Development of a Mobile Water Quality Monitoring Platform

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Background: Water quality monitoring efforts typically involve the measurement of variables at fixed locations. With in situ sensors, high temporal resolution can be achieved, but spatial resolution is not captured. A mobile monitoring platform has the potential to ***observe fine scale spatial variability*** of water quality in streams or lakes to identify spatial hot spots and constituent sources.

The Mobile Monitoring Platform

- Consists of a small, tethered boat outfitted with in situ water quality sensors.
- Equipped with an on-board GPS that tracks the route of the boat so the ***data can be temporally and spatially referenced***.
- Can be guided, floated, or pulled down a stream or lake to capture a longitudinal gradient or spatial variability of surface water quality.
- Tested along a stretch of a canal system and a reservoir.
- Challenges encountered included maintaining control of the platform, portaging around bridges, and preventing interference of ambient conditions by operators (e.g., mobilization of sediment).
- Visualizations of the data show promise in revealing spatial patterns in water quality.

We designed and built a frame for mounting sensors and a data enclosure to a small pontoon boat. Sensors are protected by housings that permit flow of water.

Water Quality Sensors

- **YSI EXO Sonde**: Measuring pH, fDOM, dissolved oxygen, conductivity, and water temperature
- **Turner Designs C6 Flourometer**: Measuring CDOM (colored dissolved organic matter)
- **FTS Turbidity Sensor**: Measuring turbidity

Enclosure Houses:

- Campbell Scientific Datalogger
- RF401 radio
- Garmin GPS
- Battery

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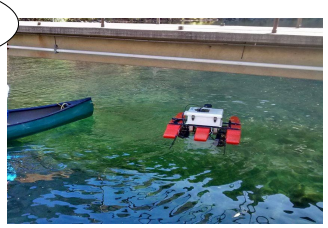
Test Deployment: Reservoir

The mobile monitoring platform was tested at First Dam, a reservoir on the Logan River at the mouth of Logan Canyon. The platform was attached by a rope to the back of a manned canoe and dragged around the reservoir. The sensors measure at approximately one foot below the water surface.

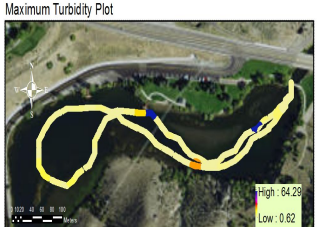


CHALLENGES

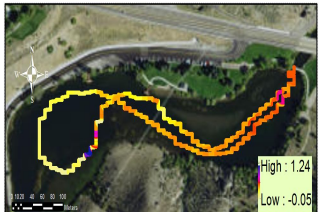
- **Control:** the platform was difficult to move smoothly.
- **Sediment suspension:** occurred when the paddle scraped the lake bottom.

These plots show spatial variability of fDOM and turbidity in the reservoir. There were high turbidity "hot spots" in shallow areas with suspended sediment.

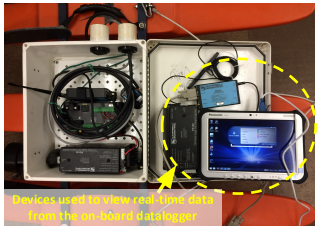
Maximum Turbidity Plot



fDOM Plot



Data Acquisition: In order to link the sensor data with time and location, the in-situ sensors and GPS were synced and programmed to send data to the on-board datalogger every 2 seconds. These data are stored and can be accessed later. To view these data in real-time to watch for "hot spots" and assure that sensors are functioning properly, a handheld tablet and connected radio are used to communicate with the onboard datalogger.

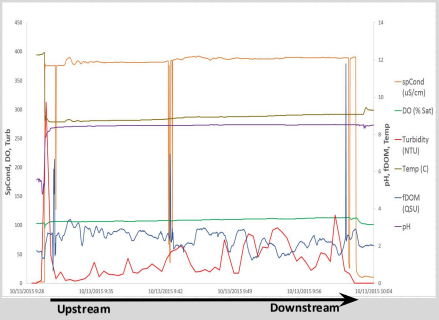


Test Deployment: Canal

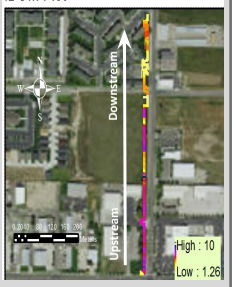
Testing was conducted along a stretch of the Northwest Field Canal in an urban area of Logan City (parallel to N 200 W). In order to keep the platform centered in the canal stream, operators attached ropes to the platform and guided it along the stream from the banks.

CHALLENGES

- **High velocity:** the platform was difficult to control in high velocities
- **Shallow water:** the sensor housings could drag on the channel bottom and require lifting until the boat could float freely.
- **Bridges:** portaging of the boat was required around bridges and culverts.
- **Sediment suspension:** occurred when operators entered the channel to move the platform.



fDOM Plot



The plot on the left shows measurements as the platform moved downstream. The plot on the right shows fDOM measurements from the same deployment.

- The turbidity and fDOM data exhibit some negative correlation.
- When operators entered the stream to move the platform, sediment was mobilized and turbidity increased.
- In some of these cases, fDOM increased as organic matter was also mobilized.
- However, when turbidity is high, suspended sediment can interfere with fluorescence, resulting in artificially low fDOM readings.
- The specific conductance, pH, DO, and water temperature remained fairly constant through the run, though there is some additional evidence of interference.
- Note that the turbidity measurements had some time delay relative to the other variables.