Regulated flows influence on river mophodynamics: The Spöl River (Swiss National Park)

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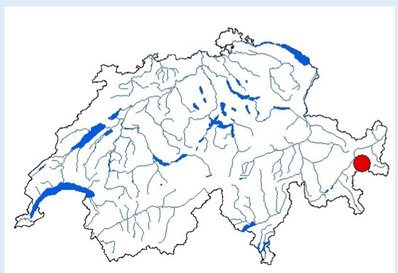
Introduction & Goals

Study site and background



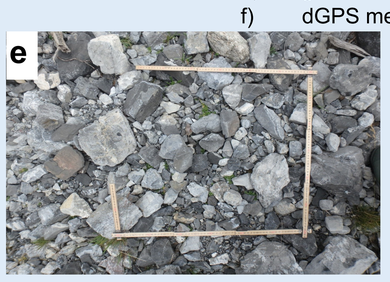
Map of Switzerland with location of the study site

The Spöl River in the Swiss National Park (SNP) is a benchmark example for river management. After the construction of the dam Punt dal Gall in 1970 the Spöl changed its character from a mountain river to a residual stream. In 2000 an artificial flood program started with the release of 2-3 high flows per year. One of the main purposes was to restore morphological and habitat heterogeneity in the river and thus gain back its natural character. Until today many studies showed that the river recovered part of its mountain river character, and the floods mitigated some of the effects of the river regulation. However, the morphodynamic effects are still not fully understood. The aim of this research project is to improve the understanding of regulated flow effects on river morphodynamics.

Research questions

- How heterogeneous is the current morphology of the Spöl River after several years of the regulated floods program?
- How can drones help to identify, classify and map fluvial features and to monitor geomorphic changes in a mountain river?
- How does the Spöl River's morphodynamics respond to flow regulation?

Methods



Laboratory investigation:
- Connectivity analysis with SedInConnect 2.3 (Crema et al., 2015)
- Mapping of geomorphologic units on aerial images from 1946 to 2013 in ArcGIS

Aerial survey:
- Drone flights with the AscTec Falcon 8 equipped with the RGB camera Sony Alpha NEX-7 to build a high-resolution digital terrain model (DTM) of the current situation

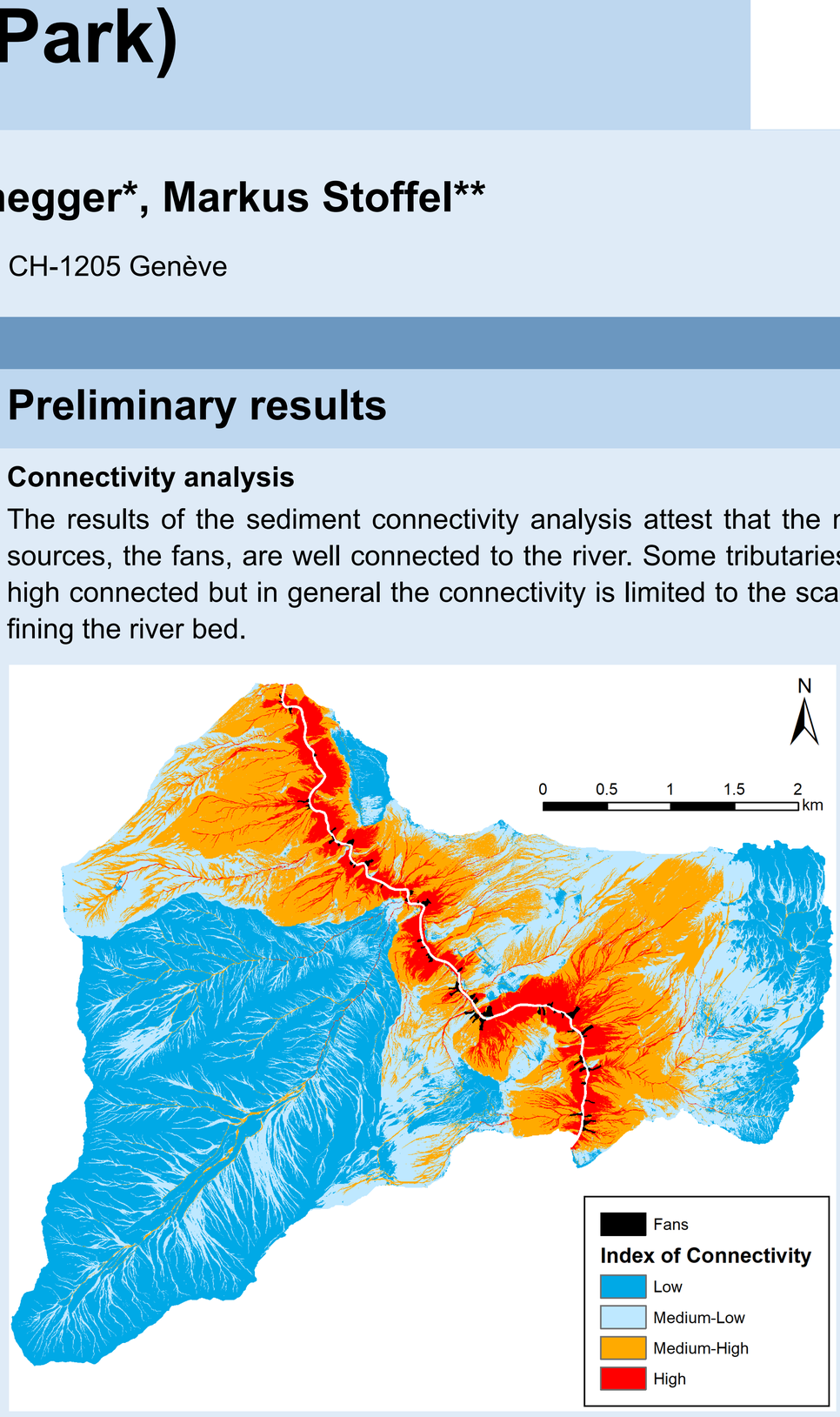
Field measurements:
- dGPS measurements of the Ground Control Points (GCPs) for the drone flights
- Measurements of the geomorphological units to validate the laboratory investigations
- Grain size analysis

