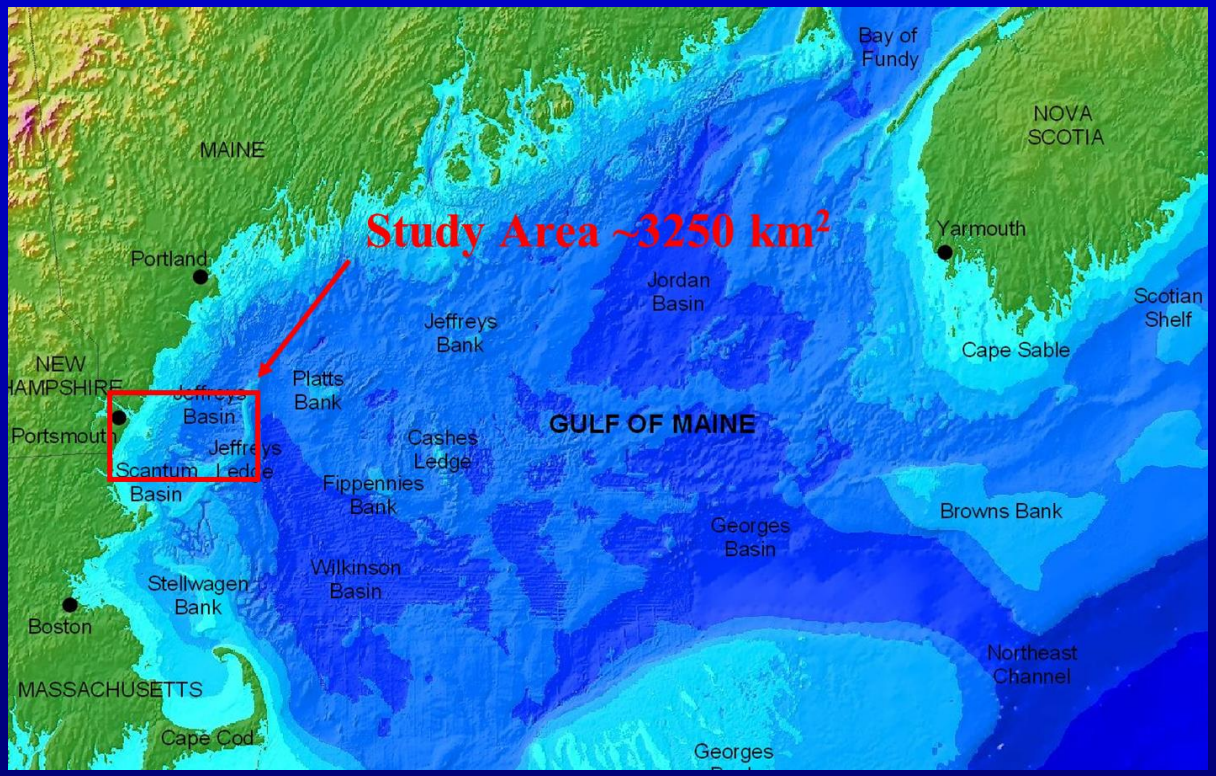
Mapping of the Major Morphologic Features and Seafloor Sediments of the New Hampshire Continental Shelf Using the Coastal and Marine Ecological Classification Standards (CMECS)



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BOEM
Bureau of Ocean Energy Management

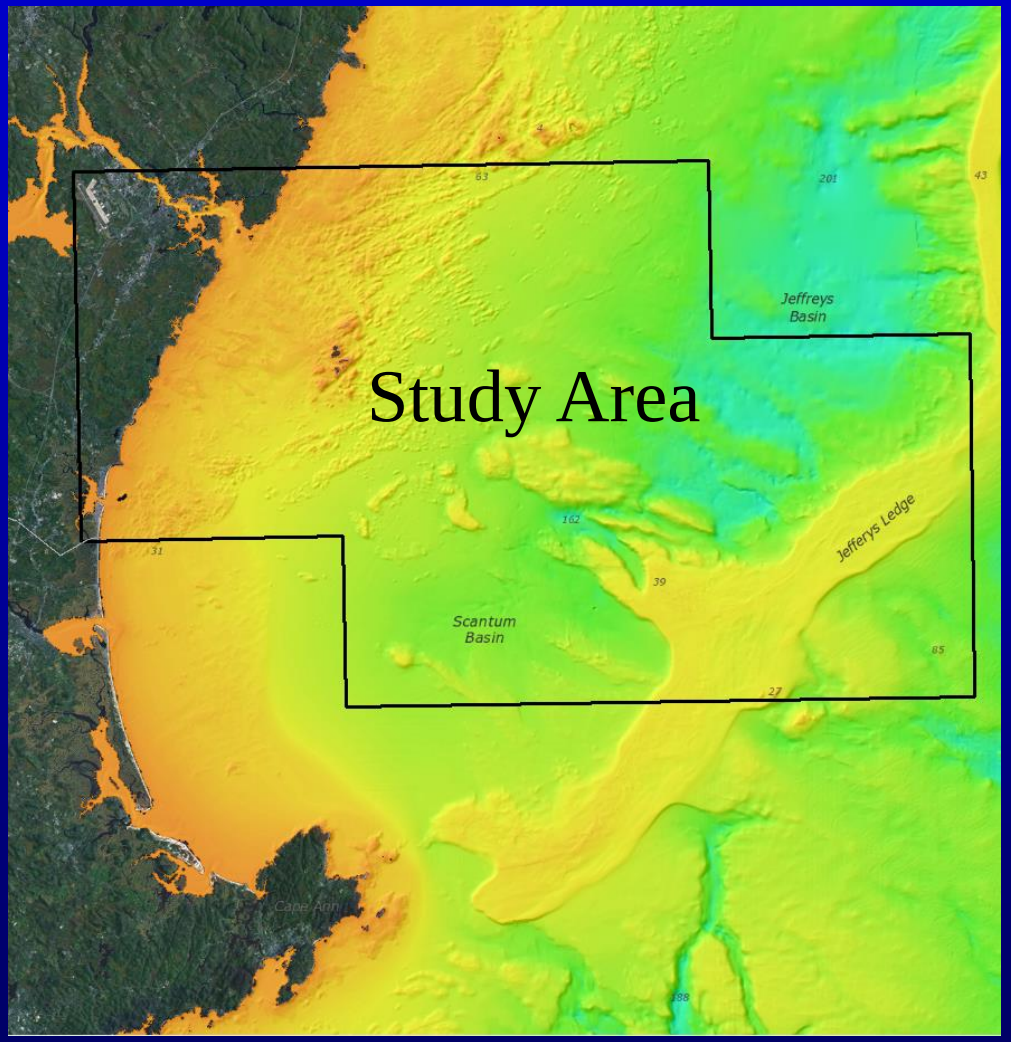
National Oceanic and Atmospheric Administration
NOAA
U.S. Department of Commerce

Center for Coastal & Ocean Mapping
Joint Hydrographic Center
CCOM JHC
University of New Hampshire

New Hampshire Geological Survey
1839 2001

Integrated Research Program on NH Shelf

- Map the Surficial Geology of the NH Continental Shelf and Vicinity
  - Morphologic Features (Geoforms)
  - Surficial Sediments (CMECS)
- Further Our Understanding of the Quaternary History of the Shelf
- And How It Was Shaped by the Interactions of:
  - Glaciations
  - Sea-level Fluctuations
  - Marine Processes
  - Fluvial Processes
- Assess Potential Sand and Gravel Resources (BOEM)
- Develop Conceptual Models to Aid in Exploration Sand and Gravel Deposits Using Acoustics and Ground Truth (NOS)



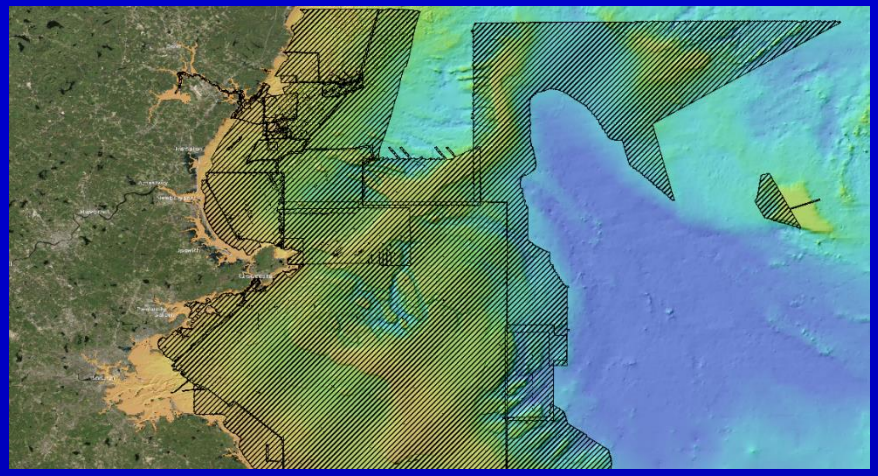
Mapping Program Includes:

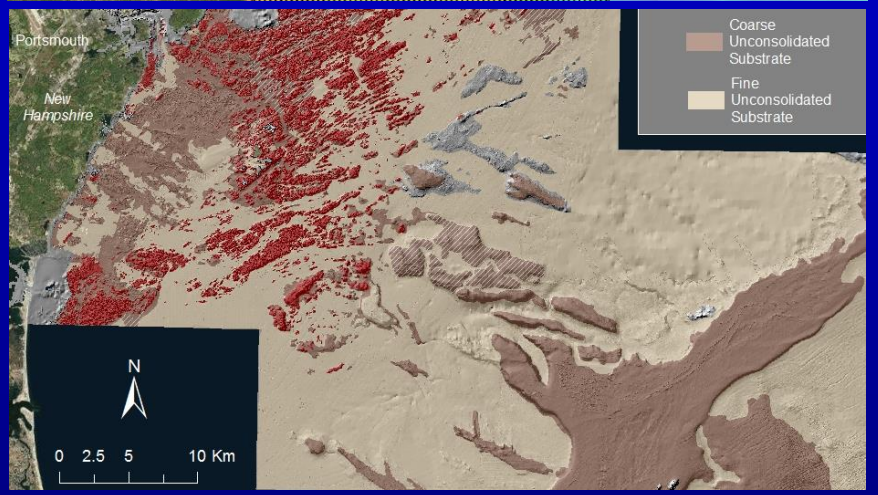
1. Development of High Resolution Bathymetric and Backscatter Maps

