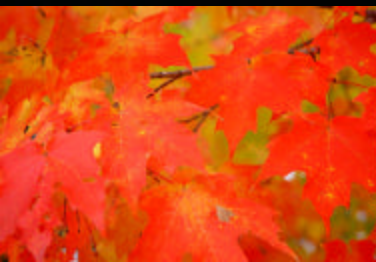


# Center for Coastal and Ocean Mapping NOAA/UNH Joint Hydrographic Center





# Operations Began - Jan 2000





# Center Goals

- To be a world leader in the development of hydrographic & ocean mapping technologies and approaches
- To expand the scope of ocean mapping clients and constituencies
- To educate a new generation of hydrographers and ocean mappers



# Complementary Centers

- NOAA/UNH Joint Hydrographic Center (JHC)
  - A NOAA and University Organization
- UNH Center for Coastal and Ocean Mapping (CCOM)
  - Provides for participation of private sector and other government agencies
  - NSF, ONR, NRL, DARPA, CICEET, USGS, USACE, Coast Guard, Nippon Foundation, BBN



# *Why map the seafloor?*

## *For safety of navigation*

**98 % of U.S. imports by weight come by sea:**



*Ecotourism – in uncharted waters*







# ***National Security and Sovereignty***







# USS San Francisco (SSN 711) – in drydock after hitting uncharted seamount



<http://www.freerepublic.com/focus/f-news/1330034/posts?page=515>

8/19/2005

Hydrographic



# SOVEREIGNTY

## *United Nations Convention on the Law of the Sea - Article 76*

Ten paragraphs that redefine the “continental shelf” of a coastal state and provide a mechanism for the state to extend its jurisdiction over the “seabed and subsoil” of the continental shelf

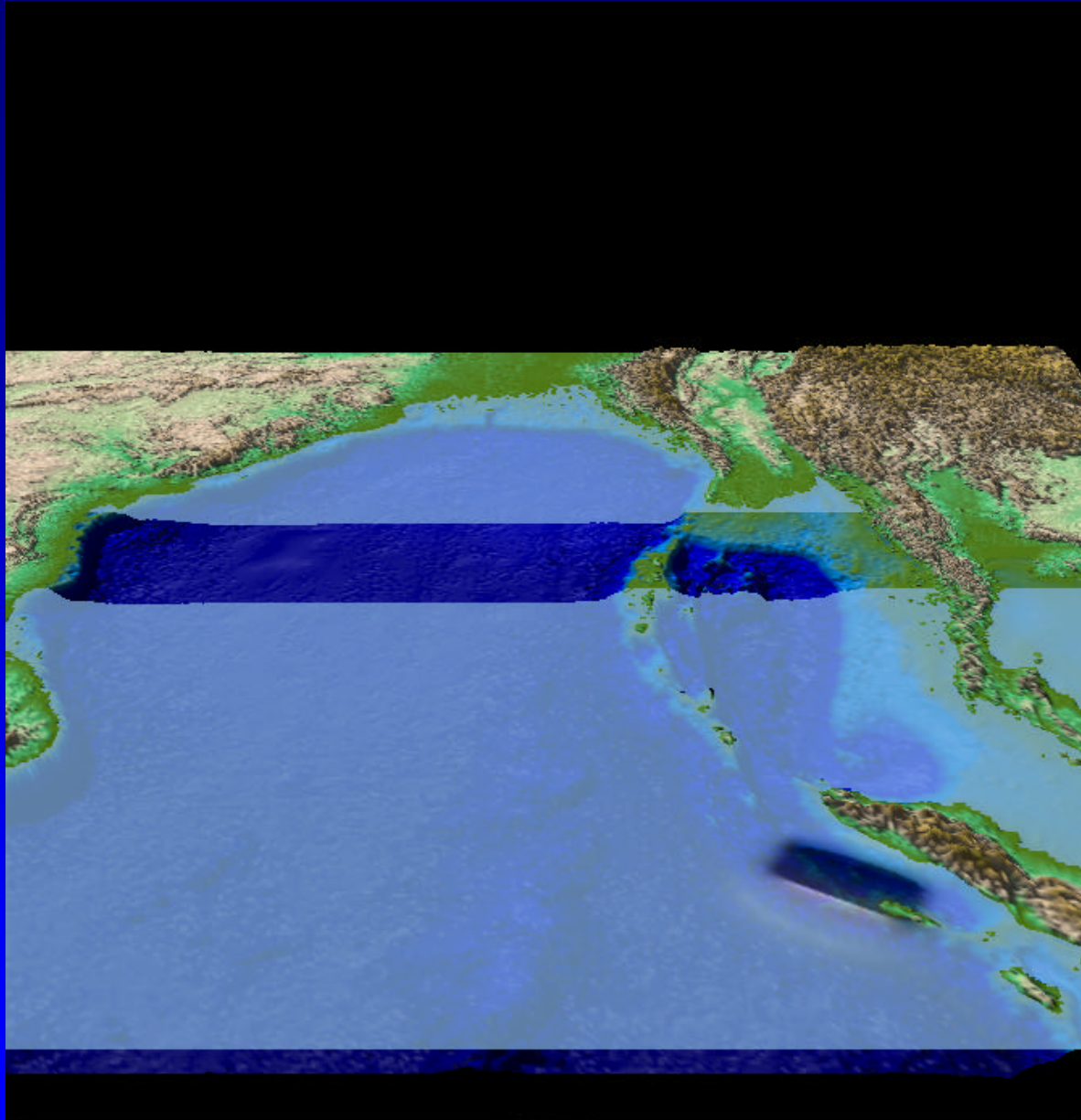


# *Why map the seafloor?*

- *For communications (fiber optic cables)*
- *For resource exploration and exploitation: oil, gas and others minerals, fisheries*
- *Modeling ocean processes: circulation, tsunamis*
- *Pure exploration!!!*



