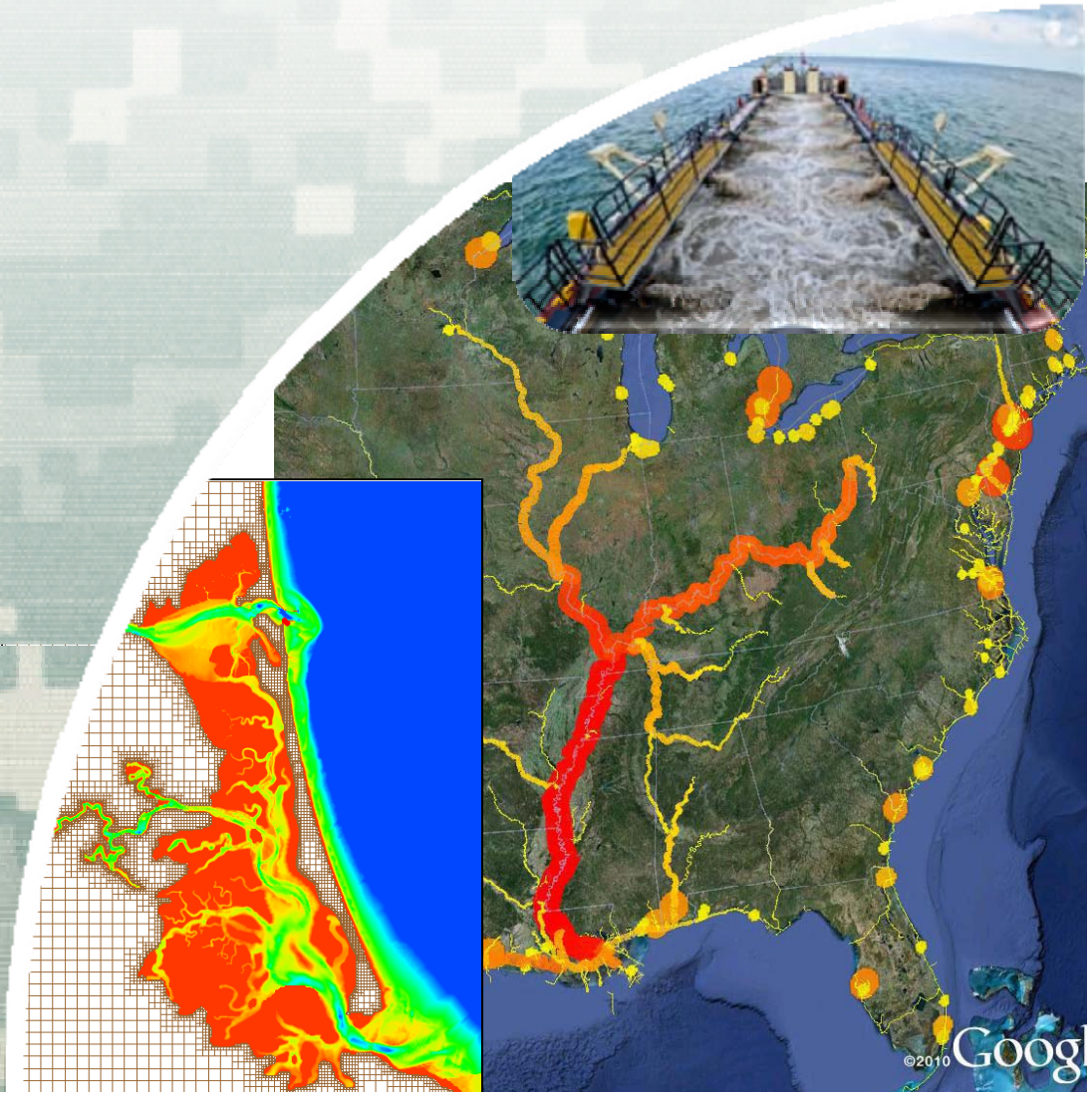
Coastal Inlets Research Program

Julie Dean Rosati
Program Manager

Jeff McKee
HQ Navigation
Business Line Manager

Jeff Lillycrop
Technical Director

Eddie Wiggins
Associate Technical
Director

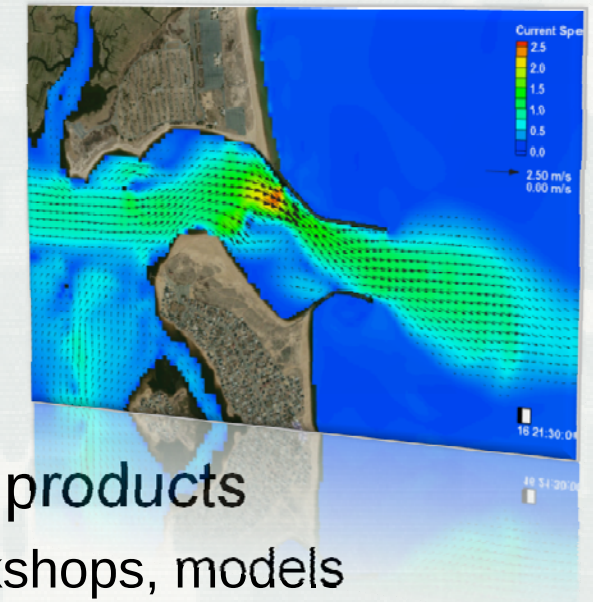


US Army Corps of Engineers
BUILDING STRONG®

CIRP Mission

- 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.

Mission Support
Technology Transfer
CIRP
Research & Development

CHL Coastal and Hydraulics Laboratory

All products & documentation: http://cirp.usace.army.mil


Mission Support
Technology Transfer
CIRP
Research & Development

CIRP Work Units

Program Management and Technology Transfer

Julie Rosati, Mitch Brown

Coastal Modeling System (CMS)

Alex Sanchez
Honghai Li

Coastal Navigation Portfolio Management

Ned Mitchell

Geomorphic Evolution

Tanya Beck

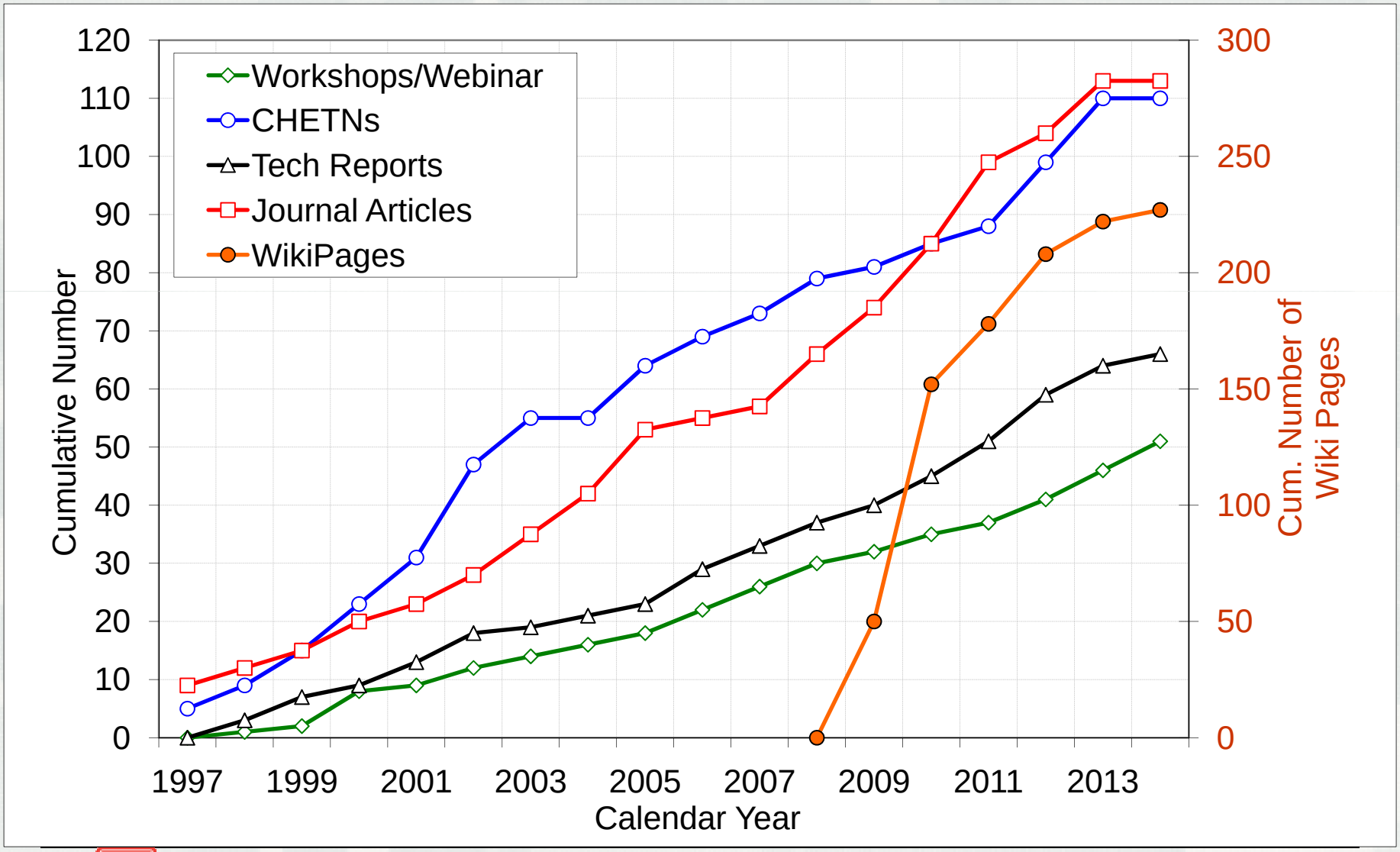
Inlet Engineering Toolbox

Ashley Frey
Julie Rosati

Waves at Navigation Structures

Lihwa Lin
Zeki Demirbilek

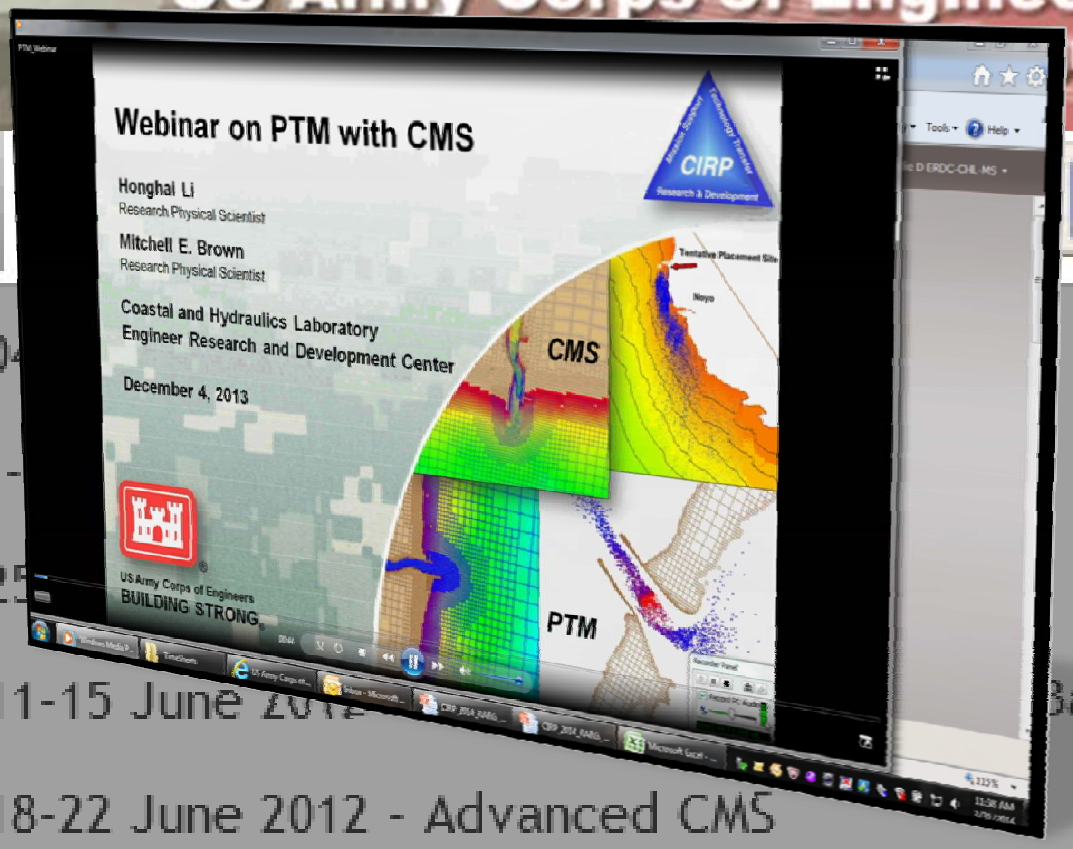
CIRP Publications and Workshops



CIRP Website: Tech Transfer

http://cirp.usace.army.mil

Online Video Clips!



