We would like to thank the Reviewer for his/her report. Below are given our point-by-point replies (regular font) to each comment (bold font) raised by the Reviewer.

**This manuscript presents a new but previously published data set of global, daily dust optical depth (DOD) at 0.1Ë spatial resolution and the resultant spatio-temporal features of dust activity over global major dust hotspots. While this is an interesting data set with a lot of potential scientific applications, and this article is well organized and well written, it looks more like a review article rather than an original research article. Indeed, this article reminds me of Ginoux et al (2012) published in Review of Geophysics, which reviewed global dust sources and their seasonal features based on a global, daily, 0.1 data set of DOD derived from MODIS measurements. My main suggestion for the current authors is thereby to decide if you want it to be a review article or a research article.**

In the submitted manuscript, we clearly stated that the goal of our study is to describe the regime of dust aerosols over specific regions of the planet hosting major dust sources, as well as those undergoing dust transport. We also focus on analyzing the monthly and year-to-year variability between 2003 and 2017 at global and regional scales. Actually, we are not summarizing all published works on dust optical depth (DOD) for each region of interest (ROI), what would be the case of a review article. Of course, reference and comparisons are made to previous studies, but this is done for justifying the validity of the MIDAS DODs, thus expanding the already comprehensive assessment analysis presented in the first paper (Gkikas et al., 2021), in order to support our findings and/or to assess the current state of the art on existing dust related datasets.

We agree with the reviewer that the structure of our manuscript reminds that of Ginoux et al. (2012) but the contents of the two papers, to our point of view are different. Here we are focusing on DOD in contrast to Ginoux et al. (2012), who is identifying natural and anthropogenic dust sources based on the Frequency of Occurrence (FoO) of exceedances above a defined DOD threshold. It is true that Section 4, in Ginoux et al. (2012), presented some results about their MODIS-derived DOD, but most of their discussion is focusing on the comparison against AERONET retrievals and also a short summary of AOD and DOD patterns is provided at global scale, based on their seasonal spatial distributions depicted in Figure 4. Even though these findings can be considered similar with those obtained here, there are also distinct differences between the two studies, consisting in the different applied methodologies for the derivation of DOD, the spatial coverage of the two datasets as well as the length of their time series (Ginoux stops in 2009). In terms of differences with the study by Ginoux et al. (2012), we would like to remind that, as described in Gkikas et al. (2021), the MIDAS DOD is derived via the synergistic implementation of quality-assured MODIS-Aqua AOD and the MERRA-

2 fraction of AOD that is due to dust (MDF). On the contrary, in Ginoux et al. (2012), the DOD is associated with MODIS AODs when the Angstrom exponent (size optical property) and the single scattering albedo (nature optical property), both obtained from MODIS, are lower than defined upper thresholds. Therefore, apart from the differences in the applied methodologies there is also a difference in the terminology of how dust optical depth is defined. Here, we are extracting the contribution on non-dust aerosol species by utilizing MDF (with all the uncertainties as these have been discussed thoroughly in Gkikas et al. (2021)) while in Ginoux et al. (2012) the DOD resembles more dust dominant conditions (with all the uncertainties of MODIS size and nature optical properties).

It is also worth mentioning that between the two DOD products there is also a difference in their spatial coverage. In Ginoux et al. (2012), the DOD is available only above land either because their focus was on the identification of dust sources or on the utilization of the single scattering albedo (retrieved only over land by the MODIS Deep Blue algorithm) for screening non-dust AODs. In our study, DOD is provided above sources, nearby downwind regions and oceans. Likewise, we would like to point out that our dataset spans from 2003 to 2017 (15 years) in contrast to Ginoux et al. (2012) which covers a shorter time period (2003-2009). Furthemore, in the current work we are processing the latest version of MODIS retrievals (i.e., Collection 6.1) in contrast to Ginoux et al. (2012), who analyzed the same MODIS data obtained, however, by a prior version (i.e., Collection 5.1) of the retrieval algorithm. Finally, we would like to highlight that our study also quantifies and analyzes the average AOD and DOD along with their monthly and interannual variability and associated uncertainties at global, hemispherical and regional scales, which is not done by Ginoux et al.; (2012). For the sake of clarity, we clarify that of course, our intention is not to criticize the work of Ginoux et al. (2012), neither in our replies nor in the manuscript, but just to answer the specific comment proving that the two papers and data sets are of a different nature.

**Whether you are transferring or not, I suggest making clear about the quality of your data set throughout the paper. For example when you show the annual mean DOD over certain region, please mark the questionable regions, such as Gulf of Guinea.**

Some notifications (in lines 225-228, 335-336, 705-718 of the revised version of the manuscript) to the readers and potential users of the dataset were made in the revised manuscript.

