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AEMR Sediment Analysis

May 17, 2023

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PNNL is operated by Battelle for the U.S. Department of Energy

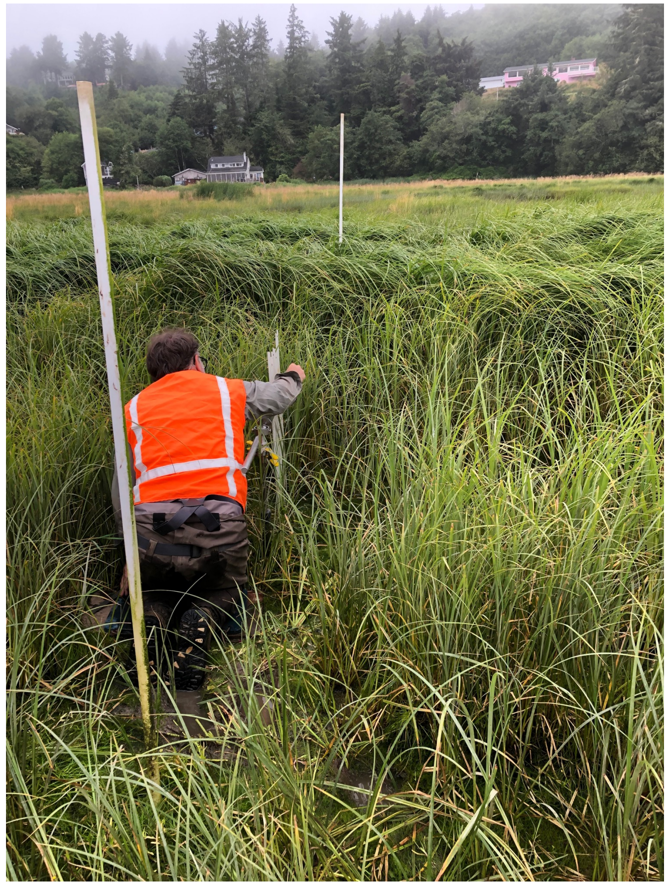
Acknowledgements

- Analysis made possible by data sharing from multiple partners in collaboration with PNNL
- Extensive field efforts for data collection, subsequent data entry, and data storage/management
- WDFW and Cowlitz Tribe data are being added to 2023 analysis

Thanks to Bonneville Power Administration for Funding this Critical Uncertainties Research

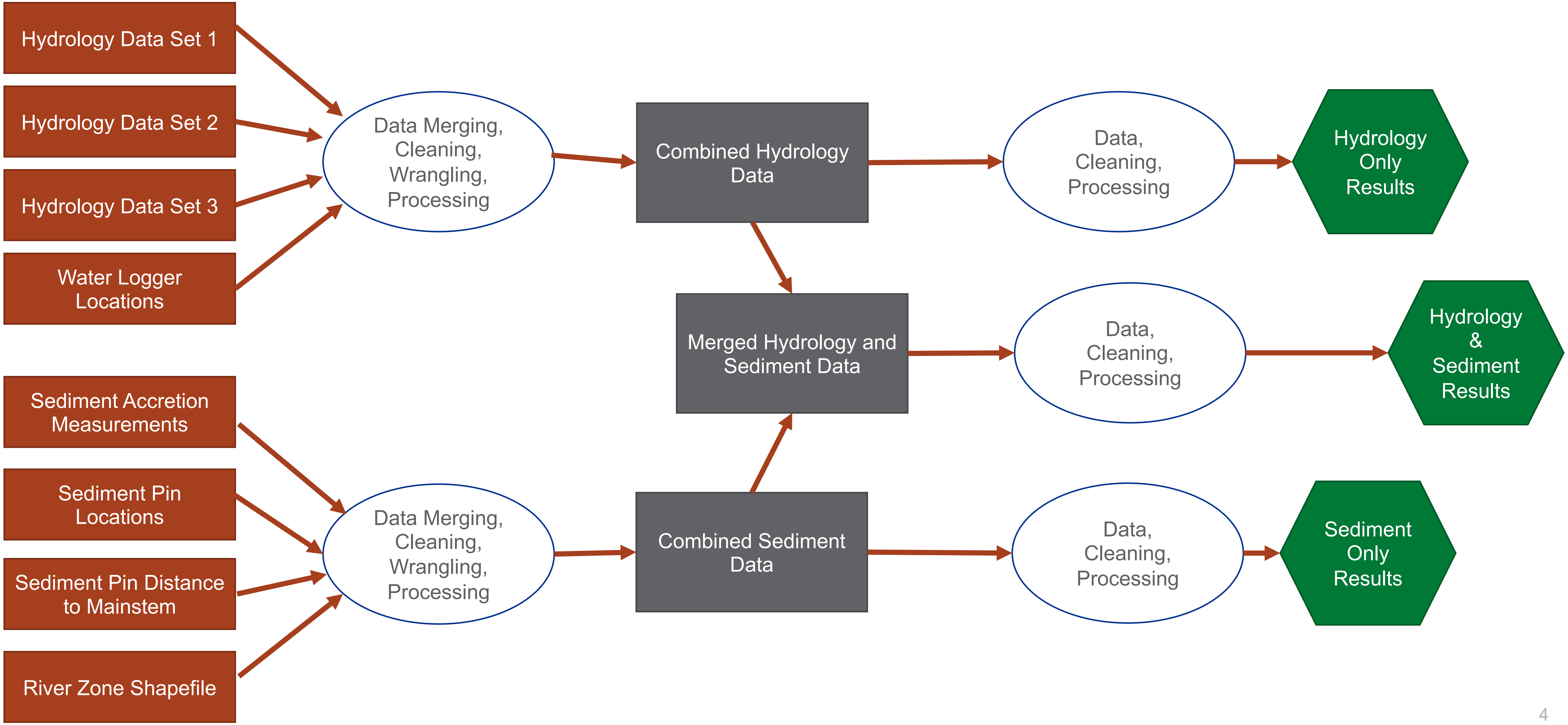
Research Q's

- Exploring sediment accretion processes
- Possible explanatory factors
  - Water depth
  - Site type
  - Location
  - Geographic: location in CRB, location relative to mainstem, lateral or vertical to the mainstem
  - Seasonal effects
  - Elevation
- **Disclaimer: Findings are preliminary and subject to change with inclusion of new observations**



SET
Baker Bay Marsh
7/28/22
Photo: Maggie McKeon

Data Wrangling Process



Previous Process Research and Indicator Development

- Introduction of annual maximum 7-day average daily maximum water depth (annual max 7DADMD)
- Found marsh sediment accretion rate increased with annual max 7DADMD
- Data included only reference sites, no restoration sites

JGR Earth Surface

RESEARCH ARTICLE

10.1029/2019JF005391

Key Points:

- A new metric, the annual maximum of the 7-day average daily maximum water depth, explains much variability of tidal river floodplain sedimentation rate
- In the estuary, up to the tidal river, cross-sectional morphology and planform channel network perimeter tend to conform to coastal processes
- Organic carbon is positively correlated with elevation and with distance from the main river channel. It is highest in the estuary

Supporting Information:

Supporting Information may be found in the online version of this article.

