SHIFTING LONG-TERM BIOGEOCHEMICAL BASELINES: TESTING NUTRIENT SYNCHRONY WITH ENHANCED MARINE CONNECTIVITY IN COASTAL WETLAND ECOSYSTEMS

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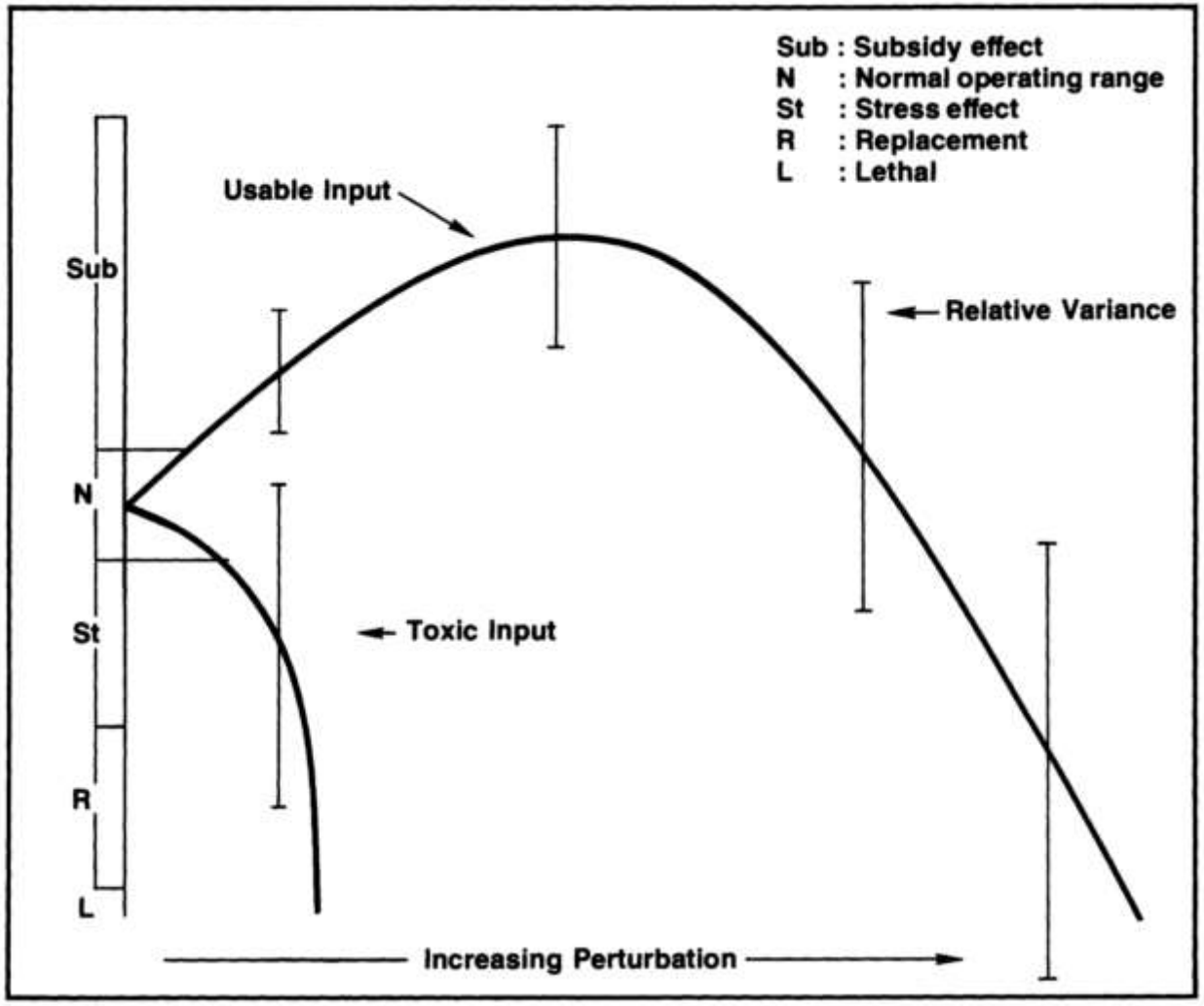
Perturbation Theory



Subsidy = favorable deflections

Stress = unfavorable deflections

Odum et al. (1979) *BioScience*

(A)synchrony in Ecology: space and time

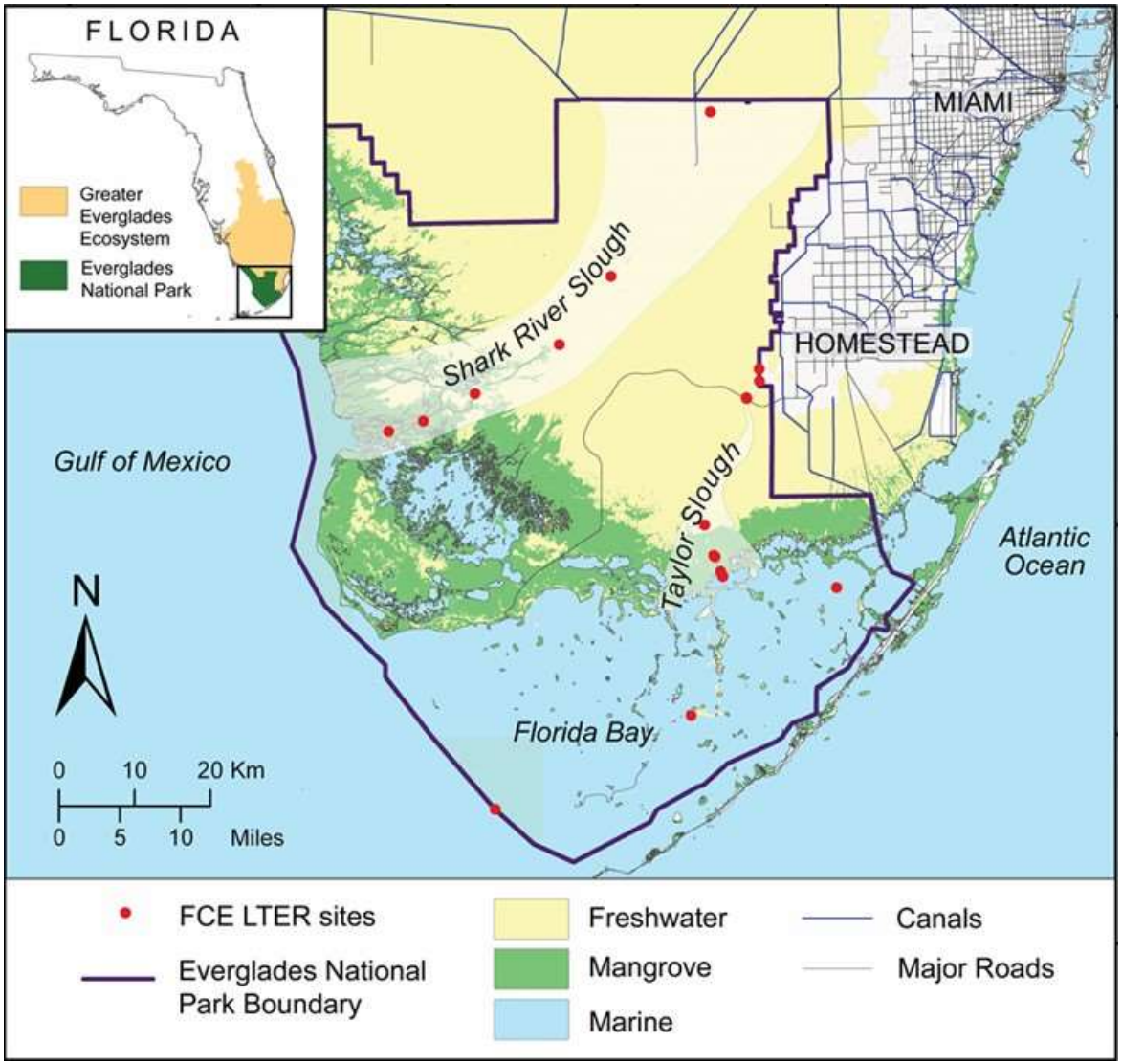
- Degree of **synchrony** among neighboring locations in a landscape indicate the relative influence of regional climate and hydrology (Baines et al. 2000 *Ecology*)

- Hydrologic and ecological connectivity among ecosystems integrate **spatial** and **temporal** variation in drivers and responses. (Jackson and Pringle 2010 *BioScience*)

- How do environmental fluctuations integrate ***subsidy*** and ***stress*** effects to explain spatiotemporal patterns of (a)synchrony among ecosystems (Moran effect)?

(Moran 1953 *Aust. J. Zool.*)

Florida Coastal Everglades
Long Term Ecological Research



Subtropical freshwater and estuarine wetlands

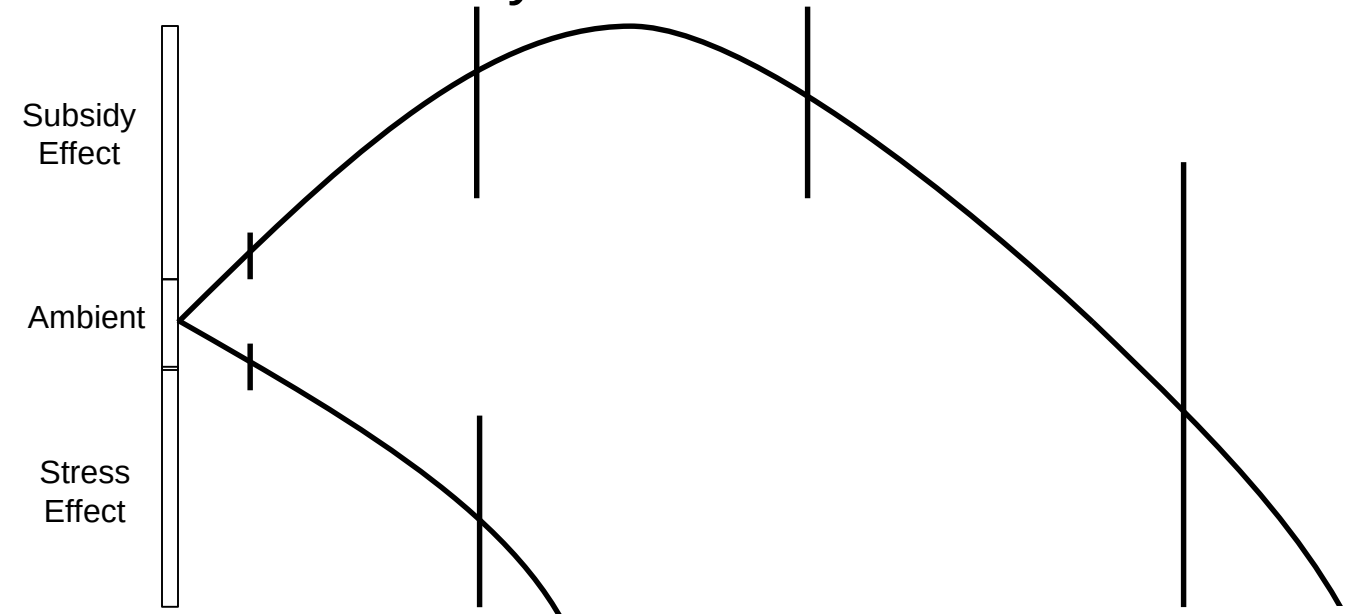
Extreme P-limitation

P sources:
freshwater – lower, discrete seasonal load

marine – higher, diffuse seasonal, tidal, events

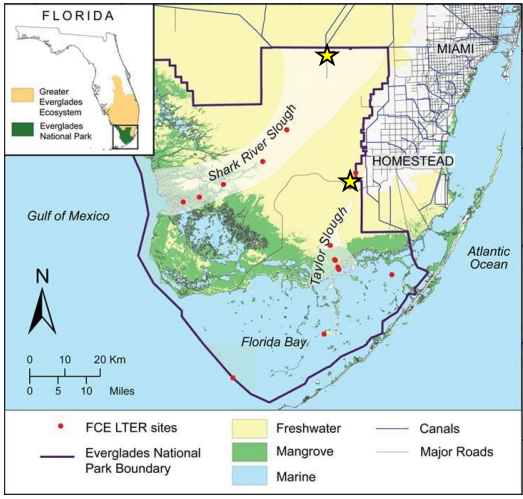
Balance of fresh and marine water on biogeochemistry

1) What are the spatiotemporal scales of P (a)synchrony?
2) What are the drivers of P (a)synchrony?
3) How does P (a)synchrony vary within/among ecosystems due to environmental fluctuations (Moran effect) and distance decay?

