1. McMurdo Station (08/13/11 – 04/30/12)

Solar data of the SUV-100 spectroradiometer discussed in this quality control summary report encompass the period 08/13/11 – 04/30/12 and are part of Volume 21. No site visit took place during the reporting period. The system performed normal and was very stable.

The system's PSP radiometer S/N 32760F3 was replaced by PSP S/N 12257F3 on 1/5/2012. PSP S/N 32760F3 was returned to NOAA for recalibration. The calibration factor used for processing data of the period 8/13/11 - 1/5/12 was 7.73 $\times 10^{-6}$ V/(W m^{-2}). The calibration factor used for PSP S/N 12257F3 was 8.62$\times 10^{-6}$ 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. Lamp 200W011 was put into service at McMurdo in January 2008 and at this time calibrated against the traveling standard M-763. It serves as a long-term standard for McMurdo and was only used three times between January 2008 and February 2011. During a site visit in February 2011, the lamp was compared with the traveling standard 200W017. The two lamps agreed to within ±0.5% (Figure 1). (The irradiance scales of the traveling standard 200W017 is traceable to the NIST 1990 scale of irradiance. Additional details are provided in the Volume 20 Quality Control Report.)

Lamps M-543 and 200W019 have been in service for a long time and have been recalibrated several times since their first use. They were recalibrated last against lamps 200W011 and 200W017 using the season closing scans of the 2011 site visit. A comparison of the two lamps with 200W017 is also included in Figure 1.

The three on-site standard were compared with each other again on 5/23/12 shortly after the close of the Volume 21 period. At this time, the calibrations of the three standards were in disagreement by up to 5% (Figure 2). For example, the calibration of lamps 200W011 and M-543 differed by about 3.5% while the calibration of lamps 200W019 and M-543 differed by about 5.0%. Closer inspection revealed that the same bias was present throughout the reporting period. It seems that the calibrations have changed between April 2011 (end of Volume 20 period) and August 2012 (start of Volume 21 period). Since the bias does not have a spectral dependence, it is likely that it originated from mishandling the lamps during the "polar night" of 2011. For example, the lamps could have been inadvertently rotated in their holders or misaligned otherwise. Photographs of the three lamps taken in November 2012 did not corroborate this hypothesis.

It could not be determined which of the three lamps (if any) maintained the calibration of the Volume 20 period. Solar data were arbitrarily calibrated against the calibration scale of lamp 200W011. Absolute scans of lamps 200W019 and M-543 were only used to track and correct changes in instrument responsivity during the reporting period, resulting in three calibration periods (P1 – P3; Table 1).

Solar data processed with this method were found to be biased low by 3.3% compared to data of Volumes 17-20. The bias was independent of wavelength. Hence solar irradiances of the entire period were scaled up by 3.3%. Of note, by scaling the irradiance scale of lamp 200W011 by 3.3%, the scale becomes very similar to that of lamp M-543, suggesting that lamp M-543 remained stable during the polar night of 2011, while the two other lamps have drifted.

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 3 show these "median ratios" for Volumes 17 – 21. It can be seen that the ratio of Volume 21 data (with the scaling factor of 1.033 applied) is very consistent with those of the earlier Volumes.

As a last check to confirm that Volume 21 data were calibrated accurately, calibrated measurements of Volume 20 and 21 for the same day-of- year were directly compared. Such a comparison is only valid for periods that are free of clouds and have similar surface albedo. As an example for a period that meets these conditions, Figure 4 compares spectral irradiance measured on 9/30/10 (Volume 20 data) with similar data from 9/30/11 (Volume 21 data). The surface albedo was 0.85 on both days. (Surface albedo is a Version 2 data product). Figure 5 shows a similar example for 9-November. The albedo on this day was 0.8 in both years. In both examples, the datasets of 2010 and 2011 agree to within ±1.5%.

The comparison with the model and the direct comparison of data from Volumes 20 and 21 confirms that the calibration of Volume 21solar data is consistent with historical data.

