Responses of the South Florida Coastal and Estuarine Ecosystems to Climate Variability, Extreme Weather Events & Sea Level Rise over the last ~4,800 years

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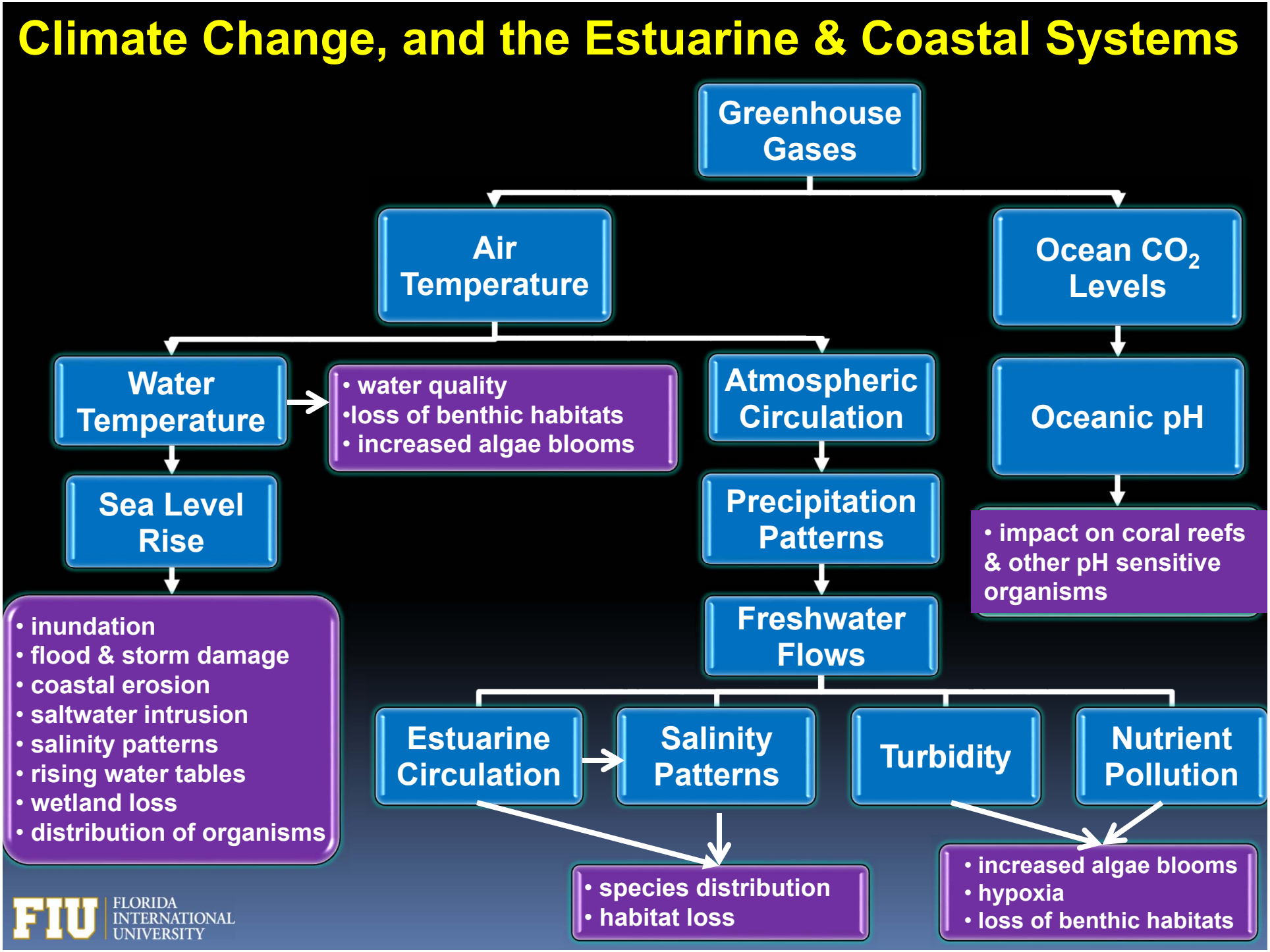
Climate Change, and the Estuarine & Coastal Systems



