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A new set of MATLAB functions (TecDEM toolbox) to analyze erosional stages in landscapes and base-level changes in river profiles

Louis Andreani (1), Richard Gloaguen (1), and Faisal Shahzad (2)

(1) Helmholtz Institute Freiberg for Resource Technology, Freiberg, Germany, (2) Research and Development (Laser Scanner), Zoller & Froehlich GmbH, Wangen im Allgäu, Germany

We implemented three new functions in the MATLAB-based TecDEM toolbox [1,2]: surface index, topographic position index, and the analysis of base-levels in river longitudinal profiles. These tools provide useful ways to understand the effects of base-level changes on topography such as stream captures, erosion or rejuvenation of pre-existing topographic features and anomalies in river longitudinal profiles. We developed a new index (referred as "surface index") which provides a quick way to map simultaneously preserved and eroded portions of an elevated landscape. This index classifies landscapes according to their erosional stages using the combination of the hypsometric integral, which efficiently highlights flat surfaces, and the surface roughness, which substantially increases with incision. We also implemented the commonly used "topographic position index". This index provides a simple way to classify the landscapes as valleys, ridges and flat areas. However, its application in tectonic geomorphology can go far beyond as it discriminates valleys shapes and reveals other important features such as wind gaps and knickpoints when associated to the extracted river system. Finally, we implemented a tool allowing the estimation of base-level changes using the reconstruction of river longitudinal profiles. River profiles can be decomposed in concave or convex segments. Relict base-levels are typically associated to gently concave segments in river profiles. By restoring the initial shape of these segments we are able to estimate the amount of incision between the present day base-level and the relict base-level. All these tools were successfully tested in different settings such as Central America, Central Europe and Pamir. In addition to the description of these tools we provide examples from these different areas.

[1] Shahzad, F., & Gloaguen, R. (2011). TecDEM: A MATLAB based toolbox for tectonic geomorphology, Part 1: Drainage network preprocessing and stream profile analysis. Computers & Geosciences, 37, 250–260.
[2] Shahzad, F., & Gloaguen, R. (2011). TecDEM: A MATLAB based toolbox for tectonic geomorphology, Part 2: Surface dynamics and basin analysis. Computers & Geosciences, 37, 261–271.