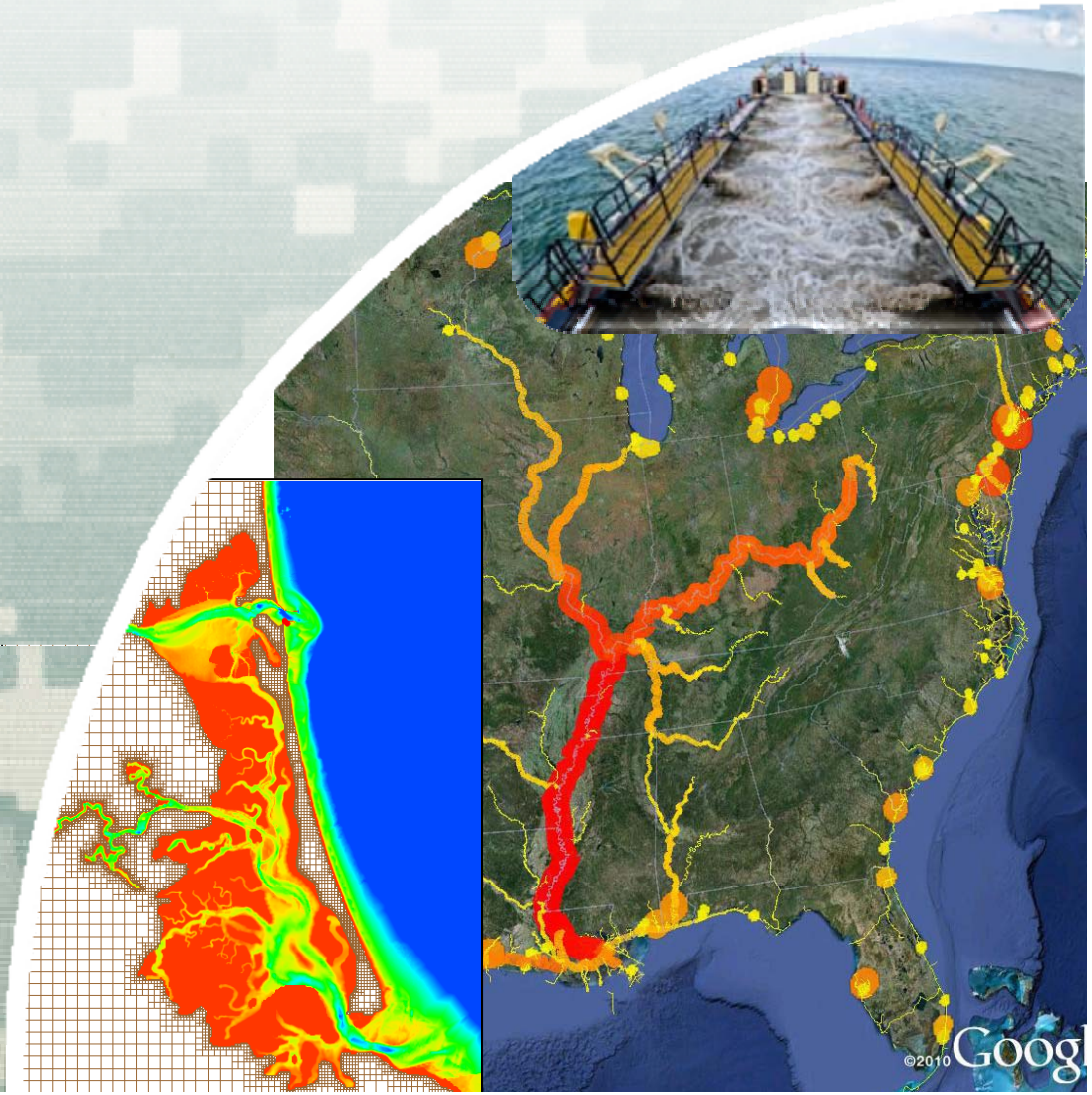
# Coastal Inlets Research Program


**Julie Dean Rosati**
Program Manager

**Jeff McKee**
HQ Navigation
Business Line Manager

**Jeff Lillycrop**
Technical Director

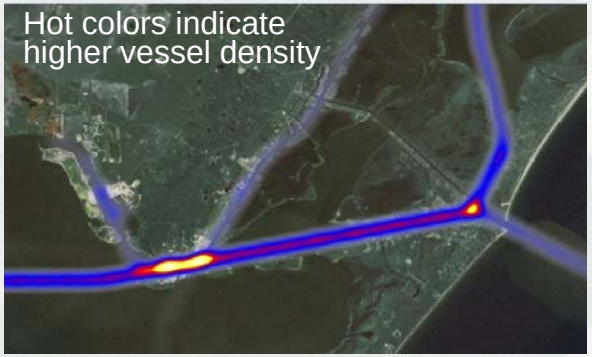
**Eddie Wiggins**
Associate Technical
Director


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.




Heat map of vessel transit patterns

- **Transfer technology** and products
  - Guidance documents, Workshops, models and tools, Web site, Wiki-pages, PC software, Web portals, Mobile device apps, video clips.


