Galveston Bay: changing land use patterns and nutrient loading. Causal or casual relationship with water quality, quantity, and patterns?

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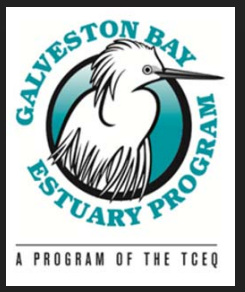
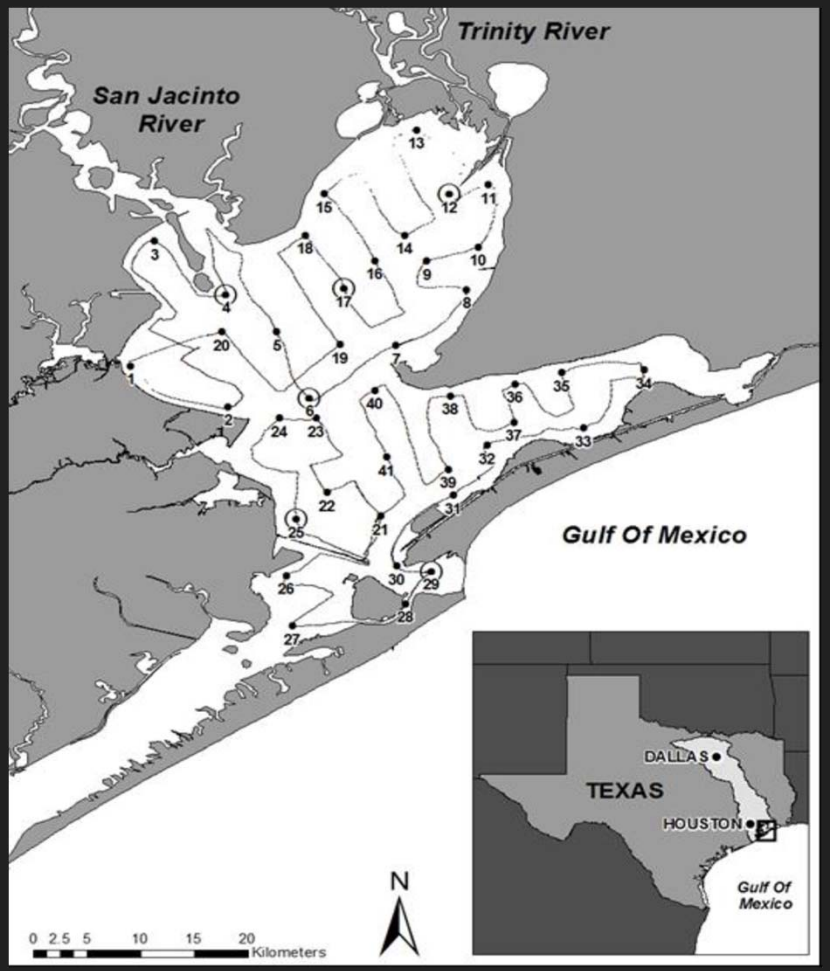


Outline

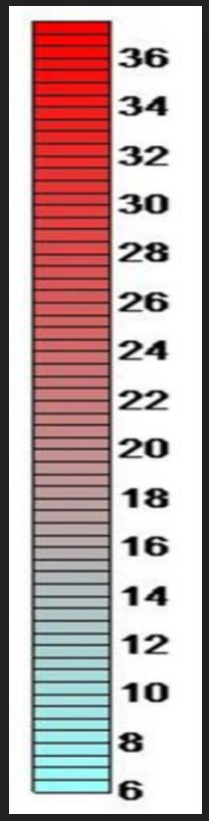
- Report Summary
  - **2016-2017**:
    - **Monthly Monitoring**, Inflow, Nutrient and Phytoplankton Dynamics
  - **1990-2014**:
    - Understand **Nutrient Loading** and Impacts of Changing **Land Use**
- Fun findings from summarizing almost a **decade of data**!
- **What next?**

Objective 1:
Monitor the bay at monthly intervals using the Dataflow system to measure water quality parameters.

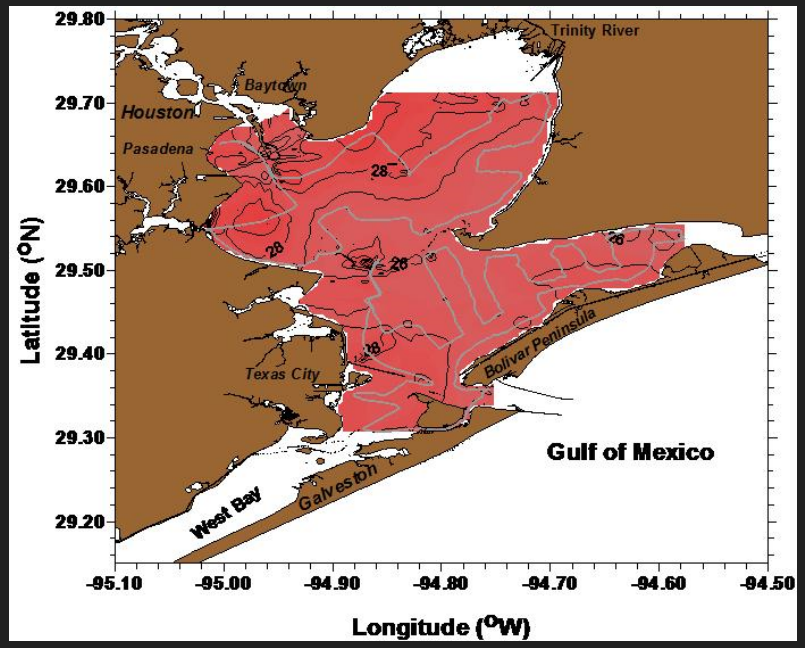
2016-2017



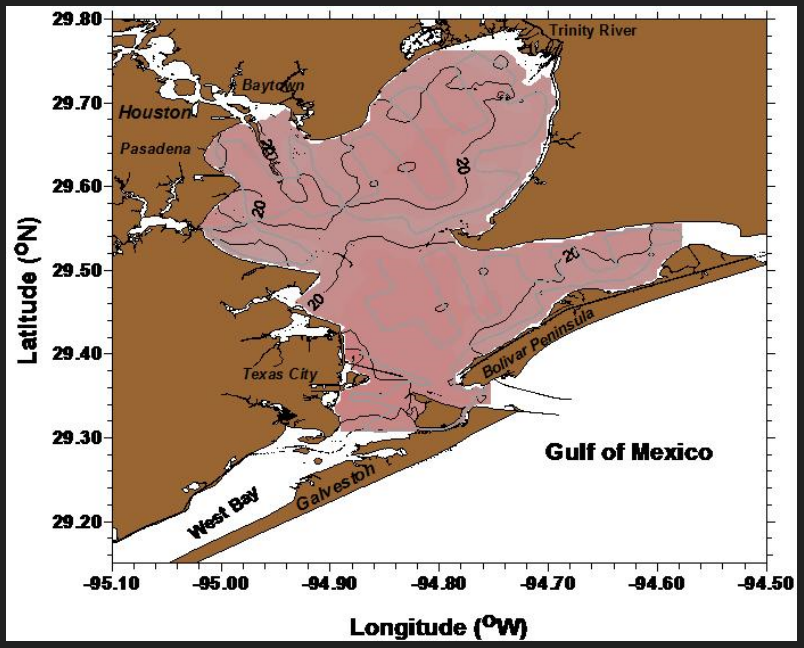
Temperature (°C)



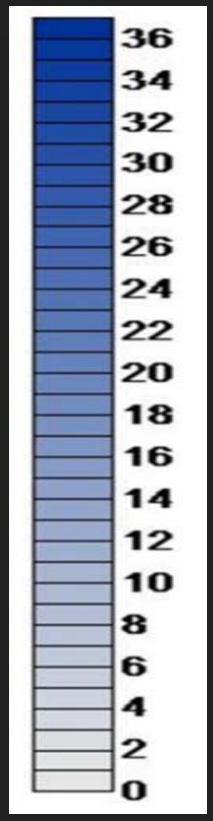
June 2016



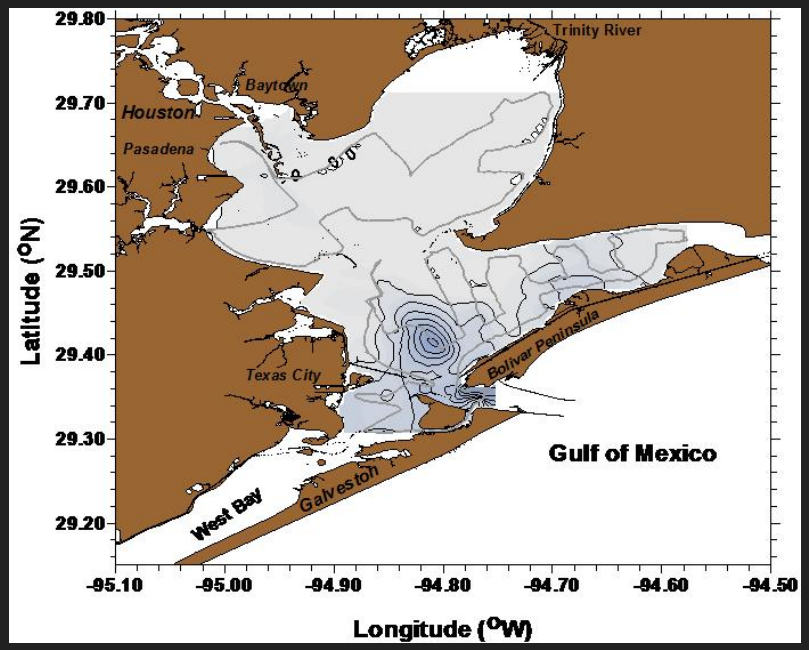
November 2016



Salinity (psu)



