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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Model development of dust emission and heterogeneous chemistry within the Community Multiscale Air Quality modeling system and its application over East Asia" *by* X. Dong et al.

Anonymous Referee #3

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In this paper, "Model development of dust emissions and heterogeneous chemistry within the Community Multiscale Air Quality modeling system and its application over East Asia", the authors present an update for the dust emission in the CMAQ model and illustrate the improvement, relative to the standard model, for both seasonal averages and for a case study. Changes to the friction velocity threshold, heterogeneous chemistry and the source mineralogy are considered.

The work is well presented and the results indicate that the changes made by including a newly developed dust emission scheme (described in another paper) do improve the

CMAQ model when compared with a range of optical, surface mass and in-situ mineral measurements.

An important issue is that the Tong et al. paper detailing the dust scheme used in this study is currently not published. Perhaps it has been accepted since submission, but without that manuscript in the literature first it is difficult to see how this work can be published. There are many details left out of the description of the dust scheme, probably because they are explained in Tong et al., which is all the more reason to wait to publish once that has been peer-reviewed.

The work of Wang et al. (2012) implements two established dust schemes into the CMAQ model, including heterogeneous chemistry, and evaluates them over Asia. This paper is mentioned in the manuscript, but it would be valuable to provide a comparison because the baseline version of CMAQ performs so poorly when simulating Asian dust, and therefore most changes would improve upon the baseline. For example, what benefit does the FENGSHAA dust scheme bring that justifies including it, rather than one of the more established dust schemes? I think the heterogeneous source mineralogy profiles are an improvement over the Wang et al. (2012) study, although the improvement in agreement with observations (shown in Figure 5 and Table 5) appears limited.

Do the authors think that the assumption that the Gilette et al. field data is for zero soil moisture conditions will be a factor for other dust schemes? If so this perhaps needs pointing out.

Can the authors test the emissions and the agreement with observations using the GLDAS soil moisture data set shown in Figure 10? The authors state that there is no observational data between 2006-2010 over East Asia, but testing the GLDAS soil moisture seems like a relatively trivial test that would provide an answer to the open question of whether soil moisture explains the underestimate of emissions in the Taklamakan.

Specific comments

pg 35593 ln 5 - the talk of double-counting feels too specific for the abstract, unless the soil moisture issue is a general issue that the authors wish to bring to the attention of the community. ln24 - "revised" repeated

pg 35595 ln8 - "deposition"

pg 35599 ln 16 'soil moisture' ln 28 - diameter or radius?

pg35607 ln2 - I cant see the two cities on Figure 1

pg 35615 ln 1 - is the slightly increasing trend significant of not?

pg 35616 ln 21 - 'aerosols' ln 23 - how close are Duolun aand Yulin to source? the sedimentation of coarse particles will alter PM2.5/TSP with distance, do you take this into account?

pg 35617 ln7 - rephrase this, implementing development doesn't really describe anything.

Figure and table captions could do with improving and cross-referencing. e.g. Table 5 does not mention what the model is evaluated against and should reference Table 4 for this, at least. Figure 3 doesn't include the time frame for the data comparison. Figure 5 should either include the statistics or the caption reference Table 5.

References Wang, K., Zhang, Y., Nenes, A. and Fountoukis, C.: Implementation of dust emission and chemistry into the Community Multiscale Air Quality modeling system and initial application to an Asian dust storm episode, Atmos. Chem. Phys., 12(21), 10209–10237, doi:10.5194/acp-12-10209-2012, 2012.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 35591, 2015.