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Human-induced shifts in geomorphic process rates: An example of landslide activity following forest cover change.

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Mountain regions present unique challenges and opportunities to land use change research. Very few, if any, mountain ecosystems remain unaffected by human impact. Based on the exemplary evidence from local case studies, it is not yet possible to have an overall assessment of the extent and impact of human activities on mountain erosion as mountain regions are typically characterized by rapid changes in geomorphic, cryospheric, climatic, hydrologic, ecological and socio-economic conditions over relatively short distances.

Here, we present a conceptual model that allows evaluating human-induced shifts in geomorphic process rates. The basic idea behind this model is that the magnitude-frequency distribution of geomorphic processes is dependent on the intensity of human disturbance. The conceptual model is here applied for characterising landslide activity following forest cover change. We selected a tropical Andean catchment with a deforestation rate of 1.4% over the last 45 years. Landslide inventories were established based on historical aerial photographs (1963, 1977, and 1989) and very high-resolution satellite images (2010). Statistical analyses show that the total number of landslides is rising, and that they are increasingly associated with human disturbances (deforestation, road construction). This is particularly the case for shallow landslides that become more frequent after clearcutting. As the human-induced shifts in landslide activity are significant for the low-magnitude events only, the total impact on geomorphic process rates is rather limited in this particular area.

This work shows that including information on the magnitude-frequency of geomorphic events before, during and after human disturbances offers new possibilities to quantify the complex response of geomorphic processes to human disturbances.