Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-470-RC2, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Chemical aging of atmospheric mineral dust during transatlantic transport" *by* M. Abdelkader et al.

Anonymous Referee #2

Received and published: 9 September 2016

General comments

This work describes the effects of chemical aging, emissions and convection parameterizations in the transport of desert dust over the Atlantic Ocean with the use of the atmospheric chemistry general circulation model EMAC. The authors have published the concept of dust chemical aging in a recent paper and in this new publication they deal with the transatlantic transport and how it can be affected by various model parameterizations related to the dust cycle. Modeling the desert dust cycle is a complicated topic given the necessity to parameterize physical processes that produce and cycle dust particles throughout the atmosphere and a better understanding of how to improve these processes is significant.

I found the paper difficult to read, in terms of the flow, especially because there is a

Printer-friendly version

Discussion paper

continuous description of the figures instead of using them to support a conclusion or remark. The main review comments are related to clarifications in the methodology and discussion of the results. I am in favor of publishing this paper with Atmospheric Chemistry and Physics with Major Revisions. The specific comments that follow will help improve the discussion of the methodology and significance of the findings so that the overall quality of the manuscript is enhanced.

Specific comments/suggestions

1. Please refer to aging of dust as “chemical aging” in all parts of the manuscript.

2. Introduction, page 2, line 34: in the sentence “mean normalized bias of the AOD model varies”, the word “model” should be omitted.

3. Please provide the specific modules used in the EMAC configuration so that the results from this work can be reproducible.

4. Are indirect aerosol-cloud interactions included in the model configuration, besides the radiative feedback effect? How different the results might have been if these interactions were included?

5. Page 3, line 23: what is the meaning of “increases the level of dust aging”? Is there a specification of levels of chemical aging that the authors consider? I am assuming that inorganic acids uptake by the dust particles is what differentiates freshly emitted dust with dust being transported in the atmosphere, which eventually leads to “chemical aging” since the original dust particle has an altered chemical signature. Unless water uptake is considered the primary aging process. Please clarify.

6. Following the same notion as in comment #4, Figure 1 indicates that insoluble emitted dust turns into aged-dust, followed by acid condensation. I would expect the acid condensation first and then the dust characterized as aged. Based on this schematic, there is no clear distinction about when dust is termed aged or non-aged.

7. Page 3, line 27: “the mineral cations are used as reactivity proxy for natural aerosols,

such as [. . .] mineral dust". Knowing how difficult it is to include chemical speciation of the emitted dust particles in the model, my question is how the authors apportioned the dust emitted mass to mineral cations. Is it a fixed percentage for calcium, magnesium and potassium? This information must be made clear in the text.

8. Sections 3 and 4: as mentioned in the beginning, in a lot of parts of the discussion there is a description of the figure instead of a narrative about the main findings, followed and supported by the figures. I strongly encourage the authors to revise parts of the text accordingly, which will greatly benefit the quality of the manuscript.

9. What is the basis for the selection of the six specific stations that were included in the sensitivity tests, out of the ones shown in Fig. 4? It seems from fig.4 that more stations were available inside the specific zones.

10. Page 6, line 9: is the 600ug/m3 an observed or simulated value for dust concentration?

11. Page 7, lines 2-3: the aging of dust particles throughout the transatlantic transport depends also on the availability of inorganic acids in this region. The EMAC model outputs corroborate with the assumption that inorganic acids can be found in the DTA and/or DIZ zone?

12. Table 1: I believe rm and ro are supposed to be standard deviations sigmam and sigmao. Please revise accordingly.

13. Table 1: what is GFE, PF2 and PF10? They are not included in the appendix and never mentioned in the text.

14. Figure 10, caption: please include the time period that the plots cover. Also, remind the reader which plots correspond to the ECMWF and TIEDTKE schemes.

15. Figure 11: is the standard deviation of the TRMM product calculated over the meridional mean to show the variation/dispersion of the precipitation at each longitude? Why not show the stdev for the model outputs as well?

16. Are Figures 10 and 11 for the same time period, July 2009? If so, the meridional means are confusing. They show that B1T5 is closer to the observations but Figure 10 indicates that maybe EMAC base case is closer to TRMM.

17. Figures 13 and 14 show monthly means for July 2009?

18. The paper title in the supplement is not correct. Please revise accordingly.

19. In the conclusions section, there is discussion on the findings from the sensitivity tests and model evaluation. A general conclusion about the new and significant findings from this work is necessary and, perhaps, a recommendation to the model users about the choices that would produce more reliable mineral dust simulations.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-470, 2016.

Printer-friendly version

Discussion paper