

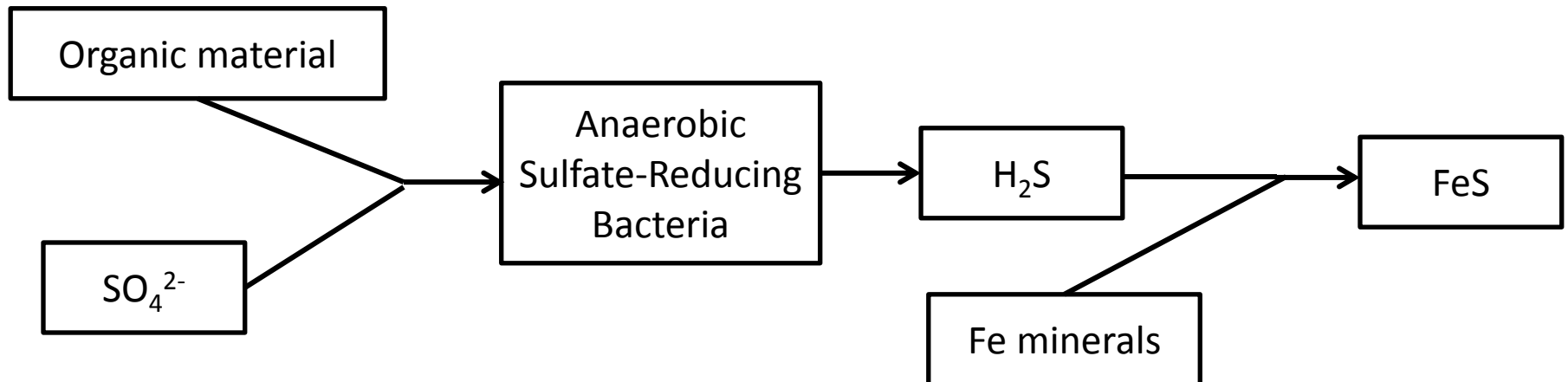
# How does salt water intrusion affect coupled iron and sulfur cycling in a coastal freshwater wetland?

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University of Nebraska, Duke University



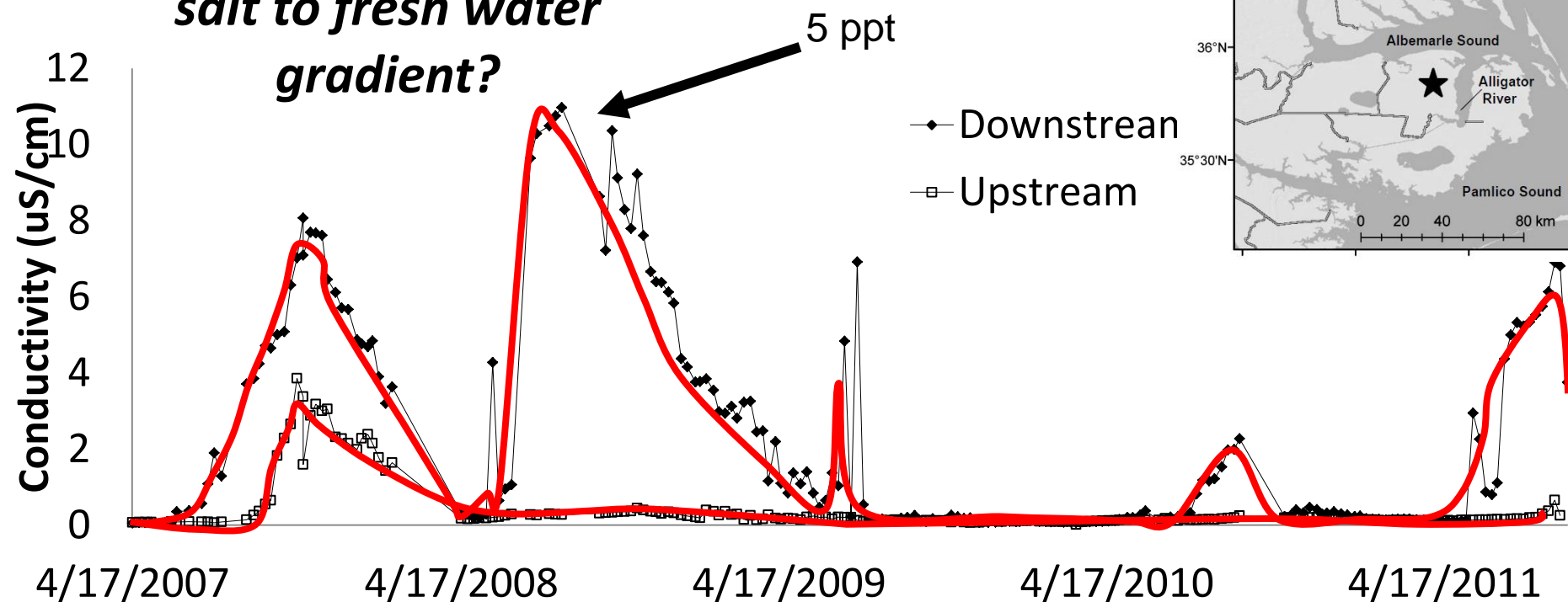
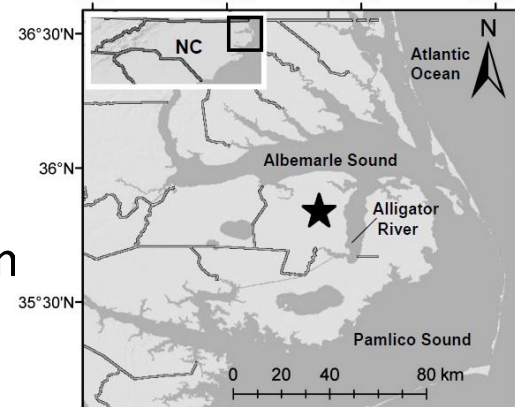
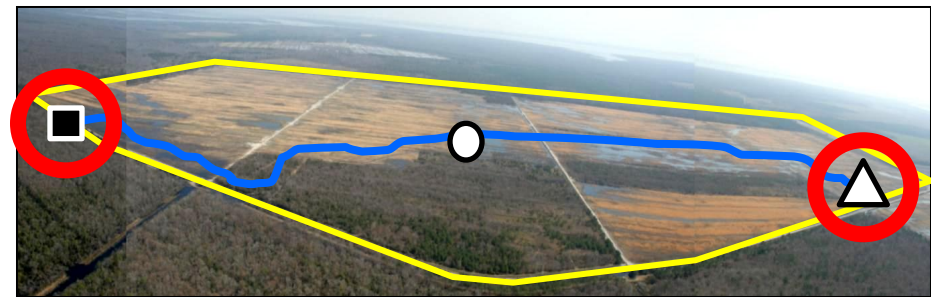
# Climate change, sulfur and iron: implications for coastal freshwater wetlands

