Wildfire smoke cases: Lidar observations in Cyprus

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Uncontrolled fires, mainly in rural areas, can be considered as wildfires. According to IPCC (AR6), wildfire-favorable weather has likely become more common in southern Europe, northern Eurasia, the USA, and Australia over the past century. Wildfire smoke poses threats to climate, air quality, visibility, and human health, making further investigation of smoke particle properties crucial. In this study we analyze the smoke optical properties observed in the free troposphere of Limassol, Cyprus, during the summer period spanning 2021 to 2023. Using the Hysplit model and VIIRS satellite data the origin and the source of the air masses are confirmed while the particle depolarization ratios at 355 nm and 532 nm retrieved from the PollyXT multiwavelength polarization Raman lidar and reveal different levels of smoke aging. A total of 30 smoke cases were analyzed, with 17 of them classified as fresh smoke (travel time ≤ 1 day) and 13 of them as aged smoke (travel time ≥ 5 days). At 532 nm, depolarization ratios were higher for fresh smoke than aged, while at 355 nm, mean values were similar for both wavelengths. Aged smoke showed consistently higher values at 355 nm than at 532 nm. Mean lidar ratios ranged from 40–90 sr for both smoke types and wavelengths, with fresh smoke generally showing $LR_{532}/LR_{355} < 1$. Further research on hygroscopic growth of smoke particles, as well as on fire radiative power of the wildfires observed will be conducted.

Key Words: Wildfires, LIDAR, Smoke particles, Optical properties