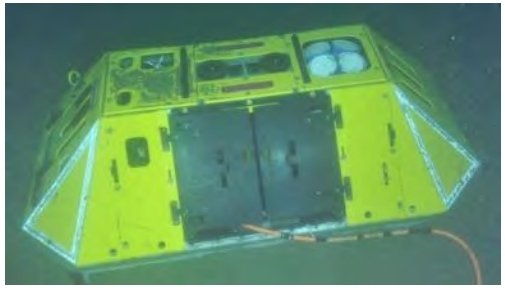
Ocean Observatories Initiative

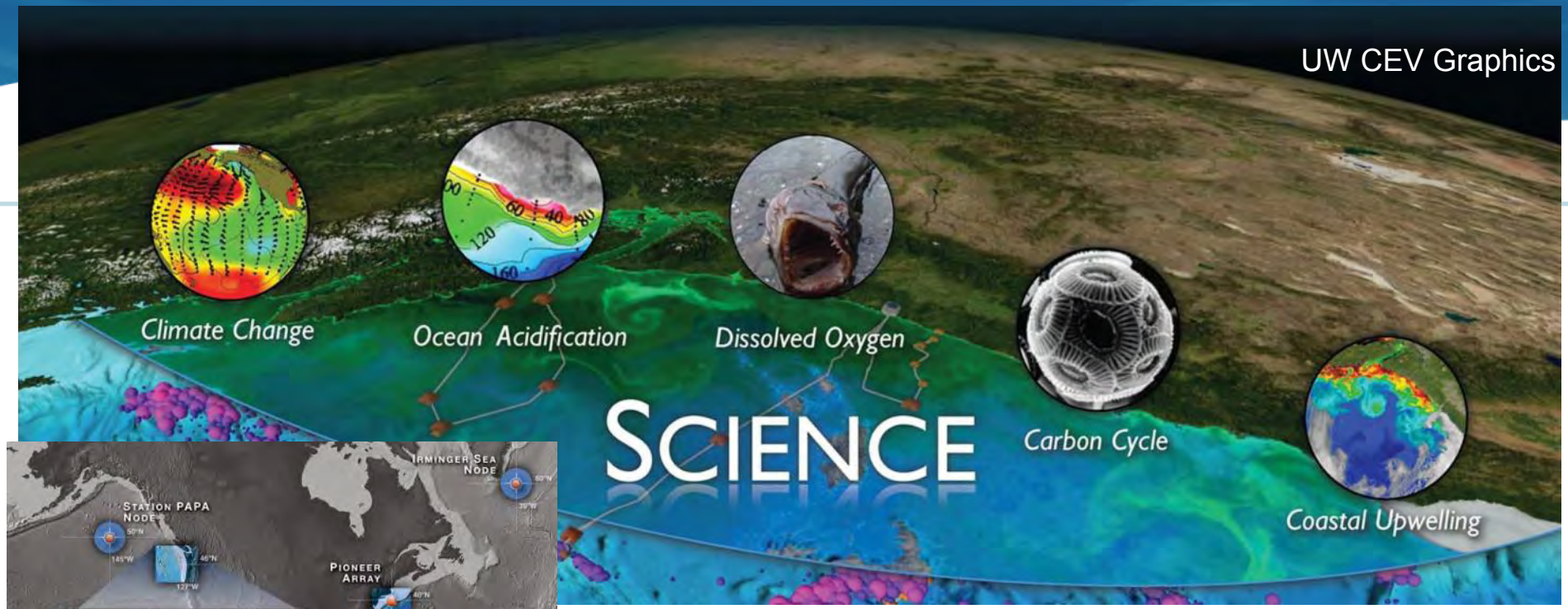


The Endurance Array

Jack Barth (Project Scientist), **Ed Dever** (Project Manager/Principal Investigator), Jon Fram (Systems Engineer), Bob Collier (former Project Manager/Principal Investigator, cyberinfrastructure), Tom Kearney (Operations and Management)

Chris Wingard, Craig Risien, Linda Fayler, Walt Waldorf, Tully Rohrer, Stuart Pearce, David Neiman, Russ Desiderio, Kent Fletcher, Jeff Woods, Ian Black

… in collaboration with our WHOI (buoys, design, etc.), UW (cabled infrastructure: Deb Kelley, **Orest Kawka**) and Rutgers/Raytheon (cyberinfrastructure) colleagues



A1 Global Biogeochemistry and Carbon Cycling

A2 Ocean-Atmosphere Exchange

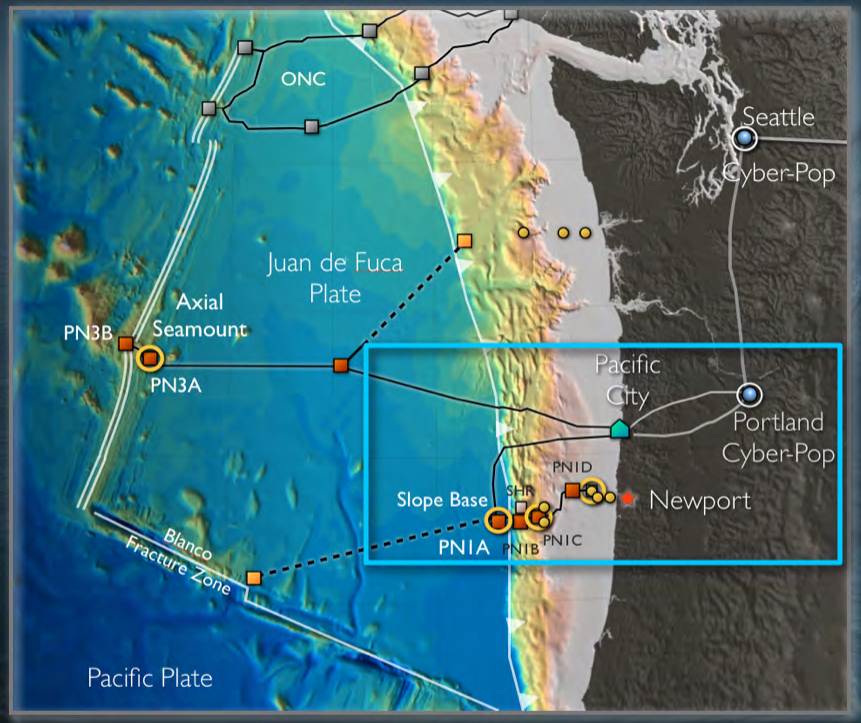
A3 Ocean Circulation, Mixing and Ecosystems

A7 Climate Variability and Ecosystems

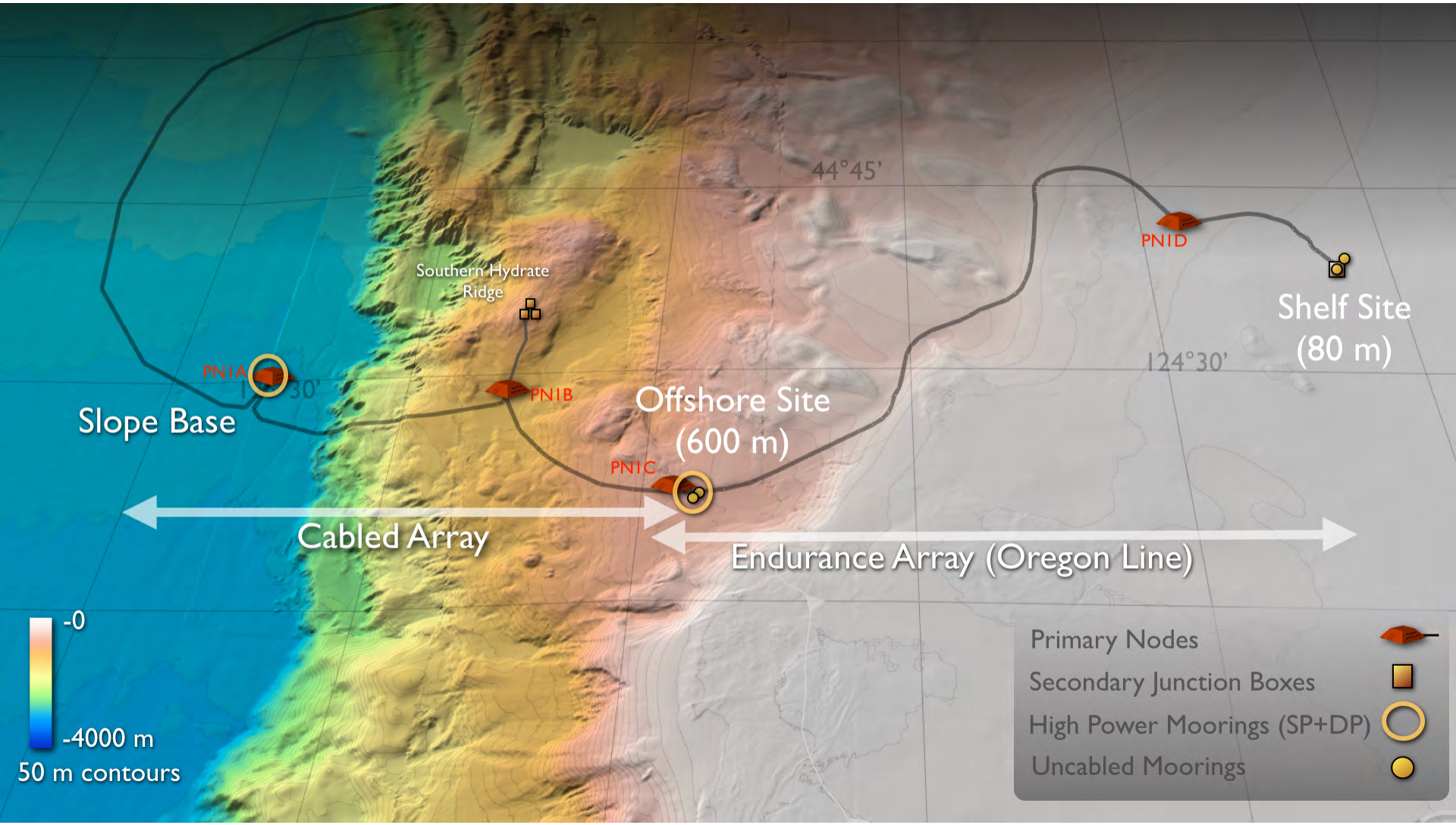
A9 Coastal Ocean Dynamics and Ecosystems - Hypoxia on Continental Shelves

A10 Coastal Ocean Dynamics and Ecosystems Shelf/Slope Exchange.