June 2016



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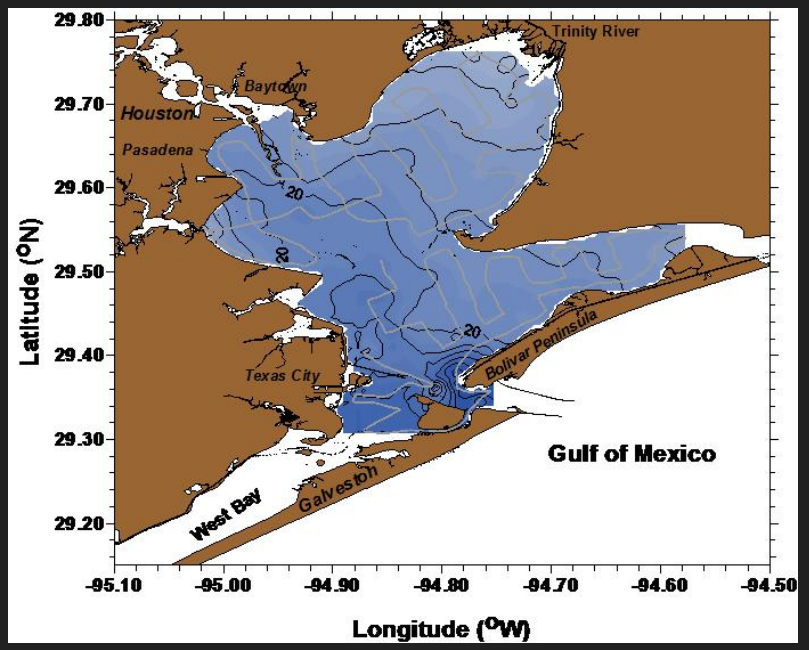
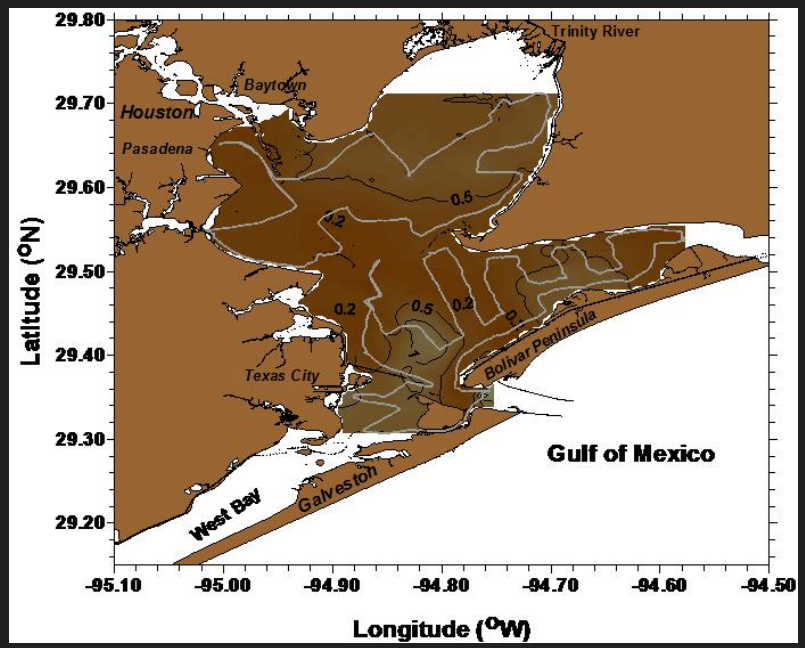
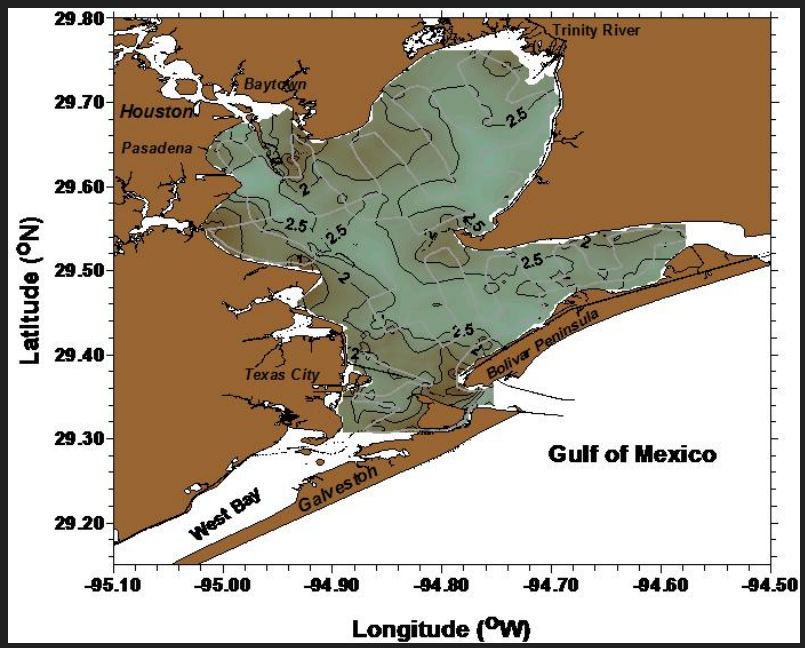


Transmittance (Volts)

June 2016



November 2016

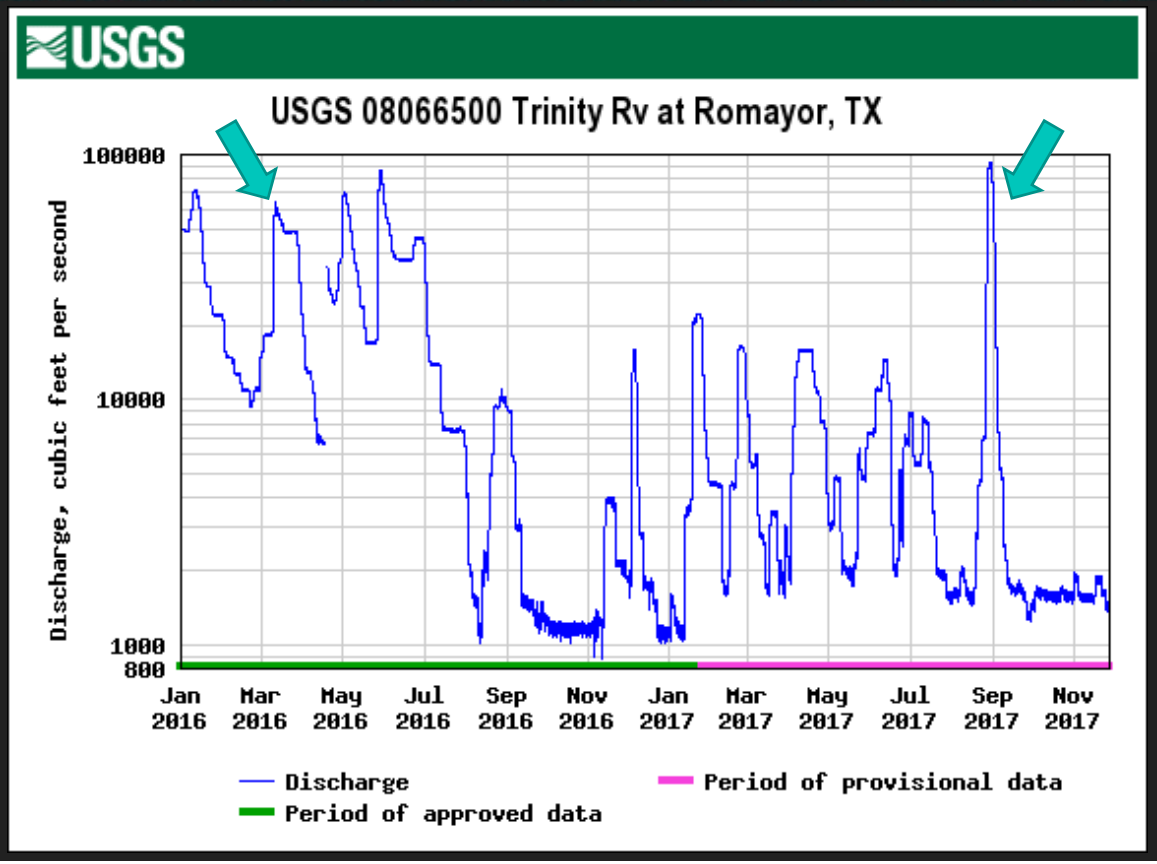


Objective 2:
Monitor freshwater inflows.

