

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2021-193

Anonymous Referee #1

Referee comment on "Investigation of a Saharan dust plume in Western Europe by remote sensing and transport modelling" by Hengheng Zhang et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-193-RC1>, 2021

The study deals with the description of a long-range Saharan dust plume that affected the Central Europe in April 2018 and captured by ground-based instruments (lidars, sunphotometer) operating at Karlsruhe (Germany). Moreover, an evaluation of the ICON-ART transport model is performed. I think that several modifications on the manuscript are needed in order to be acceptable for publication in AMT. For instance, it has not been clear by the authors which is the added value of the current study with respect to previous similar analyses. Likewise, an intercomparison of the obtained findings with those reported in past studies is missing. A critical point which must be clear to the reader is to highlight the purpose of the current study. There are parts in which different retrieval methods (raman vs klett) are compared, different observational geometries (vertical point vs off-zenith vertical profiles) are discussed, different remote sensing techniques (active vs passive) are employed and dust numerical simulations are evaluated against ground-based measurements. But it is not clear what is the exact proposition from this exercise (e.g., to deploy similar instrumentation for desert dust studies?). Even though the amount of data/techniques sounds impressive, the way that they are presented is confusing to my opinion. As you will see in my comments below it is required a restructure of the paper sections. Finally, please consider to improve the English writing throughout the manuscript.

Comments:

- **Lines 12-13:** Provide the wavelength
- **Lines 34-35:** Could you please explain better this sentence? Which are the problems for CALIOP to depict the vertical structure of dust layers?
- **Line 47:** Replace "*Recently, synergy analysis methods...*" with "*Recently, synergistic approaches/methods...*".
- **Lines 54-56:** Rephrase and explain better this sentence.
- **Lines 74-77:** Check also the SDS-WAS in which several regional models provide short-

term dust forecasts over the NAMEE domain.

- **Lines 90-91:** Not only ASD but SSA is also retrieved. Please make the appropriate corrections in this sentence.
- **Line 114:** It is strange that for the first time in the manuscript you are referring to Figure S3. Also it is missing a short description about this comparison.
- **Results and discussion:** It would be useful to add a section describing the factors driving the emission and transport of the Saharan dust plume towards central Europe. Such analysis should include model outputs (e.g., meteorology, dust) as well as ground-based observations (these have been already provided but not in an appropriate place) and satellite retrievals thus providing a complete overview.
- **Figure 1:**
 - Which is the off-zenith angle for the KASCAL aerosol profiles?
 - Use common colorbar for the three curtain plots in order to facilitate a visual intercomparison among them.
 - It would be interesting to make a quantitative comparison (e.g. bias) between the curtain plots. To realize, you have to regrid the altitude-time plots and project them in a common grid.
 - I suggest to remove the black curves from the middle plot. I don't see why they are useful and in some cases it is hard to distinguish them (packing). Moreover, the labels are missing.
 - How you have selected the timeframe for the backscatter plot (right figure)?
 - How the backscatter coefficient by the model has been calculated?
 - Why the modelled backscatter coefficient is so much overestimated?
- **Lines 196 – 199:** There is a contradiction between these two sentences. Do you mean the extinction coefficients, their uncertainties or both? According to Table S2, the variation of the alpha values is very small among the window types/lengths whereas the uncertainty (standard deviation) decreases for increasing window lengths.
- **Figure 2:** Please provide a better explanation in the caption.
- **Figure 3:** Can you provide an explanation for the differences of the lidar ratio (LR) for the dust layer (4-6 km) found between slant and vertical angles?
- **Line 226:** Replace "retrieved" with "retrieve".
- **Line 231:** Why you have used LR=55sr and not 50sr?
- **Lines 235-236:** Can you provide a short description about the collocation approach that you have followed?
- **Line 238:** Why the AE is assumed equal to 1?
- **Lines 250 – 251:** What are we expecting in the case of oriented dust particles? Please provide also some relevant references.
- **Lines 261 – 269:** I think that this part should be moved to the new section presenting an overview of the studied dust outbreak by means of numerical simulations, satellite observations and ground-based retrievals (see comment 8). Improve also the part of the text between lines 266 and 269.
- **Section 3.2:** At the end of the main body of the manuscript you are discussing the results of Figure 1 which is quite strange. To my opinion the Results section should be restructured as follows:
 - Description of the dust outbreak (lidars, AERONET, model)
 - Keep Section 3.1 after removing Figure 4 and the relevant discussion (these should be transferred to the model evaluation)
 - Model evaluation discussing also the comparison between lidars and sunphotometer
- **Line 284:** I would be more cautious with this statement!
- **Lines 289 – 290:** Why are you ignoring the potential model deficiencies?
- **Lines 296 – 297:** This sentence needs a better explanation.
- **Conclusions:** You should rewrite the whole section since it is not appropriate in its current state. You have to mention briefly the overarching goal of your work, then to highlight the main scientific outcomes and finally to propose how the performed analysis can be expanded.