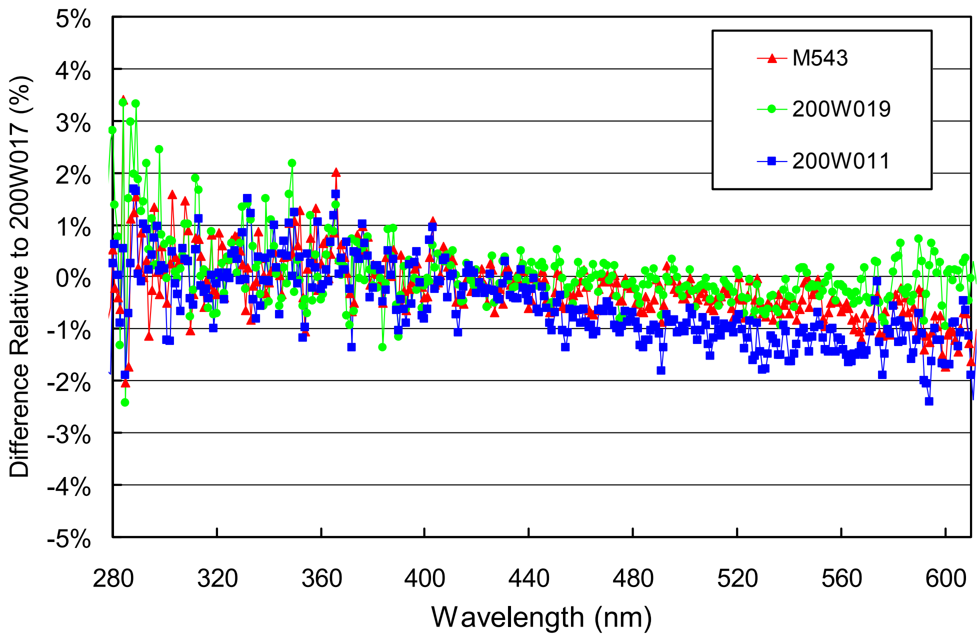

Figure 1. *Comparison of on-site lamps M-543, 200W019 and 200W011 with the BSI traveling standard 200W017 on 02/02/2011.*

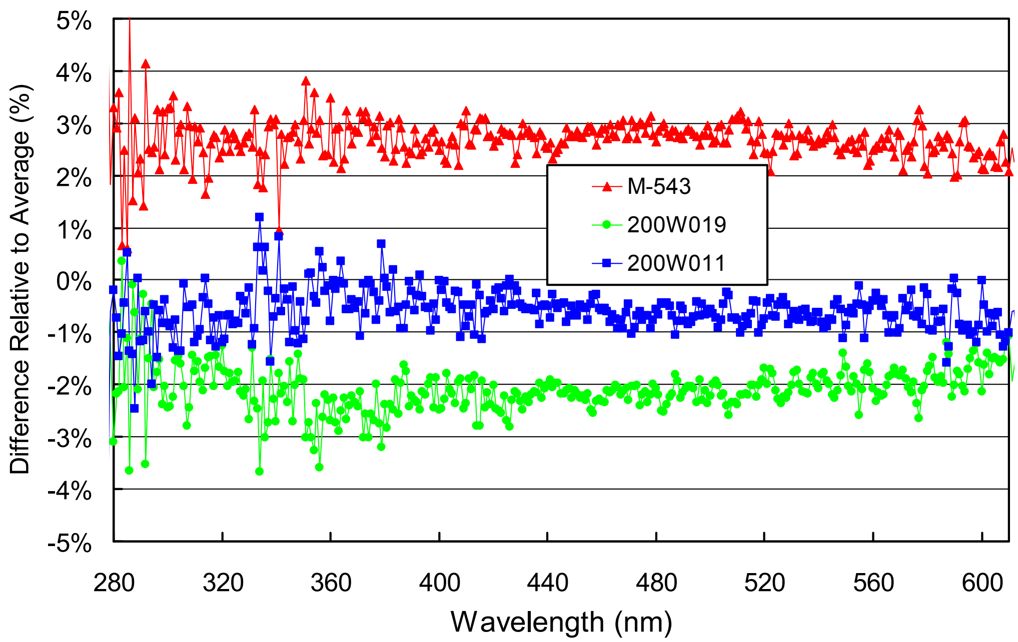

Figure 2. *Comparison of lamps M-543, 200W019 and 200W011 with their average on 5/23/2012.*

