Learning more to predict landslides in different scales (Regional to local)

*Ugur Ozturk[1,2], Oliver Korup[1], Norbert Marwan[2], Hitoshi SAITO[3], Jürgen Kurths[2,4]

1. Institute of Earth and Environmental Sciences, University of Potsdam, Germany, 2. Potsdam Institute for Climate Impact Research, Potsdam, Germany, 3. College of Economics, Kanto Gakuin University, Yokohama, Japan, 4. Department of Physics, Humboldt University, Berlin, Germany

An efficient landslide risk assessment is linked to realizing the triggering mechanisms (i.e. Rainfall, Earthquake). For example, quantifying regional-scale trajectories of extreme rainfall will aid predicting landslide prone regions; or the earthquake directivity assists identifying boundary conditions of a landscape for concomitant landslide hazards. We explored the weights of different parameters that bias the landslide distribution through investigating rainfall and earthquake triggered landslides in different scales.
We used event-synchronization derived network analysis to compare spatial features of extreme rainfall over Japan using satellite-derived rainfall data (TRMM-3B42V7). Then we traced the network flux over long distances ($>10^2$) employing radial statistics, which allows us to observe the general pattern of extreme rainfall tracks. Although increase in the rainfall intensity and duration positively correlates with landslide occurrence, common trajectories of typhoons and frontal storms are insufficient to explain the spatial distribution of landslide volumes in regional scale ($>10^2$ km). We witnessed in Braunsbach (a case study location in Germany) that landslides are triggered by rainfall derived flash floods by hillslope toe removal, which is in turn related to the flood characteristics (e.g. water depth, discharge) in short term. Thus, we found that the morphometric features (e.g. slope, curvature) play a more dominant role in micro scale ($<10^1$ km).
Topographic features (slope and curvature) are also important in case of the distribution of the earthquake triggered landslides. We discovered that the earthquake influence is amplified due to topographic site effects, e.g., surface slopes, height, and/or width of hills in another case study in Kumamoto (Japan). Nevertheless, topography partly explains the distribution of landslides; the preferred orientation of the landslides, which is normal to the rupture plane, is dominated mainly by the directivity effect of the earthquake.

Keywords: landslides, extreme rainfall trajectories, earthquake directivity