

Author reply to Review by Anonymous reviewer:

We thank the reviewer for his/her valuable comments which improve the clarity and the exactitude of the manuscript.

Referee comments are repeated in black font, author replies are given in red font.

Overview

In this study the authors report very interesting ground - based measurements of aerosol hygroscopicity and black carbon (BC) properties during wintertime in Paris. BC properties are analyzed as a function of aerosol source and air mass type. The authors find that BC originating from traffic was non - hygroscopic and does not show a coating while biomass burning aerosol is slightly more hygroscopic with a medium coating thickness and a larger mean BC - core diameter. The largest coating thickness and largest growth - factors are reported for aerosol originating from Eastern Continental Europe.

In this study an interesting data set of quality - controlled aerosol measurements is presented. The structure of the manuscript is reasoned and the paper is well - written. However, the manuscript is full of acronyms of instruments and campaigns that can hardly be avoided. I would recommend to avoid too many acronyms in a publication if the reader might be overwhelmed by so much capitalised material. For example, I did not remember at this point what a COA is.

As mentioned, it is hard not to use campaign and instrument acronyms. We tried to only define acronym reused later in the text.

I recommend this manuscript for publication in ACP after the following minor comments have been addressed:

Specific comments:

Use of the term “biomass burning” in this study: Please define how the term “biomass burning” is used in this study. Do the authors refer to emissions from the burning of living dead vegetation (boreal/tropical forests, savannas, agricultural land) or do they rather refer to the emissions from residential heating or something else?

The term biomass burning used here refer to both the burning of living dead vegetation and residential heating since the PMF analysis applied to the HR-ToF-AMS data did not allow the discrimination of 2 separate BBOA factors in this case.

p. 25122, l. 17: Coating thickness of ~ 2nm: How meaningful is this number given the uncertainty of ± 10 nm reported in section 2.3.1.

This is a very valid point. The following sentence was added:

“This number is below the previously defined detection limit of 10 nm and will therefore be reported as such.”

And the value in table 1 was changed to “below LDL”

p. 25122, l. 23: Please define D0.

Done

p. 25123, l. 1 : What is a boxdetectable BC core? Please clarify.

It was a typo. It has been changed to detectable.

p. 25124, l. 4: “primary organic matter (POM)”. Has already been defined on page 25123

It has been removed.

p. 25124, l. 3: “In Paris, the smaller EC- containing particles ($D_{va} \leq 400$ nm) were mainly externally mixed, indicating local or regional sources, while bigger EC- containing particles ($D_{va} \geq 400$ nm) were mainly internally mixed with nitrate compounds, indicating medium to long range transport.”

Results should not be presented in the introduction.

We believe that it is important to summarise the conclusions from previous publications in the introduction in order to identify the gaps that the current study addresses.

p. 25128, l. 5: remove “and“

Done

p. 25129, l.4: bias or uncertainty?

A systematic bias would be introduced if a wrong coating refractive index would be used.

p. 25129, l.12: “(...) long wavelength (...)”add: compared to the size of the BC particles

Done

p. 25129, l.21: “(...) while single particle data can have even more negative values due to random noise (as seen in Fig. 10). Please give a little bit more detail, since this might not be clear to non SP2 users.

The SP2 is a single particle instrument. Each particle is detected using 4 detectors. The signal of each detector will be associated to random noise depending on the noise of each detector and their calibrations. The signal / noise ratio for each particle will then depends on this random noise, the size of the whole particles and the mass equivalent diameter of the rBC core contained in this particle. As a result, the amount of coating determined for each particle can be associated with noise greater than the +/-10nm described at $\Delta_{coat} = 0\text{nm}$ and for a rBC core mass equivalent diameter of 200nm.

We believe adding such detail to the manuscript is not necessary since it is rather technical. However, we added two references after the sentence for the reader. It reads now:

“Systematically negative coating thickness values within this tolerance are thus not a concern, while single particle data can have even more negative values due to random noise (as discussed in Sect. 3.3.3). A more detailed discussion on the uncertainties associated to the coating thickness is available elsewhere (Schwarz et al., 2008b; Laborde et al., 2012b).“

Schwarz et al. (2008): Measurement of the mixing state, mass, and optical size of individual black carbon particles in urban and biomass burning emissions, *Geophys. Res. Lett.*, 35, L13810, doi:10.1029/2008GL033968

Laborde, et al. (2012) Single Particle Soot Photometer intercomparison at the AIDA chamber, *Atmos. Meas. Tech.*, 5, 3077-3097, 2012, doi:10.5194/amt-5-3077-2012.

p. 25129, l.23: with above assumptions. add “the” between “with” and “above”

Done

p. 25129, l. 18: “Briefly, sizing differences between the first and second DMA are corrected for with dry measurements of ambient air.(...)” please give more detail

A full description of the data inversion and correction is available elsewhere:

Gysel et al. (2009). We believe that going into more details about the well-established data correction of the HTDMA would dilute the message of the manuscript.

Gysel, M., McFiggans, G. B., and Coe, H.: Inversion of tandem differential mobility analyser (TDMA) measurements, *J. Aerosol. Sci.*, 40, 134–151, 2009. 25130

p. 25129, l. 22: TDMA_{inv} HTDMA_{inv}??

TDMA_{inv}. This algorithm is suitable for different kinds of TDMA systems.

p. 25131, l.22: “C = 4.2 (...)f =1.3” define “C” and “f” and give more detail.

We also believe that a full explanation of the aethalometer correction if available somewhere else and that giving more information about it will disturb the reader and dilute the message of the manuscript. The reference to Weingartner, 2003 is given in the current manuscript for the reader to find more information if necessary.

p. 25147, l.11: “brush fire” bush fire?

It is mentioned as brush fire in the publication.