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Atmospheric Measurement Techniques Discussions

Interactive comment on "Profiling the PM_{2.5} mass concentration vertical distribution in the boundary layer" *by* Z. Tao et al.

Anonymous Referee #2

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General comments:

The manuscript presents a methodology and case study for profiling PM2.5 mass vertical distribution in the planetary boundary layer (PBL) using a CCD lidar and PM2.5 sampler. This subject is quite interesting to the air quality modeling and lidar remote sensing communities because there is lack of direct measurement of PM2.5 vertical profile by EPA and other agencies. The ratio of aerosol extinction to PM2.5 mass (or K) and its height dependence are critical in this study. Authors estimate the ratio K at the ground level with the RH<70% and then convert the aerosol extinction profile to PM2.5 mass profile in the PBL with an assumption of constant K. Three cases show a stable value of the ratio K over the nights, however the potential uncertainty or variation of the ratio K with altitude is not discussed except the RH effect. In addition, the validation

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on the CCD-lidar retrieved extinction or PM2.5 profile is not discussed or shown. The method might work in the well-mixed PBL where the aerosols are relatively homogenous. Overall, this manuscript is within the scope of Atmos. Meas. Tech. and can be accepted for publication once the following specific comments are taken into account.

Specific comments:

1.The potential uncertainty or bias of the CCD-lidar retrieved aerosol extinction is not discussed or presented. The validation of the CCD lidar retrievals with a Raman lidar or other ground in-situ measurement might be useful to evaluate the errors or bias of the CCD-lidar retrievals.

2. The height dependence or variation of the ratio of aerosol extinction-to-PM2.5 mass (or K) is critical to the accuracy of PM2.5 mass concentration profile. An assumption of homogenous microphysics (size distribution) and chemical compound (refractive index) of aerosols in this study is quite arbitrary for the night-time PBL due to the weak turbulence mixing or even in the day-time (see the varied aerosol sizes from the aircraft measurement by Li, et al., 2015). Thus, authors need to point out this limitation or/and show further discussions or evidences for this assumption.

3. There are a few measurements of aerosol hygroscopic factor f(RH)of scattering coefficients in China (see the reference by Chen, et al., 2014; Zhang, et al., 2015). It seems that the f(RH) is in the range of 1.2-1.4 at RH=70% which is still big.

4. For the case results in this study, if possible, the relative humidity (RH) profile needs to be shown from the measurements from either radiosonde, Raman lidar or microwave radiometer.

Some minors:

1. Line-49, pleas add “in diameter” in the definition of the PM2.5.

2. Line-59, “were” should be “was”.

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3. Line-117, what is the parameter “D”?

4. Lines 180-183, please add the reference for this point.

5. For the three cases, why is the distance D between the laser beam and CCD camera set to be different?

6. Line 171, Eq.(7) is an approximate formula in which Qext is assumed to be a constant. This is fine for a single particle, but for all different sizes of aerosols in the atmosphere Qext is a function of aerosol radius and refractive index.

References:

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