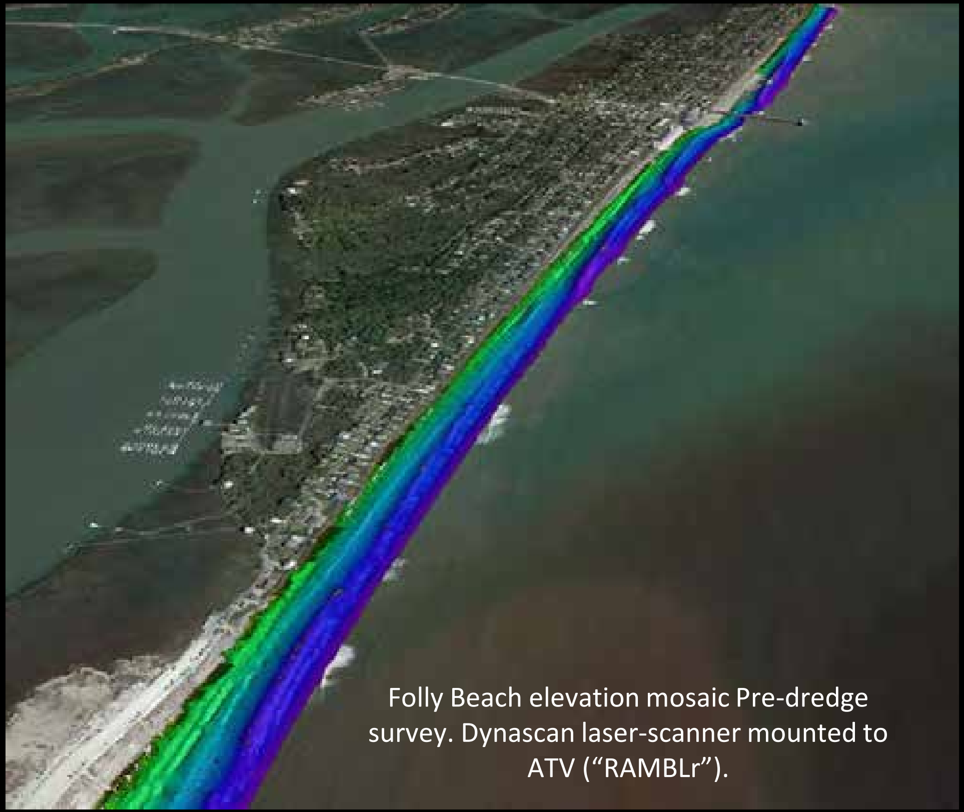
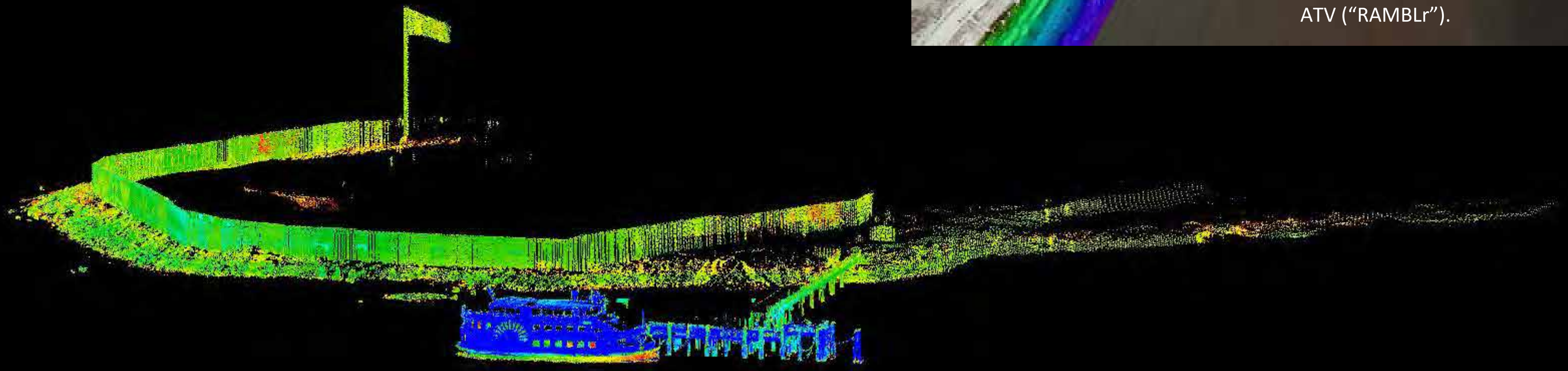
Survey Data- topographic

Mobile Lidar

- Systems on both boat and ATV
- Regularly used for beach renourishment surveys
- No RGB- intensity and elevation only
- Data is usually processed in cross sections.



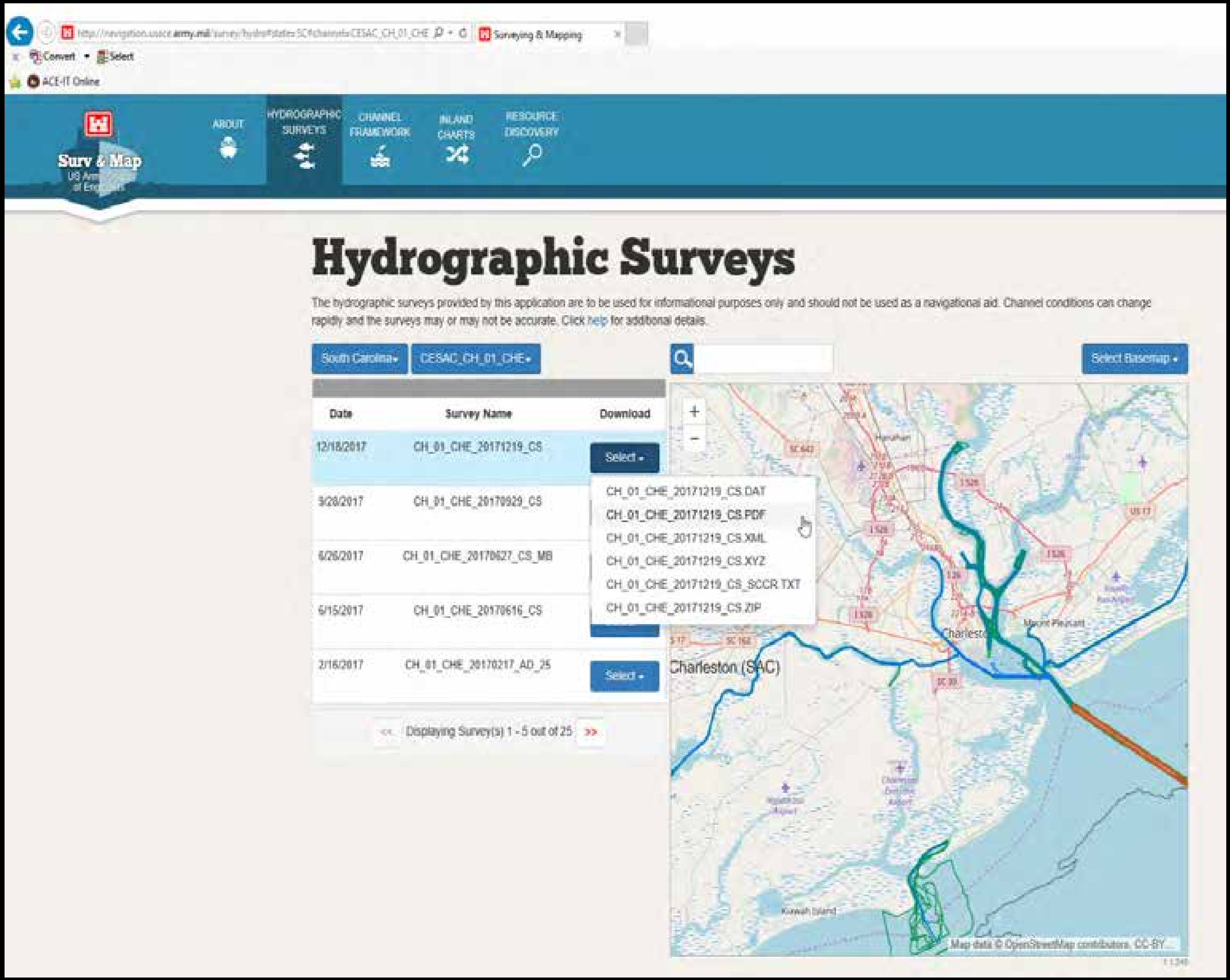
Folly Beach elevation mosaic Pre-dredge survey. Dynascan laser-scanner mounted to ATV (“RAMBLr”).



Intensity of Fort Sumter Charleston, SC. Dynascan laser-scanner mounted to S/V Heiselman.

Data Availability

- Ehydro- sounding data from all USACE
- Raw data available to public via FOIA request
- Data used for government purposes usually provided without FOIA



Charleston District - Building Strong!

Questions?

www.sac.usace.army.mil

Habitat Maps through Predictive Modeling

NCCOS
Laura Kracker
Bryan Costa
Tim Battista
Will Sautter
Ayman Mabrouk
Rachel Husted
Kim Edwards
Chris Taylor
Erik Ebert

National Centers for Coastal Ocean Science
NCCOS….we're all in the same boat

Partners
NOAA - NCCOS, OMAO, OCS, NMFS, CRCP

USGS, CFMC, USVI, DPNR, PR-DNER, UVI, UPR, UNCW

Improving seafloor mapping capabilities in the Southeast US coast and outer continental shelf
April 18-19, 2018
Charleston, SC

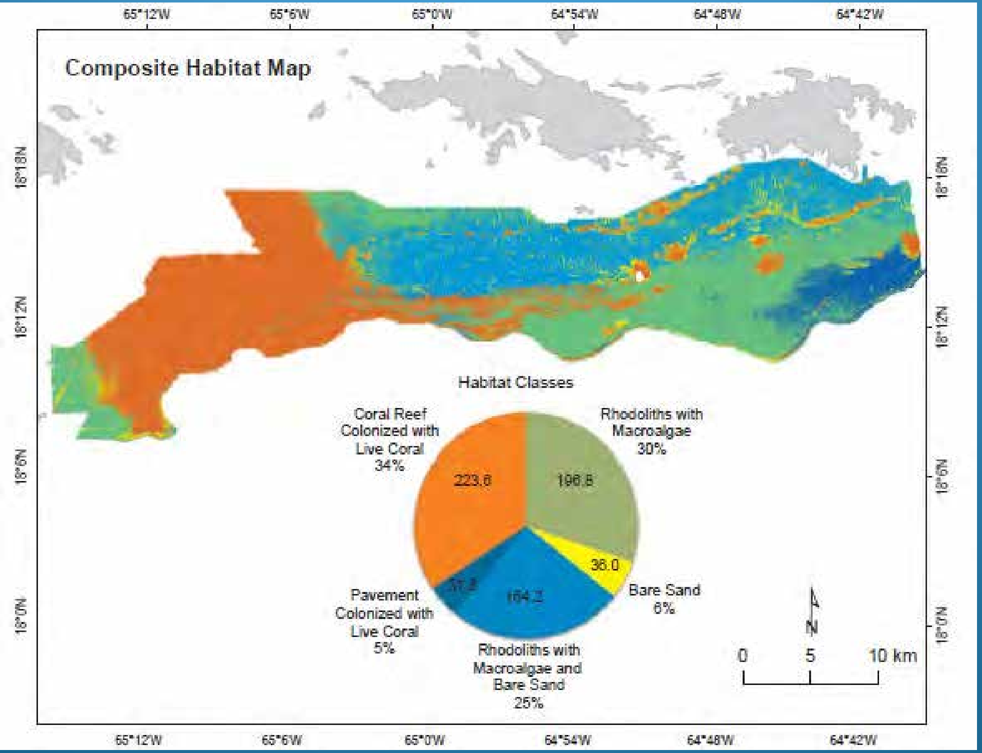
What is a "Habitat Map"?

OBJECTIVES:

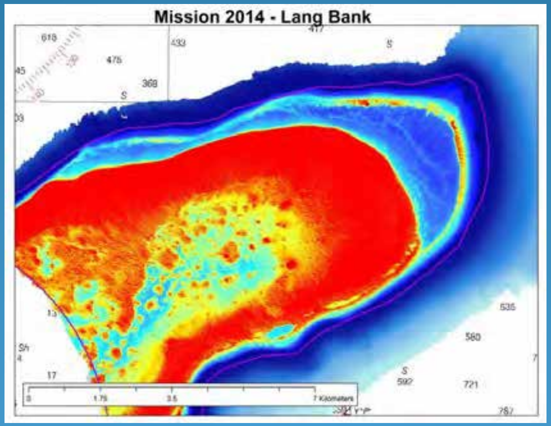
Establish common technical language

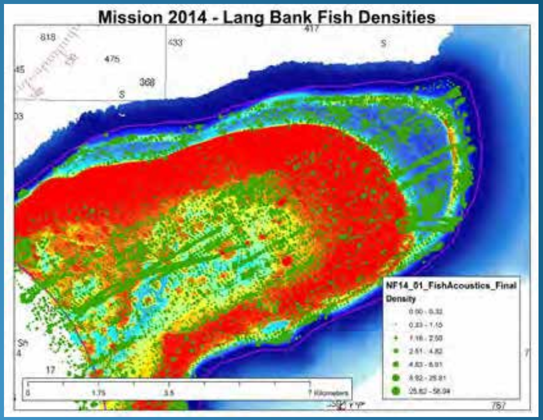
What do you want to see in a habitat map?

Minimum criteria / standards for baseline data to create a habitat map



“Habitat” Mapping





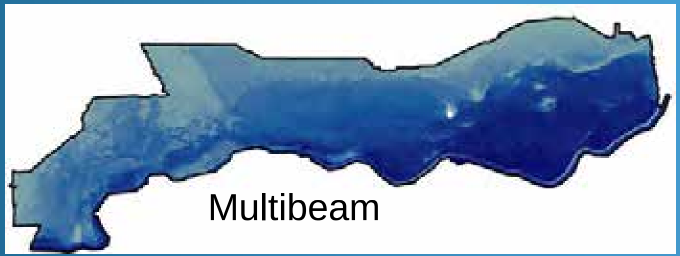
<u>Focus</u>

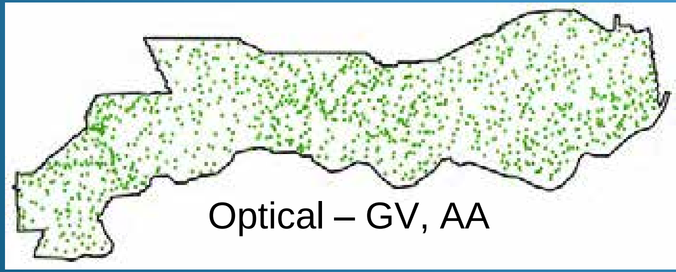
Coral reefs
Bathymetric features
Fisheries, spawning aggregations
Offshore energy
Sand resources
Archeological significance

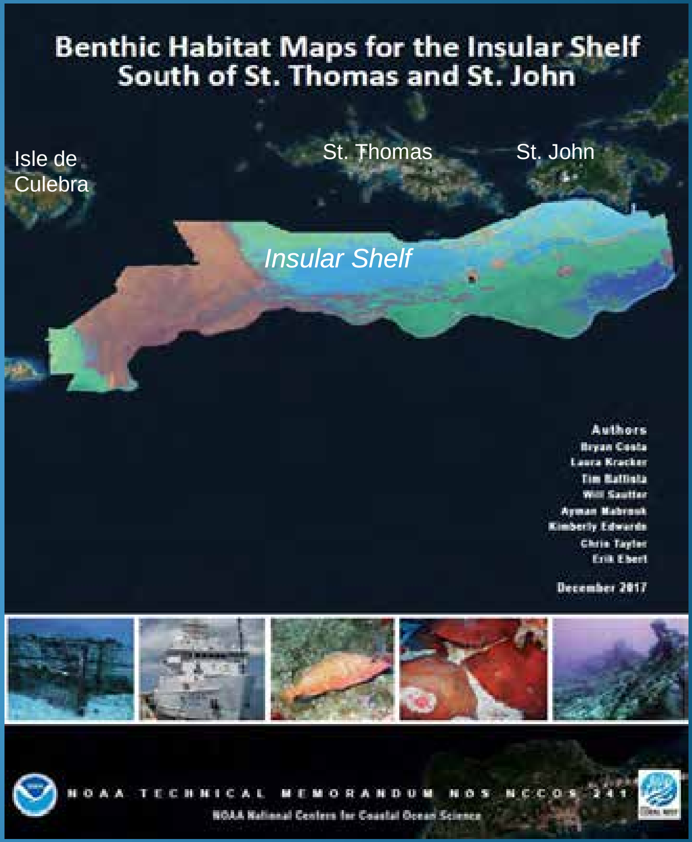
Predictive Modeling

Today's Objective: Describe a predictive modeling approach for habitat mapping*

Project Objective: Develop a habitat map* (for USVI Insular Shelf south of St. Thomas and St. John) based on *multibeam* and *optical data,* as well as *machine learning* techniques







** What is habitat mapping?*

Habitat Maps through Predictive Modeling

Pixel-based, machine learning vs. classification, delineation of polygons

Approach	Technique	Resolution (Grain Size)	Flexibility
Pixel-based predictive modeling (BRTs)	Machine learning assigns a probability of occurrence to each pixel	Based on the 'best attainable' resolution of the original data and the error associated with position of GV (ROV, camera) data. (ie. 11x11m)	Pixel resolution up to any merged or threshold-ed scale
Delineation of features (polygons)	Classify the sonar response into like pixels (PCA), segment, and label polygons	Minimum mapping unit (ie. 100 - 1000+ m^2)	Static. Can only scale up / simplify

Habitat Maps through Predictive Modeling

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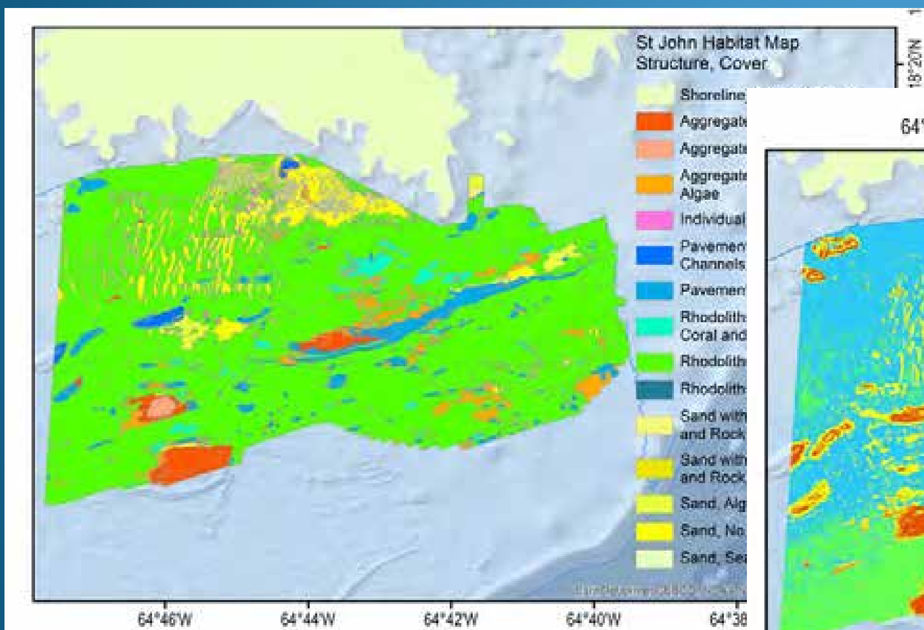
Habitat Maps through Predictive Modeling

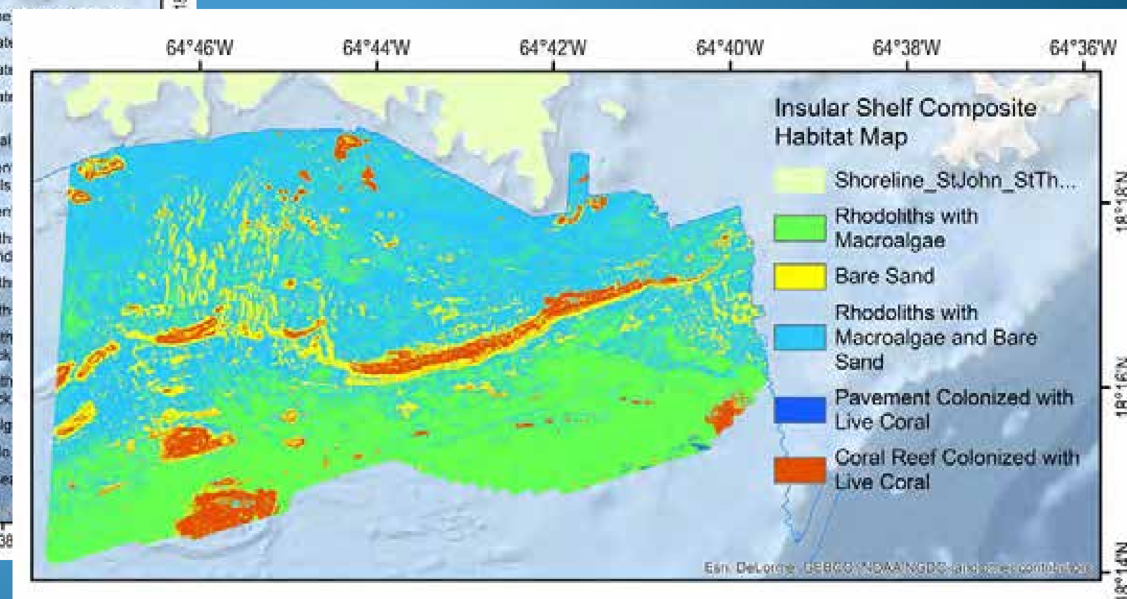
Moderate depth benthic habitats of St. John



Delineation of polygons

Costa et al. 2009

East end of the Insular shelf study area south of St. John



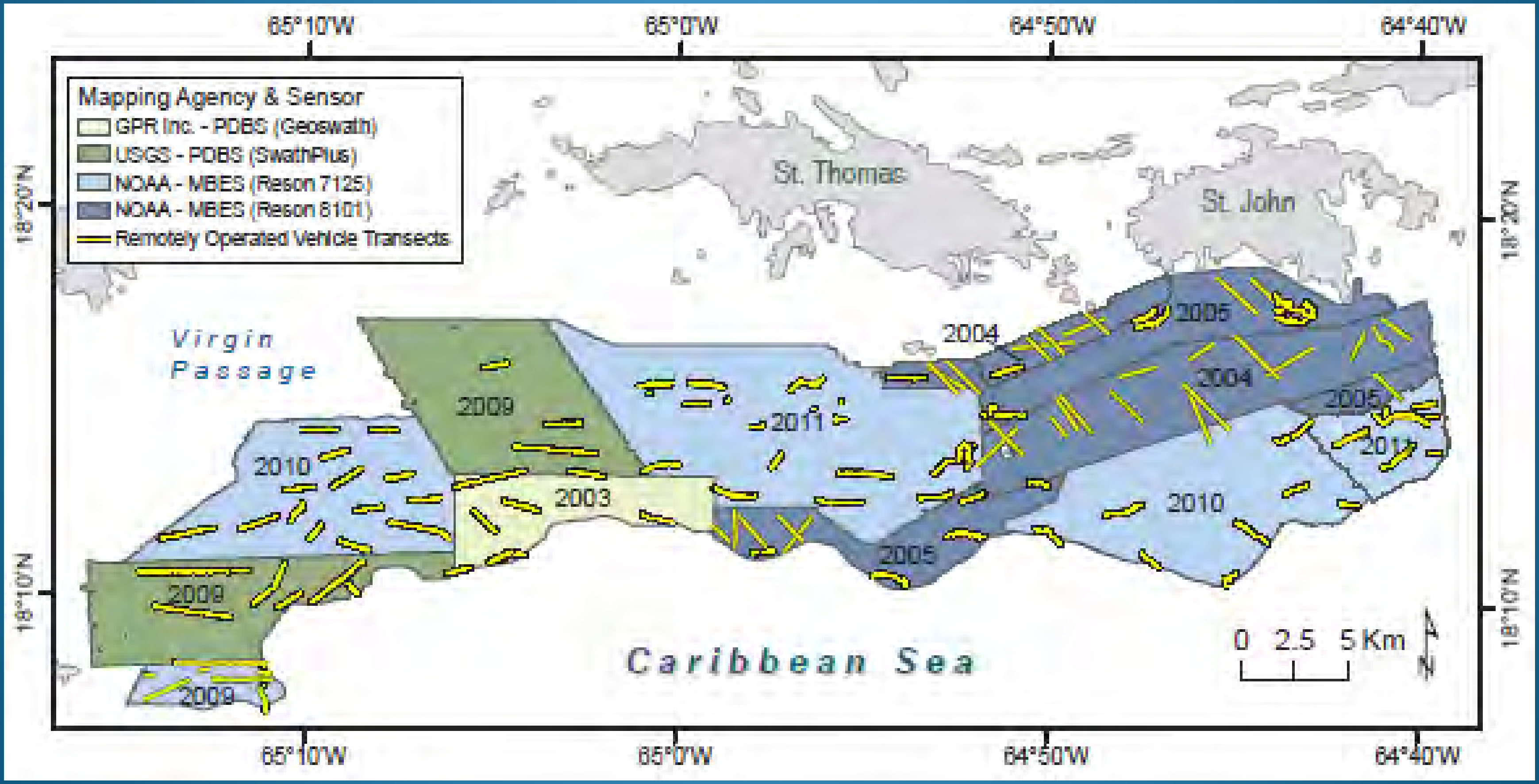
Pixel-based predictive modeling

Costa et al. 2017

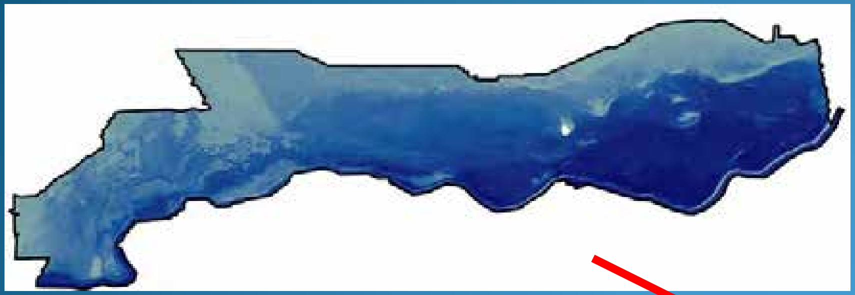
Predictive Modeling
Boosted Regression Trees

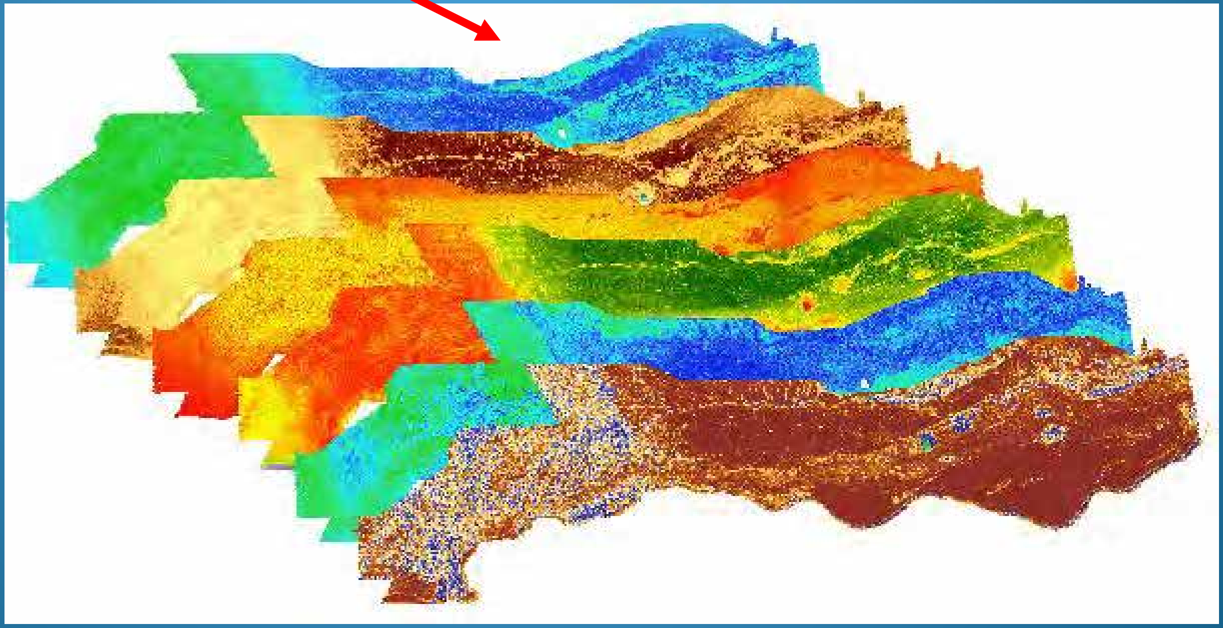
…by developing many simple regression (tree) models that relate a response (ie. habitat type) to environmental predictors by iteratively splitting the data into two homogenous groups. These models are built in a stage-wise fashion, where existing trees are left unchanged and the variance remaining from the last tree is used to fit the next one. These simple models are then combined linearly to produce one final combined model. (Friedman, 2002; Elith et al., 2006; Elith et al., 2008).

