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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Atmospheric black carbon and warming effects influenced by the source and absorption enhancement in Central Europe" *by* S. Nordmann et al.

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Specific Comments

1. *I think it is better to use EC, BC and soot carbon consistently*

   To make use of the EC/BC/C_{soot} consistent in the manuscript, we read the manuscript carefully again and modified:

P. 14652 line 5: BC modified to EC as EUCAARI emissions are for EC.
P.14641 line 3: BC modified to EC as EUCAARI emissions are for EC.
P.14641 line 10: BC modified to EC as EUCAARI emissions are for EC.
P.14644 line 21: deleted BC and added on P.14644 line 22 . . . aerosol inventory for EC, which was. . .
P.14645 line 6 and line 8: BC modified to EC
P 14648 line 9: EC modified to BC
P 14651 line 25: BC modified to EC
P 14652 line 1 and line 5: BC modified to EC
P 14653 line 5, line 11, line 19, line 23: BC modified to EC
P 14659 line 27:BC to EC
P 14660 line 6, line 16, line 18: BC to EC

Figures and Tables:
Table 2: Modified BC to EC, as we are talking about emissions.
Figure 1: BC modified to C_{soot}
Figure 2: BC modified to EC for EUCAARI and BC for MICS
Figure 3: . . .comparison between measured Csoot and modelled BC. . .
Figure S1: . . .modelled BC and observed Csoot mass concentrations. . .

2. *Model runs R1, R3 and R4 come all of a sudden on page 14647. It is better to first introduce Table 2 and provide some descriptions of these model runs.*

Thanks to the reviewer for pointing this out. Since here we only discussed base model run (R1) and other sensitivity run will only come afterwards with some background information why we did those emission scaling, it is hard to introduce

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all the runs here at one time in Table 2 in the current context. To clarify the information, we refer the R1, R3 and R4 to Table 2 at this point in the revised manuscript.

P.14647 line 11 as ”for model base run (R1, see Table 2)”
P.14647 line 21-22 as ”(R3 and R4 refer to additional sensitivity model runs with scaled emissions as described in detail in Sect. 3.1.5 and Table 2)”

3. *The Lines 9-12, page 14649, suggest the authors explain why PM10 is overestimated in the western part and underestimated in the eastern part, and why this is especially true for the continental time period.*

During the first half of the modelled time period there where mainly maritime air masses from western and north-western directions. The overprediction of PM10 by the model, especially for locations not far away from the sea, may be attributed to an overestimation of the sea salt emission calculated in the WRF-Chem module. Zhang et al. (2013) also found an overestimation of PM10 for several European observation sites and attributed this to an overestimation of the sea salt emission by WRF-Chem. We will add this discussion to P. 14649 line 11.
We meant here that the underestimation of PM10 mass concentration towards the eastern part of Germany is especially true for the continental period (middle panel of Figure 5). We have modified the sentence to clarify this information.

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4. *It Section 3.1.3, I feel some information is missing in the discussion. It is interesting to find negative bias in this work but positive bias in other studies (Schaap et al., 2008; Remer et al., 2005) over most regions in central Germany. It will be great if the authors can provide more details about this difference. Besides, authors are better to explain the causes for high overestimates of AOD in the south-western and north-eastern parts (right panel in Fig. 6).*

The studies of Schaap et al. (2008) and Remer et al. (2005) evaluated the MODIS AOD product by comparing it to AOD from AERONET sunphotometer measurements. They found an overestimation of MODIS AOD about 50% over European land surfaces. In our model simulation, we found a negative bias of about 40% when comparing modelled and observed AOD from MODIS. This means, the model is about 40% lower than the MODIS AOD. If we considered the 50% positive bias of the MODIS AOD compare to the ”true AOD” (AERONET AOD), our model results are actually more close to the ”true values”. We clarify this on P 14650 line 17.
A possible explanation for the overestimation of AOD in the south west of Germany may be the lack of detailed information of the stack height of point source emission. This may lead to an underestimation of pollutant emissions to higher atmospheric levels in this densely populated region. On the other hand, the overestimation in the north eastern part may be attribute to overestimated sea salt concentrations in lower atmospheric levels as previously mentioned for the PM10 model comparison. At last, we would like to point out that the uncertainties in the AOD itself may also contribute to these discrepancies in the comparison, as we show that by MODIS data with more strict quality filters, we got better comparison between modelled and MODIS AOD. We will add this discussion about the overestimation of AOD to P. 14651 line 1.

