Investigating the capabilities of fluorescence spectroscopy for high-frequency and real-time water quality monitoring in urban water systems

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Introduction

Urban stream syndrome is ecological degradation that plagues many streams draining urban lands. Real-time monitoring of water quality is important for meeting Clean Water Act goals. Monitoring water quality in urban waters is an essential component of maintaining the health and safety of the surrounding communities. Previous work has demonstrated that fluorescence spectroscopy, specifically tryptophan-like fluorescence intensity, can be correlated to total aerobic bacteria counts and total coliforms in source waters. Previous field deployments using portable fluorescence sensors in riverine environments have demonstrated inaccuracies in optical signals as a result of high velocity waters. Yet high flow periods are critical for data collection, due to increased runoff from anthropogenic inputs. We aim to establish best practices for sensor calibrations, sensor maintenance, and deployment strategies to ensure data quality and consistency.

Motivation and Goals

- Evaluate in-situ fluorescence sensors for real-time water quality monitoring of bacterial pollution in riverine environments
- Track the temporal variability in water quality and detect the frequency of pollution events

Methods

Instrumentation

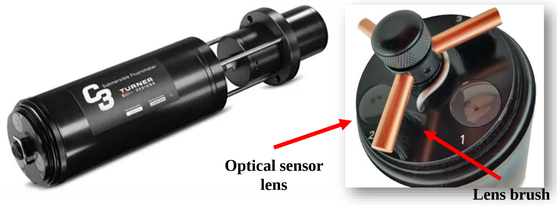

Figure 1 Turner C3 portable fluorometer with three optical sensors

- Instruments deployed
  - C3- tryptophan, CDOM, and turbidity
  - Optical dissolved oxygen (ODO)
  - Pressure transducer (future)

Figure 2 YSI ODO RTU sensor

Study Site

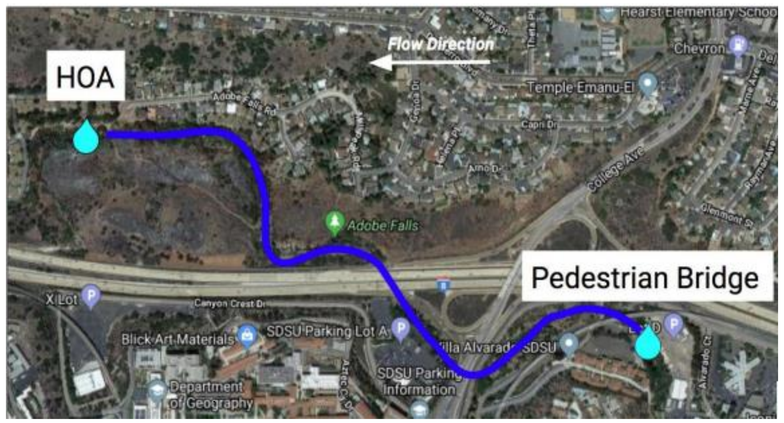

Figure 3 Map of the Alvarado Creek sampling locations. Monthly grab samples are taken from the upstream site HOA and the downstream site, PED. Samples are analyzed in the WIRLab for nutrients, bacteria, and total organic carbon. The PED site is also the location of the sensor platform which will collect real-time fluorescence and DO data.

Field and Lab Protocols

Figure 4 Sensor housing deployed in Alvarado Creek, near SDSU

- QC and Data processing
  - Standard calibrations for TRP and CDOM- quarterly
    - Dark container needed
  - Wastewater calibrations with Alvarado Creek water
    - Percentage of wastewater gradually increased
  - Calibration curve used to correct real-time data available on WQData LIVE
- Protective housing used for deployment
  - Prevent damage
  - Control high velocity waters
  - Can include additional sensors
  - Easily accessed for cleaning/maintenance
    - bi-weekly optical lens cleaning
    - Wiper brush cleaning

Future Work

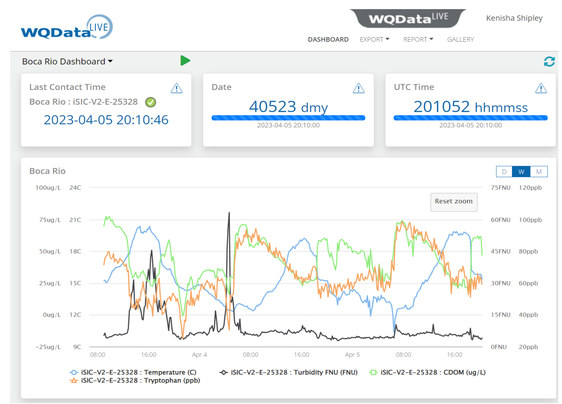

Figure 5 Shows an example of a WQData LIVE page with raw sensor data from a portable fluorometer deployed in the Tijuana Estuary.

- Launch data website on WQData LIVE
- Establish fluorescence thresholds for real-time data to indicate contaminated waters
- Determine hydrologic and biogeochemical processes underlying episodic, diel, and long-term dynamics of fecal indicator bacteria in urban streams
- Develop enhanced protocols based on data quality

References and Acknowledgements

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