

OCEAN
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The Pioneer MAB Array

Al Plueddemann and the CGSN Team

OOIFB MAB Workshop
10-12 Sep 2024



Outline

- Process and Timeline
- Science Drivers
- Platforms and sensors
- Array Design

OCEAN SCIENCES MEETING 2022

Moving Pioneer Array to Southern MAB

Monday 28 Feb | 3-4 pm ET

Status of plans, permitting, and projected timeline for relocating the Pioneer Array

Join the discussion:
bit.ly/UpdatePioneerMove

AGU ADVANCING EARTH AND SPACE SCIENCE ASLO THE OCEANOGRAPHY SOCIETY

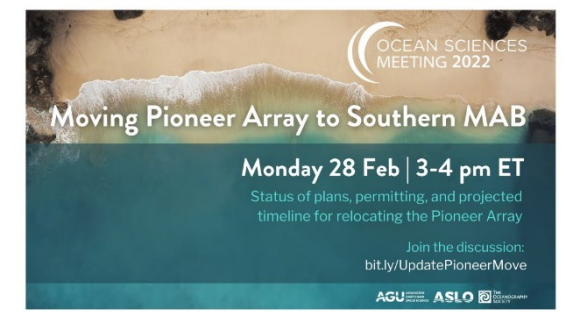
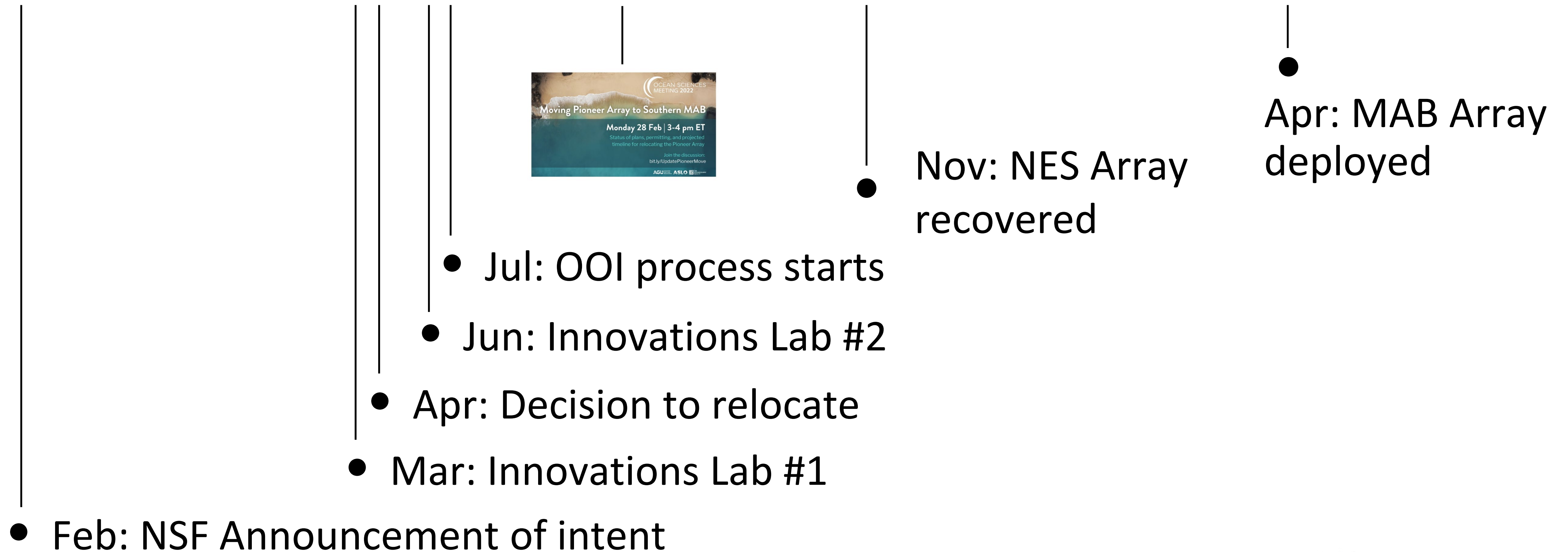
Pioneer relocation announcement,
Ocean Sciences Meeting 2022





Pioneer Array Relocation Milestones

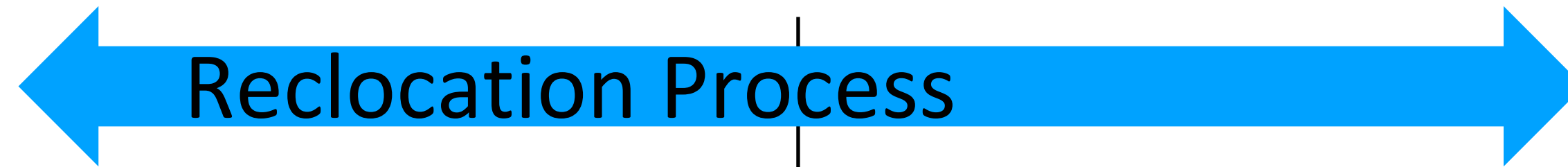
2020	2021	2022	2023	2024
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Pioneer Array Relocation Milestones

2020	2021	2022	2023	2024
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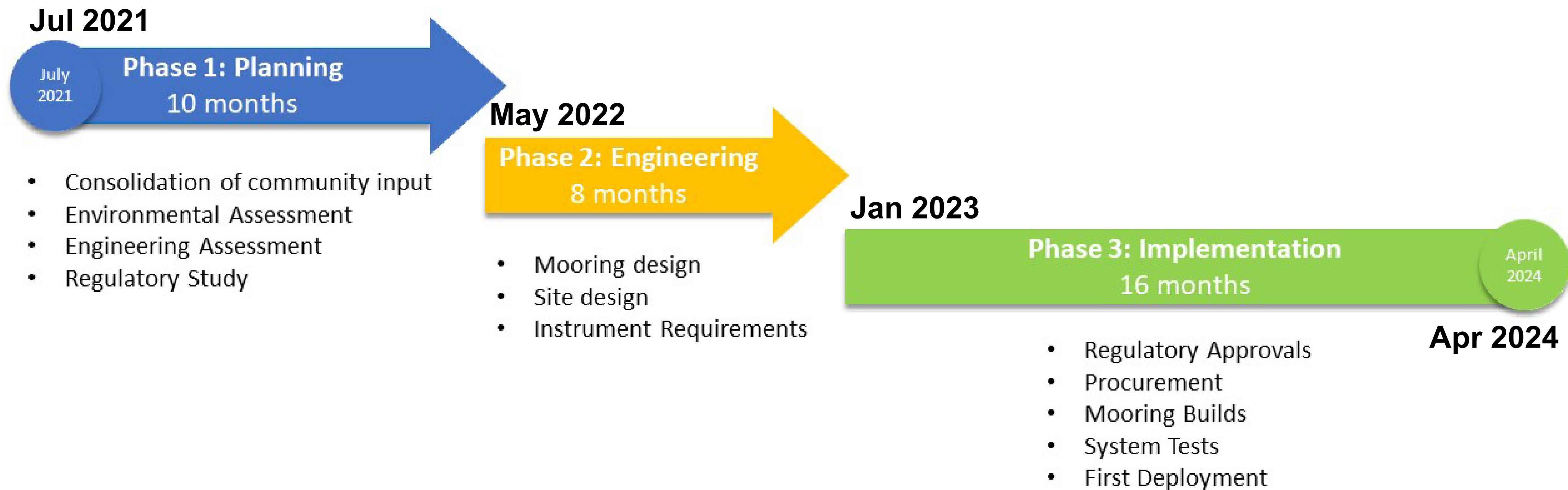
- Feb: NSF Announcement of intent
- Mar: Innovations Lab #1
- Apr: Decision to relocate
- Jun: Innovations Lab #2
- Jul: OOI process starts
- Nov: NES Array recovered
- Apr: MAB Array deployed