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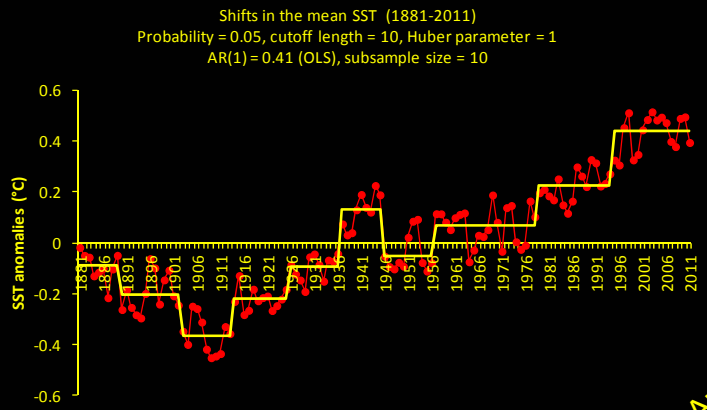
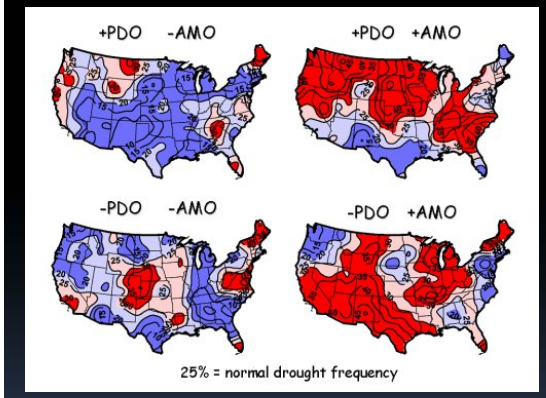
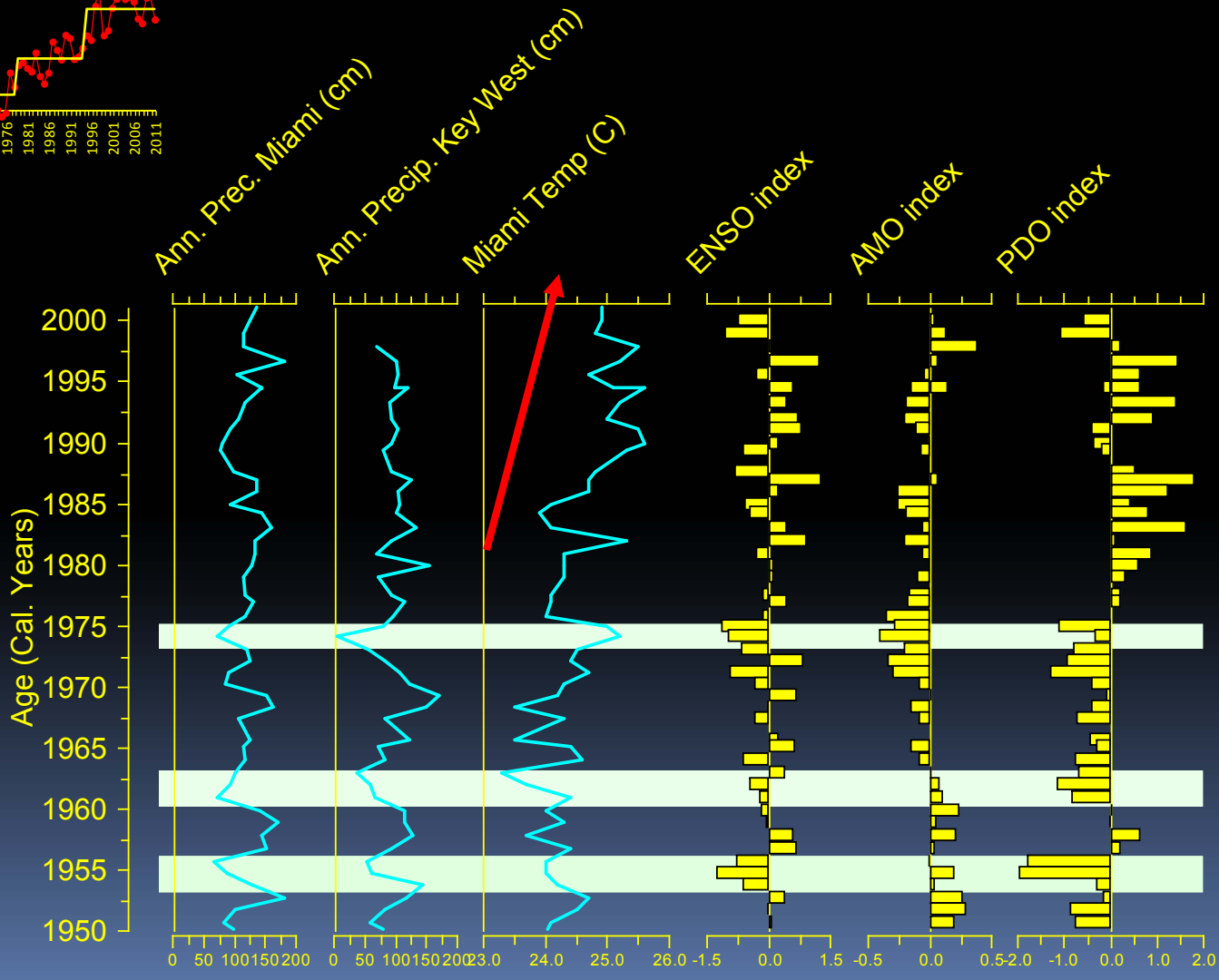
Pacific and Atlantic Ocean Influence on Precipitation & Salinity Patterns in South Florida





Source: McCabe (2004)



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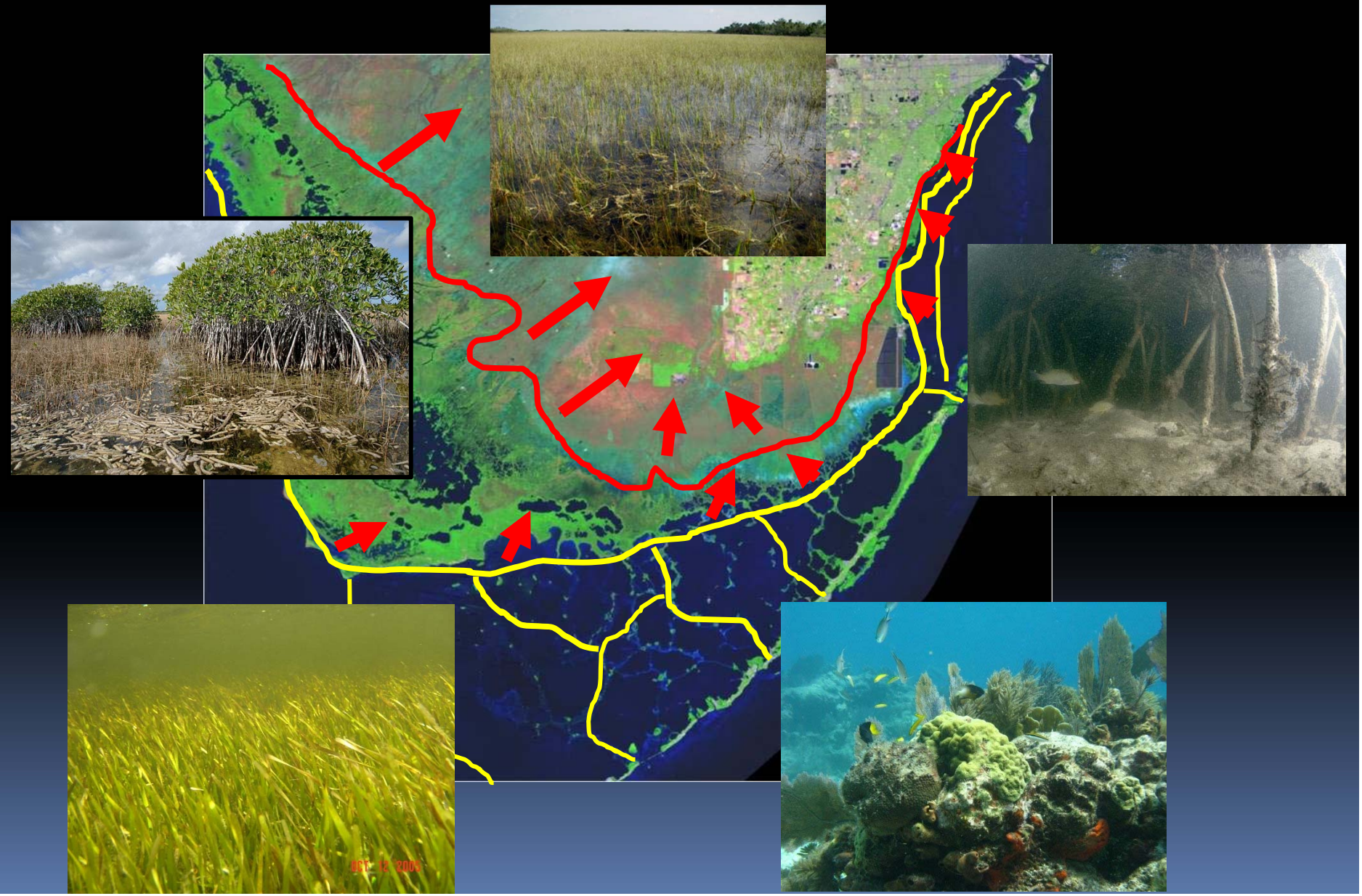
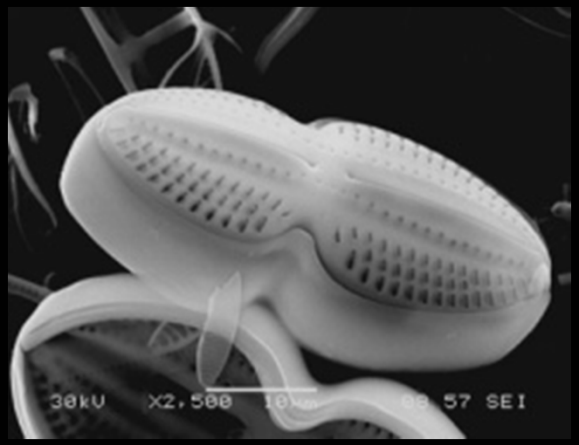
How Estuaries Respond to Warmer Temperatures & Sea Level Rise?

