The Effects of Boat Traffic on Intercoastal Stratification

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Introduction

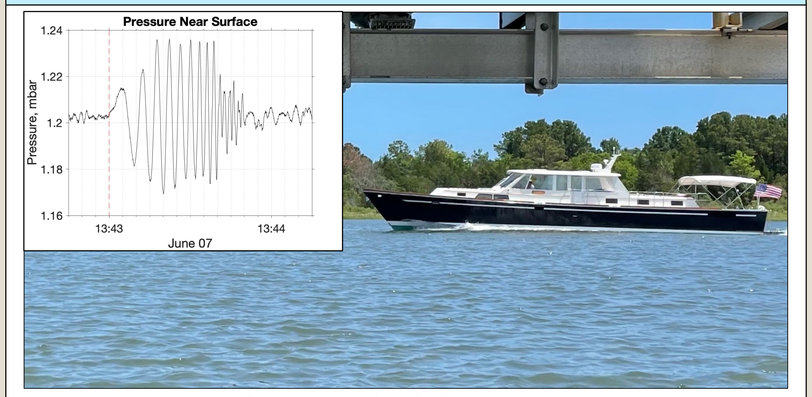

Fig. 1. Pressure (top left), associated with the yacht (right).
The pressure time series displays oscillations that correspond to the waves generated by boat wakes. Turbulence generated by breaking wakes can vertically mix the water column affecting the stratification.

- Boats push water out of their way causing the water to rise and fall, thus producing a series of waves (**Fig. 1**), called a boat wake.
- Boat wakes damage infrastructure, cause erosion of unprotected coastlines [1], and drive mixing, potentially impacting the aquatic ecosystem.
- Recreational boat wakes create unnatural spikes in pressure that affect the environment of high traffic boat areas like the Intercoastal Waterway at CMS.

Purpose

- **Goal**: Better understand the impact of recreational boat wakes on the stratification of the Intercoastal waterway.

Materials and Methods

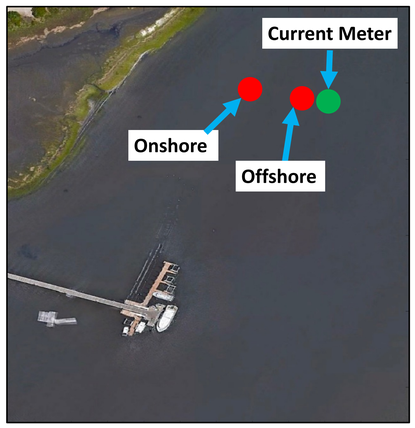

Fig. 2. Google Earth image showing the locations of where the sensor were deployed.

Instrument Setup. An array of temperature and pressure sensors (red, **Fig. 2-3**), and a current meter (green, **Fig. 2-3**) were deployed on the flank of the intercoastal waterway to study the effect of boat wakes on thermal stratification.

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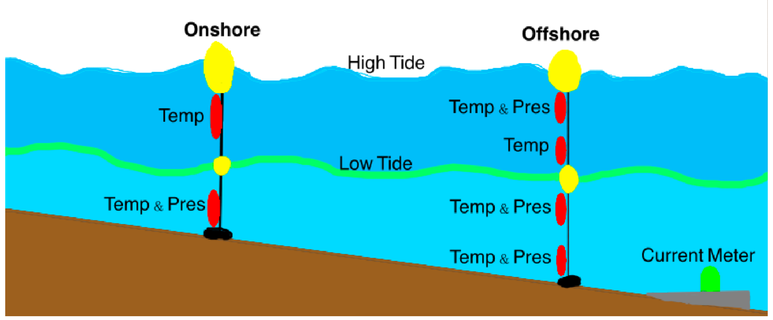

Fig. 3. Diagram of Sensor set up, with 2 moorings and a current meter resting on the bottom.

- We deployed two moorings onshore and offshore (**Fig. 2-3**)
- Onshore (**Fig. 3**) contained two sensors measuring surface and bottom temperature and the bottom pressure.
- Offshore (**Fig. 3**) contained four sensors, measuring temperature, and pressure at several depths, and nearby currents versus depth.

