3. Amundsen-Scott South Pole Station (9/14/16–3/29/17)

The 2016–2017 data season at Amundsen-Scott South Pole Station is from 9/14/16 to 3/29/17. There was no site visit during this period. Operation was affected by the failure of the mercury lamp's power supply on 12/2/16. The power supply was replaced with the on-site spare on 12/6/16. The new power supply failed on 1/15/17 and the systems was switched off to prevent further damage. On 2/7/17, the spare power supply from the system at McMurdo Station was installed and the wavelength setting of the system was re-established. Because the root cause of the power supplies' failures could not be determined, it was decided to operate the system without daily scans of the mercury lamp. The correct wavelength assignment of published data was verified with a Fraunhofer line correlation method. There are no solar data from the SUV-100 for period 1/16/17 to 2/6/17 because of this problem.

A total of 15,507 SUV-100 spectra were assigned to Volume 26.

Like for the previous two seasons, measurements of the 320 nm channel of the GUV-541 radiometer (S/N 29239) that is installed next to the SUV-100 spectroradiometer drifted greatly. GUV data products had to be produced without utilizing measurements of this channel. A comparison of calibrated GUV and SUV data indicates that the quality of GUV data products is only marginally affected by the omission of the 320 nm channel. Solar data of the GUV are therefore part of the published datasets.

The system's Eppley PSP pyranometer that was installed during the reporting period had the serial number 27228F3. The calibration constant of this instrument is 8.377 10^{-6} V/(W/m^2). Readings of the Eppley TUVR UV-A sensor were erratic between 12/11/16 and 1/15/17 and data of this period were not published.

3.1. Irradiance Calibration

The on-site irradiance standards used for calibrating the SUV-100 spectroradiometer during the reporting period were the lamps M-666, 200W021, 200W013, 200WN005 and 200WN006. The spectral irradiances assigned to these lamps during the 2016–2017 season were identical to those applied during the previous two season (2014–2015 and 2015–2016). The relevant traveling standard for the reporting period is lamp 200WN014, although the lamp was not used.

<u>History of on-site standards</u>
Lamps M-666 and 200W021 have been in service for a long time. Lamp M-666 was originally calibrated against lamps 200W006 and 200W021 using season closing scans of the Volume 9 and opening scans of the Volume 10 periods. Comparisons of lamp M-666 with lamps 200W021, 200W013, 200WN003 and 200WN004 performed during the site visit in January 2013 indicated a systematic bias of lamp M-666 with respect to the four other lamps of about 2% in the UV-B, decreasing to 0% at 600 nm. Lamp M-666 was recalibrated against lamp 200W021 using scans performed during the January 2013 site visit, and this calibration was also used for this reporting period.

The original calibration of lamp 200W021 was established by Optronic Laboratories in September 1998. Lamp 200W013 was introduced in January 2008 and had been calibrated against the former traveling standard M-763 using closing scans of the Volume 17 period. Comparisons with lamps 200WN003, 200WN004, and M-666 during the January 2015 site visit indicated that the calibrations of lamps 200W021 and 200W013 have drifted. Both lamps were recalibrated against the scale of irradiance of lamp 200WN004, which was the traveling standard at the time, using data collected at the start of the site visit in January 2015.

Lamps 200WN005 and 200WN006 were left at the South Pole in March 2014. Both lamps are designated long-term standard and are typically only used during site visits. Both lamps were calibrated by CUCF in August 2013 with the same method as that applied to the former traveling standard 200WN004 (see below).

Traveling standard

The traveling standard 200WN014 has been calibrated by NOAA/CUCF against lamps 200WN001 and 200WN002 on 1/13/16. Lamps 200WN001 and 200WN002 had in turn been calibrated by Biospherical Instruments 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 lamps 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 the SUV-100 instrument at the South Pole did not result in a significant step-change.

Figure 3.1 shows a comparison of all lamps that were used during the reporting period. The plot is based on scans performed on 9/13/2016. The calibrations of lamps 200W021, M-666, and 200W013 agree with each other to within ±0.5%. However, there is a difference of about 2% between the scale of irradiance of these three lamps and the scale of the long-term standard 200WN005. A similar offset was also observed when comparing the lamps during the site visit in January 2016 (see Volume 25 report). At this time, the three "regular" lamps agreed with the traveling standard 200WN014 to better than 1% on average. The ~2% offset between the "regular" lamps and the long-term standard 200WN005 has not changed since lamp 200WN005 was introduced, indicating that the scale of irradiance applied to solar data of the 2016-2017 season is consistent to within 0.5% to that used during the previous season.