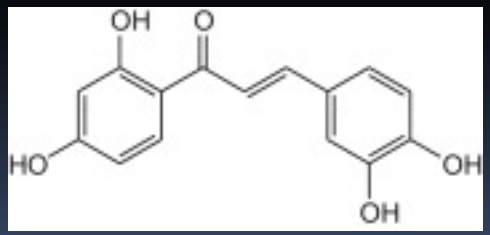


$\delta^{18}O$

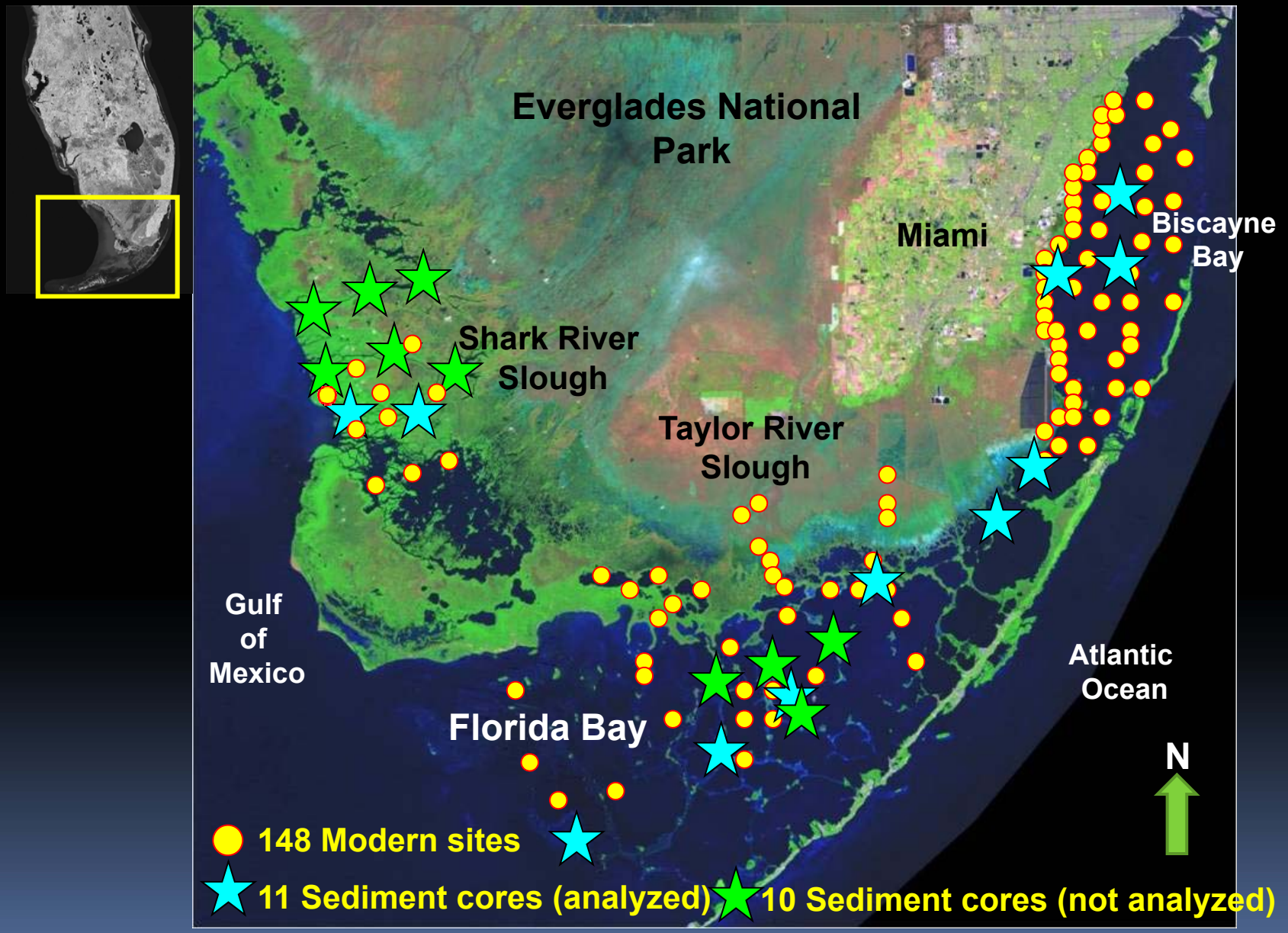
$\delta^{13}C$



The Past is the Key to the Future…



Sampling Locations



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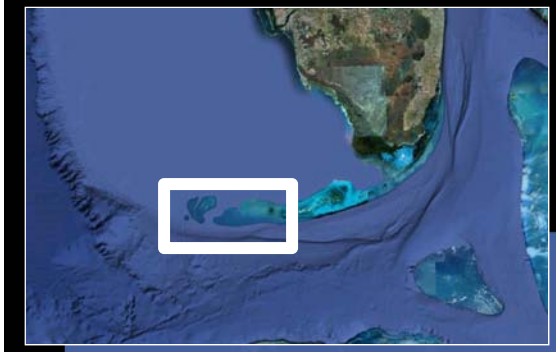
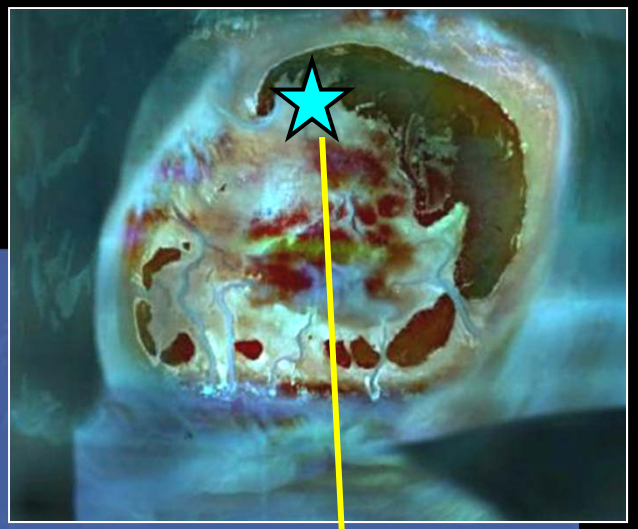
Sampling Locations





Gulf of Mexico

Dry Tortugas

Marquesas Keys

Surface sediment samples

Sediment cores (analyzed)

