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Atmospheric forcing in the occurrence of precipitation extremes in Iberia: comparison between the eastern and western sectors

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The occurrence of severe precipitation deficits in the Iberian Peninsula has major socio-economic and environmental impacts. Several previous studies emphasized the leading role of the large-scale atmospheric flow in the occurrence of long periods with significant precipitation lacks. However, due to the high complexity of the Iberian orography, the sensitivity of the local rain-generating mechanisms to large-scale anomalies is remarkably different from region to region. A principal component analysis of the annual precipitation amounts recorded at a network of meteorological stations over the entire peninsula for the period 1961-1998 corroborates this heterogeneity. With particular significance is the contrast between the western and eastern sectors of the peninsula. In fact, taking into account earlier studies, precipitation in western Iberia is strongly related to large-scale atmospheric patterns over the North Atlantic. On the contrary, precipitation over eastern Iberia is much less associated with these large-scale forcing patterns, but much more linked to local/regional mechanisms. In order to test these hypotheses, eight meteorological stations, four in the western half (Porto, Bragança, Lisboa and Beja) and four in the eastern half (Barcelona, Valencia, Tortosa and Zaragoza) of Iberia are selected taking into account, firstly, the geographical location, and secondly the quality and homogeneity of the respective time series. A set of extremely wet/dry seasons was subsequently chosen for each weather station separately, taking into account the 90th percentile of the respective empirical distributions. The analysis of the different atmospheric fields (precipitation rates, convective precipitation, precipitable water, specific humidity, relative humidity, surface temperature, sea surface pressure, geopotential heights, wind components and vorticity at different isobaric levels) is undertaken by using data from the National Centers for Environmental Prediction reanalysis project. Although the study is conducted for all seasons, only the results for winter are presented here. In general, our results clearly support the previously stated hypotheses. In fact, there is a clear connection between precipitation deficits in western Iberia and the presence of an anomalously strong anticyclonic ridge over the Eastern North Atlantic, which presents a warm-core equivalent barotropic structure. However, in eastern Iberia, the latter dynamical structure is significantly weakened, particularly in Valencia, where the regional orography leads to a strong mitigation of the Atlantic influences and no clear connection between its precipitation extremes and large-scale anomalies is found. In this particular case, local/regional processes are largely dominant in triggering rainfall conditions.