



# Exploration: Mapping and Characterization

Rachel Medley

Kelley Elliott

Craig Russell





# Strategy for Ocean Exploration Campaigns

Rachel Medley, Chief  
Expeditions and Exploration Division

# Executing on Our Vision: Exploration Campaigns



A series of expeditions over multiple years to a geographic area or theme of **exploration priority** interest



Complementary expeditions using a wide variety of **platforms, technologies,** and strategies



Package of **data and information sharing** across platforms serves as foundation of environmental intelligence



Robust **engagement** in education and outreach efforts are integral activities



**Partners** focus messaging on the breadth of work

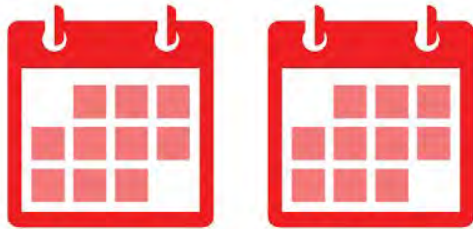


# ACUMEN

## Atlantic Canyons Undersea Mapping Expeditions



Ocean Exploration  
and Research



# CAPSTONE

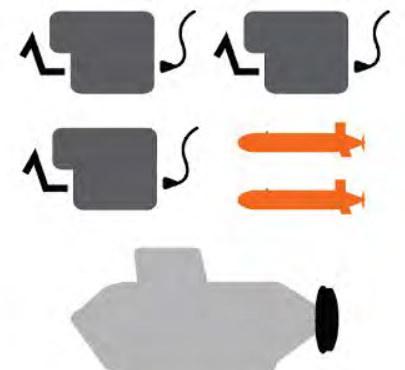
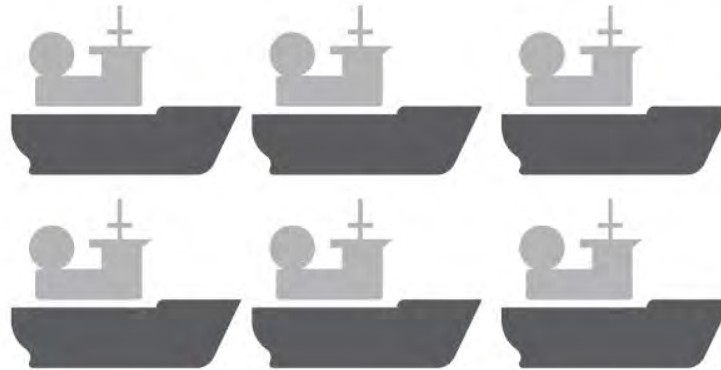
Campaign to Address Pacific Monument Science,  
Technology, and Ocean Needs



Ocean Exploration  
and Research



## Atlantic Seafloor Partnership for Integrated Research and Exploration



# Nested Approach to Expedition Planning

## CAMPAIGN

The highest level is development of a Campaign in an operating region or basin focused on themes, agreements, or interests of key partners that connect multiple expeditions and platforms in support of common goals

### COMMUNITY WORKSHOP

Conduct a community workshop to identify exploration priorities, themes, and partners in a region.

### CALL FOR INPUT

A “Call for Input” to solicit general mapping, CTD, and ROV dive targets in the operating area from the science and management community.



### CONSULTATIONS

Expeditions require the Expedition Manager to identify and consult with key partners in the region to understand their priorities, data needs, and interests.

### EXPEDITION PARTICIPATION

Any interested scientist, student, or manager with a relevant expertise is invited to join the expedition science and participate in the cruise and cruise planning meetings.



# ACUMEN - Results

## Atlantic Canyons Undersea Mapping Expeditions

- Mapped canyons from North Carolina to Maine
- Discovered each canyon is a different environment with distinct characteristics
- Revealed 570+ methane seeps along the U.S. East Coast
- Routine transit line bathy acquisition provided a model for data acquisition



**13 cruises**



**45,530 km<sup>2</sup> mapped**





# CAPSTONE - Results

Campaign to Address Pacific monument Science, Technology, and Ocean Needs

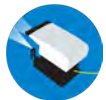
- Exponentially increased understanding of deep sea corals e.g. abundance & distribution
- New lines of scientific inquiry surrounding biogeographic patterns throughout the Pacific
- Discovered dozens of new species
- E/V *Nautilus* now building on initial CAPSTONE expeditions



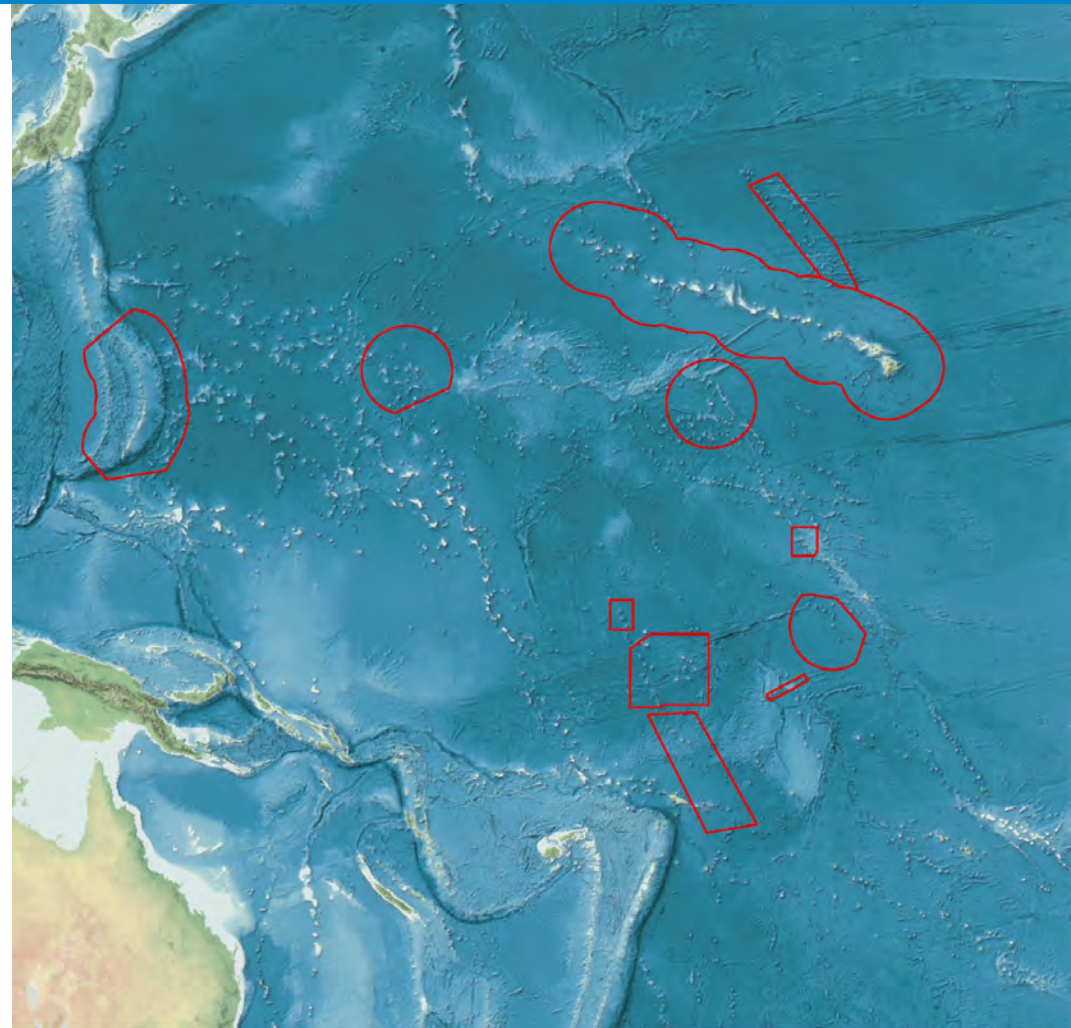
**23 cruises**



**597,230 km<sup>2</sup> mapped**



**187 vehicle dives**

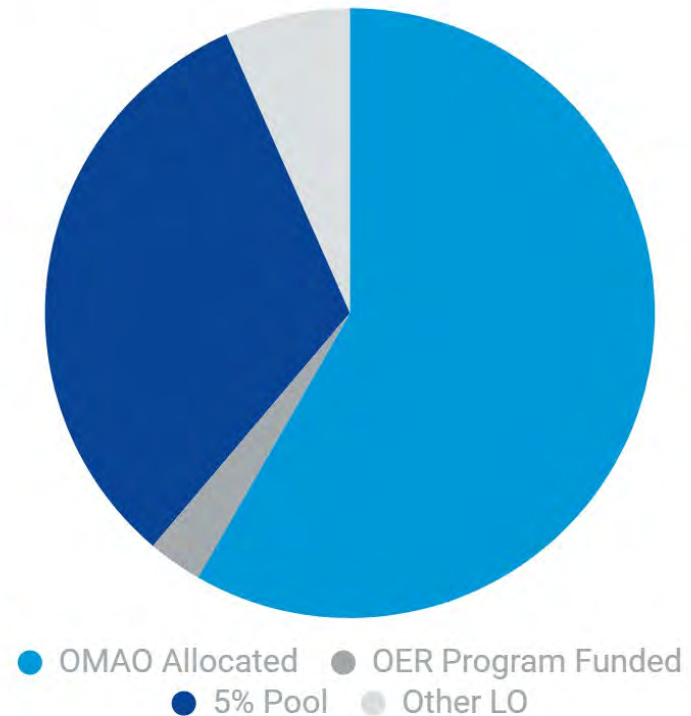


# CAPSTONE: Capitalizing on Cross-NOAA Partnerships

- CAPSTONE was the first time NOAA line offices recognized value of ocean exploration in terms of “hard currency:” DAS
- Capitalized on NOAA corporate 5% pool for cross-NOAA projects
- Leveraged variety of mechanisms for DAS needed over three years

## FY15-FY17 CAPSTONE Ship Time Funding Sources

Total Funding: \$8.6M



# Community-based Exploration Priorities

The screenshot displays the NOAA Ocean Explorer web application interface. At the top, the NOAA logo and "NOAA Ocean Exploration" are visible, along with the "seasketch" logo. The user is logged in as "Caitlin Adams". The main map area shows the Pacific Ocean with several exploration sites marked by yellow dots and blue hatched polygons. A sidebar on the right contains navigation tabs for "Data Layers", "My Plans", and "Participate". Below these tabs, a search bar shows "Surveys" and "Okeanos Explorer 2017 Johnston Atoll & ...". The selected survey is titled "2017 Okeanos Explorer Central Pacific Exploration: Johnston Atoll & Musicians Seamounts". The text panel provides details about the CAPSTONE campaign and invites the community to submit exploration priorities.

NOAA Ocean Exploration  
NOAA Office of Ocean Exploration and Research admin

English take a tour help Caitlin Adams

Data Layers My Plans Participate

Surveys Okeanos Explorer 2017 Johnston Atoll & ...

### 2017 Okeanos Explorer Central Pacific Exploration: Johnston Atoll & Musicians Seamounts

2017 is the third and final year of NOAA's Campaign to Address the Pacific monument Science, Technology, and Ocean NEeds (CAPSTONE) - a major multi-year foundational science effort focused on deepwater areas of U.S. marine protected areas in the central and western Pacific. NOAA conducts telepresence-enabled mapping and remotely operated vehicle (ROV) operations in poorly known ocean areas with NOAA Ship Okeanos Explorer to support deepwater habitat characterization and spur follow-on investigations.

