SORCE-SIM Release Notes for Version 27, Level 3 data products (v1.2, 01/03/22)

The SORCE spacecraft was turned off on February 25, 2020, SORCE Mission Day 6241 (SD6241). This SORCE-SIM data release, Version 27 (V27), contains data taken over the entire mission. SORCE-SIM data (DOI = https://doi.org/10.5067/LDDKZ3PXZZ5G) appears in three locations:

1) LISIRD website (see: http://lasp.colorado.edu/lisird/sorce/),
2) SORCE website (see: http://lasp.colorado.edu/home/sorce/data/) and
3) NASA DAAC (see: https://disc.gsfc.nasa.gov/datasets/SOR3SIMD_027/summary/).

Table 1 gives a description of available time and wavelength ranges for each location. Visualizations of the full SORCE-SIM V27 data acquisition are presented in Appendix A. The SORCE website contains ASCII, IDL SAVfile, and netCDF data distributions; only the ASCII file is available from the DAAC. An IDL reader for the ASCII formatted data is available on the SORCE web site at http://lasp.colorado.edu/home/sorce/data/lasp.colorado.edu/sorce/file_readers/read_lasp_ascii_file.pro

Time Range	Wavelength Range (nm)		
04/14/2003 – 02/25/2020	240 – 2416	300 – 2416	240 – 2416
	SORCE	LISIRD	NASA DAAC

Table 1: V27 Time and wavelength ranges for each repository location.

V27 Calibration Changes:

SORCE-SIM V27 correction algorithms differ from V26 in the following ways (page numbers provided)

Additional Calibration Algorithm Details: Users should consult previous version notes for additional algorithm details: http://lasp.colorado.edu/home/sorce/instruments/sim/sorce-sim-data-products-release-notes/ .

Revision History –

1.0: 12/15/2020 – Steven Penton, James Mothersbaugh, Stéphane Béland, Jerald Harder, Aimee Merkel and Laura Sandoval.
1.1: 04/01/2021 – Updated DOI URLs, changed reported data range from 240–2413 to 240–2416 nm, added netCDF pointer and documented irradiance format change from E11.4 to E13.6. Irradiance data is now double-precision.
1.2: 01/03/2022 – Changed "-present" to "02/25/2020" in table 1. Changed NetCDF to netCDF where appropriate.

1) NEW DIODE SPACECRAFT POINTING 'ROLL' CORRECTION:

a. As in previous releases, irradiance measurements taken when the spacecraft pointing was known to be off-axis by more than 2' (arcmin) are filtered from the data record. However, an analysis of V26 data showed that diode-based observations with pointing offsets between 1–2' were observed to be out of family with other irradiance measurements.

b. The irradiance-based wavelength-dependent correction is linear in off-axis pointing and captured as a slope of **Δ**Irradiance / offset angle in units of W m^{-2} nm^{-1} $arcmin^{-1}$. Figure 1 shows these slopes for the UVA, VISA, and IRA. Figure 2 shows an IR time series at 1589 nm. Irradiance outliers ('spikes') are greatly deduced in **V27** when compared to **V26**.

c. ESR doesn't require correction.

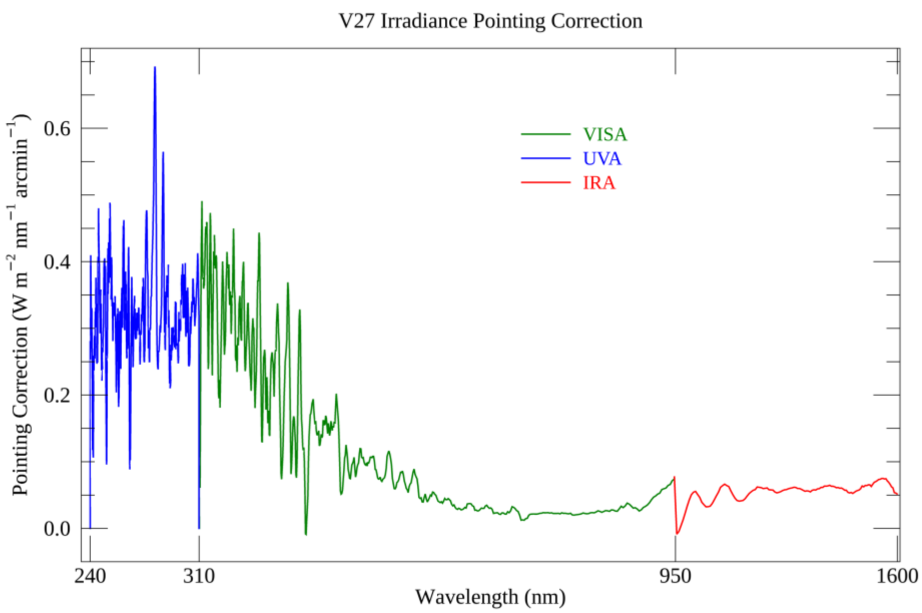

Figure 1: V27 UVA, VISA and IRA offset pointing correction (W m^{-2} nm^{-1} $arcmin^{-1}$) vs. wavelength.

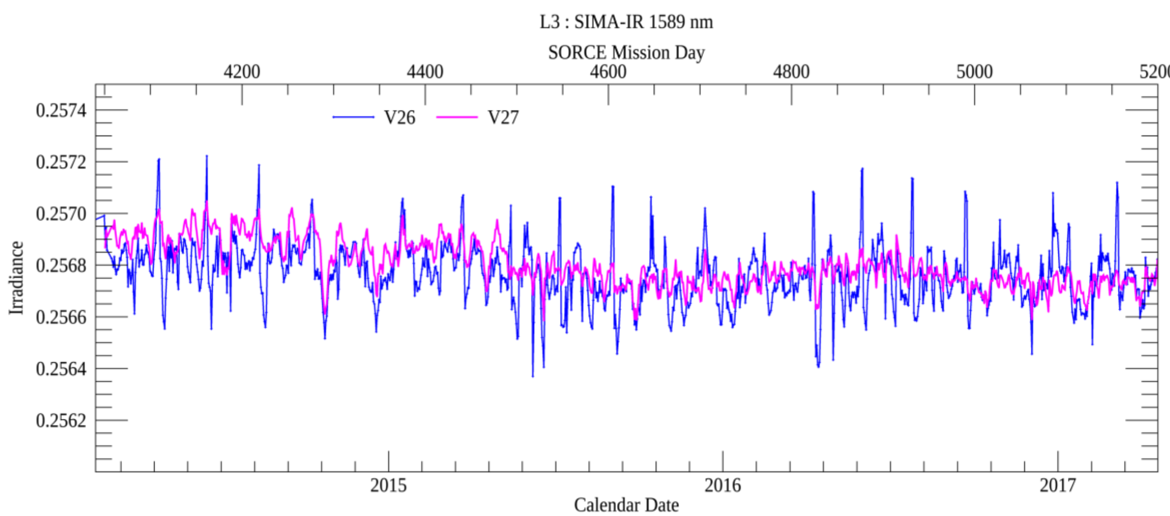

Figure 2: **V27** IRA irradiance time-series at 1589 nm versus **V26**. The new spacecraft pointing correction greatly reduces the irradiance outliers ('spikes'). As described in the following section, the improved temperature correction in **V27** improves the day-to-day measurement stability.

2) IMPROVED DIODE TEMPERATURE CORRECTIONS:

a. V27 updates for IRA, VISA/B and UVA/B diodes. IRB correction **not** available due to long-standing performance issues. For all corrections, except IRA, the irradiance ***without*** the diode temperature correction was analyzed as a function of temperature at each wavelength during the low solar activity time range of SD5600–5900 (June 2018–March 2019). The slope of irradiance vs. temperature vs. wavelength defines the diode temperature correction. Figure 3 shows a comparison of the V26 versus V27 UVA and VISA temperature corrections.

b. For the IRA, we have moved to a two-epoch temperature correction, one for SD < 5866 and one for SD ≥ 5866. These two corrections are compared in Figure 4. Figures 2 and 5 shows the improved measurement stability in the updated V27 IRA correction.

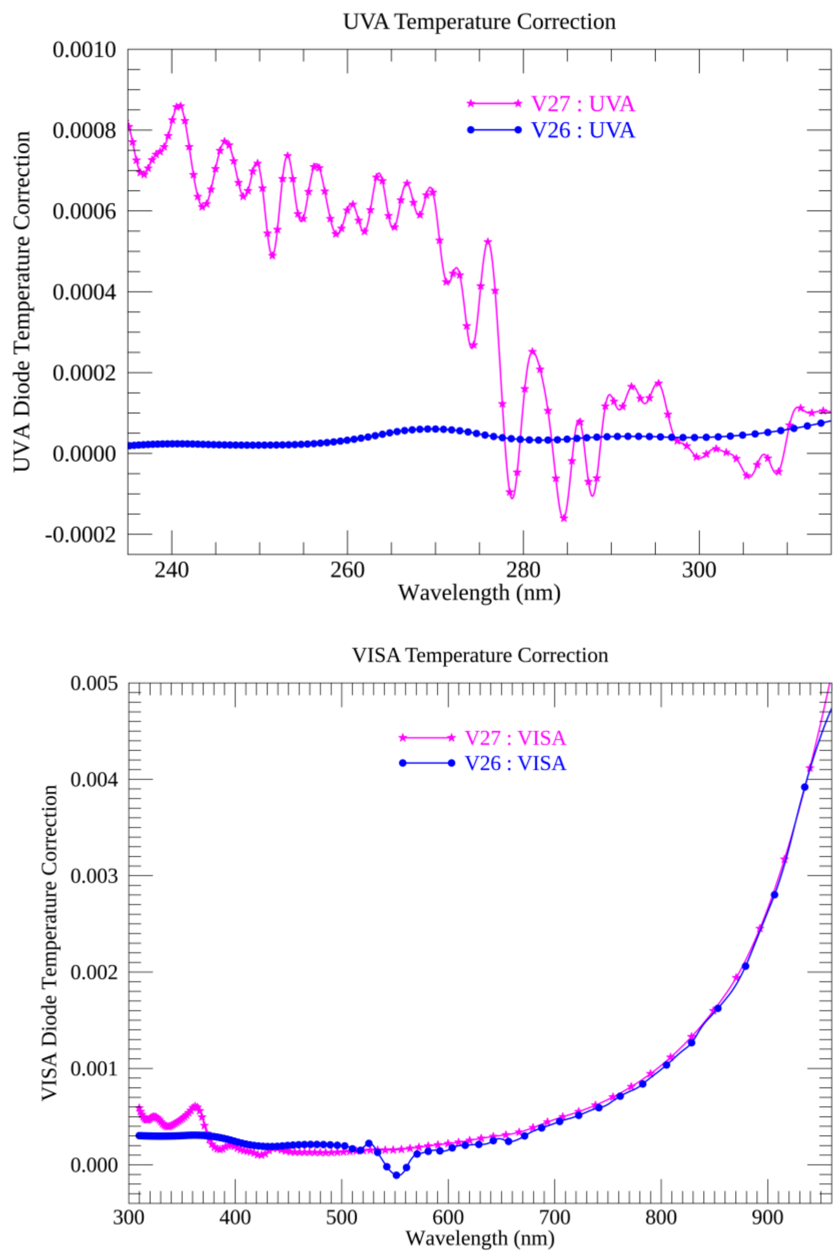

Figure 3: Comparison of V26 & V27 UVA/B (top) and VISA/B (bottom) temperature corrections.

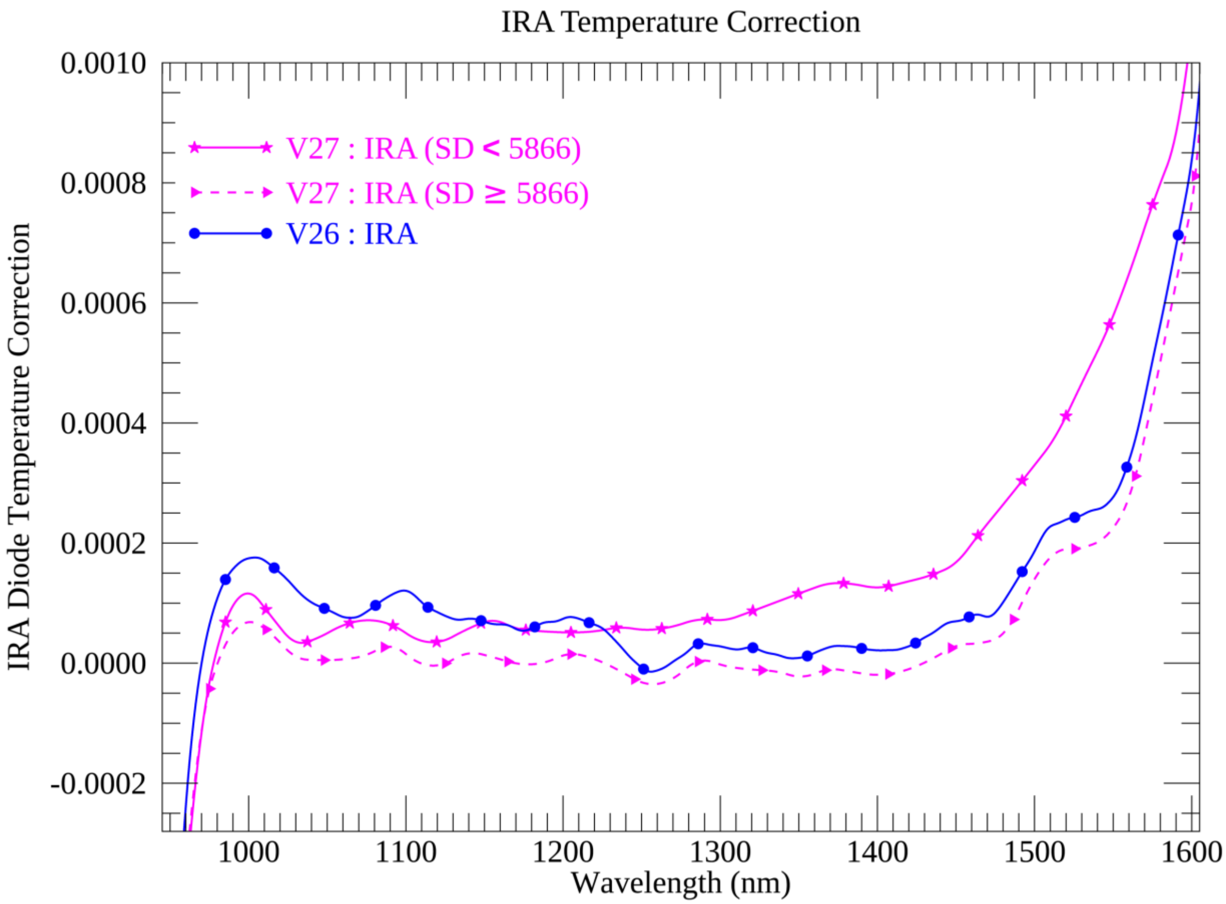

Figure 4: Comparison of V26 & V27 IRA temperature corrections. Two V27 IRA temperature corrections are used; SD < 5866, solid line with stars, and SD ≥ 5866, dashed line with triangles (SD5866 = 02/15/2019).

