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S2S Future
SIGNAL PROPAGATION IN SOURCE-TO-SINK

Impact of river management on grain size patterns: example of the Sense and Gürbe Rivers in the Swiss Alps

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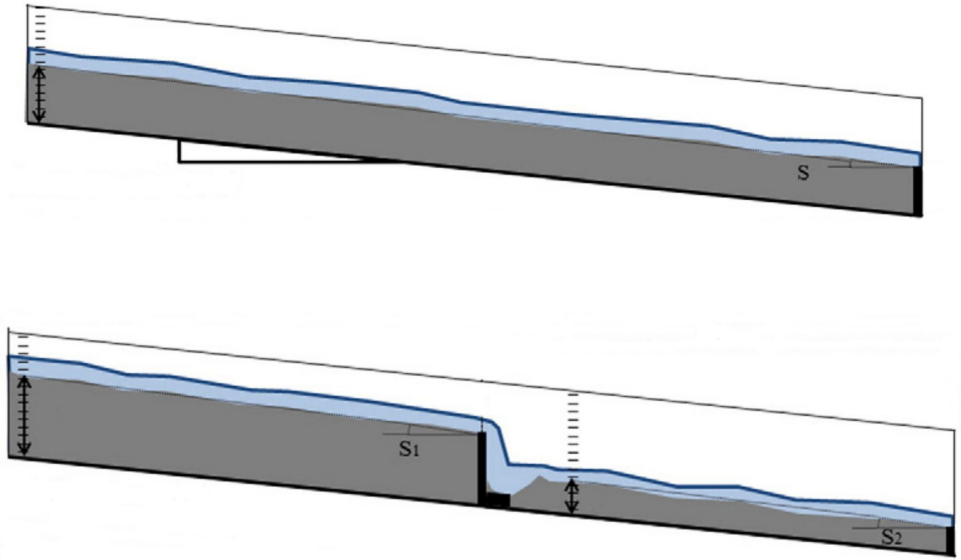
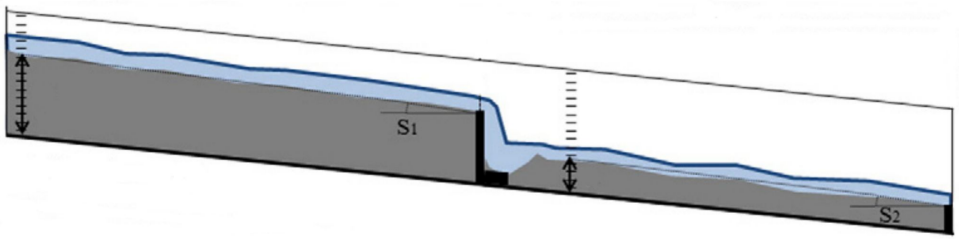
Sense River - August 2021

What is a check dam?



Very common in mountain streams

What is a check dam?



This structure is built to:

(1) Prevent riverbed incision.

(2) Decrease lateral hillslopes

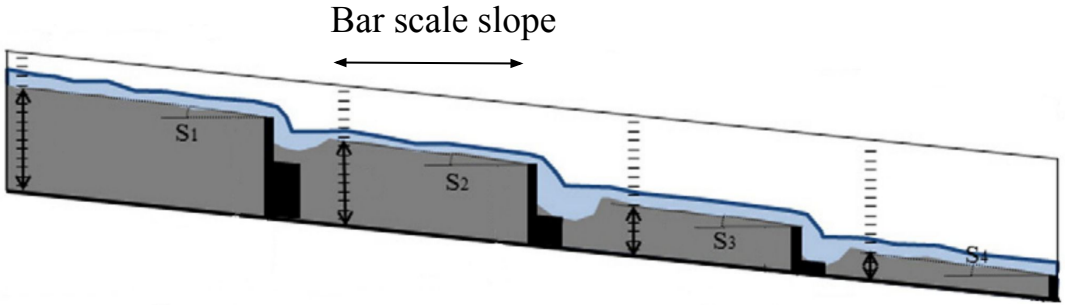
(3) Decrease the probability of debris flows.

(4) Regulate the sediment transport

(Piton et al. 2016)

The Gürbe River case

116 check dams along cc. 5km



(1) Can the construction of check dams on mountain streams impact their grain size patterns?

