

Datasets: Rachel Carson Reserve Bathymetry, Hydraulics, and Sediment Dynamics Data

This document provides detailed information about nine datasets that were generated through a collaborative research project titled “*Improved Understanding of Sediment Dynamics for the Rachel Carson Reserve, North Carolina.*” This [webpage](#) provides information about the project. The project was supported by the National Estuarine Research Reserve System (NERRS) Science Collaborative, which is funded by the National Oceanic and Atmospheric Administration. All Science Collaborative supported projects that collect new data adhere to federal data sharing and archiving requirements.

About the Associated Project

Project page: <https://nerrssciencecollaborative.org/project/Castro-Bolinaga22>

Grant Type: Collaborative Research

Focus Area(s): Climate Change

Keyword(s): sediment dynamics, resilience, resilience planning

Reserve(s): North Carolina

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Project Contacts:

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Project Description

The Rachel Carson Reserve in North Carolina consists of a group of islands connected by a series of shoals and channels that are home to a diverse array of coastal habitats. Over the past 60 years, significant shoreline erosion has widened the Beaufort Inlet, located just south of the Reserve. To inform engineering practices at the Beaufort Inlet and plan for the resilience of local infrastructure and vulnerable coastal habitats, the Reserve and coastal resource managers need to understand how these geomorphic changes have impacted sediment movement in the area.

The project team, in collaboration with the N.C. Coastal Reserve and NERR, produced a numerical model that simulates sediment dynamics at and around the Reserve. The collaborative approach was centered on the direct involvement of members of the N.C. Coastal Reserve and NERR as part of the project team, enabling them to directly and actively guide the project’s technical aspects, from planning field data collection campaigns to defining scenarios for the application of the numerical model. Such direct involvement was also key when transferring the numerical

model to members of the N.C. Coastal Reserve and NERR, increasing the effectiveness of training efforts that were undertaken toward the end of the project. In addition to the N.C. Coastal Reserve and NERR, the project team also collaborated with other relevant end users, including the US Army Corps of Engineers Wilmington District, the Town of Beaufort, the Cape Lookout National Seashore, the Carteret County Shoreline Protection Office, Kris Bass Engineering, and NC State Extension.

The numerical model enables the N.C. Coastal Reserve and NERR to predict the complex interactions between extreme storm events, river systems, and other coastal processes that influence sediment movement at and around the Reserve. Key research findings from this numerical model indicated that, as a result of a widening Beaufort Inlet, the water flow's capacity to move sediment has progressively changed, increasing along shores located in the inlet's vicinity and reducing along shores and channels located further inland. Notably, predictions from the numerical model indicated that these changes were exacerbated when considering hurricane-like conditions, more than doubling water flow's erosive forces along shores located in the inlet's vicinity. These research findings suggest that storm events and major hurricanes are important catalysts of large-scale geomorphic changes at and around the Reserve.

The numerical model's findings allowed the project team to map the vulnerability of shores at and around the Reserve. The maps highlighted that not all areas within the Reserve have the same level of vulnerability to pronounced geomorphic changes. For example, shores located in the inlet's vicinity were found to be consistently more vulnerable to continued geomorphic change, whereas the vulnerability of shores and channels located further inland depended upon the considered flow condition (e.g., monthly average vs. hurricane-like). By deepening understanding of spatial vulnerability and its drivers, the maps are helping the N.C. Coastal Reserve and NERR to identify hotspots of geomorphic change and targets for adaptive management strategies while informing effective resilience planning for critical habitats and infrastructure in the region.

Overview of Datasets

Eight datasets are described in this document:

- Dataset 1: Bathymetry of channel network around the Rachel Carson Reserve.
- Dataset 2: Longitudinal Flow velocity profiles along channel network.
- Dataset 3: Flow velocity time series.
- Dataset 4: ADV-derived flow velocity time series at discrete depths.
- Dataset 5: Water property time series.
- Dataset 6: Suspended sediment granulometry time series.
- Dataset 7: Bed sediment erodibility characterization.
- Dataset 8: Bed sediment grain size distribution.

Data Access and Archival:

All data will be made publicly available within two years of project completion or upon publication of the associated manuscript, whichever is sooner. Data will be archived in the interim with the NERRS Centralized Data Management Office (CDMO).

