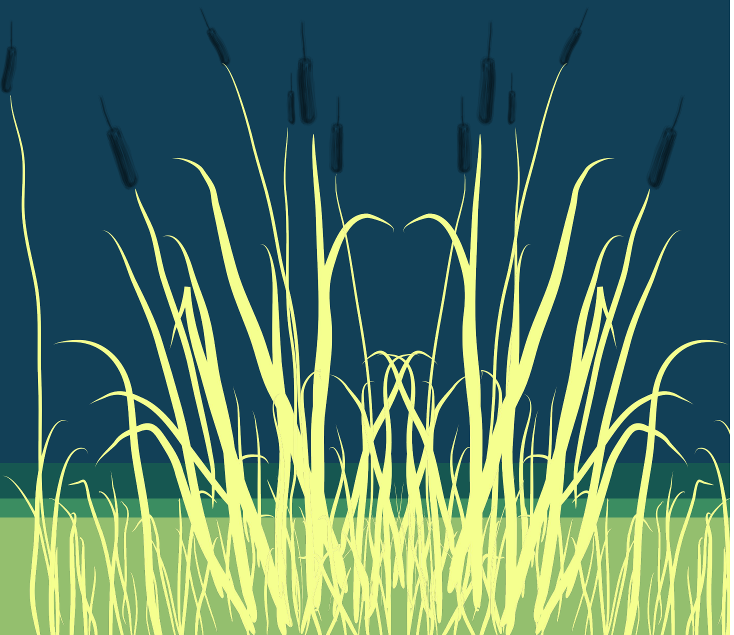
Chesapeake Bay Program
Science. Restoration. Partnership.

WORKING MEETING: ASSESSING ADAPTATION OPTIONS FOR MARSHES IN CHOPTANK RIVER, MD

October 21, 2025

University of Michigan SEAS Students
Envision the Choptank
Chesapeake Bay Program

Welcome!



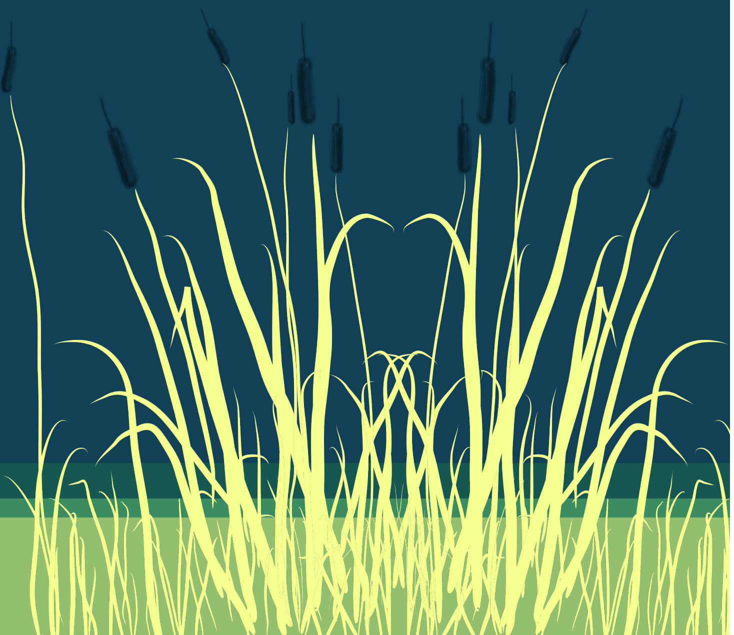
Student Team

Mia McNinch, Ilana Greenspan, Paul Cirillo, Bojun (William) Zong

Facilitators

Emily Thorpe, Hilary Gibson, Joanna Ogburn, Julia Fucci, & Taryn Sudol

Meeting Agenda

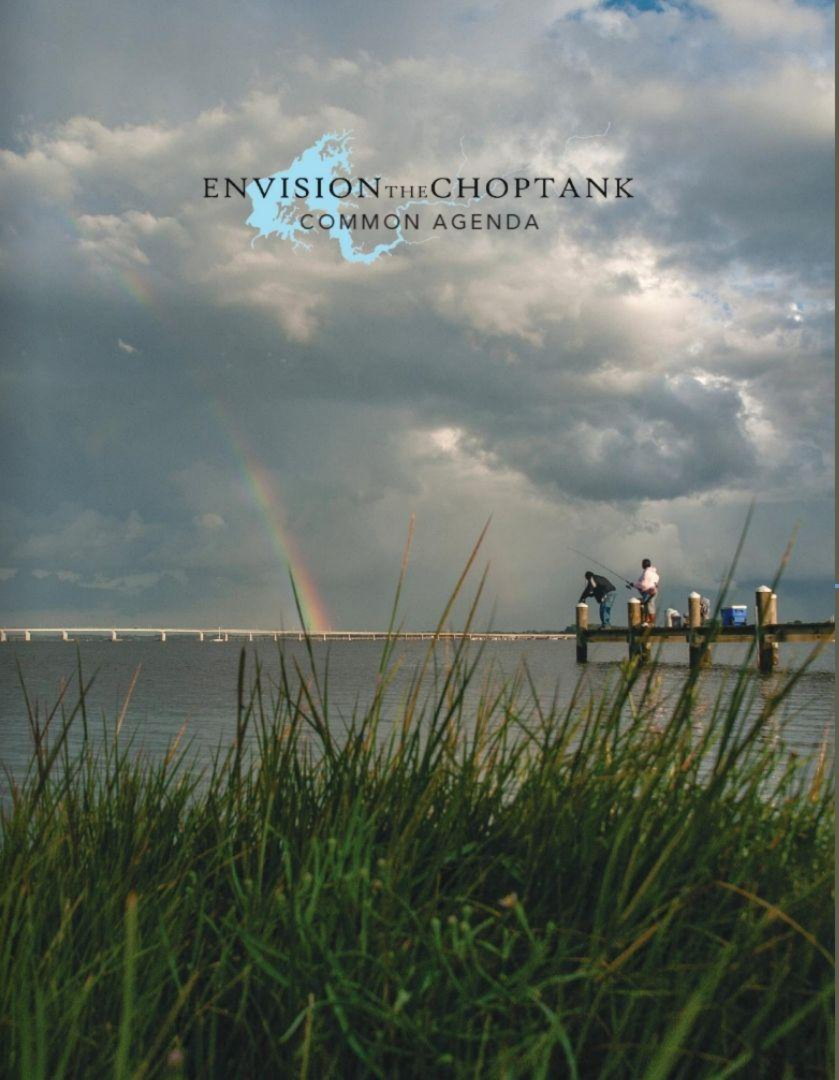


- Welcome & Introduction
- Student Presentations
- Breakout Groups
- Lunch
- Next Steps Discussion

What is Envision the Choptank?

- A COLLABORATIVE PARTNERSHIP
- A NETWORK OF INDIVIDUALS & ORGANIZATIONS
- INITIATED IN 2015 TO ACHIEVE COMMON GOALS
- KICKSTARTED BY NOAA


Mission
Provide swimmable, fishable waters and enhance the health and productivity of native oysters in a way that best meets the needs of surrounding communities.



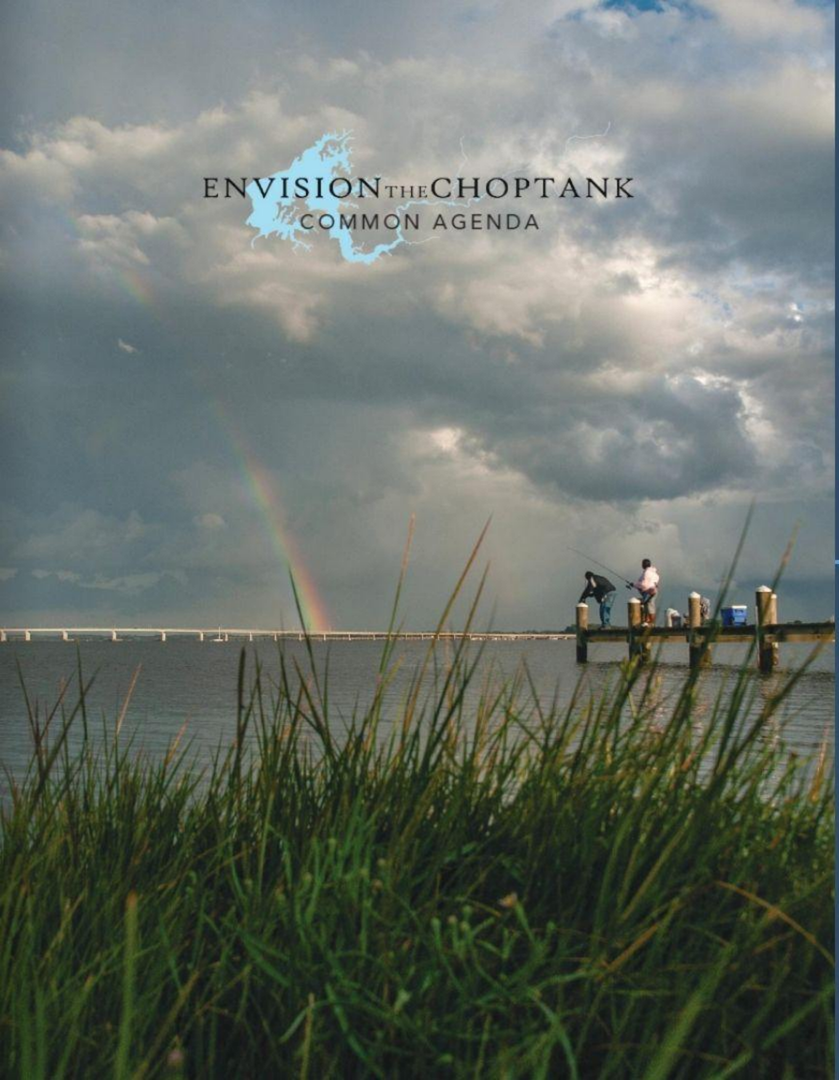
COMMON AGENDA

5-Year Plan (Updated in 2023)

4 Goal Areas

- Conserve Natural Resources
- Restore Habitat & Clean Water
- Engage Communities
- Strengthen & Expand the Partnership

6 Objectives, 20 Strategies



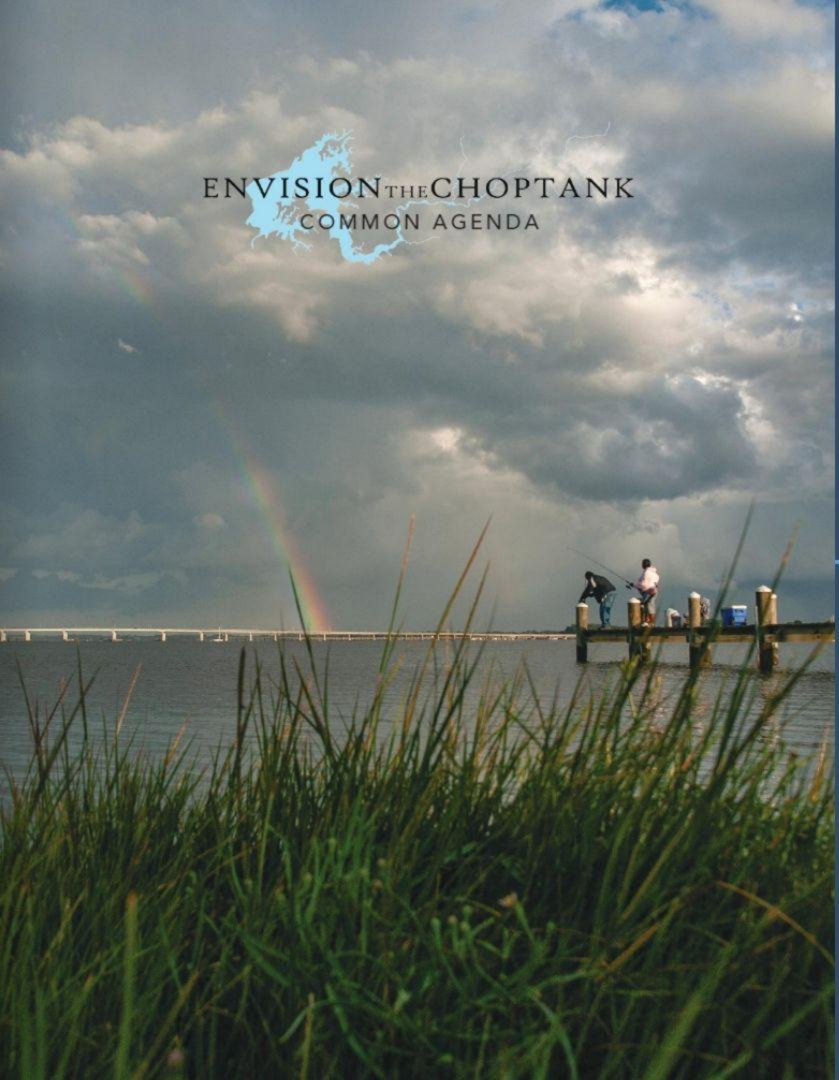
Core Focus Areas of the Partnership

Working with Local Governments
- Address natural resource challenges
- Strengthen planning efforts

Engaging Disenfranchised Communities
- More equitably share resources of the environmental movement
- Provide communities with direct connections to make positive change

Breaking Barriers to Agricultural BMPs
- Implement best management practices
- Innovative funding for farmers

Advancing Large-Scale Restoration
- Enhance ecological integrity & resilience
- Connect efforts & maximize outcomes



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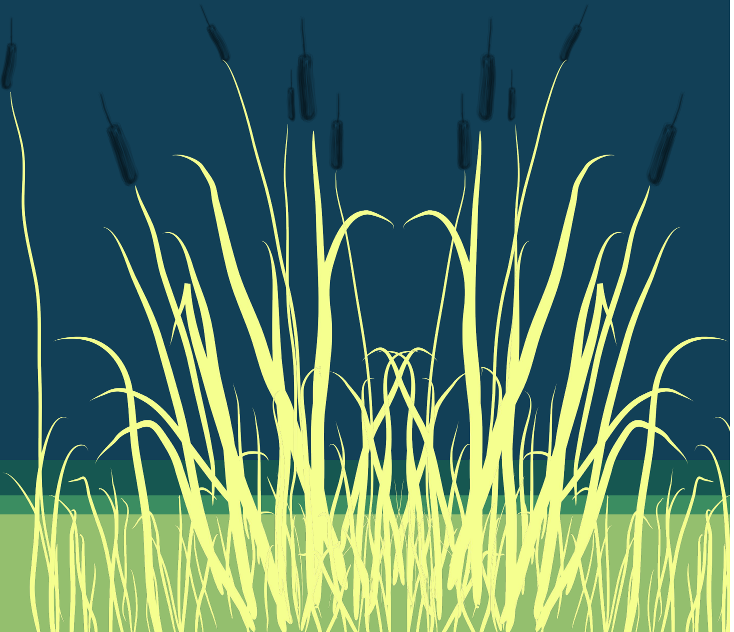
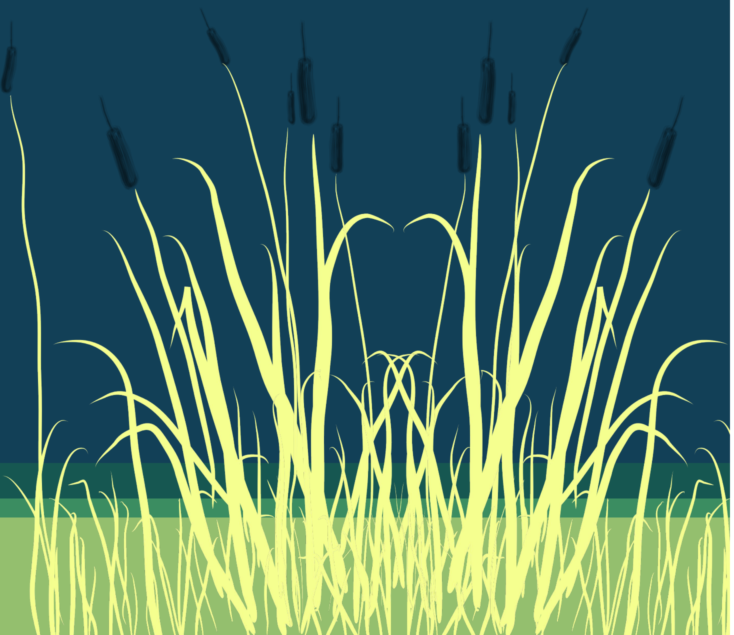
Project History



- 2022 - Chesapeake Bay Program's Collaborative Tidal Marsh Adaptation Project
    - Identified tidal marsh areas and potential protection and restoration strategies
- 2024 - Choptank Marsh Adaptation Workshop
- 2025 - NOAA pursued opportunity to work UMich SEAS graduate students
    - In collaboration with Envision the Choptank

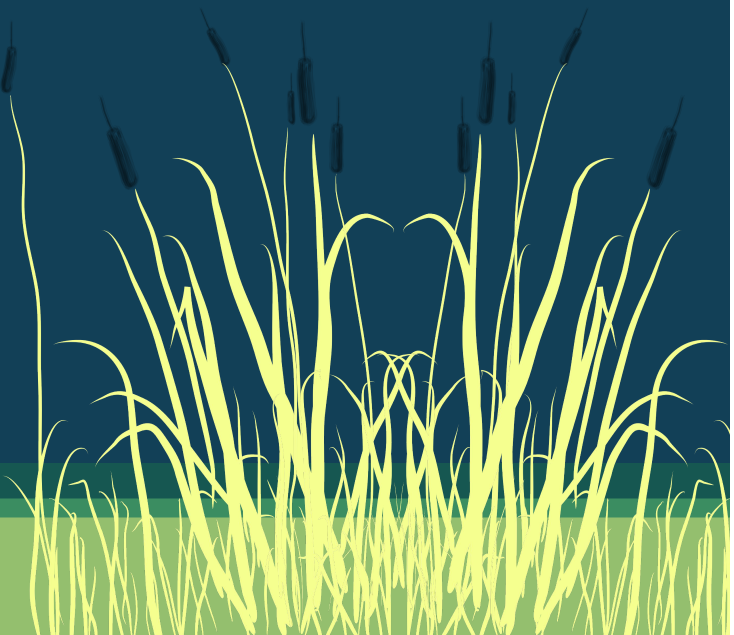
2024 Workshop



Presentations Provided:

- Overview of Choptank Marshes
- Adaptation Considerations for Different Marsh Types
- Case Studies of Marsh Restoration Strategies
- Highlights from Marsh Adaptation Mapper

