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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Estimation of Asian dust aerosol effect on cloud radiation forcingusing Fu-Liou radiative model and CERES measurements" *by* J. Su et al.

J. Su et al.

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Reviewer 1

We are very appreciative of the reviewer’s thorough review of the paper. The suggestions are very helpful in improving the paper. The paper has been revised, making changes according to reviewers’ comments. The following are our responses to the reviewer’s comments:

Question 1: Throughout the manuscript, the authors should take greater care when discussing the radiative effects. Often, it is not immediately clear whether the author is referring to aerosol direct effect, cloud effect, or both combined. After carefully reading the manuscript, I was able to figure it out, but it would greatly help future readers if you

define one set of terminology and use it consistently throughout the paper.

Response: In the revised version, the radiative effects have been defined clearly for aerosol, cloud and both of them, respectively. We hope it will help the readers to understand the paper more easily.

Question 2: You select 16 dust cases, each of which has somewhat different geographical locations. Have you checked whether or not the change in geography has an effect on your results, especially for region #6. Please explain whether or not geography is important. . Response: Actually, the COD (cloud over dust) and CLD (dust-free cloud) cases are pairs. Each COD case has a corresponding CLD case. Although the geography is important, especially the surface type, once we choose a COD case, we find the best corresponding CLD case with close geographical and meteorological conditions to minimize both the geographical and meteorological influences.

Question3: Please explain in more detail how dust and pristine areas within each case are selected, since the reader may not have that reference readily available.

Response: The CLD and COD regions are selected based on MODIS satellite data and the observations from 701 surface meteorological stations. Ackerman [1997] showed that the brightness temperature (BT) difference between the 11 and 12 μm channels (T45) is negative for dust because dust layers have a higher emissivity at 12 μm than at 11 μm. Gu et al. [2003] demonstrated that the BT difference (T45) can be used to detect Asian dust and the clouds are easily distinguishable from the dust in the T45 image. So we used MODIS T45 data combined with surface meteorological stations observation to select these two regions.

Question4: Do you have statistics on the relative sizes of COD vs. CLD sample size? It appears the each case includes both COD and CLD data; however, the proportion of COD to CLD data is not reported. If this interpretation is not correct, please explain this in greater detail.

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Response: We have added CLD vs. COD statistics in Table 1 in the revised version.

Question5: For the results to be considered significant, information on the relative distributions of COD and CLD needs to be reported. I agree with reviewer 2 that the overall sample size is too low, and that a time series based off a single region would provide more convincing results.

Response: We think it is a good suggestion, but CERES SSF data are available for only 4 years and it is difficult to find many pairs of COD and CLD due to the limited number of dust events during the 4-year period. In addition, although the number of cases is not large, the number of cloud pixels is large enough to be statistically significant.

Question6: Is the dust aerosol direct radiative effect alone negative (cooling) at the TOA? If it is, which I believe is the case, please state this explicitly somewhere. If not, please explain why you disagree with other results showing absorption as important, but not enough to offset the aerosol cooling effect.

Response: In this paper, the model simulation results show that dust aerosol direct radiative effect alone is positive (warming) at the TOA. The disagreement with other results should be caused by differences in absorption for different dust types.

Question7: the meteorological conditions associated with each case are not reported, specifically humidity conditions. You attribute much of the difference between COD and CLD regions as due to aerosol indirect effects on clouds. However, you do not consider the impact of the prevailing meteorological conditions on those clouds. Generally, dust aerosols are present under dryer than normal conditions. In dry conditions, clouds are less likely to form compared to more moist conditions. Your conclusions state that dust through indirect effects reduces cloud cover thereby decreasing the total radiative effect. How do you know that the reduction in clouds is not simply a result of the drier conditions co-located with the dust aerosols. Please explain this point further and give evidence as to why you do not consider this issue important.

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Response: Actually, it is difficult to find two regions which have the same weather conditions. The COD and CLD regions of all the cases except of the NO.2 case were selected closely and both of them were in the Mongolian cyclone system. In the Mongolian cyclone system, the clouds generally occur in warmer and moist air ahead of cold front. When dust aerosols present in this area, they will change the properties of clouds as a nuclei. Thus, the COD and CLD regions have the similar meteorological conditions and the reduction of cloud cover maybe mainly caused by the indirect effects of dust aerosol.

Question8: Page 2067, lines 19-28. Please provide some evidence for your statements in this paragraph. Page 206, line 5. State coarse mode size here for the reader.

Response: Page 2067, line 19-28: In our revised version, we add a reference (i.e., Huang, J. P., Lin, B., Minnis, P., Wang, T., Wang, X., Hu, Y., Yi, Y., and Ayers, J. K.: Satellite-based assessment of possible dust aerosols semi-direct effect on cloud water path over east Asia, Geophys. Res. Lett., 33, L19802, doi:10.1029/2006GL026561, 2006b.). In this paper, we provided some evidence for supporting our statements in this paragraph. We have added the information of the single-scatting-albedo and asymmetry factor statement in our revised version. The single-scatting-albedo and asymmetry factor of coarse mode dust is 0.7266 and 0.8613, respectively.

Question9: Page 2070, line 8. Change “word” to “words” Figure text needs to be made larger.

Response: We have changed word to words and amplified the Figure text.

Question10: Table 1. Add CLD vs. COD statistics in an additional column.

Response: We have add CLD vs. COD statistics in Table 1.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 2061, 2008.