Ship/Shore Communications Subcommittee

UNOLS Council Meeting

12 March 2014

Goal Statement

"The goal of the ship/shore communications subcommittee is to help the federal funding agencies develop a viable plan for the US Academic fleet's ship/shore communications that will help the ships meet the growing demands of internet connectivity for general communications and telepresence."

- Define/quantify day to day bandwidth needs
- Give guidance on infrastructure and models for telepresence
- Create ideas/plans on how to meet the above

Ship/Shore Communications Subcommittee

- 12 members
- 2 Meetings:
  - RVTEC – College Station, TX – 21Nov13
  - NSF – 16Jan14
- Report of findings and recommendations

Report

1. Current Systems/Background
2. Future Day to Day Requirements
3. Telepresence
4. Bandwidth Management
5. Upcoming Technology
6. Recommendations

Current Systems/Background

HiSeasNet (HSN)/C & Ku-Band

- In place since 2002
- "Use it or Lose it"

Pros	Cons
Global Coverage (C- band)	Antennas are large and complicated
Room for Expansion	Not enough bandwidth
Cost/MB	Infrastructure is older
	Ships go out of HSN footprint

~4TB sent through HSN in 2013

Current Systems/Background

Fleet BroadBand (FBB)/L-band

- In place since 2009
- Pay per MB sent

Pros	Cons
Global Coverage	Limited bandwidth
Smaller, more robust antenna	Cost
Reliability	

~1.2TB sent through FBB in 2013

Day to Day Requirements

- Internet at sea
  - Science Operational Support
  - Ship Operational Support
  - Data to ship
  - Data from ship
  - Ship email
  - Access to shore/web email
  - Morale
  - Non-cruise related science business
- Telemedicine
- Voice
  - Science Operational
  - Ship Operational
  - Safety
  - Morale
- Video –streaming
- Video-conferencing
- Desktop-sharing (eg Webex, Go To meeting)
  - Telepresence
  - VPN

Day to Day Requirements (cont.)

- Separate systems
- Auditing capabilities
- Security
- Flexibility
- Scalability
- Reliability

	Shore to Ship	Ship to Shore
C-Band	512 Kbps	256 Kbps
Ku-Band	256 Kbps	256 Kbps

4X the current bandwidth!

Telepresence

- Requests are on the rise

Level	Type	Bandwidth		Example
		Ship to Shore	Shore to Ship	
1	Public Viewing	1.5-2 Mbps	512 Kbps	Streaming standard definition video to the internet.
2	Remote Learning/ Media Events/ Outreach	1.5-2 Mbps	1024 Kbps	Streaming standard definition video to the internet with direct interaction (2-way audio/video) with a school, other venue or media via two-way audio.
3	Telepresence-Enabled Science	6.0-20 Mbps	1.5 Mbps	Streaming at least one channel of high definition video to shore with bi-lateral audio support to shore based scientists working daily with ship-based scientists on a cruise.

Bandwidth Management

- Concern that “bigger pipe” will simply become clogged again.
- Various “systems” within the fleet
- Difficult to create a one-size fits all policy
- Will collect user-level data for 1year
- Draft a plan at the next RVTEC meeting

Upcoming Technology

- C & Ku-Band
  - More efficient, less expensive modems
  - Dual band antennas
- Ka-Band & INMARSAT Global Express (GX)
  - Ka-Band is large spectrum with incredible capability
  - Global spot-beam coverage
  - GX combines L-Band with Ka-band
  - Pros & Cons
  - GX to be fully operational by Q2 2015