Lamps M-666, 200W013, and 200W021 were also compared with each other on 3/27/17. Results agreed to within ±1%.

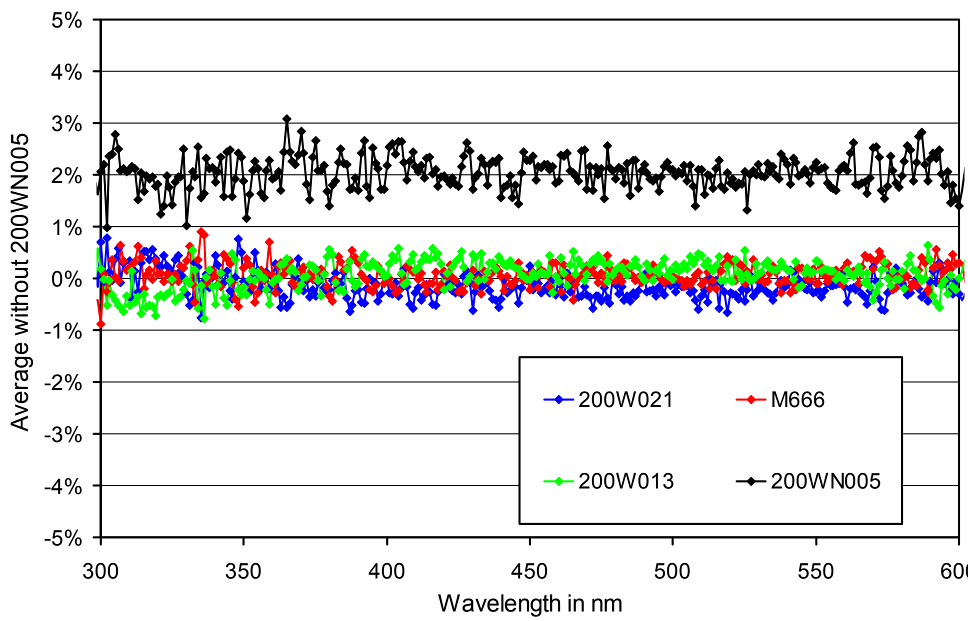

Figure 3.1. *Comparison of South Pole lamps M-666, 200W021, 200W013, and 200WN005 on 9/13/2016.*

The GUV-541 radiometers was calibrated vicariously against SUV-100 data. Calibration factors of all GUV channels with exception of the drifting 320 nm channel agreed to within ±2% with similar factors established during the previous four years (2012 – 2015), confirming the good consistency of calibrations over time.

3.2. Instrument Stability

The stability of the SUV-100 spectroradiometer within the reporting period was assessed by comparison with data of the collocated GUV-541 radiometer and model calculations that are part of "Version 2" data edition. Figures 3.2 shows the ratio of GUV-541 (340 nm channel) and final SUV-100 measurements. The latter were weighted with the spectral response function of the GUV's 340 nm channel. The ratio was normalized and should ideally be equal to one. The graphs indicates that GUV and SUV measurements are generally consistent to within ±5%. Most outliers can be explained by shading from obstacles (e.g. air sampling masts) that are in the field of view of the instruments. Because GUV and SUV radiometers are not positioned at exactly the same location, the shadow from these obstacles falls on the collectors of the two instruments at different times. Scans affected by shadowing from stacks were flagged in the SUV-100 Version 2 dataset and removed from the GUV dataset.