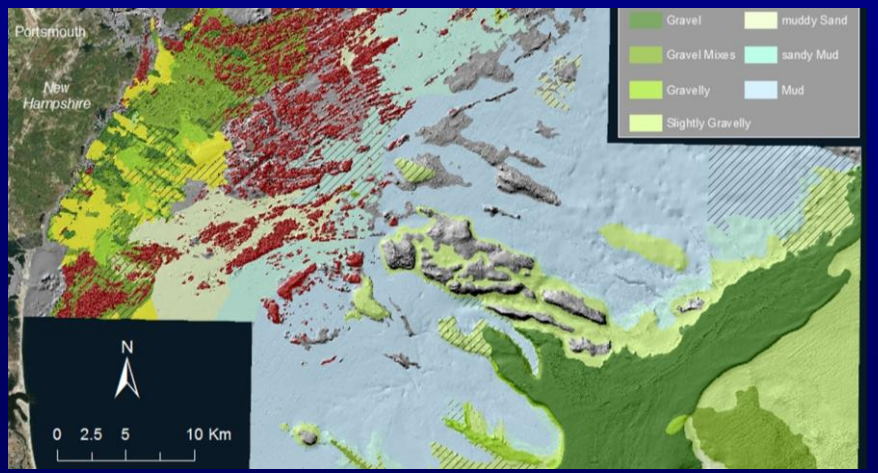
2. Development of Surficial Sediment and Geoform Maps (CMECS)

3. Development of Sand and Fine-Gravel Isopach Maps

4. Merging Databases To Develop Seafloor Geology Maps (Underway)
   - Surficial Sediments
   - Physiographic Features (or Geoforms)
   - Sand and Gravel Deposits
   - Ultimately Combine with Coastal Surficial Geology Maps



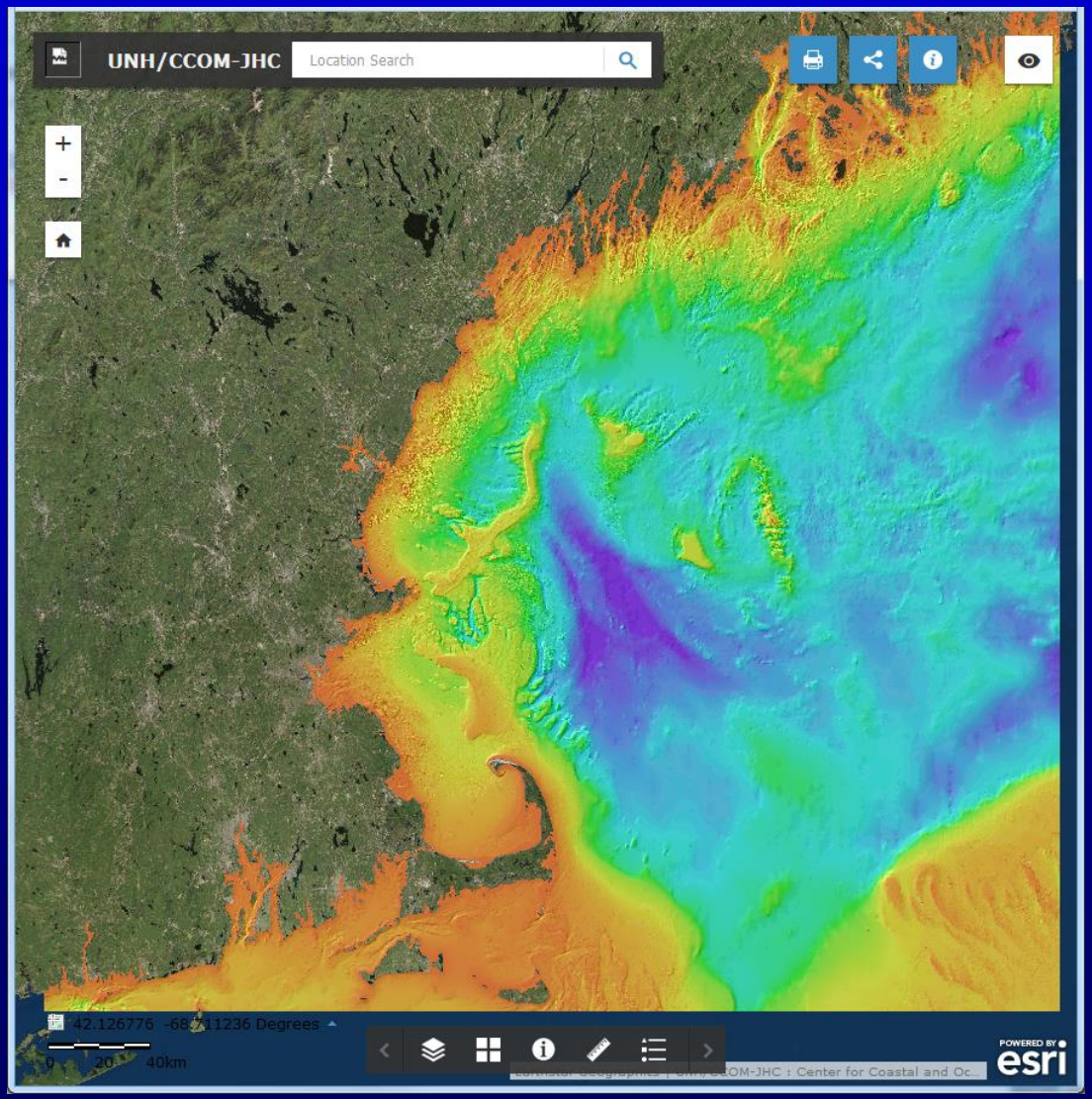




1. WGOM Bathymetry Synthesis

(UNH CCOM: Paul Johnson and Erin Nagel)

- Shows Bathymetry at Best Possible Gridding
- Serves as Base Map for Multiple Studies
- New Bathymetry Added as it Becomes Available
- Frequently Being Updated and Upgraded
- Available via CCOM/JHC Web Site

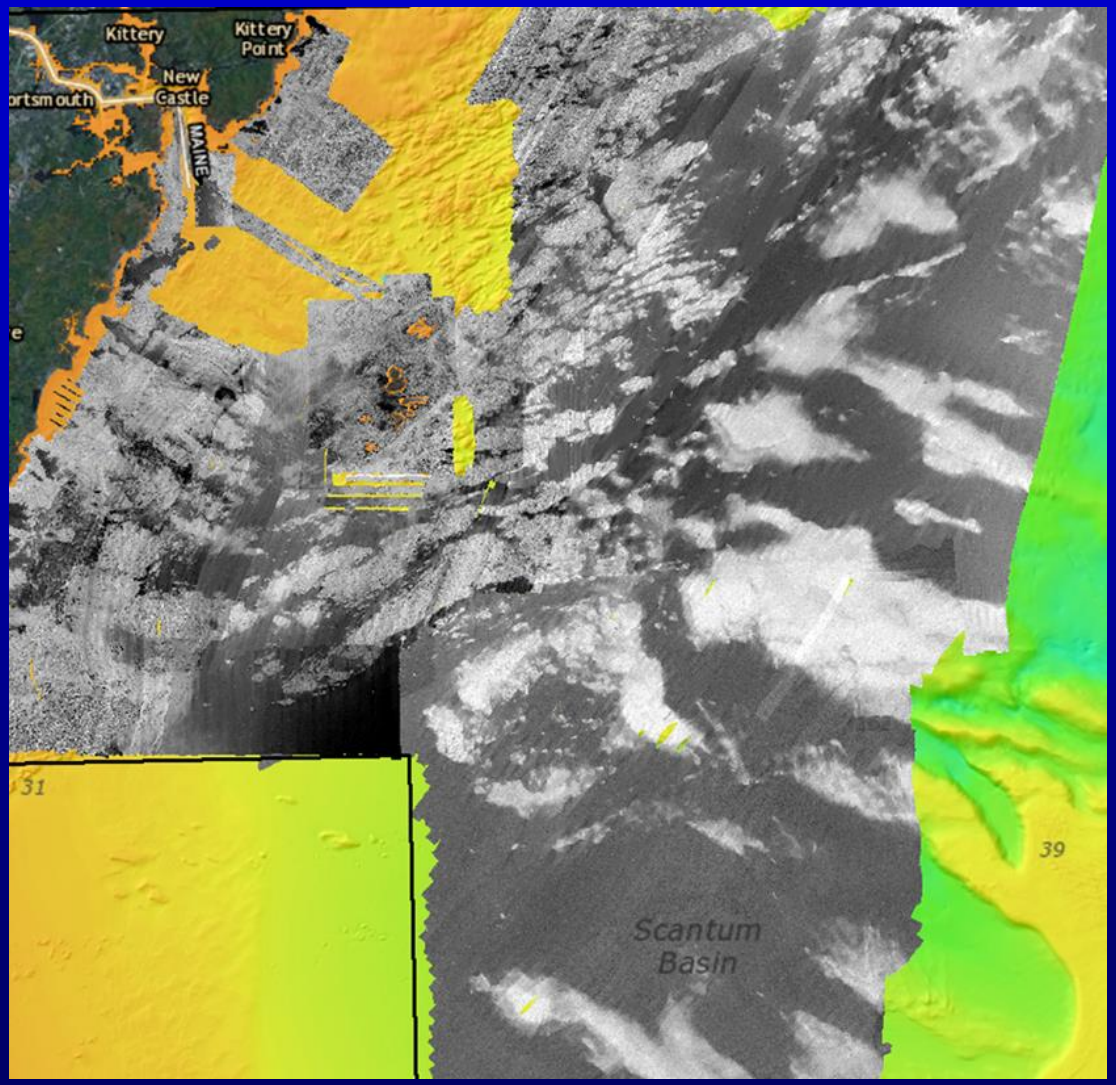


http://ccom.unh.edu/gis/maps/WGOM_4m/

1. WGOM Backscatter Synthesis

(UNH CCOM: Paul Johnson and Erin Nagel)

- Shows Backscatter at 1.5 m Gridding
- Based on 14 Surveys with Different Systems and Frequencies (300 and 400 kHz)
- Individual Surveys Re-Processed and Merged Into a Mosaic for General Mapping Purposes (Qualitative)
- Available via CCOM/JHC Web Site

