Water Workshop 2025

Monitoring of microplastics in water and sediments of the Danube - UPSTREAM and SUNDANCE project approach

Dr Aleksandra Tubić, Full professor

University of Novi Sad, Faculty of Sciences, Department of Chemistry, biochemisty and environmental protection

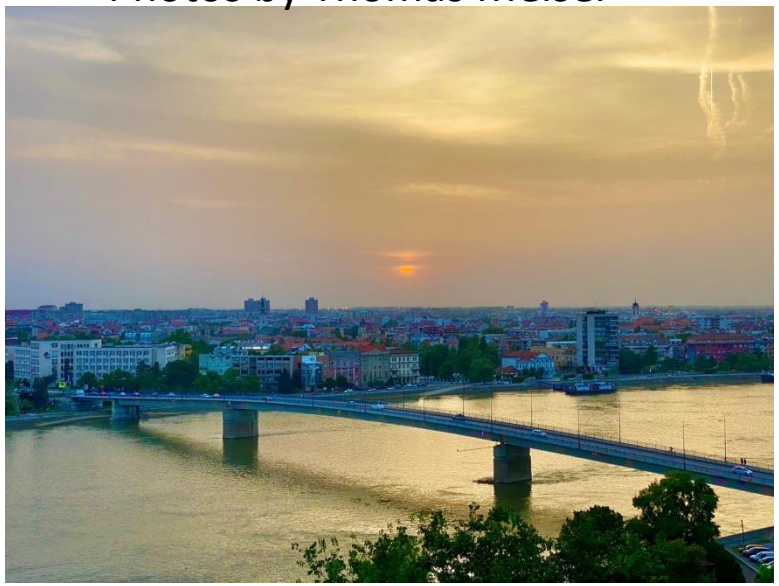
Interreg sufinansira Evropska unija
IPA Mađarska - Srbija
Microplastics

The Danube is Europe's second-longest river, stretching over 2,800 kilometers.
It flows through 10 countries, from Germany's Black Forest to the Black Sea in Romania and Ukraine, making it one of the most international rivers in the world.

Photos by Thomas Meisel

Social importance

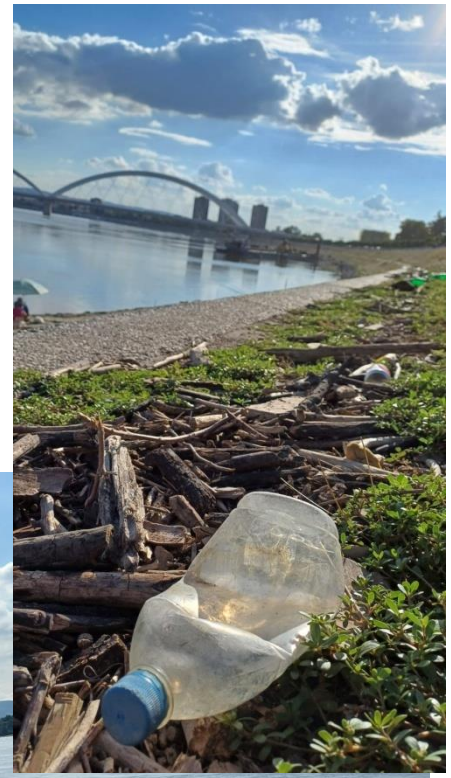
Danube connects diverse cultures and communities, serving as a historical link between Central and Eastern Europe.
It supports industry, tourism, recreation, and provides drinking water.



Economical importance

The river is a vital transport corridor, enabling inland shipping and trade across the region.
It also supports agriculture through irrigation and powers industry with hydroelectric energy, making it a crucial resource for regional development and cooperation.

Plastic and microplastic sources in the Danube region



- Industry
- Agricultural activity
- Non-sanitary landfills and illegal dumpsites
- Wastewater discharge
- Transportation on the Danube
- Fishing and recreational activities

