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Atmospheric Measurement Techniques Discussions

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5, C2537–C2543, 2012

Interactive Comment

Interactive comment on "Calibration of the SBUV version 8.6 ozone data product" *by* M. T. DeLand et al.

M. T. DeLand et al.

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NOTE: Our responses are inserted immediately after each referee comment, and begin with the characters '»'.

Comments:

- The main goal of all the calibration procedures applied to the SBUV spectra is to improve the consistency between the ozone profiles retrieved from the different sensors. The procedures themselves are clearly described. But the paper would greatly benefit from an illustration of the impact of these calibrations on the retrieved ozone profiles themselves, where possible. Is it possible to show how improved is the consistency between the ozone profile data sets from the different instruments as a consequence of some of the calibration procedures?

» While other forthcoming papers from our group address the behavior of the SBUV V8.6 ozone products in extensive detail, we agree that an illustration of the improved data quality in this paper is also useful. We have added Figure 12 in the revised manuscript to compare the agreement between Aura MLS profile ozone data and data from overlapping SBUV/2 instruments (NOAA-16, NOAA-17, NOAA-18), using both our previous Version 8 (V8) product and the new V8.6 product.

Revised Text (p. 5168, after line 15). The improvement in ozone profile data quality produced by the calibration changes discussed in this section is noticeable when examining data from the most recent SBUV instruments on NOAA-16, NOAA-17, and NOAA-18. Figure 12 shows zonal average profile ozone comparisons with Aura MLS Version 3.3 ozone data, using both the previous SBUV V8 data product (top panel) and the current V8.6 data product (bottom panel). The significant decrease in oscillating vertical structure, or "ringing", for the V8.6 comparisons comes from the channel adjustment procedure used for NOAA-17. The improved agreement between these three SBUV instruments in the V8.6 product comes from the use of the "no local time difference" intercalibration technique.

Caption for Figure 12. Profile ozone differences [in percent] between Aura MLS V3.3 data and SBUV/2 instruments on NOAA-16, NOAA-17, and NOAA-18, using zonal averages between 50°N-50°S for the period July 2005 – June 2007. Comparisons to the SBUV V8 data product are shown in the top panel, and comparisons to the SBUV V8.6 product discussed in this paper are shown in the bottom panel.

- In the snow/radiance method, it is mentioned that the small ozone absorption effect at 340 nm is easy to correct. Could you clarify how this is done? Is it based on a-priori information (climatology)?

» The correction for ozone absorption at 340 nm in the snow/ice albedo analysis is

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based on the retrieved total ozone value for each scan. We have added a sentence in Section 2.2 to clarify this point.

Revised Text (p. 5157, line 6). We calculate this correction by taking the retrieved total ozone value for each scan and running a forward model radiative transfer calculation to determine the appropriate adjustment.

- The term SBUV/2 is often used as a generic term (sections 2.2 and 2.3) making unclear if the calibrations presented there are also applied to earlier (S)BUV instruments. If this is the case, please replace SBUV/2 by SBUV. Otherwise, could you clarify in the text?

» We have revised or removed the usage of 'SBUV/2' in multiple locations to clarify our intent. Text Changes. p. 5156, line 18; p. 5157, lines 1, 4; p. 5158, line 18; p. 5159, lines 5, 8, 18; p. 5160, line 6.

- Section 3.1: For the NOAA-16 and -18 instruments, an adjustment of the albedo calibration is realized based on a comparison of Antarctica measurements with some from the NOAA-17 SBUV/2 sensor. However, what is really intercompared is not clear to me. Are the radiances intercompared (this is what I understand from the manuscript) or the measured albedo (it would seem more logical in order to adjust the albedo calibration)? Could you clarify this?

» The reviewer is correct that comparisons are performed using albedo values. We have revised the text on p. 5162 (lines 4, 8, 12, 19) to clarify this point.

- Section 3.2 - line 16: Are there any calibration adjustments at 340nm based on SSBUV for NOAA-14? In section 2.4, it is mentioned that the on-board calibration is used for this instrument.

» The discussion of on-board calibration for NOAA-14 in Section 2.4 (p. 5160, lines 8-10) refers to the determination of time-dependent instrument characterization based on the diffuser reflectivity system described in Sec. 2.1. The calibration adjustments

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described in Sec. 3.2 (p. 5163, lines 16-18) refer to the absolute calibration.

- Section 3.2 – lines 10-20: I would move Figure 18 here and refer to it.

» We agree that moving this figure earlier in the paper is more effective. We have moved it to the end of Sec. 3.4 (p. 5168, line 15) to help summarize the discussion of our intercalibration approach.

- Section 3.2: The method presented here to adjust the individual channels appears to be applied to the NOAA-17 instrument only. Are there fundamental reasons why this technique cannot be applied to the other instruments? Perhaps, it would reduce the need for inter-instrument calibrations.

» The individual channel adjustment approach described in Sec. 3.2 can be applied to each instrument separately. However, we found that we obtained better inter-instrument agreement by deriving overlap adjustments as described in the following sections. We have added text at the end of Sec. 3.2 to clarify this point.

