

# TSIS / SORCE News

Total & Spectral Solar Irradiance Sensor / Solar Radiation & Climate Experiment



June-July 2019

## SORCE Reaches 6000 Days in Orbit!

The SORCE team hosted an Ice Cream Social at LASP to celebrate that SORCE has been in orbit for 6000 days at the end of June 2019! To recognize this milestone attendees topped their ice cream sundaes with 6000 M&Ms, which included some fun custom M&Ms (see photo). SORCE launched on Jan. 25, 2003 and reached 6000 days in orbit on June 30, 2019.



SORCE PI Tom Woods (left) and the original SORCE PM Tom Sparr enjoying another SORCE milestone.

## SORCE Operations Extended to January 2020 –



Great news for the SORCE mission! After a Key Decision Point (KDP) Meeting regarding SORCE's Phase F, NASA Headquarters has decided to extend SORCE operations into January 2020.

SORCE has had battery issues for years and had some communication outages in April 2019. This later anomaly triggered NASA HQ to accelerate the SORCE decommissioning planning and to hold the SORCE KDP-F meeting on July 11, 2019. The objective for this meeting was to evaluate the SORCE decommissioning plan, schedule, and

budget for mission close-out and decide between a mid July 2019 passivation (turn-off) or the original January 2020 passivation date.

The final decision to stay with January 2020 passivation was based on SORCE's compelling science, than the potential battery and other spacecraft risks, which might force an early passivation. The current plan for SORCE is to continue operations until January 15, 2020, and SORCE Phase F will start the day after passivation and go through September 2020 to produce and archive the final data products.

## TCTE Mission Ends –

As planned, the Total Solar Irradiance Calibration Transfer Experiment (TCTE) science mission ended on June 30, 2019. TCTE was built and operated by CU/LASP for NOAA under a NASA contract. TCTE launched aboard the U.S. Air Force Space Test Program Satellite-3 (STPSat-3) on Nov. 19, 2013 from NASA's Wallops Flight Facility.



TCTE's Total Irradiance Monitor (TIM) in the lab before launch.

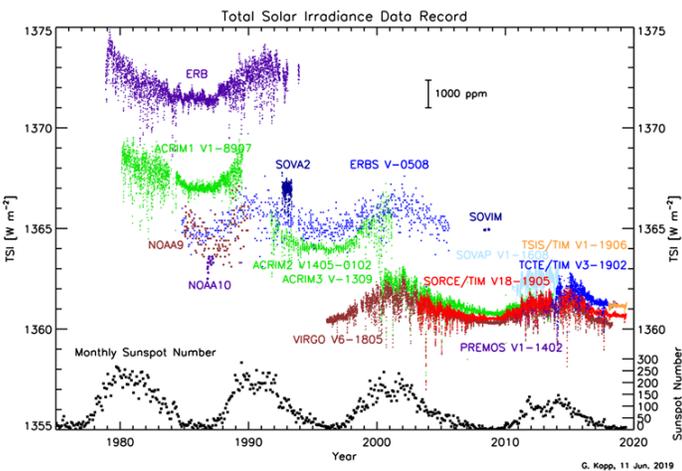
To achieve the levels of stability needed for climate studies, the total solar irradiance (TSI) record relies on measurement continuity from stable, on-orbit instruments. In order to fill a potential gap in the 35+ year TSI climate record after the failed launch of the Glory mission in 2011 and the concerns regarding SORCE's ability to continue

operations due to battery degradation, the TCTE TIM instrument was quickly readied for flight by refurbishing the SORCE's ground-based TIM witness unit.

Although STPSat-3 was initially planned as a short technology-demonstration mission of only 18 months, NOAA extended the TCTE mission multiple times to provide the desired TSI-measurement overlap between the SORCE and the Total and Spectral Solar Irradiance Sensor 1 (TSIS-1). NASA assumed responsibility of continued STPSat-3 TCTE operations in 2017.

