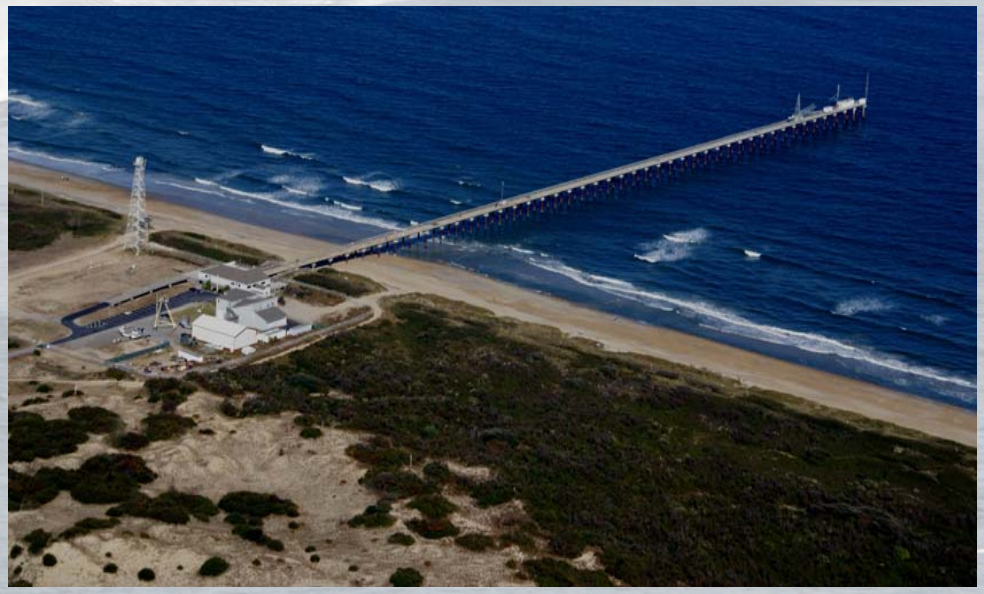
Coastal Process Investigations

Jeff Hanson
Research Oceanographer
MORPHOS Program Manager

US Army Engineer Research and Development Center (ERDC)
Field Research Facility (FRF) - Duck, NC

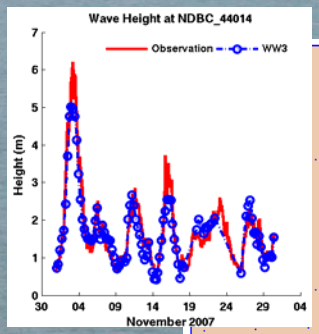


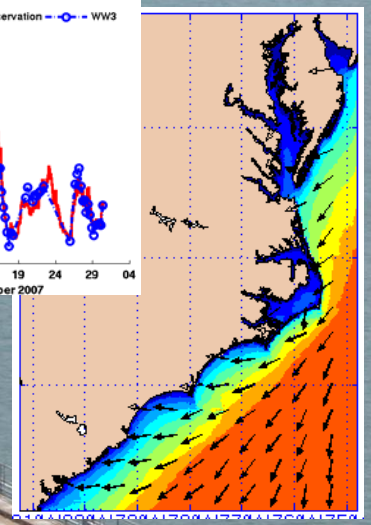
APNEP STAC Quarterly Meeting, 29 April 2008

Field Research Facility

Established in 1977 to Advance Coastal Knowledge Through Research and Discovery

- Observations
- Modeling
- Model Validations





Our Coasts at Risk

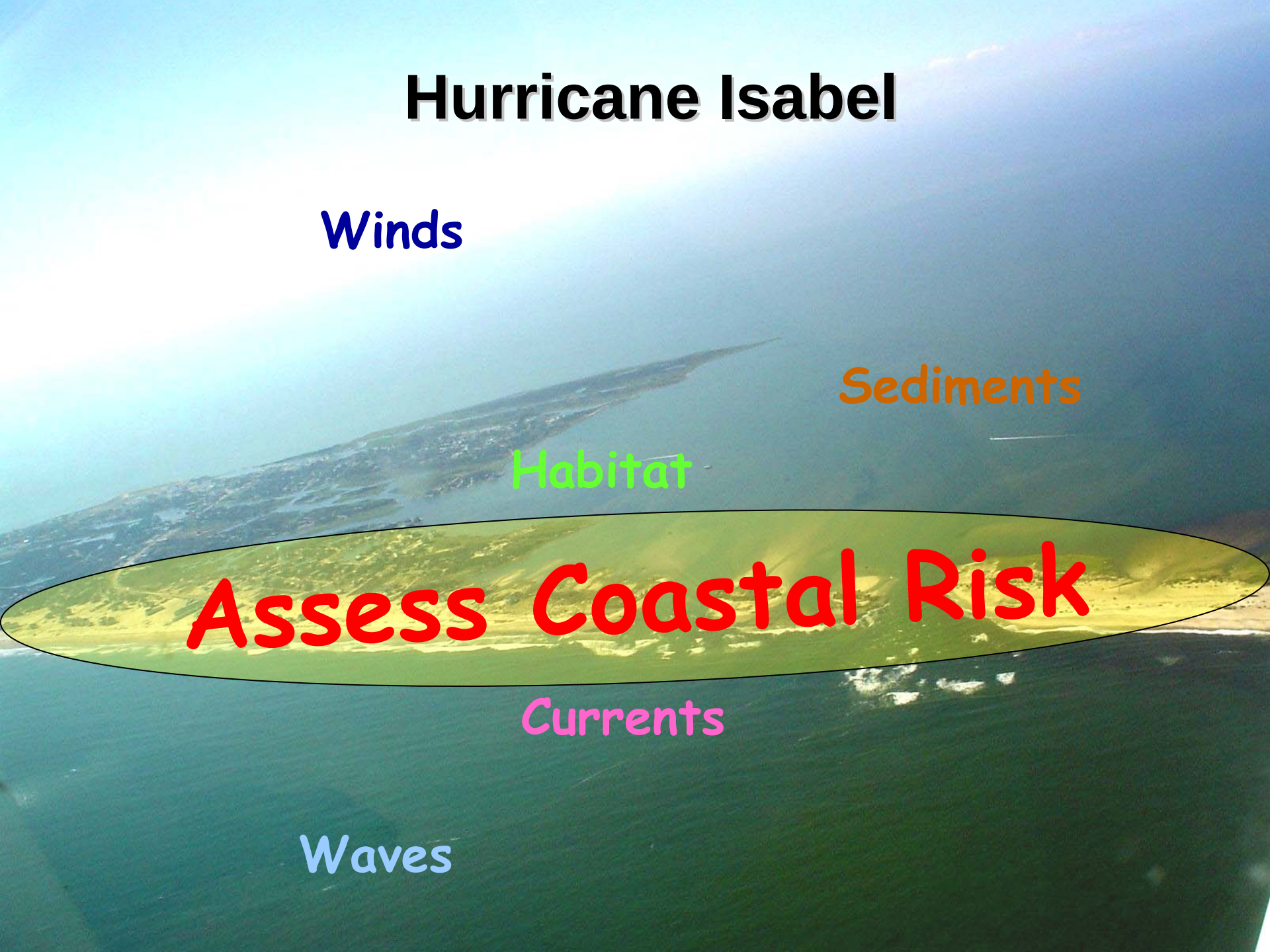
FL 2004 Hurricane Season:
Beach Erosion

2005 Hurricane Season:
Inundation/Flooding

Issues

- Developmental Pressure
- Increased Storm Activity
- Wetlands
- Sea Level Rise
- Subsidence

- Modeling Weaknesses Exposed
- Major catastrophes transcend past experience
- Events exceed range of model tuning


