SORCE SIM Release Notes for Version 20, Level 3 data product

SIM data in LISIRD (see: http://lasp.colorado.edu/lisird/sorce/) covers the wavelength range 310.25 to 2412.34 over the extended time span of 2003/4/14 to 2013/08/09. This dataset includes the first year of the mission and up to the time of the major battery failure when the instruments were turned off for several months. Several issues with the data were addressed in version 20 but some still remains. Section 1 below, lists the improvements made from version 19, Section 2 assesses the data and Section 3 presents the current list of issues that will be addressed in the next release.

SIM data on the SORCE website (see: http://lasp.colorado.edu/home/sorce/data/) will now include the wavelength range extended in the ultraviolet to 240.02 to partially overlap with the SOLSTICE data product and give the user the option to use either of these data sets. An IDL reader for the ASCII format is available at: http://lasp.colorado.edu/home/sorce/data/lasp.colorado.edu/sorce/file_readers/read_lasp_ascii_file.pro

Section 1
Version 20 of the SIM data product includes many changes from Version 19.

- Each spectrum is now being re-aligned in wavelength space before calibrating.
- Improved diode temperature corrections.
- Improved values for the ray path corrections corresponding to a more consistant wavelength degradation factor across the different detectors (see Figures 1a and 1b).
- Addition of a new one-AU factor for the ray-path with much improved overall one-AU correction for the degradation model.
- Improved diode degradation corrections.
- Improved agreement between the two instruments SimA and SimB
- Improved agreement between integrated SSI and TIM time series over the whole mission

Section 2
The UV diode covers the range from 240 to 306 nm. The VIS diode covers the range from 310 to 950 nm and the IR diode covers 950 to 1600 nm. A gap in the wavelength coverage exists between 306 and 310 nm.

The quality of the degradation correction is not as good for the first three months of the mission (2003/04/14 to 2003/07/21) and residual trends can still be seen. The same applies to the later part of the mission after starting the power cycling of the instrument (2011/05/10) as can be seen by the larger changes in the irradiance and from the differences seen between the VIS and IR diodes in their region of overlapping wavelengths. These are indicative of residual temperature correction adjustment and possibly a ray path adjustment.

To improve the agreement with TIM and conserve the coherence between SimA and SimB, a new “effective solar exposure” record was determined. Adjustments to the solar exposure were made for SimA and SimB for the UV and VIS detectors. The Figure 1c) below represents the new “effective solar exposure” with the solar exposure from the telemetry records.

