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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Climate response due to carbonaceous aerosols and aerosol-induced SST effects in NCAR community atmospheric model CAM3.5" *by* W.-C. Hsieh et al.

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General Comment. The authors might want to focus their discussions on the two sets of simulations that derived Et, Es, and Ea, i.e., the SOM set runs and the prescribed SST runs using SOMc output. All the other simulations and their purposes could be mentioned very briefly in Section 2, with results being provided as a supplementary material or up on request. The current discussions of these "other runs" in the text along with figures deviate the central point of the paper.

We would like to thank the review's comments. Indeed, the majority of our paper compares SOM simulations with fixed SST runs using SOMc output. We only briefly show

different combination of SST and carbonaceous aerosols setting in section 4.1 to illustrate using linear difference between SOM and fixed SST runs to approximate SST feedback is reasonable.

The authors also need to remind the reader and themselves about the scope of their simulations. The aerosol component addressed in this study is total carbonaceous aerosols including black carbon (absorbing and scattering) and organic carbon (mainly scattering unless "brown carbon" is concerned). This differs from some cited works where either black carbon or total anthropogenic aerosol was addressed. In many cases, "carbonaceous aerosol" or CA in short could be used instead of simply "aerosol" in discussion to better define the scope. In addition, when comparing to other works, the authors need to recognize the difference in targeted aerosol component. Specific Comments.

Thanks the reviewer's comments. We have modified some text in the revised paper to make discussion clearer that the climatic effects shown in this paper is mainly total carbonaceous aerosols including black carbon and organic carbon.

Page 7356, line 7, "by factor of 3": I assume this means that (BC + OC) x 3, not BC x 3. While the atmospheric heating should be greatly increased to match a few other works (a global mean of 3.7 w/mËĘ2 is still much higher than the values in most models including AeroCOM models), the surface forcing would also be very high due to increased BC and OC, and the TOA total clear sky forcing would be more negative than previous setting. Perhaps all these should be indicated. I'm curious also about the values of TOA and surface clear sky forcings after applied 3x (BC + OC).

We have modified the text to be more precise about the climatic effects discussed in this paper is for 3 x (BC+OC). We have also added a table summarizing the values of TOA and surface shortware and longwave radiative focing for all sky and clear sky cases.

Page 7356, line 15, "High concentrations of black and organic carbon are emitted from:

: :": the high concentrations of BC and OC during the dry season of MAM are likely due to a weaker sink, i.e., precipitation scavenging rather than a higher emission comparing to the summer monsoon season.

Thanks reviewer's comments. We have modified the text as suggested.

Page 7357, line 15, eq (2): I'm not sure if FSSTnc_SOMnc is more adequate than FSSTnc_SOMc for no-carbon case here in order to derive Ea. The equilibrium reached in a no-carbon-aerosol case with SOM that settled in a SST along with climate state would better reflect the ocean adjustment due to aerosols other than carbonaceous ones. The FSSTnc using SOMc would force a different equilibrium state. Nevertheless, the difference might not be significant.

We have compared different Ea in section 4.1 and found the spatial patterns are quiet similar among different Ea. So we focus on one Ea (from FSSTnc_SOMc) for most of discussions later. We think general findings can be applied to runs using SST initialized from no carbonaceous aerosols.

Eq(3): under a linear response assumption, Es = Et – Ea. The equation could be written in this format.

Text has been modified as suggested, thank you.

Eq(4) – Eq(8): for clarity, these equations are not very significant to the discussions, perhaps Table 1 already serves the purpose to let the reader know about the existence of these additional simulations. A brief description here would be sufficient.

Our description for these equations is brief and serves the purpose for explaining the design of our experiments.

Page 7359, line 23, "The dimming effects of particles": please be specific, this should be referred to "carbonaceous particle". There are many some places throughout the text demanding for clarification. All the aerosol effects discussed in this study are the effects of CA.

We have modified the text as suggested. Thanks you for pointing it out.

Page 7360, line 5, "South" to "Southern".

We have modified the text as suggested.

Page 7361, line 16, "The possible reasons for the discrepancy: : :": Meehl et al. only included black carbon while this study is about total carbonaceous aerosols, the former introduces a strong atmospheric heating and a surface cooling in close magnitude, the latter perhaps introduces a much higher cooling effect comparing to the atmospheric heating in terms of absolute magnitude.

We have revised the sentences. Thank you for the comments.

Page 7363, line 10, "Because the opposite temperature change: : :", this sentence needs to be elaborated.

We have rephrased the sentence. Thank you.

Page 7365, the first paragraph of 4.4: please note the difference in aerosol component between this study and the two other works cited here.

We have modified the text as suggested. Thank you.

Page 7365, line 21, ": : :equals zero poleward of the subtropical maxima" is not quite clear.

We have rephrased the sentence in the revised paper.

Page 7368, line 5, "with positive changes of clouds" and a few following sentences: should it be made more specifically of low clouds?

We have modified the text as suggested. Thank you.

Page 7369, Eq (8): the dynamic, thermodynamical terms etc. should be labeled here or briefly described in the text. In the description of the equation, "represents the difference from the no carbon simulation" should be "represents the perturbation caused

by carbon aerosols".

We have included a description for each term in the text and rephrased the sentence as suggested. Thank you so much for the suggestion.

Page 7370, line 18-22: the correlation between the dynamic term in the moist budget equation and precipitation change identified in this study is very interesting, It would be good to know how carbonaceous aerosols cause the perturbed flow.

Indeed the close pattern between dynamic term and precipitation response is very interesting. We think carbonaceous aerosols could cause the perturbed flow due to radiative forcing they exert which have the effects to redistribute energy in the atmosphere.

Page 7371, line 28: "air-ocean model"?

We have modified the text to "atmosphere-ocean model".

Figures.

Fig. 2: it would make an easy comparison should all the panels have the same scale in vertical axis.

We have modified the figure as suggested.

Fig. 4 and 5: perhaps only three panels are need here, Et, Ea, and Es.

As mentioned before, we include all plots only in Fig. 4 and 5 as a reference for discussing our experiment design. Only Et, Ea and Es(in some plots) after Fig. 5 are shown because climatic response induced by carbonaceous aerosols is similar between different SST states obtained from the SOM.

Fig. 6: time series plots here are less informative. Could the zonal mean changes derived based on equilibrium period (last 50 or 70 years) be displayed instead?

We have removed Fig. 6 and the zonal mean plots were already shown in Fig. 9.

Fig. 10: perhaps the same color scale could be used here.

We have modified the figure as suggested. Thank you.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 7349, 2013.