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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evidence of mineral dust altering cloud microphysics and precipitation" *by* Q.-L. Min et al.

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We thank the reviewer for very thorough and constructive comments and suggestions. They have helped us to improve the quality of the paper and our understanding. We have taken the comments seriously; they will be addressed in the revision.

1) It is good to use a transport model to study the movement of Saharan dust plume in this case. However, the satellite observations from Meteosat-8 clearly show the transport of the dust storm and its interaction with the mesoscale convection system (MCS). The high temporal resolution (15-mins interval) images from March 7 to March 8, 2004 have been attached as a supplementary material for this paper. The detailed movements of both MCS and dust plume are shown.

In addition, the entire transport process of the dust storm from its original outbreak

(March 3, 2004) to its encountering with the MCS (March 8 2004) is illustrated in http://oiswww.eumetsat.org/WEBOPS/iotm/iotm/20040306_dust/20040306_dust.html . All images come from Meteosat-8 SEVIRI at UTC 12:00. The standard RGB composites (12.0-10.8; 10.8-3.9; 10.8) suggested by EUMETSET User Service Division are used here. The dust plume appears to be pink, which can be easily distinguished from other features in the images.

2) The issue of smoke or dust has been addressed in the response to the short comments. In this case, MODIS retrieved coarse mode aerosol optical depth (AOD) ranged from 1 to 3, while the fine mode AODs were less than 0.1. It illustrates that aerosols were dominated by large size particles of mineral dust. Additionally, five other independent studies also verified that this was a typical dust case rather than a smoke case.

3) How to separate aerosol induced changes in MCS inner structures from that by dynamics is the key question in this study. We attempted to minimize the impacts of cloud evolution stages via three steps, as listed in response to reviewer #2. The MCS of our case, in which a portion of the MCS was under the influence of mineral dust, was in its mature stage. Indeed there are still some differences of evolution stage among each individual cell in the MCS. Some cells can be relatively younger/elder than others. We believe this is the reason there are some variation in Figure 3 under both dust and dust-free conditions. However, those points can be easily divided into two groups. The separation of the two groups is statistically significant. It indicates that the scattering associated with possible different stages (in addition to different dust loading) is the second order of variations comparing with the difference between dust and dust-free conditions.

We seriously considered the suggestions of using Meteosat 15-min resolution dataset. Measurements from sensors onboard Meteosat, however, do not provide information of inner structure of deep convection clouds. We analyzed cloud and precipitation in a domain from 4°N to 1°S and from 10°W to 5°E for a dust-free period (1-5 March 2004) and for a dust period (6-10 March 2004). The new study (sorry we can not upload the new plot right now, but we can send it to you if you want it) shows a consistent result with the case study in the paper. Observed reflectivities from the PR in the stratiform rain region of the dust period were higher than in the dust-free period at altitudes above 7 km. In contrast, the convective region of dust period has less frequent occurrence of high reflectivity than in the dust-free period. The cloud systems in these multiple rain events occurred in each period could be in different life stages and under different dynamic conditions. It further suggests that impacts of mineral dust on the observed features.

We did realize that the samples of active PR measurements are not large enough. As we outlined in the paper, we combined passive microwave, visible and infrared measurements with active PR measurements. The combined measurements provide information from precipitation inner structure to clouds, allowing us looking at dust-cloud-precipitation interaction from different view angles. All evidences from different instruments and directions provide a consistent picture of dust-cloud-precipitation interaction. We will follow reviewer's suggestion of concentrating on more qualitative interpretations in our revision.

4) We will correct those minor points in our revision.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 18893, 2008.