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Monitoring sediment- and instream wood-transport during *e-flows* in the Spöl River

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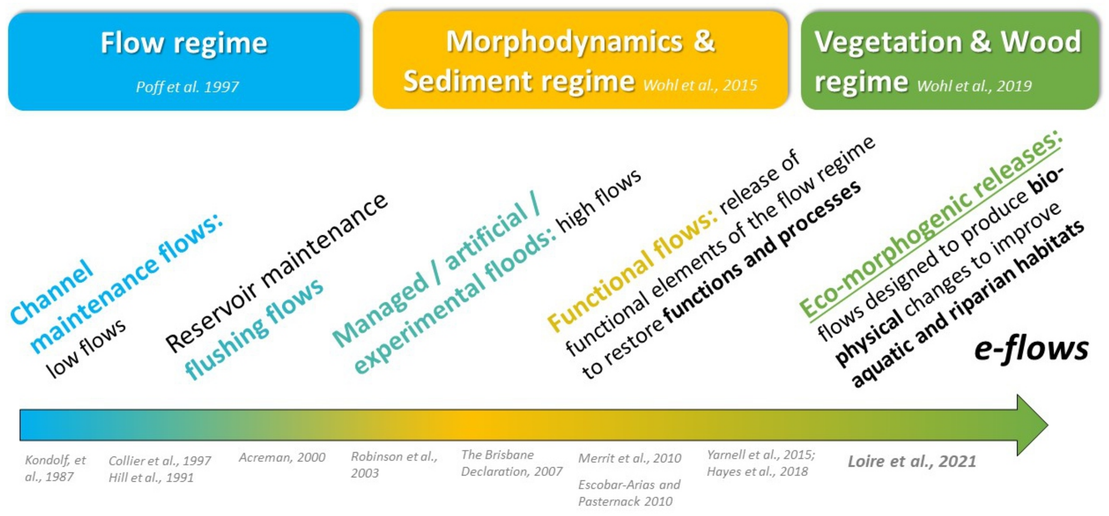
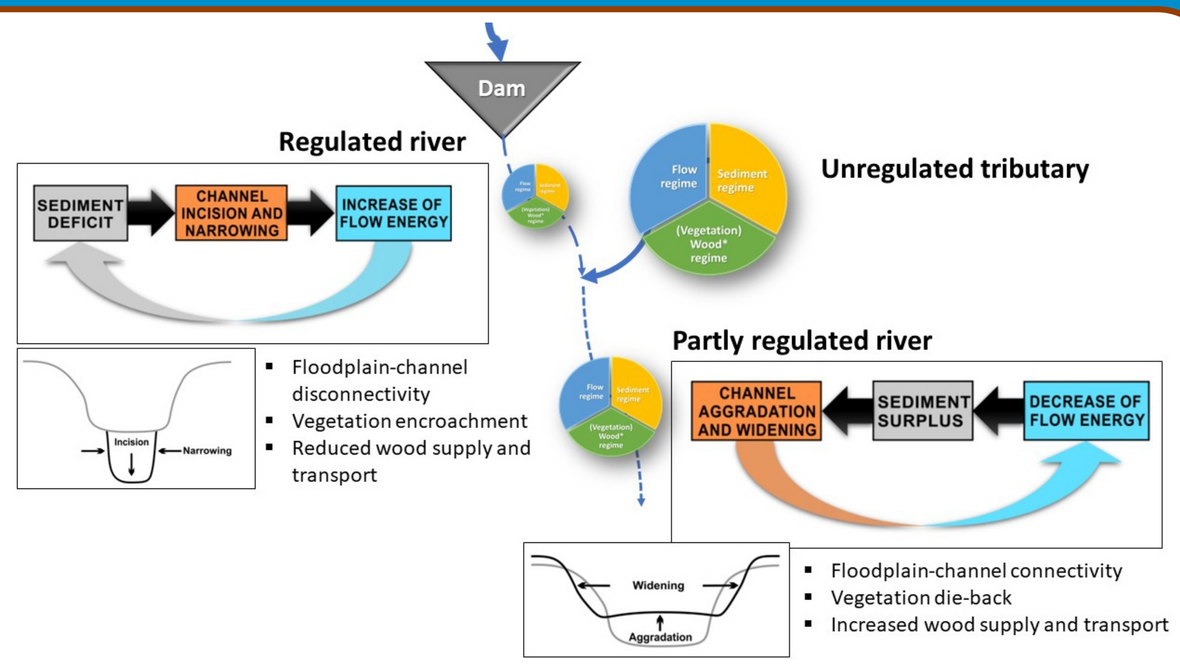
1. What *e-flows* are?

