# Check dam impact on sediment load: a catchment scale experiment from the Guerbe River, Swiss Alps

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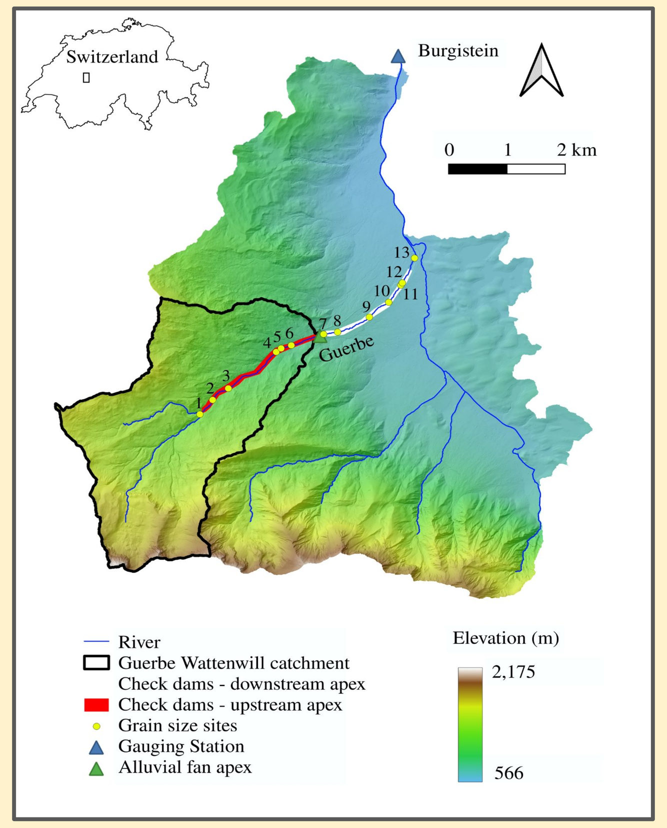
## Introduction

- The construction of check dams is a common practice where the aim is to reduce the damage by flooding events along mountain streams.
- Quantifying the effectiveness of such engineering structures has remained very challenging, especially when considering cases with check dams older than 100 years.
- Variations in the stream bedload capacity for engineered or non-engineered conditions are a potential indicator of the check dam's efficiency.

Our objective is to present a method able to quantitatively evaluate the functioning of check dams using the Guerbe River as a study case.

## Local setting

- The Guerbe River has been engineered since the century XIX.
- Currently presents more than 110 check dams along a c. 5 km reach where sediment has been continuously supplied from adjacent hillslopes, primarily by landsliding.
- This stream is engineered along a reach that ran on a steep sediment supply area followed by a depositional zone above an alluvial fan.