Questions about these datasets can be directed to:

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About the Project Datasets

Detailed dataset descriptions are provided below.

Dataset 1: Bathymetry of channel network around the Rachel Carson Reserve

General description of data:

Water depths were collected across 32 cross-sections and 45 transects within the network of tidal channels surrounding the Rachel Carson Reserve (RCR). These surveys were conducted using a SonTek M9 Acoustic Doppler Current Profiler (ADCP) integrated with the Xylem HYPACK. The Sontek M9 ADCP was mounted over the Xylem torrent board (TB board). These data were used to support the development of an updated bathymetry for hydrodynamic modeling. For most cross-sections, two transects (back and forth) were conducted to minimize discrepancies and improve data accuracy. In the case of longer cross-sections, single transects were performed to maintain time efficiency while preserving spatial coverage. When data collection spanned multiple days, each subsequent day began with a repeat of the final transect from the previous day to facilitate tidal datum correction and ensure continuity in depth referencing.

Search keywords:

Acoustic Doppler Current Profiler, Bathymetry, Rachel Carson Reserve

Data collection period:

13th-15th June 2023; and 18th-19th October 2023

Geographic extent:

Data were collected in the WGS 1984 Geographic Coordinate system, spanning from approximately 76°42'0.92"W to 76°36'21.68"W longitude and 34°41'35.00"N to 34°42'20.22"N latitude, covering the inshore area south of the Town of Beaufort, North Carolina.

File format:

The raw data for each transect is provided in *.RAW and *.ydff formats, readable with HYPACK software. Each day of data collection includes a corresponding *.LOG file containing all log entries for that day. Processed data are available as .txt files, with detailed descriptions for each transect provided in the accompanying *README.txt* file. The complete dataset occupies approximately 68.4 MB.

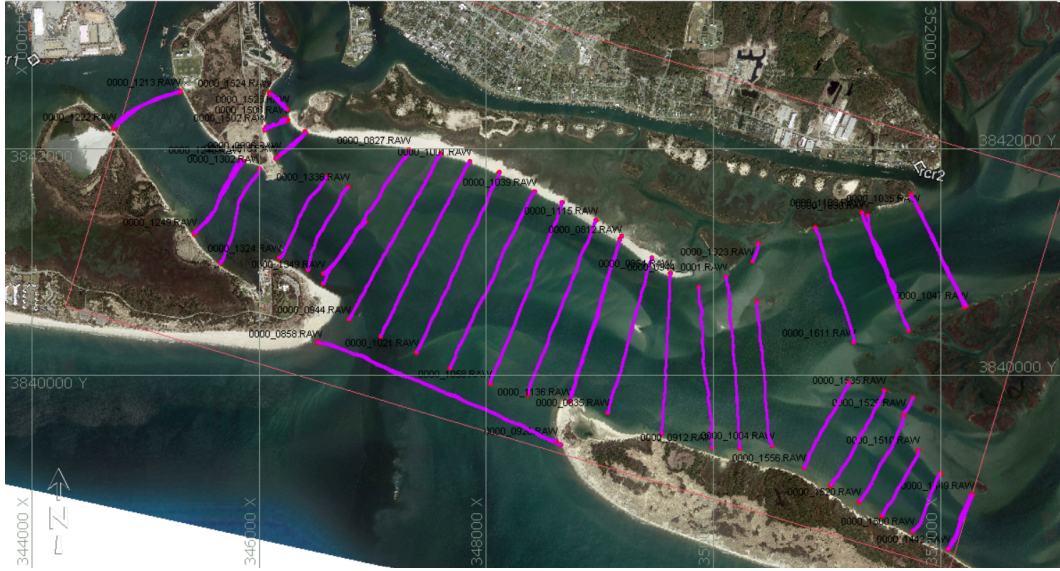
File name(s):

Each transect is recorded with filenames in the format *0000_hhmm.RAW* and *0000_hhmm.ydff*, while daily log files are named using the format *RAWmmdyyy.LOG*.

Data access and archival:

All data will be made publicly available within two years of project completion or upon publication of the associated manuscript, whichever is sooner. Data will be archived in the interim with the NERRS Centralized Data Management Office (CDMO).

Maps and schematics for data collection:



Transects collected for bathymetric surveying around the RCR, as displayed in the HYPACK software interface.

