

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 #1

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The paper describes an exceptional dust storm over Cyprus. Using lidar data, visibility studies, ground based PM10 measurements and several assumptions it is tried to characterize the event. This should help to improve transport models which – according to the authors – totally failed to predict this outbreak. The paper is clearly structured and easy to understand. It focusses on nothing but the dust storm – thus it is quite short. I did not find any errors.

I think that the paper can in principle contribute to two aspects: validation of transport models or (optical) characterization of desert dust. In both cases the current version must be improved significantly.

According to the manuscript the main motivation is to provide information for the im-

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provement of transport models. However, no strategy how to reach this goal is detailed, not even outlined. Which models are meant (in the introduction the authors mention 'state-of-the-art dust transport models' [plural], but only HYSPLIT is mentioned later)? Are the depolarization ratio and the lidar ratio useful parameters to improve a transport model? How can these parameters actually contribute to this goal? Would it be sufficient to determine only the backscatter coefficient and the PM10-concentration to check any improvement of the model? According to Section 3.6 wrong meteorological fields were primarily responsible for the bad forecast (not the numerical description of the microphysics of the model). Is it necessary to estimate the vertical profile of 8. September (this is really vague!) for this purpose or would an agreement for the other days be sufficient to check the improvement of the model? From this point of view I recommend to combine this paper with the 'follow-up'-paper mentioned on page 5 line 25. Then it would be possible to clearly demonstrate the role of the data for the improvement of the model, and to show whether it was successful or not.

The other aspect – I had expected this when I saw the paper the first time – is to study optical properties of desert dust. Though there are already many similar papers on dust of different deserts and different transport paths (mixing, aging), this paper could potentially be a useful contribution: it comprises the 'standard output' of advanced lidar systems (lidar ratio, depolarization ratio, wavelength-dependent extinction and backscatter coefficients), provided that the accuracy of these parameters will be added. If the source region can clearly be identified this study can be a contribution towards a climatology of optical properties of different deserts.

A combination of both aspects would certainly be the most attractive solution and together with the improvement of the transport model this paper could be a really interesting scientific study (different from many previous 'dust-papers') and would fit to ACP.

By the way: it is surprising that more than 80% of the references are from the authors themselves. I am sure that there are more publications on these topics.

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A few minor comments:

- 1-12: 'hit' change to 'hits'
- 2-14: What is CUT-TEPAK?
- 3-10: 'observations from pilots': where are these information actually coming from? What exactly do they provide?
- 3-16: Is this from the Koschmider's formula?
- 3-22: 'are not validated': What does this mean? What errors can be expected? Would it have been possible to validated these data (under which conditions)?
- 4-6: 'AOT close to 1': where is this estimate coming from?
- 5-8: 'The technique applied ... is described': This should be briefly outlined here so that the reader immediately can understand which measurements and which assumptions are used.
- 5-10: typo: 'extreme'
- Fig. 7: I would expect that the curves in Fig. 7 (dust concentration) are proportional to the backscatter profiles shown in Fig. 6. At least for 10. September this seems not to be the case. This emphasizes the need to better explain the way how the mass concentration is determined (see previous comment).

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