A climatology of air temperature extremes in the Mediterranean region for the 85-year period 1940-2024

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Extremely high/low temperatures along with the synoptic conditions leading to their appearance are investigated for the Mediterranean region (55°N - 30°N, 0°E – 40°E) during the 85-year period 1940 - 2024. The data used are daily (04UTC and 12UTC) values of air temperature at 2m above the Earth's surface, 850hPa air temperature and 1000hPa and 500hPa geopotential heights, with 1°x1° spatial resolution, obtained from the ERA5 database. For 2m air temperature, the anomalies are calculated as the differences between the initial values and the 85-year long-term averages for the corresponding dates and are then used for the definition of Extreme High Temperature Days (EHTDs) and Extreme Low Temperature Days (ELTDs). 3890 EHTDs and 4882 ELTDs are defined. Statistically significant trends in the inter-annual variation of the number of these extreme days show that EHTDs are evidently more frequent in recent years whereas ELTDs are less frequent. A statistical analysis is applied on the data separately for the EHTDs and the ELTDs, which includes the application of Principal Component Analysis (PCA) followed by Cluster Analysis (CA), a procedure known as spectral clustering. As a result, 8 clusters are defined for the EHTDs and 9 clusters are defined for the ELTDs, corresponding to different Mediterranean sub-regions. The occurrence of EHTDs is mainly associated with intense solar heating, blocking anticyclones and warm air advection from southern latitudes. On the contrary, ELTDs are connected to intense radiative cooling of the Earth's surface, cold air advection from northern latitudes and Arctic outbreaks.

Key Words: Extreme air temperatures, Mediterranean region, synoptic patterns, spectral clustering, ERA5

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