Improving urban drainage modelling with path-average rainfall from telecommunication microwave links

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ABSTRACT

Incomplete knowledge about spatio-temporal rainfall dynamics causes input uncertainty in rainfall—runoff modelling. This is especially critical in urban areas, where subcatchments are small and runoff is generated extremely fast on the impervious areas. Networks of telecommunication microwave links (MWL) are very dense in urban areas and therefore could provide novel rainfall information which has the potential to reduce input uncertainty in urban drainage modelling. In this study, we therefore investigate how the better information on spatio-temporal rainfall variability from MWL observations improves pipe flow predictions. Specifically, we perform numerical experiments with virtual rainfall fields and compare the results of MWL rainfall reconstructions to those of rain gauge observations. For a case study of a suburb in Prague, Czech Republic, we are able to show that MWL networks in urban areas are sufficiently dense to provide good information on spatio-temporal rainfall variability. Total rainfall volumes are reproduced very well, with errors of about 6 %. Although peak rainfall intensities are still systematically underestimated by approximately 30%, this clearly outperforms rain gauge observations. Also, we find that peak flows from MWL observations are only biased by –6 %, whereas rain gauge observations cause a bias of 16 %. In our study, we did not include effects of uncertainties in both MWL and rain gauge measurements, which, arguably, can be high. Nevertheless, MWL networks could provide hundreds of rainfall sensors, which would be available at virtually no cost. As demonstrated, MWLs can significantly reduce input uncertainties in future rainfall-runoff modeling and thus improve discharge predictions.

KEYWORDS

Rainfall estimation, rainfall spatial dynamics, telecommunication microwave links, urban drainage modelling