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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.

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We thank Referee 1 for the very helpful comments. Below we have copied the comments of the referee followed by our response.

> 1) Page 20194, lines 20-26: The discussion of atmospheric NO3 chemistry could be tidied up a bit: It probably would be good to mention up-front that the description deals with nighttime only (sentence in lines 4,5 of page 20194). Likewise, the statement that N2O5 thermal decay is a source for NO3 holds for the troposphere just as well as for the upper stratosphere. In fact the equilibrium between NO2, NO3 and N2O5 could be mentioned.

We agree with the referee's comments on how to clarify the introduction. We have added mention that NO3 is important in nocturnal chemistry in first sentence of introduction, and have mentioned the equilibrium between NO2, NO3, and N2O5.

> 2) Page 20195, lines 1 and 6ff: Heterogeneous reaction of N2O5 with water: Probably this is on surfaces of ice particles in the stratosphere and any moist surface in the troposphere?

We have now specified the loss is on moist aerosol surfaces.

> 3) Page 20196, lines 7ff: Measurements of free tropospheric NO3 were also reported by: Platt et al., J. Geophys. Res. 86, 11965-11970, 1981 and: Penkett et al., Atmos. Environ. 41, 3465?3478. 2007.

Thank you for these references. They have been added.

> 4) Page 20196, line 12: The remark about NO3 in the free trop. may also be informative to make in the abstract.

Thank you for the suggestion, but we feel the emphasis on the free troposphere is implied and made sufficiently clear by the description of the technique we use. Lunar occultation is inherently most sensitive to the free trop and stratosphere.

> 5) Page 20196, lines 20,21: What kind of ?input??

We have clarified that the inputs are ozone concentration and temperature from lidar measurements at our site.

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6) Page 20196, line 26: This statement belongs into section 2.1.

We have moved mention of the clean and polluted air masses at measurement site to section 2.1.

7) Page 20197, section 2.1: It might be of interest to the reader to have a little more precise information here: does ?two days before and after full moon? mean a period of 4 or five days? How many full moon periods did occur during the measurent period (16 or 17)? So measurements were acturally made during e.g. 40 out of 80 possible nights?

We have made this section more detailed. The optimal period is 5 days, but we only planned to take data for 3 of these 5 days. Data was taken during 16 out of 18 events, so we took data for 40 out of 90 possible observations.

8) Page 20197, section 2.2.1: Give spectral range of the instr. here.

Spectral range of instrument, 616.7-674.5 nm, has been added to text.

9) Page 20198, section 2.2.1: Were the spectra co-added for 10-20 min.?

The spectra were not co-added for 10-20 min, but are snapshots taken every 10 to 20 minutes. Will add a table of measurement conditions for complete clarity.

10) Page 20199, line 3: The total vertical O4 column corresponds to a horizontal path at sea level of 4km (or to about 3 km for the column above 2000m) and more at slant views. Why is this negligible?

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Referee 1 is correct. Instead, the O4 signal is taken out the same way as the O2 signal: the majority of the signal is taken from the solar spectra, and then the remaining signal is fit with the empirical O2/O4 spectra. This is possible since O4 scales with the square of O2 concentration. (In our initial fit routine, O4 was fit separately, but there was no substantial signal.) The text and graphics will be edited to reflect this.

> 11) Page 20200, lines 5, 6: The authors state: ?The solar spectral features in the non diffuse spectra differed from those in the lunar spectra.? But what is required is that the diffuse solar spectra do not differ from the lunar spectra. This does not follow from the statement made.

We agree with the referee, and have clarified that solar spectra with the ground glass diffusers do not differ from lunar spectra, as evidenced by the small residuals achieved.

> 12) Page 20200, line 21: What about saturation effects if the lines are not resolved??

We will discuss saturation effects in the text in more detail. A lot has already been written on saturation effects in the literature. In our experience, using water spectra from line-by-line radiative transfer models did not give the best residuals. Therefore we employed our empirical method, which intrinsically deals with saturation effects. This method accounts for saturation of the water vapor lines and provides an accurate representation of water spectra broaden by instrument line shape.

> 13) Page 20203, line 13: Mean values of what?

We have added clarification in the text that mean values of ozone concentration and temperature were used.

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14) Page 20205, line 9: Negligible daytime NO3 values are not really visible in Fig. 3.

We could not measure daytime values, so cannot show explicitly that it is negligible.

15) Page 20209, para. starting in line 19: Give more clear explanation of the boundary layer issue and ?constructed? columns.

We have changed to clearer terminology: "thickest boundary layer" and "thinnest free troposphere".

16) Page 20212, conclusion section: What are the consequences of this interesting finding for the oxidation capacity of the free troposphere and its NOx contents?

Our finding suggests that the upper troposphere often has similar chemical characteristics as the stratosphere. There is a lack of chemical loss of NOx which keeps the oxidation capacity high. We will make this finding more explicit in the text.

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