



Detection of rainfall-induced landslides on regional seismic networks

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Seismic techniques are increasingly adopted to detect signals induced by mass movements and to quantitatively evaluate geo-hydrological hazards at different spatial and temporal scales. By analyzing landslide-induced seismicity, it is possible obtaining significant information on the source of the mass wasting, as well as on its dynamics. However, currently only few studies have performed a systematic back analysis on comprehensive catalogues of events to evaluate the performance of proposed algorithms. In this work, we analyze a catalogue of 1058 landslides induced by rainfall in Italy. Among these phenomena, there are 234 rock falls, 55 debris flows, 54 mud flows, and 715 unspecified shallow landslides. This is a subset of a larger catalogue collected by the Italian research institute for geo-hydrological protection (CNR IRPI) during the period 2000-2014 (Brunetti et al., 2015). For each record, the following information are available: the type of landslide; the geographical location of the landslide (coordinates, site, municipality, province, and 3 classes of geographic accuracy); the temporal information on the landslide occurrence (day, month, year, time, date, and 3 classes of temporal accuracy); the rainfall conditions (rainfall duration and cumulated event rainfall) that have resulted in the landslide. We consider here only rainfall-induced landslides for which exact date and time were known from chronicle information. The analysis of coeval seismic data acquired by regional seismic networks show clear signals in at least 3 stations for 64 events (6% of the total dataset). Among them, 20 are associated to local earthquakes and 2 to teleseisms; 10 are anomalous signals characterized by irregular and impulsive waveforms in both time and frequency domains; 33 signals are likely associated to the landslide occurrence, as they have a cigar-shaped waveform characterized by emerging onsets, duration of several tens of seconds, and low frequencies (1-10 Hz). For this last category of events, we have applied the approach proposed in Manconi et al. (2016), in order to evaluate the performance of automatic identification, location and first order classification of landslide events through seismic data only. Our analysis may provide important insights for the development and calibration of landslide identification algorithms, which might be used to enhance the completeness of landslide catalogues by relying on quantitative data.

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