Sediment replenishment at the Sarine river

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Content

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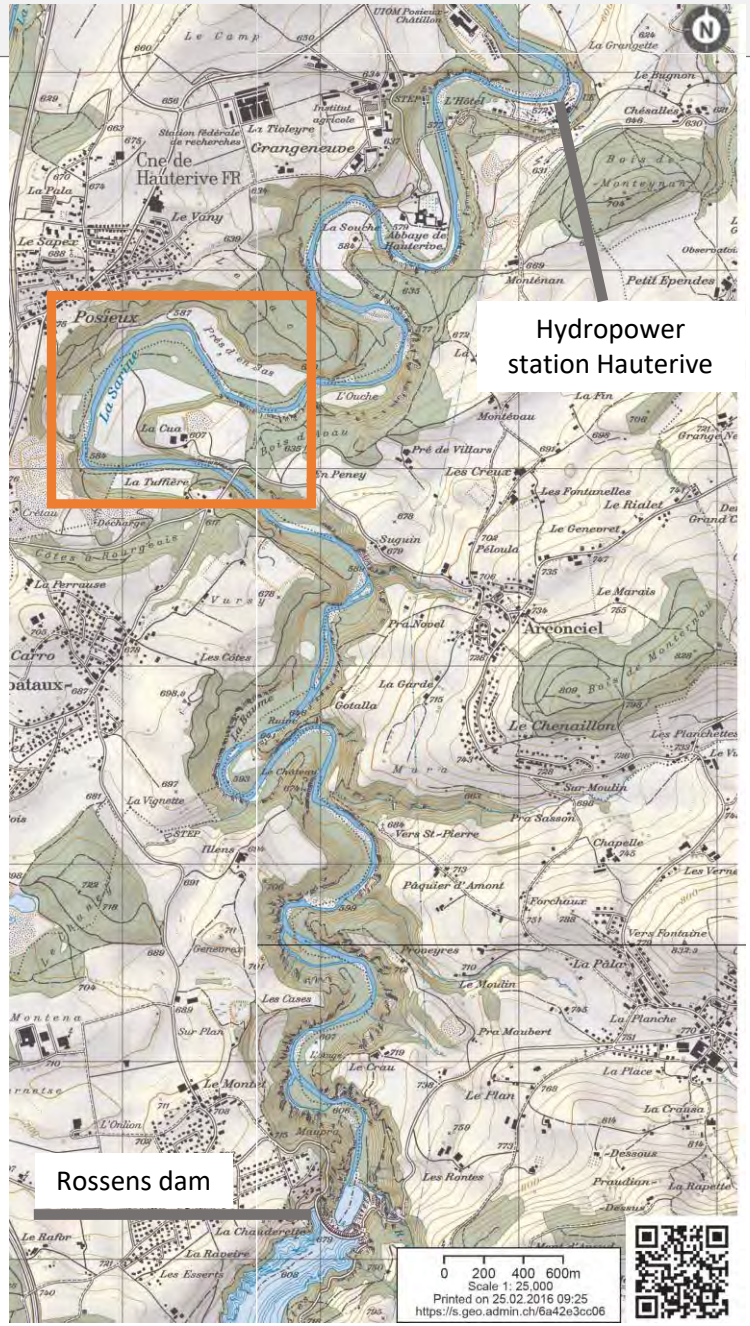
Sarine river, Fribourg

- Bed-rock alluvial meandering river **in a gorge**
- Floodplain classified as **national important**
- Dam construction in Rossens in **1948**
- **Hydrology** highly impacted
- **Sediment** deficit → incision



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Rossens Dam, Lac de la Gruyère

- Dam: 83 m high, 320 m long (since 1948)
- Reservoir: 200 mio m3 (13.5 km long)