# Dec. 26 Tsunami





2000 B.C.



Bass, et al, *Men, Ships and the Sea*



1940 A.D.

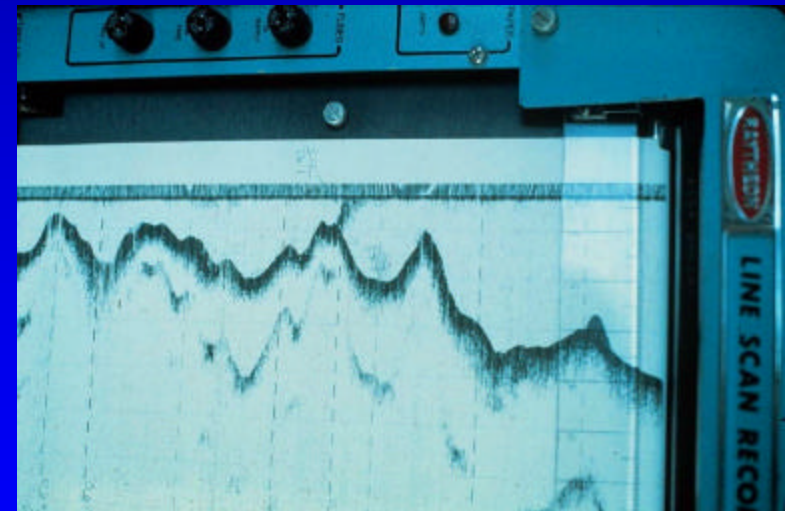
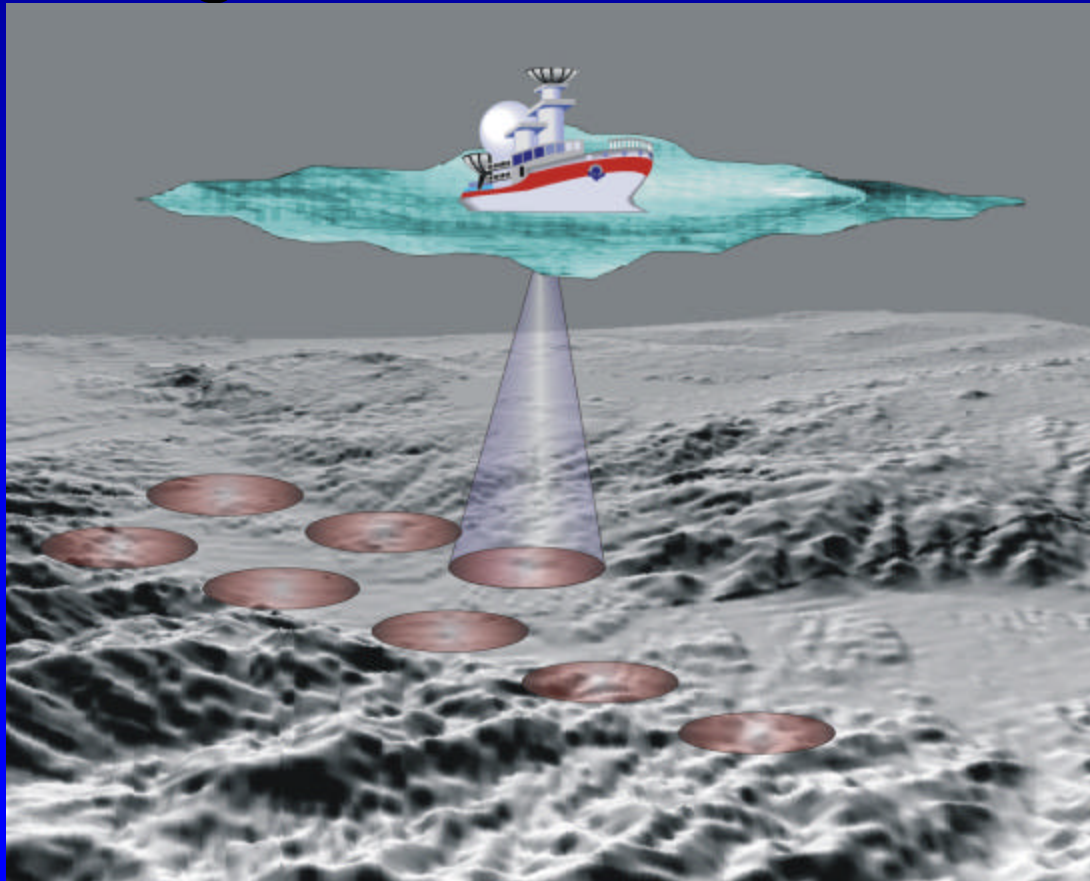


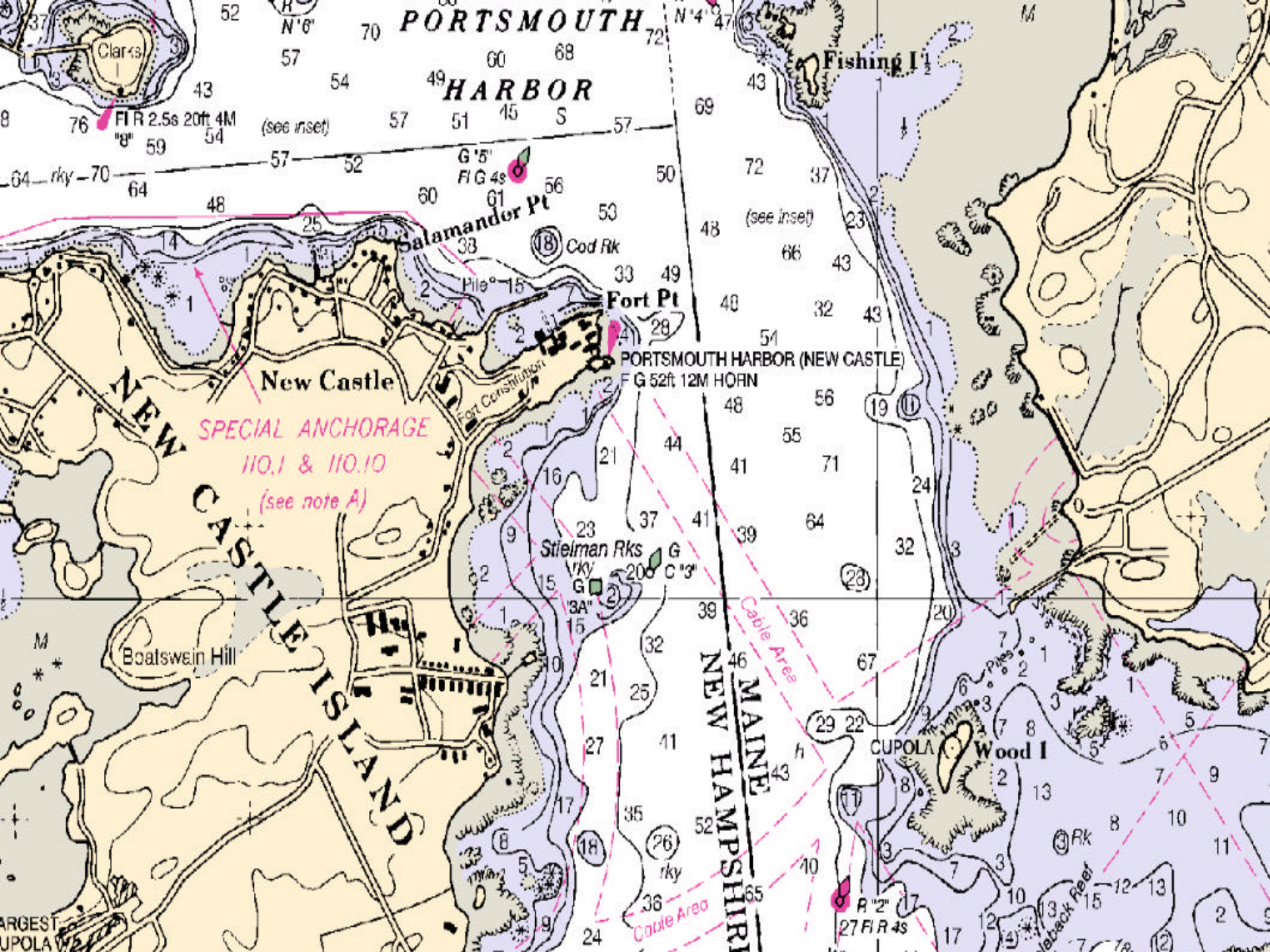
<http://www.photolib.noaa.gov/historic/c&gs>



