

lifelineMDD

Sediment balance and transport study

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Mid-Term Conference

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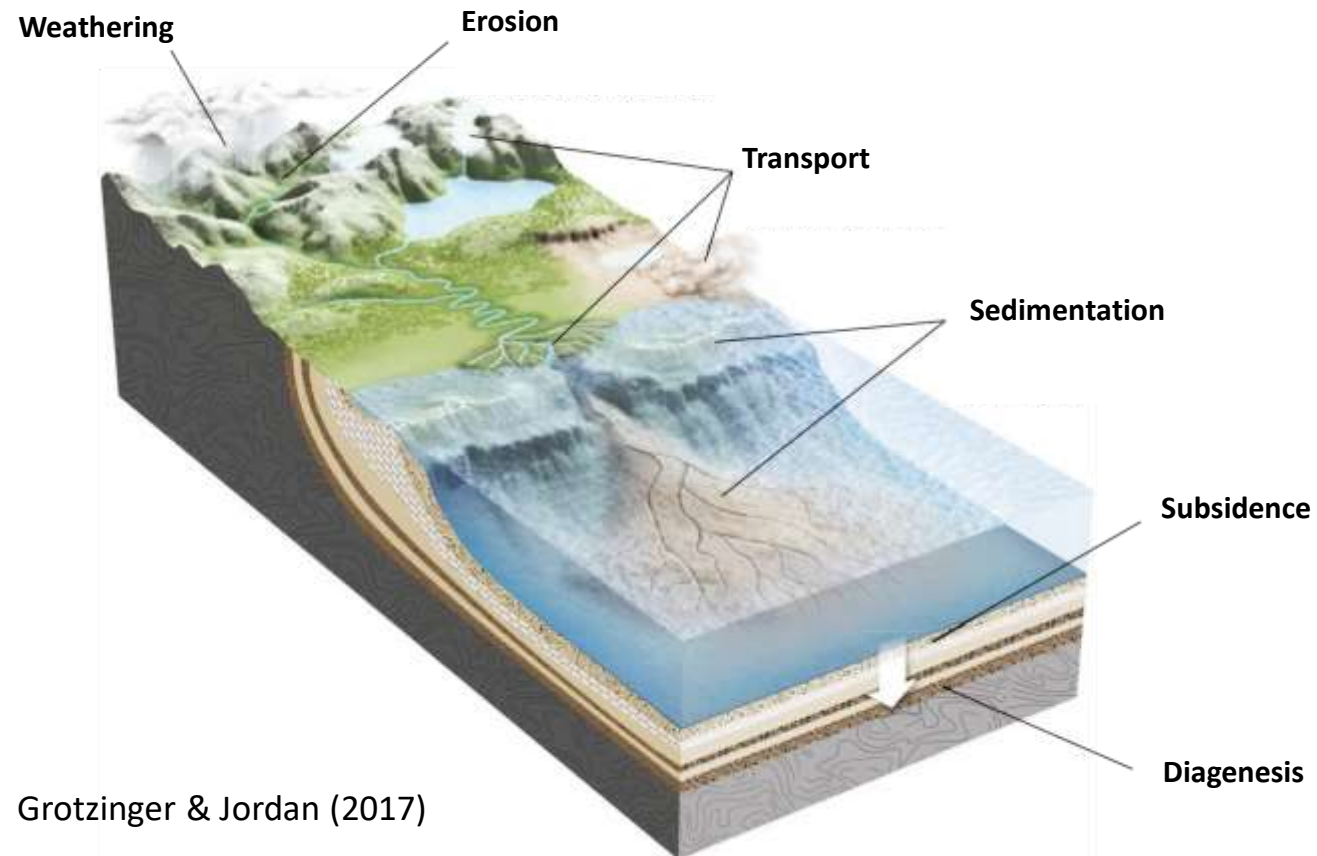


Content

- Introduction into sediment transport and pressures in TBR MDD
- Objectives
- Methods
- Results
- Recommendations
- Conclusions

Introduction

Sediment cycle

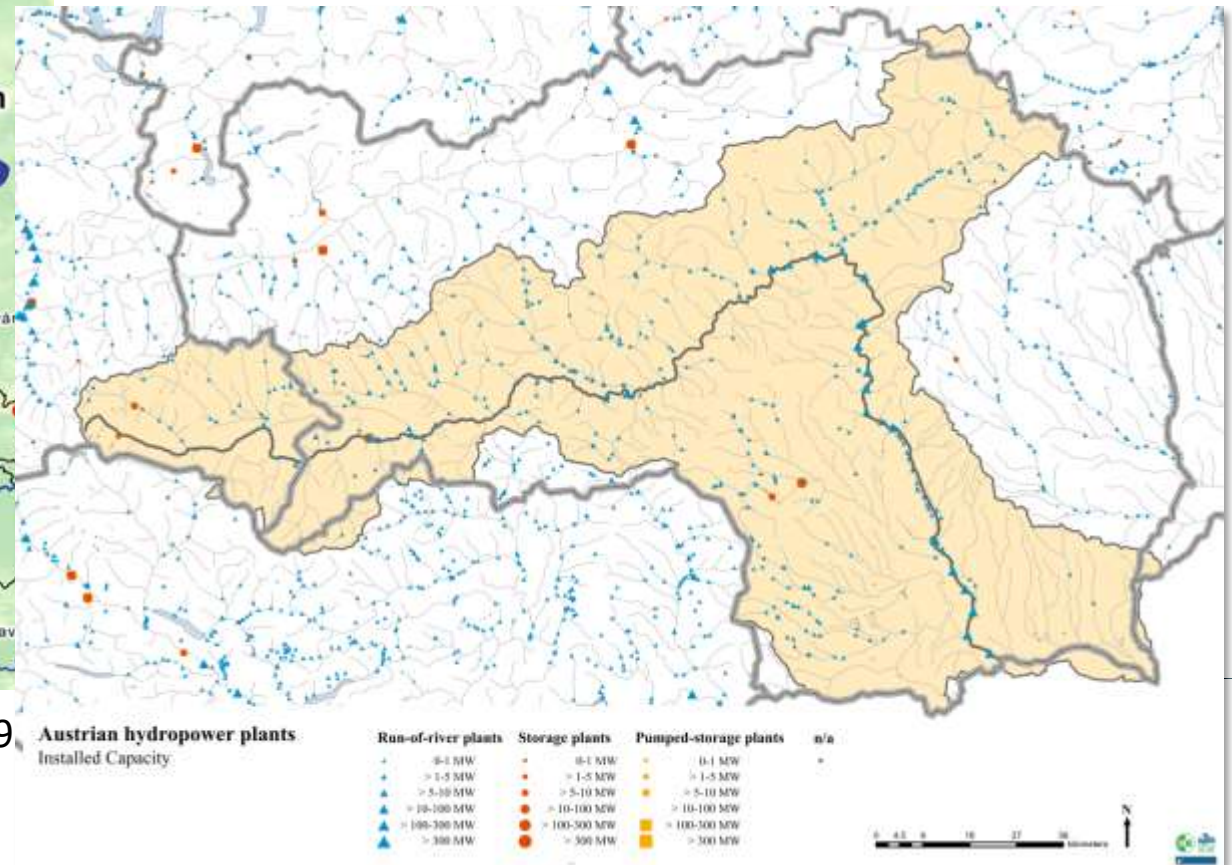


Introduction

Sediment retention in the MDD catchment



(Ulrich Schwarz, FLUVIUS, 2019)

