The OOI Pioneer MAB Array

Al Plueddemann and Derek Buffitt| Woods Hole Oceanographic Inst, Woods Hole, MA 02543

Background

The OOI Pioneer Array was envisioned as a relocatable coastal array to investigate exchange processes on the continental shelf and upper slope.

- Originally sited on the New England Shelf in 2016, NSF launched a process to consider relocation of the array in the fall of 2020.
- Input was solicited from the community by means of two week-long Innovations Labs where interdisciplinary teams of researchers, stakeholders, and educators worked together to consider relocation options, develop research themes, and provide array design recommendations.
- The process concluded with a decision to move the array to the southern Mid-Atlantic Bight (MAB) in the spring of 2024.

Input from the Innovations Labs resulted in high-level science themes, a preliminary array design, and recommendations for additional instrument types and locations. With this as input, the OOI Program:

- Evaluated community recommendations in the context of operating constraints, logistical constraints, and the projected operating budget.
- Created an array layout, updated mooring designs, and procured new instruments.
- Conducted an environmental assessment, solicited a regulatory study and participated in a NEPA review.

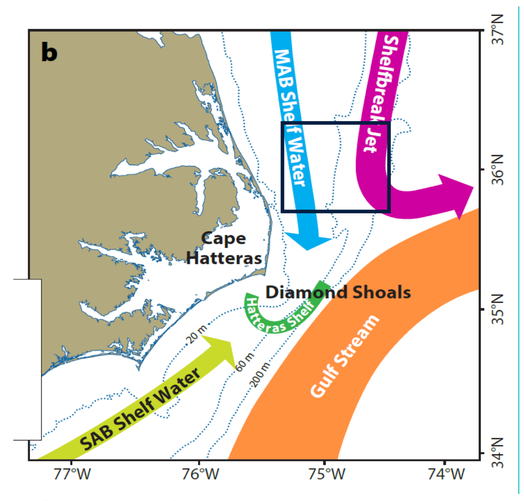
Science Themes

Pioneer MAB science themes were generated from community. More than 100 science topics and questions from the Innovations Labs were consolidated into three overarching themes:

Dynamics of shelf-slope exchange
- Wind forcing, frontal instabilities, Gulf Stream influence
- Role of ageostrophic currents and submesoscale variability

Biogeochemical cycling and transport
- Carbon, nutrients and particulates
- Ecosystem response
- Role of freshwater plumes

Extreme events
- Hurricanes, winter storms
- Freshwater outflows
- Impact on shelf stratification



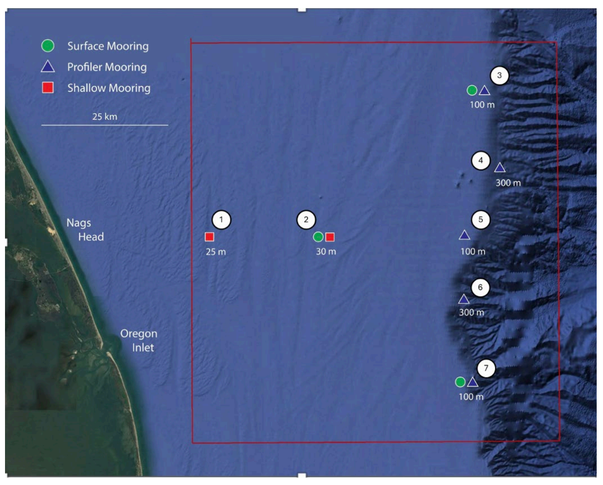
Schematic of major current systems in the sourthern Middle Atlantic Bight (MAB). The region to be occupied by the moored array is overlaid (black rectangle). Adapted from Seim et al., 2022.

Array Design: Moorings

The moored array design was based on the consensus developed during the Innovations Labs. Goals included: a spatially coherent array spanning the shelf and slope, a mooring line oriented cross-shelf, multiple sites north-south near the shelfbreak, and one or more moorings in the slope sea.

Challenges for mooring placement and glider lines in the MAB region included:
- Range of water depths, strong currents, intermittent freshwater outflows
- Regulatory, environmental, and permitting requirements
- Waterspace management (navigation lanes, shipwrecks, wind farms)

The Moored Array consists of ten moorings occupying seven sites in a sideways 'T' shaped array.
- Site spacing is 20 to 25 km
- North, South and Central sites contain mooring pairs
- Shallow Water Moorings are at 25-30 m depth, sites (1), (2)
- Surface Moorings are at 30 and 100 m depth, sites (2), (3), (7).
- Profiler Moorings are at 100 and 300 m depth, sites (3) - (7).

