Discrete sample measurements of dissolved oxygen, dissolved inorganic carbon, and total alkalinity from the Seven Mile Island Innovation Laboratory (SMIIL) from Aug 2022 to Jun 2024

Website: https://www.bco-dmo.org/dataset/971872
Data Type: Other Field Results
Version: 1
Version Date: 2025-08-18

Project
» Sediment transport and water quality in watersheds and coastlines of the United States (SMIIL Water Quality)

Contributors	Affiliation	Role
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Abstract
This dataset contains discrete sample measurements of dissolved oxygen, dissolved inorganic carbon, and total alkalinity collected from 2022 through 2024 from a tidal salt marsh in New Jersey, USA. The marsh is located landward of Seven Mile Island, a populated barrier island in Cape May County, New Jersey, and is a part of the Seven Mile Island Innovation Laboratory (SMIIL), a research initiative focused on advancing dredging and marsh restoration practices. Samples in this dataset were collected as part of a collaboration between Boston College and the U.S. Army Corps of Engineers Engineer Research and Development Center. This project encompassed multi-year biogeochemical sensor deployments within the main tidal salt marsh channel and salt ponds on the marsh platform, as well as targeted deployments to monitor beneficial use dredged sediment placements. Beginning in August-September 2022, discrete samples for dissolved oxygen, total alkalinity, and dissolved inorganic carbon were collected at the start and end of each sensor deployment for additional sensor calibration and validation. We provide the discrete sample measurements alongside collected salinity and temperature sensor data from the locations where sensors were deployed.

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Coverage

Location: Shallow marsh channel waters of Seven Mile Island Innovation Laboratory, Cape May County, New Jersey (39.072oN, 74.778oW)
Spatial Extent: **N**:39.1032 **E**:-74.7467 **S**:39.0425 **W**:-74.801926
Temporal Extent: 2022-08-02 - 2024-06-04

Methods & Sampling

This dataset contains measurements from discrete water samples collected for dissolved oxygen, dissolved inorganic carbon (DIC), and total alkalinity (TA) measurements during eleven instrument maintenance trips to recover and redeploy biogeochemical sensors at the SMIIL. Beginning in 2022, the SMIIL water quality monitoring program began discrete sample collection at 1) three Open Water Platforms (OWPs), named North, Gull, and South Platform, within the main salt marsh channel; 2) three salt ponds, named Ring West, Ring East, and Shark; and 3) five dredged sediment placement moorings. The monitoring program expanded over the next two years to three more salt ponds, named Long Reach, White, and Drum, and a second dredged sediment placement mooring system in 2023. During field maintenance trips that included discrete sample collection, samples were collected at the last measurement before removal of instruments for maintenance and again upon first available measurement once the sensors were re-deployed. Sample bottles were held by hand under ~0.2 m of seawater for 30 seconds to equilibrate with surrounding seawater before capping.

Data Processing Description

Dissolved Oxygen:

Samples were collected into volume-calibrated flasks and preserved for Winkler dissolved oxygen analysis following standard protocols (Langdon, 2010). After collection, samples were stored until laboratory analysis following the procedures of Zhang et al. (2002). All samples were titrated within one week of collection at the Boston College Marine Biogeochemistry Lab using a custom-built Winkler titrator with automated potentiometric end point detection (control software available here: Dnicholson et al., 2023).

Precision of the sample collection and analysis procedure is determined by agreement between replicate measurements from the same location. Due to the need to preserve samples for short term storage, the majority of samples were collected in triplicate. After removal of outlier replicates in cases with triplicate sampling, median agreement among replicates was 0.18%. Larger discrepancies among replicates may reflect errors in sample collection and/or preservation; these results are reported for completeness but are flagged as questionable and/or bad (details of flagging scheme provided under “Problems/Issues” section).

Accuracy of sample measurements depends on standardization of the sodium thiosulfate titrant based on a reference standard. The sodium thiosulfate titrant used was determined by standardization with a 0.01N potassium iodate reference solution from Ocean Scientific International Ltd (OSIL). Lab-prepared potassium iodate standards, measured routinely throughout the monitoring period to verify titration accuracy and stability, were verified and adjusted by measurements against the OSIL standard.

Dissolved Inorganic Carbon and Total Alkalinity:

Samples were collected for dissolved inorganic carbon (DIC) and total alkalinity (TA) analysis following standard protocols (Dickson et al., 2007). Samples were collected into either 250 mL or 500 mL borosilicate glass bottles and preserved with saturated mercuric chloride (100 µL in 250 mL bottles, 200 µL in 500 mL bottles) for later analysis.