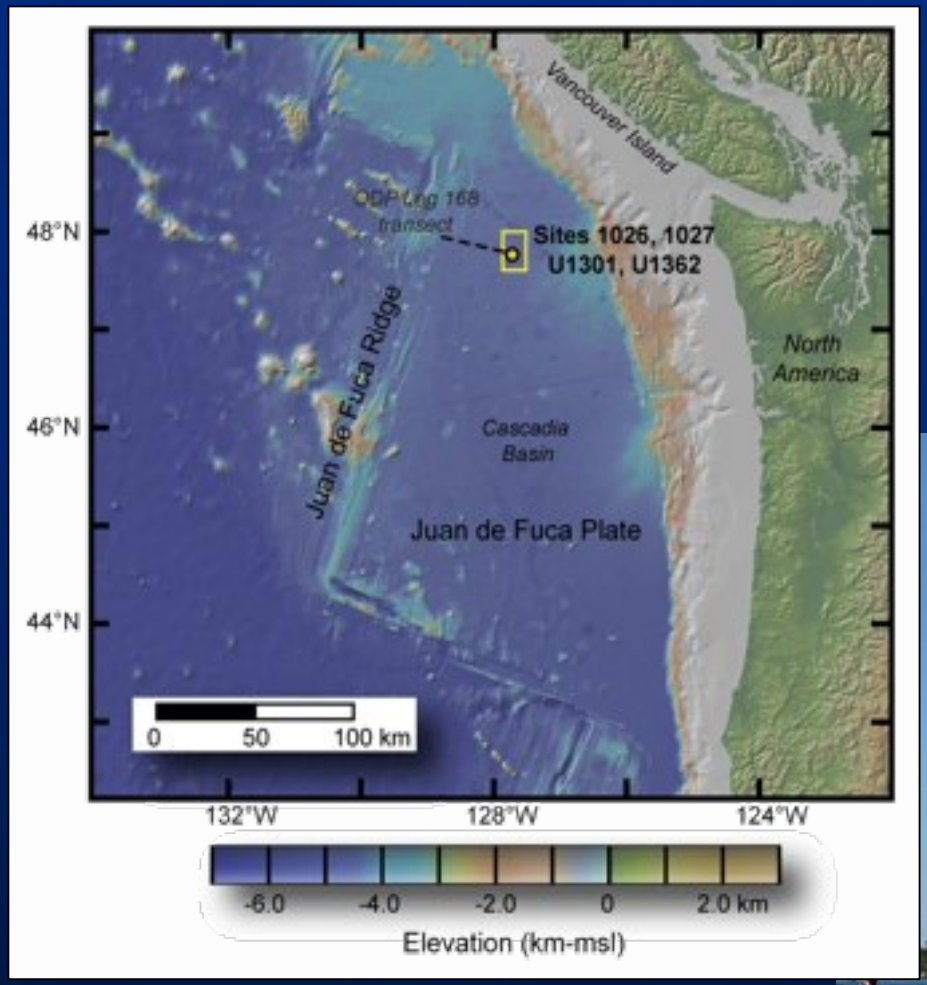
Recommendations
Three-Year Plan

Overall:

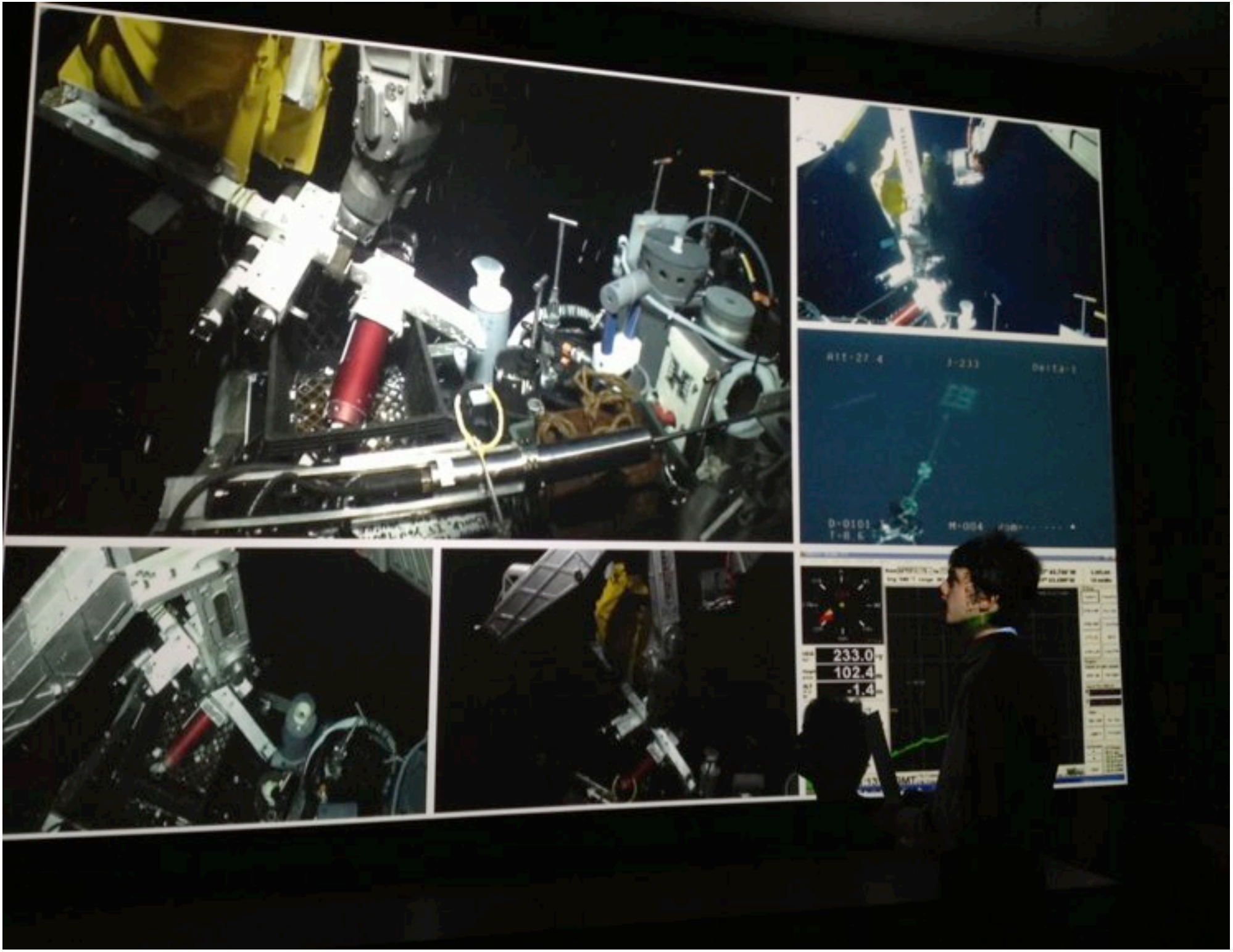
- Keep current system of HSN as primary & FBB back-up
- Increase HSN bandwidth by 4x & improve infrastructure
- Thoroughly test GX as it starts coming online
- Monitor bandwidth and create a Management Plan
- Move ships toward Level 3 telepresence capability as need and budget allow
- Meet annually at RVTEC
- Review after 3 years