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Citation:

Diefenderfer, H. L., Borde, A. B., & Cullinan, V. I. (2021). Floodplain wetland channel planform, cross-sectional morphology, and sediment characteristics along an estuarine to tidal river gradient. *Journal of Geophysical Research: Earth Surface*

Floodplain Wetland Channel Planform, Cross-Sectional Morphology, and Sediment Characteristics Along an Estuarine to Tidal River Gradient

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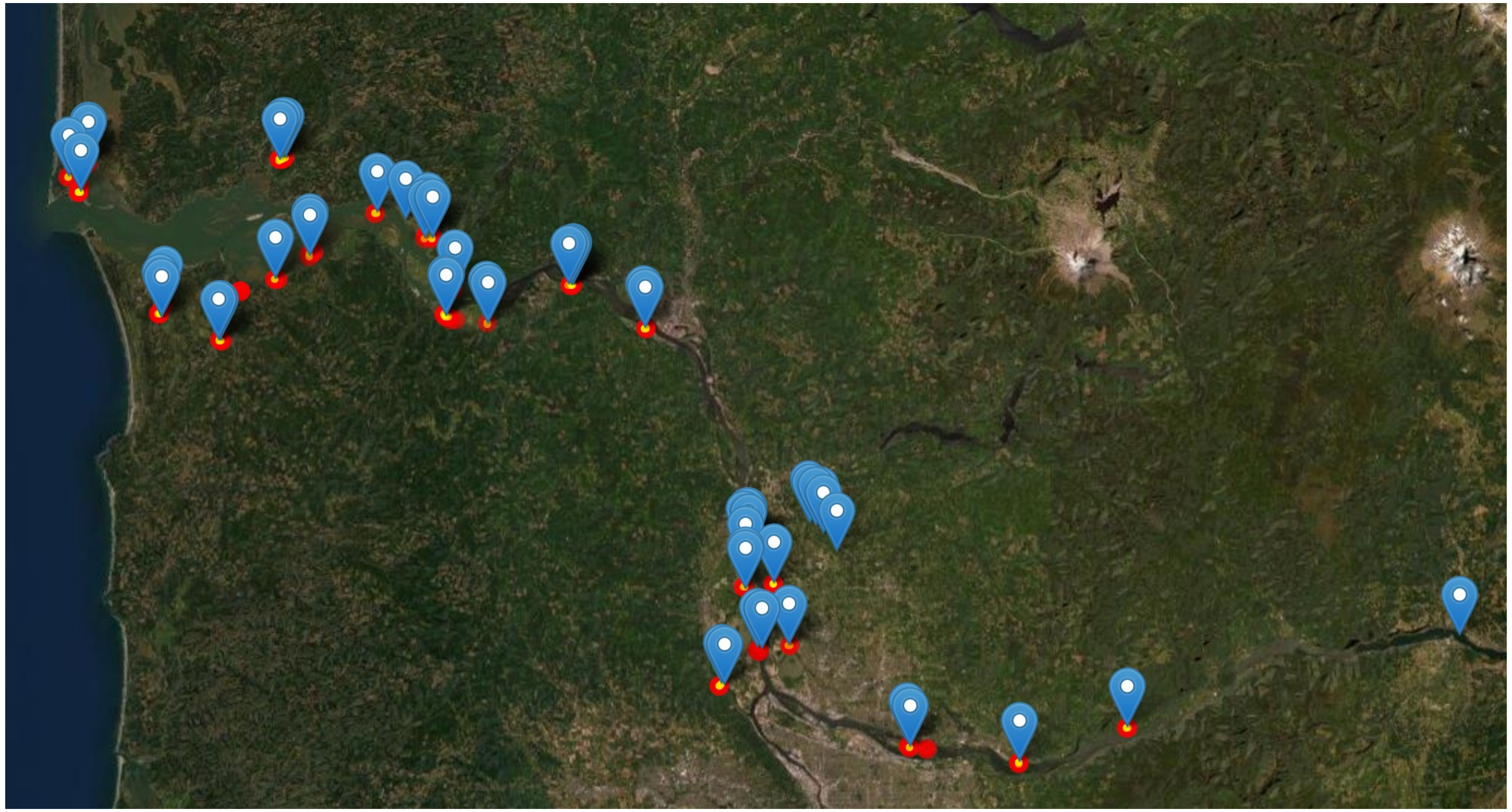
Abstract The formation of wetland channel networks on coastal river floodplains is affected by spatial transitions in tidal-fluvial processes. This study evaluated sedimentation patterns in tidal marshes on the 147-km tidal Columbia River and its 87-km estuary and characterized the cross-sectional geometry and planform morphometry of tidal wetlands along the estuarine to riverine gradient. Tidal marshes were predominantly depositional (median 0.7 cm yr^{-1}, primarily silt), consistent with late-Holocene rates. Marsh sediment accretion rate increased with annual maximum 7-day average daily maximum water depth. Elevation was negatively correlated with accretion rate in the tidal river and positively correlated with total organic carbon (TOC%) in the tidal river and estuary. TOC% was greater in the estuary and, like percent fines, greater farther from the main-channel Columbia River. For four single-channel and six channel-network planforms of tidal marsh, shrub-dominated, and forested wetlands: (1) Spatial patterns of cross-sectional morphology conformed to typical coastal wetland morphology in estuarine reaches up to the tidal river. (2) Reach-based and common slope linear models for channel perimeter on wetland area were predictive in the estuary ($R^2 > 0.81$) and differed between island ($n = 144$) and mainland ($n = 164$) wetlands. No planform linear models were predictive for the entire study area or the tidal river. No models for channel outlets were acceptable. (3) Channel perimeter, surface area, and outlets were all highly variable within and among estuarine–riverine reaches. Analyses of sediment, cross-section, and planform support the use of a “natural network paradigm” for wetland-restoration design on tidal river floodplains.

