**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "Assessment of vertically-resolved PM$_{10}$ from mobile lidar observations" *by* J.-C. Raut and P. Chazette

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Response to reviewer3

The authors appreciated the comments of reviewer3 that help to improve our manuscript. Please find a point-by-point discussion and answer of the issues raised by the reviewer.

1/ The definition of Paris Peripherique has been clarified: it is indeed a highly trafficked beltway around Paris. The authors agree that the first sentence can be confusing about the objectives of the paper. The goal of the paper is to investigate vertical PM10 distributions from mobile measurements carried out from locations along the Peripherique,

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to examine distinctions in terms of aerosol concentrations between the outlying regions of Paris and the inner city and to discuss the influence of aerosol sources, meteorology, and dynamics on the retrieved PM10 distributions.

2/ The approach used to compute the uncertainties on k parameters is given in Eq. 3. Hence the relative uncertainty on k depends on the uncertainties on the single-scattering albedo (3%), on the Angström exponent (3%) and the slope C0 of the regression analysis between the scattering coefficient and PM10 concentration. The latter varies with the type of aerosol. According to Fig. 2, it has been assessed to 10% for urban and periurban aerosols and 25% for rural aerosols. The global relative uncertainty on k is thus 12% for urban and periurban aerosols and 26% for rural aerosols.

The authors agree with Reviewer3 that the uncertainties in the nephelometer measurements and in the humidity corrections do not explicitly appear in the manuscript. However, these uncertainties have been taken into account in the calculations. Indeed, the uncertainty $\delta C0$ on C0 depends on the uncertainties in the PM10 concentrations and in the aerosol scattering coefficient at 700 nm measured by the nephelometer. Uncertainties on the relative humidity corrections are not taken into account in the computation of k1 and k2 constants since Eq. 1 and Eq. 5 are determined for dry aerosols. But these uncertainties influence the uncertainties on the dry PM10 concentrations retrieved from the lidar-derived aerosol extinction coefficients that have been adjusted from relative humidity. Finally, taking into account the uncertainties in the extinction coefficient, relative humidity, k constant and in the choice of k, the global uncertainty on the lidar-derived PM10 is 25 % (see reply to Reviewer2).

3/ Sunphotometer data were actually taken from a stationary site located in Paris or in Palaiseau depending on the considered campaign.

Dependence of the BER on the aerosol type:

The column-averaged BER has been determined from coincident lidar and sunpho-

tometer data for both urban aerosols during LISAIR (Raut and Chazette, 2007) and periurban aerosols (Chazette et al., 2005; Raut and Chazette, 2008a) during ESQUIF. In both cases, BER has been assessed to be 0.011 +/- 0.002 / sr at 355 nm whatever the meteorological conditions were. The only case when the influence of the aerosol type on the BER value was not negligible is on the 26 and 27 May due to a dust episode. In that particular case, BER has been calculated in the dust layer: we found 0.020 / sr (P 13495, lines 4-7).

Dependence of the BER on the relative humidity:

This has been fully investigated in a previous paper from the authors (Raut and Chazette, 2007). BER has been computed as a function of RH through a Mie code using the complex refractive index and the size distribution, both dependent on RH. The result of this previous study performed during LISAIR experiment highlighted a variability of the BER at 532 nm lower than 10 % when RH increased from 20% to 70%. But the variability of BER over the same range of relative humidity decreased down to 0.5 % at 355 nm. It is due to a compensation between the changes in the single-scattering albedo and in the backscattering phase function with RH. During the mobile lidar measurements, RH exceeded the deliquescence point only during the night of 26-27 May when RH was in the range 65%-70% at the surface and in a layer located between 2.5 and 3 km height. Hence, the extinction profiles computed using the constant BER estimate do not have any systematic errors due to differences in water uptake of aerosols in the profile.

4/ The instruments located in the periurban sites (Palaiseau and Saclay) have measured an aerosol far from the sources that has had time to age. Assuming that aerosols in the residual layers are periurban is suggested by the fact that those layers are mainly composed with aged aerosols trapped in altitude during the erosion of the boundary layer in the evening. Hence, the difference between the layers is expressed in terms of aging rather than in terms of location.

5/ This is a mistake on the altitude region. The sentence has been corrected as follows: the aerosol extinction coefficient nevertheless shows unexpected large values in the free troposphere all day long and higher values at 3 km from 15:00 UTC. Fig. 9a has been labelled in UTC time.

6/ PM10 concentrations given by layer in Table 3 and discussed in Sect. 5 are layer and time-averaged values.

Concerning the discussion about the discrepancy between lidar-derived PM10 concentrations and ground-based measurements, this has been discussed in replies to Reviewer1 and Reviewer2. The overestimation observed at Les Halles station can be explain by the fact that this is actually a site representative of Paris background, contrary to what is observed in traffic stations (Bd. Auteuil, Pl. Victor Basch and Champs-Elysées). It is worth noting that lidar-derived mass concentrations generally overestimate PM10 values reported on Paris background stations, but underestimate measurements obtained in traffic stations. This can be explain by the fact that lidar measurements are performed over Paris highways and in traffic conditions but, due to the overlap factor, only values above 200 m are given in this study. At this altitude, pollutants have had time to be slightly diluted along the vertical and their concentrations have therefore decreased.

The vertical variability observed in the scanning lidar measurement was due to variability in aerosol loading and not due to the variability in RH with altitude (see Answer n°3).

Please also refer to the discussion on Sect. 6 detailed in the comments to Reviewer1.

Technical corrections.

All the technical corrections have been done.

The black line circling Paris on the maps is the geographic demarcation of Paris city.

Showing the line for the Peripherique has not any interest since it would be exactly superimposed with the route taken by the mobile lidar.

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