Determining vegetation establishment thresholds with custom-built sensors

Madeline Foster-Martinez[1], **Abby Eckland (presenting)[1]**, Vitalii Sheremet[2], & Jenneke Visser[3]

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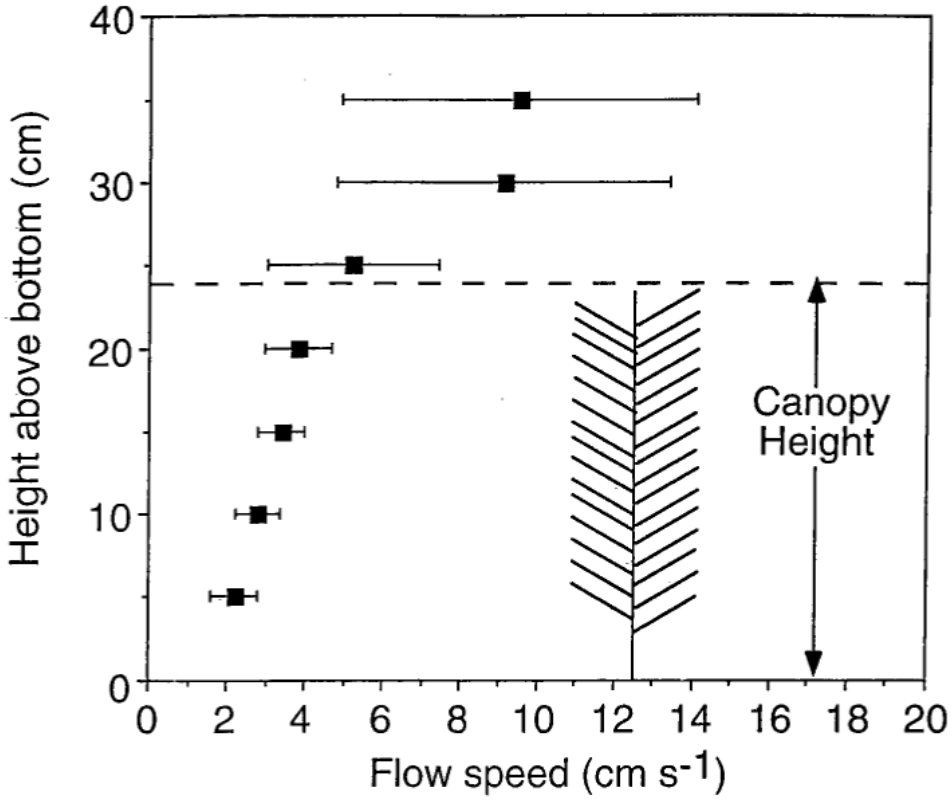
1. University of New Orleans, New Orleans, LA, USA
2. OkeanoLog, North Falmouth, MA, USA
3. University of Louisiana at Lafayette, Lafayette, LA, USA

Vegetation is critical for the establishment and maintenance of wetlands

- Vegetation influences hydrodynamics and sedimentation
- Belowground roots strengthen the soil surface, reducing erosion

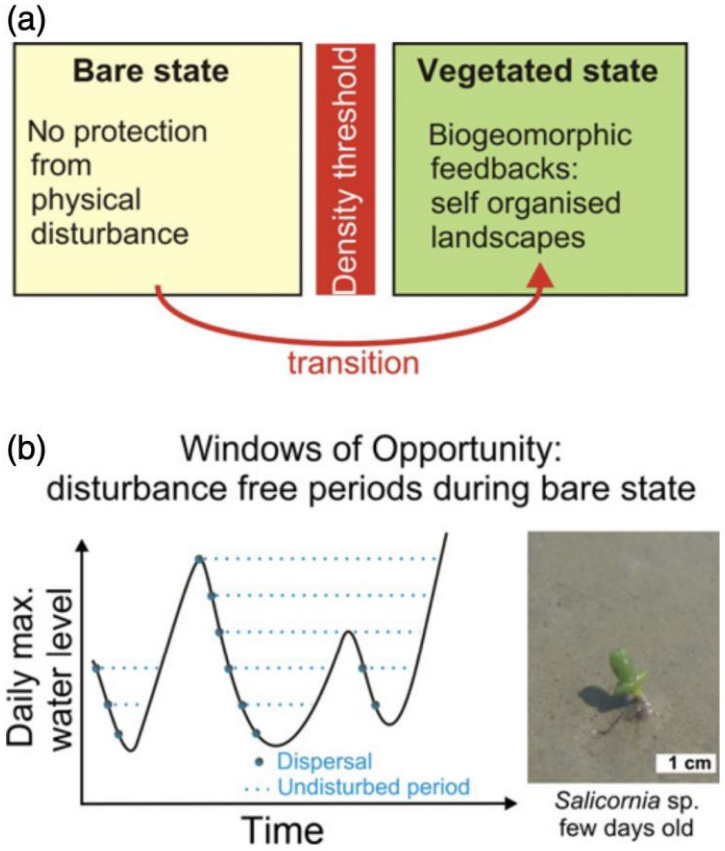
➢ Wetland surface aggrades with sediment and organic matter



Leonard & Luther, 1995

Established plants are less sensitive to the conditions required for their initial establishment

- Seeds are dispersed through physical processes to bareground areas
    - Must be left relatively undisturbed to germinate and establish
- This sequence is known as a ***window of opportunity***

