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SedNet

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Sustainable, Integrated Transnational Sediment Quantity and Quality Management in the Danube River Basin

SedNet Conference
Madrid, 16.10.2025

Presenter
H. Habersack, **S. Baranya**, V. Gabrian, G. Jordán, N. Cvijanović, P. Flödl, M. Haimann

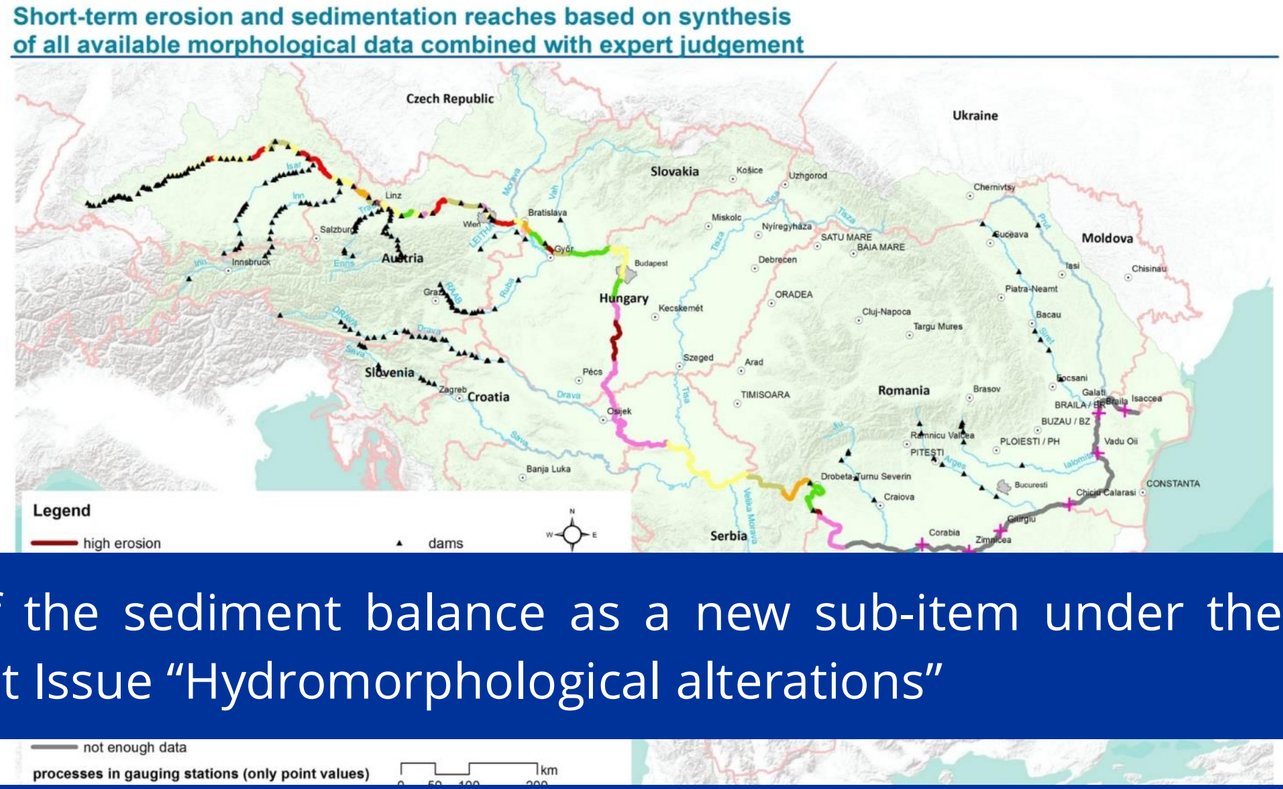
Introduction

- In the last Danube Transnational Programme period, two very successful projects were realized related to sediments: DanubeSediment and SIMONA

- These projects showed that sediment management is a significant topic at the Danube River, but also highlight many open issues, challenges and needs.

DanubeSediment

Due to many sediment related impacts the sediment regime in the Danube River has changed.



DRBMP – Update 2021: Alteration of the sediment balance as a new sub-item under the existing Significant Water Management Issue “Hydromorphological alterations”

Sedimentation: 34 %

Vision

The ICPDR’s basin-wide vision is a **balanced sediment regime** and an **undisturbed sediment continuity.** […]

→ Reduction of suspended sediment input to Black Sea by about 60 %

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- The main objective is to **improve sediment quantity and quality management** in the Danube River Basin (DRB) to support the ecological conditions

- Specific Objectives:
  - Improved sediment monitoring, data management and evaluation methods in the Danube River Basin

  - Feasibility of practical solutions to address sediment alteration being co-created with stakeholders

  - Developed transboundary Integrated Sediment Management Plan (ISMP) for the Danube River Basin

- Project start: 01.01.2024
- Project end: 30.06.2026
- Project duration: 2,5 years
- 14 Project Partners
- 40 Associated Strategic Partners
- Total budget: 2,893,187.47 EUR
- Interreg Funds: 2,314,549.97 EUR

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A1.1 Improve joint Danube sediment monitoring

- New sediment data is collected (for period 2016-2023), from new sediment stations and from tributaries