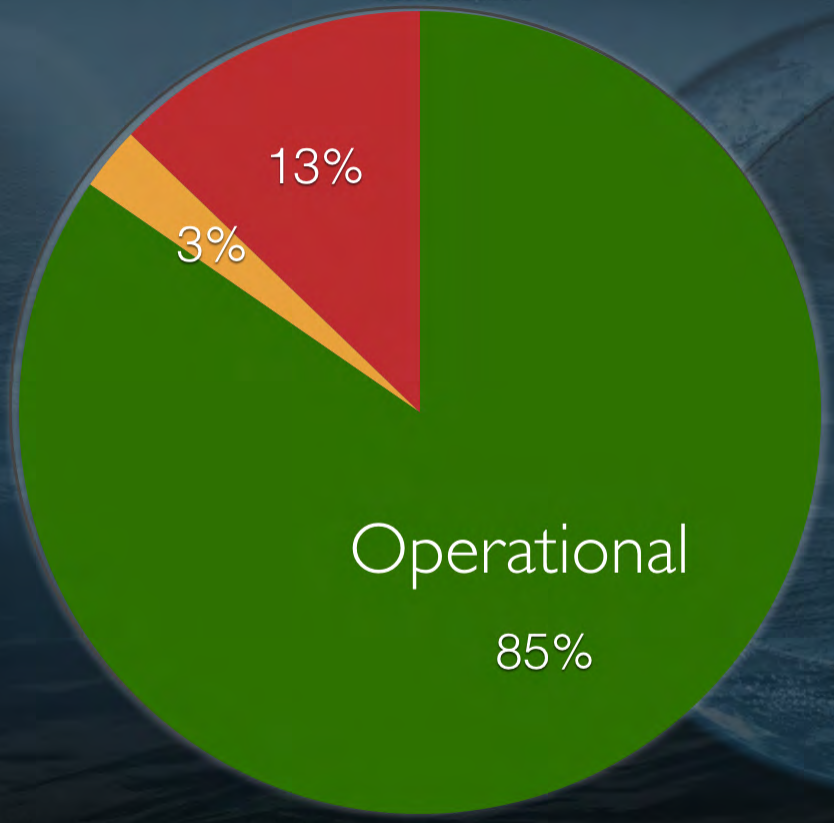
Cabled Array and Endurance Coastal Array



- Monitoring offshore seismic activity - Cascadia Subduction Zone: **Expand for early warning detection system**
- Hypoxia (low oxygen waters) events and ocean acidification
- Methane seeps and novel microbial communities
- Climate change & biogeochemical processes


44°45'
124°30'
PN1A
PN1B
PN1C
PN1D
Southern Hydrate Ridge
Slope Base
Offshore Site (600 m)
Shelf Site (80 m)
Cabled Array
Endurance Array (Oregon Line)
-0
-4000 m
50 m contours
Primary Nodes
Secondary Junction Boxes
High Power Moorings (SP+DP)
Uncabled Moorings

Cabled Endurance Array Operational Status Dec 2, 2015



- Operational (Full or Partial)
- Troubleshooting - 1
- Failed* - 5

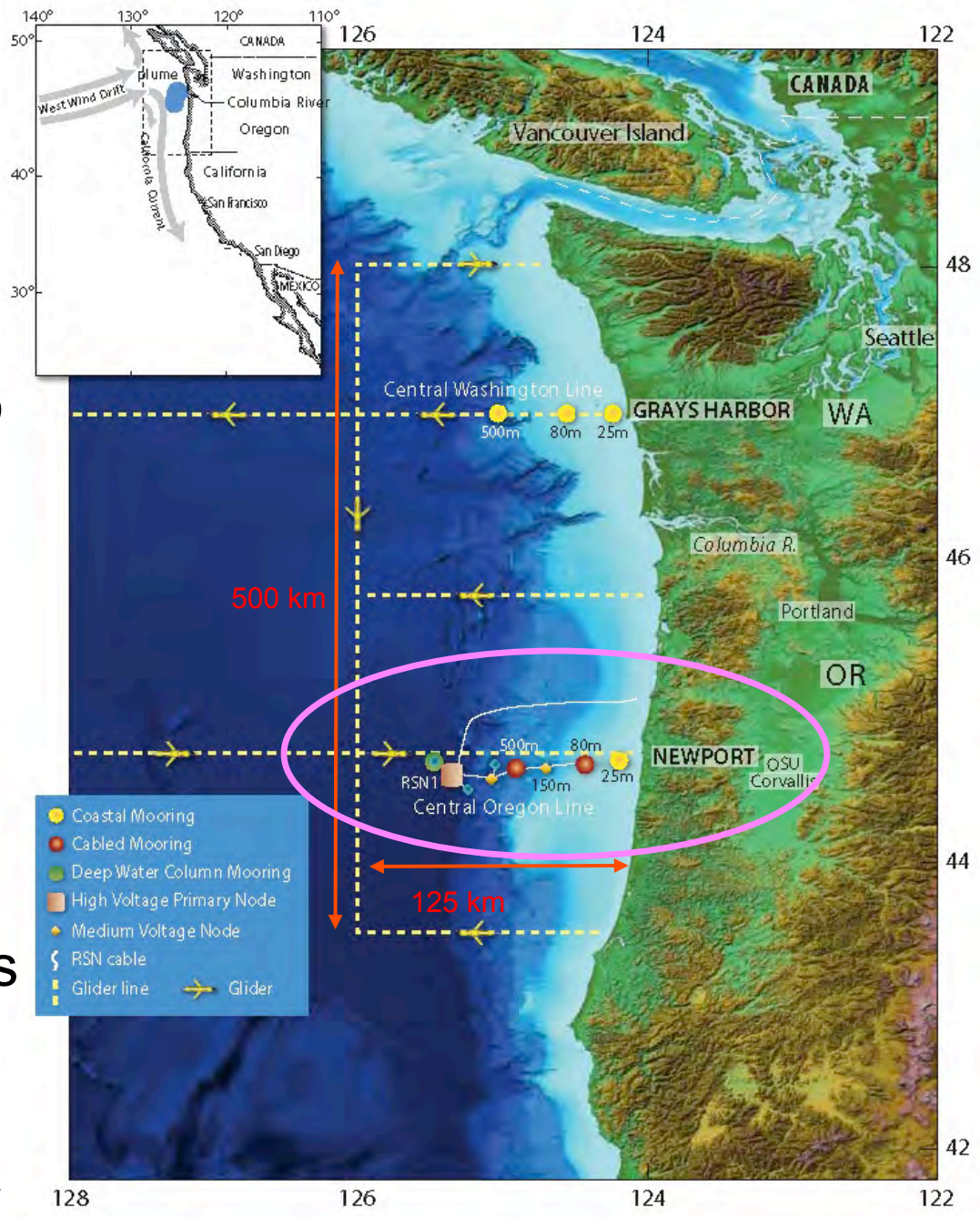
*Excludes Coastal Surface Piercing Profiler (CSPP)

All data are streaming live to shore

39 Total Instruments, 19 types

Endurance Array

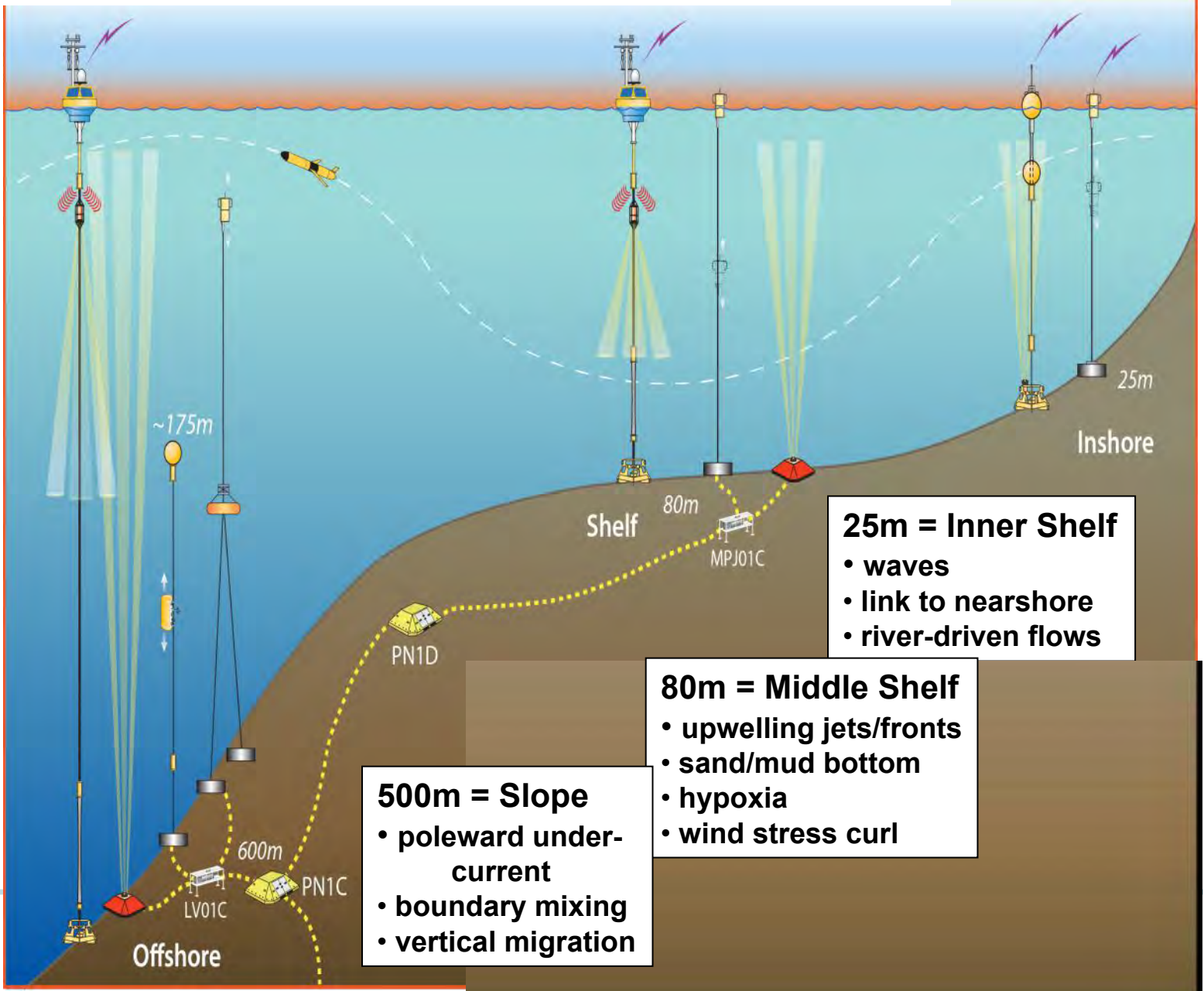
- Cross-shelf mooring lines at Newport and Grays Harbor (N & S of Columbia River)
- Oregon Line connected to the Cabled Array
- 6 deployed gliders year-round
- 20 platforms:
  - EA ~240 sensors
  - Cabled EA 39 sensors
- Locations chosen based on existing long-term data



Endurance Array: Oregon Line

As designed:

