

Response to comments by Prof. Wiegner

We would like to thank you for your comments and helpful suggestions. We revised our manuscript according to these comments and suggestions.

Question 1: For this reason the authors should not use terms as "aerosol attenuated backscattering coefficient profile" (e.g. 13174/9, 13178/24, 13182/19, 13190/27) or "vertical aerosol profile" (13177/23). Moreover, "aerosol concentration" (13177/28) is strongly misleading as only the particle backscatter coefficient (see Wiegner et al., 2014) as an optical property can be derived provided the signal has been calibrated.

Response 1: We really thank you for your suggestion. We have read your paper introduced in the comment. It is very important for us to improve the manuscript. As you said, the attenuated backscattering coefficient is not the same as aerosol concentrations, which is influenced by the water vapor absorption. Therefore, we have revised the in proper words in the manuscript according to your suggestions. The revisions mainly include removing the word "aerosol" and adding some descriptions about the observed deviations due to water vapor absorption.

The revision in the section 2.2 is as follows.

"Although aerosol concentration cannot be measured directly by a ceilometer (Wiegner et al., 2014), the attenuated backscattering coefficient is a good indicator of the aerosol stratification. However, uncertainties might occur in the attenuated backscattering coefficients measured by the lidar ceilometer, especially above the boundary layer where the aerosol concentration is low (Jin et al., 2015). In addition, the attenuated backscattering coefficients measured in the spectral region of 910nm are influenced by water vapor absorption, and the strength of the influence can be highly variable in time and space (Wiegner and Gasteiger, 2015). Therefore, the representativeness of the attenuated backscattering coefficient must be evaluated by comparison with other observations, and a good relationship indicates that the influence of water vapor absorption is negligible."

The revision in the section 3.2.1 is as follows.

"It is noteworthy that any comparison with other parameters (PM or AOD) cannot lead to full agreement as long as we cannot quantify the water vapor effect (Wiegner and Gasteiger, 2015). Even so, the significant correlations between the attenuated backscattering coefficients and concentrations of PM_{2.5} and the AOD showed that the vertical attenuated backscattering coefficient profile measured by the lidar ceilometer could accurately represent the vertical distribution of atmospheric aerosols in Beijing."

Question 2: Another issue is the "validation". As discussed in Wiegner et al. (2014) it is not possible to determine the particle extinction coefficient from data of a simple backscatter lidar or ceilometer. Thus, comparisons with independently determined AOD (here: microtops) suffer from the unknown lidar ratio. A good correlation between AOD and integrated backscatter (but see comments above!) can be

plausible but cannot serve as validation. By the way it is not clear what is meant by "AOD concentration" (13183/5).

Response 2: Thank you for your suggestion. Actually, validation is not proper in the manuscript. Therefore, we have revised it to “evaluation” because we want use it as an indicator of the aerosols. Otherwise, we revise “AOD concentration” to “AOD”.

Question 3: Finally, I want to mention that the abstract seems to be too long, and that in contrast to the text (13183/13) "variations" cannot be seen in Fig. 5. This figure should be explained in more details as it is surprising that such a smooth signal is obtained as an average of measurements: it resembles simulated idealized signals (see also Fig. 6a).

Response 3: Thank you for your suggestion. I have rewritten the abstract and delete the word “variations” in page 13183, line 13. Also, we have revised the word “decline” to “lapse rate” and the word “decreasing rate” to “lapse rate” for the title of Fig. 6 in the revised manuscript.

In addition, you are surprised that the signal of the backscattering coefficient is very smooth. Because the data are easily affected by noise and interference from the aerosol layering structure, time and space were smoothly averaged before the backscattering coefficients can be used to illustrate the vertical profiles. Therefore, we have added some descriptions in the section as follows. “To filter the noise of the observed data, 240m vertical, 1200 s time smoothly averaging was applied by BLVIEW software before analyses (Münkel et al., 2007).”