Relocation Process

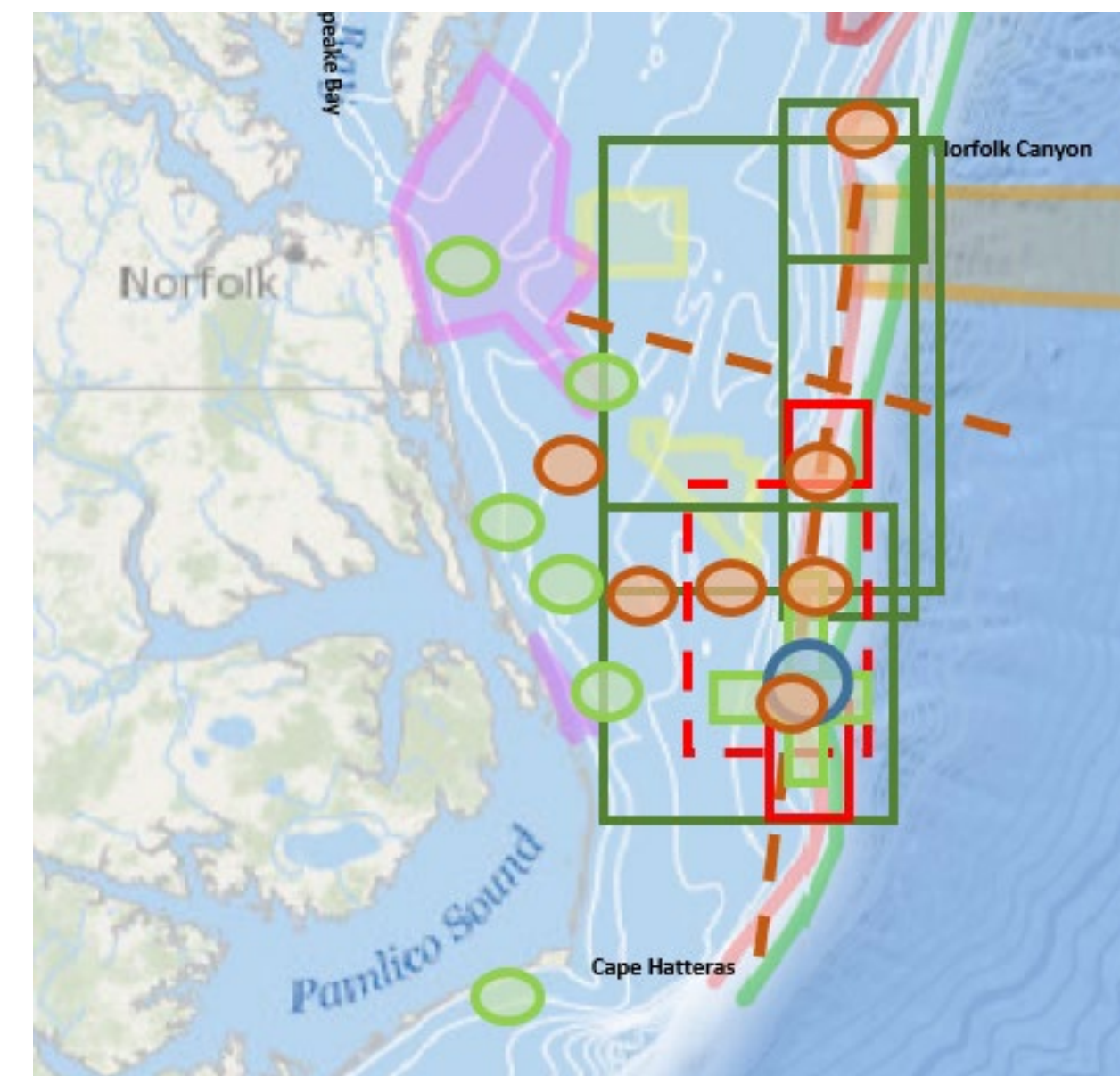
- Three main phases: Planning, Engineering/Design, Implementation
 - Operating NES Pioneer until Nov 2022





Relocation Process

- Approach
 - Guided by community input from Innovations Labs:
 - Address high-level science themes
 - Implement consensus Array design
 - Assessment and refinement by OOI Team
- Constraints
 - Optimize use of existing inventory
 - Ensure feasible implementation
 - Operate within existing budget

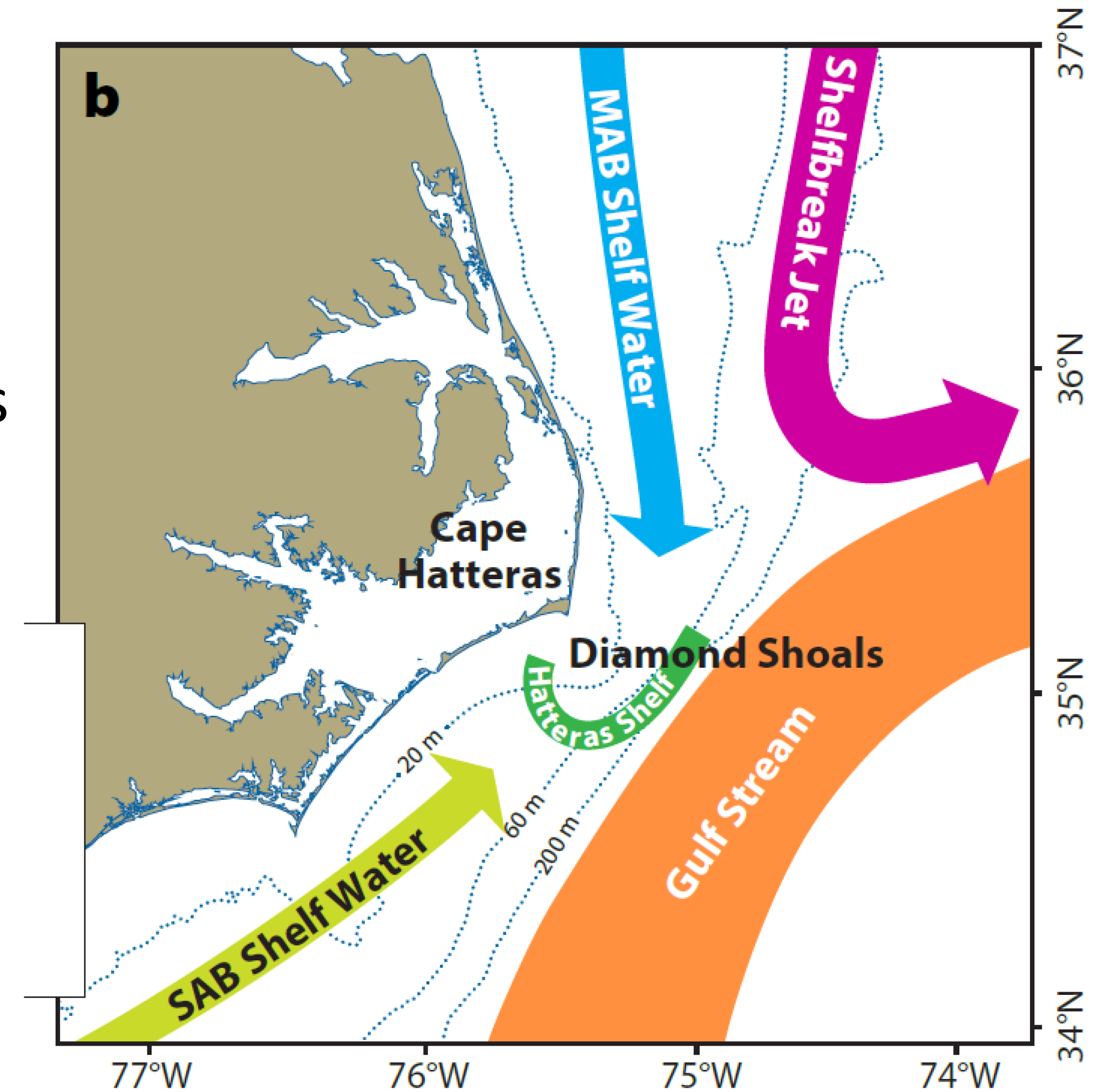


OOI Innovations Lab, June 2021



Regional Science Drivers

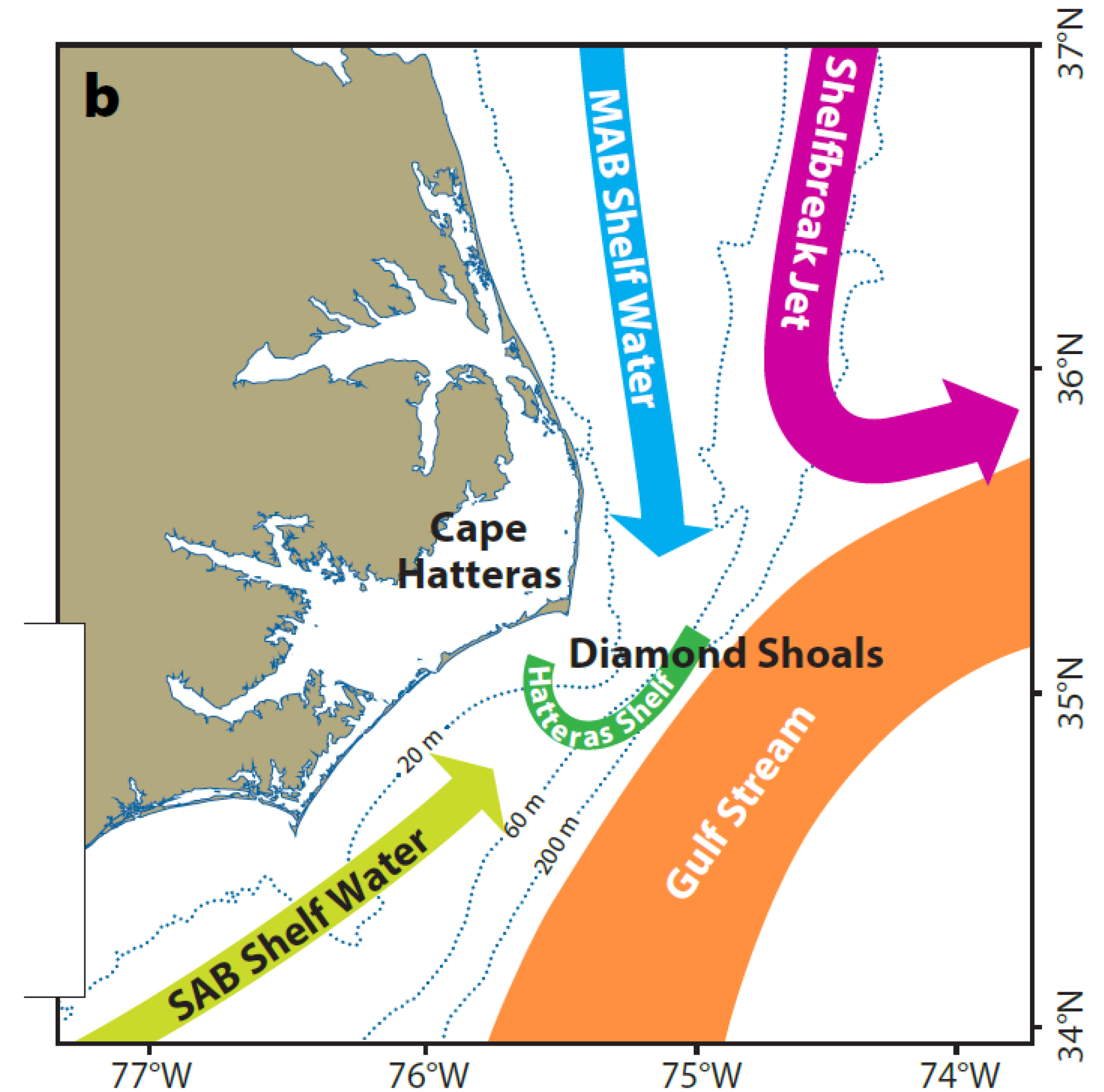
- An important shelf/slope system
 - MAB shelf water with northern origins
 - Modified by exchange with slope waters offshore and freshwater inflows
- A convergence zone
 - Relatively cool, fresh MAB shelf water meets warmer, saltier SAB water
 - Gulf Stream entrains the shelfbreak jet
- Multiple processes
 - Fronts, currents, plumes and storms influence biogeographic boundaries



