When Climate Crisis Meets the Coast
Uncovering the Hidden Salt Threat to Agriculture

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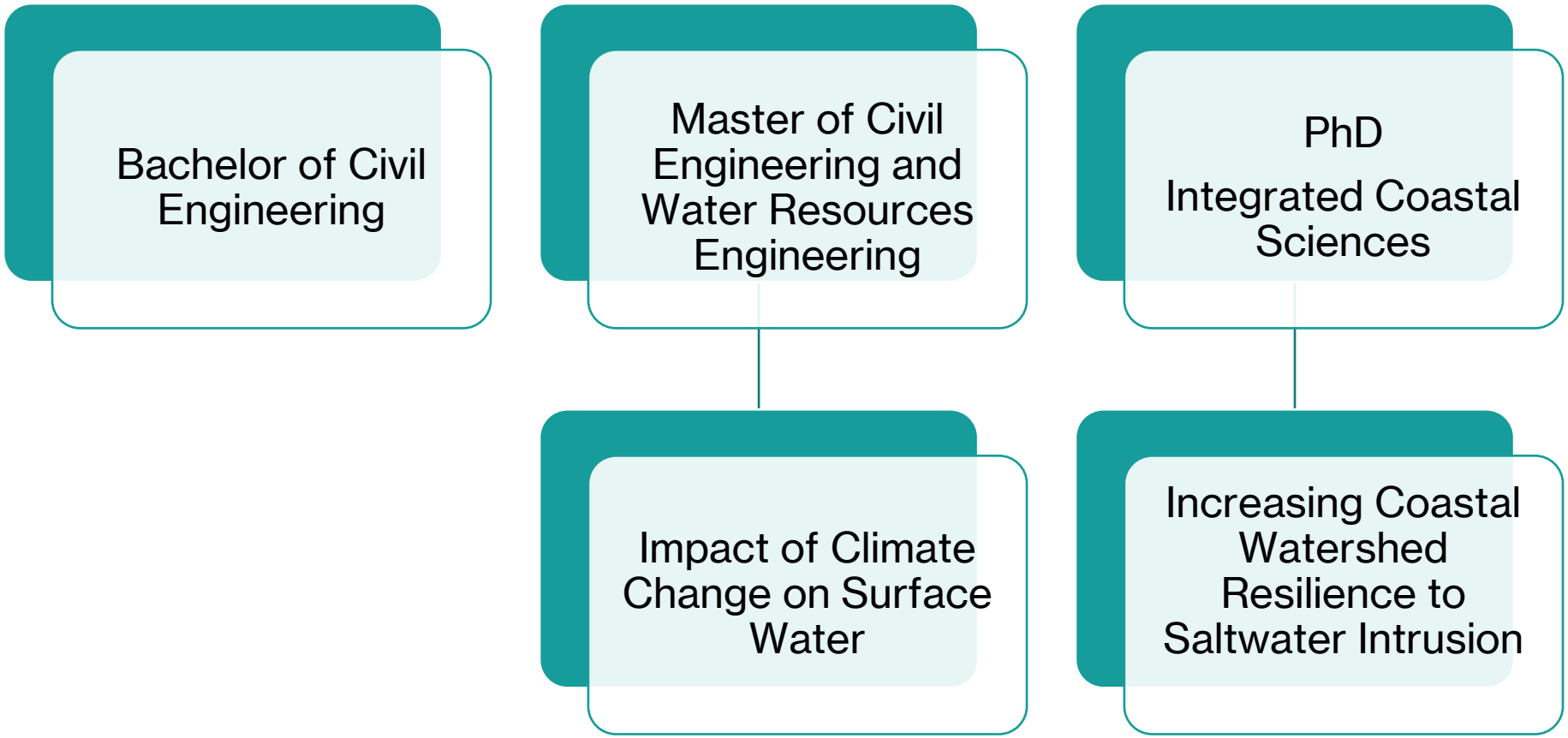
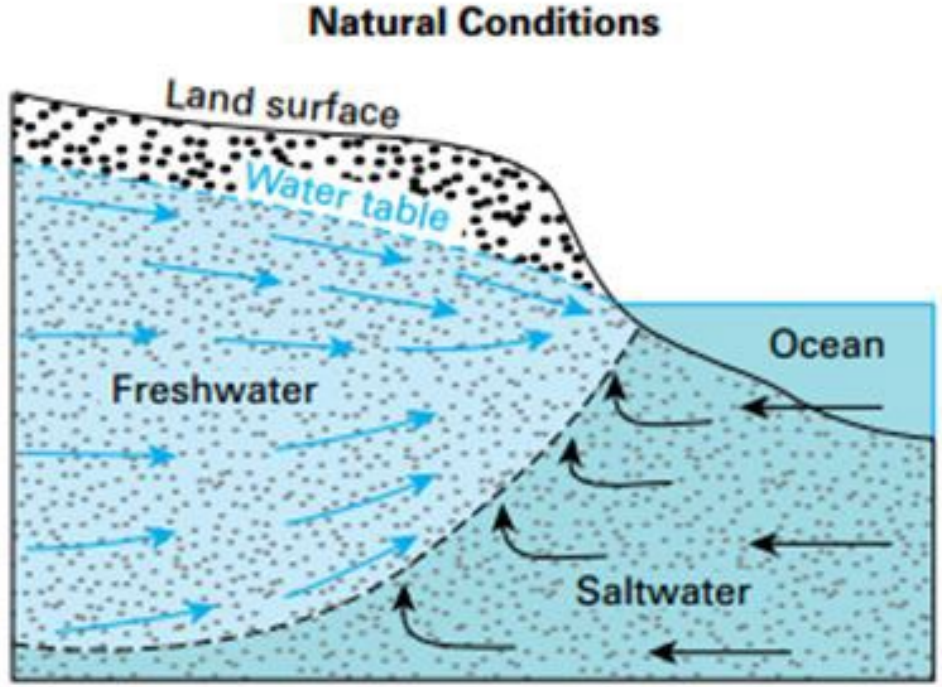
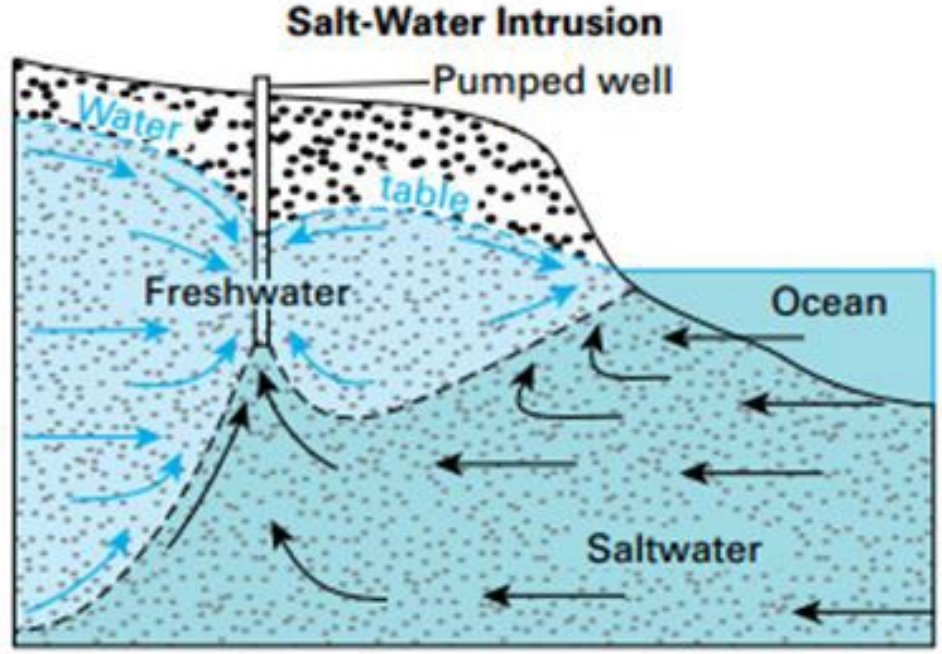
Background


Bachelor of Civil Engineering
Master of Civil Engineering and Water Resources Engineering
Impact of Climate Change on Surface Water
PhD
Integrated Coastal Sciences
Increasing Coastal Watershed Resilience to Saltwater Intrusion