The presence and operation of dams significantly impact river ecosystems and lead to biodiversity loss worldwide. The concept of environmental flows (***e-flows***) emerged to mitigate some of these impacts. As the scientific understanding of the bio-physical processes that govern rivers is evolving, so does the assessment of e-flows and their terminology:

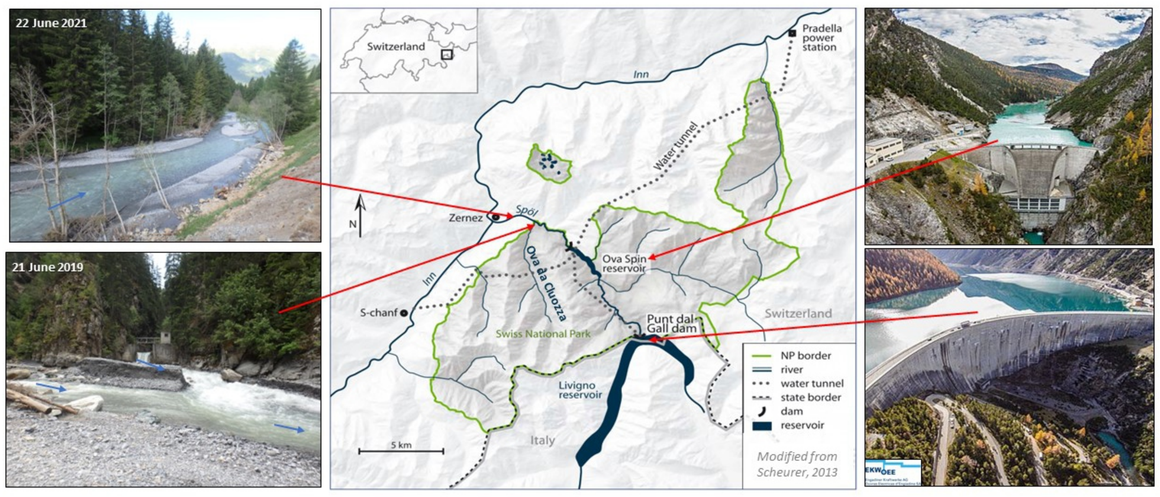




The riverregulated by a dam results in narrowing and incision processes due to the flow and sediment deficit, but if an unregulated tributary joins the regulated river, as in the case of the Spöl River, the downstream segment becomes only partly regulated and is characterized by different processes.

2. STUDY SITE AND GOALS

The **Spöl River** is the largest in the Swiss National Park (SNP), and is dammed by the Punt dal Gal and the Ova Spin dams. We focused on the lower segment.

