

## ***Interactive comment on “Diurnal variation of midlatitudinal NO<sub>3</sub> column abundance over Table Mountain Facility, California” by C. M. Chen et al.***

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Received and published: 23 December 2010

We thank Referee 2 for constructive comments. Below we have copied the comment of the referee followed by our response.

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 NO<sub>3</sub> at substantial concentrations in the free troposphere implies a lack of reactivity. The presence of large amounts of NO<sub>3</sub> in the free troposphere implies a lack of reactivity. NO<sub>3</sub> is created through the NO<sub>2</sub> and ozone reaction, and if sufficient NO<sub>2</sub> is present the equilibrium favours N<sub>2</sub>O<sub>5</sub>, which can make nitric acid and is lost to particle surfaces.

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Also, NO<sub>3</sub> will react with any unsaturated VOC if it is available. In these situations NO<sub>3</sub> reaction offers a removal mechanism for oxidised nitrogen and one would expect NO<sub>3</sub> lifetimes to be short and concentrations low. In the free troposphere, NO<sub>2</sub> is low and hence NO<sub>3</sub> is favoured over N<sub>2</sub>O<sub>5</sub> and as there is little with which NO<sub>3</sub> 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 NO<sub>3</sub> 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.

What we call model-like is what Referee 2 states here. For those days with model-like behavior, we believe the chemistry is well understood. We will add a few lines to the manuscript along what Referee 2 has stated.

Page 20196 lines 9-11: “Due to this relative lack of measurements above the boundary layer, our quantitative understanding of the role of NO<sub>3</sub>-N<sub>2</sub>O<sub>5</sub> chemistry in the free and upper troposphere is incomplete.” The lack of measurements does not suggest that understanding of NO<sub>3</sub> chemistry is incomplete, rather quantitative prediction of NO<sub>3</sub> chemistry in the free troposphere has not been thoroughly tested or constrained.

Agree with Referee 2, as this is the point we wished to communicate. Have rephrased to make it clear that the role of NO<sub>3</sub>-N<sub>2</sub>O<sub>5</sub> chemistry has not been quantitatively tested, rather than the understanding not established.

Page 20210 lines 12-13 “As discussed below, this suggests that there is NO<sub>3</sub> in the free troposphere that can reside for days in substantial concentrations” The authors should make it clear that the NO<sub>3</sub> decreases to

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zero during the day through photolysis and reforms the following night. It is the lack of chemical loss of NO<sub>x</sub> and NO<sub>3</sub> that leads to the persistence of night-time free tropospheric NO<sub>3</sub> over multiple nights.

True, the sentence is misleading. We have rephrased it to make it explicit that the NO<sub>3</sub> is reforming each evening, which also indicates a lack of chemical loss of NO<sub>x</sub>.

Page 20210 line 27: have not has

Has been corrected.

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 20193, 2010.

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