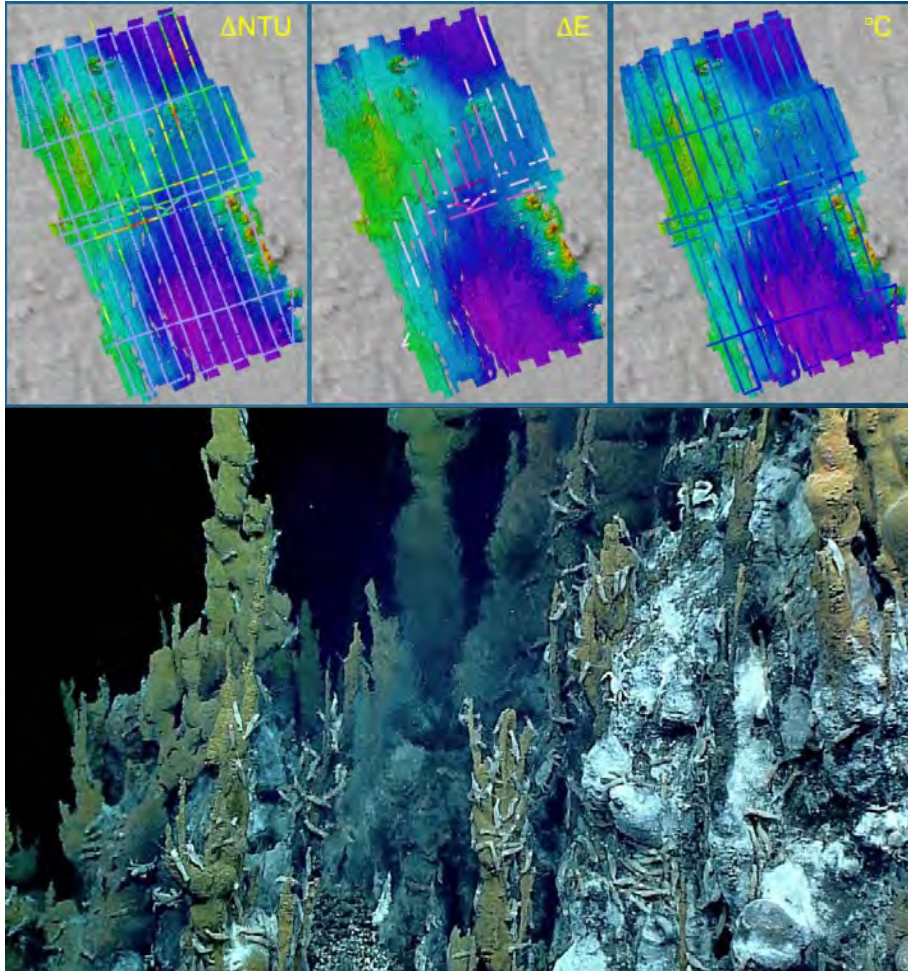
On behalf of NOAA, OER invites members of the ocean science and management community to submit areas and sites for deepwater acoustic seafloor mapping and remotely operated vehicle (ROV) investigation within our summer 2017 operating area. The information received will be used to refine our cruise tracks, and a selection of these targets and areas will be explored during upcoming expeditions. In summer 2017, NOAA intends to investigate and document the diversity and distribution of deep-water environments in and around:

- The Johnston Atoll unit of the Pacific Remote Islands Marine National Monument;
- The Musicians Seamounts north of the Hawaiian archipelago; and
- U.S. and high seas locations crossed during transits to and from specified operating areas and Honolulu, Hawaii.

Esri, HERE, Garmin, NGA, USGS | Powered by Esri and SeaSketch



# Collaborating beyond *Okeanos Explorer*



- Leveraged across platforms and projects: NSF, ECS, Falkor, PMEL, HURL, and OER grant funded scientists
- Leveraged data to complement operations
- Collaboratively planned expeditions across deep ocean community capitalizing on concurrent or near-concurrent expeditions on multiple platforms

# ASPIRE Outcomes to date

Atlantic Seafloor Partnership for Integrated Research and Exploration

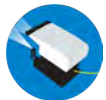
- Extensive, previously unknown, deep sea coral habitats identified and characterized
- First U.S. government-led, focused mapping survey in support of the Atlantic Seabed Mapping International Working Group (ASMIWG)
- Significant contributions to mapping bathy gaps of US East Coast EEZ >200m



**20 cruises**



**244,000+ km<sup>2</sup> mapped**



**122 vehicle dives**





# ASPIRE EXPEDITIONS

## Northern Neighbors: Transboundary Exploration of Deepwater Communities

June 2017, June 2019

NOAA NMFS/Dalhousie University, NOAA Ship *Henry B. Bigelow*

## Northeast US Tech Demonstration

July 2019

NOAA OER, NOAA Ship *Okeanos Explorer*

## Carolina Canyons

August 2016, August 2017

NOAA NMFS, NOAA Ship *Pisces*

## DEEP SEARCH

2017-2019

BOEM/USGS/NOAA, Multiple Platforms

## Blake Plateau Mapping

Spring 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

## Southeast US ROV and Mapping

Summer 2018, Spring 2019

NOAA OER/NMFS/ONMS, NOAA Ship *Okeanos Explorer*

## US-Canada ROV and Mapping

Summer 2019

NOAA OER/ONMS, NOAA Ship *Okeanos Explorer*

## Canada Mapping

Summer 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

## Mid-Atlantic Ridge ROV and Mapping

Summer 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

## Southeast US ROV and Mapping

Fall 2019

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

## US Southeast and Bahama Ridge Mapping

October 2018

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

## ASMIWG Pilot Area Mapping

July 2018

NOAA OER, NOAA Ship *Okeanos Explorer*

## US Caribbean ROV and Mapping

Fall 2018

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

## US Caribbean Tech Demonstration

Spring 2020

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

## US Caribbean Mapping

Spring 2020

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

## Mid-Atlantic Ridge ROV and Mapping

Summer 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

## Mid-Atlantic Ridge Mapping

Summer 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

Last updated: October 8, 2019




# Expanding impacts: *Okeanos Explorer* and DEEP SEARCH

**HUFFPOST**

## Scientists Discover Giant Deep-Sea Coral Reef Off Atlantic Coast

The chief scientist on the expedition said it was like nothing he'd seen before.

By Dan Ohman



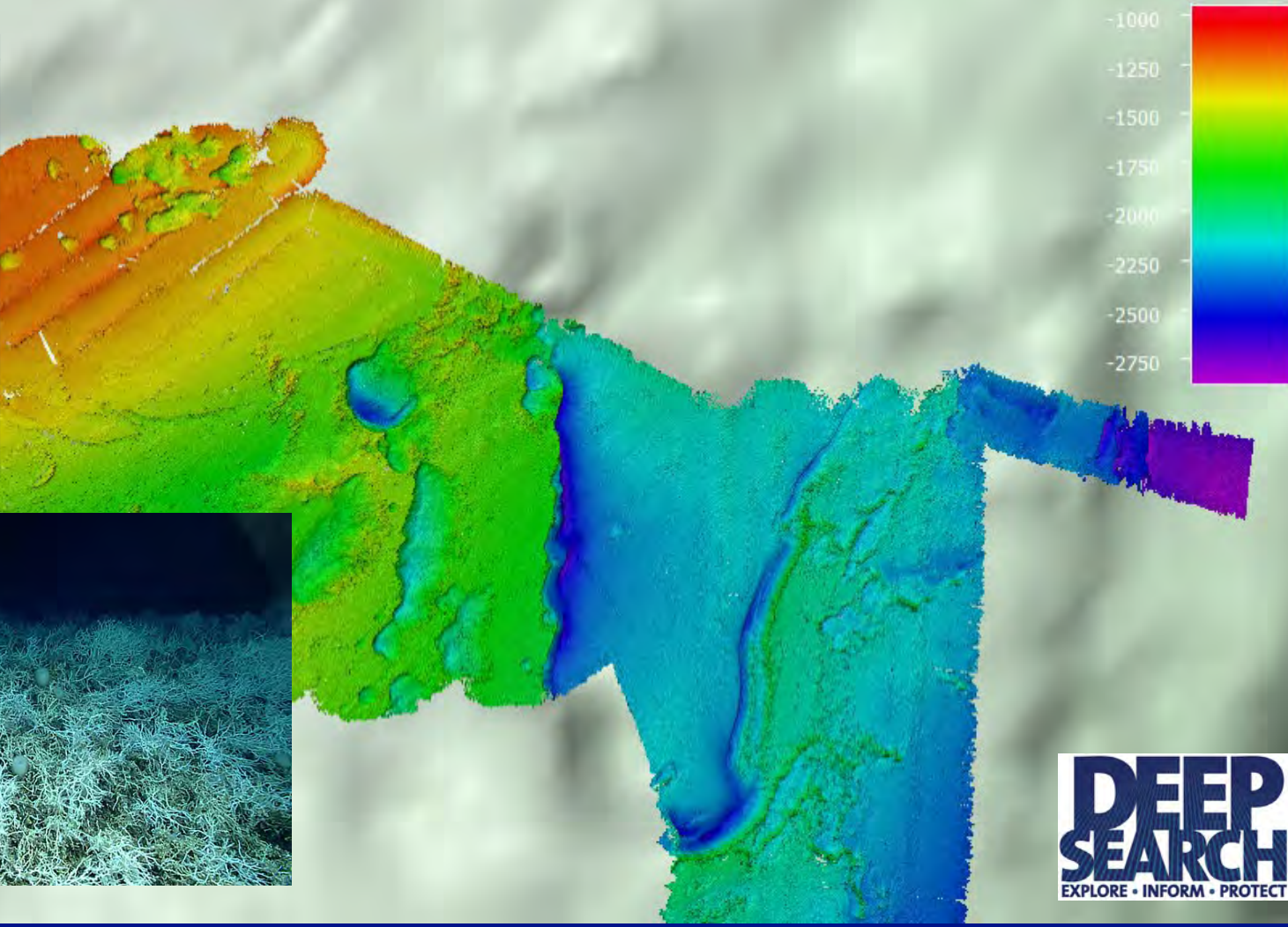
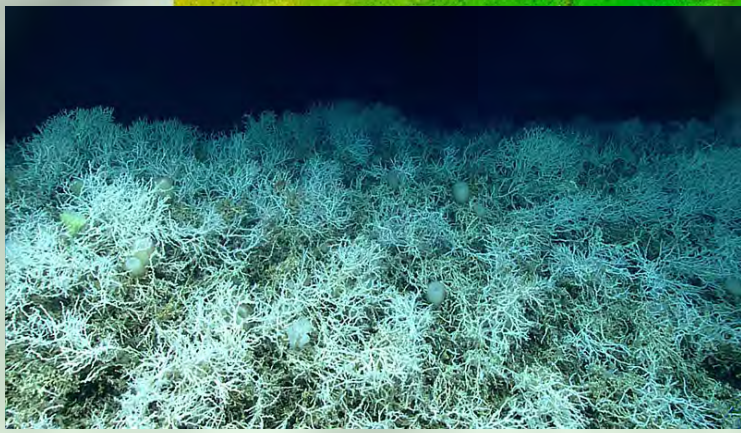
**Sprint**  
Unlimited Talk, Text, and Data  
Unlimited Kickstar  
**\$25**  
NO. REALL  
Streaming Video  
Gaming and Music

**SEEKING**  
Serenity Williams' Love  
Taps to Another Species  
By The U.S. Open

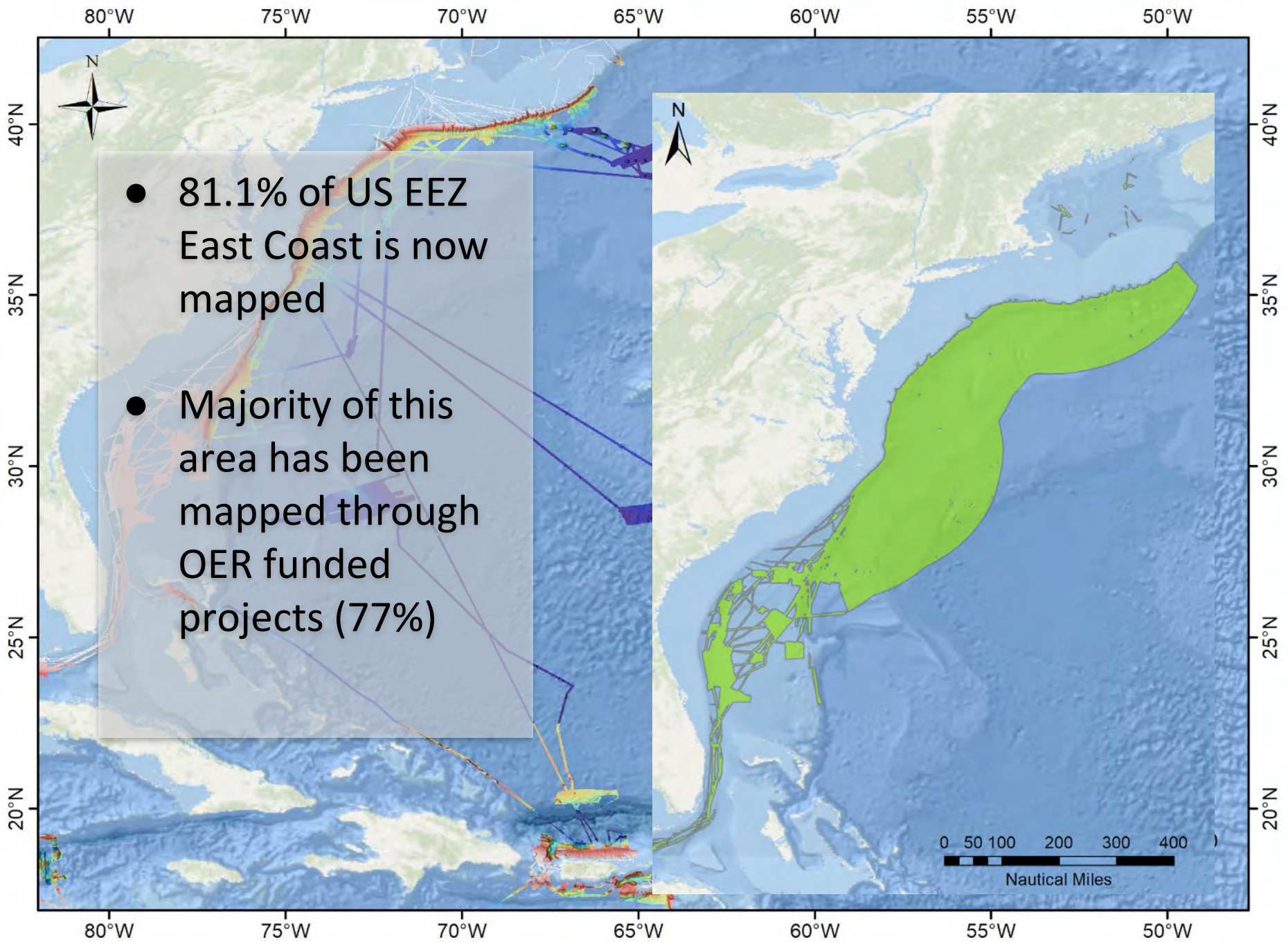
At 1,000 meters, scientists have the largest of the giant *Paragorgia*, a living *Paragorgia* (see below) that is the most massive coral reef ever discovered. It is the largest of the giant *Paragorgia* ever discovered. It is the largest of the giant *Paragorgia* ever discovered. It is the largest of the giant *Paragorgia* ever discovered.

