Sediment Monitoring Workshop
DanubeSediment project

Suggestion for an improved sediment monitoring network

Budapest, 18.04.2018.

Do we need to improve the sediment monitoring network?

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- Different monitoring methods along the Danube
- Discrepancies in sediment data
- Poor sediment data quality at existing monitoring stations
- Data gaps at relevant locations

Do we need to improve the sediment monitoring network?

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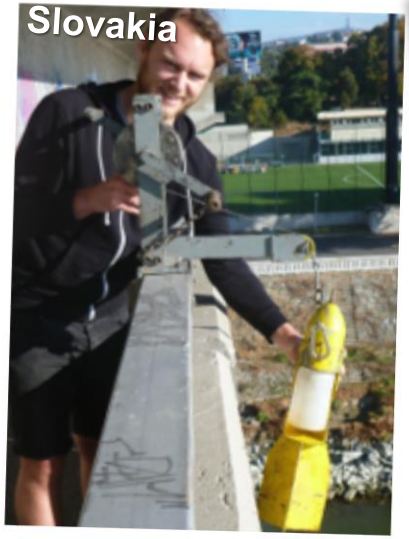
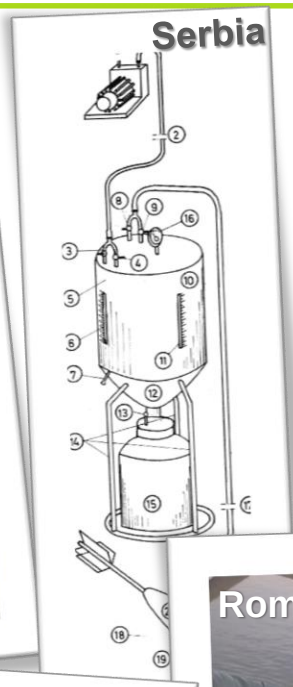
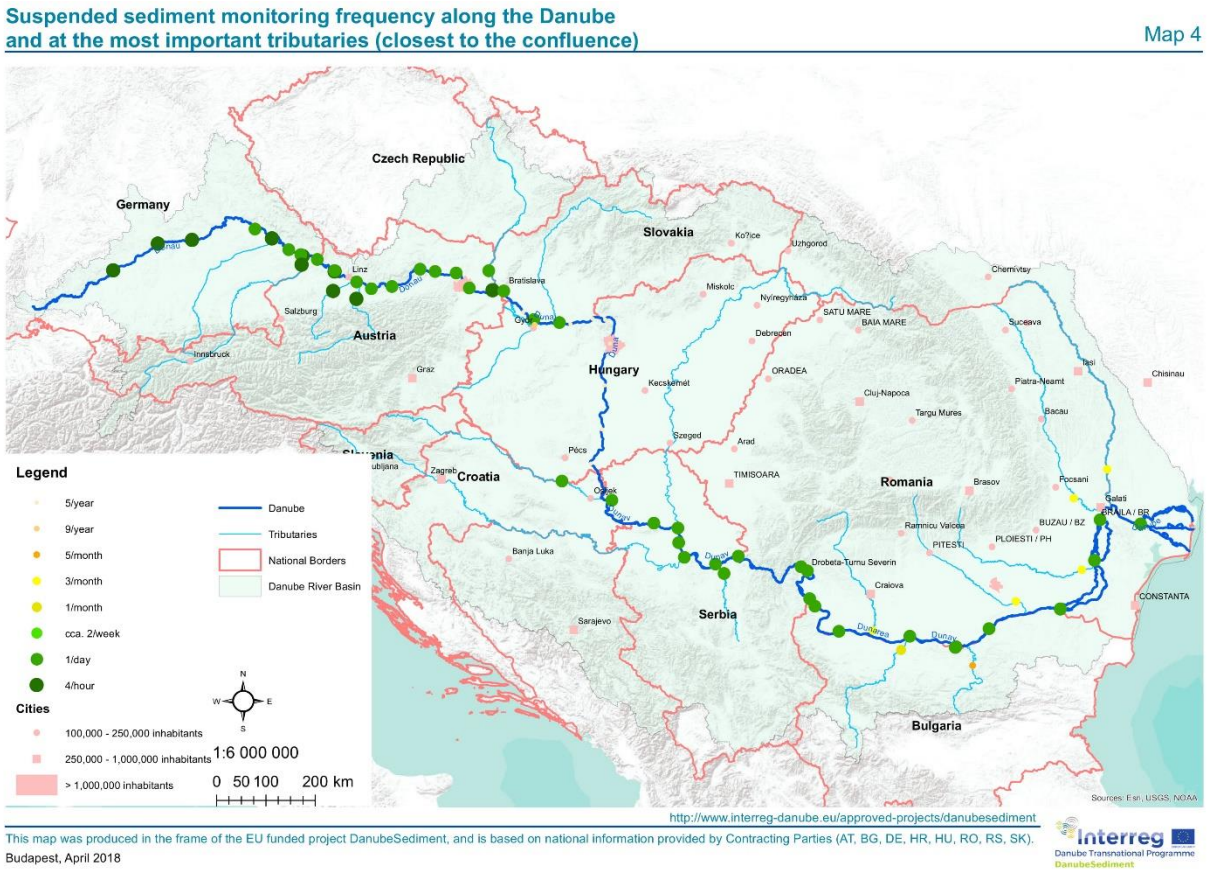
- Different monitoring methods along the Danube
  - **Different instruments, with different uncertainties**





