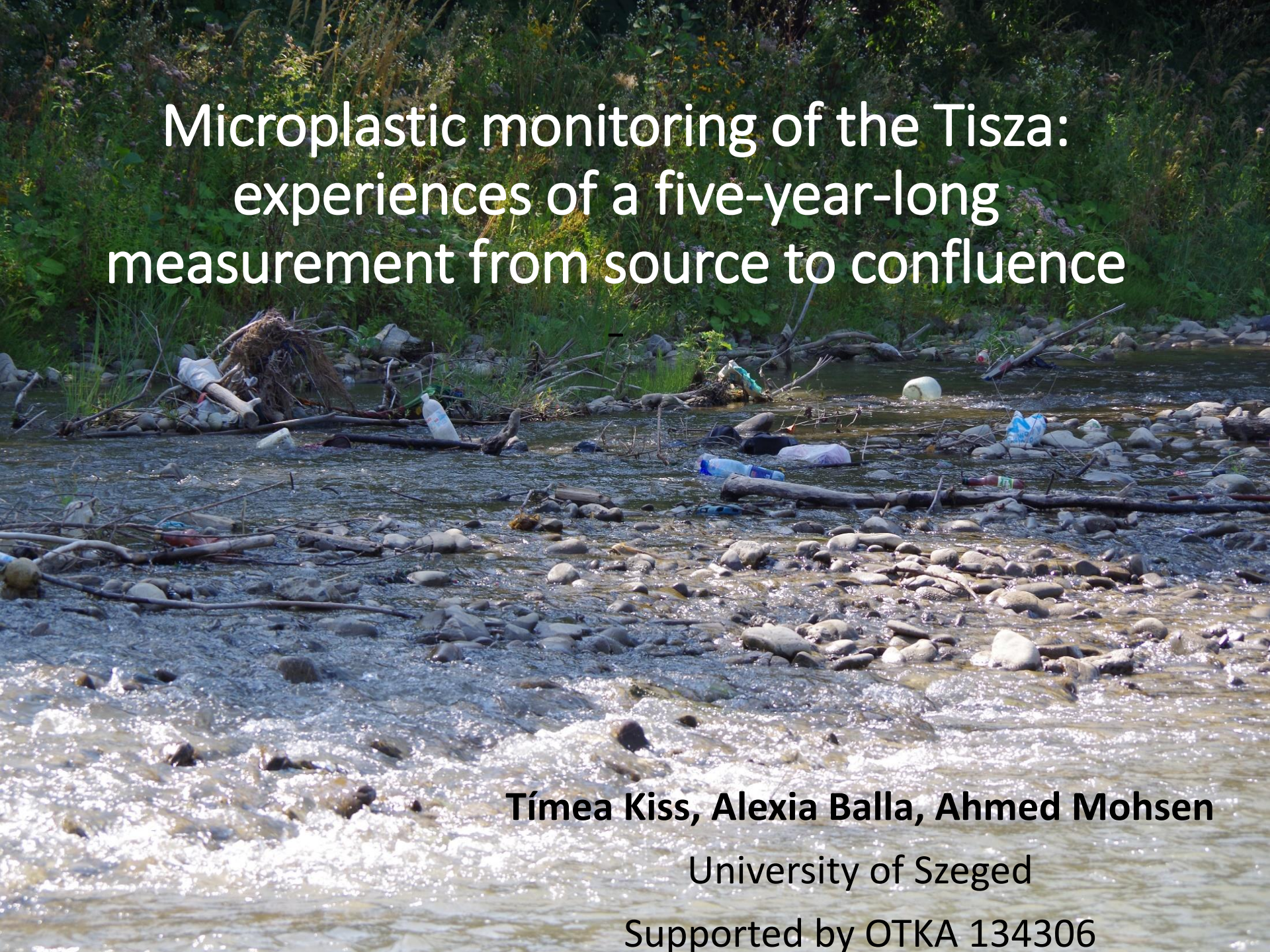
# Microplastic monitoring of the Tisza: experiences of a five-year-long measurement from source to confluence



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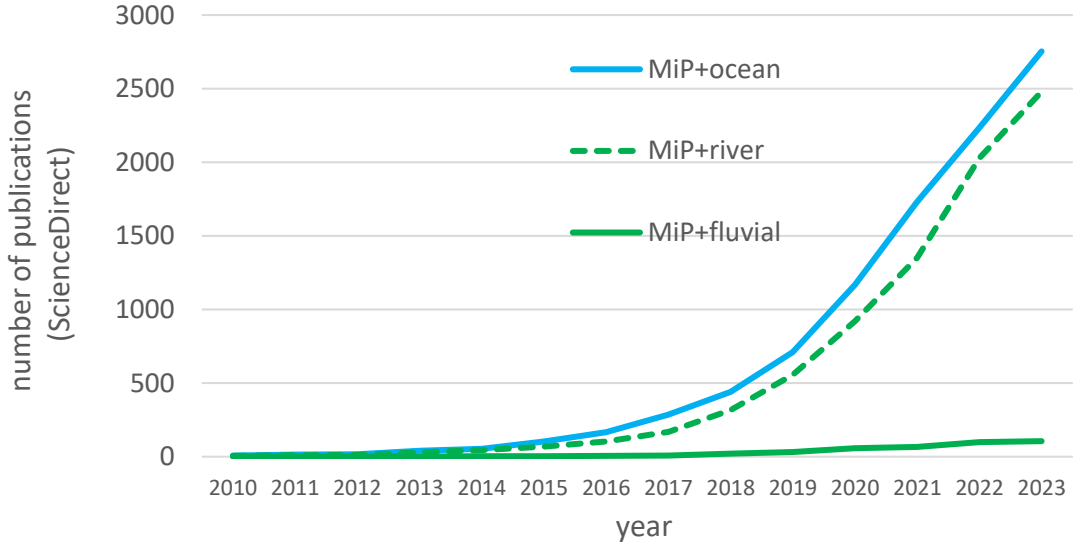
University of Szeged

Supported by OTKA 134306

# Problems of microplastic measurements

Increasing number of studies ↔ environmental conditions (?)




What to sample?

Water - sediments

Where to sample?

Representative

point – crosss-section

When to sample?

low stage – flood stage

Repetition?

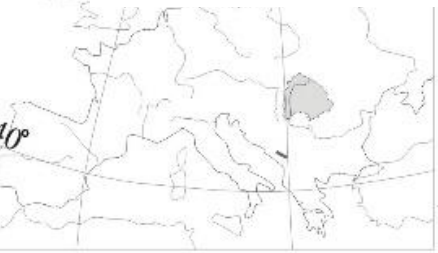
spatial – temporal

# Our measurements: water + sediment

Spatial repetition

70 sites (sediment)

34 sites (water)




Temporal repetition

annual: 2019–

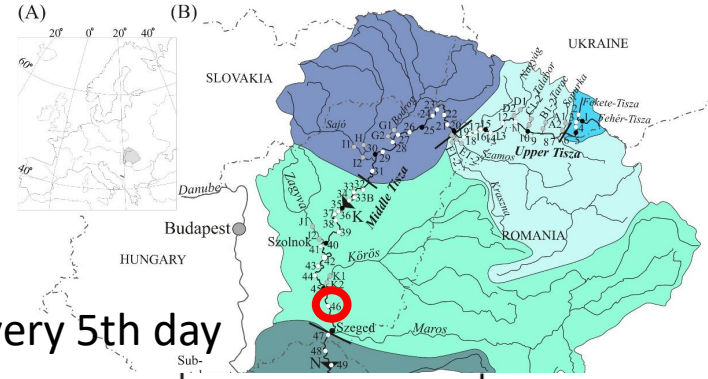
every 5 days (for 2 y)

UKRAINE
ROMANIA
SERBIA
Sajó
Bodrog
Nagyág
Talabor
Tarac
Sopurka
Fekete-Tisza
Fehér-Tisza
Upper Tisza
Szamos
Middle Tisza
Zagyva
Kraszna
Szolnok
Körös
Szeged
Maros
Lower Tisza
Danube
N
0 50 100km
Sub-catchment
S1
S2
S3
S4
S5
river
reach boundary
dam
sampling site (Tisza)
sampling site (tributary)
country border

