Letter of Reply to Referee 1

Thank you for carefully reading the manuscript and providing useful suggestions to improve the paper.
The replies to your comments are given below.

Major Comments 1. Please add the comments about background depolarization ratio at the observation site. The authors mentioned about the effect of dust and biomass particles. And there is no effect by dust and/or biomass particles during study period by satellite data etc. But, there are any explanation about background data except pollen period. Please add depolarization ratio value in normal day (No pollen, dust and biomass particle).

To check the background aerosol at our measurement site, lidar measurements during different times of the year have been checked. The particle depolarization ratio of the ground-near aerosol layer during the winter months of 2015 and 2016 are shown in Fig.1a. The winter time was selected to ensure the absence of pollen. Backward trajectories have been checked and measurements with distinct aerosol layers were omitted. The mean PDR during normal days without influence of pollen or other depolarizing aerosols is 4±1%, which is smaller than during the pollen-influenced period. Also pollen-free periods during spring and summer time, which means no pollen have been counted by the Hirst-type pollen collector, have been checked and are shown in Fig1 b, c. The mean values of PDR during those periods was 3.5±1% in March/May and 3.9±1% in July/August. However, during spring and summer the absence of pollen in the atmosphere cannot be confirmed with absolute certainty even if there are no pollen collected by the Hirst-type sampler.

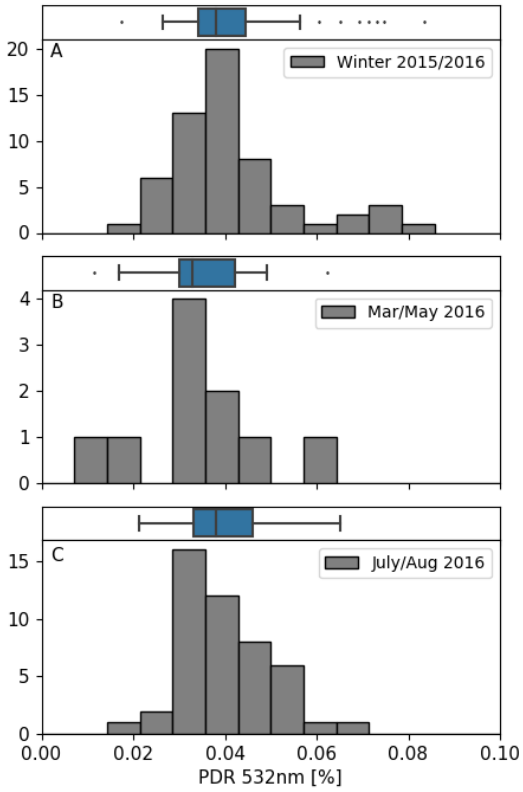

Figure 1 Histograms of mean PDR within the lowest aerosol layer during January 2015 and 2016 (A) and pollen-free cases during March/May 2016 (B) and July/August 2016 (C)

As the depolarization ratio of cases without detected pollen on ground-level or other depolarizing aerosol is below 4% and therefore significantly lower than during the presented pollination period, the particle depolarization ratio can be used to detect the presence of pollen in the atmosphere.
Information about background aerosol was added in section 4.2., as:

"*However the effect of the background particles has to be considered. Lidar measurements during the winter months of 2015 and 2016 and during pollen-free periods in spring and summer 2016 have been analyzed to determine the effect of background aerosol at our measurement site. During winter time the absence of pollen can be ensured, but there is a possibility that pollen also have been present in the atmosphere during spring and summer when no pollen were detected by the Hirst-type sampler on ground. Nevertheless, values of mean PDR at 532 nm are below 4% during all analyzed periods with no observed pollen concentration. Since the PDR during the pollination period is significantly higher than the PDR of the background aerosol, the depolarization ratio can be used as an indicator for detecting the presence of pollen.*"

2. Authors separated the layer as shown in Fig. 2. Only the lowest layer (black color) is considered in the study as mentioned in section 3. But, diurnal variation and maximum heights are different between two pollen period in Fig. 1 (c). In addition, the authors explained that the number of pollen grains is higher in the first period (5-9 May), but the degree of polarization extinction is higher in the second periods, which is explained by the high non-sphericity of spruce pollen. However, only explained reason in the paper is not sufficient. Therefore, it seems that data for other weather elements such as atmospheric boundary layer changes in each period should be added.

We checked the meteorological variation during our campaign. Mean values of the diurnal cycle of temperature and relative humidity at our measurement site 2 m above ground, during the first (green) and second (black) period are shown in Fig.2. Green and grey shaded areas indicate the variability during the two periods. The higher pollen concentration during the first period is likely related to the higher temperature and lower relative humidity during this period. In previous studies a correlation between pollen concentration and temperature and relative humidity has been shown. The different mixture of pollen types can be explained by the changing wind direction during the periods (see Fig.3). The most frequent wind direction in this first period was northwest. In the second period the air masses were mainly advected from southeast. The boundary layer height only changes slightly during the selected period and there are no significant differences between the two periods. A paragraph about the meteorological conditions during both periods is added in section 3, as:

"Those variations can be explained by the different meteorological conditions during the two periods. A big difference of the predominant wind direction in the two periods has been observed, which may cause the different mixture of pollen types. The most frequent wind direction in period 1 was northwest, whereas in period 2 the air masses were mainly advected from southeast. When comparing the diurnal cycle of temperature and relative humidity measured at ground level, we found higher temperature values and lower relative humidity in period 1 than period 2. Temperature and pollen concentration have been shown to be positive correlated whereas pollen concentration and relative humidity show a negative correlation (Bartková-Ščevková, 2003). The different pollen concentration could therefore be explained by variations of temperature and humidity."

