



UNIVERSITY OF ZAGREB
FACULTY OF CIVIL ENGINEERING
WATER RESEARCH DEPARTMENT

Towards practical Guidance for Sustainable Sediment Management using the Sava River as a showcase

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Innovative Sediment Management: How to do more with less*

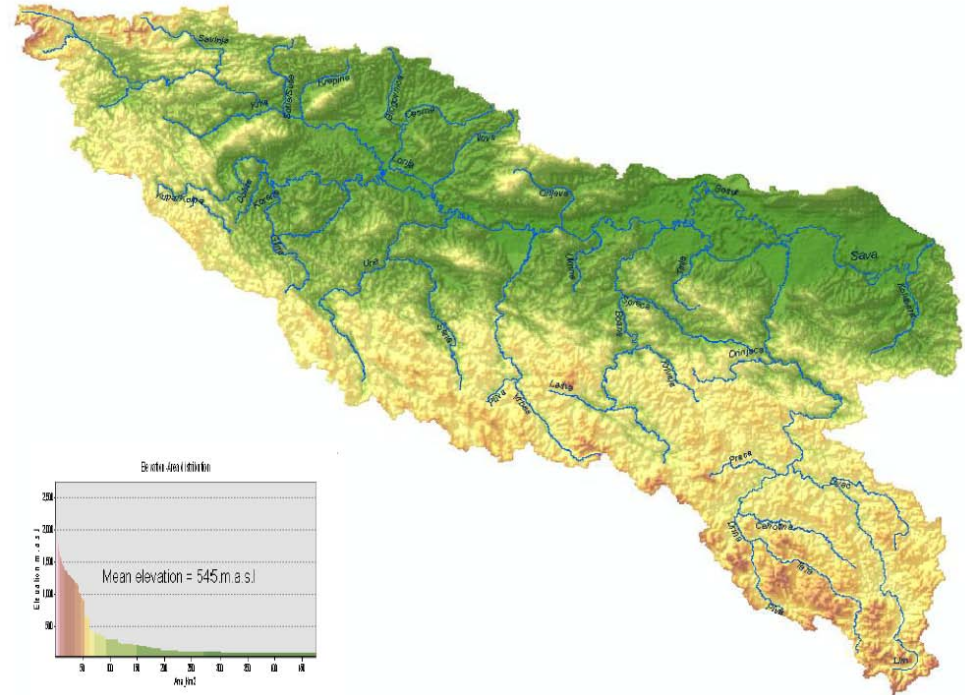


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1. INTRODUCTION

➤ The River Sava



- 3rd longest in the Danube Basin = 944 km (source-mouth)
- largest by discharge tributary of the Danube River ($Q_m = 1.564 \text{ m}^3/\text{s}$, contributing by 25% to Q_{Danube})

➤ The River Sava Basin

- shared by five countries:

Country	Share (km ²)	(%)
Slovenia	11,734.8	12.0
Croatia	25,373.5	26.0
Bosnia and Herzegovina	38,349.1	39.2
Serbia	15,147.0	15.5
Montenegro	6,929.8	7.1
Albania	179.0	0.2
<i>Total</i>	<i>97,713.2</i>	<i>100.0</i>

➤ Background

- No examples yet to integrate SSM into RBMP
- The key driver for UNESCO IHP, ISI and SedNet to promote SSM

➤ Legal background in the Sava River Basin

- Framework Agreement on Sava River Basin (FASRB) = *framework for transboundary cooperation in WM, navigation, etc.*
- Protocol on Sediment Management to FASRB (*not yet harmonized*)



2. PROJECT: Towards practical Guidance for SSM

➤ General facts

- Main objective = to develop and validate practical guidance to achieve SSM plan on the river basin scale
- Project partners = experts appointed by UNESCO, ISI, SedNet and ISRBC