Samples were analyzed at the Boston College Marine Biogeochemistry Laboratory. DIC was analyzed using an Apollo SciTech AS-C6L DIC Analyzer and TA was analyzed using an Apollo SciTech AS-ALK2 TA Analyzer. Both DIC and TA were measured from each sample bottle. All DIC measurements were made on the day the bottle was opened for analysis, and TA measurements were made within the same week. DIC and TA instruments were calibrated daily and monitored throughout each analysis session by measuring Certified Reference Materials (Andrew Dickson, UCSD).

Analytical replicates were measured for all samples such that after analytical outliers (1 sigma) were removed, all samples for both DIC and TA retained at least two replicate measurements (median number of replicates for DIC = 3; median number of replicates for TA = 4). Analytical precision was determined for each sample as the standard deviation of analytical replicates. Mean analytical precision for all DIC samples in this dataset is 1.06 µmol/kg. Mean analytical precision for all TA samples in this dataset is 1.84 µmol/kg.

BCO-DMO Processing Description

- Imported "SMIIL_DiscreteSampleOutput_all.xlsx" into the BCO-DMO system

- Converted datetime to ISO 8601 format YYYY-MM-DDTHH:MM
- Exported file as "971872_v1_smiil_discrete_sample.csv"

Problem Description

Quality flags applied to this dataset follow the recommendations of Jiang et al. 2022:

0 = interpolated data
1 = not evaluated
2 = acceptable
3 = questionable
4 = known bad
6 = median of replicates
9 = Missing value

For dissolved oxygen, quality flags are applied individually to each of the replicate measurements. Measurements are flagged as acceptable (QC flag = 2) if replicate measurements agree within 0.5%. Replicate samples that exceed this threshold but agree within 1% are marked as questionable (QC flag = 3). Replicates that do not agree within 1% are marked as bad (QC flag = 4). In cases where measurements were made in triplicate, two of the three measurements may agree within the tolerance for the QC flag of 2 (or 3) even if the third measurement is an outlier and marked as a 3 or 4.

For DIC and TA, individual samples are flagged as a known bad (QC flag = 4) if the analytical precision is >5 for DIC or >6 µmol/kg for TA. Individual samples for DIC are also flagged as a known bad (QC flag = 4) if CRMs run prior and subsequent to the sample in question differ by >8 µmol/kg. Outlier values (>2 standard deviations away from the dataset mean) are flagged as questionable (QC flag = 3).

Along with the measured discrete sample data, we report temperature and salinity measured on the sensor deployed at the sample location at the time of sample collection, which were separately subject to quality control (for further details on sensor deployment and data processing, see the additional related datasets from this project). Temperature and salinity were marked as acceptable (QC flag = 2) if sensor data were available from the sampling location at the exact time that discrete samples were collected. If there was no available sensor data that matched the time the discrete sample was taken, but data were available from within ± 30 minutes, these data were flagged as interpolated (QC flag = 0). Note that samples were collected at the surface (~0.2 m), which in some cases was multiple meters above the sensors (in particular, at the Open Water Platforms - see Chua et al. 2025 related dataset).

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Data Files

File	
971872_v1_smiil_discrete_sample.csv	(Comma Separated Values (.csv), 27.88 KB) MD5:866be256c30505ffbc57fe88546454b7
Primary data file for dataset ID 971872, version 1	

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Related Publications

Chua, E.J., Supino, J., Fogaren, K.E., and Palevsky, H.I. (2025). Multiyear monitoring reveals seasonal and short-term dynamics of ecosystem metabolism in a temperate salt marsh channel. Manuscript in review at Estuaries and Coasts. (Under Review).
Results

Dickson, A.G.; Sabine, C.L. and Christian, J.R. (eds) (2007) Guide to best practices for ocean CO2 measurement. Sidney, British Columbia, North Pacific Marine Science Organization, 191pp. (PICES Special Publication 3; IOCCP Report 8). DOI: https://doi.org/10.25607/OBP-1342

Methods

Dnicholson, Barrette, J., & Zoehakai. (2023). boom-lab/winkler-titrator: v0.1.0-alpha(v0.1.0-alpha) [Computer software]. Zenodo. https://doi.org/10.5281/ZENODO.8048208 https://doi.org/10.5281/zenodo.8048208
Software

