The authors would like to thank the reviewer for his/her valuable comments and suggestions. We have modified the manuscript with the proposed changes along with step-by-step answers to the suggestions. Please note that changes have been highlighted (in bold or 'track changes') in the manuscript and the corresponding answers to the reviewer by text below. The original comments are presented in bold letters.

Reviewer #2

The main research content of this paper is the difference in depolarization ratio by wavelength depending on the type of pollen. It is judged to have important value as a paper with high continuity with previously published papers related to pollen. Overall, it is judged to be of excellent quality, but it is judged that it needs some revision.

Please refer to the information below.

Since the PDR value of pollen changes depending on mixing with aerosols other than pollen, such as PM10, it would be good to include this information in the text. In the current thesis, it is indicated in the graph, but it is not separately indicated in the text. It would be better to distinguish the PDR value when it is pure pollen and the value when mixed and indicate the average value in the text.

Thank you for your comment. We have added the following sentence in the methodology for further clarification:

'The percentage share of PM10 in the aerosol mixture was calculated as 100*PM10/ (PM10 + PM_{pollen})'.

We have also included the mean PDR value for each pollen type considering all cases. The following sentences have been added to the manuscript:

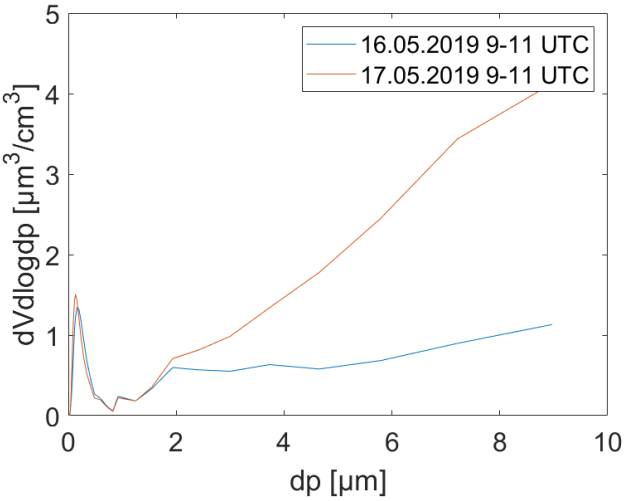
Line 243: 'Considering all cases with the variable birch contribution to the aerosol mixture a mean PDR of 4 ± 2%, 16 ± 6%, 13 ± 8% and, 18 ± 8% at 355, 532, 910 and 1565 nm wavelengths was estimated, respectively.'

Line 283: '….and a mean PDR of 4 ± 2%, 25 ± 15%, 14 ± 9% and, 21 ± 6% at 355, 532, 910 and 1565 nm wavelengths was obtained, respectively.'

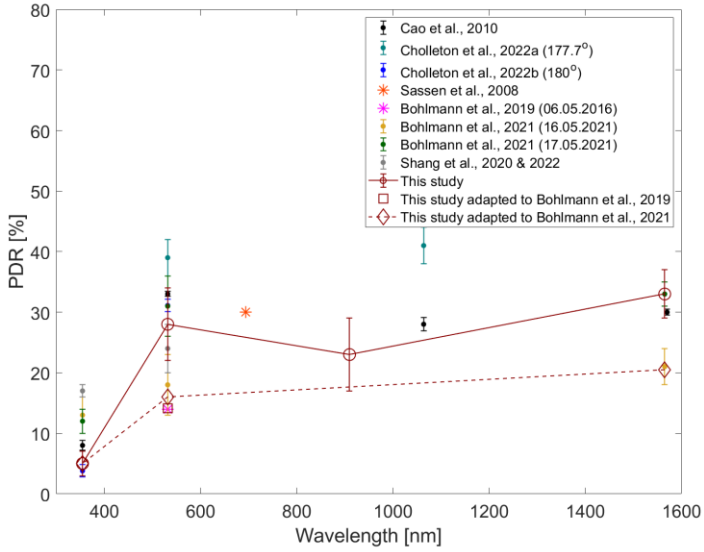
In line 268~271 and Figure 5, you can see the difference between shang et al (2022), but there is no difference between Bolnmann (2019, 2021) and this study's PDR532, so it would be nice to add it in Figure 5.

