Combining high resolution surveys and numerical modeling to optimize water level management in the Guana River Lake

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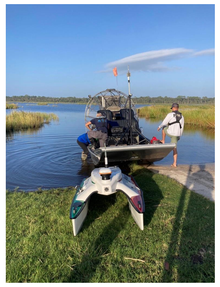
Background and Objectives

Background

The Guana River "Lake" is an impounded estuary that receives water from a highly urbanized watershed (i.e., the Ponte Vedra area). A water control structure (i.e., the Guana Dam) separates the natural portion of Guana River from the impounded Guana "Lake" where tidal flushing is reduced, causing accumulation of excess nutrients and algal blooms.



Objective

- Develop a hydrodynamic and water quality model for the Guana Lake and its watershed.
- Collect field observations to calibrate and validate the numerical model using the YSI HYCAT
- develop a water quality remediation plan containing a list of best management practices to fine-tune dam operations and improve water and habitat quality within Guana Lake.

Numerical Model

Resolution

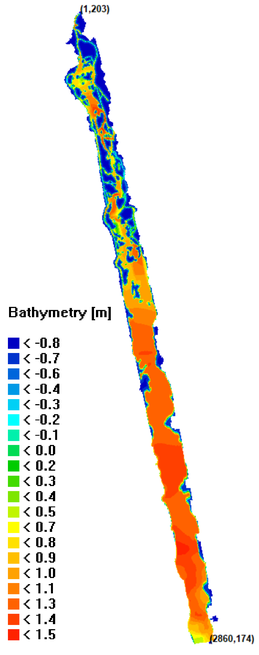
- 3 m × 15 m (Guana Dam)
- 3 m × 3 m (Mickler's Dam)

Bathymetry

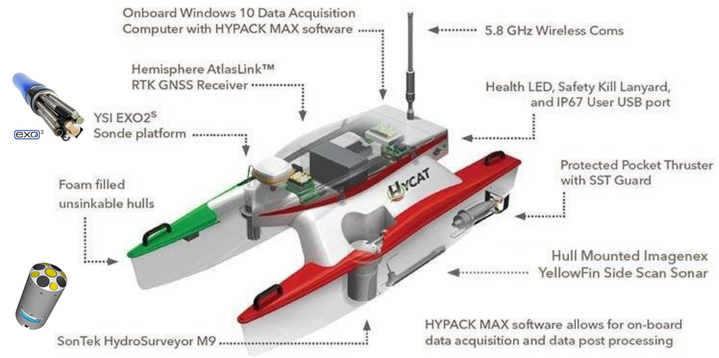
- Elevation obtained from the HYCAT in the channels and the Lake
- 0.80 m fixed elevation on the marshes [data can be obtained in the future using a GPS, a drone, or existing LiDAR]

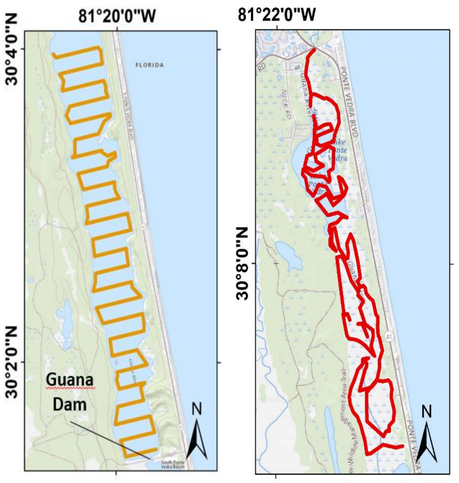
Boundary conditions

- Discharge calculated from the water level and a rating curve, both at the Guana Dam and Mickler's Dam by measuring water levels with HOBO pressure sensors.



Surveys and instrumentation





Survey

Two days are needed to cover the whole lake surface. Several paths were followed to make the bathymetry resolution as high as possible.
We also collected pressure and salinity data in the dam upstream and downstream (HOBO pressure sensor in the picture below). Moreover, the M9 sontek was deployed with the HYCAT to measure the flow discharge at the dams.

