TSIS / SORCE News

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

July 2018

2018 AGU: Solar Session –

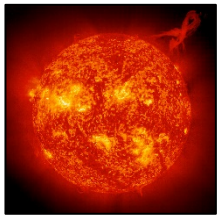
Abstract Due: August 1
https://fallmeeting.agu.org/2018/
Dec. 10-14, 2018

Join us! SORCE and TSIS scientists have a session topic for the 2018 Fall AGU Meeting focusing on solar irradiance measurements and modeling. This year's meeting is in Washington, DC, Dec. 10-14, and we hope you will consider submitting an abstract to the following SPA-Solar and Heliospheric Physics session:

SH024: Solar radiative variability: from minutes to millennia. The Sun's influence on the Earth's space environment, atmosphere, and climate

Conveners: Martin Snow (primary), LASP, Univ. of Colorado; Peter Pilewskie, LASP/CU; Natalie Krivova, Max Planck Inst. for Solar System Research, Katlenburg-Lindau Germany; and Odele Coddington, LASP/CU

Web: https://agu.confex.com/agu/fm18/prelim.cgi/Session/48481



Session ID# 48481: Variability of the incoming solar irradiance and its effects on the terrestrial environment and climate have received wide attention in recent years. There is a continuous effort to reduce measurement uncertainties of the total and spectral solar irradiances. Physical and empirical modelling have also made considerable progress in reconstructing accurate and reliable records. At the same time, models and observations have been extensively used to characterize the influence of solar irradiance variability on Earth's atmosphere and climate. This session invites abstracts on measurements and models of solar spectral and total irradiance on all time scales – including the recently launched Total and Spectral Solar Irradiance Sensor (TSIS-1) – as well as abstracts on the response of the surface, atmosphere and the heliosphere to solar radiative forcing. Abstracts focused on comparisons of surface and atmospheric effects to different solar radiative forcing are particularly welcome.

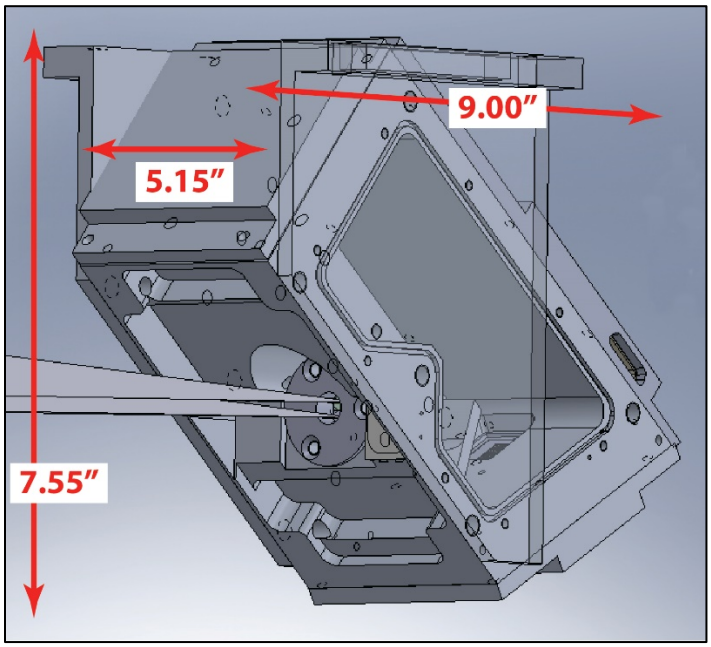
AGU is launching their Centennial Celebration by observing 100 years of Earth and space science accomplishments at this year's meeting. ***Join in the celebration by submitting your abstract today!***

Washington DC skyline. The backbone of the city is built on history and culture. Enjoy awe-inspiring art galleries, unmatched museums, thriving performing arts and so much more. With 19 Smithsonian Museums (free admission!) and the National Zoo, there are ways to explore every interest. Delve deeper into science, art, history, or American culture. You can also walk along the National Mall to see iconic monuments like the Lincoln and Jefferson Memorials, and Washington Monument while taking in the beauty of the Tidal Basin, reflecting pool, and Potomac River. And of course, don't forget the Capitol Building or the Library of Congress. (Tip – wear comfortable walking shoes and see it all!)

