How to adapt a low-cost turbidimeter for low-tech water quality monitoring?

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# ABSTRACT

This study introduces a novel approach to monitoring the quality of inland waters, focusing on monitoring the effects of anthropogenic interferences and climate change on suspended sediment in aquatic environments. Suspended sediments can signify a host of issues, such as chemical pollution, pathogens, soil erosion, and sedimentation directly impacting the health of aquatic ecosystems and the availability of clean water for human use (Owens, 2020; Newcombe & MacDonald, 1991).

Our study recognizes that in some cases it is advantageous to utilize a low-cost and low-technology approach, installing a greater number of sensors and thus accounting for the spatial-temporal variability of turbidity and suspended matter flows within large-scale hydro systems even with decreased precision. This enables us to attain a wider scope of analysis. Furthermore, affordable technology enables the monitoring of measurements to be managed and measurement tools to be adapted for social sharing. One such instance includes their use by waterway managers or in citizen science programs.

With this in mind, we focus on the development of a low-tech optical turbidimeter (based on transmittance), utilizing the SEN0189 sensor, Arduino boards, and additional sensors for temperature measurement. We address challenges associated with field deployment of this low-tech system, using high tech sensors as benchmarks for comparison. The original SEN0189 sensor, known for its simplicity and prevalent use in literature, was modified to enhance performance in real-world conditions.

The methodological framework involved a three-step process: prototype, compensation for environmental factors, and field deployment. Sensor specific calibration equations were developed, reaching a coefficient of determination (R²) of 0.9994. A correction equation for temperature effects was developed. In the last step, field deployment, a 3D printed case for the sensor was designed and built, a relation between measurement uncertainty (in NTU) and energy consumption was defined and a minimum depth of 6cm of sensor installation was defined.

In summary, this study presents a holistic approach to a low-tech optical turbidimeter. The use of the system, coupled with strategies for compensating environmental factors, underscores its potential for accurate and affordable field deployment, addressing the critical need for sustainable inland water management.

# REFERENCES

Owens, P.N., 2020. Soil erosion and sediment dynamics in the Anthropocene: a review of human impacts during a period of rapid global environmental change. J Soils Sediments 20, 4115–4143.

Newcombe, C. P., & MacDonald, D. D., 1991. Effects of suspended sediments on aquatic ecosystems. North American journal of fisheries management, 11(1), 72-82.