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Rainfall thresholds for landslide triggering following volcanic ash eruptions and earthquakes

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Early-warning systems for precipitation-induced landslides that are mainly based on rainfall measurements use fixed threshold levels, which is an adequate practise as long as susceptibility to landsliding remains fairly constant over time. However, this practise may not be acceptable in slopes that undergo significant weakening-healing processes. Within the above context, this study presents a conceptual model for variable rainfall thresholds. The model accounts for an initial lowering of threshold levels in response to a weakening stage, followed by an increase of these levels as a healing process occurs. The model is explained by using two types of natural threats at the weakening stage: volcanic ash eruptions and strong-motion earthquakes. The first type is illustrated with an example from Mount Pinatubo (Philippines) using triggering rainfall from a 4-year period that followed intense eruptive activity during 1991-1993. The second type is exemplified with an analysis of data from Taiwan which comprises rainfall-triggered events both before and after the 1999 Chi Chi earthquake. A potential application of this model is the calibration of rainfall threshold levels following earthquakes and volcanic ash eruptions in order to reduce the number of false alarms and/or missed events.