Dataset 2: Longitudinal flow velocity profiles:

General description of data:

The bathymetry data files also include longitudinal flow velocity profiles collected along each transect, following the same file structure. As the velocity data are derived from the same dataset as the bathymetry data, the file format, data collection methods, and associated metadata are identical to those described for the bathymetry files (see above). Detailed information is also provided in the accompanying README_ADCP.txt file.

Data access and archival:

All data will be made publicly available within two years of project completion or upon publication of the associated manuscript, whichever is sooner. Data will be archived in the interim with the NERRS Centralized Data Management Office (CDMO).

Dataset 3: Flow velocity time series

General description of data:

Time series of vertical flow velocity profiles were collected using a SonTek M9 Acoustic Doppler Current Profiler (ADCP) integrated with RiverSurveyor at five fixed locations (hereafter referred to as base stations): four at the mouths of tidal channels and one at the inlet. Each station aimed to capture one complete tidal cycle, comprising approximately 6 hours of flood and 6 hours of ebb flow. At the inlet site, only the ebb tide was successfully recorded due to high swell and strong wind conditions that prevented deployment during the flood tide. The five base station names are: Morehead City Channel (MHC), Bulkhead Channel (BHC), North River Channel (NRC), Shackleford Channel or Slue (SFC), and Beaufort Inlet (BI).

Search keywords:

Acoustic Doppler Current Profiler, Flow Velocity, Rachel Carson Reserve, Time Series

Data collection period:

All the base station data were collected between April 5th and May 10th, 2023. For specific station and tidal conditions collection time are listed below:

MHC Ebb: April 19, 2023

MHC Flood: April 13, 2023

BHC Ebb: April 18, 2023

BHC Flood: April 11, 2023

NRC Ebb: April 5, 2023

NRC Flood: May 9, 2023

SFC Ebb: April 06, 2023

SFC Flood: May 10, 2023

BI Ebb: April 20, 2023

Geographic extent:

Same geographic extent as bathymetry data.

File format:

The dataset is organized into five folders, each representing a base station. Within each station folder, data are further separated into ebb and flood subfolders. Raw data for each sampling are provided in *.rivr and *.mat two file formats, compatible with RiverSurveyor Live and HYPACK software. Detailed descriptions of each sampling session are included in the accompanying README.txt file. The total dataset size ranges from approximately 107 MB to 219 MB.

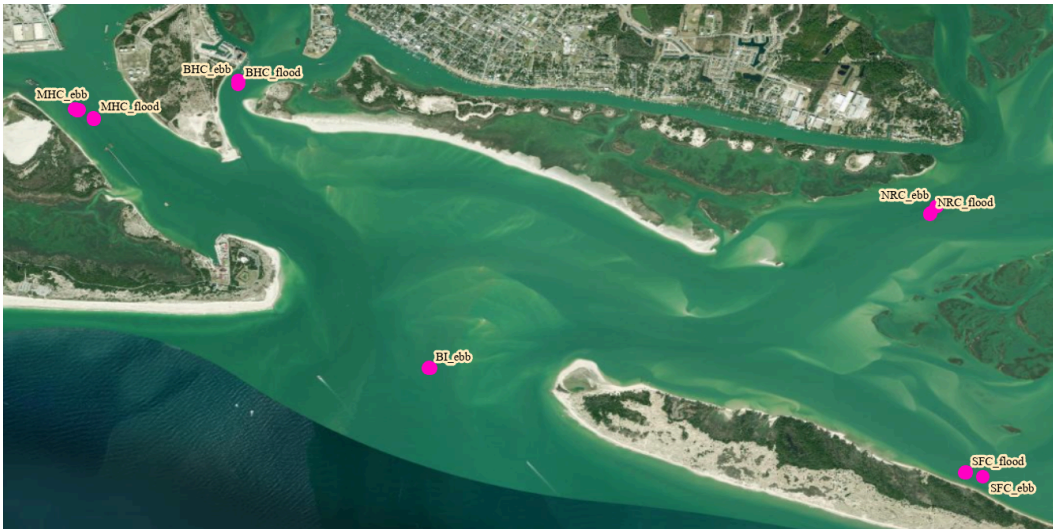
File name(s):

Each sampling is saved using the format YYYYMMDDHHMMSSr.rivr and YYYYMMDDHHMMSSr.mat, where YYYYMMDDHHMMSS represents the start time of the data collection (year, month, day, hour, minute, and second).