Consequences for the:

- Gravel industry
- Fluvial ecosystems
- Interpretation of grain size patterns in geosciences.

To answer the presented question we:

(1) Selected two Alpine mountain streams, the Gürbe and the Sense rivers. One highly engineered and the other in its natural state.

(2) Obtained large dataset of grain sizes and slopes of exposed gravel bars, for both rivers.

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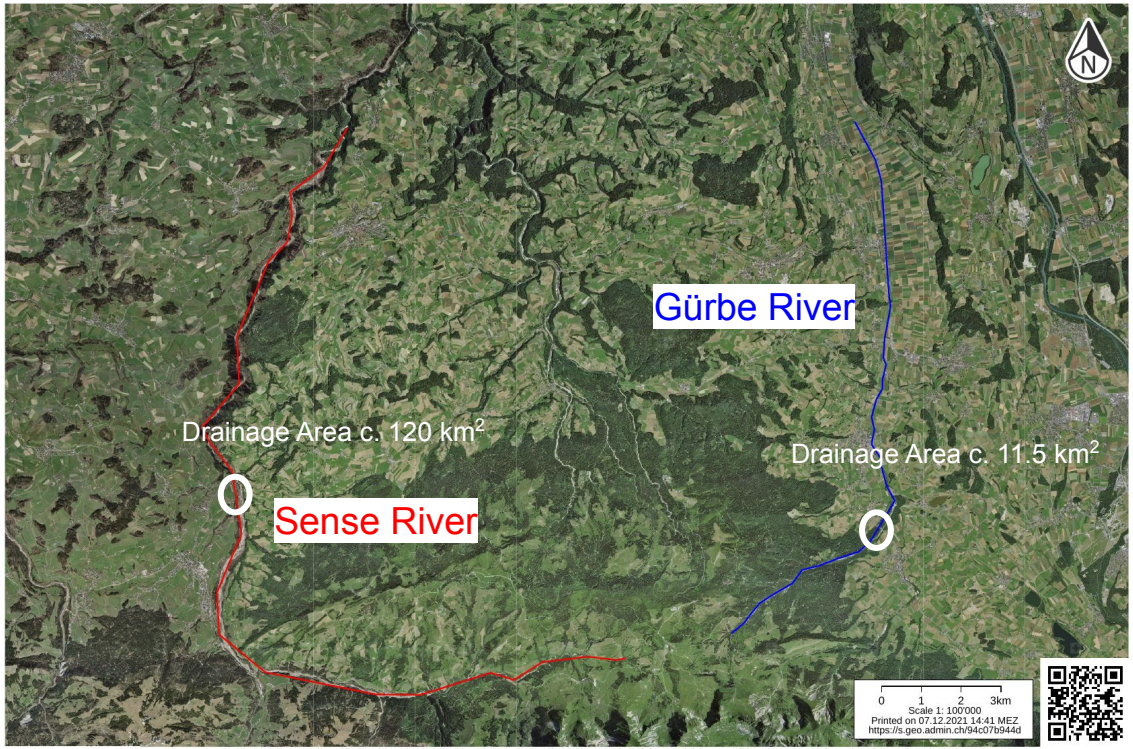
The Sense River

