

OOI Coastal Pioneer Mid-Atlantic Bight Array CTD and Discrete Water Sampling Data from Mooring Maintenance Cruises from 2024 to 2026 (OOI Cruise Data Project)

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Project

» [OOI Discrete CTD and Water Sampling Cruise Data](#) (OOI Cruise Data)

Program

» [Ocean Observatories Initiative](#) (OOI)

Contributors	Affiliation	Role
Plueddemann, Albert	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
Reed, Andrew	Woods Hole Oceanographic Institution (WHOI)	Data Manager
Newman, Sawyer	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

The hydrographic sampling performed by OOI-CGSN (the Ocean Observatories Initiative - Coastal and Global Scale Nodes) as part of each Array turn represents a significant collection of valuable physical, chemical, and biological information. In addition to the CTD, collected hydrographic data include discrete oxygen, salinity, nutrient (nitrate, nitrite, silicate, phosphate, ammonium), chlorophyll, and carbon system measurements. These data serve several important functions. First, they are necessary for the calibration and evaluation of the moored instrumentation at each Array. Furthermore, the annual (Global) or biannual (Coastal) collection of data at the same locations provides a unique time series of a large set of water properties following established community standards and methods, independent of its association with the OOI moorings. The analyses of collected water samples for the parameters listed above are performed by a number of outside labs on behalf of OOI-CGSN. Consequently, the water sampling data for a given cruise is distributed among a number of different files. The Discrete Sampling Summary integrates the related CTD, metadata, and discrete water sample data into a single file. Additionally, it synthesizes qualitative and quantitative information about the quality of a measurement into data quality flags for each associated parameter which follow WOCE-standards. The final product per cruise is the Discrete Sampling Summary spreadsheet which contains the metadata, CTD data and discrete water sample data into a single spreadsheet with data quality flags. For the original sample data files per cruise, navigate into the "Water_Sampling" folder within each cruise in OOI's Raw Data Archive (see Related Dataset). This BCO-DMO dataset combines the Summary spreadsheets for all cruises together into a single tabular data file. The Coastal Pioneer Mid Atlantic Bight (MAB) Array is located off the coast of North Carolina, starting about 25 km east of Nags Head. The MAB continental shelf north of Cape Hatteras is characterized by a persistent equator-ward current originating from the north, a shelfbreak front separating shelf and slope waters, distributed buoyancy inputs from rivers, variable wind forcing, and intermittent offshore forcing by Gulf Stream meanders. The Pioneer MAB Array is designed to resolve transport processes and ecosystem dynamics in the vicinity of the shelfbreak front, which is a region of complex oceanographic dynamics, intermittent mesoscale variability, and enhanced biological productivity. The MAB array began sampling in 2024 and consists of 10 moorings at 7 sites arranged in a T-shape spanning 50 km east/west and 50 km north/south along the continental shelf, centered near the shelf-break front.

Table of Contents

- [Coverage](#)
- [Dataset Description](#)
 - [Methods & Sampling](#)
 - [Data Processing Description](#)
 - [Problem Description](#)
- [Related Publications](#)
- [Parameters](#)
- [Instruments](#)

- [Project Information](#)
 - [Program Information](#)
 - [Funding](#)
-

Coverage

Location: The Mid-Atlantic Bight in the western Atlantic Ocean

Spatial Extent: Lat:0 Lon:0

Dataset Description

OOI-CGSN CTD Sampling Guidelines

In general, water samples are collected for analysis at depths that correspond to instrumentation making in situ measurements. For example, Near Surface Instrument Frames (NSIFs) have instrumentation that measure dissolved oxygen (DO), salinity (CTD), nitrate (NUTNR), the partial pressure of CO₂ (CO₂), and chlorophyll a fluorescence, so water samples should be collected at the depth of the NSIF for analyses of all those parameters. Additionally, as noted above, OOI water sampling data are valid long-term datasets in and of themselves. Thus, some measurement locations are driven by broader science questions.

Soak Time – The CTD rosette should be allowed to equilibrate (e.g., the CTD sensor readout stabilizes) at the desired target depth for at least 1 minute or more depending on conditions. Longer soak times may occur to accommodate acoustic release testing or other activities.

Citing OOI Data

Refer to specific guidance related to citing OOI data on the OOI website at <https://oceanobservatories.org/how-to-use-acknowledge-and-cite-data/>.