*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**

*Cheryl Pollock*
*Katie Brutsché*

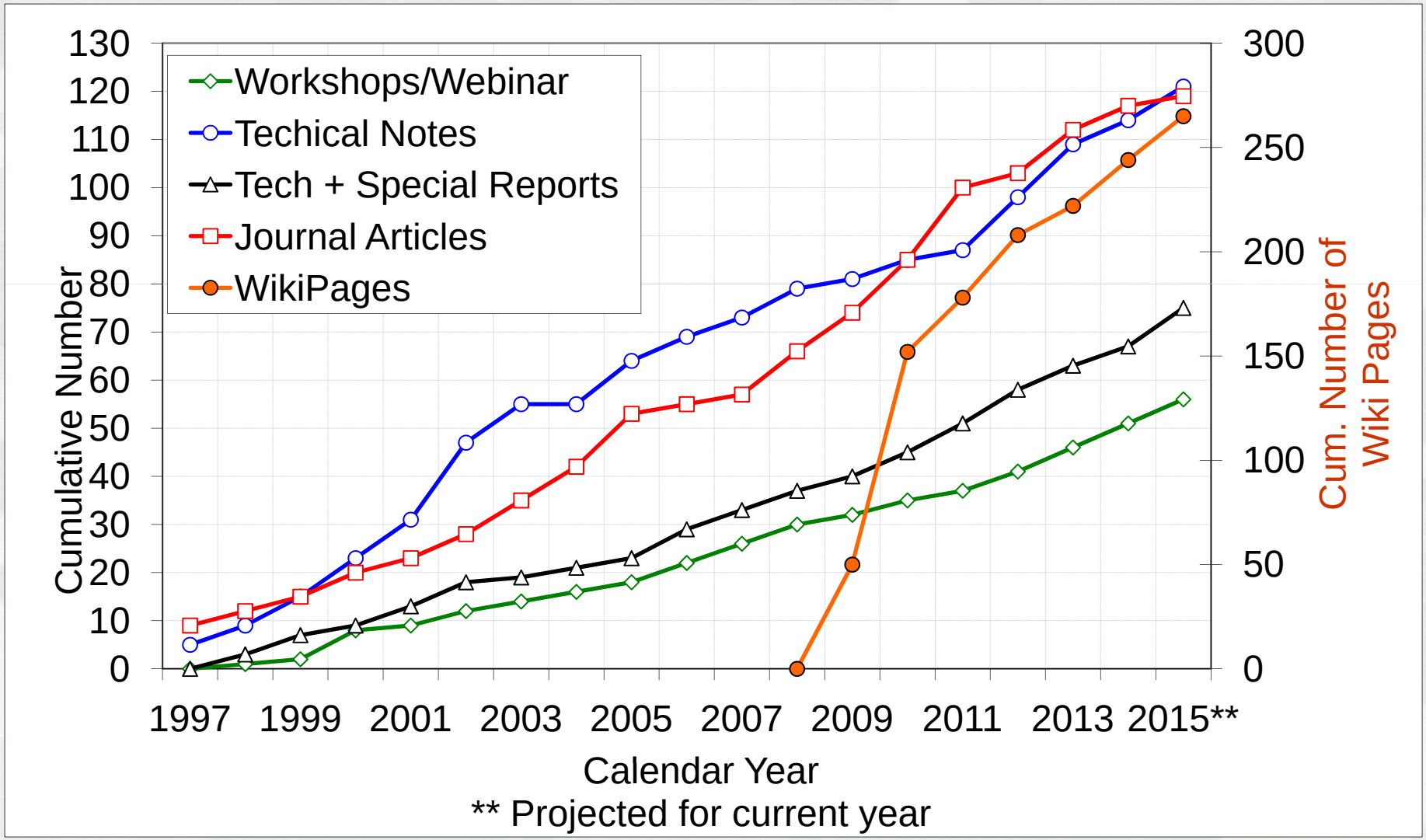
**Inlet Engineering Toolbox**

*Ashley Frey*

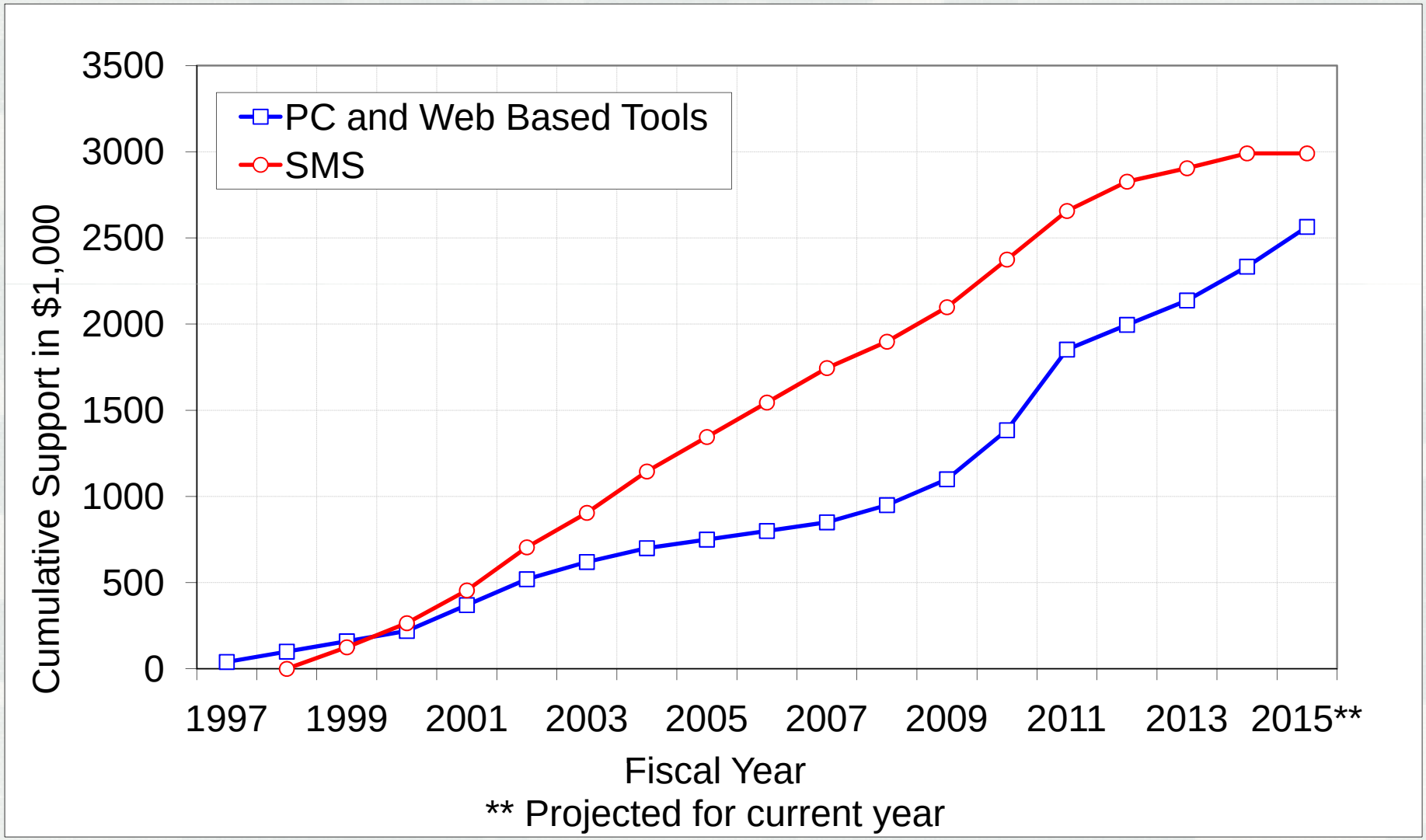
**Waves at Navigation Structures**

*Lihwa Lin*
*Zeki Demirbilek*

# CIRP Publications and Workshops



# CIRP Investments: SMS, PC, and Web Tools



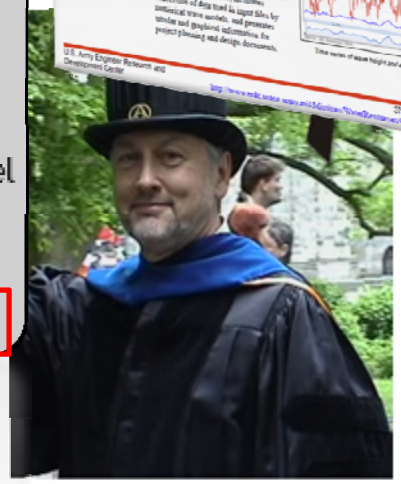
# CIRP Website: Tech Transfer

http://cirp.usace.army.mil

Products
CMS
SMS
---
Bouss 2D
CPT
CSMART
GenCade
IIAB (Section 211)
Inlet Reservoir Model
RMAP
Sediment Budget Tools
Shoaling Toolbox
WaveNet
---
CIRP Portal
US Depth of Closure Info

CIRP
Contact Information
Fact Sheets
CMS Subscription List
Related Links
Visitor Information
FAQs

CIRP Program
---
CMS Work Unit
CNPM Work Unit
IET Work Unit
Waves Work Unit
---
Bouss2d
CMS-Wave
Particle Tracking Model
TideNet Web Service
WaveNet Web Service

Dr. Nicholas Kraus
Library Dedication Page

# Technology Transfer, Nov98 - Apr15

**Program Management and Technology Transfer**

## *16 Years of Tech Transfer Activities*

## Since RARG 2014:

## 3 On-Site Training Sessions

## (1 CIRP-DOTS; 1 KEI; 1 CIRP-RSM)

## 2 Webinars

## Oct 2014, Apr 2015 eNewsletters

| | | |
|---|---|---|
| Oct 2014 | Coastal Inlet Breaching | Webinar |
| Nov 2014 | Galveston District | CIRP –DOTS: CMS & SMS training |
| Jan 2015 | Resilience of Coastal Dunes | Webinar |
| Jan 2015 | Korean Environmental Institute | CMS & SMS training |
| Mar 2015 | Jacksonville, FL | CIRP-RSM: Tools for Regional Sediment Management |

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# Coastal Navigation Portfolio Management

*PI: Dr. Kenneth Ned Mitchell*

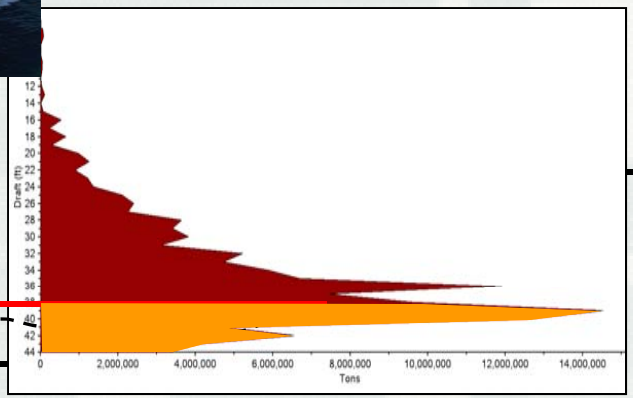
**Coastal Navigation Portfolio Management**

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

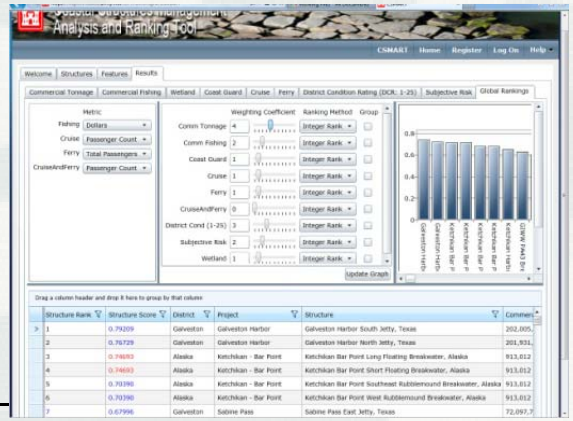
## Channel Portfolio Tool (CPT):

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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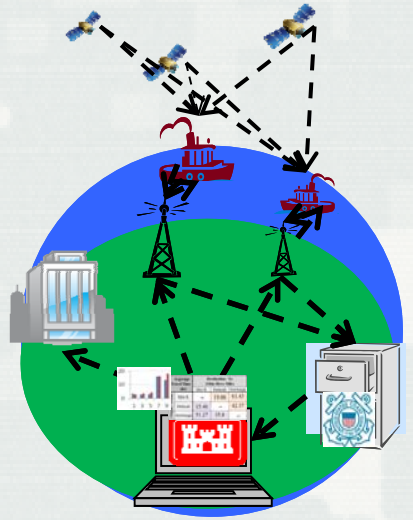
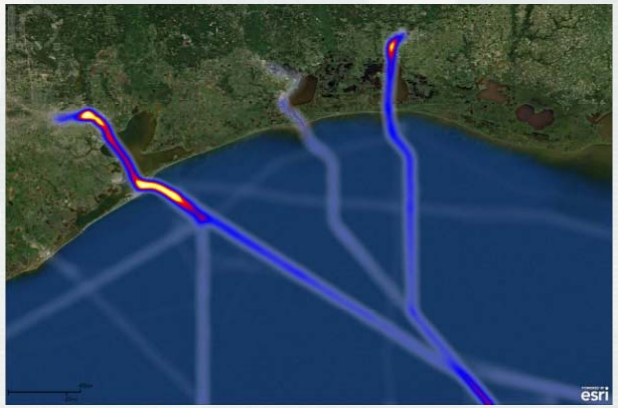
# Coastal Navigation Portfolio Management

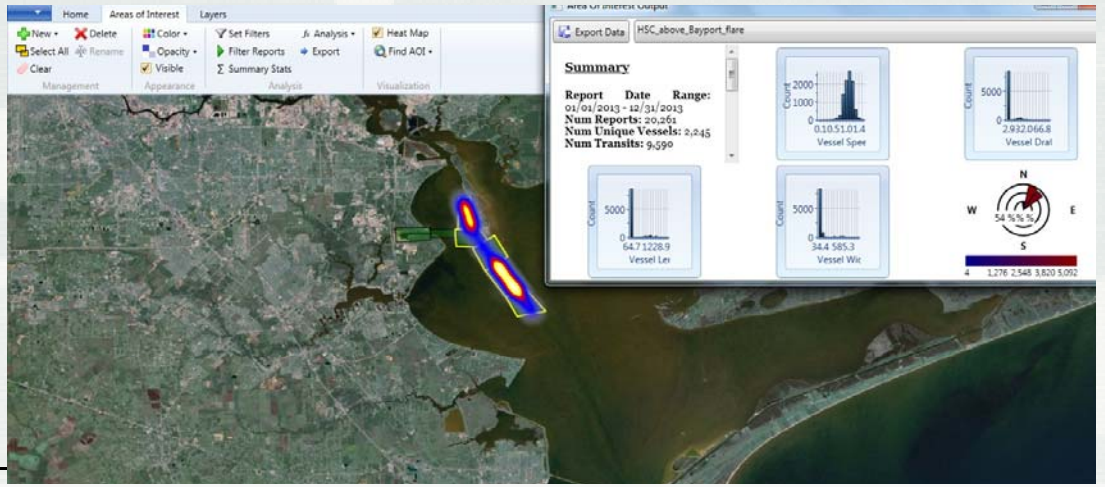
**Coastal Navigation Portfolio Management**

## Automatic Identification System Analysis Package (AISAP)



- Access and analyze large amounts of archived spatial-temporal AIS data - archived vessel movement data from USCG for coastal & inland waters.
- Analysis capabilities include traffic density patterns, fleet characteristics, average transit 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

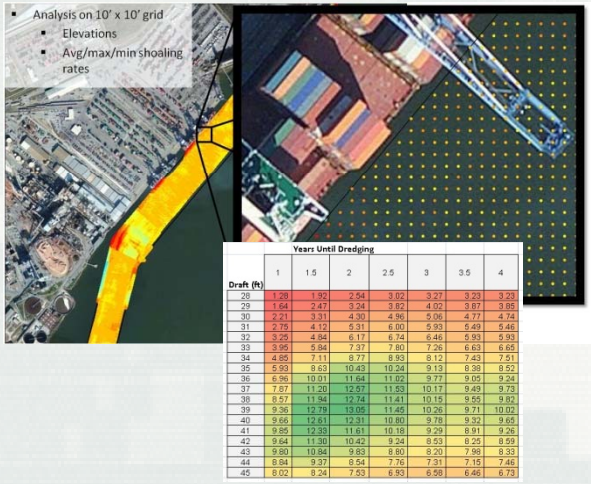
# Coastal Navigation Portfolio Management
## *FY14 Progress*