THE ATLANTIC OCEAN — As the research vessel *Albatross* made its way out to sea from Woods Hole, Massachusetts, last week, expedition chief scientist Erik Cordes [predicted](#) the team would discover something no one has ever seen before. It didn't take long.

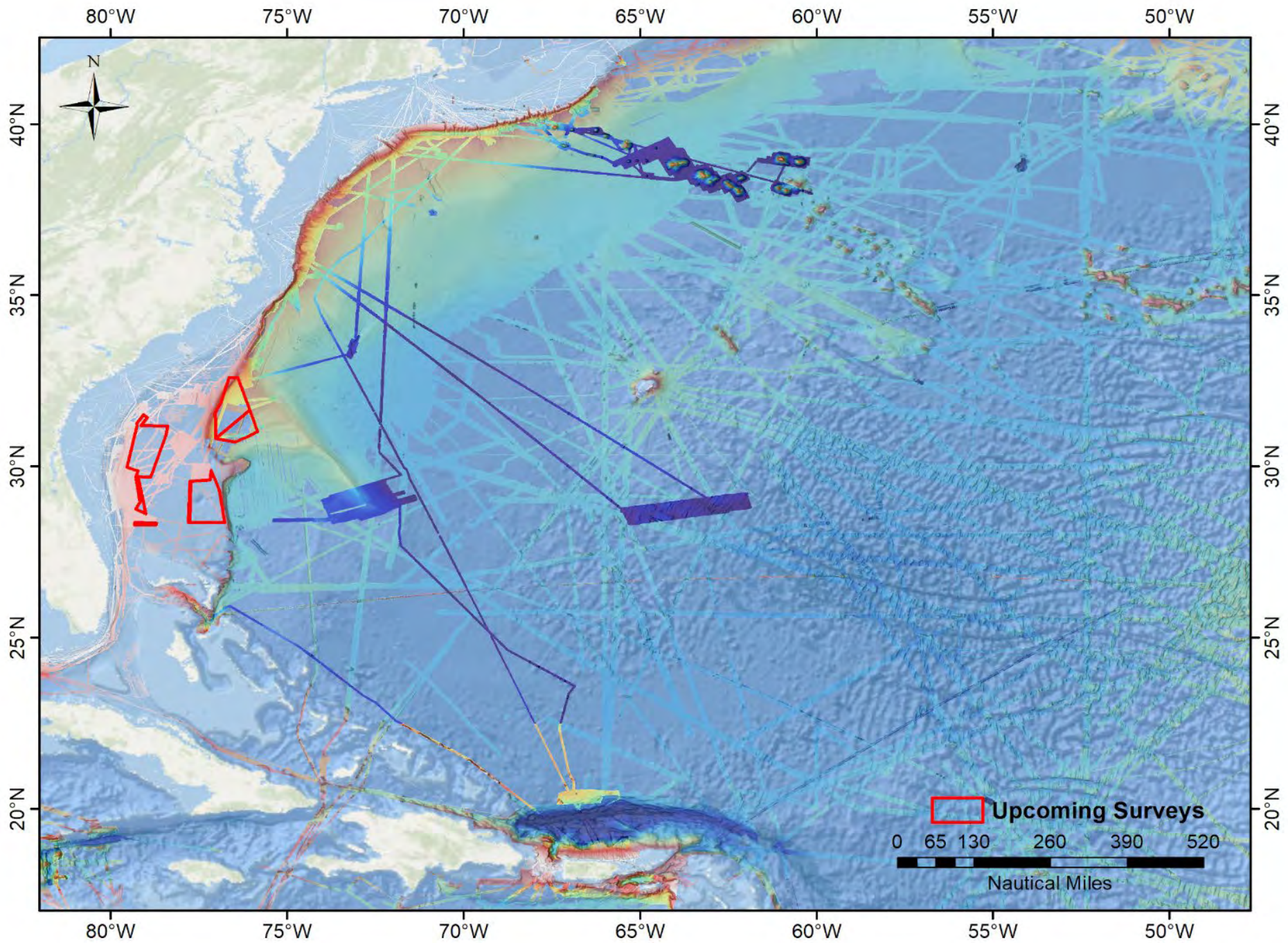
Some 100 miles off the coast of Charleston, South Carolina, a half mile below the ocean surface, is a dense forest of cold water corals. And based on their observations and recent sonar mapping of the ocean floor, researchers estimate that the reef runs for at













# Looking to the Future

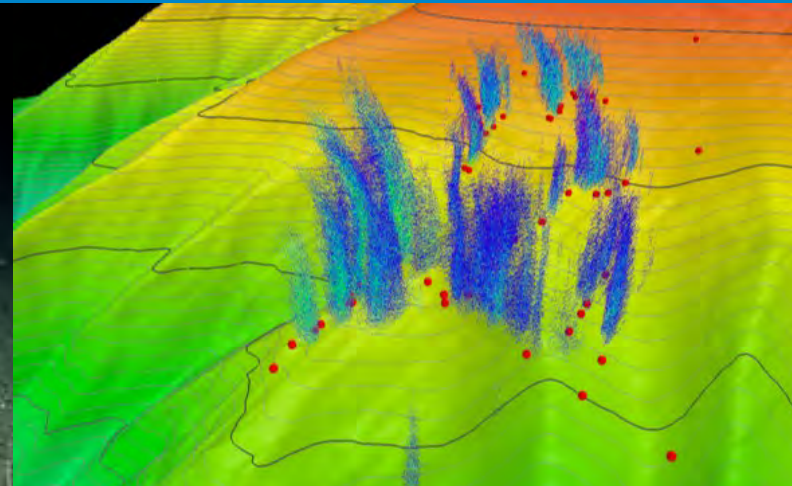


[OceanExplorer.NOAA.gov](http://OceanExplorer.NOAA.gov)



**Ocean Exploration  
and Research**

# Campaign Strategies for Decision Support





[OceanExplorer.NOAA.gov](http://OceanExplorer.NOAA.gov)



**Ocean Exploration  
and Research**





# Exploration Results for Management

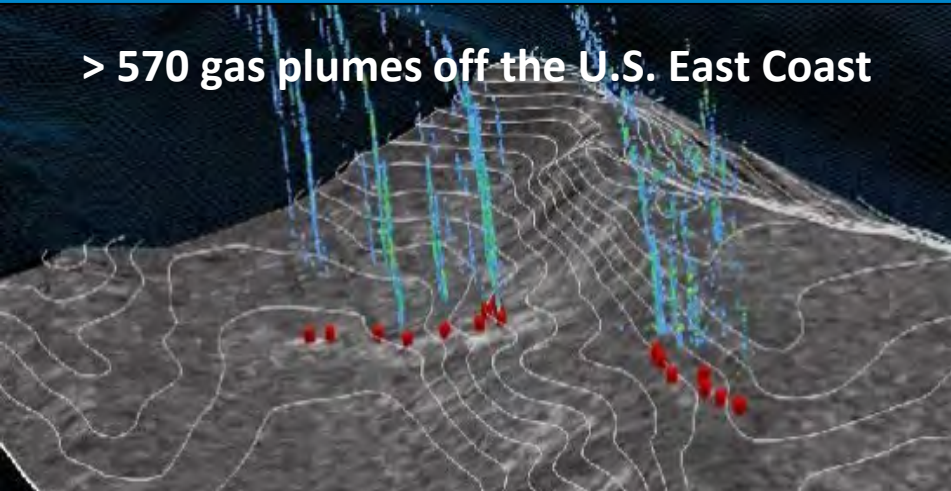
Kelley Elliott

Expeditions and Exploration Division

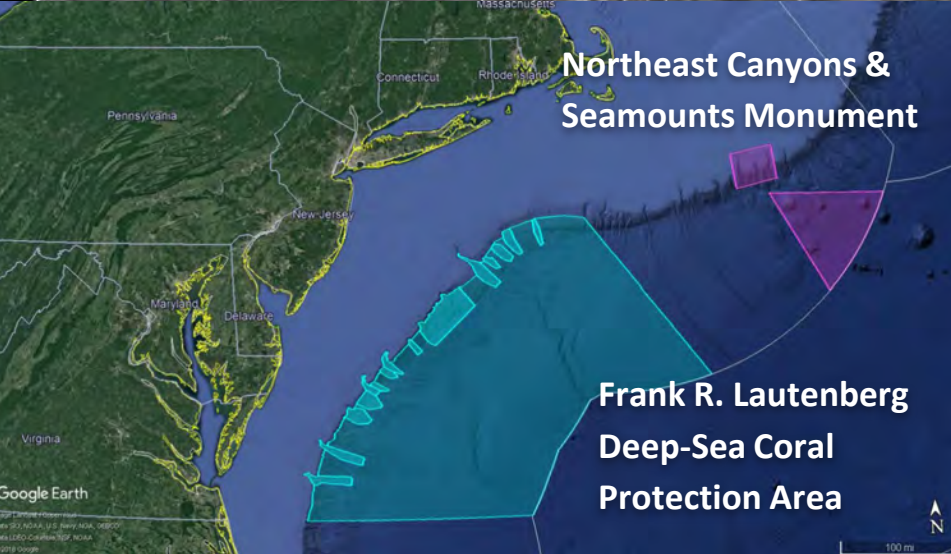


# Northeast Canyons Management Highlights

> 570 gas plumes off the U.S. East Coast



Increased knowledge of Deep-Sea coral diversity and distribution; Model Validation.