Multibeam surveys (2003-2011)
with ROV tracks

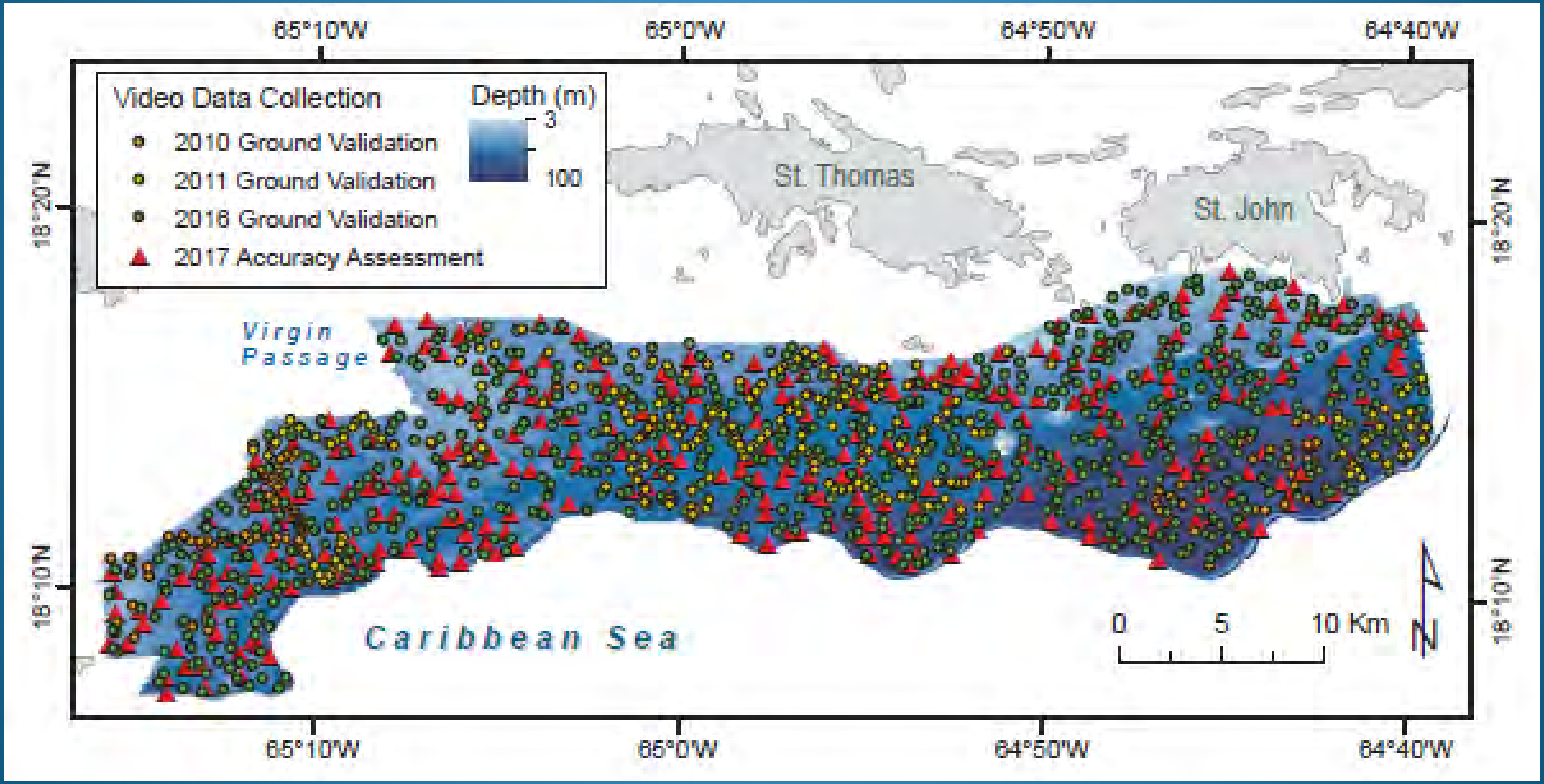


Bathymetric derivatives





Ground Validation and Accuracy Assessment data collection sites



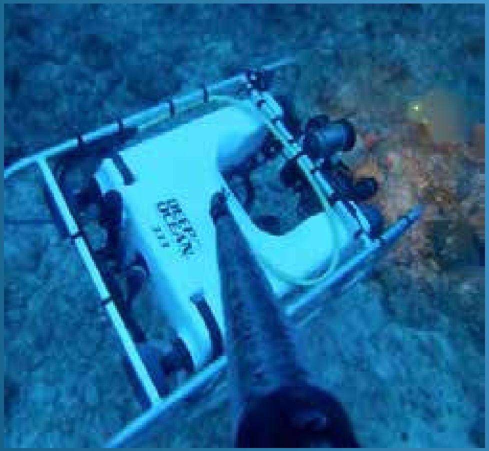
NCCOS NOAA NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

science for coastal communities

1. Take pictures of seafloor at GV and AA sites

Optical methods

When camera is 1-2 m above seafloor
(start annotation) |--------------------| (end annotation)
Time 0 ⟶ 10 sec



2. Review video; annotate substrate and cover type

RESPONSE:

presence-absence for each substrate and cover type

Coral Reef

Pavement

Sand

Rhodoliths

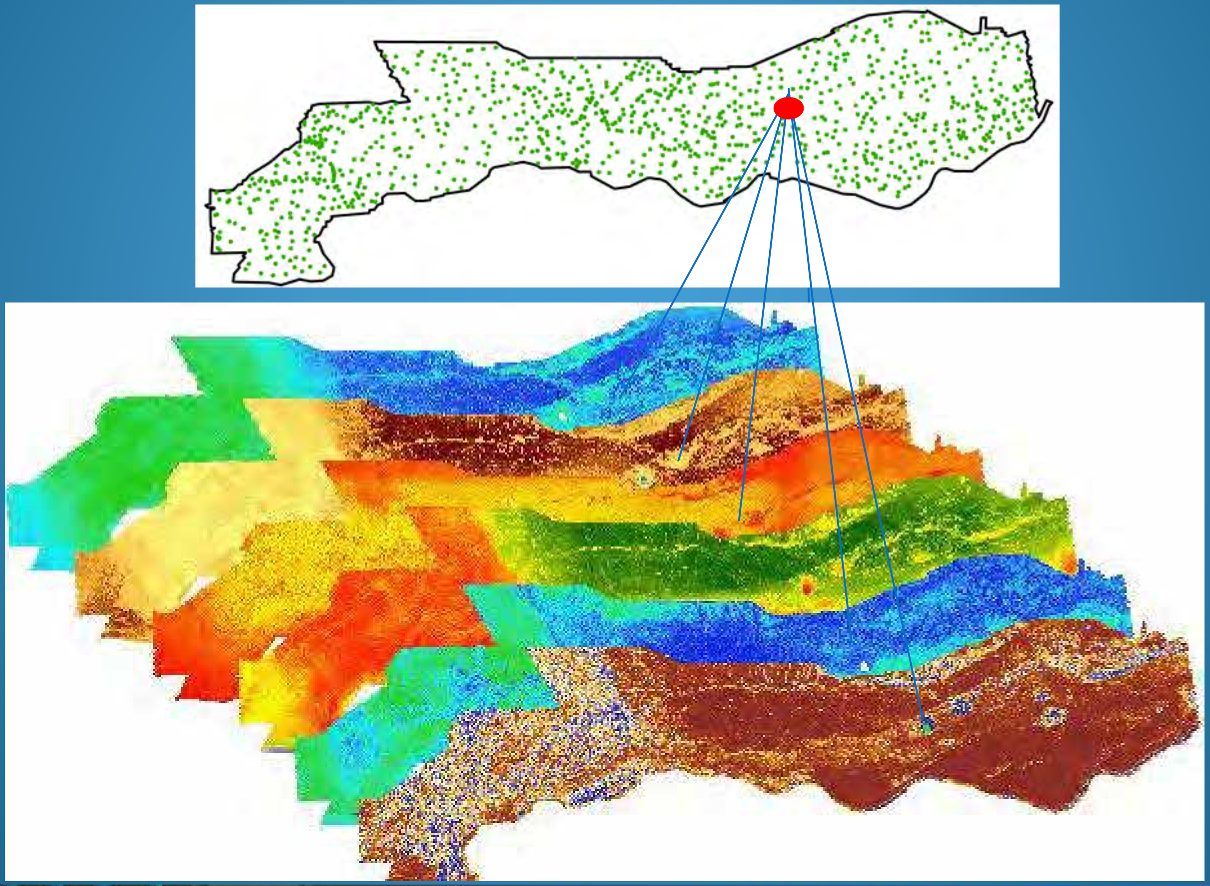
Live hard coral

Live soft coral

3. Extract seafloor metrics, etc. at each GV site

PREDICTORS:

Bathymetric, oceanographic, geographic attributes



Bathymetric data as Predictors

PREDICTORS

Bathy/Seafloor characteristics at GV sites

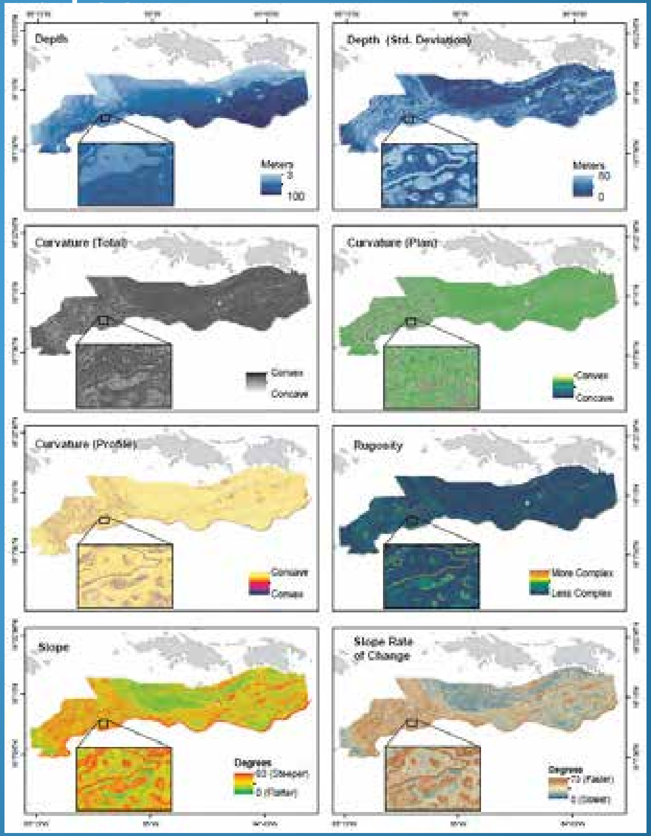
Seafloor metrics (n=8)

Depth
Depth std dev.

Curvature
Curvature (plan)

Curvature (profile)
Rugosity

Slope
Slope rate of change



Oceanographic data as Predictors

PREDICTORS

Oceanographic characteristics at GV sites

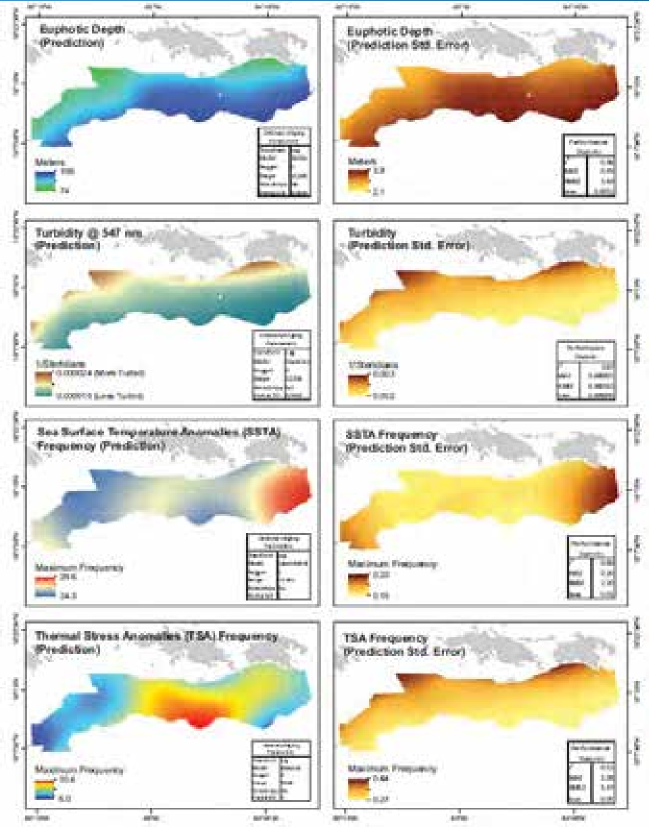
Oceanographic variables (n=8)

Euphotic depth
Euphotic depth std error

Turbidity @547nm
Turbidity std error

SST anomaly frequency
SSTA frequency std error

Thermal stress anomaly frequency
TSA frequency std error



Geographic data as Predictors

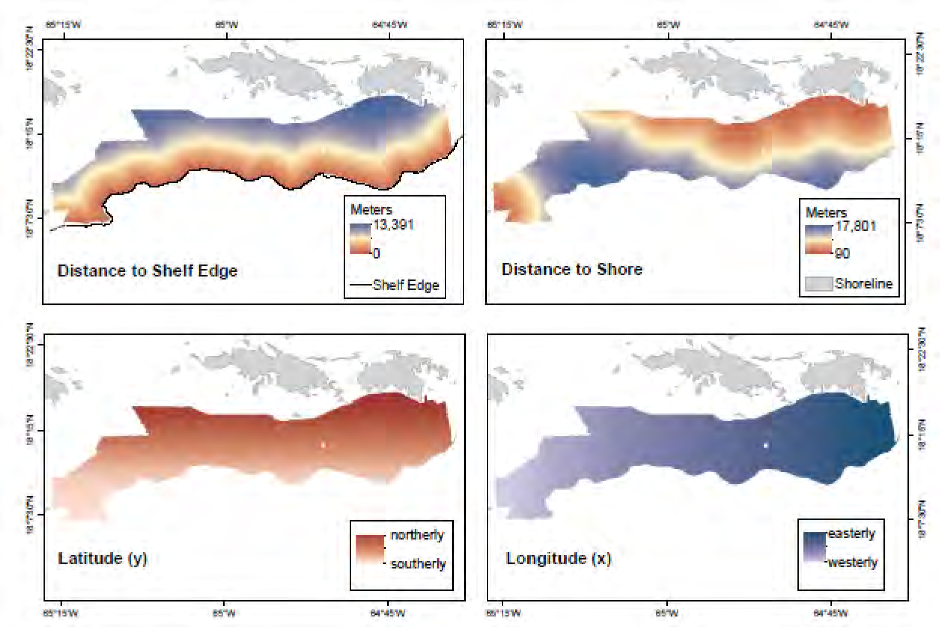
PREDICTORS

Geographic characteristics at GV sites

Geographic variables (n=4)

Distance to shelf edge
Distance to shore

Latitude
Longitude



Next

4. Run the BRT model many times and create:

- predictive surface of probability of occurrence
- coefficient of variation surface

Boosted regression trees (BRTs) model complex ecological relationships by developing many simple regression (tree) models that relate a response (ie. habitat type) to environmental predictors by iteratively splitting the data into two homogenous groups. These models are built in a stage-wise fashion, where existing trees are left unchanged and the variance remaining from the last tree is used to fit the next one. These simple models are then combined linearly to produce one final combined model (Friedman, 2002; Elith etal., 2006; Elith etal., 2008).

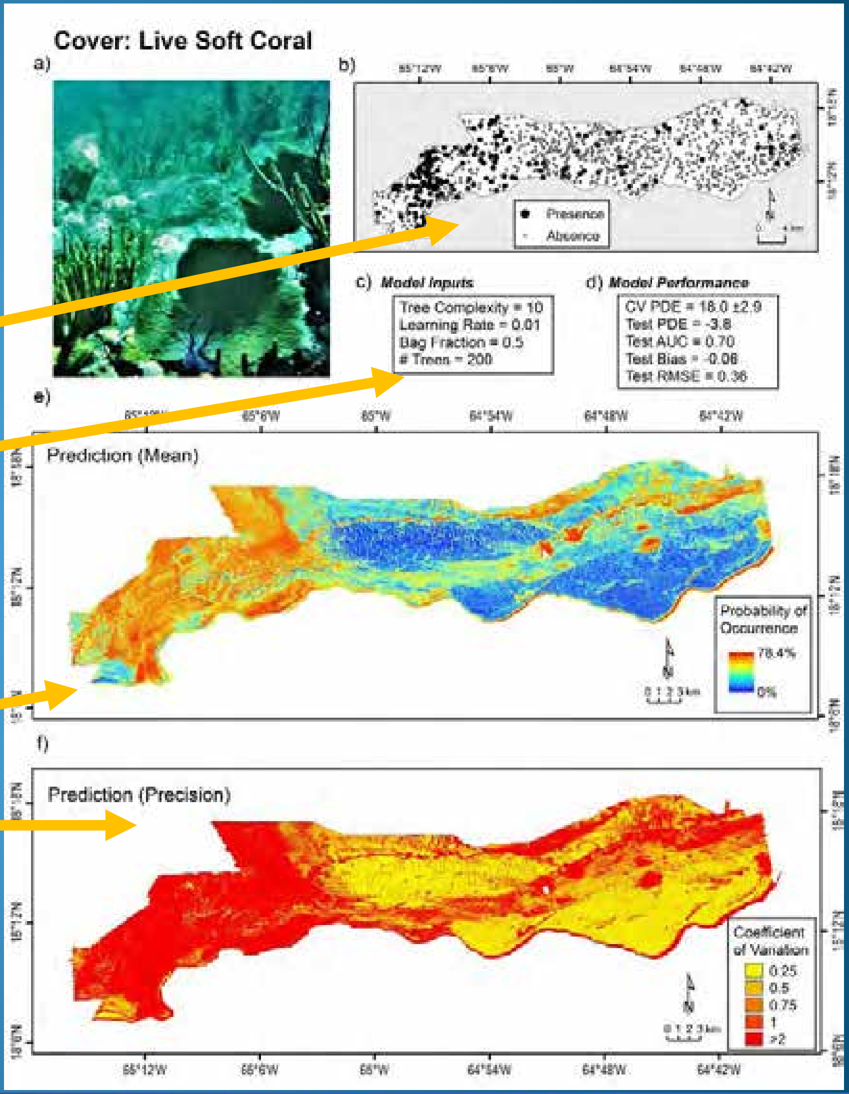
Results:

Prevalence in GV data

Model parameters and performance

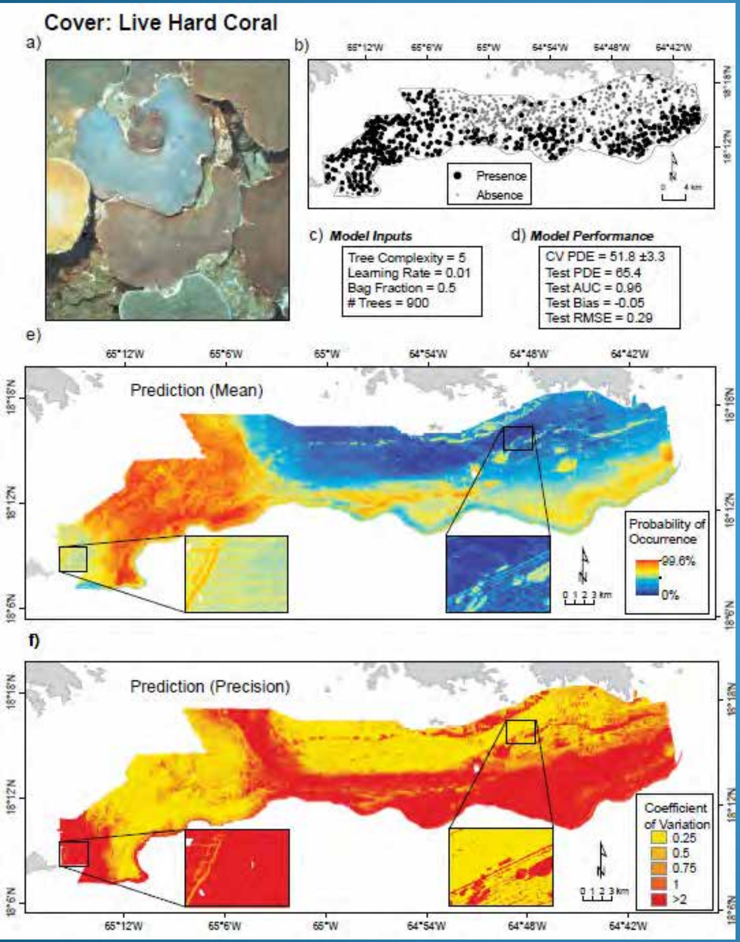
Predicted surfaces showing

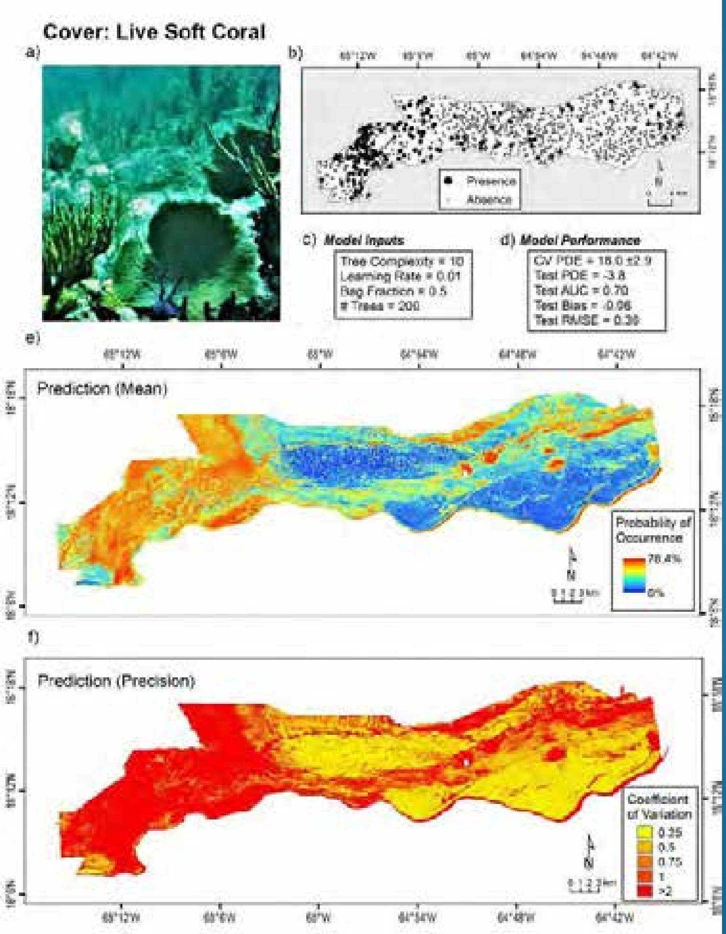
- Probability of occurrence
- Coefficient of variation



Results: Cover

- Probability of occurrence and coefficient of variation





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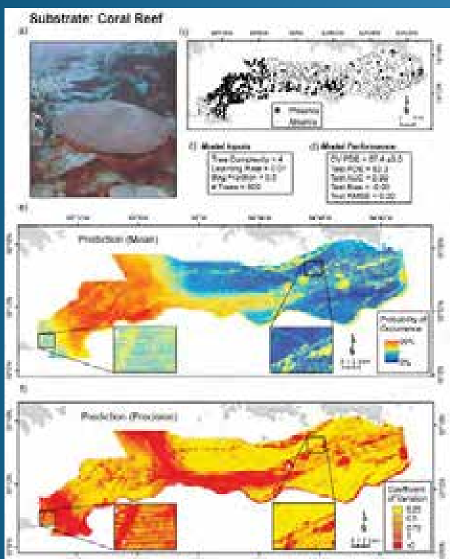
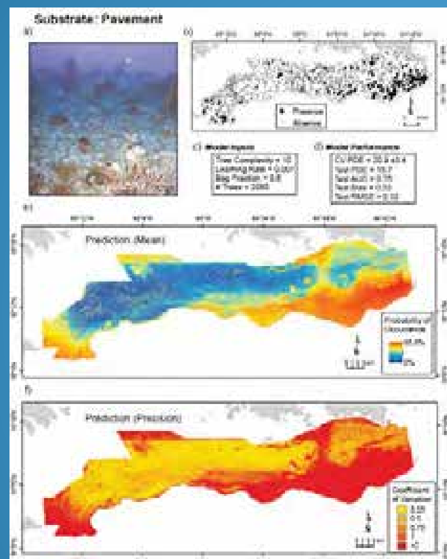
science for coastal communities

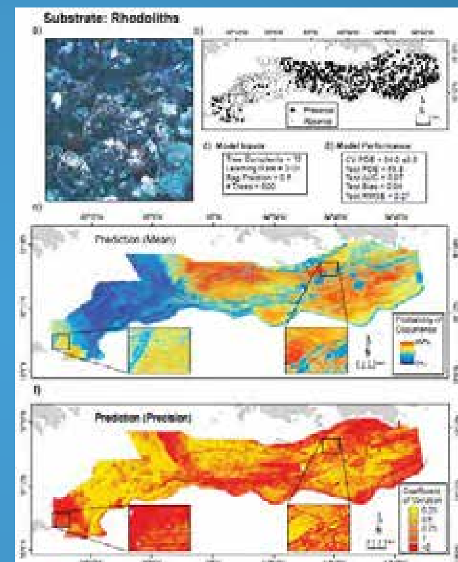
Results: Substrate

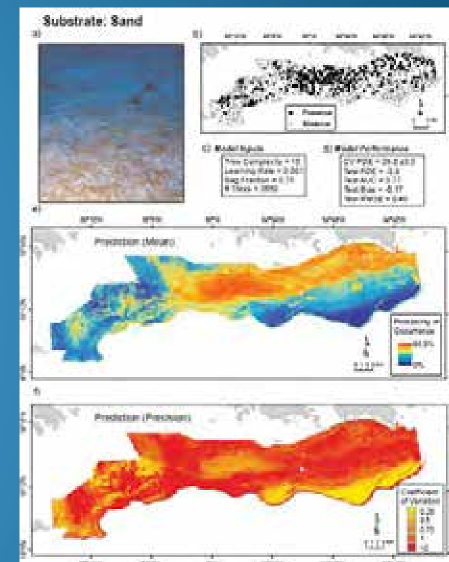
- Probability of occurrence and coefficient of variation

Coral reef | Pavement | Rhodoliths | Sand



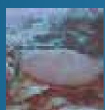


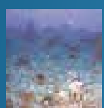


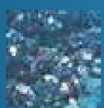


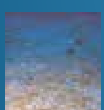
Model runs for each substrate and cover type

STEP 5. Cluster the predicted surfaces of each substrate and cover type into commonly co-occurring habitat classes (BCTs)

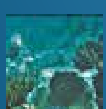

Coral Reef

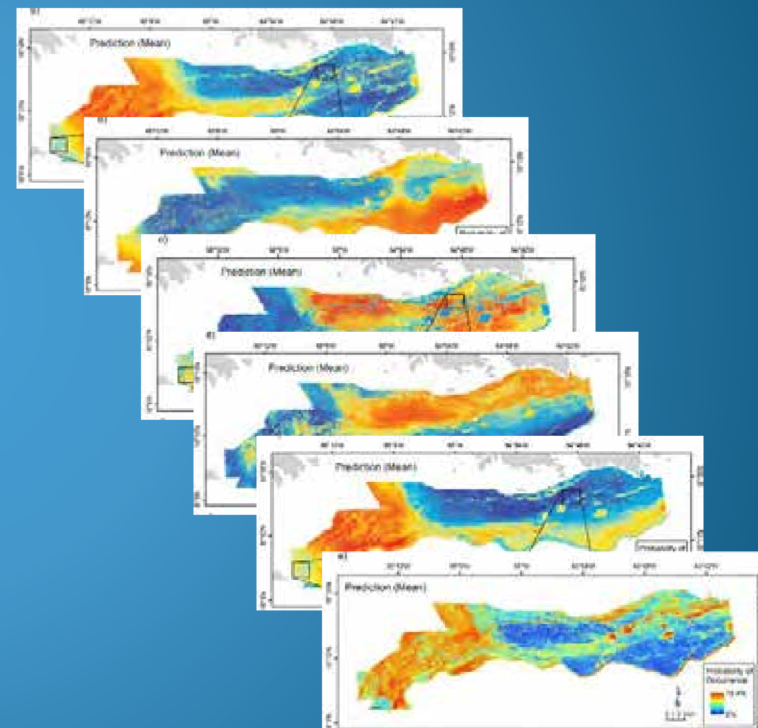

Pavement


Rhodoliths


Sand


Live hard coral


Live soft coral

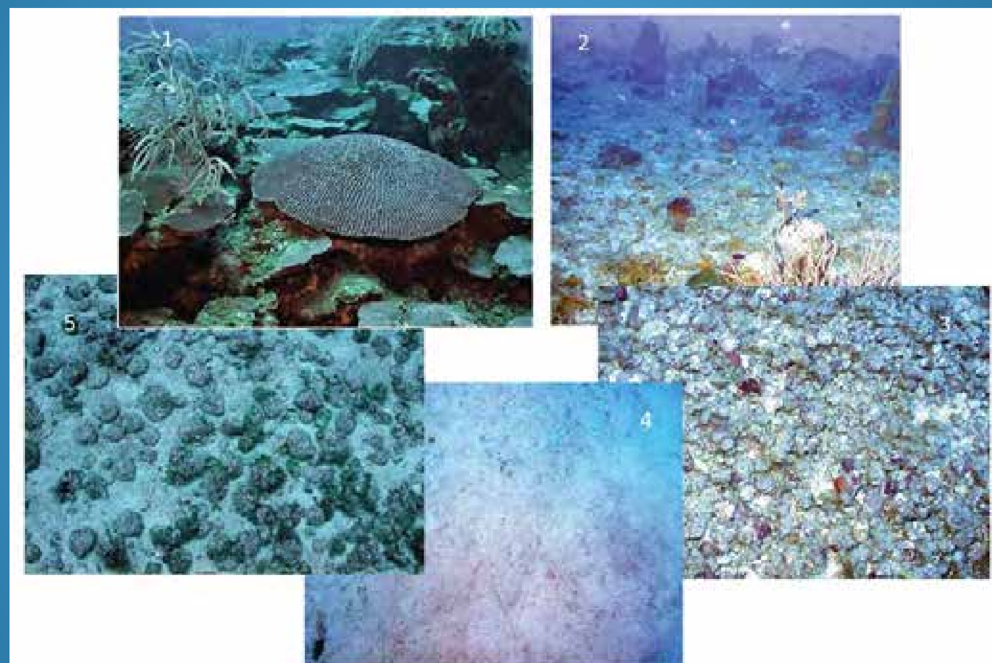


Results: Composite benthic habitat map

Cluster substrate & cover types into five commonly co-occurring habitat classes

1. Coral reef colonized with live coral

2. Pavement colonized with live coral

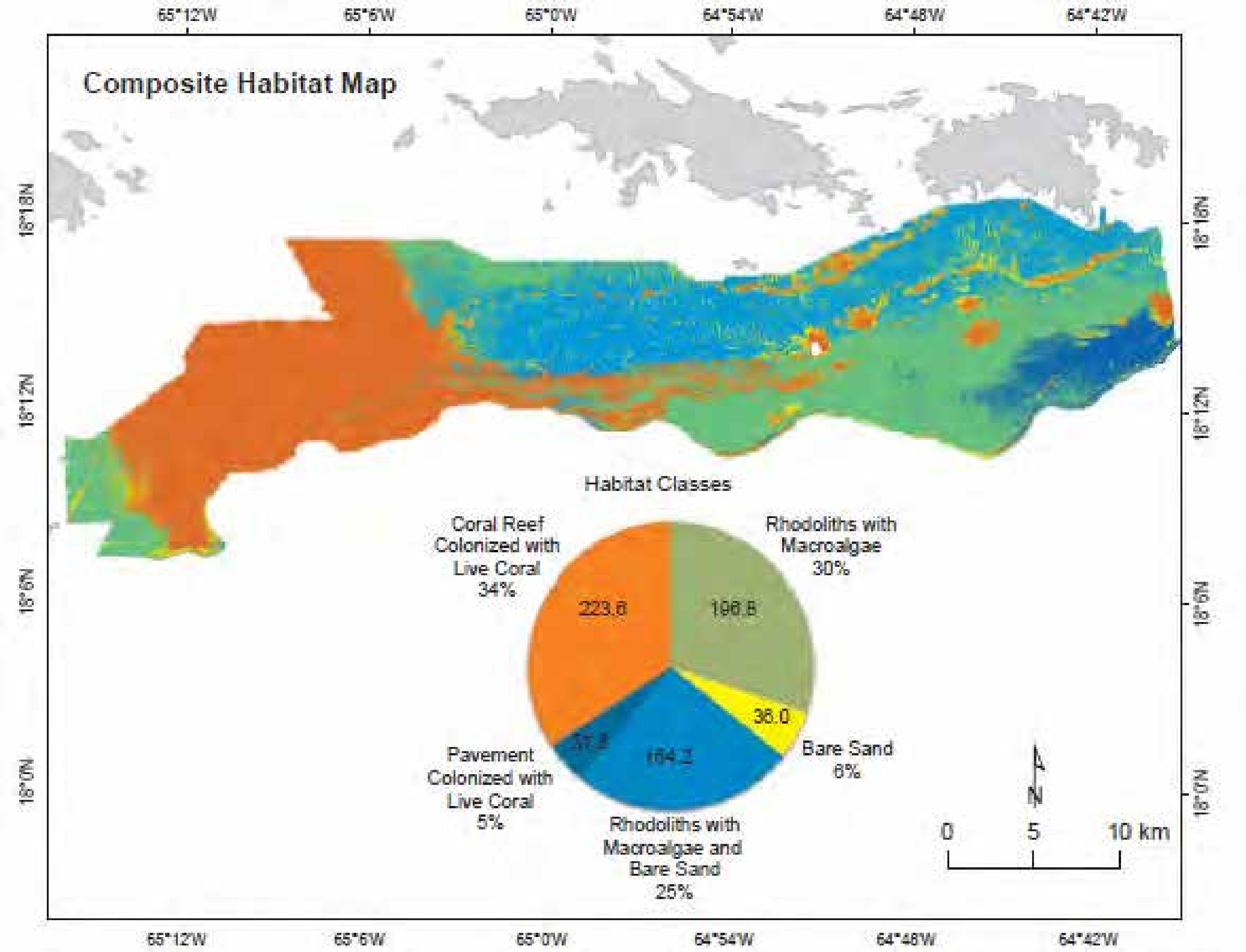


5. Rhodoliths with macroalgae and bare sand

3. Rhodoliths with macroalgae

4. Bare sand

Results: Composite benthic habitat map



Results: Map Accuracy

348 underwater videos used to evaluate map accuracy

OA = 85.6% tau = 0.82

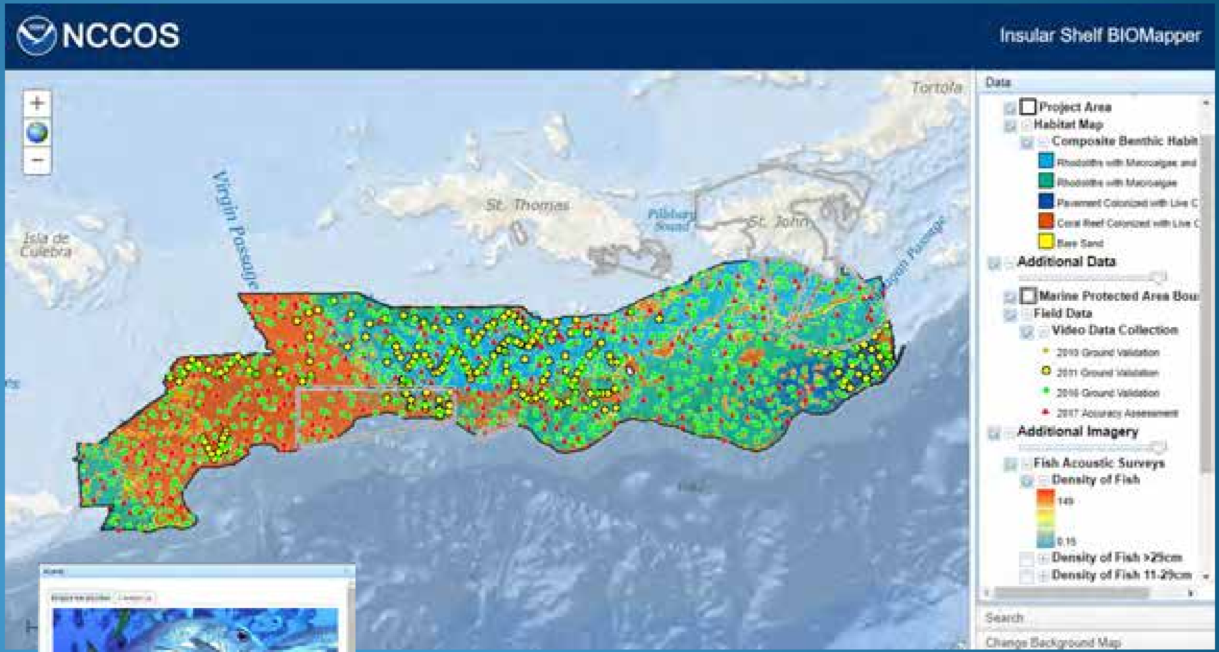
AA (i)

Map (j)	Coral Reef Colonized with Live Coral	Pavement Colonized with Live Coral	Rhodoliths with Macroalgae and Bare Sand	Rhodoliths with Macroalgae	Bare Sand	n_j	User's Accuracy (%)
Coral Reef Colonized with Live Coral	119	8	2		5	134	89%
Pavement Colonized with Live Coral		10		1		11	91%
Rhodoliths with Macroalgae and Bare Sand		2	48	13	6	69	70%
Rhodoliths with Macroalgae	1	1	1	104	3	110	95%
Bare Sand		2	1	4	17	24	71%
n_i	120	23	52	122	31	348	
Producer's Accuracy (%)	99%	43%	92%	85%	55%		

OA = 85.6%
Tau = 0.82
CI (±) = 0.05

Products

NOAA Tech Memo 241



https://maps.coastalscience.noaa.gov/biomapper/biomapper.html?id=insular

Questions?

