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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Taklimakan dust aerosol radiative heating derived from CALIPSO observations using the Fu-Liou radiation model with CERES constraints" *by* J. Huang et al.

**Anonymous Referee #1**

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Review of “Taklimakan dust aerosol radiative heating derived from CALIPSO observations using the Fu-Liou radiation model with CERES constraints” by Huang et al.

This manuscript estimates dust aerosol radiative forcing and heating rate over the Taklimakan Desert in northwestern China in July 2006 by the combination of the Fu-Liou radiative transfer model with the CALIPSO and CERES observations. The purpose of such approach is to reduce uncertainties in the calculation of radiative effects of dust aerosol. The manuscript provides useful information about dust forcing during a dust event and can be accepted after addressing the following comments:

1. Introduction: The manuscript misses a review of previous studies that have used radiative transfer models and CALIPSO/CERES observations to estimate aerosol forcing. Is this a new approach or a previously used approach?

2. How accurate are the extinction coefficients of dust obtained from CALIPSO? This manuscript should either evaluate CALIPSO data in this work or cite previously studies that have done the evaluation.

3. In the calculation of radiative effects of dust, extinction coefficients were from CALIPSO, but single scattering albedo and asymmetry factor were from the work of Hess et al. [1998]. I think using parameters from Hess et al. is the weak part of this work. Why not calculating these two parameters based on measurements (e.g., aerosol size from satellite or other method, if available)?

4. Second paragraph of Page 5975: Dust aerosol single-scattering albedo and asymmetry factor used over Taklimakan region were determined by comparing the CERES TOA solar fluxes with Fu-Liou model simulations along the CALIPSO orbit, using 4 different dust aerosol types Hess et al. (1998). The authors found that the dust aerosol type that fits best is the transported mode. I have two concerns about this treatment: (1) The manuscript evaluated TOA radiative fluxes from the model by comparing them with CERES measurements. Based on this comparison, the authors claimed that “the radiative transfer model constrained with the CERES observations can be used to reliably determine the variation of dust aerosol radiative heating rate with the input of vertical distributions of dust aerosols from CALIPSO measurements”. I think it is too early to draw such a conclusion. The evaluation of model should also be done for the atmosphere without dust (for example, for several days before the dust event), because the concentrations of absorbing gases, vertical profiles of meteorological variables, and assumptions of surface albedo can all influence TOA fluxes. The model is ready to estimate dust forcing and heating rate only when fluxes simulated both with and without dust have been evaluated. (2) Single scattering albedo and asymmetry factor of transported mode of dust were picked out and used in all the sim-



**ACPD**

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Interactive Comment



ulations. Because all four modes of dust coexist in the atmosphere in reality, how does this assumption influence your model results? Can you justify that contributions from other modes of dust are small?

5. Table 2 shows that LW forcing values are positive at TOA, surface, and in the atmosphere. Explain in the text why LW heating rates show cooling in Figure 8?

6. Figure 1 is not necessary; Remove it. Just need to describe the dust event in the text.

7. Surface albedo used in this work should be given explicitly in the manuscript.

8. Section 6: Describe clearly how uncertainties in forcing values were calculated.

9. It is stated in the conclusion section that “However, our results suggest that the single scattering albedo of Taklimakan dust aerosols is about 0.89 at 0.67 $\mu$m which is about 6% less than Saharan dust”. What results showed that single scattering albedo of 0.89 is reasonable for Taklimakan dust?

10. Finally, heating rates or forcing values obtained in this work should be compared with previous estimates for dust events. Do the values from this work agree with those from previous studies or does this work have new findings?

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 5967, 2009.