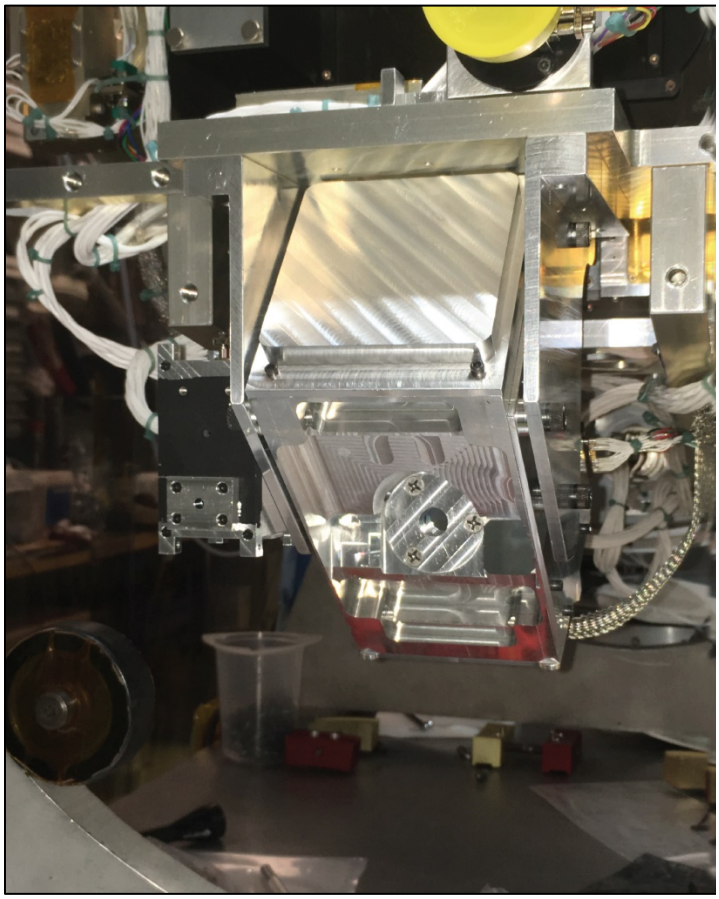
Compact SOLSTICE –

On June 18, NASA rocket 36.336 was launched from White Sands Missile Range. Onboard this flight was the Compact SOLSTICE (CSOL) instrument, which served as an under-flight calibration for the SOCE SOLSTICE instrument that has been on orbit for over 15 years. The SORCE program developed the CSOL and it has capability to acquire the full 110-300 nm spectral range on a 10-second cadence. The highly compact nature of the CSOL instrument will allow for future developments of FUV/MUV CubeSat-sized instruments that are capable of routine monitoring of solar irradiance. CSOL is also adaptable to accommodate other Earth-atmospheric and

planetary CubeSat missions that measure the ultraviolet spectrum.

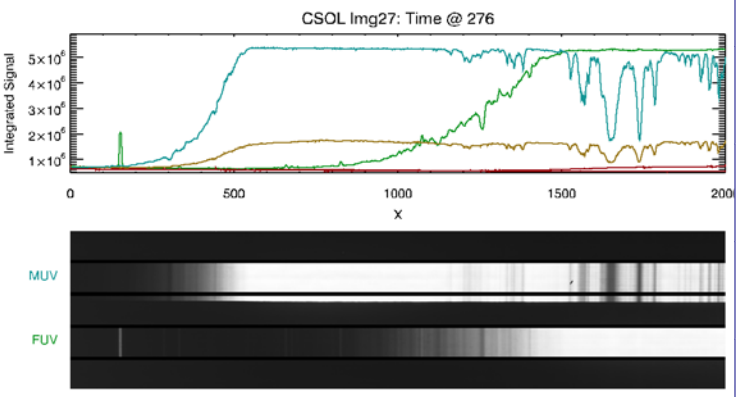


This is a mechanical rendering of the CSOL instrument. CSOL occupies about 10% the volume of the SORCE SOLSTICE and provides the same wavelength coverage.



This is CSOL mounted in the observatory section of NASA rocket 36.336.

The Quicklook results (log scale) from the rocket flight, show excellent measurements for 115-200 nm and 250-300 nm. It is clear that CSOL got good data and these results meet SORCE calibration minimum requirements for 115-200 nm. Once the rocket payload arrived back at LASP, the SD-card inside the CSOL camera board was extracted. This revealed a full set of CSOL images, since only part of the CSOL images were transmitted realtime to the ground during the flight.

