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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Implementation of dust emission and chemistry into the Community Multiscale Air Quality modeling system and initial application to an Asian dust storm episode" *by* K. Wang et al.

Anonymous Referee #1

Received and published: 13 July 2012

General comments: The authors implemented an updated thermodynamic equilibrium module, two wind-blown dust emissions schemes, and 9 dust related heterogeneous reactions into CMAQv4.7. They applied the model to simulate air quality for a dust storm in April 2001, conducted nine different simulations, and described the results. The article is well prepared and merits publication. However, several issues need to be addressed before publication. Specific comments are given below: Specific Comments

Comment #1 Page 13466, first paragraph, line 1: Variable "w" - the threshold gravimetric soil moisture has a prime in the equation but not in the explanatory text.

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Comment #2 Page 13468, second paragraph, line 10: Eqs. (1), (2), and (14) have been referred for dust flux generation. Please check these equations; they are not the correct equations for dust flux.

Comment #3 Page 13473, equation for scattering coefficient: [SO4], [NO3], etc, are not defined.

Comment #4 Page 13476-13477, section 4.2.1: Based on the results presented here, can the authors make any suggestion on the dust emissions scheme to be used in regional air quality models?

Comment #5 Page 13477, second paragraph, line 14-17: Dust is emitted from surface. Concentrations are expected to be higher near the source. However, it indicates the total concentrations of dust at $\sim$5 km are higher than the surface. What is causing the total concentration aloft to be higher than the source region?

Comment #6 Page 13479, 13480: The authors describe the importance of crustal species here but comparison of the predicted crustal materials with any observed data is not provided. Some crustal materials are measured in the US (IMPROVE and STN sites). The section would have benefitted from such a comparison. I am not suggesting the authors to provide such a comparison. But an acknowledgement that such a comparison has not been done is needed.

Comment #7 Page 13479, second paragraph, line 15-20: One sentence indicates that the two simulations show very small differences for non-volatile species like sulfate (line 15). While the next sentence indicates that the CRUST_ONLY predicts relatively lower sulfate over the East Asia. Need to reconcile these statements. The prediction of lower sulfate for CRUST_ONLY is explained by less oxidation of SO2 into sulfate. The lower oxidation can occur via lower OH, H2O2 or other oxidants that converts SO2 into sulfate. In the CRUST_ONLY simulation, the crustal materials affect the model results via the updated ISOROPIA. It is appropriate to discuss how the updated ISPROPIA affects these oxidants and subsequently the SO2 oxidation.

ACPD

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Interactive Comment

Comment #8 Page 13480, first paragraph, line 15: Here, the mixing ratio of gas-phase NO3- is referred; should it be NO3?

Comment #9 Page 13503, Table 6: It is not clear which columns are for Beijing and which columns are for Japan. Need to distinguish the columns for Beijing and Japan.

Comment #10 Figure 4, 6, 7, 8, 9: Legends and numbers are difficult to read; bolder and larger fonts are helpful.

Comment #11 Page 13510, Figure 6: The spatial distribution of the differences between DUST and CRUST_ONLY for NOx (second panel on the figure) shows that the heterogeneous reactions mostly increase NOx. However, the spatial distribution of the differences between DUST_HIGH_UPTAKE and CRUST_ONLY for NOx shows that they increase NOx in some areas while decreasing in other areas. Please explain the reason for such behavior.

The spatial distribution of the differences between DUST and CRUST_ONLY for H2O2 (third panel on the figure) shows that the heterogeneous reactions increase H2O2. However, the spatial distribution of the differences between DUST_HIGH_UPTAKE and CRUST_ONLY for H2O2 shows that they decrease H2O2. Please explain the reason for such behavior.

The spatial distribution of the differences between DUST and CRUST_ONLY for NO3- (fourth panel on the figure) shows that the heterogeneous reactions decrease NO3-. However, the spatial distribution of the differences between DUST_HIGH_UPTAKE and CRUST_ONLY for NO3- shows that they increase NO3-. Please explain the reason for such behavior.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 13457, 2012.