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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Wildfires in Northern Eurasia affect the budget of black carbon in the Arctic. A 12-year retrospective synopsis (2002–2013)." *by* N. Evangeliou et al.

Anonymous Referee #1

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Review: Wildfires in Northern Eurasia affect the budget of black carbon in the Arctic. A 12-year retrospective synopsis (2002–2013).

The manuscript introduces a modeling study applying BC emission inventories in an atmospheric chemistry transport model to analyse the deposition of BC in the Artic stemming from Northern Eurasia. Several sensitivity simulations were performed to disentangle the contribution of different regions within the Northern Hemisphere. This is an interesting and relevant topic and the methods used in the study sound valid. The manuscript, however, would benefit from a better structuring of the results. In general, I do recommend publication, but suggest a number of changes.

General comments:

1. The study applies the new biomass burning emission dataset by Hao et al. for Northern Eurasia (NE). How this emission dataset has been derived has to be discussed more in detail in this paper. Particularly, the differences to the GFEDv3 emissions have to be outlined as these are applied in this study as well.

2. Naming of the experiments: MACCity-FEI-NE and MACCity simulation do differ only in the representation of biomass burning in NE. One uses Hao et al., the other one GFEDv3. I'd suggest that the simulations are renamed to more explicitly reflect this differences (e.g. FEI-NE and GFEDv3).

3. The difference between the simulations MACCity-FEI-NE and MACCity have to be discussed more in detail. Here the manuscript would benefit from a comparison of the MACCity simulation with the observations and not only the comparison MACCity-FEI-NE and observations.

4. At the same time, the discussion of the region specific simulation should only refer to the MACCity-FEI-NE simulation and it has to made clear throughout the manuscript that the conclusion are based on the MACCity-FEI-NE settings.

The abstract is way too long and should be shortened.

Page1/Line12: estimated is not the right term here – used?

Page1/Line 14: is this area based on FEI-NE or GFEDv3? Is the global number based on GFEDv3?

Page1/Line16: 70% is this for the FEI-NE or GFEDv3?

Page1/Line19: " . . . was twice as much as when using MACCity " , i.e. twice as much as when excluding biomass burning emissions? Maybe here and in the following it would be easier for the reader to follow when you refer to anthropogenic emissions in more general and not specifically to the MACCity inventory. You mentioned in the beginning that anthropogenic emissions are used from MACCity.

Page1/Line23: As mentioned in another comments here it must be made clear what emission inventories these numbers refer to. All regions based on GFEDv3, or northern Eurasia set to FEI-NE? Best is both scenarios are mentioned.

Introduction:

Page5/Line9: this argument is already given in the paragraph above. Please combine The introduction should also briefly discuss the emission inventories available for biomass burning in NE. These make up a substantial part of the paper and the conclusions.

Page7/Line26: isn't it 2005 and not 2000?

Page8/Line 25: And what injection height is used outside NE?

2.3 BC emissions . . ..

I do find the naming convention not that intuitive. Why don't you use FEI-NE and GFEDv3 for Biomass burning and MACCity for the anthropogenic. That GFEDv3 is part of MACCity is not that obvious and a bit hidden in the manuscript.

Page 11/Line2: from the FEI-NE+MACCity and the MACCity simulation" →used/applied in the . . . and . . . simulation.

Page 11/Line10: Shouldn't there be a difference between FEI-NE and MACCity for the global number?

Page 11/Line12: Tg – Tg/year here and in the following.

Page 11/Line17: Why do you reference Bond et al., Isn't this number based on your study?

Table2:

- that the anthropogenic sources are listed twice is confusing. Also the numbers should be identical but this is not the case for some of the years.

- artic deposition from NE fires and artic deposition from anthropogenic sources do add to the total artic deposition, this can not be correct.

Page11/ Line 20: which four years do you refer to 2006, 2003 and ? and do you refer to global or NE values?

Page 11/Line13: "This indicates that during these years the largest amounts of BC were deposited over Arctic regions as a result of large fire events in Siberia, Western Russia, and Kazakhstan. " – I don't see here how you reached this conclusion.

Page 13: The deposition rates for the artic results form all sources have to be discussed for both emission inventories. In addition, a simulation evaluation the contribution of NE fires to the Artic deposition based on GFEDv3 would be valuable for comparison.

Page13/Line 29: but fire detection is not directly related to fire emissions.

Page14/Line 18: I do not understand how the anthropogenic fraction is derived and what it exactly refers to (all anthropogenic, anthropogenic from NE?). Please clarify here and in Figure 5d.

Page16/Line1: Figure 7 compares the surface concentrations not Figure 8

Page16/Line7: Figure 7 compares the simulated versus observed daily surface concentrations by a Box and Whisker – what is blue and red for the model results? Also, it would be interesting to compare to the observations also the MACCity simulation. Does the different representation of fire in NE in the FEI-NE simulation actually improve the model results?

Page16/Line 20: How do you distinguish in the plot between anthropogenic and BB sources?

Page17/ Line 25: Here you have to be more specific. Differences arise mainly from the fact that the BC emissions are lower in NE (a region you identified as being important for artic BC deposition) and not so much from the fact that global depositions are

reduced.

Page17/ Line28: Why do you derive the importance of NE fires here from the difference of the MACCity-FEI-NE and MACCity simulation for atmospheric burden, etc. and not from the simulation were you excluded fires in NE as in the previous paragraph? More interesting would be a comparison of MACCity with observations.

Page 18/Line1: 'We also analyzed the influence of all anthropogenic and BB emissions from the regions (defined in Table 1) to the average surface concentration of the Arctic stations (Figure 9). ' – but the anthropogenic sources are only assessed globally and not by region.

Page18/Line 14: Region 'other' . The explanation here reads different from the figure caption.

Page 18/Line19: " . . . while our runs suggested that BB lower contribution of 29%" – please correct

Page19/Line 12: but you didn't explicitly differentiate for different anthropogenic source regions – or did I miss something?

Page 20/Line8: 3.0 *10^6 or 250.000 as stated in the abstract?

Page20/Line14: 3.5 times higher in NE or globally?

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