

Coastal Inlets Research Program



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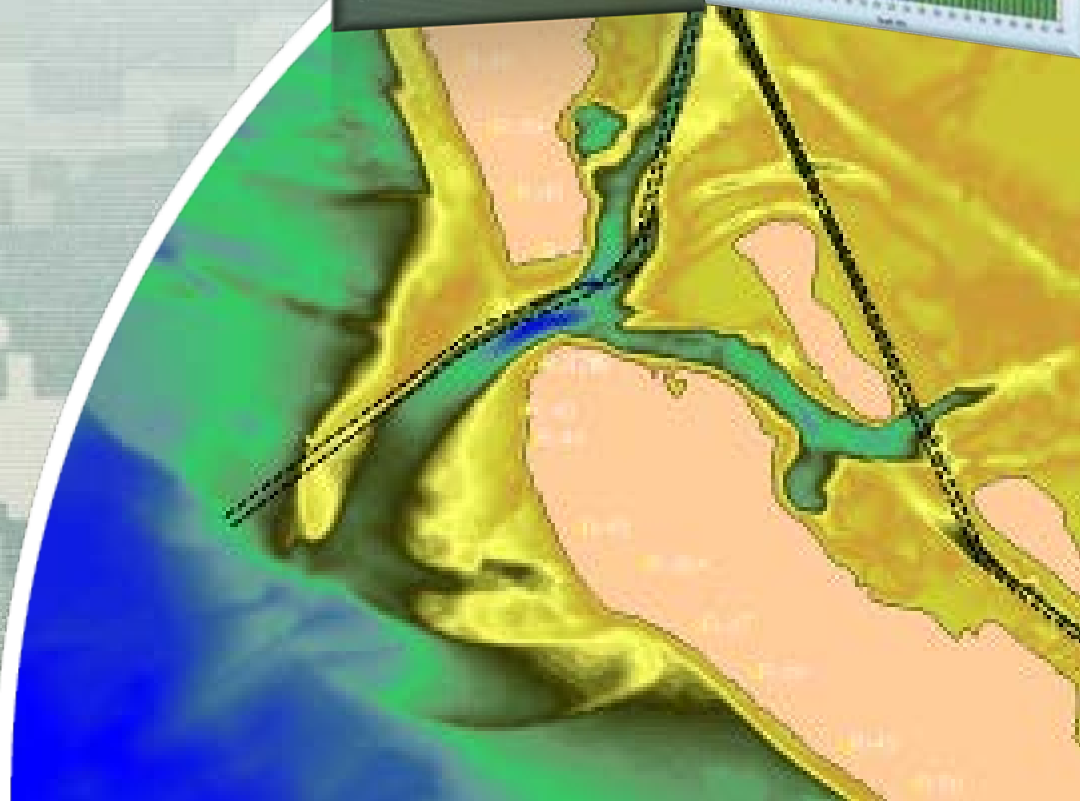
Eddie Wiggins

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Overview of Presentation

■ Coastal Inlets Research Program

- Mission
- Technology and Products

■ FY12 Activities - *Models in Surface-water Modeling System*

■ Coastal Modeling System

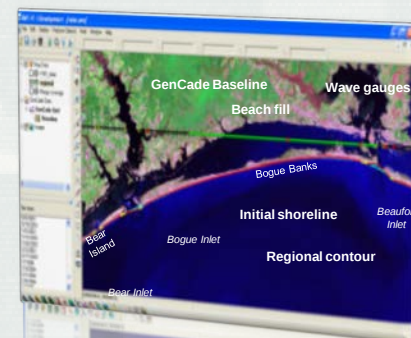
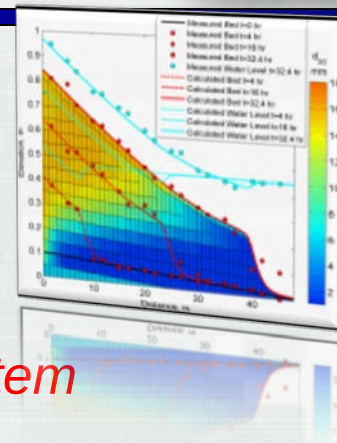
CMS-Wave, CMS-Flow *SoN 2008-N-6: Long-term Morph Chg*

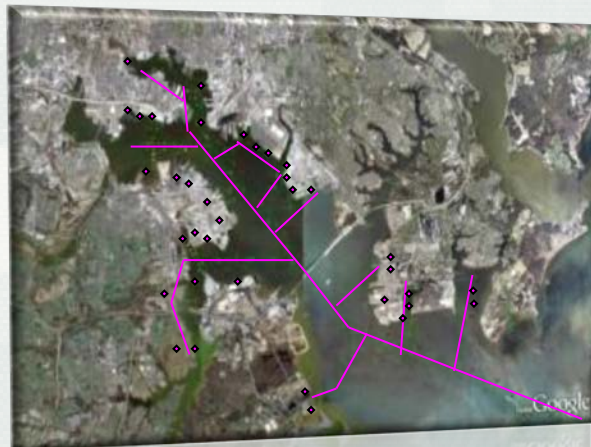
 CMS-MixSed *Mixed cohesive/non-cohesive sediment transport as forced by waves and currents*

 PTM for CMS *Upgrade to operate with telescoping grid*

■ GenCade

SoN 2008-N-6: Long-term Morphology Chg





WebTools

- CPT, CSMART

SoN 2009-N-8: Justification for Dredging



- Berm Planning Calculator

SoNs 2011-N-15b/19b: Nearshore Berms

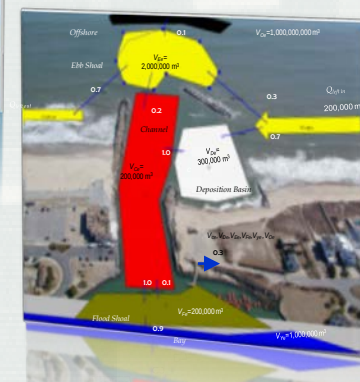
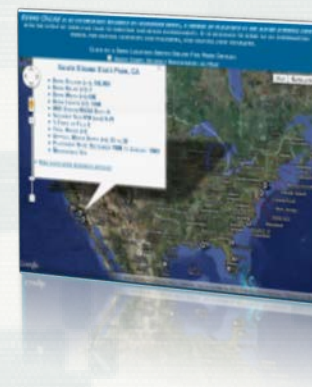
- WaveNet

SoN 2011-N-10: Dynamic WebLink Environ

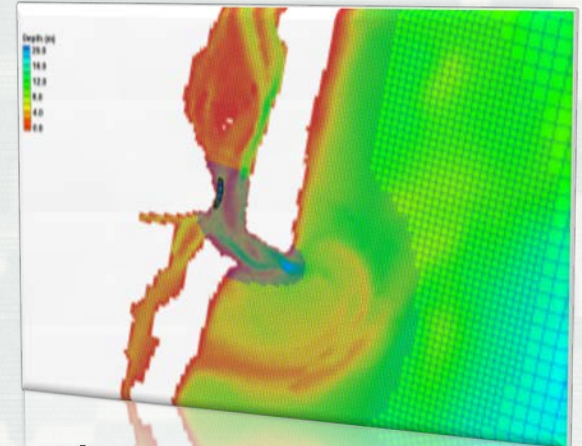


FY13 Proposed Activities

- Sea Level Rise Impacts on Coastal Navigation Projects *SoN 2012-N-11*
- Automated Feature Extraction for Sediment Budgets *SoN 2012-N-15*
- Validation Measurements *SoN 2009-N-5*



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



Coastal Inlets Research Program

Mission Areas

Tools and Models:

*CMS, CPT, CSMART,
GenCade, Inlet Res Model,
RMAP, Shoaling Toolbox,
CMS pre/post processing tools
WaveNet, Nearshore
Berm Calculator*

Mission Support

Technology Transfer

Tech Transfer:

*Workshops, Website, Wiki,
Mobile apps, Video clips,
Webinars, TRs, TNs, JPs*



CIRP

Research & Development

R&D: *Berm migration, Mixed-grain sediment transport,
Long-term morphology change, Sand sharing relationships for inlets*

