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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Optical-microphysical properties of Saharan dust aerosols and composition relationship using a multi-wavelength Raman lidar, in situ sensors and modelling: a case study analysis" *by* A. Papayannis et al.

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Respond to Reviewer's #3 comments (See also Annotated Manuscript, where corrections and additions are given in green text)

We would like first to thank the reviewer for his valuable comments.

ABSTRACT LINE 3 - The model would evaluate or simulate the vertical profiles of aerosol not PROVIDE. LINE 7 - cloud free instead of UNCLOUDED.

The reviewer is right. We have corrected the relevant words.

INTRODUCTION LINE 26 - spatio-temporal.

The reviewer is right. We have corrected the relevant words.

PAGE 25746 LINE 9 - originated LINE 11 - Western and Eastern Sahara LINE 11 - large instead of PRONOUNCED LINE 29 - REPHRASE: The lidar measurement can provide many aerosol optical and physico-chemical properties largely found in the literature (REFERENCES) both from space and ground based platforms (REFS).

The reviewer is right. We have corrected the relevant words and rephrased line 29.

PAGE 25477 LINE 13 - CONCLUDE with FINAL REMARKS is a little bit redundant - We provide final remarks and a summary of the work carried on this paper in Section 4.

The reviewer is right. We have corrected the relevant words (end of section 1).

PAGE 25478 LINE 21 - from the nighttime period in the same date as the event (Saharan Dust) occurred.

The reviewer is right. We have corrected the relevant words.

PAGE 25480 LINE 1 - that that - repeated LINE 22 - IN the last years.

The reviewer is right. We have corrected the relevant words.

PAGE 25481 LINE 4 - based on viscous...and ON soil moisture content.

The reviewer is right. We have corrected the relevant words.

LINE 5 - From an BSC-DREAM8b outsider point of view is hard to understand what is meant by description and bins - Is it possible to clarify this in a concise phrase ?

The reviewer is right. Now section 2.4 on BSC-DREAM has been corrected (since we used simulations for dates before the implementation of BSC-DREAM8b model we provided description of the BSC-DREAM model and not of the BSC-DREAM8b) and rephrased.

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LINE 12 - 1=3o is that right ?

The reviewer is right. In section 2.4, 1-3o has been corrected to 0.33°x0.33°.

LINE 12 - within 24 layers LINE 13 - long-range dust transport studies might sound better.

The reviewer is right. We have corrected the relevant words.

LINE 22 - weaker is not a good term to describe a scattering.

“Weaker” is the right term according to the electromagnetic theory. So we decided to keep “weaker”.

PAGE 25482 LINE 5 - What are real differences?

It has been rephrased to important differences (section 2.5).

LINE 16 - Which coefficients aaer,baer are retrieved by the Raman and which are retrieved by the elastic channels ?

The reviewer is right. We have rephrased and present more clearly the relevant section 2.1 (3rd paragraph of section 2.5).

LINE 17 - The INVERTED aerosol microphysical properties take into account or provide.

The reviewer is right. We have corrected the relevant words.

LINE 18 - real and imaginary PARTS.

The reviewer is right. We have corrected the relevant words.

LINE 19 - within different layers.

The reviewer is right. We have corrected the relevant words.

LINE 21 - dependence of the refractive index WITH size ?

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The reviewer is right. We have corrected the relevant text as “In our approach we do not consider the spectral dependence of the refractive index”.

LINE 23 - Which MEANS (averages) are you referring to ?

MEANS has been corrected to AVERAGE.

LINE 25-28 - Despite the fact you mention the reference how are these uncertainties reached?

We have added “according to Veselovskii et al. (2010) and now sentence is clearly given”

PAGE 25485 LINE 20 - What does EDXFR stand for?

The reviewer is right. We have included the full name of EDXRF as well (end of section 2.6).

PAGE 25486 LINE 21 - left-side and right-side figures.

The reviewer is right. We have corrected the relevant words in 3rd paragraph of section 3.

LINE 21 - In which sense do the trajectories suggest the time of the event outbreak ? From my knowledge the user setup the simulation starting time.

The reviewer is right. We have rephrased this sentence as follows: “These trajectories show that the air masses sampled over Athens had passed 3-7 days earlier from central, western and eastern Sahara (sometimes within the Planetary Boundary Layer: PBL), so they were enriched with dust particles”.

PAGE 25487 LINE 19 - How come it is inferred the dust layers descended and that not a new layer is present ? Besides from a ground based system the lower layers could mask the higher ones.

The reviewer is right. We have slightly rephrased our sentence as “Both aerosol layers

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detected by lidar slightly descended to lower altitudes with time and became diluted during the afternoon hours". The dust layer indeed descended to lower levels (we clearly see this in Fig. 3, as we have seen that in thousands of dust profiles), which is clearly seen in Fig. 3).

Also, the reviewer says that: "Besides from a ground based system the lower layers could mask the higher ones". This is real when the lower layers are too thick for the laser beam to penetrate them, which is not the case in our case study.

LINE 24 - 27 - This increase can originate from other effects such as marine aerosols present and humidity.

The reviewer is right. We have corrected and more clearly presented the relevant section in 5th paragraph of section 3.

