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Bridging the timescales between thermochronological and cosmogenic nuclide data

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Reconstructing the evolution of Earth's landscape is a key to understand its future evolution and to identify the driving forces that shape Earth's surface. Cosmogenic nuclide and thermochronological methods are routinely used to quantify Earth surface processes over 10^2-10^4 yr and 10^6-10^7 yr, respectively (e.g. Lal 1991; Reiners and Ehlers 2005; von Blanckenburg 2006). A comparison of the rates of surface processes derived from these methods is, however, hampered by the large difference in their timescales. For instance, a constant erosion rate of 0.1 mm/yr yield an apatite (U-Th)/He age of ∼24 Ma and a ^{10}Be age of ∼6 ka, respectively. Analytical methods that bridge this time gap are on the way, but are not yet fully established (e.g. Herman et al. 2010). A ready to use alternative are river profiles, which record the regional uplift history over 10^2-10^7 yr (e.g. Pritchard et al. 2009). Changes in uplift are retained in knickzones that propagate with a distinct velocity upstream, and therefore the time of an uplift event can be estimated. Here I present an integrative inverse modelling approach to simultaneously reconstruct river profiles, model thermochronological and cosmogenic nuclide data and to derive robust information about landscape evolution over thousands to millions of years. An efficient inversion routine is used to solve the forward problem and find the best uplift history and erosional parameters that reproduce the observed data. I test the performance of the algorithm by inverting a synthetic dataset and a dataset from the Sila massif (Italy). Results show that even complicated uplift histories can be reliably retrieved by the combined interpretation of river profiles, thermochronological and cosmogenic nuclide data.

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