2016-2017

Freshwater inflows (cfs)

- Major **inflow events** in spring 2016 and August 2017
- Can compare effects of prolonged flooding vs. extreme weather

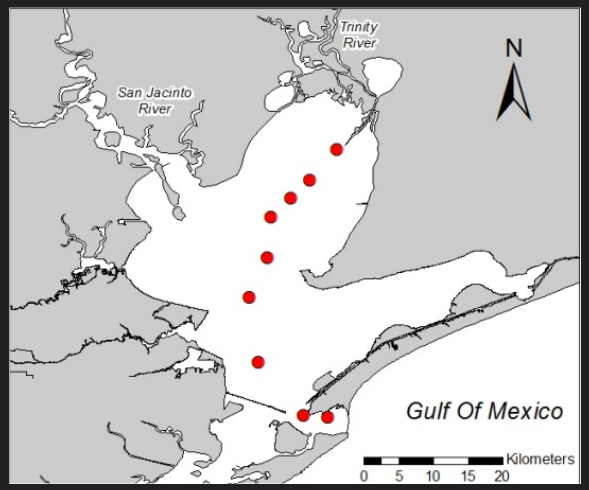


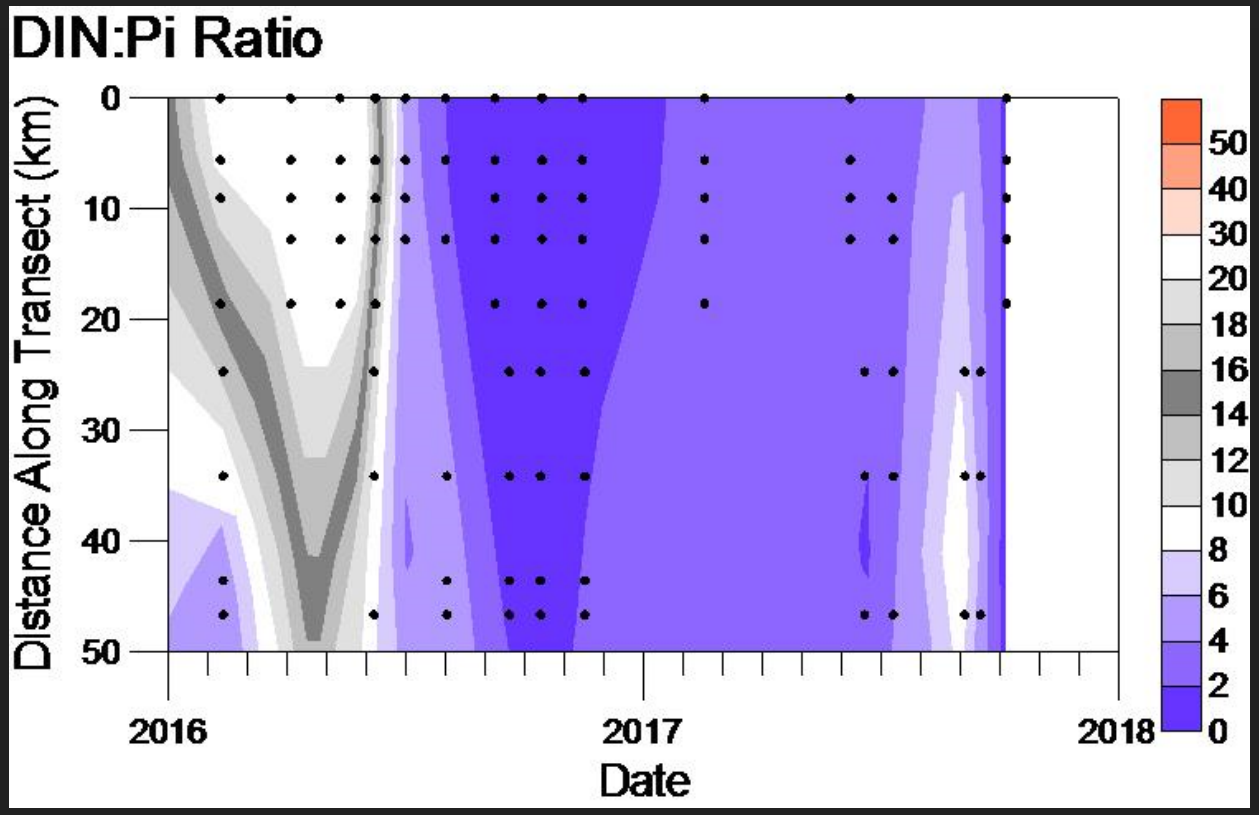
Objective 3:

Collect nutrient and other data at fixed stations in the bay which can then be used to explain patterns in water quality such as the chlorophyll data.

2016-2017

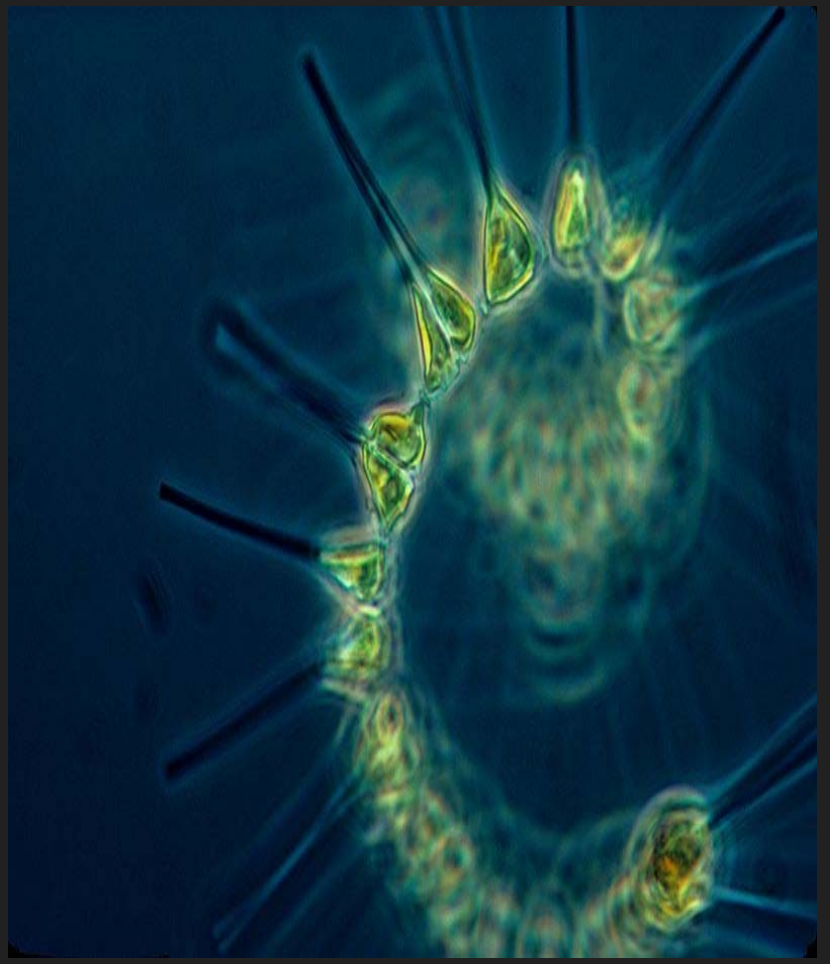
Dissolved Nitrogen to Phosphorous Ratios





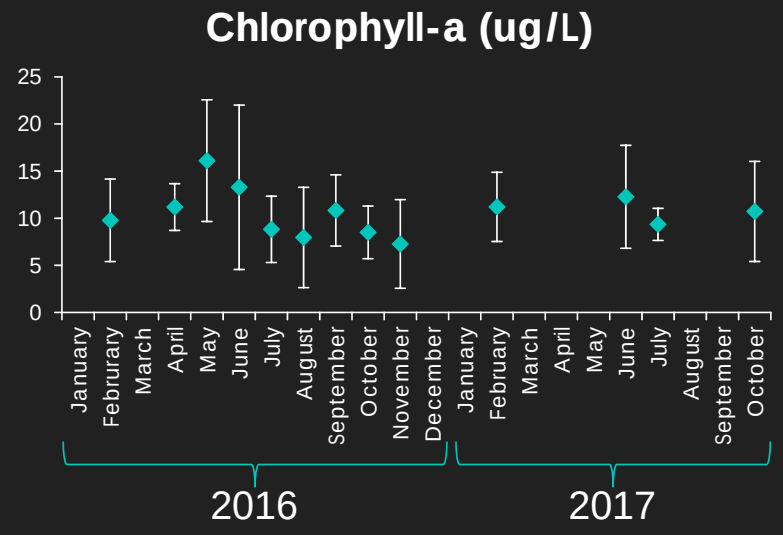
Objective 4:
Measure phytoplankton productivity, community composition, and the presence of harmful algal blooms (HABs), if present.

