

Interactive comment on “Compositional changes of present-day transatlantic Saharan dust deposition” by Laura F. Korte et al.

Anonymous Referee #2

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Korte et al. present an interesting account of the total mass and compositional fluxes of African dust across the Atlantic Ocean. This study is complimentary to the size-dependent transport study by van der Does et al. (2016). Generally, the authors report higher concentrations of mass closest to Africa and the Caribbean, yet the composition changes as dust is transported downwind, indicating different dust sources of the study area. Although the authors present a unique story for ACP, there are several issues that need to be addressed prior to publication in its final form.

General comments:

Previous studies have demonstrated atmospheric transport of North African dust is strongest in the summer (Jun – Aug), which is not consistent with the current work. Can the authors comment on why this inconsistency exists?

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Chiapello, I., and C. Moulin (2002) TOMS and METEOSAT satellite records of the variability of Saharan dust transport over the Atlantic during the last two decades (1979–1997), *Geophys. Res. Lett.*, 29(8), doi:10.1029/2001GL013767.

Perry, K. D., T. A. Cahill, R. A. Eldred, D. D. Dutcher, and T. E. Gill (1997) Long-range transport of North African dust to the eastern United States, *J. Geophys. Res.*, 102(D10), 11225–11238, doi:10.1029/97JD00260.

The authors should more clearly link the spatiotemporal heterogeneity in the composition of the current work to the size-dependent depositional trends of van der Does et al. (2016), i.e., the smaller clays are transported farther while the larger quartz are deposited closer to Africa.

The first paragraph of the introduction contains a nice summary of previous work, but it reads somewhat like a list of dust observation references with reporting their main findings. The first few sentences do contain this information, stating the quantities of dust measured, but what about the latter half of this paragraph? In order to demonstrate how this study is an advancement of and unique from previous work, discussing what these previous studies found is useful. Additionally, the introduction, in general, is lacking broader implications for evaluating Saharan dust transport. Without the broader impacts, the motivation behind this work is not evident.

Clarification on some of the methods and calculations is needed, specifically pertaining to biogenic Si, the experimental setup with the mast and moored trap locations, and horizontal flux transport. See specific comments below:

Was BSiO₂ measured in the Iwlik samples to serve as a control; to truly indicate that this Si was of a marine biogenic origin? How was this silica discernable from the mineral dust Si? What would be helpful is if the methods for extracting and detecting BSi contained more explanation, especially since this is not a technique one commonly encounters in an atmospheric journal. For instance, why the 660 nm laser; does it differentiate biogenic from mineral Si somehow, or is there something done in tandem

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to the diatom reference material? How does this differ from, say, XRF, in terms of measuring Si? More explanation would be helpful for someone who is not familiar with this technique.

Horizontal flux transport indicates transport over a set distance, however, the authors present this factor as $\text{g m}^{-2} \text{d}^{-1}$, which indicates a time-dependent flux. I would assume both masts would be used to calculate the true horizontal flux of dust. Perhaps the wording is throwing me off here, but it seems as if this calculation is at one MWAC sampler as indicated on p8, l11, yet there were 20 samplers (2 masts with 5 pairs of samplers each). How far apart were these masts? Additionally, can the authors comment on how much of the dust flux is missed at higher altitudes, since the samplers extend up to 2.9 m but dust transport can happen up to 5 km?

For those of us not familiar with sediment traps, why were they located so deep and not closer to the surface where the dust would initially deposit and where the Northern Equatorial Current would carry dust from east to west? It seems like there would be a lot of room (literally) for different processes to remove the dust during sedimentation, like the deeper circulation from the conveyor belt in that region (N-to-S directionality). Since many readers will not have an oceanographic background, but are well versed in atmospheric transport mechanisms and how sensitive aerosol transport can be due to shifts in large and small scale circulation patterns, it would be helpful to provide a few sentences early on regarding Atlantic Ocean circulation and how this could potentially impact samples collected 2-3 km deep where the traps were located.

