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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The role of aerosol-cloud interactions in linking anthropogenic pollution over southern West Africa and dust emission over the Sahara" *by* Laurent Menut et al.

Anonymous Referee #1

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Menut et al. present a regional modelling study to evaluate the direct and indirect radiative effects of mineral dust and anthropogenic air pollution particles over West Africa for the period of the DACCIWA field campaign in July 2016. The simulations were performed with the model system WRF-CHIMERE allowing for online interaction of aerosol particles with radiation and clouds. Standard meteorological parameters, soundings and measurements of aerosol optical depth were used for model evaluation. The analysis shows that air pollution over southern West Africa appears to influence dust production in the Saharan Desert through direct and indirect aerosol radiative effects. Their study is an interesting contribution to the topic, in particular as it shows how natural and anthropogenic aerosols are interdependent and can influence the climate.

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Discussion paper

I recommend to publish this work in Atmospheric Chemistry and Physics, however with the following comments being considered.

General comments:

In my opinion, the goal of the study to evaluate the direct and indirect aerosol effects over West Africa was not fully achieved. This would need to disentangle aerosol-radiation and aerosol-cloud interactions, which however requires more than two sensitivity model runs. Direct radiative effects and rapid adjustments seem to dominate the aerosol impact on boundary layer properties, precipitation and atmospheric composition, including mineral dust (also in the way the results are presented). Therefore, I also wonder whether the title is in accordance with the text.

Considering the fact that this paper is to be published in the DACCIWA special issue, the authors should not miss the opportunity to use the rich dataset for a detailed evaluation, in particular of the aerosol-cloud interactions. In addition, nowadays, the computational costs for a 60-km regional simulation should allow for more than 1.5 months. Could you imagine to extend your model runs to cover the whole summer season or even one year?

Language wise, the manuscript is already in a good state. The text could nonetheless use another round of editing to eliminate remaining minor inconsistencies and typos. Throughout the manuscript, the format of references has to be revised.

Specific comments:

1. Page 1, lines 8-10: It should be mentioned that the values of modelled aerosol effects on temperature and radiative fluxes are monthly averages for July 2016.

2. Page 1, lines 12-13: In the Abstract but also in the Results' part and Conclusions, the impact of dust and anthropogenic air pollutants on the wind field and precipitation is presented rather descriptively. So, it remains unclear, what the connection is between the latitudinal shift of the monsoonal precipitation and an increase in surface winds,

in particular, since moist convective cold pools are not resolved in the 60-km model simulations. Here, the authors could strive for a more thorough explanation, possibly, in the context of the West African Monsoon circulation.

3. Pages 2, lines 25-34: It might be worth mentioning that also Heinold et al. (2011, doi:10.1111/j.1600-0889.2011.00574.x) had already found very similar effects of Saharan dust and biomass burning smoke strengthening the Hadley circulation, which influenced the aerosol distribution in a similar way as described in this study.

4. Page 2, line 35: Aerosol particles involved in heterogeneous freezing, today, are more commonly referred to as “ice nucleating particles (INP)”.

5. Pages 5/6, Section 3.2: Does the radiation scheme in the model consider the change in cloud properties due to the aerosol-cloud interactions?

6. Page 6, Section 4: To my knowledge, extensive aircraft measurements of aerosol chemistry, radiation, and cloud-aerosol interactions took place during DACCIWA. Why were these observations not used for model evaluation?

7. Page 21, lines 17-18: The alternating patterns are most likely due to stochastic effects of clouds between the two model representations.

8. Fig. 4: The different coloured lines are too thin and hard to distinguish. Since the individual soundings are not discussed anyway in the text, I wonder whether it would make sense to average over the profiles (or groups of them).

9. Figs. 5 to 7: In the difference plots, the tiny black dots probably indicate statistical significance. This should be mentioned in the figure caption.

10. Figs. 4 to 8: The font size of axis labels and titles and/or colour bars is too small and needs to be adjusted.

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