- Estimated duration = 26 months

Project schedule

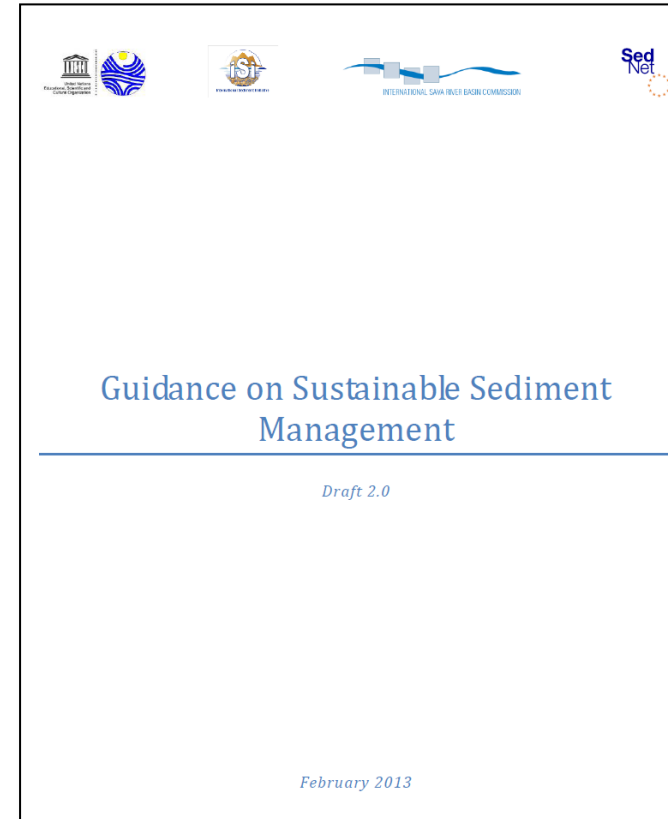
➤ Main steps

- A. Project **Part 1** = SSM course 1 + Guidance part 1
- B. Application of Guidance Part 1 in the Sava River
- C. Project **Part 2** = SSM course 2 + Guidance part 2
- D. Continuation of Guidance Part 1 application in the Sava River practice
- E. Final workshop

3. PROJECT RESULTS: Guidance on SSM

➤ Guidance purpose

- To serve as a policy-level (strategic) document **as an input in national/entity-level strategic planning** on sustainable sediment management;
- To provide expert contribution to **unified approach** to sustainable sediment management in the Sava River Basin;
- To **outline the scope of work** for the preparation of Sediment Management Plan for the Sava Basin.



➤ Guidance contents

- Introduction
 - background, definitions, main objectives, purpose and scope
- Legislative Framework for sustainable sediment management
 - linkage with EU directives and policies, Policy Framework for SSM
- Sediment as an integral part of the river basins
 - sediment quantity (budget), sediment quality, aquatic ecosystems: ecology and biodiversity, anthropogenic pressures
- Status on sediment management in the Sava River Basin
 - Overview of hydro-morphology, sed. balance, monitoring, sed. quality
- *Description of measures for SSM*
- *Institutional arrangements*
- *Means of stakeholder involvement*
- *Development of SMP*



3. PROJECT RESULTS: Guidance Part 1

➤ Scope of Part 1

- Sediment **balance**
- Sediment **monitoring**
- Evaluation of sediment **quality and quantity**

➤ Implementation of Part 1

- Step A: Execution of the training course
 - course held in October 2012 in Zagreb
- Step B: Application of the Guidance
 - Subproject: Estimation of Sediment Balance for the Sava River (BALSES)



Step B: Application of Guidance Part 1

➤ **Subproject: Estimation of Sediment Balance for the Sava River (BALSES) - Outcomes**

- Overview on the actual monitoring system, monitored variables, frequency of data sampling and operation period
- Identification of monitoring gaps and data uncertainties
- Map of sediment monitoring network
- Estimation of sediment yield from the main tributaries
- Longitudinal profile of the Sava River with presentation of riverbed changes
- Estimation of a basin-wide sediment balance
- Proposal of joint activities towards the establishment of an effective sediment monitoring system
- Proposal for the sediment database composition

Subproject: BALSES

➤ BALSES - Methodology

- Period of analysis will cover 1950-2012
- Collected data:
 - suspended sediment and bed load transport, discharges
 - dredged material - amount and the time period
 - temporal variability of the sediment data
 - longitudinal bed elevation profiles for the River Sava main channel