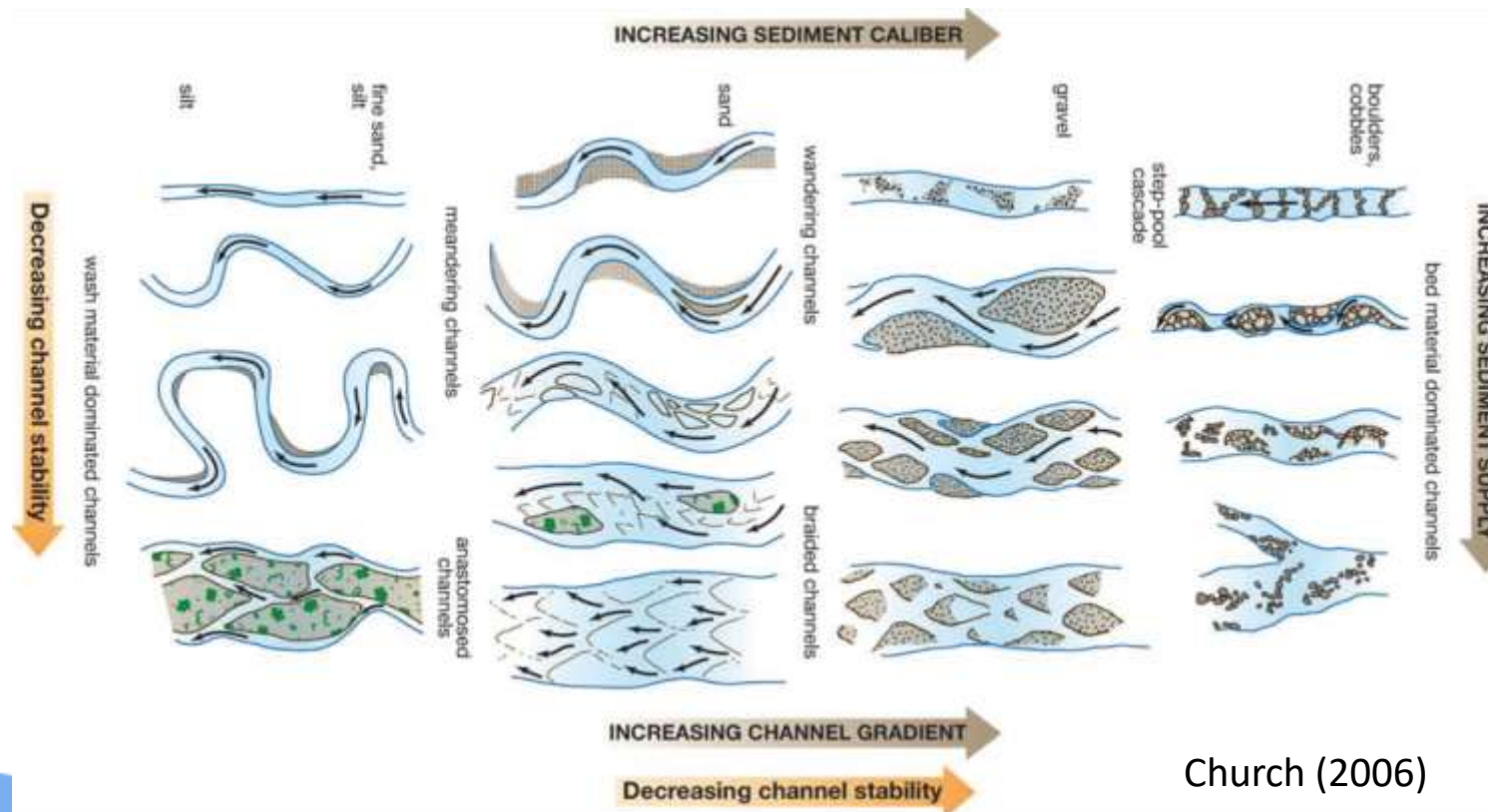


Example: Mura catchment in Austria (Wagner et al., 2015)

Introduction

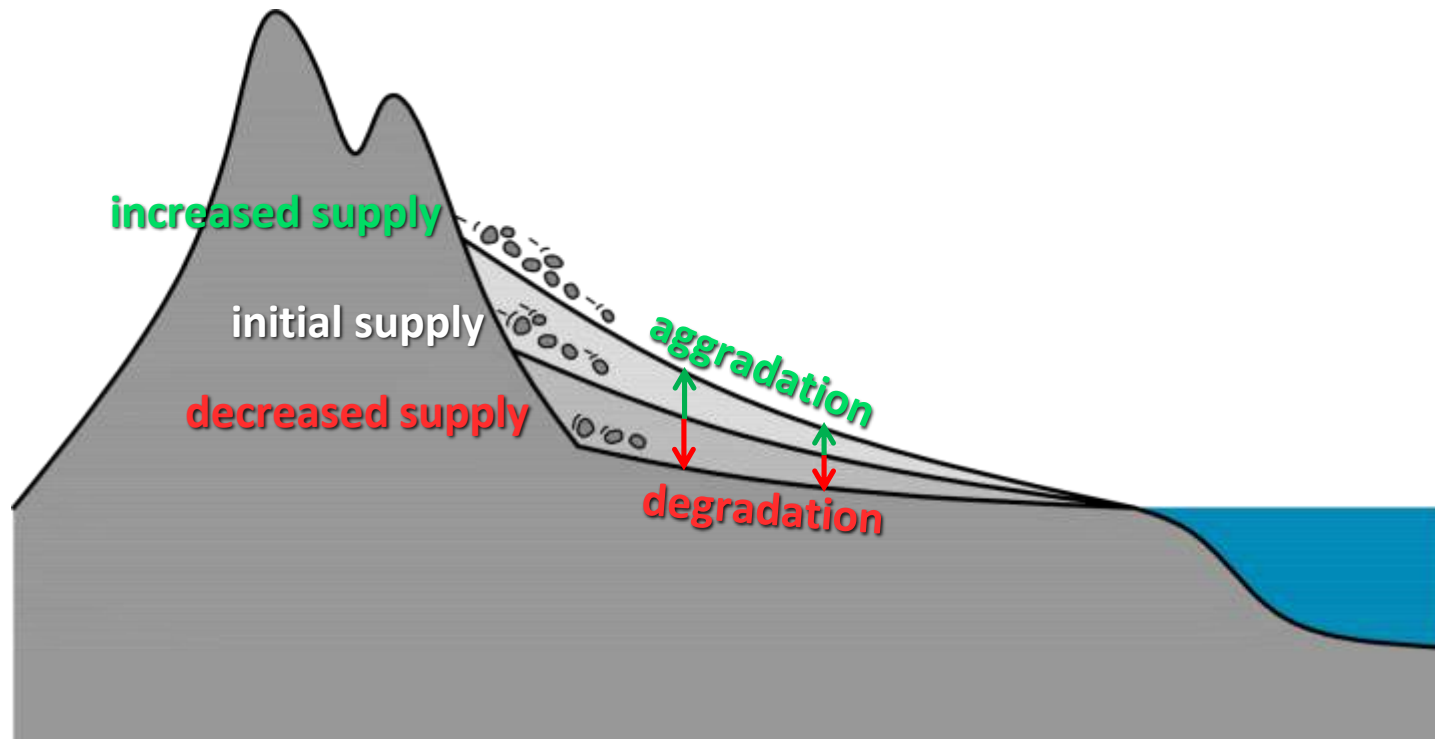
Sediment retention

Sediment supply determines morphodynamics and lateral connectivity



Introduction

Sediment retention



Degradation as a result of slope adjustment

Introduction

Channelization



0 0,5 1 2 3 4 km

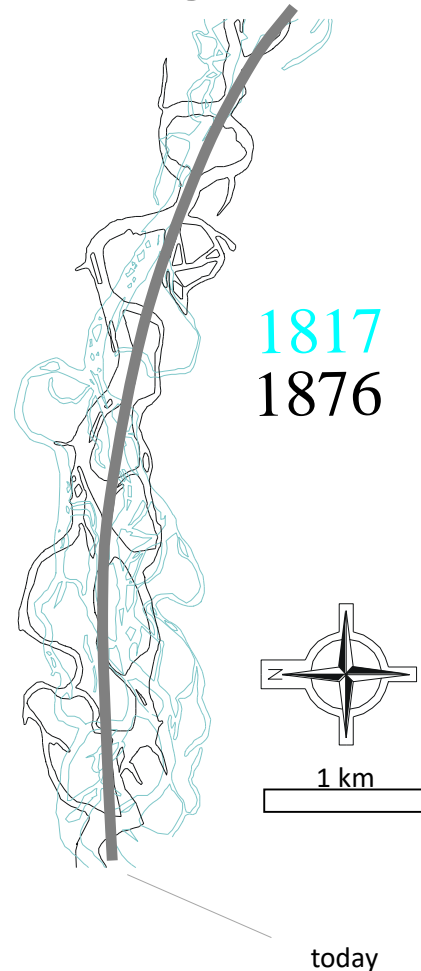


Hochenburger (1894)