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5. *Section 3.1.5, three additional model runs were performed with different emission magnitudes to verify the assumption of underestimated emissions. The emissions in these model runs are adjusted by scaling, which may miss important information in emission estimates. I am wondering whether it is possible for the authors to run the simulations with emissions widely used by global models, such as Lamarque et al. (2010). This issue is also raised by the other reviewer.*

   We compared the Lamarque et al. (2010) BC and the EUCAARI EC emission rates for different eastern European countries (details please see response to general comments #3 of reviewer #3). These emission numbers are shown in Table S1 in the revised manuscript. The values indicate that the EUCAARI emissions are already around 30% higher. We expect that using the Lamarque et al. (2010) emissions as input to the model would lead to even smaller BC mass concentrations in the continental time period.

Editorial Comments

1. *Ageing vs. aging, be consistent*

   We checked the manuscript again and modified to ageing.

2. *Line 16, page 14639, missing references in "(?)"*

   We added the missing references Khalizov et al. (2009) and Spracklen et al. (2011).

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Ref:
Khalizov, A., Zhang, R., Zhang, D., Xue, H., Pagels, J., and McMurry, P.: Formation of highly hygroscopic soot aerosols upon internal mixing with sulfuric acid vapor, J. Geophys. Res., 114, D05208, doi:10.1029/2008JD010595, 2009.

Spracklen, D. V., Carslaw, K. S., Pöschl, U., Rap, A., and Forster, P. M.: Global cloud condensation nuclei influenced by carbonaceous combustion aerosol, Atmos. Chem. Phys., 11, 9067–9087, doi:10.5194/acp-11-9067-2011, 2011.

3. *Figure1, it seems that there should be some texts in the rectangle next to each dot.*

   Originally these rectangles are filled with the observation site names. We encountered this problem when using an older version of the pdf reader. We show this figure here as Figure 1, and hope it is clear to the reviewer this time.

4. *Table 3 and 4, exchange the order since table 4 was discussed first*

   We rearranged it.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 14637, 2014.

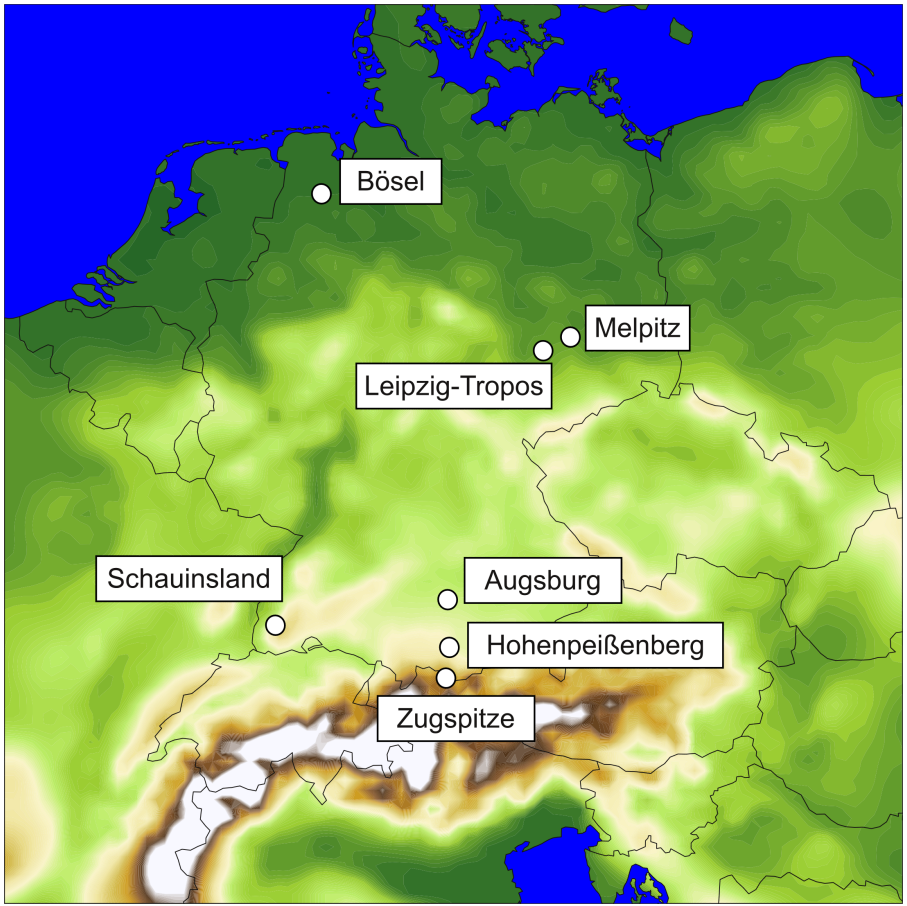

Fig. 1. Observation sites used for model evaluation.

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