Anonymous Referee #2

The manuscript is improved and most of the comments from the previous review have been addressed. The manuscript is ready for publication after some minor corrections:

[REPLY] We thank the reviewer who, for a second time, provide us useful comments. Replies to the general and specific comments follow below.

Page 9

Line 8: It would be useful if you plot the boundaries of the regions considered in a map, either in Figure 1 or as an additional figure (maybe as supplementary material?).

[REPLY] We added a new Figure 2 and changed the manuscript accordingly:

Page 9, line 8: "In order to provide a more quantitative representation of the dataset, the domain is aggregated in six areas over the study region. The main results and statistical parameters are provided in Table 2, and a map with the domains is shown in Fig.2."

Line 11: Remove "(with 100% as unity)"

[REPLY] It is removed.

Page 10

Line 14: Because of the color scale, it looks like there is no dust influence above Central and Northern Europe and this sentence might be confusing. Even though values are included in Table 2, you should consider add some text here including information on the values to avoid confusion and/or the use of a logarithmic color scale in the figure.

[REPLY] We revised this part including information on the mean dust values over Central and Northern Europe accordingly:

Page 10, line 13: "Dust is also present over central and northern Europe with mean DOD up to 0.033 ± 0.062 and occurrence percentages up to 61 % (Fig. 1c; Table 2), revealing that dust particles can be transported far away from their sources under favourable meteorological conditions."

Line 32: Indicate here if the discrepancies are within the combined uncertainty

[REPLY] WE changed this part accordingly:

Page 10 line 29: "MODIS provides the AOD for all natural and anthropogenic aerosol types. As a result the MODIS average value for the whole period and domain (0.267) is 281% bigger than our product (0.095 ± 0.04). It is noted though that the values between the two satellite products are very similar over the Sahara desert. On the contrary, the corresponding average dust optical depth values of MACC (0.100) and RegCM4 simulations (0.104) consider only dust and are in better agreement with our product, with lower values by 5% and 8.6%, respectively. The 95% confidence interval of the mean for MACC is between 0.092 and 0.108, and for

RegCM4 is between 0.099 and 0.108. Considering these ranges, the discrepancies between CALIPSO dust product and the two models are within the combined uncertainty."

Page 11

Line 16: Include the definition of a.s.e. the first time is used in the text instead of here

[REPLY] In is corrected.

Page 12

Line 2: Can you add some sentences here explaining how this correlate with the DOD in figure 1?

[REPLY] This section focuses on the height of the dust layers and how this is consistent with studies employing ground-based lidars. DOD has been discussed elsewhere and in the previous section.

Line 15: Replace "Spain" by "Iberian Peninsula"

[REPLY] It is replased.

Line 28: Add some sentences in this paragraph explaining how the uncertainties influence your results, especially when discussing values as low as 5 Mm-1.

[REPLY] We inserted a line that resumes the main point for the uncertainties, as these are presented in the dedicated section. The manuscript is revised accordingly:

Page 12 line 31: "At higher latitudes, the CALIPSO dust extinction is drastically reduced but still observed at 1-2 km a.s.l., with mean Clim-DE values of 5 Mm^{-1}. As discussed in detail in Section 2.4, the uncertainty of the dust extinction values close to the surface and at high latitudes is < 54%, with the higher uncertainty in this region mainly originate from the selection of the δ_{nd} value during the dust separation step. Moreover, the standard deviation, coming from the natural variability of the dust events is an order of magnitude higher than the mean values (Table 3)."

Page 13

Line 16: Consider starting a new paragraph here. Additionally, a reference to Table 3 is missing.

[REPLY] We deleted the rest of the paragraph here, based on the following comment of the reviewer. Additionally, we added a reference to Table 3 in the beginning of the section:

Page 12 line 8: "To further illustrate the vertical dynamics of dust reaching Europe, the area of study between 20° W and 30° E is separated into five longitudinal zones of 10°, covering latitudes from 20° to 60° N, and the results are presented as latitude-height cross-section plots in Fig.5, with the respective statistics in Table 3."

Lines 16-22: Consider rewriting this part. As it is now, it's just a listing of the values in Table 3 with little or no discussion.

[REPLY] Thank you for this comment, it is true that this paragraph had been added after a comment we received from another reviewer. We deleted this paragraph completely.

Line 22: It is still not clear what the point of including the dust mass concentration values in the study is. Consider removing them from the manuscript.

[REPLY] We added a comment that explains why we insist on giving the concentration estimations: The main reason is that this information is quite valuable in modelling studies. Page 13 line 23: "The above results are representative of the spatial distribution of dust load as this is approximated by the aerosol extinction coefficient. In order to provide the dust load in units that are more relevant for modelling studies, we estimate here the dust mass concentration."

Line 28: Start new paragraph here.

[REPLY] We started a new paragraph.