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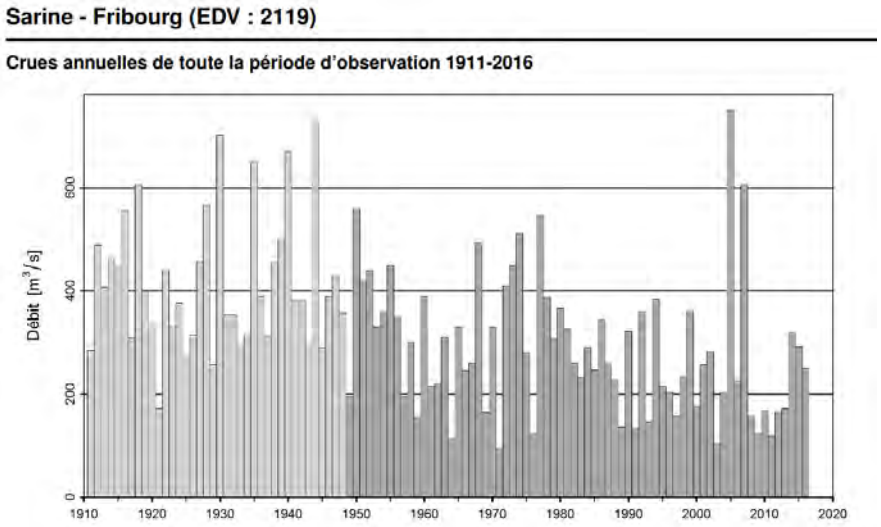
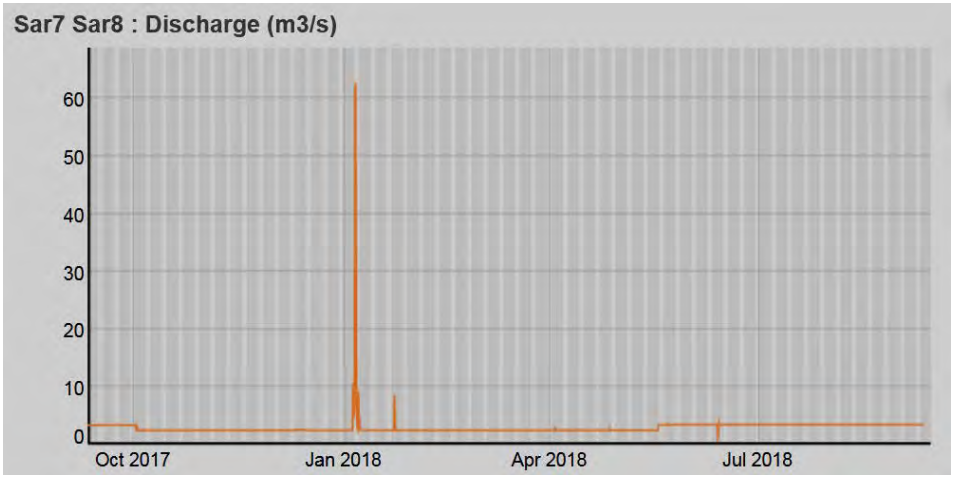
Hydrology

Hydrology in Fribourg (flood statistics)



www.hydrodaten.admin.ch, 11.09.18

Hydrology in Rossens (past 12 months)



www.swissrivers.ch, 11.09.18

Change in time

www.map.geo.admin.ch, 11.09.18

www.map.geo.admin.ch, 11.09.18

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2_ Methodology

3_ Results

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Restoration in the Sarine river

_ Loss of **river dynamics** due to **monotonous discharge and lack of sediment** supply since the construction of the dam in 1948.

_ Authorities want to act: **articifially triggered flood** combined with **sediment replenishment**.

_ **Special configuration** of sediment replenishment for steep rivers. Assembly of **four deposits** optimized in laboratory experiments. Sediment is expected to deposit in clusters (Battisacco et al., 2016)

_ **489 Stones** were equipped with **RFID PIT tags** in sediment of two diameters: d_m (57 mm) and d_{90} (113 mm) to see the reach of influence of the sediment replenishment