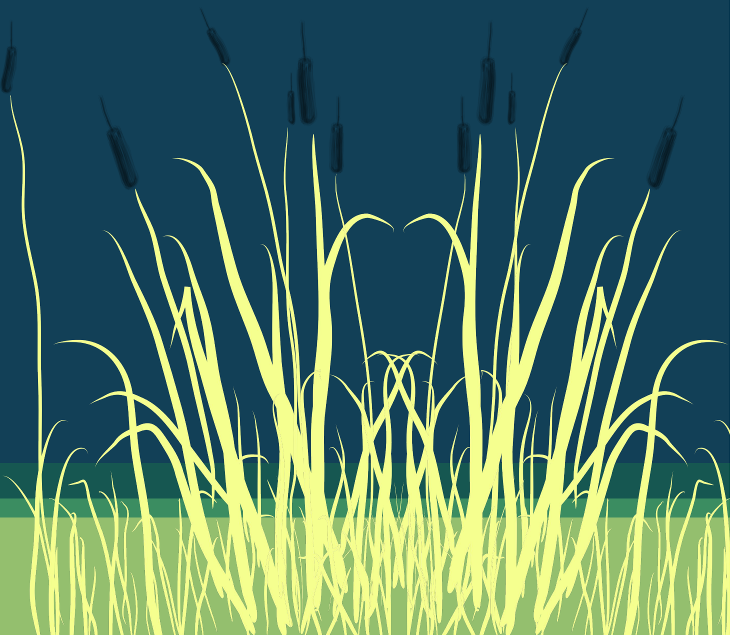
2024 Workshop



Discussions on Lower Choptank Salt Marshes & Upriver Tidal Marshes to:

- Review conditions of existing marshes and considerations for adaptation
- Identify assessments and research needs
- Share ideas for design and implementation strategies

2024 Workshop



Key Takeaways for Upriver Tidal Marshes:

- Identified several marshes with owners favorable to adaptation
- Need to ground-truth vegetation condition & type
- Must understand & address phragmites appropriately
- Adequate sediment is key
- Consider marsh edge protection
- Consider the why for conserving or restoring
- Consider creating a decision support matrix & look into student-supported projects

Advancing Marsh Adaptation Projects in the Choptank River through Management Assessments and Landscape Change Visualization Products

by Paul Cirillo, Mia McNinch, Ilana Greenspan, William Zong

Project Background

Context

- Client: Envision the Choptank
  - Advised by:
    - Julie Reichert-Nguyen (NOAA)
    - Emily Thorpe & Joanna Ogburn (JBO Conservation)
- Advancing the Chesapeake Bay Program's marsh adaptation project and partnership

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Agenda

Today's Meeting Outline:

1. Background
2. Historical Changes (Ilana)
3. Mitigation Measures (Mia)
4. Adaptation Measures (Paul)
5. Future Scope (William)
6. Breakout Groups
    a. Re-cap

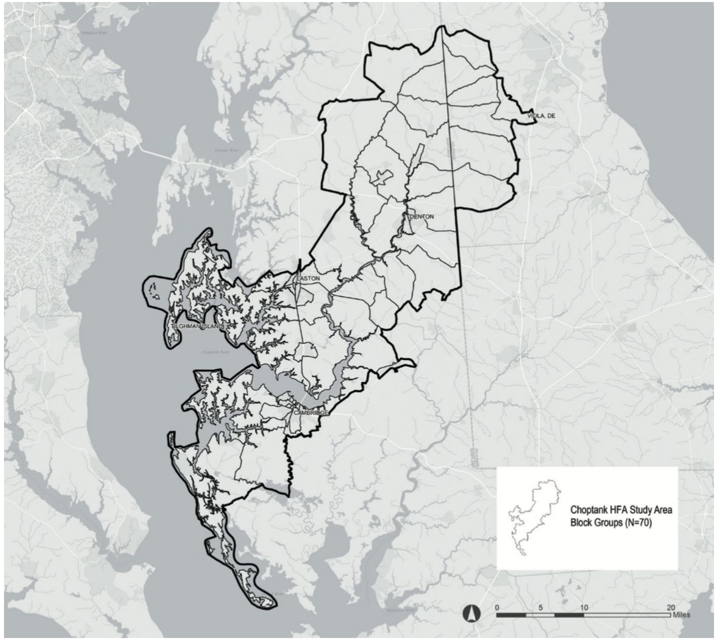
The Choptank Watershed: An Overview

The Choptank River system (1780 km2)
- Well studied
  - nitrogen and phosphorus pollution
  - oyster restoration
- Less studied
  - tidal brackish and freshwater marshes
    - need for management recommendations

Relevant Concerns:

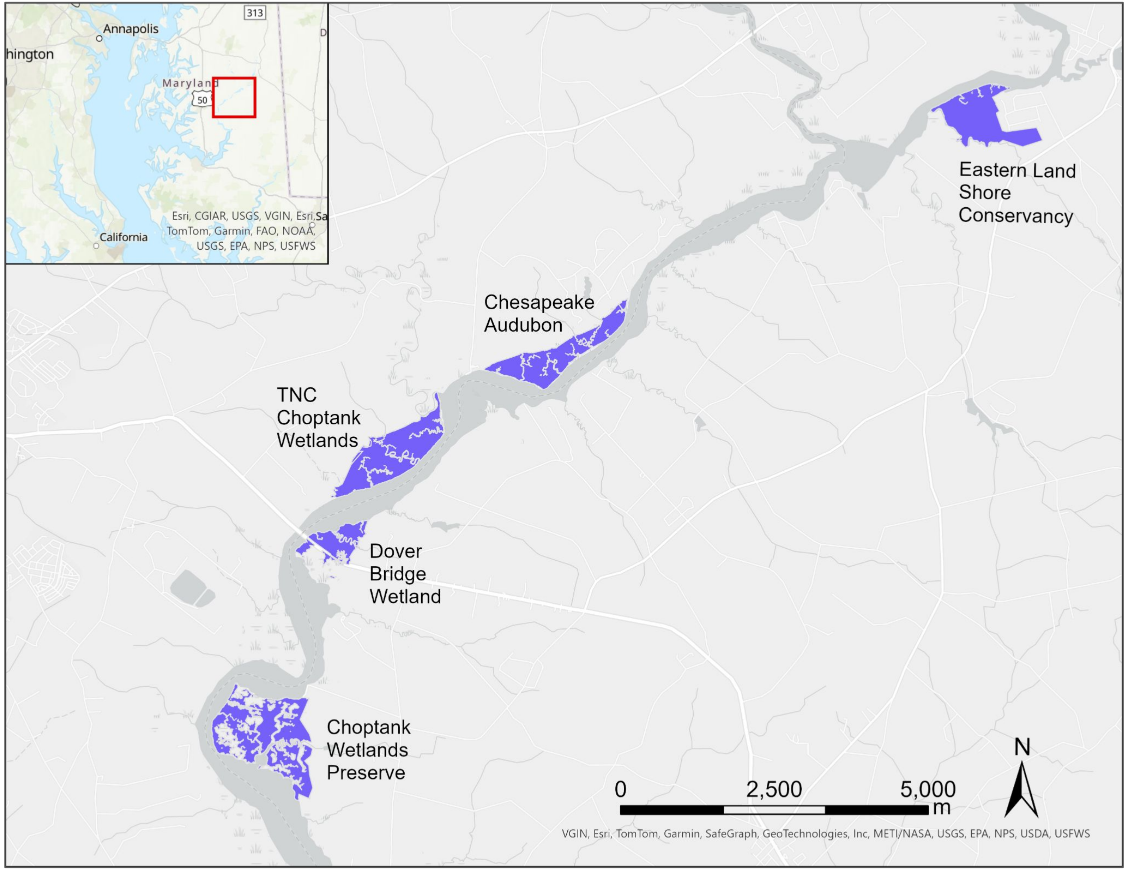
- Limited observed data
- Invasive species management
- Unique sociological concerns

Marsh Types: saltwater/brackish, non-forested tidal freshwater, and forested tidal freshwater wetlands



Fleming et al., 2017

Marshes of Interest



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Land Use / Land Cover

Chesapeake Bay Program

LULC 2018

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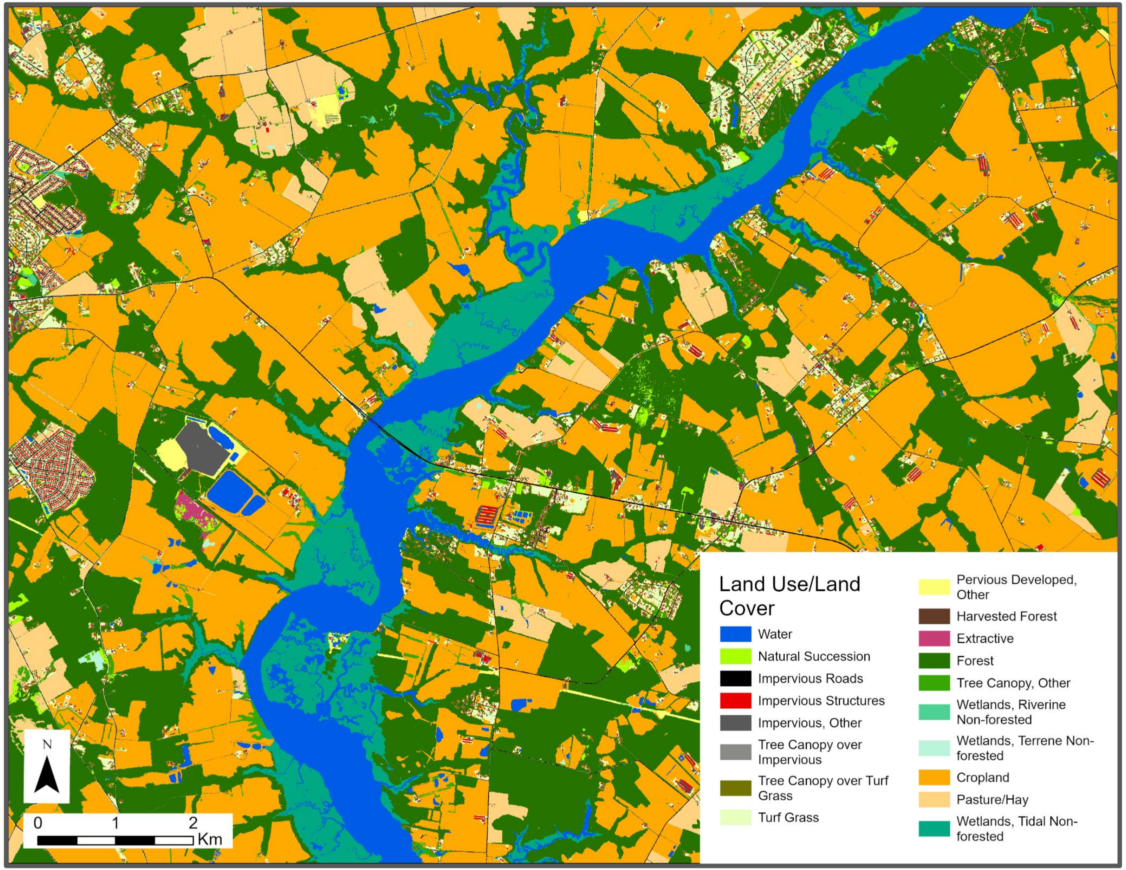

Marshes of Interest

Choptank Wetlands Preserve (NAIP 2021)

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Marshes of Interest

Dover Bridge Wetland (NAIP 2021)

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Objectives

Objectives:

For Tidal Wetlands in Choptank River

1. Characterize historical changes.
2. Characterize current ecological and social conditions.
3. Identify gaps in knowledge and potential resilience and management strategies
4. Evaluate models of future marsh migration scenarios

Deliverables

Deliverables:

1. Coastal Wetland Management Assessment for the Choptank River Ecosystem
    a. Literature review
        i. Native and Invasive species presence
        ii. Temporal changes to the system
            1. SLR and SWI
        iii. Sociological Conditions
    b. Professional Interviews
    c. Next Steps
2. Public Mapper of Choptank River Marshes
    a. Historical changes
    b. Future projections

Interview Totals

As of 10/10, we have interviewed 14 professionals across academia, natural area management, non-profits, and state agencies.

ShoreRivers

University of Maryland

Eastern Shore Land Conservancy

Jug Bay Wetlands Sanctuary

The Nature Conservancy

Maryland Department of Natural Resources

Maryland Department of Planning

Pickering Creek Audubon Center

Historical Changes

Ilana

Geospatial Analysis

Outline

Marsh Vulnerability Index:

1. Change in Area
   a. National Agriculture Imagery Project (NAIP)
   b. Legacy Historical Shorelines
2. Change in Vegetated Index
   a. Unvegetated to Vegetated Ratio (UVVR)
3. Change in Elevation
   a. 2003 and 2013 Digital Elevation Models (DEMs)

Marsh Vulnerability Index

- For each marsh, combine change in area, UVVR, and elevation to quantify a vulnerability index that can inform where to prioritize management

$$\text{Vulnerability} = \Delta A_M + \Delta U + \Delta E$$

Where:

ΔA_M = some factor relating to change in marsh area

ΔU = some factor relaying to change in UVVR

ΔE = some factor relating to change in elevation

List of Data Sources

National Agriculture Imagery Project (NAIP): aerial imagery over US during agricultural growing seasons

Legacy Historical Shorelines: digital shoreline vectors, showing historical shoreline locations in relation to the rates of change (ROC) erosion level transects data

Unvegetated to Vegetated Ratio (UVVR): annual averages of unvegetated fraction, vegetated fraction, and unvegetated to vegetated ratio

Digital Elevation Models (DEMs): bare earth elevation models (excluding height of trees, buildings, and other surface features)

National Agriculture Imagery Program (NAIP)

Pros

- Very fine spatial resolution (1m by 1m) -> can provide very detailed picture of loss over time

Cons

- NAIP imagery only starts in 2005
- Only digitized two time steps (2005 and 2023)

Legacy Historical Shorelines

Pros

- Can give us perspective of legacy shoreline dating back to the 1800s
- Contextualizes current rate of loss of marshes in comparison to historical rates

Cons

- Limited information for all of the marshes
    - not all marshes have an equal amount of data available

Unvegetated to Vegetated Ratio (UVVR)

Pros

- High temporal resolution (annual), can supplement when losses are happening that aren't clear from NAIP
- Long archive (1985-2022)
- Tells us about quality of vegetation in addition to area of marsh

Cons

- Coarse spatial resolution (classified from 30x30m Landsat)

Digital Elevation Model (DEM)

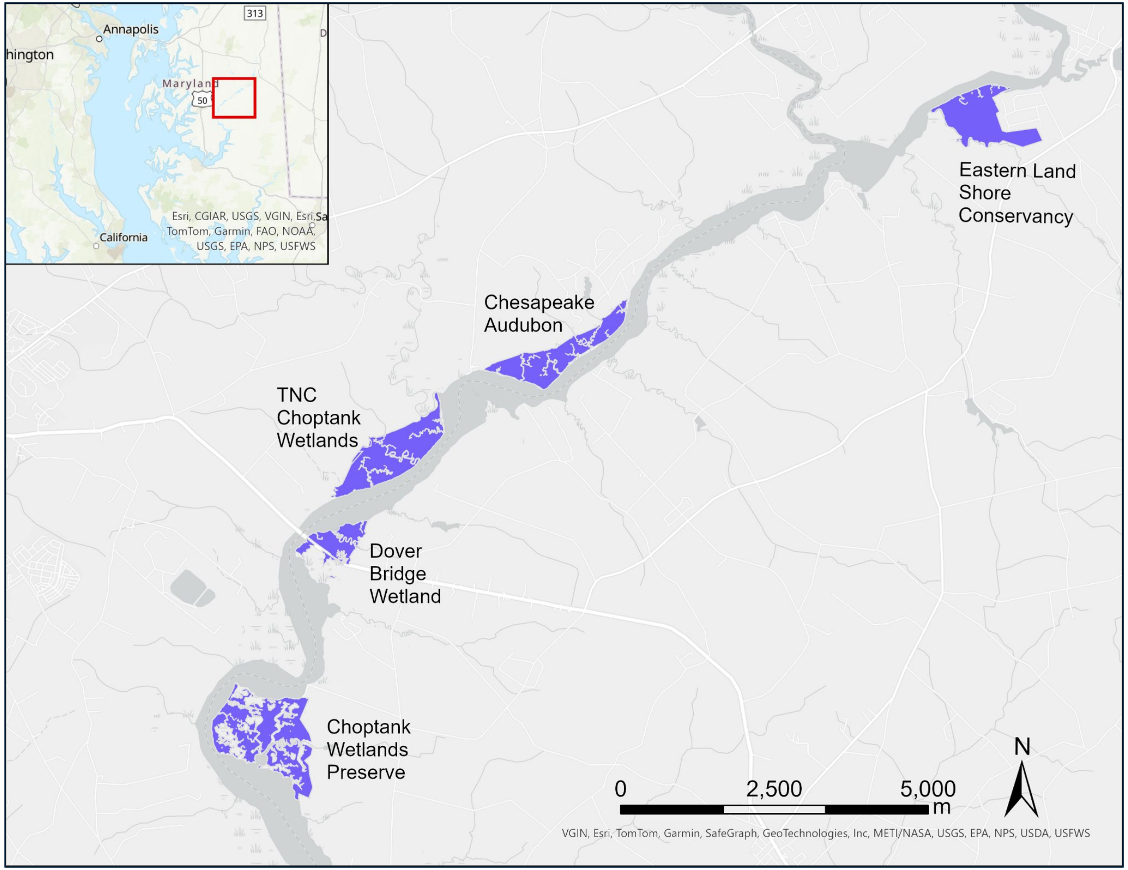
Pros

- High spatial resolution (1m x 1m)
- Change in elevation is important to evaluating sea level rise potentials

