An investigation of the nitrate inflows into a humic lake using high-frequency monitoring data.

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Introduction

- Nitrogen is a key nutrient for aquatic ecosystems. In excess, it can cause the growth of toxic algae. Therefore, nutrient monitoring of surface waters is of vital environmental importance.
- Traditionally, wet chemistry methods of grab samples are used to determine nitrate (NO_3) levels but the use of high frequency optical sensors, such as SUNA V2, has been on the rise.
- Factors such as turbidity and coloured dissolved organic matter (CDOM) have been shown to interfere with the sensor and cause higher, false readings of NO_3 (Snazelle, 2016).

Figure 1. The SUNAV2 inside a 10-litre chamber in which it measures the NO_3 concentrations of the water flowing in

Aims/Objectives

- Can the SUNAV2 operate efficiently in a low nutrient environment? i.e., is there a positive significant relationship between the sensor's NO_3 readings and the grab sample NO_3?
- Does CDOM and turbidity interfere with the sensor?
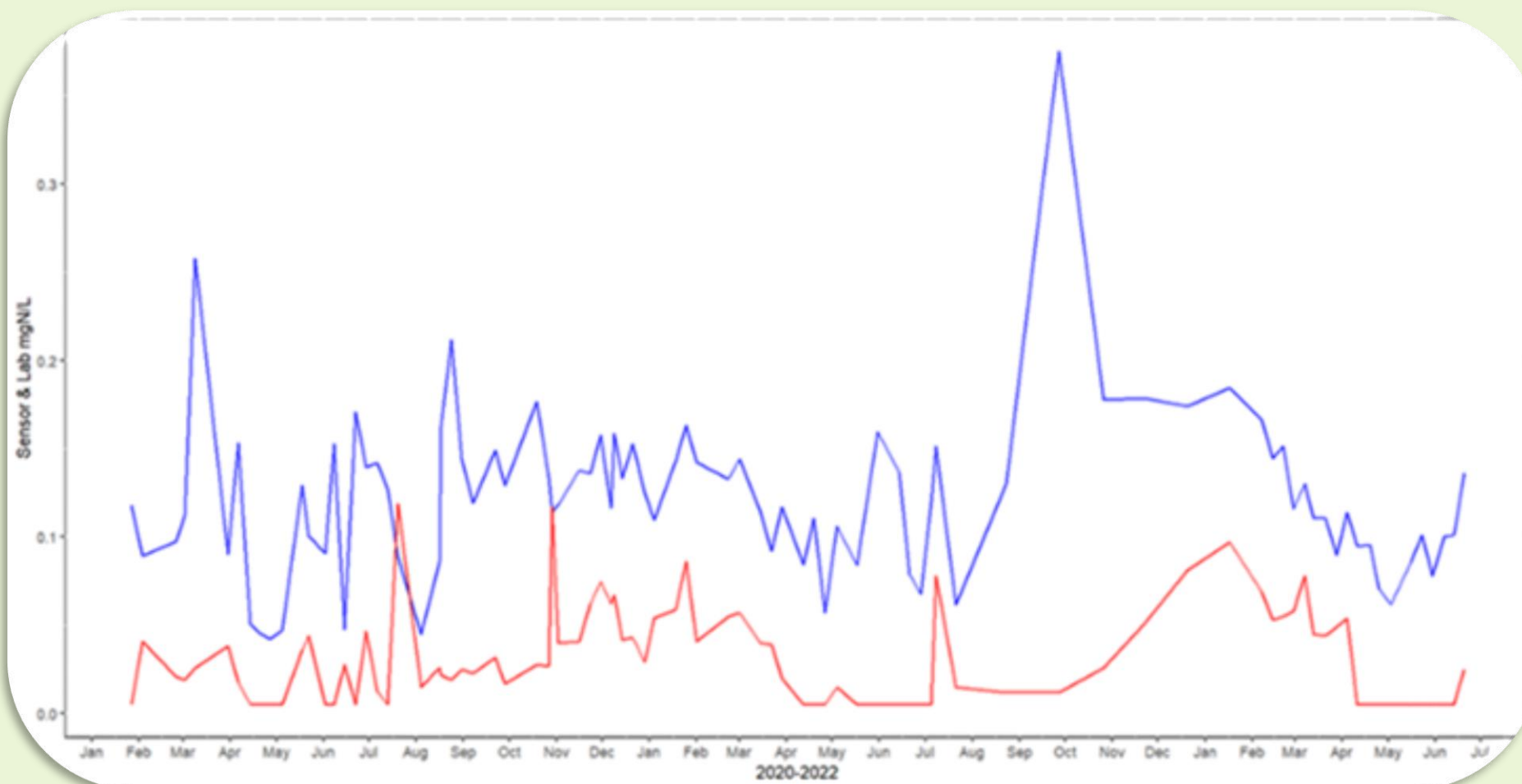
Methods & Materials

- The sensor's raw data taken from January 2020 to June 2022 were uploaded and processed in RStudio to remove data below the limit of detection of the sensor (0.035 mg/N/L) and above the maximum amount of NO_3 found in a humic environment (0.5 mg/N/L).

