Delta-X: Acoustic Doppler Current Profiler Channel Surveys, MRD, Louisiana, 2021, V2

Get Data

Documentation Revision Date: 2022-09-23

Dataset Version: 2

Summary

This dataset provides river discharge measurements collected at selected locations in the Atchafalaya and Terrebonne Basins within the Mississippi River Delta (MRD) floodplain in coastal Louisiana, USA. The measurements were made during the Delta-X 2021 field efforts from 2021-03-25 to 2021-04-11 (spring) and 2021-08-16 to 2021-09-25 (fall). Channel surveys were conducted with a Teledyne RiverPro acoustic doppler current profiler (ADCP) or a Sontek M9 RiverSurveyor ADCP on selected wide channels (>100 m wide) and a few selected narrow channels (approximately 10 m wide) near the Delta-X intensive study sites. River discharge was measured on cross-channel transects. Reported data include bathymetry, discharge (m3 s-1), and flow velocity.

This dataset includes 771 files in comma-separated values (*.csv) format and 2 files in compressed Keyhole Markup Language (*.kmz) format.

Figure 1. Locations of river discharge measurements (black triangles) in the Atchafalaya and Terrebonne Basins within the Mississippi River Delta (MRD) floodplain in coastal Louisiana, U.S. Measurements were taken by Delta-X project in March and April 2021. Source: DeltaX_RiverDischarge_Spring2021.csv

Citation

Christensen, A.L., J.M. Mallard, J. Nghiem, M. Simard, T.M. Pavelsky, and M.P. Lamb. 2022. Delta-X: Acoustic Doppler Current Profiler Channel Surveys, MRD, Louisiana, 2021, V2. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2081

Table of Contents

1. Dataset Overview

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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

Christensen, A.I., T.M. Pavelsky, D.J. Jensen, and K. Liu. 2020. Pre-Delta-X: River Discharge Channel Surveys across Atchafalaya Basin, LA, USA, 2016. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1806

- The preliminary dataset that lead to the formation of the current dataset.

Denbina, M.W., M. Simard, T.M. Pavelsky, A.I. Christensen, K. Liu, and C. Lyon. 2020. Pre-Delta-X: Channel Bathymetry of the Atchafalaya Basin, LA, USA, 2016. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1807

Denbina, M.W., M. Simard, E. Rodriguez, X. Wu, and C. Michailovsky. 2021. Pre-Delta-X: L3 AirSWOT-derived Water Level Profiles, Wax Lake Outlet, LA, USA, 2015. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1819

Acknowledgement

This work was supported by NASA Earth Venture Suborbital-3 Program (grant NNH17ZDA001N-EVS3: Delta-X) and Research and Technology Development at NASA's Jet Propulsion Laboratory (Strategic R&TD FY17–19).

2. Data Characteristics

Spatial Coverage: Atchafalaya and Terrebonne Basins, Mississippi River Delta (MRD) floodplain, southern coast of Louisiana, USA

Spatial Resolution: Point samples

Temporal Coverage: 2021-03-25 to 2021-04-11 (spring) and 2021-08-16 to 2021-09-25 (fall)

Temporal Resolution: One-time estimates

Site Boundaries: Latitude and longitude are given in decimal degrees.

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Atchafalaya and Terrebonne Basins	-91.4522	-90.6740	29.7040	29.1575

Data File Information

This dataset includes 771 files in comma-separated values (CSV, *.csv) format and 2 file in compressed Keyhole Markup Language (KMZ, *.kmz) format.

The two KMZ files illustrate the sampling locations for all ADCP transects (points mark an edge of each transect): *DeltaX_RiverDischarge_sites_Fall2021.kmz* and *DeltaX_RiverDischarge_sites_Spring2021.kmz.*

Two CSV files hold summary information compiled for all transects: *DeltaX_RiverDischarge_Fall2021.csv* and *DeltaX_RiverDischarge_Spring2021.csv*

Most CSV files hold instrument data and use the naming convention:
ADCP_*YYYYMMDD-hhmmss_AAA_BBB_CCC*_**Rep***D_EEEE***.csv**, where

- YYYYMMDD = date as year, month (MM), and day (DD),
- hhmmss = time of arrival to site in hour (hh), minute (mm), and second (ss) in UTC,
- AAA = location name,
- BBB = site name,
- CCC = transect number, and
- D = replicate number, and
- EEEE = "Bathy" or "Velocity", indicated bathymetry or flow velocity data, respectively.

