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Reconstructing geomorphic patterns and forcing factors from Alpine Lake Sediment

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In this paper we review the scientific efforts that were led over the last decades to reconstruct geomorphic patterns from continuous alpine lake sediment records. Whereas our results point a growing importance of humans as erosion forcing factors, we will focus here on climate-related processes. Our main dataset is made of a regional approach which was led without any a priori regarding erosion forcing factors. We hence integrated a set of sediment sequences from various environment along an altitudinal gradient from 200 up to 2400m asl in Northern French Alps.

Altogether our data point climate change as one of the main factor of erosion variability. In particular, the last two cold spells that occurred during the early middle age (Dark Age) and between the 14th and the 20th century AD (Little Ice Age) appear to be outstanding compared to any other periods of enhanced erosion along the Holocene. The climatic forcing of those erosion phases is supported by an increase in the contribution of glacier-eroded material at a regional scale. At local scales, our data also point the growing importance, since at least the mid Bronze Age (ca. 3500 cal. BP) of human activities as a major erosion factor. This influence peaked during the late Iron Age and Antiquity periods (200 BC – 400 AD) when we record a regional generalised period of enhanced erosion in response to the development of pasturing activities.

Thanks to provenance and weathering markers, we evidenced a strong relationship between the changes in ecosystems, soil development and erosion patterns. We hence showed the vegetal colonisation of bared soil led to a period of intense weathering while new soils were under formation between 11,000 and 8,000 cal. BP. Soils then knew an optimum until the onset of the Neoglacial at ca. 4,500 cal. BP prior to decline under both climate and human pressures.

Altogether our data point the complexity of processes that affected the Earth critical zone along the Holocene. However, we highlight the interest of leading spatialized paleo-investigation in order to reconstruct those dynamics through and thus better understand the processes in play in critical zone dynamics over long time periods.