Updated „Spezialkarten“ of the 3rd military survey (BEV)

Introduction

Parameters determining sediment transport capacity



Bed shear stress: $\tau = \rho g h l$

Bedload transport:
(eg. Meyer-Peter and Müller, 1948)

$$q_s = 8 \sqrt{\frac{(\rho_s - \rho)}{\rho}} g d^3 \left[\frac{\tau}{(\rho_s - \rho) g d} - 0.047 \right]^{\frac{3}{2}}$$

Bed level change:
(Exner-equation)

$$\frac{\delta \eta}{\delta t} = \frac{1}{n - 1} \frac{\delta q_s}{\delta x}$$

Degradation

or

Aggradation



Study objectives

- Assess disturbances of the sediment balance in the TBR MDD, their root causes, and their effects on river morphology and morphodynamics
- Give recommendations on how to counteract for improving the sediment balance in the whole TBR MDD
- Define priority river reaches for future interventions

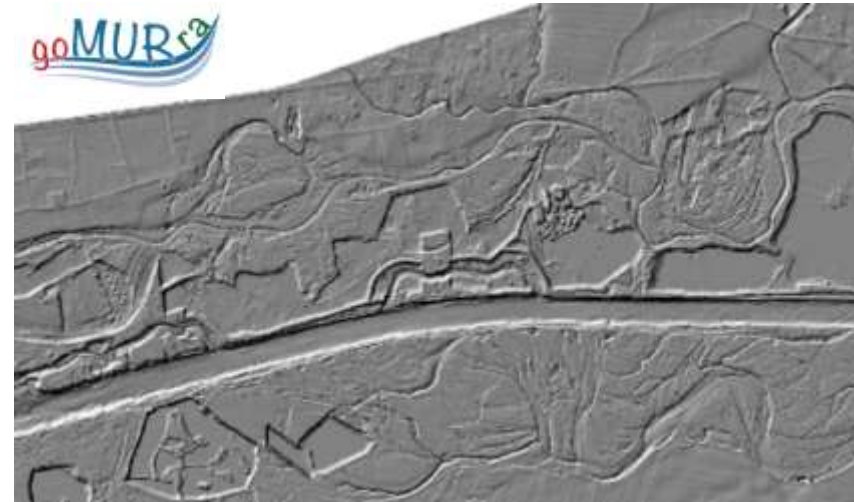
Methods

Analysis of historic state



Archiv Graz – Große Murstromkarte 1809-1815

Analysis of present state



goMURra digital elevation model 2019

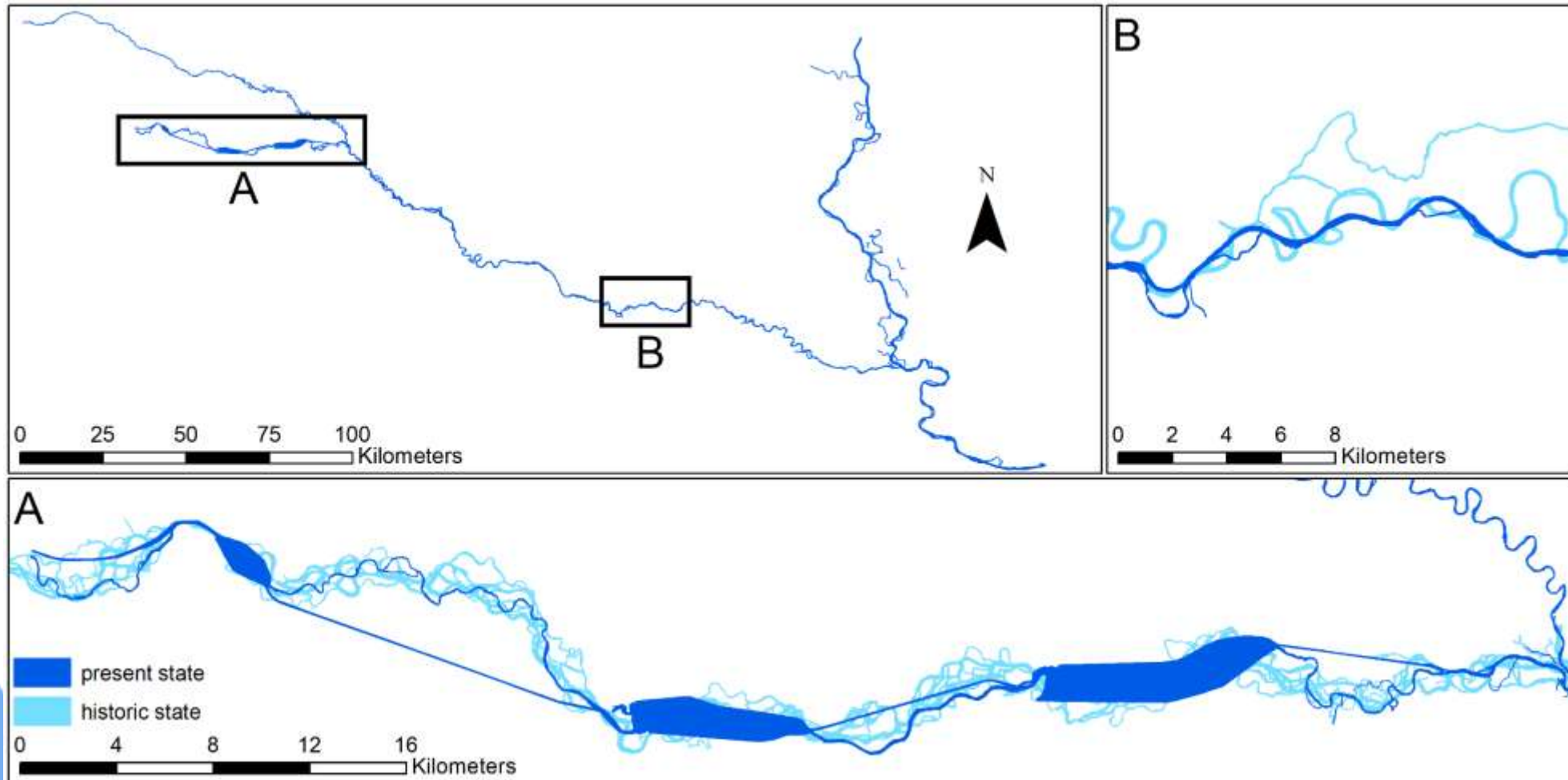
Analysis of deficits and present trajectories

Need for action

Identification of priority reaches

Results

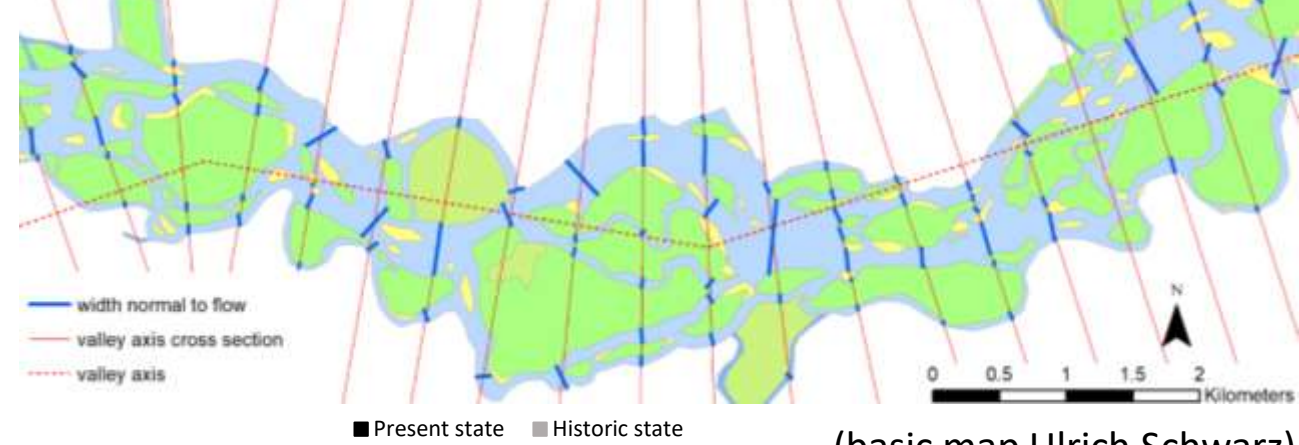
Change of parameters - Exemplified reaches



