Ocean Observatories Initiative

NSF's Ocean Observatories Initiative: Building Research Infrastructure for the Pacific Northwest and the Broader Community

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Structure of talk

- Introduction to OOI
- Regional Scale Nodes (cabled array)
- Endurance Array (cabled and uncabled array components)
- Glider, Benthic Experiment Package, Mooring Videos

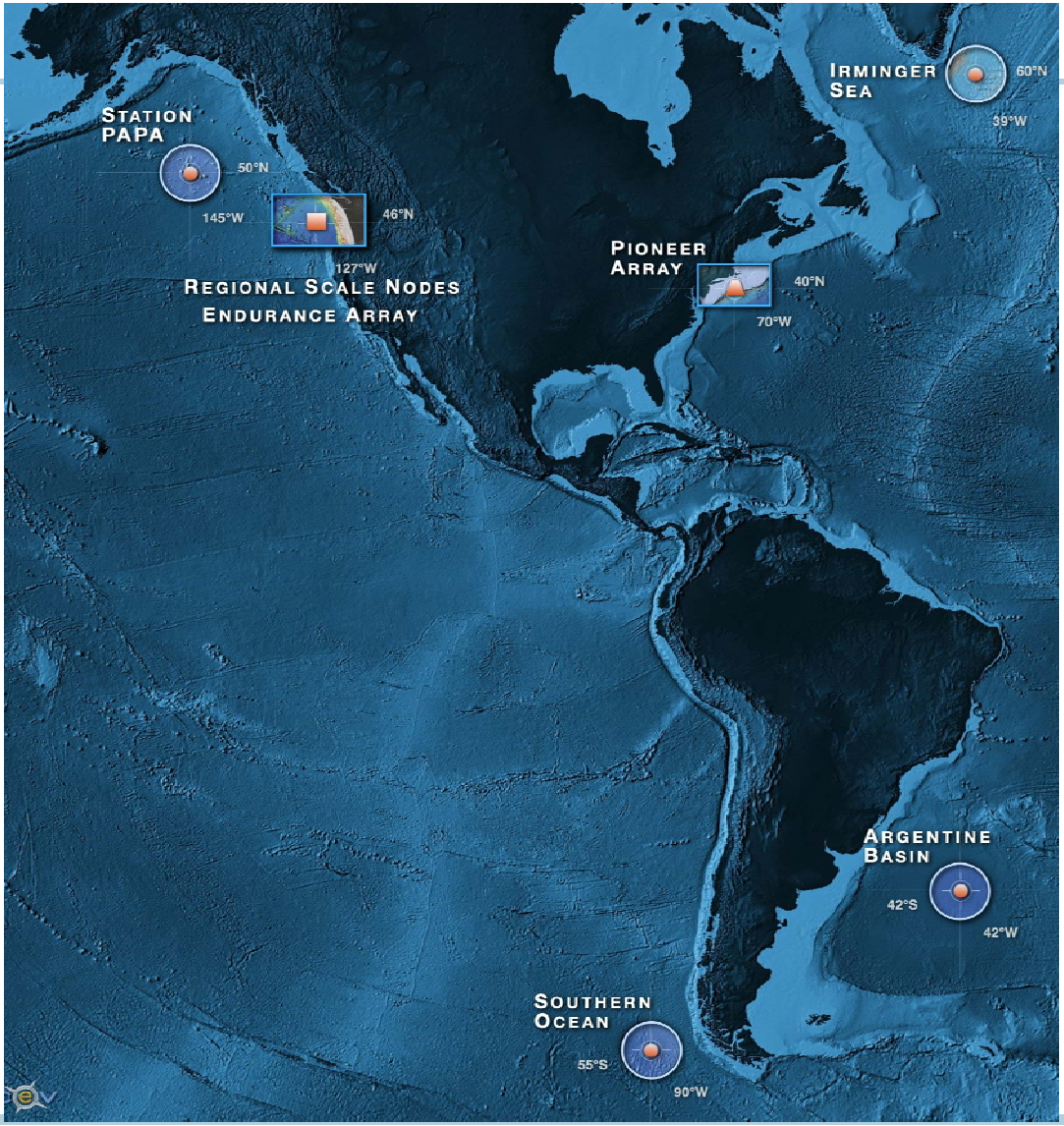
Introduction

- infrastructure (moorings, profilers, AUVs, gliders, and seafloor platforms) to measure physical, chemical, geological and biological variables at the air-sea interface, in the ocean, and seafloor.

- integrated by a cyberinfrastructure to manage resources and bring data to scientists, educators and the public.

- Education and Public Engagement component.

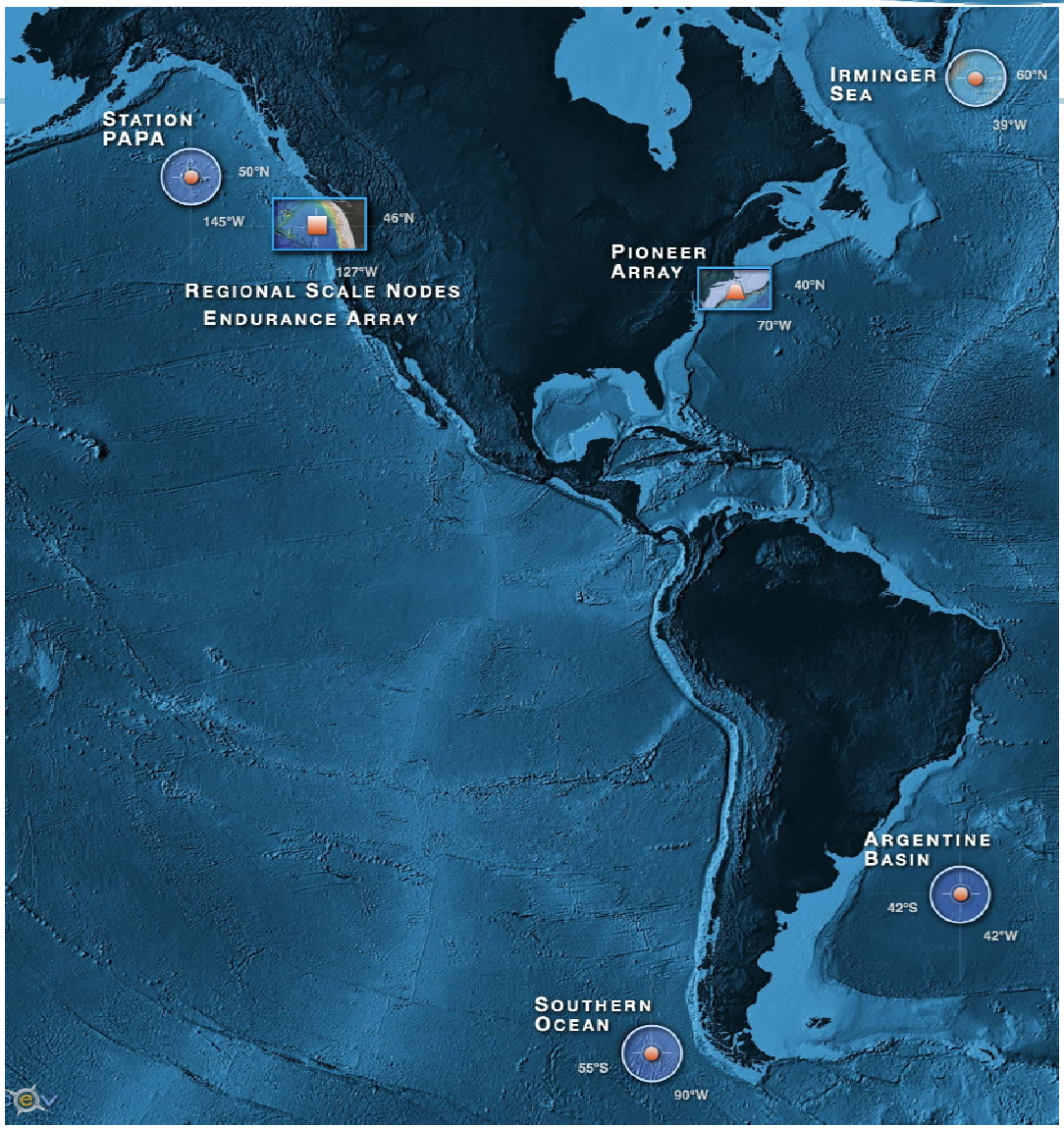
- Funded by the ***National Science Foundation*** through the Consortium for Ocean Leadership (OL). OL funds the implementing organizations



OOI Science Themes

- Coastal and Global Scale Nodes (Global, Endurance, Pioneer)
  - Ocean-Atmosphere Exchange
  - Climate Variability, Ocean Circulation and Ecosystems
  - Turbulent Mixing and Biophysical Interactions
  - Coastal Ocean Dynamics and Ecosystems

