

Interactive comment on “Sensitivity of aerosol optical properties to the aerosol size distribution over central Europe and the Mediterranean Basin” by Laura Palacios-Peña et al.

Anonymous Referee #1

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The paper presents the results of unpublished research concerning a sensitivity study of aerosol optical properties to the aerosol size distribution over central Europe and the Mediterranean Basin. Methodology and the graphical representation (figure 1-5) of this work is not described properly and in some part the text is quite obscure. In these conditions, I think there are not the ideal conditions to publish this work so I recommend Major revision.

Below a list of some more specific questions

Abstract Please avoid use of acronyms in the abstract, there are many: ARI-ACI-AOD-DG-SG

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Introduction In my opinion lines 25-44 are not appropriate for the introduction, I would rather move lines 25-44 to another section (methodology ???). As a consequence, introduction should be rewritten considering recent papers on this specific subject. The application of the GOCART aerosol scheme of the WRF-Chem model should be also mentioned and referenced. See for example: Geosci. Model Dev., 12, 131–166, 2019 <https://doi.org/10.5194/gmd-12-131-2019>

2 Methodology This chapter should include one more paragraph in which the synoptic analysis is reported including figures from possibly ERA5 or GFS. What is written in lines 63-66 is not sufficient to describe the synoptic conditions and quite superficial.

2.1 Model setup Lines 77-79: To my knowledge only ARI are considered in WRF-Chem with GOCART aerosols (using RRTMG radiation modules). If you want to consider Aerosol Clouds Interaction you should use more complex aerosol representation like MOSAIC or MADE/SORGAM for example.

In lines 80-81 authors write: “The case study selected here trusts on an extended episode evaluated in Palacios-Penl̆ca et al. (2019b). The model setup for all the experiments is the same as for that work. However, a brief summary of the configuration is included here” In my opinion each paper should be self-sufficient and not relying in other works even if from the same authors. In this context I think it would be necessary to report the physics and chemistry setup in a table and describe also which option is used for chem_opt (301 ???) and for dust_opt (1 ???).

Line 99: pls show the domain(s) with an additional figure.

Lines 105-107. To my knowledge the GOCART aerosol schemes consider a bulk formulation for BC, OC and sulfate but it is sectional for mineral dust using Kok (2011) brittle fragmentation theory to obtain (dust_1, dust_2, dust_3, dust_4, dust_5) variables. So GOCART is bulk/sectional and not modal like described here. Please clarify this point and explain also the following (lines 106/107): “The selection of this scheme is conditioned by the fact that WRF-Chem version 3.9.1.1 only allows the simulation of

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desert dust and sea salt with this GOCART scheme”

3.1 Effects on AOD representation

Fig.1 is quite difficult to interpret. The panels are described by a series of acronyms that are not introduced before, the legend is not descriptive at all. As a consequence, it is really difficult to understand what it is written in the text (lines 128-). Another question concerns the top-row in fig.1 which should represent the baseline case, that is “the temporal mean of AOD for the target period”. Then, both “temporal mean” and “target period” should be defined. A comparison with MODIS (????) should be introduced and showed for the same target period. My personal analysis of MODIS combined DT and DB for both Aqua and Terra spacecrafts show a quite different AOD distribution in the target period. So I would suggest to add HERE the comparison with experimental data (AOD/MAIAC ???) of the baseline case.

Line 137 – abroad => onboard

Line 147 – “Sensitivity experiments regarding modifications in the accumulation mode lead to higher changes with respect to the Aitken mode” where is this showed ????

3.2 Significance of AOD changes

Line 167 – “(in space and time)” what does it means ????

Line 170 – The Kolmogorov-Smirnov test is not introduced and/or explained.

Line 171-172 : “This test estimates the distance between the cumulative distribution function (represented by D) and how significant this difference is (represented by the p.value). “ D and p.values has not been introduced

Fig.2 What is reported in the abscissa ????? panels should be numbered and described in the legend together with the meaning of the red dotted line and black continuous line

Overall this paragraph is of difficult interpretation, KS test is not described, fig.2 is not properly defined and plagued by hundreds of acronyms. Please organize this para-

graph in a more readable way at least introducing tables with results, in order to help reader in the interpretation of what is written here.

3.3 Disentangling the causes of AOD variations due to size distribution

How PM (2.5 and 10) are calculated ??? I mean for the optical properties you introduced aiken-fine-coarse mode, and what happens for the mass ??? WRF-Chem has specialized routines to calculate PM from GOCART aerosol mechanism which is not modal.

Figure 3. Please explain why there is such abrupt change of PM₂₅/PM₁₀ ratio following the African coastline (top row) and why this ratio is almost zero in Africa.

This predominance of fine vs coarse particles or viceversa may be verified against MODIS products, see for example the ang exp and/or maiaac algorithm.

Line 205

Figures 4 and 5 Authors should find a way to better represent their work, figures are turned 90° left with the legends not properly exhaustive

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-68>, 2020.

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