Answer to comment acp-2021-1015-CC1 from Albert Ansmann

The method we developed to correct for attenuation of the lidar signal inherently corrects for multiple scattering. The transmission is estimated based on the effective lidar ratio, i.e., the lidar ratio is multiplied by the multiple scattering factor, which then is multiplied by the multiple scattering-affected backscattering (eqn 2 in the manuscript). We have clarified this in the revised manuscript. Thank you, hopefully we have now expressed this clearer in the manuscript.

OMPS-LP data are corrected for multiple scattering by model calculation, the total radiance error is estimated to 1-3% (Loughman et al., 2015). Thank you for this comment, we have added this information in the revised manuscript.

We are aware of the results by Haarig et al. (2018) and Hu et al. (2019). At one point we considered to estimate the multiple scattering factor and the true lidar ratio. Based on their results and literature consideration we found that the multiple scattering factor was approximately 0.85. However, the lidar ratio varies both between smoke layers and in time, and we did not measure in the same air masses as Haarig et al. or Hu et al. nor could we undertake comparisons over time. Therefore, we could not justify the estimate of the lidar ratio and multiple scattering factor. Instead, we stayed with the effective lidar ratio. Estimation of the multiple scattering factor and the true lidar ratio did not affect the AOD estimated by our method, see the first section above.

We did not assume a clean Rayleigh atmosphere ($R = 1$) below the smoke layers. Instead, we used the scattering ratio beside the smoke layer to obtain an estimate of aerosol load surrounding the smoke layer. On average the scattering ratio surrounding the different smoke layers investigated was $R = 1.08 \pm 0.05$. We used that scattering ratio as the target value in the fitting of the effective lidar ratio.

Thank you for your comments. We found them helpful in clarifying the meaning of our results.

Loughman, R., D. Flittner, E. Nyaku, and P. K. Bhartia, Gauss–Seidel limb scattering (GSLS) radiative transfer model development in support of the Ozone Mapping and Profiler Suite (OMPS) limb profiler mission. Atmos. Chem. Phys., 15, 3007–3020, doi:10.5194/acp-15-3007-2015, 2015.