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Comparison of regional approaches to the frequency analysis of extreme 1-day precipitation amounts in Slovakia

L. Gaal (1,3), J. Kysely (2), J. Szolgay (3)

(1) Czech Hydrometeorological Institute, Prague, Czech Republic (ladislav.gaal@chmi.cz), (2) Institute of Atmospheric Physics AS CR, Prague, Czech Republic (kysely@ufa.cas.cz), (3) Slovak University of Technology, Bratislava, Slovak Republic (szolgay@stuba.sk)

The method of Hosking and Wallis (1993) is generally considered as a standard tool in regional flood and precipitation frequency modelling worldwide, despite the possible undesirable step-like changes in growth curves and design value estimates at fixed boundaries of the regions. Drawbacks like that are eliminated in the region-of-influence (ROI) approach proposed by Burn (1990), which takes the advantage of defining the regions in a flexible way. Regional information in the ROI method is pooled from a group of sites that are sufficiently similar to the site of interest and, therefore, regions are unique for each site under study.

Several approaches to the L-moment-based regional frequency analysis of heavy precipitation events are adopted and compared in the geographical-climatological conditions of the Slovak Republic. Annual maxima of 1-day precipitation amounts are analyzed within a network of 56 climatological stations in Slovakia (2464 station-years of data). The paper focuses mainly on mutual comparison of 12 mathematical models of the frequency analysis:

- 9 different ROI models that arise as combinations of 3 options for the transfer of regional information (according to the original speculation of Burn) and 3 different alternatives of the between-site similarity; the proximity of sites is defined by means of a) statistical characteristics of data samples, b) long-term climatological characteristics of the precipitation regime, and c) geographical co-ordinates;

- 2 different models of the regional approach of Hosking and Wallis (HW), including i) a model which divides Slovakia into 3 homogeneous regions, and ii) a model in which the whole country is treated as one-and-only homogeneous region;
- a traditional at-site (local) frequency analysis without a regional approach.

Statistical properties of simulated data sets (bias and root mean square error of quantiles with return periods T = 2 to 200 years) are evaluated. We found out that

1. The least preferable model of the frequency analysis is the one based on the at-site approach, as it shows the poorest performance among the models considered, regardless of return period T.
2. Comparison of two HW models justifies the fact that it is beneficial to divide the area of the country into smaller homogeneous regions.
3. The best performance among the 9 ROI models is related to a variant in which the between-site similarity is determined according to statistical properties of at-site data samples and where the regional information is pooled with appropriate regional weighting coefficients from all stations under study. This model can be considered as the best one overall, too.

Even though the performance of the ROI models based on climatological or geographical characteristics is comparable with that of the HW models, the ROI models based on statistical properties of data samples are obviously superior to any of the models of the regional frequency analysis under study. In general, the region-of-influence approach outperforms the traditional approach to the regional frequency analysis of Hosking and Wallis.

Key words: regional frequency analysis, region-of-influence approach, extreme precipitation events, Slovak Republic.