Locations

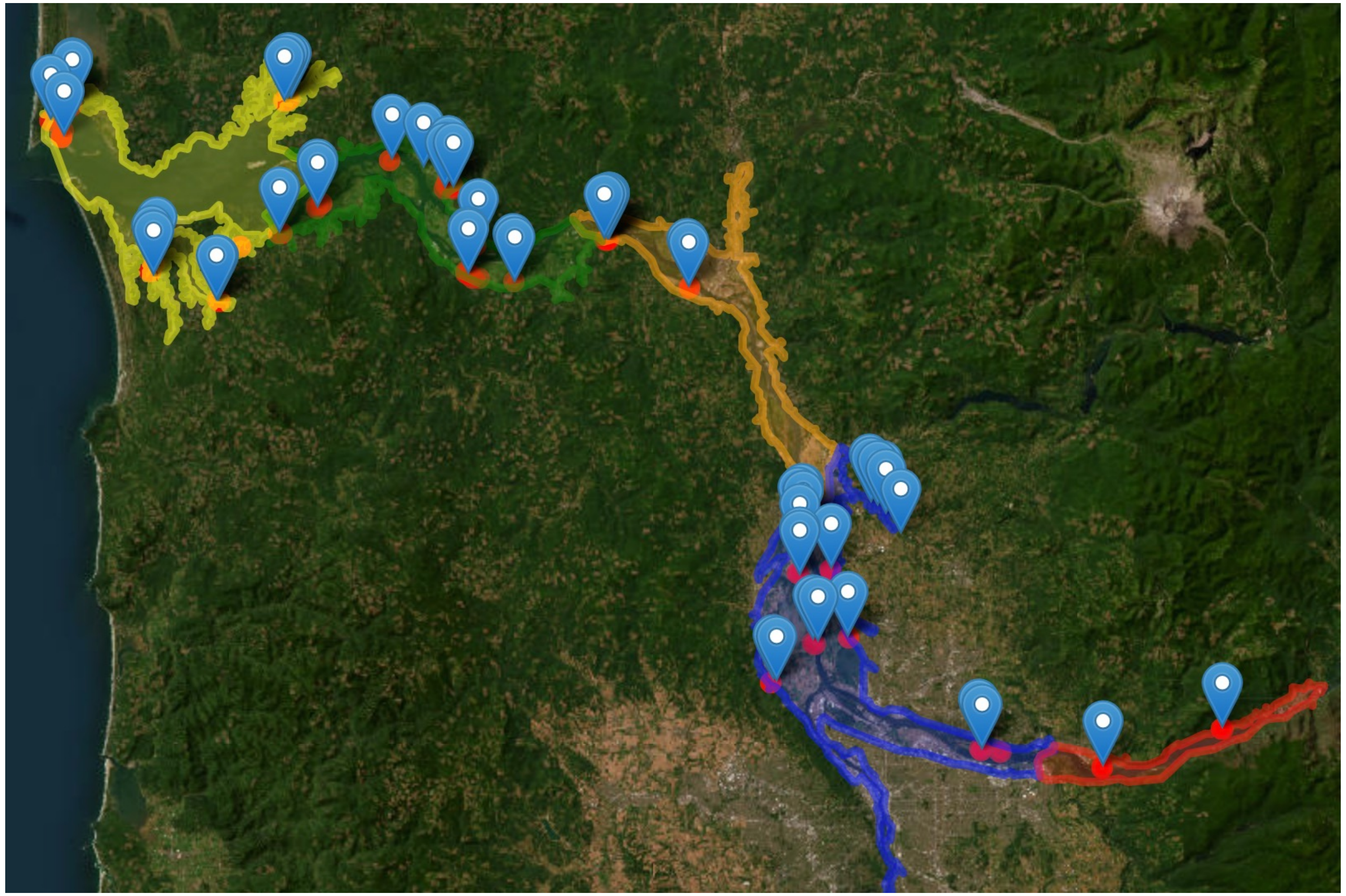


Sed stakes
Baker Bay Marsh
7/28/22
Photo: Maggie McKeon

- Blue pins: 67 water loggers
- Red dots: 103 sediment pins

Spatial Information: River Zones and KM

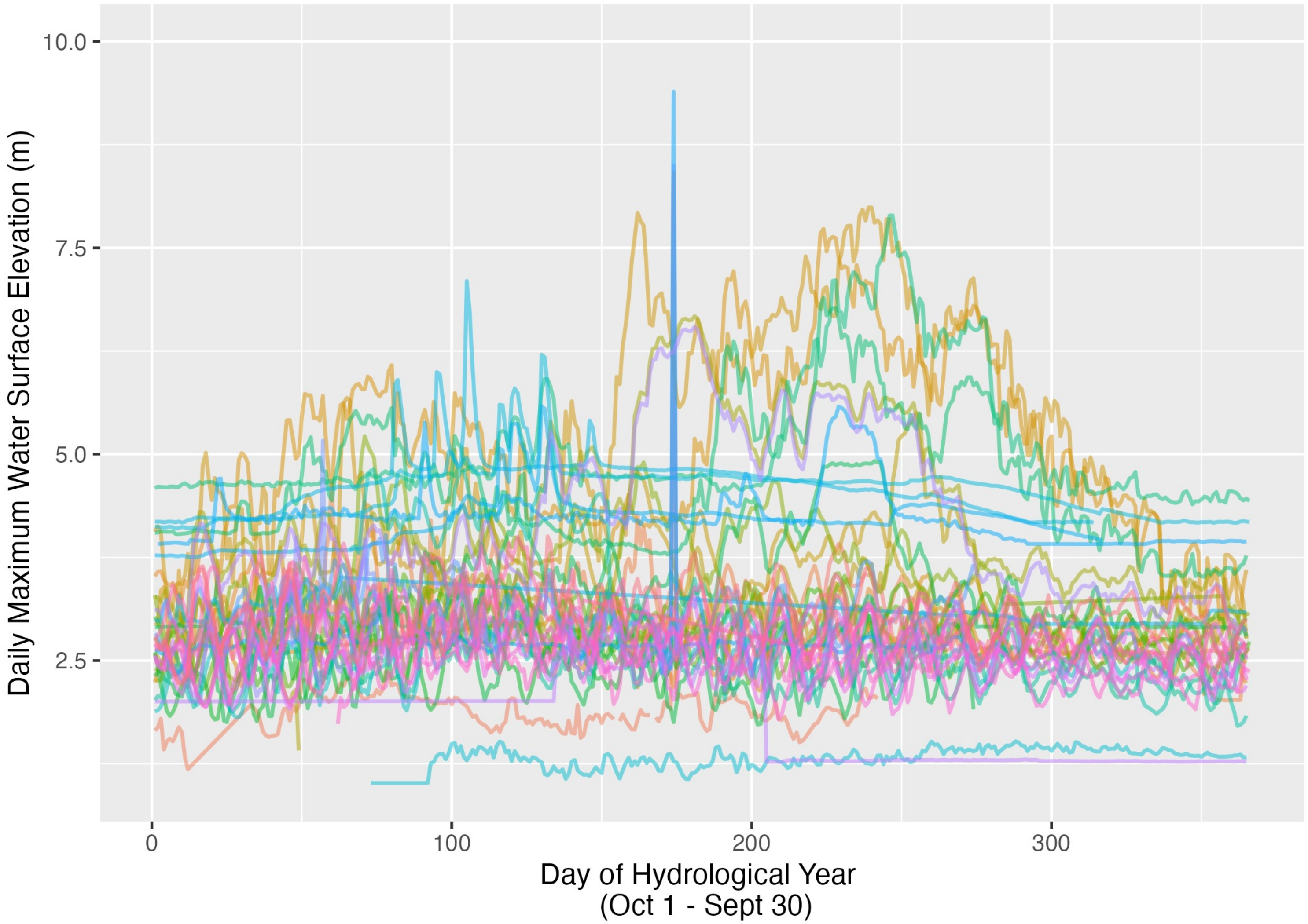
- River KM
- River zones used to identify regions with different hydrological features*
  - Lower estuary (yellow)
  - Upper estuary (green)
  - Lower tidal river (orange)