- Salt water is a large source of sulfate
- Microbes reduce sulfate to sulfide
  - Toxic to many organisms
  - With salt, organizes coastal communities
- Reduced iron binds with sulfide



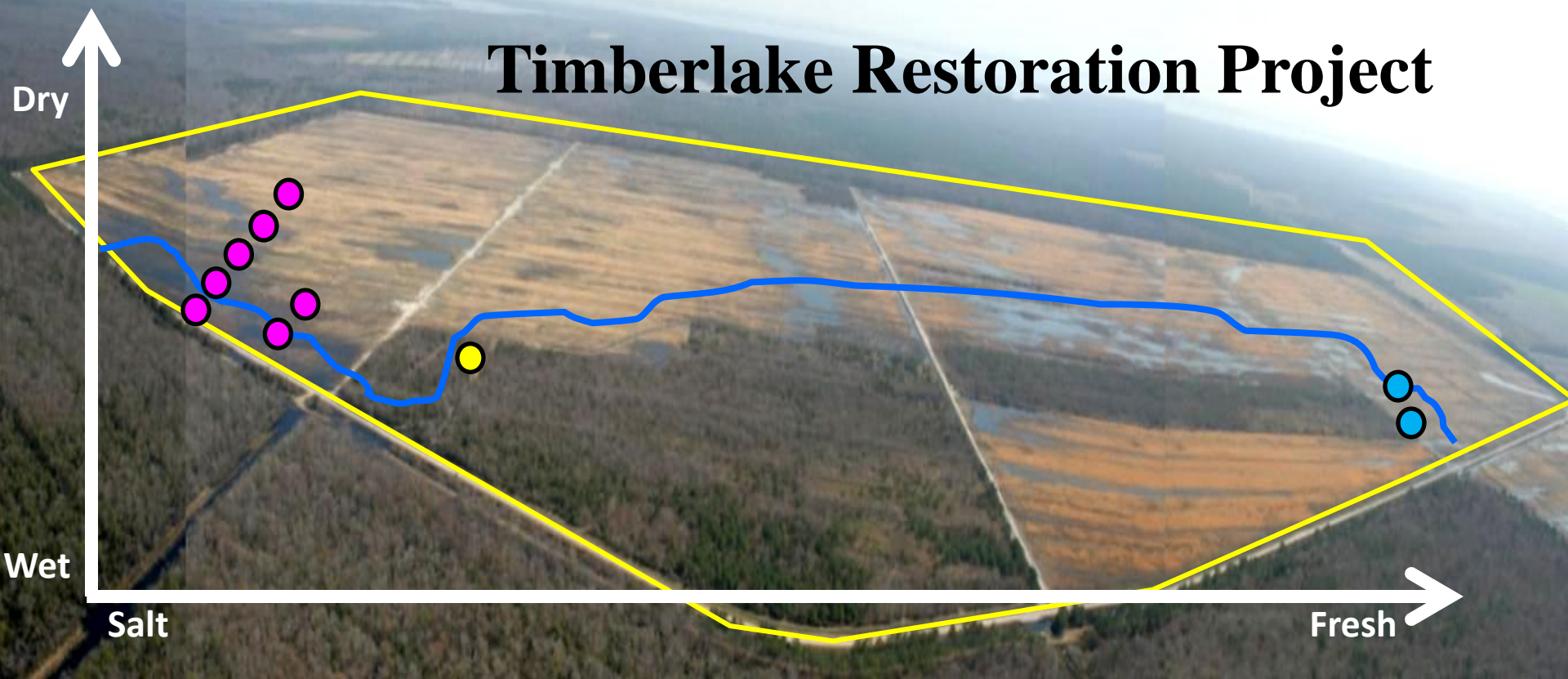
# Periodic Salt Water Intrusion

*How do sulfur inputs affect FeS complexing across the salt to fresh water gradient?*





# Timberlake Restoration Project



1 km

- Seasonal intrusion depending on groundwater levels
- 440 ha
- 10 sites

***Salt water intrusion as a natural sulfur addition***

# Indicators of Sulfate Reducing Activity

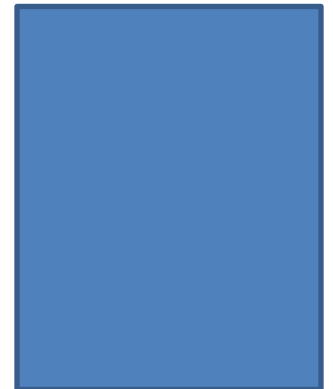
## Traditional $^{35}\text{S}$

- Radioisotope
- Uses soil core (5cm diameter)
- Glovebag
- Few samples (expensive and time consuming)
- Proven method

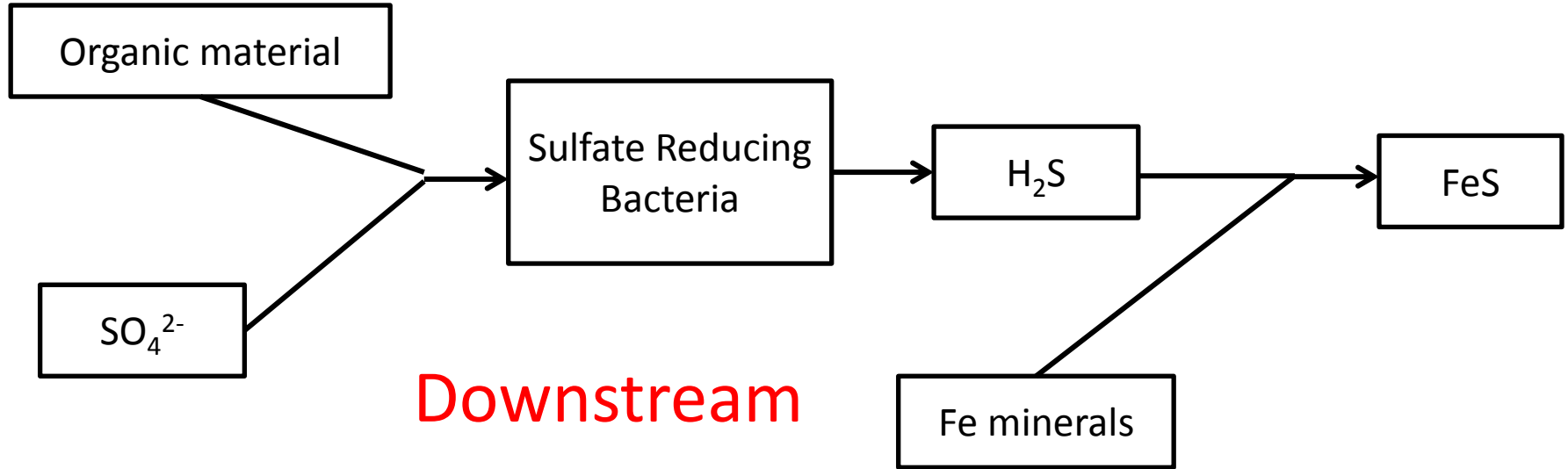


## Indicator of Reduction in Soils Method (IRIS, Rabenhorst et al 2010)

- Increased SA (20x15cm)
- Efficient, inexpensive
- Deploy easily
- See biogeochemistry in action
- New method