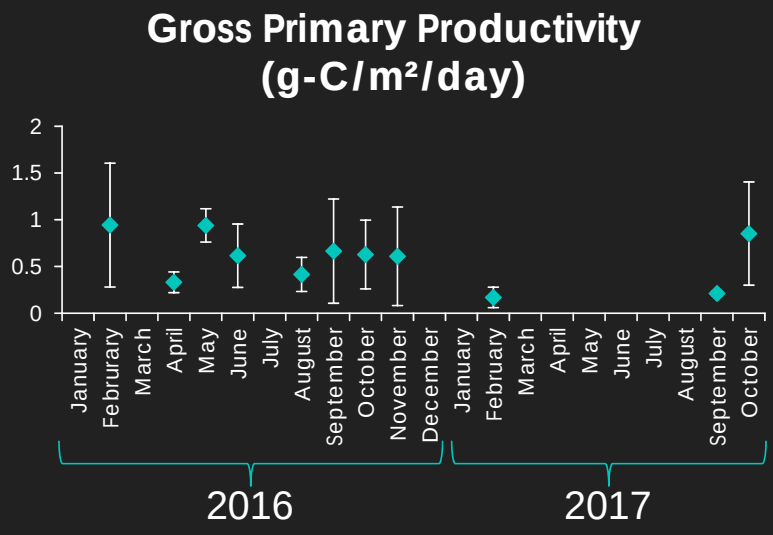
2016-2017



Chlorophyll *a* & Primary Productivity

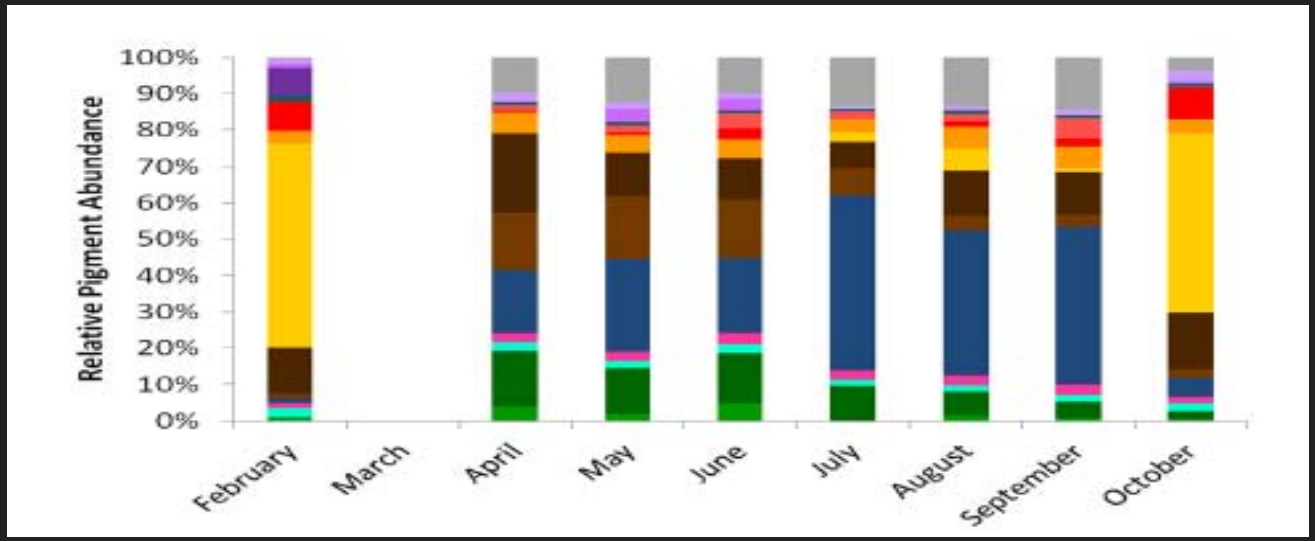
- Oscillations in these parameters are difficult to relate directly to freshwater inflows; complicated by light availability and flushing
- Values are within range reported for other estuaries

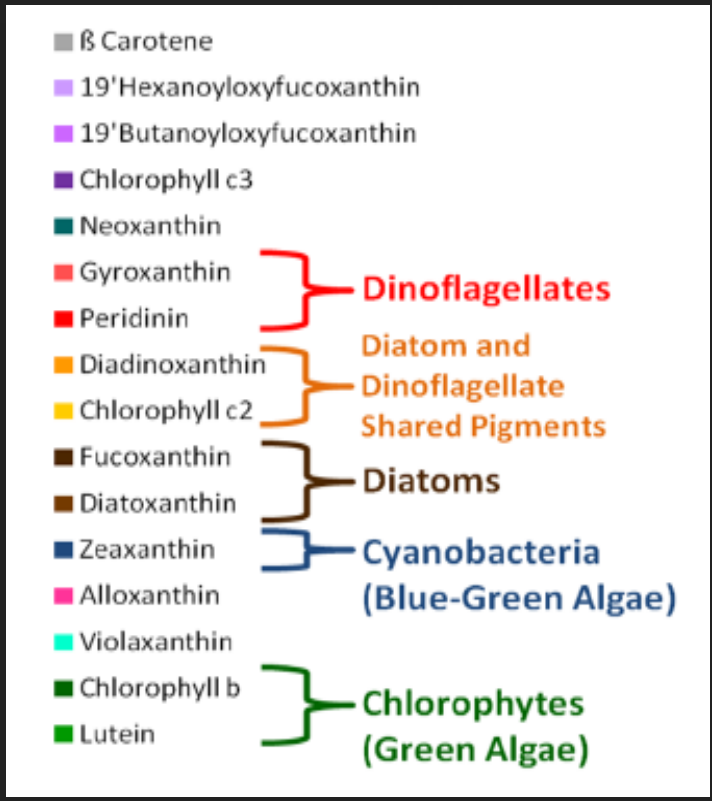




Phytoplankton Community Composition - Pigments

- **Cyanobacteroa** dominant in **warm months** while **diatoms/dinoflagellates** dominant during **cooler months**
- Increased prevalence of **chlorophytes** following **2016 flood**

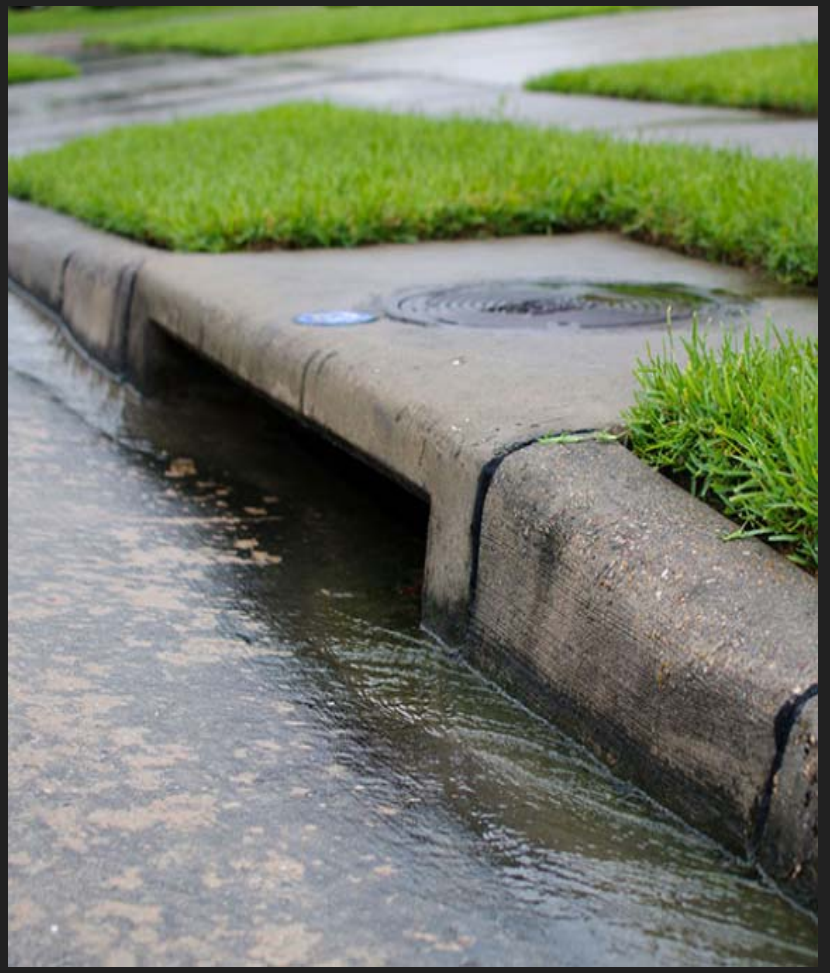




Objective 5:

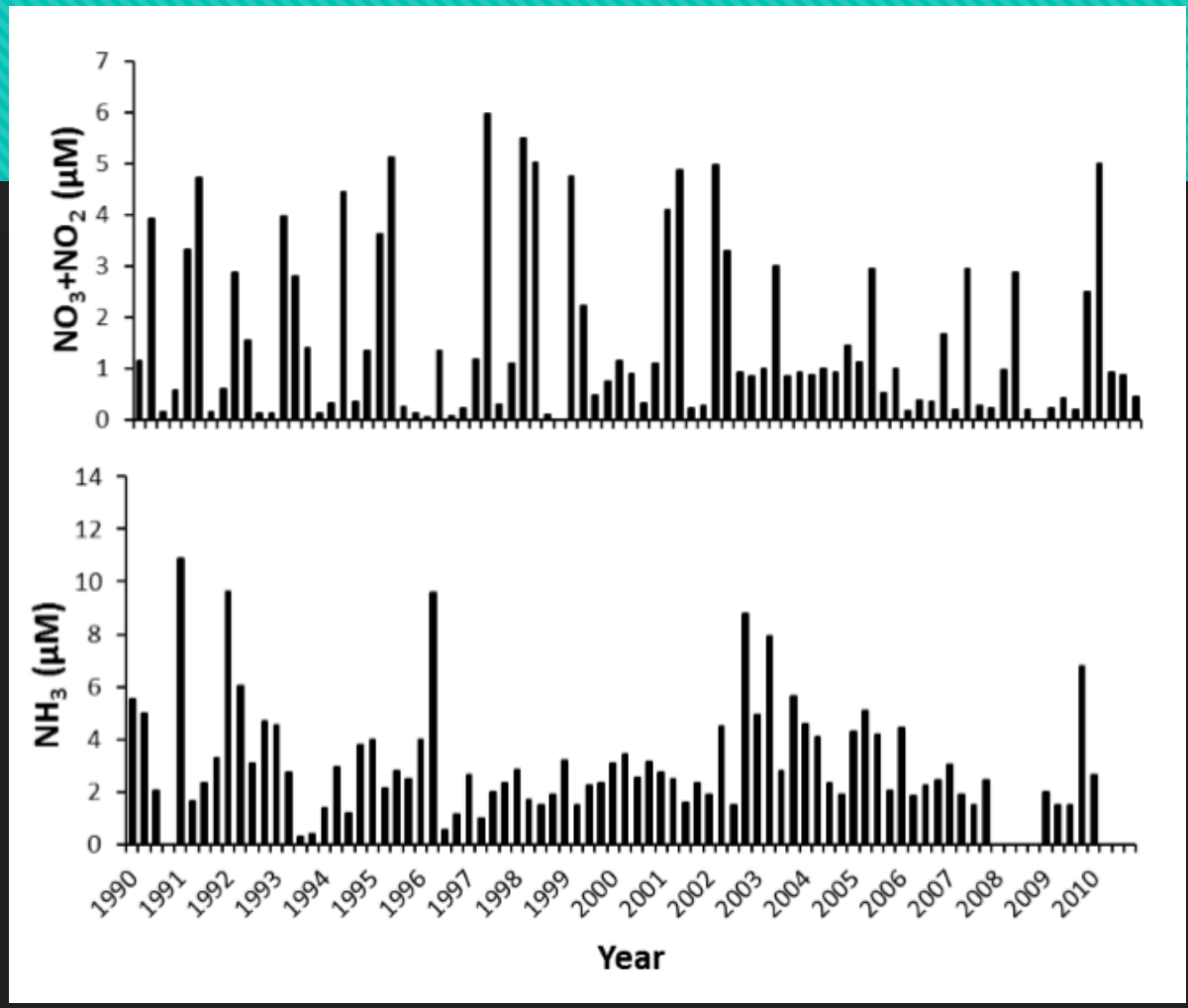
Build a quantitative understanding of the current and historical nutrient inputs from domestic and industrial wastewater sources from the large number of discharges in the bay.

