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Evaluating the performance of a max-stable process for estimating intensity-duration-frequency curves

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A recent development in the modeling of intensity-duration-frequency (IDF) curves involves the use of a spatial max-stable process to explicitly account for asymptotic dependence between durations. To accomplish this, we use a duration-space instead of a geographic-space, following Tyralis and Langousis (2018). The resulting IDF curves can then be used to estimate extreme rainfall for any arbitrary rainfall duration. We aim to determine whether the use of a model that explicitly accounts for the dependence between durations could improve the estimates of extreme rainfall. The performance of the max-stable process is compared to the duration dependent GEV (d-GEV) approach for IDF-curve estimation proposed by Koutsoyiannis et al. (1998). The max-stable approach explicitly models the dependence via a parametric model, while the d-GEV approach assumes that the durations are independent. The performance of both approaches is assessed for two scenarios, in a controlled simulation experiment, and for observations from a rain gauge. A Brown-Resnick max-stable process and a duration-dependent GEV was fitted to the data in both scenarios. The performance is measured using the Quantile Skill Score (QSS) with the d-GEV as the reference model. The resulting skill scores show that correctly specifying the dependence structure leads to the max-stable model perfomring similarly to the d-GEV. This pattern was observed also for low and high levels of dependence.