User Note: These instrument files should be considered raw data. Some files are missing longitude-latitude coordinates; however, transect coordinates are available from summary files in the *planned_latitude* and *planned_longitude* fields.

Table 1. File names and descriptions.

File Name	Description
Data Files	

File Name	Description
ADCP_YYYYMMDD_hhmmss_AAA_BBB_CCC_RepD_Bathy.csv	Bathymetry data from individual transects. These files should be considered raw data. Some files are missing longitude-latitude coordinates; however, transect coordinates are available from DeltaX_RiverDischarge_Spring2021.csv or DeltaX_RiverDischarge_Fall2021.csv in the *planned_latitude* and *planned_longitude* fields.
ADCP_YYYYMMDD_hhmmss_AAA_BBB_CCC_RepD_Velocity.csv	Flow velocity data from individual transects, including flow velocity and flow direction at various depths. These files should be considered raw data. Each row represents one velocity component of one vertical section of a particular point along the ADCP transect. Therefore, to reconstruct the vertical profile at one point along the ADCP transect, users must combine all rows with the same ensemble number.
DeltaX_RiverDischarge_Spring2021.csv, DeltaX_RiverDischarge_Fall2021.csv	Summary information for each channel transect including longitude-latitude coordinates and discharge for each transect.
DeltaX_RiverDischarge_sites_Spring2021.kmz, DeltaX_RiverDischarge_sites_Fall2021.kmz	Provides transect locations viewable in Google Earth.
DeltaX_ADCP_Measurements.pdf	A PDF version of this user guide.

Data File Details

The files contain location coordinates in longitude, latitude (EPSG: 4326).

Missing text data are indicated by NaN, and missing numeric data are indicated by the value -9999.

Table 2. Variables in the summary files *DeltaX_RiverDischarge_Spring2021.csv* and *DeltaX_RiverDischarge_Fall2021.csv*.

Variable	Units	Description	Collected During Pre-Delta-X Campaign?
profiler_id	text	Instrument used: "Sontek RiverSurveyor M9" or "Teledyne RiverPro"	Yes
team	text	Name of team that collected data	No
basin	text	Name of estuary basin: “Atchafalaya” or “Terrebonne”	Yes
campaign	text	Campaign name: "Spring 2016" or "Fall 2016"	Yes
filename	text	Name of raw data file for bathymetry or velocity readings.	Yes
transect	1	Order number of transect at a site	Yes
location	text	General location of transect (e.g. ATCH, ICWW, FLB)	No
site_name	text	Name of site	No
replicate	1	The replicate number for given transect	No
planned_latitude	degree_north	Planned location of transect	Yes
planned_longitude	degree_east	Planned location of transect	Yes
start_date	YYYY-MM-DD	Start date of the transect in year (YYYY), month (MM), and day (DD)	Yes
start_time	hh:mm:ss	Start time of the transect in hour (hh), minute (mm), second (ss) UTC	Yes
start_ensemble	1	The first ensemble included in the transect	No
start_latitude	degree_north	Location of transect start. ‘-9999’ values indicate no valid GPS data available	Yes
start_longitude	degree_east	Location of transect start. ‘-9999’ values indicate no valid GPS data available	Yes
end_date	YYYYMMDD	End date of the transect in year (YYYY), month (MM), day (DD)	No
end_time	hh:mm:ss	End time of the transect in UTC	No
end_ensemble	1	The last ensemble included in the transect	No
end_latitude	degree_north	Location of transect end. ‘-9999’ values indicate no valid GPS data available	No
end_longitude	degree_east	Location of transect end. ‘-9999’ values indicate no valid GPS data available	No
width	m	Width of the channel	Yes
area	m^2	Area of the channel	Yes
boat_speed	$m\ s^{-1}$	Average boat speed during the transect	Yes