At the conclusion of the 2017 Earth Science Sr. Review the Earth Science Directorate extended the TCTE mission to December 2018, with the goal of achieving a minimum of six months of overlap between TCTE and TSIS-1, which was launched and installed on the ISS in December 2017. The TCTE mission was subsequently extended to June 30, 2019, after which the Air Force cannot support continued TCTE operations due to other primary STPSat-3 technology-demonstration payload experiments.

TCTE was a successful mission: It assisted SORCE in maintaining measurement continuity of the now four-decade-long TSI climate data record and it helped confirm the lower TSI value established by the SORCE TIM (figure below). The TSI climate record is now being continued via NASA's TSIS-1 measurements from a newer TIM.



Calibrated to much lower uncertainties than previous flight TSI instruments, the SORCE/TIM established a new, lower TSI value of 1360.8 W/m<sup>2</sup> representative of solar minimum (Kopp & Lean, 2011). Subsequently-applied corrections to earlier instruments for scatter, which caused erroneously-high readings in those instruments, have lowered their values and greatly improved the agreement between all current TSI measurements.

### [SORCE / TSIS-1 / TCTE Update](#)

A very nice summary (although a little out of date now). The March-April issue of *The Earth Observer*, published by NASA, included an update on SORCE, TSIS-1, and TCTE in Steve Platnick's Editor's Corner. See page 3, left column (Some...). Visit:

<https://eosps.nasa.gov/earthobserver/mar-apr-2019>

## 2020 Sun-Climate Symposium –

Please mark your calendar today to join us in January 2020! Our focus topic for this 3.5-day symposium is ***“What is the Quiet Sun and What are the Subsequent Climate Implications?”*** This meeting is sponsored by the Sun-Climate Research Center – a joint venture between NASA GSFC and LASP at the University of Colorado.

**Call for Abstracts ☀ Due Nov. 15**

The abstract form and submittal instructions are available on the website. We encourage your participation and hope that you will send in an abstract and share this announcement with your colleagues. Invited speakers will be posted to the website as they accept. Join us for a great meeting in a beautiful location!



The sunset in beautiful Saguaro Natl. Park, just west of Tucson.

### Science Overview

What is the quiet Sun? Is it a time-invariant base level or is there secular variability in the Sun's radiative output? What do those alternate scenarios imply for Earth-climate responses? The current solar minimum provides an opportunity to answer these and related questions.

Observations of the Sun and Earth from space have revolutionized our view and understanding of how solar variability and other natural and anthropogenic forcings impact Earth's atmosphere and climate. For more than four decades the total and spectral solar irradiance and global terrestrial atmosphere and surface have been observed continuously, providing unprecedented high-quality data for Sun-climate studies. The 2020 Sun-Climate Symposium will convene experts from across the solar-terrestrial community, including the disciplines of climate research, atmospheric physics and chemistry, heliophysics, and metrology, to discuss solar and climate observations and models over both spacecraft-era and historical timescales.

**Tucson, Arizona  
Jan. 27-31, 2020**

<http://lasp.colorado.edu/home/sorce/news-events/meetings/2020-scs/>

**Join us! Submit your abstract today!**

## **Sessions and Descriptions**

The agenda for this interactive meeting consists of invited and contributed oral and poster presentations. Eight sessions will focus on different science topics.

### ***1. The Sunset of *SORCE****

The NASA Solar Radiation and Climate Experiment has had many accomplishments and discoveries during its 16-year long mission. Amongst *SORCE* key results are the improved climate records of the total solar irradiance (TSI) and solar spectral irradiance (SSI) with the measurements from its instruments: TIM, SIM, SOLSTICE, and XPS. As recommended from the 2017 NASA Earth Science mission senior review, *SORCE* is being passivated (turned off) in January 2020 with the successful completion of overlapping the *SORCE* and Total and Spectral solar Irradiance Sensor (TSIS) missions. This session will highlight *SORCE*'s achievements and lessons learned.