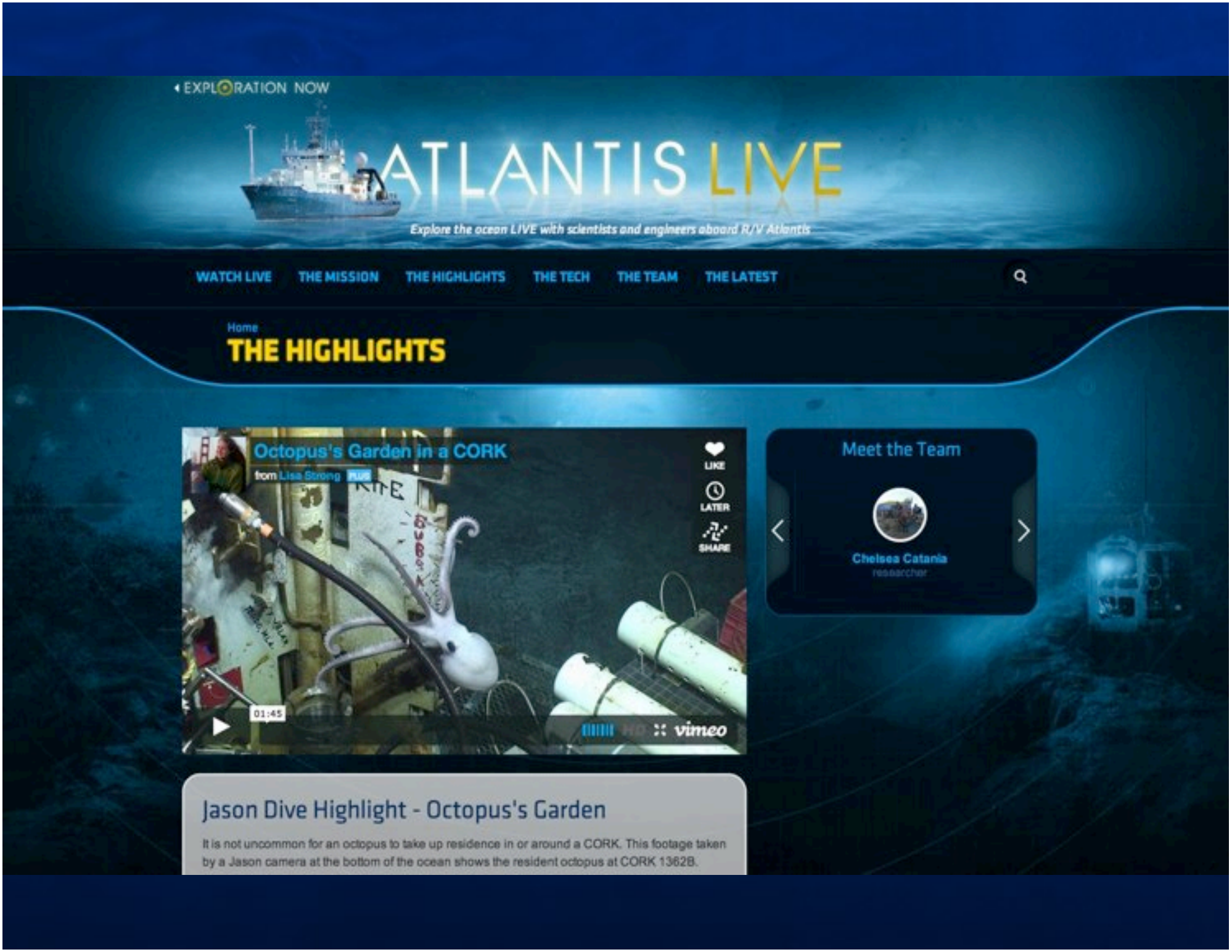
Ship-to-Shore Telepresence

National Deep Submergence Facility




15:22:32
15:22:34
HD


233.0
102.4
-1.4


EXPLORATION NOW
ATLANTIS LIVE
Explore the ocean LIVE with scientists and engineers aboard R/V Atlantis
WATCH LIVE
THE MISSION
THE HIGHLIGHTS
THE TECH
THE TEAM
THE LATEST
Home
THE HIGHLIGHTS
Octopus's Garden in a CORK
from Lisa Strong
LIKE
LATER
SHARE
01:45
vimeo
Meet the Team
Chelsea Catania
researcher
Jason Dive Highlight - Octopus's Garden
It is not uncommon for an octopus to take up residence in or around a CORK. This footage taken by a Jason camera at the bottom of the ocean shows the resident octopus at CORK 1362B.

Oceanography
VOL.27, NO.1, SUPPLEMENT | MARCH 2014

New Frontiers in Ocean Exploration

The E/V *Nautilus* 2013 Gulf of Mexico and Caribbean Field Season

GUEST EDITORS | KATHERINE L.C. BELL, MICHAEL L. BRENNAN, AND NICOLE A. RAINEAULT

EXPANDING THE TELEPRESENCE PARADIGM

Live Interactive Programming from R/V *Atlantis* and ROV *Jason*

By Dwight F. Coleman, Dean Livelybrooks, Sharon Katz Cooper, Gregory Mulder, Andrew T. Fisher, Anne M. Tréhu, and Douglas R. Toomey

Since 1981, Robert Ballard has envisioned a concept of ocean exploration with multiple ships collecting video and data from the depths of the world ocean and broadcasting discoveries in real time through ship-to-shore satellite technology. In 1989, the telepresence vision was realized when the first Jason Project broadcasts employed ROV technology developed by the Deep Submergence Laboratory at Woods Hole Oceanographic Institution (WHOI). Those early telepresence-enabled broadcasts delivered live educational programming to vast audiences who could participate in the exploration as it was happening.