Webinars »

Photo Collections »

18-22 June 2012 - Advanced CMS

16-18 October 2012 - GenCade

Excellent self-paced, low-cost learning

Technology Transfer, Nov98 - Apr14

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
#2 – FSBPA, Feb 2001	Orlando, FL	ADCIRC, STWAVE, & ADCIRC/STWAVE linkages

Program Management and Technology Transfer

14 Years of Tech Transfer Activities

Since RARG 2013:

Six On-Site Training Sessions (4 CIRP-DOTS)

2 Webinars to Date (1 more planned)

Jun 2013	Jacksonville, FL	CMS CIRP-DOTS training
Jul 2013	Webinar	Sediment Budget Family of Solutions
Sep 2013	Portland, OR	Particle Tracking Model (PTM) - CMS
Jan 2014	Webinar	CMS and Particle Tracking Model (PTM)
Feb-Apr 2014 (3)	Vicksburg, MS	3 Joint CIRP-DOTS training
Mar 2014	Vicksburg, MS	CIRP-RSM Nearshore Berms Working Mtg

Feb-Apr 2014	Vicksburg, MS	3 Joint CIRP-DOTS workshops
Mar 2014	Vicksburg, MS	Nearshore Berms Workshop

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Zeki Demirbilek

Coastal Navigation Portfolio Management

PI: Dr. Kenneth Ned Mitchell

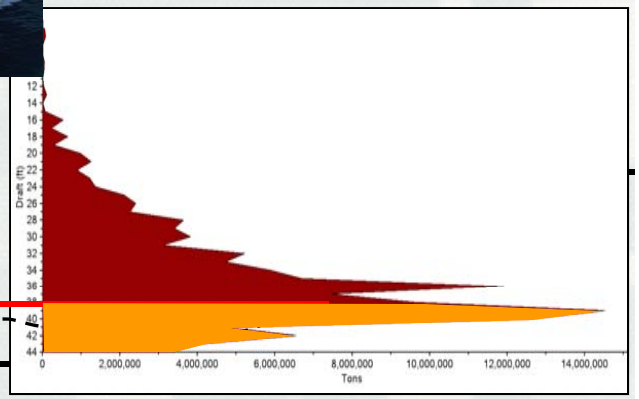
Coastal Navigation Portfolio Management

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

Poster!

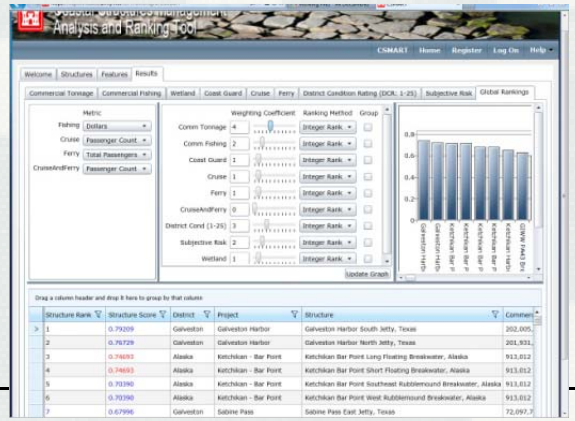
Channel Portfolio Tool (CPT):

Web-based application that **relates navigable depths to cargo** most vulnerable to shoaling.



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.
https://cpt.usace.army.mil/Silverlight/CSMART



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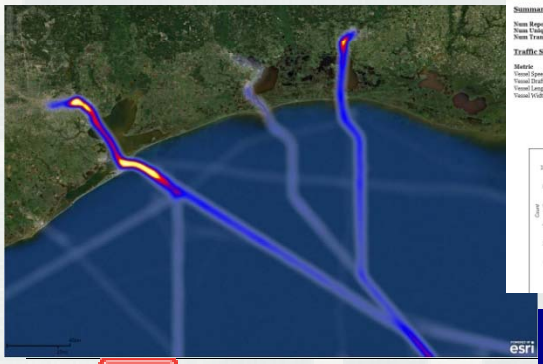
Coastal Navigation Portfolio Management

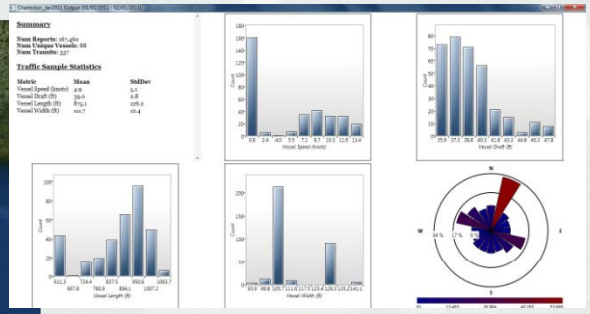
Coastal Navigation Portfolio Management

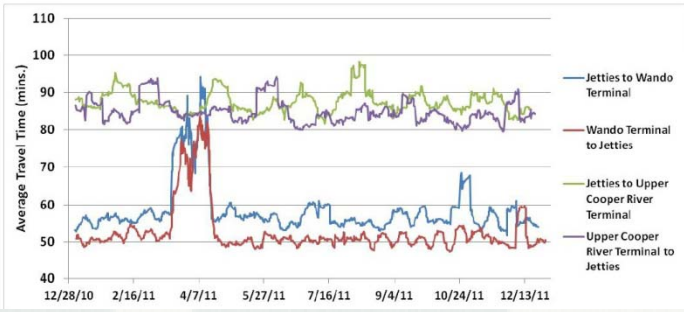
Tech Transfer Demo

Automatic Identification System Analysis Package (AISAP)

- Desktop application that provides access to and analysis capabilities for large amounts of archived spatial-temporal Automatic Identification System (AIS) data.
- Uses web services provided by USCG to access archived data of vessels movements in coastal waters and along inland rivers (from LOMA).
- Analysis capabilities include traffic density patterns, fleet characteristics, avg. speeds, travel times, dwell times, and tidal dependency.







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Statements of Need

Automatic Identification System (AIS) data use in Navigation operations and engineering.
Tracking Number 2012-N-5

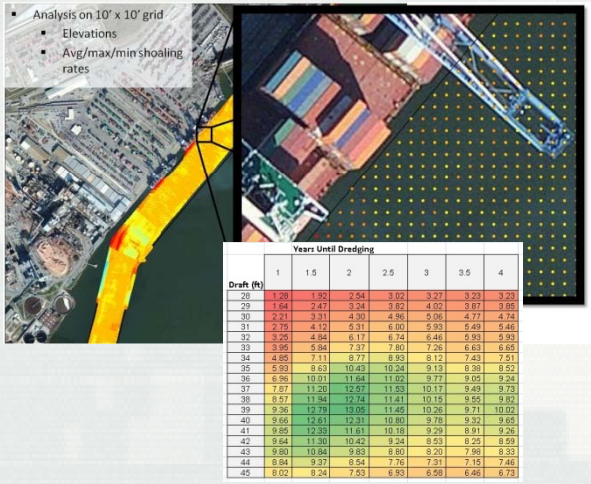
Coastal Navigation Portfolio Management
FY14 Progress

Coastal Navigation Portfolio Management

CPT:

• Supporting Asset Management with integration of e-Hydro output and Corps Shoaling Analysis Tool (CSAT) forecasts into CPT architecture.

✓ Inclusion of FY09-FY13 navigation budget data.



Years Until Dredging

Draft (ft)	1	1.5	2	2.5	3	3.5	4
28	1.28	1.92	2.54	3.02	3.27	3.23	3.23
29	1.64	2.47	3.24	3.82	4.02	3.87	3.86
30	2.21	3.31	4.30	4.96	5.06	4.77	4.74
31	2.75	4.12	5.31	6.00	5.93	5.49	5.46
32	3.26	4.94	6.17	6.74	6.46	5.93	5.93
33	3.95	5.84	7.37	7.80	7.26	6.63	6.65
34	4.85	7.11	8.77	8.93	8.12	7.43	7.51
35	5.93	8.63	10.43	10.24	9.13	8.38	8.52
36	6.96	10.01	11.64	11.02	9.77	9.05	9.04
37	7.87	11.20	12.57	11.53	10.17	9.49	9.73
38	8.57	11.94	12.74	11.41	10.15	9.55	9.82
39	9.36	12.79	13.05	11.45	10.26	9.71	10.02
40	9.66	12.61	12.31	10.80	9.78	9.32	9.65
41	9.85	12.33	11.61	10.18	9.29	8.91	9.26
42	9.64	11.30	10.42	9.24	8.53	8.25	8.59
43	9.80	10.84	9.83	8.80	8.20	7.96	8.33
44	8.64	9.37	8.54	7.76	7.31	7.15	7.46
45	8.02	8.24	7.53	6.93	6.58	6.46	6.73

CSMART:

✓ CSMART query saver.

✓ Wetlands data, USCG installations.

✓ Dynamic interface for easier sensitivity analysis of weightings (FY13 reimbursable with Asset Mgmt.)

