Isotope Patterns and Variability in an Urbanizing Estuary

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Introduction

- Anthropogenic development in headwaters has increased nitrogen (N) loading (e.g. fertilizer, yard waste, and fossil fuel combustion) and resulted in nutrient impairment in the Guana Estuary, a local site for recreation and fishing
- Estuaries remove bioavailable nutrients through assimilation by plants and dissimilatory microbial processes
- Timing, magnitude, and source of N inputs can influence storage of N and C throughout the system

Objectives

- Where are anthropogenic N and C stored in the Guana Estuary?

1) Quantify the spatial and temporal variability of N and C storage
2) Compare isotopic signatures and spatiotemporal patterns between plants and sediments

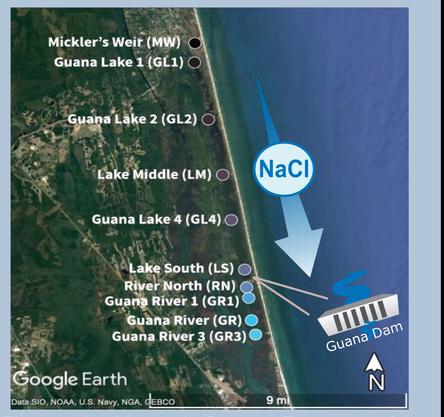
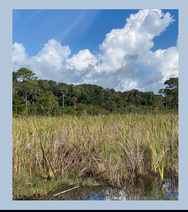
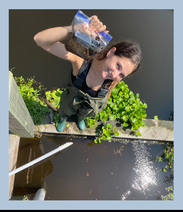


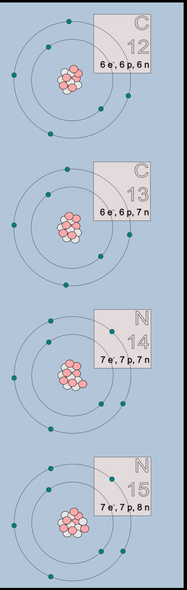
Figure 1: Map of Guana Estuary with sampling sites. Salinity decreases from 0.38 ppt (north at Mickler's Weir) to 35 ppt (south at Guana River 3)

Isotope Source Tracking

- Anthropogenic N has a **distinct isotopic signature** (elevated δ15N enrichment) caused by various human activities.
- Fractionation in biological processes (uptake, mineralization) create certain isotopic signatures and ratios
- $\delta^{15}N$ enrichment indicates sources (Heaton 1986)
  - 1-3‰ - inorganic N fertilizer
  - 3-9 ‰ - organic N (manure, or fixed in soils)
  - 8-20 ‰ - human sewage effluent
- We collected quarterly sediment samples and apical foliage from the dominant vegetation from six sites spanning a salinity gradient in GE
- Samples were analyzed for δ15N, δ13C, and C:N

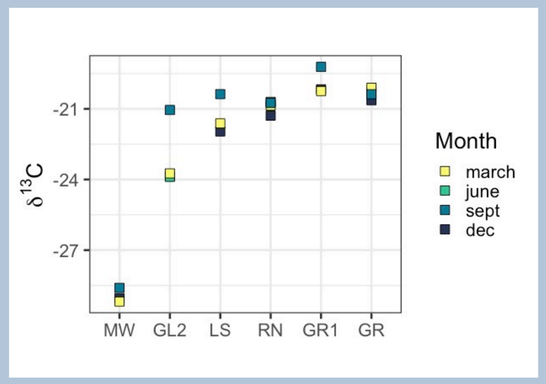




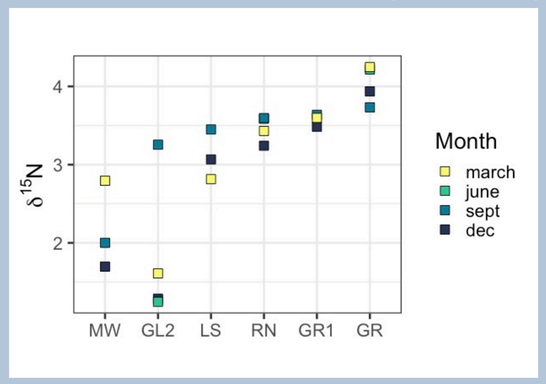


Longitudinal Sediment Changes

- C and N isotopes become more enriched as salinity increases downstream

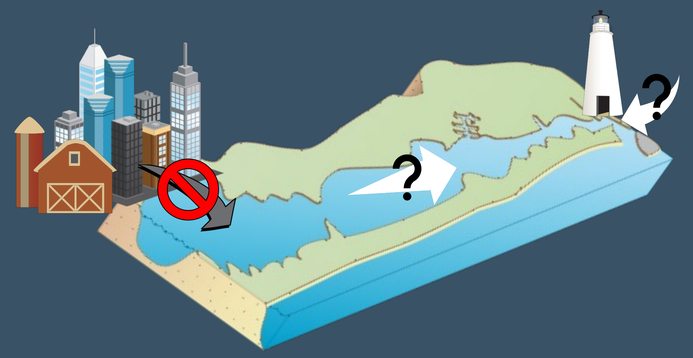


- Isotope enrichment is not influenced by seasonality



- GL2 is a tipping point of enrichment changes

Plant and sediment isotopic enrichment reveals the importance of alternative sources of C and N beyond direct anthropogenic inputs from upstream



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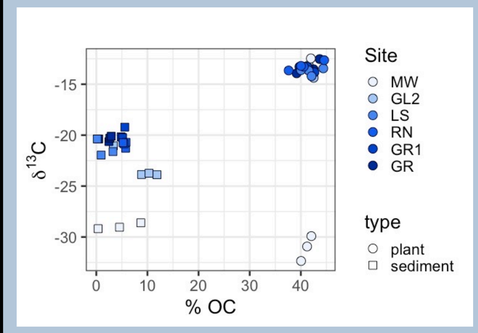
Plants vs Sediments



- Plants and sediments have distinct %OC/d13C signatures
- C3 and C4 plants have different signatures

- Sediment carbon isotopes have a decreasing enrichment gradient as they move away from sites with more enriched plant isotopes
- Most sediments look to be a mixture of carbon sourced from C3 and C4 plants.