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Pioneer Relocation Status

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and the CGSN Team

OOIFB Fall Meeting
12 Oct 2023



Background

- NSF Announcement of intent to relocate (or retain)
 - Ocean Sciences Town Hall, Feb 2020
- Extensive community input from two Innovations Labs
 - 15-19 March and 21-15 June 2021
- Decision to relocate to southern MAB
 - Announced in Apr 2021
- Relocation process
 - Initiated Jul 2021



Relocation Process

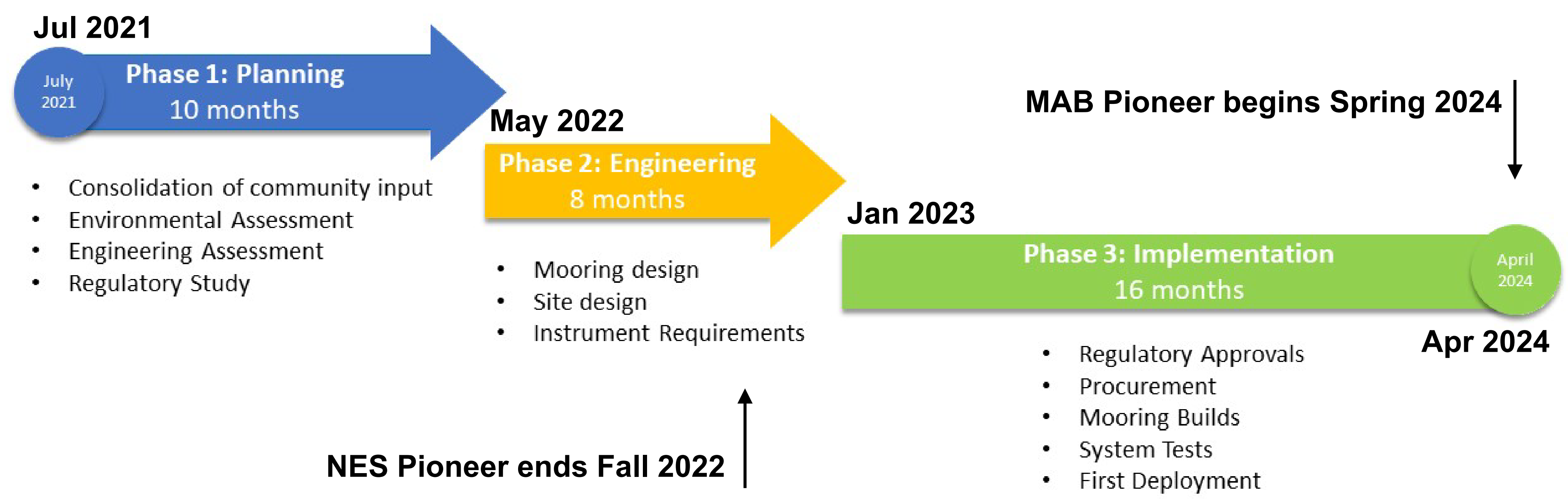
- Approach
 - Guided by Innovations Lab science questions
 - Array design based on Innovations Lab consensus
 - Assessment and refinement by OOI Team
- Goals
 - Address science questions
 - Implement the consensus array design
 - Optimize use of existing inventory
 - Ensure feasible implementation
 - Operate within existing budget





Relocation Timeline

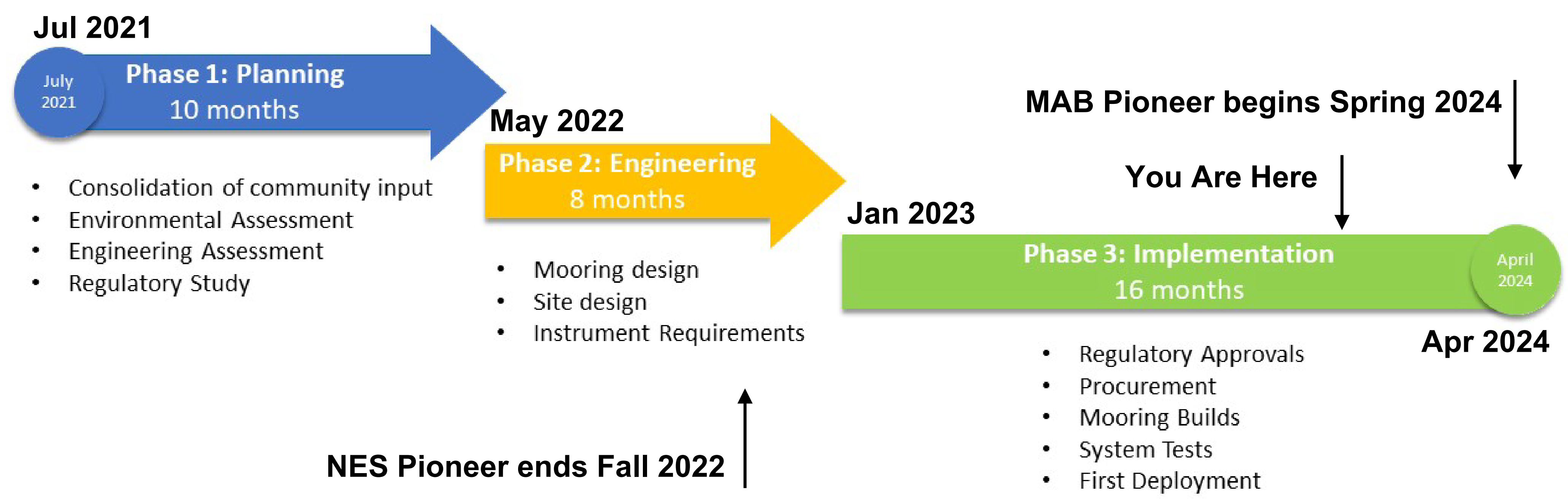
- Three main phases: Planning, Engineering, Implementation
- NE Shelf Pioneer ends Fall 2022; MAB Pioneer starts Spring 2024





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Planning Phase Tasks

- Establish Focus Group
- Consolidate Innovation Labs input
 - Science themes, array design, instrumentation
- Site Characterization
- Waterspace management
- Regulatory study
- Mooring modeling
- Regional ocean modeling
- Instrumentation assessment
- Array design



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- **Regulatory study – NEPA process**
- Mooring modeling
- Regional ocean modeling
- Instrumentation assessment
- **Array design – Response to public comments**





Engineering Phase Tasks

Selected highlights of >50 program documents created or revised.

- Site characterization (input to mooring modeling)
- Array design, fixed and mobile assets
- Mooring performance, modeling and designs
- Instrument prioritization and selection process
- Requirements review and risk assessment
- Test plans for fixed and mobile assets
- Preliminary Design Reviews (Delta-PDR; Jan 2023, Jul 2023)
- Begin configuration management and CI integration



