UNOLS Working Group on Ocean Observatory Facility Needs

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Charge to Committee

1. Identify major observatory-related ship and submergence needs and describe the process that will be used to address these issues. Provide this as input to the NRC Observatory Committee prior to their final meeting on February 18, 2003.

2. Identify the requirements for facility support of ocean observatory systems. This should include requirements for both ships and submergence vehicles.

3. What requirements can be met with currently available academic assets (vessels and submergence vehicles), and what modifications or augmentation may be suggested including efficiencies that may be gained through contracts to industry?

4. What are the changes in demand for facilities resulting from observatory initiatives?

5. Identify the specific observatory needs that cannot be met by currently available academic facilities.

6. For those observatory facility needs that cannot be met by currently available facilities, the working group should:

a) Identify what facilities should be added to the available suite of academic assets.

b) Identify commercially available assets that could be used to meet observatory needs.

c) Address the effectiveness, both in terms of cost and practicality, of adding academic assets, using commercial assets, or a combination of both.

7. When are the facilities needed for installation, operation, and maintenance of the observatories? Establish a timeline.

8. Provide suggestions for the management, scheduling and operations of facilities related to observatory infrastructure. The ships will likely fall under the UNOLS system, but coordination of vehicles such as, AUVs and ROVs will need to be considered. It is assumed that the operation of the actual observing system will be managed by the organization that established the system.

UNOLS Ship/vehicle Time Requirements

Installation and O&M requirements extensively documented in DEOS global buoy feasibility and implementation reports, NEPTUNE feasibility and O&M reports, NRC OOI Implementation rep

This committee has no major changes to these estimates to offer

We emphasize that access to ROVs must become routine for observatory maintenance and science

ROVs are preferable to manned submersible for all observatory operations due to improved endurance, maneuverability, and flexibility

UNOLS Ship/vehicle O&M Time Requirements

NRC OOI estimates

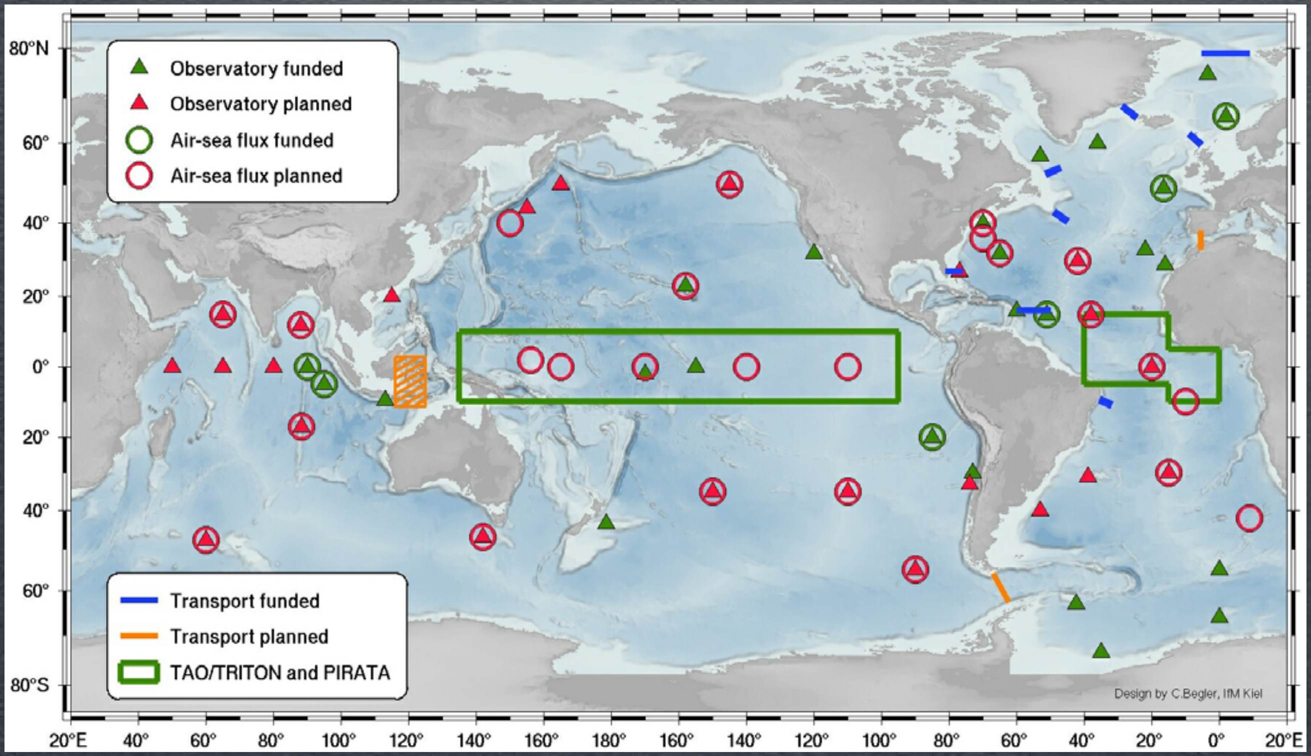
- Global buoy component: 20 ship-months/y (10 with ROV)
- Regional cabled observatory: 4-8 ship-months/y (with ROV)
- Coastal observatories: 6 ship-months/y

