

SNS • **SORCE News Source**



Solar Radiation and Climate Experiment Monthly Newsletter

October 2004

SORCE Celebrates “NASA Group Achievement Award” –

SORCE team members celebrated receiving the “NASA Group Achievement Award” at LASP on October 1st with a late afternoon party. Principal Investigator Gary Rottman and Tom Sparn, SORCE Program Manager, distributed individual certificates to the original 2002 SORCE team members. Gary expressed his sincere appreciation and congratulated *everyone* who has been a part of the SORCE Mission through the years. He looks to the future and feels that we have much higher expectations and we should look forward to surpassing the five-year design lifetime, the six-year goal, and then moving into extended operations beyond 2008.

SORCE continues to exceed all of our expectations, and the spacecraft and instruments continue their flawless operation. Work continues on promoting future TSI



Gary Rottman stands beside the award presented to the SORCE team at the NASA Awards Ceremony in August.

and SSI measurements with new and improved SORCE instruments on future missions.

The “NASA Group Achievement Award” is presented to a group in recognition of an outstanding accomplishment which has been made through the coordination of many individual efforts and has contributed substantially to the accomplishment of the mission of NASA. The NASA Honor Awards Ceremony was held near Goddard on August 24, 2004.



Tom Sparn acknowledges that it was and continues to be a team effort to make this mission a success. He is very grateful to have worked with an extremely competent group of professionals. At the NASA Awards Ceremony in August, Tom was honored by receiving NASA's Public Service Award for outstanding leadership and exceptional contribution.



Sharon Dooley, Randy Davis, Nancy Brooks, and Gary Rottman express their appreciation to everyone for the contributions over the years to SORCE.

SORCE Data Processing Update –

By Chris Pankratz, LASP Data Processing

As part of the SORCE science team's ongoing effort to maximize the quality and scientific usability of the SORCE data products, new versions have recently been released for Total Solar Irradiance (TSI) and Spectral Solar Irradiance (SSI) measurements.



Chris Pankratz from LASP heads the SORCE Data Processing team. Chris first joined LASP in 1988 as an undergraduate student, continuing as a professional in 1991. After leaving LASP to pursue graduate studies, he rejoined LASP and has been working on SORCE since 1998. He also oversees the data processing systems for UARS SOLSTICE and AIM CIPS/CDE.

Total Solar Irradiance (TSI) Release

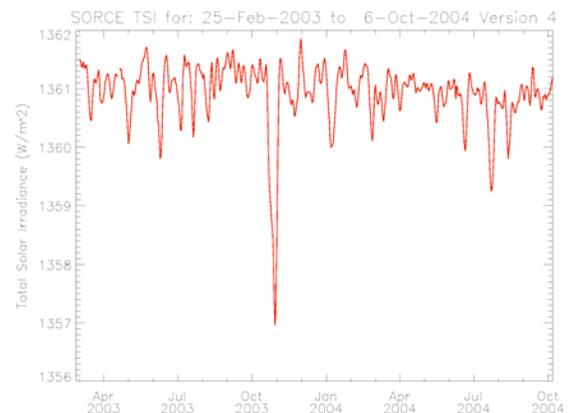
TSI measurements are made by the Total Irradiance Monitor (TIM) instrument on board the SORCE spacecraft, which provided ongoing measurements of TSI beginning in February 2003. In mid-September 2004, version 4 daily and 6-hourly TSI data products were made publicly available on the SORCE web site and at the [NASA GES DAAC](#). The most current release incorporates a number of updates to instrument characterization and data processing algorithms, including the following:

- Updated Instrument Linearity Correction, which takes into account recent measurements of linearity in the two TIM "witness" instruments, providing much better accuracy in the linearity correction, and reduces annual trends in the TIM TSI data to a few ppm (~100 ppm effect overall).
- Updated Dark Correction Algorithm to generate dark data with the same convolution filter that is used in the phase sensitive detection algorithm that produces the primary TSI irradiances.
- Updated servo gain calibration to include ongoing in-flight characterization measurements.
- Updated cone degradation correction.
- Filter for data spikes due to occasional telemetry glitches.
- Minor bug fixes and performance improvements.