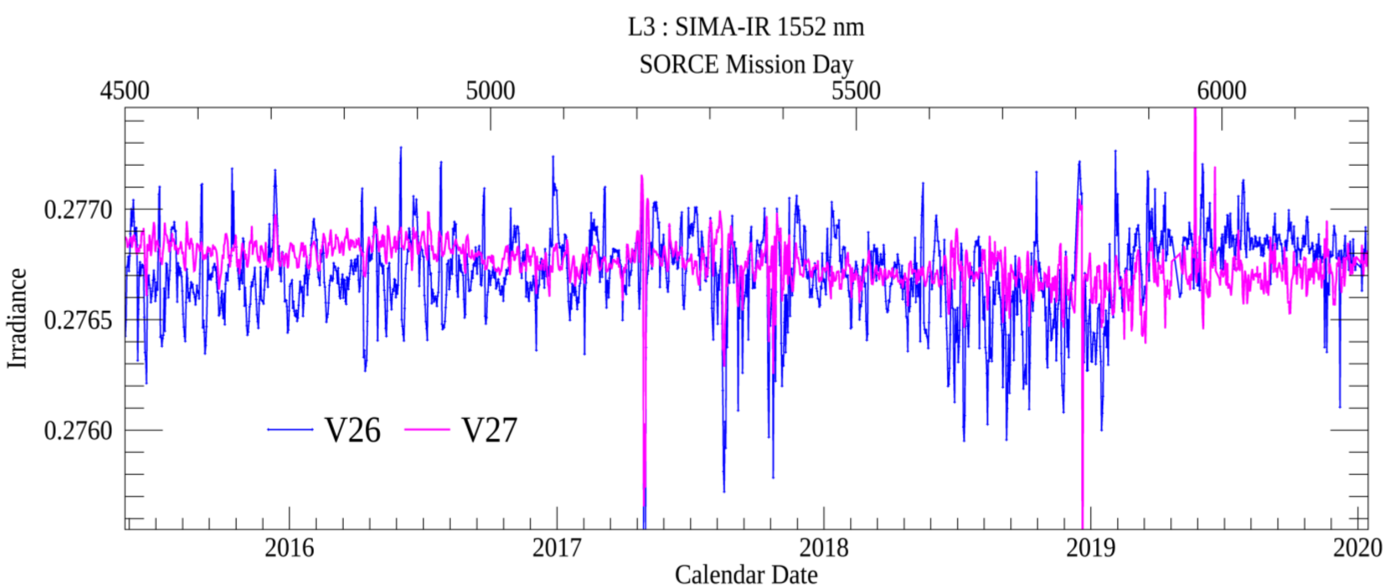

Figure 5: V27 time-series at 1552 nm versus V26. The V27 pointing correction greatly reduces the irradiance outliers (‘spikes’), while the new temperature correction improves the day-to-day measurement stability. V27 IRA uses a two-epoch correction before and after SD5866 (02/15/2019).

3) IMPROVED DEGRADATION COLUMNS:

a. VIS degradation columns were re-calculated using the V27 pointing correction (VISA) and diode temperature corrections (VISA/B) described above.
   i. The 310‒325 nm VISA degradation column could not be calculated in this manner as there is no VISB coverage. To prevent unreasonable extrapolations (which occasionally occurred in V26), the 325 nm value was assigned to these wavelengths.

b. The UV f-function algorithm, and thus the degradation column, was significantly improved. Calculation and smoothing parameters were updated to address long-standing issues, particularly near 280 nm. Four changes were made to the V27 UV f-function:
   i. UVA/B irradiance comparison now starts at SD120, instead of SD38. Scans taken SD38‒118 showed abnormal instrument performance and have been excluded.
   ii. F-function 'buffer values' before SD120 are now assigned the SD120 value.
   iii. F-function 'step size' was changed from 3 to 4 scans; improving the UVB temporal irradiance smoothing, and significantly improving the 240‒270 nm correction. Figure 6 shown the UV f-function for V26 & V27 at 280 nm. Figure 7 shows the UVA V26 & V27 degradation column vs. time at 280 nm
   iv. Matching-day to daily interpolation was changed from linear to a least-squares fit. This improves data quality early in the mission at short UV wavelengths.
   v. Figure 8 shows a comparison of 280 nm UVA time series for V26 & V27.

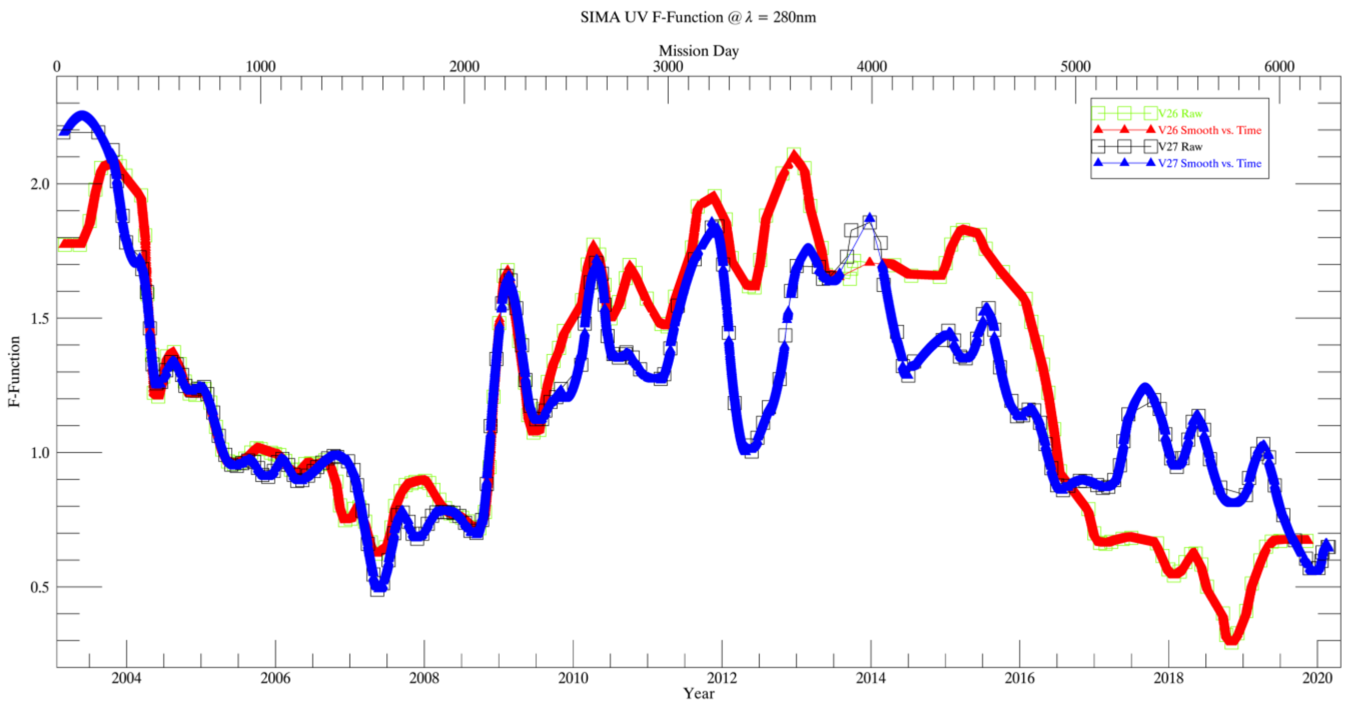

Figure 6: UVA V26 & V27 f-function vs. time at 280 nm. Raw data is shown with open symbols.

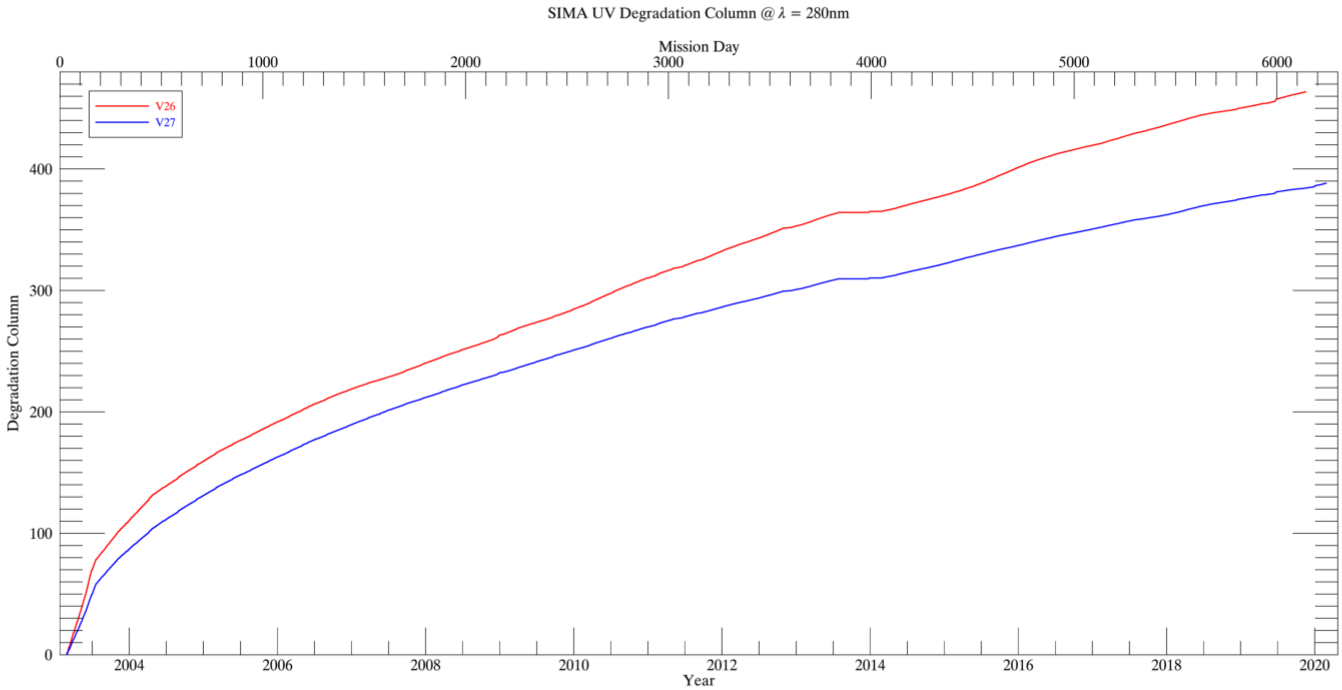

Figure 7: UVA V26 & V27 degradation column vs. time at 280 nm. This wavelength shows the largest change in the degradation column from V26 to V27.

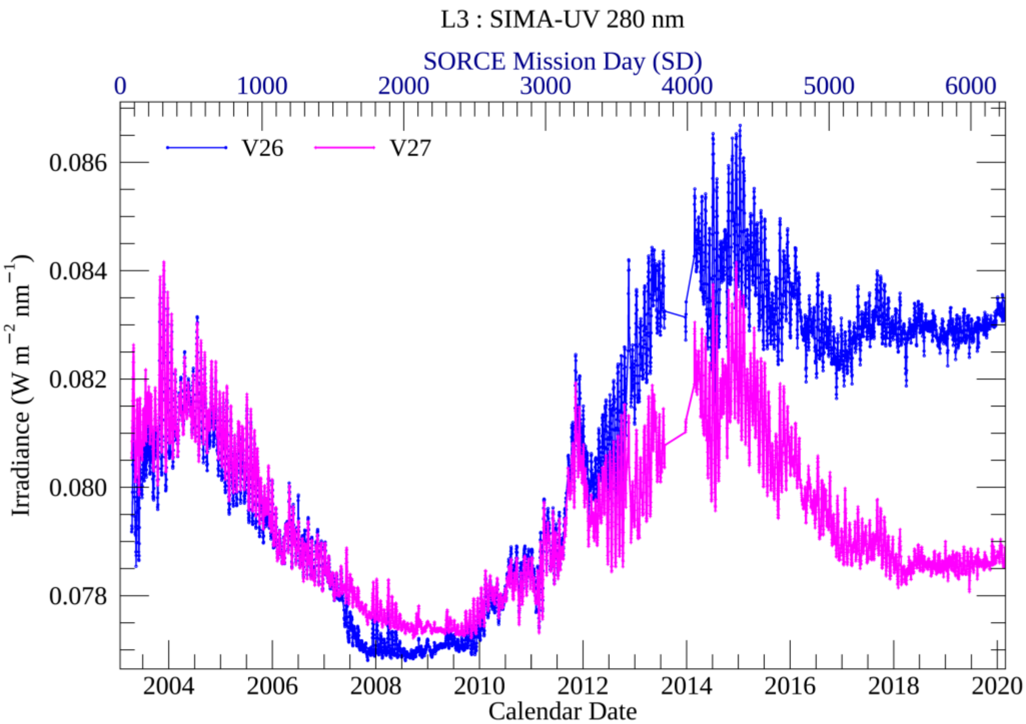

Figure 8: Comparison of 280 nm UVA time series for V27 & V26. The changes are mainly driven by the degradation column changes explained above.