USTREAM & SUNDANSE Project Perspectives

UPSTREAM

Call: **HORIZON-MISS-2022-OCEAN-01-04**

Project Number: **101112877**

Start date: **1 September 2023**

End date: **31 August 2027**

EU contribution: **€ 7 024 032,90**

Upstream
FOR WASTE-FREE EUROPEAN RIVERS

SUNDANSE

Call: **HORIZON-MISS-2023-OCEAN-01-02**

Project Number: **101156533**

Start date: **3 Jun 2024**

End date: **02 Jun 2028**

EU contribution: **€ 8 497 157,50**

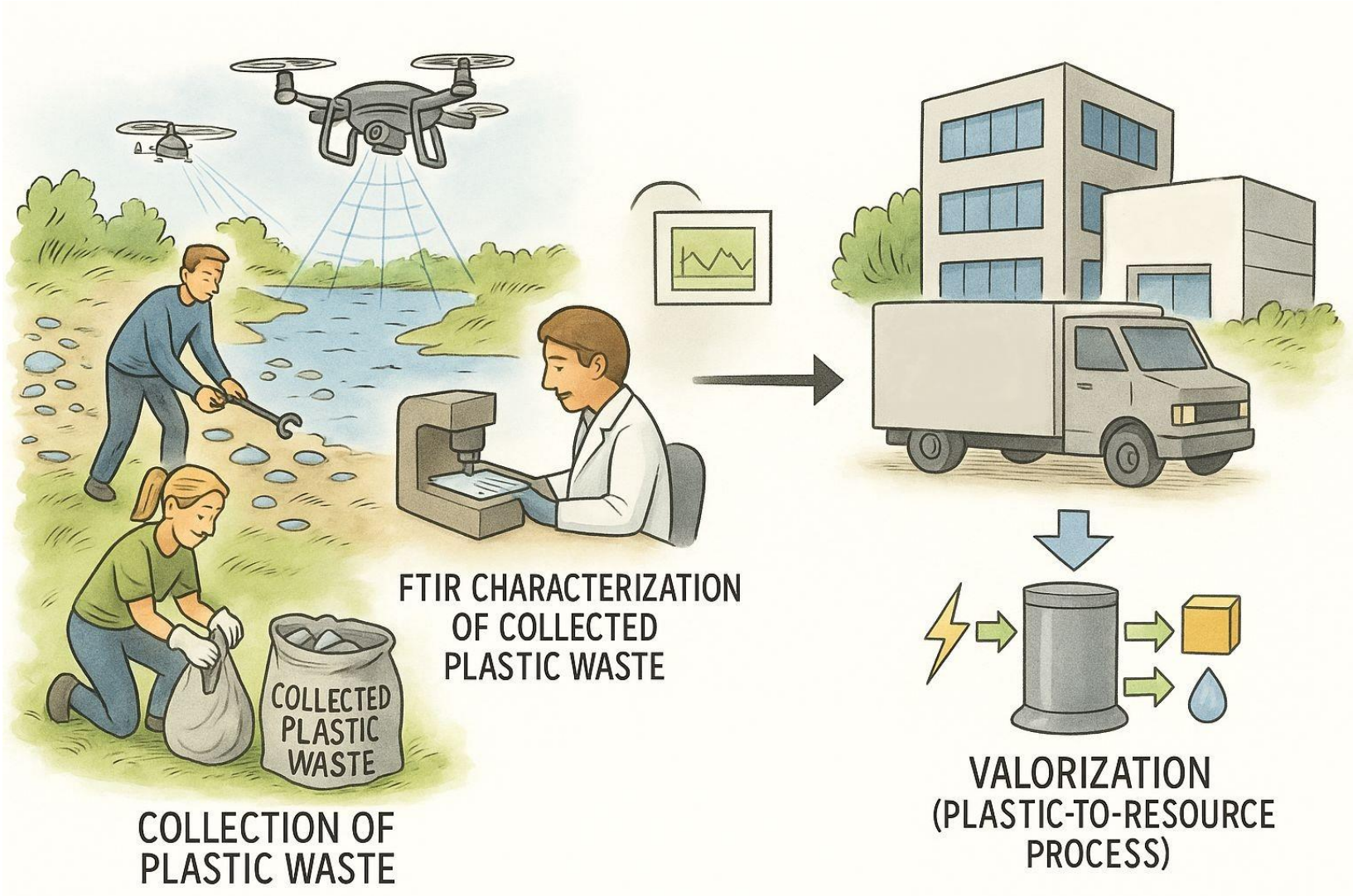
sundanse
Sustainable Sediment solutions for the Danube - Black Sea system