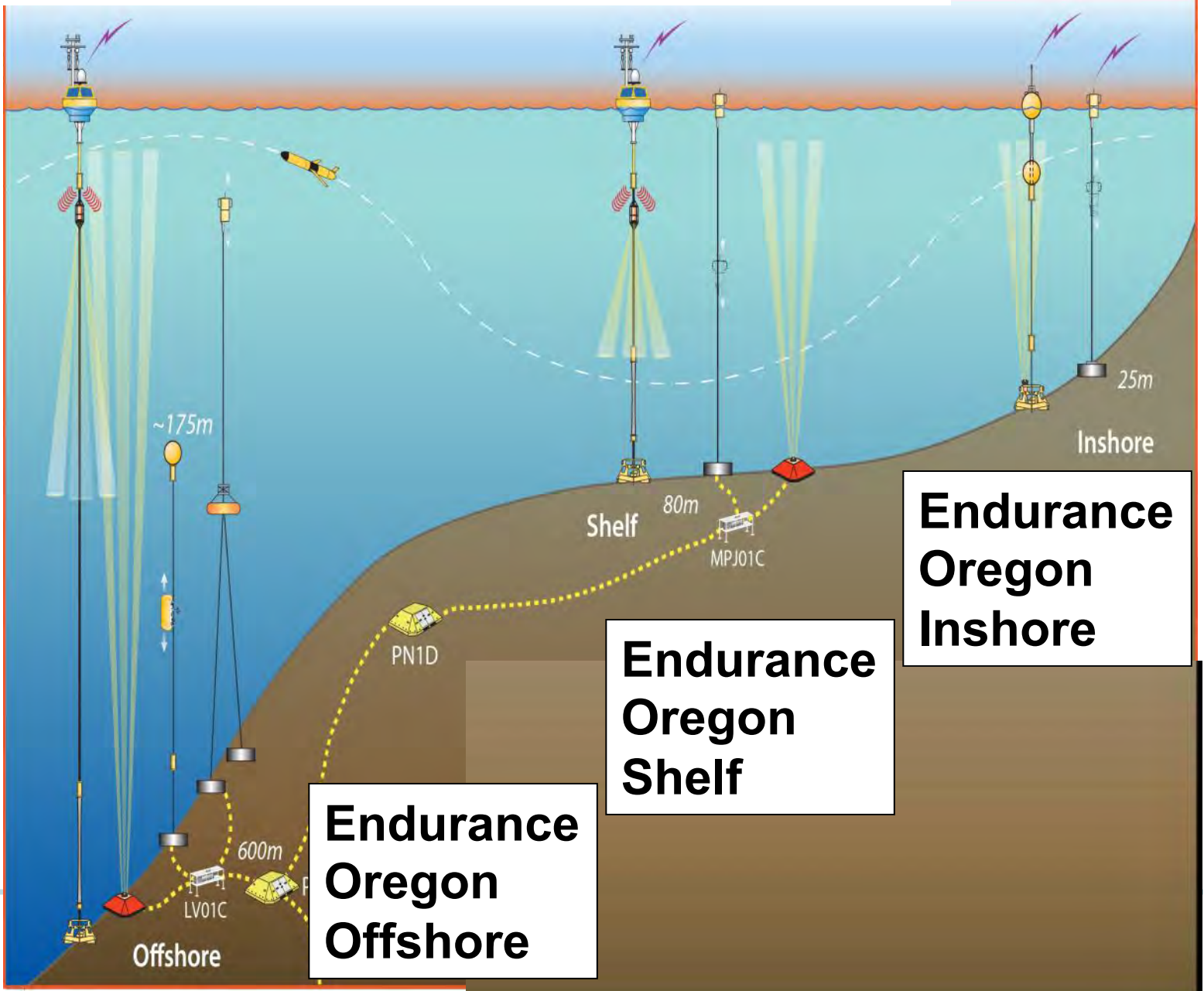
- Full water column
- Cross-shelf resolution
- High power, high bandwidth via cable to 80 & 500m
- Benthic platforms



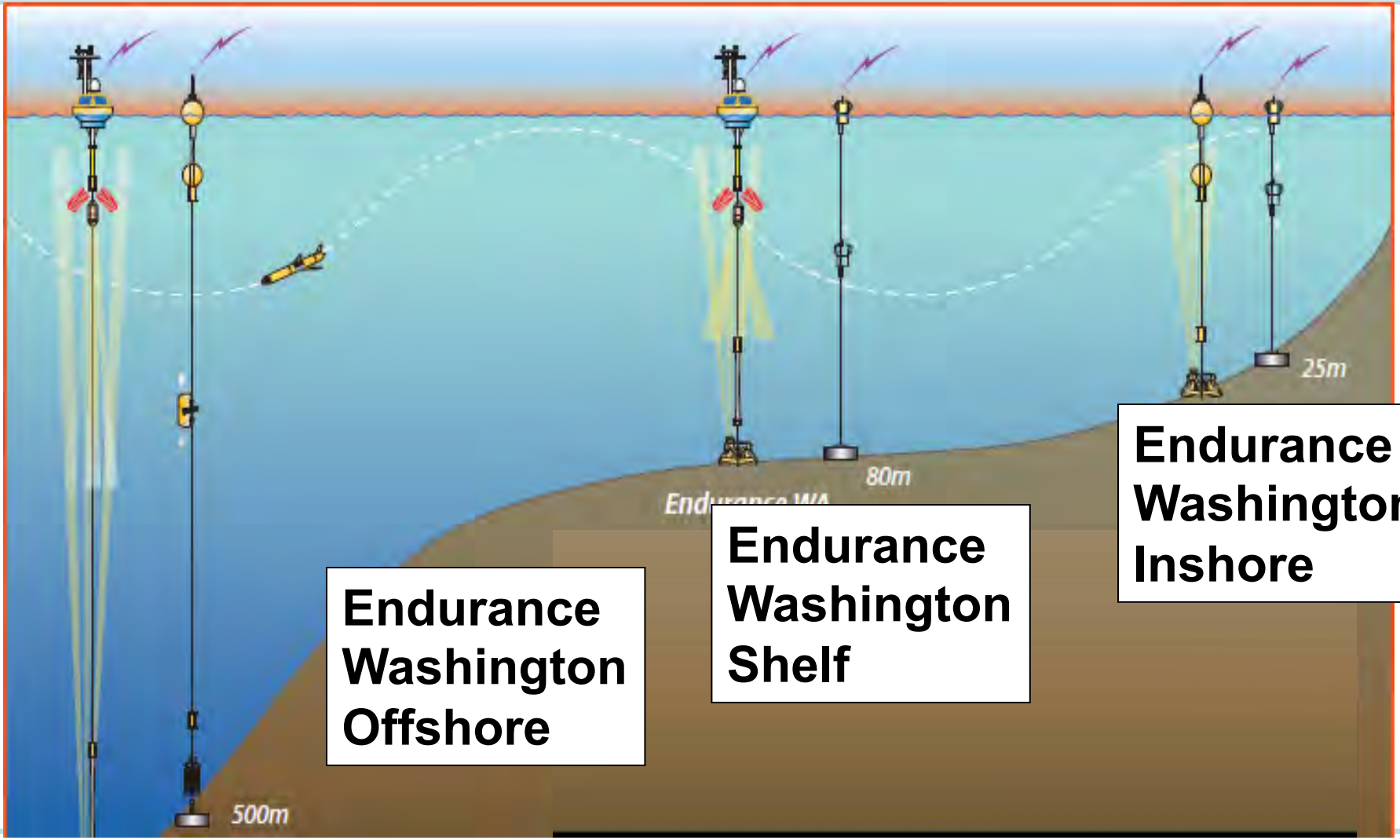
Endurance Array: Oregon Line

As designed:

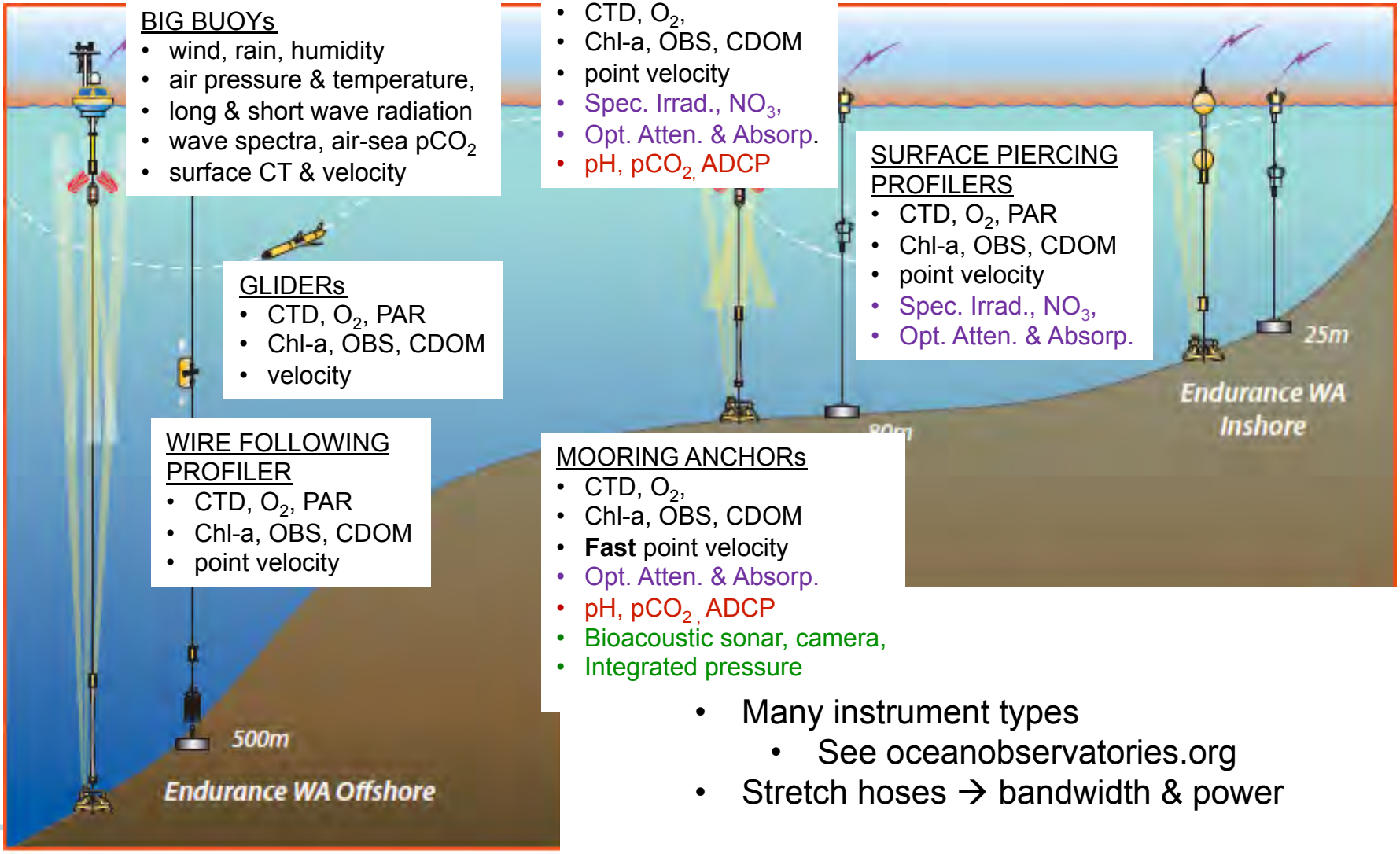
- Full water column
- Cross-shelf resolution
- High power, high bandwidth via cable to 80 & 500m
- Benthic platforms



Endurance Array: Washington Line



Endurance Array: Washington Line



BIG BUOYs
- wind, rain, humidity
- air pressure & temperature,
- long & short wave radiation
- wave spectra, air-sea pCO_2
- surface CT & velocity

7m on MOORINGs
- CTD, O_2,
- Chl-a, OBS, CDOM
- point velocity
- Spec. Irrad., NO_3,
- Opt. Atten. & Absorp.
- pH, pCO_2, ADCP

SURFACE PIERCING PROFILERS
- CTD, O_2, PAR
- Chl-a, OBS, CDOM
- point velocity
- Spec. Irrad., NO_3,
- Opt. Atten. & Absorp.