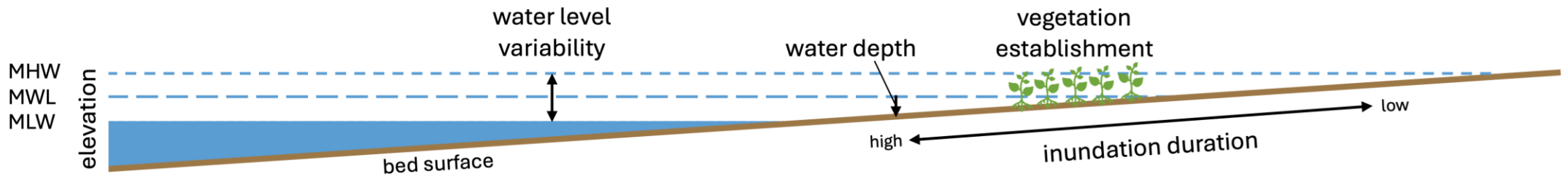


Balke et al., 2014

Physical conditions that influence vegetation establishment in coastal Louisiana are:

- Water depth and its variability
- Duration of inundation
- Wave activity
- Salinity

➢ Microtidal (0.3m), diurnal tides control water levels while larger variations are driven by wind and pressure systems, and river floods



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Thresholds?

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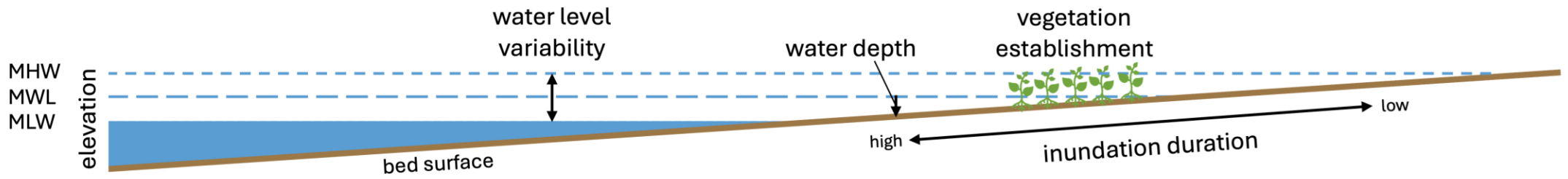

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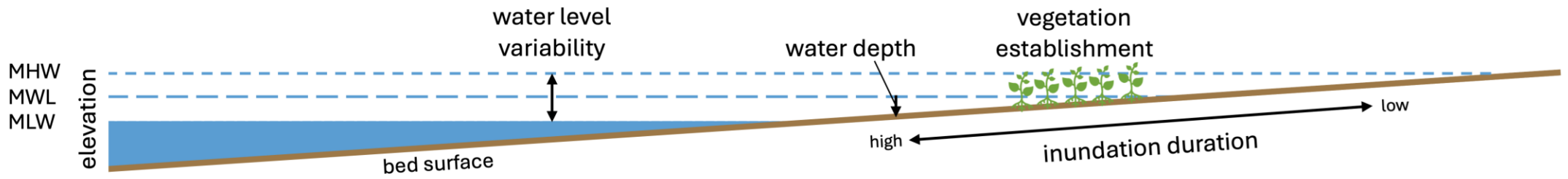
Thresholds?

We need to identify thresholds for vegetation establishment to accurately forecast land building within a modeling framework.

variations are driven by wind and pressure systems, and river floods



We focus on the physical conditions that influence vegetation establishment in emerging wetlands

- Previous research references inconsistent elevation and tidal datums, so findings are not comparable

- Shallow nature of these environments (-10 cm below MSL) makes field investigations difficult

➢ ***Need for a new approach***

Our approach is rooted in field measurements to capture the process of vegetation establishment *in-situ*

