Workshop on "Recent advancements in remote sensing and modeling of aerosols, clouds and surfaces",
GRASP ACE Summer school,
Lille, France, May 22-26, 2023

An automatic algorithm of the airborne pollen characterization using lidar derived parameters

Xiaoxia Shang[a*], Maria Filioglou[a], Elina Giannakaki[a,b] and Mika Komppula[a]

[a] *Finnish Meteorological Institute, Kuopio, Finland*
[b] *Department of Environmental Physics and Meteorology, University of Athens, Athens, Greece*

***Corresponding author e-mail**: xiaoxia.shang@fmi.fi

As one important type of biogenic particles, pollen has various climatic and environmental impacts. The vertical distribution of pollen in the atmosphere can be investigated using lidars. Studies have shown that lidar observations can detect the presence of pollen in the atmosphere, with a strong diurnal cycle on the pollen backscattering, since the non-spherical pollen grains can generate strong depolarization of laser light. In this study, we have developed a novel method, based on our previous studies [1, 2], for characterizing the optical properties of pure pollen particles, based on the lidar derived particle backscatter coefficients (BSCs) and particle linear depolarization ratios (PDRs). The non-linear least square regression fitting was applied on the backscatter-related Ångström exponents (BÅEs) and PDRs, following the lidar equations. The algorithm determines the theoretical relationship between PDR and BÅE for a certain aerosol mixture by estimating two coefficients. This relationship is valid under two constraints: (i) only two aerosol populations, depolarizing (e.g. pollen or dust) and non-depolarizing (e.g. non-depolarizing background) aerosols, are present in the aerosol mixture, (ii) both the characteristic PDR and BÅE values of the two aerosol types should be different enough. The method was applied to both synthetic cases and lidar-measured profiles.

Keywords: aerosol, pollen

References

[1] Shang, X., Giannakaki, E., Bohlmann, S., Filioglou, M., Saarto, A., Ruuskanen, A., Leskinen, A., Romakkaniemi, S., and Komppula, M.: Optical characterization of pure pollen types using a multi-wavelength Raman polarization lidar, Atmos. Chem. Phys., 20, 15323–15339, https://doi.org/10.5194/acp-20-15323-2020, 2020.
[2] Shang, X., Baars, H., Stachlewska, I. S., Mattis, I., and Komppula, M.: Pollen observations at four EARLINET stations during the ACTRIS-COVID-19 campaign, Atmos. Chem. Phys., 22, 3931–3944, https://doi.org/10.5194/acp-22-3931-2022, 2022.