Seim et al., 2022, PEACH

MAB Science Themes

- Approach
 - Created broad themes based on Innovations Lab input and ranking
- High level themes
 - Dynamics of shelf/slope exchange
 - Wind forcing, frontal instability, Gulf Stream influence
 - BGC cycling and transport
 - Carbon, nutrients, particulates
 - Ecosystem response
 - Extreme events
 - Hurricanes, freshwater outflows

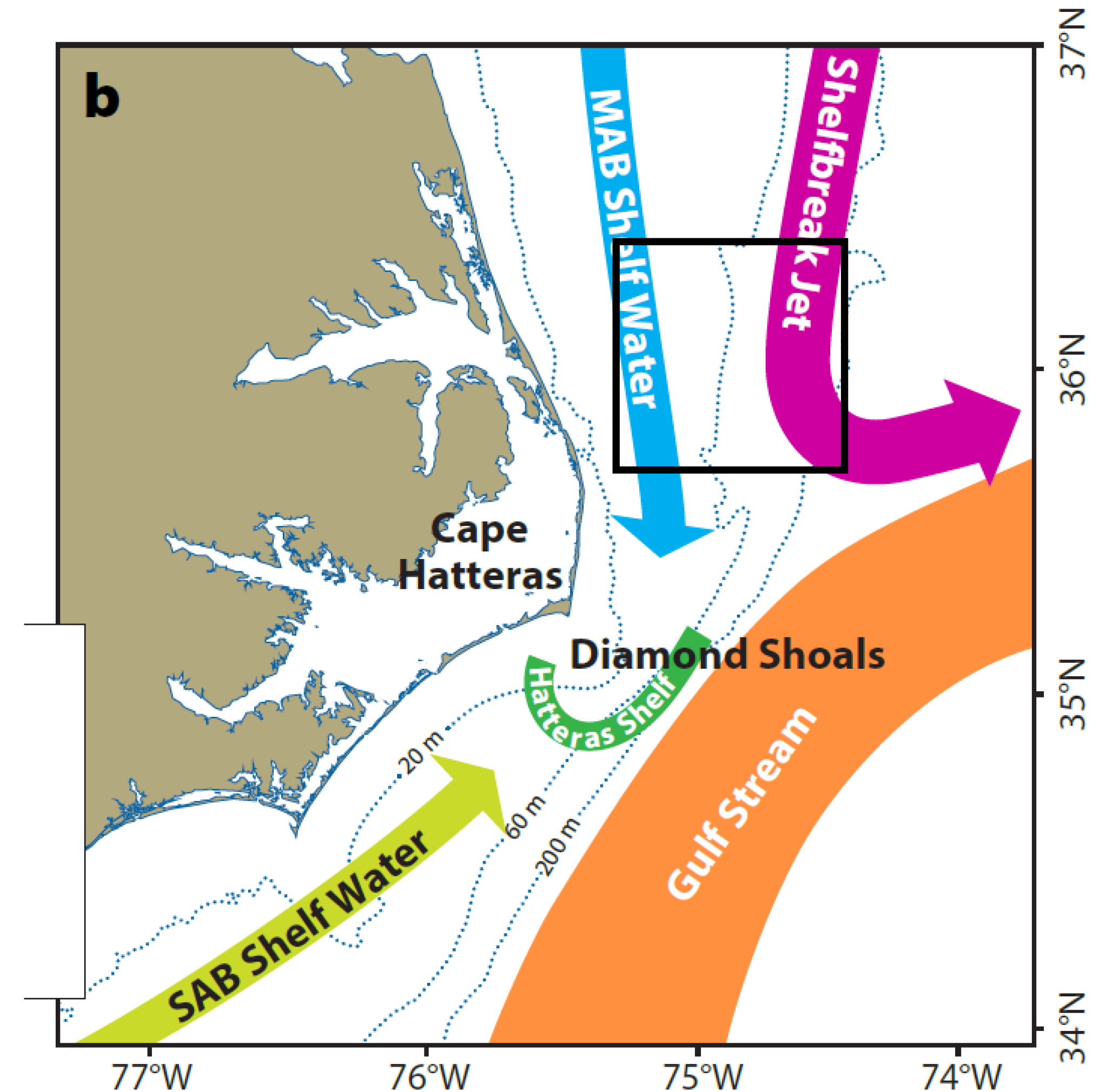


Seim et al., 2022, PEACH



MAB Observing Region

- Consensus to focus on:
 - Shelf-slope region
 - S of Chesapeake, N of Hatteras
- Constraints
 - Away from: Gulf Stream, shallow water, strong fronts, strong currents
 - Waterspace management
 - Environmental compliance
- A spatially coherent array
 - Moored array ~ 60 km x 60 km