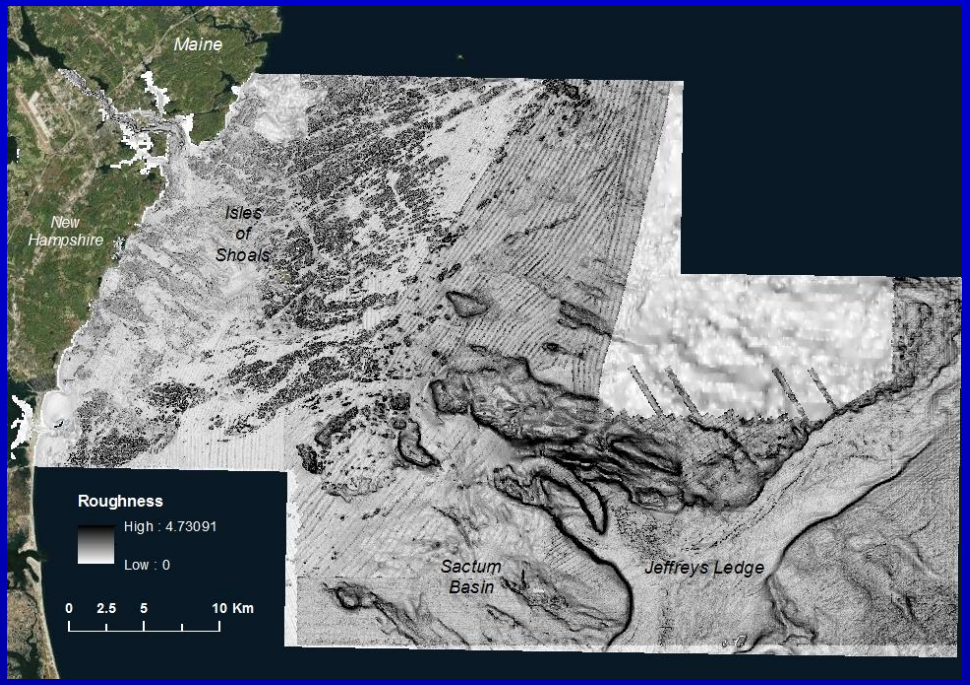


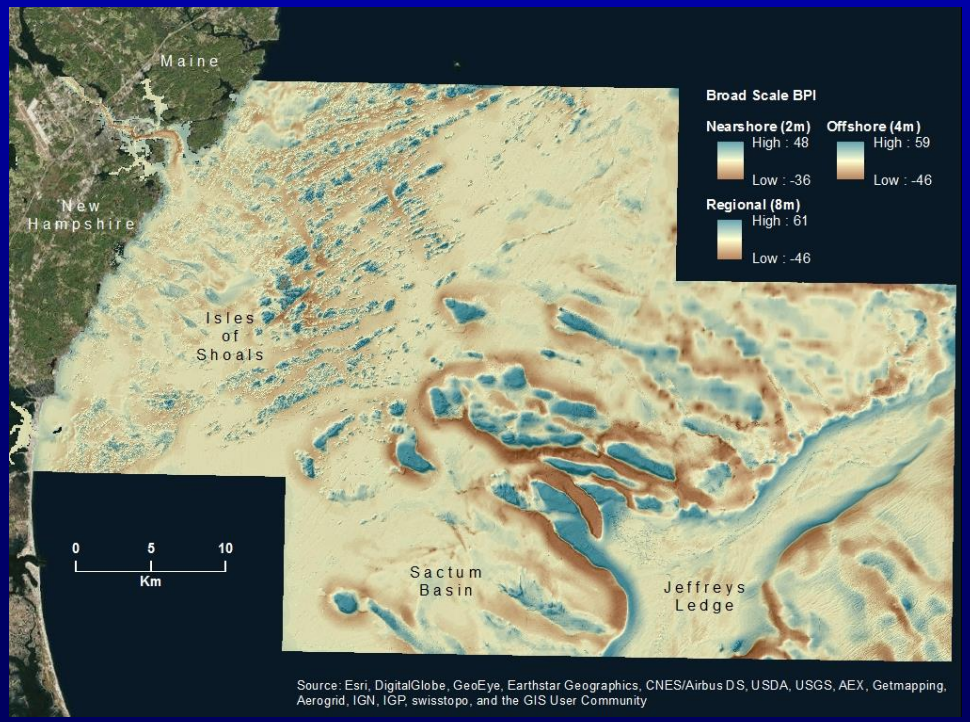
http://ccom.unh.edu/gis/maps/WGOM_4m/

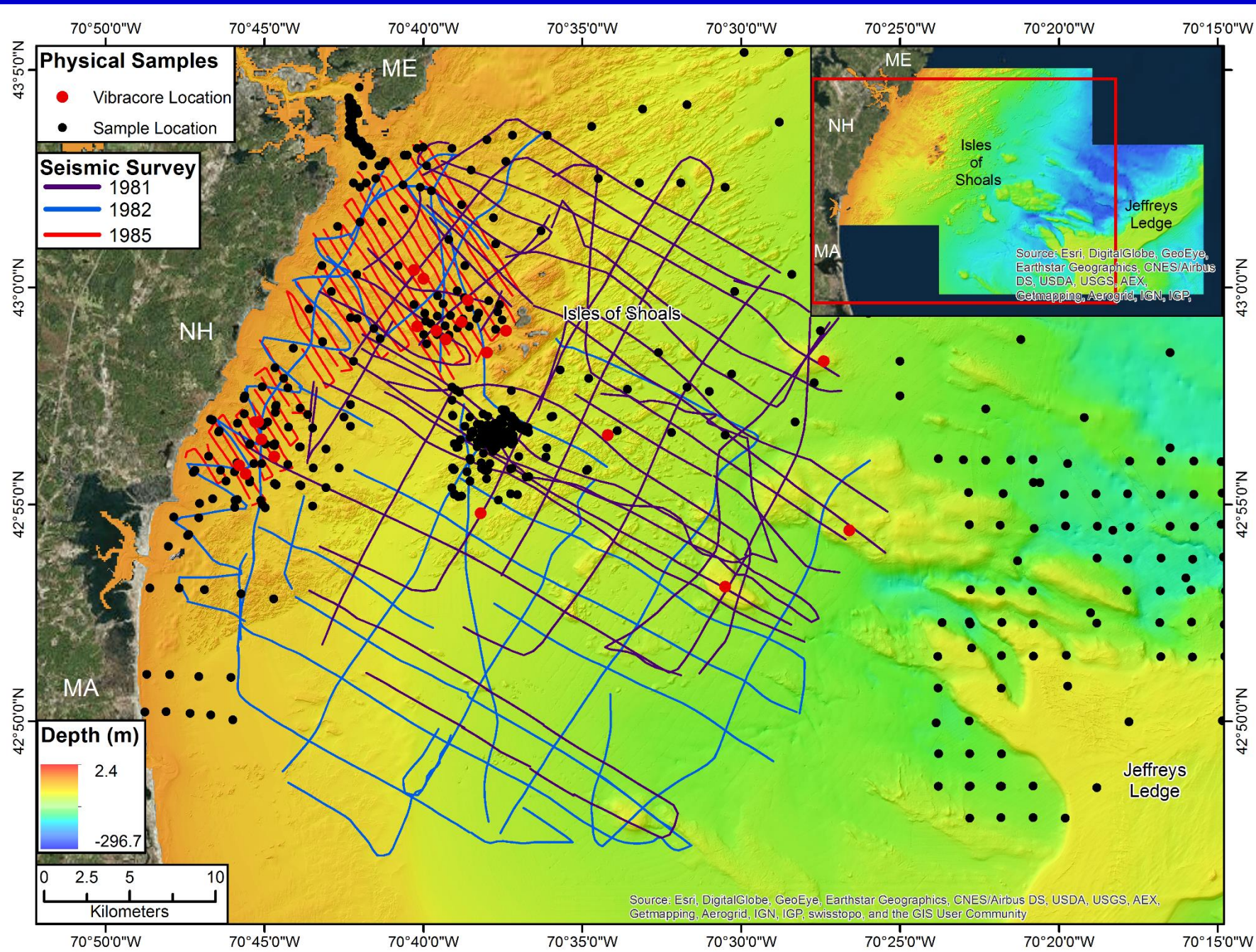
2. Development of Surficial Geology Maps

Inputs:

- WGOM Bathymetric and Backscatter Synthesis
- Bathymetric Derivatives
  - Hillshade, Rugosity, BPI
- Archived Sediment Database
  - 1200 Surf Sediment Analyses
  - 23 Vibracores
  - ~1300 km of subbottom seismics (analog)





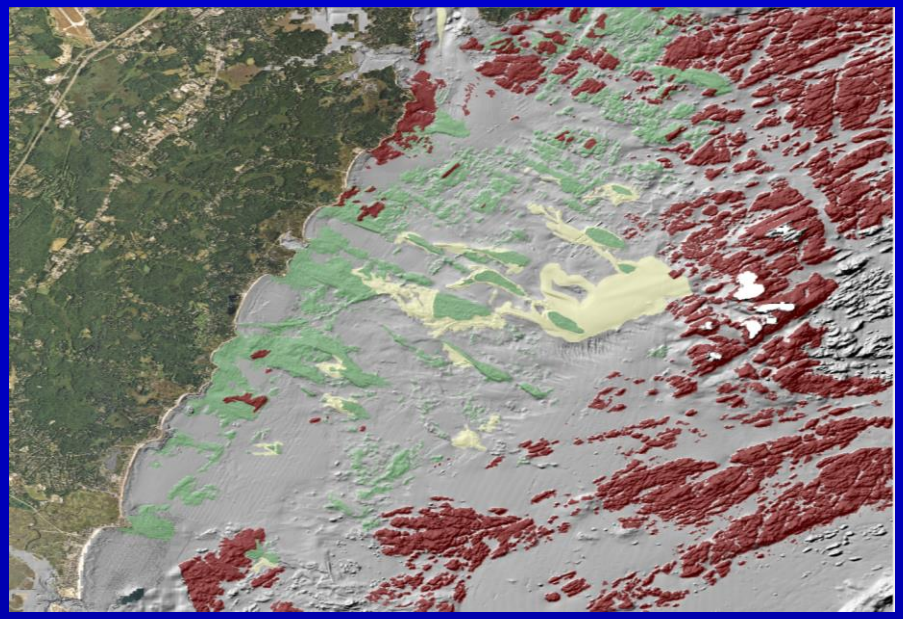

Physical Samples
Vibracore Location
Sample Location
Seismic Survey
1981
1982
1985
Depth (m)
2.4
-296.7
0 2.5 5 10
Kilometers
ME
NH
MA
Isles of Shoals
Jeffreys Ledge
70°50'0"W
70°45'0"W
70°40'0"W
70°35'0"W
70°30'0"W
70°25'0"W
70°20'0"W
70°15'0"W
43°5'0"N
43°0'0"N
42°55'0"N
42°50'0"N
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Surficial Geology Maps

(Maxlimer Vallee-Anziani and Larry Ward)

