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Aspects of a climatology and dynamics of the summer Etesians

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The summer circulation over the Eastern Mediterranean (EM) is dominated by a persistent northerly flow known as the Etesians. Its ventilating effect is balanced by adiabatic warming induced by large-scale subsidence that inhibits cloud formation resulting to clear skies. Both phenomena are reconciled manifestations of the Rossby wave structures triggered by the summer South Asian monsoon convection, which essentially drives the large-scale background state that expands over the EM. The monsoonal nature of the Etesians is already known since antiquity, which features a recurrent July-August maximum, makes the phenomenon a key component of the climatic system, occurring over the EM climate change hot spot. This study aims at the compilation of a climatology of the Etesians, based on objective criteria and with the aid of the ERA-40 and ERA-Interim datasets, leading to a new climate index that could facilitate the study of climate change over the area. The Etesians are traditionally seen only as a near surface flow, but here, focus is put also on the dynamics and the vertical structure of the phenomenon.

The northern sector 1000 hPa wind averaged over the Aegean Sea is used as a proxy for the intensity of the Etesians. Successive periods of strong northerly flow over the Aegean (Etesian outbreaks) are identified, which are interrupted by quieter spells. A climatology of the frequency, intensity and duration of the phenomenon is presented. Composite analysis reveals that the Etesian outbreaks are driven by a mid-latitude wave train originating in the North Atlantic, emerging as early as 4-5 days prior to the outbreak onset, which provides the seed for the formation of a ridge over the Balkans. This leads to the additional enhancement, on synoptic timescales, of the large-scale background northwest-southeast slope of the isentropes induced by the monsoon. As air masses are released southwards along the sloping isentropes, sharp tropopause folds accompany the outbreaks of northerly flow and subsidence. A climatology of the phenomenon is presented and the distinct underlying dynamics of the so far poorly documented summer EM events are discussed, which involve the monsoon influence and result to spatially localized and semi-permanent tropopause folds over the EM, in contrast to their winter mobile counterparts accompanying extratropical cyclones. Unlike the zonal mean, the seasonal variability of potential vorticity (PV) at mid and upper troposphere over the EM is characterized by a double annual cycle, with a winter and an additional distinct early August maximum caused by the widespread summer tropopause folds and associated with filaments of high-PV air of stratospheric origin.