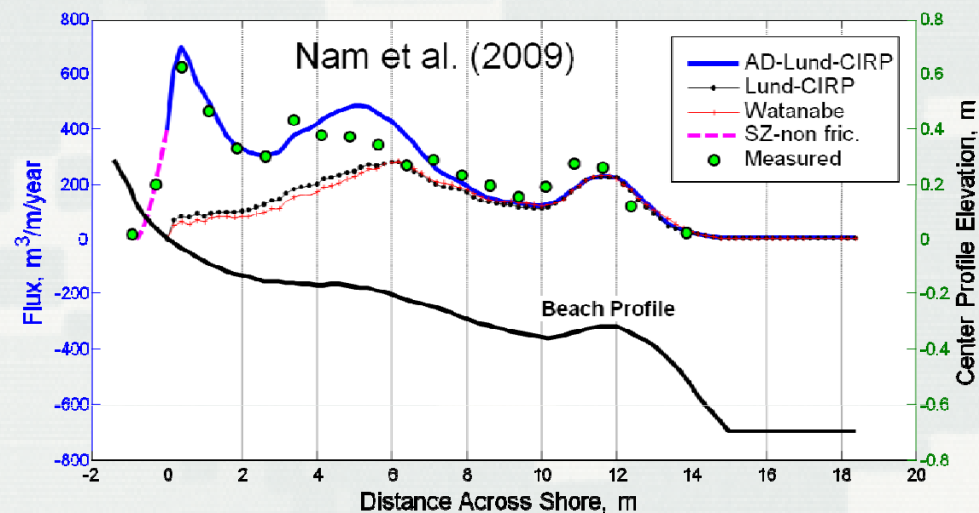
CMS features/updates

- Sediment Mapping
- Dredging events
- Explicit telescoping grid
- Parallelization for HPC
- Tidal potentials
- Improved Open BC's, etc



R&D

- V&V of Quasi3D
- Swash zone
- V&V of mixed sediments

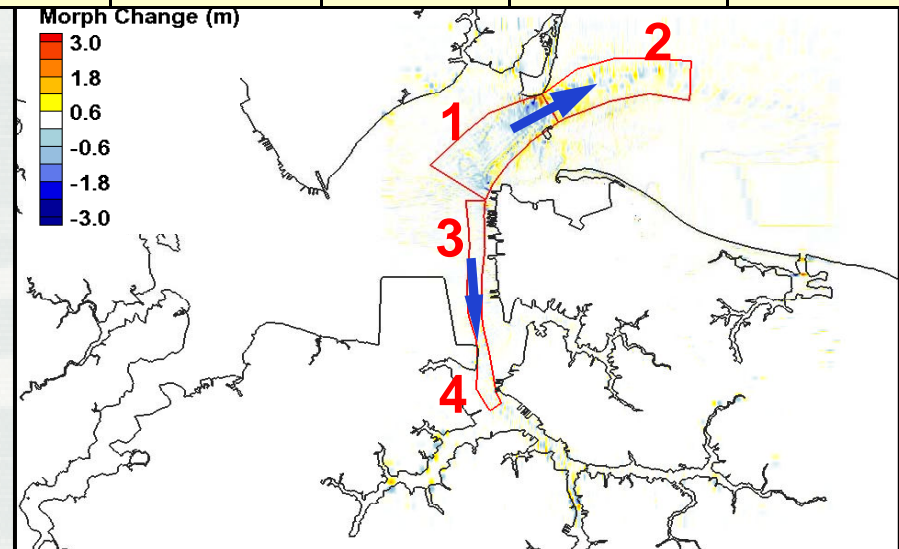
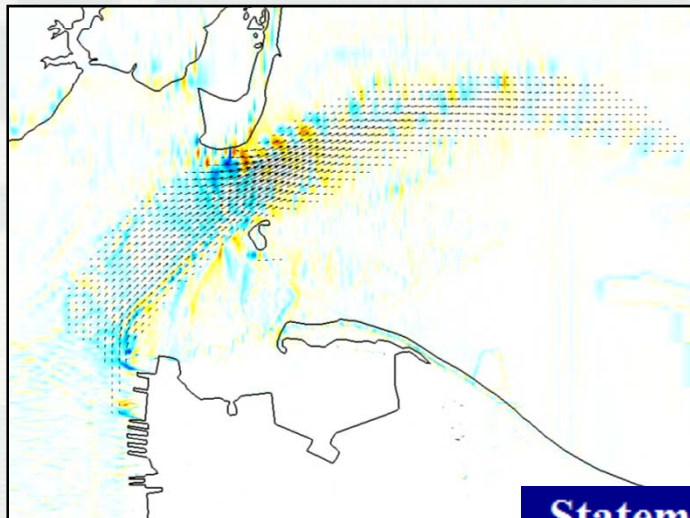


100-year return synthetic storm and sea level rise scenarios

Average sediment transport, channel volume and bed changes in Hampton Roads, near Norfolk, VA

→ Increased SLR increases response (either more erosion or accretion)

Region	SLR = 0 m		SLR = 2 m	
	Volume Change (m ³)	Bed Change (m/m ²)	Volume Change (m ³)	Bed Change (m/m ²)
1	6,800	0.003	26,000	0.01
2	-18,800	-0.01	-51,000	-0.02
3	-940,000	-0.10	-1,569,000	-0.17
4	566,000	0.06	894,000	0.10