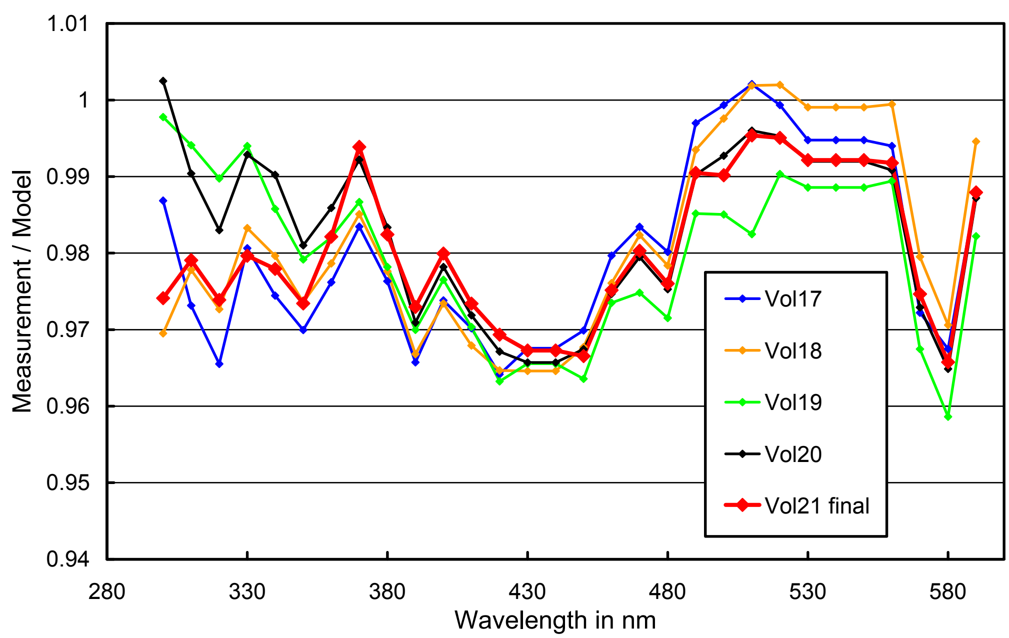

Figure 3. *Median measurement/model ratios calculated from clear-sky solar measurements for data of Volumes 17 – 21. Ratios were averaged over 10 nm intervals (305-315, 315-325, ... 585-595 nm) before the median was calculated. There is a systematic bias between measurement and model, however, this bias is generally to within ±1% for the five volumes, confirming that the irradiance scale used for processing of Volume 21 data is consistent with that used for earlier volumes.*

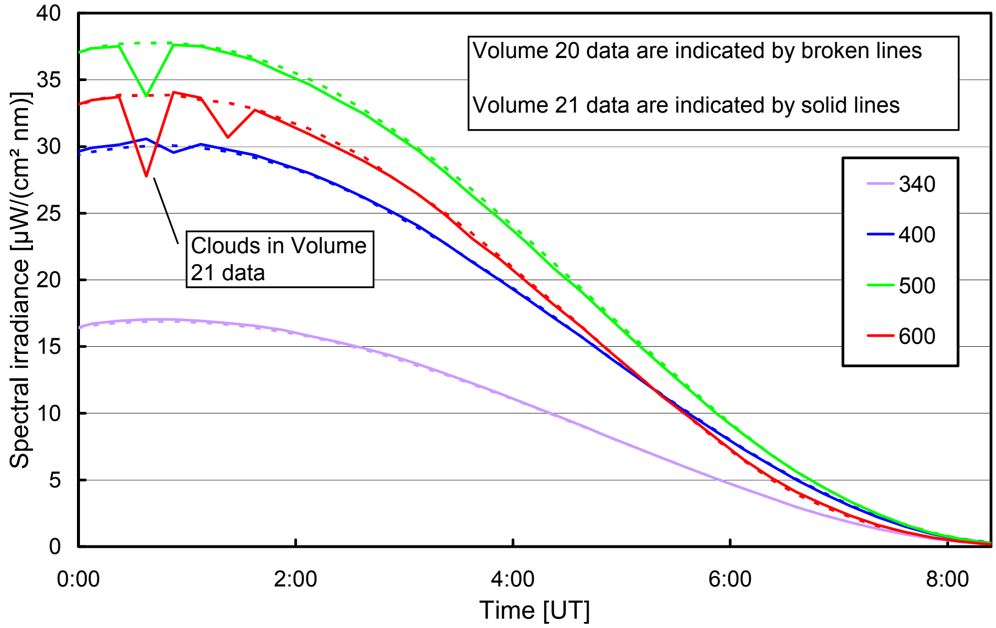

Figure 4. *Spectral irradiance at 340, 400, 500 and 600 nm on 9/30/10 (Volume 20 data, broken lines) and 9/30/11 (Volume 21 data, solid lines). The surface albedo was 0.85 on both days. The graph indicates that measurements at the same time, one year apart, are consistent to within ±1.5%.*