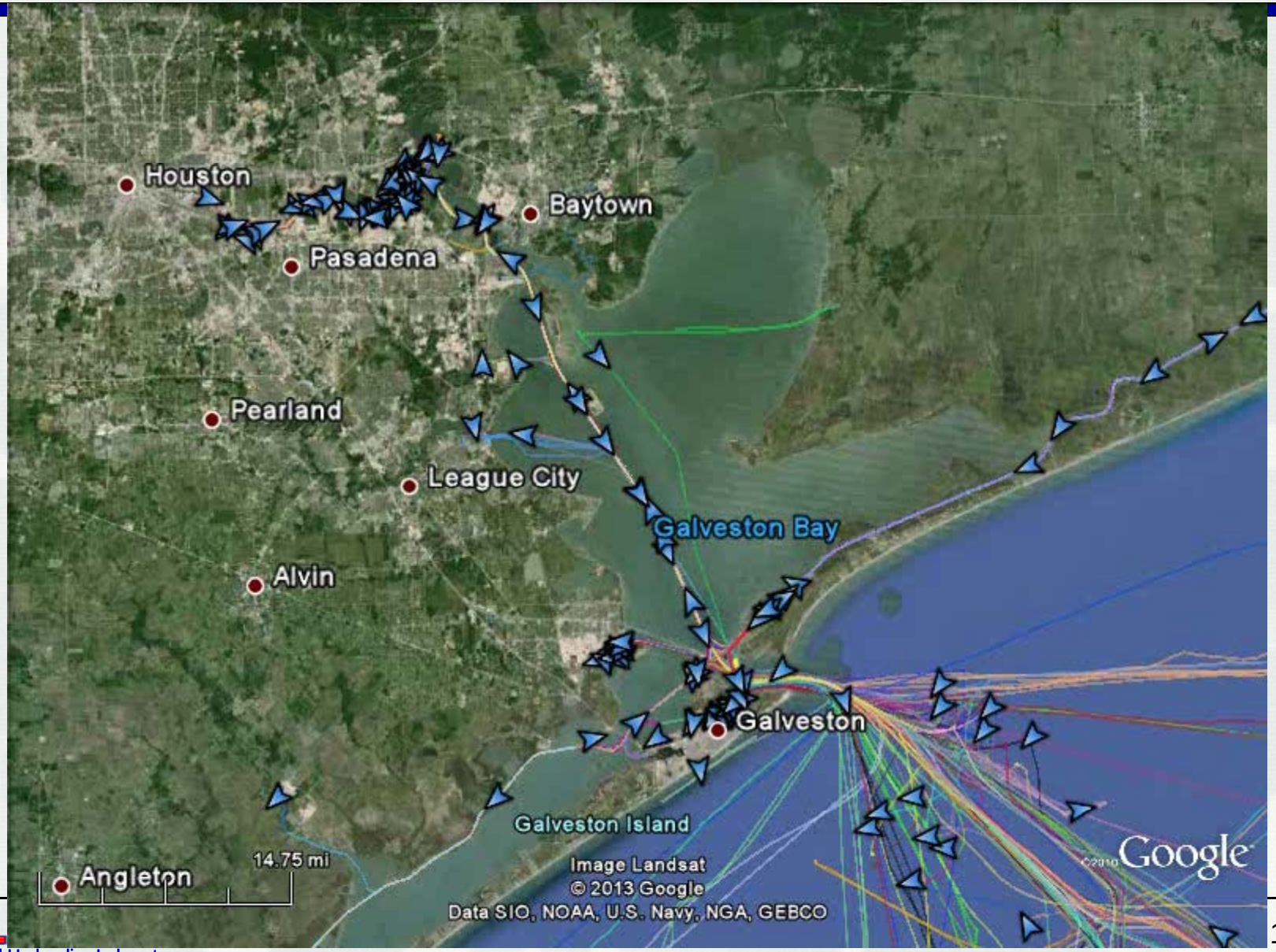
AISAP:

✓ JP: Waterway Performance Monitoring via Automatic Identification System Data (Mitchell and Scully, 2014)

✓ Methodology for quantifying tidal influence on vessel transits

• Similar approach for waves, winds, currents

AISAP:
Houston-Galveston Navigation Channel



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Waves at Navigation Structures

Lihwa Lin
Zeki Demirbilek

Waves at Navigation Structures

PIs: Dr. Lihwa Lin and Dr. Zeki Demirbilek

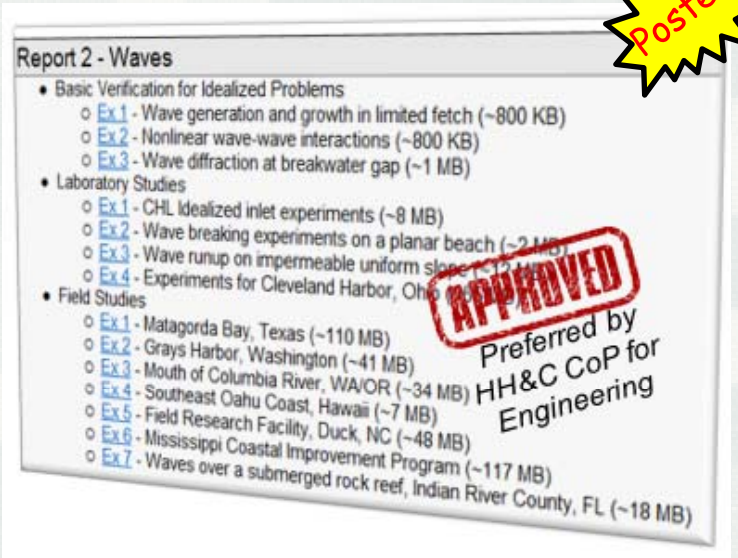
Waves at Navigation Structures

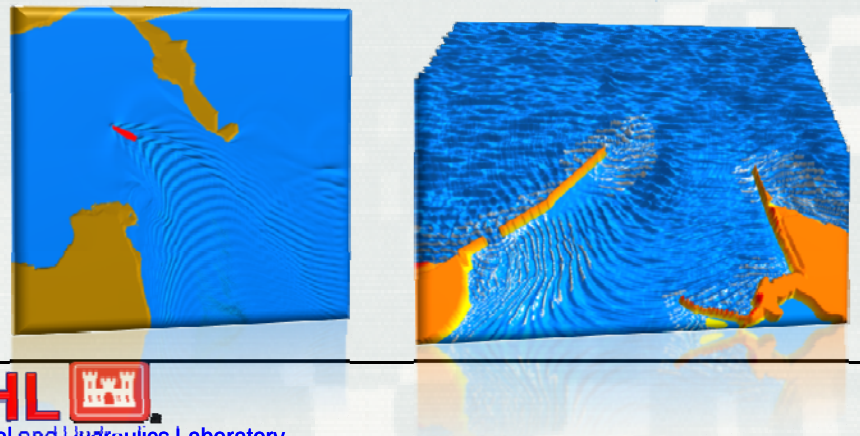
Focus: to **advance wave predictive capability** in support of USACE missions for coastal inlets, navigation, structures, ports/harbors/marinas, and adjacent beaches, reefs and wetlands.

CMS-Wave:

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

Verification & Validation Cases (14)





Bouss-2D: Phase-resolving shallow-water, nonlinear wave model for ports/harbors/marinas, navigation, fluid-structure interaction, vessel-generated waves.

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Waves at Navigation Structures: *FY13-14 Activities* Metocean Data Access/Analysis: WaveNet

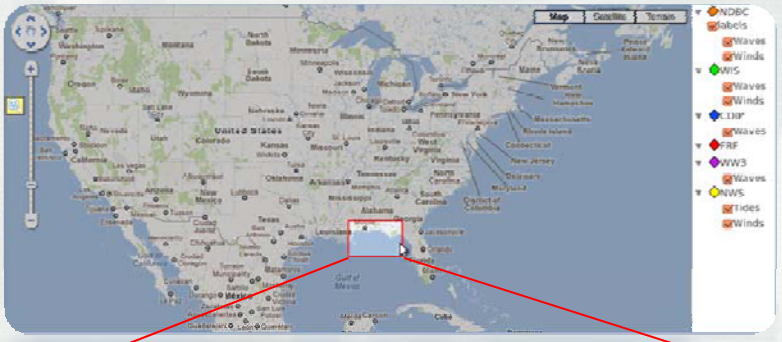
Waves at Navigation Structures

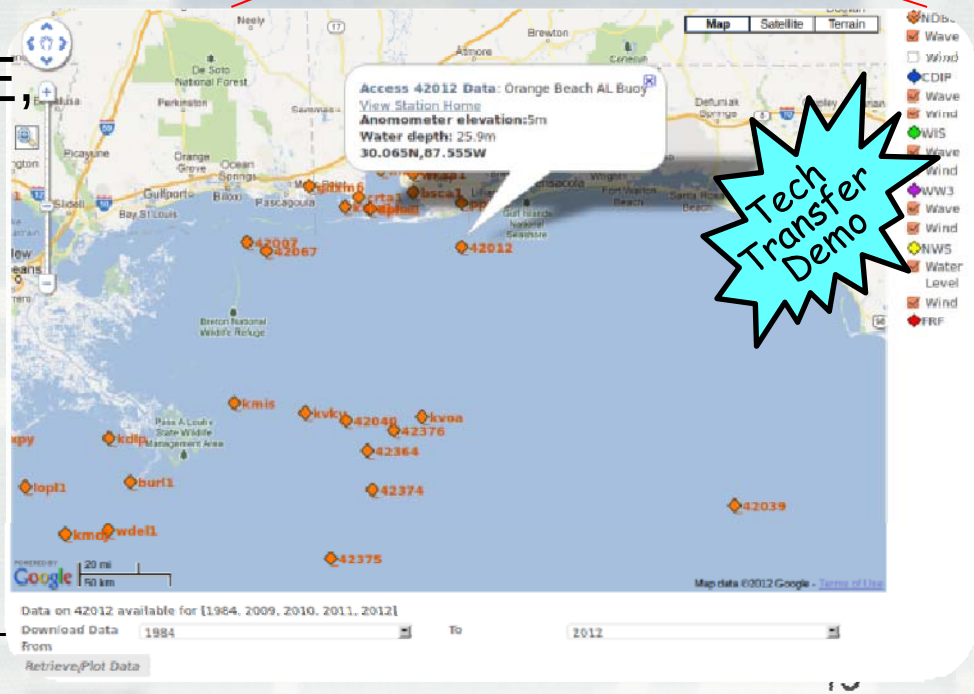
WaveNet: Web-based interactive GUI with Google Map

- **Purpose:** Access, analyze, plot, and format wave and wind data for projects and models

- **Data Sources:** NOAA, USACE, CDIP

- **Future Additions**: CPT and AIS coupling



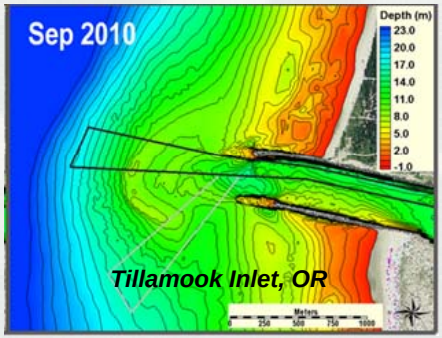


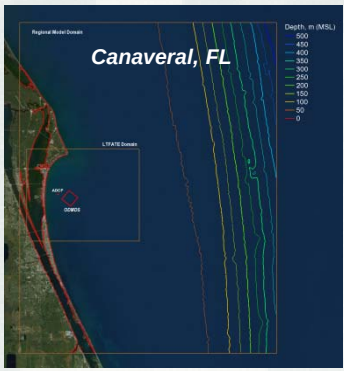
Coastal and Hydraulics Laboratory

Waves at Navigation Structures
FY13 Project Applications/Reimbursables

Waves at Navigation Structures

- NWP: Port Orford, OR
  Tillamook Inlet, OR
- SPN: Half Moon Bay, CA
- SWG: Matagorda Ship Channel, TX
  West Galveston Bay, TX
  Freeport, TX
- MVN: Terrebonne Bay, LA
- NAE: Merrimack Inlet, MA
- NAN: Ambrose Channel, NY
- LRB: Braddock Bay, NY
- LRE: Sand Island, WI
- NAO: Tangier Island, VA
- SAJ: Cape Canaveral, FL
  St. Johns River, FL
- POH: Kikiaola Harbor, HI





