Sediment-Water Exchanges and Internal Nutrient Loading in the St. Lucie Estuary

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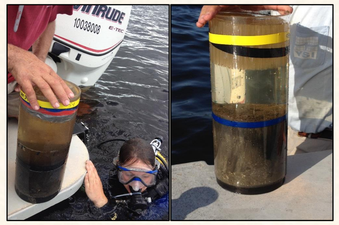
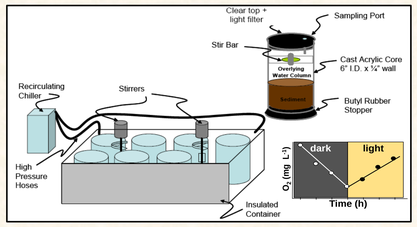
BACKGROUND

- External loading of nitrogen (N) and phosphorus (P) can promote algal blooms and hypoxia in the St. Lucie Estuary (SLE)
- Internal loading/recycling of dissolved inorganic N & P (DIN & DIP) can be important for gross primary production (GPP) of algae
- The efflux of DIN & DIP across the sediment-water interface into the water column can be an internal source of recycled nutrients
- Objectives of this study were to:
  1. Quantify sediment-water dissolved inorganic N & P exchange rates in the SLE in both dry and wet seasons
  2. Compare external nutrient loads (Lake Okeechobee and SLE Watershed) and internal recycling across the sediment-water interface
  3. Compare nutrient supplies to that required for algal gross primary production

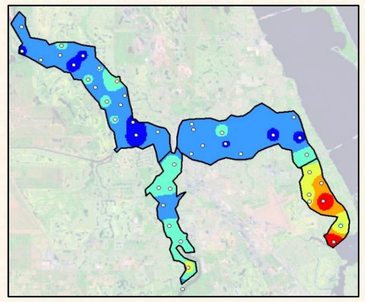
METHODS



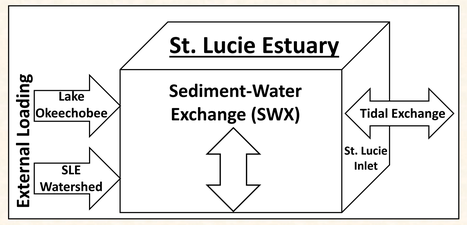
(1) Obtain ~50 sediment-water cores in both 1/2008 and 8/2014



(2) Incubate under dark/light to determine concentration change (mg L^{-1} h^{-1}) ; Normalize by core volume (V; L) and surface area (A; m^2) to calculate daily rates of DIN & DIP exchange (g m^{-2} d^{-1})

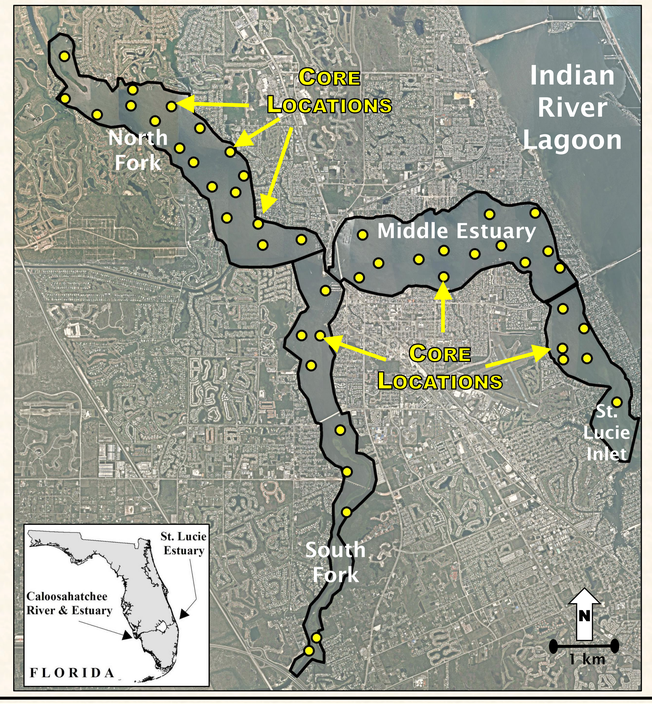


(3) Spatially interpolate rates across grid. Multiply the rate for each cell (g m^{-2} d^{-1}) by its area (m^2) and sum (g d^{-1})

