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Discussions

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**Interactive
comment**

Interactive comment on "Regional effects of atmospheric aerosols on temperature: an evaluation of an ensemble of on-line coupled models" *by* Rocío Baró et al.

Anonymous Referee #2

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The manuscripts analyses the effects of aerosol-cloud-radiation interactions on temperature for two study cases over Europe (smoke and dust episodes) using an ensemble of models and surface observations. The results points towards an improvement of spatial and temporal correlations when adding these interactions. The paper is well written and the topic is in the scope of the Journal. I have some comments and suggestions below.

General comments

The authors jump directly to the statistical assessment but it would be good to also provide a figure(s) showing observed AOD and clouds for the period of analysis and then how each model was able to represent them. If this is performed in other papers

please include it anyways for context.

In general whether aerosols effects improve the simulation depends on the initial bias of the model. However, since the authors perform their statistical analysis over the whole domain, the overlaying bias in regions with little aerosol impact could be driving the results in the wrong direction, especially as the biases are very inhomogeneous throughout the domain. I suggest the authors to restrict their analysis only to regions where large aerosol impact is expected. For instance, bias could be computed only for regions where AOD is over a fixed threshold, or you could weigh the bias by AOD. If the former was done then the regions not included in the analysis could be shaded in the figures showing the different statistics.

Given that the radiation effects tend to be maximized in the early morning and later afternoon (light path through the atmosphere is longer) previous studies have used other metrics to assess the impacts of aerosols. For instance, the trend in daytime temperature range (See Xing at al., 2015). This metric and others could also be included in this study.

The Results section tends to focus on presenting results and not providing much explanation why the findings happen. This would be fine if there was a discussion section, but this is not the case. I encourage the authors to add more of these details to the Results sections. Some examples can be found below.

Comments by line

Page 2, line 10. Somewhere in the text define "EuMetChem COST Action ES1004"

Page 2, Line 19. I think that the statement "especially for those areas closest to emissions sources of atmospheric aerosols" is not explained or mentioned in the text.

Page 9, lines 14-15. Can you elaborate more why it is remarkable? I don't see much change from the figures. It would be good if you added a % decrease of the bias as for ARI.

Section 3.2. What strikes me the most from these results are the differences between the smoke and the dust case. For the smoke case, most of the changes come from the radiation effects, while for the dust effects most changes come from aerosol-cloud effects. Can you explain why this happens? Does the dust case has more clouds over the domain? Is it related to better cirrus representation?

Section 3.3. Why some of the models show large variations and other just intermediate? Can you elaborate?

Figure 10. Because of the narrow spread for all cases, it would be nice to plot a zoomed-in version of the taylor plot to better read the differences between the simulations.

Technical corrections

Page 4, line 22. Erase "are run"

Equation 2. There is either an error on the notation or a variable is not defined ($V\hat{}k\_ic$)

Page 15, line 11. Fix the forkeletal2015 reference

References

Xing, J., R. Mathur, J. Pleim, C. Hogrefe, C.-M. Gan, D. C. Wong, C. Wei, and J. Wang (2015), Air pollution and climate response to aerosol direct radiative effects: A modeling study of decadal trends across the northern hemisphere, J. Geophys. Res. Atmos., 120, 12,221–12,236, doi:10.1002/2015JD023933.

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Discussion paper