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Regional and local stationary estimates of extreme rainfall in Slovakia based on Block-maxima (BM) and Peaks-Over-Threshold (POT) approaches

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The monitoring and statistical as well as spatial analyses of extreme rainfall events are highly important because of observed negative impacts linked with their occurrence. Moreover, extreme short-term rainfall as well as several-day precipitation events might have gained a rising tendency as a consequence of the global warming. Probabilistic modeling and statistical analysis of relationships between rainfall intensity and its duration as well as frequency (generally expressed by Intensity-Duration-Frequency [IDF] curves) represents one of the most commonly used tools in the flood risk management, water resources engineering as well as for flood protection projects.

In the paper two different "regional" as well as "at-site" (local) estimation schemes for analysing extreme rainfall events, based on annual maximum series (AMS) and partial duration series (PDS) created using the POT (Peaks-Over-Threshold) approach with stationary threshold, are compared. The POT approach, considering the Generalized Pareto Distribution (GP), is an interesting alternative to the one based on AMS series (using the General Extreme Value Distribution – GEV) since it gives the opportunity to take into consideration extreme events that would be considered otherwise, particularly in the cases when the studied series are not long enough. Regional estimation of high quantiles, T-year event values and their uncertainty improves statistical inference when compared to the local approach, assuming that region is statistically homogeneous.

The regional and local POT and PDS estimation approaches were applied to the network of more than 100 meteorological stations located in Slovakia for 5-, 10-, 15-, 30-min and 1-, 2-, 6-, 12-, 24-h rainfall duration series over the 1961-2009 and 1995-2009 periods, respectively. The both AMS and PDS series, respectively, were constructed considering the annual maxima as well as r-largest statistics and fixed (stationary) exceedance rate, respectively. In terms of regional analysis two different methods of creating homogeneous regions (HR) were applied: the Hosking-Wallis regional frequency analysis (using fixed HR) and the Region-Of-Influence (ROI) method, using unique flexible HR.

Since the PDS approach provides the most efficient T-year event estimations (in terms of stability and robustness of the return period estimates) for heavy-tailed distributions, with negative shape parameters, the PDS model is to be preferred for both local and regional estimation scheme. It has been also recognized that the regional approach base on PDS data yields more homogeneous regions and provides an unambiguous interpretation, supporting a GP distribution.