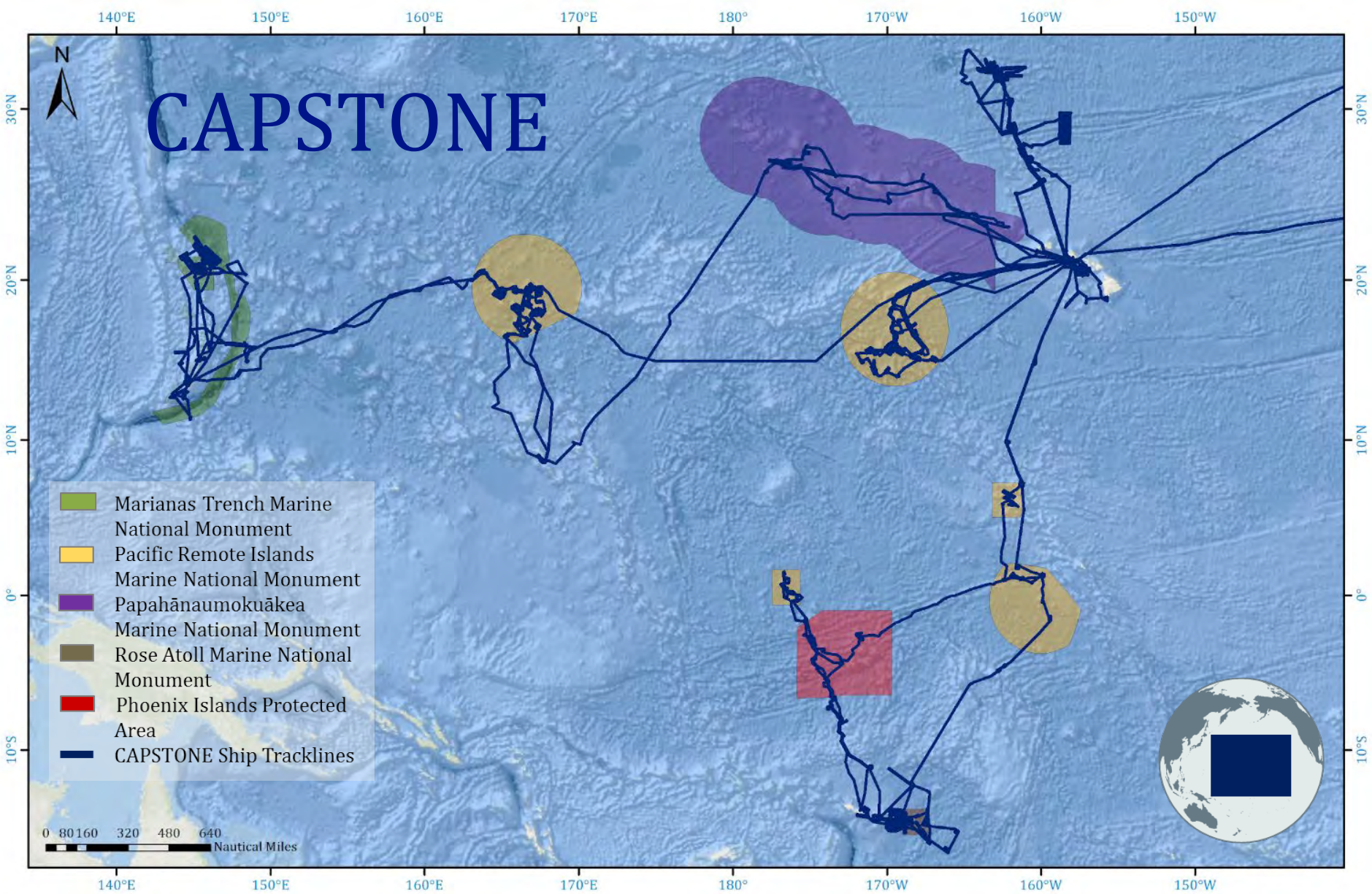
Northeast Canyons & Seamounts Monument

Frank R. Lautenberg Deep-Sea Coral Protection Area



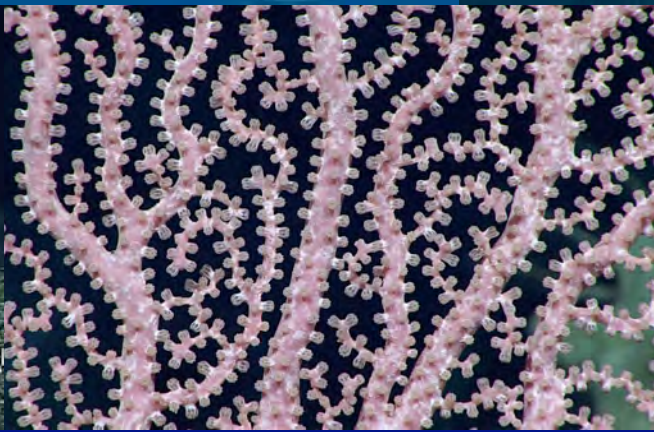
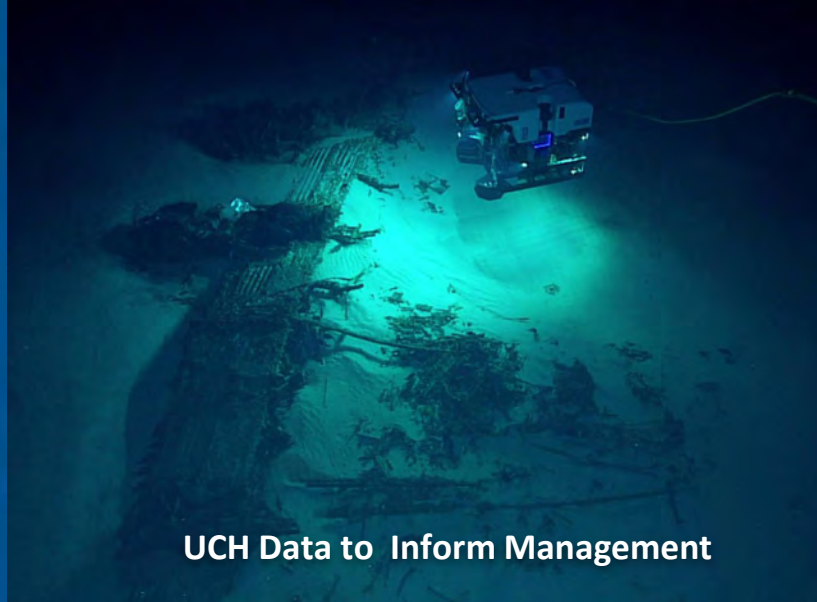
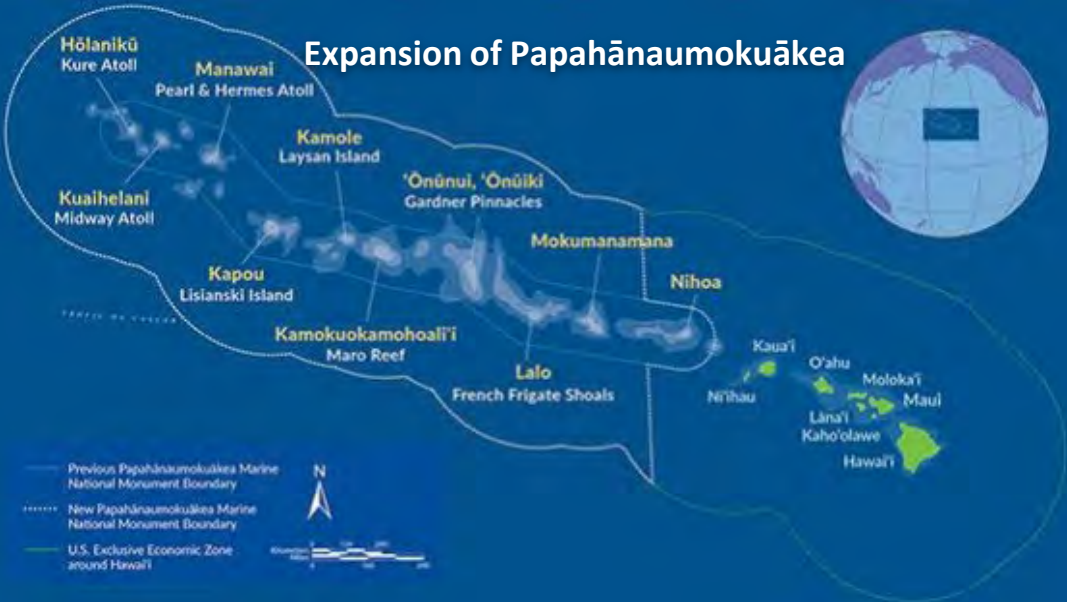
“Billy Mitchell Fleet” Nominated to National Register of Historic Places





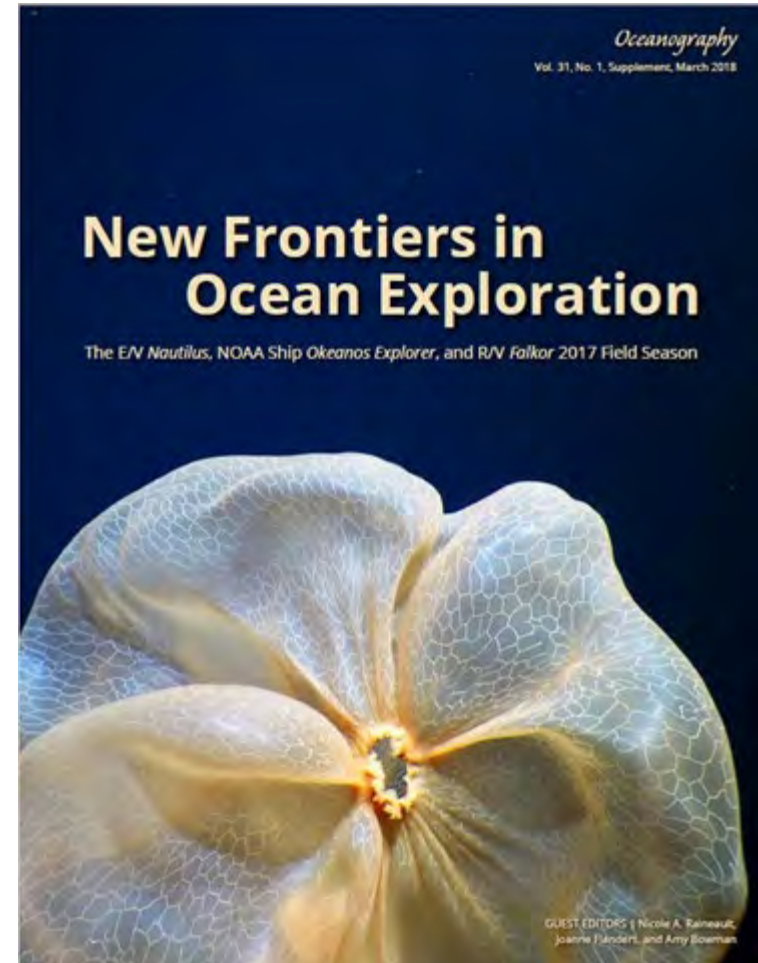


# CAPSTONE Results: Management Highlights



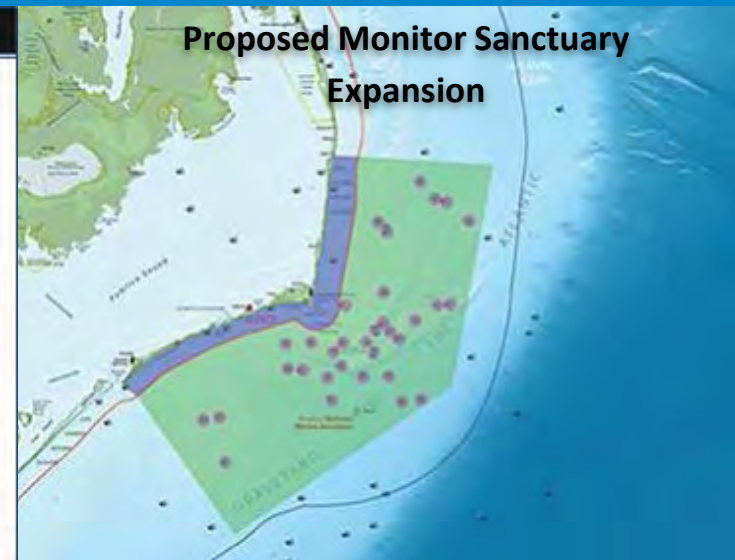
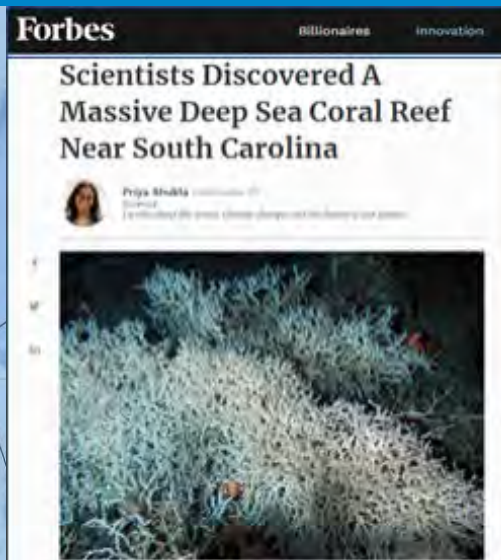
# CAPSTONE Science Products

- Oceanography supplement
- Ocean Sciences session
- Frontiers in Marine Sciences research topic
- Deep-Sea Animal Guide
- DSCRTP database Annotations
- Cruise reports
- A foundation of public data



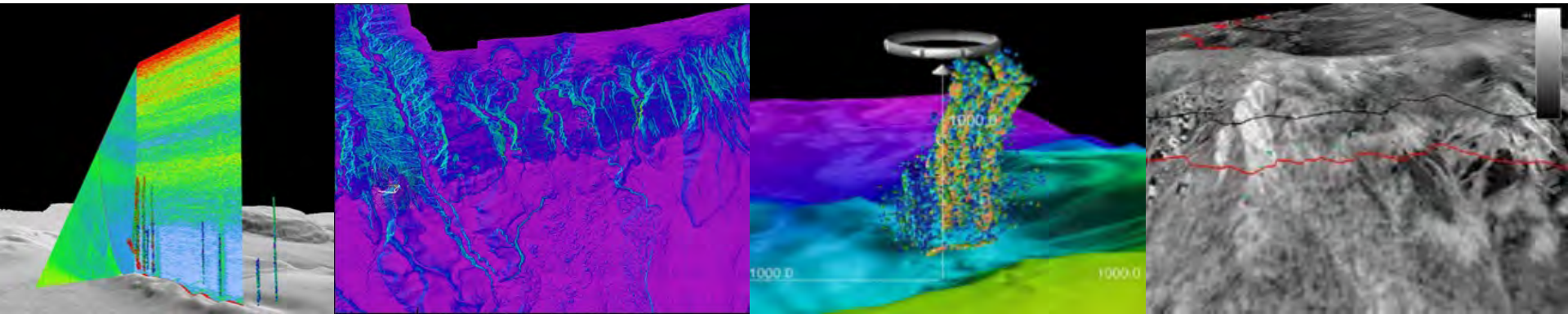


# ASPIRE Results to Date



# What's Next?

- CAPSTONE and ASPIRE Results Continued...
  - Additional lines of inquiry and analysis
  - Future management decisions and delineations
- Assessment of data & product improvements to enhance future data analysis