Seim et al., 2022, PEACH

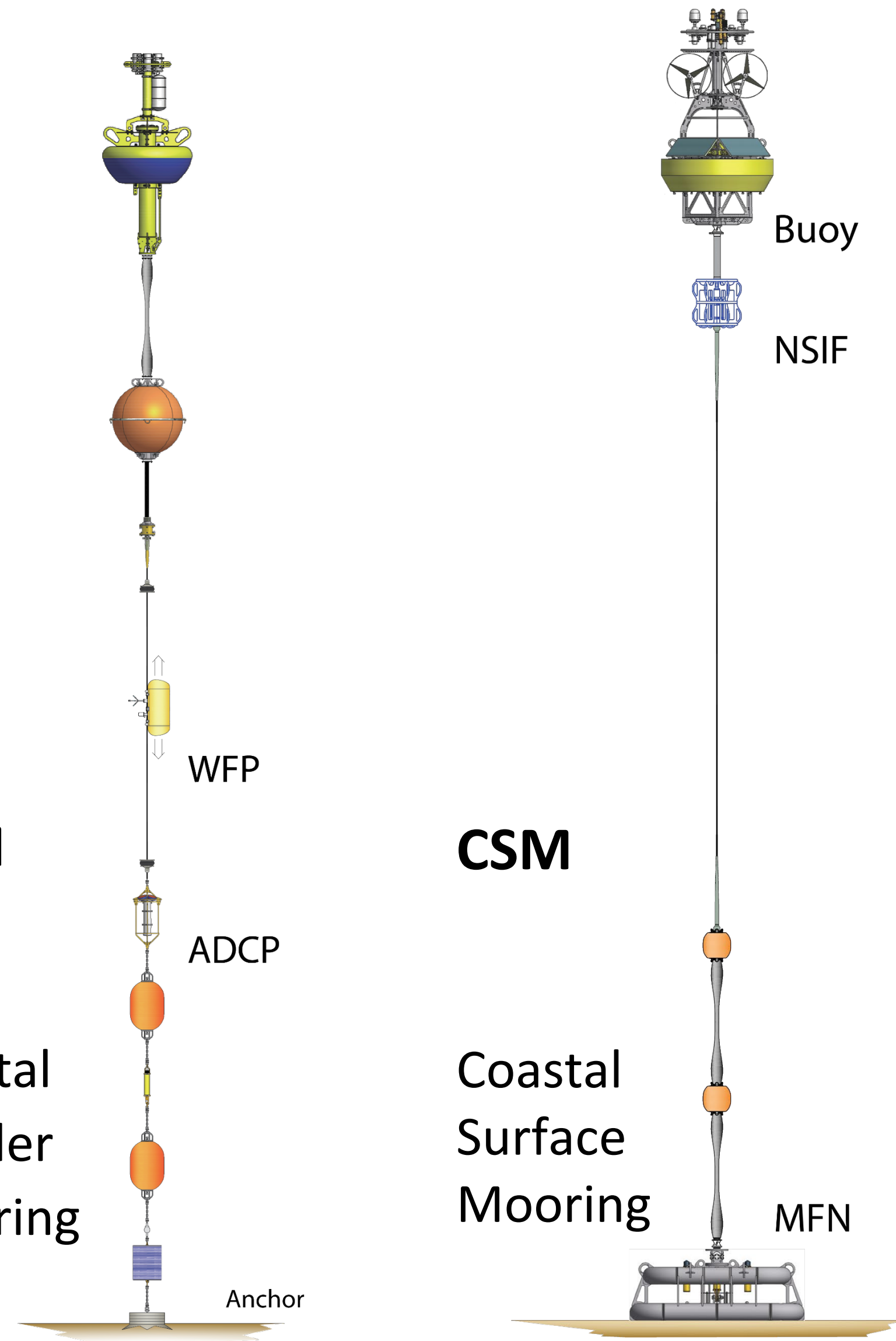


Platforms: NES

AUV



Glider



CPM

CSM

Coastal Profiler Mooring

Coastal Surface Mooring



Platforms: MAB

AUV

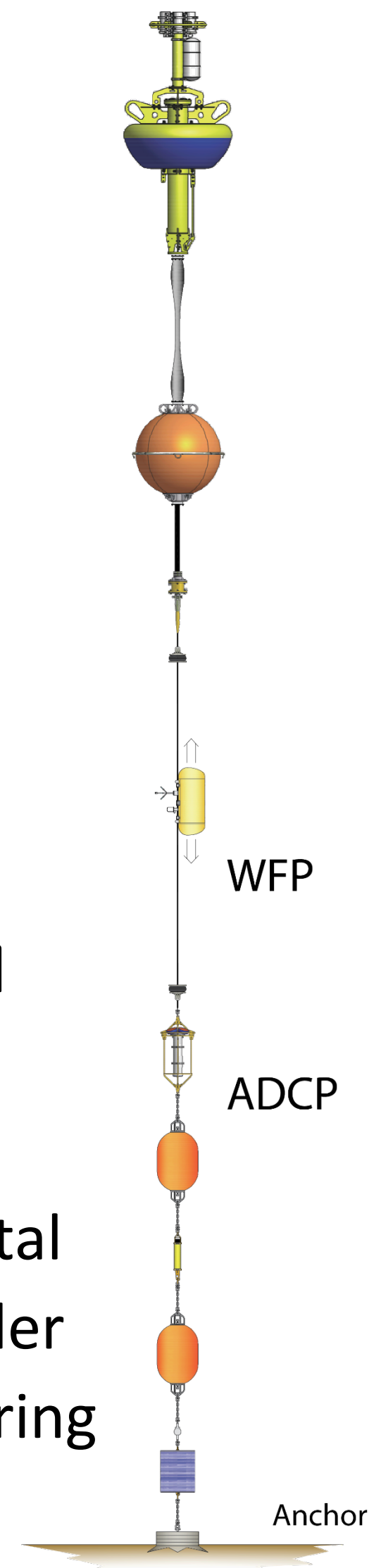


Glider



CPM

Coastal
Profiler
Mooring



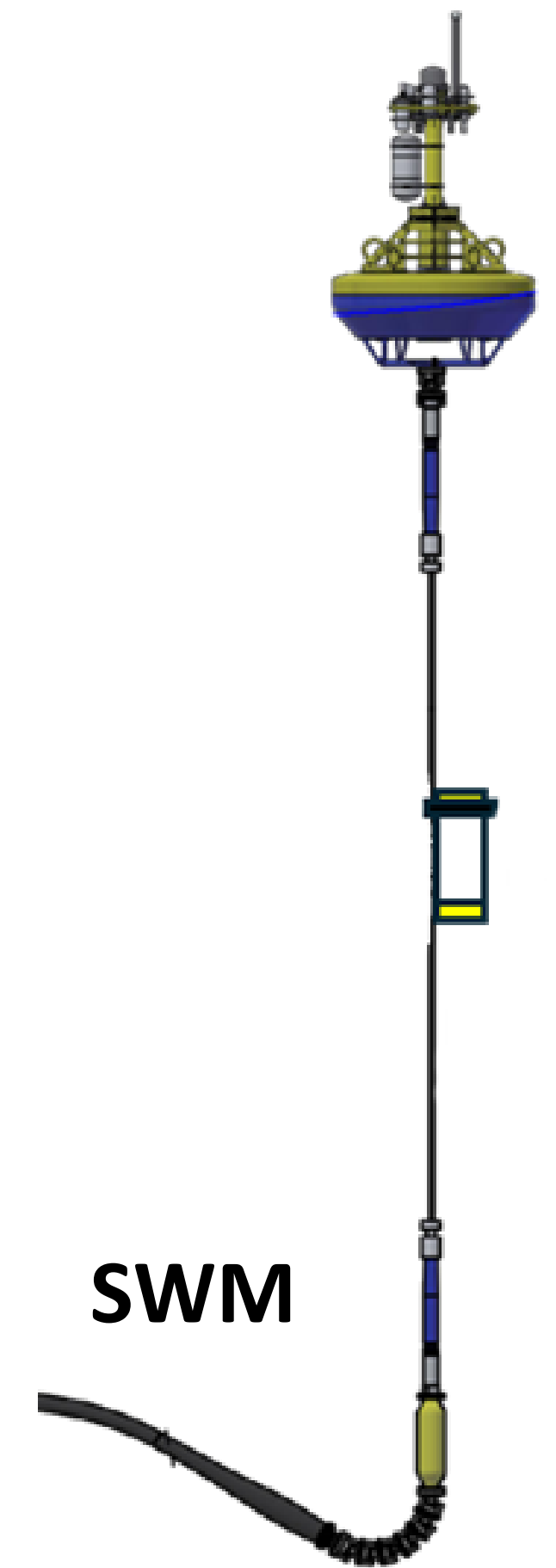
CSM

Coastal
Surface
Mooring



SWM

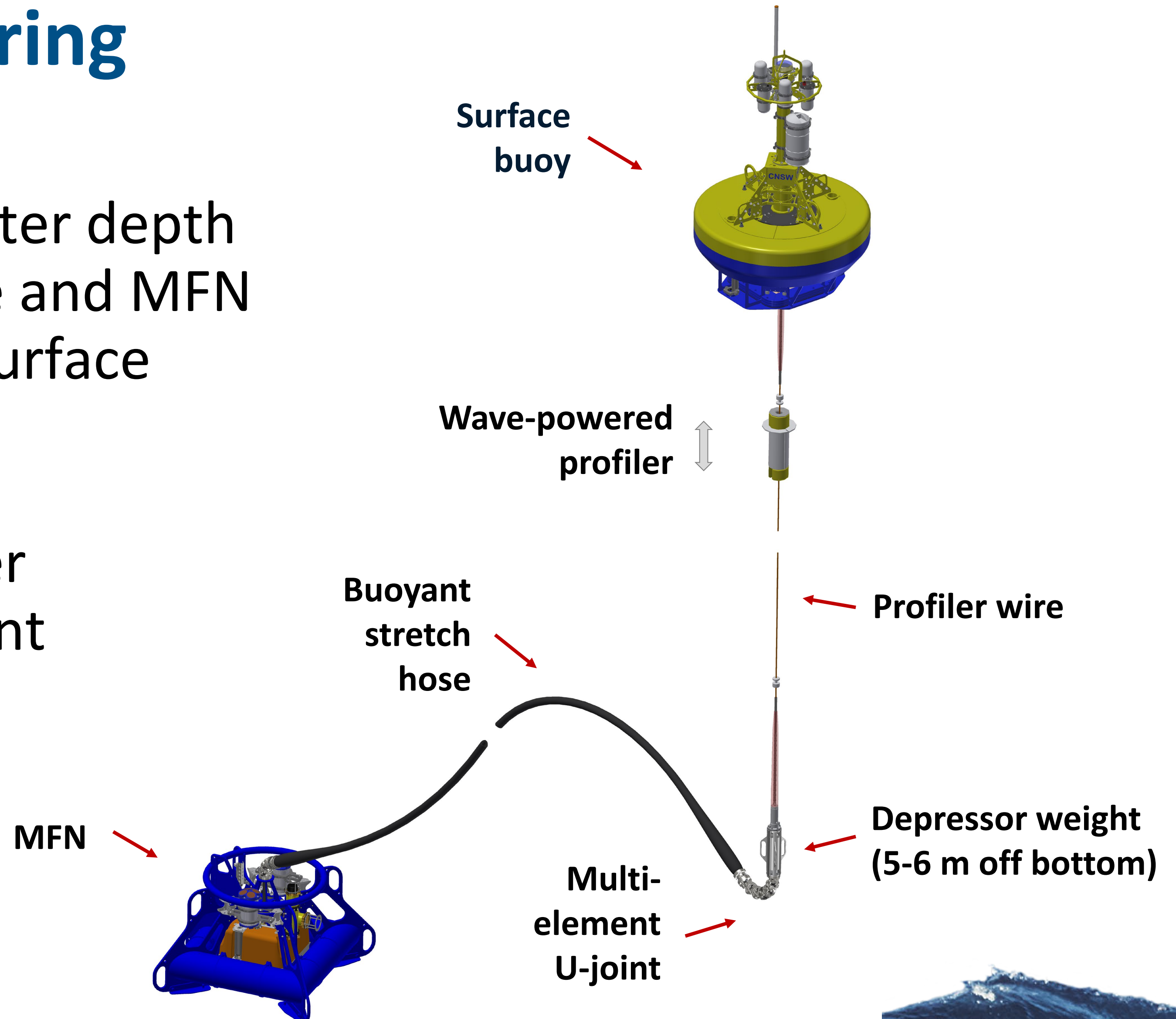
Shallow
Water
Mooring



Shallow Water Mooring

Peters et al., 2024

- Designed for 25-30 m water depth
- Instruments in buoy base and MFN
- Profiler within 2-3 m of surface
- Hollow buoy
- Weighted wire for profiler
- 6-element, 180 deg U-joint
- Buoyant stretch hose
- Small MFN



