



Prediction of landslide velocity at given cumulated rainfall values based on analysis of continuous monitoring data using ROC curves: application to the Piagneto landslide (Northern Apennine, Italy)

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A novel approach to predict landslide velocity at given cumulated rainfall values based on the analysis of continuous displacement and rainfall monitoring data by using ROC curves has been developed and tested in the Piagneto landslide (northern Apennines, Italy). It is an active rock slide for which a velocity dataset covering the period October 2009 to December 2014 is available thanks to a total station that has been monitoring tens of prisms at duty cycles of 2 hours. Over the same time frame, an hourly rainfall dataset is available from rain gauges located just a few km away from the landslide.

The ROC curve (Receiver Operating Characteristic) is a well-known and widely used method to assess the efficiency of a binary classifier. In this case, it is used to assess the efficiency of different values of cumulated rainfall to determine a given value of velocity in the landslide. Operatively, the daily velocity distributions of selected monitoring prisms is plotted in order to assess upper values at given levels of occurrence probability, i.e. velocity values at the upper 1st, 2nd, 3rd quartile and 2 sigma. These velocity values are then classified with respect to daily rainfall cumulated over different time windows (from 1 to 120 days), that are considered singularly or in combination one another. The area under the ROC curves, as well as the max distance from the random line, is used as indicator of performance in order to assess the cumulated rainfall (in terms of amount and duration) showing the higher performance in predicting a defined landslide velocity level. The values obtained with the retrospective analysis of monitoring data, can then be used for prediction of expected velocity levels. This has been verified by using the conventional approach of dividing the dataset in a training and a validation subsets.

Results underline the added value of the analysis of long time-series of continuous landslide monitoring data by mean of operational research tools, such as in this case the ROC curves, for extracting information useful for improving the comprehension and the prediction of slope dynamics that, in specific cases, can be of great support to risk management.