Data access and archival:

All data will be made publicly available within two years of project completion or upon publication of the associated manuscript, whichever is sooner. Data will be archived in the interim with the NERRS Centralized Data Management Office (CDMO).

Maps and schematics for data collection:



Locations of flow velocity time series measurements at base stations around the RCR.

Dataset 4: ADV-derived flow velocity time series at discrete depths

General description of data:

Flow velocity time series at three discrete depths (i.e., near the bottom, mid-depth, and surface) were collected using a Nortek Acoustic Doppler Velocimeter (ADV) at the base stations described in dataset number 3. Each station was designed to capture a full tidal cycle, encompassing approximately 6 hours of flood and 6 hours of ebb flow. At the inlet station, only the ebb tide was successfully measured due to adverse field conditions, including high swell and strong winds, which prevented deployment during the flood tide. The ADV data were utilized to extract depth-specific, flow velocity time series and to derive turbulence statistics.

Search keywords:

Acoustic Doppler Velocimeter, Flow Velocity, Rachel Carson Reserve, Time Series

Data collection period:

All the base station data were collected between April 5th and May 10th, 2023, same as the dataset number 3 data collection period.

Geographic extent:

Same geographic extent as bathymetry data.

File format:

The dataset is organized into five folders, each representing a base station. Within each station folder, data are further separated into ebb and flood subfolders. The *.vec binary file is generated for each sampling session and can be converted to ASCII format using the Data Conversion tool in Nortek's Vector software. It contains processed velocity time series, including the three velocity components (U, V, W), signal amplitude, correlation values, and sensor diagnostics. The accompanying *.vea file stores instrument configuration details and metadata, such as deployment settings, sampling intervals, and event annotations. Detailed descriptions of each sampling are included in the accompanying README.txt file. The total dataset size is approximately 3 MB -12 MB per station per tidal phase (ebb or flood).

File name(s):

Each sampling is saved with filenames in the format A####.vec and A####.vea, where #### denotes the sampling number.

Data access and archival:

All data will be made publicly available within two years of project completion or upon publication of the associated manuscript, whichever is sooner. Data will be archived in the interim with the NERRS Centralized Data Management Office (CDMO).

Maps and schematics for data collection:

Same as dataset number 3.

Dataset 5: Water property time series

General Description:

Time series of water properties including temperature, pressure, salinity, conductivity, and total dissolved solids (TDS) were collected using an EXO2 CTD at the base stations described in dataset number 3. Measurements were taken at three discrete depths (i.e., near the bottom, mid-depth, and surface), with sampling lasting approximately 2 minutes at each depth. Each station was deployed to capture a complete tidal cycle (~6 hours of flood and ~6 hours of ebb). At the inlet station, only the ebb tide was successfully recorded due to adverse field conditions, such as high swell and strong winds, which limited deployment during the flood tide.

Search Keywords:

Conductivity, CTD, Rachel Carson Reserve, Salinity, Time, Series, Total Dissolved Solids, Water Quality

Data Collection Period:

April 5th – May 10th, 2023, concurrent with collection period described in dataset number 3.

Geographic Extent:

Same geographic extent as bathymetry data.

File Format:

Data are organized into five folders, each corresponding to a base station. Within each folder, data are subdivided into ebb and flood subfolders. Each sampling is stored in text format as exported from KorEXO software, with individual *.csv files representing separate sampling events. Detailed descriptions are provided in the accompanying README.txt file. Dataset size is approximately 1–3 MB per station per tidal phase (ebb or flood).

File name(s):

Files are named in the format: KorEXO Measurement File Export – MMDDYY HHMMSS.csv, where MMDDYY and HHMMSS represent the date and time of data export or file creation.

Data Access and Archival:

All data will be made publicly available within two years of project completion or upon publication of the associated manuscript, whichever is sooner. Data will be archived in the interim with the NERRS Centralized Data Management Office (CDMO).

Maps and Schematics:

Same as dataset number 3.

