

# Package ‘SolarData’

March 9, 2019

**Title** Work with freely available solar data

**Version** 1.0.0

**Imports** raster, httr, textreadr, tiff, fields, geosphere, lubridate,  
grDevices, tibble, RCurl

**Description** Download and manipulate some publicly available solar datasets.

**Depends** R (>= 3.5.0), ggplot2, insol, dplyr

**Suggests**

**License** GPL-2

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 6.1.1

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## R topics documented:

BSRN.list . . . . .	2
BSRN.loc . . . . .	2
BSRN.read . . . . .	3
LTF.get . . . . .	4
OSMG.loc . . . . .	5
OSMG.read . . . . .	6
PSM.get . . . . .	7
SRTM.get . . . . .	8
SRTM.list . . . . .	9
SRTM.read . . . . .	10
SURFRAD.get . . . . .	10
SURFRAD.loc . . . . .	11
SURFRAD.read . . . . .	12
<b>Index</b>	<b>14</b>

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**BSRN.list***List the available BSRN files*

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**Description**

This function retrieves the directory listing, i.e., available files from <ftp://ftp.bsrn.awi.de/>.

**Usage**

```
BSRN.list(station, user, pwd)
```

**Arguments**

station	a vector of text string indicating the station abbreviations
user	BSRN ftp user name
pwd	BSRN ftp password

**Details**

BSRN ftp listing is dynamic. This functions retrives the most updated listing of BSRN station-to-archive files. However, to avoid overloading the server, please do not use this function very often. It is recommended to use it yearly to check on file updates.

**Value**

A list of tibbles, indicating the available file names.

**Author(s)**

D. Yang

**See Also**

[BSRN.read](#)

---

**BSRN.loc***Location metadata for BSRN*

---

**Description**

BSRN location metadata

**Usage**

```
data("BSRN.loc")
```

**Format**

A data frame with 76 rows (stations) on the following 19 variables.

stn a character vector for station abbreviation

full a character vector for station full name

lat a numeric vector, in degrees

lon a numeric vector, in degrees

elev a numeric vector, in meters

status a character vector showing the status of the stations, which can be either Active, Closed, or Candidate.

tz a character vector

LTF.Jan a numeric vector

LTF.Feb a numeric vector

LTF.Mar a numeric vector

LTF.Apr a numeric vector

LTF.May a numeric vector

LTF.Jun a numeric vector

LTF.Jul a numeric vector

LTF.Aug a numeric vector

LTF.Sep a numeric vector

LTF.Oct a numeric vector

LTF.Nov a numeric vector

LTF.Dec a numeric vector

**Details**

This dataset contains the metadata of the 76 BSRN stations. To facilitating fast retrieval of Linke turbidity values at these locations, they are preloaded.

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BSRN.read	<i>Read and process the BSRN dataset</i>
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**Description**

This function reads and concatenates the daily BSRN files.

**Usage**

```
BSRN.read(file, directory, use.qc = TRUE, test = NULL, use.agg = FALSE, agg = 1)
```

**Arguments**

file	character strings indicating the file names for reading
directory	the directory for files
use.qc	boolean, indicating whether the built-in QC should be used
test	vector of character strings, indicating which QC tests are used. Options include "phy", "ext", "closr", "df", "clim", and "all".
use.agg	boolean, indicating whether aggregation needs to be performed. If TRUE, agg must be stated.
agg	numeric, aggregation interval in minute

**Details**

BSRN files are monthly station-to-archive files. This function processes one file at a time.

**Value**

a tibble of the read and aggregated data.

**Author(s)**

D. Yang

**See Also**

[BSRN.loc](#)

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LTF.get

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*Read Linke turbidity factor from tiff maps*


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**Description**

Read monthly Linke turbidity factor from 12 tiff maps for any location(s) in the world.

**Usage**

```
LTF.get(lon, lat, directory)
```

**Arguments**

lon	a number or a numeric array, longitude of the location(s) for downloading
lat	a number or a numeric array, latitude of the location(s) for downloading
directory	the directory of the <i>downloaded</i> .tiff images

**Details**

Twelve monthly maps of Linke turbidity factor values were created given by latitude and longitude. Latitude is positive North, longitude is positive eastwards of longitude 0. The data are in gridded, raw format, no header (tiff images), 1 byte per value (unsigned int encoding), 2160 rows and 4320 columns. Cell size is 5' (approx. 10 km at mid-latitude). Upper left corner is 90 N, 180 W. Then, point 90 N, 179.5 W etc. Lower right is 90 S, 180 E.

**Value**

A  $n \times 12$  matrix, where  $n$  is the number of lat-lon pairs.