**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.)

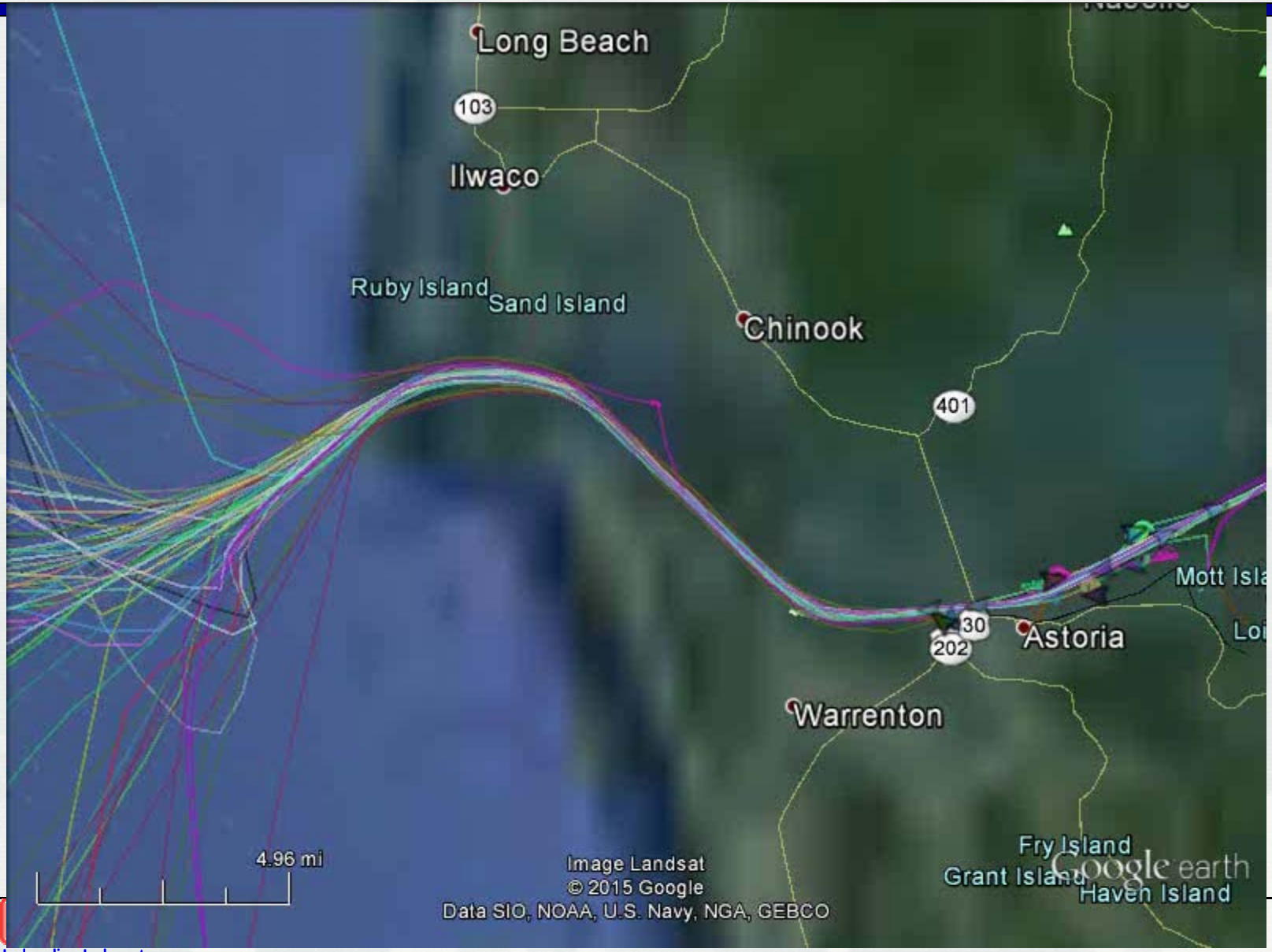
**AISAP:**

✓ 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

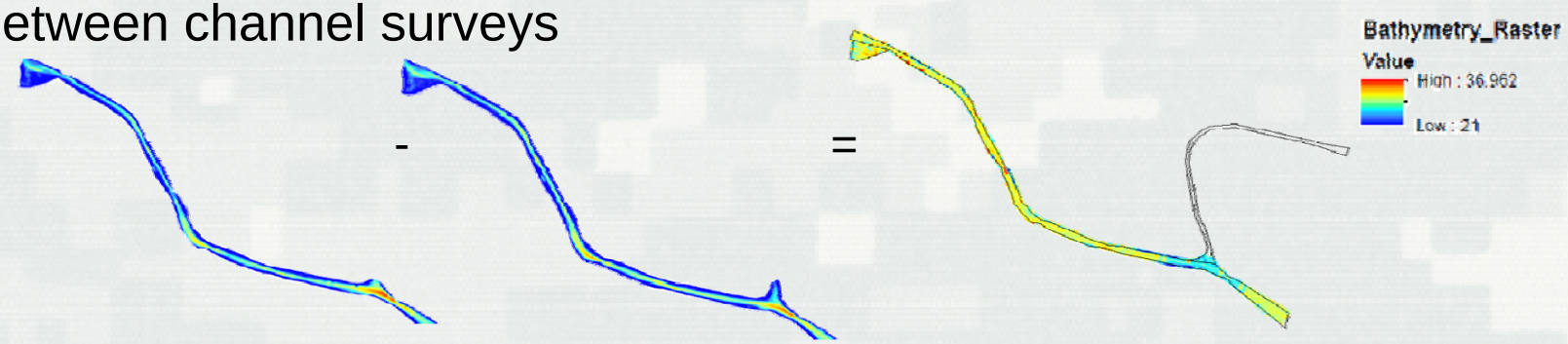
# AISAP: 5 days of Vessel Traffic at the Mouth of Columbia River, WA/OR



# CPT, eHydro & Corps' Shoaling Analysis Tool (CSAT) – Supporting Asset Management

**Coastal Navigation Portfolio Management**

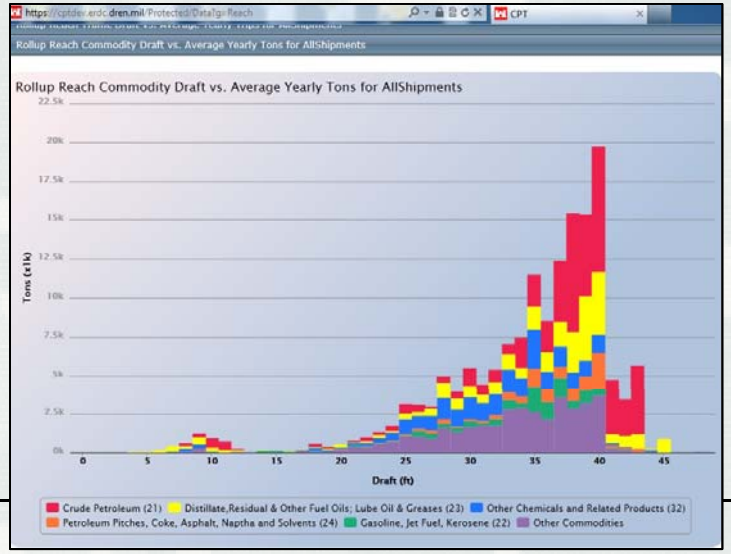
**1. eHydro + 3D Channel Framework:** Calculate shoaling rates between channel surveys




**2. CSAT+Dredging History:** Calculate infilling rates as function of time and depth

| | | Quantity (CY) at different future times to reach specified depth | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Target Elev, ft (MLLW) | Dredge Cut, ft (MLLW) | Now | 6 mos. | 12 mos. | 18 mos. | 24 mos. | 30 mos. | 36 mos. |
| -45 | -47 | 312,962 | 1,527,520 | 3,795,422 | 6,661,576 | 9,912,000 | 13,381,110 | 16,874,650 |
| -44 | -46 | 312,962 | 1,527,520 | 3,795,422 | 6,661,576 | 9,912,000 | 13,381,110 | 16,874,650 |
| -43 | -45 | 312,962 | 1,527,520 | 3,795,422 | 6,661,576 | 9,912,000 | 13,381,110 | 16,874,650 |
| -42 | -44 | 180,540 | 977,219 | 2,872,732 | 5,496,566 | 8,567,152 | 11,903,859 | 15,304,755 |
| -41 | -43 | 48,118 | 426,918 | 1,950,042 | 4,331,555 | 7,222,303 | 10,426,608 | 13,734,860 |
| -40 | -42 | 27,629 | 248,849 | 1,377,110 | 3,445,603 | 6,112,310 | 9,147,867 | 12,329,802 |
| -39 | -41 | 7,140 | 70,779 | 804,178 | 2,559,651 | 5,002,317 | 7,869,126 | 10,924,743 |
| -38 | -40 | 4,214 | 40,268 | 533,256 | 1,965,286 | 4,145,992 | 6,808,288 | 9,707,811 |
| -37 | -39 | 1,287 | 9,757 | 262,333 | 1,370,920 | 3,289,668 | 5,747,450 | 8,490,879 |
| -36 | -38 | 724 | 5,673 | 160,583 | 1,006,025 | 2,668,627 | 4,910,082 | 7,474,515 |
| -35 | -37 | 160 | 1,589 | 58,832 | 641,129 | 2,047,587 | 4,072,715 | 6,458,151 |
| -34 | -36 | 80 | 895 | 34,177 | 445,102 | 1,610,423 | 3,424,647 | 5,631,585 |
| -33 | -35 | 0 | 201 | 9,523 | 249,075 | 1,173,259 | 2,776,579 | 4,805,020 |
| -32 | -34 | 0 | 103 | 5,598 | 164,495 | 889,617 | 2,283,336 | 4,137,170 |
| -31 | -33 | - | 6 | 1,673 | 79,915 | 605,975 | 1,790,093 | 3,469,321 |
| -30 | -32 | - | 3 | 1,065 | 51,076 | 440,680 | 1,435,445 | 2,935,180 |
| -29 | -31 | - | - | 457 | 22,237 | 275,386 | 1,080,797 | 2,401,040 |
| -28 | -30 | - | - | 281 | 14,037 | 195,155 | 841,539 | 1,991,483 |
| -27 | -29 | - | - | 105 | 5,838 | 114,924 | 602,281 | 1,581,926 |
| -26 | -28 | - | - | 54 | 3,922 | 80,042 | 453,954 | 1,282,898 |
| -25 | -27 | - | - | 3 | 2,007 | 45,160 | 305,627 | 983,870 |
| -24 | -26 | - | - | 1 | 1,356 | 31,075 | 225,913 | 775,127 |

