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Interactive comment on "Atmospheric number size distributions of soot particles and estimation of emission factors" *by* D. Rose et al.

D. Rose et al.

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We would like to thank the referees for the constructive comments on our manuscript. We answered all of their questions and made a few additions to the paper in which we clarified some things. In the following, the referees' comments are summarized and discussed separately.

Response to Anonymous Referee 1

Minor Comments:

(1) p. 10130, l. 5: IfT is correct, because Melpitz is a research station of the IfT
(2) p. 10130, l. 28: correct comment; we added the definition of "DMPS" to the paper

Major Comments:

(1) Losses in the inlets and inside the VTDMA: Losses in the inlet system can be neglected, because in the measured size range of 30 to 150 nm losses neither due to diffusion nor due to impaction are significant. The losses inside the VTDMA were calibrated before the campaign and have been included in the data inversion. The calibrations showed that below a particle diameter of 12 nm 50% of the particle number is lost in the system due to thermophoresis and diffusion. That is why we decided to consider only particle cores of larger than 12 nm to minimize uncertainties in particle number. We did not find it so important to add the results of the calibration in the text, because the explicit data inversion was not the main objective of the paper.
(2) Why did we not use temperatures higher than 300°C in the VTDMA?: According to Cachier et al., 1989 and also according to Philippin et al., 2004 - a study in which the VTDMA setup, operation, and data analysis is described in more detail - an operating temperature higher than 300°C requires the use of a non-oxidative carrier gas to avoid artifacts due to charring of organic substances in the particles. Using such a gas was not possible during the measurements. We added this explanation to the text.
(3) More information about the dilution function F: A more detailed description of F will be included in the paper.
(4) p. 10137, l. 17: Correct comment from the referee, the formulation was changed.

Response to Anonymous Referee 2

Major Comments:

(1) Conclusion of that measured soot fractions can be seen as standards (p. 10142, l. 13-15): The conclusion has been softened.
(2) When did the campaigns take place?: The IfT summer campaign for soot particle measurements took place in July 2003, which was during the summer holidays. The summer campaign in EI was in late August and in September 2003, which was no

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holiday time. For calculating the emission factor a comparison between IfT and EI measurements was needed. One of these periods was within the summer holidays the other was not. One could think that this difference might have an impact on the emission factor calculation, but it is more important that the background number size distribution (from DMPS) was similar in both periods (and this was confirmed in the paper). The period, when the traffic counts were used was in November, which was also not in a holiday period and matches therefore the non-holiday time of the EI campaign. The winter campaigns took place in November 2003 in the EI-site and in December 2003 in the IfT-site. The measurements in Melpitz were in July/August 2003 and in February/March 2004. Some of these periods contained holiday- as well as non-holiday-times. In the background stations (IfT and ME) no significant difference could be observed. In the street canyon (EI) it is likely to see differences, but we did not see, because we measured only during non-holiday periods.

(3) Extrapolation on annual/seasonal basis should be avoided: In the paper it is clearly said that the individual measurement periods spanned four weeks on average. The presented values for e.g. the soot fractions are of course measured during these short periods and do not give averages for the whole season. The denotation "summer" and "winter" was only chosen to distinguish between the different campaigns in summer and winter.

(4) Are the differences in the soot fractions significant?: The mentioned values for soot fractions in different seasons and at different sites are measured directly by the VTDMA. No DMPS data is required to calculate them. So, the only variance of these averages comes from the VTDMA measurements itself and they are show in figure 2. According to the error bars, which correspond to the 25%- and the 75%-percentiles of the soot fractions, we would say, that the averages are significant.

(5) Different average emission factors: The emission factor written on p. 10138, l. 14 ($4.9 \cdot 10^{14} \#/(km \cdot veh)$) is the value calculated for the *total* particle number. The emission factor mentioned on p. 10139 l. 27 as well as on p. 10142 l. 1 ($(1.5 \pm 0.4) \cdot 10^{14} \#/(km \cdot veh)$) is for the *soot* particle number. The total particle

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emission factor was only calculated to confirm the calculations and was therefore not repeated in the conclusions.
(6) Mode of the soot emission size distributions: We also expected a different mean diameter of the soot modes of different vehicles, but we did not see any.
(7) Question to Fig. 7: During the nights, the number of vehicles in the street is much lower than during daytime, so the ratio of heavy-duty vehicles to passenger cars is not as stable and representative as during daytime. Furthermore, the instrument, which counts the vehicles, is an optical counting system and does not work so well during darkness. So, the number of vehicles during the night has only limited reliability. Therefore, when calculating the average emission factor, only the values between 8:00 and 20:00 were taken into account. We added a note concerning this error to the paper.
(8) Data from Saturday: The vehicle number and fleet on Saturdays are different from that on weekdays or Sundays, because Saturday is not a regular working day. So, the peoples moving behavior on Saturday is neither similar to that on weekends nor to that on Sundays. Therefore, also the number of soot particles differs on Saturdays. Thus, the data from Saturdays were omitted, because for us it was enough to show a represent behavior for working and for non-working days (with a minimum in heavy duty).

Minor comments:

(1) p. 10133, l. 15: We deleted the word "probably".
(2) Fig. 4: The uncertainties have been left out, because otherwise it would be difficult to spot all four averages.

References:

Cachier, H., Brémond, M.-P., and Buat-Ménard, P.: Determination of atmospheric soot

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Interactive comment on Atmos. Chem. Phys. Discuss., 5, 10125, 2005.