Atmospheric
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Discussions

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comment

Interactive comment on "February 2017 extreme Saharan dust outbreak in the Iberian Peninsula: from lidar-derived optical properties to evaluation of forecast models" *by* Alfonso J. Fernández et al.

Anonymous Referee #2

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This paper examines the optical properties of an outstanding dust plume originating from Africa and travelling over the Iberian Peninsula in February 2017, using a combination of collocated active and passive ground-based remote sensing instruments, namely lidars and sun-photometers from multiple sites in Spain and Portugal. The ground-based instruments are part of 2 networks, EARLINET and AERONET. The performances of two operational dust models for this event are also investigated.

In the present form, the paper does not bring much to the already abundant literature on the subject of dust outbreaks over Europe monitored with either or both lidars and sun-photometers.

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Discussion paper

Firstly, the authors claim that this is an outstanding dust outbreak, but this is not really assessed from a quantitative point of view. The authors should use the long time series that have been gathered in the framework of EARLINET and AERONET to demonstrate this. Without this "climatological" perspective, the case discussed here is just another dust case.

Secondly, the origin and evolution of the dust outbreak should be better explained. The outstanding nature of the dust outbreak could very well hold in the peculiar meteorological situation leading to it, so it is important that more discussion be dedicated to this aspect. What is the meteorological situation that led to this episode? This is important as one of the objectives of the paper is to assess the performance of a couple of operational dust forecast models: understanding the deficiencies of the dust models in representing the dynamical processes responsible for the dust outbreak will be quite useful in this performance assessing study.

As a non-native English speaker, I dislike saying this, but the English should really be improved.

Also, the formatting of the references in the text is not standard. . .

The paper needs major and mandatory modifications before being acceptable for publication in ACP.

Minor comments

Abstract :

- Unprecedented. . . meaning what ? You have not seen such an event over the IP before? How far back goes you series?

- Extreme what is your definition of extreme?

Introduction

- line 58-59: this sentence is unclear, please rephrase. Torrential rain leads to weath-

ering and in turn alluvial deposits in more or less ephemeral river beds. . . then wind
kicks in to lift the dust. . .

- line 61: 5000 m. . . This case occurred in winter: 5 km is the maximum altitude reached
by the top of the PBL over the Sahara. . . In the summer the PBL top can reach 7 km,
see results from FENNEC over the Sahara.

- line 83: "clear summer prevalence": meaning there is no dust max in the summer
? Prevalence of clear air? How is this different from the central Med basin? Please
clarify.

- line 87: Sharav cyclones do appear in the winter (generally jan-fev), see Bou Karam
et al. 2007

- line 103-104: not true, there is a large amount of literature on the link with meningitis
(chiapello, Martiny in Dijon)

- line 123: how is the horizontal distribution obtained? Via the multi-site approach?

- line 128: what is the AOD limit for active and passive retrievals not to be available ?
3?

- line 128-130: when were these events? Was it the largest previously observed over
the IP? Why mention this apart from the fact that they took place in other seasons?
When was the episode reported by Priessler et al., 2011?

- line 139: why these 2 models only? Aren't there other model forecasts available in
the framework of the SWS-WAS programme at WMO.

- line 143-144: what scale are we talking about, and what phenomena do we know
are not well represented in models over Africa? Uplifts associated with cold-pools from
mesoscale convective systems?

Section 2

- Given the long record of the AERONET stations used in the paper, it would be interesting to show the reader how this episode stands out from the climatology. This would invigorate the interest the dust aerosol community.

- line 199-200: what is "a great radiation extinction"? Large values of extinction coefficient?

- line 207-209: on what occasions were you able to determine ïĄạ and ïĄć independently and hence the LR? On what occasion are you using a predefined LR.

- line 209: what is an "intensive" parameter? Here for LR, but later also for the Angstrom coefficient (line 211)

Section 2.3 modeling - You are looking at forecasts from 19 to 22 February while the episode under scrutiny is 20-23 February... meaning you are not going back in time long enough to look at the origin of the dust event...

- How many levels do the models have in the first 1 km? Vertical resolution may also be an issue for uplift mechanisms.

- line 257: would not it make more sense to compare the model with lidar data in the [t-30 min, t+30 min] interval?

Section 3

- 3.1 Synoptic situation: more charts are need here to explain the situation, especially 10-m winds (for emissions) and mid-tropospheric winds (for transport) through the event, like what is done with Meteosat images. One MSLP chart from ECMWF is not enough for the reader to understand the origin and fate of the dust lifted over Africa this is transported of the IP. From the Meteosat RSB images it looks like a low pressure system is involved in the evolution of the situation. Could this be a Sharav cyclone?

- 3.2 columnar properties: I have doubts about the quality of the AAE retrievals in Barcelona as they show a bell-shaped diurnal evolution that could indicate that the solar

angle corrections are not properly done. Is this related to the nature of the dominant aerosol in the column? Also it is the only station with higher AAE on 22 February, while all the other stations show very low AAE.

- Based on Figure 3, I would say that the stations with AAE values higher than 0.6 are sensing other types of aerosols than just dust... Ths is confirmed by your analysis of SSA. What is it? Anthropogenic pollution? If this is coming from northern EU, than this re-emphasizes the need for more ECMWF charts to apprehend the complex meteorological situation.

- Between 20 and 12 February, the number of stations with higher AAE values is diminishing, consistently with the propagation of a dust front...

Section 4:

Evora - Figure 5: there is a sharp change in signal intensity at 1200 UTC on 21 February. What is this related to? Can this be trusted?

- Line 395-398: are you saying that the retrievals for the period should not be trusted because the dust load is too high for the lidar to handle??

Madrid - Figure 8: same thing at 2330 UTC on 22 February in Madrid. And to a lesser extend at 0800 UTC on 23 February.

- Cannot you use the Rayleigh signal from unaffected lidar profiles of computed from radiosondes? Would not you expect Rayleigh extinction of backscatter to be relatively constant well above the dust layer?

Barcelona - Line 517-518: why is it difficult to find a clean atmospheric layer between 5 kml and the cirrus clouds above? Don't you have the same problem for the data in Marid where cirrus clouds are also observed? Why not use the P/T data from a sounding to retrieve the Rayleigh backscatter/extinction?

Section 5

- Line 569-575: such an exercise has been conducted during the FENNEC and ChArMeX projets just to name a few... sometimes using operational models. Please refer to the relevant literature here...

- Figure 13: why are the lidar profiles displayed not exactly the same for a given station when comparing to the 2 models? Because of the differences in model outputs temporal sequences?

- Line 623-624: how do you know that Evora is closer than Barcelona to the dust source. Would not you need back-trajectory analyses to infer that?

- Line 649: what does nervousness mean for a model??

- Line 682-685: what are the physical mechanisms at play in these tropospheric/stratospheric exchanges? To what meteorological phenomena is this related ? a cut-off low? Was such a feature observed during this event? There again there is too little details on the synoptic situation and its evolution to related any of this with the dust event.

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