Custom-built water level loggers deployed in a shallow mudflat

Primary goal is to measure inundation time, water level a bonus

Dry conditions

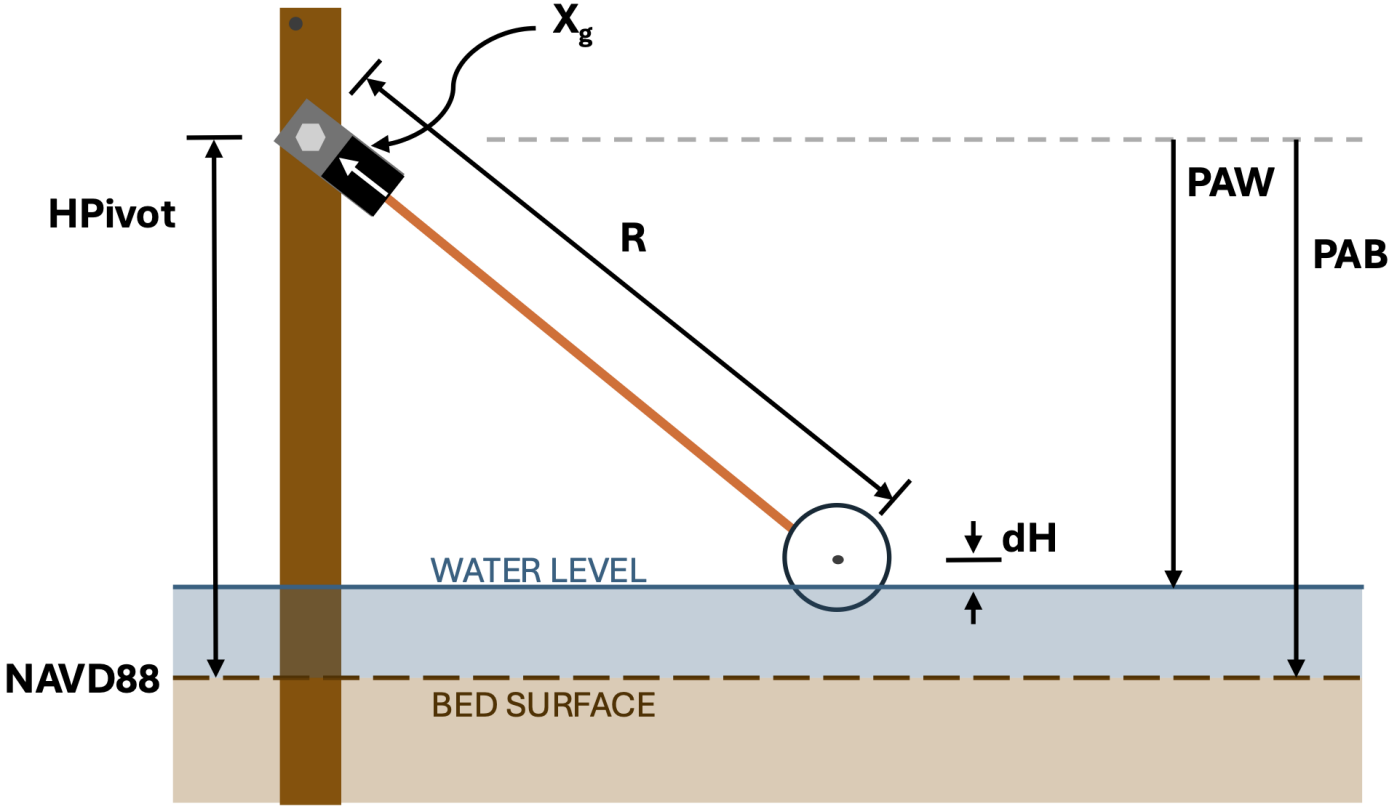
Inundated conditions

We use low-cost water level loggers to continuously monitor inundation trends

- Pendant G Acceleration Data Logger ($115, waterproof)
  - $230 total per logger (includes sensor, housing, and deployment materials)

- Low cost enables numerous loggers to be deployed at a single site (~15), giving high spatial coverage along elevation gradients

Water level and inundation time are calculated via the raw logger and RTK elevation data



$$H = Xg * R + dH + HPivot$$

Where:

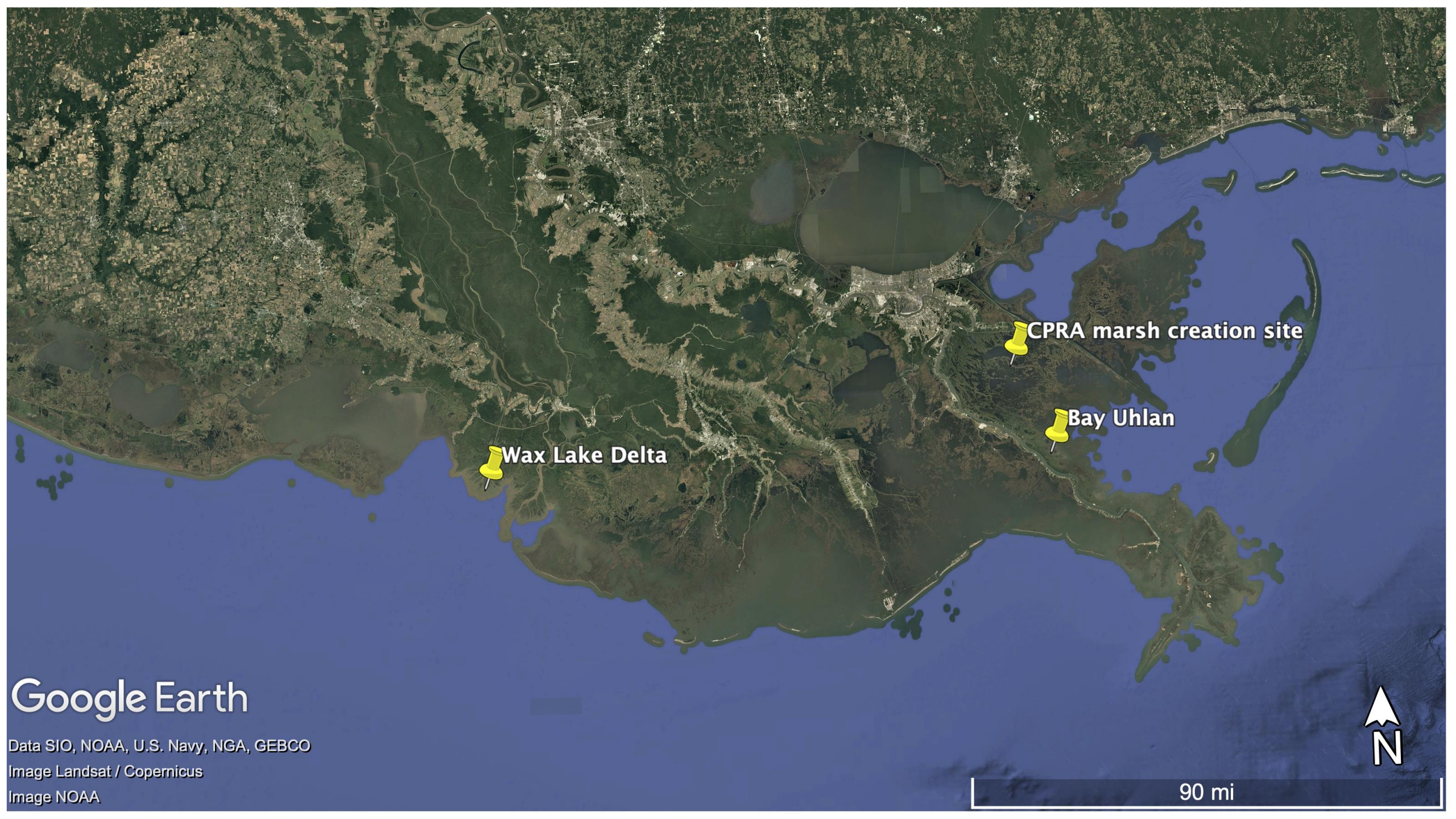
- H - Water level above NAVD88
- Xg - Raw output from the logger sensor ($Xg = (X * g)/g$)
- R - Arm length
- dH - Small correction to account for difference between water level and center of the ball
- $HPivot$ – Elevation of the pivot center above NAVD88