The standard "Level 3" TSI science data products consist of daily and 6-hourly average irradiances, reported at zero relative line-of-sight velocity with respect to the Sun at both a mean solar distance of 1 astronomical unit (AU) and at the true Sun-Earth distance. Two

TSI data products are produced - one containing daily means and the other containing four 6-hourly means. Each TSI product contains science results for the entire SORCE mission, beginning February 25, 2003. Updates to Level 3 TSI data occur monthly. To construct these products, high time cadence measurements (every 50 seconds) from the TIM instrument are combined to produce representative daily and 6-hourly values of the TSI. Shuttered operation of the instrument corrects for thermal background, and state-of-the-art phase sensitive detection algorithms applied to the data at the shutter fundamental reduce noise and sensitivity to drifts. The TIM shutter period is 100 seconds; four such cycles are weighted to give a single irradiance measurement at a 50 second cadence. These so-called "Level 2" data are averaged over an entire day as well as over each 6-hour interval to formulate the two primary TSI data products.

On-orbit instrument characterization is an ongoing effort, although only minor corrections are anticipated at this phase in the SORCE/TIM mission. The TIM instrument is proving very stable with on-orbit solar exposure, and long-term relative uncertainties are estimated to be less than 0.014 W/m²/yr (10 ppm/yr). Present absolute accuracy is estimated to be approximately 0.4 W/m² (300 ppm), largely determined by the agreement between all TIM cones. There remains an unresolved difference between the TIM and other radiometers, and this is being studied by the TSI and radiometry community.



More information about the TIM instrument and the quality and availability of SORCE TSI data products can be found at http://lasp.colorado.edu/sorce/tsi_data.html.

Spectral Solar Irradiance (SSI) Release

SSI measurements are made by the Spectral Irradiance Monitor (SIM) instrument on board the SORCE spacecraft, which provided ongoing measurements of SSI beginning in February 2003. [SIM](#) is a Fery Prism Spectrometer which provides irradiance measurements from 200 nm to 3000 nm with a spectral resolution vary-

ing from 1 to 34 nm. The [SIM ESR](#) detector provides the primary absolute calibration for the SIM instrument, and operates on the same principal and uses the same detector methodology as the active cavity radiometer in the [SORCE TIM](#) instrument. SIM contains four focal plane photodiodes, which are used to acquire the solar spectrum in a "fast-scan" mode, which provides the requisite time cadence and the spectral resolution that is not possible with the much "slower" ESR detector.

The primary motivation for producing the new version 4 SIM products was to update algorithms and instrument characterizations to accommodate a fairly significant improvement made to the onboard operation of the SIM wavelength drive mechanism. This change to instrument configuration, made in late-April 2004, was made onboard the SIM instrument and provided a significant improvement to the wavelength scale accuracy and consistency, and thus to the accuracy of the SIM irradiance measurements overall. This change optimized the CCD integration period, thus eliminating an unintentional saturation of the CCD, which measures the angular position of the Féry prism drive and thus provides determination of the observed wavelength. This long-standing saturation problem had been occurring since SORCE launch, the cause of which was only discovered in February 2004 after a meticulous investigation into occasional artifacts that were seen in SIM irradiance products.

quite good, commensurate with the design requirements of the SIM instrument. While notable improvements have been made to the quality of the SIM data products recently, and limited scientific use is possible, these data must still be considered provisional. On-orbit characterization efforts are still underway and data quality and scientific usability continues to improve dramatically with each new data version.

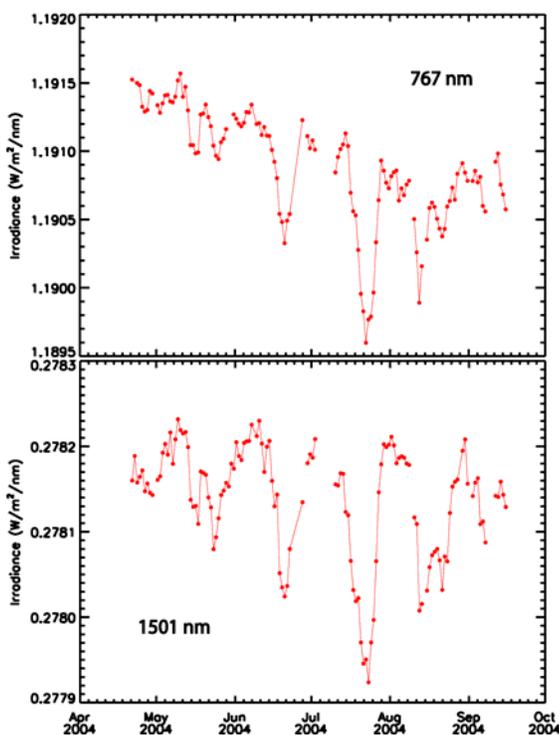
Current SIM Data Quality / Status:

- On-orbit instrument characterization is still in progress. Certain instrumental artifacts are present within the data and a few on-orbit instrument calibrations (e.g. diode degradation, ESR absorptance) have not yet been applied.
- SIM data products presently provide spectral coverage from 310-1600 nm. Additional wavelength coverage will be available in the future. (SOLSTICE and XPS provide wavelength coverage below 310 nm)
- Version 4 data are now available from 21 April 2004 through present. These data are available from the [SORCE web site](#) now, and will be delivered to the DAAC (with new SOLSTICE data) in the future.
- Version 3 data prior to 21 April 2004 are available from the DAAC; however, these data exhibit some quality problems (see known issues below) and should be used with caution.
- **Absolute Accuracy:** An important instrument correction factor is still being characterized and is not yet being applied to the SIM data. As a result, the absolute accuracy of SIM data at *visible* wavelengths is limited to approximately 3%. In the *infrared*, SIM data are estimated to be low by about 10%. We expect to complete this missing correction in the future.
- **Relative Accuracy:** The uncertainties reported with the data provide a reasonable indicator of relative precision. Above 500 nm, relative accuracy is better than approximately 300 ppm. Below 500 nm, relative accuracy declines to approximately 0.7% at 310 nm.
- **Wavelength Scale:** SIM wavelengths (310-1600 nm) are presently estimated to be accurate to between 0.5 and 5 nm, depending on wavelength (more accurate at shorter wavelengths). Relative (day-to-day) accuracy is about a factor of 50 better.
- Currently, data products were measured with the HRT (Hard Radiation Trap) *out* of the optical path. Most of the SIM measurements are made with the HRT in the optical path (to minimize exposure-related degradation of instrument sensitivity). As a result, 6-hourly data are not available for SIM at this time. Once the SORCE science team has completed the time-dependent characterization of the HRT, additional SIM data with improved time cadence will become available.

Known Issues:

- Data prior to 21 April 2004 (older version 3) exhibit discrete "jumps" or discontinuities at the ~0.1% level from day to day. These artifacts are caused by shifts in

SIM Version 4 Irradiance Time Series



Since the advent of the CCD integration period change on 21 April 2004, the quality of the SIM data has improved dramatically. Wavelength precision is now

the SIM wavelength scale, and will be corrected in the next SIM data version.

- The SIM VIS2 diode (coverage from 800-1000 nm) exhibits a small amount of degradation. A correction is being developed based upon in-flight characterization measurements, and will be made in the future.
- Characterization of SIM ESR absorptivity is not complete, hence increased absolute irradiance uncertainty.
- A small field-of-view sensitivity correction is not yet being applied to the SIM data. In-flight experiments are performed on a regular basis, and are being analyzed to complete this correction.

SIM data products are publicly available from the [SORCE web site](#) and will eventually be available at the [NASA GES DAAC](#). The version 4 data processing system release incorporates a number of updates to instrument characterization and data processing algorithms, including the following:

- Updated prism transmission degradation correction
- Updated various calibrations to support the new CCD integration period (slit profile, slit partition, diode responsivity, profile integral)
- New software to produce dynamic customized reference spectra, which will support the forthcoming wavelength shift algorithm

More information about the SIM instrument and the quality and availability of SORCE SSI data products can be found at http://lasp.colorado.edu/sorce/ssi_data.html.

Next Month: 2004 SORCE Science Meeting Summary –

Another successful meeting! A science program summary from the Meredith, New Hampshire meeting will be in the November SORCE News Source.

Upcoming Meetings / Talks – SORCE scientists plan to present papers or attend the following 2004 meetings:

AGU Fall Meeting, Dec. 13-17
San Francisco, California

**To submit information to this newsletter, please contact:
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75,221
Hits to the SORCE Website
(Since 4/21/03, As of 11/1/04)