LAKES AND COASTAL CANALS AS NITROGEN SINKS FOR BISCAYNE BAY: PUTRID LAKES AS BAY PROTECTORS

UNIVERSITY OF MIAMI ROSENSTIEL SCHOOL of MARINE & ATMOSPHERIC SCIENCE

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Introduction

- The objective of this study is to map nutrient concentrations in order to understand the relationship between nutrient loading sources and sinks along the Coral Gables Waterway (CGW) and Biscayne Bay.
- Enclosed bodies of water such as lakes, rivers, and coastal embayments are highly susceptible to eutrophication.
- Stalker et al. (2016) states that groundwater, precipitation, and canal water act as freshwater sources for Biscayne Bay.
- In Biscayne Bay, Florida, the water quality has been substantially altered by urban development.
- Bouck (2017) has correlated the Coral Gables Waterway canal system adjacent to the bay with high nutrient loading from point sources that result from anthropogenic activities.

Materials and Methods

- Coral Gables Waterway is a series of canals that are linked to Biscayne Bay (Figure 1).
- Nutrient and water quality measurements were taken from June 2019 to October 2019 that included chlorophyll a (Chl a), PO_4, NH_4, NO_2, NO_3,N+N.
- Chl a was measured with a TD Fluorometer 700 and nutrients were measured via gas segmented continuous-flow colorimetric analysis on a Seal Analytical Autoanalyzer AA3.
- Sampling was conducted 1.5 to 2 hours after the start of high tide to minimize tidal influences and only sample on ebb tides.
- Groundwater measurements were taken from a well on the University of Miami Coral Gables campus in November.

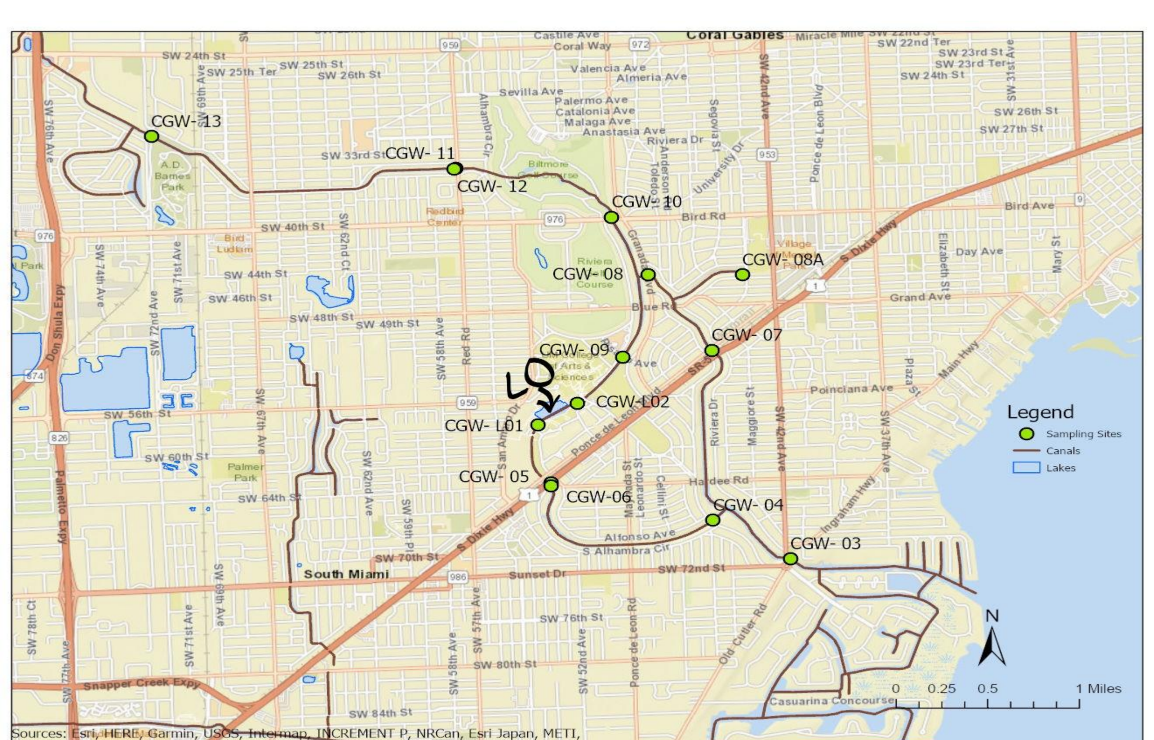

Figure 1. Map of Coral Gables Waterway and the adjacent Biscayne Bay. LO stands for Lake Osceola.