1990-2014



N-Trinity River

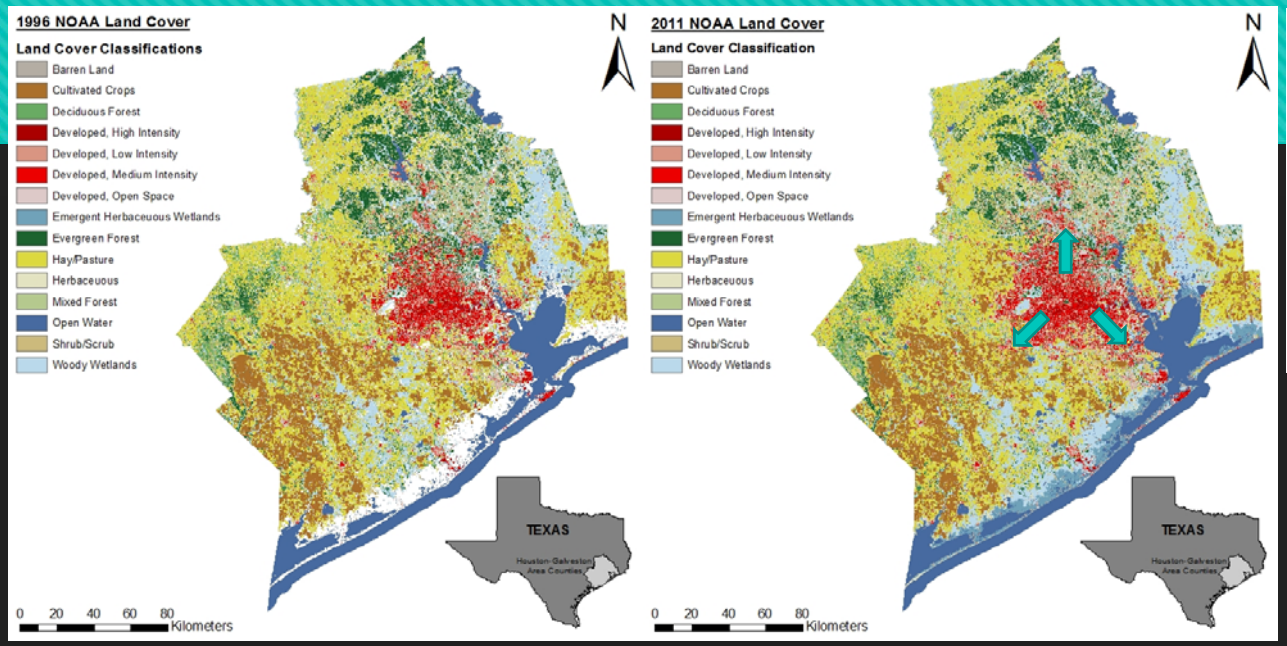
- Inter-annual oscillations which could not be linked to drive flow or other factors (waster water plants, dams, etc..)

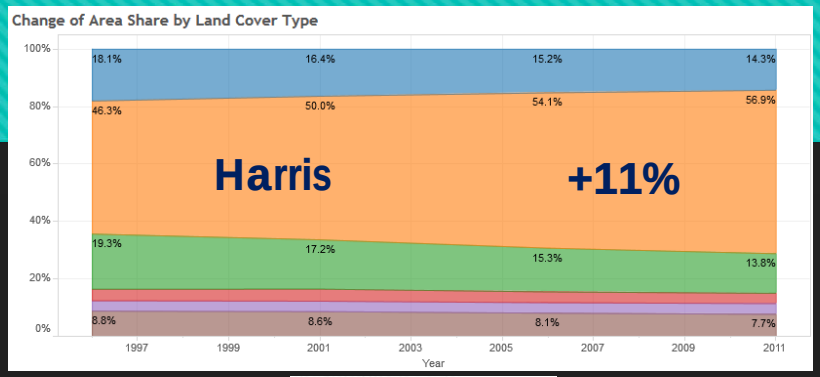


Objective 6:
Use the long term data to understand freshwater inflows effects on the bay.

- Examined land use land change maps 1992-2014 (HGAC databases)
- Examined water quality (TCEQ, other state agencies and ourselves)

Changes in Land Use

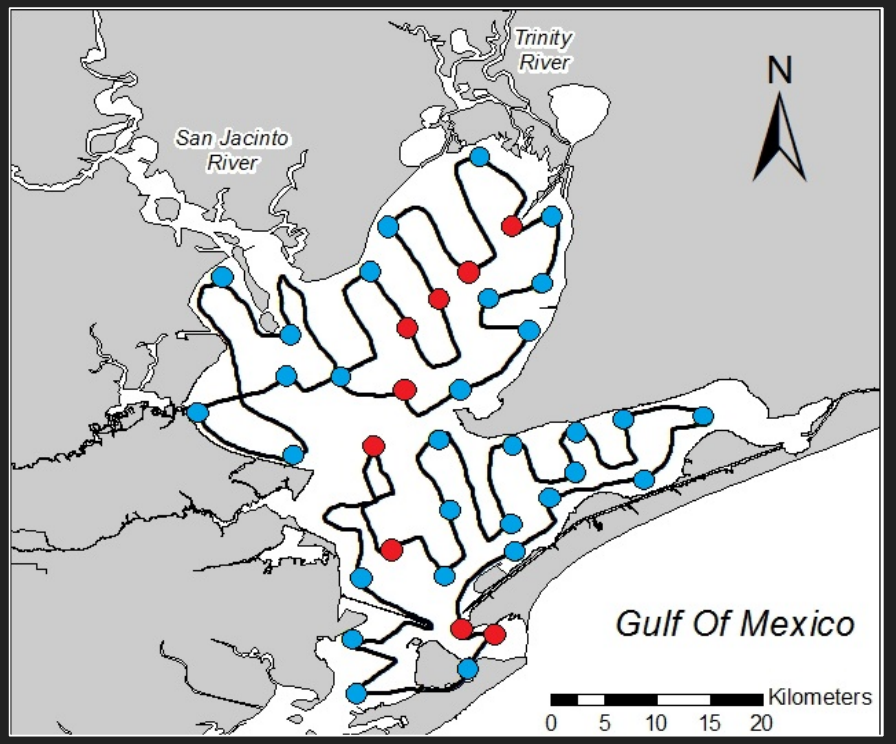




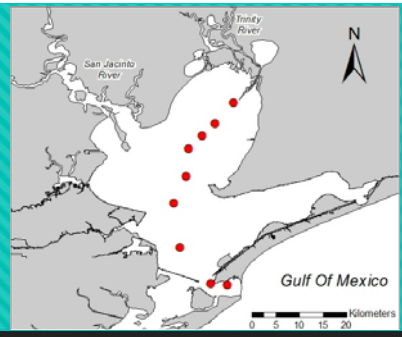
i. forest land cover experienced the greatest loss, primarily due to development (urbanization)
ii. forests were also lost to grasslands and more shrubs; agricultural (cultivated) lands and wetlands also lost
iii. wetlands were converted into developed lands, to shrubs and grasslands associated with urban community centers connected to waterways

