

SPECIFICITY OF THE SEISMIC RISK ASSESSMENT IN MOUNTAIN AREAS (TAJIKISTAN LIKE EXAMPLE)

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Tajikistan is located in very interesting place around the World: junction of the Tien Shan area and Hindu Kush-Pamir-Himalayas area. It is the area of very active modern geodynamics with active processes of geological structures deformations and active seismicity. Very often the earthquakes trigger slopes instabilities, and as a result, many such slope instabilities lead to many victims and lost of property often much more than just structures damages under the Earth's surface shaking.

Between the natural hazards the earthquakes lead to more dangerous situations especially in the mountain areas. Tajikistan runs the danger of two types of earthquakes - shallow earthquakes and deep-focal earthquakes. Shallow earthquakes represent main danger, whereas deep focal earthquakes produce shaking with maximum intensity $I = 7$ units of MSK-64 scale.

Main earthquake sources zone in Tajikistan is Southern Tien-Shan zone and it is located along Southern Hissar fault zone. Few catastrophic earthquakes with $M = 7$ occurred here. It is Kashgar earthquake in 1902, Karatag earthquake in 1907, Khait earthquake in 1949.

The past experience of strong earthquakes in the area of Tajikistan indicates that more victims and property lost connected with slope instabilities like landslides. The specificity of the Tajikistan is that landslides in loose deposits, that are widely distributed in Central Asia transform to earth-flow or mudflow, which can move to long distances.

The existing seismic hazard map of the area of Tajikistan in the units of MSK-64 scale like a base of seismic risk estimation, was prepared in 1978 (Babaev et al., 1978), and not enough for the estimation of seismic risk in mountain areas.

During last few years new seismic hazard map was created in the Institute of Geology, Earthquake Engineering and Seismology of the Academy of Sciences of the Republic of Tajikistan based on the seismic sources map with help of GIS technology and up-to-date ground motion prediction equations (GMPE) (Ischuk and Ilyasova, 2012). More correct to call such map a "seismic impact map", because it indicates the distribution of peak ground acceleration (PGA) in the area (Figure 1). This calculation is based on map of earthquake source zones with given M_{max} and GMPS proposed by Akkar and Bommer (2007).

The seismic risk estimation for mountain areas should take into account the probability of earthquake induced landslides like an important part of the seismic impact. For this reason the map of earthquake induced landslides probability for Tajikistan area was created.

The experience of landslides occurrence indicates that majority of landslides are occurred on the slopes of 5 – 30 degrees. First of all, the slope map of the area of Tajikistan was created with help of ArcGIS Spatial Analyst software and DEM. Next the map with distribution of the slopes between 5 and 30 degrees was extracted from the slope map. The cell size of the different slopes depends from DEM resolution. For the area of Tajikistan the SRTM2007 with 90m resolution was used.

The equation proposed by Uchida et al. (2004) was used for calculation the probability of landslides occurrence during seismic impact. Two raster maps, i.e. PGA distribution map and 5 – 30 degrees slopes map were transformed to earthquake induced landslide probability map using Uchida's equation and ArcGIS Spatial Analyst. The map with three level of probability (low, moderate and high) of earthquake induced landslides is given in Figure 2. Such map can give sufficient contribution to seismic risk estimation for the mountain area.

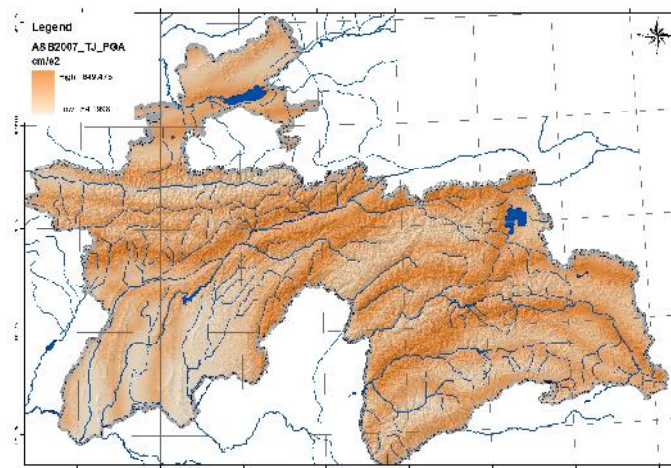


Figure 1. PGA distribution map for the area of Tajikistan

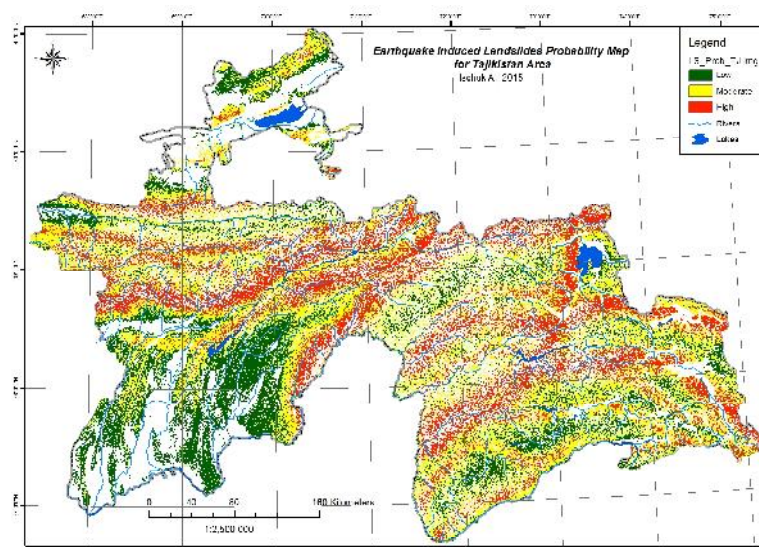


Figure 2. Earthquake induced landslides probability map for the area of Tajikistan

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