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Quantification of tectonic deformation processes using nonlinear analysis of river systems.

R. Gloaguen, F. Shahzag, F. Wobbe, A. Kaessner
Remote Sensing Group, TU Bergakademie Freiberg, 09599 Freiberg, Germany
(gloaguen@geo.tu-freiberg.de)

Rivers are sensitive to changes in tectonic deformation, adjusting over different periods of time depending on the physical properties of the host rocks, climatic effects and tectonic activity. Thus, the drainage system of a region records the evolution of tectonic deformation. Quantitative measurements of a number of geomorphic indices are commonly used as a reconnaissance tool in tectonic geomorphology studies to identify areas experiencing tectonic deformation. In order to estimate the relative variations of tectonic activity in a study area, we propose to use the combination of different geomorphic indices. These tools allow the quantification of surface deformation both on maps and on stream profiles. For this purpose we developed a series of algorithms to automatize the extraction of both known and newly developed indices from Digital Elevation Models (DEM). As each method is equivocal due to the number of factors influencing each index, the objective is to generate several maps which, integrated in a GIS, allow a better interpretation of the results. Backed with remote sensing data and ground-checking we expect to provide a precise localization of the deformed area and the local strain intensity. We are currently testing these methods in Tibet, Pamirs, and Ethiopia and compare the results with independent measurements of erosion. The first step concerns the DEM generation. We have now generated DEMs using most of the remote sensing methods existing (Photogrammetry, Radargrammetry, Stereogrammetry, InSAR etc.). Depending on the location and the expected resolution different techniques are selected. The estimation of fractal dimensions allows us to measure the degree of complexity by evaluating how a dimension measurement increases or decreases at different scales. The idea here is to quantify the influence of neotectonic

activity on the drainage system by measuring the reduction of complexity as the deformation intensity increases. In other words we expect the drainage system to loose its original complexity (dendritic network) and linearize as topographical changes triggered by faults will modify the flow network geometry. We have already created an algorithm based on semivariograms and power spectrum density to measure fault network complexity. For this purpose we also implemented a box counting method.