**3. CPT:** tonnage & commodities transiting as a function of depth




**4. Work Packages:** dredging requirements to maximize tonnage & minimize expenditures

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# CIRP Work Units

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*Alex Sanchez*
*Honghai Li*


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*Cheryl Pollock*
*Katie Brutsché*

**Inlet Engineering Toolbox**

*Ashley Frey*

**Waves at Navigation Structures**

*Lihwa Lin*
*Zeki Demirbilek*

# Waves at Navigation Structures

*PIs: Dr. Lihwa Lin and Dr. Zeki Demirbilek*

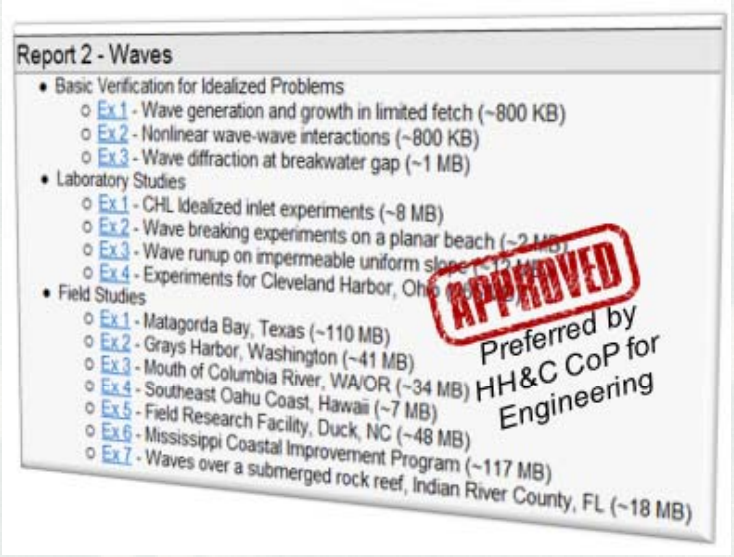
**Waves at Navigation Structures**

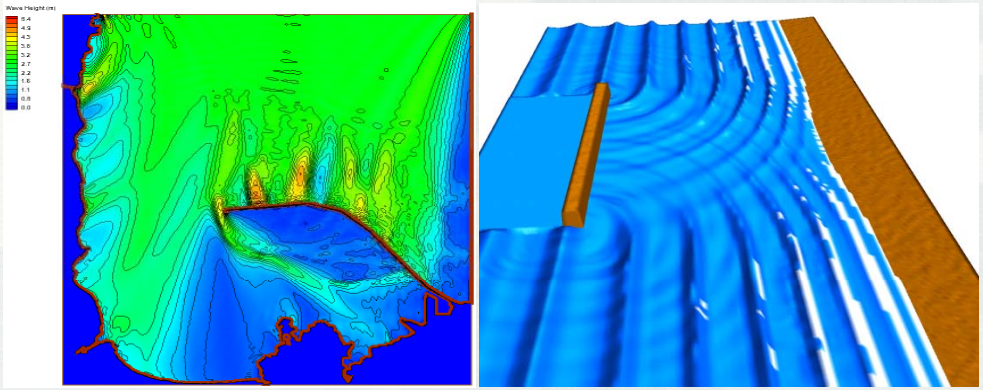
Focus: to **advance wave predictive capability** in support of USACE missions for coastal inlets, navigation, structures, ports/harbors/marinas, and adjacent beaches, reefs and wetlands.

## 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)



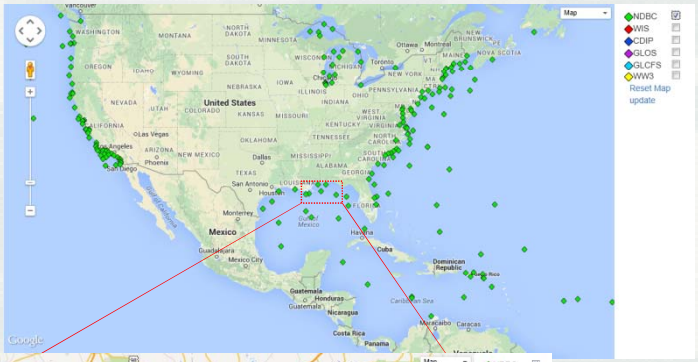
Bouss-2D: Phase-resolving shallow-water, nonlinear wave model for ports/harbors/marinas, navigation, fluid-structure interaction, vessel-generated waves.

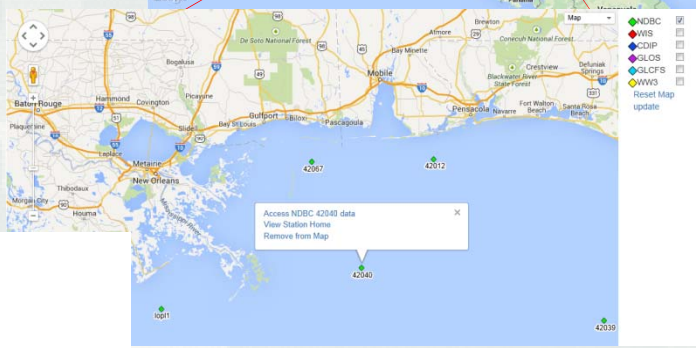
# Waves at Navigation Structures: *FY14-15 Activities* Metocean Data Access/Analysis: WaveNet

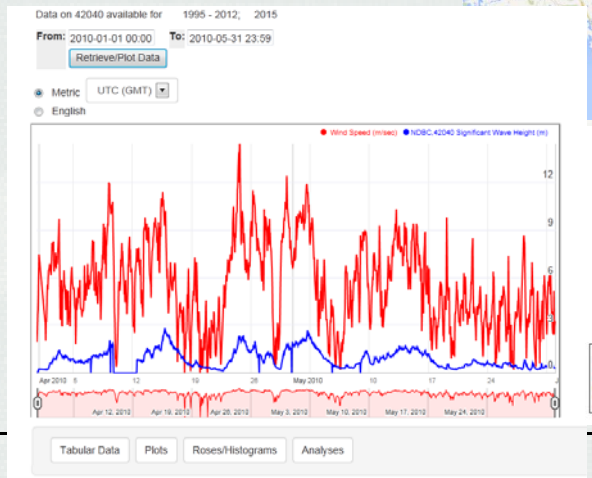
Waves at Navigation Structures

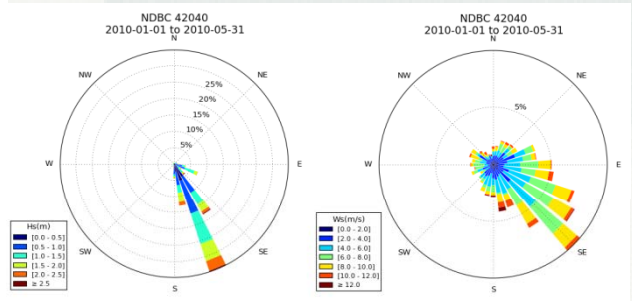
## WaveNet: Web-based interactive GUI with Google Map

- **Purpose:** Access, analyze, plot, and format wave and wind data for projects and models
- **Data Sources:** NDBC, WIS, CDIP, WW3, GLCFS, GLOS
- **Future Additions**: CPT and AIS coupling

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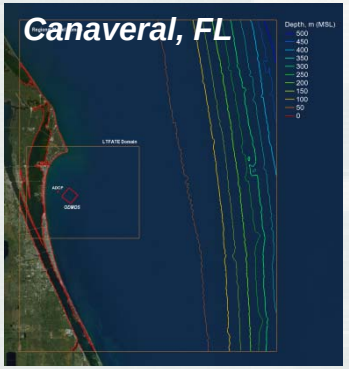
# Waves at Navigation Structures
## *FY14 Project Applications & Reimbursables*

**Waves at Navigation Structures**

- POH: Kikiaola Harbor, HI
  Faleasao Harbor, Samoa
  Kaanapali Beach, Maui, HI
- SPN: Half Moon Bay, CA
- SWG: West Galveston Bay, TX
- LRB: Braddock Bay, NY
  Oswego Harbor, NY
- NAO: Tangier Island, VA
- SAJ: Cape Canaveral, FL
- LRE: Sand Island, WI
  Duluth Harbor, MN
  Stamp Sand, WI
  Traverse City, MI
- NWP: Port Orford, OR



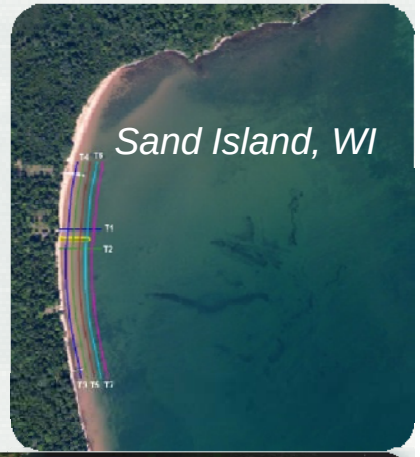



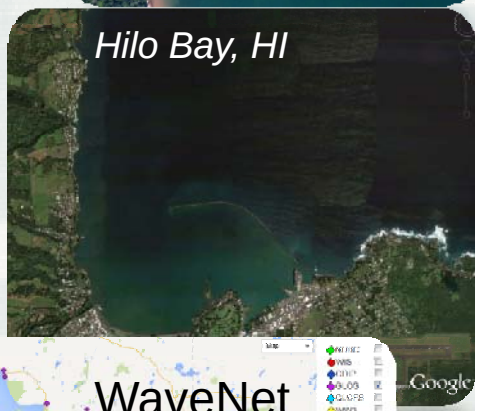


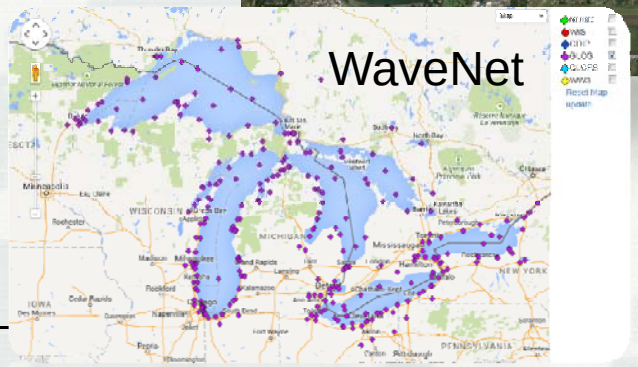
# Waves at Navigation Structures
## *FY15 Plans*

