

Interactive comment on “Seasonal provenance changes of present-day Saharan dust collected on- and offshore Mauritania” by Carmen A. Friese et al.

Anonymous Referee #1

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Review of the manuscript “Seasonal provenance changes of present-day Saharan dust collected on- and offshore Mauritania” by C. Friese et al., submitted to ACPD:

The work is an extensive analysis of different dust samples, sampled both on land and in the ocean. Samples were analyzed concerning different properties as grain size distributions and mineral composition, aiming at assigning source regions to the samples. Samples on land seem to be more influenced by local sources than oceanic samples, and it is indicated that long range transport decreases the average grain size of the deposited dust. This is all interesting and important information. However, being not a mineralogist, some passages were difficult to follow, and the overall structuring should be improved as well (see below). Also, occasionally statements seem to be

C1

too far-fetched. So in total, my judgement is that the manuscript can become fit for publication in ACP, but only after major revisions.

General comments:

Several times in the manuscript, the impression is given that dust settling from the SAL starts to appear at the time when the air mass crosses the shore line, i.e., that SAL is a dust source above the Atlantic, only. This might just be formulated misunderstandingly, but in any case, dust will always settle from the SAL – it is just that on land, where nearby dust sources are present, they might be overwhelming. You have to go through the text and change the respective passages accordingly.

Your tables 1 and 2 are helpful, already, but I would have wished for an additional overview, showing which of the different locations contributed data for which kind of analysis. Also, all sites should be introduced together. E.g., Buoy Carmen is treated differently from CB and CBi, appearing for the first time in line 161, but not being shown in Fig. 1 and Fig. 2. Fig. 4 then shows the location of Iwik, CBi and Carmen and also of two new locations, but not the location of CB. This is all confusing, and a table could help to clarify that e.g., one place was only used for its information on meteorology, another one only for size distribution, etc. . Similarly, it is not clear to me what is gained by showing wind directions in Nouadhibou if information from that location is then dismissed due to local effects, unless you want to make it clearer that ground based sampling on land will not reflect long range transported dust (due to local sources and local winds) – but in this case, this needs to be discussed somewhat stronger. Consequently: if there are these local effects on land, will Iwik not be influenced similarly? This should be discussed, too.

For your determination of possible dust sources, you use trajectories in heights of 10m and 4500m. You chose 10m based on your even lower sampling heights. But still, trajectories in heights as low as 100m or below are always very prone to errors, and 4500m is so height that it might be above the heights of the SAL. Please at least

C2

mention that and explain why you chose to calculate the trajectories at these heights, nevertheless. Alternatively, choose additional different heights (e.g., 100m and 2000m or so) – you could check, if they are similar to those you used. Adding them could add credibility to your work.

When you discuss the dust sources, the basic assumption seems to be that there is always one source with one mixture of minerals. But couldn't dust be emitted from areas with differing mineral composition in one dust storm (in fact, even the regions you selected as "major potential source regions" are not homogenous concerning the mineral compositions). My understanding of mineralogy might be too limited, here, but for me the attribution to the characteristics of the sampled dusts to the source regions seemed to include a lot of guessing. Again, tables could help, showing minerals that are present in the different "major potential source regions", and at the same time showing the minerals found in the different samples. This would certainly have helped me to follow your conclusions. Also, statistically, the number of dust sample cases that could be evaluated and the number of particles analyzed all are rather low. It is, no doubt, a lot of effort to do all this, but the resulting data should not be overrated. In this context, certainly the last sentence in the "summary and conclusion" (line 843) (and some other sentences as well) is formulated too strongly.

Specific comments:

Line 67-69: Is this statement taken from one of the papers cited in the text close by? Which one? And in general: How far offshore can regional / local dust emissions be found? (Or, in other words, how large is the "footprint" of a dust source when it does not emit the dust to large heights?)

Line 82: Do you mean your Fig. 1 or the Fig. 1 from Scheuven et al.? Clarify.

Line 383: Arkeiss and Iwik are not oceanic, are they? Rephrase.

Line 432 - 436: This discussion about dust fluxes is confusing, and I suggest to com-

C3

pletely remove it, also because (see next comment):

Line 438: Not surprisingly, the sampling heights has influences the results. This prohibits a direct comparison of mass concentrations and such parameters between the different sampling types (on mast and in traps in the water), while comparing shapes of size distributions and dust compositions might be possible. This should be discussed in the text somewhere. It is mentioned at line 607 again, but also not discussed. Based on this, a comparison of fluxes between the stations makes no sense.

