



## Natural and anthropogenic multi-type hazards for loess territories

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Central Asia (CA) is an extremely large region of varied geography from plains to high, rugged mountains (the region belongs to the Tien-Shan and Pamirs mountain system), vast deserts (Kara Kum, Kyzyl Kum, Taklamakan). The area of the CA region is including the territories of following countries: of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. CA is particularly exposed to natural hazards like earthquakes, landslide, rockfalls, avalanches, mudflows, flooding, high mountains lakes, sub flooding, and debris flow. This region is one of the most seismically active in the world. In XX century almost in each of five countries have occurred strong earthquakes with magnitude more than 7, led to human victims.

Loess soils are widespread in this region in foothills, foothill plains and intermountain depressions. Loess can cause a number of engineering problems because loess undergoes structural collapse and subsidence due to saturation when both the initial dry density and initial water content are low. By comparison of the map of seismic zoning to a map of distribution of loess soils it is easy to be convinced that the territory of the majority of seismic areas are covering by collapsible loess soils with significant thickness (50-150 m). The natural hazards leads to a disaster, if it develops in an urbanized or industrial areas and directly affects people and economic objects. In this case, risk takes place with all its consequences especially on loess soil.

In the past a formation of natural hazards was connected generally with two main groups of factors: geological structure and climatic conditions. Now to them the third factor – of human made influence was added. Intensive influence of human activity to the loess territories in CA for last 60 years is destruction of nature balance and changing in environment of loess land in zone with high seismic hazard. This processes primarily associated with following: 1) irrigation of new lands; 2) the developing of mining manufactures and their waste located in the foothill areas with high seismic risk and where manifested of dangerous geological processes as landslide, collapse, mud stream, rock falls and toxic contamination; 3) development of urbanization with manifestation of difference engineering geological processes in loess soil on the based of constructions in cities (collapse, liquefaction).

That example of cascade effects when natural and anthropogenic multi type hazards in loess was the Gissar earthquake (1989) in Tajikistan when the earthquake of rather moderate intensity ( $M=5.2$ ;  $H=5-7$  km;  $I=7$  - MSK scale) was triggered several landslides and mudslides connected with liquefaction of wetted loess and can cause a large number of human victims. In the pre 20 years steady irrigation of the slope area occurred for cotton field. This moistening has increase and the water content of the soil to wet 24-28%, up to a depth of 20-30 m that increased the vulnerability of this territory.

The interactions between different natural hazards, include triggered, especially earthquakes, landslides, collapses, liquefaction in loess soil with taking account of anthropogenic hazard influence was investigate.