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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Black carbon measurements in the boundary layer over western and northern Europe" *by* G. R. McMeeking et al.

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Review of McMeeking et al. ACPD, 2010

Referee general comment:

Black carbon (BC) aerosol, a by-product of incomplete combustion, is a strong absorber of visible solar radiation, thus it affects regional and global climate by direct and indirect effect. There is still a lack of information about spatial/vertical distribution and size distribution of BC. Using a single particle soot photometer (SP2) and other filter-based absorption measurements this study provides first such information over Europe, which is useful to estimate climate impacts in this region. The paper fits well within the scope of ACP, is clearly written and addresses an important topic. I recommend it for

publication after the following comments and suggestions for correction/improvement have been addressed.

Major comments:

1. Throughout the manuscript the authors claim that filter-based methods have a number of artefacts and much less sensitive than SP2. Please specify and discuss more about what artefacts they are and why these artefacts tend to lead overestimation of absorption measurements as shown in Figure 6.

2. Please estimate the uncertainty of the derived BC core diameter. This is important as authors discuss the small shift of mass median diameter of BC. In this study Aquadag carbon particles were used as standard to calibrate LII detectors of SP2. The calibration line of LII detectors may change depending on the type of BC, as emissivity and shape of the particle are different (Shiraiwa et al. 2008). If the ambient BC has different characteristic (emissivity, shape) from Aquadag, this will lead to some uncertainties. Please discuss this point in the paper.

3. The detection limit of BC is reported to be 0.2 fg, which is much better than previous studies. The authors mention that the detection efficiency drops below unity for masses below 0.7 fg. Do authors have any idea of detection efficiency in this mass range? Do LII signals for such small particles, which are close to detection limit, still show triangle shapes (which means BC evaporates completely in the laser beam) or are the signals distorted?

4. Dust can also contribute to the absorption measurement of PSAP, whereas SP2 are insensitive to dust. The large mass absorption efficiency of 18 – 39 m2/g might be due to the contribution of dust. Do authors have any information about dust? At least this should be discussed in the paper. The authors claim that the limited detection range of SP2 (55 - 400 nm) can be one of the reason, but they also say that the scaling factor ranges only 1-1.2, which cannot explain the factor of 2 -3 difference.

5. It is interesting to see the systematic decrease of BC mass mean diameter (Dgm) with altitude (Fig. 5c). The authors speculate that the main reason is the BC removal by cloud and precipitation scavenging. In section 3.1, however, authors mention that the ADIENT flights were conducted under conditions with clear skies and little influence from precipitation and loss of BC in precipitation scavenging is minor.

Minor comments:

- L20, P13799, Please provide a reference for '. . . have been shown to be independent on the BC mixing state [reference]'.

- L25, P13802: Please explain briefly about the approach given by Bond et al. (1999).

- L18, P13804: Please provide a reference for aerosol particle mass analyzer, which is not a common instrument.

- L14, P13806: Please provide a reference for BC density of 1.8 g cm-3.

- L16, P13806: Please explain briefly about the recommendations of Schwarz et al. (2010).

- L1, P13824: Please add (McMeeking et al., 2010).

- I would suggest summarizing obtained and reported mass absorption efficiency in table, but this is up to authors.

- L1, P13827: Petzold et al. (2008) shows that the diameter of the ship emitted particles is small (D < 0.3 um).

- Figure 6: Is this PSAP one wavelength PSAP (567 nm)? Did authors compare also with 3-wavelength PSAP measurements?

- Figure 6: What are the slopes if y=A*x are used instead of y=A*x+B to fit the data?

- Figure 9: Why did authors normalize mass size distribution? I want to rather see non-normalized mass size distribution (dM/dlogD, ug/m3).

- McMeeking et al. (2010) is missing in the reference list.

References:

Petzold, A., Hasselbach, J., Lauer, P., Baumann, R., Franke, K., Gurk, C., Schlager, H. and Weingartner, E.: Experimental studies on particle emissions from cruising ship, their characteristic properties, transformation and atmospheric lifetime in the marine boundary layer, Atmospheric Chemistry and Physics, 8, 2387-2403, 2008.

Shiraiwa, M., Kondo, Y., Moteki, N., Takegawa, N., Sahu, L. K., Takami, A., Hatakeyama, S., Yonemura, S. and Blake, D. R.: Radiative impact of mixing state of black carbon aerosol in Asian outflow, Journal of Geophysical Research-Atmospheres, 113, D24210, 2008.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 13797, 2010.