

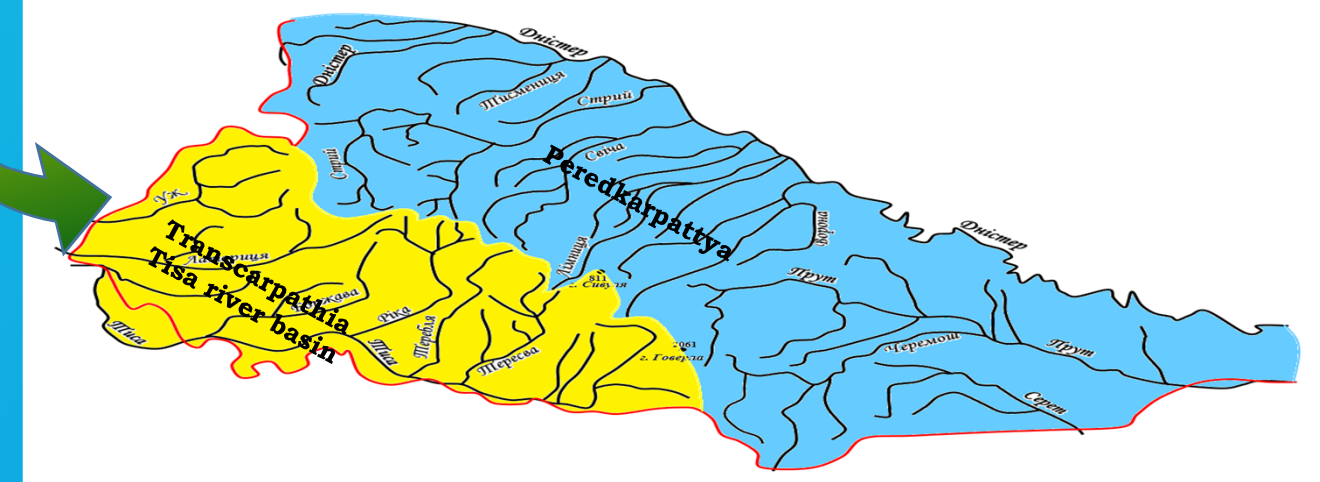


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**Introduction.** According to the scheme of hydrographic zoning of the territory of Ukraine in accordance with the requirements of the Water Framework Directive of the European Union, nine areas of river basins and nine sub-basins have been identified (Khilchevskiy et al, 2019). One of the districts is the Danube basin, which has three sub-basins: the Tisza, the Prut and the Siret and the Lower Danube. This study examines the Tisza sub-basin. On the territory of Ukraine there is an upper, mostly right-bank part of the Tisza basin, which situated on the southwestern slopes of the Ukrainian Carpathians and the Transcarpathian lowlands. Within Ukraine, the Tisza is used for water supply, fish farming and recreation.

The peculiarity of the study area is that the Carpathian Mountains protect the territory from the intrusion of cold air masses from the northeast and east. The rivers in question are characterized by a flood regime caused by melting snow and heavy rainfall in the spring (from February-March to June-July), as well as heavy rain and snow-rainfall during the rest of the year. Recently, a large number of studies have been devoted to assessing the impact of climate change on river runoff (Blöschl et al, 2017), in particular, possible changes in the structure of intra-annual runoff distribution Tisza sub-basin are of scientific and practical interest.



**Methodology.** To process the initial information, methods of hydrological-genetic and statistical analysis were used.

**Results.** The analysis of the intra-annual distribution of river runoff was carried out for catchments with an area range from 189 to 2870 km<sup>2</sup>. The calculation is performed for 3 time intervals: for the entire observation period (60-70 years); the period of the climatic norm (1961-1991) and period of climatic changes (1989-2015). At the first stage, the residual mass curves were calculated and constructed to analyze the cyclicity in fluctuations in the time runoff series (Fig. 1). Analysis of Fig. 1 shows that for the entire period and the period of the climatic norm, full cycles of water availability can be distinguished, which include both low-water and high-water phases; on the another hand, the period of climatic changes is characterized by a stable decreasing trend against the background of insignificant increases in certain years.

The calculation of the intra-annual runoff distribution was carried out for water management years, the beginning of which coincides with the beginning of the first flood month. For the rivers of the Tisza sub-basin, this is March (Fig. 2a). The intra-annual runoff regime of the region under study is characterized by floods from March to August, and in some years to November-December. Analyzing the entire available series of observations for the considered catchments, it can be noted that the runoff in the spring season is 36-41% of the annual runoff, summer 15-27%, autumn 15-19% and winter 14-29%, respectively (Fig. 2b). On the rivers in the eastern part of Transcarpathia, the largest runoff occurs in April, less often in May, and on the rivers in the western part of the region it is March. The average monthly runoff of the wet month is from 14% to 17% of the annual runoff.