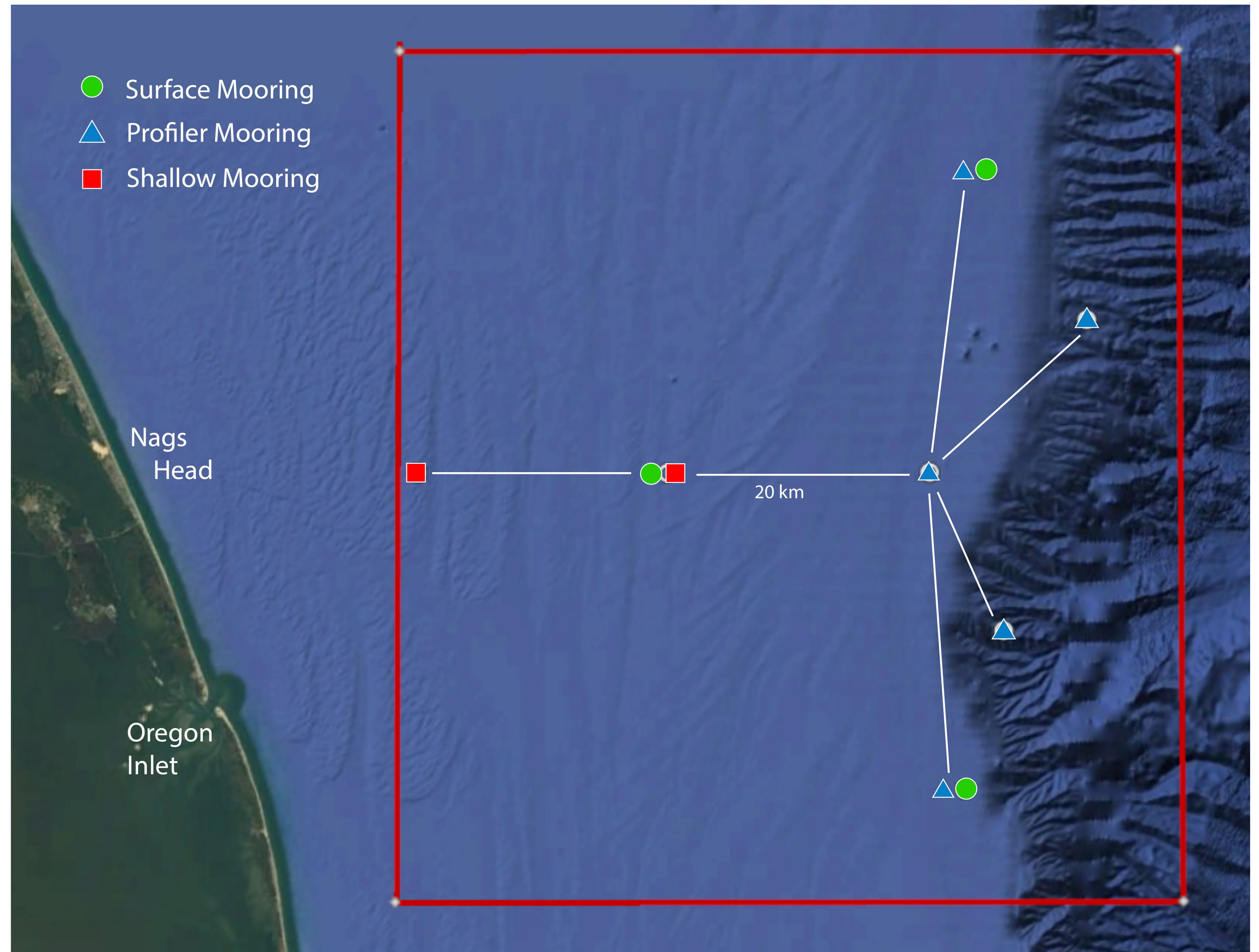
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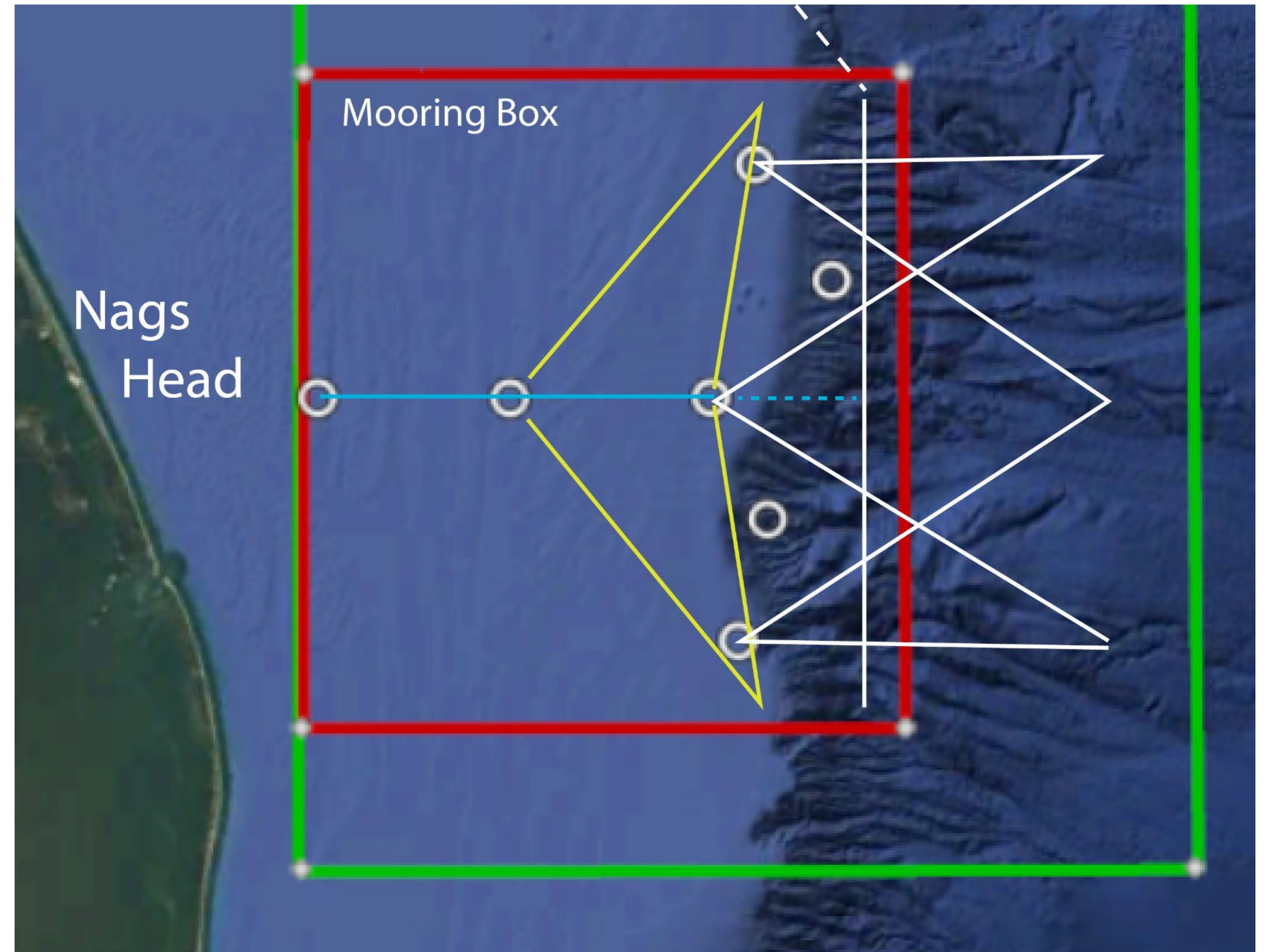
Moored Array

- Proposed Design
- Components
 - 3 CSM
 - 5 CPM
 - 2 SWM
- Challenges
 - Regulatory
 - Shallow water
 - Instruments
 - Logistics
 - Budget



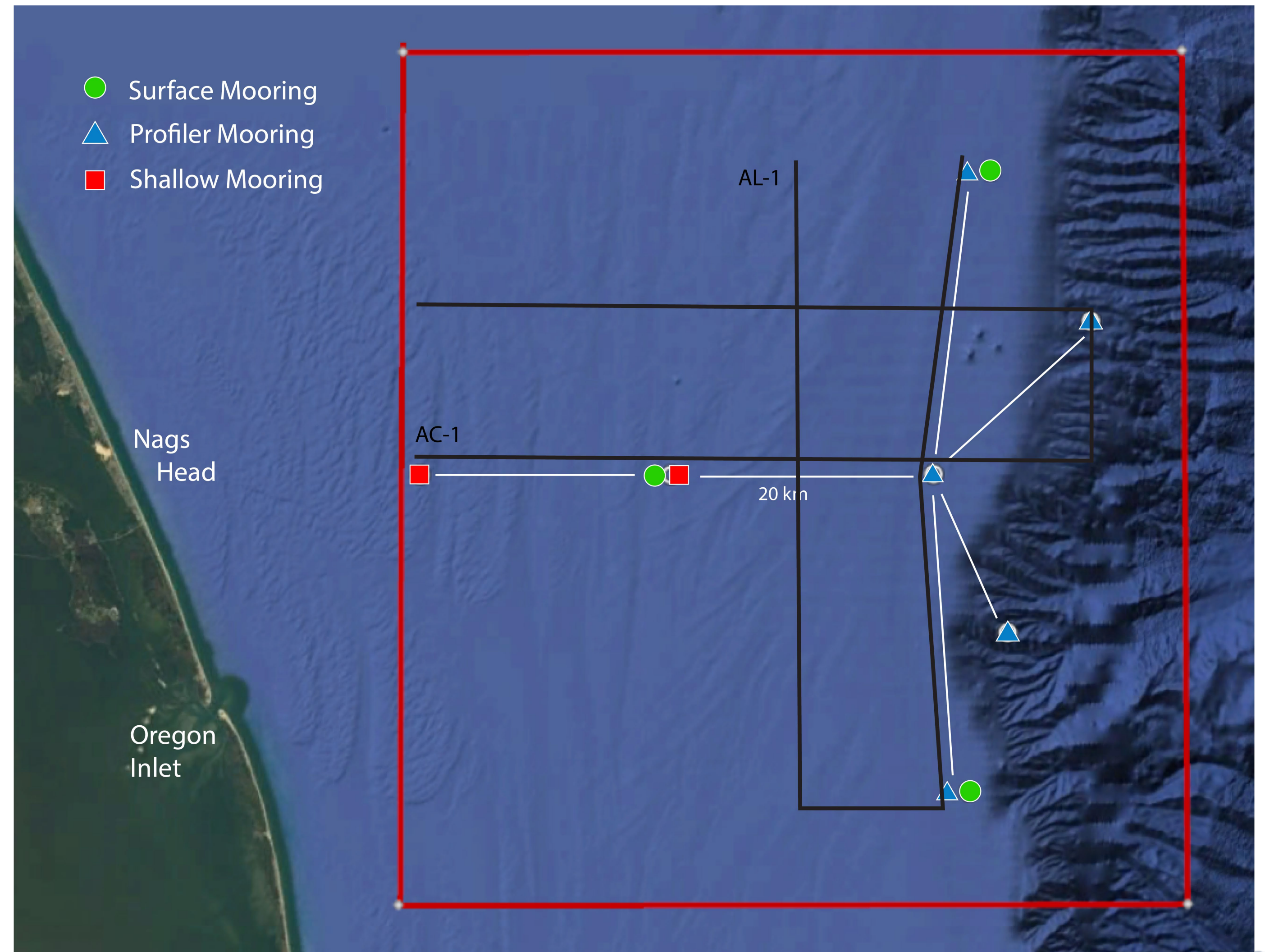
MAB glider plan

- Proposed design
- Operations
 - Retain current fleet of 12
 - Deploy 4 (3:1 ratio)
- Four main tracklines
 - Offshore mesoscale (white)
 - Offshore flux (white)
 - Moored array (yellow)
 - Cross-shelf (blue)
- Supplemental lines (dashed)
 - Norfolk Canyon (2x/yr)



