

Authors' reply to Editor

May 11, 2021

We thank the editor for the last feedback, and we tried to resolve all the minor correction proposed.

Publish subject to minor revisions

Thank you for submitting your manuscript entitled "Evaluation of natural aerosols in CRESCENDO-ESMs: Mineral Dust" to Atmospheric Chemistry and Physics, and for your efforts in addressing the Referee comments, as well as the clear information regarding the update to the CNRM results. After reviewing your response to the Referee comments and tracked changes, my decision is "Publish subject to minor revisions".

While the Referee comments have largely been addressed, I would like to ask you to strengthen the response to a few of the comments raised. In particular:

1. The discussions on the topics of "How can model disagreement be resolved?" and "which observations can support further progress" (Referee 1) seem to me to be important. I would like to encourage you to consider whether some version of the comments you have provided in the review response could be fruitfully incorporated into the manuscript.

Several points had been added to the last section named **Future research directions**, but we agree that the point related with the comparisons based on dust particle size distribution has not been full clarified. So we have added the following text in the section 7:

This also illustrates that comparisons where the particle size distribution is resolved (comparisons based on the contributions of each DPSD bin) is needed to understand better the source of model discrepancies, in that regard CRESCENDO-ESMs simulations were designed with these future evaluations in mind. Also we created specific tools to estimate binned contributions from models based on modal DPSD to support these comparisons.

2. On the topic of the Pearson correlation, raised by Referee 1: to avoid the impression of a subjective value judgment, please make more explicit (in the manuscript text) what you mean by "not robust", or otherwise clarify this sentence.

Thank for the comment. We have improved the sentence and we have added a new reference where it is explained what we meant by "not robust". Now it reads:

Given that this statistic is not robust, because its instability in the presence of outliers [2], and only representative of linear relationships, the skill is also estimated based on the Spearman rank correlation to ensure the robustness of the results. For the other comparisons the scatter-plots are informative of the quality of the correlation estimator.

3. On the discussion of "why the EC-Earth and the NorESM have MEE values that differ from the other models", this discussion also contains useful information. Again, I would like to encourage you to consider whether it would be appropriate to include some of this information in the manuscript text.

We added few remarks to explain the possible reasons of these differences:

The larger MEE values of the EC-Earth and the NorESM models can be due a combination of factors: they have the lowest dust loadings, and both are not modelling particles larger than about 8 μm , also in the case of NorESM the imaginary part of the refractive index is also the largest of all the models analysed.

4. Referee 3 had pointed out, in the comment on Page 28, Line 7, statements where additional referencing may be appropriate. The revised version of the text adds referencing and additional details for improvements to the description of soil properties. However, it is still not clear what evidence the statement "the modelled wind surface friction velocity and speed agree better with actual meteorological conditions" is based on. Please provide a source of information or otherwise clarify the basis for this statement.

This sentence relies on the general improvement of current models to reproduce the surface wind speed and the logical impact in the dust emission. There are aspects that contribute to improve the description of wind in the boundary layer, e.g the progressive increase of vertical levels close to surface, but to keep brief this part of the paper we have just included a new citation based on the book reference Knippertz and Stuut [1] where the role of the evolution/progress in modelling the dust schemes is commented.

5. Referee 3 comment on Page 30, Line 26: Adding a reference to Table 8 in this sentence would eliminate any potential for confusion by readers.

Thank you. We have added the reference to Table 8.

References

- [1] Peter Knippertz and Jan-Berend W. Stuut, eds. *Mineral Dust*. Springer Netherlands, 2014. DOI: [10.1007/978-94-017-8978-3](https://doi.org/10.1007/978-94-017-8978-3). URL: <https://doi.org/10.1007/978-94-017-8978-3>.
- [2] Zh. V. Li, G. L. Shevlyakov, and V. I. Shin. "Robust estimation of a correlation coefficient for ϵ -contaminated bivariate normal distributions". In: *Automation and Remote Control* 67.12 (Dec. 2006), pp. 1940–1957. DOI: [10.1134/s0005117906120071](https://doi.org/10.1134/s0005117906120071). URL: <https://doi.org/10.1134/s0005117906120071>.