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Investigating post-glacial transient phases as hot-moments of landscape dynamics - combining numerical modelling and topographic analysis

Coline Ariagno[1], Philippe Steer[1], and Pierre Valla[2]
[1]Université de Rennes, Géosciences, France (coline.ariagno@univ-rennes.fr)
[2]ISTERRE, Univ. Grenoble Alpes, CNRS, IRD, IFSTAR, , Univ. Savoie Mont Blanc, Grenoble 38000, France

In steep alpine environments, the succession of glacial-interglacial cycles during the Quaternary led to multiple transient geomorphological phases. These periods are induced by an imbalance between the inherited shape of the topography and the dominant geomorphological processes. In particular, post-glacial periods are key transition phases experiencing rapid geomorphic changes, characterized by intense hillslope processes where ice and permafrost have shrunk. As landslides are the main factors controlling sediment production in steep mountain environments, we approach numerically their late-glacial to interglacial dynamics and explore the associated evolution of catchment topography across a wide range of morphological signatures (i.e. from fluvial to glacial initial topographies). Using the landscape evolution model 'Hyland', we quantitatively assess the response of each type of catchment to landsliding. We focus on the cumulative impact of landslides, during the post-glacial phase, on catchment slope distribution, hypsometry and produced sediment volume. Moreover, glacial topographic inheritance seems strongly sensitive to hillslope processes with a non-homogeneous spreading of landslides over the catchments, both spatially and temporarily. Our results reveal a temporal change in slope-elevation distribution associated to a general lowering in maximum catchment elevations. On the contrary, fluvial catchments show more stable topography and less intense landslide activity. Landscape evolution models appear as a suitable tool to quantitatively explore (1) the role of different internal or external parameters (e.g., bedrock cohesion, return time of landslides), and (2) the non-linear interactions between landsliding and catchment topographic evolution, which are strongly influenced by external forcing such as climatic fluctuations in mountainous settings.