CIRP Work Units

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

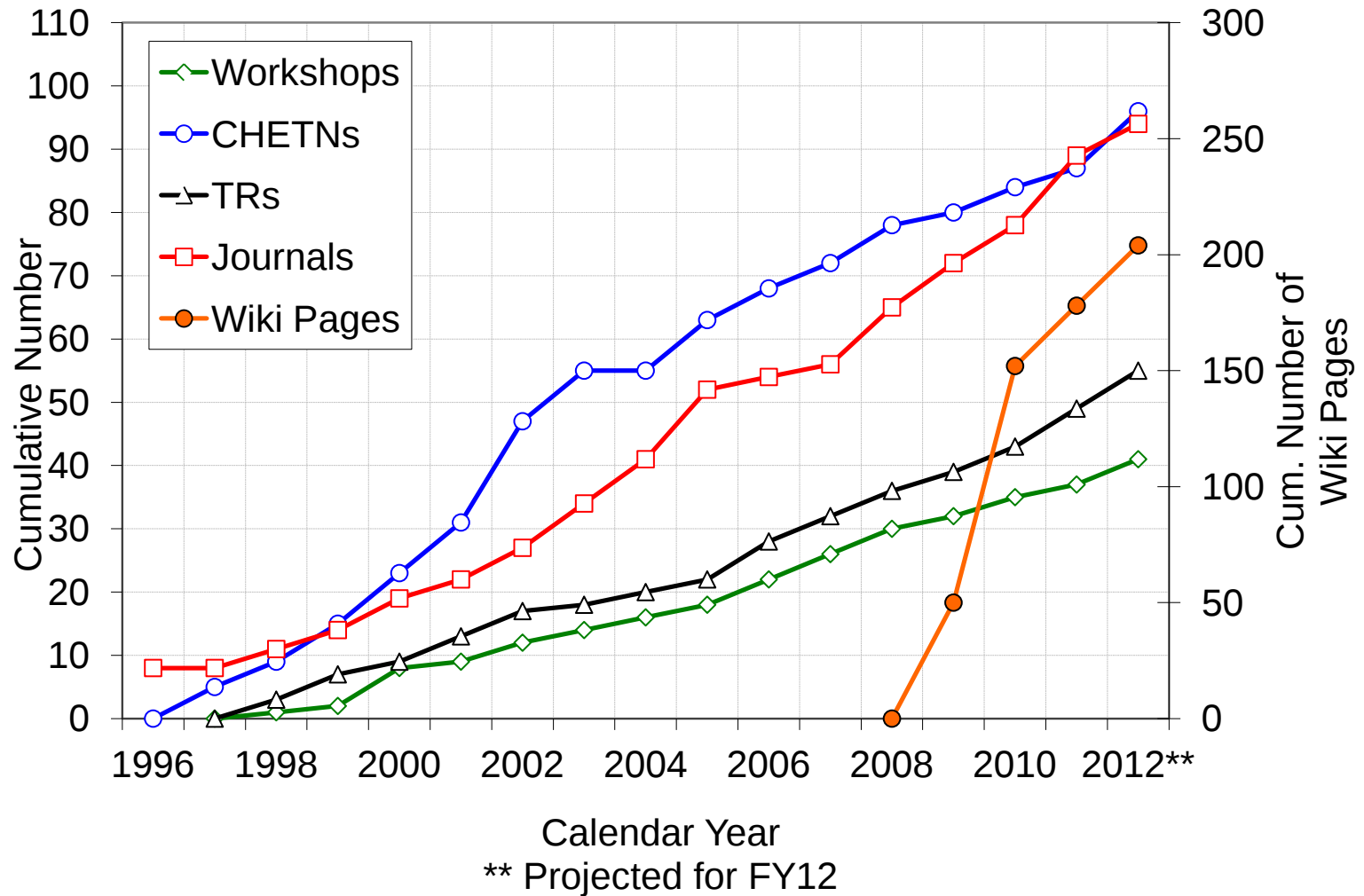
Inlet Engineering Toolbox

*Ashley Frey
Julie Rosati*

Coastal Navigation Portfolio Management

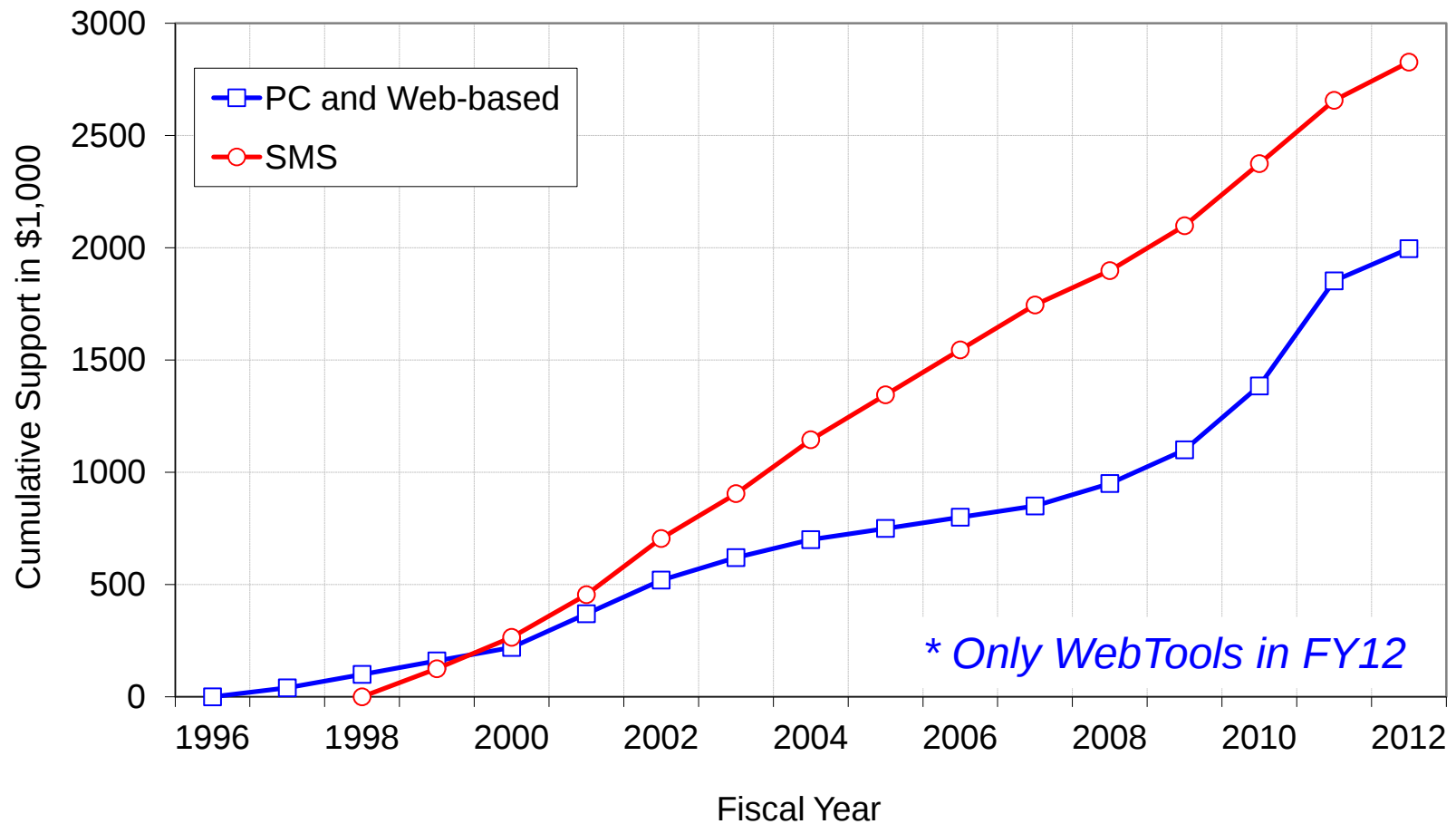
Ned Mitchell

CIRP Publications and Workshops



Investment Chart

SMS & PC/Web* Tools Interface Support





Workshops, Nov98-Aug12

13 Years of Annual Workshops
40 Cumulative Workshops
3 Workshops (2 w/DOTS) and
3 Webinars in FY12

E & W Coasts, Nov 1998
#1 – FSBPA, Feb 2000
#2 – FSBPA, Feb 2001
#3 – FSBPA, Jan 2002
Jul 2002
#4 – FSBPA, Feb 2003
May 2003
#5 – FSBPA, Feb 2004
Aug 2004
#6 – FSBPA, Feb 2005
Aug 2005

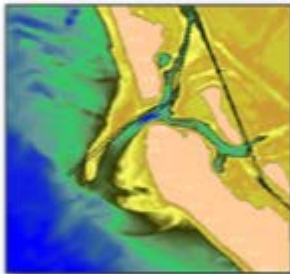
#7 – FSBPA, Jan/Feb 2006	Sarasota, FL	Modeling of waves, circulation, sediment transp. and morph. change
--------------------------	--------------	--

I: Beginning CMS and SMS (Jun 11-15, 1-3 pm CDT)
 II: Advanced CMS (Jun 18-22, 1-3 pm CDT)
 III: GenCade (Sep 11-13, 1-3 pm CDT)
 Register on CIRP Website

#12 FSBPA, Feb 2011	Jacksonville, FL	Modeling & Decision-Support for Coastal Inlets
Aug 2011	San Diego, CA	CMS&GenCade for Regional Sediment Management
#13 NAP, Mar 2012	Philadelphia, PA	Technology Transfer Workshop/Webinar
Jun (2), Sep 2012	Webinars	CMS and GenCade Webinars

Feedback from NAP Workshop

CIRP Numerical Model Tools and Capabilities



U.S. Army Engineer
Research and
Development Center
Coastal and Hydraulics
Laboratory

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Coastal Inlets Research Program

Coming Soon: Quick-Reference Summary of CIRP's WebTools

Coastal Inlets Research Program **BUILDING STRONG®**

numerical model tools and capabilities

Model	What does it do?	What are typical time scales and platforms?	Where has it been validated?	What are advantages?	What are limitations?	Where do I find info?	Who is the main POC?
COUSS-1D/2D <i>Wave model for navigation, port/harbor, flood & risk assessment; decision-support</i>	- High-fidelity, advanced, most accurate model for short and long waves 1-10 km regions - Wave-structure-ship interactions, ship wake - Surf & swash zone waves (rip currents, runup/over-topping, infra-gravity & tsunami)	20 wave conditions run with rectangular grids in projects - Can be used with one grid or grids for each project alternative - Runs on PC, Linux, and HPCLs (supercomputers) - Hours to a week	10+ sites including coastal inlets, harbors, ports, flood control structures, and reefs	- Physics & process based; no empiricism - Only 2DQ model for nonlinear shallow-water waves - Ideal for ports/harbors/marinas, & design/rehab of infrastructure	- Need expertise to run - Time-consuming - Not necessary for all coastal problems - No winds - No unstructured-grid capability	 - CIRP, navSys, FDOT, SWHMS websites - Knowledge Hub (KH)	Dr. Zaki Demirelbek
CMS-Flow <i>1D, depth-integrated</i>	- Tidal flow, wave-induced currents, sediment transport, and morphology change - Integrated with CMS-Wave	- Runs on multi-core desktop machines - Typical simulation lengths of several months to years	20+ sites including coastal inlets, estuaries and beaches	- Integrated system - Robust and fast - Flexible Cartesian meshes - SMS interface - User-friendly	- Depth integrated - No boundary fitting capability - No swash zone or cross-shore sediment transport (yet)	 - CIRP website - KH	Alex Sanchez
CMS-Wave <i>2D, depth-integrated</i>	- Full-plane spectral wave generation-transformation - Integrated with CMS-Flow - Designed for inlet applications	- Runs on PC in SMS, DOS - Typical simulation lengths of several months to years	20+ sites: US East and West coasts, Gulf of Mexico	- Efficient SMS interface - Theoretical-based wave diffraction, reflection - Includes structure-wave interactions	- Empirical wave-breaking formula - Structured grid	 - CIRP website - KH	Dr. Lihua Lin
GenCode <i>1D regional beach and inlet shoal evolution model</i>	- Can represent coastal structures, beach fills, dredging and placement - Includes Inlet Reservoir Model* to account for inlet shoal and channel evolution *Also available in PC version	- Runs on PC in SMS - Years to multiple decades - Wave conditions representing 1-10 years	- Basic V&V completed 5+ sites: Orinolu Bay, NC; Sargent Beach, TX; St. Johns County, FL; Point Lookout, NY	- User-friendly, easy to learn - Conceptual model = fast grid creation and set up - Integrates cumulative projects - Fast	- Empirically based sand transport - Explicit solution scheme (solution stability) - Constrained by standard 1-line model assumptions	 - CIRP website - KH	Ashley Frey
PTM <i>Particle Tracking Model for 2D/3D hydro models</i>	- Joint DOER-CIRP product - Coupled to CMS by CIRP - Predicts particle transport pathways and fate - SMS based interface	- Accepts input from CMS and other hydro and wave models - Runs on desktop PCs and HPCLs (super-computers) - Seconds to hours	- Basic V&V completed - Detailed V&V studies in progress	- Fast and efficient - Flexible; not tied to any hydro or wave model - SMS interface connects to flow and wave models	- Not designed for sediment transport calculations - Some empirical formulas - Too many particles can slow runtimes	 - CIRP, DOER websites - KH	Dr. Tabitha Lackey (DOER), Ronghui Li (CIRP), Zaki Demirelbek (CIRP & DOER)



CIRP Technology & Products*



IWR-NDC

IRIP

MCNP



SERDP



Surface Water Modeling System

CMS

- CMS-Wave
- CMS-Flow
- PTM



GenCade

Bouss-2D

Web-Tools and Guidance

CPT and CSMART

CHANNEL
SHOALING
TOOLBOX

CIRP Website
& Wiki



Inlets  online

INLETS DATABASE
Section 111

Toolbox

Berms  online



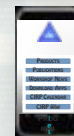
Nearshore Berm
M&D
Web Calculator
WaveNet

Mobile Device Applications

CPT-LITE



CIRP WEBSITE



PC Tools

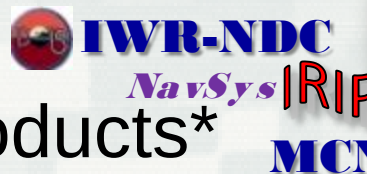
Inlet
Reservoir
Model

RMAP

SBAS-PC



CIRP Technology & Products*



Surface Water Modeling System

CMS

- CMS-Wave
- CMS-Flow
- PTM



GenCade

Bouss-2D

Web-Tools and Guidance

CPT and CSMART

CHANNEL SHOALING TOOLBOX

CIRP Website & Wiki



Inlets online Berms online



INLETS DATABASE Section III Toolbox

Nearshore Berm Calculator

MetOcnDat: WaveNet

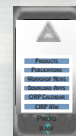
IRM Webtool

Mobile Device Applications

CPT-LITE



CIRP WEBSITE

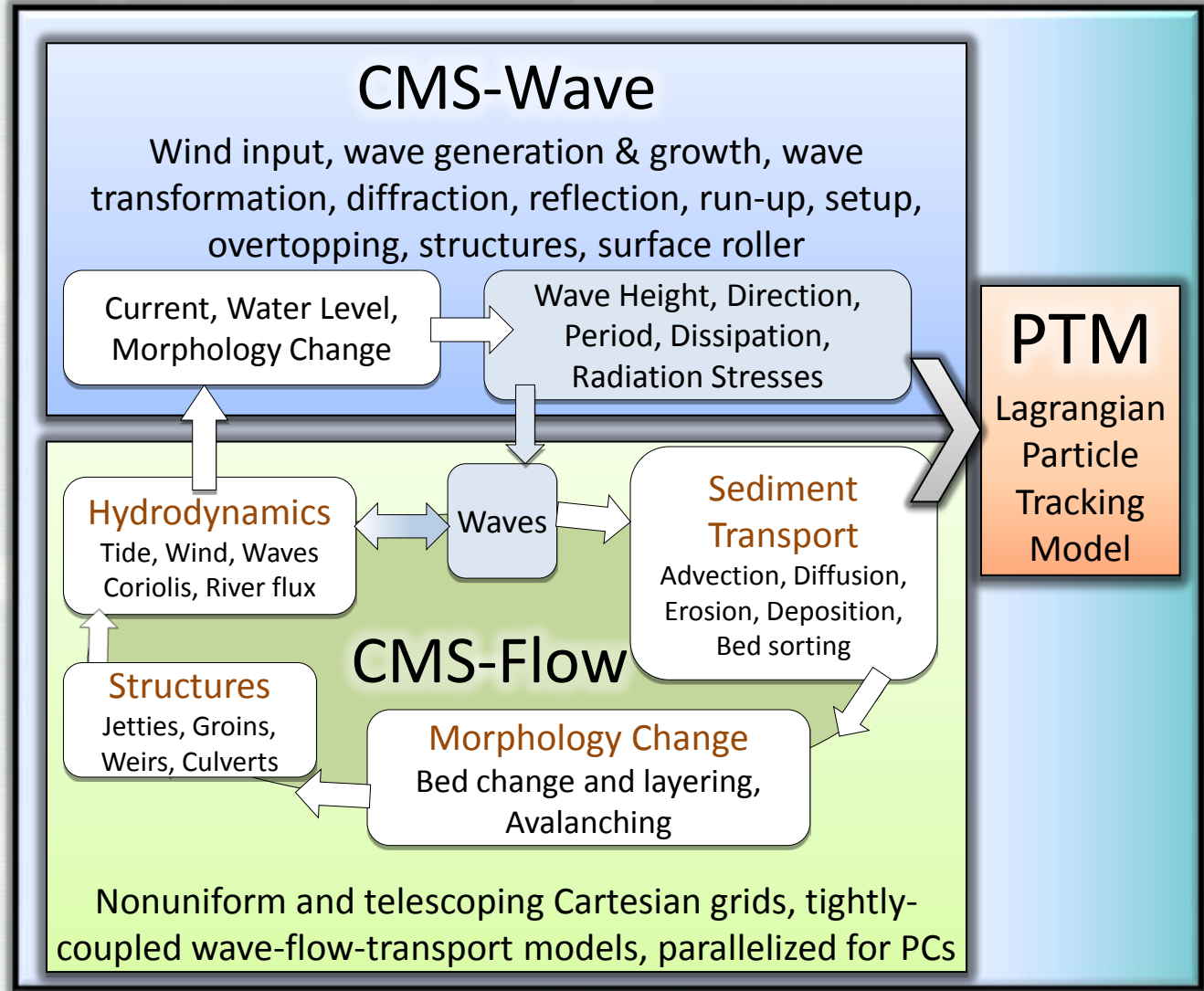


PC Tools

Inlet Reservoir Model

What is the CMS?

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



Why CMS?

Operational at 12 Districts

Practice-oriented: *1 day simulation ~ 1 hr on PC!*

Integrated system for wave-current-morphology modeling

4 Verification & Validation reports document theoretical, laboratory, and real-world applications

Approved by H&H CoP for use in USACE applications

Recent Tech Transfer activities

Feb 2011: Jacksonville, FL

Sep 2011: San Diego, CA

Nov 2011: New York District, NY (DOTS)

Feb 2012: Baltimore District, MD (DOTS)

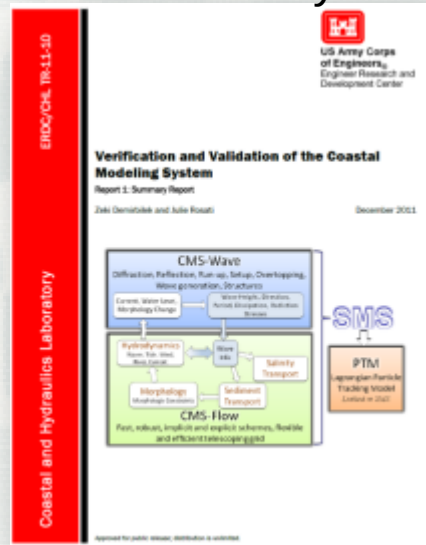
Mar 2012: Philadelphia, PA



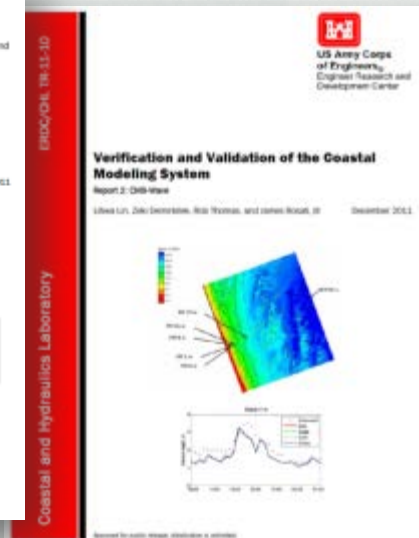
Coastal Modeling System Accomplishments: Four V&V Reports Published!