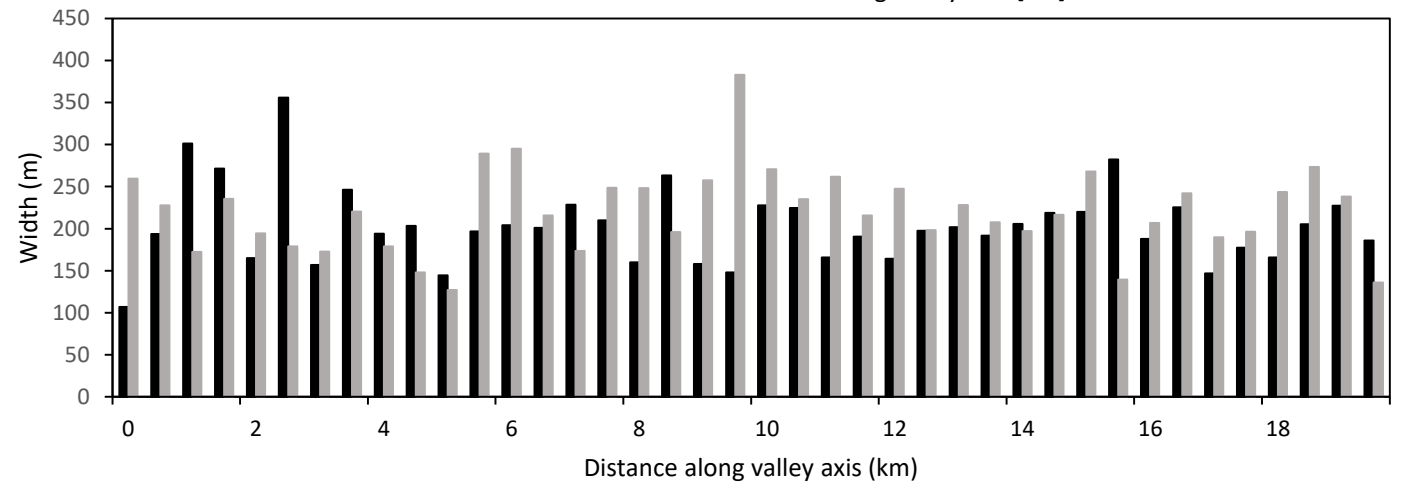
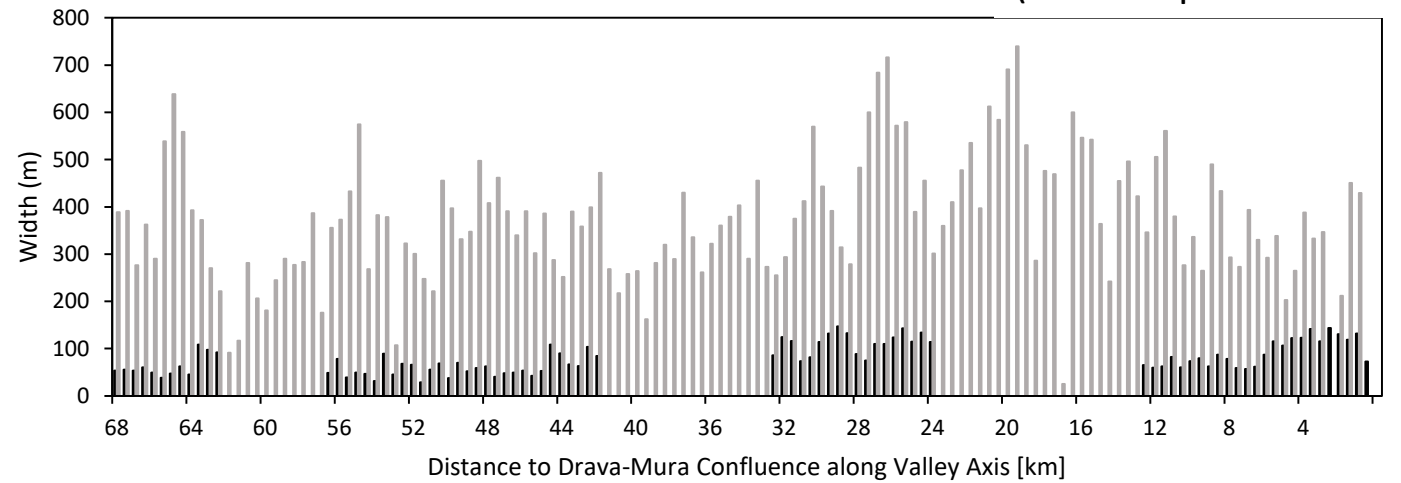
(basic map Ulrich Schwarz)

Results

Channelization - Change of widths

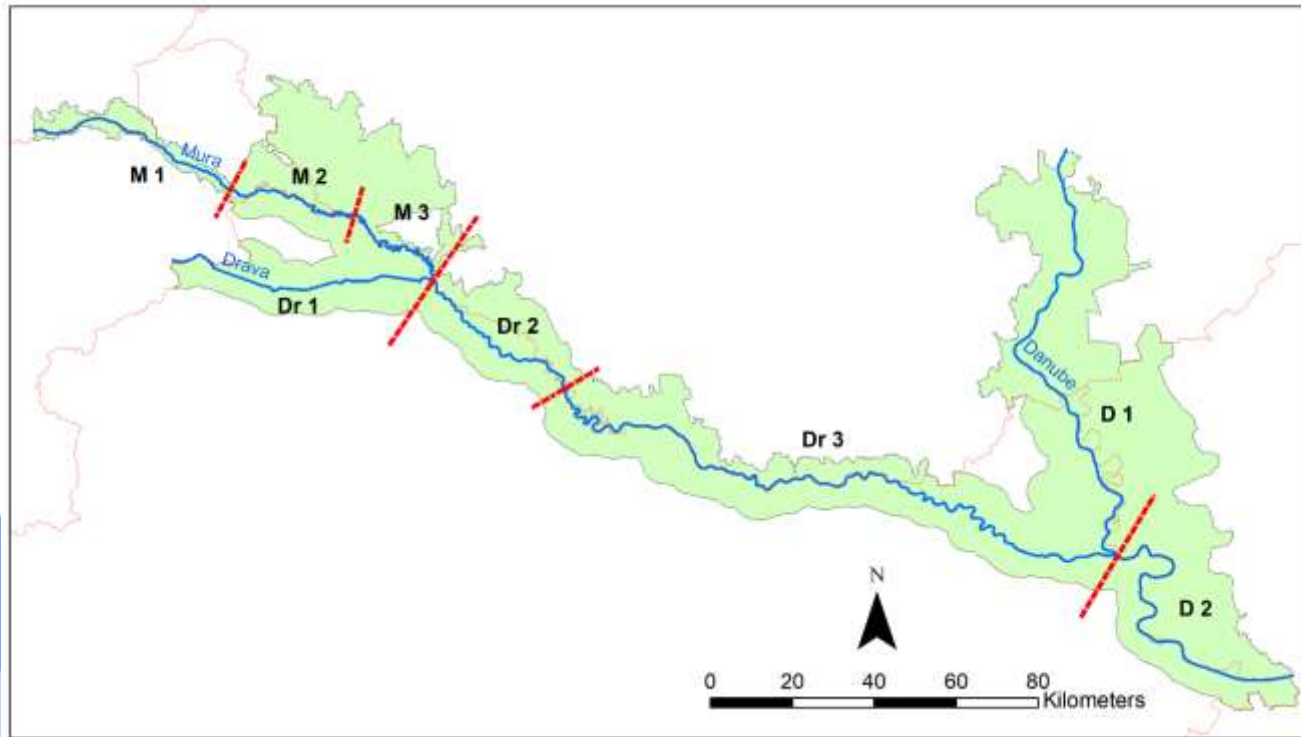


(basic map Ulrich Schwarz)

