

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

Anonymous Referee #2

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This manuscript “Offsetting Effects of Aerosols on Arctic and Global Climate in the Late 20th Century” by Yang et al. studies the effects that sulfate and black carbon aerosol have on the arctic climate. The authors have carried out transient climate model simulations over a period from 1975 to 2005 varying concentrations of sulfate and black carbon. The paper is clearly written and the analysis of model results is easy to follow. However, the manuscript would have benefited from in-depth analysis of the model results. I recommend publishing the manuscript after the following minor issues have been addressed:

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
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varied in the simulations? Also, what is meant by “at once”?

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? 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.

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.

Page 30934, Line 25, Correct “sight” to “slight”

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?

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.

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