Geophysical Research Abstracts
Vol. 14, EGU2012-8699, 2012
EGU General Assembly 2012

Validating vulnerability functions for buildings exposed to Alpine torrent processes

R. Totschnig and S. Fuchs

Institute of Mountain Risk Engineering, University of Natural Resources and Life Sciences, Vienna, Austria
(reinhold.totschnig@boku.ac.at)

Vulnerability assessment is generally seen as an important component in the framework of risk assessment. Focusing on the physical vulnerability and following a natural science perspective, vulnerability functions can be used to quantify vulnerability by setting up a mathematical relationship between the degree of loss of an element at risk exposed and the corresponding intensity of the hazardous process. The examined elements at risk were defined as those buildings that were firstly located on the torrent fans of individual Austrian test sites and secondly characterised by mixed types of construction composed from brick masonry and concrete, however used for different purposes (private residential and commercial accommodation buildings). The degree of loss was calculated as the ratio between the damage and the reconstruction value of the corresponding building. The damage was quantitatively registered in terms of monetary loss after the event by professional damage appraisers. The reconstruction values were calculated based on an insurance approach using unit prices per m^2. The intensity of the process (fluvial sediment transport and debris flow) was proxied for each individual building in terms of deposition height. Additionally, a relative intensity, composed from a ratio between the deposition height and the height of the affected building, was used to compensate the influence of different building heights on the degree of loss at a given process intensity. The determination of the degree of loss as well as the corresponding intensity yields a scatterplot of vulnerability values for each individual building; illustrating both the degree of loss (ordinate) and the process intensity (abscissa). Nonlinear regression approaches in terms of cumulative distribution functions were applied to derive the mathematical relation between process intensities and degrees of loss. The corresponding parameters were estimated by using a sequential quadratic programming algorithm based on a nonlinear least squares estimation.
Based on first results published for fluvial sediment transport in torrents, this study pursued the following aims: (1) testing the possibility to merge the data based on different processes or building types to derive an overall vulnerability function for torrent processes; and (2) validating the final functions to show their practical applicability in Alpine areas outside of Austria. The conducted statistical tests confirmed that in case of absolute intensity a pooling of the vulnerability values for fluvial sediment transport and debris flows as well as for the two building types and the calculation of a joint vulnerability function is justifiable. In the case of relative intensity, commercial accommodation buildings showed higher vulnerability values than private residential buildings considering low intensity values of process intensities. Therefore, based on relative intensity, individual vulnerability functions are proposed for private residential and commercial accommodation buildings. Using data from an Italian validation test site, the broader applicability of the proposed vulnerability functions was confirmed.