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Persistent warm and dry extremes over the Eastern Mediterranean during winter: the role of upstream Rossby wave pattern

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Persistent dry winter events over the Eastern Mediterranean (EM) disrupt the precipitation patterns in the rainy (winter) season and dramatically reduce water availability in the region. Self-organizing map classification of atmospheric profile data over Israel has shown that the most persistent (over 4 days) dry and warm winter extreme events are induced by a stagnant ridge over the EM, pronounced trough/cutoff low over the western/central Mediterranean and blocking over the north Atlantic. It is however, unclear how this Rossby wave pattern emerges and what are the atmospheric mechanisms that govern the associated development of dry and warm surface conditions. Here we objectively identify persistent dry and warm winter events over Israel, and focus on three case studies, aiming to understand the relation between the baroclinic synoptic setting, precursor Rossby waves, and how the dry and warm conditions emerge using a Lagrangian approach to study the history of the involved airmasses. We found large day-to-day variability within events and identified the leading mechanisms of the warm and dry conditions to be: adiabatic heating during slantwise subsidence, heating by sensible heat fluxes from the surface, and advection of warm and dry continental air. In addition, the Atlantic blocking and EM ridge are supported by upstream diabatic heating in warm conveyor belts (WCB) of north Atlantic cyclones and Mediterranean cyclones, respectively. A tripole flow during these events demonstrates the sequential relation between Atlantic ridge (or block), trough over Europe and ridge over EM and/or West Russia. These results place local persistent warm and dry anomalies as an outcome of a stationary Rossby-wave pattern, providing new opportunities for understanding such extremes and their predictability.