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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Dispersion of traffic-related exhaust particles near the Berlin urban motorway: estimation of fleet emission factors" *by* W. Birmili et al.

**W. Birmili et al.**

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Thank you for your comments to the manuscript. For clarity, your statements will appear in italic face, and our response in standard face.

*In section 2.3 the used particle measurement method is described. For SMPS measurements at the roadside site with certainly highly varying particle size distributions it is advantageous (or necessary) to use a buffer volume at the entrance of the instrument. Otherwise, the measured total particle number concentrations can systematically be too low and the size distributions can be biased. It seems from the text that no buffer volume was used. This issue should be discussed, it should be mentioned what effect on the results can be expected from not using a buffer volume.*

On the one hand, a buffer volume will smooth out temporal variations in the ambient aerosol, on the other hand a buffer volume will cause additional losses. Since we used no buffer volume, we only need to discuss the first issue. We understand the comment of the referee so that he/she is interested in possible effects that fluctuations in the ambient aerosol will have on the mobility distributions recorded, and on the inverted size distributions. A proper answer would require a comparison experiment using two equivalent SMPS instruments, one connected to the buffer, the other not. Such data are available to us for a different measurement site (Leipzig, Eisenbahnstrasse street canyon), but not in the proper shape from which useful conclusions could be made with respect to the Berlin experiment.

As a solution we carried out a sensitivity analysis, based on a typical raw mobility distribution recorded at Leipzig-Eisenbahnstrasse. (For the Berlin site, the raw data are not available, because it was a TSI SMPS which measured these data. By default, the instrument software only delivers inverted size distribution data.). The average raw mobility distribution of Leipzig-Eisenbahnstrasse (see Klose *et al.* (2009) for typical data from that site) was altered by a sinusoidal noise with random phasing. That noise had an amplitude of up to 60 per cent of the average size distribution and period times between 30 sec and 2 min, at a measurement time of 10 min. We believe that this kind of noise is representative of what we encounter in a measurement system near roadside. Fifty raw spectra were thus randomly generated, and subsequently inverted by the multiple charge algorithm. As a matter of fact the average of these inverted spectra closely resembled the inverted spectrum of the original raw mobility spectrum. In summary, using a buffer volume or not has no significant influence on the resulting inverted size distributions as long as we are talking about averages of 50 spectra or more.

These results were summarized in a new paragraph in the end of Section 2.3. (Particle mobility spectrometers): “In the field, none of the instruments was equipped with an inlet buffer volume. The lack of such a buffer volume may hypothetically cause



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the measured size distributions to diverge systematically, since the ambient aerosols at roadside tend to fluctuate much faster than a size distribution measurement cycle (4 min). To assess this issue, a sensitivity analysis was carried out by modulating random oscillations onto the raw mobility distributions before the multiple charge inversion. Fortunately, we found that the oscillations did not change the mean values of the inverted particle size distributions by more than 2 % based on a sample number of 50. In conclusion, statistically averaged size distributions are subject to minor changes only by the choice of using a buffer volume or not."

Klose, S., W. Birmili, J. Voigtländer, T. Tuch, B. Wehner, A. Wiedensohler, and M. Ketzel. Particle number emissions of motor traffic derived from street canyon measurements in a Central European city. Atmos. Chem. Phys. Discuss., 9, 3763-3809, 2009

*Page 15551, last sentence: This sentence is unclear to me because equations (1) and (2) describe the dependence of u* and c* on U and Q, so why is it important to assume independence. This should be clarified.*

The entire section of text was clarified. In fact, the statement you mentioned was misleading, so we dropped it here.

*Minor comments*

A consistent notation for the two vehicle classes is now used throughout the MS (lorry-like vehicles and passenger car-like vehicles). All other formal errors were also corrected according to your suggestion. Thank you for your patient reading.

*Page 15561, Discussion: It is mentioned that it is a useful byproduct of the method, that "the 3-D simulation pictures the impact of traffic emissions in the surroundings of the motorway". This could be more exploited in this study, e.g. some brief analysis of the small-scale variability of the particle number concentrations could be included.*

We added the following sentence in the presentation of the modeling results (Now



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Sect. 5.1.): “Under southerly and northerly wind directions (0 and 180 degree), the model predicts the highest tracer concentrations directly over, and adjacent to the motorway, which is straightforward from its north-south alignment. Under easterly winds (90 degree), areas to the west of the motorway are affected by the motorway plume. The most complicated situation occurs under westerly winds (270 degree) where both areas upstream and downstream of the motorway show high concentrations of traffic tracer. A vertical cross-section in east-west direction (not shown) reveals a vertical vortex behind the tallest building block, associated with small wind speeds and low exchange conditions.”

*Fig. 12: Label of y-axis is wrong, should be dE/dlogDp rather that emission factor E.*

This was corrected as well.

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 15537, 2008.