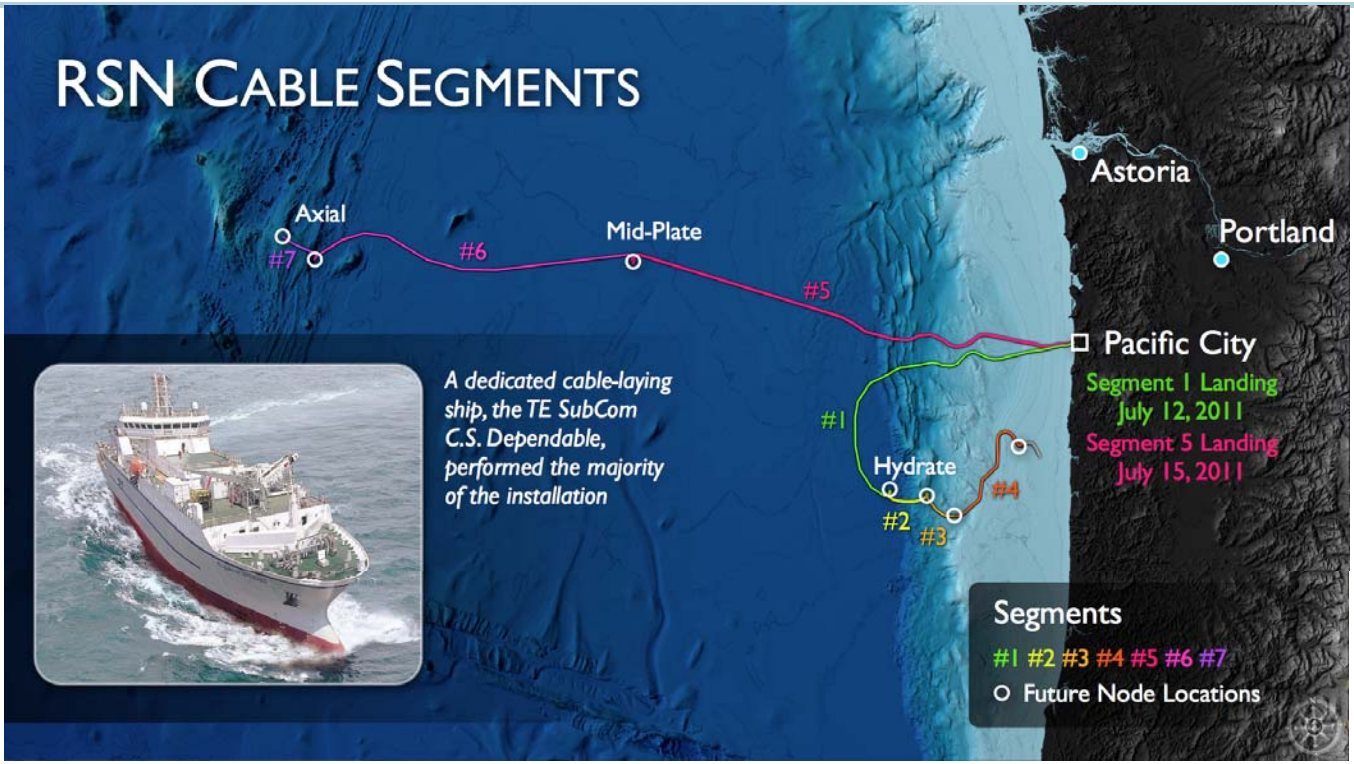
- Regional Scale Nodes
  - Fluid Rock Scale Interactions and the Sub-Seafloor Biosphere
  - Plate-Scale Geodynamics



OOI By the Numbers

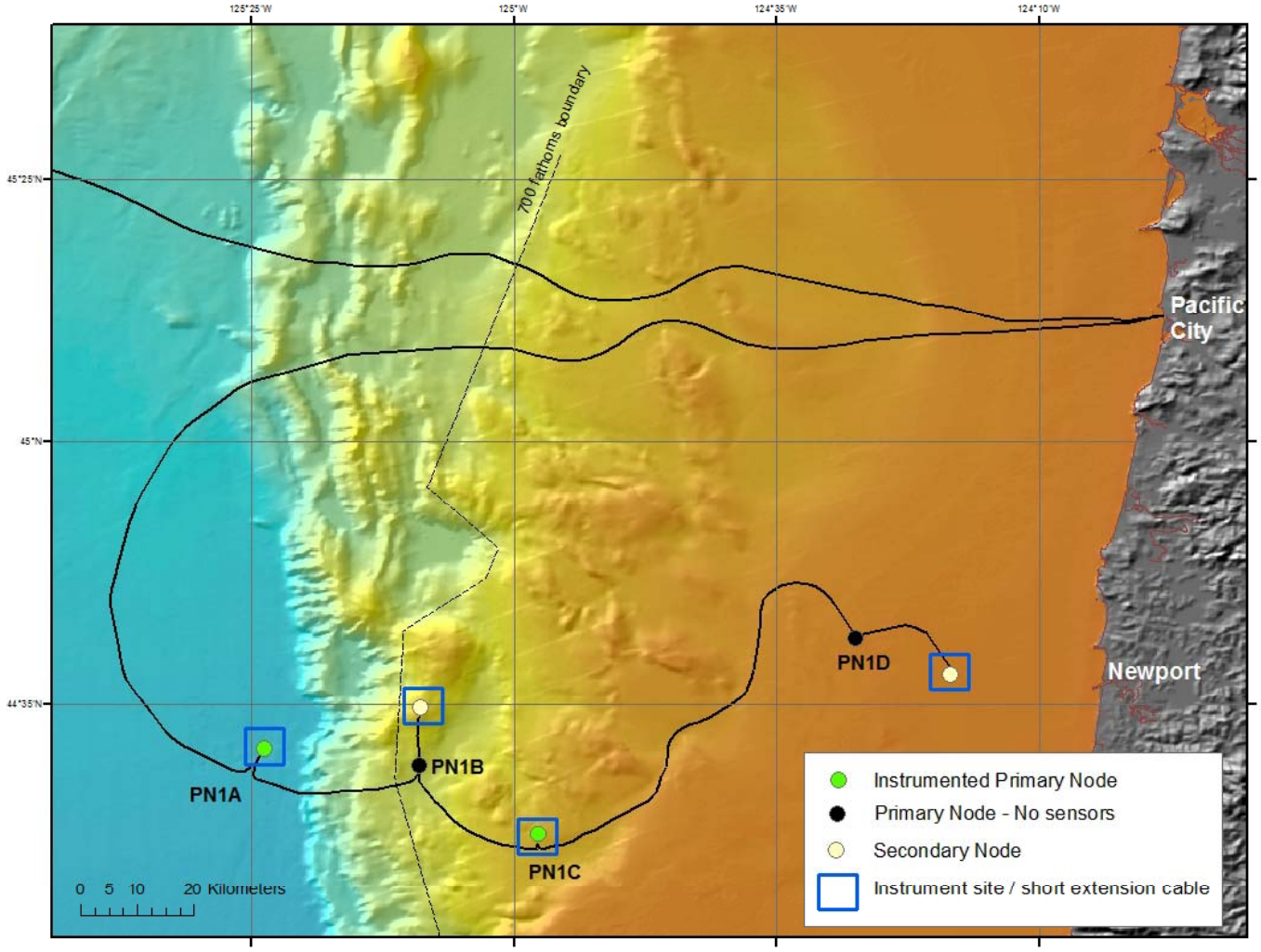
- Number of Arrays: 7 (4 Global, 2 Coastal, 1 Regional Cabled)
- Types of platforms: Gliders, AUVs, profilers, surface moorings, fixed instrument chains, seafloor and subseafloor installations
- Number of simultaneously deployed instruments: 764
- Number of instrument types: 48
- Data Volume Produced: 3 Petabytes/year
- High power (10kV) and high speed data (10Gbs) fiber optic cable, satellite modem, acoustic modem, inductive modem
- Build: 5 years
- Operations: 25 years +
- See oceanobservatories.org for more information

Regional Scale Nodes (RSN)



The RSN will provide high power and high bandwidth connectivity to instruments installed on the seafloor and deep water column moorings via undersea fiber optic cables. Two electro-optical undersea cables, totaling 880 km, were installed, landed, and connected to the shore station at Pacific City, OR.