# Predictions



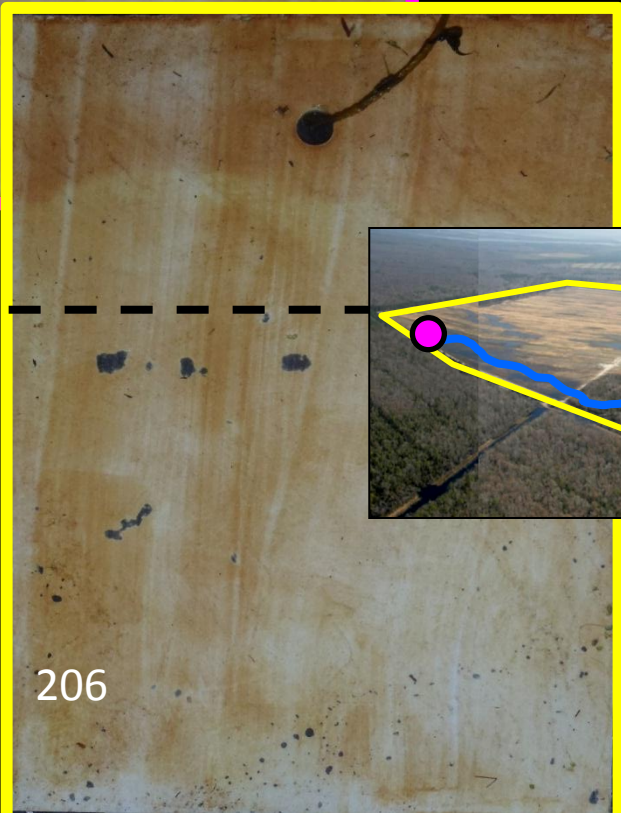
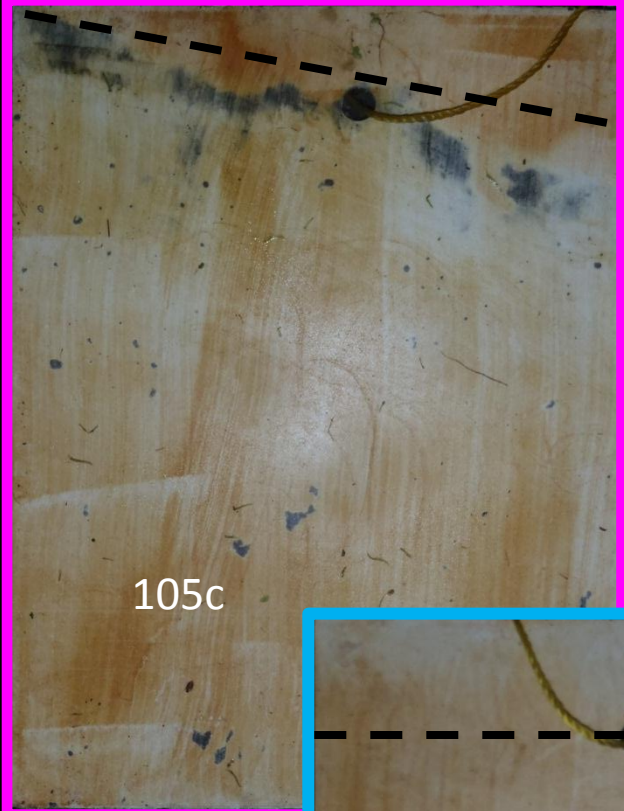
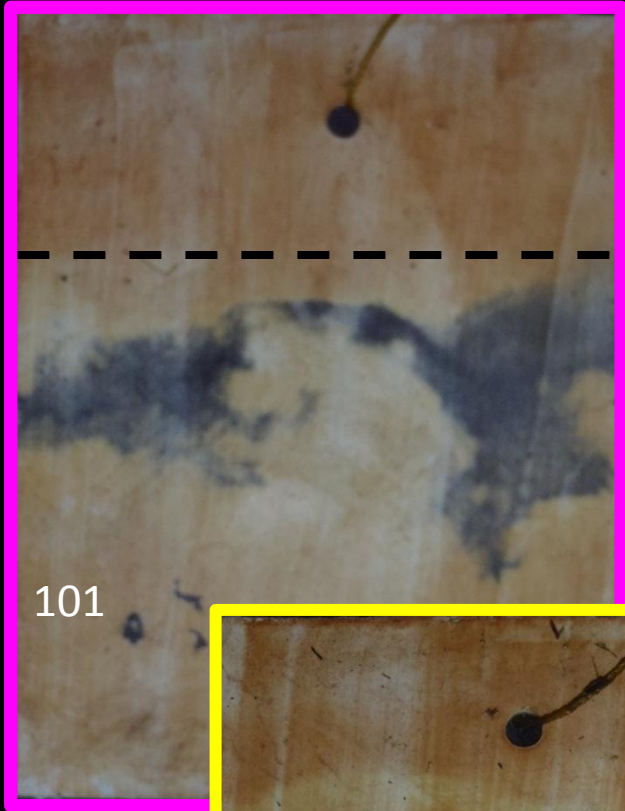


NASA GOES PROJECT

Hurricane Irene was downgraded early Saturday to a Category 1 storm, but forecasters warned it's still a major threat. Ferocious winds and torrential rainfall lashed coastal North









# June sulfate reduction rate ( $^{35}\text{S}$ ) along the saline to fresh gradient

0.03

SRR ( $\mu\text{moles}/\text{cm}^3/\text{hr}$ )