# How technology can get us to the next level for decision making







[OceanExplorer.NOAA.gov](http://OceanExplorer.NOAA.gov)



**Ocean Exploration  
and Research**

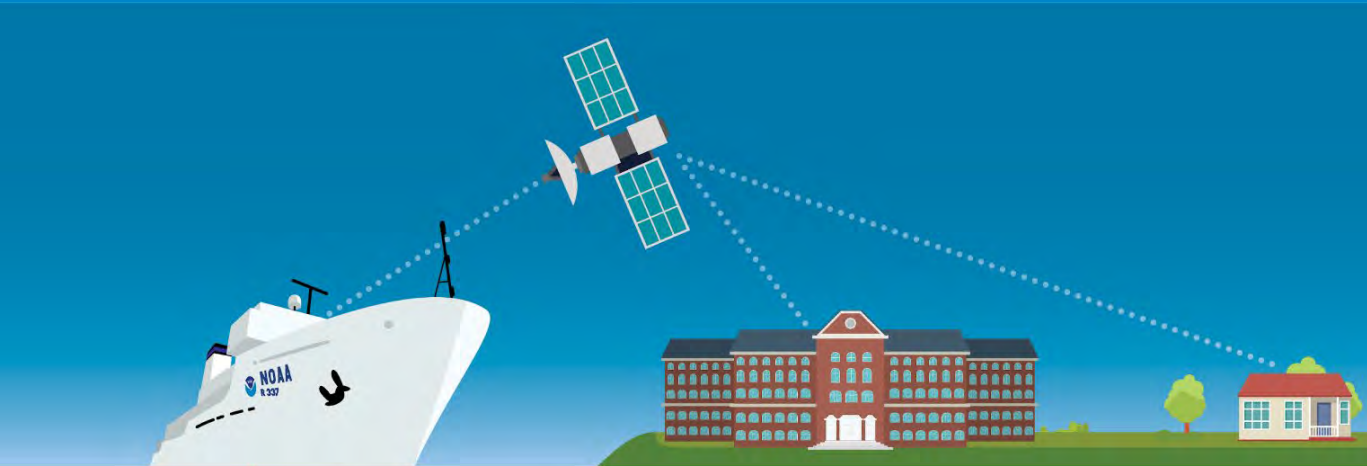


# Innovation for Exploration



Craig Russell  
*Okeanos Explorer* Program Manager

# Dedicated Exploration Platform





# Telepresence-Enabled Science



# Telepresence-Enabled Science







# Standard Protocols and Tools

Ocean Networks Canada SeaTube v2 Logged in as [Kasey Cantwell](#) | [Profile](#) | [Help](#) | [Logout](#)


Oceans 2.0

[Data Preview](#) [Data Search](#) [Plotting Utility](#) [SeaTube](#) [Digital Fishers](#) [Cameras](#) [More](#) [Admin](#)

Videos | Playlists | Dive


Resolution: Low  

Dive: EX1811-Dive13  
 PI: Wagner, Daniel  
 Area: U.S. Caribbean Sea  
 Start Date: 13-Nov-2018 10:00:00  
 End Date: 13-Nov-2018 23:00:00  
 Dive Plan: This dive will explore an escarpment at 400-535 m depths located northeast off Mona Island inside the Isla de Mona Natural Reserve. This dive will target the potential habitats of deepwater fish species, including snappers and groupers.




Leaflet | Marine Geoscience Data System

Time    To Be Reviewed

Select a Taxonomy... Type First Three Characters... 

[Add Attribute](#)


Camera #1
















































Enter free text here...

Hide Map Hide Video

**Annotations** [Search](#) [Show Filter](#)

Auto-Refresh   333 / 333

13:04	shiptest	431 m	  
13:07	Test2	481 m	  
13:15	Callogorgia   ID: 125317 [WORM] x1	566 m	  
13:15	Chirostylidae (squat lobsters)   ID: 106732 [WORM]	567 m	  
13:16	Ophiuroidea (brittle stars, brittlestars)   ID: 123084 [WORM]	567 m	  
13:18	Plumarella   ID: 177839 [WORM] x3	567 m	  
13:18	-	567 m	  
13:19	Astroidea (starfish; sea stars)   ID: 123080 [WORM]	567 m	  
13:20	Demospongiae (horny sponges; demosponges)   ID: 164811 [WORM] many	567 m	  
13:22	Octocorallia   ID: 1341 [WORM]	568 m	  
13:23	Stylasteridae (lace corals)   ID: 22805 [WORM]	568 m	  
13:23	Porifera (sponges)   ID: 558 [WORM] several small	568 m	  
13:23	Stylasteridae (lace corals)   ID: 22805 [WORM] Crypthelia? x1	568 m	  
13:24	Astroidea (starfish; sea stars)   ID: 123080 [WORM]	568 m	  
13:26	Porifera (sponges)   ID: 558 [WORM] many	566 m	  

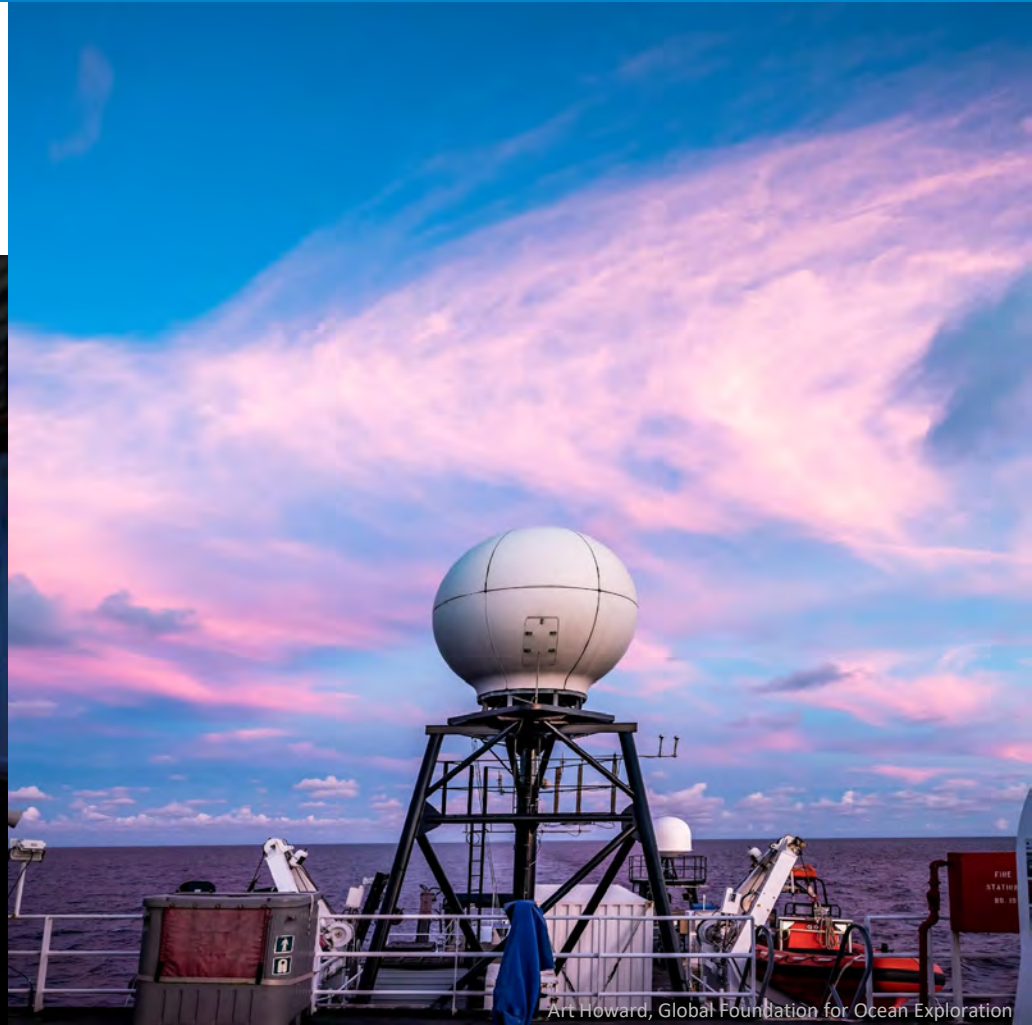
**Sensor Values** [Show Sensor Values](#)

# Advanced Telepresence Network



## VSAT & Network

GLOBAL FOUNDATION  
FOR OCEAN EXPLORATION



Art Howard, Global Foundation for Ocean Exploration





# Catalyzing Others

Fly-away VSAT for EXPRESS Campaign on  
NOAA ship *Reuben Lasker* - Underway



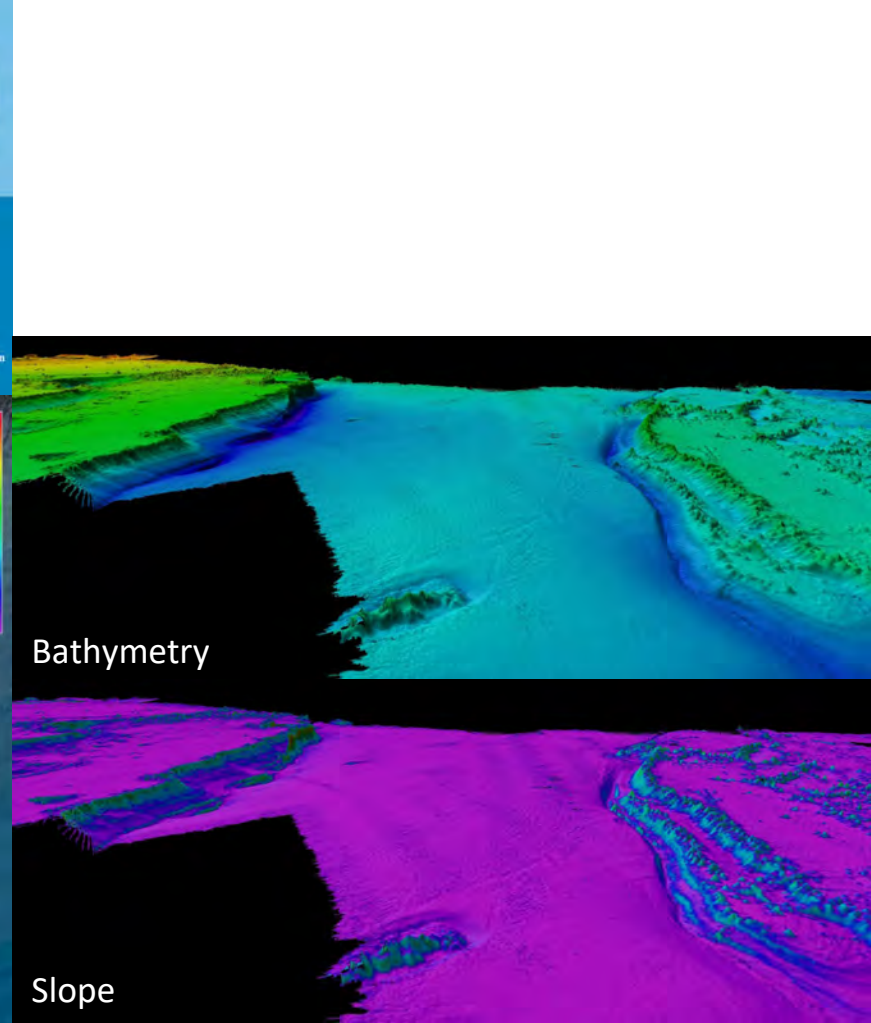
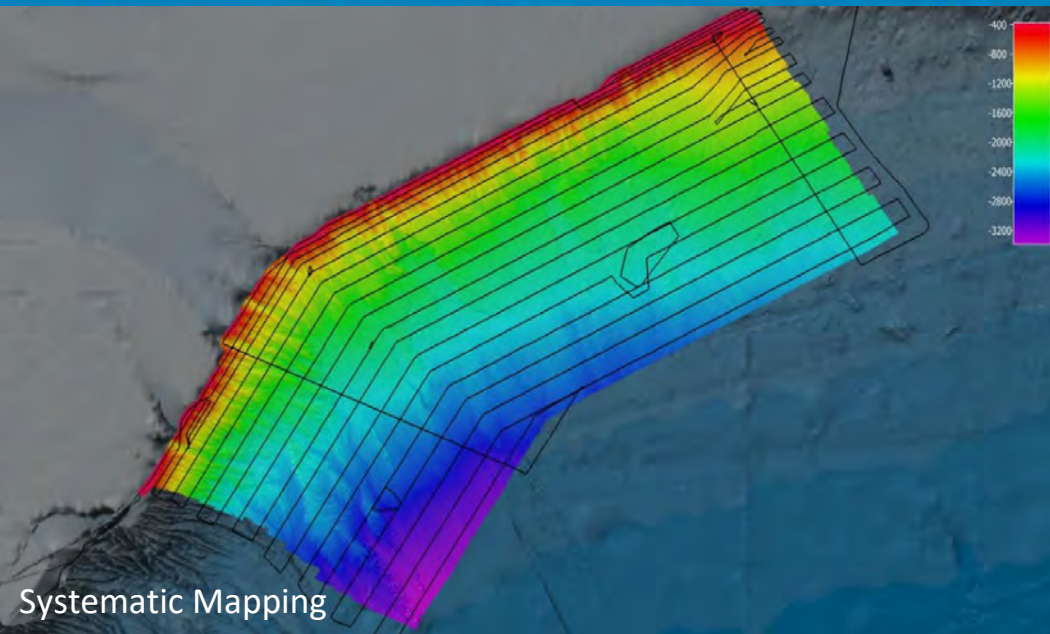
# Ocean Mapping Innovation