Instruments

Pioneer Array Core Instrumentation		
Instrument Series	Measurement(s)	Platform
CTD	Temp, cond, press	all
Oxygen	Dissolved oxygen	all
Fluorometer	Chl-a, CDOM, optical backscatter	all
Radiometer	Spectral irradiance or PAR	all
Velocity profile	Profile and/or single point	all
Nutrients	Nitrate concentration	CSM, AUV
Surface Meteorology	AT, RH, BP, PRC, WSPD, WDIR, SWR, LWR, SST, SSS, covariance flux	CSM
Surface Waves	Surface wave properties	CSM
CO2	Partial press CO2 in air, water	CSM
pH	Seawater pH	CSM
Pressure	Seafloor pressure	CSM
Spectrophotometer	Optical absorp, attenuation	CSM
Bio-acoustics	Multi-frequency acoustic backscatter	CSM

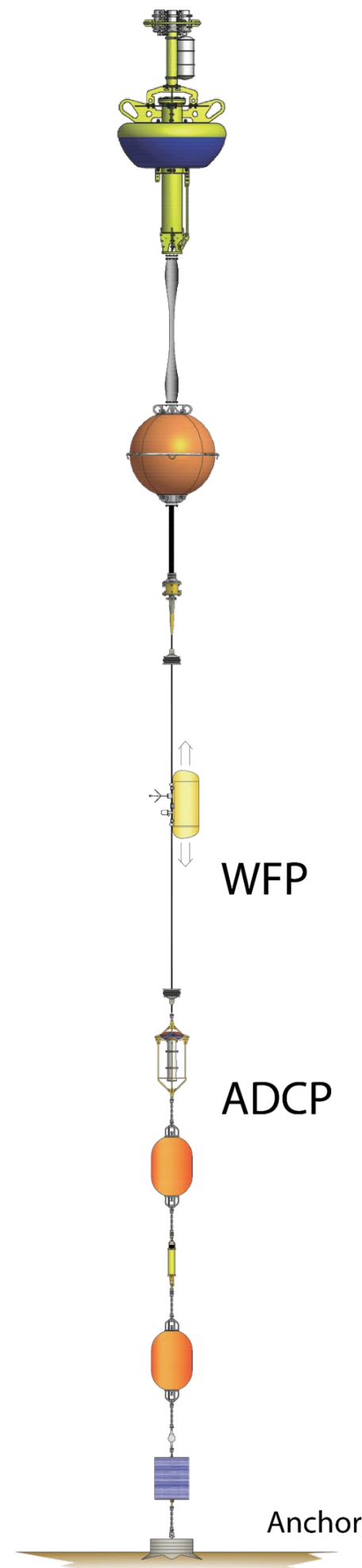


Instrumentation: CPM and CSM

MAB added

Surface Buoy
Buoy base CTD

Sphere
Uplooking ADCP



NES Core

Wire Following Profiler
CTD, oxygen, fluorometer, PAR, single-point velocity

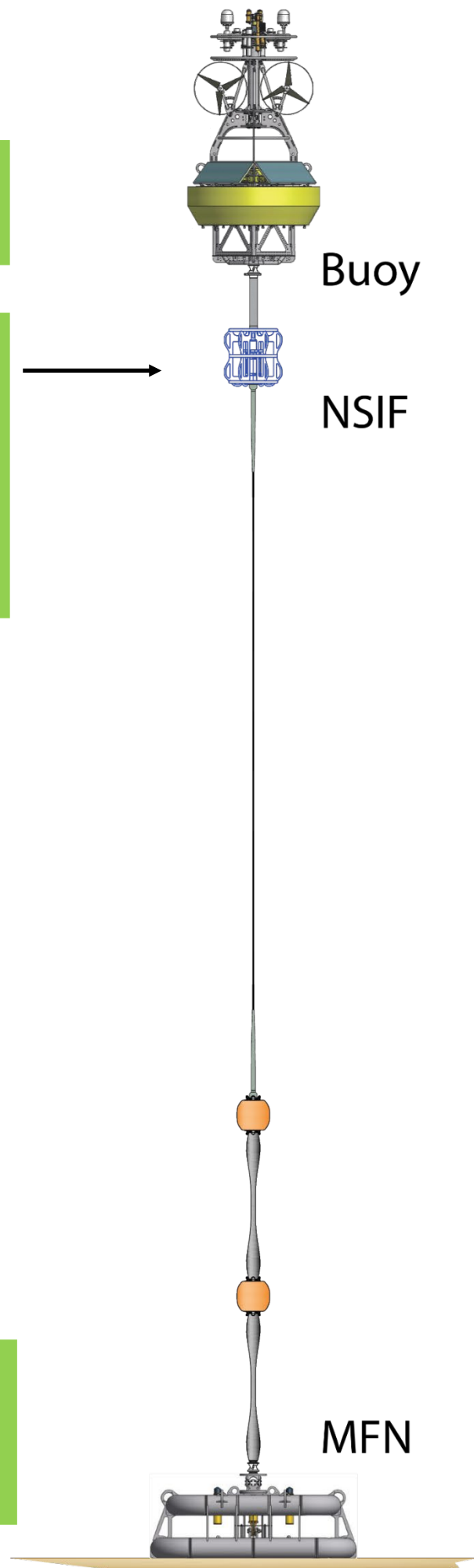
In-Line Cage
Uplooking ADCP

MAB added

Surface Buoy
Buoy: SPKIR

NSIF
Phyto imagery (CNSM only), particulates, turbidity

MFN
Particulates, turbidity



NES Core

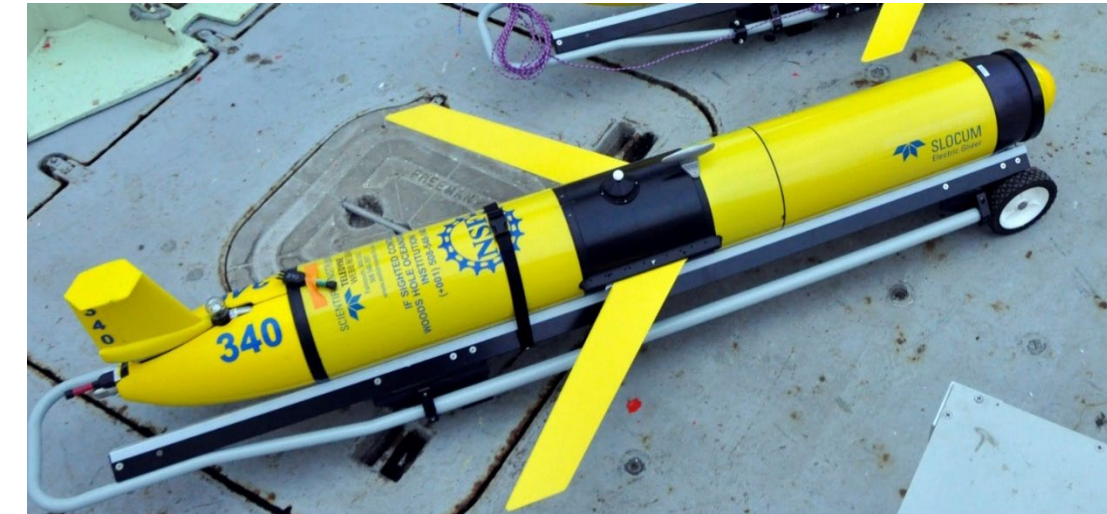
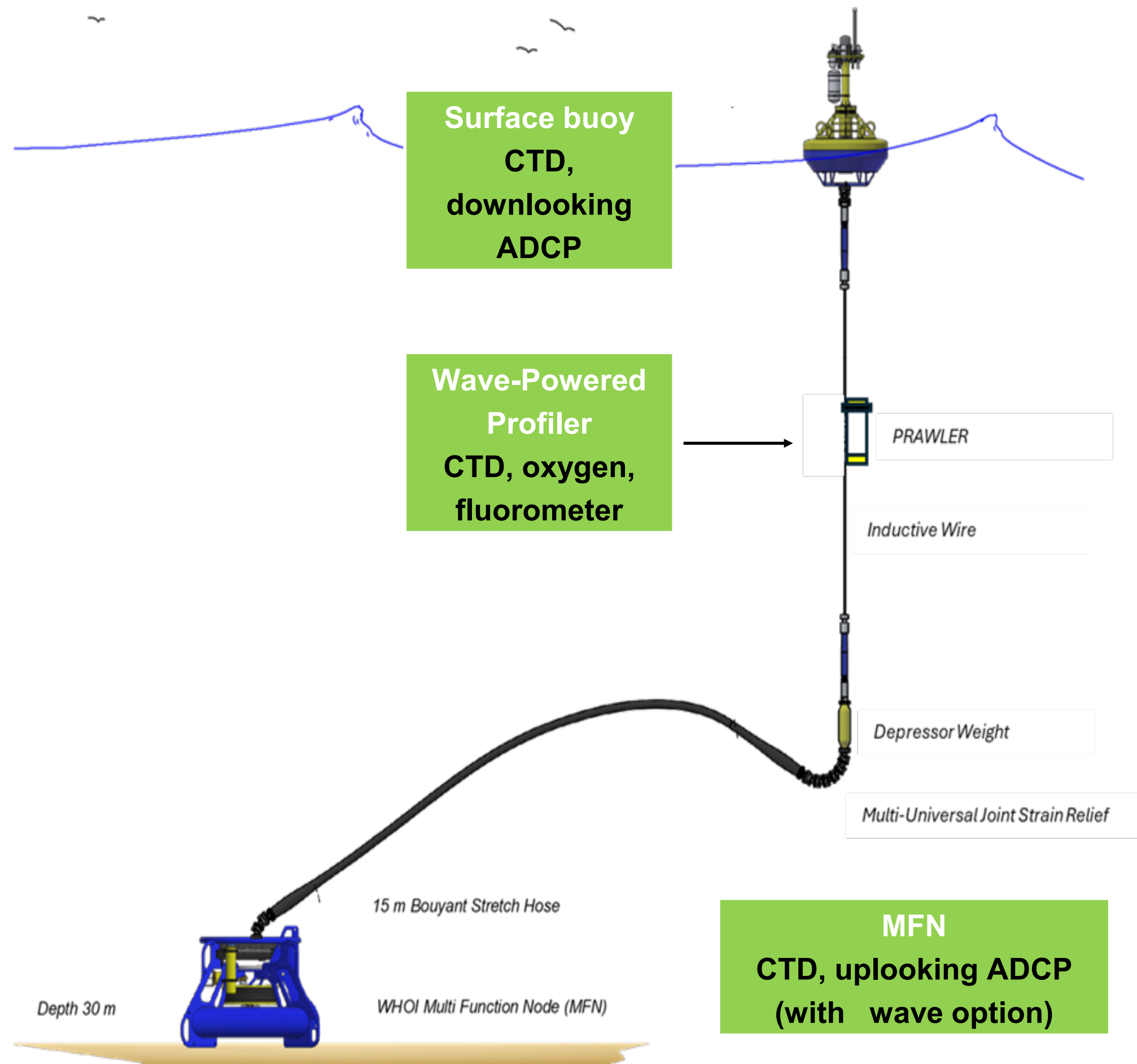
Surface Buoy
Meteorology, waves
CTD, pCO₂,