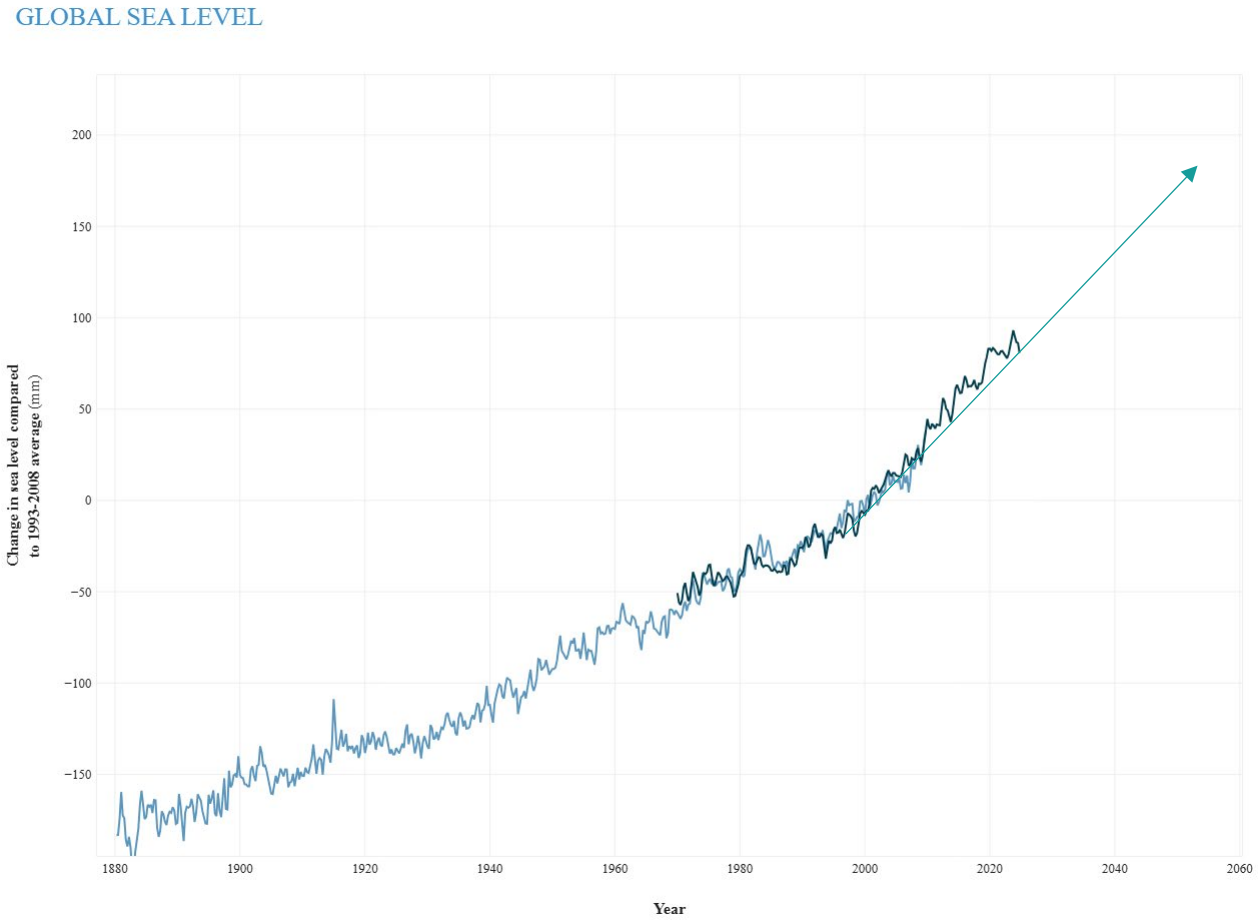
What is Saltwater intrusion and why it is important

- Seawater intrusion is the movement of saline water from the ocean or estuaries into freshwater systems. This problem exacerbated by rising sea levels and excessive groundwater pumping. It is important because it contaminates drinking water sources, renders land unusable for agriculture, harms ecosystems, and can lead to infrastructure corrosion. This contamination threatens coastal communities' water security, food production, and overall environmental health.

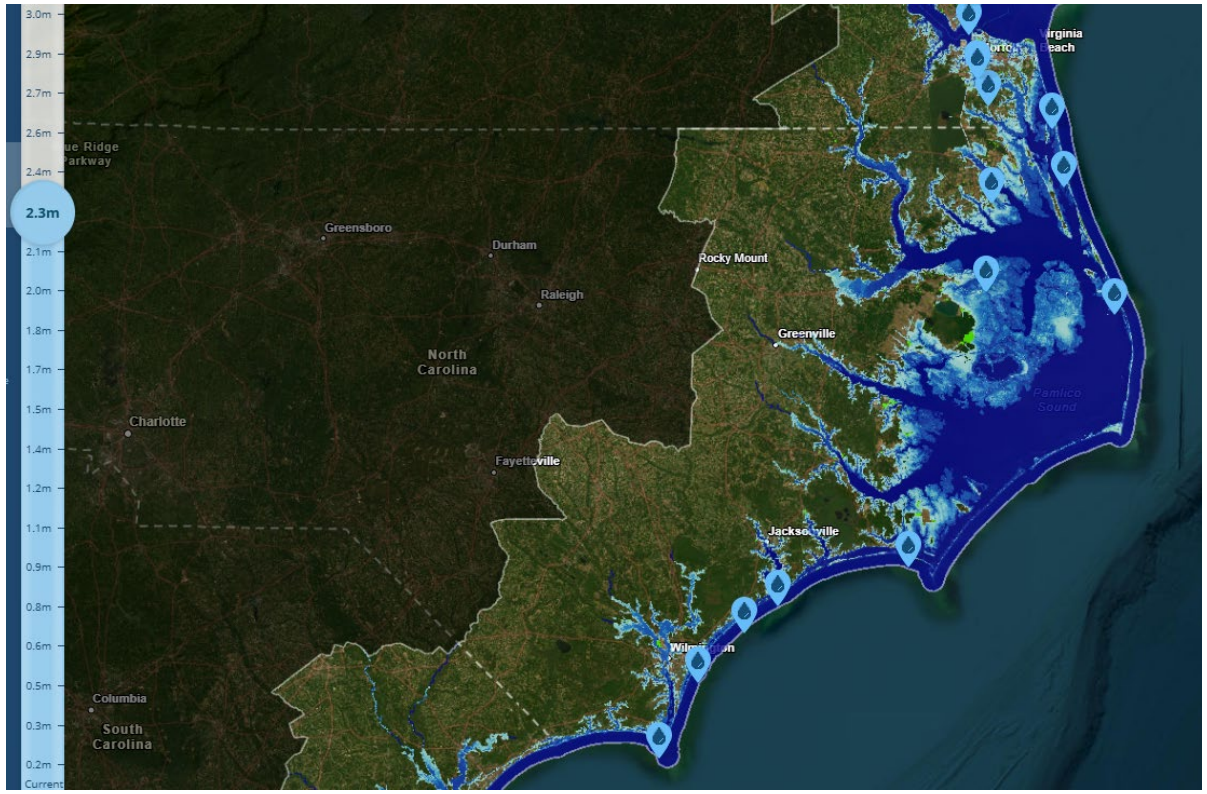




•On a pathway with high greenhouse gas emissions and rapid ice sheet collapse, models project that average sea level rise for the contiguous United States could be **2.2 meters (7.2 feet)** by 2100 and **3.9 meters (13 feet)** by 2150. NOAA, climate.gov

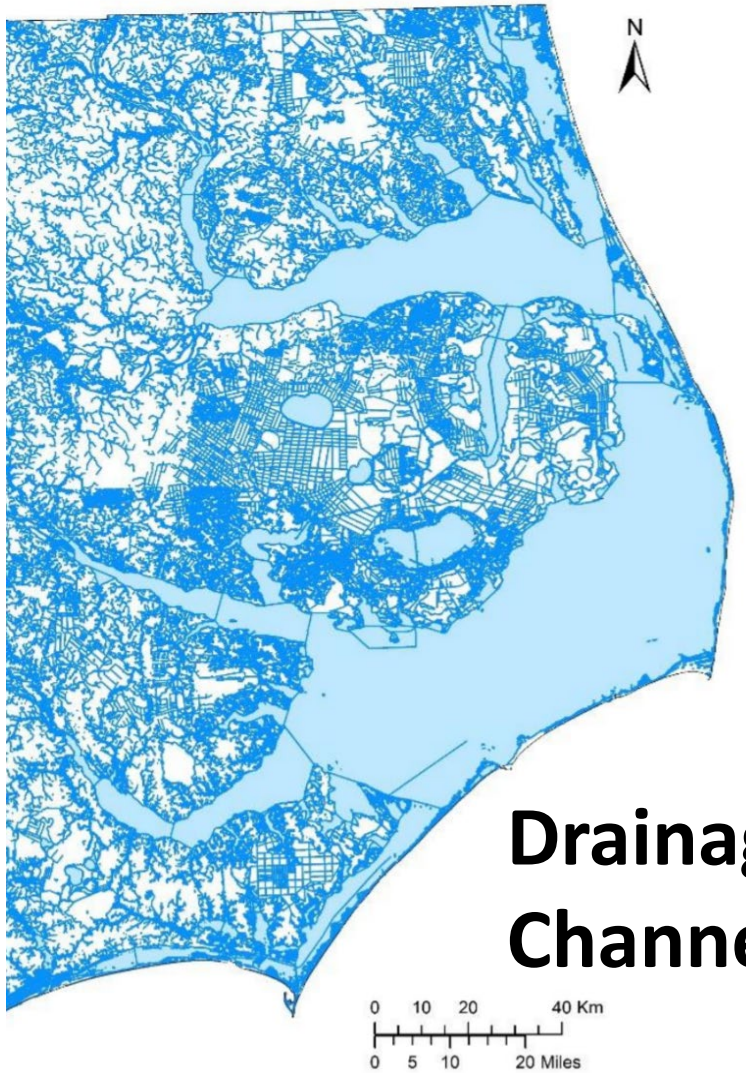


Global Sea Level (NOAA)(climate.gov)