Cons

- Only exists for marshes of interest in 2003 and 2013

Marshes of Interest



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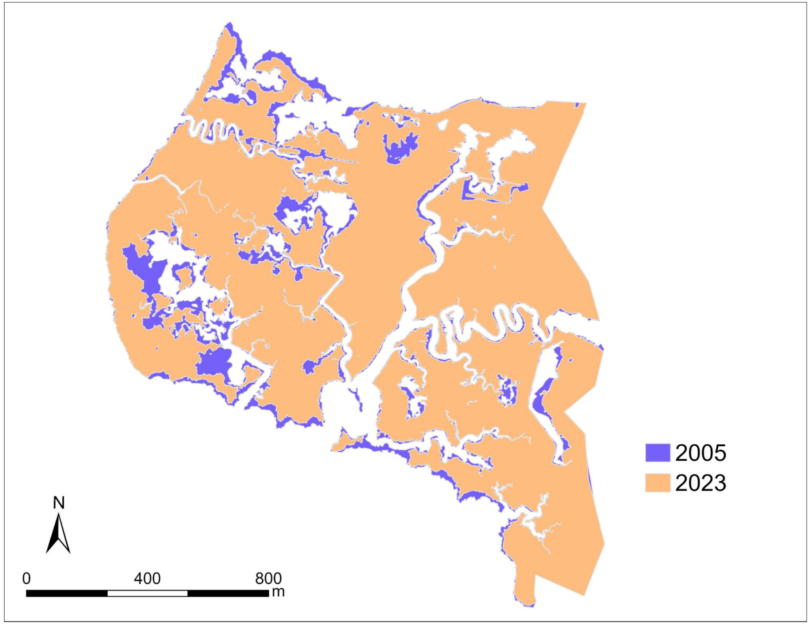
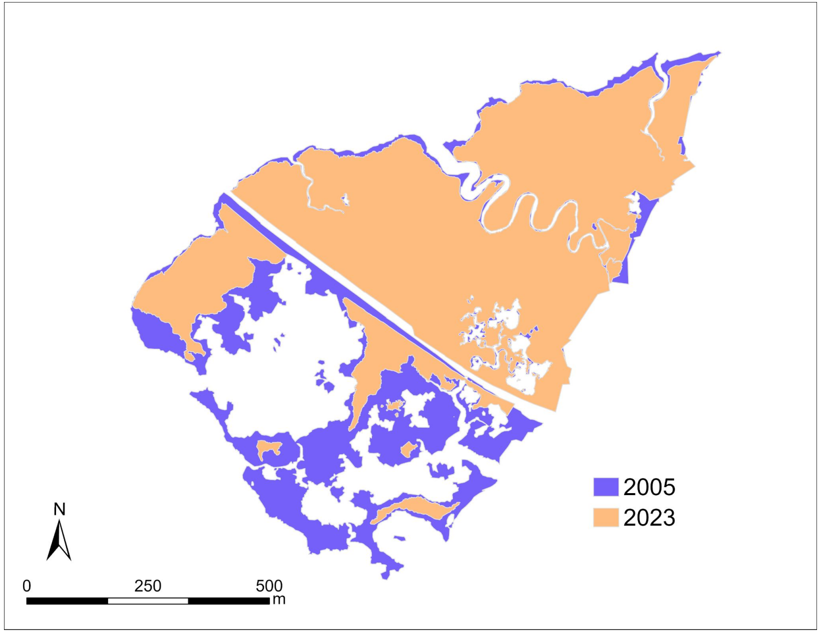
Marsh Loss

Choptank Wetlands Preserve



Dover Bridge Wetland



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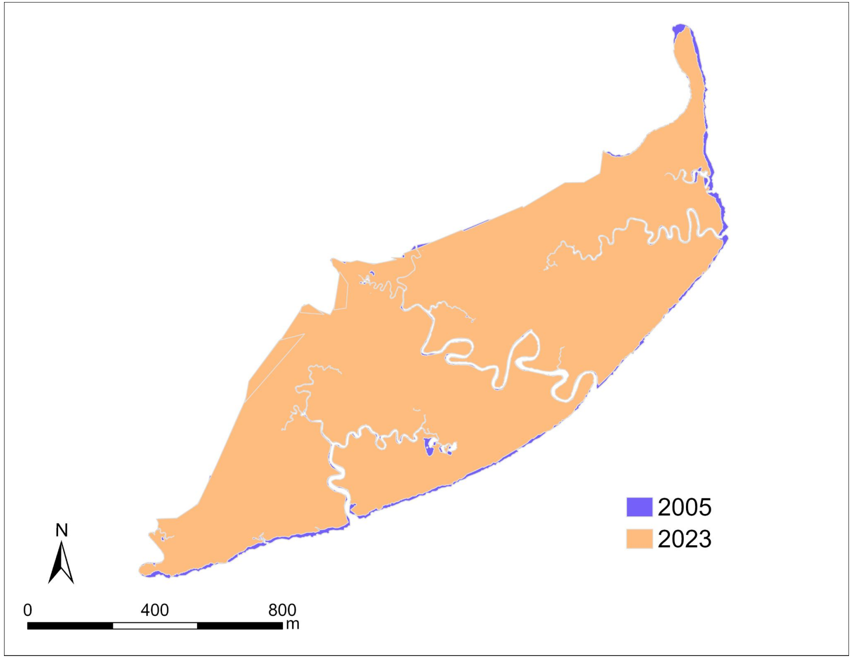
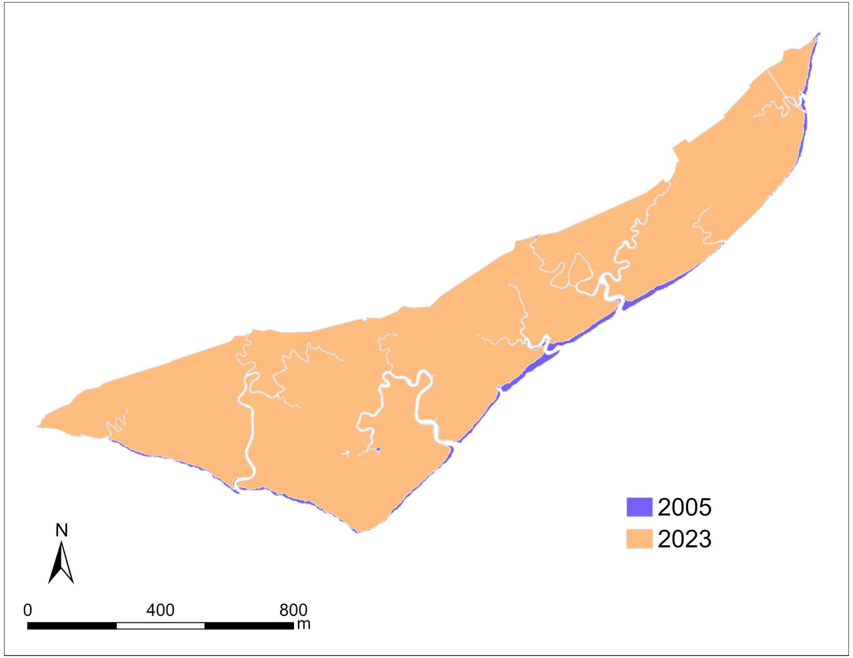
Marsh Loss

TNC Choptank Wetlands



Chesapeake Audubon



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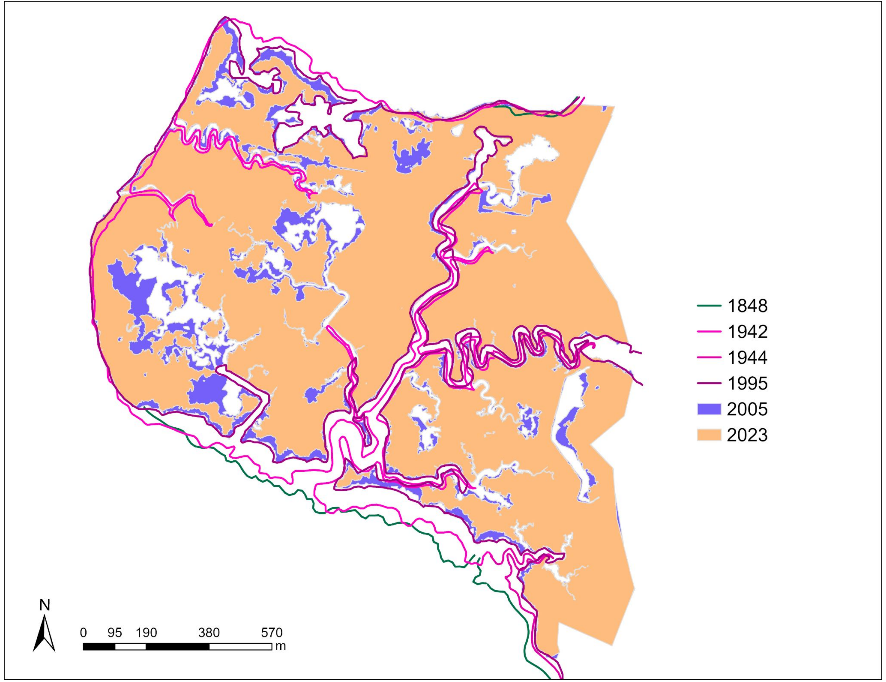
Marsh Loss

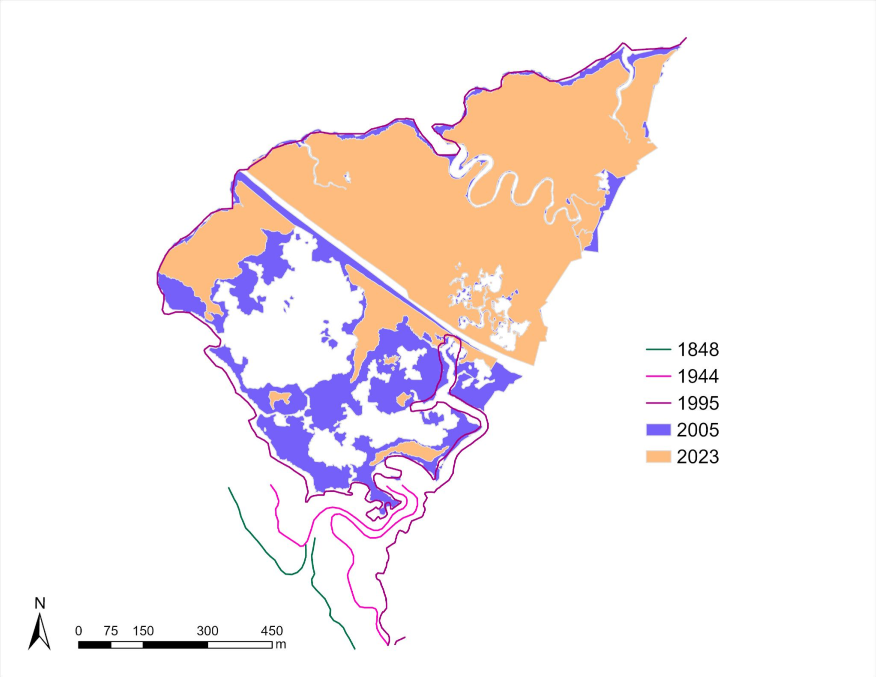
Marsh	A_{2005} (km^2)	A_{2023} (km^2)	$\Delta A_{2023\text{-}2005}$ (km^2)	% Loss
Choptank Wetlands Preserve	1.518	1.317	-0.201	**-13.25%**
Dover Bridge Wetland	0.515	0.377	-0.138	**-26.78%**
TNC Choptank Wetland	1.091	1.065	-0.026	**-2.34%**
Chesapeake Audubon	0.861	0.849	-0.012	**-1.42%**

Historical Shorelines

Choptank Wetlands Preserve



Dover Bridge Wetland



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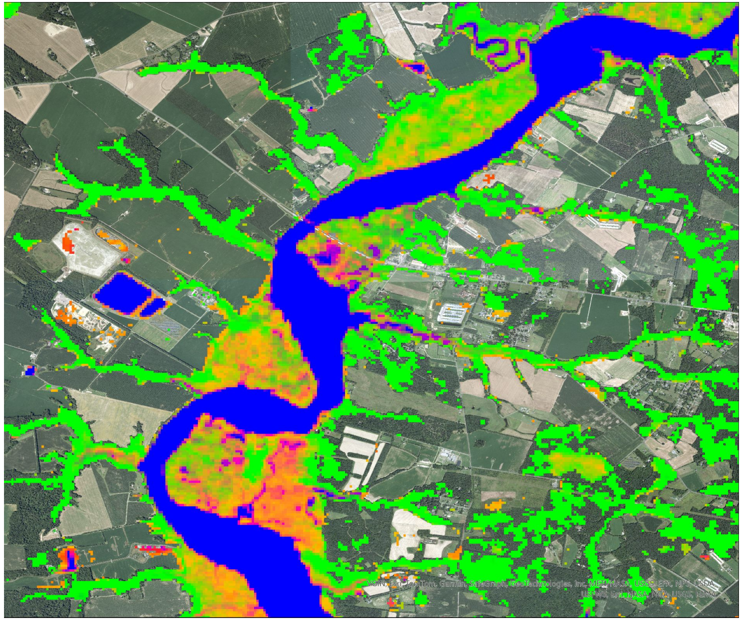
Area Discussion

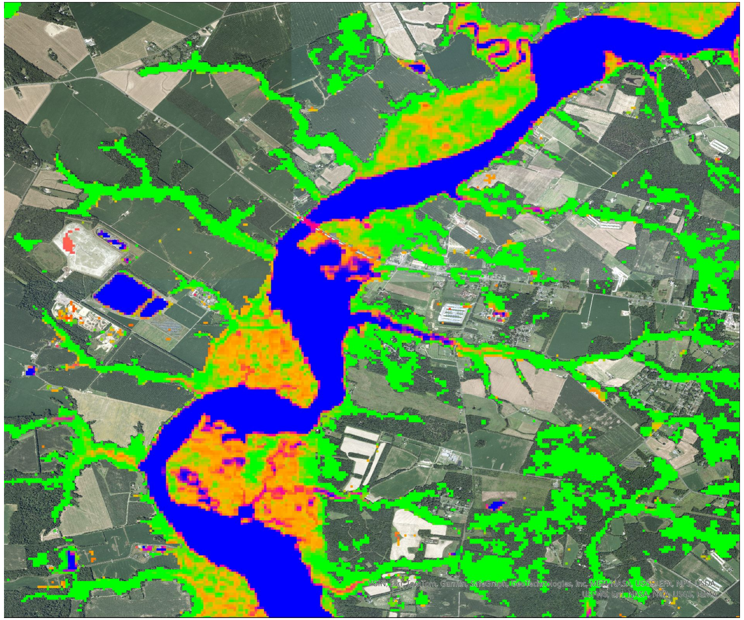
- Large-scale loss between 2005-2023, but variation in quantity of loss from marsh to marsh
- Change seems to be occurring at a more rapid rate now - but additional analyses needed

Unvegetated to Vegetated Ratio (UVVR)

1990



2020



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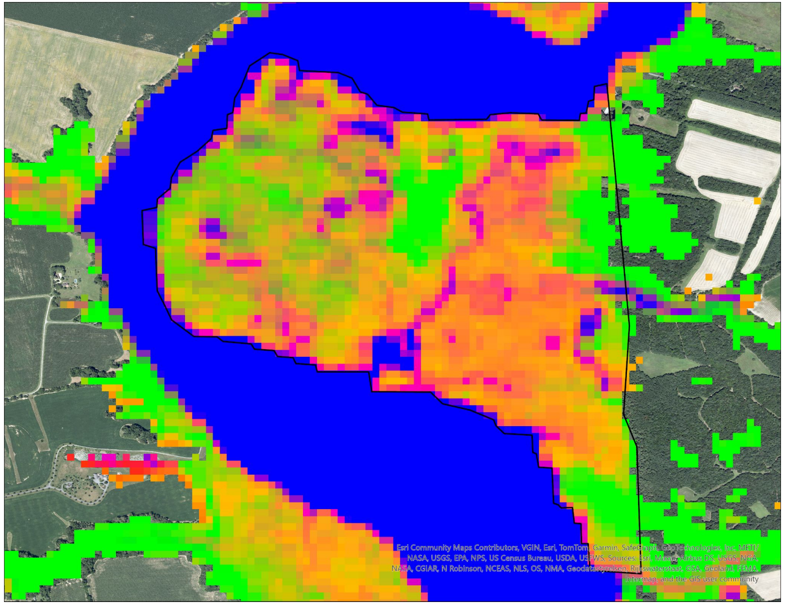
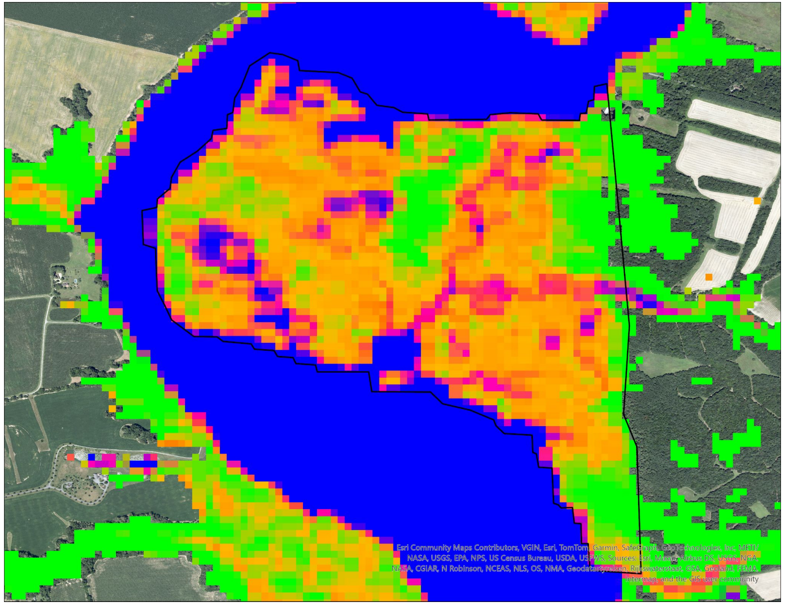
Choptank Wetlands Preserve UVVR