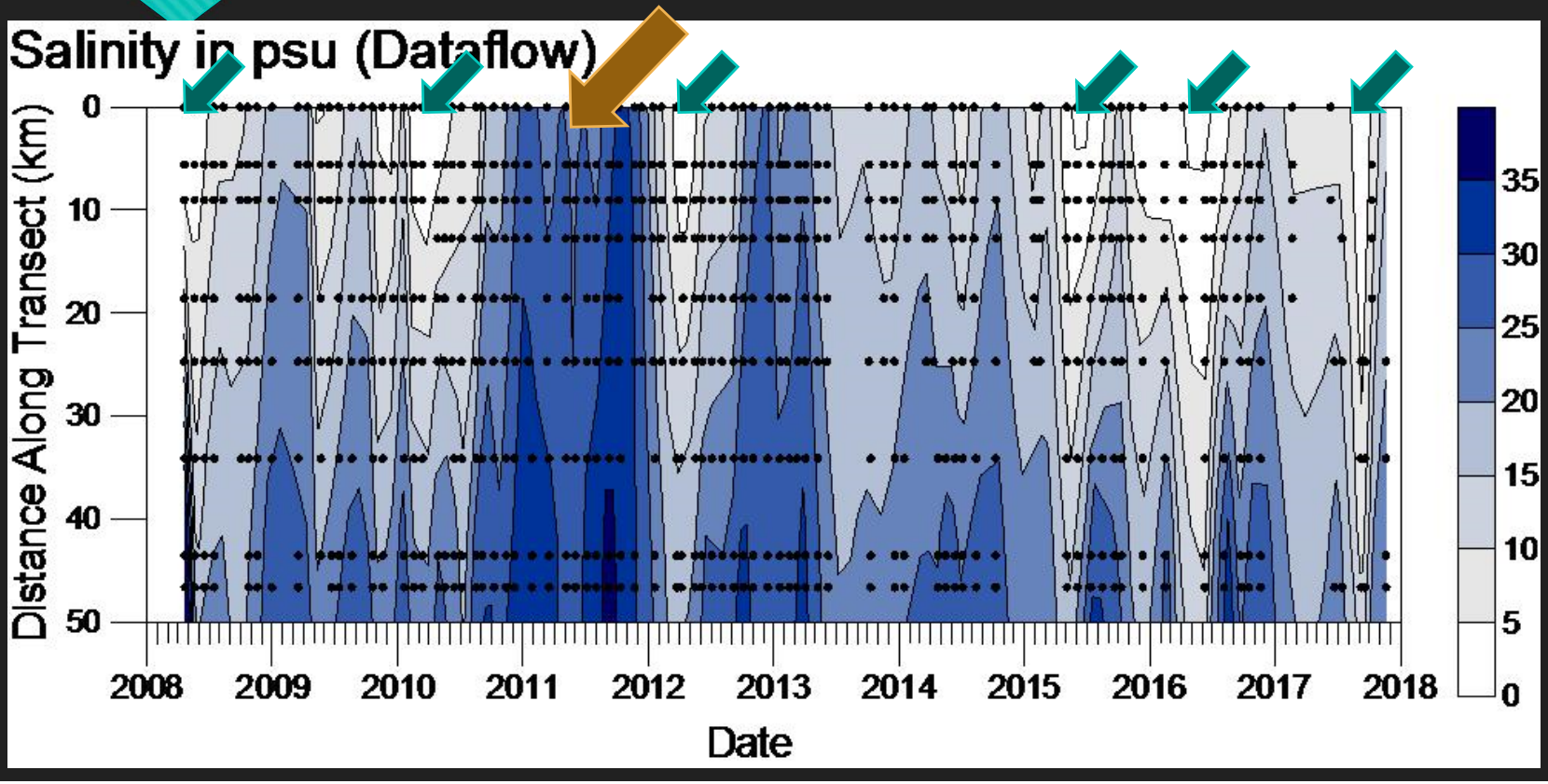
Decade of Change

- **Transect line** chosen to examine connection between river flow, gulf and water quality in the bay

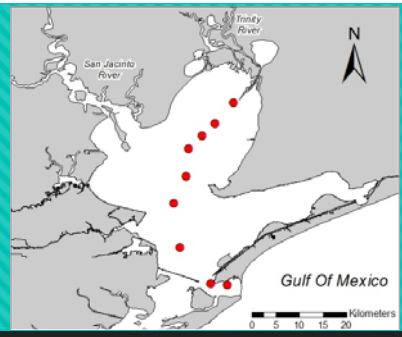


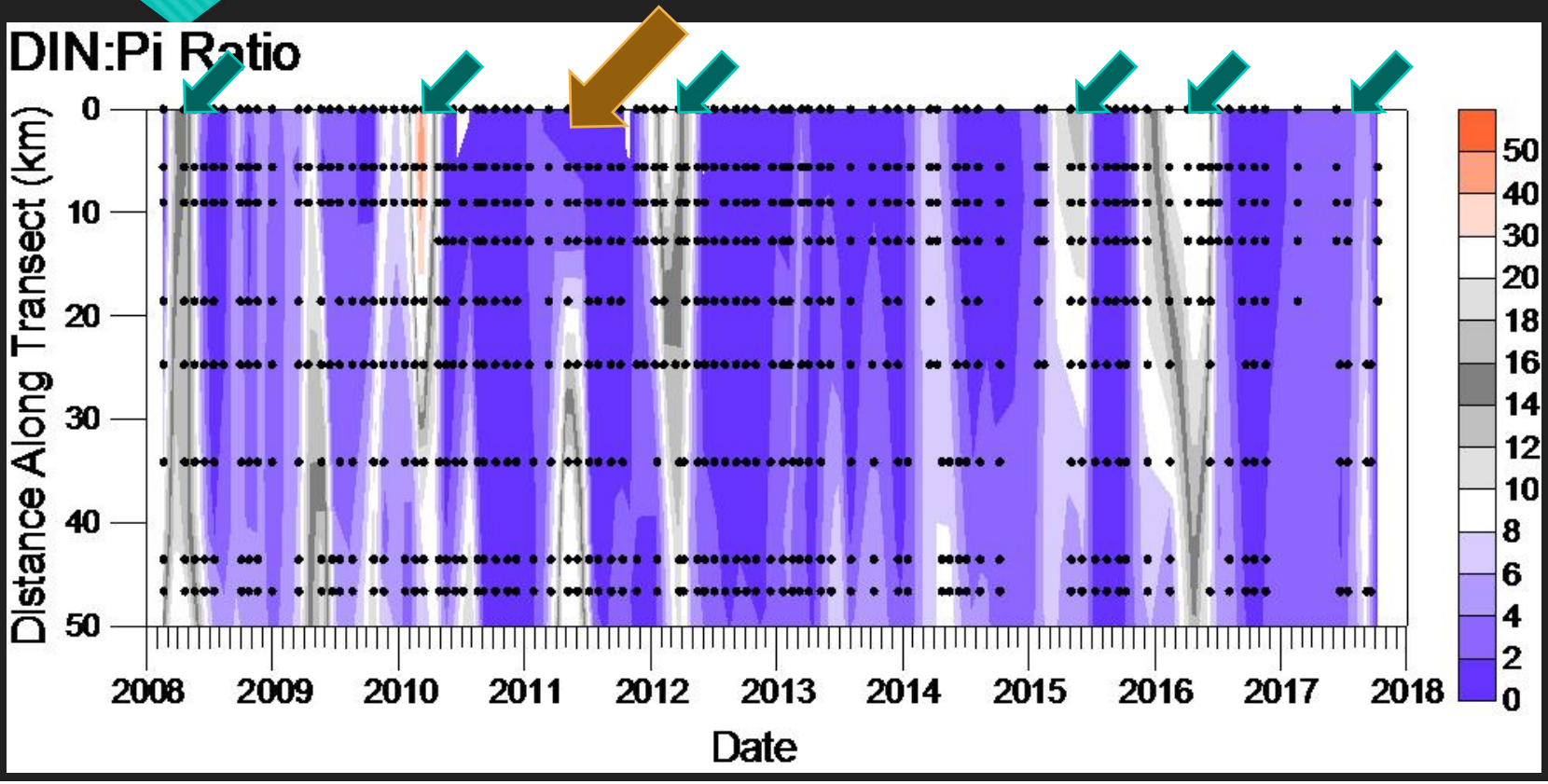
Salinity 2008-2018



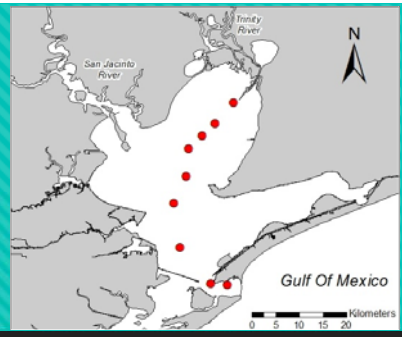


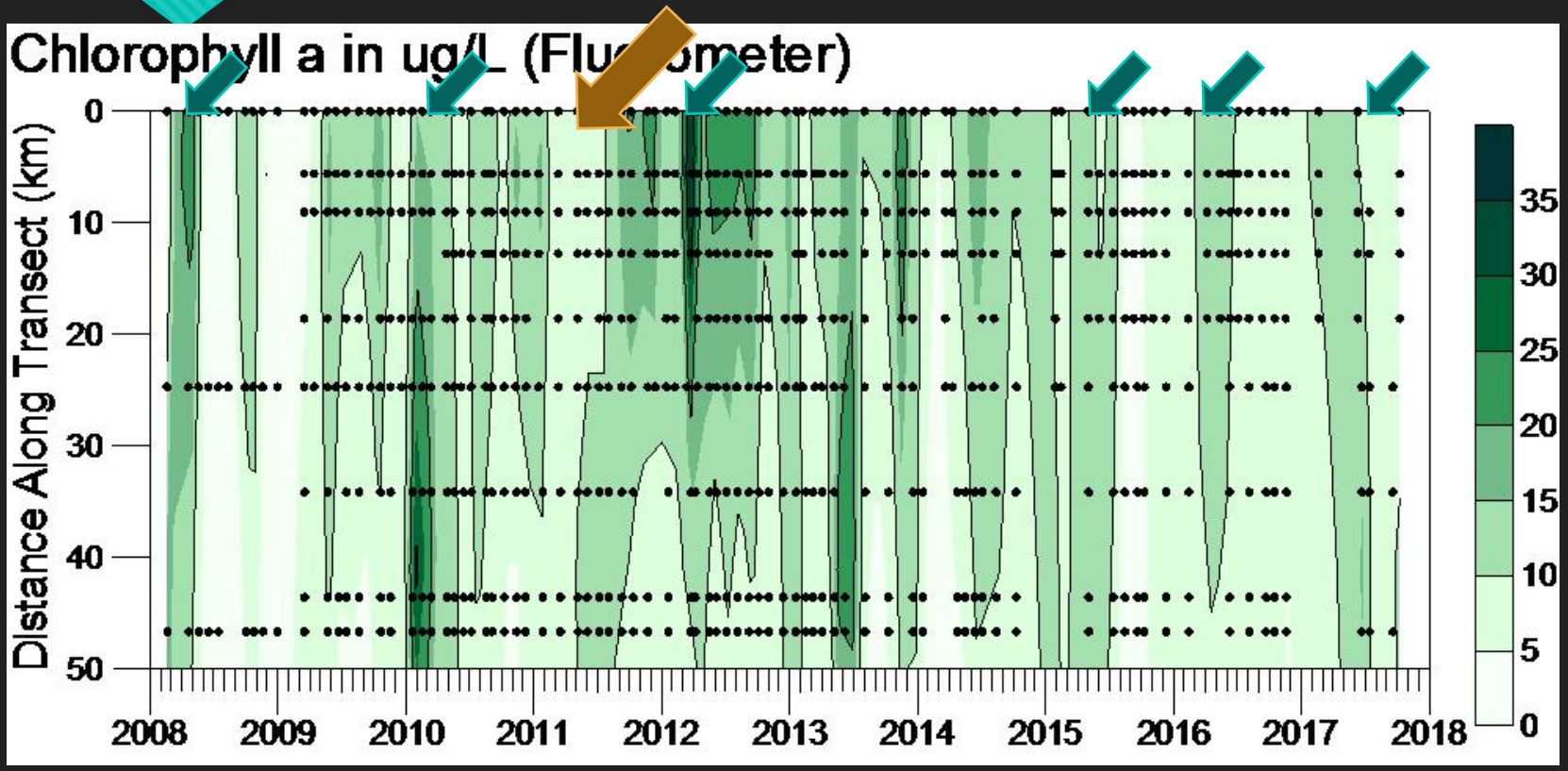
Dissolved Nitrogen to Phosphorous Ratio 2008-2018