Comparison of the seasonal and intra-seasonal distribution of river runoff for the period of climatic normal and climatic changes showed that no significant changes have yet been observed, however, there is a slight increase in runoff in the autumn-winter period, which coincides with the data (Blöschl et al, 2017), which shows the shift maximum of runoff for the study territory at a later period.

### CONCLUSION

- ✓ Information on the intra-annual distribution of runoff is of significant applied importance for the economy of the region. Assessment of possible climate impacts should be carried out regularly for efficient and rational use of water resources;
- ✓ At the moment, no significant influence of climate change on the runoff of rivers in the Tisza sub-basin and its intra-annual distribution has been revealed, which is due to the peculiar conditions of the formation of river flow in the study area.

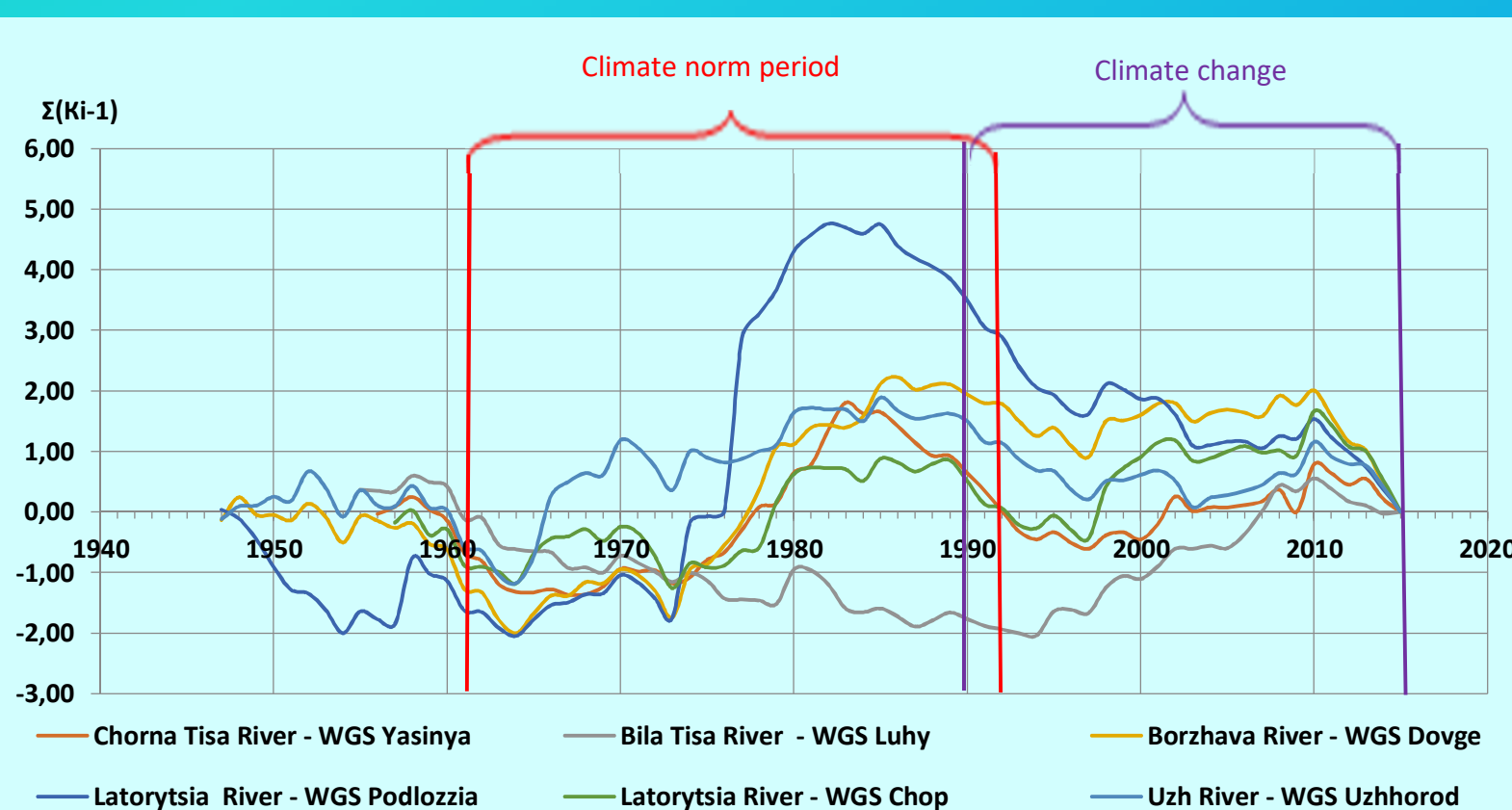


Fig. 1 - Residual mass curves of water discharge at the rivers of Tisza sub-basin

