

Interactive comment on “On the effectiveness of nitrogen oxide reductions as a control over ammonium nitrate aerosol” by S. E. Pusede et al.

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General Comments

This paper uses a combination of data from long term monitoring at surface sites and from the recent DISCOVER campaign in the central valley of California to ascertain the chemical and dynamical mechanism responsible for winter NH_4NO_3 aerosol formation. The paper further analyzes response of aerosol mass loading to past and predicted future changes in NO_x emissions.

This is a highly valuable contribution. I recommend publication in ACP with attention to the following minor comments.

Specific Comments

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Page 27092, line 15: Does the 20% correlation between NO₂ and NO₃- imply that 20% of NO_x emissions form ammonium nitrate? Some further reference to the overall NO_x loss budget would be helpful at this stage of the manuscript.

Page 27092, line 20: No error limits are given, only units.

Page 27093, line 15: Were there nighttime flight to measure the winds aloft, or is the “nighttime winds near zero” statement based on surface observations. Nocturnal low level jets are common in the SJV (e.g., Bao, J. Appl. Met. and Climat., 47, 2372, 2008), at least in summer. The authors should comment on the possibility for this transport mechanism to operate in winter.

Page 27093, line 25: Whether or not NO₃- is aerosol bound depends on the available ammonia in addition to temperature, correct?

Page 27093, Figure A1: Residual layers are called out on the figure, which is shown as a time series, but without reference to the potential temperature structure. A plot of the chemical data (O₃ and total nitrate) against height, with potential temperature included, would make a better case for the assignment of the residual layer structure.

Page 27095, line 1-2: Statement that N₂O₅ » NO₃ is true for high NO₂ and low T, but is not general unless these conditions are met.

Page 27095, line 8: Should also reference reaction with Cl- to produce HNO₃ + ClNO₂ here. The paper as a whole lacks any other reference to this potential effect on the production rate of NO₃- in the NRL. Similarly, the paper should reference the possibility for limitation of NO₃- via the presence of aerosol nitrate (e.g., Wahner, et al, JGR, 103(D23), 31103-31112.)

Page 27096, line 10: Check grammar – appears to be a run-on sentence. Can a quantitative measure of the NBL vs NRL be given here? Data such as that in Figure A1 must provide some insight.

Page 27098, line 27: Where do the specified parameters for BL heights come from? Is

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this all measured using the micro pulsed lidar data?

Page 27099, lines 24-27: See comment above. If nighttime transport can occur via low level jet formation during wintertime, Bakersfield could be regarded as a receptor site.

Page 27108, line 2-3: A figure showing the agreement between the TD-LIF and PiLS NO₃- would be extremely helpful. Few if any such comparisons exist in the literature, and TD-LIF could be a very important method for this measurement if well validated.

Figure B1. NO₃ radical production rates are compared to photochemical HNO₃ production. The figure would be more representative if nighttime HNO₃ production, occurring at twice the nitrate radical production rate, were compared to photochemical HNO₃. The former would assume hydrolysis rapid in comparison to the NO₂ + O₃ rate.

Page 27109, line 15: Is NO_x well mixed in the afternoon BL? The DISCOVER data should show this. DISCOVER data from the east coast shows that this is not a good approximation, so a comment on how well mixed NO₂ is in the data is warranted here.

Page 27110, lines 10-11: The statement implies that NO₃ reactivity is calculated by comparing NO₂ + NO₃ to NO₃ + VOC. This is not how standard NO₃ budgets are calculated, since it neglects the back reaction of N₂O₅ to reform NO₂ + NO₃. Rather, NO₃ + VOC is compared to the estimated heterogeneous uptake rate coefficient of N₂O₅, multiplied by the equilibrium ratio of N₂O₅/NO₃ (given as K*NO₂). Direct comparison of NO₃ + VOC to NO₃ + NO₂ is incorrect, and should be modified accordingly if this is what the authors mean. See Brown et al., JGR 108(D17), D174539 for more details on this method. Use of daytime VOCs may not be appropriate for NRL calculations, since the reactive VOC content of the NRL is likely lower, and could be substantially lower, than the daytime BL.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 27087, 2015.

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