2. Palmer Station (01/01/12 – 12/31/13)

This sections describes quality control of solar data recorded at Palmer Station between 01/01/12 and 12/31/13. The system was inspected and serviced in May 2013. At this time, on-site standards of spectral irradiance were compared with traveling standards. The internal reference lamp that was installed during the site visit was not stable and daily "response" scans of the lamp performed between 5/21/13 and 8/23/13 could not be used for processing of solar data. An alternative calibration method was devised for this period. All other system components performed normal during the reporting period and the system was overall very stable. The period resulted in a total of 38317 solar scans.

2.1. Irradiance Calibration

<u>On-site standards</u>
The on-site irradiance standards for the reporting period were the lamps 200W007, M-700, and M-765. The calibration of lamp 200W007 had been established against the traveling standards 200W017 and 200W038 using absolute scans performed on 5/10/08 ("closing scans" of the Volume 17 period). Lamp M-700 had been calibrated against lamp 200W007 using scans performed on 9/22/08. Lamp M-765 was rotated in its holder sometime between 6/6/11 and 7/4/11 (see Volume 20 report). Lamp M-765 was recalibrated using measurements of the other two site standards on 12/17/11, and this calibration was used for processing of solar data of the reporting period.

<u>Traveling standard</u>
The traveling standards used during the site visit in May 2013 were the lamp 200WN003 and 200WN004. Both lamps had been calibrated at NOAA on 3/21/13 against lamps 200WN001 and 200WN002. 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 standard were compared with the two traveling standards at the beginning and end of the site visit. Figure 1 show the comparison for data collected at the beginning of site visit, referenced against the travelling standard 200WN003. At this time, the calibrations of all lamps agreed to within ±1.0%, although there is a bias in the calibration of the two traveling standards in the order of 1.0 %. Results obtained from the scans at the end of the site visit were similar. Overall, the result is very good considering that the five lamps are not traceable to the same calibration source.

To confirm the irradiance scale of solar measurements of the SUV-100 spectroradiometer of the reporting period, the GUV-511 radiometer that is collocated with the SUV was vicariously calibrated against SUV measurements. The calibration factors that were calculated with this method were compared with similar calibration factors established during previous years. The analysis showed that calibration factors of the years 2006 - 2013 are in agreement at the ±1% level. This result confirms the excellent consistency of SUV calibrations.