For the calculations of carbonates and OM: Where does the 8.33 correction factor come from for CaCO_3 ? For OM, it seems like this calculation is likely underrepresenting total OM. Why isn't the TON included in OM? There is more than just C in organic matter (O, S, H, N to name a few; see references below as a couple examples), so if these aren't accounted for, the authors should clearly state the limitations and caveats with this calculation. And lastly, what is Corg and how was this measured/calculated (is it just TOC)?

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Hazem S El-Zanan, Barbara Zielinska, Lynn R Mazzoleni & D. Alan Hansen (2009) Analytical Determination of the Aerosol Organic Mass-to-Organic Carbon Ratio, Journal of the Air & Waste Management Association, 59:1, 58-69, DOI: 10.3155/1047-3289.59.1.58.

L. M. Russell (2003) Aerosol Organic-Mass-to-Organic-Carbon Ratio Measurements. Environmental Science & Technology 37, 2982-2987.

Some clarification on the elemental components used for mineral classification is needed. For determining the elemental compositions of lithogenic and biogenic minerals, why is Ca not used? Wouldn't this corroborate the carbonates calculation from TOC and TC? For K, was biomass burning K removed? Central Africa is prone to fires and thus a large source of biomass burning aerosol (K is commonly used as a biomass burning marker). This could simply be resolved by calculating soil K, where $[\text{non-soil K}] = [\text{K}] - 0.6[\text{Fe}]$ and $[\text{soil K}] = [\text{total K}] - [\text{non-soil K}]$ from Kreidenweis et al. (2001). Kreidenweis, S. M., Remer, L. A., Bruintjes, R., and Dubovik, O. (2001) Smoke aerosol from biomass burning in Mexico: Hygroscopic smoke optical model, J Geophys Res-Atmos, 106, 4831-4844.

Along these lines, what is the possible contribution from sea salt minerals (i.e., K) recrystallizing during sample processing to the elemental concentrations? Even though the samples were washed for salts, could the authors comment on how salts could potentially recrystallize onto insoluble particles during processing?

None of the figures show uncertainties/error bars. For instance, the methods section says the total mass fluxes (MWAC) have a 90% collection efficiency, so that remaining mass not collected should be accounted for in the measurement uncertainty. In order to clearly draw statistically significant relationships between the months, error bars should be provided.

The seasonal maxima of the MWAC versus moored traps are offset. Can the authors comment on this in the discussion section?

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Specific comments:

P1, I17: The way this is written, it sounds like the authors are stating that the African coast is the source. Perhaps change to “African continent” or “North Africa”.

P6, I8: To be clear up front, it would be helpful to provide a statement saying which analyses were conducted on the MWAC and which were conducted on the moored trap samples.

P8, I2: State that lithogenic minerals are clays, quartz, and feldspars here. These are in fact listed but much later on.

P8, I6: Please provide the chemical compositions/components of these standards.

P8, I11-23: The addition of all the figures in parentheses in this paragraph place the figures out of order and cause confusion as they are not fully described (my eye was jumping back and forth between figures and text without enough clarification). It would be easier if references to these figures were eliminated here and remain discussed in the following sections. Additionally, this is a nice summary of what is to come, but perhaps providing a sentence at the end describing how all of these different observations will be used in tandem to develop the main picture “X” would clearly tie it all together.

P8, I26-27: Only Apr and Aug have the spikes (remove Mar and Jul).

Fig 3.: Swap the y and x axes to align with how time series are shown in the rest of the figures.

P9, I16: Why isn't the lower trap shown? At the very least, provide it in the supporting information.

P13, I14-15: It can also contain Ca in the form of calcite (see Glaccum and Prospero (1980)), although at < 10%. A reference for this statement is needed.

P15, I11: First mention of DUSTTRAFFIC; should be introduced in the methods section.

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