Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-902-RC2, 2016

Atmospheric Chemistry and Physics Discussions

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 #4

Received and published: 22 December 2016

General remarks:

The present manuscript provides a monthly climatology (from 2007 to 2015) of African dust based on an optimised CALIPSO dust product was recently developed with a regional correction of the Saharan dust LR using EARLINET measurements (Amiridis et al., 2013). The monthly climatology of African dust obtained allows the description of the spatiotemporal features of dust properties over North Africa and Europe. The study of the mean state climatology shows strong seasonal shifts in dust source regions and transportation pathways. While the results of the study are interesting to be published, their presentation and discussion are not yet sufficient to be published in Atmospheric Chemistry and Physics in the current form. Therefore, it is worth to be published after

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addressing major revisions which are explained below along with a few other details.

Major comments:

In Amiridis et al. (2013), this EARLINET-optimized CALIPSO dust optical depth (for the period 2007-2011) is described and qualitatively compared with MODIS and AERONET. The present manuscript is focusing on the analysis of the resulting EARLINET-optimized CALIPSO dust climatology. I would be desirable to include a short discussion of the uncertainties of the EARLINET-optimized CALIPSO dust product. I understand that this discussion is partly in Amiridis et al. (2013, 2015) although the authors should include a summary in Sect. 2.2 as well as about the uncertainties of the algorithm of CALIOP to determine the corresponding aerosol subtype (in Sect 2.1). In Figure 1, there are some features that they look associated with the number of available observations, and consequently with the presence of clouds over the Mediterranean and Europe. I am not sure if the "%Dust/Used Overpasses" is enough to explain the DOD seasonal patterns in Europe. I would suggest to include an additional column with the number of used overpasses and to check how is working the algorithm of CALIOP to determine the corresponding aerosol subtype in this part of the domain. In Page 10 Line 1, you mention that the results from Clim-DE can be used to estimate the impact of dust on cloud formation. As far as I understood, the EARLINET-optimized CALIPSO dust product is provided only for clear-sky conditions. In Sect. 4, you mention a recent paper from Mamouri and Ansmann (2016), but it is based on a ground-based lidar. Then, how could you estimate the dust impact on cloud formation from this EARLINET-optimized CALIPSO dust product? In my opinion, a further discussion about the similarities and discrepancies with other dust climatologies will enhance the impact of the results presented in the manuscript. Any comparison with other dust climatologies based on other datasets such as satellites (e.g. MODIS, AERONET, EARLINET or the official CALIPSO aerosol product); and models (as CAMS reanalysis or AEROCOM) is considered in the manuscript. Furthermore, how do the results of the present study improve those results of LIVAS (Amiridis et al., 2015)? These discus-

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sions will be useful for model evaluation, for example. Otherwise, it seems to me that some results are general and not enough justify in the manuscript. In Sect. 3.1 (Page 10) I don't understand the reason to include the dust mass concentration inversion results. This part of the discussion doesn't include any new insight with respect the analysis of the optical properties or any link to a particular previous study. In Sect. 3.5, you could compare your results with a climatic index as the North Atlantic Oscillation Index (NAO) as Pey et at. (2013) did for PM10. Is this de-seasonalised trend analysis sensitive to the number of available observations?

Minor comments:

Page 2 Line 13: Add Nickovic et al. (2016).

Page 2 Line 16: Add Granados-Muñoz et al. (2016) and Bovchaliuk et al. (2016).

Page 3 Line 25: Replace Gkikas et al. (2015, ACPD) by Gkikas et al. (2016, ACP).

Page 3 Line 30: When you said "large scale statistics of discriminate and optimised dust extinction and AOD fields from CALIPSO", what does it mean? What about Amiridis et al. (2013) and Amiridis et al. (2015)?

Sect. 3.1: It would be good if you can add a short comparison of the resulting DOD seasonal maps with the results of MODIS, MISR or any available reanalysis (as CAMS or MERRA).

Sect. 3.2: In this case, you could compare your results from those obtained from EARLINET o models.

Sect 3.5: how do your results fit with those showed in Gkikas et al. (2016)?

Page 10 Line 28: Add Huneeus et al. (2016).

Page 10 Line 30: "it is likely that the surface and elevated dust have different origins" sounds speculative. You could check this assumption with models or back trajectories.

Figure 3. I would use the same colour palette than in Figure 4. Moreover, could you provide any further explanation about the sharp transition over the Atlas?

Figures 3,4,5: Longitude and Latitude labels can be removed. They are too small.

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

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