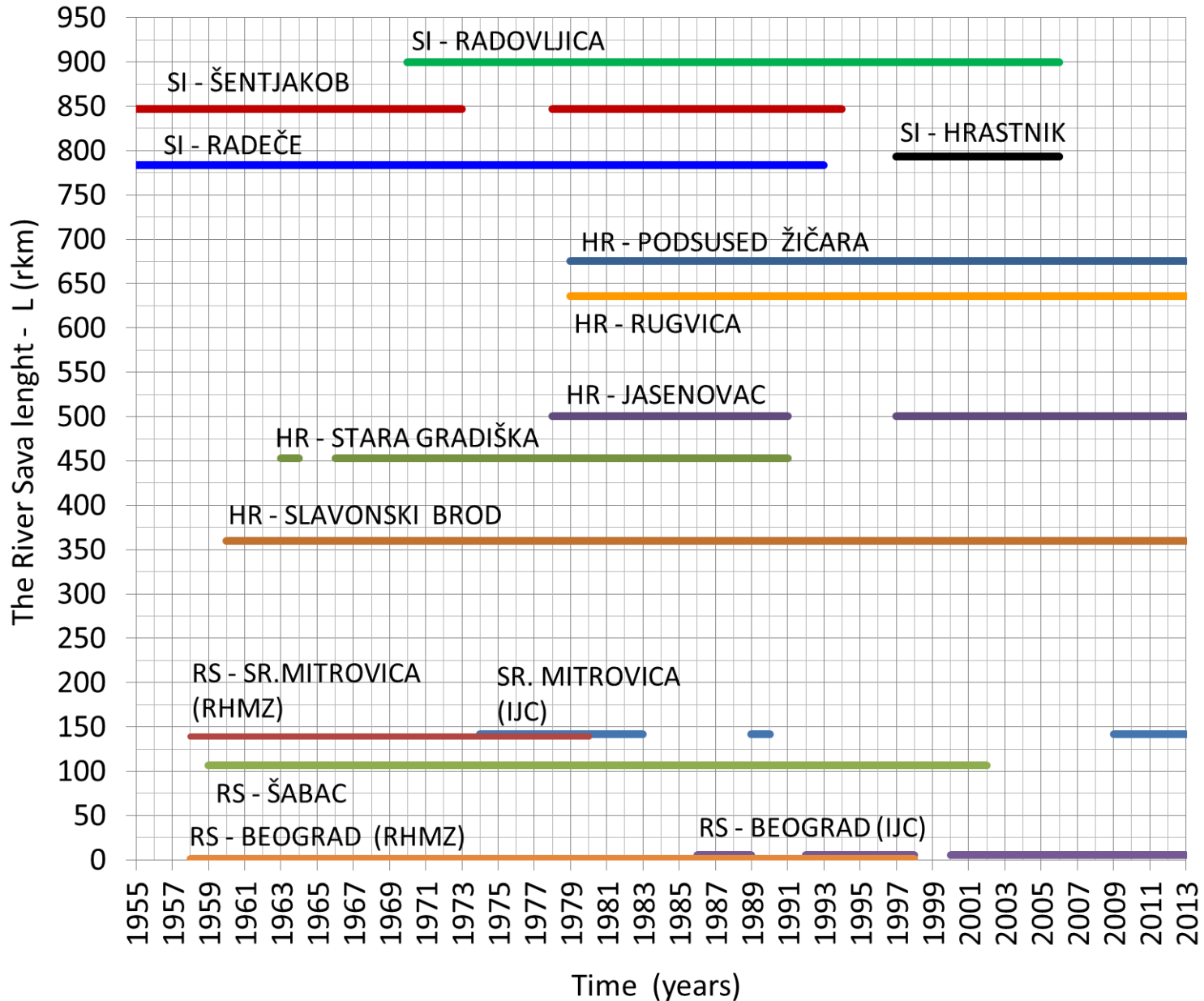
DISCHARGE SUSPENDED SEDIMENT 2008												
m ³ /s												
Date	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
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3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
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31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mean	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Max	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008												



