5.3. Amundsen-Scott South Pole Station (9/15/10–3/31/11)

The 2010–2011 season at Amundsen-Scott South Pole Station is from 9/15/10–3/31/11. This is the period of the year when the solar zenith angle is smaller than 93°. The system was serviced at the end of January 2011 by NOAA personnel. At this time, the on-site standards were compared with a travelling standard. 17311 SUV-100 spectra are part of the Volume 20 dataset.

Data processing showed that the 313 nm channel of the GUV-541 radiometer installed next to the SUV-100 was highly unstable during the entire period. Measurements of other channels were stable and were used to quality-control the SUV-100 data. For the low solar elevations prevailing that the South Pole, the 313 nm channel is important to calculate data products with a strong contribution from the UV-B. Calculations without data of this channel will have a large uncertainty. For this reason, we did not produce GUV data products for this season.

5.3.1. Irradiance Calibration

The site irradiance standards used during the 2010/11 season were the lamps M-666, 200W021, and 200W013. Lamp 200W017 was used as traveling standard during the site visit. These standards are the same as those used during the 2009/10 season.

<u>On-site standards</u>
Lamps 200W021 and M-666 have been in service for a long time. The original calibration of lamp 200W021 was established by Optronic Laboratories in September 1998. Lamp M-666 was originally calibrated with lamps 200W006 and 200W021, using season closing scans of Volume 9 and opening scans of Volume 10. Based on comparisons performed during the site visit in January 2006, it was determined that lamps 200W021 and M-666 had drifted by about 2%. New calibration were transferred to the lamp using the traveling standard 200W017 as reference, and these calibrations were also used to process solar data from the 2010/11 season.

Lamp 200W013 was introduced in January 2008. It was calibrated against the traveling standard M-763 using closing scans of the Volume 17 season. Comparisons with the other two on-site standards and the traveling standard in February 2010 suggested that the calibration of the lamp had drifted by about 2%. The lamp was recalibrated against lamp 200W017 using scans performed on 2/4/2010.

<u>Traveling standard</u>
The traveling standard 200W017 has been originally calibrated by Optronic Laboratories in March 2001. It has been recalibrated in June 2007 at BSI against a set of four 1000-W FEL lamps, which in turn had been calibrated by the U.S. Central UV Calibration Facility (CUCF) in Boulder, Colo. This calibration procedure was complicated by the fact that the irradiance scale of the four FEL lamps refers to the detector-based scale of the National Institute of Standards and Technology established in 2000 (NIST2000; Yoon et al., 2002), whereas all solar data of the NSF UVSIMN refer to the source-based NIST scale from 1990 (NIST1990, Walker et al., 1987). The NIST2000 scale is about 1.3% larger than the NIST1990 scale. Data of certificates issued by the CUCF were converted to the NIST1990 scale before the calibration was transferred to 200W017.

Figure 5.3.1 shows a comparison of all lamps performed on 1/27/2011 before start of instrument service. The calibrations of all lamps agree to within ±1.5%. The three site standards were also compared with each other on 9/10/10. At that time, their calibrations agreed to within ±1%. These comparisons suggest that the calibrations applied to solar data of the Volume 20 period are consistent to within ±1.5%.

