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Commercial microwave links in urban rainfall-runoff modelling: Two different approaches to removing the bias

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Commercial microwave links (CMLs) are point-to-point radio connections widely used as cellular backhaul and thus very well covering urbanized areas. They can provide path-integrated quantitative precipitation estimates (QPEs) as they operate at frequencies where radio wave attenuation caused by raindrops is almost proportional to rainfall intensity. Pastorek et al. (2019b) demonstrated the feasibility of using CML QPEs to predict rainfall-runoff in a small urban catchment. Unfortunately, runoff volumes were highly biased, mostly for QPEs from short CMLs, although the temporal runoff dynamics were predicted very well, especially during heavy rainfall events. It was also shown that, for the heavy rainfalls, reducing the bias by adjusting the CML QPEs to traditional rainfall measurements (Fencl et al., 2017) leads to less accurate reproduction of the runoff temporal dynamics.

Current understanding is that the bias in CML QPEs is often caused by imprecise estimation of wet antenna attenuation (WAA), which is a complex process influenced by many physical phenomena, including radome hardware or positioning of the outdoor unit. However, traditional WAA estimation methods are typically unable to take into account all the individual-level factors. We proposed (Pastorek et al., 2019a) to estimate WAA separately for each of the examined CMLs by using discharge measurements at the outlet of a small urban catchment and showed that this approach can reduce the bias in CML QPEs, leading to generally satisfying performance of rainfall-runoff models, mainly for heavy rainfalls.

In the presented study, we evaluate the effect of the method proposed in Pastorek et al. (2019a) (method i) on rainfall-runoff modelling in more detail and compare it to the method of Fencl et al. (2017) (method ii). For a case study in Prague-Letňany, Czech Rep., a calibrated rainfall-runoff model is used to predict discharges at the outlet of the small urban catchment (1.3 km^2) using QPEs from 16 CMLs. First results confirm that minimizing the bias in CML QPEs using method i is convenient mainly for heavy rainfalls, as Nash-Sutcliffe efficiency is considerably higher in this case for all but one CML (on average 0.65; only 0.40 for method ii). Moreover, method i preserves the information about the rainfall temporal dynamics during heavy rainfalls better than method ii for most of the individual CMLs (correlation coefficient with observed runoffs on average 0.83 for method i and 0.78 for method ii). Next steps should include generalization for other case studies,

including an exploratory analysis of the potential mismatches.

References

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