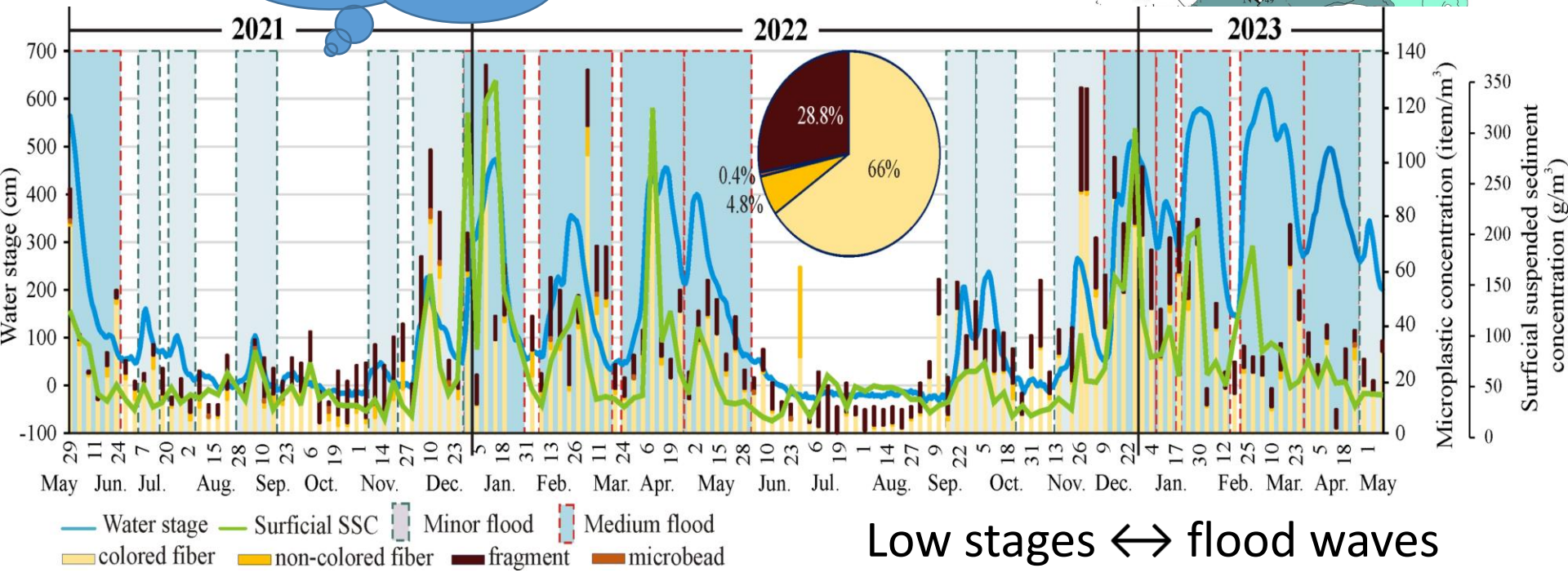
# Influencing factors of MiP transport

## 1. Hydrological situation

Sample at the similar hydrological situation (first flood peak)




At Mindszent, every 5th day

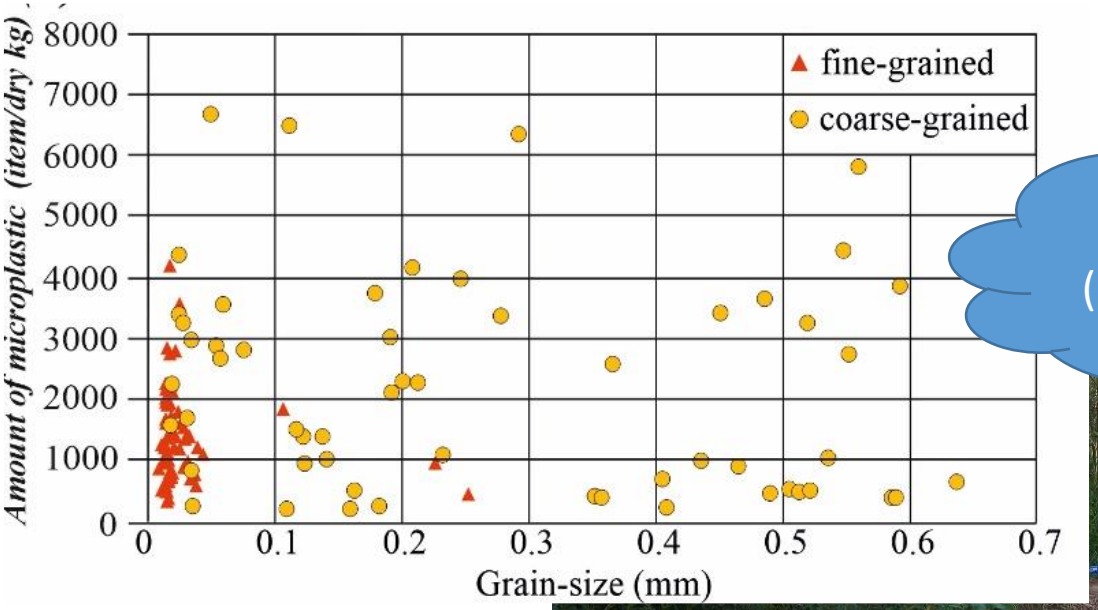



Low stages ↔ flood waves

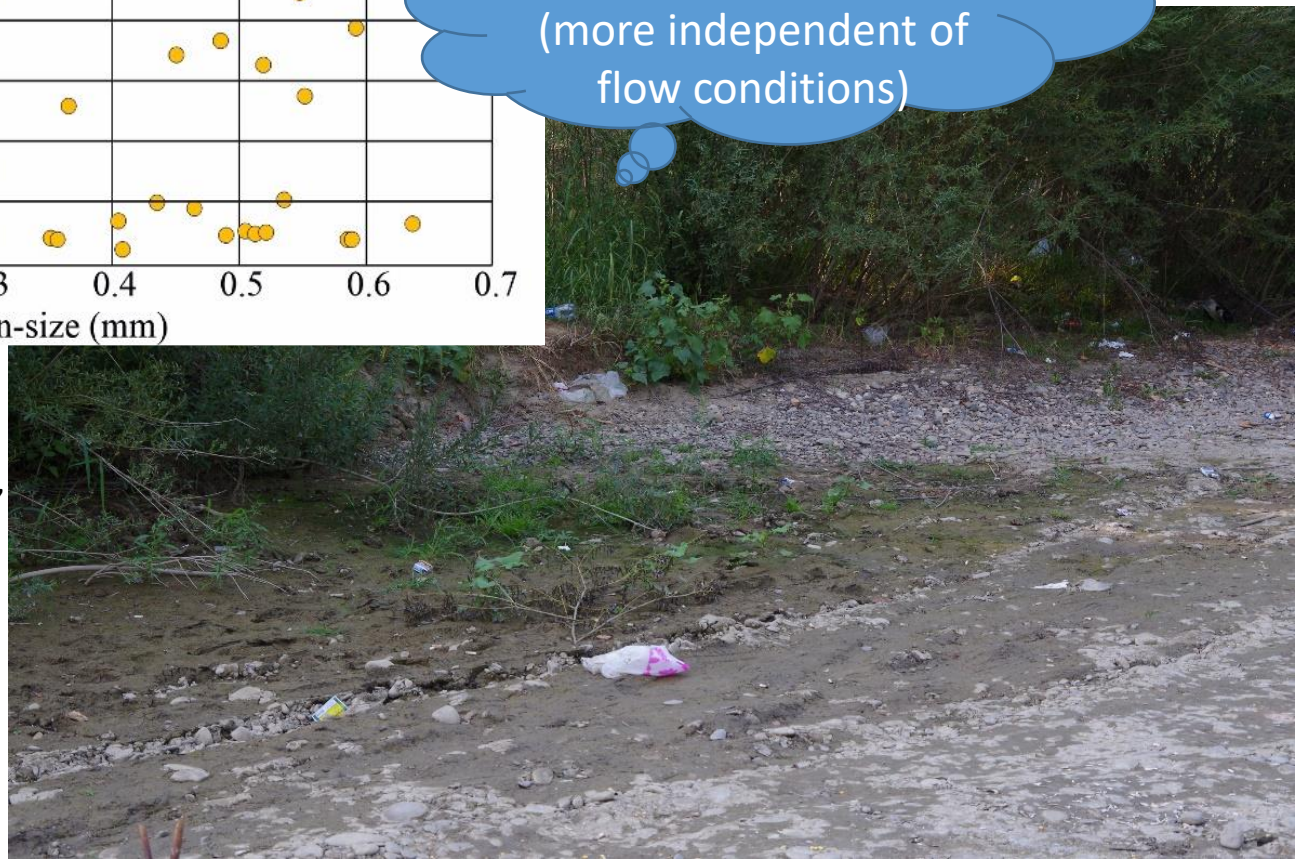
Event sequence

# Influencing factors of MiP transport

## 2. Sampled material of the sediment




Sample fine-grained sediments (more independent of flow conditions)