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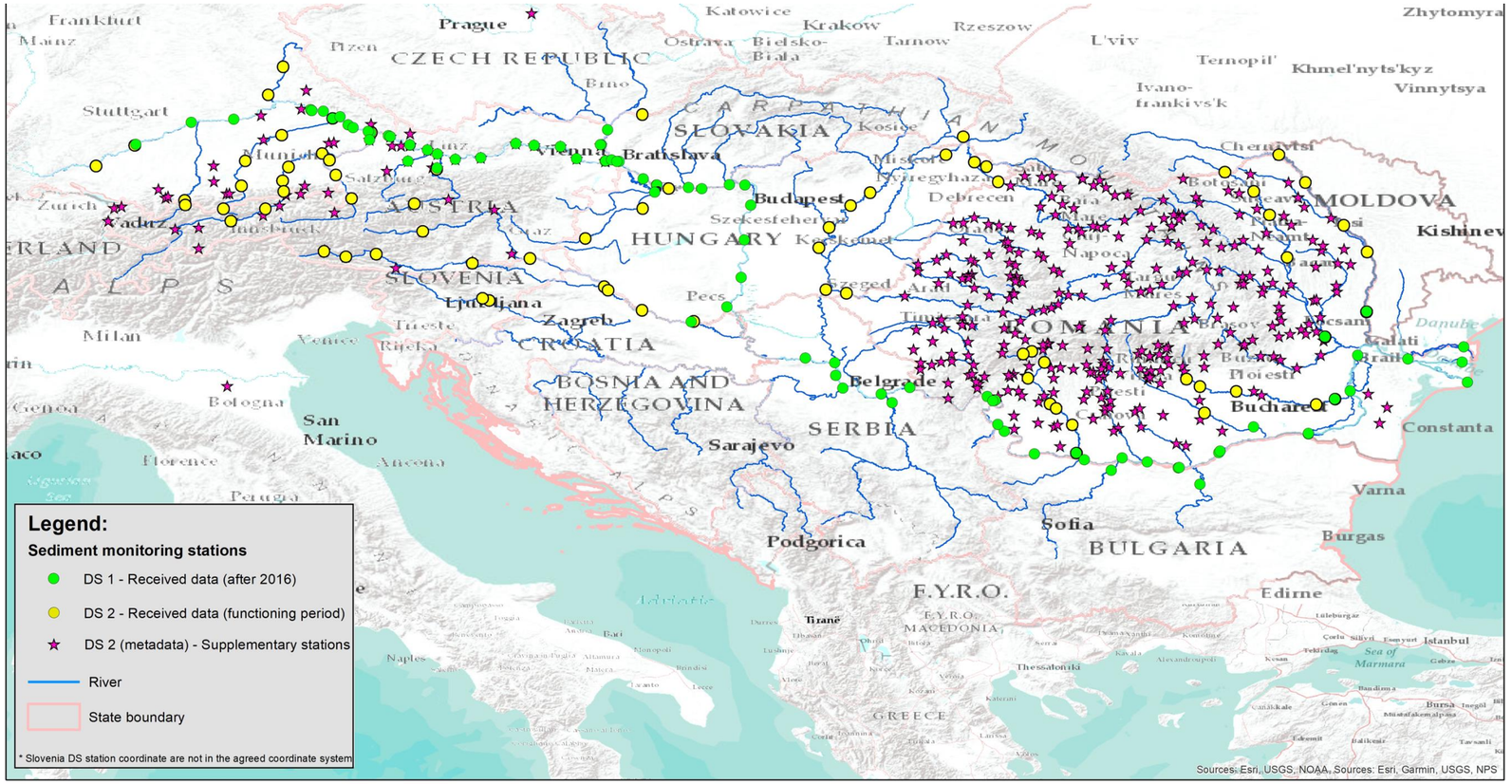
QUESTIONNAIRE 1 - SEDIMENT MONITORING ACTUAL STATUS

This questionnaire collects information about the actual status of sediment monitoring stations that provided data within former project DanubeSediment (DS1) and the measurements for suspended sediment and bedload carried out during period 2016-2023 at this stations. One questionnaire is to be completed for each monitoring station.



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A1.1 Improve joint Danube sediment monitoring

- New sediment data is collected (for period 2016-2023), from new sediment stations and from tributaries
- Sediment quality data, TNMN database
- 2 new sediment monitoring platforms (Danube+Dráva)