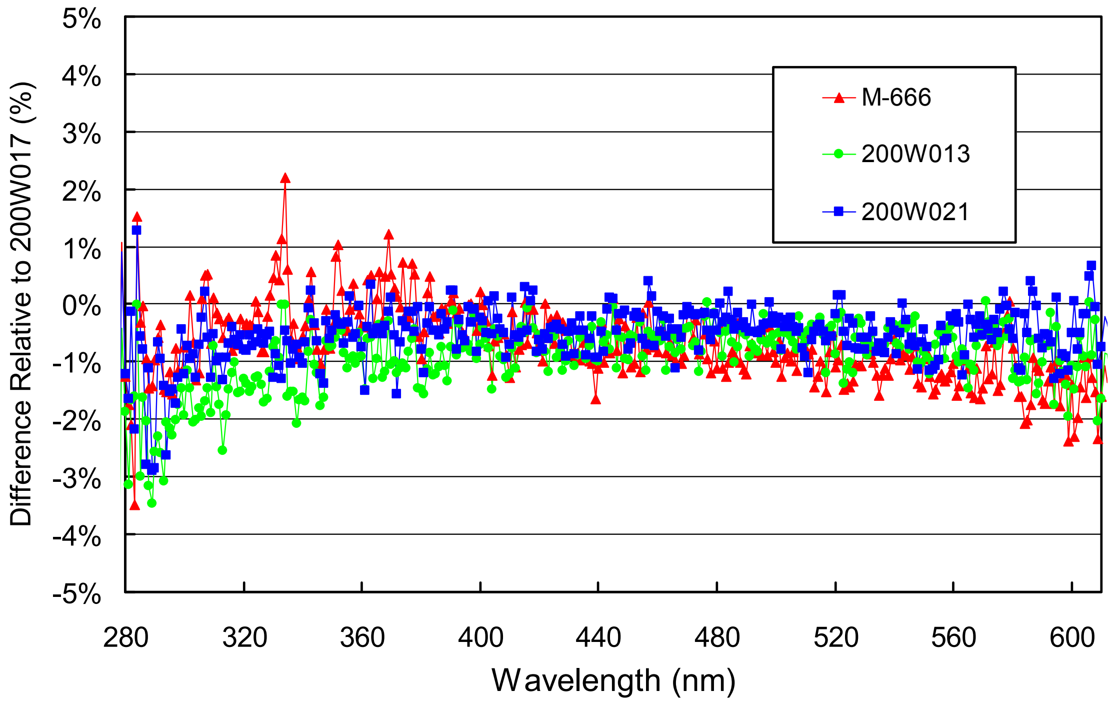

Figure 5.3.1. *Comparison of South Pole lamps M-666, 200W021, and 200W013 with BSI traveling standard 200W017on 1/27/2011.*

5.3.2. Instrument Stability

The stability of the spectroradiometer over time was assessed by comparison with data of the collocated GUV-541 radiometer and model calculations that are part of "Version 2" data processing. Figure 5.3.2 shows the ratio of GUV-541 (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 ±4%.

Four calibrations were applied (P1 – P4) to data of the reporting period. Times when the calibration changed are indicated by vertical lines in Figure 5.3.2. More information on these calibrations is provided in Table 5.3.1. Figure 5.3.3 shows ratios of the calibration functions applied during Periods P2 – P4, relative to the function of Period P1. There is a large change in instrument responsivity between Periods P2 and P3, the periods before and after the site visit. The change is caused by the system service, during which the instrument was dismantled, cleaned, and reassembled.

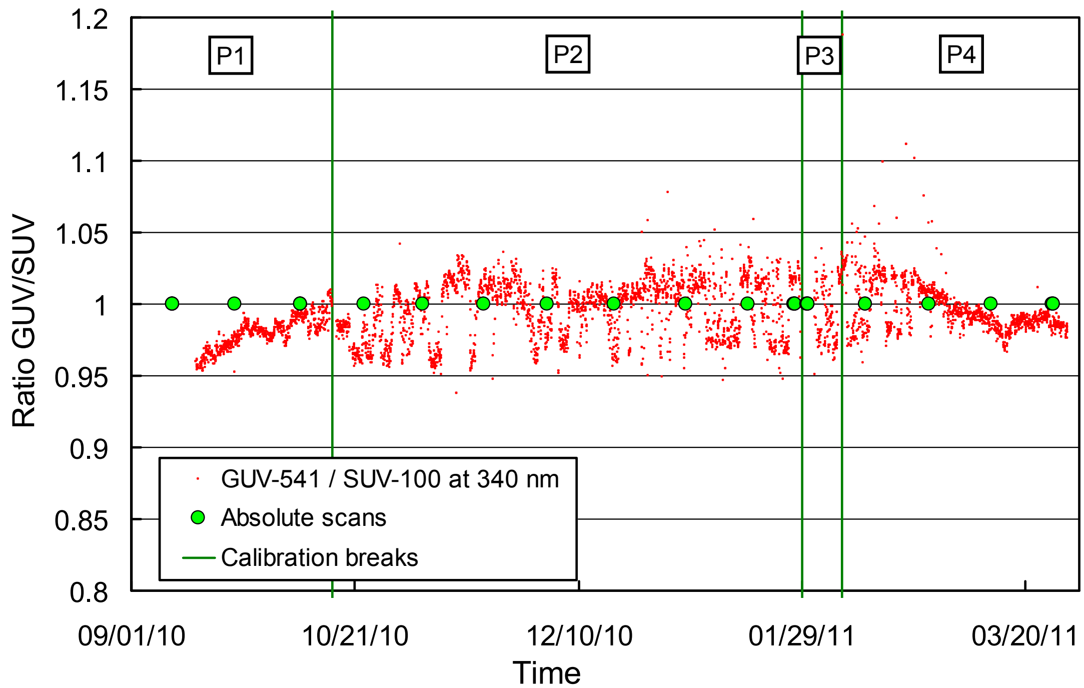

Figure 5.3.2. *Ratio of GUV-541 measurements of its 340 nm channel with final SUV-100 measurements that were weighted with the spectral response function of this channel.*

Table 5.3.1: Calibration periods for South Pole Volume 20 data.