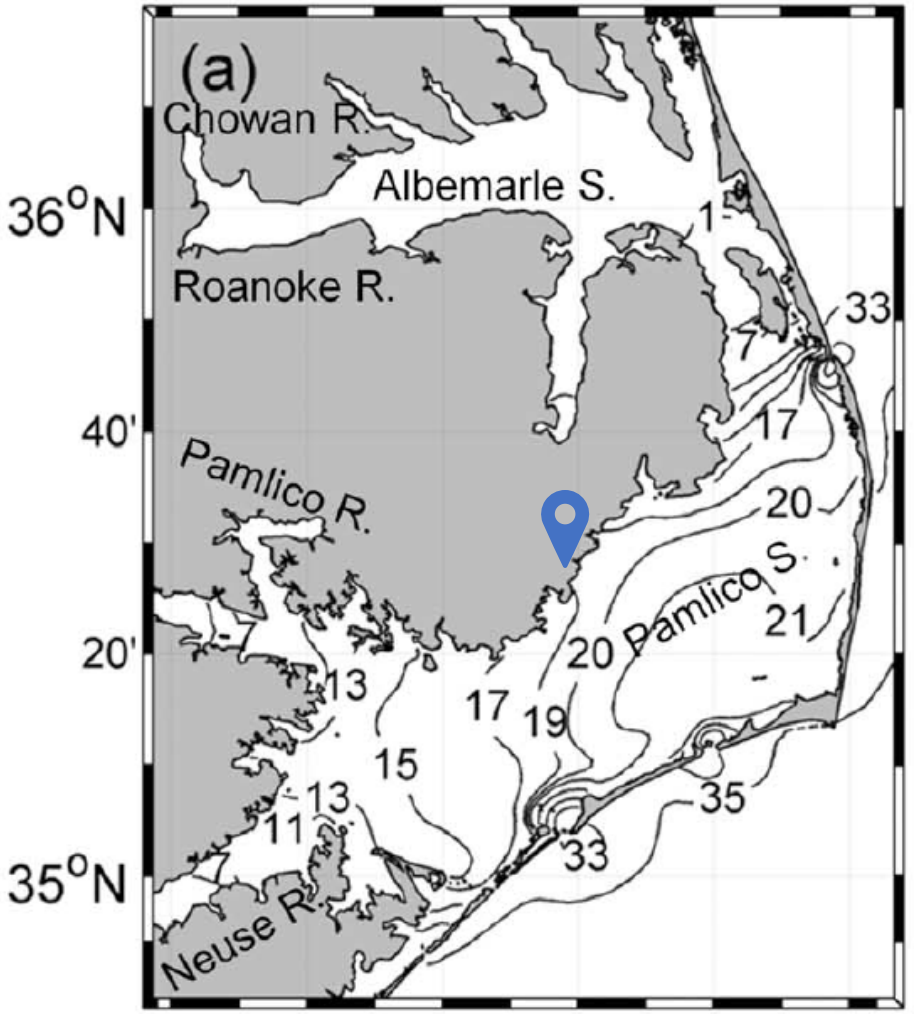


Sea Level Rise Viewer (coastal.noaa.gov)

Eastern North Carolina has been drastically drained over the past few decades.



Drainage Channels



(Jia & Li, 2012, JGR)

Introduction: Saltwater intrusion and soil salinization


Photo credit: Brynna Bruxellas


Photo credit: Elnaz Pezeshki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The Local Story: Hyde County Farms

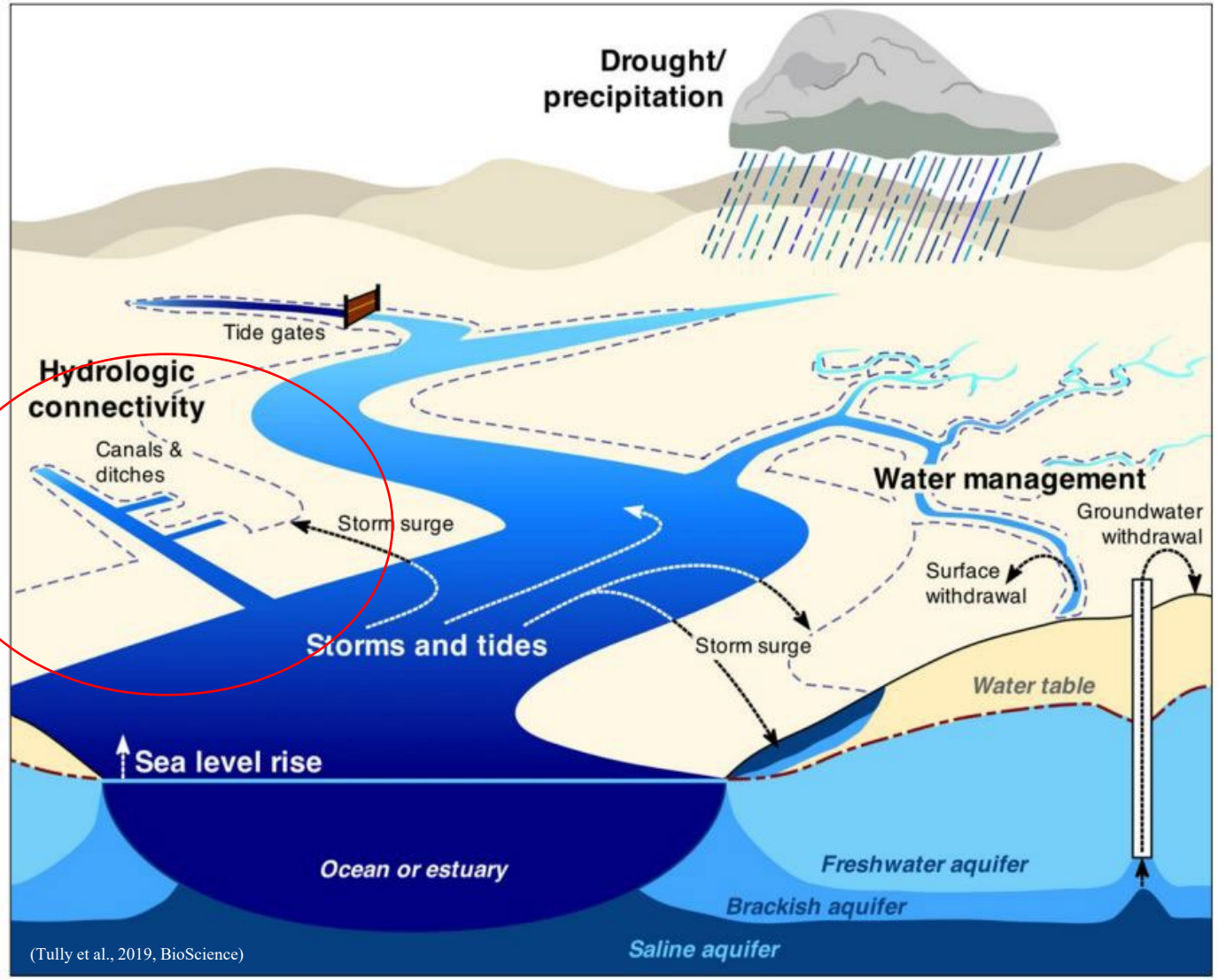
“We've been fighting salt forever. My daddy said that his granddaddy dealt with it, so it's nothing new. It just seems like it’s getting worse.”

Farmer Dawson Pugh in one of his fields. “If we have another year or two like the past five,” he says, “not only will I not be farming. A lot of us won’t.” (Eamon Queeney/for The Washington Post)