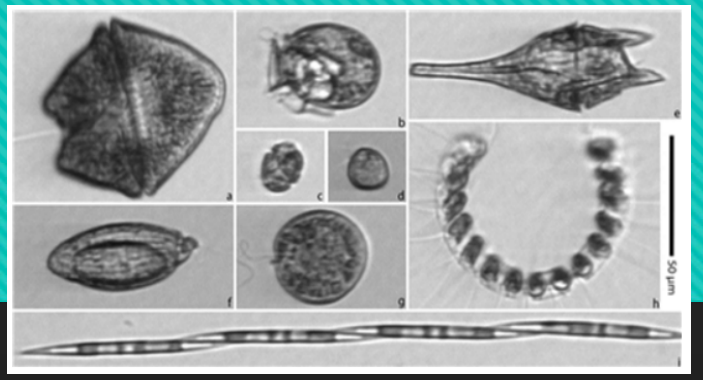


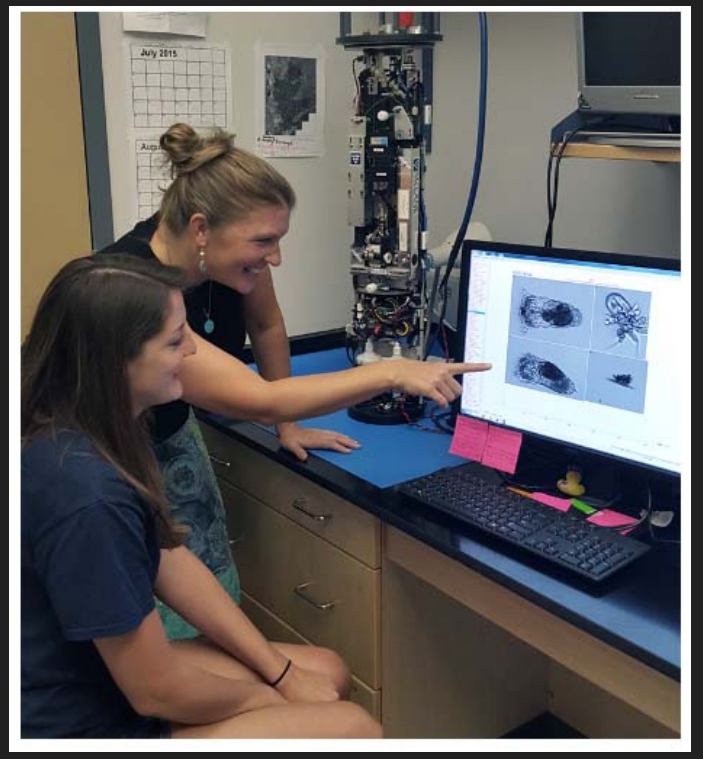
Chlorophyll *a* 2008-2018





Harmful algal blooms - using an Imaging FlowCytobot as an early detection system



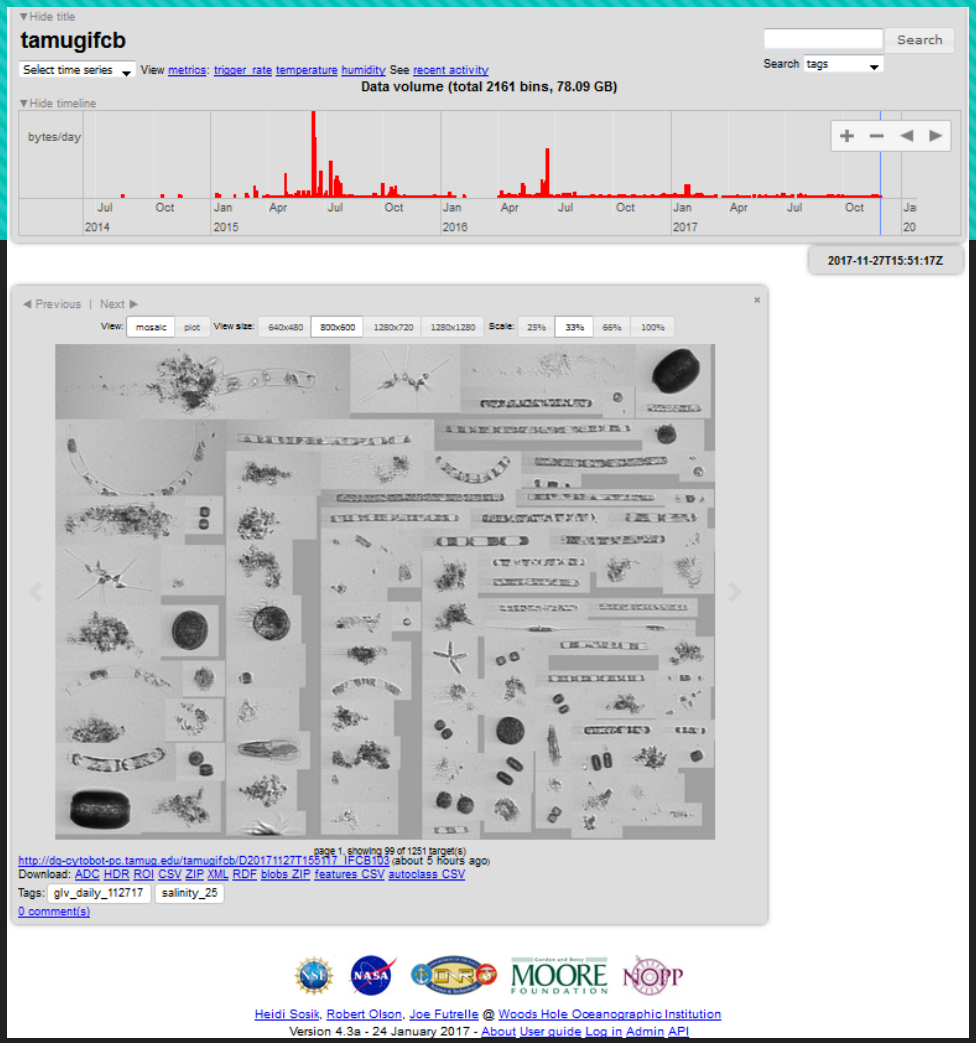


- Historical record sparse
- **Blooms** occur on a semi-regular cycle
- **Infrequent** that they are associated with harmful – toxin producing species

Go to our dashboard to see phytoplankton in real time

- **Resource managers** (health dept, texas parks, etc.) can check in daily
- Library focuses on **all species** not just HABs

http://www.tamug.edu/phytoplankton/Research/Imaging_FlowCytobot.html



Thank you!

Questions?

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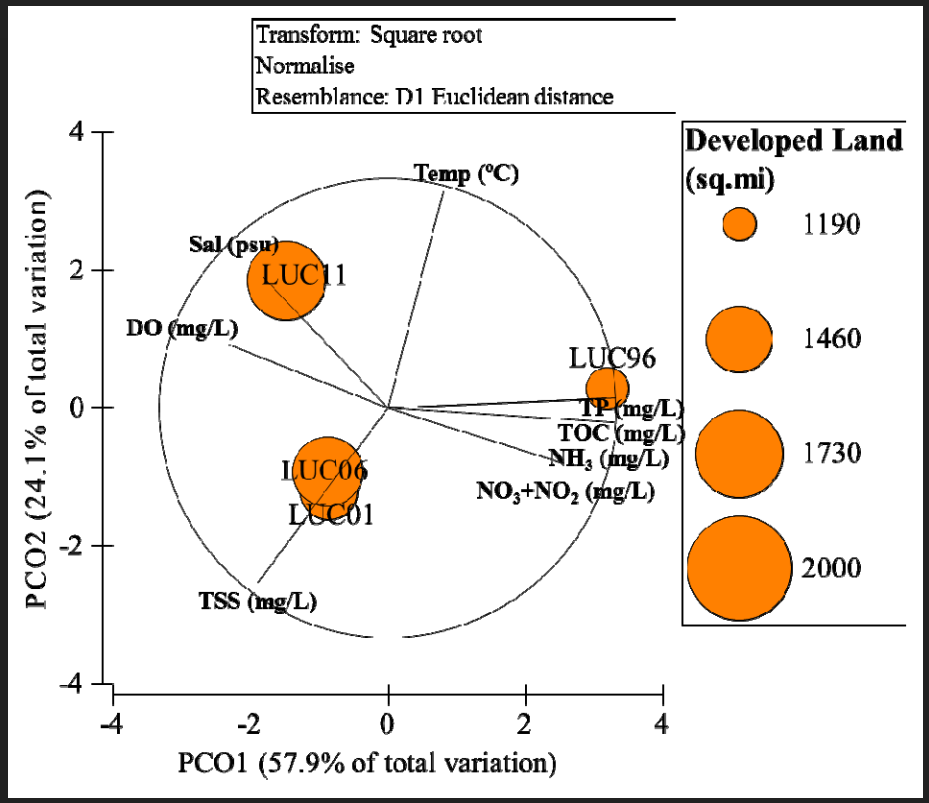
Supplemental Slides