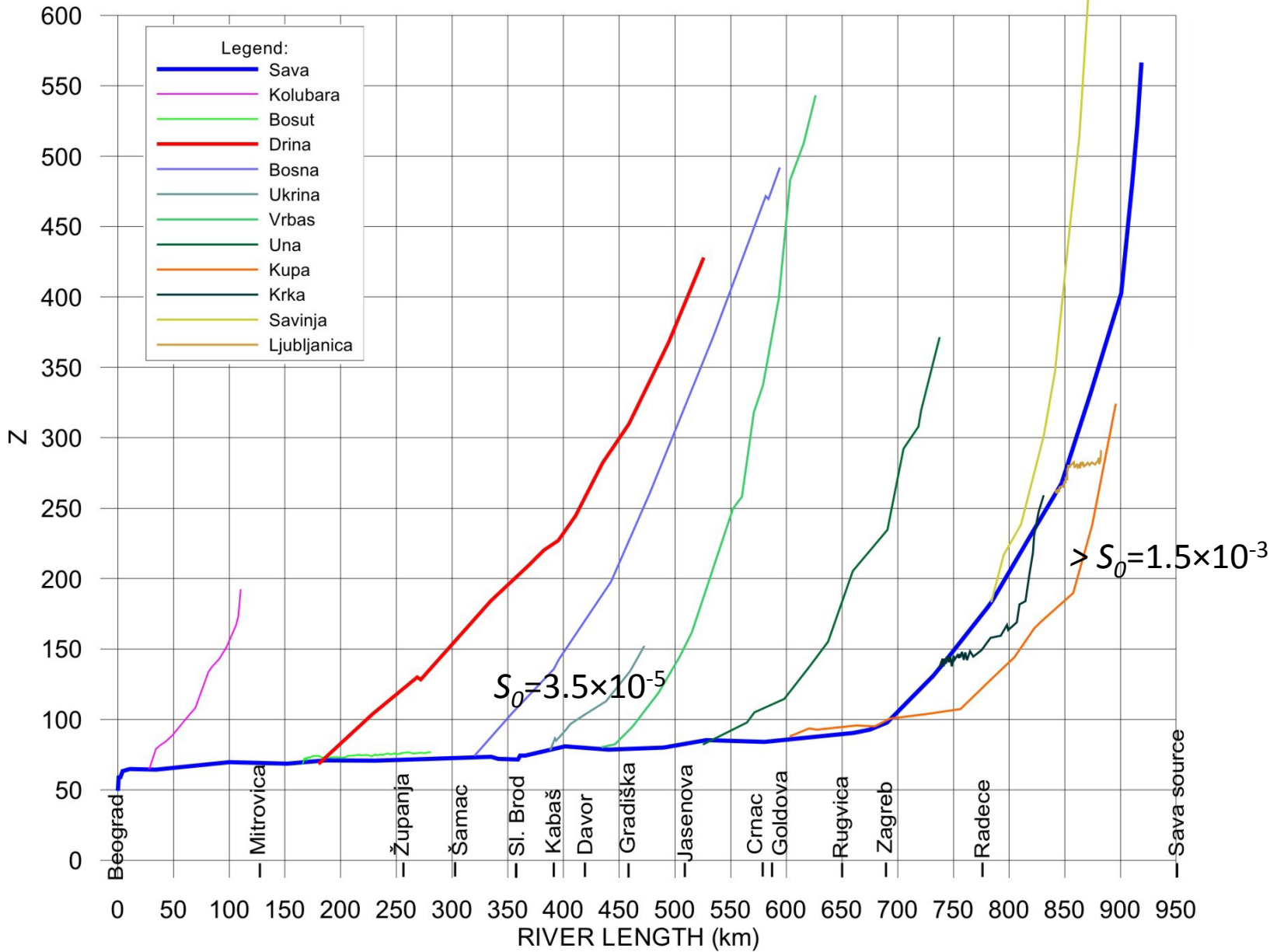
Active and inactive measurement sites in the Sava River Basin

Country	Stream	Measurement site	L (rkm)	Monitoring period
SLOVENIA	SAVA	Radovljica	901	xxxx-2006
	SAVA	Hrastnik	794	1997-2006
	SAVA	Šentjakob	847	(1955-1994)
	SAVA	Radeče	784	(1955-1993)
	Sora	Suha I		(xxxx-200x)
	Savinja	Laško I		(1990-1993)
	Savinja	Veliko Širje I		(1955-2005)
	Sotla	Rakovec I		(1978-2006)
CROATIA	SAVA	Podsused žičara	675	1978 -
	SAVA	Rugvica	636	1979 -
	SAVA	Jasenovac	501	1978 -
	SAVA	Slavonski Brod	360	1960 -
	SAVA	Stara Gradiška	453	(1963-1991)
	Una	Kostajnica		(1967-1991)
	Orljava	Mijači		(1975-1991)
	Pakra	Manastir		(1984-1991)
SERBIA	SAVA	Sr. Mitrovica	142	1974-
	SAVA	Beograd	6	1986-
	SAVA	Sr. Mitrovica	139	1958-1980
	SAVA	Sabac	106	1958-2002
	SAVA	Beograd	1	1958-1998
	Drina	Mihaljevici	132	1991-2002
	Drina	Radalj	86	1984-2002
	Drina	Badovinci	17	1990-2001
	Kolubara	Slovac	88	1958-1992
	Kolubara	Beli Brod	72	1986-2001
	Kolubara	Drazevac	12	1958-2002

