Dataset Description: Field Observations and Model Simulations for the Dams and Sediment in the Hudson (DaSH) Project

This document provides detailed information about three datasets that were generated through a 2016- 2020 collaborative research project titled *Dams and Sediment in the Hudson (DaSH)*. 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.

Three related datasets are described in this document:

1. Lower Hudson Watershed Dam Impoundments Sediment Data
2. Hudson River Estuary Tidal Marsh Sediment Data
3. Hudson River Estuary Model Simulations of Dam Sediment Releases

About the Associated Project

Project title: Dams and Sediment in the Hudson (DaSH)
Reserves involved in the project: Hudson River National Estuarine Research Reserve, NY
Project period: November 2016 to March 2020
Science Collaborative project page:
http://www.nerrssciencecollaborative.org/project/Ralston16

Project lead and contact information:
David Ralston
Woods Hole Oceanographic Institution
dralston@whoi.edu

Purpose:
Hundreds of dams built on tributaries of the Hudson River estuary have outlived their usefulness. Removing these relic dams is a priority for the state of New York in order to improve aquatic habitat connectivity, restore fish spawning grounds, and reduce the risk of dam failure. For those who regulate and permit dam removal, questions about the fate of sediment trapped behind these dams and its potential impact on downstream habitat has encumbered the permitting process. To better understand how sediment released by dam removal in the lower Hudson River watershed will affect the estuary, including the potential for dam-derived sediments to help offset sea level rise in tidal wetlands, the Dams and Sediment in the Hudson project brought together a collaborative team of scientists and stakeholders to research key questions and provide practical tools to regulators and practitioners.

Abstract:
Dams and Sediment in the Hudson answered key questions about how dam removal will impact conditions in the estuary and offered surprising new findings about tidal marshes in the Hudson

River valley. The project used a multidisciplinary approach that combined field observations with an analysis of sediment transport using a proven hydrodynamic model.

Researchers surveyed 17 representative dams in the Lower Hudson River watershed by measuring water depth and sediment thickness and collecting sediment cores. Results were extrapolated to the 1700 registered dams located on tributaries of the Lower Hudson River to estimate the total amount of sediment trapped in the watershed. These observations were complemented by an analysis of sediment discharge data from existing monitoring stations on tributaries to characterize typical sediment input to the estuary and conditions following major storm events. A numerical model of circulation and sediment transport in the estuary was used to evaluate the impact of dam removal scenarios. To understand sediment contributions to tidal wetlands along the Hudson, researchers collected transects of sediment core from 6 representative tidal wetlands and coves. Geochronological data of sediment cores combined with an analysis of historical and aerial photos was used to assess when wetlands began to form and their rates of accumulation.

Results show that dam removals would have a minimal impact on sediment supply to the estuary and tidal wetland growth. Only 10% of dams in the Lower Hudson River watershed are effective sediment traps, and the potential amount of sediment that would be released if all dams were removed represents less than 2 years average sediment input from the watershed. Tidal wetlands along the Hudson were found to be remarkably young and rapidly accumulating sediment despite the presence of dams, growing vertically at rates several times faster than sea level rise.

About Each Dataset

1. Lower Hudson Watershed Dam Impoundments Sediment Data

General description of data: This dataset is based on sediment cores collected from 17 impoundments behind dams on tributaries to the tidal portion of the Hudson River. Sediment cores were recovered via piston push coring, which tends to minimize compaction and be representative of true sediment thicknesses. Analyses of this dataset found that the small sediment masses present in most of these dams relative to expected masses based on regional sediment yield is representative of the small aggregate trapping of sediment by legacy mill dams in the Northeast US.

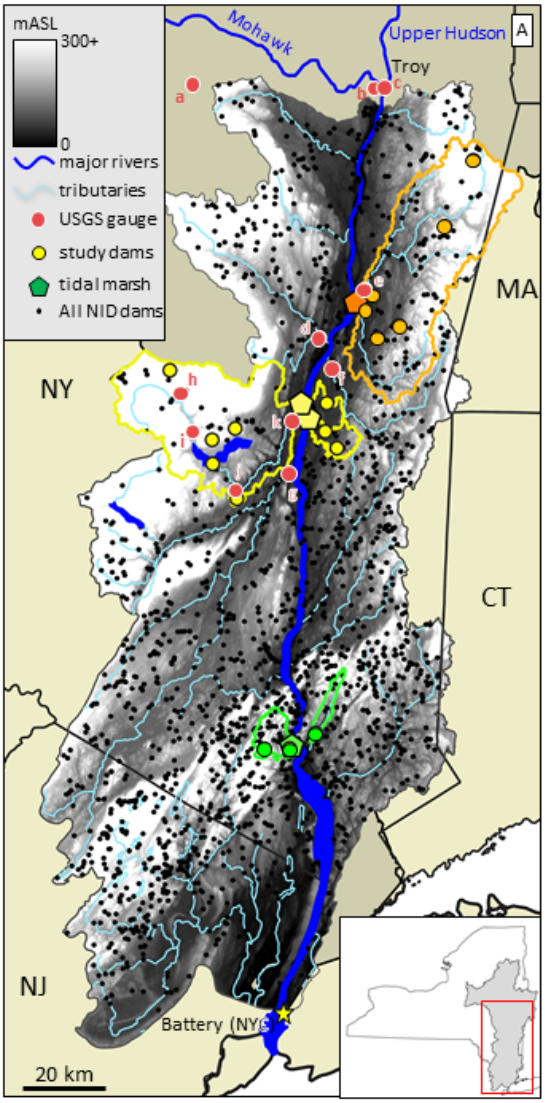
This data set and associated findings are highlighted in this manuscript: Ralston, DK, B Yellen, JD Woodruff, “Watershed sediment supply and potential impacts of dam removals for an estuary”, submitted to *Estuaries and Coasts*, March 2020.

