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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Dust aerosol impact on North Africa climate: a GCM investigation of aerosol-cloud-radiation interactions using A-Train satellite data" *by* Y. Gu et al.

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We appreciate the constructive comments provided by Reviewer 1. Below are our responses to these comments.

This work attempts a rare combined investigation of aerosol direct, semi-direct and indirect effects by performing an offline and a full GCM investigation. I recommend its publication after addressing the following points.

1. The empirical expression for the effective diameter reported in Jiang et al (2011) is used to characterize the relationship of effective diameter to AOD and convective index CONV. My guess this AOD cannot be totally attributed to dust particles. So, the title



seems somewhat misleading.

We agree with the reviewer that the De-IWC-AOD relationships reported in Jiang et al. (2011) actually applies to AOD from different aerosol types. In this study, our objective is to investigate the impact of dust aerosols on regional climate through their direct, semi-direct, and indirect effects. We specifically select North Africa region because a significant contribution of AOD comes from dust aerosols in this region (page 1, lines 52-57).

2. Only the effective diameter expression for the North Africa is used. This seems OK with the offline investigation; however, it poses problems in the full GCM investigation due to potential regional interactions. I suggest performing another experiment using all the empirical expressions for different regions and comparing the results.

Since the focus of this paper is on the dust impact, we determine that it will give a much clearer picture when dust is the only forcing in North Africa region. This appears to be a common practice in sensitivity studies (e.g., Menon et al. 2002; Ramanathan et al. 2002). We agree with the reviewer that ideally an experiment using all the empirical expressions would be more realistic for a full GCM investigation. This is a big task and we plan to continue the current study on aerosol indirect effect using available global AOD data and the De-IWC-AOD relationships for different regions.

3. The authors perform both offline and GCM investigations, but provide little comparative discussion between the two sets of studies. A paragraph to discuss the similarities and differences will definitely enhance the paper.

The comment is well-taken. We have added comparisons between offline and GCM investigations (page, 19, lines 467-469; Page 21, Lines 517-522). In the GCM simulation with dust indirect effect, the net radiative forcing at TOA, including both solar and IR, shows negative in the North Africa region. This is in line with the offline calculation result which illustrates the reduction in net forcing when aerosol indirect effect is included (Fig. 4f). When aerosol direct and semi-direct effects are included, differences

in OLR follow the patterns in cloud cover and precipitation instead of the dust loadings, indicating that the aerosol semi-direct effect plays a critical role in dust-induced climate change. A decrease in OLR and the consequence of an increase in net radiative forcing is shown, which is also reinforced from offline simulations with the aerosol semi-direct effect (Fig. 4c).

4. Minor comments: 1) P31404 and L16: delete “aerosols” 2) The last paragraph between L10 in P31415 and L 10 in P31416 fits better as the introduction of Section 4.

The two comments are well-taken and revisions followed (page 1, line 48; page 17-18, lines 424-453).

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 31401, 2011.