2013/2014 operations – Secondary infrastructure



2013:

Seabed sensors and short surface laid extension cables

2014:

Water column sensors and moorings

2013/2014 operations – Secondary infrastructure

Science requirements

- sensor positions based on scientific value
- sensor extension cables less than ~1km in length

Feasibility

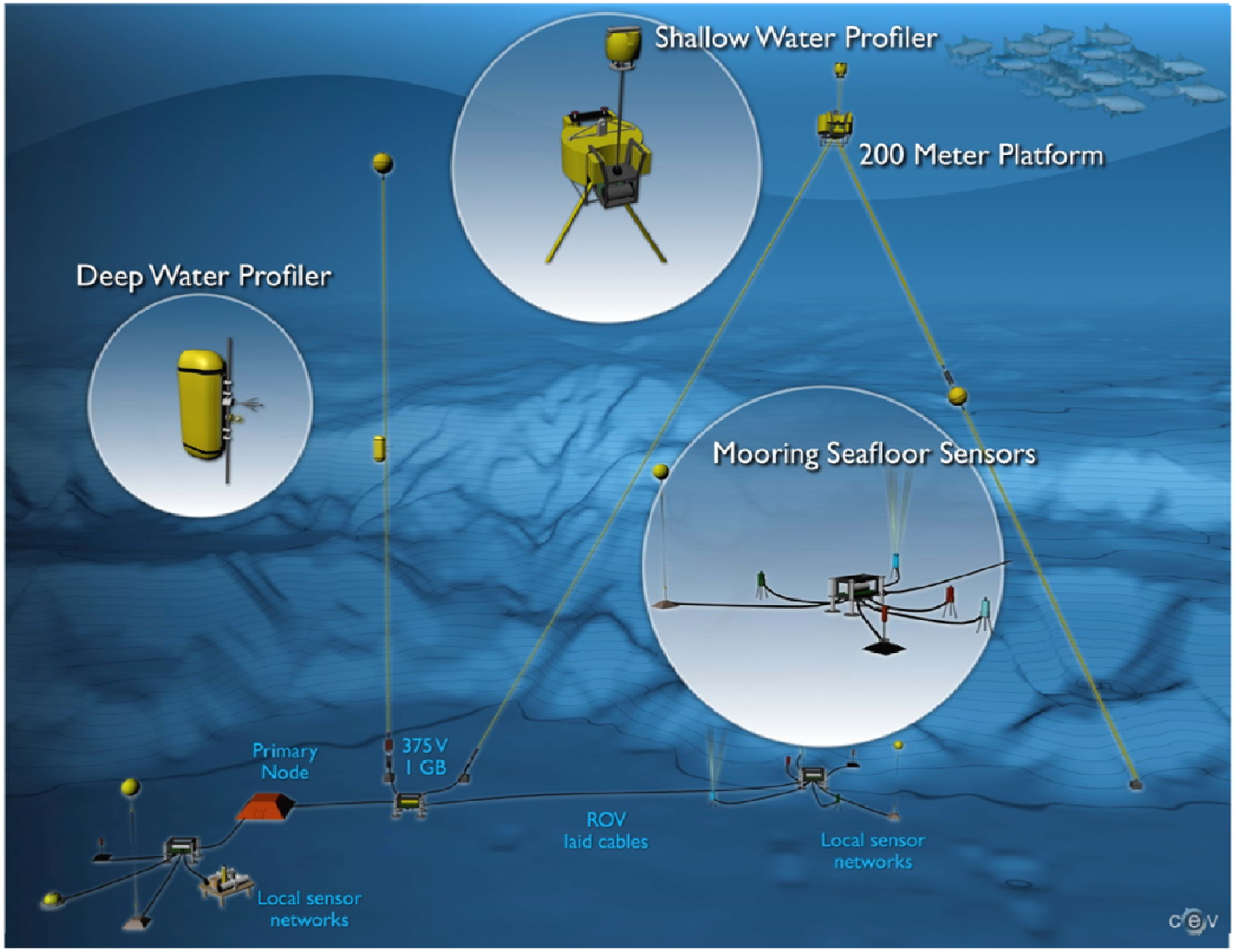
- Based on site conditions: landing, bathymetry, geology, currents

Other marine users

- fishing & recreational activities
- existing submarine systems
- Environmental hazards and protected areas

➡ **Minimize impacts and maximize protection of the OOI network**

2013/2014 operations – Secondary infrastructure



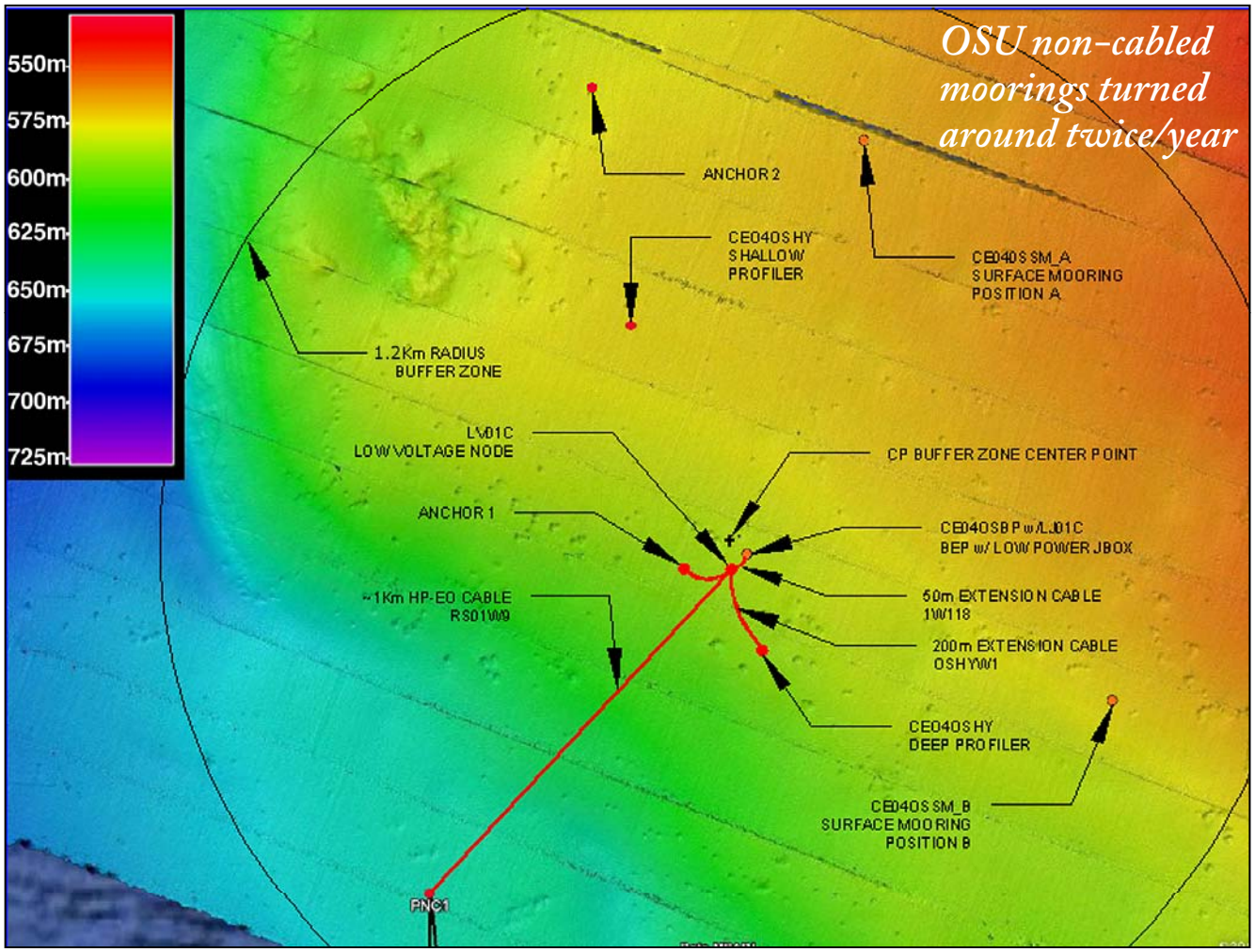
Variable sensors configuration at each site

Sensors on seabed and in water column, linked by:

- extension cables
- junction boxes
- low voltage nodes

Data back to shore in real-time

Infrastructure at PN1C (Oregon slope site)



PN1C (617m)

