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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Asian dust storm observed at a rural mountain site in Southern China: chemical evolution and heterogeneous photochemistry" *by* W. Nie et al.

Anonymous Referee #2

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General comments:

In this study, the authors tried to describe the modifications of dust storm particles as the particles approached the observation site at Mt. Heng with the data they obtained during the passage of the dust event. Although the manuscript includes many solid data and the discussion sounds reasonable, the data and discussion are not sufficient to support the major conclusion that "the mineral dust . . . underwent significant modifications during the transport".

My major concern is the lack of the details of the dust plume arrival and passage and the sample collections. Authors used integrated filter samples to study the evolution

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of metals and ions. There are anthropogenic sources of mineral particles in China, such as coal burning emissions, road dust, and construction dust. They are the major anthropogenic particulate matters and frequently enhance the production of nitrate and sulfate in polluted air in China besides soot particles. I checked the weather charts and found that, from 25 to 27 April, the Mt. Heng areas were covered by a strong high pressure. The air was quite stable in this period and the weather conditions favored the accumulation of anthropogenic pollutants that were emitted from the surrounding areas (Fig.3 supports this expectation). From the evolution of PM2.5 and PM10 in Fig.2, the dust arrival was likely between the midnight 24 April and the morning 25 April. There are many papers reporting that dust plumes' arrival usually causes a short-time decrease of anthropogenic pollutants in the air in eastern China areas. In this regard, it is likely more reasonable, at least to a large extent, to attribute the results or evolutions shown in Fig.4, Fig.5, Fig.6, Fig.8 and Table 1 to the gradual accumulation of anthropogenic pollutants (including chemical reaction products on anthropogenic mineral and soot particles) than totally to the heterogeneous reactions on the dust storm particles. The effects of the dust storm particles might be small. In many places of the manuscript, the authors actually cited results on anthropogenic pollutants in published literatures to support their discussions, in particular in the subsection 3.3.

Therefore, evidences are necessary to demonstrate that the observed ions were produced, at least most probably, on natural-dust particles (i.e. the dust storm particles) rather than on anthropogenic mineral or soot particles if the conclusion is correct. My concern might be wrong. But authors do need to provide more details and evidences (such as comparisons with non-dust cases; the high-time-resolution evolution of weather conditions, NOx or SO2 or black carbon as in the upper panel in Fig.2; the start and stop time of the filter sample collection; the accurate time and position of air parcels from the backward trajectory calculation; and etc. . .) to fix the confidence of the conclusion. Otherwise, the results and conclusion may mislead readers and are difficult to be cited correctly and accurately.

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Other comments:

(1) The comparison between Mt. Heng and Mt. Hua needs to be conducted carefully by showing clearly if the comparison was on the same air parcel. This is because pollutants are usually not homogeneously distributed within the territory of a high pressure.

(2) Bimodal and monomodal distributions as shown in Fig. 4 can be frequently detected in polluted air with filter-based samples. They are not exceptionally meaningful in case of dust storm particles to the extent of the current manuscript contents.

(3) Fig.6: I cannot find why PM>1 was used in this figure and when these samples were collected. There is no explanation for it. Are the time periods of the sample collection similar to or different from those shown in Fig.8?

(4) "carbonate-rich Asian dust" may cause confusion. Carbonate is always one of the major components of Asian dust. It is true that some dust particles are carbonate-rich and some are not. But the methods of this study could not separately identify them and there is no such information in the manuscript. The discussion in the subsection 3.2.3 was completely a speculation without any evidences from this study. Fig.7 is not supported by the data in this paper. It is meaningful if the authors, with this model, can quantitatively (not qualitatively) explain the ammonium they speculated on dust storm particles.

(5) I am not sure when Sample-I, -II, -III, and –IV were collected. Descriptions for Fig.4 and Fig.8 in the text are not consistent with the figure legends or what the figures show. I consider them as shown in Fig.8 in this review.

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Interactive Comment