

TSIS / SORCE News

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



Aug.-Oct. 2019

2020 Sun-Climate Symposium –

What is the Quiet Sun and What are the Subsequent Climate Implications?

This symposium is sponsored by the Sun-Climate Research Center – a joint venture between NASA GSFC and LASP at the University of Colorado. We encourage your participation and hope that you will send in an abstract and share this announcement with your colleagues. Join us for a great meeting in a beautiful location! ☺

Call for Abstracts 🌀 Due Nov. 15

The abstract form and submittal instructions are available on the website:

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

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.

**Marriott University Park
Tucson, Arizona
Jan. 27-31, 2020**



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

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 mission. Key among SORCE 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 overlap between 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

The focus of this session is on the measured and 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 covers 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

Papers in this session will attempt to answer: 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

Questions addressed in this session include: What solar spectra are being used by the atmospheric modeling and remote sensing communities? How important are their applications to space-, air-, and ground-based remote sensing? What are the accuracy and spectral resolution requirements for reference spectra?

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 Oct. 23)

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
CO₂ Response

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*

Location / Venue

Tucson, AZ 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***.

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

Join us for this interesting symposium!



TCTE / SORCE / TSIS Update –

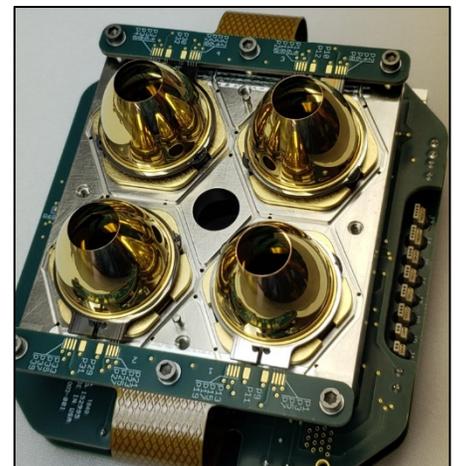
On June 30 the Total Solar Irradiance Calibration Transfer Experiment (**TCTE**) successfully finished its journey linking the SORCE TSI calibration scale with TSIS-1. The Solar Radiation and Climate Experiment (**SORCE**) is planning to conclude its historic mission on January 15. SORCE Phase F, starting the day after passivation, will continue through September 2020 to produce and archive the final data products. The Total and Spectral Solar Irradiance Sensor (**TSIS-1**) continues to produce high quality solar irradiance data on its perch aboard the International Space Station. TSIS is currently midway through its second year of a 5-year prime mission. And to keep things moving forward, preparations for **TSIS-2** have already begun – with a launch-readiness date of February 2023. Exciting!



TSIS-1 onboard the International Space Station.

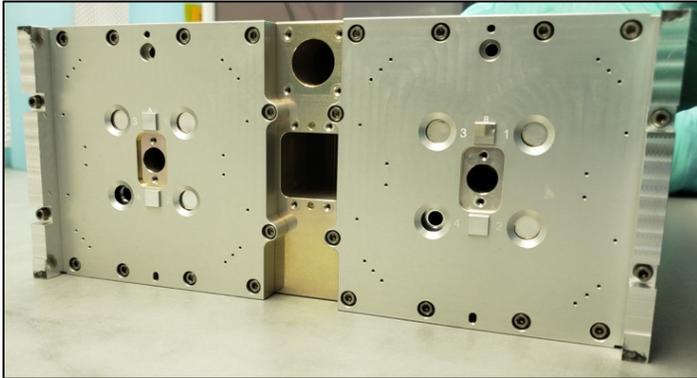
CTIM Update –

The Compact Total Irradiance Monitor (CTIM) is a technology demonstration mission funded by the NASA Earth Science Technology Office that will test a next-generation TSI instrument on a 6U CubeSat. The key new technologies in CTIM are silicon bolometers with vertically-aligned carbon nanotube optical absorbers. These bolometers have higher optical absorptivity than the SORCE/TSIS TIM cavities with only 10% of the mass. The CTIM



One CTIM engineering head showing four detectors.

engineering model just completed successful environmental testing (TVAC, vibe testing) and radiometric validation in the TSI Radiometer Facility (TRF). The flight instrument and CubeSat build are starting this fall in preparation for a planned launch in the first quarter of 2021.



