

Geosci. Model Dev. Discuss., referee comment RC1  
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## Comment on gmd-2021-32

Anonymous Referee #1

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Referee comment on "Mineral dust cycle in the Multiscale Online Nonhydrostatic Atmosphere Chemistry model (MONARCH) Version 2.0" by Martina Klose et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-32-RC1>, 2021

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Comment on gmd-2021-32: "Mineral dust cycle in the Multiscale Online Nonhydrostatic Atmosphere Chemistry model (MONARCH) Version 2.0" by Klose et al.

### General comments

This manuscript describes the dust module in the Multiscale Online Non-hydrostatic Atmosphere Chemistry model (MONARCH) Version 2.0, a state-of-the-art global chemical weather prediction system. The dust module includes a variety of dust emission processes, from conventional, simplified schemes of Marticorena and Bergametti (1995) and Ginoux et al. (2001) to more physically based methods of Shao (2001, 2004), Shao et al. (2011), Kok et al. (2014), and Klose et al. (2014). The processes of the model are well documented, especially for the dust emission processes.

In the experiment and results, the authors conducted a one-year simulation with the four configurations. The model generally shows good representations of the global dust distribution. The evaluation methods are sound, and the presentations are of good quality. However, it is desirable to have a more in-depth evaluation of the characteristics of each dust module (I am curious that which one (or the ensemble of the four) is the default setting of the dust module for the dust forecasting). Most of the evaluations are global picture of dust emission, deposition, loading and AOD. I would like to see the evaluation of the representation of dust storm events and surface dust concentrations in a future study. Also, I think it is desirable for a multi-year simulation, not just a specific year (2012), to evaluate the model results since the dust aerosol exhibits year-to-year variability.

The authors evaluate the radiative effects of dust aerosol and show the direct radiative effects of the dust. I am not sure that the dust direct radiative forcing interactively affects the meteorological process, but the radiative feedback to the meteorology should be minor because the meteorological fields are re-initialized daily by the ERA reanalysis. I think the

evaluation of dust radiative effect can be a reference for the climate models: hence the multi-year evaluation of it is also desirable (in a future study).

In all, I find this manuscript is suitable for publication in the Geoscientific Model Development after a minor revision.

### **Specific (minor) comments**

Line 254: How is the fixed minimal threshold ( $u_{td0} = 5\text{ms}^{-1}$ ) determined?

Line 266: How the authors set the "optional constant scaling parameter"  $c_{thr}$  ?

Line 638: "Fig. 7 shows ...": "Fig." should be spelled out as "Figure" at the top of the sentence.

Line 710: A typo: "radition" should be "radiation"

Line 745: "work flow" -> "workflow"