THE WASHINGTON POST

Introduction: Saltwater intrusion and soil salinization

- Drainage ditches may facilitate saltwater distribution to the farms

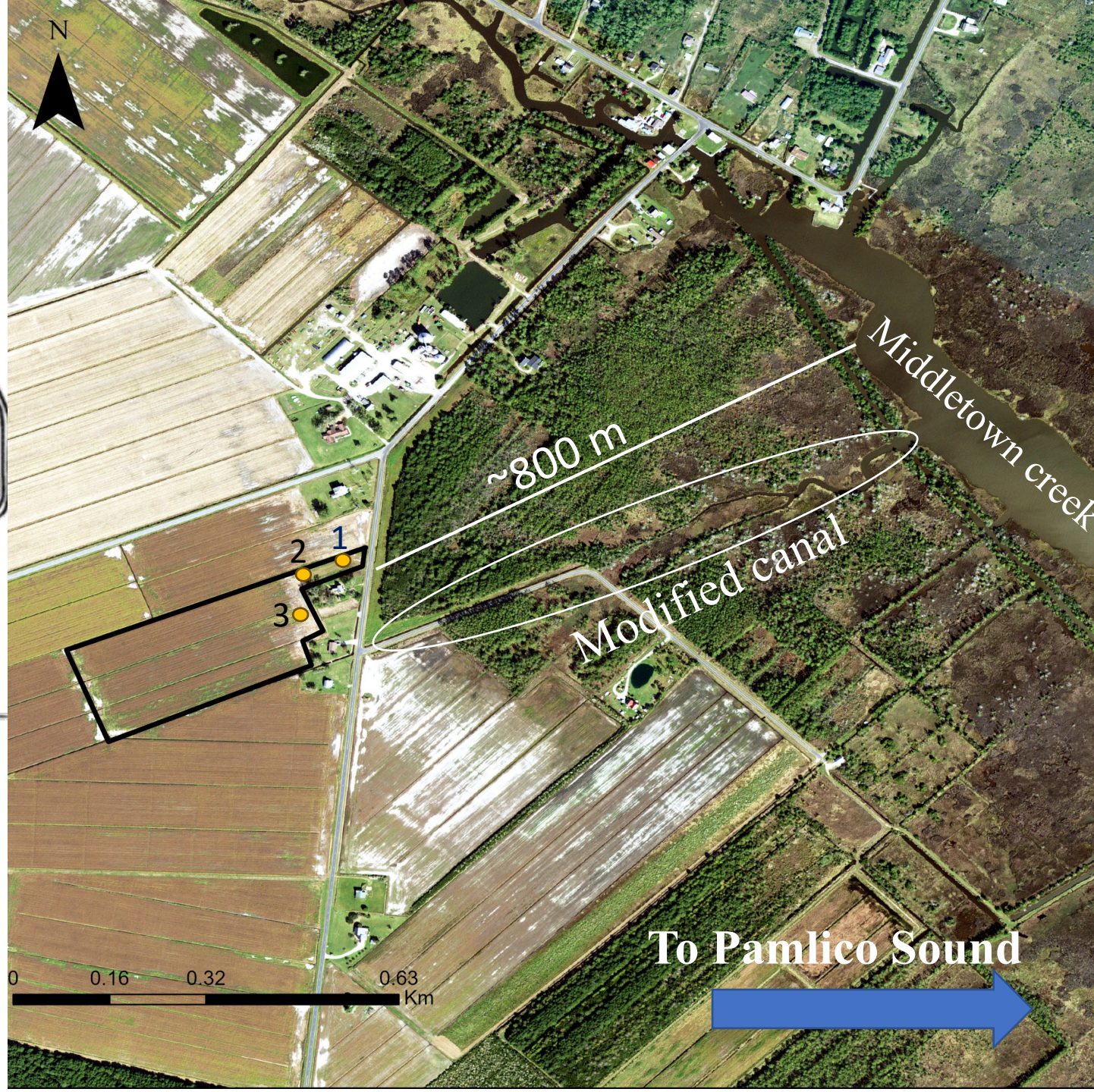


Study Region and Case Study

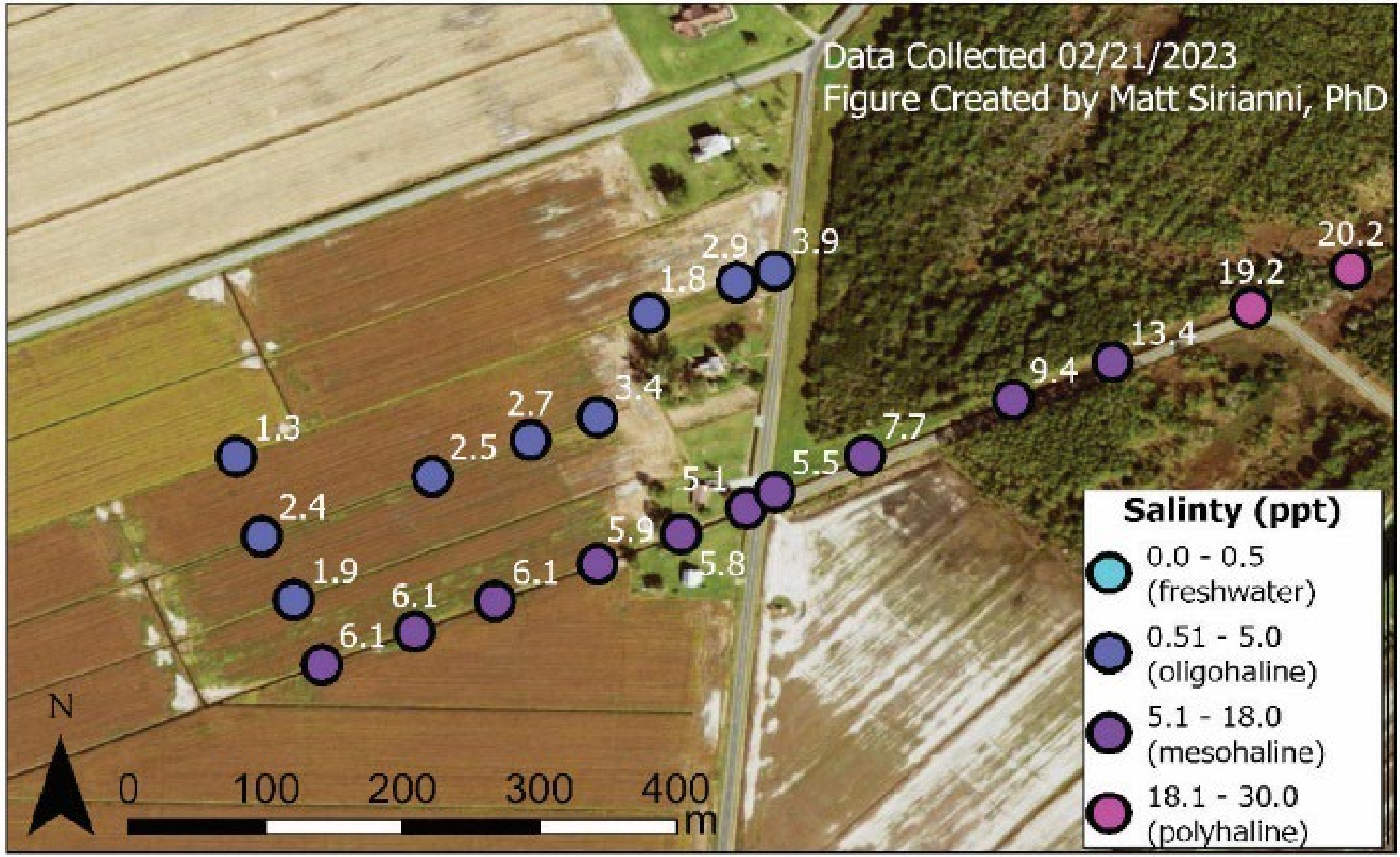
Hyde county field site, NC

Pamlico Sound

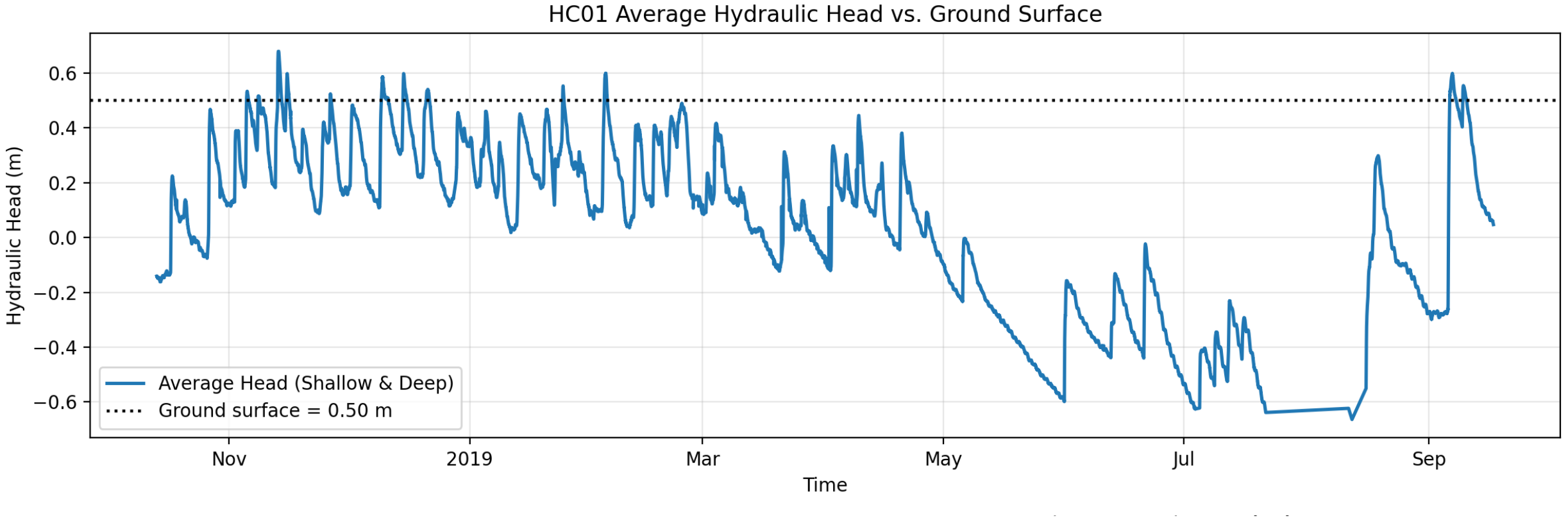
- Piezometric wells