GLIDERs
- CTD, O_2, PAR
- Chl-a, OBS, CDOM
- velocity

WIRE FOLLOWING PROFILER
- CTD, O_2, PAR
- Chl-a, OBS, CDOM
- point velocity

MOORING ANCHORs
- CTD, O_2,
- Chl-a, OBS, CDOM
- **Fast** point velocity
- Opt. Atten. & Absorp.
- pH, pCO_2, ADCP
- Bioacoustic sonar, camera,
- Integrated pressure

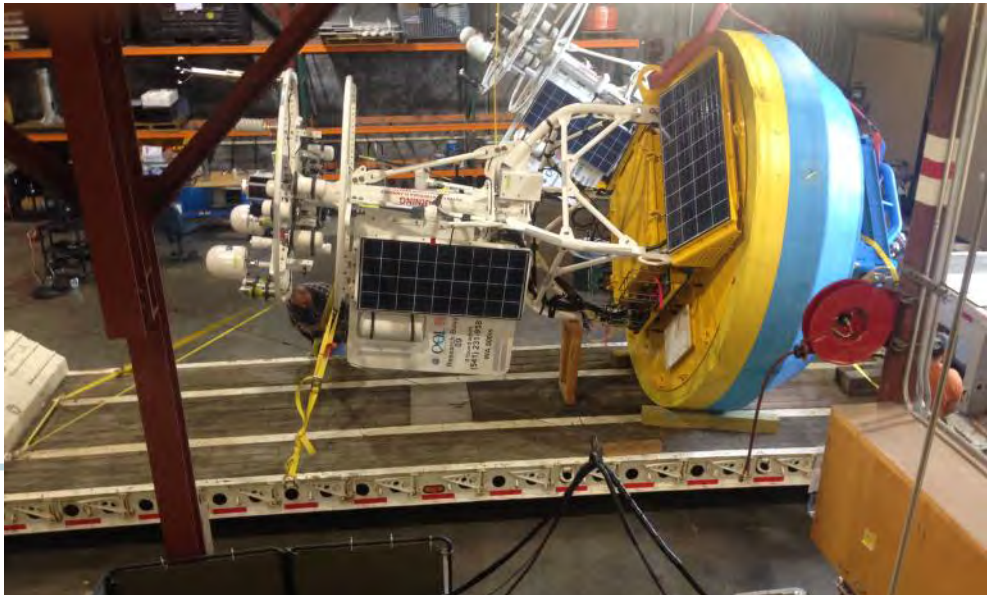
- Many instrument types
  - See oceanobservatories.org
- Stretch hoses → bandwidth & power

OOI's Timeline

- Design & Build
  - Started 1-Sep-2009
  - 5+1 year build.
- All Endurance platforms and sensors have been deployed
- Operate and Maintain

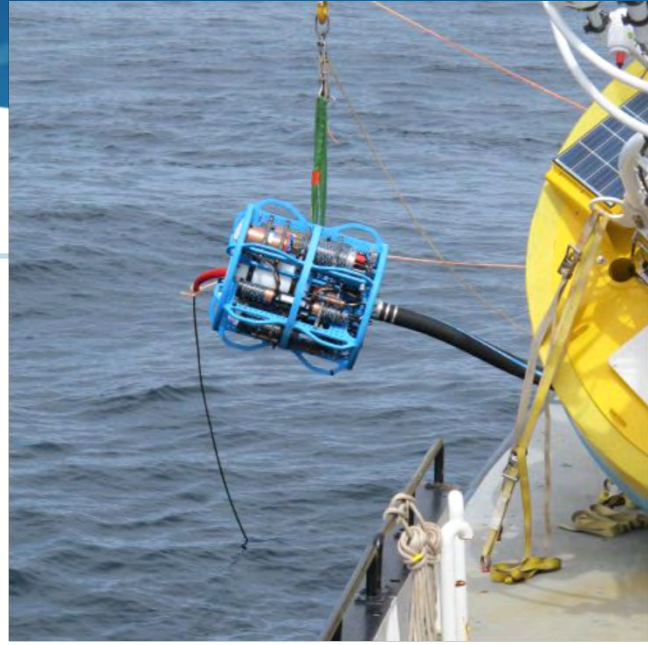
Mooring Integration
Ocean Observing Center

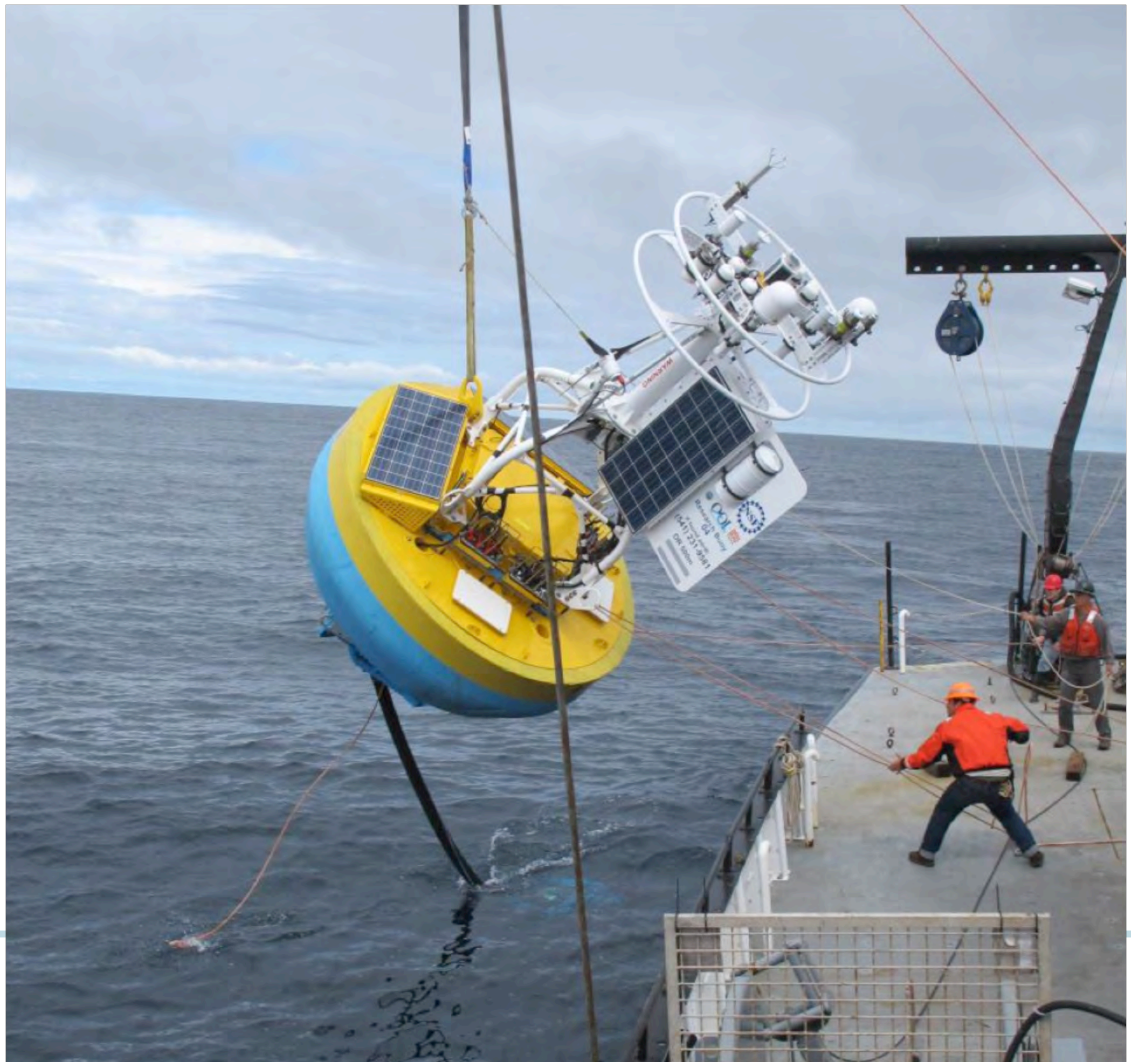
WHOI-led mooring design



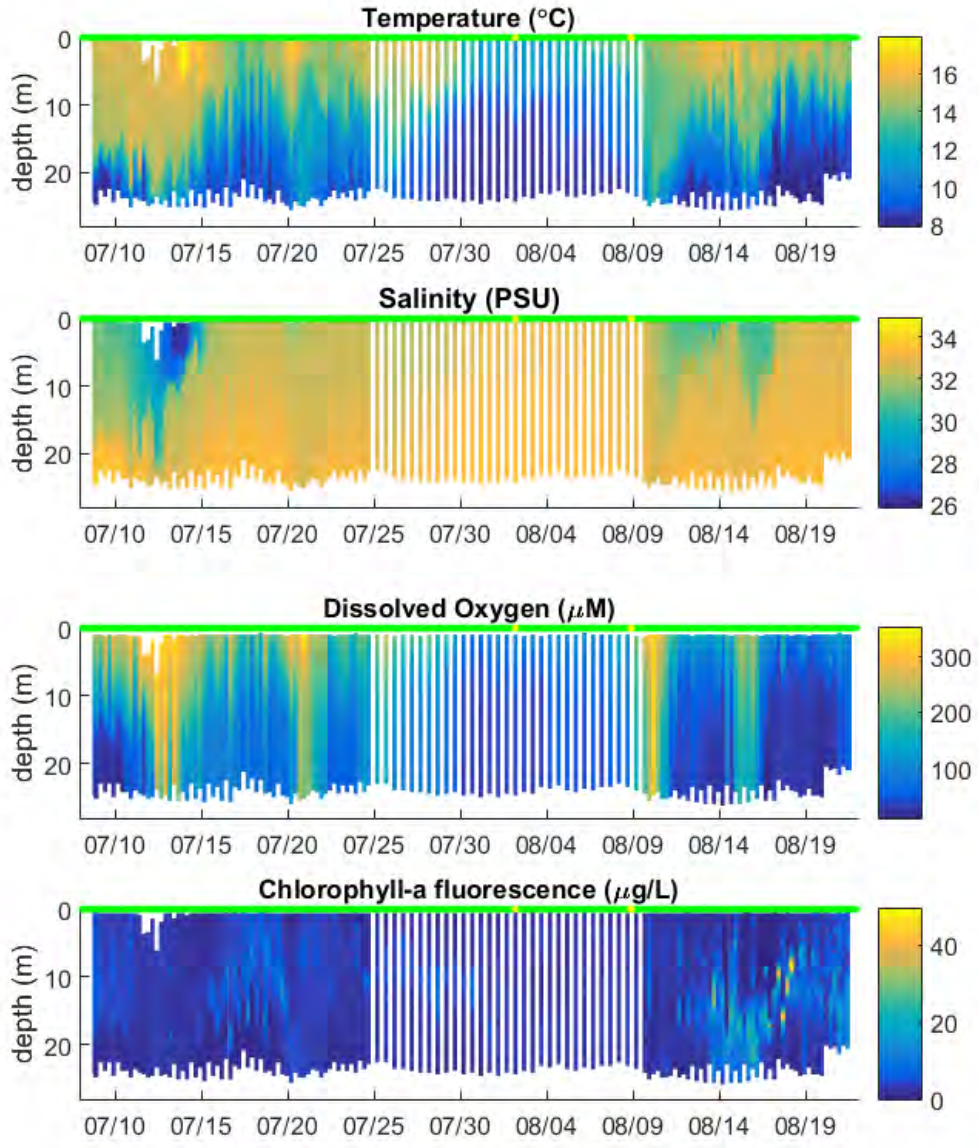
Packed Deck

Deploy



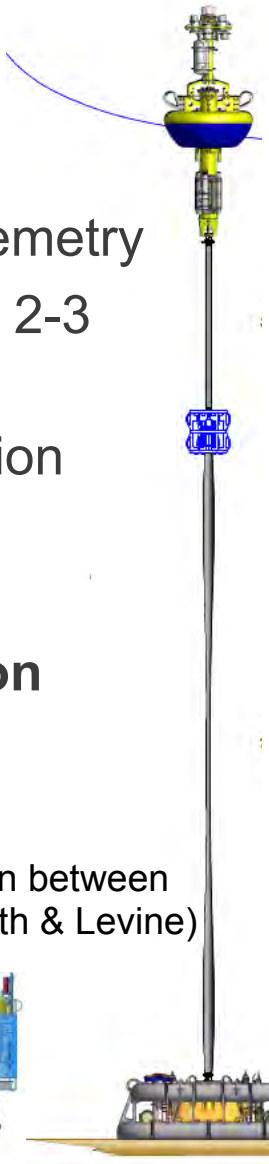


Uncabled Coastal Surface Piercing Profiler



Features

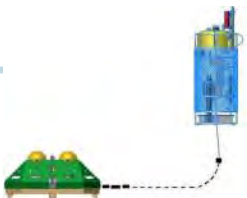
- Surface piercing
- Onboard smart winch
- Iridium & acoustic telemetry
- 3 month duration with 2-3 profiles per day
- 25 cm vertical resolution (CTD 1.5 cm)
- **Development focus: year-round operation**