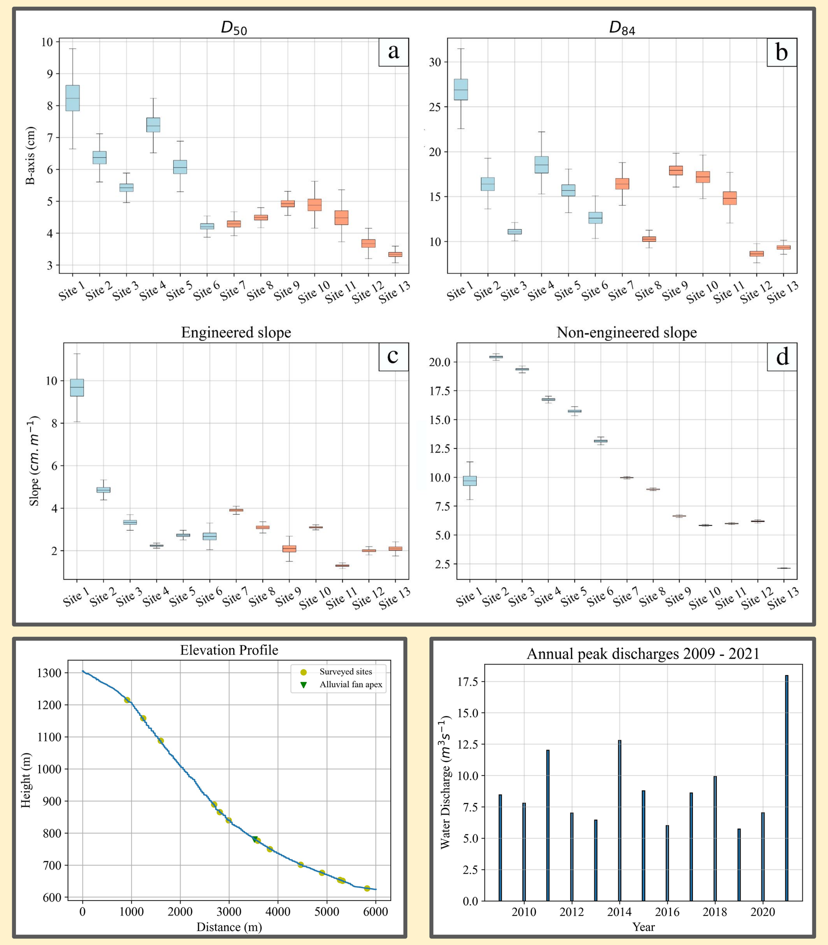



## Methods

- Data acquisition on grain sizes and slopes with high-quality control from UAV imagery, photogrammetry processing, and DEMs.
- Water discharge estimation using data obtained in a gauging station as reference.
- Define conservative assignments of values to the parameters for non-engineered scenarios.
- Calculation of the bedload flux for engineered and non-engineered conditions by applying two different equations: Meyer-Peter and Müller [1,5] (MP.M.) and Recking [2,4].

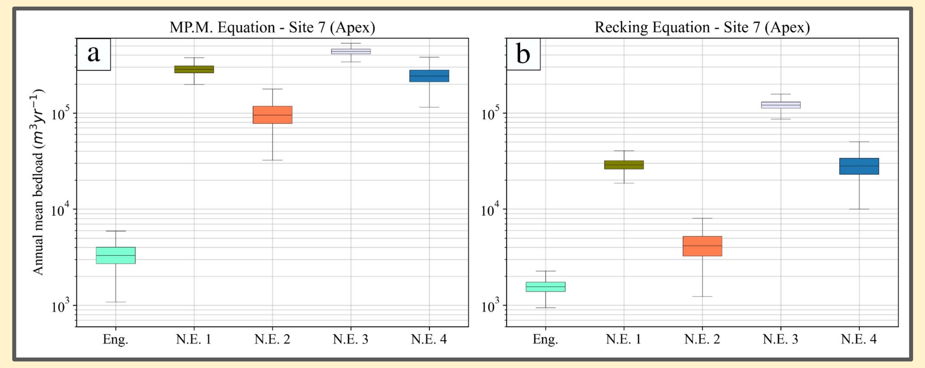
## Field measurements

- Rapid decay of grain size percentiles in the sediment supply reach.
- Flatter slopes in the engineered reach downstream to site 1.
- Steeper slopes in the sediment supply reach for non-engineered conditions.
- Peak discharges variating between 5 to 18 $m^3 s^{-1}$ at the fan apex.



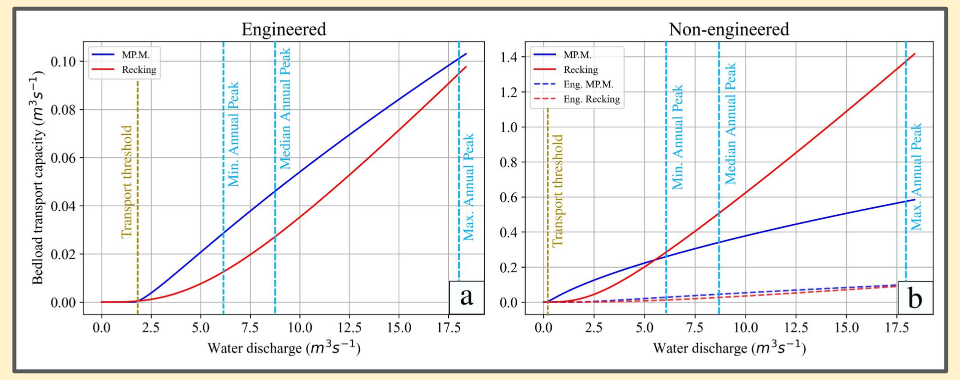

- Evidence of a knickpoint between sites 1 and 2.