  - Middle tidal river (blue)
  - Upper tidal river (red)
- Used for both water loggers and pins



*Citation: David Jay

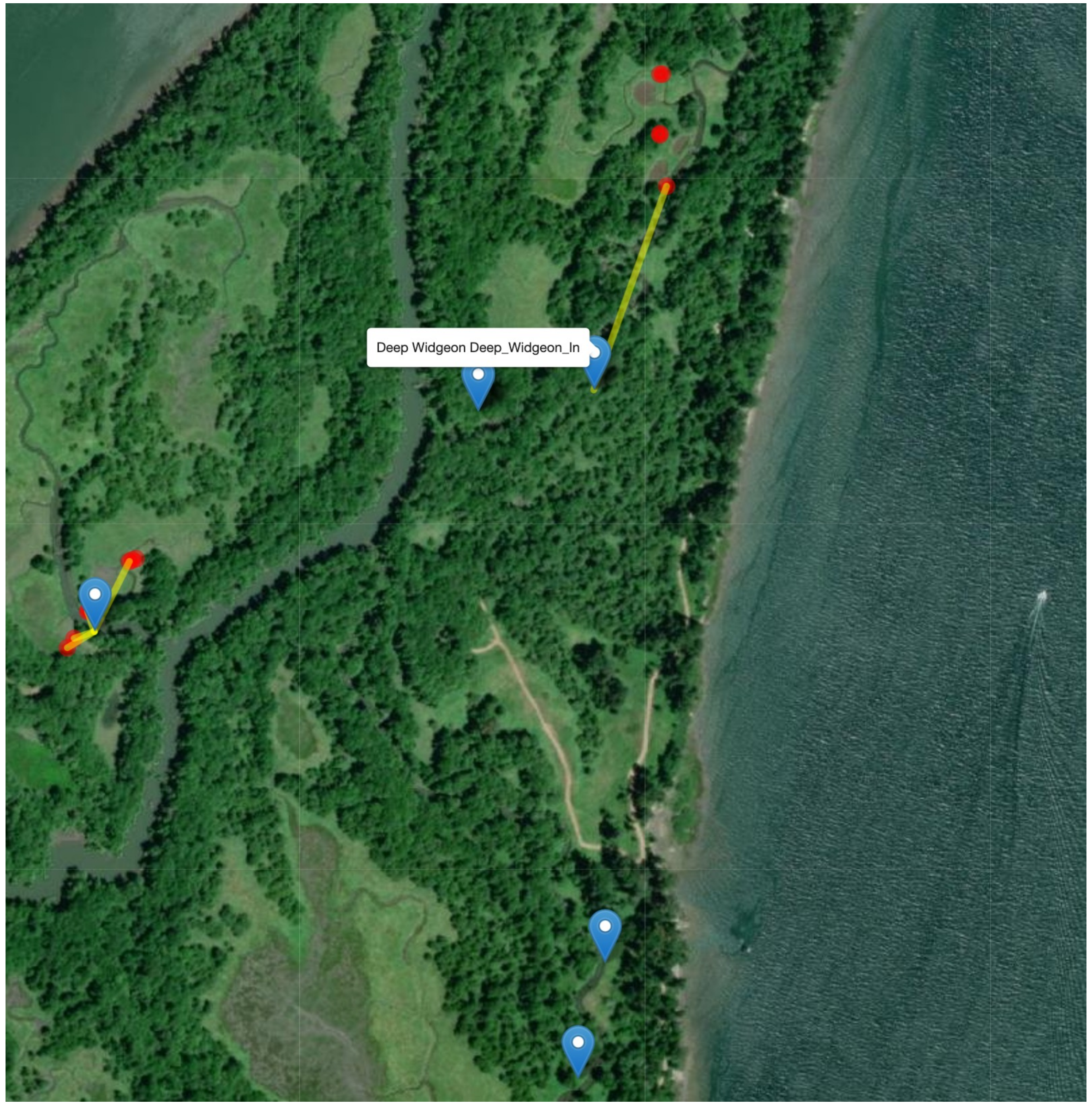
Water Loggers

- 67 water loggers
- Data 2014-2021
- 3.2 million measurements of water surface elevation (wse)
- Resolving data quality issues:
  - Missing data
  - Beaver dam
  - Single erroneous measurement
- 108 complete site-location-hydro years