the River Sava main channel - suspended load measurements

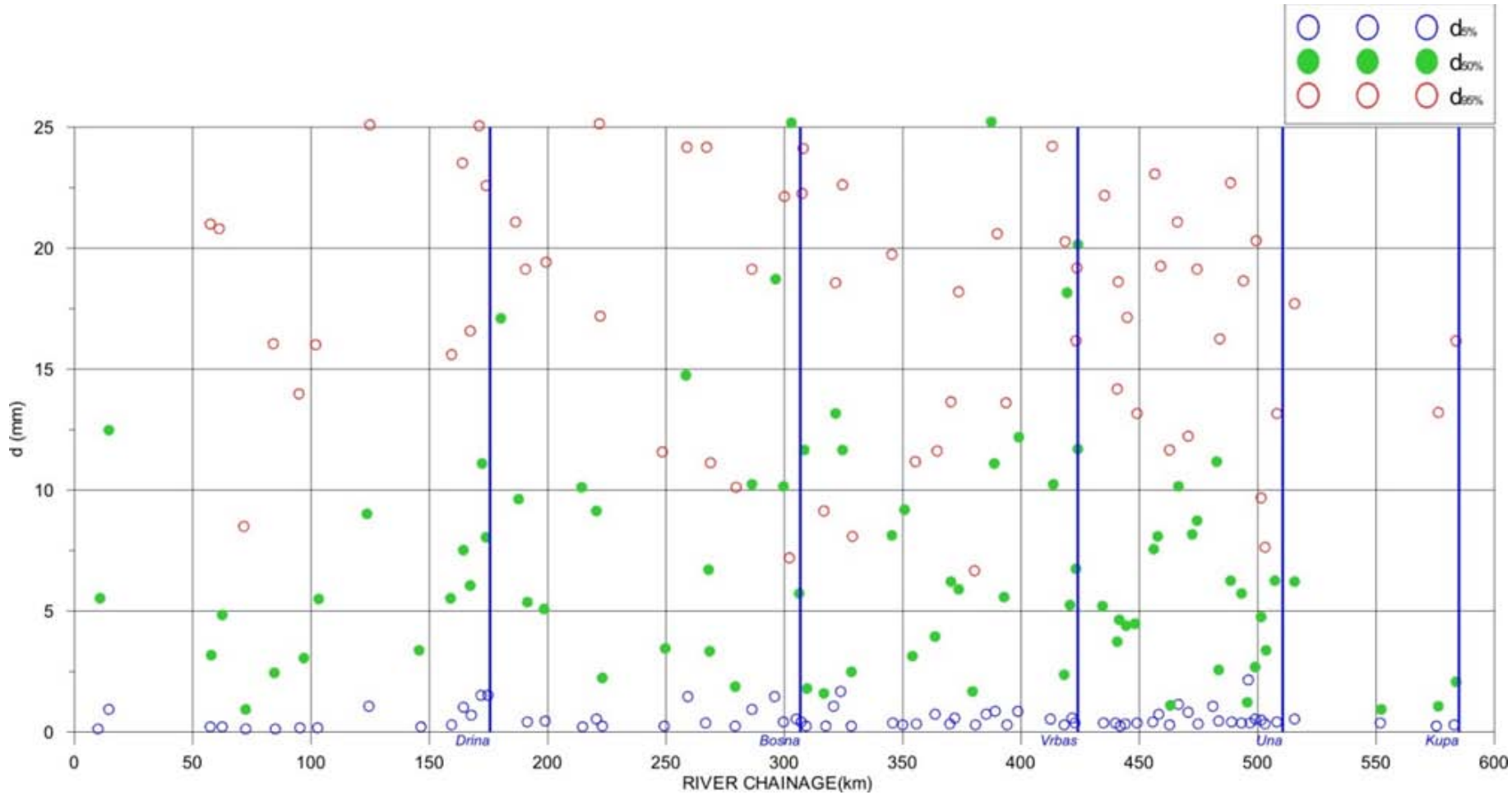


Longitudinal profiles of the River Sava and main tributaries