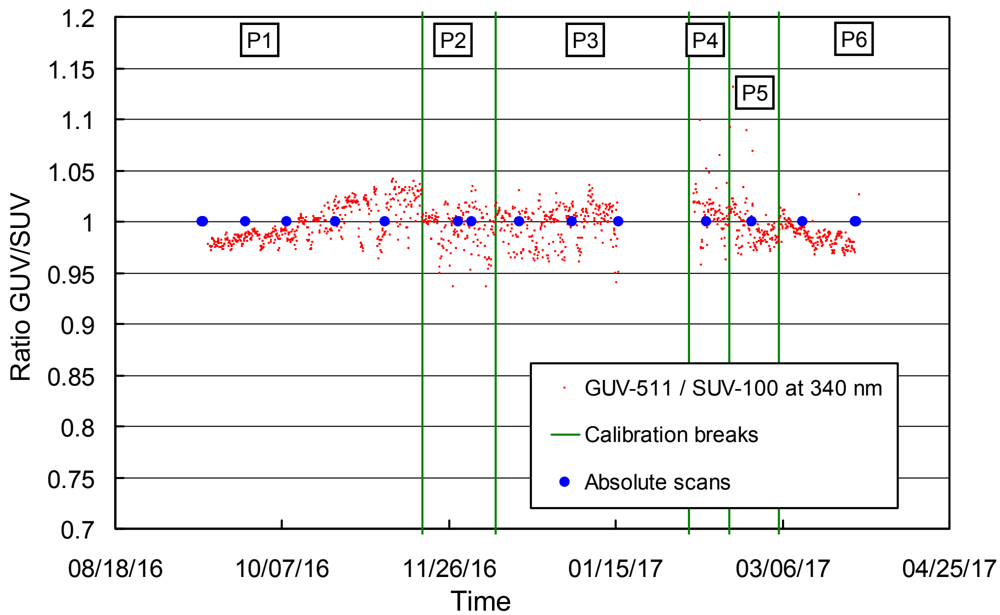

Figure 3.2. *Ratio of GUV-541 S/N 29239 measurements (340 nm channel) with SUV-100 measurements. SUV-100 data were weighted with the spectral response function of this GUV channel. The vertical green lines indicate times when the calibration applied to SUV-100 data was changed (see also Table 3.1).*

Six calibration functions were applied to SUV-100 data of the reporting period. Times when the calibration changed are indicated by vertical lines in Figure 3.2. More information on these calibrations is provided in Table 3.1. Figures 3.3 shows ratios of all calibration functions relative to the function of the first period (Period P1). Functions were smoothed to reduce noise. All calibration scans agree to within 3% with the calibration of the first period.

Table 3.1 Calibration periods for South Pole data of Volume 26.

Period	Period range	Number of absolute scans
P1	04/02/16 – 11/17/16	6
P2	11/18/16 – 12/09/16	2
P3	12/10/16 – 01/16/17	3
P4	02/06/17 – 02/17/17	1
P5	02/18/17 – 03/04/17	1
P6	03/05/17 – 04/01/17	1

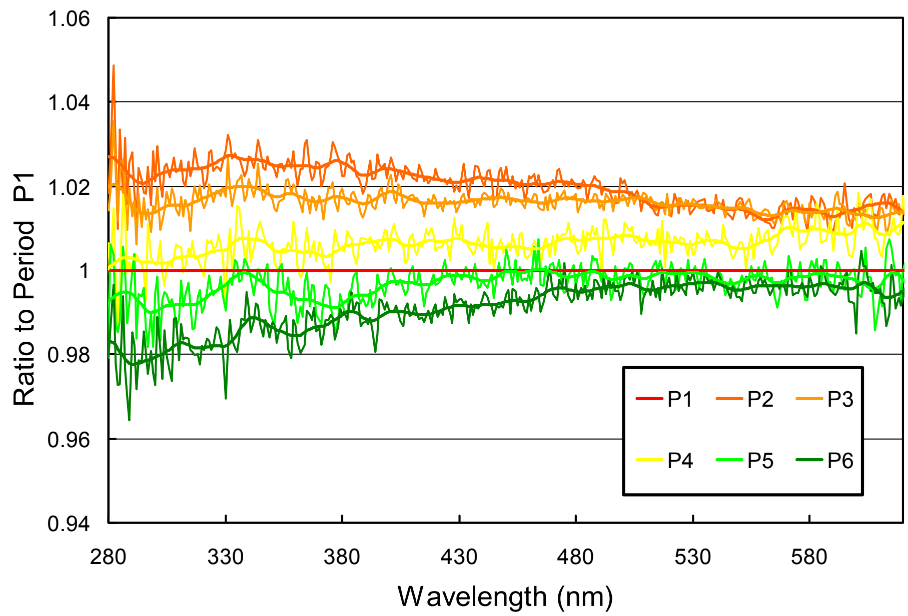

Figure 3.3. *Ratios of spectral irradiance assigned to the internal lamp relative to Period P1 (09/14/16 – 11/17/16). Thick lines indicate the smoothed datasets.*

3.3. Wavelength Calibration

Wavelength stability of the system was monitored with the internal mercury lamp until the lamp's power supply became defective on 1/15/17. 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. Figure 3.4 shows the correction function calculated with this algorithm.

Figure 3.5 indicates the wavelength accuracy of final "Version 0" data for five wavelengths in the UV and visible range. The plot was generated by applying the Version 2 Fraunhofer-line correlation method for a second time. Residual wavelength shifts are typically smaller than ±0.1 nm. The wavelength accuracy was further improved when processing Version 2 data.

3.4. Missing data

There are no SUV-100 data for the period 1/16/17 – 2/6/17 due to the defective power supply of the mercury lamp. There are no other significant data gaps.

