LISIRD: LASP Interactive Solar Irradiance Data Center

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

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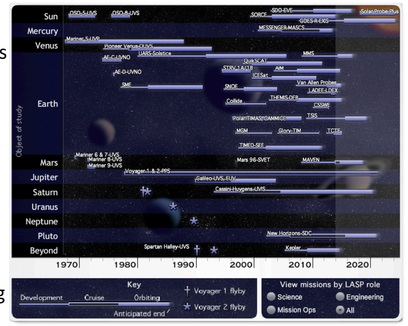
AGU 2013: GC51C-0987

Overview

The Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado has been measuring solar irradiance for more than 30 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:



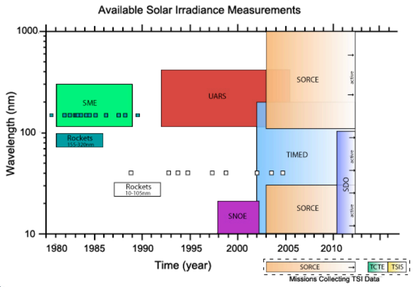
- Flexible user-friendly interfaces for accessing solar irradiance data products
- Composite solar irradiance data products, integrating measurements from different instruments into aggregate products, reference spectra, etc.
- Near real-time solar irradiance data products for rapid use
- Access to solar 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
- Service-oriented data access, filtering, and format transformation
- Expert end-user support (access, analysis, interpretation)

Solar Irradiance Measurements

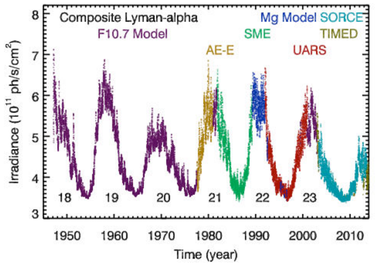
LISIRD serves a broad variety of solar irradiance data. We provide data from SNOE, TIMED-SEE, UARS, SME, and SORCE. SORCE's TIM instrument measures the total solar irradiance (TSI), while the SORCE SOLSTICE, SIM, and XPS instruments together yield measurements of the full-disk solar spectral irradiance (SSI) from ~0.1 nm to 2400 nm (excluding 34-115 nm which is covered by TIMED-SEE). 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	SORCE XPS, SNOE, TIMED-SEE
Extreme Ultraviolet (EUV)	30-115	TIMED-SEE
Far Ultraviolet (FUV)	115-180	SORCE SOLSTICE, SME, UARS, TIMED-SEE
Middle Ultraviolet (MUV)	180-310	SORCE SOLSTICE, SME, UARS
Near Ultraviolet (NUV)	240-310	SORCE SIM, UARS
Visible (VIS)	310-950	SORCE SIM
Near Infrared (NIR)	950-2400	SORCE SIM
Total Solar Irradiance (TSI)	Bolometric	SORCE TIM

Solar Irradiance Measurements Timeline and Spectral Coverage



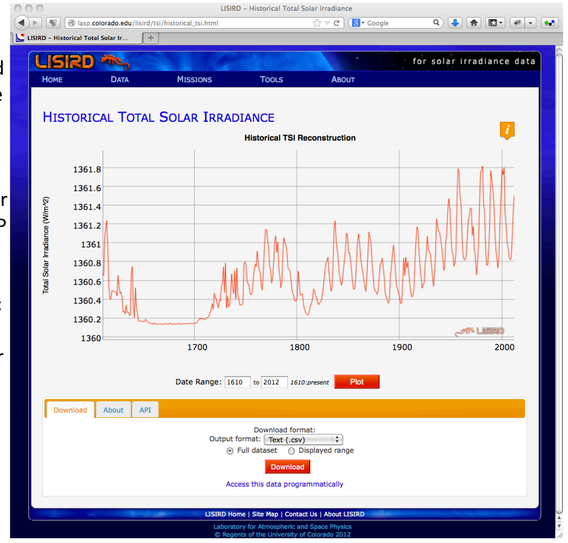
Composite Lyman-α timeseries containing data from multiple missions



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.

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 compliant web service access (LaTiS) is also available for programmatic subsetting and downloads including an IDL routine for reading data directly into an IDL data structure.



In response to user requests, we plan to add more access options:

- IDL save files
- IDL code snippets
- NetCDF, HDF
- Time formats
- Unit conversions
- More capable IDL, python, and other access routines

We are continuing to add related data products (e.g. solar indices, other solar irradiance measurements and models) and tools to facilitate data comparison and data fusion.

LaTiS Server Usage: http://server/latis/dataset.suffix?projection&selection&filter

suffix: type of output (e.g. csv, nc, h5, sav)

projection: list of variables to return

selection: relative constraint (*e.g.* time>=2012-01-01)

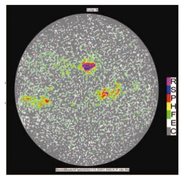
filter: One or more functions to be applied to the data (e.g. thin, binavg)

Example:

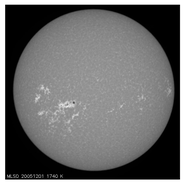
http://lasp.colorado.edu/lisird/tss/historical_tsi.csv? time,Irradiance&Irradiance>1361.5

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.



Feature decomposed image mask

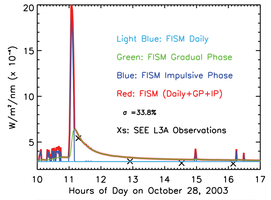


Ca II K Image

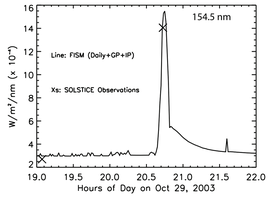
Solar Models

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:

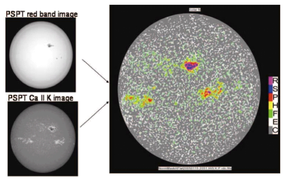
- Flare Irradiance Spectral Model (FISM): LISIRD provides downloads of Phil Chamberlin's FISM model, including daily and flare data. FISM reproduces the EUV and FUV spectrum of the Sun on 1-minute time cadence to model the effects of flares on the solar irradiance.



- 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 µm 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:

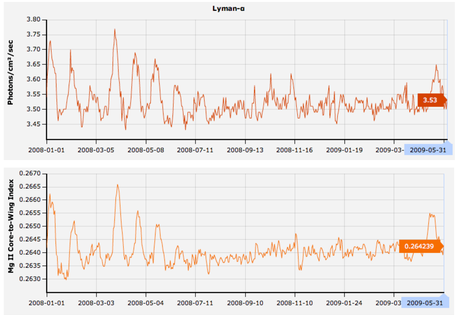
1. Chamberlin, P. C., T. N. Woods, and F. G. Eparvier, Flare Irradiance Spectral Model (FISM): Flare component algorithms and results, Space Weather, 6, S05001, doi:10.1029/2007SW000372, 2008.
2. Chamberlin, P. C., T. N. Woods, and F. G. Eparvier, Flare Irradiance Spectral Model (FISM): Daily component algorithms and results, Space Weather, 5, S07005, doi:10.1029/2007SW000316, 2007.

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)
3. Fontenla, J., Harder, J., "Physical Models of Spectral Irradiance Variations", MmSAI, 76, 826-833 (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 Acitivity 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 timely access to daily measurements from SORCE, TIMED-SEE, and SDO EVE including Lyman α (121.6 nm) and magnesium II index. At present, Lyman α and Mg II are available with a short lag due to processing delays.