Global estimate is appropriate for 20 mooring system

RCO estimate of 4 months is appropriate

Coastal estimate is probably quite low

Locations of Moored-Buoy Observatories



Green: sites that are currently operating or funded.
Red: Sites to be implemented during pilot phase.

RECOMMENDATIONS FOR DEEP WATER OBSERVATORY OPERATIONS

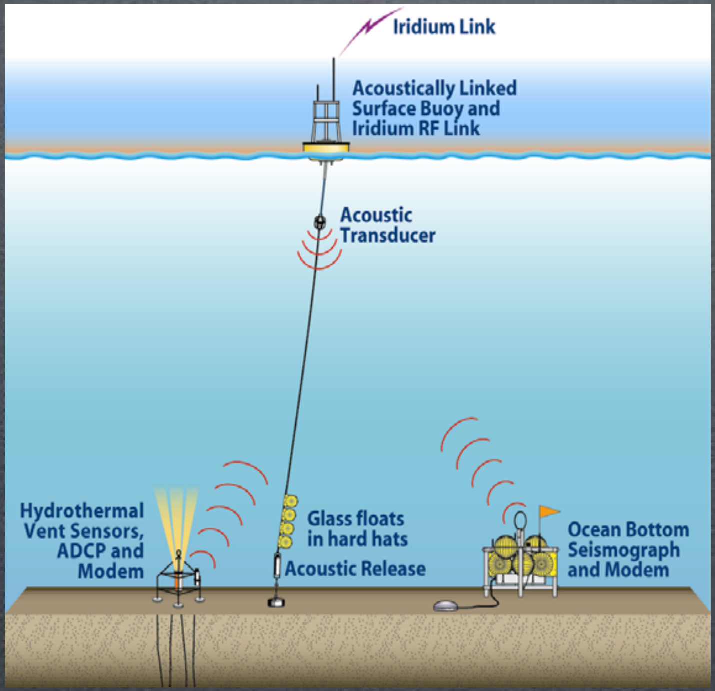
A heavy lift capability (routine ops with 20,000 lb loads, occasional ops with 40,000 lb loads, limited cable handling and repair) will be required

Large (~1/2 ship length) open deck space will be required for many ops

Some modification of Thompson-class vessels to improve their utility for observatory ops should be implemented

UNOLS should consider the acquisition or long term lease of a heavy lift vessel (cable repair or equivalent)

