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Identification of wet and dry periods in commercial microwave link observations via information theory framework

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Commercial microwave links (CML) have already demonstrated their promising potential in rainfall observation and sensing. The CMLs enable indirect monitoring of path-averaged rainfall intensity as the transmitted signal is attenuated along the link path mainly by raindrops. However, the signal is also attenuated during dry weather periods and is affected by both atmospheric and hardware conditions. Faulty separation of wet and dry periods can easily lead to incorrect rainfall estimates and remains challenging to estimate due to irregular fluctuations of the attenuated signal.

This study aims to use information theory approach to estimate wet and dry periods in the CML signal attenuation observation, which is achieved by evaluating individual predictors and combinations of predictors. The method enables any data to be used as predictors without the need for parameters to describe relations between different variables, as the discrete probability distributions are applied. The model that provides the strongest information content to the wet and dry classification is binarized using an optimized threshold and validated. Thiesen et al. (2019) recently applied this approach to identify rainfall-runoff events in discharge timeseries.

Data of non-winter periods between 2014 and 2016 are used with a temporal resolution of 1 minute. For one CML in the Prague network, wet and dry periods were defined manually as reference (target). Predictors included raw CML data (signal attenuation), as well as derived timeseries such as signal attenuation shifted in time, relative magnitude of attenuation, gradient of the signal attenuation and signal deviation. In addition, external predictors such as temperature deviation, rain gauge precipitation observations or synoptic types are used as additional predictors.

By selecting different predictors, it is possible to compare effectiveness in estimating the reference wet and dry periods. Variation in the strength of the relations between the target and the predictors allows ranking the suitability of available predictors and their combinations for the task. Subsequently, having the best performing predictor, it is combined with others and their collective performance was iteratively evaluated to find the most accurate combination of three predictors described in a multidimensional discrete distribution model. The resulting predictor combination was then converted into binary form and validated. A method comparison is performed with separation of constant and moving average baseline attenuation for wet periods identification as

well as wet/dry classification using a threshold for rolling standard deviation of the signal.

Having sufficient data amount for data-driven models enables utilizing the relationships within the dataset without being limited by parametric or operational assumptions, which are often embedded part of wet/dry in classification methods.

References

Thiesen, S., Darscheid, P., and Ehret, U.: Identifying rainfall-runoff events in discharge time series: a data-driven method based on information theory, Hydrol. Earth Syst. Sci., 23, 1015–1034, https://doi.org/10.5194/hess-23-1015-2019, 2019.

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