NOAA Ship *Okeanos Explorer* has mapped in excess of

**1,970,000**  
square kilometers

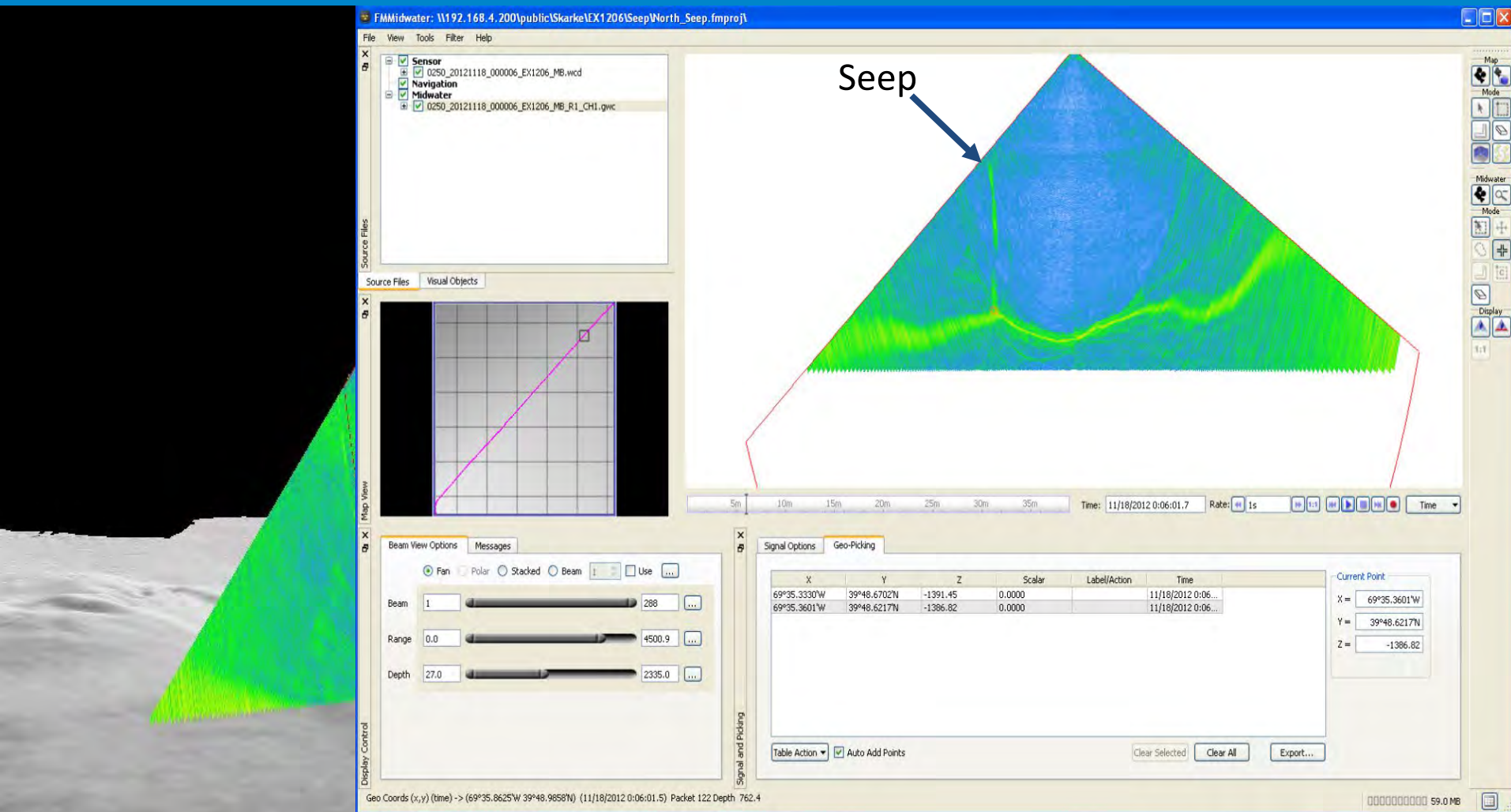


That's bigger than  
Alaska and California  
combined!

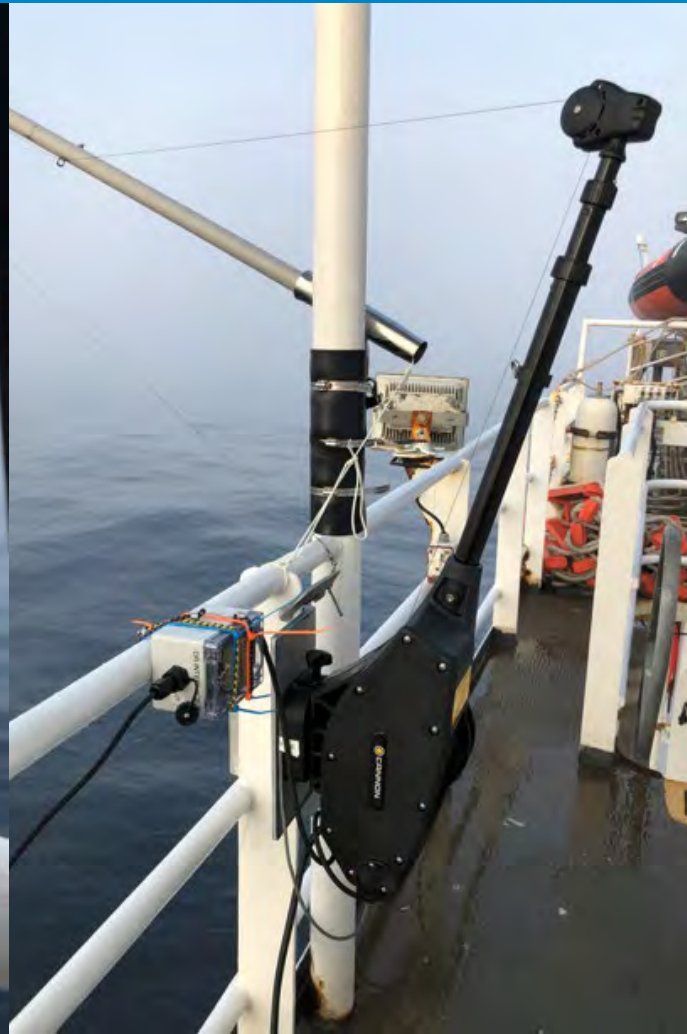




# Ocean Mapping Innovation

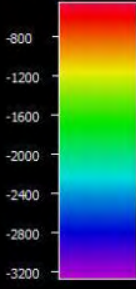
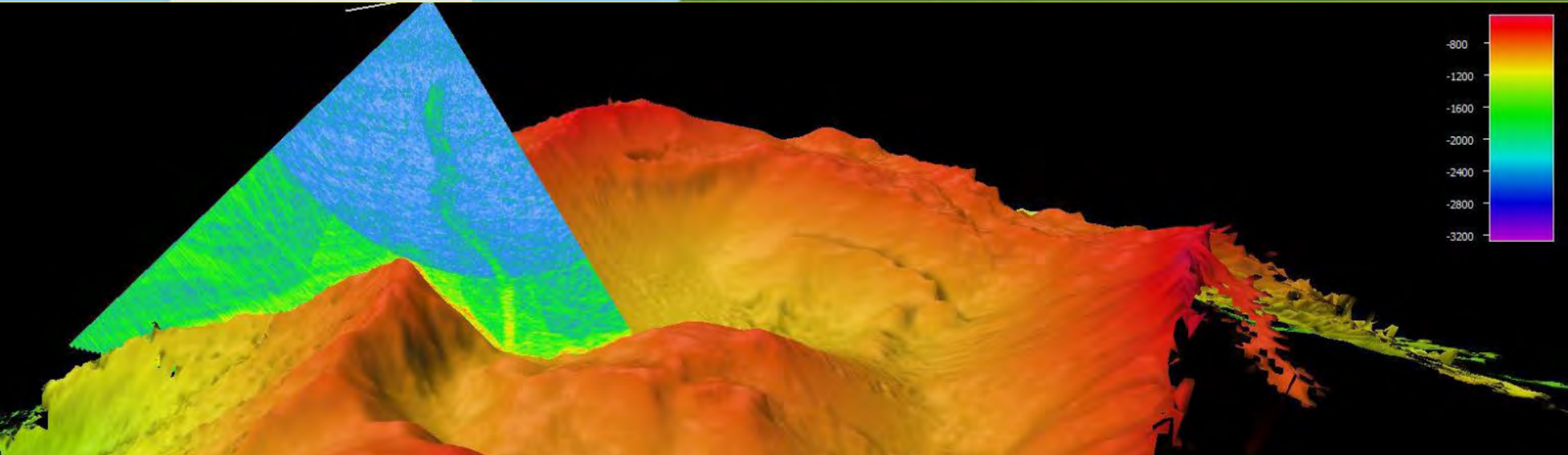
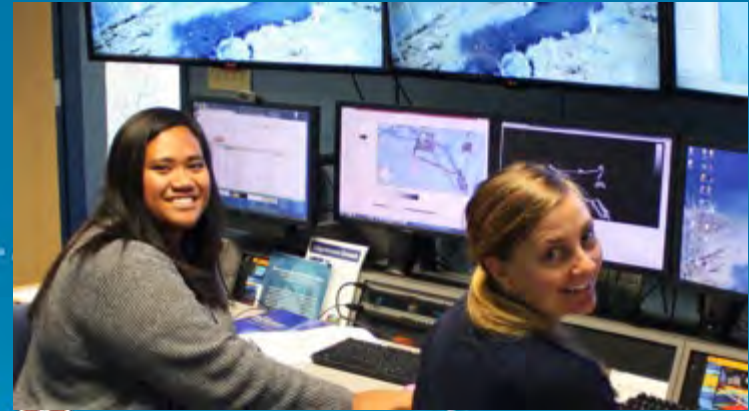