USTREAM & SUNDANSE Project Perspectives

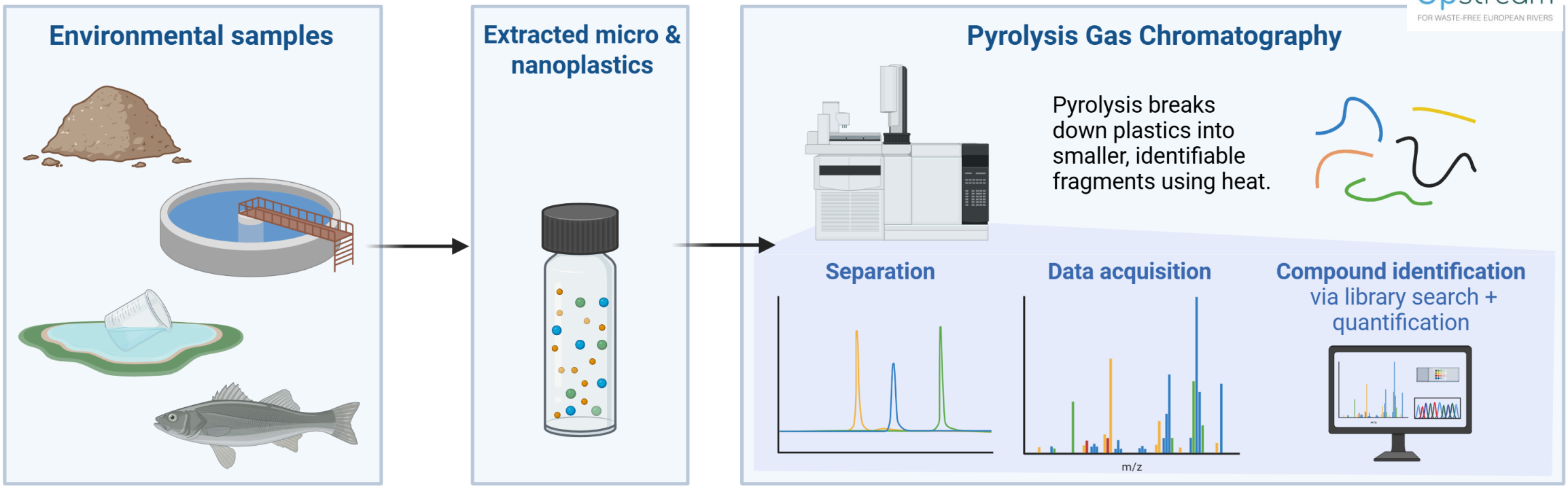
UPSTREAM

- Reduced pollution from litter, plastics and microplastics in European rivers.
- Accelerated uptake of innovative solutions to prevent and minimize pollution of rivers by L, P, and MP.
- **Effective monitoring of litter, plastics and MP in freshwaters to implement the Water Framework Directive and Marine Strategy Framework Directive.**
- Reduction by at least 50% plastic litter at sea and by at least 30% MP released into the environment.
- Contribution to the Mission's Digital Ocean and Water Knowledge system through marine observations and open data and knowledge sharing.

Upstream
FOR WASTE-FREE EUROPEAN RIVERS



Pyrolysis Gas Chromatography



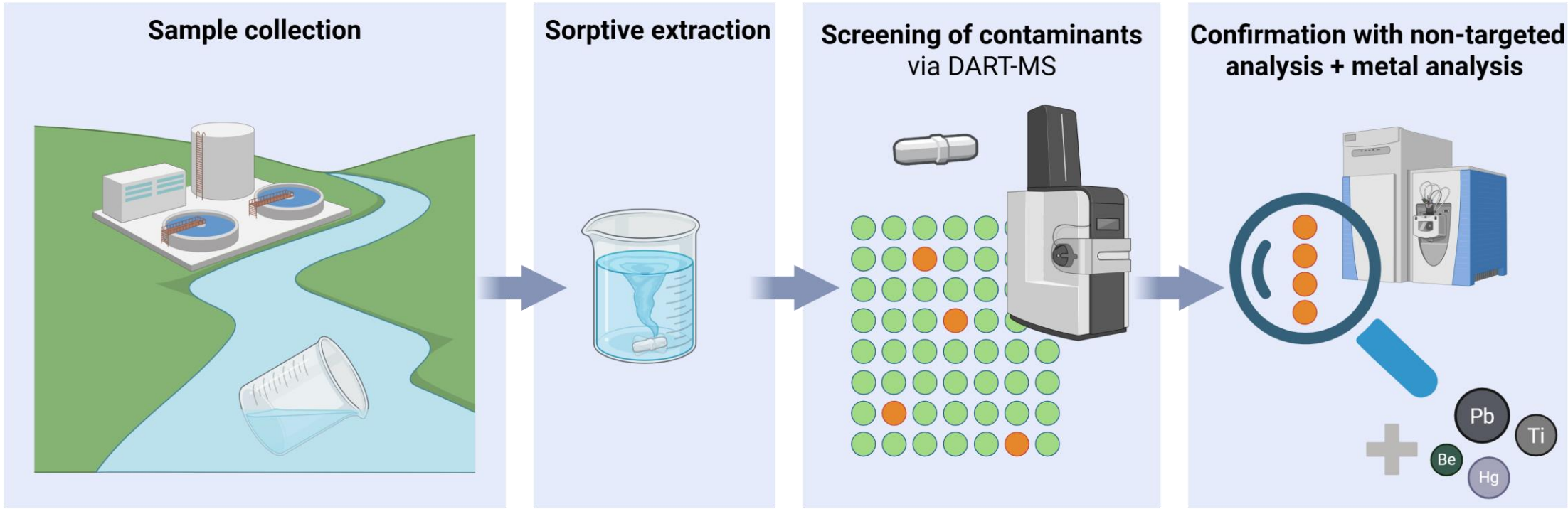
Pyr-GC-MS is a powerful technique for the **qualitative and quantitative analysis** of complex materials like plastics that can't be analyzed by direct methods.

In the UPSTREAM project, this capability is used to:

- **Confirm:** Precisely identify the chemical makeup of microplastics.
- **Verify:** Accurately measure the mass of microplastics, confirming estimations by other techniques.
- **Complete the Picture:** Work alongside other tools to provide a full characterization of microplastic pollution in a sample.