NSIF
CTD, oxygen, pH, fluorometer, nitrate, spectral irradiance, optical absorption and attenuation, single-point velocity

MFN
CTD, oxygen, pH, pCO₂, optical absorption and attenuation, pressure, single-point velocity, uplooking ADCP, bioacoustics sonar



Instrumentation: SWM, glider, AUV



Glider
CTD, oxygen,
fluorometer, PAR,
short-range ADCP

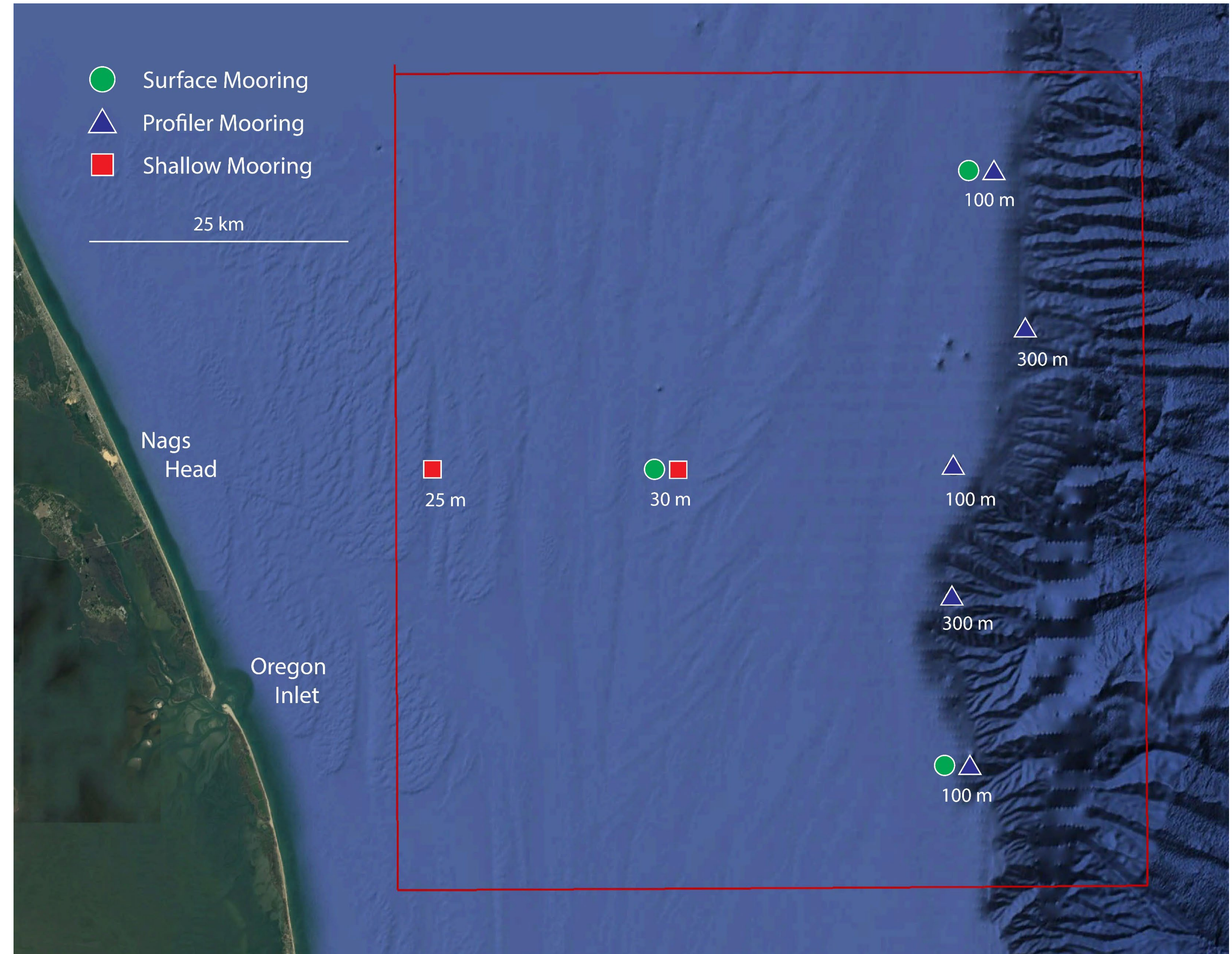
Nitrate (1x)