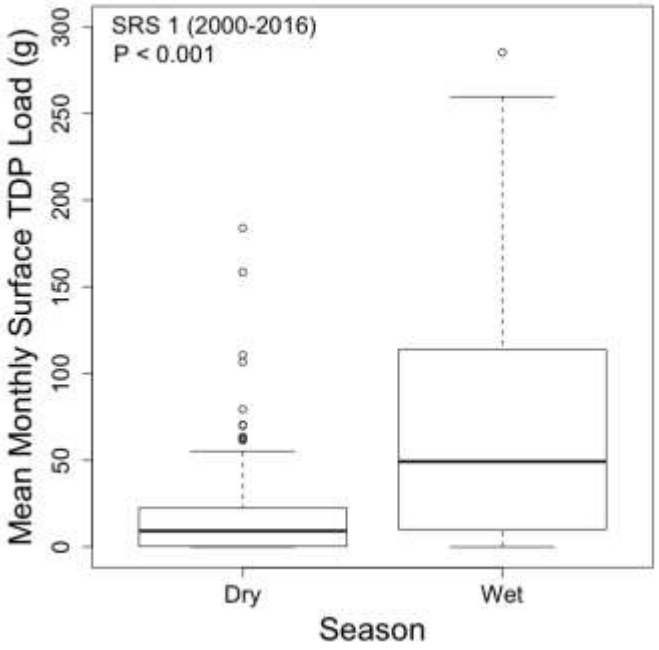


revised from Odum et al. (1979) *BioScience*

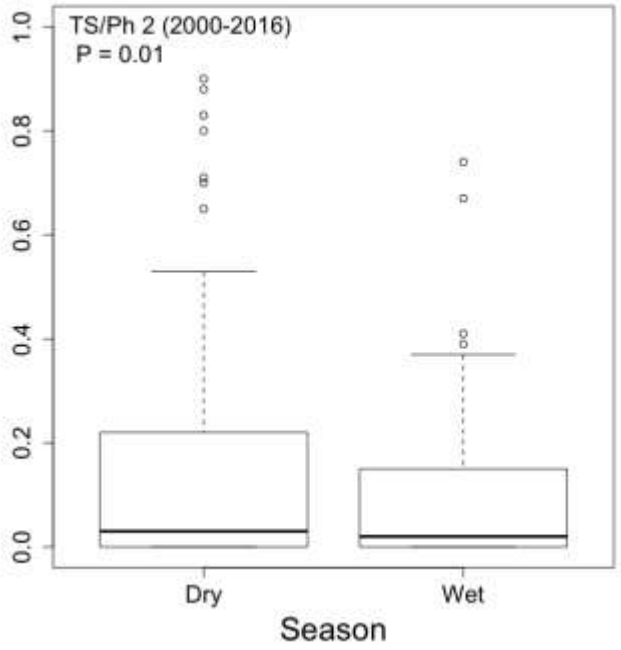
Freshwater P driven by wet-dry seasonality in flow load and drought-induced release.



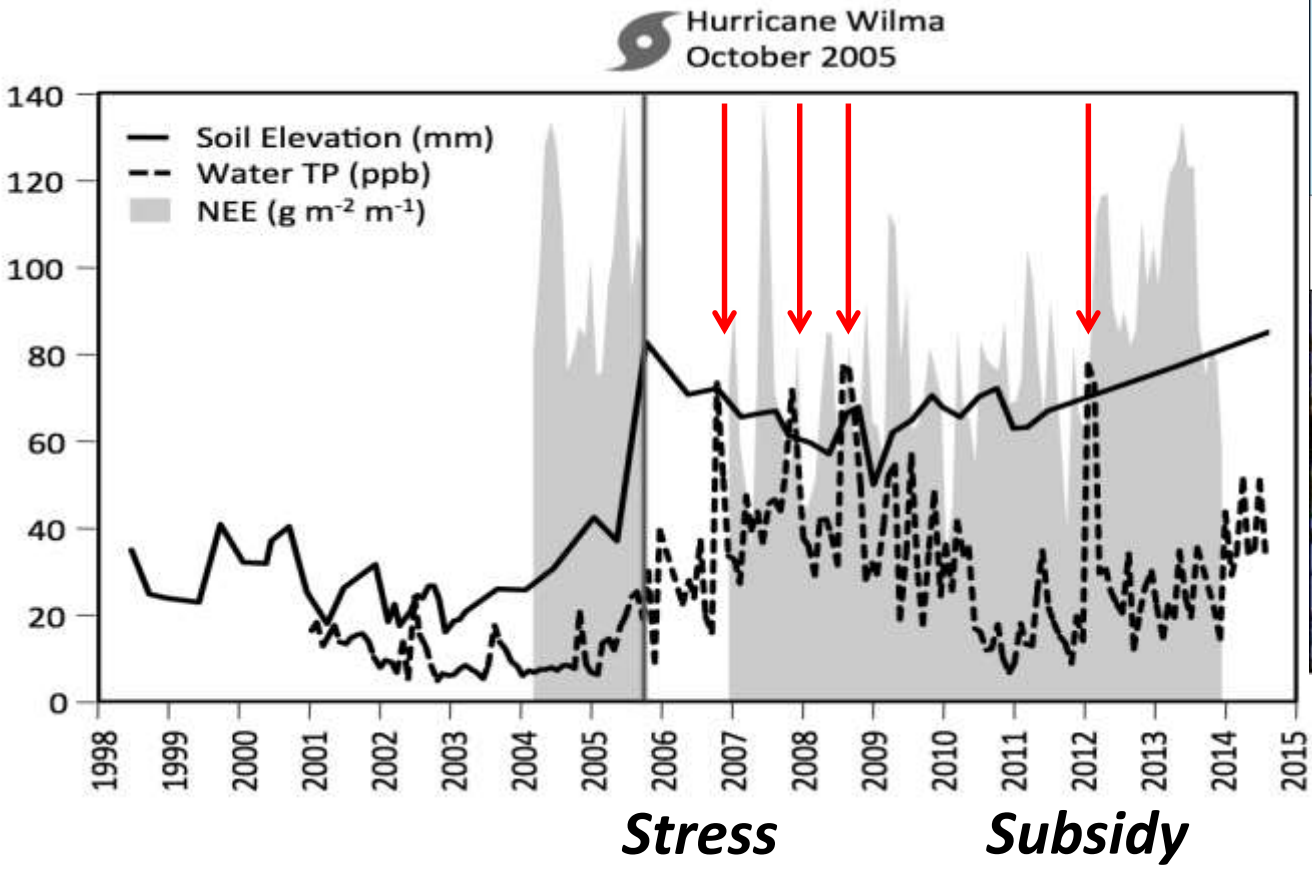
Subsidy?

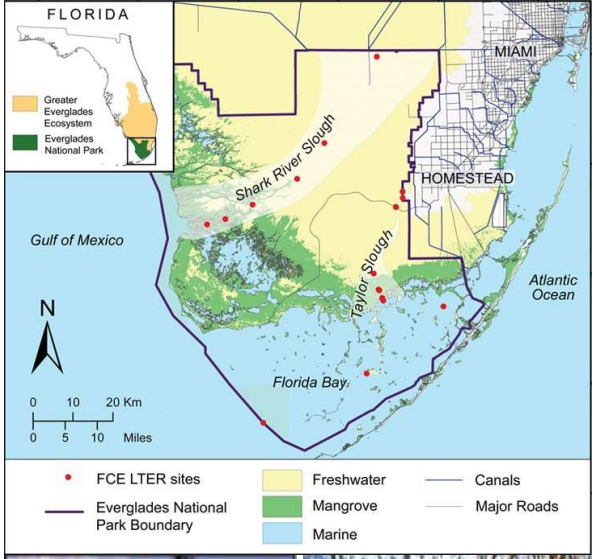


Stress?