4) IMPROVED DIODE DEGRADATION CORRECTIONS:

a. The V27 diode degradation corrections were calculated and applied using the same method as V26. However, improved V27 input data improves the corrections. The improved wavelength and time-dependent correction is shown in Figure 9.
b. Additional ESRA/B full scans were taken in late December 2019 & early January 2020. These full scans yielded four quality spectra in each ESR channel. These spectra were used to recalculate the ESR daily kappa to extend it to the end of the mission.
c. The VISA irradiance used for comparison to the ESR contains the new pointing and temperature corrections, resulting in an improved diode degradation determination.

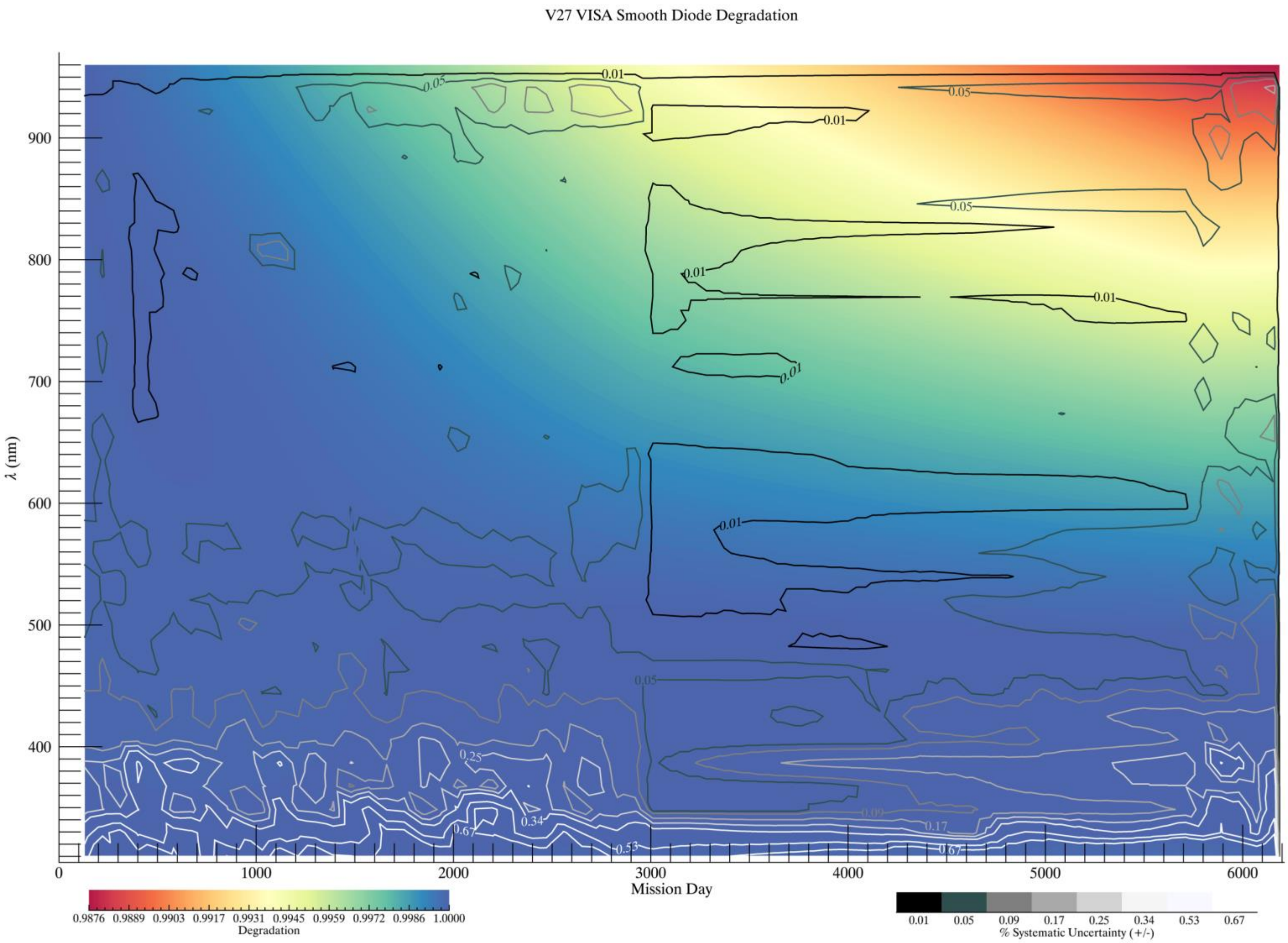

Figure 9. V27 VISA diode degradation correction (absolute scale) and percent uncertainty contours vs. wavelength vs. time. The uncertainty contours are evenly spaced on the correction surface, and show an increase at the shortest VIS wavelengths. For example, at the end of the mission (SD6241; Feb 25, 2020), the V27 VISA degradation @ 950 nm is 0.9876 (-1.24 ± 0.01 %). The measured irradiance is divided by this correction.

a. The ESR kappa ($\kappa(\lambda)$, degradation rate) was updated by analyzing matched ESRA/B full scan data taken on SD2729. This was the final matched ESRA/B full scan before day-only operations (DO-Op). Previously released data assumed a higher degradation rate, based upon an early mission measurement. The V27 ESRA $\kappa(\lambda)$ is compared to V26 in Figure 10.
b. Figure 11 shows the effects of the ESRA κ update with a 2096 nm irradiance time series.

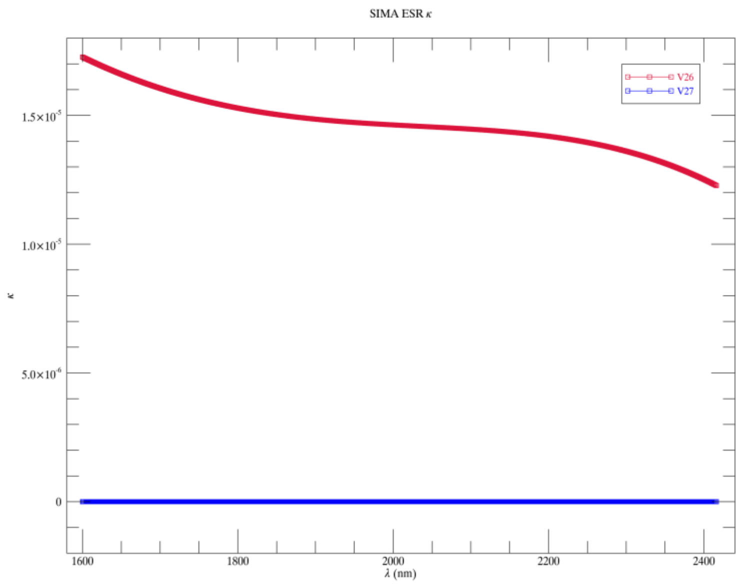

Figure 10: ESRA degradation rate (κ) as a function of wavelength for V26 and V27.

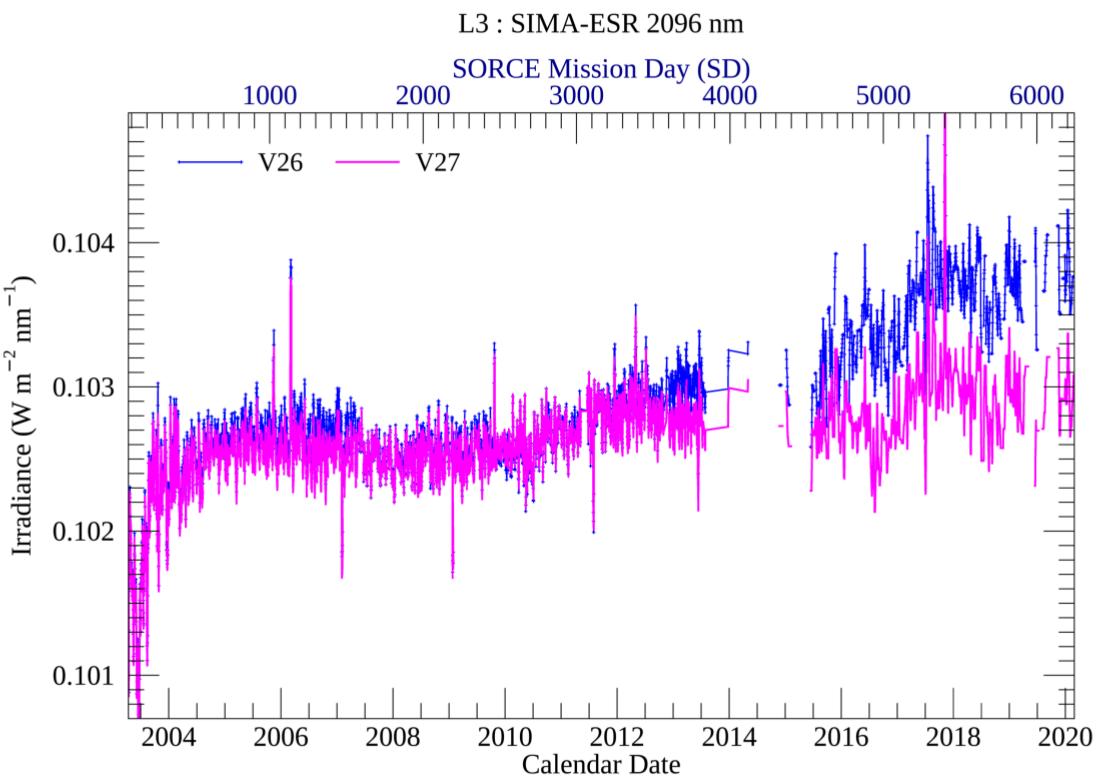

Figure 11: V27 vs V26 ESRA irradiance time series showing the effect of the updated Kappa (κ).

a. In every data release, new irradiance calibrations are required for all modes to convert from our 'Corrected' Irradiance to 'Calibrated' Irradiance. This correction is applied as the ratio of the ATLAS-3 irradiance to the V27 Corrected Irradiance.

b. Due to diode and prism degradation improvements, the V27 UVA and VISA alephs show the most change from V26, particularly near 280 nm for UVA and 400–600 nm for VISA. These alephs are shown in Figures 12 and 13.

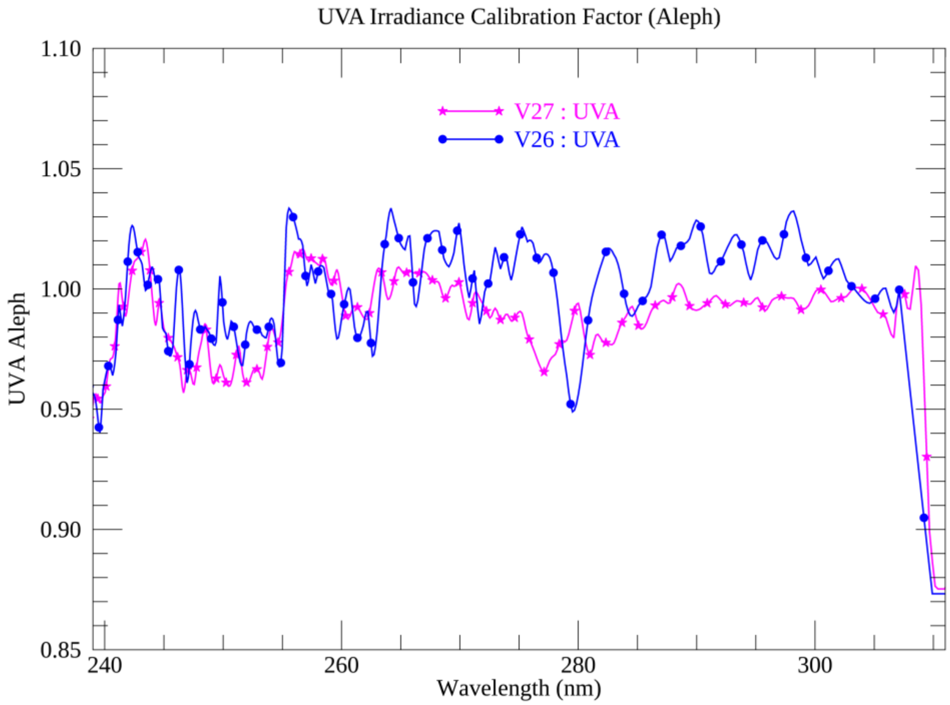

Figure 12: V26 and V27 UVA Aleph correction factors. The 'Corrected' irradiance is multiplied by these factors to obtain 'Calibrated' irradiance.