Builds on results of a collaboration between WET Labs (Barnard) & OSU (Barth & Levine)

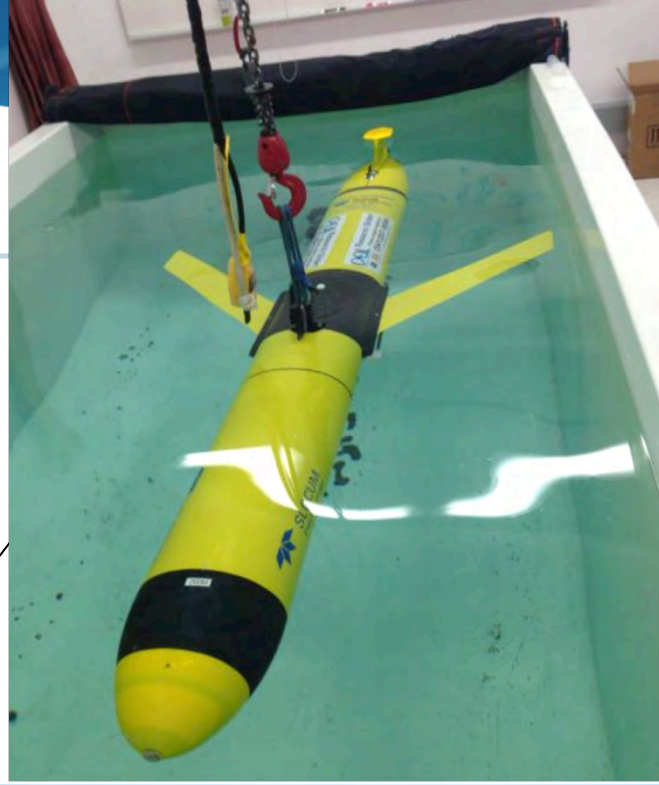
WET Labs

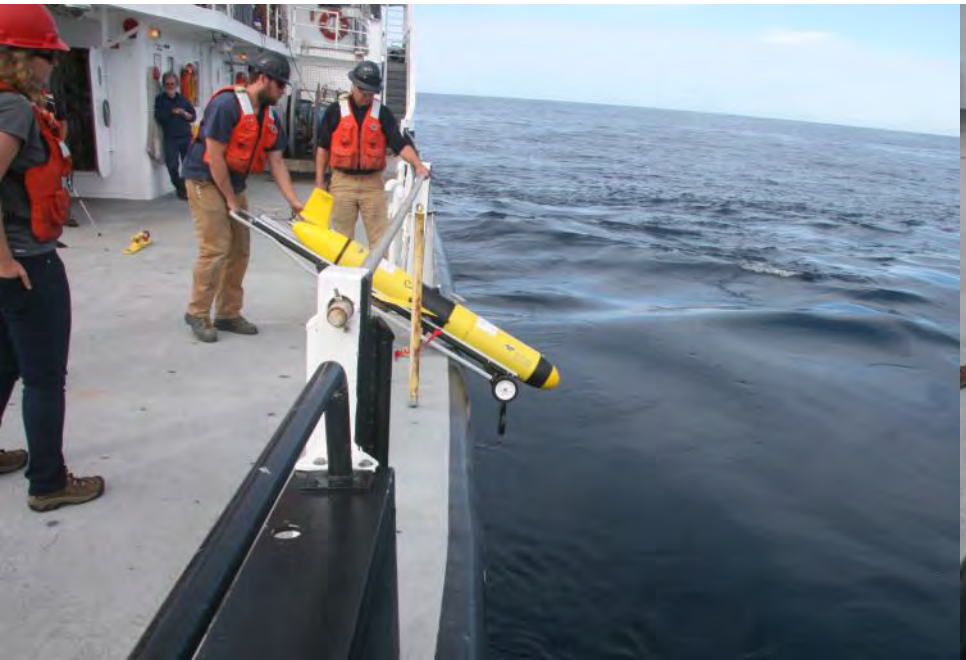
OSU Oregon State



Endurance Array Gliders

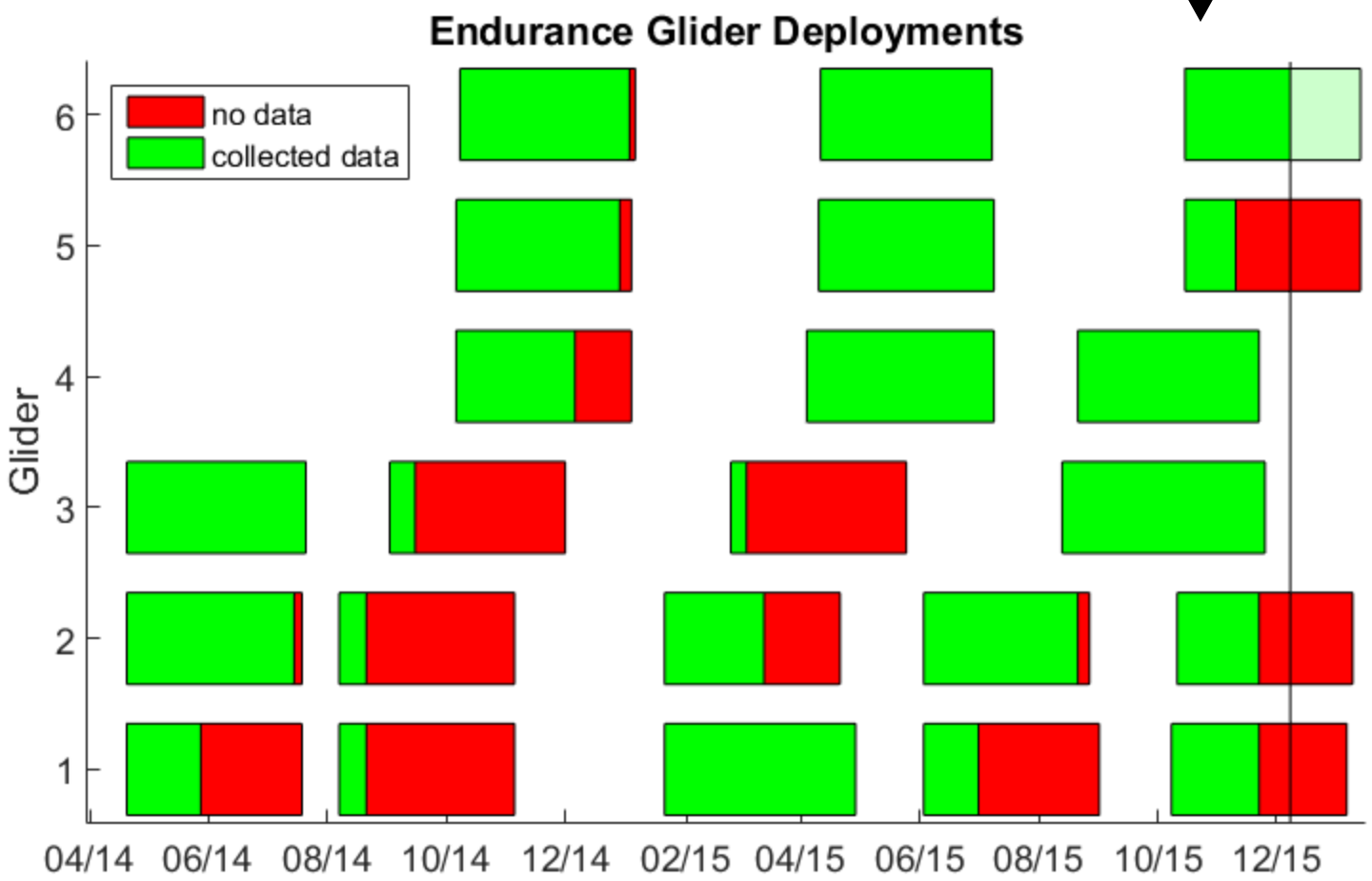
- Lithium batteries→3 month deployments
- 20 km per day
- CTD, O_2, PAR, Chl-a, OBS, CDOM, velocity



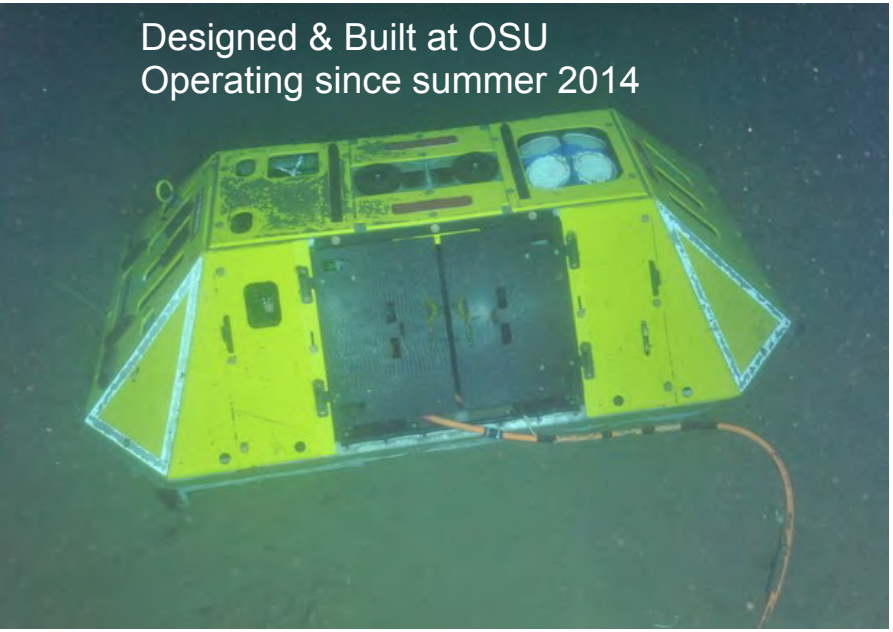


All 6 deployed!