- Documents goodness-of-fit statistics for CMS applications:
 - 9 Analytical Cases
 - 13 Laboratory Cases
 - 21 Field Cases
- V&V Study established data bank for coastal wave, flow, and sediment transport model validation

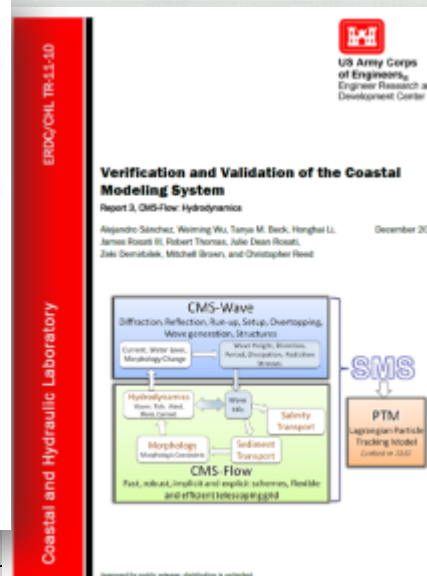
1: Summary



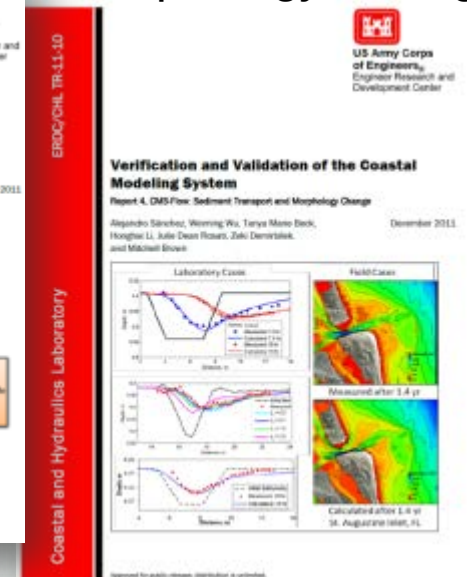
2: Waves



3: Flow



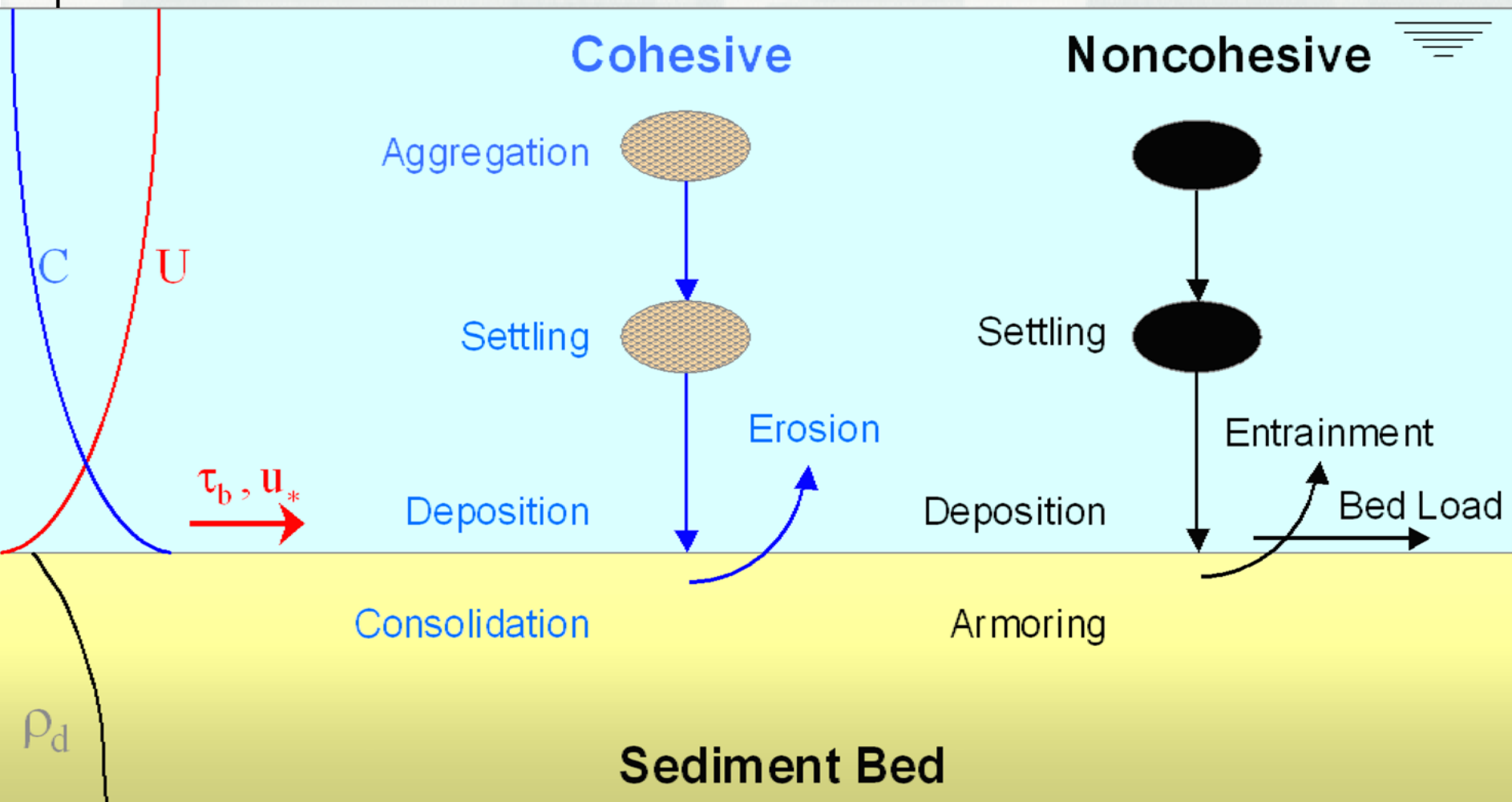
4: Sediment Transport & Morphology Change



FY12 Activities: Implementation of MIXSED into CMS

What is MIXSED?

Sediment bed model that enables representation of multiple size classes of cohesive and non-cohesive sediment in coastal projects



FY12 Activities: Capabilities MIXSED Adds to CMS

Simulates erosion and transport of mixed cohesive and non-cohesive sediment under **combined wave & currents**

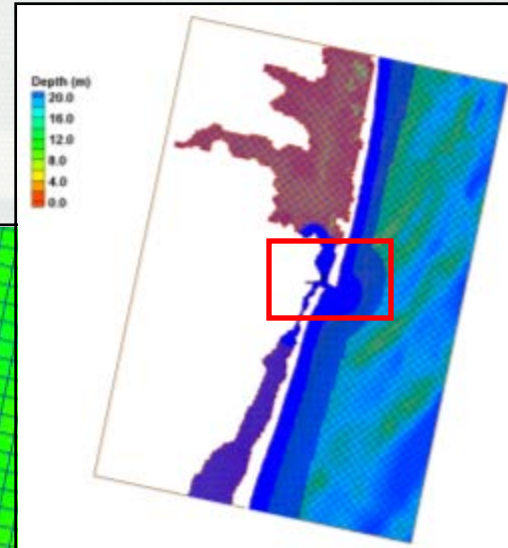
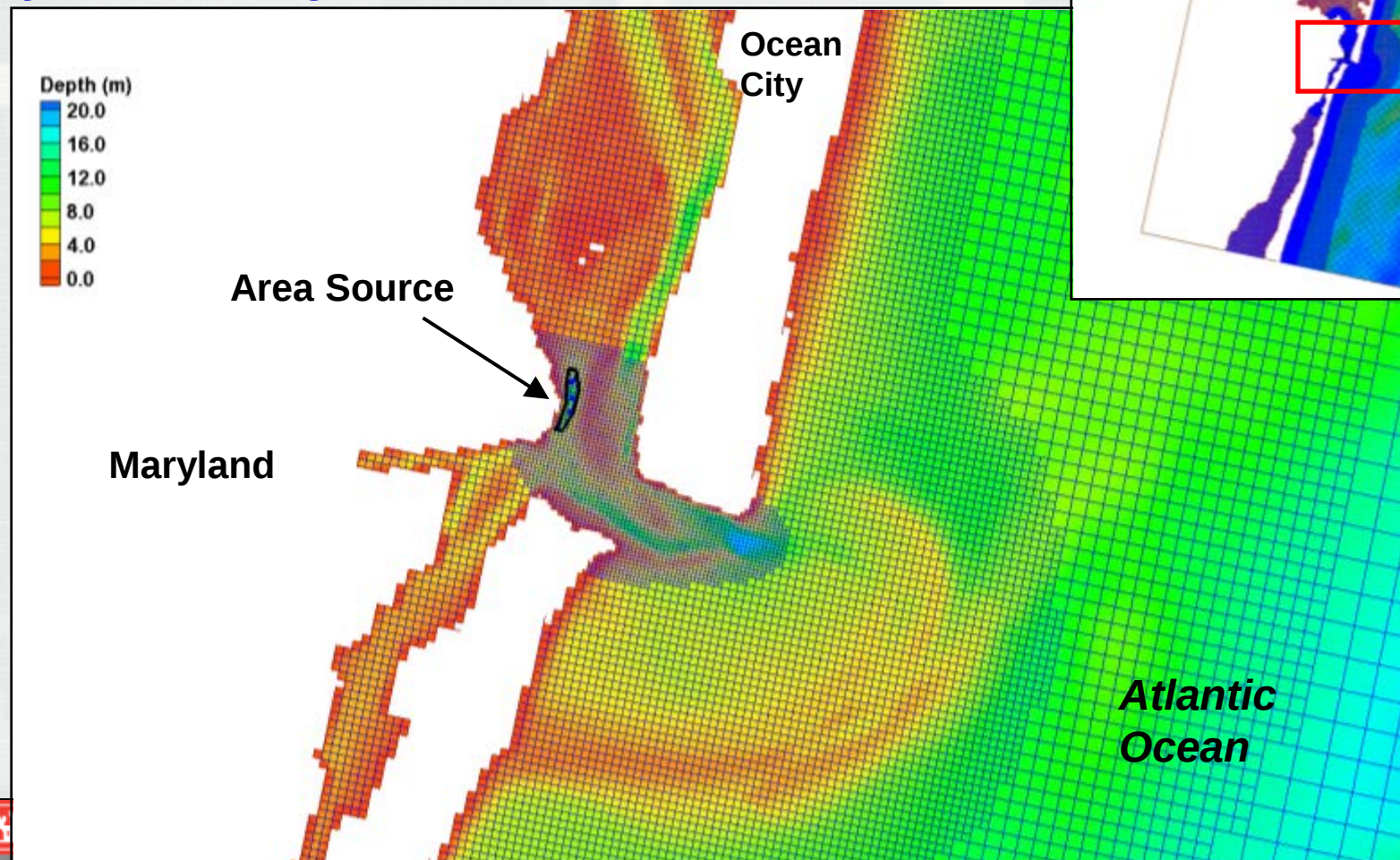
- Nearshore & offshore O&M placement of mixed cohesive/non-cohesive sediments
- Sediment transport of mixed sediments in inlets, harbors, bays
- Examples:
 - Mobile Bay, AL
 - Galveston Bay, TX
 - Buzzards Bay, MA
 - Upper Cook Inlet, AK