Salt exposure  
 $p=0.778$

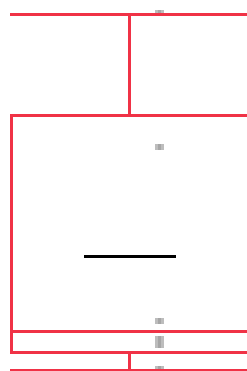
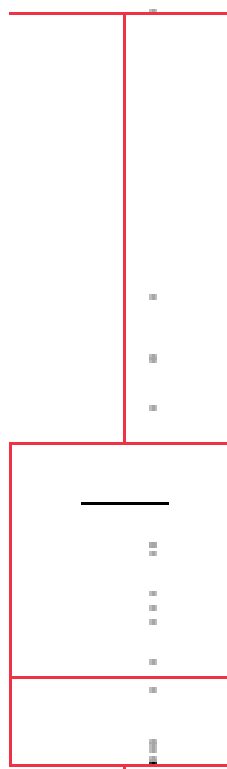
0

Salt

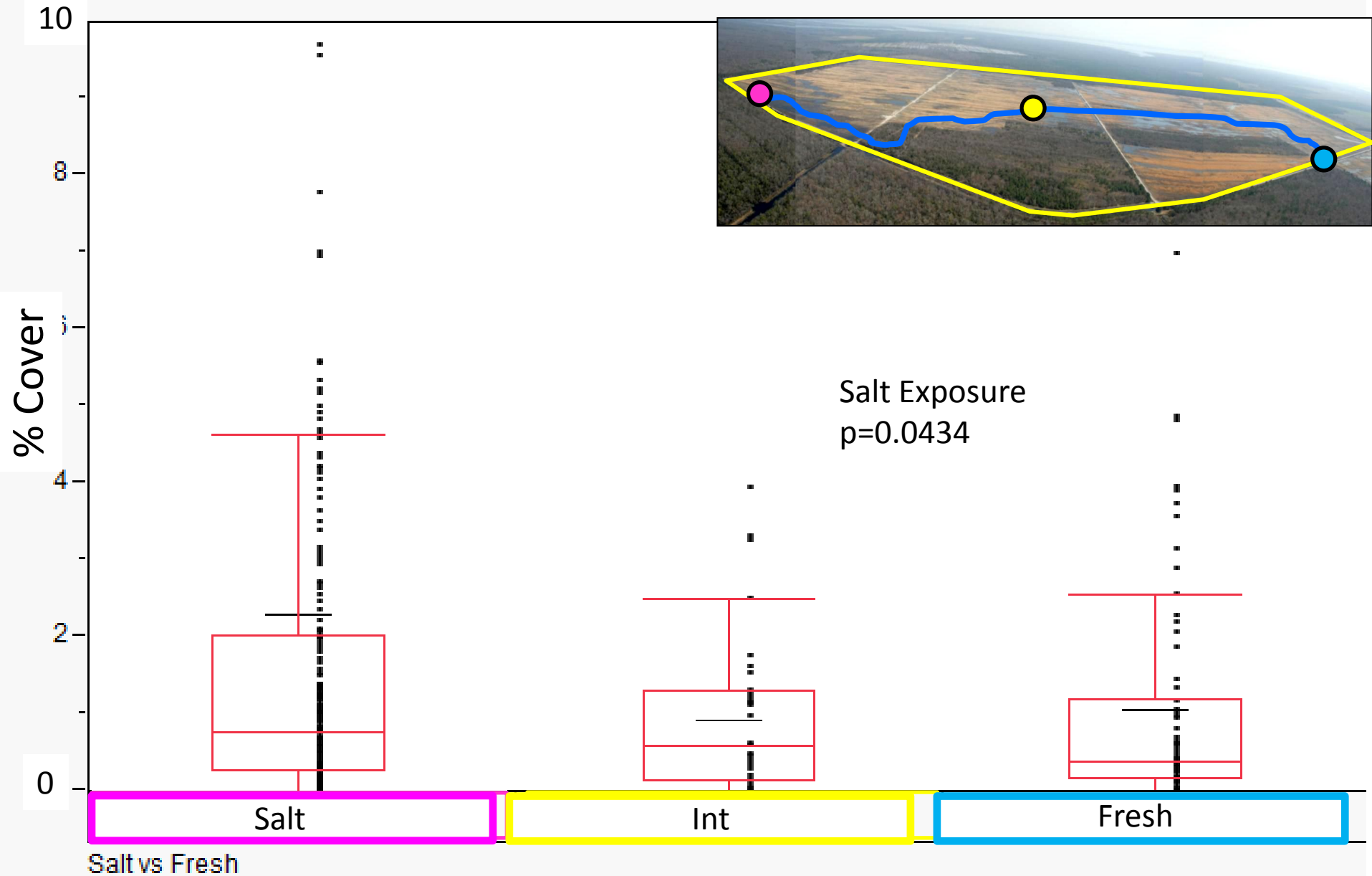
Int

Fresh

