Water level and surface salinity trends in the Everglades freshwater-saline ecotone

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Introduction

- Sea-level-rise brings both stresses (salinity)[1] and nutrient subsidies (phosphorus)[2] to freshwater coastal ecosystems, causing ecotone development [3].
- The Everglades freshwater-saline ecotone is defined here by the plant communities of mixed salinity tolerances between coastal mangrove forests and inland freshwater marl prairies on the southeast coast [4, 5].
- It is not clear if salinity changes in the ecotone are due to presses (sea-level-rise)[6], pulses (disturbances that introduce saltwater and/or reduce freshwater)[7], or changes is freshwater delivery (Fig. 1)[8, 9].

The primary objective of this work is to identify marine and freshwater influences in the ecotone, by evaluating water level trends and surface salinity-water level relationships.

Q1) Does water level change across the ecotone over time?

Q2) What is the relationship between water level and salinity and does it vary spatially and temporally?

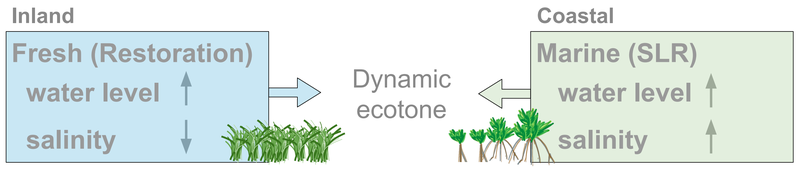

Figure 1. Conceptual diagram of competing drivers of water level and salinity within the coastal Everglades.

Methods

- Gap-filled water level time series from Everglades stations (Fig. 2) were used to:
  - analyze water level trend over the last 40 years (Fig. 3)
  - compare the last 25 years of water level trends across the landscape (Fig. 4).
- Surface salinity-water level relationships were evaluated using generalized additive models (Fig. 5)[10]. Variables included mean weekly water level, 6 month season, and categorical low or high water level (calculated as bottom and top 10% values).

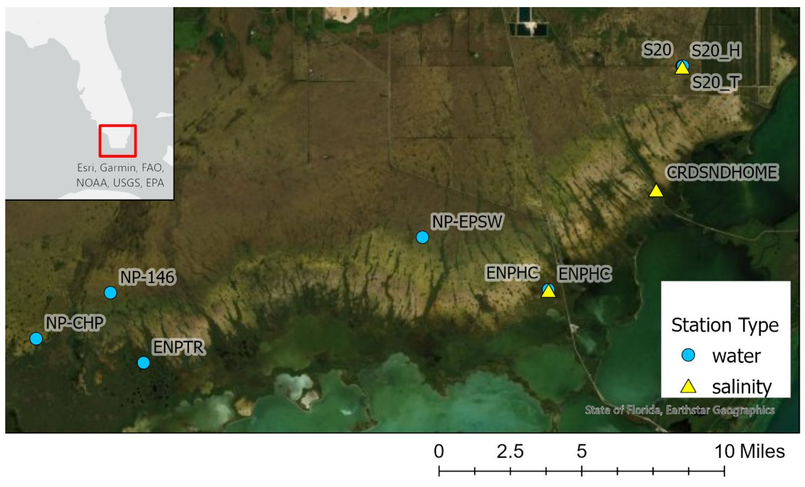

Figure 2. Water level and salinity environmental monitoring stations throughout the freshwater saline ecotone. Inland sites (NP-146, NPEPSW) are in marl prairies. Ecotone sites (NP-CHP, S20, CRDSNDHOME) are within a low productivity zone. Coastal sites (ENPTR, ENPHC) are in mangrove scrub ecosystems.

Results

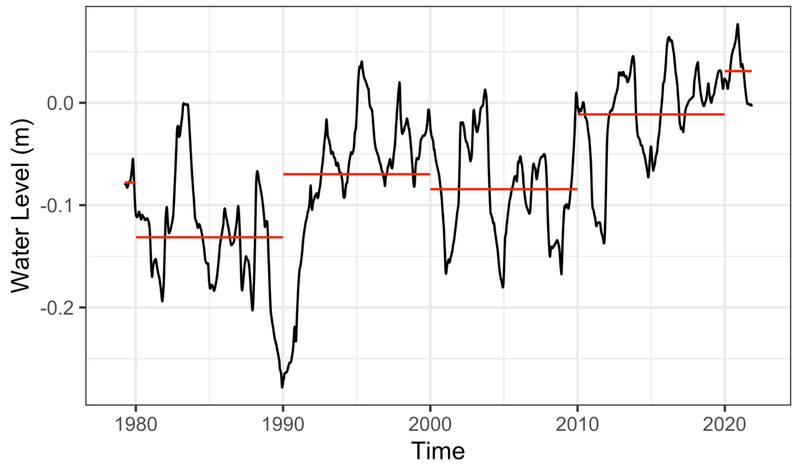

Figure 3. Seasonally corrected weekly mean water level trend for station NP-CHP from March 25, 1979 to Nov. 7, 2021. Red bars denote the mean water level for a 10 year period beginning 1970 to 1980.