# The History of Ocean Mapping

## Single Beam Echo Sounder



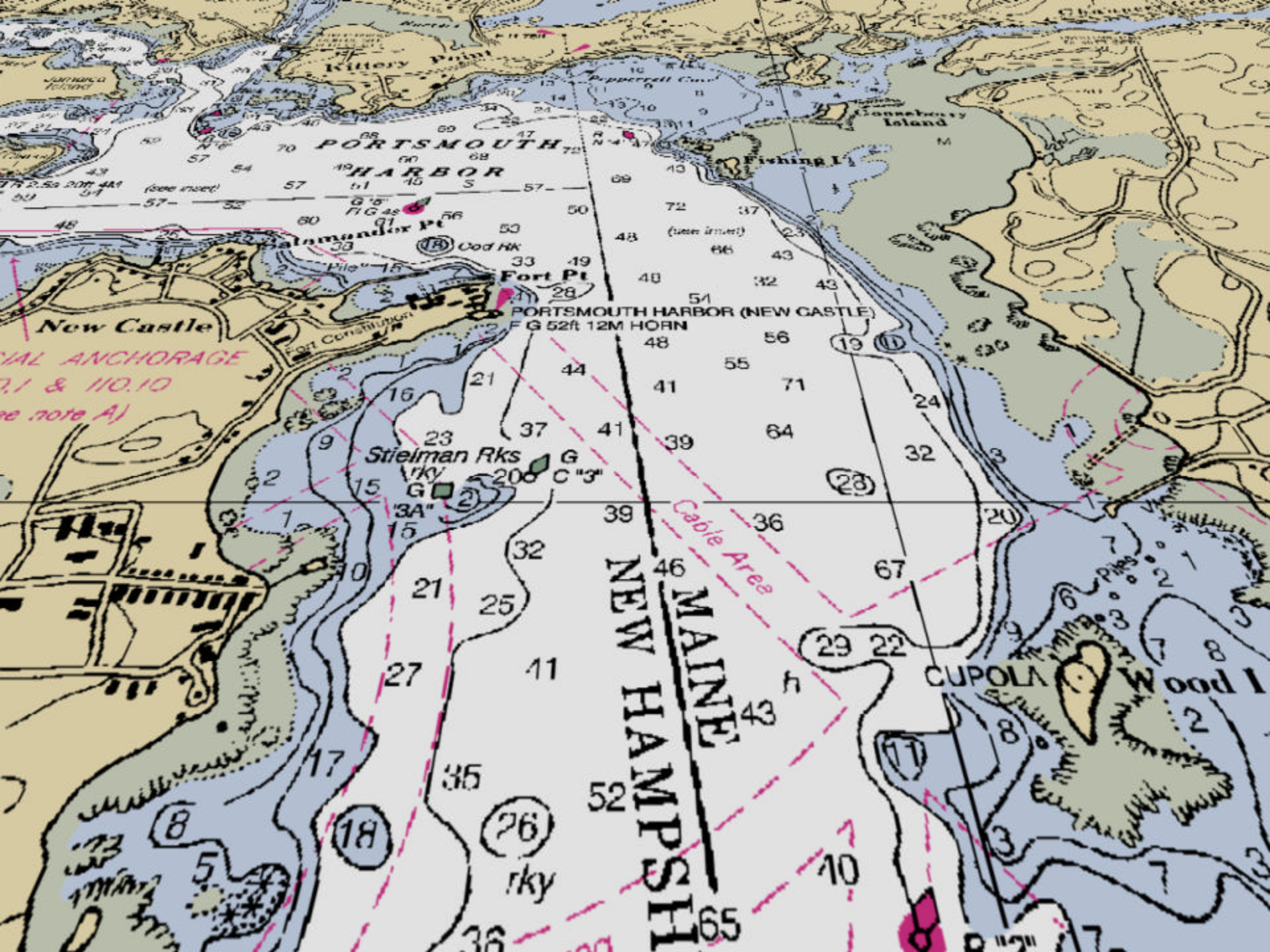






# *Multibeam Sonar*





**PORTSMOUTH HARBOR**

**Fort Pt**

**PORTSMOUTH HARBOR (NEW CASTLE)**  
F G 52ft 12M HORN

**Stielman Rks**

**MAINE**  
**NEW HAMPSHIRE**

**CUPOLA**

**Wood I**

**New Castle**

*Special Anchorage  
10.1 & 10.10  
(see note A)*

*Cable Area*

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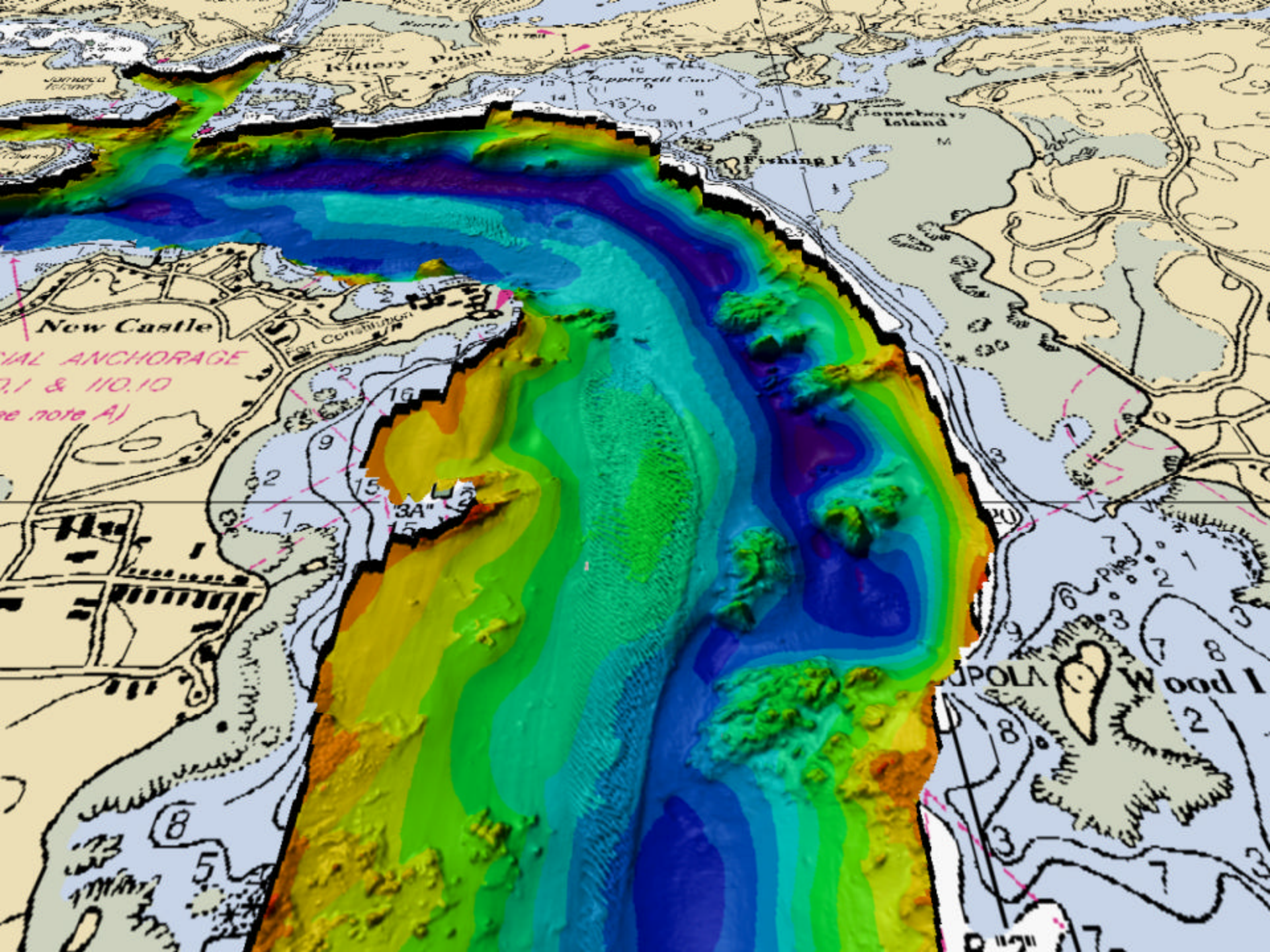
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New Castle

SPECIAL ANCHORAGE  
10.1 & 110.10  
(see note A)