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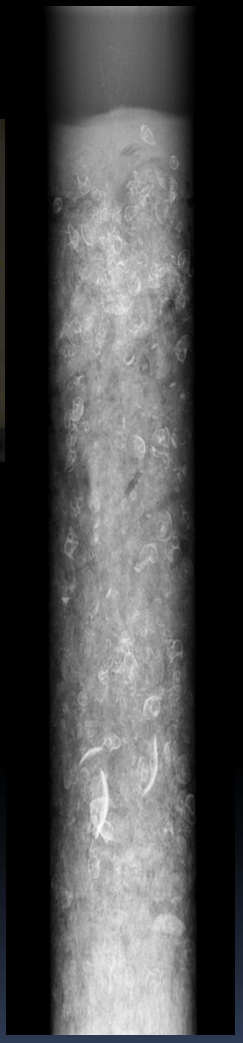
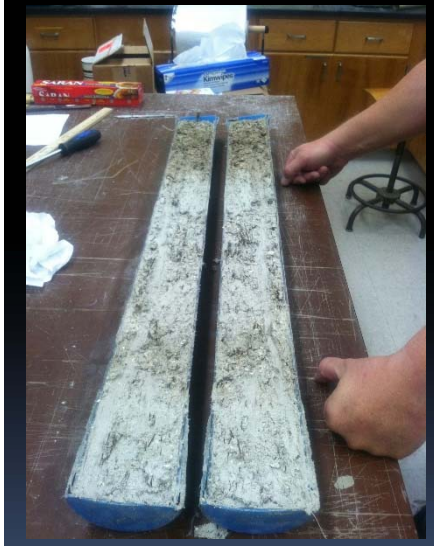
Sediment cores





- XRF core scanner for elemental analysis

CAT-scan

Modern samples

Epipelon

Epiphyton

Plankton

- **Radiometric Methods:** ^{210}Pb, ^{14}C

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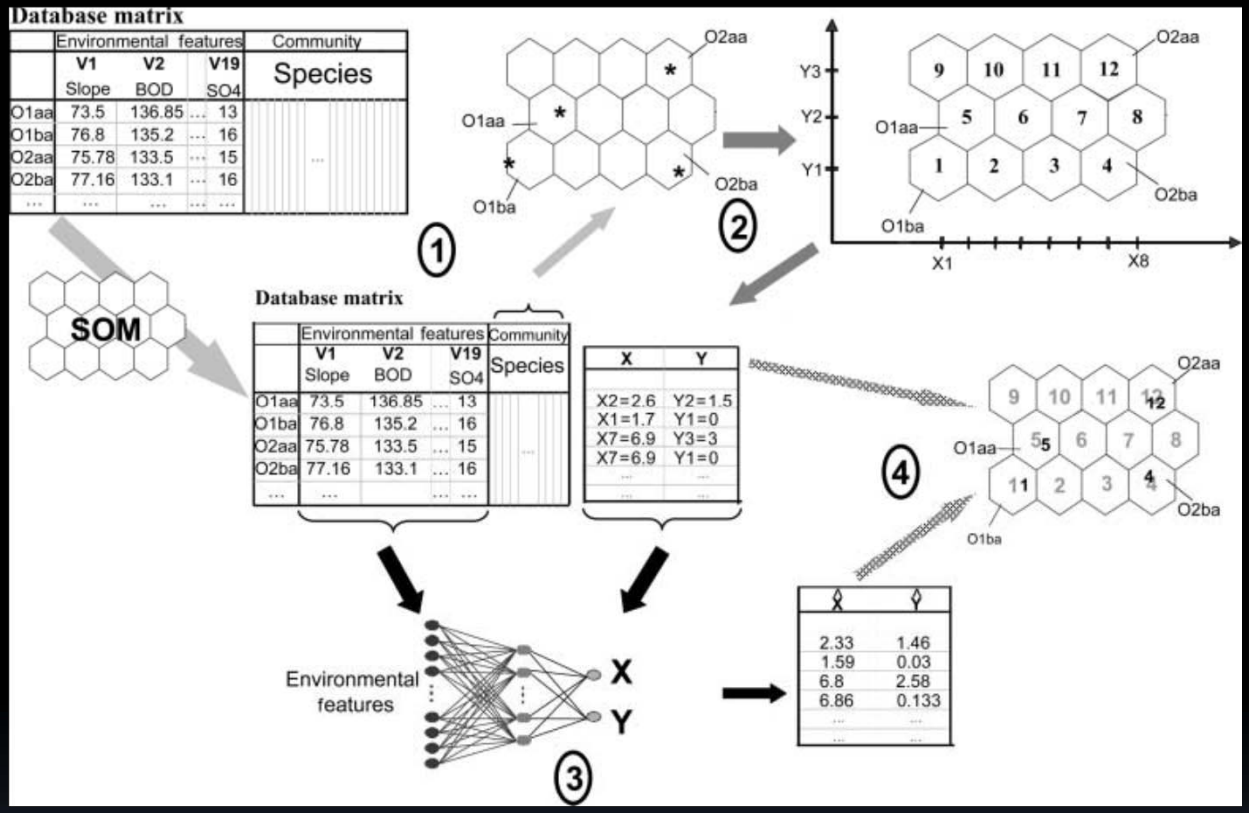
Peat and Marl Deposits in Florida Bay cores