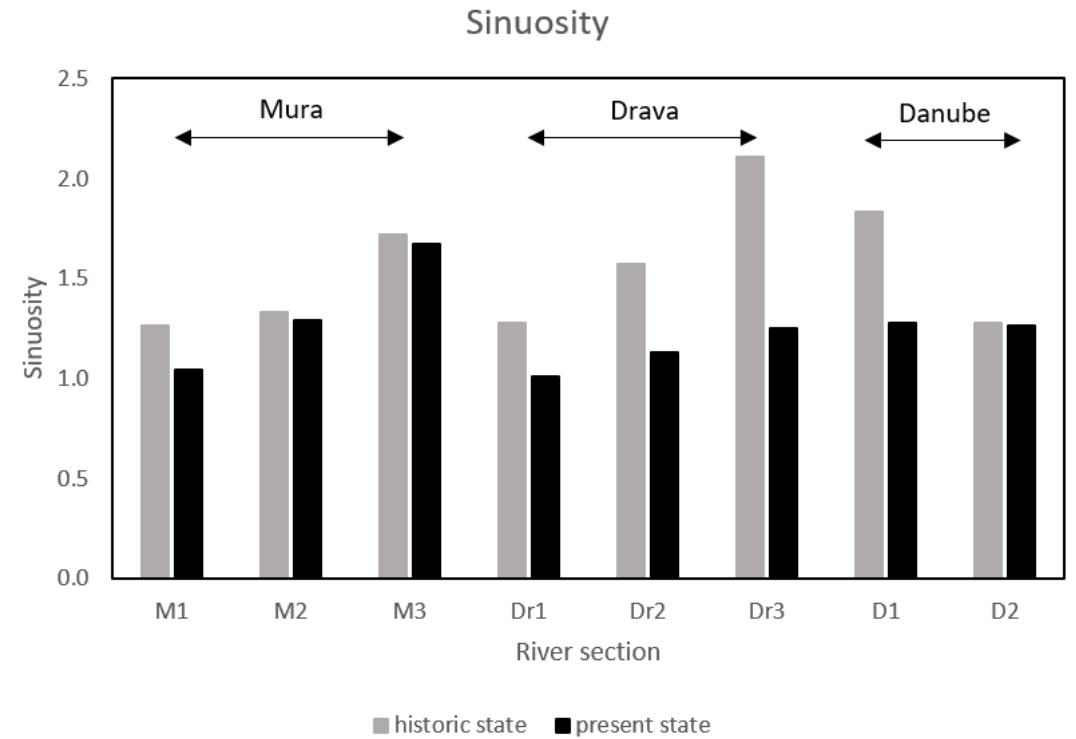


Results

Channelization - Change of sinuosity and slope



(basic map Ulrich Schwarz)



Results

Disturbance of sediment connectivity – Sediment barriers

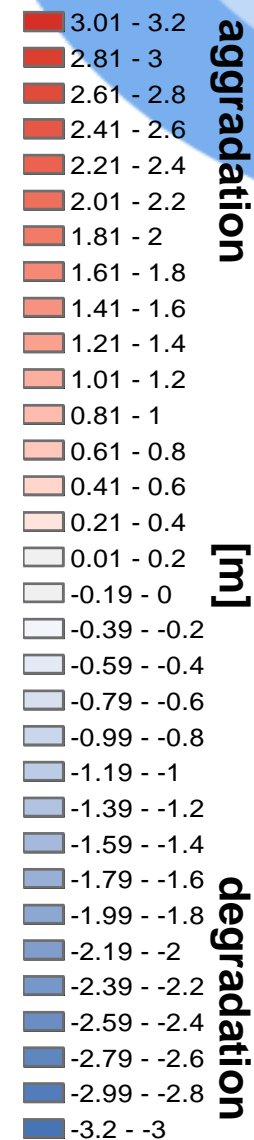
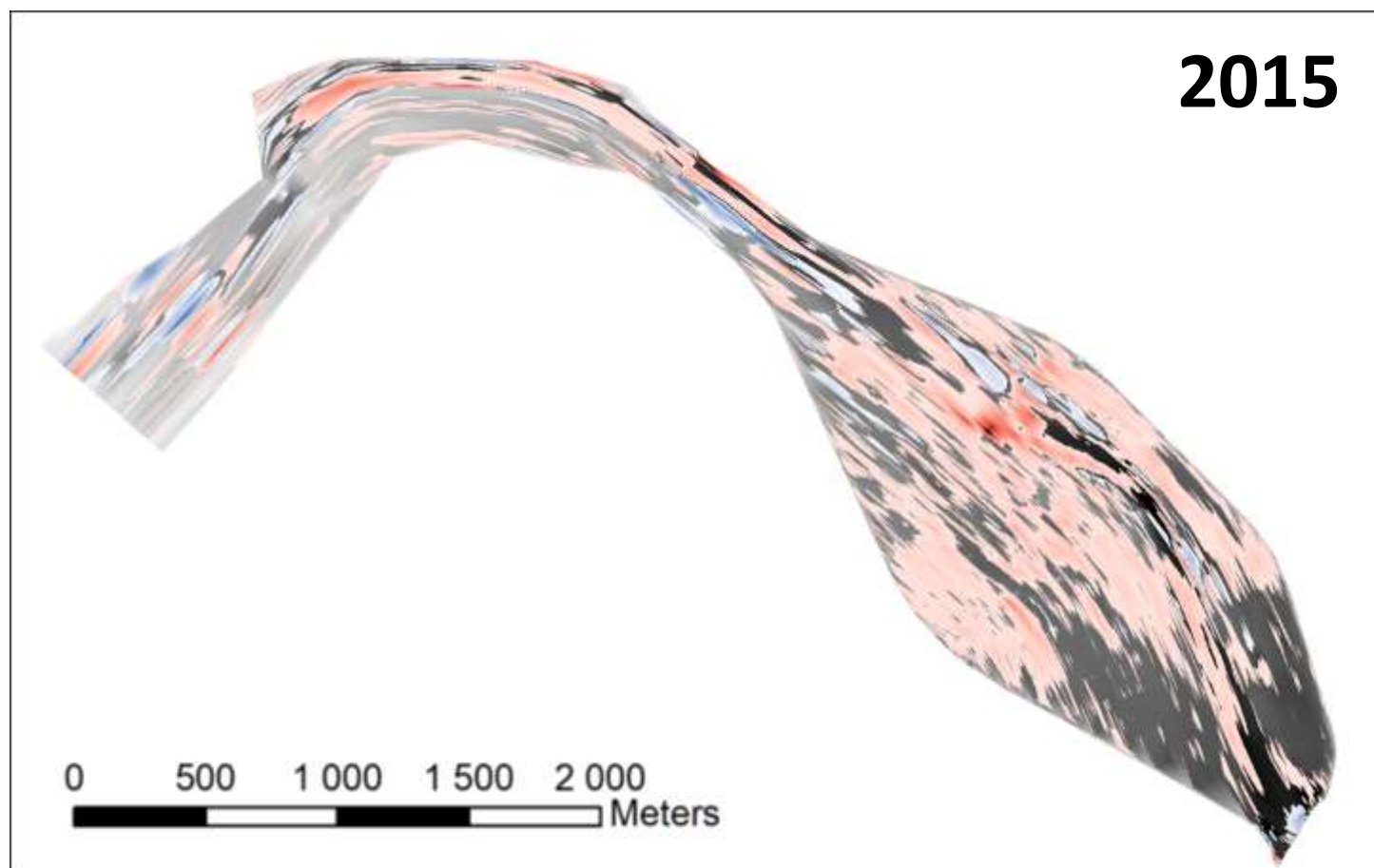


(Ulrich Schwarz,
FLUVIUS, 2019)

