



Land use and surface process domains on alpine hillslopes

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Shrubs and trees are generally considered to protect hillslopes from erosion. As a consequence, shrub encroachment on mountain pastures after abandoning grazing is not considered a threat to soils. However, the abandonment of mown or grazed grasslands causes a shift in vegetation composition and thus a change in landscape ecology and geomorphology. On many alpine slopes, current changes in land use and vegetation cover are accompanied by climate change, potentially generating a new geomorphic regime. Most of the debate focuses on the effect of land abandonment on water erosion rates. Generally, an established perennial vegetation cover improves the mechanical anchoring of the soil and the regulation of the soil water budget, including runoff generation and erosion. However, changing vegetation composition affects many other above- and below-ground properties like root density, -diversity and -geometry, soil structure, pore volume and acidity. Each combination of these properties can lead to a distinct scenario of dominating surface processes, often not reflected by common erosion risk assessment procedures. The study of soil properties along a chronosequence of green alder (*alnusviridis*) encroachment on the Unteralpental in central Switzerland reveals that shrub encroachment changes soil and vegetation properties towards an increase of resistance to run-off related erosion processes, but a decrease of slope stability against shallow landslides. The latter are a particular threat because of the currently increasing frequency of slide-triggering high magnitude rainfalls. The potential change of process domain on alpine pastures highlights the need for a careful use of erosion models when assessing future land use and climate scenarios. In mountains, but also other intensively managed agricultural landscapes, risk assessment without the appropriate reflection on the shifting relevance of surface processes carries the risk of missing future threats to environmental quality, services and hazards.