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A mountain river sediment cascade and its controls: the Schöttlbach torrent, Styria

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Steep alpine headwater torrents are characterized by episodic heavy floods and bedload pulses triggered by local high-intensity mountain rainstorms. They frequently pose serious risks and damage in the densely populated East Alpine Region. It is important to understand where critical sediments are mobilized, how much bedload is delivered to the outlet and what controls the variability.

We present a concept to quantify the sediment cascade's components and influencing factors for the Schöttlbach torrent – a 71 km2 non-glaciated catchment in the Niedere Tauern mountain Range in Styria, Austria. Geomorphic mapping is used to identify primary bedload sources on slope as well as patterns of lithology, slope-channel coupling and vegetation conditioning erosion intensity. We apply modern near-range measuring techniques (TLS, Structure from Motion) to monitor erosion rates from representative erosion sites and sediment delivery rates at the outlet since 2014. These measurements are interpreted based on the geomorphic map to derive a catchment-wide seasonal sediment budget. To explain seasonal variations we evaluate precipitation and discharge data from a dense station network as storm precipitation and runoff events are the main triggers of torrent sediment mobilization.

Torrent reaches in instable glaciofluvial sediments of the last glaciation show high average erosion rates of ca. 0.08 m/a from 2014 to 2016 surpassing rates in deeply weathered bedrock reaches by an order of magnitude (approx. 0.006 m/a). We model a torrent-wide erosion volume of 2000 m3/a opposing an output of 7000 m3/a in that period. We attribute parts of this discrepancy to a sediment wave reworking signal of an extreme flood event in 2011.