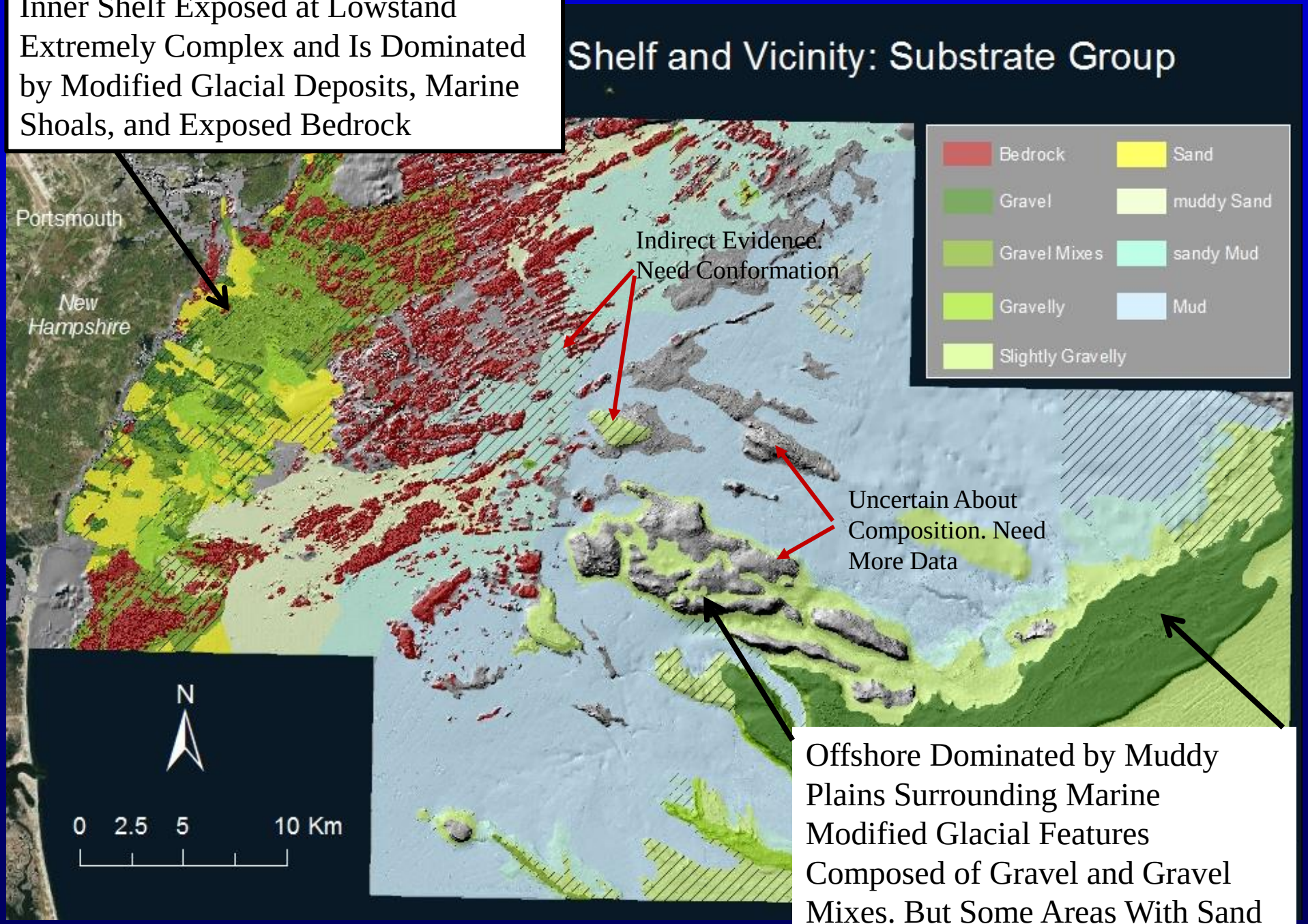
Method:

- Segmented Seafloor Using ArcGIS and Bathymetric Derivatives
- Isolated Morphologic Features (Geoforms)
- Described and Classified the Seafloor Geology in ArcGIS
  - Features
    - Bedrock, Glacial, Marine
  - Sediments
    - CMECS Sediment Classification
- Based on “Expert Opinion”
  - After trying Supervised Classifications



Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup
Geologic Substrate	Rock Substrate	Bedrock		
	Unconsolidated Mineral Substrate	Coarse Unconsolidated Substrate	Gravel	Boulder
				Cobble
				Pebble
				Granule
			Gravel Mixes	Sandy Gravel
				Muddy Sandy Gravel
				Muddy Gravel
			Gravelly	Gravelly Sand
				Gravelly Muddy Sand
				Gravelly Mud
		Fine Unconsolidated Substrate	Slightly Gravelly	Slightly Gravelly Sand
				Slightly Gravelly Muddy Sand
				Slightly Gravelly Sandy Mud
				Slightly Gravelly Mud
			Sand	Very Coarse Sand
				Coarse Sand
				Medium Sand
				Fine Sand
				Very Fine Sand
			Muddy Sand	Silty Sand
				Silty-Clayey Sand
				Clayey Sand
			Sandy Mud	Sandy Silt
				Sandy Silt-Clay
				Sandy Clay
			Mud	Silt
				Silt-Clay
				Clay

Inner Shelf Exposed at Lowstand Extremely Complex and Is Dominated by Modified Glacial Deposits, Marine Shoals, and Exposed Bedrock



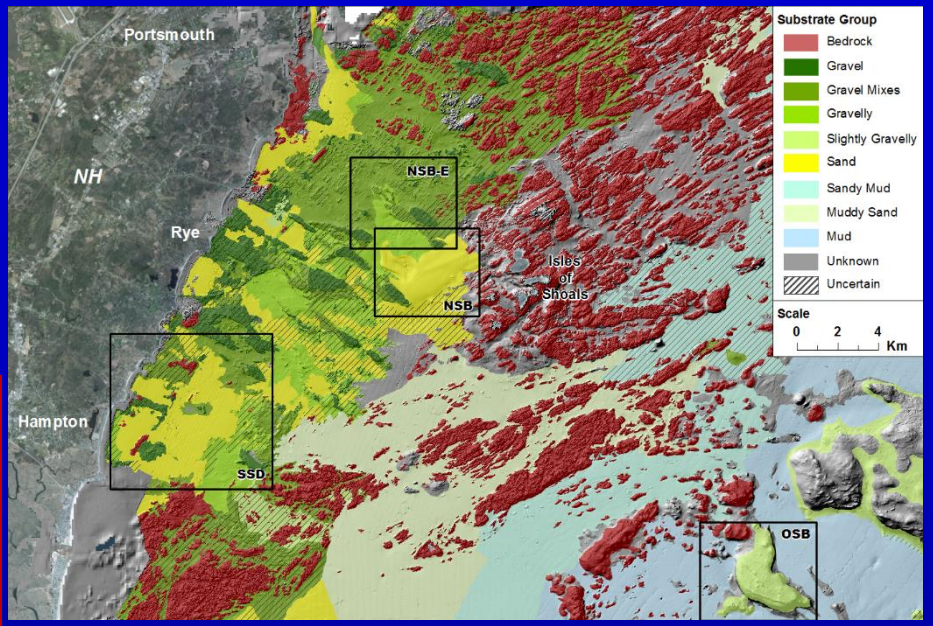
Offshore Dominated by Muddy Plains Surrounding Marine Modified Glacial Features Composed of Gravel and Gravel Mixes. But Some Areas With Sand

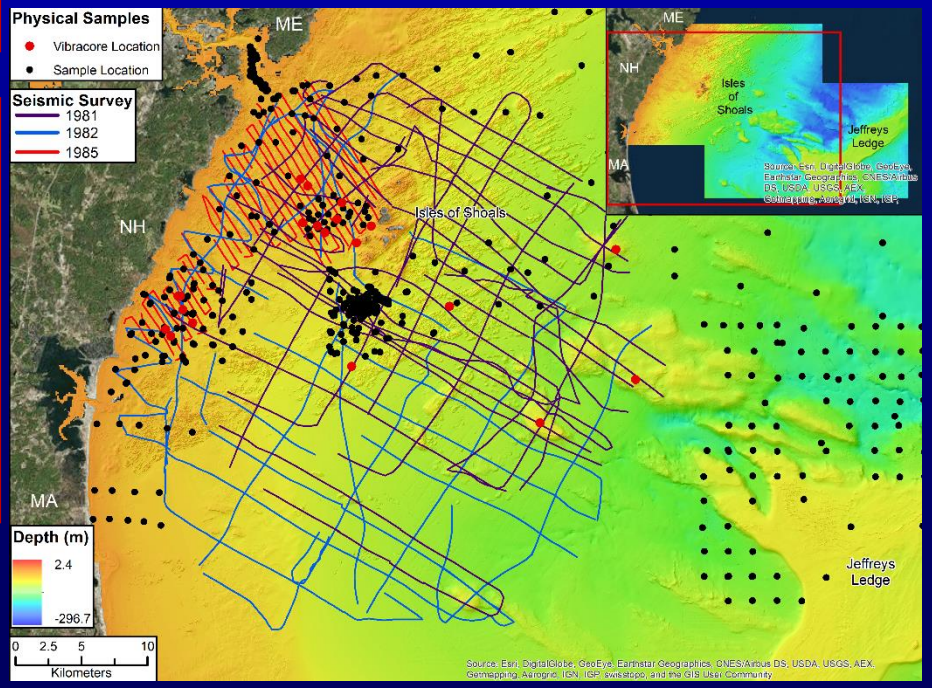
3. Development of Sand and Gravel Isopach Maps

