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Improvement of autocorrelation in synthetic time series and its impact on urban hydrological applications

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Time series with high temporal resolution are crucial for many fields in hydrology. Observed time series of this kind are very short in most cases, so they cannot be used. However, time series with daily resolution exist for much longer periods and a higher network density. The objective in this study is to disaggregate the daily time series to derive long time series with a temporal resolution of 5 minutes. The micro-canonical cascade model is a well-known disaggregation, whereby the autocorrelation of the generated time series is often underestimated. This underestimation leads to unrealistic results if the disaggregated time series are used as input for urban hydrological simulations. In this study, several approaches to improve the autocorrelation by i) modifications of the disaggregation process and ii) subsequent resampling approaches after the disaggregation as well as combinations of i) and ii) are shown. For the resampling, a novel approach is introduced to conserve the well represented rainfall extreme events in the disaggregated time series by a simultaneously improvement of the autocorrelation.

All analyzed approaches lead to an improvement of the autocorrelation. However, the improvement achieved by the resampling algorithm is much stronger in comparison to all other approaches. An additional evaluation is carried out with urban hydrological simulations of an artificial sewage system. Without an improvement of the autocorrelation, flood volumes of manholes and combined sewer overflow volumes are strongly underestimated. The best overall improvement of the autocorrelation is achieved by a combination of a position refinement during the disaggregation process and the resampling approach.