Application of Radium Isotopes to Study the Transport of Dissolved Inorganic Carbon from the Caloosahatchee River to the Gulf of Mexico

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INTRODUCTION

- Dissolved Inorganic Carbon (DIC) in the marine carbonate system (CO_2, H_2CO_3, HCO_3^- and CO_3^{2-}) acts as a major buffer in the ocean making it integral in the study of ocean acidification.
- Alkalinity refers to water's ability or inability to neutralize acids. It determines the buffering capacity of seawater and moderates the change in pH.
- DIC is an important component of alkalinity (HCO_3^- and CO_3^{2-}).
- Short-lived radium isotopes (^{223}Ra & ^{224}Ra) can be used to track the residence times, mixing rates, transport fluxes of water and associated DIC as well as nutrients in the coastal marine environments.

OBJECTIVE

- Use radium isotopes to track the transport of DIC and nutrients from the Caloosahatchee River to the Gulf of Mexico.

METHODOLOGY

RADIUM

- 40 liters of water was collected in two 20 L cubitainers passing through a 1.0-µm cartridge filter & then gravity filtered through Mn fibers.
- The manganese oxide coated fibers were analyzed using a Radium Delayed Coincidence Counter (Radecc) for ^{223}Ra and ^{224}Ra isotopes.

DISSOLVED INORGANIC CARBON

- 125 mL of water was filtered through a 0.45-µm syringe filter and spiked with a 5-µl $HgCl_2$ solution.
- The samples were run in the total organic carbon analyzer, TOC-L, and then were calculated to find the DIC concentration.

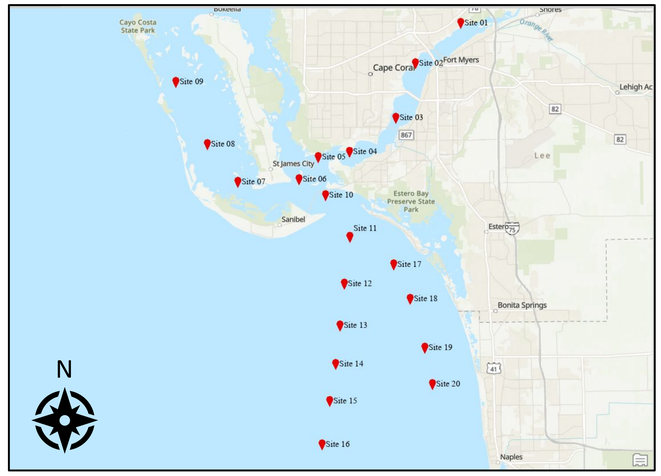
ALKALINITY

- 125 mL of water was filtered through a 1.0-µm cartridge filter.
- The Easy Plus automated titrator was used to perform a titration and then the data was used to calculate alkalinity, expressed as mg $CaCO_3$/L.

NUTRIENTS

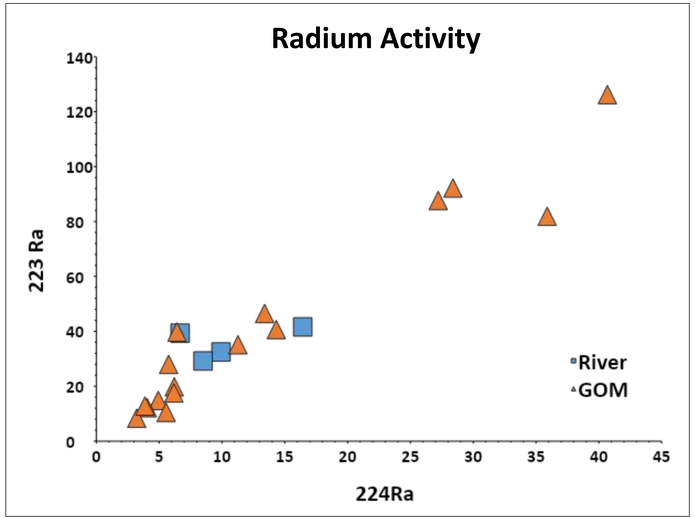
- 125 mL of water was collected and analyzed using an auto-analyzer.