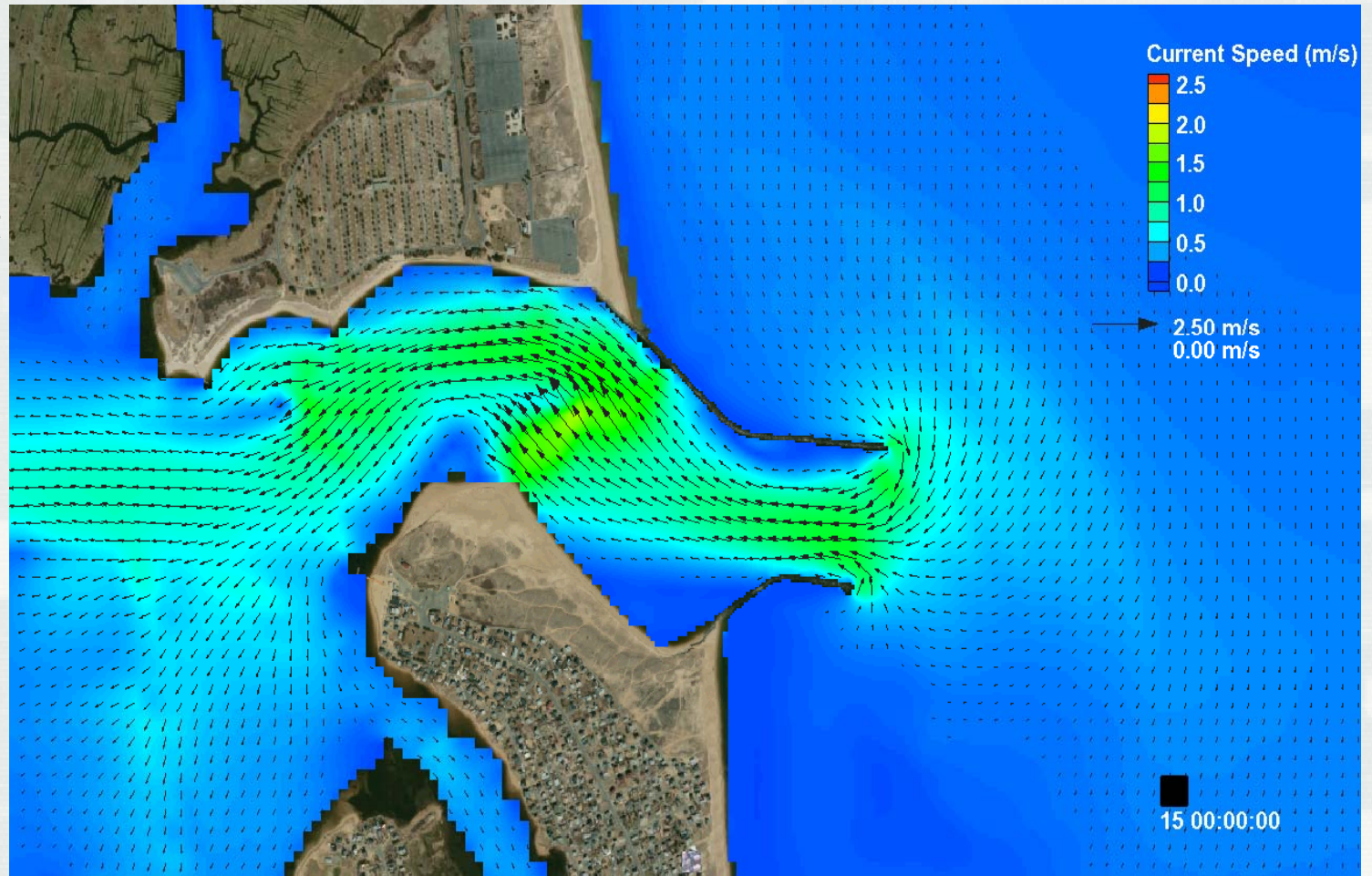
Statements of Need

Concerns:

- Erosion of downdrift beach
- Reduced navigability of inlet

Watch:

- Currents up to 2.5 m/sec in inlet
- 2.6-m tidal range
- Island appearing in middle of channel
- Currents thru degraded jetties may exacerbate downdrift erosion



Examining 19 Alternatives including mining ebb/flood shoal, jetty modifications, detached breakwaters

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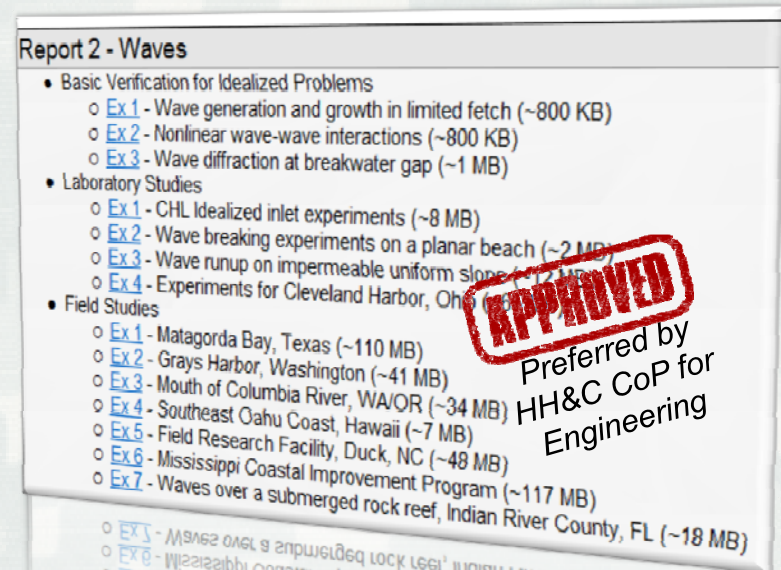
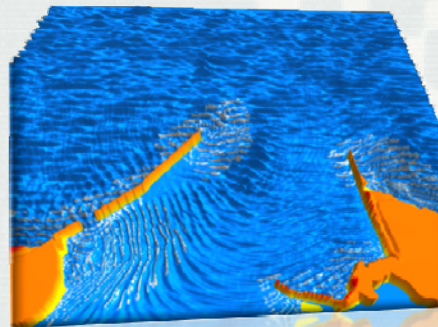
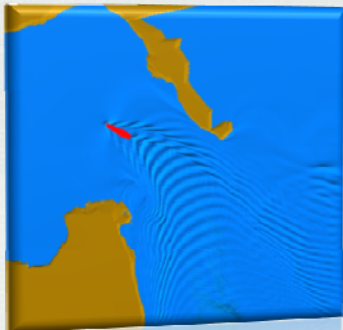
Waves at
Navigation
Structures

Focus: to advance wave predictive capability in support of USACE missions for coastal navigation, structures, ports/harbors/marinas, and adjacent beaches, reefs and wetlands.

CMS-Wave:

Advanced spectral wave propagation model including diffraction, reflection, run-up, setup, overtopping, wave generation, structures (breakwaters, jetties, groins, etc.), nested grids; integrated with CMS-Flow

14 Verification & Validation Cases



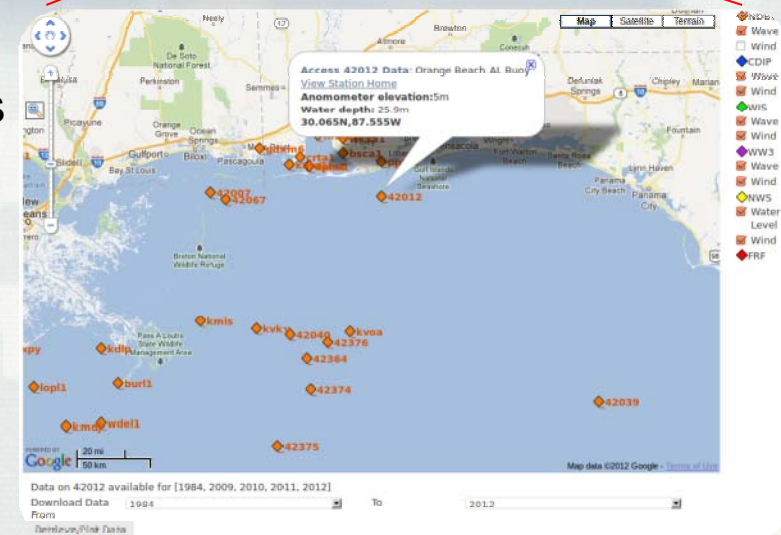
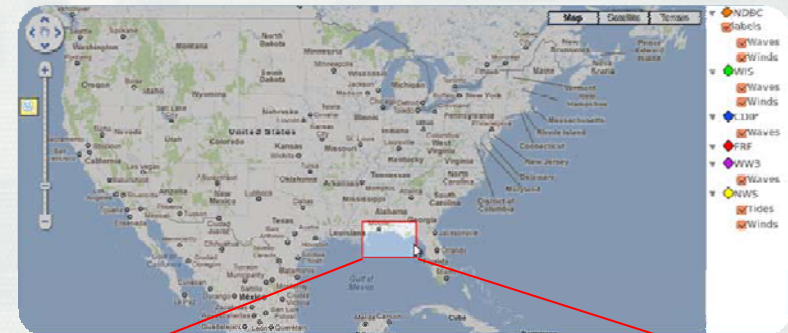
Bouss-2D:

Advanced phase-resolving wave propagation and transformation model.