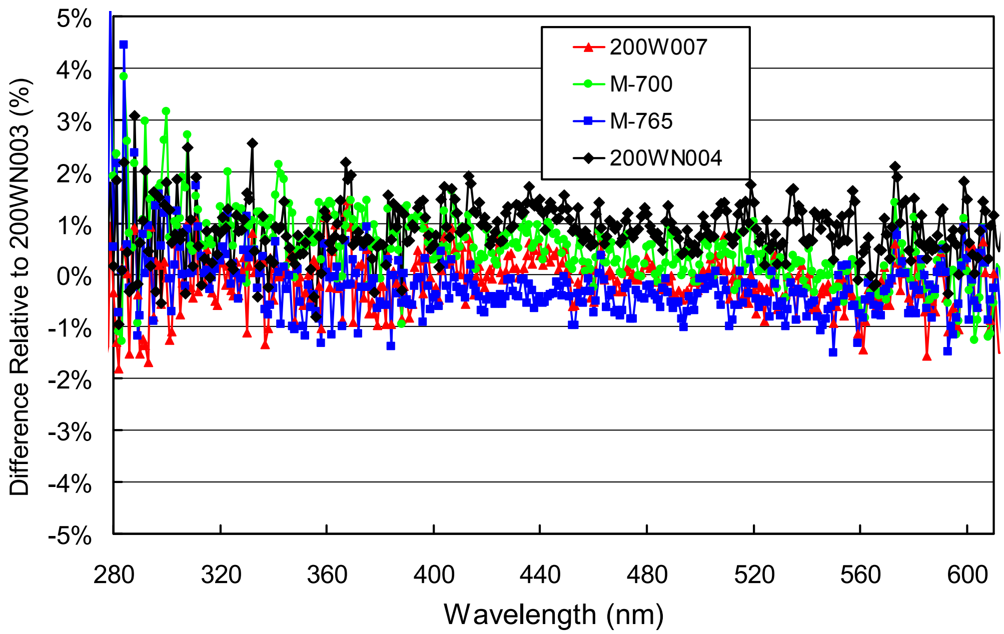

Figure 1. *Comparison the calibration of lamps 200W007, M-700, M-765, and 200WN004 with traveling standard 200WN003 at the beginning of the site visit in May 2013.*

2.2. Instrument Stability

The radiometric stability of the SUV-100 spectroradiometer was monitored with calibrations utilizing the three site irradiance standards, daily "response" scans of the internal lamp, by comparison with measurements of the collocated GUV-511 multifilter radiometer, and by comparisons with results of a radiative transfer model. Figure 2 shows the ratio of GUV-511 (340 nm channel) and final SUV-100 measurements, which were weighted with the spectral response function of this channel. The ratio is normalized and should ideally be one. The graph indicates that GUV and SUV measurements are consistent to within ±3.3% (±1σ), with the exception of short periods when the ratio is abnormally high. These high values occurred in the winter of 2013 (May -August 2013) when snow was presumably covering the diffuser of the SUV-100 spectroradiometer for short times. These periods were also affected by heavy cloud cover. Table 1 provides a listing of the periods affected. Associated scans were flagged in the Version 2 data edition.

Table 1. Periods with abnormally high ratios of GUV/SUV, indicating snow on the SUV collector.

Period	Ratio GUV / SUV
06/02/13 14:15 - 15:00	1.12
06/07/13 17:00 - 18:00	1.10 -1.21
06/08/13 14:30 - 17:00	1.12
07/06/13 14:30 - 16:45	1.13
07/07/13 15:45 - 17:15	1.15 - 1.20
07/21/13 14:00 - 14:15 and 16:45 - 17:45	1.10 -1.20
07/28/13 15:45 - 19:15	1.30 - 1.45
08/07/13 15:45 - 18:00	1.30 - 1.40
08/11/13 16:00 - 20:00	1.20 - 1.28
08/12/13 12:45 - 20:00	1.08 - 1.16

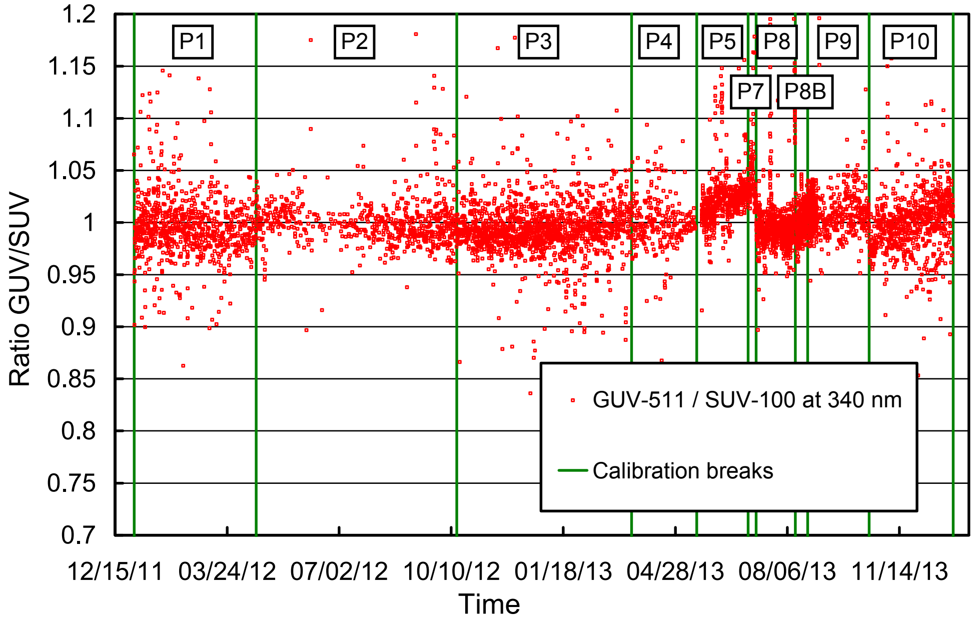

Figure 2. *Ratio of GUV-511 measurements at 340 nm with final SUV-100 measurements. The latter were weighted with the spectral response function of the GUV-511 340 nm channel.*