Period name	Period range	Number of Absolute Scans	Remarks
P1	09/15/10 - 10/15/10	5	
P2	10/16/10 - 01/28/11	11	Before site visit
P3	01/29/11 - 02/06/11	4	After site visit
P4	02/07/11 - 03/31/11	6	

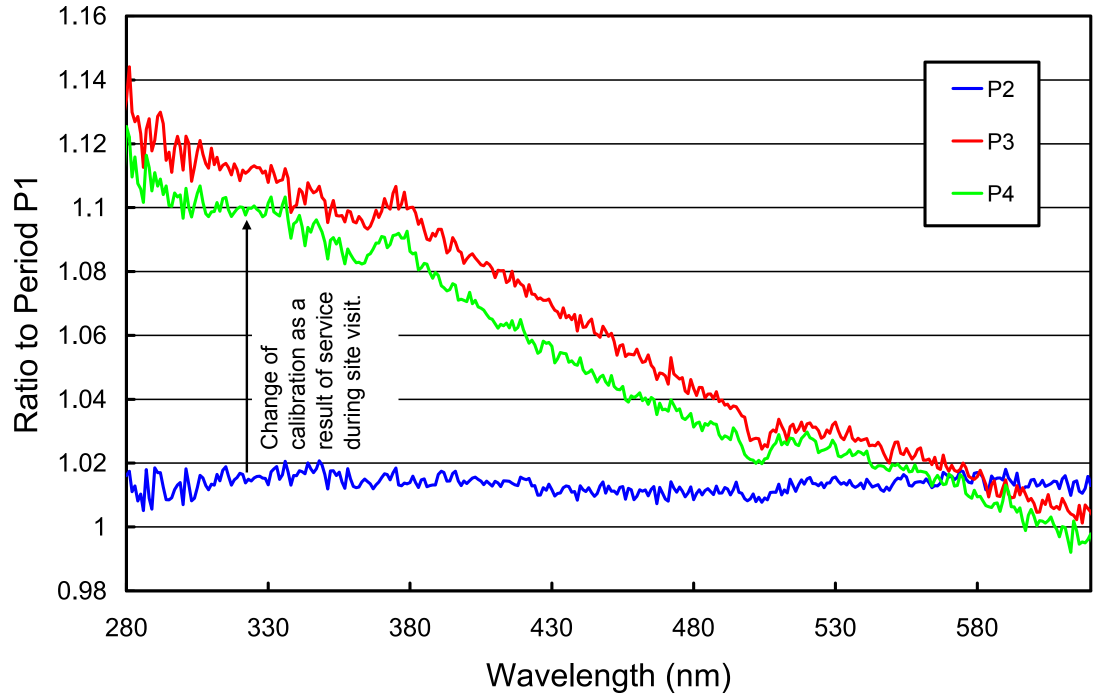

Figure 5.3.3. *Ratios of spectral irradiance assigned to the internal lamp relative to Period P1.*

5.3.3. 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 5.3.4 shows three correction functions calculated with this algorithm from data of the periods 9/15/2010 - 11/22/2010 (Period 1), 11/23/2010 - 01/28/2011 (Period 2), and 01/29/2011 - 05/01/2011 (Period 3). Note that the instrument was serviced between periods 2 and 3.

Figure 5.3.5 indicates the wavelength accuracy of final 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 ±0.05 nm.

