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Hysteresis in sediment export from an Alpine catchment using continuous bedload transport measurement

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The fluctuations of bedload transport in mountainous rivers are still poorly understood. Many reasons have been proposed such as the stochasticity of transport processes, the presence of bedforms and the characteristics of transported grains, among other causes. Particularly, at the scale of a small catchment, the variation of sediment supply might be a major explanation for these sediment transport fluctuations. In this study, we use 3 years of high resolution (minute time scale) continuous measurement of a proxy for bedload transport at the outlet of an Alpine catchment to understand when and how coarse sediments are produced, transferred through the catchment and flushed out by the main channel.

The focus of the analysis is the relationship between total shear stress and bedload transport, and its hysteresis. By exploring this hysteresis at multiple time-scales we are able to distinguish between different scales of variability including those associated with snow-melt, high magnitude short duration convective storms and seasonal cycles. The hysteresis points to: (1) a major flushing of sediment from the system at the beginning of snow-melt; and (2) interrupted transport at other time-periods when the extent to which a given storm can both produce and evacuate sediment during the same event depends on its magnitude and duration. Most storms are too short leading to intermittent sediment accumulation and release, and independence between the degree of hydraulic forcing (i.e. shear stress) and transport.