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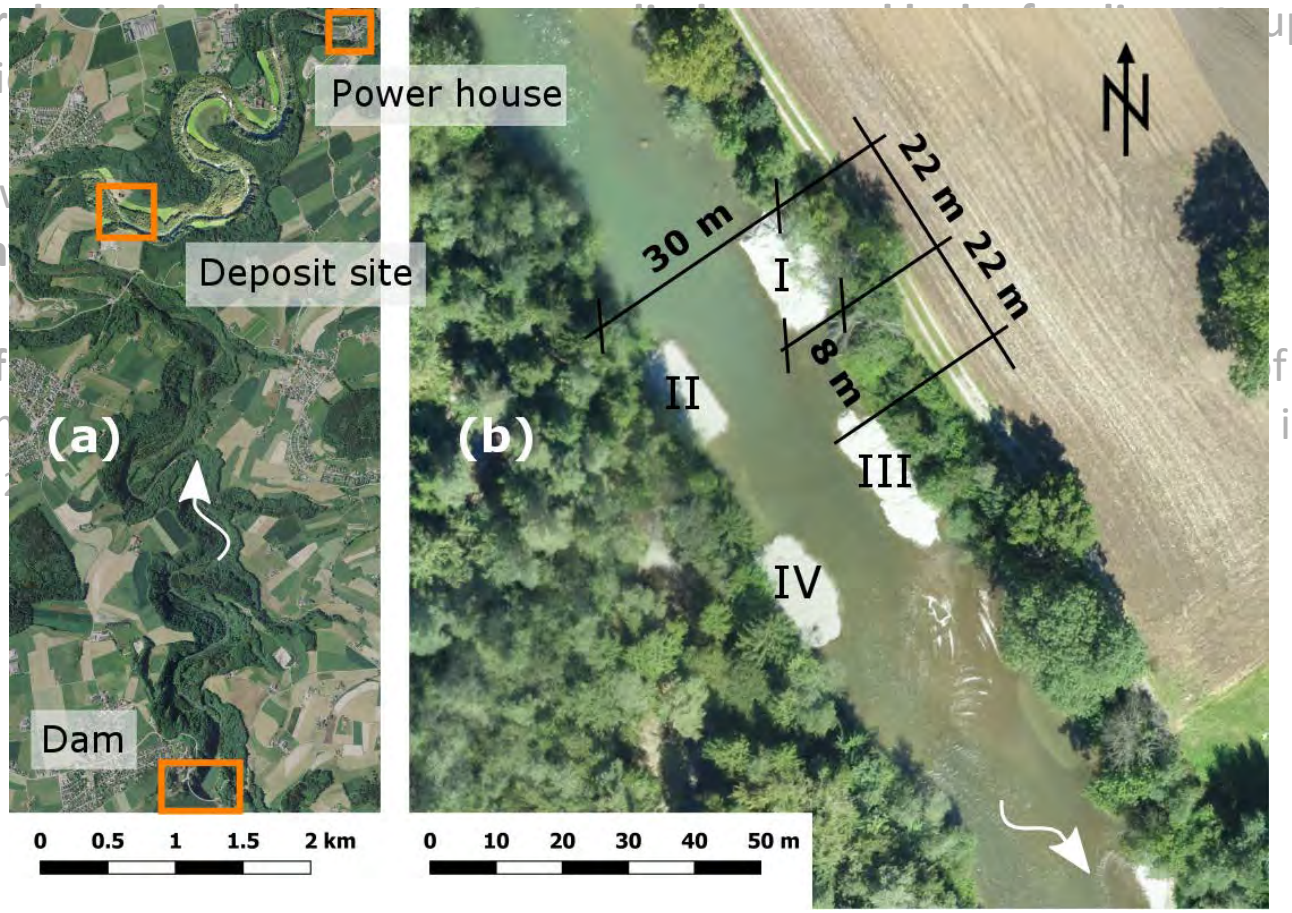
Restoration in the Sarine river

More information → Poster (in german)

_ Loss of **river** … upply since the constructi…

_ Authorities … **replenishmen**…

_ **Special conf**… f **four deposits** optim… in clusters (Battisacco et al., …



Analysis of the change in habitat diversity with HMID

Determine the Hydromorphological Index of Diversity **(HMID) before** and **after** the event

(HMID, Gostner et al., 2013)

$$HMID_{site} = \left(1 + \frac{\sigma_v}{\mu_v}\right)^2 * \left(1 + \frac{\sigma_h}{\mu_h}\right)^2$$

σ_v = standard deviation of the flow velocity [m/s]
μ_v = mean value of the flow velocity [m/s]
σ_h = standard deviation of the water depth [m]
μ_h = mean value of the water depth [m]

Three classes:

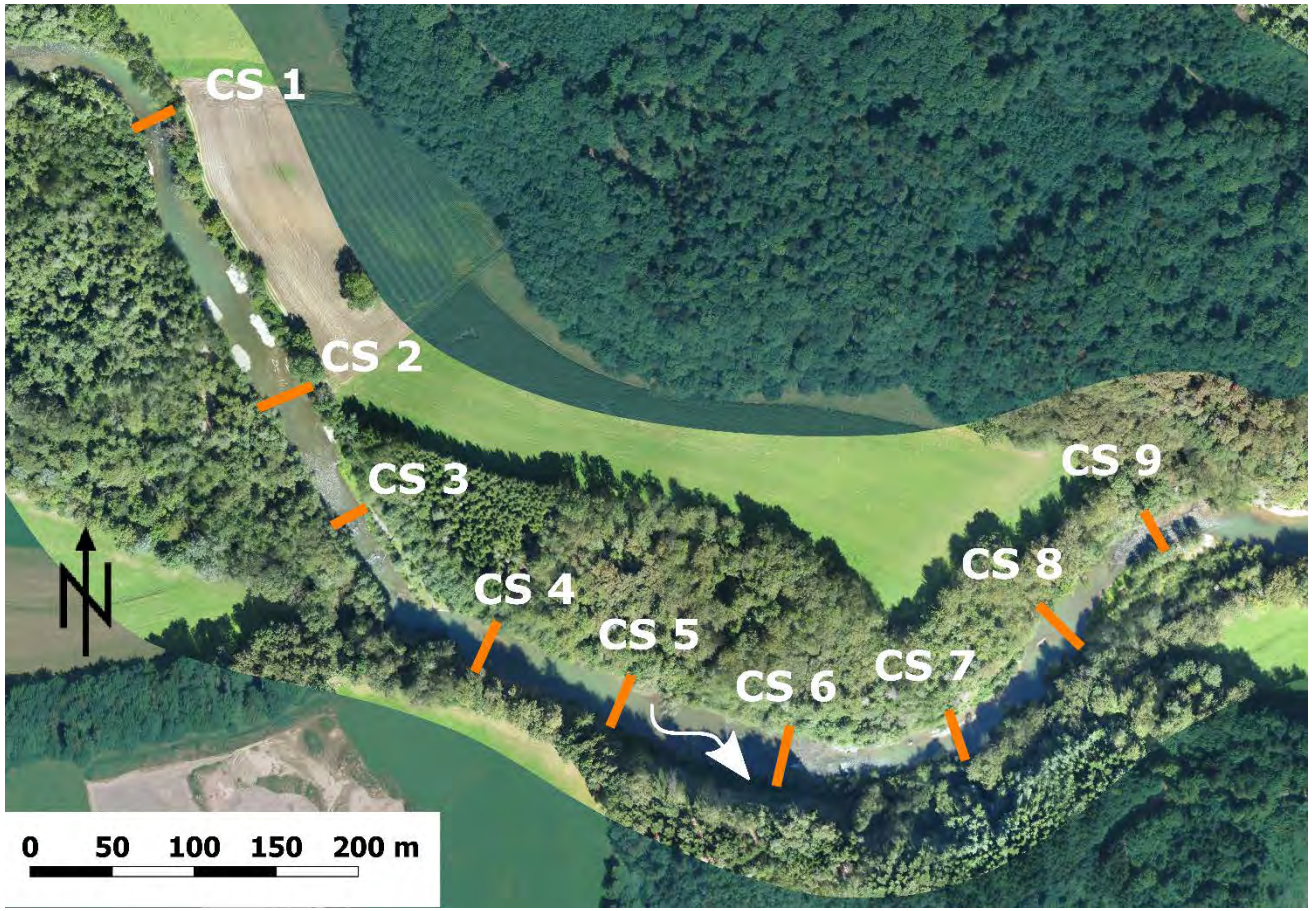
HMID < 5 : channelized or heavily altered site.

5 < HMID < 9 : site showing limited variability to near natural morphology.

HMID > 9 : reference site with fully developed spatial dynamics.