Our intensive field campaign at 3 highly targeted sites will record:

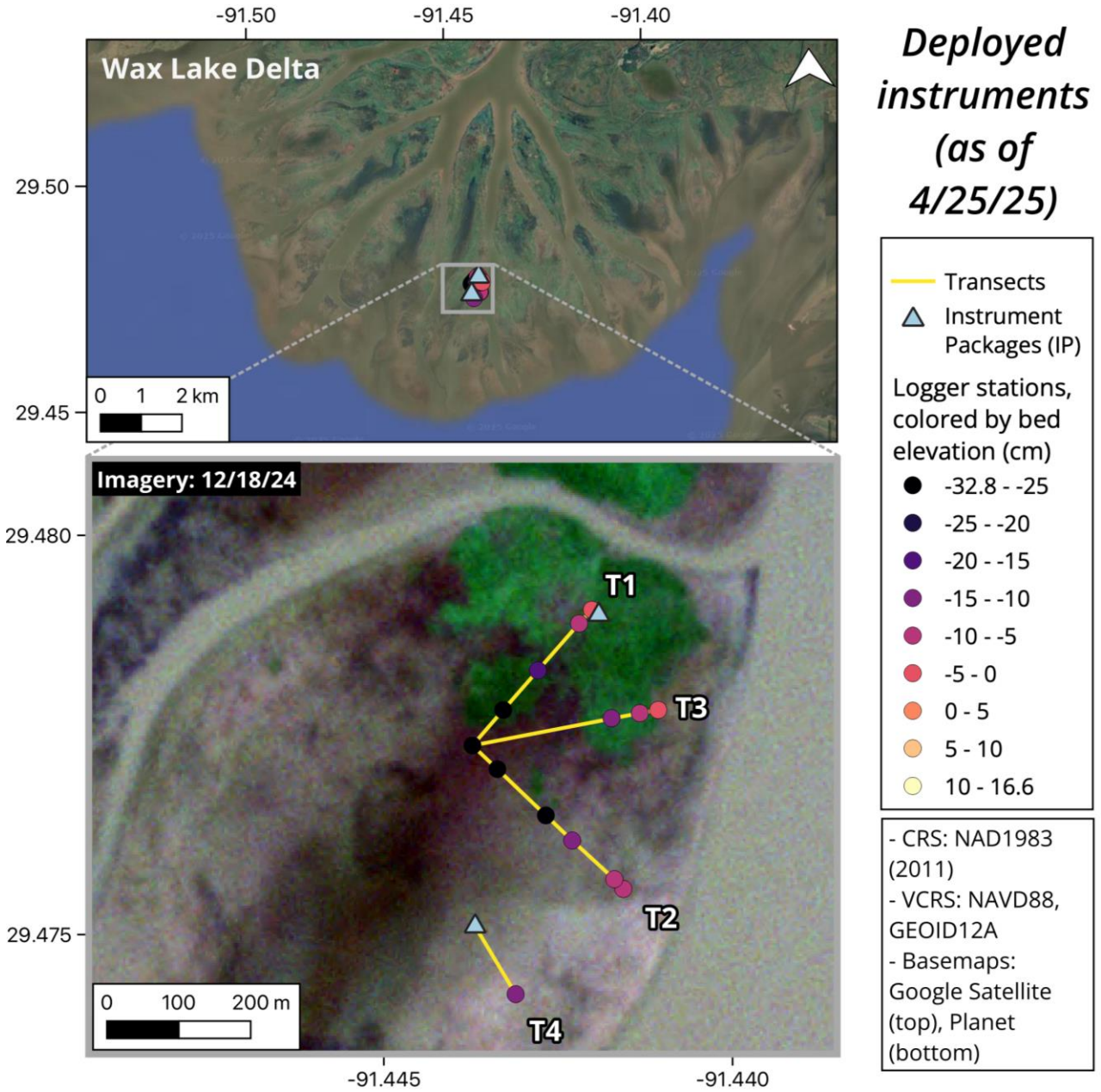
1. Environmental conditions (duration of inundation, water depth, wave activity)

2. Site characteristics (soil strength, sediment texture)

3. Vegetative species


CPRA marsh creation site
Bay Uhlan
Wax Lake Delta
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Image NOAA
N
90 mi

We focus on **aggrading** parts of the delta: Wax Lake Delta and Bay Uhlan



Deployed instruments (as of 4/25/25)

Transects

Instrument Packages (IP)

Logger stations, colored by bed elevation (cm)

- -32.8 - -25
- -25 - -20
- -20 - -15
- -15 - -10
- -10 - -5
- -5 - 0
- 0 - 5
- 5 - 10
- 10 - 16.6

- CRS: NAD1983 (2011)
- VCRS: NAVD88, GEOID12A
- Basemaps: Google Satellite (top), Planet (bottom)