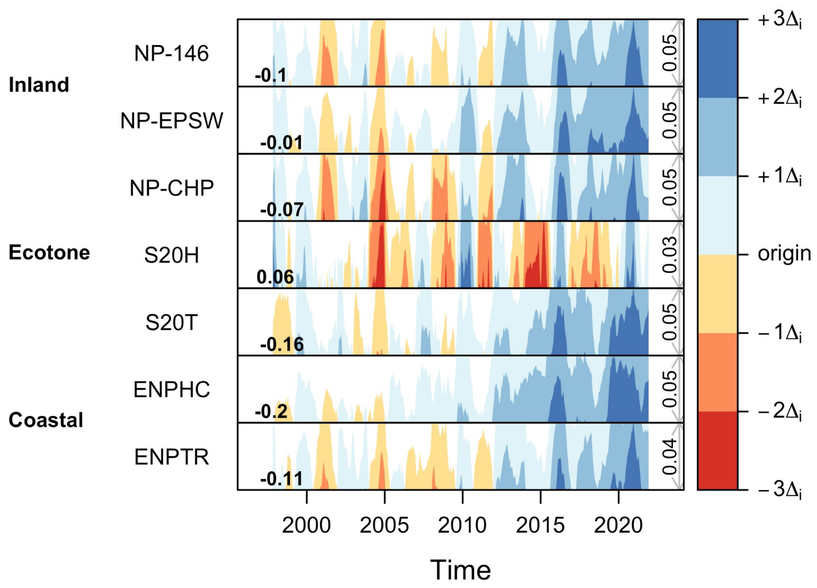

Figure 4. Time series of seasonally corrected trends in weekly mean water level for seven stations from Oct. 19, 1997 - Nov. 7, 2021. Warm colors indicate decreasing water level and cool colors indicate increasing water level compared to the origin. The origin is the mean weekly water level in meters of the first 10 year period (bold value in lower left of each plot). Intensity of colors indicate magnitude of change.

- Water level increases after 2005 for the ecotone station NP-CHP at the mouth of Taylor Slough (Fig. 3).
- Water level increases synchronously over time throughout the ecotone, except for ecotone station S20H (Fig. 4).

Discussion

- Water level increases at the long term site (Fig. 3) could indicate increased freshwater flow from Comprehensive Everglades Restoration Plan implementation[11].
- Water level increases at coastal sites over time (Fig. 4), indicating sea level rise[12].
- Salinity was positively correlated to water level for each station, indicating marine influence at all stations, regardless of distance from the coast.

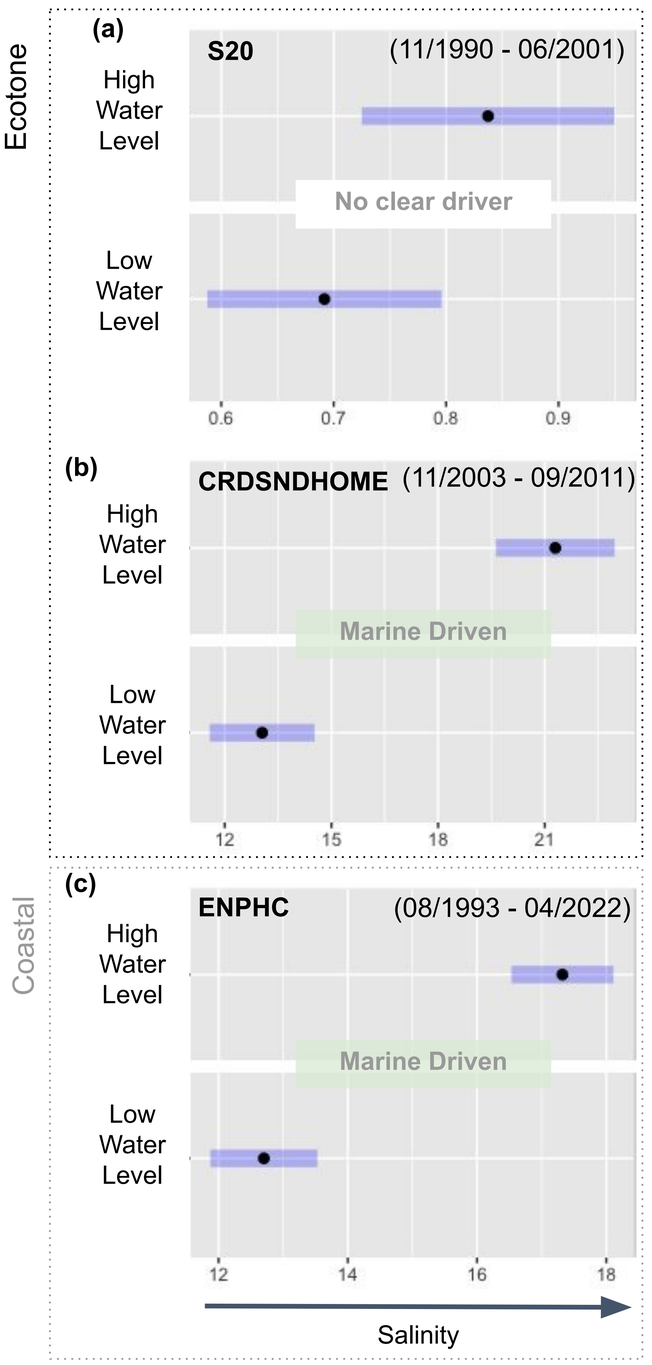

Figure 5. Estimated marginal means of surface salinity for low and high water level conditions at (a and b) ecotone stations and a (c) coastal station.

- Ecotone station S20 had higher salinity at high water level, but this was not significantly different between water level conditions (Fig 5a).
- Although salinity changed seasonally, mean weekly water level did not contribute largely to explained deviance in station models (S20: 12% ; CRDSNDHOME: 2%; ENPHC: 4%).

Next Steps

- Salinity and water level relationships will be explored at different water level time scales, including monthly and seasonal mean, minimum, and maximum.
- Water level and salinity effects on net CO_2 uptake (-NEE) will be evaluated at FCE LTER flux tower site SE-1.

Amanda Richey is pursuing a MS in the Malone Disturbance Ecology Lab where she will use eddy covariance data to assess how ecotonal wetlands' carbon storage capacity respond to changes in salinity and water level.

Contact

References

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