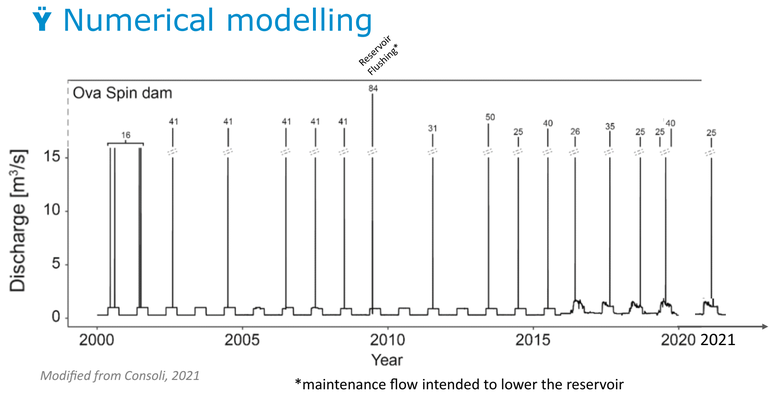


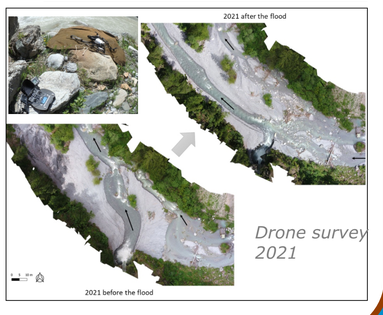
Our goal is to include the **sediment and wood regimes** into the e-flows monitoring and better understand how the e-flows affect the river morphology, and how much and which sediment and wood sizes are mobilized during the e-flows.

3. METHODS AND *e-flows*

Since the year **2018** we enhanced the existing **monitoring** program including:

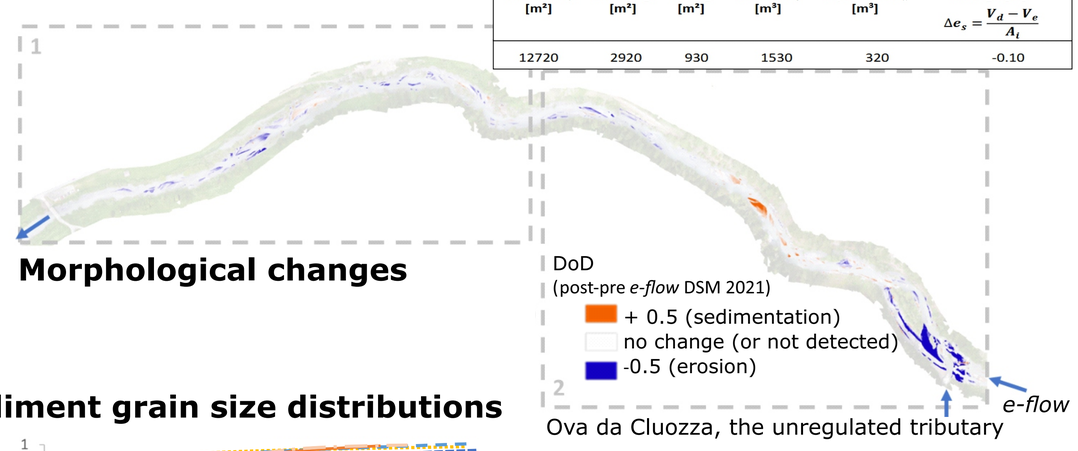
- Topographical surveys
- Sediment grain size and tracing
- Wood surveys and tracking
- Drone surveys (provided by the SNP)
- Numerical modelling



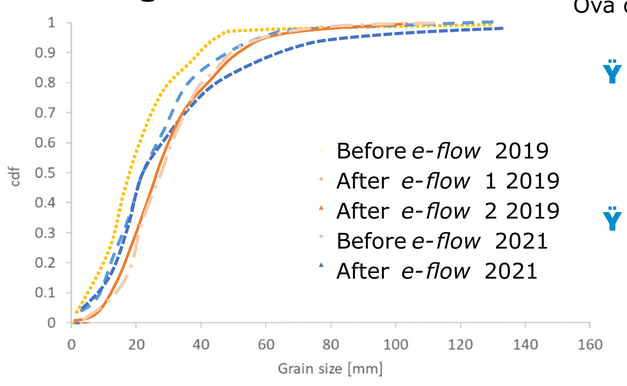


4. PRELIMINARY RESULTS

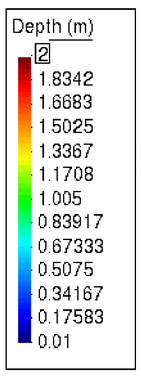
Total area of interest A_t [m²]	Area of lowering [m²]	Area of raising [m²]	Volume of erosion V_e [m³]	Volume of deposition V_d [m³]	Specific elevation change [m] $\Delta e_s = \frac{V_d - V_e}{A_t}$
12720	2920	930	1530	320	-0.10