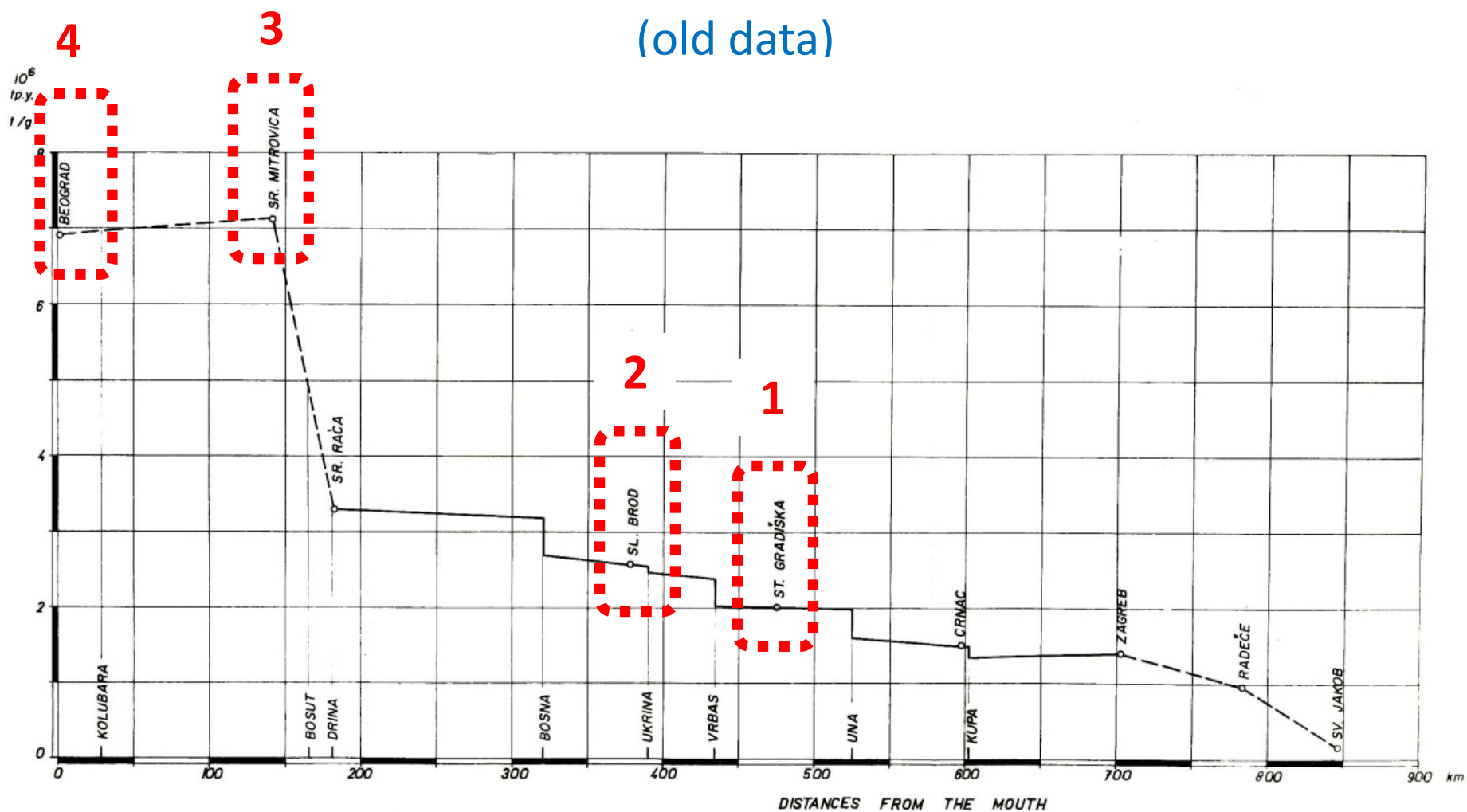
Longitudinal distribution of river bed grain size ($d_{5\%}$, $d_{50\%}$, $d_{95\%}$)

