Sediment Monitoring Workshop DanubeSediment project

Main results of the sediment data collection and analysis

Budapest, 18.04.2018.

Activity 3.1 – Metadata and sediment data collection

Interreg
Danube Transnational Programme
DanubeSediment

- Suspended sediment:
  - GE: 9 (2 trib.)
  - AT: 11 (4 trib.)
  - SK: 5 (1 trib.)
  - HU: 7 (1 trib.)
  - SB: 7 (3 trib.)
  - CR: 1 trib.
  - BG: 6 (2 trib.)
  - RO: 19 (5 trib.) – 3 from Delta region

  - Total: 47 stations on Danube + 18 on tributaries

Activity 3.1 – Metadata and sediment data collection

Interreg
Danube Transnational Programme
DanubeSediment

- Bedload:
  - GE: 9 – campaigns, no monitoring
  - AT: 1
  - SK: 3 (1 trib.) – campaigns, no monitoring
  - HU: 1
  - SB: no monitoring
  - CR: no monitoring
  - BG: no monitoring
  - RO: 11

  - Total: 24 stations on Danube + 1 on tributaries

Activity 3.2 – Comparative Analysis

Interreg
Danube Transnational Programme
DanubeSediment

- Historical data (1986-2016)
  - For stations where the river is shared by two countries or at boundary sections:
    - GE-AT
    - AT-SK
    - HU-SK
    - RS-RO
    - RO-BG

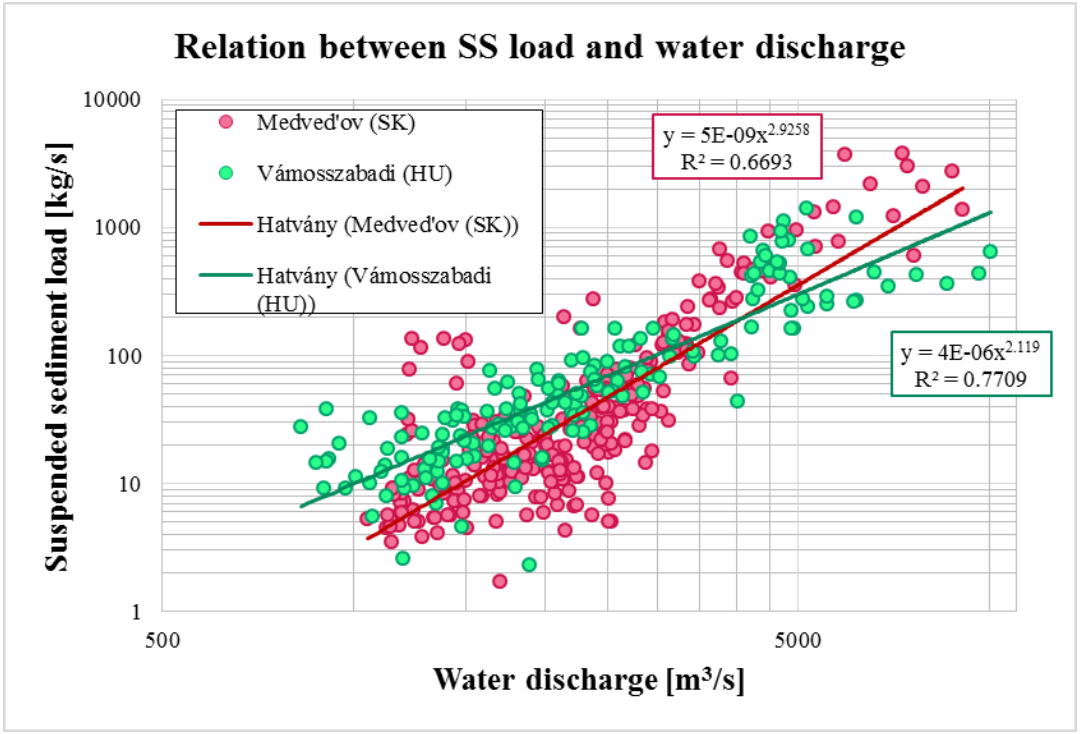
- On-site comparison within joint measurement campaigns
  - Romania-Bulgaria (Giurgiu)
  - Serbia-Romania (Kladovo)
  - Austria (Bad-Deutsch Altenburg)

Activity 3.2 – Comparative Analysis

Interreg
Danube Transnational Programme
DanubeSediment

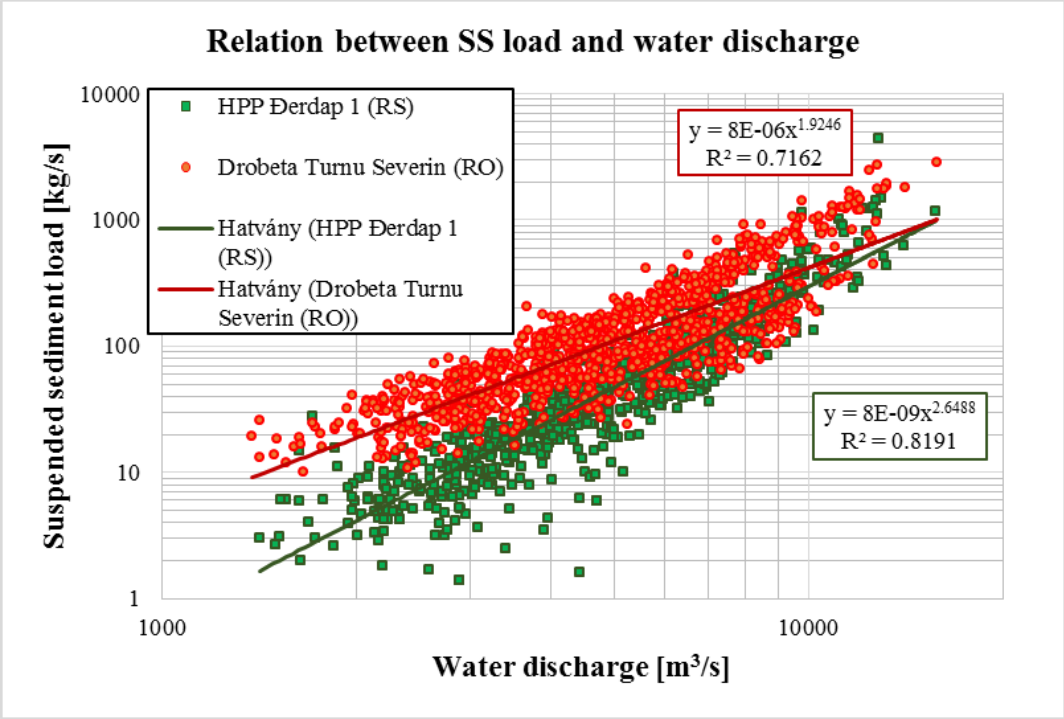
Slovakia-Hungary at Medvedov (rkm 1806)

Name of the monitoring site	Location of the monitoring site	SS measurement method	Frequency	SSC analysis method
Medved'ov (Slovakia)	1806.30 rkm	Physical sampling, isokinetic sampling (depth-integrating)	Flow-dependent, from 1/d to 1+/d	Filtration
Vámosszabadi (Hungary)	1805.60 rkm	Physical sampling, pump sampling	5 times per year	Evaporation