PAGE 25488 LINE 2-5 - I am a little bit confused here if the aerosol load decrease wouldn't the LIDAR SIGNAL as well. This brings me idea that perhaps the use of the Aerosol Scattering Ratio might be more useful in these instances.

The reviewer is right. We have corrected and more clearly presented the relevant section in 5th paragraph of section 3, as follows: "During noon and early afternoon hours of 2 April, PM10 concentrations at ground reached 60-70 μg m-3, consistent with the lidar data concerning the detection of the arrival of the dust layers over Athens (Figure 3)".

LINE 21-25 - The reasoning here might have some pitfalls as comparing water vapor mixing ratio and relative humidity is meaningless with further information regarding the WV saturation. Perhaps extra data might be available to give more background to the discussion raised in this part of the paper.

The reviewer is right. As we do not have available extra data on the wv saturation, we have corrected and more clearly presented the relevant section in 6th paragraph of section 3, as follows: "The corresponding water vapour vertical profile derived by the

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NTUA Raman lidar showed that its mixing ratio remained of the order of 4 g kg-1 inside the dust layer. Moreover, the relative humidity (RH) profile obtained by radiosonde at a nearby location (about 15000 m away) showed RH humidity values (79-80%) around the 3000 m height region, which could lead to a probable mixing of the dust particles with humidity."

LINE 28 - Perhaps a section describing these quantities would be handy as they firs appear in this section in the paper.

The reviewer is right. We have corrected the relevant quantities as they first appear (2nd paragraph of section 2.1).

PAGE 25489 LINE 1-9 - Here a table or even a figure comparing all the previous and present results should be presented or inserted in FIGURE 6 (those which relate Angström exponents)

The reviewer is right. A Table has been created (Table 1).

LINE 21 - GREATER area of Athens LINE 26 - 0.70 or 0.700 would be in the right number of significant digits.

The reviewer is right. We have corrected the relevant words/numbers.

PAGE 25490 LINE 6 - Thick layers instead of STRONG LINE 14 - PERCENTUAL

The reviewer is right. We have corrected the relevant words.

LINE 14 - 21 - From the source point of view how can explain the presence of these two distinct species of aerosols ? Dust and Sulfates.

The reviewer is right. We have added 2 citations "Karageorgos and Rapsomanikis, 2007; Theodosi et al., 2011" which clarify the presence of sulfate in the aerosols sampled. Chemical analysis together with air mass backtrakectory analysis provide evidence of the presence of dust. Moreover, this dust event was so strong, even in April 2, that one could very easily see the dust particles suspended in the atmosphere.

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PAGE 25492 LINE 19 - FIG. 7a and 7b LINE 24 - IN the order of FOR layers 1 and 2 LINE 27 - while FOR layers 3 and 4.

The reviewer is right. Fig. 7 has been drawn as a single figure. Relevant text has been rephrased.

PAGE 25493 LINE 1 - I had the impression the dust layers were somehow absorbing but this results shows the opposite. Is that right?

Response: This refractive index is a slightly absorbing one, and is not inconsistent with aerosol that is internally mixed with slightly absorbing dust.

LINE 23 - SLIGHTLY instead of slide.

The reviewer is right. This correction has been performed.

PAGE 25494 LINE 1 - Reflects the tendency of organic carbon to partition to the aerosols phase. Can this further explained? Just extracting this conclusion from a single value of the refractive index is not too much rely on a bold assumption?

The reviewer is right. This correction has been incorporated, adding a reference of: Heald, C. L., Jacob, D. J., Park, R. J., Russell, L. M., Huebert, B., J., Seinfeld, J. H., Liao, H., and Weber, R. J.: A large organic aerosol source in the free troposphere missing from current models, J. Geophys. Res. 32, L18809, doi:10.1029/2005GL023831, 2005.

PAGE 25495 LINE 16 - 0.33$\pm$ 0.10.

The reviewer is right. This correction has been performed.

PAGE 25507 In table title please refer where these data were taken from.

The reviewer is right. This correction has been performed.

PAGE 25508 Overall please pay attention to the right amount of significant digits provided in the table. For example 0.007 $\pm$ 0.0035 is not the correct form.

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The reviewer is right. This correction has been performed.

FIG 1. Aren't the font too small ?

The reviewer is right. Figure has been re-drawn with bigger fonts.

PAGE 25510 FIG 2. Same comment as FIG 1.

The reviewer is right. The figure has been re-drawn with bigger fonts

PAGE 25513 FIG 5. Definitely these plots are very hard to read. Perhaps merging them would be a good idea.

Merging cannot be done. However, Fig. 5 has now correct legends.

PAGE 25514 Fig 6. The time gap in the figure can be omitted and provide more room for the data.

The reviewer is right. The figure has been re-drawn merging the time gap.

PAGE 25515 FIG 7a. In the legend the layers height could be mentioned (Suggestion).

The reviewer is right. The figure has been re-drawn with layer heights and Figs 7a and 7b, are now merged, following reviewer's #1, suggestion.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/11/C16277/2012/acpd-11-C16277-2012-supplement.pdf

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 25473, 2011.