DEOS Low Bandwidth Buoy

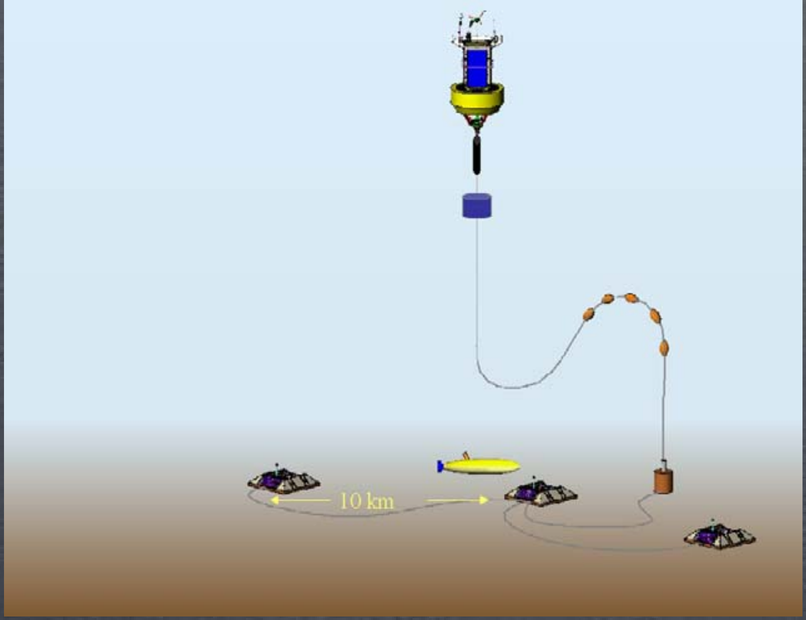


Single point, semi-taut surface mooring with acoustic link

Installation from large UNOLS vessel is routine

No ROV required for installation or maintenance

DEOS Low Bandwidth Cable Linked Buoy



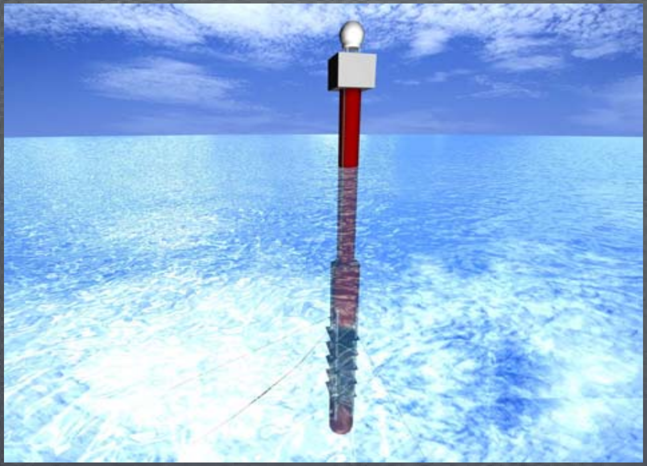
Single point mooring with electro-optical S-link

2.4 m discus buoy

Installation from large UNOLS vessel is feasible

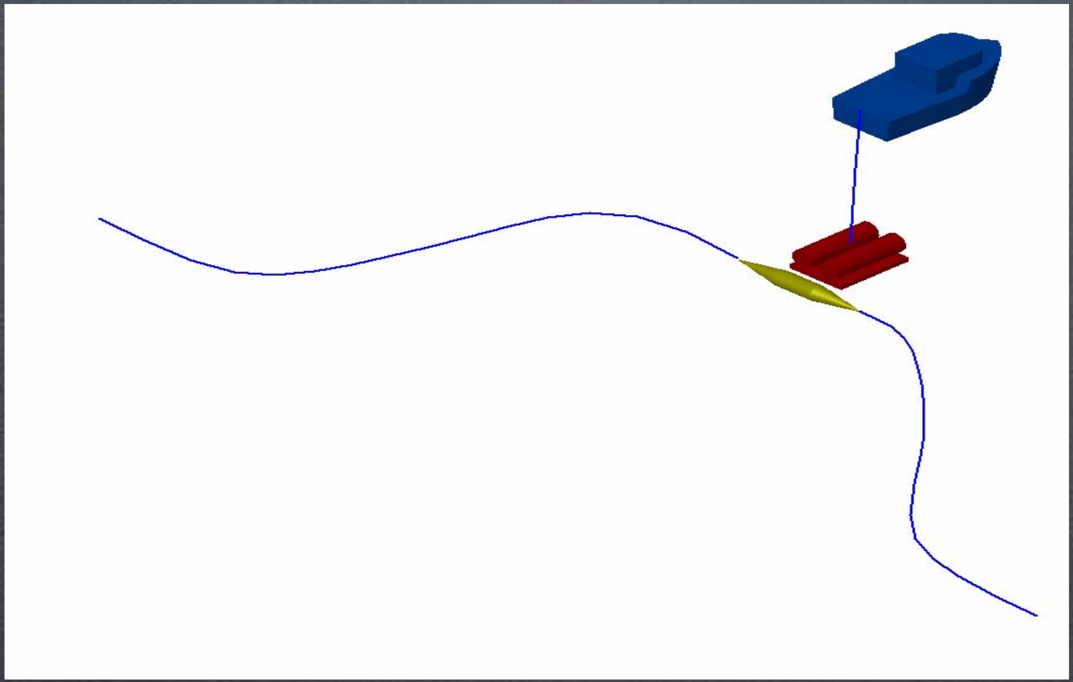
ROV required for installation and maintenance