Ocean Exploration in the Southeast FY17 and FY18

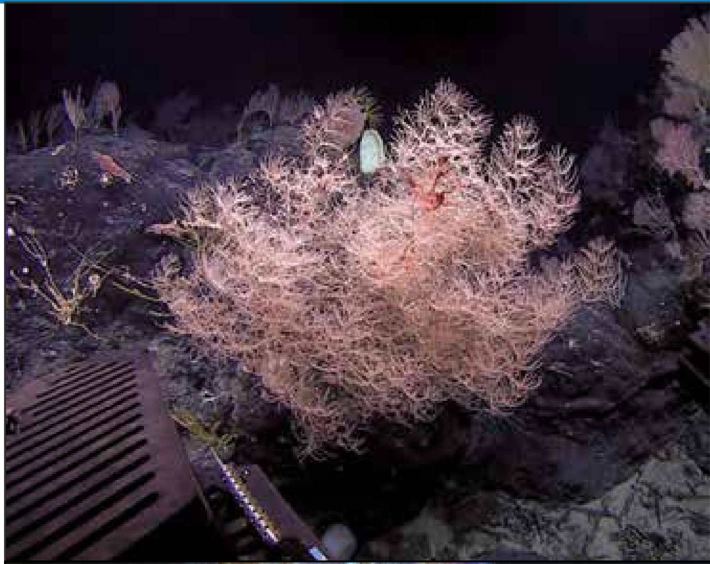
Kasey Cantwell & Derek Sowers
NOAA Office of Ocean Exploration and Research

SECART 2018 Mapping Workshop

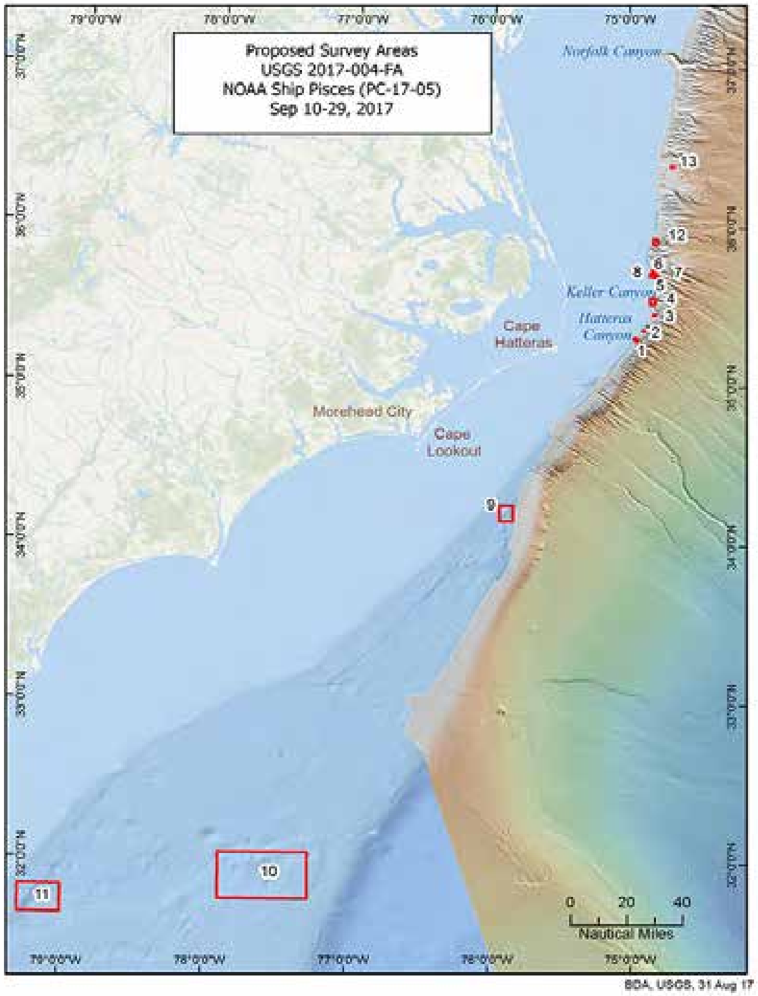
NOAA OER

The only federal organization dedicated to exploring our unknown ocean

- Support innovations in exploration tools and capabilities
- Encourage the next generation of ocean explorers, scientists, and engineers
- Provide a foundation of publicly available data and information to give resource managers the information they need to make informed decisions



DEEP SEARCH: Deep Sea Exploration to Advance Research on Coral/Canyon/Cold seep Habitats



- 4.5 yr BOEM-USGS-NOAA study
- BOEM contractor: TDI-Brooks International; project manager: Erik Cordes (Temple U)
- USGS supporting 5 complementary science teams; lead: Amanda Demopoulos
- Y1 field work: NOAA Ship *Pisces*, AUV *Sentry*
- Y2 field work: NOAA Ship *Nancy Foster* (April); R/V *Atlantis,* HOV *Alvin* (August)

NOAA Ship *Okeanos Explorer*

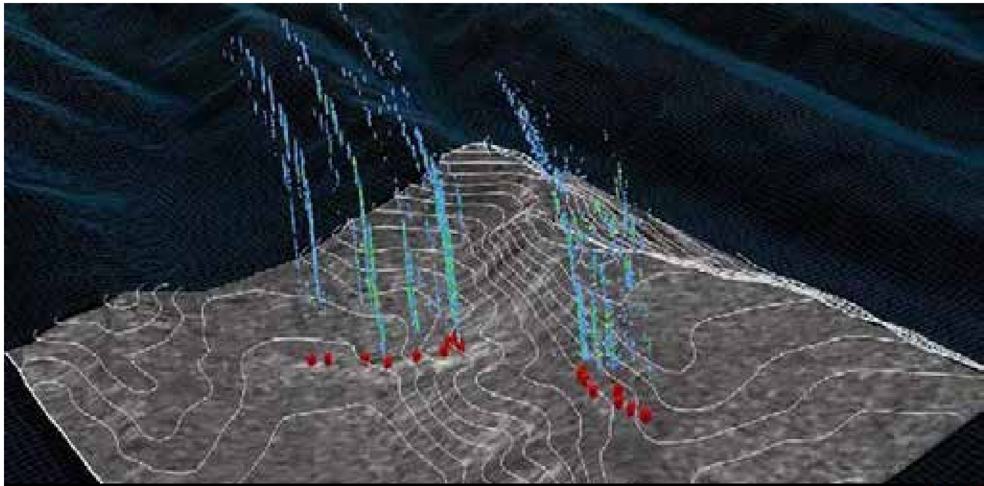
America’s ship for ocean exploration

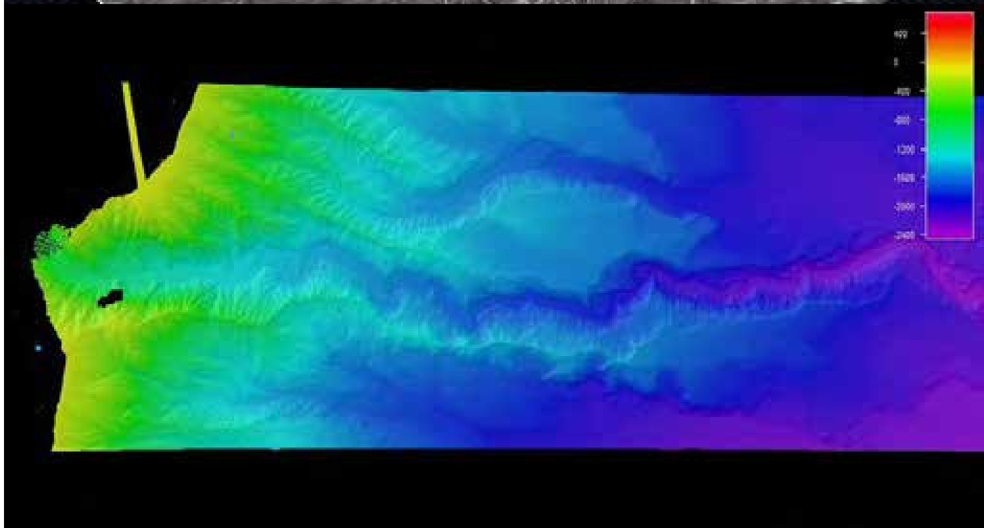
- 9 scientific sonars to map the seafloor and water column
- Custom-built, 6,000 m dual ROV system
- CTD with DO, LSS, and ORP
- Cutting edge telepresence technology
- Science team primarily based on shore

Mapping Sonars: Multibeam

- Kongsberg 30 kHz EM302 Multibeam
- Operating efficiency depths ~250m – 6500m

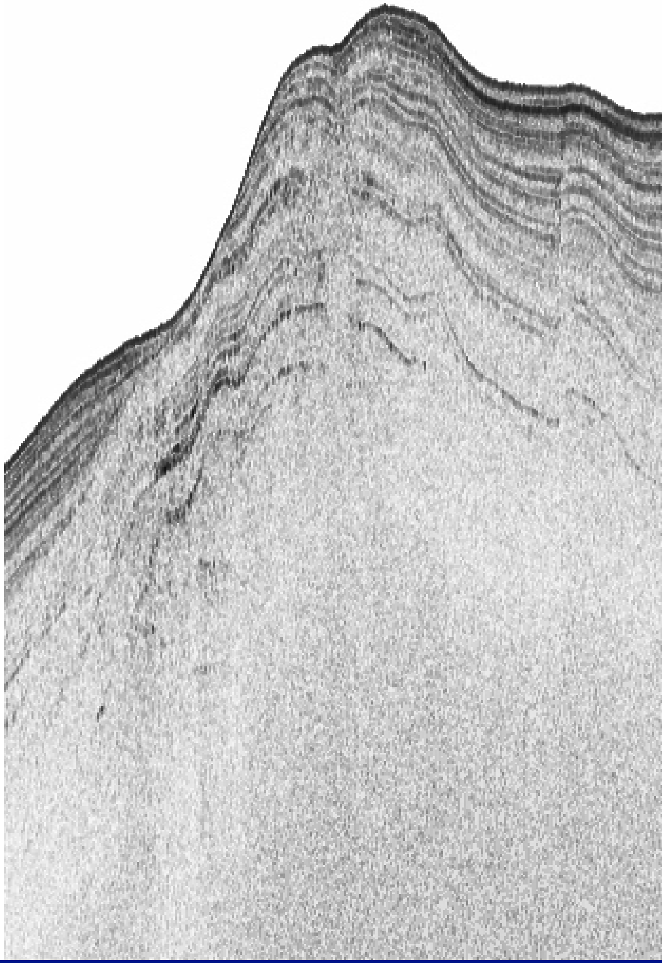
Water Depth (meters)	Cell Size (meters)
100	1
300	3
500	4
1000	9
2000	17
3000	26
4000	35
5000	44
6000	52



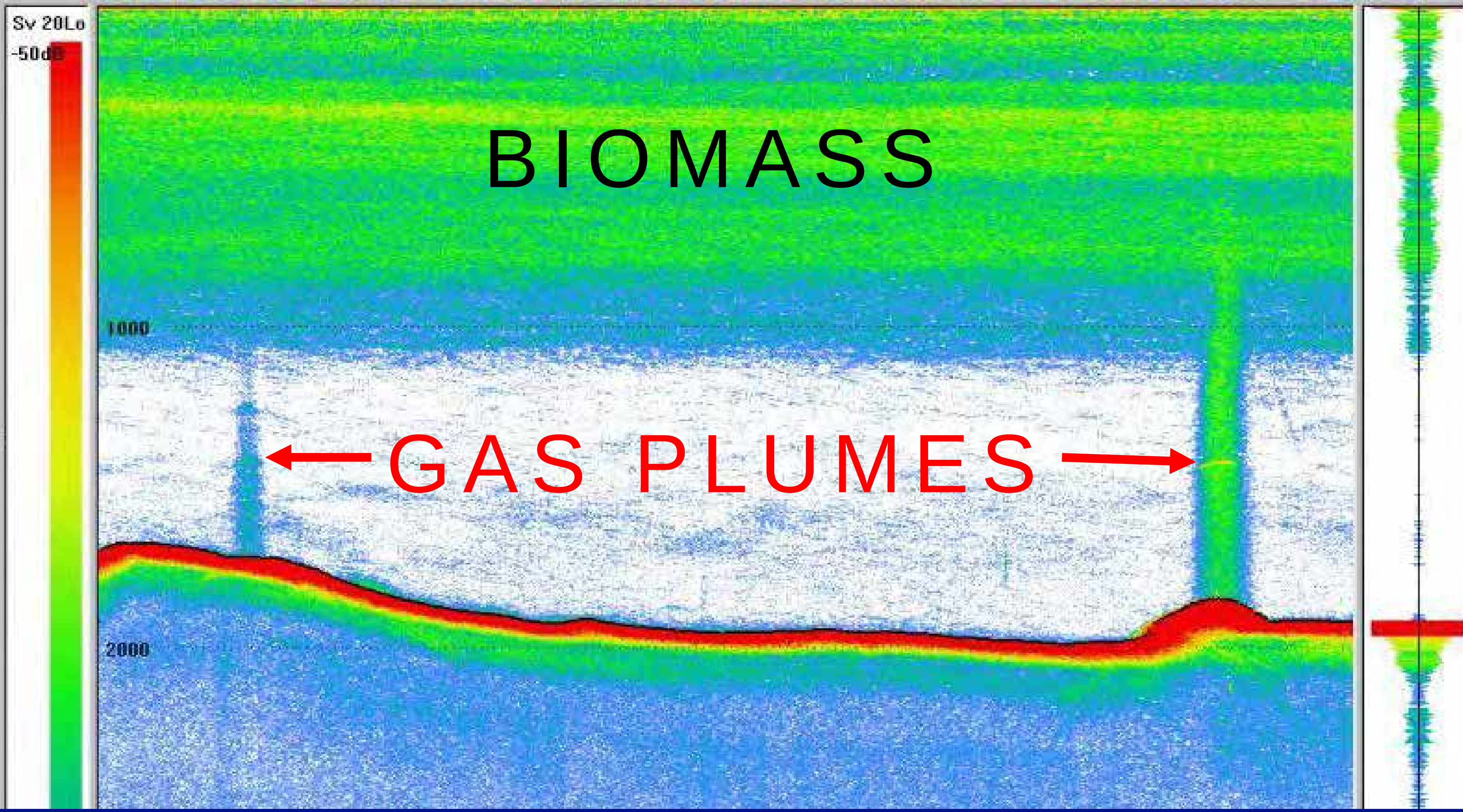


Knudsen 3260 Subbottom Profiler

- Knudsen Subbottom Profiler
  - Sub-seabed structures
    - Sediment layers
    - Gas
    - Buried channels
- 3.5 kHz chirp
- Up to ~ 80 m penetration below seabed



Simrad EK 60 Split beam sonars:
18, 38, 70, 120, 200 kHz



Teledyne ADCPs 38, 300 kHz

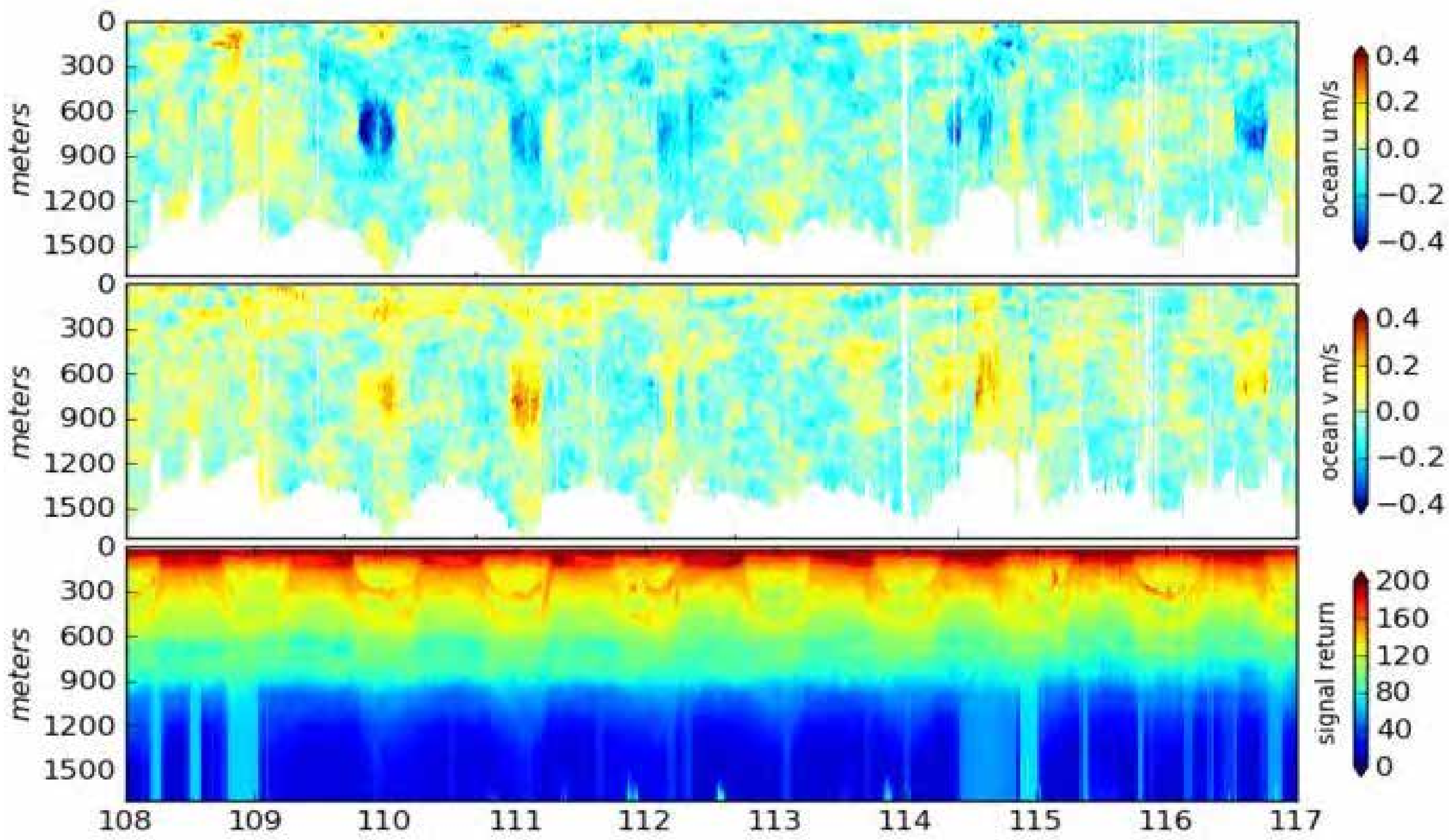
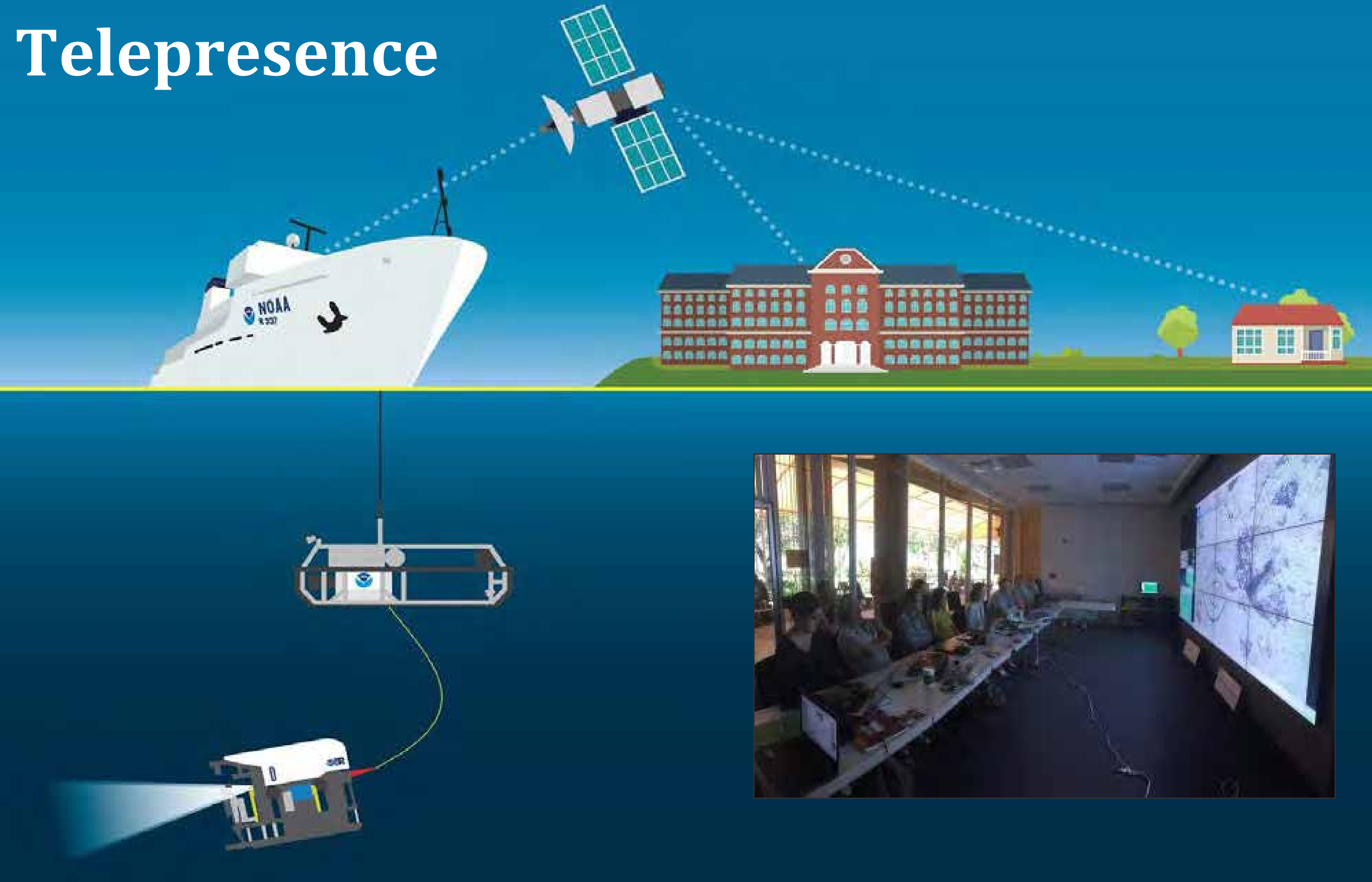
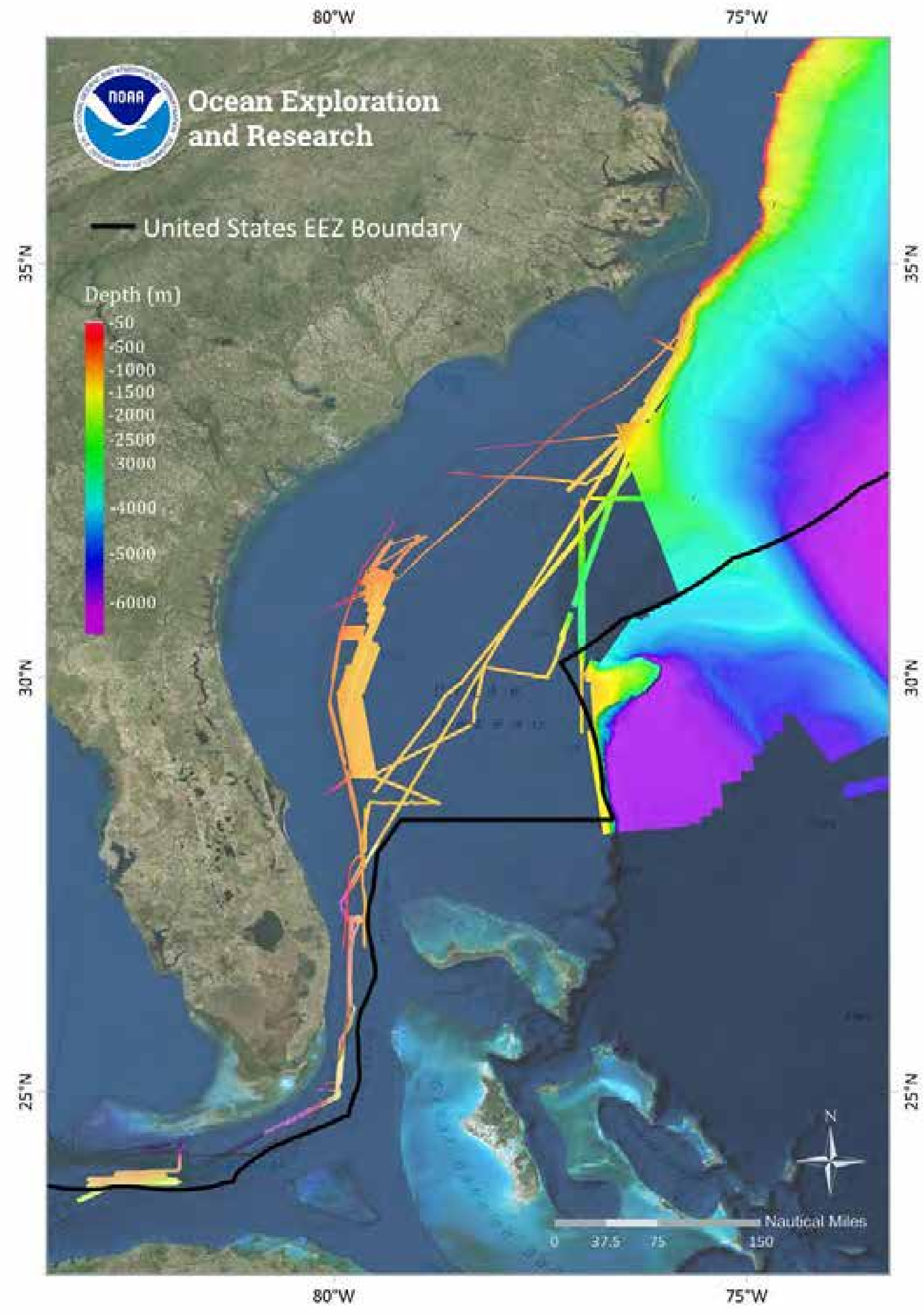


Image: Jules Hummon UHDAS

Telepresence



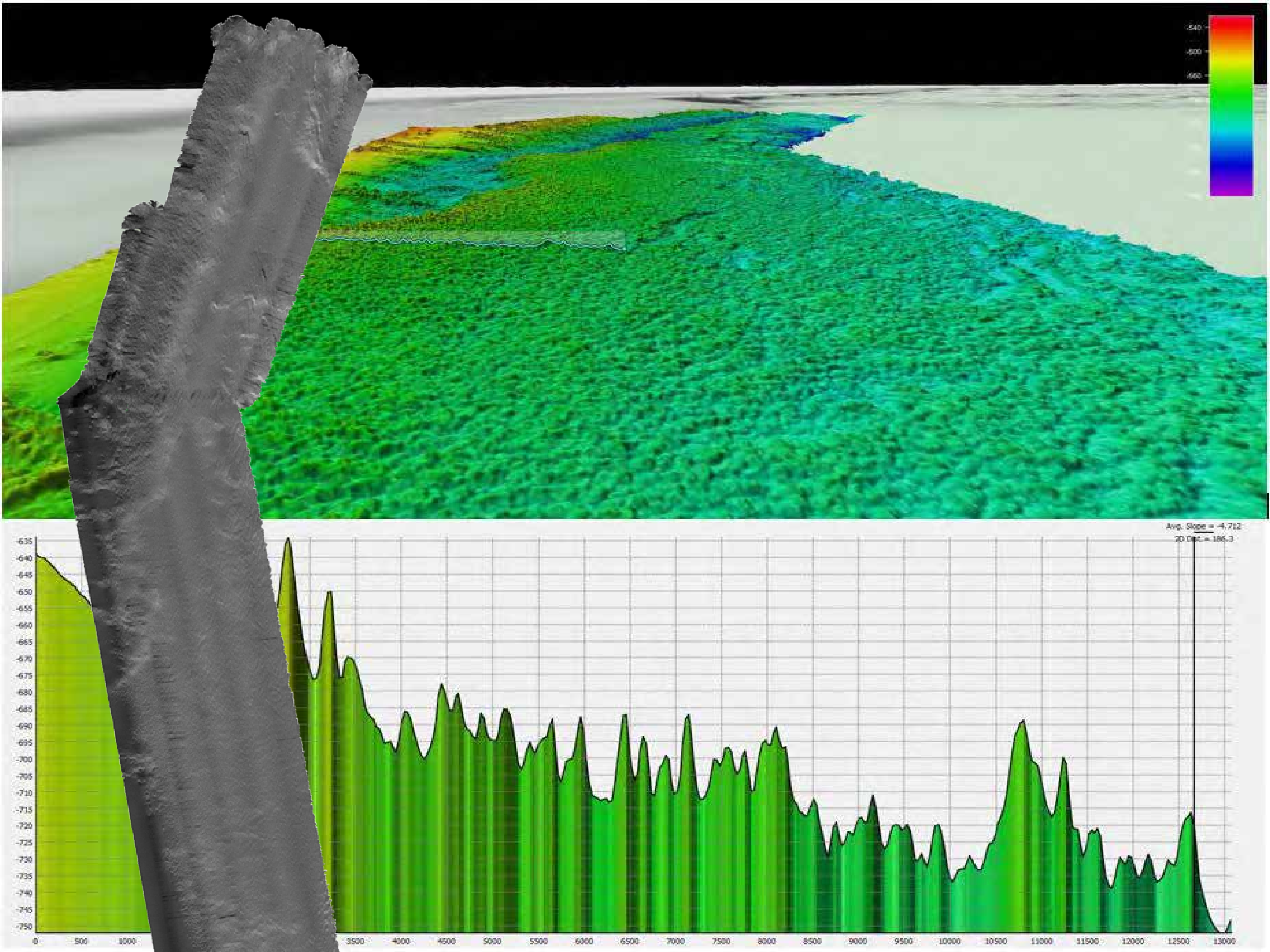


Atlantic Deepwater Data

Okeanos Explorer (EX) and Extended Continental Shelf (ECS) mapping efforts

- Cumulative multibeam sonar coverage
- EX cruises
- ECS cruises (NOAA/UNH)
- 10- 30m resolution on shelf
- 50-100m resolution canyons/abyss

