

Computing Total Solar Irradiance (TSI) and Solar Spectral Irradiance (SSI)

Overview

A new version (v2) of the Naval Research Laboratory (NRL) solar variability model to compute Total Solar Irradiance (TSI) and Solar Spectral Irradiance (SSI) is used to produce time series of daily-, monthly-, and yearly-averaged TSI and SSI, with uncertainties, for 1882 to 2014 and yearly-averaged TSI and SSI, with uncertainties, for 1610-1882. The data record will be extended with quarterly updates. The variability models are called NRLTSI2 and NRLSSI2, respectively, for TSI and SSI. The data record is jointly developed by the University of Colorado at Boulder's Laboratory for Atmospheric and Space Physics (LASP) and the Naval Research Laboratory (NRL).

The NRLTSI2 and NRLSSI2 models are 2-component regression models that determine the changes from quiet Sun conditions when facular brightening and sunspot darkening features are present on the solar disk, where the magnitude of the changes in irradiance are determined from linear regression of the proxy Mg II index and sunspot area indices against the approximately decade-long solar irradiance measurements of the Solar Radiation and Climate Experiment (SORCE). The model regression coefficients and quiet Sun irradiance are pre-determined. For a user-specified time period of interest, the Solar Irradiance CDR source code extracts values for the proxy indices facular brightening and sunspot darkening and computes the irradiance using the proxy indices and the model regression coefficients.

The modeled irradiances are dependent upon the values of the proxy indices used as model input. To ensure the NRLTSI2 and NRLSSI2 irradiances are 100% reproducible, given the same model inputs, yet also allow the Solar Irradiance Data Record Team to evaluate the stability of the model inputs and test the validity of different proxy indicators of solar variability, the operational code can be run in different ("final" or "dev") development environments.

Code Compilation

Extract the source code from the tar file. The source code includes all processing routines and utility routines. Navigate to the "irradiance" directory. Compile the main driver procedure, "nrl2_to_irradiance.pro". The main driver, and all subfunctions, contain comprehensive header documentation.

Usage

The driver procedure expects the following inputs:

ymd1 - starting time range respective to midnight GMT of the given day, of the form 'yyyy-mm-dd'

ymd2 - ending time range respective to midnight GMT of the given day (i.e. is NOT inclusive), of the form 'yyyy-mm-dd'.

final - Data processing is delegated to the LaTiS server for accessing final released values of model inputs. If not set, data processing is delegated to the development environment (to be used by the Solar Irradiance Data Record team).

time_bin - A value of 'year', 'month', or 'day' that defines the time-averaging performed for the given data records. 'day' is the default.

Version - version and revision number of the NRLTSI2 and NRLSSI2 models (e.g., v02r00). Default to current final release version.

output_dir - path to data output directory.

The following usage example computes monthly-averaged TSI and SSI for the time period 1981-09-01 (i.e., September 1, 1981) to 2004-12-31 (i.e., December 31, 2004) and writes files to an example user-specified directory.

```
IDL> nrl2_to_irradiance, '1981-09-01', '2004-12-31', time_bin= 'month',/final, output_dir =
 '~/Documents/CDR/SolarIrradiance/'
```

Hierarchical Flow Chart of Source Code

The flow chart provides a high-level outline of the main procedure and subfunctions to produce TSI and SSI and write the data to output. Subfunctions that are nested below the top two levels are not included on the flow chart.