Waves at Navigation Structures

WaveNet: Web-based interactive GUI with Google Map

- Purpose: Provides data for projects and models
- Data Sources: NOAA, USGS, USACE, NAVY
- Actions: Access, process, plot, and analyze data
- Data Types: Waves, Winds, Water levels, Currents
- Future Additions: Bathymetry and Shoreline
Inlet Structures
Navigation Channels
Ports/Harbors/Marinas
Tidal Databases



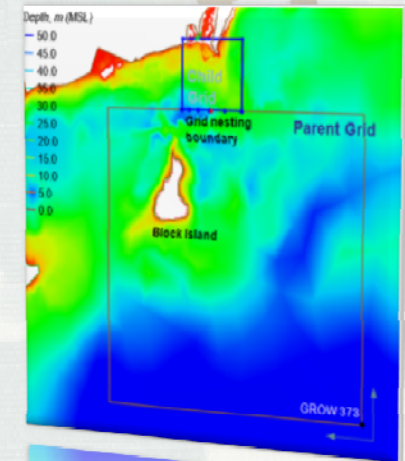
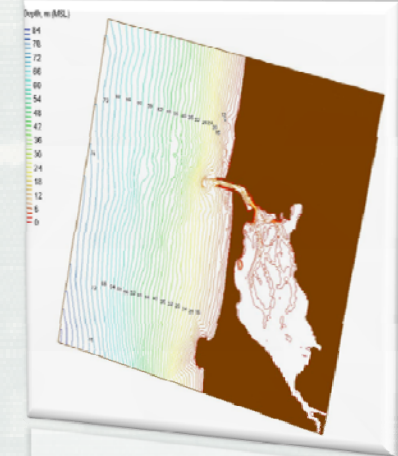
Waves at Navigation Structures

FY12 Project Applications/Reimbursables

Waves at
Navigation
Structures

- NWS: Grays Harbor, WA
- NWP: Tillamook Inlet, OR
- SPN: Ocean Beach San Francisco Bight, CA 
Noyo Bay, CA
Half Moon Bay, CA
- SWG: Matagorda Ship Channel, TX 
Galveston Bay, TX  MCNP
Sargent Beach, TX
- NAE: Point Judith Harbor, RI
Merrimack Inlet, MA
- NAN: Ambrose Channel, NY
- SAJ: St. Johns River, FL
St. Augustine Inlet, FL 
- POH: North Kahola Harbor, HI
Kikiaola Harbor, HI




Tillamook Inlet, OR

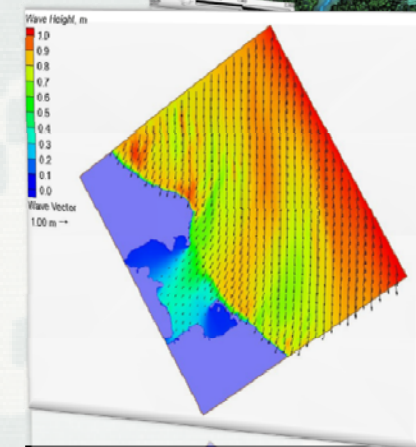
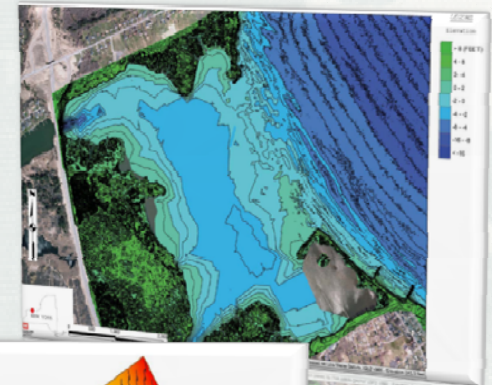


Waves at Navigation Structures

FY13 Plan

Waves at Navigation Structures

- TR: Regional and Nearshore Wave Modeling at Point Judith Harbor, RI
- CHETN: Advanced Numerical Wave Modeling for Reefs
- TR: Matagorda Bay Channel Shoaling Study, TX 
- CP: Littoral Transport Modeling of Ocean Beach and San Francisco Bight, CA 
- JP: Numerical Modeling of Coastal Inundation and Sedimentation by Storm Surge, Tides, and Waves at Norfolk, Virginia, USA
- CHETN: WaveNet Part II: Other Data Sources
- CHETN: WaveNet and GenCade Coupling
- CHETN: Coupling of CMS-Wave to AIS
- TR: Wave, Circulation, and Sedimentation Study at Braddock Bay, NY
- TR: Storm Waves, Circulation, and Sedimentation Study at Dana Point Harbor, CA
- CP: Mixed Sediment Modeling for Matagorda Ship Channel, TX 
- CP: Numerical Modeling of Coastal Dredged Material Placement Study at Noyo Harbor, CA



Waves at Navigation Structures

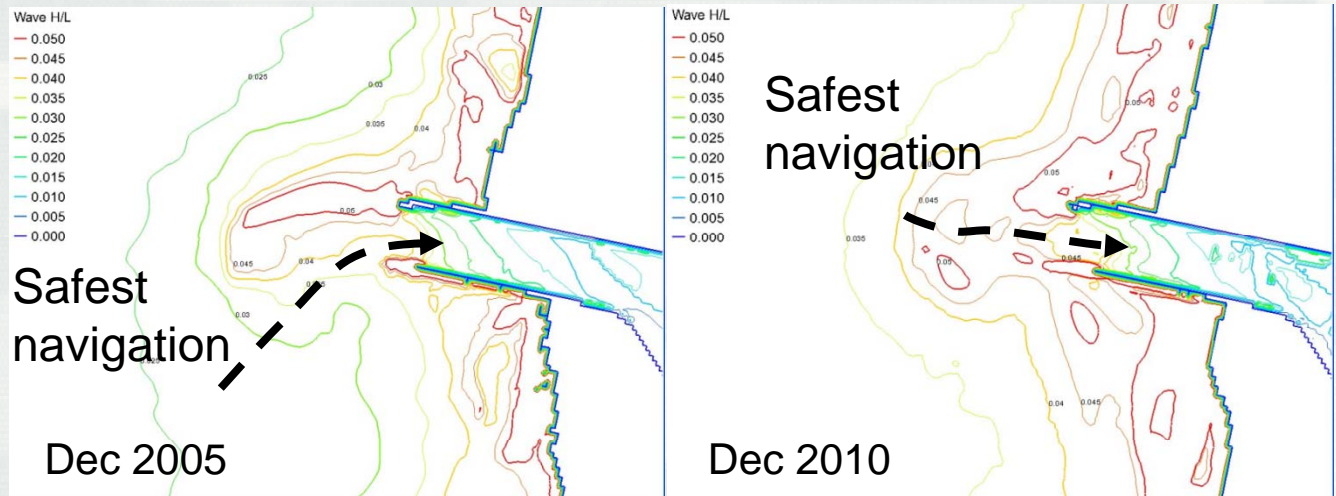
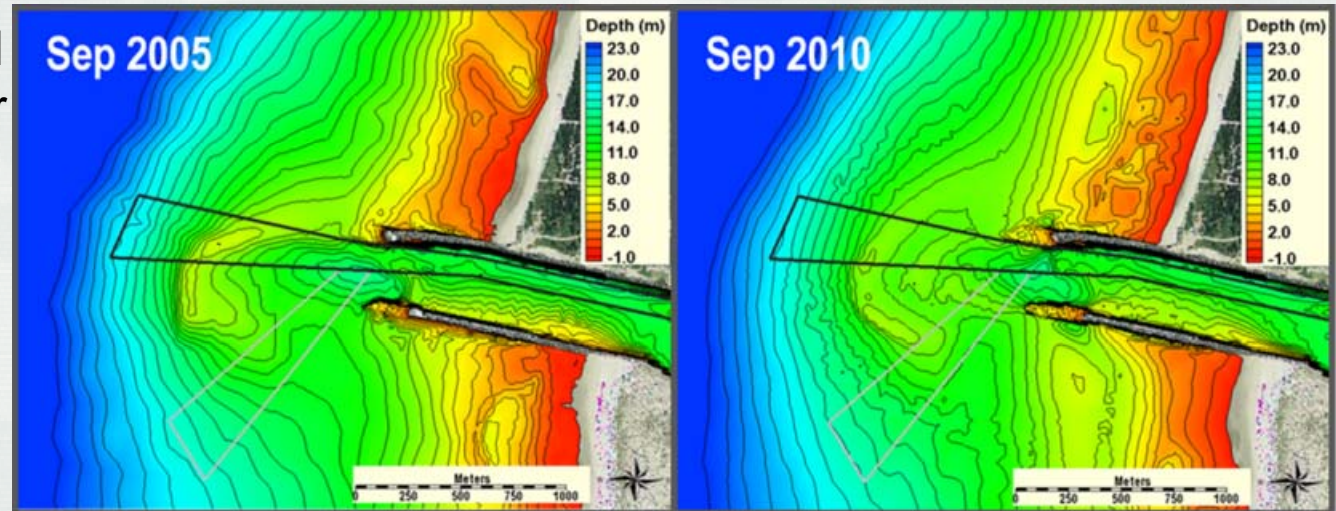
Purpose:

- Quantify hazard and risk levels for navigation

- Evaluate wave and current condition near degraded jetties

Conditions:

- Currents up to 6 kt in inlet
- 1.9-m tidal range
- High wave energy coast
- Seasonal migration of large ebb shoal
- Increased wave breaking and current flow at submerged relic jetty sections



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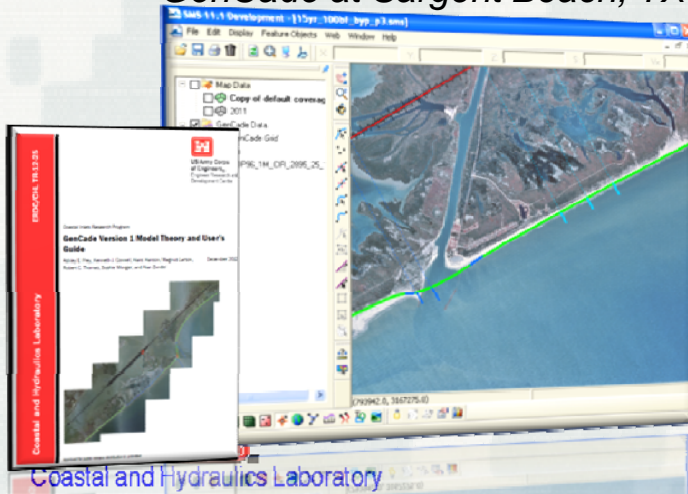
Inlet Engineering Toolbox

Focus: develop desktop PC and web-based tools to assess how engineering actions affect coastal inlets, navigation channels, and adjacent beaches

GenCade

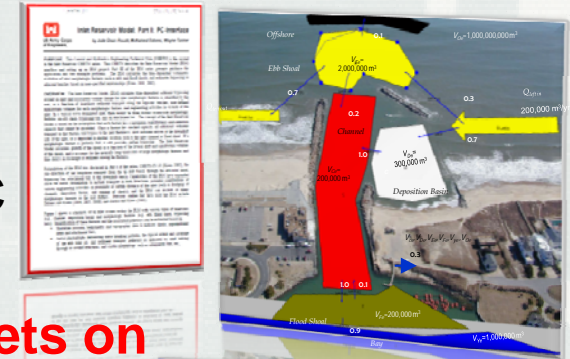
- A 1-line model for shoreline change, sand transport, and inlet sand sharing
- Based on GENESIS (project scale) and Cascade (regional scale)
- GenCade Version 1 released in FY12
- GenCade available in SMS 11.1 Beta
- Published TR: Theory and Users Guide

GenCade at Sargent Beach, TX



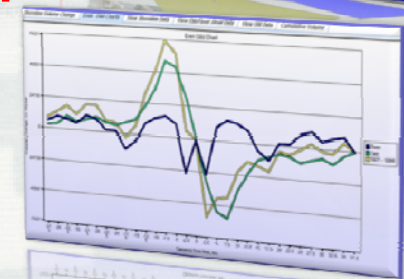
Inlet Reservoir Model

- PC-based, time-dependent sand sharing model for inlet morphologic evolution
- CHETN on PC interface



Impacts of Inlets on Adjacent Beaches (IIAB) application

- Calculates alongshore extent of inlet influence (CEM method) and total volumetric impact of inlet



Statements of Need

Need long-term morphologic evolution predictors
Tracking Number 2008-N-6

Inlet Engineering Toolbox FY12-13 Accomplishments

Inlet Engineering Toolbox

GenCade

Completed GenCade studies at 3 sites:
 St. Johns County, FL (TR-12-14: Report 3)
 Onslow Bay, NC (CHETN-IV-85) Sargent Beach and Matagorda Peninsula (TR in editing)

- Wiki documentation enhanced activities

16 - 18 October 2012 - Gencade

Overview	Files
<p>16 October 2012 - Day 1</p> <ul style="list-style-type: none"> Welcome Introduction to GenCade Introduction to GenCade in the SMS Helpful Hints GenCade Applications Completed Project Demo Simple Case Demo <p>17 October 2012 - Day 2</p> <ul style="list-style-type: none"> Simple Case Demo (continued) Inlets and Beach Fills Case Complex Case (start) <p>18 October 2012 - Day 3</p> <ul style="list-style-type: none"> Complex Case (continued) Future Capabilities Wave Conversion Tool 	<p>Click <u>underlined</u> links on the agenda to access presentation material, CMS User's Guide, and data files.</p> <ul style="list-style-type: none"> GenCade Executable SMS 11.1 Beta (Full Installation) <ul style="list-style-type: none"> 32-bit Installer 64-bit Installer Day 1 material Day 2 material Day 3 material <p>Webinar Audio/Video Files</p> <ul style="list-style-type: none"> Day 1 (~100 MB) Day 2 (~113 MB) Day 3 (~ 75 MB)



GenCade
1. GenCade

ERDC/CIL TR-12-14

Coastal Inlets Research Program
Optimization of Ebb Shoal Mining and Beach Nourishment at St. Johns County, St. Augustine Inlet, Florida



GenCade Application at Onslow Bay, North Caroli
 by Ashley E. Frey, Sophie Mungler, Greg L. Williams, Michal Witkowski, and Kevin B. Con

GenCade Applications

Ashley Frey
 Research Civil Engineer, Co-PI of the Inlet Engineering Toolbox work unit of CIRP



Tech Transfer
 GenCade was highlighted during two CIRP Workshops in 2011. The first took place in February in Jacksonville, FL. This was the first workshop to include GenCade. About 25 students listened to several GenCade presentations, watched a demonstration, and participated in a hands-on example. A full day session of GenCade was featured in San Diego in August.
 A full day session of GenCade was presented during the March 2012 CIRP Workshop in Philadelphia. The morning consisted of presentations and a hands-on demonstration. In the afternoon, students worked through an example independently while instructors walked around answering questions.

