Review of Manuscript ACP-2009-329

Technical Note: A Time-dependent I_o Correction for Solar Occultation Instruments

by Burton *et al*.

This manuscript discusses an improvement to the data processing algorithms used for the SAGE II and III solar occultation instruments. It is pointed out that the sun rotates, in the reference frame of the instrument, during the time it takes to perform an occultation scan of the atmosphere. This can introduce a calibration error in the calculation of atmospheric transmission (the fundamental occultation measurement) due to misalignment between the assumed solar track point sampled above the atmosphere (I_o normalization phase) and in the atmosphere.

A method is presented to correct for this effect in the SAGE data and results are shown from a few specific SAGE scans to support the conclusion that this algorithm improvement significantly reduces the variance in the SAGE Level 1 transmission data.

The paper is clear enough in its presentation of the measurements and the analysis. The conclusions are straightforward and I have no significant objections to the analysis used. I recommend that the paper be published, but offer some comments below for the authors to consider.

General Comments:

I think the title is somewhat vague and possibly misleading. "Time-dependent" in the sense of this paper simply means correcting a calibration error that is varying with time during a specific occultation event. A reader scanning the title of the paper would probably assume that the authors address some long-term time-dependent calibration errors (i.e., something that might affect trend analysis).

The paper is correct in stating that this issue of the rotation of the solar disk during an event is common to all solar occultation measurements. All such instruments look at the sun as it rises or sets, and when doing so from the vantage point of a low-earth orbiting satellite the sun will definitely rotate to some extent. However, all instruments track the sun differently and the procedure outlined here is specific to the unique SAGE approach of continuously scanning up and down over the full solar disk. I think the claims of generality for this correction algorithm are exaggerated.

Finally, if this approach has already been made operational for new versions of the SAGE II/III retrievals, then presumably it has been applied to a much larger set of data than the handful of specific occultations shown in this paper. It would be much more instructive to the reader (and SAGE data users) to show a more global, statistical study of the improvement in data quality when the calibration correction is made. Also, of course, the final data product is gas densities and aerosol extinction rather than transmission. The paper would be improved if the authors could show quantitatively how these products are affected by the new calibration.

***Specific Comments & Questions**:*

Section 3.1

The 3rd sentence as worded is confusing. It implies that the normalization factor I_o itself ranged from 0 to 2, not the relative position on the sun. Change "…on the Sun and is …" to "…on the Sun, which is….".

How is the instrument scan point maintained at the center of the sun in the azimuth direction? How well is the azimuth pointing maintained (how accurately is this known?). Any variation in this dimension will obviously affect the correction you're attempting to make for the solar rotation.

Figure 3 – the caption states that a sunspot artifact is at position 1.1 on the sun – it looks more like 0.9 to me.

Section 3.2

Figure 5 – What is the meaning of the "40 to 120 km altitude" caption in the figure? It seems to me that nothing in this simulation has anything to do with altitude.

Section 3.3

Figure 6 – These results are somewhat surprising, at least for the middle panels. At the Sun position 1.0, you are by definition looking at the center of the sun. Therefore (if I understand correctly) the SAGE FOV is simply rotating slightly at the same location on the sun from scan-to-scan. Given the size of the FOV I would expect the smallest changes to occur here. Also, presumably these patterns change with time and are more or less random, since the changes are just caused by small-scale solar structures that come and go at various locations on the solar disk. Is this true? It would have been instructive to show more than a single example of these results.

Section 3.4

In the discussion of Figure 9, it is stated that the reduction in transmission variance between Version 3 and 4 data is due to a number of factors, not just the I_o correction described here. It would be helpful to know what other changes were made to improve Version 4 (at a top level) and what fraction of the improvement is estimated to be due to the I_o correction.

Minor comments and corrections:

Section 1

Paragraph 1, sentence 1 – "… that includes SAGE.." should be "… which includes SAGE…"

Paragraph 2, sentence 3 – "…Impacts on the normalization…" should be "…impacts the normalization…"

Section 2

Paragraph 1, sentence 1 – Should be "The SAGE II mission…."

Section 3.1

Paragraph 1, sentence 7 – "successfully represent" should be "successfully represents".

Section 3.4

2nd paragraph - The sentence beginning "There is a clear reduction …". is poorly worded and confusing to read – please try to clarify it. In the last sentence of the paragraph "scale" should be "scale height".

Figure 7 caption – A wavelength needs to be associated with channel 7.