Inherited anthropogenic disturbance, channel incision into bedrock, and the need for sustainable management strategies across streams of the Northern Apennines

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* **This abstract is for an Oral**
* **Session: GIS/Remote Sensing of Connectivity and Geomorphic Change**

# ABSTRACT

Rivers in the Northern Apennines are characterized by a high degree of longitudinal discontinuity and lateral confinement respectively associated with the construction of check dams and bank protection structures. This anthropogenic structural setting, and a post-WW2 history of gravel mining, by reducing sediment supply to fluvial corridors and channel-floodplain sedimentary exchange, has caused generalized depletion of alluvial storage. In extreme cases, depletion has exposed highly erodible pelitic bedrock, leading to the abrupt formation of km-long canyons, which today are rapidly growing through knickpoint headward migration (Llena et al., 2023).

In this contribution, we present: (1) the planimetric historical evolution of the Sillaro and Marecchia Rivers (1954-2023) at the fluvial corridor scale; and (2) the annual volumetric changes (2020-2021-2022-2023) in three reaches located respectively upstream, within, and downstream of the Marecchia River canyon, including those caused by the extreme flood occurred in mid May 2023. The first component relies on the multi-temporal mapping of the active channel bed conducted on sequential aerial photos. The second builds on annual UAV-based photogrammetric surveys, followed by SfM (Structure-from-Motion) processing and geomorphic change detection (Wheaton et al., 2010).

Results point to generalized sedimentary disequilibrium fostered by inherited anthropogenic disturbance and ineffective sediment management strategies. Today, disequilibrium dynamics are rapidly migrating upstream, posing threat to bridges and other infrastructure adjacent to the active channel. In this context, the May 2023 flood has led to major sediment supply to starved channels, bringing about channel re-widening and bed aggradation, but also major lateral migration in unconfined reaches (eg, loss of agricultural land) and canyon deepening and widening. The occurrence of similar extreme events raises the question of fluvial vulnerability to channel incision into bedrock, and the need to adopt management strategies able to increase resilience to change. In this respect, upcoming geophysical investigations (eg, Sgattoni and Castellaro, 2020) in selected reaches of the Sillaro and Marecchia Rivers, aim to constrain the alluvium thickness, a datum we believe will form a critical quantitative basis to inform numerical simulations on three-dimensional channel changes and, most importantly, sustainable sediment management plans.

# REFERENCES

Llena, M., Simonelli, T., Brardinoni, F., 2023. Inherited anthropogenic disturbance and decadal sediment dynamics in a mountain fluvial system: the case of the Marecchia River canyon, Northern Apennines. Geological Society of America Bulletin. <https://doi.org/10.1130/B36720.1>

Sgattoni, G., Castellaro, S., 2020. Detecting 1D and 2D ground resonances with a single-station approach. Geophysical Journal International, 223, 471-487.

Wheaton, J.M., Brasington, J., Darby, S.E., Sear, D.A., 2010. Accounting for uncertainty in DEMs from repeat topographic surveys: Improved sediment budgets. Earth Surface Processes and Landforms, 35, 136-156.