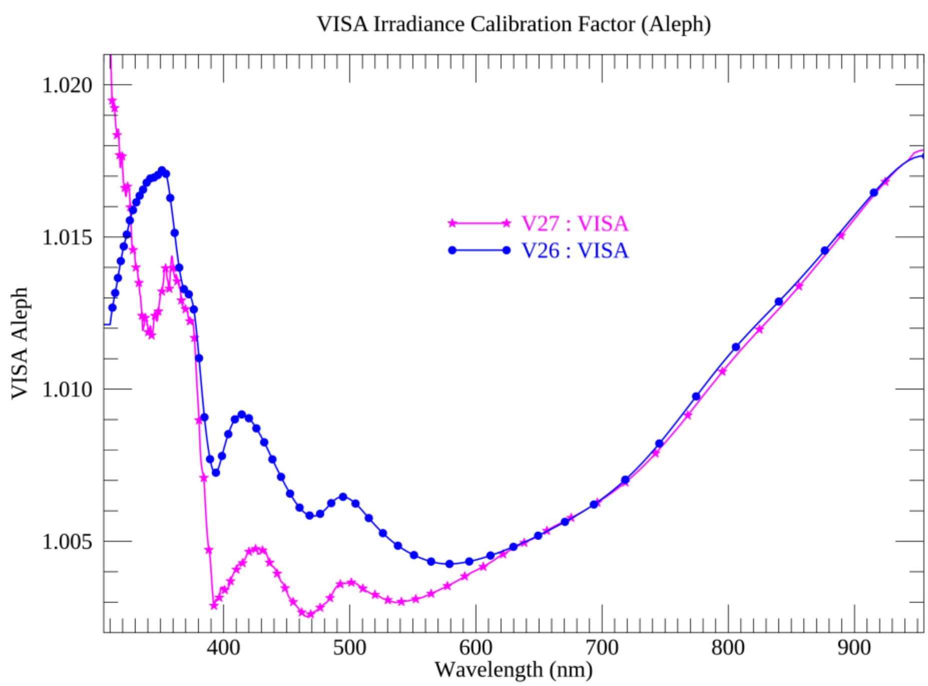

Figure 13: V26 and V27 VISA Aleph correction factors.

c. For V27, the UV aleph derivation method from 306–310 nm was modified. For V26, a linear connection was inserted from the 306 nm value to that which forced the irradiance to match the VIS at 310 nm. For V27, the correction aligns the 306–310 nm irradiance directly to that of ATLAS-3, similar to all other wavelengths. This calibration is an excellent match at 310 nm to the V27 VIS irradiance, as shown in Figure 14 for UVA. The change was possible due to the improved UV degradation previously described.

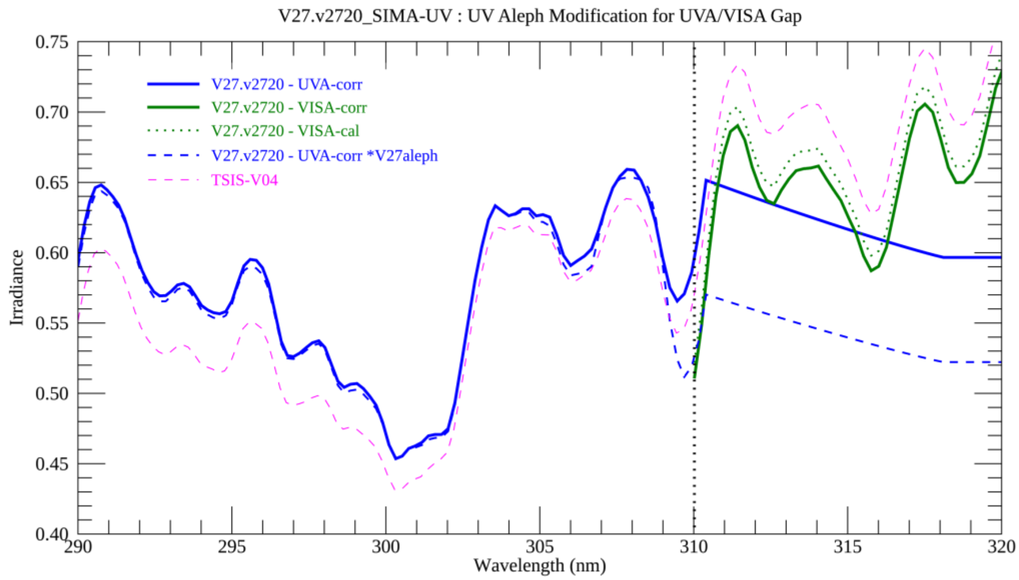

Figure 14: Solid lines show V27 UVA and VISA L2 corrected, but not flux-calibrated, irradiance from test version V27.v2720 on SD801. Green dotted line is the flux-calibrated VISA. UVA L2 irradiance in test version does not match VISA at 310 nm. V27 UVA aleph was updated with a direct comparison to the ATLAS-3 spectrum, without consideration to the VISA measurements. Flux-calibrated UVA V27 irradiance (blue dashed line) is an excellent match to the VISA irradiance at 310 nm. For comparison, a TSIS-1 V04 spectrum taken from the entire overlap of SORCE and TSIS is shown in magenta**.**

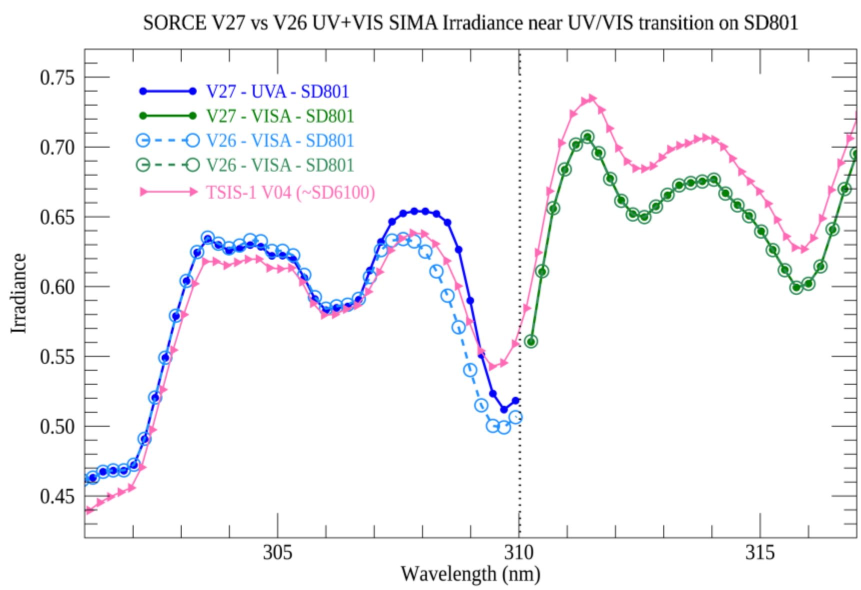

Figure 15: Solid lines with filled circles show the V27 UVA and VISA L3 V27 irradiance on SD801. The open-circled dashed lines are theV26 measurements. The V27 UVA aleph was updated with a direct comparison to the ATLAS-3 spectrum. For comparison, a TSIS-1 V04 spectrum taken from the entire overlap of SORCE and TSIS-1 (labeled ~SD6100) is in magenta.

7) DATA QUALITY FLAGS:

V27 marks the debut of bit-wise data quality flags (DQF) associated with each wavelength + irradiance pair. DQFs alert the user to various spacecraft events, changes in instrument performance, and space enviro nment issues. Some DQFs indicate times of note related to instrument operational changes such as power cycling of detectors, or day-only operations (DO-Op), while others indicate discrete events such as temperature excursions or abnormal spacecraft roll angle. The DQFs are listed in Table 2.

Bit#	Bit Value	Flag Name	Flag Description	Notes
1	1	MISSING_VALUE	Missing data	No data for this wavelength.
2	2	FILL_VALUE	Filled data (from a previous scan)	Irradiance filled from a previous measurement.
3	4	TEMP_LOW	Detector temperature below nominal range	Nominal Temp Range (°C): ESR: 25—36, VIS: 18—26, UV: 15—22, IR: 18—26
4	8	TEMP_HIGH	Detector temperature above nominal range	Nominal Temp Range (°C): ESR: 25—36, VIS: 18—26, UV: 15—22, IR: 18—26
5	16	TEMP_EXTRAPOLATED	Detector temperature extrapolated from previous scans	Temperature estimate based upon available telemetry.
6	32	POOR_POINTING	Spacecraft pointing outside nominal range	1' < pointing < 2' warning (properly corrected), pointings > 2' are filtered.
7	64	SATURATED_CCD	Saturated CCD	0 < SD < 453 data potentially saturated due to incorrect integration times/prism step-size
8	128	UNSTABLE_REACTION_WHEEL	Time range of unstable reaction wheel	2064 < SD < 2096; Unstable pointing (abnormal reaction wheel)
9	256	SIMA_POWER_CYCLING	SIMA power-cycled every orbit	3030 < SD < 3985; SIMA turned off every eclipse
10	512	SIMB_POWER_CYCLING	SIMB power-cycled every orbit	2777 < SD < 3985; SIMB was turned off every eclipse
11	1024	ESR_NOT_THERMALLY_STABLE	Unstable ESR detector temperature	2777 < SD ESR thermal stability affected by power cycling or DO-Op
12	2048	CAMPAIGN	Time range of vacation recovery observations	3986 < SD <3991
13	4056	DO_OP	Time range day-only operations (DO-Op)	4049 < SD DO-Op due to battery failure
14	8112	GLINT	Optical Glints affect UVA & VISA at certain prism positions (prismPos) Filtered from L3 product	SD < 190 VISA: 12170 < prismPos < 12588 (378.7 < λ <383.9) UVA: 34666 < prismPos < 34970 (2136.1 < λ < 2168.5)
15	16224	TIMERANGE_REJECTION	Data filtered because of spacecraft issues.	Abnormal spacecraft performance. See table below for specific times.

Table 2 : SORCE-SIM DQFs. Reported DQF is the numerical sum of all appropriate flags.

DQF Name	SD (SORCE Mission Day) Range	Value
Saturated_CCD	SD < 453	64
UNSTABLE_REACTION_WH	2064 <= SD < 2097	128
SIMA_POWER_CYCLING	3030 <= SD < 3985	256
SIMB_POWER_CYCLING	2777 <= SD < 3985	512
ESR_NOT_THERMALLY_STABLE	2777 <= SD	1024
CAMPAIGN	3986 <= SD < 3992	2048
DO-Op (Day Only Operations)	4049 <= SD	4096

Table 3: Temporal range flags in SORCE mission Days (SD), indicating abnormal spacecraft operations.

8) *DATABASE SYSTEM CHANGE TO ORACLE COMPLETED*

a. All SORCE telemetry and housekeeping data was migrated from the SYBASE database system to the Oracle databases. Extensive testing verified that all telemetry was successfully migrated.

b. All JAVA and IDL processing tools were upgraded to use only ORACLE-based resources

c. Telemetry and tools were extensively tested.

d. SORCE-SIM irradiance measurements processed by the ORACLE system were compared to the SYBASE results to ensure accuracy.

9) *UPDATED DATABASE REFERENCE SPECTRA (SIMA AND SIMB)*

a. The internal database reference spectra that are used for identifying data outliers were updated for V27. The improved corrections and alephs described here necessitated this change as errors in previous irradiance calibrations were causing some V27 data to be incorrectly filtered.
    i. This was especially true for the UV/VIS gap (306–310 nm).

b. SIMB reference spectra were added to the JAVA system. Fully processed L3 SIMB data was needed for the SIMA irradiance uncertainties calculations.

10) ESR LOOK-BACK TIME UPDATED FROM 10 TO 16 DAYS

a. In nominal processing, scans often have measurement or telemetry issues causing rejection or other loss of irradiance measurements. In these cases, measurements from previous days are used if within 2 days for diodes and 16 days for the ESRs.

b. In V26, the ESR lookback time was 10 days, this was changed to 16 days for V27. This results in 9322 additional ESRA filled data points, the majority during DO-Op (see Figure 16).

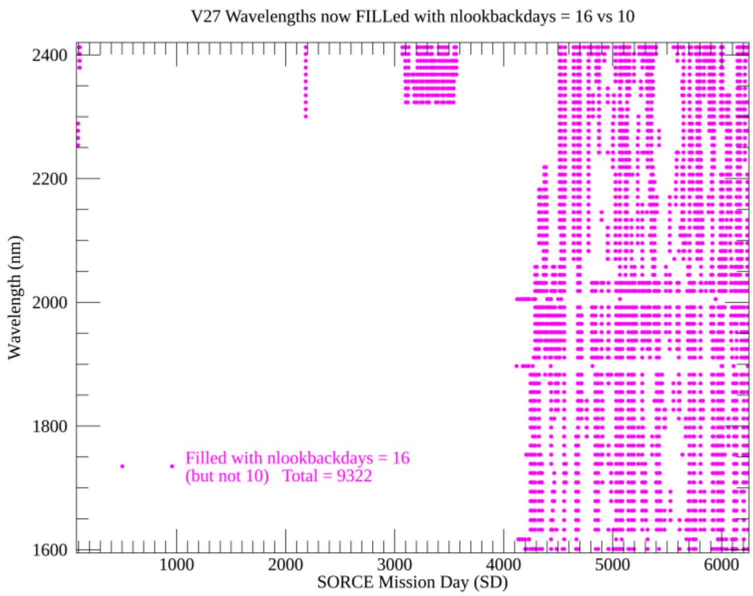

Figure 16: The change in the number of FILLed irradiances resulting in the change of lookback days from 10 to 16 for V27 ESR data. As shown, this results in 9322 additional ESRA data values in V27. FILLed values can be identified by the FILL bit (2) being set in the Data Quality Flag (DQF).

11) MODIFIED FORMAT OF IRRADIANCE VALUES FROM E11.4 TO E13.6

Previous versions of the SORCE-SIM data release used the format code E11.4 to print database irradiance values to the ASCII and IDL SAVfiles. This format was changed to E13.6 for SORCE-SIM V27 to prevent rounding errors present in previous versions. In previous versions, this rounding error could have been as large as 50 parts per million (PPM). The new E13.6 format reduces this error to, at most, 0.5 PPM.

In conjunction with this change, the variable type for "**irradiance**" in the ASCII header and in the IDL SAVfiles was changed from float (R4) to double-precision (R8).

12) UPDATES TO BAD TIME RANGES:

- A review of data quality identified 11 new time ranges where SIM data was compromised due to spacecraft, commanding or enviro nmental issues. Scans during these time ranges are still created in our L2 processing but are filtered in our L3 processing.
- Table 4 lists the bad time ranges in SORCE Mission Days (SD), Julian Day (JD), and YYYYDDD.DDD, the formats that appear in the ASCII data products. Times that are listed in **BOLD** are new in V27.