Sediment Pins

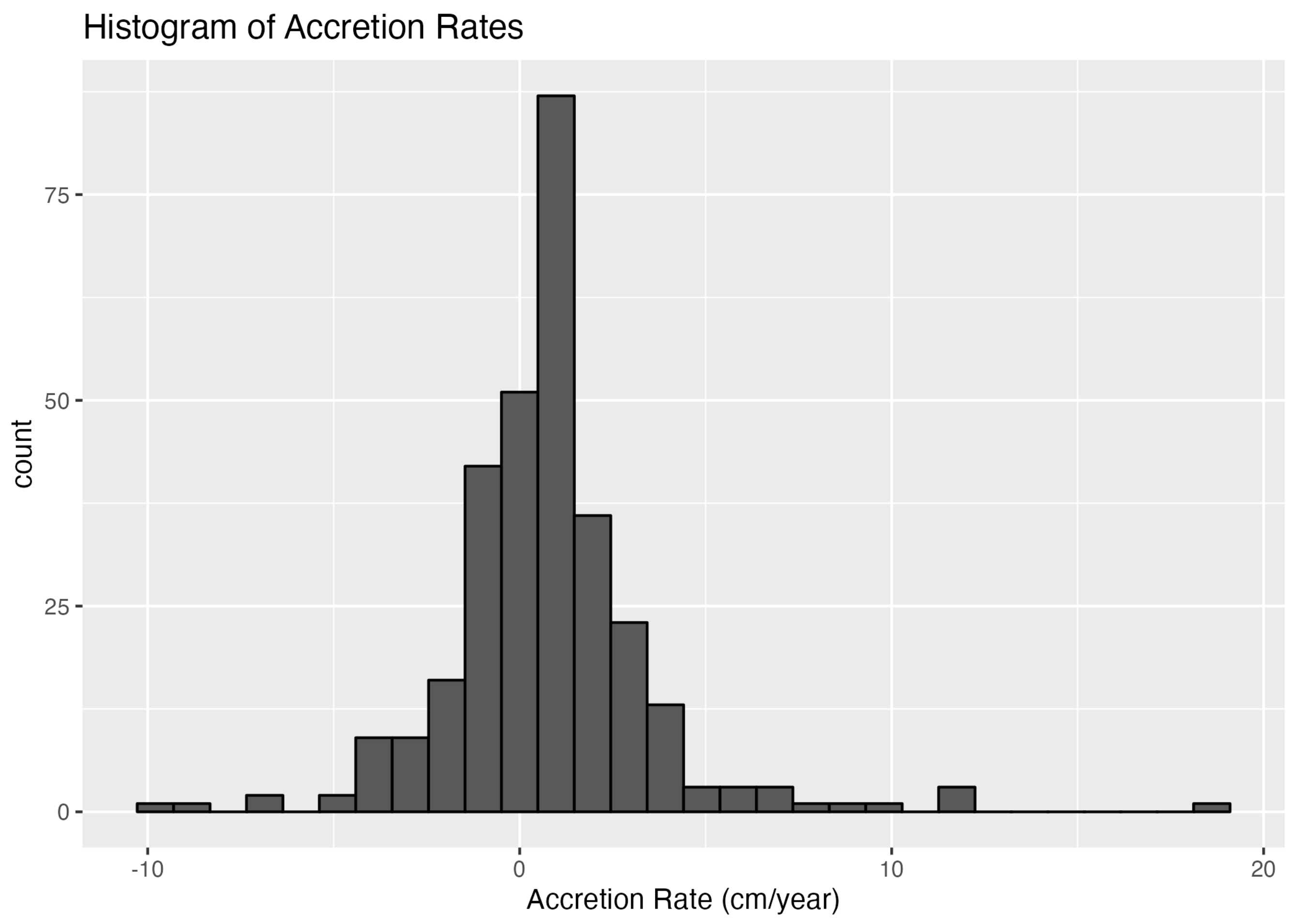
- 103* sediment pin locations
  - Site type
  - Site elevation (CRD and NAVD88)
  - River zone
- Pin counts:
  - Reference: 19
  - Restoration: 84
- No data from reference site pins in Lower Tidal River in this analysis
- No data from restoration site pins in Upper Tidal River in this analysis