Waves at Navigation Structures
FY14 Plan

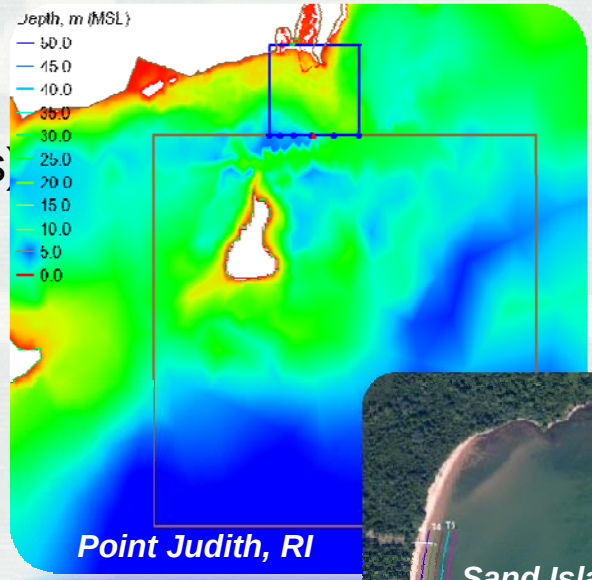
Waves at Navigation Structures

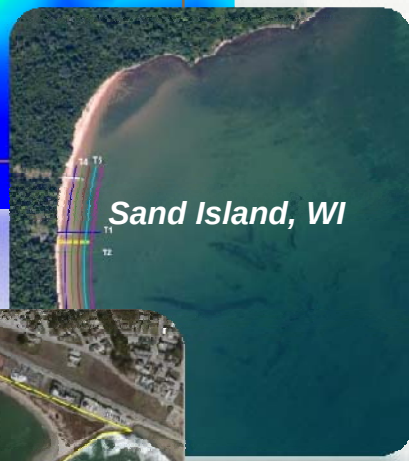
- R&D activities
- Tech transfer
- Support to Districts (project applications)

- R&D
  - Enhancements to CMS-Wave
  - Pre- and post-processing capabilities
  - Complete WaveNet and TideNet

- Tech Transfer
  - Conduct trainings for wave models for Districts
  - Complete publications (5 TRs, 4 CHETNs, 2 JPs)

- Support Districts in project studies
  - POH (2)
  - SPN (1)
  - LRC (4)
  - LRE (3)
  - LRB (3)



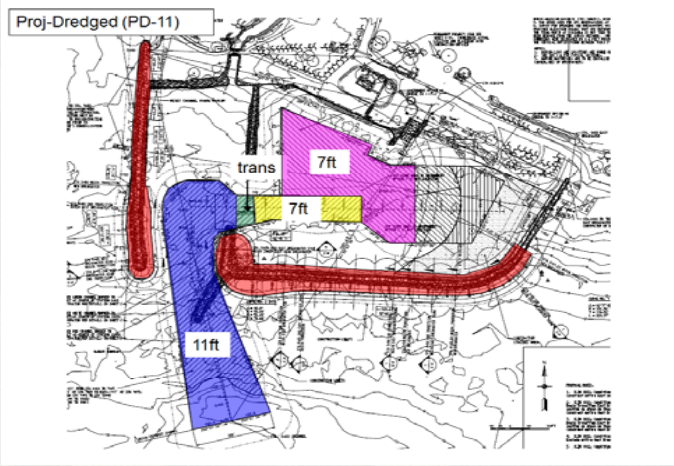


Example of Support to District Navigation Projects: *Kikiaola Harbor, HI*

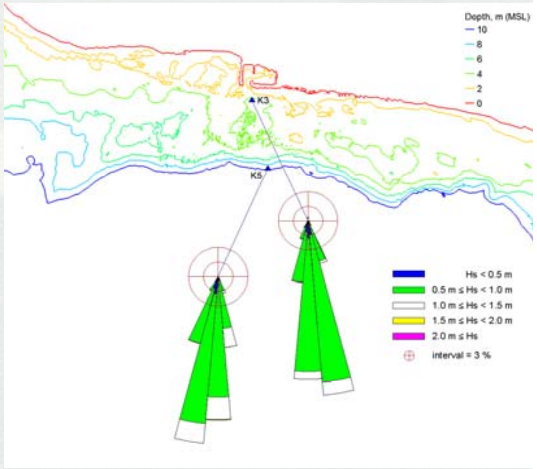
Waves at Navigation Structures

Purpose:

Evaluate improvements to navigation and infrastructure



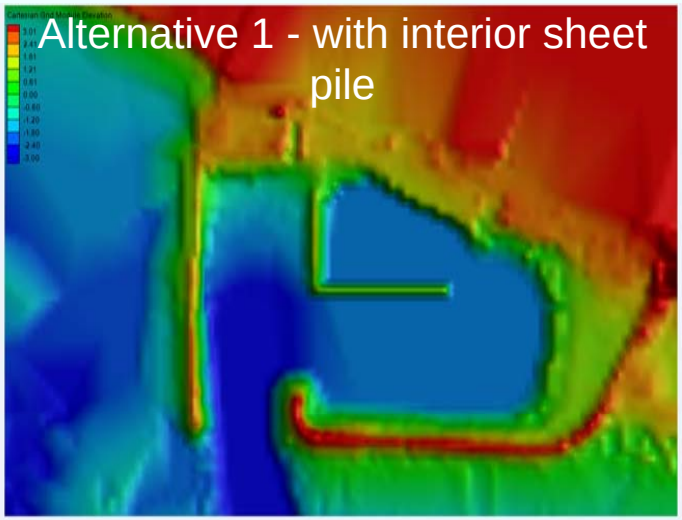
Federal project 2009

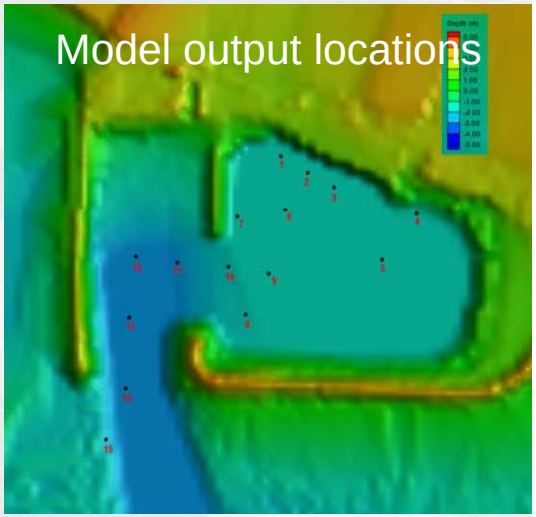


Wave roses, Oct 2012 - Feb 2013

Tasks completed:

- Defined waves at the entrance and interior harbor
- Ranked 8 alternatives for dominant waves
- Sized infrastructure mods to minimize harbor oscillations (surge) and improve harbor interior basin design





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Inlet Engineering Toolbox

PIs: Ashley Frey and Julie Rosati

Poster!

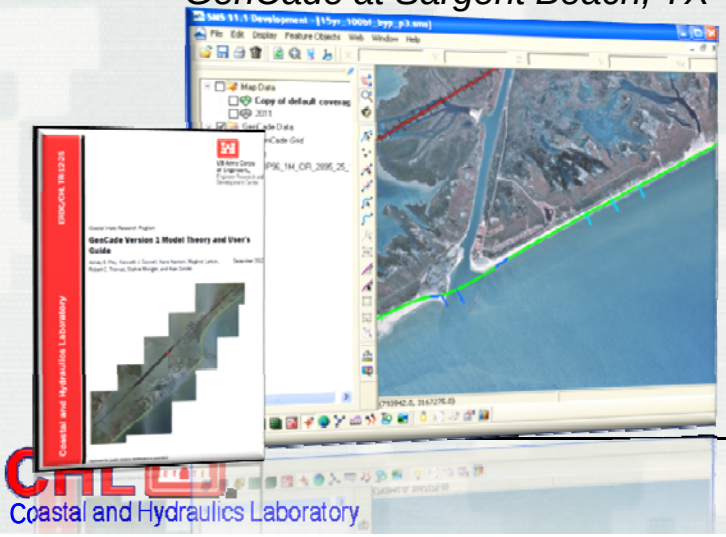
Inlet Engineering Toolbox

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

GenCade

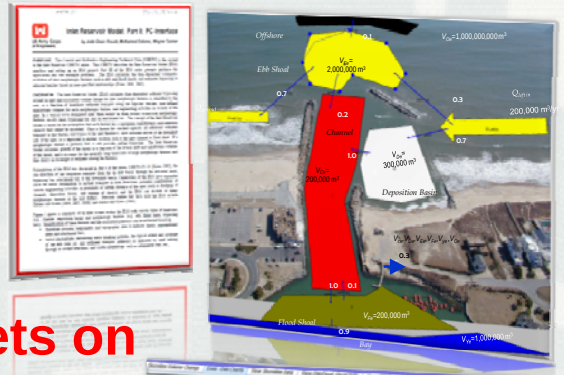
- A 1-line model **for shoreline change, sand transport, and inlet sand sharing**
- Based on GENESIS (project scale) and Cascade (regional scale)
- TRs and previous webinar audio/video and slides are available

GenCade at Sargent Beach, TX



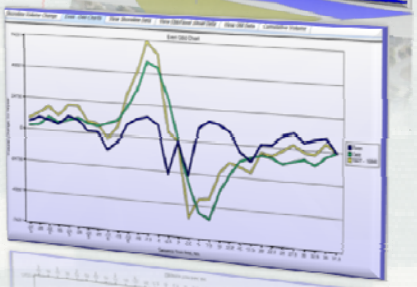
Inlet Reservoir Model

- 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

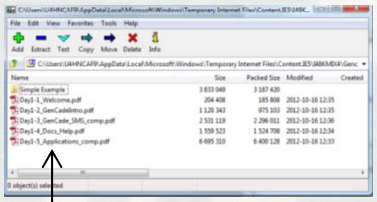
Coastal and Hydraulics Laboratory

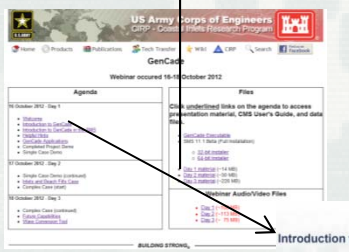
Inlet Engineering Toolbox

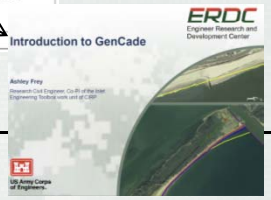
FY13 Accomplishments

GenCade

- **Documented Applications and Guidance**
  - Published 2 CHETNs on wave conversion tool
  - Published TR on Matagorda & Sargent Beach application
  - Completed TR on GenCade recommendations and CHETN on 1-line model comparisons (published in FY14)
- **Tech Transfer**
  - DOTS request at NAB
  - GenCade webinar (6 hrs)
  - GenCade webinar for SAW

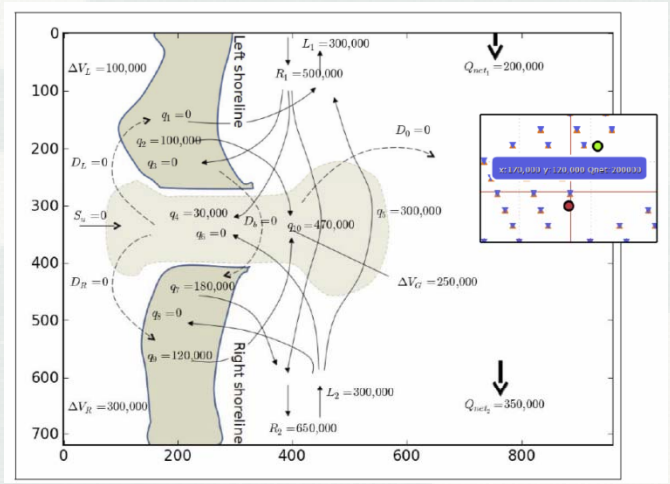






Sediment Budget Calculator

- An online web-tool that applies the Bodge Method of formulating an inlet and adjacent beach sediment budget through developing a **Family of Solutions** that satisfy user-defined constraints
- Webinar in July 2013 with 11 attendees from Districts
- CHETN published in August 2013



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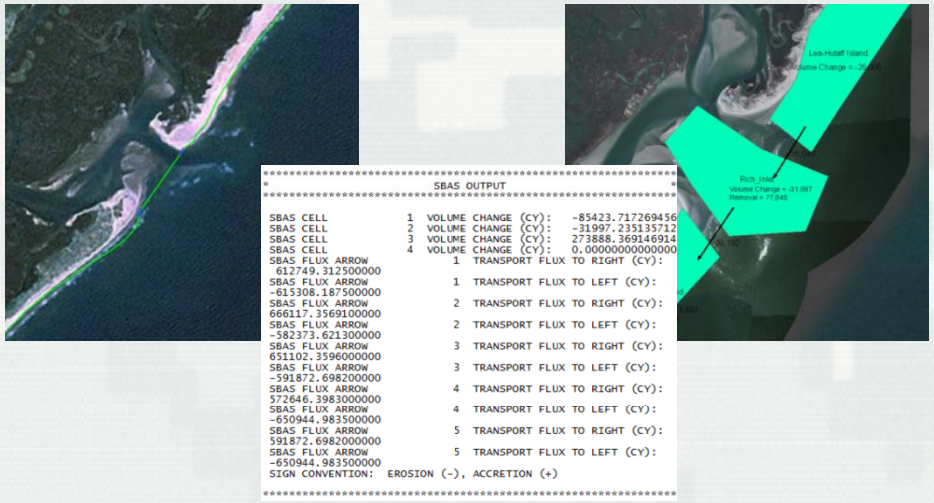
Inlet Engineering Toolbox

FY14 Plans

Poster!

