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The effect of spatial deposition behaviour on vulnerability of elements at risk exposed to torrent processes

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Fluvial sediment transport repeatedly causes damage in mountain environments to elements at risk exposed. Recent empirical studies suggested a dependency of the degree of damage on the hazard impact, and respective damage-loss (vulnerability) functions were deduced for individual torrent fans. However, until now only little information was available on the spatial process characteristics causing the damage. Considerable ranges in the loss ratio only provided the hint that there might be a dependency on the spatial behaviour of the process intensity in the run-out area during individual events. Moreover, frequency-magnitude relationships developed for torrent processes do not deal with such spatial deposition characteristics on a local scale.

Based on data from the Austrian Alps the spatial pattern of depositions was studied with a particular focus on the question whether or not settlement structures have effects on the clustering of high process intensities, and thus high loss ratios for buildings exposed. Using spatial scan statistics, clusters of high and low values of process intensities and loss ratios were analysed. Methodologically, in order to include uncertainties, threshold values concerning the amount and composition of data points necessary for such an approach were studied. It is shown that – within a certain range – the significance and spatial position of clusters of high and low process intensities remains stable over the torrent fans under investigation.

This study contributes to the discussion of the applicability of the frequency-magnitude concept within applied geomorphology, and links fundamental research to applied natural hazard and risk management. It is argued that an approach using spatial statistics may be used to increase our understanding of the spatial dynamics in the run-out areas of torrent processes, and as such to the development of sustainable land-use policies in mountain environments.