Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-695-RC2, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Saharan dust and biomass burning aerosols during ex-hurricane Ophelia: validation of the new UK lidar and sun-photometer network" *by* Martin Osborne et al.

Anonymous Referee #3

Received and published: 10 December 2018

This paper is well-written and presents important new observations on an extremely unusual aerosol event in the UK, caused by transport by ex-hurricane Ophelia, which is therefore of interest. A new network of lidar and sun-photometer observations is presented and the event of October 2017 is used as a case study to demonstrate its abilities. The authors show the vertical structure of the aerosol and separate the contribution from dust and smoke particles, which they demonstrate to have different optical properties and originate from different geographical regions. They explain the structure of the aerosol in relation to the ex-hurricane to a limited extent.

The methodology appears sound and is mostly well-explained, though a few areas

Printer-friendly version

Discussion paper

need some extra detail. Figure captions are fairly minimal and require extra information, and one figure omits axis labels. Overall the paper is easy to follow and clearly written. The paper would benefit from additional exploration of aerosol transport with regard to the structure of the ex-hurricane, in order to give the paper a wider context and reflect the unusual event. Additionally the authors should cite and compare to another paper already published on this event (details are given below). If the authors are able to satisfy these minor points, I consider the paper suitable for publication in ACP.

Specific comments

General

There are a few typos/spelling errors which I will not point out, as they will be corrected at production (if not before), which the authors should correct.

Smoke/biomass burning aerosol are referred to interchangeably. This should be confirmed/clarified early on in the paper.

Date and time terminology – please check you are in line with that specified by ACP https://www.atmospheric-chemistry-and-physics.net/for_authors/manuscript_preparation.html

Information provided in figure captions is rather sparse and specific suggestions are made below. One figure (8) even omits any axis labels so it was necessary to infer what is being shown.

Abstract

L7 – please note that the online abstract reads 'hallow' not 'shallow'

L10 – AOD at what wavelength?

L15 – 'aerosol types' instead of 'aerosols'?

P2 L6 – 'type' – are you not referring to volcanic ash as an aerosol type? If not what

other ‘types’ do you refer to?

P5 l1-2 – what is the uncertainty in these 2 depolarization ratios? How does this impact the mass concentration calcuations?

P5 l24 – there are a number of different defninitions of aspect ratio – please state how you define yours.

P6 l17 – ‘aerosols can be seen’ – NW of Morocco and SW of Portugal?

P6 l20 – please avoid referring to the aerosol as an ‘aerosol cloud’ to avoid confusion to the inexperienced reader via terminology. Please use the term ‘cloud’ only to refer to real clouds, not aerosol.

P6 l26 – please make this clearer – is the uplift calculated in 6 bins, and subsequently converted to 2 bins for transport? Is there a reference for the 2 bin scheme? What size ranges are covered? Is any dust data assimilation included?

P7 l3 – are lidar measurements not continuous then? Are they only activated when an aerosol event occurs?

P7 l8-9 – the only portion of morning in fig 5 is 11am-12pm. Please add a time to this sentence to confirm.

P7 l10- please add timings again to clarify the difference to the above point.

P7 l13-14 – again please add a time, e.g. for one location, to help interpretation by the reader. Section 4.1 – when referring/introducing Figure 5, it may be helpful to point out to a reader not so familiar with meteorological interpretations that the frontal/sector structure shown in Fig 5 has the opposite ordering left to right to that shown in the east-west structure shown and described in Fig 2-3.

P8 l3-5 – Figure 6 y-axis states aod_500, these lines suggest different sites use different wavelengths. Please state clearly in figure caption which wavelengths are used, and correct figure axis title if necessary.

P8 l7-20 – misclassification of thick aerosol, such as dust, by AERONET to cloud, has been reported in the literature and examples should be cited here.

P9 l10-17 – This section needs some expansion and clarification. It is not clear which kext values the authors are suggesting are different due to different measurement technique (SKYNET vs AERONET) or due to different aerosol type (dust v smoke).

P9 l25-26 – please add a brief explanation of the methodology of Gross et al. (2015) here, such as typical LR and PDR values for dust and biomass, since the explanations in the following paragraphs rely on this interpretation.

P10 l6-10 – what is the reason for excluding altitudes greater than 3km in top row of figure 9?

P10 l26-27 – it's not possible to discern any brownish colour on these clouds.

P10 l 28-35 – Please note that your trajectories still suggest a well-mixed atmosphere in the vertical in terms of the dust transport when they are over Algeria. Although I believe this is sufficient for this paper in showing that the aerosol type and origin was likely Saharan dust, it is not sufficient for pinpointing specific sources. Please also note that defining dust sources using back trajectories over the Sahara is error-prone due to the challenges meteorological datasets experience over the Sahara (e.g. Trzeciak et al., 2017).

P11 l10-12 – please add altitude ranges for the first two dust plumes mentioned. Same for L16.

P11 l15-16 – since the total AOD exceeds all values on record for the UK it would be useful to repeat this fact (stated earlier in the paper) again in the conclusion.

P11 l17 – again, see point above about dust sources. The NAME trajectories only show a North African origin (i.e. dust), not a source specifically in Algeria.

Conclusion, specifically p11 l17-26 – there seems to be a lack of clarity about how

the dust layers, which seemed to be generally present, relate to the meteorology. It is suggested that the warm conveyor belt transported the dust, but does this result in the mostly continual dust presence in the lidar results? How does this semi-continual presence relate to the dynamics of the ex-hurricane? Likewise for the smoke, which part of the system caused the transport? (Not the warm conveyor?). This paragraph is very interesting and relevant, and could do with some clarification and expansion.

P11 l27-28 – please cite references for the dust values. My understanding is that dust LR is frequently cited as ∼50Sr. Same for the following sentence on BBA.

Conclusion – the authors may not be aware of a published study in ERL on the same event over the UK (Harrison et al., 2018). Harrison et al. (2018) provide vertical profile information on the same event from several locations as the aerosol/low pressure system passed over the UK, and observations of aerosol charging. The authors should provide an evaluation in the conclusion, or earlier in the manuscript, of any differences/similarities to the findings of Harrison et al. (2018), and evaluate how the two publications may complement each other.

Figures

Figure 1 – caption – also sea level pressure? The figure is fairly small – please make sure this appears as full width. The AOD colour bar is indistinct and such fine resolution of colour differentiation is unnecessary and difficult to relate to the colours in the figure. I suggest decreasing the contour interval to every 0.2 AOD so that colours can be easily related to the values in the colour bar.

Figure 2 – i.e. sea level pressure?

Figure 3 – please give times of day. True colour images? Again, please make these images larger for clarity.

Figure 4 is not referred to in the text!

Figure 6 – Please add more information to the captions – such as information on trian-

gles, and break in y-axis as stated in the text.

Table 2 caption – please give AOD wavelength and mass concentration units.

Figure 8 caption – please add which sector (warm/cold etc) these time periods relate to. Same for Figure 9.

Figure 8 – Axis titles need adding.

References

Trzeciak et al., Cross-Saharan transport of water vapor via recycled cold pool outflows from moist convection, GRL, 2017, https://doi.org/10.1002/2016GL072108.

Harrison, R.G., Nicoll, K.A., Marlton, G.J., Ryder, C.L., Bennett, A.J., Saharan dust plume charging observed over the UK, Environmental Research Letters, 13, 054018, https://doi.org/10.1088/1748-9326/aabcd9, 2018.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-695, 2018.