Pollen Observations at Four EARLINET Stations in May 2020

Xiaoxia Shang[(1)], Holger Baars[(2)], Iwona S. Stachlewska[(3)], Ina Mattis[(4)], Artur Tomczak[(3)], Mika Komppula[(1)]

[(1)] *Finnish Meteorological Institute, Kuopio, Finland, E-mail: xiaoxia.shang@fmi.fi, Mika.Komppula@fmi.fi*

[(2)] *Leibniz Institute for Tropospheric Research (TROPOS), Leipzig, Germany, E-mail: baars@tropos.de*

[(3)] *University of Warsaw, Faculty of Physics, Poland), E-mail: Iwona.Stachlewska@fuw.edu.pl, artur.tomczak@fuw.edu.pl*

[(4)] *Deutscher Wetterdienst, Meteorologisches Observatorium Hohenpeißenberg, Hohenpeissenberg, Germany, E-mail: Ina.Mattis@dwd.de*

Lidar observations were analyzed to characterize atmospheric pollen at four EARLINET (European Aerosol Research Lidar Network) stations (Hohenpeißenberg, Germany; Kuopio, Finland, Leipzig, Germany; and Warsaw, Poland) during the ACTRIS (Aerosol, Clouds and Trace Gases Research Infrastructure) COVID-19 campaign in May 2020.

The re-analysis lidar data products, after the centralized and automatic data processing with the Single Calculus Chain (SCC), were used in this study, focusing on particle backscatter coefficients at 355 nm and 532 nm, and particle linear depolarization ratios (PDRs) at 532 nm.

A novel method, based on the non-linear least square regression fitting using lidar-derived backscatter-related Ångström exponents (BAEs) and PDRs, was used for the characterization of the pure pollen depolarization ratio. This easy-to-apply algorithm can estimate two coefficients to determine the relationship between PDR and BAE. Such a 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, can be assumed in the aerosol mixture, (ii) both the depolarization ratio and the BAE of the two aerosol types should be different. Mathematically (or under ideal conditions), the PDR and BAE of a mixture of depolarizing and non-depolarizing aerosols, with whichever mixing rate, should follow the derived relationship. Hence, with the knowledge of one parameter (PDR or BAE), the other can be evaluated

Under the assumption that the BAE between 355 and 532 nm should be zero (± 0.5) for pure pollen, the pollen depolarization ratios were estimated: for Kuopio and Warsaw stations, the pollen depolarization ratios at 532 nm were of 0.24 (0.19–0.28) during the birch dominant pollen periods; whereas for Hohenpeißenberg and Leipzig stations, the pollen depolarization ratios of 0.21 (0.15–0.27) and 0.20 (0.15–0.25) were observed for periods of mixture of birch and grass pollen. The method was also applied for the aerosol classification, using two case examples from the campaign periods: the different pollen types (or pollen mixtures) were identified at Warsaw station, and dust and pollen were classified at Hohenpeißenberg station.

This study shows that automatically retrieved lidar data profiles (using SCC) are suitable for pollen characterizations. However, additional information, e.g. dust-free period from dust models, is need to exclude dust impact. The proposed methodology demonstrated a first step towards automated pollen detection in lidar networks.