5.3. Amundsen-Scott South Pole Station (9/15/09–3/31/10)

The 2009–2010 season at Amundsen-Scott South Pole Station is from 9/15/09–3/31/10. This is the period of the year when the solar zenith angle is smaller than 93°. There were no site visits during this season, however, the three site standards were compared with a traveling standard on 2/4/10. 17523 SUV-100 spectra are part of the Volume 19 dataset.

During several periods of the year, the dark-current of the system's photomultiplier tube (PMT) showed larger-than-usual variations. This led to increased uncertainties of measurements below 305 nm. Affected measurements tend to be high. About 775 scans were affected and were flagged in the Version 2 dataset.

5.3.1. Irradiance Calibration

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

On-site standards
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 2009/10 season.

Lamp 200W013 is a relatively new standard, 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 standards and the traveling standard 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.

Traveling standards
Lamp 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 2/4/2010, using the new calibration of lamp 200W013. The calibrations of all lamps agree to within ±1%. The three site standards were also compared with each other on 3/29/09; their calibrations agreed to within ±1% at this time. These comparisons suggest that the calibrations applied to solar data of the Volume 19 period are consistent to within ±1%.

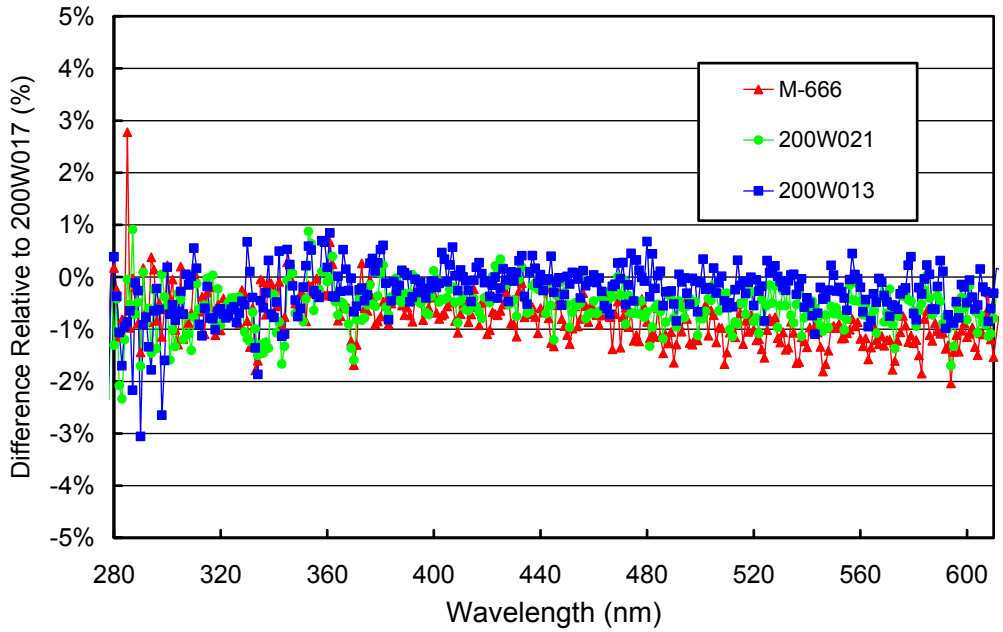

Figure 5.3.1. *Comparison of South Pole lamps M-666, 200W021, and 200W013 with BSI traveling standard 200W017on 2/4/2010.*

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%. The ratio shows an upward trend in 2009 of about 5%, which is likely caused by a change of the SUV-100's angular response. This change may have been caused by moisture freezing at the underside of the instrument's irradiance collector. The drift was corrected during preparation of Version 2 data.

Nine calibrations were applied (P1 – P8) 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 – P8, relative to the function of Period P1.

