Atmospheric Chemistry and Physics Discussions

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Comment on acp-2021-811

Anonymous Referee #1

Referee comment on "High atmospheric oxidation capacity drives wintertime nitrate pollution in the eastern Yangtze River Delta of China" by Han Zang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-811-RC1, 2021

This study investigates the key controlling factors nitrate formation in YRD region during wintertime based on field observation and box model. They found large ALWC significantly promoted the uptake of N2O5 and gas-to-partition of gaseous HNO3, the partitioning coefficient of which varied with pH values of particles. The model calculation showed that N2O5 uptake contribute to the major fraction of particulate nitrate formation in this region during the pollution periods. Further analysis on the correlation of nitrate with its precursors indicated the controlling effect on nitrate formation resulted from atmospheric oxidation, which could be the availability of ozone and OH radical. A comparison over various parameters associated with nitrate formation made between the data before and during the epidemics also provided confidence for the results derived above.

Overall, this work provides valuable data on analyzing nitrate formation. It shows the dominant contribution from N2O5 uptake to nitrate formation in YRD region which might be different from other regions in China, and reinforces the importance of atmospheric oxidation on mitigating secondary pollution. I would recommend publication of this paper in *Atmospheric Chemistry and Physics* after the following comments are well addressed.

Specific comments:

Line 240~243: A constant dilution rate for model is inappropriate. For example, the dilution should be significantly enhanced during the breakup of nocturnal boundary layer in the morning at sunrise. It therefore could influence the calculated abundance of long lifetime species, like particulate nitrate, and change the relative contribution from different pathways. Suggest the parameterization of dilution rate constant varying with PBL for a

more accurate quantification.

Line 338: The sentence of "The nitrate formation mechanism is different during the different time of a day" is a wrong statement, as the chemical mechanism should be basically the same throughout the day while the dominant formation pathway could change. It should be rephrased or deleted since it is closed to following sentence.

Line 340~350: There are two major problems on the evaluation of nighttime nitrate formation pathway. First, the concentration of particulate nitrate observed during nighttime is composed of both daytime remainder and nighttime formation, as it is a long lifetime species. Thus the positive correlation of particulate nitrate concentration with $[NO2]^2 \times O_3$ might fail to represent the contribution from N2O5 uptake pathway. Second, what is the time resolution of data points showed in Figure 6? If it is one hour, the level of $[NO2]^2 \times O_3$ at the point just after sunset, when nighttime formation of nitrate starts, should be the highest over the night under a stable condition without transports. The positive correlation tends to unreasonable accordingly. Suggest replacing the point-to-point correlation with nighttime averages correlation. Similar problems also apply to the daytime cases.

Line 473~474: References as to the statement that reduction of NO2 could result in the increase of O3 and OH radical are suggested to be provided here.

Line 522~523: Please explain why regional transport with more aged air plume leads to higher NOR and SOR values before the epidemic periods than that during the epidemic periods? It seems confusing to readers.