Hurricane Isabel
Winds
Sediments
Habitat
Assess Coastal Risk
Currents
Waves

Regional Observations

US Army Engineer Research and Development Center

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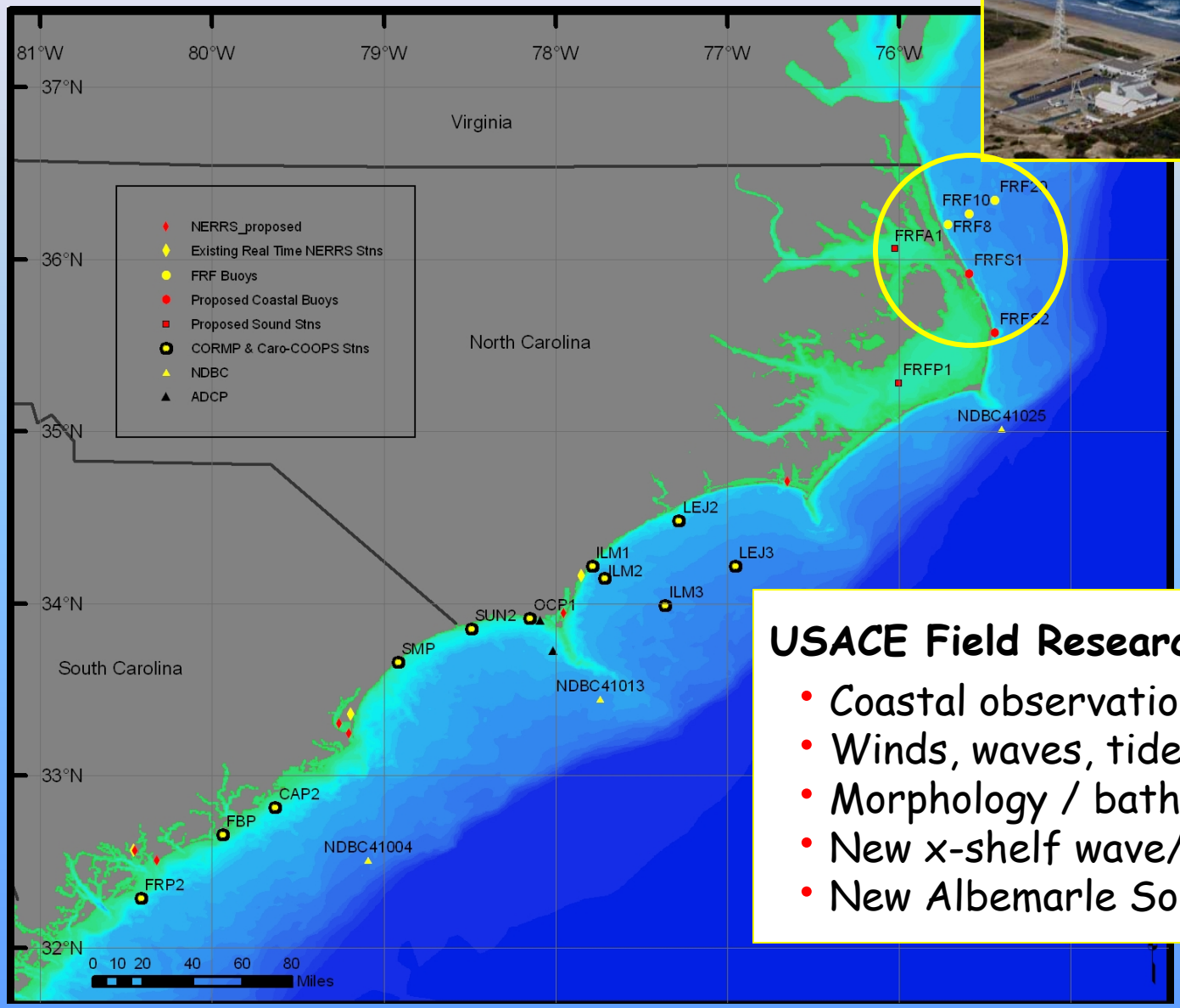
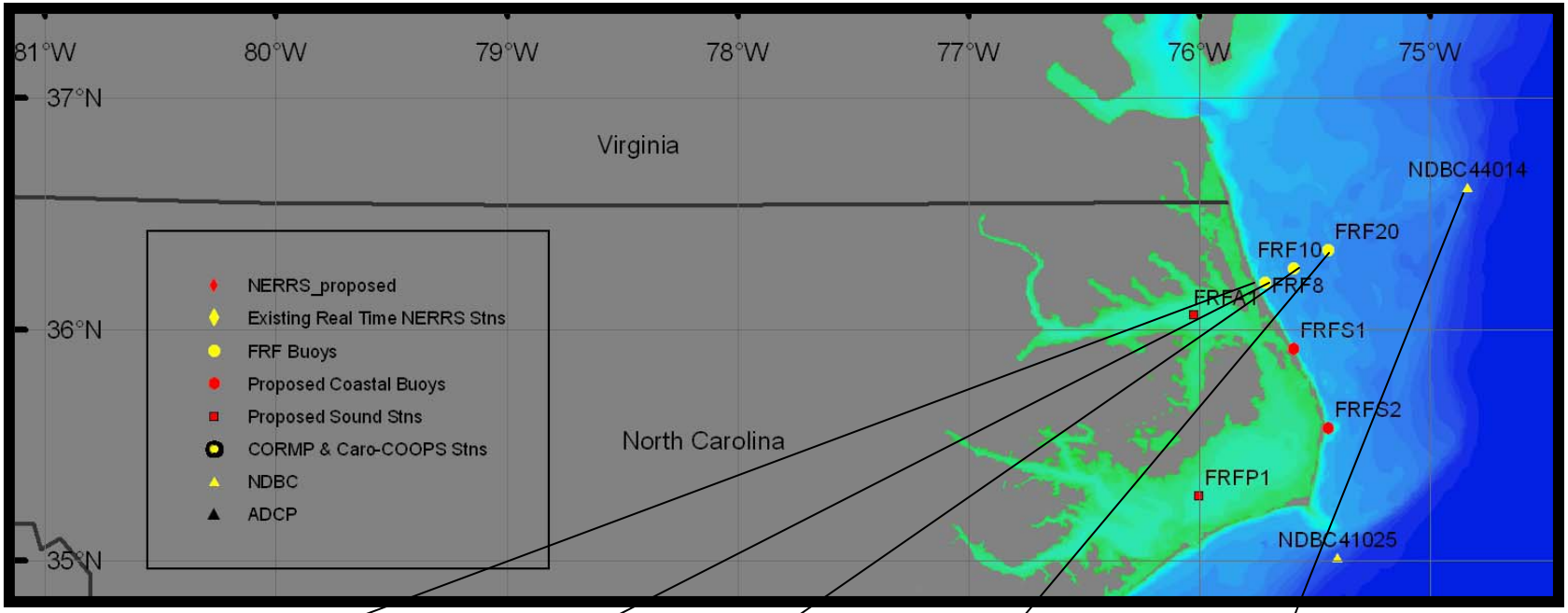
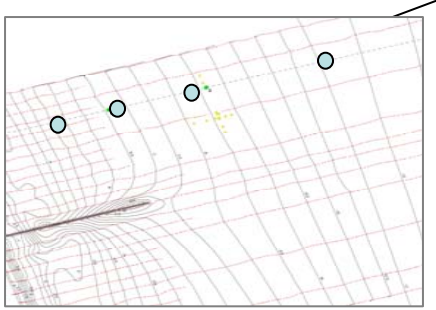


USACE Field Research Facility (FRF)

- Coastal observations since 1970's
- Winds, waves, tides and sediments
- Morphology / bathymetry surveys
- New x-shelf wave/current array
- New Albemarle Sound Station

Cross-Shelf Wave Array





8-m Array; Nearshore AWAC Array (5-11 m depth)

