

Interactive comment on “Multi-model simulations of springtime dust storms in East Asia: Implications of an evaluation of four commonly used air quality models (CMAQv5.2.1, CAMxv6.50, CHIMEREv2017r4, and WRF-Chem v3.9.1)” by Siqi Ma et al.

Anonymous Referee #2

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The authors present an evaluation of different well established regional air quality models in combination with various implementations of dust emissions in terms of their ability to reproduce atmospheric mineral dust observations over Northeast China.

They focus on a rather small domain which is predominantly characterised by anthropogenic agriculture related mineral dust sources as opposed to natural desert dust sources. Therefore specifically the model performance regarding these non-desert

C1

dust sources is assessed, which represent a challenging and very important aspect of the dust cycle. On a global scale, however, the emissions from that domain play a minor role as shown in Fig. 1.

Further, they focus on one single dust event with a duration of about one day. This dust event seems to be a reasonable choice as it is clearly identified as such, it is an outbreak from sources within the model domain, and it is not significantly affected by dust transport from the west which would be typical for the region but involves sources outside the model domain.

Due to the aforementioned focussing, the results of the study do not necessarily generalise to other regions or time periods and hence the general relevance of the study might be limited, but still the study reveals differences between the models and emissions and will help to make suitable choices for future model applications and improvements.

I therefore consider the manuscript, which is overall clear and well written, to be suitable for publication in GMD, after addressing the following.

Title

To better reflect the content of the article, I suggest to change the title to

"Multi-model simulations of a springtime dust storm over Northeast China: Implications of an evaluation of three commonly used air quality models (CMAQ v5.2.1, CHIMERE v2017r4, and WRF-Chem v3.9.1)"

due to the following reasons:

1. Only one dust storm is considered.
2. Referring to East Asia is misleading as only a comparably small subregion of East Asia is considered. East Asia in contrast comprises two of the earth's major deserts, Taklamakan and Gobi, which are not at all subject of the study.
3. The evaluation of CAMx is limited to identifying that practically no emissions can be produced from within the model domain due to the MODIS based

C2

desert mask applied in the emission scheme which precludes emissions from regions that are not barren or sparsely vegetated. While this is an important conclusion, no further evaluation of CAMx is presented and thus the present title is misleading. Considering that some efforts were made to adjust the emissions of other models, it would have been interesting to see results from CAMx after expanding the mask to include other landcover types, but I understand that this might be beyond the scope of the study. In that case I recommend to simply adjust the title, to clarify in the abstract that three models are evaluated and (as before) to discuss in the main text why CAMx is not one of them.

Page 1, line 27

"to simulate dust storms in East Asia" should read "to simulate a dust storm over North-east China", see above

Page 5, line 8

The line in Fig. 1 is hardly recognisable as being dark blue

Page 7, Fig. 1

Please label the regions with CTA, NWA, NEA and SWA. The CALIPSO path can hardly be identified as being blue as mentioned in the caption.

Page 8, line 20

"would" or "did"?

Page 10, line 11

"omitting the effect of soil moisture" should read "omitting the term supposed to account for the effect of soil moisture"

Page 10, line 13

"maximum", not "minimum"

C3

Page 17, line 5

In Figs. 2 and 6 it is not possible to identify trajectories, not even the approximate direction of the outflow from the source regions can be identified in Fig. 2, it is therefore hard to make this comparison. Neither do I expect any difference, as the WRF wind fields should be quite realistic.

Page 17, line 11

"The most striking feature of the model results was their concentration" should read "The most striking discrepancy between the model results was in their concentration level" or similar

Page 17, line 15

"might" should be deleted

Page 18, line 7

The sentence "With further comparison ..." needs rephrasing

Page 19, Eqs. (1) and (2) and Section 3.4 in general

Please define all variables and make sure to use units (e.g. for the p limits in Eq. (2)). The discussion would benefit from some revision because it is hard to follow what is used in (a) the different models (b) the literature cited and (c) in the present study. E.g., it would help to mention both, model name and the related citation next to each other where applicable and make use of active voice.

Page 19, Eq. (2)

Unless u^* is about 1, the RHS has a discontinuity at $p = 3e4 \text{ Nm}^{-2}$. The two cases on the RHS are limiting expressions for large and small p , it seems to be problematic to apply them on adjacent p intervals, and not use the full expression for intermediate values of p . Where does this distinction of cases and the threshold of $p = 3e4 \text{ Nm}^{-2}$

C4

come from?

Page 21, line 13 to 15

Please mention that you use the AGO scheme

Page 20, line 19

The sentence "Furthermore, ..." needs rephrasing

Page 22, line 3

Please mention that you analyse hourly values

Page 22, line 9

"was shown" should read "is shown"

Page 22, line 10

"abscissa" should be replaced by "distance to point OBS"

Page 23, line 6

"Thus, NSD..." should read "Thus, NWA..."

Page 23, Fig. 9

The colours for NEA and CWA are hard to distinguish

Page 24, Fig. 11

It might be worth to enlarge the figure and refine the colours

Page 26, line 25

"best near" should read "perform best close" or similar

Page 27, line 3

This clearly is not related to the resolution but simply a matter of allowing emissions

C5

from areas not classified as desert or sparsely vegetated by refining the landcover mask.

Page 27, Author contributions

Please make sure that the order of the initials of each contributor is consistent with the author names on the title page

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2019-57>, 2019.