Start Time (SD)	Stop Time (SD)	Start Time (JD)	Stop Time (JD)	Start Time (yyyyddd.ddd)	Stop Time (yyyyddd.ddd)
91.000	92.000	2452754.500	2452755.500	2003115.000	2003116.000
93.233	**93.278**	**2452756.733**	**2452756.778**	**2003117.233**	**2003117.278**
94.247	**94.291**	**2452757.747**	**2452757.791**	**2003118.247**	**2003118.291**
101.000	104.000	2452764.500	2452767.500	2003125.000	2003128.000
406.150	406.167	2453069.650	2453069.667	2004065.150	2004065.167
406.622	406.639	2453070.122	2453070.139	2004065.622	2004065.639
419.802	419.827	2453083.302	2453083.327	2004078.802	2004078.827
433.770	433.802	2453097.270	2453097.302	2004092.770	2004092.802
450.168	**450.182**	**2453113.668**	**2453113.682**	**2004109.168**	**2004109.182**
496.600	496.640	2453160.100	2453160.140	2004155.600	2004155.640
516.840	519.010	2453180.340	2453182.510	2004175.840	2004178.010
528.770	532.800	2453192.270	2453196.300	2004187.770	2004191.800
721.000	722.000	2453384.500	2453385.500	2005014.000	2005015.000
1325.668	**1325.682**	**2453989.168**	**2453989.182**	**2006253.668**	**2006253.682**
1571.000	1578.000	2454234.500	2454241.500	2007134.000	2007141.000
1741.179	**1741.193**	**2454404.679**	**2454404.693**	**2007304.179**	**2007304.193**
2181.000	2182.000	2454844.500	2454845.500	2009013.000	2009014.000
2455.000	2461.000	2455118.500	2455124.500	2009287.000	2009293.000
2491.632	**2491.640**	**2455155.132**	**2455155.140**	**2009323.632**	**2009323.640**
3035.000	3037.000	2455698.500	2455700.500	2011137.000	2011139.000
3327.620	3327.660	2455991.120	2455991.160	2012064.620	2012064.660
3850.000	3986.000	2456513.500	2456649.500	2013221.000	2013357.000
4049.923	**4049.937**	**2456713.423**	**2456713.437**	**2014055.923**	**2014055.937**
4052.907	**4052.979**	**2456716.407**	**2456716.479**	**2014058.907**	**2014058.979**
4066.838	**4066.845**	**2456730.338**	**2456730.345**	**2014072.838**	**2014072.845**
4236.682	**4236.692**	**2456900.182**	**2456900.192**	**2014242.682**	**2014242.692**
4792.933	**4792.953**	**2457456.433**	**2457456.453**	**2016068.933**	**2016068.953**
5932.000	5942.000	2458595.500	2458605.500	2019112.000	2019122.000

Table 4: V27 bad time ranges. Data within these time ranges is not included in the delivered data. Time ranges that are new to V27 are shown in **BOLD.** This is V3 of the SORCE-SIM bad time ranges file.

13) IRRADIANCE UNCERTAINTIES:

V27 marks the first release in which uncertainties are reported with the irradiance data.

a. The reported uncertainties are the difference between the SIMA and SIMB L3 irradiance measurements. This approach assumes that any statistical uncertainties or systematic uncertainties associated with individual parameters of the irradiance measurement and corrections (prism degradation, wavelength alig nment, etc.) are accounted for in the final uncertainty measurement. The L3 uncertainty is thus a single measurement of the total uncertainty of the observational and degradation correction characteristics of the SIM instrument.

b. To accurately compare SIMA and SIMB L3 data, both channels must have OBC/jump corrections applied to the irradiance. This removes systematic offsets in the irradiance due to known instrument performance problems caused by spacecraft events.

c. The SIMB data was not processed to L3 in previous versions, so there were no previous SIMB jump corrections available for reference. SIMB jump corrections were calculated, and applied, outside of the JAVA processing code using IDL.

d. Due to detector-specific data characteristics, each detector was processed independently. The uncertainty process is described for each detector below. In all detectors, the uncertainty is set to 0.0 when the irradiance is 0.0. Most often the irradiance is 0.0 because missing values were not filled from a previous scan, or the wavelength is in the 306−310 nm bandpass with SD < 800.

   i. **UV**: Jump correction temporal locations were determined by examining the L2 UVB data. Jump locations are not informed by the UVA corrections, preventing forcing UVB to match the UVA trend. Residual irradiance differences translate to systematic instrumental uncertainties and reflect the inability of the measurement to account for non-common mode behavior in the two instruments.

   ii. **VIS:** The VISB jumps were performed identically to the UVB procedure.

   iii. **IR**: The SIMB IR detector has long been affected by considerable scatter in the irradiance measurements. This scatter is significant enough that there is no reliably discernible trend in the IRB irradiance, or correlation to the solar cycle. This prevents comparing the SIMA and SIMB IR data as in the UV and VIS. Instead, a single value of 2.5E-4 W m^{-2} nm^{-1} is reported for all SIMA IR uncertainties at every wavelength and timestamp. This value is roughly equivalent to the uncertainty of the TSIS-1 SIM IR diode measurement.

   iv. **ESR**: The ESR detector is used for 3 different observation activities: IR_Scans, Table_Scans, and Full_Scans. Data taken in the IR_Scans is the published ESR data. During analysis, it was determined that the ESRB IR_Scan observation commanding was not optimal for most of the mission. The ESRB commanding template excluded many of the SIMA IR_Scan wavelengths (1600–2400 nm), leaving little data available for comparison.

      1. Instead of using the IR_Scans, ESR Full_Scan observations were used to calculate irradiance uncertainties. The number of concurrent ESRA+B Full_Scan observations is limited (20 at most wavelengths). These provide a good estimate of the instrument differences at the times of observation, but yields limited information to the trending over the mission.
      2. Uncertainties were calculated by determining the difference between the L2 ESRA and B full scan irradiances. Because there are fewer ESRB scans, the differences were determined only at the ESRB observation times, then interpolated to the ESR wavelength scale and observation times.
      3. Due to the high variability of the measurements, the ESRA uncertainty at each wavelength, for all observation times, is the average of the absolute value of the ESRA-ESRB irradiance differences.

The following series of figures illustrate the various stages of the uncertainty calculation. Figure 17 shows the SIMB measurements at 250 nm (UV) and 500 nm (VIS), with, and without, the jump corrections. Figure 18 compares jump-corrected SIMA and SIMB data for 250 nm (UV) and 500 nm (VIS). In this figure, the differences between the SIMA and SIMB measured irradiances are highlighted, as the reported uncertainties are derived from these differences. Figure 18 shows the derived uncertainties for 250 nm (UV) and 500 nm (VIS) in both irradiance (W m^{-2} nm^{-1}) and percentage difference. Figure 20 illustrates the derived ESRA uncertainties, in percentage, at 2005 nm.

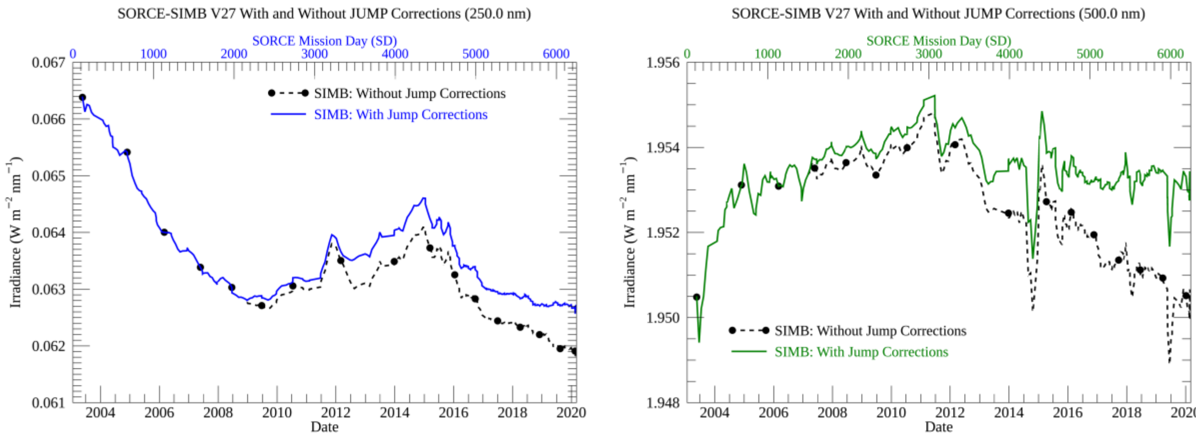

Figure 17: Left panel shows UVB data at 250 nm with, and without (black dashed line with black dots), jump corrections. Right panel shows VISB data at 500 nm. Calendar date is shown on the bottom axis, and SORCE mission day (SD) on the top axis.

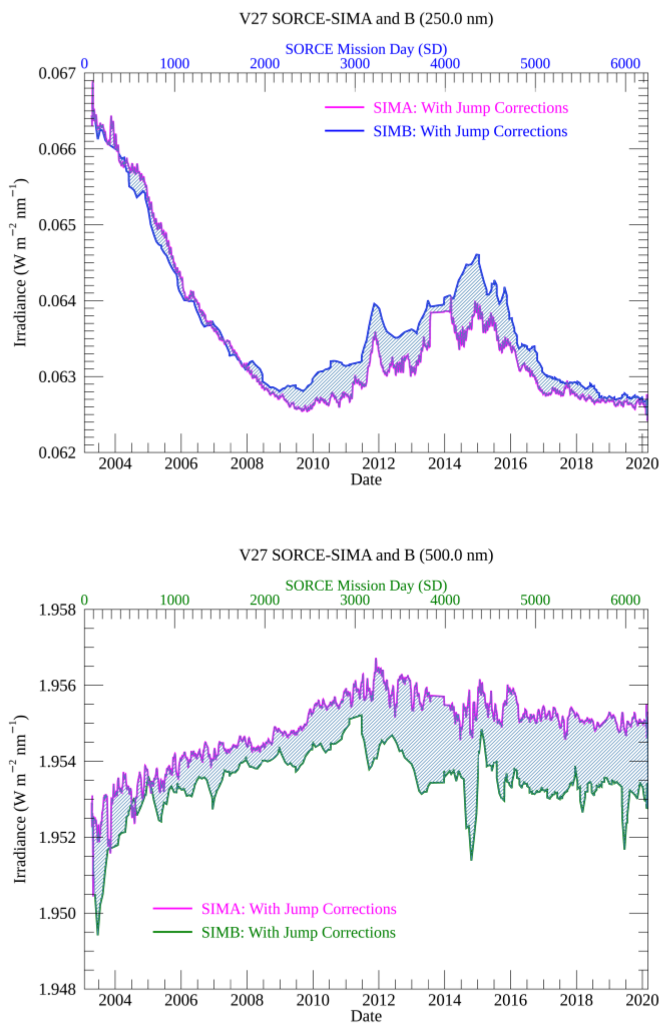

Figure 18: Top panel shows jump-corrected UVA and UVB irradiance at 250 nm. Bottom panel shows jump-corrected VISA and VISB irradiances at 500 nm. The reported uncertainties are derived from the differences between the SIMA and SIMB jump-corrected irradiances, shown as the grey hatched area. Calendar date is shown on the bottom axis, and SORCE mission day (SD) on the top axis.

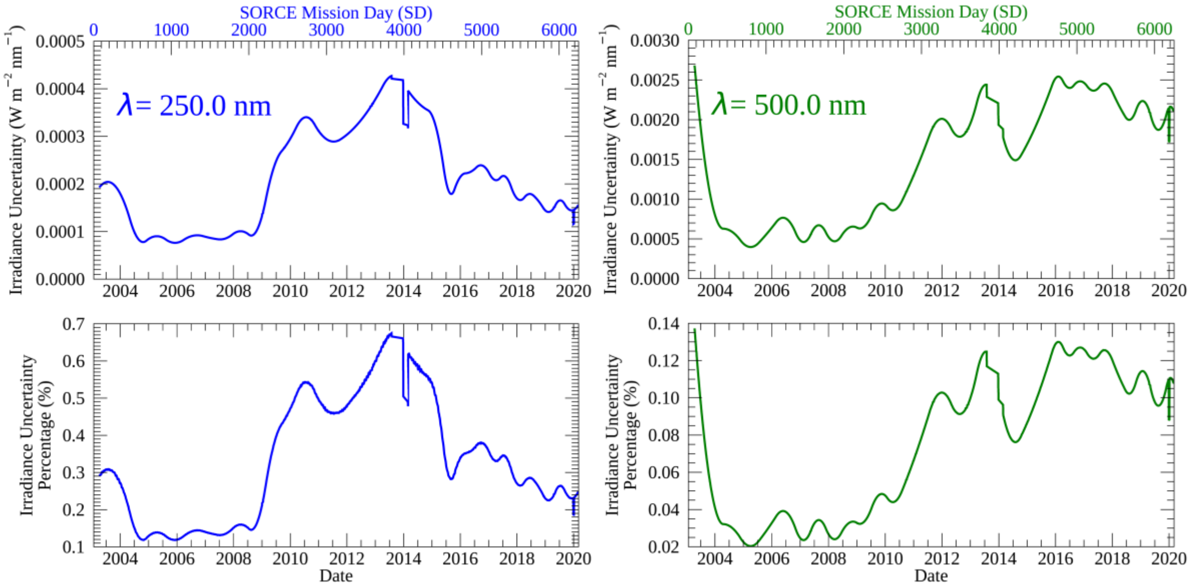

Figure 19: Left panel shows V27 reported UVA 250 nm irradiance uncertainties in both W m^{-2} nm^{-1} (top) and in percentage (%, bottom). Right panel shows VISA 500 nm uncertainties. Calendar date is shown on the bottom axis, and SORCE mission day (SD) on the top axis.