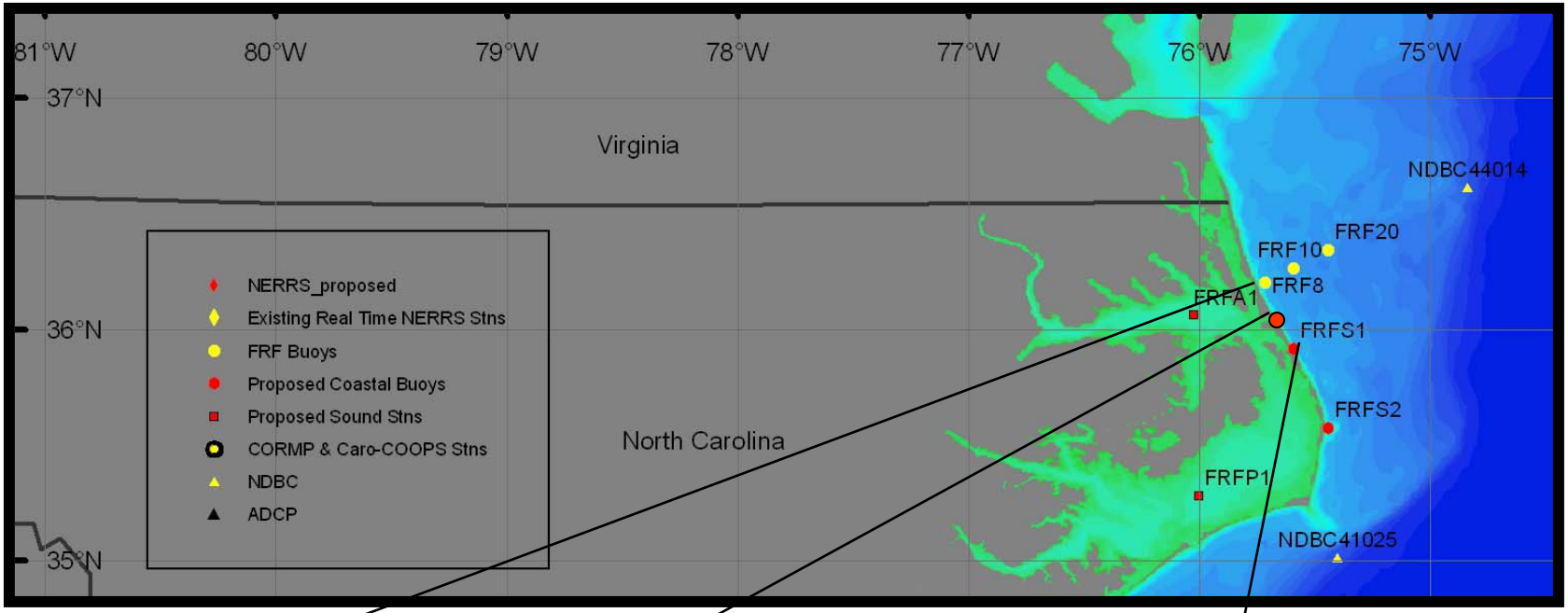
17-m Datawell Waverider

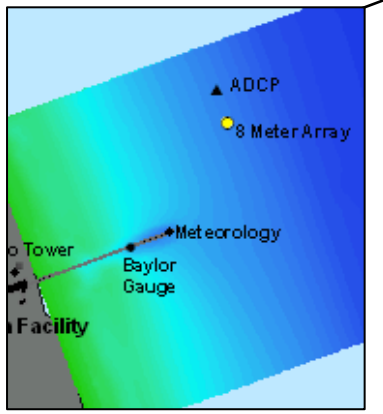
26-m Datawell Waverider

35-m Wavescan

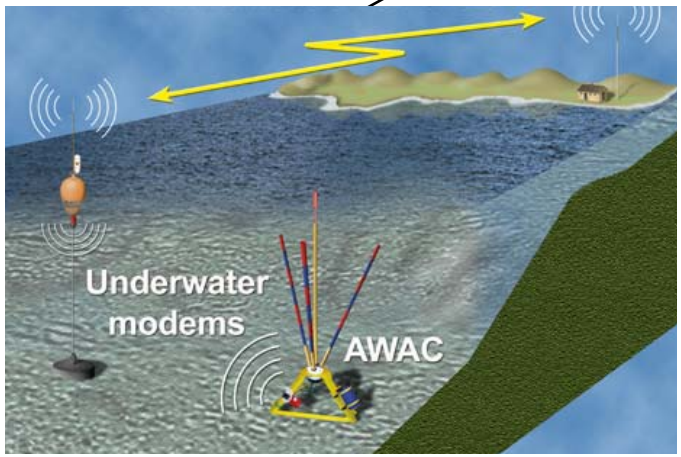
48-m NDBC 44014

Along-Shore Wave and Current Array

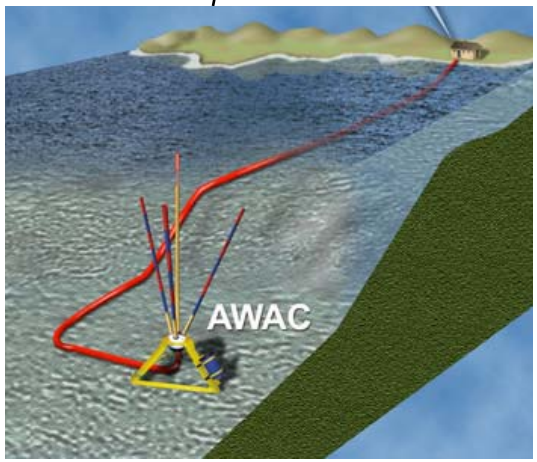




FRF 11-m AWAC

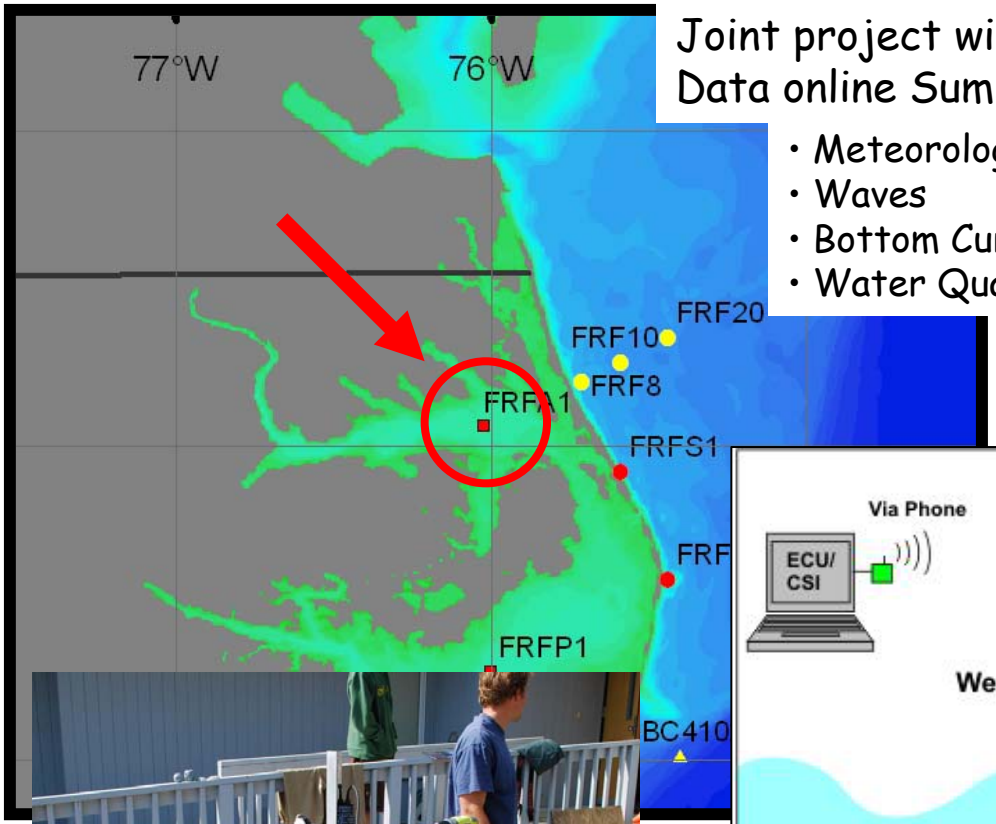


Kitty Hawk 11-m AWAC



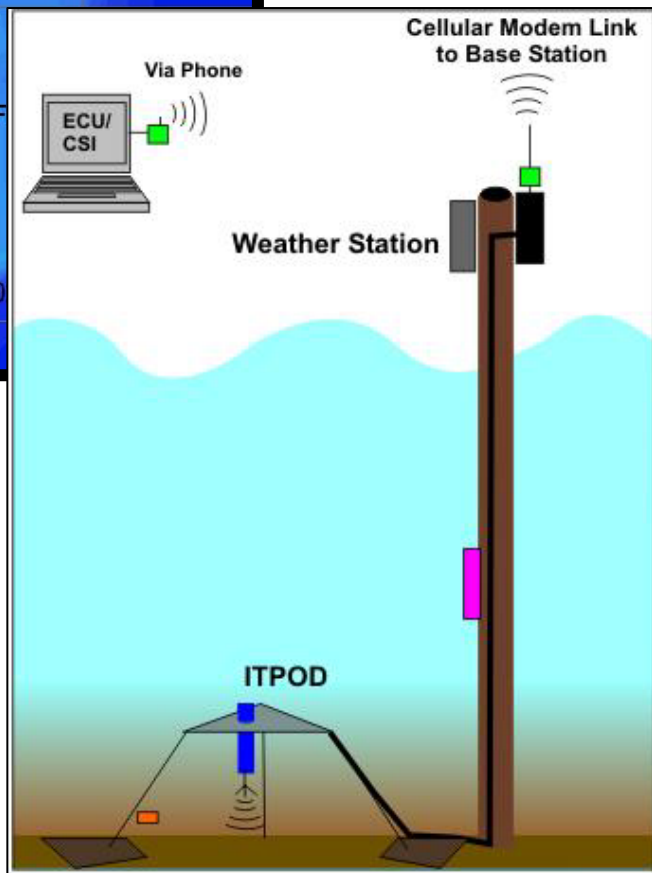
Jeanette's Pier
11-m AWAC

Albemarle Sound Observing System



Joint project with CSI/ECU/ECSU
Data online Summer 2008

- Meteorology
- Waves
- Bottom Currents
- Water Quality

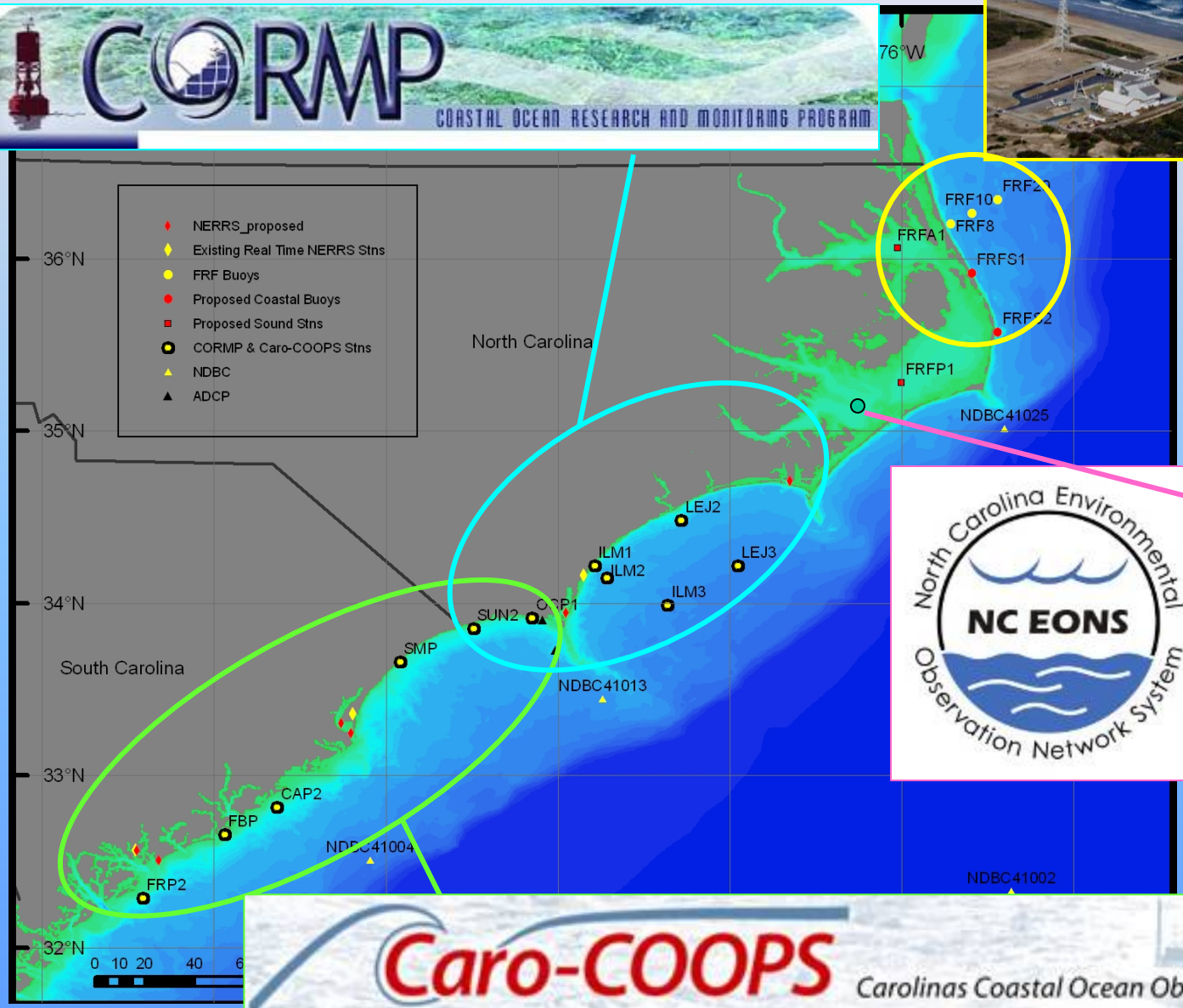


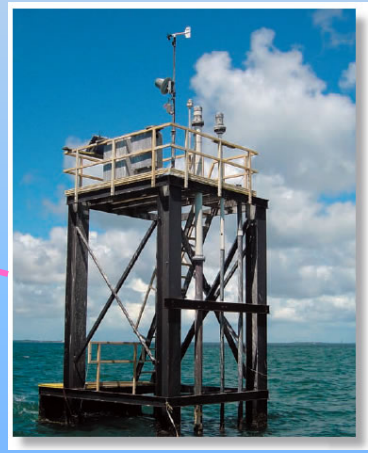
Regional Observations

US Army Engineer Research and Development Center

UNC Institute of Marine Sciences

CORMP Coastal Ocean Research and Monitoring Program





2008 Tower

North Carolina Environmental Observation Network System — NC EONS

Caro-COOPS Carolinas Coastal Ocean Observing and Prediction System

US Army Engineer Research and Development Center

Regional Observations

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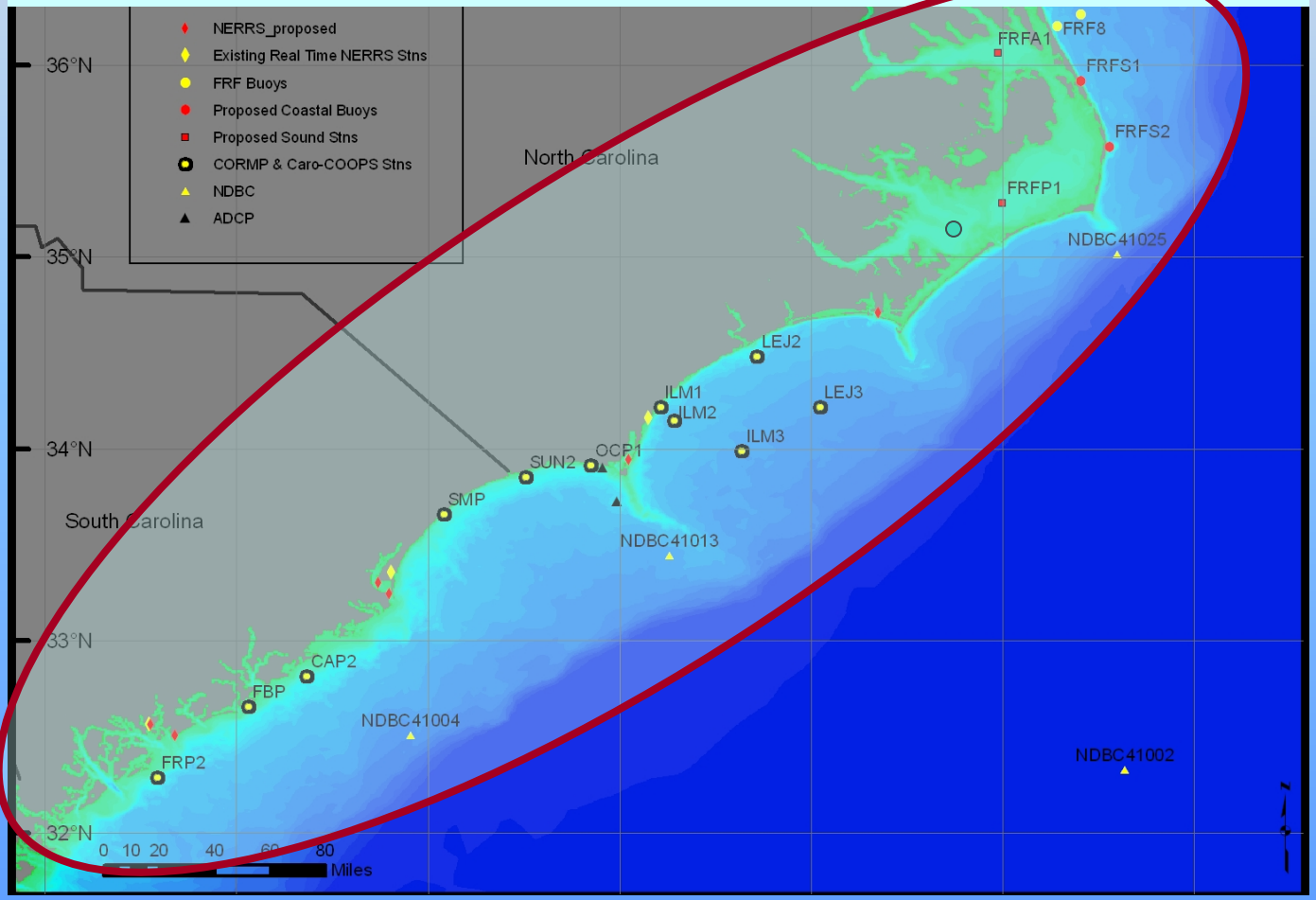
NOAA
Carolinas Regional Coastal Ocean Observing System
"Carolinas RCOOS"



