**Atmospheric
Chemistry
and Physics
Discussions**

Interactive
Comment

Interactive comment on "Dust storms come to central and southwestern China, too: implications from a major dust event in Chongqing" *by* Q. Zhao et al.

Anonymous Referee #1

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****I would rate the scientific quality of the paper between good and fair

The paper presents an investigation of dust storms in central and southwestern China based on data from Chongqing. The main contribution of the study is the suggestion that the influence of Asian dust on Chongqing and surrounding regions has been underestimated. My overall impression of the paper is that it presents some interesting information, but there are several major issues that need to be addressed, and the presentation needs major improvements to raise the standard of English.

First, I think it is essential that the authors emphasize that dust is a minor component of thePM2.5 aerosol. Now, it isn't exactly clear, but the fraction of the PM2.5 attributable

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to dust during the "major ADE" may have been only 15-20%. Overall, the contribution of mineral dust to PM2.5 was 6-8%, with a major fraction of the PM2.5 undetermined (the percentage was not given, but looks like it could approach 50%). While beyond the scope of this paper, I'd think that it would be important to find out what makes up that large undetermined component of the PM2.5 and that this issue should be included in statements regarding future work. Also, data for either PM10 or TSP also would almost certainly provide additional insights into ADEs.

Along these lines, the paper's concluding statement is this: "Since dust episodes are natural events, their effects should be carefully considered when developing and pro-mulgating China's National Ambient Air Quality Standard." While I agree with this state-ment in general, their study actually shows that dust is but a small fraction of PM2.5, and therefore its impact on air quality is arguably much smaller than those of other sources.

In their conclusions, the authors suggest, "that anthropogenic sources played a minor role during this dust event in Chongqing." This is based on their finding that some pollution-derived substances decreased during the ADE (see comment below), but they have not directly addressed the impacts of anthropogenic sources on dust loads in their study. Could this not be resuspended dust from construction activities or agriculture? They note that an assessment of sources is going to be presented elsewhere, but without seeing that information, the contributions from anthropogenic sources cannot be ascertained.

The method for estimating PM10 from the API needs to be described in some detail and more important, caveats included to make it clear to readers that the reconstructed PM10 not only includes dust but also other substances. The authors do acknowl-edge this albeit somewhat obliquely on page 27032 (l 32), but the limitations of the reconstructed PM10 should be made clear early on, preferably in the description of the method. The difference between PM10 and dust weakens the analysis of the chronol-ogy of the major ADE considerably, and furthermore, one would expect that much of

the PM10 could be from local sources.

A technical point regarding the calculation of dust concentrations. The authors statement (p28, line 8): "the mineral dust concentration, which was conservatively estimated from the 9 oxides of nine major crustal elements Al, Si, Fe, Ca, Mg, Na, K, Mn and Ti" is inaccurate. Earlier (p12, line 8), it was stated: "For other elements, the mineral oxides (K_2O, Fe_2O_3, MnO, Na_2O, Ti_2O) are estimated from Earth average crustal composition provided by Taylor and McLennan (1995), based on their ratios to Al." If there are no useable data for crustal K, Fe, etc., it doesn't make sense to estimate them from Al unless there is a reason to discuss them independentlyâĂŤthat is, no new information beyond what is contained in the Al concentrations is being added by this procedure (they are just weighting the Al data more than the other well determined elements). My suggestion would be to estimate the dust concentration based on the data for each of the crustal elements that is well determined and then take an average or weighted average of those estimates.

I also wondered why the authors relied on the Taylor and McLennan reference for crustal material. There must be good data for soils from the source regions available. This would likely not make a big difference, but would be a more valid approach.

Further in terms of crustal signatures, I have two questions (1) how are the elemental ratio lines in Fig. 6 determined? And (2) in each of these plots, especially Mg/Al, there a numerous points below the crustal lineâĂŤwhat do these points represent? One explanation is that they are the result of material containing Al from non-crustal sources, another is that the elemental ratios vary with dust load, which could be possible if there the mineralogy or particle sizes with dust load. Finally, this could be a consequence of analytical uncertainties, which brings me back to question (1)âĂŤwhat are the uncertainties associated with the ratios determined in this way?