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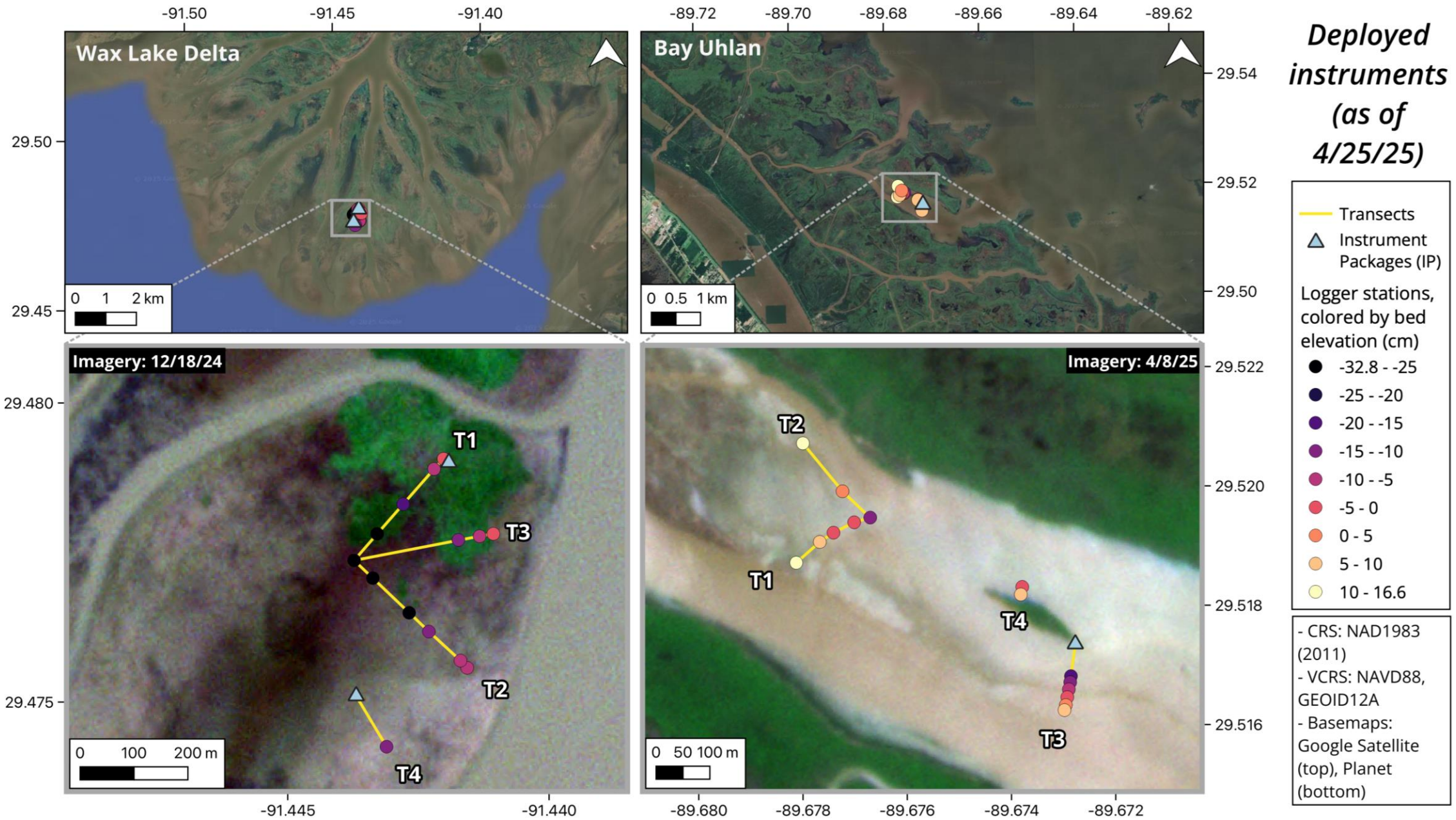

Logger data from the highest and lowest elevation stations along a transect at **Bay Uhlan**

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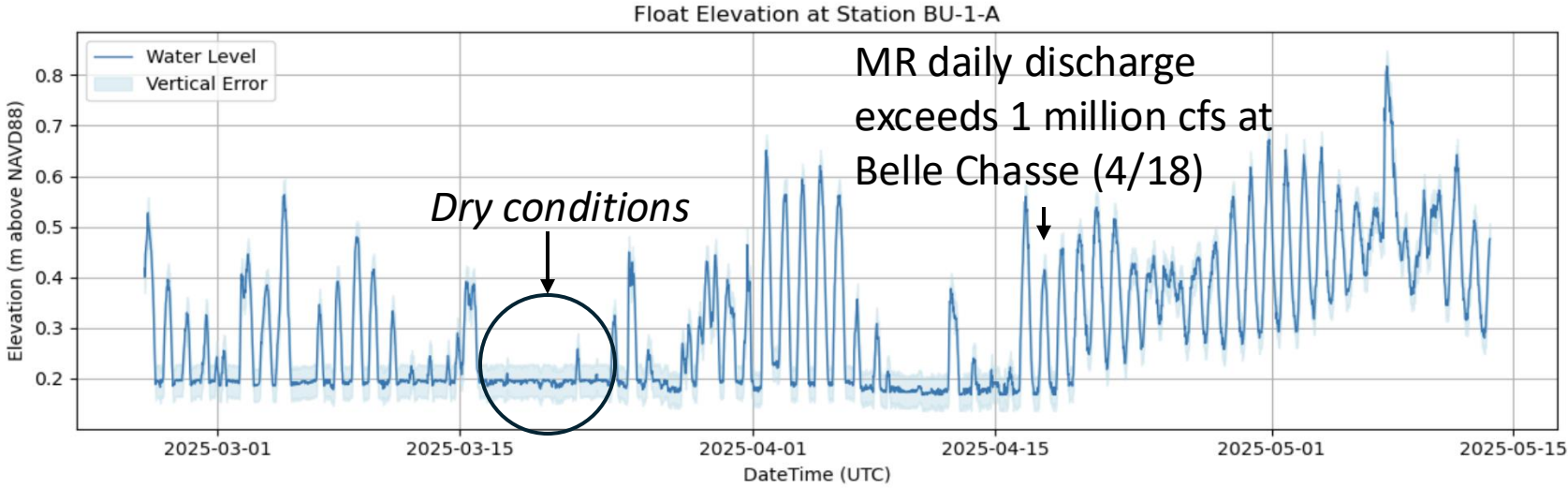