Do we need to improve the sediment monitoring network?

- Different monitoring methods along the Danube
  - Different instruments, with different uncertainties
  - **Different sampling frequencies (from 4/hour to 5/year)**



Do we need to improve the sediment monitoring network?

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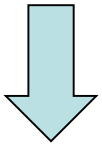
- Different monitoring methods along the Danube
  - Different instruments, with different uncertainties
  - Different sampling frequencies (from 4/hour to 5/year)
  - Different sampling methods (nr. of verticals, nr. of points)
  - Different laboratory analysis method:
    - Filtering of different filter sizes
    - No filtering (e.g. HU, RS)
    - Turbidity (RO)



Harmonization is needed to provide comparable data!

Do we need to improve the sediment monitoring network?

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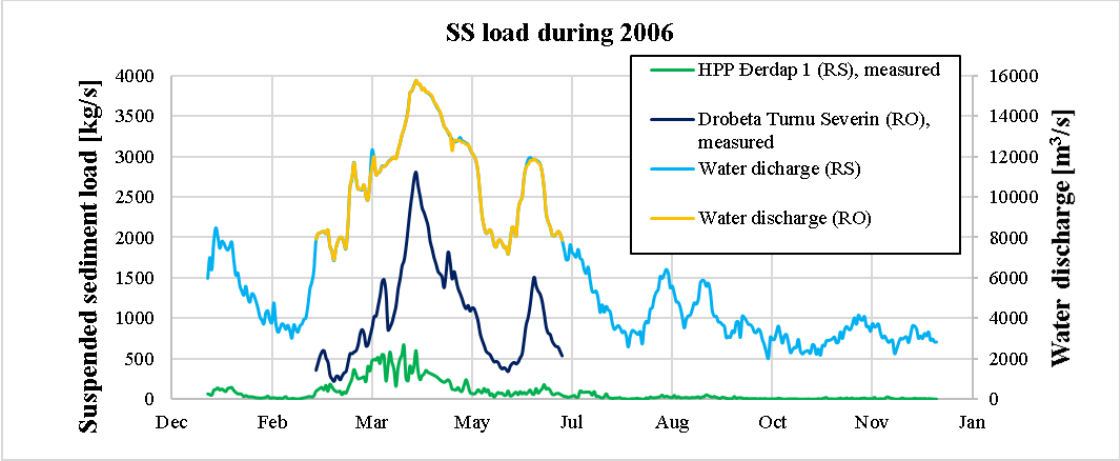
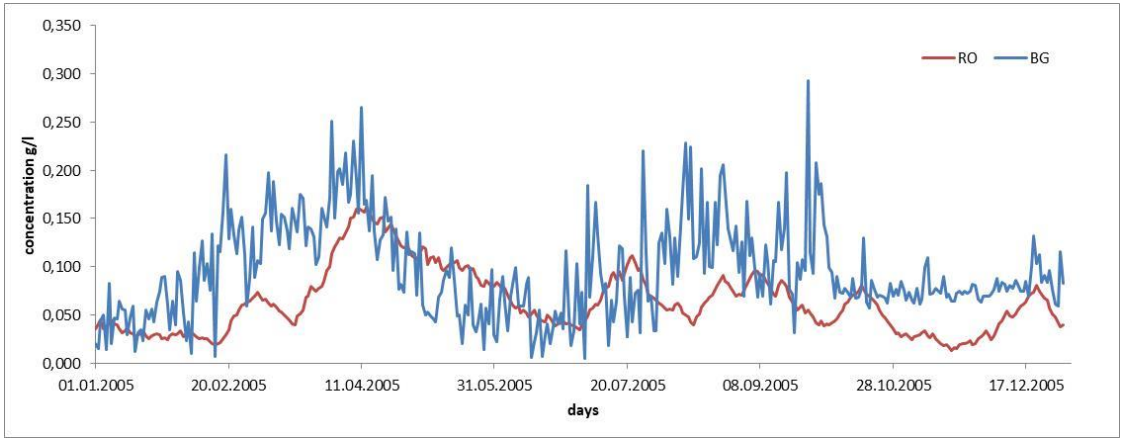
- Discrepancies in sediment data
  - e.g. Serbian and Romanian datasets at Iron Gate:



  - e.g. Romanian-Bulgarian datasets:



Do we need to improve the sediment monitoring network?

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- Poor sediment data quality at existing monitoring stations, e.g.:
  - High water sediment data at some Austrian hydropower plants
  - Data from Slovak Hydrometeorological Institute
  - High water sediment data at Hungarian stations

Do we need to improve the sediment monitoring network?

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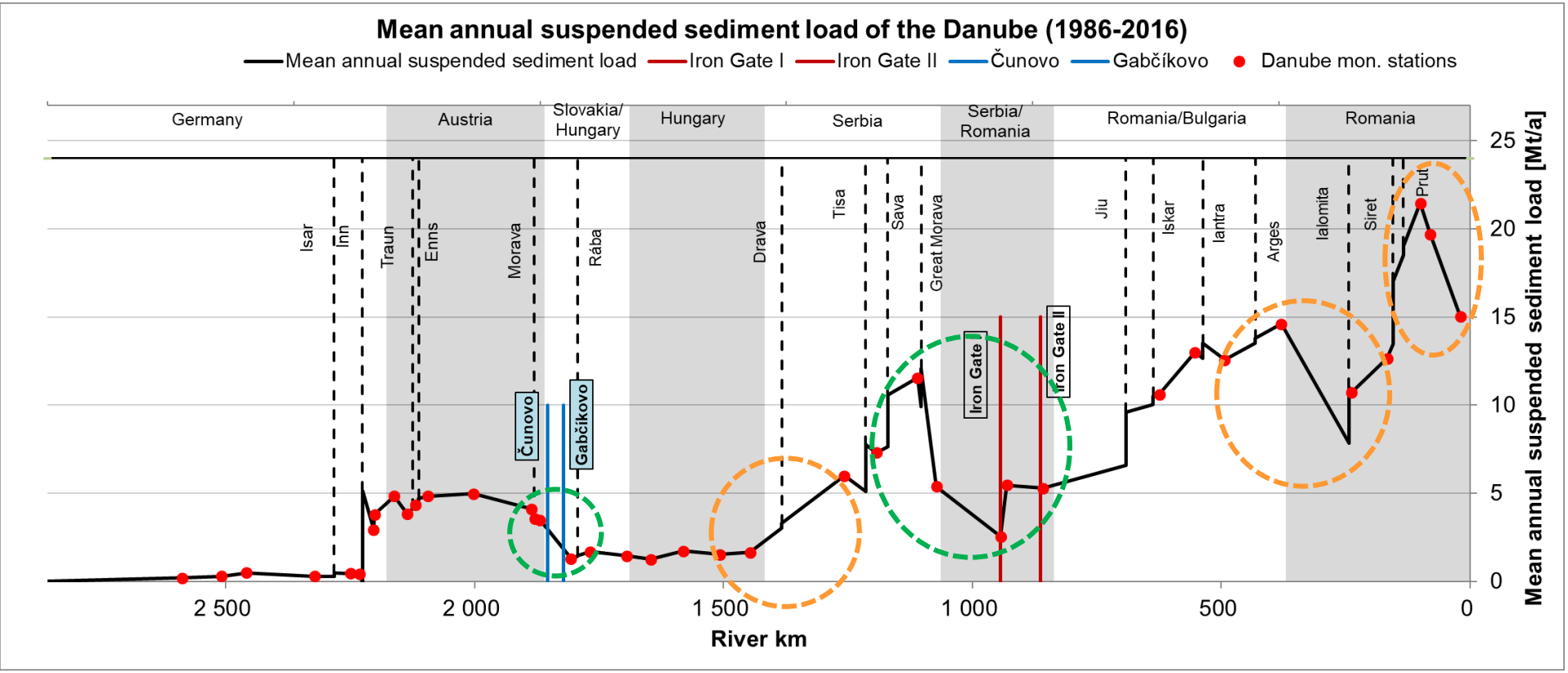
- Data gaps at relevant locations:
  - In Szigetköz area in Hungary
  - Monitoring stations at important tributaries are sometimes located too far from confluence, e.g.:
    - Drava at Donji Miholjac (rkm 80.5)
  - Where sediment balance shows continuity problems
    - Sediment surplus
    - Sediment deficit