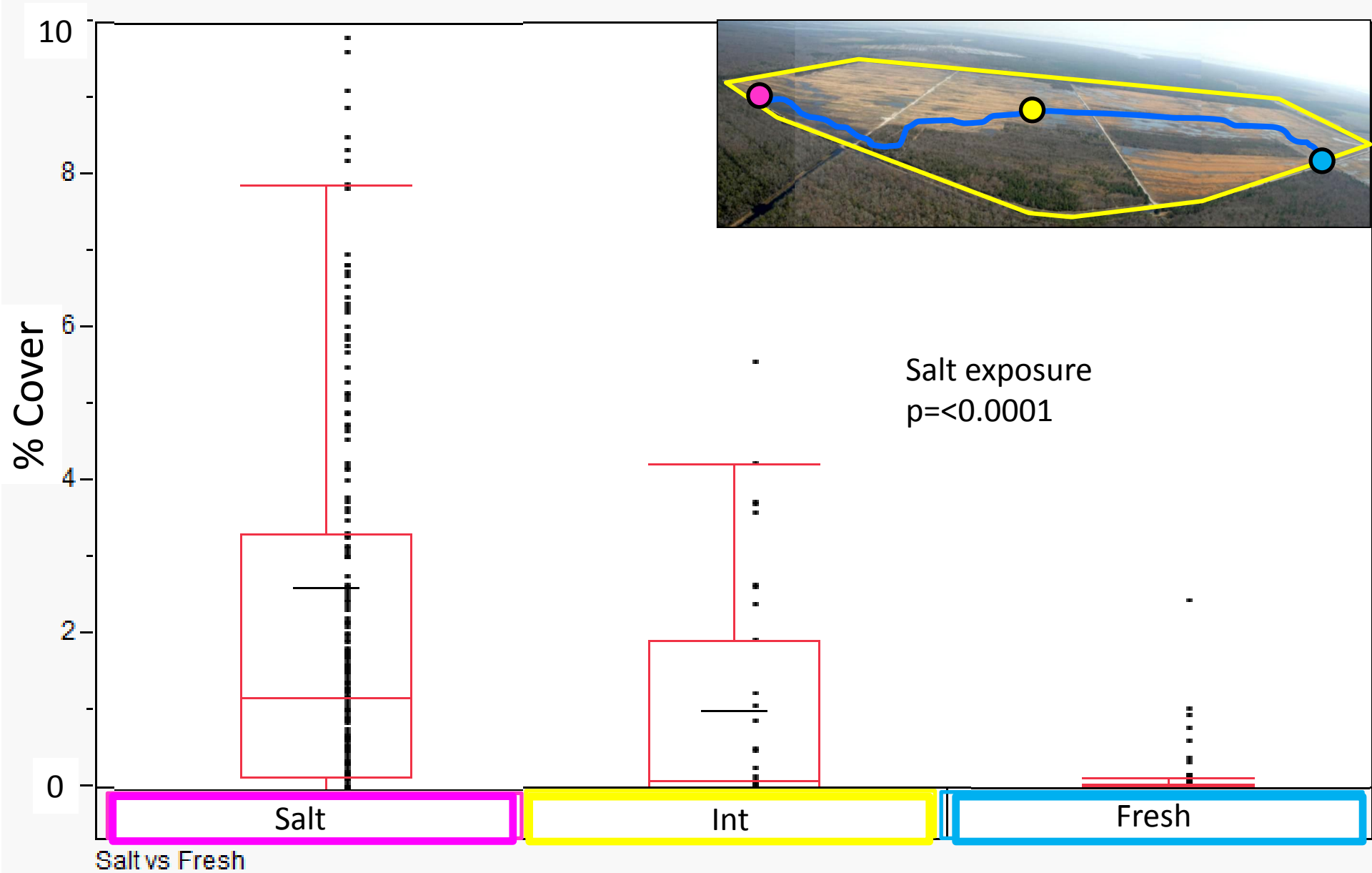
Salt to Fresh



# IRIS June Percent Cover

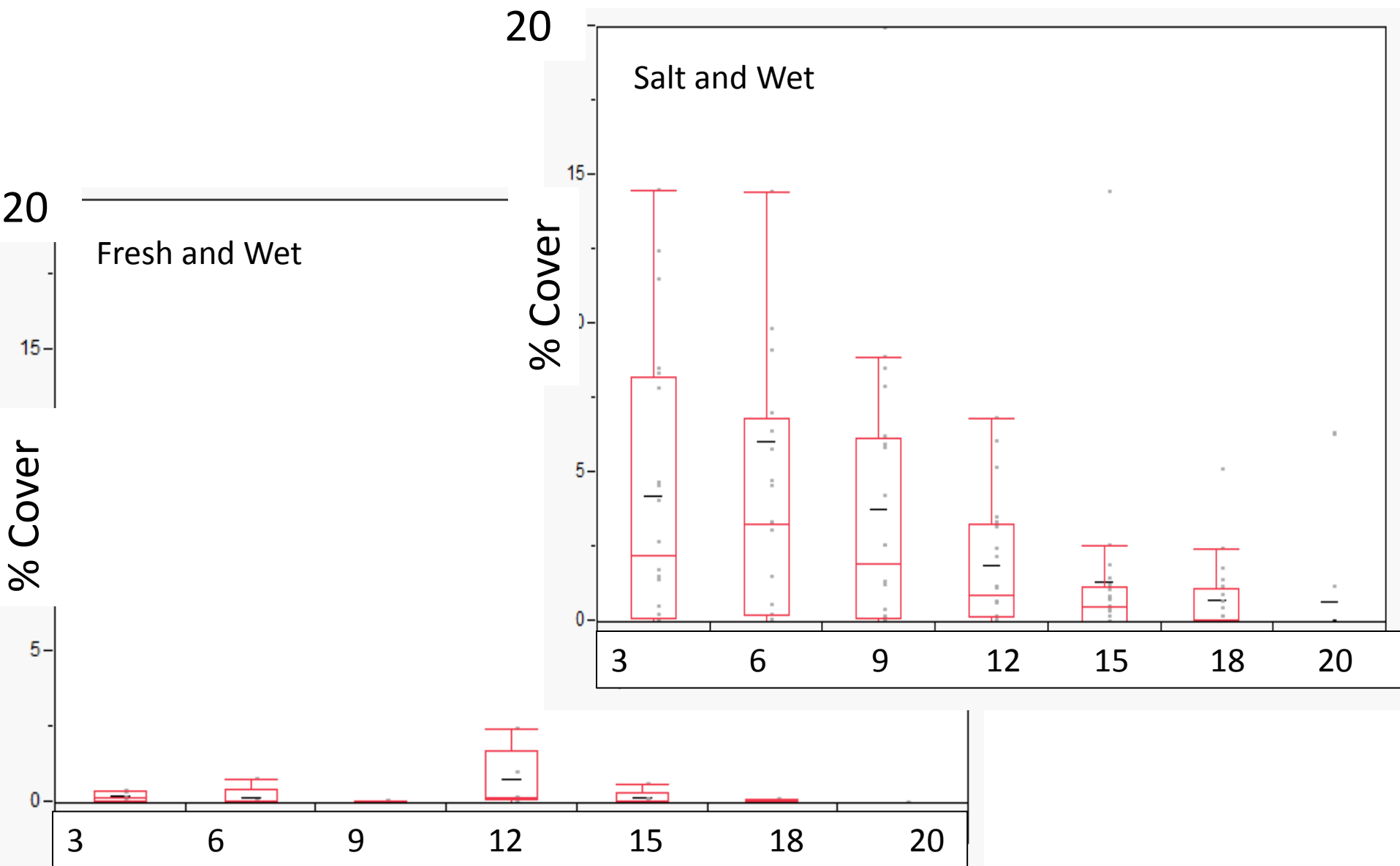


# IRIS September Percent Cover



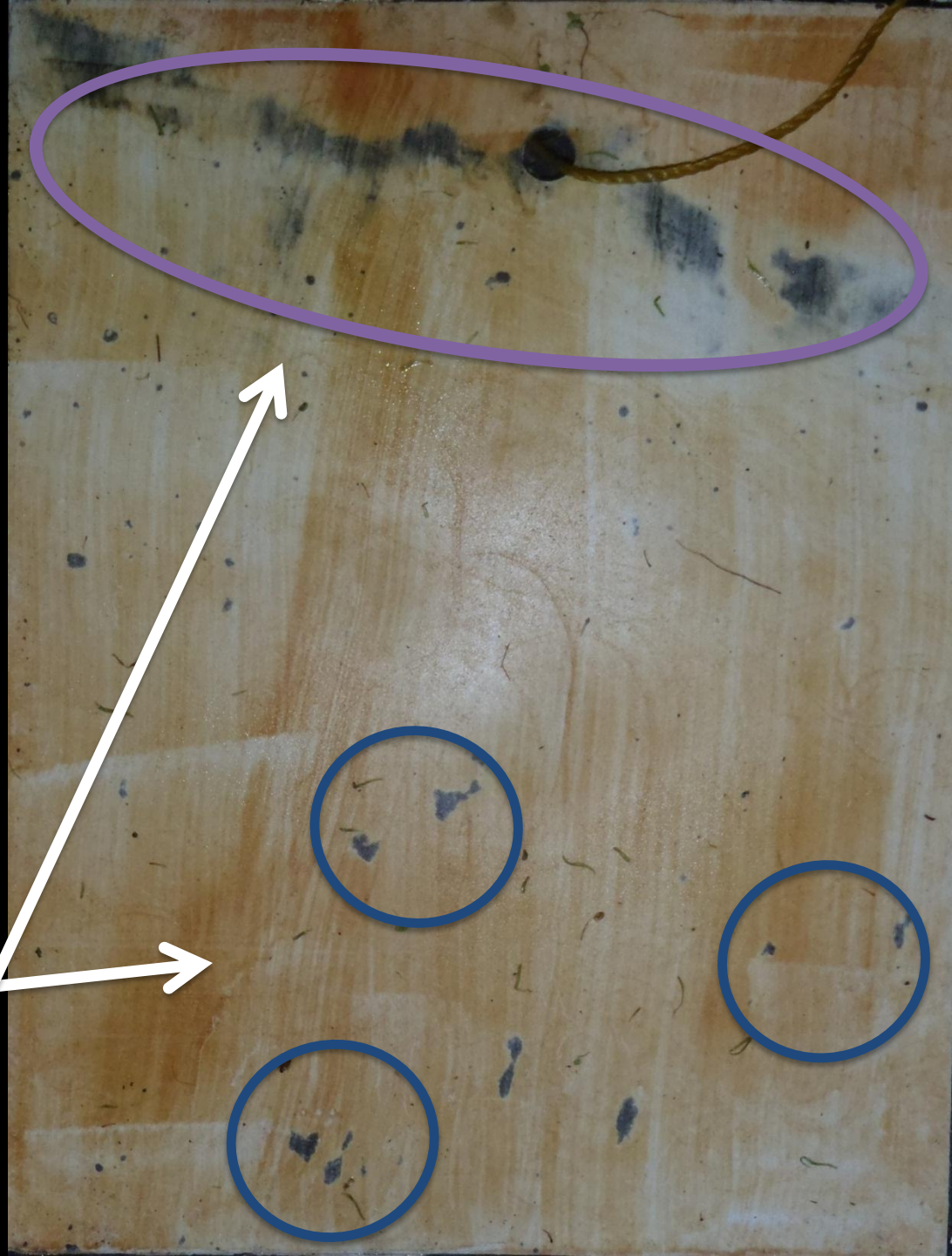


