

Solar Irradiance Data Products at the LASP Interactive Solar Irradiance Datacenter (LISIRD)

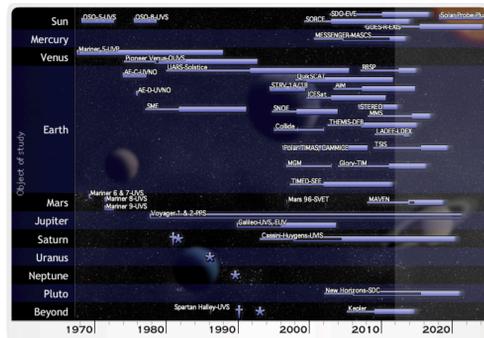
<http://lasp.colorado.edu/lisird/>

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Overview

The Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado has been measuring solar irradiance for more than 25 years and has extensive data holdings. To better share this data with the scientific community, we have created the LASP Interactive Solar Irradiance Datacenter (LISIRD), a centralized archive and distribution site for solar irradiance data. With this site, we provide:

- Flexible user-friendly interfaces for accessing solar irradiance data products
- Composite solar irradiance data products, integrating measurements from different instruments into aggregate products, reference spectra, etc.
- Access to solar irradiance models, synthesized spectra, and associated results
- Flexible options for data access and formats
- Web-based and downloadable tools to facilitate data analysis and visualization
- Web service and programming language APIs
- Interoperability with Virtual Observatories (VOs)
- Expert end-user support (access, analysis, interpretation)

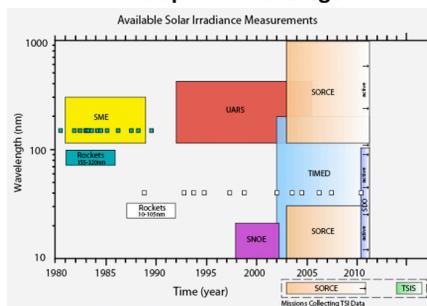


Solar Irradiance Measurements

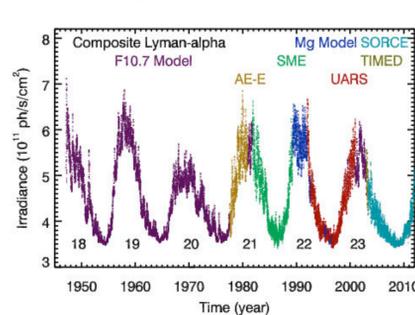
LISIRD serves a broad variety of solar irradiance data. We provide data from SNOE, TIMED, UARS, SME, and SORCE. SORCE's TIM instrument measures the total solar irradiance (TSI), while the SORCE SOLSTICE, SIM, and XPS instruments together yield measurements of the full-disk solar spectral irradiance (SSI) from ~0.1 nm to 2400 nm (excluding 34-115 nm). These datasets are combined with data from previous and current missions to provide solar data coverage spanning decades.

Spectral Region	Wavelength (nm)	Missions
Soft X-ray (XUV)	0.1-30	SNOE, TIMED, & SORCE
Extreme Ultraviolet (EUV)	30-115	TIMED
Far Ultraviolet (FUV)	115-200	SME, UARS, TIMED, & SORCE
Middle Ultraviolet (MUV)	200-300	SME, UARS, & SORCE
Near Ultraviolet (NUV)	300-400	UARS & SORCE
Visible (VIS)	400-750	SORCE
Near Infrared (NIR)	750-2400	SORCE
Total Solar Irradiance (TSI)	Bolometric	SORCE

Solar Irradiance Measurements Timeline and Spectral Coverage



Composite Lyman- α timeseries containing data from multiple missions



LISIRD Data Access

The LISIRD website provides an interactive web-based interface to several solar irradiance data sets, including total solar irradiance (TSI) and spectral solar irradiance (SSI) spectra and timeseries. Users can dynamically explore the data and choose to download either complete datasets or subsets. For the purpose of comparison, we also host additional solar irradiance data products from other sources, such as sunspot index, sunspot number, and f10.7.