- Statistical analysis was performed to determine the relationship between the sensor's NO_3 readings and the grab sample NO_3 readings as well as the relationship between the sensor's NO_3 readings and colour and turbidity readings

Results

Figure 1. Correlation between SUNAV2 NO_3 data (blue) and grab sample NO_3 data (red) displays a significant positive relationship (p<0.05) (correlation coefficient = 0.43)
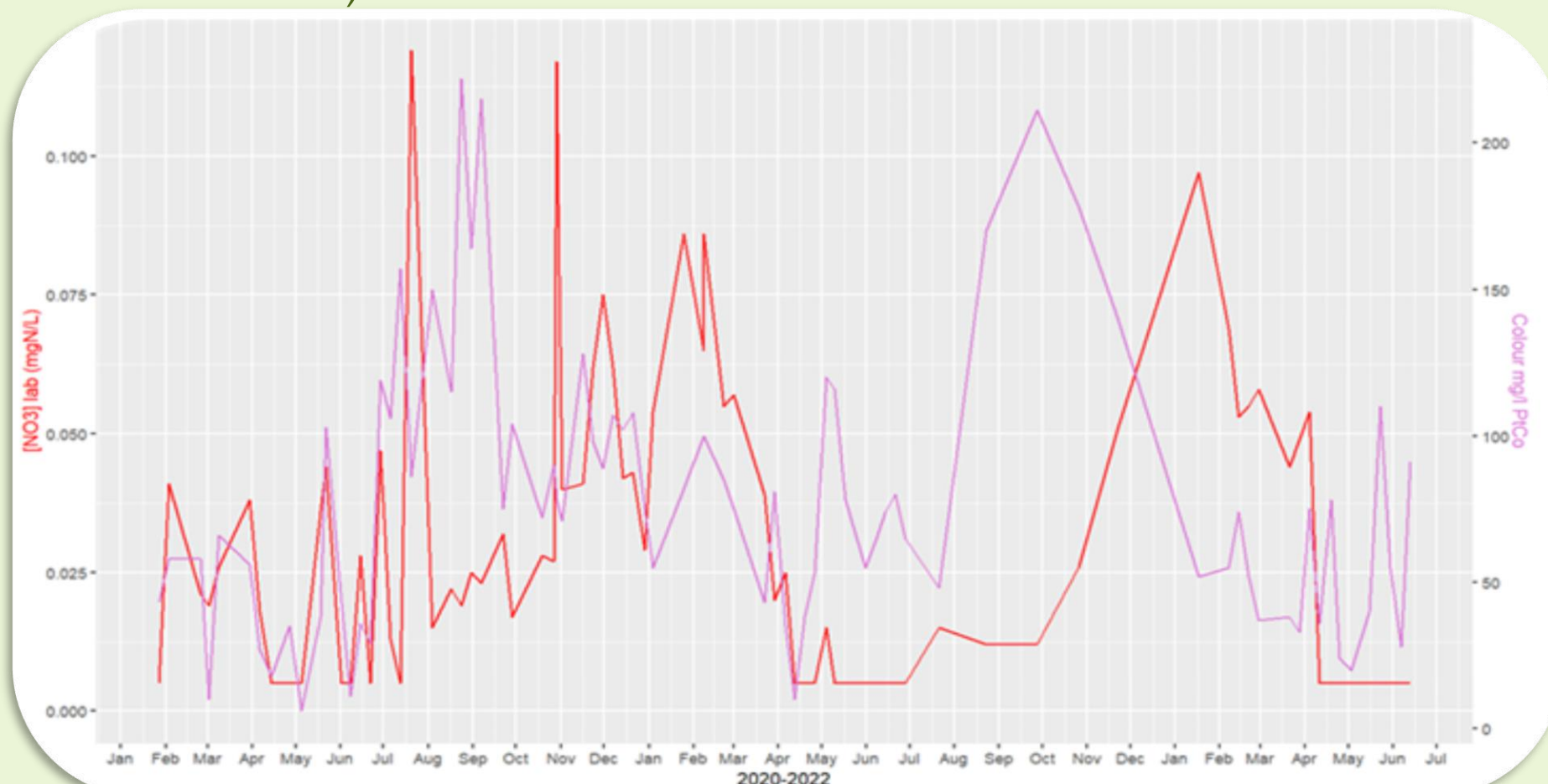

Figure 2. Correlation between the SUNAV2 NO_3 data and colour displays a significant positive relationship (p<0.05) (correlation coefficient = 0.34).

A slight positive correlation was also found between the SUNAV2 NO_3 data and turbidity (p<0.05) (correlation coefficient = 0.08).

Conclusions

- The positive significant relationship between the SUNAV2's NO_3 readings and the sample NO_3 readings indicates that the SUNAV2 does operate effectively in a humic environment.
- CDOM does interfere with the sensor, causing it to give higher, false NO_3 readings.
- Turbidity causes very little interference with the sensor.
- Due to the interference of the sensor by CDOM, the SUNAV2's data will require post processing work if it were to be used as a reliable replacement for traditional wet chemistry methods.

SURE Science Undergraduate Research Experience

References
Snazelle, T.T. 2016. The Effect of Suspended Sediment and Color on Ultraviolet Spectrophotometric Nitrate Sensors. U.S. Geological Survey Open-File Report, 2016 [online], 1014(10).