## Bedload predictions

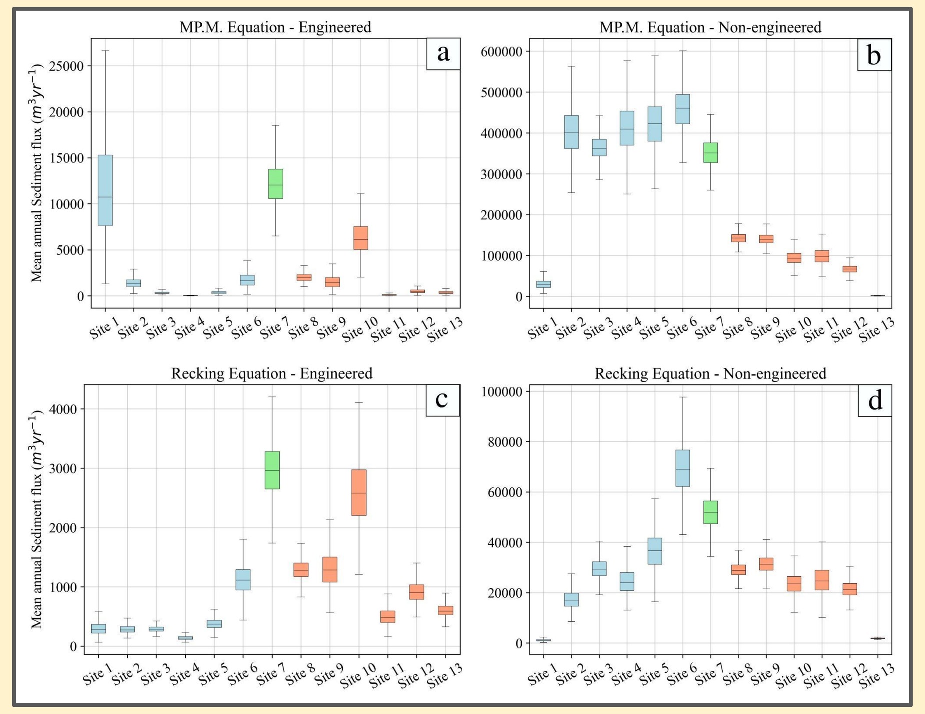



Non-engineered scenarios at fan apex:
N.E. 1: 75% of the width and grain sizes from site 7.
N.E. 2: 75% of the width and grain sizes from site 1.
N.E. 3: 25% of the width and grain sizes from site 7.
N.E. 4: 25% of the width and grain sizes from site 1.

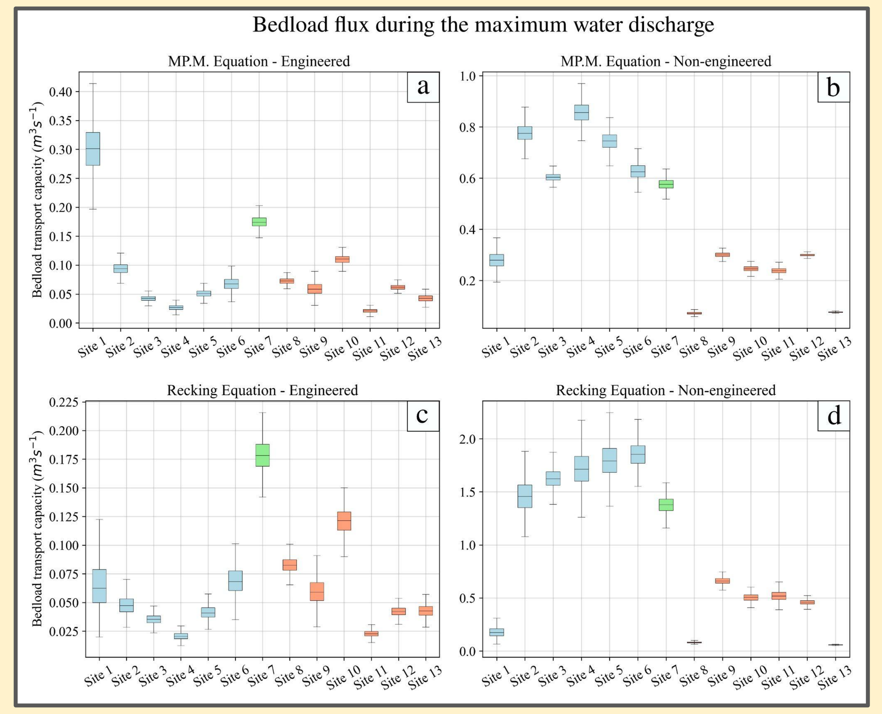
- For non-engineered conditions at the fan apex, we calculate mean annual bedload rates that are between c. 10 (Recking approach) to 100 times higher (MP.M. approach).
- Fluctuations of bedload capacity for engineered conditions in the downstream direction evidence regulation in the sediment transport.




- Both equations presented similar patterns and values for engineered conditions.
- For non-engineered conditions, the two approaches present distinct patterns.




- An expressive increase in the bedload flux between sites 1 and 2 for non-engineered conditions indicates the presence of riverbed erosion at the knickpoint.




- The high capacity of sediment transport at the natural state along the reach upstream of the fan apex evidences an increase in the sediment input, more likely from activation of the hillslope instabilities.

## Conclusions

- The applied method allowed us to quantify within uncertainty ranges the impact on sediment production due to the presence of check dams in the Guerbe River.
- Additionally, our analysis identified three functions of the check dams to prevent hazards [3]:
  - Sediment transport regulation, which decreases the intensity of bedload fluxes during peak discharge events.
  - Bed stabilization, which avoids incision at the head of the river.
  - Hillslope consolidation, which increases the stability of the hillslopes next to the channel, thus decreasing the probability of landslides.

## References

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