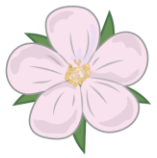
DART-MS in UPSTREAMS

To develop a workflow for rapid screening, confirmation, and metal analysis of leaching micropollutants from plastics in riverine water.



The universe of plastic additives

Upstream
FOR WASTE-FREE EUROPEAN RIVERS

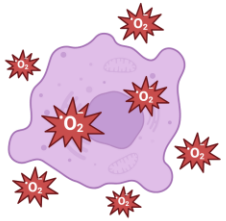


Fragrances

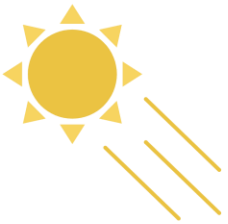
Monomers

Intermediates

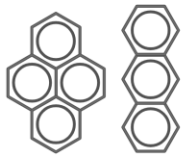
Flame retardants



Anti-oxidants



UV stabilisers

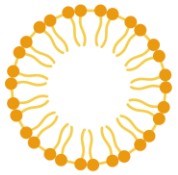


Polycyclic aromatic hydrocarbons

Plasticizers

Solvents / Pesticides

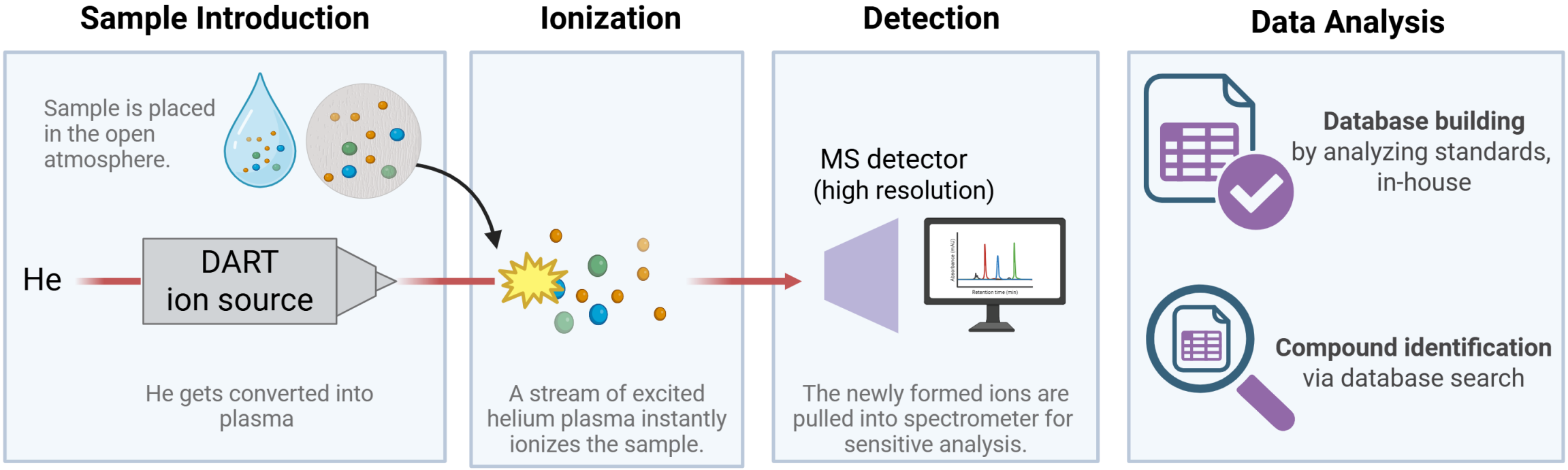
Dyes



Surfactants

Fungicides & Biocides

Direct Analysis in Real Time coupled to Mass Spectrometry (DART-MS)



The advantages:

- Fast Screening
- Minimal Preparation
- Easy identification

In the UPSTREAM project, this capability is used to:

deliver fast, ambient screening method for identifying various leaching micropollutants from plastics in water.

It's a quick and efficient way to analyze a wide range of organic compounds without complex sample preparation.

