Water Workshop 2025

SOURCES AND TRANSPORTATION OF MICROPLASTICS IN **SOIL AND FRESHWATER SYSTEMS**

Izabella Babcsányi, Alexia Balla, Karolina Solymos, Viktória Blanka-Végi

University of Szeged

Department of Physical and Environmental Geography

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National Research, Development and Innovation Office Hungary

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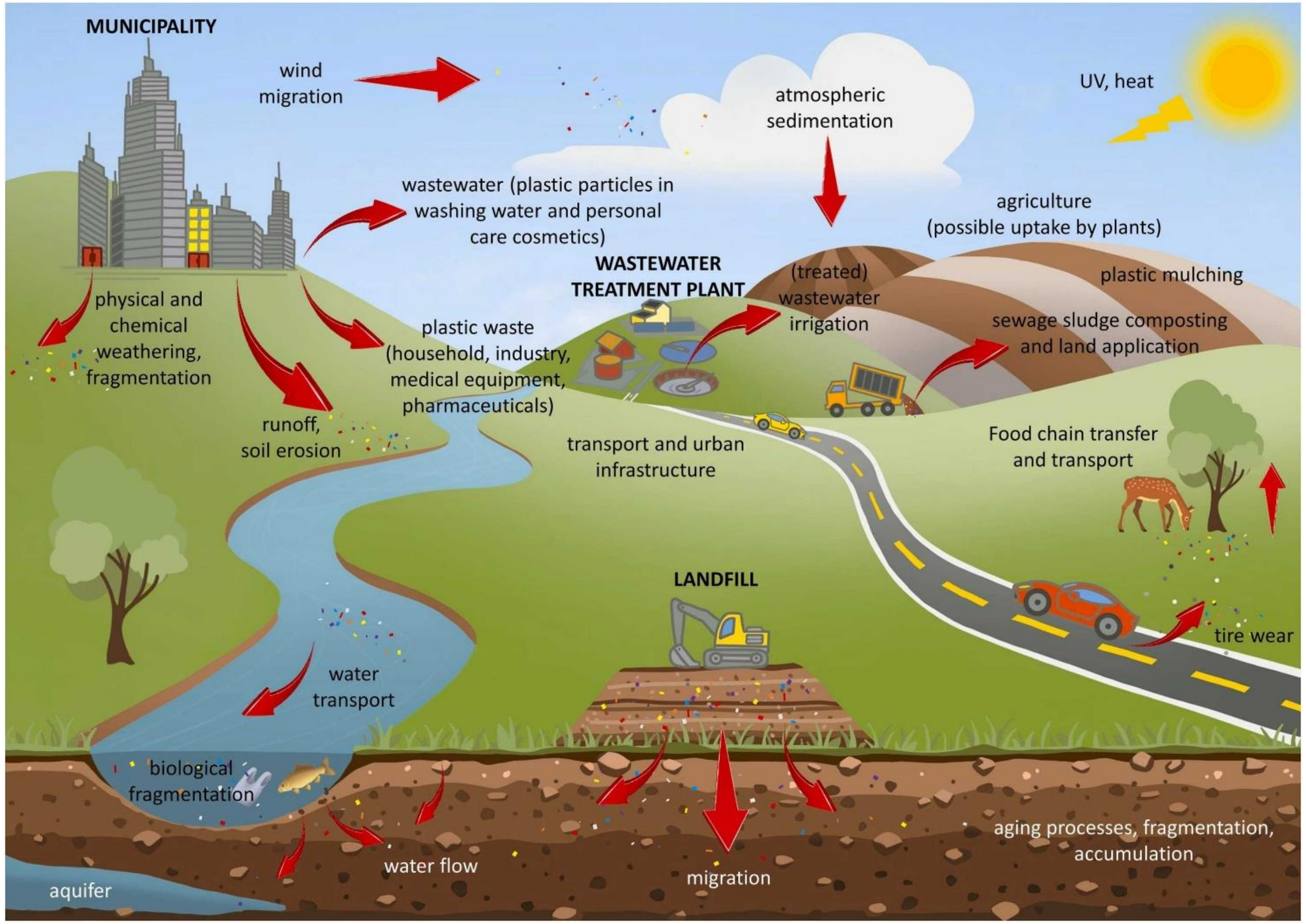
Interreg IPA Mađarska - Srbija sufinansira Evropska unija