Ocean Exploration and Research


Avg. Slope = -4,712
2D Dist. = 186.3
-635
-640
-645
-650
-655
-660
-665
-670
-675
-680
-685
-690
-695
-700
-705
-710
-715
-720
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-750
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500
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8500
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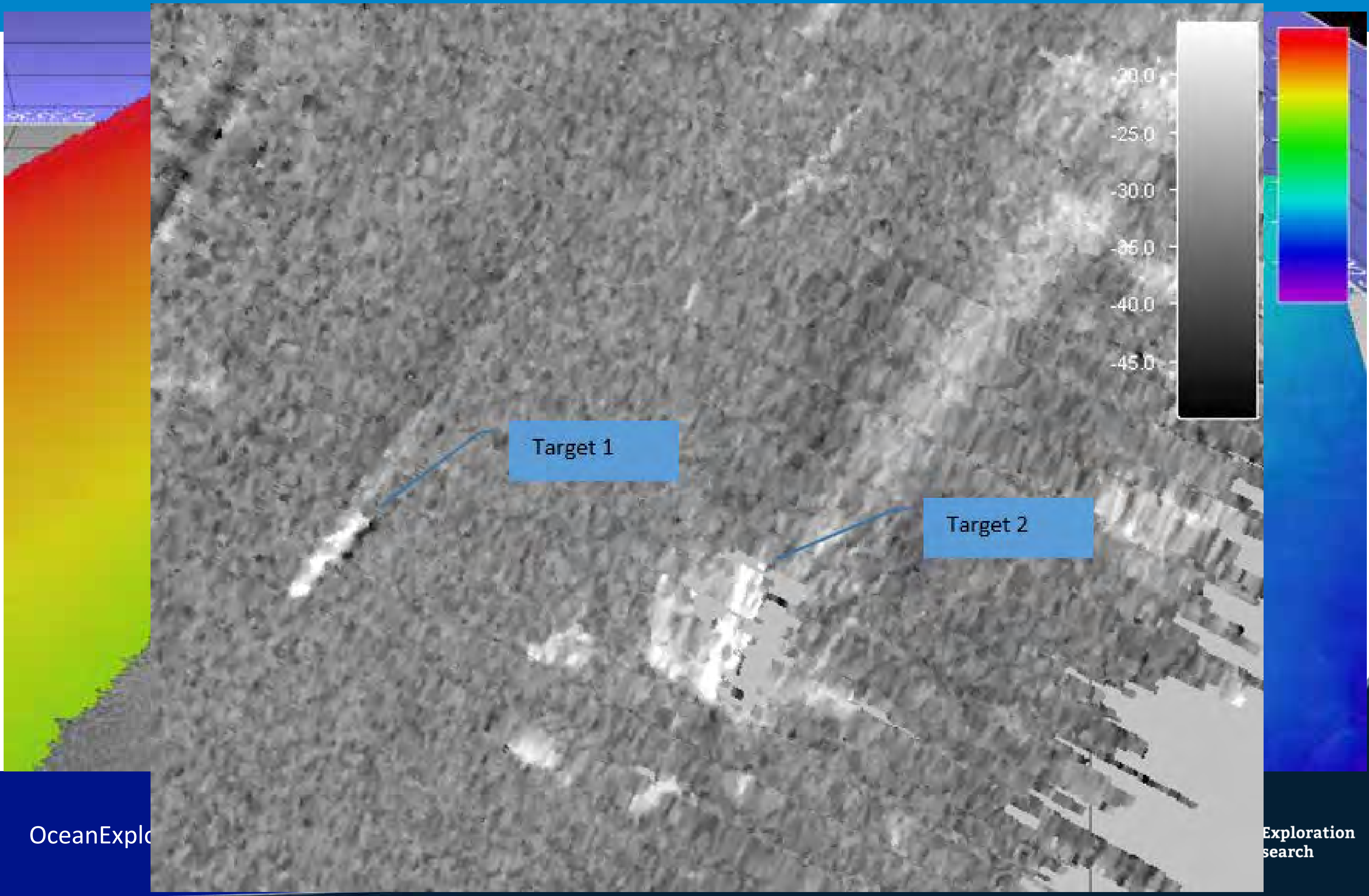
9500
10000
10500
11000
11500
12000
12500
13000

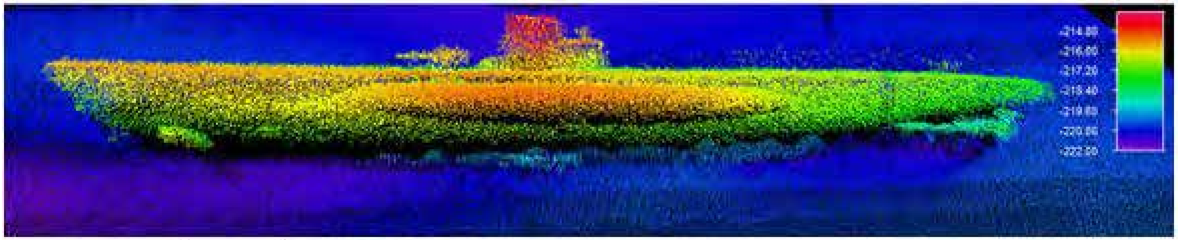
Searching for U-576



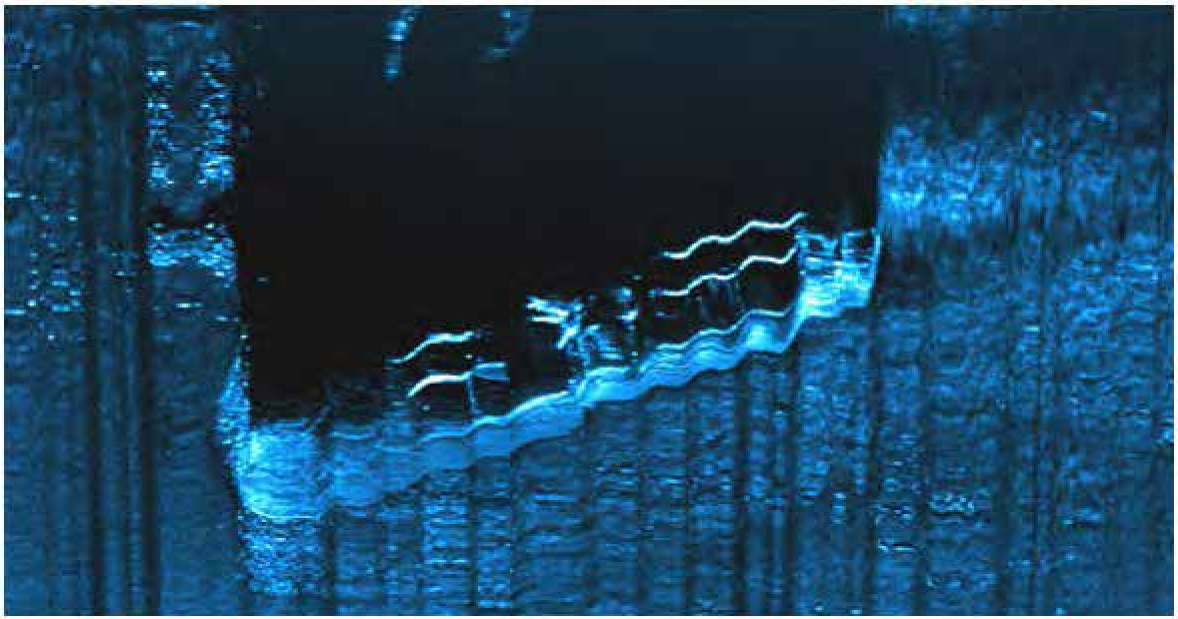
NOAA team discovers two vessels from WWII convoy battle off North Carolina

German U-boat *576* and freighter *Bluefields* found within 240 yards of one another

October 21, 2014



U-*576* sonar image. Photo: NOAA



Bluefields sonar image. Photo: NOAA

The German U-*576* departing Saint-Nazaire, France, circa 1940-1942. The submarine was sunk in 1942 by aircraft fire after attacking and sinking the Nicaraguan freighter *Bluefields* and two other ships off North Carolina. (Credit: With permission from Ed Caram)

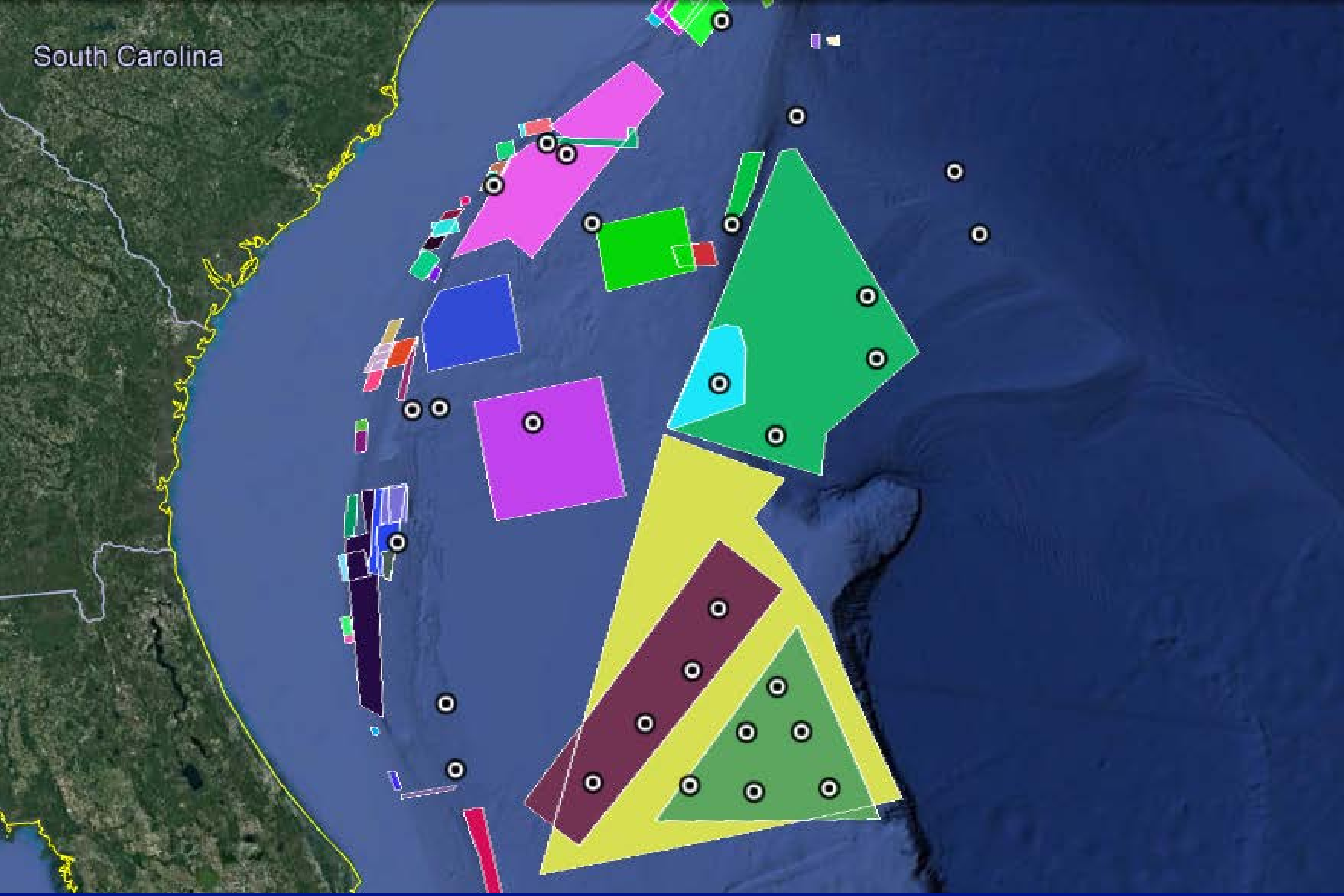
2018 Planned Operations

- First year of new campaign — Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE)
- 32 DAS
  - 5/23-6/1: Mapping cruise (Mayport, FL to Charleston)
  - 6/6-6/27: ROV/Mapping cruise (Charleston, SC to Norfolk, VA)
- Deep sea corals, shipwrecks, canyons, Blake Plateau and Ridge, seeps, and geohazards

The Opportunity/ How to get involved

FY19+
- Submit high level priorities
- Identify regional data gaps

FY18
- Participate and share expedition within your network
- Engage with the ship via outreach opportunities


South Carolina

Virginia
Mountains
North Carolina
uth Carolina

Timeline

January/February:

- Refine operating areas

February- April:

- Call for mapping and dive targets
- Regular planning calls begin (week of 5/1)

May-June:

- Participate!
- Real-time data available
- Outreach opportunities

July: Initial summary materials

July- September: Data and samples to archives

2019-2020: Continue Southeast work and potentially expand to Caribbean pending regional input and support

Questions?

Follow up with Kasey Cantwell (Kasey.Cantwell@noaa.gov) and Derek Sowers (Derek.sowers@noaa.gov)

OceanExplorer.NOAA.gov

Ocean Exploration and Research

BOEM
Bureau of Ocean Energy Management

SE Seafloor Habitat Mapping Workshop

Marine Minerals Information System (MMIS)

Lora Turner (BOEM Project Lead)
Brian Zweibel (DOI PM)
Alexa Ramirez (QSI PM)
Dave Stein (NOAA COR)

Charleston, SC
April 18, 2018

BOEM Bureau of Ocean Energy Management

Agenda

- Background
- Data
- Coastal and Marine Ecological Classification Standard (CMECS) Implementation
- Access
- MMIS Demo
- Mapping Plans

BOEM
Bureau of Ocean Energy Management

Background

Why?

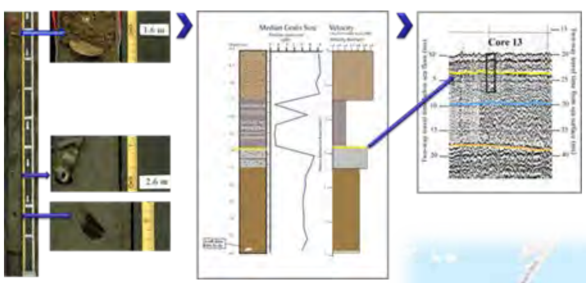
Data Steward
- Maintain marine minerals data

Physical Scientist / Analyst
- Characterize the subsurface to support leasing and environmental decisions

Planner
- Consume authoritative marine mineral datasets to identify conflicts with other OCS activities / regional planning

Manager
- To manage the resource, we need to know what we have

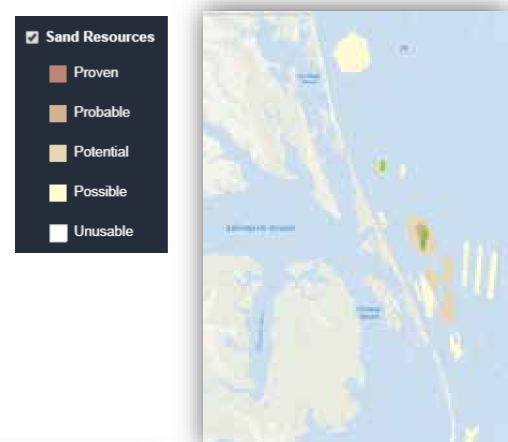
Leadership
- Oversee the development of marine mineral resources on the OCS

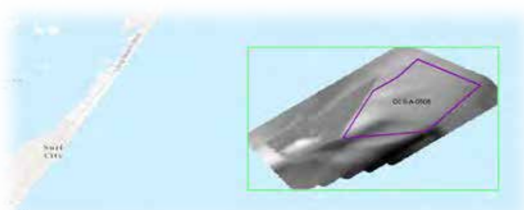


Pre-dredge Survey

Post-dredge Survey

SC Folly Lease OCS-A-0504





NJ LBI Lease OCS-A-0505

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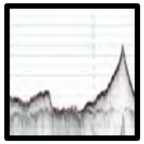
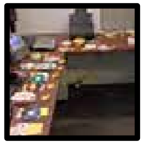
Background

Collaboration with our Partners



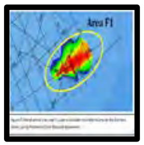
Analyzed Geotechnical / Geophysical Source Data

Digital data from physical core samples



Digital derived data from external drives, CD's, paper sources

Cooperative Agreements



Leasing data

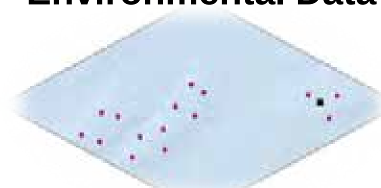
Dredge data

Environmental Studies Data

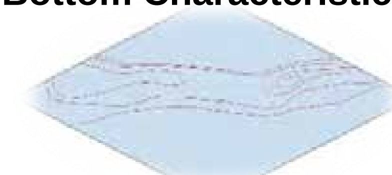
MMIS

Bathymetry & Backscatter

Environmental Data



Bottom Characteristics



Leasing / Planning/Construction

Discover

Analysis

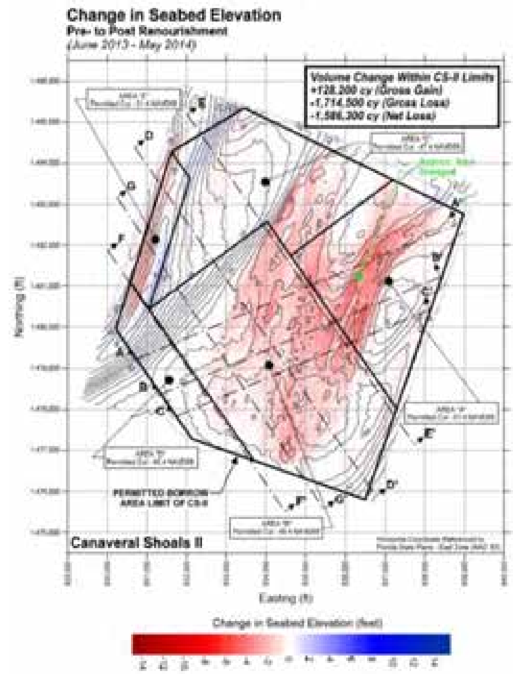
Id Gaps

A tool to support the National OCS Sand Inventory for Coastal Restoration Projects

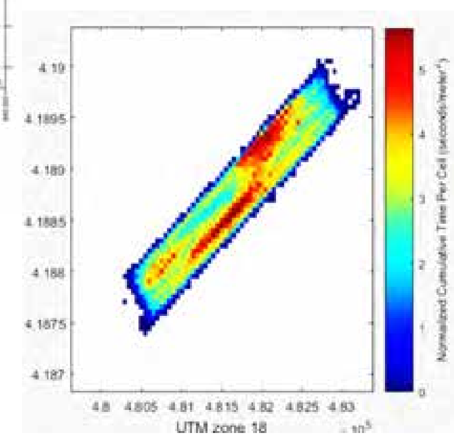
Data

- Data are being used to understand seafloor/subsurface composition as well as habitat
  - Interferometric Sidescan Sonar, Multibeam, Sub-bottom Seismic, Sidescan Sonar, Magnetometer, grab and core samples…

- ***Importance of Mapping***
  - OCS energy and mineral resource assessment
  - Locations of sensitive benthic habitats, submerged cultural resources, undersea cables, etc. for environmental analysis, reviews and post monitoring
  - Track Federal leases and resource utilization
  - Pre- and post-dredge bathymetric surveys



Florida Canaveral Shoals Dredge Area



Wallops Dredge Area

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Data

NC - BOEM
Cooperative Agreement

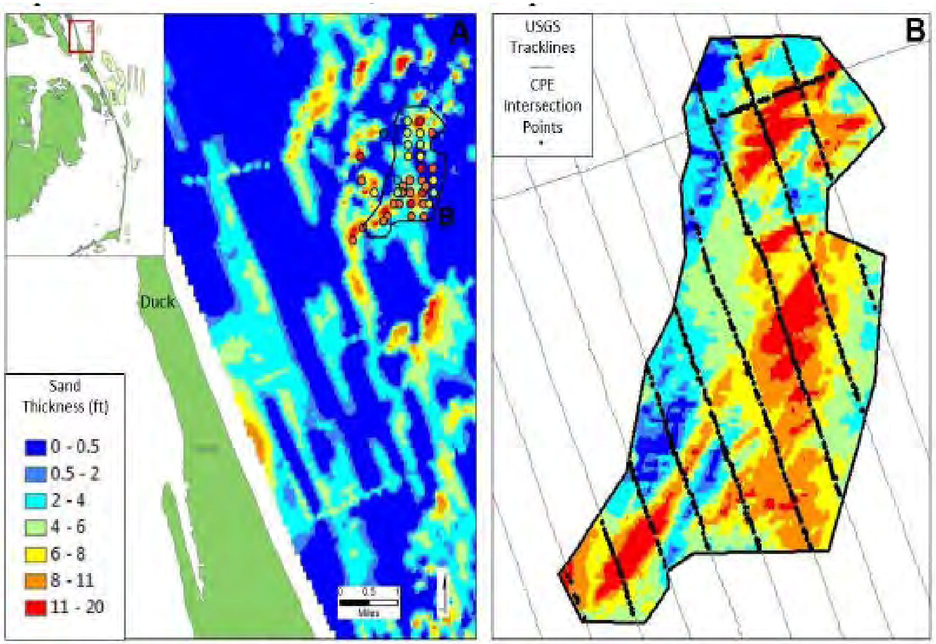


Fig. 5: Spatial comparison of sand resource assessment offshore Duck, NC.

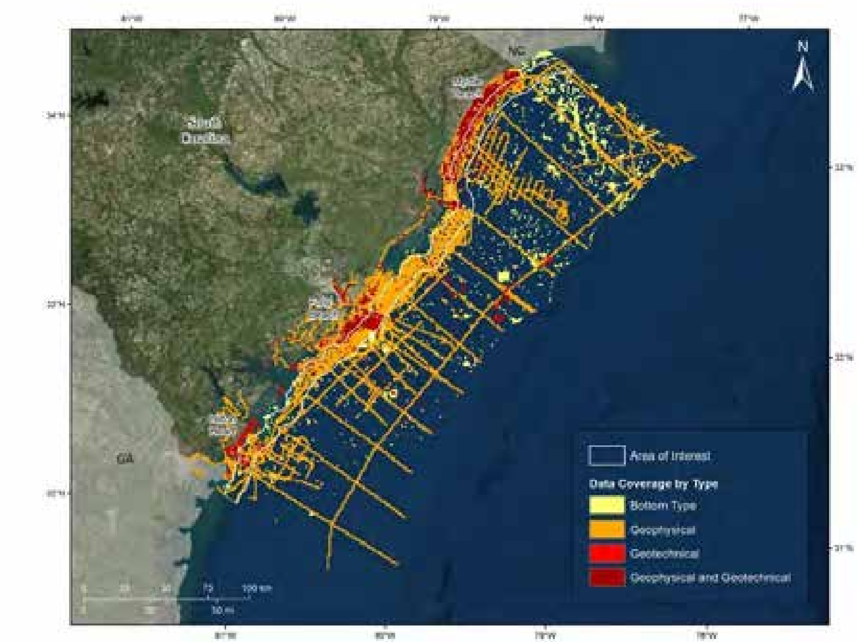


Figure 4. This map presents a grid of composite data coverage by data type (1 km² grid). The darker colors represent higher quality data. Inferred bottom type is classified as lower quality than the information collected through geophysical surveys, vibracores, and surficial grab samples. The highest quality coverage includes a combination of both geophysical and geotechnical data.

Mapping offshore resources with our partners

Data

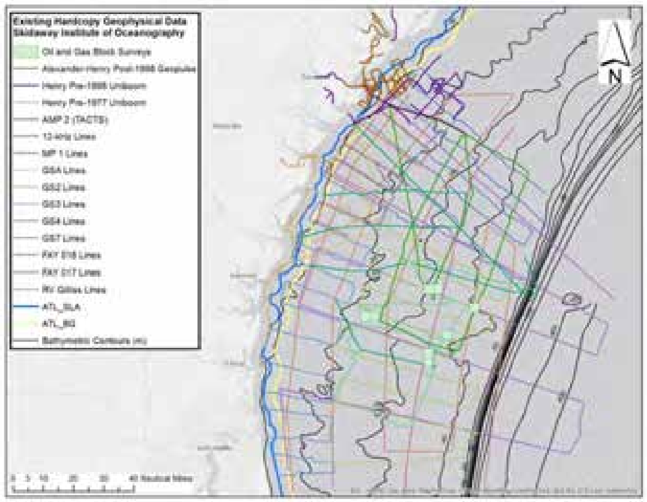
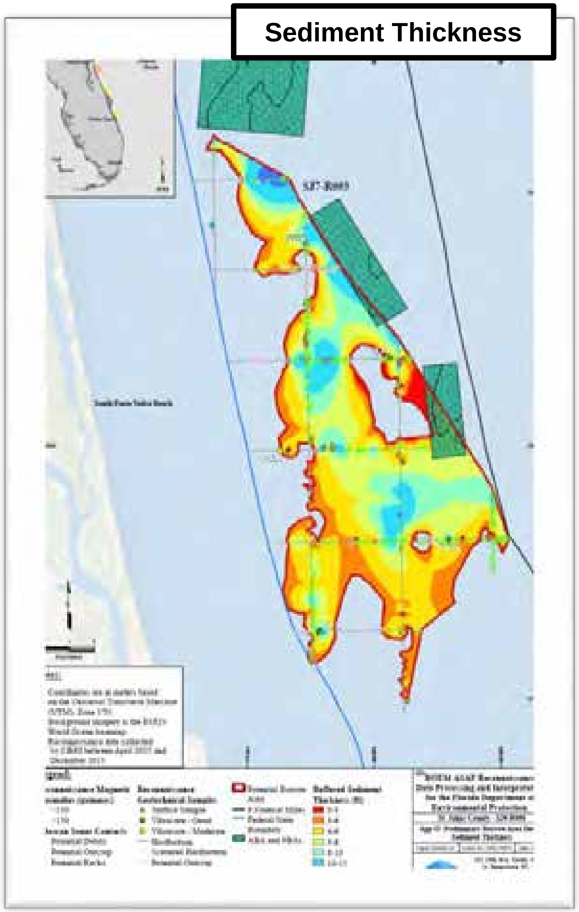
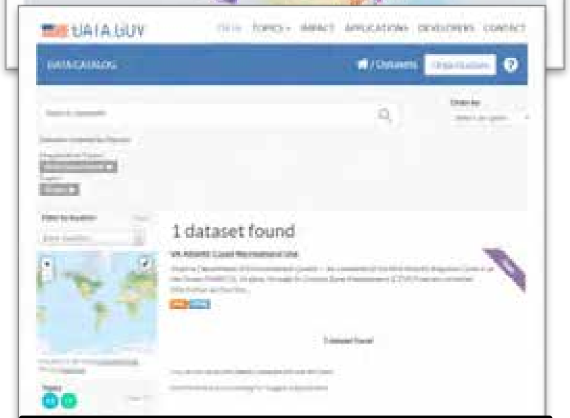


Figure 3: Track lines of legacy geophysical datasets existing in the archives at the Georgia southern University Applied Coastal Research Laboratory on Skidaway Island. Note that few lines cover the 3-8 nm region of interest.

