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# Development of a water monitoring network based on open architecture and Internet-of-Things technologies

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Good water quality status in rivers and lakes is vital for both human well-being and biodiversity conservation and requires efficient monitoring and restoration strategies. This is reflected in an increasing number of International and National legislations which enforce water resources management and monitoring at a basin scale.

For this purpose, state-of-the-art monitoring schemes have been developed by using low-cost, technologically advanced sensors and Internet of Things (IoT) infrastructure. Remote sensing offers also a good water monitoring alternative but is more appropriate for medium to large water bodies with less dynamic character in comparison to small scale, temporary rivers.

Recent technological advances in sensors technology, energy supply, telecommunication protocols and data handling, facilitate the use of automated monitoring stations, but still, deployment of extended networks with readily available data remains far from common practice. Installation and operational costs for the development of such monitoring networks are among the most commonly faced challenges.

The main aim of this effort is to present the development of a network of automatic monitoring stations that measure in near real time water level and physicochemical parameters in several Greek rivers. This infrastructure has been developed under the project “Open ELIoT” (Open Internet of Things infrastructure for online environmental services - https://www.openeliot.com/en/), which was funded by the Greek National Structural Funds. It includes a low cost and easy to produce hardware node, coupled with commercial sensors of industrial specifications, as well as an IoT data platform, elaborating and presenting data, based on open technologies.

During its initial operation phase, the system has been deployed in sites with different hydrological regimes and various pressures to water quality, including (a) an urban Mediterranean stream (Pikrodafni stream), and (b) the urban part of a continental river running through an agricultural area (Lithaios stream).

Preliminary data on the continuous monitoring of sites (a) and (b) are presented here, reflecting the differences in pressures to the respective water bodies. Pikrodafni stream which is located close to the center of Athens – Greece and receives a lot of pressure from urban waste, illustrates

Dissolved Oxygen (DO) concentration with a heavily skewed distribution towards low values (mean value: 2.15 mg/l and median: 0.93 mg/l). On the contrary, in Lithaios stream, which is more affected by agricultural runoff, dissolved oxygen data approach a normal distribution (mean value: 6.93 mg/l and median: 7.03 mg/l). The $25^{th}$ and $75^{th}$ percentiles in Pikrodafni stream are: 0.1 mg/l and 3.47 mg/l respectively while in Lithaios stream are: 5.6 mg/l and 8.45 mg/l. The average water temperature is similar to both streams (18.8 oC in Pikrodafni and 16.2 oC in Lithaios). Therefore, the significant differences in DO concentrations between the two streams indicate the need for continuous monitoring of data that facilitates the identification of pressures and enables stakeholders to respond to pollution events in time.