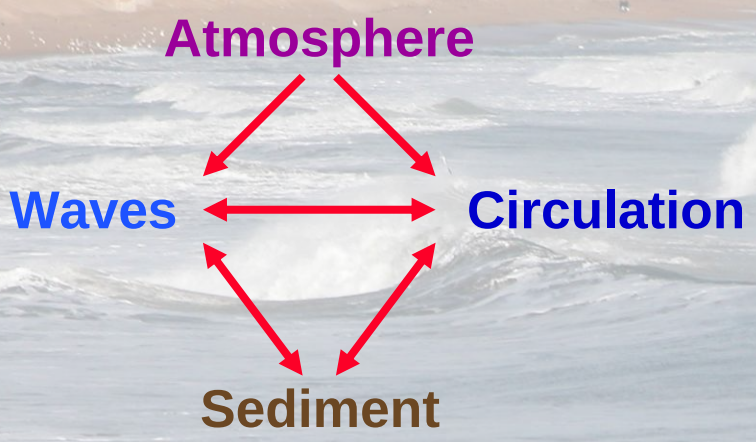
Partners

- NOAA
- USACE
- UNCW
- UNC-CH
- UNC RENCI
- CSI
- ECSU
- USC
- NWS WFOs

MORPHOS Program

System-Wide Water Resources Program SWWRP

Advancing Coastal Process Research, Modeling and Risk Assessment



MISSION:

Develop, verify and apply a physics based coastal and estuarine simulation and prediction capability with emphasis on storm-driven events

MORPHOS Program Elements

Community Steering

Research and Development

Coastal Modeling System

Atmosphere

Waves ↔ Circulation

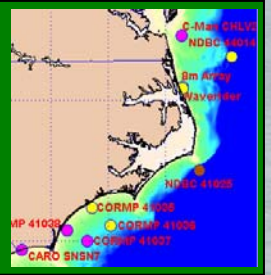
Sediment

Community Tools

- Risk Assessment
- Project Design
- Event Reconstruction

Test and Evaluation

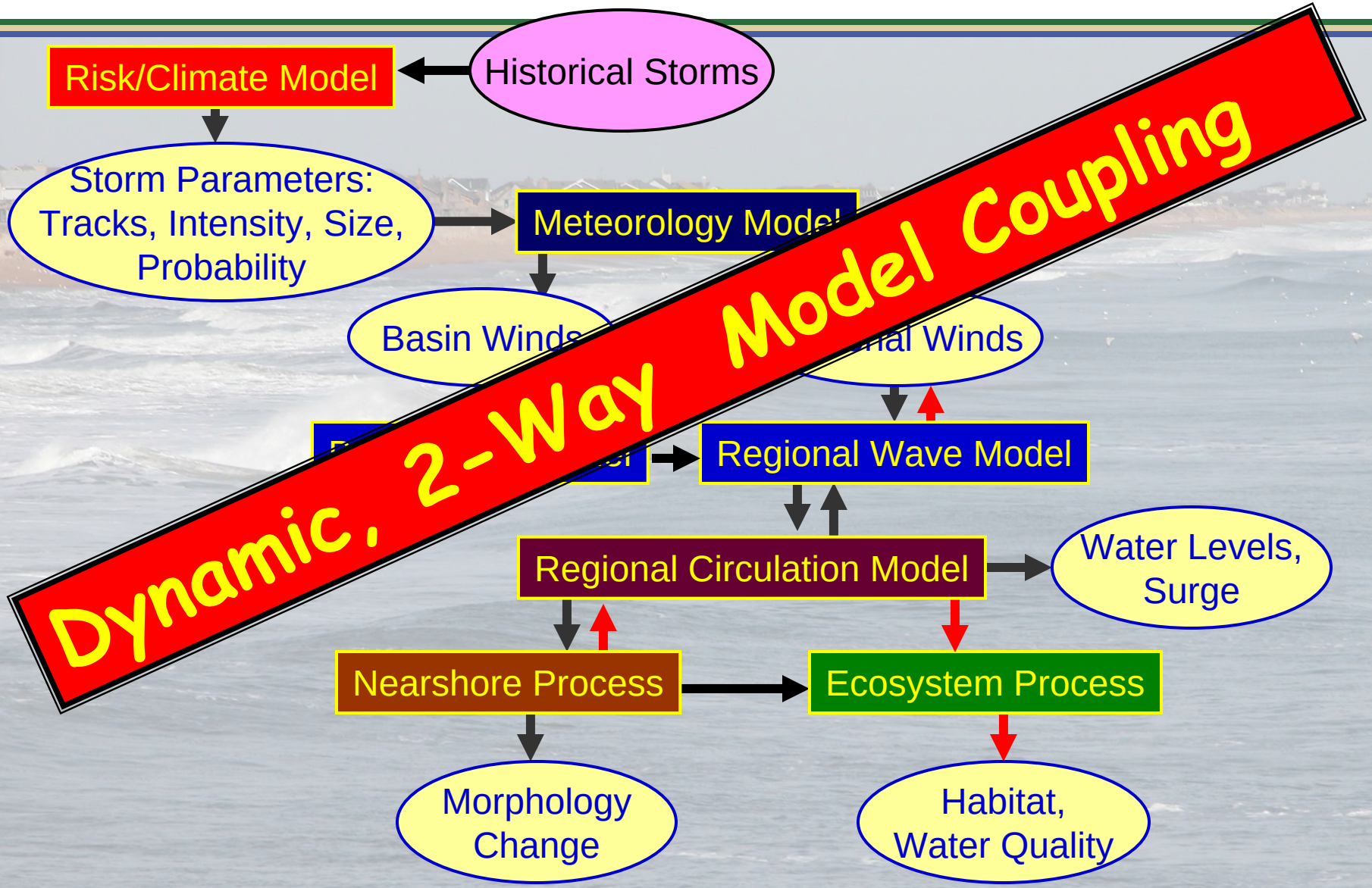
- Critical Data Sets
- Model Test Bed



Morphos Program Team

Government Agencies	US Army Corps of Engineers NOAA NCEP, National Weather Service USGS Woods Hole Science Center
Academic Institutions	University of North Carolina University of Delaware Brigham-Young University DelftTU
Private Industry	Oceanweather Inc. Baird and Associates, Inc Applied Research Associates, Inc. Non-Linear Waves, Inc. Risk Engineering, Inc. Watershed Concepts Inc Waves and Solitons, LLC Alkyon Hydraulic Consultancy & Research Woolpert, Inc.