Sediment Thickness



Reconnaissance Offshore Sand Search Inventory (OSSI)



OSSI registered with DATA.GOV

Mapping offshore resources with our partners

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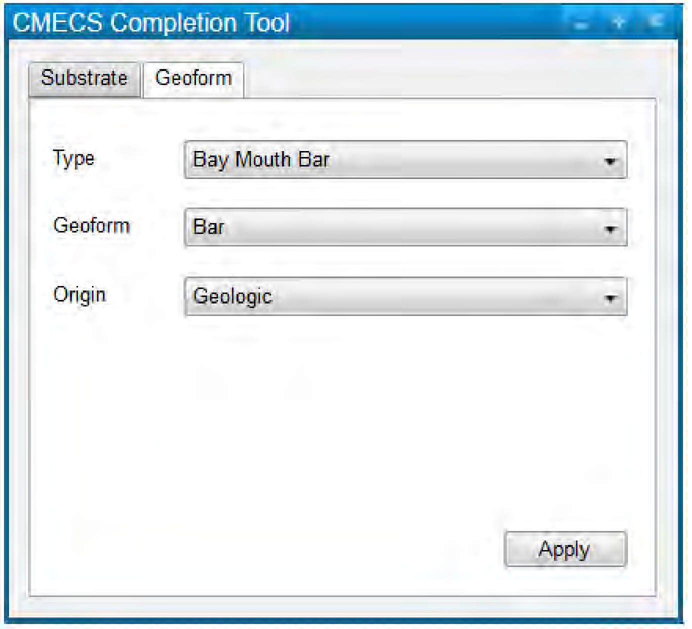
BUREAU OF OCEAN ENERGY MANAGEMENT

CMECS Implementation

- MMIS crosswalk completed
- Incorporated CMECS attributes into MMIS schema
- QSI development towards a CMECS completion tool



Substrate Component

Attributes and Domains

Affected Feature Class:
- Sample Table
- Sediment Primary
- Sediment Secondary

New Attribute
- Domain

SCOrigin
- Anthorpogenic
- Biogenic
- Geologic

SCClass
- Rock
- Unconsolidated Mineral
- Algal
- Coral
- Organic
- Ooze
- Shell
- Worm
- Anthropogenic Rock
- Anthropogenic Wood
- Construction Materials
- Metal
- Trash

SCSubclass
- Many

SCGroup
- Many

SCSubgroup
- Many

Geoform Component

Attributes and Domains

Affected Feature Class:
- Seabed Features (Poly, Arc, Pnt)
  - Keep Feature Description Attribute
  - Remove Feature Type Attribute

New Attribute
- Domain

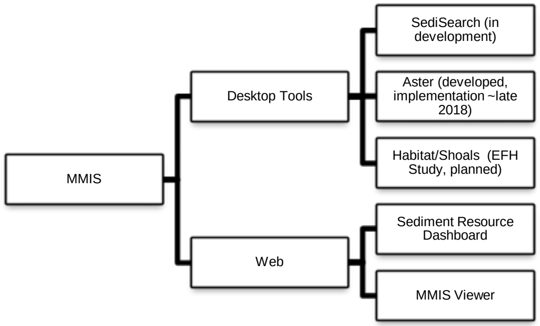
GCLevel
- Level 1 (>1km²)
- Level 2 (<1km²)

GCOrigin
- Anthorpogenic
- Biogenic
- Geologic

GCGeoform
- Many

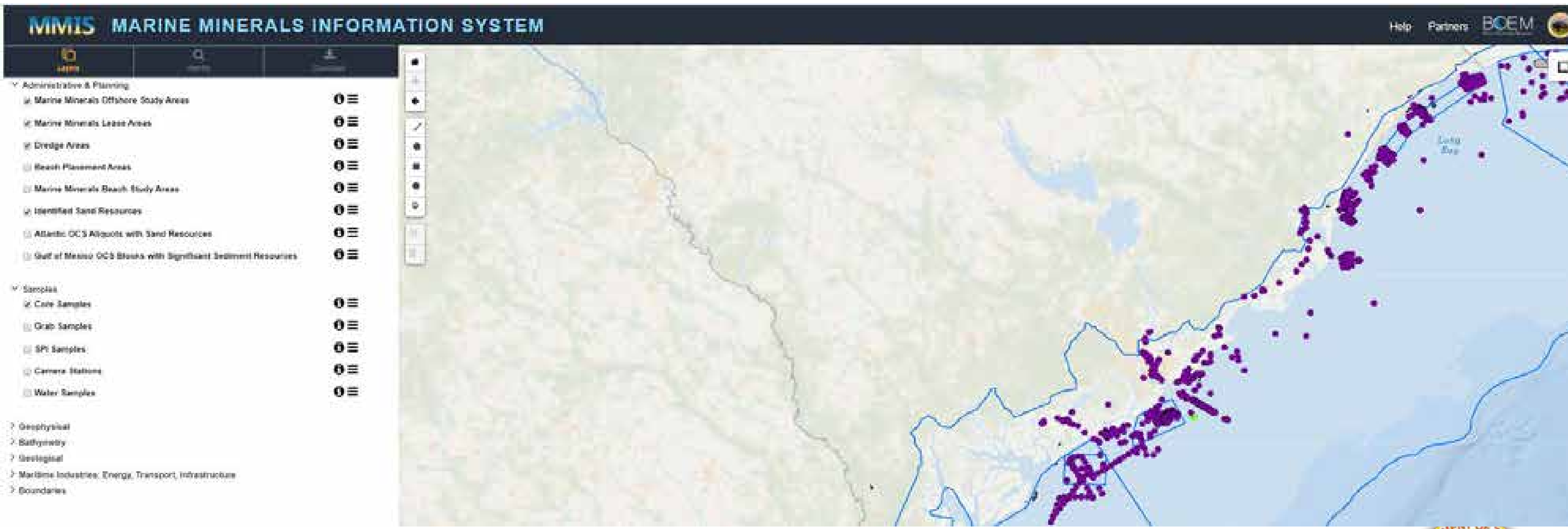
GCType
- Many

Access



MMIS Demo

Planned for the Public



5 Year Mapping Plans

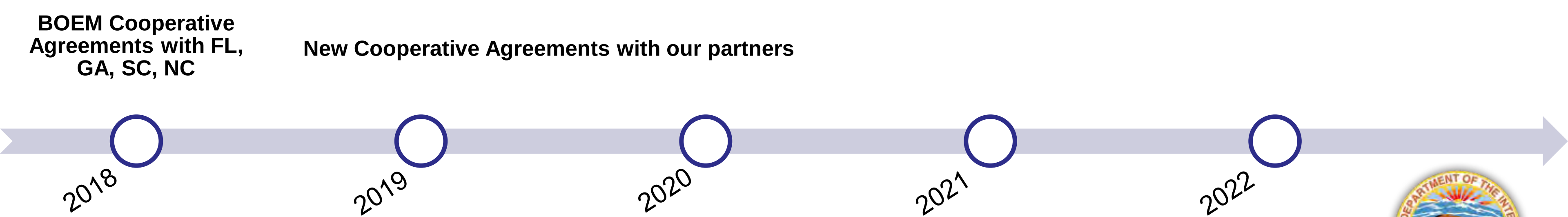
- **Collection** - currently no new acquisition plans
  - (ASAP Phase 2 / GSAP - tbd)
- **Evaluate existing offshore data –** ongoing
  - Geophysical data: multi-beam, chirp sub-bottom profiling, swath bathymetry, sidescan sonar and magnetometer
  - Geotechnical data: sediment samples (vibracores and surface grab samples) analyzed for texture (grain size) and composition (organic, mineral and shell content, color and sand percentage)
- **Identify data gaps / priority areas -** ongoing
- **Assess future sand / sediment needs -** ongoing
- **Identify potential sources** – ongoing
- **Facilitate public accessibility of data** – in progress

Lease Borrow Areas

- **USACE Pre Dredge Surveys**
  - Martin – Jan 2018
  - Longboat Key - tbd
  - Patrick AFB - tbd
  - Collier – tbd
- **USACE Post Dredge Surveys**
  - Brevard – tbd
  - Myrtle Beach –tbd

Agreements / Partnerships

- Cooperative Agreements (2014-2018) (processing)
- USACE MOA (2017) (collaboration)
- AASG MOA (2015-2020) (collaboration)
- IA with NOAA OCM (2017-2022) (acquisition)



Thank you

Lora Turner

https://www.boem.gov/Marine-Minerals-Program/

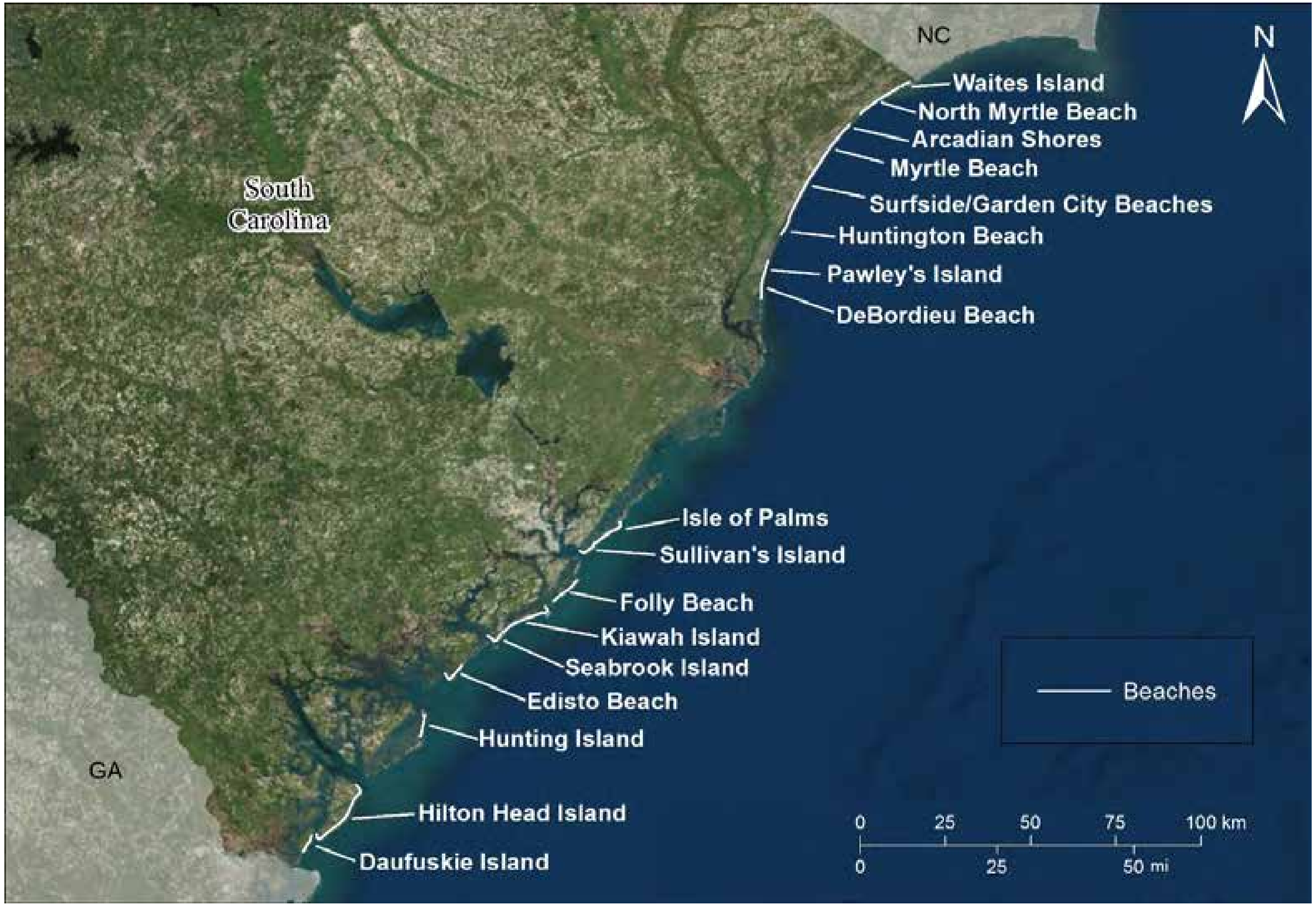
marineminerals@boem.gov

Investigations Into South Carolina's Outer Continental Shelf (OCS) Sand Resources: Data Inventory, Resource Assessment, and Recent Data Collection and Analysis Efforts

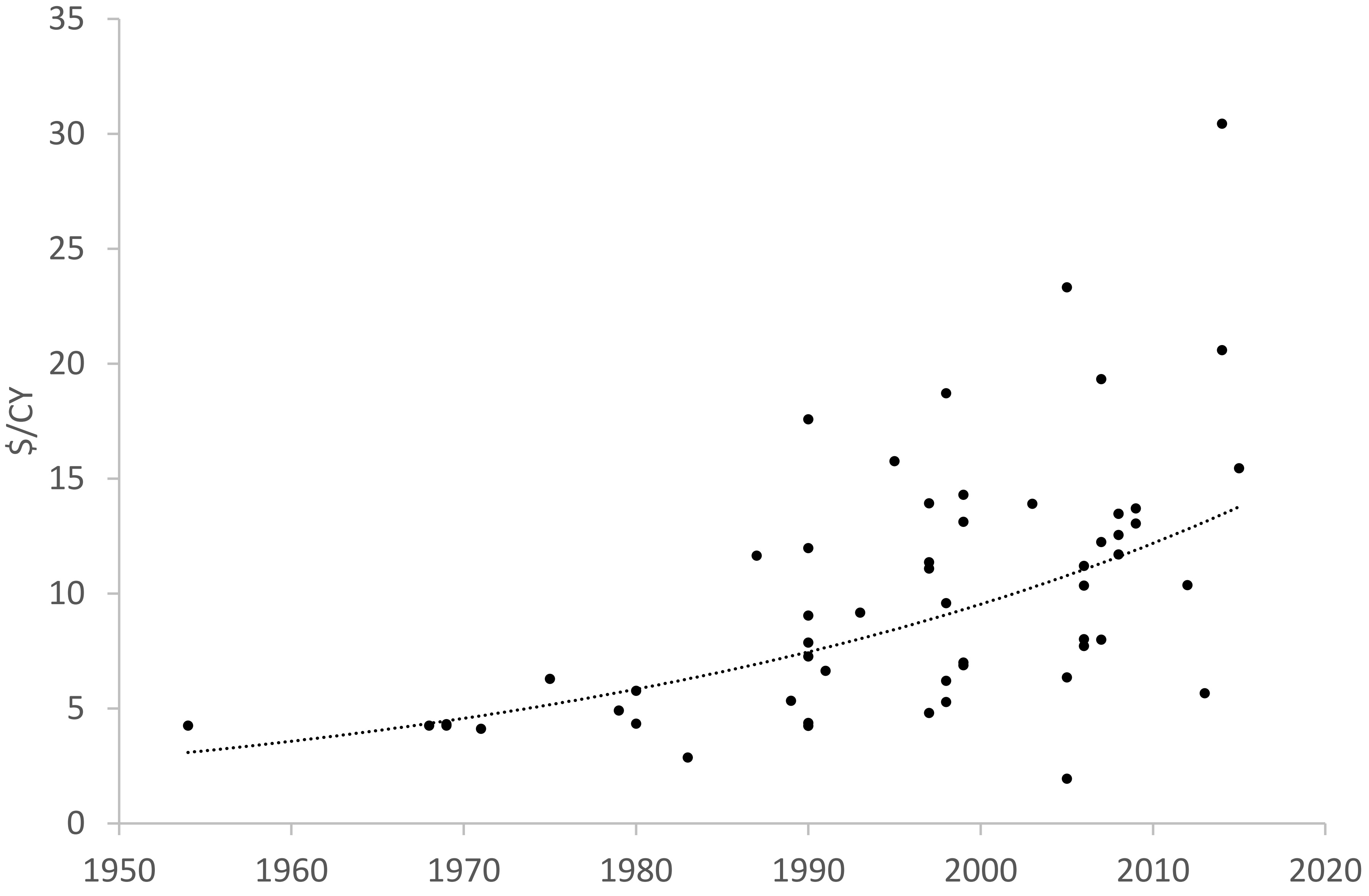
Andrew Tweel[1], Katherine Luciano[2], Denise Sanger[1], Scott Howard[2]

[1] Marine Resources Research Institute, Marine Resources Division – South Carolina Department of Natural Resources

[2] South Carolina Geological Survey, Land, Water and Conservation Division – South Carolina Department of Natural Resources



Increase in Offshore Borrow Cost Over Time



Goals for the BOEM SC State Cooperative Project I (2014 – 2016):

1. Identify existing geophysical/geotechnical data and acquire data, where possible

2. Assess South Carolina's coastal communities' sand needs in relation to identified data gaps

3. Compile data and provide to BOEM with FGDC-compliant metadata and in a compatible format

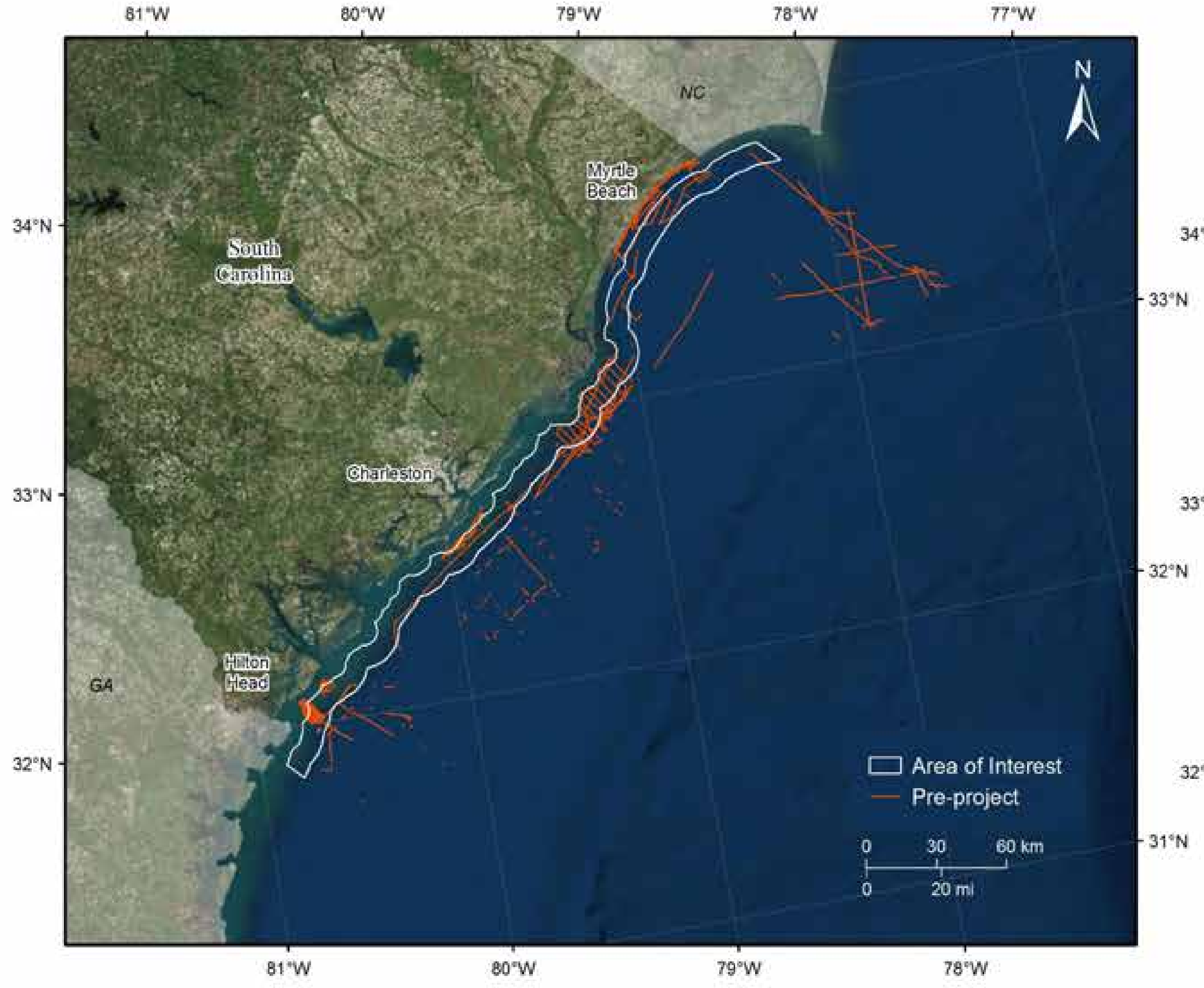
Goals for the BOEM SC State Cooperative Project II (2016 – 2018):

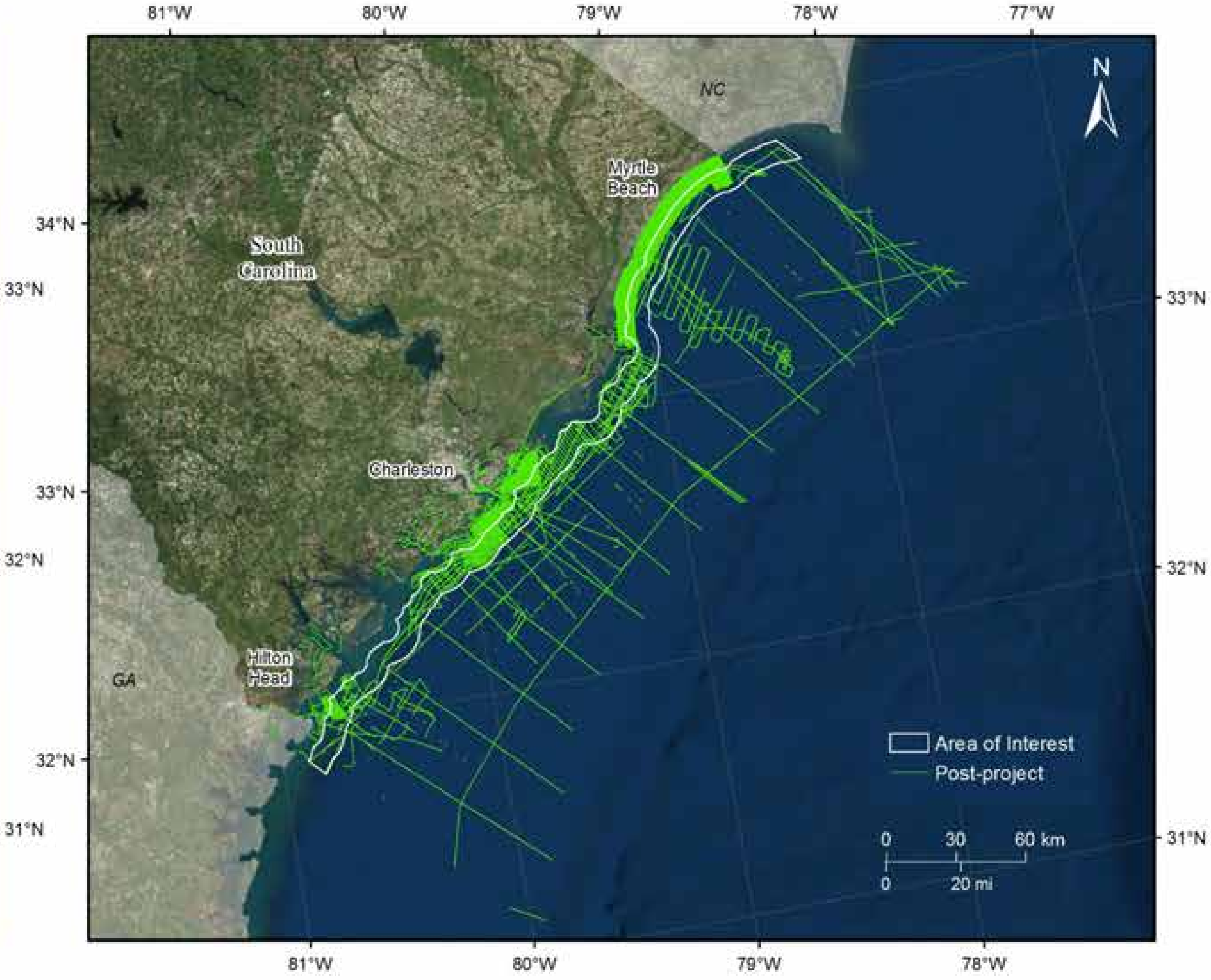
1. Continue integrating historical datasets into database through sub-projects with the College of Charleston and the University of South Carolina

2. Process and analyze all data collected offshore of South Carolina by CB&I in 2015

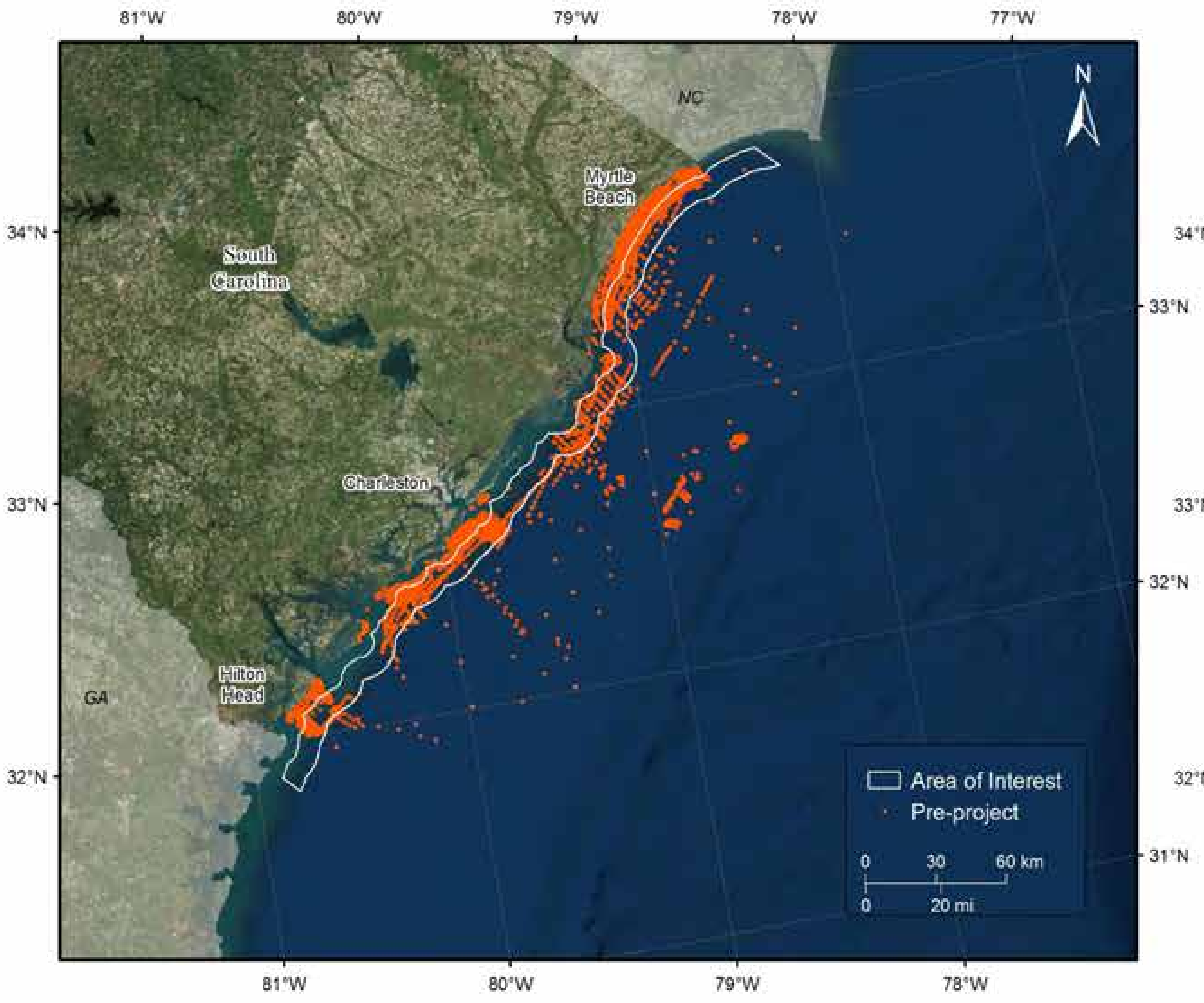
3. Integrate historical data and ASAP data, along with high-resolution bathymetry, to identify potential areas of beach-compatible sand material in the 3-8 nautical mile Outer Continental Shelf

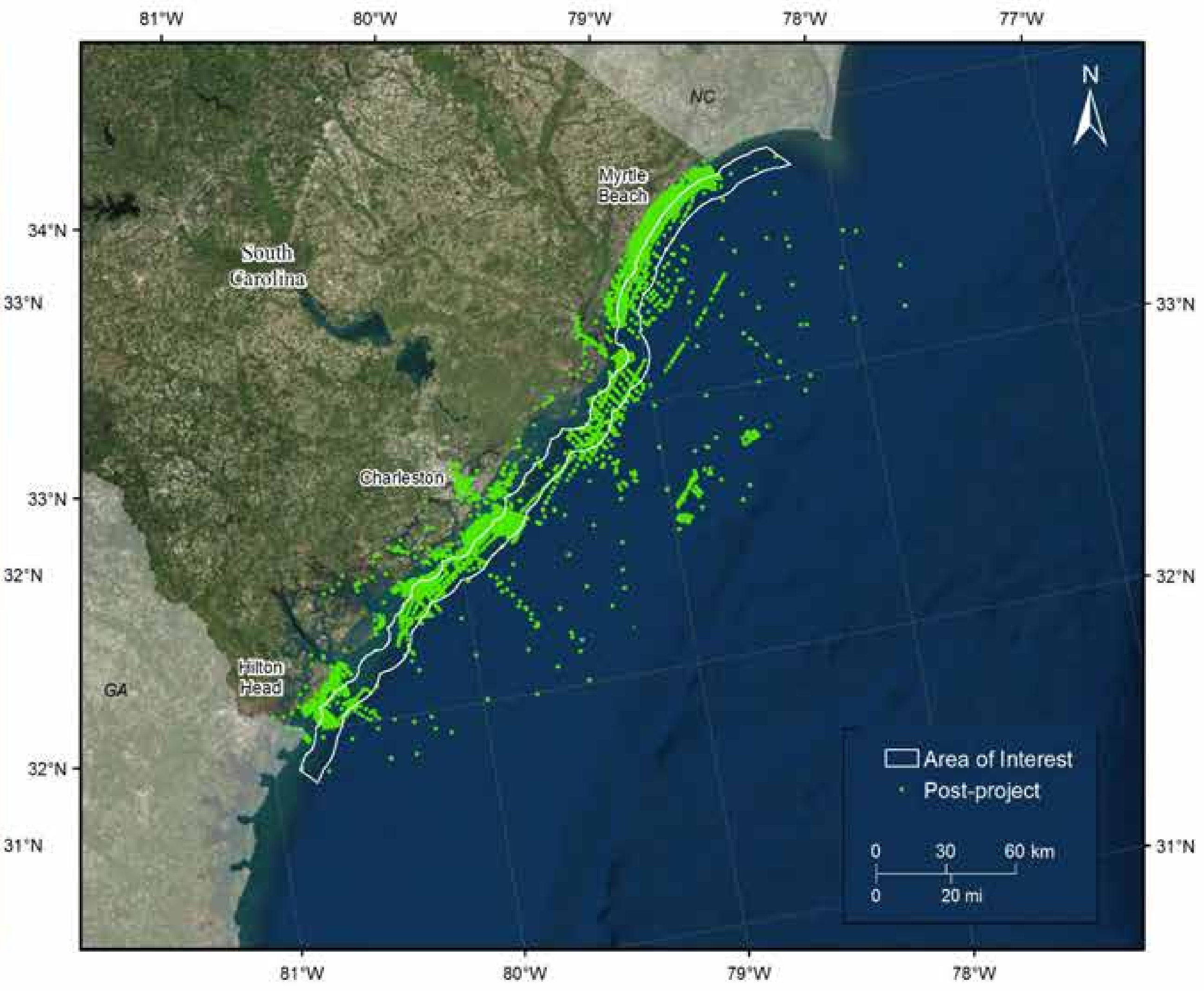
Geophysical Data Coverage: Pre- and Post-Project