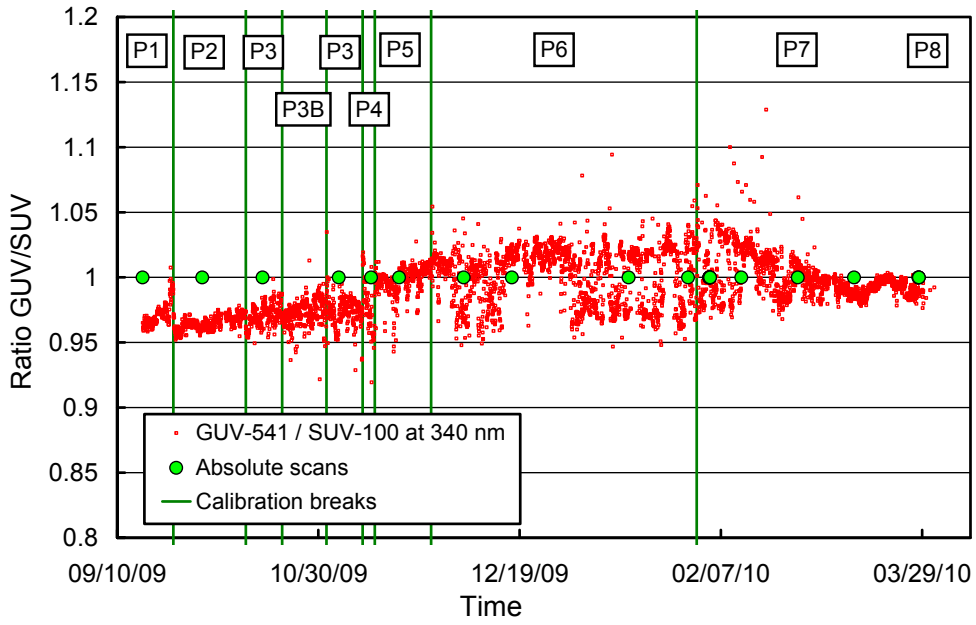

Figure 5.3.2. *Ratio of GUV-541 measurements of its 340 nm channel with final SUV-100 measurements that were weighted with the spectral response function of this channel.*

Table 5.3.1: Calibration periods for South Pole Volume 19 data.

Period name	Period range	Number of Absolute Scans	Remarks
P1	06/21/09 - 09/23/09	1	
P2	09/24/09 - 10/11/09	1	
P3	10/12/09 - 10/20/09 and 11/01/09 - 11/09/09	2	Applied in two periods
P3B	10/21/09 - 10/31/09	0	P3, scaled up by 2.0%
P4	11/10/09 - 11/12/09	1	
P5	11/13/09 - 11/26/09	1	
P6	11/27/09 - 01/31/10	10	
P7	02/01/10 - 03/21/10	3	
P8	03/22/10 - 03/31/10	2	

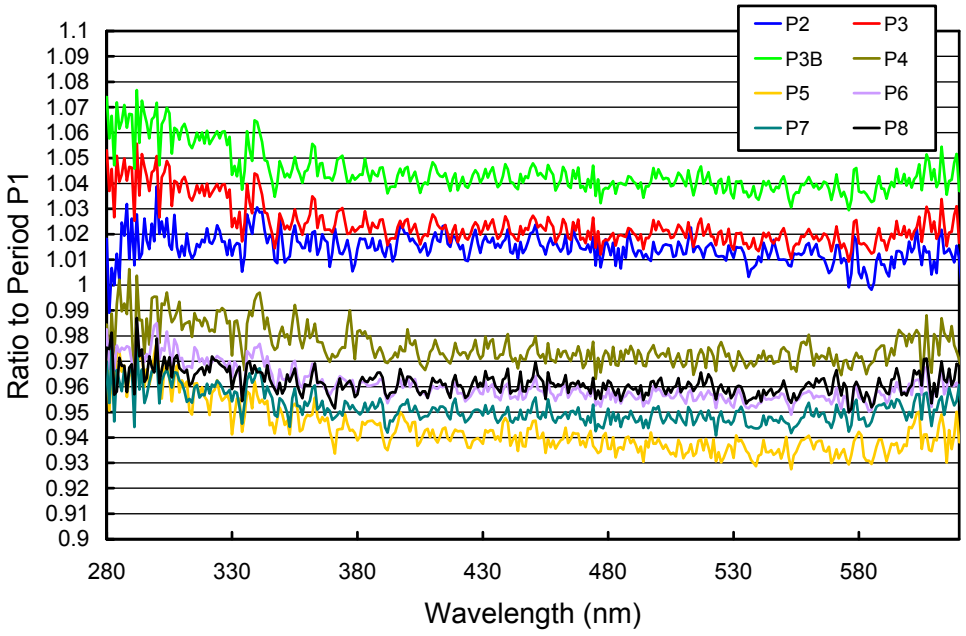

Figure 5.3.3. *Ratios of irradiance assigned to the internal lamp relative to Period P1.*

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 the correction function calculated with this algorithm. Figure 5.3.5 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 ±0.05 nm. Version 2 data have even smaller wavelength errors.

