

The paper evaluated simulated black carbon in OsloCTM2-M7 against various observations and performed several sensitivity simulations by varying BC aging and scavenging parameters. The paper particularly focused on improving BC predictions over the high latitude, which is a particularly interesting topic as potentially important role of BC on climate changes occurring in high latitude such as Arctic.

Despite this importance, I have major concerns with this paper. I agree with all the concerns addressed by the referee #1. I particularly agree that this paper does not provide new findings. Here is the list of my major comments. Please consider them to improve this manuscript.

Major comments:

1) Regarding BC modeling in OsloCTM2-M7, please explain any difference/update in BC modeling used in this study compared to the ones used in previous studies.

Without such information, this paper appears to be very redundant to previous studies with OsloCTM2. This is particularly because OsloCTM2 has participated several multi-model inter-comparison studies (e.g., AEROCOM) focused on black carbon evaluations against observation. Also, there were previous studies using OsloCTM2 (maybe with bulk aerosol model) improved BC prediction by adjusting aging/deposition parameterization and shortening BC lifetime (e.g., Skeie et al. 2011; Hodnebrog et al, 2014).

The authors should make it clear how the model different from previous studies with OsloCTM2, and how BC predictions in this model are improved from previous OsloCTM2 evaluation. Specifically, Lund and Berntsen (2012) evaluated OsloCTM2-M7 BC predictions against the same observation. Please explain how the BC modeling and evaluation results in this paper differ from that previous paper.

2) The BC sensitivity results do not seem so informative.

Large portion of the paper results are focused on BC evaluations, not the sensitivity results - This paper actually fit better as OsloCTM2-M7 BC evaluation paper, rather than BC sensitivity study. If the authors wish to stay focused on BC sensitivity study, I strongly recommend examining details comparison (i.e., spatial and temporal distributions of concentrations and radiative forcing) among the sensitivity simulations to find any interesting spatial and temporal differences. This may be helpful to understand the climate impact.

Minor comments:

Abstract section

1) Please re-write Abstract. I got an impression that the current abstract is just a short version of the conclusion section. I found some identical sentences or

phrases between abstract and conclusions. Also, the abstract seems too long and needs to improve readability. Here are some examples:

P1 L12 : please modify “microphysical aerosol to “aerosol microphysical”

P1 L14 : Please clarify “Arctic surface concentrations”. Is this BC ambient concentrations or BC in Arctic snow or both?

P1 L14: please modify “remote region BC vertical profiles” to “BC vertical profiles at remote region”.

P1 L17 : please modify “annual averaged” to “annually averaged” or “annual average”

P2 L22: Please re-write this sentence: “Several processes can achieve this”.

Section 2.3

- 1) Regarding BC aging by HNO₃ condensation, please explain why HNO₃ produced in the aq. Chemistry has to be excluded. Is this to estimate gas-phase production?
- 2) It looks like the required ML is different for sulfate and nitrate. In reality, these hydrophilic aerosols will condense on BC surface and change BC properties. Isn't it more realistic to set the required ML combined for sulfate and nitrate? Am I missing something?

Section 2.4

- 1) I can't follow the first paragraph describing the method (L226-L238) to distribute BC burden to CESM-CAM4 model. Can you please re-write this method more clearly? Did you have to re-gridding BC burden?

Section 3.1.1

- 1) L314-L315 : Please provide a citation.
- 2) L323-340 : This study applies seasonality in agricultural waste burning and domestic BC emissions. What about other emission sources? What is the impact of missing seasonality of other emission sources?
- 3) L335-336 : Is this for certain year? 2008?
- 4) L 348-349 : Please present the CO evaluation for SH region.

Section 3.1.2

- 1) L361 : Please provide a citation.
- 2) L364-367 : This doesn't apply to ARCTAS summer. Please explain why.
- 3) L385-386 : I am not sure what this mean. Please explain why it is less important for aerosol distribution.

Conclusion section

- 1) Please see the comments for Abstract section above, which are also applied to this section as well.
- 2) L561: put comma between “aging” and “and”.
- 3) L581: please specify how much MNB is changed

- 4) L584: It looks like this part has a grammatical error: "... available for removal, a parameter with large".
- 5) L584 : "uncertaines" typo
- 6) L587: "fligh" typo
- 7) L589: please specify how big is the overestimation.
- 8) L607- L609 : This sentence should be rewritten. It doesn't read well.
- 9) L610: please change "is" to "are".
- 10) L617 : please fix this part: "dependen on"
- 11) L614-618: This is very long sentence and it is not well read. Please re-write this.
- 12) L618-619: Please explain more what you mean by "tradeoffs ... between different regions".
- 13) L621 -L622: If possible, please specify what kind of observation data that would be especially useful to improve BC modeling?