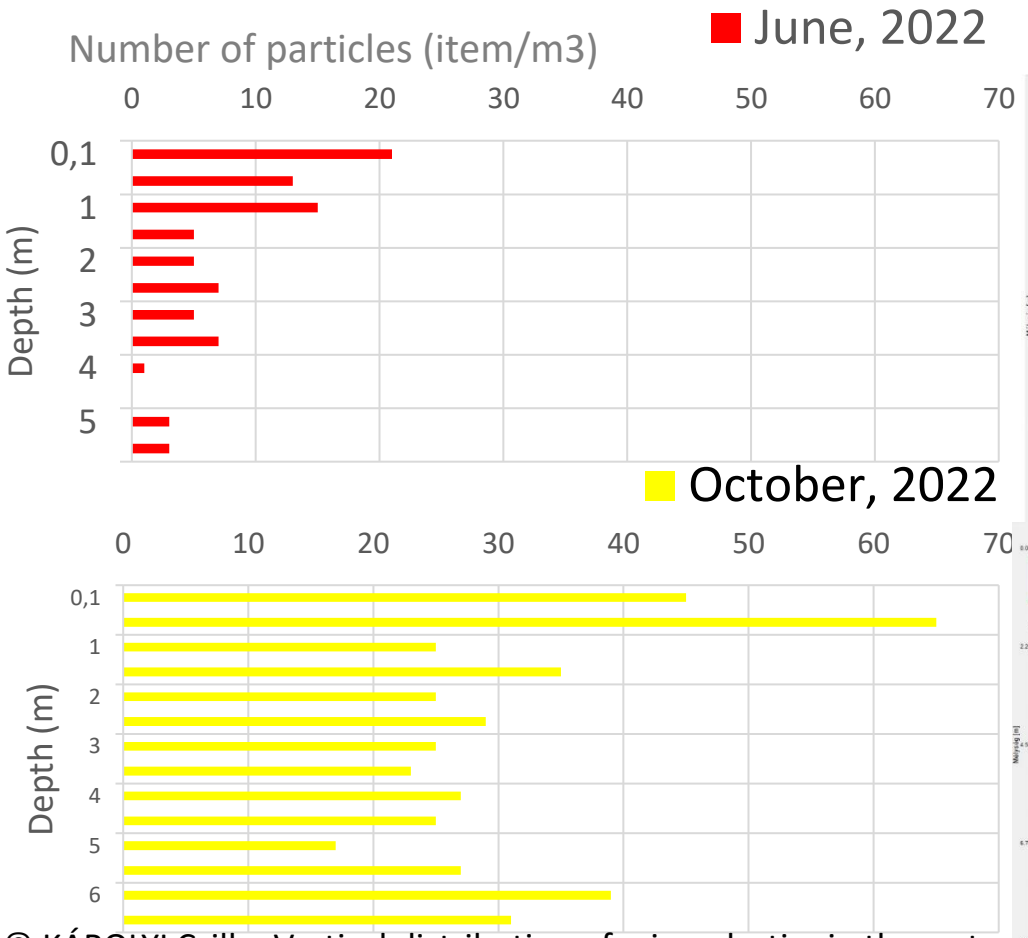


# Influencing factors of MiP transport

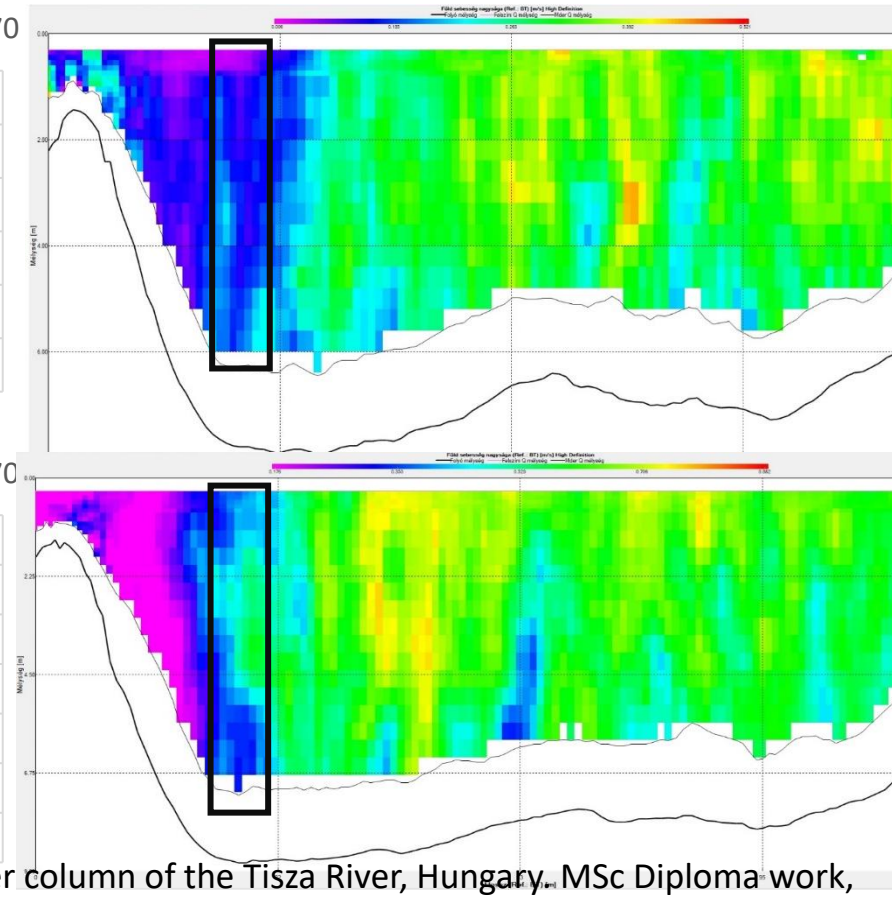
## 3. Depth of sampling

### Water column

Sample the near-surface water (same depth)