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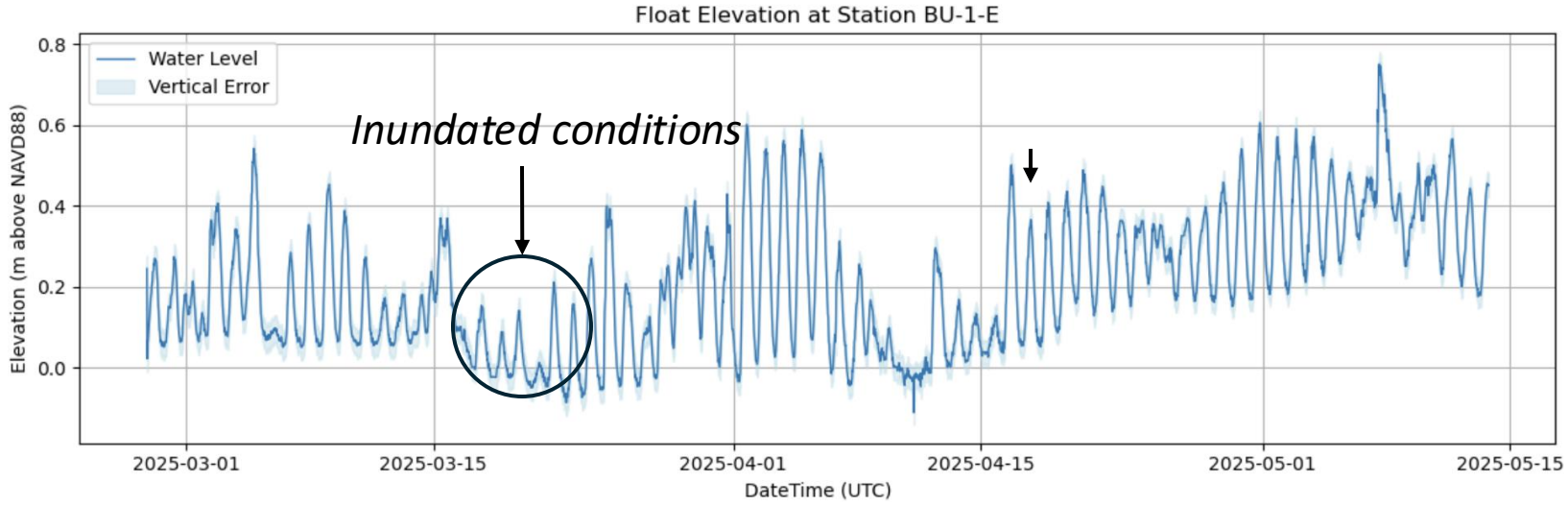
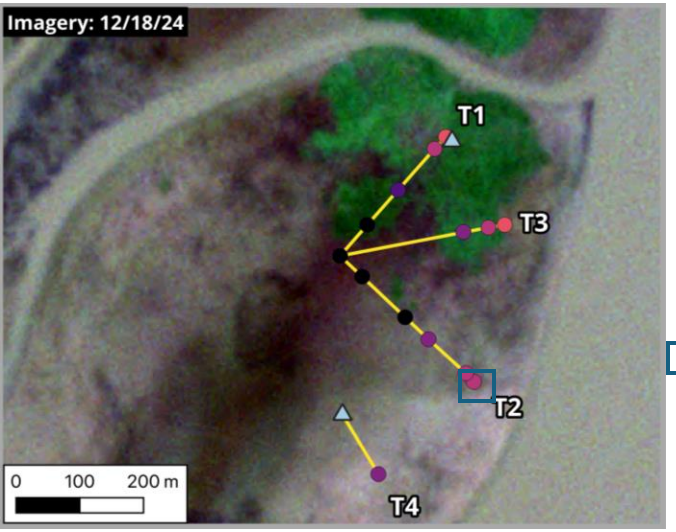


Logger data from the highest and lowest elevation stations along a transect at **Wax Lake Delta**



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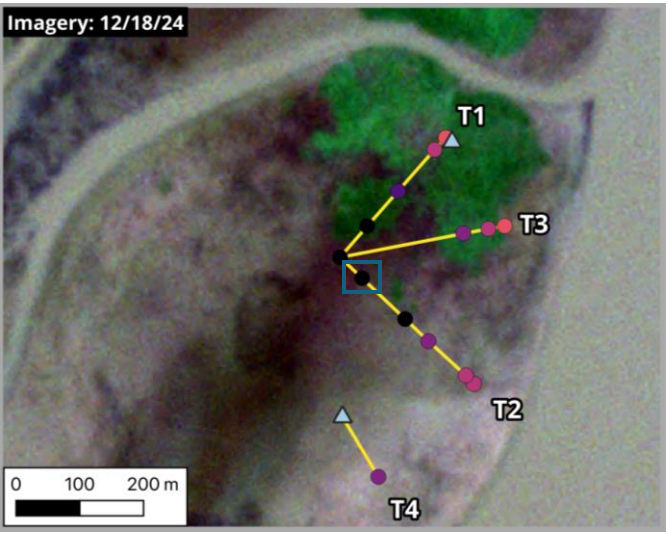

