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Four-year study of Middle East and Sahara dust intrusions in terms of particle lidar ratio: Observations with lidar and sun/sky photometer over Limassol, Cyprus

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The remote sensing station of the Cyprus University of Technology (CUT) at Limassol (34.7oN, 33oE, 50m above sea level a.s.l.) is located in the southeast part of the Mediterranean (150km south of Turkey and 250km west of Syria) and dust aerosol components from Sahara and Middle East deserts comprise the major sources of dust layers in the study area. The CUT station is equipped with a European Aerosol Research Lidar Network (EARLINET) lidar and Aerosol Robotic Network (AERONET) sun/sky photometer. The combined database of four years (2010 –2013) of observations was used to compare extinction-to-backscatter ratios (lidar ratios) for dust from Middle East and Sahara deserts.

For the first time, a long-term lidar study on the lidar ratio of Middle East desert dust is presented. The results are compared with respective findings for Saharan dust outbreaks. The Limassol lidar station at the island of Cyprus in the eastern Mediterranean Sea is unique because it is the only site of the EARLINET which is influenced by a statistically significant number (5-7) of Middle East dust outbreaks each year as well as by numerous Saharan dust outbreaks (>10 per year). For this analysis we considered 17 major dust outbreaks from the Middle East and 32 dust outbreaks from North Africa. Simultaneous EARLINET lidar and AERONET photometer observations were conducted at Limassol almost day by day over the four year period from April 2010 to December 2013.

The quality of the retrieval is checked within a case study by comparing the results with respective Raman lidar solutions for particle backscatter, extinction, and lidar ratio. The applied combined lidar/photometer retrievals corroborate recent findings regarding the difference between Middle East and Saharan desert dust lidar ratios. We found values from 44-65 sr with a mean value of 52.7 sr for Saharan dust and from 35-46 sr with a mean value of 41.1 sr for Middle East dust. The presented data analysis, however, also demonstrates the difficulties in identifying the optical properties of dust even during outbreak situations in the presence of complex aerosol mixtures of desert dust, marine particles, fire smoke, and anthropogenic haze.

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