- Blue: water logger location
- Red: sediment pin location

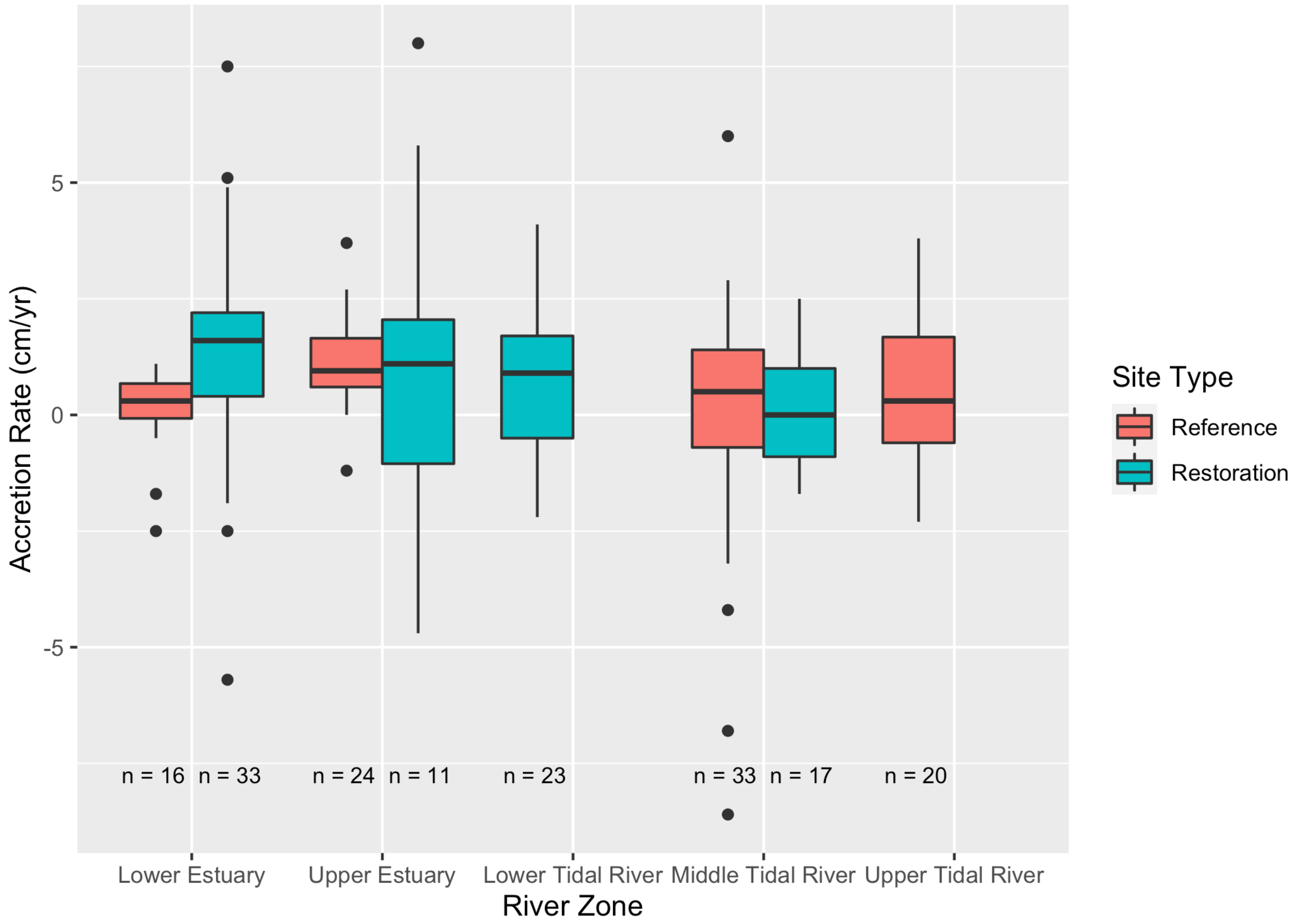
Sediment Pins

- Data quality issues
- 437 original accretion rate estimates
  - Restricted to accretion rates based on two measurements taken 275 – 455 days apart
  - Example: 25 of these based on measurements taken <180 days apart
- 177 final accretion rate estimates that could be joined to water surface elevation



River Zone, Site Type, and Accretion

- Greater accretion in restoration sites relative to reference sites in the Lower Estuary Zone -- restoration sites were on average 1.4 cm greater, 95% CI (0.2, 2.6)
- Restoration 0.14 cm greater, on average, in Middle Tidal River
- Restoration 0.05 cm smaller, on average, in Upper Estuary



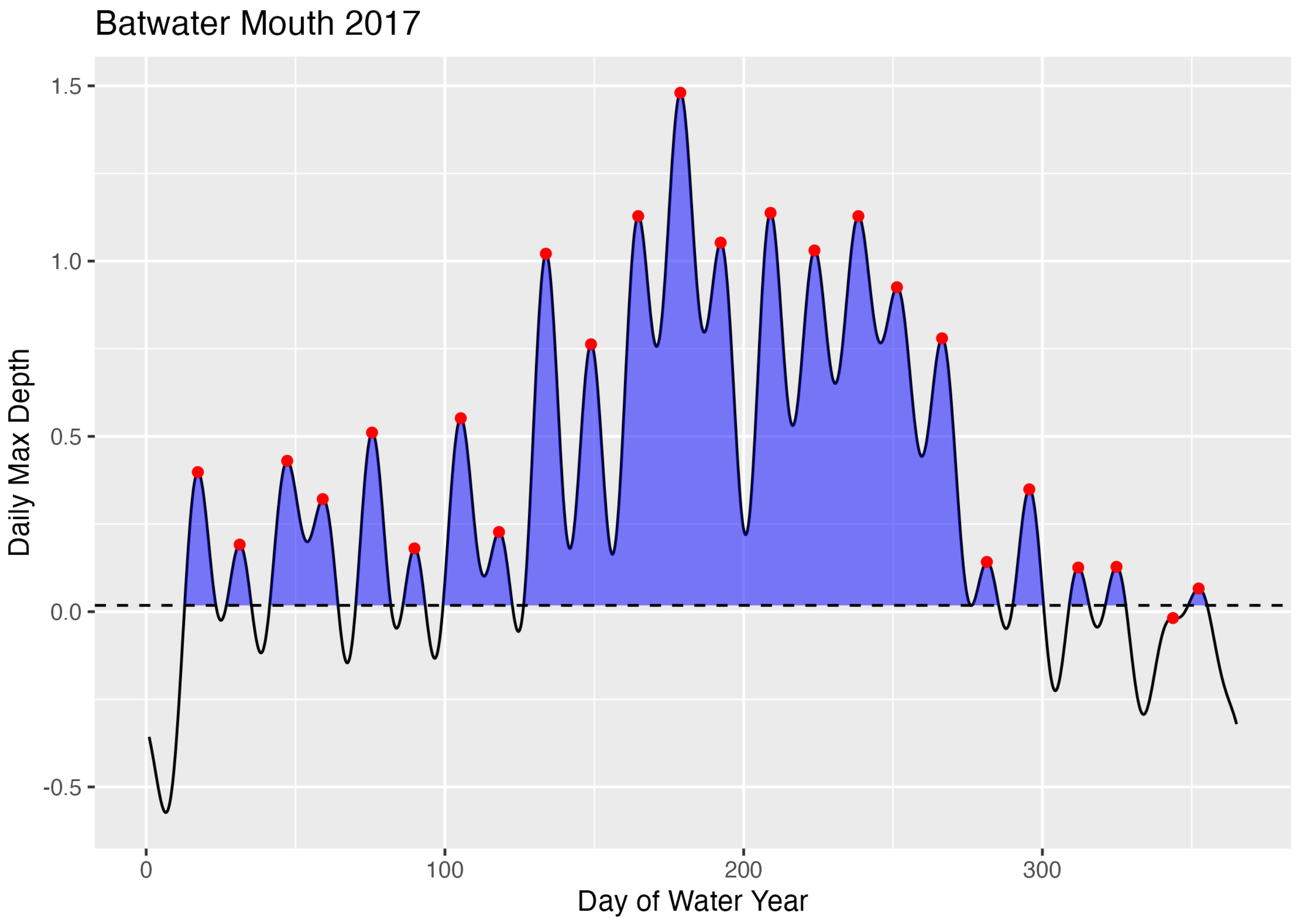
Water Logger – Pin Join

- Join each sediment pin to the nearest water logger within 300 m
  - Average distance of 100 m
  - 75% of matches <150 m
- The same water logger could be joined to multiple sediment pins
- Join accretion measurements based on hydrological year
- 54 logger-pin-year matches