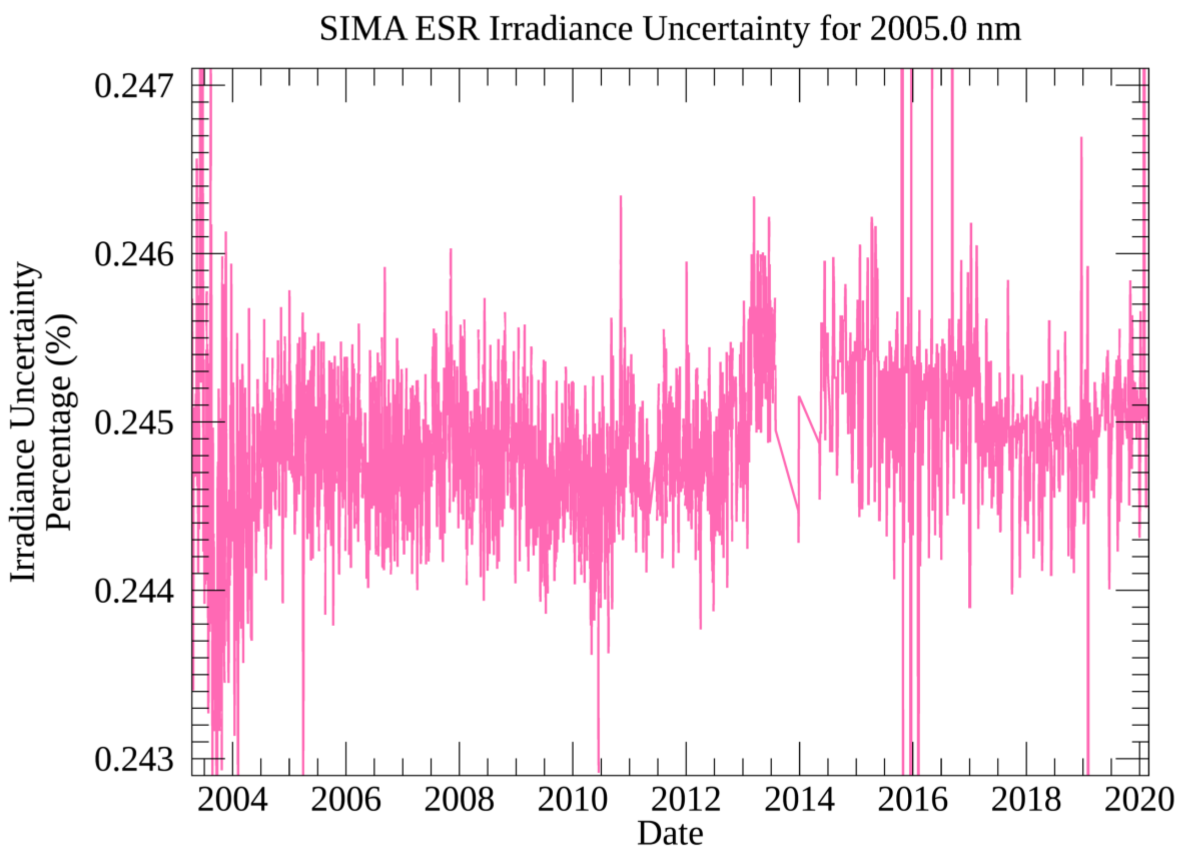

Figure 20: V27 ESRA 2005 nm irradiance percentage uncertainty. For the ESR, the uncertainty is a constant for each wavelength for the entire mission. Different wavelengths are assigned different constant values based upon the ESRA-ESRB differences.

a. Three new On-board Computer (OBC) SIMA "Jump" corrections were included in V27 to account for spacecraft temperature excursions near and after the V26 data release at SD6040, SD6156, and SD6211. The SORCE mission ended about a month after this last jump correction (SD6241, 2/25/2020).
b. One new jump correction was added to all modes at the beginning of SIMB power cycling (SD3663), however the before and after windows were optimized for each mode.
c. One new IRA jump was added at the new temperature correction boundary (SD5866).
d. All ESRA DO-Op jump corrections were removed, except SD5158.
e. The net effect of the jump corrections, in terms of integrated Solar Spectral Irradiance (iSSI) is given in Figure 21. The times of the corrections, and the 'before' and 'after' windows are given in Appendix B. An example of the jump window locations for the end of the mission is shown in Figure 21.
f. Comparisons of SORCE-SIM V27 integrated Solar Spectral Irradiance (iSSI) and SORCE-TIM V19 TSI are given in Figures 22 and 23.
    i. For display purposes, 146.88 W/m^2 has been subtracted from the TIM TSI to account for the different bandpasses.
    ii. The original TIM scale is on the right axis.
    iii. The offset was calculated at the Solar Cycle (SC) 24 minimum defined here as SD2215±100 days.
g. Sample V27 vs V26 time-series are given in Figures 24 (UV at 308 nm), Figure 25 (VIS @ 550 nm), Figure 26 (IR @ 1230 nm) and Figure 27 (ESR @ 2000 nm). Figure 8 also shows the UV time-series at 280 nm, and Figure 11 the ESRA at 2096 nm.

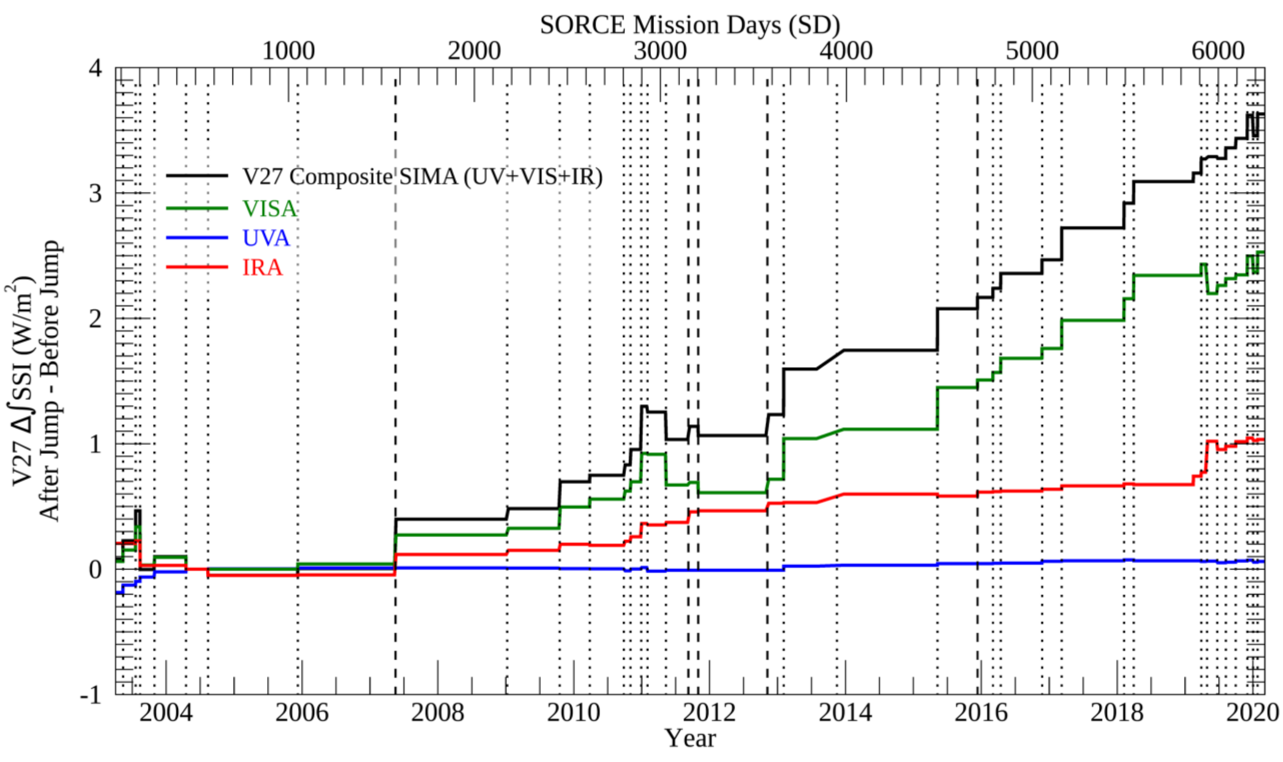

Figure 21: Cumulative V27 "Jump'' correction for each SIMA diode (and a composite) showing the integrated SSI (iSSI) adjustments as a function of SORCE mission day (SD) and calendar year. Vertical lines show the timestamp where an individual OBC/jump correction is applied. Some jumps were not warranted for the UVA channel, these vertical lines are shown with a bold dashed line. For reference, the SORCE-SIM iSSI on the SD453 reference day is 1214.3731 W m^{-2}, so the maximum composite jump correction is ~0.3%.

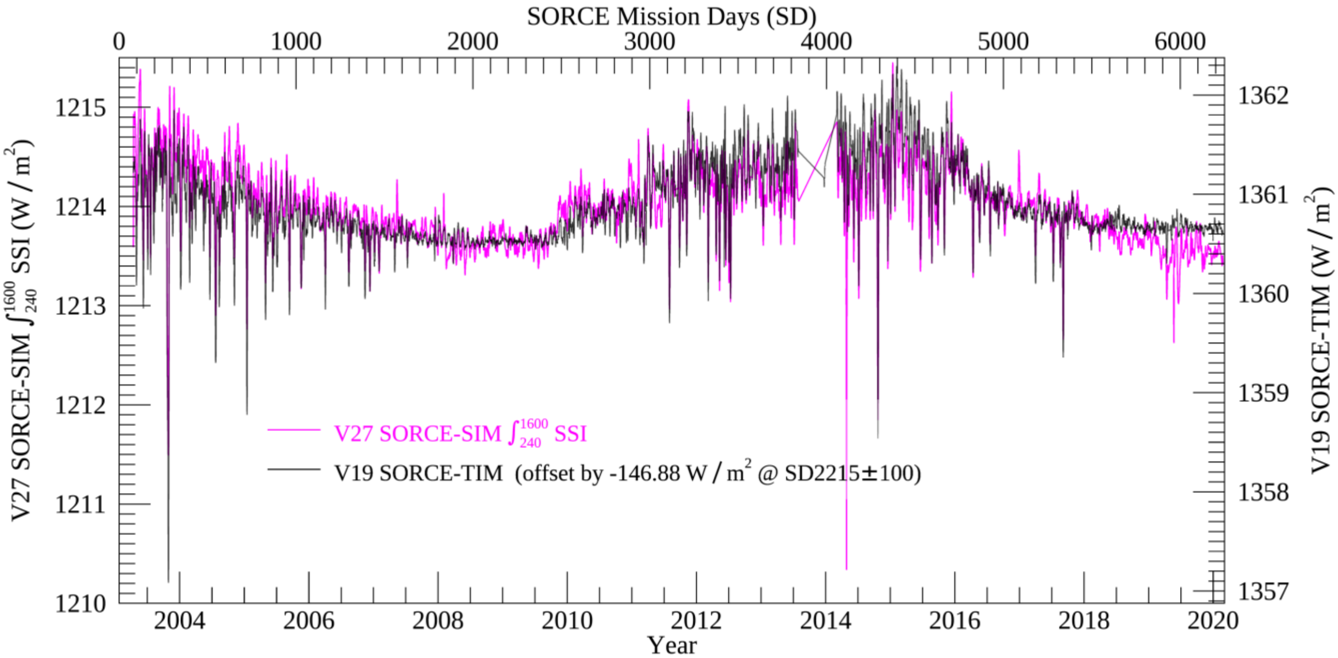

Figure 22: V27 integrated Solar Spectral Irradiance (iSSI) vs. SORCE-TIM TSI V19 (black) by calendar year and SORCE mission day (SD, top). SORCE-SIM iSSI is a combination of the UV, VIS & IR channels from 240-1600 nm. The offset between TIM 19 and SIM V27 is -146.88 W m^{-2}, and is calculated at the SC24 minimum, defined here as SD2215±100 days. The left axis gives the SORCE-SIM iSSI in W m^{-2}, and has a value of 1214.3731 at our reference day of SD453. The right axis gives the SORCE-TIM V19 TSI in the same units. See Figure 23 for the difference between the two measurements.

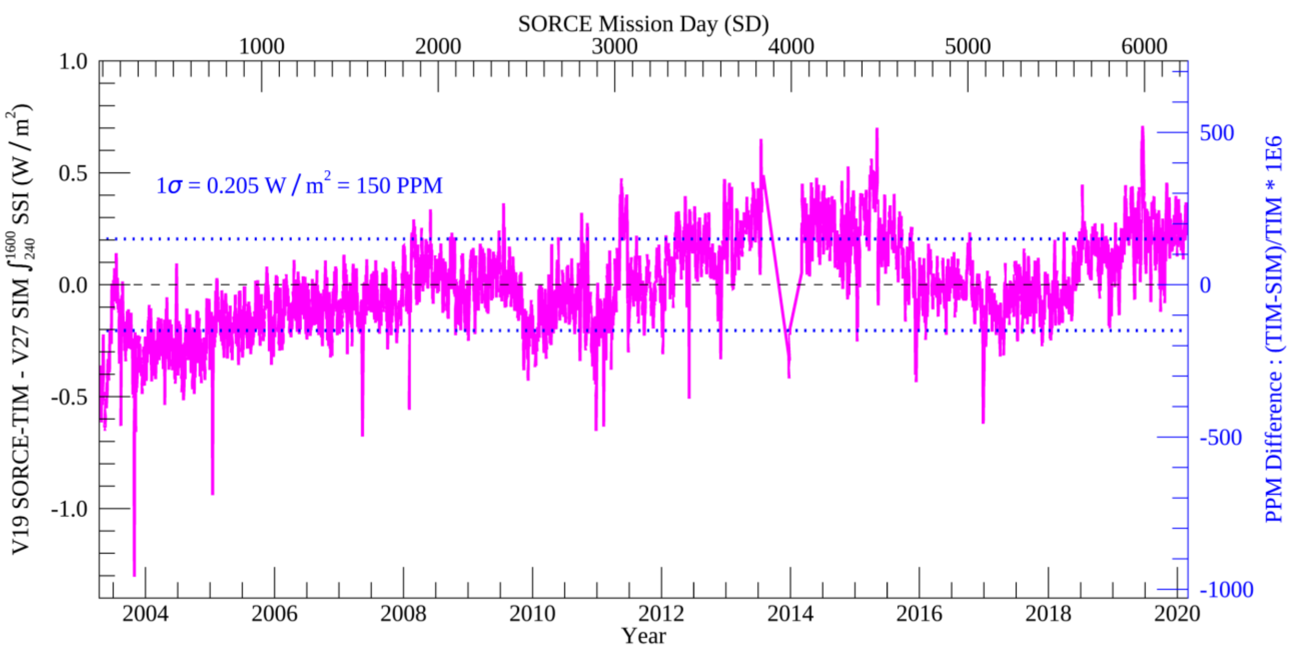

Figure 23: SORCE-TIM V19 TSI minus SORCE-SIM V27 iSSI in W m^{-2} (left axis) and PPM (parts per million) difference (right axis). PPM is defined as (TIM-SIM)/TIM after the TIM-SIM SC24 minimum offset has been applied (see Figure 22).

