Responses to Reviewers on “A global dust emission dataset for estimating dust radiative forcings in climate models” by Danny M. Leung et al. (MS No: egusphere-2024-1124)

We thank the reviewers for their careful examinations and thoughtful comments. Our point-by-point responses are provided below. The reviewers’ comments are *italicized*, and our new/modified text is highlighted in blue.

Reviewer 1:

General comments：

This paper constructed a globally gridded dust emission dataset spanning 1841-2000 according to combining 19 sedimentary records of dust deposition. Their results are interesting and important for improving GCM simulations at historical and future dust change. Several points of the manuscript still need to be improved before accepted. Specifically, the dust radiative forcing can lead to non-uniform feedbacks on dust emissions from dust radiative effect, e.g., dust direct and dust-in-snow forcing, which will affect the results from CESM2-DustCOMM. Therefore, the manuscript needs to make several revisions before their paper is considered acceptable. Please see the following comments.

> We thank the reviewer for the helpful comments. Please see the detailed response below in the specific comments.

Specific comments：

1, Previous studies have shown that the dust emission fluxes can significantly be influenced by dust direct effect and dust-in-snow effect (e.g., Miller et al., 2004; Xie et al., 2018b), which can affect the regional dust cycle including dust emissions, depositions, and dust AOD, in turn lead to positive or negative feedbacks. The dust radiative forcing can lead to non-uniform feedbacks on dust emissions from dust direct effect (positive feedback over North Africa and negative feedback over East Asia in Xie et al., 2018a) and from dust-in-snow effect (only positive feedback over East Asia in Xie et al., 2018b). These non-uniform feedbacks induced by dust radiative forcing may result in inconsistency between simulations from dust reconstructed gridded dust emission dataset (red line) and observation (black line) in Figs 4, 6, and 7. I think the authors should discuss this point about these radiative feedbacks on dust emission. Dust-ice cloud interaction (DeMott et al., 2010; Sagoo and Storelvmo, 2017) maybe also have important influence on dust cycle?

> We agree that dust feedbacks could lead to further changes (increase or decrease) in dust emissions and loading. We would like to state that many dust feedbacks are incorporated in our analysis and in the ESMs: Our inverse analysis employs a DustCOMM model

ensemble of the dust deposition-to-emission relationship $f_{i,j}^{\mathrm{cc}}$ to yield the DustCOMM emission dataset F_{EI} as described in Sect. 2.1 (also see Kok et al., 2021a, b). $f_{i,j}^{\mathrm{cc}}$ represents the dust deposition-to-emission sensitivity, which inherently includes various feedbacks: The model ensemble for constructing $f_{i,j}^{\mathrm{cc}}$ represents dust effects on meteorological forcings (e.g., wind circulation, rainfall, and solar radiation) and aerosol/chemistry solvers (e.g., advection, chemistry, and deposition). Earth system models like the CESM further contain higher-order feedback impacts of dust on radiation, clouds (Gettelman et al., 2023), and ecosystems/biogeochemistry (Hamilton et al., 2020): The radiative transfer model (RRTMG) and the PUMAS module (Gettelman et al., 2023) also enable dust–radiation and dust–cloud feedbacks; CESM dust also provides nutrients to ecosystems that enhance marine CO2 sink, which in turn regulates radiation. CESM recently further incorporated the two-way dust–snow interactions through the SNICAR snow module (He et al., 2024), although our simulations were conducted before the publication of this work. Therefore, our analysis has the capability to incorporate both impacts of forcings and most feedback mechanisms on dust, except dust–snow interactions. We acknowledge that there are uncertainties with the aerosol schemes and parameters inside the forcings and the ESM parameterization, so we do not claim the ESMs' $f_{i,j}^{\mathrm{cc}}$ to be perfectly representing the reality. Still, we would like to acknowledge in the main text that the feedbacks are important in representing dust emissions and historical trends. Therefore, we added a discussion about the impacts of feedback on dust at the end of Sect. 2.1:
"… Third, the model ensemble representation of $f_{i,j}^{\mathrm{cc}}$ contains further model internal uncertainties due to inaccurate parameters and missing mechanisms in the ensemble of global models, which are not characterized by the bootstrapping procedure. For instance, there are parameter uncertainties in dust aerodynamic and optical properties as well as potentially biased aerosol transport and deposition mechanisms in models (Li et al., 2022, 2024). Also, uncertainties in parameterizing dust's two-way interactions with different Earth system processes (Miller et al., 2004), such as dust feedback on radiation, clouds, snow, ice, and ecosystems (e.g., Hamilton et al., 2020; He et al., 2024; Sagoo and Storelvmo, 2017; Xie et al., 2018a, b), could also impact $f_{i,j}^{\mathrm{cc}}$ and dust variability."