Surface water salinity

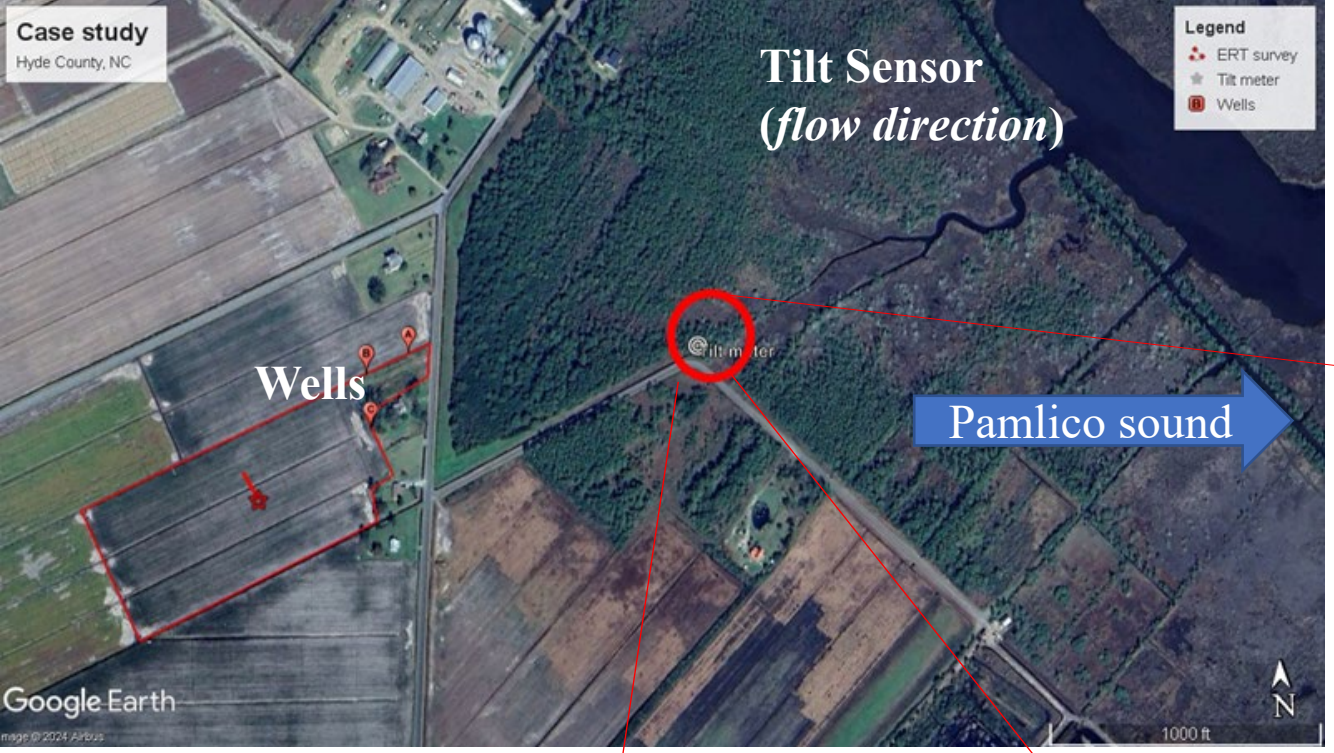


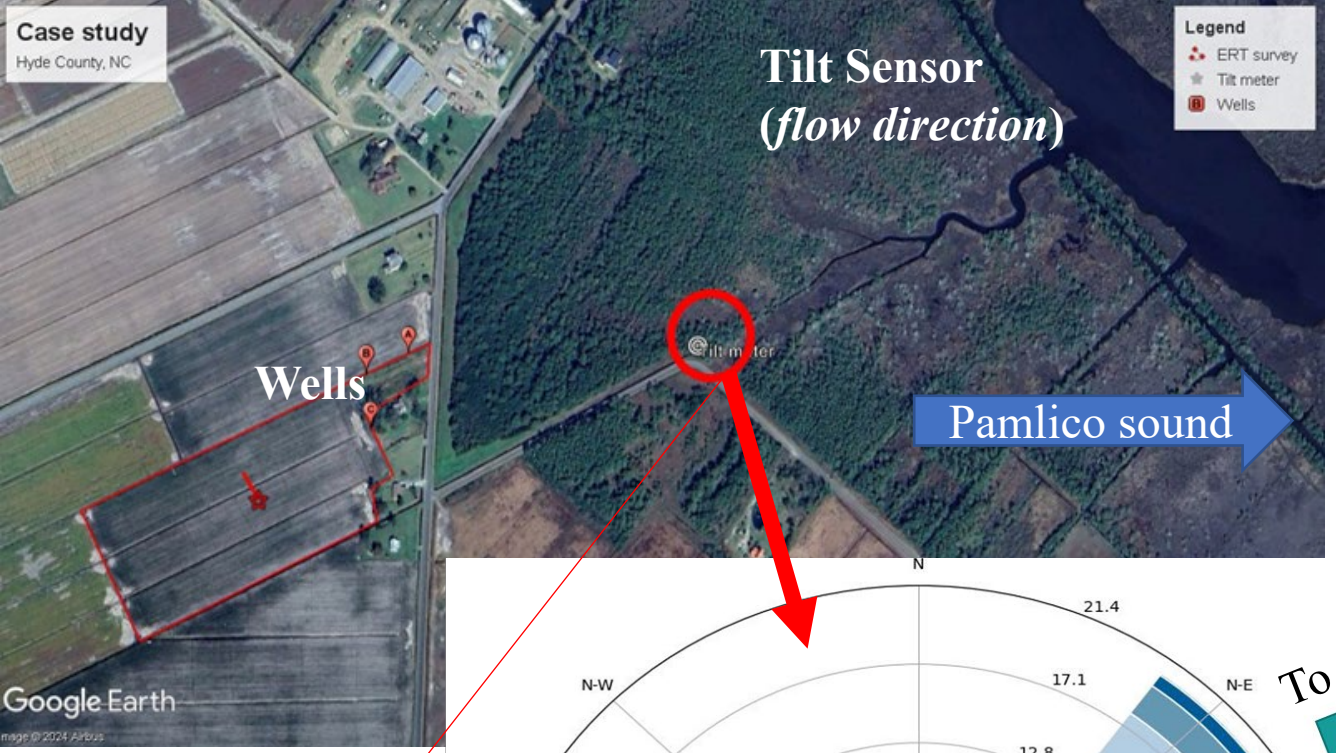
Groundwater/Surface Water Salinity

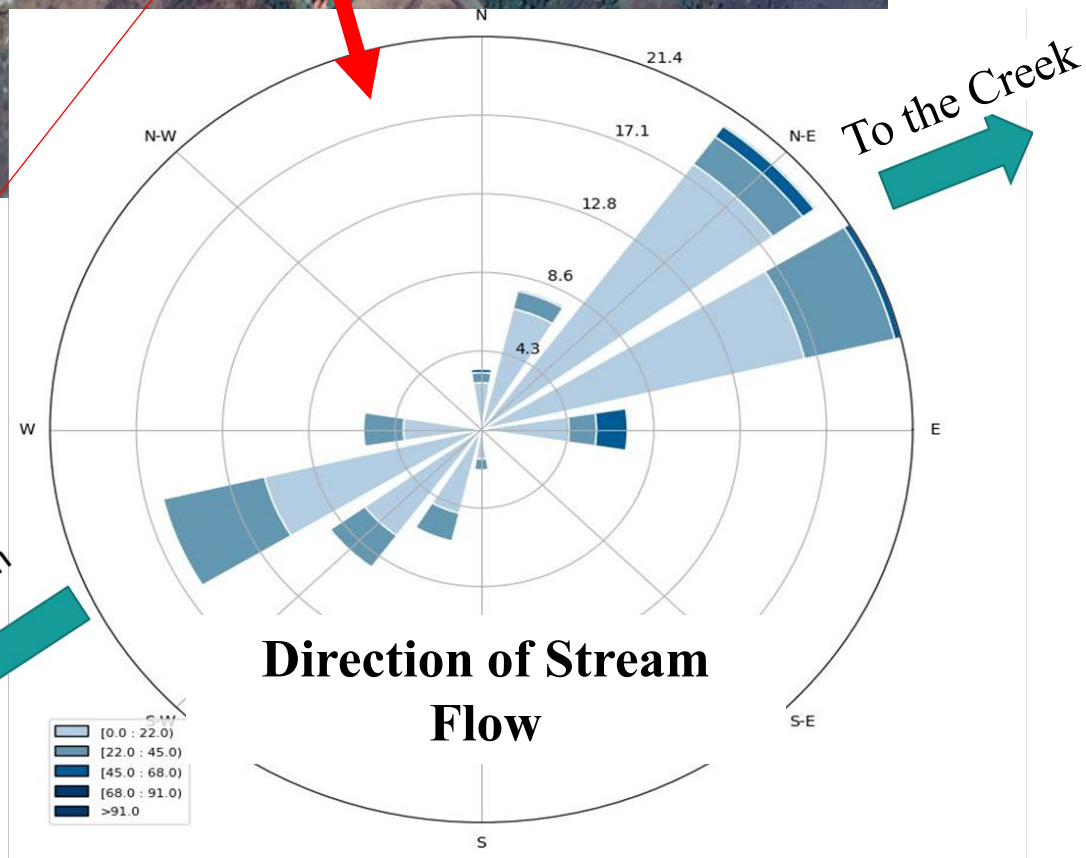




Data Collection and Methodology


Case study
Hyde County, NC
Legend
ERT survey
Tilt meter
Wells
Tilt Sensor
(flow direction)
Wells
Pamlico sound
Google Earth
1000 ft
N