from 1958



Longitudinal distribution of annual suspended sediment transport

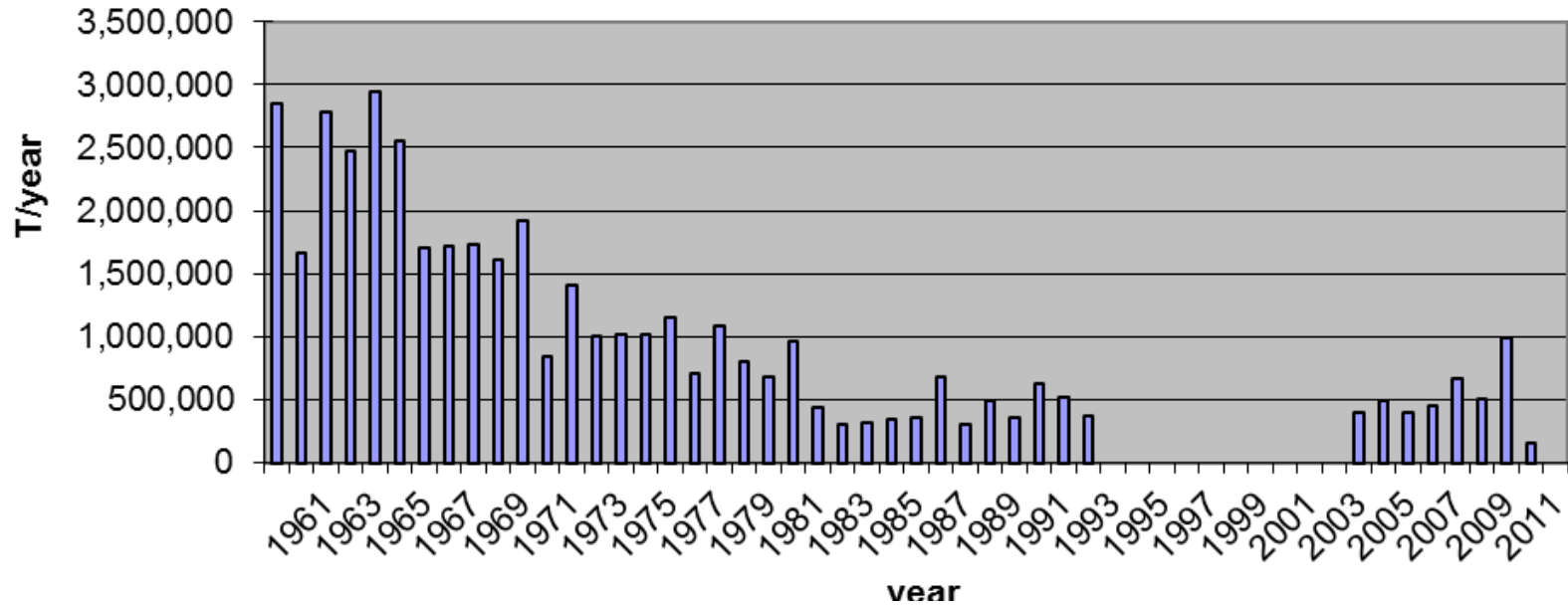
(old data)



