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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Airborne pollen observations using a multi-wavelength Raman polarization lidar in Finland: characterization of pure pollen types" *by* Xiaoxia Shang et al.

Anonymous Referee #3

Received and published: 29 September 2020

The authors present multi-wavelength Raman polarization lidar measurements of pollen layers in Finland combined with a Burkard pollen sampler. Active remote sensing measurements of pollen are rarely found in literature. Therefore, the present manuscript enriches our knowledge about the optical properties of abundant pollen types such as birch and pine pollen. Northern Europe (Finland) is a good location for such a study as it is less affected by other depolarizing aerosol particles such as mineral dust. Additionally, the authors present a novel approach to derive the depolarization ratio of pure pollen layers. Although it is related to some uncertainties, it is a big step forward compared to just presenting the layer mean values. I support the idea that measurements of the depolarization ratio at various wavelengths should be enforced in

future pollen-related studies. Polarization lidars may in future support pollen forecasts and help citizens with pollen allergy thanks to the characterization of pure pollen types by these authors. The quality of the figures and tables is high.

Finally, I recommend publication after minor revisions.

Major remarks:

1. You use a value of 3 for the backscatter-related Ångström exponent of the background aerosol. Do you have any statistical evidence of this value for the station at Kuopio? Is it a mean value for the pollen-free periods? And how sensitive is your analysis to this assumption?

2. Your novel approach for getting the depolarization ratio of the pure aerosol type is remarkable. I am just wondering whether the mixture of continental background aerosol and pollen has a significant effect on the lidar ratio, too. It would be great to have the lidar ratio and the depolarization ratio for pure birch and pine pollen at the end. Please comment on this.

Minor remarks:

3. P5,L25: "The extinction-related and backscatter-related Ångström exponent were also retrieved for pollen layers." – Is the extinction-related Ångström exponent shown somewhere? It must not be shown in the manuscript, some descriptive words are sufficient.

4. P10,L30 The Ångström exponent is related to extinction or backscatter?

5. P11,L10 Are the measurements presented by Cao et al., (2010) performed at exactly 180° backscatter direction? This is not so easy to achieve in chamber experiments. Maybe there is an additional source for the discrepancy arising from the optical design of the Cao measurements?

6. Fig. 1+2 and Tab. 1: Please provide the year (2016) whenever you provide dates.

Do it in the caption or just like this “Date mm/dd in 2016 [UTC]”.

7. How do you get to the uncertainty range +/-5% for pine pollen? Varying the Ångström exponent by +/- 0.5 leads to values of 26 to 44% (Fig. 12 and P11,L9).

Technical remarks

- Affiliations: “P.O. Box 1627, 5 70211” – seems not necessary and isn’t provided for the other institutes

- P1,L11 / P2,L32: depolarization ratio values/value

- P3,L17: volume linear depolarization ratio (VDR) and particle linear depolarization ratio (PDR)

- P4,L18: spoken communication – with whom? Please acknowledge the name of the person

- P6,L10: non-depolarizing aerosol – the received light is depolarized, but the aerosol is depolarizing, please change it throughout the manuscript

- P6,L12+L30: this type of indices should not be written in italic – please change it throughout the manuscript

- P6,L21: “thus six pollen backscattering are simulated.” – backscatter coefficients or backscatter coefficient profiles (similar P12,L8)

- P9,L8/9: It would be a good idea to begin a new paragraph with line 9

- Fig. 1, caption of y-axis: [no m-3] – it is -3

- Fig. 3a, caption of y-axis: LR 532 [sr] – unit is missing

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