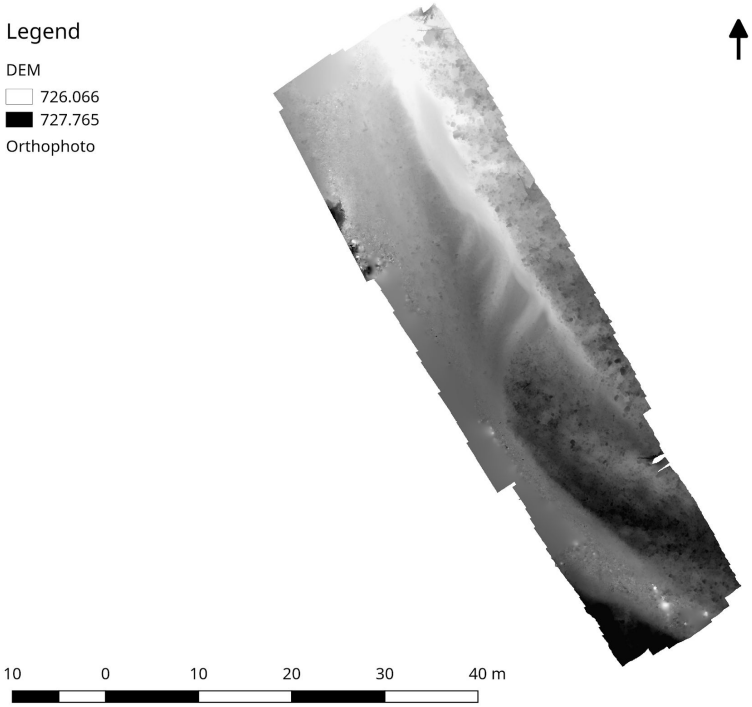


Grain size acquisition

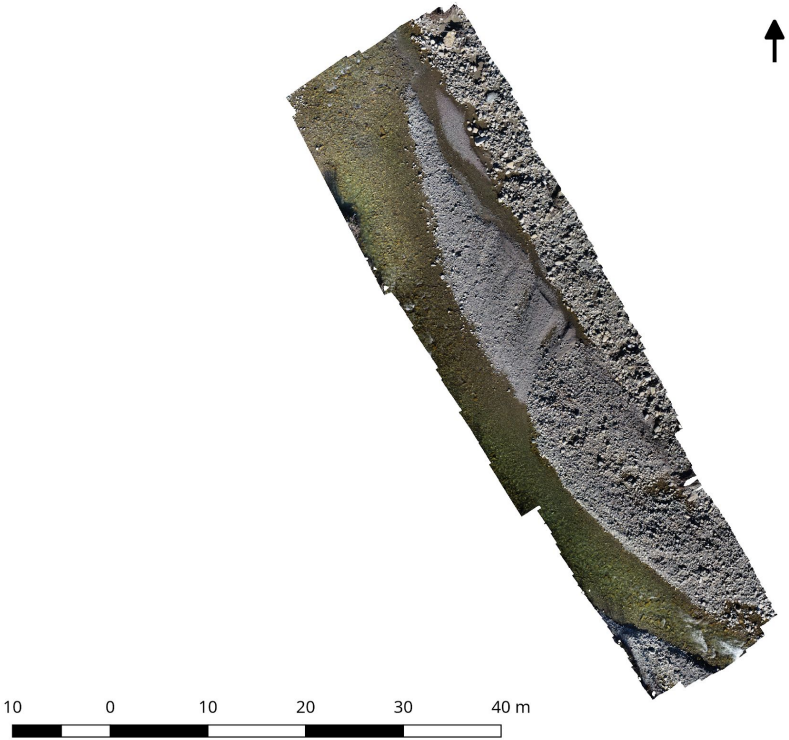
UAV Dji
Mavic 2 Pro

GNSS Leica Zeno GG04 Plus Accuracy of c. 2cm