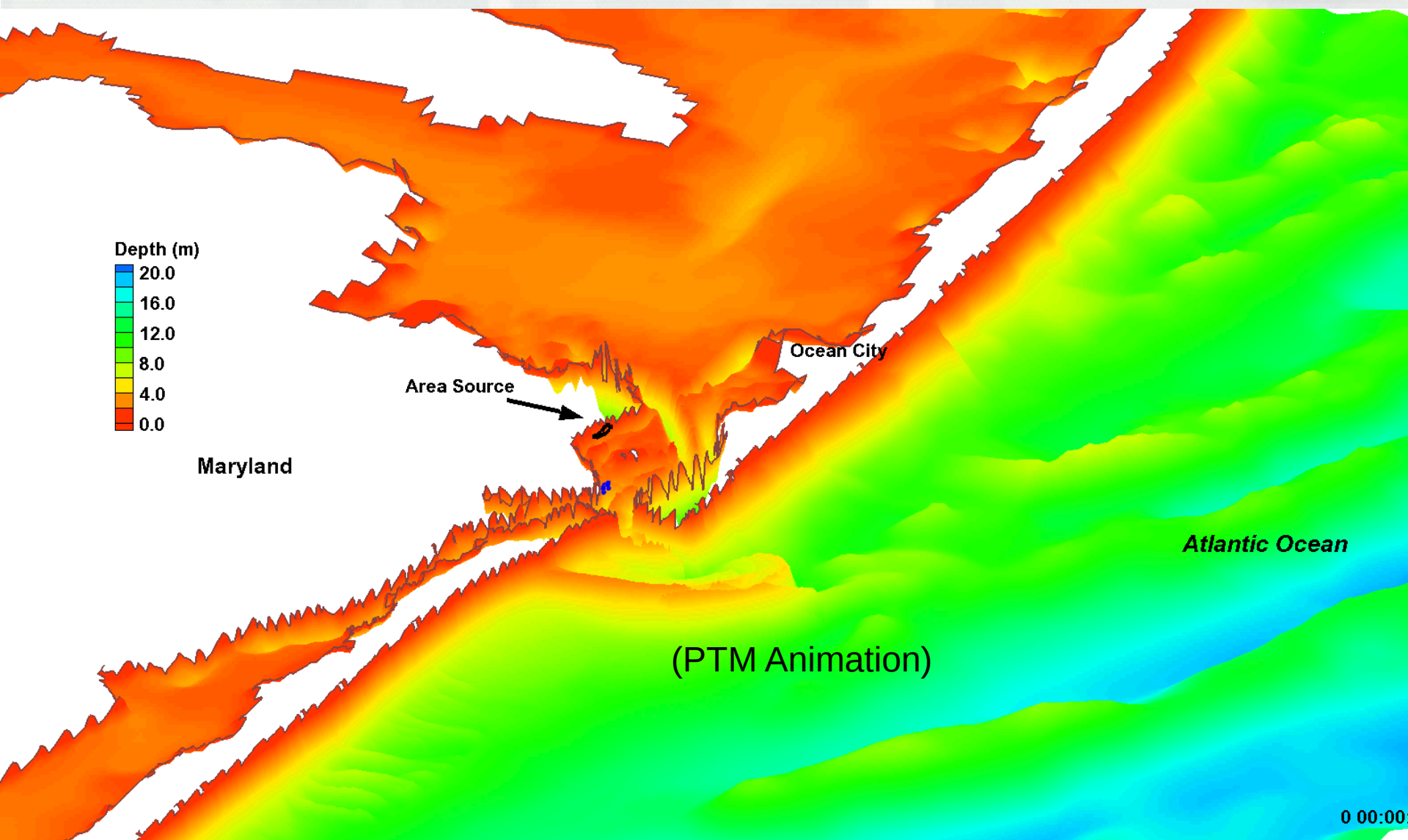
Particles released from deep scour hole

Particle size released (silt): 0.02 mm

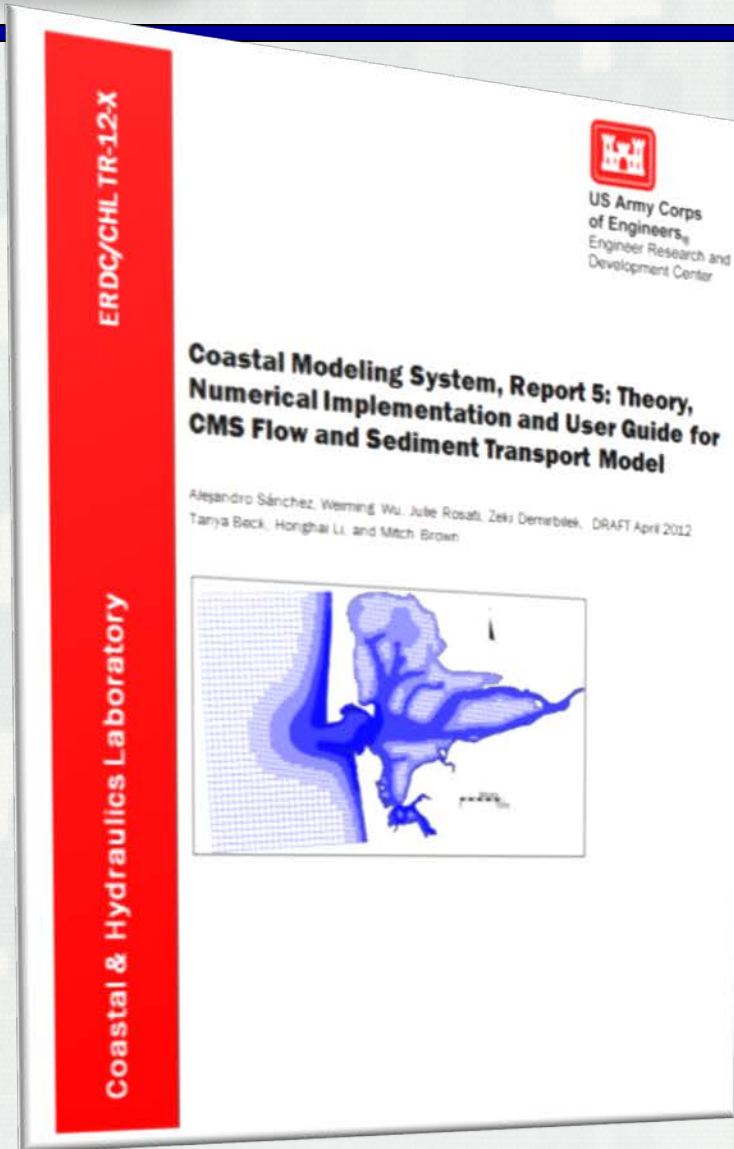
Hydrodynamic forcing: Tide and waves



FY12 Accomplishments: PTM Upgrade for CMS Telescoping Grids



FY12 Accomplishments: CMS: Theory & User's Guide



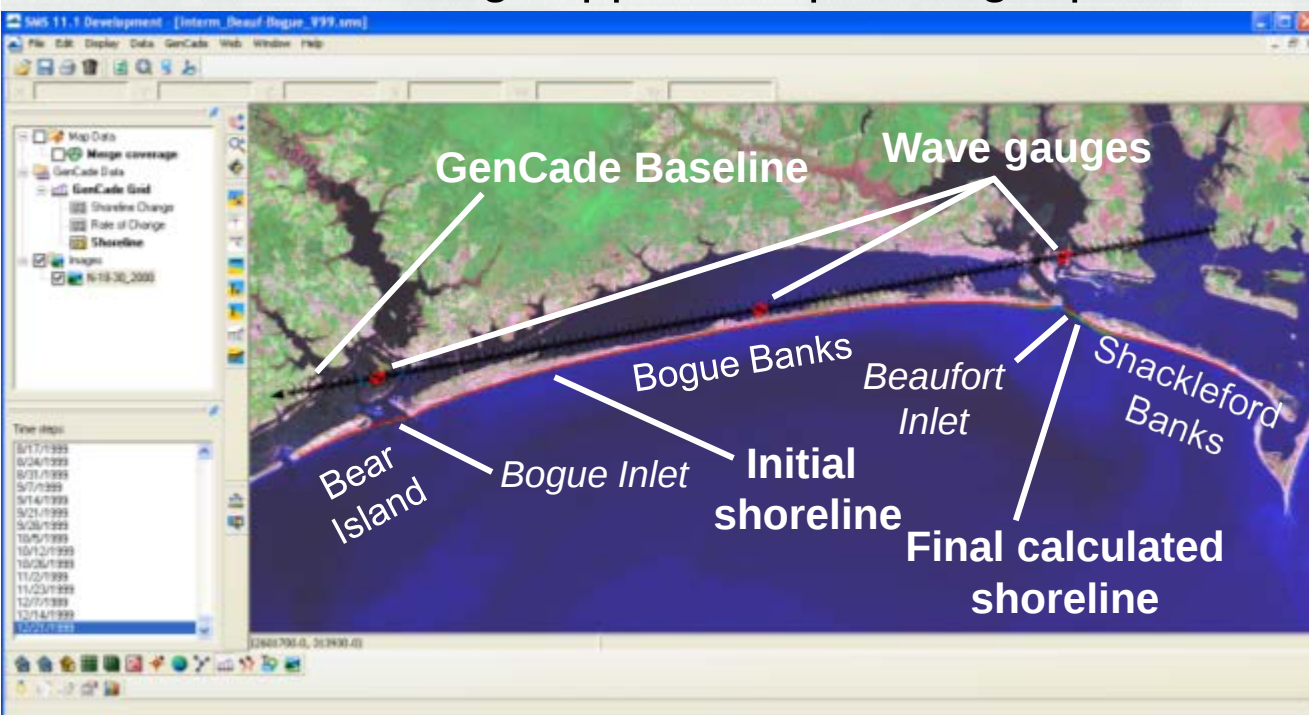
CMS-Flow and Sediment Transport: Theory, Numerical Implementation & User's Guide

- Theory
 - Hydrodynamics
 - Salinity
 - Sediment Transport
- Numerical Methods
- User's Guide
- Appendices: Input and Output Files

Visit the
CMS/PTM
Booth!

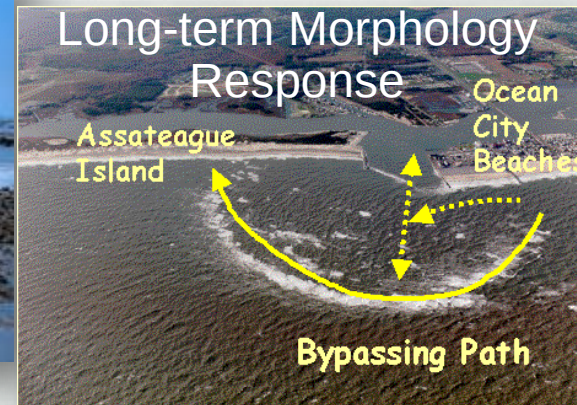
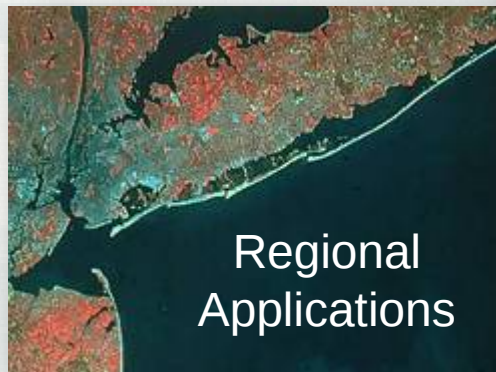
What is GenCade?

- Integrated GENESIS and Cascade models for shoreline change and sand sharing with inlet channels and shoals.
- Connects inlets, navigation channels, ebb and flood shoals, beaches, and engineering activities in a regional framework.
- Decision-making support for planning, operation, and engineering.



Second GenCade Workshop, Aug '11





Why GenCade?

- Sediment storage and transfer (bypassing, back-passing)
- Navigation channel maintenance
- Multiple interacting inlet dredging & placements on beaches
- Cumulative impacts
- Sources & sinks (shoal dredging and beach nourishment)
- Compatibility with previous calculations
- In SMS 11.1; PC, user-friendly interface for engineers & scientists



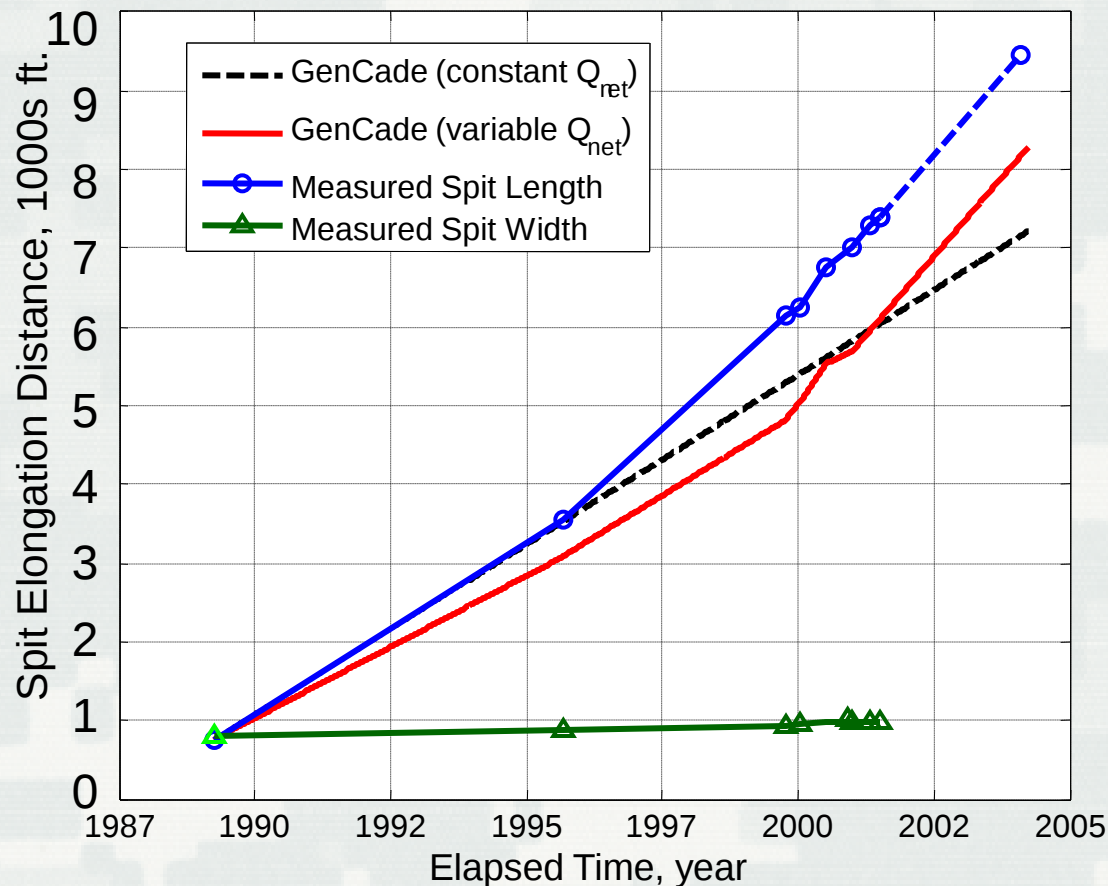
GenCade Model Theory & User's Guide

- Theory
- Validation
- Interface & User's Guide
 - Input & output files
 - Conceptual model
 - Visualization
 - Calibration & developing alternatives
- Application to Long Island, NY