The reporting period was divided into four calibration periods before the site visit (periods P1 - P4) and six periods after the site visit (Periods P5 - P10). Figure 2 shows ratios of the calibration functions applied during Periods P2, P3, and P4 relative to the function of Period P1. Relative drifts during this period were smaller than 2%, indicating excellent system stability. Because of the large (> 60%) fluctuations in the output of the internal lamp that was installed during the site visit, scans of the lamp could not be used for the calibration of solar data. Instead, calibrations were based on absolute scans with the external 200-W lamps and it was assumed that monochromator and PMT were stable between the calibration events. A new internal lamp was installed on 8/23/13 and normal processing procedures resumed from this day onward.

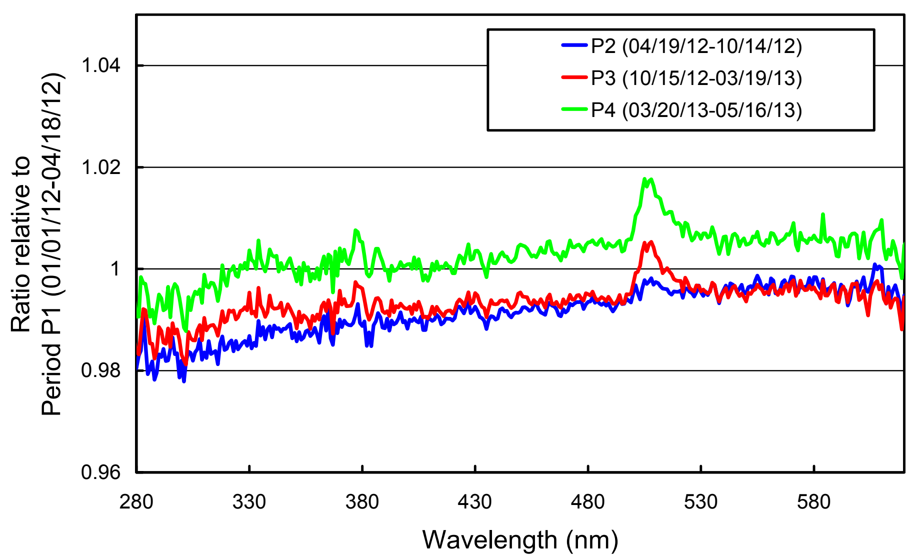

Figure 3. *Ratios of spectral irradiance assigned to the internal reference lamp for periods P2, P3, and P4 relative to Period P1.*

2.3. 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 4 shows the correction functions calculated with this algorithm for data collected before the site visit (red) and thereafter (blue). Figure 5 indicates the wavelength accuracy of final Version 0 data for five wavelengths in the UV and visible by running the Version 2 Fraunhofer-line correlation method a second time. Shifts are typically smaller than ±0.1 nm. (The average standard deviation for the wavelength range 305-400 nm is 0.034 nm). The wavelength accuracy was further improved as part of the production of Version 2 data. For example, the small step change between 6/28/12 and 6/29/12 was removed.

