Geophysical Research Abstracts
Vol. 19, EGU2017-10639, 2017
EGU General Assembly 2017

Can earthquake fissures predispose hillslopes to landslides? – Evidence from Central and East Asia

Roy C. Sidle (1), Takashi Gomi (2), Muslim Rajapbaev (3), and Nurstan Chyngozhoev (3)

(1) University of the Sunshine Coast, Sustainability Research Centre, Maroochydore, Australia (rsidle@usc.edu.au), (2) Tokyo University of Agriculture and Technology, Department of International Environmental and Agriculture Science, Tokyo, Japan (gomit@cc.tuat.ac.jp), (3) Forest Institute of National Academy of Sciences, Bishkek, Kyrgyz Republic (nurstan@mail.ru)

Factors affecting earthquake-initiated landslides include earthquake magnitude, focal depth, and seismic wave propagation and attenuation. In contrast to rainfall-initiated landslides, earthquake-induced landslides often occur on convex slopes and near ridgelines. Here we present evidence from Fergana Basin, Kyrgyzstan and Kumamoto, Japan on how fissures developed during earthquakes may promote subsequent initiation of rainfall-triggered landslides.

More than 1800 recent major landslides in hilly terrain and soft sediments of the Fergana Basin have been largely attributed to accumulation of heavy rainfall and snowmelt. While no large earthquakes have occurred in the Fergana Basin, smaller earthquakes have generated fissures near ridgelines and on convex slopes. The connection of fissures, developed years or decades before slope failure, with preferential transport of rainwater and runoff into the soil has not been previously investigated. Fissures have been observed to expand with time, particularly during subsequent minor earthquakes, further promoting preferential infiltration. Because the soil mantle does not have large contrasts in permeability that would define a slip plane for landslides, it appears that the position and depth of these fissures may control the location and depth of failures. Zones in the soil where surficial inputs of water are preferentially transported, augment natural subsurface accumulation of antecedent rainfall. Many landslides in the eastern Fergana Basin occur after several months of accumulated precipitation and groundwater has been observed emerging on critical hillside locations (near ridgelines and on convex slopes) prior to slope failure.

During the 2016 Kumamoto Earthquake (M 7.3), many landslides were triggered in forest and grassland hillslopes near Mount Aso. All of these earthquakes were shallow (focal depths about 10 km), causing high shaking intensity and ground rupturing. Because soils were relatively dry during these earthquakes, occurrence of debris flows was limited. Instead, most landslides travelled limited distances and consisted of ruptured soil blocks. Large, parallel fissures developed along ridgelines and convex slopes, providing opportunities for preferential flow to initiate mass wasting during later heavy rainfalls. The progressive deterioration of ridgelines could change future catchment drainage patterns. Additionally, sediment accumulated in headwater channels from the initial earthquake-triggered landslides may mobilize as devastating debris flows after additional sediment loading during a large storm. As such, cascading effects of prior earthquakes on later mass wasting appear evident in both regions.