DEOS Spar Buoy



40 m long spar buoy with diesel generators and radome
Three point mooring with electro-optical link to j-box
Installation and instrument maintenance will require an ROV
Installation and buoy maintenance not feasible with largest UNOLS vessels

RCO REPAIR SCENARIO

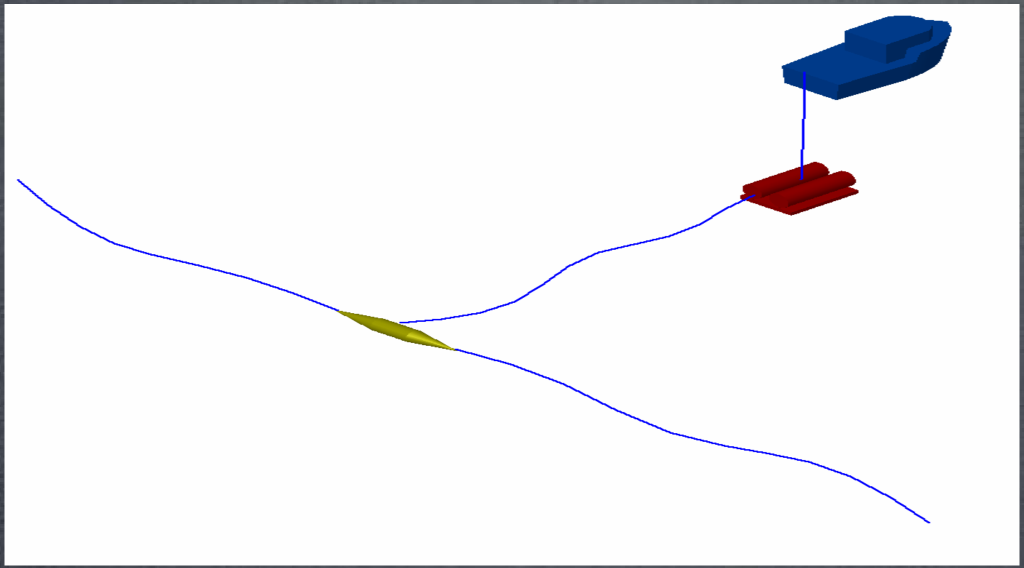


J-BOX PLUGS INTO BACKBONE BRANCHING UNIT

REPAIR J-BOX BY DISCONNECTING WITH ROV, LIFTING ~2000 LB LOAD TO SURFACE

CURRENTLY FEASIBLE WITH LARGE UNOLS VESSEL (H2O IS EXAMPLE)

