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A Changing Magnitude-Frequency Distribution of Landslides in the Central Range, Taiwan

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Evaluating an aerial hazard level of landslide is very important to mitigate the landslide disaster and there have been several approaches for it: Physical modeling, statistical modeling, geological and geomorphological characterization, and geomorphological classification. The first three approaches are to pinpoint potential sites and the last one is to classify hazard potential over wider areas, which, however, comparatively little research has been conducted. We propose to classify the hazard level based on geomorphological classification according to the landslide sits in relation to convex slope breaks. Landslide scars including shallow landslides (debris slides) and catastrophic large landslides (rock slides) were mapped by examining aerial photographs in upstream Dahan River catchment, northern Central Range in Taiwan. The mapped landslide scars were then subdivided into three categories according to their relationship with three series of slope breaks, that were observed throughout the catchment. For each inventory, we calculate the probability densities of landslide areas, compare these results to each other, and finally estimate landslide event magnitude of each inventory.

As a result, the probability density distribution of each landslide inventory shows a power law relationship for larger landslide events and follows a rollover (i.e., an inflection point) profile, where the distribution changes direction for smaller landslides. The power law scaling exponents for landslides along the highest, middle, and lowest slope breaks, were 0.7, 0.8, and 1.2, respectively. These estimates suggest that the subset of data may be biased towards larger landslides for landslides on slopes along the highest and middle slope breaks. Medium–large landslides ($>6.0 \times 10^{-4}$ km^2) are more common on slopes along the highest and middle slope breaks and numerous small landslide scars are evident around the middle slope break. On the other hand, small landslides ($<5.0 \times 10^{-4}$ km^2) are most abundant on slopes along the lowest slope break. By these approaches, it is possible to determine the hazard level of future landslide in a given hillslope section.