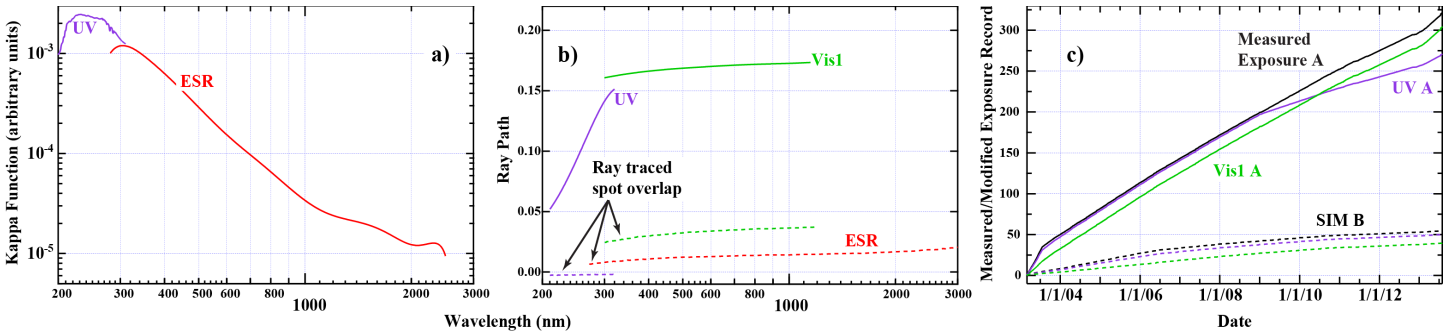

Figure 1. The three panels in this graph show the final parameter set that is used to construct the degradation function. Panel a) is the absorption coefficient (κ). Panel b) shows the values of the ray path that are used in the final data processing along with the initial values determined from the ray trace analysis (dashed lines) and the modifications to the UV and Vis1 photodiodes that are used to match the ESR trend. Panel c) shows the modification to the solar exposure record to simultaneously satisfy both agreement of the integrated SIM to approximate the TSI and to match the A & B spectrometers.

The occurrence of the spacecraft/instrument events affect the trends in the different detectors and time regimes differently. The estimated long-term trends are deduced from the scatter of degradation corrected SIMA and SIMB time series at common measurement times and within the boundaries between spacecraft events. Table 1 lists these events.

Table 1

Date (UT)	Spacecraft/instrument event
2003/04/19.1	OBC reset
2003/08/13.5	Overheat anomaly
2003/10/28.6	Cold soak experiment
2004/04/18.0	Prism rotation encoder corrected
2007/05/14.9	OBC reset
2009/01/05.0	OBC reset
2009/10/14.5	Safehold, Battery under-voltage
2010/09/27.0	OBC reset
2010/11/01.0	OBC reset
2010/12/27.0	OBC reset
2011/01/29.0	OBC reset
2011/05/16.0	CPV 10 failure (battery failure)
2011/05/10.0	Start of power cycling
2013/08/09.0	Battery Failure

The general level of agreement in the SIM A&B traces provides an objective way to determine the effectiveness of the degradation corrections as well as the agreement of the integrated SSI to the measure TSI from the TIM instrument. Figure 2 below depicts the level of agreement between SimA and SimB for the UV and VIS photodiodes.

For comparison with the TSI, SIM spectrum integrated from 240-1630 nm accounting for about 90% of the TSI. Over the SIM integration range the average difference is 139.57 Wm^{-2} with standard deviation of 0.22 Wm^{-2}; the solar minimum value of the integrated SIM is 1221.15 Wm^{-2} yielding a 1σ difference of 180 ppm (parts per million). The structure seen in the difference plot (Figure 3b) is indicative of the magnitude of the overall systematic error in the data corrections. Figure 4 represents the level of agreement between TIM and integrated SSI we obtained for version 19.

