Review of the manuscript submitted for publication to the Journal of Atmospheric Chemistry and Physics entitled "Pollution affects Arabian and Saharan dust optical properties in the Eastern Mediterranean", by Marilena Teri et al. (ref. egusphere-2024-701)

By François Dulac, LSCE, 14 June 2024

Recommendation

Major revision

Reviewer Comments to Authors

Synthesis:

This manuscript analyses an extensive set of aircraft observations obtained in the eastern Mediterranean troposphere during the A-LIFE field campaign in April 2017. It focuses on the influence of the presence of pollution particles on soil dust particles long-range transported either form the Saharan or the Arabian desert. The paper is written in good English, well structured, and easy to read. I find that the topic is adapted to the scope of the journal and the proposed approach quite sound. Conclusions bring interesting new knowledge on optical properties of dust from the two main source regions affecting the eastern Mediterranean. I do consider that this study deserves publication. I think, however, that a revision is necessary to bring additional information and analyses. I hope that my remarks and suggestions listed below will be helpful.

Major comments:

1- I consider critical that the A-LIFE generic paper by Weinzierl et al., cited "in preparation" in the present manuscript, is not available to the reader. The corresponding reference given in the bibliography is quite approximative and let think that it might not be available in a near future. It is an important reference for the present manuscript, cited 10 times for various reasons. According to me, such a paper definitely needs to be available to the reader of the Teri et al.'s paper since it provides complementary information on the campaign, meteorological conditions, various dust events, aerosol composition and classification, including the aerosol classification methodology. If this A-LIFE generic paper were not available when submitting the revised Teri et al. manuscript, it would be requested to substantially increase methodological information to make the present paper self-consistent, especially regarding the dust cases classification.

2- The absence of information from microscopy analyses on the internal/external mixing nature of dust with pollution particles is a bit striking. The nature of mixing is an important information to understand how pollution particles affect dust particle properties, and variability in the type of mixing, e.g. between Arabian and Saharan dust, might explain some of the differences. I would expect this aspect on mixing is considered in the paper and that additional relevant information is included based on the microscopic investigations performed (see also comment 6).

3- Optical measurements used to derive the various Angström exponents are based on the blue and red channels (section 2.3.2). Given the wavelength dependence of dust absorption, I wonder whether useful additional information could not be derived from additional Angström exponents using also the green wavelength.

4- Suppl. line 78: I do not agree that the comparison between the simulated and directly measured optical properties is out of scope. Showing that the in-cabin optical properties are correctly reproduced by this approach would provide better confidence in the approach used.

5- Suppl. lines 125-126: you should be able to support this statement based on airmass trajectories and satellite products (e.g., see in particular the North African Sand Storm Survey products for dust source regions at https://nascube.univ-lille1.fr/).

6- Suppl. section S4.1 should be enhanced to consolidate relevant results: please specify the number of respective Saharan and Arabian dust particles analysed, how they were selected, and from how many cases of each type; referring to the particle size distribution of the analysed particles would also be helpful to discard a possible bias between Saharan and Arabian dust subsets; we also expect some details on the respective criteria used for defining the 7 particle types; what about possible variability between cases of a given type? What about internal/external mixing (see also comment 2); Figures S4 and F5 compare Arabian and Saharan dust, combining pure dust and moderately polluted dust cases; do we have the same proportion of those two types of cases for Saharan and Arabian dust; relevant information could be provided in section S4.1.

Minor comments:

7- Lines 261-262: there is some inconsistency since the UHSAS is wing-mounted and not an in-cabin instrument behind the inlet system.

8- Line 271: could you specify on which substrate are particles collected and the type of sampler used?

9- Legend of Figure 2: please specify the respective size of the three sub-samples (N= 37, 40, and 10, I assume, following the text).

10- Lines 315-317: I do not understand your conclusion on aerosol optical properties since we are only dealing here with mass contributions of various aerosol components.

11- Figure 3: please specify the respective size of the three sub-samples (note that it seems less than 37 and 10 points are plotted for pure dust and polluted dust, respectively) and plot correlation lines; in panel (a) at least, I would expect 2 significantly different slopes with respective r values computed separately for pure dust and polluted dust cases.

