

A flood study in Spain using storm track data and K-means clustering

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We propose the use of storm track data and K-means clustering to better understand the driving mechanisms of floods in Spain. A number of recent studies have analyzed trends in low flows and floods in the country and there is a general agreement on the occurrence of downward trends in hydrological variables in the last decades across central and southwestern Spain. This is of major concern especially in a scenario of climate changes, where new climate regimes affect our understanding of whether these trends will persist, increase or decline in the near future. That being said, the drivers of the observed changes should be identified in order to better understand their effect on the local hydrology so that a proper prognostic could be proposed for the future. Some studies have tried to attribute observed changes in Spain to a variety of drivers. In natural or near-natural catchments, some studies attributed the observed trends to an upward trend in the North Atlantic Oscillation Index as well as to an increasing trend in evapotranspiration and downward trends in rainfall patterns. In this study, we go further into the investigation of the atmospheric component as a driver of hydrological changes in Spain using storm track data generated by the Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT). In this way, we intend to establish a direct link between moisture transport in the atmosphere, including the storm path, and important attributes of flood events in the region. Storm tracks associated with annual maximum flood series from 14 streamflow gauges across Spain are then obtained using Reanalysis data and classified into clusters using the K-means algorithm. Preliminary results show that atmospheric systems originating in the Atlantic Ocean are responsible for the majority of floods over a large portion of the country. Atmospheric systems from the Mediterranean tend to hit more frequently the southeastern region. In general, the most frequent type of storm is also associated with the most extremes floods. In the north coast, however, Atlantic storms are the most frequent systems but the largest floods are most associated with northern storms. Flood attributes such as mean, variance, skewness and seasonality have been also found to vary across the different atmospheric systems, suggesting that annual maximum flood series in Spain are non-homogeneous and should be considered as such in flood frequency studies.