Results

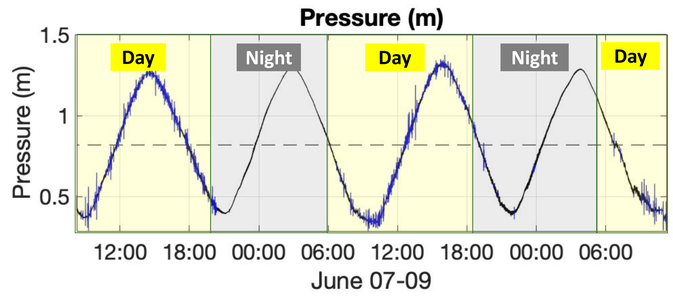

Fig. 4 This is the raw pressure time series from our 2-day test in June, the (blue) represents the detected boat wakes, and the black is the tide and wind pressure.

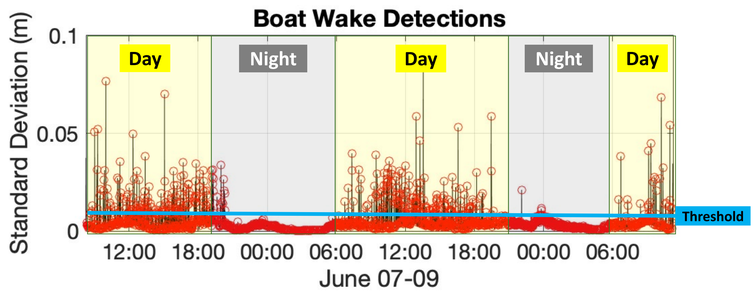

Fig. 5 This is the 15-s window standard deviation of pressure with peaks circled in red.

- I coded an algorithm to detect boat wakes from pressure time series
- The algorithm uses a standard deviation (std) of pressure (**Fig. 5**) in two moving windows, 60 s wide and 15 s wide.
- The 60-s-window accounts for persistent waves generated by wind.
- Boat wakes are intermittent with short duration, lasting roughly 15 s
- A wake is defined by a difference in 15s/60s std greater than 0.5 cm

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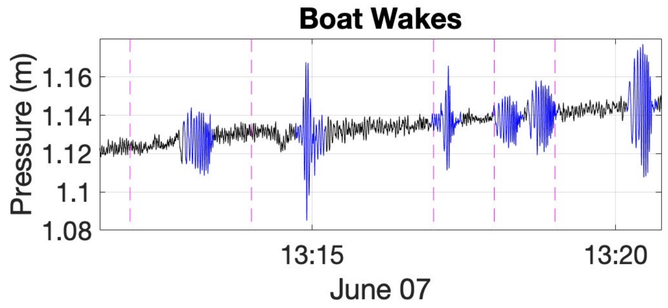

Fig. 6. The blue is what the boat wake sensor highlighted; The (pink) vertical line is when a boat was observed passing the sensor; The (black) is the pressure data.

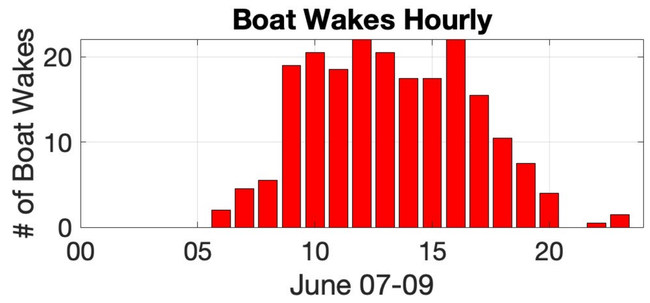

Fig. 7. The average number of boat wakes detected per hour (0-24 hours).

- Utilizing the threshold from (**Fig. 5**) the algorithm can identify irregular spikes in pressure and highlight them in (blue) (**Fig. 6**).
- The boat wake algorithm was tested for accuracy using the personal observation data from Ruben Trejo, and Karla Mills, describing when a boat passed the moorings.
- This data is represented with pink lines (**Fig. 6**), we tested the algorithm against the observation data, resulting in 82% accuracy of highlighting boat wakes.

Improvements

- Results of this project will be used to align boat wakes with temperature and current variability to study how boat wakes affect the stratification of the water column.
- This will also be applied to the larger 2-week period data collected.

References

1. Bilkovic, Donna Marie & Mitchell, Molly & Davis, Jennifer & Herman, Julie & Andrews, Elizabeth & King, Angela & Mason, Pamela & Tahvildari, Navid & Davis, Jana & Dixon, Rachel. (2019). Defining boat wake impacts on shoreline stability toward management and policy solutions. Ocean & Coastal Management. 182. 104945. 10.1016/j.ocecoaman.2019.104945.

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