1990

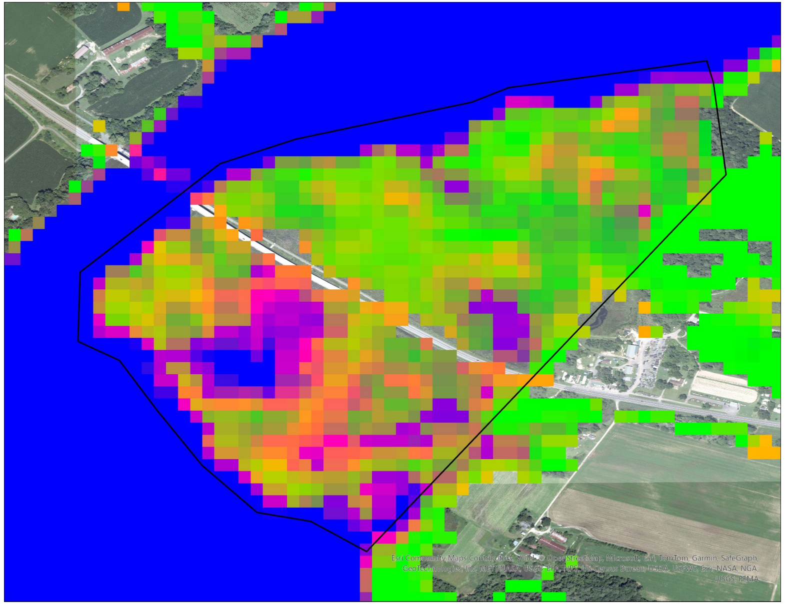


2020

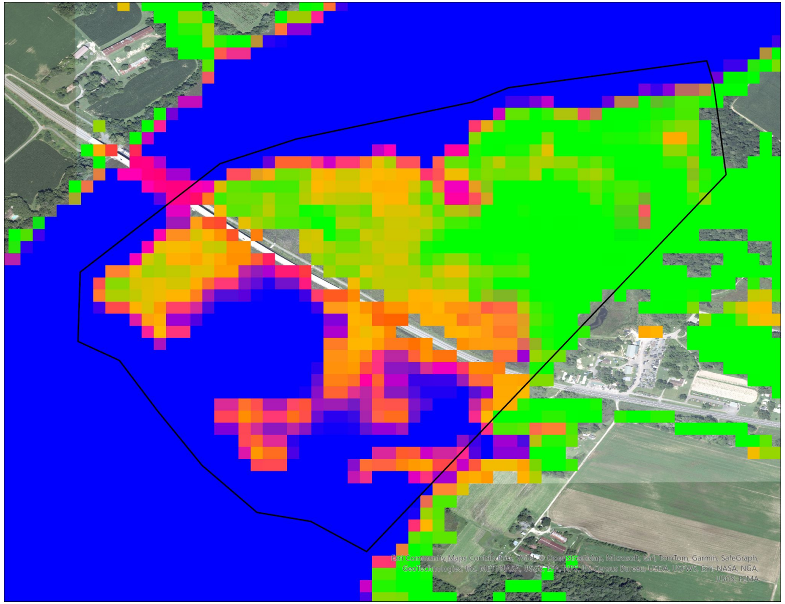


Dover Bridge Wetland UVVR

1990



2020



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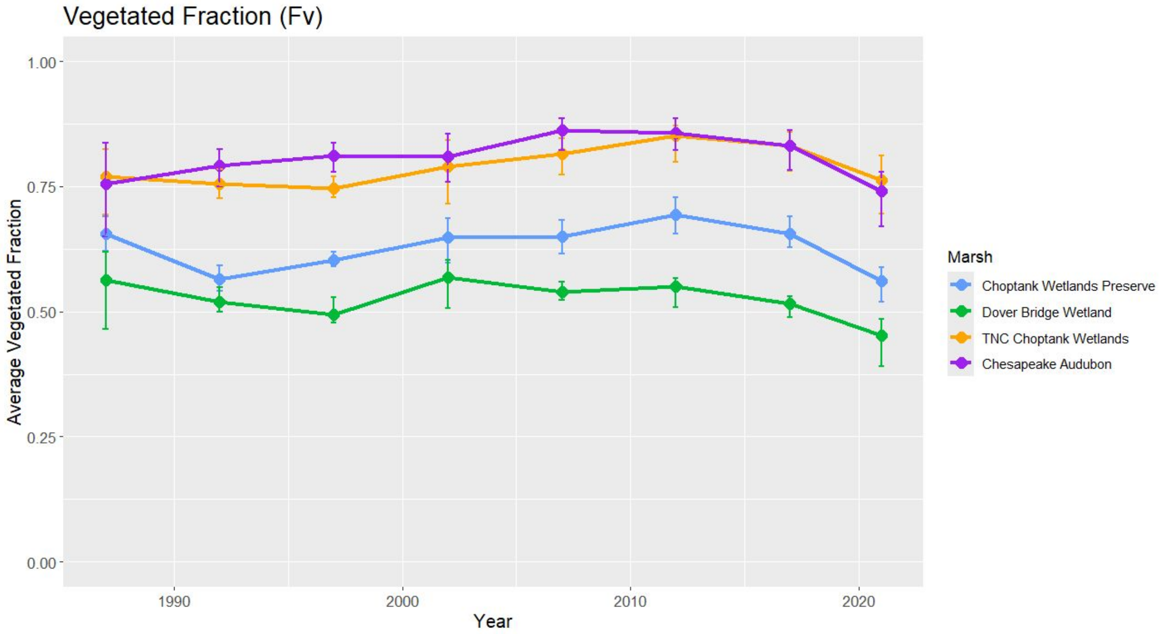
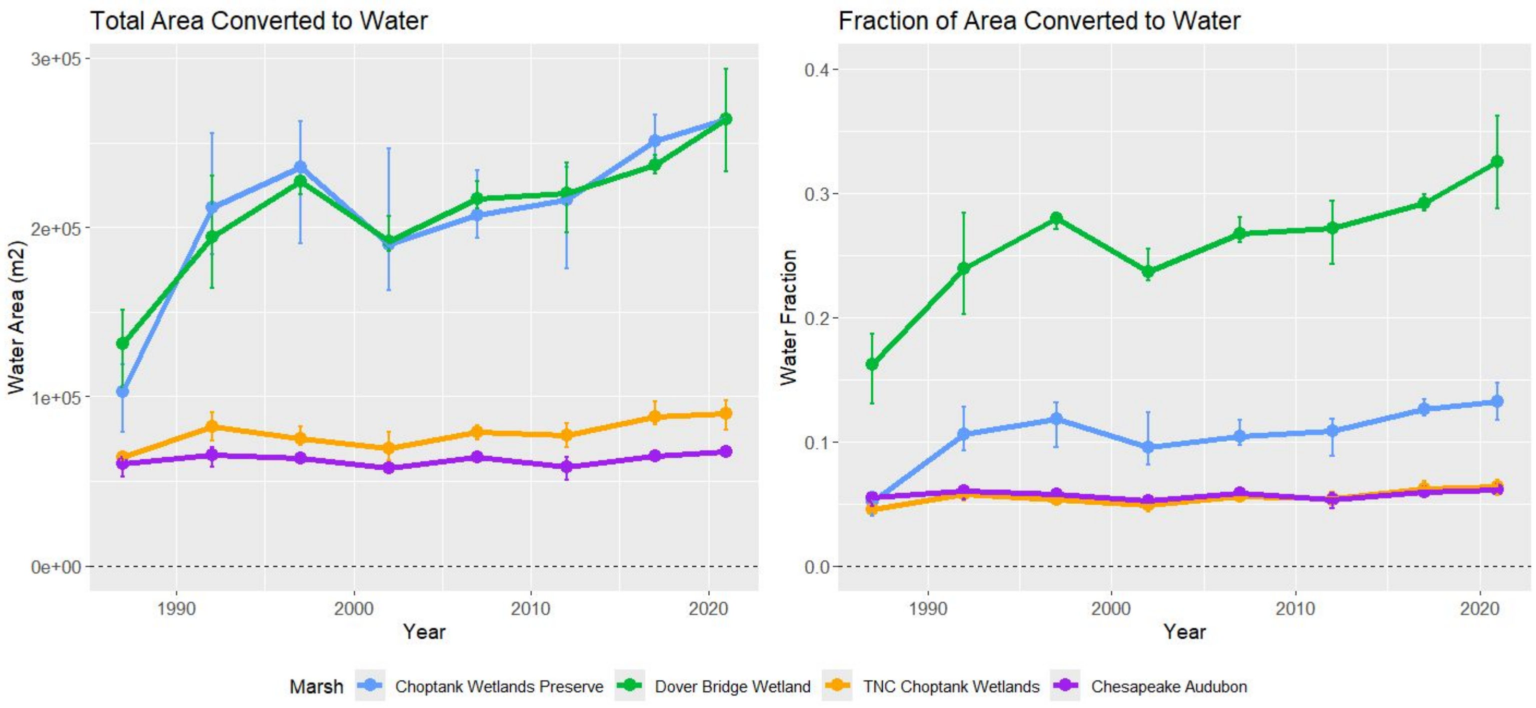
Vegetated Fraction (Fv)

- Average Vegetated Fraction for each marsh
- Grouped by years within a 5-year period



Open Water Conversion

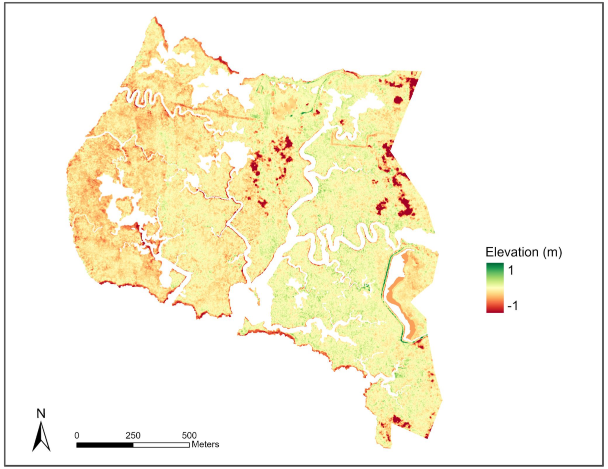


UVVR Discussion

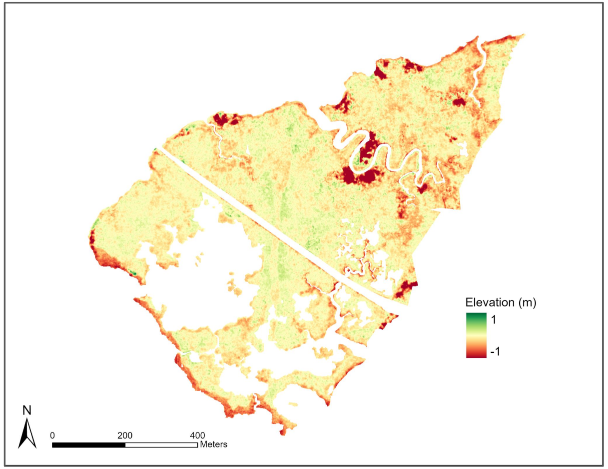
- Despite large scale marsh loss, some areas are showing improvement in vegetation cover
  - Optimal vertical position relative to sea level where a marsh can maximize biomass production
  - With sea level rise, some higher parts of the marsh will move into this optimal zone despite getting lower in elevation (Kirwan et al., 2010; Morris et al., 2013)
- Part of the recent decline in vegetation can be attributed to open water conversion
- Recent decline in UVVR is undocumented in literature

Change in Elevation 2003 - 2013

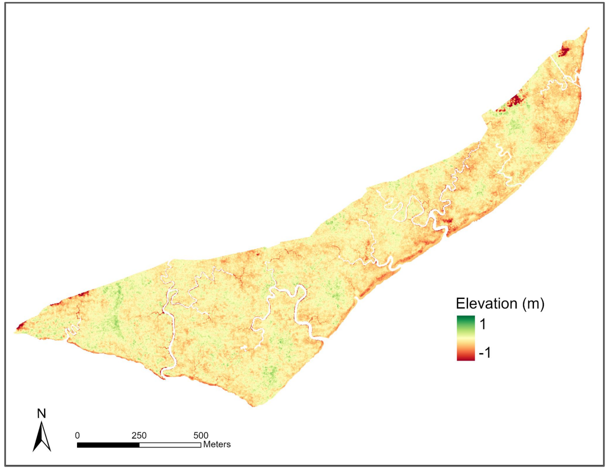
Choptank Wetland Preserve



Dover Bridge Wetland



Chesapeake Audubon



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Elevation Discussion

- Some areas in the marshes had marginal gains in elevation, but most areas faced losses in elevation
- Steepest declines in elevation from 2003 to 2013 tended to fall along the perimeter of the marshes adjacent to water
- Some areas declined near 1 meter in elevation

Questions

1. Are there any other publicly available datasets that I have not yet included in my analysis that could inform how the marshes have changed over time?

2. What is the best way to measure change in elevation across the marsh (i.e., median elevation change)?

3. What are some ways that I can use these results to inform management plans for the marshes?

Mitigation Measures

Mia

Literature Review and Interviews

Questions and Points of Focus

- What is the current status of invasive *Phragmites australis* across the wetland, and how is it affecting ecosystem function?
- What is the current status of Ash tree populations, and what might future populations look like?
- Other Topics:
  - Sediment Dredging
  - Other invasive species in the area

Current State of *Phragmites australis* (Literature)

***Phragmites australis* continues to aggressively spread throughout the Chesapeake Bay.**[2][4]

- Presence is distinct based on **wetland stress levels**, with a positive correlation between *Phragmites australis* and wetland stress/disturbance.[8]

Current State of *Phragmites australis* (Perspectives from Interviewees)

- Several interviewees that work in and around the Choptank have stated an observed take over of *Phragmites*.
- Considered the worst invasive species on agricultural land within the Choptank, doing exceptionally well in mildly salty shorelines.
- Though some raise concern over the lack of attention towards distinguishing between native and invasive *Phragmites* species.
- Multiple interviewees stated that it is highly difficult to manage, especially once established.

The Impact of *Phragmites australis* on Ecosystem Function

Negative Impacts:

- Loss of biodiversity [6,7]
  - Aggressive competition against native species, blocking and crowding out native competition.
  - Limited diversity in food and shelter availability for insects, birds, and aquatic animals.
- Genetic homogenization [4]
  - Creation of monocultures due to dense colony formation.
- Habitat Loss and Alteration [2,3]
  - *Phragmites australis* can often increase soil nitrogen and phosphorus, increasing spread and limiting inhabitability of certain native species.
  - Dense, thick root systems can alter water movement and turbidity.

The Impact of *Phragmites australis* on ecosystem function

Potential Positive Impacts for Our System:

- Increased Sediment Accretion [3] □
  - Sediment accretion in older *Phragmites* stands (7 years old or older) showed 2-3x more sediment deposition than native species.
- Marsh Stability [3] □
  - Its dense litter and root system could potentially aid in reducing edge erosion and provide a buffer against sea level rise.
- Organic Matter Accumulation [3] □
  - *Phragmites* mats (organic matter) continuously build throughout the season, which could aid in substrate elevation. This would be particularly helpful given the threat of erosion and further marsh loss.

Presence of *Phragmites australis* in the Chesapeake Bay

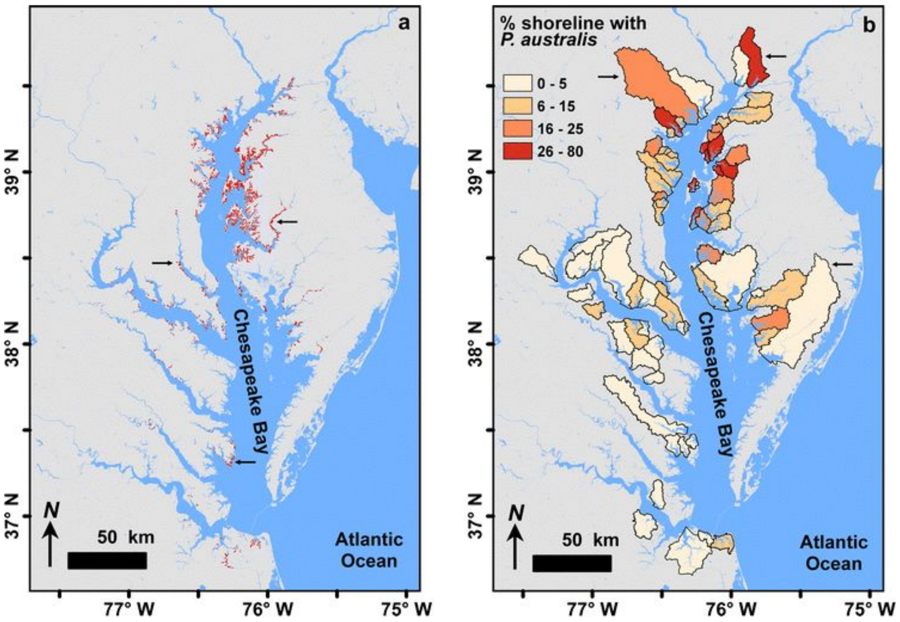


Figure. *Phragmites australis* distribution in the Chesapeake Bay mapped by the shoreline survey (VIMS-CCRM 2009). Sourced from *Local and regional disturbances associated with the invasion of Chesapeake Bay marshes by the common reed Phragmites australis* by Sciance et al.

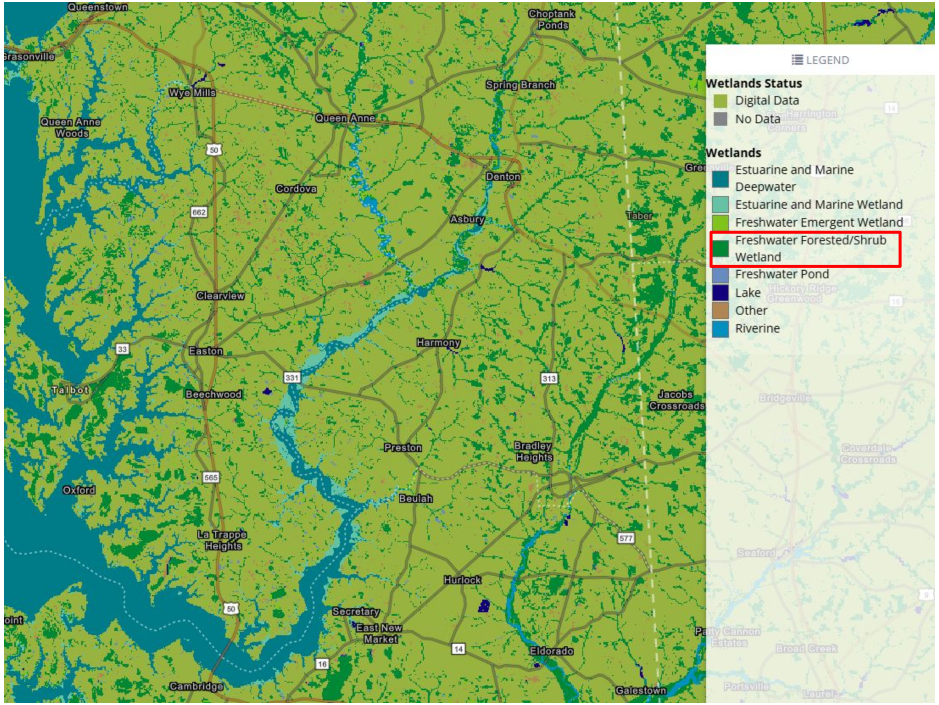
Current State of Ash Tree Populations

Ash tree populations throughout Chesapeake Bay wetlands are experiencing rapid dieback. [1]

- Primary Cause: Introduction and Spread of the **Emerald Ash Borer** [1]
  - Invasive species first detected in the region in 2015
  - Wood-boring beetle
  - Emerald Ash Borer larvae burrow into Ash trees to feed on the phloem and xylem tissue (transports water and nutrients), effectively girdling it and resulting in tree death.
- Less known are the impacts from **saltwater intrusion**
  - Limited information behind this potential threat to Ash populations
  - With the existing invasive species threat, saltwater intrusion could increase the impact on the persistence of these forested tidal wetlands.
  - Further analysis into sea level rise projections could provide insights into this.

Ash Species Impacted

While all native ash species are impacted by the introduction and spread of the Emerald Ash Borer, the predominant species in the Choptank is **Pumpkin Ash** (*Fraxinus profunda*), mainly found in forested tidal wetlands. [1]



Future Outlook and Management Options

- Most mature Ash trees are expected to die off, ultimately leading to major shifts in forest structure and wetland composition. [1]□
- Management Options:
  - Biological controls: parasitoid wasps
  - Proactive Restoration Planning
  - Adaptive Management and Monitoring
    - Interviewees mentioned replanting tree species with similar eco niches to fill spaces left by ash trees.
      - **Bald Cypress** (*Taxodium distichum*)
      - **White Cedar** (*Thuja occidentalis*)
  - Interviewees noted the possibility to inoculate surviving ash trees in an effort to kill the beetles, though this has partial success.