PORT CONDUITAGE

3A

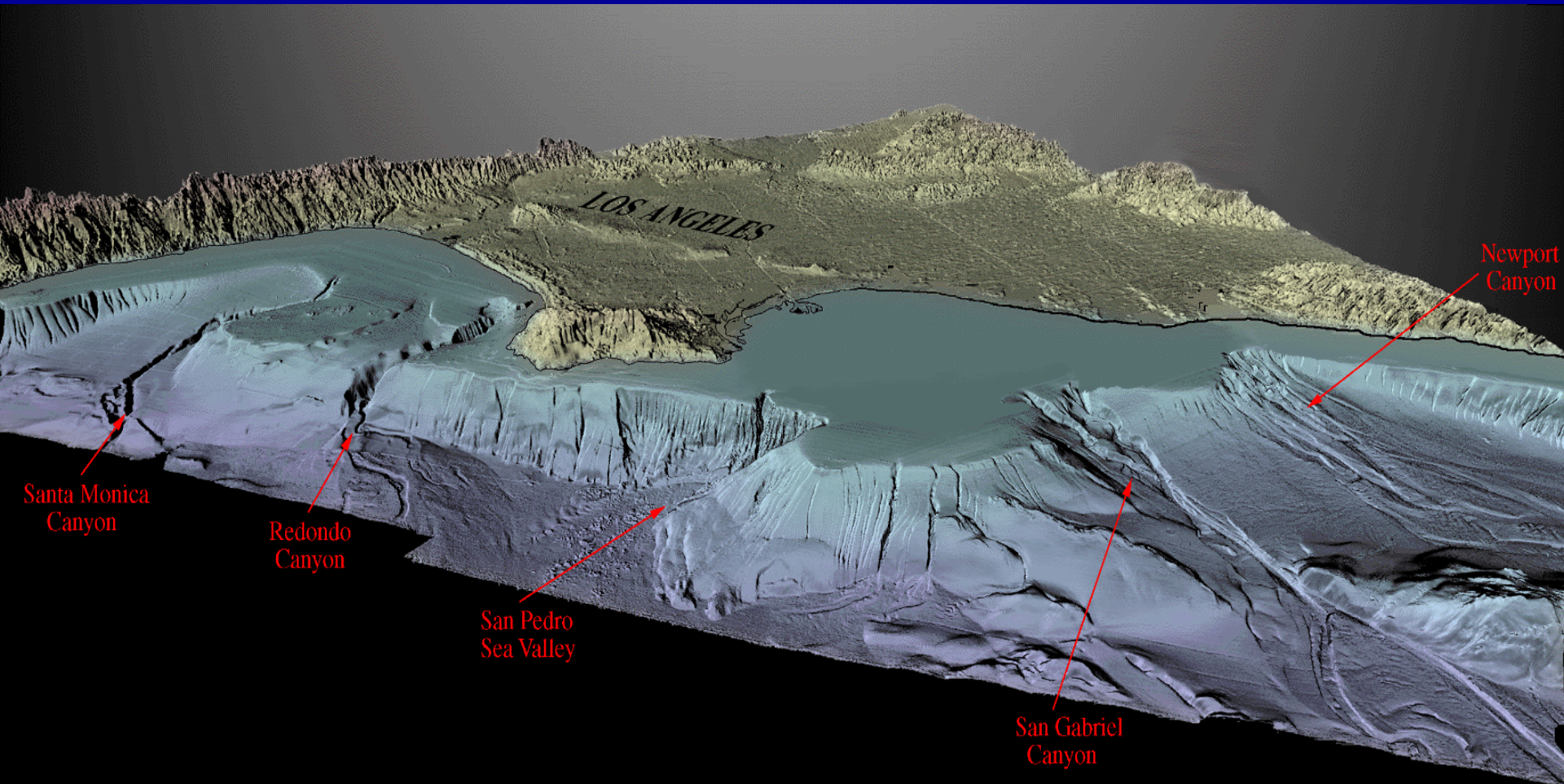
POLA

Wood I





# A new perspective → new insights





# Increase in Data Density

in 100 m of water

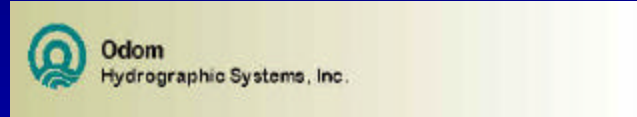
<u>Method</u>	<u>Soundings/hr</u>	<u>Mb/hr</u>
Lead line	10	.00008
Echo sounder	21,600	.1728
1st Generation	292,000	2.1
2nd Generation	324,000	27.9 (ss)
<u>3rd Generation</u>	<u>1,500,000</u>	<u>79.8 (ss)</u>

in 5 m of water 30,000,000 800 (ss)



# Industry Partners

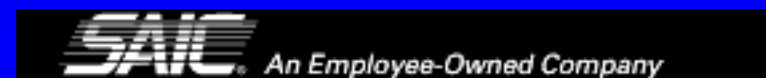
Sonar/LI D AR manufacturers :



Survey Companies:



Mapping and processing software:







# Educational Programs

- M.S. and Ph.D.
  - Two Ocean Mapping tracks:
    - Ocean Engineering
    - Earth Sciences/Oceanography/Natural Resources
    - IHO Cat “A” Certification – May 2001
  - Computer Science, Elect. & Mech. Engineering
- Graduate Certificate Program
- Nippon Foundation/GEBCO Training Program
- Non-Degree Programs



# Who are we?

- 12 Faculty
- 12 Research Scientists
- 8 Support Staff
- 20 Grad Students
  
- 11 Students have graduated



# Who are we?

## Visiting Scholars

- Danish Hydrographic Office
- Texas A&M University
- Froenhofer Institute (Germany)
- University of Stockholm
- Newcastle University (Australia)
- Geological Survey of Israel
- Royal Australian Navy Hydrographic Office



# Facilities

- T-1000 network with 14 Dell servers supporting > 12 Terabytes of RAID and NAS. Dedicated servers for Web, GIS and Common Data Set
- Backup site for NOAA NowCoast
- State-of-art Intrusion Prevention System
- Computer class-room for training



# Facilities

- Unix, Linux and > 107 high-end PC workstations and laptops (and 4 Macs)
- High-end 60” and 48” large format plotters and scanner
- Real-time, interactive, ship-shore data, video and control station – “Ocean Exploration Tele-presence Console”