Index of /webinars/101612-Files/Day1

Name	Last modified	Size	Description
Parent Directory			
Day1-1_Welcome.pdf	16-Oct-2012 13:48	200K	
Day1-2_GenCadeIntro.pdf	16-Oct-2012 13:48	1.1M	
Day1-3_GenCade_SMS_comp.pdf	16-Oct-2012 13:48	2.4M	
Day1-4_Docs_Help.pdf	16-Oct-2012 13:48	1.5M	
Day1-5_Applications_comp.pdf	16-Oct-2012 13:48	6.4M	
Simple Example/	16-Oct-2012 13:47	-	



Inlet
Engineering
Toolbox

GenCade

Guidance Documentation

- Recommendations & requirements (TR, extension of Model Theory TR)
- Site-specific guidance
 - ✓ Definition of “region”
 - ✓ Pre-calibration assessment
 - ✓ Standard procedure for calibration
 - ✓ Purposes & goals of calibration & validation
 - ✓ Statistics
- Lateral boundary conditions (CHETN)

Wave Conversion Tool (2 CHETNs in review)

CMS-Wave

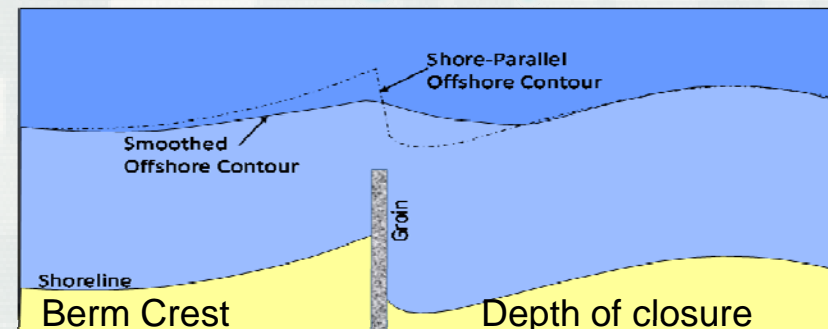
Wind input, wave generation & growth, wave transformation, diffraction, reflection, run-up, setup, overtopping, structures, surface roller



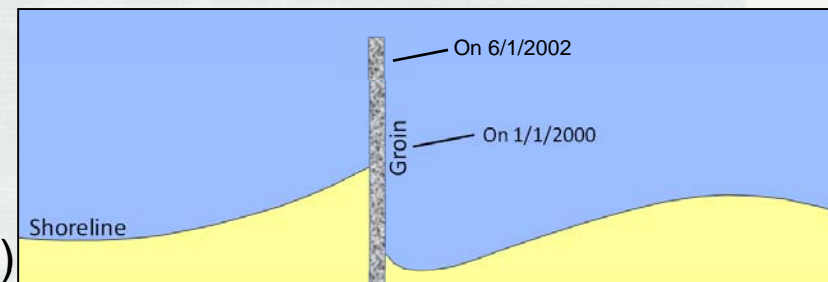
GenCade

Option for GenCade to accept forcing from an external wave model

Variable alongshore parameters



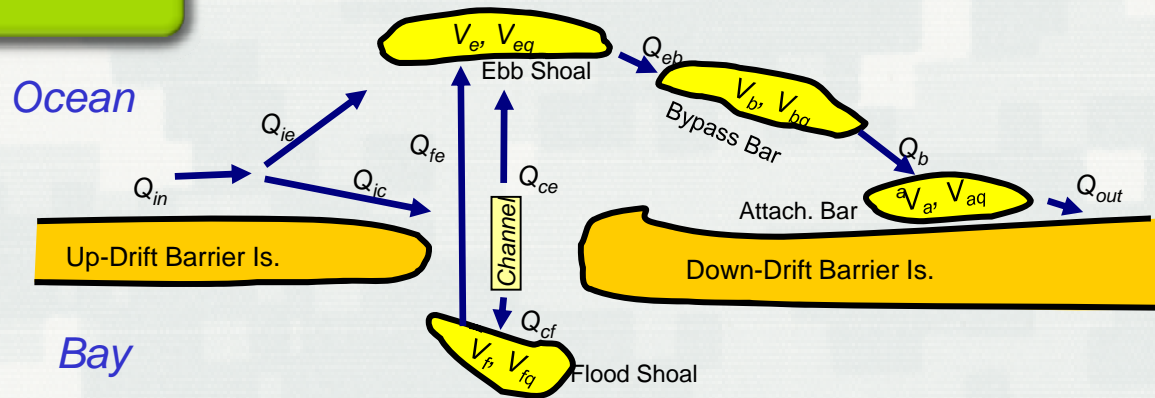
Variable structures in time



Inlet Engineering Toolbox

GenCade

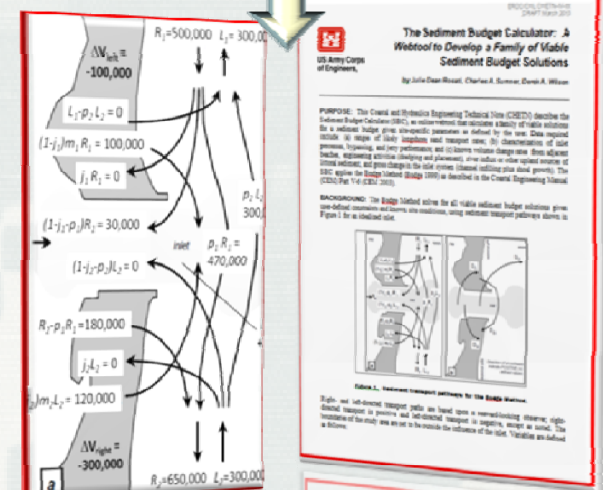
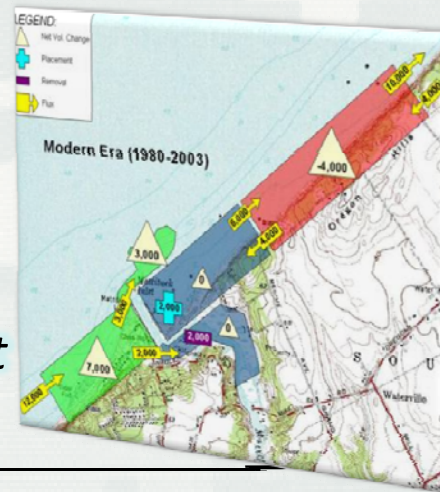
Improve Inlet Reservoir Model in GenCade



Sediment Budget Calculator

- CEM (Bodge) Method to develop Family of Solutions for sediment Budgets
- Web Tool and TN

GenCade → **SBAS Arc10** → **GenCade output used as input to create an SBAS Calculated Sediment Budget**



Program Management and Technology Transfer

Julie Rosati, Mitch Brown

Coastal Modeling System (CMS)

*Alex Sanchez
Honghai Li*



Waves at Navigation Structures

*Lihwa Lin
Zeki Demirbilek*

Geomorphic Evolution

Tanya Beck

Inlet Engineering Toolbox

*Ashley Frey
Julie Rosati*

Coastal Navigation Portfolio Management

Ned Mitchell

Geomorphic Evolution

FY12 Accomplishments

Geomorphic Evolution

Develops methods and context for studies on federal navigation and coastal projects over time scales much greater than dredging cycles, planning timelines, and the dimensions of the navigation channel.

