

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

Anonymous Referee #3

Received and published: 1 July 2014

This paper investigates the mass concentration and absorption properties of BC particles over Central Europe using WRF-Chem and a high resolution BC emission inventory. The model results are evaluated against various observations over the period 25 March to 10 April 2009.

Modelled BC mass concentrations were found to be a factor of 2 lower than the observations. The study suggests that BC emissions east of Germany might be underestimated by a factor of 5 in the simulation period. The study also finds that the internal mixture treatment of BC in the optical calculation in WRF-chem is unrealistic in this case. Even when the model is underestimating the BC mass concentration, the model

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slightly overestimates the absorption coefficient indicating that the mass absorption cross-sections were overestimated. Adjusting the modeled mass absorption cross-section towards the measured values lowered the positive BC forcing between 30 and 70%.

The paper presents a good effort comparing surface observations and model results, and point at large uncertainties in the emission inventories of BC. The paper also point at the unrealistic assumptions in the WRF-chem model.

I recommend that the paper can be published in ACP, considering my comments below.

As you stated in the introduction, the uncertainties in BC concentrations is due to uncertainties in the removal processes as well as aging processes and emissions. In the model description I would like more info regarding the removal processes of BC in WRF-Chem. It would also be interesting to include a discussion regarding the vertical profile of BC in the model and how uncertainties in the modeled vertical profile of BC would affect the results.

The paper suggests that the emissions might be underestimated. It would be useful to compare the emission values with the Lamarque et al. 2010 emissions that have been widely used in global models (e.g. the AeroCom and ACCMIP model inter comparisons) and GEFD data for biomass burning.

It would also be useful to see the contribution of different emission sources (sectors or fossil fuel/ biofuel, and open biomass burning) to the BC concentration, but I understand if additional model simulations are needed this might be too time consuming.

Specific Comments:

P. 14639 line 22: Be consequent when using BC/EC/Csoot. Especially look at figure legends and tables. You use EC for emission inventories, BC for model results and Csoot for the observations as I understand.

P. 14640 line 7: Could you also mention the uncertainty range in the forcing?

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P. 14645 line 4: What is the assumed diurnal variation?

P. 14648 line 12: "biomass burning activities cannot be responsible for the overall large bias". This was not clear for me from Fig S1. Please clarify. What is done in the QFED run?

P. 14652 line 12: unit t d-1. Can you write tons day⁻¹ instead?

P. 14653 line 14: Is there a reference to MICS Asia emissions?

P. 14653 line 20: Have you looked into agricultural waste burning (that occur during spring) and how it is represented in the inventories?

P. 14660 line 16-20: How large is the fraction of BC of PM10 and PM2.5? And did you perturb the co-emitted species as well?

Figure 2: It is space for more values along the colour bar. Use numbers that are more rounded. Since the grid is different among the two inventories, wouldn't it be easier to compare if the unit is per m²?

Figure 4 and 5: Larger font for the colour bars.

Figure 4: Specify the sites.

Technical corrections:

P. 14639 line 16: "(?)" the reference is missing.

Caption Figure 3: defer -> differ

P. 14653 line 12: EUCAARI BC emissions and MICS emissions is Fig. 2 and not Fig. 5. Make sure all figure numbering are correct.

P. 14653 line 18: "might also interannual" -> "might also be interannual"

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