

Interactive comment on “On the contribution of nocturnal heterogeneous reactive nitrogen chemistry to particulate matter formation during wintertime pollution events in Northern Utah” by Erin E. McDuffie et al.

Anonymous Referee #1

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McDuffie et al., presented an observed constrain analysis about the particulate nitrate production over vertical scale in the Northern Utah Valley. They found large amount of nitrate was produced aloft due to the air mass is free from the titration effect by the emitted NO near the surface. Although N₂O₅ uptake coefficient in this study is much higher than previous winter studies in US, the nocturnal particulate nitrate production rate is not limited by heterogeneous hydrolysis but the oxidation of NO₂ by O₃. Take the consideration of the nocturnal dilution and daytime entrainment, the model predicted nocturnal nitrate production in residual layer dominates the increasing of nitrate

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in the diagnosed polluted episode, and highlights future work should considering these processes. This study is very important to the community for recognizing the winter particulate nitrate pollution by heterogeneous reaction not only in surface layer but also above the canopy of the urban/suburban (similar results also obtained in Beijing based on tower measurements <https://doi.org/10.5194/acp-18-10483-2018> which is worth to be cited in this paper). This paper certainly worth to be published on ACP subject to minor revision.

1. Section 3.3.1, I can understand what the authors want to present here, but I strongly suggest changing the PN₂O₅ to PNO₃. for the convenience of readers who not so familiar with NO₃ chemistry, otherwise it is hard to get the point of Eq. 6.
2. The derived N₂O₅ uptake coefficient is high that previous two studies conducted by the same group though the iterative box model, if the N₂O₅ uptake efficiency is high enough and the production rate of particulate nitrate is only limited by the NO₂ + O₃, N₂O₅ concentration should be low, could the author provide more information about observed N₂O₅ concentration?
3. The label in Figure S2(b) is inconsistent with the description in the main text, where the median dry SA should be 151.9 ug m⁻³.
4. Page 8, line 7, missed a subscript the (NH₄)₂SO₄
5. The production rate of particulate nitrate in Figure 6 and Figure 7 should be united in the main text as PNO₃⁻. Figure 6b the unit of P(NO₃⁻) and PM_{1.0} should be corrected.
6. SI, Section S2 PNO₃⁻ Calculation Details, repeated “in” (In in Section 3.3.1 of this analysis)

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