Thank you for your suggestion. Figure 5 represents the characteristic PDR behaviour of birch pollen with minimum contribution of other aerosols at high pollen counts thus, a straightforward comparison is not necessarily valid. One way to include Bohlmann et al., (2019, 2021) works in Figure 5 is to estimate the spectral dependence of PDR at the birch concentration and PM10 share reported in these two studies. Although our dataset includes a wide range of birch pollen concentration and PM10 percentage shares, a close enough pair combination of birch pollen amount and PM10 percentage share to the ones reported at Bohlmann et al., (2019, 2021) works was not found. This means that, we can either report the spectral dependence of PDR for the pollen concentration or the PM10 share found in the aforementioned studies. Having this is mind, we have included here an adaptation for the pollen concentration, and we discuss the implications of this approach.

To make the comparison as straightforward as possible, we have considered three case studies as reported at Bohlmann et al., (2019, 2021) works. For these cases, we know the exact amount of birch to other pollen types and the full optical profiles are available. In turn, this ensures that the slightly different first layer definition between our studies can be modified to adapt to this manuscript's definition. The three chosen case studies are on the 6th of May 2016 (see Fig. 3 in Bohlmann et al., (2019)) (case 1), the 16th of May 2021(case 2) and the 17th of May 2021 (see Fig. 4 in Bohlmann et al., (2021)) (case 3). These cases were chosen because they had a 100% birch pollen contribution with no presence of pine/spruce. Regarding the birch pollen concentration, a 205 #/m^3 (case 1), 3247 #/m^3 (case 2) and 3226 #/m^3 (case 3) were estimated using the in-situ pollen collector. Although the PM10 share in the aerosol mixture is not reported in the original papers, we have calculated them here. The PM10 share was 86 % (case 1), 10 % (case 2) and 16 % (case 3), respectively with an actual PM10 concentration of 9 μg/m^3 (case 1), 2 μg/m^3 (case 2) and 4 μg/m^3 (case 3), respectively. The mean RH amounted to about 53 % (case 1), 36 % (case 2) and 39 % (case 3), respectively. Using Figure 4, we have estimated the PDR at the birch concentration occurred during the three cases. Note that cases 2 and 3 had a similar birch concentration hence one estimation was enough. We conclude that the concentration adaptation forecasts the PDR values with satisfactory results (good correlation in two out of three cases). Cases 2 and 3 had similar birch concentration and although the PDR in case 3 was higher the PM10 share was also higher. In the updated Figure 5 (see below), we see that already at ~3200 #/m^3 with a 16% PM10 share contribution, the characteristic PDR is concluded. Reading Figure 4 from the PM10 share perspective, the 9 and 16% PM10 share in cases 2 and 3 imply a mean PDR of 5 ± 2%, 20 ± 7% and, 25 ± 4% at 355, 532 and 1565 nm wavelengths, respectively. This range of values covers the spectral PDR behavior in both case 2 and 3. To shed further light, we have included the mean volume aerosol size distributions for these two cases. It is evident that case 3 had a notable difference in the aerosol population above 2.5 μm in size compared to case 2. No mineral dust was present in the atmosphere and the BC concentration was the same between the two cases. We conclude that the pollen concentration or PM10 share adaptation is a simplified approach. The difference between case 2 and case 3 may lie in the additional presence and type of pollen fragments with a diameter less than 10 μm. In turn, this marks the importance of instrument synergies and, at the same time, points out the complexity in pollen detection and classification using lidars. It also brings up the importance of pollen fragment detection.



Volume aerosol distributions for the 16th and 17th of May 2019.



Updated Figure 5 including Bohlmann et al., (2019 & 2021) works.

Given that Figure 5 represents the characteristic birch PDR spectral dependence, adding individual cases with variable contribution of birch pollen and PM10 aerosols can rather confuse the reader and shift the focus of this figure. Therefore, we prefer to leave Figure 5 as it is.

line 28, SSPs -> SPPs

Corrected

line 61, bioaresols -> bioaerosols

Corrected

line83, Stremline -> Streamline

Corrected