Products

Characterized Environments for Nearshore Berm Prediction

Documentation & Guidance

Numerical Modeling



Statements of Need

Design and Evaluation Tool for Nearshore Berm Placement of Non-Beach Compatible Material
Tracking Number 2011-N-15

Nearshore Placement of Dredged Sediment Assessment
Tracking Number 2011-N-19

Statements of Need

Need long-term morphologic evolution predictors
Tracking Number 2008-N-6

Statements of Need

Identifying and Addressing Potential Sea Level Change Impacts to Navigation Projects
Tracking Number 2013-N-11

Monitoring Nearshore Berms in Collaboration with SAJ & SAM

- **Perdido Key:** Monitored Starting Jan 2013
- **Egmont:** Starting Sep 2012
- **New Smyrna Beach:** Started Aug 2012 (Complete)
- **Ft. Myers Beach:** Monitored since May 2010 (Complete; Starting Oct 2012)



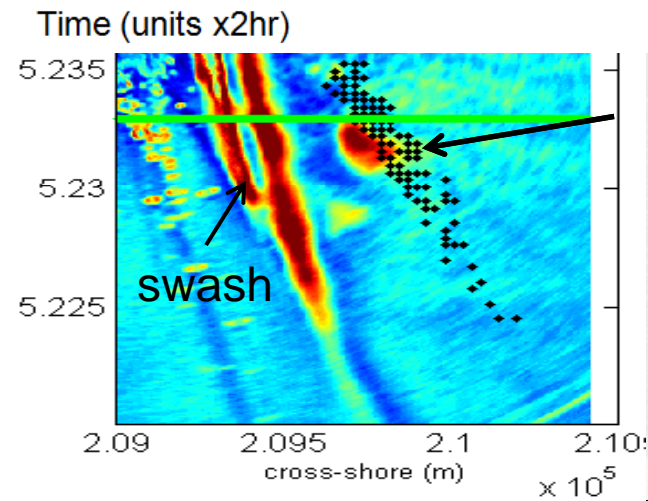
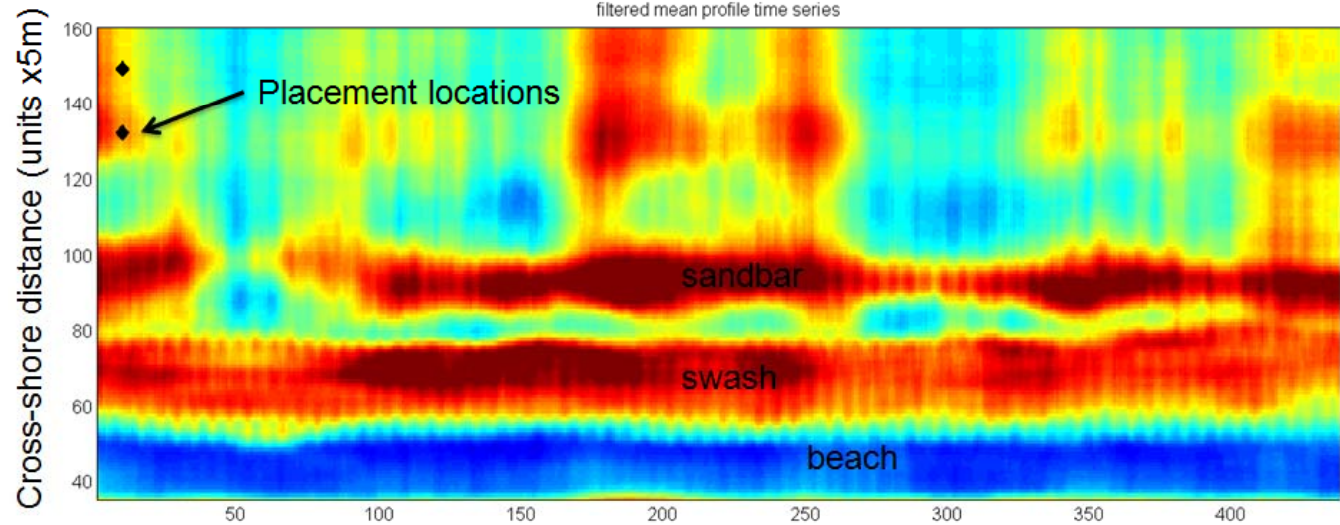
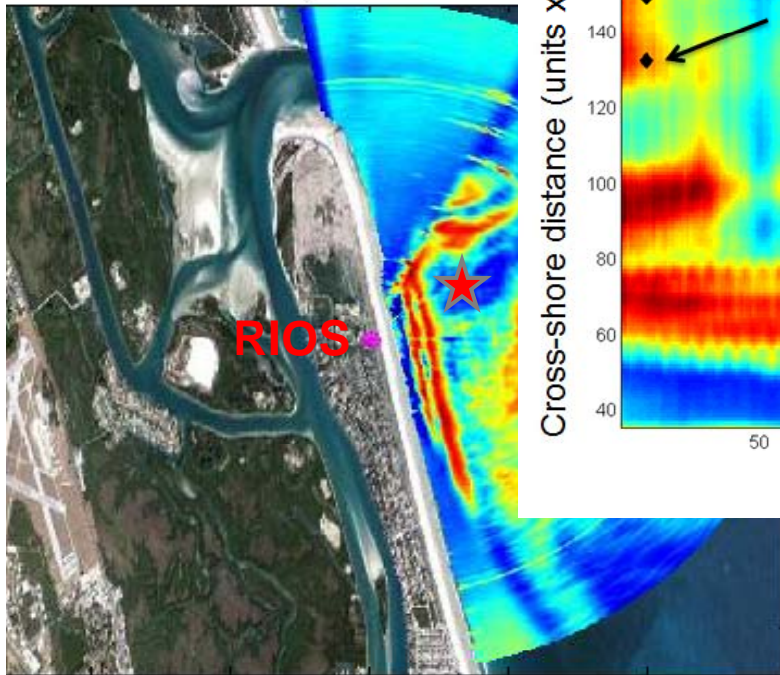
Geomorphic Evolution

FY12 : New Smyrna Nearshore Placement (Aug 2012)