GenCade

- Model improvements
  - Connect GenCade & SBAS
  - Improve Inlet Reservoir Model (IRM)
  - Apply variable parameters and time-varying structures
- New documentation on comparison of 1-line models (Part 2), a Quick Start Guide, GenCade calibration, and the external wave model
- GenCade YouTube clips



```
*****************************************************************
*                          SBAS_OUTPUT                          *
*****************************************************************

SBAS CELL            1  VOLUME CHANGE (CY):   -85423.717269456
SBAS CELL            2  VOLUME CHANGE (CY):   -31997.235135712
SBAS CELL            3  VOLUME CHANGE (CY):   273888.369146914
SBAS CELL            4  VOLUME CHANGE (CY):   0.000000000000000
SBAS FLUX ARROW              1  TRANSPORT FLUX TO RIGHT (CY):
 612749.312500000
SBAS FLUX ARROW              1  TRANSPORT FLUX TO LEFT (CY):
-615308.187500000
SBAS FLUX ARROW              2  TRANSPORT FLUX TO RIGHT (CY):
666117.3569100000
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SBAS FLUX ARROW              3  TRANSPORT FLUX TO RIGHT (CY):
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572646.3983000000
SBAS FLUX ARROW              4  TRANSPORT FLUX TO LEFT (CY):
-650944.983500000
SBAS FLUX ARROW              5  TRANSPORT FLUX TO RIGHT (CY):
591872.6982000000
SBAS FLUX ARROW              5  TRANSPORT FLUX TO LEFT (CY):
-650944.983500000
SIGN CONVENTION:  EROSION (-), ACCRETION (+)
*****************************************************************
```
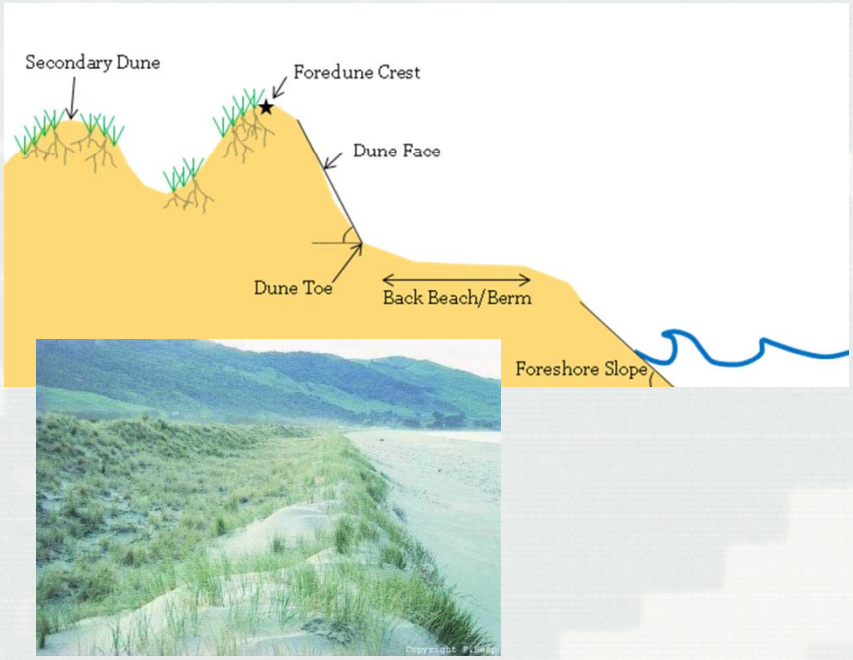

Foredunes

- Foredune state of response TR
- Develop code to classify foredune state
- Evaluate morphologic response of foredune states to high magnitude storm events



CIRP Work Units

Program Management and Technology Transfer

Julie Rosati, Mitch Brown

Coastal Modeling System (CMS)

Alex Sanchez
Honghai Li

Coastal Navigation Portfolio Management

Ned Mitchell

Geomorphic Evolution

Tanya Beck

Inlet Engineering Toolbox

Ashley Frey
Julie Rosati

Waves at Navigation Structures

Lihwa Lin
Zeki Demirbilek

Geomorphic Evolution
FY13 Accomplishments

Geomorphic Evolution

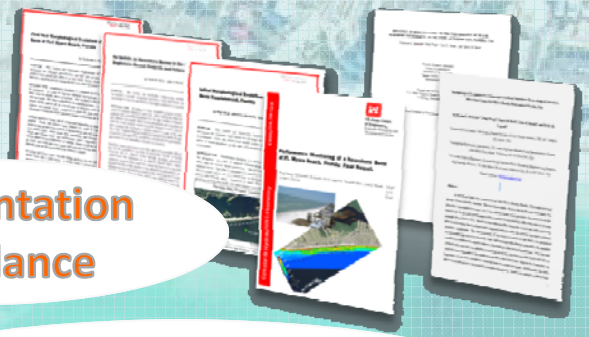
Develops methods and provides geomorphic perspective for studies on federal navigation and coastal projects concerning scales much greater than dredging cycles, planning timelines, and the dimensions of the navigation channel.

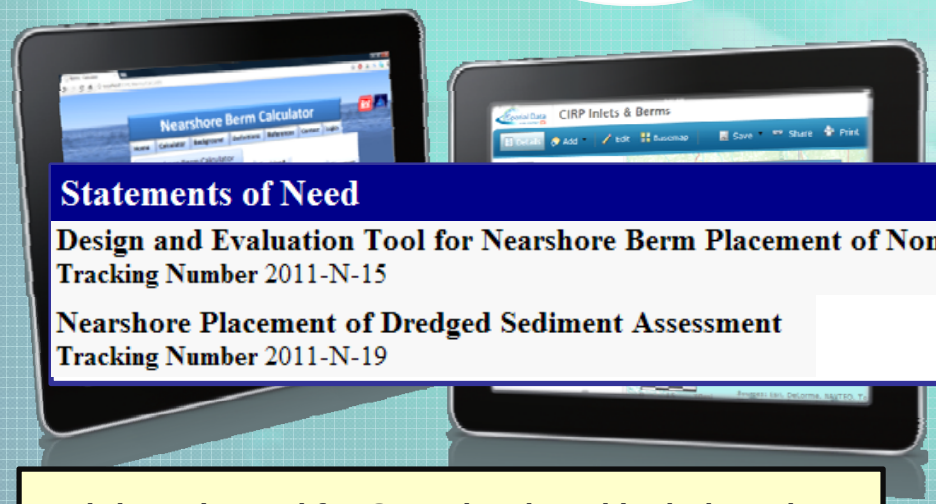
Nearshore Berms R&D

Nearshore Berm Calculator

Mobile Tools

Documentation & Guidance





Numerical Modeling & Scoping Level Calculations ...hore Berms

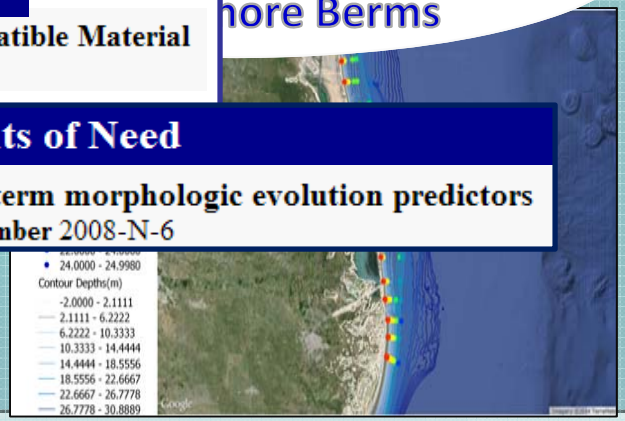
Statements of Need

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



Web-based portal for CIRP developed includes Inlets Online Database and the Nearshore Berms Database

Geomorphic Evolution
FY13 Accomplishments

Geomorphic Evolution

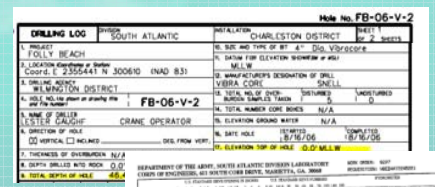
Sediment Enterprise Database & Research

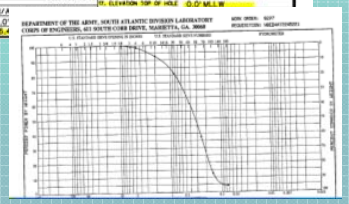
Field Data Collection

- CIRP, RSM, DOER Leveraged Dredge and Placement Sediment Study at Egmont Key, Florida
- Field monitoring study on the reduction of fines through dredging and nearshore placement process
- DOER-TN: Effect of turbidity on light attenuation over SAVs
- Tech Report: Fate of fines through the dredging process

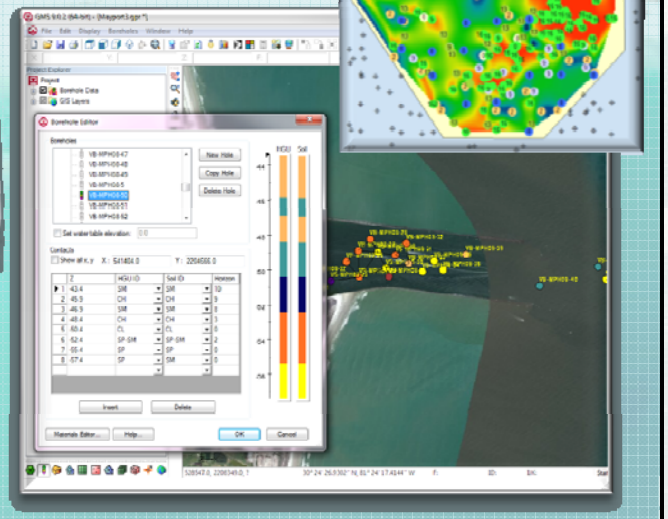
Initiate Corps-wide Sediment Database Template (future SAGA)

Retaining Digital Data





Sediment Database & GIS Resource Mapping Tools



3D Sediment Resource Tool: Integrated to GMS, and designed to provide 3D sedimentologic input for SMS numerical models

