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Can data from intelligent water meters inform water demand modelling and management accurately, feasibly, and cost-effectively?

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Since the first experimental applications in the late 1990s, several trials exploiting intelligent metering technologies worldwide allowed to gather water consumption data at the building/household level with sub-daily sampling resolution. Yet, the deployment of these technologies at the utility/urban scale is still limited because costs, benefits, and tradeoffs of smart water meter investments are still unclear and not quantified. Moreover, explorative and comparative research on smart water meter data is often limited by the low availability of open or accessible water use data gathered at high spatial and temporal resolution.

In this work, we quantitatively explore the impacts of reading residential water meters every 10 seconds, and progressively coarser sampling resolutions, on information retrieval and water demand modelling and management. To explore the potential tradeoffs between data information content and opportunities/limitations for water demand modelling and management, we introduce a comparative framework that contrasts data storage requirements and commercial availability of meters against accuracy in end-use disaggregation, time to detect post meter leaks, and errors in estimating the volume and timing of peak flows for each sampling resolution. We apply the comparative framework on water use data generated via STREaM, an open-source STochastic Residential water End-use Model we developed based on end-use data observed from over 300 single-family households in nine U.S. cities to stochastically generate water end-use time series with finer sampling resolution of 10 seconds.

Our results quantitatively demonstrate that increased sampling resolution to few minutes or seconds allows significantly more accurate end-use disaggregation, prompt water leakage detection, and accurate and timely estimates of peak demand. Conversely, fine resolution data trade-off with higher storage requirements and limited product availability. This research provides insights to water managers and utilities for further research, commercial deployment, and use of intelligent water meters. It also delivers the software STREaM, made available as a collaborative project for future development as new heterogeneous high-resolution water use data are made available worldwide.