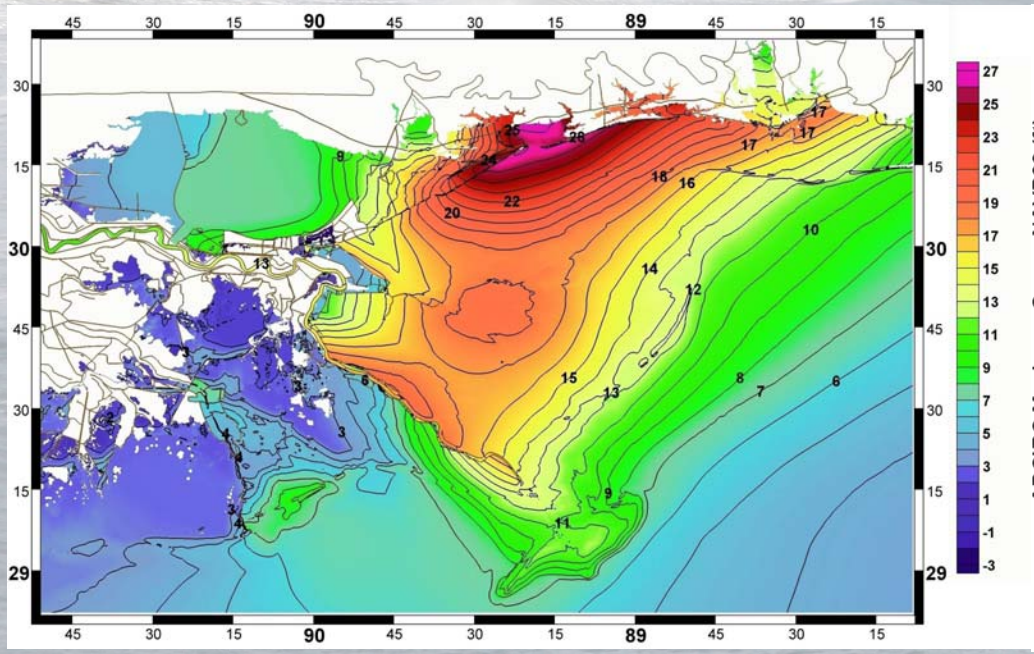
Coastal Response Modeling

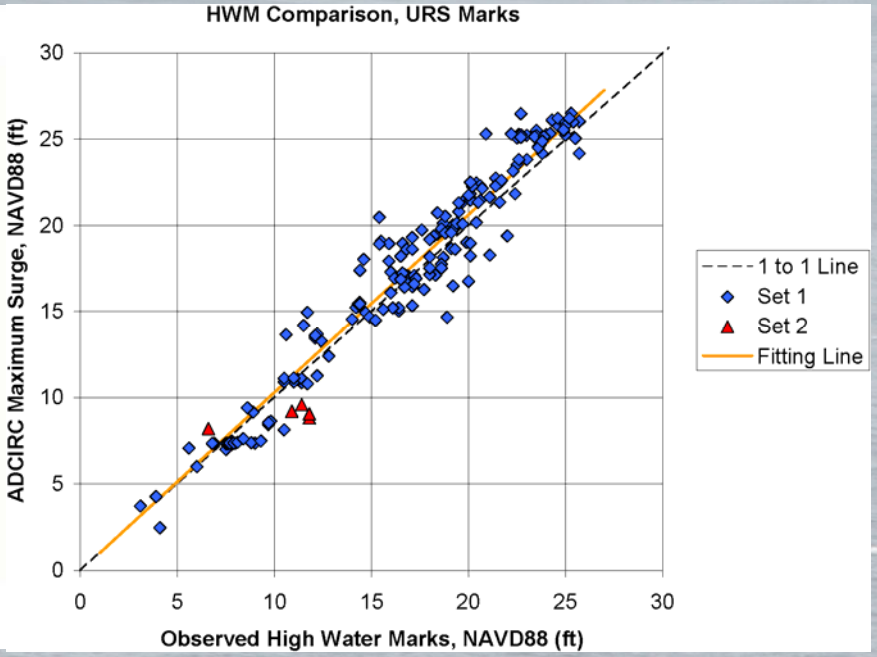


Coastal Storm Surge

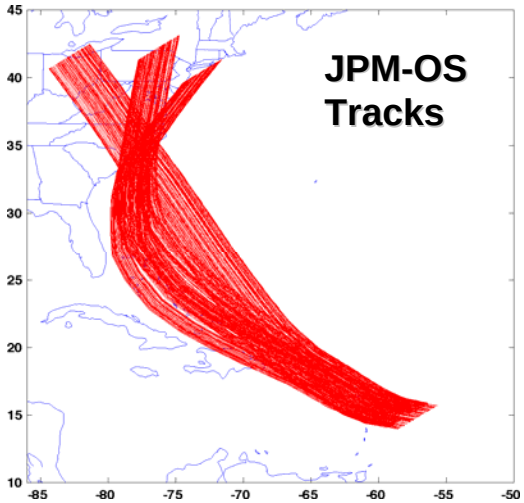
- ADCIRC 2D and 3D model developments for storm surge simulations
- Optimized parallel computational efficiency
- Robust wetting/drying of grid elements
- Generic serial/parallel dynamic wave coupler

Hurricane Katrina Peak Surge (ft)





North Carolina Floodplain Mapping Program (NC FMP)



1. Storm selection completed (JPM-OS)
2. High-resolution topo/bathy grid constructed
3. Production modeling system in place
4. System validation initiated on 4 major hurricanes