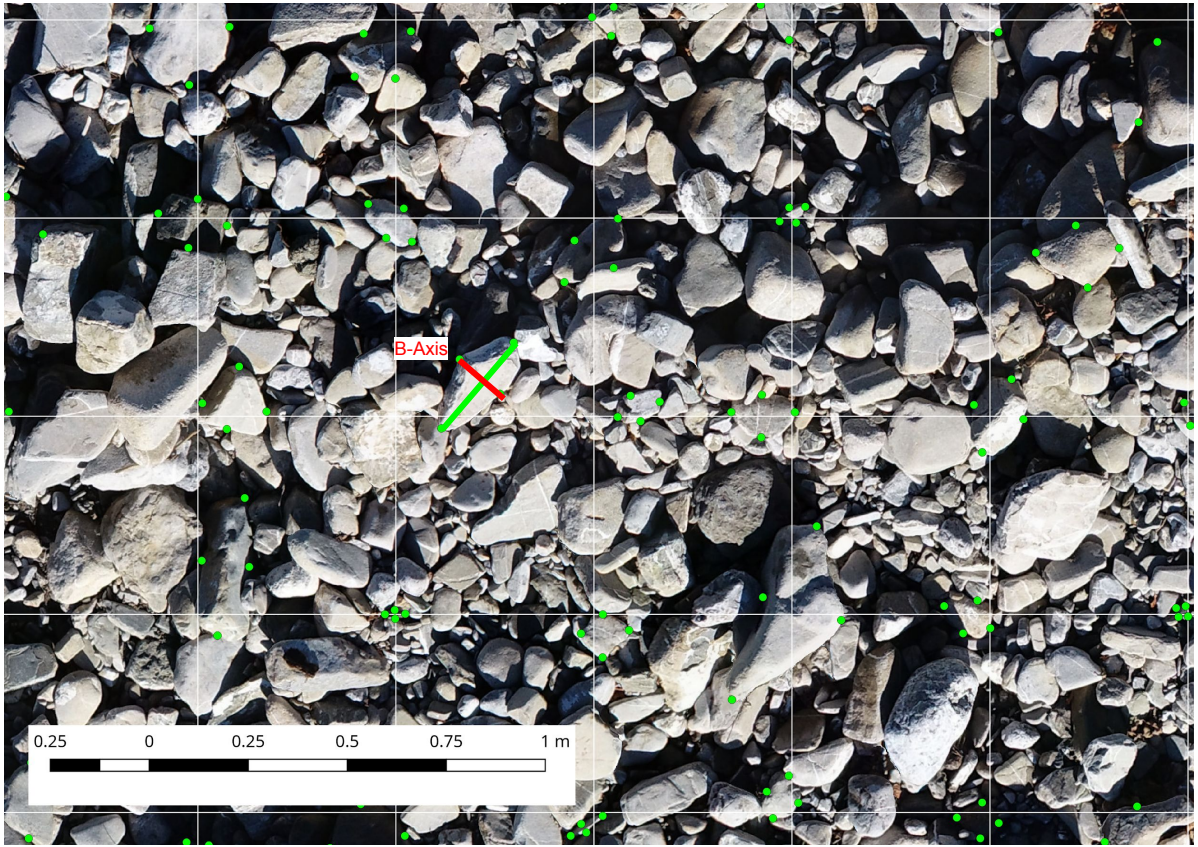
Grain size acquisition



Grain size acquisition

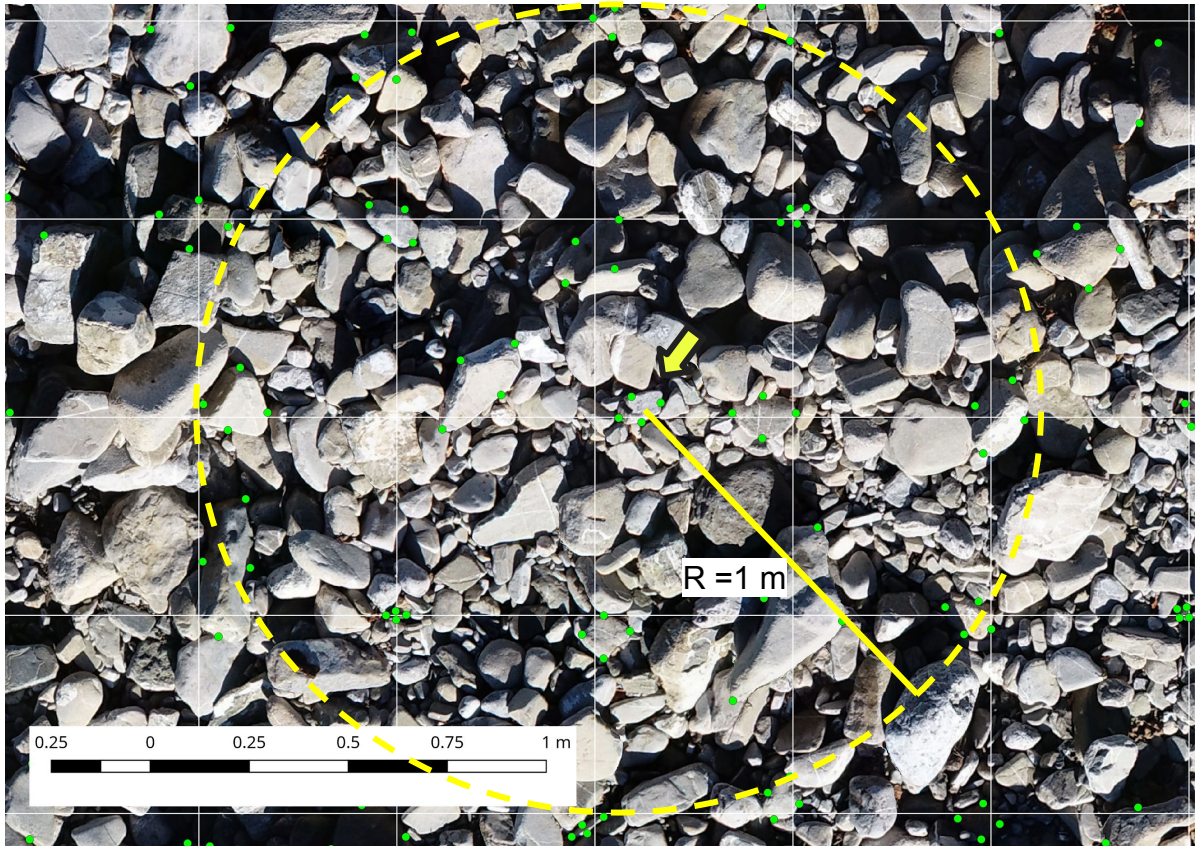


Grain size acquisition



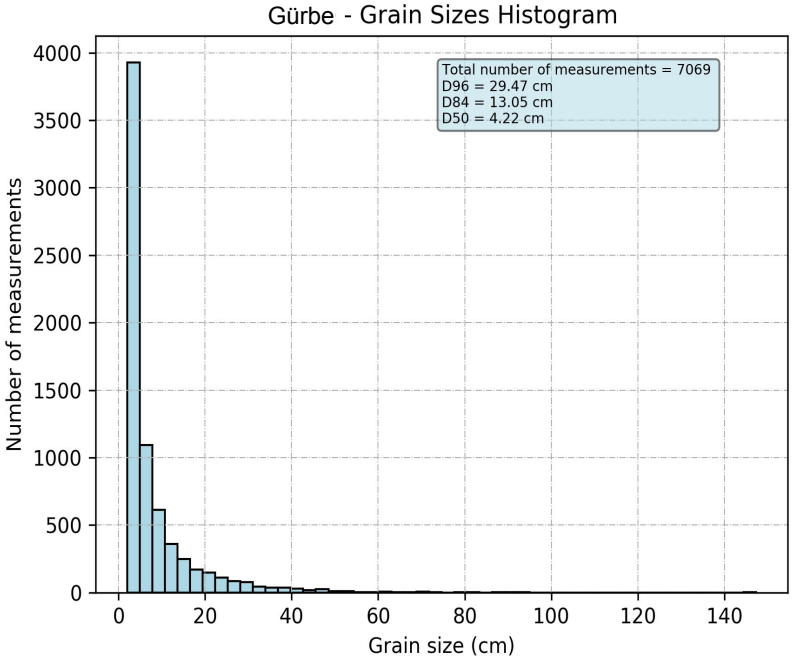