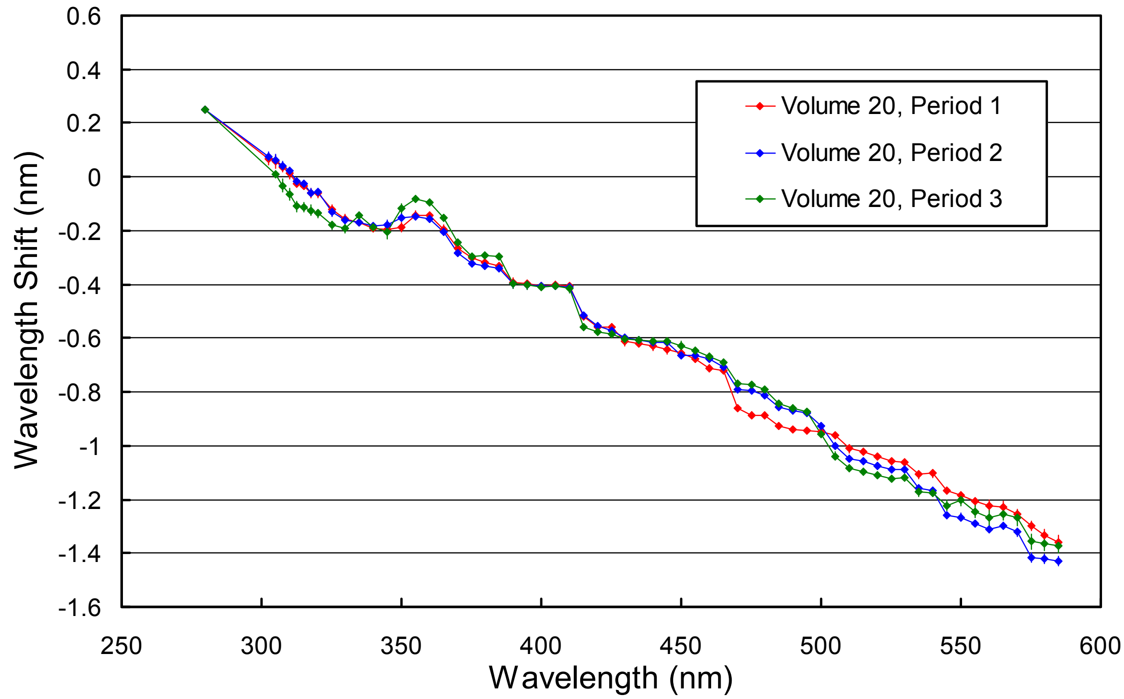

Figure 5.3.4. *Monochromator non-linearity correction functions for the South Pole 2010/11 season.*

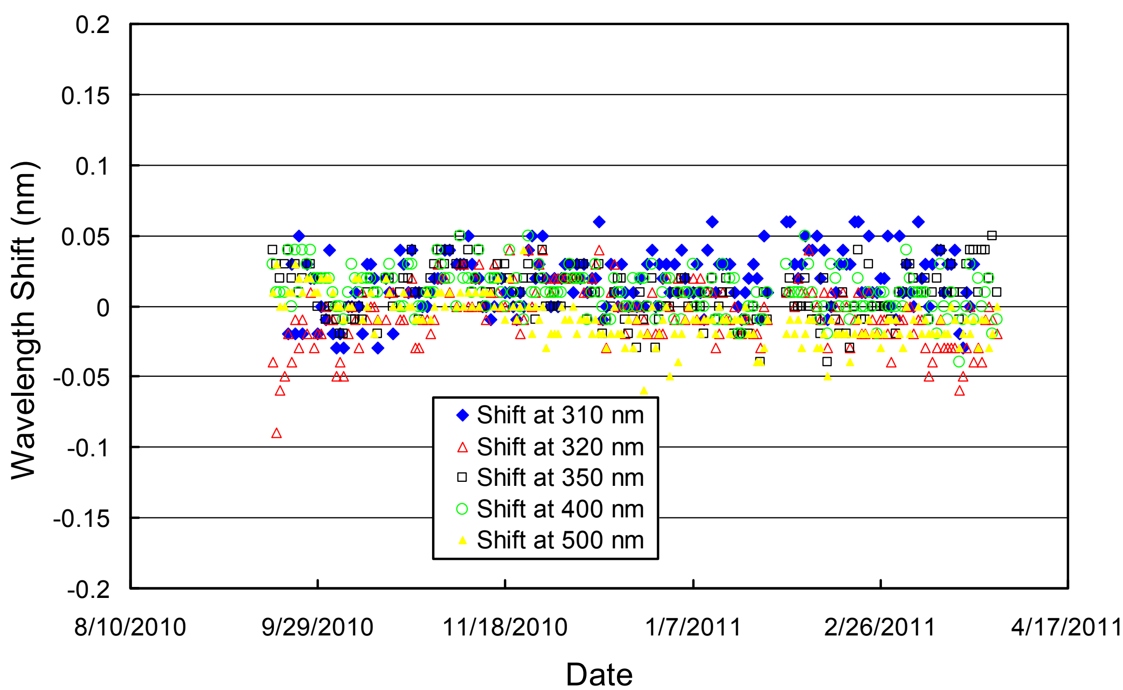

Figure 5.3.5. *Wavelength accuracy check of final data at four wavelengths by means of Fraunhofer-line correlation. Measurement performed at 00:00 UT were evaluated for each day of the season. No data exist during Polar Night.*