MAB AUV plan

- Proposed design
- Operations
 - Two REMUS-600 AUVs
 - “Campaign mode”
 - 4-6 missions/yr
- Two mission boxes
 - Cross-shelf box (20 hr)
 - Along-shelf box (20 hr)
- Objectives
 - Synoptic transects
 - Resolve shelfbreak front



Implementation Phase Tasks

- Instrument procurement process: Underway, phased deliveries
- At-Sea Test 3 (AST3), CSM and CPM: Underway, recovery Oct 2023
- Assess AST3 site survey results and real-time data: Underway
- At-Sea Test 4 (AST4), SWM: Planned (Fall 2023)
- Glider and AUV performance testing: Underway
- Infrastructure procurement and fabrication: Underway
- Environmental Compliance/NEPA: Underway
- Community Outreach: Ongoing





Instrumentation Assessment

- Baseline: current OOI core sensors
- Innovations Lab input:
 - >40 instruments or measurement concepts suggested
 - “Short List” of 12 based on cross-group consensus
- Prioritized implementation list based on:
 - Science themes
 - Technical readiness
 - Operational feasibility/array design
 - Budget impacts
- Programmatic process
 - Requirements, specs, RFIs, assessment, procurement





MAB Instrument Additions/Changes

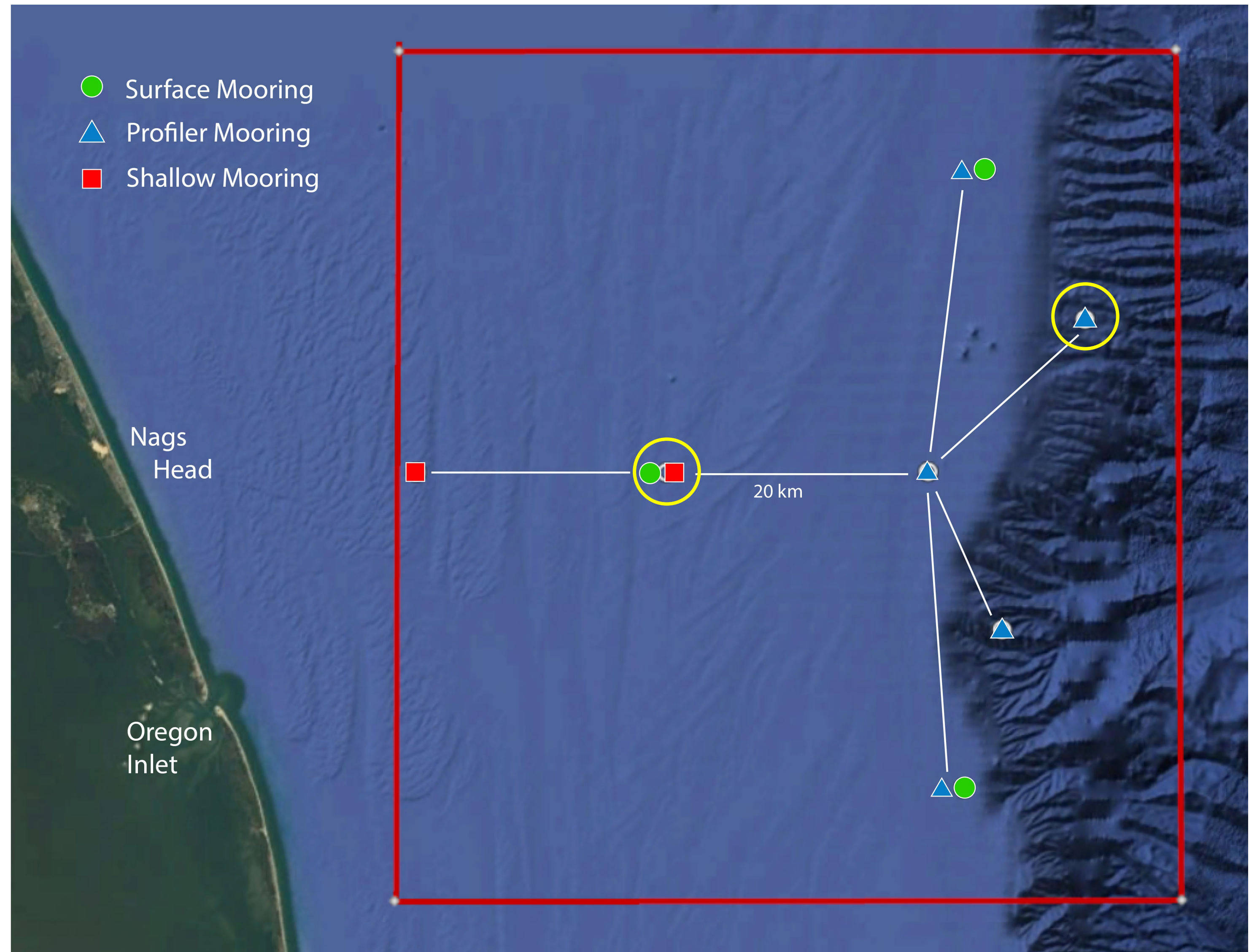
- Existing inventory, **new procurements** and **tech refresh**
 - Near-surface temp/salinity (CPM buoy) – SeaBird SBE-37
 - Near-surface velocity profile (CPM sphere) – **Nortek 1 MHz ADCP**
 - Turbidity (CSM NSIF and MFN) – Sea Bird ECO triplet w/NTU cal
 - Suspended particulates (CSM NSIF and MFN) – **Sequoia LISST**
 - Phytoplankton imaging (CSM NSIF, one instance) – **McLane IFCB**
 - Incident radiation* (CSM buoys) – SPKIR multispectral radiometer
 - Glider nitrate (flux line glider) – Pioneer profiling gliders
 - Shallow water ADCP with waves (MFN) – **RDI 600 kHz ADCP**
 - Seafloor pressure – replacing SBE-26, **RBR QuartzQ**

