Technologies and Methods Used at the Laboratory for Atmospheric and Space Physics (LASP) to Serve Solar Irradiance Data

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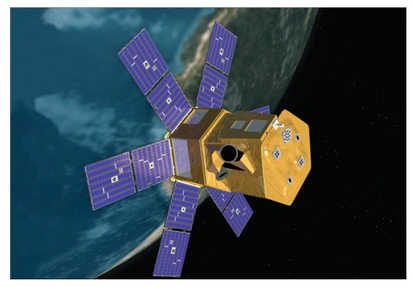
Abstract / Overview

The Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado in Boulder, USA operates the Solar Radiation and Climate Experiment (SORCE) NASA mission, as well as several other NASA spacecraft and instruments. Dozens of Solar Irradiance data sets are produced, managed, and disseminated to the science community. Data are made freely available to the scientific immediately after they are produced using a variety of data access interfaces, including the LASP Interactive Solar Irradiance Datacenter (LISIRD), which provides centralized access to a variety of solar irradiance data sets using both interactive and scriptable/programmatic methods. This poster highlights the key technological elements used for the NASA SORCE mission ground system to produce, manage, and disseminate data to the scientific community and facilitate long-term data stewardship. The poster presentation will convey designs, technological elements, practices and procedures, and software management processes used for SORCE and their relationship to data quality and data management standards, interoperability, NASA data policy, and community expectations.

NASA's Solar Radiation and Climate Experiment (SORCE) Mission

SORCE is a free-flying, Earth-orbiting satellite carrying four instruments to measure the solar radiation incident at the top of the Earth's atmosphere. Spectral measurements identify the irradiance of the Sun by characterizing the Sun's energy over the full spectral range from ultraviolet to infrared.



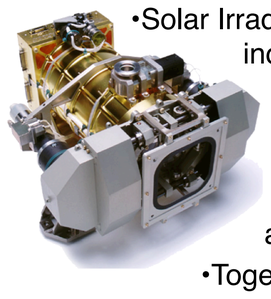
- Launched January 25, 2003
- Data Product Summary

  Total Solar Irradiance (TSI), W/m²
  - Daily and 6-Hourly Mean Irradiances. Provided by the TIM Instrument

  Solar Spectral Irradiance (SSI), W/m²/nm
  - Daily Irradiance spectra from 115-2400 nm, normalized to 1 AU
  - Measurements from the SIM, SOLSTICE, and XPS instruments
  - XPS: 0.1 - 34 nm at 5-10 nm intervals, 6-channels

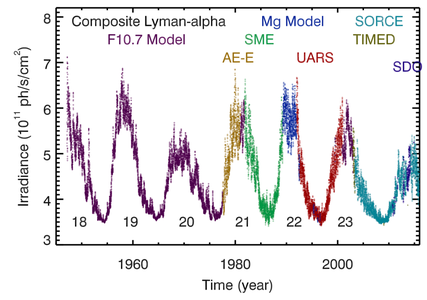
Solar Irradiance Measurements

- LASP produces and serves a broad variety of solar irradiance measurements



- Solar Irradiance Data sets are time series of either individual measurements or timetagged electromagnetic spectra
- Measurements are available from several space missions, including the full-disk Spectral Solar Irradiance (SSI) from ~0.1 nm to 2400 nm and Total Solar Irradiance (TSI).
- Together, these datasets provide solar data coverage spanning decades.

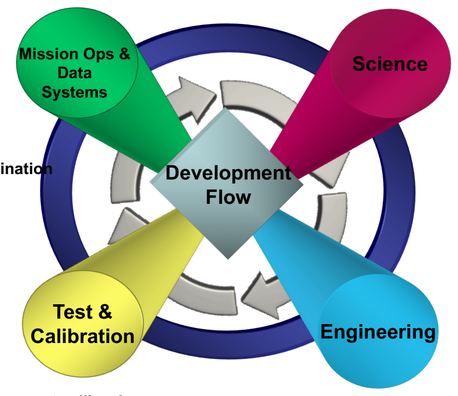
Composite Lyman-α time series containing data from multiple missions