Secondary node location

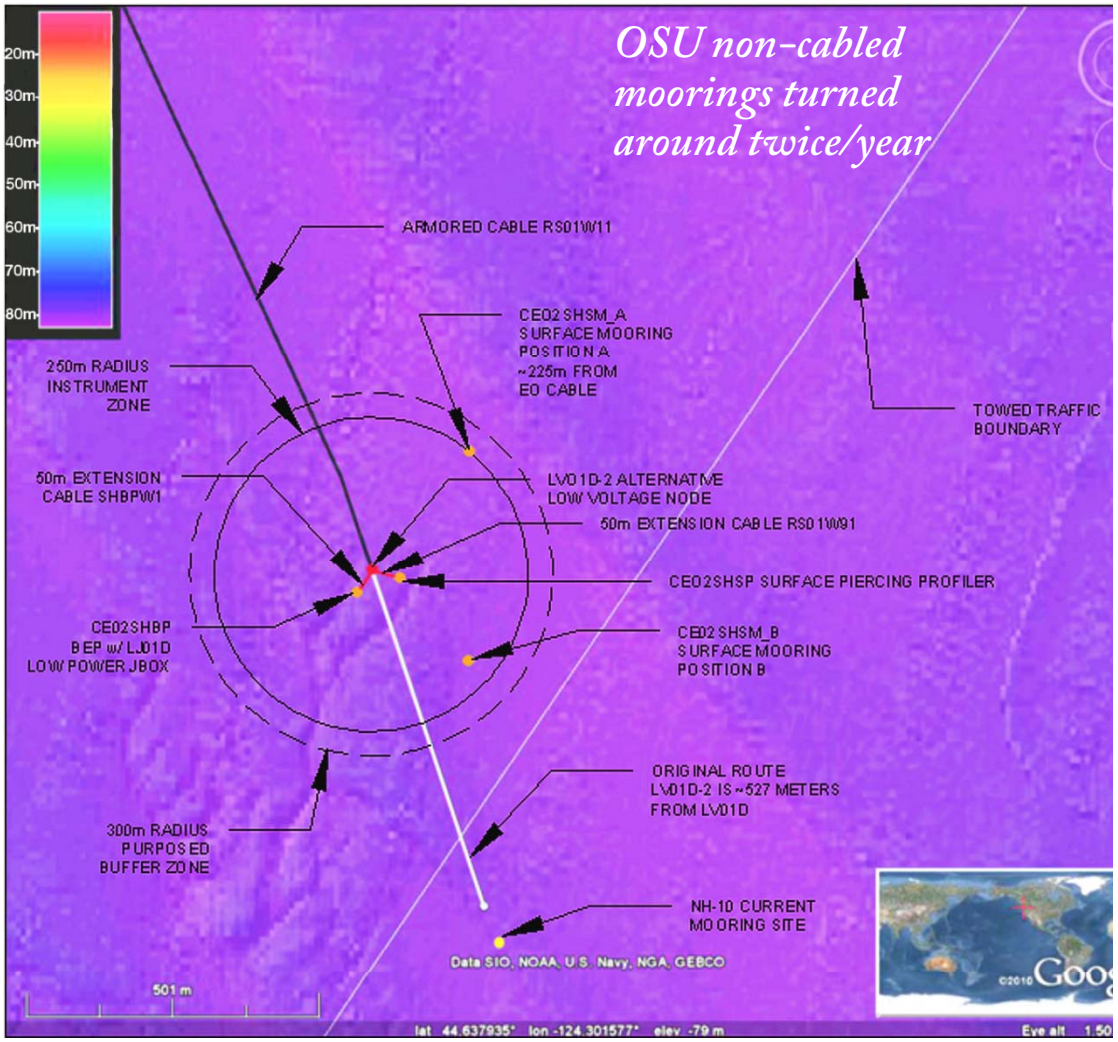
Lat. : 44° 22.146' N

Long. : 124° 57.246' W

Depth : 588 m (322 fms)

- All equipment within 2 water depths of secondary node
- 1.2km (0.65nm) radius buffer zone

Infrastructure at the Oregon 80m site



Oregon mid-shelf

Secondary node location

Lat. : 44.637° N

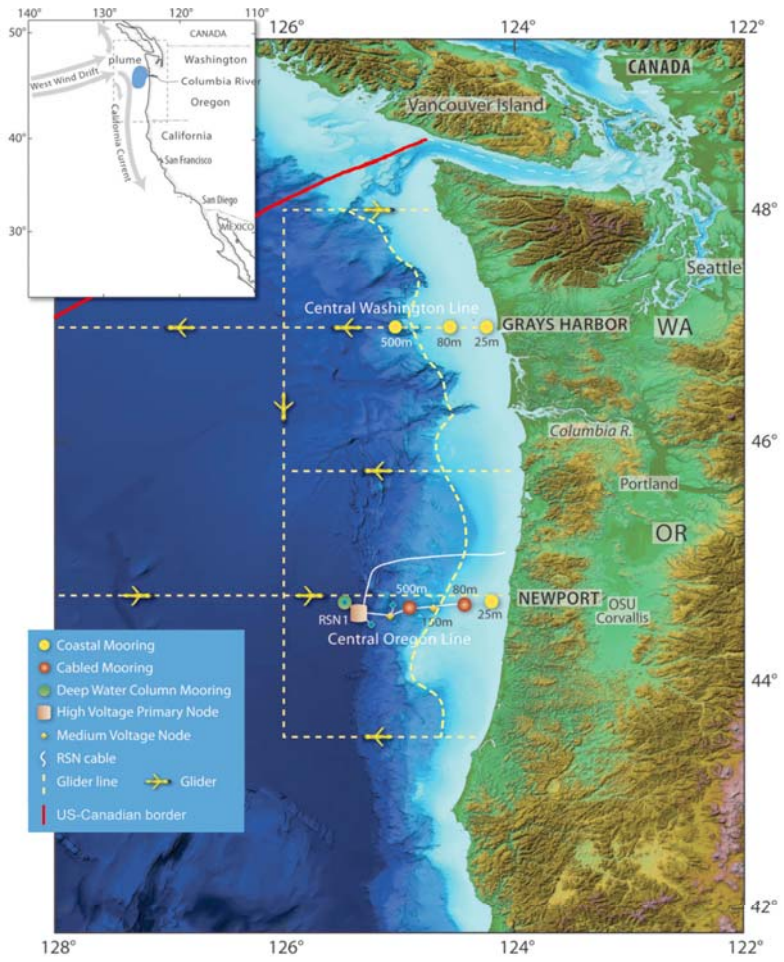
Long. :124.301° W

Depth : 80 m

- All sensors within 3 water depths of low voltage node
- ~300m radius buffer zone

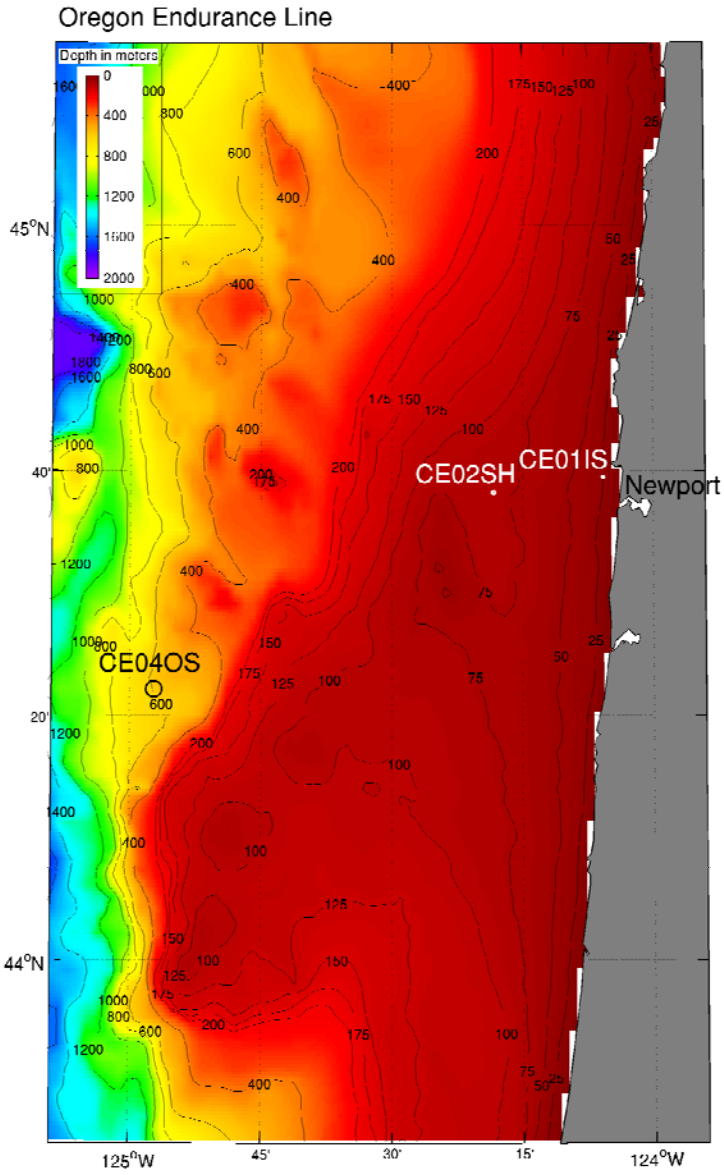
Endurance Array

- The Endurance Array has two lines of cross-shelf moorings (inner-shelf, mid-shelf, and slope) off Newport and Grays Harbor.
- At the Newport line, two of the sites at 80 and 600 m depths will have cabled as well as uncabled platforms.
- Six glider lines will support the Endurance array by resolving mesoscale spatial variability.

