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# Heavy warm season precipitation events in northern Spain: ¿mediterranean processes in an oceanic temperate region?

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The northern coast of the Iberian Peninsula is one of the wettest areas of Europe. Most of the coastal observatories receive exceed 1000mm, and the rainfall is higher than 1700mm along the basque coast. The contribution of late summer-early fall precipitation is remarkable (about 25 %), unusual taking in account the southern latitude of the region at continental scale (Cfb climate, following Köppen's notation). One of the causes of this summertime wetness are the frequent heavy rainfall events, historically responsible of the most damaging floods in the region.
The aim of this paper is to identify and investigate the spatial and temporal characteristics of those heavy rain events, improving the understanding of the dynamical mechanisms by means of a classification of the related atmospheric patterns. The role of the exchange of heat fluxes from a very warm pool of water around the vertex of the Gulf of Biscay, feeding the lowest atmospheric layers, is also discussed.
Heavy rainfall events were analyzed using long-term daily rainfall records from 22 stations belonging to the spanish, portuguese and french meteorological networks. The 1000 hPa and 500 hPa geopotential heights (hereafter Z1000 and Z500), as well as the 850 hPa temperature (T850) were utilized to derive a typology of circulation pattern, combining principal components analysis (PCA) and cluster analysis (CA).
Results show that most of those heavy precipitation events, whose atmospheric environment and spatial impacts remember some of the typical features of the heavy precipitation events in the Spanish Mediterranean coast, implicate convective systems, associated to upper level stationary disturbances ("cold lows"), which trigger a thermodynamic instability. Most of them affect a relatively restricted area, from Cantabria to the Basque Country, and, even within this area, most of the precipitation falls in the shorelines and the first orographic ridges. Finally, it is worth to mention that the location of most of the stream gauges in the middle basin area underestimates the hydrological response of most of those events in comparison with wintertime heavy precipitation events.