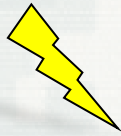
Classic Groin Response: Cape May, NJ

GenCade FY12 Accomplishments: Spit Growth at San Bernard River Mouth, TX



Statements of Need

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



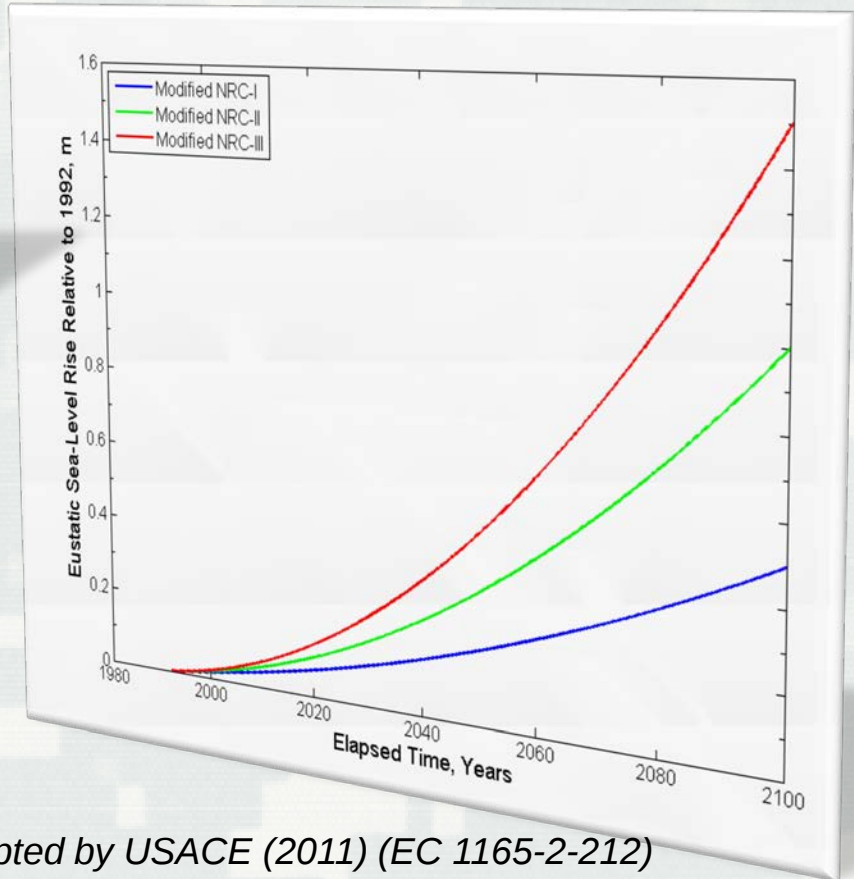
Incorporating Sea Level Change (SLC) into GenCade Calculations*

- Incorporate USACE (2011) methods for range in SLC as GenCade input
- Add change in sea level into GenCade calculations

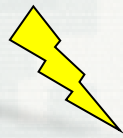


Engineering and planning incorporating SLC can be investigated with GenCade

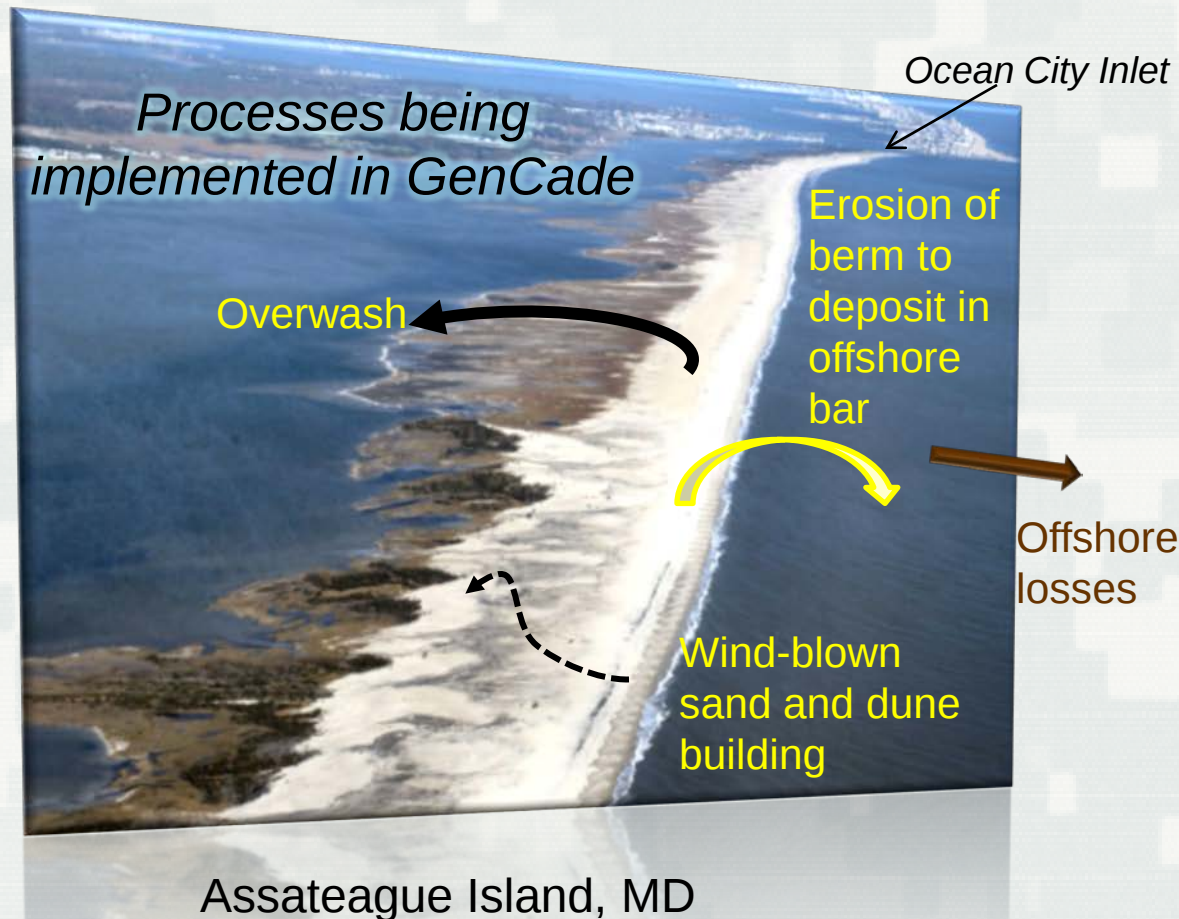
*SLC is presently considered in GenCade applications in an ad hoc manner



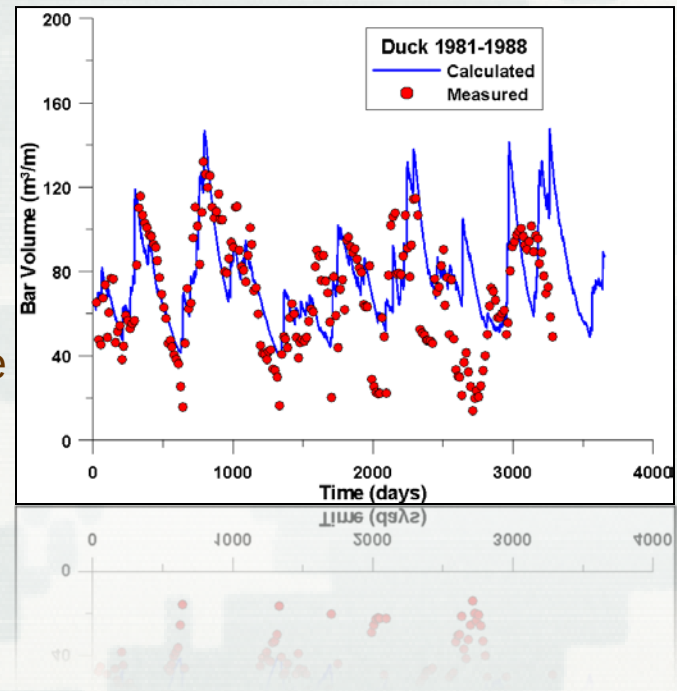
Adopted by USACE (2011) (EC 1165-2-212)
Based on updates to NRC 1987 equation

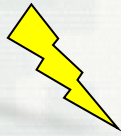


Incorporating Cross-Shore Transport in GenCade



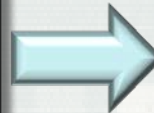
Example comparison between measured and calculated bar volume, Duck, NC





CMS-Wave

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



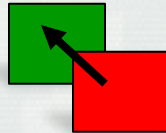
GenCade

*Option for GenCade to
accept forcing from an
external wave model*

GenCade

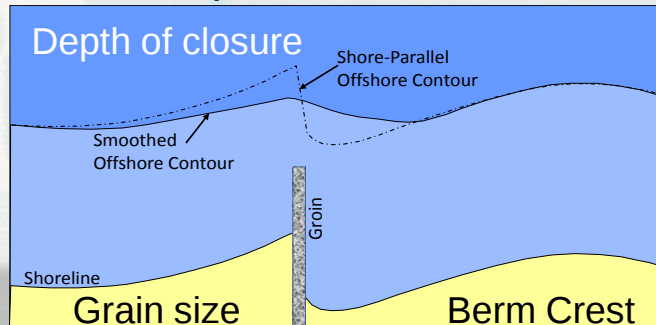


SBAS Arc10



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

*Variable alongshore
parameters*



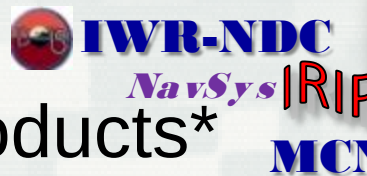
Wiki-TN: Standard Methodology for Calibration and Validation

- *Statistical toolkit*
- *Recommended statistics for acceptable Cal/Val*
- *Standard, unified approach*

Visit the
GenCade
Booth!



CIRP Technology & Products*



Surface Water
Modeling System

Web-Tools and Guidance

Mobile Device
Applications

CMS

• CMS-Wave
• CMS-Flow
• PTM



CPT and
CSMART

CHANNEL
SHOALING
TOOLBOX

CIRP Website
& Wiki



Inlets  online

Berms   online

INLETS DATABASE

Section III
Toolbox

*Nearshore Berm
Calculator*

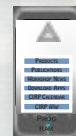
*MetOcnDat:
WaveNet*

IRM
Webtool

CPT-LITE



CIRP WEBSITE



PC Tools

Inlet
Reservoir
Model

GenCade

Bouss-2D

Channel Portfolio Tool (CPT)

What is CPT?

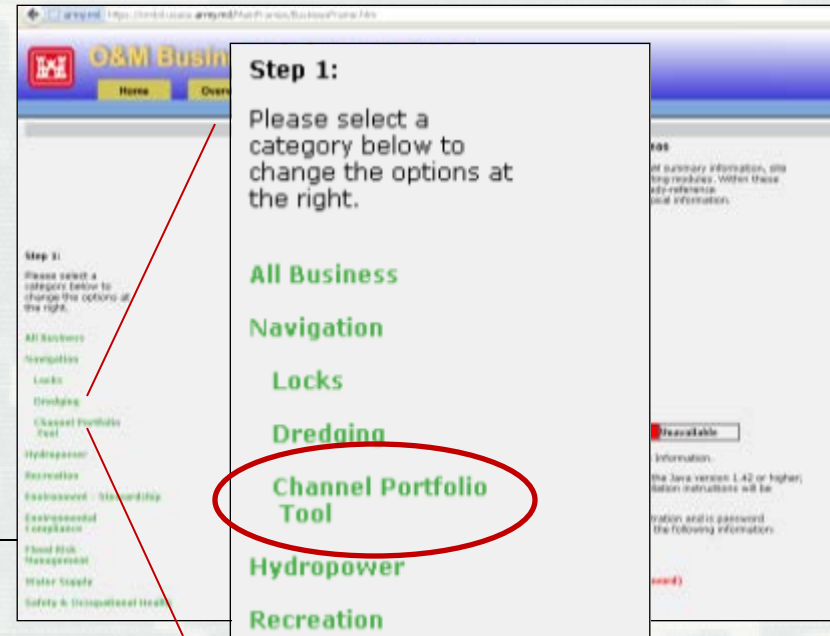
Web-based application that relates navigable depths to cargo most vulnerable to shoaling. Allows for detailed, reach-level analysis as well as regional and national summaries of the **waterborne transportation systems** supported by Corps navigation projects.

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

CPT uses data provided by the Waterborne Commerce Statistics Center (WCSC), and is available via the OMBIL portal.

Statements of Need

Improved Justification for and Prioritization of Annual Maintenance Dredging Investments
Tracking Number 2009-N-8



Why CPT?

- Navigation project managers need consistent, objective data to justify funding for O&M dredging requests.
- OMB has indicated that improved O&M justification is a precondition for increased outlays from the Harbor Maintenance Trust Fund (HMTF).
- CPT conducts the data processing and filtering necessary for system-level analysis and performance evaluation.



Channel Portfolio Tool (CPT)

Channel Portfolio Tool - CPT - Mozilla Firefox

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

 Channel Portfolio Tool

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WARNING These pages contain commercially sensitive statistics pertaining to rivers, harbors, and waterways and must be held in strict confidence as required by 33 C.F.R. § 209.320. Unauthorized disclosure could result in loss of employment, fines, and imprisonment under 18 U.S.C. § 1905.

Steps for gaining access to CPT:

1. Electronically sign the WCSC non-disclosure document. Then save and send as an attachment to CPT@usace.army.mil. If electronic signature capability is not available then print the document, manually sign it, scan it and send as an attachment to CPT@usace.army.mil.
2. Read and print out the Census non-disclosure document. Manually sign the document, scan it, and send as an attachment to CPT@usace.army.mil. This document MUST contain a manual signature.
3. After selecting the "Register" tab above, fill out all required registry information and select the "Register" button at the bottom of the screen.

[Waterborne Commerce Non-Disclosure \(WCSC\)](#) [Census Non-Disclosure](#) [Foreign Trade Statistics Security Guidelines Handbook](#)

You must agree to both the Waterborne Commerce and Census Non-Disclosure statements in order to view any data. You can either agree or disagree by checking the associated checkbox while registering or logging in and updating your user profile by clicking profile on the menu above and choosing update profile.

