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Events of extreme summer temperatures in the Eastern Mediterranean – classification according to air trajectories

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The summer temperature regime in the Eastern Mediterranean (EM) is characterized by small inter-diurnal variations. Even though, there are periods of heat waves, in which the temperature exceeds the seasonal average by several standard deviations. 'Cool' spells occur as well, though are shorter than the heat waves and less extreme.
A 3-D analysis, including composite air-trajectories and vertical profiles was performed for 3 groups of days. These are the 5% quantile of the lower, median and higher temperatures at the 850-hPa level at the representative grid point (RGP), i.e. 32.5N 35E, for the study region. All of them show distinct differences among the 3 types of days, the 'hot', 'regular' and 'cool' days. The temperature differences were found only at the lower levels, up to 4Km. As for the back air-trajectories, the major differences among the dynamic and thermodynamic features of the 3 groups of days were found at the height of 4Km (∼600hPa). The 'cool' group is characterized by long back air-trajectories, entering the EM from north-west at this height, implying a cool advection, while the back air-trajectories of the 'hot' days are much shorter, and have no distinct origin.
Based on synoptic approach, 3 evolution scenarios were proposed for the 'hot' events. One type reflects air transport from the south or from the east, transporting tropical-like characteristics, expressed by high relative humidity and instability at the mid-levels. The second is associated with an expansion of the subtropical high over the entire EM. The third is of baroclinic nature, when a pronounced upper-trough extends from Europe toward the central Mediterranean and a pronounced ridge, with its implied subsidence, affects the EM. For the 'cool' events, there is one proposed scenario, i.e. an upper-level trough enters the EM from Eastern Europe accompanied by enhanced cool advection at the lower-levels.
A K-means clustering algorithm was applied for each group of days in order to discriminate among different types of evolution scenarios. The algorithm was applied on the back air-trajectories ending at the RGP in the height of 4Km. The 'hot' days were classified objectively into 6 clusters, grouped into 3 major types, having substantial differences among them. One reflects air transport from the near vicinity of the RGP, with tropical-like characteristics, expressed by high relative humidity and air ascent at the mid-levels. The second shows widespread warming over the entire EM, presumably due to an expansion of the subtropical high, and the third is propagation of warm anomalies from northwest toward the EM.
Four 'cool' clusters were objectively identified, being most similar in their behavior, i.e. long air trajectories from northwest. They are characterized by propagation of cool anomalies from northwest reflecting the influence of European traveling disturbances, as for the 3rd type of 'hot' events.