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Developing scenarios to assess future landslide risks: a model-based approach applied to mountainous regions

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In the last century, European mountain landscapes have experienced significant transformations. Natural and anthropogenic changes, climate changes, touristic and industrial development, socio-economic interactions, and their implications in terms of LUCC (land use and land cover changes) have directly influenced the spatial organization and vulnerability of mountain landscapes. This study is conducted as part of the SAMCO project founded by the French National Science Agency (ANR). It aims at developing a methodological approach, combining various tools, modelling platforms and methods, to identify vulnerable regions to landslide hazards accounting for futures LUCC. It presents an integrated approach combining participative scenarios and a LULC changes simulation models to assess the combined effects of LUCC and climate change on landslide risks in the Cauterets valley (French Pyrenees Mountains) up to 2100. Through vulnerability and risk mapping, the objective is to gather information to support landscape planning and implement land use strategies with local stakeholders for risk management.
Four contrasting scenarios are developed and exhibit contrasting trajectories of socio-economic development. Prospective scenarios are based on national and international socio-economic contexts relying on existing assessment reports. The methodological approach integrates knowledge from local stakeholders to refine each scenario during their construction and to reinforce their plausibility and relevance by accounting for local specificities, e.g. logging and pastoral activities, touristic development, urban planning, etc. A process-based model, the Forecasting Scenarios for Mountains (ForeSceM) model, developed on the Dinamica Ego modelling platform is used to spatially allocate futures LUCC for each prospective scenario. Concurrently, a spatial decision support tool, i.e. the SYLVACCESS model, is used to identify accessible areas for forestry in scenario projecting logging activities. The method results in the development of LULC maps providing insights into a range of alternative futures using a scope of socio-economic and environmental conditions. A landslides assessment model, the ALICE model is then used as a final tool to analyze the potential impacts of simulated LUCC on landslide risks and the consequences in terms of vulnerability, e.g. changes in disaster risk allocation or characterization, degree of perturbation. This assessment intends to provide insights onto the potential future development of the valley to help identify areas at stake and to guide decision makers to help the risk management. Preliminary results show strong differences of futures land use and land cover maps that have significant influence on landslides hazards.