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Investigation of the impact of an upper troposphere teleconnection pattern on the Mediterranean climate

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In a previous study, a teleconnection pattern between Eastern Mediterranean and Northwestern Europe was identified in the geopotential field during winter with the aid of correlation analysis covering the Northern Hemisphere region. This pattern was found to be more intense at 300 and 500hPa and weakens at lower levels, so that at 1000hPa is not evident. In autumn, this upper troposphere pattern persists with the Northwestern pole being shifted over Central Europe. In spring and summer the pattern is visibly weakened while is not statistically significant.

In this study, this upper troposphere teleconnection pattern was further examined with the aid of principal component analysis, intending to confirm the existence of the poles, as derived from the correlation analysis. For this purpose, gridded daily geopotential height and temperature data from the NCEP/NCAR Reanalysis Data Base were used for the period 1958-2003 on a seasonal basis. The datasets cover the greater European region between longitudes 60˚W and 60˚E and latitudes between 25˚N and 67.5˚N with a resolution of 2.5ºx2.5º. The first four principal components are retained for all datasets used. These PCs share from 70 to 80% of the total variance. Also, the varimax method was used for the PCs' rotation to increase the discrimination among the factor loadings and make them easier to interpret. Specifically, at 300hPa in winter a centre was found in the Northwestern Europe and an opposite sign one in Eastern Mediterranean, as the second principal component, explaining the 24% of the total variance, further supporting the existence of the corresponding teleconnection pattern. The first component seems to form the well known North Atlantic Oscillation

(NAO) pattern while the third one reveals a pattern corresponding to the North Sea-Caspian pattern (NCP). At 500hPa, the examined pattern forms together with NAO as the first component, while the second component represents the NCP. The analysis for the other seasons did not reveal the Northwestern Europe-Eastern Mediterranean pattern, as expected. The application of PCA in the temperature fields verified the existence of the pattern with similar characteristics found in the geopotential fields.

Furthermore, in this study an attempt is made to investigate the impact of the teleconnection pattern on the Mediterranean climate. For this purpose, gridded daily data from the regional model Précis Data Base of the Handley Centre are used with a resolution of 0.5º x 0.5º for the Mediterranean region for the period 1960-1990. Model data became available through the EU project MICE (Modelling the impacts of Climate extremes). The data fields concern daily precipitation, minimum and maximum surface temperature. The relationship between the principal components of the geopotential height fields at 300 and 500hPa and the above mentioned parameters on monthly basis is studied with the aid of canonical correlation analysis. Preliminary results showed that a statistical relationship occurs between temperature in Eastern Mediterranean and the Northwestern Europe-Eastern Mediterranean pattern while the implications for rainfall seem rather complicated.