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Delta-X: Particulate Organic Carbon Concentration from Water Samples, MRD, LA, 2021

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Summary

This dataset provides measurements of particulate organic carbon (POC) concentrations made on water samples collected during 2021 in surface waters of the Atchafalaya River and Terrebonne Basins, portions of the Mississippi River Delta in coastal Louisiana. Water samples were collected at ~0.5 m depth from surface during the spring (2021-03-25 to 2021-04-22) and fall (2021-08-14 to 2021-09-24) field efforts. Field sampling was paused on August 25 and resumed on September 13 due to the landfall of Hurricane Ida on 2021-08-26 approximately 70 km east of the study sites. Water quality changes in this dataset caused by the hurricane are expected to be minimal. Samples were collected in multiple channels of varying width (from a few meters to >100 m) near Delta-X intensive study sites, in open bays and lakes, and a few locations in the nearshore Gulf of Mexico. For each sample, the water sample volume was filtered (in triplicate) through 25-mm glass microfiber (GF/F) filters to retain the suspended particles. The amount of organic carbon retained on each filter was measured using an elemental carbon, hydrogen and nitrogen (CHN) analyzer and normalized by the volume of sample water filtered. The reported values in this dataset include the mean and standard deviation of POC measurements from three replicate samples collected at each site.

This dataset includes two files in comma separated values (CSV) format.

Figure 1: Types of waters being sampled in this study region (left), van Dorn sampler being used to collect surface samples (middle), and deployment of van Dorn sampler (right).

Citation

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1. Dataset Overview

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depth from surface during the spring (2021-03-25 to 2021-04-22) and fall (2021-08-14 to 2021-09-24) field efforts. Field sampling was paused on August 25 and resumed on September 13 due to the landfall of Hurricane Ida on 2021-08-26 approximately 70 km east of the study sites. Water quality changes in this dataset caused by the hurricane are expected to be minimal. Samples were collected in multiple channels of varying width (from a few meters to >100 m) near Delta-X intensive study sites, in open bays and lakes, and a few locations in the nearshore Gulf of Mexico. For each sample, the water sample volume was filtered (in triplicate) through 25-mm glass microfiber (GF/F) filters to retain the suspended particles. The amount of organic carbon retained on each filter was measured using an elemental carbon, hydrogen and nitrogen (CHN) analyzer and normalized by the volume of sample water filtered.

Project: Delta-X

The Delta-X mission is a 5-year NASA Earth Venture Suborbital-3 mission to study the Mississippi River Delta in the United States, which is growing and sinking in different areas. River deltas and their wetlands are drowning as a result of sea level rise and reduced sediment inputs. The Delta-X mission will determine which parts will survive and continue to grow, and which parts will be lost. Delta-X begins with airborne and in-situ data acquisition and carries through data analysis, model integration, and validation to predict the extent and spatial patterns of future deltaic land loss or gain.

Related Datasets

Related datasets for water quality and other aspects of this project are available on the   Delta-X project page .

Acknowledgement

2. Data Characteristics

Spatial Coverage: Atchafalaya and Terrebonne Basins and the Wax Lake Delta (WLD), Louisiana, USA

Spatial Resolution: Point

Temporal Coverage: 2021-03-25 to 2021-09-24

Temporal Resolution: Point

Study Area: Latitude and longitude are given in decimal degrees.

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Atchafalaya and Terrebonne Basins, Wax Lake Delta (WLD), Louisiana, USA	-91.4676	-90.5696	29.7546	28.7913

Data File Information

This dataset includes two files in comma separated values (CSV) format: *DeltaX_POC_Spring2021.csv* and *DeltaX_POC_Fall2021.csv*. Missing data are indicated by the value -9999.

Table 1. Variables in the CSV files.

Variable	Unit	Description
basin		Basin name: "Atchafalaya" or "Terrebonne"
site_id		Site identifier with format *<basin>_<mmdd>_<station type><station number>*, where *mm* = month and *dd* = day. See Table 2 for *basin* and *station type* abbreviations
campaign		Field campaign: "Spring 2021" or "Fall 2021"
latitude	degrees north	Latitude of sampling location
longitude	degrees east	Longitude of sampling location
date	YYYY-MM-DD	Date of sampling and measurement
time	HH:MM:SS	UTC time of sampling
depth	m	Depth of sample below surface
POC	µmol L-1	Average particulate organic carbon (POC) concentration
SD_POC	µmol L-1	Standard deviation of POC concentration measurement

Table 2. Abbreviations encoded in *site_id* variable.

Abbreviation	Description
Basin names	
WLD	Atchafalaya Basin (including Wax Lake Delta)
TB	Terrebonne Basin

Type of sampling station	
S	Full station: Water samples for total suspended solids (TSS) and Particulate Organic Carbon (POC) were collected along with water reflectance, measurements from the Sequoia Scientific® LISST-200X instrument (LISST), and water-quality indicators from ProDSS probe.
D	Dry stations: No water samples for TSS were collected. Measurements of water reflectance, from the LISST, and water-quality indicators from ProDSS probe were collected.
B	Basic station: Only measurements of LISST, and water-quality indicators from ProDSS probe were collected.

