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Solar Radiation and Climate Experiment Monthly Newsletter **June 2008**

SORCE Returns $3M to NASA –

SORCE is making news! CU-LASP sponsored a News Briefing on June 17 to return $3 million in cost savings to NASA. This is money that was not spent during the SORCE Prime Mission development and operations (first 5 years). The cost savings is a result of an efficient management team, effective pre-launch testing, an extraordinary science team, and the sharing of LASP Mission Operation Center personnel. A $2,997,000 check was presented to Ed Chang, NASA Project Manager for SORCE.

Tom Woods, SORCE PI, gave a short summary regarding the cost savings before the check was presented. In front of Tom is the back of the check, an engraved aluminum plate, that was later flipped around during the presentation. Tom Sparn, LASP SORCE Program Manager looks on.

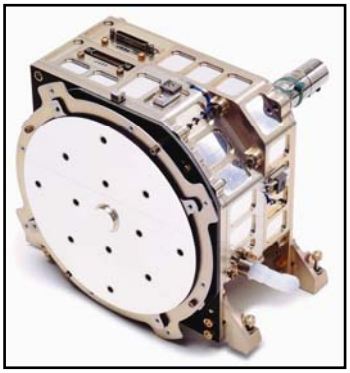
The rare occasion of funds going *back* to NASA was appreciated by the local and national news media. The full CU Press Release is at: http://www.colorado.edu/news/r/85fe271b821f779df19d25e59ebc5ca9.html.

The check being passed from CU-LASP to NASA-GSFC. Left to right: Bronson Hilliard, CU Dir. of University Communications; Stein Sture, CU Vice Chancellor for Research; Tom Sparn, CU-LASP SORCE Program Manager; Tom Woods, SORCE Principal Investigator, CU-LASP; Edward Chang, NASA Project Manager for SORCE.

SORCE Data Needed for NOAA Space Weather Operations –

By Tom Woods, LASP, University of Colorado

The NOAA GOES-10 satellite is the only satellite measuring the solar X-ray irradiance that is used for Space Weather Operations by NOAA Space Weather Prediction Center (SWPC) and other organizations such as the Air Force. These GOES solar observations obtained from their X-Ray Sensor (XRS) are critical for real-time monitoring of solar flares and are used as a warning for other possible solar storm events such as solar energetic particles (SEPs) and coronal mass ejections (CMEs). With the failures of the solar pointing platform on GOES-11 and GOES-12 and GOES-13 not being operational yet (plus additional limitations of the GOES-13 XRS), only the GOES-10 satellite is making the solar X-ray measurements currently.



It is important for the National Space Weather Program (NSWP) to continuously monitor the solar X-ray irradiance, so an option is being considered for SORCE XPS to provide realtime solar X-ray monitoring for NOAA. SORCE currently only has downlink of data 2-3 times per day. However, SORCE can have essentially 24-hour downlink through TDRS if so scheduled with the NASA TDRS center. This type of continuous, and fully automated, operation has been done with LASP's sister satellite AIM which has the same OSC spacecraft bus. This option is considered as a short term solution until NASA SDO is launched; the SDO EUV Variability Experiment (EVE) will provide solar X-ray measurements with 10-sec cadence and 100% duty cycle and will have near realtime space weather data products available soon after SDO launches in late 2008 / early 2009.