Jiang, L.-Q., Pierrot, D., Wanninkhof, R., Feely, R. A., Tilbrook, B., Alin, S., Barbero, L., Byrne, R. H., Carter, B. R., Dickson, A. G., Gattuso, J.-P., Greeley, D., Hoppema, M., Humphreys, M. P., Karstensen, J., Lange, N., Lauvset, S. K., Lewis, E. R., Olsen, A., … Xue, L. (2022). Best Practice Data Standards for Discrete Chemical Oceanographic Observations. Frontiers in Marine Science, 8. https://doi.org/10.3389/fmars.2021.705638
Methods

Langdon, C. (2010). *Determination of Dissolved Oxygen in Seaweater By Winkler Titration using Amperometric Technique. In, The GO-SHIP Repeat Hydrography Manual: A Collection of Expert Reports and Guidelines. Version 1,* GO-SHIP. https://doi.org/10.25607/OBP-1350
Methods

Zhang, J.-Z., Berberian, G., & Wanninkhof, R. (2002). Long-term storage of natural water samples for dissolved oxygen determination. Water Research, 36(16), 4165–4168. https://doi.org/10.1016/s0043-1354(02)00093-3 https://doi.org/10.1016/S0043-1354(02)00093-3
Methods

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Related Datasets

IsRelatedTo

Chua, E. J., Supino, J., Fogaren, K. E., Palevsky, H. I. (2025) **Continuously monitored water quality parameters from three open-water sites in a tidal salt marsh channel in New Jersey, USA from June 2021 to June 2024.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-08-08 doi:10.26008/1912/bco-dmo.971943.1 [view at BCO-DMO]
Relationship Description: Monitoring data collected during sampling trips.

Supino, J., Fogaren, K. E., Chua, E. J., Palevsky, H. I. (2025) **Continuously monitored water quality measurements from five salt marsh ponds in New Jersey, USA from Apr 2023 to Jun 2024.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-11-14 http://lod.bco-dmo.org/id/dataset/988873 [view at BCO-DMO]
Relationship Description: Dissolved oxygen and carbonate chemistry discrete samples were collected for sensor validation at the beginning and end of each deployment of continuous sensing instrumentation.

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Parameters

Parameter	Description	Units
Trip_ID	Identification of sample collection trip	unitless
ISO_DateTime_UTC	ISO 8601 formatted datetime of sample collection	unitless
Station_ID	Station identification	unitless
Latitude	Latitude in decimal degrees North	decimal degrees
Longitude	Longitude in decimal degrees West	decimal degrees

Temp_C	In situ temperature	degrees Celsius
Temp_flag	Quality control flag; see data Problems and Issues section	unitless
Sal_PSU	Calibrated salinity calculated from conductivity recorded in-situ	Practical Salinity Units
Sal_flag	Quality control flag; see data Problems and Issues section	unitless
Oxygen1	Dissolved oxygen content measured from discrete-bottle-based Winkler titration	umol/kg
Oxygen1_flag	Quality control flag; see data Problems and Issues section	unitless
Oxygen2	Dissolved oxygen content measured from discrete-bottle-based Winkler titration	umol/kg
Oxygen2_flag	Quality control flag; see data Problems and Issues section	unitless
Oxygen3	Dissolved oxygen content measured from discrete-bottle-based Winkler titration	umol/kg
Oxygen3_flag	Quality control flag; see data Problems and Issues section	unitless
DIC	Total dissolved inorganic carbon content	umol/kg
DIC_std	Standard deviation between acceptable DIC replicates	umol/kg
DIC_flag	Quality control flag; see data Problems and Issues section	unitless
TA	Total alkalinity content	umol/kg
TA_std	Standard deviation between acceptable TALK replicates	umol/kg
TA_flag	Quality control flag; see data Problems and Issues section	unitless