Measurement of the A-Axis and B-Axis

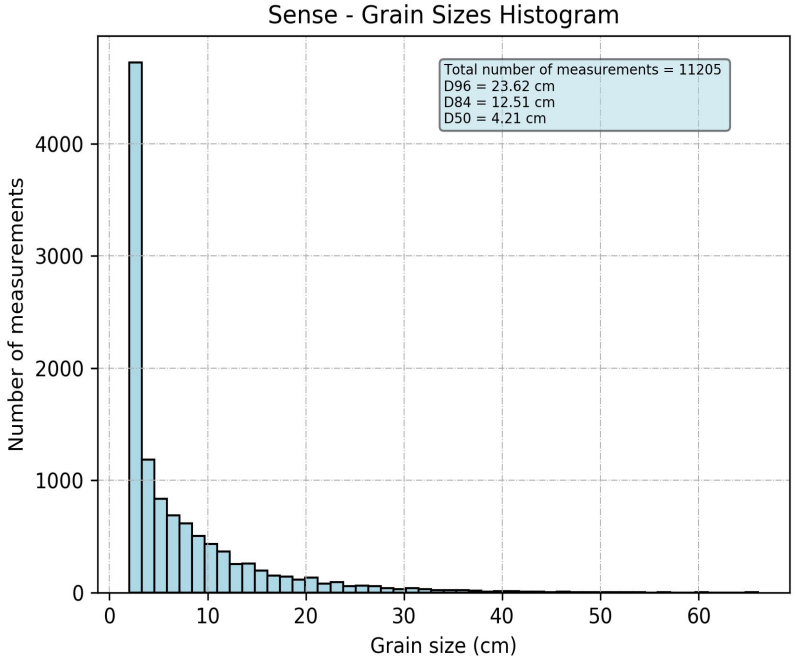
*Grains with axis below 2 cm are considered as 2 cm, due the model uncertainties.

