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Geoscientific Model Development Discussions

Interactive comment on "Grid-independent High Resolution Dust Emissions (v1.0) for Chemical Transport Models: Application to GEOS-Chem (version 12.5.0)" *by* Jun Meng et al.

Anonymous Referee #4

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The production of an improved dust emission dataset would be useful for CTMs varying spatial resolution (and idealized simulations in multi-model studies like AeroCom). Generation of high spatial and temporal resolution mineral dust emissions fields for use in lower-resolution simulations is thus a worthwhile product. However, I find the light evaluation of the simulations a concern. Improving the evaluation would increase confidence if the proposed dust emissions are representative at both global and regional levels. For example, only having a single AERONET observation site (and only in spring?) for all of Asia is particularly concerning, especially given issues with satellite retrievals over land. There also appears to be no evaluation of Southern Hemisphere sources. Until a more comprehensive evaluation of the dust atmospheric state is un-

dertaken an evaluation of emissions, and thus the dataset as whole, is difficult to judge.

It is probably good to point out that models have a large uncertainty in predicting AOD themselves. Therefore, a reliance on evaluating with only this variable is somewhat questionable. Furthermore, in the Southern Hemisphere satellites revivals are hindered persistent high levels of clouds and that dust activity also tends to occur later in the afternoon after the overpass of polar satellites (e.g., Gassó & Torres, 2019). Comparison to observations of dust concentration and deposition (e.g., Albani et al., 2015), can alleviate the dependency on remote sensing and modelling of one variable. I recommend such an evaluation be included.

The explanation for the approximate doubling of emissions in the optimal simulation appears to be to better match North African dust sources, but is the optimization not best served if undertaken regionally? For example, as D. A. Ridley is a co-author a regional AOD evaluation based on (Ridley et al., 2016) should be possible. An optimal estimation of the regional source strengths is particularly important given the goal is to prove a dataset for the community where other dust regions are important contributors to regional climate. E.g., within the Southern Hemisphere in providing IN or dusts role in marine biogeochemical cycles.

As significant amounts of dust mass occur above 6um (Adebiyi & Kok, 2020; Ryder et al., 2019), how does this impact results here and what are the impacts for generating a dataset for other CTMs given the size bins and cut off here?

Minor Comments: L103: Dust entrainment and deposition

L106: Why is a fixed global value of clay fraction used when datasets are readily available giving the regional fraction. E.g., (Journet et al., 2014)

L119: Define HEMCO?

Refs: Adebiyi, A. A., & Kok, J. F. (2020). Climate models miss most of the coarse dust in the atmosphere. Science Advances, 6(15), 1–10.

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