Sediment continuity problems
Suspended sediment

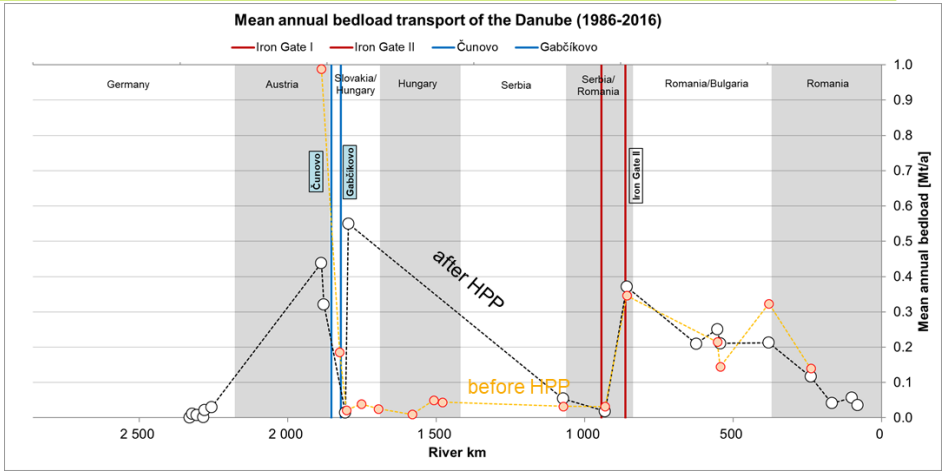


~5 Mt/a surplus or deficit along 100-150 km long reaches

Sediment trapping of reservoirs

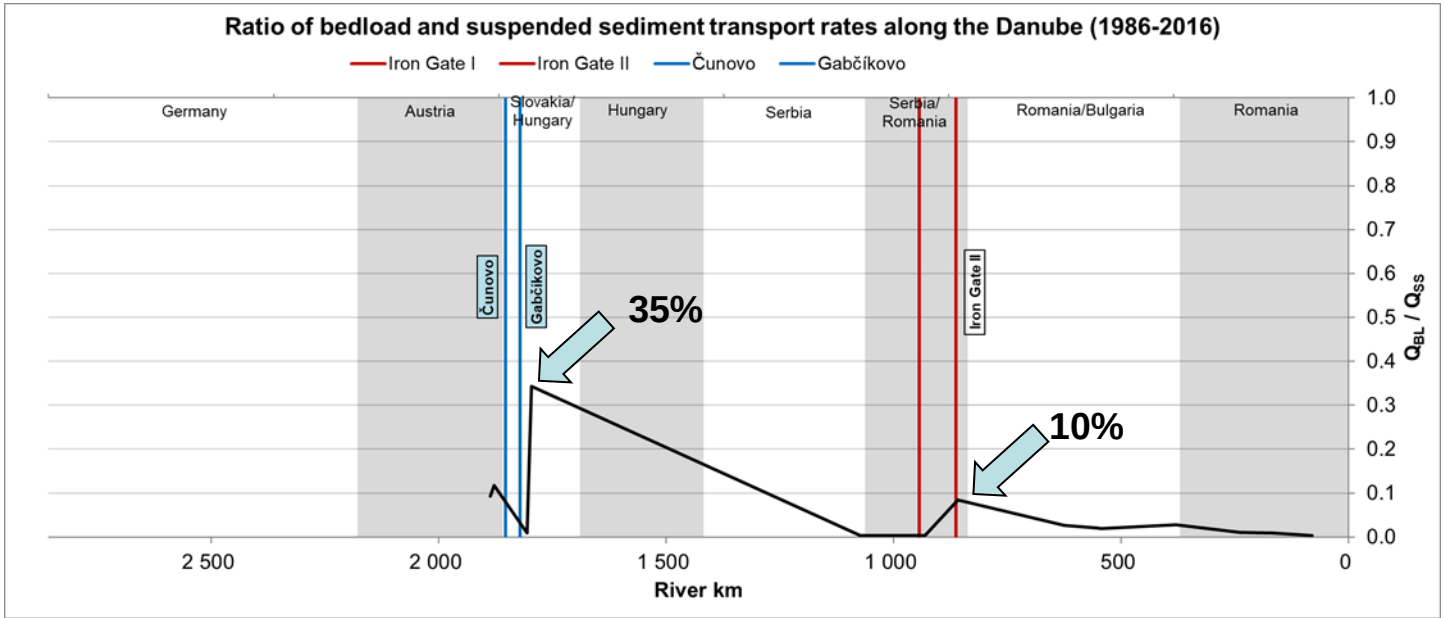
Sediment continuity problems
Bedload transport

- Is bedload transport significant?



Ratio of bedload and suspended sediment transport:

Bedload transport increases again downstream of HPPs leading to bed incision



Recommendation for improvements (SS)