- Blue: water logger location
- Red: sediment pin location
- Yellow: distance between pin and nearest water logger

Water Surface Curve Data

- Compute features of the water year curve for each site-year
- Water year curve features
  - Annual max 7DADMD
  - Number of peaks
  - Area under curve above the 25^{th} percentile of depth



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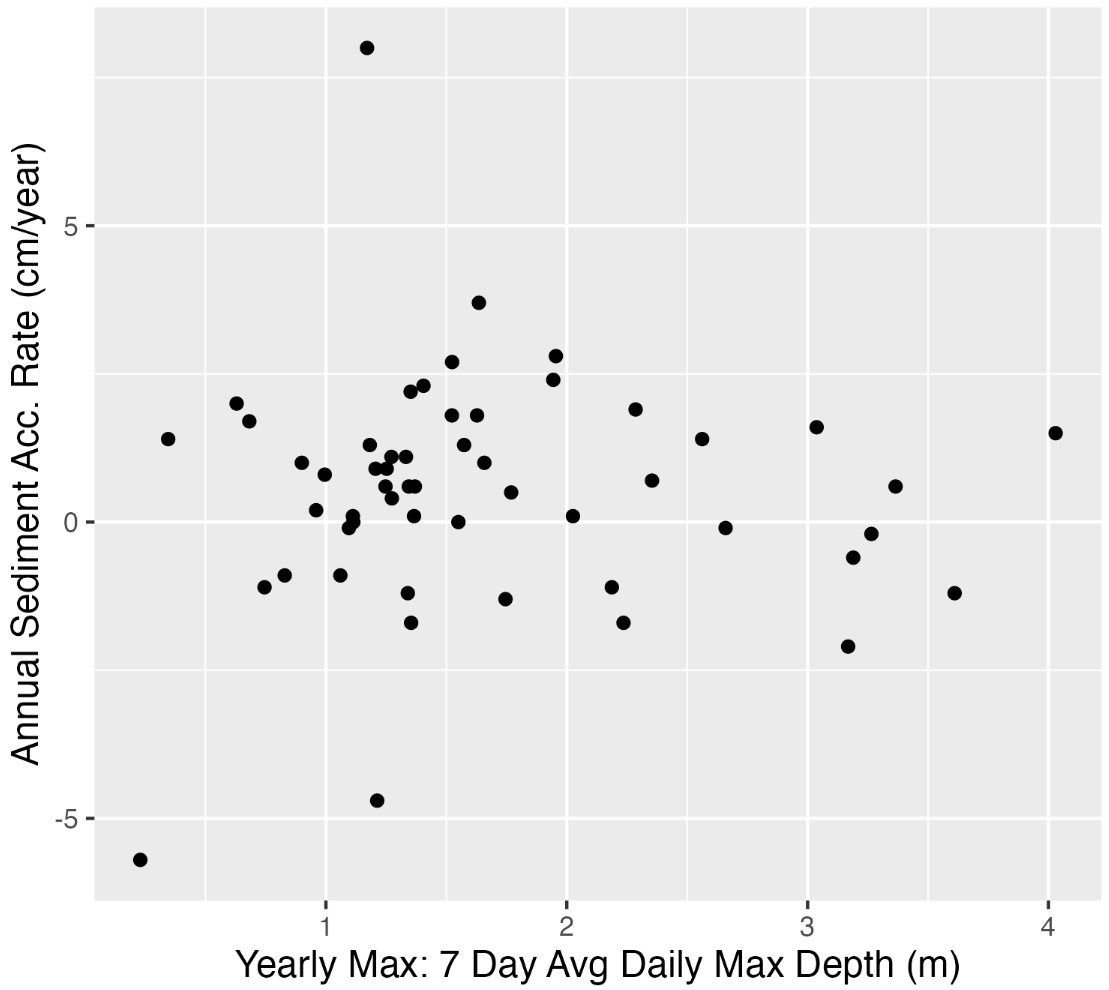
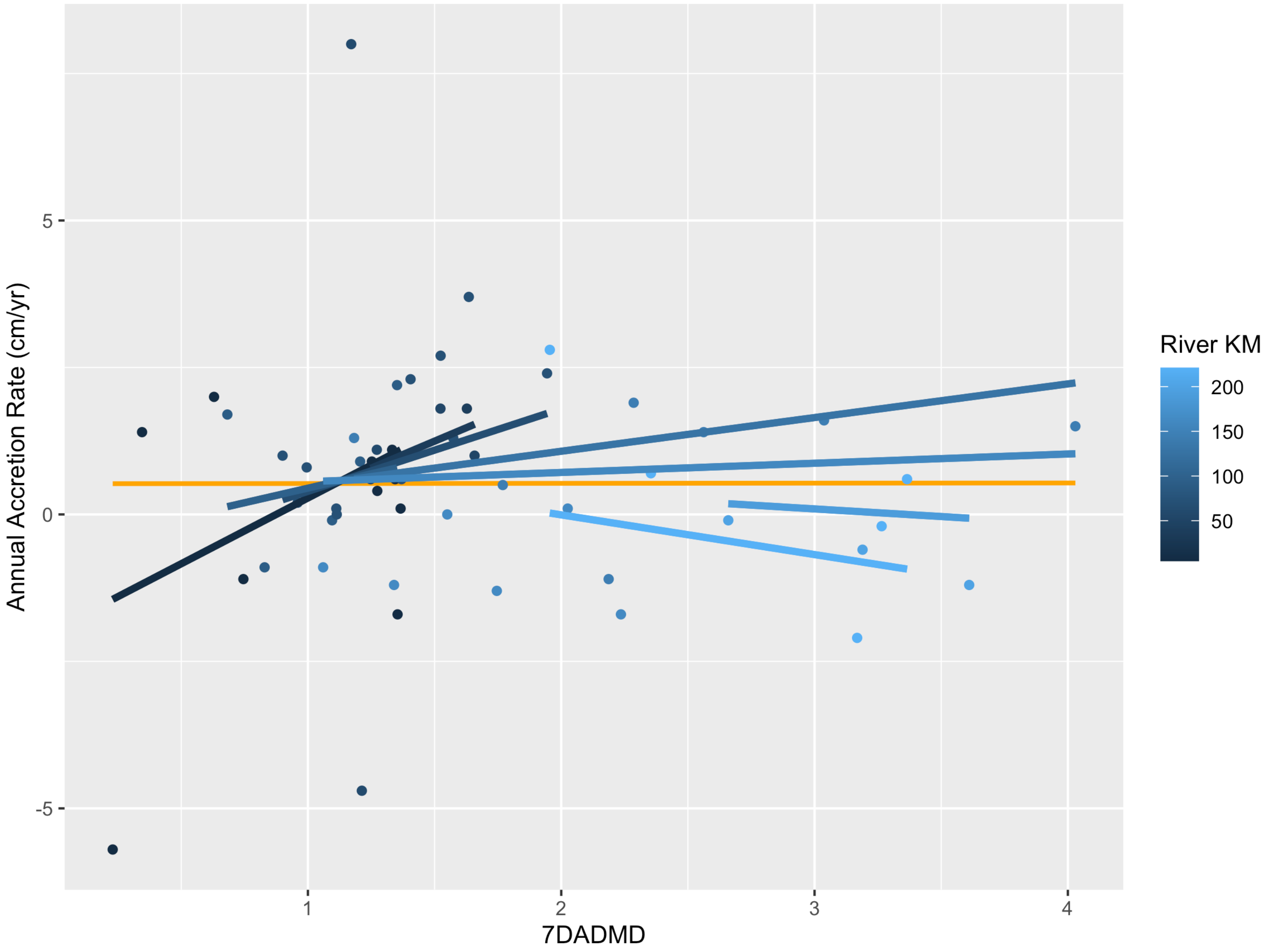
Prelim Results