Other Invasive Species of Concern

- Packing Grass (*Microstegium vimineum*)
- Multiflora Rose (*Rosa multiflora*)
- Golden-and-Silver Honeysuckle (*Lonicera japonica*)
- Purple Loosestrife (*Lythrum salicaria*)
- Spongy Moth (*Lymantria dispar*)
- Marsh Dewflower (*Murdannia keisak*)
- Yellow Flag Iris (*Iris pseudacorus*)

Sediment Dredging

- **Beneficial Use** [5]
  - Using sediment dredged from the Chesapeake Bay and its tributaries to aid in the restoration of underwater grasses, island restoration, stabilization of eroding shoreline, generating a space for the restoration of wetlands, and the creation, restoration, and/or enhancement of aquatic habitats.
- **Benefits of Sediment Dredging** [5]
  - Preservation of existing island habitats
  - Aids in the restoration of island and coastal wetlands
  - Reduces erosion and its impacts to local shorelines
  - Enhances habitat for native species

Questions

What are the decision matrices and considerations for ways to approach invasive species within marsh areas? How do we weigh the positives and negatives to properly address each site?

Do you have any reference materials or guidelines for vegetation to implement in these marshes that will be more resilient moving forward given the stressors discussed in this presentation?

Do you have any sediment adaptation advise or successful implementation methods that could benefit tidal freshwater marshes?

Citations

1. University of Maryland Extension. (2021). *Emerald ash borer will affect Maryland's Eastern Shore wetlands* (EB-428). https://extension.umd.edu/sites/extension.umd.edu/files/2021-03/EB-428%20EAB%20Will%20Affect%20MD%27s%20Eastern%20Shore%20Wetlands.pdf

2. Rooth, J. E. (2002). *The role of the invasive, Phragmites australis, in Chesapeake Bay marsh stability* [Master's thesis, University of Maryland].

3. Rooth, J. E., Stevenson, J. C., & Cornwell, J. C. (2003). Increased sediment accretion rates following invasion by Phragmites australis: The role of litter. *Aquatic Botany*, *75*(4), 325–338.

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Adaptation Measures

Paul

Literature Review and Interviews

Overview

If marshes cannot be conserved in their current locations, what factors will impact their ability to migrate inland?

Topics of Interest

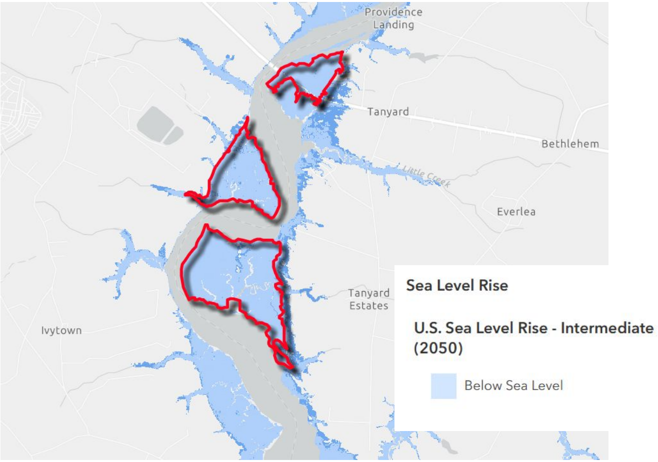
1. Effects of sea level rise and saltwater intrusion on marshes
2. The role of farmers in marsh migration and management
3. Financing solutions (will not cover today)

Outline:

1. What we know/Background
2. Current management solutions and recommendations
3. Remaining questions

Sea Level Rise/Saltwater Intrusion: What we know

- **Major existential threat to marsh persistence**
  - Listed as a primary threat by majority of interviewees
- **Lack of observed data and monitoring**, especially on the Upper Choptank
  - Supported by interviews
    - When, where, and how quickly
  - Modeling > monitoring
    - Uses for GIS
- **Unique land uses of the Choptank exacerbate SWI/SLR effects**
  - Groundwater extraction and agricultural canal ditching (O'Donnell et al., 2024)
  - Concerns of subsidence (Beckett et al., 2016)



NOAA SLR Data, Choptank Marshes

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Sea Level Rise/Saltwater Intrusion: What we know

- **Tidal freshwater marsh area is predicted to decrease compared to salt marsh area** (de Lima et al., 2024)
  - Accretion rates < SLR (White and Kaplan, 2017)
  - Salt marsh conversion (MD Dept. of Planning, 2024)
- **Limited potential for migration inland**
  - Largely due to topographic variability (Molino et al., 2022)
  - GIS could be used to understand which key marshes might migrate inland
    - Surrounding elevation data for key marshes could be useful
  - Interviews anecdotally support

Historical data supports GIS analysis

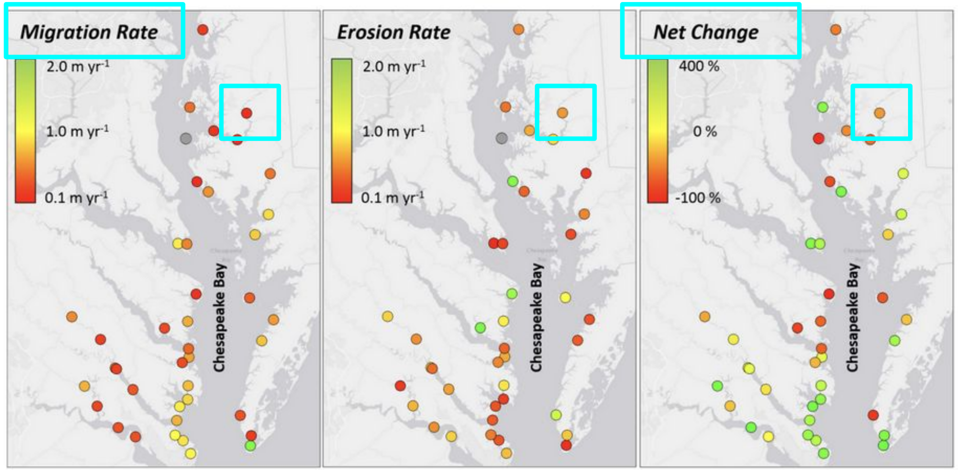
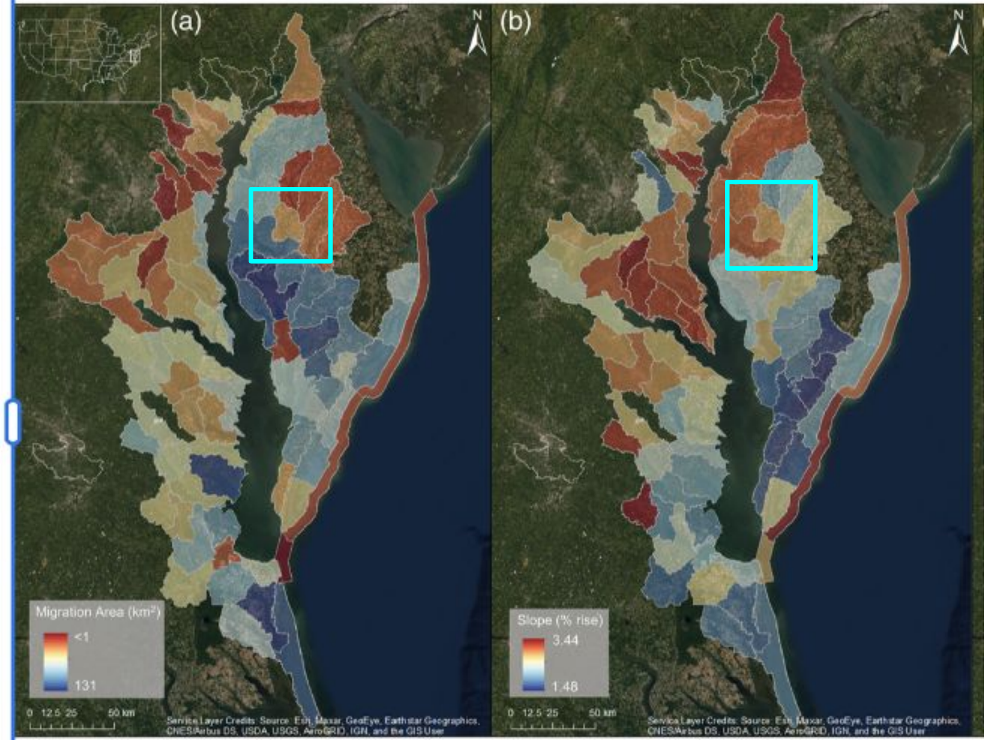


Fig. 4 Marsh migration rates (m year^{-1}), erosion rates (m year^{-1}), and net change in area (%) along the Chesapeake Bay. Each circle represents an individual T-sheet, where reported values represent the change averaged over the entire T-sheet extent. Green colors denote rapid change and red colors denote slow change, except for in the "Net Change" panel where green indicates net marsh expansion (migration > erosion) and red indicates net marsh loss (erosion > loss). The gray dot represents Sharps Island and does not have a migration or erosion rate because complete land loss occurred prior to 2013

Schneider et al 2018

Limited migration and steep elevation

Migration Area under 1.0 m of SLR



Median Slope for each watershed at tidal marsh/forest boundary

Molino et al., 2022

Sea Level Rise/Saltwater Intrusion: Management Strategies

1. Thin-layer placement
    a. Cost intensive
        i. Primarily due to transportation
    b. Pair up dredging and placement projects
2. Better monitoring and observed data
    a. When, where, and how fast
3. Centralized information and infrastructure
    a. Salinity Resilience Network (MD Plan to Adapt to SWI, 2024)

Photo from Maryland Asphalt Association

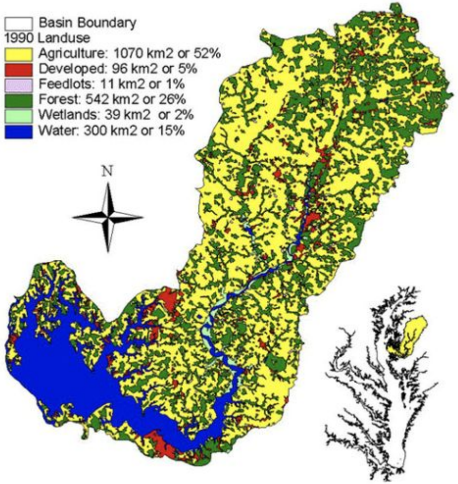
Sea Level Rise/Saltwater Intrusion: Remaining Questions

1. Is there possibility to implement mechanical measures that reduce elevation grade on the perimeters of these marshes which allows them to migrate inland?
   a. Financial and other resource limitations

2. What mechanical measures are available to limit and/or reduce the effects of SWI (White and Kaplan, 2017)
   i. Changes at the land surface that increase the proportion of precipitation that infiltrates and is then available for surface and groundwater
3. How we can we use our GIS analysis to help predict which key marshes can migrate more easily?
4. What are we restoring to? What is our baseline?

Farmer Collaboration: Background

1. Choptank Watershed - 62% agricultural (USDA CEAP, 2021, right)
    a. 50% historically drained for crop production
2. Primarily private land
3. Farmers are experiencing, very acutely, the effects of SWI and marsh migration onto their land (Sudol et al., 2023)



Choptank River Watershed

How do we incentivize and work with farmers to enact marsh management practices on their land?

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Farmer Collaboration: What we know

1. **Opposing perspectives**
   a. Protecting marshes versus protecting crop production and bottor
   b. Extensive cultural context
2. **Confusing and complicated incentive programs**
   a. Conservation easements, Conservation Reserve Enhancement Program (CREP), Pay-for-performance programs (PEP)
      i. Permanent versus predefined length of contract
   b. Limitation on those who lease
   c. Permitting and logistical barriers

CREP Pays Landowners Attractive Land Rental Rates to Protect Streams and Other Environmentally Sensitive Areas

Farmer Collaboration: What we know

1. **Need for "middle" people to better reach stakeholders**
    a. Building relationships
2. **Incentive programs might not be the most effective** (Newburn et al., 2025)
    a. Farmers/landowners were given hypothetical, randomized incentive programs to implement vegetation buffers on their land
        i. **Almost half stated they would not enroll in any**

Photo of Choptank River by ESLC

Farmer Collaboration: Management Strategies

1. <u>Advocate for legislation</u>
    a. Increased payments for owners and renters
    b. Increased veg buffer width
2. <u>Target landowners who are more likely to enact strategies</u>
    a. Within the predicted migration pathways

Photo by Chesapeake Bay Journal

Farmer Collaboration: Management Strategies

1. **Centralize information**
   a. Streamline processes for stakeholders
      i. Decision support model
         1. Work being done by interviewees
2. **Research on what to plant on affected land to adapt to SWI/ease transition to marshland**
   a. For farmers experiencing SWI (Barros et al., 2025) (see right)
      i. *Tripsacum dactyloides*
      ii. *Spartina patens*
      iii. *Spartina pectinata*

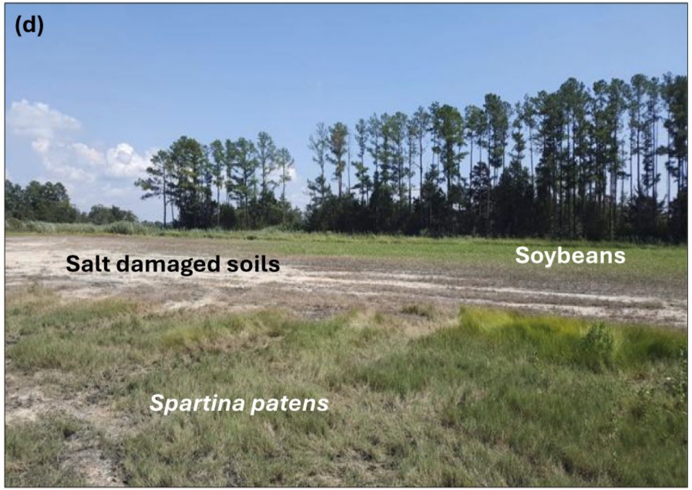

Image of a nearby farm field showing a salt-damaged area transitioning to marsh vegetation, dominated by Spartina patens.

Farmer Collaboration: Remaining Questions

1. **How do we better target farmers** that are more likely to implement certain strategies?
2. **Better local understanding and collaboration** is direly needed. How can organizations get people on the ground with ***such limited financial and human resources?***
3. How can marsh managers better **prioritize and elevate farmers' role** in developing marsh management strategies that may better align with their wants and needs?

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Future Scopes

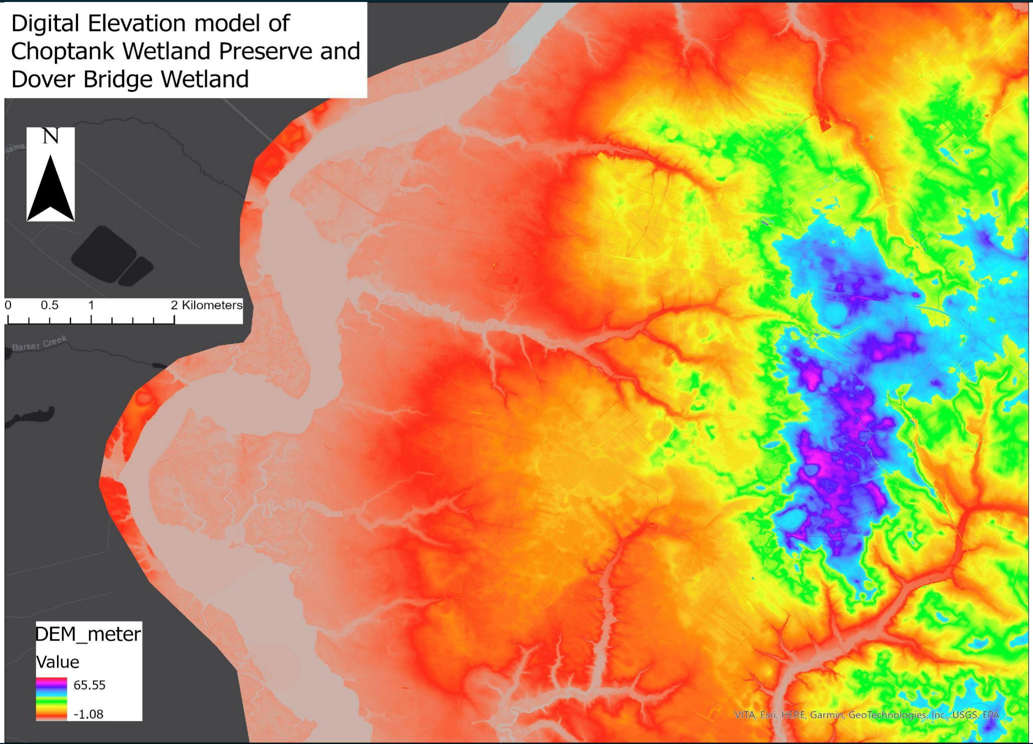
William

Geospatial Analysis

Data Sources

- **NOAA Sea Level Rise and Coastal Flooding Impacts:** Sea Level Rise and Coastal Flooding Impacts
- **Digital Elevation Model (DEM):** State of Maryland Open GIS Data
- ***Polygons for marsh migration under sea-level rise in Chesapeake Bay.*** Defne, Z., Ackerman, K.V., Andrews, B.D., and Ganju, N.K., 2025, Chesapeake Bay marsh migration potential under sea-level rise: U.S. Geological Survey data release, https://doi.org/10.5066/P18BWN2U.