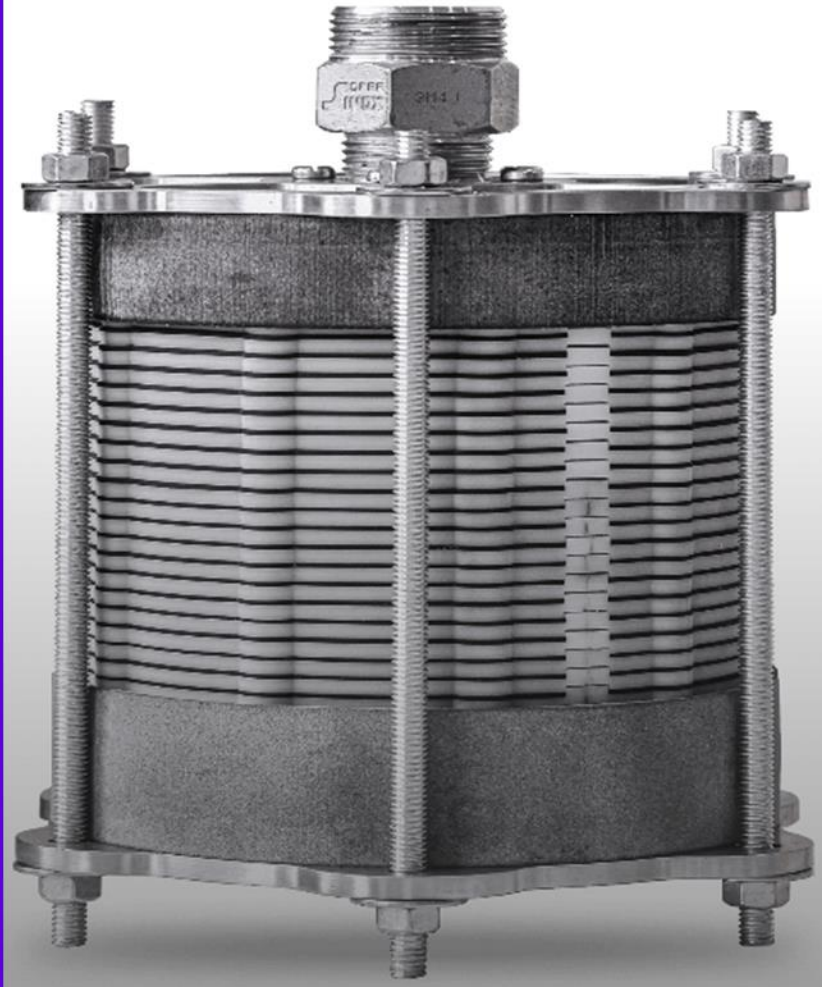
Upstream
FOR WASTE-FREE EUROPEAN RIVERS

FILTRATION SYSTEM

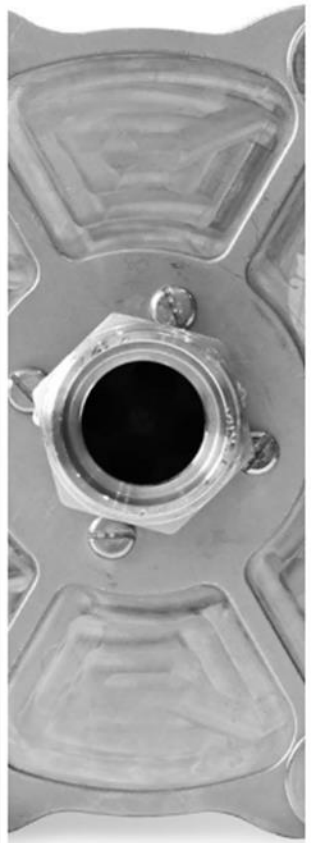
ASCANDRA FOR MICROPLASTICS

Inspired by Nature for Nature, addressing microplastic pollution at the global scale.

