



2010 SORCE Meeting

Keystone, Colorado

May 19-21, 2010



Solar and Anthropogenic Influences on Earth: The Current Solar Minimum and Predictions for Future Decades

We are pleased to announce the next SORCE Science Meeting! The organizing committee (Bob Cahalan, Greg Kopp, Judith Lean, Peter Pilewskie, and Tom Woods) have been honing in on the best sessions to address *Solar and Anthropogenic Impacts on Earth: The Current Solar Minimum and Predictions for Future Decades*. We will be meeting in beautiful Keystone, Colorado, May 19-21, 2010. As in the past, this interactive meeting will be an opportunity for cross-disciplinary interaction between solar, climate, and atmospheric scientists. The agenda will consist of invited and contributed oral and poster presentations. A brief meeting summary is below.

Relative to the past three solar minimum epochs of the space era (1976, 1986 and 1996) the current solar minimum (2008-2009) between solar cycles 23 and 24 is unusually prolonged, with record numbers of spotless days, record low solar polar magnetic fields, and record high levels of cosmic ray flux. Evidence is accumulating for broad ranging terrestrial responses to the current inactivity of the Sun. The lack of global warming since

2002 can be attributed in part to declining solar irradiance, which, together with La Niña cooling, has cancelled much of recent anthropogenic warming. Reduced solar UV irradiance and corresponding lower ozone levels may be obscuring the recovery from anthropogenic ozone depletion by CFCs. In the upper atmosphere and ionosphere, temperatures are anomalously cool and densities are reduced relative to previous solar minima; but these changes may also be related to accumulated greenhouse gas cooling in the upper atmosphere.

Are spectral and total solar irradiance levels lower now than during past minima, and how much will they increase during solar cycle 24? Are we entering a new prolonged period of anomalously low activity such as the Dalton Minimum in the early 1800s? Can we identify anomalous behavior in the solar dynamo and surface flux transport during the current minimum? How are heliospheric changes altering incident cosmic ray fluxes and the Earth's near-space environment? Can we reliably discern the terrestrial signatures of the current solar inactivity – at the surface, in the stratosphere and in space weather? What does understanding of the present (in the context of the past) infer for the future variability of Earth's environment?

Motivated by these questions, the 2010 SORCE Meeting will address the current state of and future expectations for the integrated Sun-Earth system.

Proposed Sessions:

1. **This Unique Solar Cycle Minimum**

- 1.1. Total Solar Irradiance (TSI): Comparison of Solar Cycle Minima and Recent Validation Results
- 1.2. Solar Spectral Irradiance (SSI): Solar Cycle Variation and Comparison of Cycle Minima
- 1.3. Solar Physics: What do we learn about the Sun from this unique cycle minimum?

2. **Forcings During This Solar Minimum and Forecasts for the Next Solar Cycle**

- 2.1. Space Weather Effects Observed During This Solar Cycle Minimum



2.2. Atmosphere and Ozone Change: Has the ozone recovery started yet?

2.3. Climate Change: What's the future going to be?

3. Recommendations for the Future: How to improve the climate data records?

Meeting details will be posted on the SORCE website (<http://lasp.colorado.edu/sorce/news/meetings.htm>) as soon as they are available. Registration materials will be available in early 2010, but mark your calendar today! We encourage your participation and hope you will join us. The meeting will be held at the *Keystone Resort and Conference Center*. Additional activities prior to the SORCE Meeting are in the planning stages as well.

~~ Please join us! ~~

On the Go –

By Marty Snow, LASP, Univ. of Colorado

The first floor west wing at LASP has been unusually quiet this summer. Not because of spectacularly exotic vacations, but due to the many interesting scientific conferences that the SORCE scientists have been participating in.



Late August/earlier September gatherings included the IAU Meeting in Brazil, CALCON Technical Conference in Utah, ISSI Working Group in Switzerland, and the 25th NSO Workshop at Sacramento Peak Observatory. One more recent meeting was the *Solar Analogs II Workshop*, held at the Lowell Observatory in Flagstaff, Arizona, on September 21-23. Three SORCE scientists, Juan Fontenla, Greg Kopp, and Marty Snow, presented results from the SORCE mission. Juan Fontenla's talk discussed the new results from the SIM instrument on the wavelength dependence of solar cycle variability in the visible and infra-red regions of the spectrum. As described in Harder *et al.*, 2009 (doi:10.1029/2008GL036797), certain regions of the spectrum vary out of phase with the TSI over the solar cycle. For astronomers studying solar-type stars, this new information about how the Sun varies in the b and y filter bandpasses is very important. When the Sun is now transformed to the stellar scale, it shows less variability than previously estimated, bringing it more in line with other stars of its spectral type.



Greg Kopp and long-time solar researcher and friend Bill Livingston enjoyed the Arizona sunshine during a morning break.

Greg Kopp presented TIM TSI measurements, including the flare observed in 2003. Astronomers have detected many flares in stars over the years, but never in integrated irradiance. A comparison of the Ca II K index observed from the ground and the Mg II index from SOLSTICE was the main element of Marty Snow's presentation. Examination of the two data records together may help reveal instrumental artifacts in each.