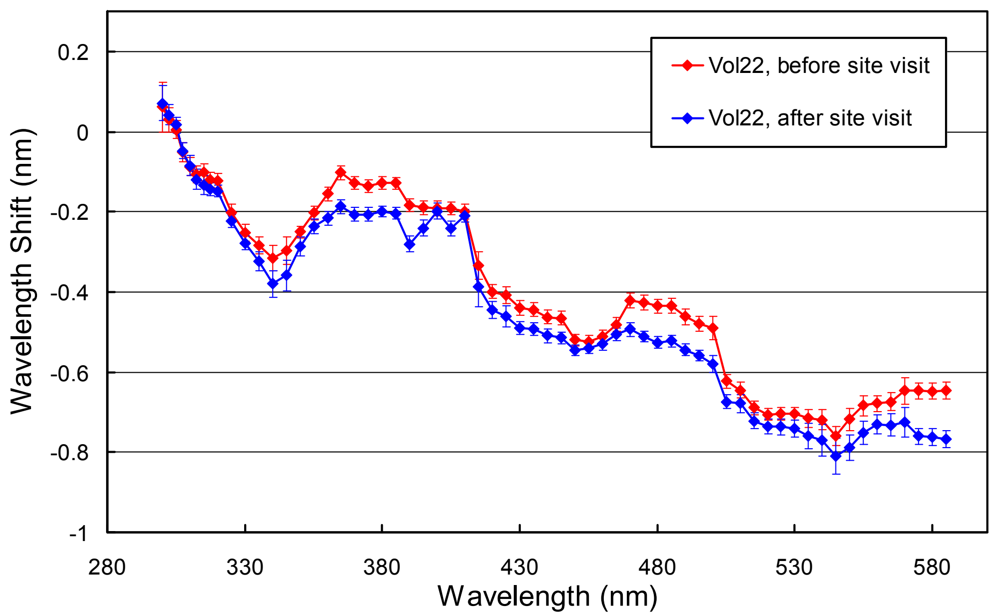

Figure 4. *Monochromator mapping function.*

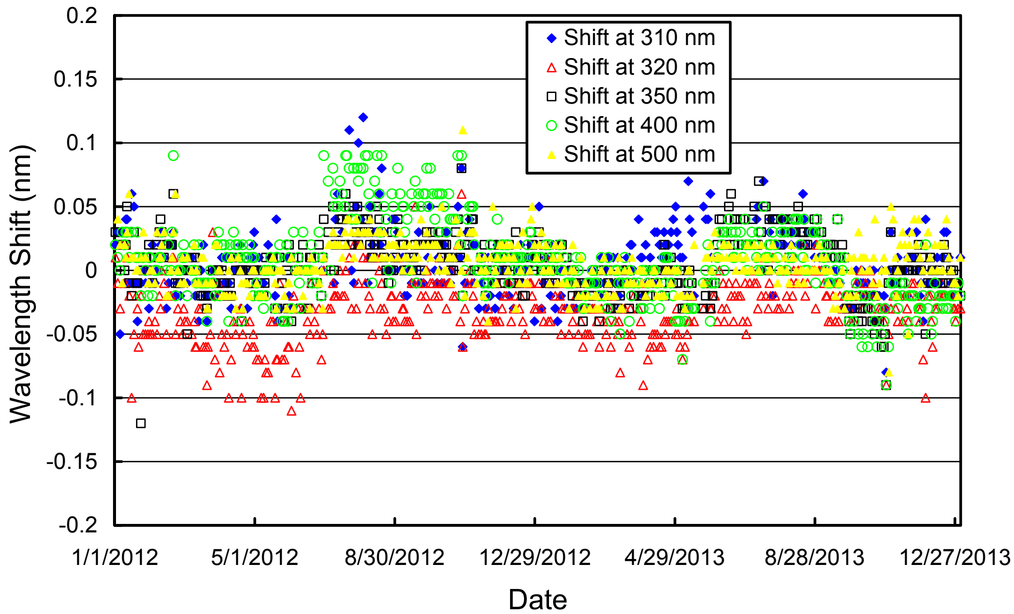

Figure 5. *Wavelength accuracy check of the final data at five wavelengths by means of Fraunhofer-line correlation. Noontime measurements from every day of the year have been evaluated.*

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.