Annual suspended load transport – Middle Sava

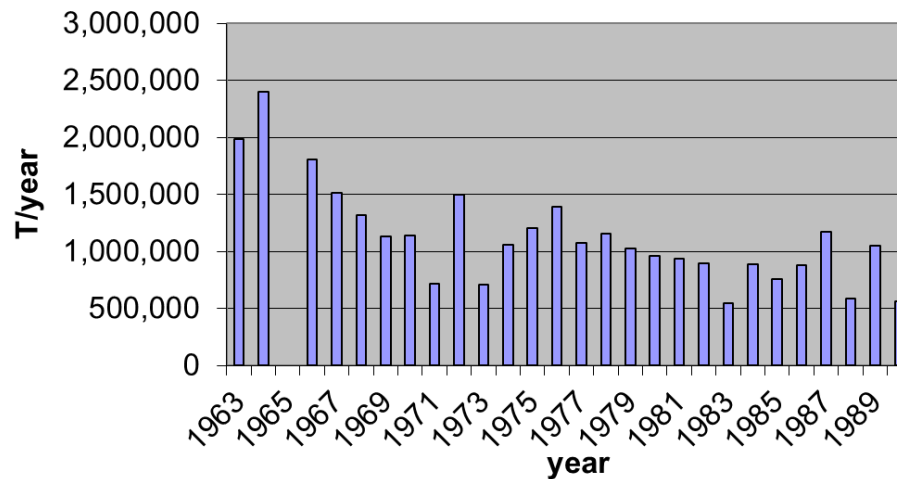
STATION 2

SAVA - Slavonski brod



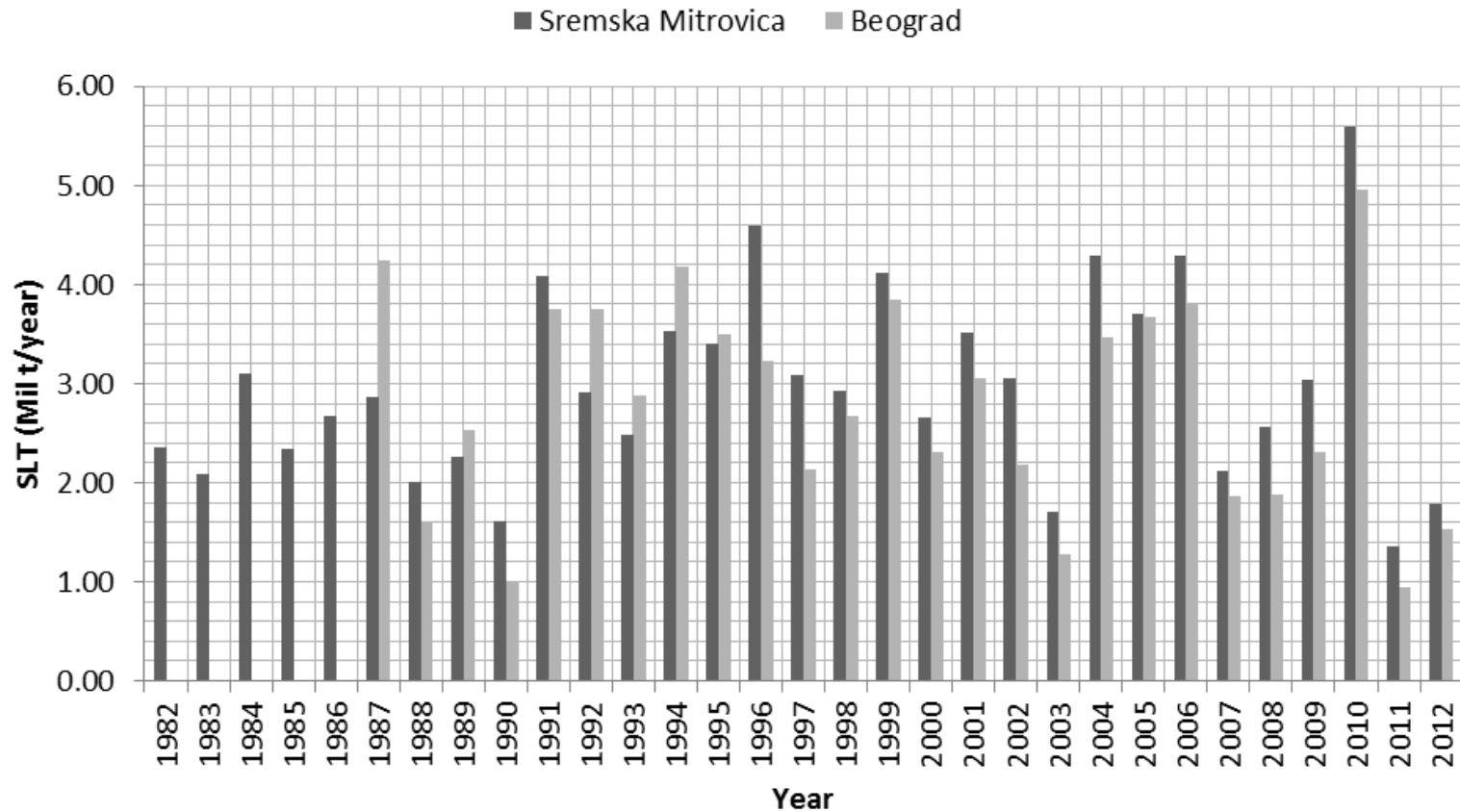
STATION 1

SAVA - Stara Gradiška



Annual suspended load transport – Lower Sava

STATIONS 3, 4



4. FUTURE STEPS

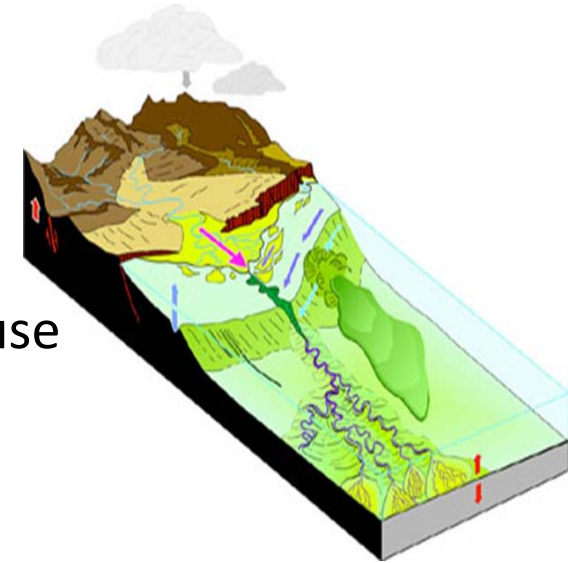
➤ Step C: Project Part 2

- Scope:
 - Description of measures for SSM
 - Sediment dredging, disposal, treatment and use
 - Institutional arrangements
 - Stakeholder involvement
- Training course + Guidance (part 2)

➤ Step D: Continuation of the application of the Guidance (part 1)

➤ Step E: Final workshop

- Presentation and discussion of the results
- Finalization of the Guidance document





Thank you for your attention

Marina Babić-Mladenović (Serbia)
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