HMID measurements

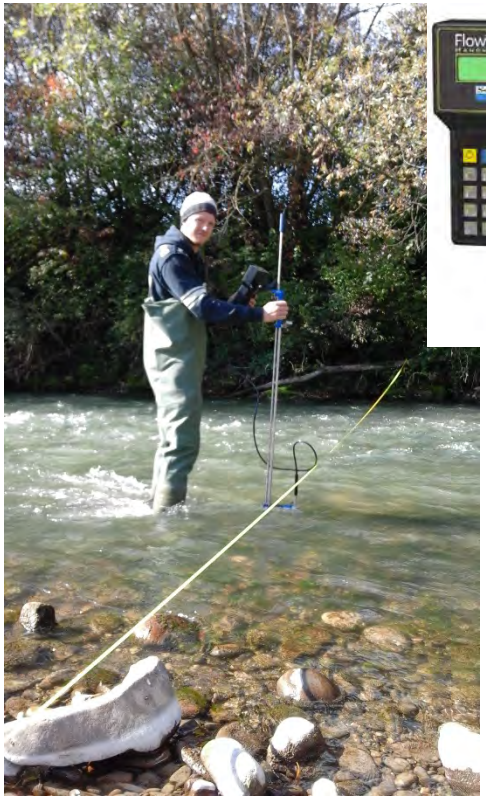
Measuring flow depth and average flow velocity in **9 cross-sections (CS)**



HMID measurements

Measurement instruments:

- Flowtracker handheld-ADV (left)
- Differential GPS (middle)
- RFID antenna (right)



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Flood in the Sarine

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Flood in the Sarine II

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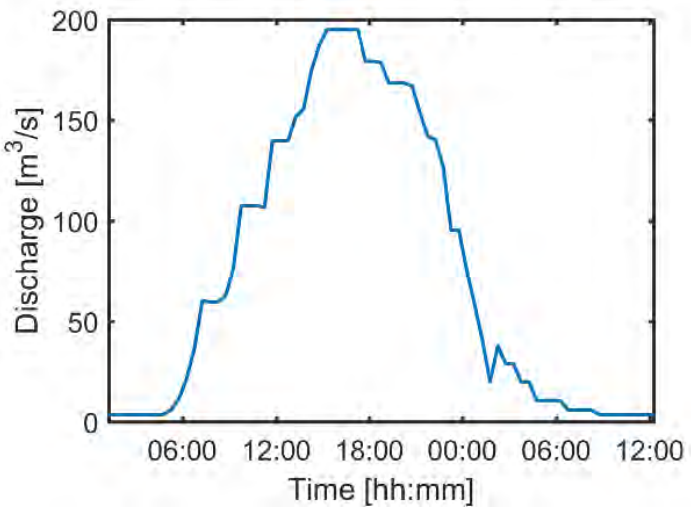
Flood in the Sarine III



