

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2021-946

Anonymous Referee #2

Referee comment on "Limitations in representation of physical processes prevent successful simulation of PM_{2.5} during KORUS-AQ" by Katherine R. Travis et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-946-RC2>, 2022

This is a very comprehensive study elucidating the causes of model biases in PM_{2.5} inorganic components simulated by the GEOS-Chem chemical transport model, using observations from the Korean United States-Air Quality (KORUS-AQ) field campaign. Model deficiencies, including overestimates of daytime HNO₃ and nighttime nitrate, too rapid uptake of NO₂ by aerosols at night, and underestimates of sulfate during pollution events, were identified and analyzed. A series of model sensitivity simulations were carefully designed in order to lower the model biases and to interpret the possible causes of these model biases.

The study is well conducted and presented, and is an important piece of work advancing our understanding on the processes affecting the inorganic aerosol simulation. I thus recommend publish on ACP. Below are several comments for clarification in the manuscript.

Specific comments:

1) Page 7, Line 25,

The linkage of excess model nitrate with overestimated ALWC (aerosol liquid water content) needs some explanation. How ALWC is estimated in the GEOS-Chem model and in the observations? Why overestimated nitrate lead to higher ALWC, although model

PM2.5 is biased low? Please clarify.

2) Page 10, 2nd paragraph,

As shown in Figure 5, the model epsilon-NO₃ values are overall biased low suggesting excess partitioning to the gas phase. Are there any sensitivity simulations conducted in the study that can improve the simulated NO₃ gas-aerosol partitioning? How about the one with enhanced dry deposition velocities?

3) Page 16, 2nd paragraph,

It is not clear how the model treated the simulation with increased sensible heat flux as GEOS-Chem used assimilated meteorology. Which processes and parameters would be affected in this simulation? Would the other sensitivity simulation with increased PBL have the same effect?

4) Page 36, Figure 6,

The panels c and d of Figure 6 did not show the simulated results from the other three simulations, e.g., 5x dry deposition. Was there any reason?

5) 9th line of Page 11, 4th line of Page 15,

Here "Section 2" should be "Section 3".

