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Quantifying Characteristic Length Scales and Patterns in Topography

Matthias Schmiddunser and Todd A. Ehlers
Department of Geosciences, University of Tübingen, Tübingen, Germany (matthias.schmiddunser@uni-tuebingen.de)

The geometry of mountain topography depends on climate, tectonic, and biologic processes that operate on different temporal and spatial scales. Quantitative measures of landscape geometry are of interest for a) identifying potential correlations with the different types of processes, and b) for comparing observed topography with calibrated landscape evolution models of different regions.
Over the years, several of these geomorphic metrics have been developed and used. Most of these metrics are regional values, i.e. they are calculated over an area of specific extent. Usually a region's typical horizontal length scale, like the average ridge-to-valley-distance, is used for this. However, this value is often chosen arbitrarily from a visual assessment of the landscape.
In this study we aim to develop a quantitative measure of landscape properties that identifies dominant trends in drainage spacing and orientation. This is done by taking into account variations in topographic relief on different wavelenghts. More specifically, we use an autocorrelation function that is evaluated for different directions, thereby identifying prevalent orientation of features. The area of interest is then subdivided into parts of the thus obtained size and the process repeated, so that higher order structures are revealed.
The results not only provides a size for the area over which other geomorphic metrics can be calculated such as the mean slope or the hypsometric integral, but may also be used as an additional measure for the form of the landscape itself.
The method is applied to three regions along the South American Pacific coastal areas between latitudes of 26°S and 40°S. The study areas have distinctly different climate and vegetation conditions, showing the effect of different landscape forms on the values obtained.
Results indicate a systematic variation between the three investigated regions. In the northern drier part of the coast results indicate large variations in the obtained correlation lengths depending on orientation and distinct higher order features. This is in stark contrast to the southern most region where little variation in correlation length and only weak secondary structures can be seen.