ALTERNATE RCO REPAIR SCENARIO



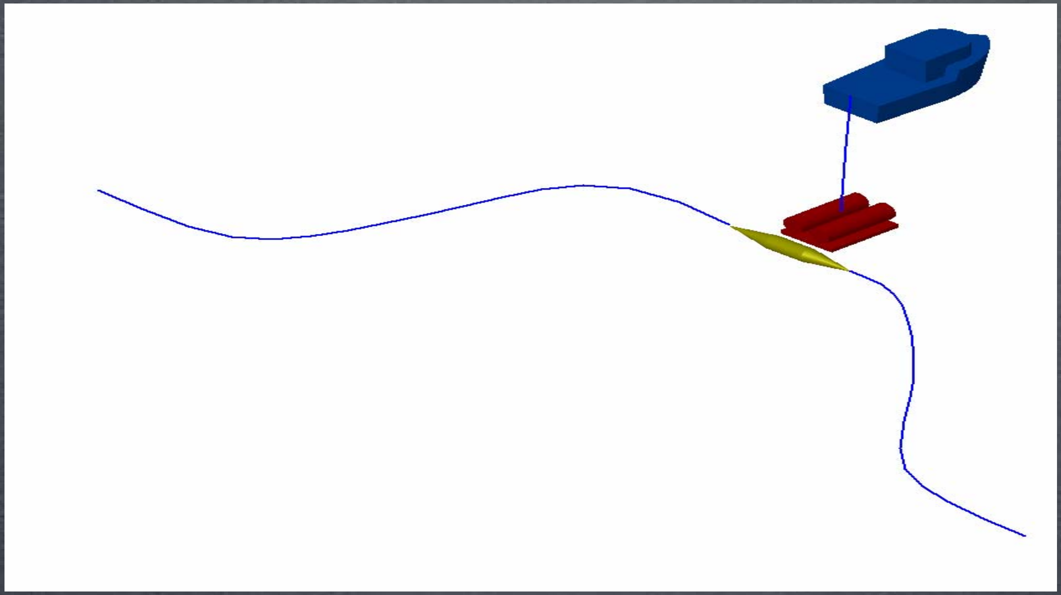
J-BOX IS HARDWIRED TO SPUR CABLE FROM BACKBONE

REPAIR REQUIRES LIFTING J-BOX AND ATTACHED CABLE TO SURFACE

~10,000 LB STATIC LOAD IN 4000 M WATER DEPTH

MARGINAL ON LARGE UNOLS VESSEL WITH PRESENT HANDLING GEAR ABOVE SS2

ADDITIONAL RCO REPAIR SCENARIO



FAILURE IN NODE BRANCHING UNIT REQUIRES LIFTING NBU PLUS TWO ATTACHED CABLES

~20000 LB STATIC LOAD IN 4000 M WATER DEPTH

HIGH RISK ON LARGE UNOLS VESSSEL WITH PRESENT DECK GEAR AT ANY SEA STATE

REQUIRED CABLE HANDLING EQUIPMENT

MINIMAL HANDLING EQUIPMENT

CHUTE, 20000 LB SWL WINCH AND 2 CAPSTANS (10000 LB EACH FOR HANDLING SOFT LINE) WITH STOPPERS APPLIED ON DECK

BETTER HANDLING EQUIPMENT

ABOVE PLUS 20000 LB SWL (WHILE ROTATING) A-FRAME. PROBABLY REQUIRED FOR DOUBLE ENDED NODE

BEST HANDLING SYSTEM

ABOVE PLUS EITHER 2 LCEs OR 2 2-3 M DIAMETER CABLE DRUMS

GENERIC EQUIPMENT

CAPSTANS/TUGGERS, GRAPPLING GEAR, HARD/SOFT STOPPERS, CABLE SPLICING GEAR (SEVERAL TRANSPORTAINERS), DECK SPACE

IMPROVEMENTS TO UNOLS VESSELS

- Shroud Z-drive nozzles to protect props from cables
  - Slight increase in fuel consumption, improvement in low speed/DP efficiency
- Install redundant DP systems to improve reliability during critical ops Expense is about 50% of DP system cost
- Remove part or all of the hangar on Thompson class ships to increase deck space (simple option)
- Remove all of superstructure aft of hydrolab to really increase deck space (requires naval architect study)

