



Spatially varying prediction uncertainties and their implications on landslide susceptibility maps

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Statistical methods for landslide susceptibility modelling are popular methods assessing the landslide susceptibility of a region (e.g. countries, province, municipalities), as they operate with less data compared to physically-based models. With statistical methods an overview over the region can be provided to identify areas where more detailed analysis (e.g. using geotechnical site investigation) is necessary to learn more about the slope stability.

As with any model, statistical models are riddled with epistemic and aleatory uncertainties. As one model uncertainty spatially varying prediction uncertainties arise from the usage of a statistical model. The output of a statistical model is an individual value for each grid cell or terrain unit giving an estimated conditional mean value of the predicted probability. Therefore, there is a possible range to this value, a prediction uncertainty, as determined by the spatially varying standard error of the predicted probabilities conditional on the selected model form.

Our objective is to assess and visualize the prediction uncertainties and their implications on a landslide susceptibility map with three susceptibility classes in a case study in Lower Austria. We performed the statistical landslide susceptibility modelling with generalized additive models (GAM). The standard error of the prediction for each grid cell in the prediction map was assessed using a lookup table. The resulting standard error map aided to estimate the upper and lower limit of a 95% confidence interval of the predicted probability. The comparison of the classified maps of the upper and lower confidence limits and the map showing the predicted probability of landslide susceptibility revealed the spatially varying prediction uncertainties shown by overlaps of different susceptibility classes (high, medium or low).

While seven types of overlaps of different susceptibility classes were found, the most frequent overlap occurred between the low and medium susceptibility class of each of the three maps. In less than 1 % of the area an overlap of low and high susceptibility classes occurred. However, for 85 % of the area no overlaps of different susceptibility classes either with the lower or the upper confidence limit were found.

Naturally, the amount of overlapping cells might be dependent on the number of classes and selected class thresholds. However, once class thresholds are determined the analysis and visualization of these results may help to differentiate between areas of high certainty and high uncertainty instead of giving an impression of certainty for the entire modelling result. This is important information to evaluate the quality of the landslide susceptibility map, to raise awareness of the existence of uncertainties and to target more detailed analysis of slope stability more effectively.