We also clarify in the model configuration section (Sect. 3.3) that dust has two-way couplings with different processes:
"… for both stratiform and convective clouds (Shan et al., 2021). Dust aerosols have two-way couplings and interactions with different Earth system components and processes, such as radiation (Iacono et al., 2008), clouds (Gettelman et al., 2023), and biogeochemistry (Hamilton et al., 2020)."

3, In Figure 1, it shows the source region contributes the greatest deposition flux in the present day at a given grid. These dust deposition fluxes in Figure 1 are from the previous study (Ron L. Miller)? If the dust deposition flux data is from the previous study (Ron L. Miller) in Figure 1, your new results from DustCOMMv1 will show different pattern of the fractional contribution of that dominant source region. I think the authors should clarify this point.

We apologize for the confusion. We solely wanted to acknowledge Ron Miller's original production of the plot and code (Fig. 8a of Kok et al., 2021b). The main difference in our Fig. 1 was that we used a slightly different definition of dust source regions and that we added a color legend for clarity. To avoid confusion, we remove this sentence from Fig. 1 caption and move it to the Acknowledgements section. Fig. 1 caption becomes:
"…, and hexagons respectively denoting records extracted from ice, marine/lake sediment, coral, and peat cores. The figure is modified after Kok et al. (2021b) Fig. 8a."
The acknowledgements becomes:
"…Figure 1 in this paper was modified after Kok et al. (2021b) Fig. 8a, which was originally created by Ron L. Miller."

4, To directly compare to other GCM results (or CMIP6), the authors should show the global mean value as one table for CESM2-L23 and CESM2-DustCOMM about dust emissions (Tg/yr), dust dry/wet deposition (Tg/yr), dust burden (Tg), lifetime (days), and Dust AOD,…

Per the reviewer's request, we provide a table at the end of Sect. 5.1 that lists the global dust cycle budgets simulated by both the CESM2–L23 run and the CESM2–DustCOMM runs in the preindustrial era (1850s) and the contemporary times (1990s):
"… We summarize the global dust budgets for both the CESM2–L23 and the CESM2–DustCOMM runs for the preindustrial (1851–1870) and modern (1981–2000) time periods in Table 1."

Table 1. Simulated dust cycle budgets for the CESM2–L23 run and the CESM2–DustCOMM run in the preindustrial era (1851–1870) and the contemporary times (1981–2000). Fluxes are rounded to the nearest integers while other quantities are rounds to 3 significant figures.

Globally aggregated dust PM_{10} cycle quantities	CESM2–L23 in 1851–1870	CESM2–DustCOMM in 1851–1870	CESM2–L23 in 1981–2000	CESM2–DustCOMM in 1981–2000
total emission (Tg/yr)	1791	1406	1776	2148
mean dust AOD	0.0274	0.0222	0.0274	0.0338
total dust loading (Tg)	19.8	16.0	20.0	24.6

total wet deposition (Tg/yr)	1246	827	1231	1262
total dry deposition (Tg/yr)	560	589	558	903
mean lifetime (days)	4.00	4.12	4.08	4.15

5, In Figure 5 caption, the authors should point out what the box and the error bar represent?