AUV
CTD, oxygen,
fluorometer, PAR,
ADCP, nitrate



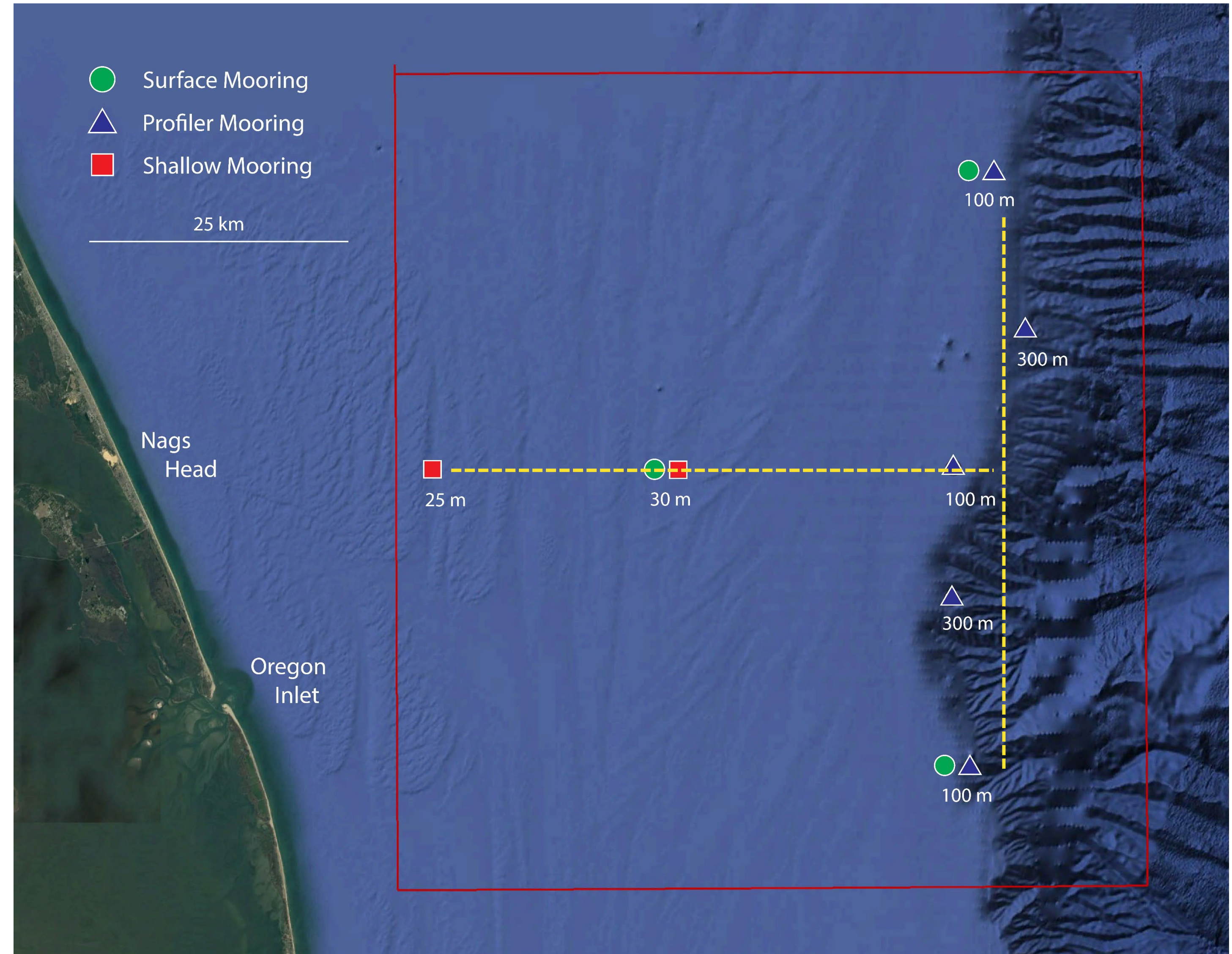
Moored Array

- Ten moorings at seven sites
 - 3 CSM, 5 CPM, 2 SWM
- 30 – 300 m depths



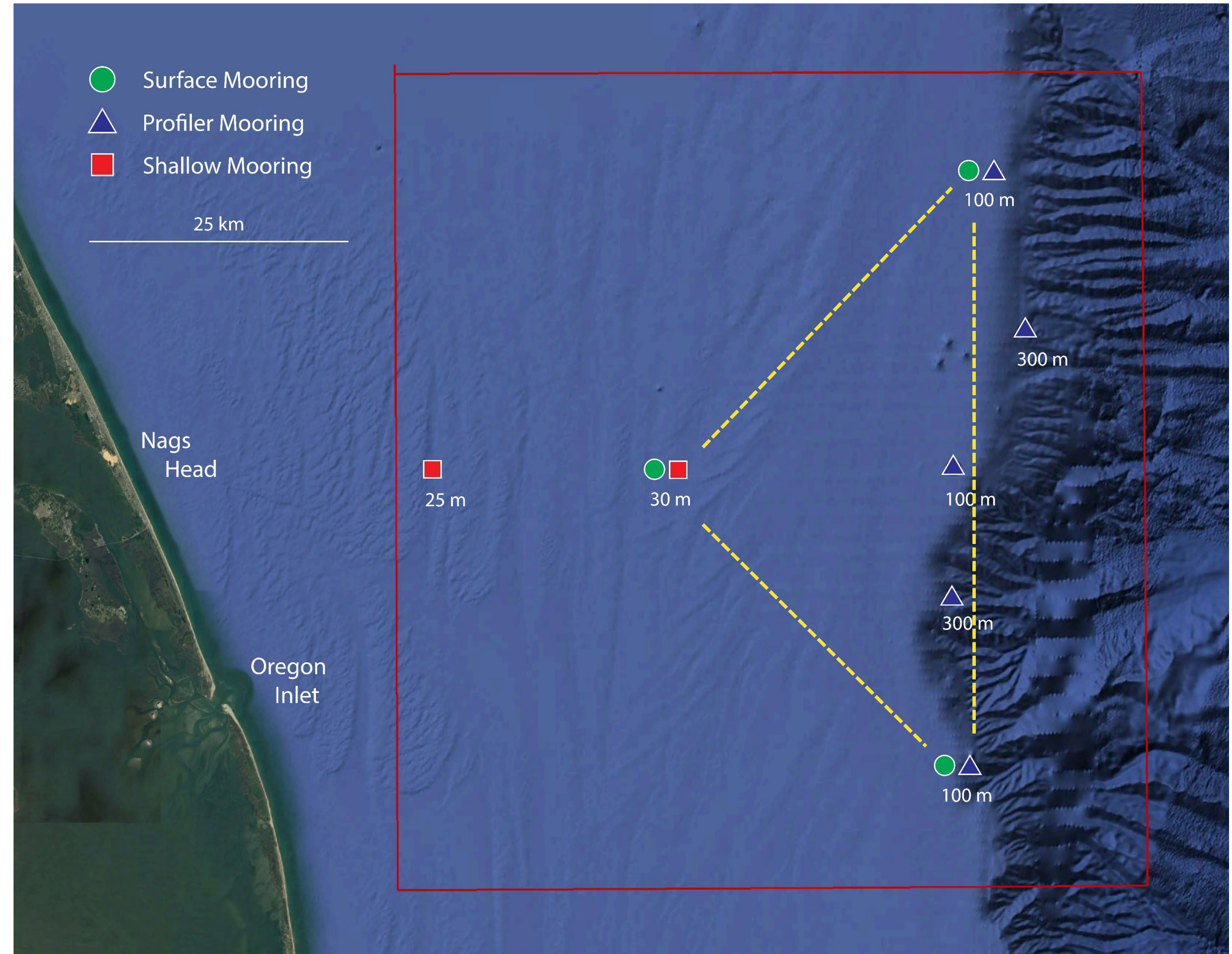
Moored Array

- Ten moorings at seven sites
 - 3 CSM, 5 CPM, 2 SWM
- 30 – 300 m depths
- T-shaped Array
 - ~50 km extent
 - 15 – 25 km spacing



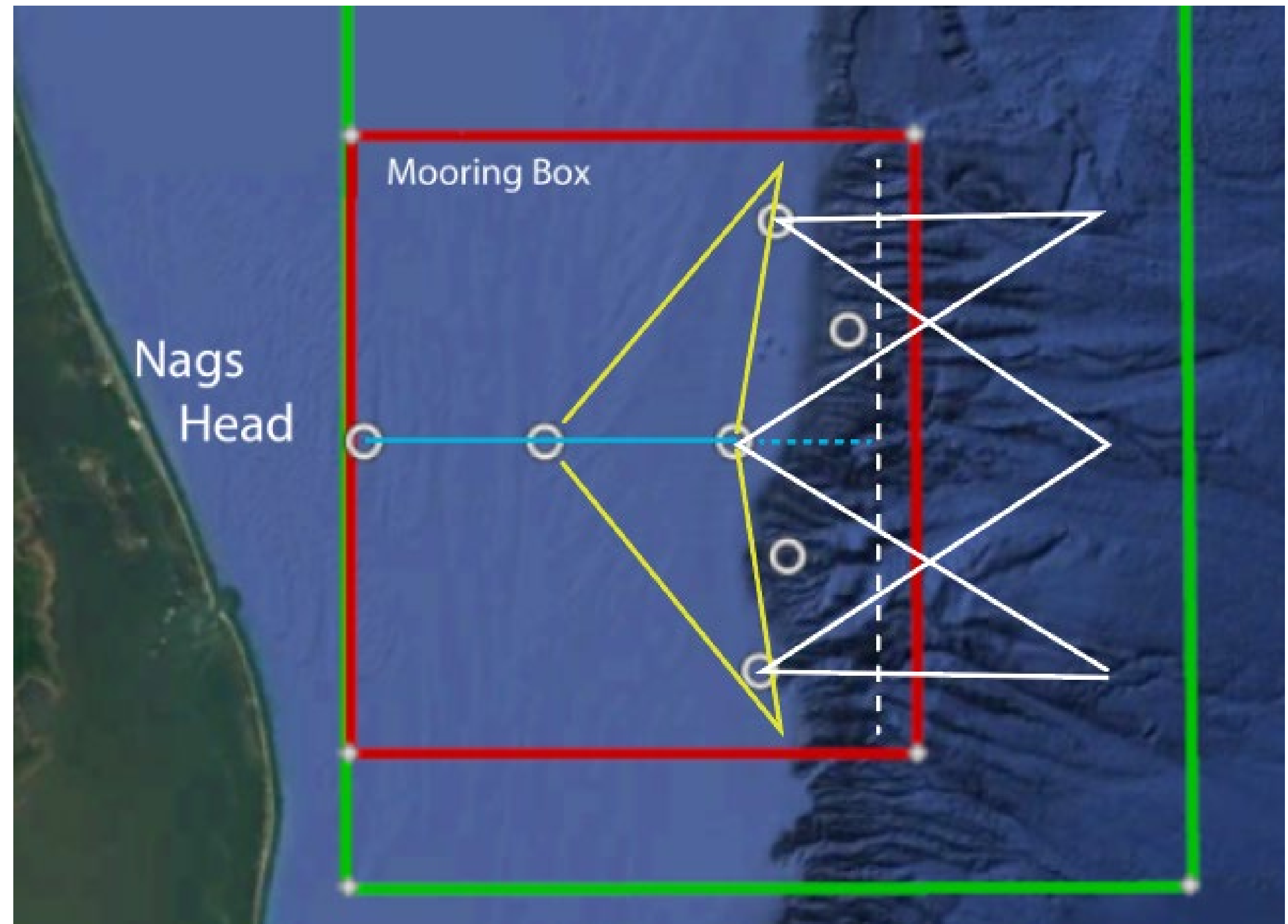
Moored Array

- Ten moorings at seven sites
 - 3 CSM, 5 CPM, 2 SWM
- 30 – 300 m depths
- T-shaped Array
 - ~50 km extent
 - 15 – 25 km spacing
- Three sites with mooring pairs