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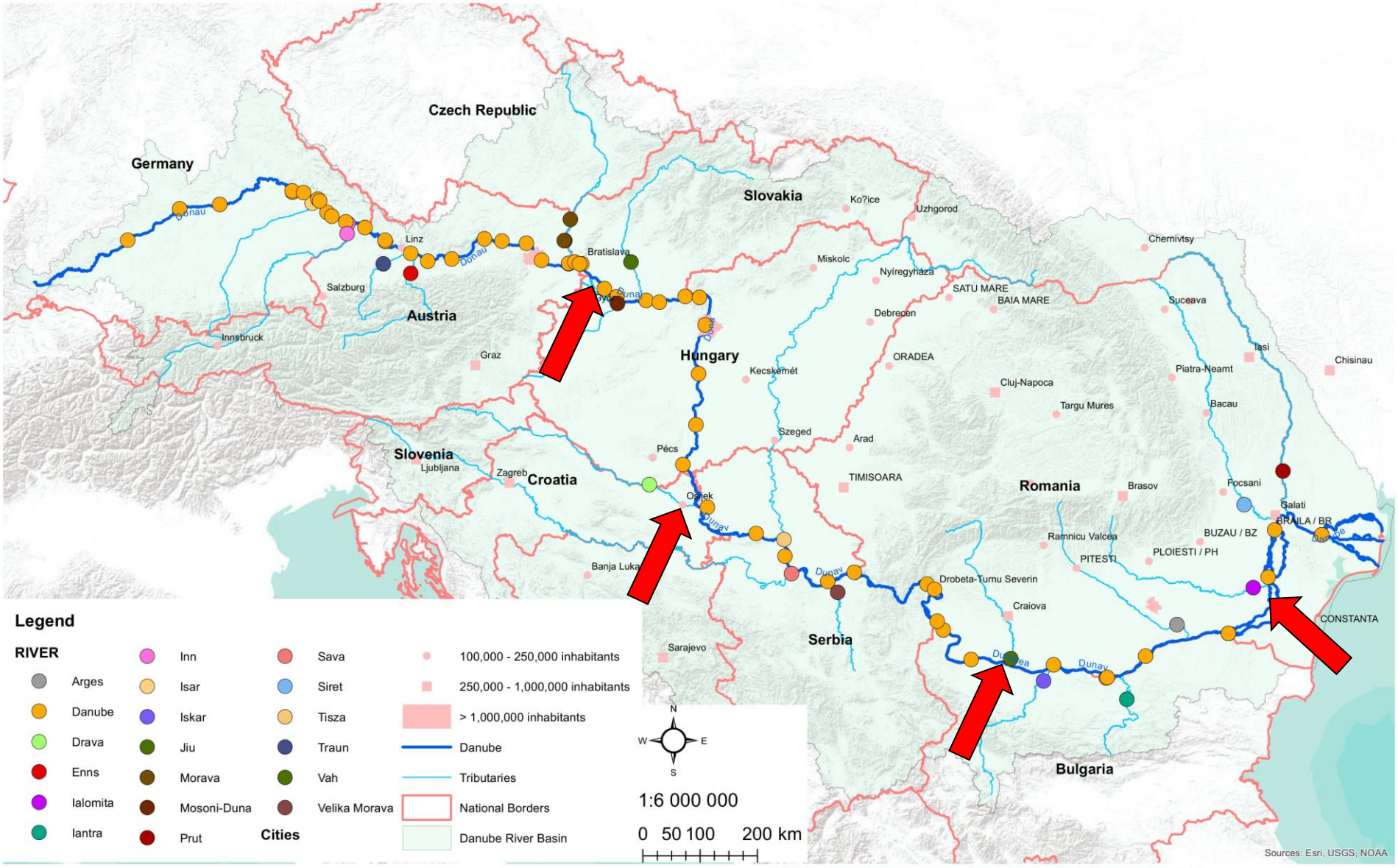
- Improvement of existing monitoring stations:
  - Continuous turbidity monitoring with OBS (or ABS) sensors mounted on the river bank
  - If possible, automatized and connected to online monitoring system
  - Calibration of sensors with samples taken at the sensor
  - Cross-sectional calibration is crucial at different water regimes, with a special attention to floods (more frequent expeditionary measurements) as the contribution to yearly sediment load can be significant (e.g. ~40% of yearly load passed during the 2013 flood in HU)
  - Cross-sectional calibration 4-6 times a year, which corresponds well with conventional sampling frequencies in the Danubian countries
  - Laboratory analysis using filtering method and/or laser diffraction method
  - ADCP survey together with multipoint sampling can contribute to a more detailed analysis of cross-sectional distribution of SSC (even in a subsequent stage of data analysis)

Recommendation for improvements (SS)

- Setup of new monitoring stations
  - Recommended locations based on revealed sediment continuity problems:
    - Hungary: at the inlet and outlet sections of Szigetköz area (Rajka, Szap)
    - Croatia: In River Dráva (CR), much closer to the confluence zone, e.g. Osijek
    - Romania: In Danube, upstream of the confluence of River Jiu, outside the potential influence of the tributary
    - Romania: In Danube, upstream of the confluence of River Ialomita, outside the potential influence of the tributary
  - General recommendations for site selection:
    - Sections, free of obstructions and recent measures
    - Relatively even velocity distribution
    - Outside the influence of local sediment sources
  - Recommended method: same as before

Suspended sediment monitoring stations along the Danube and at the most important tributaries (closest to the confluence)

Map 1



http://www.interreg-danube.eu/approved-projects/danubesediment

This map was produced in the frame of the EU funded project DanubeSediment, and is based on national information provided by Contracting Parties (AT, BG, DE, HR, HU, RO, RS, SK).