Page 16

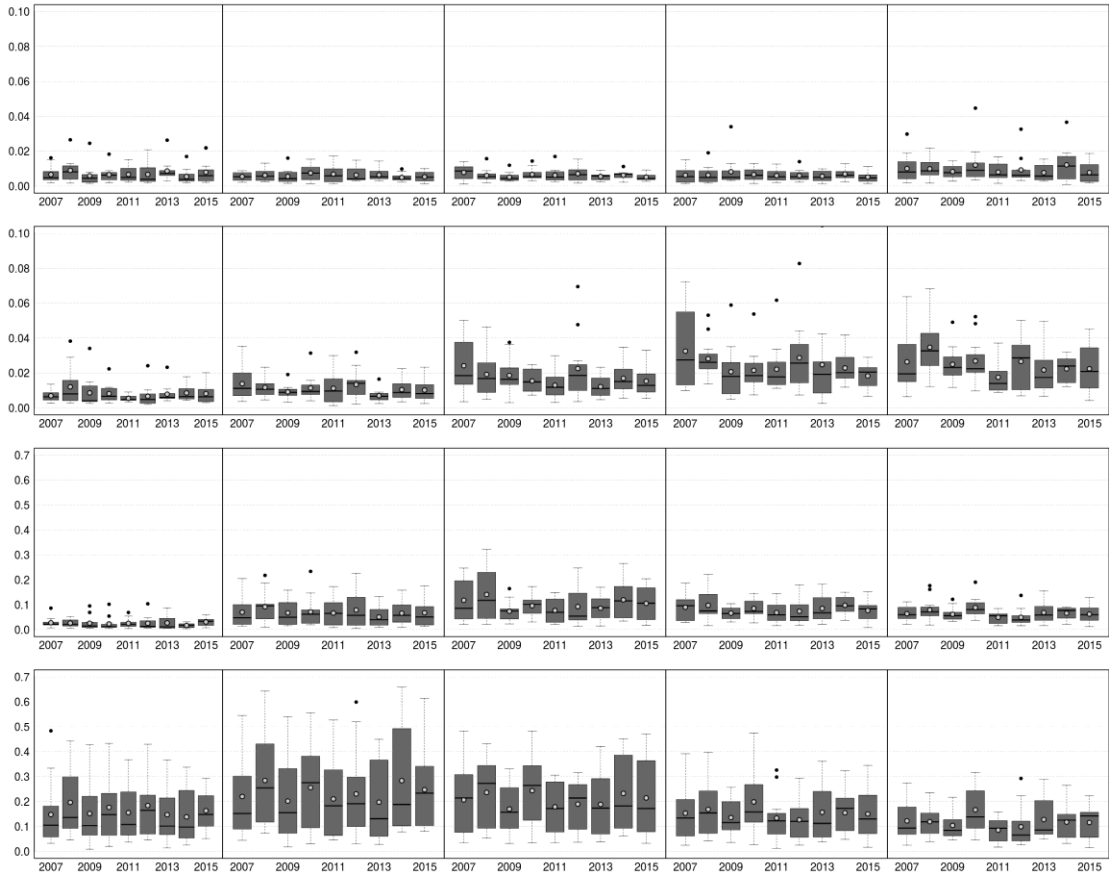
Lines 14-17: Consider moving this information to earlier in the section or rewriting.

[REPLY] We moved this information earlier in the section. The section now begins as:

Page 15, line 16: "In this section we present the CALIPSO derived monthly mean DOD values, for the total-column and for five individual layers (0.18–0.5, 0.5–1, 1–2, 2–4, 4–8 km), in order to study their inter-annual variability during the 9 year period between 2007 and 2015. The selected layers are representative for both near surface and long-range transported dust plumes. The data are aggregated on a 10° x 10° cell over the study region. Using a first-order autoregressive linear regression model on the de-seasonalized monthly DOD values (108 in total) as described in Zanis et al. (2006), temporal trends of DOD were calculated. We note that nine years are considered a small period for a robust trend calculation and it would be interesting to extend this analysis with future measurements. Figure 7 shows the geographical distribution of de-seasonalized trends ($year^{-1}$) for the columnar DOD (a), for the five individual layers (b-f)..."

Figure 7: Please, change the scale in Figure 7. It's difficult to obtain any information from the plots in the first two rows with the current scale.

[REPLY] Reply: we changed the scale in this figure (now figure 8). In comparison with the max value of 0.7 (before), the new max value of the first two rows is 0.1.



Revise the manuscript to check for misspelling and typos:

Page 2, line 9: “andupon”

Page 10, line 30: Replace “thought” by "though"

Page 11, line 18: “kmand”

Page 12, Line 16: “kmheight”

Page 12, line 17: “kma.s.l.”

[REPLY] We revised the manuscript for misspelling and typos.