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Using sediment morphometry to infer transport dynamics in Alpine catchments: which variables matter?

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Decisions on water resources infrastructures' planning and management are, at the moment, only rarely taking into consideration their impacts on sediment transport dynamics and on river geomorphological changes at basin scale. The reasons for this are the fact that these changes in most cases happen over time scales longer than the so called "engineering scale" (around 70/100 years) and the inherent complexity in accurately modelling these processes at the scales of interest. Recently, simplified schematizations have been proposed to assess different scenarios for river basin development strategies (e.g. dams development and operations). The possibility to calibrate and validate these models still is hindered by the scarcity of measurements of sediment fluxes in most catchments worldwide. If one could accurately infer transport processes (fluxes) (e.g. travel distances, source areas, relative production etc.) from sediment properties (shape, size, lithology, etc.), this would allow the use of already available data and would simplify the collection of future datasets.

Recent studies on sediment attrition claim the existence of a "universal" relation between particles relative mass loss and their circularity (Novák-Szabó et al., 2018). The relationship between relative mass-loss and travel distance is, however, still unclear and thought to depend on the transport conditions and on particles mechanical properties.

In order to start assessing the importance of the latter, we identified a case study, the Sarzana River basin, in North-East Italy, characterized by the presence of localized sources of arenites and metabasalts, which are expected to have different abrasion rates. We measured sediment size and shape properties with a photogrammetric method and compared their longitudinal evolution. We also performed the same analysis on mixed samples, collected using the Wolman method. The inclusion of particles lithology among the control variables of the study allowed the identification of a series of transport dynamics that would otherwise be completely overlooked by mixed sampling. This example stresses the importance for a thorough basin analysis when designing a sediment monitoring campaign in order to maximise the amount of information minable from data.