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Estimation of the runoff coefficient: Advantages and disadvantages of using observed rainfall-runoff data in a small catchment

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The runoff coefficient still represents a crucial part of predicting extreme runoff for the safe design of water structures. Despite its importance, it remains a subject of many hydrological discussions. The issue lies in how many unknown processes control the runoff in catchments. Therefore, in recent years, we have witnessed that the estimation of the runoff coefficient using tables and formulas has been abandoned, and the current hydrological community focuses on direct estimations from real observed data. The presented study uses rainfall-runoff data to directly estimate the peak runoff coefficient for the return period for 2-, 5-, 10-, 50- and 100- years.

The subjects of the study are three catchments with sizes from 45 to 250 km^2 located in the territory of Slovakia. The catchments Horné Orešany (stream Parná), Liptovský Mikuláš (stream Jalovecký potok) and Liptovský Hrádok (stream Belá) have different landscape characters, from rural lowlands to mountains landscape.

The runoff and rainfall data series used to estimate the peak runoff coefficient are measured in hourly time steps from 1989 to 2023.

The data were subsequently subjected to the manual and automatic separation of flood wave characteristics, such as flood volume, flood peak, duration of the flood wave, and the time to peak duration. The maximum flood waves from the summer and winter seasons were selected for each year. The reason for dividing the annual data into summer and winter seasons is to reduce the impact of phenomena that we cannot yet exclude from the measured data (snow, soil saturation).

The study shows differences in the chosen method of estimating the peak runoff coefficient. The winter seasons revealed higher values of estimated peak runoff coefficients than the summer seasons. The question also arises about the impact of the length of the available data series on the estimated runoff coefficients.

The study results are intended to help understand the extent to which different estimation methods are applicable in practical engineering.

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