## CCOM/JHC Meeting, Workshop, and Training Facilities



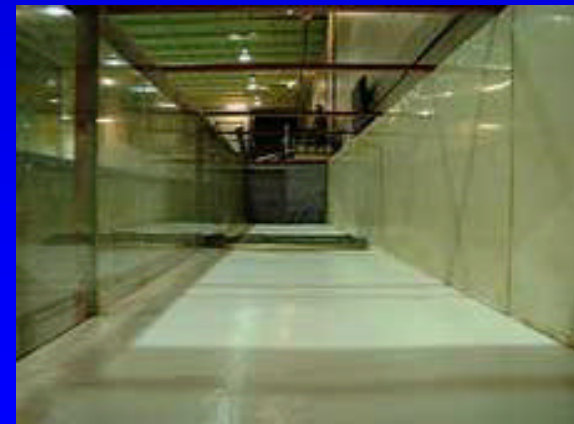


# Facilities

***Tow and wave tank (120' x 12' x 8')  
2-5 second waves up to .5m***



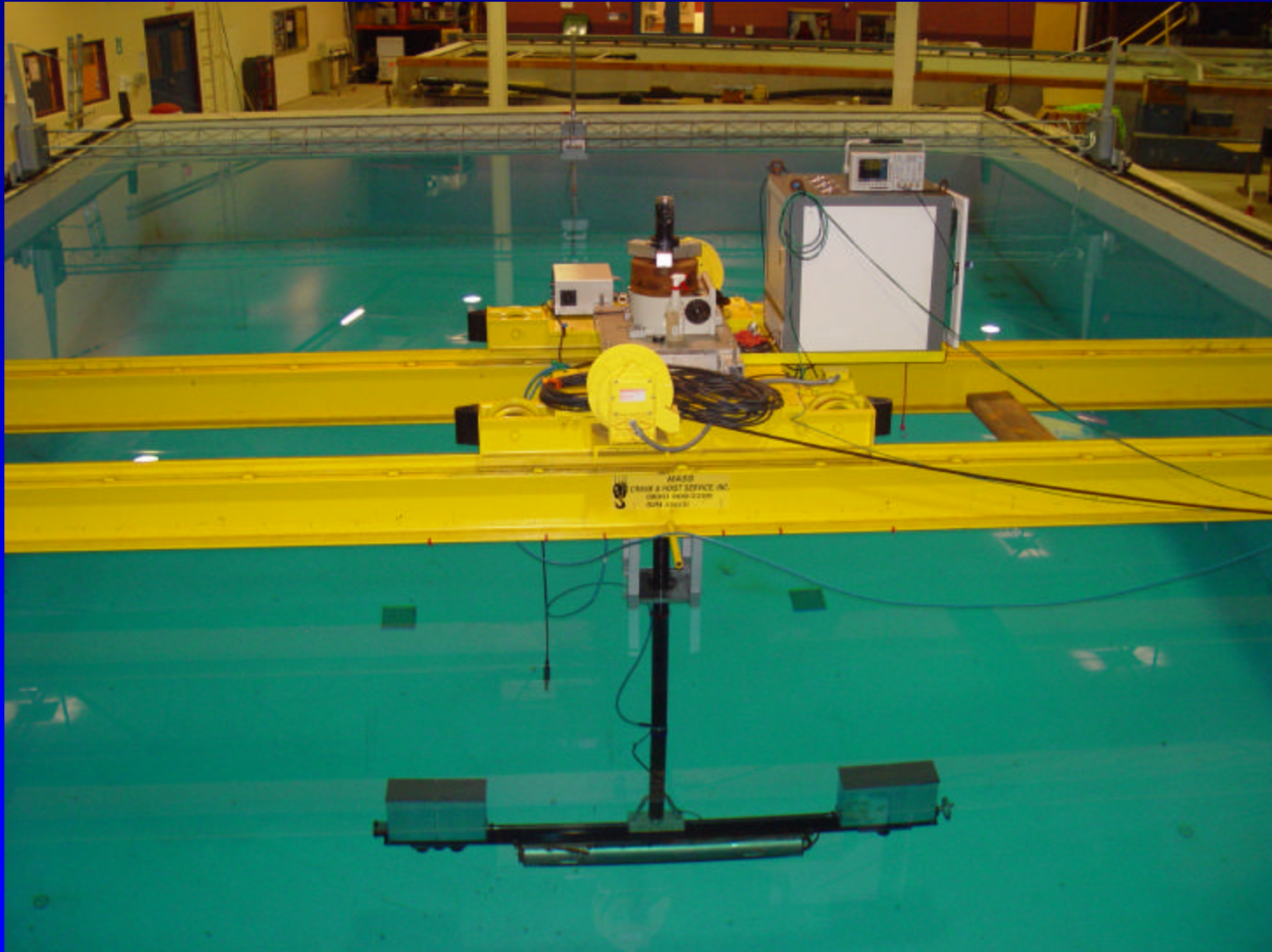
***Recirculating Flume Tank  
(45' x 4' x 4') - up to 3.5 knots***





# Acoustic Test Tank Facility

60' x 40' x 20'







# *R/V Coastal Surveyor*



**Odom Echo-Track profiler, sidescan and Digibar**

**Knudsen 50 - 200 kHz chirp profiler**

**Trimble RTK GPS**

**C-NAV**

**POS-MV 320**

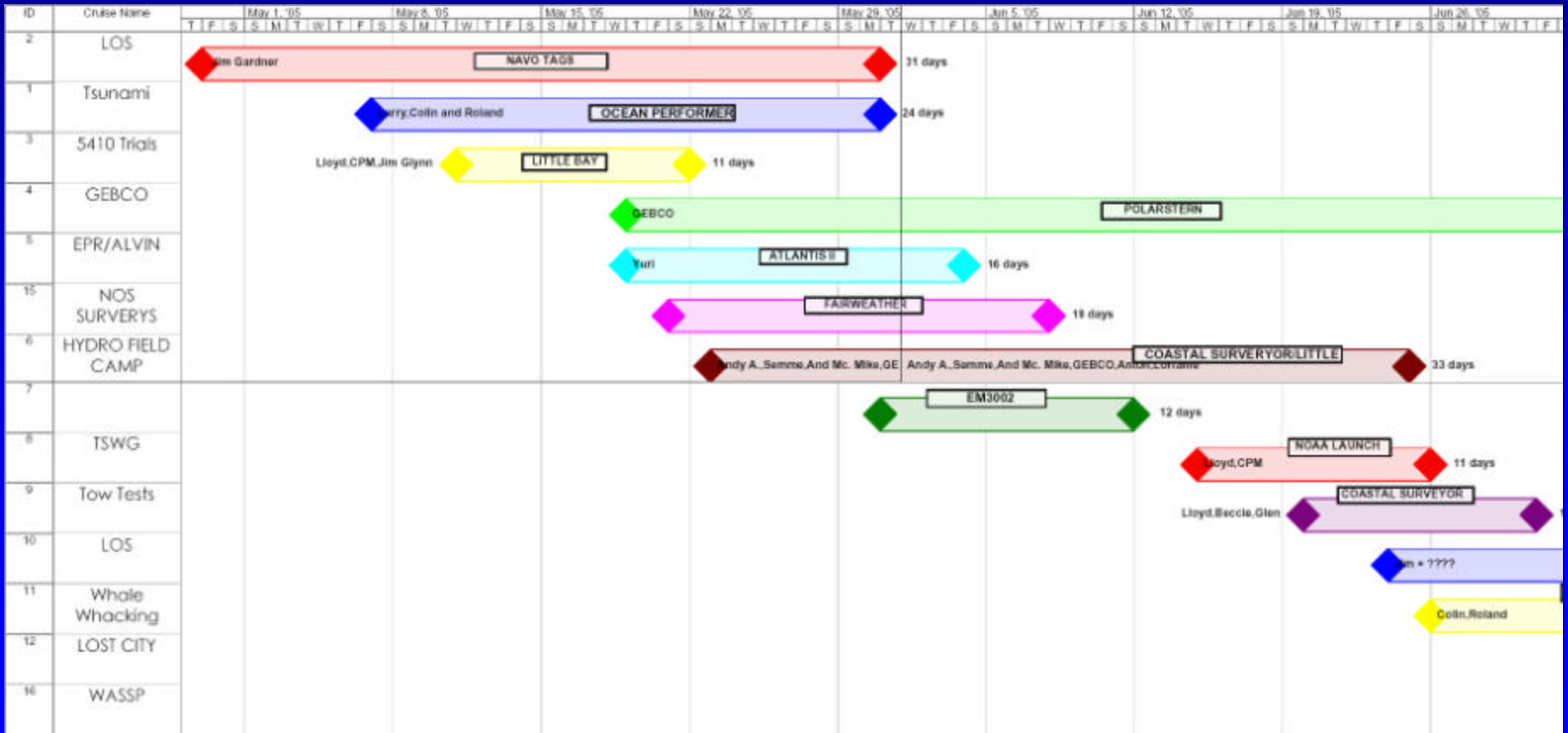
**TSS-335B**

**Seabird CTD**

**Dell server with new radar and GPS displays**



# JHC/CCOM Field Programs





# Research Themes

- Sonar System Capabilities and Limitations
- New approaches to multibeam sonar data processing
- New Applications of Seafloor Mapping Data
  - Remote Seafloor Characterization and Fisheries Habitat
  - Homeland Defense
- Data Visualization and Management



