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Improved region-of-influence approach for modelling probabilities of heavy precipitation in the Czech Republic

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The region-of-influence (ROI) approach, which is one of the alternatives to a regional frequency analysis of extreme hydro-climatological events, is aimed at defining unique pooling groups of similar sites for each site under study. The similarity of sites is evaluated using a properly chosen set of site attributes that are supposed to explain the observed behaviour of the extremes, and the regional homogeneity of the data may be evaluated by a built-in regional homogeneity test.

There are generally two ways the pooling groups are constructed: (i) by gradually building up, i.e., the next similar site is appended to the existing ROI in each turn, until a given ROI becomes heterogeneous (the 'forward' approach), and (ii) by gradually cutting down, i.e., the most dissimilar sites are removed from the bulk of the sites in each turn, until the remaining group of sites is homogeneous (the 'backward' approach). Both methods have their own pros and cons. The drawback of the 'forward' approach is that it may end up in pooling groups with insufficient number of sites for reliable estimation of low-frequency events; on the other hand, the deficiency of the 'backward' approach is that it often leads to large pooling groups that may smooth fine regional differences in the behaviour of extremes. We propose a hybrid method of building the pooling groups that eliminates the drawbacks of both the 'forward' and 'backward' approaches.

Based on annual maxima of 1-day precipitation amounts from 209 sites in the Czech Republic (Central Europe), we perform a sensitivity analysis which examines the consequences of the changes made to the input sets of site attributes – climatological and geographical site characteristics. Furthermore, several frequency models that include the ROI pooling schemes, a conventional model based on fixed regions, and an at-site analysis are compared by means of Monte Carlo simulations. The main conclusion of the sensitivity analysis and the inter-comparison of various regional frequency models is that the ROI pooling scheme based on the actual proximity of sites (latitude and longitude) outperforms the other models that include the ROI pooling scheme based on three geographical co-ordinates (with altitude included), the ROI pooling schemes based on different combination of climatological site characteristics, and the Hosking-Wallis regional analysis.

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