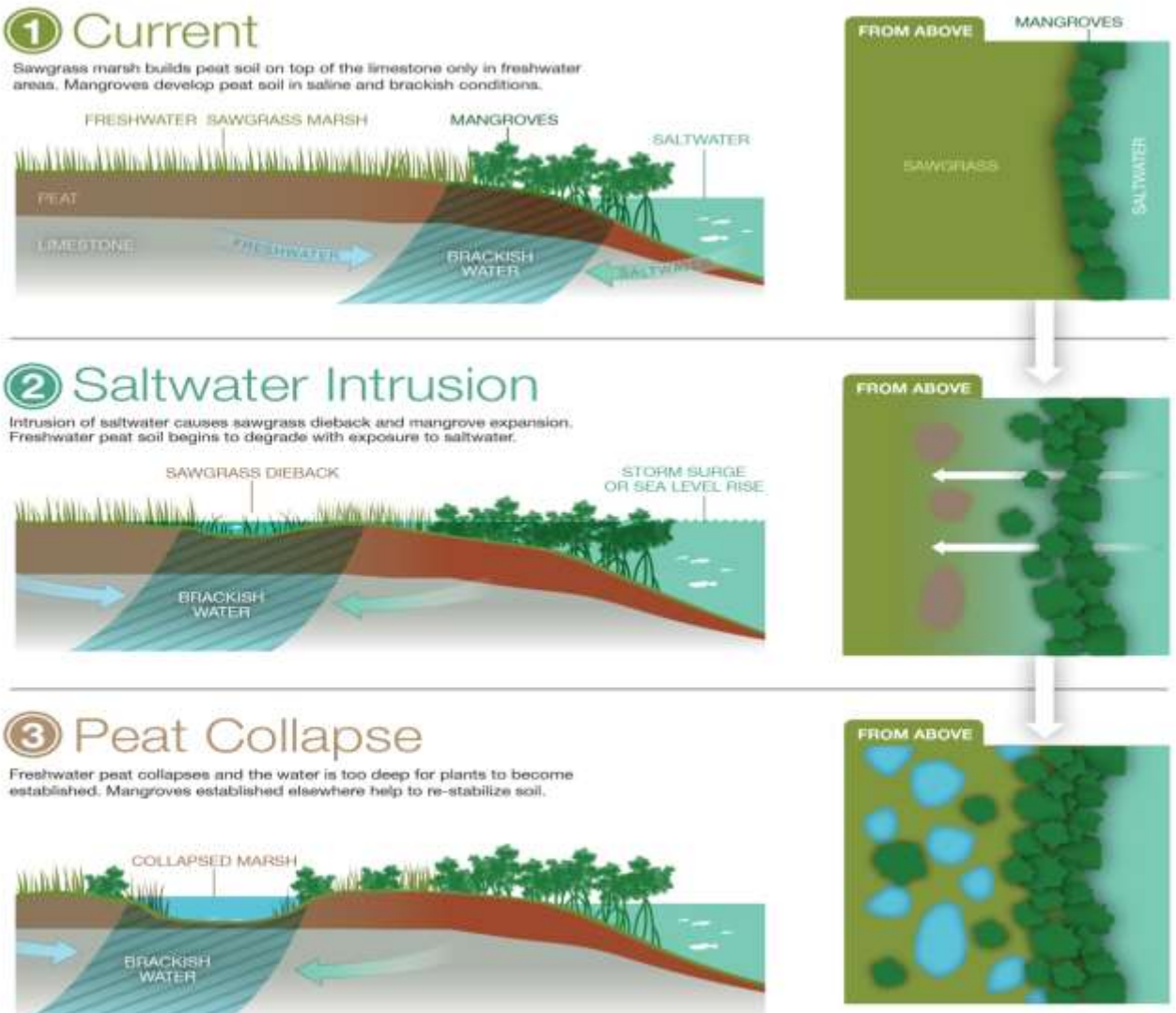


Strong marine forcings (tides, storms, SLR) increase TP and ecosystem resilience.





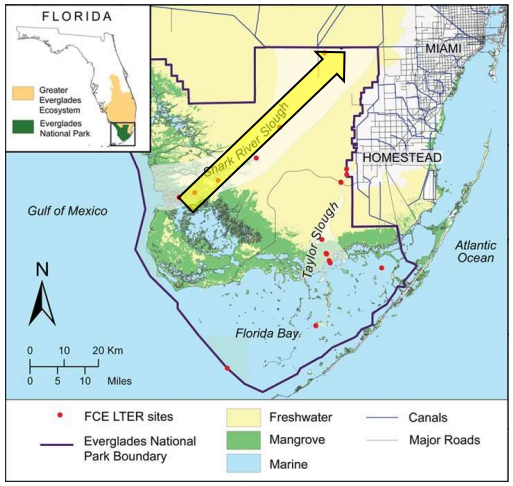
Peat Collapse = Stress



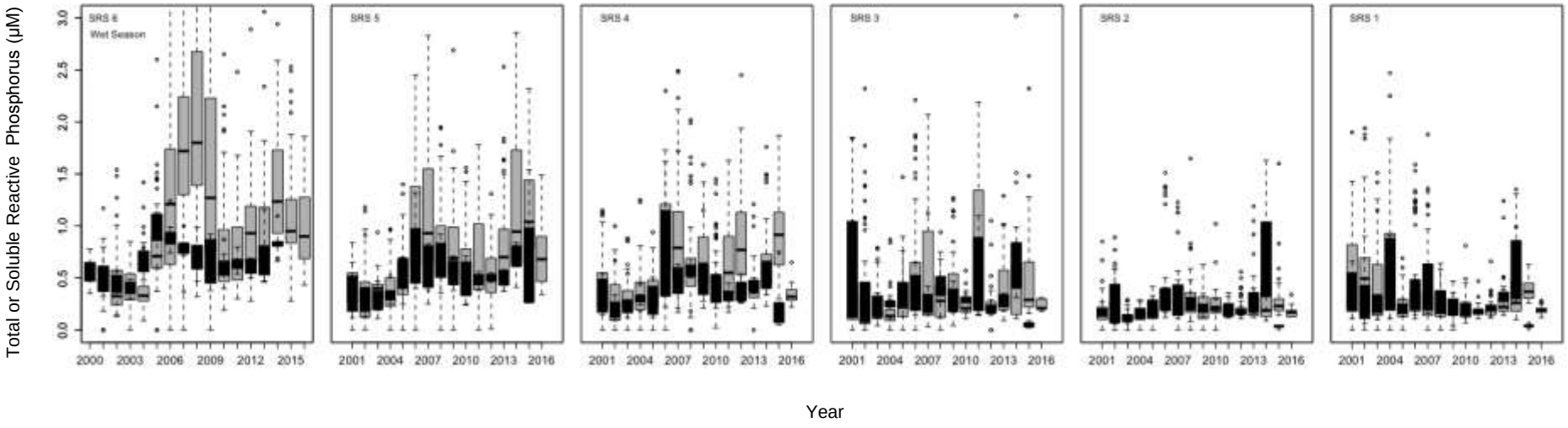
Davis and Hernandez 2016 H2H Graphics

Shark River Slough (wet season):

- Surface brackish **TP** increased by up 3× above **SRP** from 2005-2016.
- Estuarine P subsidizes marsh

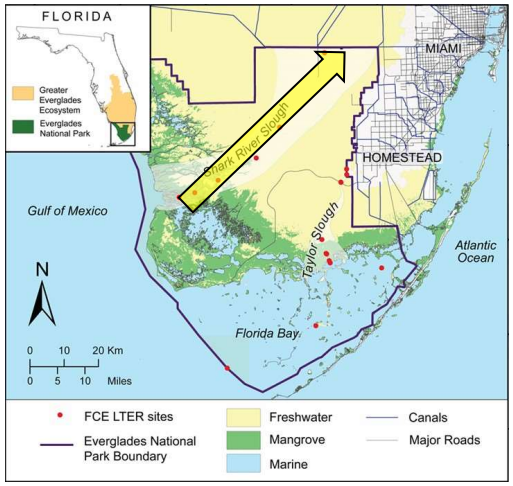


Estuarine ***Freshwater***

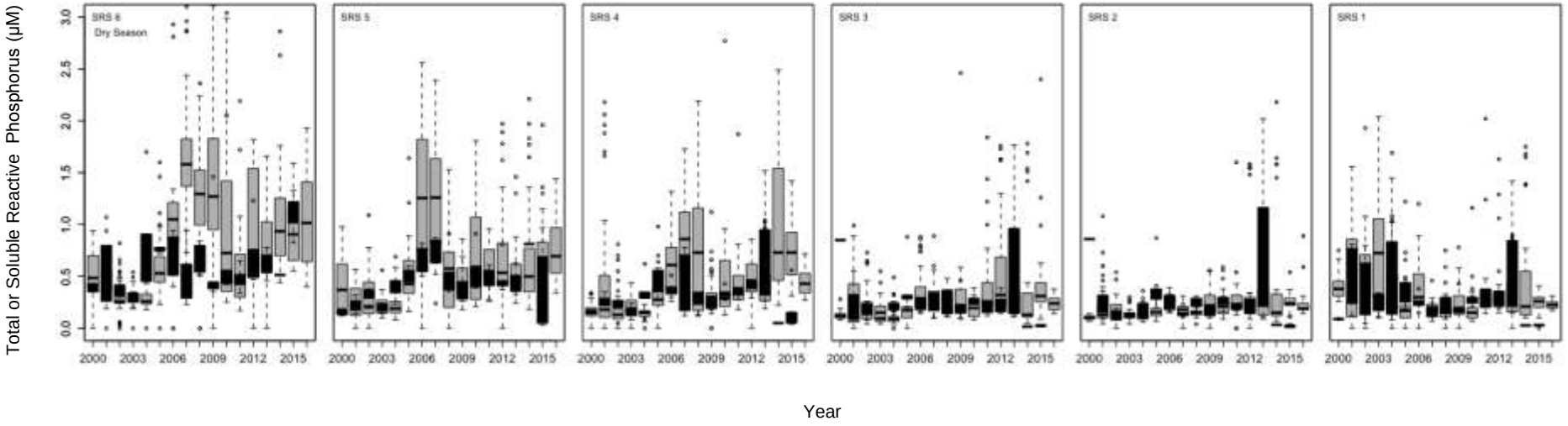


Shark River Slough (dry season):

- Surface brackish **TP** increased by up 2× above **SRP** from 2005-2016.
- Estuarine P subsidizes marsh
- Drought-induced P release in marsh

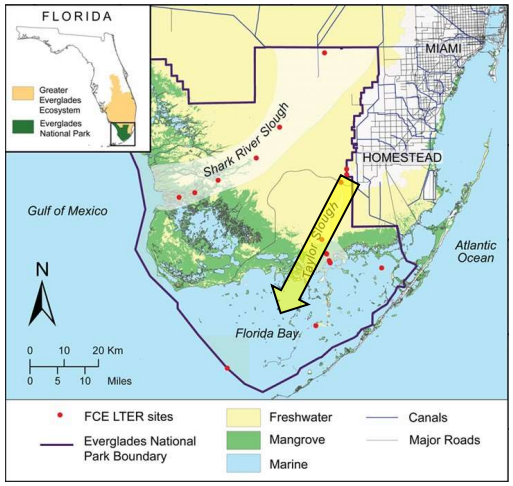


Estuarine ***Freshwater***

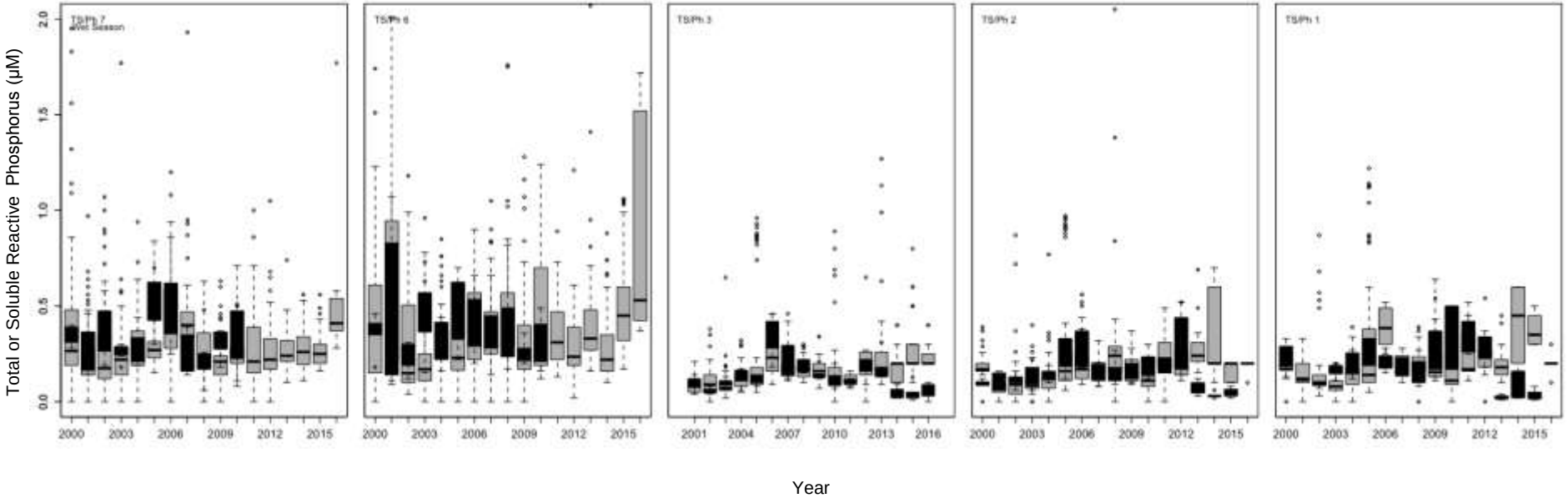


Taylor Slough (wet season):