Marty Snow learns about Lowell's 42 inch telescope used to gather starlight for the Solar-Stellar Spectrograph (SSS).

The workshop also included sessions on exoplanets around solar-type stars, analysis of solar analogs in distant clusters as well as in the solar neighborhood, and the range of variability shown by cool stars. Observations discussed at this workshop come from a large number of observatories around the world, including the telescopes operated by the host organization, Lowell.

Jeff Hall, the organizer of the Solar Analogs II workshop was kind enough to give a tour of Lowell's facilities the day before the meeting. This included the two telescopes currently operating as well as the Discovery Channel Telescope (see photo below) which is still under

construction. The new telescope will begin operations next year, and continued measurement of solar-type stars will be high on its list of priorities. The SORCE team looks forward to continued collaboration with the astronomical community in understanding variability of Sun-like stars.



Workshop organizer Jeff Hall from Lowell Observatory gave a tour of the facility. It included the 4.2 m Discovery Channel Telescope, shown behind Jeff.

SORCE PI Tom Woods gave an invited talk at another recent meeting, *SOHO-23: Understanding a Peculiar Solar Minimum Conference* in Northeast Harbor, Maine. His talk, *Review of Recent Solar Irradiance Variations*, was part of Session 2 – Manifestations of the Unusual Solar Minimum in the Photosphere and Chromosphere.



He discussed the characteristics of the current cycle minimum (deeper and broader than recent cycle minima) and that this minimum appears similar to the minima in the early 1900s. With the best-ever solar irradiance measurements from SOHO, SORCE, and TIMED, this minimum offers a unique opportunity to advance our understanding of secular (long-term) changes in the solar irradiance. A first task towards

this goal is the comparison of the 2007-2009 irradiance results of this current minimum to the irradiance levels during the previous minimum in 1996. The TSI indicates lower irradiance in 2008 than in 1996 by about 200 ppm according to both the VIRGO composite (Claus Fröhlich) and ACRIM composite (Dick Willson). The SOHO SEM 26-34 nm irradiance is about 5% lower in 2008 than in 1996. Similarly, the SORCE SOLSTICE far ultraviolet (120-180 nm) irradiance is 1-6% lower in 2008 than the same UARS SOLSTICE measurements.

The uncertainties in these irradiance results are high though because they depend strongly on understanding instrument degradation trends over 12 years. These lower irradiances are only about 1-sigma results that is, the change in irradiance between the 1996 and 2008 minima is about the same as the uncertainty in instrument degradation trends. The more convincing evidence for a potentially lower irradiance is the lower magnetic field at the poles. Other possible evidence for the expected irradiance level for this current minimum can be obtained from examining solar images to access the differences in the network contributions during the minima.

For the complete program, you can visit the SOHO-23 meeting website: <http://www.soho23.org/>

1,199,042

Hits to the SORCE Website

(Since 4/21/03, As of 9/25/09)

SORCE Visitors at LASP –

Summer is a wonderful time to visit Boulder and SORCE collaborators from around the world have taken advantage of the opportunity to visit LASP to work with the instrument scientists on various projects and publications.

Gérard Thuillier from CRNS in France came to work with the SIM instrument team on a paper called, "The visible solar spectrum measured by the SIM spectrometer placed on board the SORCE satellite: Comparison with recent observations". This paper will be submitted to *Solar Physics* very soon.



While at LASP, Gérard gave two presentations on his current work. His first presentation was an overview called *The PICARD Mission*. The PICARD mission measurements will be carried out with two absolute radiometers, a bolometer, sun photometers, and an imaging telescope. The measurements comprise the total and spectral solar irradiance, solar diameter, limb shape, solar asphericity, and helioseismic waves. For additional information, see <http://smc.cnes.fr/PICARD/>. The expected launch date is January 2010.

Dr. Thuillier also gave a presentation on the International Space Station's SOLSPEC instrument, which measures the Sun's absolute spectral irradiance and its variability from 165 to 3080 nm. The instrument is composed of three double spectrometers using concave gratings, and includes reference sources to check its photometric stability and its spectral characteristics during the three-year mission.

Oran (Dick) White also spent a week at LASP this past month, working with the SIM, SOLSTICE, and TIM instrument teams. In particular he spent time working with Juan Fontenla on a paper regarding image analysis, discussing the comparison of CaII and MgII time series with Marty Snow, and learning about the TSI Radiometer Facility from Greg Kopp.



Upcoming Meetings / Talks – SORCE scientists plan to present papers or attend the following 2009 meetings:

- WHI (Whole Heliosphere Interval) Workshop,
Nov. 10-13, Boulder, Colorado
- ISSI Working Group – Modeling of Solar Spectral
Irradiance Measurements,
Dec. 9-11, Bern, Switzerland
- AGU Fall Meeting, December 14-18,
San Francisco, California
- ISSI Working Group – Tools for UV Calibration,
Jan. 2010, Bern, Switzerland

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