32nd Poster day
TRANSPORT OF WATER, CHEMICALS AND ENERGY IN THE SOIL – PLANT – ATMOSPHERE SYSTEM in conditions of the climate variability

REGIME OF SUSPENDED SEDIMENTS OF THE DANUBE RIVER IN SLOVAKIA: LONG-TERM TRENDS AND IMPACTS OF HIGH-FLOW EVENTS IN 2024

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ABSTRACT

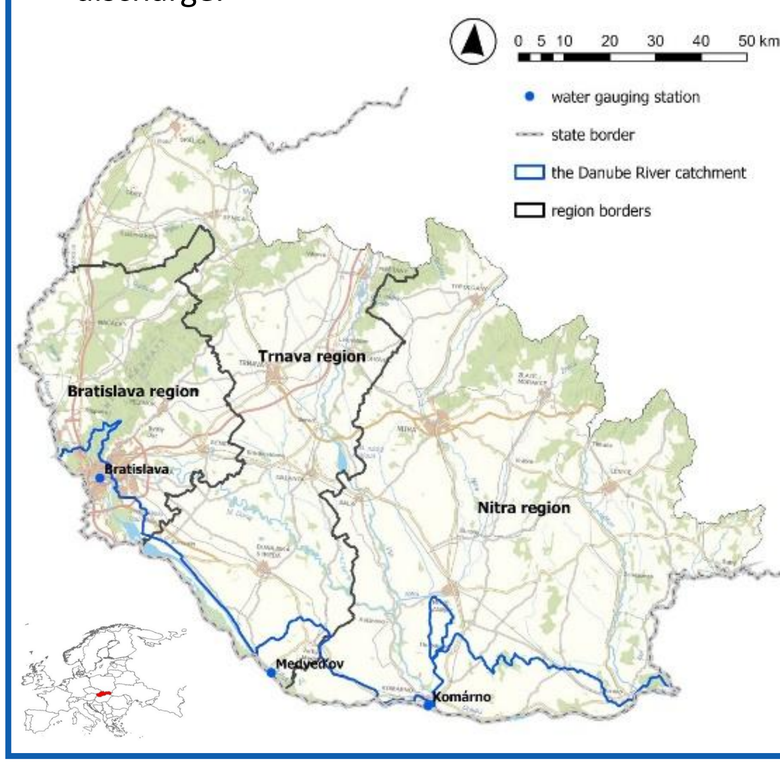
The suspended sediment load is defined as the total mass of inorganic and organic particulate matter that is transported in suspension by streamflow within a specified temporal interval. Its quantification is of fundamental significance in the context of hydrological research and water resources management, as well as in assessing and enhancing environmental protection measures. The systematic monitoring of suspended sediments constitutes an essential element of surface water quality surveillance and is mandated under the provisions of the European Water Framework Directive (2000/60/EC). This directive has been transposed into the national legislative framework through Act No. 364/2004 Coll., as subsequently amended (the Water Act), together with the corresponding implementing regulations.
In this study, the suspended sediment regime was investigated at three water gauging stations along the Danube River, where long-term data of suspended sediment concentration have been maintained since 1993, with particular emphasis on the year 2024. Hydrological observations indicated that during the past year, the high water levels in January, June, and September led to a significant influence on the transport of suspended sediments in the river.

Keywords: suspended sediment load, sediment transport, Danube River, flood impacts

DATA

Input data were
mean daily/monthly discharge,
monthly suspended sediment load,
mean daily suspended sediment discharge.

3 water gauging stations in the Danube River basin where the suspended sediments are monitored:



Bratislava
River log: 1 868.75 km
Observation:
since 1992

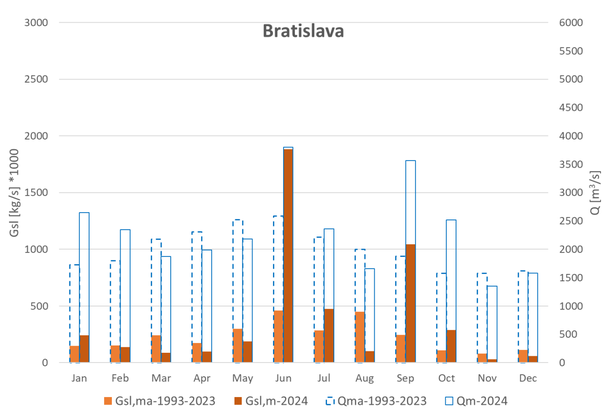
Medveďov
River log: 1 806.3 km
Observation:
since 1992