- Surface TP and **SRP** low, similar, and variability brackish > freshwater

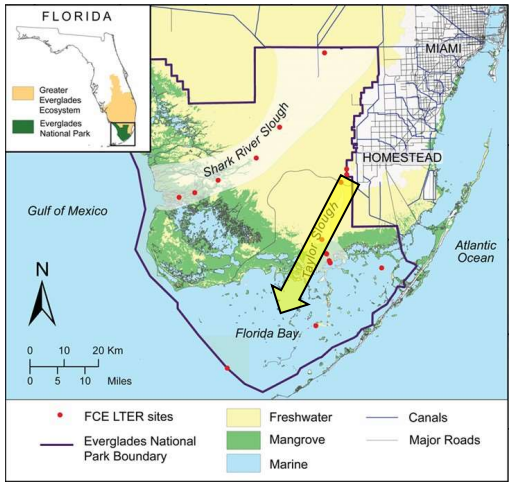


Estuarine ***Freshwater***

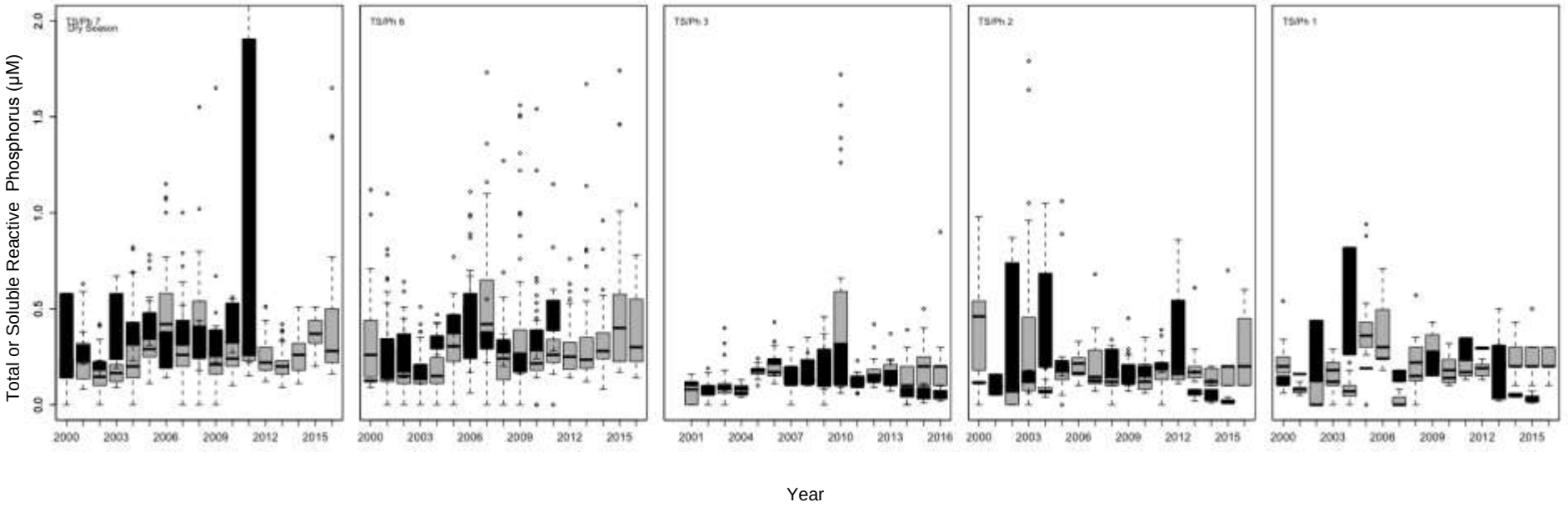


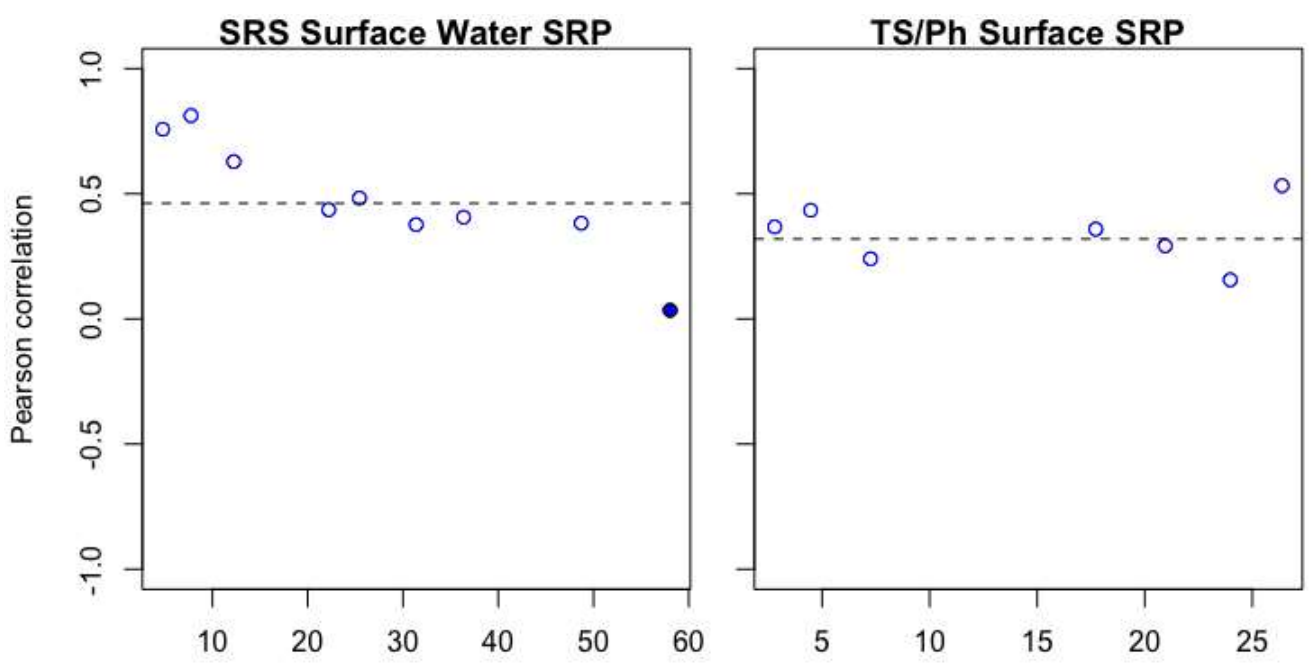
Taylor Slough (dry season):

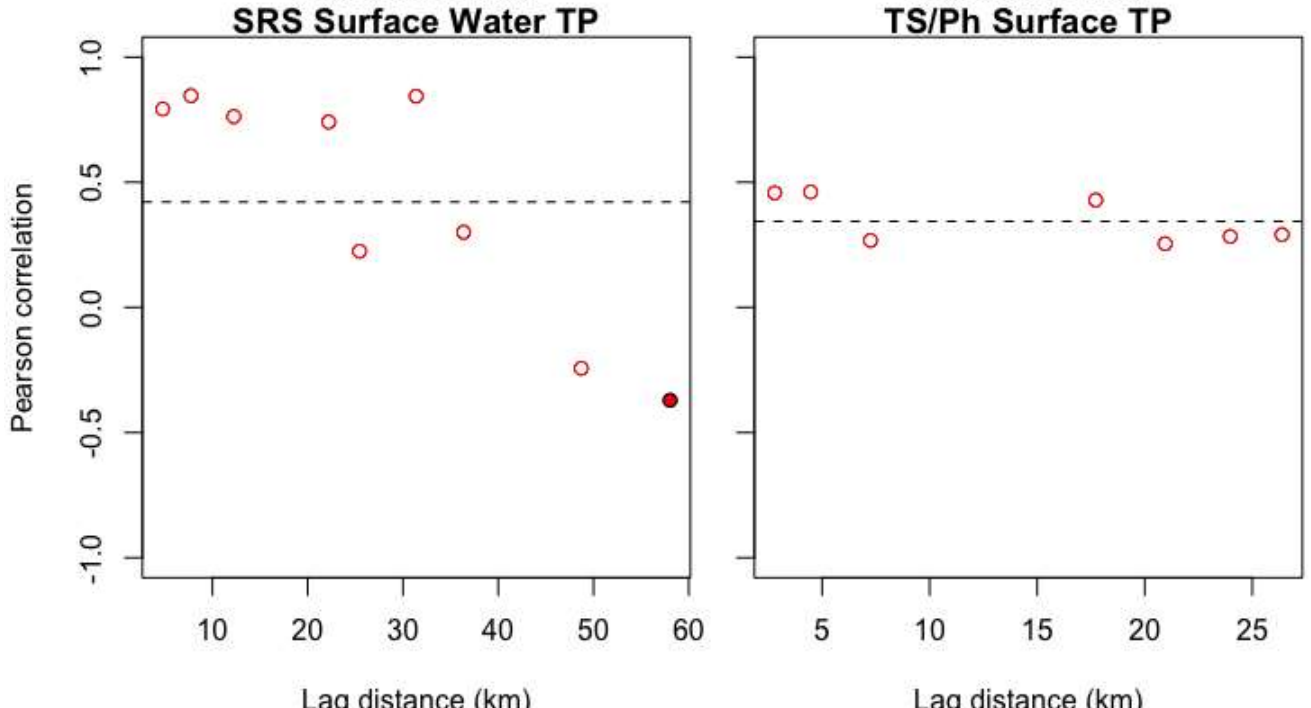
- Surface TP and **SRP** low, similar, and variability brackish > freshwater
- Groundwater upwelling and drought-induced P release

