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Using turbidity and seismic measurements to unravel sources and transport interactions of fine and coarse sediments in a mountain river (La Séveraisse, French Alps).

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Fine sediments transported in suspension by rivers are associated with important socio-economic and environmental stakes such as pollutant transport, riverbed clogging or reservoir siltation. Suspended load is highly variable and difficult to predict in mountainous catchments since fine particles can originate from various sources and processes. Thus, being able to determine which sediment sources control suspended load dynamics is crucial with regard to sediment transport understanding and management.

In the present study, we investigate the use of continuous measurements from pressure transducers, turbidimeters and seismometers to identify sediment sources and to analyze the interactions between suspended load and bedload transport in a mountain river, the Séveraisse, French Alps. During the snowmelt season (April-June), both turbidity (fine particles, suspended load) and seismic power (coarse particles, bedload) exhibit clockwise hysteresis as a function of flow rate. Interestingly, hysteresis is no longer observed when turbidity is expressed as a function of seismic power, indicating that suspended load and bedload transport vary synchronously and are strongly correlated. A clear exception is found for rainstorm events in the late summer (July-October), which are characterized by short and intense rainfalls and relatively low water discharges, where high suspended sediment concentrations associated with low seismic intensity are observed. These observations demonstrate that (i) river bed mobility significantly controls suspended load dynamics, which is often considered as wash load having no or little interactions with the river bed, and that (ii) this control can be quantified with unprecedently high temporal resolution from combining turbidity with seismic measurements. Eventually, these results raise questions about the relevance of the wash load concept in mountain rivers having large alluvial sections.