### ***2. Recent/Space-Era Solar Cycles Timescales***

This session, spanning the "spacecraft era," is devoted to solar measurements and models covering the last few solar cycles. Abstracts relating to our current understanding of the quiet Sun are particularly welcome.

### ***3. Solar Influence on the Atmosphere and Climate***

This session is devoted to the measured or modeled response of the Earth's atmosphere and climate to solar variability over the last few solar cycles.

### ***4. Solar Variability and Climate Trends on Secular Times Scales***

This session will discuss variability in the Sun and trends in climate records on long timescales. What have we learned about the ranges of total and spectral solar irradiance variability? What are the trends in proxies of solar activity and paleoclimate records, such as tree rings and cosmogenic isotopes, on multi-decadal to millennial timescales? What are the potential secular trends in the Sun based on stars? What are the associated impacts on Earth's climate that are estimated from these records?

### ***5. Observational Predictions***

What are expectations for the next solar cycle and what are climate-change scenarios for the upcoming decades? What future measurements are expected to improve knowledge of Sun-climate connections?

### ***6. A New Reference Spectra for Remote Sensing***

What solar spectra are being used by the model and remote sensing communities?

### ***7. Looking Ahead – Future Observations of the Sun and Earth***

We will examine what is planned for the next generation of solar and terrestrial observations. We will also address new Sun and Earth observations, missions and implementation strategies for a next-generation observing system to meet the current and future challenges facing climate change studies.

### ***8. Climate of the Desert Southwest***

This session is an opportunity for scientists to present their research on the climate attributes and recent trends unique to the Southwestern U.S. and in particular, the Arizona Sonoran desert. For example, changes in monsoon patterns, extreme events, and hydrology of the region are of particular interest.

## **Confirmed Speakers (as of July 19)**

The confirmed invited speakers listed below are in alphabetical order (not by session) and presentation titles are tentative. Abstracts will be posted online closer to the abstract deadline.

**Bo Andersen**, Norwegian Space Agency  
*VIRGO, Solar Minimi and a Tribute to Claus Fröhlich*

**Don Anderson**, Johns Hopkins University, APL  
*SORCE Programmatic History from a NASA Perspective*

**Robert Cahalan**, NASA GSFC, Retired  
*SORCE Science History from the NASA Perspective*

**Christopher Castro**, Univ. of Arizona, Tucson  
*Southwestern Climate and the Southern Arizona Monsoon*

**Serena Criscuoli**, Natl. Solar Observatory, Boulder, CO  
*Models of Solar Spectral Irradiance Variability*

**David Crisp**, JPL / California Inst. of Technology  
*The Impact of the TSIS-SIM Data on the OCO-2/OCO-3 Data Analysis*

**David Doelling**, NASA Langley Research Center  
*The Importance of a Recommended Solar Spectra for the Satellite Remote Sensing Community as part of the GSICS Effort*

**Thierry Dudok de Wit**, Univ. of Orléans, LPC2E, France  
*Response of Solar Irradiance to Sunspot-Area Variations*

**Parminder Ghuman**, NASA GSFC  
*Earth Science Technology Office (ESTO) Invest*

**Brent Holben**, NASA GSFC  
*AERONET Retrievals (NASA's Ground-based Satellite)*

**Lon Hood**, Univ. of Arizona, Tucson  
*Top-Down Solar Influences on the Madden-Julian Short-Term Climate Oscillation and its Effects on Extratropical Weather and Climate*

**Philip Judge**, High Altitude Observatory, NCAR  
*Overview: Stellar Activity and the Potential Behavior of the Sun over the Next Few Decades*

**Pradeep Kayshap**, Inst. of Physics, Univ. of South Bohemia, Ceske Budejovice, Czech Republic  
*Variability of Mg II Line in Quiet Sun and Coronal Hole*

