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LONG-TERM MONITORING PERSPECTIVE ON DROUGHT IN THE MORAVA RIVER BASIN

Interreg Slovensko – Česko

Spolufinancovaný Európskou úniou

Jeneiová K., Melová K., Kajaba P.
Slovenský hydrometeorologický ústav, Jeséniova 17, 833 15 Bratislava, katarina.jeneiova@shmu.sk

ABSTRACT

Smaller catchments are highly sensitive to hydrological drought and can experience complete drying during extreme conditions, which directly affects hydrological connectivity and aquatic ecosystems. In the Morava River Basin, we have analyzed long-term series of mean daily discharges from 14 gauging stations situated in catchments smaller than 50 km², with the objective of quantifying the occurrence of zero-flow conditions. Zero discharges were detected at 9 of the monitored stations. To evaluate their characteristics, we examined the temporal clustering of zero-flow days, identified the duration of drying episodes, and applied trend analysis to assess temporal changes. The results indicate that drying events were not isolated phenomena and zero discharges were recorded at 4 stations in 2017 and at 3 stations in both 2012 and 2022. Seasonal analysis showed that August, September, and October were the most affected months, corresponding to periods of low precipitation and high evapotranspiration. These findings reveal that smaller catchments in the Morava River Basin are vulnerable to repeated and extended drying episodes, with implications for future water demands, water quality and ecological resilience. The presence of zero-flow conditions across multiple years suggests that they may become more common in the region, especially under projected climate change scenarios that anticipate hotter and drier summers. The importance of long-term hydrological monitoring networks is in capturing the frequency and persistence of drying events and provides basis for understanding hydrological drought processes, evaluating ecological impacts, and supporting adaptation strategies in water resources management.

DATA AND METHODOLOGY

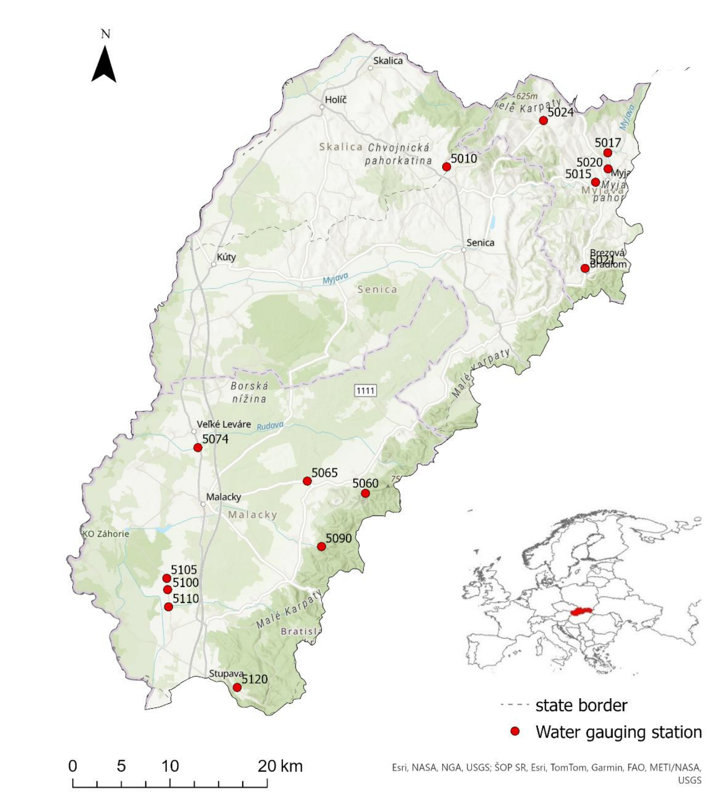

Fig. 1 Location of selected water gauges

ID	Name	River	Catchment area [km²]	Q since
5010	Lopašov	Chvojnica	31.13	1969
5015	Turá Lúka	Svacenický jarok	6.85	2009
5017	Brestovec	Brestovský p.	9.19	2005
5020	Myjava	Myjava	32.02	1974
5021	Brezová pod Bradlom	Brezovský potok	35.86	1989
5024	Vrbovce	Teplica	41.17	2008
5060	Sološnica	Sološnický p.	10.38	1971
5065	Rohožník	Rudavka	26.10	1971
5074	Veľké Leváre	Rudava - náhon	0.10	1962
5090	Kuchyňa	Malina	7.94	1974
5100	Láb	Močiarka	47.10	1961
5105	Láb	Oliva	19.50	1961
5110	Zohor	Suchý potok	40.16	1964
5120	Borinka	Stupávka	33.76	1974

Table 1 Selected water gauging stations

Input data:

Mean daily discharges from 14 water gauging stations witch catchment size less than 50 km² (Fig. 1, Tab.1) from start of the observations to 2024.

