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Comparing landslide proximity to roads in national and event landslide inventories

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Road influence on landslides is an often-used variable in landslide susceptibility models. However, in many studies, there is limited detail explaining the processes and interactions between roads and landslides; instead a constant road buffer or standard function is used. Here, we present a spatial statistical analysis of landslide proximity to roads across a range of geographic settings and landslide inventory types. We examine the proximity of landslide centroids to roads at regional to national scales using twelve landslide inventories; with a variety of inventory types (6 triggered event, 6 multi-temporal), mapping methods (2 field based, 6 remote sensing, and 4 a combination of the two), and country of origin (6 high and 6 low human development index). Each inventory contains between ≈270 to 81,000 landslides ($n_{Landslides}$) and covers areas of ≈80 km^2 to 385,000 km^2.

We have developed a pyQGIS tool that calculates the distance between each landslide centroid and road vectors within the same drainage basin; this make sure no distances are calculated between landslides and roads that are on opposite sides of ridges and therefore do not influence each other. For each landslide inventory, we calculate the distance to the closest road for each landslide. We then compare this distribution that of a set of randomly generated points (number of random points is calculated for each landslide inventory using the equation $n_{Landslides}$*100) to roads, to test whether landslide occurrence is influenced by road presence.

For ten of the twelve inventories, the results show no strong preference of landslides to occur closer to roads than the random points; the exceptions being landslide inventories that we believe have a bias towards roads due to the mapping remit (e.g. highway agencies). For some of the ten inventories showing no robust relationship with roads, we believe this is related to the location of the roads on the slope (e.g. at the toe, mid-slope or on the ridge), but it is not readily explainable in others. Based on our results, we suggest that a more nuanced use of road proximity within landslide susceptibility models should be adopted, and further research to understand the interactions between landslides and proximity to roads at the regional to national scale.