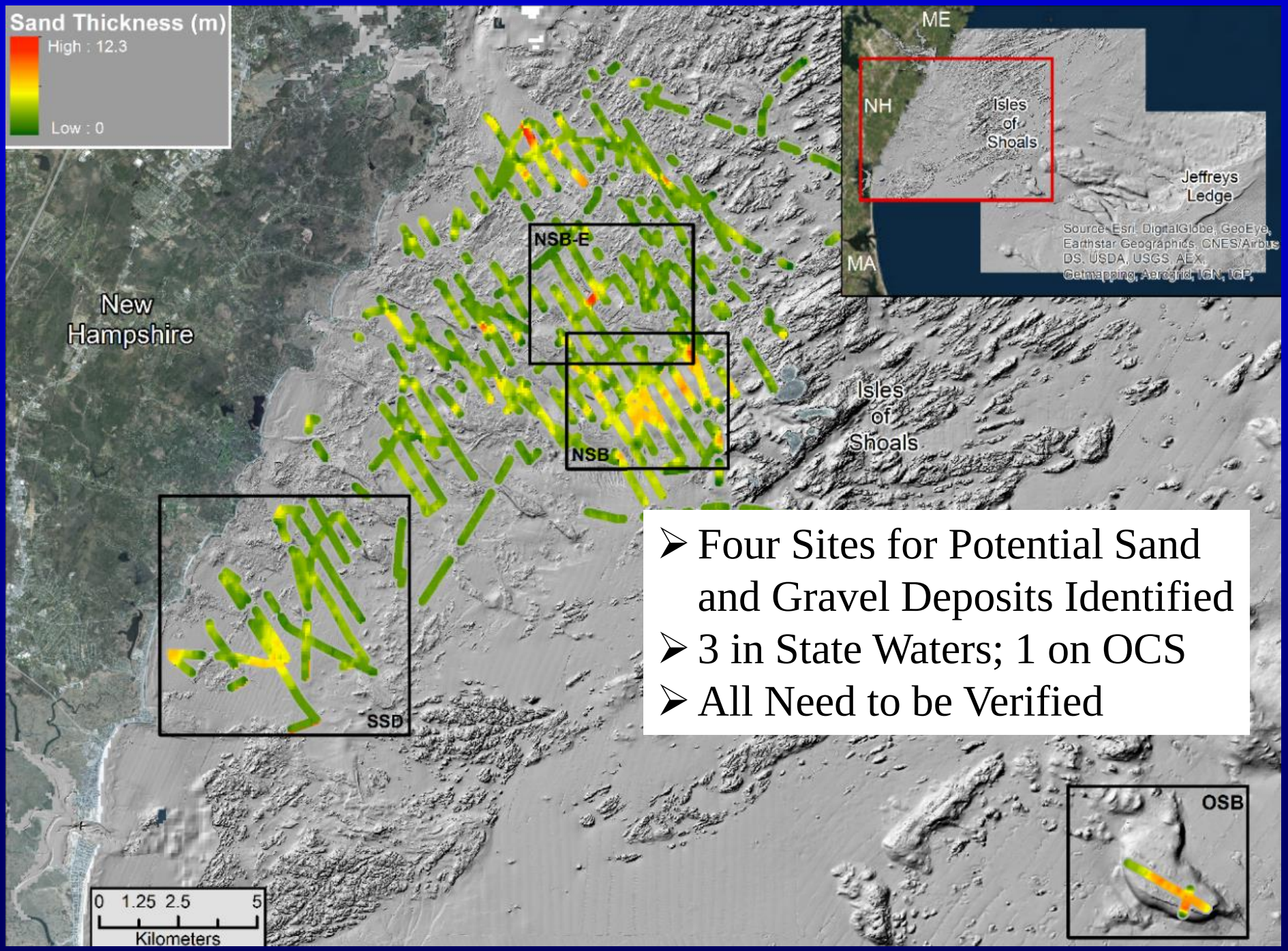
Inputs:

- Bathymetric Synthesis
- Surficial Sediment Maps
- Geoform Maps

- Archived Seismic Database
  - 1981, 1982, and 1985 Analog Subbottom Seismic Profiles
  - Birch (1984, 1986) Interpretations
  - 23 Vibracores



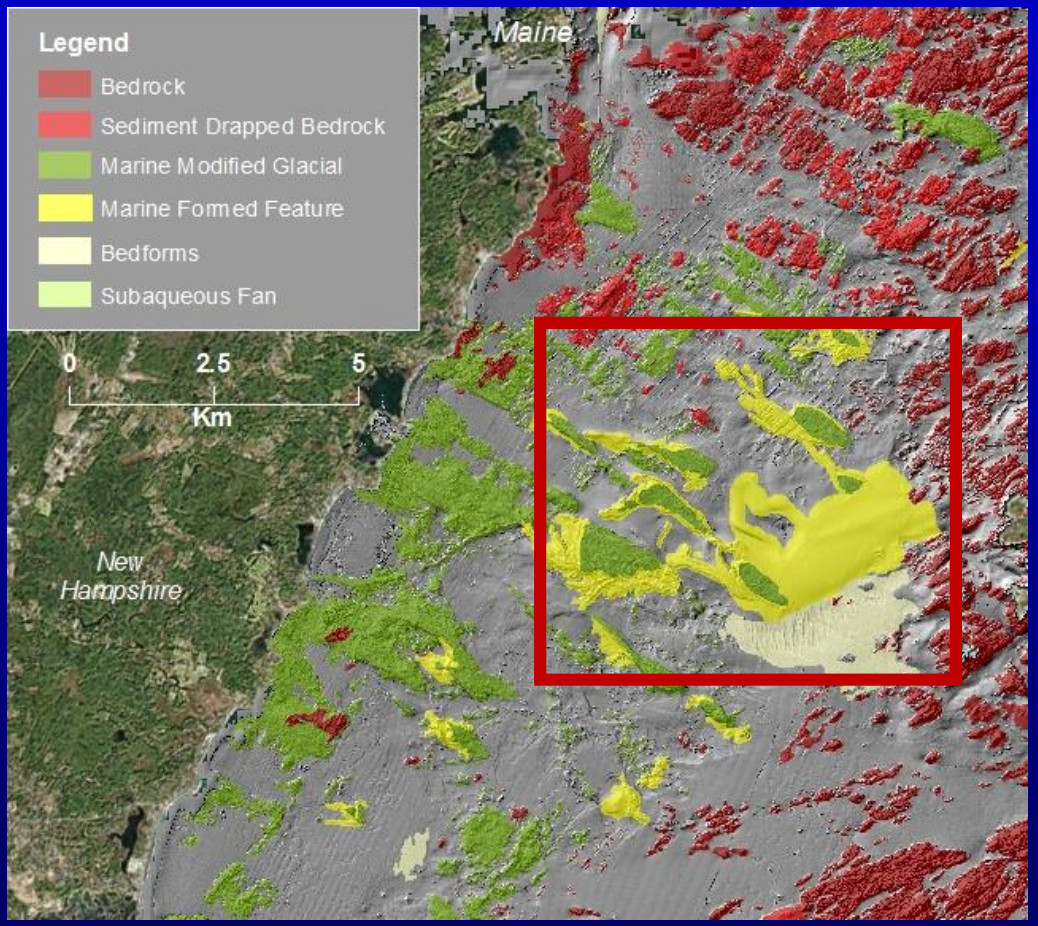




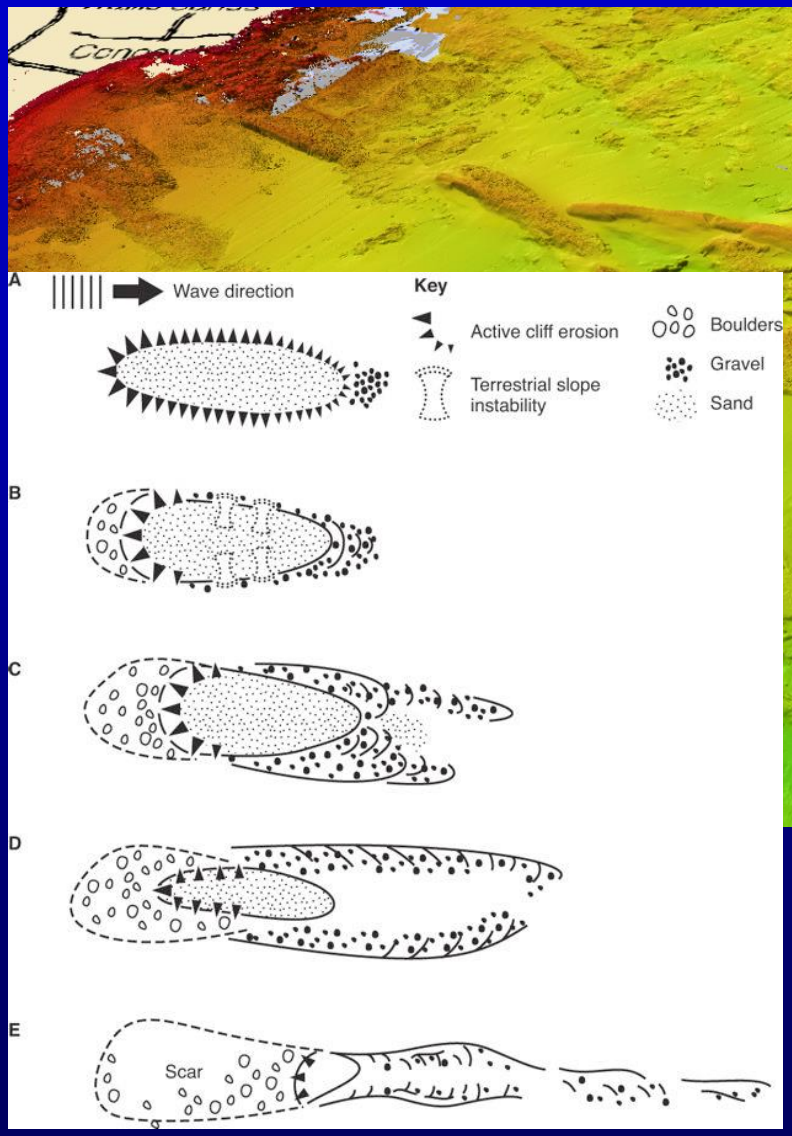
- Four Sites for Potential Sand and Gravel Deposits Identified
- 3 in State Waters; 1 on OCS
- All Need to be Verified

Origin of Some of the Nearshore Sand Bodies

- Developed From Eroding Glacial Features and Marine Processes (Waves and Tides)
- During Last Transgression
- Marine Modified Glacial Features