* Initially only incident (downwelling) radiation on buoy tower



At-Sea Test 3

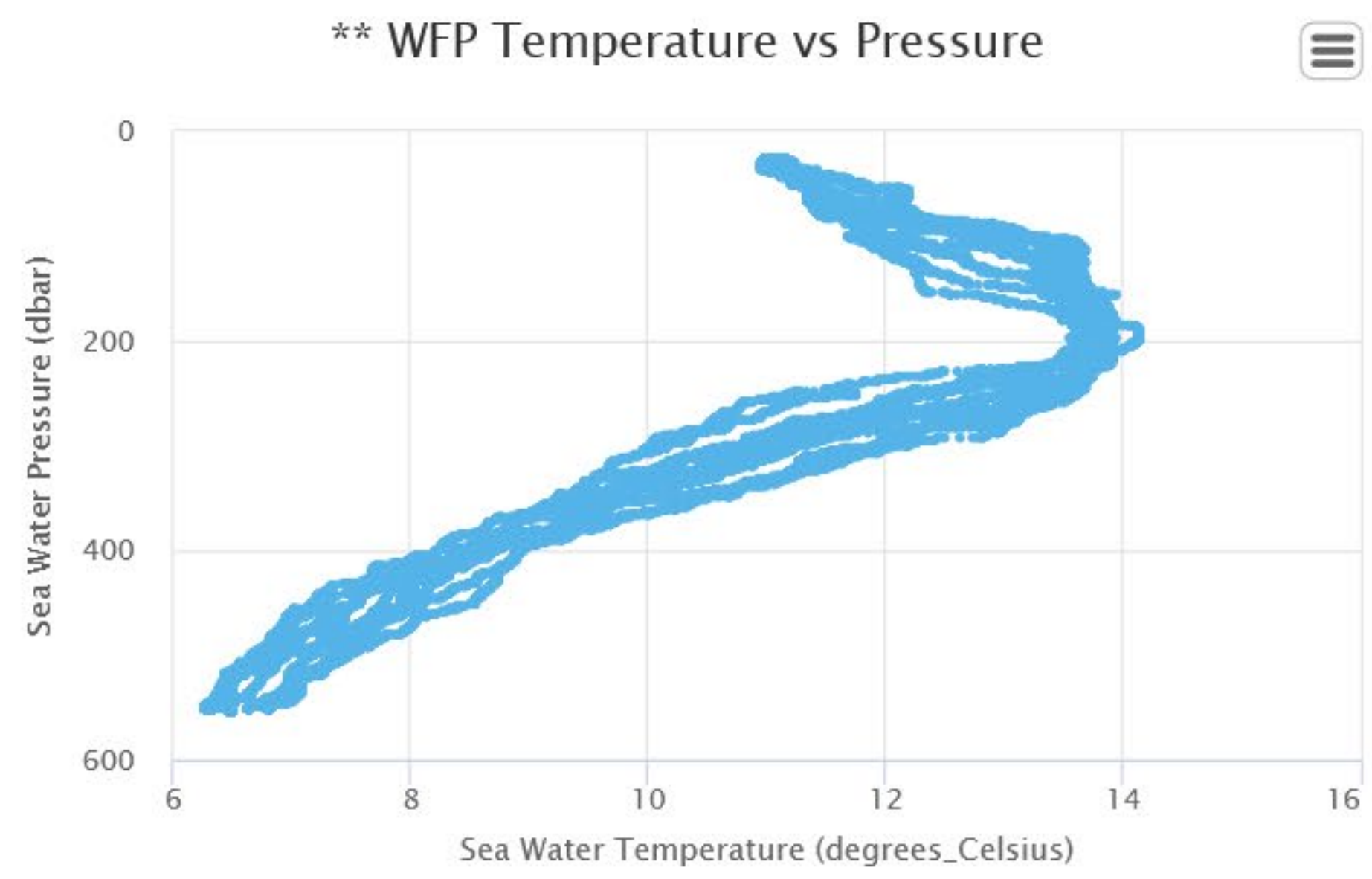
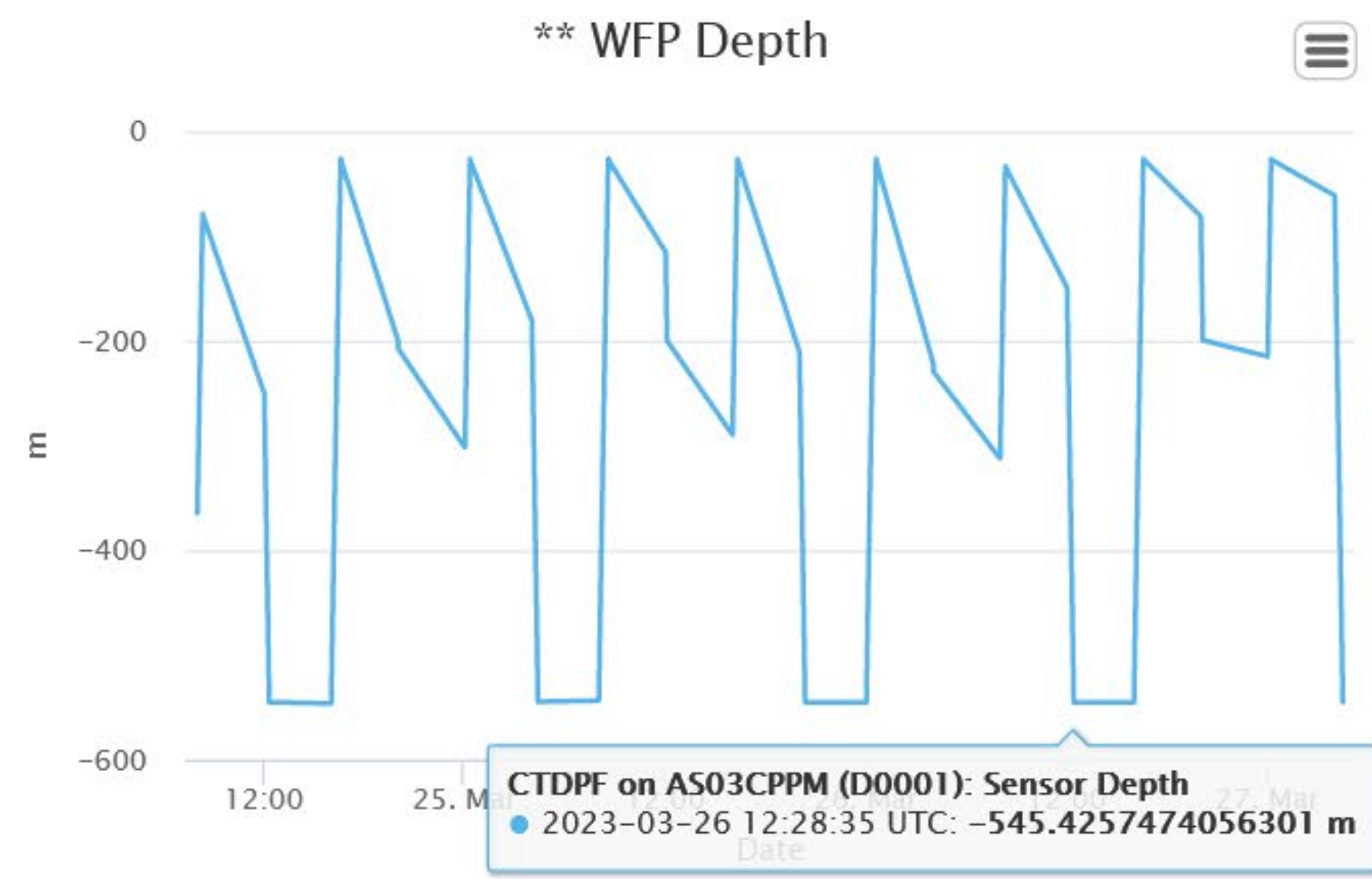
- Feb 2023- Oct 2024
- Surface Mooring
 - Central Site
- Profiler Mooring
 - Northeast site
- Engineering tests
 - Minimal science data





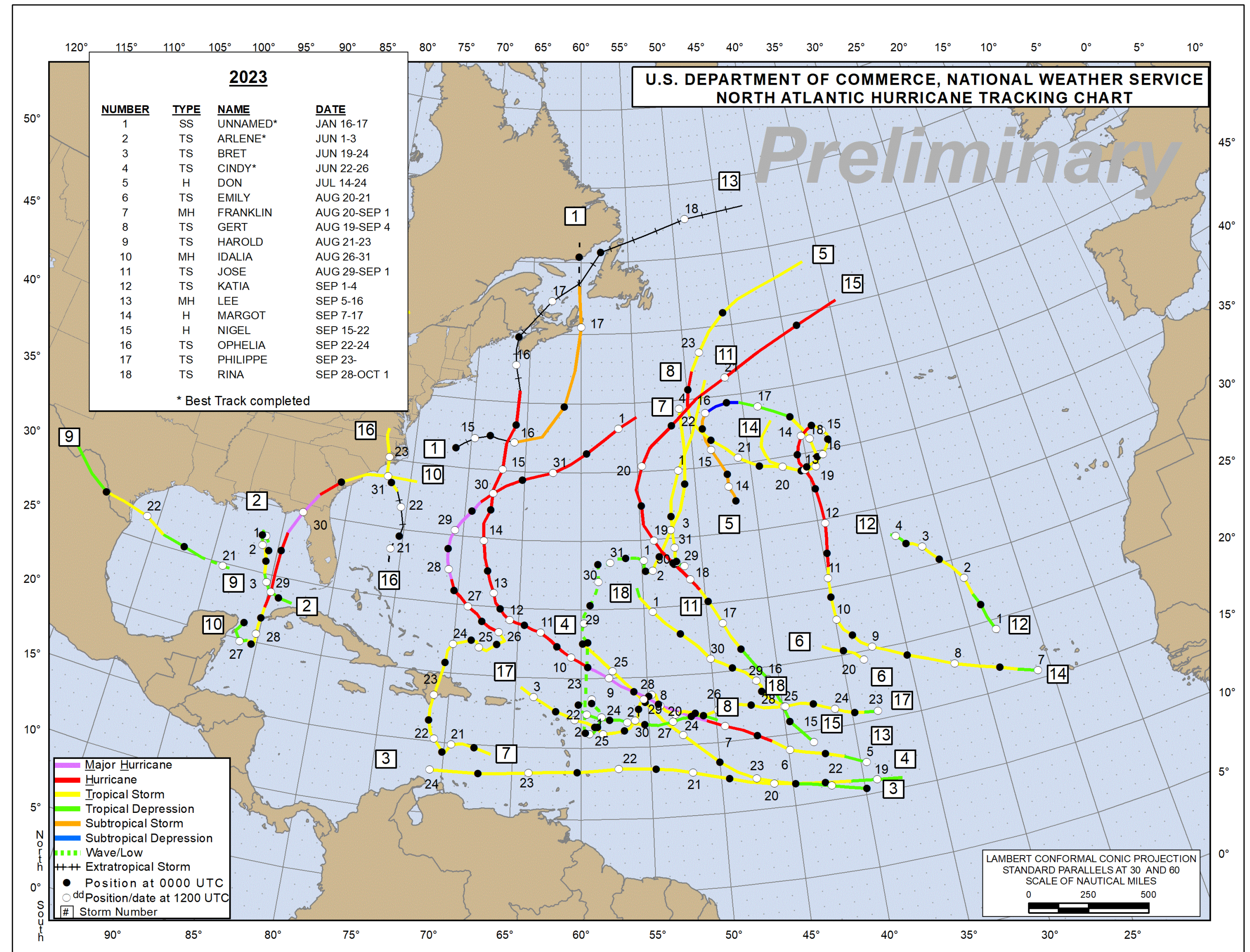
AST3 Profiler Mooring

- Northeast site, 600 m depth, modified NES design
- “MAB configuration” with sphere ADCP, surface T/S, new linepack
- 5-month deployment, no issues



