



Precipitation changes over Western Europe in early spring and its modulation by large-scale atmospheric circulation variability

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The Mediterranean is particularly sensitive to variations in precipitation amount, a vulnerability which has produced intense public and political interest. Several recent studies have revealed the existence of general decline of winter precipitation, particularly in the northern Mediterranean Basin. Over the western Mediterranean sector the most prominent trend of precipitation occurs during early spring, particularly during the month of March. In fact, March precipitation is dramatically decreasing over the Iberian Peninsula for the last decades. In particular, the western and central regions of Iberia are the most affected, an area which corresponds to the three major Iberian river basins (Tagus, Duero and Guadiana). The analysis of the averaged precipitation series for this region as a whole reveals a monotonic descend of 50% since the early 60's. A thorough analysis with daily data for the entire Iberian Peninsula shows that the downward trend is exactly confined to the civil month of March.

However, this decreasing tendency of Iberian precipitation in March is just a regional reflection of large changes occurring throughout Europe. In fact, a careful analysis of March precipitation for the entire European continent reveals significant downward trends along the whole Mediterranean basin, accompanied by upward and significant trends in Northern Europe. To understand the physical mechanisms involved we have applied two different methodologies, a regional approach based on the frequencies of Weather Types (WTs) over Iberia and the UK, and a larger-scale method based on the preferred paths of storm-tracks over the Atlantic/European window. Results show significant decreasing frequency trends of major rainfall contributors to March precip-

itation in Iberia, which are related to low pressure systems moving along the Northern Atlantic. A similar analysis displays opposite results in the UK/Ireland sector. The analysis of storm-tracks over the North Atlantic confirms the existence of a significant decrease (increase) of 50% in the frequency of storms west of Iberia (UK), between the 50s and the 90s, revealing a high correspondence between regional precipitation trends and the location of nearby sectors with significant trends of cyclones passages.

There are clear evidences of large-scale processes being involved. Among these, the most determinant role is played by the NAO mode that presents a correlation coefficient value with March precipitation in Iberia of -0.60. NAO, which is considered the most prominent large-scale oscillation steering cyclones along the North Atlantic sector, is then pointed out as the major responsible for these large changes. Anyway, significant correlations with several large-scale modes such as the Scandinavian pattern, the Pacific North America and the Southern Oscillation index reveal the more complex nature of this phenomenon.