Landslide susceptibility prediction by supervised Kohonen network on classic and spectral geomorphometric variables (case study of the Krasnaya Polyana resort, Russia)

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Landslides are an important component in the formation of the slope sediment flux of the sediment discharges of mountain rivers. In this regard, assessing the likelihood of their formation is an important task. The territory of the Russian ski resort Krasnaya Polyana (the Mzymta River basin) is subject to active landslide processes, including due to increased anthropogenic activity during the preparations for the 2014 Winter Olympics. The resort continues to develop actively after the Winter Olympics. The construction of new facilities continues recently including on potentially landslide slopes. When designing objects, the engineering and geological substantiation of the project is carried out. However, modeling of the landslide risk is not performed at all. We undertaken such a simulation on an area of 1,500 square kilometers, including the villages of Krasnaya Polyana and Estosadok and the resort of Rosa Khutor. The study area covers the Mzymta River Valley, the Laura River and their small tributaries, as well as the slopes of the Aibga and Psekhako Ranges. For forecasting, we used the landslide distribution scheme (part of the geomorphological map of the territory with landslide destruction walls) created by one of the co-authors in 2008. Various “classic” morphometric variables (calculated by SAGA GIS) were applied for prediction. In total, 66 different variables were used, both standard for such forecasting (bias, aspect, flow accumulation), and less commonly used (topographic openness, etc.). In addition, the spectral characteristics of the terrain were used: the result of DEM decomposition into a two-dimensional Fourier series on a moving window. These variables characterize the topographic pattern within a sliding window of different sizes minus the linear trend of elevation. The prediction of the danger of a landslide was made for three variants: only by “classical” variables, only by spectral variables and by all variables combined. Due to the small amount of input data, the accuracy of the obtained models was estimated by cross-checking without dividing the data into training and test samples. The final accuracy in the first case was 64%, in the second case - 69%, in the third case - 73%. The spectral characteristics of the terrain can enhance the predicted potential of landslide susceptibility models using DEM.

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