Figure 2. A well on the University of Miami Coral Gables campus, where groundwater samples were collected.

Results

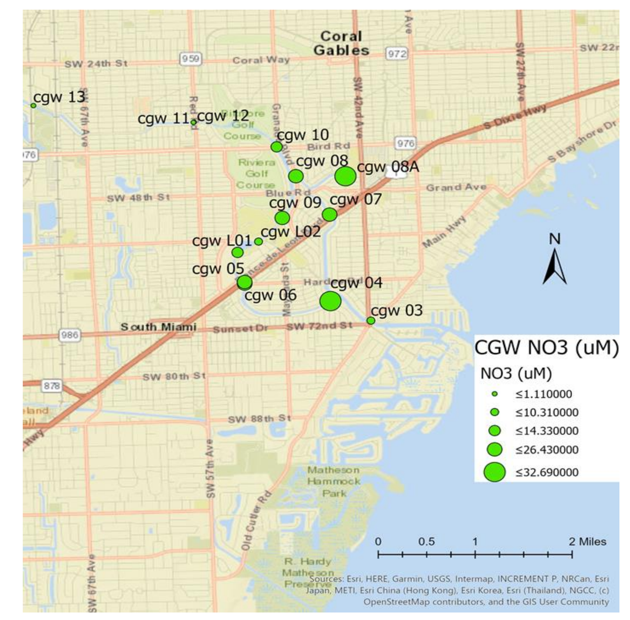

Figure 3. NO_3 distribution across CGW on June 5, 2019. LO consistently has lower NO_3 concentrations than the mouth of Biscayne Bay.

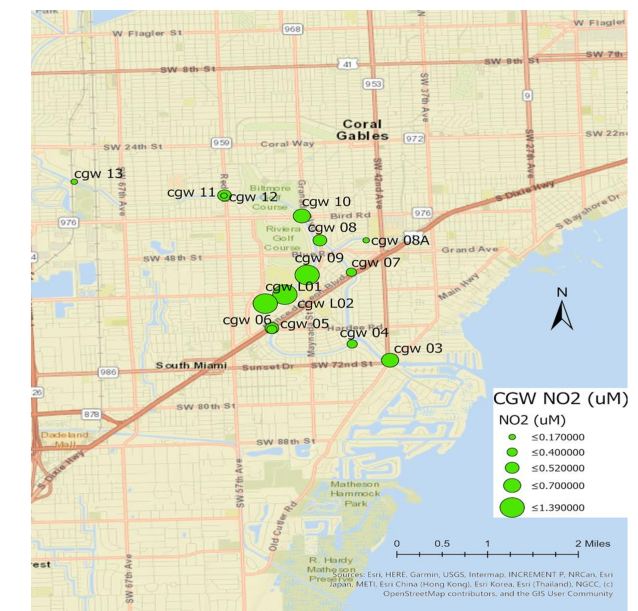

Figure 4. NO_2 distribution across CGW on June 5, 2019. LO consistently has higher NO_2 concentrations than the mouth of Biscayne Bay.

