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## A multiple threshold method for fitting the generalized Pareto distribution to rainfall time series

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**Abstract.** Previous studies indicate the generalized Pareto distribution (GPD) as a suitable distribution function to reliably describe the exceedances of daily rainfall records above a proper optimum threshold which should be selected as small as possible to retain the largest while assuring an acceptable fitting. Such an optimum threshold may vary from site to site, affecting consequently not only the GPD scale parameter but also the probability of threshold exceedance.

Thus a first objective of this paper is to derive some expressions to parameterize a simple threshold-invariant three-parameter distribution function which assures a perfect overlapping with the GPD fitted to exceedances over any threshold larger than the optimum one. Since the proposed distribution does not depend on the local thresholds used for fitting the GPD, it is expected to reflect the on-site climatic signature, thus appears particularly suitable for hydrological applications and analyses.

A second objective is to develop and test the Multiple Threshold Method (MTM) to infer the parameters of interest by using exceedances over a wide range of thresholds applying again the concept of parameter threshold-invariance. We show the ability of the MTM in fitting historical daily rainfall time series recorded with different resolutions and with a significant percentage of heavily quantized data. Finally, we prove the supremacy of the MTM fit against the standard single threshold fit, adopted for partial duration series, by evaluating and comparing their performances on Monte Carlo samples drawn by GPDs with different scale parameters and different discretizations.

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