Microplastics

18. September 2025. Novi Sad

Ubiquitous presence of micro-(and nano)plastics

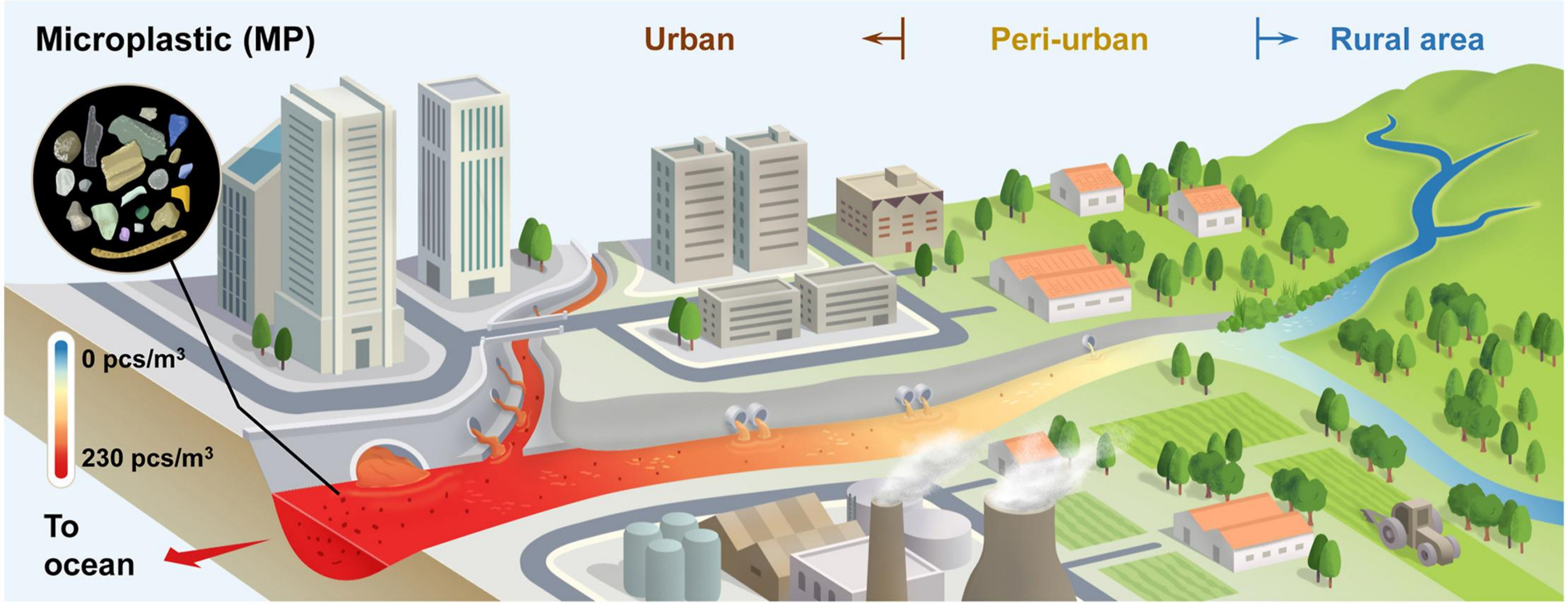


Potential sources of (micro)plastics and their migration in the continental region, (Bodor et al., 2024)

- Plastic pollution is now considered **one of the main environmental challenges**
- Emerging threat for all living species, especially due to the **chemical species (additives and other adsorbed elements)** associated with plastics,
- MPs also serve as vectors for invasive species and pathogens.
- Plastic pollution is primarily studied in marine ecosystems, but terrestrial plastic pollution is **4-23 times higher** each year.

Abundance and potencial sources of microplastics from rural to urban environments

- Inadequate waste management, illegal waste disposals
- Surface runoff from urban and agricultural areas
- Industrial activities
- Wastewater



Kunz et al. 2023

Aims

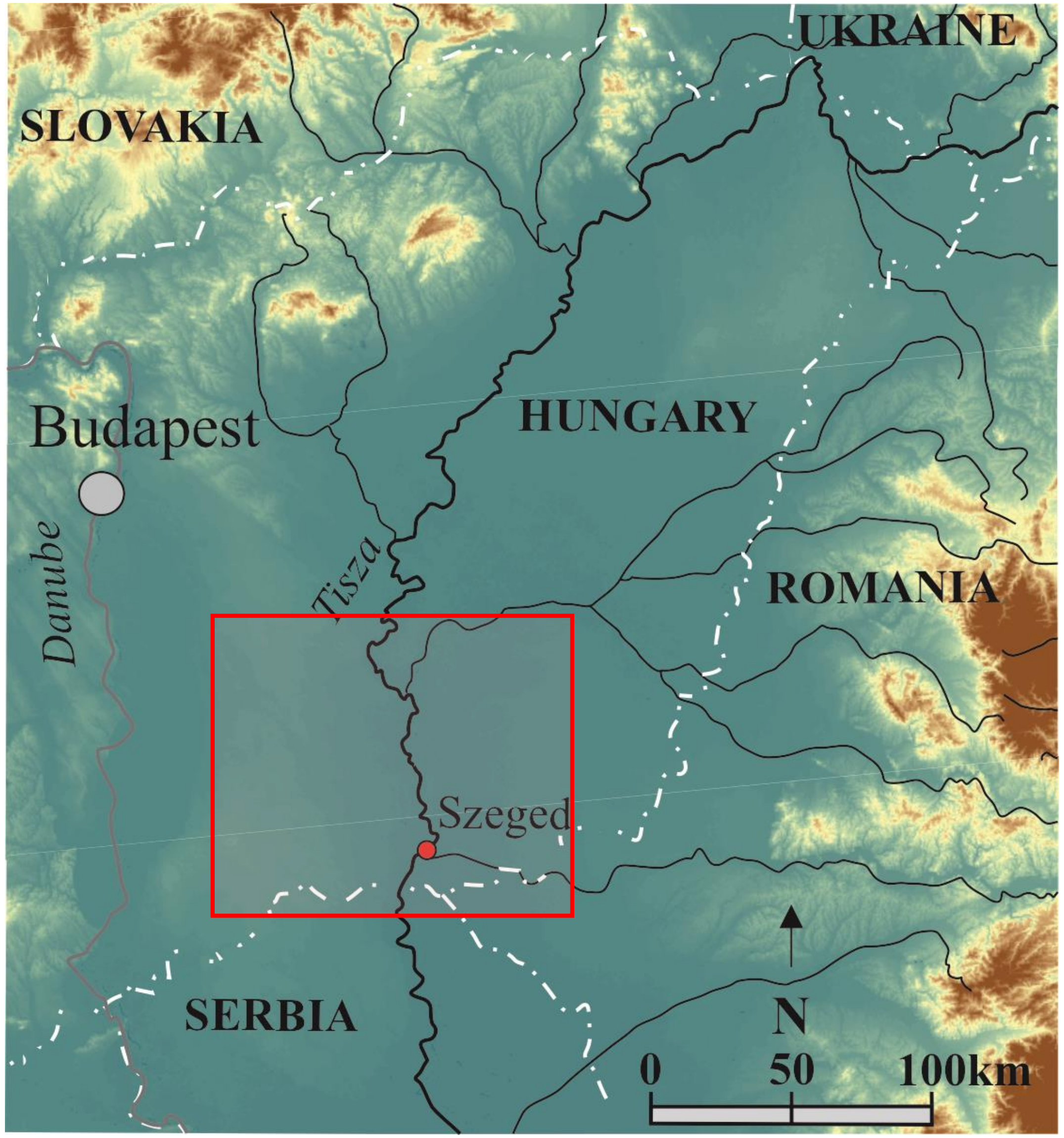
- The aim was to analyse the concentration and spatial pattern of MPs and their influencing factors in different freshwater systems

- Urban stormwater ponds and a river, located in the same urban area (with the same socio-economic conditions) were studied

