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Landslide scaling relationship and its seismic-climatic implications, Himalaya

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We have mapped more than 400 major landslides (debris slides, rockfalls, and rock avalanches) in 5 fluvial valleys in Himalaya (India) between 77.3° E - 80.5° E longitudes. Field/high- resolution satellite imagery based landslide area mapping and field based landslide thickness approximation were used to determine landslide area and volume. Area-volume scaling exponents of these landslides revealed a lateral variation in the study area implying that landslide slopes in the eastern part of the study area retain relatively less volume that increases towards western part of the study area. We have hypothesized that such lateral variation is possibly caused by lateral variation in the landslide occurrence that in turn is mostly caused by lateral variation in the seismic-climatic regimes.

Following the hypothesis, we noted that rainfall, surface runoff, soil moisture, and air moisture (climatic variables) data of years 1982-2020 represent a general decrease laterally from east to west in the study area. Further, the role of topography on the climate variables is also noted as it increases from east to west. Earthquake (Mw=>4) distribution (1960-2020), Arc Parallel Gravity Anomaly (APGA), cumulative seismic moment, shear stress accumulation rate, and convergence (India-Eurasia) rate (Seismic variables) also represent a general decrease laterally from east to west in the study area. The climatic variability is attributed to the spatial variability of the Indian Summer Monsoon (ISM), whereas seismic variability is referred to the spatial variability in the subsurface pattern of the Main Himalayan Thrust (MHT). Thus, such variability in the seismic-climatic regimes is noted to support our hypothesis.