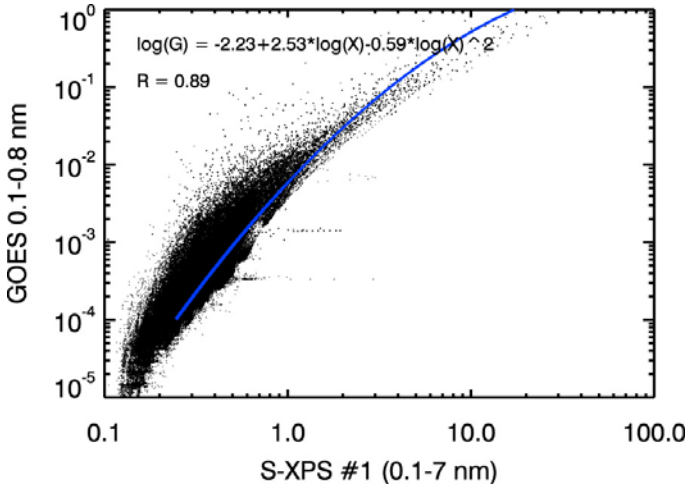


Figure 1. Power law fit between SORCE XPS #1 and GOES XRS-B.

The SORCE XPS observes the 0.1-7 nm solar irradiance, currently with 1-min cadence but could be higher cadence. This soft X-ray band correlates well with the GOES X-Ray Sensor (XRS) B channel (0.1-0.8 nm band), so the XPS measurement can be used as a proxy for the GOES X-ray measurements. Figure 1 shows the relationship between SORCE XPS 0.1-7 nm band and the GOES XRS-B 0.1-0.8 nm band. Figure 2 shows the predictions for 3 days in 2003 using the proxy model parameters given in Figure 1. This proxy model indicates very good fit to the GOES X-ray measurement during flare events, but quality of the fit decreases for non-flare events. The fit of just the flares yields a more linear power-law fit, so an improved algorithm (proxy model) would be considered for flare and non-flare data. To determine if the Sun is currently having a flare or not, more than one XPS photometer might be used to determine mean solar plasma temperature.

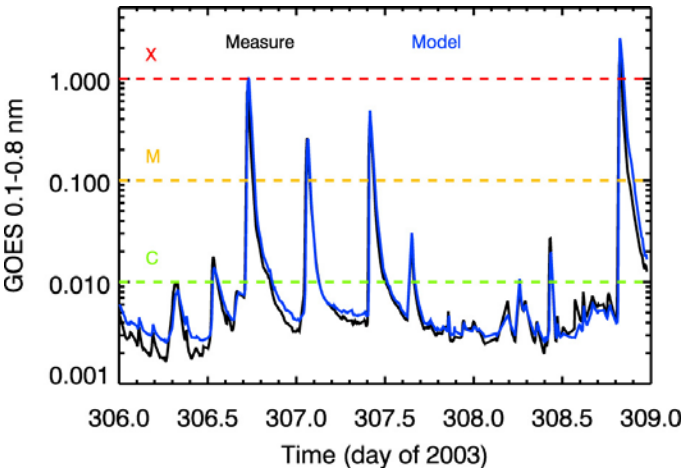


Figure 2. Comparison of model using the SORCE XPS proxy to actual GOES measurement. The model works best for the large flares (C class and above) but has larger differences for the lower levels of the X-ray irradiance (below C class).

A proposal to have the option to operate SORCE with 24-hour coverage by TDRS is being reviewed by NOAA. Development of the operations, planning, and data processing for a space weather data product is expected to take about 2 months, but the 24-hour operations would not implemented unless the GOES-10 solar platform was to fail in 2008.

559,887

Hits to the SORCE Website

(Since 4/21/03, As of 6/6/08)