Peat mixed with marl

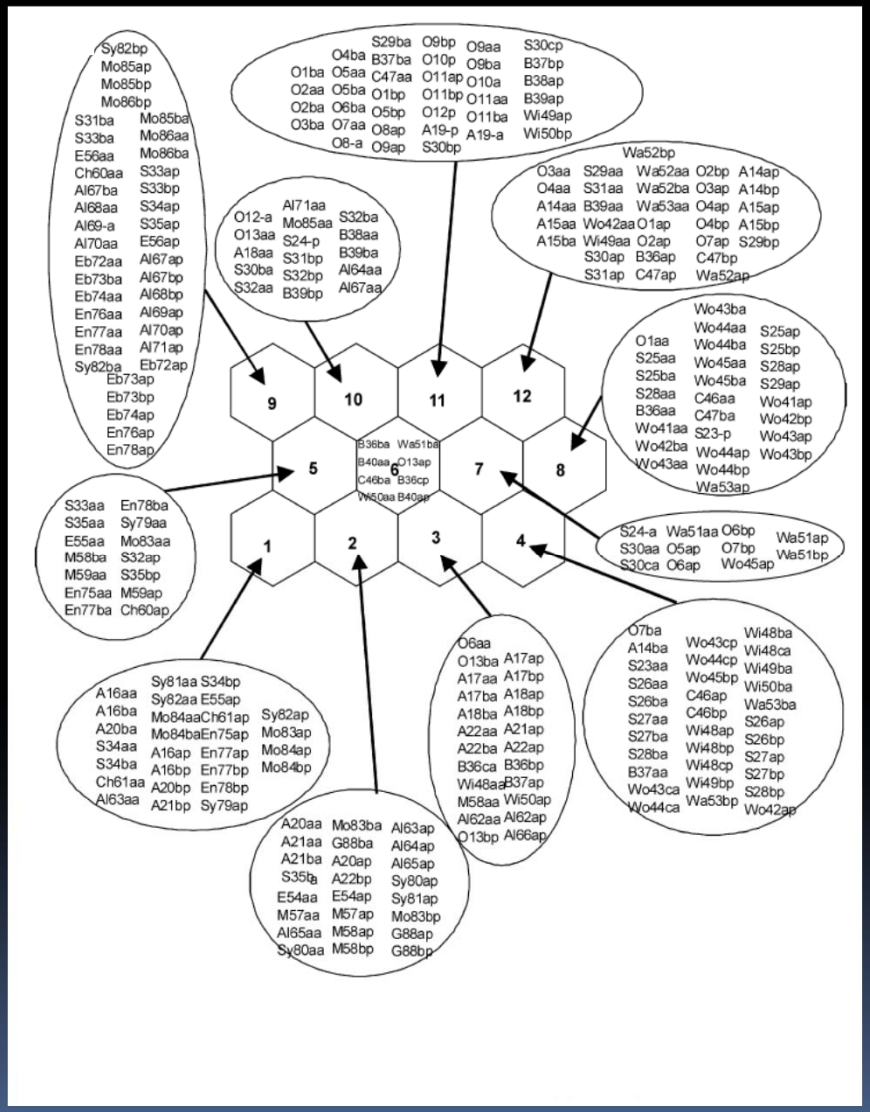
Bob Allen & Ninemile Bank Cores

Modeling the Structure of Diatom Assemblages using Artificial Neural Networking Algorithms (ANN)

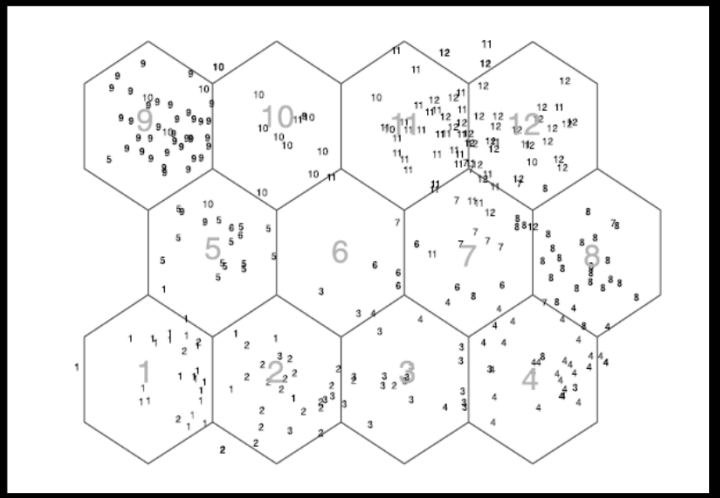


1. Self Organizing Maps (SOM) used to reduce dimensionality & to classify samples according to similarities in sp. composition
2. Samples with distinct diatom communities represented by coordinates (X,Y) according to their env. features
3. Backpropagation Learning Algorithm (BPN) uses env. features of the samples as input var. & coordinates as output var.
4. The predicted values ($\dot{X}$,$\dot{Y}$) ploted on a 12 celled SOM map to test predictability of BNP