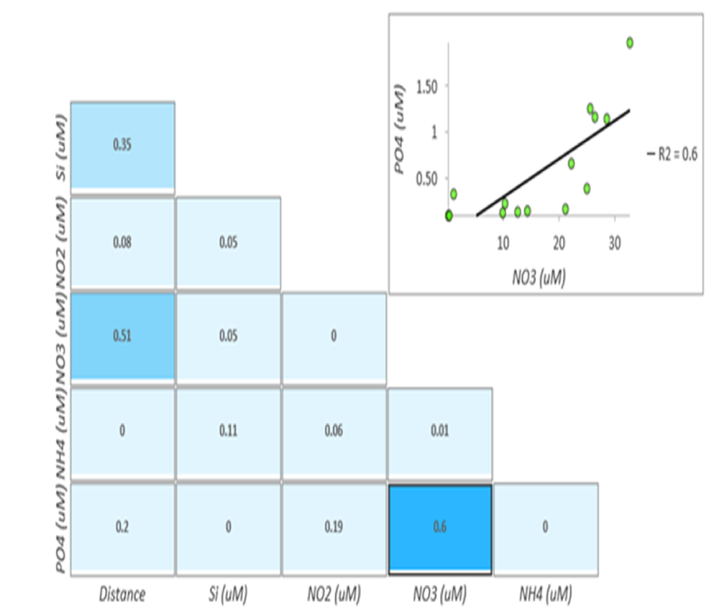

Figure 5. Correlation between nutrients and distance from the bay on June 5, 2019. Significant correlations exist between Si vs. distance, NO_3 vs. distance, and NO_3 vs. PO_4.

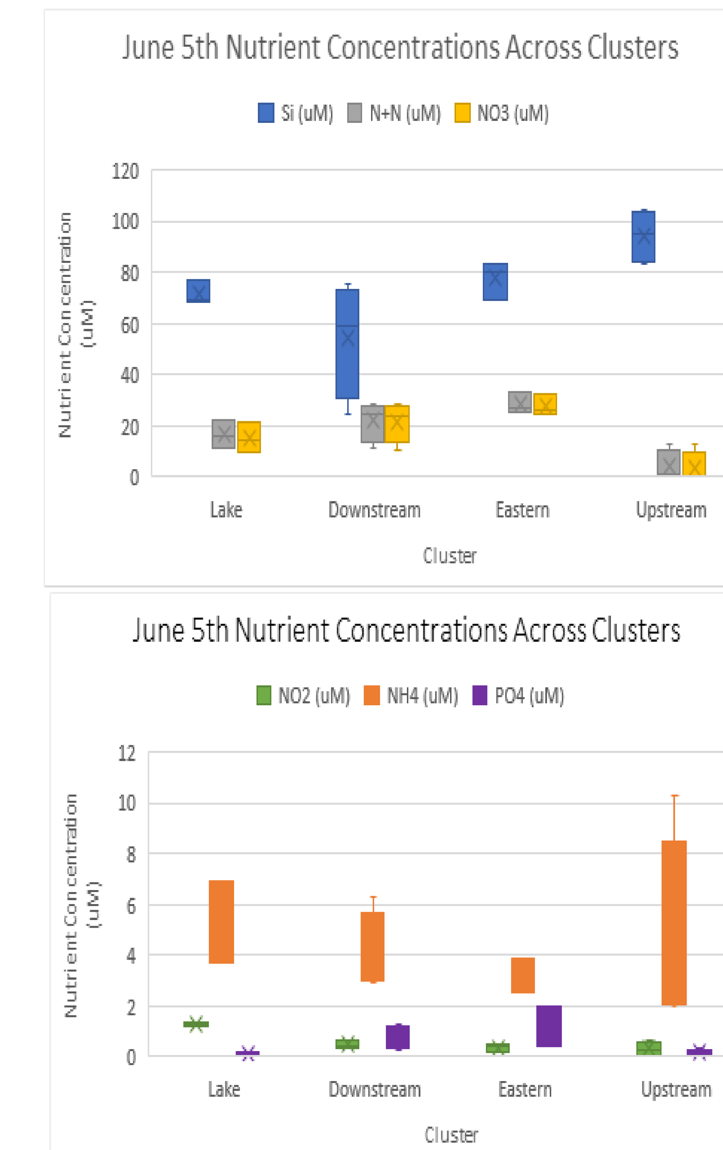

Figure 6. Box and whisker plots of nutrient concentrations (top: Si, N+N, and NO_3 and bottom: NO_2, NH_4, and PO_4) in each cluster on June 5th.

