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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Physical and chemical properties of deposited airborne particulates over the Arabian Red Sea coastal plain" *by* Johann Engelbrecht et al.

Anonymous Referee #1

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The present manuscript describes and analyzes the measurement of dust deposition at 6 sites at the King Abdullah University of Science and Technology (KAUST) campus along the Red Sea. The description includes local meteorology and instruments used. The analysis includes size distribution, chemical and mineralogical composition of dust. They compare their results with a previous work performed on soil sample of the same area. It is interesting to see their similarity. They also compare with measurements at other locations in the Arabian Peninsula, Middle East and United States.

These results could quite useful to better characterize dust in the atmosphere. Unfortunately, their use by the modeling community necessitates assumptions, which have

not been discussed. The only thing they provide is a figure showing the number size distribution at one collection site, and they suggest to derive from this figure the mass of particles. This method is inadequate. First, they should provide the values in a Table. Second, this implies assumption concerning shape and density, which varies with soil texture. Third, they should provide variability between sites.

In addition, some work will be necessary to better structure the text, and to clarify some sentences throughout the manuscript. There are also grammatical errors, and typos to correct.

Overall, some efforts have to be done to improve the manuscript and make it more appropriate for publication in Atmospheric Chemistry and Physics, but otherwise it would be a good paper.

Detailed comments: Abstract: Page 2, Line 21-22: "These data will also support dust modeling.. mass balance and optical properties". I wish this would be true. But there is no possibility to derive mass balance from one figure of number size distribution. Concerning optical properties, they are strong function of size distribution. Providing mineralogical data as a function of size will make this paper really useful.

Introduction: The Introduction should be reworked. Some paragraphs in subsequent sections could be moved in the Introduction to improve the reading of the manuscript. I would suggest the following structure, which hopefully help in my following comments. 1. Introduction 1.1 Importance of dust 1.2 Importance of mineralogy 1.3 Previous work on mineralogy 1.4 Gaps 1.5 How is your work filling the gaps 2. Description of the area 2.1. Meteorology 2.2 Dust sources and deposition

Page 3, Line 4. I would rather use Schulz et al. (2012) instead of Bergametti and Foret (2014). It is a more appropriate citation for uncertainties associated with model dust deposition. Page 3. Line 9: "..important dust source regions". You may want to cite the comprehensive work on the subject by Prospero et al. (2002) and Ginoux et al. (2012) Page 3 Line17-21: Limit the number of citations to key papers. Page 4, Line

19 –Page 5, Line 4: this paragraph does not fit in the flow of thinking. I suggest to move it in the proposed Section 2.1 providing description of the general area. Page 4, Line 5: You never say why mineralogy is important, although this should be the key motivation of this work. You should develop this into a full paragraph (proposed Section 1.2). Page 5, Line 9: “However” remove Page 5, Line 12. Break the sentence after the citations, and replace “varying with” by “Its adverse effects will depend on” Page 5 Objectives: This should be articulate within the Introduction. Start by saying why mineralogy is important, then what has been done, then what is the originality of the work, and then finish by providing a succinct outline of the manuscript. Page 5, Line 25: “plain to be an” => “plain is an” Page 5, Line 25: remove “province” Page 5, Line 25-26: sentence unclear, and provide a reference. Page 5, Line 27: remove “inevitably” Page 6, Line 8-18: you repeat yourself. Restructure as suggested. Page 6: Line 20-25: Move to suggested Section 2.2 where you describe the general area. Page 8, Line 15 “soils and dusts” replace (as well as all other occurrences) by “soil and dust”. Page 8, Line 16-18. This is an argument showing the importance of mineralogy and should be moved in suggested Section 1.2 Page 8, Line 19-23: It is unclear what are these 3 methods for. Are they all used for mineralogical analysis? What are the benefits of using 3 methods? Page 9, Line 1 to 14. I don’t see the relevance between your measurement and ambient temperatures. Does it matter? On the other hand, did it rain anytime? Page 9, “Gravimetric Analysis”: In Figure 5, you did not discuss the peak in dust deposition in August in DT3. This maximum is 3 times higher than the annual mean, and 30% higher than DT4. Why such difference between DT3 and DT4 and all other sites in August? This factor 3 difference will affect your analysis, but first you will have to know its origin. Is it construction? What is the mineralogy or chemical components of construction dust? Do you see its signature in your data? Page 10, Line 5-7. Reformulate the sentence. => The dust deposition measured in Kuwait on the other hand, varies substantially between sites due to the contribution from disturbed soils in lowlands during periods of northwesterly Shamal. Page 10, Line 8-13: Remove, this is repeating what is already in Table 3. Page 10, AERONET:

You should either use the Ansgtrom exponent to screen out non-dusty days or use SDA coarse mode optical depth. Page 10, Line 26: “dust particles are predominantly from local sources” but in Abstract you wrote “dust deposits along the Red Sea coast are a mixture of dust emission from local soils, and soils imported from distal sources.” This is contradictory. Page 10 Line 28-30: You should remove and screen AERONET data using low Angstrom values, or use AERONET SDA coarse mode AOD. Page 11, Line 10: Merge Figure 6 and 7. Page 11, Line 13-15: This is irrelevant for this study. Remove. Page 11, Mineral analysis: A point that needs clarification is the units. Are all the % values given by mass or by number? In section 4.6, it is specified by mass. This means that you should be able to provide the mass size distribution! Page 12, Line 11: “DT1”. Why only one site and not all of them? Why is there no standard deviation in Figure 9a. What is the error associated with these measurements? Page 12, Line 21-22. “. . . Figure 9 could be used to distinguish the contribution of PM10 in deposited mass and reconcile models with observations.” Are you suggesting that modelers use a ruler to derive approximately some fraction of particle numbers, then assume some density and shape for each sizes? This is an inadequate method. You should provide the values of each dots of Figure 9a in a Table,as well as the errors associated with the measurement, and assumptions on shape and density. Page 13, Line 3 “soils and dusts” => “soil and dust” Page 14, Line 13: “This paper has as its goal the provision” Needs to be reformulated Page 14, Line 16: “..meant to be used for validating dust mass balance..” No. The method suggested in Section 4.5 is inadequate. Page 15, Line 3-4 contradicts Line 5-6. Page 15, Line 12: you may want to add “construction dust”. Page 15, Line 13: “To better represent..” In what sense? By models? This may be a good place to add that the “inclusion of particle size into mineralogical and chemical analysis will provide more effectively data for the modeling community.” Page 25, Line 4: “Locality” => Position Page 25, Line 5: “campus. . .Sea” => on the Arabian Peninsula (red dot) Page 27: Provide a Figure caption rather than an analysis of the Figure. Page 28: add the color of each lines in the Figure caption in parenthesis. Page 30 & 31: Merge the 2 Figures. Page 32: Is there a possibility to split between fine,

coarse and super-coarse modes? Page 33, Figure 9a: Error bars

References: Ginoux, P., Prospero, J.M., Gill, T.E., Hsu, N.C. and Zhao, M., 2012. GlobalâĂŘscale attribution of anthropogenic and natural dust sources and their emission rates based on MODIS Deep Blue aerosol products. Reviews of Geophysics, 50(3). Prospero, J.M., Ginoux, P., Torres, O., Nicholson, S.E. and Gill, T.E., 2002. Environmental characterization of global sources of atmospheric soil dust identified with the Nimbus 7 Total Ozone Mapping Spectrometer (TOMS) absorbing aerosol product. Reviews of geophysics, 40(1). Schulz, M., Prospero, J.M., Baker, A.R., Dentener, F., Ickes, L., Liss, P.S., Mahowald, N.M., Nickovic, S., García-Pando, C.P., Rodríguez, S. and Sarin, M., 2012. Atmospheric transport and deposition of mineral dust to the ocean: implications for research needs. Environmental science & technology, 46(19), pp.10390-10404.

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