Methods & Sampling

OOI Coastal Pioneer MAB Array Sampling Guidelines

The Coastal Pioneer Array at the Mid-Atlantic Bight had its first deployment in Spring of 2024. The Pioneer-MAB Array consists of 3 Coastal Surface Moorings, 5 Coastal Profiler moorings, two Coastal Shallow Water profiler moorings, and mobile assets. Four Coastal Gliders are present in the Array year-round. AUVs are operated in the Array during OOI cruises.

There are a few general guidelines which also inform the strategies defined below:

- Collect 4-6 water samples spaced throughout the water column (surface, 7 m, bottom, and 2-3 in between).
- Depths selected based on water column stratification and/or location of min/max features (e.g., O₂ minimum, Chlorophyll maximum).
- Collect Chlorophyll in surface waters down to ~50 m + one deep sample (or where a fluorescence signal is no longer detected).
- Collect DIC/TA, pH at 7 m and at the bottom, and DIC/TA at intermediate depths.
- Collect duplicate O₂ and Salts at every depth.

Coastal Central Surface Mooring Sampling / Coastal Shallow Water Profiler Sampling

- Collect 4 water samples spaced throughout the water column (surf, 7 m, 25 m, and bottom).
- Collect Nutrients and IFCB discrete samples at surface, 7 m, and at the bottom.
- Collect Chlorophyll at all depths.
- Collect DIC/TA, pH at 7 m and at the bottom, and DIC/TA at the surface.

Coastal Northern/Southern Surface Mooring & Coastal Profiler Mooring Sampling

- Collect 4-6 water samples spaced throughout the water column (surface, 7 m, bottom, and 2-3 in between).
- Depths selected based on water column stratification and/or location of min/max features (e.g., O₂

- minimum, Chlorophyll maximum).
- Collect Chlorophyll in surface waters down to ~50 m + one deep sample (no need to sample where a fluorescence signal is no longer detected).
- Collect Nutrients through column except at the surface.
- For carbon measurements – pH at the bottom and 7 m depth; DIC/TA is important throughout water column and at depths with nutrient sampling.

Sampling Associated with Mobile Assets

- Collect 4-5 water samples spaced throughout the water column (surface, bottom, and 2-3 in between)
- Depths selected based on water column stratification and/or location of min/max features (e.g., O₂ minimum, Chlorophyll max)
- Collect Chlorophyll in surface waters down to ~50 m + one deep sample (no need to sample where a fluorescence signal is no longer detected)
- AUVs and Profiling Gliders – sample at 7 m instead of surface, and include nutrient sampling (because these vehicles transit close to Surface Moorings with an NSIF at 7 m).

Methods

Salinity

Salinity measurements are performed following the methodology outlined in the WHOI Hydrography Blue Book, *Automated Oxygen Titration and Salinity Determination* (Knapp et al. 1990). Measurements are performed using a Guildline Autosol model 8400B salinometer (Guildline Instruments of Canada). Manufacturer stated accuracy and precision at 35 psu is +/- 0.003 psu and 0.0002 psu. IAPSO standard seawater is used to standardize the Autosol daily before runs.

Oxygen

Dissolved oxygen measurements are performed following the methodology outlined in the WHOI Hydrography Blue Book *Automated Oxygen Titration and Salinity Determination* (Knapp et al. 1990), and the GO-SHIP Repeat Hydrography Manual oxygen chapter "Determination of dissolved oxygen in seawater by Winkler titration using the amperometric technique" (Langdon, 2010). For Pioneer cruises 20, 21, and 22 measurements are performed using a Metrohm Model 888 Titrando dosing device, with the titration endpoint determined amperometrically. Stated accuracy is 0.02 ml/l, with a precision of 0.001 ml/l.

Starting Pioneer 23, measurements are performed using a Metrohm Model 888 Titrando dosing device, Metrohm Model 805 Dosimat, Metrohm 20 mL exchange unit (burette), and Metrohm Pt Titrode, with the titration endpoint determined potentiometrically. Per the manufacturer following measuring mode U, the resolution is 0.1 mV with a measuring accuracy of +/-0.2 mV under reference conditions.

Nutrients

All nutrient values are reported as the average of triplicate analysis on a single collected sample.

Carbon System

Carbon system measurements are performed by the Wang lab (Woods Hole Oceanographic Institution). DIC and TA measurements follow the methodology of Wang and Cai (2004) with uncertainties of 2 umol/kg. DIC measurements are performed with an Apollo Sci-Tech AS-C3. TA measurements are performed with an Apollo Sci-Tech AS-ALK2 and ROSS electrode. pH measurements follow the methodology of Clayton and Byrne (1993) with an uncertainty of 0.002 pH units using an Agilent 8453.

Chlorophyll and Phaeo

Analysis was completed using a Turner Designs Aquafluor Handheld 800446.

