

Anonymous Referee #2

Before I complete my review, I would like the answers to the following points from the authors. In my pre-review of this manuscript I commented that the authors had not even mentioned the model performance for any species other than OA. I cannot see that they have added anything in this respect, so my worry remains.

During the pre-review of our manuscript the referee has made the following comment:

“The authors present no information on the spatial performance of their model. This is a major weakness since global-averages of concentrations and burdens can hide a multitude of errors. How does the model perform in North America, Europe and Asia?”

Given that the focus of the manuscript is the organic aerosols (OA), we presumed that the referee was referring to the spatial evaluation of OA and not the inorganic components. We apologize for this misunderstanding.

They present no evidence to suggest that this model can reproduce e.g. sulfate, nitrate, NO₂, CO, or any other inorganic component. I consider this a major weakness of the manuscript, since one cannot draw conclusions about such a complex field as OA modeling unless one knows that the modeling system can cope with the inorganic components.

The performance of the model for the inorganic aerosol and gas components has been recently tested by several studies in different spatial resolutions (e.g., Karydis et al., 2016; Pozzer et al., 2012a; Pozzer et al., 2012b). In our recent paper (Karydis et al., 2016) we have found that EMAC tends to overestimate the inorganic aerosol components over Europe while over North America and Eastern Asia, the inorganic aerosol concentrations are slightly underestimated by the model. Given that the performance of the model is increasingly realistic with increasing resolution, the acceptable model performance shown from all the previous model evaluations (in both higher and lower spatial resolutions than the one used in our work) should be enough to verify that EMAC can cope with the inorganic components under any resolution. Following the reviewer’s comment, we will add a paragraph discussing the results of the previous evaluation studies in the revised manuscript.

I can also note that the cited Jöckel et al. 2006 paper for ECHAM/MESSy is not in the reference list. That paper (I assume they mean the ACP one) gives some clues of course, but much of the evaluation presented there is not relevant to this study. For example, Jöckel did not attempt (wisely in my view) to compare with urban areas, and in any case they used lower spatial resolution (but higher vertical, with 90 layers).

The Jöckel et al. (2006) exists in the reference list of the discussion paper. As mentioned above, there are several recent studies that have performed the EMAC

evaluation in different resolutions (e.g., Karydis et al., 2016; Pozzer et al., 2012a; Pozzer et al., 2012b). We will include these studies in the reference list of the revised manuscript as well. The EMAC and AMS results are used to provide further insights into the composition of OA over urban locations. However, we agree with the reviewer that we cannot expect from the model to reproduce the OA concentrations over urban locations due to its coarse resolution. In that respect, the results over the urban areas are not taken into consideration for the seasonal and the overall evaluation of our model performance. This is clearly stated in section 5.2 of the manuscript.

How well does this model compare to inorganic components for (i) this model-setup, and against for example long-term data, and (ii) against the much more relevant AMS data in these field campaigns, and (iii) in general for urban areas since the authors choose to include that in their analysis of OA components.

As stated above, EMAC has been extensively evaluated in a range of spatial resolutions (e.g., Karydis et al., 2016; Pozzer et al., 2012 a; Pozzer et al., 2012b). Furthermore, there is no chemical or thermodynamic link between the inorganic (GMXe) and organic (ORACLE) aerosol modules used in this study. Therefore, we strongly believe that a comprehensive evaluation of inorganic components in our manuscript will disorientate the reader without providing him/her any useful information regarding the behavior of the OA in our model system. In turn, we will add a paragraph in the revised manuscript which will briefly present the model evaluation results from our previous study regarding the inorganic components (Karydis et al., 2016).

References

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