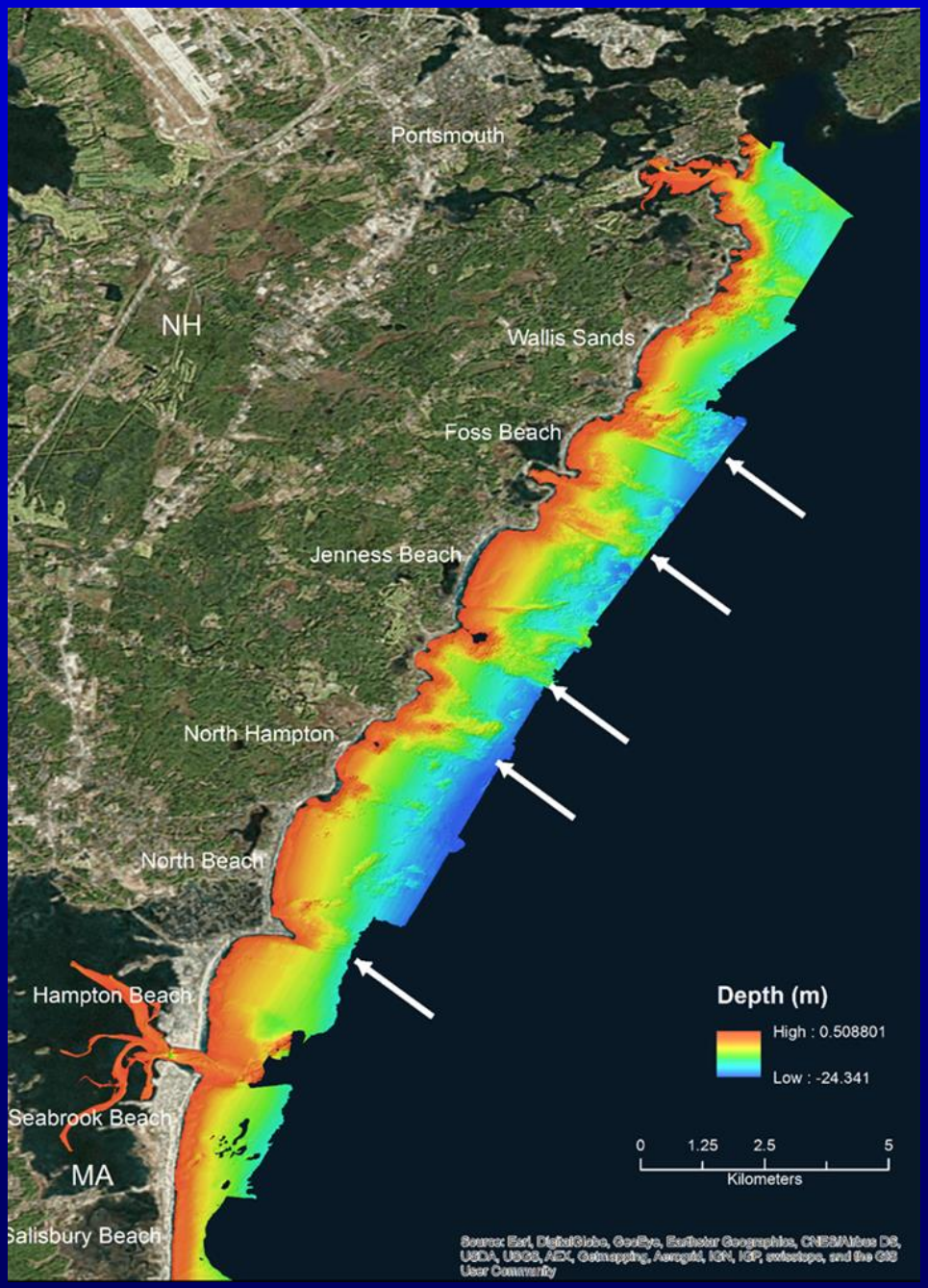


Model for Development of Sand and Gravel Deposits (With Positive Relief)

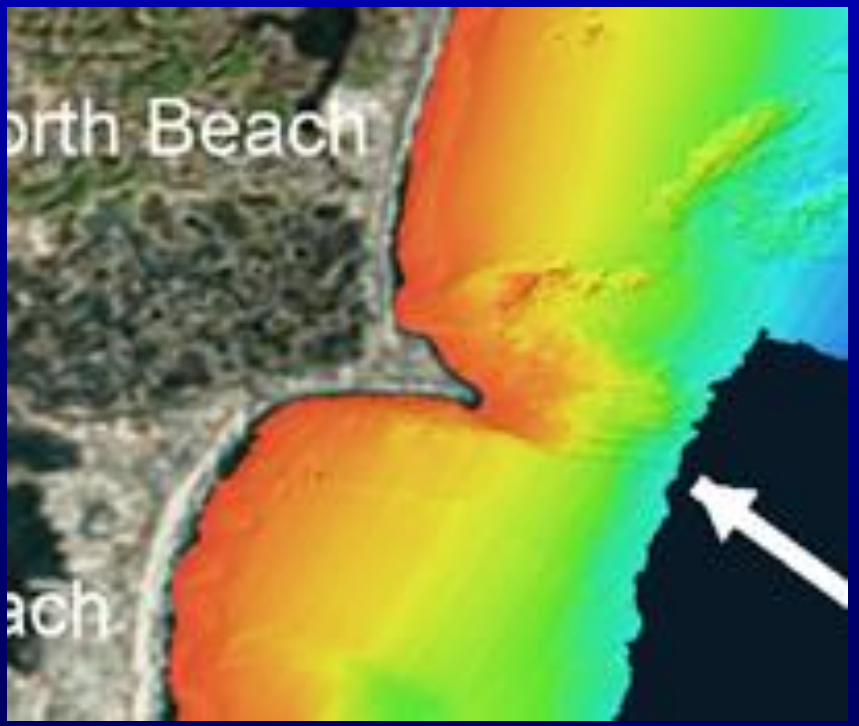


1. Drumlin or Glacial Feature Deposited
2. Drumlins Eroded By Wave Processes During Sea-level Fluctuations
3. Shoals Form From Material Eroded From Drumlin by Marine Processes (Waves and Tides)

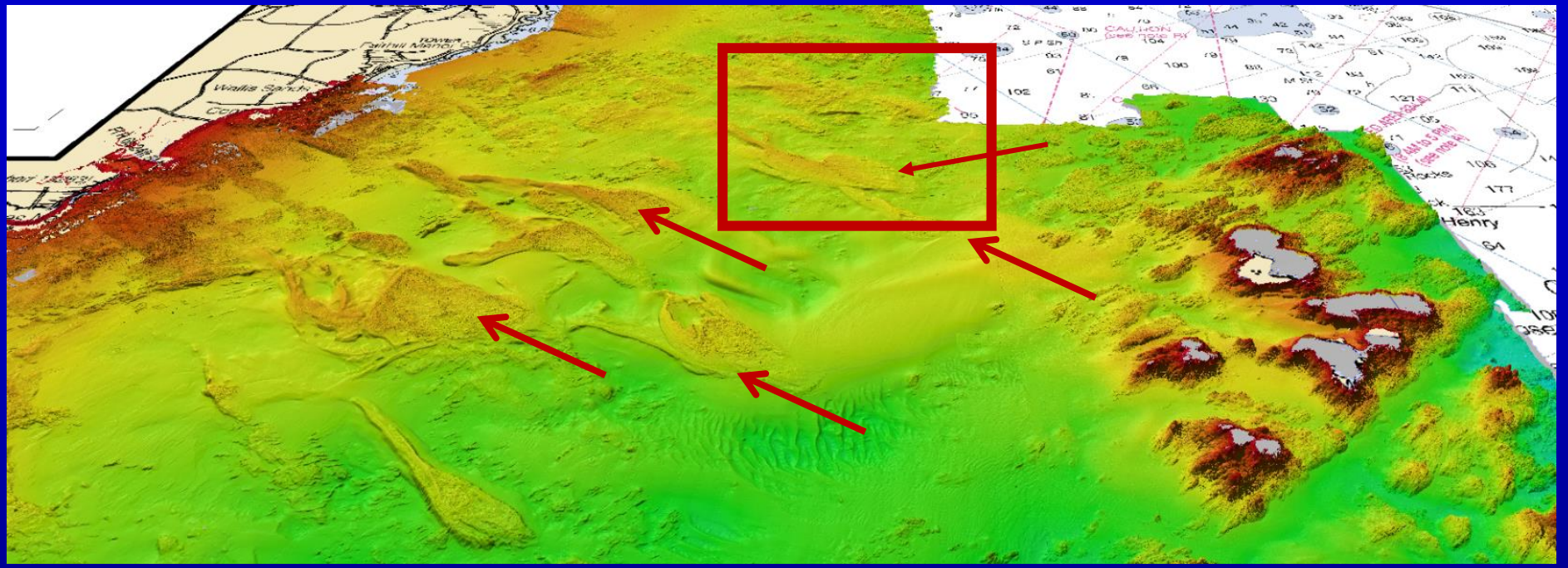
Carter and Orford. 1988. Model for Erosion of Drumlin and Beach Ridge Formation (figure reproduced in Masselink, Hughes and Knight. 2011. Introduction to Coastal Processes and Geomorphology, 2nd edition. Hodder Education. Figure 11.6

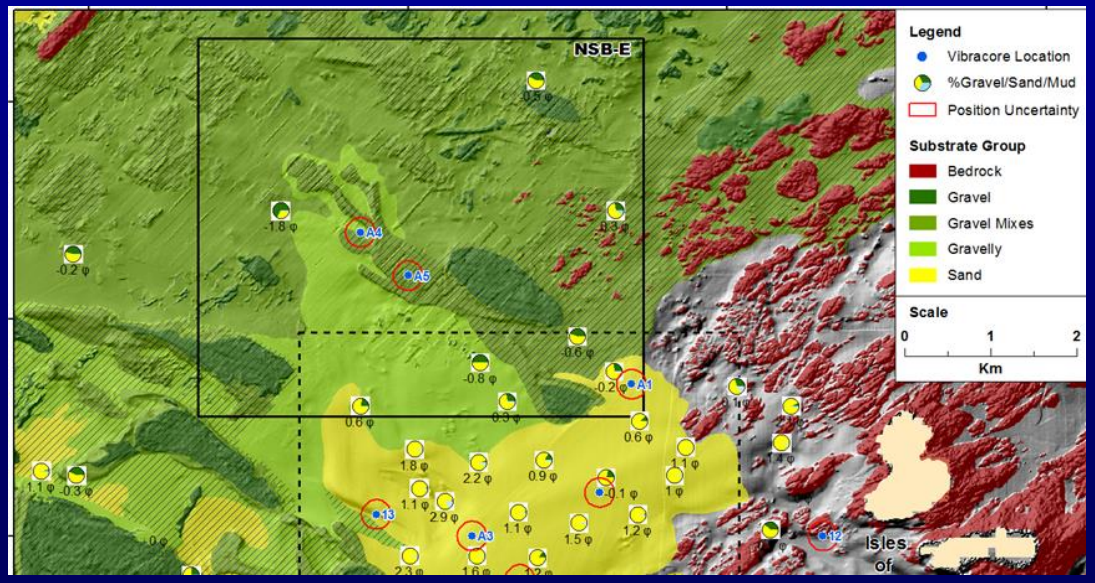

Portsmouth
NH
Wallis Sands
Foss Beach
Jenness Beach
North Hampton
North Beach
Hampton Beach
Seabrook Beach
MA
Salisbury Beach
Depth (m)
High : 0.508801
Low : -24.341
0 1.25 2.5 5
Kilometers
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