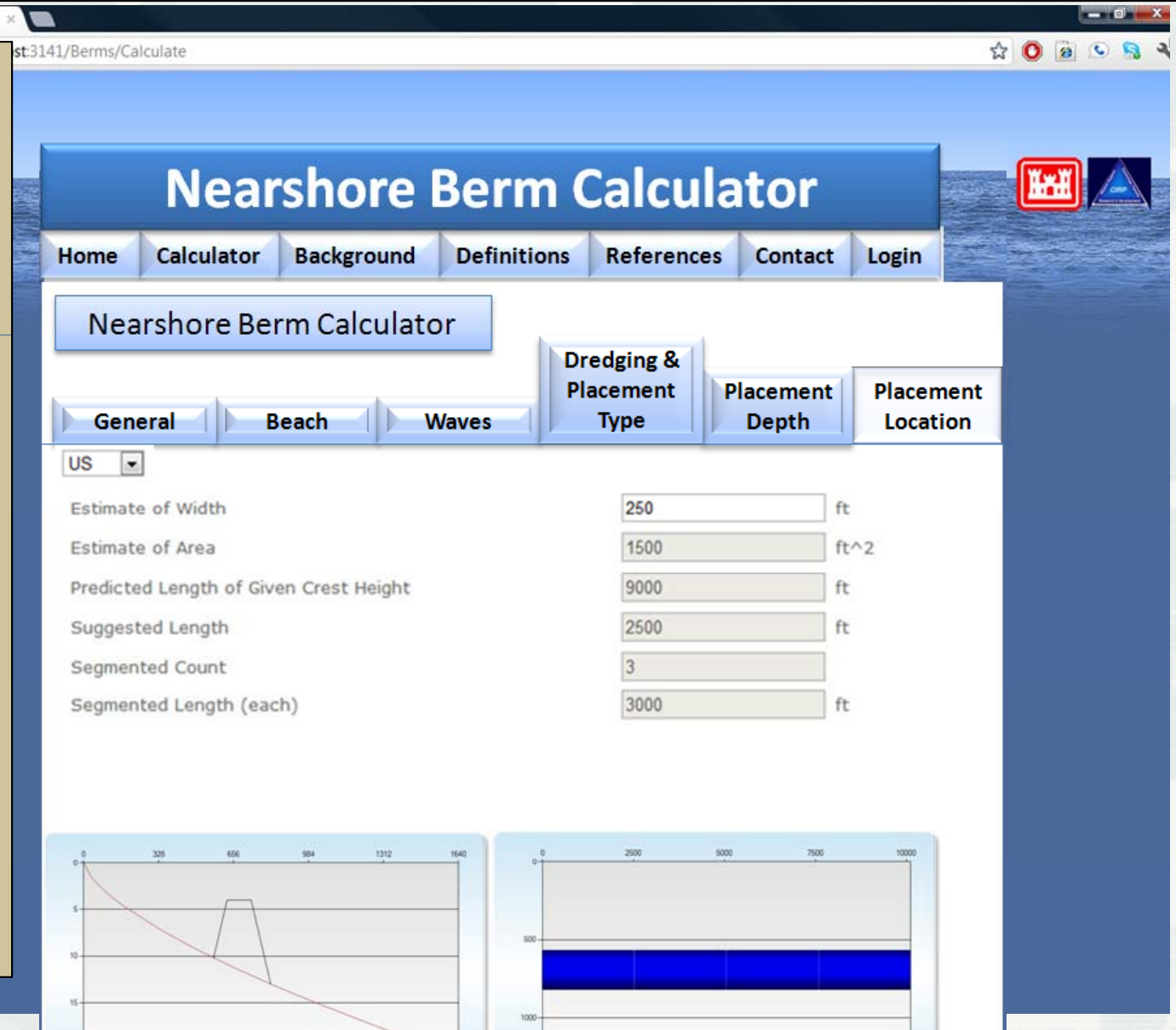
www.offshoreswell.com

25-Sep-2012 10:00:00



Placement
locations

- **Planning-Scoping Tool**
- **Estimates placement depth (based on wave-limited cross-shore transport)**
- **Calculates position and design from user-defined parameters and coastal engineering design practices**
- **Automated wave parameter extraction; user-defined beach profile; draft depth and placement limitations based on dredge**



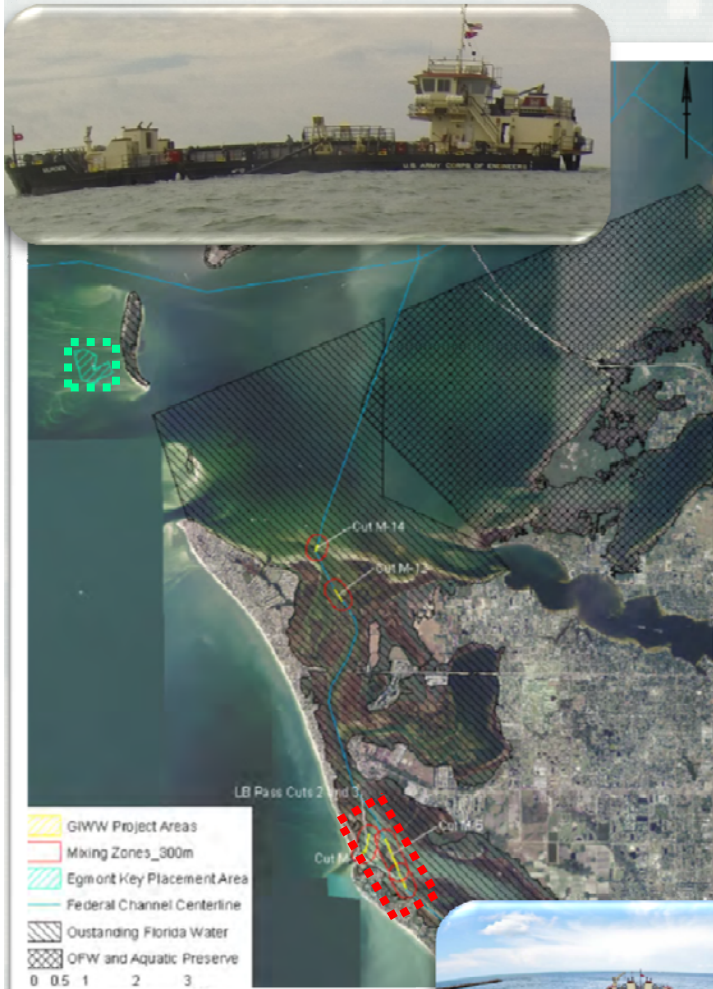
The screenshot shows a web browser window with the URL `st:3141/Berms/Calculate`. The page title is "Nearshore Berm Calculator". The navigation menu includes: Home, Calculator, Background, Definitions, References, Contact, and Login. The main content area has a sub-header "Nearshore Berm Calculator" and a set of tabs: General, Beach, Waves, Dredging & Placement Type (selected), Placement Depth, and Placement Location. Below the tabs, there is a dropdown menu set to "US". The input fields and their values are:

Parameter	Value	Unit
Estimate of Width	250	ft
Estimate of Area	1500	ft ²
Predicted Length of Given Crest Height	9000	ft
Suggested Length	2500	ft
Segmented Count	3	
Segmented Length (each)	3000	ft

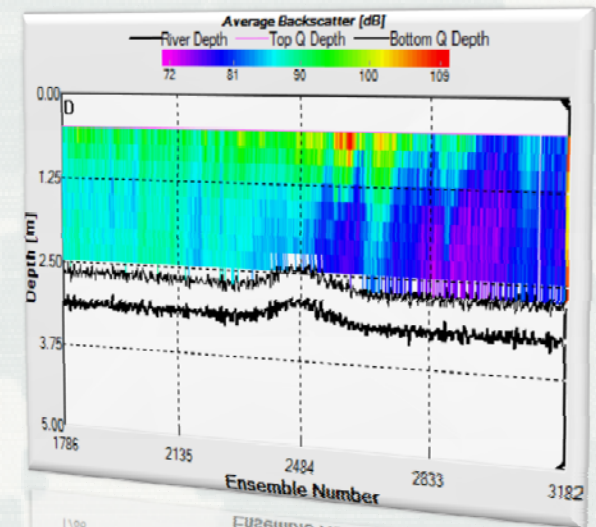
At the bottom, there are two graphs. The left graph shows a cross-section of a beach profile with a crest height of approximately 5 feet and a width of 250 feet. The right graph shows a plan view of the berm placement, with a blue shaded area representing the berm structure extending across the width of the beach.

