Updating of existing vulnerability curves with data from recent events in the European Alps

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Lea Dosser[1], Maria Papathoma-Köhle[1], Marco Borga[2], and Sven Fuchs[1]
1University of Natural Resources and Life Sciences, Institute of Mountain Risk Engineering, Vienna, Austria
2University of Padova, Department of Land, Environment, Agriculture and Forestry, Padova, Italy

Correspondence to: Lea Dosser (lea.dosser@students.boku.ac.at)

Introduction: Due to effects of climate change and an increase in elements at risk in many mountain areas, loss increased throughout Europe. Yet, factors influencing loss, i.e. physical vulnerability of elements at risk, have gained less attention to date. Here, vulnerability is defined as the degree of loss resulting from the hazard impact on the building envelope. Existing vulnerability curves for the expression of the physical vulnerability of buildings to dynamic flooding in the alpine space are associated with a large number of uncertainties. The updating of the existing curves with data from recent events is necessary in order to make existing curves more reliable.

Aim: In the present study damage data from the torrential event of the Rotian River creek in Dimaro, autonomous Province of Trento, Italy, have been collected and analyzed. Based on these data a new vulnerability curve has been developed and compared to the existing beta-model (Fuchs et.al., 2019). Furthermore the indicator-based method of the PVI – physical vulnerability index (Papathoma-Köhle et. al.,2019), has been used as a second assessment method. Due to given circumstances, the evalua-tion of most parameters, such as the process magnitude on the 24 exanimated buildings, has been carried out based on photo- and video-analysis.

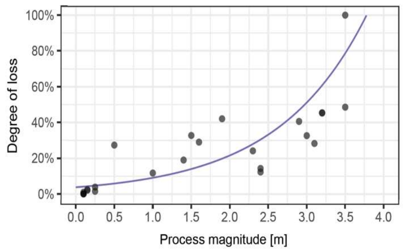
Case study: The torrential event analyzed in this study case occurred on the 29th October 2018 in the municipality of Dimaro Folgarida. After three days of intensive precipitation, the Rotian River has overflown its riverbeds and caused in conjunction with the instability of the rain-sodden soil and loose sediments, a destructive debris flow towards an inhabited area. The intensity of the event amounts to approximately 200.000 m³ of transported debris with about 200 people forced to evacuate their homes and a high extent of damaged buildings.

Dimaro on the 29th October 2018
(Acquaseri – inserto speciale, 2018)

Methods and preliminary results:

- **vulnerability curve**

The present vulnerability curve for the study case has been calculated with the degree of loss and the process magnitude observed at 24 damaged buildings by using a Weibull-distribution.



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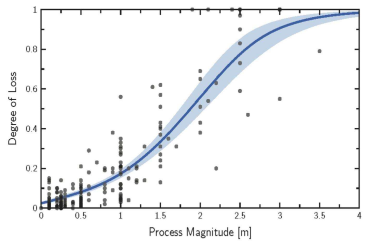
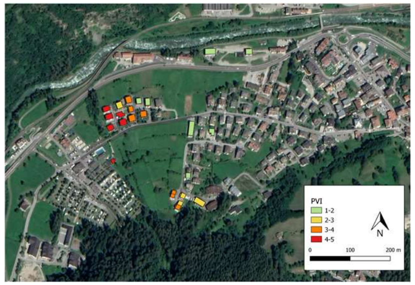
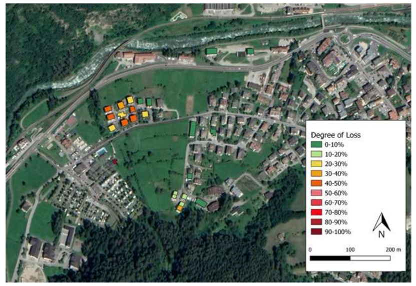


The elaborated vulnerability curve for the Dimaro-event (left side) does not match the verified beta-model for the Alpine space (Fuchs et.al., 2019) (right side). This result requires further investigations and also considerations about uncertainties in the execution of the method.

- **PVI – physical vulnerability index**

The calculation of the PVI implies the use of different indicators, e.g. the exposure, the vulnerability to water intrusion or the height of openings, and their weighting.





As shown in the maps above, the PVI reflects the degree of loss for 20 of the 24 exanimated buildings quite well, whereas 4 buildings don't seem to have a correlation. This can be due to individual characteristics of the building itself or unpredictable trends in the process of the event.

References:
Fuchs, S., Heiser, M., Schlögl, M., Zischg, A., Papathoma-Köhle, M., and Keiler, M.: Short communication: A model to predict flood loss in mountain areas, Environmental Modelling and Software, 117, 176-180, https://doi.org/10.1016/j.envsoft.2019.03.026, 2019
Papathoma-Köhle, M., Schlögl, M., and Fuchs, S.: Vulnerability indicators for natural hazards: an innovative selection and weighting approach, Scientific Reports, 9, Article 15026, https://doi.org/10.1038/s41598-019-50257-2, 2019

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