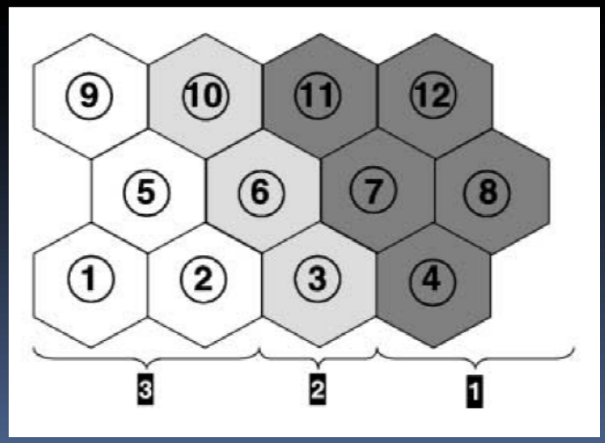
Self Organizing Map with Each Cell Corresponding to a Specific Assemblage



Samples allocated to a given cell have similar diatom assemblages



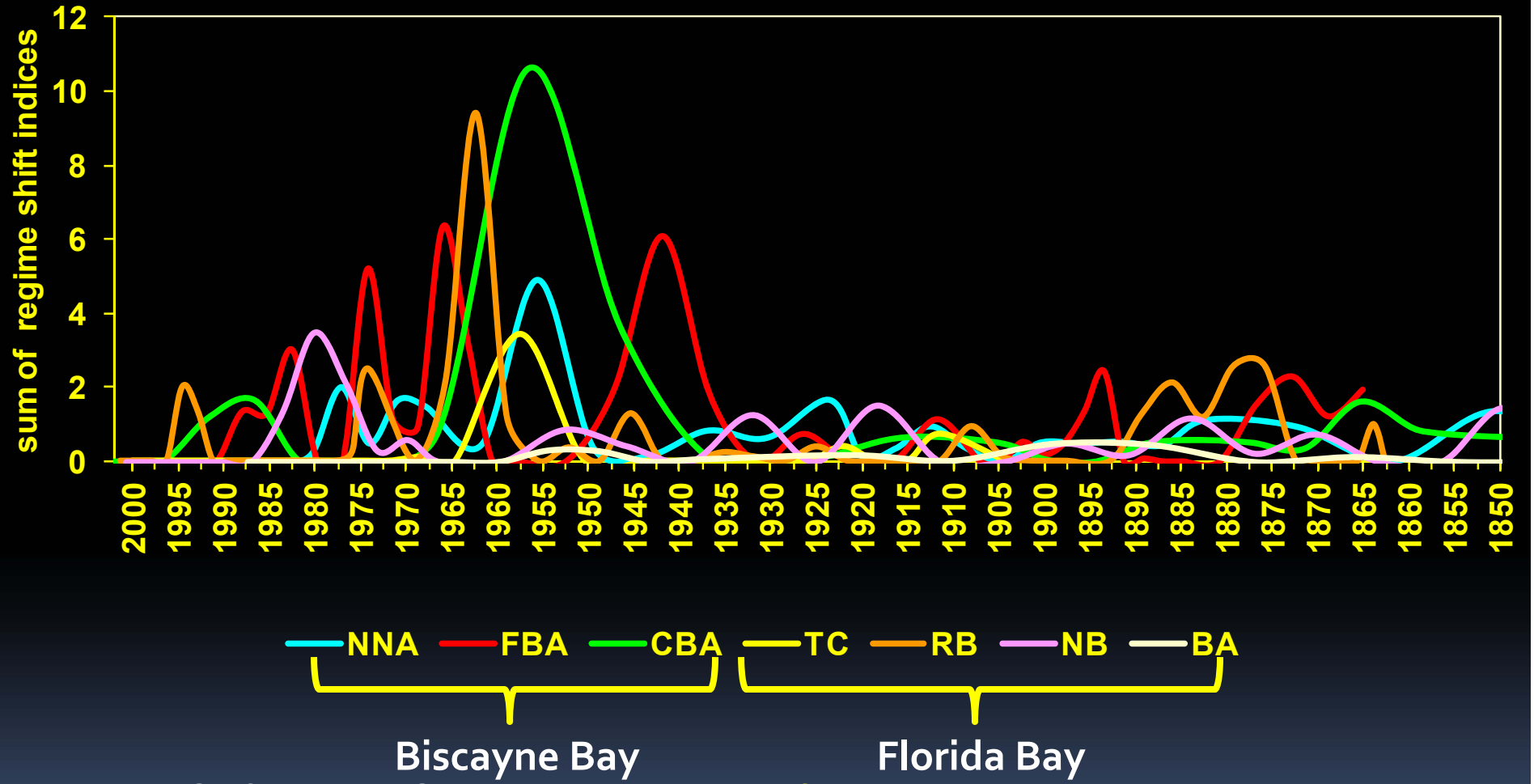
Jacknife leave-one-out validation procedure of BPN used to compare observed and predicted sample allocations



Next step (not done yet) will be to correlate the taxa with different env. gradients

Major Shifts in Diatom Communities in South Florida cores

Major Restructuring of Diatom Assemblages, Florida Bay and Biscayne Bay, Post-1940s



- Regime Shift Index (RSI) = cumulative sum of normalized anomalies relative to a critical value
- Method used: Sequential t-test Analyzes of Regime Shifts (STAR)

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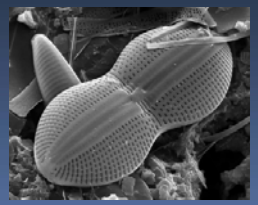
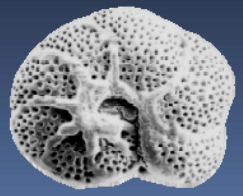
Microbenthic Community Response to Environmental Change, Featherbed Bank (Biscayne Bay)