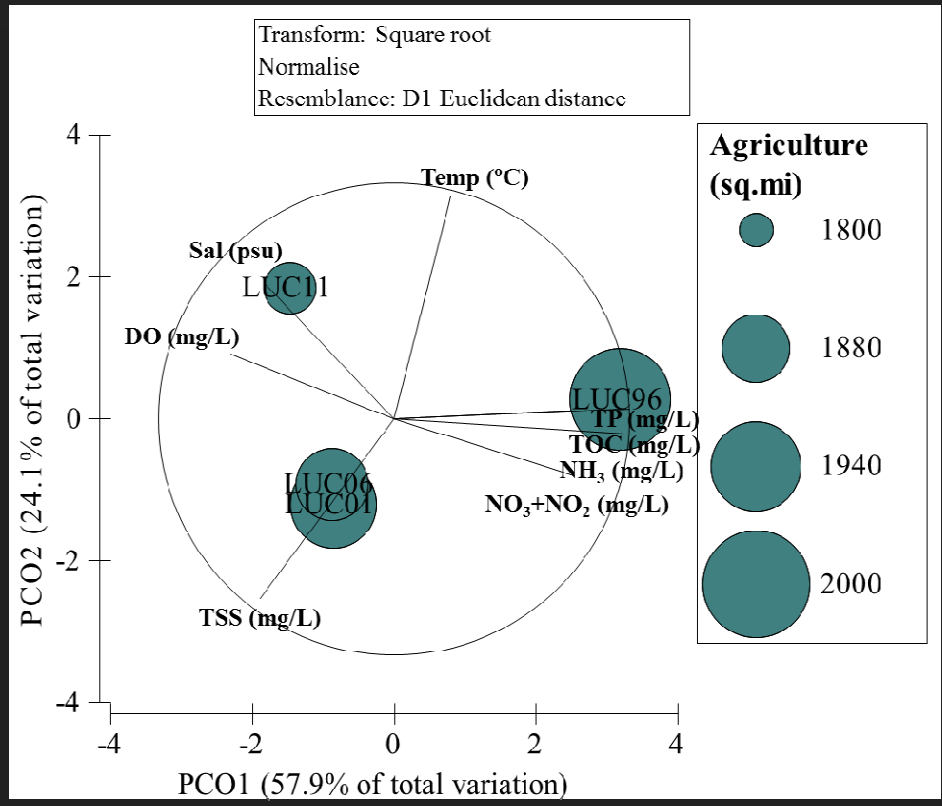
Developed land

- More developed land towards present
- Positive correlation with salinity, which we hypothesize may be the result of reduced freshwater inflows (total volume) to the bay as a result of diversions for upstream uses
- Lower nutrients in present result of Clean Water Act and other policies; or less flows

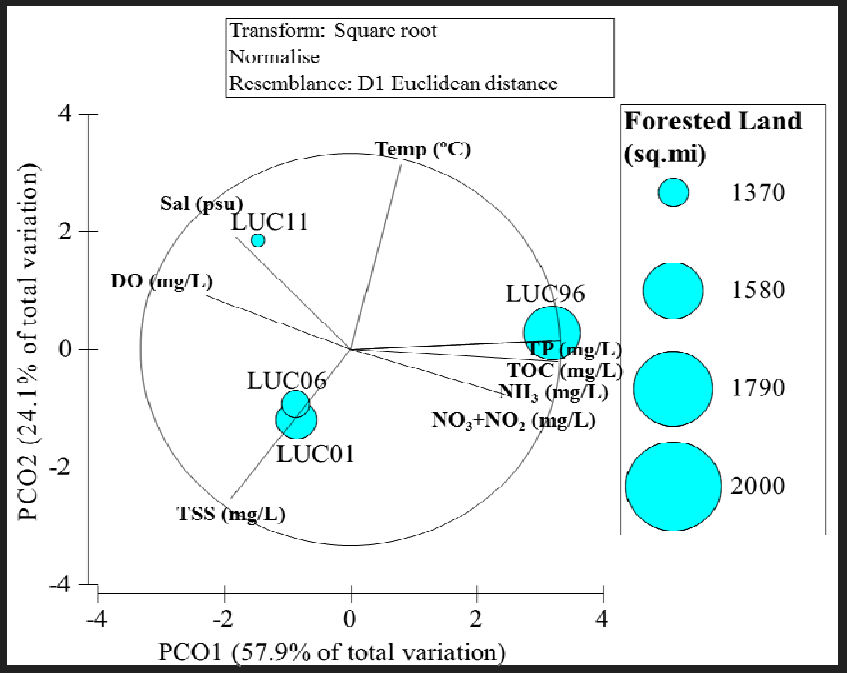


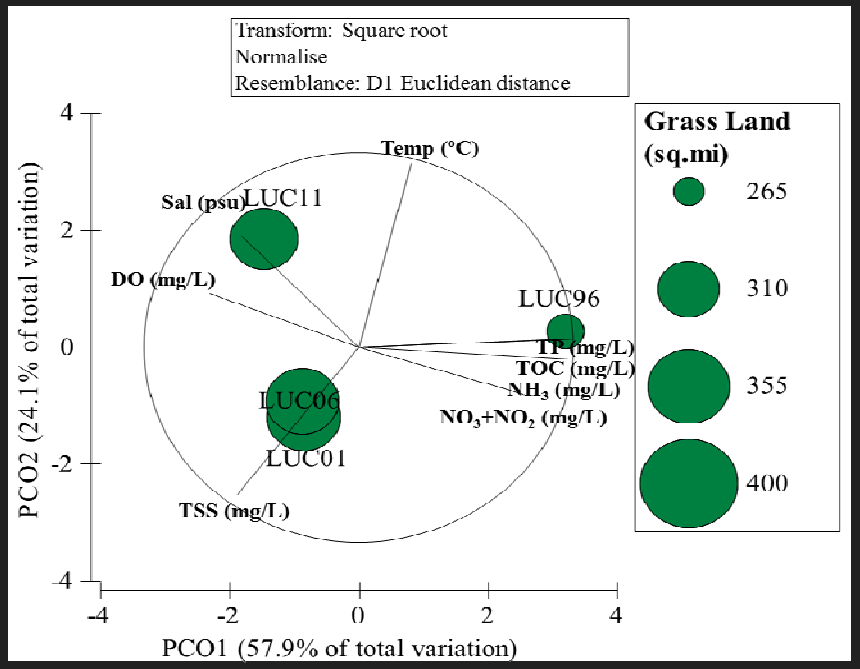
Agricultural lands

- Less ag land towards present
- In 1996, ag land associated with high nutrient loads in bay; with decreases towards present
- Lower nutrients in present result of Clean Water Act and other policies



Forest lands & grass lands

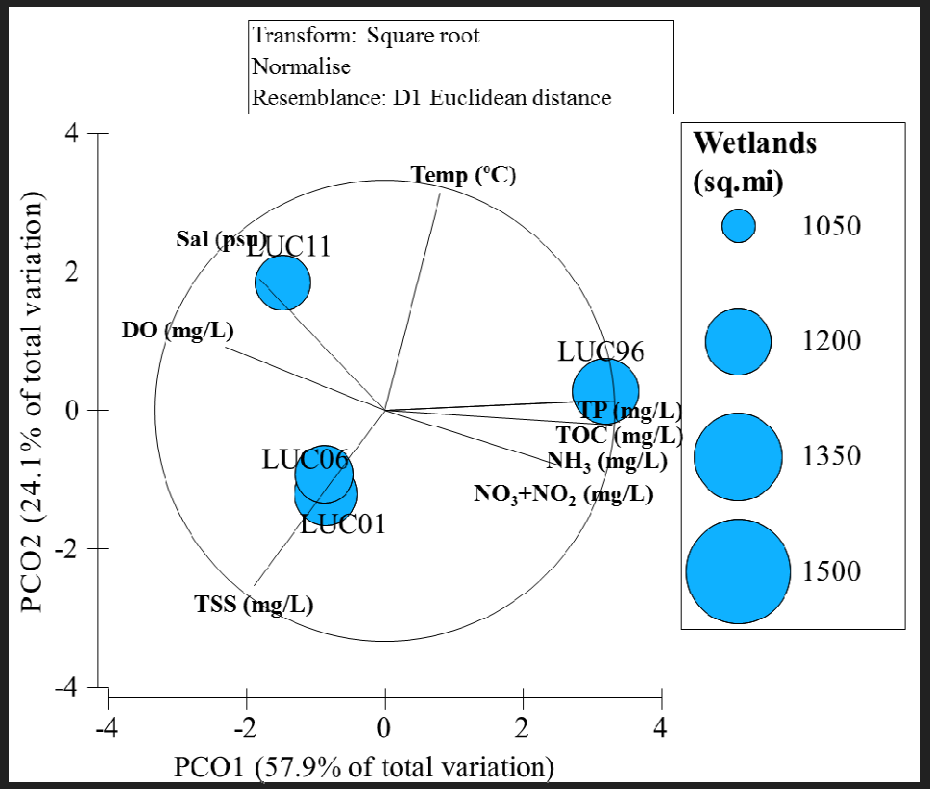




- Less forested land towards present; significantly more grass lands

Wetlands

- Significant losses towards present
- Increasing salinities mean we cannot replace our freshwater wetlands; restoration efforts are focused on brackish/marine species
- Both habitat quality and food changes likely to impact higher trophic levels



Less lands and more waterways

- Increased population growth leading to development of communities and residential complexes – with detention ponds and lakes

- Increased impervious surfaces directed towards filling ponds; may be protecting the bay