Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-782-RC1, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sensitivity of black carbon concentrations and climate impact to aging and scavenging" *by* Marianne T. Lund et al.

Anonymous Referee #1

Received and published: 19 October 2016

In this paper, the authors investigated the sensitivity of black carbon (BC) concentrations in the chemistry-transport model OsloCTM2-M7 to parameters controlling aerosol and scavenging. They especially focused on surface concentrations over the Arctic and vertical profiles over remote regions. Many sensitivity simulations were conducted considering the uncertainties in the coating thickness of sulfate, scavenging by convective and ice precipitation, nitrate formation, and emissions, and the authors showed the importance of the BC ice nucleating efficiency and the change in hygroscopicity with aging.

It is very important to understand the sources of uncertainties in simulating BC concentrations especially over remote regions. So, the theme of this paper is interesting and important. However, I feel there are some fundamental problems in the method (the model representation of aging processes) and the description of this paper, as shown

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in the major comments below. I suggest the authors to consider these comments carefully because they may be important for the results of this study. The modifications of the model and/or additional sensitivity simulations will be useful to consider these comments.

Major comments:

(1) New findings in this study

What are new findings in this paper scientifically? The authors show the results of many sensitivity simulations, but I think most conclusions obtained from the simulations are already shown by previous studies. For example, previous studies (listed on the references in this paper) showed the uncertainties of BC scavenging by convective precipitation, the poor agreement of BC concentrations over the Pacific (HIPPO) and Arctic (ARCTAS, ARCPAC), the overestimation of BC concentrations at higher altitudes, and sensitivity simulations focused on the aging timescale of BC. Some global aerosol models already consider nitrate formation. Considering these points, I suggest the authors to highlight the important conclusions (new scientific findings) obtained in this study.

(2) BC aging by organic aerosol formation

BC aging processes by organic aerosol (OA) formation will be important because OA mass concentrations are high and are roughly similar to sulfate mass concentrations on global average (at the surface). Considering the concentrations in the atmosphere, OA formation is probably more important than nitrate formation in terms of BC aging by condensation. However, I could not find any description about the BC aging by OA formation. If the OsloCTM2-M7 model does not consider the BC aging by OA formation, the model is insufficient to represent BC aging processes. It is better to improve the model to consider OA formation and the BC aging by OA formation. If it is difficult for the authors to modify the model in a short time, I suggest the authors to add some sensitivity simulations to show the potential uncertainties due to the BC aging by

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OA formation processes by using the current model.

(3) BC aging by nitrate

Please clarify the treatment of nitrate evaporation. As for sulfate, it is relatively easy because it is enough to consider the conversion from hydrophobic BC to hydrophilic BC. However, as for nitrate, the conversion of both directions will be important. The evaporation of nitrate is especially important over remote regions, and it may be possible to change from hydrophilic BC to hydrophobic BC over the regions through evaporation of nitrate. If the model already considers the effect of nitrate evaporation, please describe about it and show its importance (e.g., as a sensitivity simulation). If not, please add the effect to the model or please show some results that the effect is not important.

Other comments:

(1) Section 3.1.3

I suggest the authors to add a figure showing the results of this section.

(2) Figures 6 and 7

It is hard to see the lines in Figures 6 and 7. Please revise these figures to make them easy to understand.

(3) The number of ML (lines 491-492)

Please describe why the authors use different MLs for sulfate and nitrate.

(4) Typos

There are some typos in the text. Please correct them.

Line 212: onHoose et al.

Line 581: amont

Line 617: dependen

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