The vision expanded in 2003 when the Institute for Exploration developed a new suite of ROV and telepresence technologies as part of a portable system that was installed on ships of opportunity. In 2007, those expeditions began to feature live broadcasts 24 hours a day to audiences on the Internet and at venues such as Mystic Aquarium, all made possible through a prototype version of the Inner Space Center (ISC) at URI GSO. Since 2009, the telepresence paradigm has grown substantially with the development of E/V *Nautilus*, introduction of the NOAA Ship *Okeanos Explorer*, and construction of the permanent ISC. Live broadcasting can now originate from two ships of

Figure 1 (above). ROV Jason, part of the UNOLS National Deep Submergence Facility operated by Woods Hole Oceanographic Institution. Photo credit: Tom Kleiner, Woods Hole Oceanographic Institution

exploration that have dedicated ROV and telepresence systems installed on board and that conduct field work up to six months each year.

Beginning in 2013, the telepresence-enabled exploration paradigm expanded yet again to involve more ships, including the Schmidt Ocean Institute's R/V *Falkor*, the University of Washington operated R/V *Thomas G. Thompson*, and the WHOI operated R/V *Atlantis* (the latter two ships are part of the University-National Oceanographic Laboratory System [UNOLS]). Many more live feeds could now be received and distributed through the ISC and used for live video production associated with the Exploration Now program (see page 22). We report here on two specific telepresence-enabled projects conducted during the summer of 2013 on board R/V *Atlantis* that used the Jason ROV system (Figure 1). This project represents a milestone in the development and use of telepresence technology for UNOLS platforms, leading to even greater expansion of the telepresence vision for the academic research fleet, with several new ships slated to come on line in the near future.

Challenges

- Need for more technical support – satellite operations, network engineering, telepresence systems, production logistics, shore

- Funding – can't rely on supplemental funding - need to plan for and budget for telepresence activities through the proposal process

Successes

- Outreach – lots of interest in the scientific activities, conducted more than 100 live interactions with various audiences

- Data transfers to shore for remote science collaboration

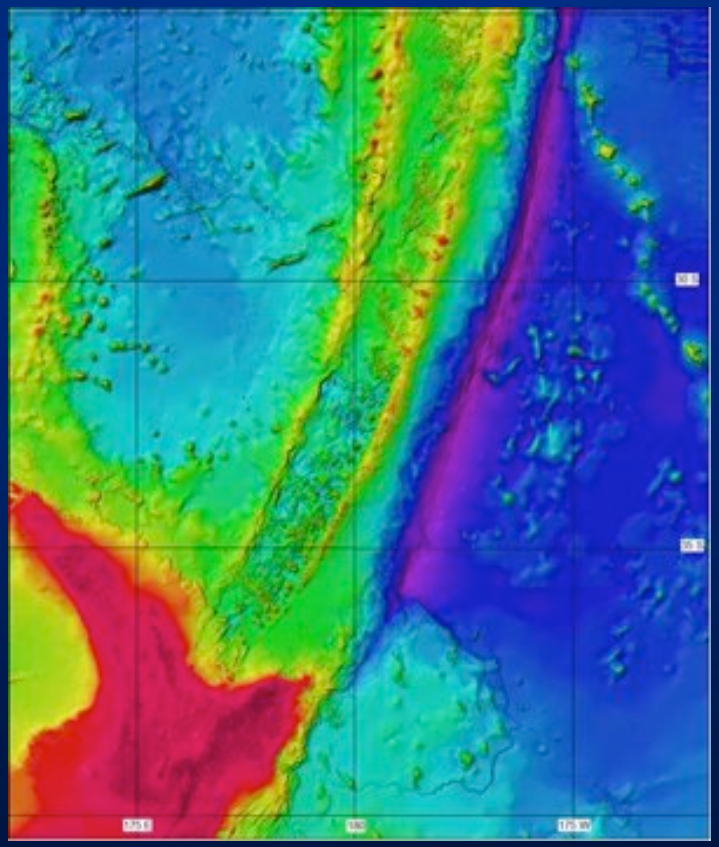
- Bonus – supported Chris Reddy's shore-based participation during Dave Valentine's cruise in October