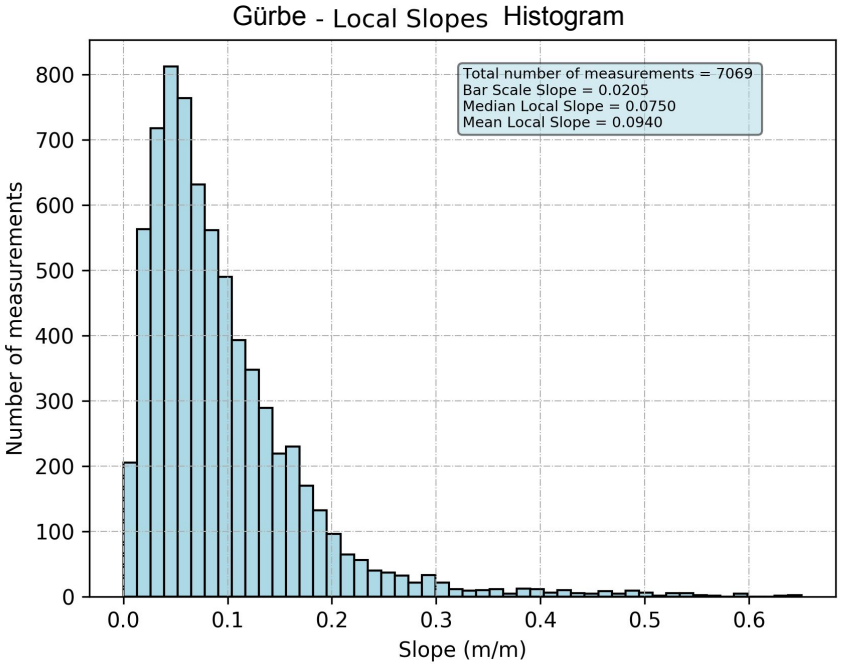


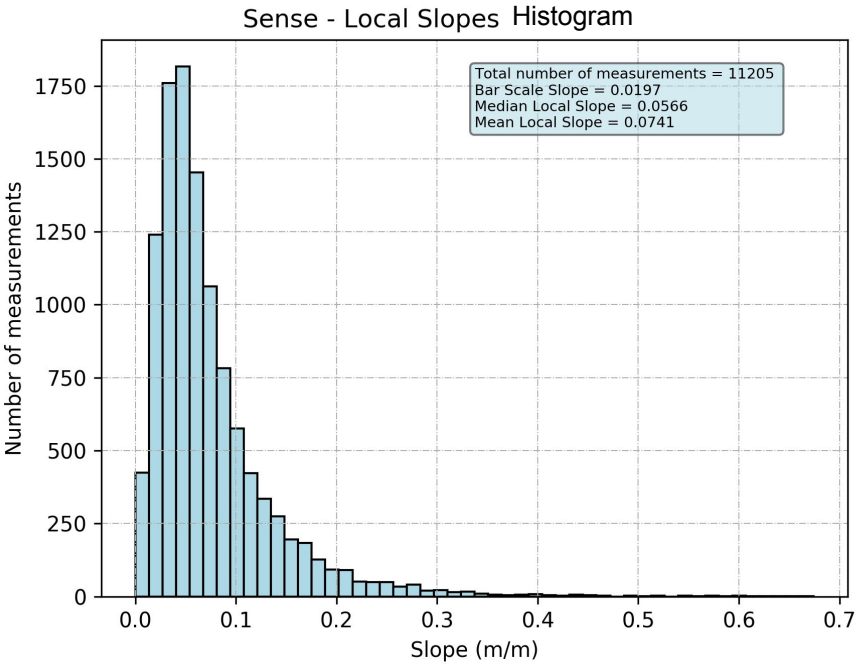
Local slope scale

Results

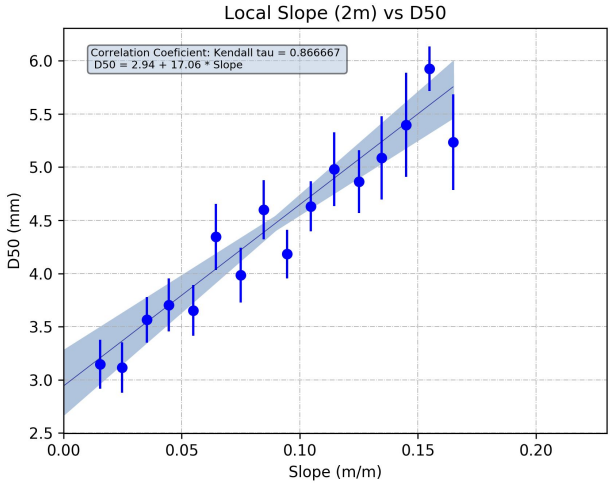

Gürbe - Grain Sizes Histogram
Total number of measurements = 7069
D96 = 29.47 cm
D84 = 13.05 cm
D50 = 4.22 cm
Number of measurements
Grain size (cm)
0
500
1000
1500
2000
2500
3000
3500
4000
0
20
40
60
80
100
120
140

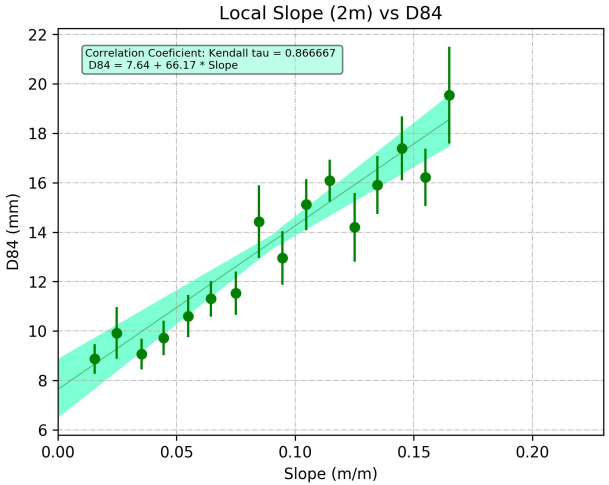

Sense - Grain Sizes Histogram
Total number of measurements = 11205
D96 = 23.62 cm
D84 = 12.51 cm
D50 = 4.21 cm
Number of measurements
Grain size (cm)
0
1000
2000
3000
