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Validation of an in-situ spectrometer for real-time monitoring of surface water

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Introduction

Increased human activities are negatively impacting the quality of surface water bodies (Telci et. al., 2008). To protect and preserve them, continuous and real-time monitoring are necessary. The usual methodology consists of sample collection and transportation, followed by laboratory analysis. This could lead to quality changes and poor data accuracy. The application of in-situ technologies provides direct and more accurate measurements, on-line visualization, guaranteeing a real-time monitoring.

Material and methods

Integrated system - setting

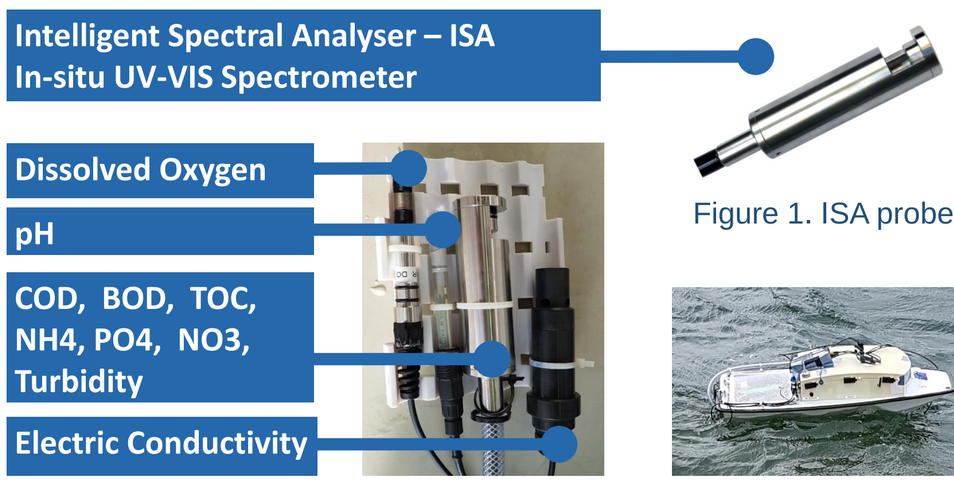

Figure 1. ISA probe

Figure 2. Probes carrier

Figure 3. Autonomous boat

Integrated system - validation

In-door simulation of real-world scenarios

Tests with Danube water, spiked with influent and effluent from a Sequential Batch Reactor (Figure 4).

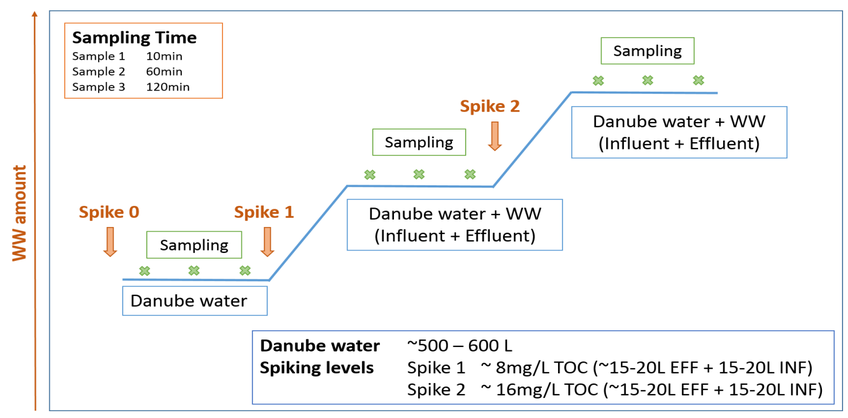

Figure 4. Sampling and Spiking process in Lab

Out-door trial

Test of the boat functions, like autonomous movement, GPS, remote control and documentation functions. Measurements were sent to the online platform WAQUIN, where the data can be displayed as a route on a map.

Results and discussion

In-door simulation of real-world scenarios

The results obtained from the in-door trials allowed to describe the performance characteristics of the integrated system, in particular ISA, DO, pH and EC probes (Table 1).

	LOD	LDC	Repeatability (%)	Accuracy (%)
EC (µS/cm)	22 - 40	9 - 40	0.6 - 3.3	92 - 93
pH (--)	0.1 - 0.4	0.05 - 0.4	0.2 - 1.7	94 - 102
DO (mg/L)	1.0	1.0 - 1.2	3.0 - 5.5	92 - 96
BOD5 (mg/L O_2)	1.7	1.7 - 3.4	6 - 37	101 - 106
COD (mg/L O_2)	4.1	4.1 - 20.1	4 - 15	91 - 103
NH_4 (mg/L NH_4)	0.5	0.5 - 2.4	5 - 48	97 - 103
NO_3 (mg/L NO_3)	0.1	0.1 - 0.9	0.7 - 4	97 - 104
PO_4 (mg/L PO_4)	0.2	0.2 - 0.4	9 - 49	95 - 97
TOC (mg/L C)	2.3	2.3 - 5.5	7 - 20	101 - 109
Turbidity (NTU)	39	54	14 - 20	85 - 96

Table 1. Performance characteristics of the integrated system

Out-door trial

The data collected during a field campaign are stored in the cloud on-line. Through the use of the on-line platform WAQUIN, it is possible to visualise those data and the related exact point of measurement on a map (Figure 5).

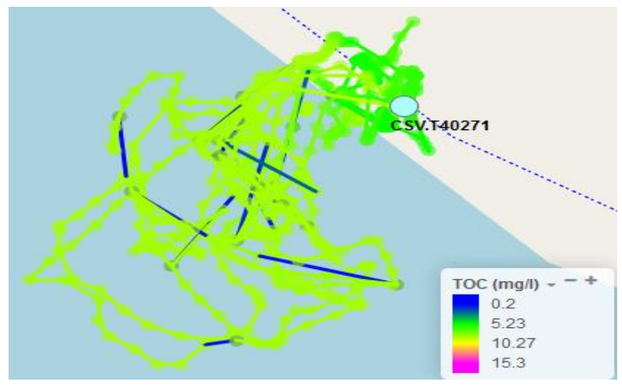

Figure 5. WAQUIN Map

Conclusions

The integrated system composed of the autonomous surface vehicle and the in-situ spectrometer showed positive outcomes. The in-situ spectrometer device could perform accurate and precise measurements, both out-door and in-door scenarios. The autonomous was shown to be able to navigate autonomously and to monitor selected water bodies of interest. It was possible to collect reliable real-time water quality data.

References

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