> Fig. 5 is a summary of the 19 correlation coefficients for each ESM between their modeled deposition and the measured dust depositions from the sedimentary records, as shown in Fig. 4. Each box plot for an ESM is comprised of a distribution of 19 correlation coefficients, and the boxplots depict the range, interquartile range, and the median of the 19 values. To clarify this, we have now added this information to the Fig. 5 caption: "… The boxplot for each model summarizes the 19 correlation coefficients between the sedimentary records of dust deposition fluxes (black lines) and the ESM-modeled dust deposition fluxes (colored lines) in Fig. 4, depicting the medium, interquartile range, and range of the 19 correlation coefficients. The CMIP6 multimodel ensemble (MME) gives…"

References

DeMott P J et al 2010 Predicting global atmospheric ice nuclei distributions and their impacts on climate Proc. Natl. Acad. Sci. U.S.A. 107(25) 11,217-11,222

Miller, R. L., Perlwitz, J., and Tegen, I.: Feedback upon dust emission by dust radiative forcing through the planetary boundary layer, J. Geophys. Res., 109, D24209, https://doi.org/10.1029/2004JD004912, 2004.

Sagoo N and Storelvmo T 2017 Testing the sensitivity of past climates to the indirect effects of dust Geophys. Res. Lett. 44 5807-5817

Xie, X.N., X.D. Liu, H.Z. Che, X.X. Xie, H.L. Wang, J.D. Li, Z.G. Shi, and Y.G. Liu, 2018a, Modeling East Asian dust and its radiative feedbacks in CAM4-BAM, Journal of Geophysical Research–Atmospheres, 123, 1079-1096, https://doi.org/10.1002/2017JD027343.

Xie, X.N., X.D. Liu, H.Z. Che, X.X. Xie, X.Z. Li, Z.G. Shi, H.L. Wang, T.L. Zhao, Y.G. Liu, 2018b: Radiative feedbacks of dust-in-snow over eastern Asia in CAM4-BAM, Atmospheric Chemistry and Physics, 18, 12683–12698, https://doi.org/10.5194/acp-18-12683-2018.

Reviewer 2:

This is a quite complete paper where dust emissions and deposition are considered. It may be divided in several parts. The first one is devoted to obtain a global gridded dust emission dataset. This dataset is extended into the future under three emission scenarios: enhancement, constant, and reduction. The second part is focused on the modelling, and comparison with experimental values at two sites (Miami and Barbados), ice cores, or marine sediments, is presented. Finally, optical properties are analysed and a negative radiative forcing is obtained. Both the study extension and depth of this paper are noticeable. Paper information is extremely dense. However, this study can be published in Atmospheric Chemistry and Physics after the inclusion of the following minor changes.

In its current form, this paper is oriented towards a specialised community, which could be small. To increase and attract possible readers, some simple sentences should be introduced to highlight the main results, strengths and weaknesses of this paper.

> Thank you for your comments. We agree that the paper looks a little specialized to the aerosol modeling and radiation. We added some texts in the abstract and the conclusion to provide a high-level summary for this work's impacts on climate change assessments, which would be more relevant to the general Earth science community. Specifically, we added the following to the end of the abstract:
>
> "… Our CESM2 simulations estimate a 1981–2000 minus 1851–1870 direct RF of –0.10 W m^{-2} from dust particles up to 10 µm in diameter (PM$_{10}$). This dust emission dataset thus enables models to improve climate change projections due to changes in aerosol forcings and reduces uncertainties associated with aerosol–climate interactions, such as those in the Intergovernmental Panel on Climate Change (IPCC) assessments."
>
> Also, in the conclusion section we suggest that our findings and developments could improve aerosol simulations and climate assessments in other ESMs:
>
> "… and thus can better estimate the radiative forcing (RF) due to this dust increase. Because CMIP6 ESMs are unable to reproduce the observed historical dust trend, it could be greatly beneficial for ESMs to improve the simulated aerosol radiative forcings and the resulting climate impacts by 1) directly prescribing the DustCOMM emissions F_{EI} in the simulations or 2) using the regional emission constraints λ_i to scale dust every decade. Indeed, prescribing DustCOMM emissions in CESM2 yielded a much more significant 1851–2000 dust direct RF of –0.10 W m^{-2} (cooling), …"