mean_speed	m s^{-1}	Average water speed during the transect	Yes
discharge_side	m^3 s^{-1}	Sum of discharge on the left and right edges of the transect	Yes
discharge_top	m^3 s^{-1}	Discharge in the top portion of the transect	Yes
discharge_middle	m^3 s^{-1}	Discharge in the middle portion of the transect	Yes
discharge_bottom	m^3 s^{-1}	Discharge in the bottom portion of the transect	Yes
discharge_total	m^3 s^{-1}	Total discharge	Yes
flow_direction	degree	Azimuth direction of water flow. Degrees from north, clockwise.	No
notes	text	Notes regarding data collection	No
mount_type	text	Method for mounting instrument to boat: boat bow, boat port, hydroboard, and ADCP float	

Table 3. Variables in files named *ADCP_YYYYMMDD_hhmmss_AAA_BBB_CCC_RepD_Bathy.csv*.

Variable	Units	Description
ensemble	1	Ensemble number
date	YYYY-MM-DD	Date of the transect in year (YYYY), month (MM), and day (DD)
time	hh:mm:ss	Time of the ensemble in hour (hh), minute (mm), second (ss) UTC
distance_traveled	m	Distance traveled since the beginning of the transect
river_depth	m	Measured river depth
latitude	degree_north	Location of transect start. '-9999' values indicate no valid GPS data available
longitude	degree_east	Location of transect start. '-9999' values indicate no valid GPS data available
bin_width	m	The horizontal length of the bin represented by the ensemble number. Values of -9999 indicate that bin_width was not calculated due to GPS problems.

Table 4. Variables in files named *ADCP_YYYYMMDD_hhmmss_AAA_BBB_CCC_RepD_Velocity.csv*.

Variable	Units	Description
ensemble	1	Ensemble number
upper_depth	m	Upper depth of measurement cell
lower_depth	m	Lower depth of cell
velocity_component	text	The velocity component: "easting", "northing", "vertical"
flow_velocity	m s^{-1}	The flow velocity of that cell in the given direction

3. Application and Derivation

Understanding and mitigating the impact of the relative sea-level rise on coastal deltas is an urgent concern. If ignored, sea-level rise will very soon have devastating consequences on the livelihood of the half-billion people that live in these low-lying coastal regions. Estuarine wetlands provide protection from storms and confer some resilience in the face of environmental change. Therefore, understanding the processes that control the location, extent, and topography of these ecosystems is essential.

This dataset is used to calibrate and validate Delta-X's hydrodynamic models. Acoustic doppler current profiler (ADCP) data provide near-instantaneous estimates of river discharge across the sampled channels at particular times. These locations and time-specific measurements are compared to hydrodynamic models to calibrate and validate their parameters. The hydrology models quantify the mesoscale (i.e., 1 ha) patterns of soil accretion that control land loss and gain (Simard et al., 2017), and they predict the resilience of deltaic floodplains under projected sea-level rise.

4. Quality Assessment

Two or more replicate transects were taken and compared at each site. Transects were inspected for data loss due to instrument communication issues, and transects with lost data were removed. The goal was for measured discharge of replicates to differ by no more than 5%. This standard was met in most cases, except where flow rate was very small. Replicate transects are included in this dataset to allow the user to compare transects.

Users are encouraged to consult tide charts for the transect times as differences between replicates are often related to tides.

5. Data Acquisition, Materials, and Methods

Acoustic doppler current profiler (ADCP) measurements of discharge rates were collected in estuarine channels of the Atchafalaya River and Terrebonne Basin in coastal Louisiana (Fig. 1) in 2021-03-26 to 2021-04-11 (spring) and 2021-08-17 to 2021-09-24 (fall). Before the field work, 53 sites were chosen as part of a sampling design to incorporate major river channels in both basins and smaller channels surrounding Delta-X intensive study sites. Cross-

sectional surveys of all wide channels (>100 m wide) and selected narrow channels (approximately 10 m wide) were conducted under AirSWOT flight paths. AirSWOT is an airborne instrument used to measure water levels during tidal cycles for Delta-X (Denbina et al., 2019; Denbina et al., 2021). River discharge was measured on cross-channel transects. Transects were spaced at six times the river width, making sure to target each total pressure transducer location (Simard et al., 2020). Transect site selection followed the guidelines in Mueller et al. (2013).