Once per year, on the first use after January 1st, you will be required to agree to the Non-Disclosure agreements in order to view the associated analysis data. To do this, use the appropriate forms above and email the signed forms to CPT@usace.army.mil. Electronic signatures are allowed for the WCSC Non-Disclosure. Once signed and approved, you will be able to use the tool. If you can login, but can only see the Profile tab, then you have not been approved and need to resubmit your signed Non-Disclosure forms or your password has expired and you need to change your password.

Visit the
CPT Booth!

help USACE operations personnel analyze the extent to which maintained navigation channels are used by commercial shipping. Analyses can be grouping of channels treated as a single project. Additionally, USACE planning personnel can use CPT to extract historical data concerning region-validated statements of traffic for arbitrary listings of projects and channels.

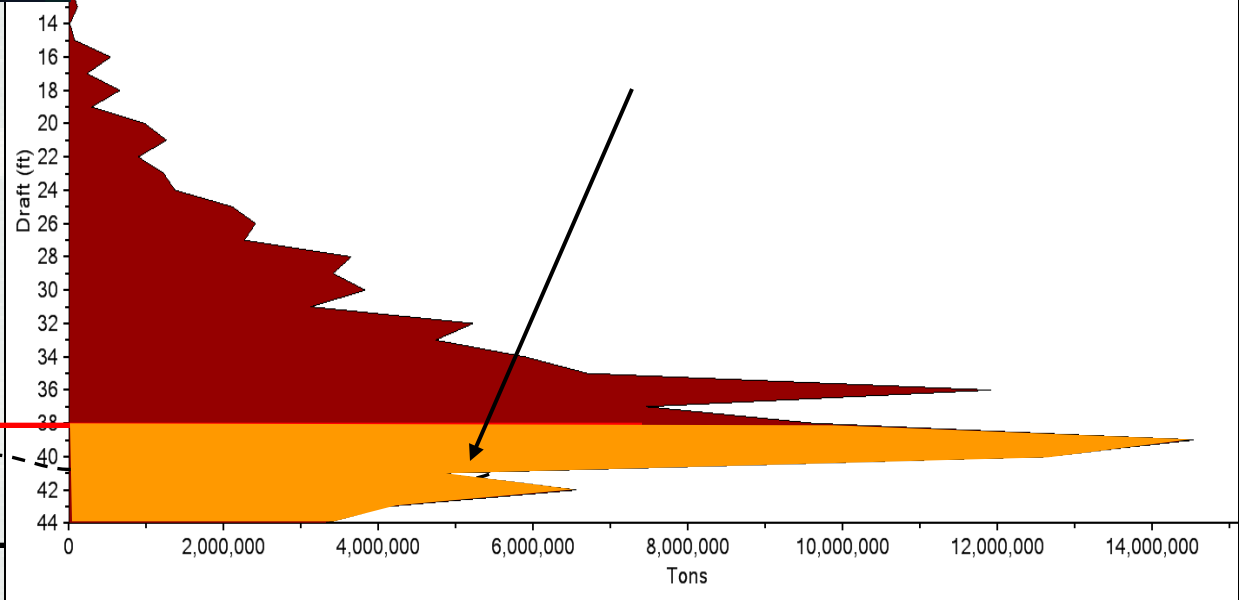
should be directed to Dr. Ned Mitchell at kenneth.n.mitchell@usace.army.mil.

level of prioritization you would like to see.

Depth-Utilization Analysis

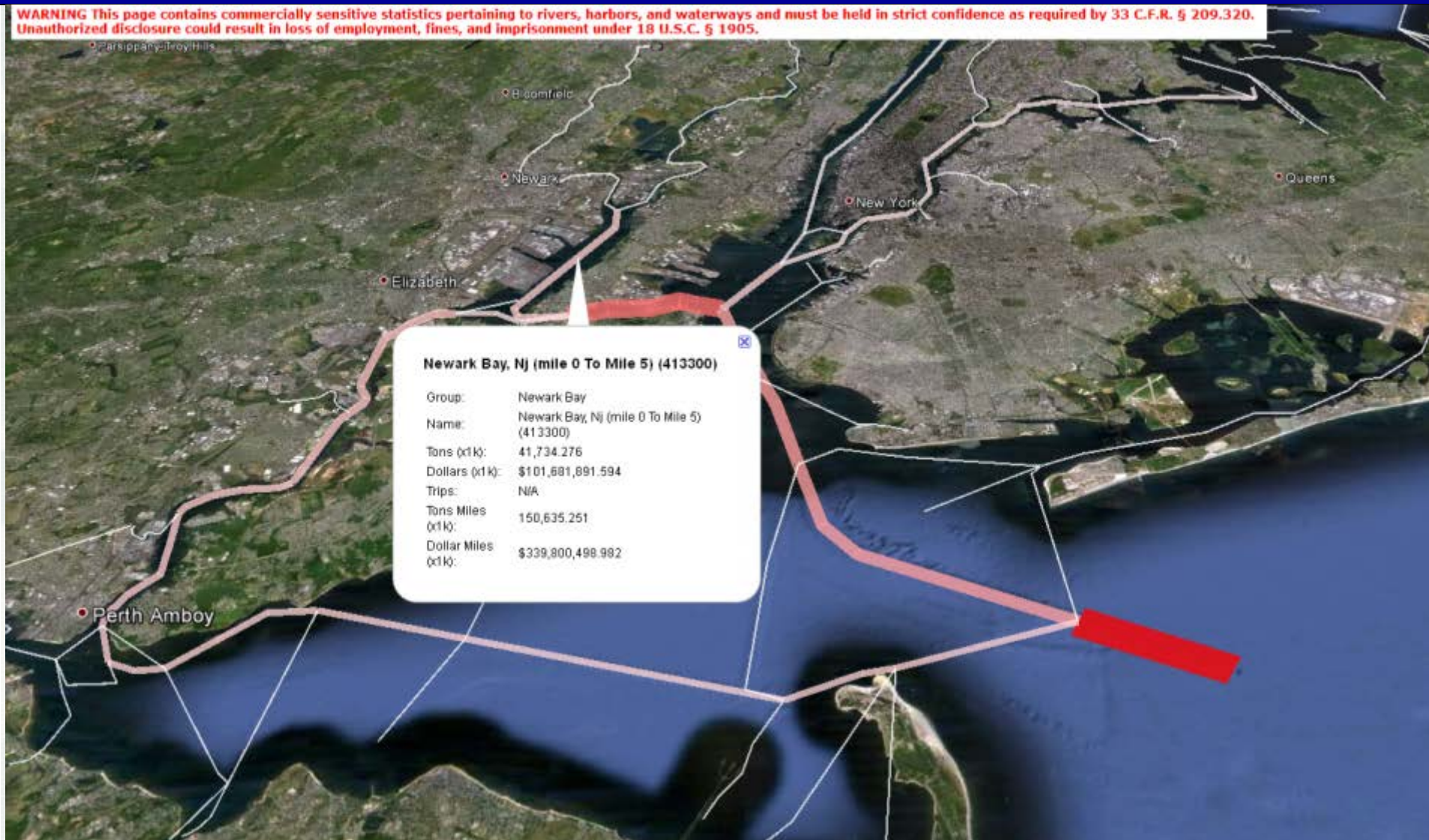


CPT tabulates the historical rates of shoal-vulnerable tonnage transiting navigation channels and uses the respective quantities as a basis for prioritizing O&M dredging jobs.



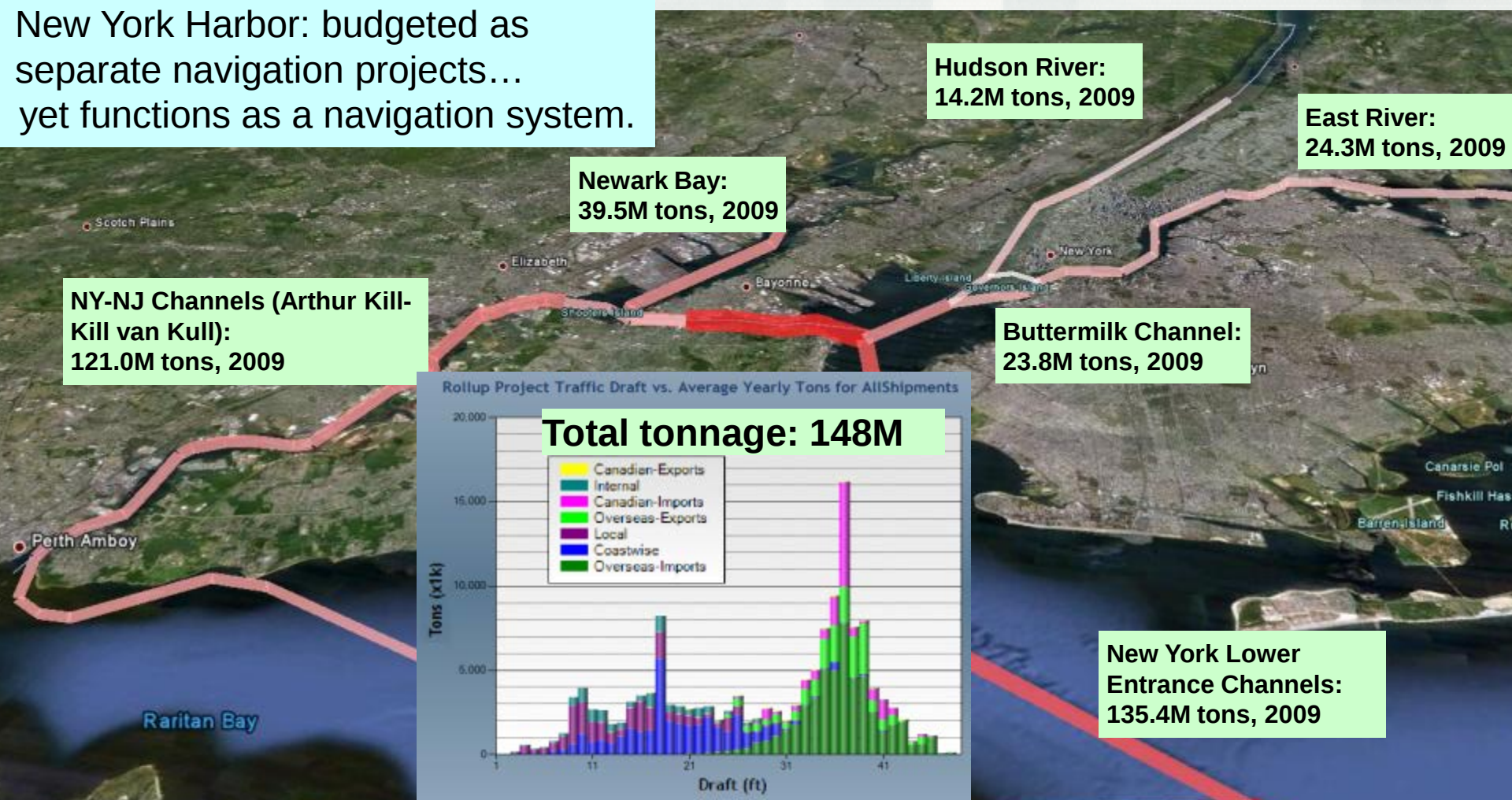
Visualization with CPT

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CPT and Navigation Systems

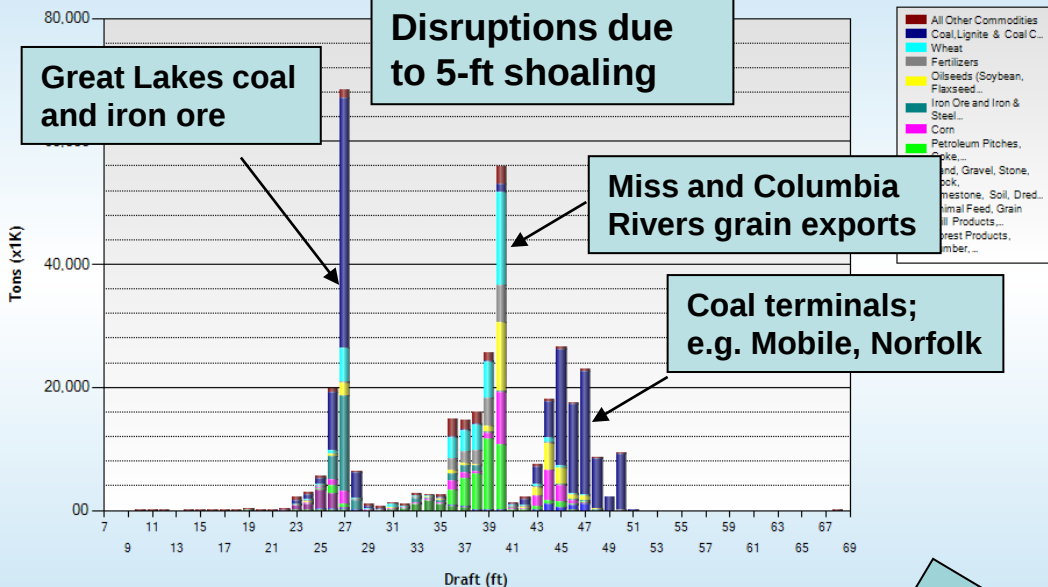
New York Harbor: budgeted as separate navigation projects... yet functions as a navigation system.



CPT is helping to ensure that Project O&M budgeting considers channel depth-utilization, cargo types, and system interdependencies (i.e. condition of other projects!).