Figure 2 presents three possible scenarios, taking into account that the past trend presented increasing emissions, do the authors think that a reduction scenario is possible?

We think that a dust reduction scenario is possible. This is because over the past few decades there has been more reforestation (King et al., 2024), water use management (Cook et al., 2020), and soil conservation over different parts of the globe. Meanwhile, climate change could also play a role in dust decline, such as due to weaker wind circulation (Zha et al., 2021) and increasing soil moisture under future climate (Schewe and Levermann, 2017). Observational studies already reported that there are dust reductions over some deserts in the recent decades (Wang et al., 2024; Wu et al., 2022). There could be different signs of changes in the coming decades, and hence it is important to provide different scenarios in the emission dataset. We add this comment and provide a more detailed physical explanation to the end of Sect. 2.2:

"…because we currently have insufficient mechanistic understanding of what caused the historical changes in dust emissions and how those drivers might change in the future (Ginoux et al., 2012; Kok et al., 2023). Factors that could drive an increase in future dust include further land use changes, a decline in biological soil crusts (Rodriguez-Caballero et al., 2022), and increased aridity from increased evaporative demand over land (Cook et al., 2020). Conversely, factors that could drive a decrease in future dust emissions include reforestation (King et al., 2024), increased rainfall in prominent dust sources such as the Sahel (Schewe and Levermann, 2017), greening of semiarid regions from CO_2 fertilization (Mahowald and Luo, 2003; Smith et al., 2017), and possible reductions in wind speeds (Yuan et al., 2020; Zha et al., 2021).

Since the future evolution of dust emissions is unclear, we provide three future emission scenarios that span a range of plausible possibilities. …"

Figure 5. Perhaps modelling results should be considered with caution due to the box ranges and even the negative values that are obtained.

We agree that the model results should be considered with caution. The boxplots in Fig. 5 show the correlations between the ESM runs and the 19 deposition records. Negative values indicate that there are negative correlations in interdecadal dust variability over certain locations between ESMs and core records, e.g., NEGIS (Fig. 4a) and San Juan Lakes (Fig. 4o). We explained in the text that the sites with negative correlations with the CESM2–DustCOMM run are typically located over regions dominated by several desert source regions (as shown in Fig. 1). The CESM2–DustCOMM run still yielded mostly positive correlations of dust with dust deposition measurements over the majority of the sites. Thus, when interpreting the results in Sect. 5.2, we judged which model simulations tend to produce better dust variability by looking at the whole boxplot/distribution of correlations. To address the reviewer comment, we have now added this information more clearly to the end of Sect. 5.2:

"… although the CMIP6 multimodel ensemble run (median = 0.18) performs better than the individual CMIP6 ESMs. Figure 5 shows that model simulations have large ranges in

> the correlation coefficients, meaning that a simulation could replicate interdecadal dust variability well over certain locations but not others. This is possibly because 1) certain site locations contain dust from several source regions, 2) CESM's sensitivity $f_{i,j}$ could change over time and be different from DustCOMM's $f_{i,j}^{cc}$ (from Kok et al. 2021a, b), and 3) there are large representation errors for comparing grid box-level ESM-simulated dust deposition fluxes against site-level dust depositions from core sites (Brasseur and Jacob, 2017). However, the CESM2–DustCOMM run clearly agrees best with measured dust deposition timeseries."

