

Interactive comment on “Evaluation of size segregation of elemental carbon emission in Europe: influence on atmospheric long-range transportation” by Y. Chen et al.

Anonymous Referee #1

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General

The paper describes WRF-Chem simulations for Europe and Eastern Germany with anthropogenic EC emissions from the EUCAARI project as input. Based on the simulation results and observations at Melpitz, Leipzig-TROPOS, and Bösel, the authors discuss uncertainties of the EUCAARI EC emission inventory and their effect on the simulation results. The model results show that the aerosol mass in the coarse mode is overestimated by the model. The authors conclude that the fraction of EC allocated to the coarse mode in the EUCAARI emission inventory may be too high for point sources and for all Russian sources. They discuss the effect of the size segregation

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of EC in the emission inventory on atmospheric life times and transport of EC and on simulated concentrations in Germany by means of a case study with modified EC size segregation.

I think this is a nice study and I generally favor the publication in ACP. The paper can be of interest for all modelers working with EC emission inventories.

However, the focus of the paper is not very clear, the choice of figures could be optimized, and several questions are not addressed in the paper. Furthermore, there are many language lapses (odd wording, missing verbs, mixture of extremely long and very short sentences, etc., see comments below). Therefore, considerable revision of the paper is necessary.

Detailed comments

Title:

It is not clear that the size segregation is just related to the representation in the emission inventory. Also, much attention is paid to the evaluation of cases where long range transport plays only a minor role. Finally, 'transportation' only refers to the transport of EC. Therefore, please adapt the title accordingly.

Abstract:

It is not clear from the abstract that the topic of the paper is the evaluation of the representation of EC emissions in an emission inventory and not the size segregation of real emissions. This should be mentioned right at the beginning.

I think the concept model should not to be mentioned in the abstract. Better mention the case study.

1 Introduction:

The introduction needs some reorganization: The sentence about emission inventories

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(page 31055, line 22 -26) should follow after ‘... take place (Denier et al., 2015).’ Some more information about the EUCAARI inventory might also be nice.

The paragraph starting with ‘The definition of EC and BC depend on how ...’ (‘depends’, not ‘depend’, or ‘definitions’, btw) should be moved directly after ‘(Pope et al., 2009; Meister et al., 2012).’

‘The lifetime size dependent transportation concept model was designed to show the significance of size information for EC transport.’ If this concept model is that important, why do you still need a case study? Better remove the mentioning of the concept model in the abstract and the introduction.

2 Data and method:

2.1 WRF-Chem Model

No need to split 2.1 into subsections

Please add one sentence explaining your choice of the chemistry modules. Please add some information about the resolution of the other domains.

2.2 Emissions

The less important information about biogenic, fire, and dust emissions should be moved to the end of this section.

‘... and area sources are distributed using distribution maps of proxy data such as population density, detailed descriptions for gridding are given in Denier et al. (2010).’ Was this procedure performed for the preparation of the $1/8^\circ \times 1/16^\circ$ inventory, or was the inventory additionally refined for this study? In the first case, please skip the remark about the proxy data and just cite Denier et al. In the second case, a more detailed description is required.

‘The EC emissions in different size modes (PM₁, PM_{1–2.5} and PM_{2.5–10}) are provided.’ Please add more information here (perhaps include figures for all modes in the

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supplement).

'The emissions are assumed to be equally distributed over the whole year.' I guess, this is not an assumption but just the way how emission inventories are frequently supplied.

'The vertical turbulent mixing was turned on in the simulation.' This statement looks a bit out of context her. What does this mean? Was this done during the WRF-Chem run? (This is probably not meant here) Or does this refer to some plume rise issue for the vertical distribution of point source emissions?

'The comparison between EUCAARI and Lamarque EC emission (Bond et al., 2007; Junker et al., 2008; Lamarque et al., 2010) was given in Nordmann et al. (2014), which shown that the EUCAARI emissions are around 30% higher in eastern European countries Poland, Czech Republic and Belarus'. a) Language! b) higher than what?

Why was EMEP used for the other compounds, and not MACC, which has a much better resolution?

3 Results and Discussion

3.1 Meteorology conditions

Please either reduce the frequency of references to the figures in the supplement. 'Good' sounds sometimes somewhat too positive to me. Also, 'some' is quite flattering for the agreement between observed and simulated NO_x peaks. How does NO_x look like?

3.2 Particle size Distribution

Even if a comparison with observation may not be possible: Are the size distributions inside or outside the plume (e.g. during and off a plume episode or difference between Leipzig and Melpitz) significantly different?

3.3 Elemental carbon sources Evaluation

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This subsection does not contain only evaluation. It also deals with the size segregation of EC from point sources in the EUCAARI inventory. Please consider a different title. (See Fig. 5 in the Supplement): Why not Fig. 4 b?

As shown in Fig. 5, this fraction for the sum of area and point sources is generally lower than 10%: This figure is not a good choice, better include Figure S6 into the paper and skip Figure 5 or move Figure 5 to the supplement.

Do we really need equation 2? It may be sufficient, to write that the life time is proportional to $1/v_d$ (deposition velocity) for stationary concentrations.

3.4 Influence on atmospheric transportation

'Transportation' refers only to the transport of EC!

'EC is in general mostly emitted in the fine mode, especially for the area emissions (Echalar et al., 1998; Hitzenberger et al., 2001; Kuenen et al., 2014).': In the previous section you write about exceptions.

'(Stern et al., 2008; Genberg et al., 2013; Nordmann et al., 2014)': Was the EUCAARI inventory used for all these studies? Probably this is not the case. As this paper is a study about the consequences of the EC size segregation in an emission inventory, the issue of different emission inventories should be discussed earlier in this paper.

4. Conclusions

'The main goals of this study are the evaluation for EC emission in Europe, including size segregation and point sources.' The study is about EC emissions in Europe as described by the EUCAARI emission inventory. It is sufficient to start with 'A WRF-Chem simulation was performed ...' anyway.

Quality of the figures:

Figures 4, S5, and S6: Some features and barbs are hardly visible. Please change

color shadings to light colors for low values.

Examples for language issues:

Page 31054, line 15: emission in the nearby point sources. . .

Page 31054, line 17: . . . for Russian . . .

Page 31055, lines 11 – 16: Please split this sentence

The European Environment Agency report (EEA, 2013) indicate that . . .
significane

However, it was mostly dry condition before 16 September 2013 in this simulation.

On the other hand, longer lifetime makes fine mode EC having more opportunity to be transported from Eastern Europe to Melpitz.

The overestimation of ECc emission fraction in EUCAARI inventory make less EC could be transported from the Eastern Europe and Russia to Melpitz.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 31053, 2015.

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