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How badly are we doing? Estimating misclassification rates of shallow landslide susceptibility maps

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An important motivation for continuing efforts in landslide susceptibility mapping is the need for reliable maps of landslide-prone areas. “Reliable” means that a map should not systematically under- or overpredict landslide incidence and provide a fair measure of its predictive power. Probabilistic susceptibility maps may be generated by various statistical methods (logistic regression, neural networks, classification trees, etc.). These methods must be “trained” with data on past landslide occurrence and information about conditioning features (terrain, geology, land use, vegetation, soil, . . .). Once trained, most approaches fit observed landslide incidences in training areas reasonably well. If probabilistic predictions are thresholded, the *error rate* (total percentage of misclassifications), the *true positive rate* (sensitivity) and *false positive rate* $(1 - \text{specificity})$ — which form the receiver operating characteristics curve (ROC) when plotted against each other for several thresholds — provide, seemingly, a favourable picture of the predictive power of the methods. However, these *apparent* misclassification rates give too small estimates of the *true* rates. Remedy for bias is cross-validation, which provides nearly unbiased estimates, but suffers from large random variation. The large variance of cross-validation estimates can be mitigated by *bootstrapping*. Efron and Tibshirani [1] proposed the .632+ bootstrap for estimating the true error rate. Adler and Lausen [2] extended the method for estimating ROC curves.

We use the .632+ bootstrap to estimate misclassification rates (ROC curve, bias score [3]) of landslide susceptibility maps, generated by logistic regression and a random forest classifier. The methods are trained with data on incidence of shallow landslides, released in a pre-alpine catchment in Switzerland during a heavy rainfall in summer 2005. Geomorphological terrain attributes and information on land use are used as conditioning features. Two event-based landslides surveys in another two catchments in the same region are used as independent test data to estimate true misclassification rates. These estimates will be compared with the apparent, the cross-validation and the .632+ bootstrap estimates of misclassification rates computed from the training data only. This comparison will reveal whether bootstrapping offers some advantage over cross-validation for obtaining honest estimates of the predictive power of landslide susceptibility maps.

References

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