Figure 7. Is there any special reason to justify the good agreement between the CESM2-DustCOMM and reconstruction? Why is a 68% confidence level selected?

> The reason for the good agreement is that both Kok's reconstruction and our analysis made use of the sensitivity $f_{i,j}^{cc}$ from the same ensemble of global models (see Sect. 2.1). The difference is that we use gridded deposition-to-emission relationship $f_{i,j}^{cc}$ to obtain gridded emissions and then further used CESM (as a forward model $f_{i,j}$) to simulate dust AOD, whereas Kok et al. (2023) used the global deposition-to-loading relationship $f_{i,j}^{cc}$ to obtain global dust loading/AOD. In other words, we further expanded Kok's inverse analysis to a gridded level so that any ESM could use the DustCOMM emissions. Another minor difference is that CESM is itself a transient $f_{i,j}(d)$ when we simulate 1851–2000 dust AOD, whereas Kok used a time-constant $f_{i,j}^{cc}$ (for 2004–2008) from the model ensemble to obtain dust AOD for all decades. We add the following sentence to Sect. 5.4:
> "… Only the CESM2–DustCOMM run generates the historical increasing dust trend highly consistent with the sedimentary records. This is reasonable since both the dust reconstruction from Kok et al. (2023) and our analysis made use of the same sedimentary records of β_j and $f_{i,j}^{cc}$ from the same model ensemble (Sect. 2.1). The main difference is that we expanded Kok's inverse analysis to regional level to obtain λ_i. …"
> As for the 68 % confidence level, this represents the uncertainty of the reconstruction / inversion. We chose to use one standard deviation of the reconstructed dust AOD to characterize the uncertainty, while Kok et al. (2023) chose to use 90 % to characterize their uncertainty (their Fig. 5).

Since deserts are major dust sources, is it possible to select the main sources against the minor contributors? Is the contribution of both groups quantified?

> We are not entirely sure what the reviewer means by "minor contributors" here, but we think the reviewer is referring to smaller sources such as agricultural dust and road/vehicle dust. The sedimentary records used for our reconstruction would contain

dust from all sources and would not distinguish between natural and anthropogenic sources. Since the Jacobian matrix $f_{i,j}^{cc}$ from the global model ensemble only describe dust from deserts, all the dust trends and variability from the core records are converted to desert dust emission variability during the inverse analysis. Thus, it is hard to distinguish the contributions between the deserts and other minor sources. We call the derived emission dataset as dust emissions, which would technically contain both natural and anthropogenic dust signals. We think this is an important caveat to mention, so we added it in Sect. 2.1 as follows:

"… the error estimates on our emission inventory from the bootstrapping should be considered a lower bound.

Fourth, as Kok et al. (2021a) pointed out, while most global models focus on simulating natural/desert dust emissions and neglect anthropogenic (e.g., agricultural and fugitive) dust sources, the core records of dust depositions will not distinguish between the two sources and inherently includes both. Therefore, in Eq. 2 all the observed dust variability in β_j will be attributed to the source regions defined by the model ensemble, i.e., $F_{\mathrm{cc},i}$ in Eq. 4, although some model grids (e.g., the Sahel) will both contain deserts and urban areas / farmlands. For estimating dust impacts on climate, the partition between natural and anthropogenic sources does not matter that much as long as both sources produces dust aerosols with similar climate impacts."

Minor remarks.

These is a version of the Wilks title published in 2019. Is it possible to update this reference?

Thanks for the suggestion, we have changed it in Sect. 2.1: "… The DustCOMM deposition fluxes from each source region include uncertainties, which were obtained through a bootstrap procedure (Wilks, 2019) that propagates uncertainty from the spread in the model simulations, …"

References

Cook, B. I., Mankin, J. S., Marvel, K., Williams, A. P., Smerdon, J. E., and Anchukaitis, K. J.: Twenty-First Century Drought Projections in the CMIP6 Forcing Scenarios, Earth's Future, 8, e2019EF001461, https://doi.org/10.1029/2019EF001461, 2020.

