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Interactive comment

Interactive comment on "Weaker cooling by aerosols due to dust-pollution interactions" *by* Klaus Klingmüller et al.

Anonymous Referee #1

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The study described in the manuscript uses the atmospheric chemistry model EMAC to evaluate the direct and indirect radiative effects of dust-pollution interactions, i.e. as mineral dust particles are allowed to act as a surface for condensation of aerosol precursors, with the effect of changing the aerosol mix optical properties, hygroscopicity, number, and size. I found the manuscript and its results interesting, and generally well written and clear. I recommend that some aspects are clarified before publication.

p. 3, 19 – Could you give a few more details on what are the actual dust-pollution interactions happening in the model? i.e. which are the other aerosol species interacting with dust? Can you specify what "pollution" is exactly here? Black carbon?

p. 3, 24 - Please discuss dust optical properties in your model in light of the relevant literature (e.g. Kaufman et al. 2001, Müller et al., 2011, Di Biagio et al. 2019). It is

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relevant to assess this potential source of uncertainty.

p. 3, 34 - The indirect statement about the particle size distributions seems unjustified. AOD at a given wavelength is usually parameterized as the product of aerosol column loading for a given size mode/bin times the size-dependent mass extinction efficiency. At least, the statement should be supported by additional evidence that the optical properties that you use are "reliable".

p. 5, 11 – Is there a spatial component in your procedure of reducing anthropogenic biomass burning emissions?

p. 5, 20 – Can you elaborate on the two different strategies for averaging?

p. 5, 25 – Please clarify what your strategy is, in light of e.g. IPCC AR5 terminology: "The difference of the radiative fluxes from both calls yields the instantaneous forcing . . ." vs e.g. "Globally averaged, the net forcing in the solar spectrum shown in Fig. 2 (a) is (0.23 $\pm$ 0.01) Wm-2, the SST simulations yield an ERF of (0.3 $\pm$ 0.1) Wm-2" (p. 7, 8). Please clarify how each metric that you will discuss is calculated, and try to be consistent in the terminology you chose, in differentiating between instantaneous RF, ERF, and direct and indirect radiative effects.

p. 6, 6 – In light of your strategy (i.e. experimental design) is that because of a local aerosol effect or else?

p. 8, 17 – "Our SST simulations . . ." please rephrase, and resume briefly your experimental setup in the conclusions. Also, in this section you should discuss the limitations related to the experimental setup, as suggested by the editor.

Figures 1, 2, 3 - It would be useful to see the individual (dust, pollution) effects alongside with their interactions. It would also be useful to see the average dust and pollution burden maps somewhere also within this manuscript.

Figure captions – "Over stippled regions the results are consistent with zero at 2 σ significance level." What do you mean by "zero"? A null hypothesis of zero difference

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in the mean among the ensemble members? Please clarify the captions, and provide the details of your procedure.

Figure 4 – The bar chart is not very clear in its present form. Please make it explicit which simulation ensembles you are depicting in each of the top bars: only pollution and dust+pollution?

References

Kaufman, Y. J., D. Tanré, O. Dubovik, A. Karnieli, and L. A. Remer, 2001: Absorption of sunlight by dust as inferred from satellite and ground-based remote sensing. Geophys. Res. Lett., 28, 1479–1482, https://doi.org/10.1029/2000GL012647.

Müller, T., A. Schladitz, K. Kandler, and A. Wiedensohler, 2011: Spectral particle absorption coefficients, single scattering albedos and imaginary parts of refractive indices from ground based in situ measurements at Cape Verde Island during SAMUM-2. Tellus, 63B, 573–588, https://doi.org/10.1111/ j.1600-0889.2011.00572.x.

Di Biagio, C., Formenti, P., Balkanski, Y., Caponi, L., Cazaunau, M., Pangui, E., et al. (2019). Complex refractive indices and single scattering albedo of global dust aerosols in the shortwave spectrum and relationship to iron content and size. Atmospheric Chemistry and Physics Discussions, 19(24), 15,503–15,531. https://doi.org/10.5194/acpâĂŘ2019âĂŘ145.

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