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Atmospheric Measurement Techniques Discussions

Interactive comment on "Optimised degradation correction for SCIAMACHY satellite solar measurements from 330 to 1600 nm by using its internal white light source" *by* Tina Hilbig et al.

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We thank the reviewer for the detailed remarks and the effort to improve our paper. We responded to all comments as best as we can. Section 5.2 of the manuscript with marked changes is attached to the answers.

In general, this is a good paper and I recommend only a few minor corrections.

Section 3.4 is about the aging correction for the WLS. As I understand your text, the WLS is only used to make a flat-field correction to the detector array.

Corrections to the long-term trends in the SSI time series come from the other sources. Is this correct?

In the operational processor, the original purpose of the WLS measurements was to derive corrections for several effects: e.g. verification of the in-flight memory effect, the pixel-to-pixel gain, and the etalon effect. Within our project, which is focussing on the solar measurements by SCIAMACHY, the on-ground to in-flight correction used the WLS measurements. It corrects for all calibration changes until a reference day shortly after launch (Hilbig et al., 2018). As a stable light source the WLS was intended for long-term monitoring of the instrument. In this study/paper, it is used for the first time to derive a degradation correction; or rather we added the time series of WLS measurements in the fit of the degradation parameter.

In the new degradation model, the WLS is an "independent" light source. The corrections shown in Figure 5 and described in Equation 1 seem to assume that all of the observed changes in the lamp are due to degradation of the lamp and none of the loss of signal is due to the rest of the system. Fitting a curve to remove the variation in the WLS seems to make an assumption about the magnitude of changes in the detector (for example). If I have interpreted the text correctly, can you add some discussion on how this changes the trends in the SSI time series? If I have not interpreted the text correctly, then could you add another paragraph explaining how the WLS correction does not impact the final degradation correction?

The WLS data (as shown in Fig. 5) include a degradation correction: It is shown for V9.01 in the upper panel of Fig. 5 and with our newly derived degradation correction in the lower panel. In the upper panel (V9.01) deviations from a constant signal are observed. This is caused by a combination of uncorrected instrument degradation

and WLS ageing. We know from the literature e.g. Sperling et al. (1996) that the lamp ageing follows (approximately) an exponential curve. In the first step of our new approach we derive and correct only the WLS ageing by fitting an exponential curve. The ageing corrected WLS time series (green line in Fig.5) show remaining deviations from a constant signal. This is attributed to uncorrected instrument degradation and is addressed in the second step of our approach. After we got a new instrument degradation correction, we derived again the WLS ageing correction and so on. With this iterative approach we can improve and better separate both the WLS ageing and the instrument degradation correction. This iterative approach is described in detail in the following section 3.5 and a sketch of the iterative approach is shown in Fig.6.

In Figure 9, the 430 nm time series shows out of phase trends. Is this a statistically significant result about the Sun, or does this fall within the uncertainty of your SSI time series? In Figure 10, the 425-435 band also shows this behaviour. In the text, you do mention the out of phase behaviour in the SCIAMACHY data, but you don't make a clear statement on whether or not this is a new finding of SCIAMACHY. I would like to see a clarification on this point.

Currently, this algorithm is not mature enough to distinguish instrumental from physical trends. Therefore, the out of band trends at 430 nm falls within the uncertainty of the correction method. We add two sentences to the paper:

At Sec. 4, p13: *"... an unexpected anti-cyclic increase during solar minimum, similar to the behaviour of V9.01, becomes evident in the NUV and above; see further discussion and comparisons with other SSI data sets in Section 5."*

At Sec. 5.2, p16/17: *"The observed anti-correlation for the new SCIAMACHY results is therefore likely a remaining residual instrument artefact."*

P16 L12: you refer to Woods' MuSIL and Mauceri's SIMc as if they were observational datasets. Both are essentially corrections based on proxies (or TSI) rather than instrument data. So comparisons to those time series should fall in the same category as comparisons to SATIRE-S or NRLSSI2.

Thank you for clarification. We changed the text as follows: *"Recent studies by Woods et al. (2018) and Mauceri et al. (2018) developed new methods to account for uncorrected degradation in SIM SSI. Both results, the MuSIL-corrected SIM and SIMc, show better agreement with independent SSI data such as SATIRE-S than the operational SIM product (Harder, 2019)."*

Figure 11 uses different colors for the different missions than Figure 9. I would recommend that each instrument in the two figures have a consistent color assigned. It will make it easier for the reader to compare the time series.

The Figure 11 is updated, so that each instrument has consistent colour assigned in all figures.

Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2019-433/amt-2019-433-AC2-supplement.pdf

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