2023 Atlantic Storms (so far)

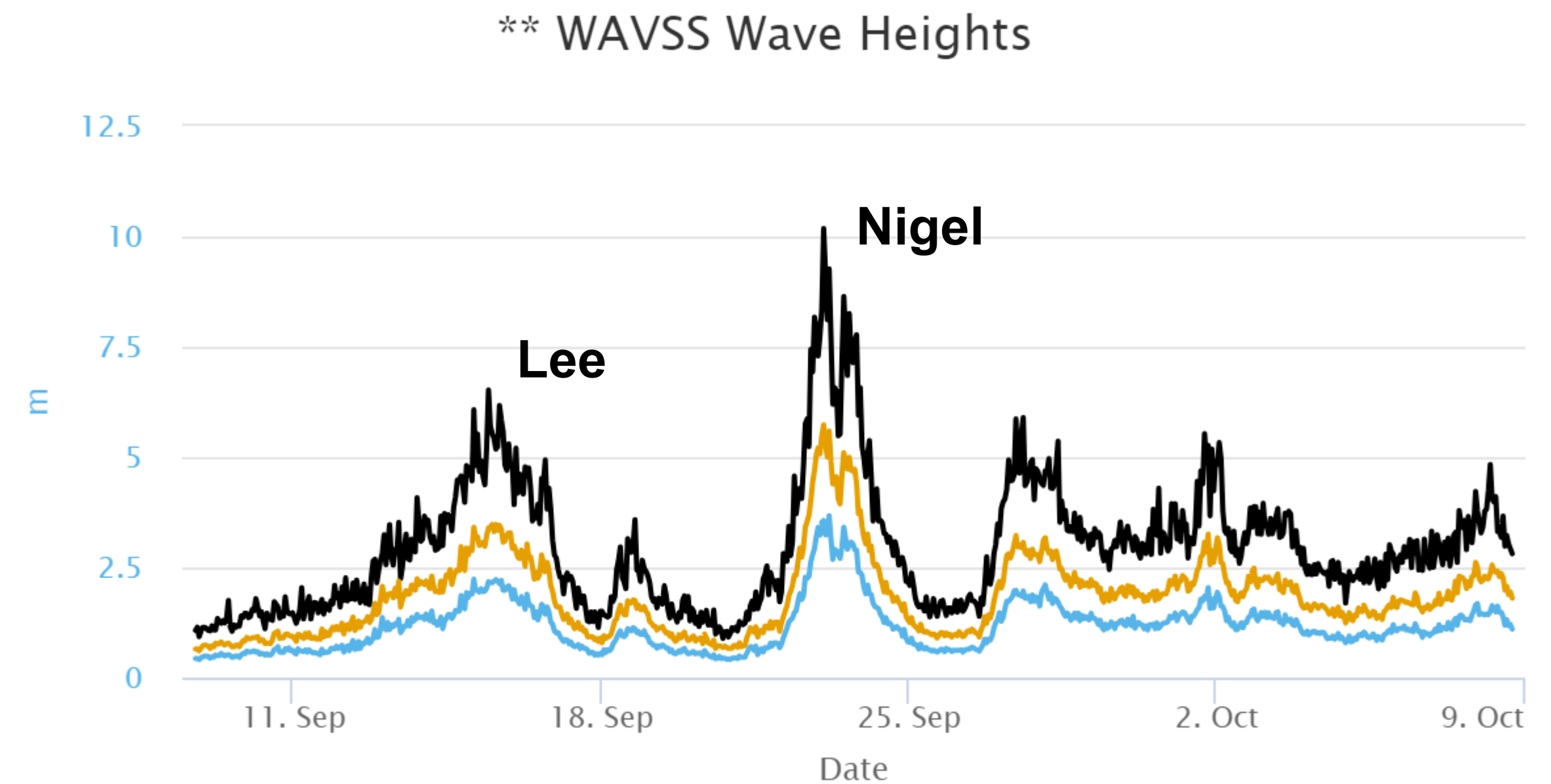
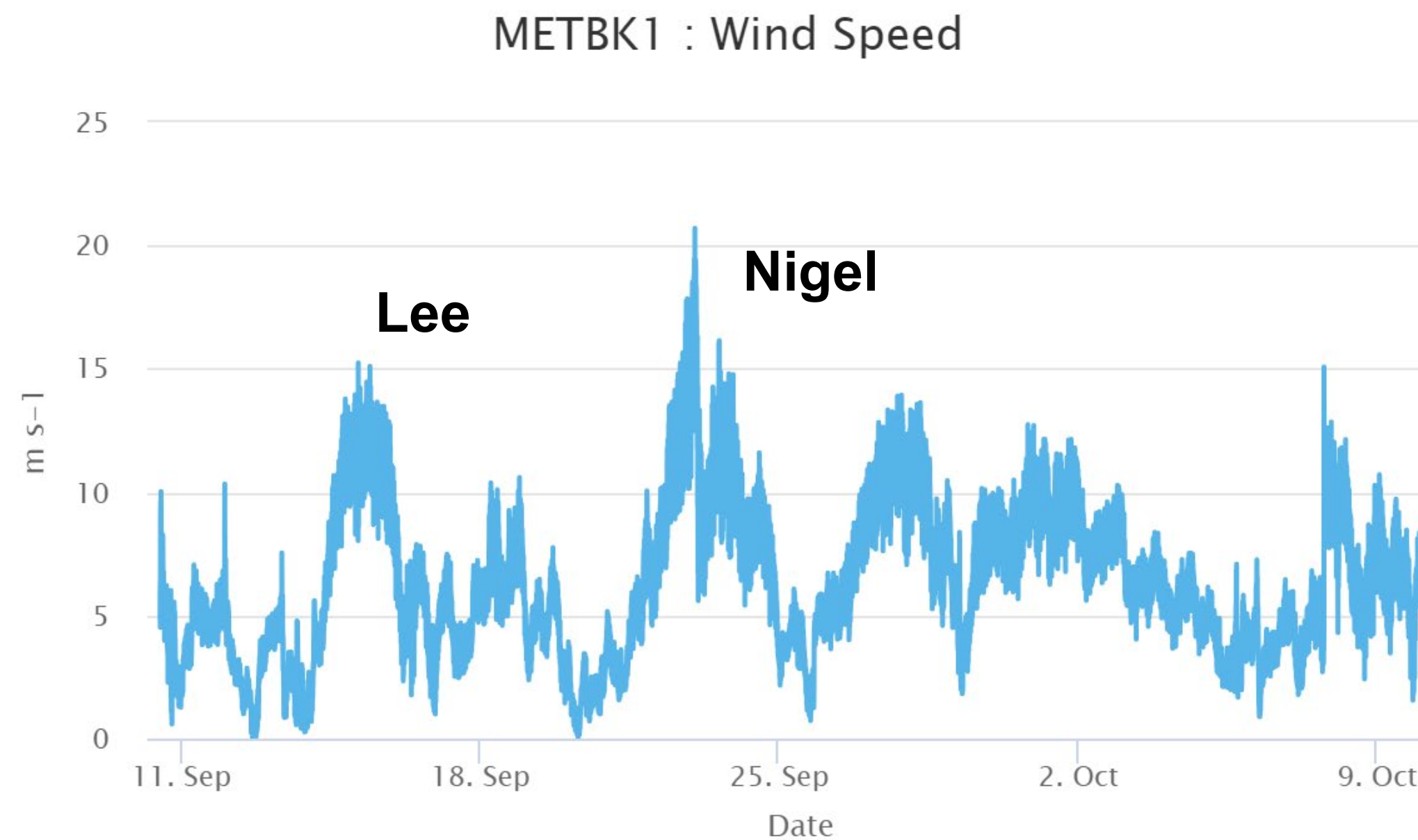
- 18 named storms
- 6 hurricanes (3 MH)
- Significant wind and wave events at MAB
- Lee and Nigel particularly impactful
- No direct hits





