



Will future land cover changes decrease the landslide susceptibility in high mountain areas? Inventory and modelling results from the Val d'Aran, Pyrenees.

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The role of land use and land cover (LULC) dynamics on landslide susceptibility is an important issue for regional risk assessment and land-use planning in hillslope environments. In 2013, a catastrophic landslide and flood episode hit the Val d'Aran region (Catalan Pyrenees, Spain). After this episode, a detailed landslide inventory was obtained by the interpretation of aerial photographs and field surveys. The inventory included 393 initiation points of shallow slides and debris flows. The analysis of these data showed that there is a strong relation between the landslide initiation and morphometric factors like slope angle, but also revealed a clear influence of the LULC on the landslide susceptibility.

Based on these results, two simple models (heuristic and deterministic) were defined and susceptibility maps with four different classes (very low, low, medium and high) were created and validated for the present situation of LULC.

In the next step, future prediction of landslide susceptibility was assessed by modelling the LULC up to 2097 and applying the two landslide models. The future LULC changes were analysed with the LCM module of the TerrSet software. One main input information of the LULC modelling is the historic LULC, which was determined in a previous step by the digitalization of the most important vegetation classes from aerial photographs of 1946, 1956, 1990, 2001 and 2013.

The results of the historic LULC evolution showed an important increase of forest area (+68%) and shrubs (+65%), while grassland and bare rock decreased (-33% and -52% respectively). In addition, urban area also increased; in particular between 1990 and 2013. The outputs of the LULC modelling indicated similar general trends for the future. Especially forest area is augmenting, while the other vegetation classes are slightly decreasing. Finally, the prediction of landslides susceptibility in the Val d'Aran was calculated up to 2097. The results show that the area of high landslide susceptibility will decrease almost to the half, while the class of very low susceptibility will considerably increase.

In conclusion, the overall susceptibility conditions for landsliding will improve in the future. However, it must be stated that this study only includes preparing factors and totally neglects the triggering factors like rainfall, which probably will change in the future. Nevertheless, studies like the present one provide a useful tool for the administration in order to define guidelines for mitigation measures and thus to reduce the risk of instability processes.