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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Technical Note: A time-dependent calibration correction for solar occultation instruments" *by* S. P. Burton et al.

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To the anonymous referee (#2),

Thank you for your helpful comments. In response to your general comments, I agree that the vagueness of the title could lead to a brief misunderstanding. The new title will be "Time-dependent limb-darkening calibration for solar occultation instruments". Hopefully the extra information in the title combined with the abstract will be enough to dispel any misunderstanding.

I take your point that the correction technique described here is probably applicable only to solar occultation instruments that scan the face of the sun and not those that "stare" at a point on the sun, and I think it is appropriate to add "scanning" in sev-

eral places to make our statements more specific. However, I would point out that the scanning technique is not unique to SAGE instruments, having also been used by SCIAMACHY (Meyer et al, 2004). Future solar occultation satellites, if any are forthcoming, may also use the scanning technique, which produces more precise altitude registration (about 100 m for SAGE II/III) than the staring technique. The specific correction technique derived in this note is probably less important that the observation that taking the rotation of the sun into account can improve the calibration and decrease what has been assumed to be unavoidable random noise in the resulting transmittance measurements. Rotation of the sun will affect even staring solar occultation measurements, since features may rotate in and out of the rectangular field of view, which, in addition, may be pointed away from the center of the sun (e.g. SOFIE, described by Gordley et al., 2008). While the correction described in this note may not suit this situation, it is relevant to observe that taking the rotation of the sun into account will reduce calibration errors compared to assuming a one-dimensional limb-darkening function.

To address the request that results relating to a large statistical sampling of events would be preferable over the examples shown in the paper, we have revised Figure 9 to show an average over a month's SAGE III data. We have also added an additional comment about the effect on the ozone product.

Specific comments:

Third sentence of Section 3.1: reworded as requested

How accurate is the pointing? Instrument details are given by Mauldin et al. [1985]. The pointing accuracy is 30 arcseconds for SAGE II. The reference will be added to the final paper.

The sunspot artifact is indeed near 0.9, not 1.1. It will be corrected in the final paper.

Figure 5: I agree that "40 to 120 km altitude" is not explained and not very useful. You are correct that the simulation doesn't have anything to do with altitude. The rotation

angles of the solar disk were taken from a real SAGE II event to ensure realistic rotations. The altitude range is the range from that event for which the rotation angles were applicable. It's not necessary to include the information in the figure and it will be removed.

Figure 6: While the center of the sun can still yield a rotational effect, since the FOV is not round, you are right that the correction is generally smallest near the center of the sun. This can be better appreciated by looking at Figure 3, which shows, in general, the smallest amount of variation near 1.0. However, you are also correct that the size of the effect and also the pattern are more-or-less random since they depend on what solar features are present. This is also evident in Figure 3, since the largest variations, due to a sunspot, are also fairly close to the center of the sun. As for the pattern (in time), we find the results shown to be typical, although we were also somewhat surprised that such simple fits worked as well as they did. However, we did not actually use quadratic fits for final implementation of the correction, as described in the manuscript, in order to allow for a more general variation. The figure (and the description of this simpler algorithm) are present in order to illustrate that the variation is fairly smooth, consistent with the idea that the variation is due to rotation of the scan plane and therefore highly correlated from one scan to the next. Since we wanted to keep the manuscript quite short, and since what's shown in Figure 6 isn't the final form of the algorithm, we thought a very small sample of results was appropriate for illustration.

Figure 9 discussion: More information of the type requested has been included in section 2.4.

Minor comments:

that/which: changed

impacts on: changed

missing the: added

"We can successfully represent" is grammatically correct as written, but the parenthetical makes verb agreement dubious with either "represent" or "represents". The parenthetical has been removed.

The sentence "There is a clear reduction" has been rewritten for improved clarity. Figure 7 caption: the wavelength has been added.

Again, thank you for your time and helpful comments.

Sincerely,

Sharon Burton

REFERENCES

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Mauldin, L. E., III, Zaun, N. H., McCormick, M. P., Jr., Guy, J. H., and Vaughn, W. R.: Stratospheric Aerosol and Gas Experiment II instrument: a functional description, Optical Engineering, 24, 307–312, 1985.

Meyer, J., A. Schlesier, A. Rozanov, H. Bovensmann, and J. Burrows, "Towards O3 and NO2 vertical profile retrieval from SCIAMACHY solar occultation measurements: first results," Advances in Space Research, 34, 744-748, 2004, doi: 10.1016/j.asr.2003.05.053

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