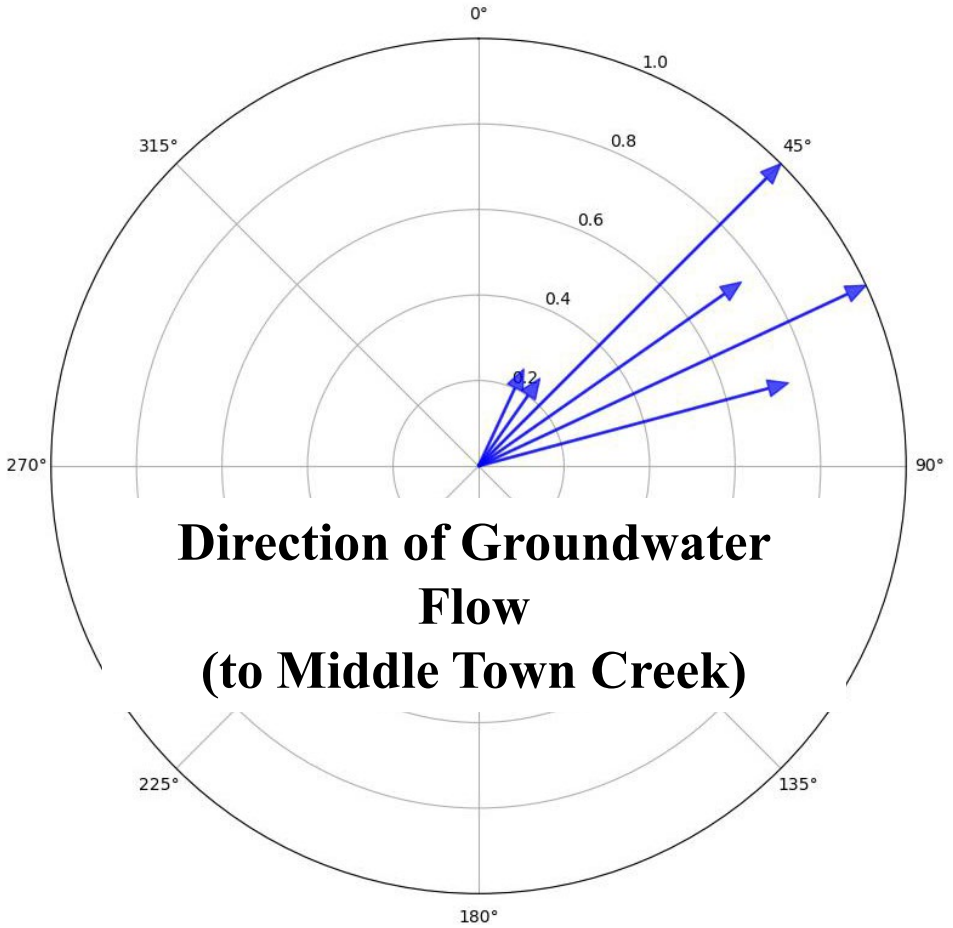


To the Creek

To the farm

Direction of Stream Flow

- **Groundwater flow is toward Middle Town Creek**
- **Stream flow is bidirectional**
  ➔***potential source of salt***

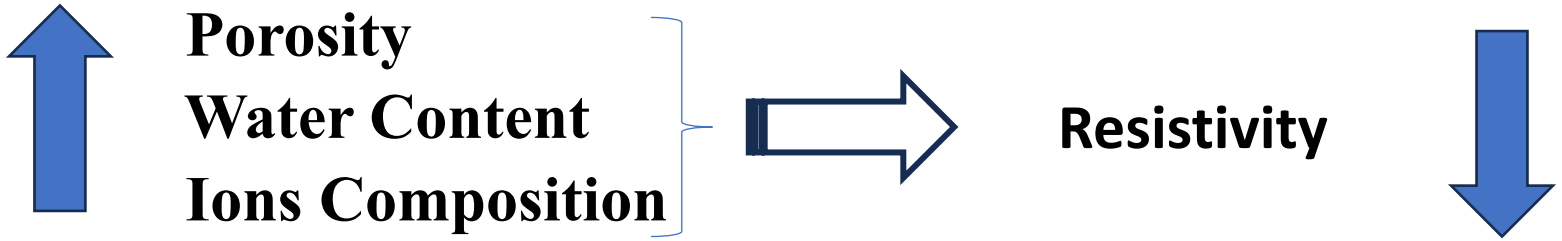


Direction of Groundwater Flow (to Middle Town Creek)

Electrical Resistivity Surveys

- Different material have different electrical resistivity.
  - Clay and water typically have low resistivity ⇩
  - Rocks and dry soils have higher resistivity ⇧

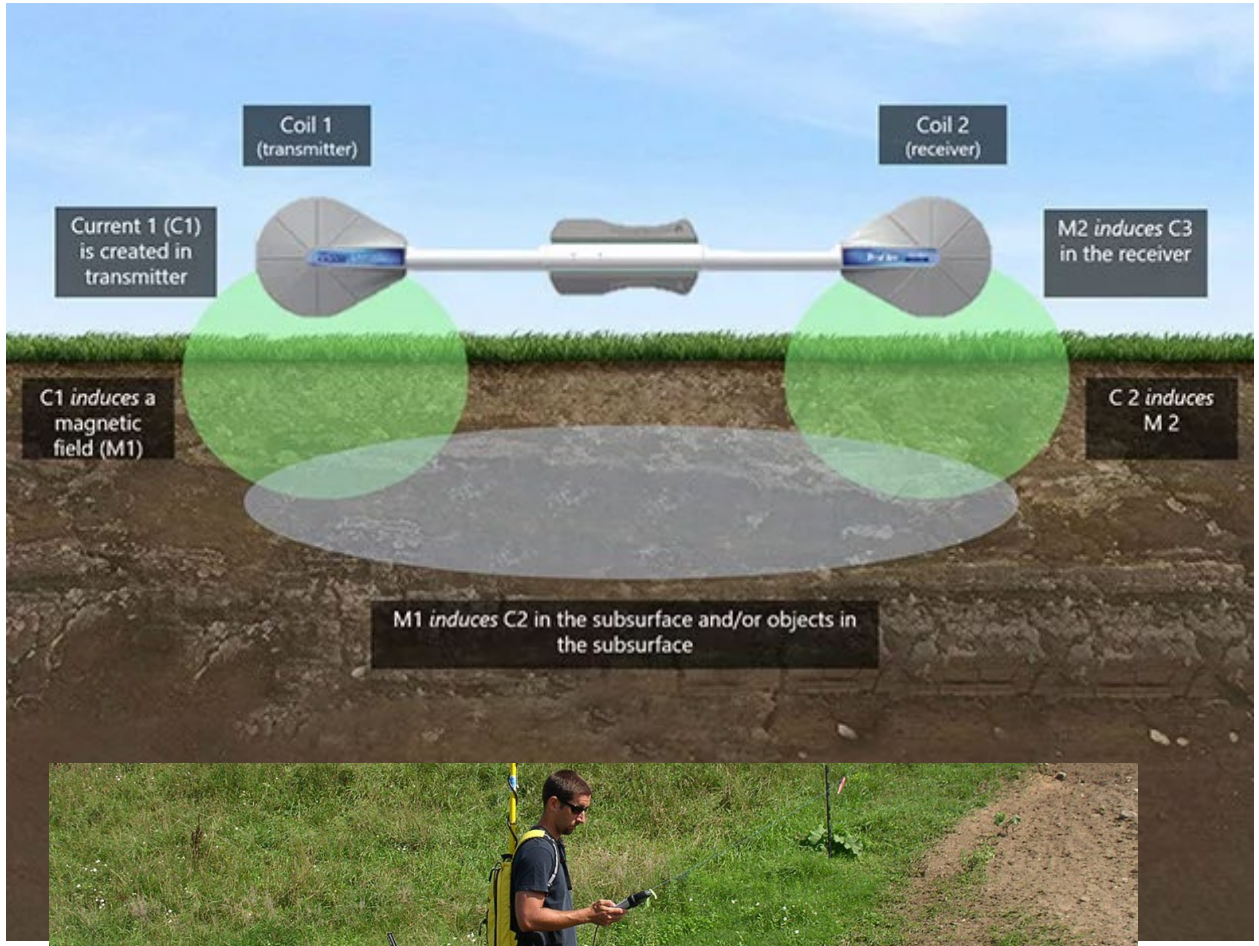
Factors Influencing Resistivity in Geological Materials:

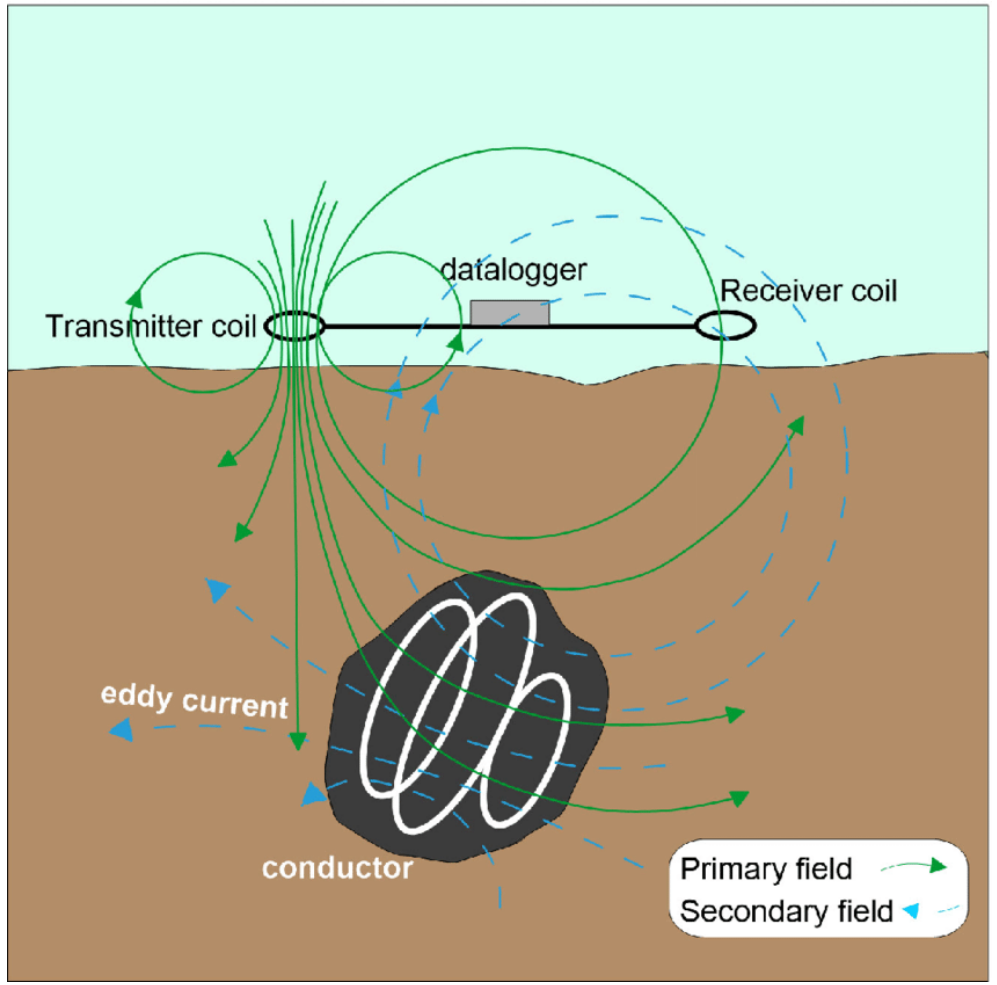


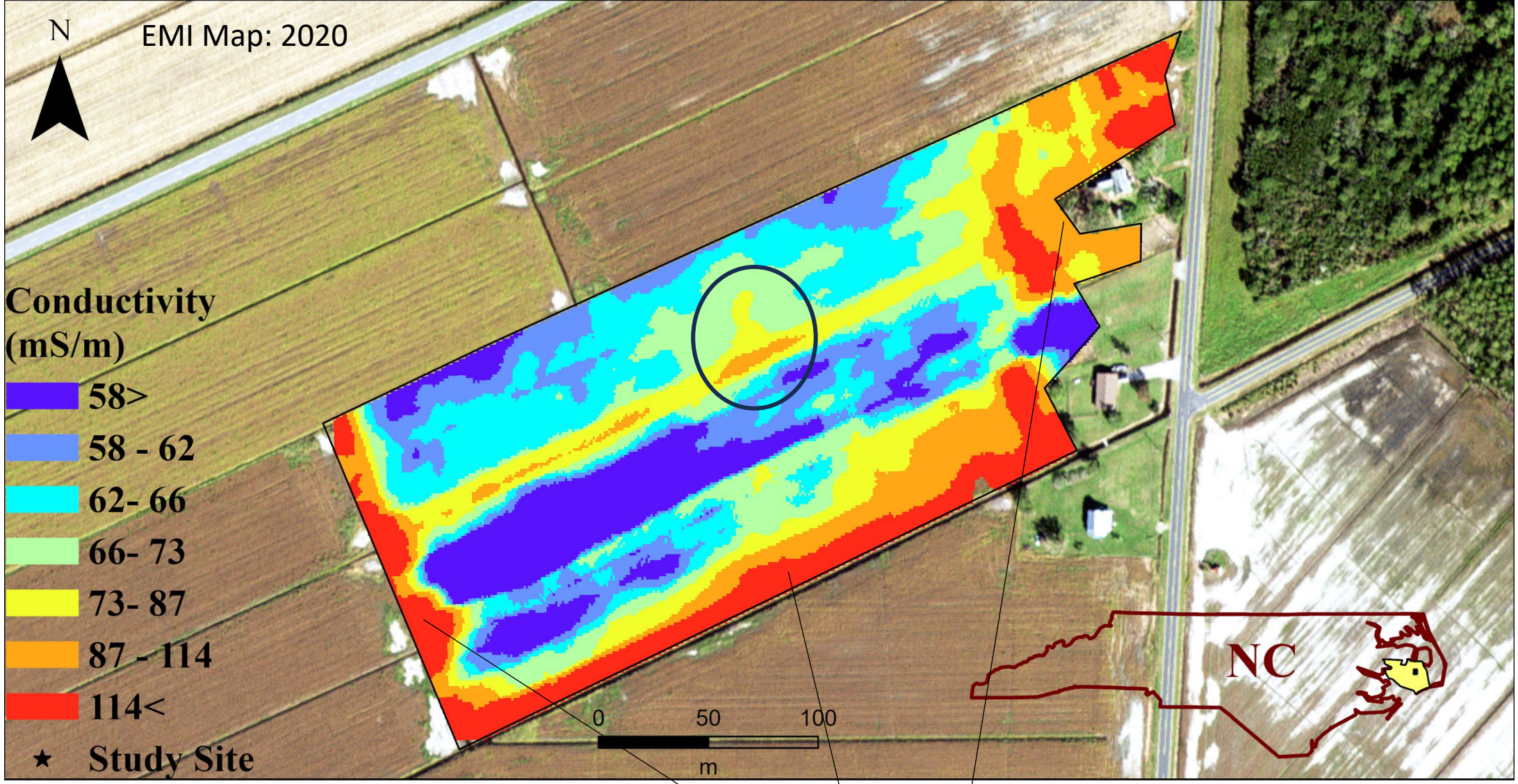
$$\text{Conductivity} = \frac{1}{Resistivity}$$

Here, we use conductivity for consistency in our discussion.

Electromagnetic Induction (EMI) Survey

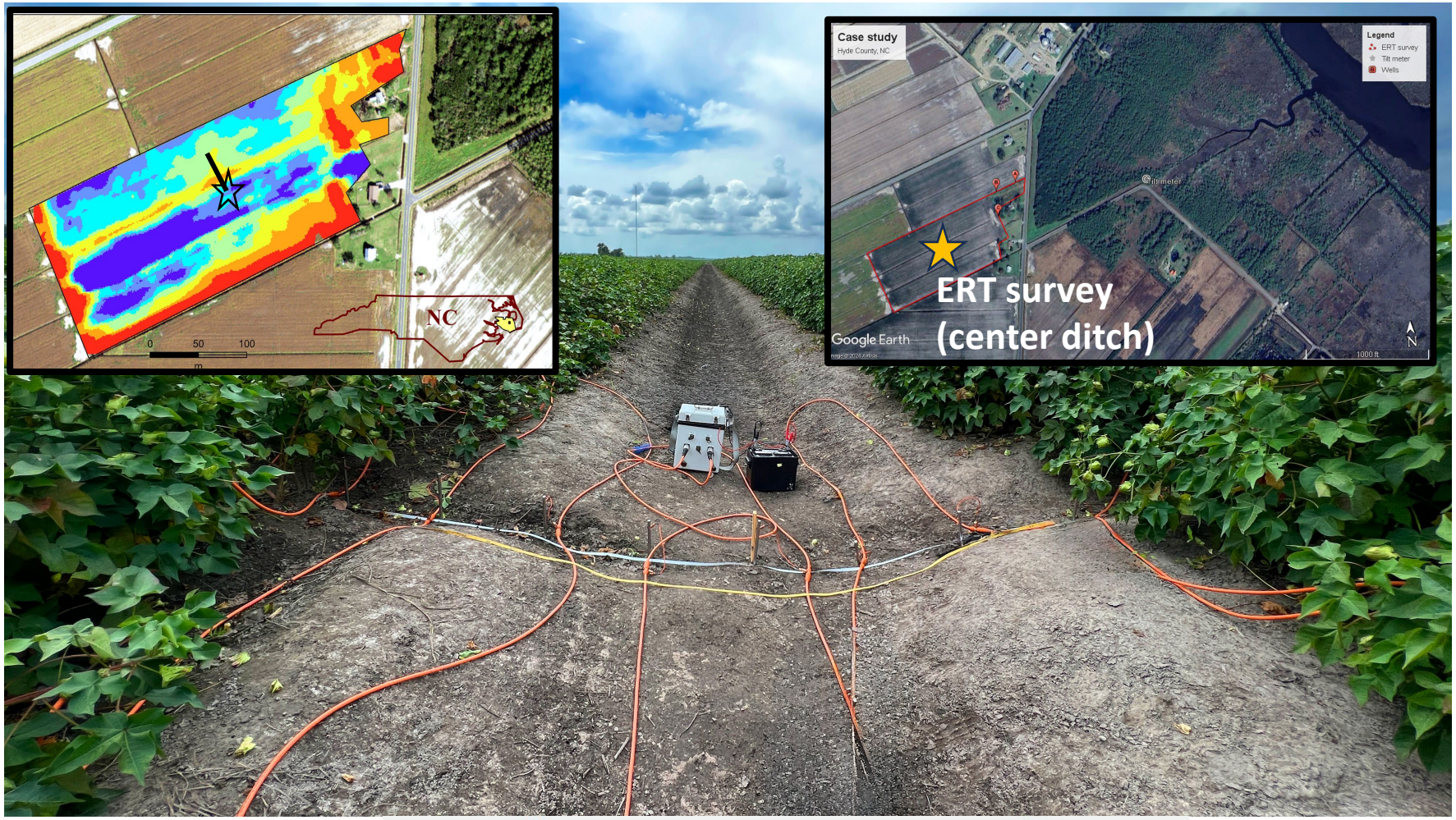




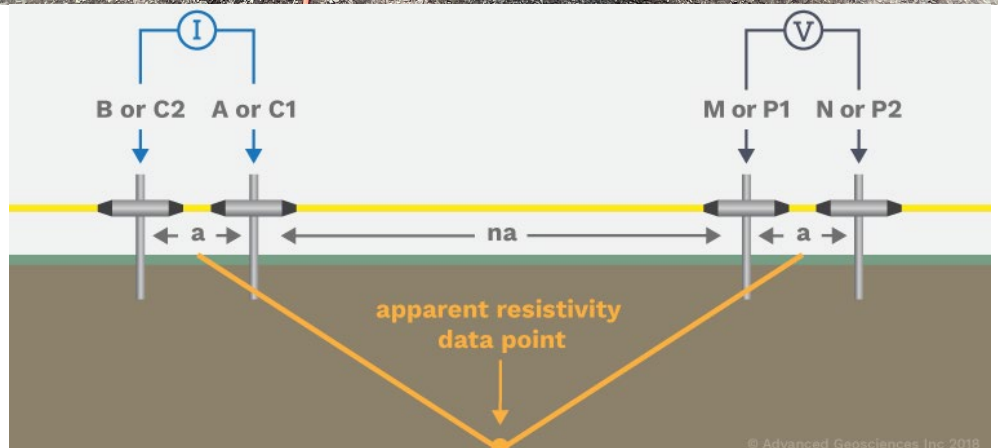


Area of high conductivity values, low to no crop yield. Presenting areas influenced by saltwater intrusion and soil salinization