4000
0
10
20
30
40
50
60

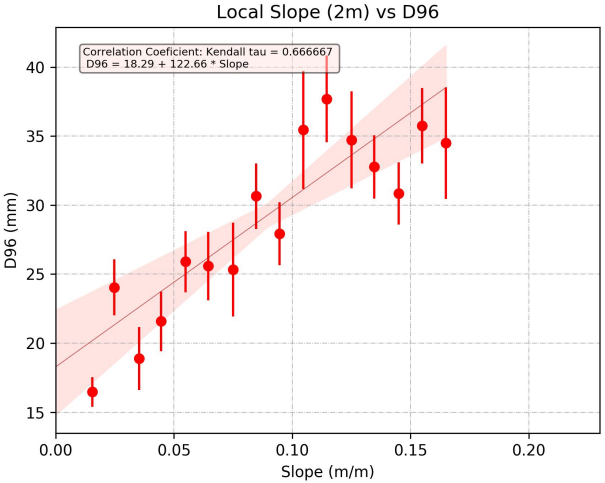

Gürbe - Local Slopes Histogram
Total number of measurements = 7069
Bar Scale Slope = 0.0205
Median Local Slope = 0.0750
Mean Local Slope = 0.0940
Number of measurements
Slope (m/m)
0
100
200
300
400
500
600
700
800
0.0
0.1
0.2
0.3
0.4
0.5
0.6


Sense - Local Slopes Histogram
Total number of measurements = 11205
Bar Scale Slope = 0.0197
Median Local Slope = 0.0566
Mean Local Slope = 0.0741
Number of measurements
Slope (m/m)
0
250
500
750
1000
1250
1500
1750
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7