Throughout the paper the authors allude to differences or significant differences between concentrations (or that the concentrations for one site were higher than the

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other). There is no indication of statistical significance here or whether any tests were done to evaluate the significance of the differences; therefore, the validity of these statements and arguments is questionable, e.g., the difference between 130 and 118 on pages 27026 and 27. Further, there appears to be a mismatch in data between Chonqing and Beijing, and I did not see that the authors adjusted for this in their comparisons. The reason for the data gap needs to be explained and taken into account even if it is only a failure of the sampling gear.

I am having some difficulty reconciling the argument (p27040), "This suggests the Asian desert dusts are influencing air quality over broad regions of China." with another argument (p27041): "Because meteorological stations are normally located at reachable sites such as urban areas or agricultural lands, there can be other days when ADEs are present in remote regions but go unreported." That is, the authors might want to modify their conclusions and argue either that the dust storms are of a broad regional scale or they are small enough to affect remote sites but not areas where observations are normally made. (I would argue the former is more often accurate). Indeed, the x-y plot of the dust concentrations at Chongqing vs. Beijing shows that the correlations between the dust concentrations are driven by a small number of pointsâĂŤthese presumably represent the large-scale events.

Minor points

The African deserts are larger sources of dust than the Asian ones, so the first sentence of the Introduction is not accurate.

P 27023 (henceforth just P23, L 19) Since alkaline dust helps offset acidic aerosols (awk) L 25 is restrained by climatic (word choice)

P 24 L12 At the end is discussed the possibility (awk)

P 25 L3 The rural site was near the Jinyun L6 Great North China Plain, and <it> has

Sampling and analysis: technically, I think it is more accurate to state that concentra-

tions were determined rather than measured.

P27âĂŤis it possible to compare the TEOM and gravimetric data directly? L24 "elsewhere" could mean in another section of this paper, but what is meant is in another paper.

P29 L 28 I think of secondary aerosols as forming heterogeneouslyâĂŤthus the dust would provide surfaces on which reactions would occur but not lead to secondary particle formation. In fact, reactions on the dust may well remove aerosol precursors from the atmosphere and reduce the number of secondary aerosols formed!

P35 L 17âĂŤwhat's the significance of 3 km? (with reference to above or below it?) L 25 During this event... (which event?)

P36 L 5 "were kept" (word choice) L6 "took over" (word choice)

P37 L 2 throughout the event (which event?) L5 low- and high- pressure systems began to accumulate over these regions simultaneously (not sure this is accurate) L 19 observed (How?)

P38 APIs and transport pathwaysâĂŤeven assuming the APIs were a measure of PM (the index also can be affected by trace gases), dust is a small fraction of PM2.5 and an unknown fraction of PM10 or TSP (but probably a minor fraction in most cases) and so the APIs are generally not directly related to dust concentrations. L20 it activated a variety of deserts {caused the production of dust (or dust storms) in}

P42 L 9 The pollution-derived components, such as Pb, SO4, and OC, decreased significantly as Al concentration increased (In other studies, pollutants have increased during Asian dust stormsâĂŤwhy should they decrease as dust loads increase?) L 15 dusts were (I'd change this to dust was) L 24 "normal pollution events (strange expression)

Tables & Figures

I assume tables and figures should "stand alone" and in several cases the tables and figures in this paper do not.

Table 1. Give N, the numbers of samples. That do the +/- denote? There should be a footnote for the abbreviations. Too many significant figures, I'd think.

Fig 1. Spell out names Fig 2. Are the enrichments the same or different among sites? Fig 4. I would change the x-scale (maybe just the labels need to be changed) to be time and show the concentrations as horizontal lines, with samples connected by vertical lines. Fig. 6. Doesn't need to be in color.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 27021, 2009.