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Regional frequency analysis for maximum 5-day precipitation totals using L-moments approach in Slovakia.

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Understanding the patterns of extreme precipitation is crucial for effective water resource management, infrastructure design, and flood risk assessment. This study offers a comprehensive analysis of the maximum annual 5-day precipitation totals (Rx5d) in Slovakia using regional frequency analysis (RFA) to elucidate the probabilistic behavior of these events, essential for informed decision-making amid changing climate patterns. The main objectives were to identify homogeneous regions based on Rx5D, estimate regional frequency distributions, calculate maximum Rx5D for return periods of 5, 10, 20, 50, 100, and 200 years, and map these estimates for Slovakia. The cluster analysis, employing index-flood procedure and Ward's method, identified 14 reasonably homogeneous clusters. Homogeneity and discordancy tests further refined these clusters. The regional frequency distribution for each Rx5D region was determined using L-moment ratio diagrams, measure and Anderson-Darling tests, resulting in the selection of Gumbel (GUM), Generalized Pareto (GPA), and Generalized Logistic (GLO) as the best-fit distributions for different regions. Our results indicate that, design Rx5D values expected once every 100 years in lowland regions could occur as frequently as once every 25 years in mountainous areas. The most extreme design Rx5D values exceeding 200 mm were observed in the high-elevation mountainous regions, underscoring the heightened risk of extreme precipitation events in these areas. The study suggests that cluster analysis coupled with L-moments-based regional frequency analysis can effectively derive design rainfall estimates for Slovakia. The developed regional frequency curves are invaluable for estimating return periods of extreme 5-day precipitation events at any location within the study area, proving indispensable for effective flood risk management, infrastructure design, and climate adaptation planning.