Geophysical Research Abstracts, Vol. 9, 02191, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02191

The rainfall intensity-duration control of shallow landslides and debris flows: an update

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We have updated the dependency of the minimum level of rainfall duration and intensity likely to result in shallow landslides and debris falls established by Nel Caine in 1980. For the purpose, we have compiled a global database of 2626 rainfall events that have resulted in shallow landslides and debris flows. We plot the rainfall intensity-duration values in logarithmic coordinates, and we establish that with increased rainfall duration the minimum average intensity likely to trigger shallow slope failures decreases linearly, in the range of durations from 10 minutes to 35 days. Based on this observation, we determine the minimum intensity-duration (ID) for the possible initiation of shallow landslides and debris flows. The threshold curve is obtained from the empirical rainfall data using an objective technique that exploits Bayesian inference. To cope with differences in the intensity and duration of rainfall likely to result in shallow slope failures in different climatic regions, we normalize the rainfall information. Normalization is performed using two climate indexes, the mean annual precipitation and the rainy-day-normal. Climate information was obtained form the global climate dataset compiled by the Climate Research Unit of the East Anglia University. By comparing the obtained ID thresholds with other global ID thresholds proposed in the literature, we establish that the new thresholds are significantly lower than the threshold proposed by Caine (1980), and lower than the other global thresholds proposed in the literature. We conclude proposing the new global ID thresholds be used in a worldwide operational landslide warning system based on global precipitation measurements, where more accurate rainfall thresholds have not been established.