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The "stream power" of the Alpine Rivers

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We examine the spatial pattern of fluvial erosion on the entire European Alps and adjacent areas by applying the widely used stream power model (e.g. Whipple and Tucker, 1999). According to that model, the bedrock incision rate (E) equals the water flux (upstream contributing area (A) times rainfall (W)) multiplied by the channel slope (S) and a coefficient K which aggregates the influence of many factors, e.g. rock resistance to erosion or channel geometry.
E= (Am * W) * Sn * K
We apply the stream power (SP) approach as a generalized abstraction of erosional processes in the Alps using the highest available DEM (ASTER GDEM) for the entire orogen in a resolution of 1" (∼30m). Climatic variability is implemented in to the SP adding a precipitation correction factor (average precipitation per year). We further average rates of large drainage basins' stream power to compare with existing post-LGM and Holocene erosion rates (Hinderer, 2001; Wittmann et al., 2007; Champagnac et al., 2009).
Results show that the ice extension during the LGM is still represented in the extracted stream power. More specifically, SP values generally start to rise as soon as streams reach the areas of the former piedmont ice lobes. Outside of the LGM limits, SP values rise continuously, representing generally higher values in bedrock sections and lower values in alluvial-dominated sections.
To better interpret the relative potential for erosion across the entire Alps, we use an averaged moving window on large catchments, and across the belt as a whole. At the scale of our analysis SP is used as a surrogate for the spatial pattern of erosion for which values may be used as an index of erosion (e.g. Finlaysson and Montgomery).
Finally, we examine the important role of different East and West Alpine base levels on SP and discuss the associated effects on the evolution of the belt: the large eastern alpine rivers show generally higher SP values than those in the western Alps (e.g. Rhine or Rhône), which is linked to shorter stream length in W-Alps with respect to their base level, than E-Alps rivers, largely flowing parallel to the belt.

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