Data comparison

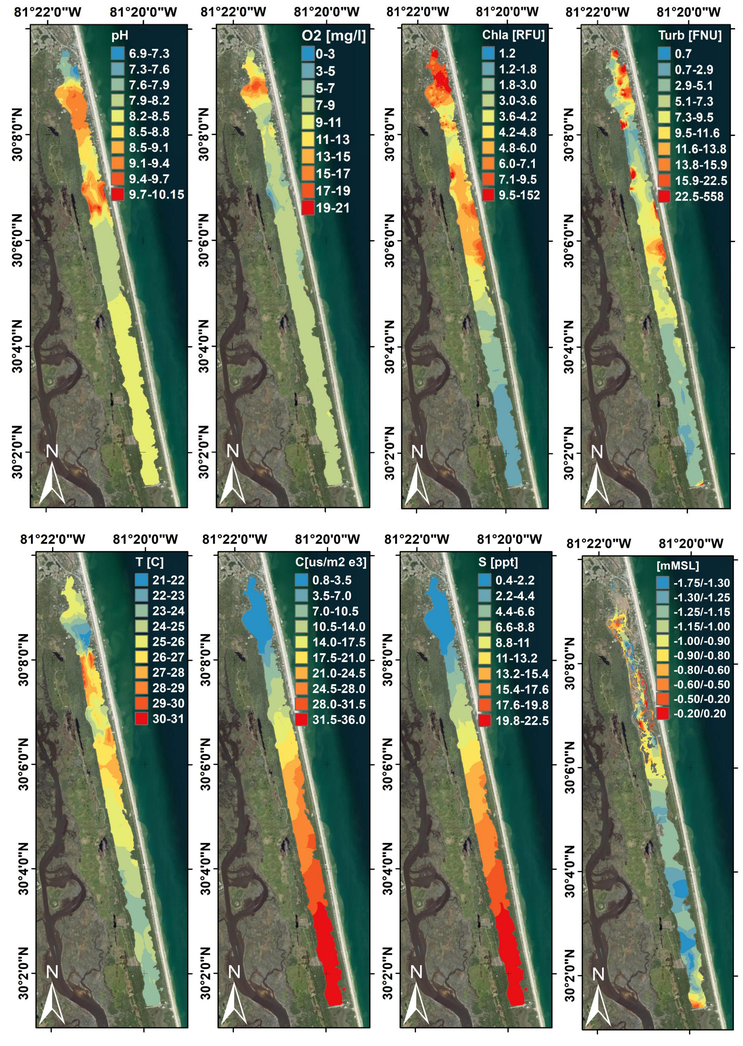
During every survey, we collected water quality data with the YSI proDSS as a validation for the EXO2 placed in the HYCAT

Nitrogen

Seabird **SUNA** for Nitrogen NO3- measurements. This device works with ion-detection, which makes it not 100% precise in defining NO3 in salt water. To address this issue, water sample in different location were collected and analyzed. This will allow to get the corrections needed to the Nitrogen curve detected by the SUNA

Results (September)

- **Salinity** decreases from south (Guana Dam) to north (Mickler's Dam)
- **Conductivity** gradients are lower close to the two dams. This depends on the higher depth and to the lower water fluxes of these areas
- **Chlorophyll-a** concentration is higher in the north side
- **Turbidity** is higher close to the landing sites
- North side shows a lower **pH** due to the Nitrogen fluxes at the Mickler's Dam
- O_2 is higher in the north dam due to the higher fluxes and therefore higher turbulence.
- **Temperature** shows an unusual behavior because we surveyed the lake in different days



Future steps

Data will be collected for the next 6 months. Nitrogen measured with the seabird SUNA will be compared with the values of NO3- of the collected water samples.
Discharge measured in the dams will be used to define a rating curve that explains hydrodynamicaly the fluxes of the dams.