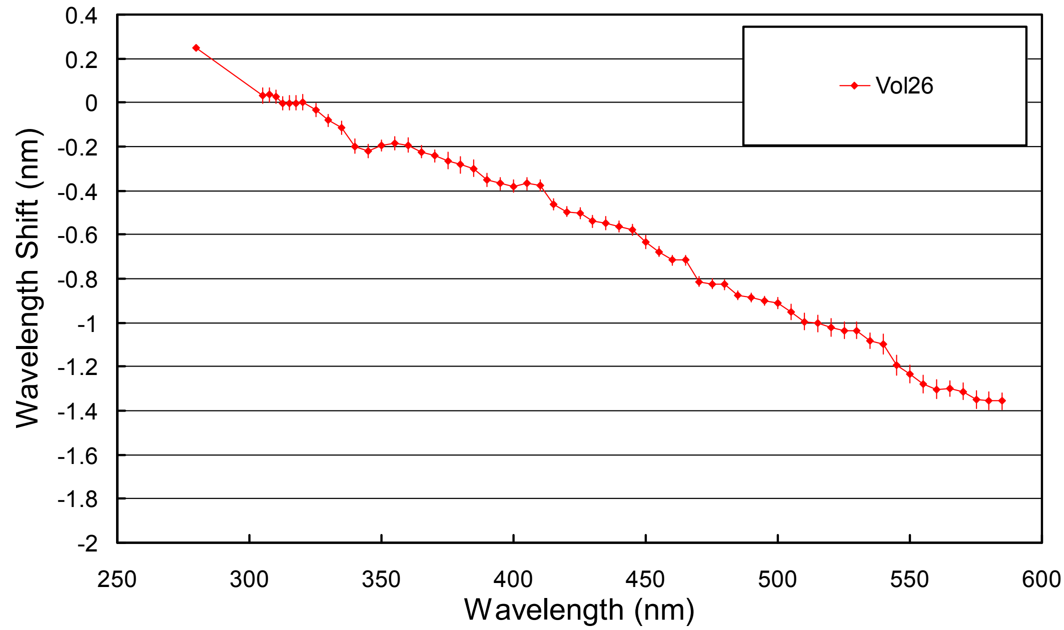

Figure 3.4. *Monochromator non-linearity correction function.*

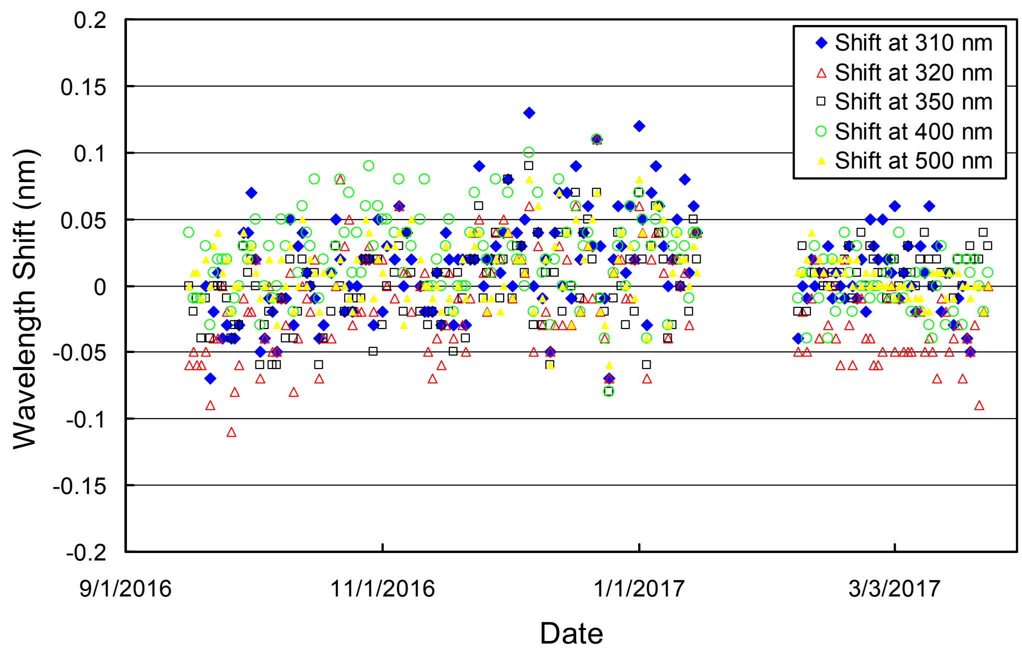

Figure 3.5. *Wavelength accuracy check of Version 0 data at five wavelengths by means of Fraunhofer-line correlation.*