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Temporal and spatial evaluation of pollutants in urban runoff

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INTRODUCTION & AIM

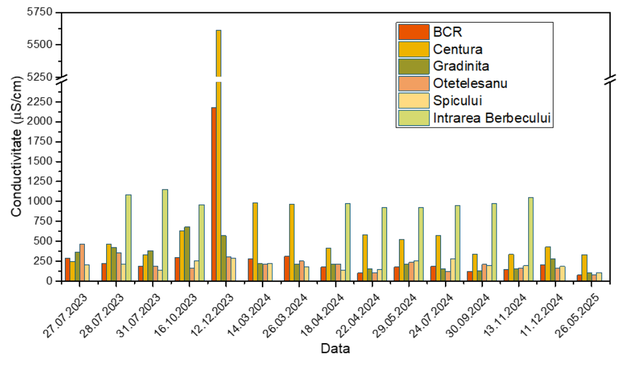
Urban areas generate large quantities of surface runoff, which are loaded with dissolved organic matter (DOM), hydrocarbons, nutrients, heavy metals, pesticides etc. The composition of urban surface runoff varies significantly at temporal and spatial scales. Limited knowledge on the types and concentrations of pollutants can lead to severe pollution of aquatic ecosystems. This study aims to evaluate the temporal and spatial variation of surface runoff DOM due to its potential impact in water systems, on active microbial populations in sediments or on the transport of pollutants due to DOM's ability to bind heavy metal ions and other persistent pollutants. Samples were collected, during 24 months, from 6 locations with different traffic surface cover and anthropogenic activities.

METHOD

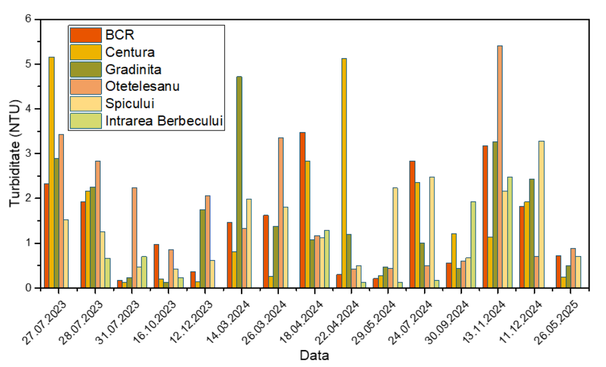
Rainwater sampling points in the Măgurele area: 1 – BCR, 2 – Centură, 3 – Grădiniță, 4 – Intrarea Berbecului, 5 – Otetelișanu, 6 – Spicului. Map made with Google Maps

All rainwater samples were collected between July 27, 2023 and May 26, 2025, according to internal collection procedures, and measurements were performed as soon as possible after sampling to reduce the risk of microbial proliferation. To evaluate the properties of the water samples, the following parameters were measured: pH, conductivity, turbidity, total/dissolved organic carbon, phosphates, nitrates, nitrites, total dissolved solids (TDS) and salinity. The following equipment was used: Hanna Instruments HI 255 multimeter, PF-12Plus photometer, Thermo Fisher Scientific Nano Drop one spectrophotometer, Jasco FP8200 spectrofluorimeter. Fluorescence spectra were processed by the PARAFAC method, using the EEMs_toolkit.py package (https://github.com/HHhyJJ/EEMs-toolkit/blob/main/EEMs_toolkit.py) and associated scripts, developed by Shu et al. (2025) for Python.

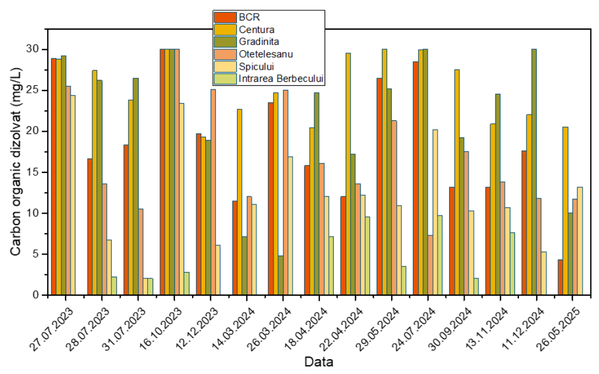
RESULTS & DISCUSSION



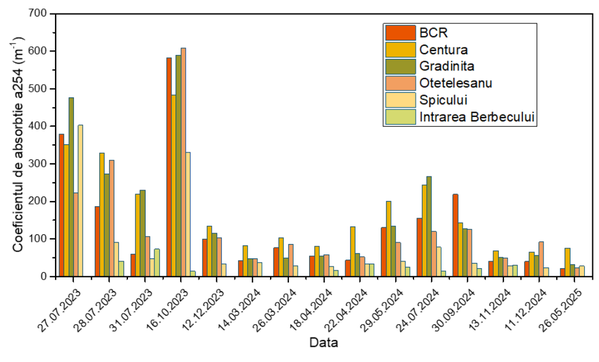
Electrical conductivity recorded between July 2023 and May 2025.



