Geophysical Research Abstracts
Vol. 21, EGU2019-9199, 2019
EGU General Assembly 2019

Recent slope stability of an ancient landslide in the Iskar Gorge, Bulgaria

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The Iskar River crosses transversely the tectonic structures of the Balkan Mountains and shapes a deeply incised valley. Different gravitational processes like landslides, rockfalls and scree are developed on these slopes. The largest known landslide in the region, named Ezerishte (lake area), is situated on the right bank of the river, northeast of Svoge town, Western Bulgaria. The locals gave the name more than a century ago after the landslide materials dammed the river and created a temporary lake. A road and railway line of national importance is passing through the valley.

The landslide has very significant dimensions: length ≈1250 m, width ≈350-1200 m. Based on calculations from satellite images the estimated landslide area is 69 ha. The slip surface depth is assumed to be up to 50 m, resulting in landslide volume of approximately 15 Mm^3. The activation of the landslide is mainly governed by the erosional undermining of the slope's foot and saturation of the landslide body from precipitation. Other destabilizing factors are the regional seismicity and human influence. Geotechnical monitoring report conducted in the period 2002-2009 concluded that the landslide is currently unstable. The established displacements velocities were on average 0.05-0.10 m/year, but in 2005 reached 1.20 m/year in the lower part. This data correlates well with the recorded extreme rainfall and river discharge values in Bulgaria and most of Central and Eastern Europe at the time.

The current study aims to extend the previous investigation by using remote photogrammetry and surface measurements in order to establish the recent stability of the slope and the landslide development. The employed methodology includes monitoring the landslide process based on comparison of available aerial and satellite images, newly obtained aerial photographs made by UAV, as well as continuing the geodetic measurements of benchmarks from the previous study. The location of observable elements like buildings, roads and geomorphological features was compared for the period of available and newly obtained data. Based on geodetic survey conducted in the autumn of 2018 it was established that from 2010 to 2018 the total horizontal displacements in six locations are in the range 0.98-2.17 m. The average annual velocity for all benchmarks is 0.17 m/year. The displacement was likely variable during the period, depending on the influencing factors.

The following conclusions are drawn: a) the landslide continues to be active at present; b) the lower part is more active than the upper one; c) the average displacement velocities are higher compared to the previously established values; d) critical velocities in the landslide process are still not observed, however a slight trend of acceleration is noticed. The results are expected to contribute in quantification of the potential risk for the local people and the infrastructure passing through the valley in order to implement protection measures.

The study was financed by project №72-00-40-301/2017, Support for Young Scientists and Scholars by the Bulgarian Academy of Sciences.