**Waves at Navigation Structures**

- R&D
  - Enhancements to CMS-Wave
  - Pre- and post-processing capabilities
  - Complete WaveNet and TideNet
- Tech Transfer
  - Conduct District training for wave model applications
  - Complete publications (3 TRs, 2 CHETNs, 2 JPs)
  - Conduct WaveNet webinar
- Support Districts in project studies
  - POH (2), SPN (1), LRE (1), LRB (1)



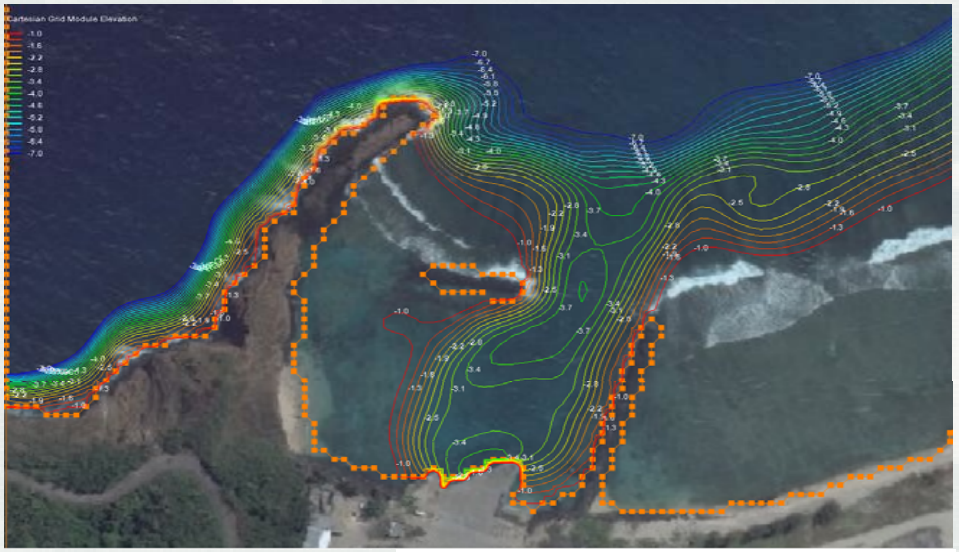



# Example of Support to District Navigation Projects: *Faleasao Harbor, Samoa*

**Waves at Navigation Structures**

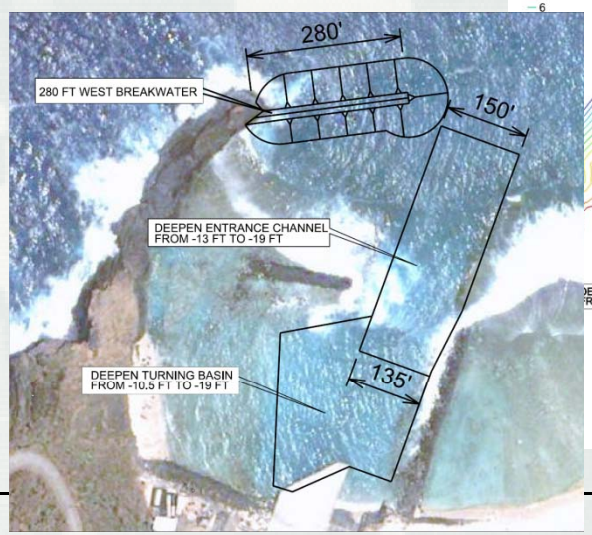
## Purpose:

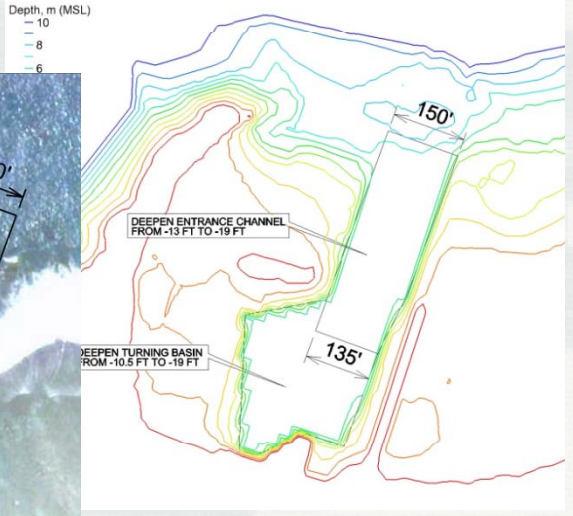
Evaluate improvements to navigation and infrastructure



## Tasks completed:

- Developed design wave estimates for harbor protection structures and safe operational condition at the entrance and interior harbor
- Evaluated three alternatives for infrastructure modifications
- Sized infrastructure modifications to minimize navigation risk
- Deepened and widened channel and mooring basin to allow larger vessels access the harbor



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# Inlet Engineering Toolbox

*PI: Ashley Frey*

Poster!

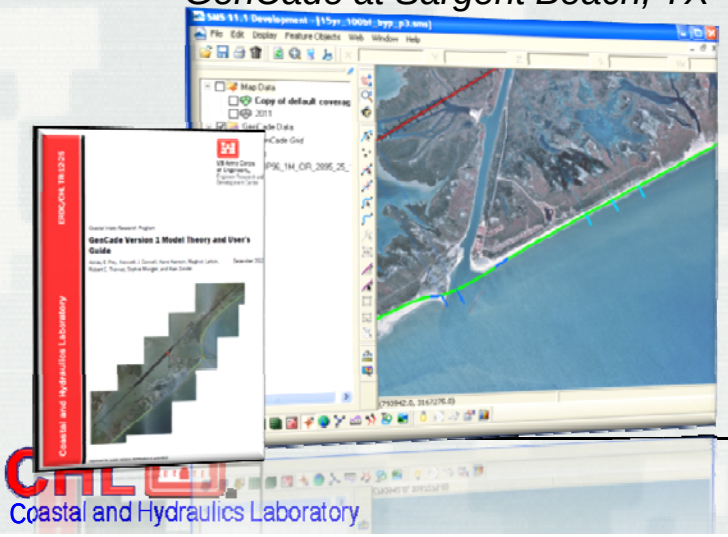
**Inlet Engineering Toolbox**

**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 on CIRP website

*GenCade at Sargent Beach, TX*



## Inlet Reservoir Model

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

## GenCade-SBAS Connection

- Calculated transport rates and volumetric change from GenCade can be imported to the **S**ediment **B**udget **A**nalysis **S**ystem (SBAS) and utilized to create a sediment budget

Coastal and Hydraulics Laboratory

# Inlet Engineering Toolbox
## *FY14 Accomplishments*

**Inlet Engineering Toolbox**

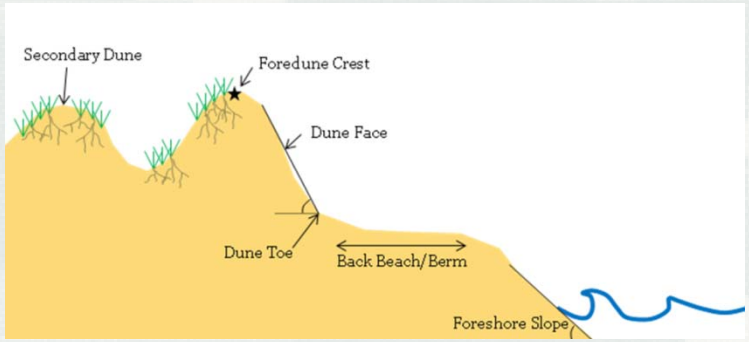
## GenCade

### Documented Guidance and Applications

- Published TR on GenCade recommendations and requirements
- Published 2 CHETNs on comparison of 1-line models
- Published PIANC CP on GenCade-SBAS application at Onslow Bay
- Completed GenCade Quick-Start Guide SR (published in FY15; SR-15-1)


## Natural and Constructed Dunes

- Foredune state of response TR (completed in FY14; published in FY15)





## Resilience

- JP accepted, in revision; defines concept of resilience, develops methodology, and provides a way to quantify engineering, environmental, and community resilience

# Inlet Engineering Toolbox
*FY15 Activities*

Inlet Engineering Toolbox

Poster!

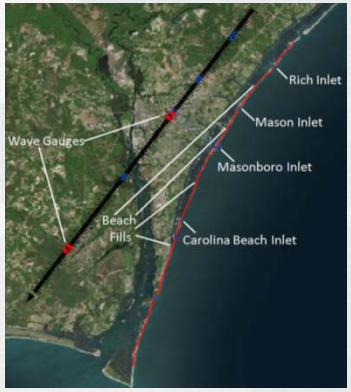
## GenCade

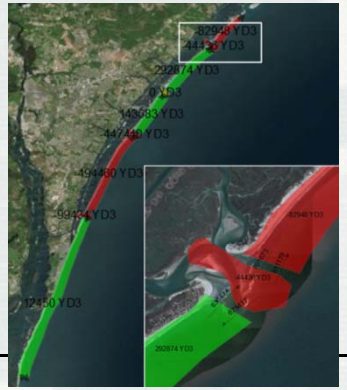
## Model improvements

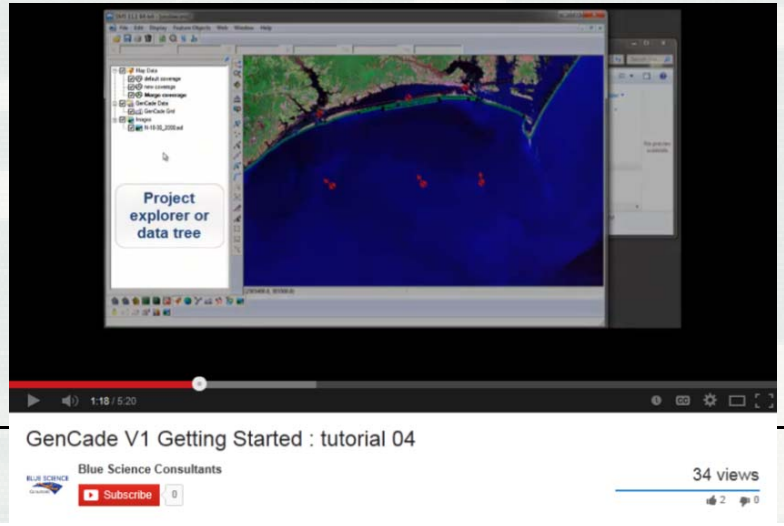
- GenCade-SBAS connection (completed; TN in review)
- Simplify inlets and groins for regional enhancements
- Sea level change

• New documentation on calibration (TR), analytical solutions (JP), model theory and application (JP), lateral boundary conditions (TR), and dredging and beach fills (TN)

