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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ocean mediation of tropospheric response to reflecting and absorbing aerosols" *by* Y. Xu and S.-P. Xie

Anonymous Referee #2

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General comments:

This study compares the atmospheric circulation responses to absorbing black carbon (BC) and reflective sulfate (SO4) aerosols. It had been previously hypothesized that the atmospheric responses to these 2 types of aerosols differ significantly, since BC aerosols alter the atmospheric vertical heating profile whereas SO4 do not. However, this study finds similar mid-latitude responses (of opposite sign) to BC and SO4 aerosols in the CESM model, both characterized by adjustments of the Hadley cell and mid-latitude jets. The authors attribute the SO4-related changes to the interhemispheric pattern of SST changes, which perturbs the atmospheric column even though SO4 aerosols cause very little direct forcing.

This is an interesting study which contributes to the understanding of the dynamical effects of aerosols on the tropospheric circulation. My main suggestion is that the contrast with the GHG response should be drawn out further. In particular, the difference in the jet stream response to aerosol v. GHG forcings [e.g. Lu et al. 2008; DOI: 10.1175/2008JCLI2200.1] should be made more explicit. More broadly, how can the conclusions of this study be reconciled with [Xie et al. 2013; DOI: 10.1038/NGEO1931], which finds fundamental similarities between the responses to aerosol and GHG forcing?

Specific comments / questions:

1: The extremely small magnitude of the SO4 fast component in Figure 2 is striking. Are all of the aerosol cloud indirect interaction effects accounted for by the fast component, or could some be decomposed into the slow component?

2. In Figure 3, it is not clear that the Hadley cell responses are similar except in magnitude. The BC Hadley cell change appears to be mainly in the northern cell, whereas the SO4 change appears to be mainly the southern cell. Please explain this difference (or alternatively, why it is not important).

3. In the conclusion, the authors suggest that projected SO4 reductions may result in deep mid-latitude warming. However, would future air pollution controls also reduce BC emissions, and thus produce a mid-latitude cooling response?

Technical and clarification comments:

a. [Page 5539, line 2]: The singular "dust" is the more proper usage.

b. [Page 5539, lines 9-11]: It is not clear what previous studies are being referred to.

c. [Section 2.2.d]: It would be helpful to include a supplementary figure of the SST perturbation pattern, considering its importance for the mechanism.

d. [Figure S1]: This is a key overview of the main heating and temperature responses.

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Perhaps it could be included as a main figure rather than supplementary?

e. [Figure 3]: Would it be clearer if the sign convention for Figures 3a and 3b were reversed to match Figures 1 and 2?

f. [Page 5543, bottom; and Figure S5 caption]: I suggest the wording should be "the climatology."

g. [Page 5544, bottom paragraph]: The use of parenthesis to indicate opposites in this way is difficult to read. See http://climate.envsci.rutgers.edu/robock/Parentheses2010EO450004.pdf

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 5537, 2015.