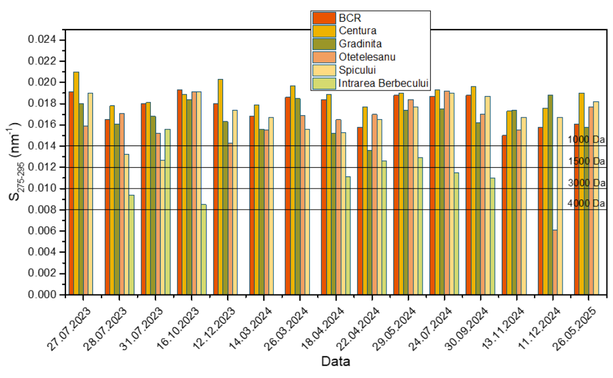
Turbidity recorded between July 2023 and May 2025.



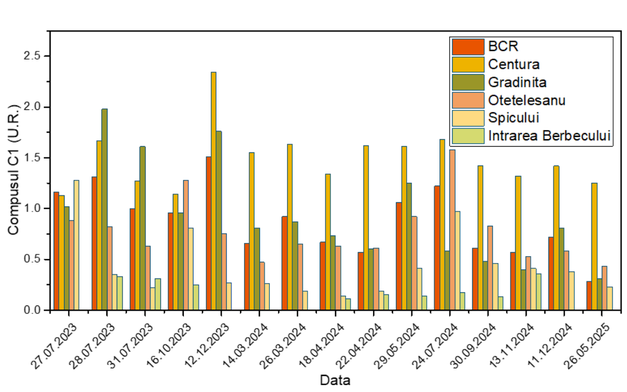
Dissolved organic carbon concentration recorded between July 2023 and May 2025



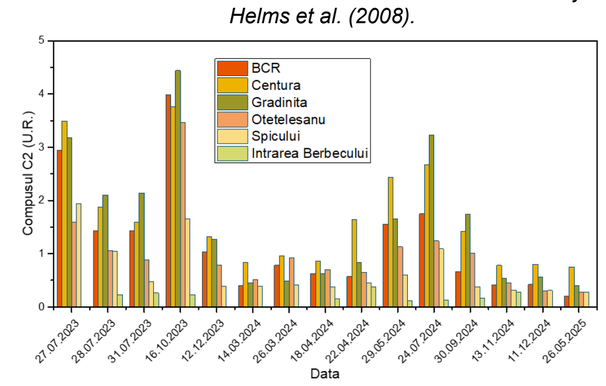
Absorption coefficient a254 recorded during the period July 2023 – May 2025



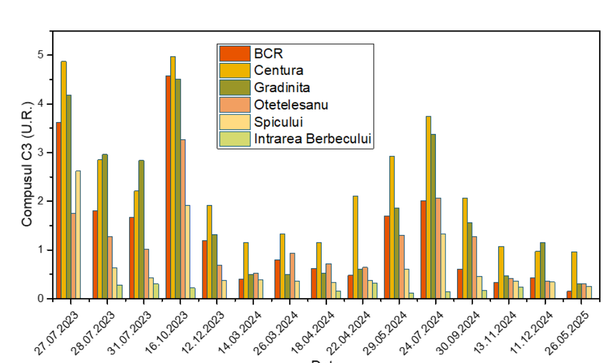
S275-295 spectral slope determined for samples collected between July 2023 and May 2025. Horizontal lines indicate estimated molar mass thresholds measured by Helms et al. (2008).



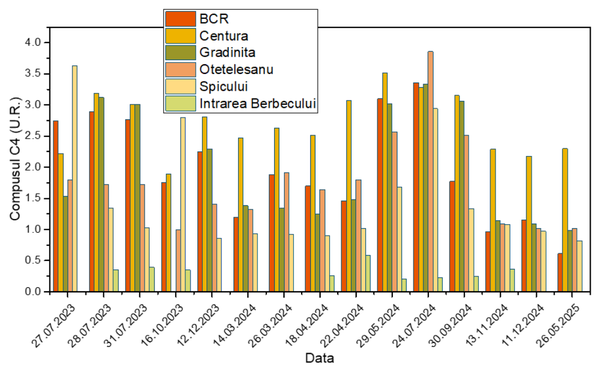
Concentration of the PARAFAC C1 compound determined for samples collected between July 2023 and May 2025.



Concentration of the PARAFAC C2 compound determined for samples collected between July 2023 and May 2025.



PARAFAC C3 compound concentration determined for samples collected between July 2023 and May 2025



Concentration of the PARAFAC C4 compound determined for samples collected between July 2023 and May 2025

CONCLUSION

Fluorescence peaks corresponding to humic and microbial fractions were identified. Samples taken from high and moderate traffic areas showed fluorescence peaks with similar intensity and trends. The concentration of humic matter increased from spring to late autumn. In winter, all samples from these locations were dominated by microbial matter. The results could be explained by the accumulation of plant matter towards autumn, which led to increased microbial activity. Also, an increase in humic matter was observed during summer. All fluorescence peaks revealed a significant difference ($p < 0.05$) between agricultural samples and high and moderate traffic samples. Also, the samples from unpaved surfaces, showed a different fluorescent signature compared to samples with road traffic. Fluorescence spectroscopy showed high capacity to differentiate between surface runoff samples collected from areas with different DOM influences and sources.

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