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Atmospheric Measurement Techniques Discussions

Interactive comment on "Tracking of urban aerosols using combined lidar-based remote sensing and ground-based measurements" *by* T.-Y. He et al.

Anonymous Referee #2

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This paper describes how combining surface point measurements with active remote-sensing instruments can provide the information required for monitoring air quality in urban areas, which, as shown in the examples given in this paper, can be highly variable both spatially and temporally.

The case studies presented in the paper show the potential of scanning lidar for mapping such a heterogeneuous environment, and how the two-dimensional scans can help place individual surface point-based measurements in their true context.

The methodology presented in this paper is accurate and relevant, and the figures clear

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Interactive Discussion

Discussion Paper

and appropriate. One minor criticism is that, although the assumptions made at each step are correctly described, the uncertainties that are introduced are not necessarily carried through to the final stage. Firstly, it is not made clear whether the surface point-based in-situ measurements of PM10 are being compared to lidar extinction values from a point 200 m directly above the in-situ measurements, or from a path-integrated value of lidar extinction. This distinction is important for understanding Fig 8 (see next point).

Secondly, the uncertainty stated in the lidar extinction is for the path-integrated value, not for an extinction value at a single point. The uncertainty in extinction at a single point will be much higher, and, given the variability in backscatter shown in the lidar PPI sector scans, there is also potential for the lidar ratio (the relationship between lidar backscatter and extinction) to also vary.

Comparing the lidar-derived extinction coefficients to the PM10 concentration is certainly valid, but the error bars are probably wider than those shown in Fig 8. and, if it is true that this figure is comparing in-situ point measurements to path-integrated values, then it may not be surprising that the correlation coefficient is not that high, since Fig 5 shows how variable the aerosol emission appears to be.

For the scientific community (and for potential operational monitoring), an assessment of the uncertainties in the retrieval is crucial. Overall, this manuscript is appropriate for publication, providing the authors address the issue of the uncertainty in their retrieval, and whether they are comparing point sources of PM10 measurements to point-based or path-integrated values of lidar extinction.

Specific Comments

p 6388 line 19. The introduction could expanded slightly, to include some of the many advances made in the scientific understanding alluded to in the opening line. Please also include a few references to recent research on the radiative and microphysical impact of particulate matter in the atmosphere; for example, the impact on clouds!

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p 6389 line 10. Update references! Again,there is a huge amount of recent research on the use of lidars in this area.

p 6389 line 15. As an example, 'traditional micro-pulse lidars' do provide high temporal resolution if required, certainlyhigher than the temporal resolution discussed here (150 shots gives a temporal resolution of 15 seconds per line-of-sight-profile). I agree that they have not yet been routinely used for scanning purposes though.

In section 2.1 you should complete the details of the lidar setup. For instance, where is full overlap of the laser beam and telescope achieved? Figure 4 suggests that full overlap does not occur until about 700-800 m. Is any attempt made to apply an overlap correction for data closer to the lidar? Or is this regarded as a 'blind zone' for the instrument?

p 6392 equation 1. The character 'C' is what is commonly used in the literature to represent the lidar system constant. This avoids any potential conflict with some authors choice of k for the lidar ratio (although S is preferred for the lidar ratio when in units of sr).

p 6392 line 17. The range resolution is no longer really 3.75 m after such a smoothing. p 6392 line 22. What is the resolution of the Cartesian 2-D grid that the data is interpolated to?

p 6393 equation 2. P_bg is not defined

An additional assumption is that the lidar ratio is constant over the entire profile path (fig 4). Is this likely if you have localized point sources, and/or gradients in relative humidity (for RHIs)? I understand that it is difficult to account for the variability in the lidar ratio along an individual profile, but this should still be discussed as a potentially significant source of error, even in those cases which do not appear to show such variability. This would manifest itself as uncertainties in the derived lidar extinction.

p 6398 line 21. Why necessarily constrain to zero, if other scatterers could be respon-

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sible for the residual (for example PM2.5 only), and you have no measurements above the surface to discern whether there has been particle growth?

Technical and typographical corrections.

p 6388 line 7. Suggest that you modify sentence to 'Based on the data we collected..

p 3688 line 10. Suggest that it is probably safer to say ', which are associated with the presence of point sources..'

p 6391 line 12. Suggest that you modify sentence to 'In this study, only the infrared channel was used, to minimize the amount of molecular scattering relative to particultae scattering'

p 6391 line 24. Suggest that you modify sentence to 'a busy road'?

p 6397 line 3. Suggest that you modify sentence to 'result in the appearance of prominent ..'

p 6397 line 9-10. Suggest that you modify sentence to 'In addition to the exhaust emissions, road dust picked up and injected into the boundary layer by vehicles may also be responsible for the concentration increase.'

p 6397 line 15. 'heating season'? Do you mean the 'winter season'?

Figs. 2 and 5. There is no mention of what is actually being plotted in these figures. There are no units for the colour scale axis. I assume this is just lidar signal and the units should be AU (arbitrary units), is it linear or logarithmic? Has the signal been range corrected?

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 6387, 2011.