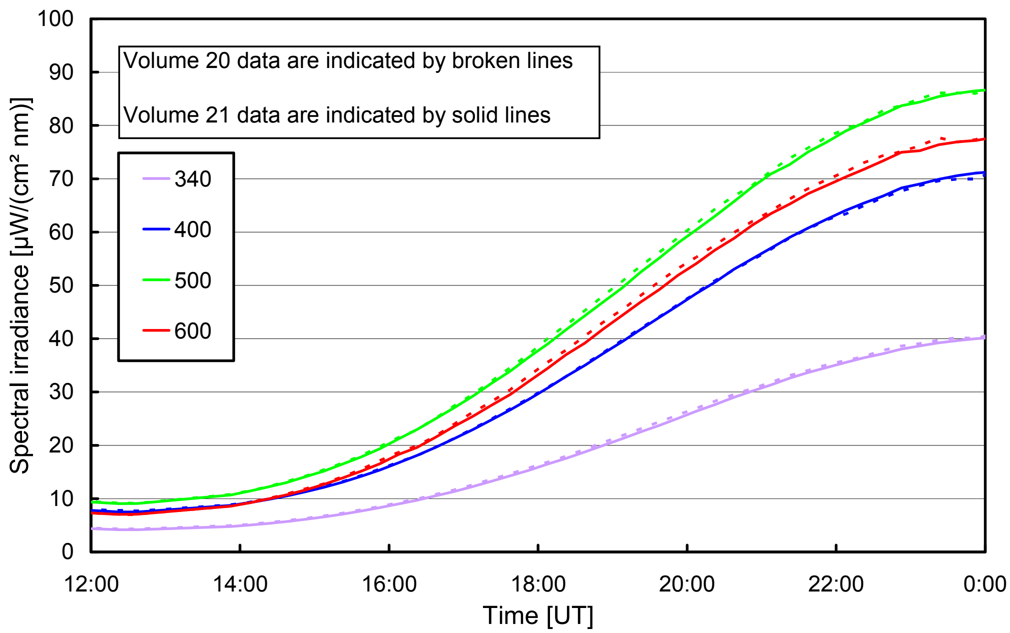

Figure 5. *Spectral irradiance at 340, 400, 500 and 600 nm on 11/9/10 (Volume 20 data, broken lines) and 11/9/11 (Volume 21 data, solid lines). The surface albedo was 0.80 on both days. The graph indicates that measurements at the same time, one year apart are consistent to within ±1.5%.*

1.2. Instrument Stability

The temporal stability of the spectroradiometer was assessed by comparison with data of the collocated GUV-511 radiometer. Figure 6 shows the ratio of GUV-511 (340 nm channel) 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 ±4%; the standard deviation of the ratio is 2.4%. Times when the SUV-100 calibration changed are indicated by vertical lines. Of note, the comparison indicates that the GUV-511 collector was shaded on 8/25/11, likely by snow.

Three calibrations were applied for processing of solar data of the SUV-100. More information on these calibrations is provided in Table 1. Figure 7 shows ratios of the calibration functions applied during Periods P2 and P3 relative to the function of Period P1. The relative difference between consecutive calibration functions is less than 2%.

Table 1: Calibration periods for McMurdo Volume 21 data.

Period name	Period range
P1	08/14/11 - 02/11/12
P2	02/12/12 - 03/10/12
P3	03/11/12 - 04/30/12

