

Interactive comment on “3D evolution of Saharan dust transport towards Europe based on a 9-year EARLINET-optimized CALIPSO dataset” by Eleni Marinou et al.

Anonymous Referee #3

Received and published: 21 December 2016

In this manuscript, "3D evolution of Saharan dust transport towards Europe based on a 9-year EARLINET-optimized CALIPSO dataset", the authors use a combination of CALIPSO and EARLINET to present a climatology of recent dust vertical distribution and transport to Europe from Africa. The consideration of both climatological extinction and 'conditional' extinction is useful to elucidate the episodic transport as well as the dust distribution.

The manuscript is generally well written and the climatology will be useful to the community and to evaluate models. However, there is a lack of discussion of uncertainties in the product and some limited interpretation of the particle depolarization ratio and interannual variability that need revision. Please see the major and minor comments

C1

below.

Major Comments

There is limited discussion of the uncertainties and detection limits of dust occurrences throughout the manuscript. There are some very high occurrences of dust shown in regions far from dust sources in Figure 1 (e.g. the North Atlantic). How certain are we that this is actually dust and based on what detection limit? Similarly, Figures 3 and 4 show infrequent but high extinction dust at the surface at high latitudes. Can we be sure this is not a retrieval artifact? When climatological extinctions as low as 5 Mm⁻¹ are considered (e.g. pg9 line 22) it would be useful to know the uncertainty on the estimates.

The retrieval is provided only for clear-sky conditions. Can you comment on how this might bias the dust extinction and how it relates to cloud formation (mentioned on page 10)?

In Figure 1 there is a strong boundary along the European coastline for dust occurrences, is this the result of a marked difference in used overpasses between the mainland and the Mediterranean? Please make sure that this feature is explained.

I don't think simply listing papers that have used specific instruments to explore dust over the Mediterranean is the best way of presenting the introduction (pg3 lines 10-20). Please consider reconstructing this paragraph to briefly discuss what these papers show that is relevant to understanding dust transport to Europe, rather than framing around the instrument used.

The seasonal climatological and conditional meridional dust extinction product will be useful for evaluating model representation of dust transport to Europe. I recommend that the authors make this available to the research community and include a link to the dataset in the manuscript, if possible.

The section on interannual variability is quite weak. The comparisons with other studies

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should be relevant to the time period considered in this work. There does seem to be a general downward trend, but based on the lack of significance in many regions it is understandably difficult to determine long term trends over a relatively short 8 year period. Maybe the authors could include a timeseries panel in Figure 6 to indicate the interannual variability, rather than focus on the weak trends.?

Minor Comments

Please replace all instances of 'utilize' with 'use'

pg1 ln21 - "During spring..." sentence is not clear, please revise.

pg1 ln22 - "on" should be "in"

pg1 ln23 - "0.1", should this be "up to 0.1"?

pg1 ln28 - units are sometimes italicized, other times not

pg1 ln31 - change to "the Alps and Carpathian Mountains"

pg2 ln25 - remove "now"

pg3 ln30 - what is meant by "large scale statistics"

pg4 ln22 - extra space after "biases"

pg5 ln13 - perhaps provide the link as a reference?

pg5 ln21 - "categorized"

pg6 ln17 - "However..." it is not clear why this is an issue. Please elaborate or remove.

pg7 ln8 - "suppressed", this should be caveated as there are still significant emissions from African regions, like the Bodele, that are just not transported northwards.

pg7 ln23 - "Strong topographical heights", unclear meaning - please rephrase

pg8 ln3-5 - It is not clear what this tells us (high DOD, high sdev). Please explain what

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this indicates.

pg8 ln3 - "In general,"

pg8 ln31 - "situation", please be more specific.

pg9 ln11 - "England" should be "Ireland"

pg9 ln15 - "England" should be "British Isles"

pg10 ln2 - "higher" than what?

pg10 ln18 - no new paragraph and replace "Nevertheless" with "However"

pg10 ln23 - delete the first sentence

pg10 ln24 - "Number of Exceedances", exceedances of what? Perhaps "Number of occurrences" or "Number of observations" makes more sense?

pg11 ln3 - "move" should be "moves"

pg11 ln11 - "mean" should be "means"

pg11 ln11-20 - this section is out of place as the following paragraph returns to Fig. 4. Also, sentences in the paragraph somewhat contradict each other. If the PDR is a means of estimating age, but "cannot be considered as a possible age index". If the latter is true, why is this useful? The paragraph needs moving and restructuring, or removing (which would also mean removing the figure) unless the the PDR provides some insight.

pg11 ln22 - I think panel "I" should be panel "i"

pg11 ln25 - "plums" should be "plumes"

pg11 ln26 - give the latitude range of the mountainous regions

pg11 ln29 - "dust in" should be "dust at"

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pg11 ln30 - can you be more specific why the deposition is stronger during that season
- is it primarily wet or dry deposition?

pg11 ln31-34 - why is there a sudden drop off in extinction at 40N during the AMJ season? Please explain this.

pg12 ln1 - I think panel "i" should be panel "l"

pg12 ln19-24 - the studies referenced consider longer time periods and/or different geographical regions, please alter to so that the discussion relates better to the region and period you are considering.

pg12 ln26 - replace LR with lidar ratio

pg24 - The EARLINET reference is repeated multiple times.

Figure 2(b,d,f,h) - Why is the color bar different for the CoM panels relative to the Top Height panels when they are both showing altitude? Consider using the same color to avoid confusion

Figure 2 - In titles, "TOP" should be "Top"

Figures 3,4,5 - longitude and latitude labels are too small on the domain panels

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-902, 2016.