Geophysical Research Abstracts
Vol. 15, EGU2013-4709-1, 2013
EGU General Assembly 2013

Late-Cenozoic relief evolution under evolving climate: A review of quantitative arguments

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Relief is the defined as an elevation difference between two points. Relief can increase, decrease, or remain constant through time, regardless of the absolute erosion rates. The relief evolution directly reflects the spatial distribution of the equilibrium between the uplift and the erosion of rocks. Understanding how, why, and when relief has changed in the past can help to understand the causal relationship between tectonics, topography and climate and the relation between erosion and the climate. Relief change can be addressed by three different ways, or by combination of them: (1) direct quantification of differential erosion by surface dating, or direct erosion rate quantification with cosmogenic radionuclides inventories, (2) quantification of differential exhumation histories using thermochronology, and (3) numerical modeling of landscape evolution. This study mostly focus on the results from cosmogenic radionuclides dating that has demonstrated the ability to quantify relief change at kyr timescale, and from low-temperature thermochronology, which has been used to constrain relief change at Myr timescale, as well as a critical review of results from landscape evolution modelling. Finally, I review the different views provided by the literature on the potential links between relief and erosion, climate and tectonics, as well as their respective evolution through geological times. Tracking relief evolution is different than tracking changes in erosion rate, because relief evolution depends on the spatial variability of the erosion, not directly on the local or spatially-averaged erosion rates. Hence, tracking relief changes through time may provide insights on the location of the erosion, and therefore can be used to better understand (1) geomorphic/physical rules that govern each individual erosional agent (e.g. fluvial, glacial, etc.), and 2) how the distribution of the different erosional mechanisms are distributed in both space and time.