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Generating local scale land use/cover change scenarios: case studies of high-risk mountain areas

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The relationship between land use/cover changes and consequences to human well-being is well acknowledged and has led to higher interest of both researchers and decision makers in driving forces and consequences of such changes. For example, removal of natural vegetation cover or urban expansion resulting in new elements at risk can increase hydro-meteorological risk. This is why it is necessary to study how the land use/cover could evolve in the future. Emphasis should especially be given to areas experiencing, or expecting, high rates of socio-economic change.

A suitable approach to address these changes is scenario development; it offers exploring possible futures and the corresponding environmental consequences, and aids decision-making, as it enables to analyse possible options. Scenarios provide a creative methodology to depict possible futures, resulting from existing decisions, based on different assumptions of future socio-economic development. They have been used in various disciplines and on various scales, such as flood risk and soil erosion. Several studies have simulated future scenarios of land use/cover changes at a very high success rate, however usually these approaches are tailor made for specific case study areas and fit to available data. This study presents a multi-step scenario generation framework, which can be transferable to other local scale case study areas, taking into account the case study specific consequences of land use/cover changes.

Through the use of experts' and decision-makers' knowledge, we aimed to develop a framework with the following characteristics: (1) it enables development of scenarios that are plausible, (2) it can overcome data inaccessibility, (3) it can address intangible and external driving forces of land use/cover change, and (4) it ensures transferability to other local scale case study areas with different land use/cover change processes and consequences. To achieve this, a set of different methods is applied including: qualitative methods such as interviews, group discussions and fuzzy cognitive mapping to identify land use/cover change processes, their driving forces and possible consequences, and final scenario generation; and geospatial methods such as GIS, geostatistics and environmental modeling in an environment for geoprocessing objects (Dinamica EGO) for spatial allocation of these scenarios.

The methods were applied in the Italian Alps and the Romanian Carpathians. Both are mountainous areas, however they differ in terms of past and most likely future socio-economic development, and therefore consequent land use/cover changes. Whereas we focused on urban expansion due to tourism development in the Alps, we focused on possible deforestation trajectories in the Carpathians. In both areas, the recognized most significant driving forces were either not covered by accessible data, or were characterized as intangible. With the proposed framework we were able to generate futures scenarios despite these shortcomings, and enabling the transferability of the method.