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Will the Pyrenees suffer less rainfall-triggered landslides in the future? Results of regional-scale stability modelling in the Val d'Aran focussing on land cover and rainfall predictions.

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The occurrence of rainfall-induced landslides in high-mountain areas will be affected by future environmental changes. We analysed the influence of climate changes as well as land use and land cover (LULC) changes on shallow slope failures in the Val d'Aran region (Central Pyrenees) applying the simplified physically-based susceptibility model FSLAM. In this study, the event rainfall as well as the root strength were defined as the two input parameters that will be affected by the future changes.

On one side, the climate changes were analysed by the rainfall projections that are defined in the 26 regional climate models available at the moment in the EURO-CORDEX database using RCP 8.5 scenarios. Future precipitation return periods up to 2100 were calculated by a simplified peaks-over-threshold method based on storm events frequency analysis. Finally, daily rainfall scenarios for the entire study were estimated by weighting current rainfall extremes using a multiplier factor. On the other side, the LULC changes were calculated by the IDRISI TerrSet software suite. All the predictions were performed for three time periods (near, mid and far future).

The results of the climate change prediction showed that the daily rainfall will increase between 15 and 27 % assuming a return period of 100 years. In addition, the LULC predictions foresee a strong increase of the forest area, while in particular grassland, but also shrubs, decrease in area. Using the different rainfall and LULC predictions, multiples scenarios were defined and the corresponding susceptibility maps calculated. The stability calculations by the FSLAM model indicate that the overall stability conditions in the study area reduces when only the future rainfall prediction is considered. In contrast, the overall stability largely improves when only considering the LULC predictions (due to the increase of forest area and the corresponding higher root strength). However, the effect of LULC-changes is more important than the influence of rainfall-changes. Therefore, the overall stability conditions will improve in the future.

Many simplifications were incorporated in this susceptibility assessment and there are many uncertainties. Nonetheless, these results may help future studies to improve our knowledge on the impacts of future environmental changes on landslide occurrence in high-mountain areas.