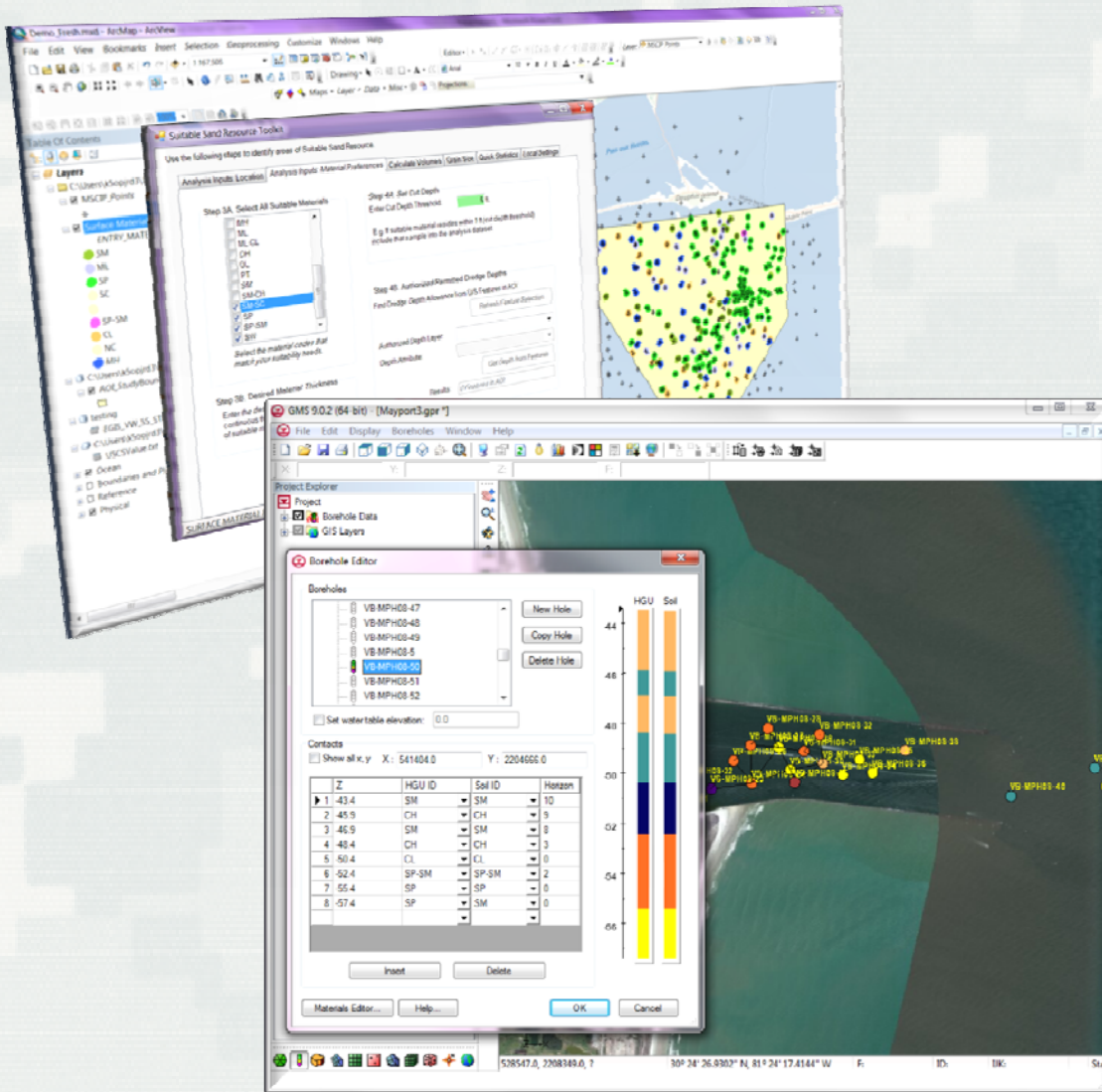
Geomorphic Evolution

FY13: Field Monitoring Study of GIWW Dredging and Nearshore Placement at Egmont Key



- ADCP Currents
- ADCP Backscatter
- Total Suspended Solids
- Turbidity Sensor Array
- Wave Array
- Light Attenuation
- Surface Sediment





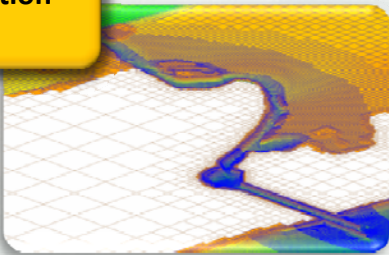
- Develop a standard web-service linked to individual District Servers to serve out sediment data into a common format
- Web Application version of data submission form feeds directly to NCDB
- Integrated to GMS, and designed to provide 3D sedimentologic input for SMS numerical models

Geomorphic Evolution

FY13 Plans: Modeling Methodology for Design of Nearshore Berms

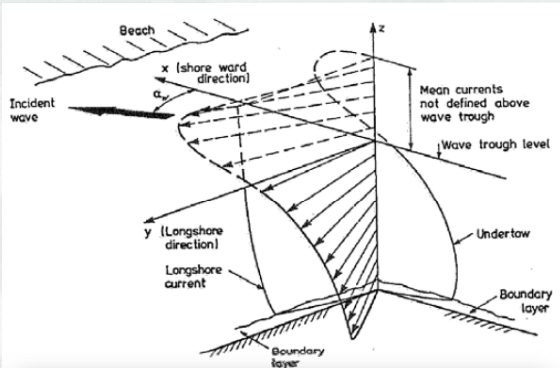
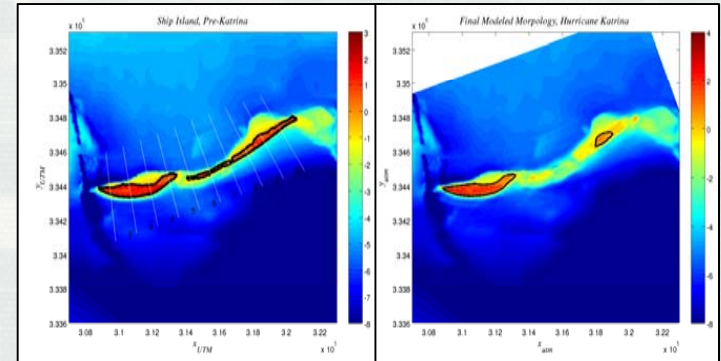
Geomorphic Evolution

CMS

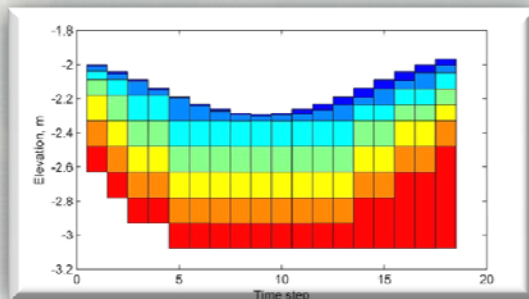
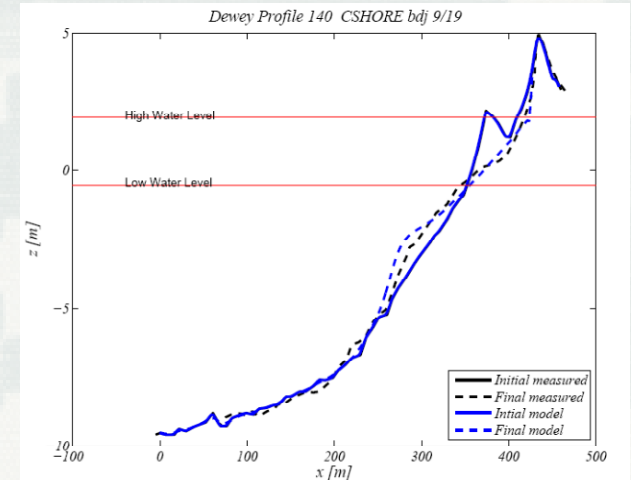


← Validated 2DH Coastal Model that simulates vertical variation of horizontal velocities and includes mixed sands

CShore



Surf Zone Processes in Both Models:
 Undertow
 Stokes Drift
 Wave Asymmetry
 Separated Bed and Suspended Load



1D Coastal Model → validated for erosion/accretion in the cross-shore for both East and West Coast Applications

CIRP Summary

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

- All products & documentation available on website and wiki
- CIRP available to travel to your District and provide training on products
 - CIRP travel and labor free (until funding runs out)
- We invite suggestions for improvement, new methods for technology transfer, and challenging inlet applications

New Initiatives with CIRP assistance:

- Corps of Engineers Coastal Engineering Certificate Program
- FRF Field Experiment with Nearshore Berm