**Author(s)**

D. Yang

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OSMG.loc

*Location data for the OSMG*

---

**Description**

Location metadata for the Oahu Solar Measurement Gird data

**Usage**

```
data("OSMG.loc")
```

**Format**

A data frame with 20 observations on the following 4 variables.

Location a factor with levels AP1 AP2 AP3 AP4 AP5 AP6 AP6T AP7 DH1 DH10 DH11 DH1T DH2 DH3 DH4 DH5 DH6 DH7 DH8 DH9

Pakbus a factor with levels 201 202 203 204 205 206 207 208 208T 209 209T 210 211 212 213 214 215 216 217 230

Latitude a numeric vector

Longitude a numeric vector

**Details**

These metadata include 17 LI-200 horizontal GHI pyranometers, 2 tilted paranometers, as well as a rotating shadowband radiometer that measures all three component, namely, GHI, DNI, and DHI (or DIF, diffuse horizontal irradiance)

**Source**

[https://midcdmz.nrel.gov/oahu\\_archive/](https://midcdmz.nrel.gov/oahu_archive/)

**Examples**

```
data(OSMG.loc)
```

---

`OSMG.read`*Read and process the OSMG dataset*

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### Description

This function reads and concatenates the daily OSMG files.

### Usage

```
OSMG.read(files, directory.LI200, directory.RSR = NULL,  
          clear.sky = FALSE, AP2 = FALSE, agg = 1)
```

### Arguments

<code>files</code>	character strings indicating the file names for reading
<code>directory.LI200</code>	the directory for the LI-200 files
<code>directory.RSR</code>	the directory for the LI-200 files
<code>clear.sky</code>	boolean, indicating whether the Ineichen–Perez clera-sky irradiance should be calculated
<code>AP2</code>	boolean, indicating whether 3-second data from AP2 should be joint to the 1-second data from other stations
<code>agg</code>	numeric, aggregation interval in seconds

### Details

Since the RSR files and the LI-200 files have the same file names, it is advised to store these two group of files in two separate folders, and thus I define two path variables for this function.

### Value

a tibble of the read and aggregated data.

### Author(s)

D. Yang

### See Also

[OSMG.loc](#)

PSM.get

*Get NREL PSM version 3 data***Description**

Use API to download NREL Physical Solar Model (PSM) version 3 data in .csv format.

**Usage**

```
PSM.get(lon, lat, api.key, attributes, name, affiliation, year, leap.year,
interval, utc, reason.for.use, email, mailing.list, directory = "data-raw")
```

**Arguments**

lon	a number or a numeric array, longitude of the location(s) for downloading
lat	a number or a numeric array, latitude of the location(s) for downloading
api.key	the API key as a character string, can be obtained at <a href="https://developer.nrel.gov/signup/">https://developer.nrel.gov/signup/</a>
attributes	the parameters to be downloaded, options are: "air_temperature", "clearsky_dhi", "clearsky_dni", "clearsky_ghi", "cloud_type", "dew_point", "dhi", "dni", "fill_flag", "ghi", "relative_humidity", "solar_zenith_angle", "surface_albedo", "surface_pressure", "total_precipitable_water", "wind_direction", "wind_speed". This argument should be passed in as a character string. If more than one, separate them using comma without spaces.
name	your name as a character string, e.g., "John+Smith". Spaces need to be replace with the + sign
affiliation	your affiliation as a character string, e.g., "National+Renewable+Energy+Lab". Spaces need to be replace with the + sign.
year	the year to be downloaded, options are: "1998", "1999", ..., "2016", "tmy". This argument should be passed in as a character string. The API only allows downloading one year at a time
leap.year	a character string ("true" or "false") indicating whether you want the data on 29 Feb if it is a leap year
interval	a character string ("30" or "60") indicating whether you want 30 min or 60 min data
utc	a character string ("true" or "false") indicating whether you want the time to be UTC
reason.for.use	a character string indicating your purpose, e.g., "research+development"
email	your email as a character string, e.g., "john.smith@gmail.com"
mailing.list	a character string ("true" or "false") indicating whether you want to be on the NREL mainling list
directory	the directory for the downloads, default to "~/data-raw"

**Details**

NREL PSM v3 contains half-hourly, regularly-gridded, satellite-derived irradiance and other meteorological parameters.

Value

A .csv file, or .csv files if length(lat) > 1, saved into your intended directory

Author(s)

D. Yang

References

Manajit Sengupta, Yu Xie, Anthony Lopez, Aron Habte, Galen Maclaurin, and James Shelby, The National Solar Radiation Data Base (NSRDB), *Renewable and Sustainable Energy Reviews*, Volume 89, 2018, Pages 51-60, <https://doi.org/10.1016/j.rser.2018.03.003>.