- Leading to more telepresence-enabled cruise opportunities

Tim Shank's project:

HADES

HADal Ecosystem Studies



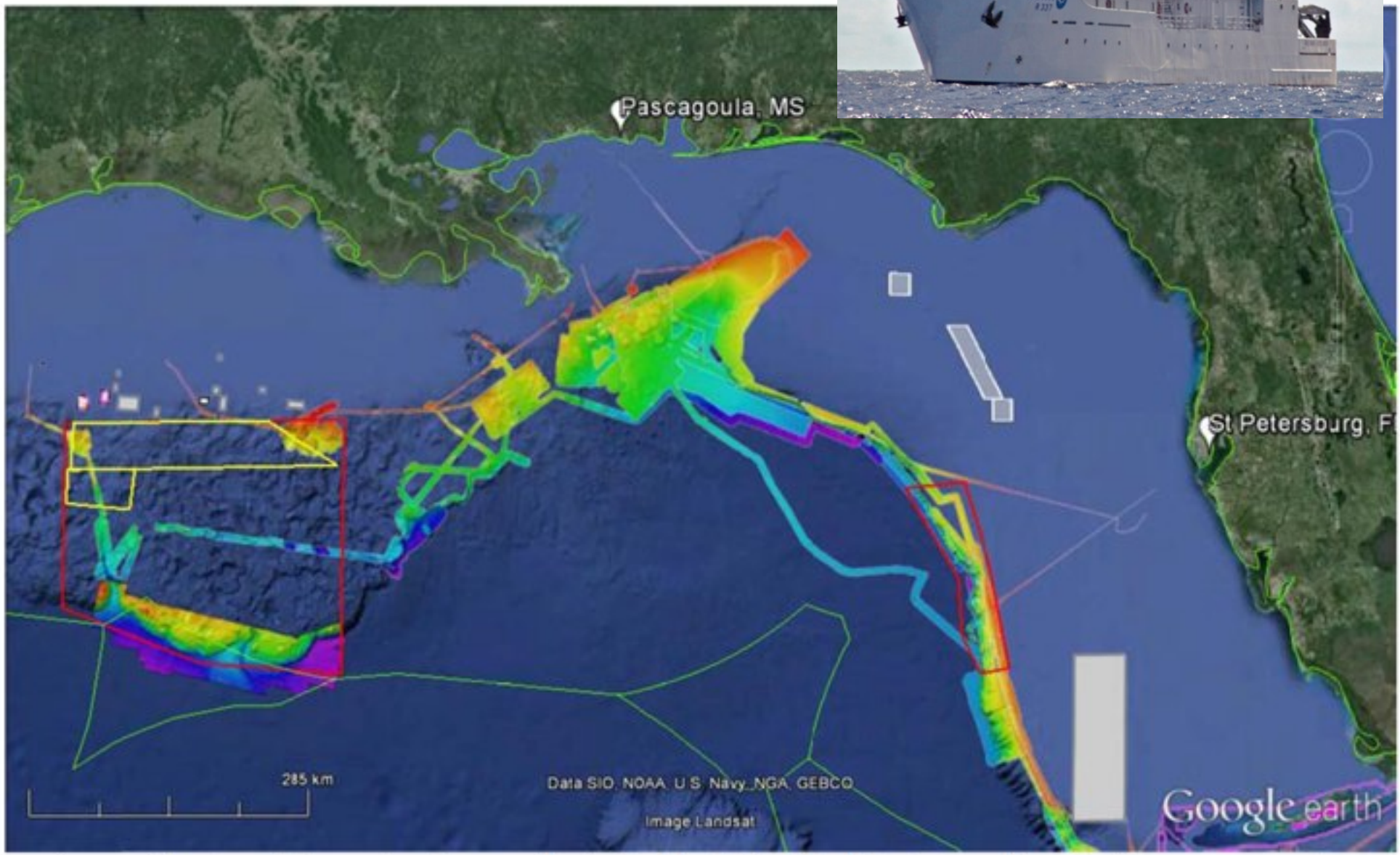
Kermadec Trench, April 10 to May 20, 2014