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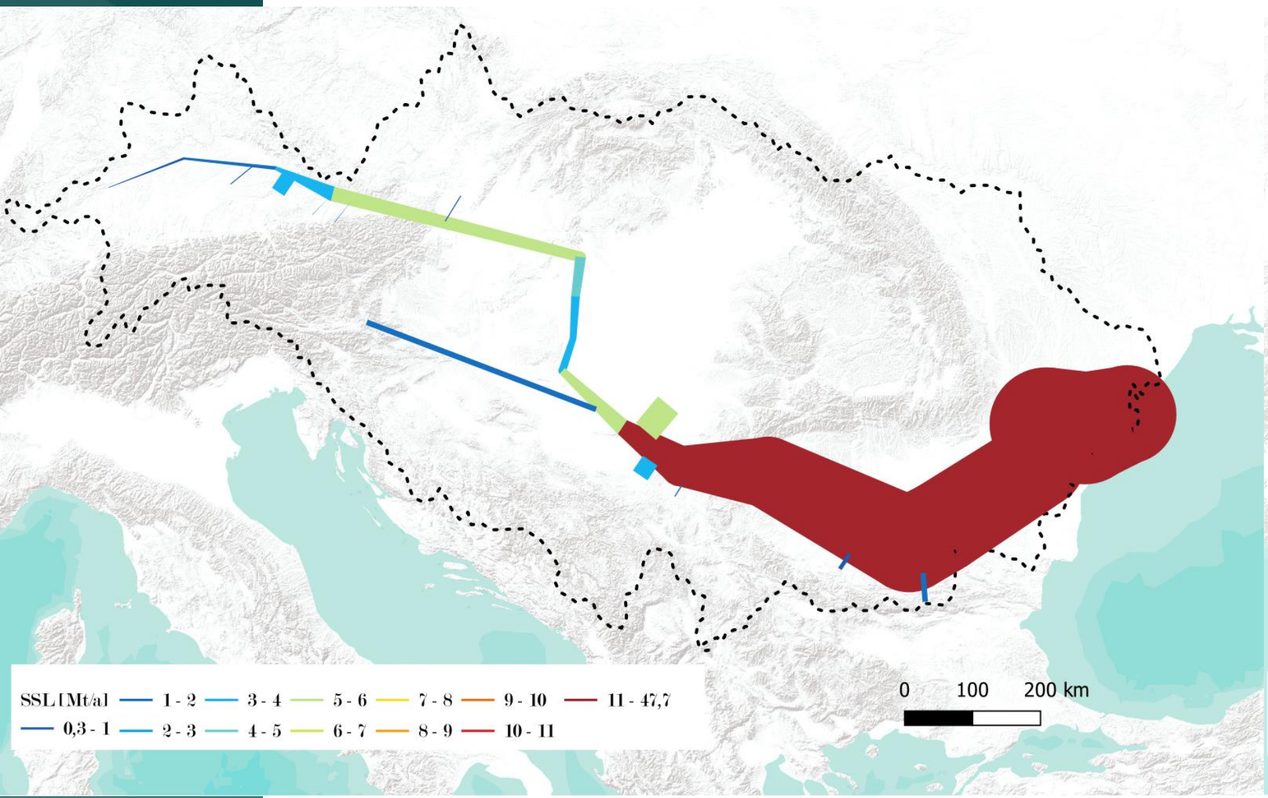
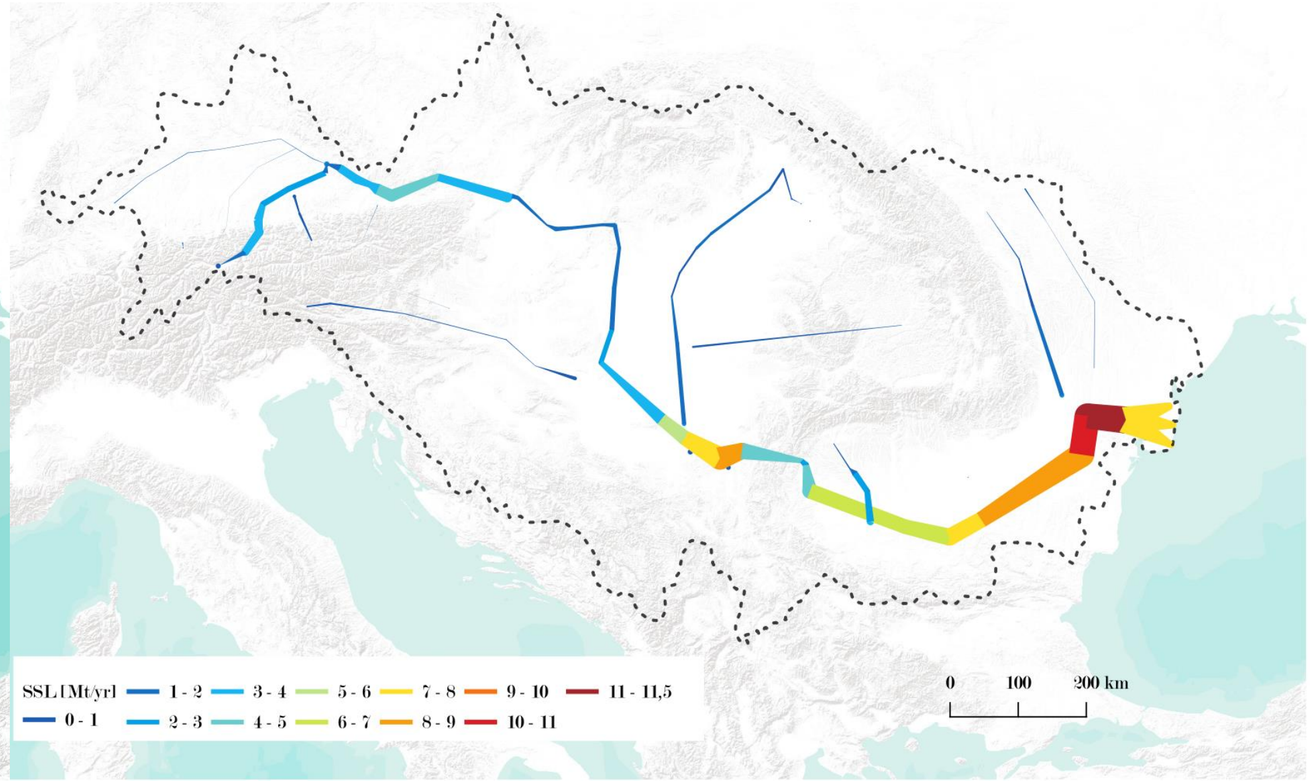
A1.2 Advance Danube sediment budget analysis

