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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Particle size traces modern Saharan dust transport and deposition across the equatorial North Atlantic" *by* Michèlle van der Does et al.

Anonymous Referee #2

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Van der Does and colleagues present their preliminary findings for one year of data from a multi-year sampling campaign, aimed at retrieving samples of dust deposited to the equatorial Atlantic Ocean (at latitudes ∼12 N), utilizing a transect of moored sediments traps at different water depths, downwind from the North African dust sources. The aim of this ambitious project to better constrain the evolution of the North African dust plume is of certain interest, and it is positive for the atmospheric and dust communities to be informed about these preliminary findings. This is a very interesting study, and the manuscript is in general well organized and quite clear. Nonetheless I do revise three major aspects that would deserve some revision, in order to clarify the work and perhaps improve the possible interpretation of the data.

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Discussion paper

General major comments

The particle size distributions are central in the manuscript. Nonetheless the descriptive metrics that are used for some of the diagnostic plots are only briefly mentioned. I think it would be very important to clearly show a validation of the metric used (e.g. mode of distributions fitted using GRADISTAT) against the specific observational data, before following with the discussion. This is particularly relevant since many of the samples show an apparent bi-modal distribution.

In the discussion of the data, the coarseness of grain size distributions is assumed to mimic the behavior of dust deposition flux, despite the fact that such information is not reported. In addition, a full comparison among different samples is hampered by the lack of this piece of information.

Some of the interpretations of the data provided in the discussion remain rather speculative. Please see the specific comments below.

Specific comments

2 / 8-9. Which is the mechanism that would explain this statement, in relation to the previous sentence?

3 / 26-32. I would argue that the point here is that we need to quantify how far a significant number of those particles can travel, to both (a) constrain the inputs to the ocean and (b) be able to estimate if, because of their actual amount, they are in fact relevant in terms of direct radiative effects or rather they could actually be ignored from this point of view, as typically done so far in models. That is why it would be important to have dust deposition fluxes associated to the size distribution data. If this piece of information is not available, the discussion should take into account this fact, and the interpretation of similarities / differences in the samples should be pondered accordingly.

4 / 30. Briefly, why did you discard some of the traps?

5 / 19-20. Please clarify if you refer to radius or diameter, here and throughout the manuscript.

5 / 20-21. As indicated above, please discuss much more extensively this aspect. For instance, describe how the method works, and show the comparison of the full distribution and the metric (mode) for two-three representative cases, e.g. a typical sample for each Winter, Summer, Spring from Figure 5. This should highlight how the metric vary according to the distribution's shape, thus help better understanding/constraining the following interpretations. This should also highlight whether the choice of the metric is the best option or better ones could be adopted in this case.

5 / 30. Did you only simulate four days? Later in the manuscript (9 / 31-32) it sounds like you may have selected four days out of a larger ensemble? Is that the case? If so, it would be interesting to see those. If not, how did you exactly determine that those would be representative days?

6 / 1. Do you have dust deposition flux data? I believe that all the comparisons among the samples in this study and the derived interpretations are subject to the limitation of not being associated to dust deposition fluxes. Therefore only partial information is available to derive conclusions.

7 / 14-17. As already mentioned, I think that the point is not whether a handful of giant particles make it a great distance, but rather how many and how far. If they appear to be quantitatively important, then this suggest that models should account for that, and they will need data to constrain their results. Hopefully your study will help addressing this issue!

7 / 17. "Preferentially" vs what? Please clarify this sentence.

7 / 25-30. This paragraph seems very speculative: there is no support to it in the discussion, and no time control is reported about the age of those seefloor sediments.

8 / 11-15. Here you seem to suggest a direct relation between coarse grain size and

high dust load (or AOD), and for extension to a high deposition flux? The reported study of Skonieczny et al. (2013) on the other hand shows coarser dust deposition at M'Bour, Senegal, associated with the season of low dust deposition flux. How would you justify your assumption in light of that? I think that absolute magnitudes of size distributions could help here in two different ways, most importantly with reference to Figures 6, 7, 8, 11. First, absolute values of particles concentrations (i.e. counting statistics on the direct output from the particle counter) may help to understand if the "shoulders" associated to the larger particles are actually statistically significant in all cases. One can see "tail effects" associated to sometimes individual large particles in low concentration samples such as from ice cores (e.g. Albani et al., 2012). This piece of information should be considered together with the choice of the mode as a metric to compare those samples. Second, even when samples are screened against possibly noisy signals, any interpretation on the actual quantitative transport potential (whether with season, or distance, or depth) of giant particles remains speculative without deposition flux data. The same way, in order to trace the spatial evolution of the North African dust plume, size distributions are necessary but not sufficient. Comparing sediment records from the Atlantic on different size ranges in fact yield surprising results, demonstrating the importance of considering both size distributions and fluxes (Albani et al., 2015). If this piece of information is missing, then the discussion should be extended to discuss the possible limitations of the derived interpretations.

8 / 24-28. Interesting approach!

8 / 31-32. Quite the opposite. I cite: "On balance, the measurements (Fig. 4) indicate that dust PSD is independent of the wind speed at emission. This conclusion is supported ..."

9 / 3. I would suggest changing "these air layers" with something like "the starting points for back-trajectories calculations".

9 / 8-9. This sentence is not very clear, please rephrase.

9 / 12-14. It seems that here “air-layer” is used to indicate “air parcel trajectory”?

9 / 15-18. You are not showing this. Please at least provide some reference.

9 / 18. “Increased deposition”: where?

9 / 21-22. How do you know? You do not show any information about the atmospheric column above.

9 / 23-24. Again, it is not clear whether the mode is a good metric to compare bi-modal distributions.

9 / 25-30. How does a laser particle counter sees a flat particle? Overestimate it’s spherical equivalent diameter? See e.g. Reid et al. (2003). How do you interpret this in your data, and according to the evolution of size distribution with distance from the source?

9 / 30-32. As already mentioned, if more back-trajectories calculations were performed, it would be interesting to see them.

10 / 1-6. Also in this respect, absolute values of concentration and most importantly dust deposition fluxes might shed some light on the issue. In addition, a little more discussion on the fate of particles throughout the water column and the the expected relation to the corresponding surface water and atmosphere could be added here.

10 / 11. Please add also here in the conclusions whether you refer to particle radius or diameter.

10 / 11-12. As indicated earlier, this statement is so far very speculative.

10 / 22-23. From your study, one would expect to learn how many.

Figure 2. Please differentiate the markers based on the depth for M2 and M4.

Figure 7. Could you provide a brief explanation about those outliers?

References

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