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Comment on acp-2021-811

Anonymous Referee #2

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-RC2, 2021

Zang et al., present a comprehensive study to identify the major nitrate formation pathways and their key controlling factors during the winter haze pollution period in the eastern YRD, China using two-year (2018-2019) field observations and detailed observation-constrained model simulations. They find that high atmospheric oxidation capacity is the reason for the winter nitrate aerosol pollution in YRD region in China. And N_2O_5 uptake contributes 60-70% in urban and suburban sites in polluted days. The analysis of the observation data is sound, I only have some comments to the model simulations.

- Line 24-27, The quantification of nitrate formation importance is derived from pollution episodes only. The campaign average result should be much more different. Please clarify it.
- The model includes the dry deposition of HNO3, it seems that the authors want to simulate the variation the particle nitrate. I am very interesting whether the modelled nitrate comparable with the observation. Is it possible to provide more details about the intercomparison? In addition, when calculating the contribution of nitrate formation, are you just accumulate the nitrate production rate during a certain period from different channel? Are the only represent the formation potential without considering the dry deposition, what is the role of the dry deposition in the model simulation since it cannot influence any result in the paper?
- The heterogeneous chemistry is well considered in the model simulation, such as the N2O5 and NO2 uptake mechanism, but limited by the observation, the importance of these reactions cannot be confirmed, If the field measurement of N2O5 or ClNO2 are available, the result would be more insightful with smaller uncertainties. Here, I suggest the author provide more information about the parameterized N2O5 uptake and ClNO2 yield in the main text or SI, which could help people to connect the further observation studies that quantifying N2O5 uptake coefficient and/or ClNO2 yield.
- Monoterpene is very reactive to NO3 radical, and we notice that monoterpene was not included in the model simulation, although the monoterpenes concentration may be low during the winter due to low temperature, but it maybe still have large contribution to the NO3 loss and affect the budget, I encourage the authors do some sensitivity tests to assess the impacts to N2O5 uptake and following nitrate formation.

- Line 249-250, why only constrain the sum NO and NO2, if the NO and NO2 not constrained separately but only the sum, I guess the modeled nocturnal NO always be zero when O3 over ppb. While in fact NO spikes by local emission always observed in urban regions during the nighttime, which would lead to a bias of nitrate formation from N2O5 uptake (possibly an overestimation).
- Figure 8 case 1, the observed NO2 during daytime and nighttime had a lower and higher biases, are they mean the modelled nitrate during the daytime is lower and nighttime is higher. This phenomenon also happened in case 3.
- Line 81 or change to "and"
- Line 361 weaker change to "weak".
- Line 346 the value 15000 misses the unit, may be $pppbv^3$.