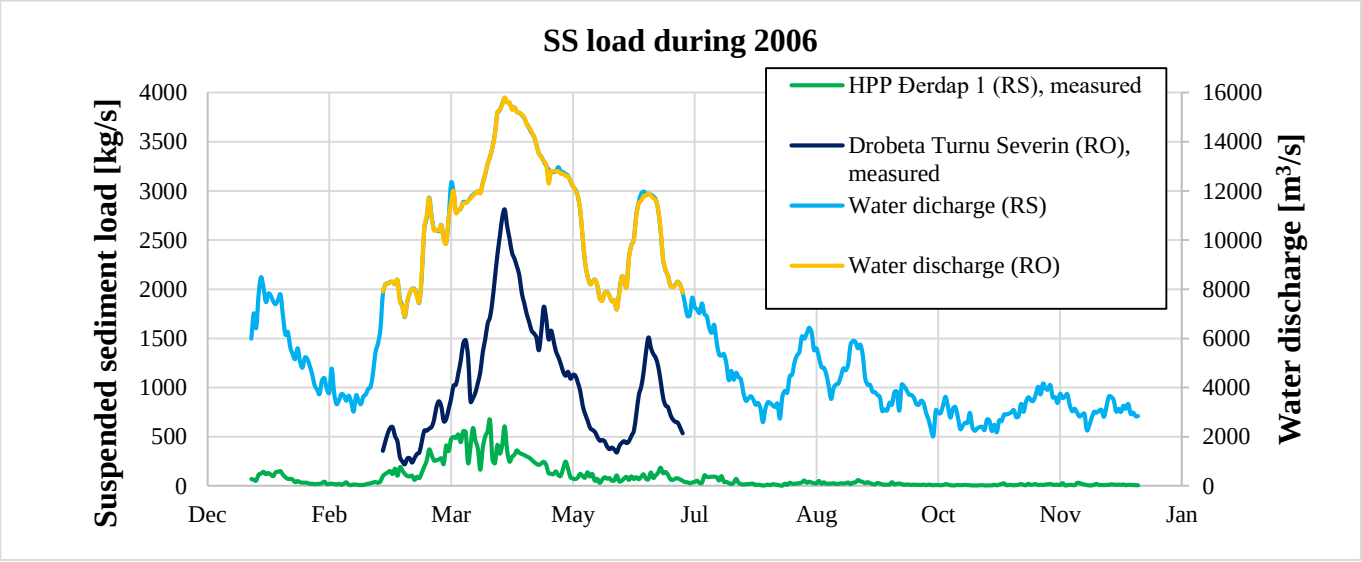


Serbia-Romania at Iron Gate I (rkm 943 and rkm 931)

Name of the monitoring site	Location of the monitoring site	SS measurement method	Frequency	SSC analysis method
HPP Đerdap 1 dam (Serbia)	943.00 rkm	Physical sampling	1 times per day	Evaporation
Drobeta Turnu Severin (Romania)	931.00 rkm	Physical sampling	1 times per day	Turbidity meter



Serbia-Romania (2006 flood)

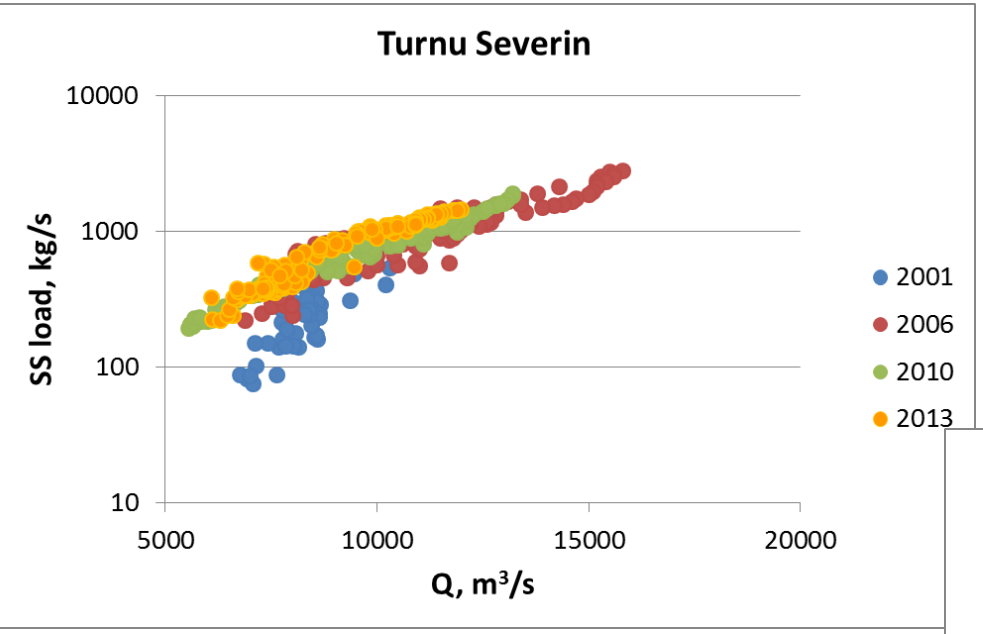


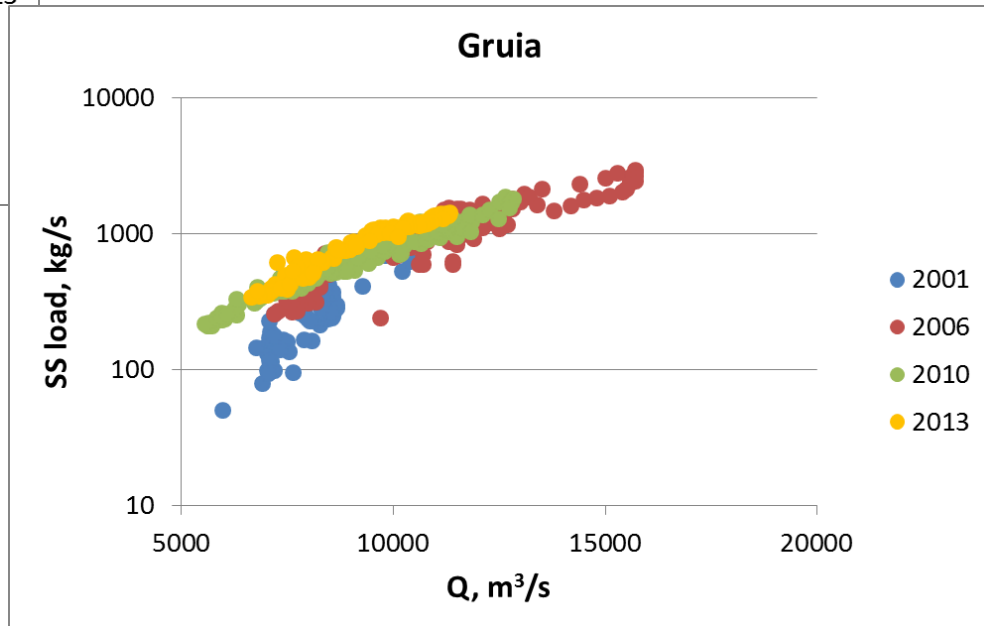
- Flow discharge values agree very well
- Measured RO data shows significantly higher sediment load