Sea Level Rise: Elevation



NOAA Sea Level Rise and Coastal Flooding Impacts

1m SLR

3m SLR

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Transcripted DEM (3m)

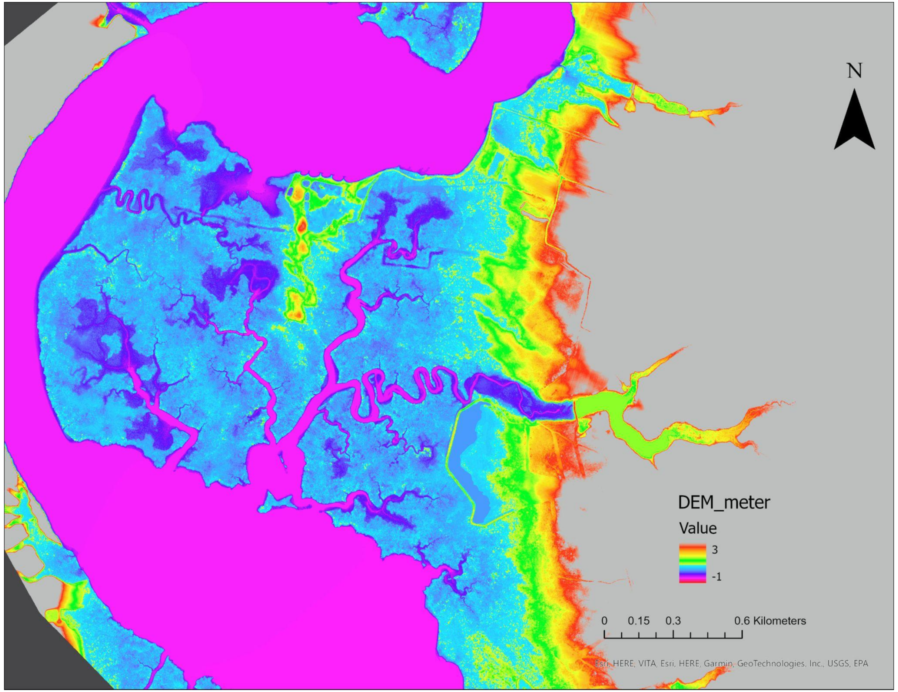
Choptank Wetland Preserve

Pink: Choptank River

Dark blue: marshes below water surface

Green: Possible Marsh Migration Areas

Red: Marsh Migration Boundaries



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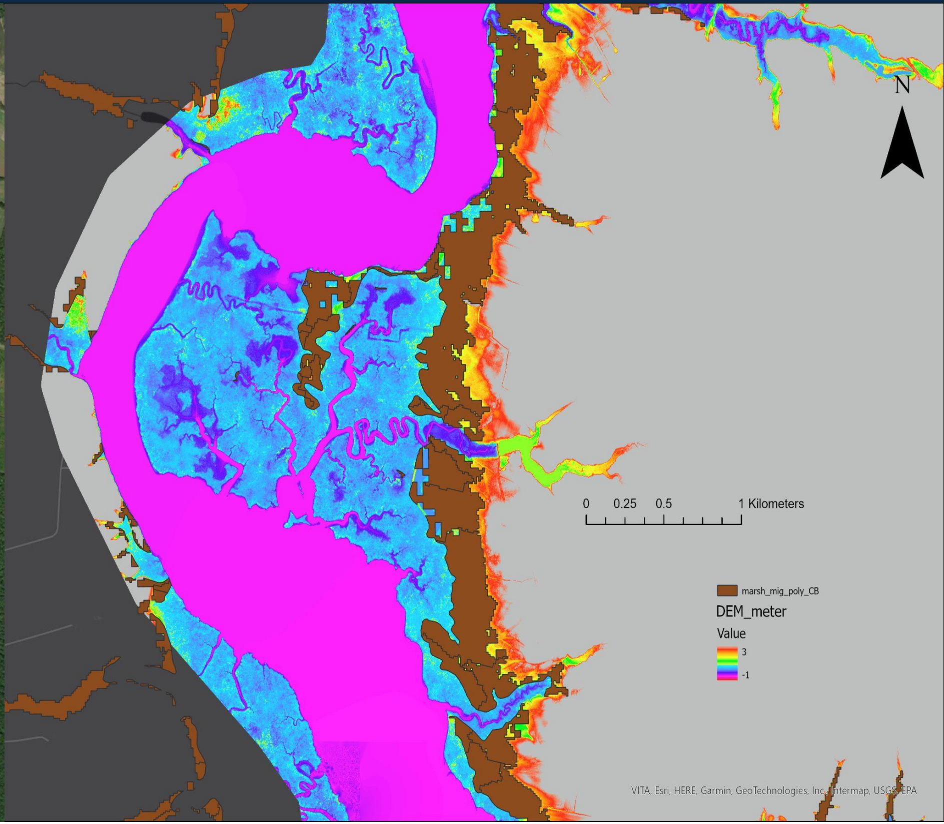
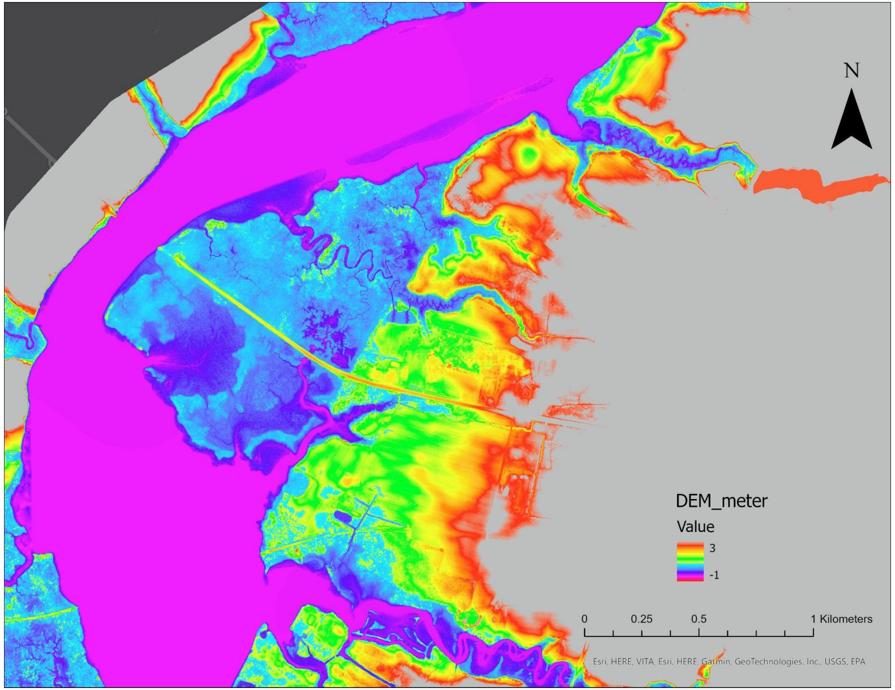
Marsh Migration Corridors

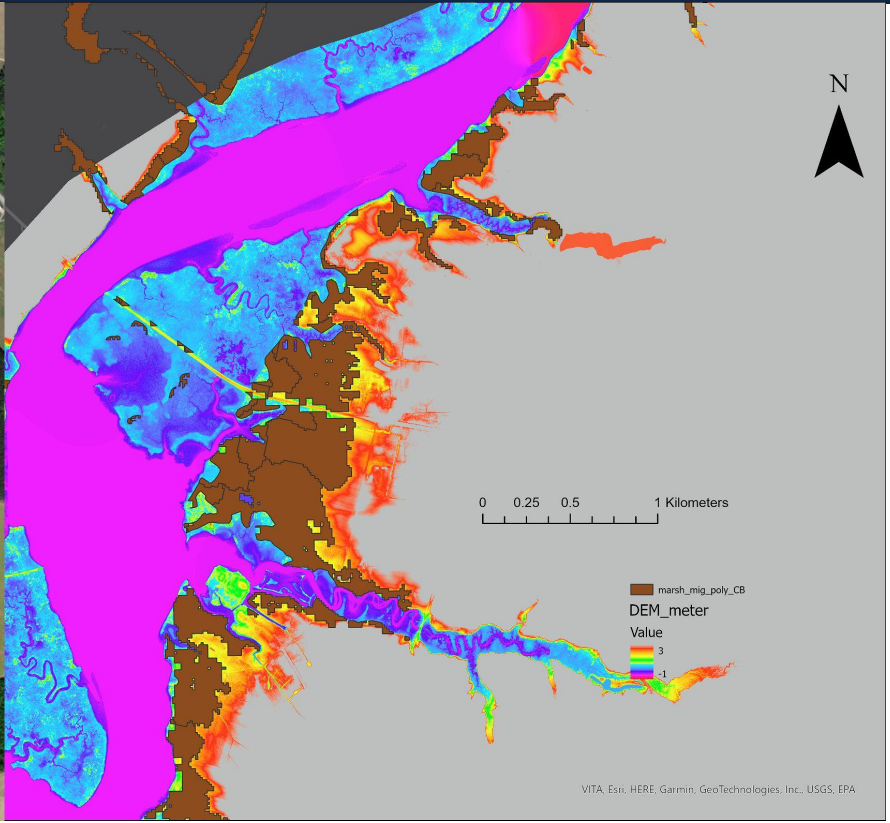


Transcripted DEM (3m)

Dover Bridge Wetland

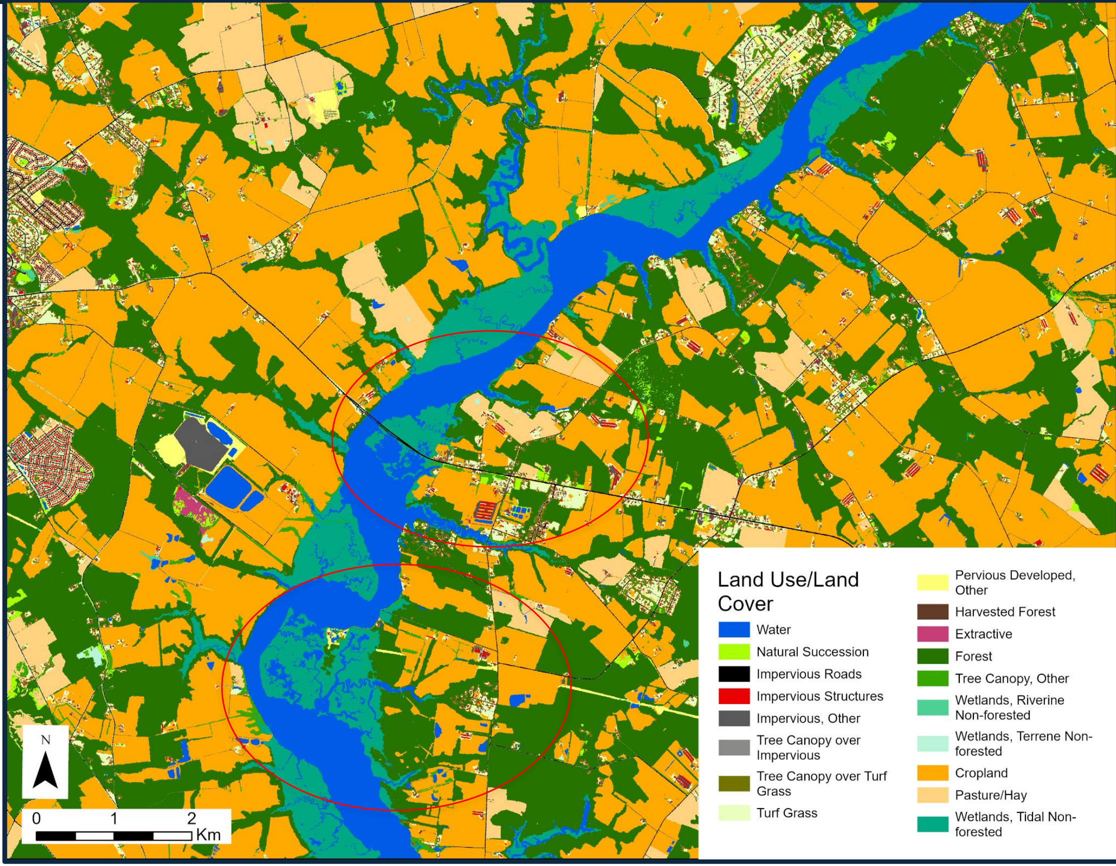


Marsh Migration Corridors



Land Use

- Adjacent areas mainly forest and cropland



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Discussions

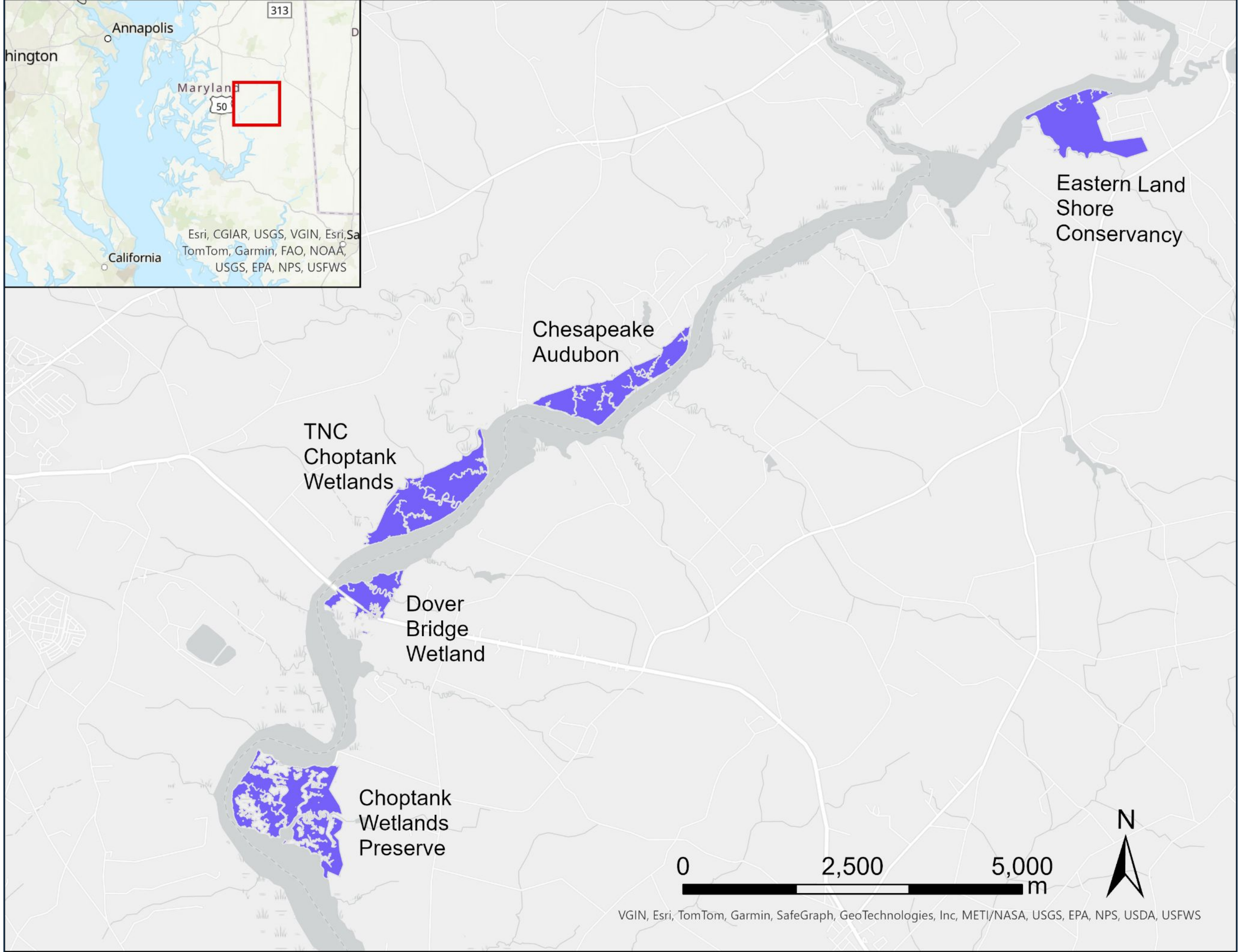
- Marsh Migration Corridors largely overlaps with private cropland/forest →cropland/forest blocks migrations
- Remove cropland and forest for marshes to migrate?
- Time urgent, plan early

Breakout Groups

- 11:10-12:00
- Based on student questions and presentations
- Each group will have a note-taker; during lunch, notes will be compiled to share and review with the larger group

Lunch until 12:45

Breakout Group Review



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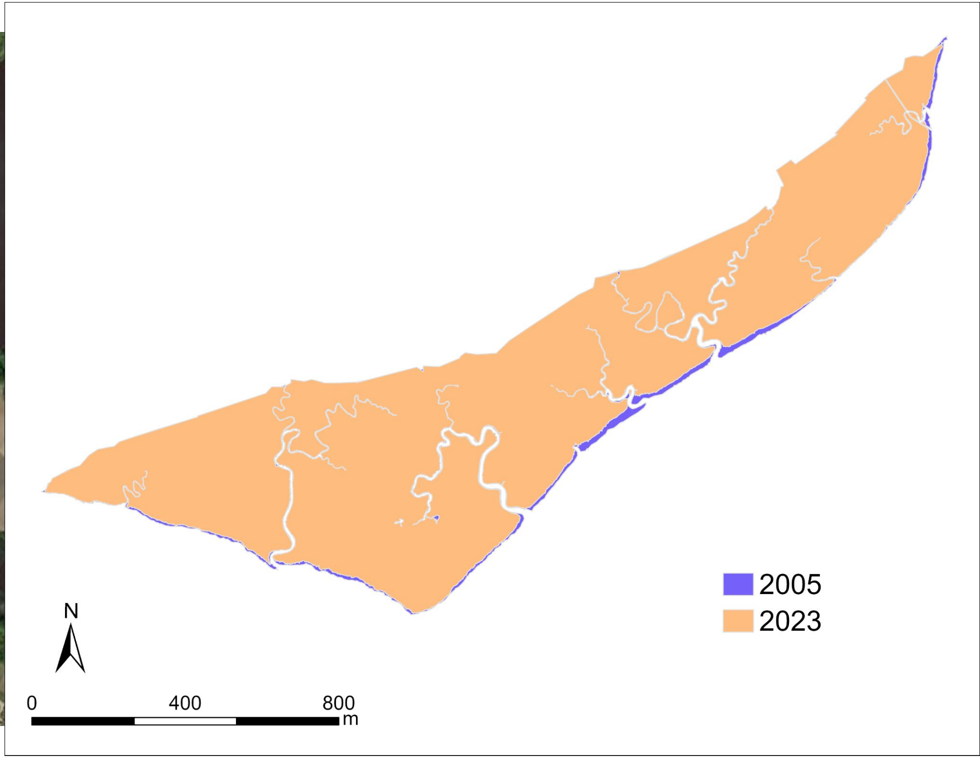
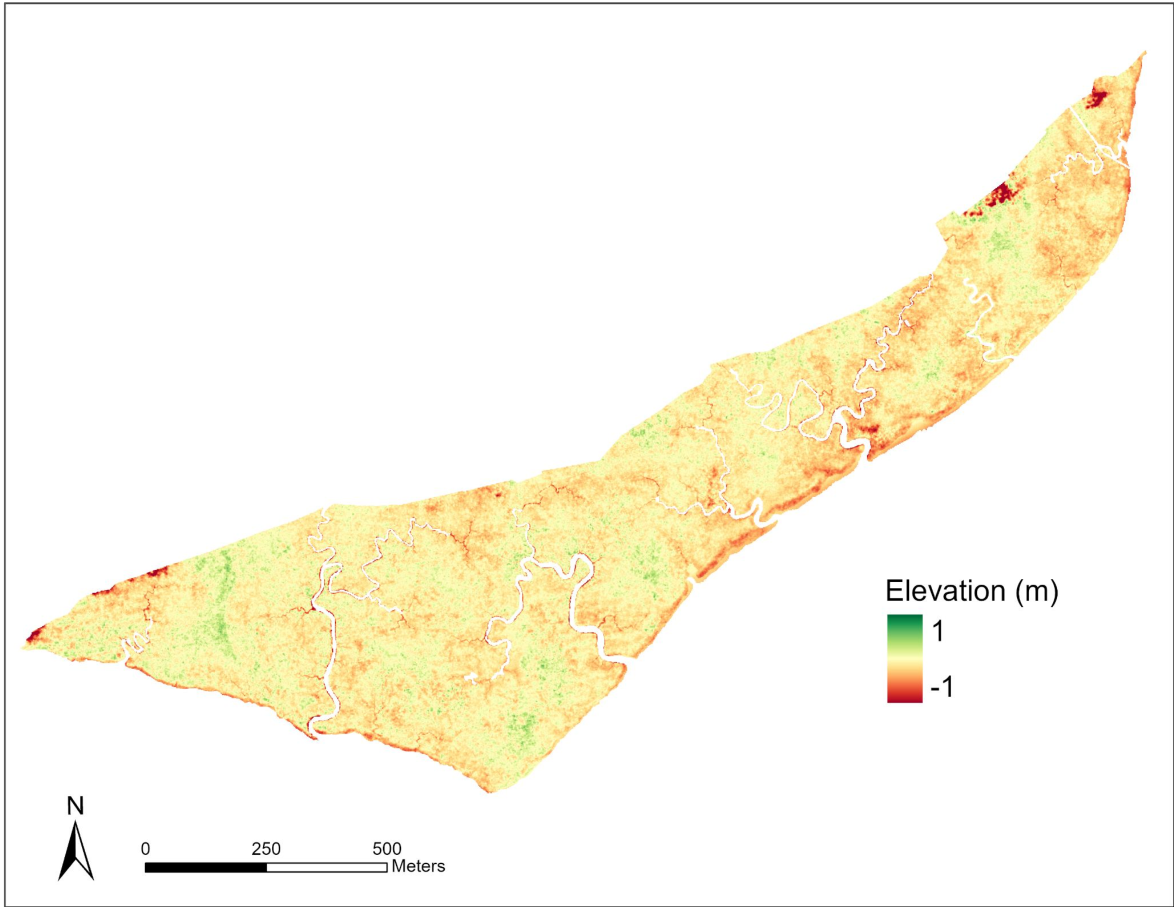
ESLC Lynch Preserve