12- About Figure 2 and 3, can you conclude on the absence of differences between Saharan and Arabian dust?

13- I find that we miss comments on Table 1; in particular, could a variance analysis confirm whether the 3 subsets are significantly different or could be possibly reduced to 2?

14- Table 1 and Table 2: please add the respective number of samples of the 3 subsets.

15- Figure 4: please indicate respective number of samples of the 2 subsets.

16- Line 395-396: what about the case of Saharan dust in the western Mediterranean (Denjean et al., 2016)?

17- Lines 411-412: I would expect a figure to illustrate the statement on respective particle size distributions of Arabian and Saharan dust.

18- Line 447: I find that the conclusive statement is too strong and should be formulated a bit differently; I suggest “as sole indicators to detect the presence of mineral dust in case of mixing with pollution aerosols, because […]”.

19- Line 531: better specifying “considered” before “representative”; could you support this hypothesis with a reference?

20- Lines 354 and 542: the term “global” is probably not appropriate here; in line 354, do you mean “regional”?

21- Line 618: I would also expect some information on respective variabilities around those numbers.

22- Suppl. line 119: can we consider that the difference is significant (might you provide respective std. dev.)?

23- -Lines 963-964 and Suppl. lines 201-202: the very incomplete reference to the expected paper by Weinzierl and coauthors (in prep.) must be specified, or omitted and the paper content be augmented accordingly (see General Comment 1).

Editorial comments and suggestions:

-Line 34: after “absorption properties” replace “ and“ by a comma.

-Line 66: here, I would add Denjean et al. (2016) in the list of references.

-Line 73: I assume “my mask” should read “may mask”.

-Line 74: I suggest “place” instead of “emplacement”.

-Line 87: remove “decreasing”.

-Lines 96-99: I suggest a different formulation in a single sentence, e.g.: “However, optical properties of mineral dust from various source regions may be affected differently by mixing with pollution ([the 3 references reordered chronologically]) and this influence needs to be further investigated”.

-Lines 106-107: remove “’s” after “dust” (2 times).

-Line 112: prefer “we use” to “we ued”.

-Line 125: add “namely, ” before “the Arabian Peninsula”.

-Line 126: I would speak of “sub-sections”.

-Line 136: rather than “in Cyprus”, I suggest to specify “south-west of Cyprus” with latitude and longitude of the airport within brackets.

-Lines 138-139: I suggest “from the nearby deserts, the Arabian Peninsula over the easternmost part of the basin and the Sahara over the central basin”.

-Line 139: add “over the central basin” at the end of the sentence.

-Legend of Figure 1: I would add “, last accessed 16 January 2024” at the end of the source reference, and remove NASA-Worldview website from the bibliography (line 842).

-Line 221: “sizes” rather than “size”.

-Line 225: “measured” rather than “measure”.

-Line 229 and bottom note 1 in page 9, 2nd line: reverse order of the 2 references, for chronology.

-Line 236: specify “aerosol” before “single scattering albedo”.

-Line 206: please specify origin of the Dolomite dust used for tests; is there any related specification, commercial reference or publication that could be referred to?

-Line 246: change order of references for chronology.

-Line 275: I suggest “an aerosol classification was determined for all 262 flight sequences. Twelve different”.

-Line 280: check citation chronology.

-Lines 281-282: remove the last sentence, which is repeated at the end of the following paragraph.

-Line 295: I suggest “We could investigate” instead of “We investigated”.

-Line 301: “in terms of” (plural).

-Line 309: “ratios” rather than “rations”.

-Legend of Table 1: I would specify “(median and various percentiles)” after “statistics”.

-Legend of Figure 4: I would remove all occurrences of “Panel” or “panel”, as well as of “shows” after the panel letters.

-Line 384: it seems to be the 1st citation of Formenti et al. (2011) and should then read “2011a” rather than “2011b”; please check all your citations of Formenti et al. (2011) and possibly shift 2011a and b in the bibliography.

-Line 396: move 2007 before 2011.

-Line 416: “illite” rather than “ilite”.

-Line 426-427: unclear conclusion to me; do you mean “While the pollution significantly changes the optical properties of dust particles, we cannot conclude that it has the same effect on Arabian and Saharan dust”?

