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Predicting urban stormwater runoff with quantitative precipitation estimates from commercial microwave links

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Reliable and representative rainfall data are crucial for urban runoff modelling. However, traditional precipitation measurement devices often fail to provide sufficient information about the spatial variability of rainfall, especially when heavy storm events (determining design of urban stormwater systems) are considered. Commercial microwave links (CMLs), typically very dense in urban areas, allow for indirect precipitation detection with desired spatial and temporal resolution. Fencl et al. (2016) recognised the high bias in quantitative precipitation estimates (QPEs) from CMLs which significantly limits their usability and, in order to reduce the bias, suggested a novel method for adjusting the QPEs to existing rain gauge networks.

Studies evaluating the potential of CMLs for rainfall detection so far focused primarily on direct comparison of the QPEs from CMLs to ground observations. In contrast, this investigation evaluates the suitability of these innovative rainfall data for stormwater runoff modelling on a case study of a small ungauged (in long-term perspective) urban catchment in Prague-Letňany, Czech Republic (Fencl et al., 2016). We compare the runoff measured at the outlet from the catchment with the outputs of a rainfall-runoff model operated using (i) CML data adjusted by distant rain gauges, (ii) rainfall data from the distant gauges alone and (iii) data from a single temporary rain gauge located directly in the catchment, as it is common practice in drainage engineering. Uncertainties of the simulated runoff are analysed using the Bayesian method for uncertainty evaluation incorporating a statistical bias description as formulated by Del Giudice et al. (2013).

Our results show that adjusted CML data are able to yield reliable runoff modelling results, primarily for rainfall events with convective character. Performance statistics, most significantly the timing of maximal discharge, reach better (less uncertain) values with the adjusted CML data than with the distant rain gauges. When the relative error of the volume discharged during the maximum flow period is concerned, the adjusted CMLs perform even better than the rain gauge in the catchment. This seem to be very promising, especially for urban catchments with sparse rain gauge networks.

References:

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