SORCE PI Gives Invited Talk at CAWSES Workshop –

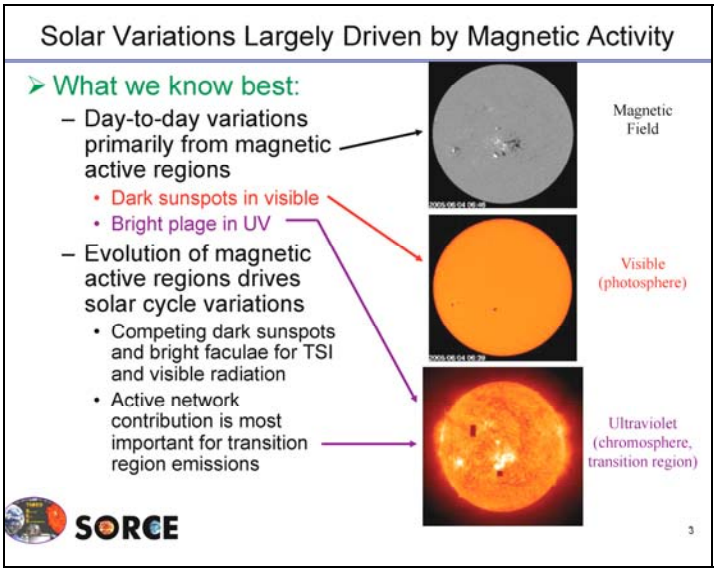
By Tom Woods, LASP, University of Colorado

SORCE PI Tom Woods recently attended the CAWSES-sponsored International Workshop on "Solar Variability, Earth's Climate and the Space Environment", June 2-6, 2008 in Bozeman, Montana. Approximately 90 solar scientists gathered to specifically discuss solar irradiance, its variability, its influence on climate change, and the solar events that impact space weather. Except for the space weather sessions, this workshop is similar to the SORCE science workshops. This was the last workshop for CAWSES as this international program is ending this year; however, a new international program is likely to replace it, perhaps called CAWSES-2 and led by Susan Avery.

Following the meetings theme, Tom gave an invited talk on ***"Solar Irradiance Variability Observed During Solar Cycle 23"***. The abstract is below:

The total solar irradiance (TSI) and solar spectral irradiance (SSI) from 0.1 nm to 2400 nm have been measured

daily by NASA's Solar Radiation and Climate Experiment (SORCE) and Solar Extreme ultraviolet Experiment (SEE) aboard the TIMED satellite. These irradiance observations over solar cycle 23 range from solar cycle maximum levels in early 2002 to minimum levels in late 2007. Additional observations of the TSI and the ultraviolet range between 119 nm to 420 nm provide a more complete understanding of the variations during this solar cycle. The dominant temporal variations are due to flares (minutes-hours), active region evolution and solar rotation (days-weeks), and solar cycle magnetic evolution (months-years). The variations in wavelength are dependent on where in the solar atmosphere the emissions arise. The photospheric emissions, which dominate in the near infrared, visible, and near ultraviolet ranges, vary by about 0.1% over the 11-year solar cycle and are characterized by dark sunspots and bright faculae. The emissions from the solar chromosphere and transition region are easily identified in the extreme ultraviolet and far ultraviolet ranges, and their solar cycle variations of 20% to 300% are associated with the evolution of bright plage and active network features on the Sun. Finally, coronal emissions, which dominate in the X-ray and the lower part of the extreme ultraviolet range, vary by factors of 5 to 1000 over the solar cycle. LASP's Interactive Solar Irradiance Datacenter: http://lasp.colorado.edu/lisird/



Slide 3 from Woods' CAWSES presentation.

SORCE XPS Paper Published in May 2008 Solar Physics –

Tom Woods *et al*. recently published **"XUV Photometer System (XPS): Improved Solar Irradiance Algorithm Using CHIANTI Spectral Models"** in the May 2008 issue of *Solar Physics*, page 95, doi: 10.1007/s11207-008-9196-6. The abstract is below:

Solar soft X-ray (XUV) radiation is highly variable on all time scales and strongly affects Earth's ionosphere and upper atmosphere; consequently, the solar XUV irradiance is important for atmospheric studies and for space weather applications. Although there have been several recent measurements of the solar XUV irradiance, detailed understanding of the solar XUV irradiance, especially its variability during flares, has been hampered by the broad bands measured in the XUV range. In particular, the simple conversion of the XUV photometer signal into irradiance, in which a static solar spectrum is assumed, overestimates the flare variations by more than a factor of two as compared to the atmospheric response to the flares. To address this deficiency in the simple conversion, an improved algorithm using CHIANTI spectral models has been developed to process the XUV Photometer System (XPS) measurements with its broadband photometers. Model spectra representative of quiet Sun, active region, and flares are combined to match the signals from the XPS and produce spectra from 0.1 to 40 nm in 0.1-nm intervals for the XPS Level 4 data product. The two XPS instruments are aboard NASA's Solar Radiation and Climate Experiment (SORCE) and Thermosphere, Ionosphere, Mesosphere, Energetics, and Dynamics (TIMED) satellites. In addition, the XPS responsivities have been updated for the latest XPS data processing version. The new XPS results are consistent with daily variations from the previous simple conversion technique used for XPS and are also consistent with spectral measurements made at wavelengths longer than 27 nm. Most importantly, the XPS flare variations are reduced by factors of 2 – 4 at wavelengths shorter than 14 nm and are more consistent, for the first time, with atmospheric response to solar flares. Along with the details of the new XPS algorithm, several comparisons to dayglow and photoelectron measurements and model results are also presented to help verify the accuracy of the new XUV irradiance spectra.

The complete article is available on-line at: http://www.springerlink.com/content/675m419m88x18n05/fulltext.pdf. A summary of this paper was presented by Tom Woods at the February 2008 SORCE Science Team Meeting in Santa Fe, NM. The poster can be viewed at: http://lasp.colorado.edu/sorce/news/2008ScienceMeeting/posters/P1_07_Woods.pdf.

SORCE Team Organizes Informal SSI Comparison Workshop –

By Jerry Harder, LASP, University of Colorado

SORCE scientists organized a very informal Solar Spectral Irradiance Comparison Workshop within LASP to discuss concurrently acquired data sets from the April 10-14, 2008 rocket campaign conducted at White Sands Missile Range. Supporting information from the SORCE SIM and SOLSTICE instruments, SRPM image analysis, and the TIMED SEE instrument provide a very strong data set that defines the Solar Cycle 23 solar minimum state. The agenda included input from Phil Chamberlin who presented the 'first light' findings from the SDO EVE underflight rocket instrument. TIMED SEE results were summa-

rized by Frank Eparvier, SORCE SOLSTICE data from Marty Snow, and SORCE SIM results and SRPM modeling were presented by Jerry Harder.

These concurrent observations will provide information for both space weather applications and climate studies since the data represents the solar minimum state. This data will be used as part of the Whole Heliosphere Interval (WHI) study. WHI (http://ihy2007.org/WHI/WHI.shtml) is an international coordinated observing and modeling effort to characterize the 3-dimensional interconnected solar-heliospheric-planetary system.

A "Whole Heliosphere Interval Data and Modeling Analysis Workshop" (WHIDMAW) is planned for August 26-29 at NCAR in Boulder, Colorado. This workshop will focus on gathering data and model information, performing preliminary assessment and analysis, and connecting and linking the various data and models. The workshop structure will include plenary/full group discussion sessions in the mornings, and small group breakouts in the afternoon. Daily themes will include:

- Characterizing the global, interconnected, (non-transient) heliosphere
- Analyzing energy transport/transient origins and impact
- Studying physics at boundaries throughout the heliosphere

The WHI Workshop registration is now open at: http://www.hao.ucar.edu/forms/whidmaw_registration.html.