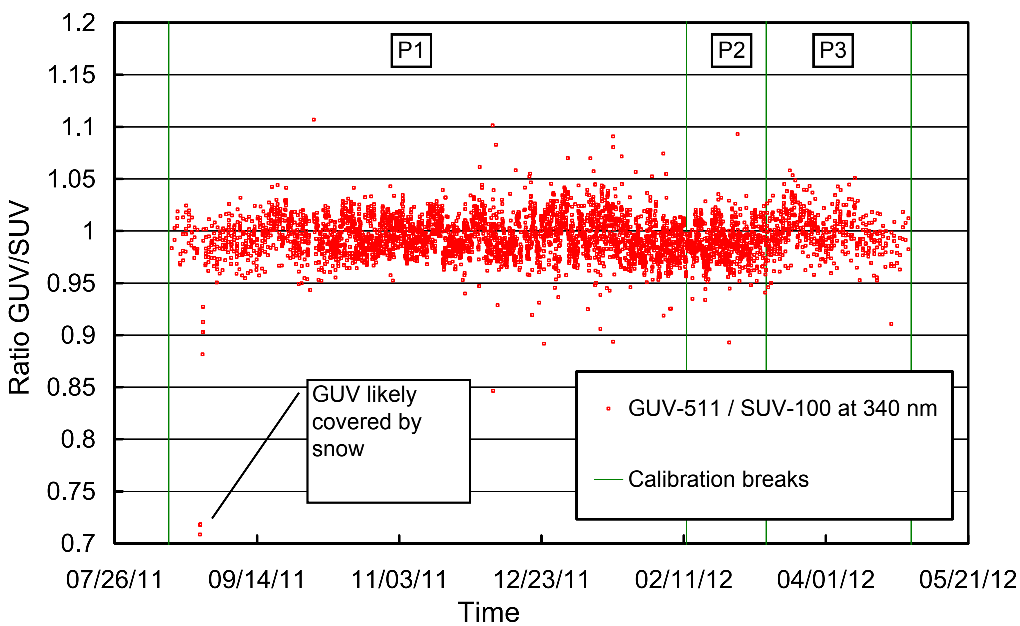

Figure 6. *Ratio of GUV-511 measurements (340 nm channel) with final SUV-100 measurements that were weighted with the spectral response function of this channel. Green vertical lines indicate times when the SUV-100 calibration was changed.*

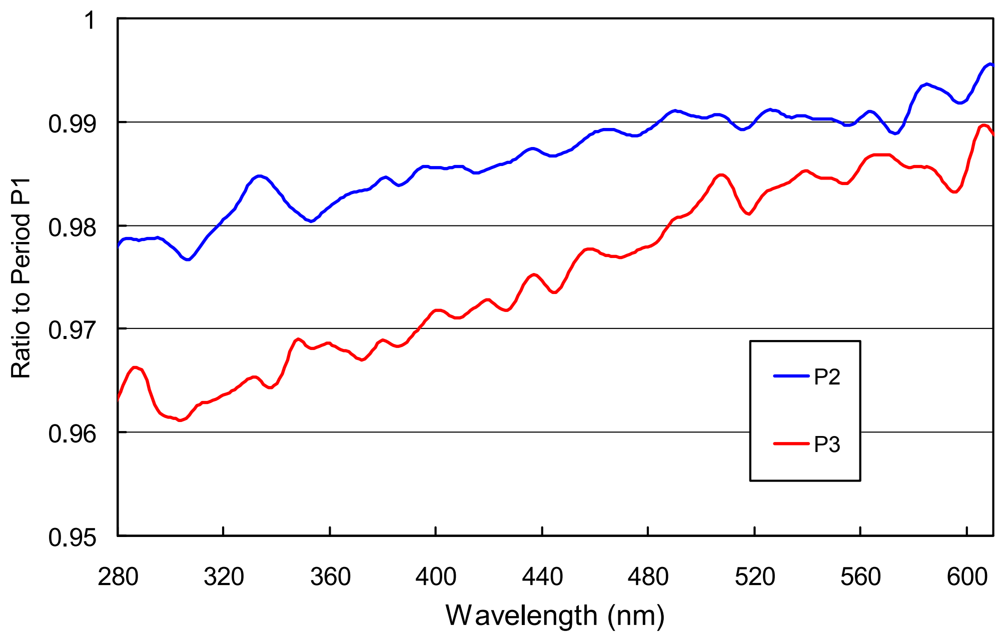

Figure 7. *Ratios of irradiance assigned to the internal reference lamp during periods P2 and P3, relative to Period P1. Changes from period to period are smaller than 2%.*

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 8 shows the correction functions calculated with this algorithm. Figure 9 indicates the wavelength accuracy of final Version 0 data for six 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. The wavelength correction was not modified when processing Version 2 data, which consequently have the same wavelength uncertainty of 0.02 nm (1-σ) as Version 0 data.