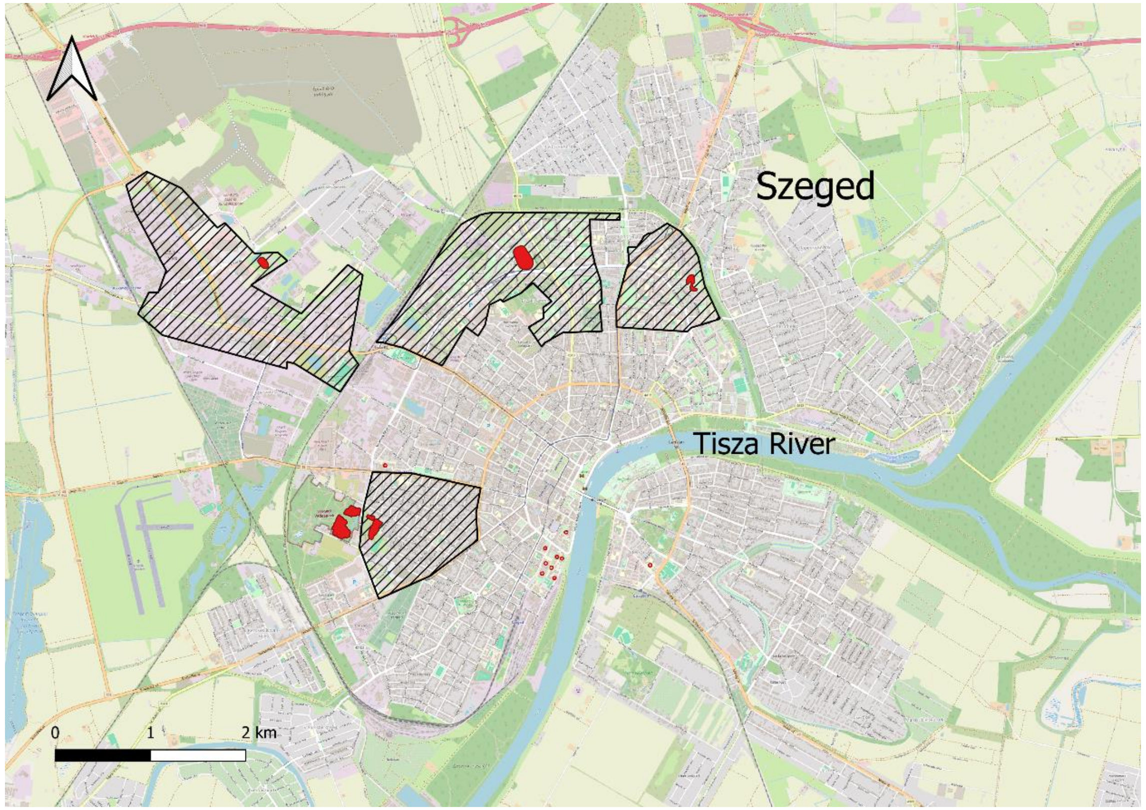
- →The lower section of the Tisza River and 4 stormwater ponds in Szeged were studied

Main Study area

- Eastern part of the Carpathian Basin;
- Lowland area,
- Szeged city with appr. 160,000 inhabitants,
- partly separated sewer system

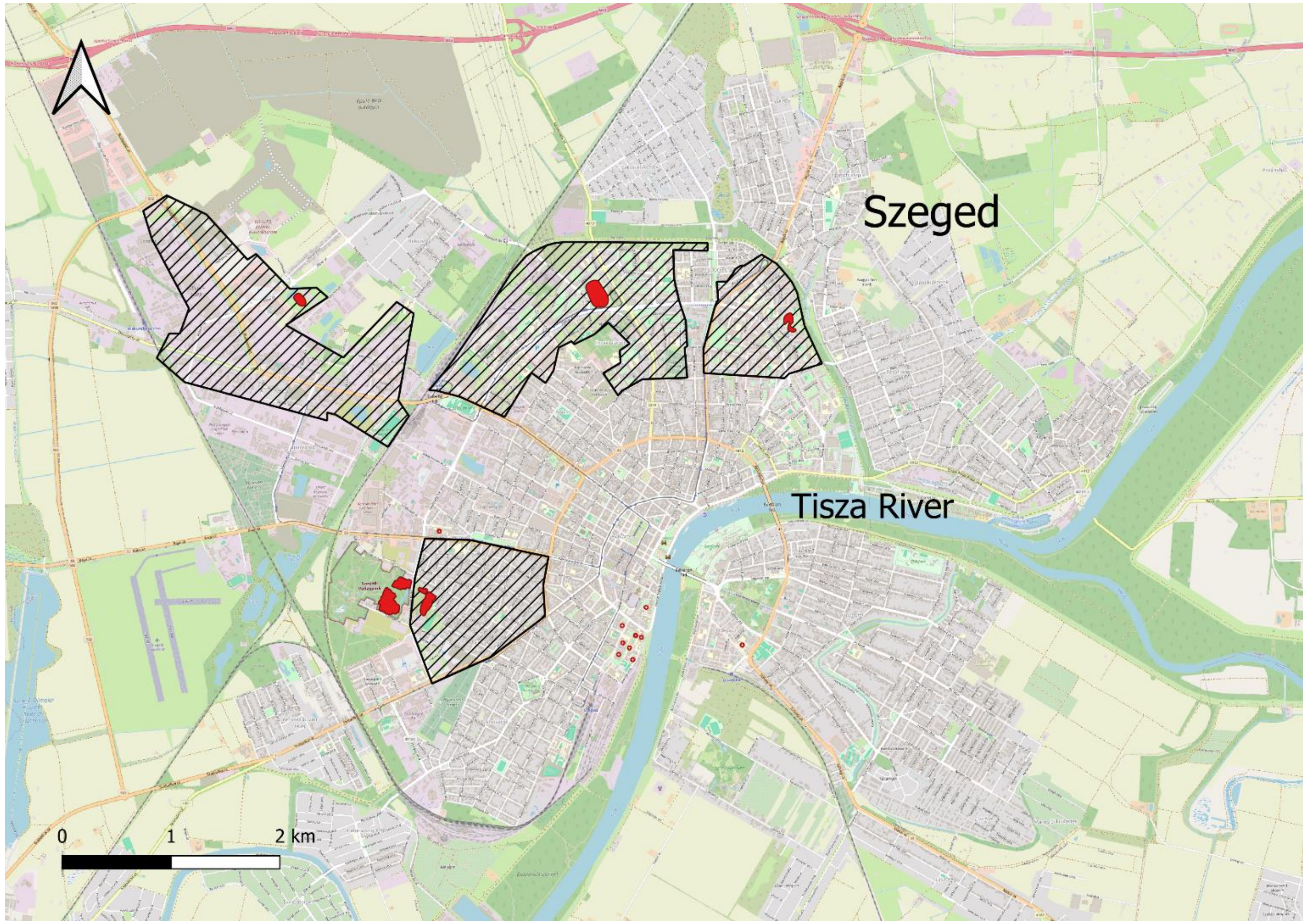


Study area: Urban stormwater ponds, Szeged (Hu)