• Training via GenCade YouTube clips





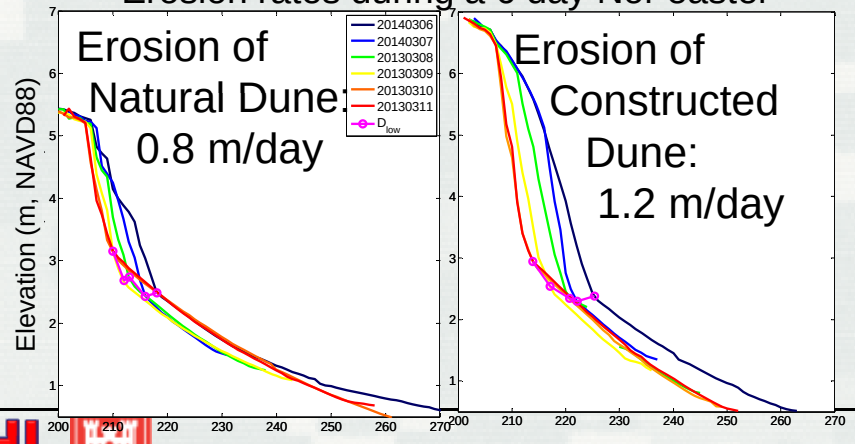
# Inlet Engineering Toolbox
## *FY15 Activities*

Inlet Engineering Toolbox

## Investigation of Short- and Long-Term Dune Recovery Processes

- Understand best practices for dune construction for long-term health and stability through comparison of natural accreting, natural eroding, and constructed dunes
  - Bi-weekly lidar
  - Analysis of long-term morphology change
  - TR describing results

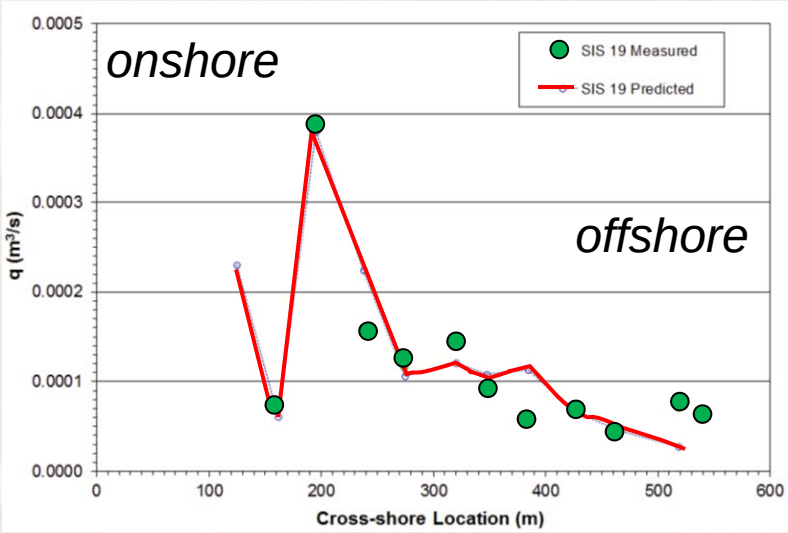
Erosion rates during a 6 day Nor'easter




Cross-shore (1-unit = 0.5m)

## Longshore Sediment Transport Equation

- Develop reliable, physics-based, cross-shore distribution desktop formula for calculating LST to field engineers
- JP describing validated equation




*Cross-shore distribution of longshore transport at the FRF*

# 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**

*Cheryl Pollock*
*Katie Brutsché*

**Inlet Engineering Toolbox**

*Ashley Frey*

**Waves at Navigation Structures**

*Lihwa Lin*
*Zeki Demirbilek*

# Inlet Geomorphology Evolution

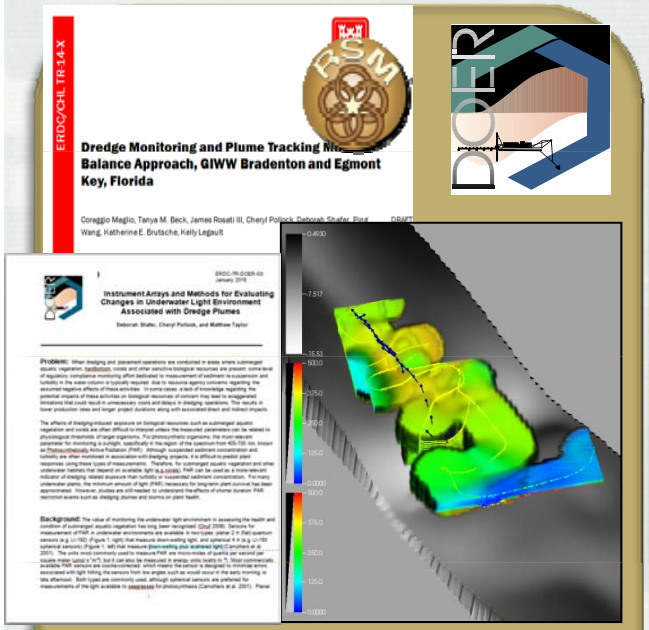
*PIs: Cheryl E. Pollock and Dr. Katherine E. Brutsché*

**Geomorphic Evolution**

Focus: Develop tools and databases for operation & management of federal navigation channels and coastal projects **considering temporal & spatial scales much greater than dredging cycles, planning timelines, and the dimensions of the navigation channel.**

- **Sediment and morphologic evolution in & around inlets**
- **Nearshore Placement guidance**
- **Collaborating with the best people at Districts to target projects of opportunity**
  - **Working closely with Engineers, Planners, Project Managers, Geotech, GIS Specialists, and Regulators in Districts**
  - **Considering a full range *perspective* on the *needs* within Districts**

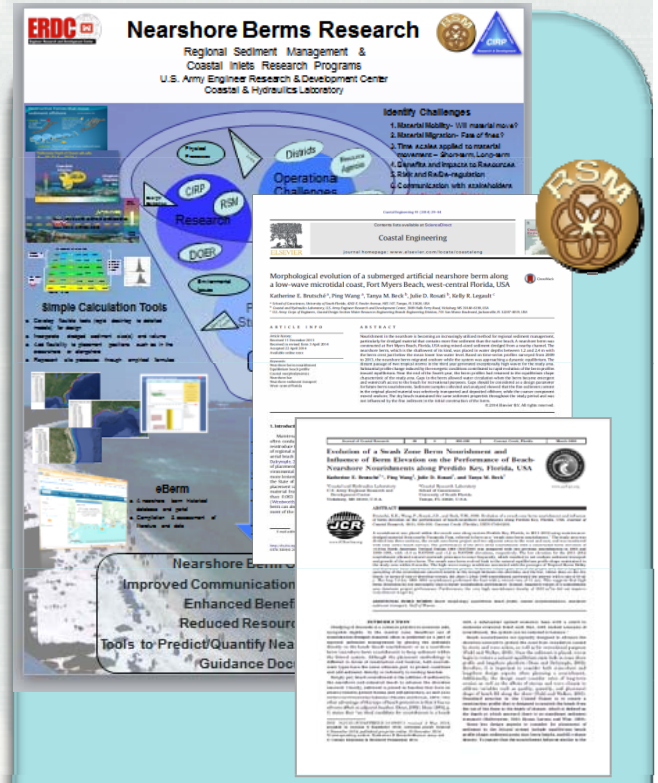
# Inlet Geomorphology Evolution
## *FY14 Accomplishments*