-Line 433: missing verb, possibly change “and that” to “they indicate that”.

-Line 451: you could provide the ranges from Lee et al. (2012).

-Line 467: change the “;” sign between references by a comma and add “and” before the last one.

-Line 482: “Figure 6 shows” instead of “Figures 6 show”.

-Line 488 and 494, and legends of Figures 6 and 7: I believe it would be needed to read “2011b” rather than “2011a” (see previous comment on Formenti et al., 2011); in the graphic legend of those 2 figures, you should also specify 2011a or b in the reference to Formenti et al., 2011.

-End of line 490: I would add “in various size ranges indicated in Figure 6”.

-Line 511: I suggest “is affected by” rather than “considers the effect of”.

-Line 512: I suggest “reflects” rather than “considers”.

-Lines 520 and 522: I would specify “the surface cooling effect” instead of “the cooling effect”.

-Line 522: I suggest changing “(or the warming effect may be enhanced)” by “and the atmospheric warming may be enhanced,”.

-Line 547: what about adding “significantly” to “does not change”?

-Line 551: remove “for” after “take into account”.

-Line 571: “does not modify”.

-Line 573: “which leads”.

-Line 586: remove “for”.

-End of the legend of Figures 8 and 9: “as a function”.

-Figure 9: for better readability, the y-axis of the left plot would better start at -5 than -11, and inserted notes about p values should be written with bigger characters.

-End of legend of Figure 9: I suggest “Respective least squares regression”.

-Line 607: I suggest “in case of mixtures with pollution particles” rather than “in polluted mixtures”.

-Line 623: since surface cooling has also been mentioned, better specify here “cooling effect at top of atmosphere”.

-Table A1, bottom of left column: change “ad” to “and”.

-Table A2, left column: change “accordingly to” to “according to” (2 occurrences).

-Figure B1 and Table B1: report number of points.

-Line 653: trajectories of what were calculated in real time? The link with the present work is not clear, is this mention necessary?

-Line 654: “partly modified” CAMS information appeals some explanation.

-Line 697: remove the sign “*”.

-Supplement line 25: remove the spare article “a”.

-Suppl. line 31: “which modifies”.

-Suppl. line 39: “with the particle”

-Suppl. line 40: move “at one wavelength” after “Mm^{-1}”; not clear to me why using the italic style for this unit.

-Suppl. lines 52 and 59: I’d rather use “at” than “for” about wavelengths.

-Suppl. Line 59: “Arctic” (missing “c”); also remove “of” before the bracket.

-Suppl. Line 65: “in-cabin measured”.

-Suppl. Lines 65, 66 and 78: I’d rather write “representative of”.

-Suppl. Line 76: please add a reference for the assumed refractive index of sulfate.

-Suppl. line 78: add “and” after “NSDs”.

-Suppl. line 86: I suggest to specify the impactor type: “A Micro Inertial Impactor (MINI) sampler” as far as I understand from Kandler et al. (2007); this single ref. seems appropriate here, if the 2011 were also cited, put 2007 first; the Schöberl et al. (2023) reference concerns the inlet efficiency, not the impactor; please clarify if it remains cited.

-Suppl. line 90: please specify the microscope model?

-Suppl. line 101: “of results of”.

-Suppl. line 108: I suggest to remove “ (21%)” and to replace by “ (21% against 8% for Arabian dust)” the last part of the sentence starting by “, while”.

-Suppl. line 110: also indicate carbonate percentage value for Saharan dust within brackets.

-Suppl. lines 111-112: please rephrase to clarify.

-Suppl. line 115: “dust mineralogical characteristic”.

-Suppl. line 116: “compared to Saharan dust,”.

-Suppl. line 117: I would cite Figure S3.

-Suppl. line 118: could you briefly summarize the Di Biagio et al.’s method?

-Suppl. line 122: cite Figure S5, which is presently not called in the text.

-Suppl. line 125: can you provide values for the Atlantic region?

-Figure S3 legend: not clear whether the class “Oxides hydroxydes” is only related to iron? The definition of particles classes should help (see comment 5).

-Figure S4 legend: “The graph shows three elemental ratios”.