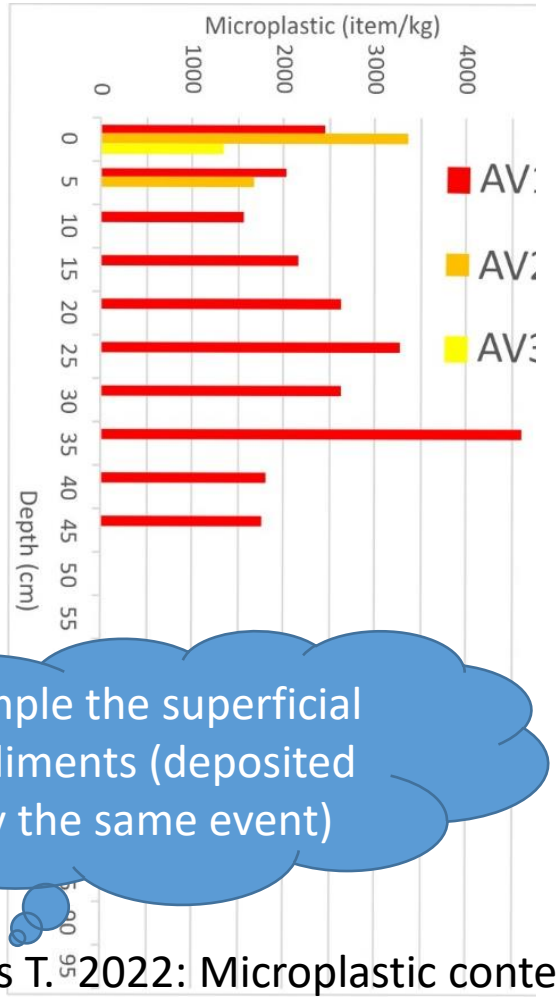

Velocity profiles



# Influencing factors of MiP transport

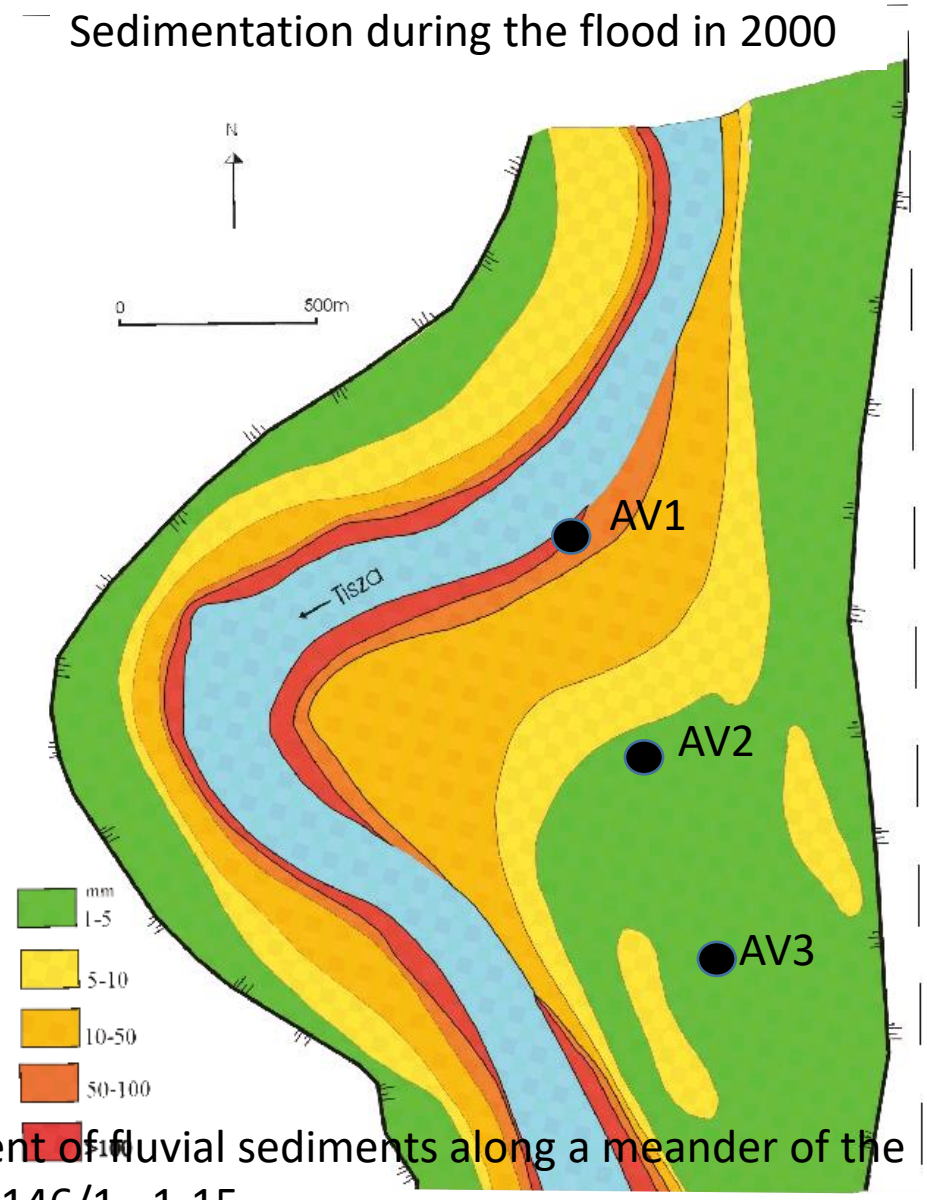
## 3. Depth of sampling

### Sediment column




Sample the superficial sediments (deposited by the same event)

Sedimentation during the flood in 2000



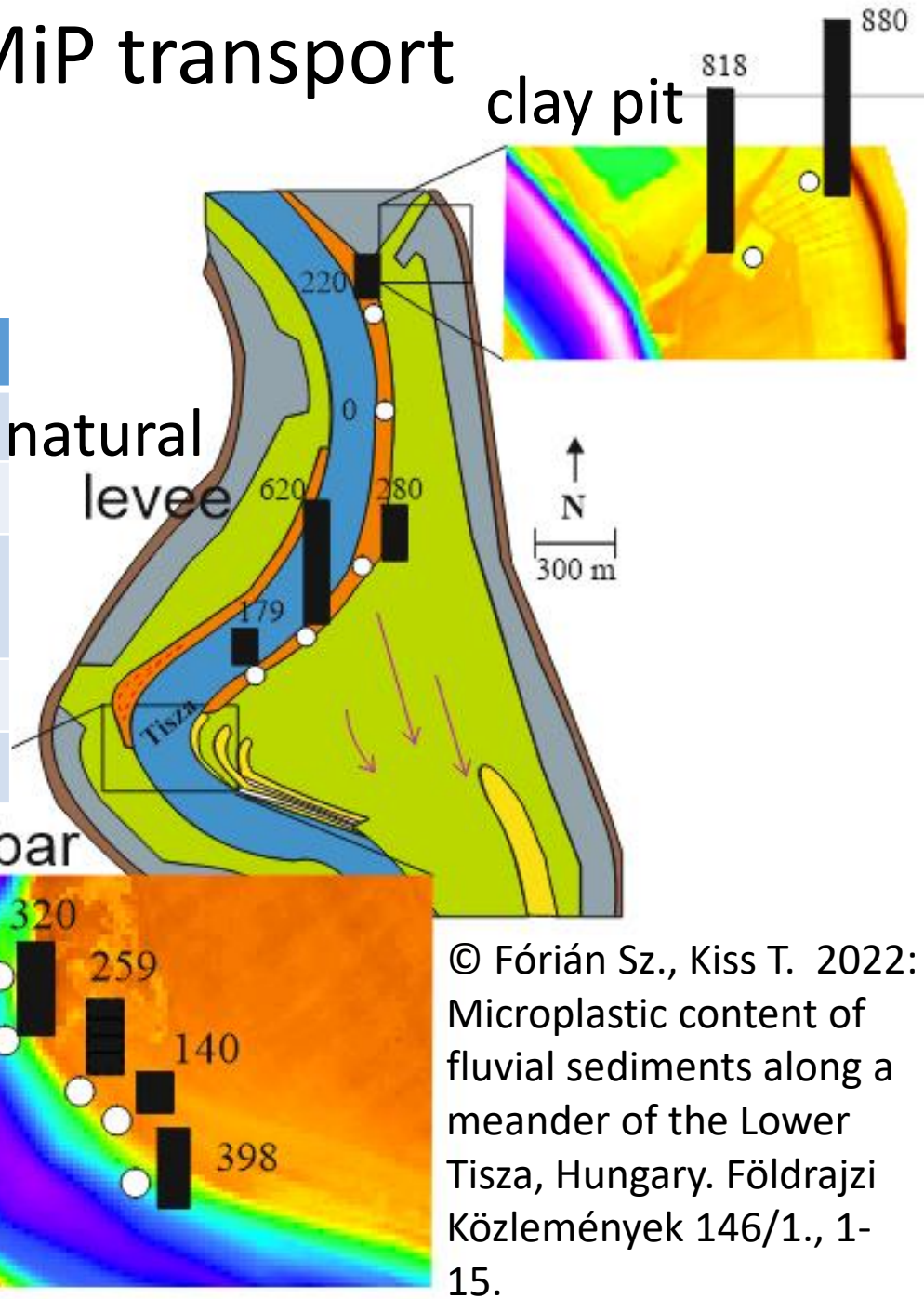

© Fórián Sz., Kiss T. 2022: Microplastic content of fluvial sediments along a meander of the Lower Tisza, Hungary. Földrajzi Közlemények 146/1., 1-15.

# Influencing factors of MiP transport

## 4. Sampling site

### 4.1. Sampled floodplain form

| Floodplain form | item/kg | median |
|---|---|---|
| Natural levee | 0-620 | 220 |
| Point-bar series | 220-1600 | 910 |
| Swales (between point-bars) | 458-1300 | 880 |
| Clay pit | 818-880 | 850 |
| Active point-bar | 0-320 | 230 |