# Acoustic Calibration Innovation





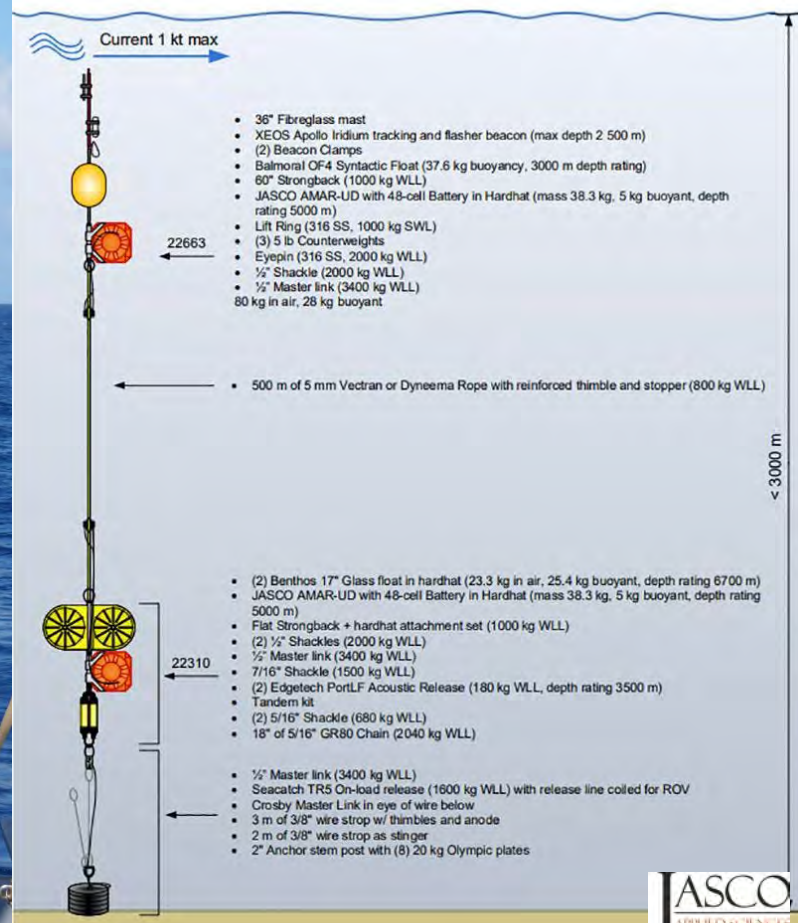
# Tele-mapping Innovation



# Ocean Mapping Innovation

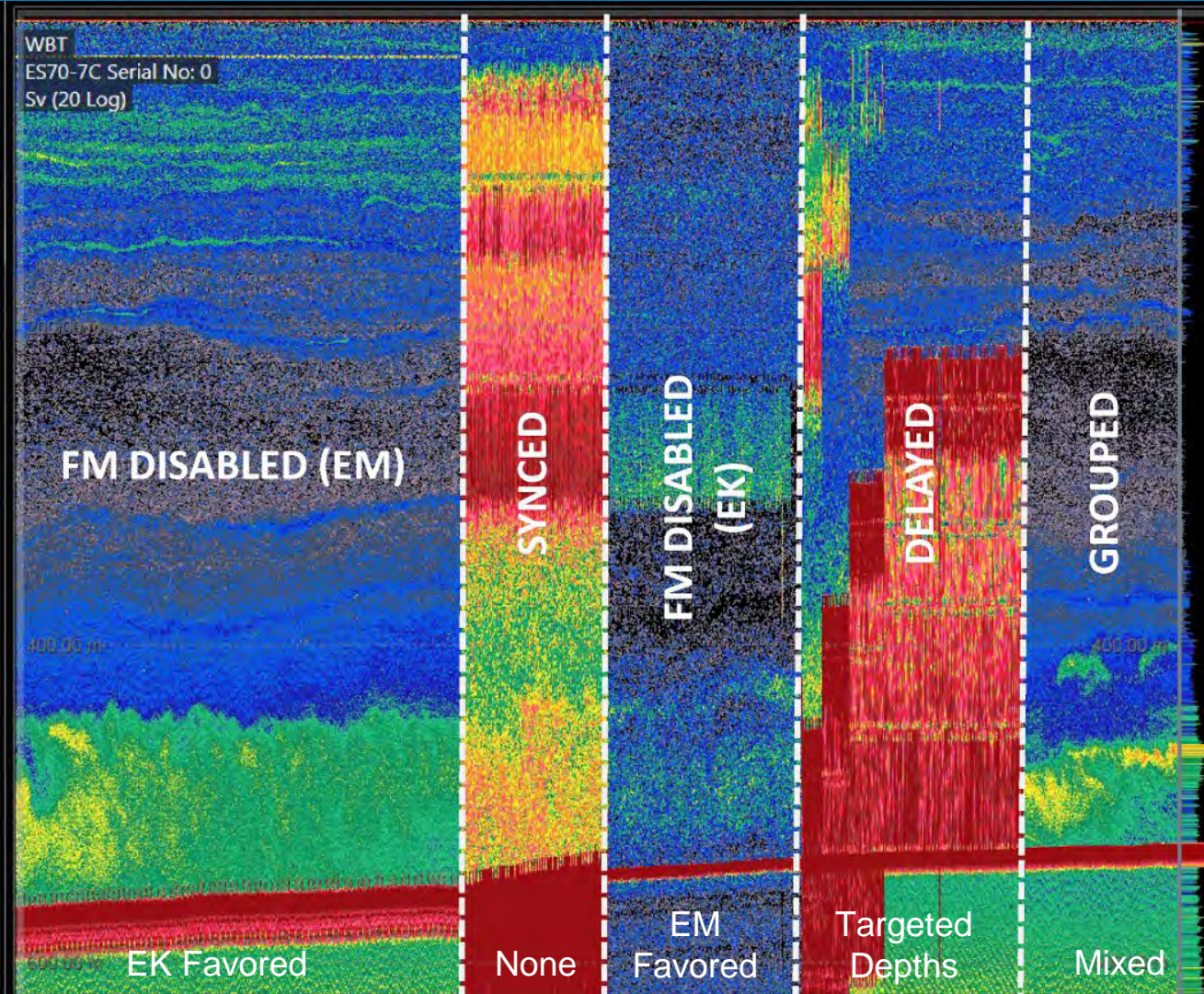


Mooring Diagram 223





# Ocean Mapping Innovation



## *DEEP (FM)* *SYNCHRONIZATION* *OPTIONS*

1. Disable FM in EM302
2. Synchronize all sonars to fire at once
3. Disable FM in EK80 70 kHz
4. Delay EK in EK80 software
5. Group in KSync

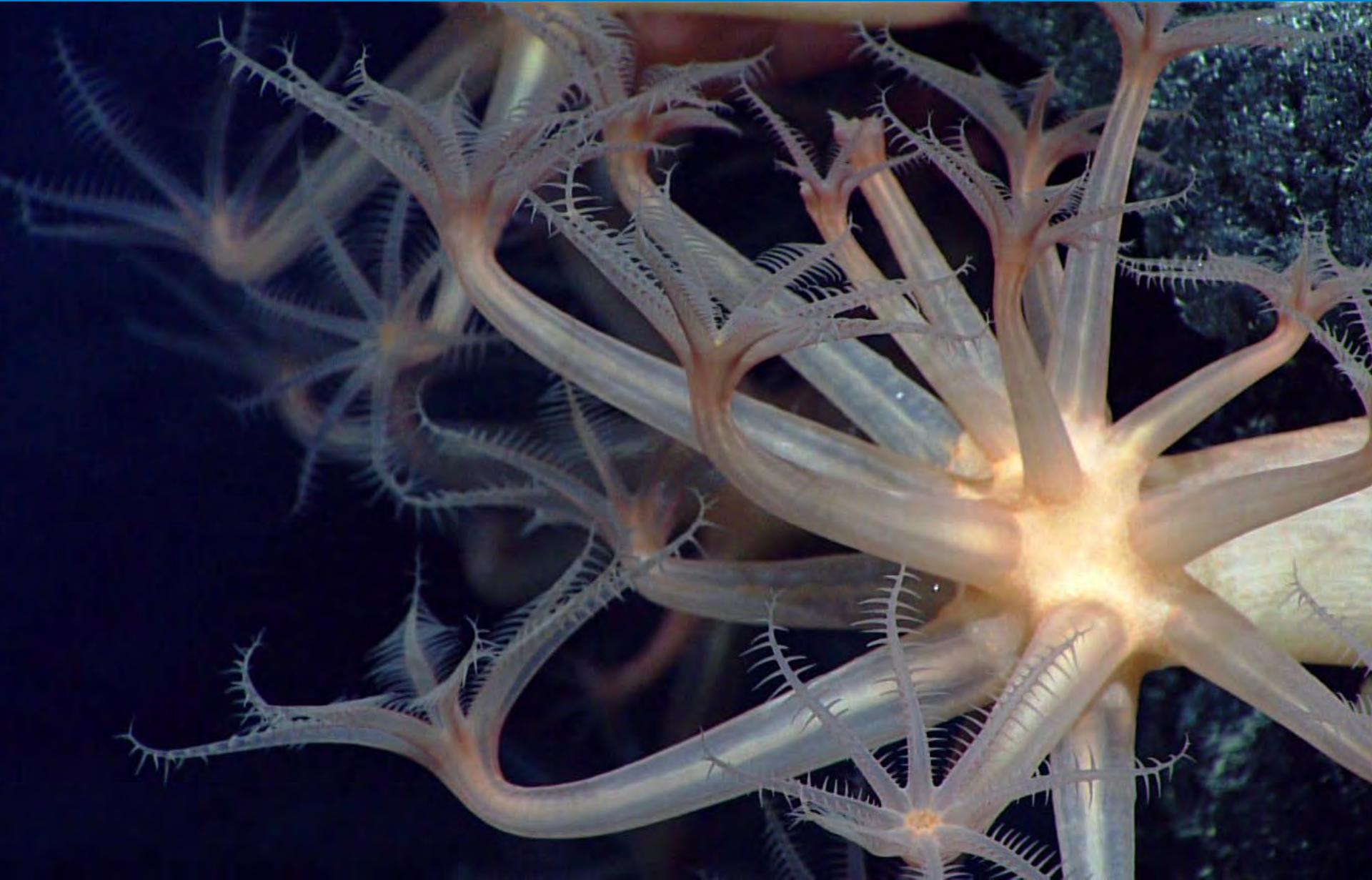


# ROV Operations Innovation





# ROV Operations Innovations





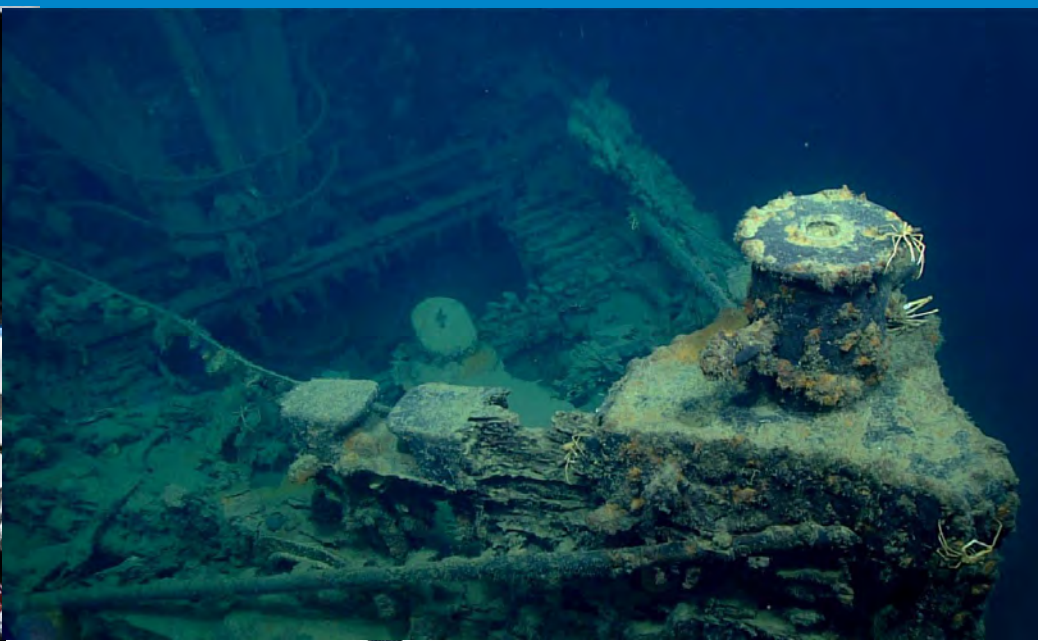
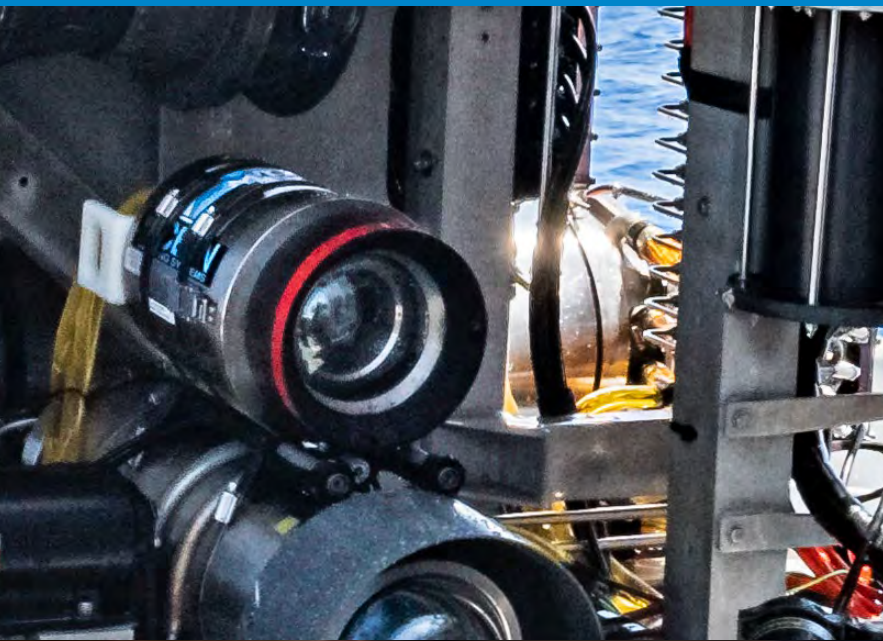
# ROV Operations Innovations







