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Transdisciplinary and multiscale reconstruction of the major flash floods in NE Iberian Peninsula

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Floods are the most severe natural hazard in the western Mediterranean basin. They, and especially flash floods in small catchments (<500 km2), cause most of the damages and most of the victims. Some of the selected flash floods caused more than one hundred casualties each and a large quantity of damages in infrastructures. Flash floods in the northeast of the Iberian Peninsula are caused by a limited array of meteorological processes, which must be identified and classified in order to improve flash floods forecasting.

We studied ten of the most important flash floods -and the rainstorms that caused them- occurred in the northeast of the Iberian Peninsula in the last 500 years: 1617, 1787, 1842, 1853, 1874, 1907, 1937, 1940, 1962 and 1996. These floods were classified by spatial and time distribution, synoptic situation and convection indexes

On the one hand, we searched information about the historical and modern events and located flood marks which allowed us to calculate the floods' peak flows, and in some cases, thanks to particular pieces of information about soil saturation and timing of the flood, even their hydrographs and the associated hyetographs, through hydraulic and hydrological modelling. On the other hand, we analysed the atmospheric synoptic situations at the time of each flood from the data provided by NOAA 20th Century Reanalysis and we compared it to the rainfall spatial distributions obtained with the hydrological modelling. Thus, we identified synoptic situations with a high probability of causing flash floods in the western Mediterranean basin and assessed how orography modified this probability at the local scale.

Hydraulic and hydrological reconstructions give an idea of the magnitude of the flash floods. Specific peak flows range between 3.5 and 11.7 m3•s-1•km-2 and rank among the highest ever recorded or modelled in the region. Similarly, the calculated water velocities in some cross sections are highly destructive (between 6 and 10 m•s-1). The spatial distribution of the specific peak flows of some of the events suggest that convective processes were enhanced by the barrier effect of the dominant orography (Pyrenees or Pre-coastal Catalan Range). The meteorological analysis of some of the events shows that there were caused by the large instability appearing when a warm air mass situated at 5500 m enhancing the vertical movements of a warm and moist air mass that accumulated in the lower levels of the atmosphere. This resulted in highly energetic convective processes. These types of events are nowadays very difficult to be forecasted reducing, therefore, the possibility of a quick response against them. The provisional classification of floods is aimed to increase the forecasting capacity.