Data Processing Description

File/Row Representation of Water Samples

There should be one row for each station-cast-niskin bottle set. Multiple samples for the same parameter from a single niskin bottle are split into separate rows, with the associated CTD data copied to the new row. The first

row of the file is the column headers.

Data Fill Values and Flag Description

The data flags are presented in the summary sheet as a 16-bit array, read from right-to-left, where a 1 in a particular bit position indicates a particular flag meaning applies. For example, a flag of 0000000000000010 for the column **CTD_File_Flag** indicates that the cast was a data cast only.

Additionally, these data flags are an assessment of the collection and processing of the relevant data or samples, and are not an assessment of the *accuracy* of the data. For example, a conductivity sensor which has the correct calibration coefficients and functions normally will receive a quality flag of 0000000000000100 (acceptable measurement). However, the calibration coefficients may be out of date and off with respect to the discrete salinity results; this does not affect the assigned flag.

For full details about flag meanings, refer to the Readme files available for download in the Supplemental Files section of this metadata page.

Problem Description

No problems or issues have been reported by the dataset authors. Refer to the Readme files available in the Supplemental Files section of this dataset for full details about data quality flags present in the data.

[[table of contents](#) | [back to top](#)]

Related Publications

Clayton, T. D., & Byrne, R. H. (1993). Spectrophotometric seawater pH measurements: total hydrogen ion concentration scale calibration of m-cresol purple and at-sea results. Deep Sea Research Part I: Oceanographic Research Papers, 40(10), 2115–2129. doi:[10.1016/0967-0637\(93\)90048-8](https://doi.org/10.1016/0967-0637(93)90048-8)
Methods

Knapp, G. P., Stalcup, M. C., & Staney, R. J. (1990). Automated oxygen titration and salinity determination. <https://doi.org/10.1575/1912/1020>
Methods

Wang, Z. A., & Cai, W.-J. (2004). Carbon dioxide degassing and inorganic carbon export from a marsh-dominated estuary (the Duplin River): A marsh CO₂ pump. Limnology and Oceanography, 49(2), 341–354. doi:[10.4319/lb.2004.49.2.0341](https://doi.org/10.4319/lb.2004.49.2.0341)
Methods

[[table of contents](#) | [back to top](#)]

Parameters

Parameters for this dataset have not yet been identified

[[table of contents](#) | [back to top](#)]

Instruments

Dataset-specific Instrument Name	Apollo Sci-Tech AS-ALK2 and ROSS electrode
Generic Instrument Name	Apollo SciTech AS-ALK2 total alkalinity titrator
Dataset-specific Description	Carbon system measurements are performed by the Wang lab (Woods Hole Oceanographic Institution). DIC and TA measurements follow the methodology of Wang and Cai (2004) with uncertainties of 2 umol/kg. DIC measurements are performed with an Apollo Sci-Tech AS-C3. TA measurements are performed with an Apollo Sci-Tech AS-ALK2 and ROSS electrode. pH measurements follow the methodology of Clayton and Byrne (1993) with an uncertainty of 0.002 pH units using an Agilent 8453.
Generic Instrument Description	An automated acid-base titrator for use in aquatic carbon dioxide parameter analysis. The titrator provides standardisation and sample analysis, using the Gran titration procedure for alkalinity determination of seawater and brackish waters. It is designed for both shipboard and land based laboratory use. The precision of the instrument is 0.1 percent or higher, and sample volumes may range from 10-25 ml. Titration takes approximately 8 minutes per sample, and the repeatability is within plus or minus 1-2 micromoles per kg.

Dataset-specific Instrument Name	8400B salinometer (Guildline Instruments of Canada)
Generic Instrument Name	Autosal salinometer
Dataset-specific Description	Salinity measurements are performed following the methodology outlined in the WHOI Hydrography Blue Book _Automated Oxygen Titration and Salinity Determination_ (Knapp et al. 1990). Measurements are performed using a Guildline Autosal model 8400B salinometer (Guildline Instruments of Canada). Manufacturer stated accuracy and precision at 35 psu is +/- 0.003 psu and 0.0002 psu. IAPSO standard seawater is used to standardize the Autosal daily before runs.
Generic Instrument Description	The salinometer is an instrument for measuring the salinity of a water sample.

