Comment on acp-2021-418
Anonymous Referee #2

Referee comment on "15-year variability of desert dust optical depth on global and regional scales" by Stavros-Andreas Logothetis et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-418-RC2, 2021

Summary and major comments:

The authors describe trends in dust aerosol optical depth and aerosol optical depth as calculated from the MIDAS fine resolution dataset. They conduct several sensitivity studies including assessing differences between the geometric and arithmetic mean, variation in start year and timeseries length, filtering, impact of spatial resolution, and regional trends. Overall, I believe that this contributes meaningfully to the existing literature on this topic as it evaluates a new dust dataset and conducts sensitivity tests that have been under-utilized in previous satellite-derived dust climatology studies. However, I believe some additional analysis and revision to the manuscript is necessary.

While the authors present comparisons to several other dust datasets, many of them are also based on MODIS AOD and are therefore not independent from the MIDAS dataset. Additional comparison with datasets that do not incorporate MODIS data are warranted eg. CALIPSO DOD, AERONET, ground-based dust measurements. At a minimum, more acknowledgement in the text of the lack of independent comparison is necessary. The discussion of the differences resulting from the use of the geometric vs. arithmetic mean of DOD is important and that analysis should be presented completely in the body of the paper. In the methods section, more discussion of the uncertainty, strengths, and weaknesses of the MIDAS data should be included. Some of the methods were not completely described. I also believe the authors should elaborate more on the motivation for this work. There have already been several studies on dust optical depth trends using MODIS-derived datasets. Please discuss why this one is a valuable contribution beyond being a different spatial resolution.

The manuscript needs substantial editing for grammar. There were uncapsitalized proper nouns, improperly used or missing articles, and generally confusing sentences throughout the text. I have included some of these in my detailed comments but this list is far from exhaustive.

Detailed comments:

Line 21: Changed to “The effect of DOD on the total aerosol optical depth (AOD) change is
determined by calculating the...”

Line 23: change to “…Gobi Deserts) the ratio value is approximately 0.6.”

Line 28: remove “which sounds a critical aspect when satellite-based measurements are utilized.”

Line 31: Change to “are a major contributor to the atmospheric aerosol...”

Line 48: Capitalize “Van der Does”

Line 52: South America

Line 108: remove “it” in “it is reasonable”

Line 111: change language “taking advantage that” to something grammatically correct

Line 141: Please elaborate on the “highly accurate” MODIS AODs by providing information on error statistics and validation studies

Line 141: Instead of saying “trustworthy”, consider providing specific information about the uncertainty in the product, based on uncertainty in MODIS AODs and MDF

Line 143: note that validation with MERRA-2 is not independent since the MDF is used in the calculation of MIDAS DOD

Line 145: Describe how you minimize contribution of non-dust aerosol species

Line 152: Change the language of “it has been justified the reliability of ...” for grammatical reasons

206: Please show this analysis in the supplementary material
Figure 1: Consider showing differences in trend between geometric mean and arithmetic mean instead of showing values

Lines 267-269: Please rephrase for clarity.

Line 298: Please indicate, with grey shading for example, where seasonal trends were not calculated due to data gaps

Line 310: Please provide some values in the text for these trends in order to make it easier to understand without flipping between the manuscript and the supplementary material. For example, “increase trends of up to X yr^-1” or similar language.

Line 327: Rephrase the final sentence of this line to reflect that the MERRA-2 dust fraction in MIDAS overestimates dust as compared to the DOD values derived from CALIOP retrievals.

Line 337: Consider discussing the relationship between cyclone activity and dust eg. Pan et al. (2018) Journal of Climate; Evan et al. (2006) GRL

Line 400: Why not state the global trend over ocean for MIDAS DOD here?

Line 413: 5 years is a very short period over which to calculate a trend.

Line 460: change “do not contradict with” to “are consistent with”

Line 462: “resulting in”

Lines 567-568: Overestimate as compared to what? What are you considering to be the "truth" dataset/value? Also, please rephrase to correct grammar

Line 574: “and globally”
575: Redundant sentence

Figure 5: explain hatching in figure caption.

Lines 582-583: Please rephrase for clarity and grammar

Lines 588: Please explain further how these trend results could be incorporated into chemical models and why this is valuable