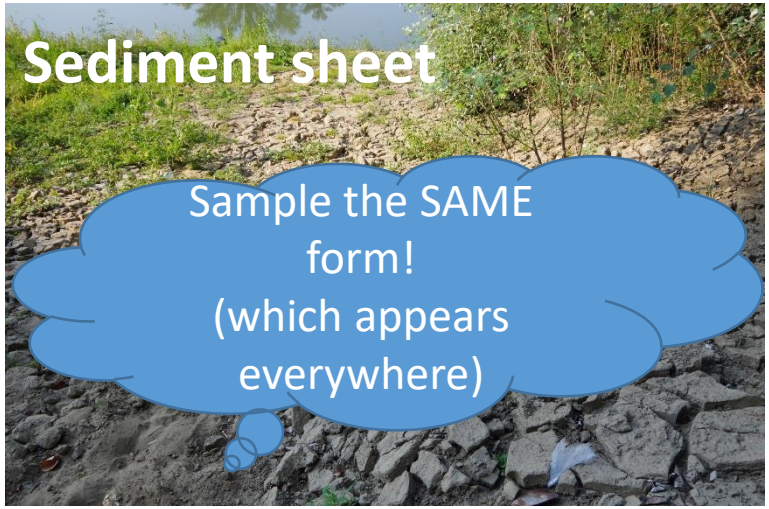


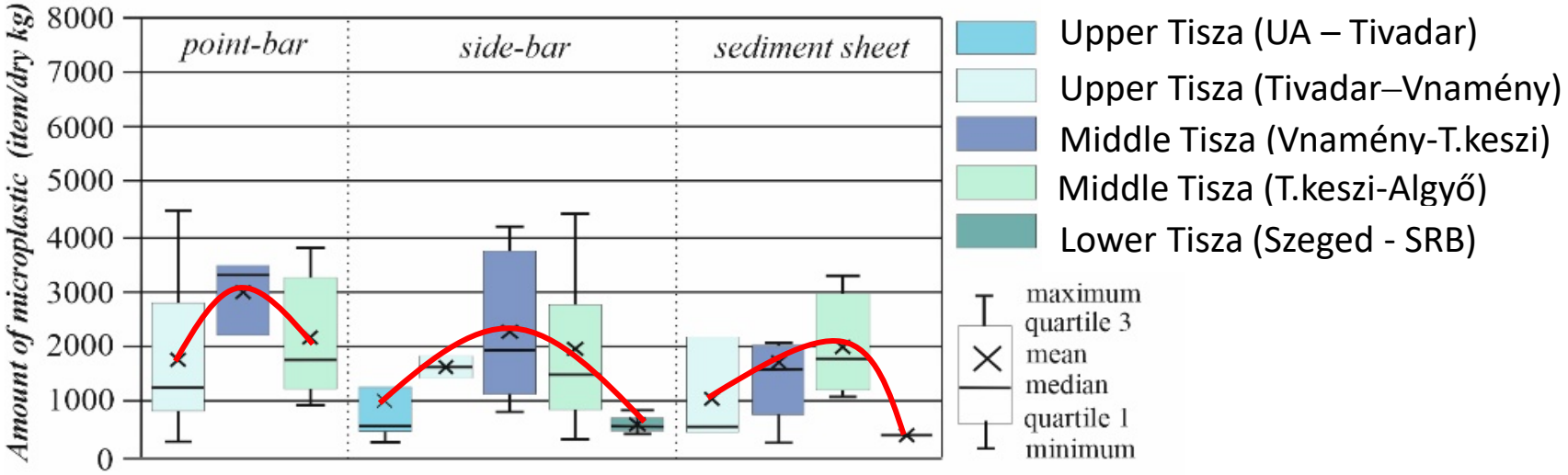

Sample the same form (same geomorphological situation)

# Influencing factors of MiP transport

## 4. Sampling site 4.2. Sampled channel form





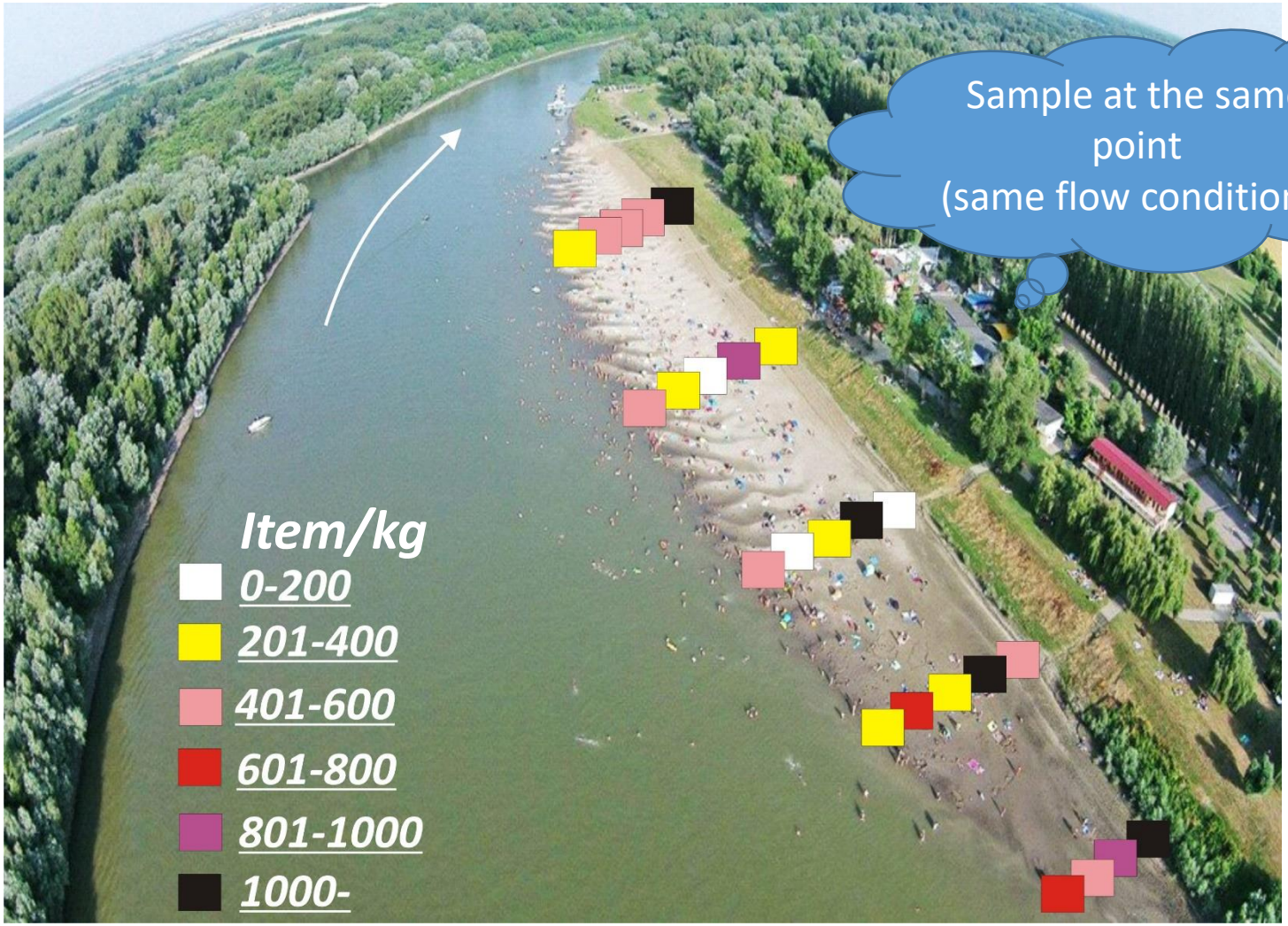




Kiss, T.; Gönczy, S.; Nagy, T.; Mesaroš, M.; Balla, A. Deposition and Mobilization of Microplastics in a Low-Energy Fluvial Environment from a Geomorphological Perspective. Appl. Sci. 2022, 12, 4367. https://doi.org/10.3390/app12094367