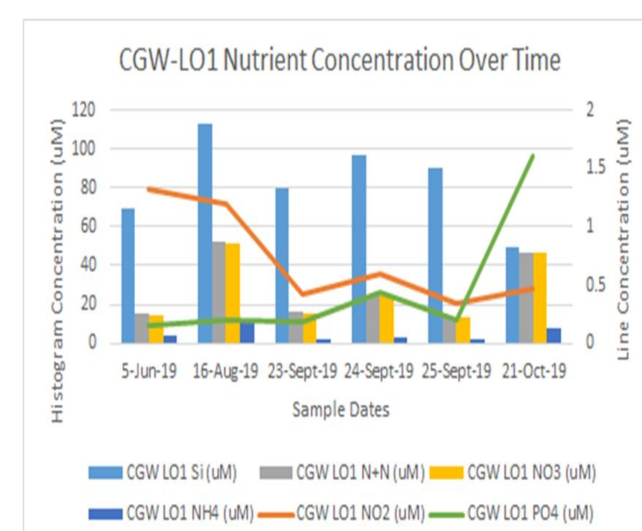

Figure 7. CGW-LO1 time series of Si, NO_2, N+N, NO_3, NH_4, and PO_4.

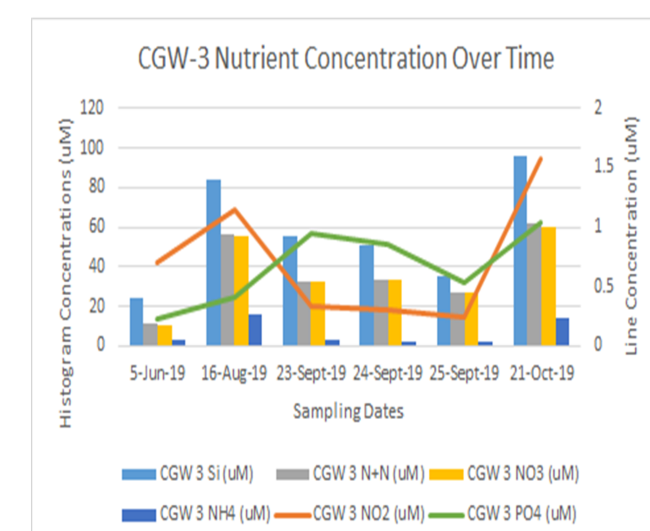

Figure 8. CGW- 3 time series of Si, NO_2, N+N, NO_3, NH_4, and PO_4.

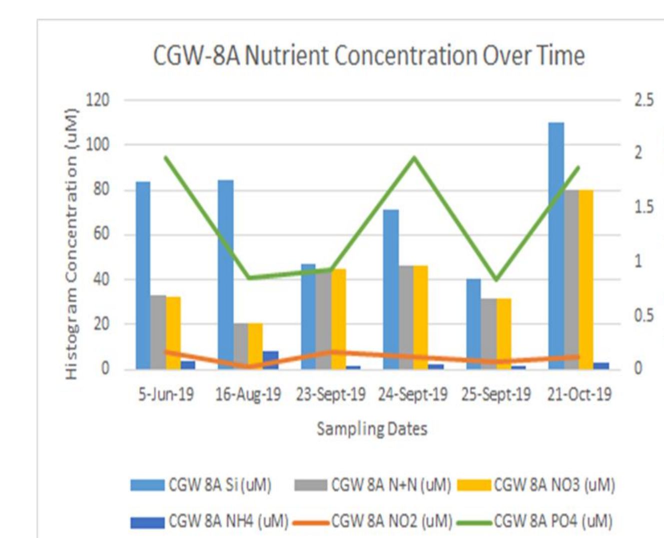

Figure 9. CGW-8A time series of Si, NO_2, N+N, NO_3, NH_4, and PO_4.