Budapest, April 2018

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Recommendation for improvements (BL)

- Expeditionary surveys using direct samplings techniques would be important at dynamic reaches
- A realistic goal can be the establishment of rating curves, i.e. Q-Q_{BL}, τ-Q_{BL} relationships
- Suitability of bedload sampler instruments has to be checked and improved if needed
- Surrogate techniques (e.g. acoustic based) can contribute to the better understanding of bedload transport processes, and can be used in a complementary manner

Recommendation for POLICY MAKERS

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- There are still several sediment data related issues to be addressed, which calls for a harmonized sediment monitoring system on a transboundary level
- This intention should be coordinated on high level (e.g. ICPDR)
- Most of the herein recommended infrastructure are already available at the relevant institutions, slight improvements are needed
- Mainly the improvement of already existing monitoring stations is needed
- Long-term, historical sediment data should be stored in a central database at e.g. ICPDR and should be made available for stakeholders (practitioners, administration, water managers, researchers, …)

Recommendation for POLICY MAKERS cont.

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- Recommendation on good practices in sediment monitoring should be included in a future Sediment Management Plan of the Danube
- Theoretical and practical training of sediment monitoring should be ensured
- Sediment monitoring activities during flood situations have to be implemented in water management tasks and priority should be given

Recommendation for PRACTITIONERS

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- Harmonized protocols along the Danube countries are expected to be implemented in sediment monitoring
- Understanding the relevance of sediment monitoring is of primary importance and can improve the quality of the measurements
- Continuous, automatized sediment monitoring greatly improves the understanding of sediment transport processes in a cost-efficient manner
- Adequate calibration of monitoring stations is of great importance, with a special attention of high water regime and floods (planning of measurement campaigns have to be somewhat flexible)
- Calibration, continuous validation of the monitoring stations are necessary and re-calibration might also be needed

Recommendation for PRACTITIONERS cont.

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- Accredited laboratories have to be involved in sediment analysis
- Surrogate techniques both in suspended sediment and bedload transport monitoring are increasingly developed, tested and applied in research and could be taken over (ADCP backscatter based SSC estimation, ADCP based BL estimation, dune tracking, …)
- Well-trained personnel is crucial for performing adequate sediment monitoring → theoretical, practical training
- Automatized sediment monitoring stations, such as other hydrographic stations, need maintenance
- The establishment of sediment balance on local and regional scale should be implemented by water management institutions and relevant stakeholders (e.g. HPPs)

Recommendation for PRACTITIONERS cont. 2

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- River restoration measures have to be planned with the consideration of sediment transport processes on local and regional scale
- Numerical flow and sediment transport models have to be thoroughly parameterized, calibrated and validated against field data
- Involvement of researchers in the development of monitoring strategies, monitoring stations, planning and implementation of restoration measures is recommended

Recommendation for RESEARCHERS

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- Continuous collaboration with relevant practitioners and joint improvement of monitoring protocols have to be performed
- Development of numerical models with improved sediment transport modelling requires good quality field data
- Thorough laboratory and field testing of new sediment measurement methods are necessary
- Researchers are expected to ensure the theoretical and practical background of new monitoring methods via university curricula, workshops, field courses

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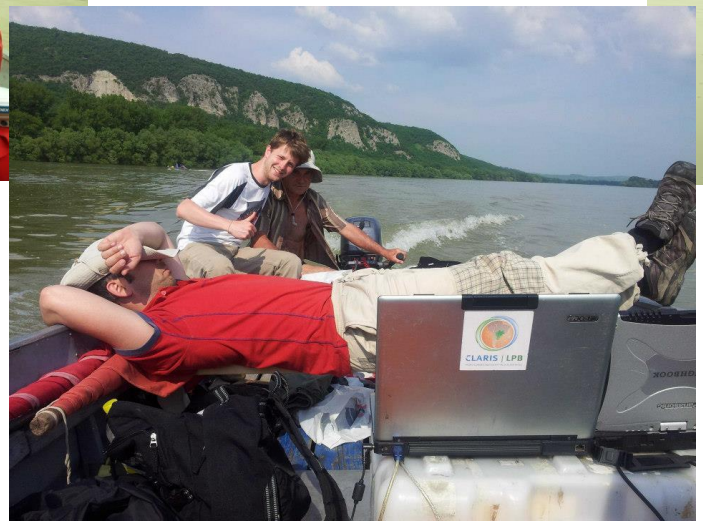
Thank you for your attention!



→ Discussion