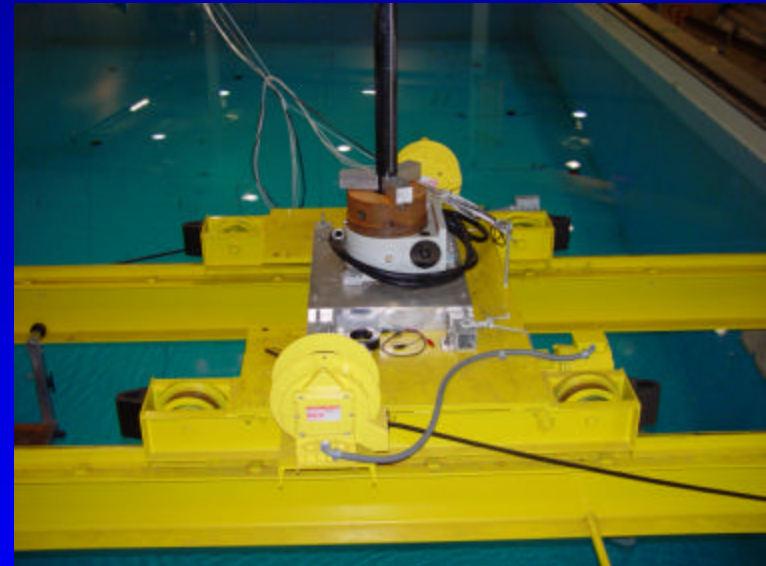
# Research Themes

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- New approaches to multibeam sonar data processing
- New Applications of Seafloor Mapping Data
  - Remote Seafloor Characterization and Fisheries Habitat
  - Homeland Defense
- Data Visualization and Management
- Portsmouth Harbor “Common Data Set”
- Law of the Sea
- Chart of the Future



# ***Sonar System Capabilities and Limitations***

**Developing state-of-the-art sonar calibration facility (with NSF)**



**Have calibrated SM2000, Reson 8101, WASSP, and Klein 5410 sonars; ISSAP, SPARR, Airmar and Wesmar transducers**



# ***Sonar System Capabilities and Limitations***

**Klein 5410**

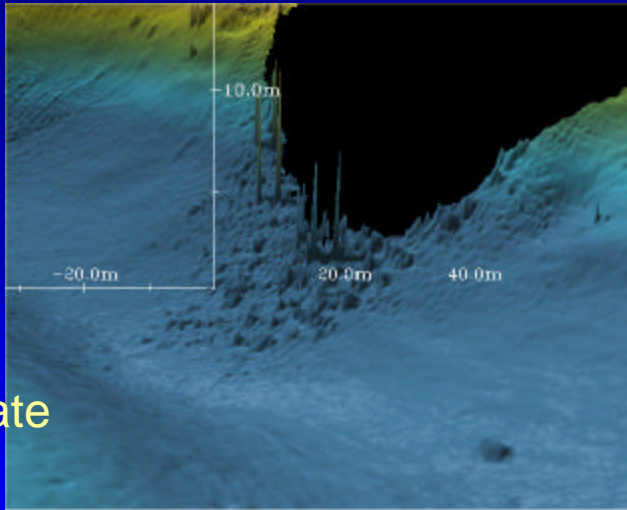


**WASSP (Wide Angle  
Sonar Seafloor Profiler)**

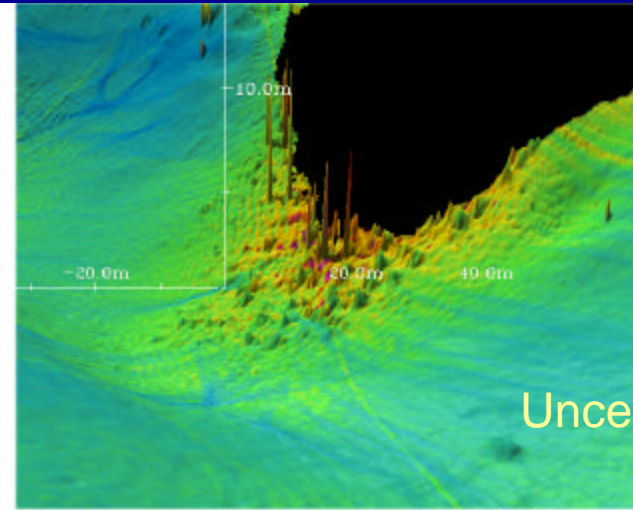


# New Approaches to Multibeam Sonar Data Processing

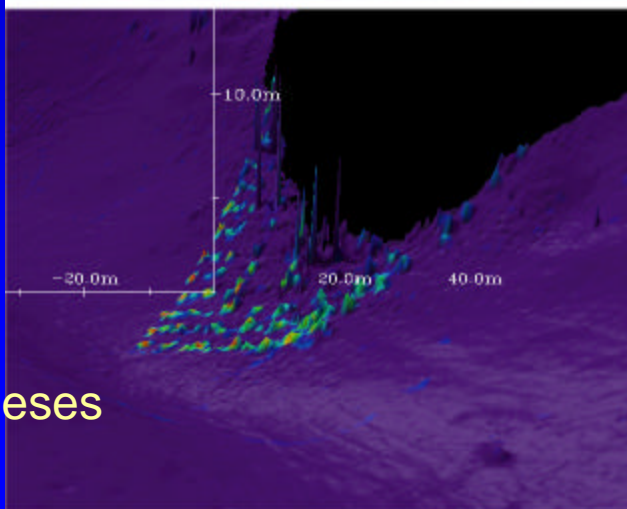
## CUBE--Combined Uncertainty and Bathymetric Estimator



