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Comparison of non-landslide sampling strategies to counteract inventory-based biases within national-scale statistical landslide susceptibility models

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Landslides can represent a significant threat for people and infrastructure in hilly and mountainous landscapes worldwide. The understanding and prediction of those geomorphic processes is crucial to avoid economic loses or even casualties to people and their properties. Statistical based landslide susceptibility models are well known for being highly reliant on the quality, representativeness and availability of input data. In this context, several studies indicate that the landslide inventory represents the most important input data. However each landslide mapping technique or data collection has its drawbacks. Consequently, biased landslide inventories may be commonly introduced into statistical models, especially at regional or even national scale. It remains to the researcher to be aware of potential limitations and design strategies to avoid or reduce the potential propagation of input data errors and biases influences on the modelling outcomes. Previous studies have proven that such erroneous landslide inventories may lead to unrealistic landslide susceptibility maps.
We assume that one possibility to tackle systematic landslide inventory-based biases might be a concentration on sampling strategies that focus on the distribution of non-landslide locations. For this purpose, we test an approach for the Austrian territory that concentrates on a modified non-landslide sampling strategy, instead the traditional applied random sampling. It is expected that the way non-landslide locations are represented (e.g. equally over the area or within those areas where mapping campaigns have been conducted) is important to reduce a potential over- or underestimation of landslide susceptibility within specific areas caused by bias. As presumably each landslide inventory is known to be systematically incomplete, especially in those areas where no mapping campaign was previously conducted. This is also applicable to the one currently available for the Austrian territory, composed by 14,519 shallow landslides. Within this study, we introduce the following explanatory variables to test the effect of different non-landslide strategies: Lithological units, grouped by their geotechnical properties and topographic parameters such as aspect, elevation, slope gradient and the topographic position. Landslide susceptibility maps will be derived by applying logistic regression, while systematic comparisons will be carried out based on models created by different non-landslide sampling strategies. Models generated by the conventional random sampling are presented against models based on stratified and clustered sampling strategies. The modelling results will be compared in terms of their prediction performance measured by the AUROC (Area Under the Receiver Operating Characteristic Curve) obtained by means of a k-fold cross-validation and also by the spatial pattern of the maps. The outcomes of this study are intended to contribute to the understanding on how landslide-inventory based biases may be counteracted.