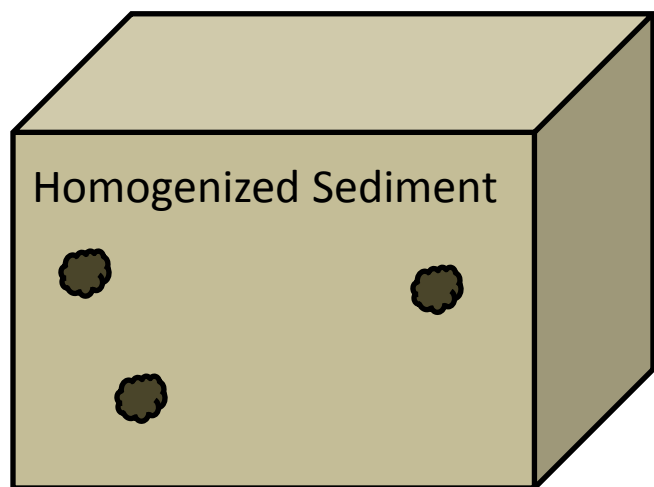
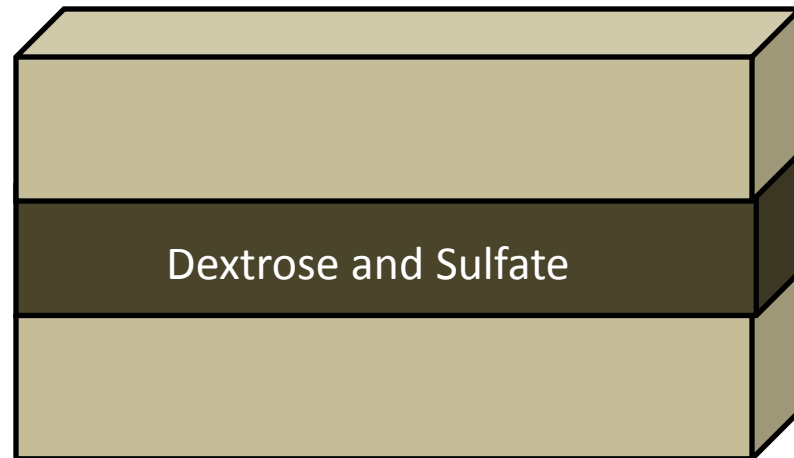
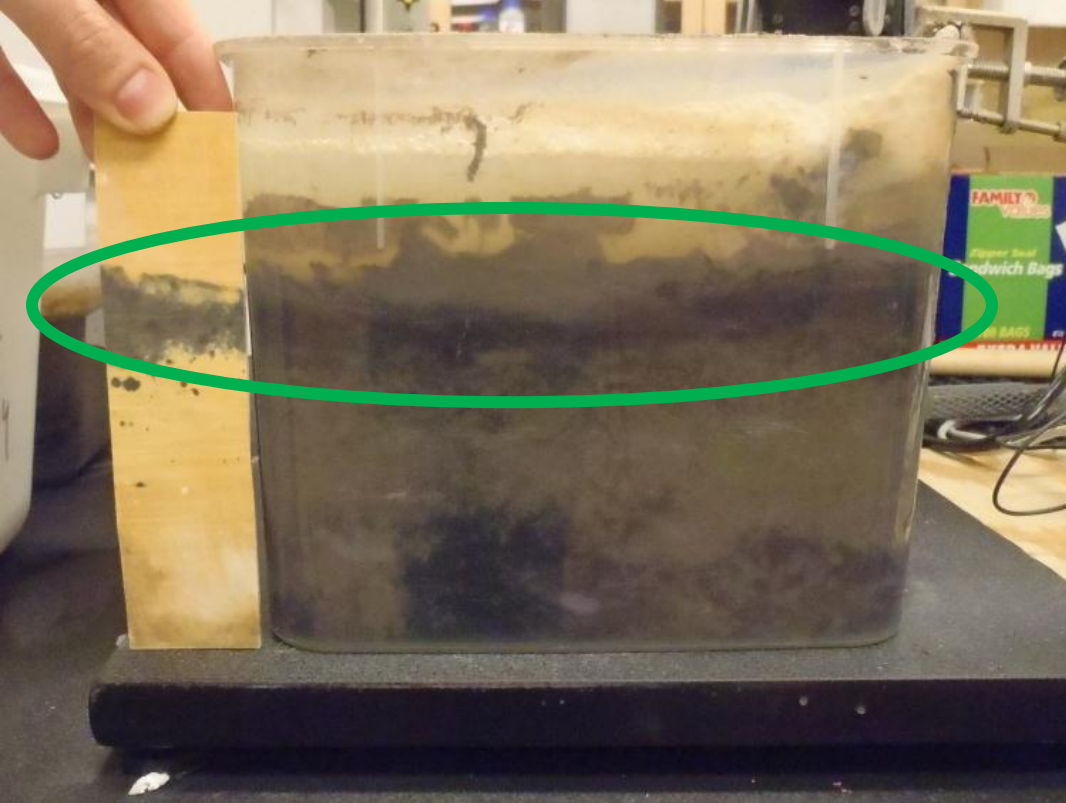
# September depth gradient