# Influencing factors of MiP transport

## 4. Sampling site

### 4.3. Location of the point within a form



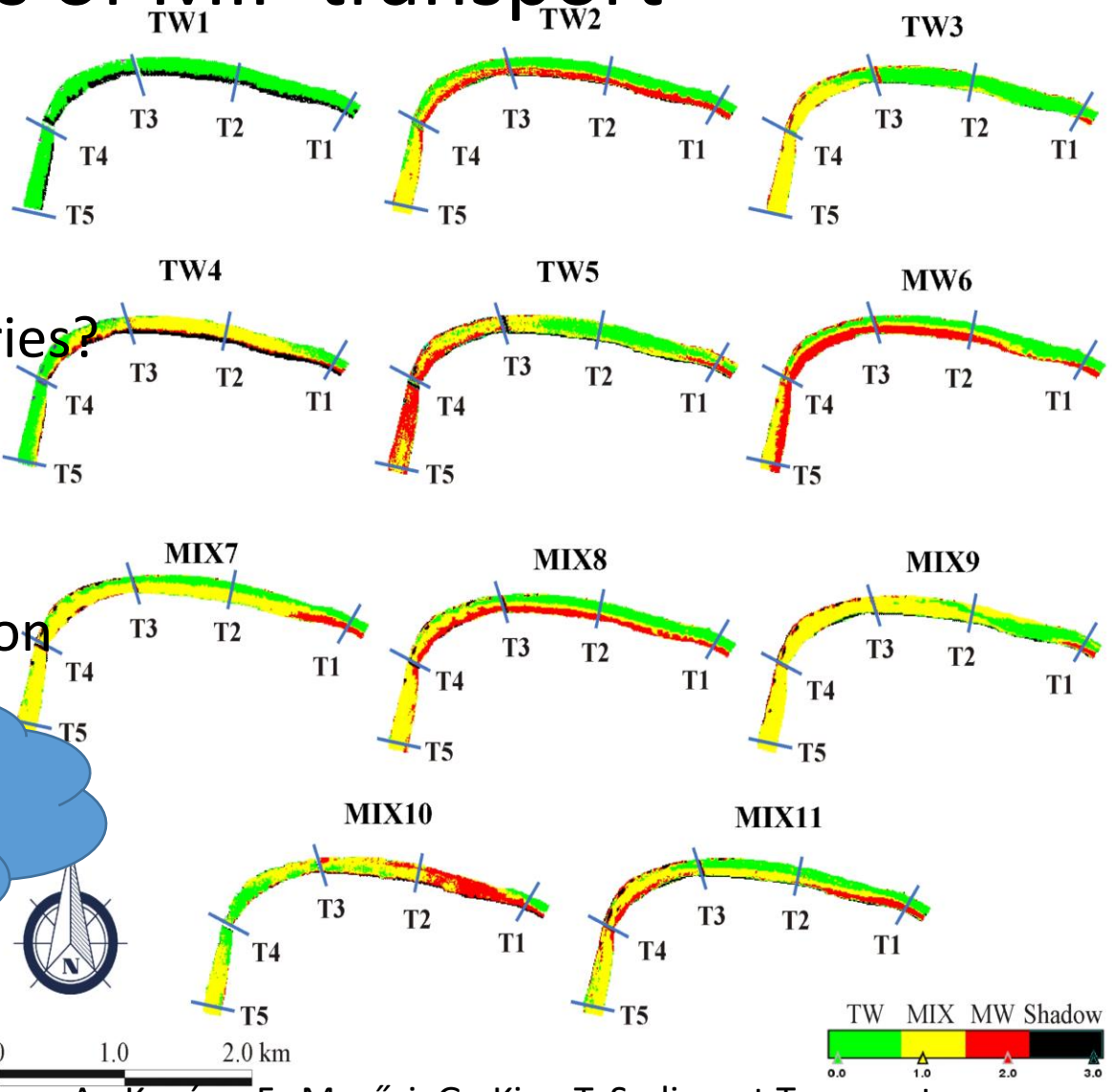
# Influencing factors of MiP transport

## 4. Location of the sampling site

### 4.4. Downstream of tributaries? mixing of waters

Water sampling: cross-section

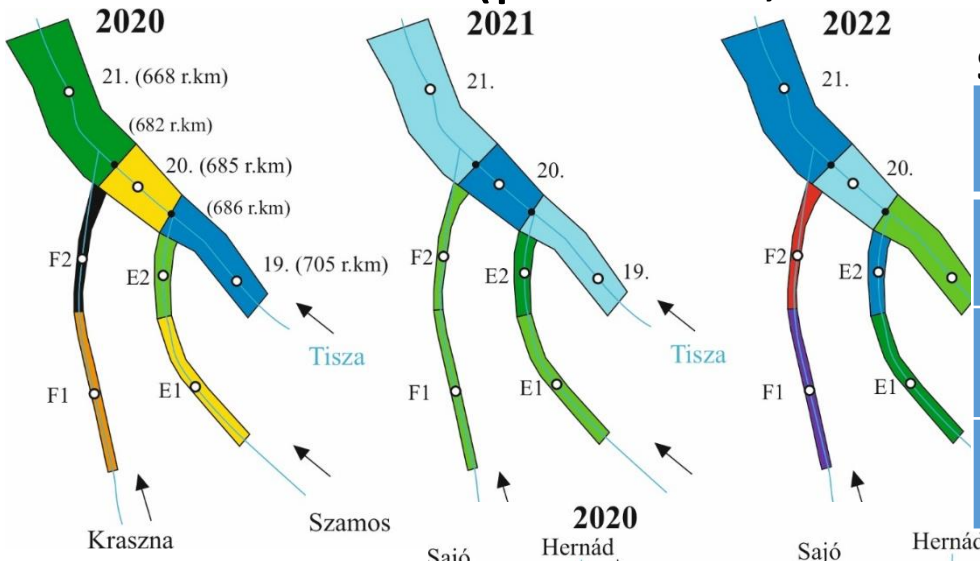
Further downstream where mixing is complete + consider the hydrology


Mohsen, A., Kovács, F., Mezősi, G., Kiss, T. Sediment Transport Dynamism in the Confluence Area of Two Rivers Transporting Mainly Suspended Sediment Based on Sentinel-2 Satellite Images. WATER 13 : 21 p. 3132 , 29 p. (2021)

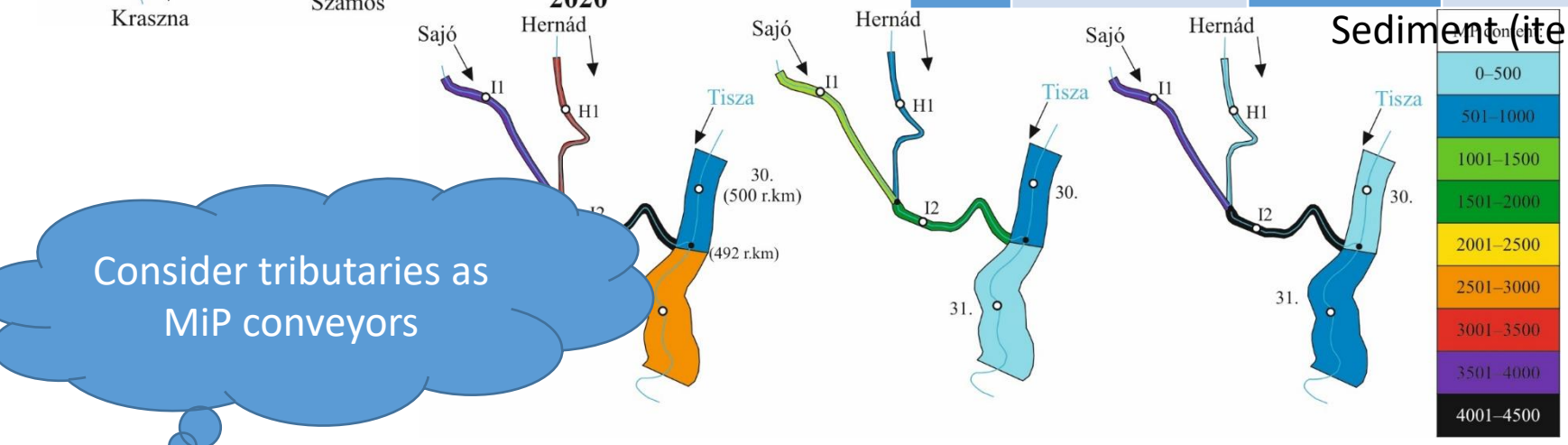
# Influencing factors of MiP transport

## 5. Tributaries (pollution, discharge)




**Sediment (item/kg)**

| | Tisza mean | Trib. mean | Tributary/Tisza |
|---|---|---|---|
| **2020** | 1291 ± 618 | 1945 ± 1532 | 1.5 |
| **2021** | 730 ± 568 | 1113 ± 465 | 1.5 |
| **2022** | 766 ± 437 | 2036 ± 1444 | 2.6 |

