

Correlations between rainfall and landslides in 3 Provinces of the Emilia-Romagna Region, northern Italy

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Rainfall is a major trigger of landslides. In this work, we attempt to determine correlations between historical landslides and rainfall in the 51-year period from 1951 to 2002, in the Reggio Emilia, Modena and Bologna Provinces of the Emilia-Romagna Region, Northern Italy. We investigate the relationship between the cumulative rainfall for different periods and the abundance of the triggered landslides. We examine the correlation between measures of the antecedent precipitation and the abundance of the triggered landslides. Adopting a Peak-Over-Threshold (POT) technique, we analyse the correlation between extreme values of daily rainfall and the abundance of the triggered historical landslides. We use daily precipitation measurements for selected rain gauges, and we exploit a catalogue of 2253 historical landslides. The 2253 individual landslides reported in the historical catalogue, corresponding to 1057 days with landslides (DL), were further grouped into 596 different landslide events (Sevent), consisting of 1 to 129 landslides each. Grouping was performed by considering the successive landslides over time; during the winter (summer) a period of four (two) days without landslides was considered a separate event. We examine the correlation between the cumulated rainfall amount for different rainfall periods, from 1 to 30 days, and: (i) the number of triggered landslides in a day, DL, and (ii) the number of triggered landslides in during a landslide events, Sevent. We find that for short periods of antecedent rainfall the minimum amount of rainfall necessary to trigger landslides varies considerably with Sevent (the magnitude of the event), and that for long antecedent period Sevent is largely independent of the cumulative amount of rainfall. However, the largest landslide events are always preceded by abundant rainfall. Next, we compare measures of precipitation with the occurrence (or lack of occurrence) of landslide events. We experiment with trend corrected and weighted trend corrected measures of precipitation, and we find that no clear relationship exists between the trend of precipitation and the occurrence and magnitude of landslide events (Sevent). We take this as indication that climate and its decadal variation were not significant for the initiation of large landslide events in the three studied provinces of northern Italy during the considered period. An improved correlation exists for the medium-term trend of precipitation, indicating that seasonal variations in rainfall were signif-

icant for the initiation of medium to large landslide events. Lastly, we analyse the correlation between extreme values of daily rainfall and extreme values of landslide magnitude, measured by DL and Sevent, and we find that this correlation is larger for Sevent and much reduced for DL. This justifies the use of Sevent to model the historical distribution of landslides in the investigated area.