Line 450: The bi-modal distribution of Iwik 13-14 is shown in Fig. 6c, right? Add this information to the text.

Fig. 6: There is a change in sequence between the two captions, which I found disturbing. I'd prefer to always list - CBi - CB - Iwik. Also: maybe put the black data on top of red one, in the plot, otherwise they are hard to see, or make a mix, so that at least some of the black ones are visible a bit better.

Line 452: Explain what you mean by "the sorting".

Figure 7 a) and b): Why was a different wind speed chosen in a) (> 5 m/s) and b) (> 6.5 m/s)? Also: there is a frame around Fig. 7 (on 3 of the 4 sides) that has to be removed for the final version.

Line 527: Why are there 2 back trajectories, only? Were they only made for the time of the dust event? Then why 2 and not only 1? This has to be clearly explained (this also is valid for Fig. 10, 11, and 12, where different numbers or trajectories are shown.)

Line 538: Just out of curiosity: does sea spray (i.e., the Cl in it) engrave the analysis of chloride?

Figure 9: The line for the 4500m back-trajectory for CBi is in the caption, but not in the plot. But it could be interesting to see it in here, as the dust transported from further away at higher altitudes might also contribute. This comment is valid also for Fig. 10.

C4

Line 551: Replace “due to the” by “as there are”.

Line 596 ff: Was this for PM10 or total particulate mass? What exactly do you mean by “annual average dust concentrations”? The average per dust storm, or really the all-time average of dust, or something else? Please explain. Also: It is not clear to me how the monitoring of less dust events in Morocco due to the shorter sampling time can affect an average value, unless this average is “per year”.

Line 606-607: If the difference is due to different sampling techniques, does it make sense to do such a comparison as you present it here?

Line 608: In which time span does 1% drop out of a moving dust cloud? Per day, per year, ever (certainly not), ...?

Line 613-614: Replace “in the following” by “as follows”.

Line 638: You could stress stronger that a bi-modal size distribution (as observed e.g., at Iwik in Fig. 6c) be indicative for nearby sources. Different size modes typically indicate different sources!

Line 641: Not only the wind speed, but also the heights into which dust was emitted, will influence how far it can be transported.

Line 648: I have a hard time imagining how precipitation droplets (with typically high fall velocities) enter your sampler in noticeable amounts. Or do you suggest here that precipitation is formed, falls, evaporates during its fall and leaves these dust particles behind at lower altitudes which can then be sampled? If this is so, mention it.

Line 692: Prior to this line, you explain that quartz seems to be present “everywhere” in North Africa. If this is the case, a high quartz content cannot be used to assume that it is mainly locally derived dust.

Line 736: This argument can only be correct if only this one nearby source does not have the mineral palygorskite in it, while it would be present in ALL other sources. Also:

C5

not finding palygorskite might simply be an issue of low sampling statistics – can you exclude this? So overall: Can this text in the manuscript really be stated like this? This is also connected to what you state in line 709, so check this location for consistency, too.

Line 784 ff: How fast do dust particles sink in the water – can they travel 500km and still be collected at the sampling site CBi? Or, in other words, how large is the catchment area of a trap? You mention 40km * 40 km above in the text yourself for the upper trap? Therefore, it seems that the here described time delay cannot be used as an explanation.

Line 833-835: For continental sampling, rather than using the word “trade wind”, the word “nearby sources” would be more appropriate. Also, the discrimination between dust particles transported in the SAL or by the trade winds is awkward. The trade winds transport the SAL, while the SAL is the source of particles that deposit from air masses that are moved by the trade winds. In this sense, “trade wind” and “SAL” both contribute together and should not be separated. The formulation needs rewording. Also check the whole text to remove respective inconsistencies.

Line 836-837: This result was only presented in bypassing (line 731 – or am I missing something), and I was quite surprised to see this as one of the main findings. On the other hand, changing grain sizes with distance to sources are not mentioned at all. I suggest to really reconsider which of your results are worth mentioning here, as for some readers, abstract and summary might be all they will ever look at.

Line 842 ff: The wind at the sampling location might differ from the wind in the source region, if the latter is far away, and the sizes of dust particles present in the source region will influence the grain sizes that can be deposited as well. There might still be a connection between wind speed and transported grain size, but it should be discussed in a broader sense, including (or at least mentioning) the points I raise in the previous sentence.

C6