Field impressions
a-c) flying the drone
d) measuring geomorphologic units
e) grain size analysis
f) dGPS measurements of the GCPs

Preliminary results

Connectivity analysis

The results of the sediment connectivity analysis attest that the main sediment sources, the fans, are well connected to the river. Some tributaries are medium-high connected but in general the connectivity is limited to the scarp slopes confining the river bed.



Classified map of the index of connectivity and sediment source arias (fans)

Historical analysis with aerial images

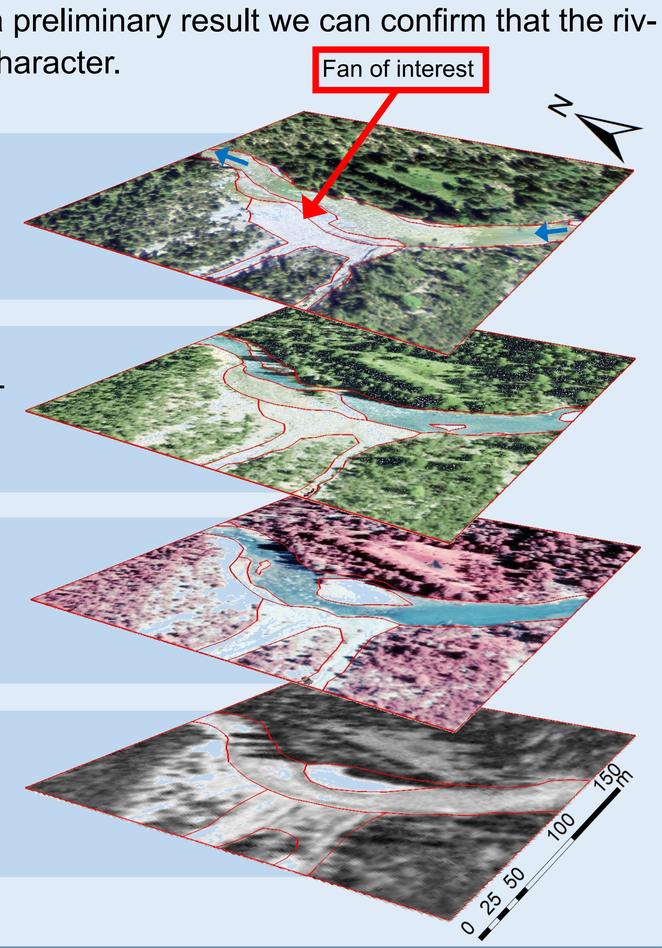
The aerial images document the changes in river morphology from before the dam was constructed to today. As a preliminary result we can confirm that the river is recovering its mountain river character.

2013
After 13 years of the flood program the river is getting back its erosional power

2000
Situation before starting the flood program, the fan prograded into the river bed

1988
Dam construction, the river was a residual stream

1946
Before dam construction the river eroded the foot of the fan



Outlook

The better understanding of the spatial distribution of fluvial landforms or geomorphic features will shed light to the fluvial processes occurring in the river (i.e., erosion and sediment deposition). Therefore, the expected results will provide an important analytical tool for the SNP and the artificial flood program in particular.
In the next steps the DTM will be constructed and mapped. The geomorphic classification will be based on consistent and the most updated guidelines (Buffington & Montgomery, 2005; Gurnell et al., 2014; Rinaldi et al., 2015; Wheaton et al., 2015). A conceptual model of the morphology changes depending on the impact of the fans in the Spöl River will be developed as an example for a monitored mountain river system.

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