Reply to Anonymous Referee #2

We thank the reviewer for the careful reading of the manuscript and helpful comments. We have revised the manuscript following the suggestion, as described below.

This paper presents the implementation of N_2O_5 hydrolysis on organic-coating particles in WRF-Chem, and analyzes the impact of such implementation on the simulation of nitrate and other aerosol particles. Overall, nitrate concentration is reduced due to this newly-added pathway for N_2O_5 heterogeneous hydrolysis.

While the parameterization for N_2O_5 hydrolysis on organic-coating particles is not new, it appears that this paper is among the first to add this parameterization into WRF- Chem. I recommend the paper to be published after addressing the following comments.

Comments: During the study time period of Feb 10 to Feb 26, there were multiple times that RH values are below 40% (especially during daytime). For sulfate particles at least, their phase is regulated by the hysteresis loop - solid sulfate will not become liquid until RH is above 80% and liquid sulfate particle will not become solid until RH is below 40%. Hence, there is another possible pathway to suppress N_2O_5 hydrolysis - that is - the inorganic particles can be in solid phase even without organic coating. Authors should at least mention how the particle phases are treated in the model? Are all sulfate particles in aqueous phase? And discuss additionally possible pathway. The following paper is recommended for the discussion. Wang, J., A. A. Hoffmann, R. Park, D. J. Jacob, and S. T. Martin, 2008. Global distribution of solid and aqueous sulfate aerosols: effect of the hysteresis of particle phase transitions, J. Geophys. Res., 113, D11206.

Response: We have clarified in Section 3.3: "*It is worth noting that, in the study, the assumption of metastable aerosols is used or the water soluble aerosol is assumed to be only in liquid state in simulations. However, Wang et al. (2008) have highlighted the effect of the hysteresis of particle phase transitions on the distribution of solid and aqueous aerosols. The aerosol phase is generally regulated by the hysteresis loop. Atmospheric particles containing inorganic salts remain solid until the RH reaches the DRH (deliquescence relative humidity). At the DRH, the solid particle spontaneously absorbs water to become a saturated aqueous solution. However, the liquid particle does not crystallize when the RH is below the DRH (Seinfeld and Pandis, 2006). Therefore, another possible pathway exists to suppress the N_2O_5*

hydrolysis, i.e., the inorganic particles might be in solid phase without organic coating. Further studies need to be conducted to evaluate the hysteresis effect on the N_2O_5 hydrolysis and organic coating."

References

Wang, J., Hoffmann, A. A., Park, R. J., Jacob, D. J., and Martin, S. T.: Global distribution of solid and aqueous sulfate aerosols: Effect of the hysteresis of particle phase transitions, J. Geophys. Res.-Atmos., 113, D11206, https://doi.org/10.1029/2007JD009367, 2008.

Seinfeld, J. H. and Pandis, S. N.: Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, 2nd Edn., John Wiley & Sons Inc., New York, 2006.