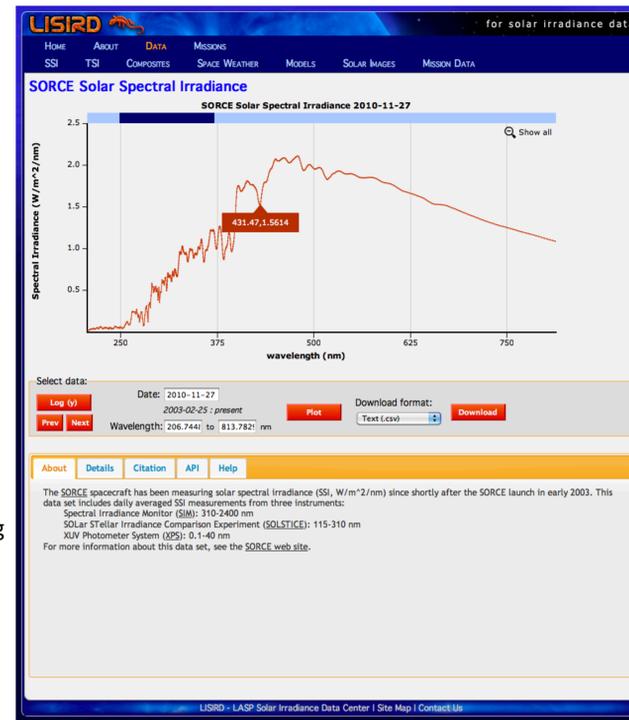
Data can be downloaded as complete datasets in ASCII format, and IDL file readers are available. It is also possible to select only a specific range of data for download (e.g. only TSI data from the past year, or SSI within a particular wavelength range), and .zip compression is available for large downloads. OPeNDAP and programming interfaces are available for accessing data from tools and code.

In the future, we plan to serve LISIRD data in several formats:

- IDL .sav files
- NetCDF, HDF

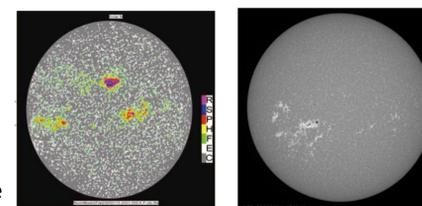
We also plan to increase interoperability with other virtual observatories and add links to additional local and remote data sources. Beyond data access, we plan to provide additional computational models and analysis tools.

For questions or comments, e-mail: lisird@lasp.colorado.edu



Solar Images

Photometric solar images from the MLSO Precision Solar Photometric Telescope (PSPT) are available via LISIRD. The PSPT is the centerpiece of the National Science Foundation (NSF) Radiative Inputs from Sun to Earth (RISE) program, the aim of which is to measure and understand variability in the solar radiative output. The PSPT produces seeing-limited full-disk digital (2048x2048) images in the blue continuum (409.4nm, FWHM 0.3nm), red continuum (607.1nm, FWHM 0.5nm), CaII K (393.4nm, FWHM 0.3nm), CaII K Narrow Band Wing (NBW) (393.6nm, FWHM 0.1nm), and CaII K Narrow Band Core (NBC) (393.4nm, FWHM 0.1nm), with an unprecedented 0.1% pixel-to-pixel relative photometric precision.



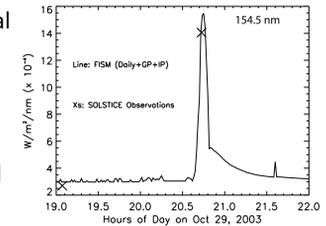
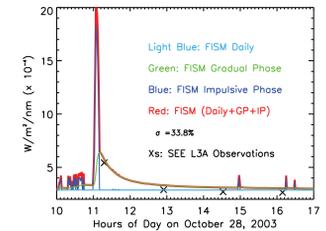
Available on mobile devices



