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# Physically-based modelling of high magnitude torrent events with uncertainty quantification

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High magnitude torrent events are associated with the rapid propagation of vast quantities of water and available sediment downslope where human settlements may be established. Assessing the vulnerability of built structures to these events is a part of consequence analysis, where hazard intensity is related to the degree of loss sustained. The specific contribution of the presented work describes a procedure simulate these damaging events by applying physically-based modelling and to include uncertainty information about the simulated results. This is a first step in the development of vulnerability curves based on several intensity parameters (i.e. maximum velocity, sediment deposition depth and impact pressure).

The investigation process begins with the collection, organization and interpretation of detailed post-event documentation and photograph-based observation data of affected structures in three sites that exemplify the impact of highly destructive mudflows and flood occurrences on settlements in Switzerland. Hazard intensity proxies are then simulated with the physically-based FLO-2D model (O'Brien et al., 1993). Prior to modelling, global sensitivity analysis is conducted to support a better understanding of model behaviour, parameterization and the quantification of uncertainties (Song et al., 2015). The inclusion of information describing the degree of confidence in the simulated results supports the credibility of vulnerability curves developed with the modelled data. First, key parameters are identified and selected based on literature review. Truncated a priori ranges of parameter values were then defined by expert solicitation. Local sensitivity analysis is performed based on manual calibration to provide an understanding of the parameters relevant to the case studies of interest. Finally, automated parameter estimation is performed to comprehensively search for optimal parameter combinations and associated values, which are evaluated using the observed data collected in the first stage of the investigation.

O'Brien, J.S., Julien, P.Y., Fullerton, W. T., 1993. Two-dimensional water flood and mudflow simulation. Journal of Hydraulic Engineering 119(2): 244-261.

Song, X., Zhang, J., Zhan, C., Xuan, Y., Ye, M., Xu C., 2015. Global sensitivity analysis in hydrological modeling: Review of concepts, methods, theoretical frameworks, Journal of Hydrology 523: 739-757.