

Interactive comment on “Offsetting effects of aerosols on Arctic and global climate in the late 20th century” by Q. Yang et al.

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Dear Reviewer,

Thanks so much for your time. Your comments and suggestions are very helpful to improve the presentation of the paper. We have followed the comments and suggestions in the revision (attached). Please see the following point-to-point responses :

(1) The role of organic carbon in the simulations has not been explained at all. In Abstract, line 6 and Page 30933, 1st line, it is said: “we also examine the response to sulfate, BC, and organic carbon aerosols varying at once.”. It is unclear, how organic carbon is varied in the simulations? Also, what is meant by “at once”?

C12725

In order to make the experiment setups more clearly, we have added Table 1 (page 19) that lists name of experiment, number of ensemble members, whether the run was obtained from CMIP5 or is a new run conducted in this study, run period, trend analysis period and aerosols that vary in the run. In the all aerosol forcing experiment, sulfate, black carbon and organic carbon aerosols were varied simultaneously.

(2) Page 30932, Line 15: “Compared with Advanced Very High Resolution Radiometer (AVHRR) observations, Shindell et al. (2013) demonstrated that CAM4 captures total aerosol optical depth trends of 1980–2000 well over the areas of high aerosol emissions (e.g., Europe, eastern North America and south and east Asia).”. Shindell et al. (2013) show results for CAM3.5. Are these two versions essentially the same?

CAM3.5 and CAM4 have the same physical treatment of atmospheric aerosols and sulfur chemistry. Therefore, these two versions of CAM are expected to have similar trends in total aerosol optical depth. We have rewritten the sentences to make it clearer on page 5 in line 89-93.

(3) Overall, it is very difficult to understand the details of the simulation setup. It seems that the aerosol fields are taken from simulations that were made for the study by Lamarque et al., 2011. However, simulations in Lamarque et al., 2011 were for years 2000-2011 while in this study, the simulations were for 1975-2005. The description of the model setup should be given in more detail. Also, it would be informative to explicitly state, which emissions were used for calculating aerosol fields.

We have added Table 1 to clarify experiment setups and have added more details of aerosol emission sources and aerosol physics in the model and experiments section on page 5 from line 79 to 88.

(4) Page 30933, 1st and 2nd paragraph: Figure 1 shows trends in aerosol optical depth, not trends in emissions. For example, I don't expect emissions from Pacific Ocean region to affect optical depth over that area. Please, rephrase these paragraphs.

C12726

We have followed the suggestion and changed “aerosol emissions” to “aerosol optical depth”.

(5) Page 30934, Line 25, Correct “sight” to “slight”

Corrected as suggested.

(6) Page 30935, Line 3, “Thus, this cooling must be a response to forcing in other regions” Do you have an idea, what response this could be?

Based on the simulations in this study and the study from Teng et al. [2012], we think surface air temperature over the Siberian and North American Arctic might be related to changes in aerosol optical depth over Asia. An increase in sulfate optical depth over Asia induces a large cooling while an increase in BC over Asia causes a significant warming.

The discussion of the relationship between forcing and response has been expanded in this section.

(7) Section 4: The weakness of this study is that the results are only from one model. Global aerosol models have great variability in their modeled aerosol fields over the Arctic areas, especially for black carbon (e.g. Koch et al., Evaluation of black carbon estimations in global aerosol models, Atmos. Chem. Phys., 9, doi:10.5194/acp-9-9001-2009). This means that different models might show different climate responses to changing aerosol concentrations. In my opinion, this should be discussed here.

Following the suggestion, we have added some discussions on page 9-10 from line 187-190.

Please also note the supplement to this comment:

<http://www.atmos-chem-phys-discuss.net/13/C12725/2014/acpd-13-C12725-2014-supplement.pdf>

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Interactive comment on Atmos. Chem. Phys. Discuss., 13, 30929, 2013.

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