Chesapeake Audubon

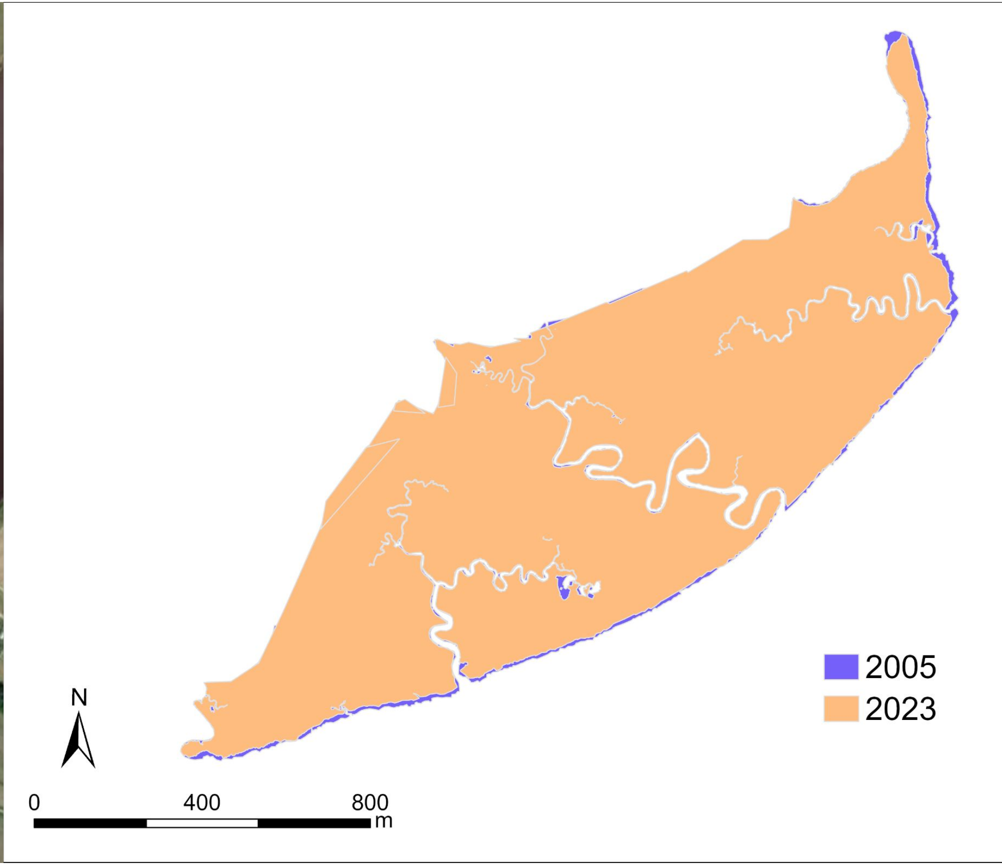


Chesapeake Audubon

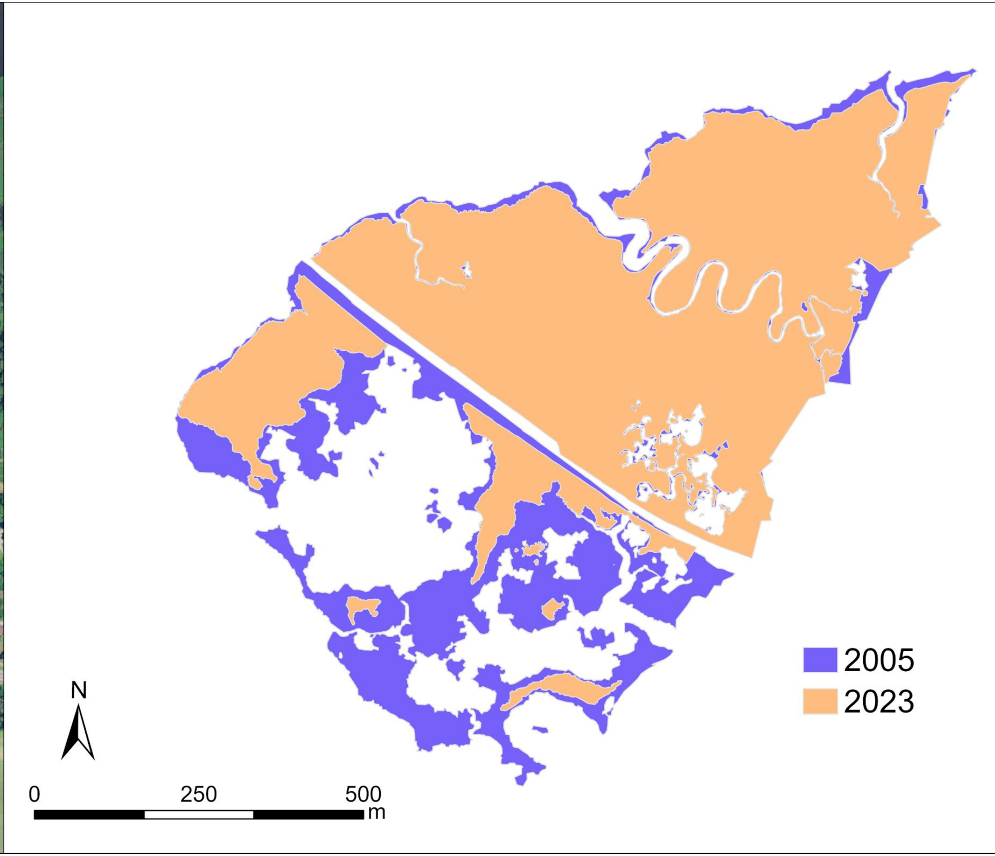
Change in Elevation 2003 - 2013



TNC Choptank Wetlands - King's Creek

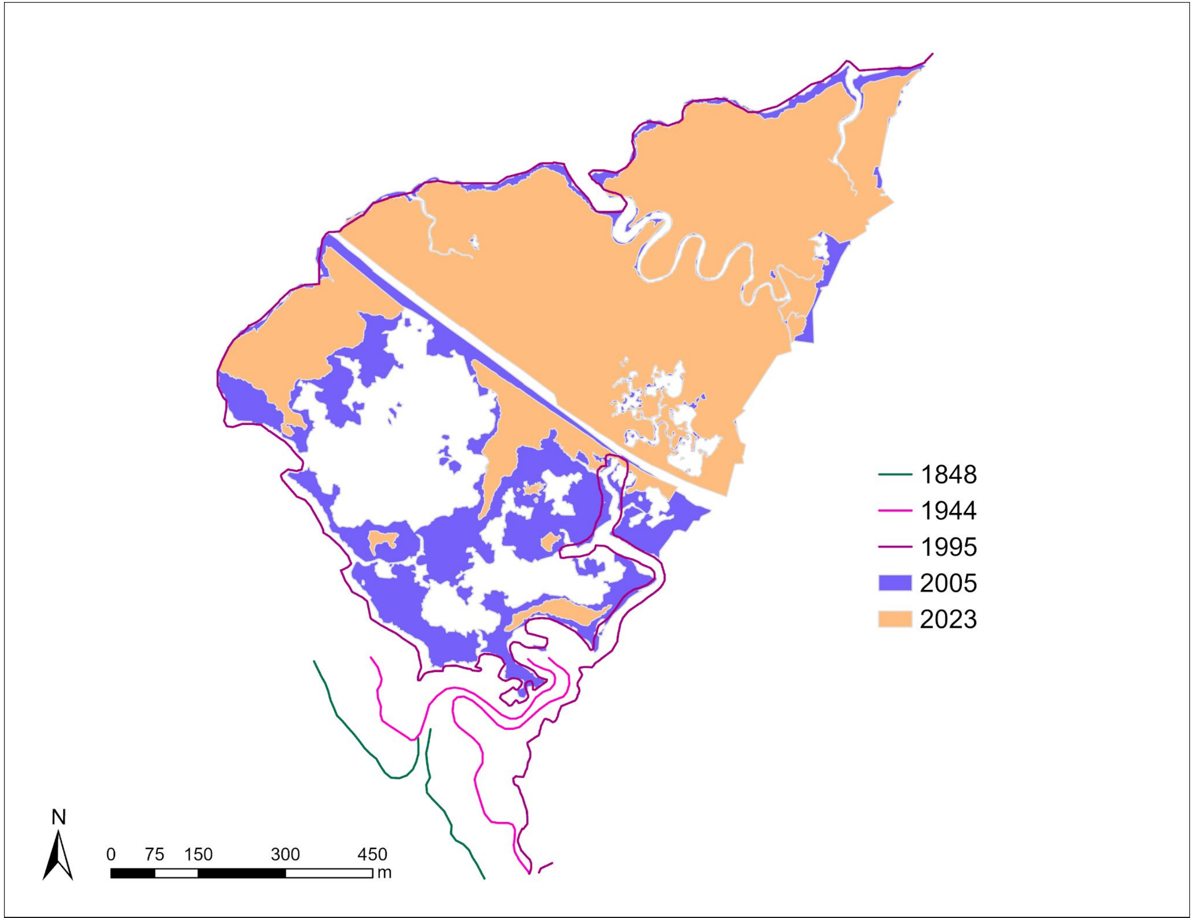


Dover Bridge Wetland



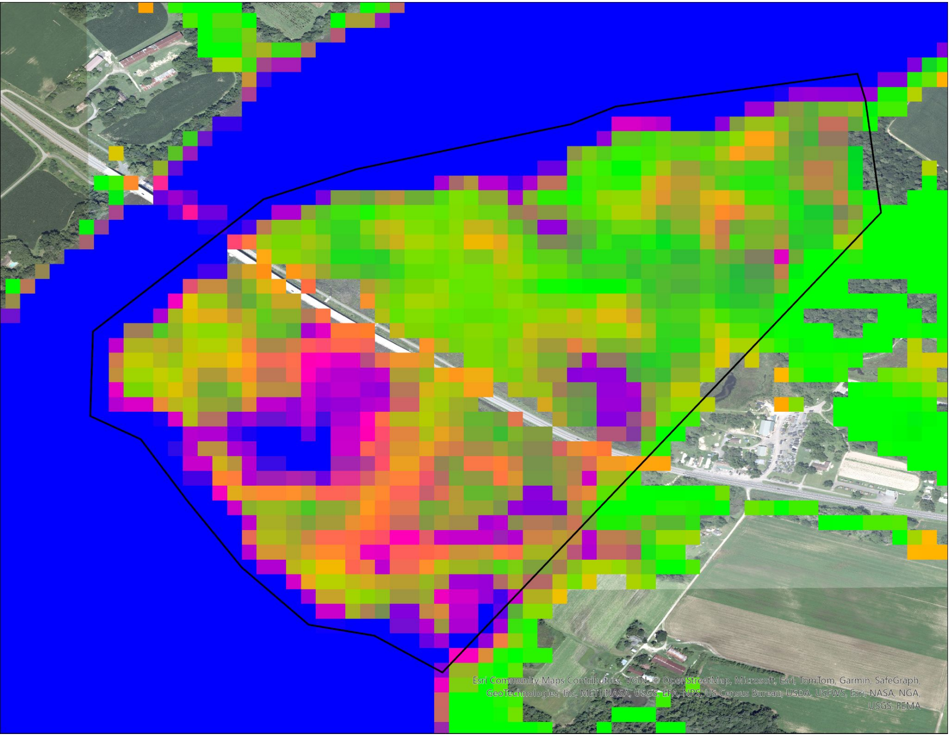
Dover Bridge Wetland

Historical Shorelines

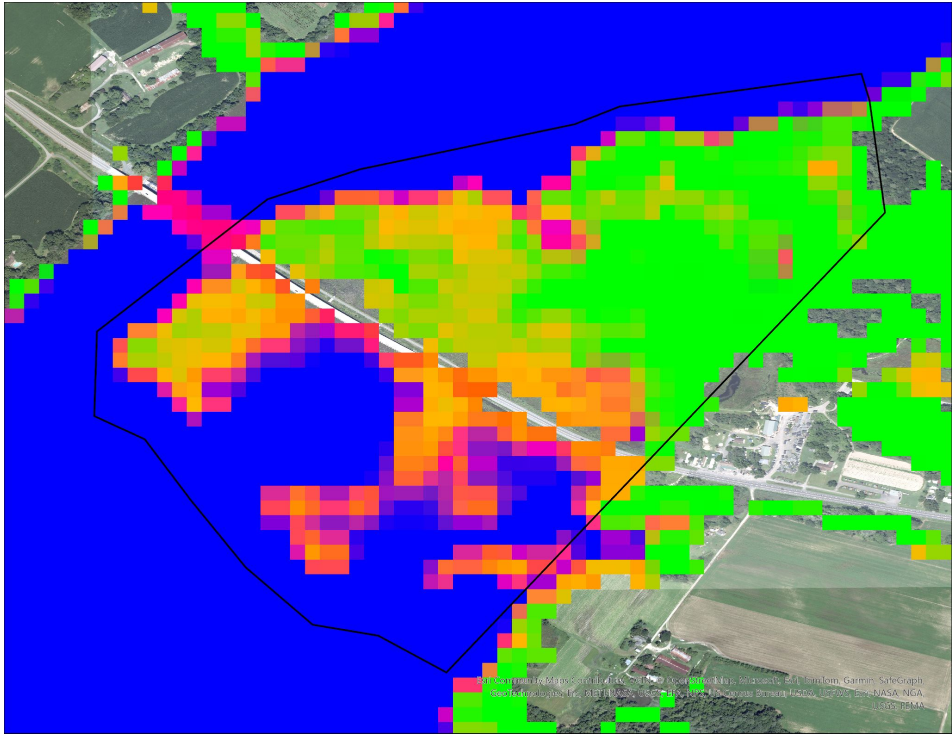


Dover Bridge Wetland - UVVR

1990

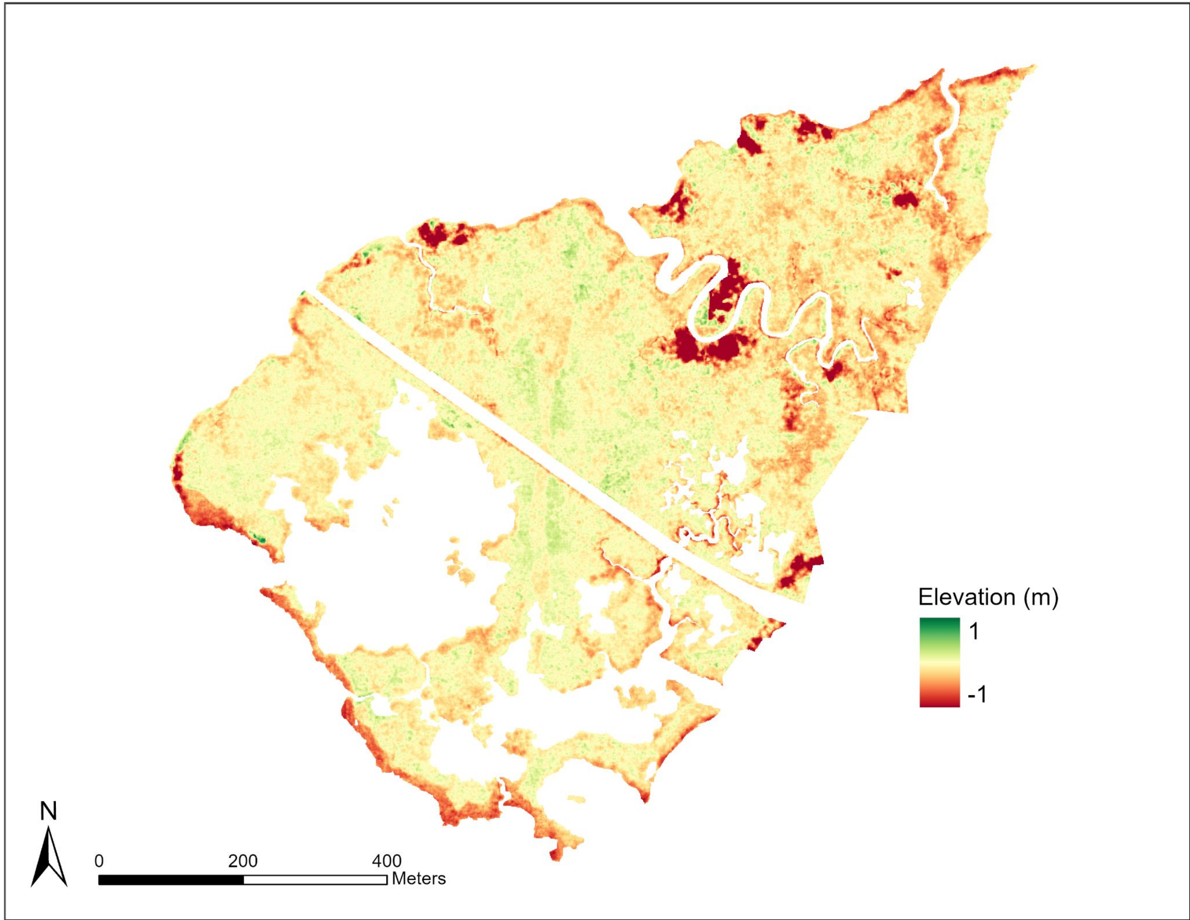


2020



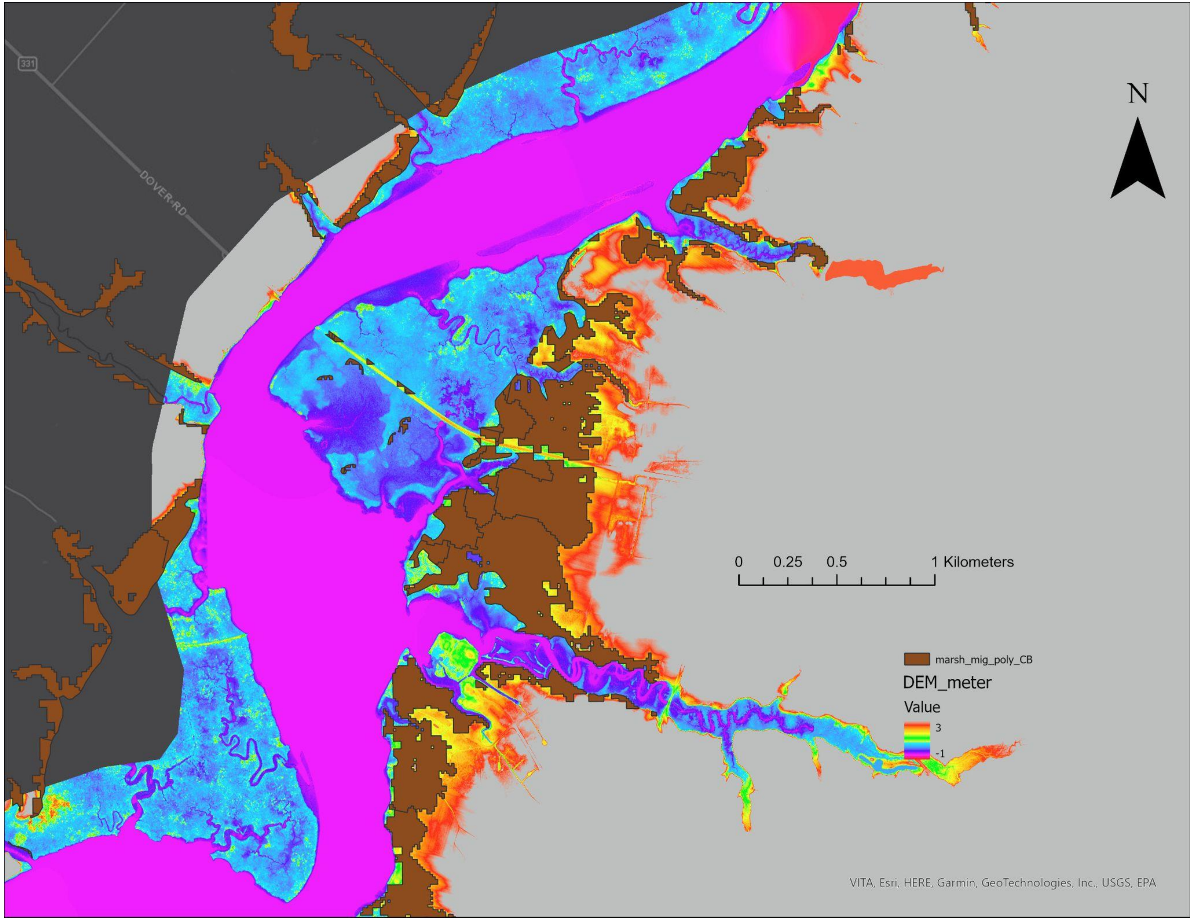
Dover Bridge Wetland

Change in Elevation 2003 - 2013