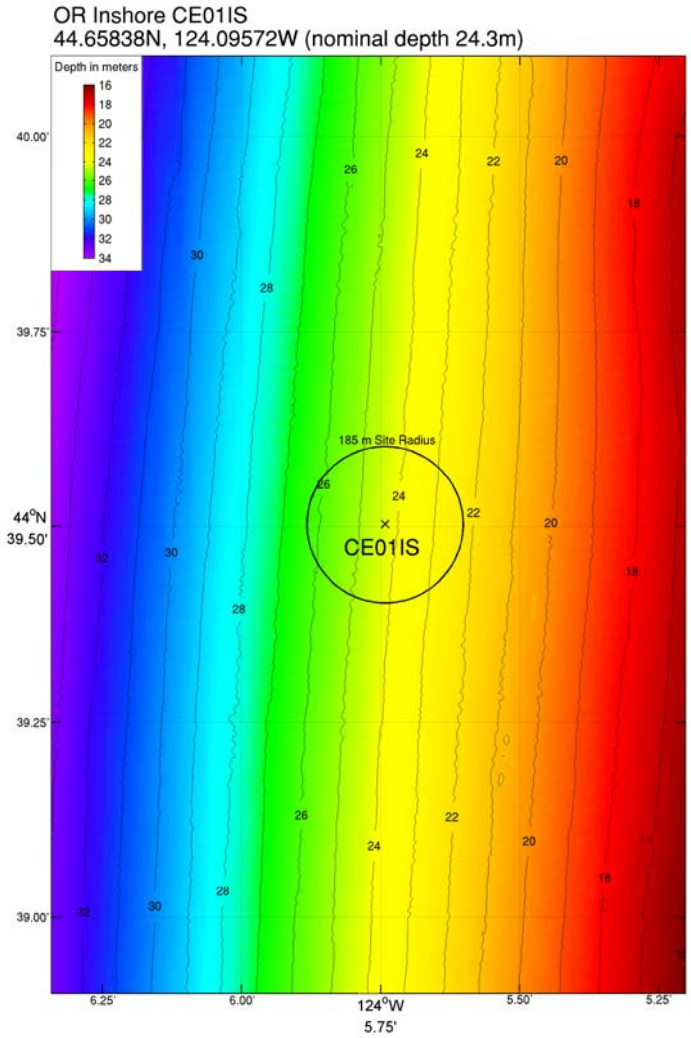


Oregon Endurance Line

Site	Site Center	Proposed buffer zone	Depth	Platforms
Inshore	44.658°N 124.096°W	185 m	24 m	Submersible Surface Buoy Uncabled Profiler
Shelf	44.637°N 124.306°W	250 m	80 m	Coastal Surface Buoy Cabled Profiler Cabled Benthic Experiment Package
Offshore	44.369°N 124.954°W	1200 m	588 m	Coastal Surface Buoy Cabled Hybrid Profiler Cabled Benthic Experiment Package



The Oregon inshore site



Oregon inshore

Site location

Lat. : 44.658° N

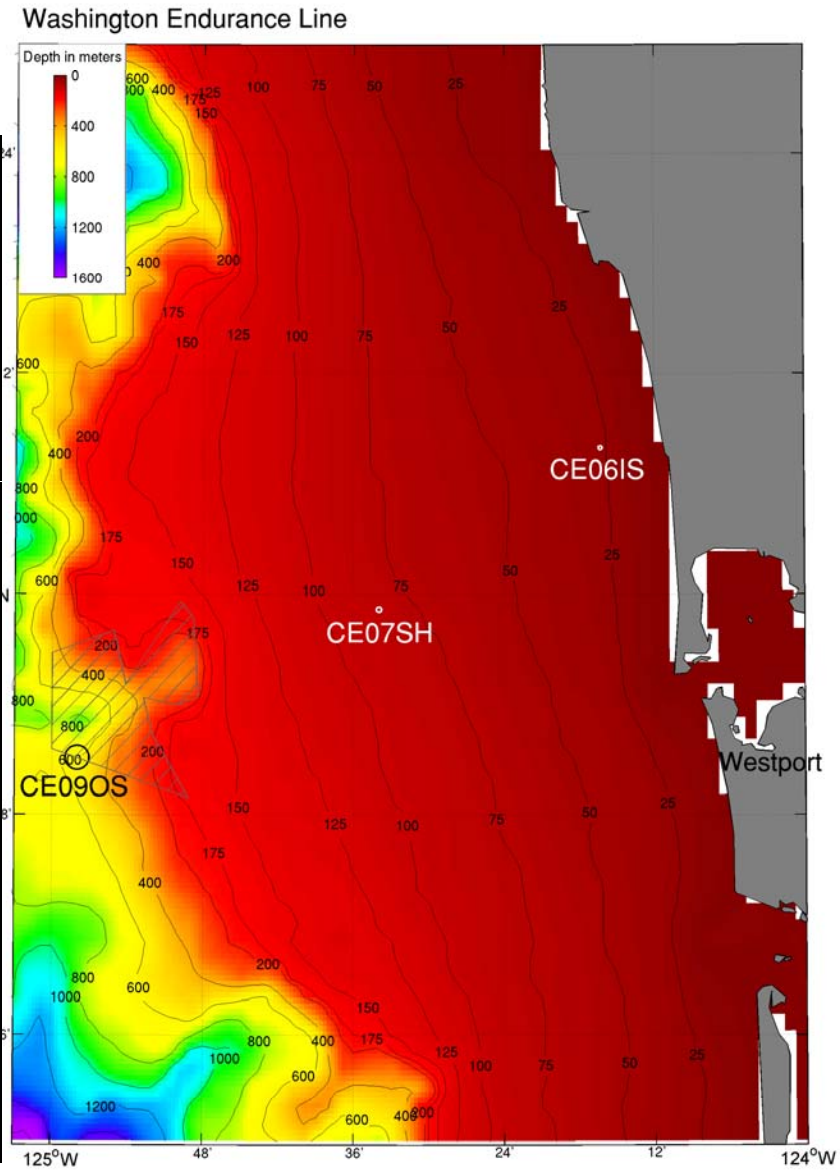
Long. : 124.096° W

Depth : 24 m

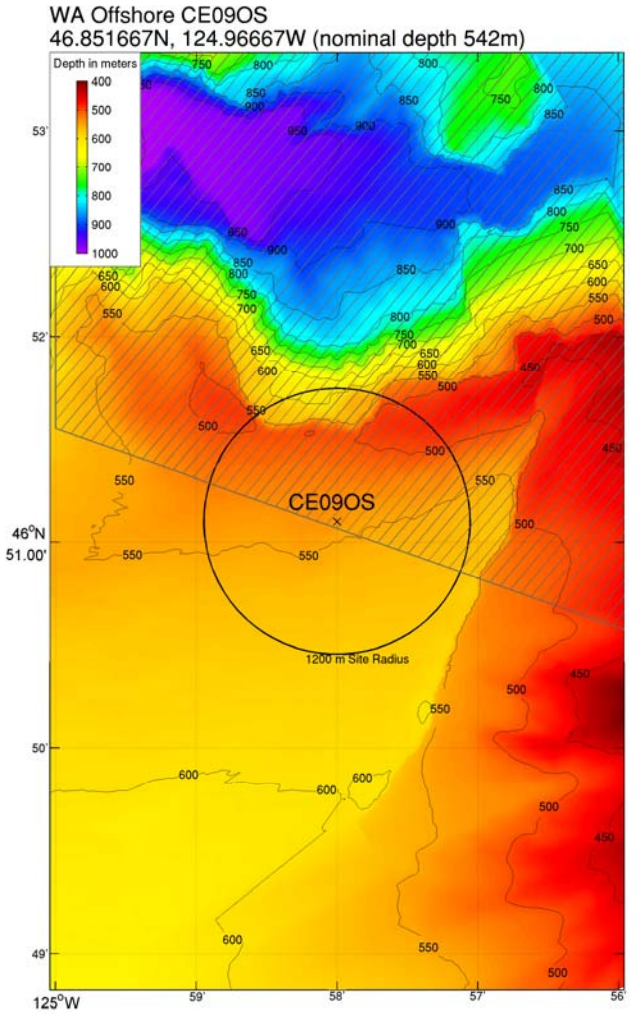
- 185m radius proposed buffer zone

Washington Endurance Line

Site	Site Center	Proposed buffer zone	Depth	Platforms
Inshore	47.133°N 124.272°W	185 m	29 m	Submersible Surface Buoy Uncabled Profiler
Shelf	46.986°N 124.566°W	250 m	87 m	Coastal Surface Buoy Uncabled Profiler
Offshore	46.852°N 124.967°W	1200 m	542 m	Coastal Surface Buoy Coastal Profiler Mooring