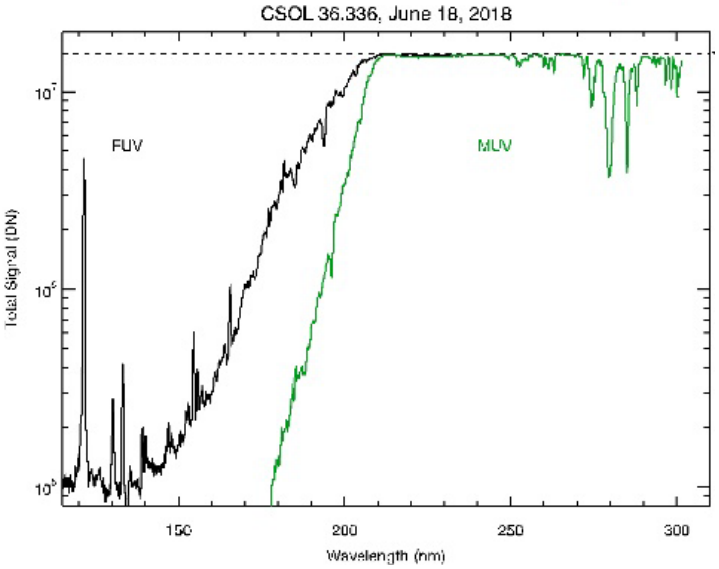


These are two plots from in-flight data from CSOL acquired 276 seconds into the flight. The bottom plot is a black and white image from the CSOL 2000x1504 CMOS camera showing the dispersion of light in two strips on the detector. The top strip is MUV spectrum from 172 to 300nm and the bottom strip is the FUV spectrum 112 to 240nm. The bright 'line' on the left-hand side of the image is the Lyman-alpha line 121.6 nm. The top plot is the data from the two channels processed into a raw spectrum. The blue image is the FUV channel, and the green spectrum is for the MUV channel. The red curve is what the spectrum would look like for 5-second integration time, that was not acquired during flight; the green and blue traces are for 10.24s integration time and shows detector saturation. The 10s integration period emphasizes the 110-200 nm FUV spectrum and the 270-300nm portion of the MUV that includes the important Mg II region.

The calibrations taken in April at NIST SURF will be applied to a reference spectrum from CSOL. This takes a few weeks, and the next step is to compare the rocket reference spectrum to the SORCE SOLSTICE, SORCE SIM, and TSIS-1 SIM concurrent measurements to estimate trend adjustments as a function of wavelength. The final step is to incorporate new instrument trends into the SOLSTICE and SIM data products.

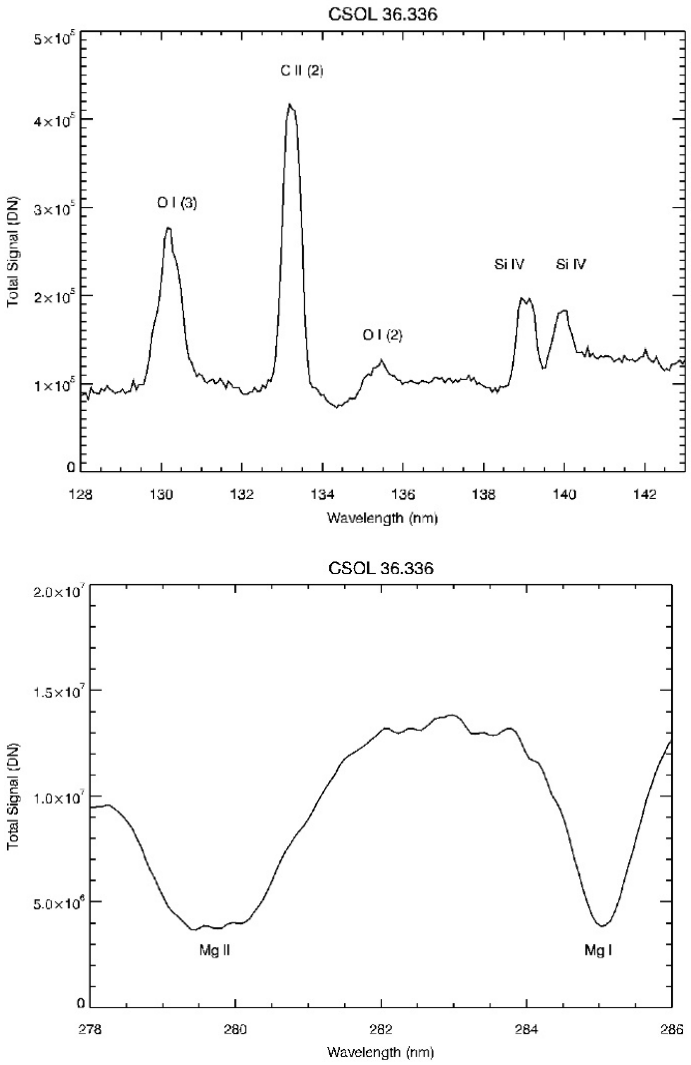
Finally, rocket flight 36.336 had two on-board cameras to monitor the flight. James Mason from Goddard Space Flight Center condensed the data from these cameras and posted them for public outreach. The 4-minute video is at: https://www.youtube.com/watch?v=kDx1Huj8sgQ. Since the rocket flight was near the White Sands National Monument, the brilliant white sands can be seen several times during the flight. At the top of the atmosphere the rocket does a back flip, so the down-looking camera then looks towards the Sun. On decent, the situation reverses again. At 55 seconds the vacuum doors opens and solar