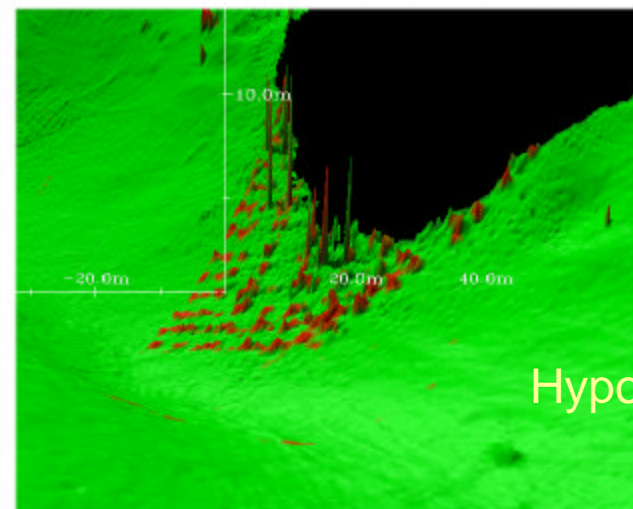
Depth Estimate



Uncertainty Estimate



Num. Hypotheses

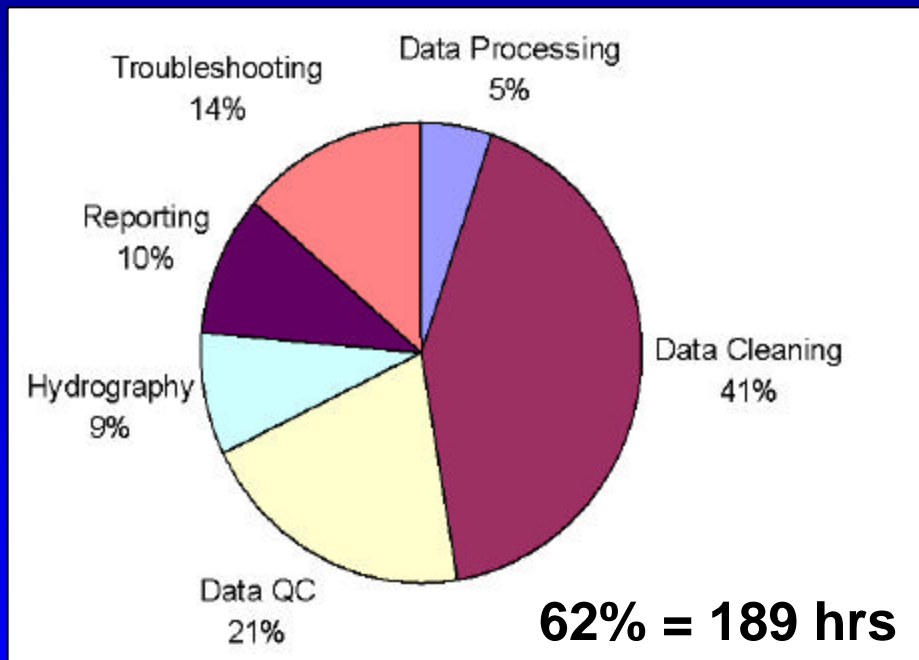


Hypothesis Strength



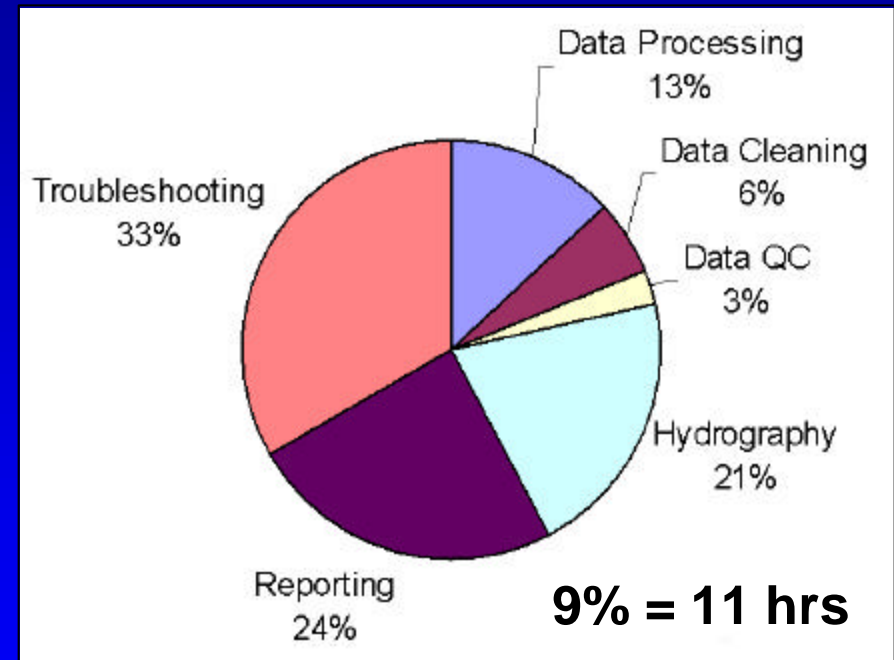
# CUBE Improvements

## Traditional



**QC+Cleaning= 189 hrs**

## w/ CUBE



**QC+Cleaning= 11 hrs**





## *CUBE Progress*

- Commercial implementation
  - now—IVS
  - Soon—CARIS, QPS, Triton, Simrad and SAIC
- Improved error models for shallow water based on feedback from NOAA hydrographers



# *CUBE Prospects*

- Uncertainty models for auxiliary sensors
- Error model development for additional sonars, including phase comparison
- Extraction of error models from real data
- Iterative application to patch test
  - 5 – 20% reduction in depth error
- Data Consistency Filtering – “The Downhill Problem --
  - **M**ulti-Algorithm **S**wath **C**onsistency **D**etector – **MASCD** – SAIC 1st to license

