1. McMurdo Station (08/15/13 – 04/30/14)

Solar data of the SUV-100 spectroradiometer discussed in this quality control report encompass the period 08/15/13 – 04/30/14 and are part of Volume 23. The system performed normal and was stable during most of this period. One exception is the period between 04/07/14 and 04/14/14 when the system cycled power periodically. The problem was caused by the system's power distribution unit (PDU), which is a power strip that can be controlled remotely. No data are available for 04/08/14 and 4/10/14 – 04/13/14 because of this problem.

The system's PSP radiometer was PSP S/N 32760F3. The calibration factor used for processing solar data was 7.73 $x10^{-6}$ V/(W m^{-2}).

1.1. Irradiance Calibration

The on-site irradiance standards used during the reporting period were the lamps M-543, 200W011, and 200W019. The three lamps have been in service at McMurdo for several years – see the Volume 21 QC report for a complete description of their history. The three lamps were recalibrated against the traveling standard 200WN003 using absolute scans performed between on 01/31/13. (This date falls into the Volume 22 period).

Calibration history of traveling standard 200WN003
The standard 200WN003 had been calibrated at NOAA against lamps 200WN001 and 200WN002 on 3/21/13. Lamps 200WN001 and 200WN002 had in turn been calibrated at BSI in November 2012 against the NIST standard F-616 using a multi-filter transfer radiometer. NIST standard F-616 is traceable to the detector-based scale of irradiance established by NIST in 2000. At the time 200WN001 and 200WN002 were calibrated, they were also compared with the long-term traveling standard 200W017 of the NSF UV monitoring network. The irradiance scales of NIST standard F-616 and lamp 200W017 agreed to within 0.3%. It can therefore be assumed that the change from 200W017 to F-616 as the primary reference for calibrating on-site standards did not result in a significant step-change.

The three site standards were also compared with NOAA lamps 200WN007 and 200WN008 on 01/25/14. Because the calibration of the two lamps has not been finalized yet, results were not used to calibrate solar data of the reporting period.

Lamp M-543 burned unstable during most of the Volume 22 and 23 periods. Absolute scans of the lamp were therefore not used to process solar data. Hence, the calibration of solar data of the Volume 23 period is based entirely on absolute scans of lamps 200W011 and 200W019.

1.2. Instrument Stability

The temporal stability of the SUV-100 spectroradiometer was assessed by (1) analyzing measurements of the internal reference lamp, (2) analyzing absolute scans using the on-site standards, (3) comparing SUV-100 measurements with data of the collocated GUV-511 radiometer, and (4) comparing with results of a radiative transfer model. Results from the four methods are reviewed below.

Figure 1 shows results from measurements of the internal lamp. Specifically, the readings of the instrument's TSI sensor are compared with measurements of the SUV-100's PMT at 300 and 400 nm. TSI readings decrease by about 4% over the course of the reporting period, indicating that the internal lamp was getting dimmer. PMT measurements increased by about 3% between August and November 2013, remained fairly constant up to January 2014, and decreased thereafter by about 4%. For a perfectly stable system, TSI and PMT measurements would track each other in response to a change in the lamp output. While this is not the case, the variations of both sensors are rather small, indicating that the internal elements of the system (monochromator, PMT) were stable to within about ±2%.

