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Comparing physically-based and statistical landslide susceptibility model outputs - a case study from Lower Austria

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By now there is a broad consensus that due to human-induced global change the frequency and magnitude of heavy precipitation events is expected to increase in certain parts of the world. Given the fact, that rainfall serves as the most common triggering agent for landslide initiation, also an increased landside activity can be expected there.

Landslide occurrence is a globally spread phenomenon that clearly needs to be handled. The present and well known problems in modelling landslide susceptibility and hazard give uncertain results in the prediction. This includes the lack of a universal applicable modelling solution for adequately assessing landslide susceptibility (which can be seen as the relative indication of the spatial probability of landslide initiation). Generally speaking, there are three major approaches for performing landslide susceptibility analysis: heuristic, statistical and deterministic models, all with different assumptions, its distinctive data requirements and differently interpretable outcomes. Still, detailed comparison of resulting landslide susceptibility maps are rare.

In this presentation, the susceptibility modelling outputs of a deterministic model (Stability INdex MAPping - SINMAP) and a statistical modelling approach (generalized additive model - GAM) are compared. SINMAP is an infinite slope stability model which requires parameterization of soil mechanical parameters. Modelling with the generalized additive model, which represents a non-linear extension of a generalized linear model, requires a high quality landslide inventory that serves as the dependent variable in the statistical approach. Both methods rely on topographical data derived from the DTM. The comparison has been carried out in a study area located in the district of Waidhofen/Ybbs in Lower Austria. For the whole district (ca. 132 km^2), 1063 landslides have been mapped and partially used within the analysis and the validation of the model outputs.

The respective susceptibility maps have been reclassified to contain three susceptibility classes each. The comparison of the susceptibility maps was performed on a grid cell basis. A match of the maps was observed for grid cells located in the same susceptibility class. In contrast, a mismatch or deviation was observed for locations with different assigned susceptibility classes (up to two classes' difference). Although the modelling approaches differ significantly, more than 70% of the pixels reveal a match in the same susceptibility class. A mismatch by two classes' difference occurred in less than 2% of all pixels.

Although the result looks promising and strengthens the confidence in the susceptibility zonation for this area, some of the general drawbacks related to the respective approaches still have to be addressed in further detail. Future work is heading towards an integration of probabilistic aspects into deterministic modelling.