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Rainfall profile characteristics in erosive and not-erosive events

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In a storm the rainfall rate shows fluctuations with showers, low rain periods or rainless periods that follow one another at short or long time intervals. The intra-storm rainfall variations and event profile have been proved to have an important influence and exert a fundamental control in many field and research areas among which in runoff generation and soil erosion (Dunkerley, 2012; Frauenfeld and Truman, 2004; Mermut et al., 1997; Parsons and Stone 2006; Ran et al, 2012; Watung et al. 1996;). In particular the possibility to incorporate into simulated rain events pre-determined intensity variations, have recently driven more investigation on the effect of further intra-storm properties on the hydrograph and on the soil loss dynamic such as the position among the rainfall of the maximum rainfall intensity and of the rainless intervals (Dunkerley, 2008, 2012; El-Jabi and Sarraf, 1991; Parsons and Stone 2006; Ran et al, 2012).
The objective of this paper is to derive the statistical expressions for the time distribution of erosive and not-erosive rainfalls and to describe the rainfall factors that influence the time distribution characteristics and that characterize an erosive event compared to a not erosive event. The analysis is based on the database of the experimental site of Masse (Central Italy): event soil loss and runoff volume from bare plot and climatic data, at 5 min time interval for the 5-years period 2008-2012 (Bagarello et al., 2011, Todisco et al., 2012). A total of 228 rainfall events were used in which the rainfall exceed 1 mm, 60 of which erosive. The soil is a Typic Haplustept (Soil Survey Staff, 2006) with a silty–clay–loam texture. The runs theory (Yevjevich, 1967) were applied to the rainfall events hyetograph to select the heavier ones named storms. The sequential periods with rainfall intensity above a threshold are defined as heavy intensity in series and called runs. All the rainfall events characterized by at least one run were considered as a heavy storm and included in the analysis. The rainfall event is defined as a sequence of rainless and rainy periods defined as burst. The statistical expressions for the time distribution of erosive and not-erosive rainfalls were derived and the rainfall factors that influence the time distribution characteristics and that characterize an erosive event compared to a not erosive event were identified. The time distribution of erosive and not erosive storms have been expressed as cumulative percentages of storm rainfall and storm duration to make valid comparisons between storms and to simplify analysis presentation of data. The time distribution models presented as probability distributions, provide quantitative measures of both the inter-storm variability and the general characteristics of the time sequence of precipitation in storms. Other characteristics derived and analyzed, that are pertinent in classification of storms, include the number and the duration of individual runs in the total storm period, the total severity of the runs, the location of the heaviest run in the storm period, the percentage of the total storm period that had occurred at the start and end of this run, the percentage of the total storm rainfall preceding the heaviest run, the percentage of the total storm rainfall occurring at the heaviest run, the percentage of total storm rainfall occurring at the shower that contain the heaviest run, the percentage of the total storm period during which rain actually fell. The results obtained should aid the hydrologist in design problems or other application such as: the design of experiments for soil erosion study corresponding with the comparable measures of natural events (Agassi et al., 1999; Dunkerley, 2008; Kinnell, 2005; Mathys et al., 2005;) both in intra-storm dynamic and overall characteristics (Hanke et al., 2004); or the extrapolation of the erosive event inter-storm characteristics in which the time distribution is a pertinent factor.