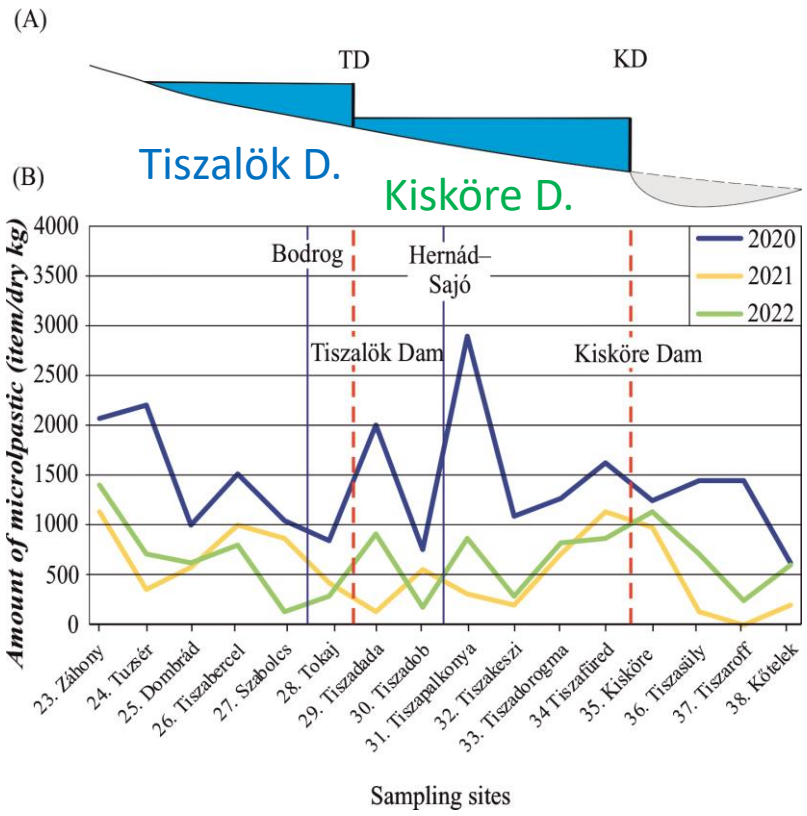


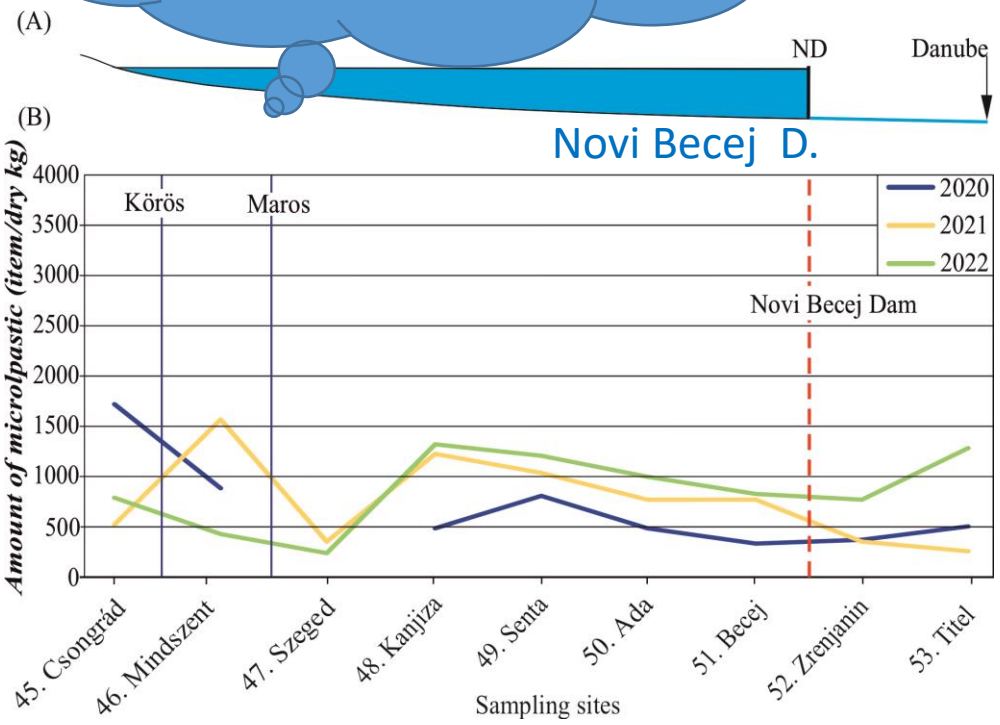

Consider tributaries as MiP conveyors

# Influencing factors of MiP transport

## 4. Dams, reservoirs

The type of impundement affects the depositionary environment



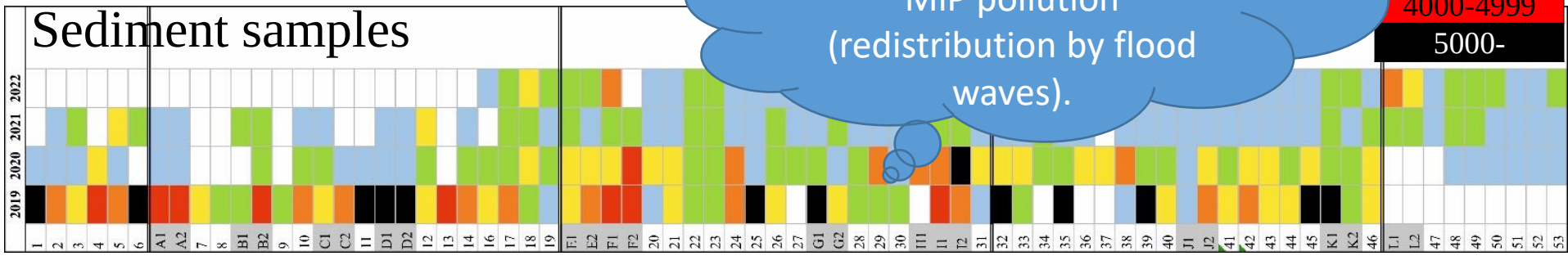
# Influencing factors of MiP transport

## 5. Redistribution, mobilisation

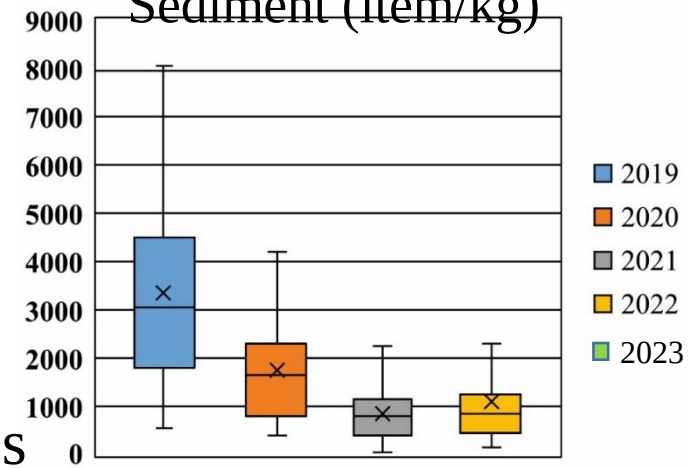
A single measurement does not reflect the real MiP pollution (redistribution by flood waves).

not measured
0-999
1000-1999
2000-2999
3000-3999
4000-4999
5000-

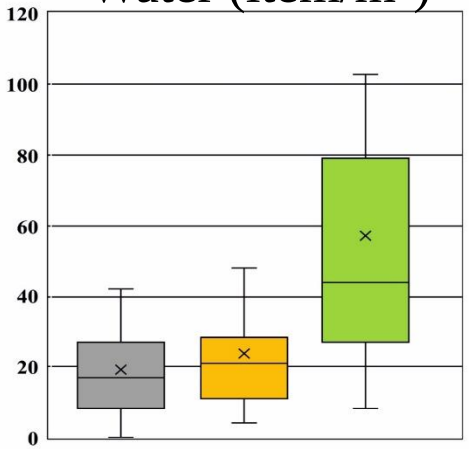
Sediment samples




Sediment (item/kg)



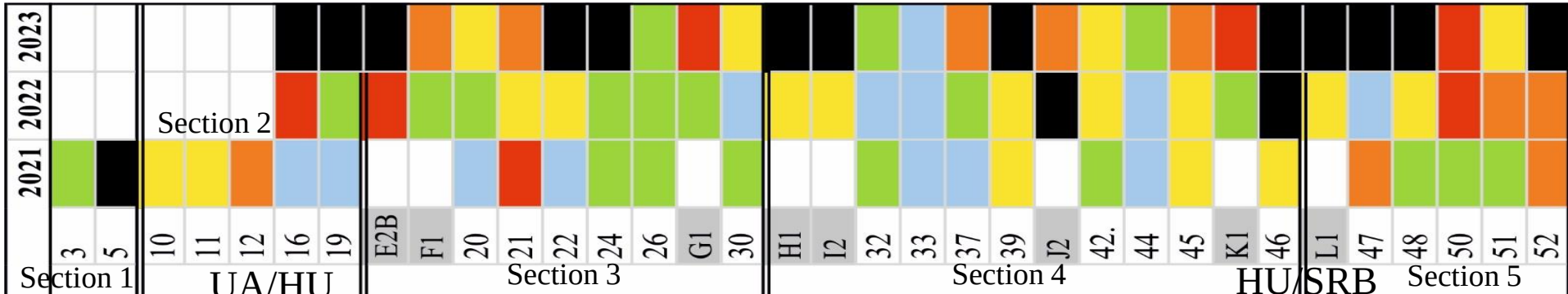

Water (item/m$^3$)