Dataset 6: Suspended sediment granulometry time series

General Description:

Suspended sediment granulometry time series were collected using a LISST-100X Type C instrument at the base stations described in dataset number 3. Measurements were taken at three discrete depths (i.e., near the bottom, mid-depth, and surface), with each sampling lasting approximately 2 minutes at each depth. Each station was deployed to capture a full tidal cycle, comprising approximately 6 hours of flood and 6 hours of ebb flow. At the inlet station, only the ebb tide was successfully recorded due to adverse conditions such as high swell and strong winds that prevented deployment during the flood tide. Raw data files (*.dat) were processed using LISST-SOP software and converted to ASCII format files. In addition to size distribution data, total suspended sediment (TSS) volumetry was derived using both GFF and mesh filters and compiled in spreadsheet format.

Search Keywords:

Granulometry, LISST, Rachel Carson Reserve, Suspended Sediment, Time Series

Data Collection Period:

April 5th – May 10th, 2023, concurrent with collection period described in dataset number 3.

Geographic Extent:

Same geographic extent as bathymetry data.

File Format:

Data are organized into five folders, each representing a base station, with subfolders for ebb and flood tidal phases. Each sampling includes six LISST-SOP output files: *.asc, *.psd, *.log, *_rs.asc, *_rs.psd, and *_rs.log. Additionally, TSS volumetric data are provided in Excel format (*.xlsx). A detailed description of each file is included in the accompanying *README.txt* file. Dataset size is approximately 15 MB per station per tidal phase (ebb or flood).

File name(s):

LISST output files follow the format: L####.asc, L####.psd, L####.log, L####_rs.asc, L####_rs.psd, L####_rs.log, where #### corresponds to the sampling number matching the ADV data. TSS volume files are named: TSS_<base station name>_<tidal phase>.xlsx.

Data Access and Archival:

All data will be made publicly available within two years of project completion or upon publication of the associated manuscript, whichever is sooner. Data will be archived in the interim with the NERRS Centralized Data Management Office (CDMO).

Maps and Schematics:

Same as dataset number 3.

Dataset 7: Bed sediment erodibility characterization

General Description:

A total of 27 bed sediment samples were collected along Bird Shoal, Shackleford Banks, and Middle Marsh using 10-cm push cores. In the laboratory, Jet Erosion Tests (JETs) using a mini-JET device were performed on each sample to characterize sediment erodibility, providing estimates of critical shear stress and erosion rate parameters.

Search Keywords:

Erodibility, Jet Erosion Test, Rachel Carson Reserve, Sediment Transport.

Data Collection Period:

June 4th, 2024.

Geographic Extent:

Same spatial coverage as the bathymetry dataset.

File Format:

Sediment erodibility data are stored in an Excel file (*.xlsx), with 27 individual sheets—each corresponding to a sediment sample and containing its associated erodibility parameters.

File name(s):

RCR_JET_20230604.xlsx

Data Access and Archival:

All data will be made publicly available within two years of project completion or upon publication of the associated manuscript, whichever is sooner. Data will be archived in the interim with the NERRS Centralized Data Management Office (CDMO).

Maps and Schematics:



Locations of sediment samples collected around the RCR.

Dataset 8: Bed sediment grain size distribution

General Description:

Following JET testing, all 27 bed sediment samples described in Section 7 were oven-dried and subjected to grain size distribution analysis in the laboratory, following ASTM D6913/D6913M-17 standards. Each sample was analyzed both with and without shell fragments, and representative images documenting sediment textures and shell components were also captured.

Search Keywords:

Grain Size Distribution, Rachel Carson Reserve, Shell Hash Content

Data Collection Period:

June 4th, 2024.

Geographic Extent:

Same spatial coverage as the bathymetry dataset.

File Format:

Grain size data are stored in two Excel files (*.xlsx): one including shell fragments and one excluding them. Each spreadsheet contains 27 individual sheets, with each sheet representing one sediment sample and its grain size distribution.

File name(s):

RCR_GSD_wshell.xlsx – with shell fragments

RCR_GSD_woshell.xlsx – without shell fragments

Data Access and Archival:

All data will be made publicly available within two years of project completion or upon publication of the associated manuscript, whichever is sooner. Data will be archived in the interim with the NERRS Centralized Data Management Office (CDMO).

Maps and Schematics:

Same as dataset number 7.