Reply to reviewers comments for the UWO open dataset

ESSD-2024-47 | Data description paper
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The UWO dataset – long-term observations from a full-scale field laboratory to better understand urban hydrology at small spatio-temporal scales
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Response to Reviewer #2 (Anonymous referee #2)

Submitted on 23 Oct 2025
https://editor.copernicus.org/index.php?_mdl=msover_md&_jrl=386&_lcm=oc93lcm94x&_ms=117976&id=1670315&salt=2134679616128295195

We thank the reviewer once more for the positive feedback on the quality and utility of the dataset and the accompanying manuscript. We appreciate the very constructive suggestions and have addressed all comments (red colour) in the revised manuscript as outlined below. Final changes are formatted in blue colour.

Report #1

The reviewer acknowledges the authors' efforts to improve the article and thank them for considering my comments and adding clarifications to the text. After carefully revising the submitted manuscript, I have following minor points which I think can further improve the quality of this manuscript before publication. In addition, there is no need to have another round of review, I trust the handling topic editor can approve the final version of this manuscript.

Nevertheless, I would like to take this opportunity to briefly comment on RC2.3. My original intention was to highlight that it is currently unclear to users what the difference between the two databases is and which database should be used for which application. To address this issue, a short text description on the website would have been sufficient.

In my view, the current solution, providing only validated data via the website, appears somewhat dependent on the availability of human resources. If, for example, qualified staff is temporarily unavailable, it may not be possible to integrate recent data in a timely manner, which would be unfortunate given the high value of this project. If the authors could find a solution to overcome this challenge, it would greatly benefit the research community by ensuring continued access to up-to date raw data and could significantly enhance the long-term impact of this great work.

The website https://uwo-opendata.eawag.ch/ basically is a dashboard application that visualises validated data. This “read-only” application represents a comfortable way to *display* validated time series and information on monitoring sites, e.g. a picture of the device and installation conditions. After screening time series or sensors, potential data users could decide quickly which data are interesting to them. Integrating recent data into the dashboard does not necessarily depend on institutional staff as it is accomplished through an automated data pipeline in the background. The SQLite databases on ERIC open then provide access to ‘hard’ raw data including validation flags. We agree, it would be extremely beneficial to continuously provide raw and validated data, quasi instantaneously as it is collected in the field (continuous real-time feed). We have not yet abandoned this idea, but the solution is not there (yet).

Best regards

Minor comments

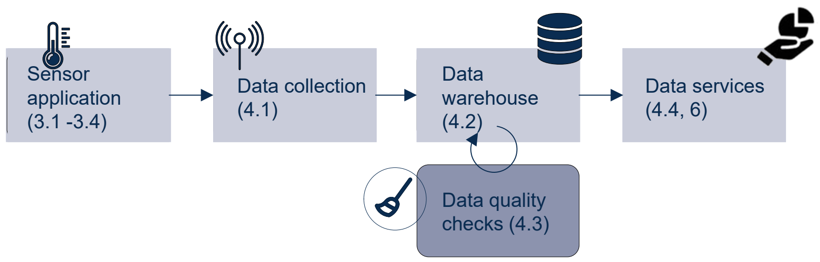
RC2.43 [following the numbering from the major revision]:• L49: The phrase “as it requires high-frequency sensors that must operate reliably in harsh environments such as sewer pipes.” is redundant to L47.

Yes, we messed up the logic during the last revisions. First, it is about input, i.e. rainfall, second about output, i.e. runoff and pollution. The correct sentences are now:

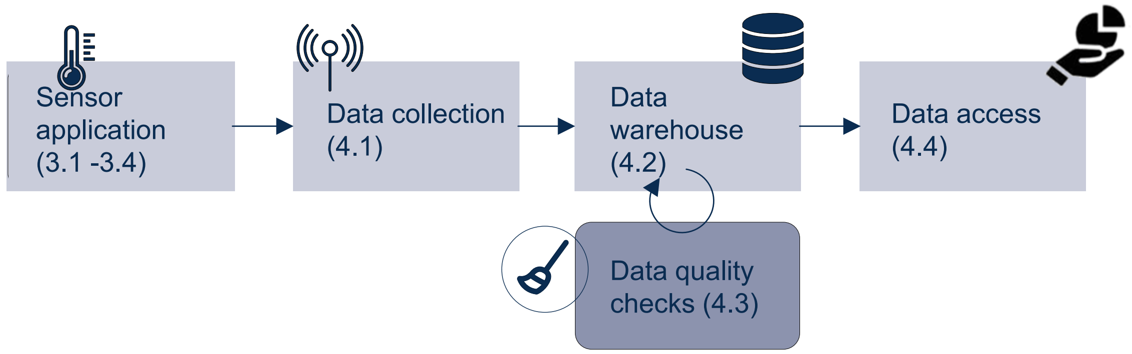
Understanding urban hydrological processes requires high-resolution data on both, the input - such as rainfall - and the output - such as wastewater flows and pollution. For rainfall, a high temporal resolution seems to be more important than spatial resolution, though both interact closely (Ochoa-Rodriguez et al., 2015), although reliably operating rain gauges collecting minute-by-minute rainfall data over many years can be challenging (Bianchi et al., 2013). Similarly, monitoring stormwater runoff, wastewater flows and pollution processes at the minute scale is resource-consuming, as it requires high-frequency sensors that must operate reliably in harsh environments such as sewer pipes.

RC2.44: • Figure 5: I suggest to rename “Data Services” into “Data access” and to remove the reference to section 6 to be consistent with the pipeline description in L350; instead, the authors could add a new box on the right side of the figure (e.g., “Data application, (6)), similar to the sensor application.

Agree. We changed the figure from



To



RC2.45: • L421: The definitions of Clemens at al., 2021 about the more classes of data points remain unclear and only raises questions. As it is not needed, I recommend to remove this sentence.

Agreed. We removed the sentence.

RC2.46: • Section “6.2 Future research directions”: There are multiple phrases in this section with “Future research should …” and “Future research must …”; I **highly recommend to rephrase them with “can” to better express the possibility of these future research directions.**

Agreed. We changed all to “can” and “could”.

RC2.47: • Section “6.2.2. Adapting Urban Drainage to Climate Change with Grey-Green Infrastructure”: The other sections in 6.2 clearly make a context to the provided dataset (including a description why this dataset helps to answer them), while in contrast, this research direction is quite general and could be performed with any (calibrated) SWMM input model. **Especially, as I think there are no (thermal) measurements of BGI in the dataset and as also the SWMM-HEAT is not provided. Therefore, I suggest to either remove this section, or to clearly outline the benefit of using the UWO Dataset for answering these research questions.**

Thank you for this very helpful comment. We agree that the previous version of Section 6.2.2 overstated the link to climate adaptation and BGI, which is not directly supported by the UWO open dataset. In hindsight, this framing was influenced by parallel discussions in a related study on climate resilience and Blue-Green infrastructure[1], but it was misleading in the context of this data paper.

However, a strength of the UWO dataset, which is unique and could be further exploited, but has not been mentioned prominently in the manuscript are the long-term, high-resolution wastewater and sewer headspace temperature measurements (dataset A3 in the FieldObservations[2], see Figure 1). Especially in combination with hydraulic and meteorological data. These data enable research on temperature-driven in-sewer processes such as heat recovery potential, thermal attenuation along the network, and temperature-dependent reactions (e.g., H_2S formation[3]), which are directly supported by the dataset.

