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Vulnerability of buildings to torrent processes

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Torrent processes pose a permanent threat to areas of settlement in an alpine country such as Austria. Risk management tools are applied nowadays to quantify and reduce these threats and the corresponding risk. Vulnerability assessment for elements at risk, such as buildings located in the run-out areas of processes or infrastructure lines crossing torrent fans, is a central component of the risk equation, and therefore of virtual importance in the framework of risk assessment. In the present work, the definition of vulnerability follows a natural sciences perspective; vulnerability is defined as the expected degree of loss for an element at risk as a consequence of an event of certain intensity. A quantitative method based on a spatially explicit and economic approach on a local scale was applied to develop a relationship between process intensity and the corresponding degree of loss, leading to distinct vulnerability values.

Based on first results published for debris flows and fluvial sediment transport in torrents and regarding the vulnerability of residential buildings, new findings show that similar physical vulnerabilities can be observed with respect to torrent processes independently from the building category and process type. The assumption that fluvial sediment transport processes are less destructive than debris flow processes cannot be confirmed for the studied torrent catchments. The considered building categories are characterised by mixed types of construction composed from brick masonry and concrete, however used for different purposes (e.g. residential buildings, hotels). The analysis yields a comprehensive vulnerability function and allows for an improved quantification of vulnerability. In addition, due to the quantitative examination of vulnerability, uncertainties resulting from such an empirical approach were assessed. Confidence bands with different confidence levels (90, 95 and 99 %) were calculated based on quantile values of the t-distribution, an ordinary least squares regression and a linear transformation approach. A 90 % confidence band was found to represent the data range appropriately relating to the present data quality.

The proposed method allows for an enhanced quantification of torrent risk, but also for an inclusion in comprehensive vulnerability models including physical, social, economic, and institutional vulnerability.