The Washington offshore site



Washington offshore site

Site Center

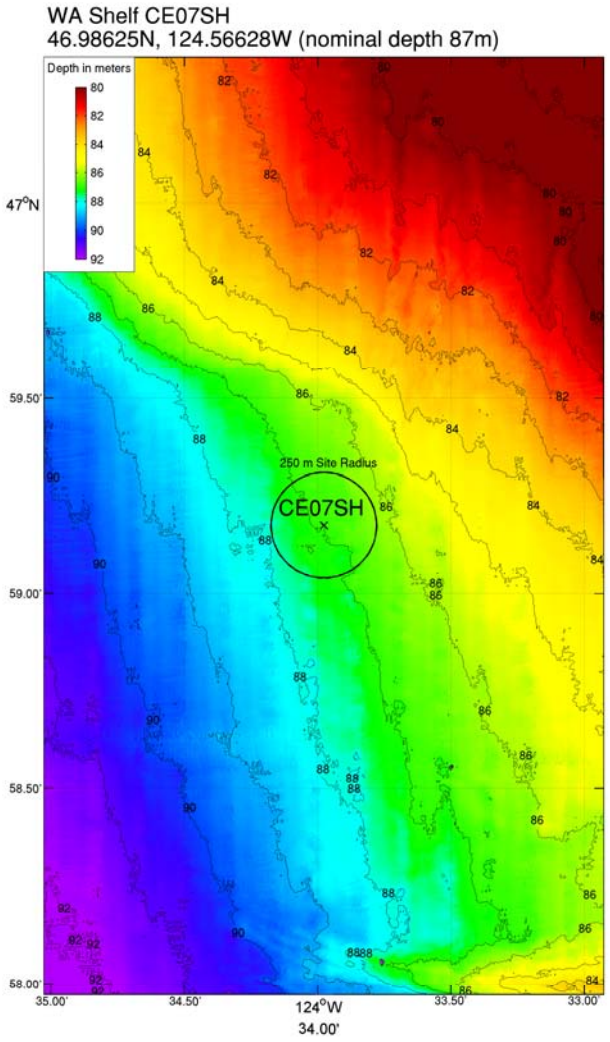
Lat. : 46.852° N

Long. : 124.967° W

Depth : 542 m

- **~ 1200 m radius proposed buffer zone**
- The hatched area demarcates the Grays Canyon Essential Fish Habitat Conservation Area.

The Washington shelf site



Washington shelf site

Site Center

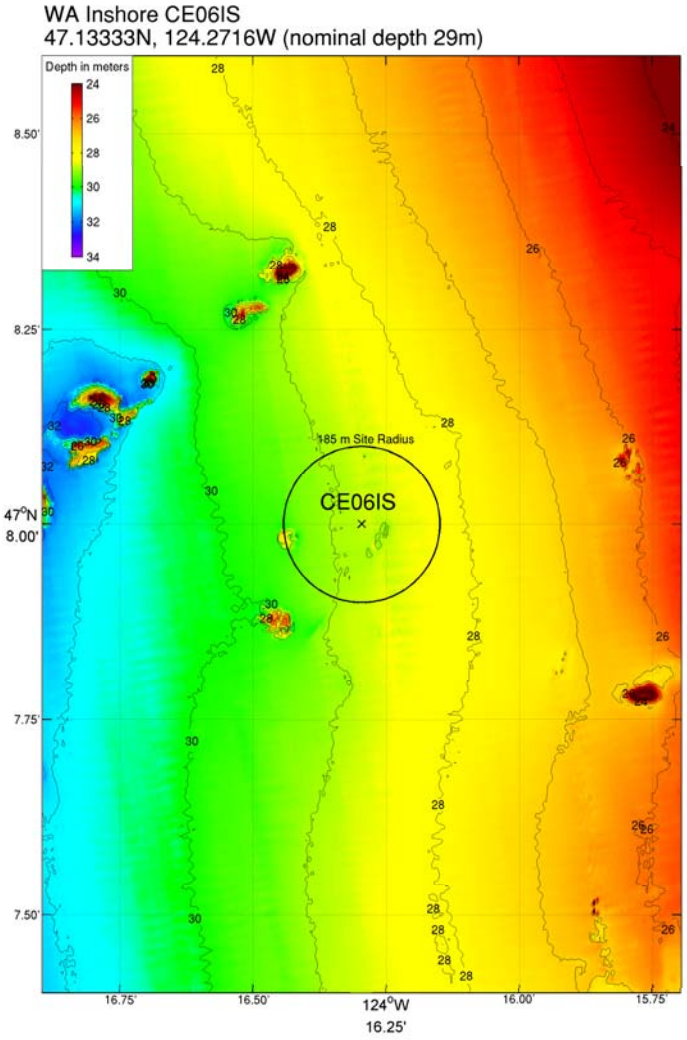
Lat. : 46.986° N

Long. : 124.566° W

Depth : 87 m

- ~250m radius proposed buffer zone

The Washington inshore site



Washington inshore site

Site Center

Lat. : 47.133° N

Long. : 124.272° W

Depth : 29 m

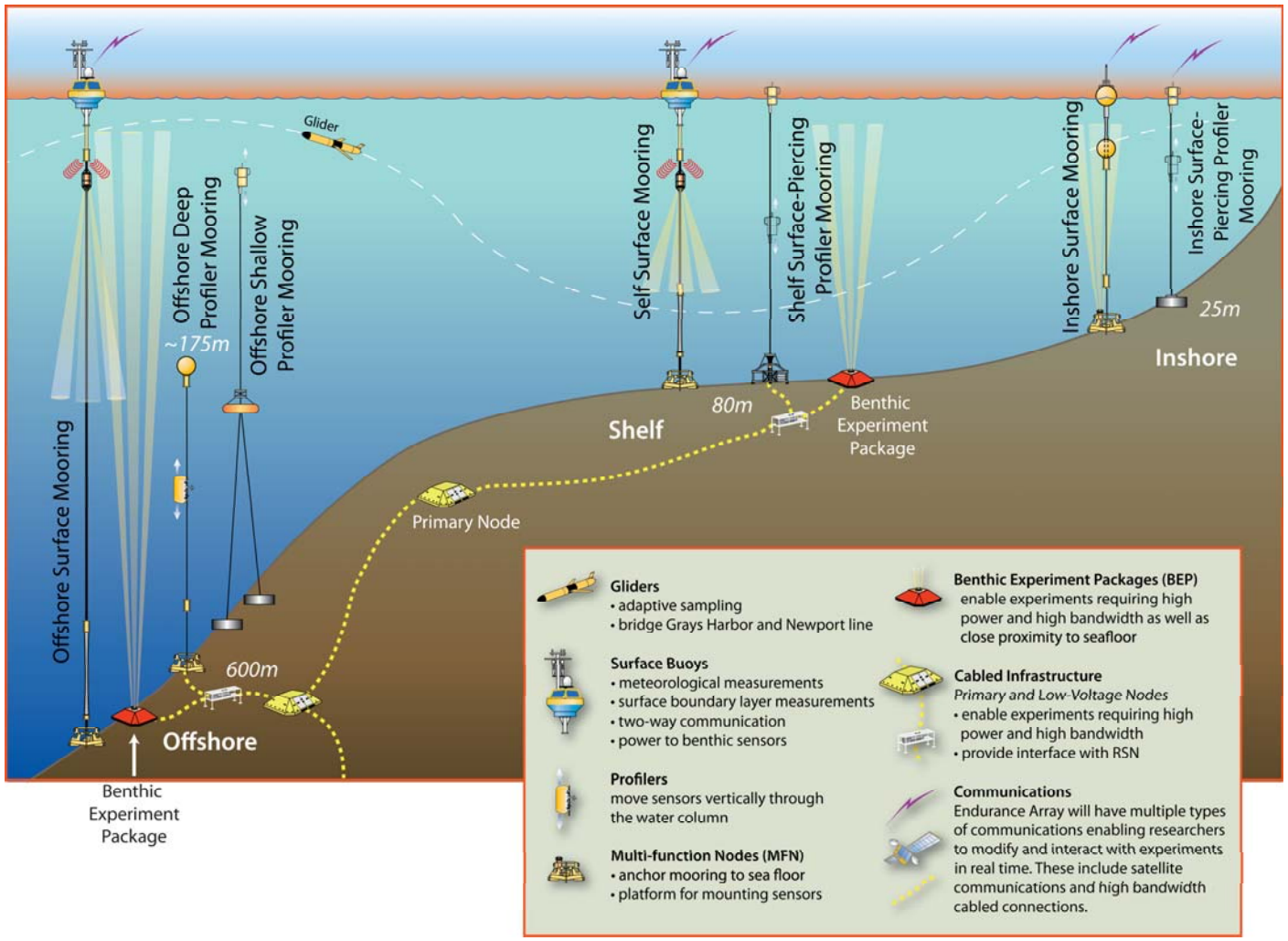
- ~185m radius proposed buffer zone

Endurance Array

- uses fixed and mobile assets to observe cross-shelf and along-shelf variability in the coastal upwelling region off Oregon and Washington

- provides an extended spatial footprint that encompasses a prototypical eastern boundary current regime

- joins with the RSN cabled infrastructure.