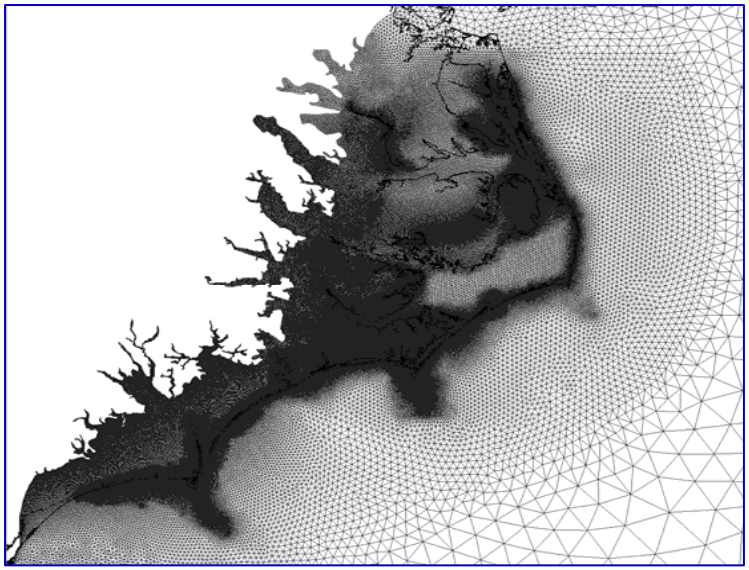
North Carolina TopoBathy

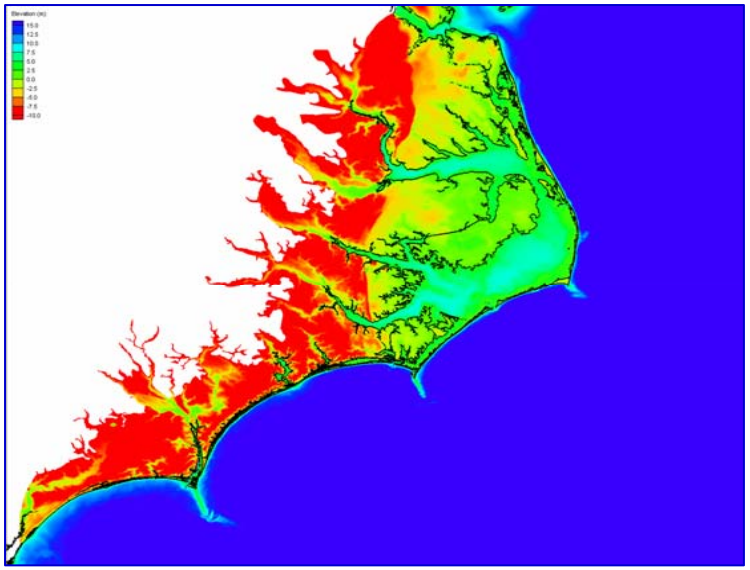
10-m Topo/Bathy Database

SeaWIFS 23 Sept 1999

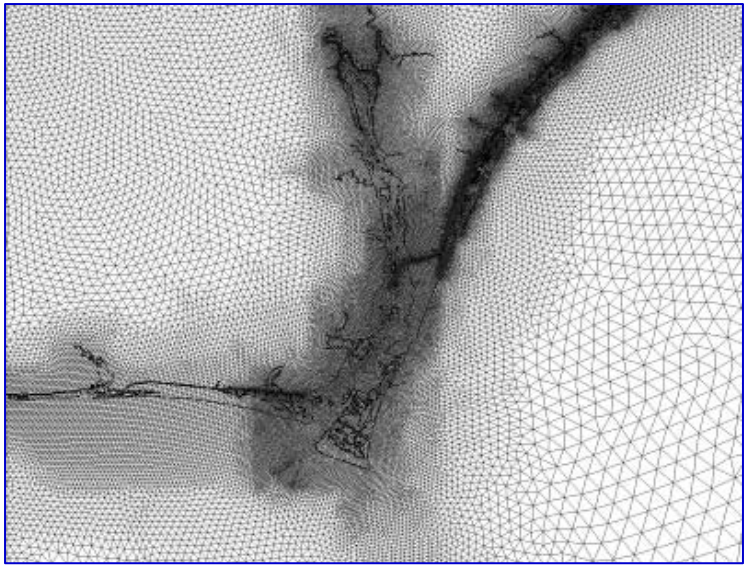
V8o_7 ADCIRC grid

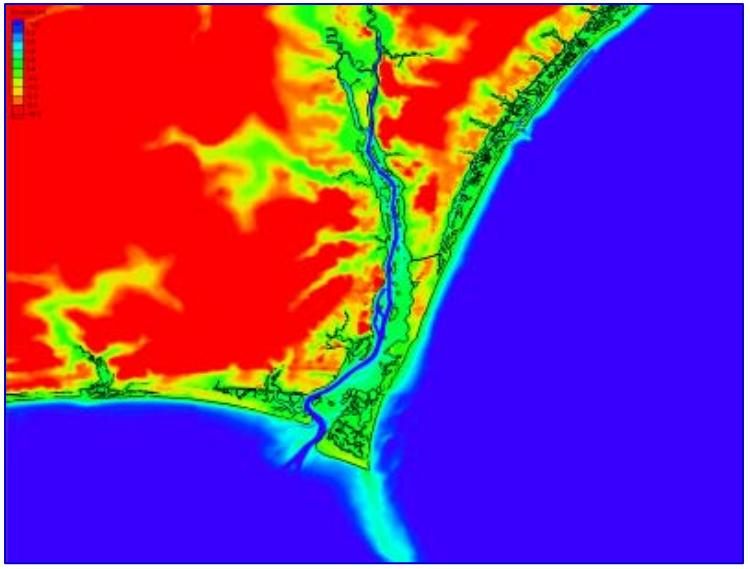
NC Region





Cape Fear



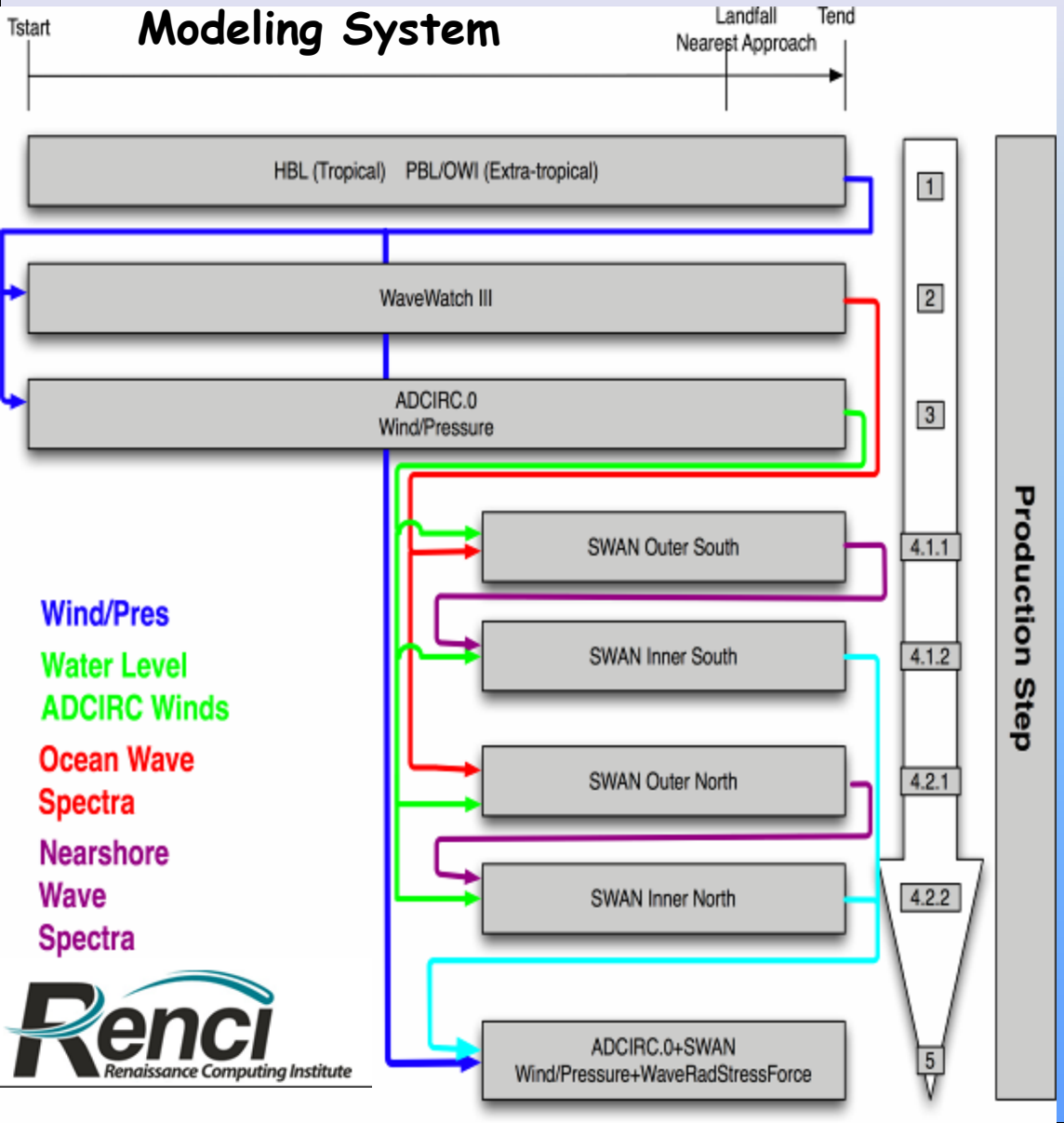


NC Floodplain Mapping Program

US Army Engineer Research and Development Center

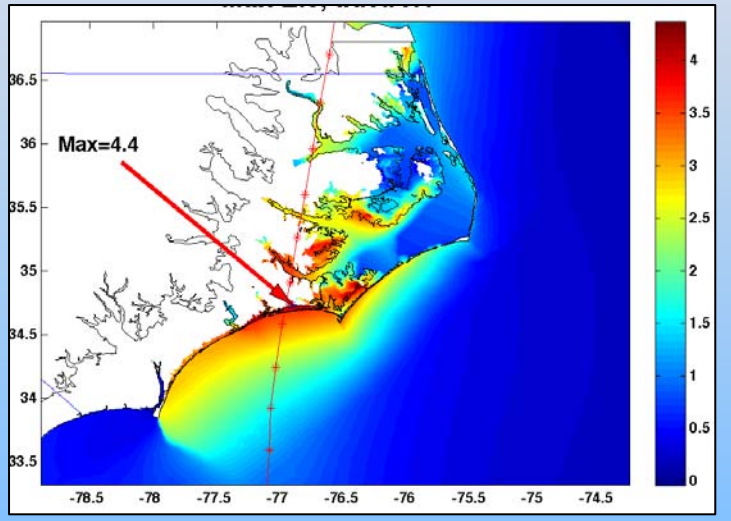
UNC Institute of Marine Sciences

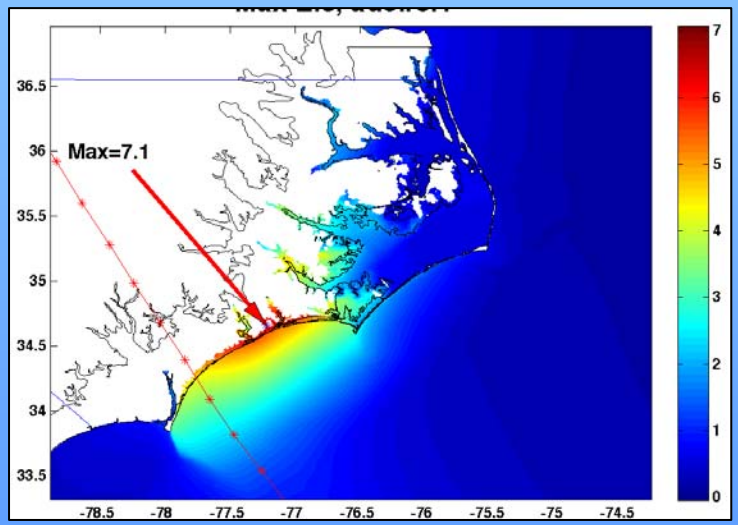
Modeling System



Renci Renaissance Computing Institute

Storm Surge Simulated Hurricanes



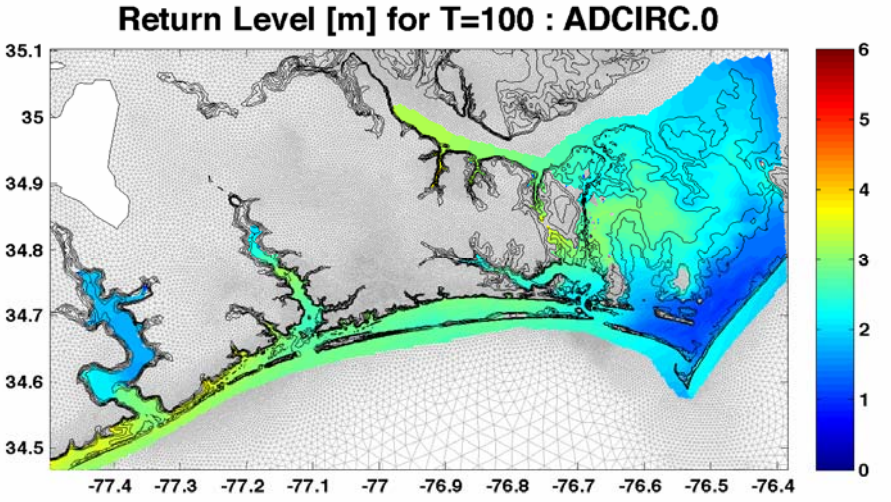


100,500 Year Return Levels

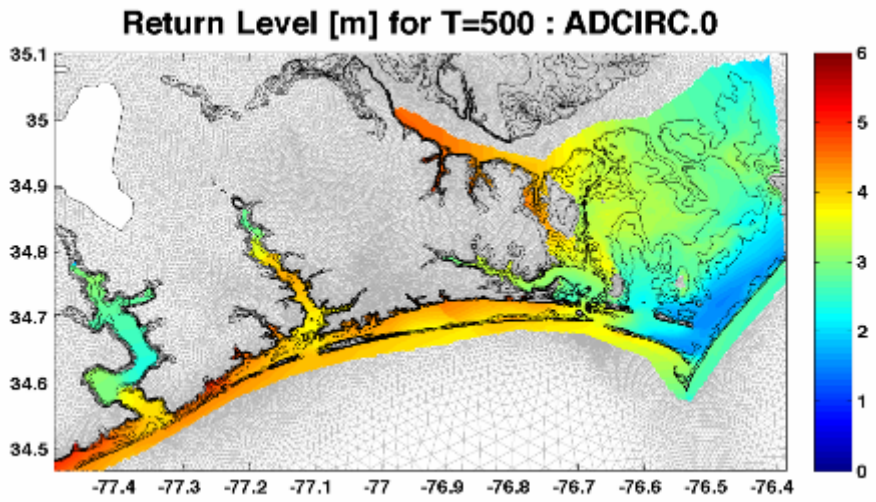
Return Level == Water Level at a point that is expected to occur at a frequency <= a specific recurrence rate (Return Period)

At each model node:
Assemble Cumulative Distribution Function (CDF) from Surge and Weights

Return Period = 100 years
1% Annual Occurrence Rate

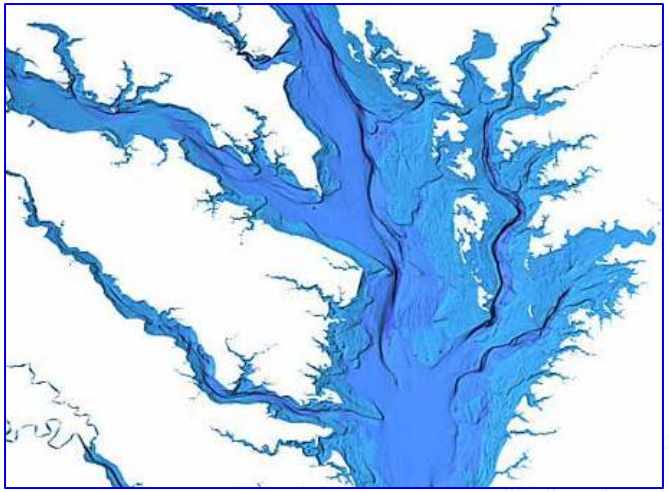


Return Period = 500 years
0.2% Annual Occurrence Rate



FEMA Region III
Tasks for 2008-2009

1. Storm Specification
2. Grid Development
3. Implement Modeling System
4. Validation/Sensitivity Study
5. Optional Grid enhancements



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and Development Center

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NOAA COMET Project: Nearshore Wave Modeling for NWS

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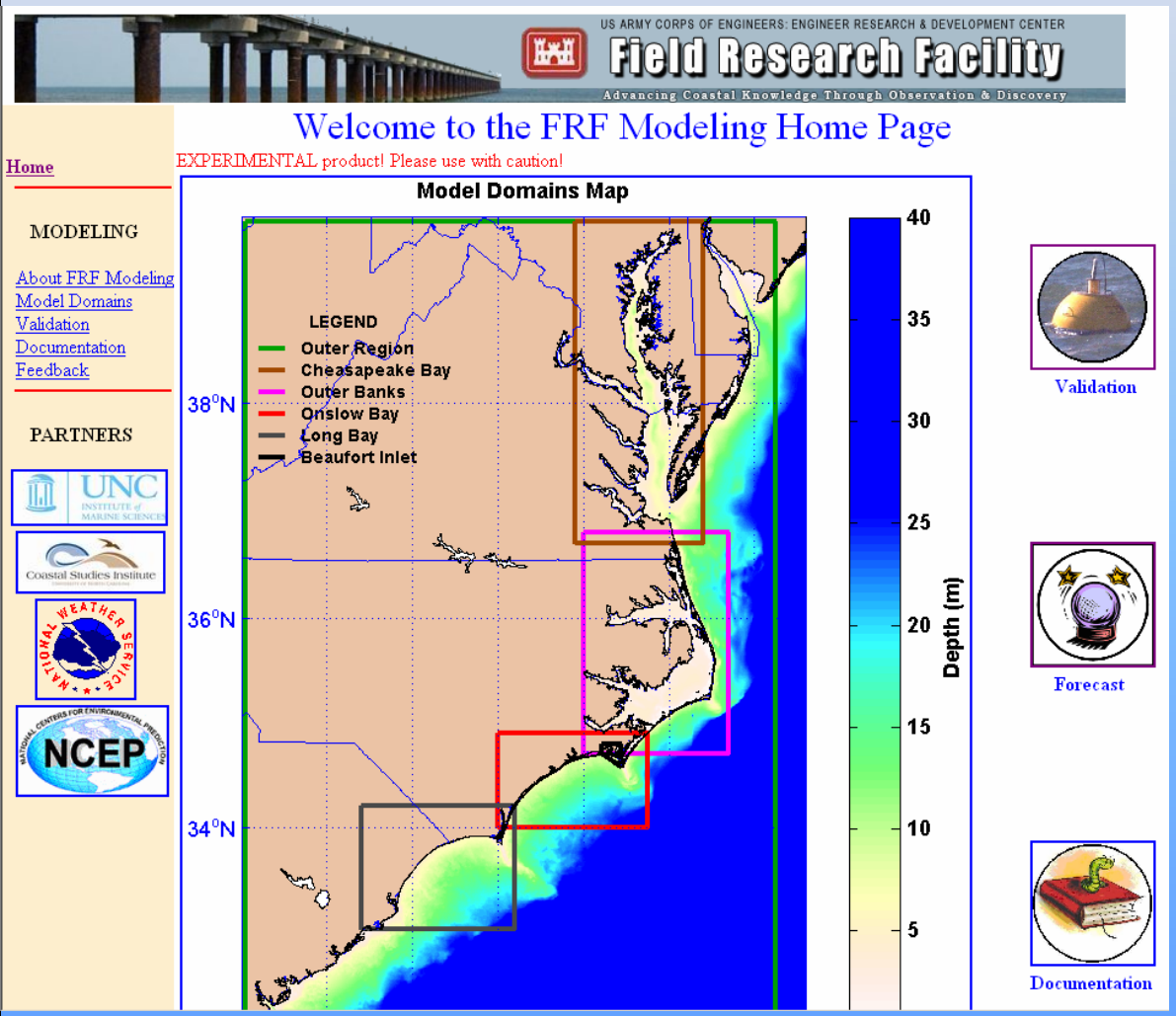
http://www.frf.usace.army.mil/