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SRTM.get	<i>Get NASA SRTM data</i>
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Description

Download NASA Shuttle Radar Topography Mission (SRTM) digital elevation model (DEM) data in .hgt format.

Usage

```
SRTM.get(resolution, files, directory = "data-raw")
```

Arguments

resolution	a number indicating the resolution of the DEM, two options are available: 1 or 3, see <a href="#">SRTM.list</a>
files	character strings indicating the file names for downloading, see <a href="#">SRTM.list</a> for available files
directory	the directory for the downloads, default to "~/data-raw"

Details

place holder for now

Value

A .dat file, or .dat files if length(day\_of\_year) > 1, saved into your intended directory

Author(s)

D. Yang

References

Bernhard Rabus, Michael Eineder, Achim Roth, Richard Bamler, The shuttle radar topography mission—a new class of digital elevation models acquired by spaceborne radar, *ISPRS Journal of Photogrammetry and Remote Sensing*, Volume 57, Issue 4, 2003, Pages 241-262, [https://doi.org/10.1016/S0924-2716\(02\)00124-7](https://doi.org/10.1016/S0924-2716(02)00124-7).



**See Also**[SRTM.list](#), [SRTM.read](#)

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SRTM.list	<i>List the available SRTM files</i>
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**Description**

This function retrieves the directory listing, i.e., available files from <https://dds.cr.usgs.gov/>.

**Usage**

```
SRTM.list(resolution, want.plot = TRUE)
```

**Arguments**

resolution	a number indicating the resolution of the DEM, two options are available: 1 or 3, see details
want.plot	boolean, if TRUE return plot

**Details**

Source: [https://dds.cr.usgs.gov/srtm/version2\\_1/Documentation/Quickstart.pdf](https://dds.cr.usgs.gov/srtm/version2_1/Documentation/Quickstart.pdf)

SRTM data are distributed in two levels: SRTM1 (for the United States and its territories and possessions) with data sampled at 1 arc-second intervals in latitude and longitude (or 30 meters or 98 feet), and SRTM3 (for the world) sampled at 3 arc-seconds (or 90 meters or 295 feet). Three arc-second data are generated by three by three averaging of the one arc-second samples.

File names refer to the latitude and longitude of the lower left corner of the tile - e.g. N37W105 has its lower left corner at 37 degrees north latitude and 105 degrees west longitude. To be more exact, these coordinates refer to the geometric center of the lower left pixel. In addition, the files are separated by geographical zones, i.e., parent directory. For example, SRTM1 contains 7 zones, whereas SRTM3 divides the zones by continent.

SRTM3 files contain 1201 lines and 1201 samples. The rows at the north and south edges as well as the columns at the east and west edges of each cell overlap and are identical to the edge rows and columns in the adjacent cell. SRTM1 files contain 3601 lines and 3601 samples, with similar overlap.

**Value**

A vector of character strings, indicating the available file names.

**Author(s)**

D. Yang

**See Also**[SRTM.get](#), [SRTM.read](#)

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SRTM.read

*Read SRTM .hgt files*


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### Description

This function reads SRTM .hgt files and outputs a RasterLayer object or a data.frame (not recommended).

### Usage

```
SRTM.read(files, as.data.frame = FALSE)
```

### Arguments

`files` a vector of character strings indicating the file names to be read  
`as.data.frame` boolean, if TRUE output a data.frame

### Details

The SRTM1 has  $3601 \times 3601$  cells, and SRTM3 has  $1201 \times 1201$  cells. It is thus not recommended to convert the output into a data.frame. Moreover, the RasterLayer object is easier to work with using the **raster** package.

### Value

A RasterLayer object or a data.frame

### Author(s)

D. Yang

### See Also

[SRTM.list](#), [SRTM.get](#)

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SURFRAD.get

*Get NOAA SURFRAD data*


---

### Description

Download NOAA Surface Radiation (SURFRAD) data in .dat format.

### Usage

```
SURFRAD.get(station, year, day.of.year, directory = "data-raw")
```

**Arguments**

station	a character string indicating the station name, options are "Bondville_IL", "Boulder_CO", "Desert_Rock_NV", "Fort_Peck_MT", "Goodwin_Creek_MS", "Penn_State_PA", "Sioux_Falls_SD". Alternatively, abbreviations of the stations can be used, i.e., "bon", "tbl", "dra", "fpk", "gwn", "psu", "sxf", respectively
year	a character string indicating the four-digit year
day.of.year	days of year to be downloaded, as a numeric array
directory	the directory for the downloads, default to "~/data-raw"

**Details**

NOAA high-resolution, long-term, ground-based irradiance measurements at 7 locations.