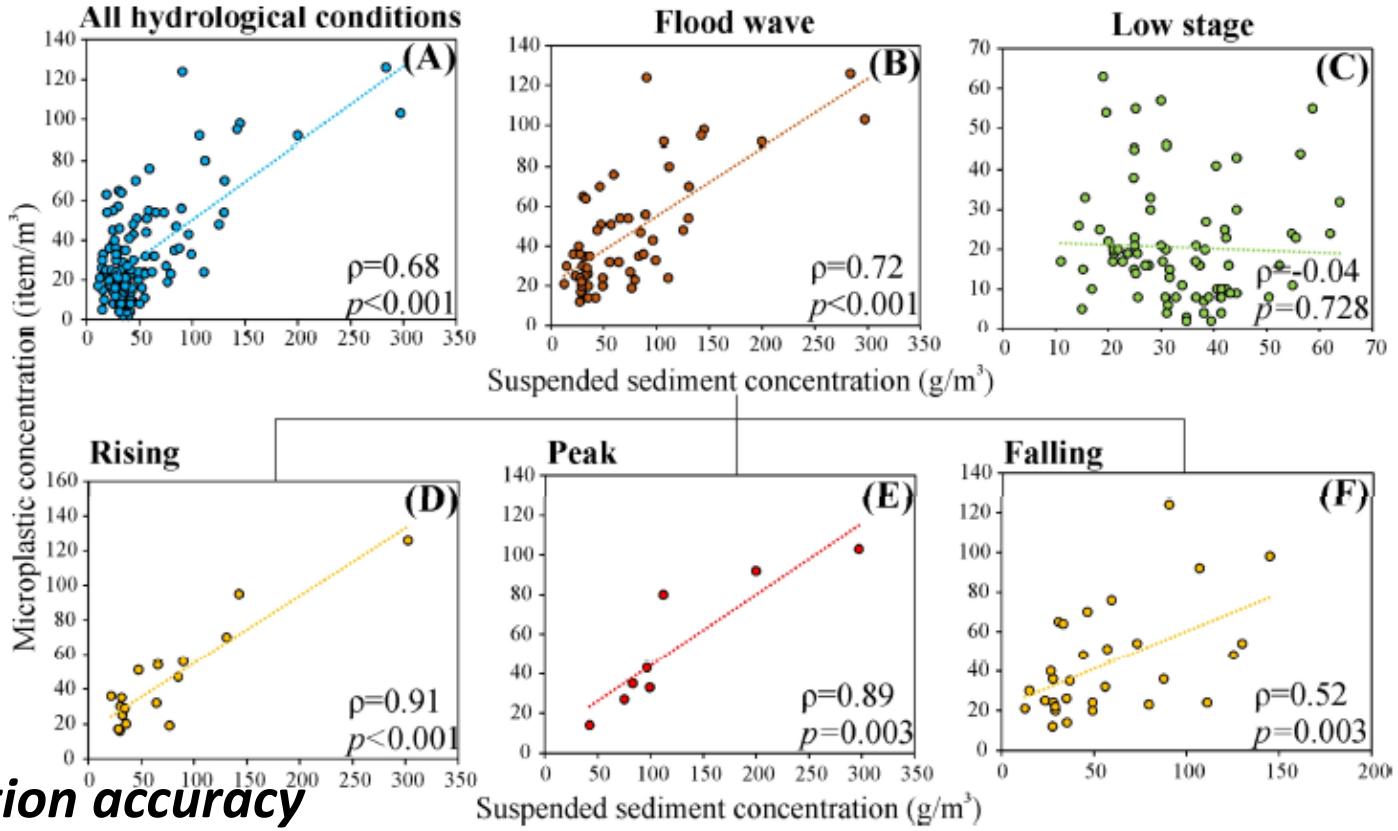



not measured
0-9
10-19
20-29
30-39
40-49
50-

Water samples



# Predicting/modelling MP transport?
# Using satellite images and suspended sediment as proxy?

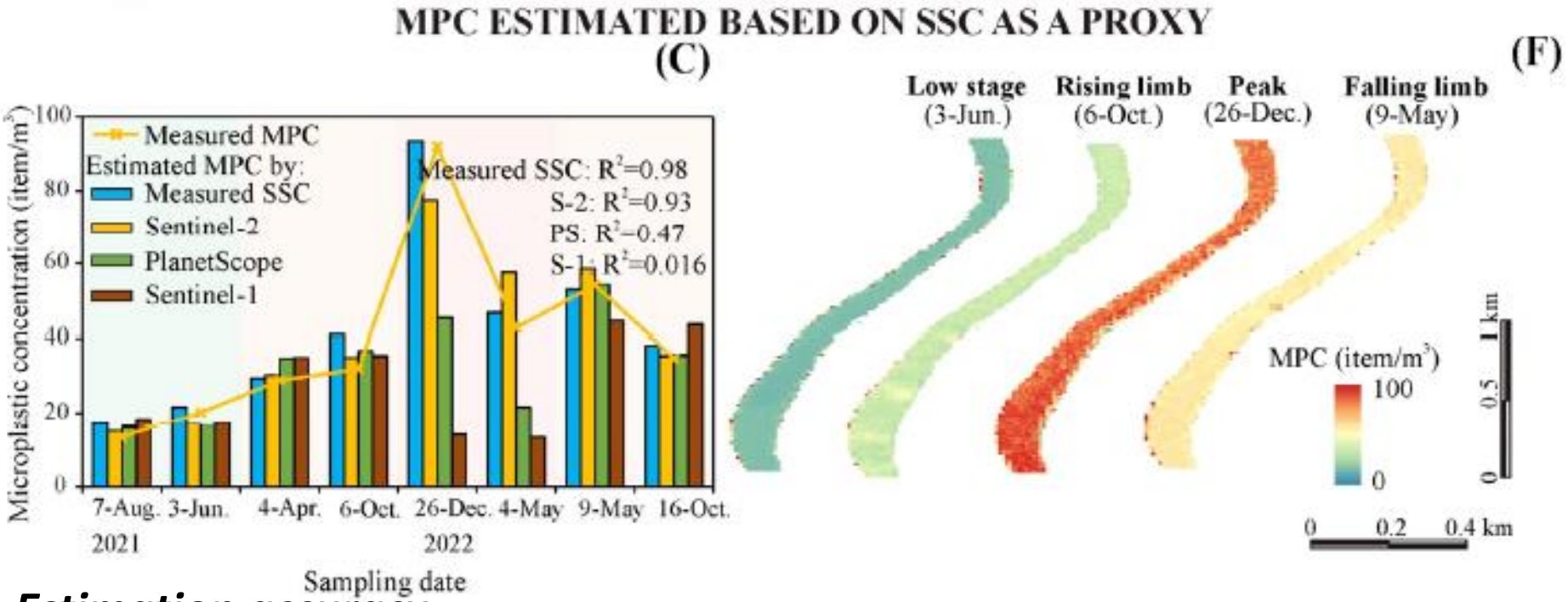



***Estimation accuracy***

| | $R^2$ | RMSE | MAE |
|---|---|---|---|
| Low stages | 0.17 | 12.9 item/m³ | 9.4 item/m³ |
| Flood waves | 0.88 | 7.8 item/m³ | 10.8 item/m³ |

© Mohsen, A.; Kovács, F.; Kiss, T. Riverine Microplastic Quantification: A Novel Approach Integrating Satellite Images, Neural Network, and Suspended Sediment Data as a Proxy. Sensors 2023, 23, 9505. https://doi.org/10.3390/s23239505

# Predicting/modelling MP transport?
# Using satellite images and suspended sediment as proxy?

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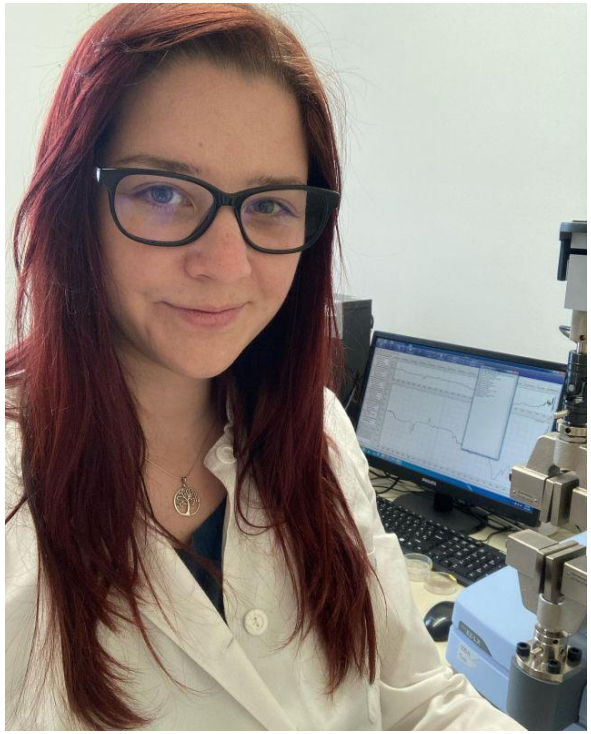
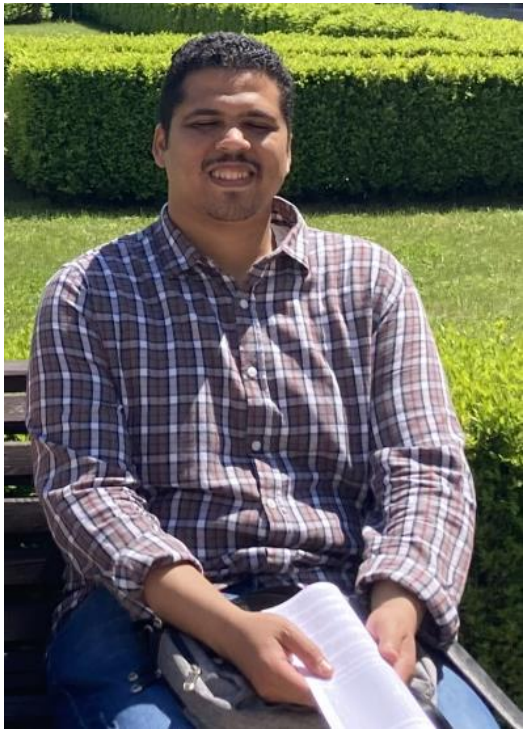
# Thank you for your attention!

## The team:



Alexia, BALLA
Sampling, laboratory work



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Viktória, BLANKA
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