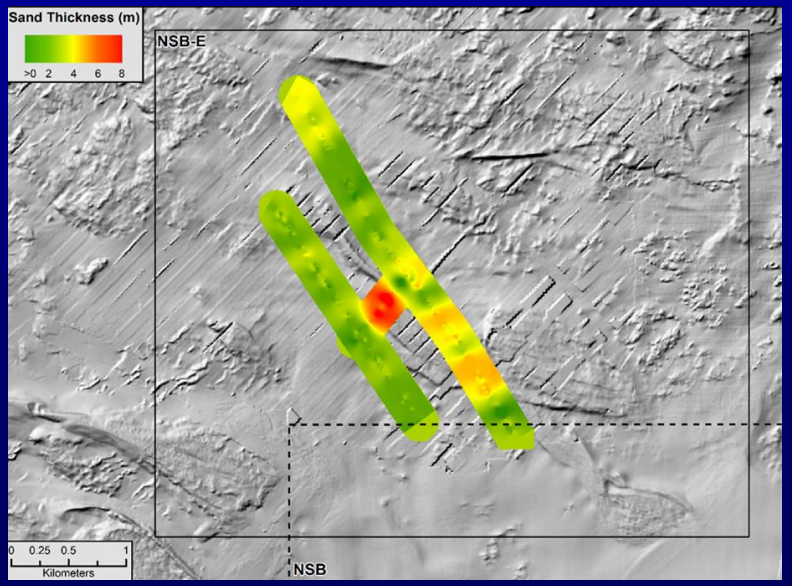

Google earth


orth Beach
ach

Example of Modified Glacial Deposit and Associated Marine Shoals

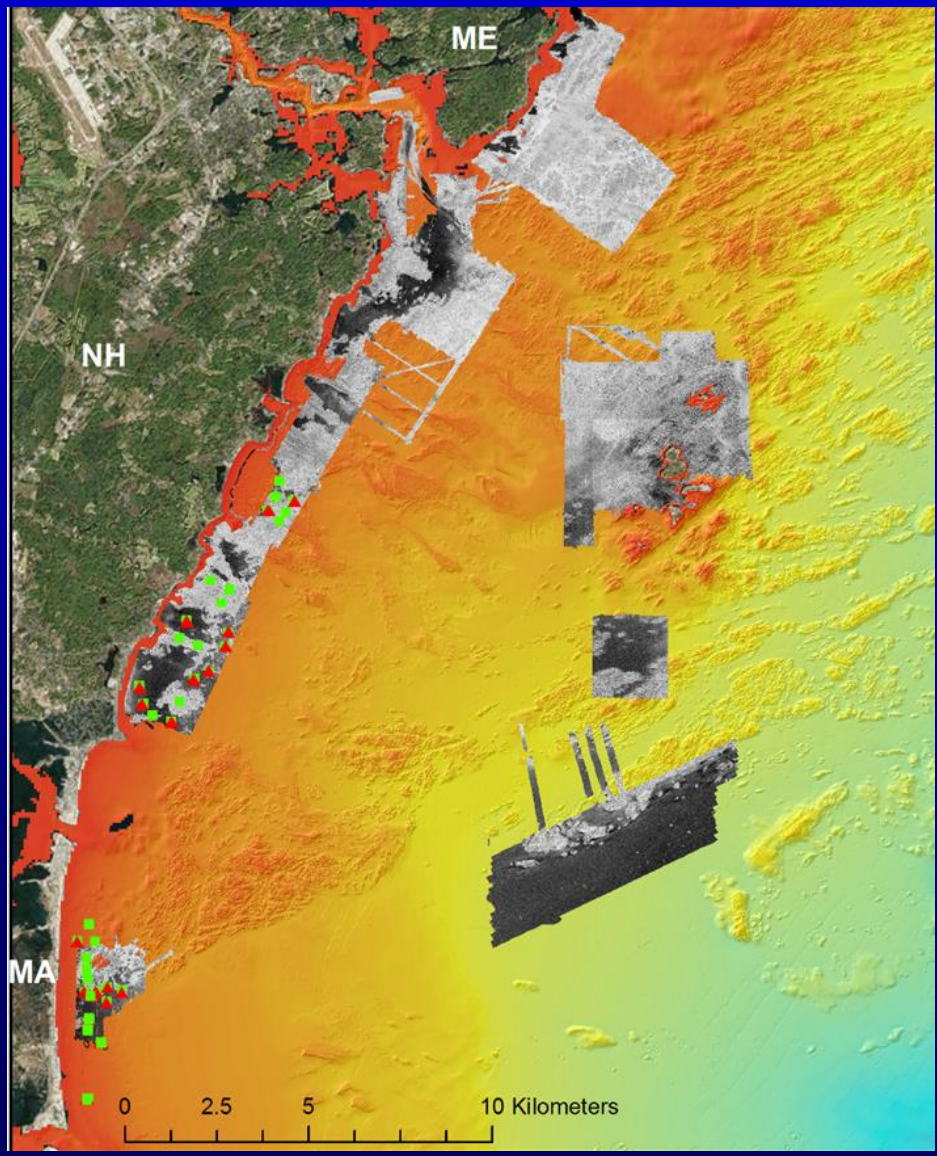


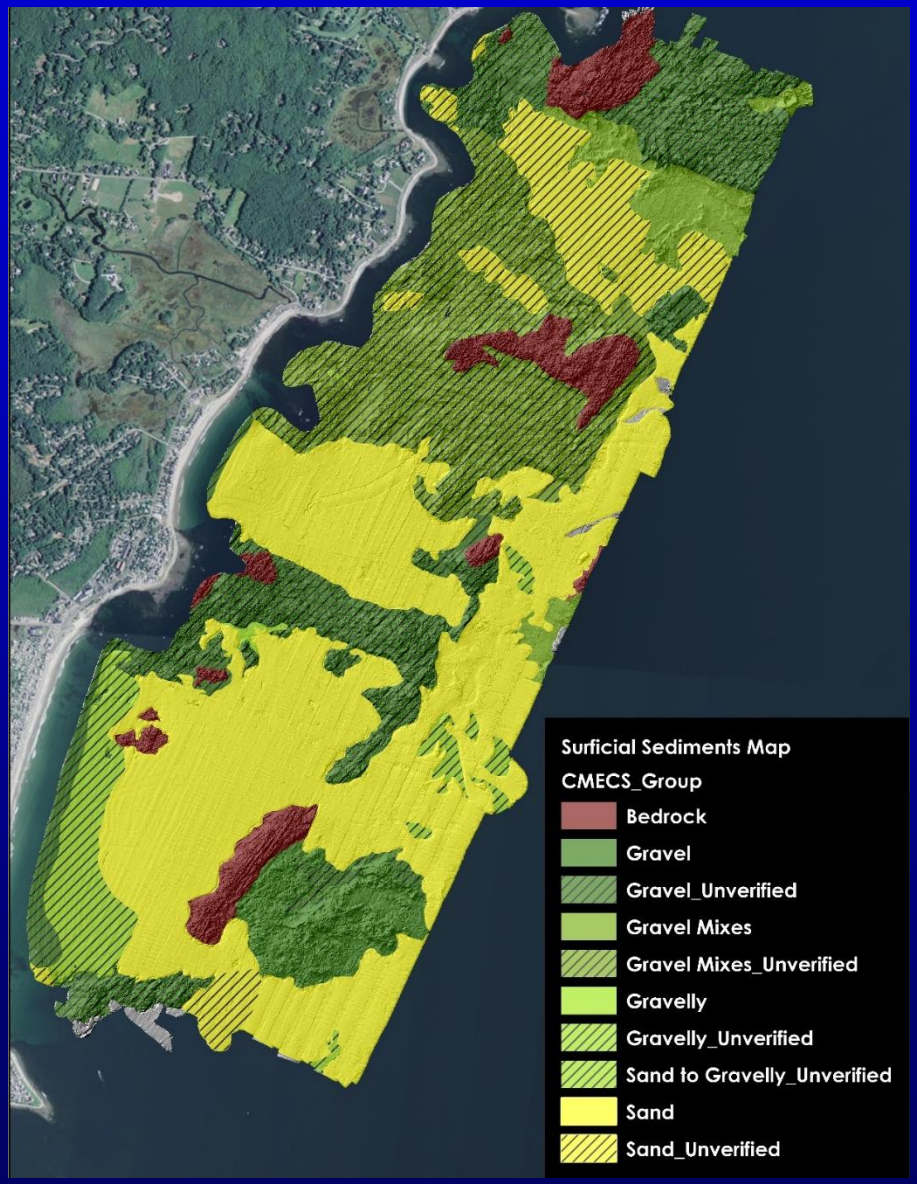




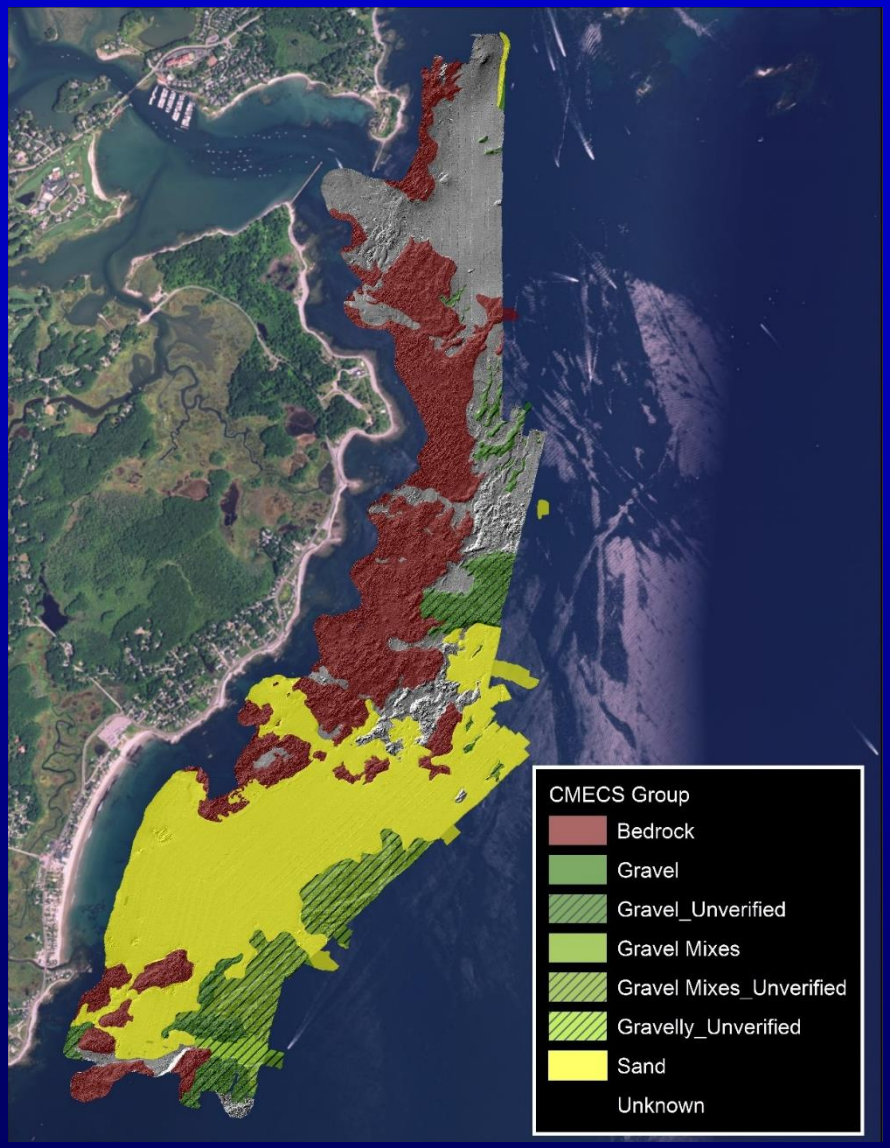
Next: Assessment of MBES Backscatter to Help Classify Bottom Sediments