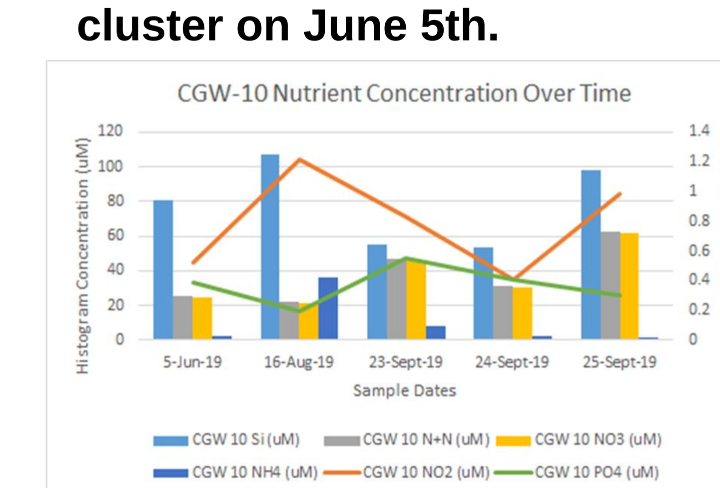

Figure 10. CGW-10 time series of Si, NO_2, N+N, NO_3, NH_4, and PO_4.

Discussion

- Denitrification and phytoplankton uptake is shown in the Si and NO_3 relationship in the downstream and outer loop.
- The lake loop shows that NO_3 is reduced to NO_2 due to denitrification and phytoplankton uptake.
- In the upstream and golf course loop, there is a positive correlation, indicating a slower reaction rate between NO_3 and NO_2 in that region.
- NO_3 input is also highly correlated with PO_4 in all portions of the waterway, except the upstream and golf course loop, due to the high concentration of nitrates and phosphates in fertilizers.
- As NO_3 and PO_4 are inputted into the canal, denitrification and phytoplankton uptake increases driving down NO_3 before it is transported to the bay.

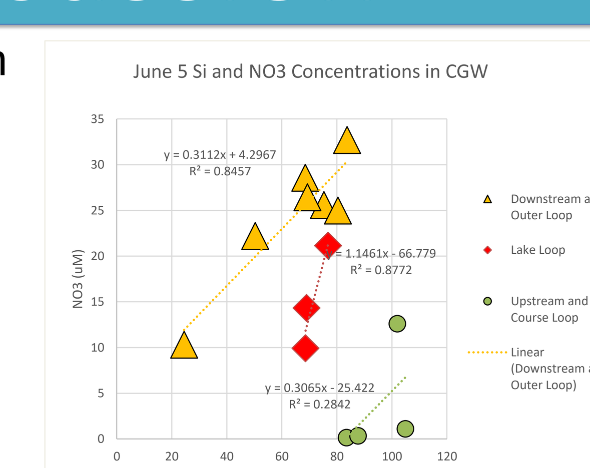

Figure 11. Strong correlation of Si and NO_3 in the lake loop and a weak correlation in the upstream and golf course loop.

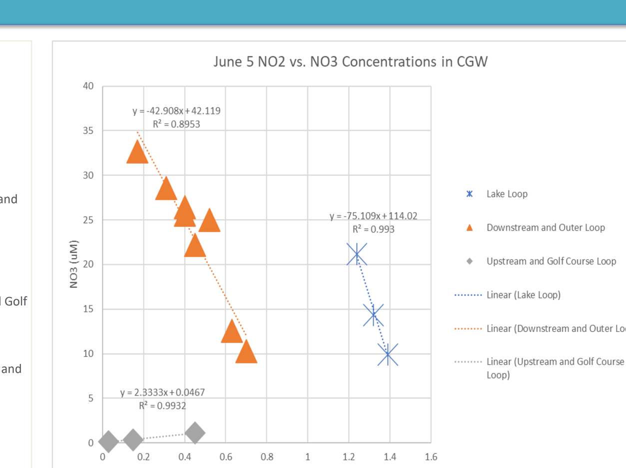

Figure 12. The lake and downstream and outer loops show an inverse relationship between NO_2 and NO_3.

Conclusion

- The NO_3 concentration was consistently lower in Lake Osceola than Biscayne Bay.
- Lake Osceola acts as an active area of denitrification and phytoplankton uptake.
- Since NO_3 and O_2 are driven down, the next available electron donor is SO_4 (Brewer, et al., 2014).
- Lake Osceola should have bubblers and fountains to account for SO_4 being reduced to H_2S.