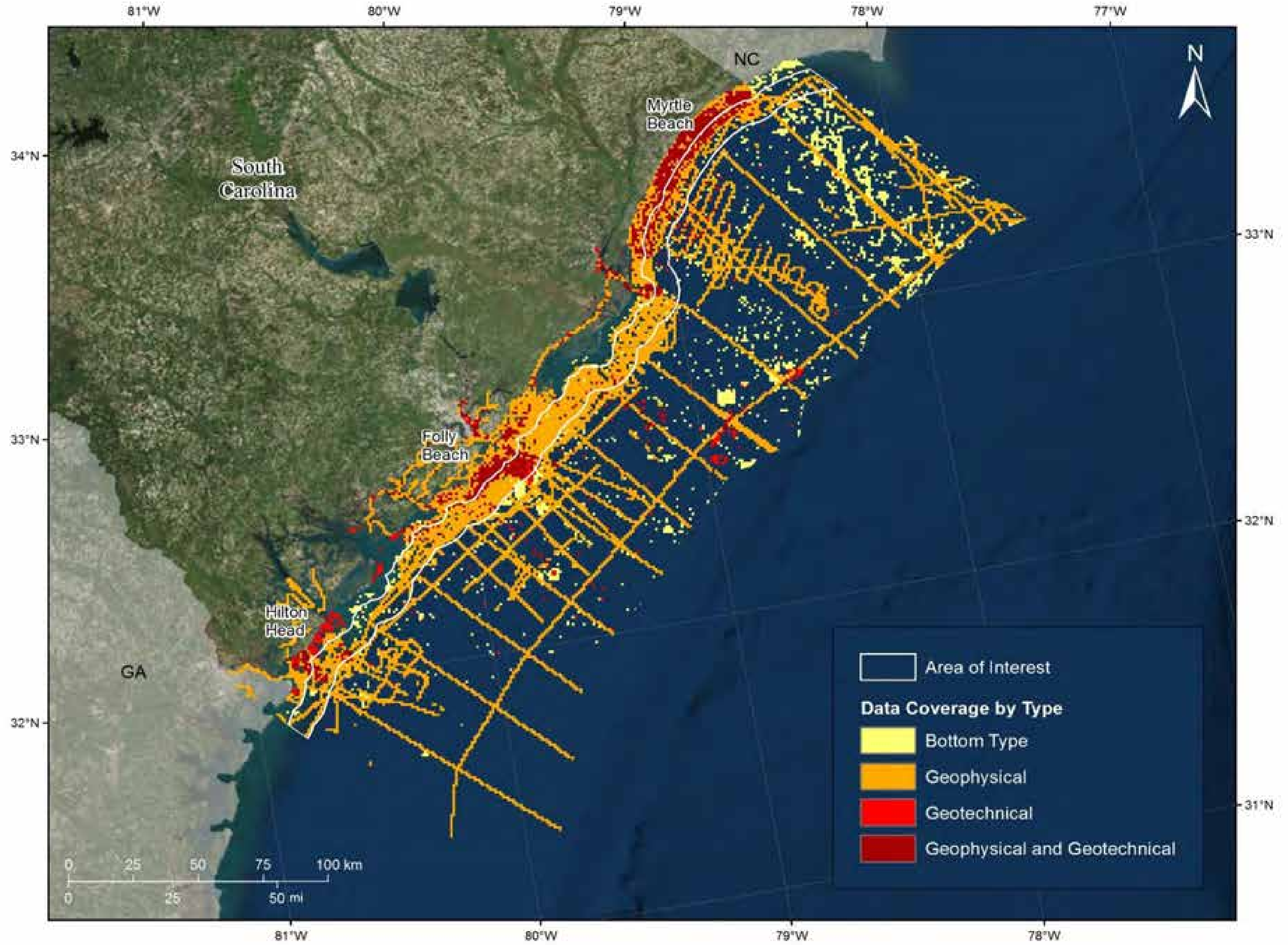


Geotechnical Data Coverage: Pre- and Post-Project

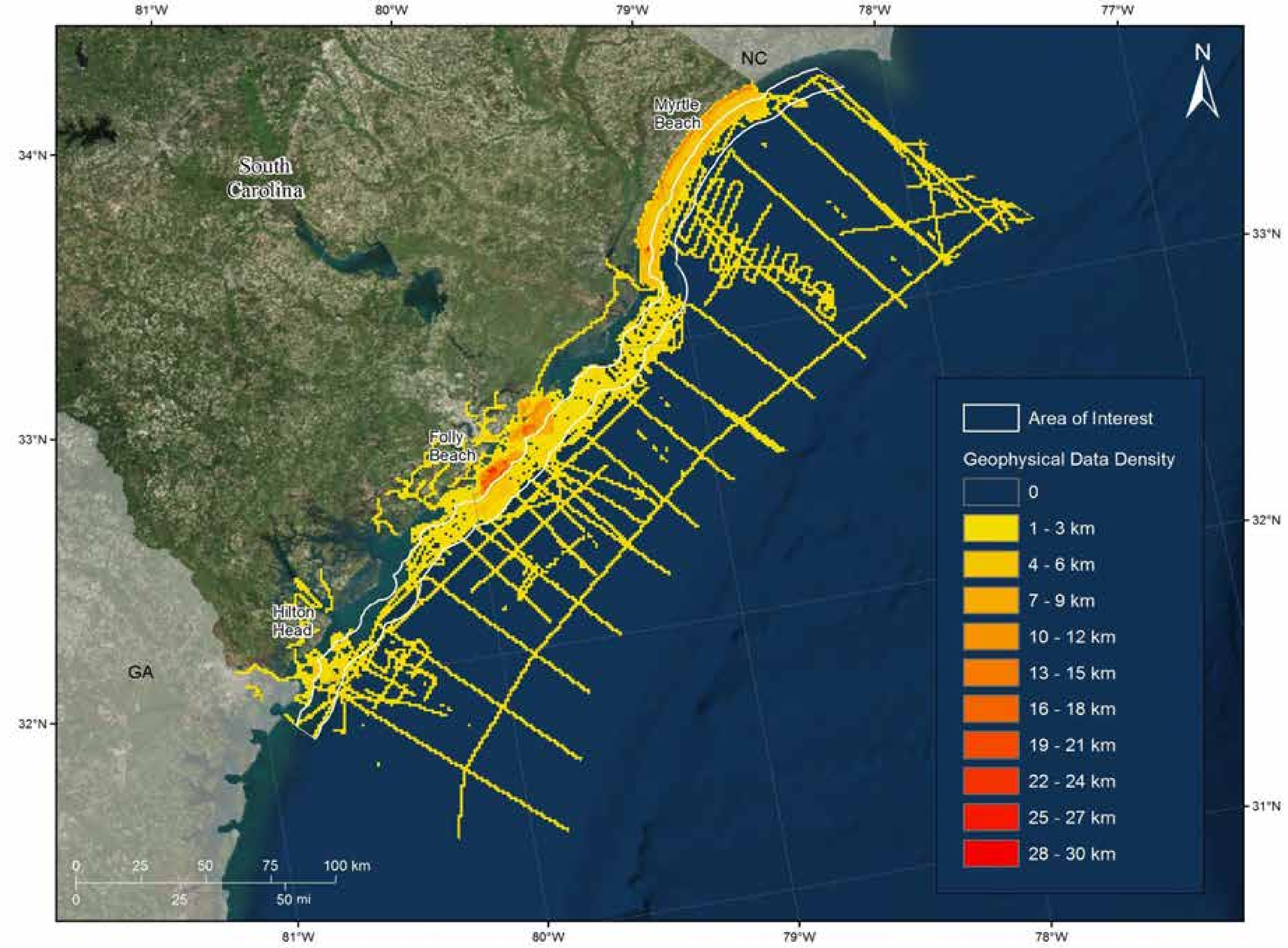




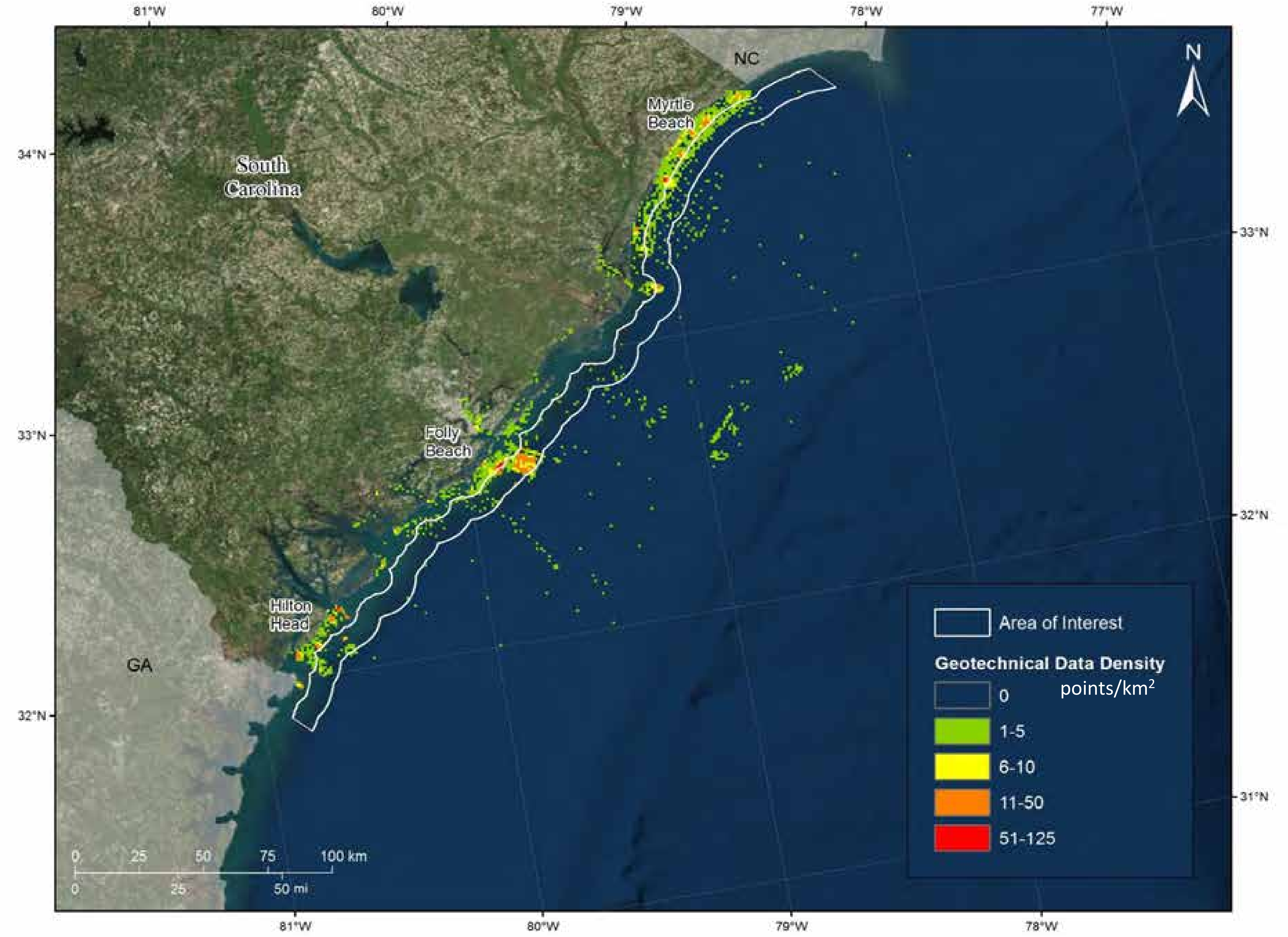
Understanding Where Data Gaps Exist: Data Coverage by Type



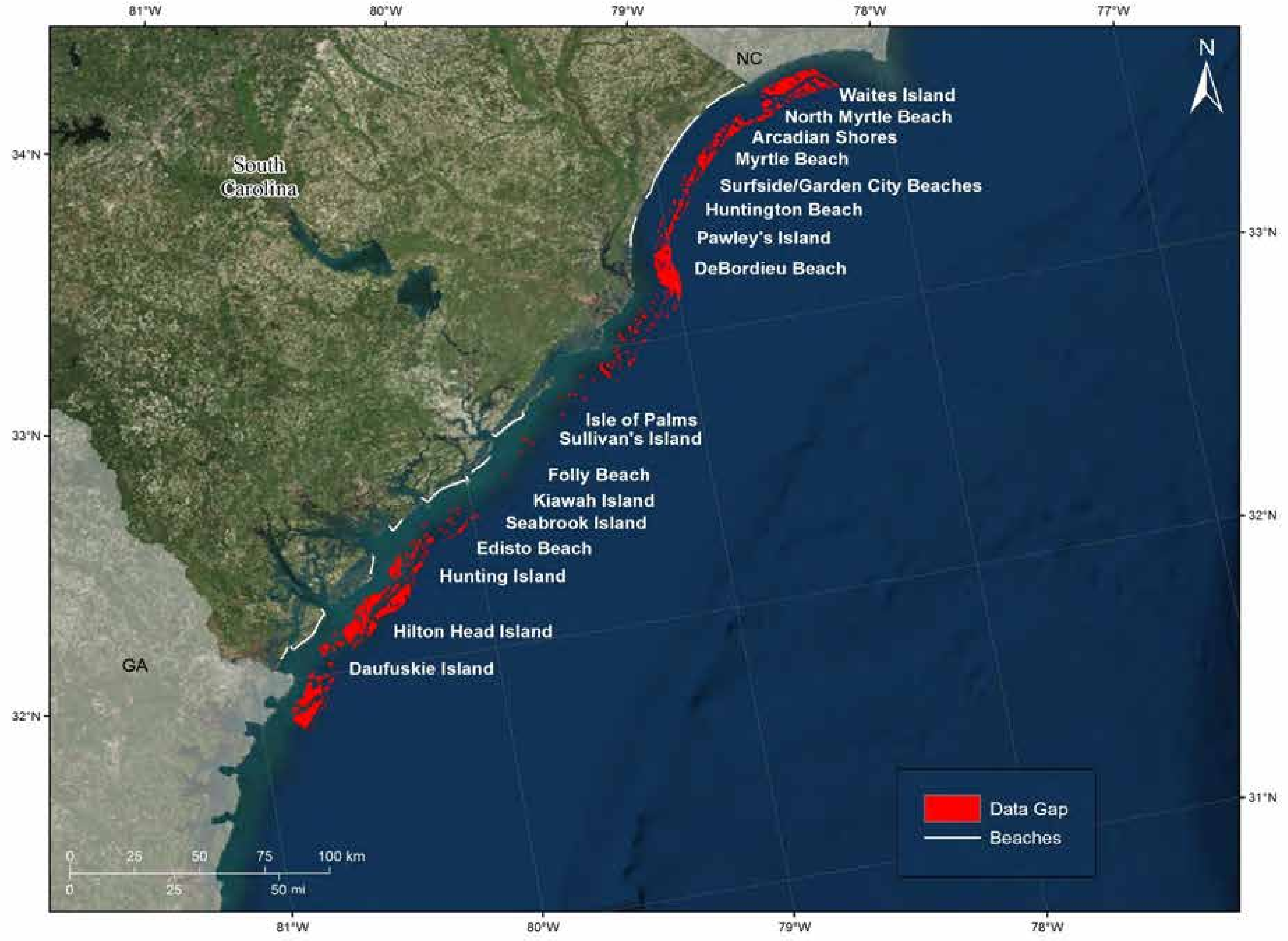
Understanding Where Data Gaps Exist: Geophysical Data Density



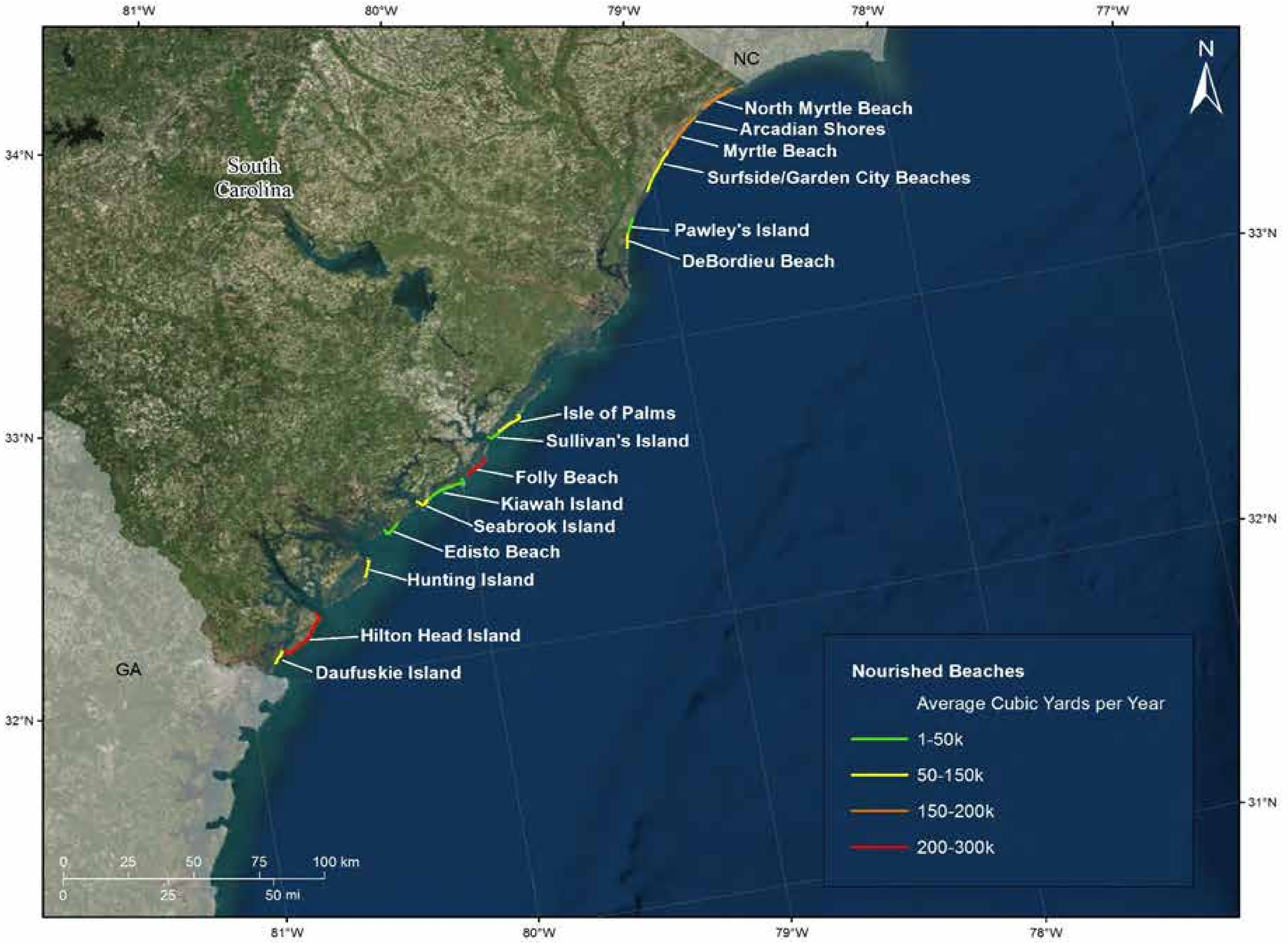
Understanding Where Data Gaps Exist: Geotechnical Data Density



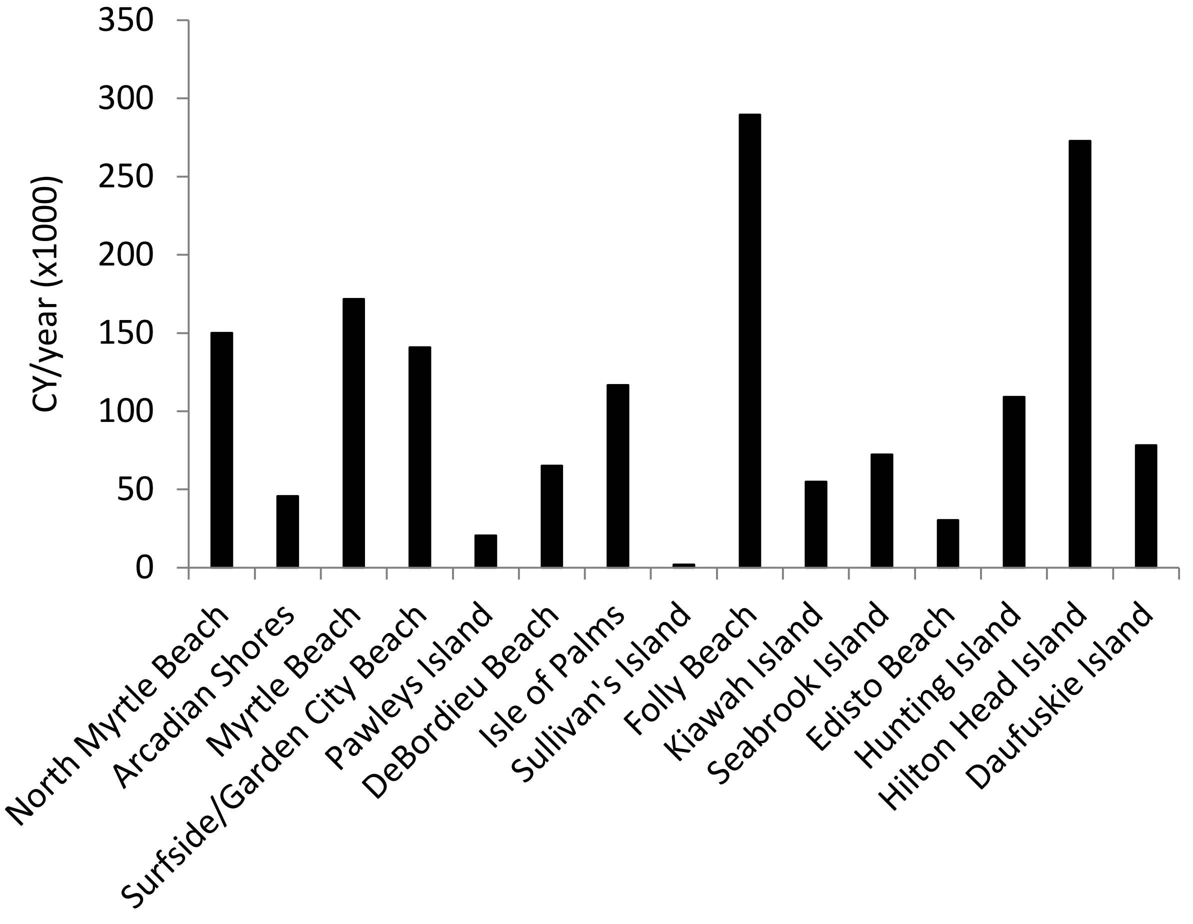
Identified Data Gaps



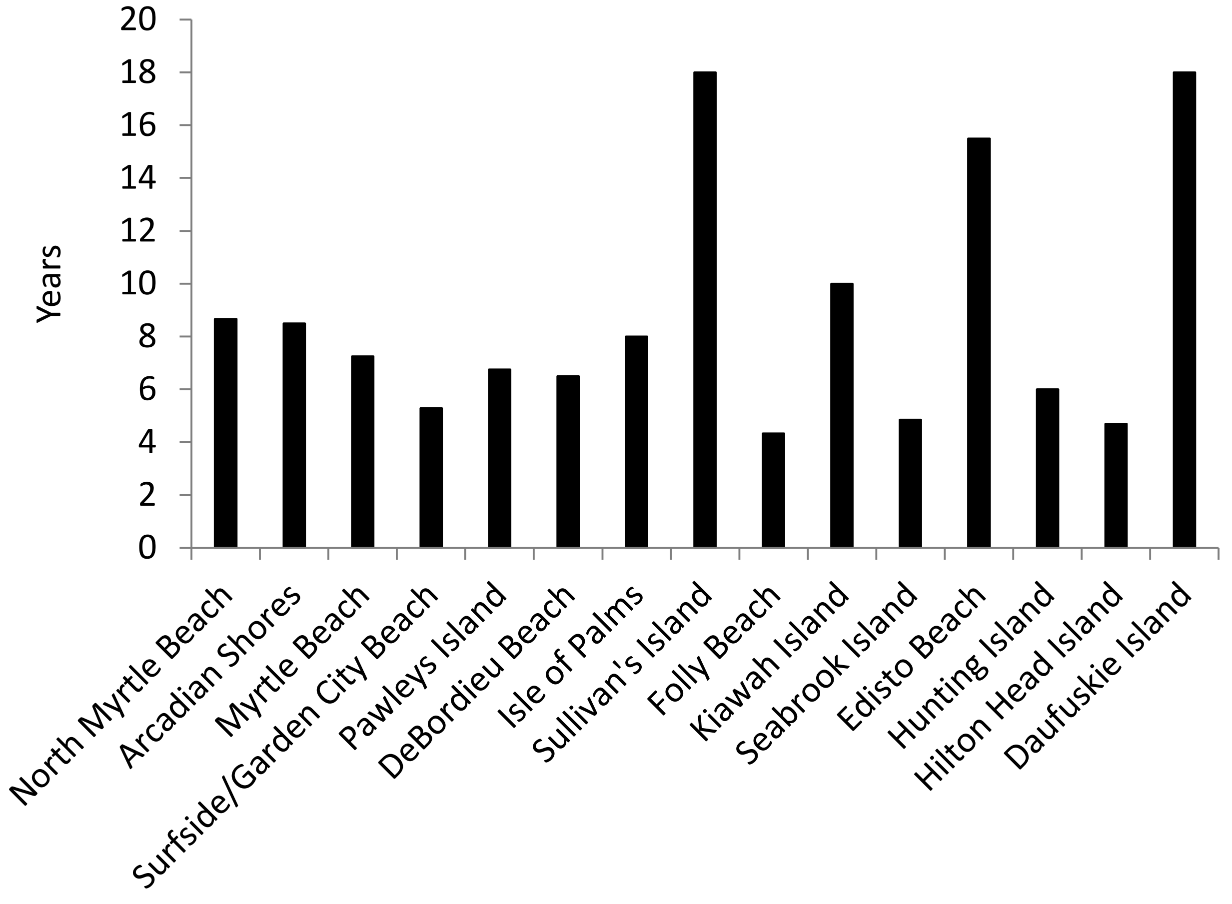
Needs for South Carolina's Nourished Beaches:



Needs for South Carolina's Nourished Beaches: Past Sand Usage



Time-average sand usage by beach community



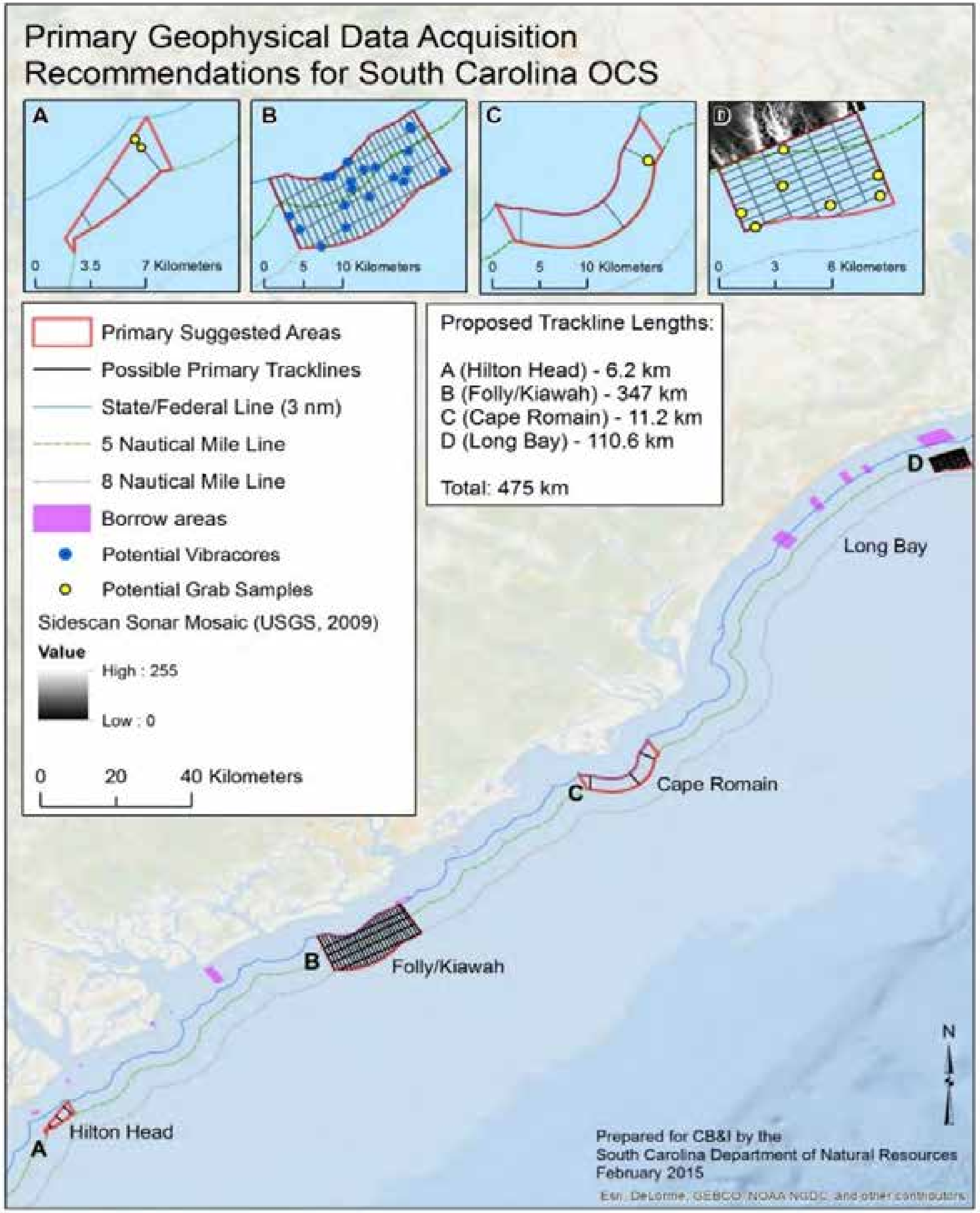
Average time span between nourishment events

Addressing Known Data Gaps: Recommendations for ASAP Data Collection

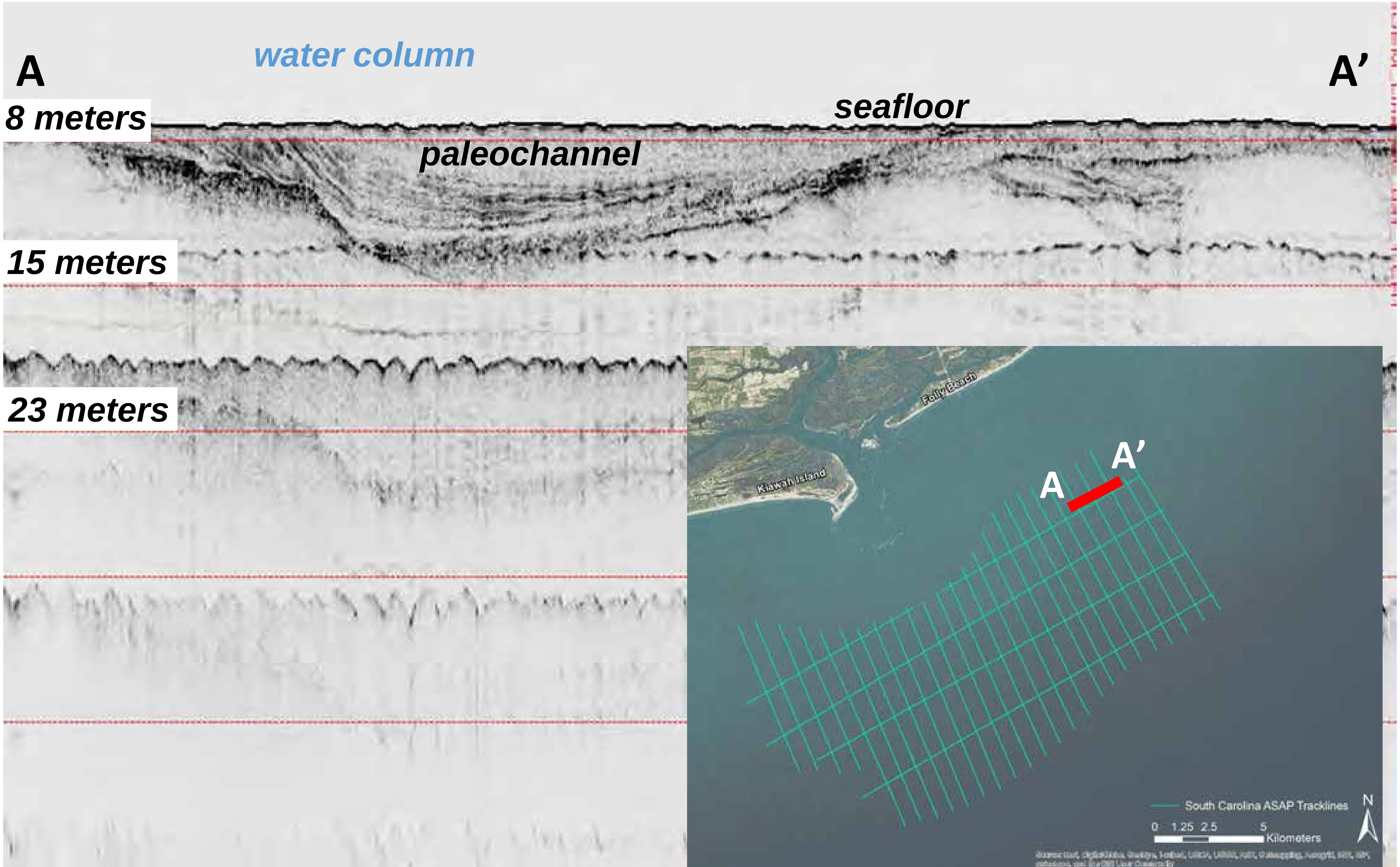
- BOEM contractor CB&I, North Carolina and Georgia state cooperative partners, and representatives from the Charleston and Wilmington district USACE met in early 2015 to discuss data acquisition

- Based on known data distribution, age and quality of the available data, and past need for nourishment quality sand resources, several areas were recommended

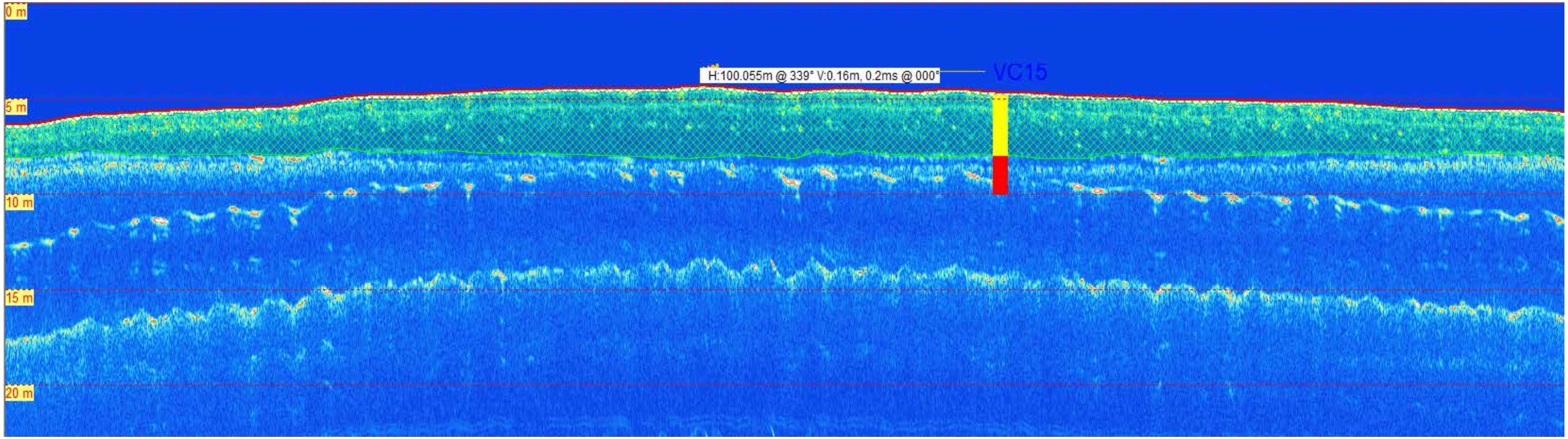
- South Carolina was allocated 475 km of trackline and 30 geologic samples (19 vibracores, 11 grab samples)