3. Application and Derivation

Particulate organic carbon (POC) concentrations were measured at sampling sites chosen to cover a representative range of POC concentrations from a variety of hydrodynamic and physical settings across the Atchafalaya and Terrebonne basins. This dataset was used to calibrate and validate Delta-X's algorithms for the retrieval of POC concentrations from Airborne Visible InfraRed Imaging Spectrometer - Next Generation (AVIRIS-NG) imagery and to inform and validate Delta-X's sediment transport models. These POC-concentration measurements represent discrete measurements and are paired with other measurements of in situ water-quality indicators, such as beam attenuation coefficient at 670 nm, average suspended particle size, suspended particle size distributions, total suspended sediment concentration, as well as water reflectance measured in situ and from airborne platforms. These location- and time-specific measurements were used to calibrate and validate numerical models that quantify the mesoscale (1 ha) patterns of soil accretion. These patterns control land loss and gain and predict the resilience of deltaic floodplains under projected relative sea-level rise.

4. Quality Assessment

Three replicates of POC measurements were made per sample. The mean and standard deviation for each sample was calculated, which provided a measure of the uncertainty. During laboratory analysis, a set of analytical blanks and check standards were run after every 6 filters (3 sample blanks and 3 samples) to check for instrument drift. An additional set of calibration standards (0.03 – 0.21 mg atropine) was run at the end of the run to ensure the instrument calibration was stable and did not drift during the duration of the analysis.

5. Data Acquisition, Materials, and Methods

Particulate organic carbon (POC) concentrations were measured at sampling sites chosen to cover a representative range of POC concentrations from a variety of hydrodynamic and physical settings across the Atchafalaya and Terrebonne basins (Figure 2). Samples were collected in multiple channels of varying width (from a few meters to >100 m), near Delta-X intensive study sites, and in open bays and lakes, and a few locations in the nearshore Gulf of Mexico.

Sites included three types of sampling stations:

- Full stations, where water samples for total suspended solids (TSS) were collected along with water reflectance (beam attenuation) measurements from the Sequoia Scientific® LISST-200X instrument (LISST) and water-quality indicators from a portable YSI® ProDSS Multiparameter Water Quality Meter (ProDSS) probe.
- Dry stations, where no Water samples for TSS were collected. Measurements of water reflectance from the LISST and water-quality indicators from ProDSS probe were collected.
- Basic stations, where only measurements of LISST, and water-quality indicators from ProDSS probe were collected.

Water samples were collected during the spring (2021-03-25 to 2021-04-22) and fall (2021-08-14 to 2021-09-24) field efforts. In fall 2021, field sampling was paused on August 25 and resumed on September 13 due to the landfall of Hurricane Ida on 2021-08-26 approximately 70 km east of the study sites. Water quality changes in this dataset caused by the hurricane are expected to be minimal.

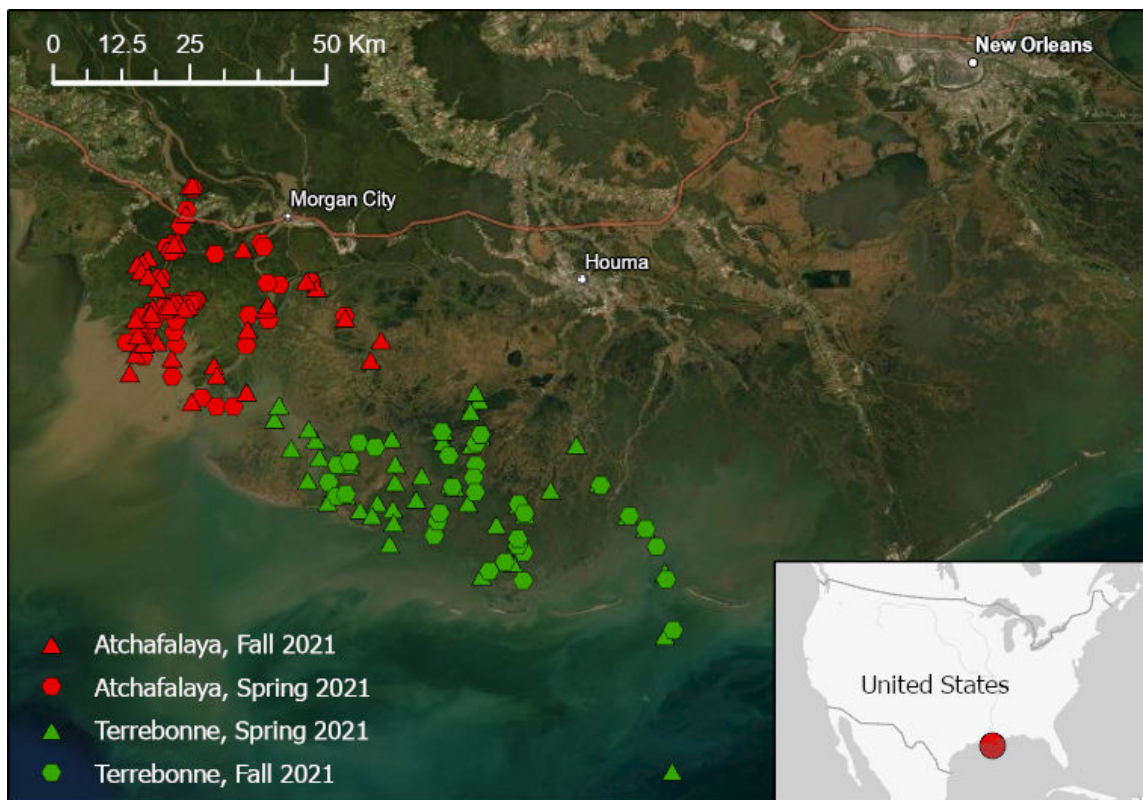Data on TSS and other water quality measurements are available in separate datasets from the Delta-X project.