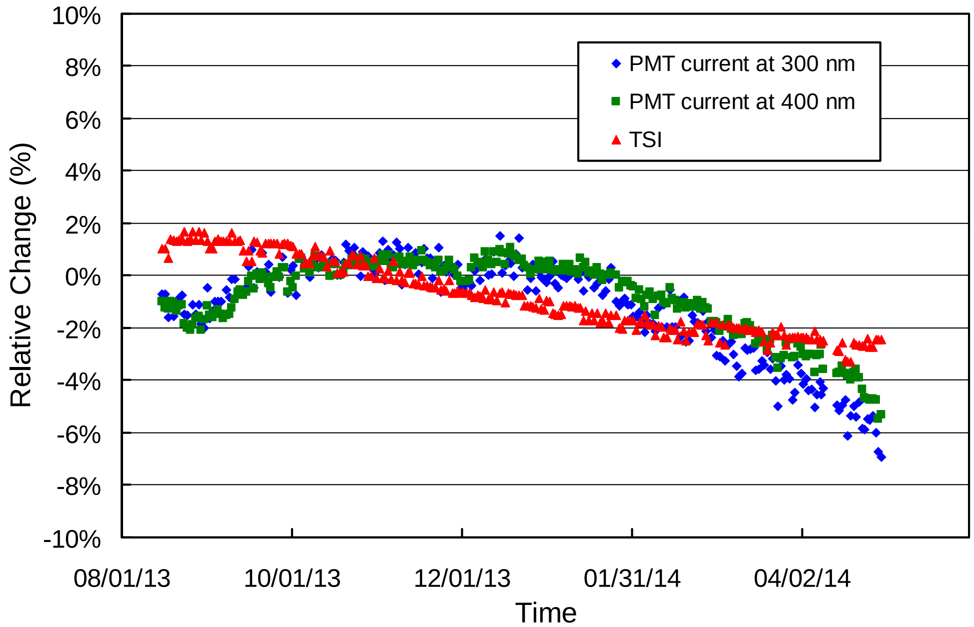

Figure 1. *Measurements of the SUV-100's TSI sensor and PMT currents at 300 and 400 nm. Data are shown as relative change, normalized to the average of all measurements.*

Examination of scans of the on-site standards confirmed that the system was quite stable during the reporting period. Data of the bi-weekly calibration events varied by about ±2% in the UV and ±3% in the visible. Normal calibration procedures were applied, resulting in three calibration periods, labeled P1 - P3 (Table 1). Figure 2 shows the ratios of irradiance spectra assigned to the internal reference lamp during periods P2 and P3, relative to Period P1. Changes from period to period are smaller than 2%.

Figure 3 shows the ratio of measurements of the GUV-511 radiometer (340 nm channel) – which is installed next to the SUV-100 system – and final SUV-100 measurements. The latter were weighted with the spectral response function of the GUV's channel. The ratio is normalized and should ideally be one. The graph indicates that GUV and SUV measurements are consistent to within about ±5%; the standard deviation of the ratio is 2.6%. Times when the calibration changed are indicated by vertical lines. The outliers indicates that the SUV-100 collector was likely covered by snow for the following times: 11/1/13 19:00 – 11/02/13 00:30, 11/09/13 07:45 – 23:00, 02/01/14 11:45 – 14:45, and 03/20/14 06:45 – 08:00. The affected periods were flagged in the Version 2 data set.

Table 1: Calibration periods for McMurdo Volume 23 SUV-100 data.

Period name	Period range
P1	08/15/13 - 09/16/13
P2	09/17/13 - 02/11/14
P3	02/12/14 - 04/30/14