Activity 3.2 – Comparative Analysis

Interreg
Danube Transnational Programme
DanubeSediment

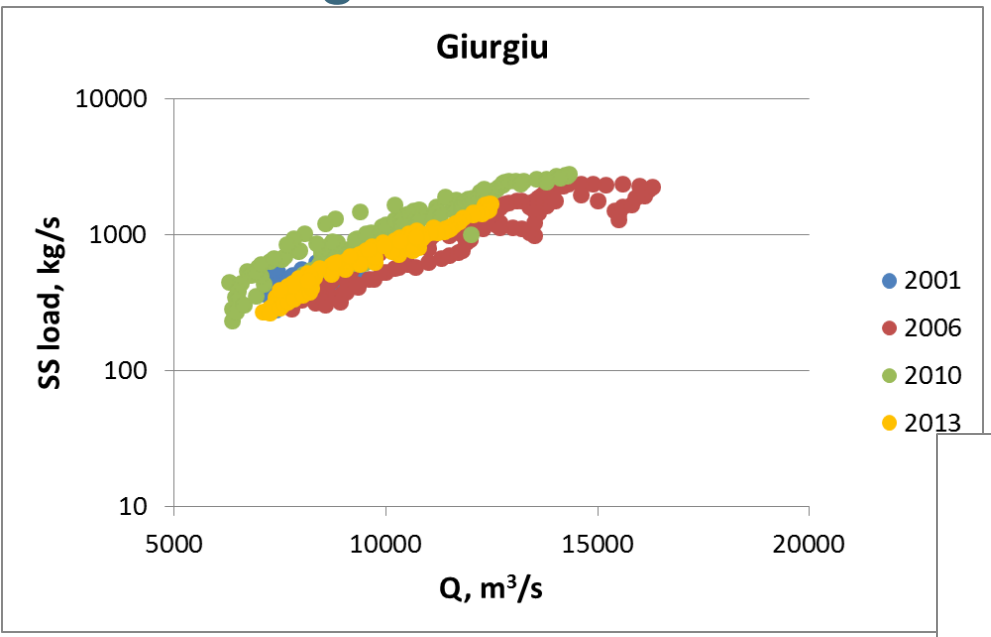
SS rating curves at Romanian stations

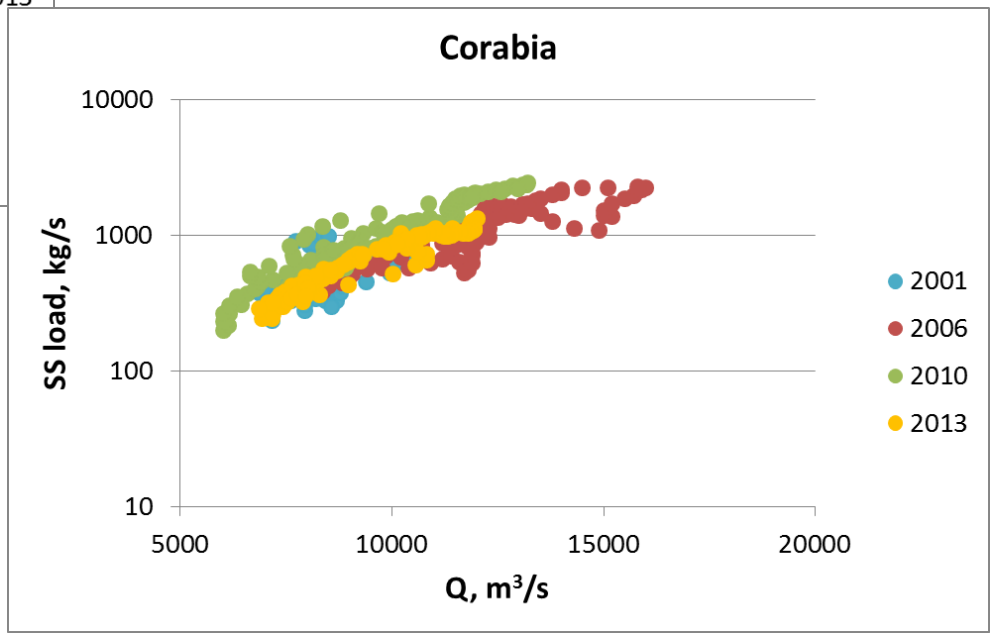




Activity 3.2 – Comparative Analysis

SS rating curves at Romanian stations





Activity 3.2 – Comparative Analysis

Interreg
Danube Transnational Programme
DanubeSediment

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

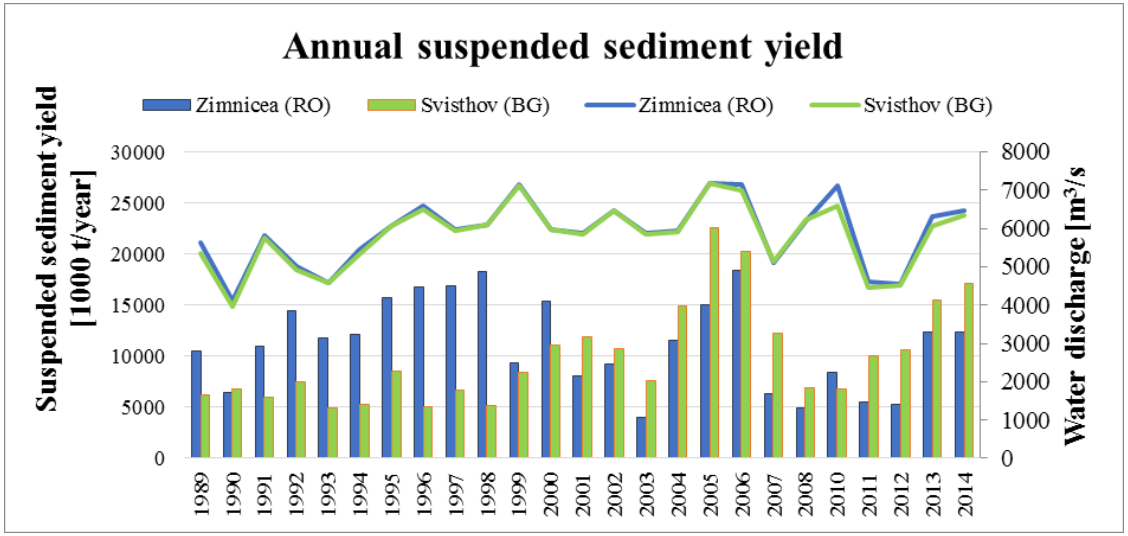
This map was produced in the frame of the EU funded project DanubeSediment, and is based on national information provided by Contracting Parties (AT, BG, DE, HR, HU, RO, RS, SK).

Budapest, April 2018

Interreg
Danube Transnational Programme
DanubeSediment

Romania-Bulgaria (ZIMNICEA – rkm 553.8)

Name of the monitoring site	Location of the monitoring site	SS measurement method	Frequency	SSC analysis method
Zimnicea (Romania)	553.23 rkm	Physical sampling	1 times per day	Turbidity meter
Svishtov (Bulgaria)	554.30 rkm	Physical sampling isokinetic sampling (depth-integrating),	1 times per day	Filtration



Activity 3.2 – Comparative Analysis

Interreg
Danube Transnational Programme
DanubeSediment

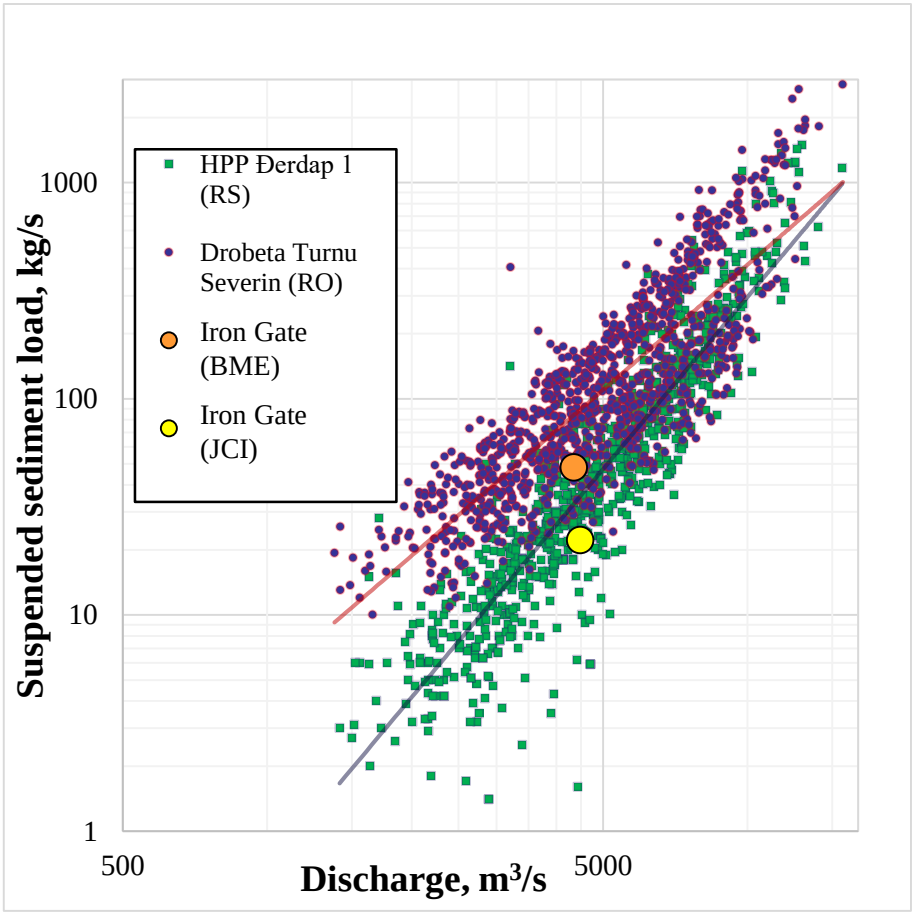
- **On-site comparison**

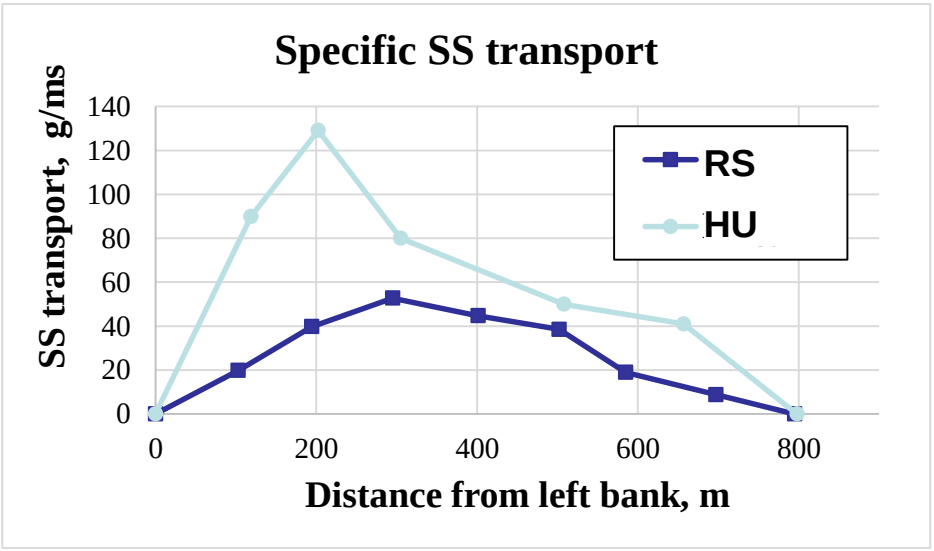
Giurgiu (RO-BG)
31.08.2017.