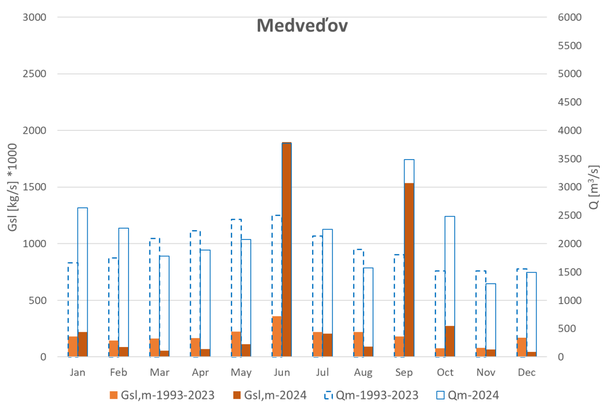
Komárno
River log: 1 767.8 km
Observation:
since 1996

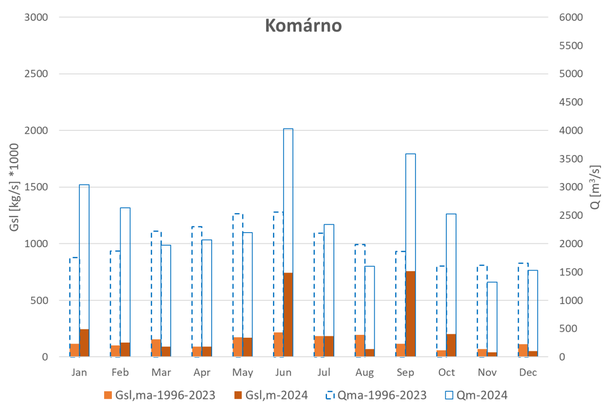
METHODOLOGY AND RESULTS

In the regime analysis, we used mean monthly discharge and monthly suspended sediment load data for the years 1993–2023, as well as for 2024.

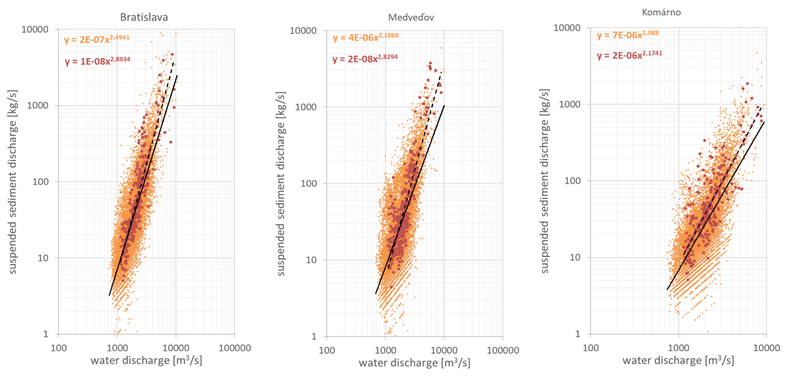
The figures show that during the period 1993–2023, the highest mean monthly discharges occurred in April, May, and June, while the highest suspended sediment load values were observed from May to August.
In 2024, the highest mean monthly discharges were recorded in January, June, and September, and the highest suspended sediment load values were mainly in June and September.