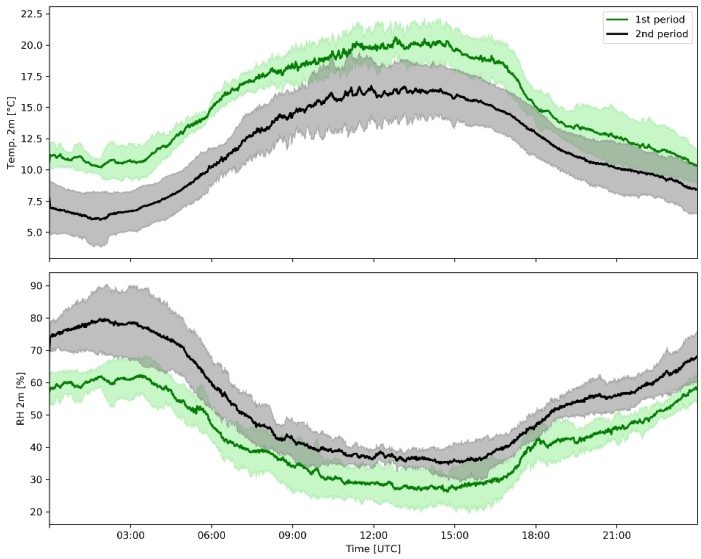

Figure 2 Diurnal cycle of mean temperature (top) and relative humidity (bottom) during the first period (green) and second period (black). The standard deviation is shown by the green and grey shaded area.

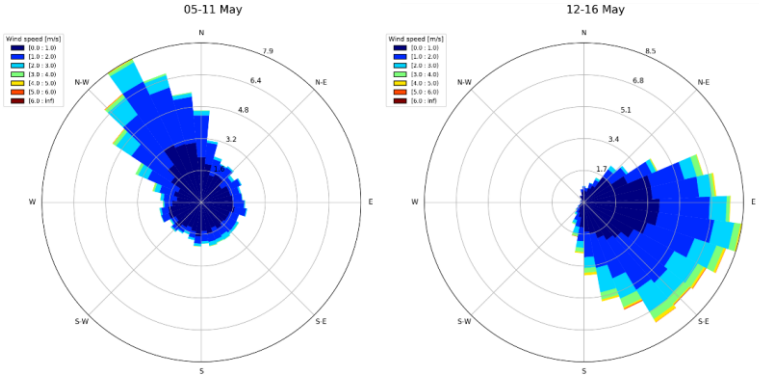

Figure 3 Wind direction during the first period (left) and second period (right).

Technical comments; 1. Page 3 line30: 10 l/min, change it as 10 L/min. 2. Page 5 line 9: fro m -> from 3. Page 8 line 9: please add wavelength for Angstrom exponent. 4. Figure 1 c. Is the scale is log scale for volume depolarization? If yes, could you change it as normal scale? The value of volume depolarization ratio is look too different between two periods.

Comments 1-3 are applied to the manuscript. We prefer to keep Fig. 1c in log scale, because the depolarization ratio, especially in the first period, is better visible as can be seen in the comparison between linear and log scale shown in Fig.4. However, we changed the color bar label of Fig.1c in the manuscript to make the log scale better recognizable.

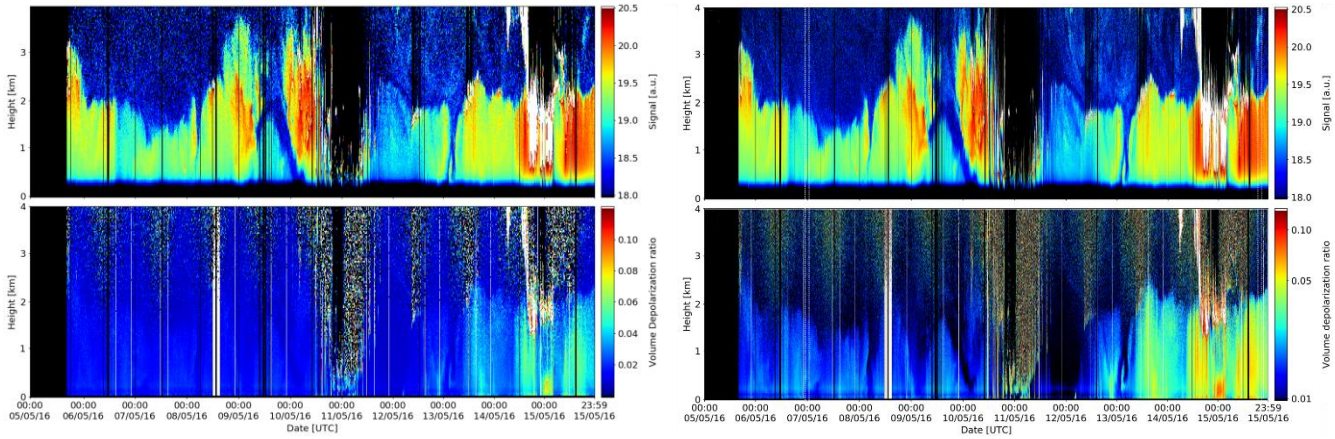

Figure 4 Comparison of Figure 1 without logarithmic scale (left) and with logarithmic scale (right).