We have therefore revised the section (originally 6.2.2) to focus explicitly on temperature-related processes and removed the emphasis on BGI and climate adaptation. The new section (numbered 6.2.3) is:

6.2.3. Temperature-Related Processes in Urban Drainage Systems

Urban drainage systems are thermodynamic systems in which temperature strongly influences physical, chemical, and biological processes. Wastewater temperature governs heat recovery potential, seasonal heat losses, and temperature-dependent reactions such as H_2S formation. Understanding in-sewer temperature dynamics is therefore essential for advancing water–energy nexus research and improving sewer operation. Key research questions in this domain that can be investigated with the UWO dataset include: “How does wastewater temperature propagate through the network under varying hydraulic conditions?”, “How do seasonal and diurnal patterns affect recoverable heat potentials?”, “How does temperature influence in-sewer biochemical processes?” The UWO dataset provides high-resolution, spatially distributed wastewater and sewer headspace temperature data combined with hydraulic and meteorological observations. Although no dedicated thermal infrastructure measurements are included, e.g. on Blue-Green Infrastructure, the dataset uniquely enables empirical analysis of in-sewer temperature dynamics and supports the development and testing of temperature-based process models at network scale (Abdel-Aal et al., 2019; Duque et al., 2025; Figueroa et al., 2021).

[1] https://www.sciencedirect.com/science/article/pii/S2210670725009539
[2] https://opendata.eawag.ch/dataset/uwo_field-observations_2019_to_2021
[3] https://www.sciencedirect.com/science/article/pii/S2589914725000453

I have also some more suggestions about future research directions in the context of the UWO dataset which could be added to the manuscript by the authors:

RC2.48: • It is stated that data quality checks still involve a great deal of manual work and expert knowledge (section 4.3.), which can be seen as a limitation for transferability and scalability. **Therefore, a major research direction could be to develop robust and automatic data quality checks to overcome these limitations in my opinion.**

Thank you for this very valid hint. We included an extra section to adequately address the issue of automated data validation:

6.2.1 Towards robust and automated data quality checks

Although the UWO dataset is unique and carefully curated, it still contains sensor failures and inconsistencies. This reflects a broader challenge: robust and automated data quality control methods are not yet well established. Across metrological (Bertrand-Krajewski et al., 2025), scientific (Disch and Blumensaat, 2019), and industry (Deheer, 2022) perspectives, the key bottleneck to date is not algorithm complexity but data readiness. The UDMT approach emphasizes that validation should be physically informed, traceable, uncertainty-aware, transparent, and reproducible. Automated checks should therefore combine calibration information, measurement uncertainty, and hydraulic plausibility (e.g., pipe capacity), rather than relying solely on statistical anomaly detection.

Machine-learning trials further show that structured preprocessing (range and gradient checks, normalization, gap handling, dry/wet separation) has a stronger influence on performance than the choice of the machine-learning model (see Section S9.1, Deheer, 2022). They also highlight the need for clearer anomaly definitions, multi-sensor integration, cautious use of complex models, and synthetic data to address limited labelled events. Key questions for future research using the UWO dataset could therefore explore: “How can automatic checks better use simple hydraulic rules and known sensor errors?” “How can clear and shared definitions of “anomalies” be established?” “How can sensors, physical models, and simple data methods be combined for reliable operational quality control?”

RC2.49: • Section “6.2.3 Developing predictive models and Real-Time Control strategies”: A key aspect here could be not only to evaluate the performance of RTC under faulty data conditions, **but also to develop RTC that, despite faulty or missing data, maintains its performance compared to perfect system knowledge or at least has only minor degradations.**

This is an excellent point and we thank the reviewer for this comment. We integrated this aspect in the section 6.2.3 as follows:

Real-time control (RTC) of urban drainage systems depends on the ability to predict system states reliably under a wide range of rainfall and runoff conditions. Future research can use the UWO data to develop predictive models that support effective control strategies. Central research questions include: “Which types of rainfall events are most critical for triggering control actions?”, “Can observed flow patterns be used to predict system states and guide real-time decisions?”, and “How can we use monitoring data, which are never 100% accurate, to quantify the performance of RTC systems?”. A key aspect for future research is not only to evaluate the performance of RTC under faulty or missing data conditions, but also to develop control strategies that remain robust despite imperfect information. The goal should be RTC systems that maintain performance close to that achieved under perfect system knowledge, or at least exhibit only minor degradations when data are incomplete, delayed, or erroneous.