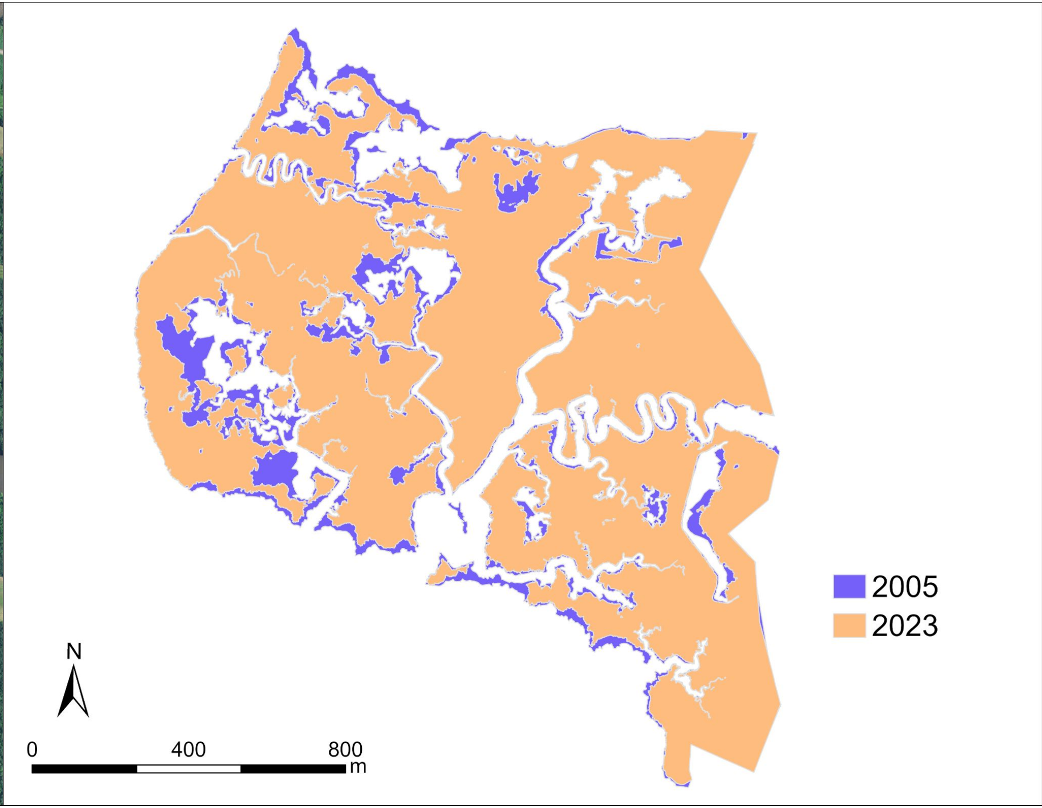


Dover Bridge Wetland

Marsh Migration Corridors



TNC Choptank Wetland Preserve



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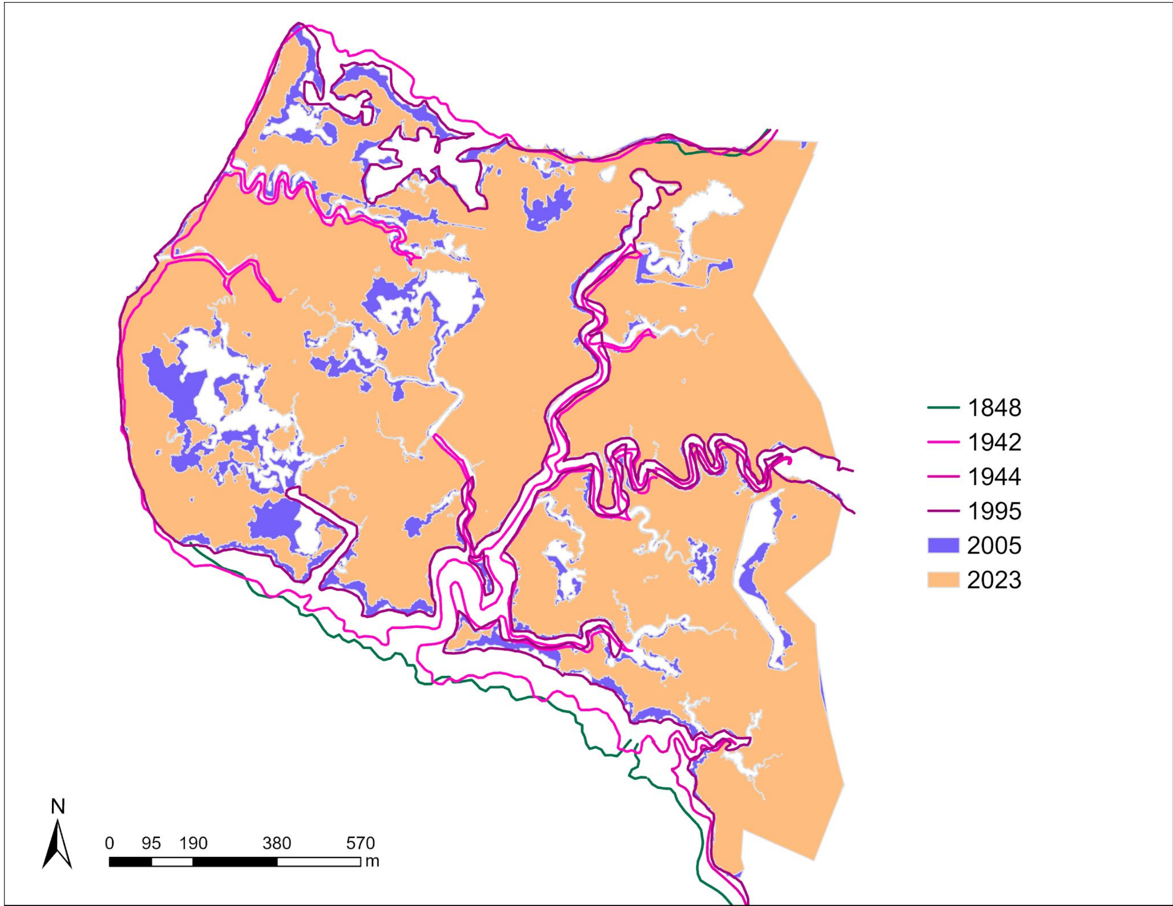
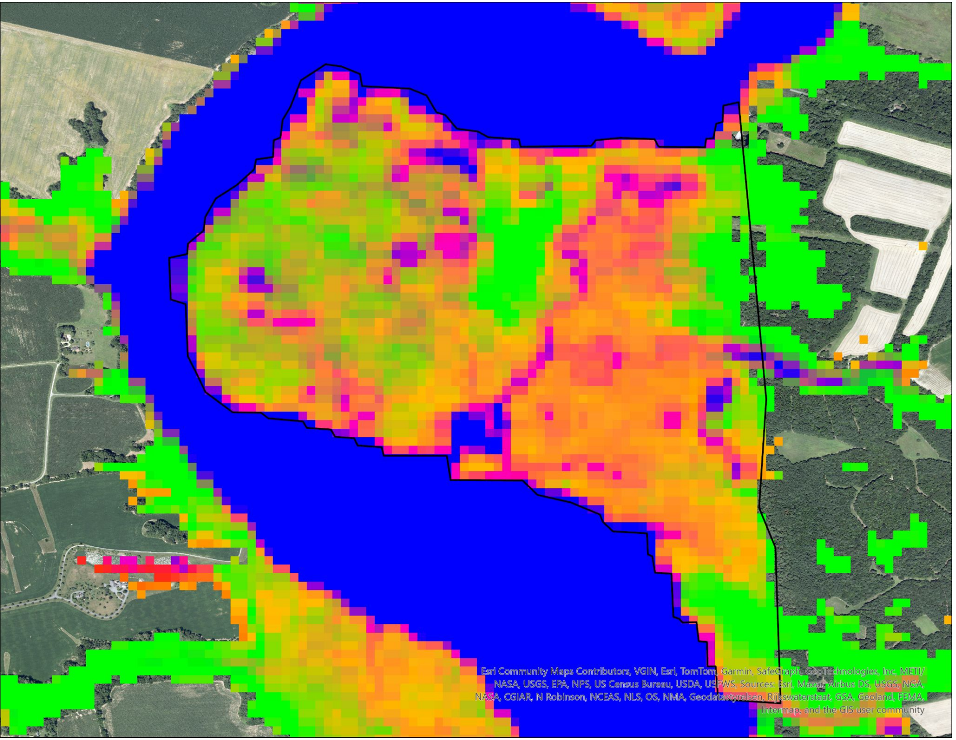
Choptank Wetlands Preserve

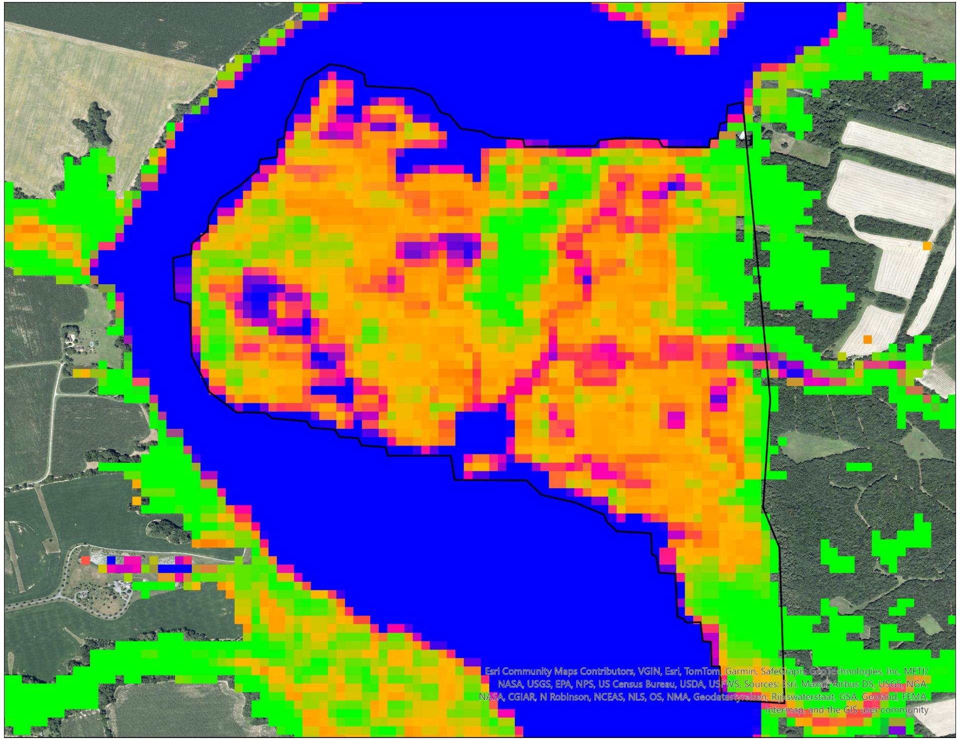


TNC Choptank Wetland Preserve - UVVR

1990

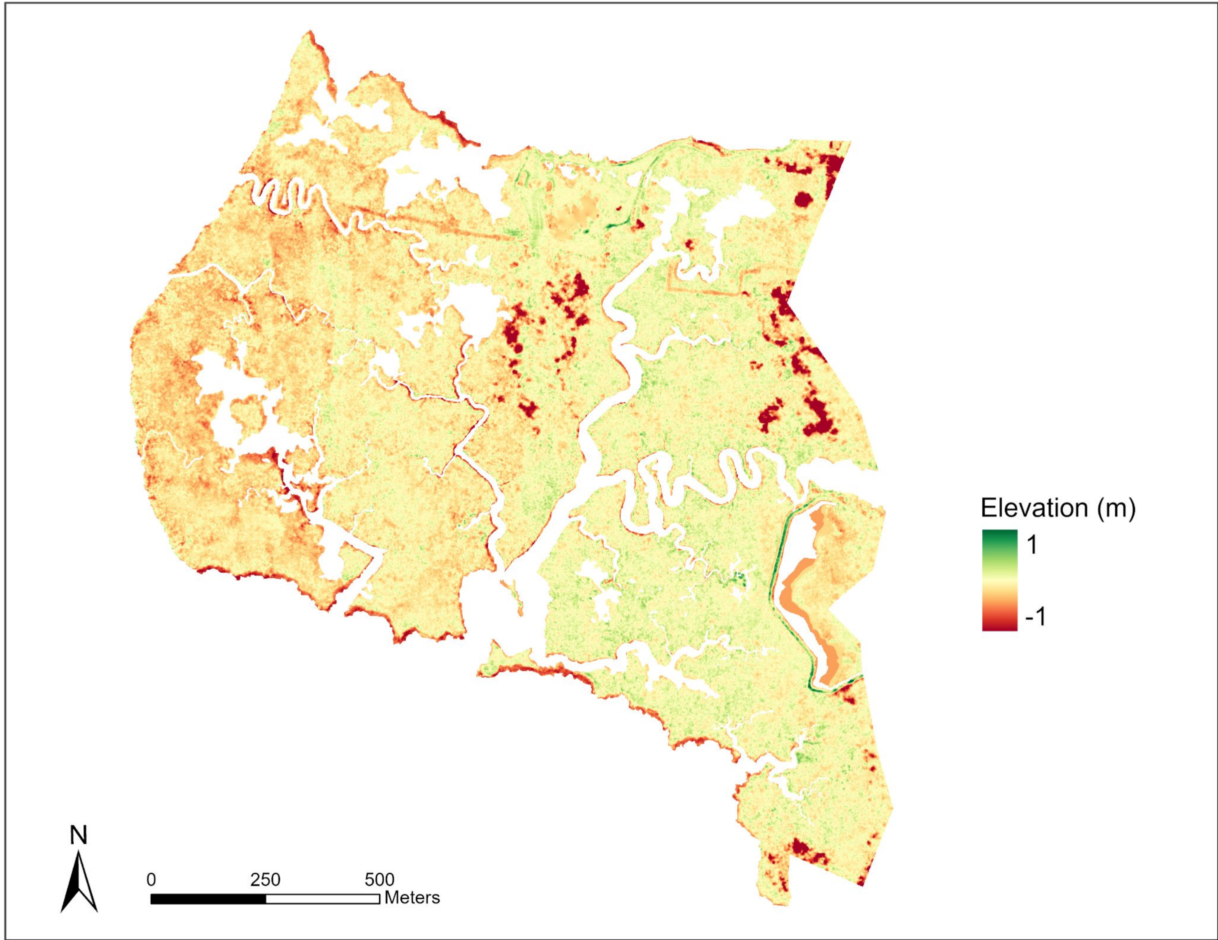


2020



TNC Choptank Wetland Preserve

Change in Elevation 2003 - 2013



TNC Choptank Wetland Preserve

Marsh Migration Corridors