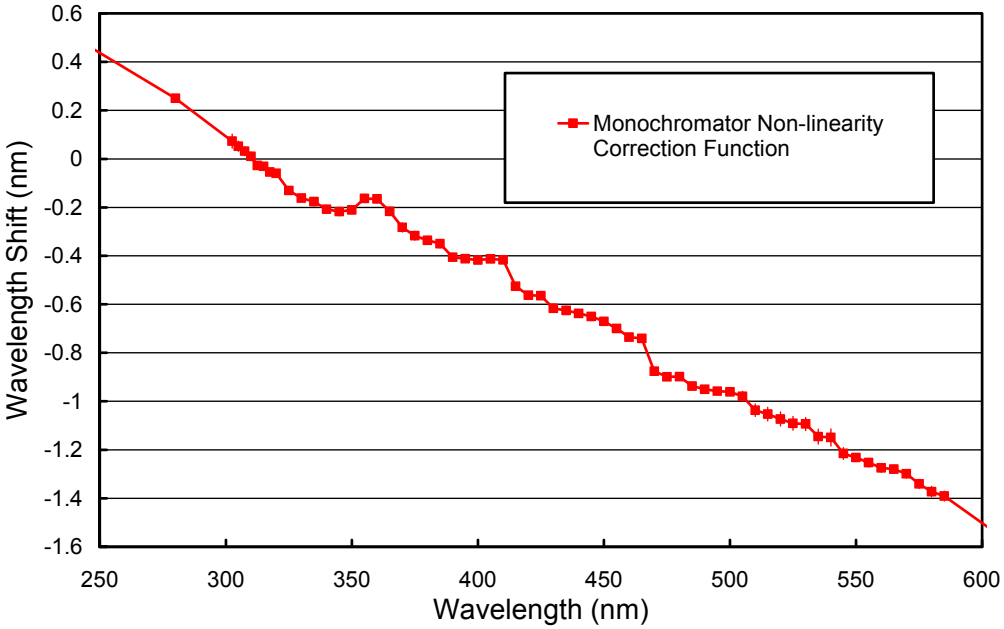

Figure 5.3.8. *Monochromator non-linearity correction function for the South Pole 2009/10 season.*

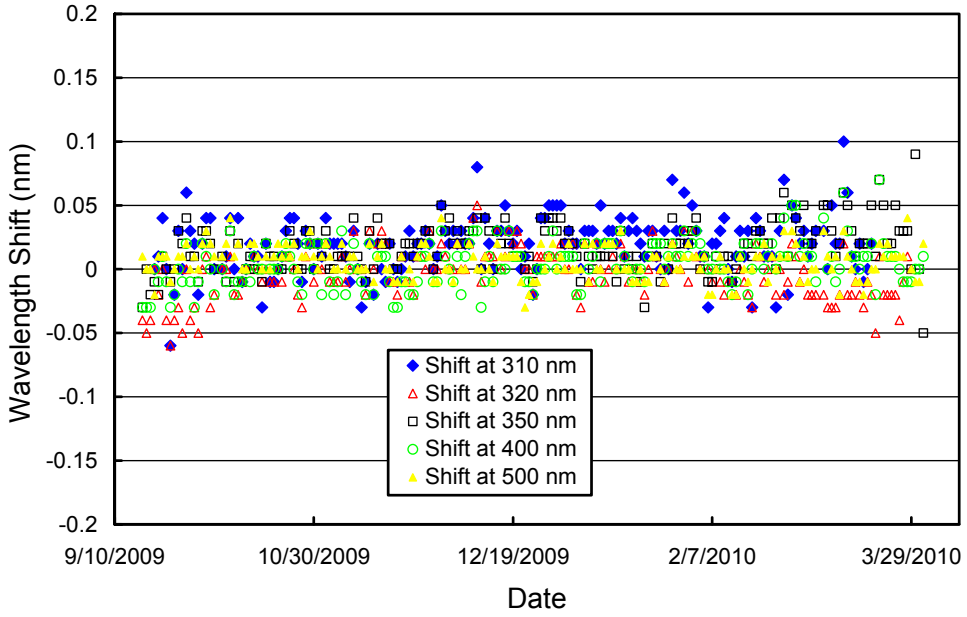

Figure 5.3.9. *Wavelength accuracy check of final data at four wavelengths by means of Fraunhofer-line correlation. Measurement performed at 00:00 UT were evaluated for each day of the season. No data exist during Polar Night.*