



BEDFLOW: Integrating fluvial and hillslope morphodynamics in the Sillaro River basin across spatial and temporal scales

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Introduction

BEDFLOW aims to evaluate fluvial dynamics along the mountain portion of the Sillaro River, in order to improve the stream channel quality.



Action 1 and Action 2

- Investigation of the historical (1920's 2018) channel changes in relation to natural and anthropogenic forcing
- Compilation of a multi-temporal earthflow inventory

Action 3

• Evaluation of the downstream hydraulic geometry and monitoring of bedload transport

Study Area

The Sillaro River, is located in the Northern Apennines. It originates from Monte Tre Poggioli (966 m a.s.l.), near Piancandoli (Tuscany) and flows through Castel San Pietro (75 m a.s.l.).

Study area: 139 km²

Elevation ranges from 996 m to 56 m a.s.l.

Geology is dominated by siltstones and argillites

Dominant hillslope processes of sediment supply: earthflows



Methods – Action 1 and Action 2



Methods – Action 3



RESULTS: Action 1 - Reconstructing historical (active) channel changes

Example of morphological changes observed in study reaches #19 and #20 in: A) 1954, B) 1976, C) 1996, and D) 2016.





RESULTS: Action 1 - Reconstructing historical (active) channel changes

Castel S. Pietro Terme Multi-temporal representation of the average channel width changes SEMI-CONFINED CONFINED UNCONFINED 250 1954 1976 Average channel width (m) 100 201 202 1996 2016 150 -San Clemente Borgo Tossignano 0 25 20 10 15 0 Reach edge Sassoleone Downstream distance (km) 5 Drainage basin HYDRAULIC STRUCTURES ↓ < 1954 ↓ 1954-1969 ↓ 1969-1976 ↓ 1976-1988 ↓ 1988-1996 ↓ 1996-2008 ↓ 2011-2014 ----- Regional border (YEAR OF CONSTRUCTION): confluence 5 km 2.5

Giugnola

RESULTS: Action 2 - Compilation of a multi-temporal earthflow inventory

- **Dominant geology:** argillites & siltstones of the Ligurian domain
- **Dominant landslide type:** earthflows



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RESULTS: Action 2 - Compilation of a multi-temporal earthflow inventory

Total earthflows number = 1085

Total disturbed area = $\sim 6 \text{ km}^2$

Single movements = 319

Recurring movements = 766





Action 3 - Downstream Hydraulic Geometry & Bedload monitoring

The characterization of the downstream hydraulic geometry and shear stress at bankfull is based on field-base measurements o 5 channel cross sections conducted in 11 reaches of the main course of the Sillaro River and along 3 sections of two tributaries, for a total of 70 cross sections. The drainage area of the reaches spans from 2.7 km² up to 112 km².





Action 3 – Downstream Hydraulic Geometry & Bedload monitoring

Both study reaches are equipped with a **water pressure transducers** recording water level every 10 minutes

> Detail of cross section D3 (looking upstream) Reach 1





Detail of cross section G1 (looking upstream) Reach 2

Action 3 - Bedload monitoring (topographic characterization)

Topographic characterization of the study reaches is was conducted by UAV photogrammetric surveys, complemented with total station georeferencing of Ground Control Points (GCPs). Bedload transport will be monitored through RFID technology, via deployment of PIT tagged tracers particles.



Action 3 - Bedload transport monitoring

Reach 1: Riffle-pool morphology, channel slope 0.8%



Action 3 - Bedload transport monitoring

Reach 2: Plane-bed morphology, channel slope 1.5%



FUTURE WORK - post COVID-19 lockdown

100 PIT-tagged tracers are ready for deployment in Reach 1

Passing (mm)	Ν	Weight (g)	
		Min	Max
32	20	33.5	88.5
45	20	78.5	211.5
64	20	130.2	612.7
90	20	491.6	1501.2
128	20	1052.3	4172.1
Total	100	33.45	4172.1

Additional 100 tracers are being prepared for Reach 2

A new photogrammetric UAV survey is scheduled at time of PIT tracer deployment

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