Results

Disturbance of sediment connectivity – Sediment barriers

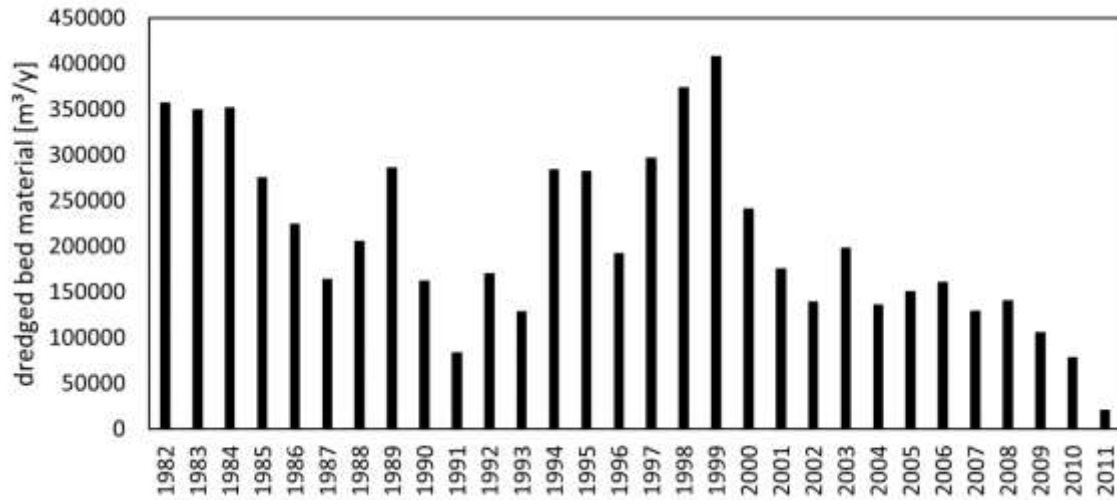
Bed level changes– Varazdin (Ormosko) 2006-2015



Data source: Croatian Waters

Results

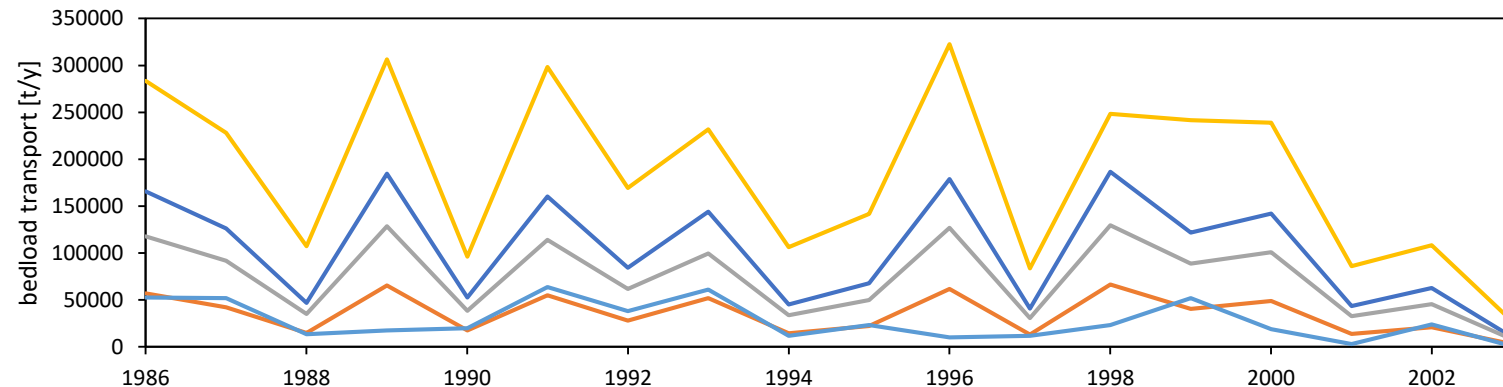
Disturbance of sediment connectivity - Dredging



Baranya (2020), including data from Vituki (2003) and EJF



For comparison: annual bedload yields



Rákóczi and Szekeres, 2004

— Botovo — Bélavár — Barcs — Drávaszabolcs — Letenye

Results

Effects: Self-dynamic narrowing

Reduction of sediment supply
decreases depositional features and
narrows the channel

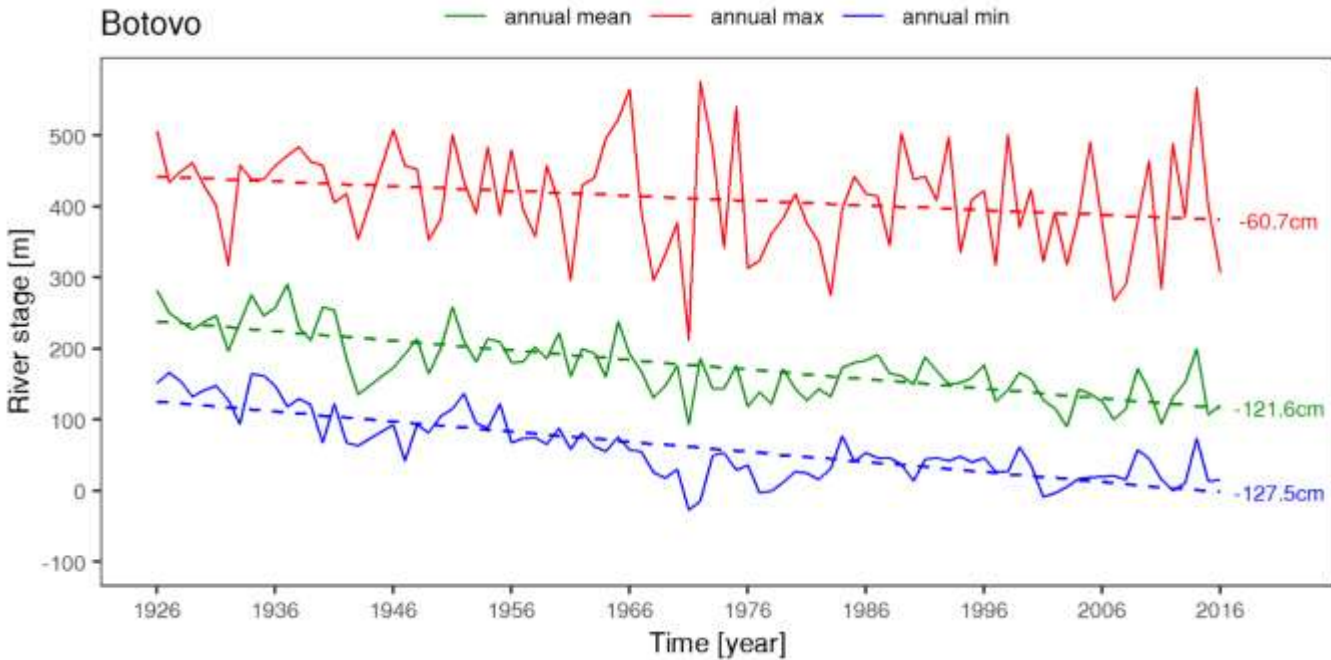


(aerial images
provided by Ulrich
Schwarz)