Challenges
- weather
- Ship strike (?)
- biofouling
- refurbishment



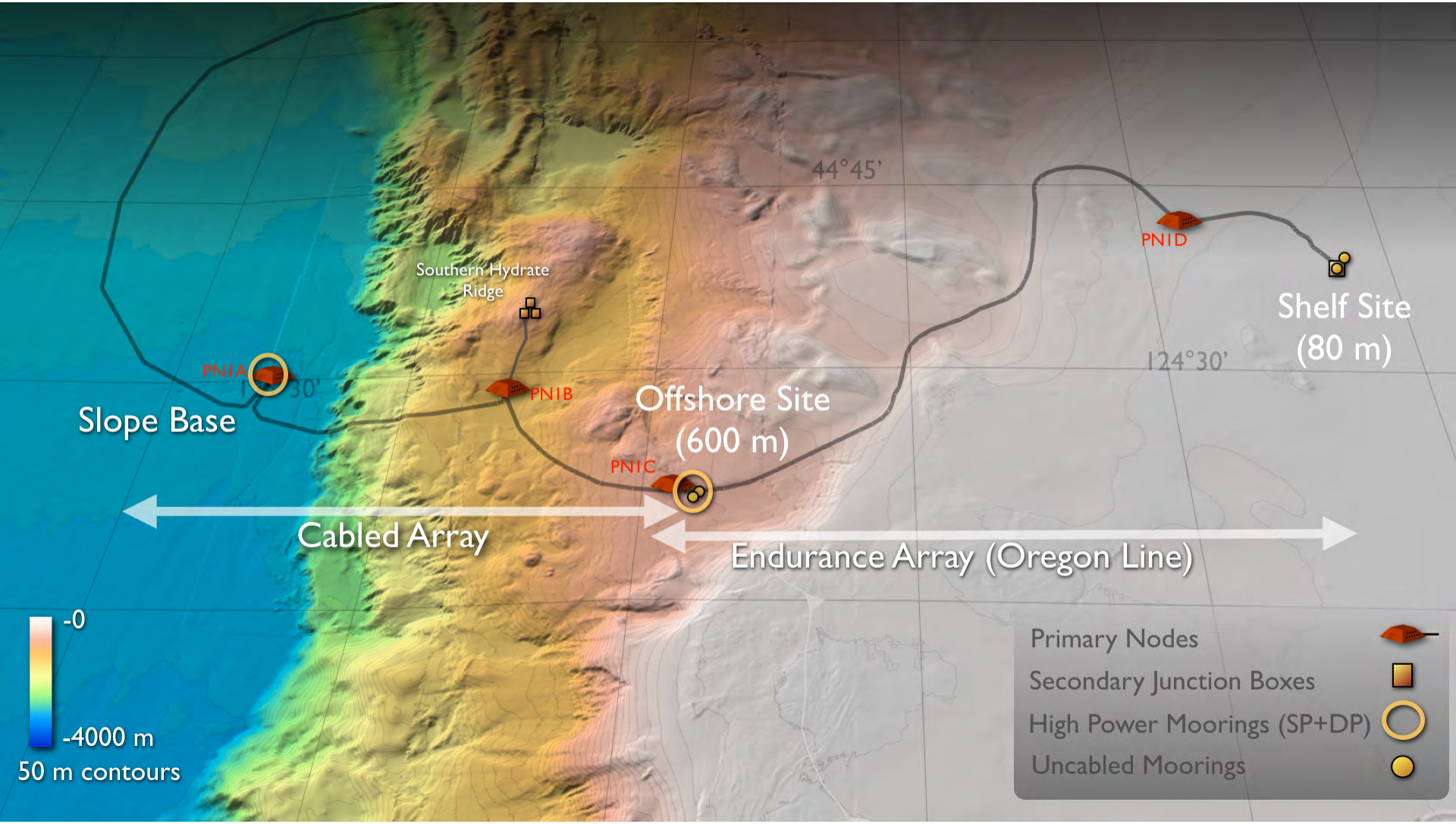
Cabled Benthic Experiment Package



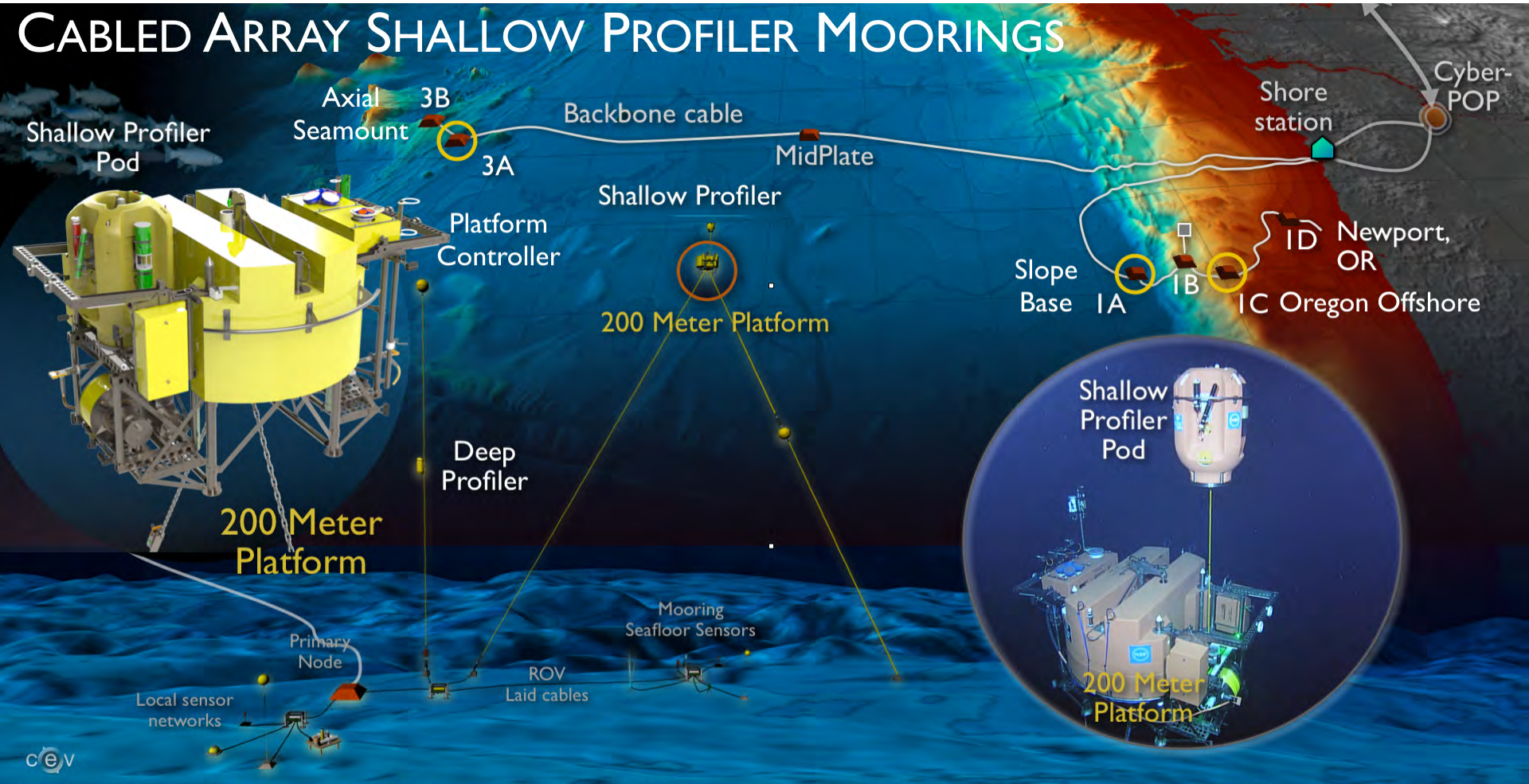

Kent Fletcher

Instruments

- CTD, O_2, pH, pCO_2,
- Chl-a, OBS, CDOM
- ADCP, fast point velocity,
- hydrophone,
- Opt. Atten. & Absorp.

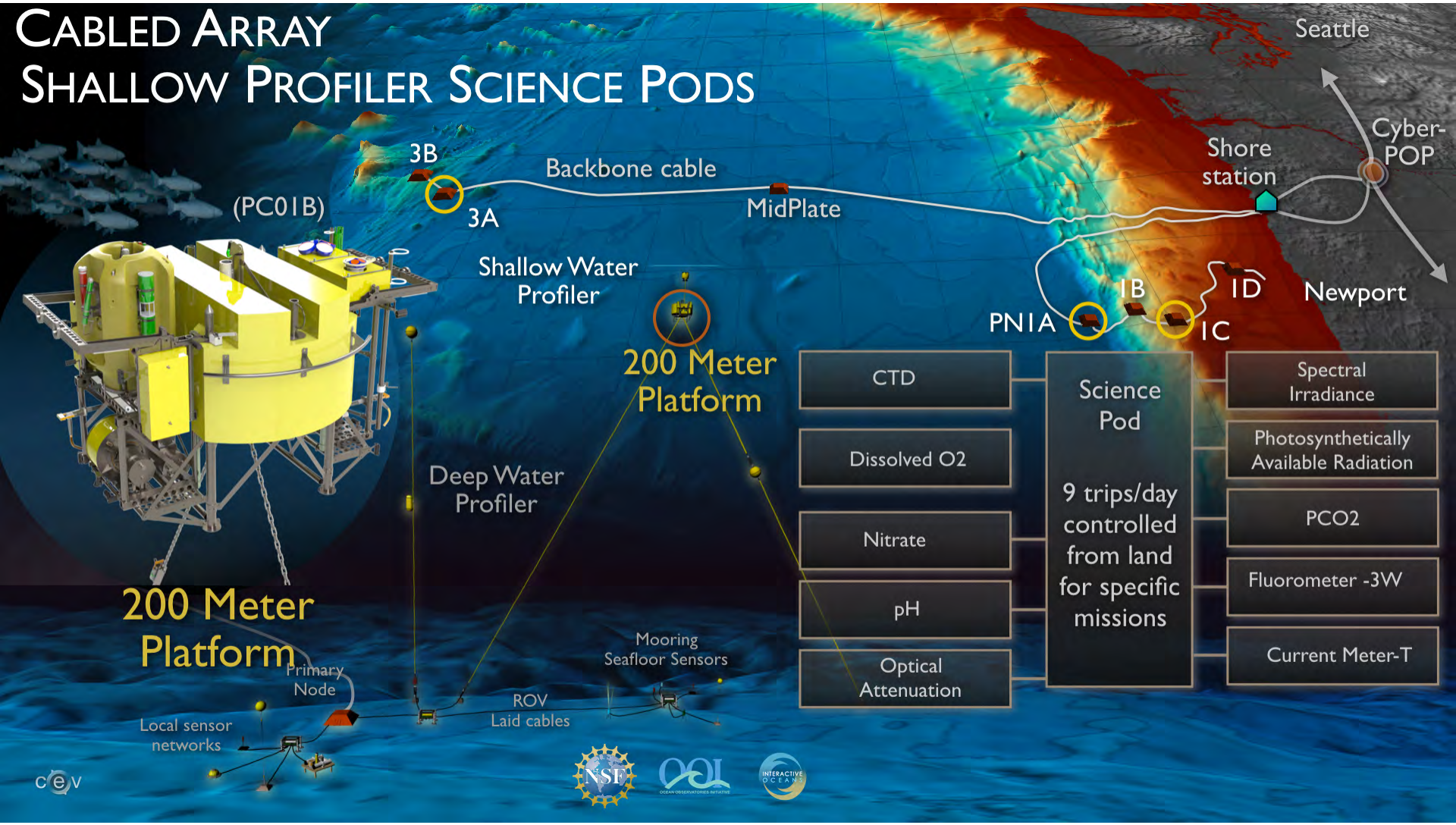

44°45'
124°30'
PN1D
Shelf Site
(80 m)
Southern Hydrate
Ridge
PN1A
PN1B
Slope Base
Offshore Site
(600 m)
PN1C
Cabled Array
Endurance Array (Oregon Line)
-0
-4000 m
50 m contours
Primary Nodes
Secondary Junction Boxes
High Power Moorings (SP+DP)
Uncabled Moorings

