

Interactive comment on “Observational assessment of the role of nocturnal residual-layer chemistry in determining daytime surface particulate nitrate concentrations” by Gouri Prabhakar et al.

Anonymous Referee #2

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This paper presents an observational analysis using flight and ground based observations and 1-D box modeling to investigate nocturnal nitrate production above the boundary layer and the role it plays on the surface concentrations the next day. The paper relies primarily on aircraft data collected during one, multiday air pollution event in the San Joaquin Vally, CA during wintertime. The focus is on understanding the impact of the chemistry and boundary layer processes, and the contribution of each on surface nitrate concentrations during winter, where approximately 30-80% of the PM mass is ammonium nitrate. Overall I find this to be an excellent paper and impactful to

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many researchers that aim to investigate wintertime nitrate concentrations and want to understand how to regulate emissions to reduce the PM concentrations.

General Comments:

1) It would be helpful to have a better discussion related to how this paper fits into previous studies from Idaho, Washington, and Utah. The authors state in the abstract (page 2, lines 17-19) that the results from their paper “provide general insights into the evolution of pollution episodes in wintertime environments”. However, the discussion that relates their findings to previous research in other areas is limited to two sentences (page 20, lines 1-5).

2) The surface heat flux and friction velocity are mentioned in the manuscript and appendix related to the calculation of mixing layer height, it is not clear what instrument this data come from, or if they came from a model. (page 12 line 10, page 25, lines 16-19)

3) The dataset might be too limited, but can the overnight advection be quantified and related to local sources? This would benefit the discussion on page 9 (lines 5-8) and the discussion about the advection from a nearby source on page 17 (lines 9-11).

Specific Comments:

1) Page 6, lines 15-16: “differential horizontal transport in the RL” sounds a bit awkward; the term advection might be suitable here.

2) Page 7, lines 22-24: “The derived, observationally constrained. . .” Referring to the estimated versus observed profiles of nitrate. While in general there is good agreement, there is not good agreement in the morning profiles close to the surface (<75m), especially in regard to the shape of the profiles. It would be worth mentioning that here.

3) Figure 4 is referenced in the text before Figure 3, these two figures should be switched.

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4) Page 9, line 17-18: The maximum wind speed occurring at 250m is not clear based on the data shown in Figure 3a.

5) Page 12, lines 24-26: “good agreement” while the timing of the morning peak between the model and observations is captured the model does not capture increases in the surface nitrate concentrations after the ML decreases. While this is discussed later in the paper, it should be mentioned here that the model does not have good agreement with observations during the evening.

6) Page 17, line 9: Should this be referencing Figure S6 instead of Figure 8?

7) Page 19, lines 18-19: “vertical mixing has a particularly large impact on the ...” Is this vertical mixing really entrainment and dry deposition? The paper does not quantify or discuss modeling results for vertical mixing throughout the boundary layer; the box model focus is dry deposition and entrainment.

8) The sampling times for the instruments might be beneficial to the reader (Table A1), for example “Fast measurements. . .” (page 7, line 16) does not really have a context.

9) Page 25, lines 25-27: Is the assumption for the boundary layer to linearly drop over a 1-hour period reasonable, it seems too quick, and how does this assumption impact the results? This is vaguely referred to on page 17 (lines 19-22) where the decoupling in the model occurs very rapidly while the temperature and RH changes from observations appear to be more gradual. Is this, or could it potentially, have an impact on the evening increase in nitrate concentrations?

Technical Corrections:

1) There are a few (~20-30) minor typos or grammatical errors.

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