

Interactive comment on “Fine particle pH and sensitivity to NH₃ and HNO₃ over summertime South Korea during KORUS-AQ” by Ifayoyinsola Ibikunle et al.

Anonymous Referee #5

Received and published: 18 August 2020

This paper presents the results of a thermodynamic equilibrium analysis to isolate the NH₃-dominant vs. HNO₃ dominant regimes by analyzing the atmospheric chemical observations measured during the KORUS-AQ campaign. The authors related the results to the policy of mitigation strategies for high levels of PM concentrations over the Korea. Above all, this study seems to be important in terms of dividing emission reduction strategies into two regimes in terms of policy approaches. Overall, this manuscript seems to deserve publication in *acp*, suggesting that between two emission reductions (HNO₃ vs. NH₃), HNO₃ (or NO_x) reduction is better to be chosen as a priority in emission reduction, than NH₃ reduction. However, the current conclusion would become more solid by supplementing the following comments (below).

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(Key Comments)

1. Before submitting the current comment, I noticed the point of anonymous referee#2, pointing out the implications for policy making: transported nitrate via free troposphere (L48) vs. local concentrations within PBL(1km). I recommend the authors to take a note on the differences from identical tests for two separated synoptic periods (classified by Peterson et al. 2019): Stagnation under a persistent anticyclone (May 17–22) and transported haze development (May 25–31).

Peterson, D. A., Hyer, E. J., Han, S.-O., Crawford, J. H., Park, R. J., Holz, R., Kuehn, R. E., Eloranta, E., Knute, C., Jordan, C. E., Lefer, B. L., 2019. Meteorology influencing springtime air quality, pollution transport, and visibility in Korea. *Elem. Sci. Anth.* 7 (1), <https://doi.org/10.1525/elementa.395>.

2. It needs to be stated that HNO₃ control does not have the same meaning as NO_x control. (e.g., line 367). Even if NO_x emissions are reduced, HNO₃ generation may not decrease much due to fluctuations in HNO₃ generation efficiency. This is related to the non-linearity of NO_x-HNO₃ reaction from three dimensional atmospheric chemistry viewpoint, rather than from equilibrium perspectives

Fu et al(2020), <https://dx.doi.org/10.1021/acs.est.9b07248>, *Environ. Sci. Technol.* 2020, 54, 3881–3889

3. It is worth mentioning that besides chemical equilibrium, there may be a role of ammonia, eg in the oxidation process of NO_x:

Li et al(2018), *PNAS* 115 (28) 7236–7241, doi.org/10.1073/pnas.1807719115, Zhang et al(2020), *PNAS* 117 (8) 3960–3966, doi.org/10.1073/pnas.1919343117

4. Regarding the NO_x control vs NH₃ control described in "Summary and broader implications", why not both "NO_x and NH₃ controls"? Reductions in both NO_x and NH₃ emissions at the same time seems to be a reasonable approach to reducing both nitrate and avoiding large increases in particle acidity. If there are any advantages of

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reducing both, please describe in the manuscript.

(Minor Comments)

5. line 52, 56, 655-656: RSSR, 2016 => RSSR, 2017

6. line 58: rephrase "air quality mitigation strategies", e.g., air pollution mitigation strategies

7. line 425: add the citation info for Wong et al. (2020) to the references section

8. line 701-710: cite Warner et al. (2017) and Womack et al. (2019) in the text

9. Figure 2: need to switch "Yes" and "No"

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-501>, 2020.