

Cover letter to the Editor

Dear Editor,

Thanks for appreciating the revision effort we made aimed at improving the clarity and robustness of the presented results. We submitted a final revision of the manuscript, integrating the final reviewers' comments. Here below we include the description of the further changes to the manuscript in response to these comments.

With kind regards,

Gabriele Curci on behalf of all co-authors

Response to reviewer's final recommendations

Color legend:

- Reviewer's comments in black
- *Authors' responses in red italic*

Report #1

The authors have addressed all of my suggestions. There is only one minor suggestion that is not well answered.

Yes, I agree that analysis of the AERONET error is beyond the scope of this study, and the authors explained that in the response. However, I think the retrieval errors may be well studied by other studies, and the authors may just slightly discuss the uncertainties in the manuscript based on literature review. This will certainly help to better understand the comparison, because the differences between this study and AERONET are not merely from the simulations. Again, as I mentioned, this is minor, and the authors can decide whether to add or not on their own.

In the manuscript we previously reported the nominal uncertainty associated to AERONET single scattering albedo measurements, which is the relevant quantity used in this work, on page 4, lines 18-20:

"The uncertainty associated with the single scattering albedo is estimated to increase from ± 0.03 for $\tau(\lambda=440 \text{ nm}) \geq 0.5$ to $\pm 0.05-0.07$ for $\tau(\lambda=440 \text{ nm}) \leq 0.2$ (Dubovik et al., 2000)."

Since most of the observations over Europe and North America are in the lower range of aerosol optical depths, the associated uncertainty for the single scene is higher ($\pm 0.05-0.07$). In a statistical sense, on averaged values this uncertainty should be decreased by a factor of \sqrt{n} , where n is the number of measurements. The average changes in single scattering albedo calculated in the sensitivity tests with respect to the mixing state assumption (Table 5) are mostly much larger than those values, i.e. they should be safely beyond the observation uncertainty. We thus prefer not to overemphasize this point more than already done in the current version of the manuscript.

Report #2

After revising the authors' responses to the two referees and the revised manuscript, I suggest to accept the manuscript for final publication in Atmospheric Chemistry and Physics after addressing the following technical comments:

- Captions of Table 4 and 7 shall be extended with the description of the contents of the tables as done in the rest of figures and tables. Table captions should be self-descriptive.

We expanded the captions clarifying their contents and making reference to the Figures where the related results are illustrated:

"Table 4. List of baseline sensitivity simulations on aerosol optical properties calculations. The case with full external mixing (EXT) is taken as reference, the other cases are sensitivity tests in which we changed one assumption per case related to the aerosol mixing state. The difference between CSBC and CSBCV cases is further illustrated in Figure 4. Results are shown in Figure 5-Figure 10."

“Table 7. List of additional sensitivity tests on BrC and size distribution assumptions. Here the changes are evaluated with respect to both the EXT and CSBC cases described in Table 4, changing one assumption per case. Results are shown in Figure 11.”

- I also suggest a final proofreading of the manuscript to correct some mistyping and spelling errors still present in the revised manuscript.

We did a final proofreading of the manuscript and corrected typos and references.