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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 #2

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This work provides a quick and smart way to fix an issue associated with the nonlinear dependency of soil dust emissions on grid resolutions. Dust emissions are known to be a function of fourth or third power of grid-scale wind speeds, which are not a conserved quantity while regridding meteorological data for downscaling or upscaling simulations. As a result, this causes several issues, including not only simulated discrepancy from the observations but also more seriously a breach of mass conservation of soil dust aerosols using the same meteorology but different grid resolutions. Authors developed an offline approach to pre-calculate dust emissions with the finest wind speed data and to use it independent on the model grid resolutions. By doing this, they were able to use consistent dust emissions for simulations with different grid resolutions and also

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Discussion paper

even scale it to better match with observations. I recommend this work for publication at GMD after addressing a few concerns about this work as follows:

1. Description of soil dust mobilization using the finest wind speed data is clearly written but its application for the coarse model resolutions needs a bit of more elaboration. For example, dust emissions on a finer resolution are simply summed up online while used for coarse model simulations. If this is the case, an instantaneous mixing of dust emission would occur. I guess that this would not be a serious issue for fine-mode dust bins. But, for example, coarse-mode dust aerosols emitted from 0.2 degree grid box could be instantaneously mixed into 2 degree grid box. Any problem with this?

2. Following up the first comment above, how do you simulate the dry deposition of dust aerosols, which are also dependent on grid-scale mixing and other micro-scale meteorological parameters. A similar issue could arise if authors use the same grid-scale dry deposition calculation especially for coarse mode dust aerosols.

3. I wonder how the model evaluation against AOD observations could properly represent the model capability to simulate dust aerosols and especially dust mobilization. Not only AOD but also Angstrom exponent or other aerosol optical properties would be helpful to give a proper measure of the model performance.

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