Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-794-RC1, 2020


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 #1**

Received and published: 21 August 2020

The authors describe a methodology to infer the particle linear depolarisation ratio (PLDR) of different types of airborne pollen in their pure state, i.e. unmixed with ambient aerosols. Due to the size and irregular shape of pollen, it can be expected that their PLDR is larger than that of most aerosol types though likely smaller that that of mineral dust. Knowing the PLDR of undiluted aerosol types is important as it allows for separating, in the presented cases, the contribution of pollen to pollen-containing aerosol mixtures.

I am not quite sure that the authors are actually presenting simulations or modelling in their discussion of a simulator. It all seems quite analytical. To my understanding,



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Discussion paper

the shape of the extinction coefficient profiles for pollen and the background aerosol is defined as given in Table 3. The magnitude of the extinction coefficient of both species is then determined by the respective optical thickness which is also set. Backscatter coefficients are obtained using the set lidar ratio and the Angstrom exponent is derived trough mixing the set values of the two aerosol types. It is totally unclear, though, how the authors arrive at the mixed PLDR profiles presented in Figs. 4 and S2b. PLDR values for both types are also set in Table 3 but the mixing rule is not linear such as summing up the backscatter or extinction coefficients. Is this when simulations come into play? If so, what is done to get the PLDR profiles? It might be that the authors have used Eq. (6) which is given in Section 3.3.2 to obtain PLDR profiles of the pollen-background-aerosol mixture. If so, the entire simulator would be circular as identical calculations would be done in both directions. This would explain the perfectly linear relationships presented in Figs. 5, 6, and 7. I am afraid I cannot assess the scientific quality of this work before the authors clarify the description of the simulator, particularly with respect to the points made above.

**Further comments**

- The title is a bit misleading as the reader might expect observations from an aircraft. I'd suggest a clearer title such as "Optical characterisation of airborne pollen from lidar measurements in Finland"
- The part about CALIPSO in the Introduction (page 2, lines 21-28) should be omitted. It is not needed as there is no later reference on how to apply the new results of this work to improve the CALIPSO aerosol typing.
- page 3, lines 3-13 are more suitable in the introduction
- I'd suggest a change of the structure of the paper: 1. Introduction, 2. Site and instruments, 3. Lidar simulator, 4. Results. Such a structure allows for a clear

separation of instruments, methods, and findings. In addition, the lidar parameters should already be introduced in the description of the lidar. This way, the reader knows what's available for the theoretical studies in the next section.

- Are there any objective criteria for determining the exact times of the different intensive pollination periods? I am thinking of a certain threshold of the extinction coefficient at a certain height or similar quantifiable criteria.
- It would be good to get some information on how often pollen are observed at such high altitudes and how they get up there in the first place.
- The abbreviation PBC is not ideal as it is often used to denote the particle backscatter coefficient. I'd suggest to rename this into some ratio with a different variable.
- There is no mentioning of the assumed shape of the pollen and background aerosol profiles in the uncertainty study. Is there any justification for selecting this shape? How general are they? Is the same pollen profile assumed in the inverse model?
- Why is the pollen layer set to extend from 0 to 1 km when the measurements (1) only start at 600 m or so and (2) show pollen all the way to 2 km height?
- It would also be good to get an idea of typical values of total and pollen-related optical thickness at your site to assess the choice of values in your method. Is a pollen optical depth of unity even possible?

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