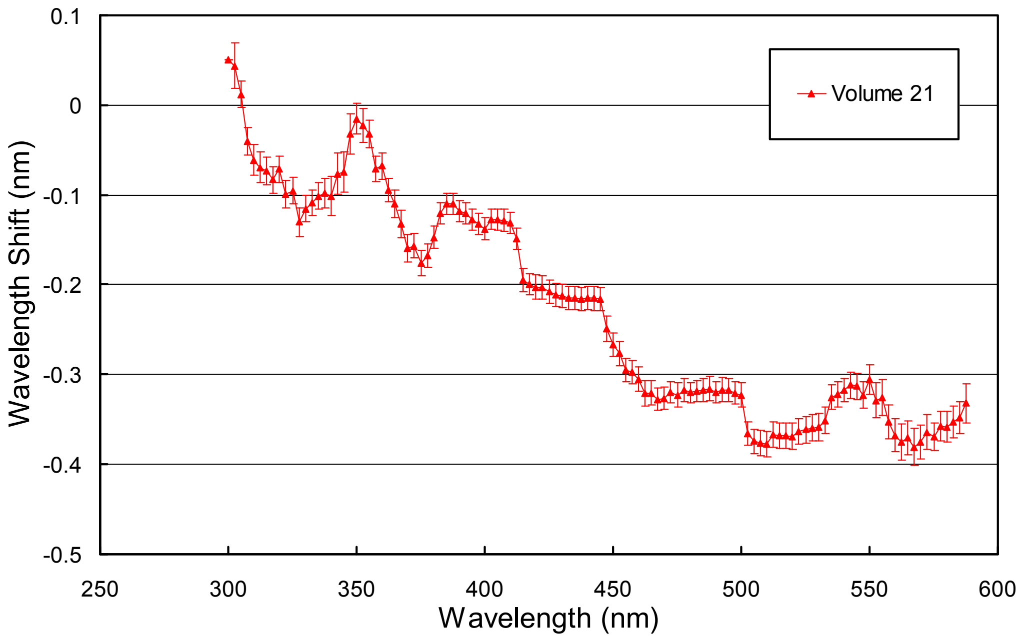

Figure 8. Monochromator non-linearity correction functions for the Volume 21 period. Error bars indicate the 1σ-variation.

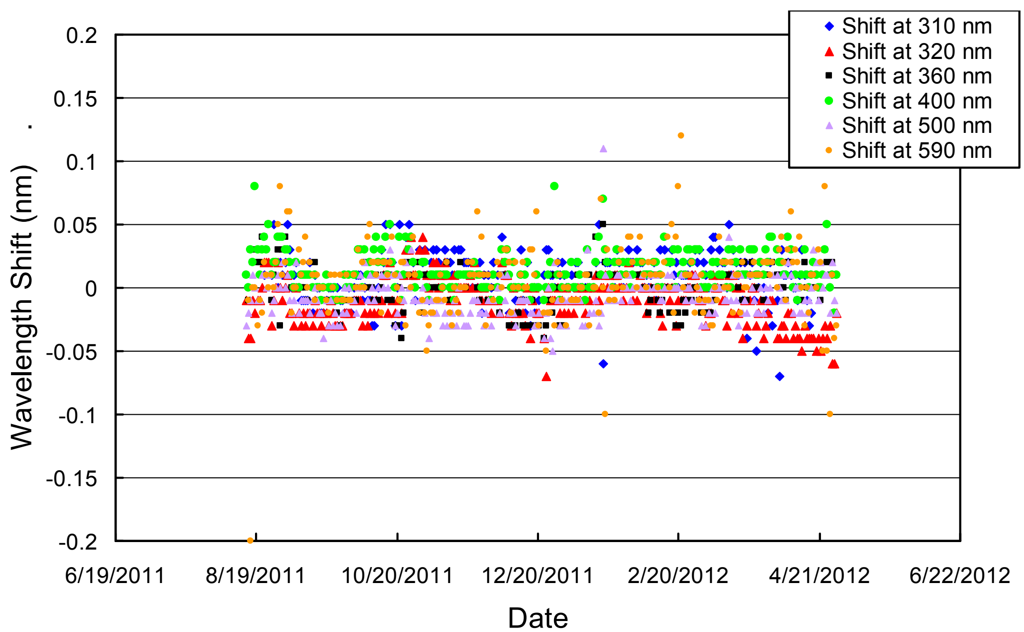

Figure 9. *Check of the wavelength accuracy of final Version 0 data at six wavelengths by means of Fraunhofer-line correlation. The plot is based on daily measurements at noon.*

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.