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Winter precipitation patterns in a mountain area of Sierra Nevada (Southern Iberian Peninsula) and their relation with large scale circulation

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Our research is focused in Sierra Nevada, the range which holds the highest summits in southwestern Europe, with peaks exceeding 3000 m at 37ºN latitude. Sierra Nevada plays a decisive role in the climate of the southern Iberian Peninsula; the singular geographical characteristics of this massif determine a wide range of microclimates in the surrounding area. The main interest in studying the factors involved in precipitation in this region lies in its geographical position in an area with crossing influences: between Europe and Africa, between the Atlantic Ocean and the Mediterranean Sea, between the subtropical high-pressure belt and the mid-latitude westerlies. To deal with such a huge dataset, we use a Factor Analysis (FA) which is an excellent tool to reduce the number of potential involved variables and to detect the relationships between them. To obtain a winter precipitation pattern (December, January and February) in this mountain area, we applied a FA with the extraction method of Principal Components (PCA) in order to identify a possible regionalization model. We analyze up to 23 climate series geographically distributed between 1961 and 2005 considering the total winter precipitation. The FA extracted two PCA: the first of them explained 75.22% of the variance and the second one the rest 24.78%. We tested several rotation methods (VARIMAX, BIQUERTIMAX, QUARTIMAX and EQUAMAX) to identify a clear behavior of the loadings (factors with higher loadings for some variables and low for another's). Among all these methods, the VARIMAX provided the best results. Only loadings > 0.7 were considered for the analysis of each factor. Our results showed two clear teleconnection patterns that influence the winter precipitation in Sierra Nevada area. The first factor presented higher positive loadings in the western stations and the second one in the eastern part of the massif. We observed that the first factor explains very well the influence area of the North Atlantic Oscillation (NAO) in Sierra Nevada, pattern that determines the winter rainfall in the Northern Hemisphere. The second factor is associated with the Western Mediterranean Oscillation (WeMO), a pattern that rules the precipitation in the western part of Mediterranean sea. After the identification of these patterns we analyzed the winter rainfall trend in both regions. A negative trend is detected since 1951 mainly in the eastern stations, which means that the NAO and especially the WeMO influence in southern Iberian Peninsula have decreased in the second half of the XX century.

Keywords: Sierra Nevada, Factor Analysis, winter precipitation, NAO, WeMO, negative trend.