**Judith Lean**, Naval Research Lab, Retired  
*Sun-Climate Recent Results & Implications for the Future*

**Bob Meier**, George Mason University, Fairfax, VA  
*GUVI / Solar Cycle Trends in the Integrated Solar EUV Energy Flux*

**Andrés Muñoz-Jaramillo**, Southwest Research Institute (SwRI), Boulder, CO  
*Solar Cycle 25 Panel Predictions*

**Nuno Pereira**, Belgium Institute for Space Aeronomy  
*Near Infrared Ground-based Spectrum*

**W. Dean Pesnell**, NASA GSFC  
*How Good Can We Be at Predicting the Solar Cycle?*

**Karen Rosenlof**, NOAA Earth System Research Lab.  
*Stratospheric Ozone Change and Its Influence on Climate*

**Gary Rottman**, LASP/University of Colorado, Retired  
*SORCE Mission Highlights and Lessons “Forgotten”*

**Cornelius Csar Jude H. Salinas**, National Central University, Taoyuan City, Taiwan  
*CO<sub>2</sub> Response*

**Werner Schmutz**, PMOD/WRC, Switzerland  
*Updates on CLARA and PREMOS*

**Alexander Shapiro**, Max Planck Institute for Solar System Research, Goettingen, Germany  
*Solar Variability over the Last Five Billion Years*

**Yolanda Shea**, NASA Langley Research Center  
*CLARREO Pathfinder*

**Tom Stone**, USGS Astrogeology Science Center, Flagstaff, AZ  
*The Need for a New Solar Irradiance Reference Spectrum in Lunar Irradiance Modeling, with a focus on GSICS Needs*

**Valerie Trouet**, Univ. of Arizona, Laboratory of Tree-Ring Research  
*Reduced Caribbean Hurricane Activity during the Maunder Solar Minimum*

**Lisa Upton**, Space System Research Corp. (SSRC)  
*Reconstructing Historical Sunspot Cycles with the Advective Flux Transport Model*

**Chi-Ju Wu**, Max Planck Institute for Solar System Research, Goettingen, Germany  
*Long Term Cosmogenic Isotope Records*

## Location / Venue

**Tucson, Arizona** is most famous for its dramatic beauty! The Sonoran Desert covers this region with spectacular cacti – including the giant saguaro, a symbol of the



American Southwest. They have captivated visitors for decades. To complement the legendary year-round sunshine and saguaro- and sunset-landscape, there are scenic mountain ranges surrounding the city. On the flip-side to its Old West heritage, Tucson offers a thriving visual and performing arts scene, not to mention the amazing restaurants (UNESCO designated City of Gastronomy). Once you immerse yourself in the laid-back atmosphere of Tucson, you may never want to leave!

We will be meeting at the **Tucson Marriott University Park Hotel**, a state-of-the-art full service conference facility near the University of Arizona campus.

## Logistics and Registration

Please visit the 2020 Sun-Climate Symposium website for logistical information, including maps and transportation options. Registration and lodging reservations are available **\*now\***.

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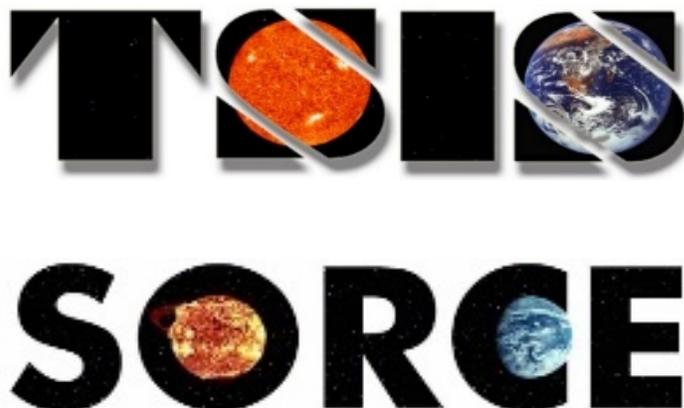
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<http://lasp.colorado.edu/home/sorce/news-events/meetings/2020-scs/>

