

Estimation of the antecedent rainfall period for mass movements in Taiwan

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Antecedent rainfall plays an important role in rainfall-induced mass movements. However, it is difficult to define the period of antecedent rainfall for mass movement assessment. To solve this problem, this study provides a simple approach that combines calibrated antecedent rainfall (*CAR*) and 24-hour rainfall for 283 mass movements that occurred in Taiwan during 2006–2013. The 24-hour rainfall at the time of each mass movement was compared with the total cumulative rainfall from various days before the event. The lowest value of the correlation coefficient occurred for the total cumulative rainfall from 15 to 20 days before a mass movements day. The 24-hour rainfall was compared with the cumulative *CAR* values for various days of antecedent rainfall. The effect of cumulative *CAR* on mass movements increased from 22.0% to 39.7% when the considered days increased from three to 30 days. However, the increase became gentle after 15–18 days. In addition, the critical antecedent rainfall conditions occurred within 18 days before mass movements for all cases. These results suggest that the antecedent rainfall of 15–18 days is useful for mass movement assessment in Taiwan. This study also established a critical antecedent rainfall threshold for mass movements in Taiwan useful for early-warnings: $I = 28.7D^{-1.24}$, where I is critical mean rainfall intensity during the antecedent rainfall period (up to 18 days) (mm/day) and D is the length of the antecedent rainfall period. According to the relationship between 24-hour rainfall and the critical antecedent rainfall conditions, low antecedent rainfall intensity continued for a long time leads to a gradual increase in soil moisture so that a small amount of 24-hour rainfall can trigger mass movements. On the other hand, high antecedent rainfall intensity for a short time is not enough to increase soil moisture, and a large amount of 24-hour rainfall is needed to flush surface materials and cause mass movements.

Keywords: mass movements, calibrated antecedent rainfall, rainfall threshold, critical rainfall, soil moisture