We have analysed the occurrence of discharges equal to 0 m³/s.

Trend analysis was done by Mann-Kendall trend test at p=0.05 significance level.

Fig. 2 Zohor – Suchý potok (5110), 18.8.2017

Fig. 3 Turá Lúka – Svacenický jarok (5015), 4.7.2017

RESULTS AND DISCUSSION

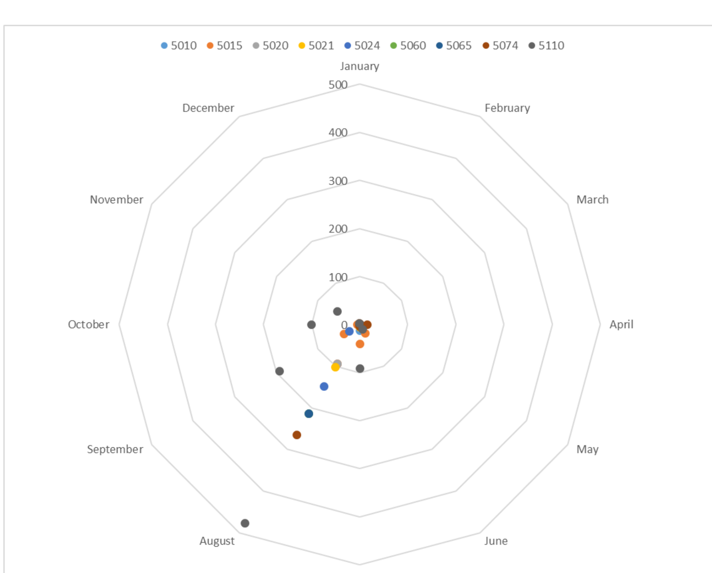

Fig. 4 Seasonal distribution of the occurrence of 0 flow days over the whole observation period for each of the water gauging stations

Zero-flow conditions, defined as discharges equal to zero for at least one day since the beginning of observations, were recorded at 9 out of the 14 analysed water gauging stations (5010, 5015, 5020, 5021, 5024, 5060, 5065, 5074, 5110). The assessment was carried out for the entire observation period available at each station, providing the longest possible time frame. This approach allowed us to capture long-term variability, where possible, to assess changes under evolving climate conditions.

The years with the highest number of affected stations were 2017 (Turá Lúka – Svacenický jarok, Vrbovce – Teplica, Sološnica – Sološnický potok, Zohor – Suchý potok), 2012 (Turá Lúka – Svacenický jarok, Vrbovce – Teplica, Zohor – Suchý potok), and 2022 (Turá Lúka – Svacenický jarok, Zohor – Suchý potok, Brezová pod Bradlom – Brezovský potok). In each of these years, dry winter and spring conditions were followed by a dry summer season (Fig. 5).

Seasonal analysis revealed that August, September, and October were the months most frequently affected by zero-flow events (Fig. 4).

Trend analysis indicated a significant decreasing trend at stations 5017, 5021, 5060, and 5100, while a significant increasing trend was detected at station 5120.

It is important to note that almost all stations where zero-flow conditions were observed are located in catchments that are not under natural or near-natural regimes. Upstream water retention structures, such as polders or dams, influence flow conditions; for example, at Veľké Leváre – Rudava – náhon station, the regime is entirely artificial. Furthermore, specific natural conditions, such as the limestone geology at Brezová pod Bradlom – Brezovský potok, reduce water retention capacity and magnify drying tendencies.

In addition to climatic drivers, increasing demands for water use represent an additional stressor, particularly for small and vulnerable catchments. These combined pressures underline the necessity of long-term hydrological monitoring to understand current processes and to prepare future water management strategies.

