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Runoff predictions in combined sewer system of the city of Prague using raw attenuation data from commercial microwave links

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Commercial microwave links (CMLs) have recently shown great potential in urban drainage modelling due to their ability to provide rainfall-runoff dynamics. Previous studies typically used mechanistic hydrodynamic models driven by quantitative precipitation estimates (QPEs) derived from CML attenuation data. Naturally, some errors are introduced, primarily related to CML rainfall retrieval model, including uncertainties in wet antenna attention correction, as well as errors originated from path-averaged character of CML QPEs. These processing steps not only generate some new uncertainties but also result in a loss of valuable information contained in raw data. Besides, mechanistic models require high-quality pre-processed input rainfall data, which adds complexity to the application.

We address these issues by employing raw CML attenuation data without QPE derivation using data-driven rainfall-runoff models in the overall Prague catchment, where runoff is influenced by both rainfall and residential water use. We find that: (1) Raw CML attenuation data can be effectively used to obtain the discharges despite the additional influence of household water consumption, achieving NSE >0.7 and PCC> 0.85 over all sub-catchments. (2) Compared with rain-gauge data as inputs, CML attenuation data outperforms in heavy and long-period rain events (e.g. reducing RMSE by 17% and increasing PCC by 18% respectively). (3) CML performs better in sub-catchments A and F, where CMLs are densely distributed, and rainfall is highly concentrated within the catchment. However, its performance in sub-catchment K is poorer, likely due to its larger area, sparser CML coverage, and longer rainfall-runoff concentration time. Additionally, the influence of non-rainfall-related flows becomes more pronounced, potentially reducing the predictive advantage of CML. (4) Models using CML data as input enable runoff prediction beyond the catchment's rainfall-runoff lag time, whereas models with rain gauge data deteriorate quickly. CML-based hydrological modelling is effective in purely rainfall-driven urban basins and adaptable to more complex systems influenced by human activities. This research underscores CML's potential as a robust alternative to traditional rain gauges, particularly for improving real-time runoff predictions in data-scarce urban environments.

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Yes

Authors: SONG, Ying; FENCL, Martin (Czech Technical University in Prague); BAREŠ, Vojtěch (Czech Technical University in Prague)

Presenter: SONG, Ying

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