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Interactive comment

Interactive comment on "Modelling carbonaceous aerosol from residential solid fuel burning with different assumptions for emissions" *by* Riinu Ots et al.

Anonymous Referee #3

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The manuscript by Ots et al. presents a modeling study that explores the uncertainty of the residential and non-industrial combustion emissions sector over the UK and Ireland. The uncertainty estimates, translated into sensitivity experiments in the manuscript, are driven from past studies (Ots et al., 2016) and comparisons with measurements. The model domain covers the whole UK and Ireland, although the analysis is heavily based on comparisons with data in London.

The work presented is a standard modeling approach, where an emissions sector is perturbed and the different model versions are compared against measurements, to evaluate which of the scenarios under study is performing best against some metric, which in this case it is a fraction of organic aerosols (solid fuel OA; SFOA) and black/elemental carbon. The analysis does not have any mistakes, although one can argue that the approach of non-volatility and ageing for SFOA deserves improvement, especially given the temperature-dependent parameterization presented for the emissions during cold days. The results are not surprising either; a low bias in SFOA is improved by increasing its emissions, and rather linearly, as seen in Table 3. For both sites studied, the NMB presented in Table 3 for the combRedist experiment is roughly equal to the arithmetic mean of the Base and Redist simulations, which is what one would expect from the experimental design. In addition, no attempts have been made to link this work with either the study in Belgium mentioned in the manuscript, or with other relevant areas, limiting the scope of the work as presented. The last sentence of the conclusions also supports my concern about the limited scope of the study, again, as presented in the manuscript. Regardless, I believe that the work is sound and deserves publication in ACP after addressing my comments below.

Specific comments

p. 3, l. 25: The FINN inventory has natural fires only, or all open burning? Some of the open biomass burning is anthropogenic (e.g. deforestation, agricultural fires).

Section 2.2: The way I understand the degree-day factors equation is that it does not affect days with temperature higher than 18 C, but it increases emissions for colder days. If this is correct, isn't it going to increase the annual totals? In addition, why not apply the same approach hourly (section 3.2) and get a more natural diurnal variability, instead of the imposed one?

p. 5, l. 17: Please start a new paragraph with "The experiments Base, . . ."

Section 3.1: How far apart are the two stations? Are they in adjacent gridboxes, the same one, really far away? How about differences in local influences, if any?

p. 11, l. 16-17: Why only correlation and not the other metrics? More generally, this is an important piece of information and should be expanded, even though it is already published.

Figure 7: Some error bars or other means that present temporal variability can be very informative here.

The AMS instruments mentioned also measure total PM1 OA. It would have been very informative if the discussion included a comparison with those data as well, either (preferably) alongside the comparisons with SFOA, or (at least) in the same way the BC/EC comparison is presented.

p. 16, l. 18-19 and Figure 13, last row: This site does not add anything to the discussion, I recommend to remove it.

p. 20, l. 28: I am not entirely convinced that "the combRedist experiments improved the comparisons". Only the negative NMB was really targeted with the experimental design, and it is expected that increased emissions of an inert aerosol tracer will increase aerosol levels at surface, especially close to sources, thus reducing (or even eliminating) the negative bias. Figures 13 and 14, which represent a more regional picture, do not show any significant improvement for that particular simulation either.

Appendix A1 contains textbook information and it is not necessary, although it consists of a nice collection of references and the discussion is fluid, so I am hesitating to propose to remove it. Appendices A2-A4 should be supplementary material. Appendix A5 should move in section 3.5.

Technical corrections

p. 5, l. 4: Is Hjj correct (so please explain) or it should have been Hdd?

p. 9, l. 9: Please take this sentence out of the parentheses.

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