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Geoscientific Model Development Discussions
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Interactive comment on "Modelling the mineralogical composition and solubility of mineral dust in the Mediterranean area with CHIMERE 2017r4" *by* Laurent Menut et al.

Anonymous Referee #2

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General comments

Numerical predictions of mineralogical effects on biogeochemistry and climate are highly uncertain. The authors implemented the mineralogical database to regional chemistry transport model. They confirm that this implementation does not substantially change the results of AOD, mass concentrations and deposition fluxes, following previous studies. I have some major comments to improve the paper.

Major comments

1. A fitting function to 4 data points, which were previously calculated by another fitting function, could introduce additional numerical errors. In fact, the fitting curve in Figure 3

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is apparently different from that calculated by the original function. Although this would not substantially affect the results of AOD, mass concentrations and deposition fluxes, it would modulate the numerical predictions of mineralogical effects on biogeochemistry and climate. The original function should be used to avoid the error. At least, this caution should be noted in the manuscript.

2. Previous modeling studies have already implemented the mineralogical data to atmospheric chemistry transport models. The multi-model results and observational data are available over the model domain (Ito et al, 2019). Please discuss the results of the Fe solubility.

Specific comments

p.4, l.104: Please describe the method to estimate the aerosols including nitrates, ammonium and sulphates. How do you consider the effect of mineralogical composition on these aerosol formations?

Section 4: Please describe the method to estimate the mineral dust deposition flux and specify the effect of the aerosol density on the dry deposition.

p.5, l.122: To clarify a new implementation in this work, the first part should be moved before the several changes. Otherwise, please clarify the improvements from the Beegum et al. (2016), who implemented the MODIS erodibility to the CHIMERE model.

p.5, l.126: Please show the smooth function and the comparison with the measurements. How did you apply the function to different land surfaces? Please clarify the differences in the dust emissions with and without the function.

p.9, Table 3: How did you estimate the Fe solubility of 0.17% for illite? Please specify the reference, or correct the value. Please evaluate the Fe solubility with observational data over the ocean in this paper. Please clarify the differences from previous modeling studies in the estimate of the Fe solubility.

p.10, l.177: How did you calculate the deposition fluxes for the mineral species?

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p.10, l.193: Presumably, you used different size distribution of emitted aerosols. How did you calculate it? Please specify your calculation using their equation, which should provide the results presented in their Table 2a in your case.

p.16, l.284 and p.21, l.344: Please show the results of radiation effect, or rephrase the sentences.

p.21, l.333 and Table 8: Please show the range of latitude and longitude for each region and compare the results over the same region.

p.21, l.349: Please clarify the strong dependency of settling velocity on the density in the method, or rephrase the sentence.

Technical comments

Figures 1 and 2 as well as Tables 1 and 2 may be moved to supplementary materials to avoid the redundancy.

p.1, l.4: Please correct in.

p.2, l.47: Please correct out.

p.3, l.49: Please correct et.

p.5, l.113: Please remove the.

p.10, l.184: Please delete ,.

p.11, Figure 3: Please correct f_clay [Scanza] and weight functions.

p.12, l.212: Please correct emission.

p.12, l.216: Please add the number to the equation.

P.17, Figure 7: Please correct the caption.

References

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Beegum, S., I. Gherboudj, N. Chaouch, F. Couvidat, L. Menut, and H. Ghedira: Simulating Aerosols over Arabian Peninsula with CHIMERE: Sensitivity to soil, surface parameters and anthropogenic emission inventories, Atmospheric Environment, 128, 185–197, https://doi.org/10.1016/j.atmosenv.2016.01.010, 2016.

Ito, A., Myriokefalitakis, S., Kanakidou, M., Mahowald, N. M., Scanza, R. A., Hamilton, D. S., Baker, A. R., Jickells, T., Sarin, M., Bikkina, S., Gao, Y., Shelley, R. U., Buck, C. S., Landing, W. M., Bowie, A. R., Perron, M. M. G., Guieu, C., Meskhidze, N., Johnson, M. S., Feng, Y., Kok, J. F., Nenes, A., and Duce, R. A.: Pyrogenic iron: The missing link to high iron solubility in aerosols, Sci. Adv., 5, eaau7671, https://doi.org/10.1126/sciadv.aau7671, 2019.

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