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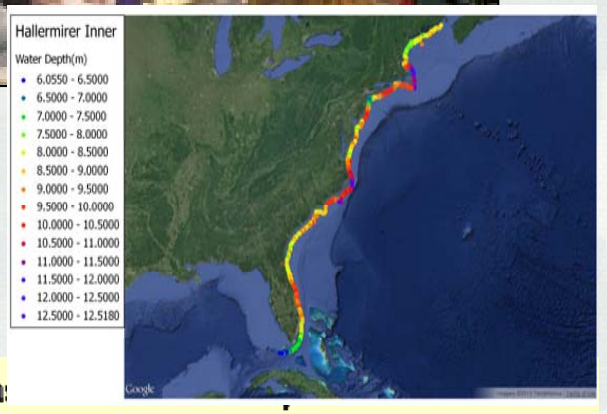
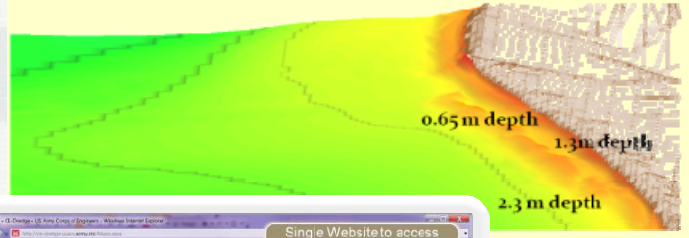
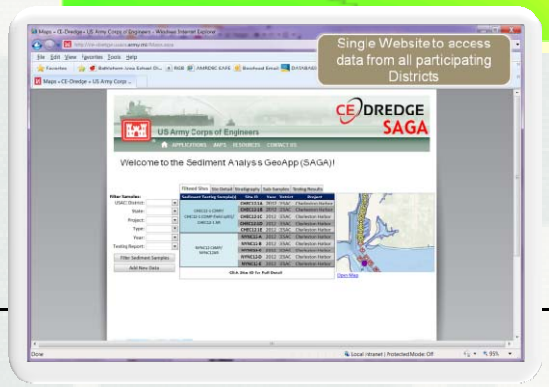
Inlet Geomorphology
FY14 Plans

- CHETN: Nearshore Berm Working Meeting Summary of Future Operational and Research Needs and Communication Strategy
- Tech Report: Improving empirical/theoretical formulations for Nearshore Berms
- JP: Nearshore Berm Modeling and Morphodynamic Analysis
- JP: Collaborate with CMS WU on Long-term Morphology Change Modeling of Tidal Inlets
- Sediment Analysis Geo-App, Release (V1)







CIRP Work Units

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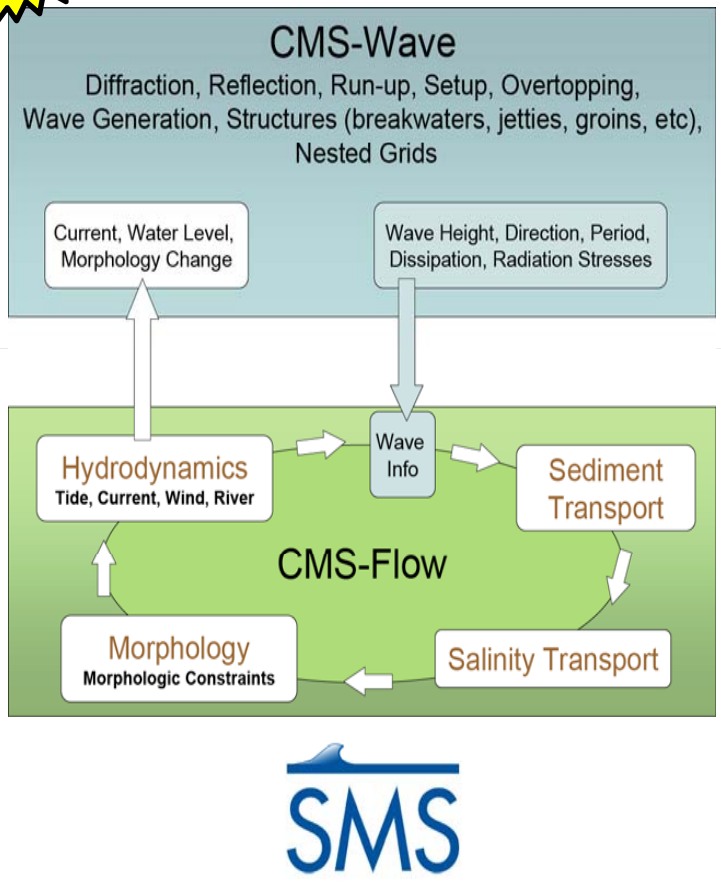
Coastal Modeling System

PIs: Dr. Alejandro Sanchez, Dr. Honghai Li

Poster!



What is the CMS?

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

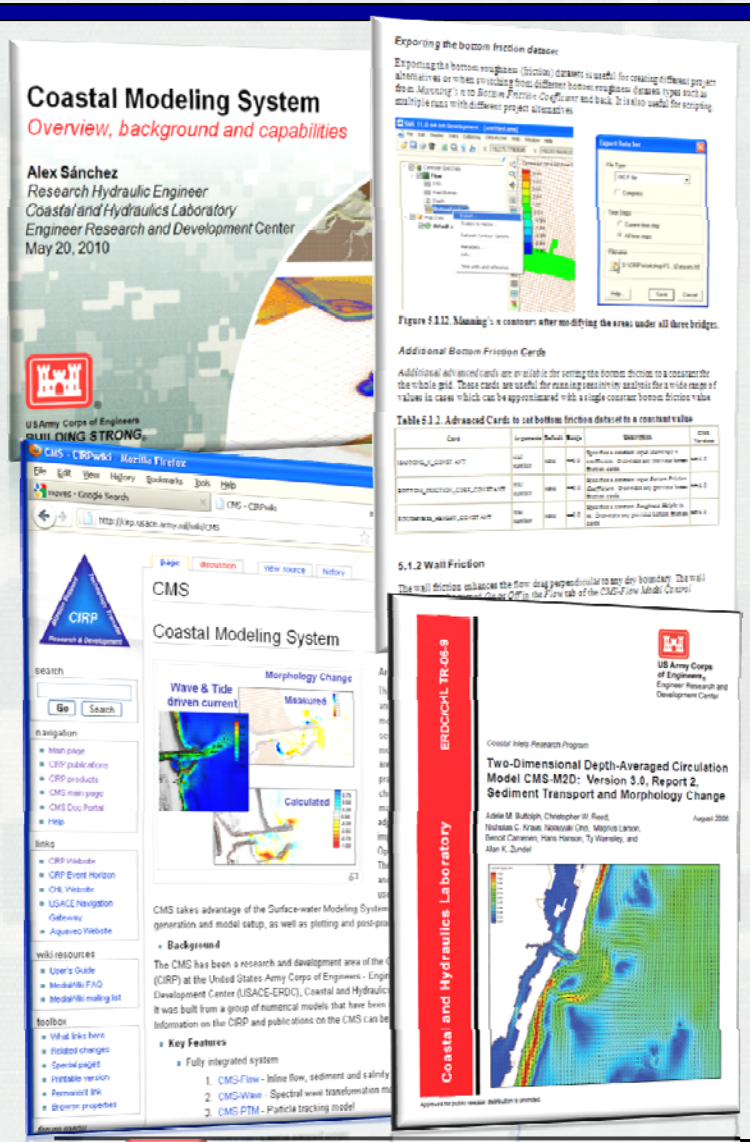
Why CMS?

- Operational at 10 Districts and consulting
- 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, sediment transport

Coastal Modeling System



Availability

- Comes with SMS installation package
- CIRP website (under Products)
- CMS is Free and interface is inexpensive
- POC's: Alejandro Sanchez, Lihwa Lin, Mitchell Brown, Honghai Li

Documentation

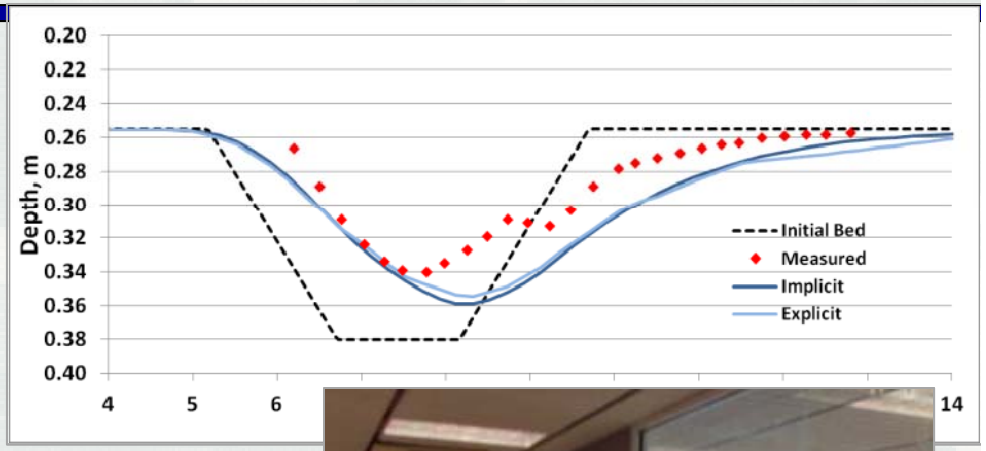
- TRs, CHETNs and journal papers http://cirp.usace.army.mil/pubs/
- CIRP Wiki http://cirp.usace.army.mil/wiki/CMS
- **New Technical Report** available

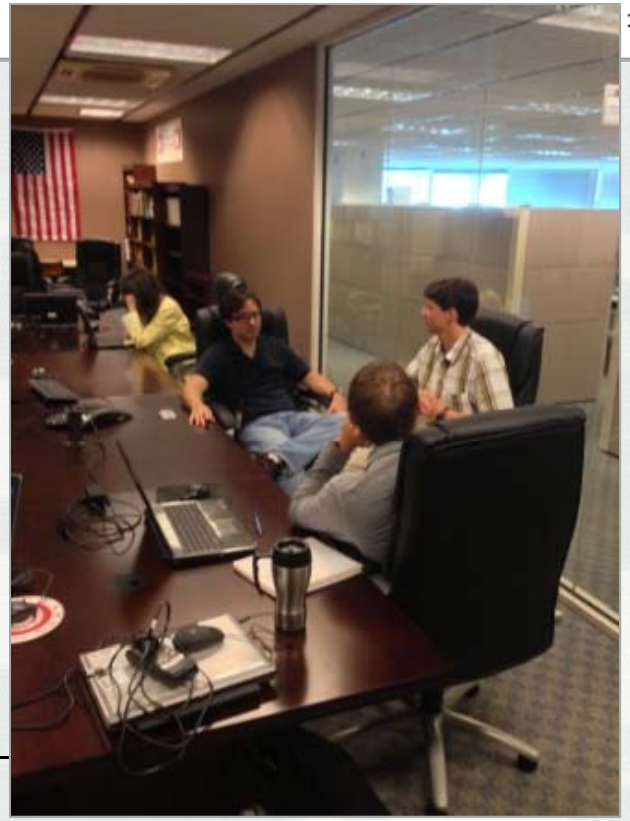
Training and Support

- Workshops http://cirp.usace.army.mil/workshops/
- Webinars http://cirp.usace.army.mil/webinars/
- On-site Training

FY13 Accomplishments

- Completed PhD 
- Publications
- Completed 2 DOTS training for SAJ and NAB
- Release of SMS 11.1
  - Dynamic dialogs
- Release of CMS 4.1
  - Many new features
- Web-based time series analysis tool
  - Prepared routines and posted on CIRP Wiki (data filtering, tidal harmonic, spectral, principal component analysis)