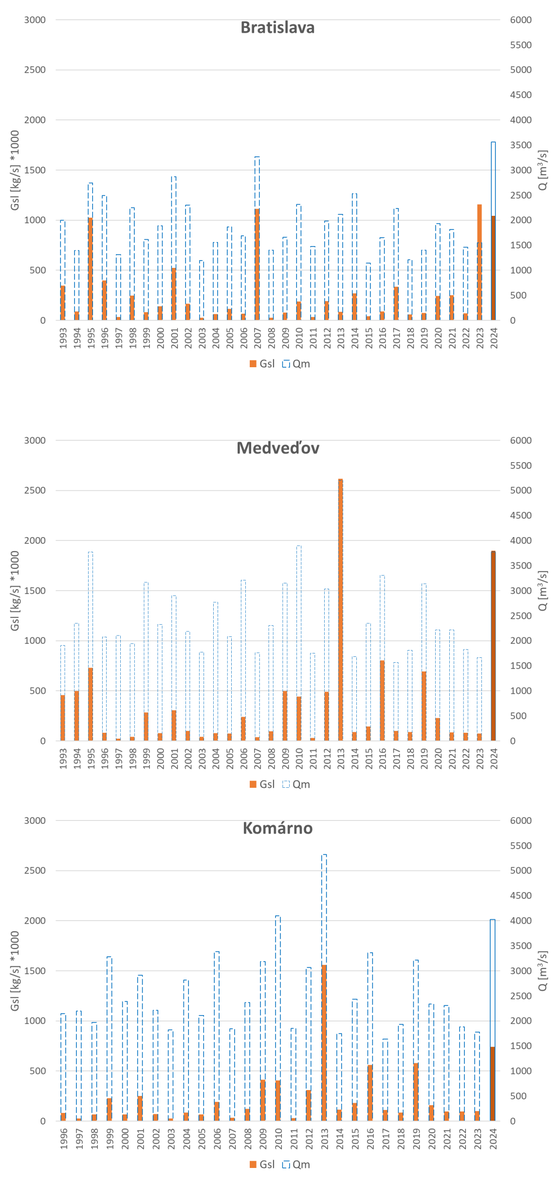


The sediment rating curves show the relationship between discharge and suspended sediment discharge, where the orange points and the solid line represent the long-term period 1993-2023, and the red points and the dashed line represent the year 2024. In 2024, the relationship between discharge and suspended sediment discharge indicated a transition from a relatively stable transport regime to one in which significant sediment mobilization occurs primarily during high-flow events, while sediment transport under low-flow conditions was reduced.

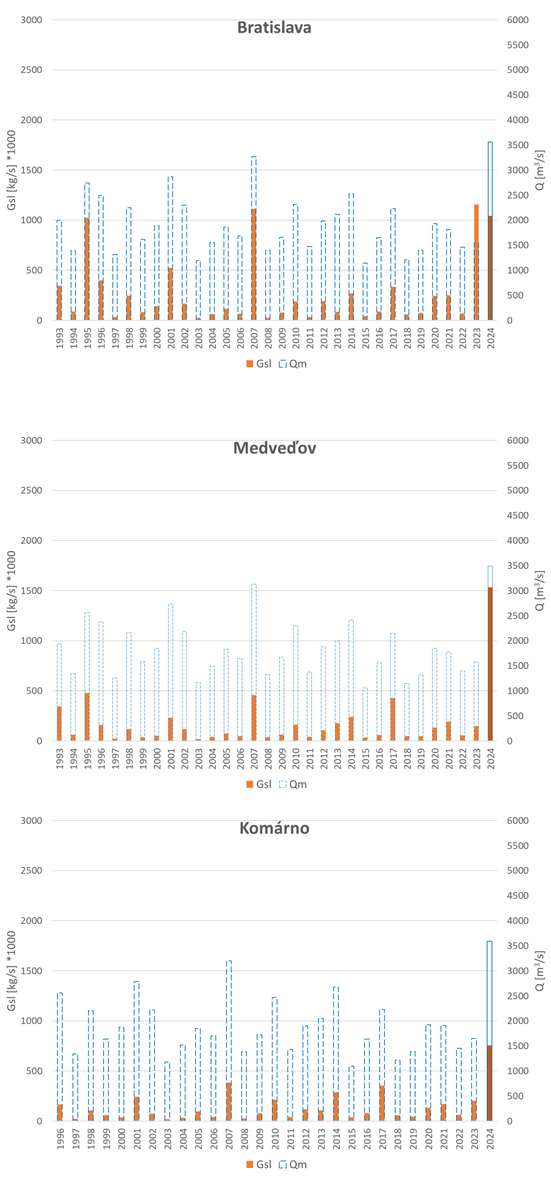


We focused on June and September, the months with the highest mean monthly discharges and the occurrence of high-flood events in the last year.
June 2024 ranked among the wettest months of the evaluated period, following 1995, 2010, and 2013. This month, we also recorded the highest suspended sediment load values since 2013.
September 2024 was among the wettest months after 2001 and 2007, and the highest suspended sediment load values of the entire 1993–2024 period were recorded in this month.

June



September



CONCLUSIONS

Based on the assessment of more than 30 years of data, a direct relationship was identified between suspended sediment load and river discharge, as well as the influence of high water levels. The analysis of the sediment rating curve, describing the relationship between mean daily discharge and mean daily suspended sediment discharge, confirmed that at the Bratislava and Komárno gauging stations the riverbed is more stable and the response to changes in discharge is smaller. In contrast, at the Medveďov gauging station, a greater amount of sediment material is available and the river's transport capacity is higher, resulting in a significantly higher suspended sediment load during high water levels.

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