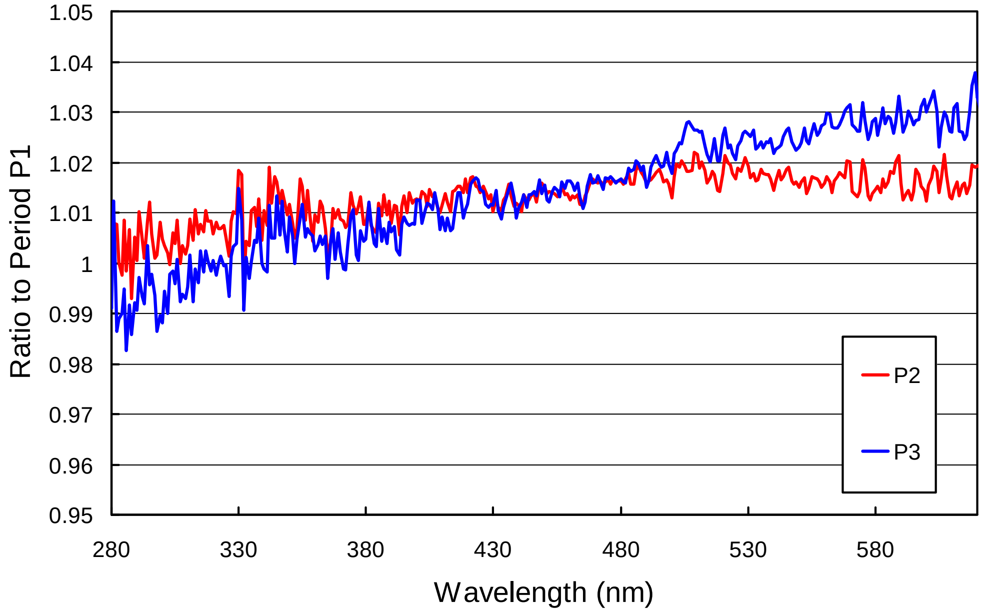

Figure 2. *Ratios of spectral irradiance assigned to the internal reference lamp during periods P2 and P3, relative to Period P1. Changes from period to period are smaller than 2%.*

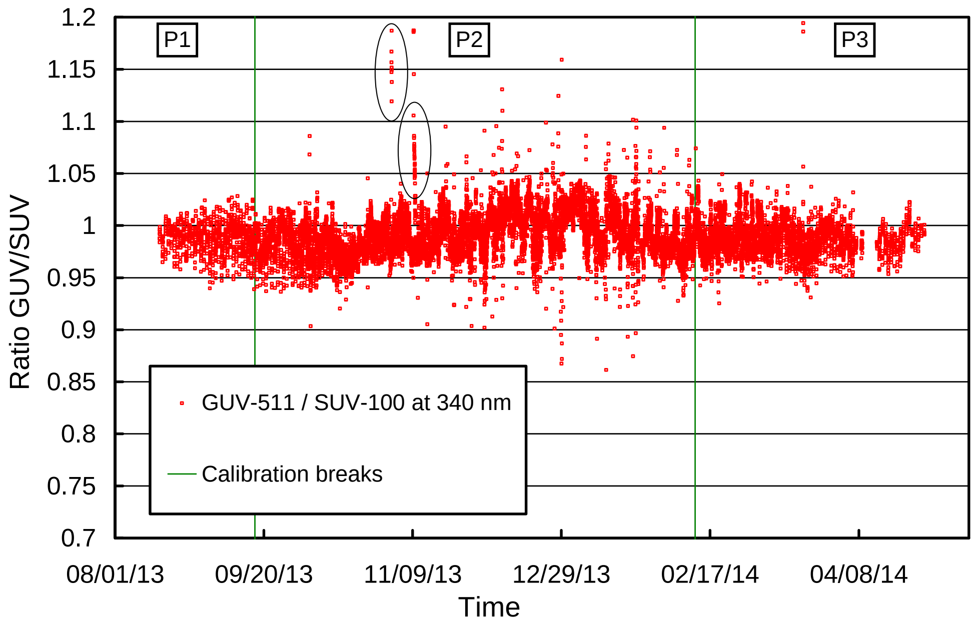

Figure 3. *Ratio of GUV-511 (340 nm channel) and SUV-100 measurements. Green vertical lines indicate times when the SUV-100 calibration was changed. Circles indicate times when the ratio of GUV and SUV measurements was abnormally large, likely due to snow accumulation on the SUV collector. The affected scans were marked in the Version 2 data set.*

As part of Version 2 processing, clear-sky measurements are routinely compared against results of a radiative transfer model (e.g., Bernhard et al., 2004). The median of measurement/model ratios, calculated from all clear-sky data of a given volume, is typically constant to within ±2% from volume to volume.

Figure 4 show these “median ratios” for Volumes 17 – 23. It can be seen that the ratio of Volume 23 data is consistent with those of the earlier Volumes.

