Atmos. Chem. Phys. Discuss., 15, C2946–C2949, 2015
www.atmos-chem-phys-discuss.net/15/C2946/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Current model capabilities for simulating black carbon and sulfate concentrations in the Arctic atmosphere: a multi-model evaluation using a comprehensive measurement data set" *by* S. Eckhardt et al.

Anonymous Referee #2

Received and published: 25 May 2015

Review of "Current model capabilities for simulating black carbon and sulfate concentrations in the Arctic atmosphere: a multi-model evaluation using a comprehensive measurement data set," by Eckhardt et al.

This paper provides an important update on the performance of models attempting to simulated Arctic aerosol concentrations. The authors gathered information from 11 different models using the same emission inventories for 2008 and 2009. They analyzed the modeled simulations of black carbon and sulfate aerosol, two important species of

aerosol with large importance to regional climate. They compared the model results against surface measurements and aircraft observations, and they also compared the models against each other. As the authors suggest, improved knowledge of the burden of Arctic aerosol provides better understanding of Arctic climate – either in the recent past or future.

The introduction does a good job laying out current knowledge of Arctic aerosols, and throughout the paper the authors provide detailed explanations for the observed seasonal trends and distributions. They also supply reasonable explanations or hypotheses for discrepancies between the models and the observations. Finally, they do a good job explaining problems in current emissions inventories.

Main criticism.

In the Conclusions section, it would be helpful to have a paragraph describing the implications of the results for climate forcing. For example, the models tend to underestimate the BC concentrations in spring, but overestimate BC in summer. What are the implications of this finding for climate simulations attempting to show the influence of Arctic aerosols on regional climate (e.g., Najafi et al., 2015).

In fact, even over mid-latitudes the differences between models are large, as seen in Figure 1. Readers are curious what difference this makes to radiative forcing calculations, and to our understanding of the role of aerosol trends in driving climate change.

Najafi, M.R., F.W. Zwiers, N.P. Gillett, Attribution of Arctic temperature change to greenhouse-gas and aerosol influences, Nature Climate Change, 5, 246–249, 2015.

Minor criticisms. 1. Page 10437. The authors state that the modeled representations of aerosol loading agree “fairly well” over source regions, but even here there are large differences, with some models yielding double the loading of others. The authors should acknowledge this discrepancy.

2. Do the authors have any clues about why the Canadian model CanAM4.2 appears

ACPD
15, C2946–C2949, 2015

to outperform the others? This would be useful information.

3. Section on sulfate/ BC correlations. The author should begin this section stating why examining such correlations could be helpful.

4. The discussion of internally vs. externally mixed aerosols comes up late in the paper. It would be helpful to learn earlier in the paper more about how the different models treated aerosol mixtures.

5. It's not clear what is meant by "SO2 (converted to sulfate) to BC emission ratio." Please reword. Also are these mass ratios?

Table 3. The practice is to put significant correlations in boldface.

Figure 4 caption. What do red boxes show? What do grey whiskers show?

Figure 5. Make clear that these are surface concentrations.

Figure 6. What do grey and red boxes show? Perhaps text could say that the boxes and whiskers are same as in Figure 4?

Figures 7 and 10. Red bar seems unnecessary.

Figure 9. As in Figure 6, the description of the Figure is incomplete.

Figure 13. It would be helpful to indicate which of the correlations are statistically significant, either by providing text on the plots or in the caption.

Typos, etc. Page 10433, line 9: "Shall" should be "should." Also, there's a typo further along in this paragraph.

Page 10435, line 9: Errant comma.

Captions for Figures 4-6 have run-on sentences.

Caption for Figure 7. Collapsed sentences are hard to read. E.g. "The top (second from top)... below (above)...."

ACPD
15, C2946–C2949, 2015

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 10425, 2015.

ACPD

15, C2946–C2949, 2015