# ROV Operations Innovations

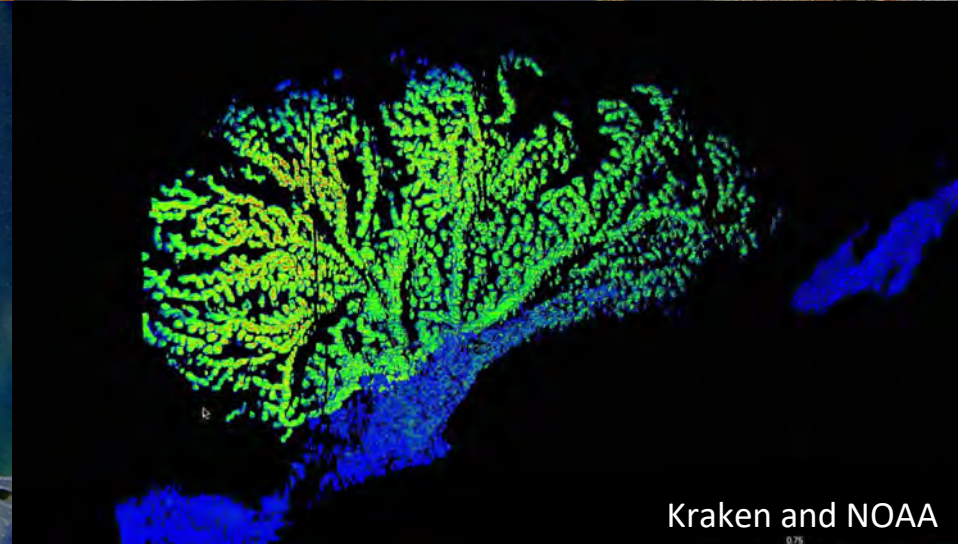
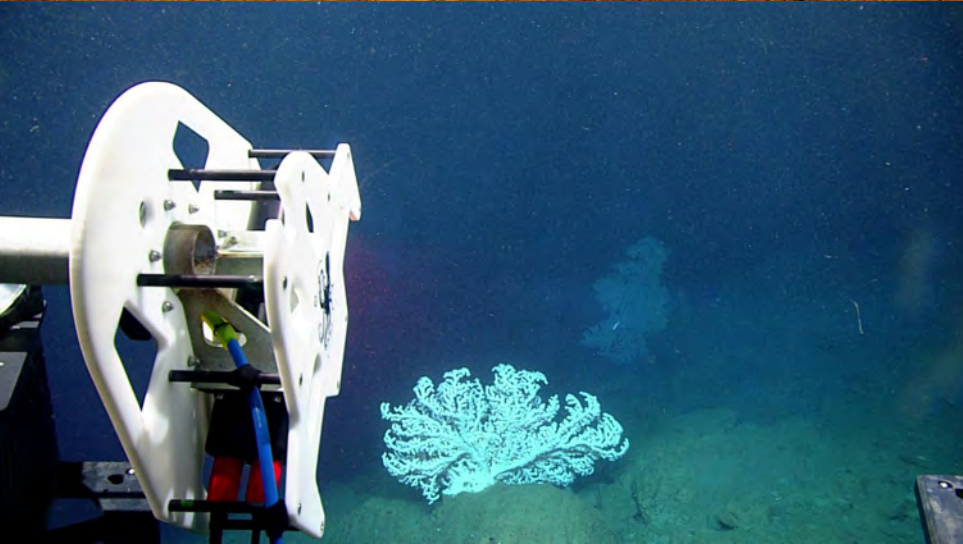




# Technology Demonstrations



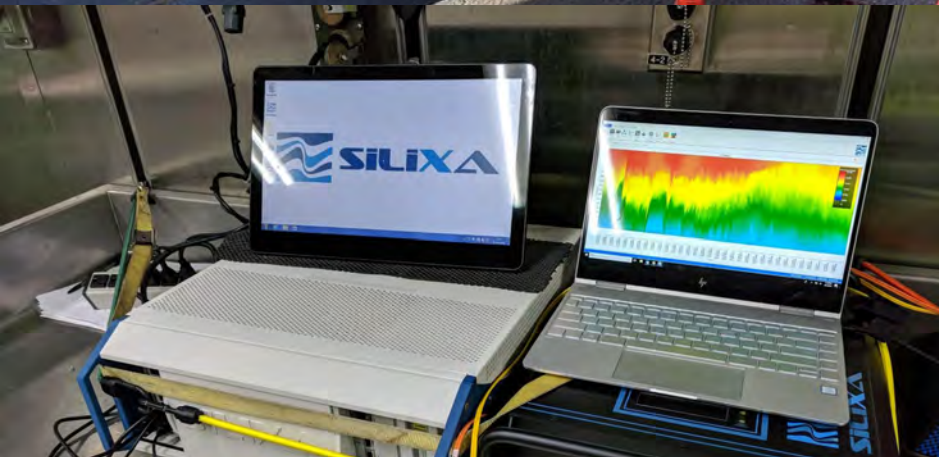
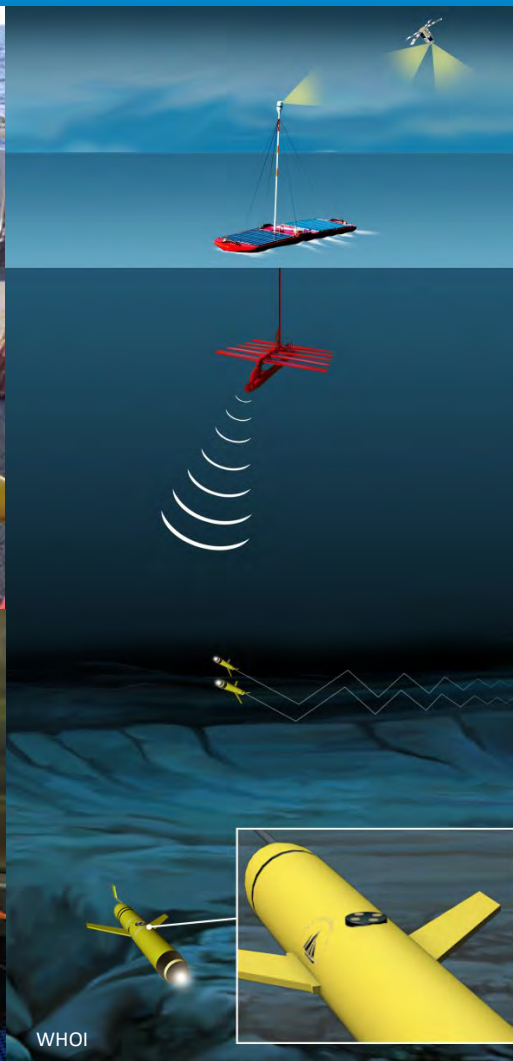
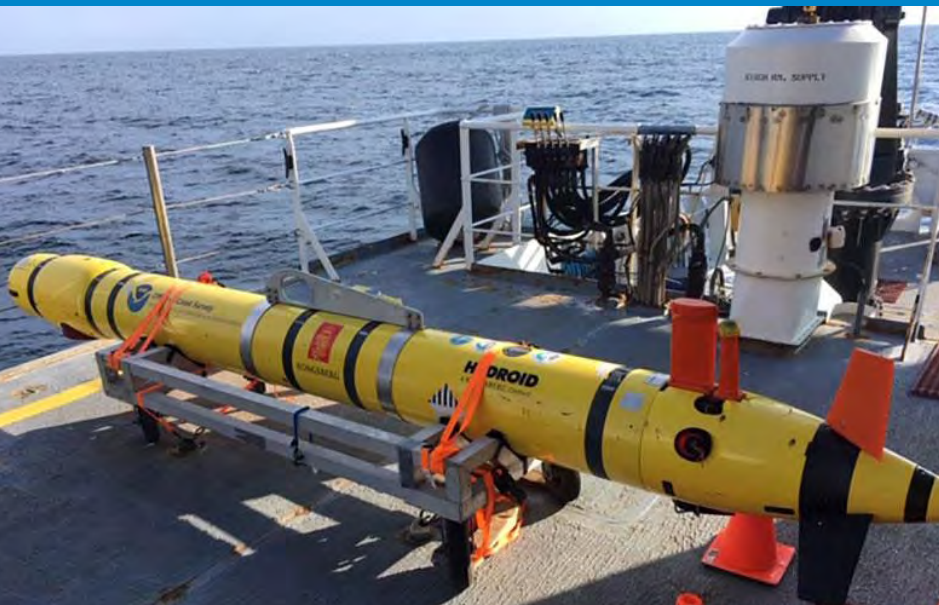
Barry Eakins, CIRES/NCEI



Kraken and NOAA



# Technology Demonstrations





# Looking to the Future

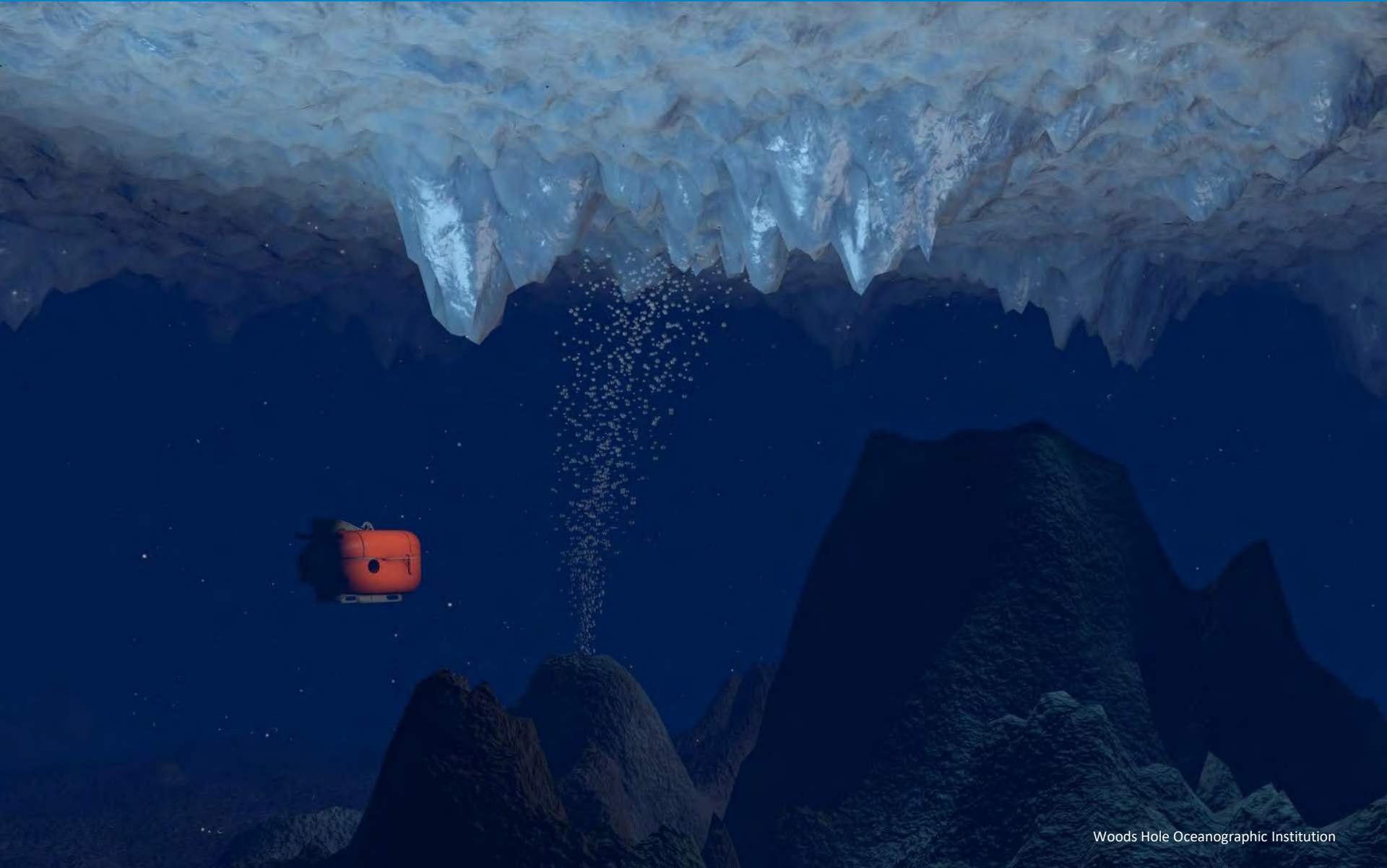


Full Tele-mapping Test

  
**OCEAN INFINITY**  
*Seabed Intelligence*

New CRADA Collaborations

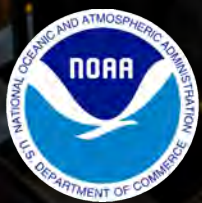
# Technology Development, Application, and Program Use







[OceanExplorer.NOAA.gov](http://OceanExplorer.NOAA.gov)



**Ocean Exploration  
and Research**