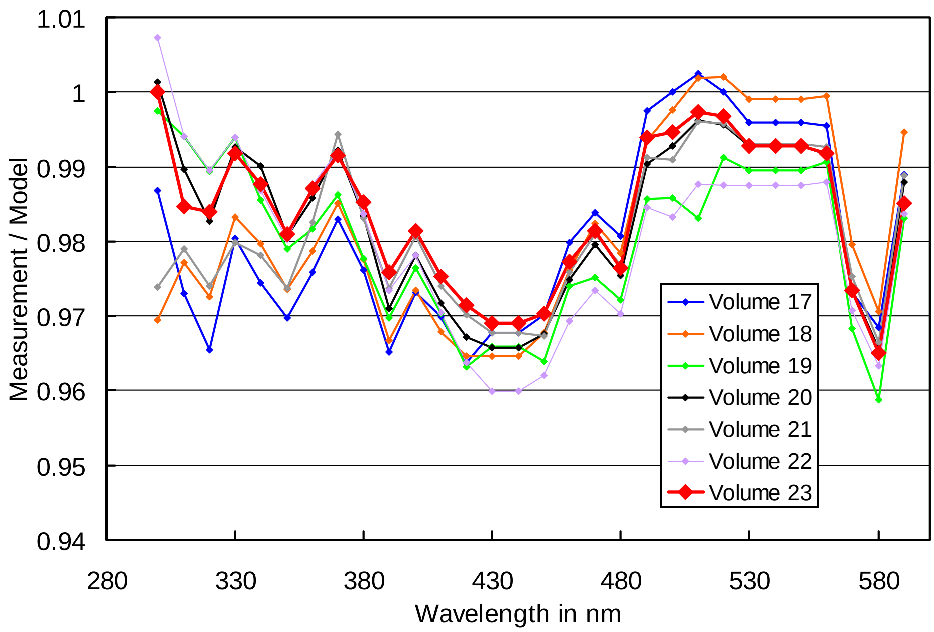

Figure 4. *Median measurement/model ratios calculated from clear-sky solar measurements for data of Volumes 17 – 23. Ratios were averaged over 10 nm intervals (305-315, 315-325, … 585-595 nm) before the median was calculated. There is a systematic, wavelength-dependent bias between measurement and model, however, this bias is generally to within ±1% for the seven volumes, confirming that the irradiance scale used for processing of Volume 23 data is consistent with that used for earlier volumes.*

1.3. Wavelength Calibration

Wavelength stability of the system was monitored with the internal mercury lamp. Information from the daily wavelength scans was used to homogenize the data set by correcting day-to-day fluctuations in the wavelength offset. The wavelength-dependent bias of this homogenized dataset and the correct wavelength scale was determined with the Version 2 Fraunhofer-line correlation method (Bernhard et al., 2004). Figure 5 shows the correction functions calculated with this algorithm. Separate functions were applied for solar data collected before (labeled Volume 23A) and after (Volume 23B) the date 02/11/14.

Figure 6 indicates the wavelength accuracy of final Version 0 data for six wavelengths in the UV and visible that was established by running the Version 2 Fraunhofer-line correlation method a second time. Shifts are typically smaller than ±0.05 nm. The wavelength correction was not modified when processing Version 2 data, which consequently have the same wavelength uncertainty of 0.02 nm (1σ) as Version 0 data.