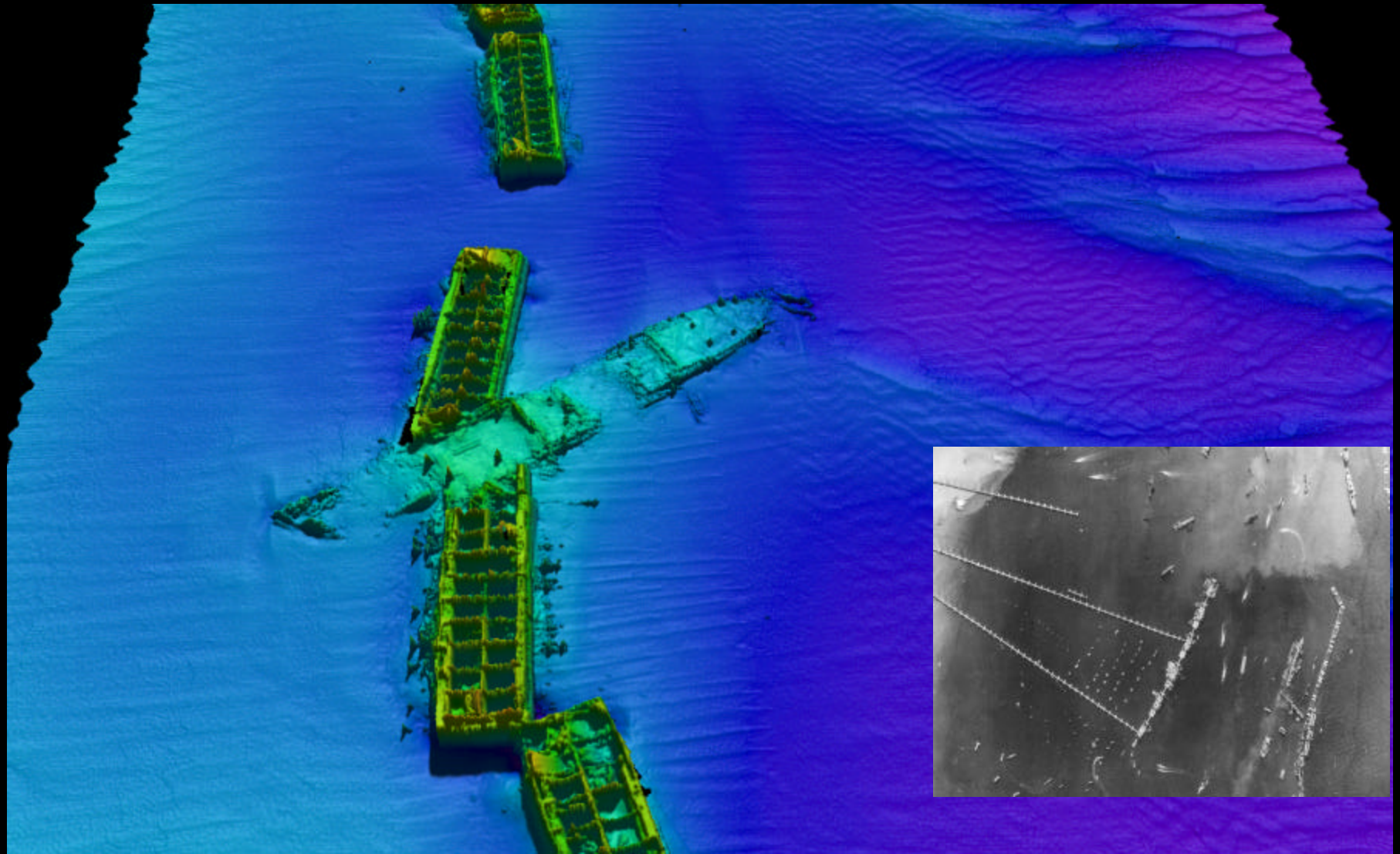


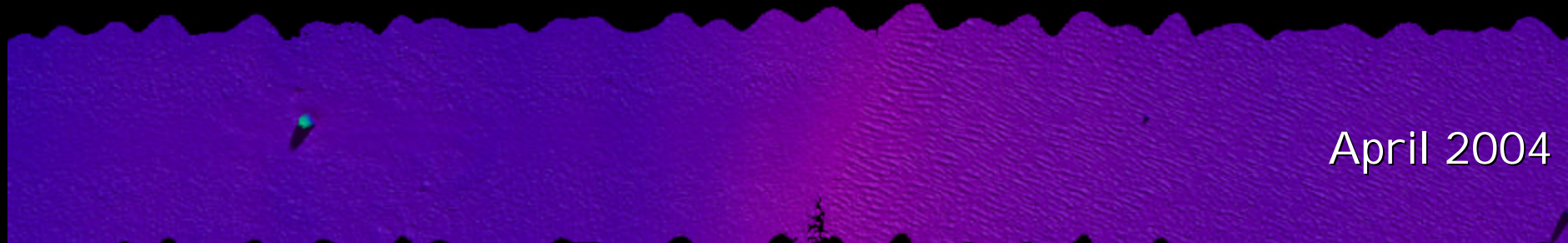
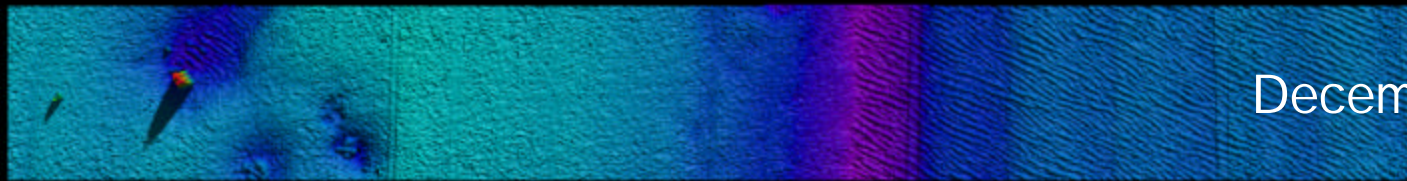
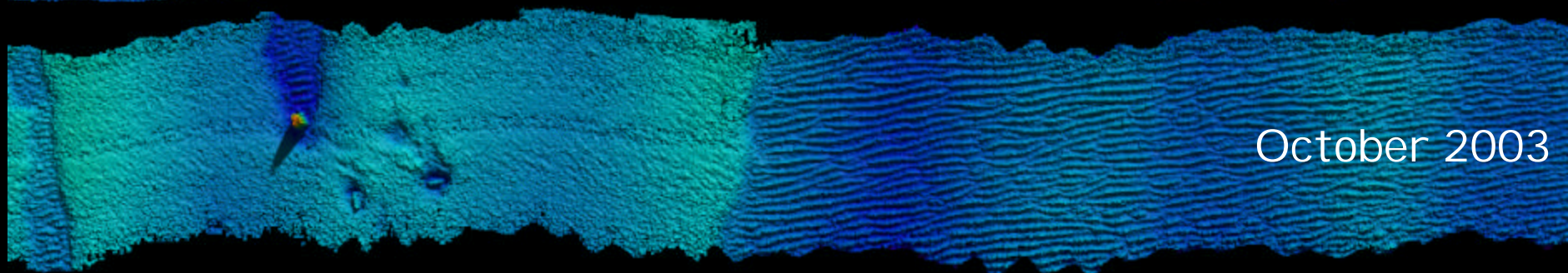
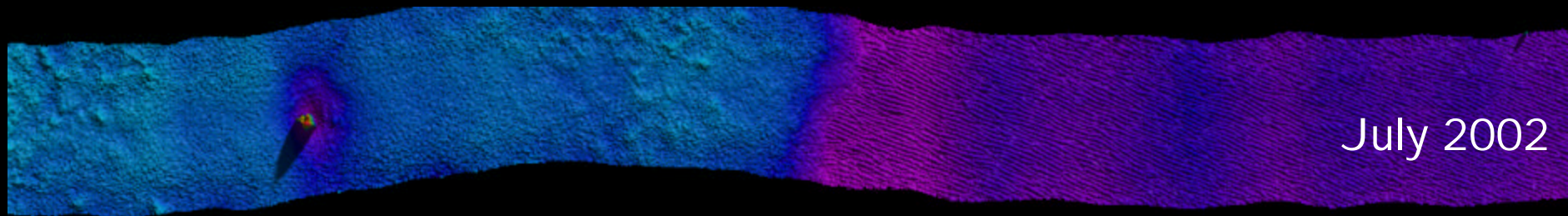
# Other Projects at CCOM/JHC

- Harbor security
- Mine burial
- Underwater ordnance clean-up
- Fishing gear impact
- Long Range Fisheries Sonar
- ROV/AUV control
- Non-traditional data for Nautical Charts
- Phase comparison for side scan depth data
- Sparse data uncertainty
- Mid-water sonar mapping
- GPS improvements
- Coral reef mapping
- Tele-presence
- Video mosaicing
- Side scan tow fish control
- Seafloor texture
- Tsunami modeling
- Lidar data analysis
- Marine archeology

# Pushing the limits of target resolution

Mulberry Harbor - off Omaha Beach, Normandy

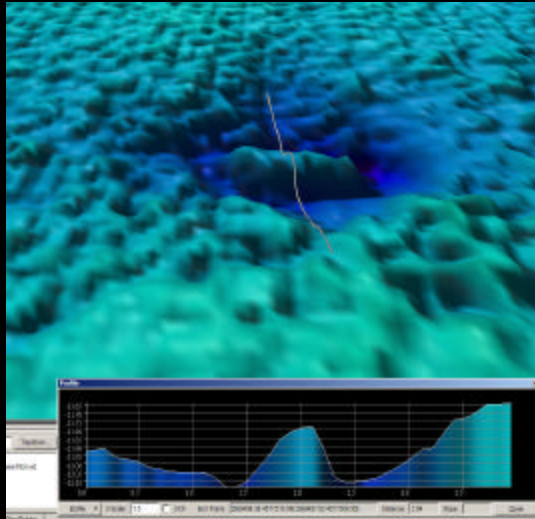




Sand ripples 1—2 cm in height



# FWG Mine



**Close-up of FWG mine in NE corner of area. Note 3 small highs representing three rings of sensors. Profile across mine and scour pit in upper left**



# What you'll hear more about today

- Law of the Sea
- Seafloor characterization
  - Multibeam Sonar Backscatter
  - Multibeam and Side Scan Sonar mosaics
- Sonar System Development and Calibration
- Visualization
  - Chart of the Future
  - Currents and Flow
  - Whale tracking
  - ROV control
  - Outreach and Education