**Talking about data quality, does MERRA2 typically assign low MDF over agricultural dust source regions? I didn't find a formal assessment of MDF over agricultural areas, such as the Great Plains, southeastern Australia, either from the current manuscript or Gkikas et al (2021).**

In Section 4.1 in Gkikas et al. (2021), we presented the evaluation of MDF versus the corresponding dust fraction derived from the LIVAS dataset. To perform this, we reproduced the annual (Figure 1) and seasonal (Figure S2) global maps, representative for the entire study period, along with the corresponding spatial distributions of some primary evaluation metrics (Figure 2; Figure S2; Figure S3 and Figure S4). Based on these plots, we think that we provided sufficient information covering all aspects, necessary for a complete evaluation of MDF. Focusing on the regions mentioned by the reviewer, we can see that in the Great Plains and southeastern Australia, the annual MDF is mainly lower than 30% while LIVAS dust fraction can reach up to 40% (Figure 1). Seasonal maps (Figure S2) provide an insight of how dust fraction variation, within the course of the year, is represented by MERRA-2 and LIVAS. Hence, it is evident that there is an underestimation of MDF in this case, whereas the correlation coefficient between LIVAS and MIDAS reaches up to 0.6. This "deficiency" can be explained either by the fact that dust sources in MERRA-2 are based on Ginoux et al. (2001), accounting mostly for natural dust emission areas, or by the LIVAS temporal availability (Figure S3-i) and grid-cell representativeness (Figure S3-ii), as it has been discussed in Gkikas et al. (2021).

**Another general question about the dataset is that if we grid this fine-scale product to the original MERRA2 grid, do we get pretty much MERRA2 DOD? Since MERRA2 assimilates MODIS AOD and MDF is defined as the ratio between MERRA2 DOD and MERRA2 AOD.**

In Section 4.3 of Gkikas et al. (2021), we are comparing the DODs derived by MIDAS, LIVAS and MERRA-2. MIDAS and MERRA-2 data have been regridded to 1° x 1° spatial resolution to match those of LIVAS while the study period (2007 - 2015) is restricted by the LIVAS availability. Based on our performed analysis a comparison between MIDAS and MERRA-2 DODs at global (Figure 6-a), hemispherical (Figures 6-b, 6-c) and regional (Figure S7) level, is shown. For brevity reasons, we would like to avoid repeating here our discussion presented in Gkikas et al. (2021).

Regarding the last part of the reviewer's comment, we would like to clarify some points in order to explain the declinations between MERRA-2 and MIDAS DODs. MERRA-2 assimilates bias-corrected, neural-network retrieved (and AERONET-calibrated) AOD that is derived over land from the Dark Target algorithm (Collection 5 instead of Collection 6.1 used here) radiances, thus excluding bright surfaces over which MISR retrievals are assimilated (without any bias correction). Additional aerosol observations which are considered in the MERRA-2 assimilation scheme are those from AVHRR (over ocean only) and AERONET. The increments induced by the assimilated total AODs are distributed among the five aerosol species simulated in MERRA-2 using model background information. Therefore, DOD is determined by the underlying GOCART module, the impact of the

GEOS-5 meteorological driver, their two-way feedbacks and the assimilation-driven adjustments. On the other hand, in MIDAS, the columnar dust optical depth is determined by MODIS AOD (which is quite reliable as it has been shown in numerous evaluation studies) and MERRA-2 MDF which is considerably reliable in areas where dust presence is evident (see Section 4.1 in Gkikas et al., (2021)).

**If you decide to retain the current article as a research article, it is necessary to define a clear scientific question. I do not see the scientific question or hypotheses in the current manuscript.**

Our purpose (as stated in lines 107-108, 651-657 of the revised manuscript) is to describe the regime of dust aerosols, at global and regional scale, relying on the MIDAS dataset, which was introduced and evaluated in the AMT published methodological paper by Gkikas et al., 2021, and to understand differences among different existing DOD databases.

**If you decide to transfer to review article, I would suggest to highlight what are the new findings since Ginoux et al (2012). Maybe one aspect is about the long-range transported dust, since the data set Ginoux et al (2012) analyzed only covered land.**

As explained in our reply to the first comment, which stated the differences between the two studies, our aim is a scientific and not a review article.

**I'll be happy to review this paper again, either in its review article form or a more scientific question-driven form.**

We would like to thank the reviewer for his/her effort and the willingness to review the new/revised document.