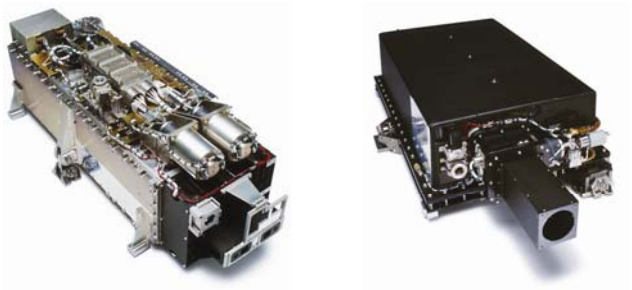
M3 Meeting Summary –

By Jerry Harder, LASP, University of Colorado

Moon Mineralogy Mapper (M3) Meeting
April 30-May 1, GSFC, Greenbelt, MD

The Indian Space Research Organization (ISRO) developed the Chandrarayan-1 mission to study the distribution and composition of lunar minerals, and ISRO invited international teams to build instruments for this study. The launch date is set for this August. One of the instruments on this mission is the Moon Mineralogy Mapper ('M-cubed'), a hyperspectral imager developed by the Jet Propulsion Laboratory with Dr. Carle Pieters of Brown University as the instrument's principal investigator. The primary science goal of M3 is to spectroscopically characterize and map lunar surface mineralogy in the context of lunar geologic evolution and to further lunar geologists' understanding of the highland crust, basaltic volcanism, impact craters, and potential volatiles. M3 is a nadir-looking instrument, so the team is interested in solar reference spectra and on possible impacts of solar variability on their observations.

There is a very good match between the wavelength coverage on the SIM instrument with M3, so possible collaborative studies between these instruments was explored during the team meeting. This meeting also provided an opportunity to show some of the very unique and potentially valuable observations of lunar albedo acquired from the SORCE SOLSTICE instrument.



SORCE SIM (left) and SORCE SOLSTICE (right).

SORCE Hosts Visitors at LASP –

By Margit Haberreiter and J. Harder, LASP, University of Colorado

In the past month SORCE has hosted many special visitors to discuss the latest state on modeling the solar spectral irradiance, data and instrument calibration.

Juan Fontenla and Margit Haberreiter working on the latest SIM data.

Eric Quemerais, from Service d'Aéronomie du CNRS in Paris and PI of SWAN/SOHO, came in early May to work with the Juan Fontenla and Margit Haberreiter on the project of forecsting the solar UV/EUV irradiance. The Lyman-alpha backscattered flux observed by SWAN is a key ingredient in the newly developed forecasting tool. Werner Curdt, from the MPS in Lindau Katlenburg, Germany and PI of the SUMER/SOHO, and Gene Avrett from the Harvard-Smithsonian Center for Astrophysics in Cambridge, came the first week in June to discuss the latest developments of the solar atmosphere structures used for modeling the variability of the solar spectrum. Spacially resolved UV/EVU spectra observed with SUMER/SOHO are used to constrain these structures. Dr. Curdt gave a special seminar on "The Solar Corona: New Insights from Spectroscopic Observations".

Micha Scholl, a PhD student working with Prof. Werner Schmutz at the Physical Meteorological Observatory Davos, visited LASP to work with Juan Fontenla and Margit Haberreiter on the improvement of the radiative transfer code COSI. In particular, they worked on the implementation of the ambipolar diffusion, an important plasma process and essential for the correct calculation of the Lyman-alpha intensity.

Joseph Pagaran of the University of Bremen, Germany, is a graduate student studying with Dr. Mark Weber

of the ESA ENVISAT SCHIAMACHY team. He was in the United States to attend the CAWSES meeting in Montana. While in the USA, Jerry Harder invited Joseph to Boulder to discuss comparisons of SCHIAMACHY and SIM. This is one of the sub-topics of the International Space Science Institutes studies on "Interpretation and modeling of Solar Spectral Irradiance measurements" led by Ilaria Ermolli. Both Joseph and Micha are participating in this activity, as well as LASP's Juan Fontenla, Margit Haberreiter, and Jerry Harder, who are also team members.

Upcoming Meetings / Talks –

SORCE scientists plan to present papers or attend the following 2008 meetings:

37th COSPAR Scientific Assembly, July 13-20, Montreal, Canada

International Radiation Symposium (IRS2008), Aug. 3-8, Iguacu Falls, Brazil

WHI (Whole Heliosphere Interval) Data and Modeling Assessment Workshop, Aug. 26-29, Boulder, CO

To submit information to this newsletter, please contact: vanessa.george@ lasp.colorado.edu.