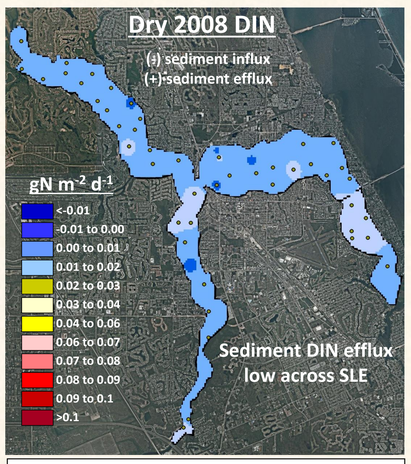


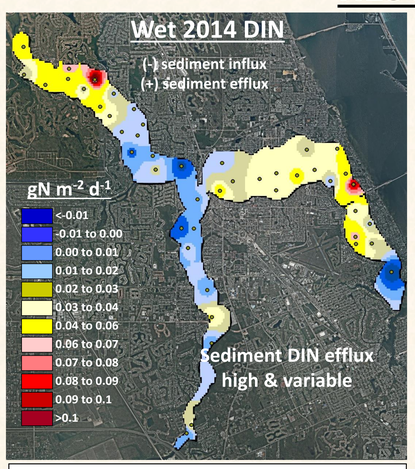
(4) Estimate internal loading at sediment-water interface compared to external loading (mton $season^{-1}$)

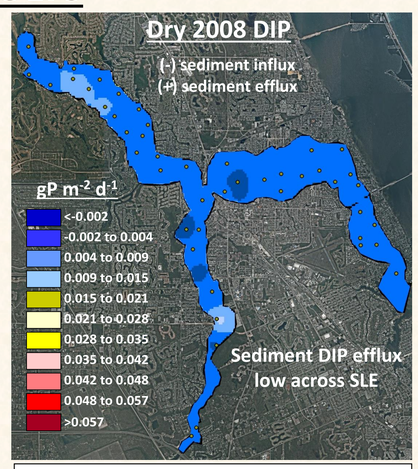
Dry Season (182.5 d) = May to Oct
Wet Season (182.5 d) = Nov to Apr

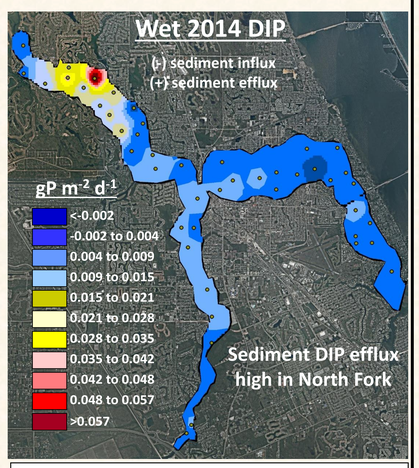


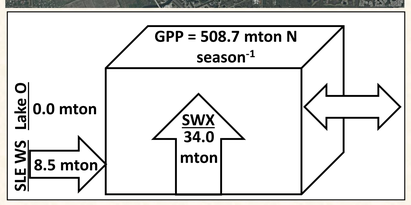
RESULTS

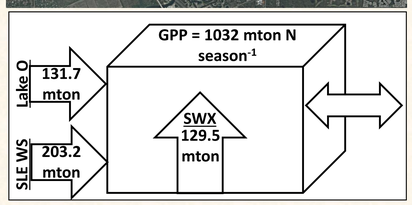


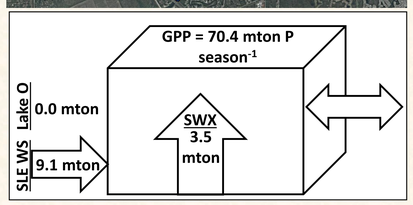


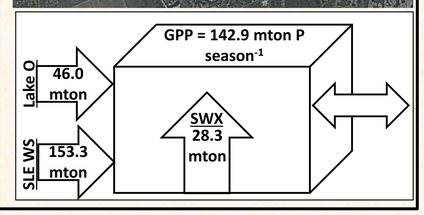












SUMMARY

- Sediment DIN and DIP efflux much lower in dry season and higher in wet season, particularly across the North Fork
- Sediment DIN efflux ~400% more than SLE Watershed loading in the dry season, but ~63.7% of the SLE Watershed DIN loading in the wet season
- Sediment DIP efflux ~38.5% and ~18.5% of the SLE Watershed DIP loading in the dry and wet seasons, respectively

SIGNIFICANCE

- Nutrients for algal production result from a combination of external loading and internal recycling
- The N for algal production is largely produced internally in the water column as external loading and sediment efflux are insufficient
- External loading and sediment efflux supply surplus P for algal production in the wet season but not in the dry season
- Sediment-water exchange rates are essential as boundary conditions for estuary nutrient budgets and water quality models

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