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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Apparent dust size discrepancy in aerosol reanalysis in north African dust after long-range transport" *by* Samantha J. Kramer et al.

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Review of Kramer et al. for ACP This paper investigates the size distribution of long-range transported African dust at Miami, Florida and compares in situ measurements of the (size-resolved) concentration against aerosol reanalysis data. They bring to bear a wide variety of experimental and numerical tools, and the breadth of the analysis is impressive, making for overall robust results. The authors find that the surface concentration of dust at Miami is somewhat overestimated by the reanalysis products and is also finer than represented in these (highly similar) reanalysis products. This last conclusion is counter to findings by several other studies, including my own, so is

surprising and possibly important.

The article is well written and is overall excellent science. I do have some comments the authors should address before publication:

âĂć The conclusion regarding the overestimation of dust surface concentration by the reanalysis products is confusing in the abstract. Line 7 of the abstracts notes: "Measured near-surface dust mass concentrations slightly exceed model values" whereas line 13 notes: "model dust mass concentrations near the surface are higher than those measured". Please resolve these seemingly contradictory statements.

âĂć A methodological problem is that the authors are comparing modeled dust size distributions in terms of geometric (volume-equivalent) diameter Dg against measured aerodynamic diameters Da. But because dust is both very aspherical (e.g., Okada et al., 2001; Kandler et al., 2007; Huang et al., 2020) and has a much larger density than water, a particle's geometric diameter is smaller than its aerodynamic diameter and a correction should be made. I recommend using the simple correction based on shape data in Kok et al. (2014), namely Dg = 0.75 Da.

âĂć I'm confused about GEOS-5 FP versus MERRA-2. The abstract describe these as "closely related" but section 2.4 ("GEOS-5 FP/MERRA-2") only includes a description of GEOS-5 FP and does not discuss MERRA-2. Please clarify the distinction (if any?) between these two products.

âĂć Data availability – the authors note data is available from the first author, but these data are valuable to the community and really ought to be posted on a publicly available repository.

âĂć I think Figure 9 is the paper's most salient result – that surface dust in Miami is finer than represented in aerosol reanalysis products – but some corrections need to be made to the presentation. Panel c shows dust mass concentration versus diameter in terms of bars, and a reader would reasonably conclude that the surface area of the bar

is representative of the mass of aerosol in that size class. But that is not the case here, and instead the total mass in each size class is plotted. This leads to a distortion of the data in that larger size bins will be correspondingly larger (e.g., if you divide the 4-10 um bin into two separate bins, then each bin would be only half the height of the current representation). To fix this, the authors need to normalize the mass concentration by the diameter range, which is equivalent to plotting dM/dD, as is standard (although they could also plot dM/dlnD and use a logarithmic x-axis).

Minor comments: âĂć Line 27-29 on p. 4: “some reduction in aerosol asphericity may also occur from chemical aging”. Measurements indicate that chemical aging of North African dust is quite limited (Denjean et al., 2015), and Huang et al. (2020) just showed that North African dust becomes more aspherical during transport, probably because of preferential settling of spherical dust particles. So this statement should be adjusted.

âĂć P. 11: “transport of at least 20,000 km”. Earth’s circumference is ∼40,000 km, so this seems incorrect.

âĂć Second column of Table 1 should specify that this is diameter.

âĂć Table 2. Length > width and aspect ratio >= 1, so the entries in the last column (which are all < 1) should be the reciprocal number. It’d be interesting to note how the measured aspect ratios compare to other literature data on dust shape, as compiled in Huang et al. (2020).

âĂć Figure 2. If there is no data, then no data should be plotted, so please remove the zeroes for the bulk mass concentration data (8/4-8/9).

âĂć Figure 3: please note units for dust mass concentrations in caption.

âĂć Figure 7: please note whether correlation is taken in linear or logarithmic space (it ought to be the latter since the data spans several orders of magnitude).

References

Denjean, C., Caquineau, S., Desboeufs, K., Laurent, B., Maille, M., Rosado, M.Q., Vallejo, P., Mayol-Bracero, O.L., Formenti, P., 2015. Long-range transport across the Atlantic in summertime does not enhance the hygroscopicity of African mineral dust. Geophys. Res. Lett. 42, 7835-7843.

Huang, Y., Kok, J.F., Kandler, K., Lindqvist, H., Nousiainen, T., Sakai, T., Adebiyi, A., Jokinen, O., 2020. Climate Models and Remote Sensing Retrievals Neglect Substantial Desert Dust Asphericity. Geophys. Res. Lett. 47, e2019GL086592.

Kandler, K., Benker, N., Bundke, U., Cuevas, E., Ebert, M., Knippertz, P., Rodriguez, S., Schuetz, L., Weinbruch, S., 2007. Chemical composition and complex refractive index of Saharan Mineral Dust at Izana, Tenerife (Spain) derived by electron microscopy. Atmos. Environ. 41, 8058-8074.

Kok, J.F., Mahowald, N.M., Fratini, G., Gillies, J.A., Ishizuka, M., Leys, J.F., Mikami, M., Park, M.S., Park, S.U., Van Pelt, R.S., Zobeck, T.M., 2014. An improved dust emission model - Part 1: Model description and comparison against measurements. Atmos. Chem. Phys. 14, 13023-13041.

Okada, K., Heintzenberg, J., Kai, K.J., Qin, Y., 2001. Shape of atmospheric mineral particles collected in three Chinese arid-regions. Geophys. Res. Lett. 28, 3123-3126.

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