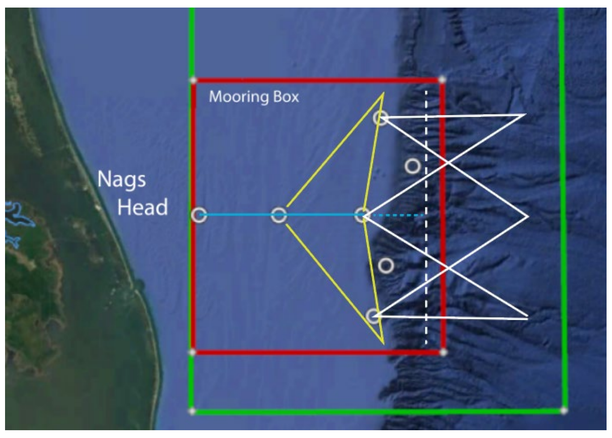


Array Design: Gliders and AUVs

The glider and AUV sampling design was based on the consensus developed during the Innovations Labs. Goals included: lines oriented both along and across shelf, lines tying together the mooring sites, sampling in the vicinity of the shelfbreak, and extending the footprint of the moored array offshore.

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

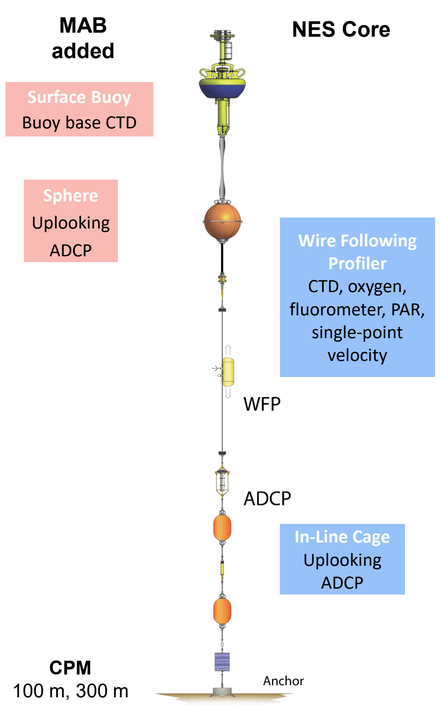
AUV
CTD, oxygen, fluorometer, PAR, nitrate, ADCP

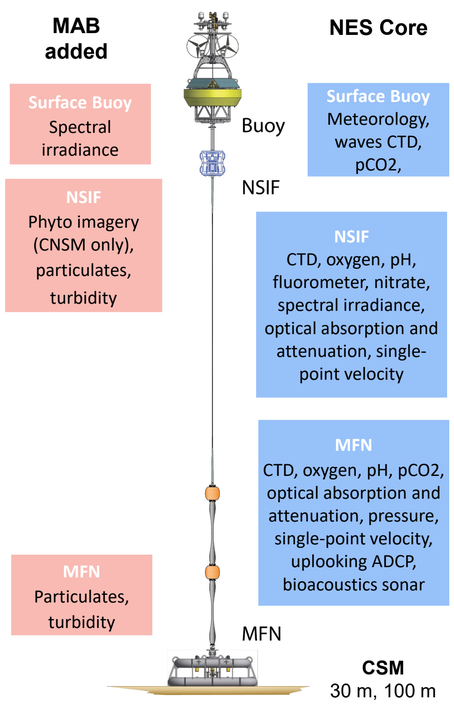


Four glider lines will be occupied:
- Cross Shelf (blue)
- Moored Array (yellow)
- Offshore Mesoscale (white)
- Offshore Flux (white dashed)

Moored Instrumentation

The instrumentation baseline is the Pioneer Array New England Shelf (NES) core sensors. Several sensors were added to Coastal Surface Moorings (CSM) and Coastal Profiler Moorings (CPM) according to consensus recommendations from the Innovations Labs.





Shallow Water Mooring

A new design was used for the Shallow Water Moorings (SWM). Objectives were to measure the upper 80% of the water column and come within a few meters of the surface. OOI core instrumentation was adapted to the SWM to the extent possible.

Shallow Water Mooring design elements include:
- Toroidal surface buoy
- Wire rope section with wave-powered profiler
- Depressor weight below the profiler wire
- Multi-element universal joint and buoyant stretch hose below the depressor for compliance
- A multi-function node at the seafloor.