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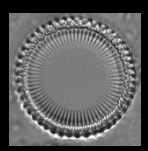
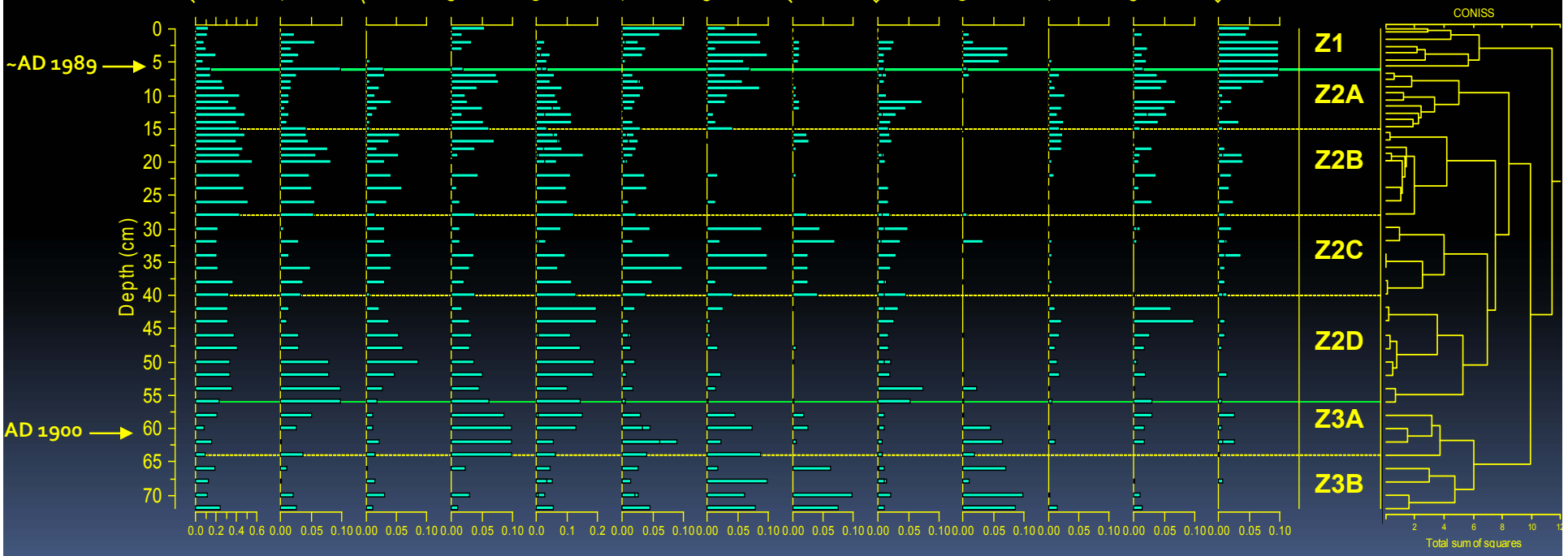
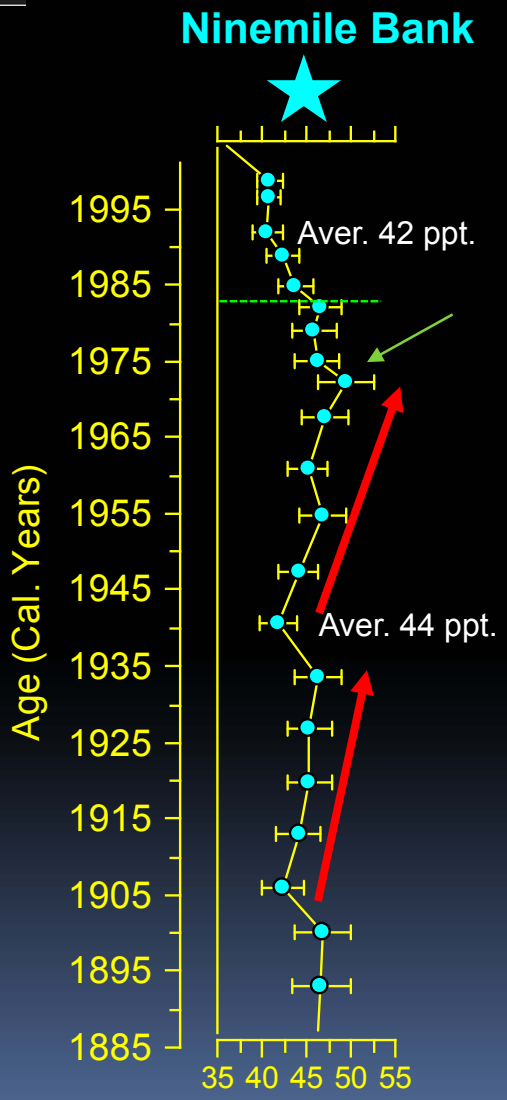
Shark River (Entrance to Ponce de Leon Bay)