Revised Text (p. 5165, line 24). When we applied the individual channel adjustment approach to other SBUV instruments, we found that we could achieve comparable results for some instruments (e.g. NOAA-18), but that other instruments had significantly larger uncertainties. Since a key goal of the V8.6 ozone product is to create individual data sets that can be merged smoothly for long-term trend studies, we felt that it was more effective to use a minimum number of reference instruments and derive further adjustments based on overlap periods. This approach also reduces the overall data set uncertainty, because the calibration uncertainty associated with the intercalibration process can be less than the absolute uncertainty for some early SBUV instruments.

- Page 5169 – lines 20-21: Was this error characterized on-ground? What is this reference photo-diode?

» The Nimbus-7 SBUV hysteresis error was not characterized prior to launch. We have added text to clarify the nature of the reference photodiode.

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Revised Text (p. 5169, line 21). This error can be characterized using concurrent samples collected by a photodiode, which receives approximately 10% of the incoming radiation through the use of a splitting mirror. This photodiode (operating at 343 nm) is not affected by the PMT problem, and thus can be used as a reference to quantify the hysteresis error.

- Page 5171 – lines 7-9: Why is an adjustment needed to account for CCR variations? Are they not implicitly included in the observed radiance at 331 nm?

» The observed radiance at 331 nm only represents the scene radiance at the time of that sample. The short wavelength measurements most affected by the out-of-band error occur earlier in the scan sequence (up to 20 seconds for the 252 nm sample), when the reflectivity could be higher or lower. We therefore use the CCR intra-scan variations to scale the observed 331 nm signal to the appropriate value for each sample.

- Grating drive errors: How can a difference between the actual and the intended grating position be detected and quantified? In other words, how is the wavelength calibration quality estimated?

» The actual location reached by the grating drive for each sample is reported, and can be compared to the programmed value to identify errors. We have added this information to the text. These large-scale errors are the primary focus of Sec. 4.4. We also monitor the wavelength calibration by scanning across emission lines in the on-board mercury lamp spectrum. These measurements typically indicate only small long-term changes that are within the uncertainty of the observations, and much less than the errors discussed in Sec. 4.4.

Revised Text (p. 5173, line 24). The position reached by the grating drive for each sample is recorded.

Editorial comments:

- Page 5156 line 3: fit –> fitted

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» We believe that the usage is correct (i.e. "the changes are fit"), but we will be happy to accept any changes suggested by the journal editor.

- Page 5163 line 22: please quote the climatology used.

» The ozone climatology was recently published by McPeters and Labow (2012). We have added this citation to the reference list.

Revised Text (p. 5181, line 6). McPeters, R. D., and Labow, G. J.: Climatology 2011: An MLS and sonde derived ozone climatology for satellite retrieval algorithms, J. Geophys. Res., 117, D10303, doi:10.1029/2011JD017006.

- Figure 8-9-10: please homogenize the units for the x-axis.

» We have changed the units on the X-axis for Figures 9 and 10 to be in N-value units, for consistency with Figure 8 and with the actual application in the processing algorithm.

- Page 5173 – line 16: 60°-65° –> -60°- -65° and 45° –> - 45°

» We have revised the text to use 60°-65°S and 45°S latitude for clarity.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 5151, 2012.

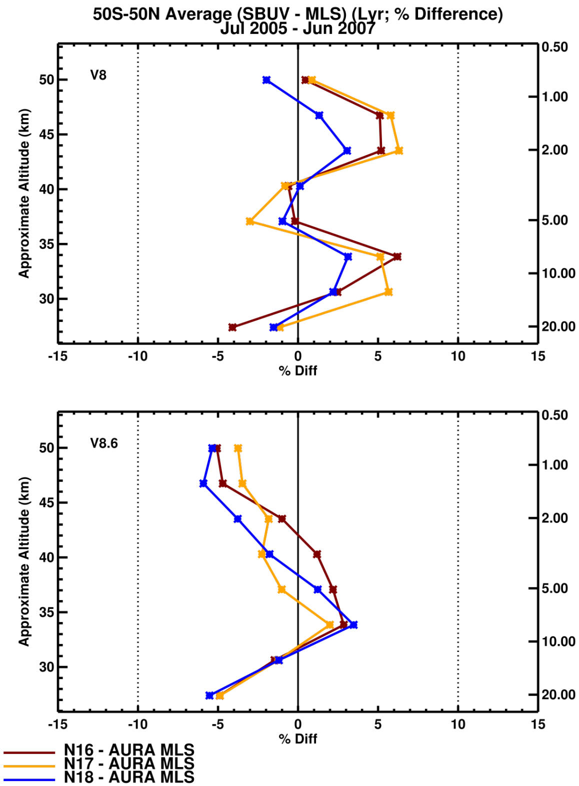

Fig. 1. Profile ozone differences between Aura MLS and SBUV V8 data (top) and SBUV V8.6 data (bottom).