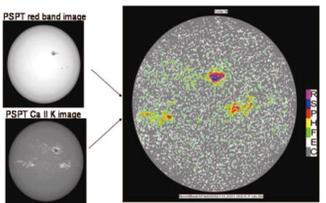
Solar Models

Solar models are crucial to understanding solar physics. On the LISIRD site, we provide composite and reconstructed time series based on the following solar models:

- Flare Irradiance Spectral Model (FISM): LISIRD provides downloads of Phil Chamberlin's FISM model, including daily and flare data. FISM reproduces the EUV and FUV spectrum of the Sun on 1-minute time cadence to model the effects of flares on the solar irradiance.
- Historical TSI: LISIRD provides downloads of historical TSI based on "Modeling the Sun's Magnetic Field and Irradiance since 1713" by Wang, Lean, and Sheeley. These data are updated through 2007 by Judith Lean and then modified by offsetting to the SORCE/TIM TSI absolute values using years 2003-2007 of overlap, and replacing years 2003-2007 and extending to more recent times using annual averages of SORCE/TIM data.



- Solar Radiation Physical Modeling (SRPM): LISIRD provides access to Juan Fontenla's SRPM model. SRPM uses daily images from the PSPT to determine the absolute contributions to the spectral irradiance at all visible and IR wavelengths, from the various features (plage, sunspots, penumbra, etc).



- NRL Solar Spectral Irradiance (NRLSSI): Dr. Judith Lean has developed the NRLSSI model, which is empirically derived using proxies of sunspot area and facular brightening and validated with SSI measurements. The NRLSSI model covers the wavelength range from 120 nm in the ultraviolet up to 100 μ m in the infrared, including the visible range. The model spectra have spectral bin widths increasing from 1 nm at 120.5 nm to 25 nm at 99.975 microns, for which estimates of the solar spectral irradiance are determined daily since 1950, monthly since 1882 and annually since 1610.

References

FISM:
1. Chamberlin, P. C., T. N. Woods, and F. G. Eparvier, Flare Irradiance Spectral Model (FISM): Flare component algorithms and results, Space Weather, 6, S05001, doi:10.1029/2007SW000372, 2008.
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Historical TSI: Y.-M. Wang, J. L. Lean and N. R. Sheeley, Jr., Modeling the Sun's Magnetic Field and Irradiance since 1713, ApJ 625 522, 2005.

SRPM:
1. Fontenla, J.M., Avrett, E., Thuillier, G., and Harder, J., "Semi-empirical models of the solar atmosphere. I. The quiet and active-Sun photosphere at mid-resolution", ApJ, 639, 441-458 (2006)
2. Fontenla, J., Harder, J., "Physical Models of Spectral Irradiance Variations", MmSAI, 76, 826-833 (2005)
3. Fontenla, J., Harder, J., White, O., Rottman, G. and Woods, T., "Solar Spectral Irradiance Variability Comparisons of the SORCE SIM Instrument with Monitors of Solar Activity and Spectral Synthesis", MmSAI, 76, 735-742 (2005)
4. Harder, J., Fontenla, J., White, O., Rottman, G. and Woods, T., "Solar Spectral Irradiance Variability Comparisons of the SORCE SIM Instrument with Monitors of Solar Activity and Spectral Synthesis", MmSAI, 76, 735-742 (2005)
5. Fontenla, J.M., White, O.R., Fox, P.A., Avrett, E.H., and Kurucz, R.L., "Calculation of Solar Irradiances I: Synthesis of the Solar Spectrum", ApJ, 518, 480-499 (1999).

NRLSSI: Lean, Judith; Rottman, Gary; Harder, Jerald; and Kopp, Greg. "SORCE Contributions to New Understanding of Global Change and Solar Variability." Solar Physics, 230, Numbers 1-2, 09/2005., 27-53(27).

Space Weather Data

There is a growing need for access to near real-time space weather data. We plan to provide rapid access to daily measurements from SORCE and TIMED-SEE, including Lyman α (121.6 nm), magnesium II index, and preliminary TSI. At present, Lyman α and Mg II are available with a short delay due to processing.