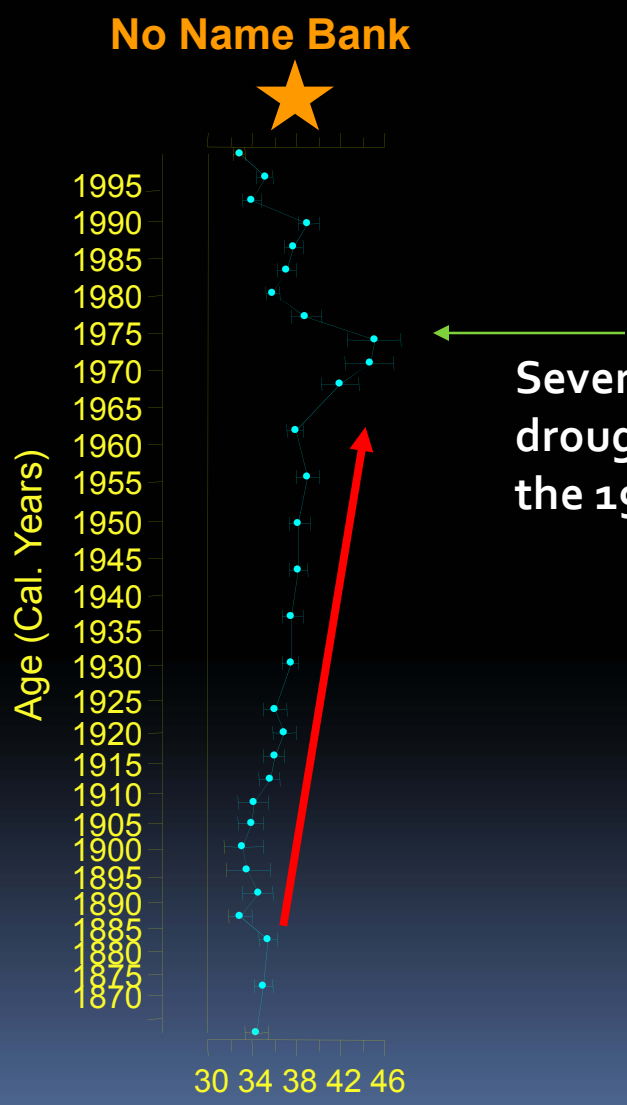
deeper water/G. of M. taxa





Changes in Salinity in Florida Bay & Biscayne Bay





Severe droughts of the 1970s

Salinity (ppt.)

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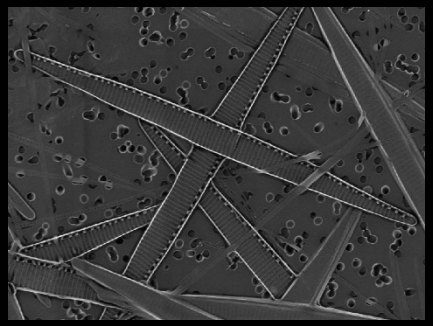
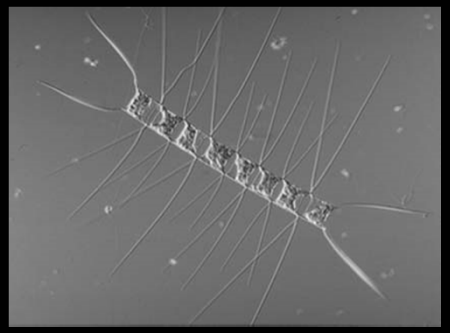
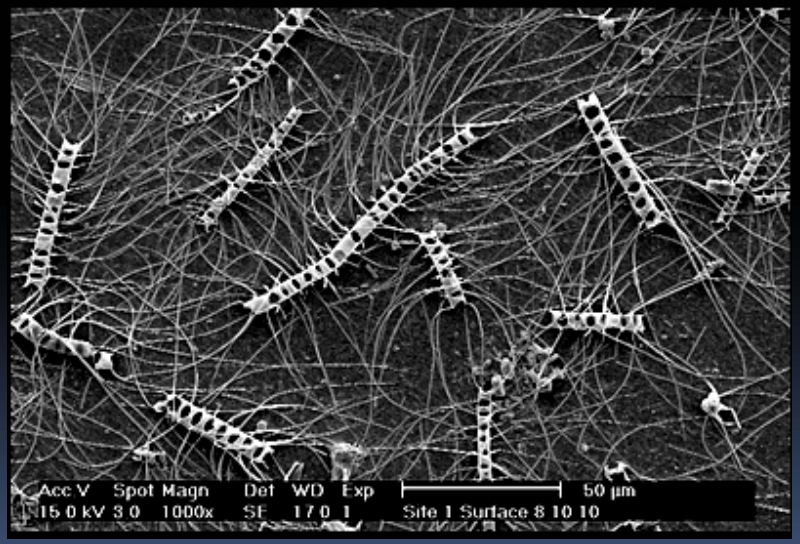
Wachnicka et al. (2013b, 2013c)

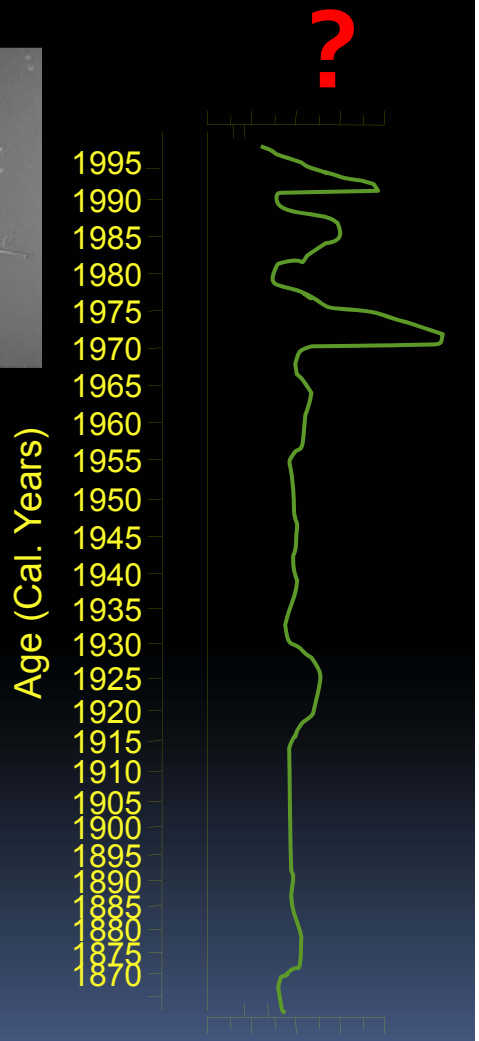
Are Algal Blooms More Frequent Now then in the Past?

Lindsey Visser (NOAA) shows a sampling net slimed by algae during a survey of Biscayne Bay (July 2013)









Conclusions

- Largest changes in community structure in the 1940s, 1950s, 1960s coincided with major hydroscape changes in South Florida

- Changes in community structure in the mid-1950s, & early 1960s, 1970s coincided with severe drought events followed by period of increased precipitation

- The early 1960s shits also coincided with 3 major hurricanes

- The mechanisms of rising salinity levels at Ninemile Bank & No Name Bank since 1900 are unclear (precipitation was actually above aver. then….; links to sea level rise?)




ACKNOWLEDGMENTS

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