- Updated sediment balance for 2023

Before HPP



Current status



A1.3 Develop an improved HYMO assessment method

Catchment
Group
Water input
Sediment input

Reach	
Anthropogenic activities	*Group*
	River channelization
	River engineering measures
	Flow alteration
River responses	*Group*
	Sediment balance – river bed level
	Planform & floodplain
	Channel morphology
	Vegetation

Local Scale (<1km)
Group
Channel pattern
Flow alteration
Riverbed and substrate
Cross-section
Riverbank
Longitudinal continuity
Riparian Zone
Floodplain

- Hymo assessment method developed and summarized in Draft operational manual :
  - 40 assessment parameters
  - hierarchical approach with 3 scales
  - Applied in JDS5: catchment and reach scale covered by DS_Q2, local scale by national hymo experts (ICPDR)
- Two ways of assessment are possible:
  - Independent assessment of parameter groups
  - Process-hierarchical assessment

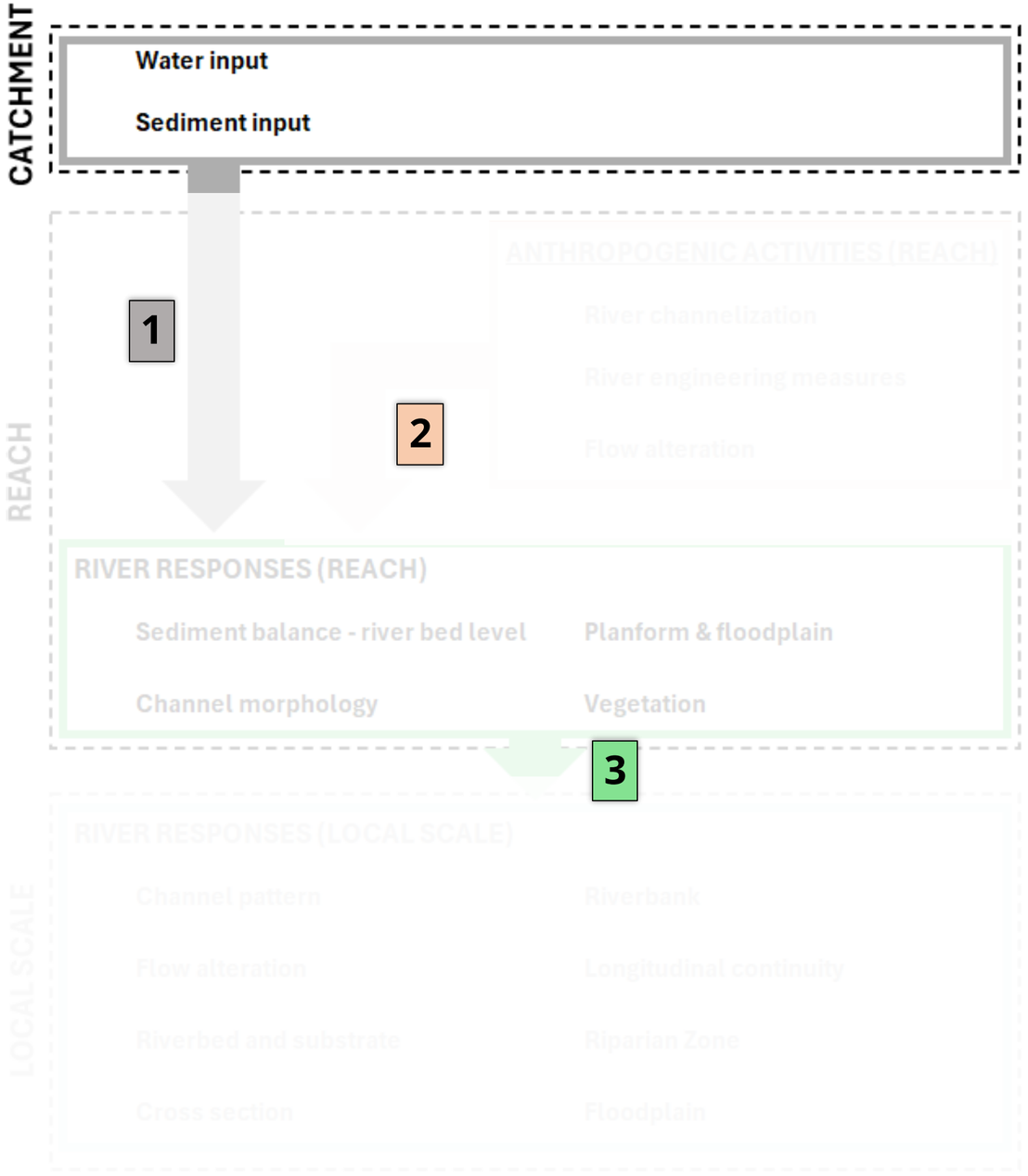
A1.3 Develop an improved HYMO assessment method

Assessment

→ *"Hierarchical group scoring"*

Calculation of hierarchical influence of parameter groups from:

1. Catchment on Reach
2. Reach on Reach
3. Reach on Local Scale



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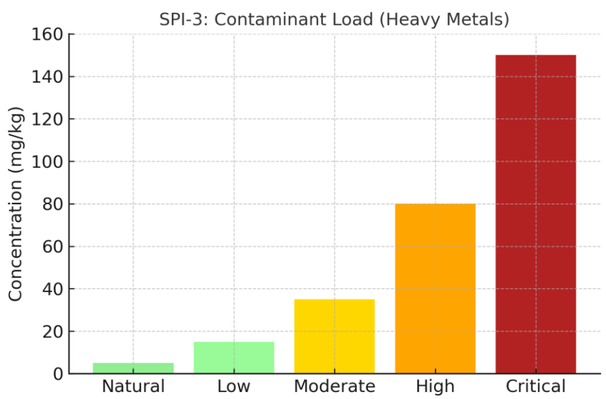
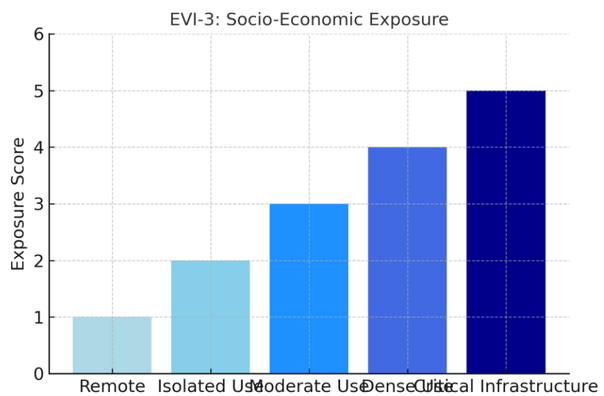
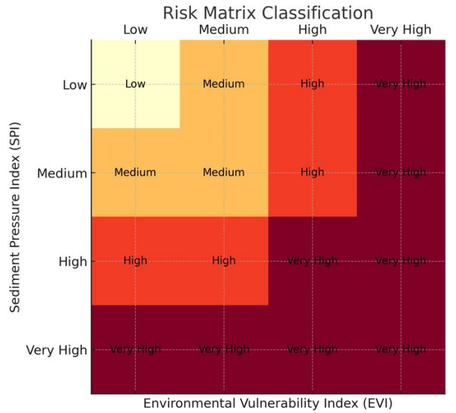
A1.4 Design and test a new risk analysis methodology

- Draft concept for the new Risk Assessment on Sediment Quantity and Quality:
  - Develop harmonized methodology for sediment risk.
  - Integrate ecological and socio-economic risks.
  - Support prioritization of ISMP measures.
  - Enable spatial risk classification across the basin.
  - Two axes: Sediment Pressure Index (SPI) & Environmental Vulnerability Index (EVI).
  - Matrix defines risk classes: Low, Medium, High, Very High.
  - Indicators normalized and aggregated, supports basin-wide comparability.







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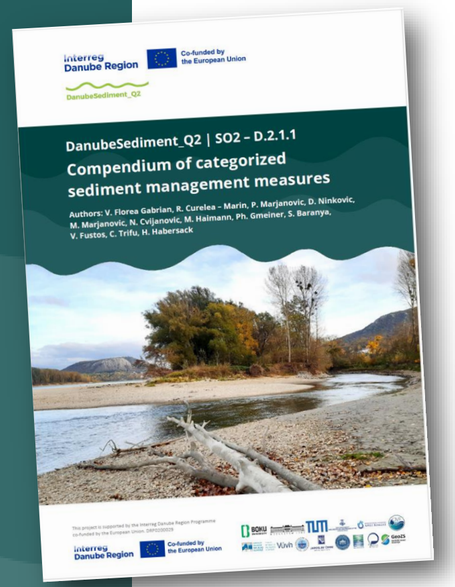
A2.1 Categorization of sediment management measures

- Compendium of categorized sediment management measures
  - Including 77 potential management measures, 51 for sediment quantity and 26 for sediment quality



In Situ TECHNOLOGIES	
Physical/Chemical in Character	M1. Capping
	M2. Containment Barriers
	M3. Solidification/Stabilization
	M4. Confined Disposal Facility
Biological in Character	M5. Monitored Natural Attenuation
***Ex Situ* TECHNOLOGIES**	
Biological in Character	M6. Bioslurry
	M7. Containment Land
	M8. Composting
Physical/Chemical in Character	M9. Chelation
	M10. Oxidation
	M11. Dechlorination
	M12. Solidification/Stabilization
	M13. Basic Extractive Sludge
	M14. Solvent Extraction
	M15. Carver-Greenfield Process
	M16. Sediment Washing
	M17. Containment Barriers
Thermal in Character	M18. Incineration
	M19. Pyrolysis
	M20. High-Pressure Oxidation
	M21. Vitrification
	M22. X*TRAX System
	M23. Desorption and Vaporization Extraction
	M24. High-Temperature Thermal System
	M25.Low-Temperature Thermal System
	M26. Low-Temperature Thermal Aeration
	M27. Anaerobic Thermal Processor

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A2.2 Assignment of potential measures to case study sites

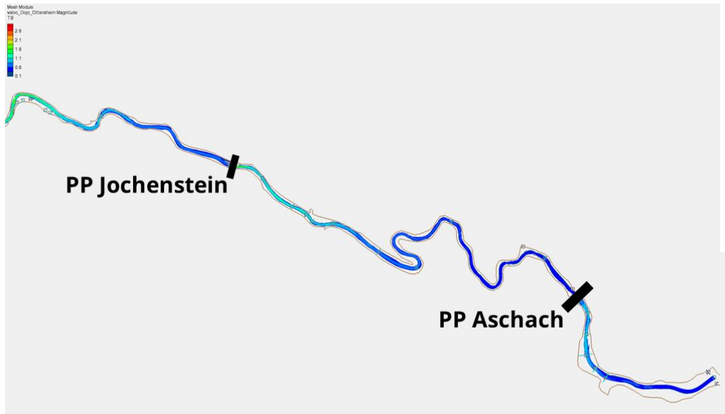
- Multi-Criteria-Assessment-Tool developed
  - for the selection of possible measures