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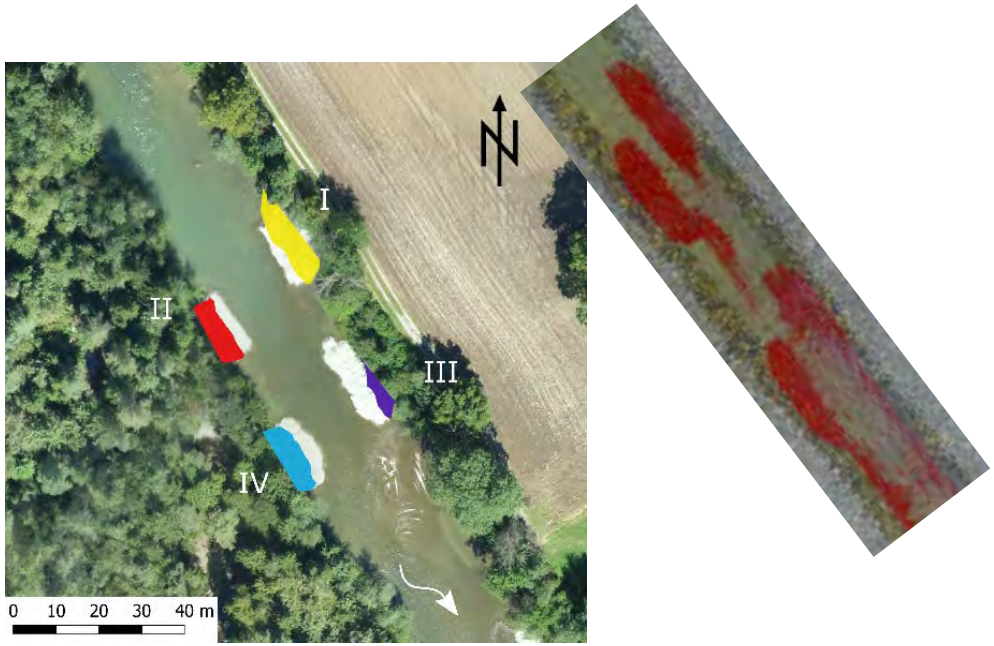
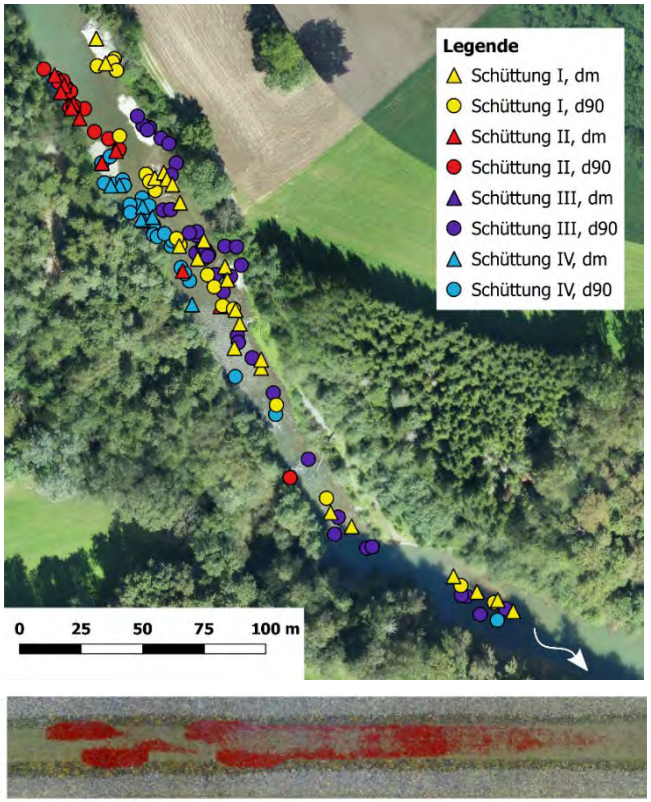
Post flood analysis

- **Partial erosion** of deposits
- Behavior as expected by previous laboratory experiments





More information concerning the laboratory results in the PhD thesis of E. Battisacco: *"Replenishment of sediment downstream of dams: erosion and transport processes"*

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Increase in hydraulic variability

		$HMID_{total}$ (9 CS, 200 dps)		**$HMID_{impact\ zone}$** (3 CS, 65 dps)		**$HMID_{rest\ zone}$** (6 CS, 135 dps)	
		BEFORE FLOOD	AFTER FLOOD	BEFORE FLOOD	AFTER FLOOD	BEFORE FLOOD	AFTER FLOOD
		Q = 3.5 [m^3/s]	Q = 2.5 [m^3/s]	Q = 3.5 [m^3/s]	Q = 2.5 [m^3/s]	Q = 3.5 [m^3/s]	Q = 2.5 [m^3/s]
μ_h	[cm]	49.7	45.9	40.2	38.3.1	54.7	49.1
σ_h	[cm]	29.4	31.4	18.2	22.6	32.8	34.0
μ_v	[m/s]	0.43	0.39	0.45	0.42	0.42	0.38
σ_v	[m/s]	0.34	0.33	0.28	0.31	0.37	0.35
HMID	[-]	**8.1**	**9.8**	**5.6**	**7.7**	**9**	**10.6**
HMID Variation		**+21%**		**+36%**		**+18%**	

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Key findings

- The **hydraulic habitat diversity increased** in the observed reach
- Significant increase **in the reach where sediment was added**

➢ Additional information on **poster or WEL 2-2018** (detailed biological survey, in german)

Thank you for your attention!

Questions?

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