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Comparative analysis of major erosive events in a set of small Mediterranean research catchments

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Soil erosion is one of the environmental problems of main concern in Mediterranean areas because of significant both on- and off-site issues such as soil loss, land degradation, reservoir siltation, water quality and ecological impacts. Even if it has longly been observed that major erosive events are almost always associated to extremely large or intense rainfall events, little is known on the exact nature of these events at the small catchment scale. One of the main reasons for this is that, frequently, the investigation of variables influencing sediment yield is done through the analysis of erosive events of highly variable magnitude, with the objective of deriving general log-relationships between sediment yield and hydrological variables. With such approach, the specificity of the most erosive events is often lost in the analysis where large events act as a single cluster at one extreme of the events distribution and their real magnitude is masked by the log scale. With the objective of determining the specific characteristics of the most erosive events, and to infer some of the key processes acting during them, this study presents an analysis of the 10 most erosive events recorded for a set of 10 small research catchments located in the Mediterranean region. The different catchments, grouped in the R-OSMed Network, are located in France (4), Spain (3), Italy (1), Portugal (1) and Tunisia (1); the catchments have areas ranging from 0.018 to 1.32 km2, mean annual precipitation from 236 to 1303 mmyear-1 and mean annual sediment yield between 7.5 and 6900 Mgkm-2year-1. In total more than 120 years of hydrological and sediment data (series between 3 and 29 years long) have been analysed to select the 10 most erosive events for each catchment. The study is based on the analysis of the relationship existing between a series of meteorological, hydrological and sediment related variables.
First results show that the cumulated sediment yield of these 10 most erosive events represented a variable proportion (from 150 to 1500%) of the mean annual suspended sediment yield. The size of the catchments, their relative area with intense erosion and the mean annual rainfall were identified as the main causes of the differences between the catchments responses. For major erosive events, runoff depth was more dependent on rainfall depth than on rainfall intensity, whereas peakflow was not clearly related to any specific variable. Suspended sediment load during major erosive events was most often related to runoff depth and to peakflow discharge, but considering all catchments, no general relationship could be observed between suspended sediment concentration (maximum and mean) and rainfall or runoff variables. Results also show that the return periods associated to rainfall and flood characteristics may be used as a measure of the singularity of the diverse variables, allowing a better characterisation of major erosive events. Finally, the comparison between the responses of the different catchments helps to improve the knowledge of the hydrological and geomorphological functioning of each of them.