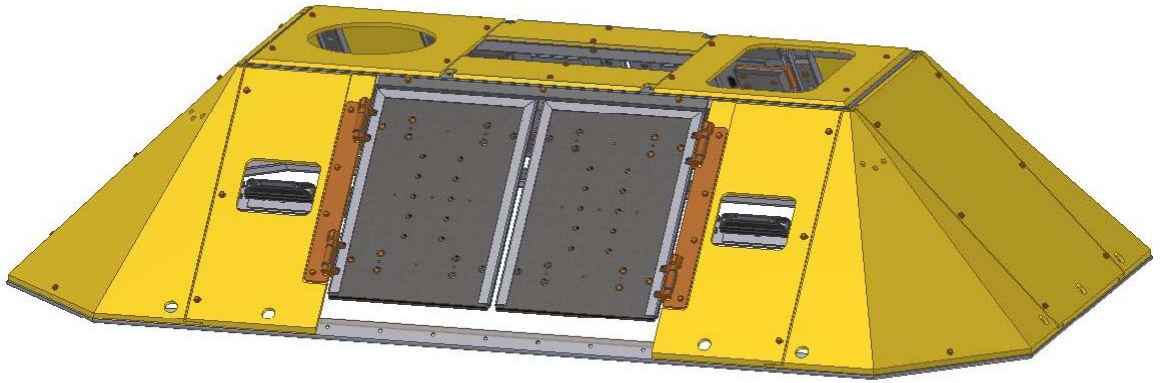
Endurance Core Sensors

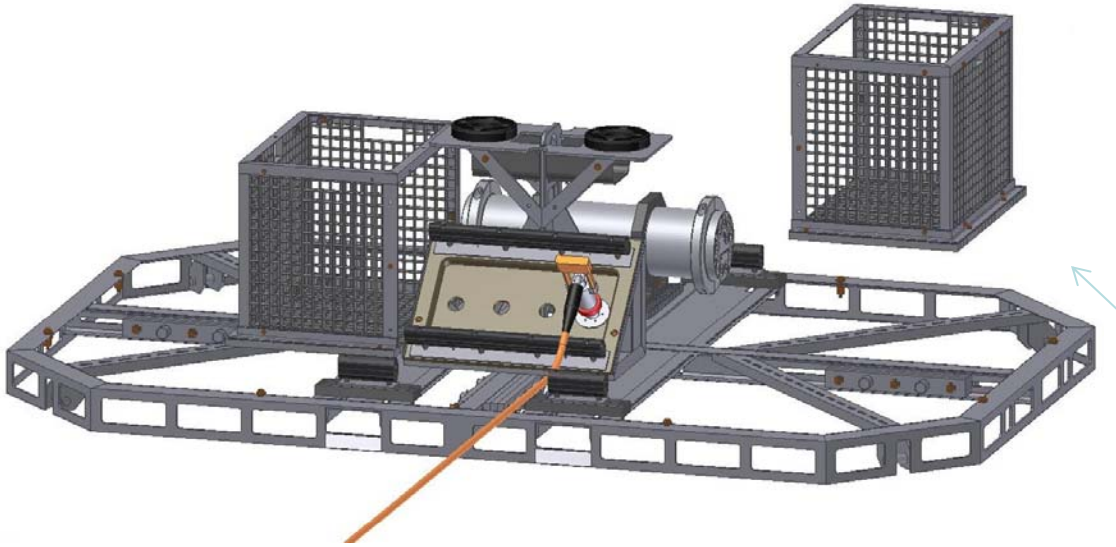
- Surface fluxes (bulk and direct covariance)
- CO2 flux and in-water
- Surface wave spectra
- *Temperature*
- *Conductivity*
- *Pressure*
- *Mean currents*
- Three-axis velocities
- Dissolved oxygen
- pH
- Spectral irradiance
- Optical attenuation and absorption
- *Chlorophyll-a and CDOM fluorescence*
- *Optical backscatter*
- *Photosynthetically active radiation (PAR)*
- Nitrate
- **Bio-acoustic sonar**
- **Digital still camera**
- **Passive hydrophone**

Endurance (RSN): Benthic Experiment Package

The BEP provides a low profile (trawl resistant) mounting platform for sensors that require high power and bandwidth as well as near proximity to the seafloor.

The BEP is connected to the RSN cabled infrastructure at the Endurance Array Offshore and Shelf sites.





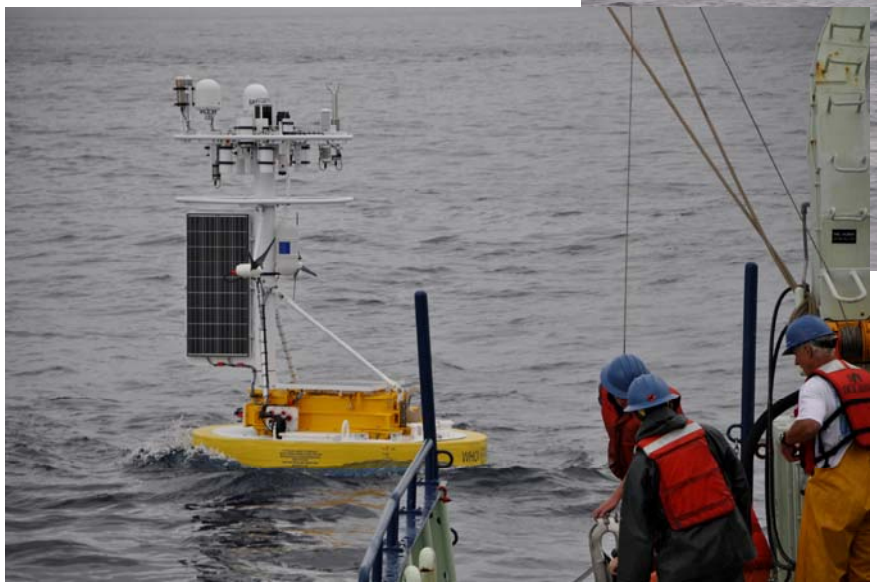
BEP Core Instruments

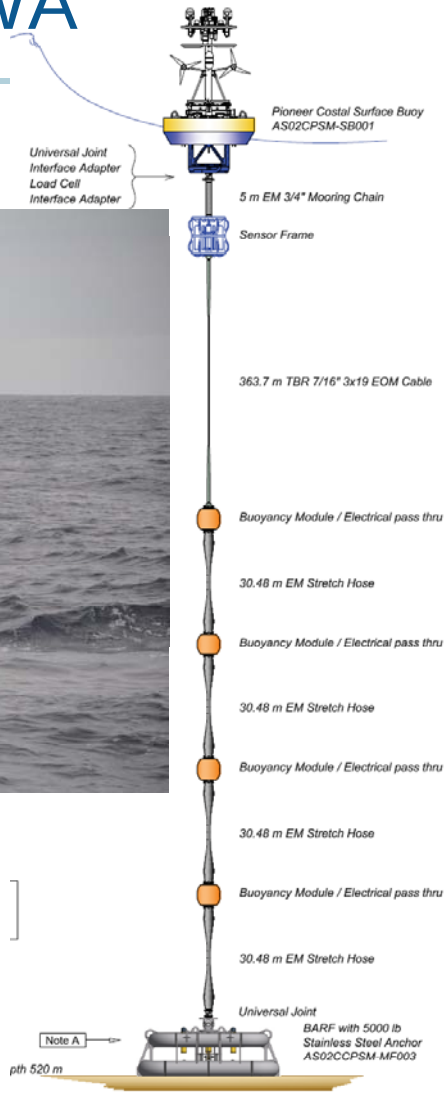
- Optical Attenuation and Absorption
- Pumped CTD w/ seafloor pressure
- Passive Broadband Hydrophone
- Dissolved Oxygen
- Water pCO_2
- pH
- 3D Single Point Current Meter
- Water Velocity Profile (ADCP)
- Zooplankton Sonar*
- Digital Camera with Strobe*

*Moved off BEP due to science and power considerations respectively, but part of cabled Endurance core instruments