IMPROVEMENTS TO UNOLS VESSELS

Current A-frame SWL ranges from 24,000 lb (Thompson) to 32,500 lb (Melville/Revelle) to 60,000 lb (Knorr through crane)

Could be doubled through ship modification to spread the load (Atlantis was modified during construction, Knorr is being modified to handle 100,000 lb load for heavy coring)

Consider installation of stronger A-frame/heavier winch combinations to increase load handling ability to 20,000 lb static

Major safety issue--requires trained crew not UNOLS-standard science party plus resident technician

ACQUISITION OF HEAVY LIFT VESSEL

Thompson-class vessels were designed for large expeditionary science programs (e.g., WOCE, JGOFS)

Maximize fuel efficiency at cost of station keeping above SS4/5

Maximize lab space at expense of deck space

Z-drives were installed in place of conventional screws, so are too far aft

Ability to modify vessels after construction will be limited (cost, naval architecture, other user class issues)

ACQUISITION OF HEAVY LIFT VESSEL

Applications

Cabled observatory maintenance and modification

Cable reuse (H2O as prototype)

Large buoy installation and maintenance

Long coring operations

ACQUISITION OF HEAVY LIFT VESSEL

Opportunity

Submarine telecommunications marketplace collapsed in 2001 just as major cableship deliveries took place

Cable maintenance vessels can be purchased for ~10% of construction cost

Short term opportunity that will not last

Recent Victoria (BC) News Bulletin article

HOME SWEET HOME: Korean-built transoceanic fiber-optic cable laying ships Knight and Baron have found a temporary home in Nanaimo, and not only are they massive in stature, they're high-tech marvels. Two massive vessels will grace Nanaimo harbour for the next two years. Korean-built transoceanic fiber-optic cable laying ships Knight and Baron have found a temporary home in Nanaimo.
Each of the 146.5-metre-long, 21 metre-wide behemoths is valued at $63 million and carry up to 12,000 kilometres of fiber optic communications cable. "They're basically brand new ships," says Nanaimo Port Authority president Bill Mills. "They've both been used, I think, to do one job and the owners were looking for someplace they felt comfortable with for lay-up for a period of time.

ACQUISITION OF HEAVY LIFT VESSEL

Advantages

Emerging observatory ops become feasible without compromising safety

ACQUISITION OF HEAVY LIFT VESSEL

Substantial improvement in ability to operate in high sea state (e.g., ROV ops in SS7 are routine vs SS4 limit on large UNOLS vessels)

High latitude operations become feasible (important to global buoy plan)

Concentration of heavy lift ops on one vessel with trained crew will reduce UNOLS-wide personnel risk

MAERSK RECORDER

General Specifications

Built	August 2000
Classification	Lloyd's Register of shipping +100A1, Cable Laying Vessel +LMC, UMS, NAV-1, SCM, DP(AA)
Dimension	Length overall : 105.00 m Breadth : 20.00 m Molded depth : 12.00 m Draft,max : 9.10 m
Speed	Economical Speed 12 - 13 kts
Cable Tank Capacity	2 Cable tanks, (each 1,316 cbm , 2,500 t) 2 Cable tanks, (each 263 cbm , 500 t)
Tank Capacity	Fuel oil Fuel ; 1,639 cbm , Gasoil ; 650 cbm
Main Engine	5,220 BHP x 2 sets (total 10,440 BHP)
Accommodation	50 (1× 9, 2× 7, 3× 9,)
Propulsion	2 × 4 blade controllable pitch
Thruster (Bow)	1,360 BHP x 1set retractable azimuth 1,600 BHP x 1 set tunnel thruster
Thruster (Stern)	1,600 BHP x 2 sets tunnel thrusters

Typical cable lay/repair vessel

(not for sale)

‘TYPICAL’ CABLE REPAIR SHIP

R/V GLOBAL EXPLORER

- MULTI-PURPOSE HEAVY LIFT VESSEL OPERATED BY OCEAN SERVICES LLC
- 273’ LOA, 2700 GT , 3 HOLDS FOR CABLE/CARGO
- TWIN 1500 HP MAIN PROPULSION, 1000 HP TUNNEL AND AZIMUTHING BOW THRUSTERS, TWIN 1100 HP AZIMUTHING STERN THRUSTERS
- LARGE OPEN DECK SPACE AFT
- 65 TON CRANE