Ginoux, P., Prospero, J. M., Gill, T. E., Hsu, N. C., and Zhao, M.: Global-scale attribution of anthropogenic and natural dust sources and their emission rates based on MODIS Deep Blue aerosol products, Reviews of Geophysics, 50, https://doi.org/10.1029/2012RG000388, 2012.

Hamilton, D. S., Moore, J. K., Arneth, A., Bond, T. C., Carslaw, K. S., Hantson, S., Ito, A., Kaplan, J. O., Lindsay, K., Nieradzik, L., Rathod, S. D., Scanza, R. A., and Mahowald, N. M.: Impact of Changes to the Atmospheric Soluble Iron Deposition Flux on Ocean Biogeochemical Cycles in the Anthropocene, Global Biogeochemical Cycles, 34, e2019GB006448, https://doi.org/10.1029/2019GB006448, 2020.

He, C., Flanner, M., Lawrence, D. M., and Gu, Y.: New Features and Enhancements in Community Land Model (CLM5) Snow Albedo Modeling: Description, Sensitivity, and Evaluation, Journal of Advances in Modeling Earth Systems, 16, e2023MS003861, https://doi.org/10.1029/2023MS003861, 2024.

King, J. A., Weber, J., Lawrence, P., Roe, S., Swann, A. L. S., and Val Martin, M.: Global and Regional Hydrological Impacts of Global Forest Expansion, EGUsphere, 1–27, https://doi.org/10.5194/egusphere-2024-710, 2024.

Kok, J. F., Ward, D. S., Mahowald, N. M., and Evan, A. T.: Global and regional importance of the direct dust-climate feedback, Nature Communications, 9, 241, https://doi.org/10.1038/s41467-017-02620-y, 2018.

Kok, J. F., Storelvmo, T., Karydis, V. A., Adebiyi, A. A., Mahowald, N. M., Evan, A. T., He, C., and Leung, D. M.: Mineral dust aerosol impacts on global climate and climate change, Nat Rev Earth Environ, 1–16, https://doi.org/10.1038/s43017-022-00379-5, 2023.

Li, L., Mahowald, N. M., Kok, J. F., Liu, X., Wu, M., Leung, D. M., Hamilton, D. S., Emmons, L. K., Huang, Y., Sexton, N., Meng, J., and Wan, J.: Importance of different parameterization changes for the updated dust cycle modeling in the Community Atmosphere Model (version 6.1), Geosci. Model Dev., 15, 8181–8219, https://doi.org/10.5194/gmd-15-8181-2022, 2022.

Li, L., Mahowald, N. M., Gonçalves Ageitos, M., Obiso, V., Miller, R. L., Pérez García-Pando, C., Di Biagio, C., Formenti, P., Brodrick, P. G., Clark, R. N., Green, R. O., Kokaly, R., Swayze, G., and Thompson, D. R.: Improved constraints on hematite refractive index for estimating climatic effects of dust aerosols, Commun Earth Environ, 5, 1–12, https://doi.org/10.1038/s43247-024-01441-4, 2024.

Mahowald, N. M. and Luo, C.: A less dusty future?, Geophysical Research Letters, 30, https://doi.org/10.1029/2003GL017880, 2003.

Miller, R. L., Perlwitz, J., and Tegen, I.: Feedback upon dust emission by dust radiative forcing through the planetary boundary layer, Journal of Geophysical Research: Atmospheres, 109, https://doi.org/10.1029/2004JD004912, 2004.

Rodriguez-Caballero, E., Stanelle, T., Egerer, S., Cheng, Y., Su, H., Canton, Y., Belnap, J., Andreae, M. O., Tegen, I., Reick, C. H., Pöschl, U., and Weber, B.: Global cycling and climate effects of aeolian dust controlled by biological soil crusts, Nat. Geosci., 15, 458–463, https://doi.org/10.1038/s41561-022-00942-1, 2022.