Quantifying Impacts of Shoaling

Commodity Details Tons (Transit) for Rollup 2005-2008

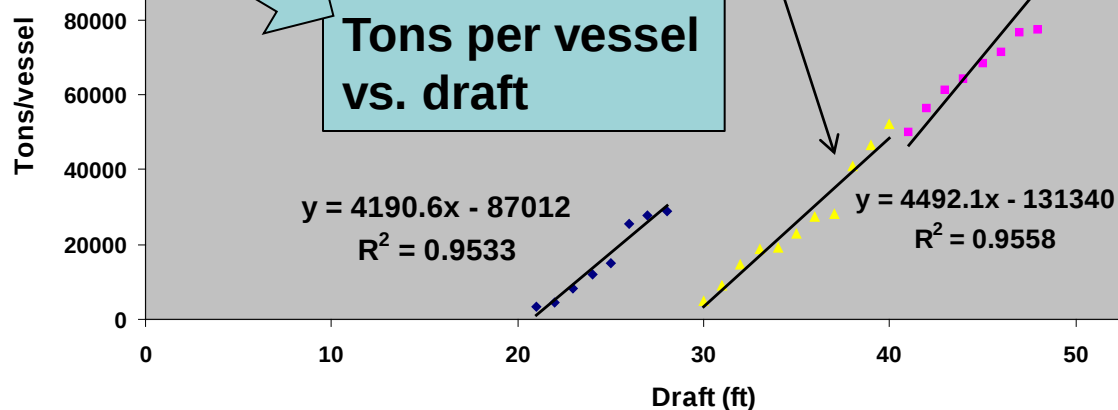


- Scalable approach for quickly estimating cargo that must be light-loaded due to shoaling conditions.

- Slopes of trend lines indicate the average amount of cargo that must be removed from each vessel in order to reduce vessel draft by 1-ft.

4,500 tons/vessel/ft of depth

- Approach can be extended to total annual cargo disruptions, number of required additional voyages, and ultimately increased shipping costs.



What is CSMART?

Web-based, Silverlight 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.

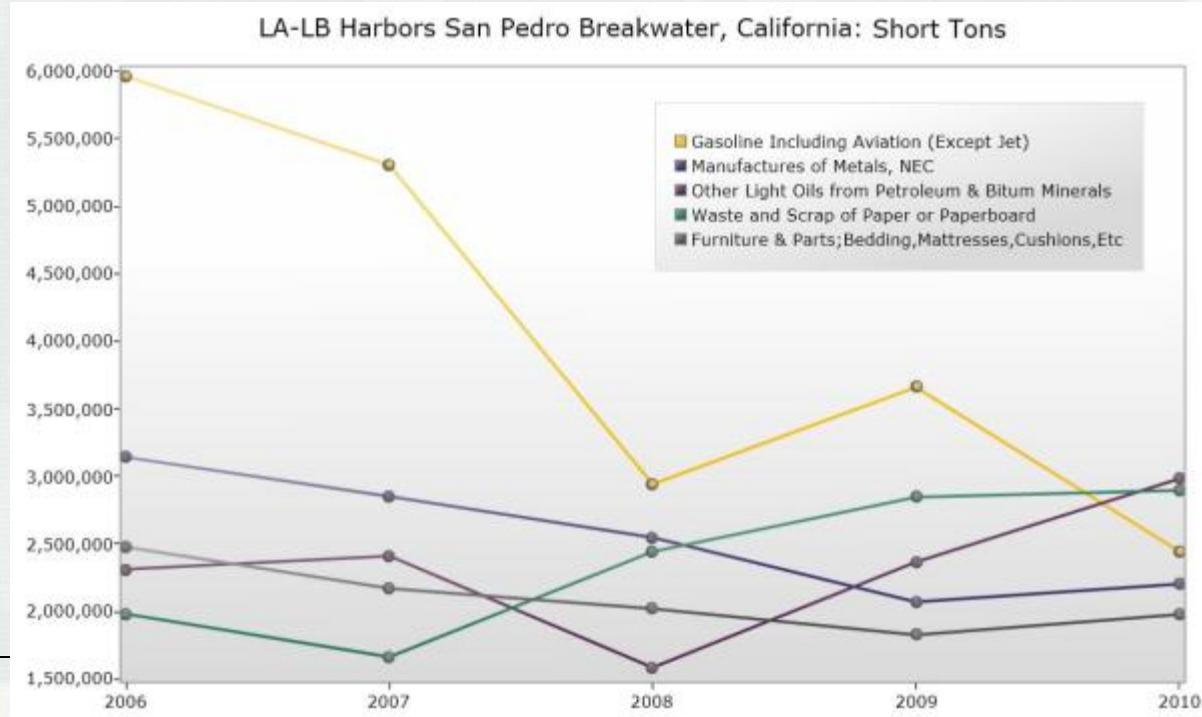
<https://itlgis01.usace.army.mil/CPT/Silverlight/CSMART>

Welcome
Structures
Features
Results

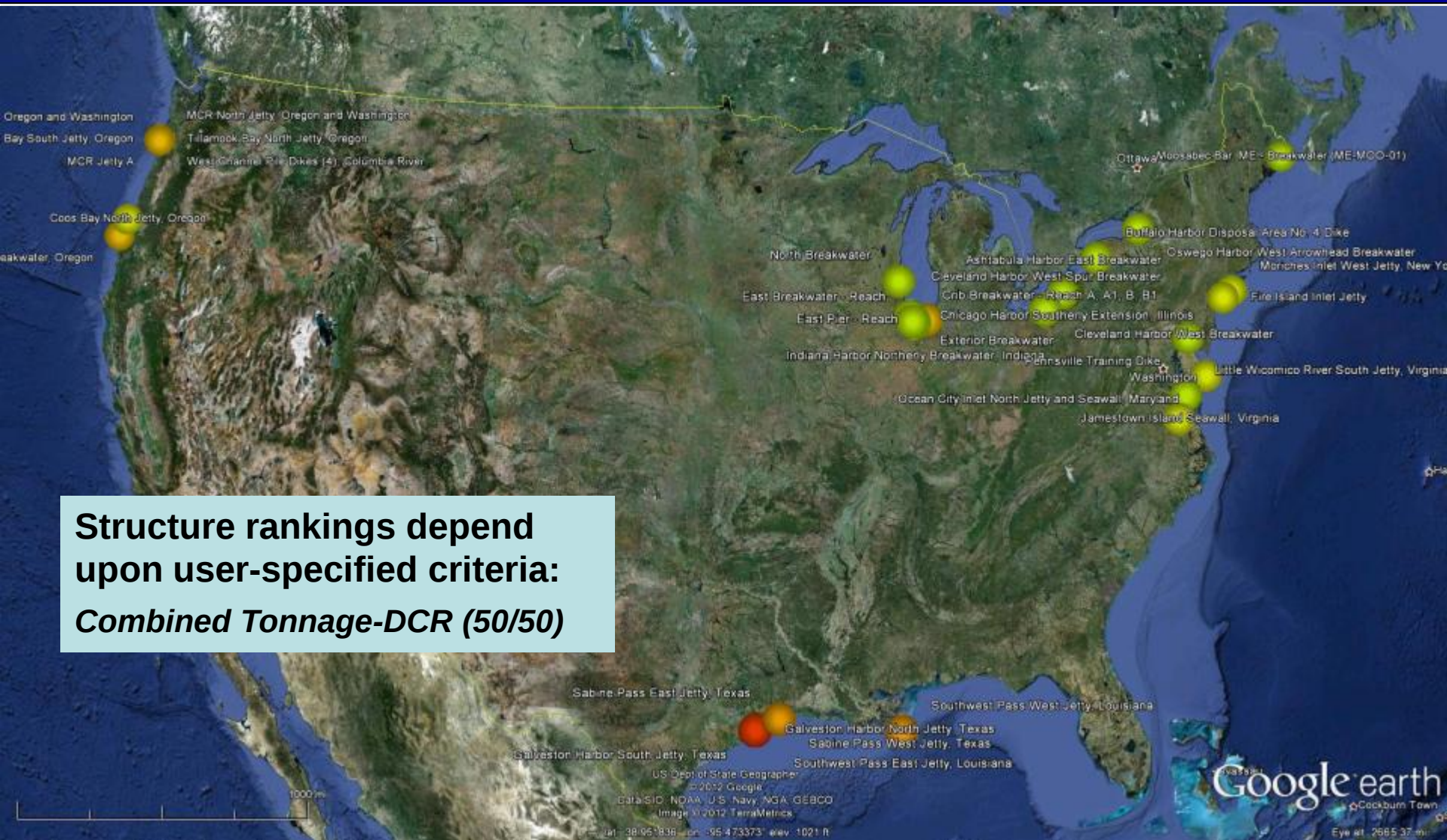
Commercial Tonnage
Commercial Fishing

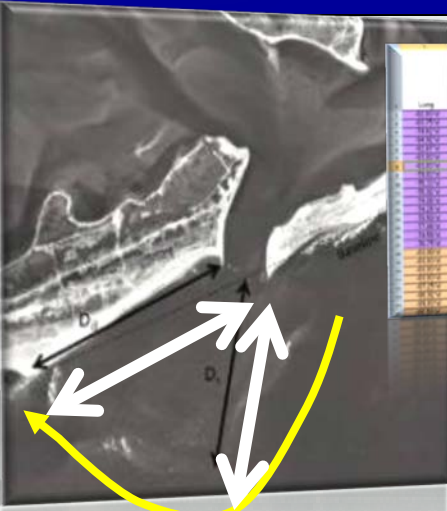
Binary Choices
Physical Condition Rating

☐ Include Caretaker Status?
☒ Include National Security Designation?
☐ Include Public Transportation Function?
☒ Include Subsistence Harbor Status?
☐ Include Navigation Safety Function?
☐ Include Excursion Vessel Presence?
☐ Include Presence of Military Base and/or Vessels?
☐ Include Presence of Vessel Construction and/or Repair Facility?
☒ Include Harbor of Refuge Status?
☐ Include only Harbor Maintenance Trust Fund Eligible Projects

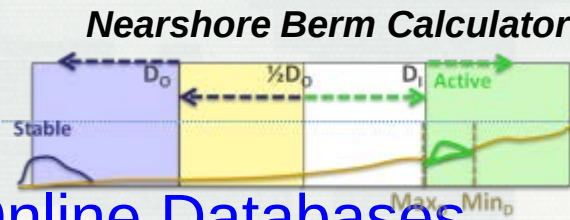


Structure Prioritization via CSMART



[illegible]

Federal Inlets Database



Nearshore Berm Calculator

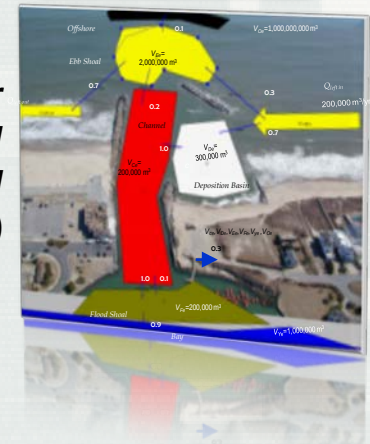
Inlets Online



Berms Online



**Inlet Reservoir
Model
(Web-based
Version)**



Inlets and Berms Online Databases

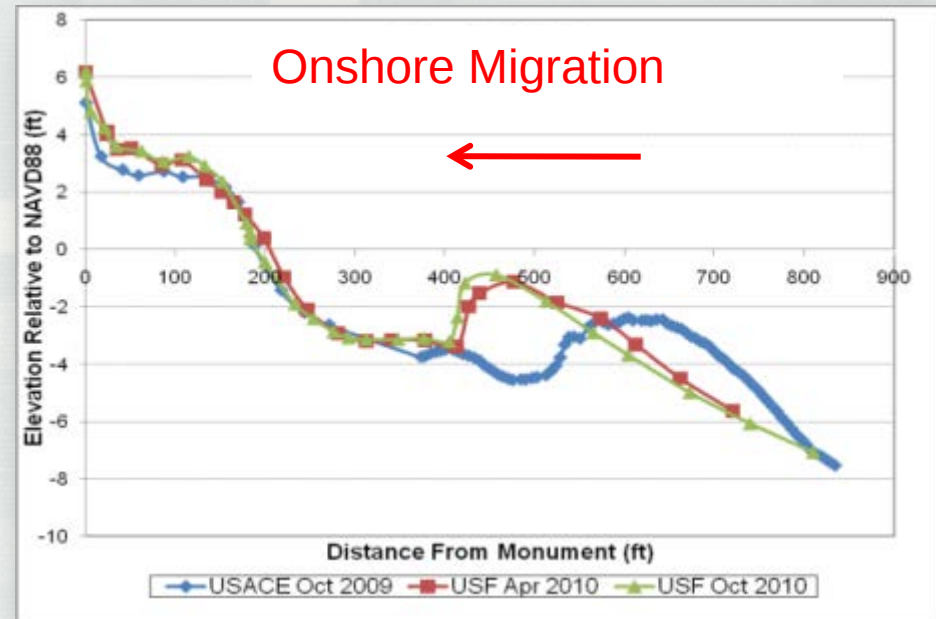
to Common Web Platform

- Geomorphic Properties of Inlets (Hayes Diagram Reform; Ebb Shoal Dimensions)
 - Define areas of influence of inlets
 - Berms Online Database
 - Nearshore Berm Calculator
 - Inlet Reservoir Model (Web Version)
- Action 3.2.1 of Navigation Strategic Vision
“Develop an inventory of all federal authorized projects...”

Action 3.2.1 of Navigation Strategic Vision
“Develop an inventory of all federal authorized projects...”