Coastal Mooring deployed off OR and WA

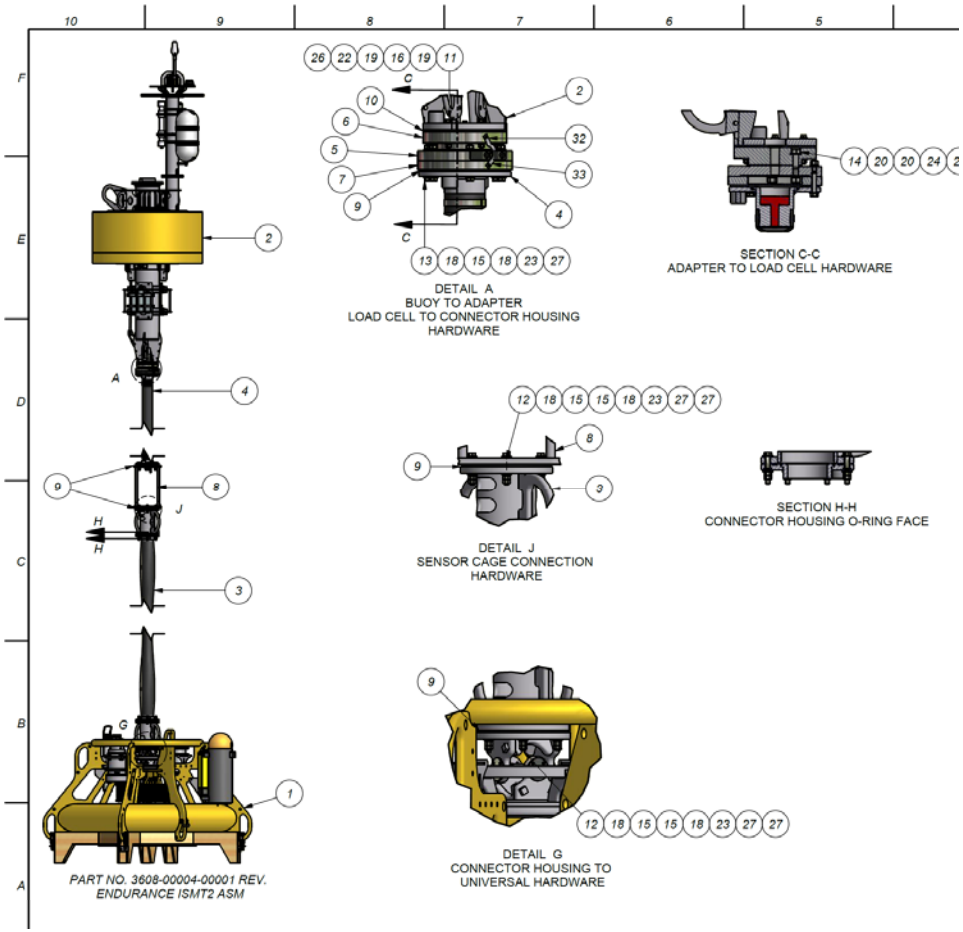
- Deployed in 80 and 500-600 m water depths
- OR moorings deployed over cabled array



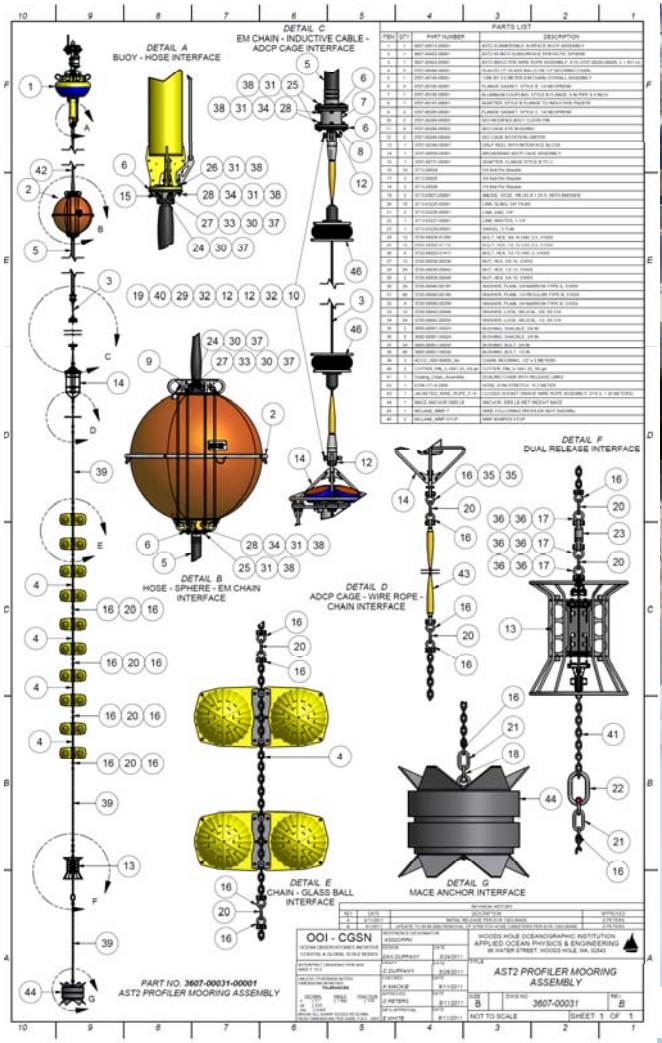


Inshore mooring (prototype shown)

- Deployed in 25 m water depth off Newport, OR and Grays Harbor, WA
- Design based on similar moorings deployed off the east coast for right whale hazard
- Surface buoy with electrical-mechanical connection to seabed
- Stretch hose allows mooring to respond to wave motion



Coastal Wire Following Profiler Mooring: deployed off WA at 500 m site



PFMC talk
March 6, 2013

Coastal Winched Profilers

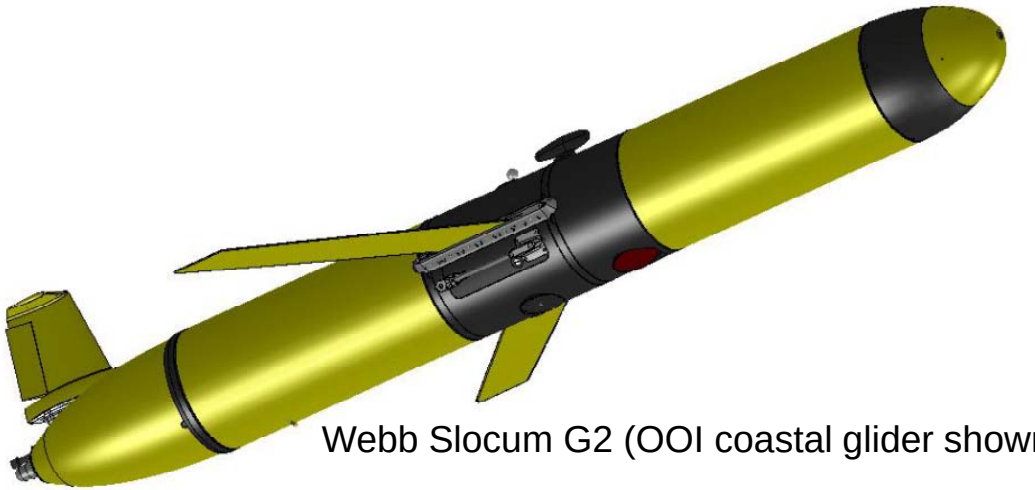
WET Labs Autonomous Moored Profiler (AMP)

- Deployed off OR and WA at 25 m and 80 m depth sites
- Small winched body raised to surface every 6-12 hours

Endurance Array gliders

Coastal gliders will be used to resolve mesoscale features over the shelf and slope between and afield from fixed platforms the Endurance (northeast Pacific) array.

Gliders will be deployed up and down the coast in 5 cross-shore lines and 1 offshore line



Webb Slocum G2 (OOI coastal glider shown)

•The gliders are configurations of the Teledyne Webb Research Slocum G2 glider.
• The Slocum G2 has a modular science bays and buoyancy pumps.
• Coastal gliders will be ordered with a mix of 200 m and 1000 m buoyancy pumps and an ADCP science bay.

Planned Deployment Schedule

- Summer 2013
  - cabled infrastructure (not including cabled profiler moorings)
- Fall 2013
  - OR inshore mooring (25 m water depth)
  - OR winched profiler mooring (80 m water depth)
  - Gliders
- Spring 2014
  - WA wire following profiler (500 m water depth)
  - WA inshore mooring (25 m water depth)
- Summer 2014
  - Remaining cabled infrastructure
- Fall 2014
  - Remaining uncabled moorings (WA 80, 500 m; OR 80, 500 m)
  - Remaining winched profilers (WA 25, 80 m; OR 25 m)

Videos

- BEP Deployment/ISMT2 recovery (Aug 2011)
- Development testing
- Evaluate the BEP hardware
- Understand the forces on the BEP as we deployed and recovered

Videos

- ISMT2 deployment (March 2011)
- Developmental testing
  - Understand the real versus predicted mooring response to wave motion
  - Evaluate deployment and recovery process
  - Evaluate burial/scouring in the near shore zone

Videos

- Coastal glider testing (Nov 2011 – Jan 2012)
- Requirements testing
  - Making sure what we are buying meets the ambitious specifications (mission endurance, speed, instrument integration etc.)
- Evaluate and practice our own deployment and recovery, data handling procedures etc.