Upstream
FOR WASTE-FREE EUROPEAN RIVERS



Ascandra Model



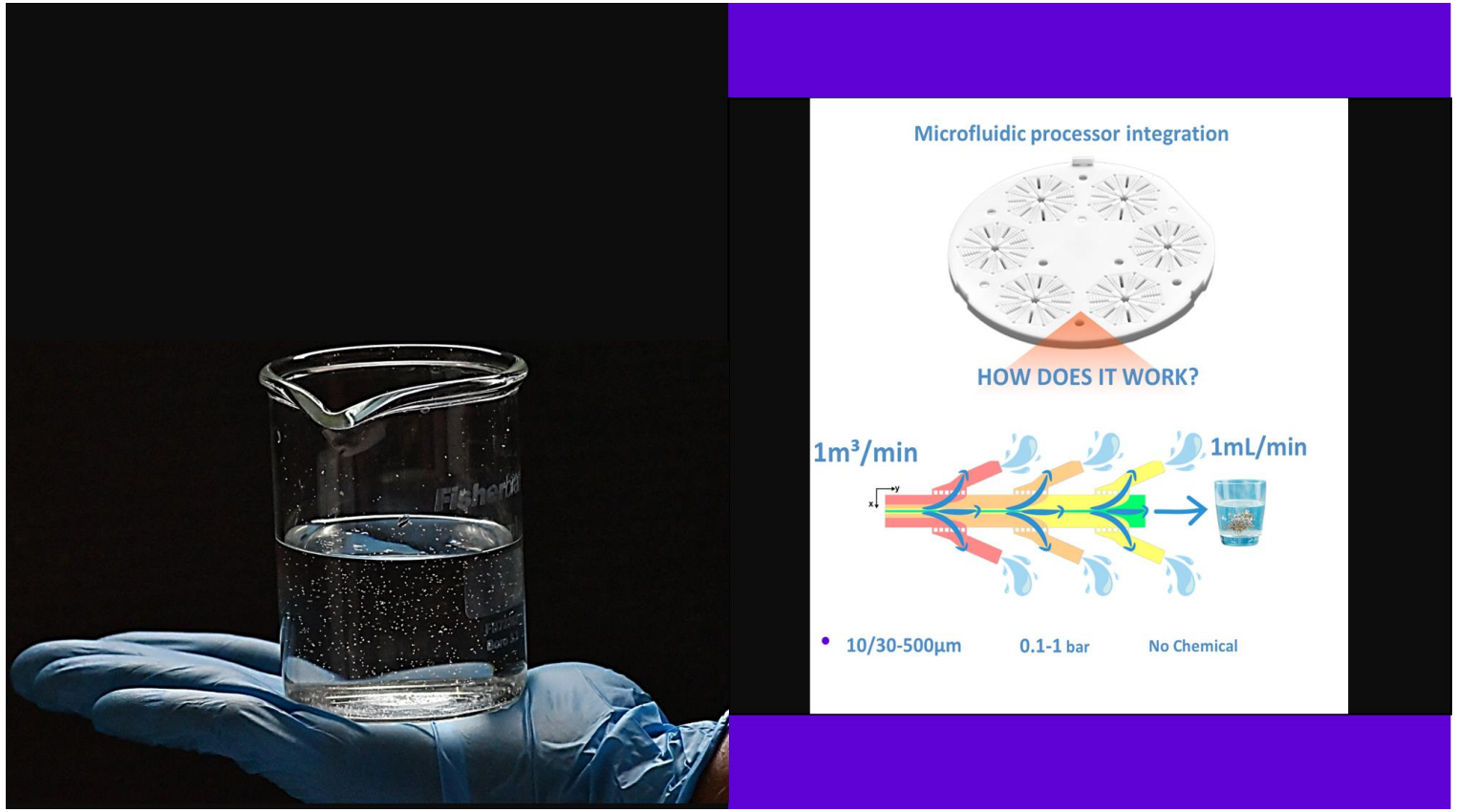
WORKING MODE

ASCANDRA CORE

The microfluidic capillaries are microstructures molded on CDs. The CDs are stacked to generate a 3D dense low-pressure network. The larger the number of stacked CDs, the higher the volume of water treated. When CDs are massively integrated, a miniaturized treatment factory is created.

Thanks to its **biomimetic conception**, Ascandra relies on microfluidic design to **isolate and capture** microplastic particles, and can be installed on any hydraulic system.

Upstream
FOR WASTE-FREE EUROPEAN RIVERS



Ascandra separates microplastics using inertial microfluidics, where water flowing through microchannel structures creates localized microvortices that steer particles based on their inertia.

Channel geometries, including curves and constrictions, enhance particle concentration along the mainstream flow, while obstacle-based filtration adds a fail safe mechanism capturing any particles that may have bypassed the inertial separation.

The system features a purge cycle that periodically backwashes accumulated microplastics into a waste collection, ensuring continuous, clog-free operation.

USTREAM & SUNDANSE Project Perspectives

sundanse
Sustainable Sediment solutions for the Danube - Black Sea system

SUNDANSE

- Conducting thorough studies to understand the problems affecting the Danube River and its surroundings.
- Creating maps to identify areas with excessive sedimentation or erosion and working to restore natural flow patterns.
- **Using advanced tools to measure microplastics and other pollutants in the water.**
- Developing computer models to predict how sediment moves in the river.
- Designing a smart plan to manage sediment in a sustainable way.

Uses cases

sundanse
Sustainable Sediment solutions for the Danube - Black Sea system

Bulgaria

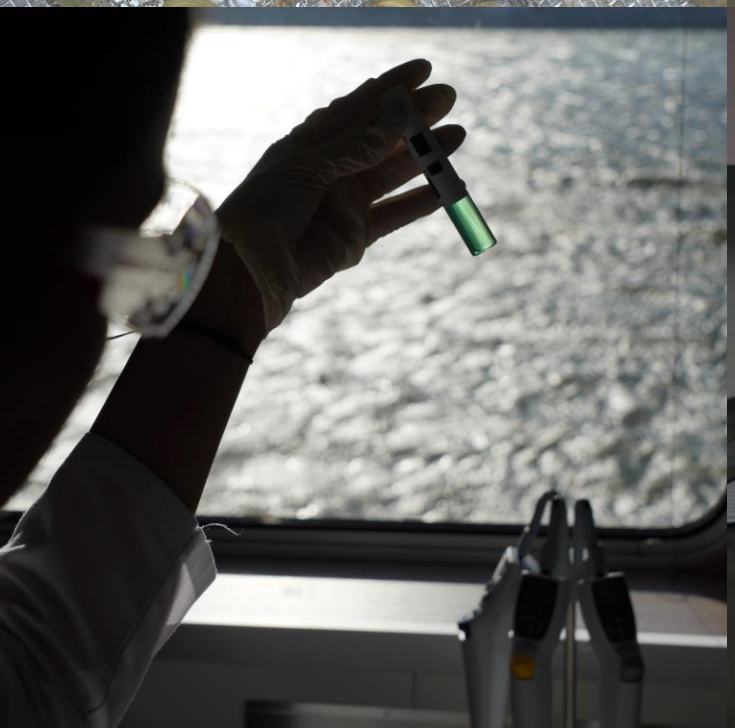
Sediment and flow management in the Danube River from Ruse to Tutrakan