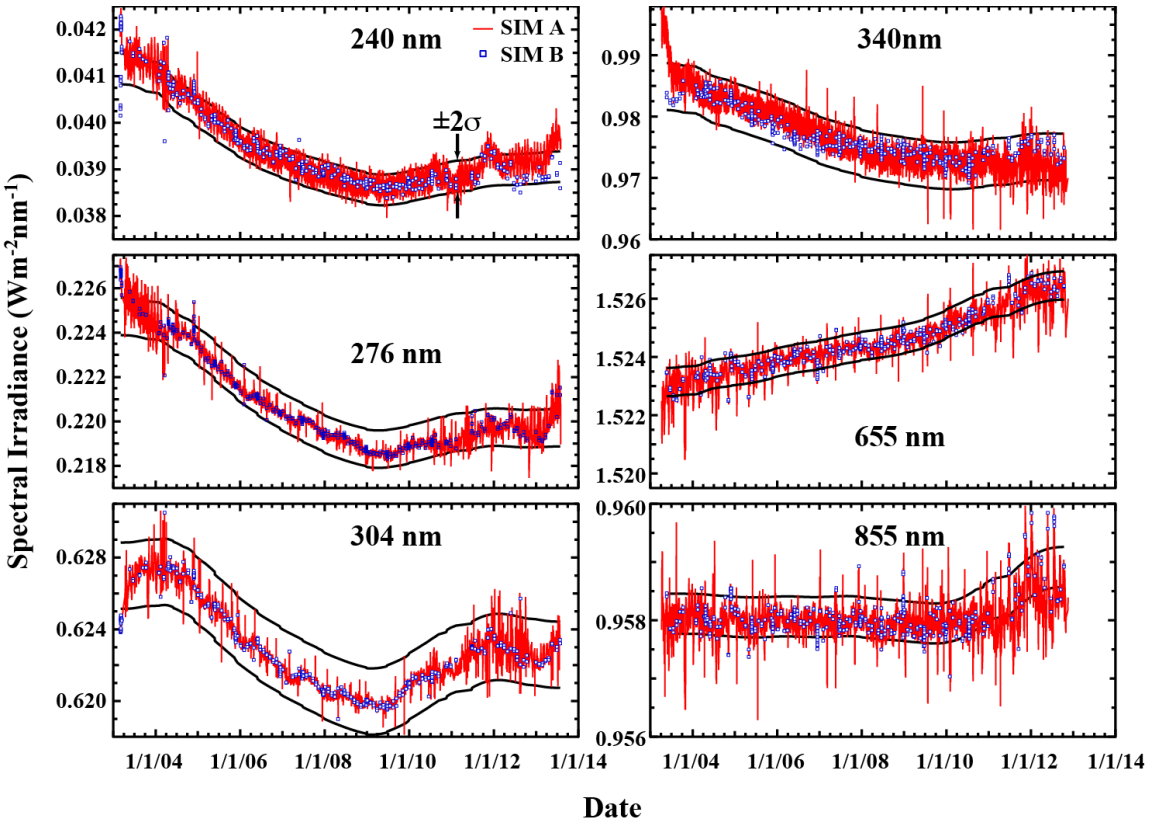

Figure 2. Comparison corrected irradiance of SIM A and B for six wavelengths in the UV and visible portions of the spectrum. Plots in the left hand column are from the UV photodiode while the plots on the right are for the VIS photodiode. The black envelope curves are estimates of the ±2σ trend uncertainties discussed in this section.

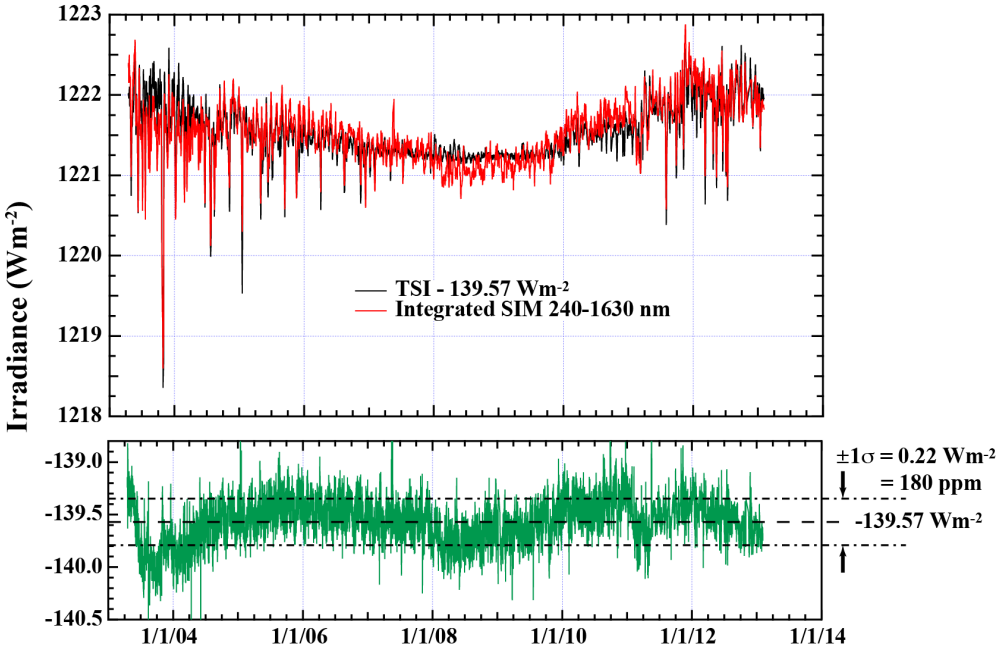

Figure 3. Panel a) is a comparison of the integrated SIM with the TSI with a subtracted offset of 139.57 Wm^{-2} subtracted so the plots can be overlaided. Panel b) is a difference plot between coincident integrated SIM and TIM. The same offset appears in this plot with a mission length standard deviation of 0.22 Wm^{-2}.

