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Impacts of future land cover and climate changes on landslide susceptibility. Results obtained from regional-scale modelling in the Pyrenees.

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Future environmental changes will strongly affect the occurrence of rainfall-induced landslides in mountainous regions. In our ongoing study, we focus on the effects of climate changes as well as land use and land cover (LULC) changes on shallow slope failures in the Pyrenees. For this reason, a physically-based susceptibility model was developed, which calculates the landslide susceptibility at regional scale. The model merges two different approaches for the calculation of pore fluid pressure and also includes the option of defining the values of input parameters stochastically.

The model was validated using landslide inventories from two different study areas located in the Central and Eastern Pyrenees. One is the inventory of historic shallow slides and debris flows in Andorra country. The other one is the inventory of the catastrophic landslide episode in Val d'Aran area in June 2013, which includes 393 landslide initiation points. The susceptibility modelling of these two validation cases produced acceptable results and showed that our physically-based model is producing consistent stability conditions.

In the next step, the future LULC and climate changes until the end of the 21th century were simulated for Val d'Aran study area. The LULC changes were determined with the IDRISI TerrSet software suite, while the climate changes were obtained from the ensemble of regional climate models using RCP 4.5 and 8.5 scenarios. The results of the susceptibility modelling showed that the impacts of future LULC changes increase the overall stability because of the larger area of forest and shrubs (and consequently higher cohesion due to root strength). In contrast, the impact of future climate changes, which was principally incorporated by higher rainfall intensity, reduced the overall slope stability. However, when we compared the impacts of both future changes, the results showed that the influence of the vegetation expansion is more important than the effect of higher rainfall intensity. Therefore, the overall stability conditions in the study area seem to slightly improve in the future.

As always in such studies, there are many uncertainties in the input data and additional simulations are necessary to confirm the observed trends. Nonetheless, the outcomes provide helpful information for researchers and practitioners that deal with the impacts of future changes

on landslide susceptibility in mountainous regions.