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Instruments

Dataset-specific Instrument Name	Apollo SciTech AS-ALK2 TA Analyzer
Generic Instrument Name	Apollo SciTech AS-ALK2 total alkalinity titrator
Dataset-specific Description	Samples were analyzed at the Boston College Marine Biogeochemistry Laboratory. DIC was analyzed using an Apollo SciTech AS-C6L DIC Analyzer and TA was analyzed using an Apollo SciTech AS-ALK2 TA Analyzer.
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	Apollo SciTech AS-C6L DIC Analyzer
Generic Instrument Name	Apollo SciTech AS-C6L Dissolved Inorganic Carbon (DIC) analyzer
Dataset-specific Description	DIC was analyzed using an Apollo SciTech AS-C6L DIC Analyzer and TA was analyzed using an Apollo SciTech AS-ALK2 TA Analyzer.
Generic Instrument Description	An instrument designed for the analysis of dissolved inorganic carbon in samples from various aquatic environments. It comprises of a laser-based CO2 detector (LI-7815), a digital syringe pump, a mass flow controller, CO2 stripping reactor, an electronic cooling system and a computer communication assembly (RS-485, USB). The AS-C6L supersedes the earlier AS-C3 model, which used non-dispersive infra-red CO2 detection (LI-7000, discontinued). The AS-C6L improves on the AS-C3 by incorporating a multi-sampler of one set of standards plus 8 samples, and uses improved Apollo SciTech software. The AS-C6L is suitable for use in either shipboard or land-based laboratories. It maintains a precision of +/-0.1 % for seawater (or +/-2 umol/kg), enables sample volumes ranging from 0.5 - 3.5 ml per analysis, and an analytical rate of approximately 3 minutes.

Dataset-specific Instrument Name	Sample bottles
Generic Instrument Name	Discrete water sampler
Dataset-specific Description	During field maintenance trips that included discrete sample collection, samples were collected at the last measurement before removal of instruments for maintenance and again upon first available measurement once the sensors were re-deployed.Sample bottles were held by hand under ~0.2 m of seawater for 30 seconds to equilibrate with surrounding seawater before capping.
Generic Instrument Description	A device that collects an in-situ discrete water sample from any depth and returns it to the surface without contamination by the waters through which it passes, such as a water bottle.

Dataset-specific Instrument Name	Custom-built Winkler dissolved oxygen titrator
Generic Instrument Name	Winkler Oxygen Titrator
Dataset-specific Description	All samples were titrated within one week of collection at the Boston College Marine Biogeochemistry Lab using a custom-built Winkler titrator with automated potentiometric end point detection (control software available here: Nicholson et al., 2023).
Generic Instrument Description	A Winkler Oxygen Titration system is used for determining concentration of dissolved oxygen in seawater.

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Project Information

Sediment transport and water quality in watersheds and coastlines of the United States (SMIIL Water Quality)

Coverage: Coastal New Jersey (Seven Mile Island Innovation Lab)

Salt marshes are highly productive, dynamic coastal environments that experience large fluctuations in biogeochemical parameters such as dissolved oxygen and pH in response to both natural forcings and anthropogenic impacts. At present, we have a limited understanding of the magnitude of biogeochemical variability in coastal habitats, hindering our ability to predict how they will respond in the future to episodic events and long-term change. This incomplete picture owes to a lack of sustained water quality measurements in coastal and estuarine systems worldwide.

This project investigates biogeochemical cycling in the Seven Mile Island Innovation Laboratory (SMIIL), a network of tidal marshes and channels in coastal New Jersey that is a site of historic and contemporary dredging and a testbed for marsh restoration techniques such as beneficial use of dredged sediment. It leverages multiple data sets of continuous, high-frequency (10-minute) measurements of physical and biogeochemical parameters, including water depth, temperature, salinity, dissolved oxygen, pH, chlorophyll a, and turbidity, as well as precipitation, wind speed, wind direction, temperature, relative humidity, and atmospheric pressure data. Two long-term biogeochemical sensor data sets, comprising a three-year time series at three sites in the main marsh channel (from June 2021–June 2024) and 1-2 year time series at six distinct salt ponds (August 2022–June 2024), were collected. Additionally, short-term (~months long) dredging and sediment placement monitoring data were collected at five different locations in 2022 and 2023. Data collection was designed to capture a variety of natural (diel, tidal, seasonal, storm-related) and human-created (sediment dredging and placement) conditions. Factory-calibrated biogeochemical sensors were field calibrated and maintained every 4 to 12 weeks. Discrete samples for dissolved oxygen, total alkalinity, and dissolved inorganic carbon were collected at the start and end of each sensor deployment for additional sensor calibration and validation. Altogether, our high-quality, multiyear dataset provides critical insights into the inherent variability of biogeochemical conditions in temperate salt marshes on diel and seasonal timescales, as well as how they may respond to transient events (e.g., storms, dredging activities) and over the longer term.

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Funding

Funding Source	Award
U.S. Army Engineer Research and Development Center (ERDC)	W912HZ2020061–RA3

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