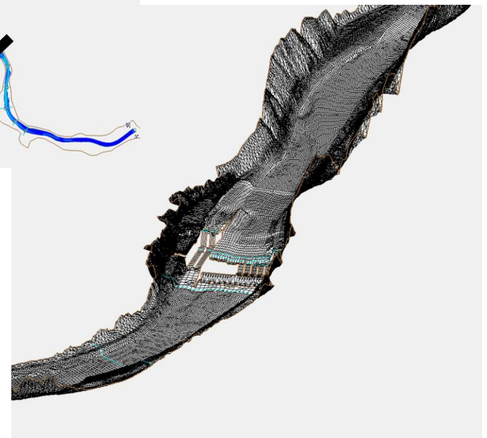
	Environmental 30%	Social 15%	Technical 15%	Economic 15%	Regulatory Compliance 25%
Very simple	0,3	0,15	0,15	0,15	0,25
Simple	0,24	0,12	0,12	0,12	0,2
Medium	0,18	0,09	0,09	0,09	0,15
Complicated	0,12	0,06	0,06	0,06	0,1
Very complicated	0,06	0,03	0,03	0,03	0,05

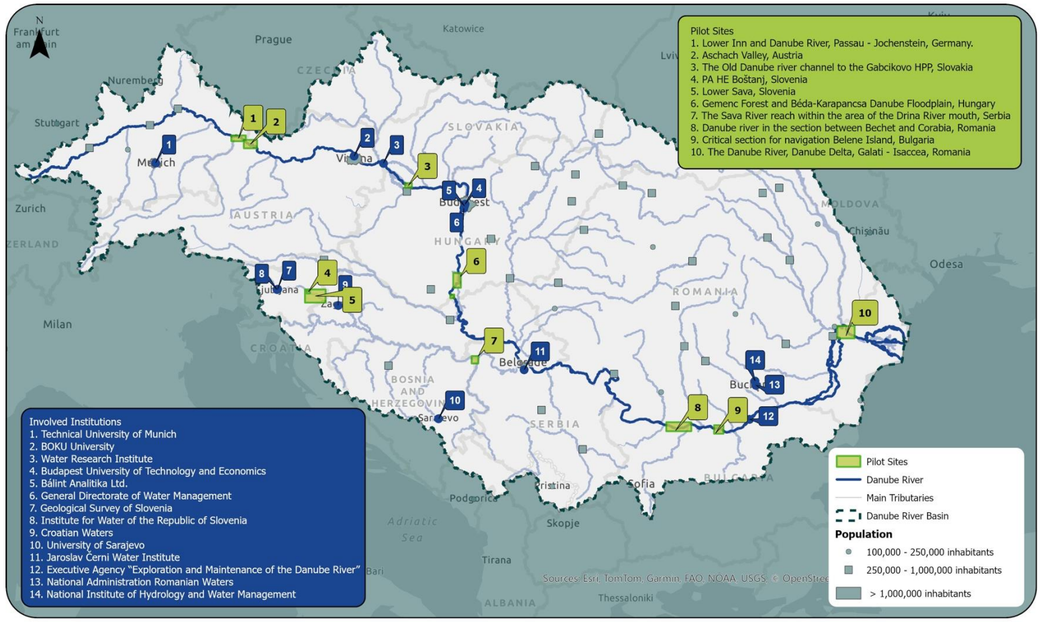
Weight	Objective	Sub-Objective	Optional Sub-Objectives
30%	**Environmental**	• Environmental permit (EIA Report)	Improvement / preservation of: ↗ sediment regime ↗ hydromorphology ↗ ecological functionality
15%	**Social**	• Public Health and Safety • Aesthetic impact • Cultural and Historical significance	↗ Social acceptability
15%	**Technical**	• Suitability of proposed measure for site • Engineering analysis • Adaptability • Durability	↗ Ability to solve the sediment problem ↗ Sustainability of the measure ↗ Minimize maintenance frequency
15%	**Economic**	• Cost-Benefit Analysis • Funding availability • Economic impact on the community	↗ Interference with other economic uses
25%	**Regulatory Compliance**	• Changes to legislation or both legislative and regulatory adjustments	

A2.3 Simulation of sediment management at case study sites

- 10 case study sites selected:
  - at the Danube, Inn and Sava
  - in free-flowing and impounded sections
- Numerical sediment transport models applied