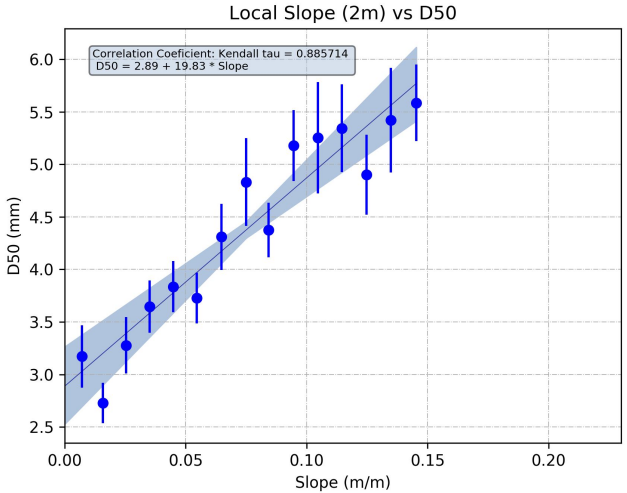
Gürbe River

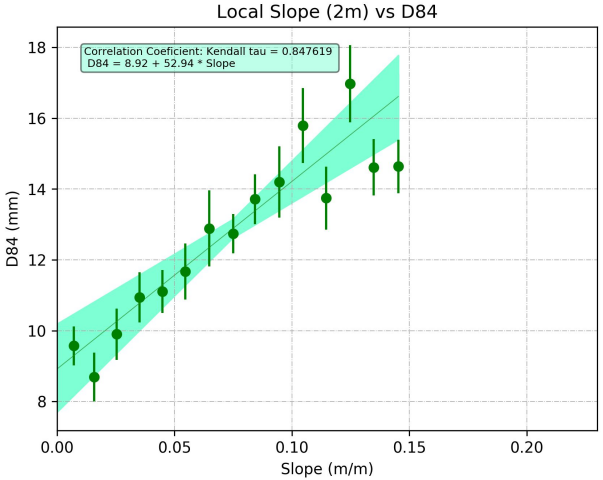

Local Slope (2m) vs D50
Correlation Coeficient: Kendall tau = 0.866667
D50 = 2.94 + 17.06 * Slope
D50 (mm)
Slope (m/m)

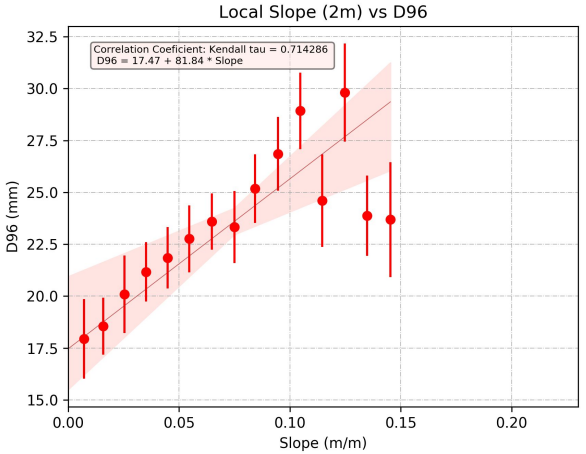

Local Slope (2m) vs D84
Correlation Coeficient: Kendall tau = 0.866667
D84 = 7.64 + 66.17 * Slope
D84 (mm)
Slope (m/m)


Local Slope (2m) vs D96
Correlation Coeficient: Kendall tau = 0.666667
D96 = 18.29 + 122.66 * Slope
D96 (mm)
Slope (m/m)

Sense River


Local Slope (2m) vs D50
Correlation Coeficient: Kendall tau = 0.885714
D50 = 2.89 + 19.83 * Slope
D50 (mm)
Slope (m/m)


Local Slope (2m) vs D84
Correlation Coeficient: Kendall tau = 0.847619
D84 = 8.92 + 52.94 * Slope
D84 (mm)
Slope (m/m)


Local Slope (2m) vs D96
Correlation Coeficient: Kendall tau = 0.714286
D96 = 17.47 + 81.84 * Slope
D96 (mm)
Slope (m/m)

Conclusions

(1) We found similar values of grain size percentiles (D50 and D84) on both the Sense and Gürbe rivers. Even with differences in discharge conditions and distance from the supply area.

(2) The data suggests that Check dams can reduce the grain size patterns.

(3) The grain size percentiles show a linear dependence with the local slopes.

(4) The local slope dependency of the grain size percentiles could be related to hydrodynamic processes.

Many thanks!