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Possible influence of large-scale climate indices on the variability of maximum streamflow in rivers of Peninsular Spain

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Variability and possible teleconnections between maximum streamflow and macroclimatic indices are addressed in this paper from two perspectives, temporal and frequency. The central issues of this study are (1) to quantify the dependence of degree between macroclimatic variables and maximum streamflow at different time scales (monthly, seasonal and annual), (2) to identify using correlation maps the areas of greatest influence for each index, and (3) evaluate the influence of climatic periodicities in the behavior of the maximum streamflow, with the aim to establishing the possible connections between two variables. Montlhy maximum peak discharge time series from 80 stations with a record of at least 35 years and 6 macroclimatic indices (NAO, AO, WeMO, MO, Niño 3.4 and MEI) are use in this study. The results show that: (1) different climatic system control the behavior of the hydrological variables in the zone of study, they showed a significant degree of dependence between the climatic and hydrological variables. In general, according to these results and influence areas of macroclimatic indices the study area can be divided into 3 regions, the Atlantic basins, the north basins (Cantabrian, Miño-Sil, North of the Duero and Ebro) and the Mediterranean basins. The results show a significant dependence on different time scales, the series of streamflow in the Atlantic compared with respect to the NAO, the AO and MO indices, being more intense this in the winter period, the overall results with these indices are presented without lag and with a month lag in the correlation. On the other hand, the results with the WeMO index showed a significant dependence with series located in the north and the Mediterranean coast and in some series in the southern Atlantic front, presenting this without lags correlation; (2) the results of spectral analysis and continuous wavelet transform, the influence of the main modes of macroclimatic index is evident in the interannual variability of the maximum streamflow series, the influence of the modes of variability the NAO, the AO and MO is in the oscillation in the Atlantic front series, besides the upper series of Jucar and the northern Ebro. The results with the WeMO index showed an important influence in the interannual variability on the fluctuations in the series of the north and the lower Jucar and Segura, and just as series in the lower Ebro. The modes of interannual variability of Niño 3.4 index, and Multivariate ENSO index, showed a link with the fluctuations in northern, Jucar and Segura series. It is important to note that according to the results, the series appear to be relatively correlated at certain periods, which shows that exist interactions between macroclimatic phenomena, which is important issue in order to further analyze these relationships. The results of the study provide valuable information for improving forecasting of the streamflow and making use of this important influence between the two variables in the frequency analysis of extremes, from a non-stationary approach in the zone of study.