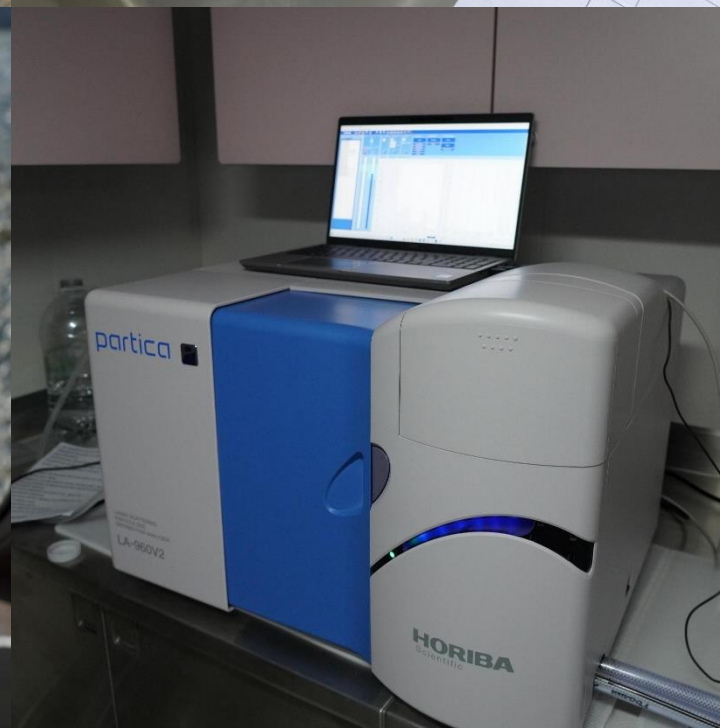
Romania

Sediment management and navigation challenges in the Danube River from Corabia to Turnu Magurele

Serbia

Impact of sediment management solutions downstream of the Srpski Itebej Lock

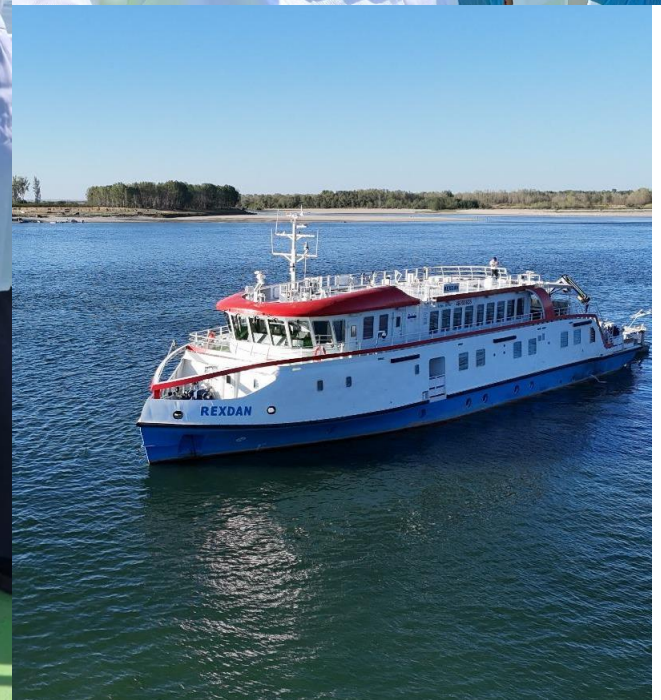




sundanse
Sustainable Sediment solutions for the Danube - Black Sea system

Romania Use-case - Corabia – Turnu Magurele

November 2024



sundanse
Sustainable Sediment solutions for the Danube - Black Sea system

Romania Use-case - Corabia – Turnu Magurele

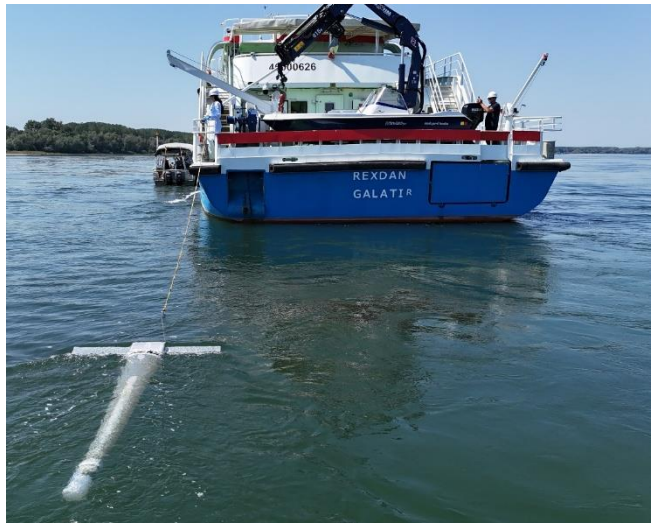
August-September 2025

Methodology for sampling and analyzing microplastics

sundanse
Sustainable Sediment solutions for the Danube - Black Sea system

Sampling

Water
- Microplastic net “Manta”
- 50 µm mesh size
- Flow meter - for quantifying the volume of water