**TR: Dredge Monitoring and Plume Tracking Mass Balance, TN: Effects of turbidity on Light Attenuation**



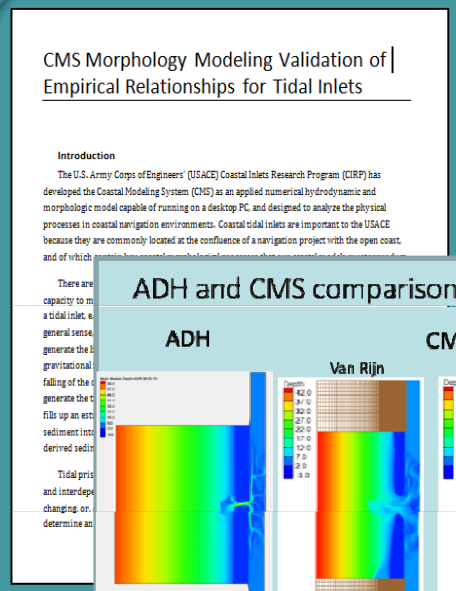

**CHETN: State of Understanding - Nearshore Berms**



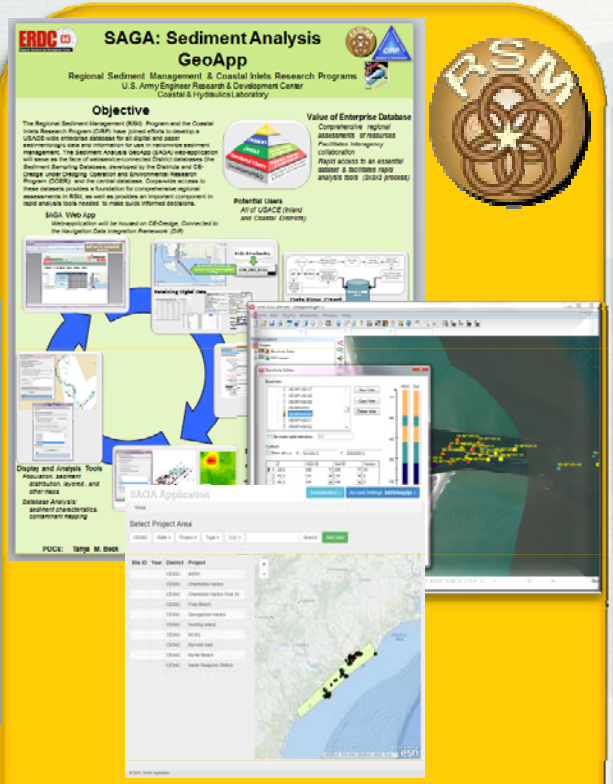

**2 JPs: Berm Performance: Perdido Key, FL; Ft. Myers Beach, FL**

# Inlet Geomorphology Evolution

## *FY14 Accomplishments*




**Long-term Morphologic Modeling of Inlets (w/CMS WU)**




**SAGA Web Application and Poster**

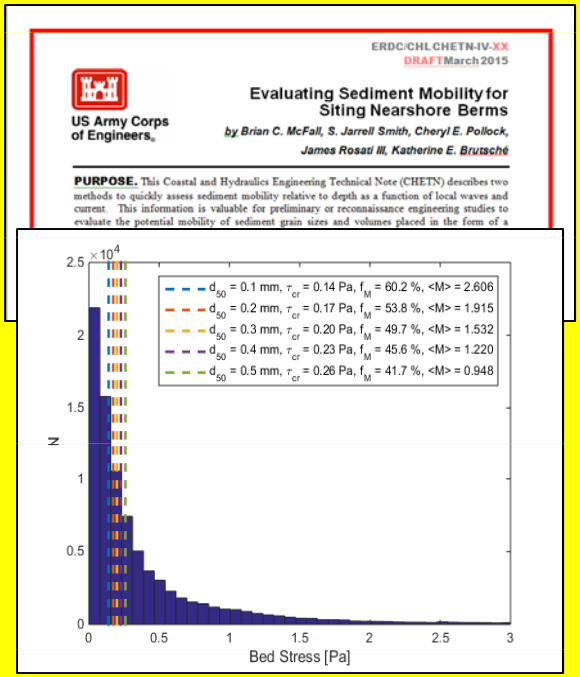

**Depth of Closure Database and Maps**

# Inlet Geomorphology Evolution

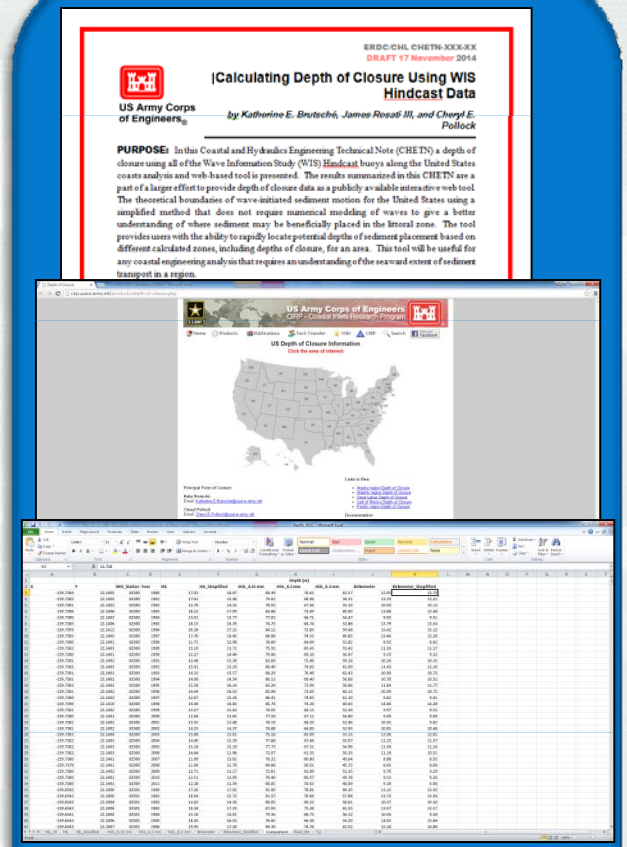
## *FY15 Activities*

Poster!


**Egmont Key Field Monitoring for Turbidity and PAR***




**Nearshore Berm Sediment Mobility CHETN**




**DOC CHETN and Database**

*Photosynthetically Active Radiation sensors, potentially low-cost indicators of turbidity

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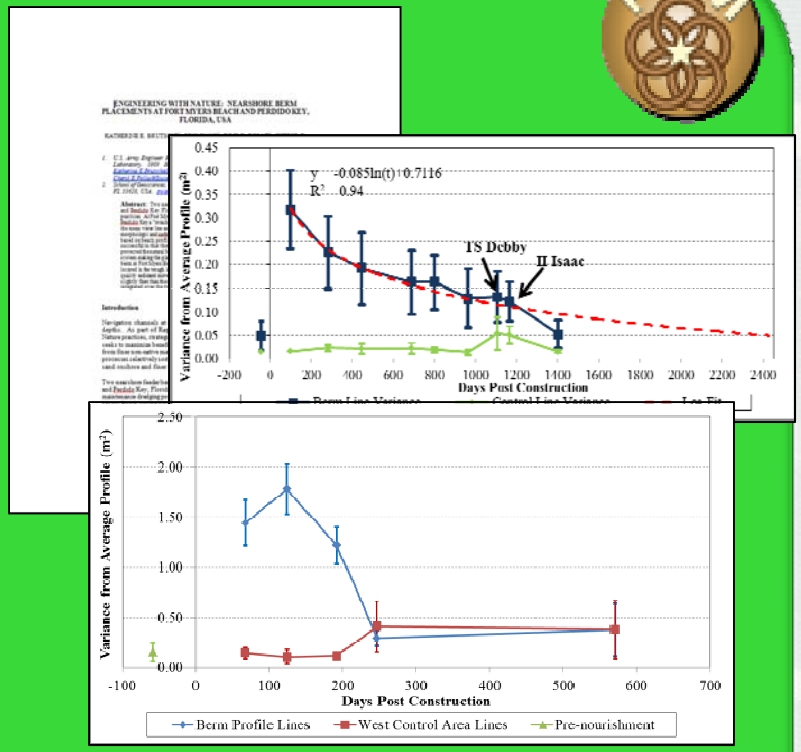
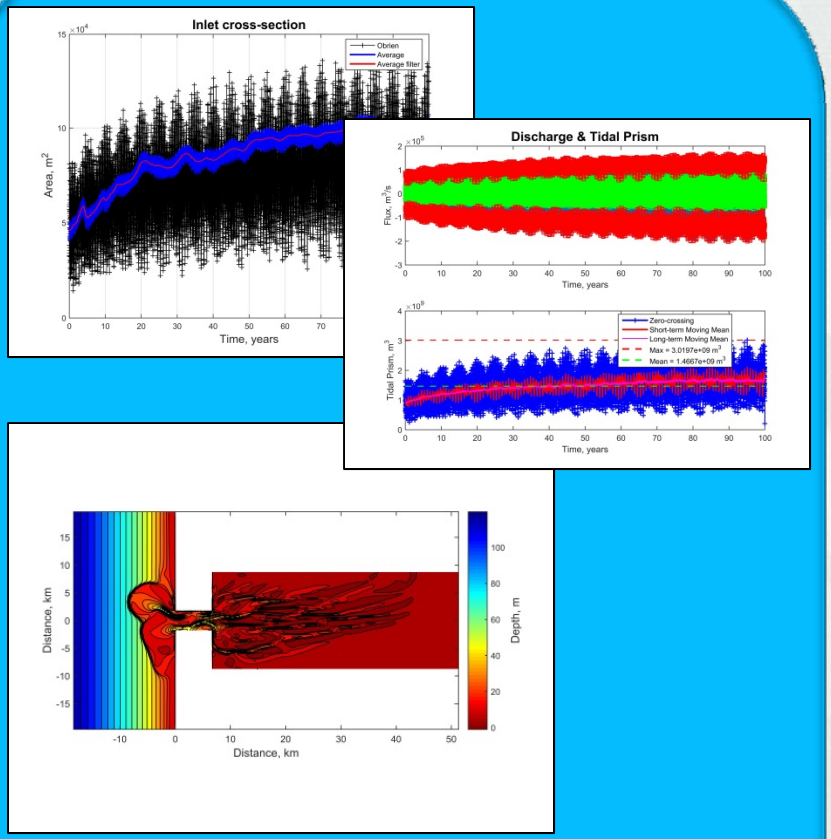
# Inlet Geomorphology Evolution
## *FY15 Activities*




**Conf Paper: Strategic Berm Placement at Ft. Myers Beach, FL**




**Long Term Inlet Morphology Change Modeling**

CHL Coastal and Hydraulics Laboratory

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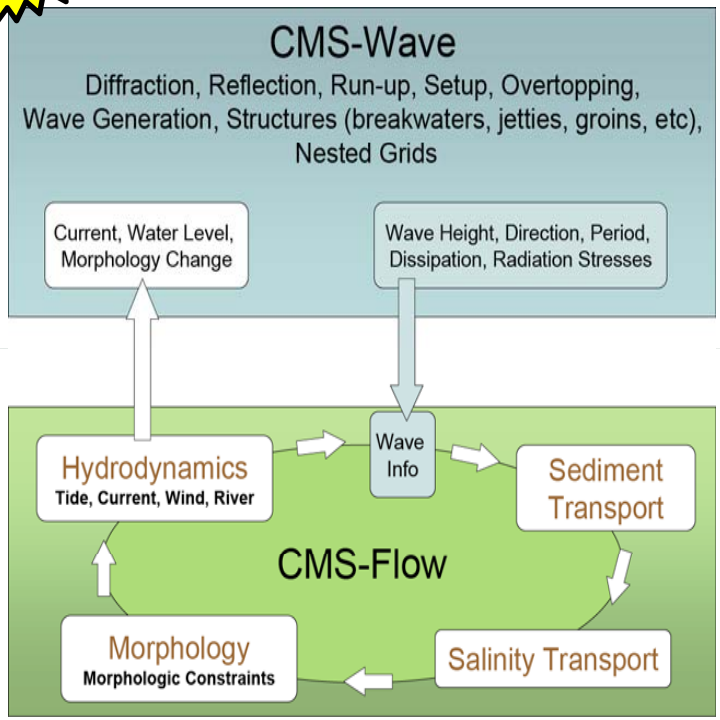
# Coastal Modeling System

*PIs: Dr. Alejandro Sanchez, Dr. Honghai Li*

Poster!