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**Please mark your calendar today to join us in January 2020 for this interesting symposium!**



## Canadian Meetings Captivate –

Many **SORCE/TSIS** scientists attended two popular meetings in beautiful Canada in early July. The **IUGG General Assembly** gathered in Montréal, July 10-17, to celebrate their 100<sup>th</sup> anniversary with a diverse program looking back on previous century of Earth and space science research accomplishments. And just prior, the **Space Climate 7 Symposium** was held about an hour outside of Montreal, July 8-11, at a smaller venue to accommodate the ~80 attendees.

### Space Climate 7 presentations:

**Greg Kopp** gave an invited talk, *An Historical TSI Reconstruction based on Reevaluations of the TSI Composite and Sunspot Records*. He described recent efforts to incorporate the effects of the new sunspot-number records into a new TSI composite. The team is incorporating the new numbers with models to show estimated changes on the historical TSI values.

**Tom Woods** also gave an invited talk – *Solar Irradiance Variability Observations during Solar Cycles 21 to 24*. He summarized the past and current irradiance measurements, and then introduced a new analysis technique which is helping to identify some uncorrected instrumental trends. When the **MuSIL** (Multiple Same-Irradiance-Level) technique is applied there is the potential to improve the understanding of solar cycle variability and to clarify the uncertainties of the trends for later combining different sets of TSI and SSI observations to make composite time series.

### IUGG presentations:

The session featuring most of the **TSIS/SORCE** presentations was titled “Solar Influence on the Atmosphere,” chaired by Joanna Haigh from Imperial College in London. **Odele Coddington** kicked-off the session presenting *Magnitudes and Trends in the Baseline 2009 and 2019 Solar Irradiance Levels of the NOAA Solar Irradiance Climate Data Record*. Others presenting in this session included **Erik Richard** (*First Year Solar Spectral Irradiance Measurements from the TSIS-1 Mission and a New Solar Minimum Reference Spectrum*), **Greg Kopp** (*The New Community-Consensus TSI Composite for Earth-Climate and Solar-Variability Studies*), **Stéphane Béland** (*An Updated Solar Irradiance Reference Spectra from Latest SORCE and TSIS Measurements*) and **Marty Snow** (*Understanding the Sources of Variability in the Magnesium II Index*). **Peter Pilewski** was a co-convenor for Session M23, Current Progress in Atmospheric Radiation (M23).



IUGG presenters Stéphane Béland (left) and Erik Richard.



## Symposium Honoring Michael Thompson –

NCAR’s High Altitude Observatory is hosting a symposium on the *Dynamics of the Sun & Stars* to honor the life and work of its former director: Michael Thompson. Michael unexpectedly passed away in October 2018. His scientific work centered on helioseismology and the solar-stellar connection. He also had a strong interest in mentoring students, including several in the CU/LASP Research Experience for Undergraduates program.



The symposium is September 24-26 in Boulder, Colorado. The web page with information on the scientific agenda and logistics is at:

<https://www2.hao.ucar.edu/MJTWorkshop2019>.

Several members of the **SORCE** team worked with Michael, and he will be sorely missed.

## Upcoming Meetings / Talks –

*SORCE* scientists will present papers or attend the following 2019-2020 meetings/workshops:

### 2019

Space Climate 7 Symposium, July 8-11, Canton Orford, Quebec County, Canada

IUGG General Assembly, July 12-18, Montreal, Canada

SHINE (Solar Heliospheric & Interplanetary

Environment) Conference, Aug. 5-9, Boulder, CO

Solar Irradiance Science Team (SIST) Meeting,

Sept. 24-25, Gaithersburg, MD

AGU Fall Meeting, Dec. 9-13, San Francisco, CA

### 2020

**Sun-Climate Symposium, Jan. 27-31, Tucson, AZ**

*Hope everyone is staying cool this summer!*