observations are initiated. That strange looking cylinder on the door is a crush pad for the eventual landing. Look at the left-hand image at 1min25sec; on the far left you can see the Baja peninsula giving an indication of how far up in the Earth's atmosphere the rocket has flown. It is fun to watch so take a few minutes to enjoy – all the way to the end for an amusing confirmation on the June heat.



Total signal is the sum over 288 columns (imaged slit height) after the background signal is subtracted per column. From SURF calibration, CSOL generates about 1 electron per 50 incoming photons every second. There are 1.8 data numbers per electron.

The rocket team for NASA Rocket 36.336, June 2018.



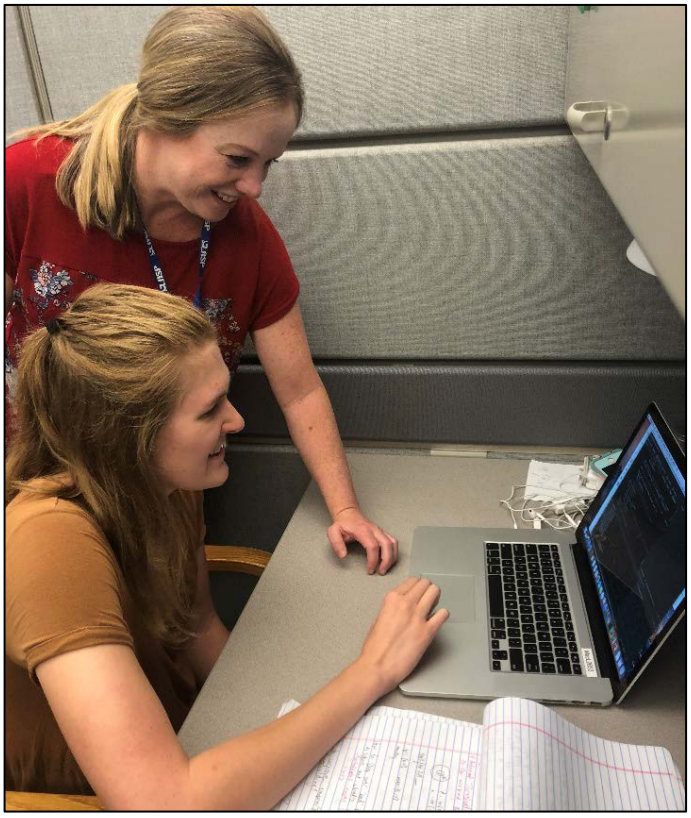
The top plot shows data from the FUV channel of CSOL providing information about important oxygen, carbon, and silicon atomic emissions that known contributions to the FUV spectrum. Likewise, the bottom plot shows the Mg II and Mg I absorption features in the MUV channel. Note that in the neighborhood of 280nm the Mg II h & k lines can be clearly observed at the resolution of this instrument. Also note that this is a preliminary wavelength scale that will be refined with additional analysis.

SORCE REU Students Update –

The 2018 REU students are nearing the end of their summer research experience. The SORCE mission funds student research projects in concert with the University of Colorado's Research Experience for Undergraduates (REU) program. For ten weeks, the students work with SORCE scientists on a project involving measurements from SORCE. The program will run through August 3rd, ending with a student symposium where the students present their findings. Marty Snow is the REU Program Organizer for the entire program which includes 27 REU students working interesting solar and space physics projects in several Boulder locations.