# Analyzing the photos

- Percent cover (abundance of dark areas)
- Intensity of darkness (concentration)
- Why pockets vs bands?







# Future Work

- Improve photography to obtain darkness of compounds and therefore quantitative rates



std 1

1mM



std 2

10mM



std 3

100mM

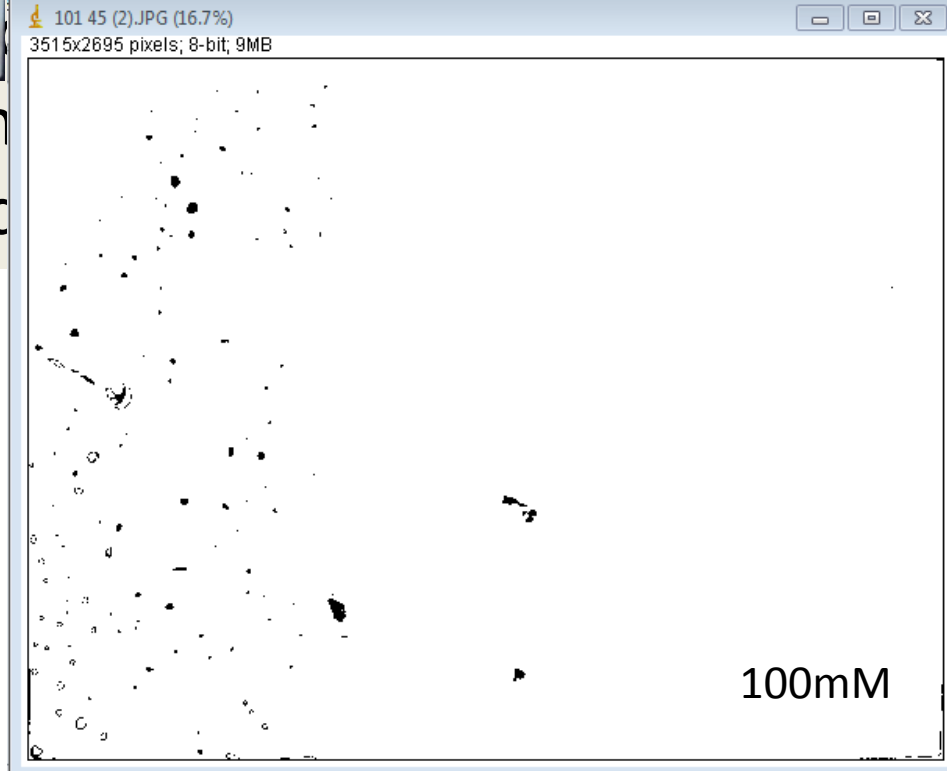
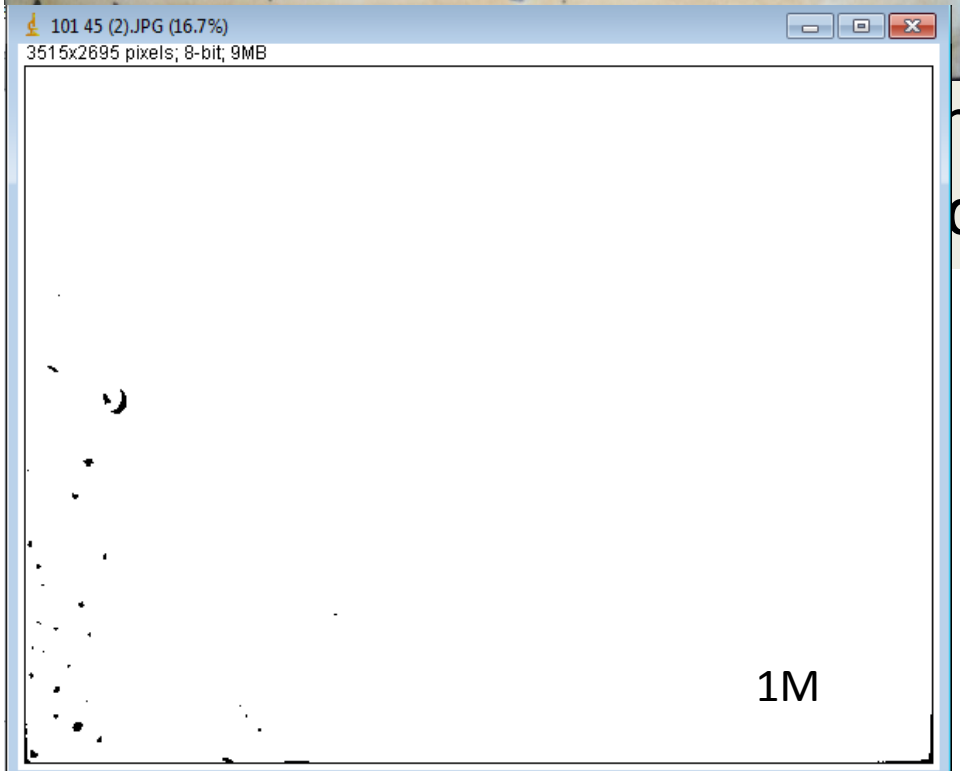
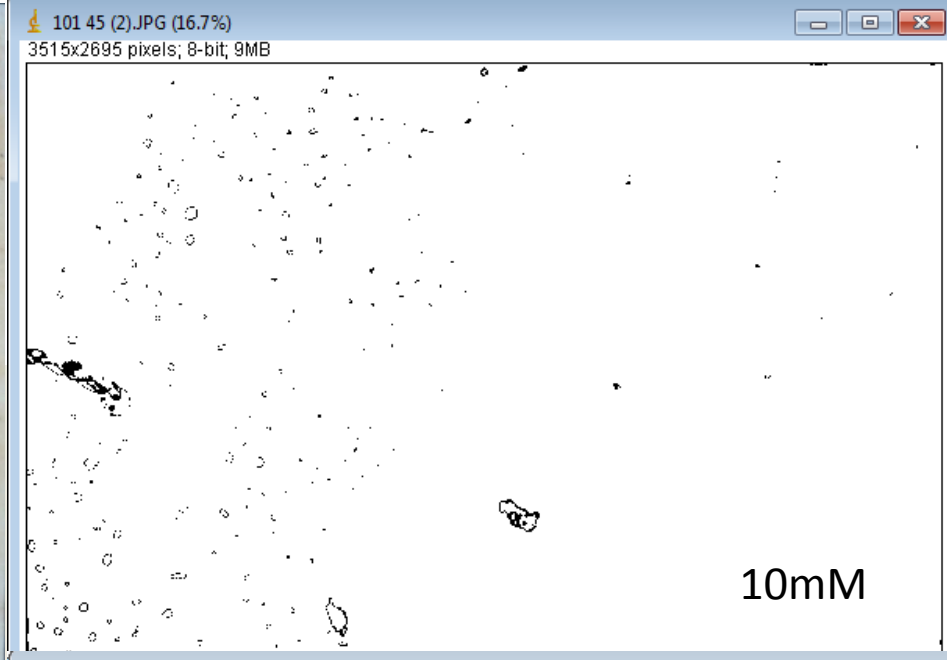