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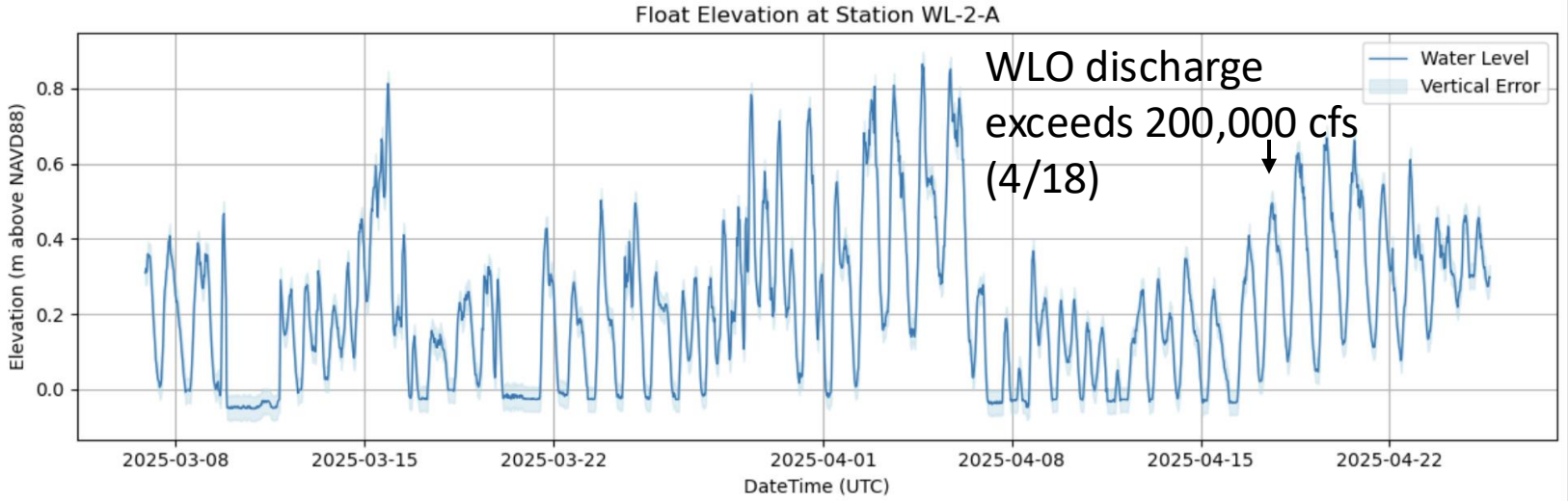
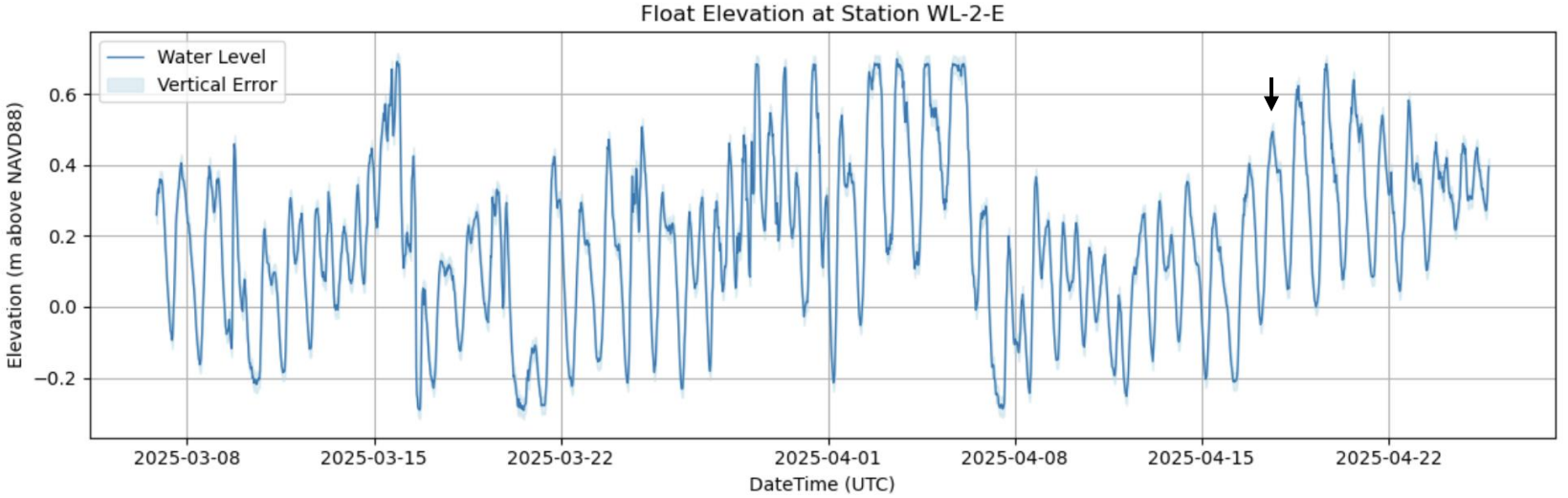
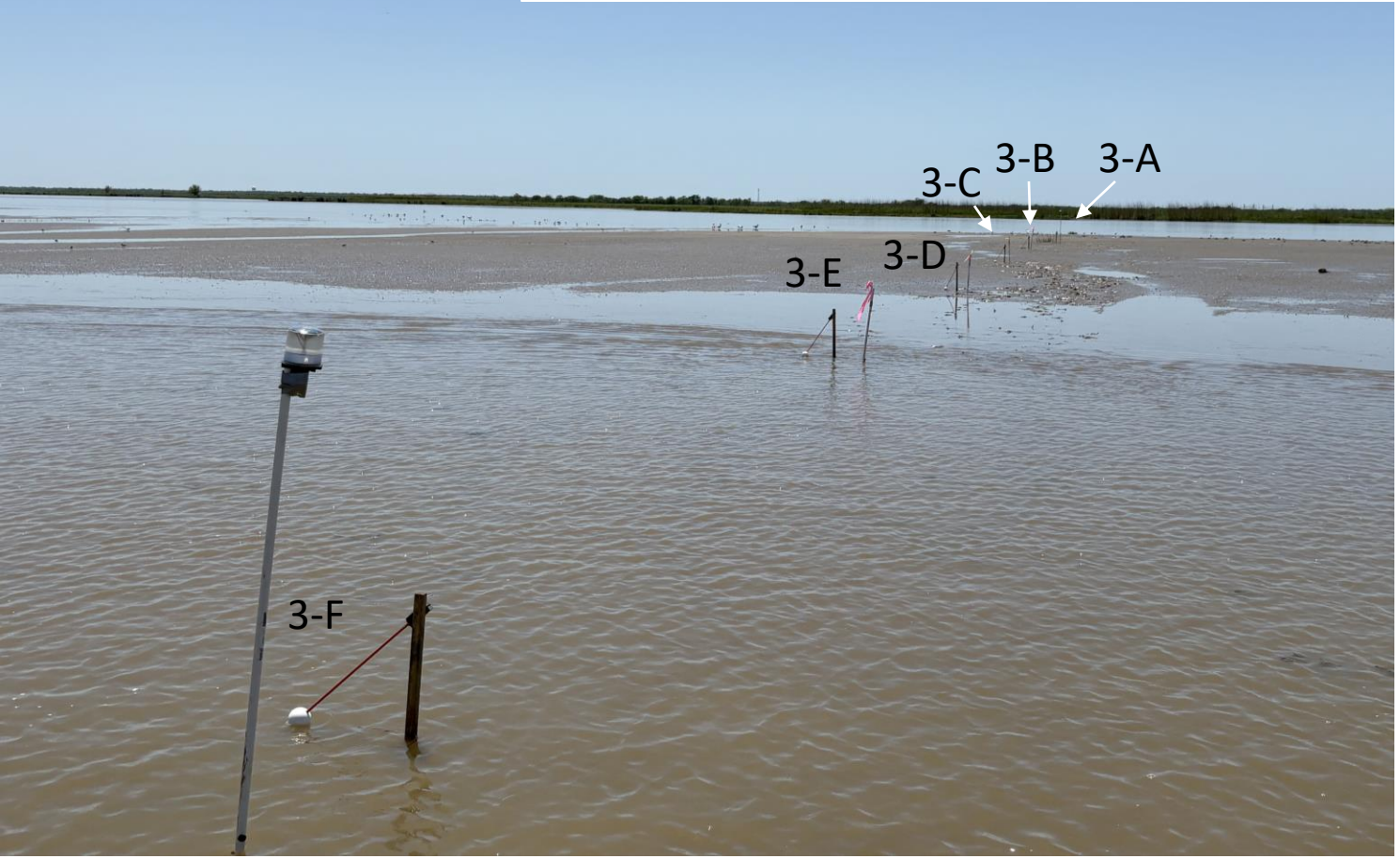