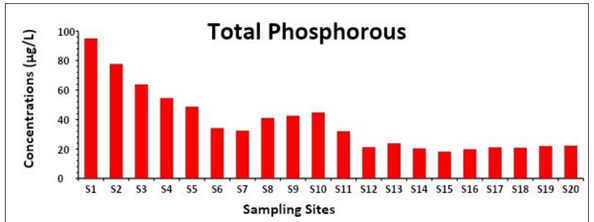
SAMPLING SITES

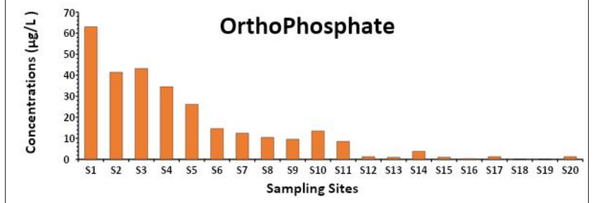


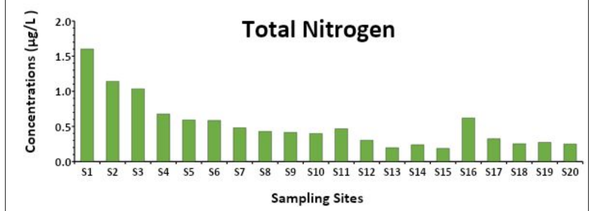
- Water samples were collected from 20 sites along two transects throughout the Caloosahatchee River and the Gulf of Mexico.

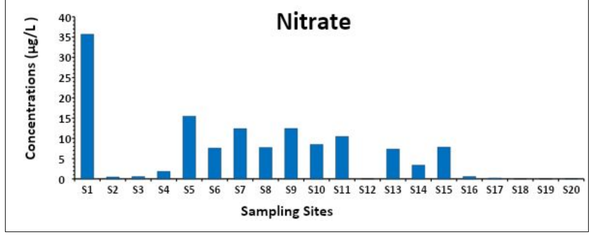
RESULTS & DISCUSSION

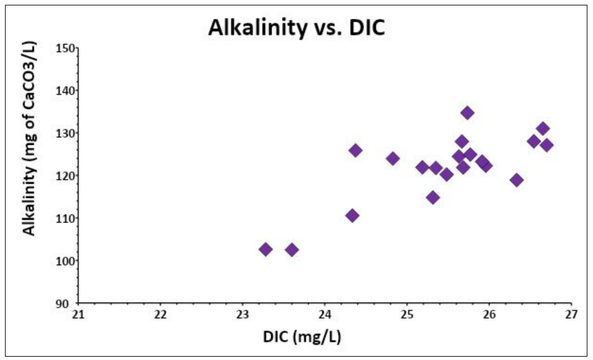






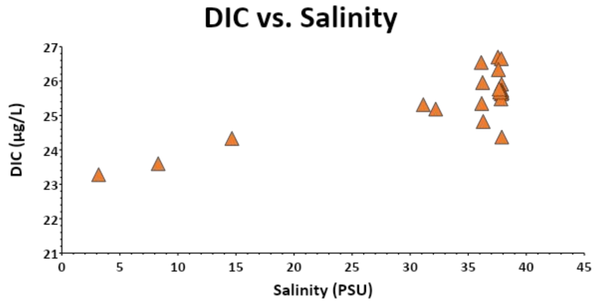


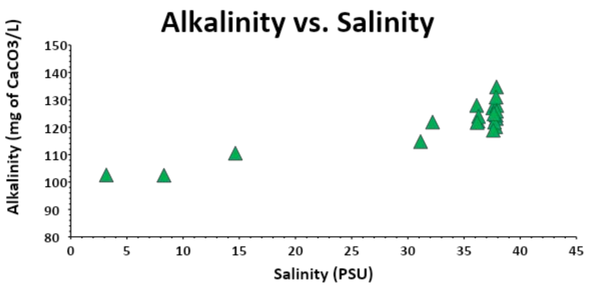




CONCLUSIONS

- Preliminary data – ongoing work. Dry season sampling coming up.
- The radioisotopes showed mixed results by location, which indicate that sources of both groundwater influx and river discharge affect DIC and nutrient concentrations in the region.
- The nutrients have a high concentration at the first site, and then decrease as they disperse in the Gulf of Mexico.
- The DIC and Alkalinity concentrations were correlated.
- The Salinity graphs of DIC and Alkalinity follow similar trends at each site.





BROADER IMPLICATIONS

- Due to the environmental problems in Southwest Florida and a lack of research regarding DIC and nutrient transport, this study will help determine the importance of freshwater plume discharge in transporting DIC, and its affect on the Gulf.

LITERATURE CITED

- Anderson, M. M., et al. "Dissolved Inorganic Carbon Transport in the Surface-Mixed Layer of the Louisiana Shelf in Northern Gulf of Mexico." *Journal of Geophysical Research: Oceans*, vol. 125, no. 11, 2020, https://doi.org/10.1029/2020jc016605.

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