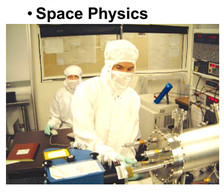
Full Lifecycle Space Research at LASP

- Spacecraft Operations
- Payload Operations
- Science Data Analysis
- Mission Scheduling
- Data Processing and Dissemination

- In-House Facilities
- Environmental test
- World-class detector and instrument calibration



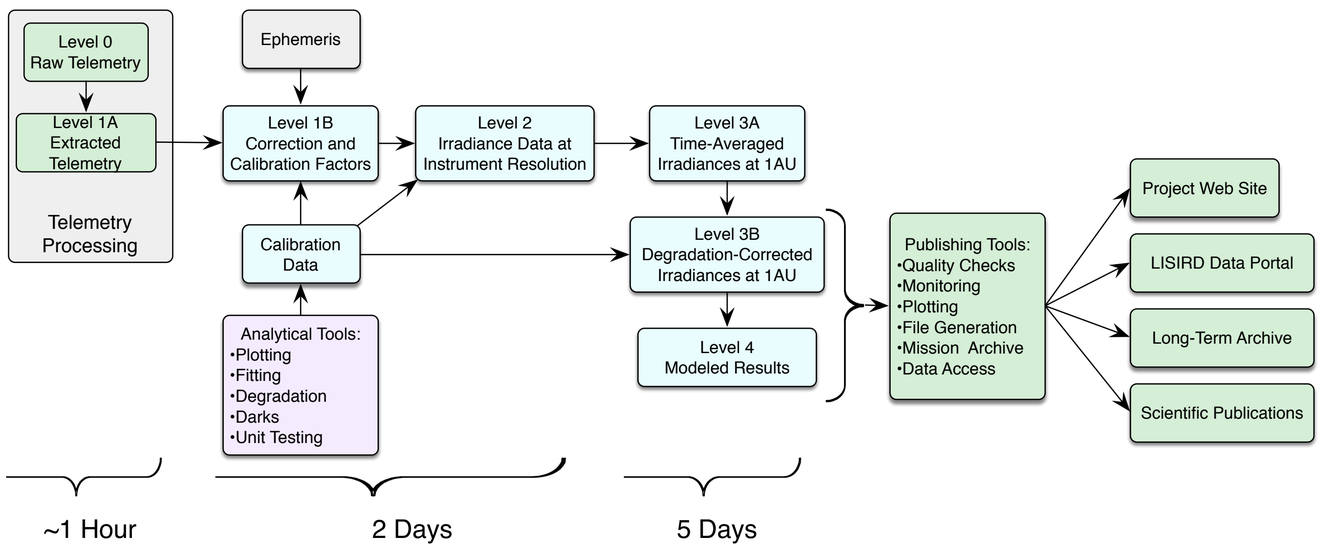
- Identify/Address Space Science Questions
  - Planetary
  - Atmospheric
  - Solar
  - Space Physics



- Design, build, test space system hardware

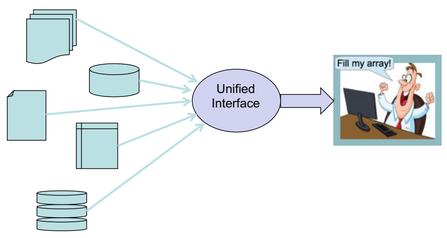
Student Involvement Throughout

Data Architecture / Flows



Time Series Data Service: LaTiS

LaTiS is a highly flexible and configurable data access web service



- Serves data
  - from various sources in disparate formats
  - to "clients" in selectable output formats
- Direct "to-your-tool" data support
- API-based to allow integration and automation
- Compliant with standards, such as OPenDAP
- Facilitates on-demand, server-side capabilities, such as
  - Generic: reformatting, subsetting, aggregation, filtering, time formatting
  - Specific: custom algorithms, data fusion, e.g. merging satellite and forecast model data into a single data set.
- Enables Data Fusion via pluggable functions
- Support for directly serving data originating from external services, e.g. Virtual Observatories, remote web systems, etc.

Programmatic Access Usage:

Most LISIRD data are available via a standard "RESTful" interface that supports specification of parameters, e.g.

