

Interactive comment on “Source attribution of Arctic black carbon constrained by aircraft and surface measurements” by Junwei Xu et al.

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We thank anonymous referee #3 for the helpful suggestions and questions, which have led to valuable improvements in our manuscript. Responses to these comments are provided below.

GENERAL COMMENTS

The present paper describes results from air campaigns and an effort to understand the transport and origin of BC from different regions and emission sectors through modelling. The paper does not really include any new story information about the transport, missing sources or origin of BC to the Arctic. This is very obvious, because the authors frequently justify most of their sentences with references throughout the

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whole manuscript. So, what the authors claim in the present study has been already well described in previously published articles, although values are different. For instance, the contribution from Europe or Asia to BC in an Arctic station may differ in the present manuscript compared to other paper. However, this is still nothing new, as it may differ due to the use of different models or due to different lifetime of BC within each of the models or for any other reason that induces modelling uncertainty. Nevertheless, measurements in the Arctic are very useful and generally lack and especially measurements from air campaigns. So, I would suggest that the authors should focus more on the measurements from the air campaigns and try to shorten the manuscript by removing the trivial statements about issues that have already been published elsewhere. Since the editor thinks that the present manuscript is novel enough to get out for a review, then I think that it deserves publication. It is very well written and it was a pleasure to reading it, although improvements can be applied, in order to be clearer and more concise. I could not find any weak point except those that I already pointed out. Everything flows well in it. Therefore, I only have some minor comments.

Response: Thanks for these. Novelties of this paper include 1) interpretation of new airborne measurements at Alert in the Arctic, 2) the first comparison with a chemical transport model of rBC measurements at Alert, 3) more accurate surface measurements used for model evaluation and source attribution, 4) improved understanding of how different emission inventories affect comparison with observations, 5) source attribution using the adjoint of the GEOS-Chem model to understand the importance of specific sources, and 6) identification of the Tarim oilfield and Indo-Gangetic plain as important sources. We have revised the manuscript to highlight these novelties and have condensed less novel material.

SPECIFIC COMMENTS

Please shorten the Abstract. E.g., Page 2 – Line 9-10 is a trivial statement and can be removed from the abstract. Please follow this pattern and mention the most important points of your paper only and not all the conclusions!

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Response: Done.

P 5 – L 16: Should it be “state-of-the-art” instead of “state-of-the-science”?

Response: Revised.

P 5 – L 15 until the end of paragraph: You are describing methodology in the Introduction. Please remove all these details from this chapter!

Response: Done.

P 5 – L 21 until the end of paragraph: Again you describe methodological issues that do not belong there, but rather in the next section of your paper.

Response: We have condensed this paragraph but we think it deserves a brief description of the motivation to use this method in the introduction because the adjoint of the GEOS-Chem simulation results are a highlight of this manuscript.

P 6 – L 26: EMEP and WDCA are mentioned for the first time in the manuscript and need explanation. Please do the same elsewhere (e.g., SP2).

Response: We have written out EMEP, WDCA and SP2 where they appear for the first time in the manuscript

P16 – comments on Fig. 6: I had really hard times to follow this part and I think it is due to the poor labeling on the Figure. Therefore, I would suggest to put 6 small letters on each of the figures and point them in the text, so the reader knows to which of the figures you refer in the text.

Response: Done.

P16 – L19-20 and L21: You are talking about the origin of the plume that arrives at the hotspot areas, but evidence is lacking. You have to point to respective figures somewhere or then remove these lines, because they cannot stand alone without any justification.

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Response: Origin removed.

P17 – L5-19: In my opinion column concentrations at the bottom panels of Fig.6 there do not say much. I think it is necessary to show the same maps with emissions. Preferably, add another panel (bottom) and show emissions in the same periods as with the column concentrations.

Response: Thanks for the suggestion. We have included emissions at the bottom panel of Fig. 6.

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