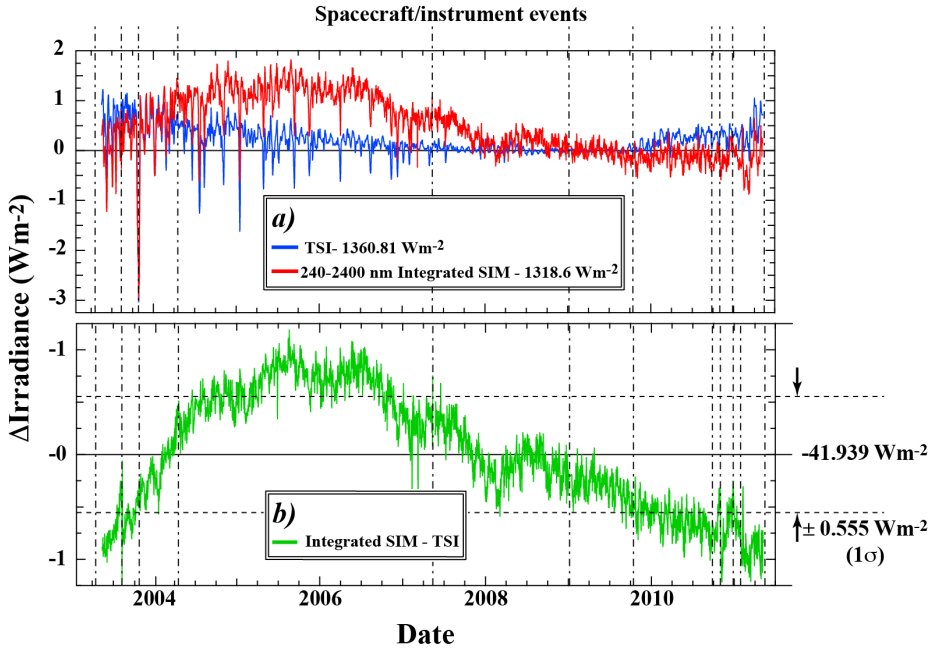

Figure 4. Compares the SIM spectrum integrated from 240 to 2400 nm from **VERSION 19** to the SORCE TSI for. The 1-σ difference is ±0.555 Wm^{-2} after accounting for the irradiance shortfall. This difference amounts to about 400 ppm integrated uncertainty distributed over 1226 measurement channels.

Section 3

Plan for SIM Version 21:

- After many iterations, the best agreement with the TSI measurement was obtained using a different effective solar exposure for the UV and the VIS photodiodes. In version 21, we will expand our analysis to optimize a new effective solar exposure that can be applied uniformly to all detectors.
- The ESR data remains significantly noisier after the start of the power cycling. These are attributed to either changes in the electrical characteristics of the ESR or a potential lag in the measured and actual temperatures of the ESR. These will be further investigated in version 21.
- A clear remaining temperature effect can be seen in the IR photodiode in the latter part of the mission, and to a lesser extend in the VIS photodiode. Initial investigations indicate that the temperature response of these photodiodes may be changing over the course of the mission. These will be addressed in version 21.
- Version 21 will also include the calibrated irradiance data taken in the hybrid mode since March 2014 up to the current day of the release.
- Version 21 will also re-instate the daily processing and publishing of the SORCE SIM data.
- Version 21 is planned for release in early 2015.