Iron Gate (RS-RO)
20.09.2017.

Bad-Deutsch Altenburg (AT)
08-09.11.2017.

On-site comparison (Iron Gate)





SS load (HU): 48 kg/s
SS load (RS): 22 kg/s

Activity 3.2 – Comparative Analysis

Interreg
Danube Transnational Programme
DanubeSediment

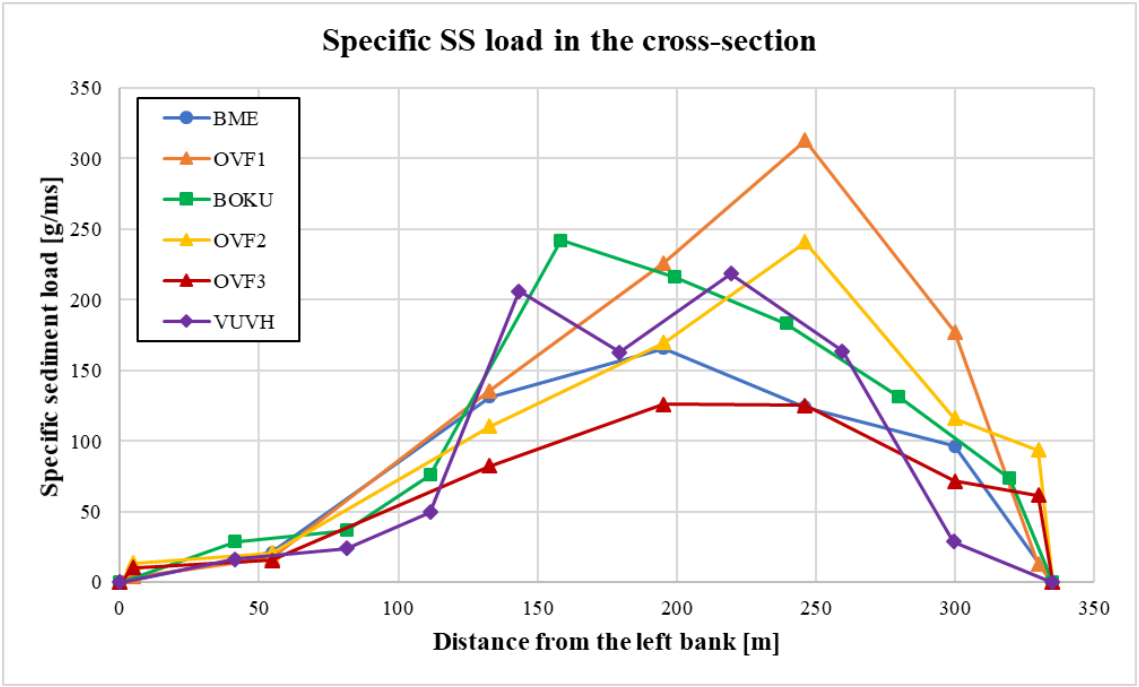
On-site comparison (Bad-Deutsch Altenburg)

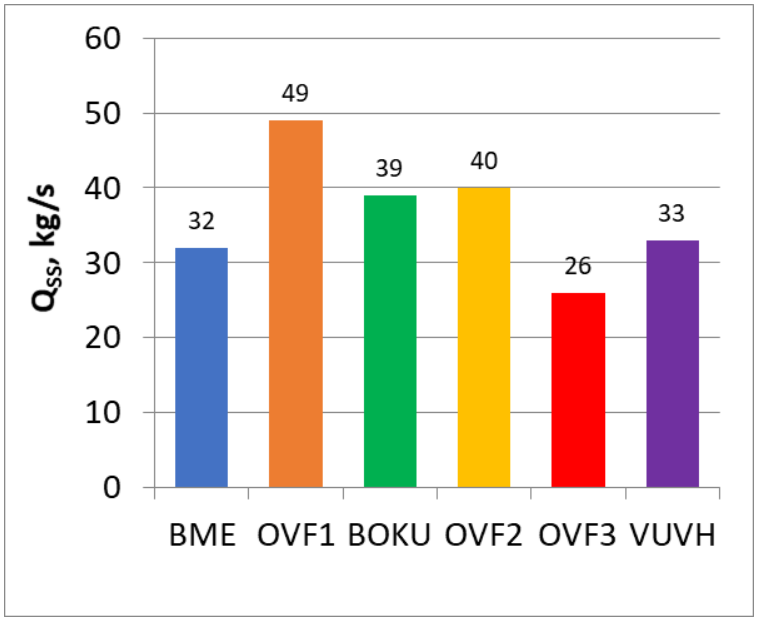
- AT (BOKU): isokinetic point-sampling + ADV + laboratory
- HU (BME): isokinetic point-sampling + ADCP + LISST
- HU (OVF1): bottle + ADCP + LISST
- HU (OVF2): bottle + ADCP + laboratory1
- HU (OVF3): bottle + ADCP + laboratory2
- SK (VUVH): depth-integrating sampler + laboratory

Activity 3.2 – Comparative Analysis

Interreg
Danube Transnational Programme
DanubeSediment

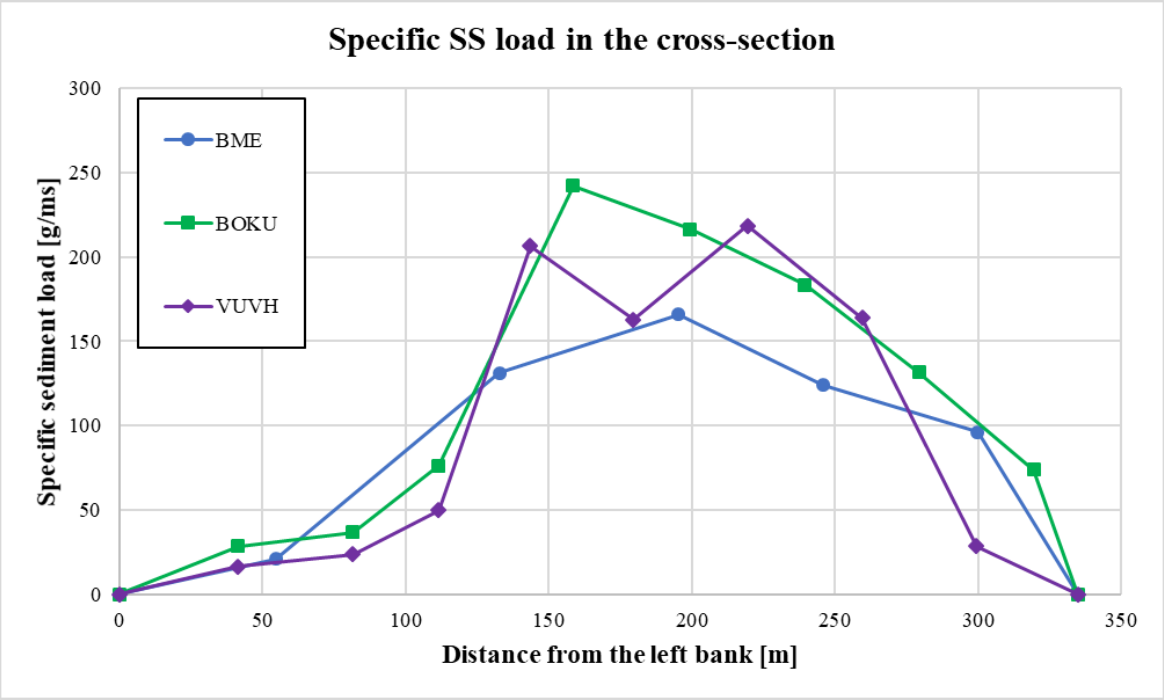
On-site comparison (Bad-Deutsch Altenburg)





On-site comparison (Bad-Deutsch Altenburg)