Measurements were made using a Teledyne RiverPro ADCP instrument or a Sontek M9 RiverSurveyor ADCP instrument. For each transect, the ADCP was mounted to the boat, a hydroboard floating beside the boat, or a custom-built float ("ADCP float"). Flow measurements were collected while crossing each channel perpendicular to flow (Figure 2). Transects were collected by multiple teams: the Coastal Studies Institute (CSI) at Louisiana State University (Figure 2A) with Teledyne RiverPro ADCP mounted to the front of the boat, the California Institute of Technology (Caltech) with the Teledyne RiverPro ADCP mounted to the port side of the boat (Figure 2B), the University of North Carolina (UNC) with the Teledyne RiverPro ADCP mounted to the port side of the boat, and the Jet Propulsion Laboratory with the Sontek M9 ADCP mounted to a hydroboard floating beside the boat. The Caltech team used the ADCP float to measure transects in channels too small (< 10 m) to maneuver the boat. In this method, the transect was measured by pulling the ADCP on a float across the channel with ropes (Figure 2E).

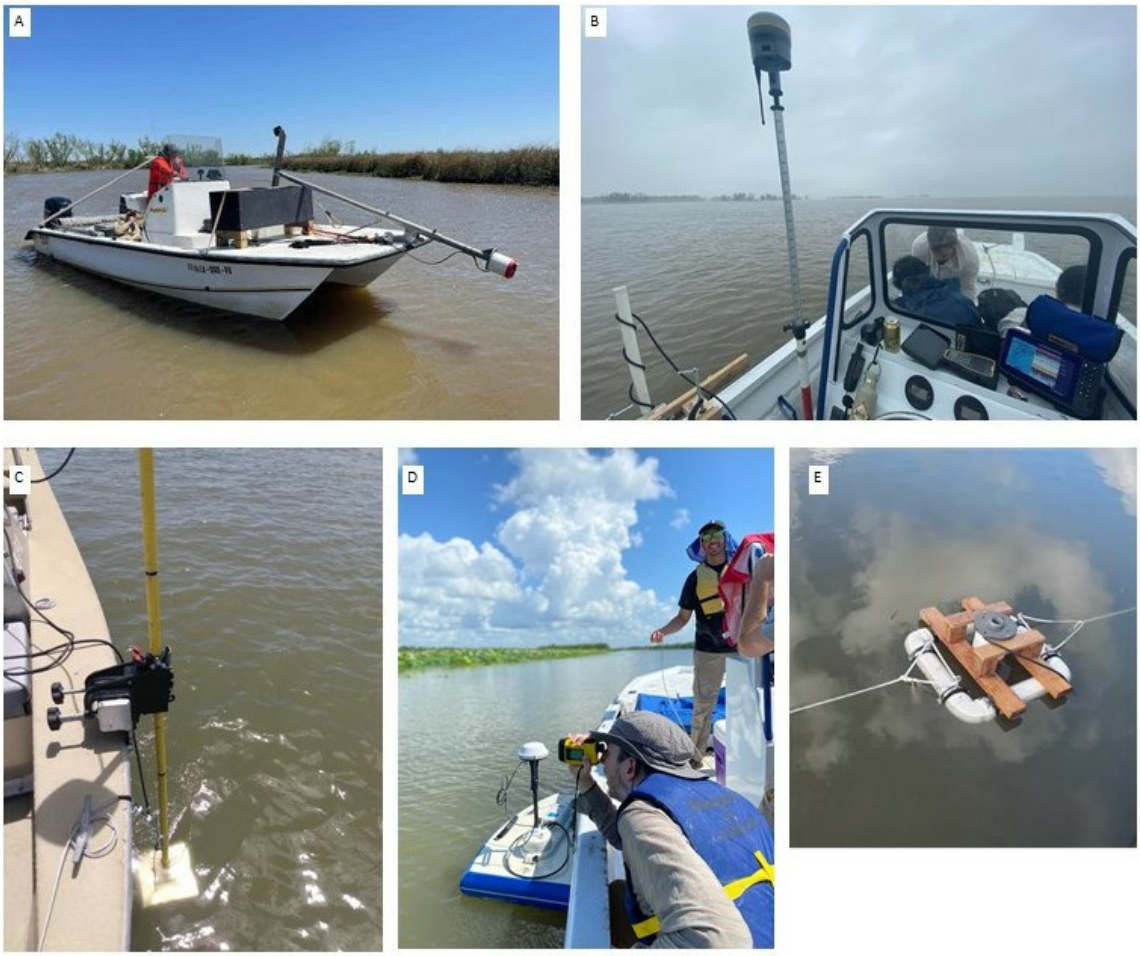

Figure 2. Researchers taking ADCP measurements along channel transects. (A) Louisiana State University Coastal Studies Institute using a front boat mount, (B) California Institute of Technology using a side boat mount, (C) the University of North Carolina using a side boat mount, (D) the Jet Propulsion Laboratory using a hydroboard mount, and (E) California Institute of Technology using a float mount.

Teams collected two or more replicates of each transect to ensure data quality, unless there was only time for collecting one transect, and returned to sites multiple times to collect data during different stages of the tidal cycle. All replicates are provided to allow users to perform additional quality assessment. The naming convention of transect files allows users to identify date, time, site, and replicate of each transect.

The CSI team collected one continuous back and forth transect, which was split and processed separately using WinRiver II software (Teledyne RD Instruments, 2018). Methods for transect data collection are described in chapter 10 of the WinRiver II User Guide (Teledyne RD Instrument, 2018). At the beginning of each day in the field, the tasks outlined in Chapter 3 of the WinRiver II User Guide (Teledyne, 2020) were completed using the WinRiver II software that controls ADCP data collection including compass calibration, system tests, and site setting adjustments. Similar tasks were completed according to Section 6 of the RiverSurveyor Live Manual (SonTek, 2018) using the RiverSurveyor Live software.