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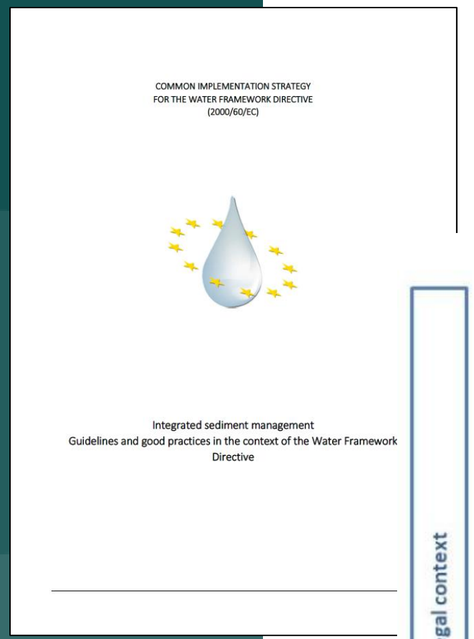
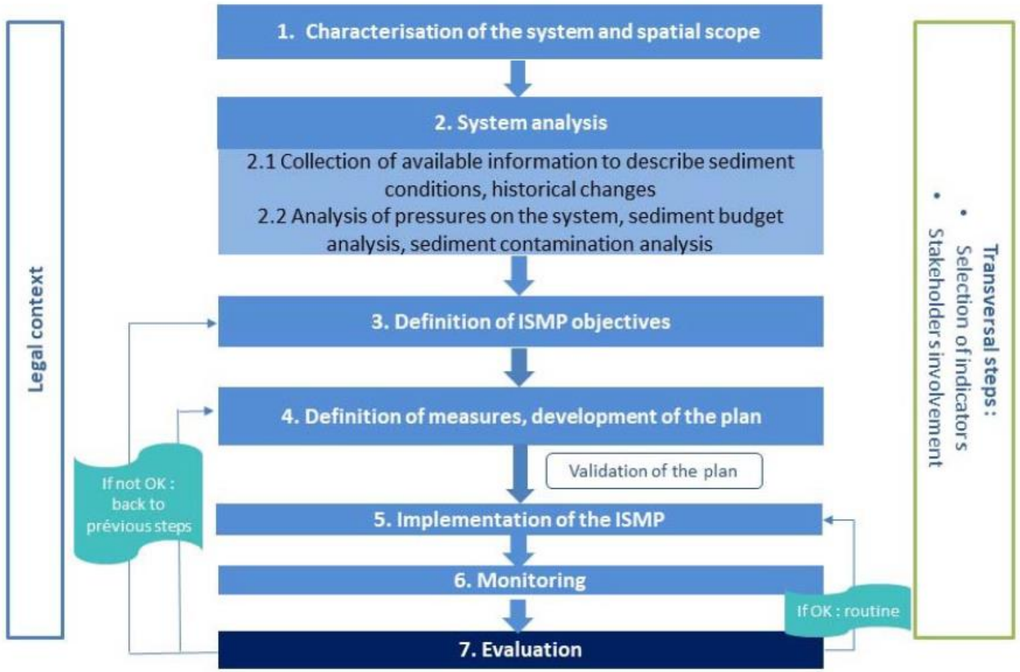
A2.4 Formulation of a DRB Sediment Improvement Strategy

- DRB Sediment Improvement Strategy
  - will contain joint upscaling steps and procedures.
  - will consider the results gained in frame of the case study areas, their upscaling possibilities, but also other suitable measures assessed.
  - Involvement of relevant stakeholder will form the basis for the strategy,
  - ensuring the practicability and acceptance of the agreed measures.

Developed transboundary Integrated Sediment Management Plan (ISMP) for the Danube River Basin





Recommendations for addressing sediment in the context of the WFD:

"Considering their natural dynamics and interactions with many uses in a river basin, sediments need to be addressed at the appropriate scale and in an integrated way. To achieve this, ***it is recommended to apply the concept of "integrated sediment management planning"****, which is defined in the context of this document as an approach that recognises the system (source to sea) scale at which sediment-related processes operate, and aligns these, in a consistent way with the objectives of environmental policies as well as those stemming from socio-economic activities (e.g., navigation, flood risk mitigation, hydropower production, irrigation). […]"*

https://environment.ec.europa.eu/system/files/2022-09/CISdocumentsedimentfinalTO_BE_PUBLISHED_1430554724.pdf

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3.1 Characterisation of the system and spatial scope

- For the Characterisation of the system and spatial scope data from different sources were investigated (DanubeGIS and HydroSHEDS).
- Analyses were conducted to determine the sediment management units, considering both sediment quantity and quality.

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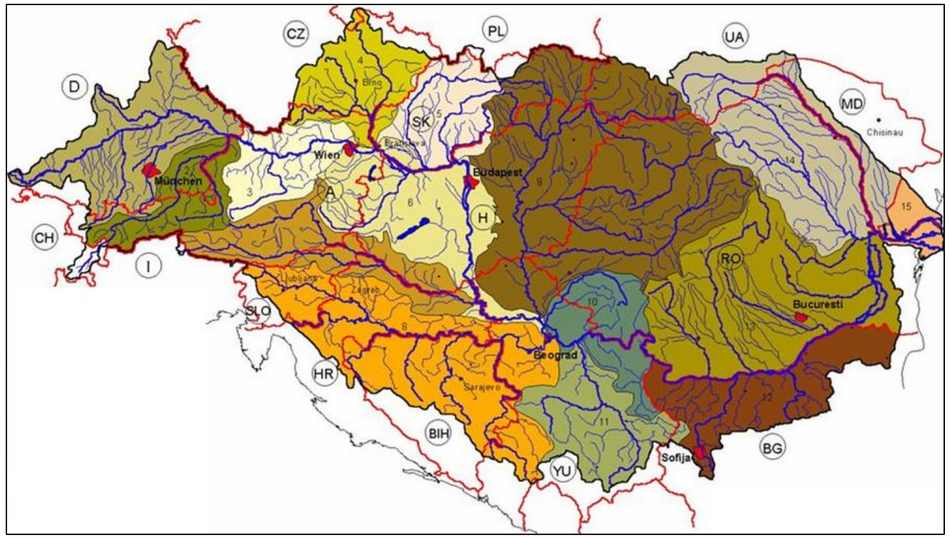
3.2 System analysis