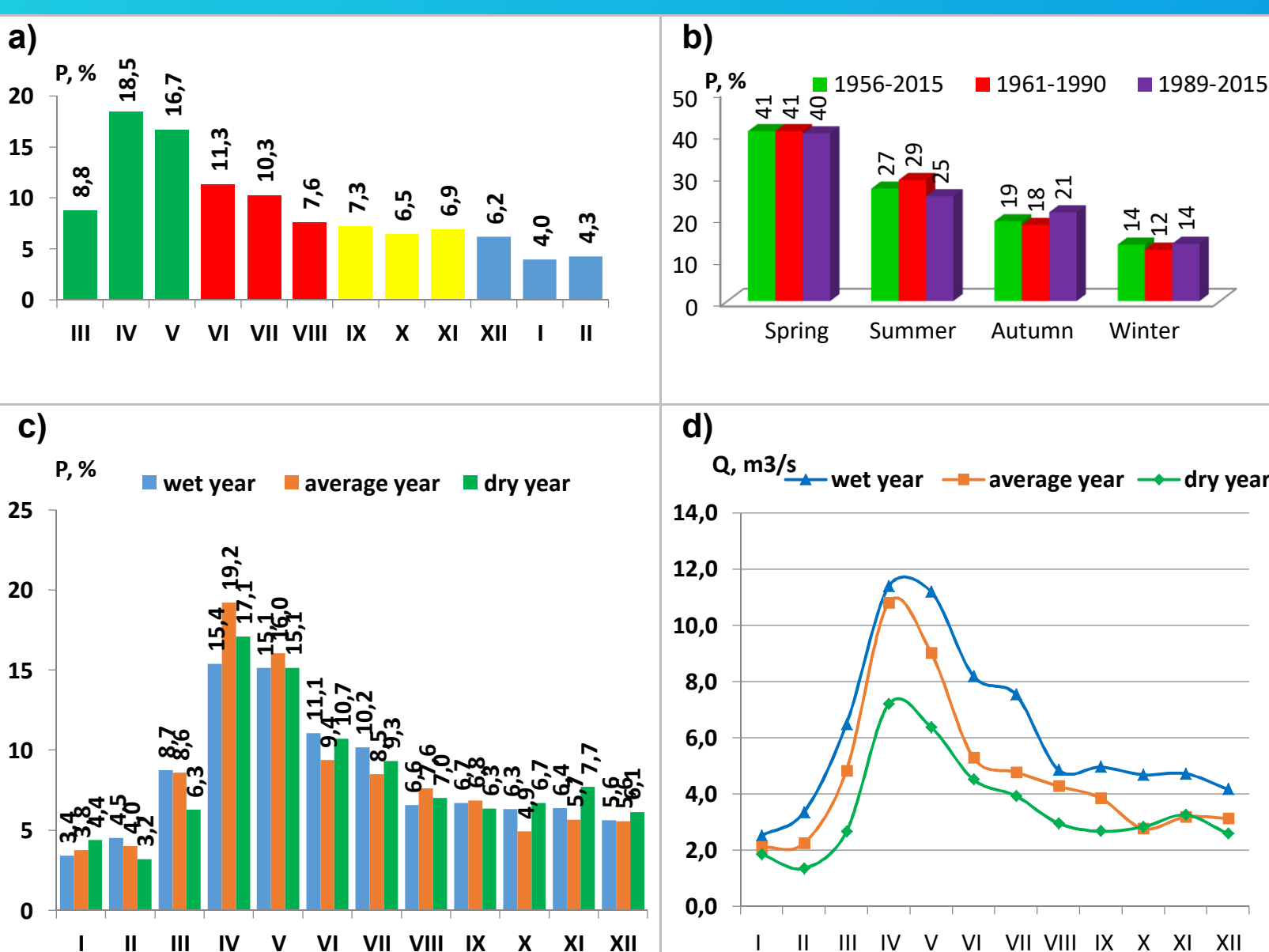


Fig.2- Intra-annual distribution of seasonal runoff for the Chorna Tisa river catchment - WGS Yasinya: a) average monthly water discharge for the entire observation period (1956-2015); b) seasonal runoff for different time intervals; c) intra-annual distribution of runoff for the models of typical years in%; d) intra-annual runoff distribution for typical year models, m<sup>3</sup>/s