ADCP flow velocity measurements depend on salinity because salinity affects the speed of sound in water. All transects in the Atchafalaya Basin were assigned a salinity of 0 parts per thousand (ppt) because all Atchafalaya transects were collected in freshwater. For the Terrebonne Basin transects, the field teams measured salinity in situ with YSI conductivity meter or equivalent for some transects and used the salinity measurements to correct ADCP flow velocity measurements. For transects without in situ salinity measurements, salinity was estimated from the data at the nearest Louisiana Coastwide Reference Monitoring System (CRMS) site. The choice of salinity estimation method is expected to have little influence on ADCP measurements because ADCP discharges varied little (within 5%) in the plausible ranges of salinity.

During Spring 2021, the CSI team experienced communication issues between the ADCP and the external GPS unit (Vector VS1000), which produced significant errors in the timestamp of GPS data for some transects. Post-processing was required in all CSI transects to correct external GPS data when possible or to replace external GPS data with internal GPS data from the ADCP instrument. In many cases, GPS data are not available for an ensemble and are replaced with -9999 values. Fortunately, transects were completed at planned locations, and users are encouraged to use planned coordinates ('planned_longitude' and 'planned_latitude' variables in DeltaX_RiverDischarge_Spring2021.csv) as a reference to transect location. Due to issues with external GPS data, the bottom track was used as the reference track for all CSI transects, but moving bed measurements were not done due to errors in the software. In addition, due to these issues, velocity profiles are not included for the CSI data. The Caltech team used an external RTK GPS unit (Trimble R12), which was merged with the ADCP data during post-processing.

During Fall 2021, the JPL, UNC, and Caltech teams did not experience GPS issues and were able to use GPS for tracking. The Caltech team again used an external RTK GPS unit (Trimble R12), the data of which were merged with the ADCP data during post-processing. GPS locations were used for tracking, and thus, moving bed tests were not needed.

6. Data Access

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

Delta-X: Acoustic Doppler Current Profiler Channel Surveys, MRD, Louisiana, 2021, V2

Contact for Data Center Access Information:

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

7. References

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8. Dataset Revisions

Version	Release Date	Revision Notes
2	2022-09-23	Fall 2021 data added. Spring 2021 data updated.
1	2021-10-29	Original release holding Spring 2021 data