- Evaluation of characteristics of sub-basins, incorporating both sediment quantity and quality.
- Analyzing key pressures, impacts, and the effectiveness of past and ongoing sediment management measures.
  - conducting deficit/surplus analyses at defined spatial scales
  - assessing impoundments for quality issues and discontinuities,
  - categorizing river reaches based on key pressures and impacts.
- Tributaries analysed so far: Isar, Inn, Traun, Enns, Morava, Rába, Drava, Sava, Tisza.
- Sub-basins to be processed soon: Great Morava, Jiu, Olt, Iskar, Yantra, Arges, Siret, Prut



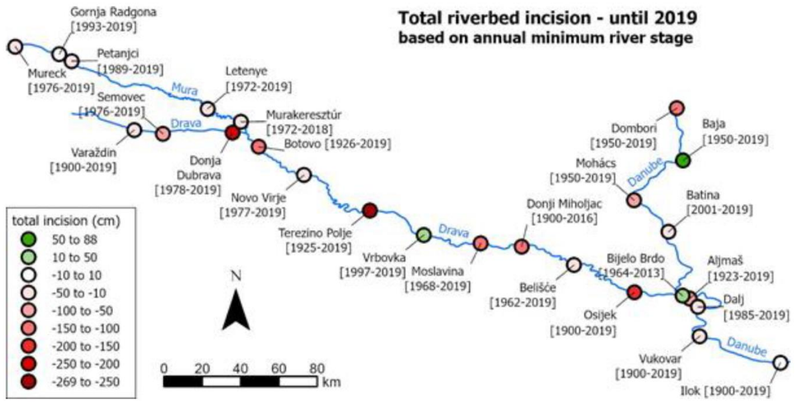


Figure: Bed incision at gauging stations (lifelineMDD)

3.3 Definition of ISMP objectives

- Focus on defining objectives for Integrated Sediment Management Plan. Objectives:
  - establish coordinated monitoring and analysis system for sediment, improving data exchange between countries, and developing measures to address sediment management, hydromorphology, and sediment pollution.
  - Enhance cooperation between sectors and countries, mitigating flood and drought risks, and building institutional capacity for integrated sediment management.
  - Education and capacity-building to ensure the continuous improvement of ISMP.

1. **Definition of specific quality and quantity objectives** of sediment, combine objectives..., for the pilot zones (according to 2.1, 2.2, 2.3), based on the analysis of the situation (Activity 3.1 and 3.2) (e.g. reduction of sediment pollution with heavy metals, and sediment quantity - eg erosion prevention).

2. Development **of indicators to measure the success of the achieved objectives**.

3. **Development and implementation of strategies for managing risks associated** with failure to achieve goals.

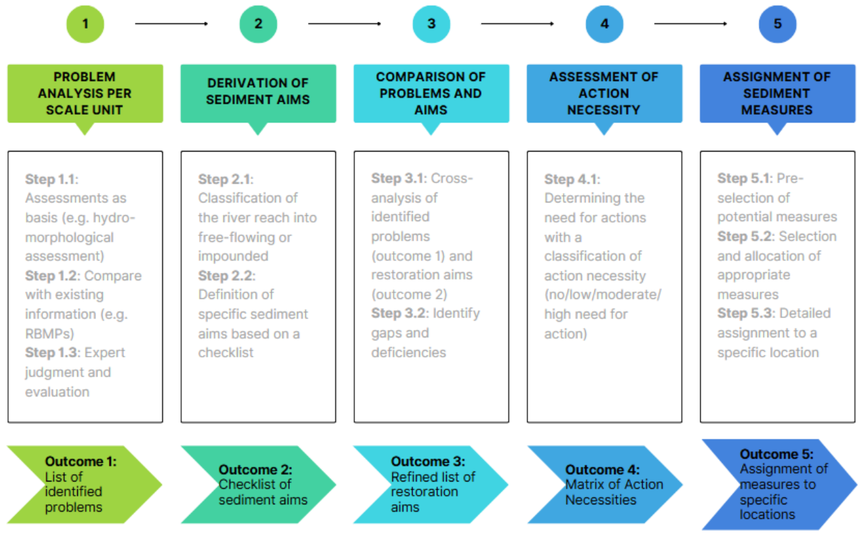
4. **Connecting sediment management with the local community's needs and economic activities**.

5. Promotion of **cross-border cooperation in sediment management**. Work on common goals among the countries of the Danube river basin.

Figure: First draft of objectives

3.4 Definition of measures, development of the plan

- Development started with in-depth study of existing sediment management plans from other river basins, including the Elbe, Rhine, Sava, and Mississippi
    - highlighted the lack of an integrated sediment management plan for the Danube River Basin
- Planned as a participatory process, involving the ICPDR, stakeholders, and local experts.
- Next steps:
    - ISMP structure, including chapters and an implementation method, under preparation.
    - Procedure for upscaling measures currently under preparatior and to be discussed with the partners



3.5 Implementation of the ISMP

- Stakeholder Engagement as key focus in this activity so far:
  - A functional network of stakeholders and decision-makers was established to support ISMP development and implementation.
  - Regular updates were provided through a newsletter and social media posts.
  - Personal discussions at national pilot site stakeholder workshops, at the partner meetings and at international stakeholder events.
  - Providing information for and participating in ICPDR TG and EG meeting to inform about the project and the development of the plan

→Get involved: https://interreg-danube.eu/projects/danubesediment-q2

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Thank you for attending!

BOKU
Institute of Hydraulic Engineering and River Research

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