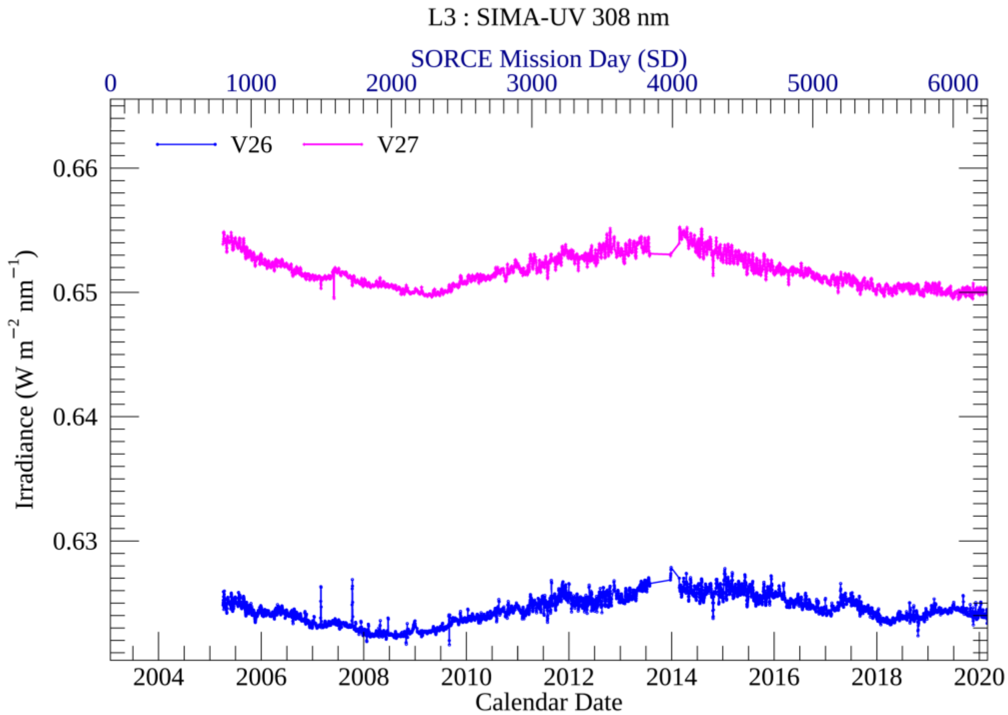

Figure 24: Comparison of 308 nm UVA time series for V27 & V26. This is in the UV/VIS gap region that was added in V25; note that data in the 306−310 nm region is not published before SD800 due to saturation issues. This figure highlights the aleph adjustment in the UV/VIS gap region in V27. Calendar date is given on the lower axis, and SORCE Mission Day (SD) is given on the top axis.

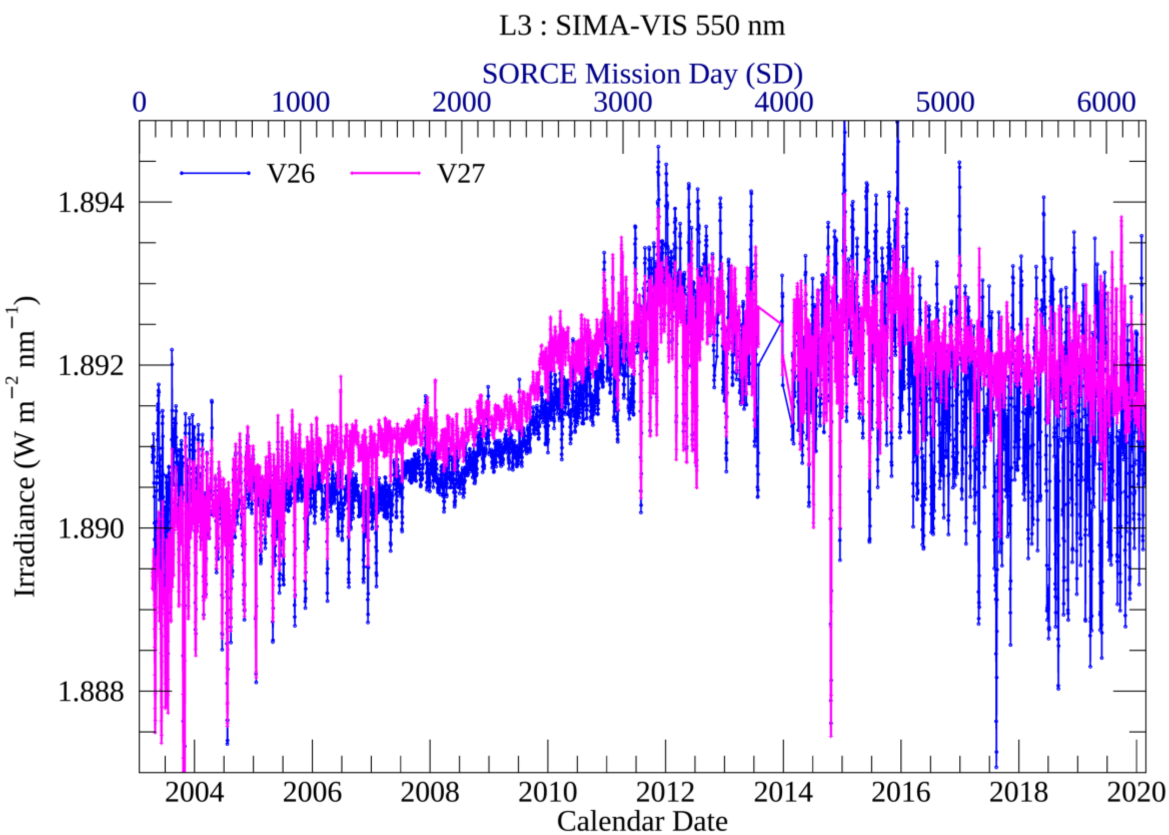

Figure 25: Comparison of 550 nm VISA time series for V27 & V26. Note the significant noise reduction in V27 during DO-Op (SD > 4000).

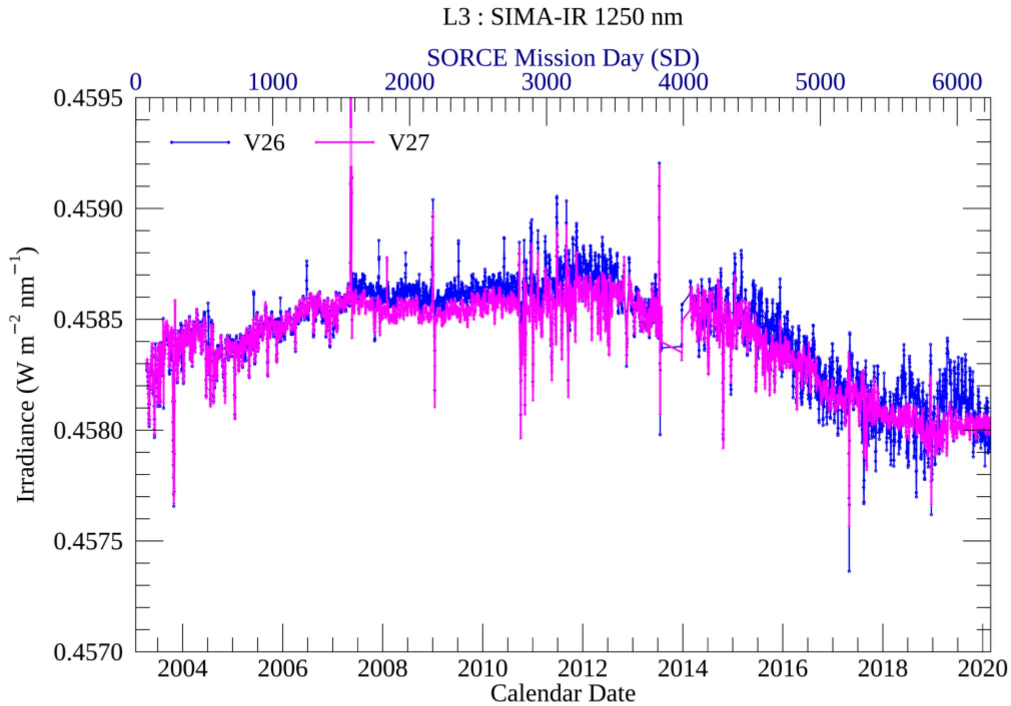

Figure 26: Comparison of 1250 nm VISA time series for V27 & V26. Note the significant noise reduction in V27 during DO-Op (SD > 4000), and the jump correction change at SD1575.

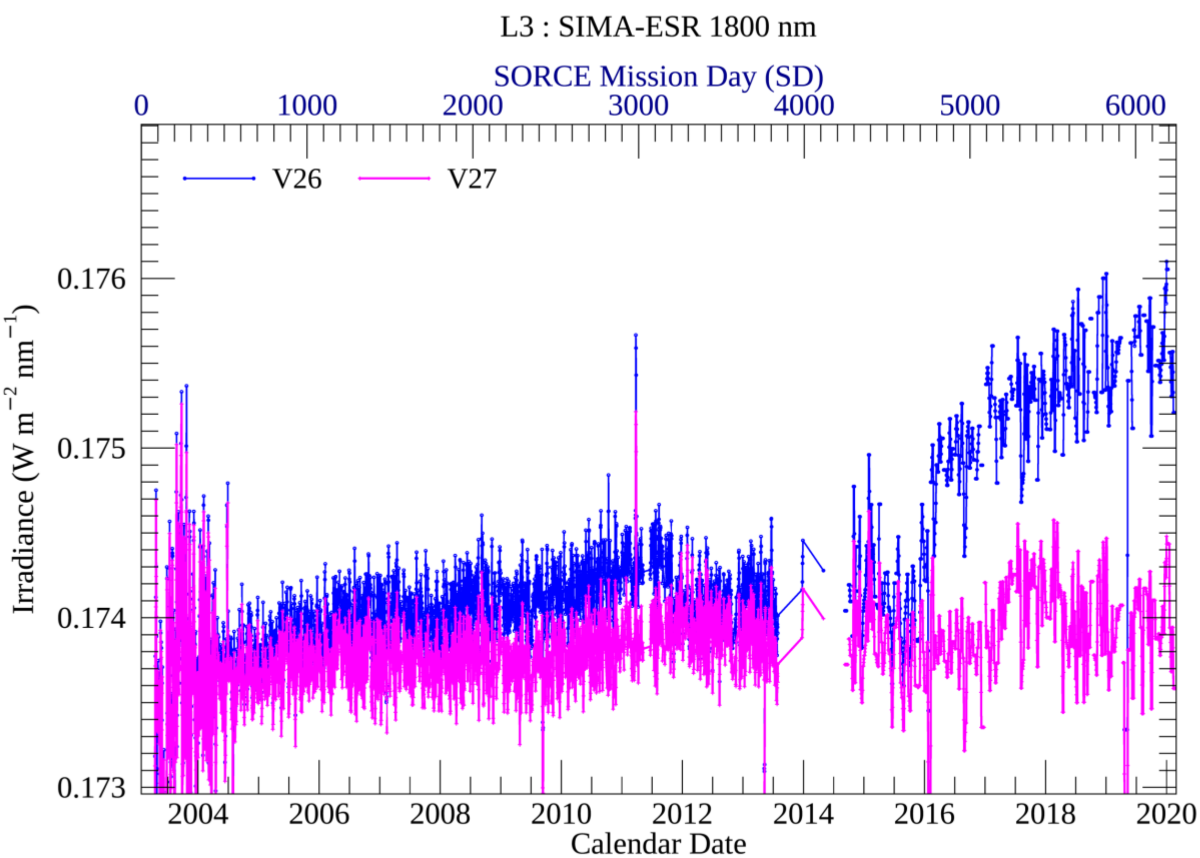

Figure 27: Comparison of 1800 nm ESRA time series for V27 & V26. Note the removal of the erroneous irradiance trend seen in V26 ESRA data during DO-Op (SD > 4000) in V27.

