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Investigating valley spacing dynamics in linear mountain fronts through terrain numerical modeling

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Competition and synergy between tectonic and erosional processes are recognized as the main factors influencing the shape of many landscapes.
While considerable efforts are dedicated to the explanation of particular landscape forms and features, such as those found in some parts of the Earth surface, another aspect which is rising interest in the scientific community is the emergence of similar patterns and regularities in a variety of situations and environmental conditions.
Recent investigations, for instance, have been dedicated to the analysis of landscape features such as regular valley spacing in drainage networks evolving on slopes affected by competing tectonic uplift and terrain erosion.
Analysis of digital terrain models reproducing either actual features, or simulated surfaces obtained through application of landscape processes to synthetic terrain, have shown how the emergence and persistence of considerable degrees of regularity in the terrain dissection into parallel river basins is a feature common to both types (real and simulated) of landscapes. Such a regularity has been observed in linear mountain fronts, in different types of tectonic and climatic settings [Hovius 1996, Talling et al. 1997, Castelltort & Simpson 2006].
Regular river spacing has been also observed in simulated landscapes obtained through application of numerical models [Perron et al. 2009], or indoor scaled reproductions of an orogen subject to erosion by rain-wash [Bonnet 2009]. Several classes of explanations have been proposed for the onset and persistence of such spacing regularities. In particular, one critical aspect is the transient phase of reorganization that involves landscapes undergoing changes in geometry.
In this work, we investigate the temporal evolution of mean river basin aspect ratio, R, defined as the ratio between mountain front width W and basin outlet spacing S, averaged over a number of basins spanning at least a given fraction (say, 2/3) of W.
The parameter R is analyzed on simulated landscapes obtained by application of numerical models of uplift, hillslope diffusion and fluvial erosion to synthetic surfaces, represented as triangulated irregular networks (TINs). The model is completely implemented in Matlab, thus leaving ample access to a number of available terrain analysis and visualization tools.
We report some observations about the temporal evolution of the R parameter, an aspect not very well covered in recent investigations. In particular, we investigate its response to different values of uplift rates and erosion power. We also simulate the response of R to the reorganization of the river network following the setup of a gradient in the precipitation regime.

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