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Andean landscapes marking the interactions of biota and humans with earth surface processes

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Tropical Andean landscapes are biogeographically very diverse: they have strong environmental gradients with rapid changes in geomorphology, geology and soils, climate and biota over short distances. Their headwater basins function as important regulators of water, sediment and nutrient supply to the Amazon basin. Anthropogenic activities have increasingly transformed the tropical Andean ecosystems into a patchwork of agricultural plots, urban and rural centres, forest plantations, and remnants of native forests and grasslands.

In this talk, we will present two Andean landscapes at the edge, that are rapidly changing under the influence of land use and climate change. In each of them, we will highlight the dynamic interactions of biota and humans with earth surface processes.

The first landscape is characteristic for the Inter-Andean valleys that were already used for agricultural production by pre-Incan Andean civilisations. Accelerated soil erosion by unsustainable farming practices led to soil fertility decline and potentially played a major role in rural out-migration. Following agricultural abandonment, recolonisation by local plants and tree planting led to landscape regreening, with measurable impacts on soil erosion and sediment transport, runoff generation and streamflow.

The second, high Andean or paramo landscape, is situated above 3200 m a.s.l., and highly sensitive to climate warming. This alpine tundra ecosystem is less affected by land use change. The mosaic of tussock grasses, cushion plants and native forests provides a good opportunity to study the influence of biota on soil-landscape development. Beyond the hillslope-scale topographic control on soil development, we observed significant differences in soil weathering extent between vegetation communities hinting to eco-evolutionary plant-soil feedbacks.

Although located only 45 km apart, the two contrasting landscapes illustrate how the interactions and feedbacks between earth surface processes, biota and humans reshape tropical Andean landscapes.