A network of low-cost temperature sensors for real-time monitoring of combined sewer overflow

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The H2020 innovation project digital-water.city (DWC) aims at boosting the integrated management of water systems in five major European cities – Berlin, Copenhagen, Milan, Paris and Sofia – by leveraging the potential of data and digital technologies. The goal is to quantify the benefits of a panel of 15 innovative digital solutions and achieve their long-term uptake and successful integration in the existing digital systems and governance processes. One of these promising technologies is a new generation of sensors for measuring combined sewer overflow occurrence, developed by ICRA and IoTsens.

Recent EU regulations have correctly identified CSOs as an important source of contamination and promote appropriate monitoring of all CSO structures in order to control and avoid the detrimental effects on receiving waters. Traditionally there has been a lack of reliable data on the occurrence of CSOs, with the main limitations being: i) the high number of CSO structures per municipality or catchment and ii) the high cost of the flow-monitoring equipment available on the market to measure CSO events. These two factors and the technical constraints of accessing and installing monitoring equipment in some CSO structures have delayed the implementation of extensive monitoring of CSOs. As a result, utilities lack information about the behaviour of the network and potential impacts on the local water bodies.

The new sensor technology developed by ICRA and IoTsens provides a simple yet robust method for CSO detection based on the deployment of a network of innovative low-cost temperature sensors. The technology reduces CAPEX and OPEX for CSO monitoring, compared to classical flow or water level measurements, and allows utilities to monitor their network extensively. The sensors are installed at the overflows crest and measure air temperature during dry-weather conditions and water temperature when the overflow crest is submerged in case of a CSO event. A CSO event and its duration can be detected by a shift in observed temperature, thanks to the temperature difference between the air and the water phase. Artificial intelligence algorithms further help to convert the continuous measurements into binary information on CSO occurrence. The sensors can quantify the CSO occurrence and duration and remotely provide real-time overflow information through LoRaWAN/2G communication protocols.

The solution is being deployed since October 2020 in the cities of Sofia, Bulgaria, and Berlin, Germany, with 10 offline sensors installed in each city to improve knowledge on CSO emissions. Further 36 (Sofia) and 9 (Berlin) online sensors will follow this winter. Besides its main goal of improving knowledge on CSO emissions, data in Sofia will also be used to identify suspected dry-weather overflows due to blockages. In Berlin, data will be used to improve the accuracy of an existing hydrodynamic sewer model for resilience analysis, flood forecasting and efficient investment in stormwater management measures. First results show a good detection accuracy of CSO events with the offline version of the technology. As measurements are ongoing and further sensors will be added, an enhanced set of results is going to be presented at the conference.

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