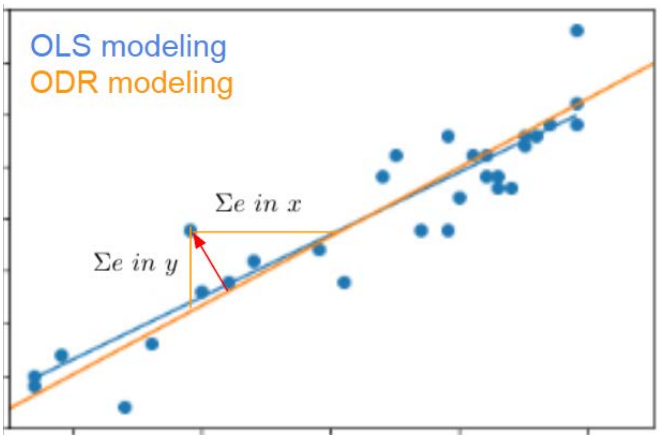
For 2018, three SORCE-related projects were selected for the REU program. The project title, mentors, and the REU student selected are:

- ***Machine Learning for the Prediction of Solar Flares***
  REU Student: Caroline Mather, Carleton College, Northfield, MN
  Mentor: Laura Sandoval (LASP)

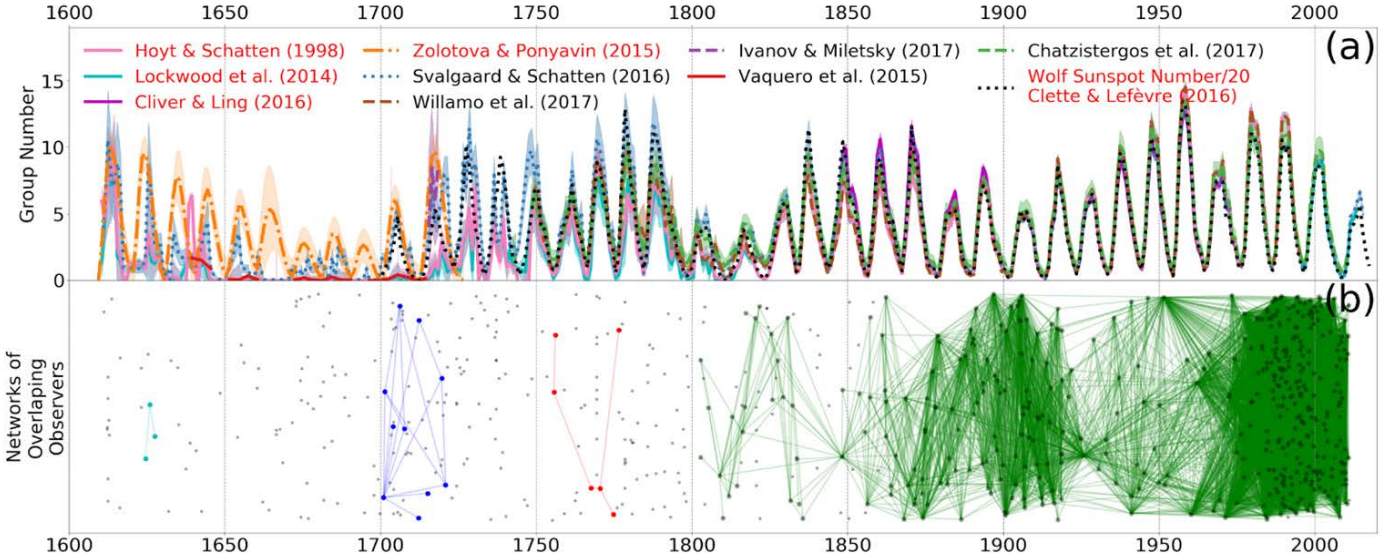


- ***Understanding Solar Activity During the Last 400 Years***
  REU Student: Sam Hollenbach, Macalester College, St. Paul, MN
  Mentors: Andres Muñoz-Jaramillo (SwRI) and Marty Snow (LASP)

- ***Walking the Line: Investigating the Impacts of Different Linear Regression Techniques on Proxy Model Estimates of Solar Irradiance***
  REU Student: Ian McComas, Red Rocks Community College, Lakewood, CO
  Mentor: Odele Coddington (LASP)



This is an example of two different regression methods.



Sam Hollenbach's re-analysis of 400 years of sunspot data.

Upcoming Meetings / Talks –

SORCE scientists will present papers or attend the following 2018 meetings/workshops:

2018

Scientific Computing with Python, July 9-15, Austin, Texas

AMS 15th Conference on Atmospheric Radiation, July 9-13, Vancouver, BC, Canada

COSPAR 2018, July 14-22, Pasadena, California

IAU General Assembly, August 20-31, Vienna, Austria

European Space Weather Week, Nov. 5-9, Leuven, Belgium

Astronomical Data Analysis Software and Systems (ADASS), Nov. 11-15, College Park, Maryland

AGU Fall Meeting, Dec. 10-14, Washington, DC

Hope everyone is staying cool this summer!