Continuous Operation since January 2007

Project Objectives

- Assess SWAN model performance in this region
- Optimize model configurations
- Transition technology to NWS for operational use

US Army Engineer Research and Development Center

FRF Wind and Wave Forecast: Thursday May 1 1300 EST

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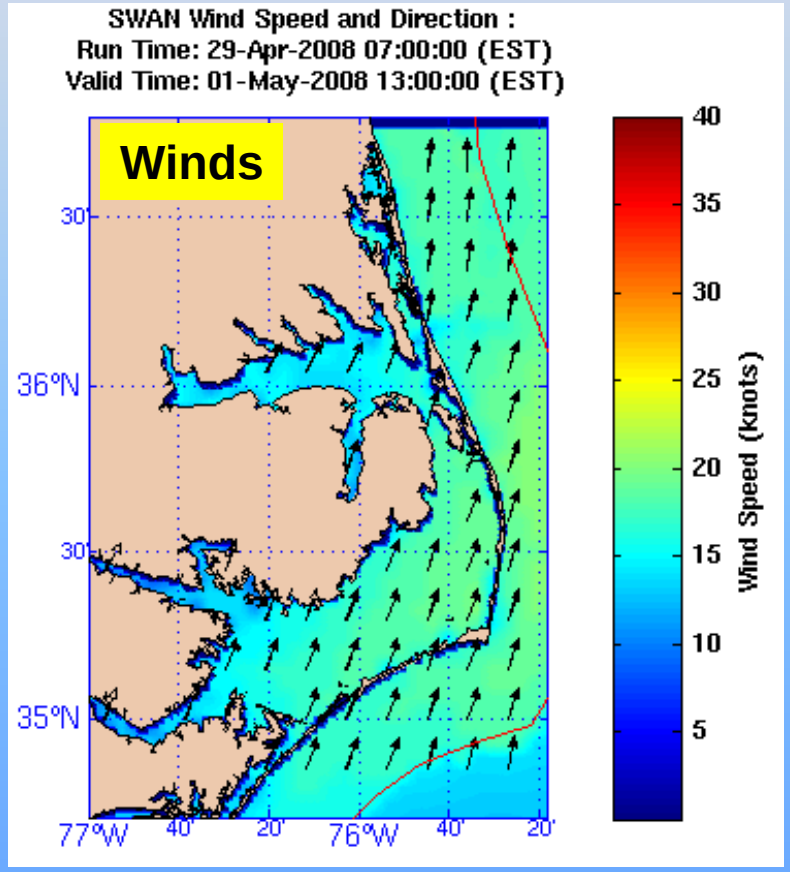

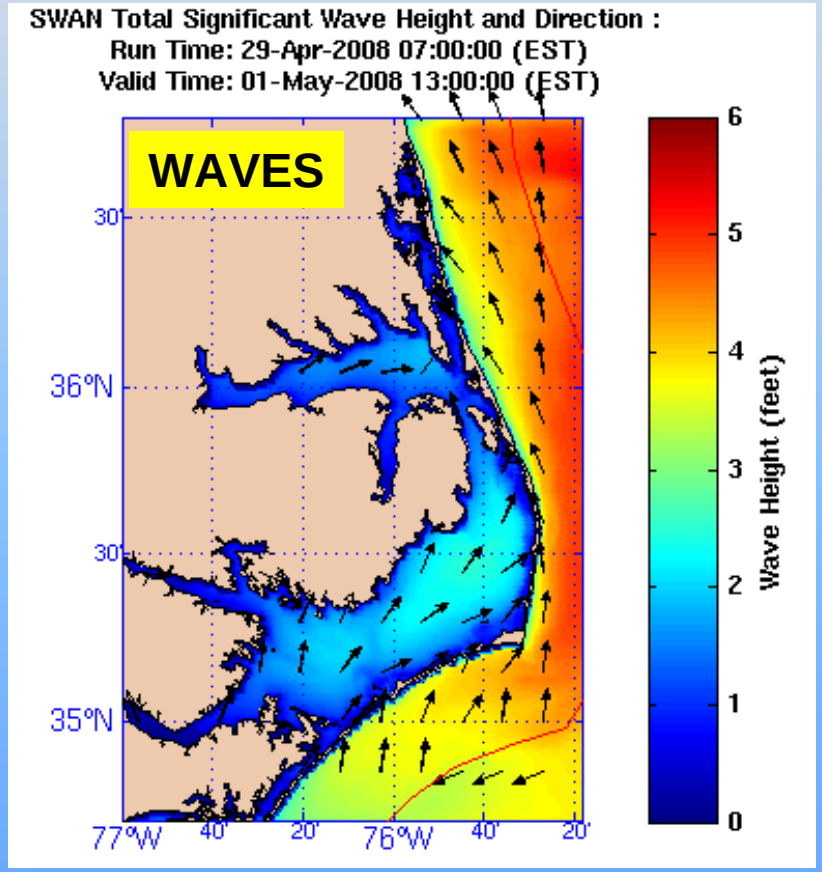

US Army Engineer Research and Development Center

FRF Wind and Wave Forecast: Thursday May 1 1300 EST

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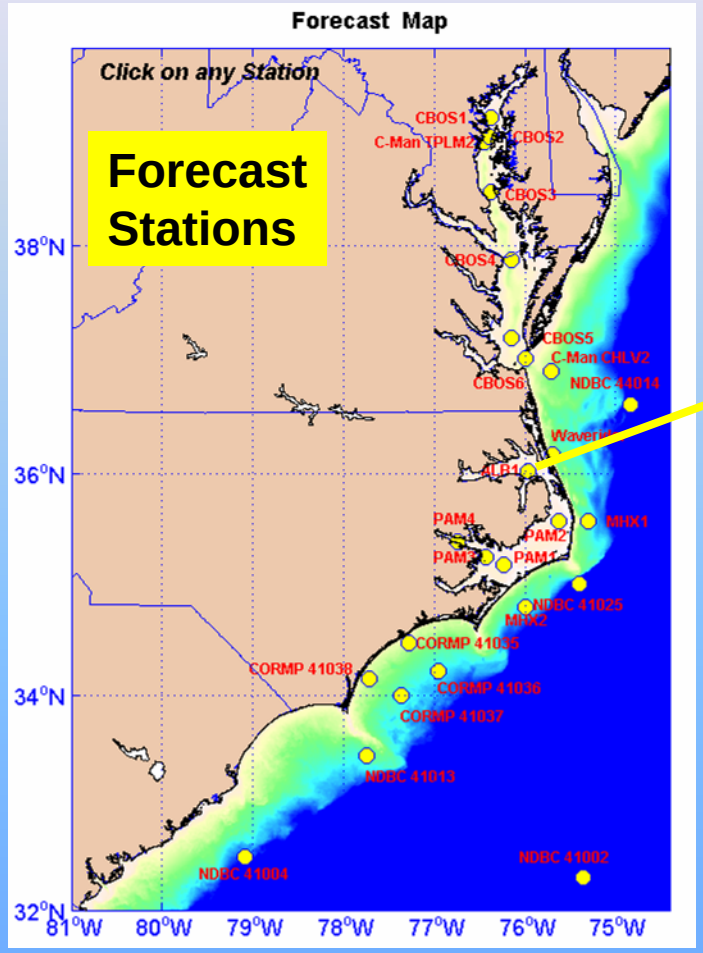

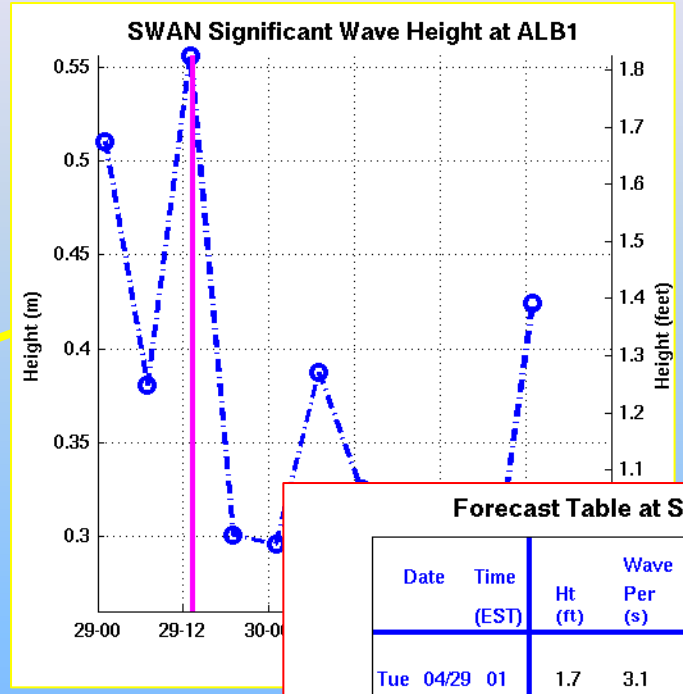

Forecast Table at Station ALB1

Date	Time (EST)	Wave Ht (ft)	Wave Per (s)	Wave Dir (° From)	Wind Speed (knt)	Wind Dir (° From)
Tue 04/29	01	1.7	3.1	308	15.8	340.6
Tue 04/29	07	1.2	2.7	353	12.9	300
Tue 04/29	13	1.8	3.1	308	16.9	330
Tue 04/29	19	1	2.4	308	9.9	310
Wed 04/30	01	1	2.4	308	10.1	340
Wed 04/30	07	1.3	2.7	8	13.9	280.6
Wed 04/30	13	1.1	2.4	38	10.9	23.5
Wed 04/30	19	0.9	2.4	113	9.9	90.9
Thu 05/01	01	0.9	2.1	128	11	160
Thu 05/01	07	0.9	2.1	203	10.2	200
Thu 05/01	13	1.4	2.4	203	14.9	210