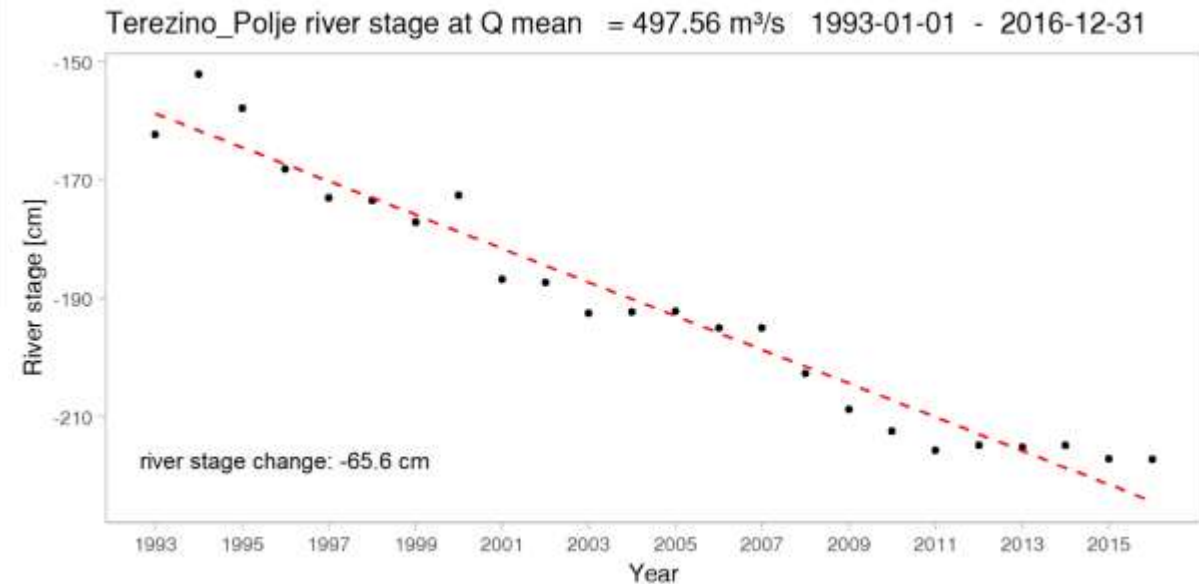
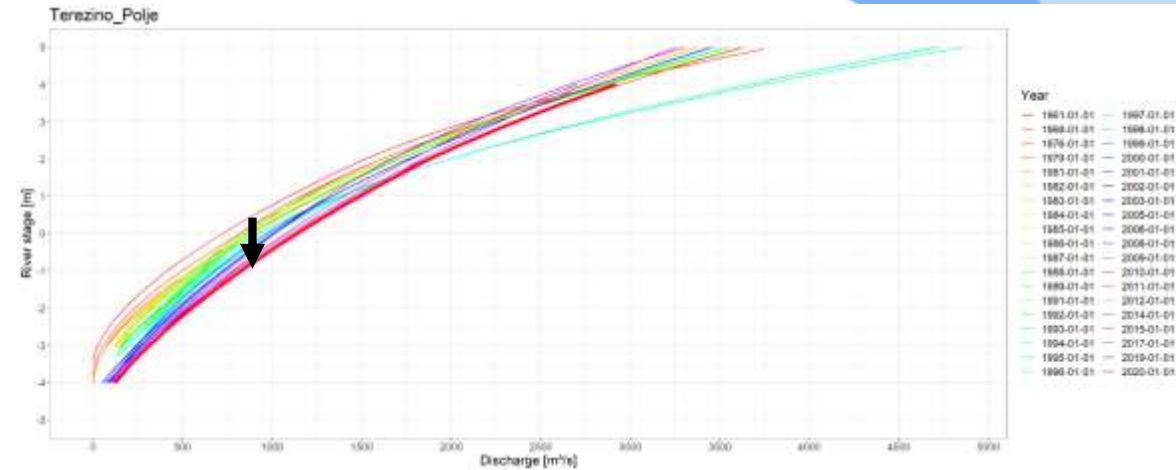
Results

Effects: Bed incision

Decrease of water levels at gauging stations



Decrease of water levels



Results

Bed level changes in TBR MDD

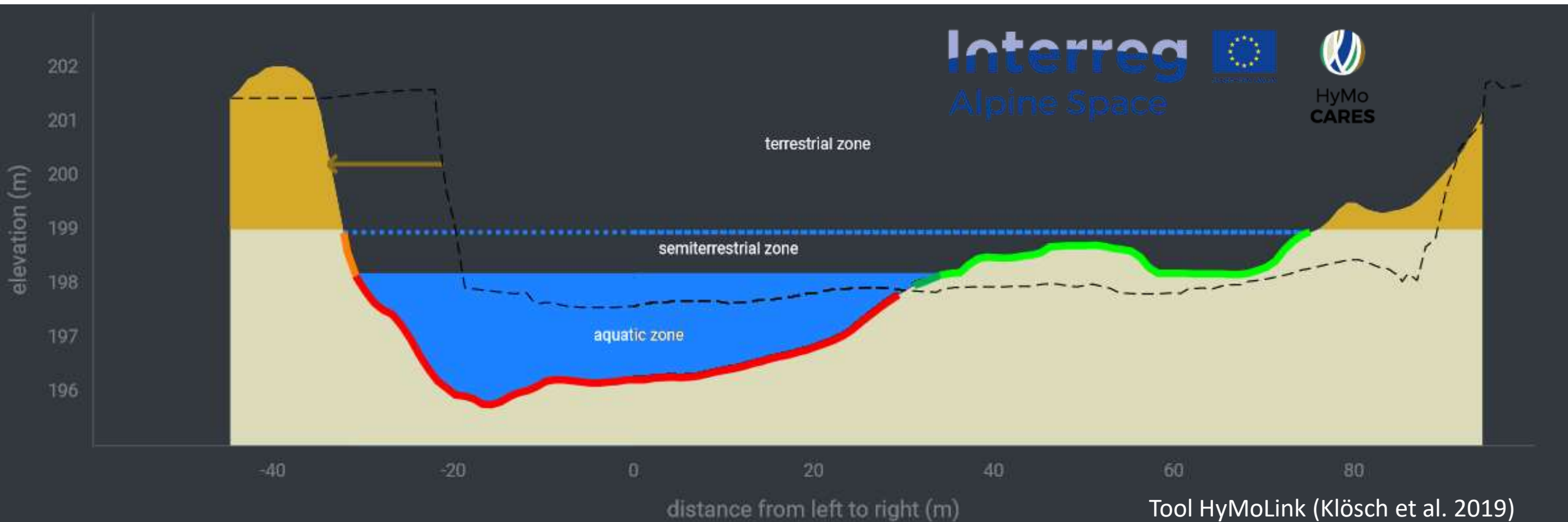


(data sources of analyses: ARSO, Croatian Waters, Hydrographic Service Styria, NYUDUVIZIG)

Results

Restoration effects

Example Sicheldorf (Mura along SI-AT border)

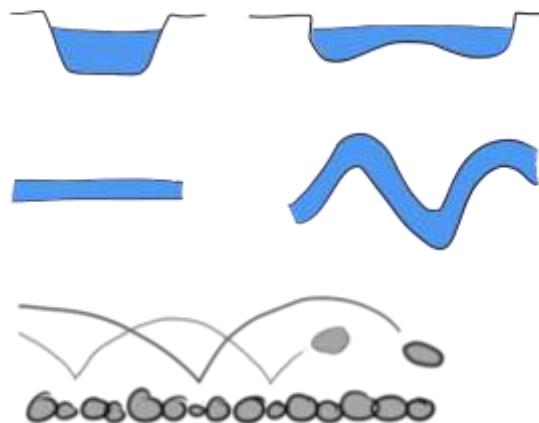


Results



Requirements for restoration

- Provide width
- Introduce curvature
- Supply with sediment
- Provide a corridor



$$\tau = \rho g h l$$

$$\tau = \rho g h l$$

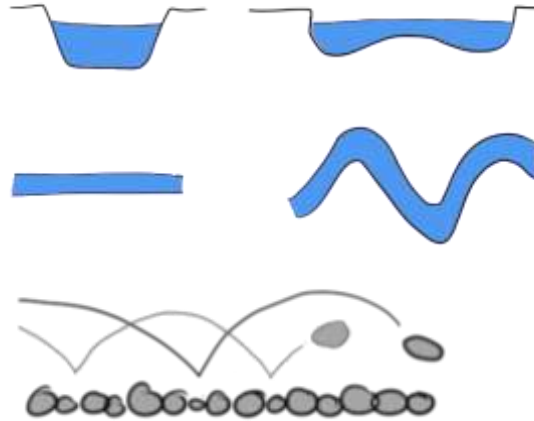
	Width	Sinuosity
Type 0		
Type A		
Type B		
Type C		