std 4

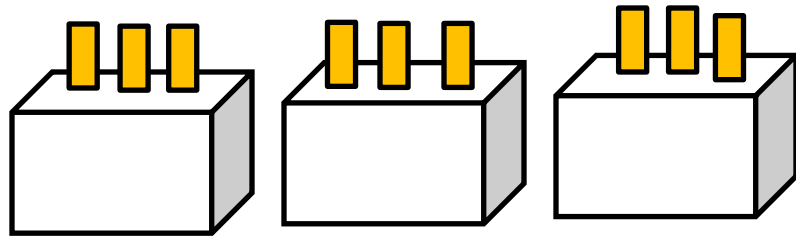
1000mM

- Sulfide solution in plastic bag
- Held in glovebox for 24 hours





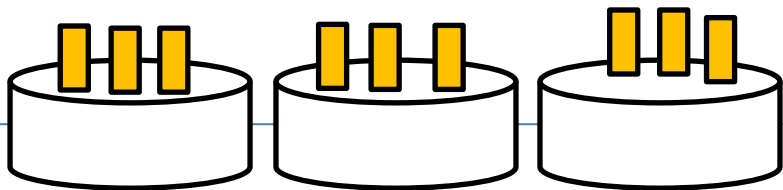
# Meso- and Microcosm Experimental Design



Salt

Int

Fresh

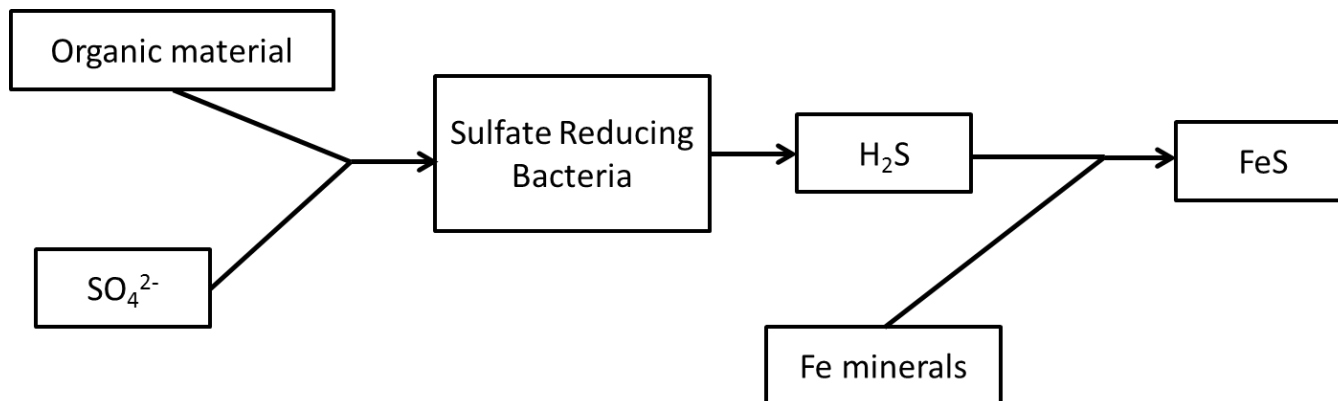


Salt

Int

Fresh

- Water amendments
  - (0, 2.5, 5ppt)
  - Lab and field component
  - 3 treatments, 2 sites, 3 reps (18 total)
- Compare plates to  $^{35}\text{S}$





# Conclusions

- Sulfate reduction increases with intrusion, and is greater in wetter sites
- Sea level rise and periodic salt water intrusion will increase coastal sulfate reduction
  - Impacts of sulfate reduction are heavily mediated by iron availability
- How much exposure is necessary to switch to sulfidic conditions?

# Acknowledgements



# Indicator of Reduction in Soils Method

(IRIS, Rabenhorst et al. 2010)

- Iron oxide paint on PVC
- Inserted into sediment for 24 hours
- Fe on plate binds with porewater sulfide
  - Black complexes that fade with exposure to  $O_2$
- See biogeochemistry in action
  - Visual reaction with sulfide and a way to quantify sulfide concentrations