Electrical Resistivity Tomography (ERT)



- Imaging perpendicular to the ditch in the center of the field
- IRIS, 72 electrodes, 0.5 m spacing
- Dipole-Dipole
- Inversion: ResIPy



Hurricane Ophelia: (09/22/2023), freshwater, precipitation

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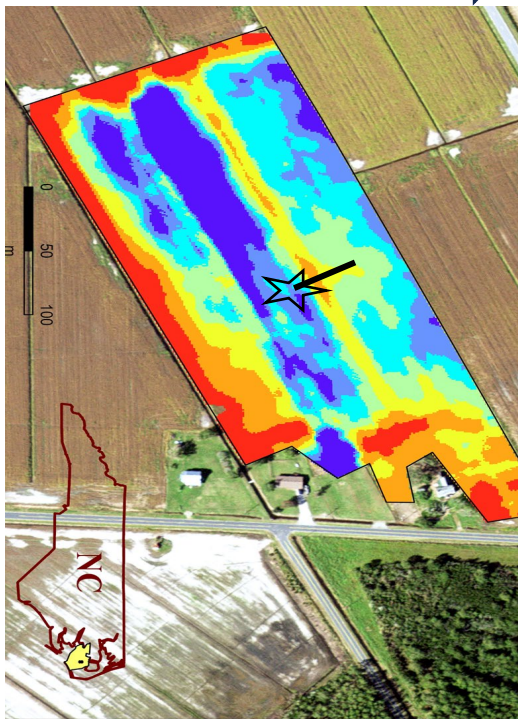

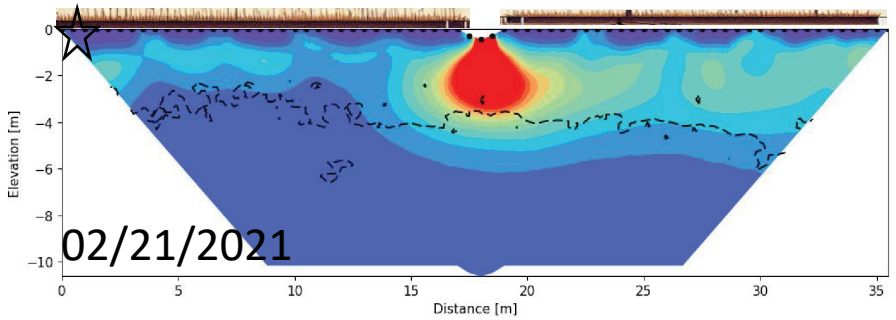

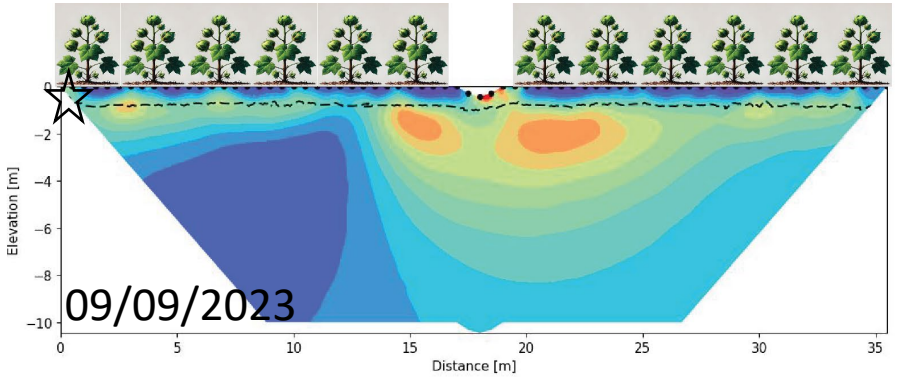

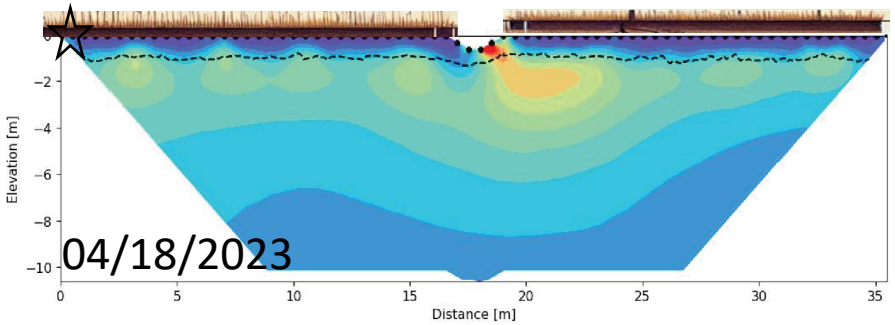

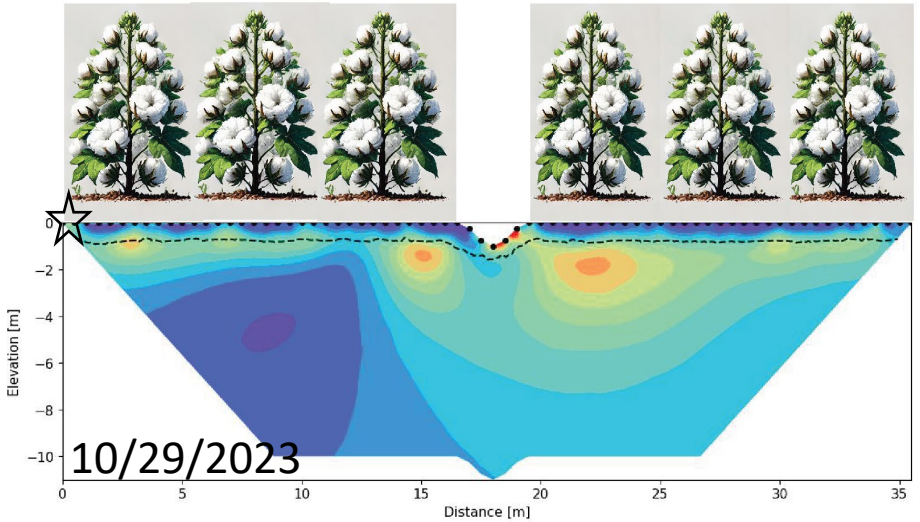

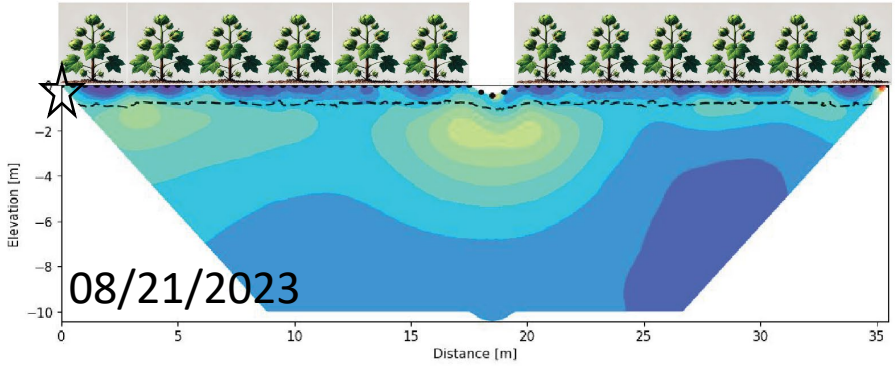

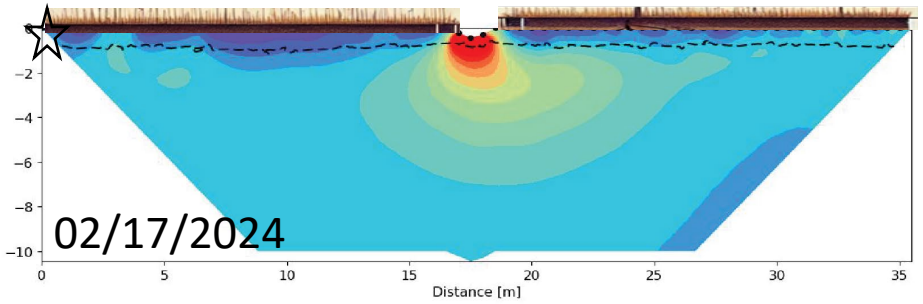

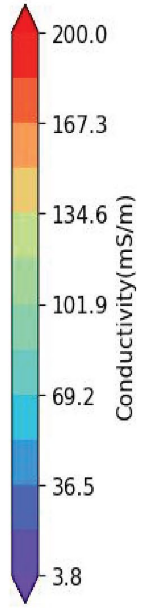

Conclusion

- **Farm's soil salinization in eastern North Carolina is a growing reality** that threatens crops, and farm livelihoods.
- **Drainage ditches and canals**, originally built to enhance agricultural productivity, are now acting as **pathways for saltwater intrusion.**
- **Geophysical monitoring** gives us a new lens to "see" how salt moves through soil and groundwater, helping us understand when and where it becomes a problem.
- **There is no single fix,** but science and engineering can guide strategies like **improved water management, controlled drainage, and resilient cropping systems.**
- **Our goal is to work alongside farmers and communities to adapt, manage risk, and build resilience in the face of a changing climate.**