- Only isokinetic methods



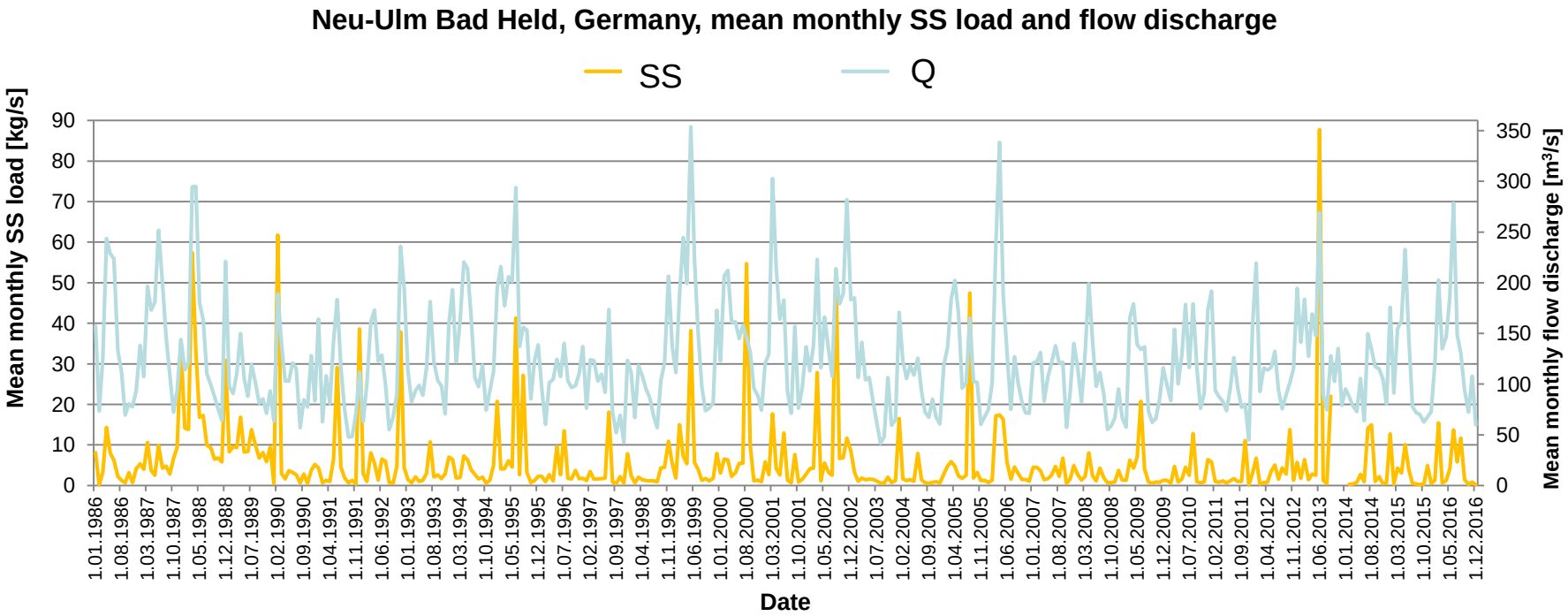
SS load (BME): 31 kg/s
SS load (BOKU): 39 kg/s
SS load (VUVH): 33 kg/s

Activity 3.3 – Assessment of sediment data

Interreg
Danube Transnational Programme
DanubeSediment

Calculation method

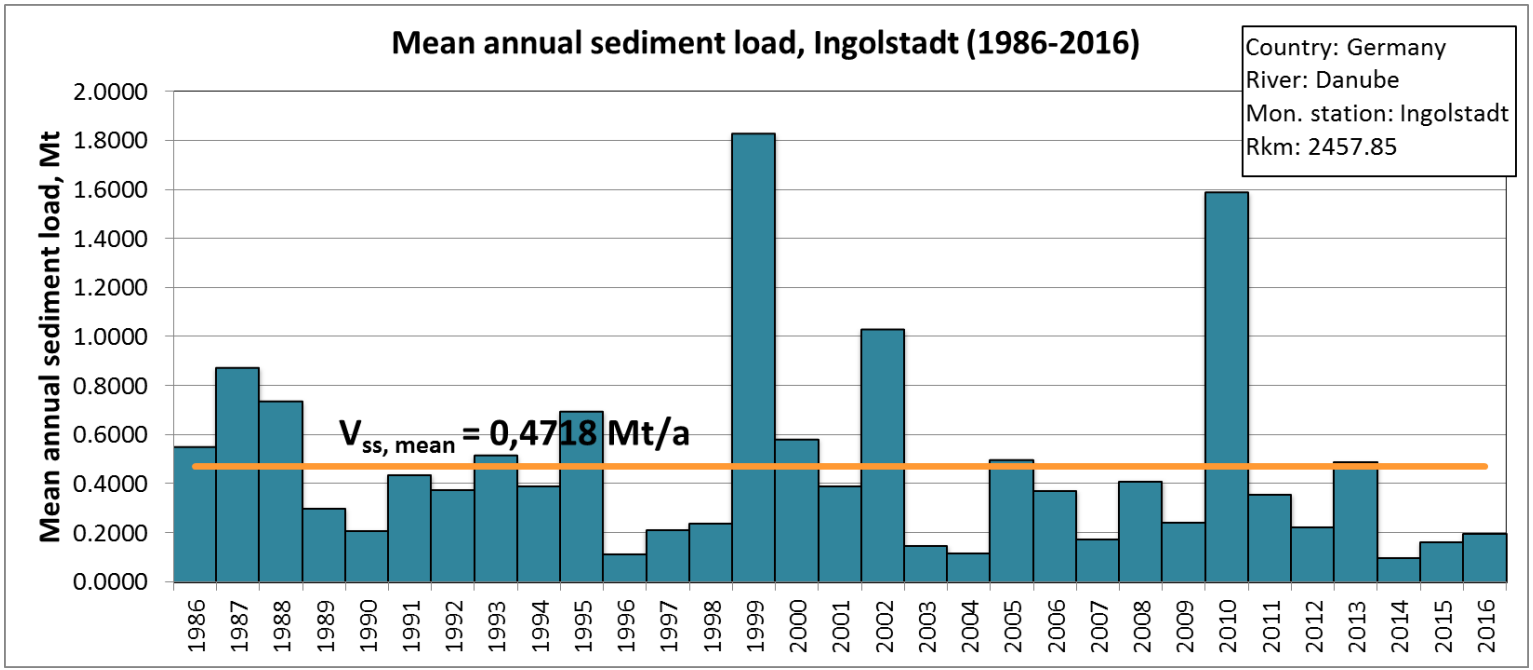
- Monthly min-mean-max SS load values for every monitoring station for the period 1986-2016, e.g.:



Activity 3.3 – Assessment of sediment data

Calculation method

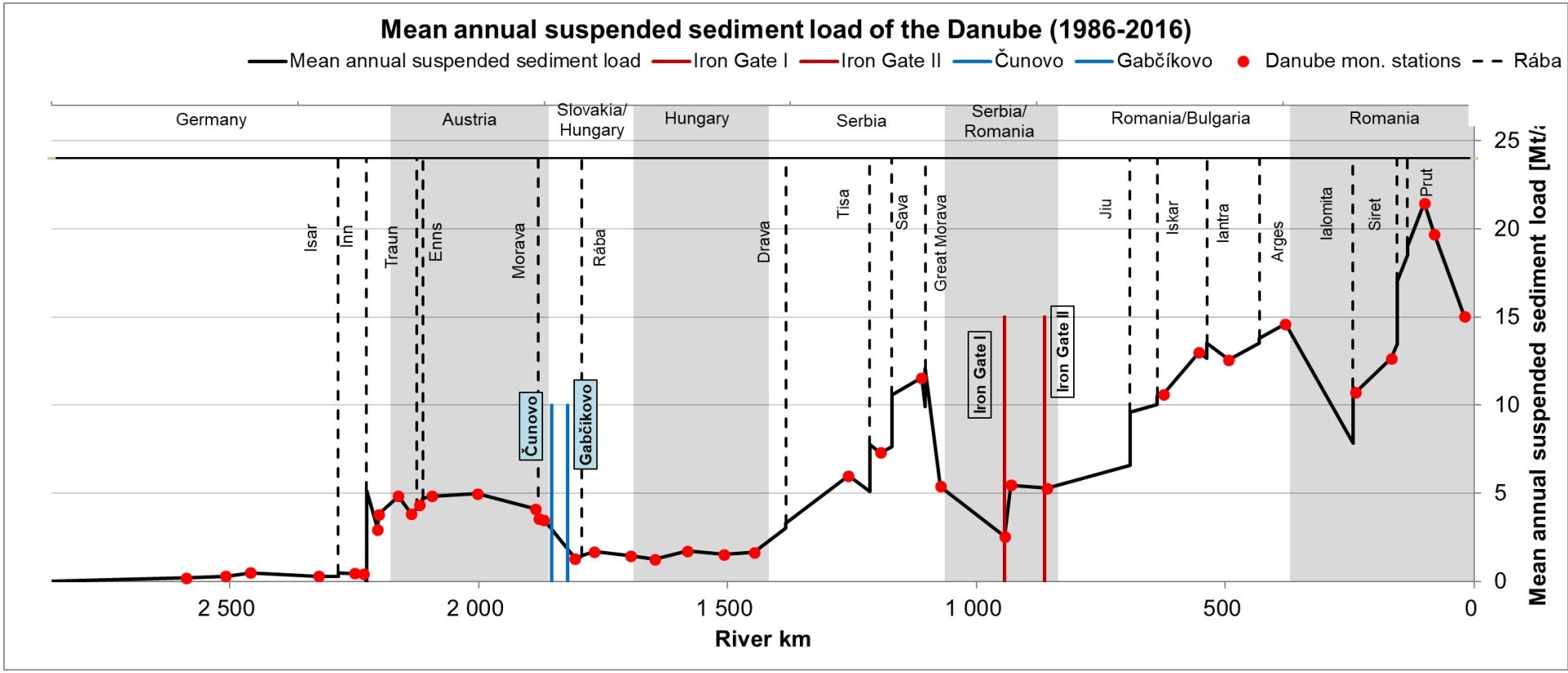
- Monthly min-mean-max SS load values for every monitoring station for the period 1986-2016
- Data quality check, correction, filling data gaps if possible (using rating curves)
- Calculation of mean yearly SS loads, and 30 year mean SS load



Activity 3.3 – Assessment of sediment data

Interreg
Danube Transnational Programme
DanubeSediment

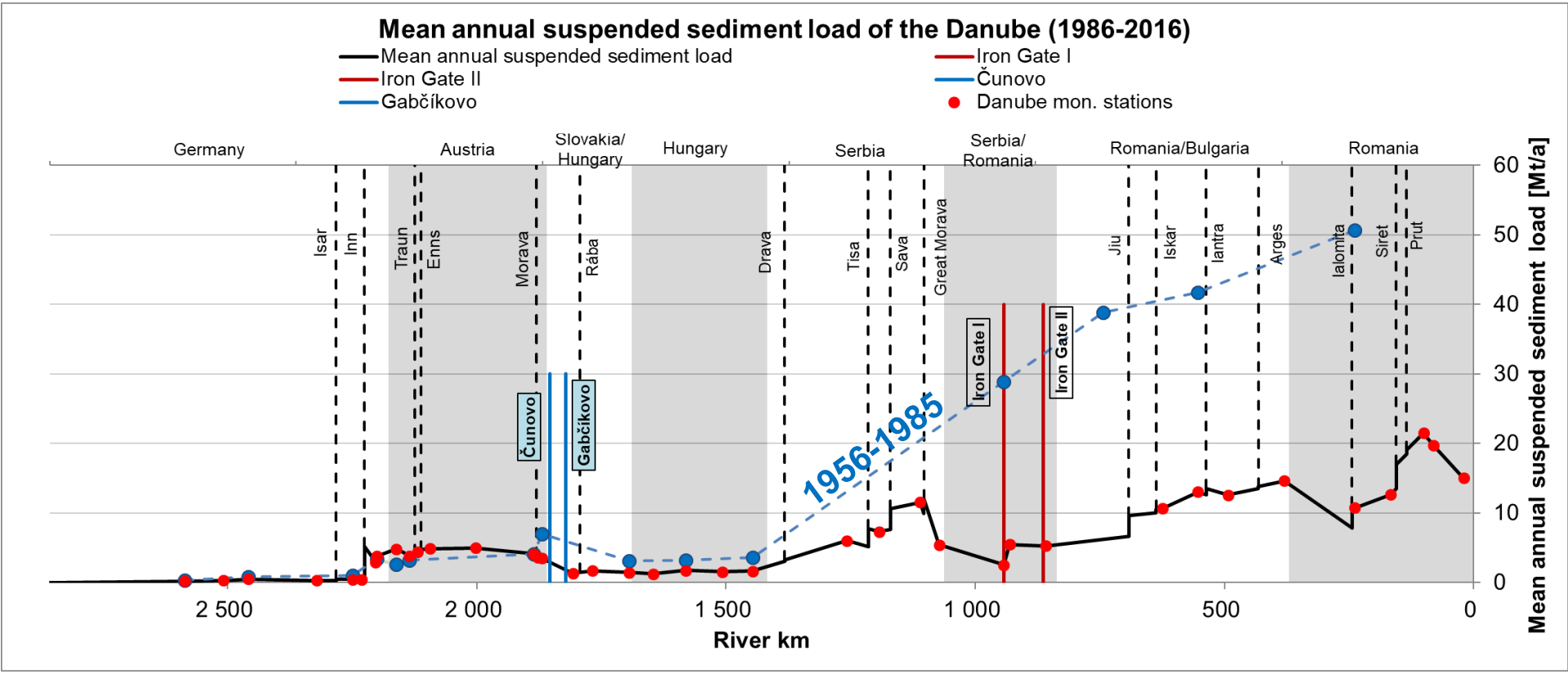
Longitudinal variation of mean annual SS load



Activity 3.3 – Assessment of sediment data

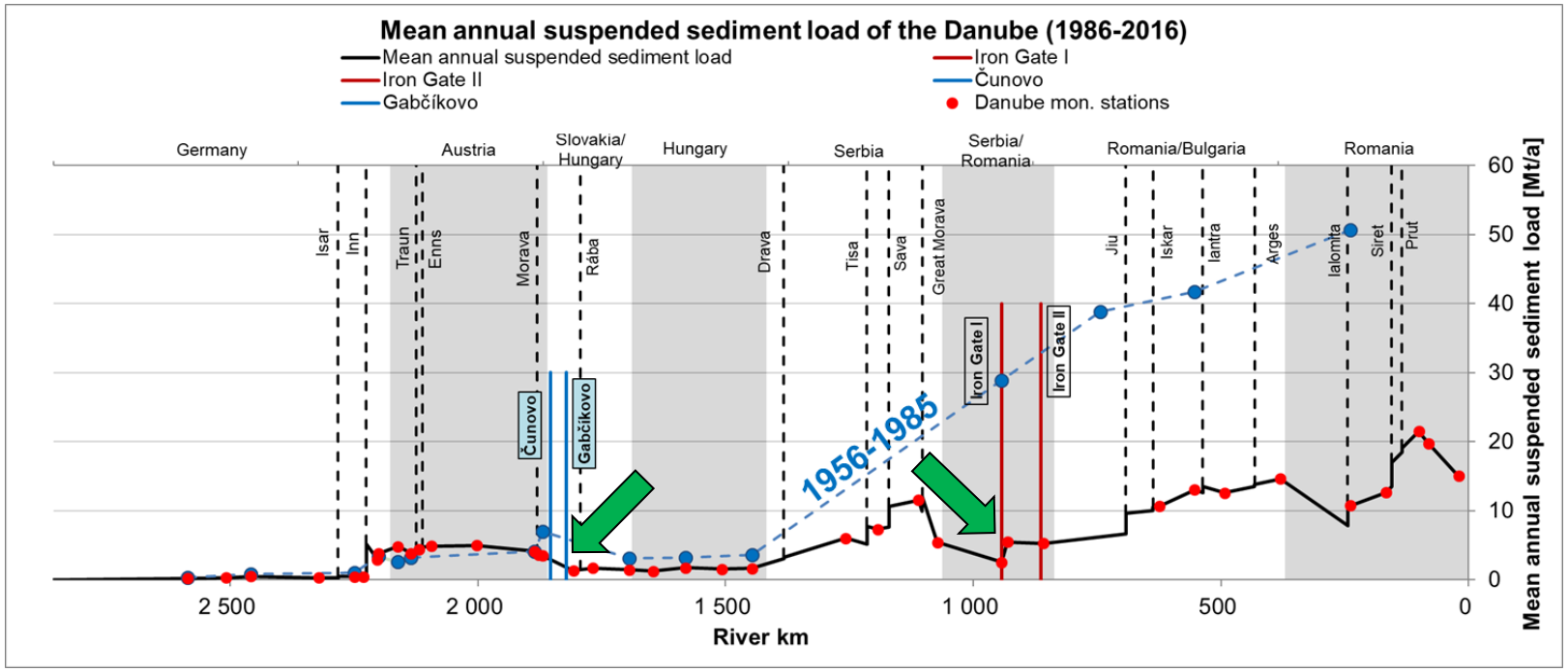
Interreg
Danube Transnational Programme
DanubeSediment