Figure 2. Delta-X 2021 sampling sites for water quality studies labeled by basin and field season.

Sampling Procedure

Each in situ water sample was collected directly from the boat by submerging a 4-L van Dorn sampler about 0.5 m beneath the surface. The volume sampled was then transferred in its entirety into a clean 4-L amber plastic bottle (HDPE) and kept in a cooler with ice until analysis in the lab within a few hours. The van Dorn sampler was rinsed multiple times with site water before collecting the sample. In the lab, three sub-samples (typically 20 to 100 mL for most samples) from the 4-L sample were then filtered through three different pre-combusted 25-mm-diameter, 0.7-µm glass-fiber filters (Whatman® GF/F). Triplicate blank filters were also prepared for each sample by passing a comparable volume of pre-filtered water through three different pre-combusted glass-fiber filters.

After filtration, the filters were folded and wrapped in clean aluminum foil squares (previously furnaced at 450°C for 4h) then frozen and stored in a -20°C freezer until returned to the laboratory for POC analysis. Filter preparation, wrapping and POC analysis were all done following the protocol described in IOCCG (2021). All POC analyses were performed in the laboratory on a Costech ECS 4010 element analyzer.

Sample Analysis

The three GF/F filters for each sample and their corresponding three sample blanks were removed from the -20°C freezer and placed in pre-combusted (450°C for 4 hours), glass petri dishes. The aluminum foil packing was opened using clean forceps and the filters were dried in a clean oven at 60°C for 24 hours. In order to remove inorganic C, the samples were then acidified by exposing them to fumes of concentrated hydrochloric acid for 24 hours in a closed glass desiccator. The filters were then dried at 60°C in an oven for 24 hours to remove any excess acid remaining on the filters. The acid-treated GF/F filters were then packed in 9x10-mm tin capsules before being compressed into pellets using a clean, stainless-steel manual press. Calibration standard (atropine), check standards (atropine), and blanks/bypasses were packed following the same method in 9x10-mm tin capsules. The POC analyses were performed on a Costech ECS 4010 element analyzer by combusting the samples in combustion chamber (chromium oxide and cobaltous/cobaltic oxide catalyst) at 980°C and then transporting the resulting CO_2 gas through a reduction chamber (copper wire catalyst; 650°C) and a gas chromatography column (65°C) using high purity helium as the carrier gas (maintaining a flow rate of 120 mL min^{-1}). The oxygen flow rate used for combustion was maintained at 25 mL min^{-1}. Three bypass standards (atropine) were first run to bring the instrument to operating conditions. These standards were followed by the analytical blank and calibration standards (0.03 – 0.21 mg atropine) before analyzing the samples. Triplicate blanks were also measured for all samples. The average mass of organic carbon measured on the blanks was then subtracted from the average mass of organic carbon estimated for the samples to produced blank-corrected estimates.

The reported values in this dataset include the mean and standard deviation of POC measurements from the three replicate samples collected at each site.

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

Delta-X: Particulate Organic Carbon Concentration from Water Samples, MRD, LA, 2021

Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
- Telephone: +1 (865) 241-3952

7. References

IOCCG. 2021. Ocean Optics and Biogeochemistry Protocols for Satellite Ocean Colour Sensor Validation, Volume 6.0: Particulate Organic Matter

Sampling and Measurement Protocols: Consensus Towards Future Ocean Color Missions. Editors: J.E. Chaves, I. Cetinic, G. Dall'Olmo, M. Estapa, W. Gardner, M. Goñi, J.R. Graff, P. Hernes, P.J. Lam, Z. Liu, M.W. Lomas, A. Mannino, M.G. Novak, R.Turnewitsch, P.J. Werdell, and T.K. Westberry. IOCCG Protocol Series, International Ocean-Colour Coordinating Group (IOCCG); Dartmouth, Nova Scotia, Canada. http://dx.doi.org/10.25607/OBP-1646

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