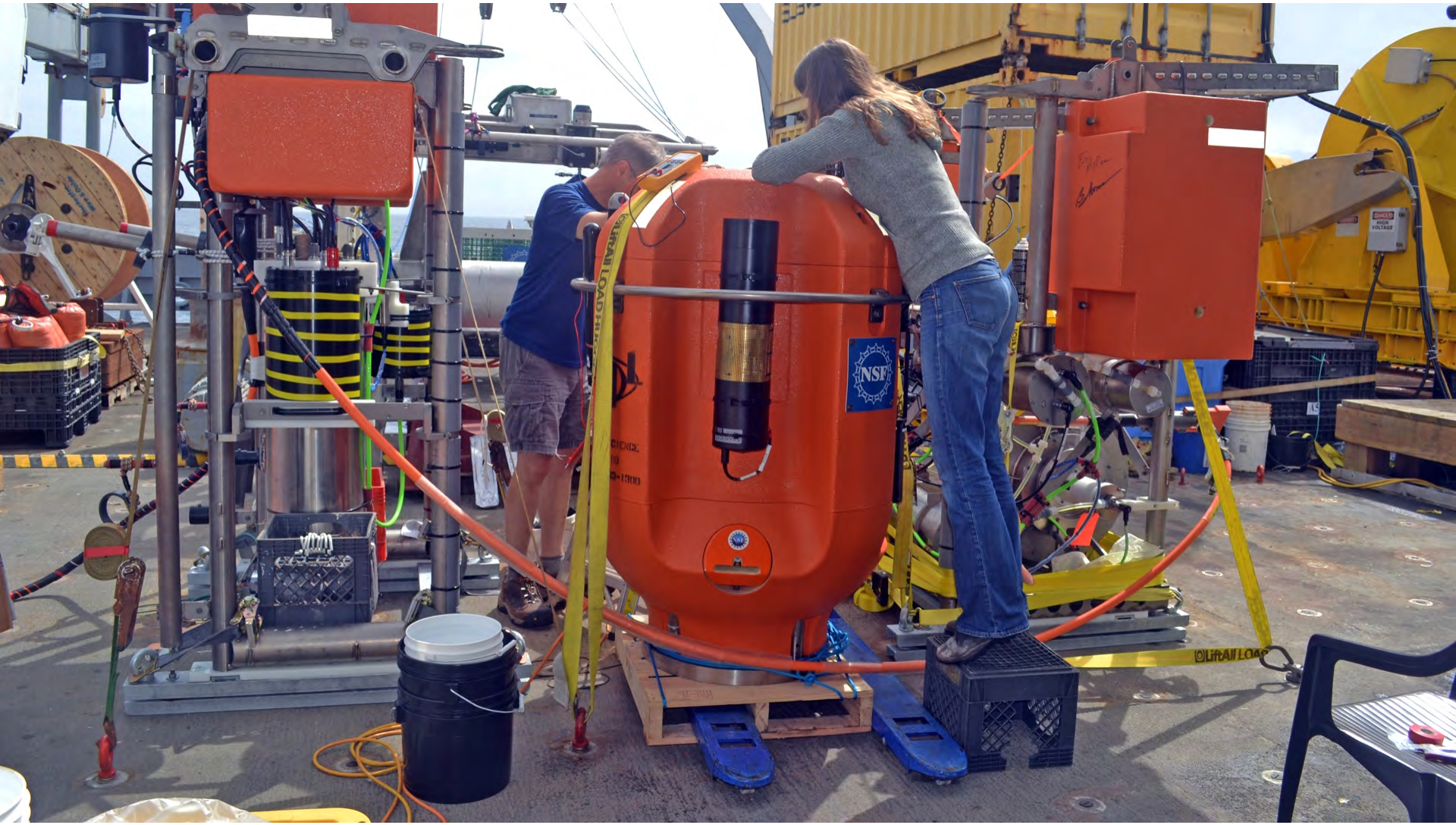
CABLED ARRAY SHALLOW PROFILER MOORINGS



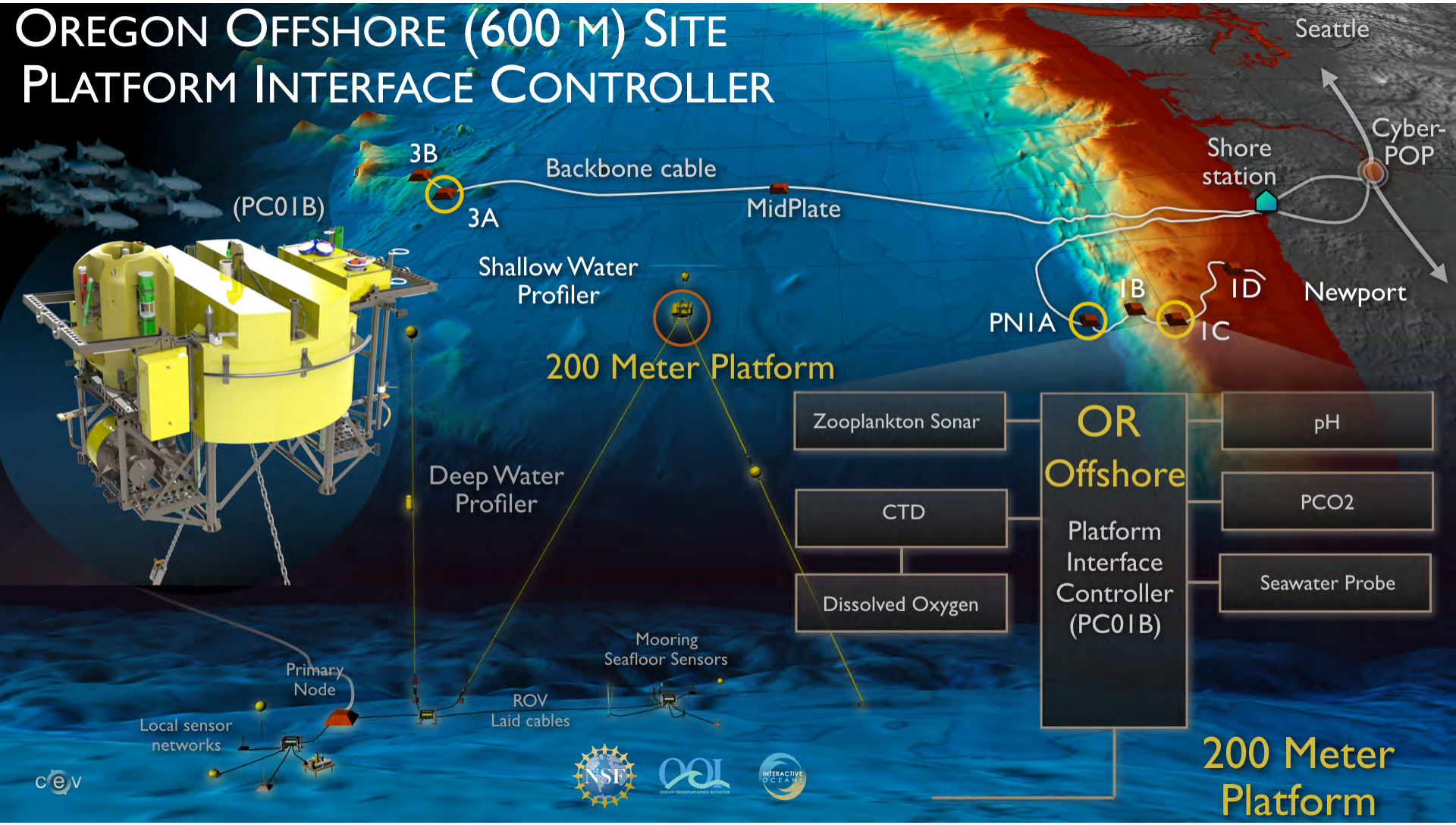
200 M DEEP PLATFORM: 12 ft across (7 ton) instrumented platform with up to 3 kW power & 1 Gbs bandwidth real-time two-way communications allow event response, highly expandable