2.5-day Forecast at Albemarle Sound Station

US Army Engineer Research and Development Center

FRF Wave Model Validation: Thursday May 1 1300 EST

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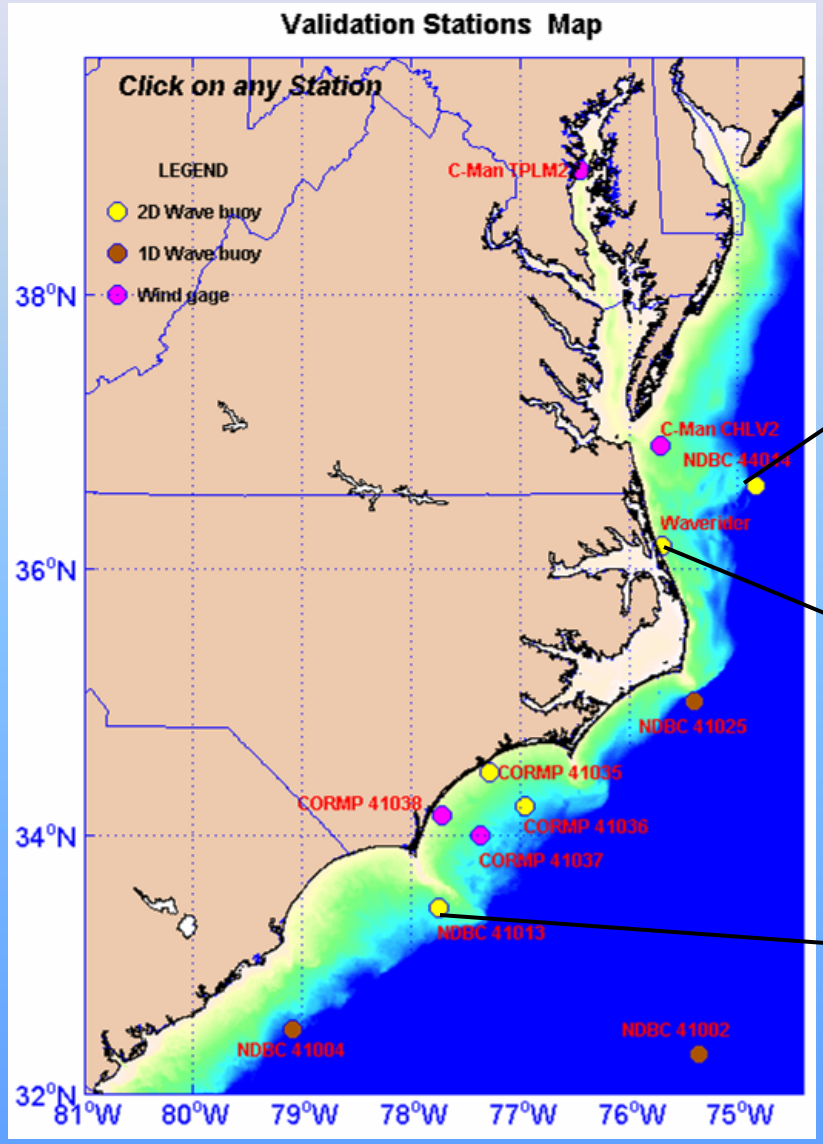

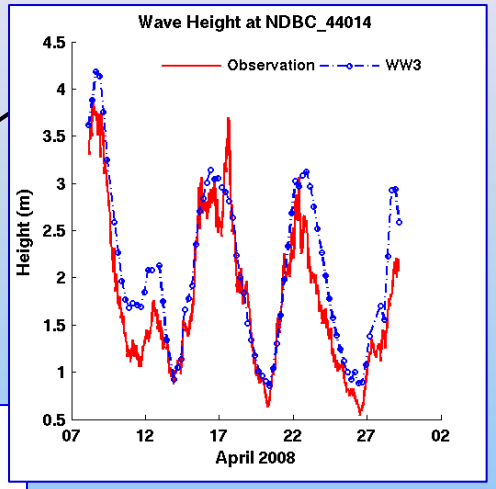

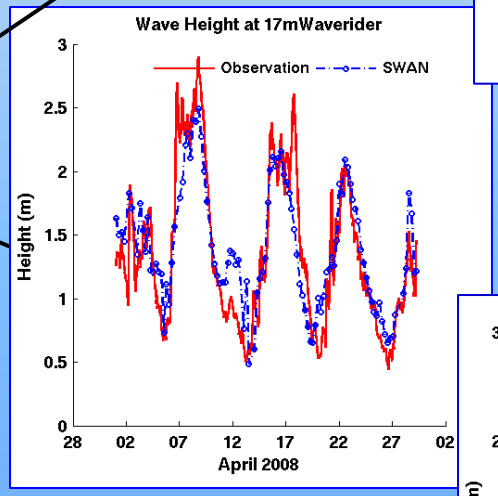

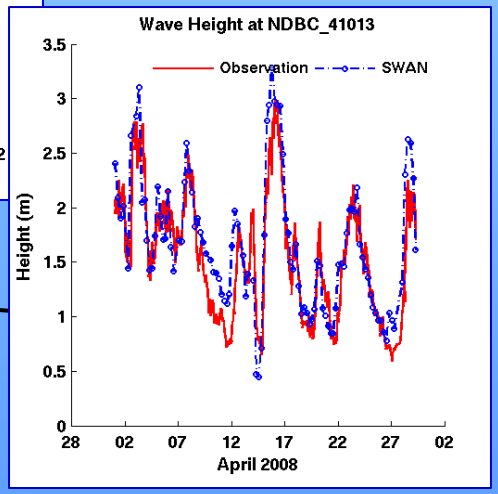

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AN INSTRUMENTED MODEL TEST BED FOR THE CAROLINAS COAST

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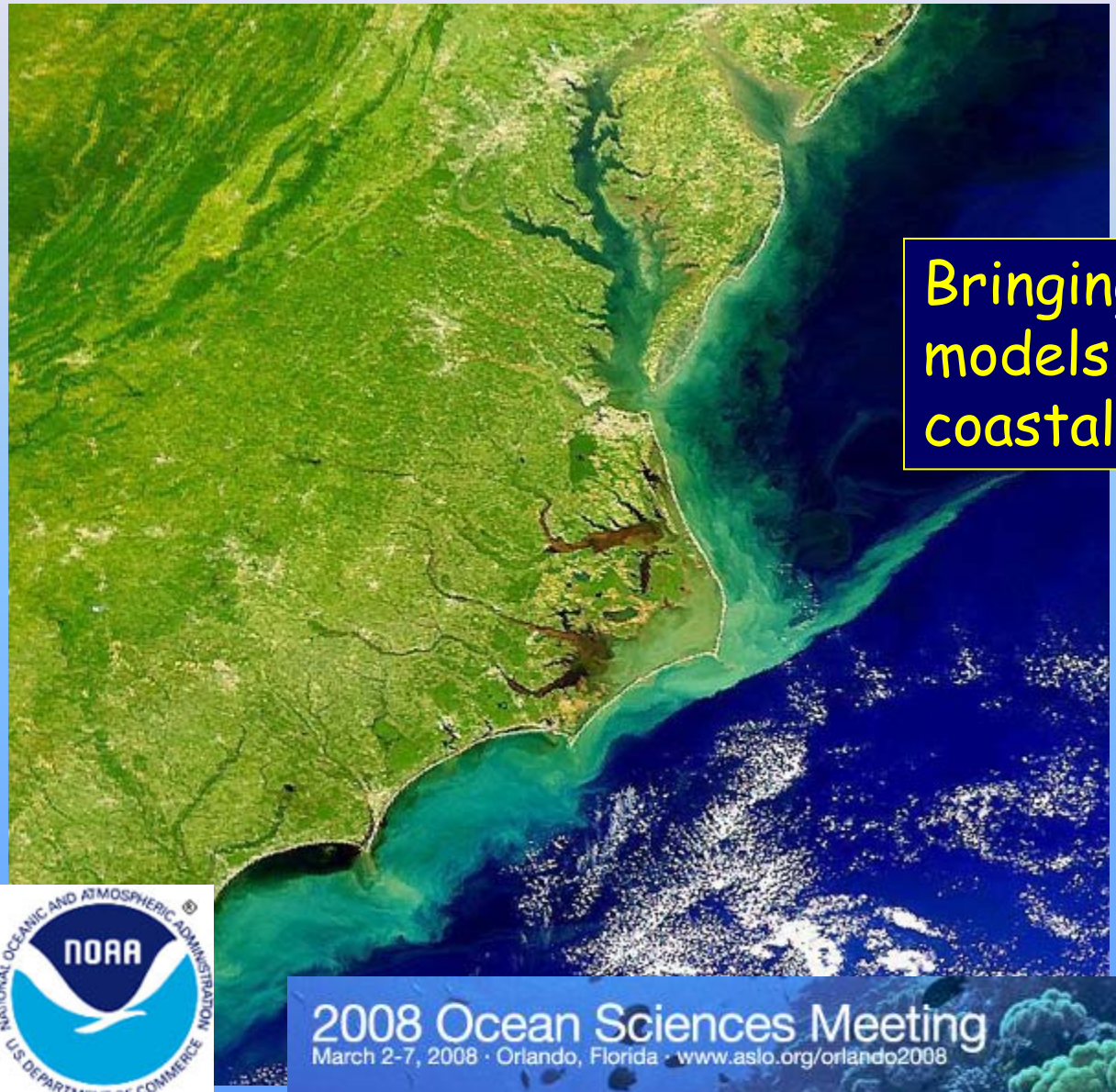


Bringing observations and models together in a natural coastal laboratory…

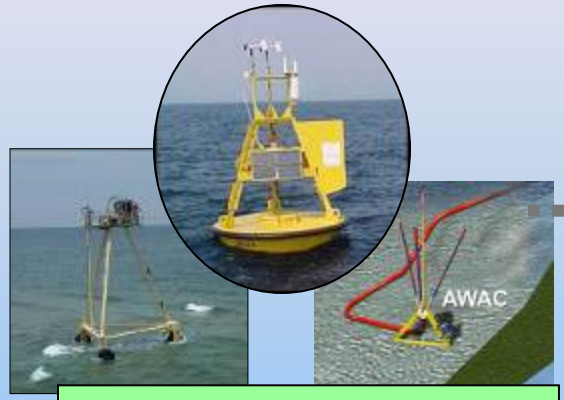
NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION · U.S. DEPARTMENT OF COMMERCE

2008 Ocean Sciences Meeting
March 2-7, 2008 · Orlando, Florida · www.aslo.org/orlando2008

Coastal Studies Institute
UNIVERSITY OF NORTH CAROLINA

US Army Engineer Research and Development Center

IOOS Model Test Bed



High-Quality Measurements

Analysis

Coastal Models

Atmosphere

Waves

Circulation

Morphology

RCOOS Data Bank

Model Evaluation and Diagnostics System (MEDS)

Analysis

Performance Evaluation Model Diagnostics


Nags Head, NC
Tropical Storm Noel
November 3, 2007
Pro Surfer Jesse Hines