Comparison with historical data from 1956-1985



Sediment deficit at HPPs

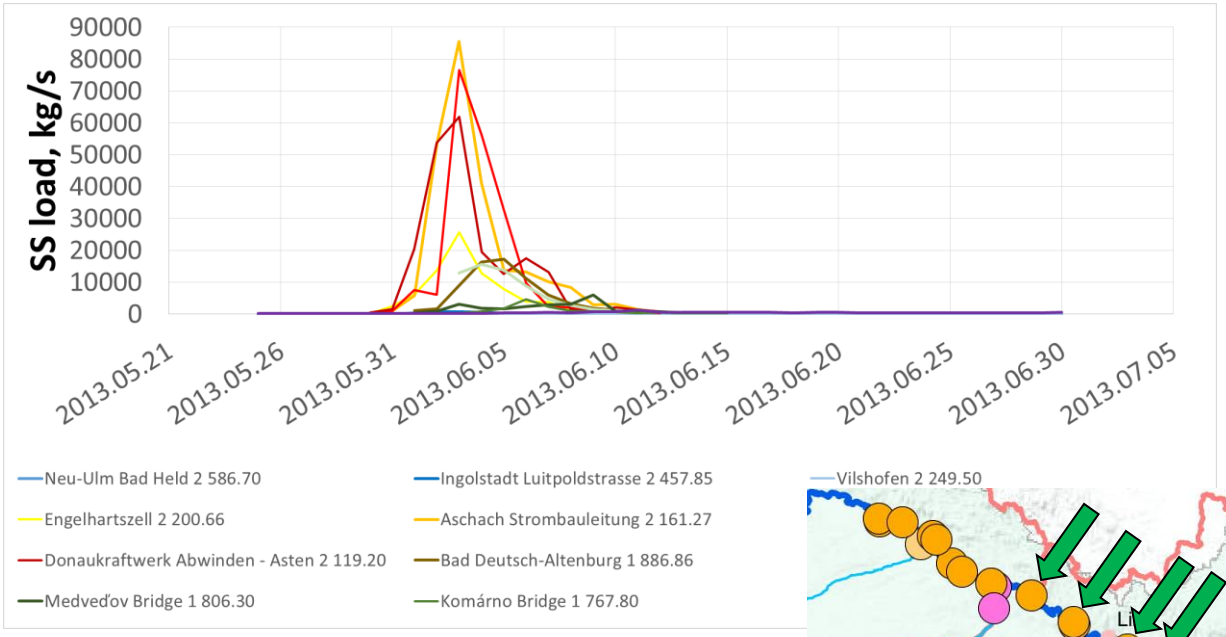
HPP	SS load 1956-1960 [Mt/a]	SS load 1986-2016 [Mt/év]	Sediment load decrease
Iron Gate I	28.84	2.53	92 %
Medvedov	6.6	1.29	80 %

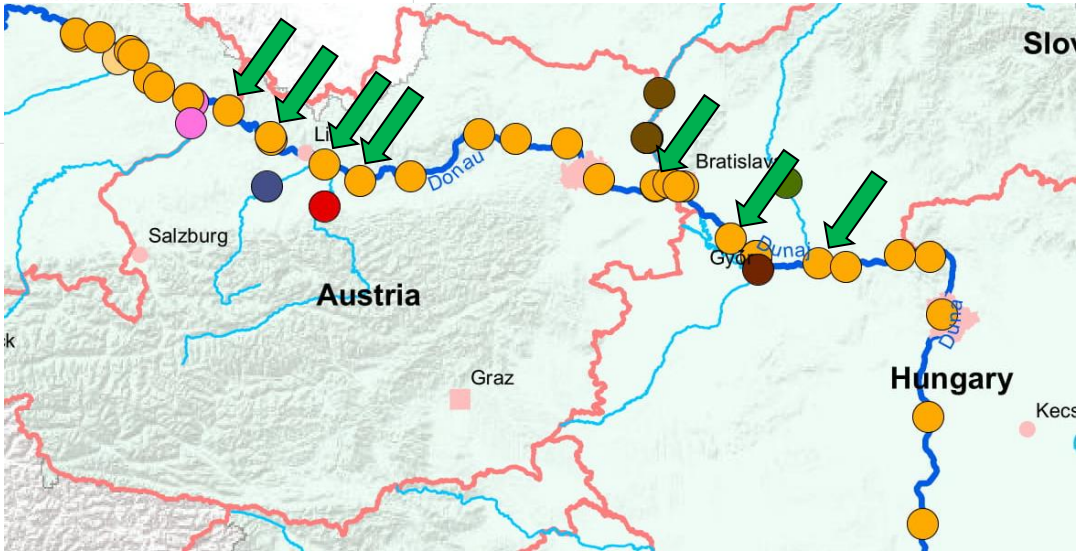


Activity 3.3 – Assessment of sediment data

Interreg
Danube Transnational Programme
DanubeSediment

SS load during floods, Upper Danube - 2013





Activity 3.3 – Assessment of sediment data

Interreg
Danube Transnational Programme
DanubeSediment

SS load during floods, Upper Danube - 2013

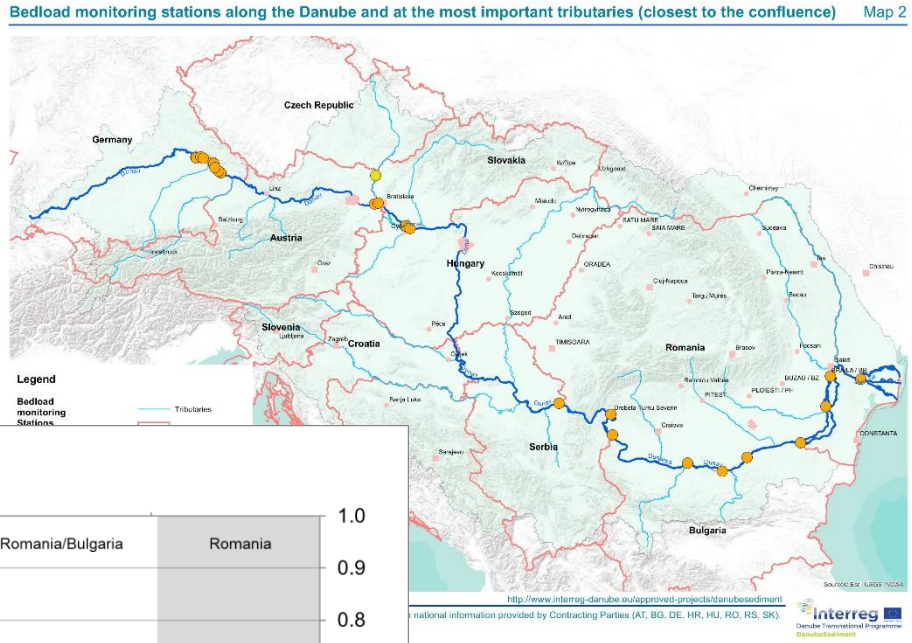
	Austria	Austria	Austria	Austria	Austria	Slovakia	Slovakia	Slovakia	
	Engelhartszell	Aschach Strombauleitung	Linz	KW Abwinden - Asten	Bad Deutsch-Altenburg	Bratislava	Medveďov Bridge	Komárno Bridge	
Date|rkm	*2 200.66*	*2 161.27*	*2 135.17*	*2 119.20*	*1 886.86*	*1 868.75*	*1 806.30*	*1 767.80*	
30.05.2013.	*47*	*-*	*128*	*465*	*-*	*-*	*-*	*-*	
31.05.2013.	*2 514*	*951*	*953*	*1 614*	*-*	*128*	*-*	*-*	
2013.06.01	*6 113*	*5 711*	*7 541*	*20 403*	*1 175*	*-*	*320*	*-*	
02.06.2013	*13 671*	*53 716*	*6 091*	*53 824*	*1 563*	*-*	*844*	*273*	
03.06.2013	*25 728*	*85 485*	*76 610*	*61 956*	*8 907*	*12 888*	*3 001*	*363*	
04.06.2013	*12 801*	*41 212*	*56 082*	*19 539*	*16 341*	*15 564*	*1 722*	*808*	
05.06.2013	*7 946*	*13 765*	*32 814*	*12 654*	*17 145*	*13 780*	*1 699*	*1 799*	
06.06.2013	*3 874*	*13 194*	*9 673*	*17 577*	*11 164*	*8 950*	*2 315*	*4 702*	
07.06.2013	*3 691*	*10 214*	*2 340*	*13 192*	*6 012*	*4 708*	*2 895*	*2 261*	*kg/s*
08.06.2013	*1 235*	*8 296*	*2 157*	*1 534*	*3 233*	*2 773*	*3 143*	*976*	
09.06.2013	*715*	*2 982*	*1 597*	*805*	*1 760*	*1 385*	*5 944*	*876*	
10.06.2013	*698*	*3 077*	*756*	*2 126*	*1 206*	*1 016*	*886*	*558*	
11.06.2013	*391*	*1 391*	*654*	*1 353*	*-*	*474*	*691*	*203*	
12.06.2013	*394*	*609*	*253*	*750*	*-*	*656*	*696*	*386*	
13.06.2013	*-*	*-*	*-*	*-*	*-*	*495*	*378*	*329*	
14.06.2013	*-*	*-*	*-*	*-*	*-*	*518*	*308*	*361*	
15.06.2013	*-*	*-*	*-*	*-*	*-*	*-*	*309*	*353*	
Total:	**6.88**	**20.72**	**17.06**	**17.90**	**5.82**	**6.46**	**2.15**	**1.20**	**Mt**

