Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-151-RC1, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Near real time processing of ceilometer network data: characterizing an extraordinary dust outbreak over the Iberian Peninsula" *by* Alberto Cazorla et al.

Anonymous Referee #2

Received and published: 22 June 2017

The manuscript entitld "Near real time processing of ceilometer network data: characterizing an extraordinary dust outbreak over the Iberian Peninsula" by Alberto Cazorla, Juan Andrés Casquero-Vera, Roberto Román, Juan Luis Guerrero-Rascado, Carlos Toledano, Victoria E. Cachorro, José Antonio G. Orza, María Luisa Cancillo, Antonio Serrano, Gloria Titos, Marco Pandolfi, Andres Alastuey, Natalie Hanrieder, and Lucas Alados-Arboledas (doi:10.5194/acp-2017-151) is appropriate for publication in Atmos. Chem. Phys.

The authors describe a new method for the combined processing of ceilometer data and sun photometer observations and they use the data obtained from this procedure

for the characterization of a dust event over the Iberian Peninsula. The development of methods for quantitative retrievals of aerosol profiles from ceilometer data is relevant to the scientific community. Nevertheless, the manuscript needs significant improvement.

The most critical points of the manuscript which should be improved before final publication are:

1) The title does not clearly reflect the content of the paper. The input of sun photometer data is essential for the proposed method, but the title does not provide any hint that the described method is not usable for standalone ceilometer instruments. Further, the manuscript provides no proof, why the described dust outbreak event is extraordinary.

2) What makes the described event extraordinary? Is it the meteorological situation, intensity, duration or something else? If the event was extraordinary in a certain aspect, this statement should be proved by comparison with typical events. If the extraordinariness of the event cannot be corroborated, the title should be adopted.

3) Why is the transmittance due to particles neglected? The authors describe how sun photometer data are used to constrain the Klett-Fernald inversions. Thus, all relevant information for the calculation of Tp is available. Why is it not used?

4) The authors shall provide an estimation of the difference between CL* and CL for different particle optical depths.

5) It would be nice to have an example plot for illustrating the calibration method which is described at page 7. It would be even better to show two examples, one of a clear day and one of a polluted day.

6) The manuscript suffers from a major internal conflict. First, it is introduced that the calibration parameter CL can be retrieved only on days with low aerosol load. But in the next part, a period with very high aerosol load is used for demonstration and validation of the method. All CL values which are derived during the dust period will lead to a systematic bias of profiles if they are applied to measurements in clean conditions.

The retrieved CL values are systematically too small due to neglecting Tp. To overcome this problem, the authors should derive and present a longer time series of CL values, with clean periods before and after the dust event. According to the theory, only the maximum values of CL in this time series (clean periods) are ok. Those maximum values before and after the dust event should be used for the retrieval of the attenuated backscatter profiles during the event. The lidar profiles can be used for the validation of these ('clean') CL values. But, it makes no sense to derive CL values during the dust event (even if constrained with lidar profiles) without taken into account Tp.

All attempts to constrain CL values measured during the dust event should be removed from the manuscript. This includes Figures 2 and 3, and all text below equation 7 and the begin of section 4.

Besides, the use of the correlation coefficient and center of mass as measures of goodness of the calibration seems to be of little help. Even if the calibration value is wrong, both profiles should have the same shape (and therefore the same Cmass and high R) because they are measured under the same atmospheric conditions.

7) The link between the two parts of the manuscript (methodology and results) is week.

8) The description of the meteorological situation during the event is quite lengthy while some interesting measurement data are not provided, e.g. ,depolarization profiles from the lidar, time series of optical depth and Angstroem exponent, fine-to-coarse mode fraction etc. from the photometer network.

9) In general, the description of the event would be more useful if the authors could provide references to other studies about dust over the Iberian Peninsula. How often do events like the described dust outbreak occur at the Iberian Peninsula? What are typical pathways and meteorological conditions? What are typical optical properties (e.g. optical depth) of the dust? What are typical geometrical properties of the dust layers? What makes this event special compared to others?

Further major concerns are:

10) abstract, the last sentence "... quantitative optical aerosol characterization with ceilometers..." is misleading. Ceilometers can be used for the quantification of the aerosol layering or aerosol load in terms of particle backscatter coefficients, but they cannot be used for characterization. 'Characterization' is often used as synonym for 'detection of aerosol type' or 'retrieval of intensive optical properties (like lidar ratio or Angstroem exponent)'. Ceilometers cannot provide this kind of information.

11) p2, l22: It is strange to write about the inadequate quality of satellite products in a paper about aerosol profiles from ceilometers. Certainly, products from ceilometers are very useful, but usually they do not provide profiles of higher quality than space-borne lidars.

12) p2, l28: There are more relevant references, e.g. Flentje et al. 2010.

13) introduction: The order of sentences in the last two paragraphs seems to be somewhat randomly. Maybe due to copy-and-paste? An outline to the structure of the manuscript is missing.

14) equation 1: CL* is not a constant in a strict sense. It changes on long time scales, e.g. due to laser aging or window contamination. Better to use 'parameter' instead of 'constant'.

15) p7, l29: how can negative CL values be explained? NMB is usually calculated as mean value of the bias profile (b_ceil(z) - b_lidar(z)) / b_lidar(z)

16) Figure 5: This kind of trajectory plot seems to be less informative than the traditional plots (with a map projection and a time-altitude plot below). To which times of observation do the red dots refer to?

17) Figure 6: Is it really necessary to show this figure?

18) Figure 7: The labels of the color bar are unreadable. Time axes of the different

stations have different tick scales.

19) Figure 8: Where does the uncertainty of 15% comes from? Please, indicate the measurement times of the individual profiles by vertical lines in figure 7.

20) Figure 9: Please, add time series of AOD and columnar mean lidar-ratio (whenever Integrated bsc and AOD are available). Also time series of Angstroem exponents and fine-to-corase mode fractions would be interesting.

Minor / pure technical or language comments:

21) The readability of the text could be improved by splitting some long sentences into shorter ones, e.g.

* p1, l23+24

* p1, l25+26

* p3, l1+2

* p3, l18-20

* p5, l28-31

22) p1, l25: it is not clear to which method the term "this method" refers.

23) p1, l26: the date of the event is described several times in the manuscript as ... on 20 February and lasted until 24 February... -> it would be better to write "between... and ..“ or "... lasted from .. to...“

24) p1, l21 + p2 l1: what refers "their" to?

25) p2, l6: The terms "in-situ" and "surface measurements" are often used for ground based remote sensing instruments like lidars, in contrast to space-borne instruments. Maybe a term like "measurements of aerosol properties at ground level" could be used instead.

26) p2, l7: when speaking about a covered area, it would be better to use "Europe" instead of "European Union".

27) p2, l10: (and elsewhere in the paper): vertical resolved -> vertically resolved

28) p2, l31: make complicate -> hinder?

29) p3, l18-20: the calibration is used to validate the inversion?

30) p4, l2: comparable -> calibrated?

31) p4, l4: constraint -> constrain

32) p5, l16: not overlap -> no overlap

33) p5, l28: what means "computing the Rayleigh fit"? -> ... particle free regions are determined by comparing the gradient... If the difference is below 1%, we can assume particle free conditions...

34) p7, l12: ... has the influence of ... -> ...is influenced by...

35) p10, l26 ... northern African... -> ... northern Africa...

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-151, 2017.