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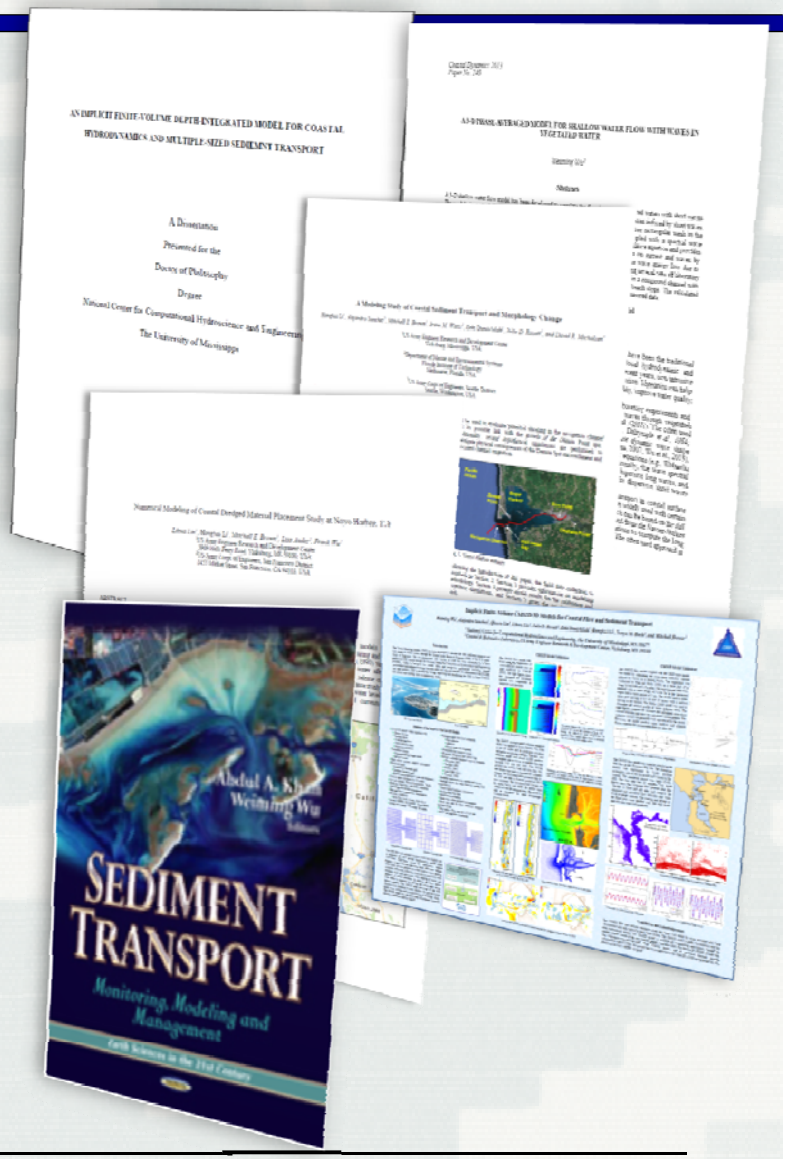
FY13 Publications

- Journal Paper
  - Naval Station Norfolk, VA
  - JP: Sediment transport through permeable breakwater
- 5 Conference Papers:
  - Coastal Inundation: Naval Station Norfolk.
  - Sediment transport: Grays Harbor, WA
  - Vegetation flow drag with CMS
  - Dredged material placement: Noyo Harbor, CA
  - Mixed Sediment Modeling: MSC, TX

  Note: 2 Coastal Dynamics papers cancelled due to travel restrictions
- 2 Book Chapters:

  Non-Equilibrium Sediment Transport Modeling –
  - Formulations and Closures
  - Extensions and Applications
- PhD Dissertation
  - An Implicit Finite-Volume Depth-Integrated Model for Coastal Hydrodynamic and Multiple-Sized Sediment Transport



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FY13 Publications (continued)

- 4 Technical Notes
  - Weirs
  - Rubble mounds
  - Tidal gates
  - Culverts
- 5 Technical Reports:
  - CMS: Theory and Numerical Methods
  - Tillamook Inlet, OR
  - Storm Waves, Circulation, and Sedimentation Study, Dana Point, CA
  - Regional Sediment Management Studies of Matagorda Ship Channel and Matagorda Bay System, TX
  - Pilot Study Evaluating Nearshore Sediment Placement Sites, Noyo Harbor, CA

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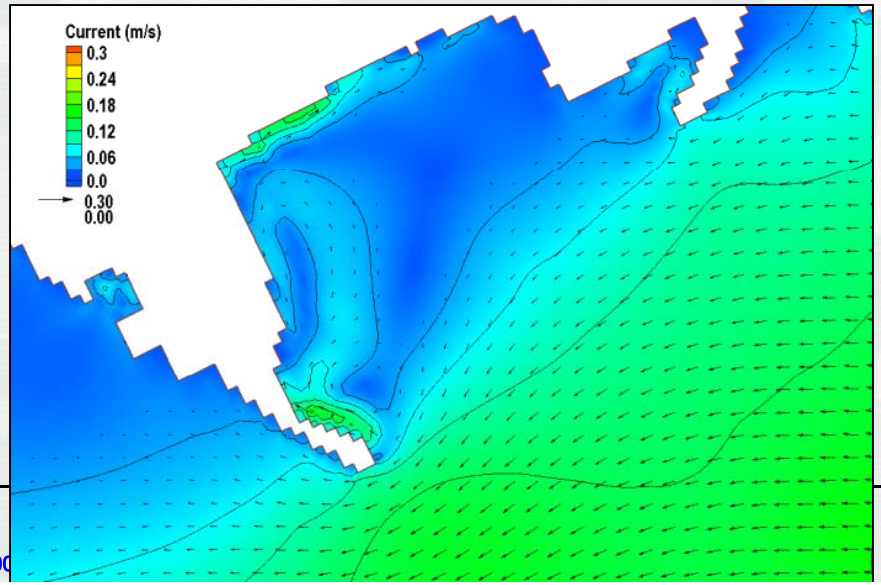
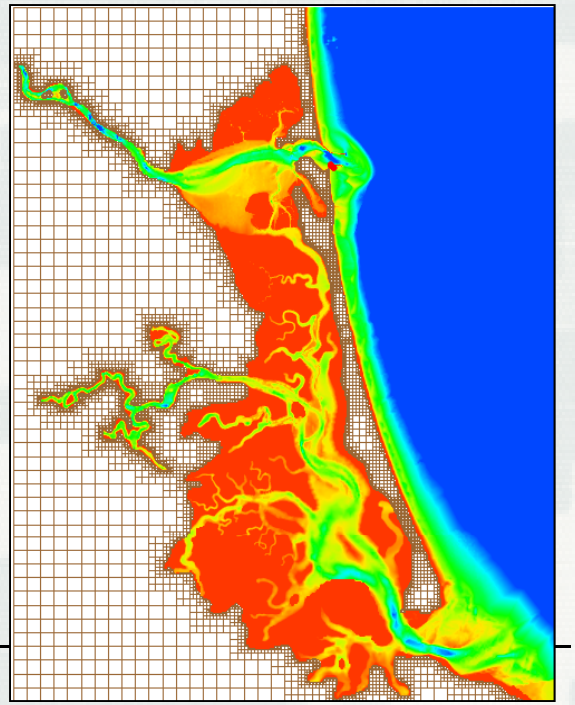
Reimbursables

- NAE: Merrimack Bay/Inlet Modeling Study
- RSM Study: Port Orford Oregon Regional Sediment Model
- NWP: Tillamook Inlet Navigation Study





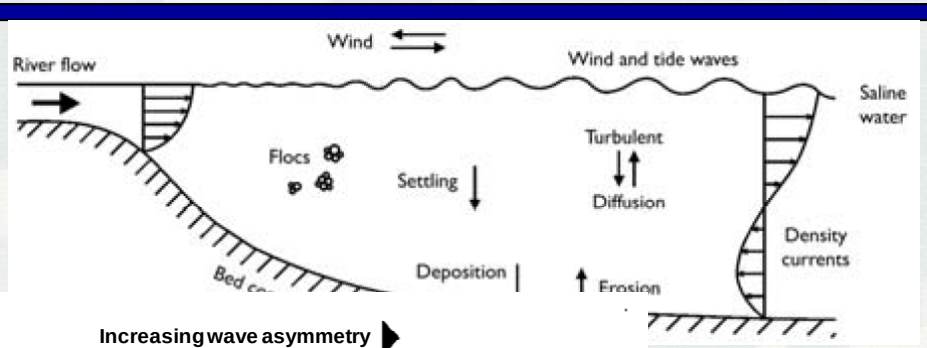
Plans for CMS

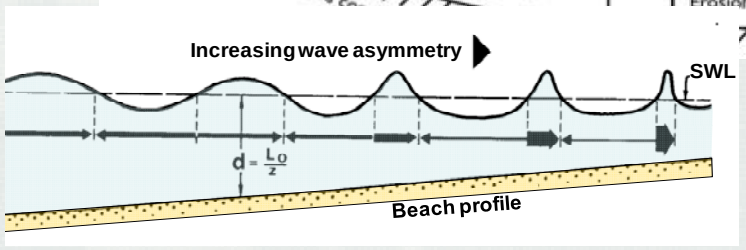
Features/updates

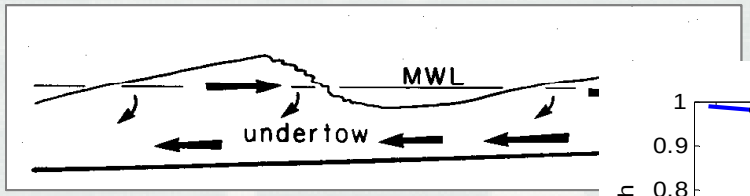
- Sediment mapping
- Dredging module
- Explicit telescoping grid
- Parallelization for HPC

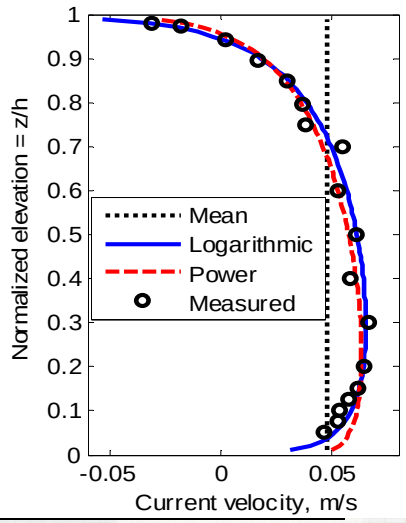
R&D

- Long-term morphology change
- Quasi-3D
- Swash zone
- Cross-shore transport
- Physical experiments of channel infilling and berms
- Mixed sediments
- Sea level change impacts to navigation projects
- Grid quality indicators