AST3 Surface Mooring

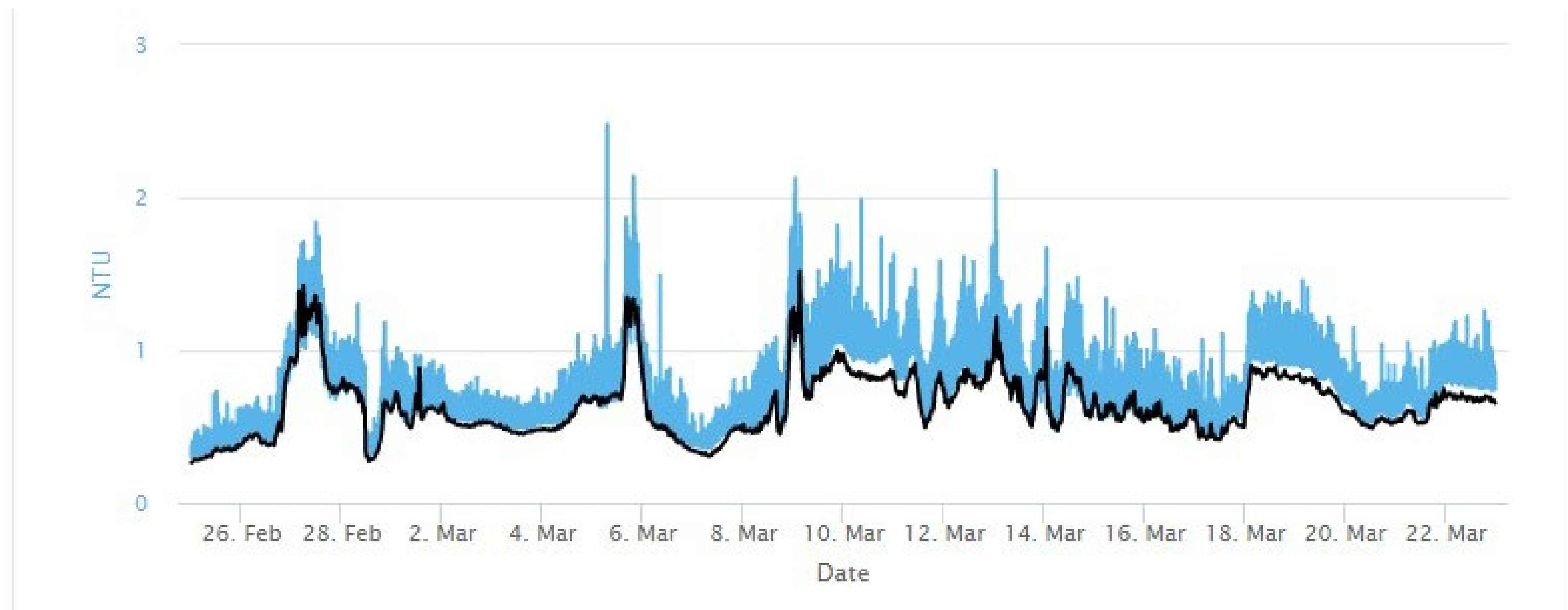
- Central Site, 30 m depth, modified NES design
- Instrumented for mooring performance (surface met, waves, tilt, ...)
- 7 months deployment, no issues





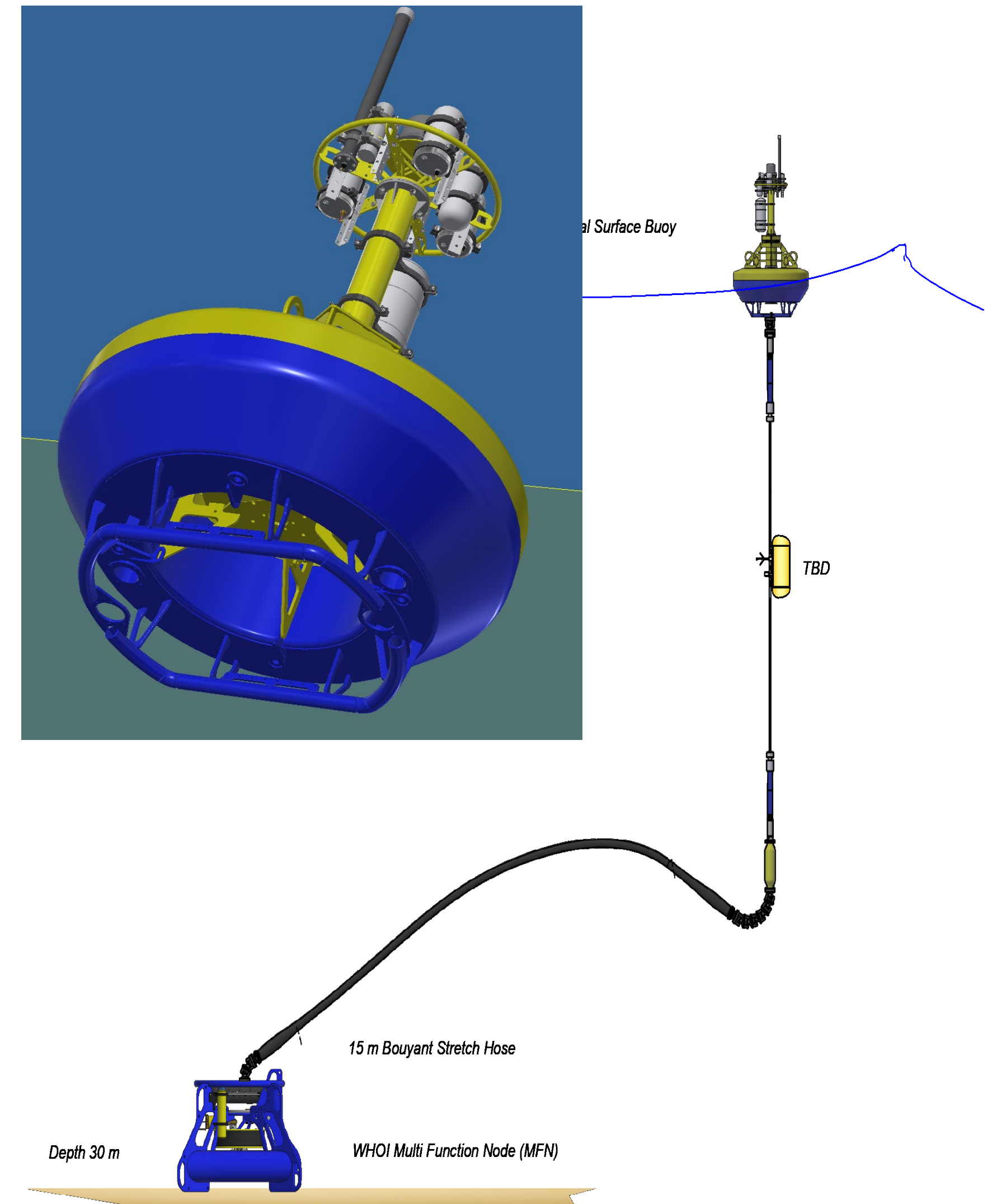
Turbidity Sensor Comparison

- Central Site CSM NSIF at 7 m depth in 30 m of water
- Fluorometer calibrated for turbidity vs. Seapoint turbidity sensor



Shallow Water Mooring (SWM)

