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Rainfall intensity-duration curve for bedload transport initiation in the Erlenbach, Switzerland

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The transport of large amounts of bedload in water courses can drastically aggravate hazardous situations during flood events, and often strongly affects resulting flood damage. The onset of transport is controlled by factors which are difficult to assess, not to mention measure or monitor, and the accurate prediction of transport rates has proved to be notoriously difficult. Channel discharge represents the primary control of sediment transport rates in mountain streams; however, this parameter is rarely measured in small catchments and thus it is often impossible to use it as a predictor of hazardous sediment events in mountain communities. With the steady development of precipitation measurement networks in Alpine regions and the progresses accomplished in radar precipitation estimation over the last 10 to 15 years, rainfall lends itself as a means for warning purposes in sediment prone areas.

Here, we describe interpretation of rainfall measurements from the Erlenbach, a 0.7 km^2 catchment located within a hydrologic research site in the Alptal valley in central Switzerland. Using rainfall data from within the catchment from 1986-2009, we investigate thresholds for bedload transport activity considering parameters such as storm duration and rainfall intensity. With indirect bedload sensor measurements, continuous discharge measurements and the availability of a retention basin downstream of the gauging station, the Erlenbach provides all necessary elements for the investigation of transport processes. Roughly 210 rainfall events were identified during which abundant sediment transport occurred in the study catchment and an intensity-duration threshold line was subsequently defined ($I = 8.3D^{-0.93}$), where I is in [mm/h] and D is in [h]), above which sediment transport activity has to be expected. This threshold could represent the basis for prediction of bedload transport in ungauged streams. By considering severe rainfall events that did not trigger any activity in the stream, we will be able to better assess the uncertainty of the identified intensity-duration threshold, and to estimate a false alarm rate and its implication on the practicability of our approach for early warning purposes.