

SPATIOTEMPORAL VARIABILITY OF MONTHLY RUNOFF AT RIVERS OF THE TISZA SUB-BASIN UNDER CLIMATE CHANGE

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The water regime of the rivers is uneven both throughout the year and from year to year, as it depends on feeding, the ratio of snowmelt and rainwater, and temperature conditions. The Carpathian region is the most flood-prone region of Ukraine, and such uneven runoff distribution in the Tisza sub-basin often leads to hydrological hazards such as floods and inundations. In certain periods of prolonged low-water years, there are risks of drought.

According to studies by many domestic and foreign scientists, changes in precipitation distribution throughout the year are expected, which may lead to increased periods of drought and decreased runoff in summer, as well as increased runoff in winter due to more frequent thaws. Climate change also leads to an increase in the frequency and intensity of extreme precipitation, which can cause sudden and significant floods. This is especially dangerous for mountain rivers, where runoff velocity is high, and the risk of landslides and mudflows is significantly increased.

Therefore, the study of the spatial and temporal distribution of runoff and its intra-annual distribution, as well as the determination of the characteristics of seasonal runoff distribution, allows for the identification of trends and dynamics of changes caused by climatic factors, the assessment of their impact on water resources, and the forecasting of future changes in the water regime and the development of adaptation strategies.

Let's consider the runoff distribution by months (Fig. 1) and seasons, using the example of control catchments with an average annual runoff of 27.3-31.5 l/(s·km²) for the rivers of the eastern part, 24.5-26.5 l/(s·km²) for the central part, and 16.5-21.1 l/(s·km²) for the western part.

It should be noted that the monthly runoff in the rivers of the Tisza sub-basin varies significantly throughout the year. For example, in the rivers of the eastern part of the sub-basin, 4.3-4.9% is formed per month in January and February, while in the rivers of the central and western parts, 5.9-10.1% is formed.

It should also be noted that in March and April, the rivers of the central and western parts of the sub-basin experience a spring flood with a total runoff share of 27.7-32.2% (monthly runoff share – 13.8-17.3%). In the rivers of the eastern part of the sub-basin, the runoff share for March is 7.1-7.8%, and the spring flood is formed in April and May with a monthly runoff share of 14.1-17.3%.

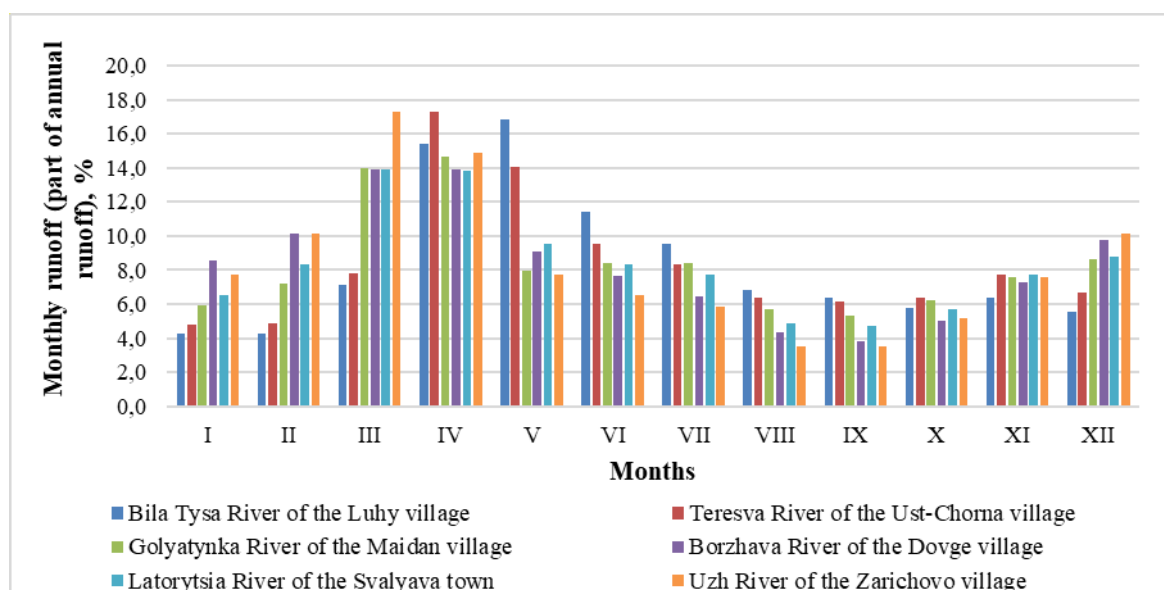


Fig.1. Spatial and temporal variability of runoff distribution by months (percentage of annual runoff) in the rivers of the Tisza sub-basin

In the central and western parts, during the summer-autumn low water period (from May to November), 3.5% to 9.5% of the annual runoff is formed. In total, 39.8-49.5% of the annual runoff is formed during this period. The smallest monthly runoff is formed in August (3.5-4.9%) and September (3.5-5.3%). In the winter low water period (from December to February), 5.9-10.1% of the annual runoff is formed monthly. Accordingly, 21.8-28.0% of the annual runoff is formed during the winter season.

A slightly different runoff distribution is observed in the eastern part of the sub-basin. Here, the least water-abundant months are January (4.3-4.8%) and February (4.3-4.9%). Accordingly, the least water-abundant winter season (total seasonal runoff 14.1-16.3%) is when the rivers are ice-covered, and snow accumulation is observed in the catchments. The beginning of melting starts in March, with a certain increase in runoff in the rivers, and the flood peak occurs in April-May. In total, 39.1-39.4% is formed during the spring flood period. Runoff in June (9.6-11.5%) and July (8.4-9.6%) is still higher than the pre-flood runoff due to intense precipitation. And in the period from August to November (summer-autumn low water season), 24.6-26.6% is formed (monthly runoff share – 6.1-7.7%).

Conclusion. The study of mountain river runoff distribution is important for ensuring ecological sustainability, water resource management, and adaptation to climate change. The monthly runoff in the rivers of the Tisza sub-basin has significant variability throughout the year, but a similar amount of runoff is formed in all rivers during the period from March to May – 38-39% of the annual runoff. It should also be noted that for the rivers of the eastern part of the sub-basin, more runoff is formed during the summer-autumn period than in the rivers of the central and western parts, and vice versa in the winter season.