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Observed absorbing signature of summer-time aerosol over the Eastern Mediterranean

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The Mediterranean region is known to be highly sensitivity to climate perturbations. Therefore it is crucial to study and understand the role of absorbing aerosols in the regional radiation budget and its climatic effects. This study was carried out using datasets from various satellites, ground-based observations and model calculations, under summer conditions. Climatology of aerosol optical depth (AOD), single scattering albedo (SSA) and size parameters were analyzed using multi-year (1999-2012) observations from MODIS, MISR and AERONET. CALIOP-derived aerosol vertical distributions and their classifications are used to calculate the AOD of 4 dominant aerosol types: dust, polluted dust, polluted continental and marine aerosol over the region. The seasonal mean (June – August, 2010) AODs are found to be 0.22±0.02, 0.11±0.04, 0.10±0.04 and 0.06±0.01 for polluted dust, polluted continental, dust and marine aerosol, respectively. Changes in the atmospheric temperature profile as a function of absorbing aerosol loading were derived for the same duration using observations from AIRS. We have inferred heating rates in the aerosol layer of ∼1.7±0.8 K/day, which is attributed to aerosol absorption of incoming solar radiation. Radiative transfer model (RTM) calculations also show significant atmospheric warming for dominant absorbing aerosol over the region. A maximum atmospheric forcing of +16.51±7.5 Wm-2 is calculated in the case of polluted dust, followed by polluted continental (+7.55±4.4 Wm-2) and dust (+7.11±4.3 Wm-2). RTM-derived heating rate profiles for dominant absorbing aerosol show warming of 0.1 – 0.9 K/day in the aerosol layer (<3.0 km altitudes), which primarily depend on AODs of the different aerosol types. Diabatic heating due to absorbing aerosol stabilizes the lower atmosphere, which could significantly reduce the atmospheric ventilation. These conditions can enhance the ‘pollution pool’ over the eastern Mediterranean.