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The summer Etesian circulation in the eastern Mediterranean : influence of the South Asian Monsoon and midlatitude dynamics.

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The aim of this study is the investigation of aspects of the climate in the eastern Mediterranean and the Middle East (EMME) during the summer, when the atmospheric circulation is less documented compared to the winter. Then the midlatitude influence weakens and the region is particularly influenced by the dominant South Asian Monsoon circulation and thus all the processes that influence its variability. The combined result of the higher pressures over the western Mediterranean and the Persian trough that extends from the Asian Monsoon trough towards the Mediterranean is the persistent etesian low level northerly flow that serves as a ventilating system and a thermostat of the whole region that is documented since antiquity. In parallel, large scale mid and upper level subsidence dominates over the central and eastern Mediterranean, inhibiting convection and giving rise to the characteristic Mediterranean climate type. In this study, based on ERA40 data of precipitation and vertical velocity, daily measures of the monsoon intensity, the Mediterranean northerly flow and subsidence are devised. The use of indices describing the etesian flow in the EMME region allowed the study of the interannual variability of the circulation in the area and the detailed investigation of the influence of the monsoon on the EMME climate. Furthermore, the introduction of such a climate index facilitates the study of future climate changes in the area.

The etesian flow and the pronounced subsidence in the eastern Mediterranean acquire a maximum during July and August and their seasonal cycle is found to be strikingly synchronous to that of convective activity, especially over the Bay of Bengal. The deep convection causes lifting of the tropopause and the reduction of the stratification over South Asia, leading to steep sloping isentropes in the western and northern periphery of the monsoon area and introducing a large scale background structure that acquires its maximum strength in mid-summer. More importantly, the identification of ‘etesian outbreaks’ and episodes of subsidence with the aid of the relevant daily indices, provides evidence that the influence of synoptic disturbances is rather important for the observed subsidence in the area. Composite analysis revealed that the high frequency variability of the EMME etesian and subsidence indices is due to wave activity originating in the North Atlantic that eventually amplifies the monsoon-induced background state over the EMME region, while consecutive pulses of southward moving air masses eventually slide down the steep isentropes. During these outbreaks, the lowering and deformation of the climatologically observed semi-permanent tropopause fold over the EMME area leads to air of stratospheric origin towards the lower troposphere affecting the air quality of the region.