Front of the CTIM CubeSat engineering model showing the eight active channels. Shutters on two of the channels are open in this picture.

SIST-2 Workshop –

SORCE and TSIS scientists and collaborators are participating once again in a NASA program called the Solar Irradiance Science Team (SIST). The primary purpose of the SIST research projects are to support the development of space-based data sets of total and spectral solar irradiance (TSI and SSI). The data sets will be used as input to global models to investigate solar variations and their impacts on the Earth climate and atmospheric composition. SIST-2 is a follow-on to SIST-1, which was a 3-year NASA award begun in 2015. SIST-2 started in 2018, with Tom Woods as the SIST-2 leader.

The eight SIST-2 teams (listed in the next column) met September 24-25 in Gaithersburg, MD, to provide individual project updates as well as partake in general discussions on three select focus topics – Earth Science Applications for Solar Irradiance, Research-to-Operations and Operations-to-Research, and SSI Spectral Resolution Needs and Infrared Irradiance Level.



- *Decoupling Solar Variability and Instrument Trends over SC 21 to SC 24 to Develop an Improved SSI Composite Record* (PI: Tom Woods, LASP)
- *MAGnesium II: Proxy for IrradianceE (MAGPIE). Improving irradiance modeling through better understanding of variability in the facular proxy* (PI: Marty Snow, LASP)
- *SORCE/TSIS Overlap Analysis: Absolute Scale Comparison, Stability Estimates, and Cycle 23/24/25 Record Construction* (PI: Stéphane Béland, LASP)
- *TSI Reconstructions Based on Updated TSI Composite and Sunspot Records* (PI: Greg Kopp, LASP)
- *Next Generation Solar Irradiance Variability Models* (PI: Judith Lean, NRL)
- *Validation and Continuation of the V2 Composite SSI Data Set* (PI: Matt DeLand, SSAI and NASA/GSFC)
- *Comparing spacecraft TSI and SSI with proxies from space- and ground-based images* (PI: Gary Chapman, California State University – Northridge)
- *Improved SUSIM Solar UV Spectral Irradiances* (PI: Harry Warren, NRL)

On the second day of the Workshop, attendees visited NIST to tour two of their calibration and test facilities: Synchrotron UV Radiation Facility (SURF) and the Primary Optical Watt Radiometer (POWR). CU/LASP use the Gaithersburg NIST facilities regularly for pre-flight testing and instrument calibrations.



Twenty people attended the 2-day SIST-2 Workshop.

The Workshop concluded with a full list of Action Items and a discussion on when and where the next workshop should be held. The group is looking at meeting in Boulder, Colorado, during July 2020.

LISIRD Resources –

The LASP Interactive Solar Irradiance Datacenter (LISIRD) is a user-friendly webpage making solar irradiance data available to scientists and the public in the format they want. It provides one-stop-shopping for solar irradiance datasets, models, and composite time series. The LISIRD team's priority is to interactively serve near real-time solar irradiance data products for rapid use by the space weather community.



The LISIRD developers are continuously enhancing the site to increase access to LASP's 40+ years of solar irradiance measurements, as well as many external solar datasets. They currently serve 77 datasets (wow!), and are always designing new and easy-to-use tools to facilitate data analysis and visualization. The interface allows users to plot multiple datasets at a time, interactively zoom and pan to browse and explore the available data, and then download the chosen selection. Additionally, LISIRD is able to "stitch" together the daily spectrum from different instruments to provide the solar irradiance over the desired wavelength range as a single data product, taking proper account of the changes in spectral resolution. Similarly, someone could take solar irradiance measurements made at Earth and apply them to other planets by shifting time and scaling to the planet-Sun distance.

To explore this premier solar data center, visit: <http://lasp.colorado.edu/LISIRD/>.

JSWSC Topical Issue

The *Journal of Space Weather and Space Climate* is planning a Topical Issue on "**Space Climate: The past and future of solar activity**" to appear in 2020.

