When it Rains it Blooms: Investigating the Role of Urban Stormwater Runoff on Blooms of *Karenia brevis* and *Pyrodinium bahamense* in Tampa Bay, Florida

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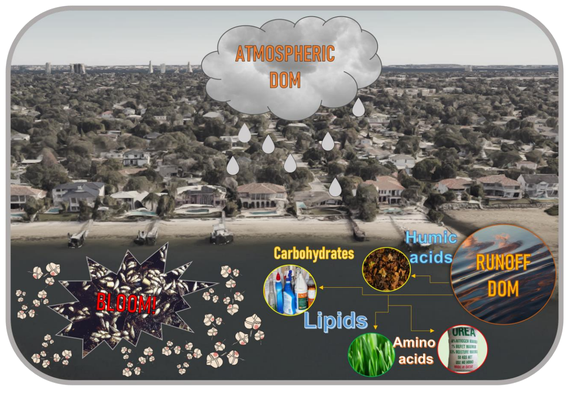
BACKGROUND

- *Karenia brevis* is the neurotoxin-producing dinoflagellate species responsible for Florida red tide
- *Pyrodinium bahamense* is a dinoflagellate that blooms annually in Old Tampa Bay, and produces paralytic shellfish poisoning
- Near annual blooms of these species can co-occur in Tampa Bay and impose human health impacts (e.g., respiratory irritation, shellfish poisoning)[1], and wildlife mortalities (i.e., fish kills and other marine biota), as well as significant economic impacts[5].
- *K brevis* and *P. bahamense* can utilize both inorganic (NH_4^+, NO_3^-) and organic forms of nitrogen (N)[2,9].
- Nutrient sources identified supporting blooms include nearshore anthropogenic inputs such as stormwater and wastewater outflows[4,7].
- Bloom occurrence of both *K. brevis* and *P. bahamense* have been correlated with precipitation events[3,8].
- Tampa Bay is Florida's largest open water estuary that receives runoff from an area of 5700 km^2 [10].
- Tampa Bay waters are N impaired, with most N originating from urban stormwater runoff[6].
- In addition to N, urban stormwater runoff can be a vector of dissolved organic matter (DOM), which can vary in composition and bioavailability[6].
- The bloom enhancing potential of urban stormwater runoff-DOM in waters plagued by *K. brevis* and *P. bahamense* is unknown.

OBJECTIVE

Characterize the quality of dissolved organic matter (DOM) in urban stormwater runoff during the wet and dry season and identify specific DOM compounds that stimulate the growth of *K. brevis* and *P. bahamense*.



HYPOTHESIS

***Urban stormwater runoff contains a pool of labile DOM compounds that can stimulate the growth of* K. brevis *and* P. bahamense.**

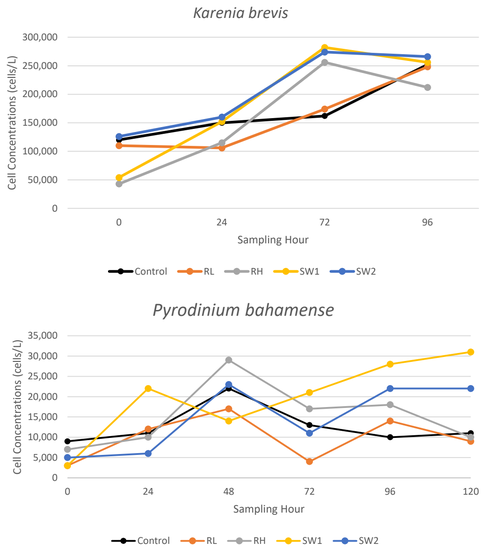
RESEARCH OUTLINE

PHASE 1- STORMWATER SAMPLING CAMPAIGN

Fig. 1. Map of stormwater and atmospheric sampling sites in Pinellas County, FL.

- 6 sites- Event response grab sampling
- July 2021- Present
- Water quality analyses- NO_3^-, NH_4^+, dissolved org-N, dissolved org-C
- Nitrogen source tracking- Stable isotopes (NO_3^-)
- Stormwater/atmospheric DOM quality- Fluorescence Spectroscopy

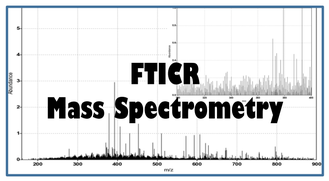
PHASE 2- LABORATORY BIOASSAYS



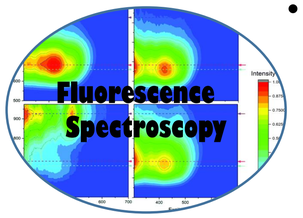
Graphs. *Karenia brevis* (top) and *Pyrodinium bahamense* (bottom) cell concentrations (cells/L) vs. sampling hour. Note: Preliminary counts are not representative of each triplicate (still being enumerated), hence the absence of standard error bars.

- Monocultures of *K. brevis* and *P. bahamense*
- Dose protocol (triplicate):
  - Rain low (RH)- 0.4 in. simulated event
  - Rain high (RH)- 2 in. simulated event
  - Stormwater runoff- 2 sites
- Monitored for up to 120 hrs.
- Parameters Measured: Nutrients (NO_3^-, NH_4^+, dissolved org-N, dissolved org-C
- DOM characterization- FTICR Mass Spectrometry

PHASE 3- DOM CHARACTERIZATION



- FTICR-MS is an ultra high-resolution spectroscopy method that can identify thousands of organic compounds within a sample, providing specific measurements of molecular mass and elemental composition.
- Powerful tool but is data-intensive.



- Fluorescence spectroscopy provides a multi-component analysis of DOM enabling identification of source material (i.e., microbial, terrestrial) and composition
- Lower resolution than FTICR-MS, however, more practical for stormwater monitoring, more samples can be analyzed.

CONCLUSIONS

- Preliminary results show a greater growth response with stormwater and 2 in. simulated rainfall event additions vs. controls in both species.
- This work will provide insight into urban stormwater runoff DOM utilization and transformation by *K. brevis* and *P. bahamense* confirmed through bioassay and FTICR-MS analysis.
- Environmental management and monitoring efforts must expand to include analysis of DOM in urban stormwater runoff.
- Management practices sequestering reactive stormwater DOM should be considered.
- Preventing the direct discharge of urban stormwater runoff to coastal waters can potentially play a role in mitigating *K. brevis* and *P. bahamense* proliferation once a bloom reaches nearshore waters, as well as other coastal harmful algal bloom species including cyanoHABs and macroalgal HABs.

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