

Influence of future land cover and climate changes on shallow slope failures: a case study from Val d'Aran, Pyrenees (Spain).

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ABSTRACT

Land use and land cover (LULC) as well as precipitation patterns will change in the future to global changes. These changes will have an important effect on the magnitude and frequency of shallow slides and debris flows. Recent studies show that such geomorphologic processes will increase in the Pyrenees. Therefore, the understanding of their impacts is fundamental for a correct regional risk assessment and land-use planning.

In 2013, a catastrophic landslide and flood episode hit the Val d'Aran region (Catalan Pyrenees, Spain). Afterwards, an inventory was created that included 393 shallow slides and debris flows. The analysis of the inventory showed that there is a strong relation between the landslide initiation and morphometric factors like slope angle, but also showed a clear influence of the LULC on the landslide susceptibility. Therefore, LULC prediction up to 2097 was performed by the LCM module of the TerrSet software.

Several regional climate change models were tested and finally the model SMHI-ECHAM5-r3 / RCA3 with the scenario A1B was selected. The predictive time series included daily precipitation values up to 2100.

The future LULC and precipitation changes were included in a regional stability model. The model, which was developed at UPC, applies the infinite slope theory and computes the probability of failure in each cell of a digital elevation model including stochastic soil properties.

The results show that the forested and urban areas will increase, while shrubs, grassland and scree area will drop. This prediction indicates that the landslide susceptibility in our study area will decrease, because forest and shrubs generally augment slope stability. On the other side, the impacts of future climate changes and the variation of the rainfall conditions are much more complex to analyse. Nevertheless, preliminary results reveal that the probability of shallow slope failures will grow because recent climate change studies of Catalonia predict an increase of rainfall amount of about 15% for return periods of 5 years or more.