Fiware-enabled tool for real-time control of the raw-water conveyance system of Athens

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The raw water network system of Athens (Greece) is a complex infrastructure comprising around 500 km of aqueducts, conveying water from four reservoirs to four water treatment plants, while serving several other local users. In this work, we focus on the most important part of this system, namely the open-channel aqueduct of Mornos. This extends over 200 km and has a dual operation, namely water conveyance and flow regulation through temporary storage along the channel. This is achieved by a series of Λ-type structures, each one comprising sluice gates for flow control and a lateral ogee spillway. Currently, the regulation across the channel is performed through empirical rules, and according to target volumes requested by the operators of the downstream water treatment plants, on a daily basis. However, this management policy, which is strongly based on expert's knowledge, is neither sustainable nor safe, from a resilience perspective. Furthermore, the system is subject to occasional failures, due to undesirable overflows resulting to non-negligible water losses. In order to establish an optimal control policy, we developed an operational tool for the real-time scheduling of the sluice gate settings. Core of the tool is a conceptual model that incorporates the following assumptions: a) the operation of a Λ-type structure does not affect the operation of the other relevant structures; b) the Λ-type structure has two flow components, namely through the sluice gate and over the lateral spillway, which can be described by theoretical and semi-empirical hydraulic formulas, considering as unknown parameters the discharge coefficients of all sluice gates. On the other hand, the known model inputs are the geometrical characteristics of Λ-type structures and the real-time data for discharge, water level and gate opening, which are obtained from the telemetric monitoring system of the channel. In this respect, the key challenge is the determination of the discharge coefficients. This is employed through a grey-box approach, in which the model parameters are calibrated in continuous mode, using real-time data. To check the plausibility of the discharge coefficients, as derived by the real-time calibration phase, a comparison is made with the corresponding coefficients derived by historical data (off-line calibration). The tool, along with other analytics and algorithms developed, has been seamlessly integrated with the existing legacy system (e.g., SCADA, databases) of the system's operator (Athens Water Supply and Sewerage Company - EYDAP), using the FIWARE standardization protocol.