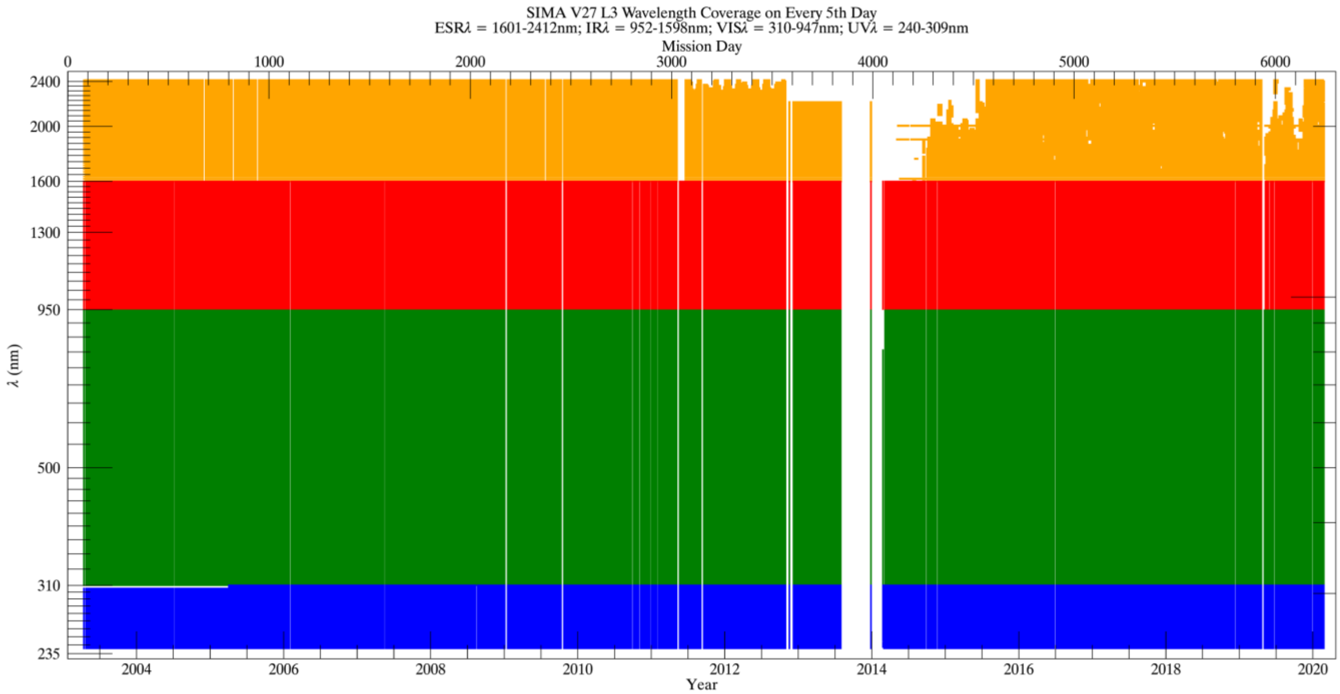

Figure 28: Data acquisition record for all SIMA instrument modes from 01/23/2003, the beginning of the mission (SD0), to 02/25/2020 (SD6241, the end of the mission). Every fifth day is plotted, so not all data gaps are visible. Note the decreased ESRA coverage (1600 < λ < 2400 nm) during Day-Only Operations (DO-Op), (SD4065–SD6241), and the UV bandpass change (306—310 nm) starting 04/04/2005 (SD800).

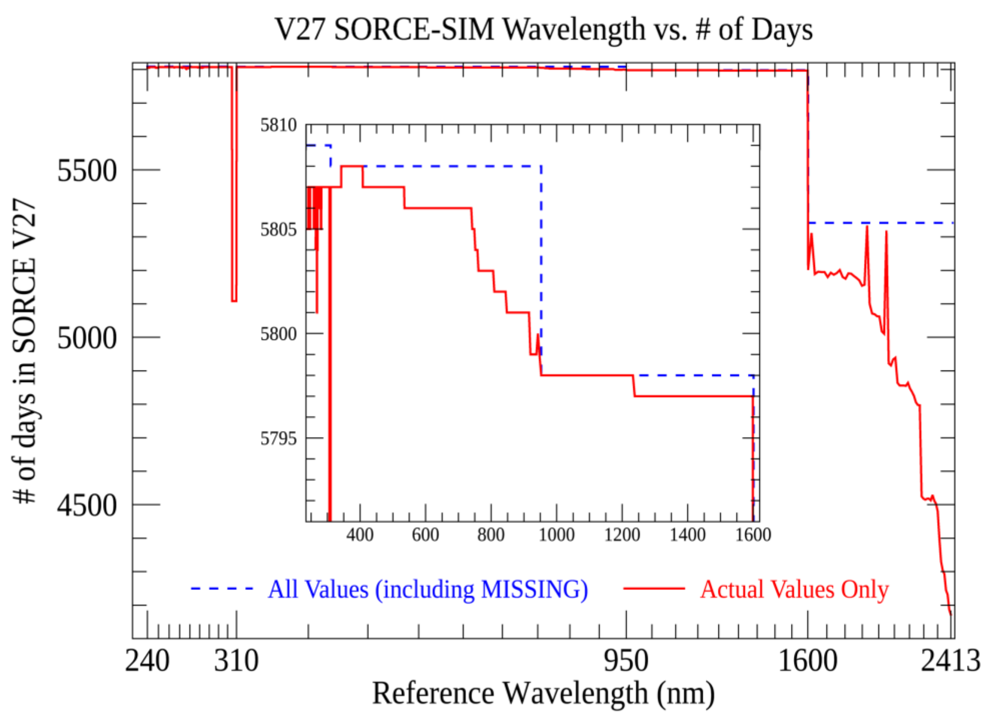

Figure 29: Alternate visualization of the data acquisition record for all SIMA instrument modes for the entire mission. The number of days that data was acquired is plotted versus wavelength. Note the decreased ESR coverage (1600 < λ < 2400 nm), and the change in UV bandpass (306-310 nm) starting on April 4, 2005 (SD800).

APPENDIX B: V27 OBC/JUMP CORRECTION TABLES

After merging all appropriate observations ("scans") into daily SIMA Diode and ESR spectra, periodic corrections are applied to compensate for instrumental anomalies. The majority of these anomalies are associated with on-board computer (OBC) lockups or other spacecraft outages that result in cold temperatures:

The tables below for ESRA (Table A1), VISA (Table A2), UVA (Table A3), and IRA (Table A4) give the 'before' and 'after' jump time windows, and the window centers. The times in this table are in SORCE Mission Days (SD), as this is timescale used in the JAVA processing code. The first SORCE mission day (SD0) was January 24, 2003. The names in these tables are also those from the JAVA processing code:

- beforeStart = The starting time for the pre-event irradiance window.
- beforeEnd = The ending time for the pre-event irradiance window.
- afterStart = The starting time for the post-event irradiance window.
- afterEnd = The ending time for the post-event irradiance window.
- correctionTime = The time associated with the correction. Observations after this time get an irradiance adjustment based upon the average irradiance in the 'before' and 'after' windows.

beforeStart	beforeEnd	afterStart	afterEnd	correctionTime
78.00	89.00	114.00	134.00	110.00
163.00	173.00	182.00	190.85	178.00
167.00	173.50	210.70	224.00	201.70
254.00	272.00	287.80	297.00	278.80
425.00	444.00	459.00	477.00	449.00
522.00	540.00	590.00	619.00	567.00
1000.00	1020.00	1065.70	1100.00	1050.00
2130.00	2147.00	2190.00	2209.00	2176.00
2425.00	2448.00	2463.00	2477.00	2458.00
2575.00	2602.00	2632.00	2668.00	2619.80
2771.50	2801.50	2824.40	2830.40	2803.00
2825.50	2829.50	2852.00	2868.00	2839.00
2857.00	2873.00	2906.00	2926.00	2897.00
2906.50	2920.50	2967.50	2985.00	2930.00
3009.60	3026.00	3091.50	3103.50	3030.00
3646.00	3650.00	3681.00	3687.00	3663.00
3758.50	3772.00	4129.50	4155.60	3949.00
5144.00	5156.60	5167.00	5176.90	5158.00

Table A1: Mode 31 (ESRA) OBC/Jumps Times and Window Assig nments

beforeStart	beforeEnd	afterStart	afterEnd	correctionTime
78.00	89.00	114.00	134.00	110.00
163.00	173.00	182.00	190.85	178.00
167.00	173.50	210.70	224.00	201.70
254.00	272.00	287.80	297.00	278.80
425.00	444.00	459.00	477.00	449.00
522.00	540.00	590.00	619.00	567.00
1000.00	1020.00	1065.70	1100.00	1050.00
1561.60	1569.00	1604.00	1615.50	1575.00
2130.00	2147.00	2190.00	2209.00	2176.00
2425.00	2448.00	2463.00	2477.00	2458.00
2575.00	2602.00	2632.00	2668.00	2619.80
2771.50	2801.50	2824.40	2830.40	2803.00
2825.50	2829.50	2852.00	2868.00	2839.00
2857.00	2873.00	2906.00	2926.00	2897.00
2906.50	2920.50	2967.50	2985.00	2930.00
3009.60	3026.00	3091.50	3103.50	3030.00
3093.00	3107.00	3172.00	3180.50	3150.50
3175.90	3184.00	3252.55	3261.00	3203.00
3551.00	3562.00	3605.50	3617.50	3575.00
3611.90	3637.60	3676.10	3713.60	3663.00
3758.50	3772.00	4129.50	4155.60	3949.00
4466.20	4480.60	4536.60	4561.60	4490.00
4645.50	4667.30	4734.00	4771.50	4705.00
4767.80	4785.00	4789.00	4800.60	4788.00
4800.90	4820.00	4840.00	4860.00	4830.00
5039.00	5046.00	5069.00	5086.90	5052.10
5144.00	5156.60	5167.00	5176.90	5158.00
5446.00	5469.00	5500.00	5530.00	5493.10
5500.00	5530.00	5576.00	5595.00	5545.00
5880.00	5890.00	5915.20	5921.20	5908.00
5915.20	5921.00	5944.50	5991.00	5939.00
5915.00	5921.00	6010.00	6034.00	5994.00
6010.00	6034.00	6048.00	6084.50	6040.00
6048.00	6084.50	6099.00	6138.50	6093.50
6140.50	6154.00	6162.90	6180.00	6156.20
6162.90	6180.00	6191.00	6210.00	6187.00
6195.00	6210.00	6212.90	6242.00	6211.00

Table A2: Mode 41 (VISA) OBC/Jumps Times and Window Assig nments

beforeStart	beforeEnd	afterStart	afterEnd	correctionTime
78.00	89.00	114.00	134.00	110.00
163.00	173.00	182.00	190.85	178.00
167.00	173.50	210.70	224.00	201.70
254.00	272.00	287.80	297.00	278.80
425.00	444.00	459.00	477.00	449.00
522.00	560.00	590.00	619.00	567.00
1005.00	1030.00	1065.70	1082.00	1050.00
2130.00	2147.00	2190.00	2209.00	2176.00
2425.00	2448.00	2463.00	2477.00	2458.00
2575.00	2602.00	2632.00	2668.00	2619.80
2771.50	2801.50	2824.40	2830.40	2803.00
2825.50	2829.50	2852.00	2868.00	2839.00
2857.00	2873.00	2906.00	2926.00	2897.00
2906.50	2920.50	2967.50	2985.00	2930.00
3009.60	3026.00	3091.50	3103.50	3030.00
3646.00	3650.00	3681.00	3687.00	3663.00
3758.50	3772.00	4129.50	4155.60	3949.00
4464.20	4474.30	4538.60	4548.30	4490.00
4767.80	4785.00	4789.00	4800.60	4788.00
4800.90	4820.00	4840.00	4860.00	4830.00
5039.00	5046.00	5069.00	5086.90	5052.10
5144.00	5156.60	5167.00	5176.90	5158.00
5446.00	5469.00	5500.00	5530.00	5493.10
5500.00	5530.00	5576.00	5595.00	5545.00
5880.00	5890.00	5915.20	5921.20	5908.00
5915.20	5921.00	5944.50	5991.00	5939.00
5915.00	5921.00	6010.00	6034.00	5994.00
6010.00	6034.00	6048.00	6084.50	6040.00
6048.00	6084.50	6099.00	6138.50	6093.50
6140.50	6154.00	6162.90	6180.00	6156.20
6162.90	6180.00	6191.00	6210.00	6187.00
6195.00	6210.00	6212.90	6242.00	6211.00

Table A3: Mode 43 (UVA) OBC/Jumps Times and Window Assig nments

beforeStart	beforeEnd	afterStart	afterEnd	correctionTime
78.00	89.00	114.00	134.00	110.00
163.00	173.00	182.00	190.85	178.00
167.00	173.50	210.70	224.00	201.70
254.00	272.00	287.80	297.00	278.80
425.00	444.00	459.00	477.00	449.00
522.00	540.00	590.00	619.00	567.00
1000.00	1020.00	1065.70	1100.00	1050.00
1561.60	1569.00	1604.00	1615.50	1575.00
2130.00	2147.00	2190.00	2209.00	2176.00
2425.00	2448.00	2463.00	2477.00	2458.00
2575.00	2602.00	2632.00	2668.00	2619.80
2771.50	2801.50	2824.40	2830.40	2803.00
2825.50	2829.50	2852.00	2868.00	2839.00
2857.00	2873.00	2906.00	2926.00	2897.00
2906.50	2920.50	2967.50	2985.00	2930.00
3009.60	3026.00	3091.50	3103.50	3030.00
3093.00	3107.00	3172.00	3180.50	3150.50
3175.90	3184.00	3252.55	3261.00	3203.00
3551.00	3562.00	3605.50	3617.50	3575.00
3646.00	3650.00	3681.00	3687.00	3663.00
3758.50	3772.00	4129.50	4155.60	3949.00
4464.20	4474.30	4538.60	4548.30	4490.00
4645.50	4667.30	4734.00	4771.50	4705.00
4767.80	4785.00	4789.00	4800.60	4788.00
4800.90	4820.00	4840.00	4860.00	4830.00
5039.00	5046.00	5069.00	5086.90	5052.10
5144.00	5156.60	5167.00	5176.90	5158.00
5446.00	5469.00	5500.00	5530.00	5493.10
5500.00	5530.00	5576.00	5595.00	5545.00
5815.00	5845.00	5870.00	5906.00	5865.70
5880.00	5890.00	5915.20	5921.20	5908.00
5915.20	5921.00	5944.50	5991.00	5939.00

Table A4: Mode 44 (IRA) OBC/Jumps Times and Window Assig nments