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Airborne study of a multi-layer aerosol structure in the eastern Mediterranean observed with the airborne polarized lidar ALEX during a STAAARTE campaign (7 June 1997)

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Abstract. We present a case study of tropospheric aerosol transport in the eastern Mediterranean, based on airborne measurements obtained south of Greece on 7 June 1997. Airborne observations (backscattering lidar at 0.532 μm with polarization measurements, in situ particle counters/sizers, and standard meteorological measurements) are complemented by monitoring with Meteosat visible and infrared images and a ground-based sun-photometer, air-mass back-trajectory computations, and meteorological analyses. As already observed from ground-based lidars in the Mediterranean region, the vertical structure of the lower troposphere appears complex, with a superposition of several turbid layers from the surface up to the clean free troposphere which is found here above 2 to 4 km in altitude. The aircraft observations also reveal an important horizontal variability. We identify the presence of depolarising dust from northern Africa in the most elevated turbid layer, which is relatively humid and has clouds embedded. The lowermost troposphere likely contains pollution water-soluble aerosols from eastern continental Greece, and an intermediate layer is found with a probable mixture of the two types of particles. The column optical depth at 0.55 μm estimated from Meteosat is in the range 0.15-0.35. It is used to constrain the aerosol backscattering-to-extinction ratio needed for the backscattering lidar data inversion. The column value of 0.017 sr^{-1} is found applicable to the various aerosol layers and allows us to derive the aerosol extinction vertical profile. The aerosol extinction coefficient ranges from 0.03 km^{-1} in the lower clean free troposphere to more than 0.25 km^{-1} in the marine boundary layer. Values are <0.1 km^{-1} in the elevated dust layer but its thickness makes it dominate the aerosol optical depth at some places.

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