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The effect of temporal observation scale on extreme rainfall analysis

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Mediterranean storms usually show high intensity and irregularity of rainfall. A single torrential event can double, even triplicate, the average annual rainfall. These features, in turn, determine rainfall-runoff conversion and other hydrological processes. As a consequence flash-floods and hydrological behaviour of ephemeral streams are dominated by these extreme events.
However the internal structure of storms varies according to the time scale at which data are collected. As the observation interval is reduced, intensity becomes more significant and emphasizes the concentrated character of the precipitation. Moreover, an equivalent amount of rainfall, registered at different time scales, can result in different rainfall spatial patterns, and it can help to indentify which factors are important at each time measurement scale.
This paper analyzes the temporal and spatial variations of rainfall pattern, associated with different time scales in data collection. The study area involves the whole territory of the River Júcar Water Authority. This area covers a surface of 43.000 km2, and shows different geographical features (topography ranking from 2000 to 0 m, sea influence, inland and coastal territories, different exposure to wet winds, etc....). Rainfall data are collected, every five minutes, by the Automatic Hydrological Information System (SAIH), from 147 rain gauges, covering a 13 years continuous period (1994-2007).
Precipitation data have been rescaling in order to obtain rainfall parameters every five minutes, 15 minutes, 30 minutes, 1 hour, 6 hours, 12 hours and 24 hours. Indicators of cumulative rainfall, maximum intensity, irregularity, probability of rain and persistence of rain have been estimated for every time scale.
From a time scale perspective, results show that there are two variables, “cumulative rainfall” and “probability of rain”, that follow a positive logarithmic trend, time-dependent. “Cumulative rainfall” shows a change of trend at 6 hours time scale, while the variable “probability of rain” changes its trend after 1 hour. Variables of "maximum intensity", "irregularity" and "persistence of rain" show negative trends, fitting power curves functions time-dependent. All of these variables show a change of trend after 1 hour.
Regarding the spatial pattern of these variables qualitative analysis have been made. Result show changes in the factors influencing this pattern, depending on the length of the measurement time interval. Thus, for the variables of "cumulative rainfall" and "maximum intensity", increasing time interval implies a reduction of the area affected by the maximum values. Moreover, in the interval of 5 minutes the factor altitude is determinant, while for longer time intervals, factors as distance to the sea and the orographic structures exposure to wet dominant winds gain importance.
The “irregularity” shows, for 5 minutes, the highest values in the plains near the sea, (exposed to wind of component E) and in the first line of relief or valleys opened to the sea (which acts as a trigger of instability). As the time interval increases, other factors, as distance to the sea, the effect of a second inland alignment of relieves, and the exposure to wet wind of component NE, become important.
Concerning the "probability of rain" the interval of five minutes, shows the importance of exposure to wet winds of component NE plus the effect of the relief as a trigger. As the time interval increases, the presence of mountainous area in combination with wind of component W acquires prominence.
The “persistence of rain” is related to the distance to the sea from the first mountainous alignments and to the exposure to winds of components NE and SE. As the time interval increases the persistence of higher values are reduced to the area exposed to winds of component NE in combination with the effect of the relief as a trigger.
Finally, although the results are preliminary, authors would remark their great applicability to detect thresholds of different rainfall behaviour and its spatial distribution in order to estimate indicators for water management.