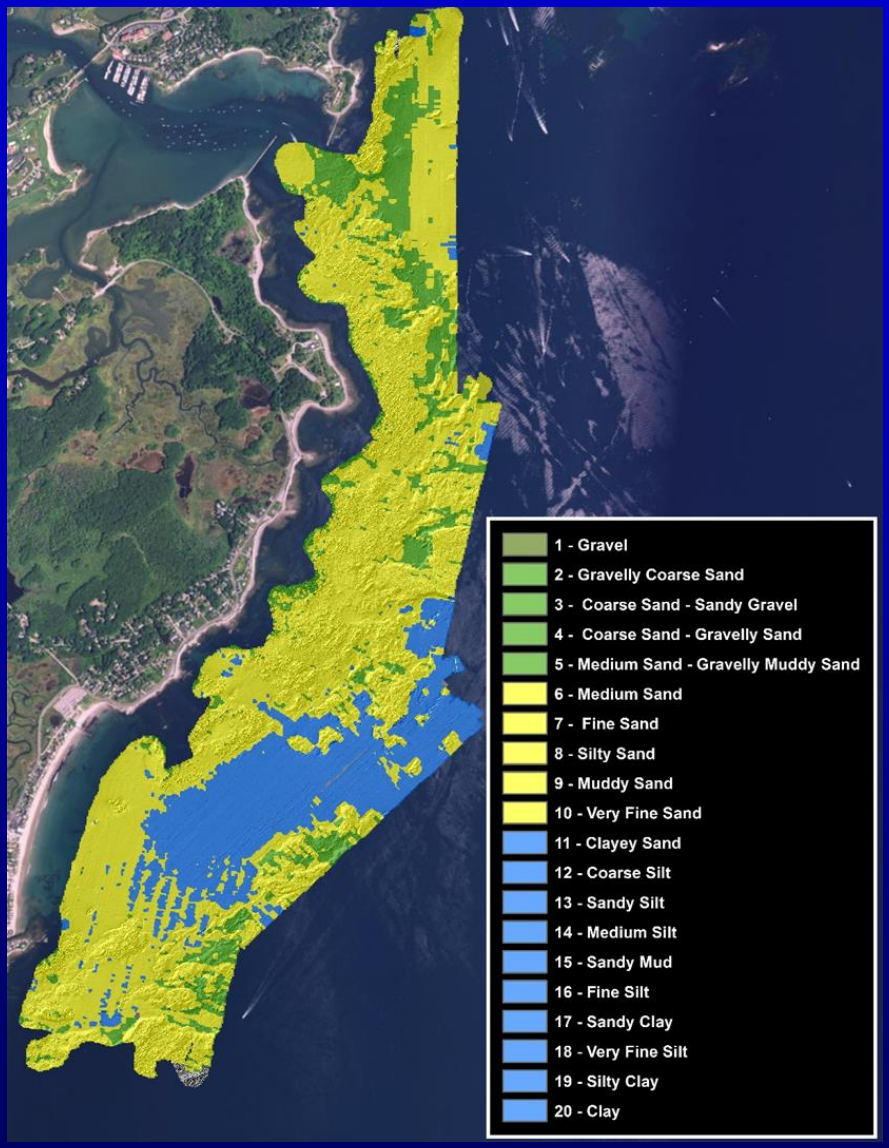
- Utilizing UNH Summer Hydro Surveys
- Using Surveys Primarily Collected with Kongsberg EM3000; EM3020; EM2040 (300kHz)
- Significant Challenges Due To Extreme Heterogeneity of the Seafloor
  - Exposed Bedrock
  - Cobbles and Boulder
  - Fine Gravel
  - Sands
- Mixed Results




Surficial Sediments Map
CMECS_Group
Bedrock
Gravel
Gravel_Unverified
Gravel Mixes
Gravel Mixes_Unverified
Gravelly
Gravelly_Unverified
Sand to Gravelly_Unverified
Sand
Sand_Unverified

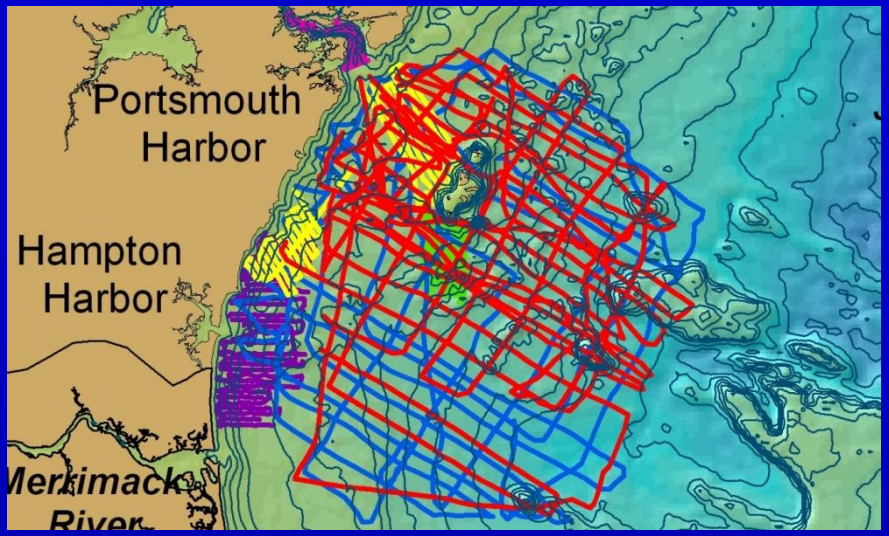

Gravel
Fine Sand
Muddy Sand
Muddy Sand
Gravel
Coarse Sand
Gravelly Sand
Medium Sand
Muddy Sand
Muddy Sand
Clayey Sand
Fine Sand
Clayey Sand
Gravel
Silty Sand
Coarse Silt
Muddy Sand
Muddy Sand
Medium Sand
Fine Sand
Medium Sand
Gravelly Muddy Sand
Medium Sand Gravelly Sand
Muddy Sand

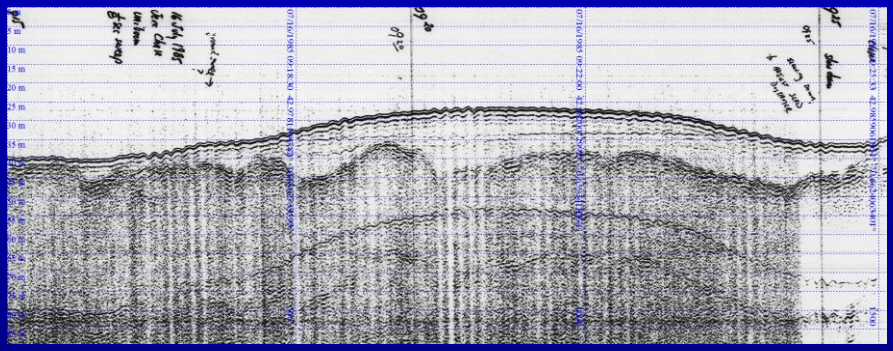

CMECS Group
Bedrock
Gravel
Gravel_Unverified
Gravel Mixes
Gravel Mixes_Unverified
Gravelly_Unverified
Sand
Unknown

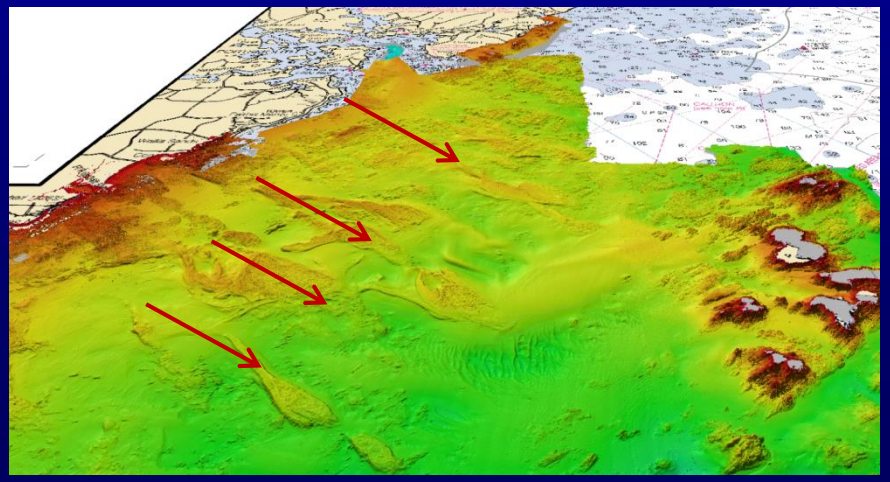

1 - Gravel
2 - Gravelly Coarse Sand
3 - Coarse Sand - Sandy Gravel
4 - Coarse Sand - Gravelly Sand
5 - Medium Sand - Gravelly Muddy Sand
6 - Medium Sand
7 - Fine Sand
8 - Silty Sand
9 - Muddy Sand
10 - Very Fine Sand
11 - Clayey Sand
12 - Coarse Silt
13 - Sandy Silt
14 - Medium Silt
15 - Sandy Mud
16 - Fine Silt
17 - Sandy Clay
18 - Very Fine Silt
19 - Silty Clay
20 - Clay

Summary

- Based on MBES Surveys and an Extensive Archived Database, the Following Products Have Been or Are Being Produced for the NH and Vicinity Continental Shelf:
  - High Resolution Bathymetry and Backscatter Maps
  - Surficial Sediment Maps
  - Geoform Maps
  - Sand and Fine-Gravel Distribution Maps
- Origin of Sand and Gravel Features on NH Shelf at Least Related to:
  - Erosion of Glacial Features
  - Followed by Formation of Shoals
- And
  - Winnowing of Glacial Marine Sediments







Acknowledgements

- BOEM – New Hampshire Cooperative Agreement
  - Larry Ward (UNH) and Rick Chormann (NHGS)
  - Neil Olson, Kaitlyn McPherran
- UNH/NOAA Joint Hydrographic Center
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- University of New Hampshire Department of Earth Sciences
- New Hampshire Geological Survey
- New Hampshire Coastal Program