RECOMMENDATIONS FOR DEEP WATER OBSERVATORY OPERATIONS

Routine access to ROVs will be required for all observatory operations

1 additional vehicle will be required when the OOI is implemented (2-3 y from now)

1 more vehicle will be required when OOI facilities are fully operational (5-7 y from now)

Commercial ROVs are not suitable for most science operations but may be usable for routine maintenance tasks

Ocean Observatory Mapping Requirements

Three categories with different requirements and scales

- Understanding the regional context of the observatory
- Cable route surveys
- Site selection for potential observatories

Ocean Observatory Mapping Requirements

Understanding the regional context of the observatory

Traditional mapping science

Well equipped for deep water low resolution (50-100 m pixel) mapping

Shallow to intermediate depth, finer resolution capability is limited

(Thompson and Kilo Moana only)

Heavy demand at increased resolution will require additional assets

and/or commercial leases

Ocean Observatory Mapping Requirements

Cable route surveys-requirements are stringent
- very high resolution over relatively narrow swath
- 100% bathymetry - 800 m swath
- sidescan (backscatter) - 1200 m swath overlapping bathymetry

- subbottom, coring and CPT if cable to be buried (2.5 m sub-bottom)
- detect obstacles to 1 m lateral dimension
- detect hazards
- real-time processing for near real-time decision making

Requires combination of deep towed/AUV mapping

Commercial sector is experienced, infrequency of CRS suggests this may
be best approach (liability issues)

Ocean Observatory Mapping Requirements

Site selection

- Higher resolution than regional context mapping
- Near bottom mapping will be needed
- Deep water needs can be met using ROV/AUV/deep towed assets
- Limited assets for mid to shallow water in UNOLS

Coastal Observatory Requirements

Much more diverse set of tasks compared to deep water

Much more diverse set of research platforms compared to deep water

Much more diverse set of coastal vessels is available

Task of estimating requirements is commensurately difficult

Coastal Observatory AUV/ROV Requirements

Long duration glider-type AUV will be key observation platform

- Deploy and recover from small fast chase boat
- Regional class vessels need this capability

Self-propelled AUVS

- Key UNOLS need is acoustic nav capability on regional class

ROVs

- Rarely used except on outer continental shelf
- Use for observatory O&M (3 months/y in Atlantic)

Coastal Observatory Vessel Requirements

Recent experience (e.g., LEO-15) has demonstrated that the availability of real-time data from ocean observatories and observing systems actually increases the demand for surface research vessels

Required response time is shorter

This need is partially fulfilled by small university day vessels

Growing need is for a larger fleet of small Regional and large Local vessels for augmentation

Coastal Observatory Vessel Requirements

New requirement for support of 30-40 coastal moorings

- One vessel-year at Regional class_
- Frequent access to ROVs will be required

Better access to mid-size vessels for research

- 10 Local to Regional vessels distributed on east and west coast

Need for coordination of multiple vessel operations

Need for rapid response capability

Midsize Coastal Research Vessel

Shallow water operations O(10m)

24 Hour operations (including Marine Techs)

Sustained operations for several days

Standard sensor suites

- Met, ADCP, CTD, Bio-optics, Acoustic Mapping

Broader bandwidth communications with shore

- Send data back in real time
- Access observatory datasets of websites

Computer Lab

Electronics Shop

Wet Lab

Deck space for a portable Lab van

Towing Capabilities (Outside the wake, both sides)

How Many Midsize Vessels

First-cut at Locations

- Gulf of Maine
- Middle Atlantic Bight
- South Atlantic Bight
- Eastern Gulf of Mexico
- Western Gulf of Mexico
- Southern California
- Northern California
- Oregon
- Washington
- Southern Gulf of Alaska
- Northern Gulf of Alaska
- Bearing Sea
- Arctic Seas