## What is the CMS?

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

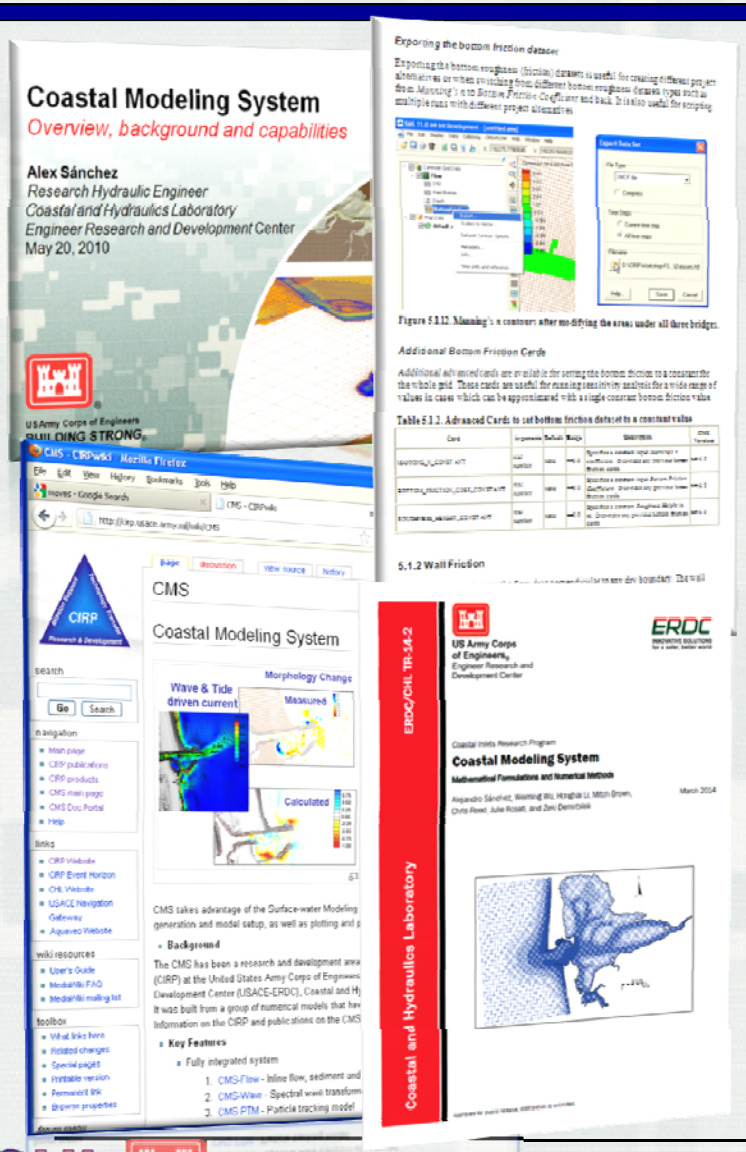
## Why CMS?

- Operational at 14 Districts and A/E firms
- Verified with analytical solutions
- Validated with lab experiments, 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
- POCs: Alejandro Sanchez, Lihwa Lin, Mitchell Brown, Honghai Li, Zeki Demirbilek

## Documentation

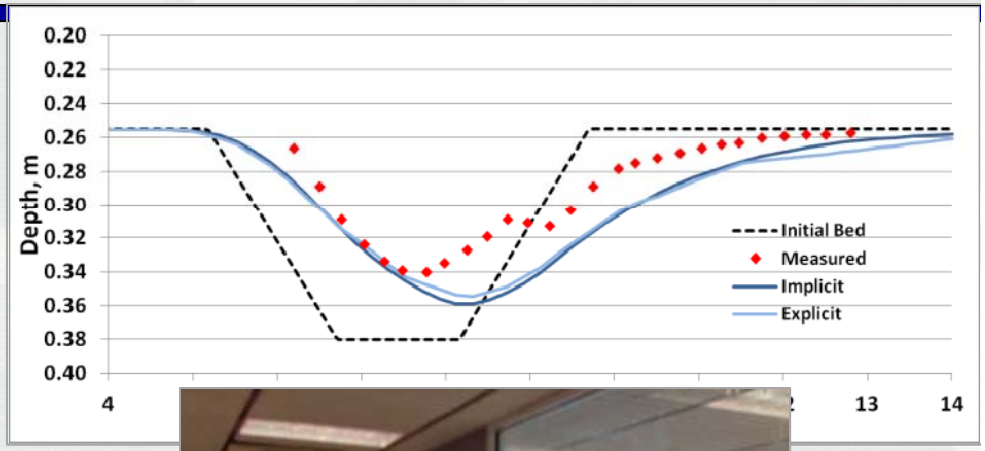
- TRs, CHETNs and journal papers http://cirp.usace.army.mil/pubs/
- CIRP Wiki http://cirp.usace.army.mil/wiki/CMS
- **New technical reports and updated users' guide** available

## Training and Support

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

# FY14 Accomplishments

- Publications (TNs, CHETNs, journal papers, conference papers)
- DOTS training for SWG
- Release of SMS 11.2
  - 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)

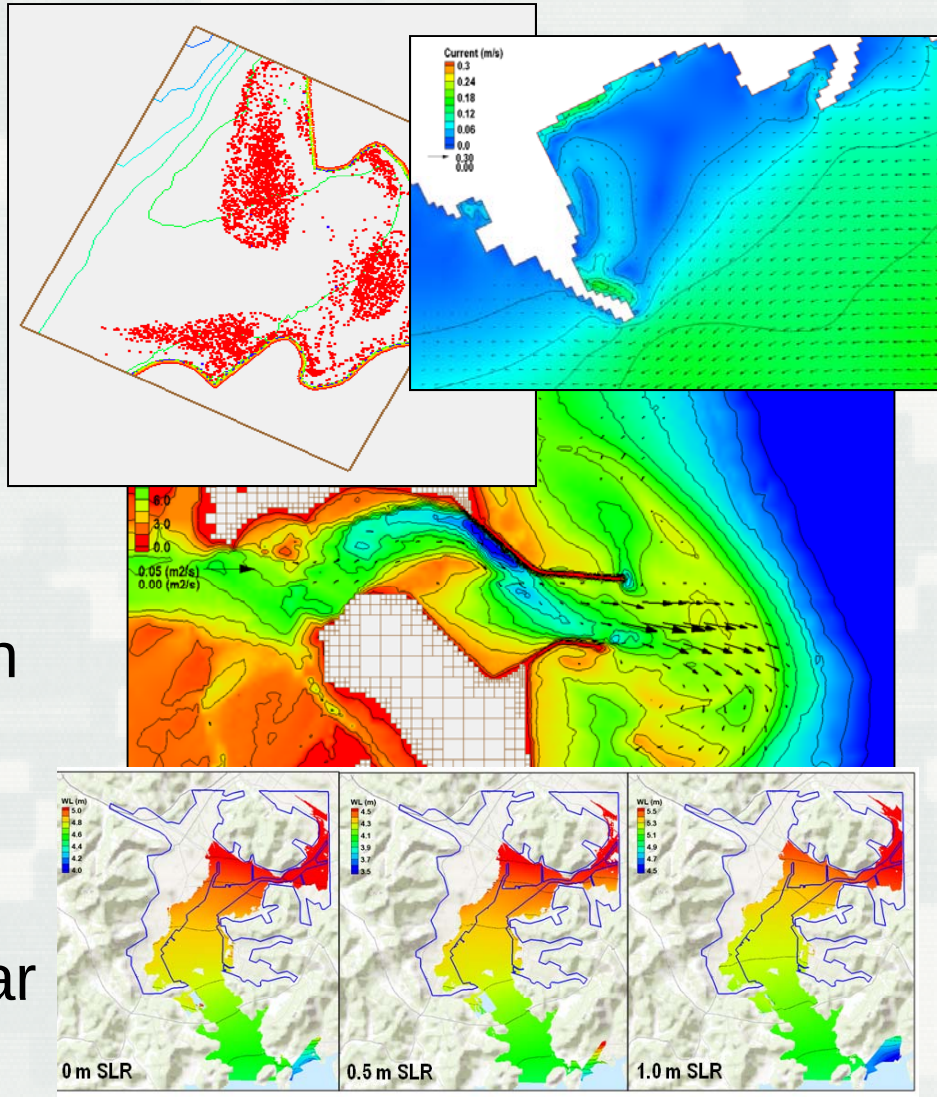



# FY14 Publications

- Journal Paper
  - Modeling study of Dana Point Harbor, California: littoral sediment transport around a semi-permeable breakwater (JOEME)
- Conference Papers:
  - Effect of hydrodynamics on sediment transport near a coastal inlet
- Tech Report:
  - Risk quantification for sustaining coastal military installation asset and mission capabilities (RC-1701)
  - Comprehensive conditions survey and storm waves, circulation, and sediment study, Dana Point Harbor, CA
  - Port Orford sediment transport analysis
- Technical Notes
  - Implementation of dredge module in CMS

# Reimbursables

- NAE: Merrimack Bay/Inlet Modeling Study
- RSM Study: Port Orford Oregon Regional Sediment Model
- Pilot study on vulnerability assessment model of climate change: application to Korean coast
- Wave, hydrodynamic, and PTM modeling in support of the lateral expansion of Poplar Island



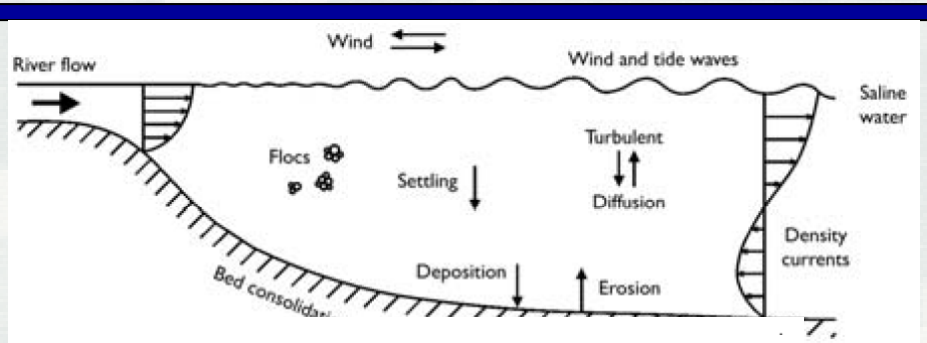
# FY15 Plans for CMS

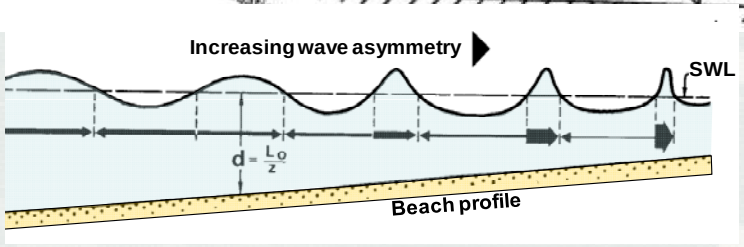
## Features/updates

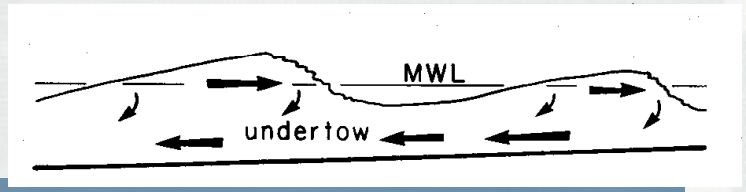
- Sediment mapping
- Dredging module
- Temperature module
- Explicit telescoping grid
- Parallelization for HPC

## R&D

- Long-term morphology change
- Automated model calibration and uncertainty analysis
- Cross-shore sediment transport
- Sea level change impacts to navigation projects
- Bed-load dispersion
- Grid quality indicators




# CIRP Wrap-Up:

What do you need to better manage inlets & adjacent beaches*?

**Including: entrances, ports, marinas, harbors, navigation structures, & channels*

How can CIRP better support your projects?


What tools, technology transfer media and guidance do you need?

What advances in coastal inlet and adjacent beach knowledge are needed?