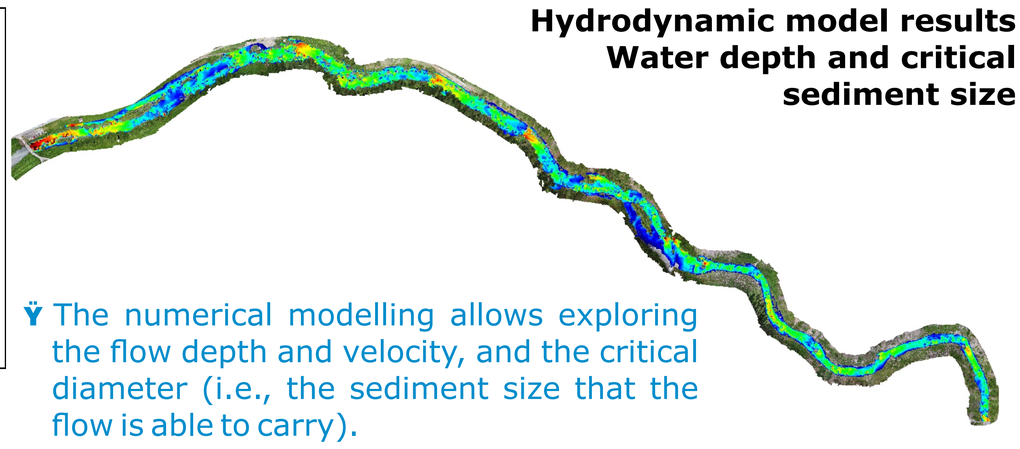
Sediment grain size distributions



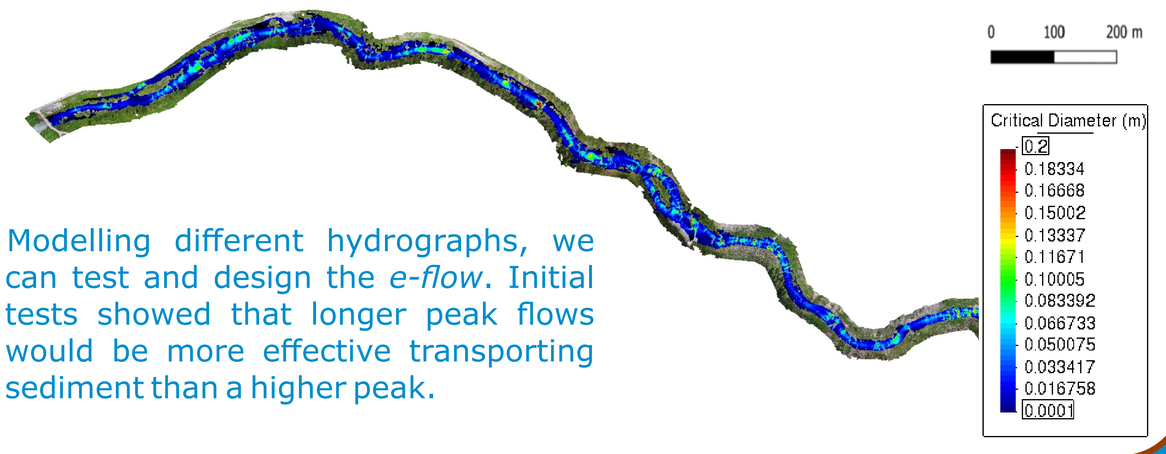
- The *e-flows* succeed in eroding part of the sediment delivered by the tributary, but not enough to reduce aggradation.
- The *e-flows* mobilize only finer material resulting in coarsening, but the tributary supplies more fine material between the *e-flows.*



Hydrodynamic model results
Water depth and critical sediment size



- The numerical modelling allows exploring the flow depth and velocity, and the critical diameter (i.e., the sediment size that the flow is able to carry).



- Modelling different hydrographs, we can test and design the *e-flow*. Initial tests showed that longer peak flows would be more effective transporting sediment than a higher peak.

5. CONCLUSIONS

This monitoring program is key for the design of future *e-flows* in the Spöl, but also for the understanding and management of regulated rivers in general.