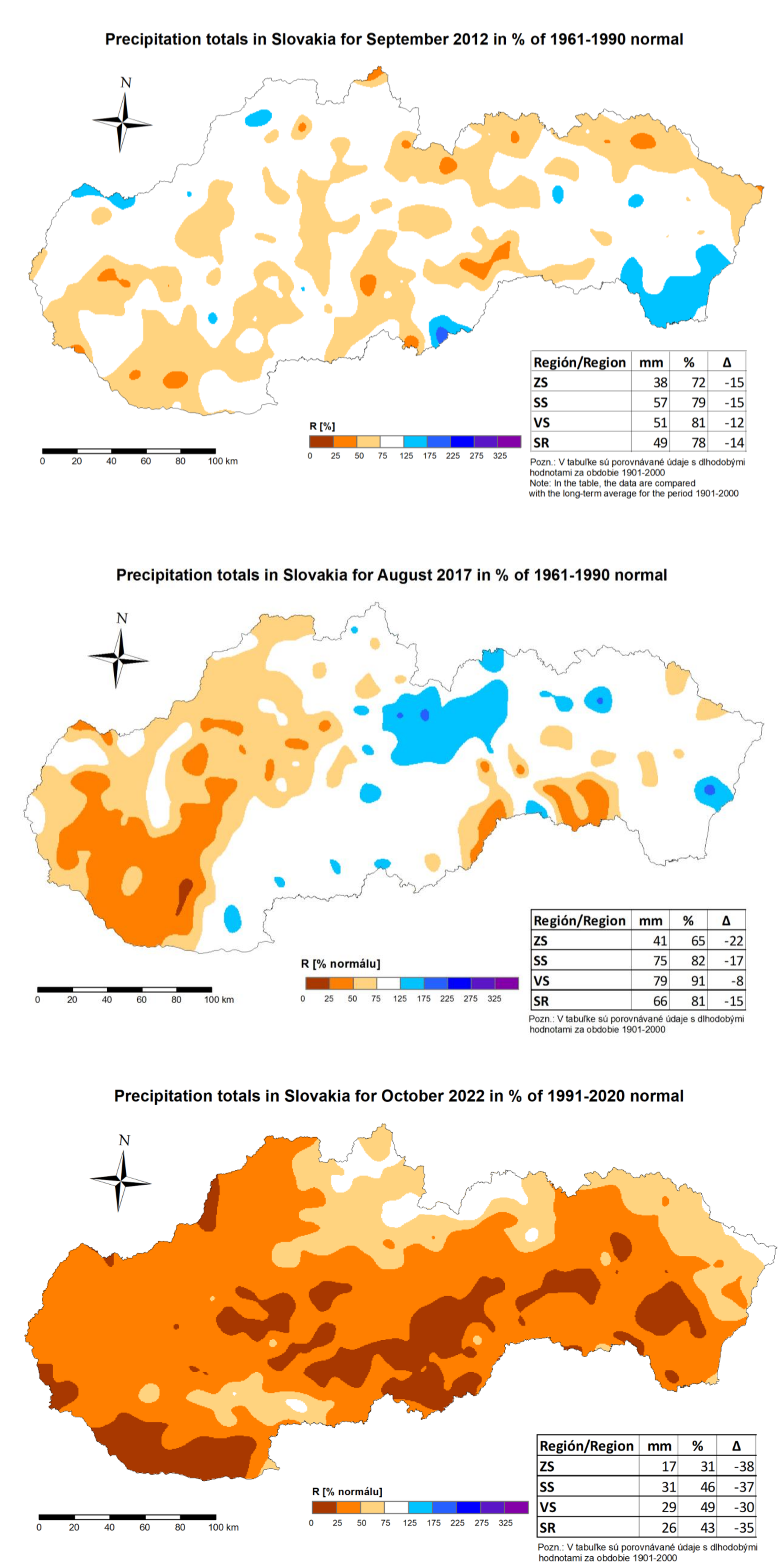

Fig. 5 Precipitation totals in Slovakia as % of the normal.

CONCLUSIONS

The analysis confirms the occurrence of zero-flow conditions across multiple stations and years, particularly during late summer and autumn. While natural factors such as geology play a role, flow regimes at many monitoring sites are strongly influenced by upstream retention structures and water management interventions. Long-term hydrological monitoring remains essential for detecting changes, and to help to distinguish between natural and anthropogenic drivers, and thus providing the base information for future water management.

ACKNOWLEDGEMENT

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