Geophysical Research Abstracts
Vol. 21, EGU2019-14332, 2019
EGU General Assembly 2019

Exploring the applications of advanced geomorphic indices in statistically based landslide susceptibility models: a case study from Tajik Tien Shan and Pamir

Natalie Barbosa Mejia, Louis Andreani, and Richard Gloaguen

Helmholtz-Zentrum Dresden-Rossendorf, Helmholtz Institute Freiberg for Resource Technology, Freiberg, Germany (l.barbosa-mejia@hzdr.de)

The identification of areas prone to landslides is essential to adapt the response and reduce the negative impact in affected regions. This is usually done using landslide susceptibility models, which give the likelihood of a landslide occurring in an area depending on the local terrain conditions and the location of known past events. Detailed databases covering different thematic groups such as geomorphology, hydrology, geology and land use are paramount in order to produce a reliable identification of susceptible areas. However, thematic data from developing countries are scarce and the situation is even worse in mountainous regions which are yet highly vulnerable to natural disasters such as landslides. As a result, susceptibility models often rely heavily on geomorphic parameters derived from DEMs. The three dominantly used variables include slope, aspect and curvature. While these variables are simple to compute and can be obtained from any GIS software, the geomorphological significance of the last two of them is often poorly justified as the window of observation (3×3 pixels) is too small to capture the morphometric signature of landslides or the overall morphology of an entire slope profile.

This study explores the use of advanced geomorphic indices as the main input for landslide susceptibility models. These indices have been often used in tectonic geomorphology to understand the relationship between surface processes and landscape evolution and can provide a useful way to characterize the topography in mountainous regions. Tested indices include surface roughness, local relief, topographic position index, elevation relief ratio, surface index and Eigen-based analysis of the landscape. The test area encompasses the mountainous areas in Tajikistan (SW Tien Shan and Western Pamir), where large magnitude historical landslides have been reported and studied. Landslide susceptibility maps with good predictive capabilities are obtained using different statistically based approaches such as logistic regression and random forest. First, we explored the spatial association between the variables and the landslide catalog. Then, the input variables are recursively selected for each model based on the spatial associations and the improvement in model performance. The best model is chosen based on its predictive capability, measured by the receiver operator curve (ROC) and its dispersion from the cross-validation. Our results suggest that landslide susceptibility modeling using advanced geomorphic indices as the primary source of thematic information is a viable approach. Measures of the relative importance of geomorphic variables used in the best models show that indices such as eigenvalues, local relief, surface roughness, slope, topographic position index and surface index contributed significantly to the models while commonly used aspect and curvatures had a limited impact. Also, the methodology we used is low cost and built on free and open source programs (R and Python), making it easily available for developing countries.