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Regional analysis of Intensity-Duration-Frequency Relationships in Slovakia using Scaling Model Approach

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Short-term rainfall intensity maxima might gain a rising tendency in the future as a consequence of the global warming. The monitoring and statistical as well as spatial analyses of above-mentioned precipitation characteristics are highly important, because of observed negative impacts linked with their occurrence. Probabilistic modeling and statistical analysis of relationships between rainfall intensity and its duration as well as frequency (generally express by Intensity-Duration-Frequency curves) represents on of the most commonly used tools in the flood risk management, water resources engineering as well as for flood protection projects. A set of IDF-curves defines a relation between the mean intensity of precipitation, the duration of the aggregation time of the rainfall and return period of the event. There are some statistical techniques how to establish the IDF-curves for annual maximum precipitation totals with selected duration.

At-site frequency analysis of rainfall data evaluated separately for particular meteorological station is frequently used method of Intensity-Duration-Frequency relationships estimation. For many years the Gumbel as well as Pearson III-type distribution have been utilized as the most suitable theoretical distribution in the order to model the extreme rainfall events. These relationships are not accurate and reliable since they depend on many assumptions such as distribution selection for each duration. Some distributions require a large number of parameters, and are not time-independent. New theoretical findings suggest to replace the Gumbel distribution by other type of Extreme Value distribution (most commonly by General Extreme Value "GEV" distribution).

Apart from testing the appropriate theoretical distribution we also focused in the contribution on application of some scaling properties to establish scaling behaviour of statistical moments over different durations. The IDF-curves are developed for gauged sites based mainly on scaling of two theoretical distributions: Generalized extreme value (GEV) and Gumbel probability distributions. Statistical analysis was applied on annual maximum rainfall time series for meteorological stations located in different regions of Slovakia, for rainfall event durations of 5, 10, 15, 20 and 30 min and 1, 2, 6, 12, and 24 h (meteorological stations: Hurbanovo, Oravská Lesná, etc.). The results suggest that obtained estimates derived from the scaling procedure are comparable to estimates obtained from traditional techniques.