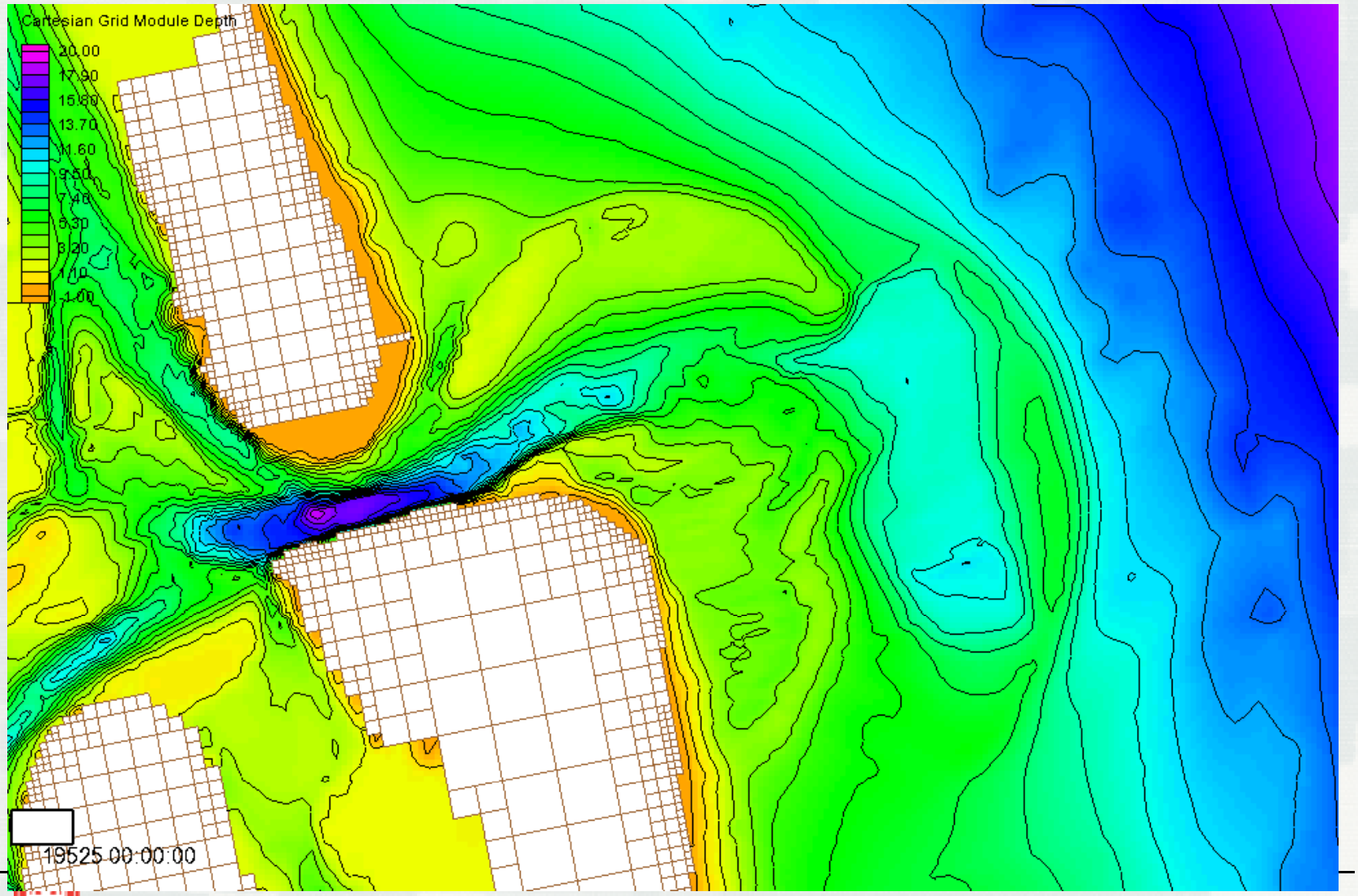








St. Augustine Inlet, FL



CHL Coastal and Hydraulics Laboratory


Mission Support
Technology Transfer
CIRP
Research & Development

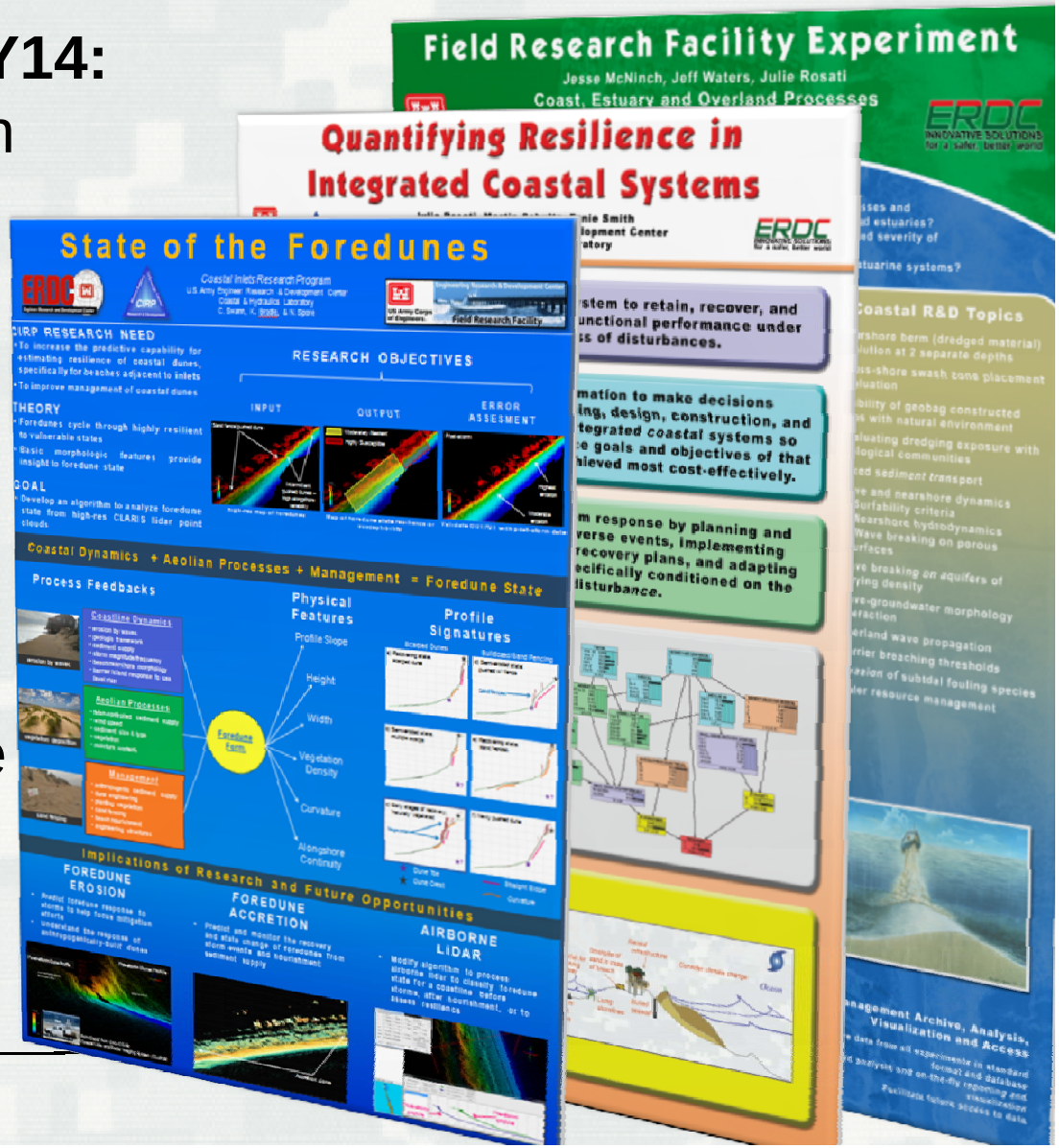
Update on CIRP-Supported Initiatives

New Initiatives in FY14:

- Foredunes research
- Coastal Resilience Metrics

Continuing in FY14:

- FRF Experiment
- CECECP = Corps of Engineers Coastal Engineering Certificate Program

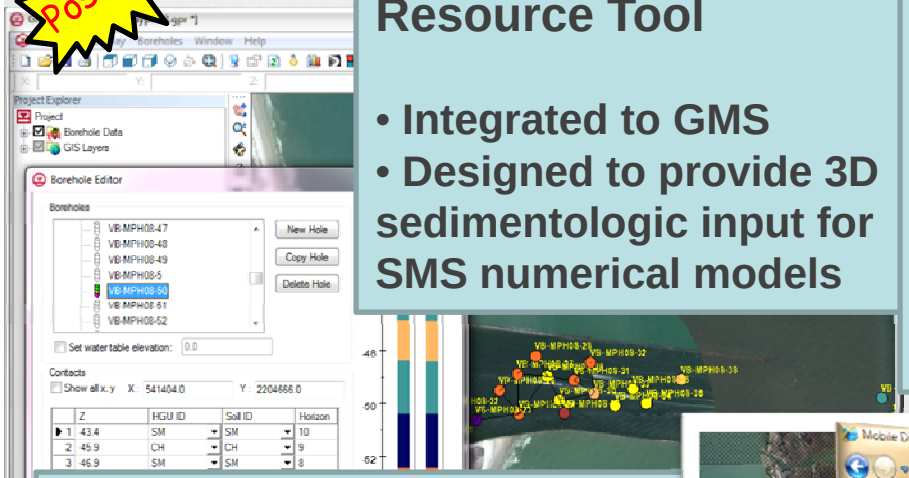


Inlet Geomorphology
FY13 Accomplishments

Poster!

Release 3D Sediment Resource Tool

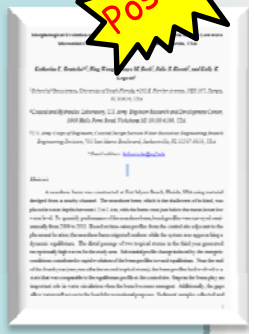
- Integrated to GMS
- Designed to provide 3D sedimentologic input for SMS numerical models



Nearshore Berm Publications

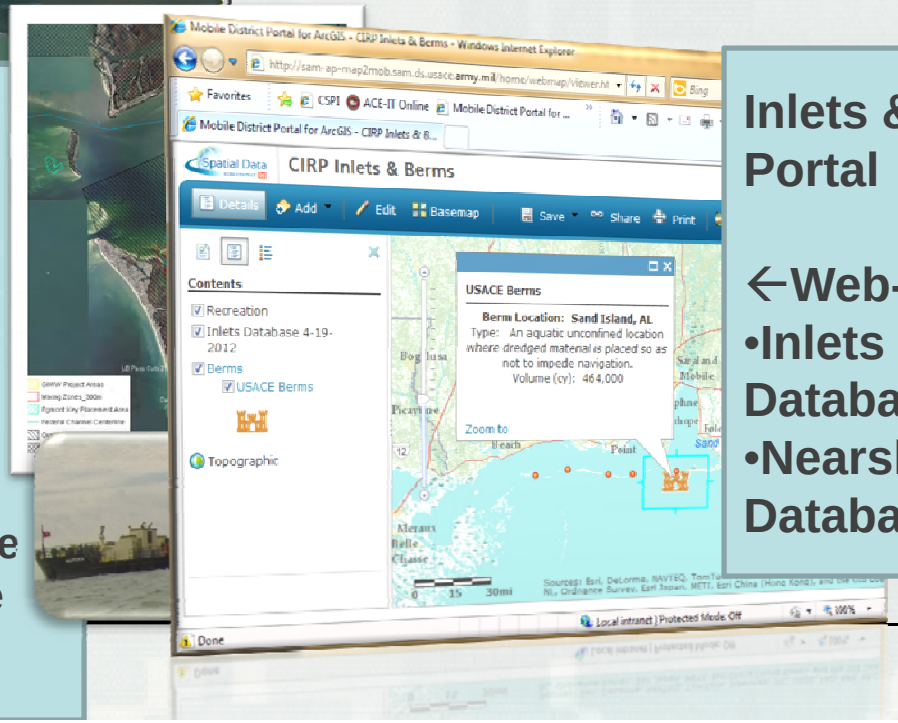
- Ft. Myers Nearshore Berm (Coastal Eng.)
- Perdido Key Swashzone Placement (JCR)

Poster!



CIRP/RSM/DOER: Dredge and Placement Sediment Study at Egmont Key, Florida

- Field monitoring study
- Nearshore placement
- Reduction of fines
- Sediment plume tracking
- One DOER-TN (in review); One Tech Report (drafted); and one Journal Article (drafted)



Inlets & Berms Portal

←Web-based portal

- Inlets Online Database
- Nearshore Berms Database