Processed ASAP Data : Chirp Subbottom Profiler



BOEM ASAP Data – Chirp Subbottom + Vibracore



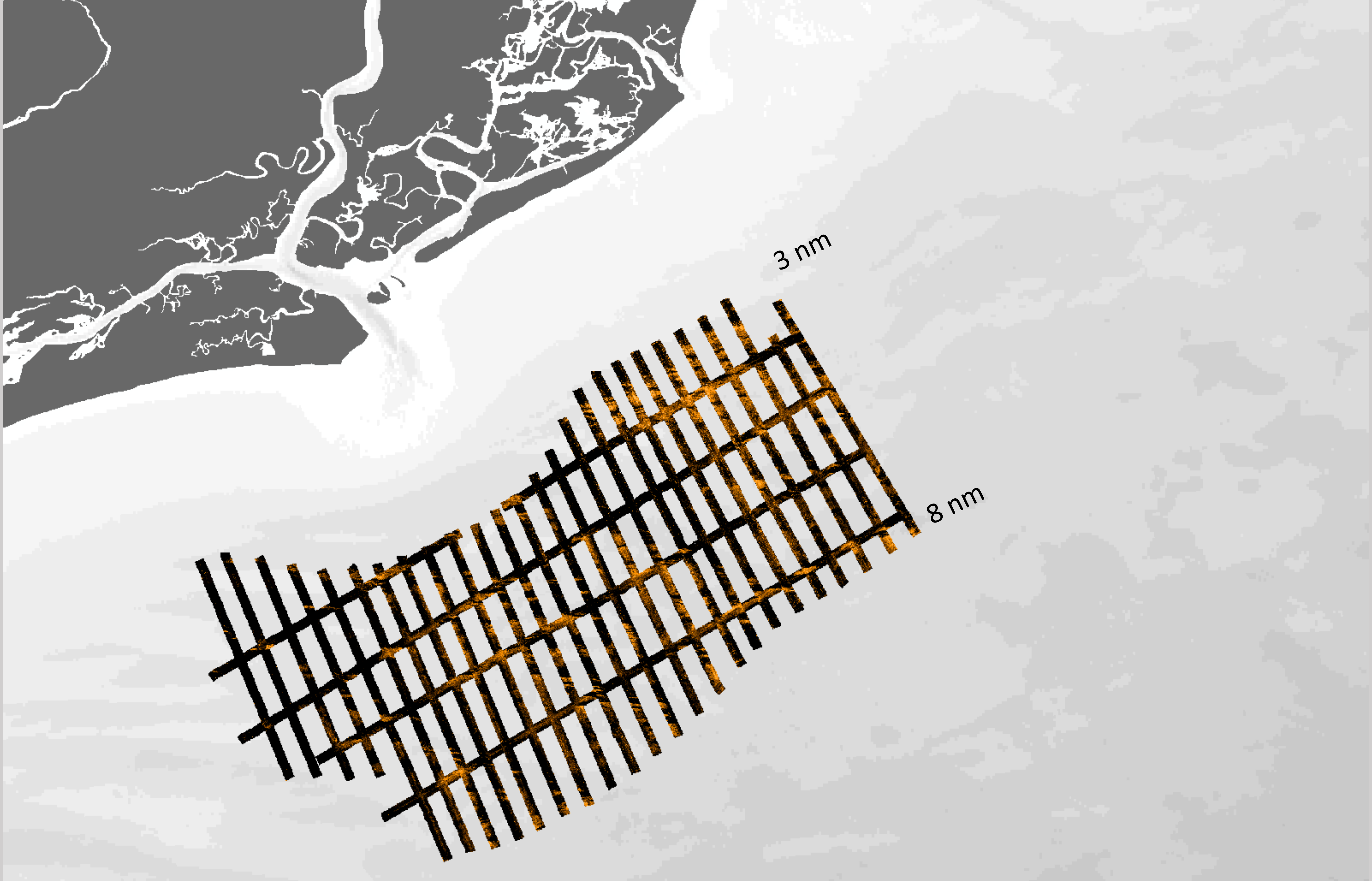
- Data obtained from ASAP project includes information on grain size, mineralogy, shell content

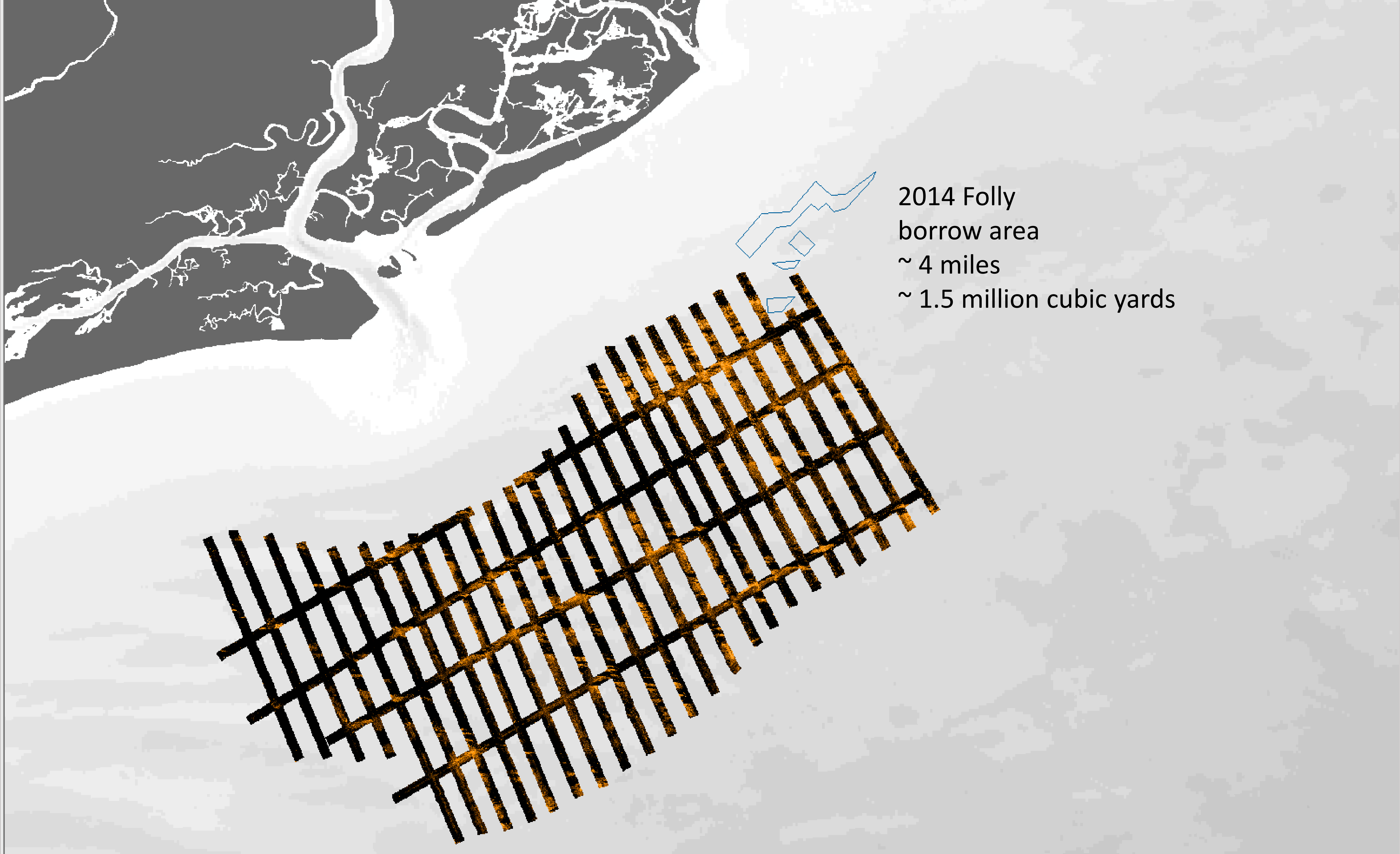
- Additional analyses are currently being conducted to learn more about the sedimentology, mineralogy, and relative ages of the surficial and sub-surface materials

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS Depths and elevations based on measured values
-29.1	0.0		
-30.9	1.8		SAND, fine grained, quartz, trace shell hash, trace silt, dark gray (5Y-4/1), (SP).
-33.5	4.4		SAND, fine grained, quartz, trace shell fragments, trace shell hash, trace silt, shell fragments up to (0.5" x 0.25"), olive gray (5Y-4/2), (SP).
-39.5	10.4		SAND, fine grained, quartz, trace shell fragments, trace shell hash, trace silt, shell fragments up to (0.5" x 0.25"), very dark gray (5Y-3/1), (SP-SM).

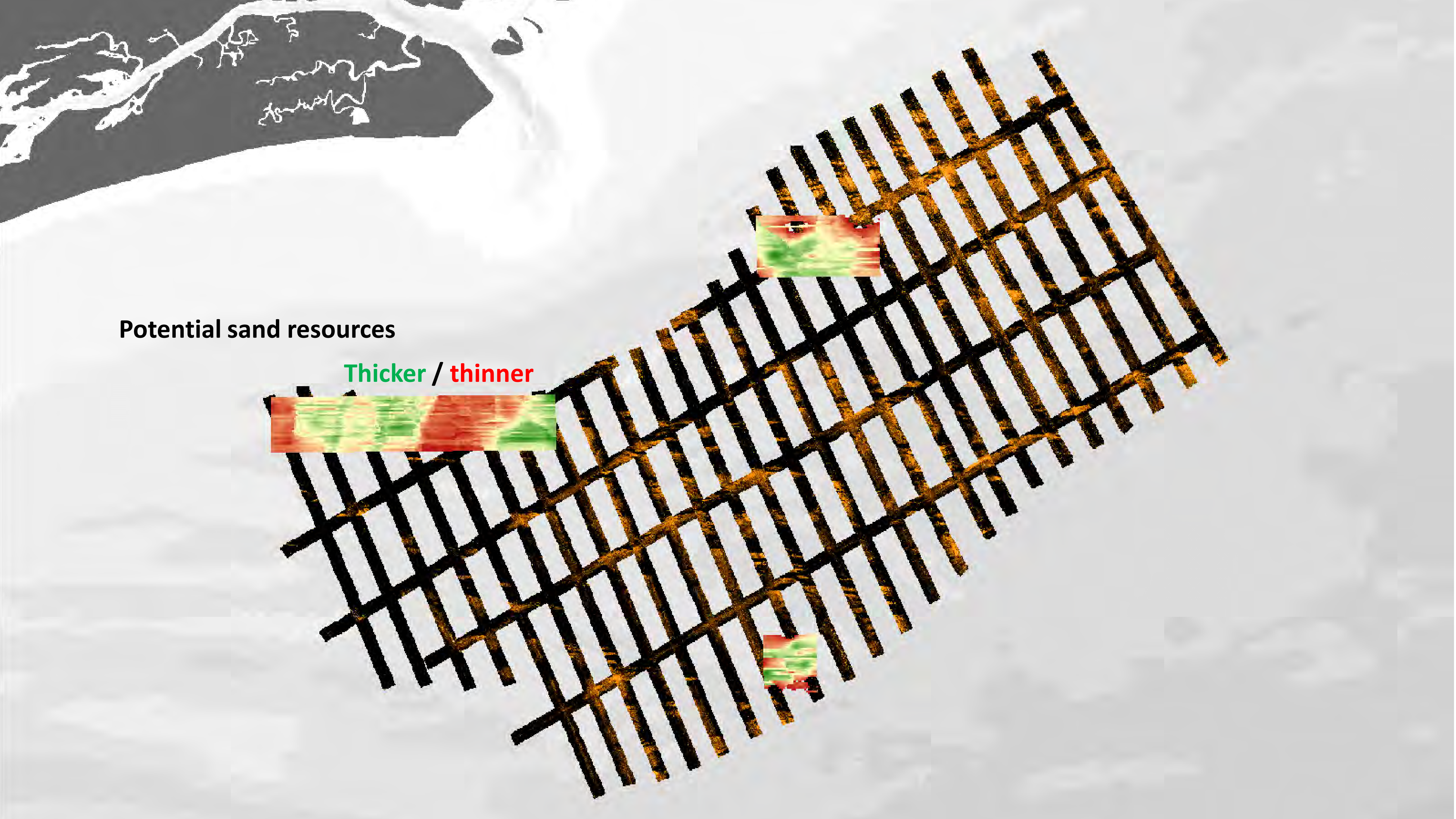
2.8 feet

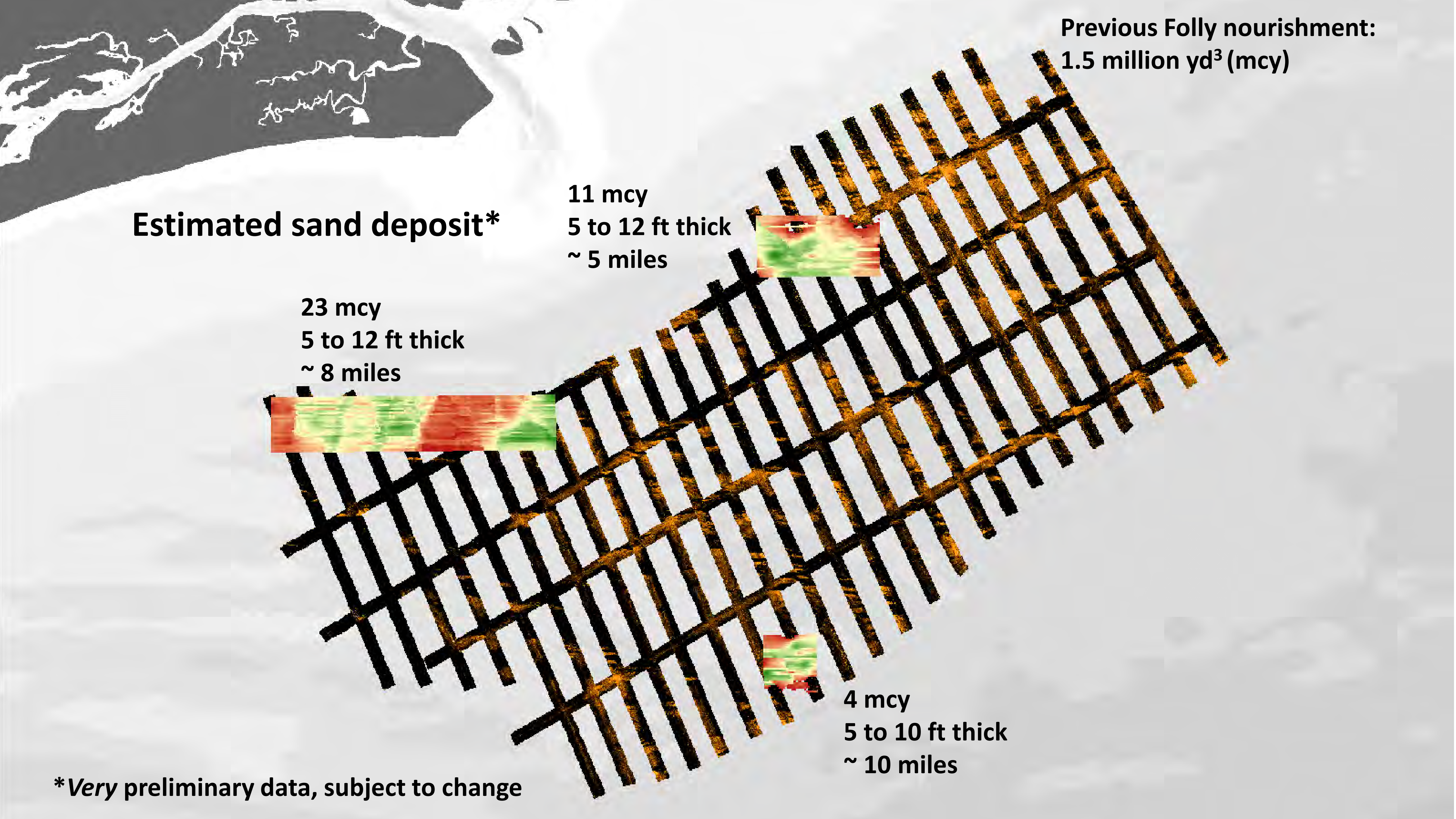
7.8 feet


3 nm
8 nm


2014 Folly
borrow area
~ 4 miles
~ 1.5 million cubic yards


Bottom vibracore sample
Sand thickness > 5 ft
Bottom grab sample


Potential sand resources
Thicker / thinner


Previous Folly nourishment:
1.5 million yd³ (mcy)
Estimated sand deposit*
11 mcy
5 to 12 ft thick
~ 5 miles
23 mcy
5 to 12 ft thick
~ 8 miles
4 mcy
5 to 10 ft thick
~ 10 miles
*Very preliminary data, subject to change

Thank You!

Andrew Tweel – tweela@dnr.sc.gov
Katie Luciano – lucianok@dnr.sc.gov

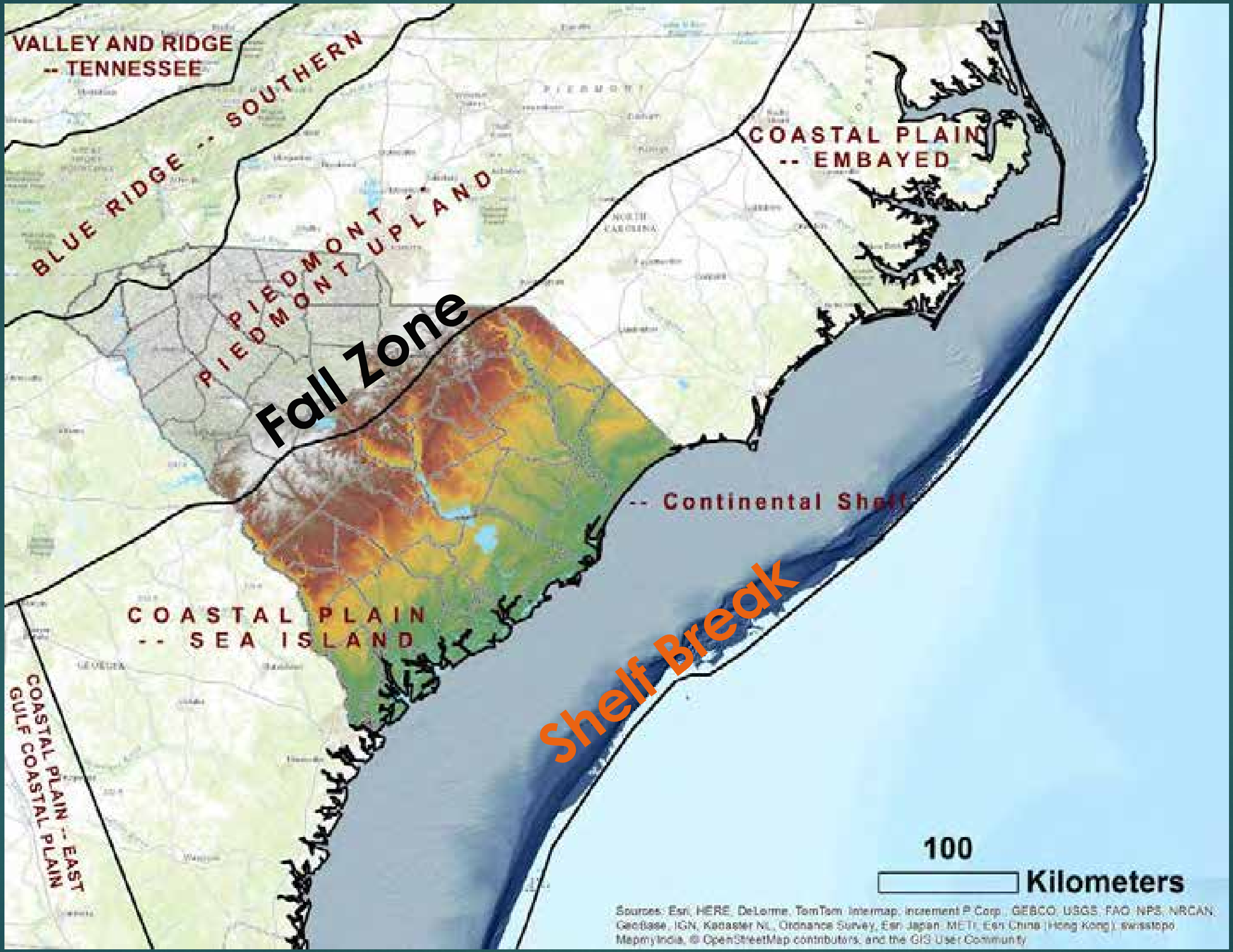
Offshore mapping and student research College of Charleston and Partners

M. SCOTT HARRIS, PH.D., P.G. (AND→LOTS OF COLLEAGUES)

DEPARTMENT OF GEOLOGY AND ENVIRONMENTAL GEOSCIENCES
DIRECTOR OF ARCHAEOLOGY
MASTER OF SCIENCE IN ENVIRONMENTAL STUDIES PROGRAM
OCCASIONALLY, MARINE BIOLOGY PROGRAM

COLLEGE of CHARLESTON
DEPARTMENT OF GEOLOGY AND ENVIRONMENTAL GEOSCIENCES

Elevations



COLLEGE of CHARLESTON
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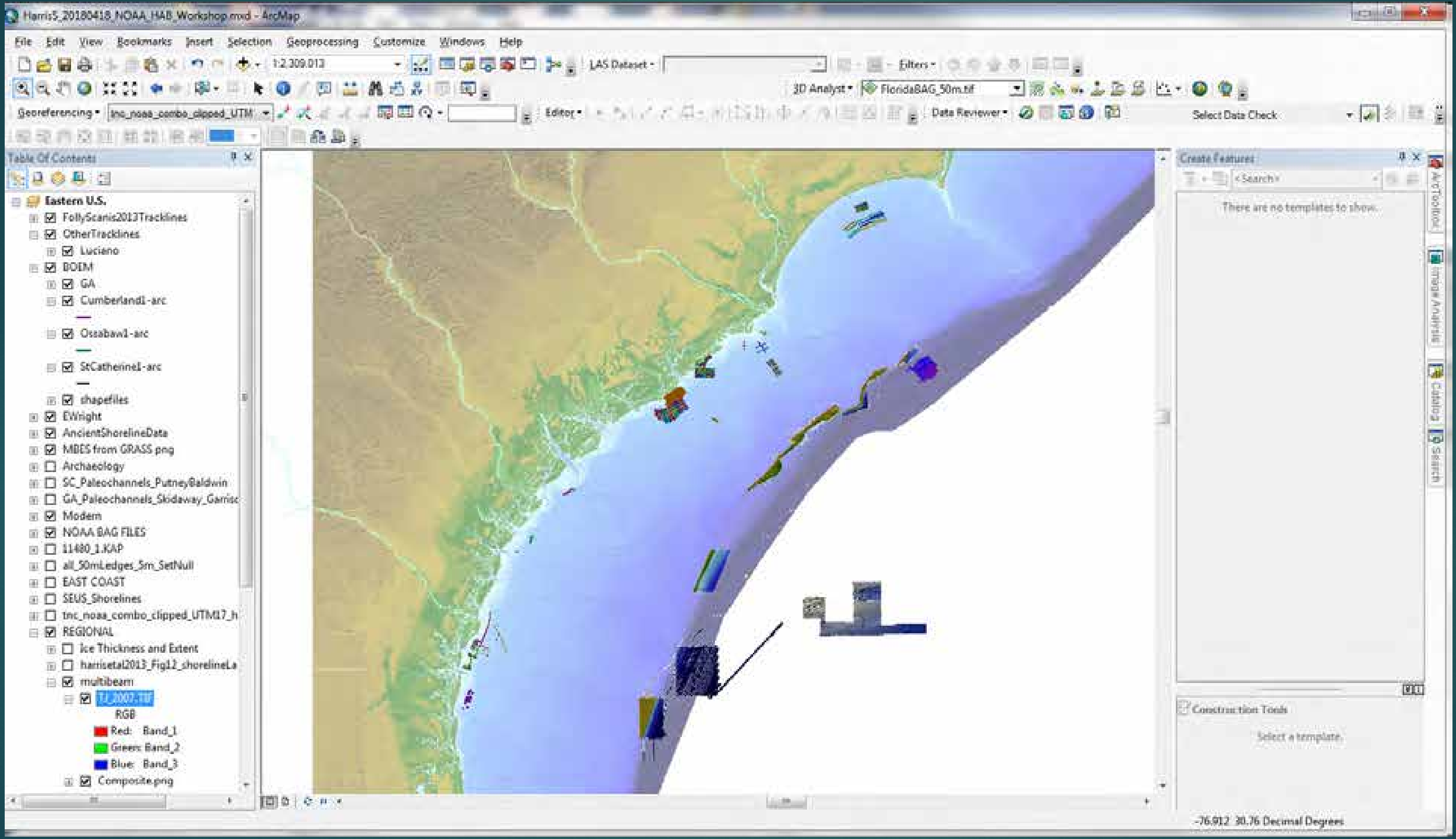
Data



COLLEGE of CHARLESTON
DEPARTMENT OF GEOLOGY AND ENVIRONMENTAL GEOSCIENCES

Data

- **BOEM/ CCU/ NOAA**
- **Inshore USGS**

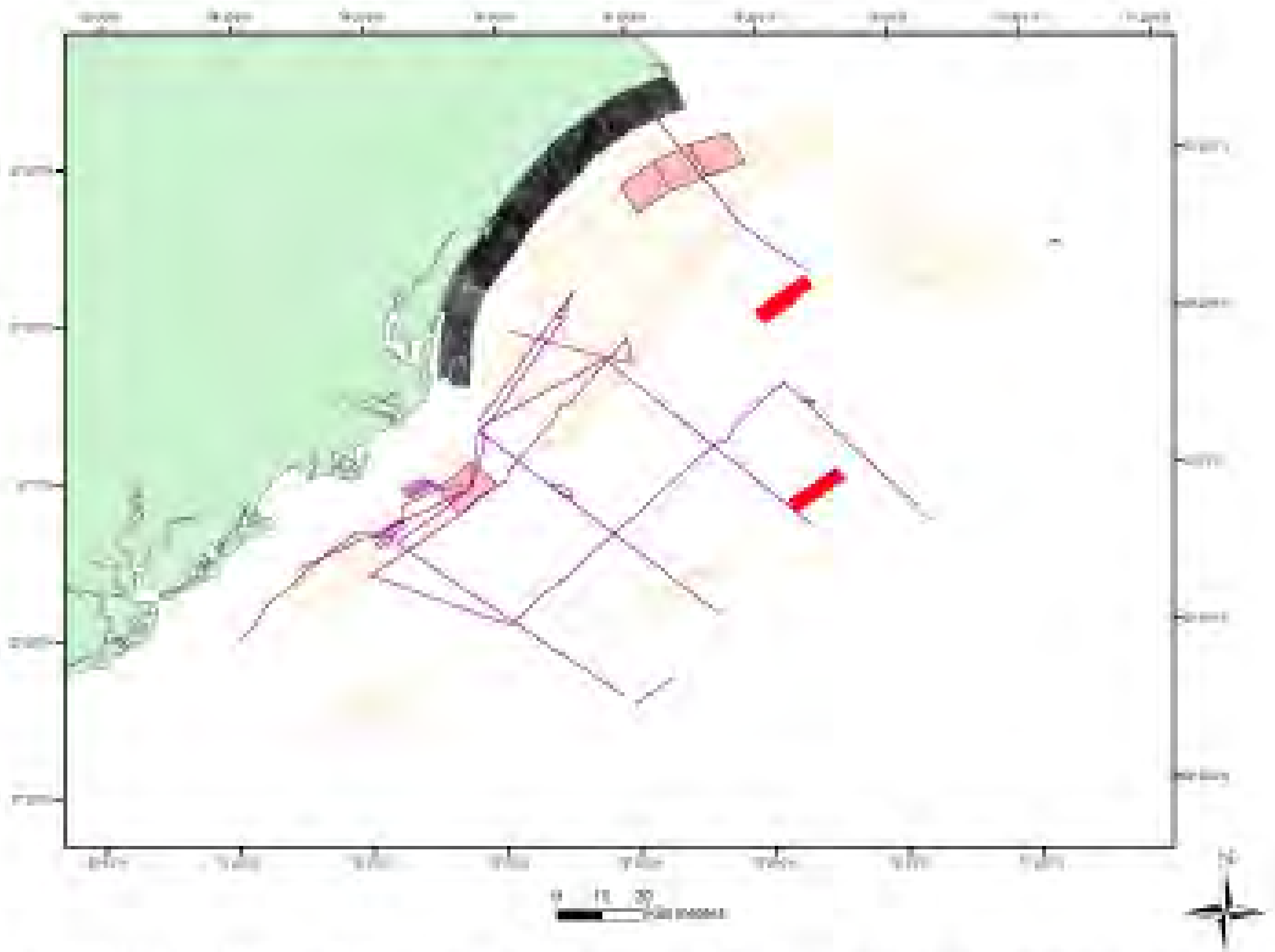
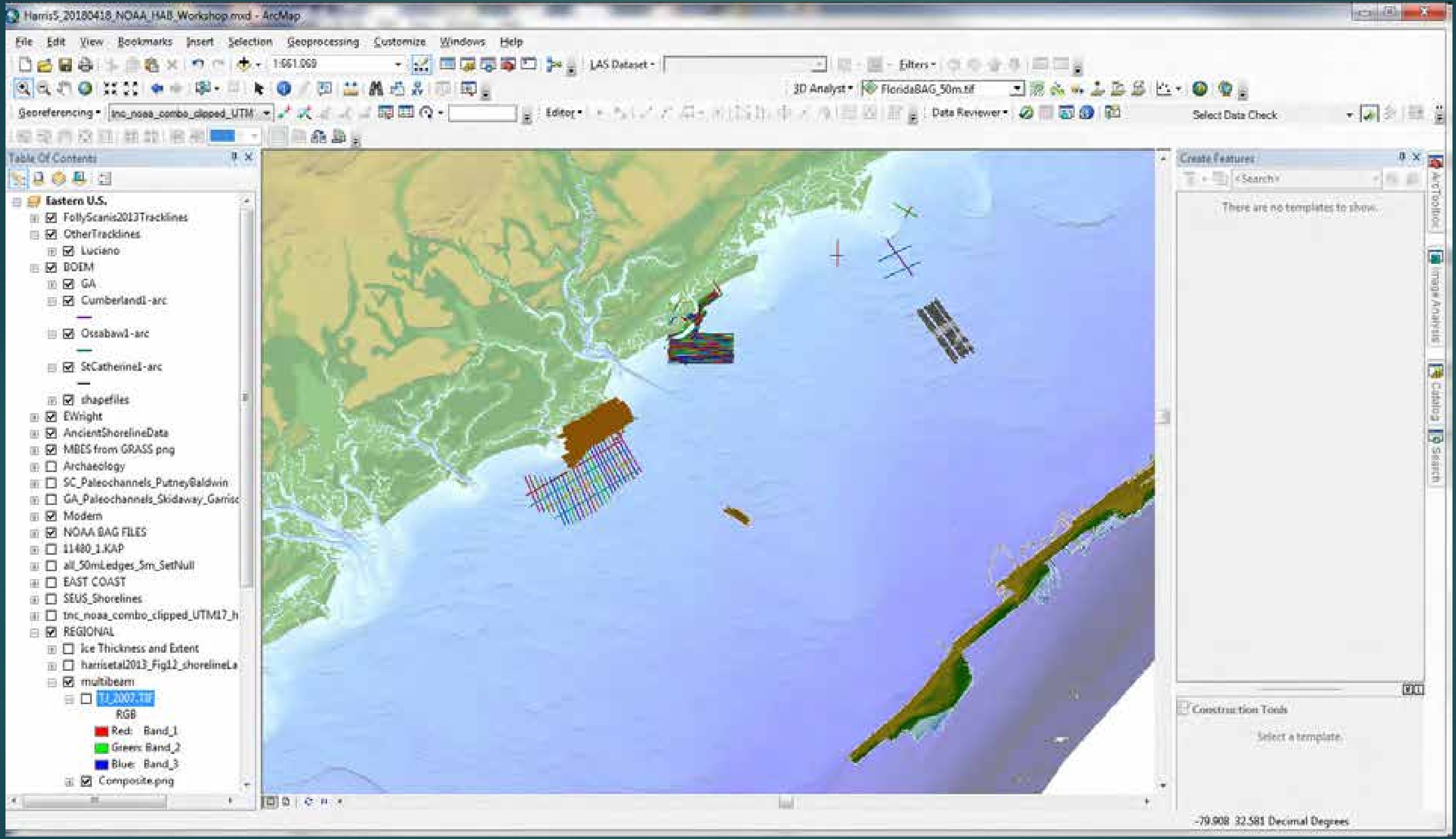


Figure 4. CCU-NOAA survey lines contributed in July 2015 to the SC BOEM initiative. The purple tracklines represent multibeam, chirp, side scan and split beam fish sonar data intended to test NOAA's thematic habitat mapper over a regional scale following a series of paleovalleys across the shelf to shelf break as well as an area of paleo-iceburg keel marks on the upper shelf near Georgetown Hole published in Geology (Hill et al., and Nature Geoscience; Hill et al.,). Two areas of detail multibeam, chirp, side scan and fish sonar data are shown in red. The inshore area had complete complete side scan and chirp data along with multibeam and fish sonar. The offshore site was predominately multibeam, fish sonar and more limited chirp data. In the detailed study areas NOAA completed numerous camera drops to verify habitat / fishery data.

