Interactive comment on "Extreme dust storm over the eastern Mediterranean in September 2015: Lidar vertical profiling of desert dust at Limassol, Cyprus" *by* R.-E. Mamouri et al.

Anonymous Referee #2

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[english]babel

Extreme dust storm over the eastern Mediterranean in September 2015: Lidar vertical profiling of desert dust at Limassol, Cyprus

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1 General comments

This article describes an exceptional dust event observed in Cyprus. The authors combined remote sensing from ground and space with ground-based in-situ aerosol measurements and models to give a comprehensive overview of the dust plume. The paper is rather descriptive, but the described methods are sound and the data set is unique. Therefore, I would recommend the paper to be published in ACP. However, there are some fundamental points that need to be addressed before publication. My specific comments and technical corrections are given below.

2 Specific comments

Both, introduction and conclusions, should be reworked. The introduction is giving results described later in the text, which is not appropriate. Besides, in a rather short and straightforward paper like this, a detailed description of the structure of the paper

is not necessary. I would suggest to present a stronger, more concise motivation. Also, the state of knowledge on Middle East dust is not discussed and should be included.

The conclusions are rather a summary of the results. One of the review criteria for publication in ACP is the following: "Are substantial conclusions reached?" Please consider this point, which is the main weakness of this manuscript in my opinion.

What I'm also missing are information on the difference between local time and UTC. Besides, it would be very beneficial to include more details on the model forecast. The failure of the model is mentioned a few times, but what was actually forecasted?

Some more detailed comments:

page 1, line 3 Please include a better discussion about the models failing to predict the event in the main text. You highlight it in the abstract and it is repeated in the main text, but it is not shown.

introduction The first paragraph of the introduction is a summary of results. Please remove. Also I'm missing some lines motivating this study. It is remarkable, but why is it important to study such cases in detail? Please also discuss literature on Middle East dust.

page 2, line 2 replace "accurately determined" by "estimated"; I don't think an estimation "around 500 m, but clearly below 750 m" should be called accurate.

page 2, line 4 Also here I have some concerns about the "good accuracy". You don't give uncertainties in your estimate, but a range of values. Which is ok, but a range of 3000 μg/m^3 should not be called accurate. You present a simple and very nice method to estimate the dust load, but the emphasis here is on "estimate". It is not a precise measurement and should not be presented as such.

page 2, line 10 Why were data at 1064 nm not used for the dust characterisation, for example to calculate the Ångström exponent (only for time-height plots, figure 5)?

page 2, line 12 Which of the cited publications describe the set-up used for this work?

page 2, line 13 Which of the cited publications describe the data analysis used in this study? It would be helpful to at least give the main points of the analysis and specify which reference describes what.

page 3, lines 17-18 Could you please discuss the influence of humidity and consequent hygroscopic growth of the dust particles on the dust mass concentration?

page 4, line 12 I would interpret "morning" and "noon" as indicators of local time. But either way, 14:20 is afternoon. It's a small detail, but can be confusing if you are not familiar with the time zone of Cyprus. Rather be specific. Local noon is 12 local time.

figure 6, caption How did you obtain the uncertainties?

page 5, line 10 A "front" is a distinct line (or surface); the front of the plume. The passage of it should not take three days. I suggest you rephrase by replacing "dust front" by "dust plume" or similar.

page 5, line 13 Who defined this threshold? And why?

page 5, line 20 Predicted by which model(s)? What did it/they predict for 35°? And for 33°?

conclusion It is a summary rather than conclusions. Try to make a stronger case for your findings. What is the contribution of this work to existing knowledge? And how does it link back to your motivation?

3 Technical corrections

page 1, line 20 replace "re-analyze" by "re-analyzing"

page 1, line 24 replace "imaginary" by "imagery"

instrumentation I suggest to rename this section to "Instrumentation and methodology".

page 2, line 18 replace "imaginary" by "imagery"

page 2, line 20	replace "dust plumes were partly" by "parts of the dust plumes were"
figure 2	Why are there two dots at the same location each day? Are those from MODIS on Aqua and on Terra, respectively? Please specify this in the text or caption.
figure 5, caption	In my opinion the following part of the caption should be included in the main text body as part of the discussion of the figure: "The signals backscattered by dust in the elevated layers above 1000-1500 m height are partly strongly attenuated by the desert particles occurring below 1500 m. As a consequence, the elevated layers are mostly given in blue and green instead of red (as it would be the case after the correction of the attenuation effect)."
page 3, line 31	Please include lines 3 and 4 from page 4 (starting with "Unfortunately, ..." ending with "... detection units.") after the sentence ending with "... the highest dust load.".
page 3, line 31	I don't think it is obvious, as you don't show lidar profiles from that day. You could rephrase this sentence, e.g. "Judging from the MODIS observations in Fig. 1., the rather thick dust layer reached 1000-1500 m height on 8 September."
page 4, line 12	replace "session" by "sessions"
page 4, line 19	replace "is" by "was"
figure 6	Please change the labelling on the x-axis of the depolarisation ratio plot. It is hard to tell the numbers apart. You could leave major ticks at 0.2 and 0.4 (with labels) and use minor ticks at 0.1 and 0.3 (without labels).
figure 6, caption	The following parts should be included in the main text body rather than the caption: "The Raman lidar method is applied.", and " Retrieval uncertainties are of the order of 10% (backscatter coefficient, depolarization ratio), 25% (extinction coefficient), and 30% (lidar ratio)."
figure 6, caption	Add reference to "Raman lidar method". [now in text body]

page 5, line 10	replace "extrem" by "extreme"
page 5, line 15	Please specify length of trajectories in days in the text. It is in my opinion not enough to include it in the caption of figure 8.
page 5, line 19	replace "dust advection" by "air mass transport"
figure 7, caption	Please move the following part of the caption to the main text body: "A dust particle mass density of 2.6 g/cm^3 is assumed in the retrieval. The overall uncertainty is 30% and mainly caused by the uncertainty in the dust volume-to-extinction ratio (extinction-to-volume conversion factor) assumed to be $0.8 * 10^{-6}$ m."
figure 7, caption	Add references for the mass density, conversion factor and uncertainty estimation. [now in text body]