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Landslide reactivation hazard mapping in the Flemish Ardennes (W Belgium)

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Most landslide hazard studies focus on predicting and mapping where, sometimes also when, new landslides will occur within a landslide-prone area. However, several examples in western Europe show that, at least for deep-seated rotational slides, reactivation of formerly slipped masses is a more frequent phenomenon, therefore representing a higher hazard. We propose here a new approach to locate the parts of pre-existing landslide scarps most susceptible to reactivation, based on the combination of stereophotogrammetric estimates of recent scarp movements and GIS-supported simulations using various sets of potential causal variables.

The Flemish Ardennes area of W Belgium is affected by more than 100 big deep-seated past landslides. Whereas no new landslide is known to have occurred for decades, several reactivation episodes have been recently observed in the area. We selected a test area comprised of 13 landslides and tried to predict the hazard related to scarp retreat. From the comparison of stereophotogrammetrically obtained DEMs for the epochs 1952 and 1996, we identified 14 places with scarp retreat exceeding 2 m and divided them into 26 reactivated scarp segments of similar length. Different modeling strategies have been tested using the Spatial Prediction Modeling System Mapping software developed by SpatialsModels Inc. Robust and reliable results were obtained with a fuzzy set approach and a combination of geomorphic, topographic and land use data. A 3 step procedure has been used to obtain the prediction maps that we present here. (1) We built a prediction model from the relations linking the 1952-1996 scarp retreat events to the environmental data of 1952. The prediction rate of the resulting susceptibility map was estimated by a cross-validation procedure sequentially excluding 2 of the 26 reactivation occurrences. (2) We applied the statistics of this

model to the data of 1996 (notably with significant changes in land use) in order to produce a susceptibility map responding to the present-day environmental conditions. (3) Finally, we estimated the conditional probabilities of occurrence of future reactivations for the periods 1996-2016 and 1996-2036 by using the prediction rate table of the model obtained from step 2.