This is an open call for papers discussing any aspect of Space Climate, i.e., the long-term change in the Sun and its effects in the heliosphere and the near-Earth space environment, including solar effects on the atmosphere and climate.

The deadline for online submissions is Jan. 31, 2020, <https://www.editorialmanager.com/jsWSC/default.aspx>.

For more details, please contact the Topical Editor-in-Chief, Kalevi Mursula, University of Oulu, Finland; kalevi.mursula@oulu.fi, or visit the JSWSC website: <https://www.swsc-journal.org/news/297-topical-issue-space-climate-the-past-and-future-of-solar-activity-deadline-31-january-2020>.

SORCE Undergrad Research Program Successful –

By Marty Snow – LASP, University of Colorado

For many years the SORCE mission has been funding student research projects in concert with the University of Colorado's Research Experience for Undergraduates (REU) program. This summer's program was another successful year for the students who came to Boulder, Colorado for ten weeks to work with scientists on a research project involving measurements from SORCE. Marty Snow is the REU Program Organizer for the entire program which included 21 REU students working interesting solar and space physics projects in several Boulder locations.



Poster session to wrap up the REU program. Willow Reed, center facing camera, assisted Marty Snow with the REU program this summer.

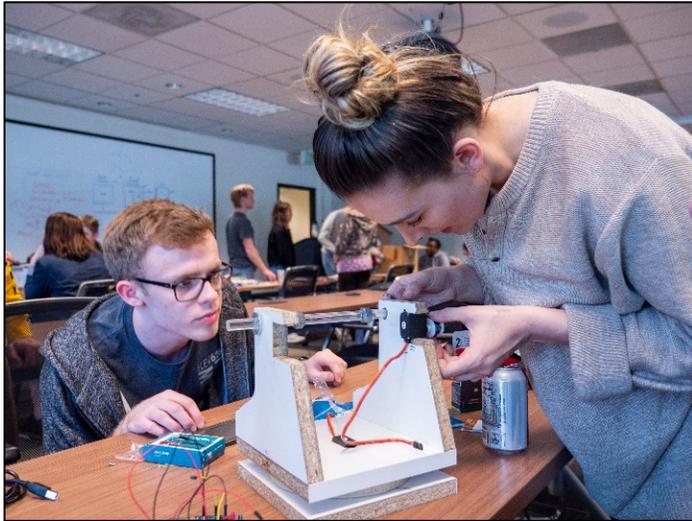
For 2019, three SORCE-related projects were selected for the REU program. Abstracts and presentations are available on <http://lasp.colorado.edu/reu>.

- **From Aleph to TAV: a project to improve the SORCE/SIM calibration using TSIS/SIM**
Mentors: Steve Penton, Stéphane Béland, and Marty Snow (LASP)
REU Student: Joel Tibbets, Grinnell College
- **Solar Applied pLanetary dataset cAlibration (SALSA)**
Mentor: Josh Elliott (LASP)
REU Student: Emma Lieb, University of Colorado Boulder

- *Solar cycle-related variability of sun-as-a-star spectral line profiles*

Mentors: Serena Criscuoli (NSO), and Marty Snow (LASP)

REU Student: Matt Kalscheur, University of Wisconsin-Madison



Joel Tibbets (left) and Emma Lieb (right) work on building a computer-controlled heliostat during the REU boot camp.

Upcoming Meetings / Talks –

TSIS/SORCE scientists are presenting papers or attending the following 2019-2020 meetings/workshops:

2019

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

2020

American Meteorological Society (AMS) Annual Meeting, Jan. 12-16, Boston, MA

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

Space Weather Workshop, April 20-24, Boulder, CO

European Geosciences Union (EGU), General Assembly, May 3-8, Vienna, Austria

New Developments and Applications in Optical Radiometry (NEWRAD), June 23-26, Boulder, CO

International Radiation Symposium (IRS), July 6-10, Thessaloniki, Greece

Solar Irradiance Science Team Meeting, July 22-23, Boulder, CO

COSPAR Scientific Assembly, Aug. 15-23, Sydney, Australia

Happy Fall!