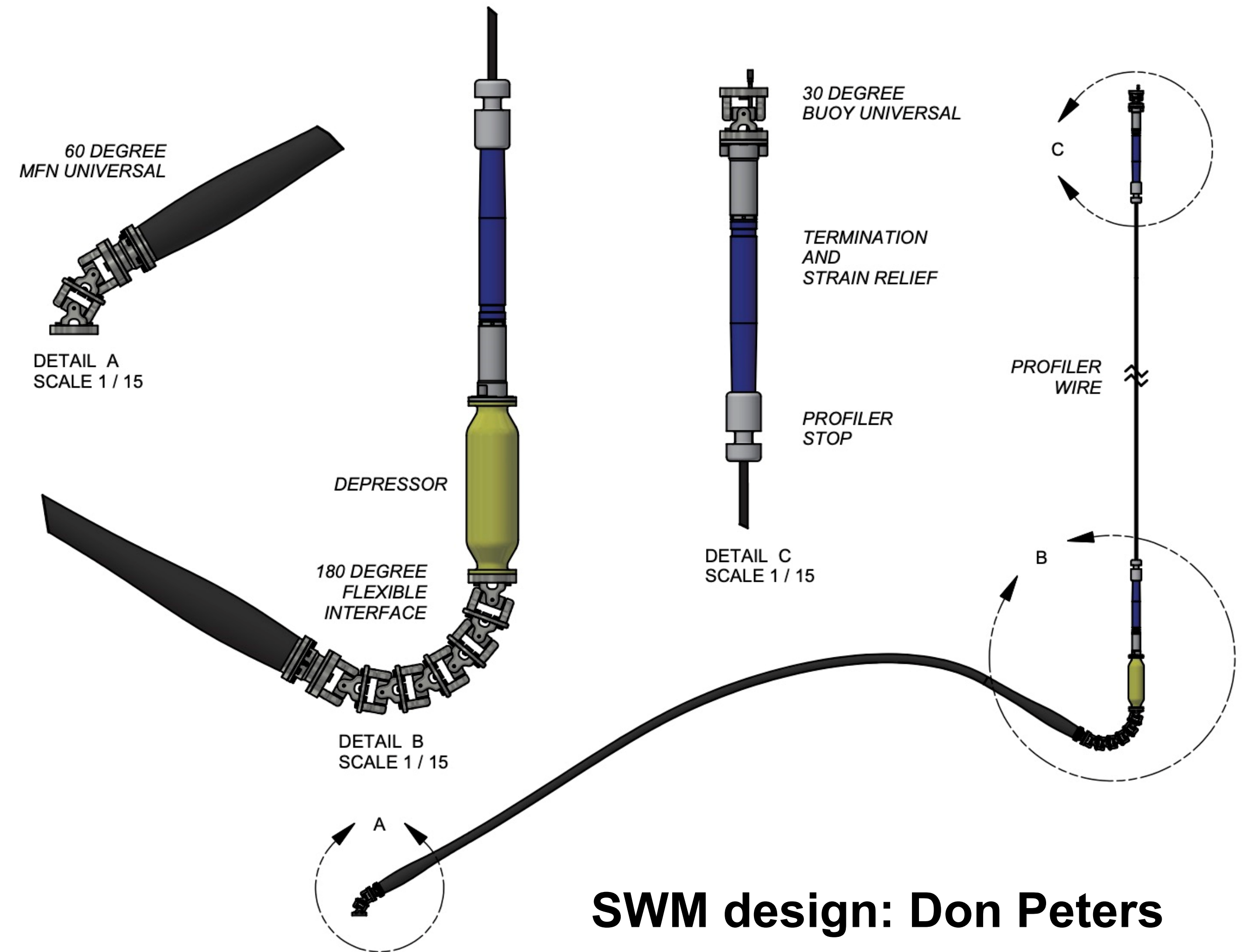
- Discus Buoy with enlarged center well
 - Wave-powered profiler on taut wire
 - Elastic inverse catenary design – depressor weight below wire section, U-joint, buoyant stretch hose
 - Reduced size Multi-Function Node
-
- MAB 30 m sites (West and Central)
 - Design Review (Delta-PDR, Jul 2023)
 - Test deployment Fall 2023



SWM Riser Components

Bottom to top (left to right)

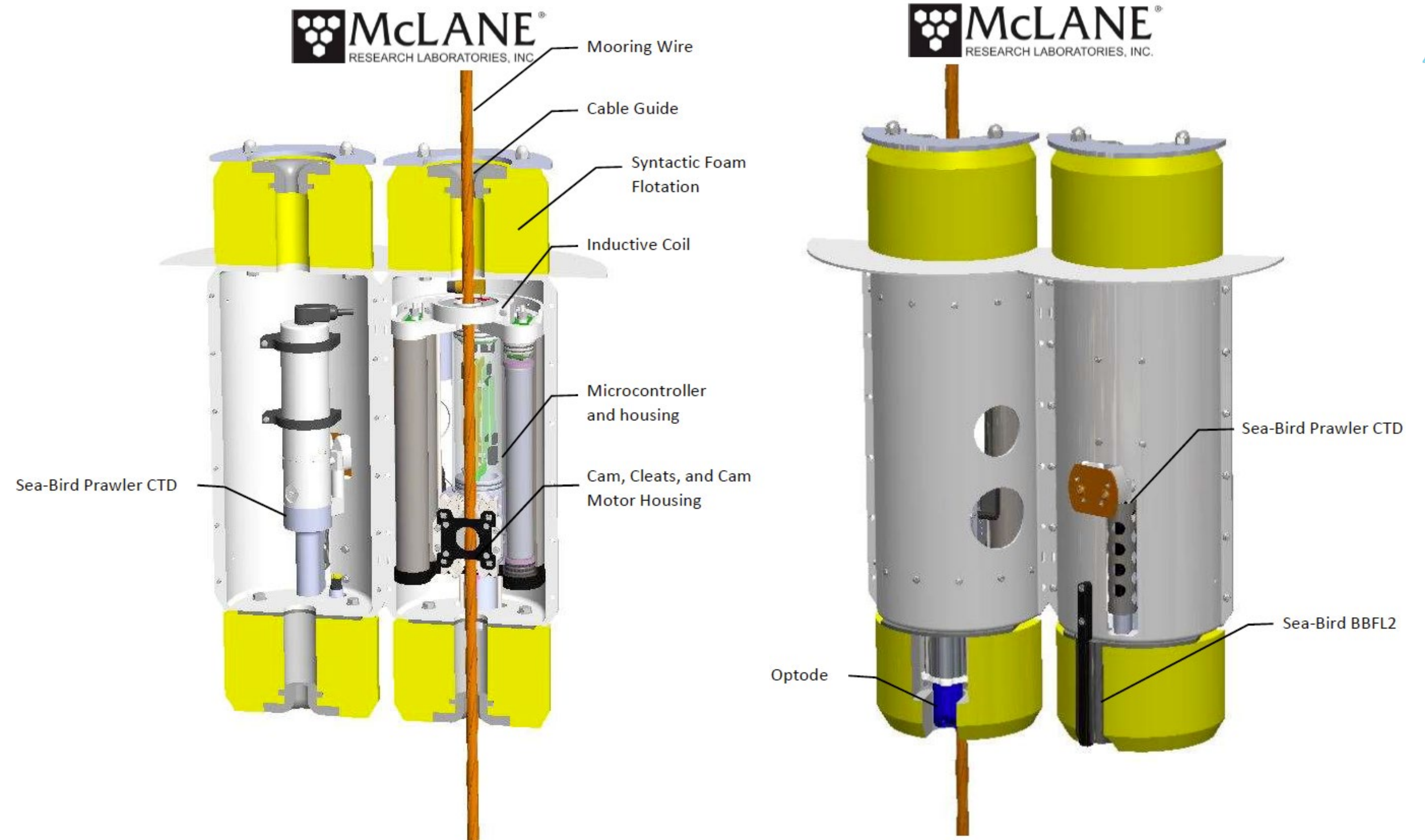
- 60 deg U-Joint at MFN
 - Buoyant stretch hose
 - 180 deg U-Joint at depressor
 - Termination/strain relief
 - Custom 3/8 wire rope
 - Termination/strain relief
 - 30 deg U-Joint at buoy base
-
- Design to be presented at MTS Buoy Workshop 2024



Wave-Powered Profiler

- **McLane Prowler**

- RFI Selection Process
- Climb up, free-fall down
- Small package – less drag
- 3/8" jacketed wire rope
- Includes CTD, DO, FLORT
- Vendor provides refurbishment services



SWM Instrumentation

- The Shallow Water Mooring incorporates current OOI instrumentation.