Sagoo, N. and Storelvmo, T.: Testing the sensitivity of past climates to the indirect effects of dust, Geophysical Research Letters, 44, 5807–5817, https://doi.org/10.1002/2017GL072584, 2017.

Schewe, J. and Levermann, A.: Non-linear intensification of Sahel rainfall as a possible dynamic response to future warming, Earth System Dynamics, 8, 495–505, https://doi.org/10.5194/esd-8-495-2017, 2017.

Smith, M. B., Mahowald, N. M., Albani, S., Perry, A., Losno, R., Qu, Z., Marticorena, B., Ridley, D. A., and Heald, C. L.: Sensitivity of the interannual variability of mineral aerosol simulations to meteorological forcing dataset, Atmos. Chem. Phys., 17, 3253–3278, https://doi.org/10.5194/acp-17-3253-2017, 2017.

Thornhill, G., Collins, W., Olivié, D., Skeie, R. B., Archibald, A., Bauer, S., Checa-Garcia, R., Fiedler, S., Folberth, G., Gjermundsen, A., Horowitz, L., Lamarque, J.-F., Michou, M., Mulcahy, J., Nabat, P., Naik, V., O'Connor, F. M., Paulot, F., Schulz, M., Scott, C. E., Séférian, R., Smith, C., Takemura, T., Tilmes, S., Tsigaridis, K., and Weber, J.: Climate-driven chemistry and aerosol feedbacks in CMIP6 Earth system models, Atmospheric Chemistry and Physics, 21, 1105–1126, https://doi.org/10.5194/acp-21-1105-2021, 2021.

Wang, F., Xu, Y., Patel, P. N., Gautam, R., Gao, M., Liu, C., Ding, Y., Chen, H., Yang, Y., Zhou, Y., Carmichael, G. R., and McElroy, M. B.: Arctic amplification–induced decline in West and South Asia dust warrants stronger antidesertification toward carbon neutrality, Proceedings of the National Academy of Sciences, 121, e2317444121, https://doi.org/10.1073/pnas.2317444121, 2024.

Wilks, D. S.: Statistical Methods in the Atmospheric Sciences, 2019.

Wu, C., Lin, Z., Shao, Y., Liu, X., and Li, Y.: Drivers of recent decline in dust activity over East Asia, Nat Commun, 13, 7105, https://doi.org/10.1038/s41467-022-34823-3, 2022.

Xie, X., Liu, X., Che, H., Xie, X., Wang, H., Li, J., Shi, Z., and Liu, Y.: Modeling East Asian Dust and Its Radiative Feedbacks in CAM4-BAM, Journal of Geophysical Research: Atmospheres, 123, 1079–1096, https://doi.org/10.1002/2017JD027343, 2018a.

Xie, X., Liu, X., Che, H., Xie, X., Li, X., Shi, Z., Wang, H., Zhao, T., and Liu, Y.: Radiative feedbacks of dust in snow over eastern Asia in CAM4-BAM, Atmospheric Chemistry and Physics, 18, 12683–12698, https://doi.org/10.5194/acp-18-12683-2018, 2018b.

Yuan, T., Yu, H., Chin, M., Remer, L. A., McGee, D., and Evan, A.: Anthropogenic Decline of African Dust: Insights From the Holocene Records and Beyond, Geophysical Research Letters, 47, e2020GL089711, https://doi.org/10.1029/2020GL089711, 2020.

Zha, J., Shen, C., Li, Z., Wu, J., Zhao, D., Fan, W., Sun, M., Azorin-Molina, C., and Deng, K.: Projected changes in global terrestrial near-surface wind speed in 1.5 °C–4.0 °C global warming levels, Environ. Res. Lett., 16, 114016, https://doi.org/10.1088/1748-9326/ac2fdd, 2021.