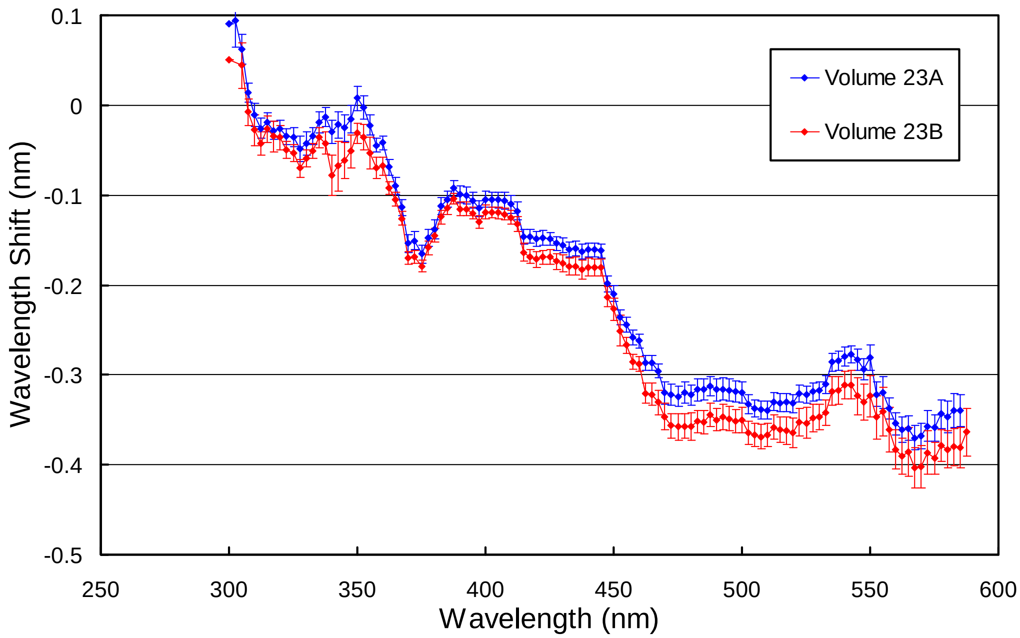

Figure 5. Monochromator non-linearity correction functions for the Volume 23 period. Error bars indicate the 1σ-variation. The function labeled "Volume 23A" was applied to solar data of the period 6/22/13 – 2/10/14 and the function labeled "Volume 22B" was applied solar data of the period 2/11/14 – 6/21/14.

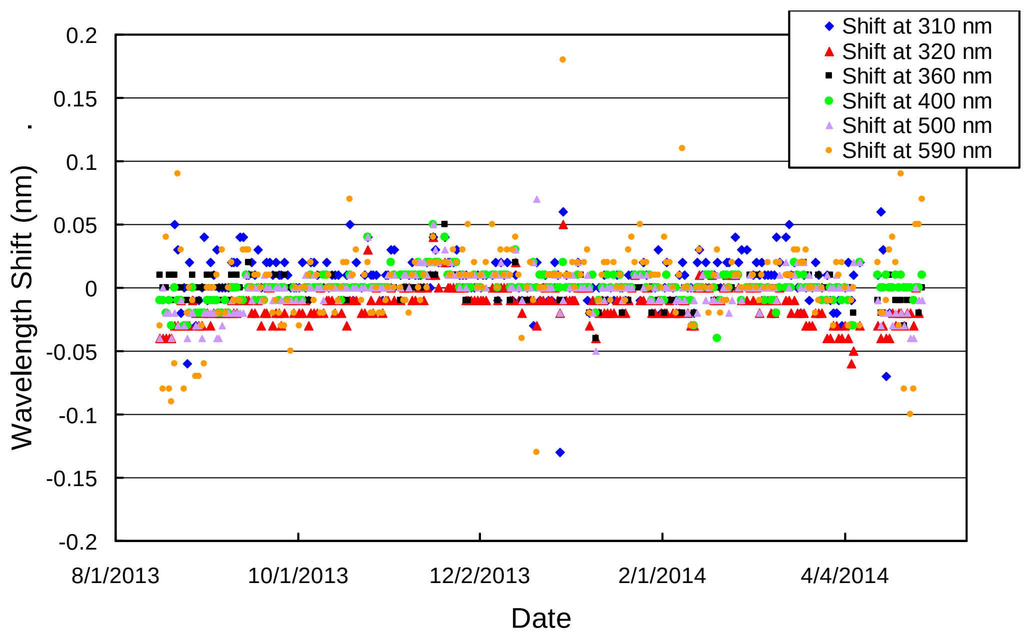

Figure 6. *Check of the wavelength accuracy of final Version 0 data at six wavelengths by means of Fraunhofer-line correlation. The plot is based on daily measurements at noon.*

References

Bernhard, G., C. R. Booth, and J. C. Ehramjian. (2004). Version 2 data of the National Science Foundation's Ultraviolet Radiation Monitoring Network: South Pole, *J. Geophys. Res., 109,* D21207, doi:10.1029/2004JD004937.