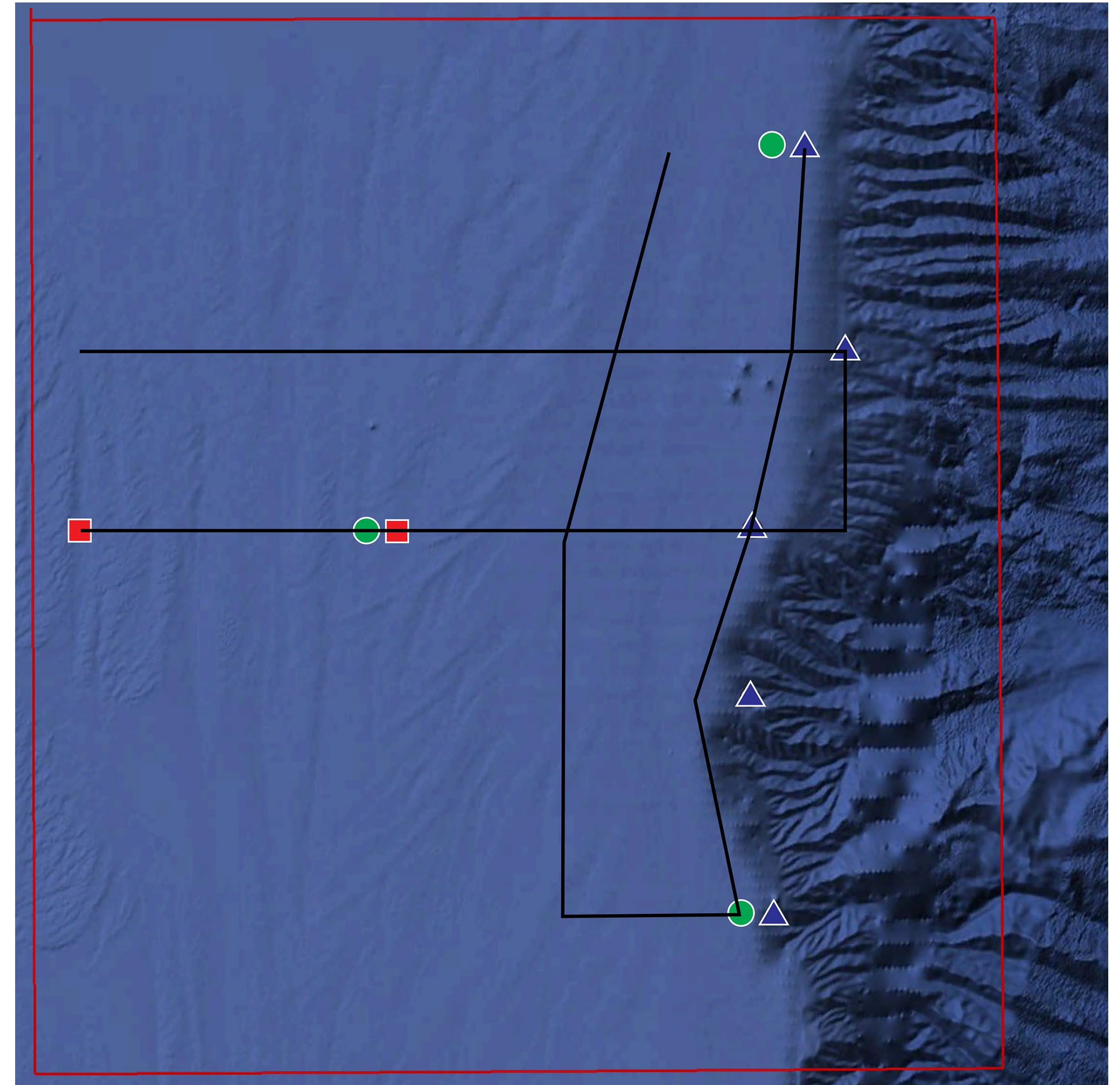
Gliders

- Four main tracklines
 - Cross-shelf (blue)
 - Moored array (yellow)
 - Offshore mesoscale (white)
 - Offshore flux (white dashed)
- Supplemental lines
 - Norfolk Canyon (2x/yr?)



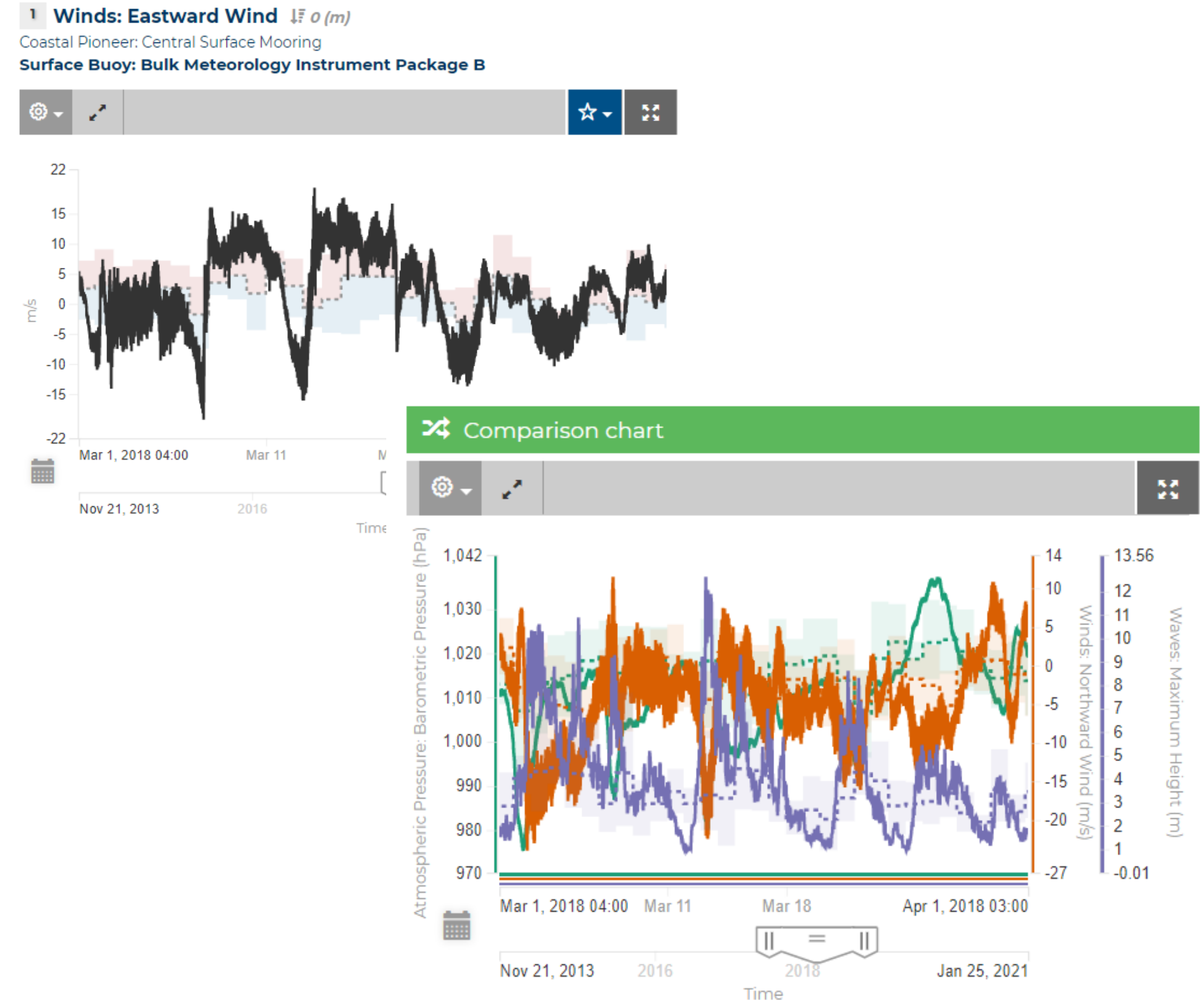
AUVs

- Two mission boxes
 - Cross-shelf box (20 hr)
 - Along-shelf box (20 hr)
- Objectives
 - Synoptic transects
 - Resolve shelfbreak front
- Operations
 - “Campaign mode”
 - 4-6 missions/yr



Data Access: <http://oceanobservatories.org>

- Data Explorer
 - GUI for data discovery, plotting and download
- THREDDS server
- ERDDAP server
- Machine to Machine interface
- Raw data archive
- And more...
- Questions:
 - help@oceanobservatories.org





Data Distribution Partners

- NDBC
 - Surface mooring data
- MARACOOS
 - Gliders, surface mooring data
- IOOS Glider DAC, OceanGliders
 - Gliders
- BCO-DMO
 - Consolidated water sample data
- GOA-ON
 - Carbon system metadata
- OceanSITES
 - Metadata for moored arrays





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Questions?

