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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Odin/OSIRIS observations of stratospheric NO_3 through sunrise and sunset" *by* C. A. McLinden and C. S. Haley

Anonymous Referee #1

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This manuscript presents retrievals of NO3 from OSIRIS spectra taken at large solar zenith angles and compares slant column density measurements taken during the optimal period of observations to those generated by a photochemical box model. The paper is in general well-written and I recommend it be published in ACP after a few revisions.

General Comment:

Sections 2 and 3 should be revised to include information on the spread of the retrieved SCDs shown as a mean in Figure 3. More attention should also be paid to the negative SCDs - which are of the same order as the positive SCDs taken to differ significantly from zero. This point is further expanded in the specific comments below.

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Specific Comments:

pg. 5903, lines 2-5: "To date all successful measurements of stratospheric NO3 have been made by sampling the atmosphere at SZA>94."

Smith and Solomon (1990) use lunar spectra taken at solar zenith angles through twilight. Coe et al. (2002) measure solar spectra through twilight, and use SZAs less than 94.

pg. 5903, Figure 1 and paragraph 1: Panels (a) and (b) show modeled profiles at two different latitudes, twilight periods, and seasons. Could you comment on the cause of the difference in the shape of the profiles? The text implies it is mainly due to sunrise/sunset differences - is this the case?

pg. 5903, paragraph 2: Twilight zenith-sky spectra from ground-based instruments have also been used to retrieve NO3, for example Coe et al. (2002).

pg. 5906, paragraph 2 and Figure 3: Figure 3 should show the standard deviation of the mean to give an idea of how representative the means are. This should also be discussed in the text. Given the large variation of the individual profiles shown in Figure 5, I imagine this standard deviation is quite large, and some of the values are very negative. The authors might also comment on this.

pg. 5906, lines 11-12: "...the SCDs do not differ significantly from zero."

It's hard to comment on the significance without knowing how much the individual profiles differ from the mean.

pg. 5906, lines 13-14: "During sunset there is essentially no NO3 until a SZA of 94..."

The profiles at 91-93 all have negative values reaching -1x10^{14}, while the 94 degree profile has a max of 1 x10^{14} - why is the positive value significant, but the negative values are not? Generally in the discussion in this paragraph I think more attention needs to be given to the negative SCDs - they are not necessarily insignificant just

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because they are negative.

pg. 5906, lines 18-20: "That is, increasing the short wavelength end of the fitting window..."

Again, does this eliminate the feature in the mean, or in the individual profiles? This fitting window has been chosen to improve the signal-to-noise ratio (pg. 5904, paragraph 3) - but if the window introduces negative SCDs, is it really the better choice?

pg. 5907, line 22: "Overall the magnitude and behaviour with SZA is very consistent between the modeled and observed SCDs."

I wouldn't call the agreement "very consistent". There are many differences which are elaborated on by the authors in the rest of the paragraph.

pg. 5908, paragraph 1 and Figure 5: The difference in the magnitude of the profiles is explained by the larger ozone amounts in scan 1 and the differences in temperature. Can the box model be used to confirm this?

References

Coe, H., B. J. Allan, and J. M. C. Plane, Retrieval of vertical profiles of NO3 from zenith sky measurements using an optimal estimation method, J. Geophys. Res., 107(D21), 4587, doi:10.1029/2002JD002111, 2002.

Smith, J.P. and S. Solomon, Atmospheric NO3 3. Sunrise Disappearance and the Stratospheric Profile, J. Geophys. Res., 95(D9), 13819, 1990.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 5901, 2008.