Sediment management in the Rhine catchment: Inventory of knowledge, research and monitoring, and an advice on future sediment research - „Rhein-Sed“

CHR 50 years jubilee conference

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Content

- Introduction
- Objectives of „Rhein-Sed“
- Methods and activities in „Rhein-Sed“
- Exemplified research questions derived
- Future project ideas
Introduction

Sediment cycle

Weathering

Erosion

Transport

Sedimentation

Subsidence

Diagenesis

Grotzinger & Jordan (2017)
Introduction

Rhine longitudinal profile
Introduction

Channelisation effects

\[ \tau = \rho g h I \]

\[ q_0 \ast = 8.047 \]

Arnaud et al. (2019)
Introduction
Effects of sediment barriers

Slope adjustment

(Rijkswaterstaat)
Introduction

The Rhine River is still adjusting to measures in the past 200 years

Effect of climate change

Large-scale human impacts

1817
Start meander cut-offs
German Rhine (Tulla)

1850

• Normalizations and dredging
• Meander cut-offs
• Storm surge barriers and dams
• Canalizations Meuse and Nederrijn-Lek
• Development of ports and harbours

(Rijkswaterstaat)
Introduction

Rhine sediment budget (1991-2010)

Hillebrand and Frings (2017), Frings et al. (2019)
Objectives

• Establishment of a coherent overview on sediment-related problems and activities at the Rhine River and relevant tributaries, especially activities affecting the sediment transport in the Rhine basin
• Identification of knowledge gaps
• Recommendations for complementing monitoring activities
• Recommendations for the establishment of a new research program
Methods

• Establishment of a Steering Committee

• Interviews with experts

• Literature research

Conclusions

Steering Committee

Report draft

Final report
Results

Exemplified challenges found in the five sections:

**Lower Delta section:** Increased backwater from sea level rise affecting sediment transport

**Upper Delta section:** The migration of the gravel-sand transition causes bed level changes, limited understanding due to unclear causes

**Free-flowing section:** For sediment budgeting, missing knowledge on the exchange of sediment between main channel and groyne fields

**Impounded section:** Nourished sediment in Old Rhine did not cause desired morphology

**Alpine section:** Encroachment of vegetation on bars – Missing guidance when vegetation has to be removed
## Results

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<th>Monitoring</th>
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**Aggregation of research questions to research topics**

- What are the sections where challenges are currently developing?
- How is the sediment transport affected by channelization measures?
- How to monitor the bedload transport through the Rhenish Massif?
Results of the Rhein-Sed project

Suggestion of 9 research topics:

1. Influence of climate change and land use change on the sediment regime
2. Impacts of river engineering (including channelization and continuity disruptions) on the entire Rhine’s morphology and sediment budget
3. Impact of sediment management activities on the overall sediment budget of the Rhine River, and identification of possibilities for improvement
4. Harmonization of monitoring strategies and consideration of new monitoring techniques
5. Optimisation of sediment budgeting
6. Assessment of the transfer of coarse sediment through the Rhenish Massif
7. Determination of the demands of different sectors (hydropower, navigation, flood risk management, ecology) on a sustainable management of sediment and morphodynamics
8. Vegetation and sedimentation
9. River restoration: Bank erosion and channel widening, and the interactions with sediment regime and sediment budget
Recommendations for follow-up research

Definition of the three most important project ideas

1. Influence of climate change and land use change on the sediment regime
2. Alteration and improvement of sediment balance and continuity, sediment transport, and morphology (in the context of the spatial and temporal development of river engineering and management in the Rhine River and major tributaries)
3. Sediment transport processes and management – National and bilateral projects
   3.1 Individual studies on sediment processes
   3.2 Bilateral projects addressing sediment management
Thank you