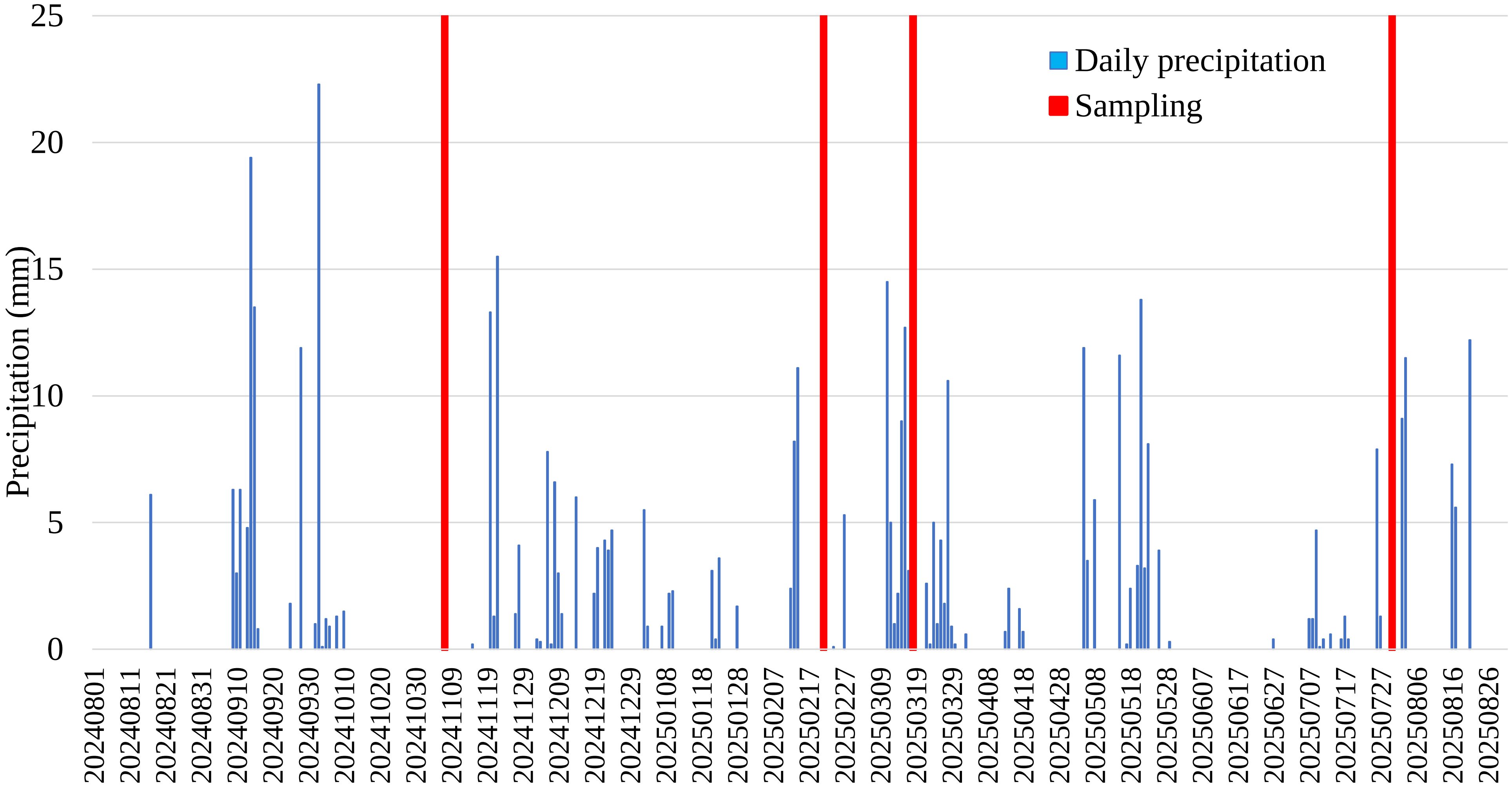
Pond	Water surface (ha)	Catchment (ha)
Sancer	2.00	121.10
Zápor	0.96	84.60
Vértó	3.50	221.40
Záportározó	0.87	258.80

Sampling: Urban stormwater ponds, Szeged (Hu)



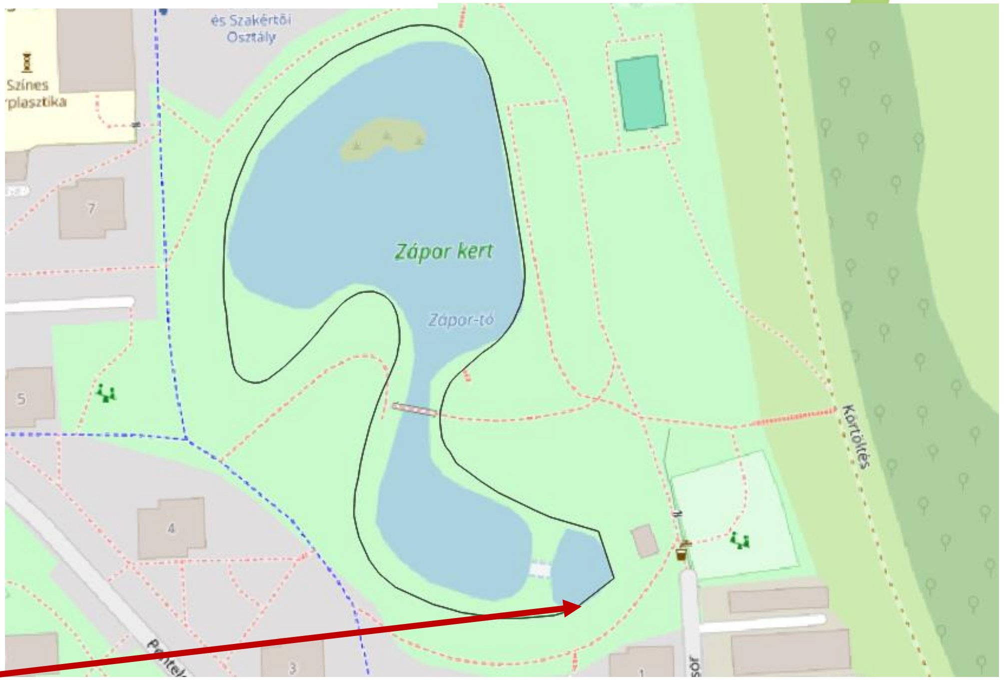
- Dry period, Wet and cold period
- 3-4 points per pond, water and sediment samples
- Sampling locations at the rainwater inlet, and equally distance from each other

