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Information-based approach for quantifying uncertainty in precipitation estimates from commercial microwave links

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Opportunistic sensors have great potential for rainfall monitoring, as the density of their networks can outperform standard rainfall monitoring networks. The commercial microwave link (CML) network enables indirect monitoring of path-averaged rainfall intensity. It is retrieved from signal attenuation caused by raindrops, which can be related to rainfall intensity by a simple power law. Quantitative precipitation estimates from CMLs are, however, affected by uncertainty, which is still challenging to estimate.

This study proposes, for the first time, to use information theory methods to quantify uncertainty in CML QPEs. This method enables measuring the firmness of relationships between different variables using discrete probability distributions and also estimates the uncertainty. The advantage resides also in the fact that it allows any type of data to be used. This approach was recently applied by Neuper and Ehret (2019) to evaluate quantitative precipitation estimates with weather radar.

Data from non-winter periods of 2014 – 2016 are used at a temporal resolution of 15 min. The target (reference) data are the rain gauge adjusted radar observation. The CML data (signal attenuation and its processing) from the Prague network and its hardware characteristics are used as predictors. Additionally, other predictors, e.g., temperature and synoptic types, are used as further predictors. First, the information content of individual predictors of the target rain gauge adjusted radar data is measured. Specifically, we tested how different combinations of predictors reduce uncertainty. Second, the effect of the sample size on uncertainty is investigated. Different sizes of random samples are selected from the dataset and their information content for the target is quantified.

Depending on the choice of the predictor(s), their abilities to estimate the target variable can be compared. Their predictive uncertainties are different, which results in a ranking of suitability of available predictors and their combinations.

References

Neuper, M. and Ehret, U. (2019) Quantitative precipitation estimation with weather radar using a data- and information-based approach, Hydrol. Earth Syst. Sci., 23, 3711–3733, https://doi.org/10.5194/hess-23-3711-2019.

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