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Influence of land-use dynamics on natural hazard risk

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In the recent past the magnitude and frequency of natural hazard events has increased notably worldwide, along with global GDP. A higher number of elements are exposed to natural events, therefore the risk is higher. Both estimated losses and understanding about natural hazards have increased during the past decades, which is contradictory as we may logically think. Risk is increasing, due to climate change and societal change: more severe hazards are happening due to changing climatic patterns and conditions, while society is concentrating assets and people in punctual places leading to a higher exposure. Increasing surface of settled area and the concentration of highly valuable assets (e.g. technology) in exposed areas lead to higher probability of losses.
Human use of land resources, namely landuse, is the product of human needs and biophysical characteristics of the land. Landuse involves arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it. These changes are due to many reasons, or driving factors: socio-economical, environmental, accessibility to land, land-tenure, etc. The change of those factors may cause many effects and impacts, at various levels and at different time spans. The relation between driving factors and impacts is not straight. It is although a complex interrelation that turns around two central questions: (1) what drives landuse changes and why and (2) what are the impacts on the environment and on the human society of these changes, regarding to natural hazards. The aim of this paper is to analyse the spatio-temporal environmental changes referring to exposure as well as to test the possibilities and limitations of the land use change model Dyna-CLUEs in a mountain region taking parts of the Republic of Austria as an example, and simulating the future landuse dynamics until 2030.
We selected an area composed by eighteen municipalities in the Ill-Walgau in the Austrian federal state of Vorarlberg. The choice is due to the interesting spatial arrangement of the area which alternate a well-developed infrastructure network, a high percentage in forest cover, industrial areas and two relatively big cities, Feldkirch and Bludenz. As we observed, the past two decades did not face substantial landuse change – in comparison with the decades from the 1950s to the 1990s – hence we may also expect that the next three decades will follow the same trend of the recent past.
Four scenarios were built in order to end up with four future landuse maps. We cross-checked these maps with hazard zoning by the Austrian Torrent and Avalanche Control Service (WLV) and the zonation by the Austrian Hydraulic Engineering Administration (BWV). Excluding a significant change in the next 30 years in the hazard propagation (intensity, frequency, etc.) – hence excluding climate change effects – we observed how the risk changes with changing landuse patterns throughout the years.
The study aims to show the importance of spatial planning and restriction policies in mitigation of natural hazards. Still, the spatial planning is or should be one fundamental pillar of risk management, although is not yet a homogenous and standardized element in risk management in Austria.