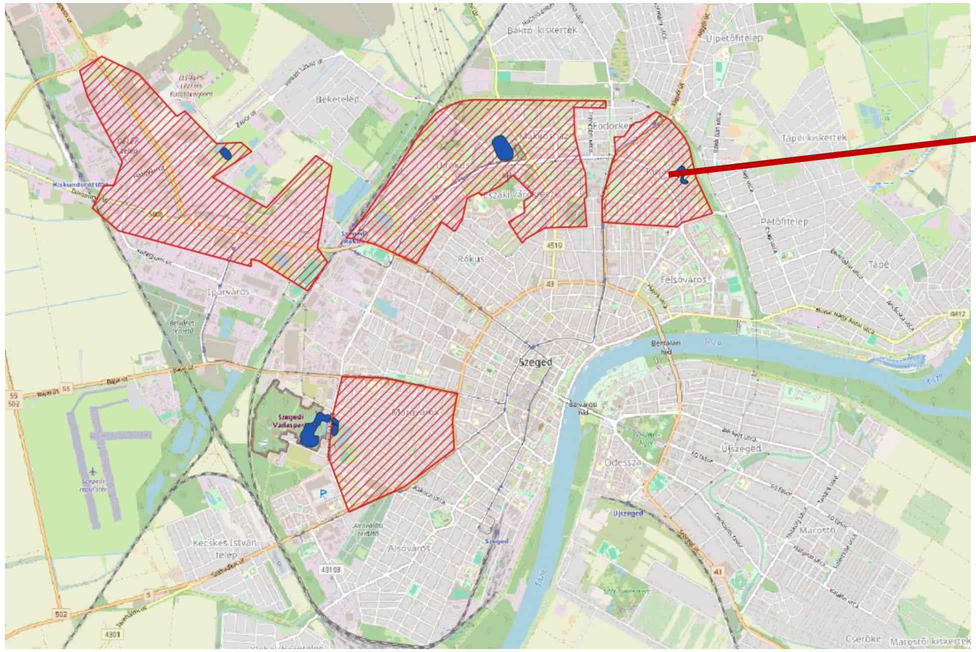
Precipitation before Sampling: Urban stormwater ponds, Szeged (Hu)



Results – Sediment samples

- MP concentration in sediments were higher in the wet period
- Extreme high value at Zápor lake: drainage water flow into a small basin