R/V *Thompson*

HROV *Nereus*

EXPLORE

EX1402 Leg 3 Overview Map



NAUTILUS EXPLORATION PROGRAM

NEW AMERICA

ECOGIG

GISR

STRAITS OF FLORIDA / GREAT BAHAMA BANK

WINDWARD PASSAGE

MESOAMERICAN REEF

PUERTO RICO / BRITISH VIRGIN ISLANDS

INSPIRE

AVES RIDGE

NAUTILUS 2014
FIELD SCHEDULE

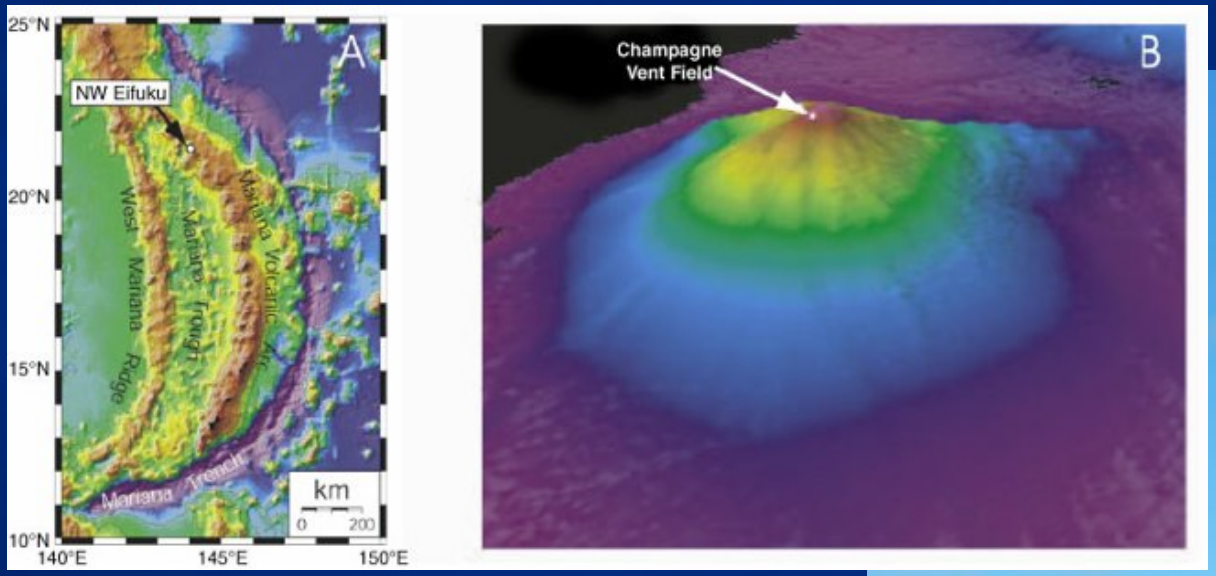
WWW.NAUTILUSLIVE.ORG

NSF INSPIRE OCE1344250

TREET: Transforming Remotely-conducted Research through Ethnography, Education, & Rapidly-evolving Technologies

Zara Mirmalek

Craig Moyer and Bill Chadwick's project, Nov-Dec, 2014:



R/V *Revelle*

R/V Sikuliaq

Future RCRV(s)

R/V Neil Armstrong and R/V Sally Ride

THE
UNIVERSITY
OF RHODE ISLAND
GRADUATE SCHOOL
OF OCEANOGRAPHY

R/V Endeavor