Questions

- **Placement Method:**
Pump vs. Hopper Dredge
- **Quantity and Rigor of Design:**
“Dumped” vs. Designed
- **Cross-shore Location:**
Feed sand vs. wave break
- **Alongshore Location:**
Relative to inlet; gaps required?
- **Environmental Concerns:**
Dispersion of fines over habitat



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

Tracking Number 2011-N-10

Nearshore Placement of Dredged Sediment Assessment

Ft. Myers Berm (Completed; Final Report Pending)

Sediment dispersion

Bathymetric change and berm migration rates

Pensacola Berm (In Monitoring Phase)

Sediment dispersion

Alongshore migration rates

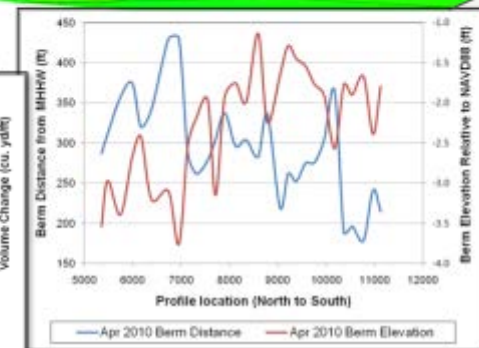
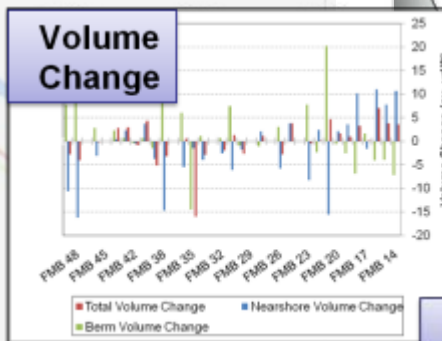
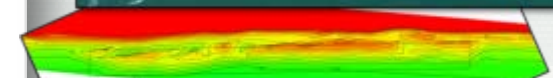
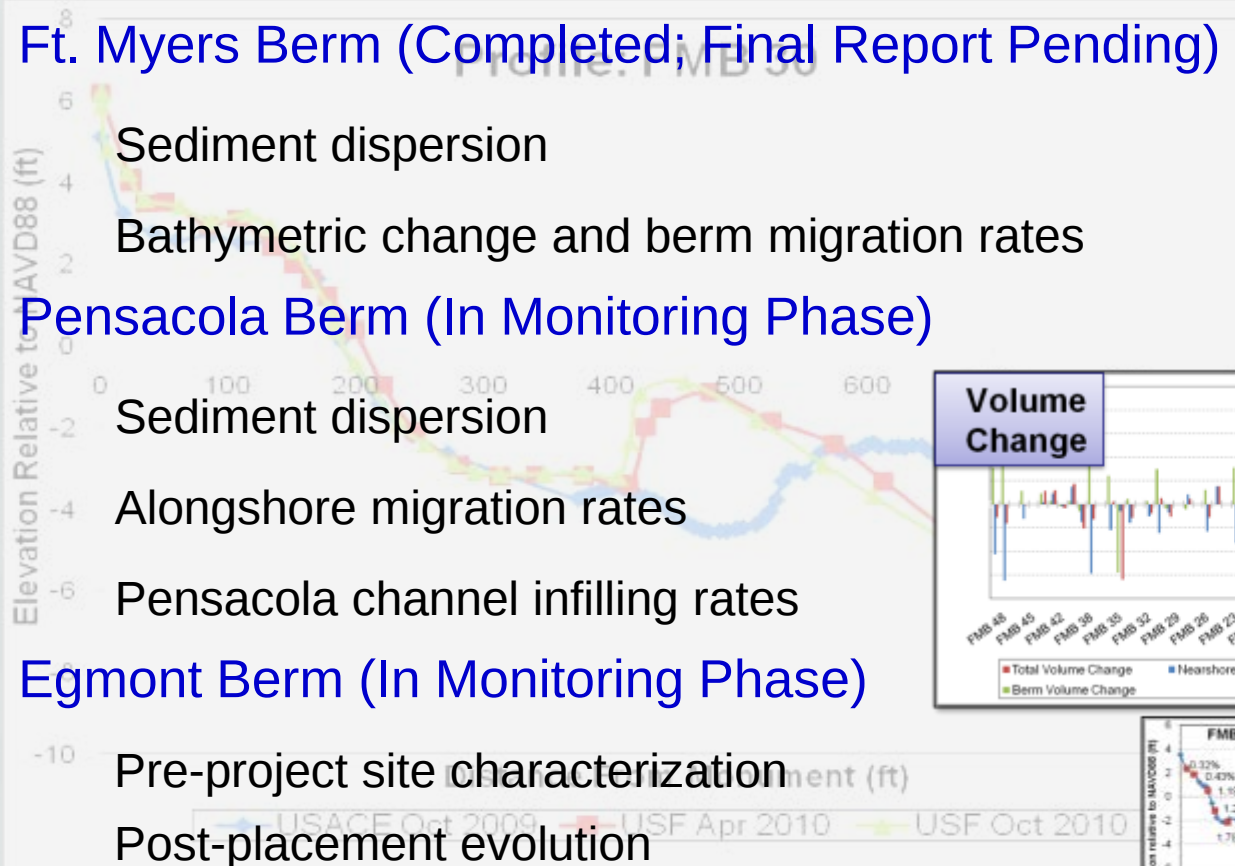
Pensacola channel infilling rates

Egmont Berm (In Monitoring Phase)

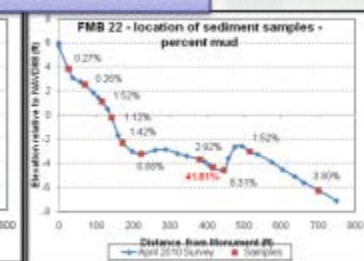
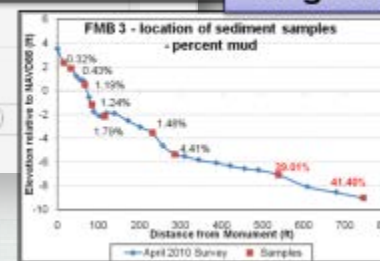
Pre-project site characterization

Post-placement evolution

Action 3.2.2 of Navigation Strategic Vision
"Establish practices...optimize environmental windows...maximize beneficial use of O&M"



Migration of Fines



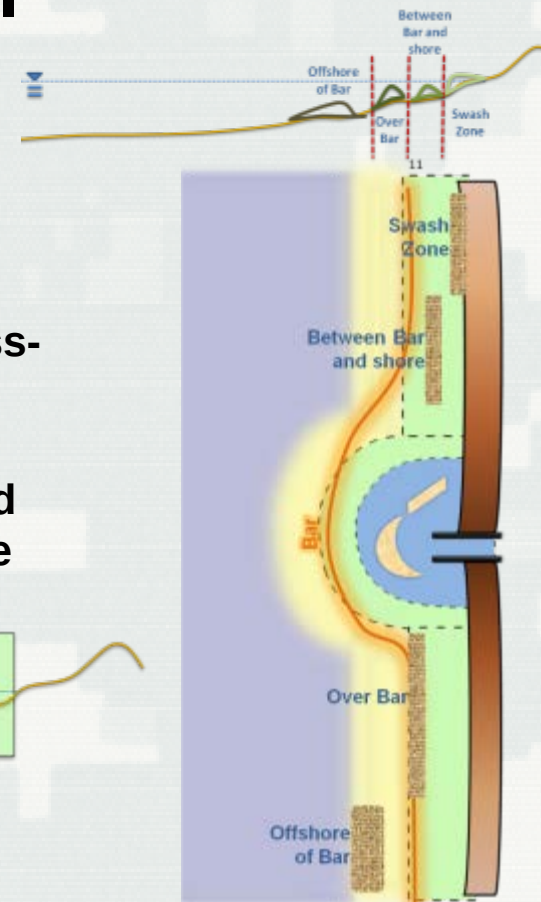
Berms Online:

A Nearshore Berm Historical Database

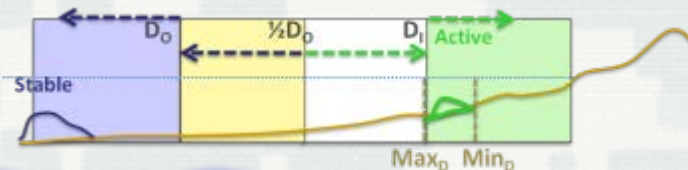


Simple Planning Calculator Tool

- **Developing flexible tools (rapid desk-top to detailed models) for design**
- **Dredged sediment size(s) and volume**
- **Placement position in cross-shore, and soon in alongshore**
- **Site processes represented through empirical formulae**



Guideline Development



Check out the Berm Booth!

CIRP Future



Advance R&D in models and tools

Link to existing data and databases

Produce accurate calculations with quantified goodness-of-fit

Roll up calculations to speed interpretation

Generate graphical and quantitative output for decision-support

Speed delivery of results to customers

Examples...

Channel Portfolio Tool (CPT),
CPT Smart Phone App



Models and Tools

Other Models and Tools

sink

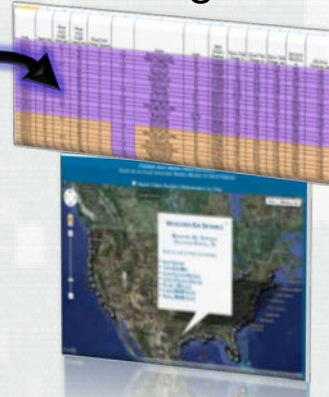


Please let us know if you have more ideas!

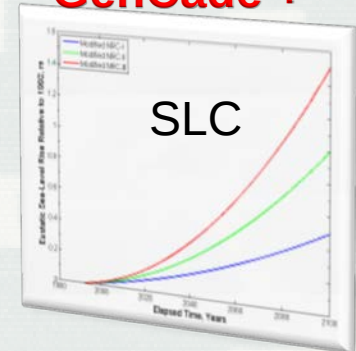
Models and Tools

sink

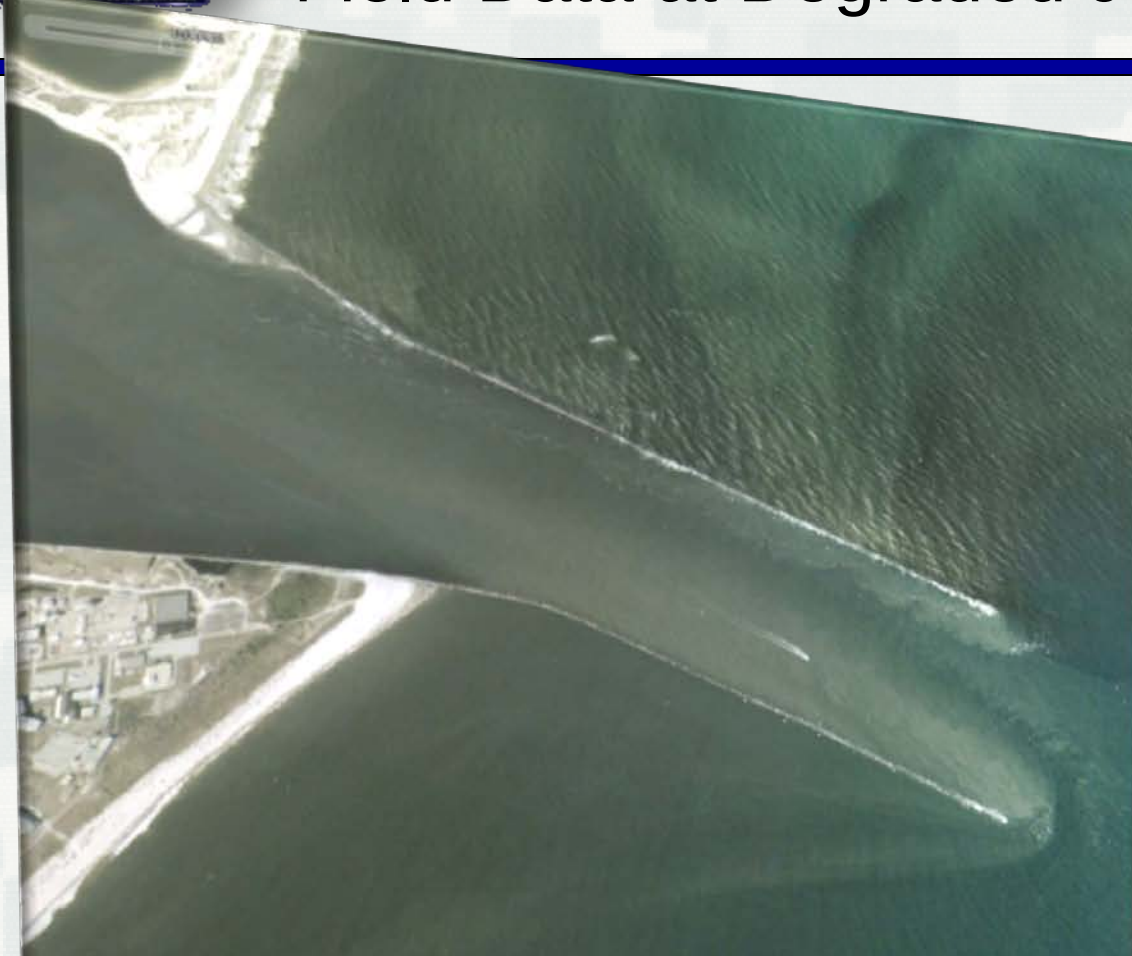
Existing Data



GenCode +



Field Data at Degraded Jetty/Breakwater



- Decision-support guidance for rehab given damage rate & SLC
- Many federal structures 50+ years old
- Validate wave overtopping, transmission, and sand transport through rubblemound structures
- Rehabilitation multi-million \$
- Consider archived AIS vessel movement; is wave transmission through jetties creating navigation hazards?

Statements of Need

Improving Wave Calculations at Coastal and Estuarine Navigation Channels
Tracking Number 2009-N-5

Statements of Need

Automatic Identification System (AIS) data use in Navigation operations and engineering.
Tracking Number 2013-N-5

Action 3.2.3 of Navigation Strategic Vision
"Develop science & engineering risk-management approach...to nationally rank reliability of navigation projects"

Presently Addressing 5 SoNs:

Statements of Need

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

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

Improved Justification for and Prioritization of Annual Maintenance Dredging Investments
Tracking Number 2009-N-8

Statements of Need

Dynamic Web-link and analysis of environmental Database for Coastal Inlet, Harbor, and Estuary Wave Modeling Projects
Tracking Number 2011-N-10

Propose Adding 4 More in FY13 (discuss Thu):

Statements of Need

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

Statements of Need

Automatic Identification System (AIS) data use in Navigation operations and engineering.
Tracking Number 2013-N-5

Statements of Need

Automated Feature Extraction for Sediment Budgets
Tracking Number 2013-N-15

Statements of Need

Improving Wave Calculations
Tracking Number 2009-N-5



Ned, Mary Beth, David, and baby John Mitchell