

Interactive comment on “Dust aerosol effect on semi-arid climate over Northwest China detected from A-Train satellite measurements” by J. Huang et al.

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We are very appreciative of the reviewer's thorough review of the paper and recommend to "accepting". Our point-by-point responses to the comments made by the reviewers are as following.

- This manuscript presents an analysis of the effects of dust aerosols on cloud properties by comparing the differences in aerosol and cloud properties between semi-arid regions in northwest China (CSR) and northwest US (USR). The subject is well fit the scope of this journal. It should be publishable if the following points are clarified in revision.

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Specific Comments:

- Page 2, line 11: It is indicated in Page 5 that five years of MODIS data are used for the analysis, why only "a 3-month period" here?

A-Train satellite measurements, including MODIS aerosol optical depth, used in this study are only the Spring (March to May) of five years (2003 to 2007). We focus only on Spring because Spring is dust event activity period.

- Page 3, line 2-3: "the remaining approximately 50% is subject to long-range transport to the Pacific Ocean and beyond" is probably too large, since main aerosol mass is contributed by the larger particles, especially coarse mode dust particles.

Yes. It may be too larger but this result was based on the following article: Zhang, X. Y., Arimoto, R., and An, Z. S.: Dust emission from Chinese desert sources linked to variations in atmospheric circulation. *J. Geophys. Res.*, 102, 28041–28047, 1997. (<http://www.agu.org/pubs/crossref/1997/97JD02300.shtml>) Detail description can be found here. And this result has been also cited by IPCC AR4 Chapter 7. (http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch7s7-5-1-1.html)

- Page 3, line 13: "society" can be removed since it is also a human factor.

The "society" has been removed in the revision by following reviewer's suggestion.

- Page 3, line 14: "Many factors that cause these disasters are natural, but human factors appear to dominate". Based on what is this concluded?

We have added the references in this revision.

- Page 6, line 12: "The depolarization ratio is low (close to zero) for other types of aerosols". SEM or TEM experiments show that most of aerosol particles are non-spherical, especially soot particles. How soot and other non-spherical particles are excluded from dust particles?

Generally, soot is always smaller than dust particles, thus color ratio (Backscat-

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ter1064nm /Backscatter532nm) can distinguish soot from dust. The detail methodology used to identify dust was given in the following reference: Omar, A., D. Winker, J.-G. Won, M. Vaughan, C. Hostetler, and J. Reagan, Selection algorithm for the CALIPSO lidar aerosol extinction-to-backscatter ratio, in Geoscience and Remote Sensing Symposium IGARSS, vol. 3, pp. 1526–1530, 2003. (http://www-calipso.larc.nasa.gov/resources/pdfs/ILRC_2006/Omar-AerosolLidarRatio-9P-3.pdf)

- Page 7, line 11: “global” should be added prior to “temperature”.

The “global” has been added prior to “temperature” in the revision by following reviewer’s suggestion.

- Page 7, line 13: “observed climate observations” should be changed to “observed climate factors”.

The “observed climate observations” has been changed to “observed climate factors” in the revision by following reviewer’s suggestion.

- Page 7, line 20: syntax error.

The “ranges” has been corrected by “ranging” in the revision by following reviewer’s suggestion.

- Page 7, line 22: How “moisture-bearing winds” can “cool down such regions”?

It might be a misunderstanding due to our unclear expression. The sentence has been changed to “because moisture-bearing winds could not be able to penetrate into and cool down such regions.” in the revision.

- Page 8, line 15: Change “play as an important role as cloud condensation nuclear” to “play an important role as cloud condensation nuclei”.

The “play as an important role as cloud condensation nuclear” has been corrected by “play an important role as cloud condensation nuclei” in the revision by following reviewer’s suggestion.

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- Page 8, line 17-19: What are the main sources for aerosol in USR?

In the USR, the population is thin and the industries are few. Thus, aerosols in USR are usually nature aerosols. AOD and AAI are respectively standing for the concentration and absorbing effect of aerosols. In our research, it is easily concluded that the aerosols in USR are few and weak in absorbing.

- Page 8, line 28: Here CMA is inconsistent with the description on Page 7 which says “Gansu Meteorological Bureau”.

“Gansu Meteorological Bureau” is subordinate to CMA. We have re-clarified and made it consistent throughout paper in the revision.

- Page 9, line 11-12: not clear to the reader. Percentage of what?

Dust event percentage is frequency of dust events observed from the surface stations, i.e., percentage of the number of dust event days in total days. We have re-clarified that in the revision.

- Page 9, line 14-16: this can not convince the reader.

We have re-clarified that in the revision: “Because of proximity, dust aerosols from both the Taklamakan and Gobi Deserts are often transported to the CSR by gale and northern cyclone, which is active in the northwestern China. This is the reason that BD occurs more frequently than DS or FD.”

- Page 9, line 29 to line 2 on page 10: This sentence should be clarified.

We have re-clarified that in the revision: “If only one surface station in the CSR observed dust storms, blowing dust, or floating dust, those days are defined as dust event days (DED). Otherwise, they are classified as no dust event (NDE) days. Such strict criteria mainly eliminate dust aerosols’ effect during NDE days.”

- Page 11, line 5: “effective radius of cloud particles” should be added prior to “Re”.

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The “effective radius of cloud particles” has been added prior to “Re” in the revision by following reviewer’s suggestion.

- Page 11, line 9-11: Since the meteorological and many other conditions are different between USR and CSR, it is very difficult to draw a conclusion as described in these lines.

Conclusion given in page11, line 9-10 was based on assumption that liquid water path was fixed.

- Page 12, line 7: “climatology and semi-arid climates” can be changed to “climatic conditions”.

The “climatology and semi-arid climates” has been changed to “climatic conditions” in the revision by following reviewer’s suggestion.

- Page 12, line13-14: need to be clarified.

During NDE days, aerosols in the CSR are still much more than that in the USR. Those aerosols are not transported dust aerosols, but local aerosols. We have re-clarified the sentence in the revision: “Even though cloud properties in the CSR are significantly changed by those transported dust aerosols when dust events occur, the local aerosols could also reduce the cloud LWP during NDE days”.

- Page 12: line 17-18: “cloud effective height” should be explained.

Cloud effective height is calculated by linearly interpolating to the cloud effective temperature using the MOA profiles of temperature and height. Cloud effective temperature is the equivalent blackbody temperature of the cloud as seen from above. The temperature of the cloud generally decreases with increasing (decreasing) height (pressure). Thus, the radiation intensity from different layers of a cloud varies with temperature. An integration of that radiation over the cloud thickness, including the attenuation of radiation from lower parts of the cloud by the upper layers, defines the effective temperature. That temperature corresponds to some location between the cloud base and

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top. We have re-clarified that in the revision.

- Page 13, line 13-18: It shows that 77% of the difference in LWP between CSR and USR is due to human activity such as agriculture and industrial activities. Is this really true? If this is true, then human activities should not be suggested as “make some contribution to the regional interaction among aerosol-cloud-radiation-precipitation processes”, it is absolutely a dominating factor.

We believe that the transported dust aerosols are nature aerosols due to CSR is proximate to desert, thus the transported dust may not be contaminated. Local aerosols in the CSR are probably produced by human activity, such as agriculture and industrial activities. We know that influences of dust events are transitory, while influences of local aerosols are long term. Thus, such large contribution of human activity is not surprising. The value of 77% is just for difference in LWP between CSR and USR, rather than aerosol-cloud-radiation-precipitation processes.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 12465, 2010.

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