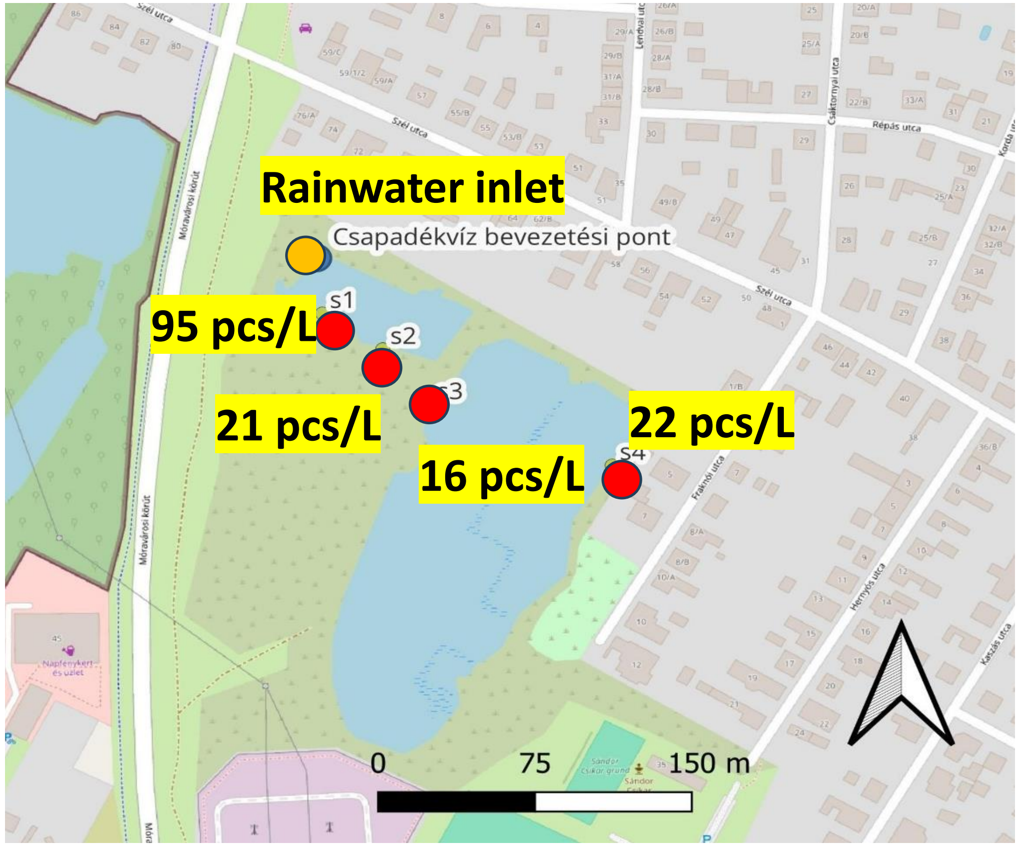




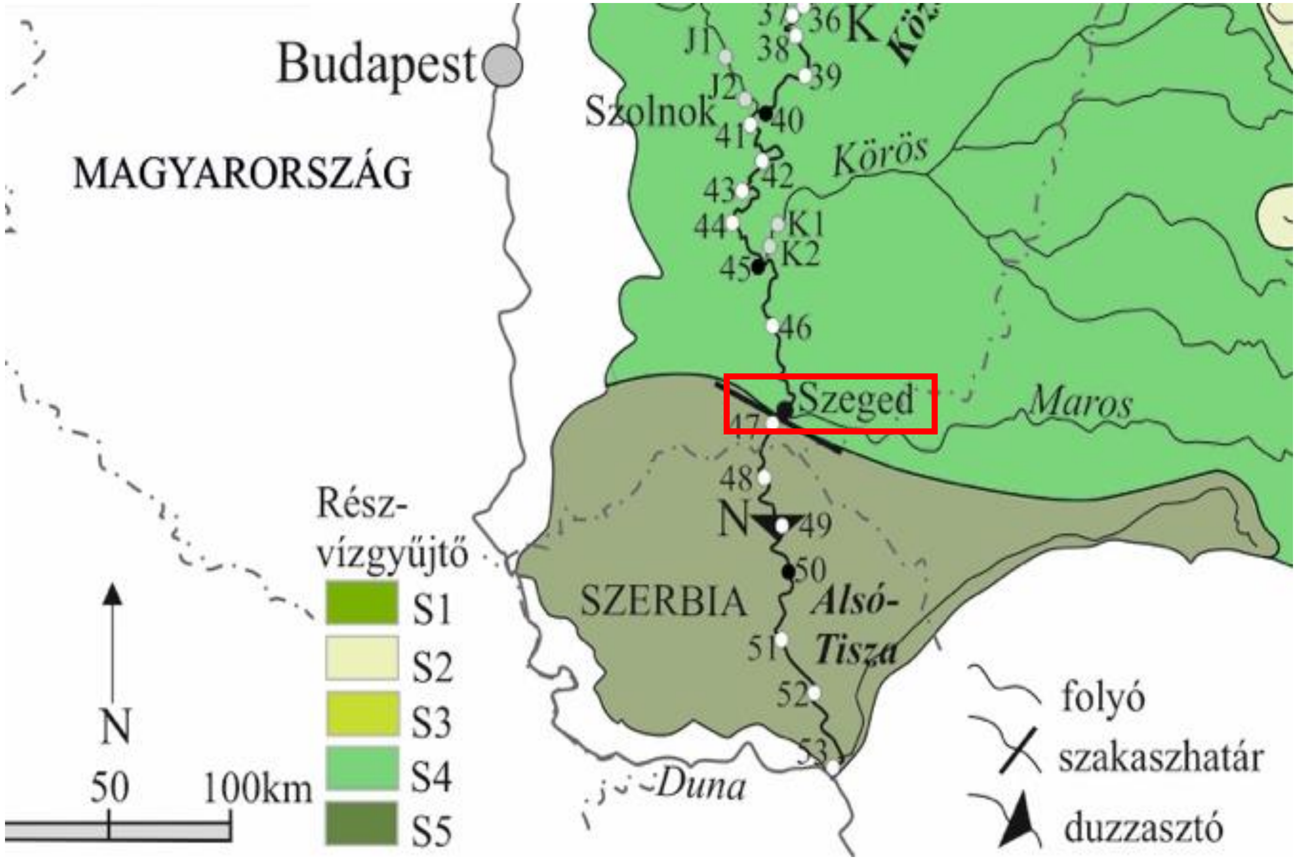
Pond	Dry Period (item/kg)	Wet Period (item/kg)
Záportározó (1)	858-1258	683-2188
Sancer (2)	418-2530	1033-6090
Zápor (3)	1155-18978	1854-19060
Vértó (4)	639-2179	598-5996

Results – water samples

	2024. 11.07.	2025. 02.21.	2025. 02.22. (ice)	2025. 03.18.	2025. 07.30.
	(item/L)				
Záportározó (1)	12-32	7-45		19-28	8-9
Sancer (2)	16-95	6-24	37-53	4-17	5-9
Zápor (3)	8-20	7-15	22	7-20	10-20
Vértó (4)	6-21	7-19		7-22	7-40



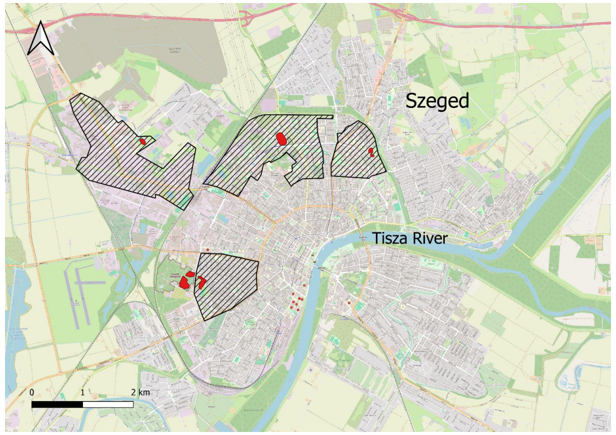
For comparison: the lower section of Tisza River



- Sediment samples were collected along the Tisza River every 25-30 kilometres
- Water samples were collected at every 50 kilometres
- Study period: 2021-2023
- Yearly sampled during summer, at low water periods + minor flood waves