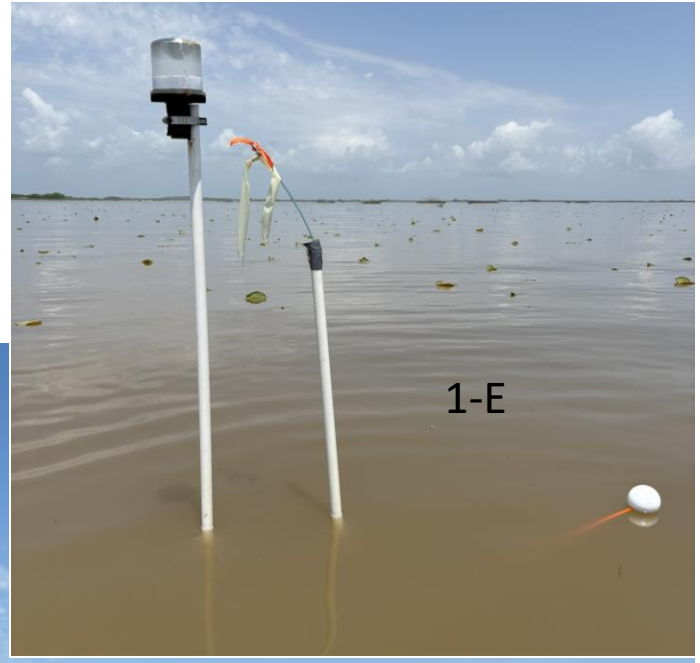
Bay Uhlan

4/9/2025



5/13/2025

Wax Lake Delta



4/25/2025

Instrument Package

1-A

3/21/2025

Ongoing and future work

- Conduct monthly vegetation surveys once Mississippi River discharge subsides
- Add a CPRA marsh creation site to our investigation once pumping of dredged material is complete (this summer)
- Collected short (10 cm) sediment cores and will process them to obtain grain size distributions and organic matter content
- Deployed ceramic tiles to monitor sediment accretion, to be measured quarterly
- Deployed instruments to continuously monitor wave activity, salinity, and temperature to further characterize site conditions that influence vegetation establishment

Thank you! Questions?

Presenting: Abby Eckland, PhD
Email: aeckland@uno.edu

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