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Probabilistic classification of triggering conditions for precipitation-induced landslides in Norway

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The aim of the project was the probabilistic estimation of thresholds for triggering of rapid soil slides in Norway. A database of 281 landslide days for the period 2000-2011 was prepared with contributions from NVE, SVV, Jernbaneverket and NGI reports. The database included also 15224 no-landslide days. Each event in the database was characterised by 18 different explanatory variables of meteorological and hydrological nature grouped in 4 categories: (a) water supply (precipitation and snow melt), (b) runoff, (c) groundwater and (d) ground saturation. Landslides in man-made slopes or clearly not triggered by water (changes in pore water pressure or erosion) were not included in the analyses. The database was analysed as a whole and also by 6 sub-sets based on two regionalizations: the precipitation regions and a newly proposed regionalization based both on meteorological and geomorphological conditions. The explanatory variables were analysed in univariate and bivariate models (i.e. 1-variable and 2-variable). Four different methods were tested: linear discriminant analysis (LDA), quadratic discriminant analysis (QDA), classification tree and Naïve Bayes classification. The performance of each method was evaluated by estimating the receiver operating characteristic (ROC) curve and by assessing the misclassification error of a 10-fold cross-validated model (i.e. 10 different random datasets with testing and validation subsets). The assessment resulted in 144 univariate and 4896 bivariate threshold models. Finally, all the models were ranked based on a performance score in order to compare their relative quality of predictions. The top ranked models were combinations of water supply and ground saturation.