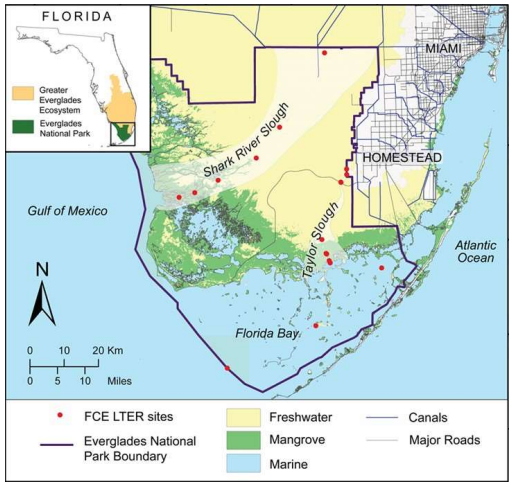


Estuarine ***Freshwater***





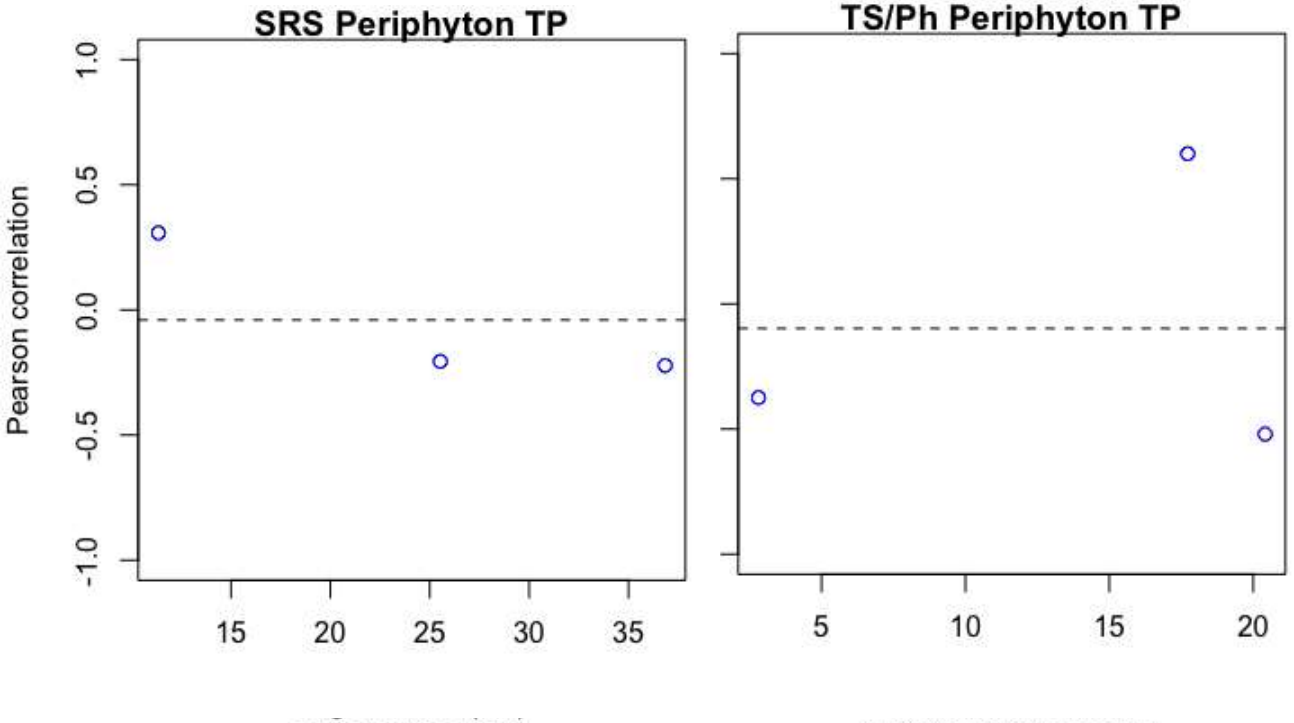


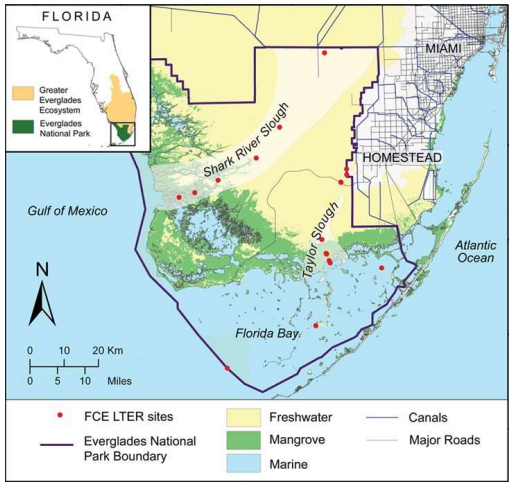


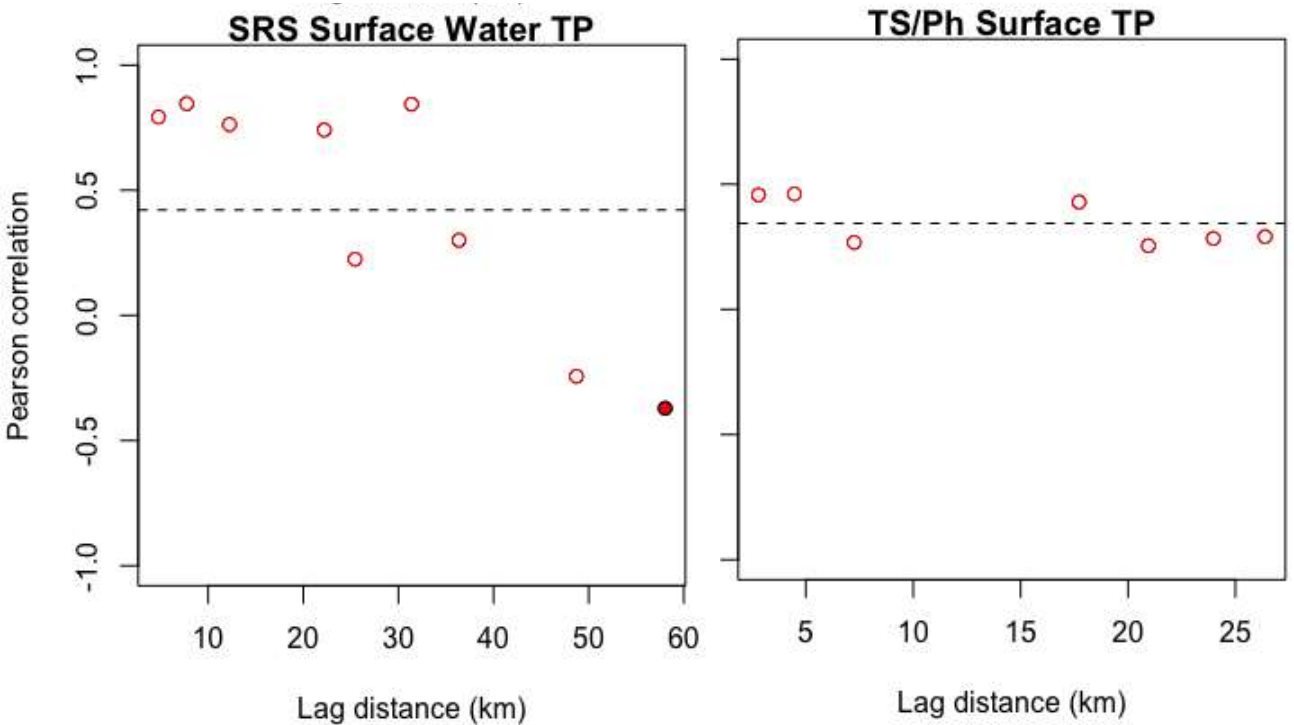
Spatial synchrony:

Surface SRP and
Surface TP

SRS asynchronous
TS/Ph synchronous



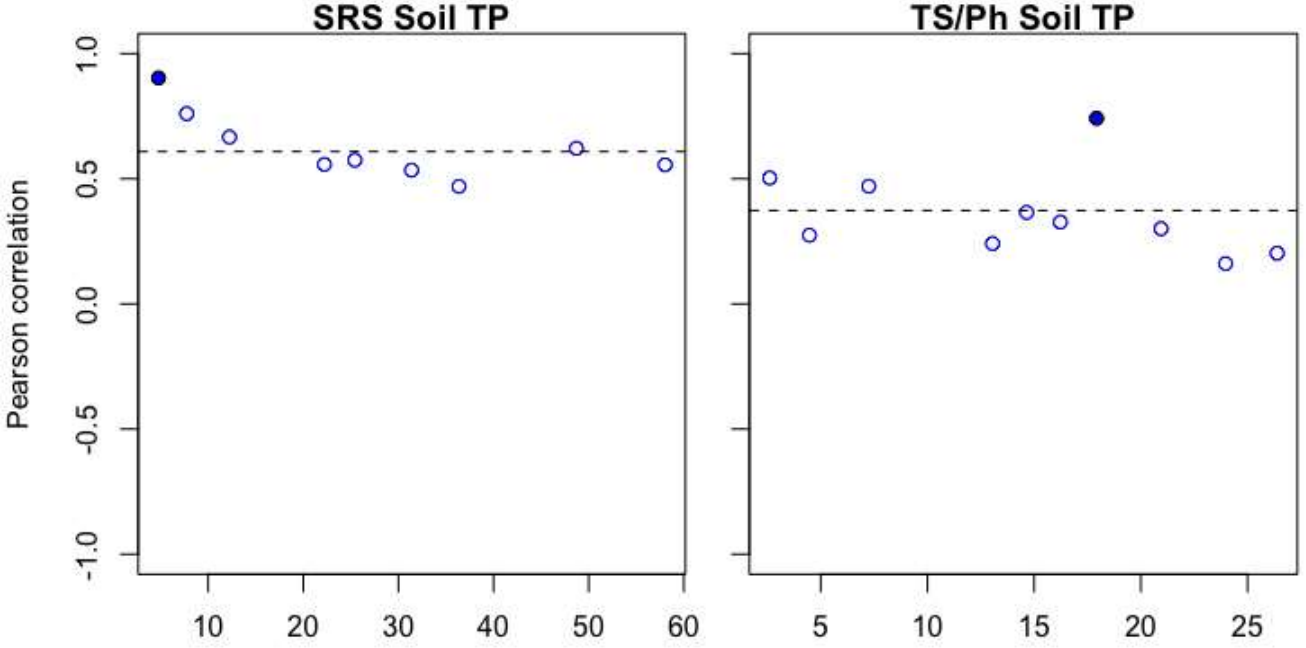


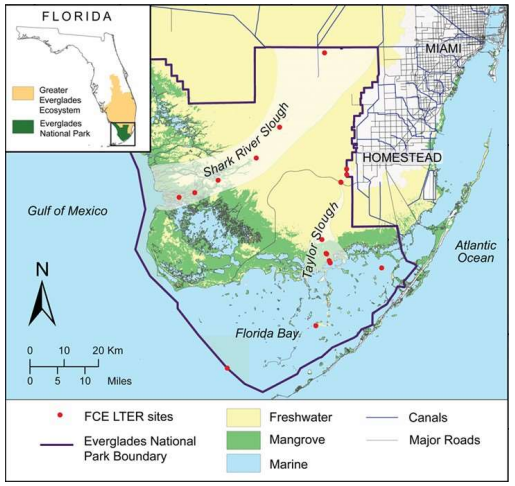


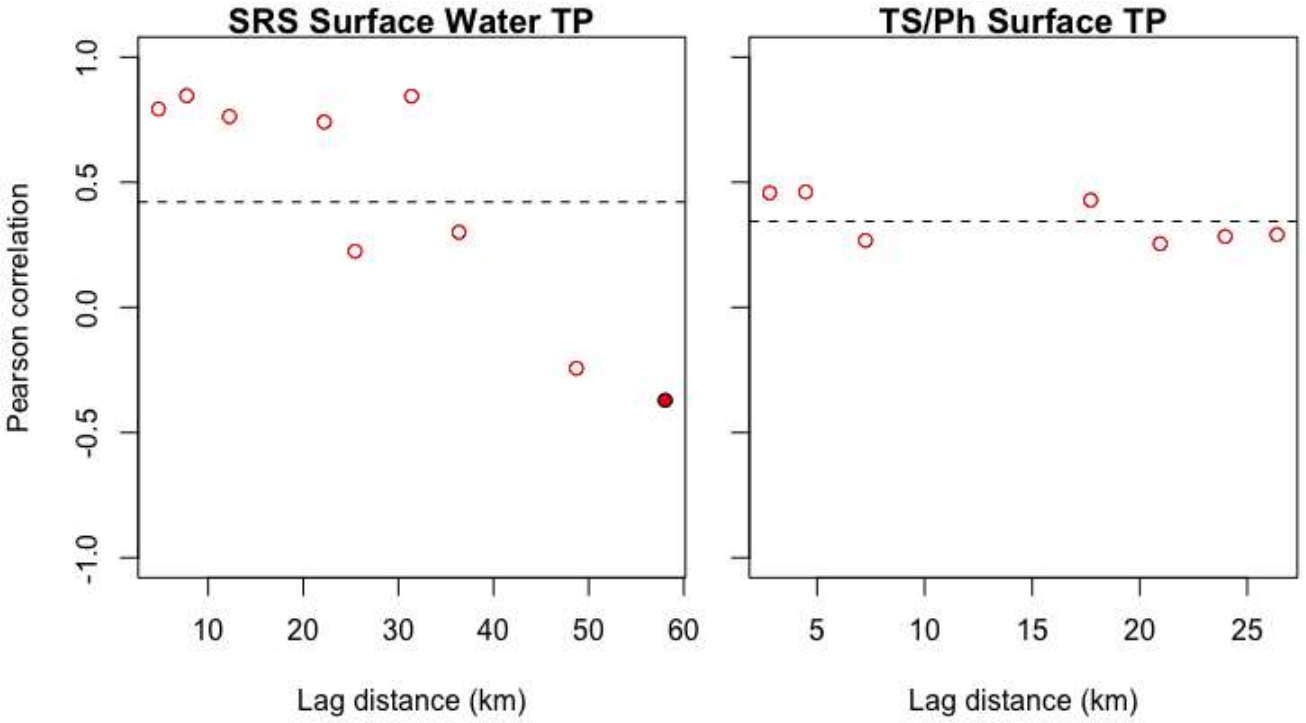
Spatial synchrony:

Periphyton TP and **Surface TP**

SRS and TS/Ph asynchronous



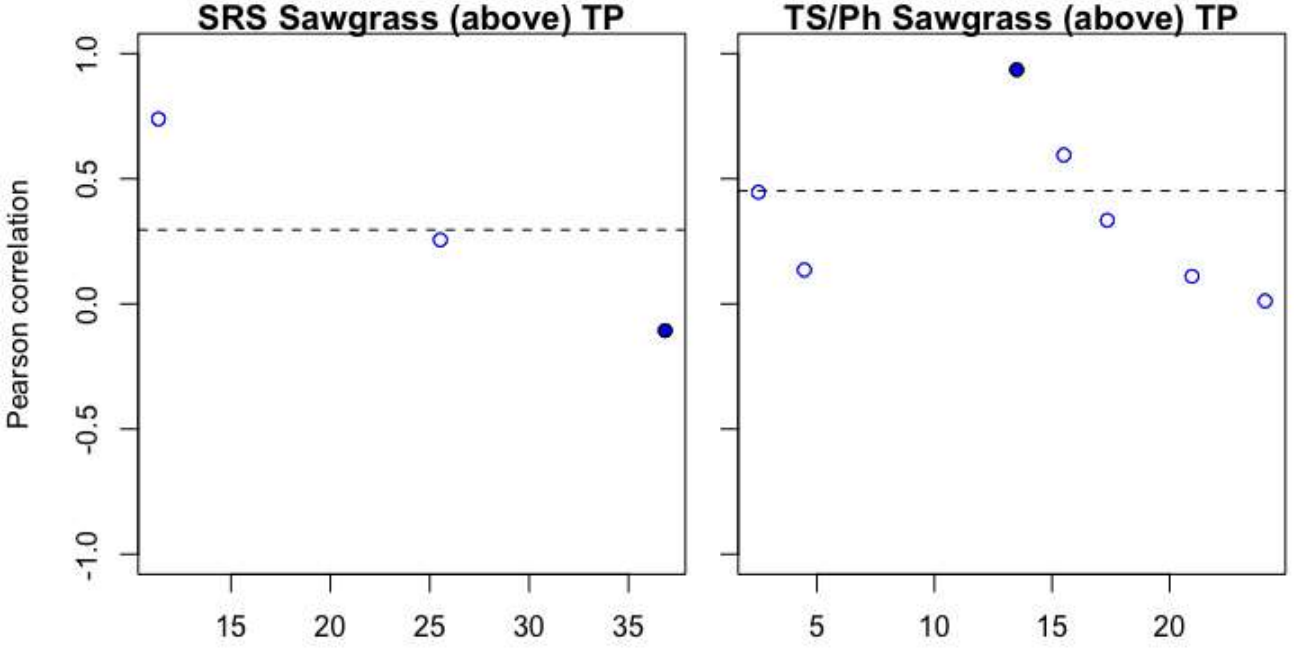


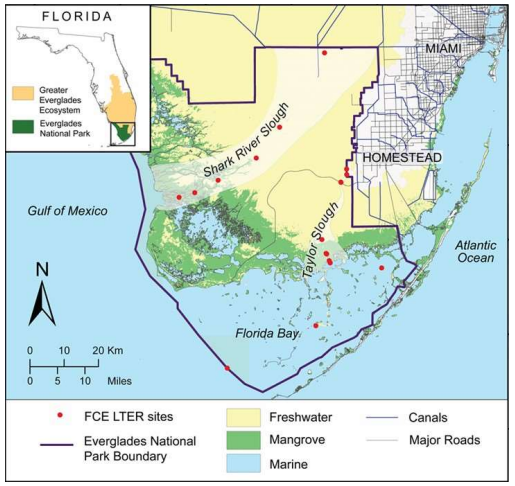


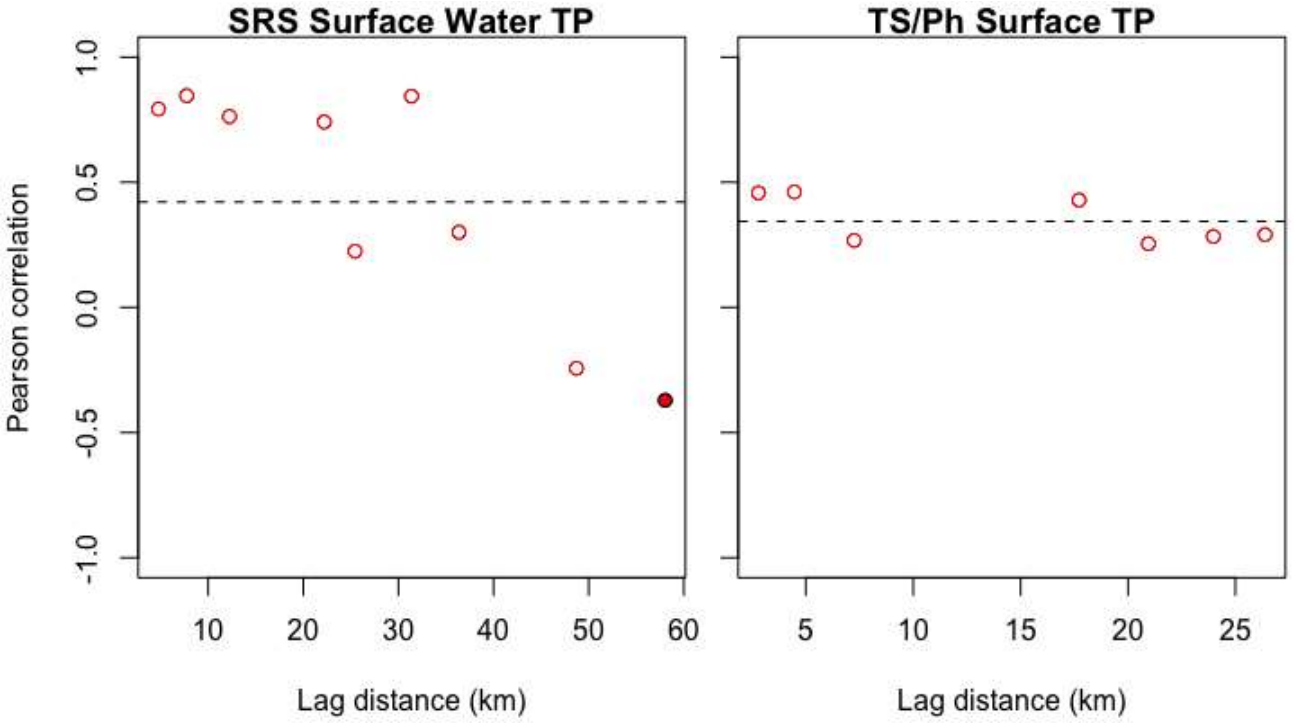
Spatial synchrony:

Soil TP and **Surface TP**

SRS asynchronous
TS/Ph asynchronous



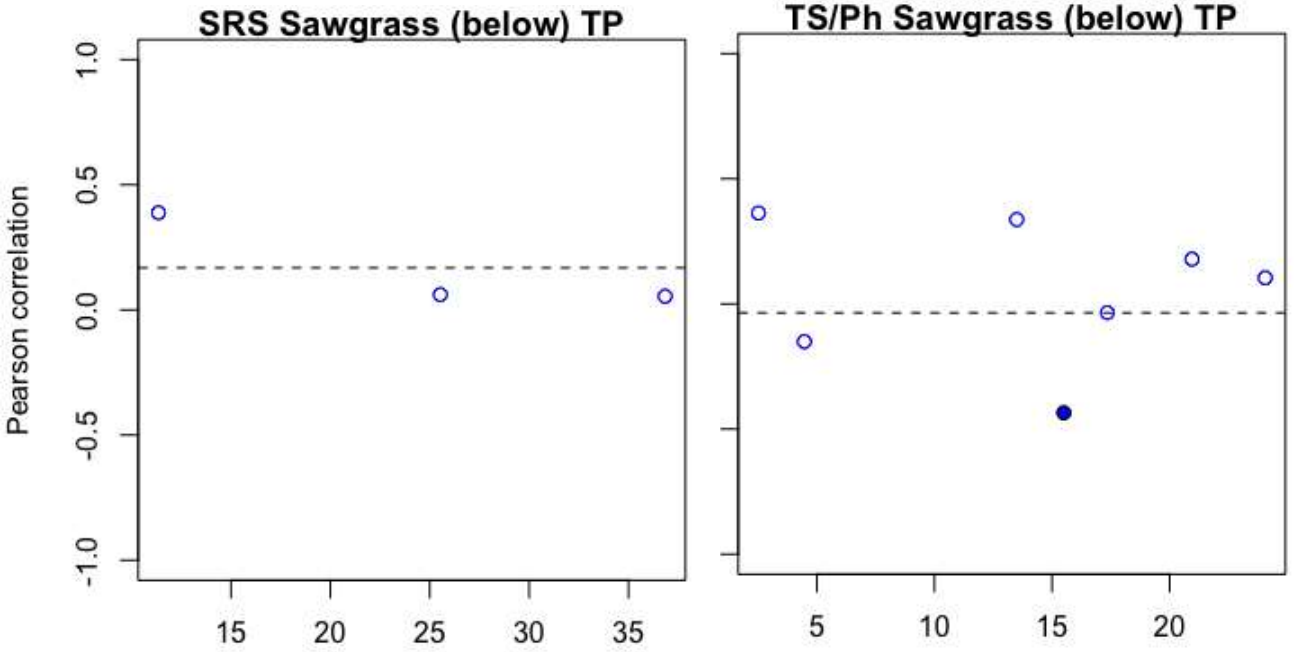


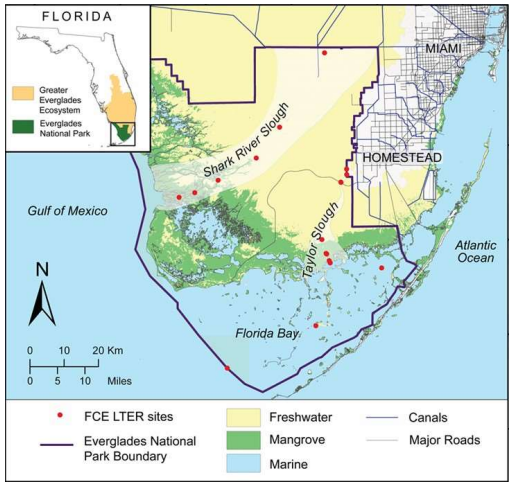


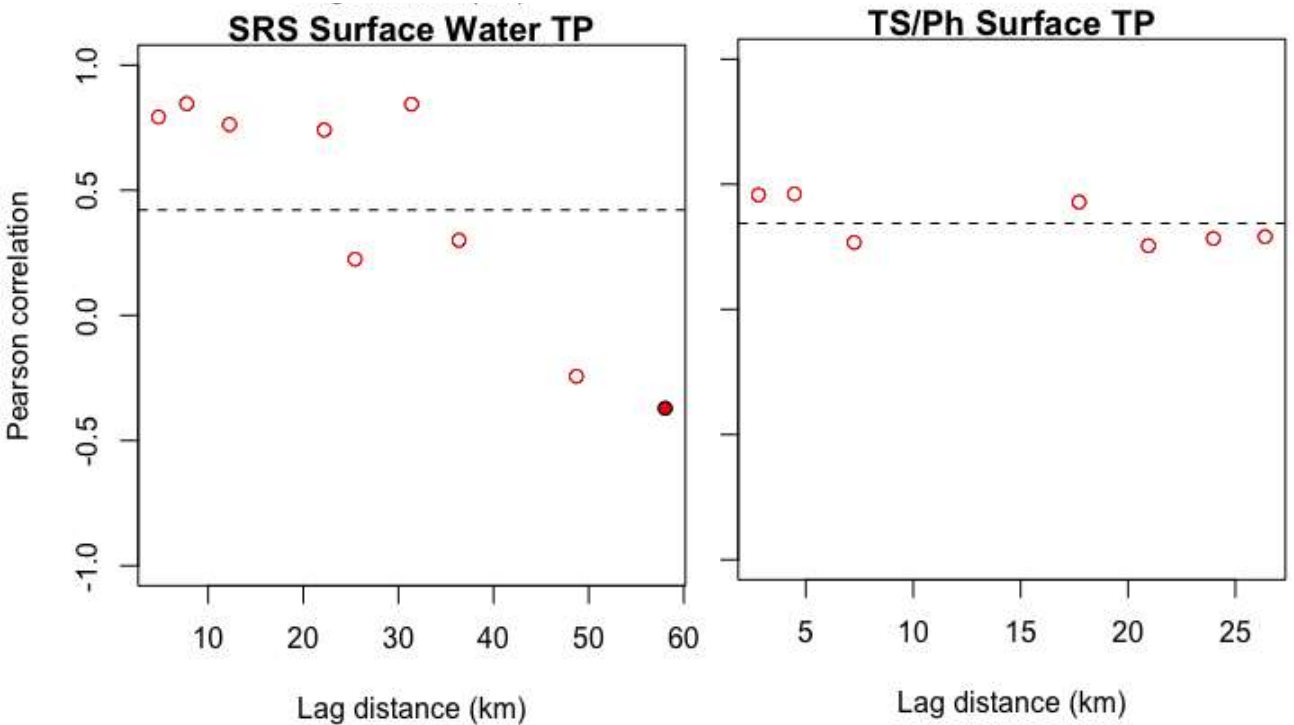
Spatial synchrony:

Sawgrass (above) TP and **Surface TP**

SRS and TS/Ph asynchronous



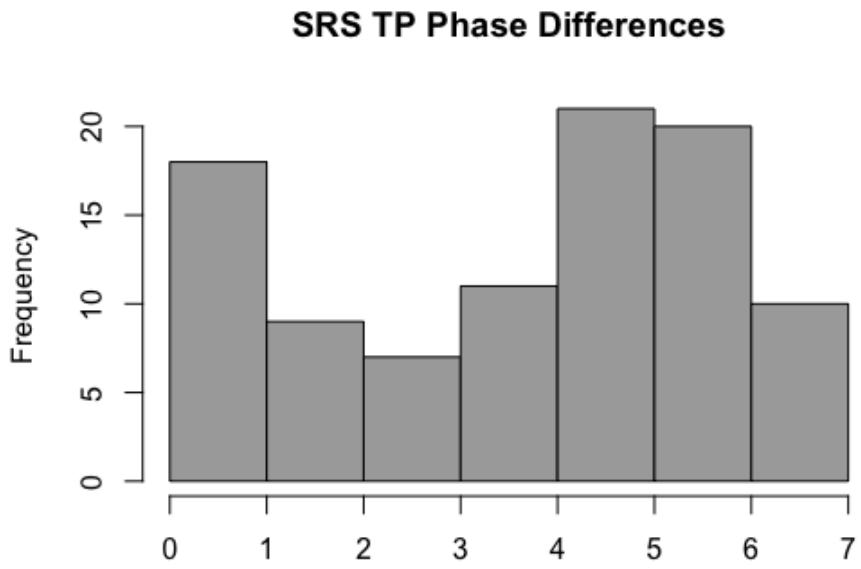


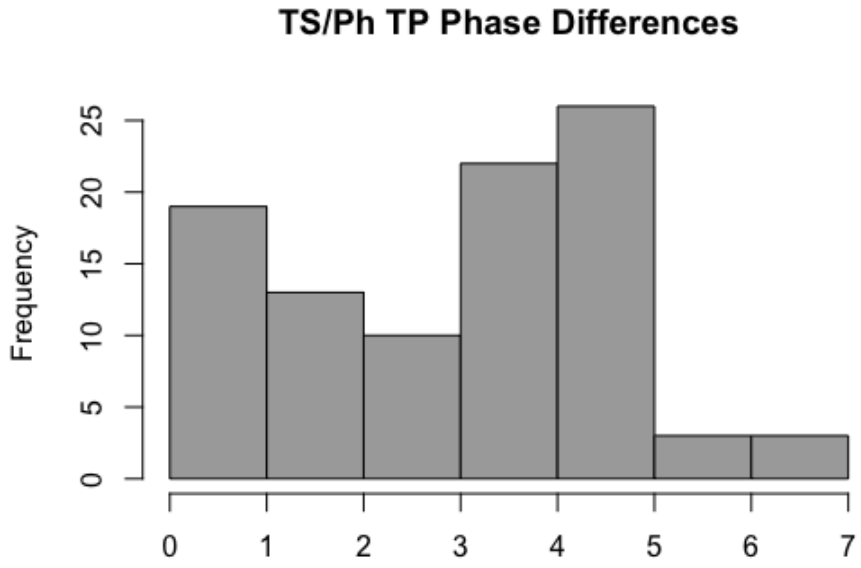


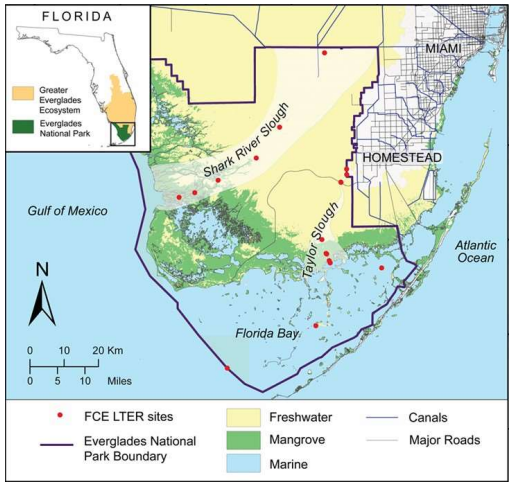
Spatial synchrony:

Sawgrass (below) TP and **Surface TP**

SRS and TS/Ph asynchronous





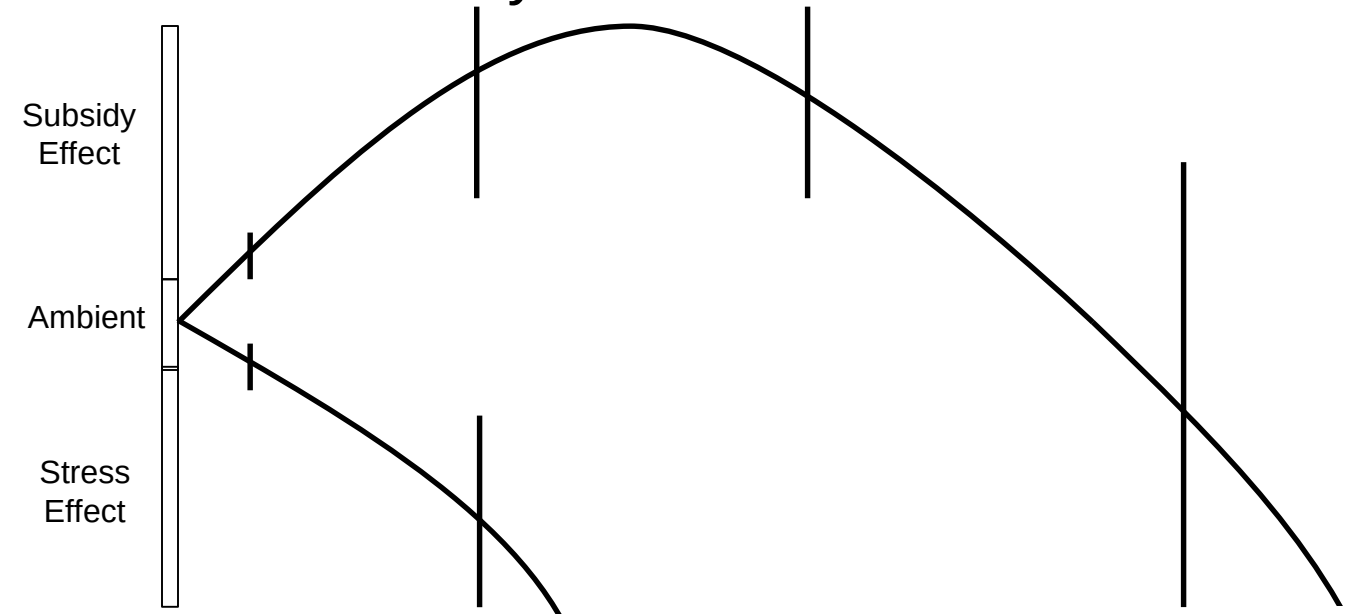


<u>Temporal synchrony:</u>
Surface TP and **Plant-Soil TP** for SRS and TS/Ph are not *phase-locked* (max. – min. phase)

Heterogeneity in temporal variance of TP indicates plant-soil TP storage

Balance of fresh and marine water on biogeochemistry

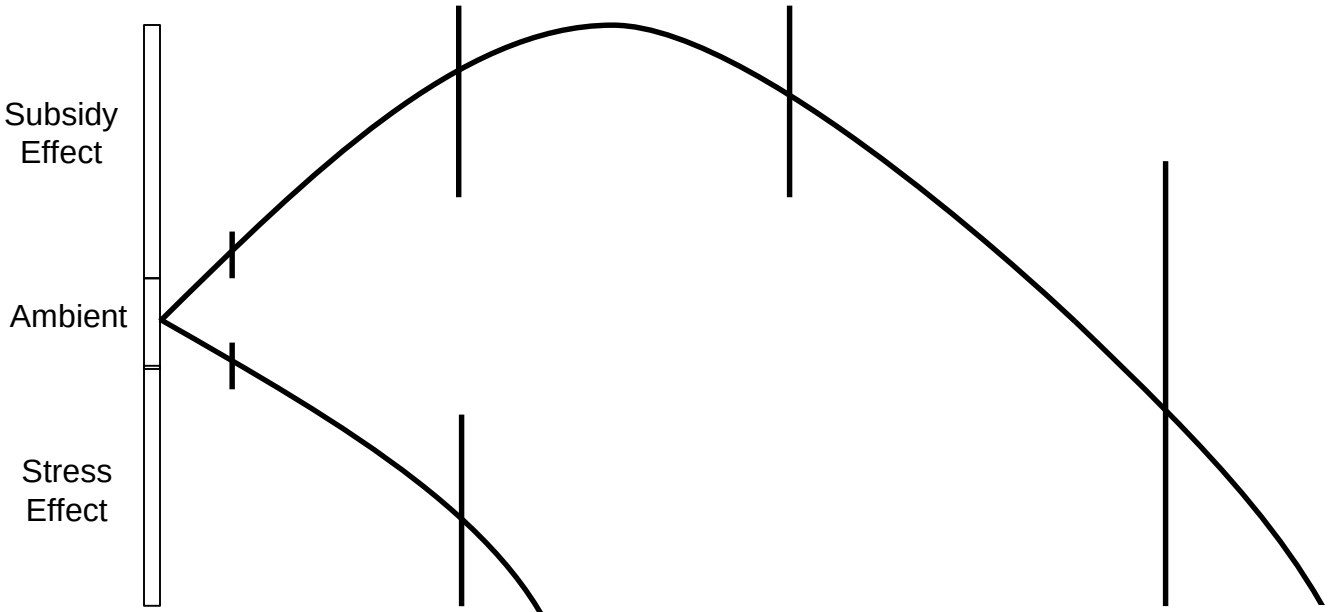
1) What are the spatiotemporal scales of P (a)synchrony?
2) What are the drivers of P (a)synchrony?
3) How does P (a)synchrony vary within/among ecosystems due to environmental fluctuations (Moran effect) and distance decay?



revised from Odum et al. (1979) *BioScience*

Balance of fresh and marine water on biogeochemistry

1) What are the spatiotemporal scales of P (a)synchrony?
   - SRS: synchrony estuarine-freshwater ecotone
   - TS: asynchrony ecotone vs. estuary & marsh



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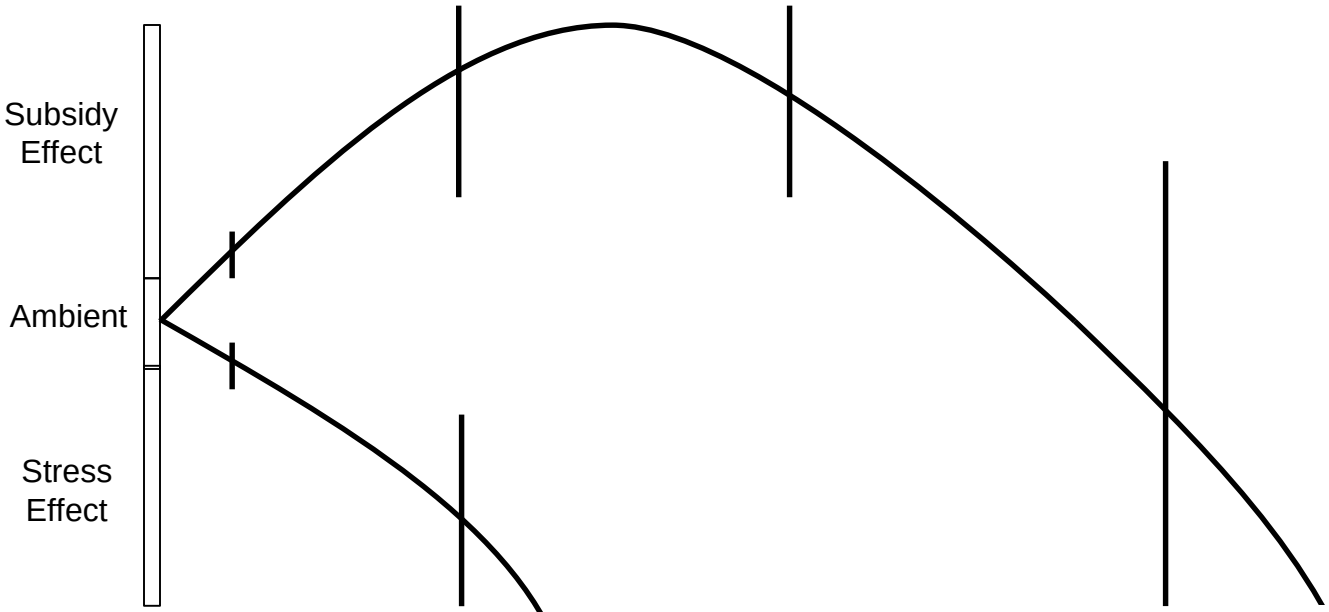
Balance of fresh and marine water on biogeochemistry

2) What are the drivers of P (a)synchrony?
   - Marine transgression and drought in freshwater marshes
   - Freshwater restoration?



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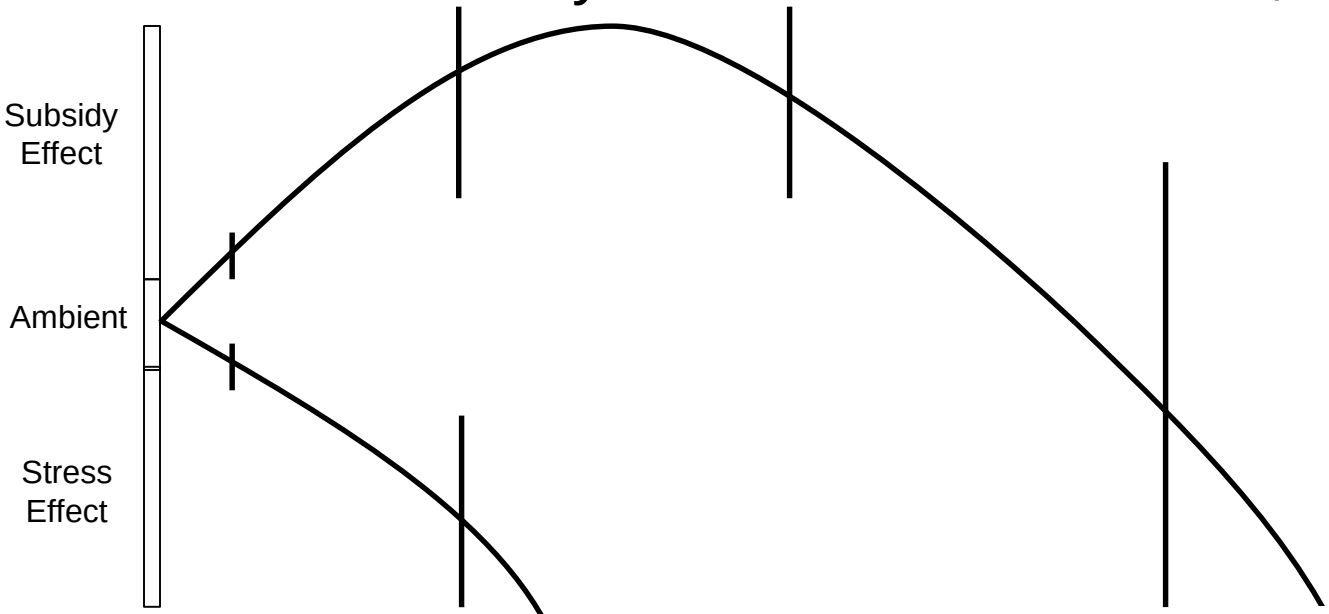
Balance of fresh and marine water on biogeochemistry

3) How does P (a)synchrony vary within/among across ecosystems due to environmental fluctuations (Moran effect) and distance decay?
   - Plant-soil TP storage drives differences in phases
   - Distance decay of surface TP SRS>TS, less plant-soil



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Acknowledgements

Co-authors: Edward Castaneda-Moya, Stephen Davis, Evelyn Gaiser, Luca Marazzi, Victor Rivera-Monroy, Andres Sola, Donatto Surratt, Rafael Travieso, Tiffany Troxler

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