Dataset-specific Instrument Name	Niskin
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Niskin bottles on CTD rosette used to collect water samples.
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	SBE 43
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Dataset-specific Description	SBE used to determine CTD oxygen values.
Generic Instrument Description	The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. More information from the manufacturer: https://www.seabird.com/products/sbe-43-dissolved-oxygen-sensor

Dataset-specific Instrument Name	Metrohm Model 888 Titrando dosing device
Generic Instrument Name	Titration
Dataset-specific Description	Dissolved oxygen measurements are performed following the methodology outlined in the WHOI Hydrography Blue Book _Automated Oxygen Titration and Salinity Determination_ (Knapp et al. 1990). Measurements are performed using a Metrohm Model 888 Titrando dosing device, with the titration endpoint determined amperometrically. Stated accuracy is 0.02 ml/l, with a precision of 0.001 ml/l.
Generic Instrument Description	Titration is an instrument that incrementally adds quantified aliquots of a reagent to a sample until the end-point of a chemical reaction is reached.

Dataset-specific Instrument Name	WL CSTAR Trans
Generic Instrument Name	WET Labs {Sea-Bird WETLabs} C-Star transmissometer
Dataset-specific Description	Wet Labs CSTAR Transmissometer was used to determine Beam Attenuation and Beam Transmission values.
Generic Instrument Description	The C-Star transmissometer has a novel monolithic housing with a highly integrated opto-electronic design to provide a low cost, compact solution for underwater measurements of beam transmittance. The C-Star is capable of free space measurements or flow-through sampling when used with a pump and optical flow tubes. The sensor can be used in profiling, moored, or underway applications. Available with a 6000 m depth rating. More information on Sea-Bird website: https://www.seabird.com/c-star-transmissometer/product?id=60762467717

[[table of contents](#) | [back to top](#)]

Project Information

OOI Discrete CTD and Water Sampling Cruise Data (OOI Cruise Data)

Website: <https://oceanobservatories.org/>

The hydrographic sampling performed by the Ocean Observatories Initiative (OOI) as part of each research array turn represents a significant collection of valuable physical, chemical, and biological information. The collected hydrographic data include oxygen, salinity, nutrient (nitrate, nitrite, silicate, phosphate, ammonium), chlorophyll, and carbon system (dissolved inorganic carbon, total alkalinity, pH and partial pressure of CO₂) measurements. These data serve several important functions. First, they are necessary for the validation and evaluation of the moored instrumentation at each Array. Furthermore, the annual (Global Arrays and the Regional Cabled Array (RCA) or biannual (Coastal Arrays and the Endurance Array) collection of data at the same locations provides a unique timeseries of a large set of water properties following established community standards and methods, independent of its association with the OOI instrumentation.

[[table of contents](#) | [back to top](#)]

Program Information

Ocean Observatories Initiative (OOI)

Website: <http://oceanobservatories.org/>

The Ocean Observatories Initiative (OOI) is a science-driven ocean observing network that delivers real-time data to address critical science questions regarding the world's oceans. Funded by the National Science Foundation to encourage scientific investigation, OOI data are freely available online to anyone with an Internet connection. OOI was designed as a long-term project to collect ocean data for up to 30 years. This longevity makes it possible to measure and directly observe both short-lived episodic events and longer-term changes occurring in the ocean. Such data make it possible to better understand ocean processes and how the ocean is changing.

The OOI has five active research arrays that comprise the three major observatory elements linked together by instrument, infrastructure, and information management systems. Global Ocean Arrays consist of moored arrays and autonomous vehicles that provide time-series observations and mesoscale spatial sampling at sparsely sampled, high-latitude regions critical to our understanding of climate, the carbon cycle, and ocean circulation. The Regional Cabled Array consists of fiber-optic cables off the Oregon coast that provide unprecedented power, bandwidth, and communication to seafloor instrumentation and profiler moorings, enabling monitoring of volcanic and hydrothermal activity, methane seeps, earthquakes, and myriad ocean processes in coastal and blue water environments. Coastal Arrays consist of cross-shelf moored arrays and autonomous vehicles that observe the dynamic coastal environment, enabling examination of upwelling, shelf break fronts, and cross-shelf exchanges.

These marine arrays are outfitted with more than 900 instruments — of 45 different types — measuring more than 200 different parameters. These instruments gather physical, chemical, geological, and biological data — from the air-sea interface to the seafloor. The data collected are transmitted through a cyberinfrastructure, an information management system that allows users to access real- to near real-time data from suites of sensors. The OOI provides annotations and automated quality control for data streams and is working to meet the IOOS Quality Assurance of Real Time Ocean Data (QARTOD) standards.

[[table of contents](#) | [back to top](#)]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1743430
NSF Division of Ocean Sciences (NSF OCE)	OCE-2244833

[[table of contents](#) | [back to top](#)]