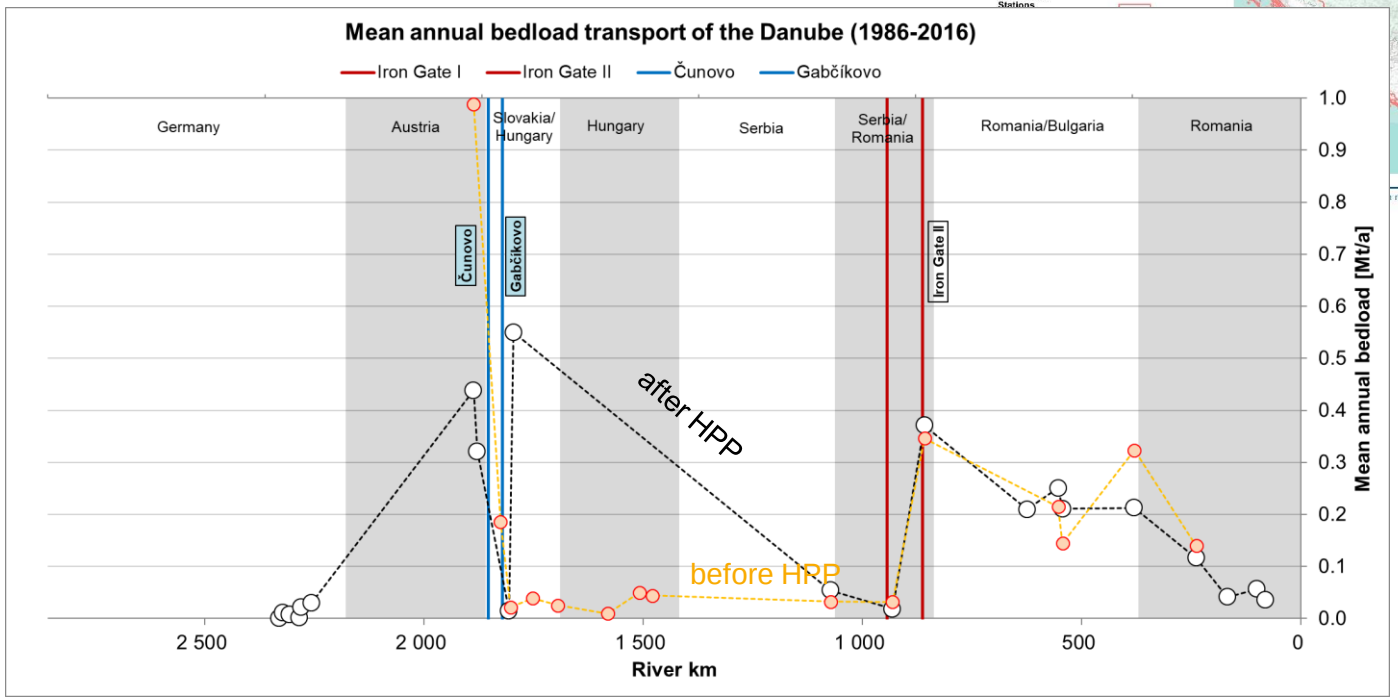
Activity 3.3 – Assessment of sediment data

Interreg
Danube Transnational Programme
DanubeSediment

Bedload transport

- Few and uncertain datasets
- Influence of reservoirs, however, can be seen
- Contribution to total load?

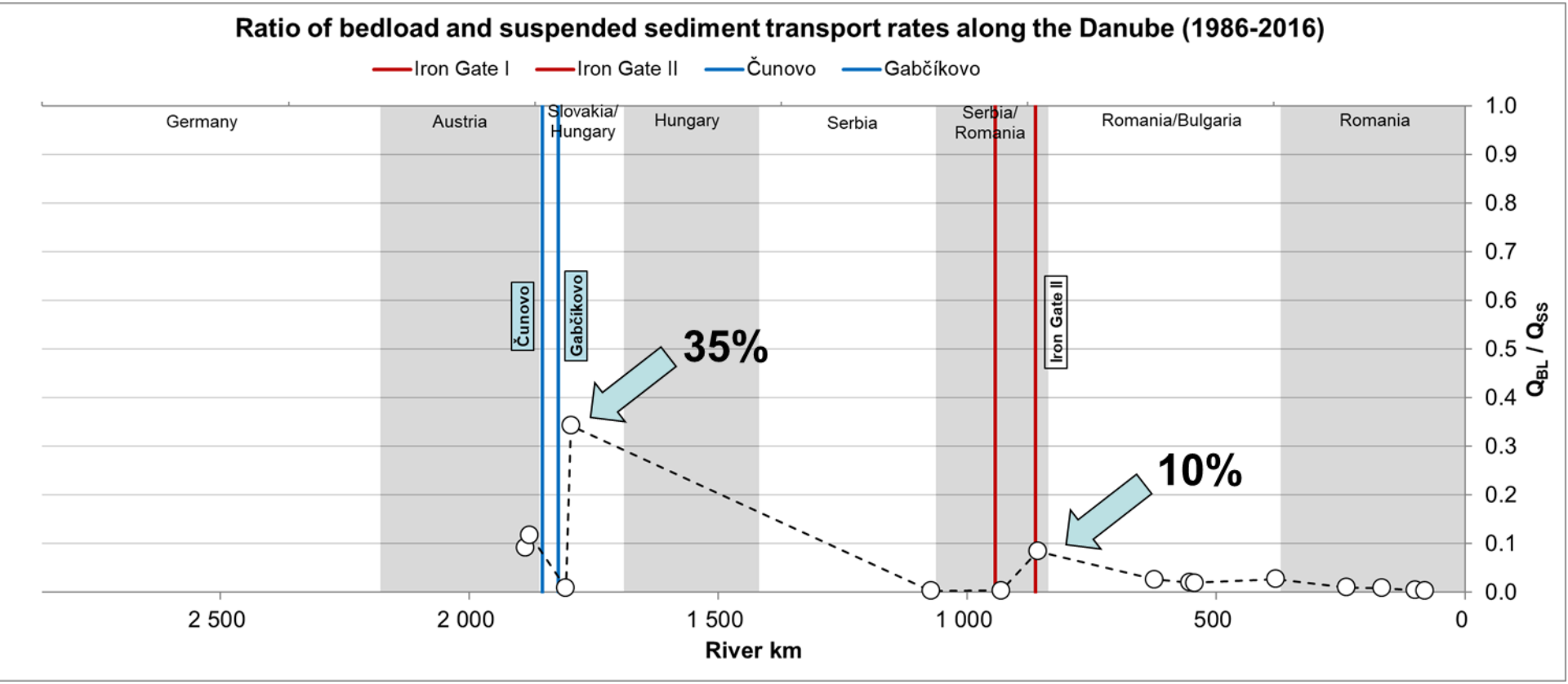




Activity 3.3 – Assessment of sediment data

Bedload transport

- Ratio of bedload and suspended sediment transport:



→ Good practices in SS monitoring – turbidity measurements