More about this data:

- The general workflow for cores included (1) splitting; (2) Itrax XRF scanning; (3) subsampling cores ~10 cm spacing; (4) drying and burning samples for percent water, organic, and mineral (Dean, 1974).
- Combusted samples were gently disaggregated with mortar and pestle and analyzed for grain size on a Coulter Laser Particle Size Analyzer.
- Basal sediments were identified by low organic content and a contrast in grainsize or sediment texture with overlying pond sediment. Sediment age was constrained by the construction date of the corresponding dam, when that information was available, and by ^{137}Cs chronology when absent.

Data collection period: 2017 to 2018

Geographic extent: Watershed of Lower Hudson River, NY. The figure below shows locations of impoundment sampling, labeled “study dams” (Ralston et al., 2020).



File format: Downloadable .zip file, which includes text README and data in various file formats including .xls, .txt, .tif.

Data access and archival: Data are publicly available for download at https://doi.org/10.7275/xktv-8m12. Contact Brian Yellen (byellen@geo.umass.edu) with questions or for additional information.

2. Hudson River Estuary Tidal Marsh Sediment Data

General description of data:
This dataset is based on sediment cores collected at six tidal wetland complexes that are located within the Hudson River Estuary. The sites include Stockport Marsh, Esopus Delta, Tivoli North Bay, Tivoli South Bay, Vanderburgh Cove, and Iona Island Marsh. A variety of core collection tools and methods were used to collect uncompacted records, including gouge coring, Russian peat coring, and piston push coring, with the method determined by coring environment. Collectively, data from these cores provide evidence within the tidal freshwater Hudson River for rapid accretion within anthropogenic tidal freshwater wetlands relative to those that developed prior to the industrial era.

This dataset and associated findings are highlighted in the manuscript: Yellen, B, JD Woodruff, C Ladlow, DK Ralston, S Fernald, W Lau, “Rapid Tidal Marsh Development in Anthropogenic Backwaters”, submitted to *Earth Surface Processes and Landforms*, March 2020.

More about this data:

- The general workflow for cores included (1) splitting; (2) Itrax XRF scanning; (3) subsampling cores ~10 cm spacing; (4) drying and burning samples for percent water, organic, and mineral content.
- Gamma spectroscopy was used to identify down-core profiles of ^{137}Cs and ^{210}Pb in at least one representative core from each site. Relative abundance and onset of heavy metals zinc (Zn) and lead (Pb) as recorded in X-ray Flourecense (XRF) data were used as additional supportive age constraint in cores.

Data collection period: 2017 to 2018

Geographic extent: Hudson River estuary marshes, NY. The figure below shows locations of marsh sampling (Yellen et al, 2020).