Data


HarrisS_20180418_NOAA_HAB_Workshop.mxd - ArcMap
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Source Rocks (Fall Zone)

Barrier systems and need

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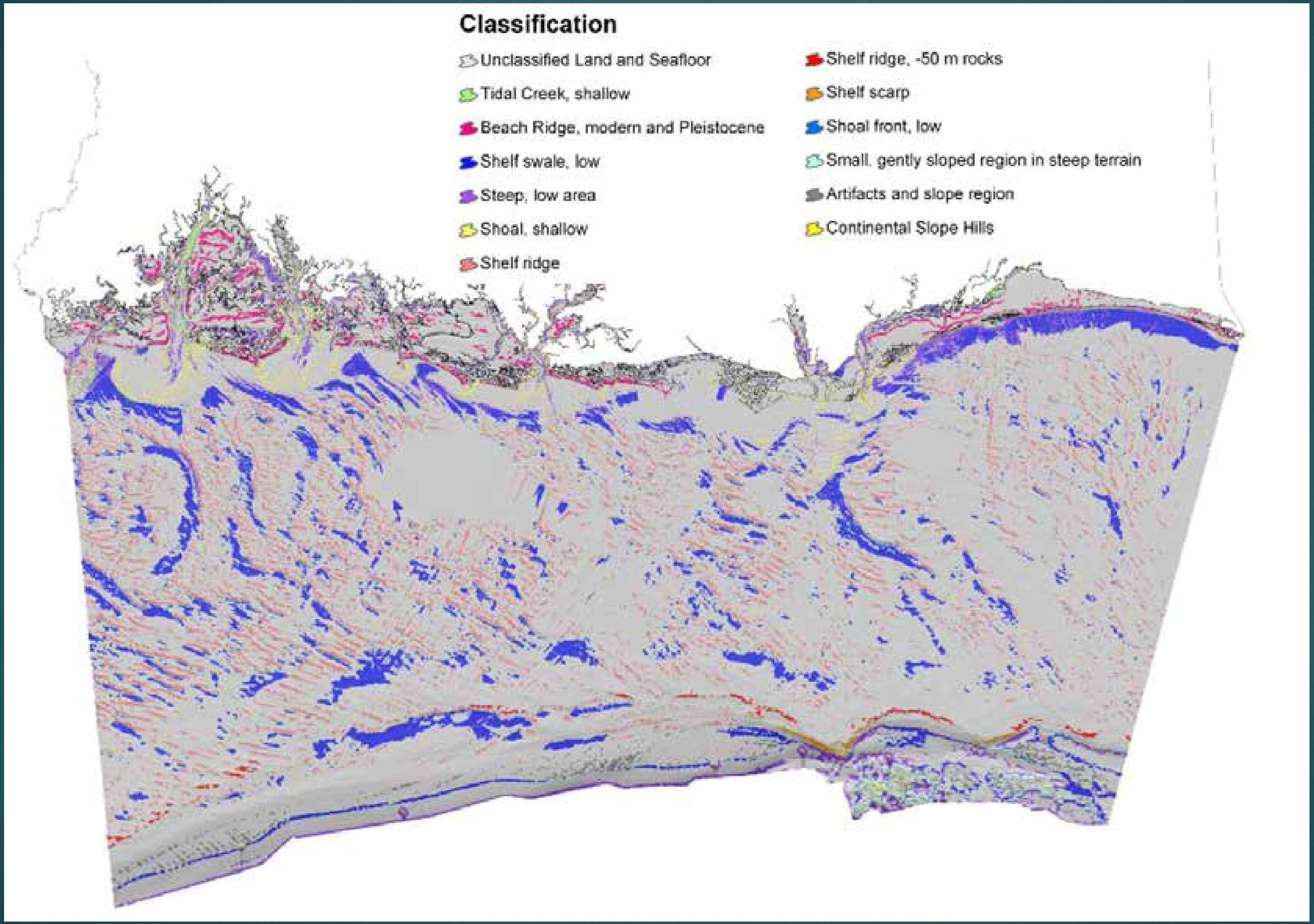
History of Continental Shelf Geology



Harris et al., 2009

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The Stats:
Since 2007…

- **142 students** have completed the CofC BEAMS Program as of Spring 2017.

- **68 of the 124 students who have graduated (<u>55%</u>) are currently in the marine geospatial workforce**
  - in private, government or academic positions
  - 32 of these students (<u>47%</u>) are women.

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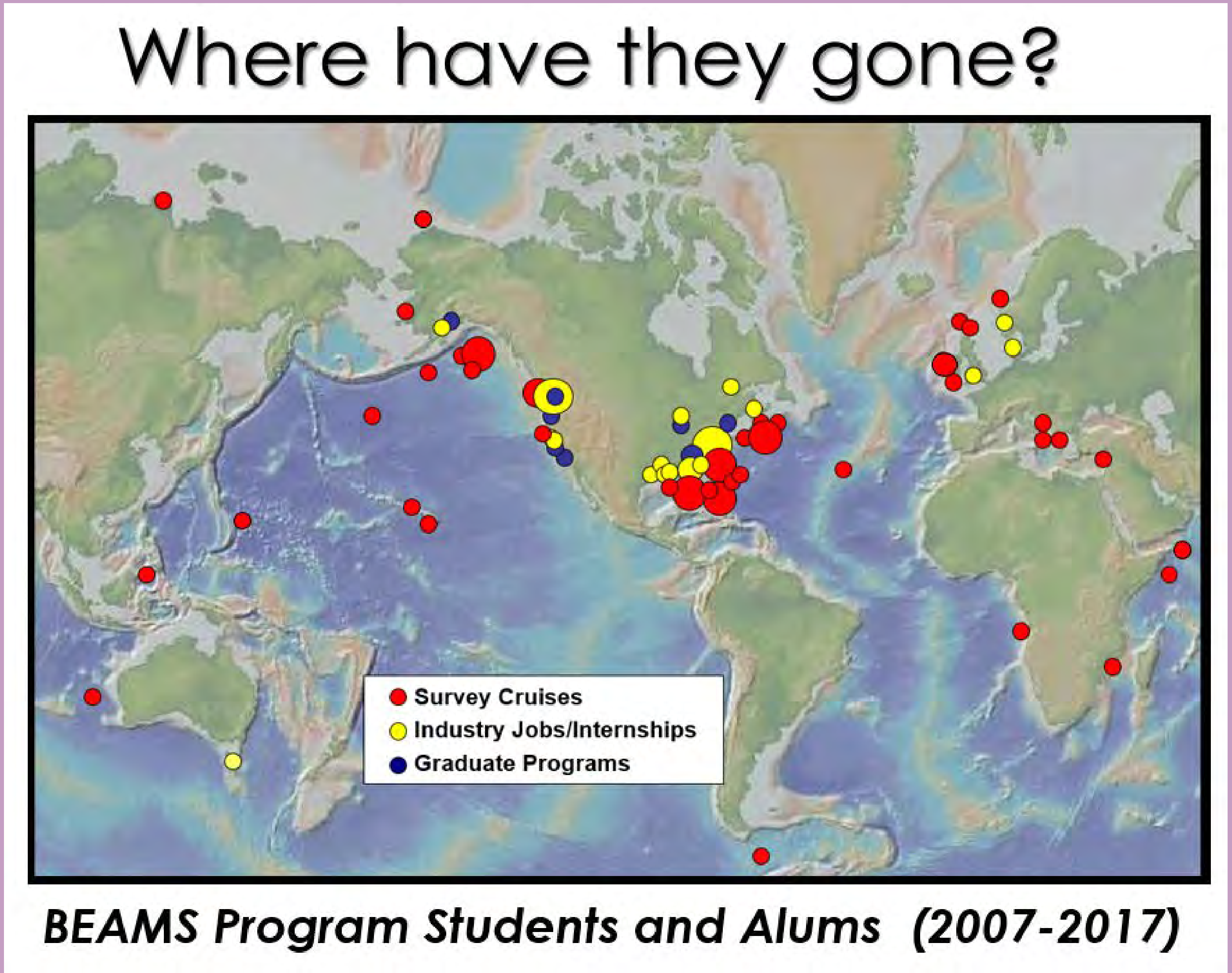
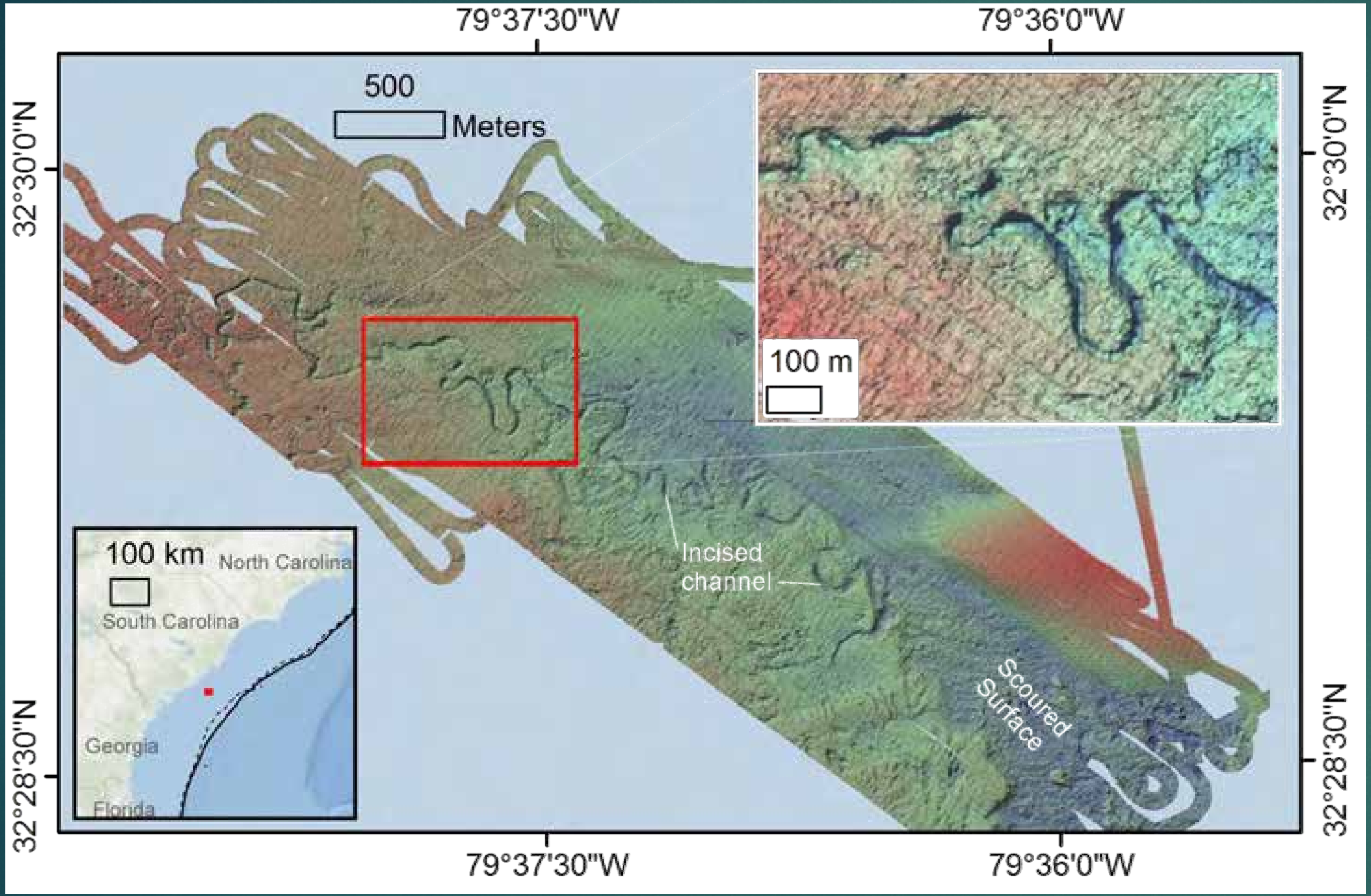
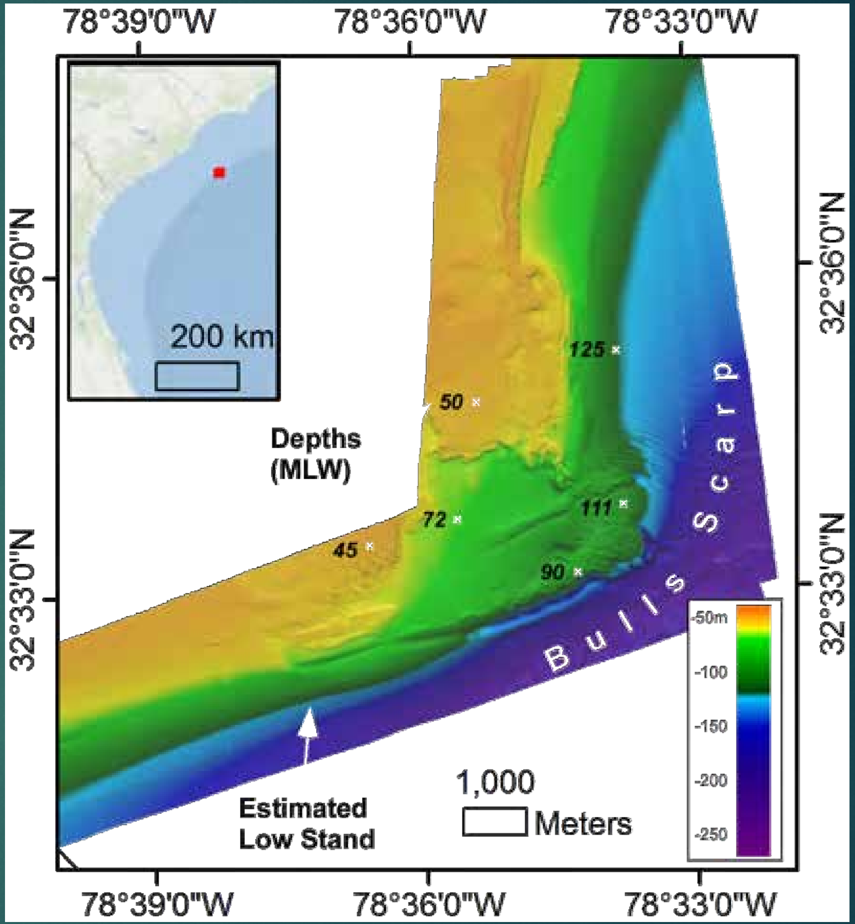
CofC BEAMS


Where have they gone?
Survey Cruises
Industry Jobs/Internships
Graduate Programs
BEAMS Program Students and Alums (2007-2017)

History of Continental Shelf Geology





Harris et al., 2013

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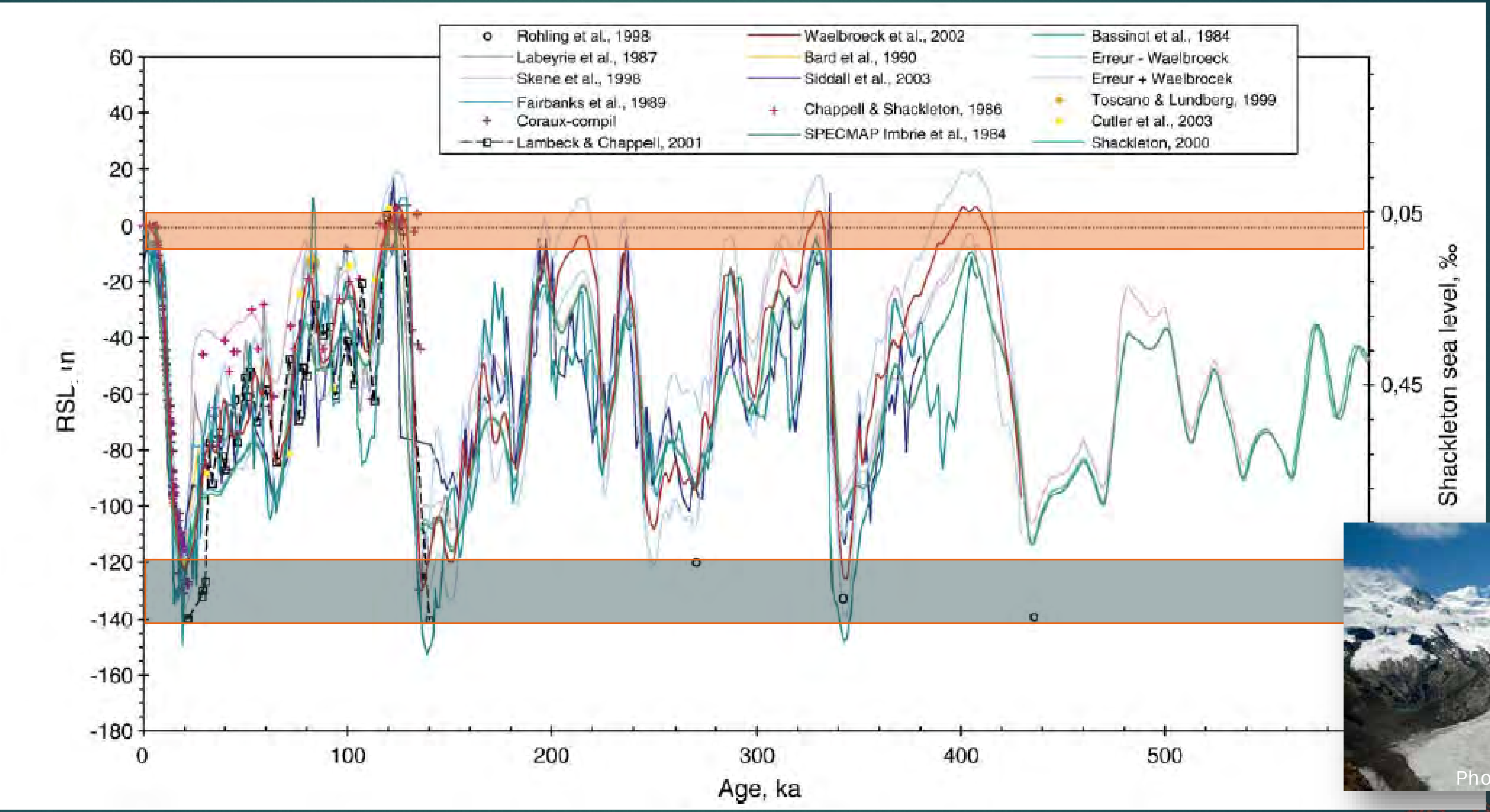
Ice Ages (last 600 ka)



Modified from Rabineau, M. *et al.* 2006, E&PSciLet252:119-37

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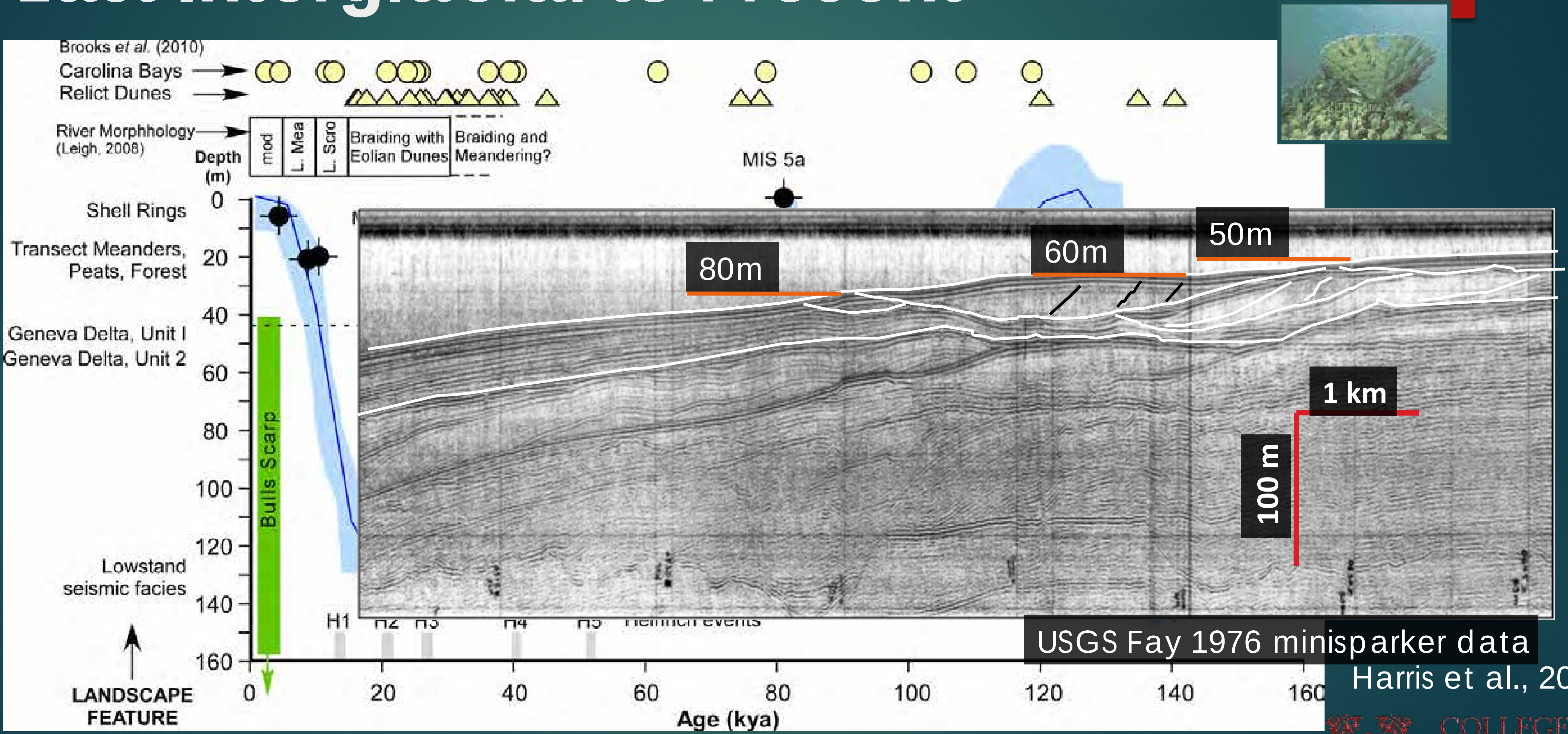
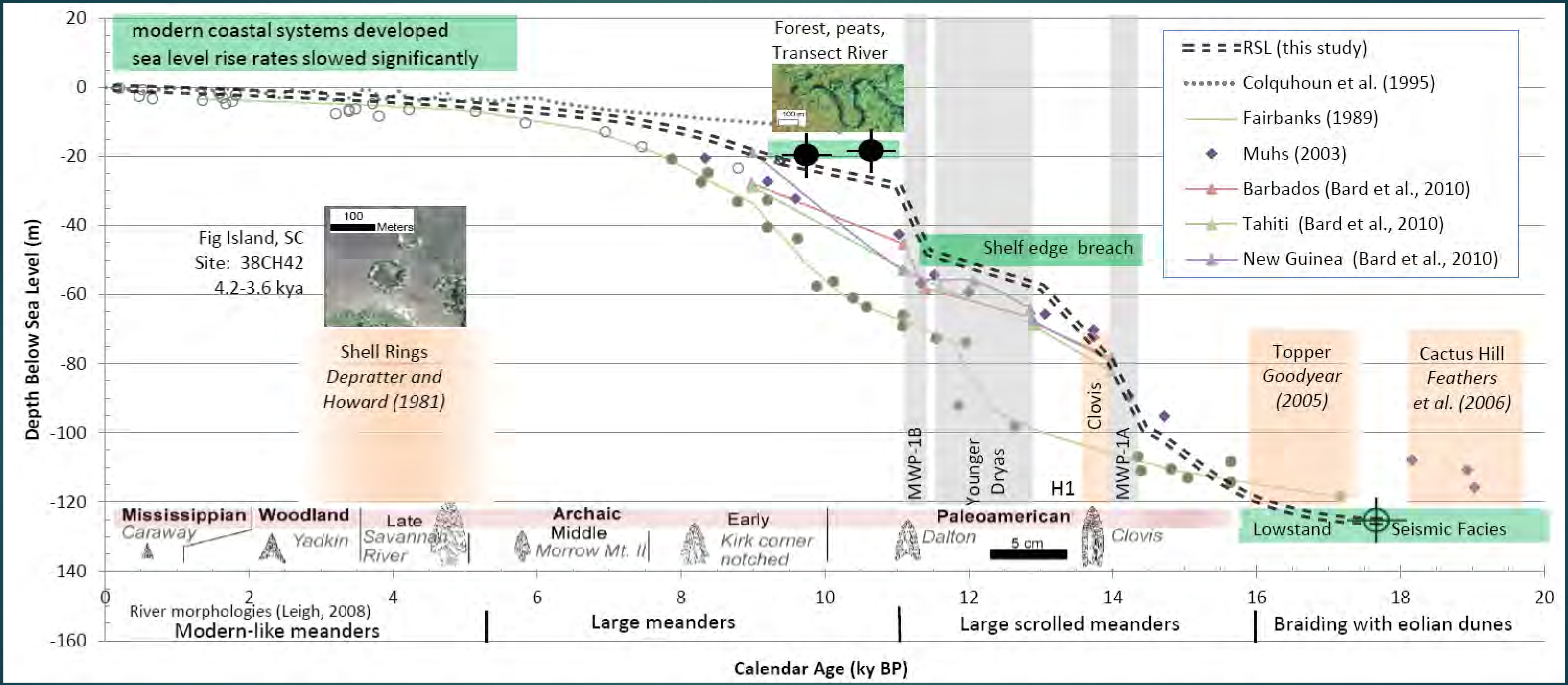
Last Interglacial to Present



Harris et al., 2013

Recent Sea Level Rise



Harris et al., 2013

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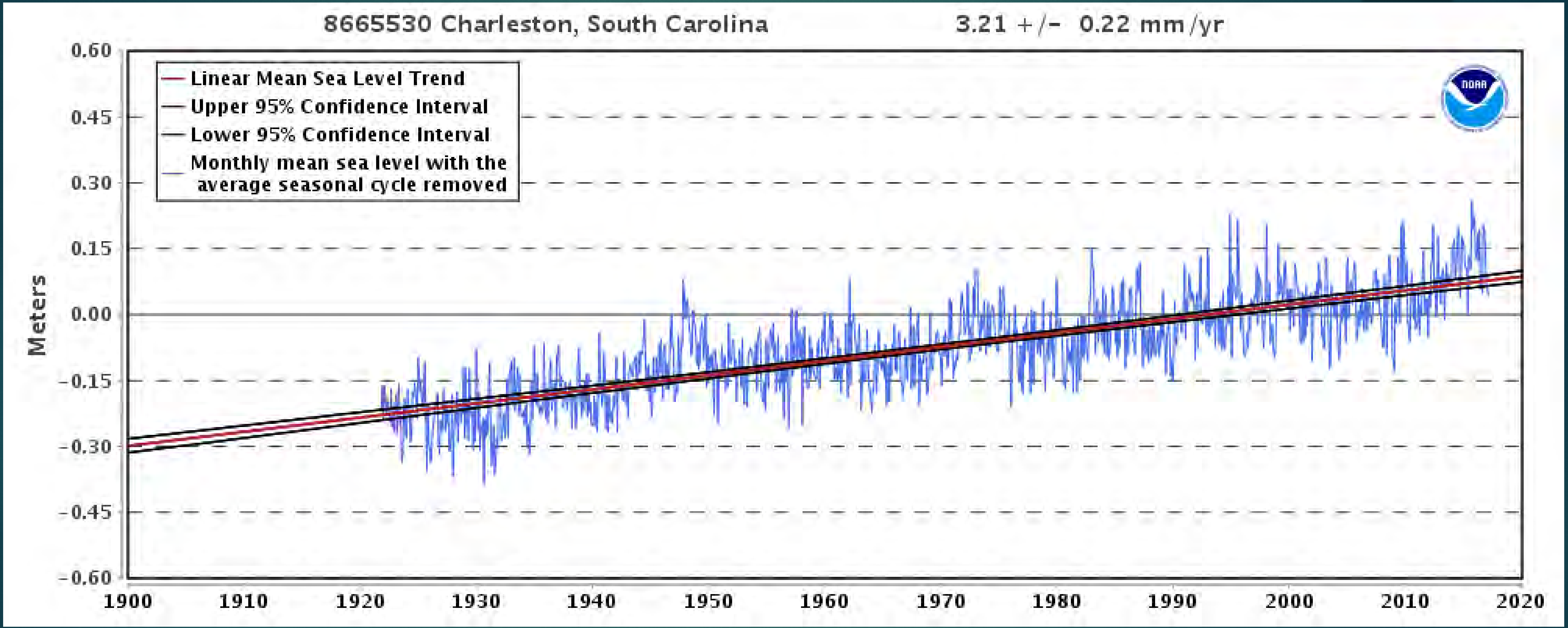
Recent Years and Sea Level RISE



https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8665530

Transitions

Photo Credit: M. Scott Harris

May 14, 2014
Renourishment
Folly Beach, SC

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Targeting ancient heritage and former coasts (Paleogeography)

- Where were the shorelines?
- Apply glacial isostatic adjustments to compensate for rebound effect of ice melting since LGM

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Findings: Shorelines Through Time 26,000

26,000 years ago

Estimated shoreline with adjustments for glacial isostatic adjustment

Positions on shelf likely +/- 10 km

Harris, 2018

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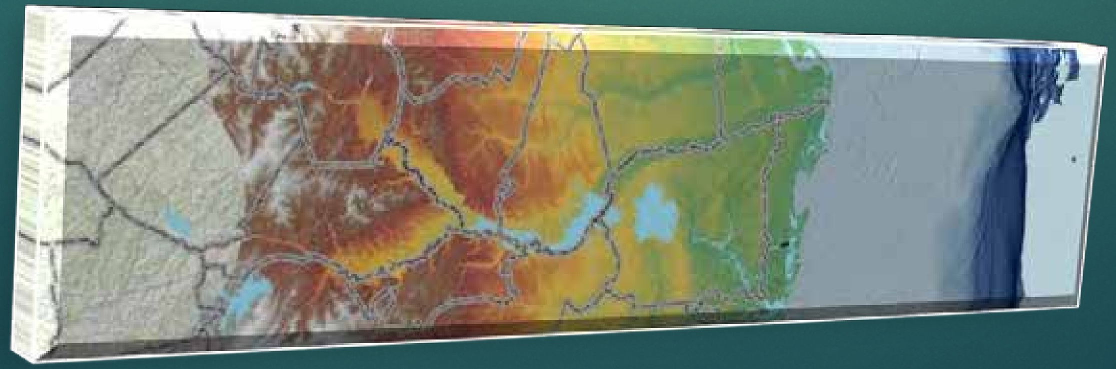
Transitions

Modern Coast
6,000 ya

Where do we go from here?

- We are continuing our offshore paleolandscape work with BOEM ASAP and BOEM Wind partners
- Attempting to more efficiently map the OCS—maybe bathy LiDAR – excellent visibility offshore!!!
- Setting up a program bridging between CP and CS using alternate geophysical techniques
- Finishing up the CP and CS map to establish working areas for cadre of students over the next decade



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(too many to count!)

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  BOEM, SC Sea Grant, USGS, College of Charleston Faculty R&D , SSM Dean, GEOL, NPS, Fulbright
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- **Software and hardware partners:**
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- **People:**
  Colleagues at CofC, USC, UNC, ECU, UGA, SKIO, W&M, Clemson, CCU, SC-DNR, Sea-Grant, BOEM, NOAA, USACE, USGS
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