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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Diurnal variation of midlatitudinal NO_3 column abundance over Table Mountain Facility, California" *by* C. M. Chen et al.

Anonymous Referee #2

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I enjoyed reading this paper very much. It was clear, well-written and presented some very good data. The authors thought clearly about the issues that underpinned their data and carefully compared it with models. I recommend the paper for publication in ACP. I would recommend that the authors include the following in the final paper: I agree with Referee 1, I too would like to see a discussion of the ramifications of the findings of this work for atmospheric chemistry. In my view the presence of NO3 at substantial concentrations in the free troposphere implies a lack of reactivity. The presence of large amounts of NO3 is the free troposphere implies a lack of reactivity. NO3 is created through the NO2 and ozone reaction, and if sufficient NO2 is present the equilibrium favours N2O5, which can make nitric acid and is lost to particle surfaces. Also, NO3 will react with any unsaturated VOC if it is available. In these situations NO3 reaction offers a removal mechanism for oxidised nitrogen and one would expect NO3

lifetimes to be short and concentrations low. In the free troposphere, NO2 is low and hence NO3 is favoured over N2O5 and as there is little with which NO3 will react its lifetimes are long and slow nocturnal build up, followed by removal by photolysis at sunrise is to be expected. This behaviour is very similar to the chemistry of NO3 in the stratosphere. My view is that the data imply that this is the case and there do not appear to be huge new chemical surprises. It would be good to see the authors discuss this at the end of their paper.

Page 20196 lines 9-11: "Due to this relative lack of measurements above the boundary layer, our quantitative understanding of the role of NO3-N2O5 chemistry in the free and upper troposphere is incomplete." The lack of measurements does not suggest that understanding of NO3 chemistry is incomplete, rather quantitative prediction of NO3 chemistry in the free troposphere has not been thoroughly tested or constrained.

Page 20210 lines 12-13 "As discussed below, this suggests that there is NO3 in the free troposphere that can reside for days in substantial concentrations" The authors should make it clear that the NO3 decreases to zero during the day through photolysis and reforms the following night. It is the lack of chemical loss of NOx and NO3 that leads to the persistence of night-time free tropospheric NO3 over multiple nights.

Page 20210 line 27: have not has

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