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

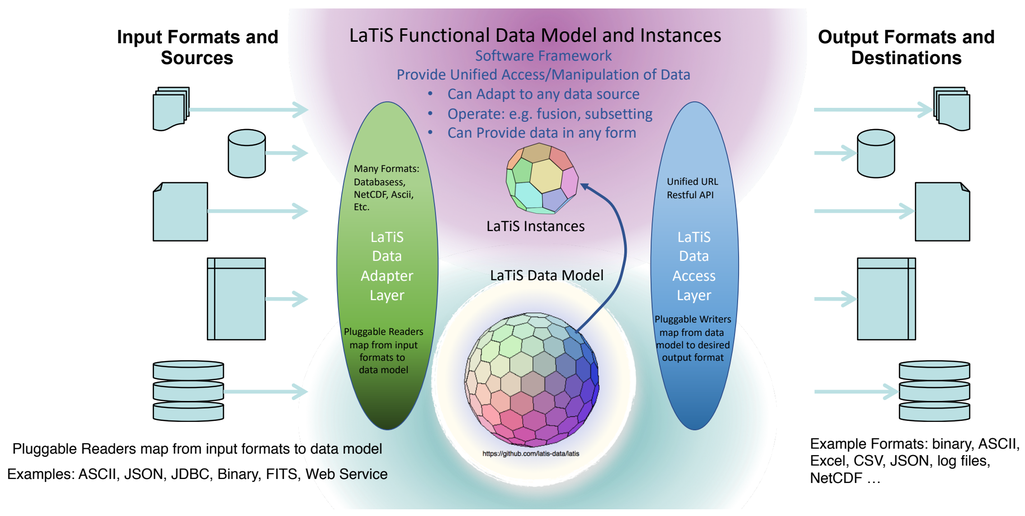
where

suffix: type of output (e.g. csv, txt, bin)

projection: list of variables to return (e.g. "time,irradiance")

selection: relative constraint (*e.g.* time>=2012-01-01 or irradiance>1360.5)

filter: Optional operations/functions to be applied to the data (e.g. thin, binavg)



Pluggable Readers map from input formats to data model
Examples: ASCII, JSON, JDBC, Binary, FITS, Web Service

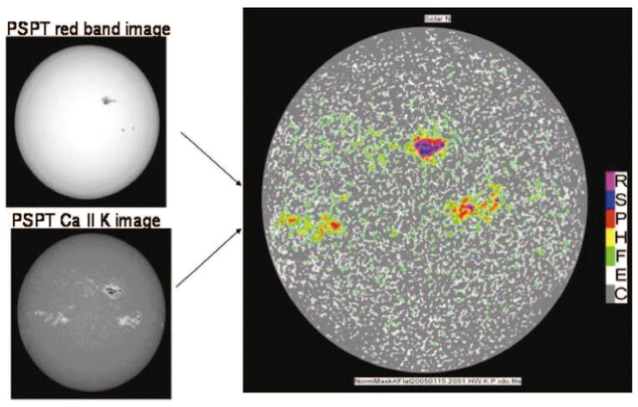
Example Formats: binary, ASCII, Excel, CSV, JSON, log files, NetCDF …

LISIRD Data Portal

LASP Interactive Solar IRradiance Datacenter (LISIRD), a centralized distribution site for solar irradiance data. With this site, we provide:

- **Solar irradiance models**
- **Composite solar irradiance data products**
- **Flexible user-friendly interfaces**
- **Rapid data availability**

- Flexible options for data access and formats
- Web-based tools to facilitate basic data analysis and visualization
- Standards-based and service-oriented data access, filtering, and format transformation
- Semantically Enabled Metadata Repository (LEMR) provides interoperable and flexible metadata management
- Tailored ontology for solar irradiance data sets, interoperable with SPASE or ISO 19115
- Flexible RESTFul Data service layer using LaTiS



The LISIRD web portal provides interactive web-based interfaces and programatic interfaces to support both data discovery and scriptable/ bookmark-able access to several solar irradiance data sets, including **spectra and time series**.

Users can **dynamically explore** data and choose to download either complete datasets or subsets in a variety of formats.

- VIVO, Apache Jena
- Javascript interactive graphics front end (Highcharts)