For comparison: the lower section of Tisza River

Tisza	MPs in sediment (item/kg)
2021	300-1240
2022	280-1340
2023	620-2300



Tisza	MPs in water (item/m³)
2021	13-35
2022	8-46
2023	21-184

×10

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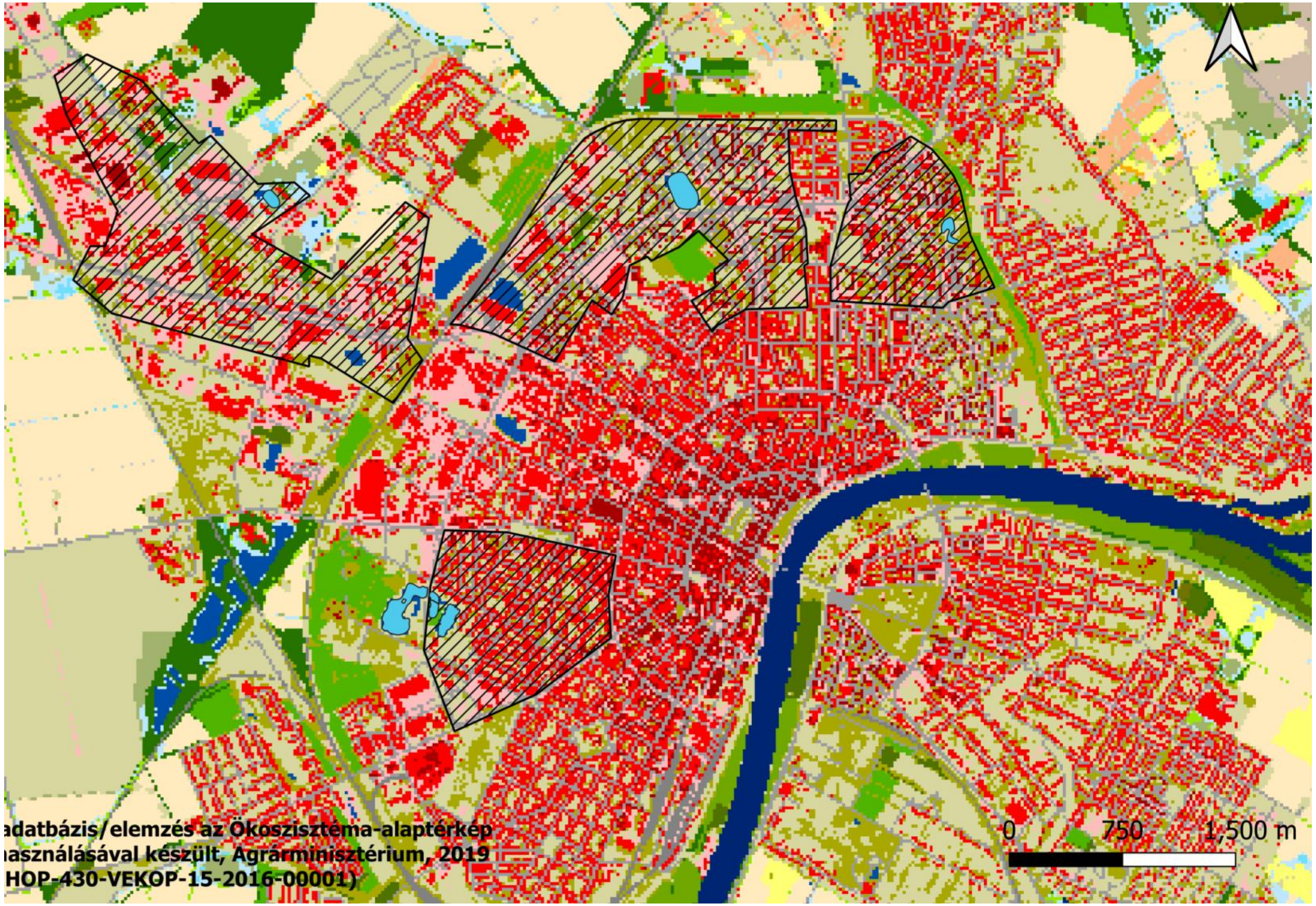
Data from Balla, A.; Moshen, A. & Kiss, T., 2024



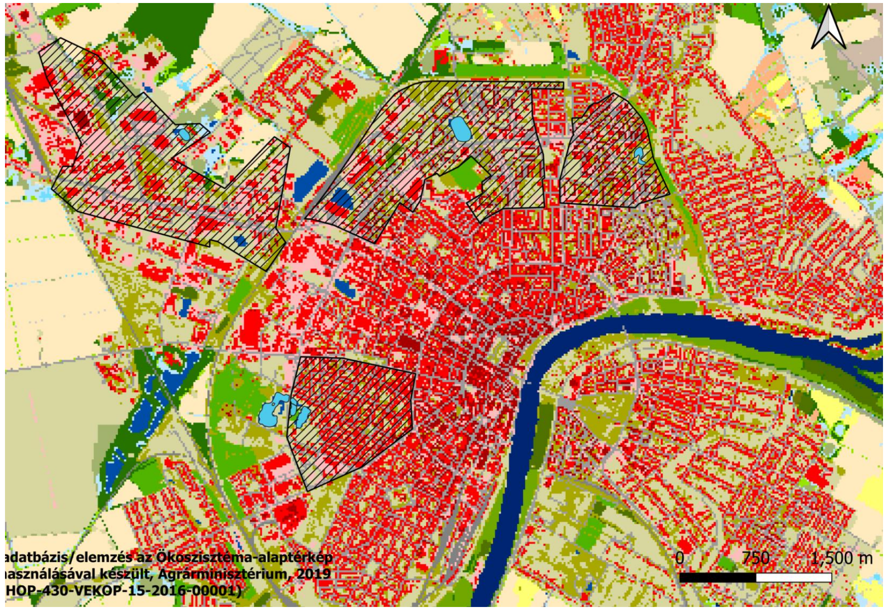
Land use

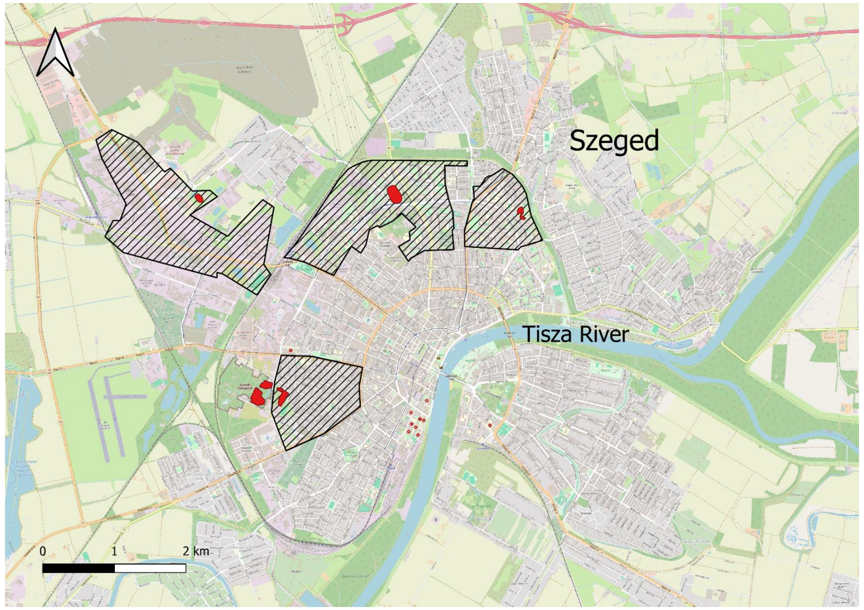
Land use is slightly different in the catchment of the ponds:

- Highest proportion of impervious surfaces at the Sancer lakes (70%)
- Lowest proportion at the Zápor lake (45%)
- Highest proportion of road surfaces at the Vértó.

Conclusions

- Inlet points and lake morphology can influence MP content;
- different land use can cause differences in MP contamination in lakes;
- No direct link between impervious surfaces and MP concentrations, population density?