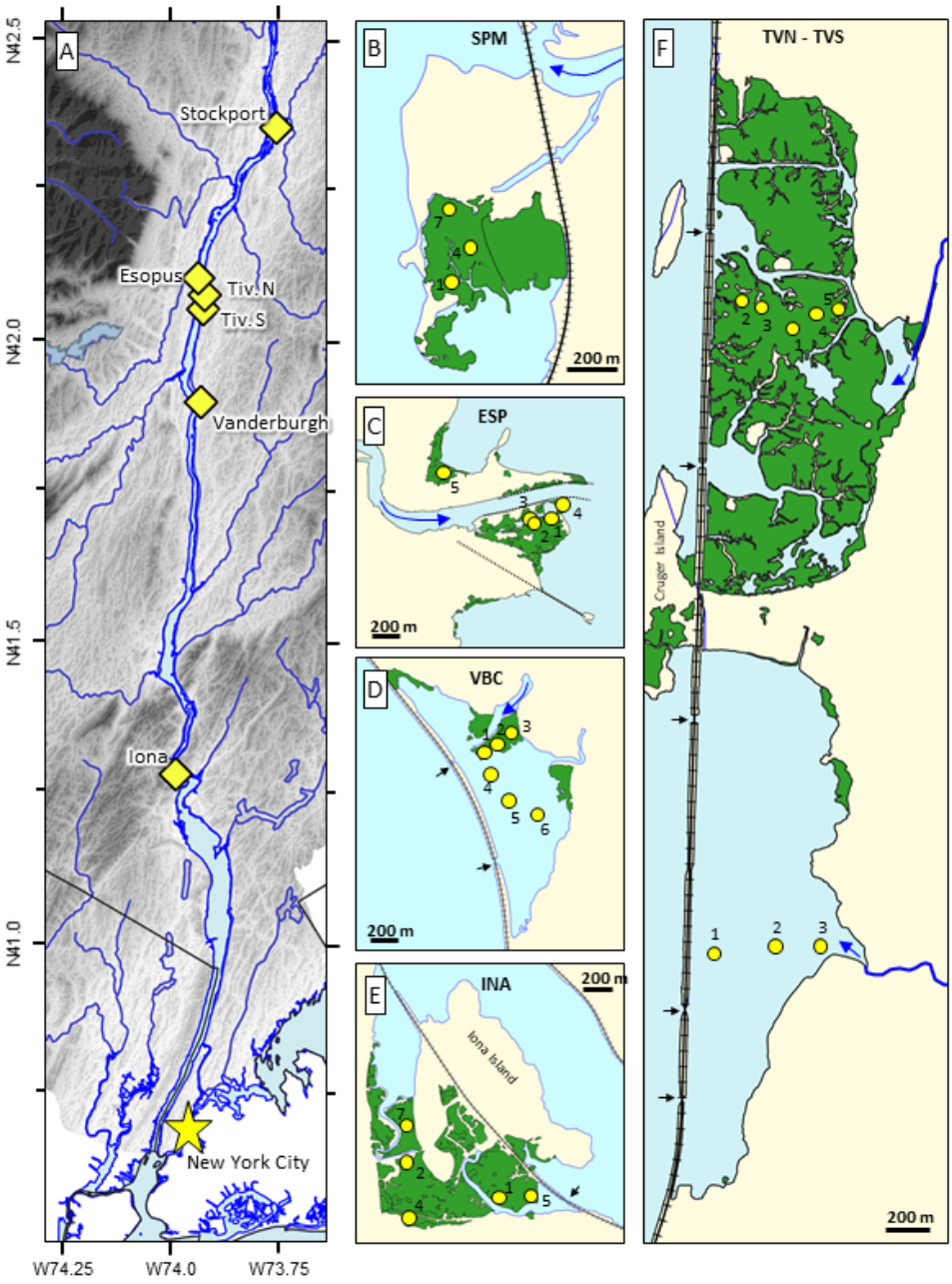


Fig 1 - Panel A shows the six study sites along the tidal Hudson River with New York City at the mouth of the river. Panels B, C, D, E, F depict the location of emergent marsh in green at Stockport (SPM), Esopus delta (ESP), Vanderburg Cove (VBC), Iona Marsh, and Tivoli North (TVN) and South (TVS) Bays. Yellow circles indicate the locations and core number of cores described in the text or in supplementary figures. Hardened structures (jetties and railroad berms) are shown in black. Significant tributary mouths are indicated with blue arrows.

File format: Downloadable .zip file, which includes text README and data in various file formats including .xls, .txt, .tif.

Data access and archival: Data are publicly available for download at https://doi.org/10.7275/dh3v-0x33. Contact Brian Yellen (byellen@geo.umass.edu) with questions or for additional information.

3. Hudson River Estuary Model Simulations of Dam Sediment Releases

General description of data: This dataset was generated by hydrodynamic and sediment transport model simulations of the Hudson River estuary. Simulations are designed to represent increased sediment loading to the estuary due to input of impounded sediment from dam removals in the watershed. Simulations were run for increased sediment loading from tributaries at different locations along the tidal Hudson: Kinderhook Creek near Stockport Marsh, Esopus Creek near Tivoli Marsh, and Doodletown Brook near Iona Island Marsh.

Modeling methods and results are explained this article: Ralston, DK, B Yellen, JD Woodruff, "Watershed sediment supply and potential impacts of dam removals for an estuary", submitted to *Estuaries and Coasts*, March 2020.

More about this data:

- The model uses the Coupled Ocean–Atmosphere–Wave–Sediment Transport (COAWST) modeling system using a unique configuration for the Hudson that was developed and evaluated against observations in previous studies.
- Simulations are run for realistic forcing conditions during spring and summer of 2014, a period for which the model has previously been evaluated against observations (Ralston and Geyer 2017).
- Model fields include spatially resolved, hourly outputs of water level, salinity, velocity, suspended sediment, and bed sediment.

Geographic extent: Hudson River estuary, NY

File format: Data are available as NetCDF files (Network Common Data Form), which is commonly used for multi-dimensional data. These data files can be displayed through different software, including ArcGIS.

Data access and archival: Data files are large (32 GB/file, 60 files per case) and cannot be served remotely at this time. Summaries of modeling runs and output data will be archived as part of the supplemental materials for the manuscript when published. Datasets are available by contacting David Ralston, dralston@whoi.edu.