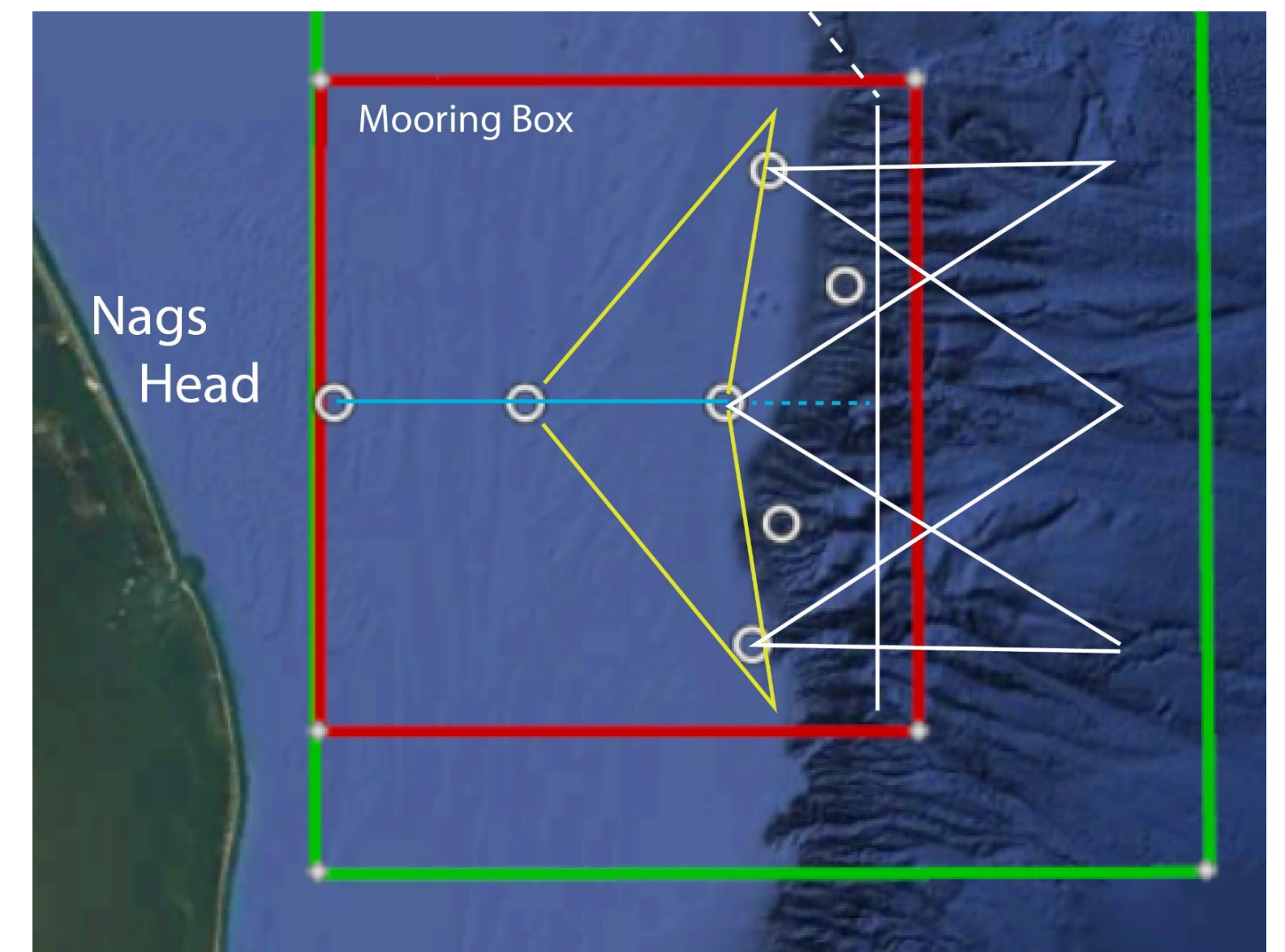
Location	OOI 5-letter Code	Measurement	Instrument
Buoy	CTDMO VELPT	CTD Point Velocity	SBE 37IM Aquadopp
Profiler	CTDPF DOSTA FLORT	CTD Dissolved O ₂ Chl & CDOM fluorescence, 700 nm backscatter	SBE 37 Aanderaa Optode 4830F WET Labs BBFL2
MFN	CTDMO ADCPT	CTD Velocity Profiler	SBE 37IM Teledyne RDI WHS600-200





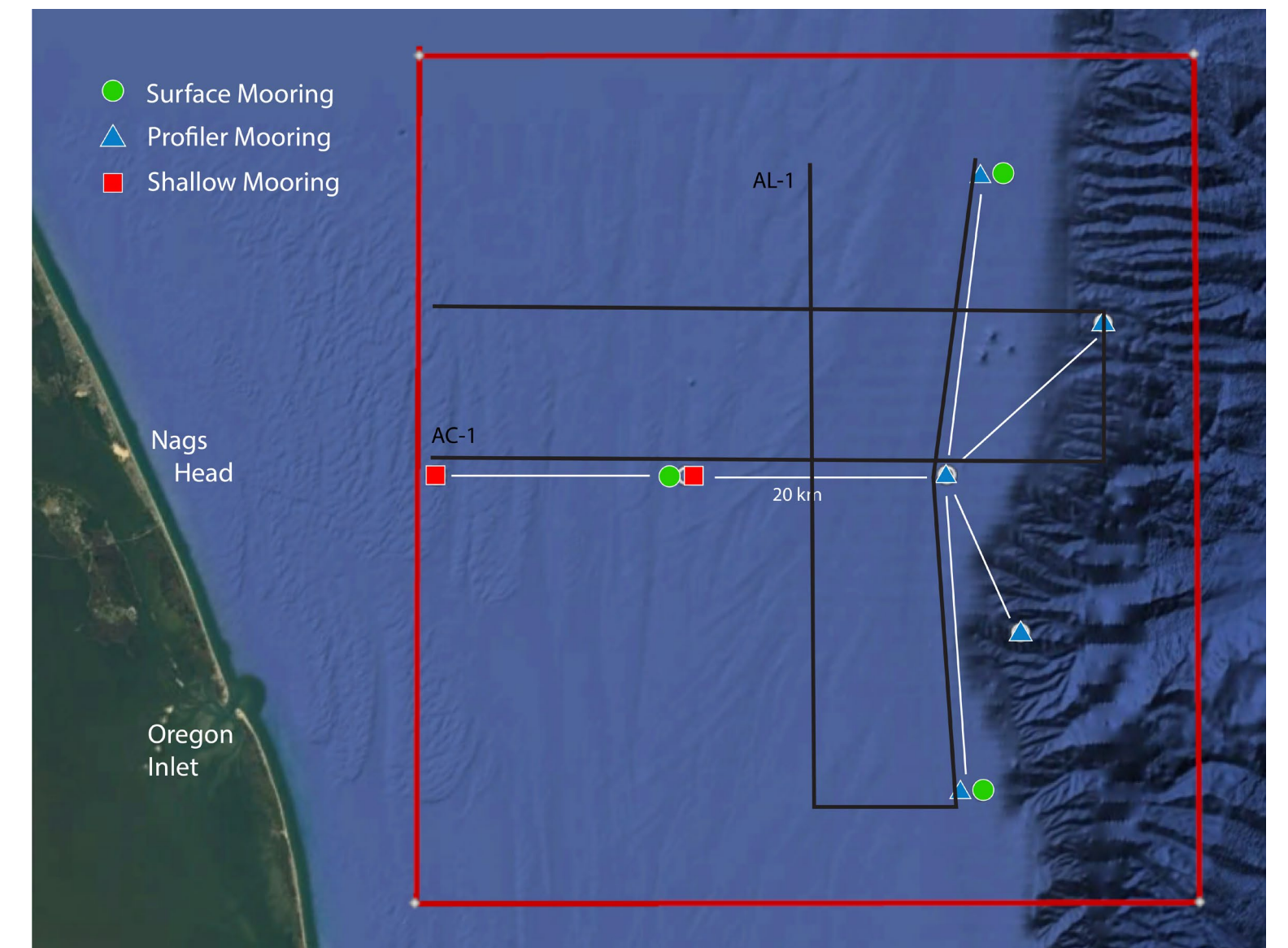
Glider Testing

- Offshore Mesoscale line: analogous to NES offshore
- Offshore Flux line: analogous to NES offshore
- Moored Array line: MAB flight test, summer 2023
- Cross Shelf line: MAB and NES flight tests, summer and fall 2023
- Issues/risks: Optimal pump, high number of pump cycles, risk of displacement by currents, risk of fouling by sediment



AUV Testing

- Along-shelf line: analogous to NES along-shelf
- Cross-shelf line: MAB flight test, fall 2023
- Issues/risks: Triangle mode behavior in shallow water; risk of fouling by suspended sediment





Regulatory and Permitting Status

- Completed review of regulatory requirements (Tetra Tech)
 - Completed Environmental Assessment (Tetra Tech)
 - Completed Marine Archeology assessment (Tetra Tech)
 - Completed initial Site Survey (AST3 deployment cruise)
 - Concurrence from USCG re: PATONs and LNM
 - Prepared Self-certification memo for USACE NWP #5
-
- Supplemental SSEA and NEPA process implemented by NSF
 - SSEA public comment period, October 2023
 - Supplemental site survey, Oct 2023





Response to commercial fishers

- Offshore moorings (600 m/330 fm) are in longline fishers “hot spot”
- One entanglement incident reported with test mooring
- Accepting formal feedback during NEPA comment period

- Potential actions
 - Recover offshore test mooring early – done (Aug 2023)
 - Site surveys for shallower sites (AST3 recovery cruise)
 - Move offshore moorings to shallower sites





Implementation Phase – Look Ahead

- Response to NEPA public comments, array “micro-siting”
- Supplemental site survey (shallower sites, Fall 2023)
- Shallow water mooring test (Fall 2023)
- Mooring performance assessment (post-recovery, AST3 & AST4)
- Glider performance assessment (Fall 2023)
- Instrument deliveries, testing, develop sampling plans
- System engineering, electrical design, configuration management
- Design Reviews: Delta-CDR for CSM & CPM; CDR for SWM
- Integration with Cyberinfrastructure, data ingestion and delivery
- Infrastructure build, integrate and test; deploy April 2024





Community Outreach

Cumulative

- >25 science community outreach activities
- >10 regulatory/stakeholder communications
- North Carolina “road show”: 4 talks, 9 institutions, ~170 people

Look ahead

- Fall AGU (Dec 2023)
- Ocean Sciences (Feb 2024)
- MTS Buoy Workshop (May 2024)
- Pioneer MAB deployment (April 2024)
- MAB Community Workshop (Sep? 2024)





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Questions?