Results



Requirements for restoration

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$$\tau = \rho g h l$$

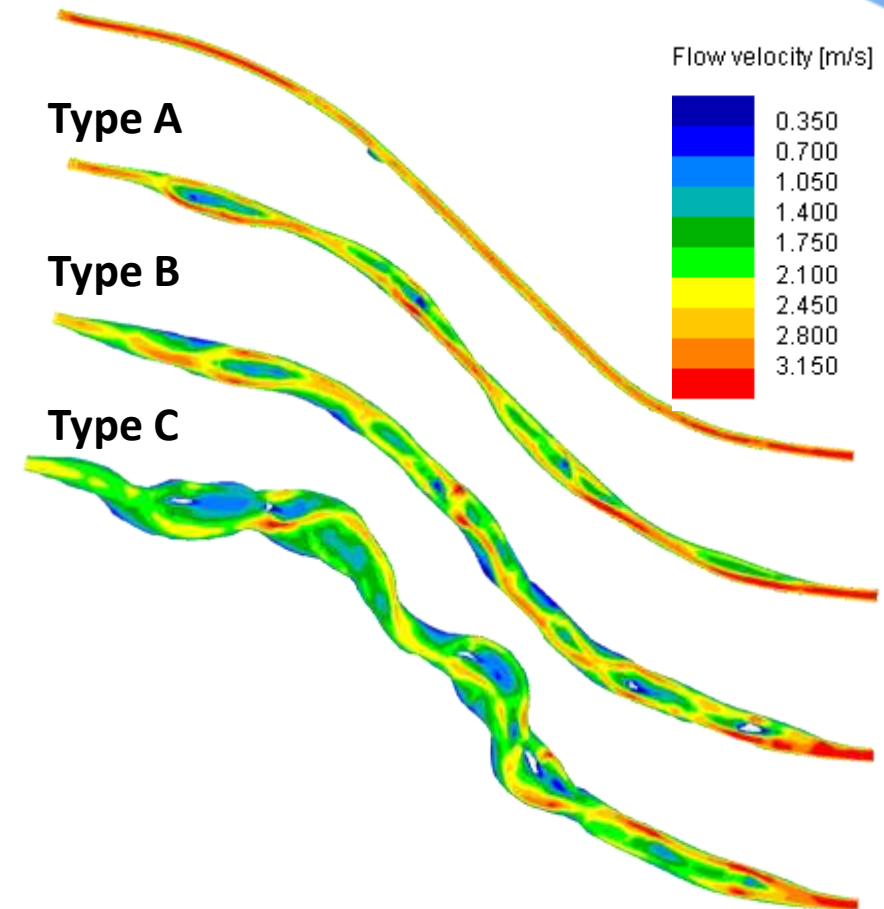
$$\tau = \rho g h l$$

Type 0

Type A

Type B

Type C

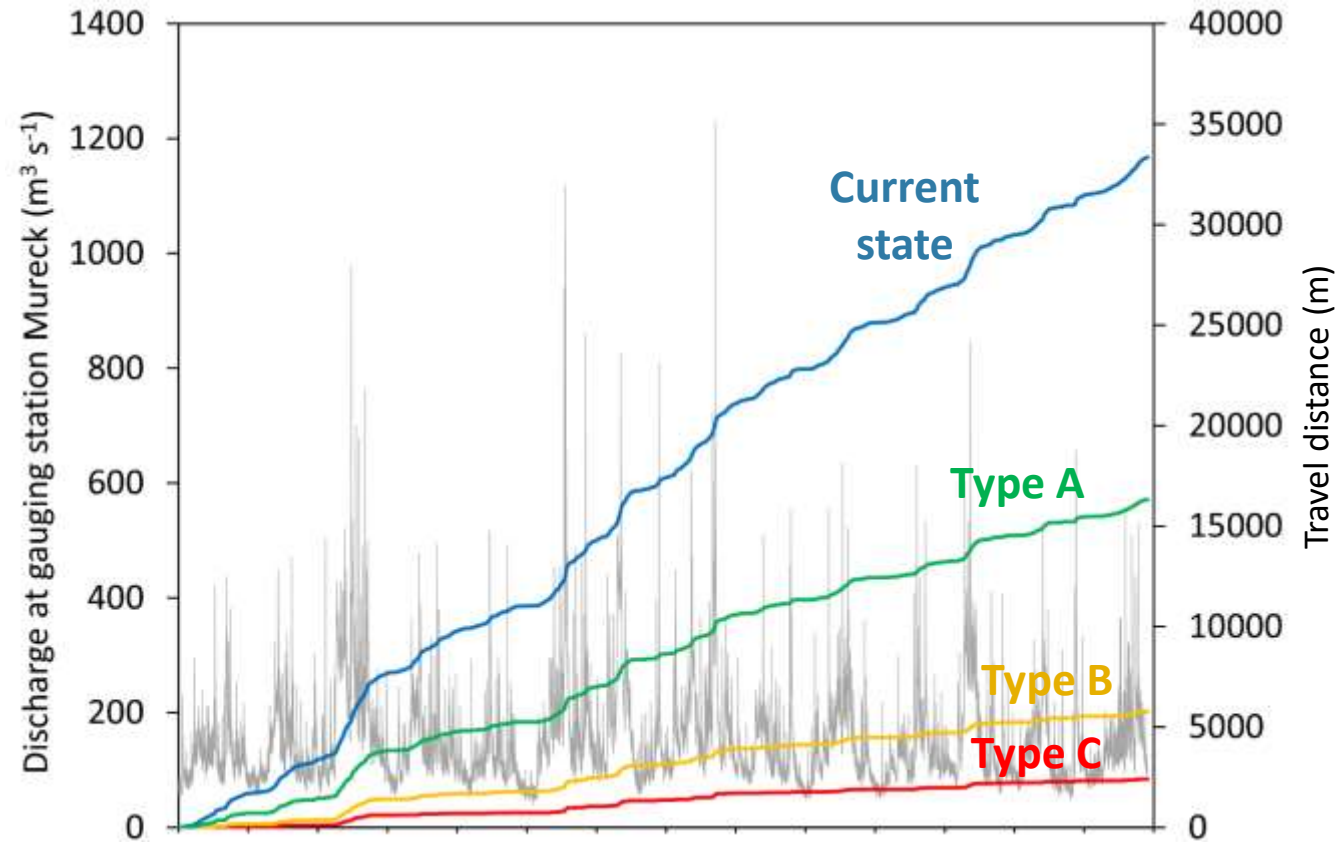
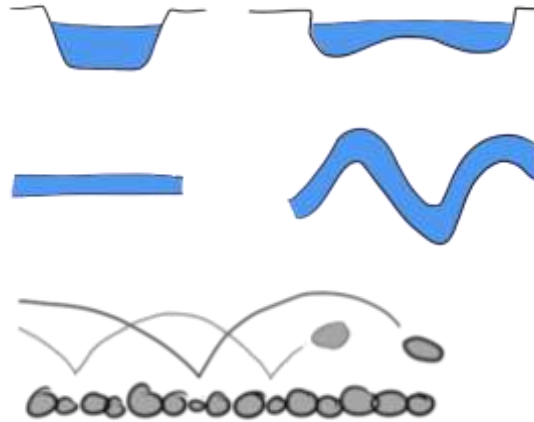


Results



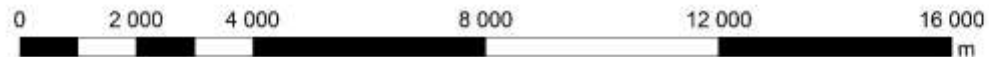
Requirements for restoration

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Discharge time series: Hydrographic Service Styria

Results



- Farbende**
-  Wasserfläche
 -  Kiesbänke
 -  Gebüsch
 -  Bäume auf Inseln
 -  Eigendynamische Uferentwicklung



Preliminary conclusions

- Channelisation strongly altered parameters which determine sediment transport capacity
 - Large dredging activities removed considerable amounts of sediment
 - Strong presence of sediment barriers in the catchment upstream, self-dynamic narrowing observed before channelisation due to barriers
- Increased transport capacity and channel incision throughout the entire TBR MDD
- Boundary conditions worsen – bedload originating from upstream incision is limited!

Recommendations:

- Increase of width and curvature and sediment supply provide morphodynamics and habitats
- Bedload supply needed for natural morphology and morphodynamics
- Wider and/or more curved channels need less sediment supply for balanced budget
- Action already needed to restore, but also just to preserve

Thank you!

...Open for Discussion