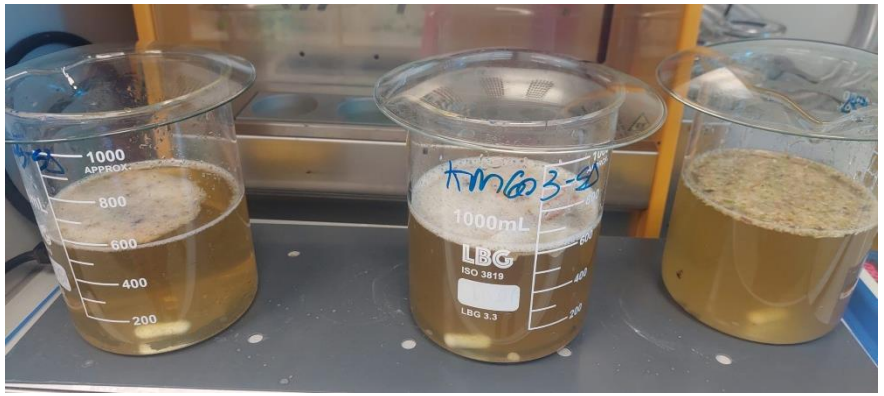


Sediment - Van Veen grab sampler

Isolation of microplastic

- Organic matter digestion

1:1 KOH 10 M and H_2O_2 30%



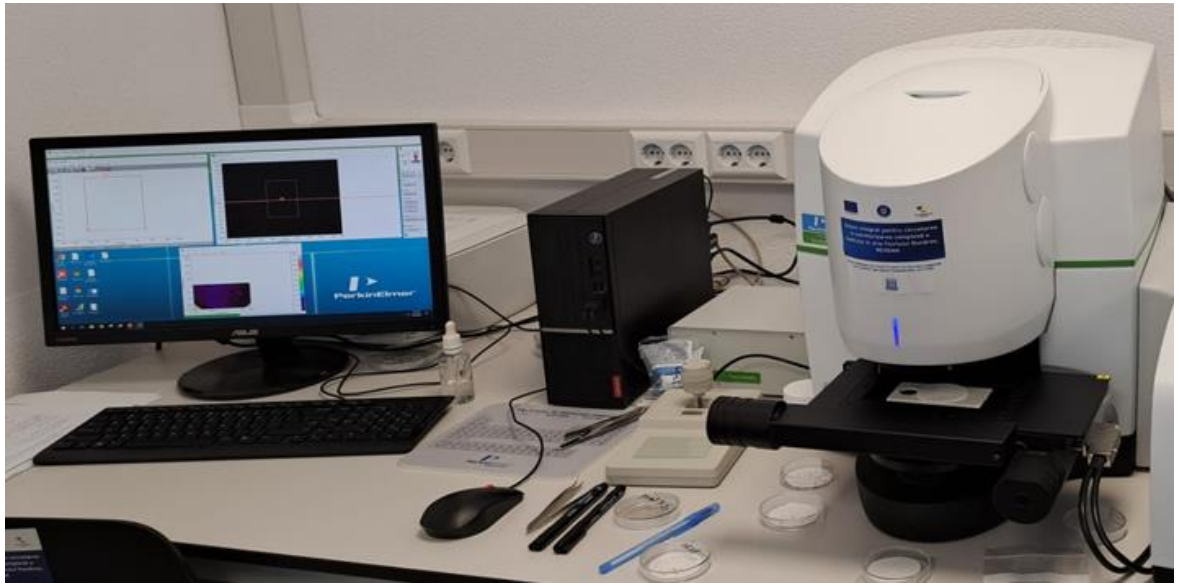
- Density separation

$ZnCl_2$ 60% solution;

Identification of microplastic

sundanse
Sustainable Sediment solutions for the Danube - Black Sea system

Analysis of polymer composition using Spectrum 3 laboratory FT-IR spectrometer coupled with Spotlight 400 micro-FTIR , PerkinElmer



Apply for up to €100,000 in funding to enhance the river sediment management in your country

Call for Associated Regions: OPENING WINTER 2025/2026

The SUNDANSE initiative is launching an Open Call designed to establish productive and long-term partnerships with carefully selected Local and/or Regional authorities within at least 3 Associated Regions*

The ultimate Open Call goal is to offer selected Associated Regions an ongoing scientific and technical assistance in adopting SUNDANSE's established sediment management strategies within their own distinct geographical and operational contexts

* Associate regions are understood as "areas with similar ecosystems (e.g., neighbouring regions and/or regions in a different river basin and/or less-developed regions, to build capacity to implement the innovative solutions) and abiotic, biotic and socio-economic conditions to at least one demonstrator site of SUNDANSE."

Thank you for your attention