Cabled Array Shallow Profiler Science Pods

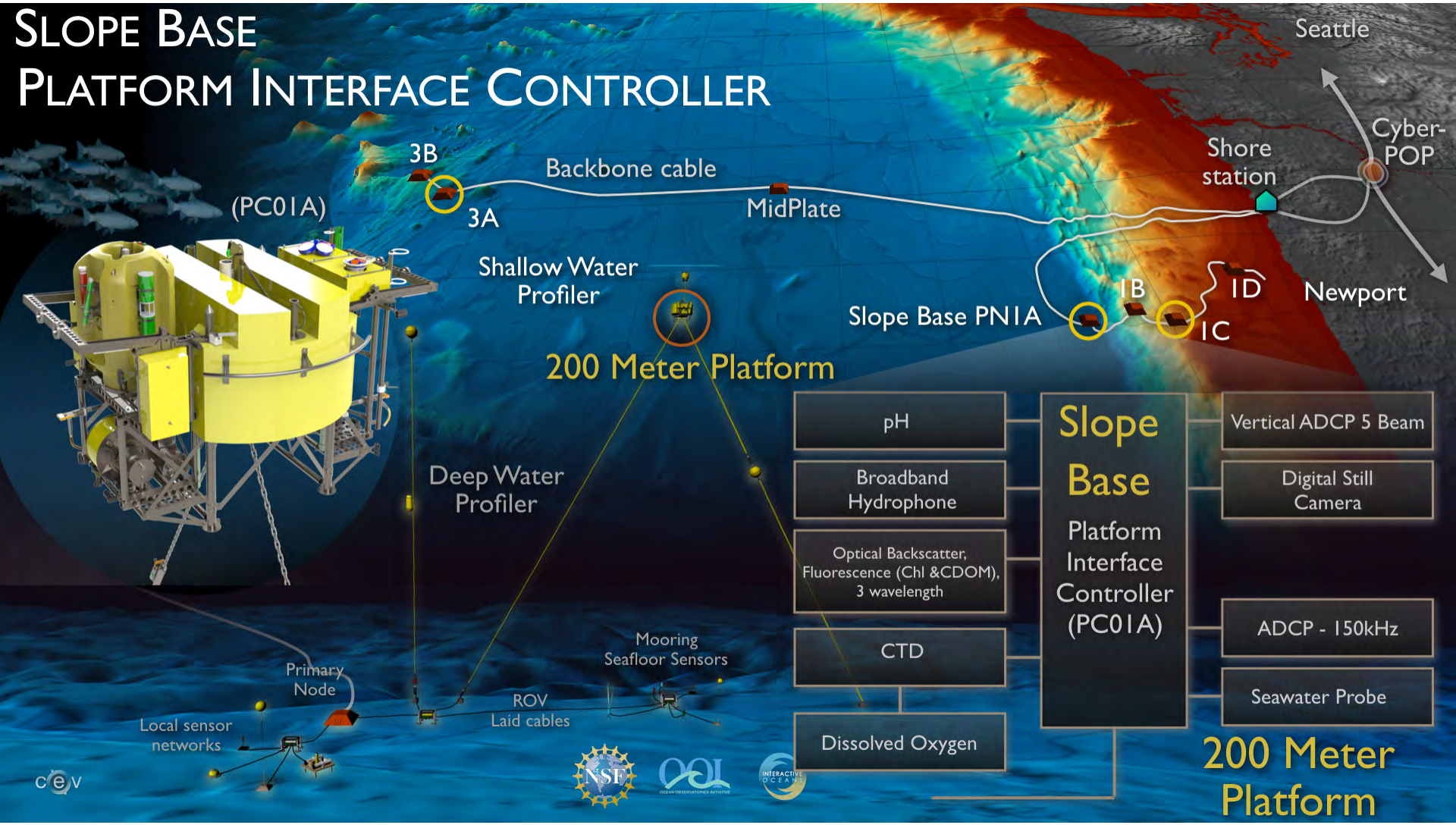



NSF
LiftAll Load

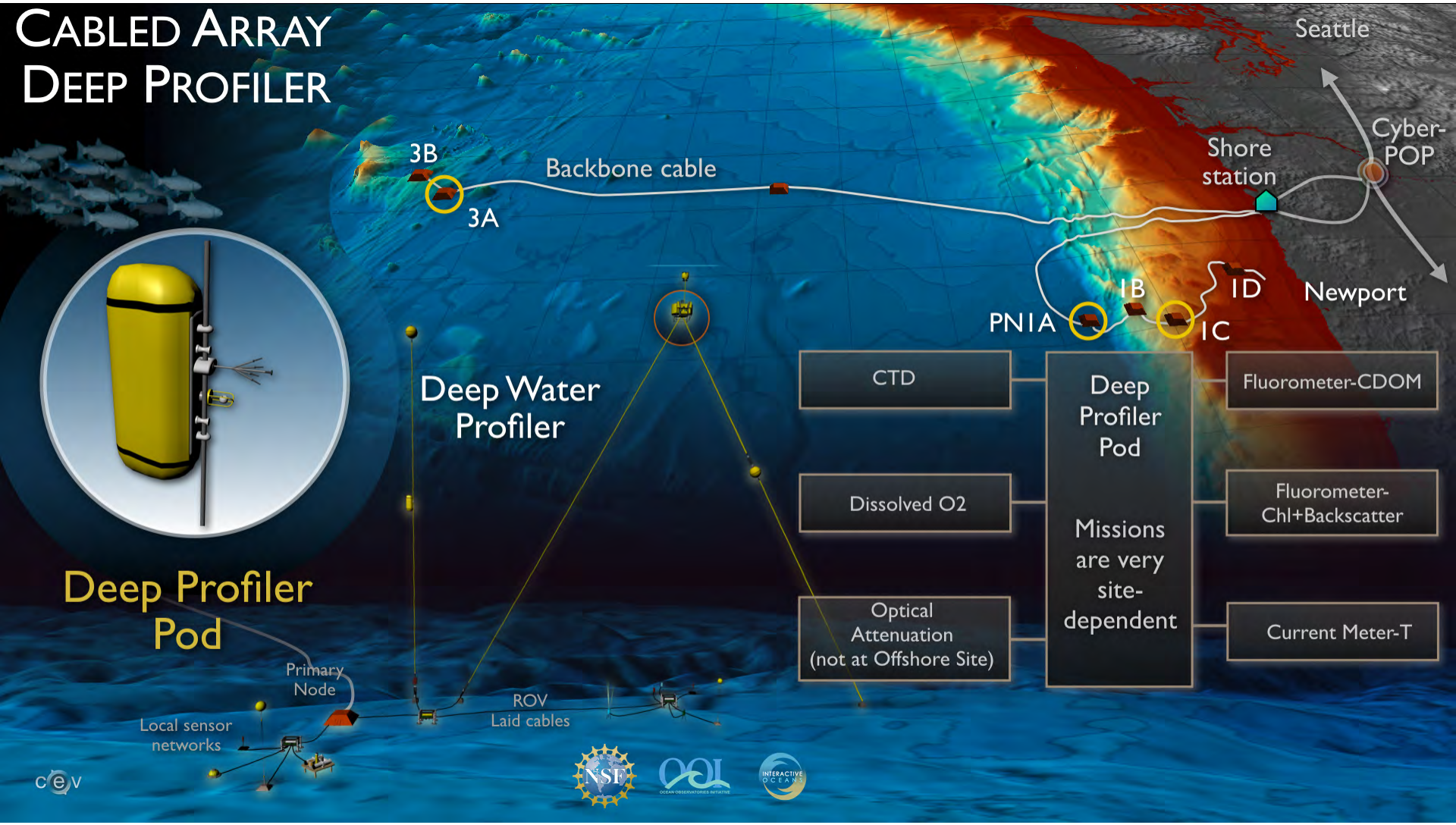
Oregon Offshore (600 m) Site Platform Interface Controller



Slope Base Platform Interface Controller



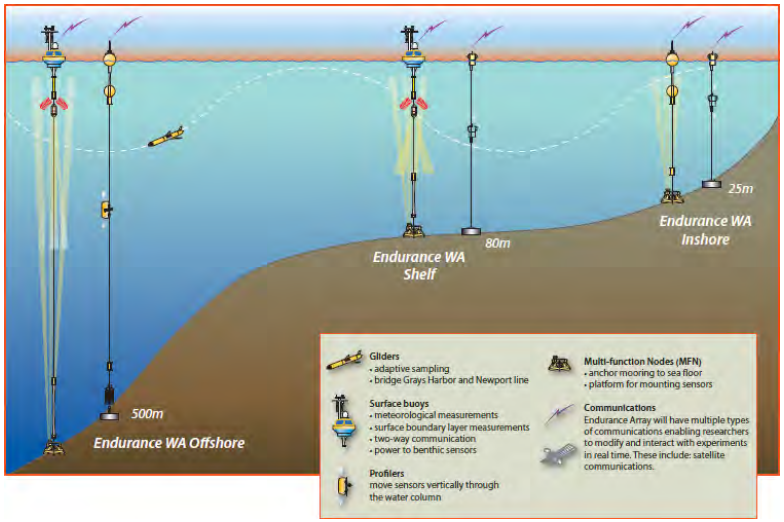
Cabled Array Deep Profiler

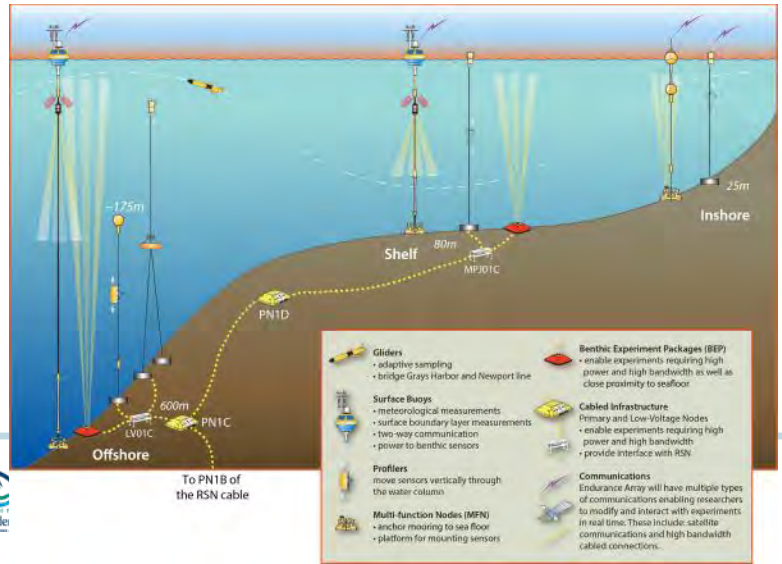


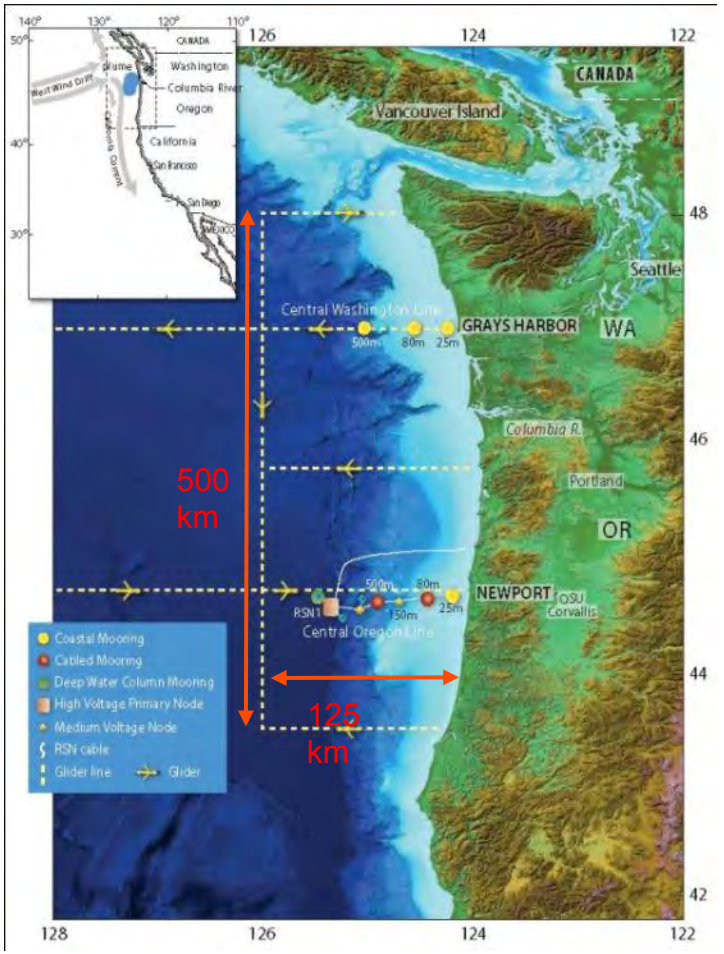

PROFILER
NSF
OCEAN OBSERVATORIES INITIATIVE
REGIONAL SCALE NODES
W
CANADI
SUBMERS

Endurance Array Summary

working hard to operate and maintain final network design







Current Ops Schedule 12/16/15

	2016											
	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Argentine Basin	Shipment	Refurb									Palmer Cruise	
55 South	Shipment											Palmer Cruise
Irminger							Armstrong Cruise					
Papa						Brown Cruise Jun-Jul						
Pioneer	-Glider Cruise	- 2/1 Quarterly Info Days			Armstrong Cruise		-Reseed gliders via Armstrong			Armstrong Cruise		
Endurance	- Ship out fm WHOI - Reseed Gliders			Thompson Cruise Apr-May			- Ship out fm WHOI - Reseed Gliders			Cruise		
RSN	-1/19 Quarterly Info Days						Sikuliaq Cruise Jul-Aug					
CI												
Software			- Build 8						- Build 9			
OL / Governance / Work Shops	-1/3-5 OOI Coastal Workshop - 1/25 NSF Review	-2/21-26 Ocean Sciences (New Orleans)	-3/9-10 Line P Workshop	- Science Self-Assessment	- OOI Workshop		- Science Plan	- OOI Workshop -NSF Review		-2017 AWP	- OOI Workshop	-12/12-16 AGU (San Francisco)