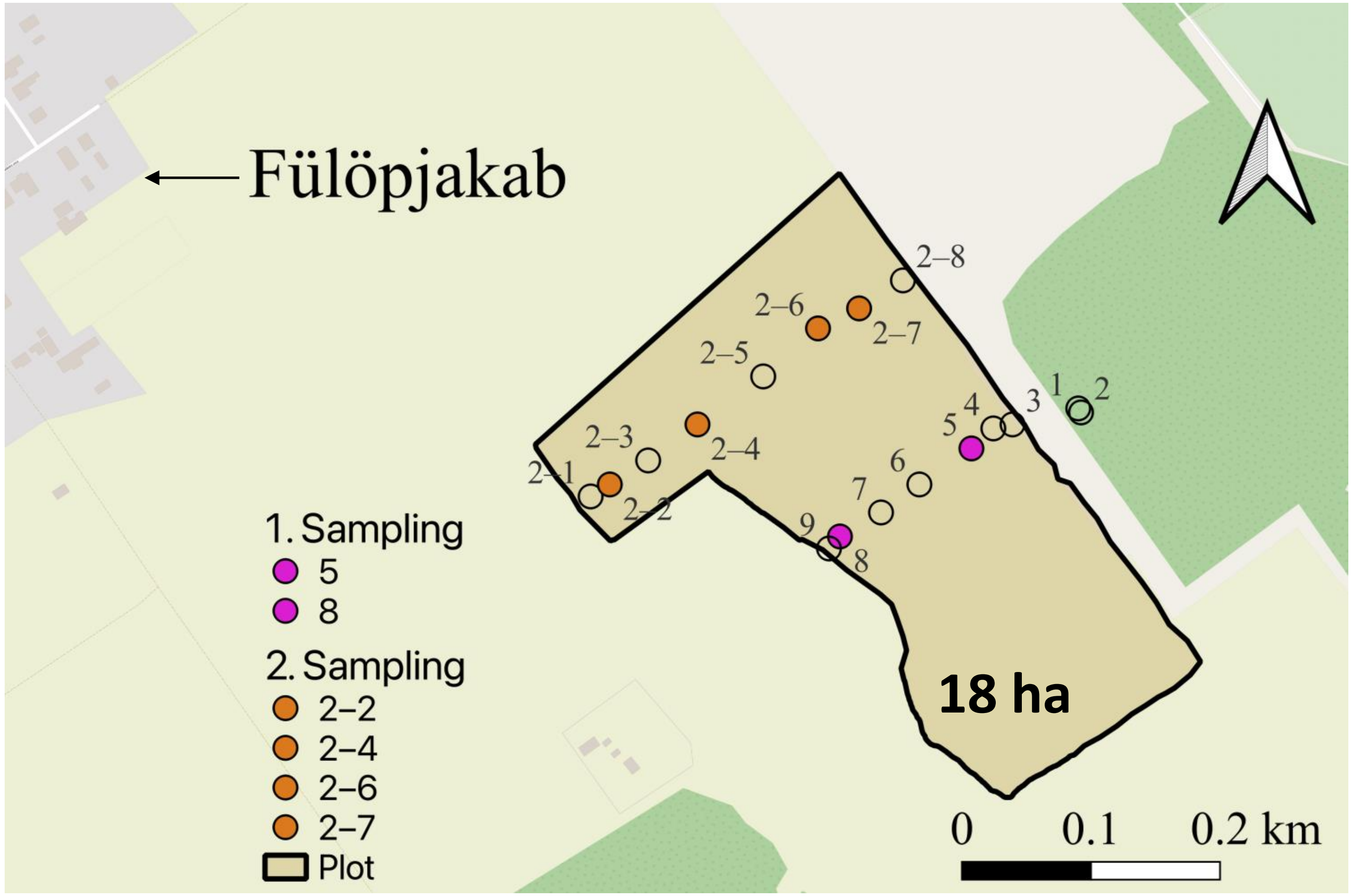


Aims and plans: Agricultural soils, Fülöpjakab (Hu)

- Monitor the microplastic accumulation in an agricultural field where sewage sludge has been used for fertilization purposes since this year;
- Detect the migration and accumulation of the MPs in agricultural soil.
- We currently working on two separate areas with different soil types: loess and sandy silt.

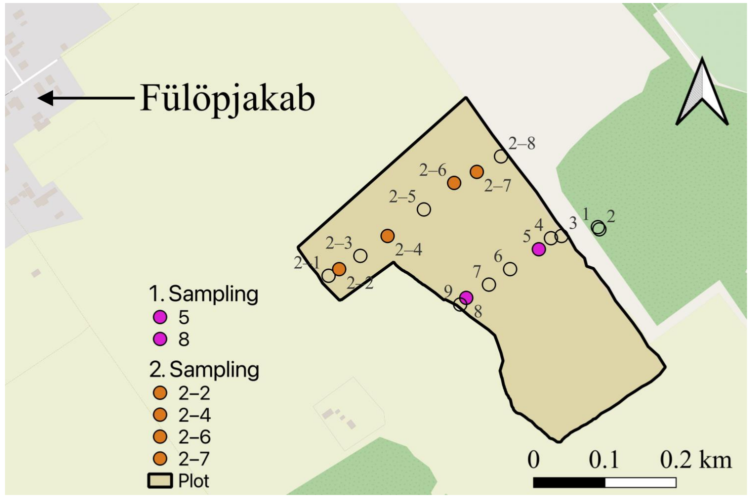
Sampling: Agricultural soils, Fülöpjakab (Hu)

- Two sample sites (18 and 46 ha)
- 11 sample points (46 ha)
- 15 sample points (18 ha)
- Soil sampling for vertical and horizontal MP migration (top 0–20 cm and 20–40 cm)
- Sewage sludge disposal in April 2025
- Dose: 13 t/ha raw sludge



Results: Agricultural soils, Fülöpjakab (Hu)

- concentrations ranged from 1000 to 3980 particles/kg
- **spatial distribution**: concentrations were lower on the edges of the plots → highest values in the central parts
- **vertical distribution**: the concentrations were 2-3 times higher in the top 20 cm layer compared to the layer underneath (20-40 cm)



	5.	8.	2–2.	2–4.	2–6.	2–7.
depth	particles/kg					
0–20 cm	3560	3840	1280	1360	3000	3980
20–40 cm	1600	1000			1160	

Conclusions

- The agricultural use of sewage sludge can cause significant microplastic pollution in the soil;
- The spatial distribution of microplastics was not homogeneous (sewage sludge distribution can differ spatially);
- Vertical distribution showed that the highest concentrations of microplastics were found in the top 20 cm layer of soil, suggesting that the source of contamination is directly linked to human activity;
- Microplastics have also been found in deeper layers of soil, suggesting that the particles can move downward, which over time could affect soil functions.

Interreg IPA Hungary - Serbia
Co-funded by the European Union
Microplastics

Water Workshop 2025

Thank you for your attention!

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