

Magnitude-frequency distribution of rainfall-triggered landslide erosion in Kaoping River watershed, southern Taiwan.

Yi-Chin Chen¹, Yu-Jia Chiu², Hong-Yuan Lee¹

¹ Department of Civil Engineering, National Taiwan University, Taipei, Taiwan

² Center for Weather Climate and Disaster Research, National Taiwan University, Taipei, Taiwan

Abstract

Magnitude-frequency of landslide erosion is a critical component to investigate the long-term erosion rate, landscape evolution, and natural hazard in tropical and mountainous area. In this study, the relationship between magnitude and temporal frequency for rainfall-triggered landslide erosion was been quantified in the Kaoping River watershed, southern Taiwan. The magnitude of landslide erosion was estimated by using multi-temporal landslide inventory with volume-area relations. The long-term frequency of landslide was derived from the record of 244 storms in 53 years and using hydrological frequency analysis by 6 types of probability distribution function. Then, we utilized the concept of an expectation of landslide erosion (EX_{LE}) to explore the contributions of different rainfall intensity and to analysis the landslide erosion rate. The results show that the magnitude-frequency distributions show negative and piecewise power-law functions and the EX_{LE} increase over the rainfall intensity. This reveals that landslide erosion triggered by intensive-extreme rainfall is more important than it triggered by moderate-frequent rainfall. Then, the landslide erosion rate is estimated to be 2.99 - 5.27 mm yr⁻¹ in which rainfall with return period ≥ 10 years contributes 56-75% of total landslide erosion in the Kaoping River watershed. Analyzing the magnitude-frequency distribution is a reliable method that can quantify the contribution of landslide by different rainfall intensity and can avoid the uncertainty resulting from extreme event in estimation of landslide erosion rate.

Keywords: Temporal frequency, Magnitude, landslide erosion rate, extreme rainfall, Taiwan