- No clear relationship between accretion and 7DADMD



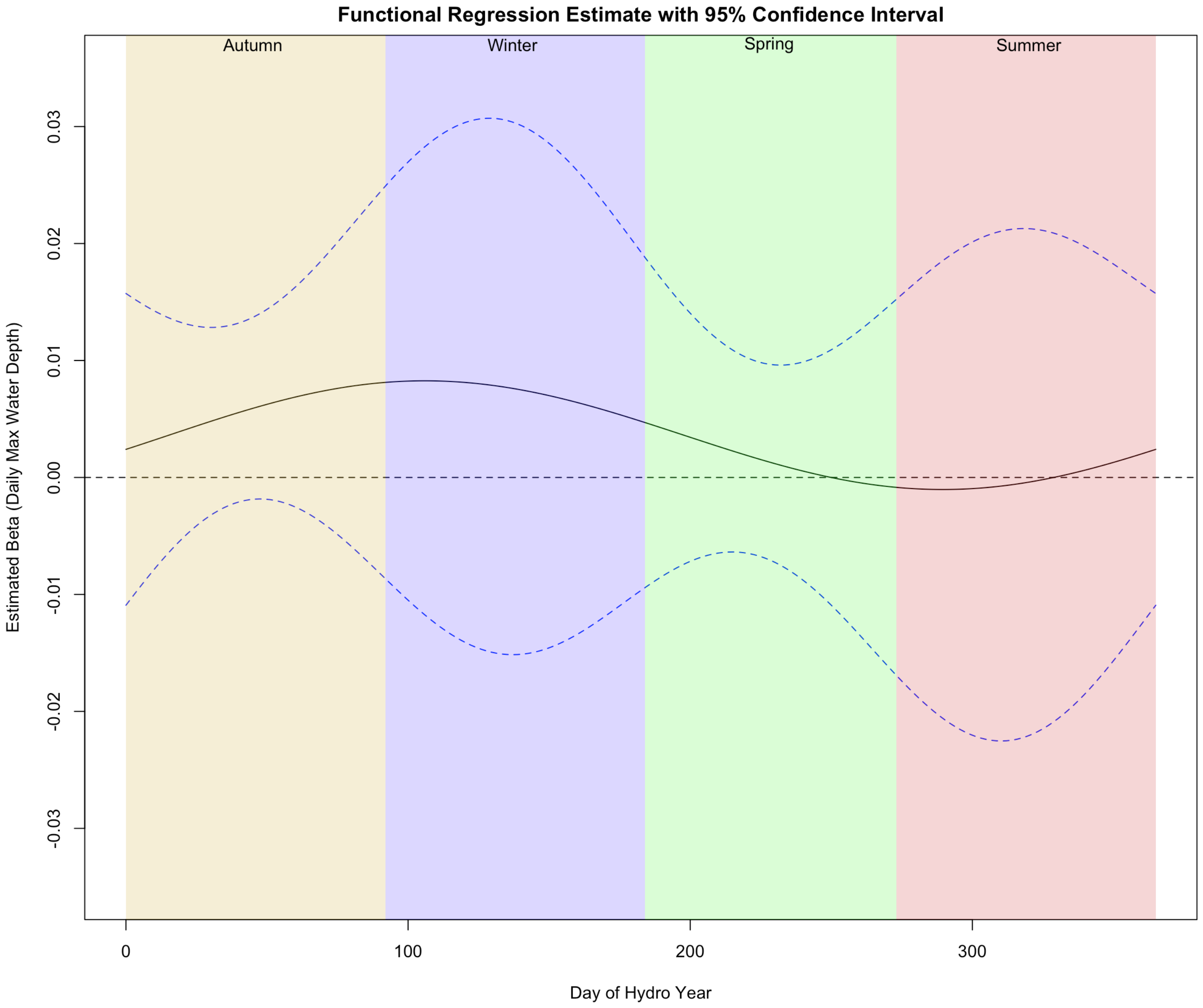
Prelim Results: 7DADMD and River KM

- Greater accretion rates associated with larger values of 7DADM for coastal sites
- As you move upriver, the relationship between accretion rate and 7DADMD gets weaker



Functional Data Approach

- Treat the predictor (daily maximum depth) and regression coefficient as functions
- Greater water depths Jan-Mar (purple) associated with greater accretion rates
- Greater water depths in June-July (green to red) associated with lower accretion rates



Data Reporting Standards

- Developing a set of standards for recording and reporting data
- Creation of metadata or data dictionary
- Facilitate future analyses

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Thank you

Questions:

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