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Role of land use change in landslide-related sediment fluxes in tropical mountain regions

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Tropical mountain regions are characterised by high denudation rates. Landslides are known to be recurrent phenomena in active mountain belts, but their contribution to the overall sedimentary fluxes is not yet well known. Previous studies on sedimentary cascades have mostly focused on natural environments, without considering the impact of human and/or anthropogenic disturbances on sedimentary budgets. In our work, we hypothesise that human-induced land use change might alter the sediment cascade through shifts in the landslide magnitude-frequency relationship. We have tested this assumption in the Virgen Yacu catchment (approximately 11km^2), in the Ecuadorian Cordillera Occidental.

Landslide inventories and land use maps were established based on a series of sequential aerial photos (1963, 1977, 1984 and 1989), a HR Landsat image (2001) and a VHR WorldView2 image (2010). Aerial photographs were ortho-rectified, and coregistred with the WorldView2 satellite image. Field campaigns were realised in 2010 and 2011 to collect field-based data on landslide type and geometry (depth, width and length). This allowed us to establish an empirical relationship between landslide area and volume, which was then applied to the landslide inventories to estimate landslide-related sediment production rates for various time periods. The contribution of landslides to the overall sediment flux of the catchment was estimated by comparing the landslide-related sediment production to the total sediment yield.

The empirical landslide area-volume relationship established here for the Ecuadorian Andes is similar to that derived for the Himalayas. It suggests that landslides are the main source of sediment in this mountainous catchment. First calculations indicate that human-induced land use change alters the magnitude-frequency relationship through strong increase of small landslides.