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The contribution of bedload transport processes to natural hazard damage costs in Switzerland

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In Alpine regions, floods are often associated with erosion along the stream channels and with bedload transport in mountain rivers. These bedload transport processes pose hazard in addition to the elevated water discharge. However, it is unclear how much bedload transport processes contribute to total damage caused by natural hazards, an information that may be vital for flood mitigation measures and for the design of protective infrastructure. Using the Swiss flood and landslide data base, which collects direct financial damage data of naturally triggered floods, debris flows and landslides since 1972, we estimated the contribution of bedload transport processes to total natural hazard damage costs in Switzerland. For each data base entry an upper and lower limit of financial damage caused by or related to fluvial bedload transport processes was estimated, and the quality of the estimate was judged.
When compared to total damage, the fraction of bedload transport damage lies between 32 and 37% (lower and upper estimates). In the 40 year study period, the bedload transport processes have induced a cumulative financial damage between 4.3 and 5.1 billion CHF. Spatial analysis revealed highest damage for mountainous regions. The analysis of the seasonal distribution of bedload erosion and deposition shows that more than 75% of the costs occurs in summer (June through August), and $\sim$23% in autumn (September through November). With roughly 56%, by far most of the damage has been registered in the month of August. In winter and spring damage due to bedload processes is very low.
Despite more than a hundred years of research, bedload transport processes are inadequately understood, and the predictive quality of common bedload equations is still poor. The importance of bedload transport processes as a natural hazard and financial source of risk, and thus the need for future structured research programmes on transport processes in steep streams has been demonstrated in our analysis.