**Value**

A .dat file, or .dat files if `length(day_of_year) > 1`, saved into your intended directory

**Author(s)**

D. Yang

**References**

J.A. Augustine, J.J. DeLuise, and C.N. Long, SURFRAD—A National Surface Radiation Budget Network for Atmospheric Research. *Bull. Amer. Meteor. Soc.*, Volume 81, Pages 2341–2358, [https://doi.org/10.1175/1520-0477\(2000\)081<2341:SANSRB>2.3.CO;2](https://doi.org/10.1175/1520-0477(2000)081<2341:SANSRB>2.3.CO;2)

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SURFRAD.loc

*Location metadata for SURFRAD*


---

**Description**

SURFRAD location metadata

**Usage**

```
data("SURFRAD.loc")
```

**Format**

A data frame with 7 observations on the following 19 variables.

stn a factor with levels bon dra fpk gcm psu sxf tbl

full a factor with levels Bondville, Illinois Desert Rock, Nevada Fort Peck, Montana Goodwin Creek, Mississippi Penn. State Univ., Pennsylvania Sioux Falls, South Dakota Table Mountain, Boulder, Colorado

lat a numeric vector

lon a numeric vector

elev a numeric vector

tz a numeric vector  
 install a factor with levels 1994-04 1994-11 1994-12 1995-07 1998-03 1998-06 2003-06  
 LTF.Jan a numeric vector  
 LTF.Feb a numeric vector  
 LTF.Mar a numeric vector  
 LTF.Apr a numeric vector  
 LTF.May a numeric vector  
 LTF.Jun a numeric vector  
 LTF.Jul a numeric vector  
 LTF.Aug a numeric vector  
 LTF.Sep a numeric vector  
 LTF.Oct a numeric vector  
 LTF.Nov a numeric vector  
 LTF.Dec a numeric vector

### Details

This dataset contains the metadata of the 7 SURFRAD stations. To facilitating fast retrieval of Linke turbidity values at these locations, they are preloaded.

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SURFRAD.read	<i>Read and process the SURFRAD dataset</i>
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---

### Description

This function reads and concatenates the daily SURFRAD files.

### Usage

```
SURFRAD.read(files, directory, use.original.qc = FALSE, use.qc = TRUE,
              test = NULL, progress.bar = TRUE, agg = 1, additional.variables = NULL)
```

### Arguments

files	character strings indicating the file names for reading
directory	the directory for files
use.original.qc	boolean, indicating whether the SURFRAD QC flags should be used
use.qc	boolean, indicating whether the built-in QC should be used
test	vector of character strings, indicating which QC tests are used. Options include "phy", "ext", "closr", "df", "clim", and "all".
progress.bar	boolean, indicating whether the progress bar should be used
agg	numeric, aggregation interval in minute
additional.variables	four compulsory variables are included, namely, "dw_solar", "direct_n", "diffuse", and "pressure". This function parameter allows the user to set additional variables for extraction, such as "temp" or "windspd". See the code for the available variable list.

**Details**

It is not recommended to put all files in a same folder. The SURFRAD FTP folder directory is good, keep that, and use a loop (outside of this function) to access all folders.

**Value**

a tibble of the read and aggregated data.

**Author(s)**

D. Yang

**See Also**

[SURFRAD.loc](#), [SURFRAD.get](#)

# Index

## \*Topic **BSRN**

BSRN.list, [2](#)

BSRN.loc, [2](#)

BSRN.read, [3](#)

## \*Topic **LTF**

LTF.get, [4](#)

## \*Topic **OSMG**

OSMG.loc, [5](#)

OSMG.read, [6](#)

## \*Topic **PSM**

PSM.get, [7](#)

## \*Topic **SRTM**

SRTM.get, [8](#)

SRTM.list, [9](#)

SRTM.read, [10](#)

## \*Topic **SURFRAD**

SURFRAD.get, [10](#)

SURFRAD.loc, [11](#)

SURFRAD.read, [12](#)

## \*Topic **datasets**

BSRN.loc, [2](#)

SURFRAD.loc, [11](#)

## \*Topic **get**

LTF.get, [4](#)

PSM.get, [7](#)

SRTM.get, [8](#)

SURFRAD.get, [10](#)

## \*Topic **list**

BSRN.list, [2](#)

SRTM.list, [9](#)

## \*Topic **read**

BSRN.read, [3](#)

OSMG.read, [6](#)

SRTM.read, [10](#)

SURFRAD.read, [12](#)

BSRN.list, [2](#)

BSRN.loc, [2](#), [4](#)

BSRN.read, [2](#), [3](#)

LTF.get, [4](#)

OSMG.loc, [5](#), [6](#)

OSMG.read, [6](#)

PSM.get, [7](#)

SRTM.get, [8](#), [9](#), [10](#)

SRTM.list, [8](#), [9](#), [9](#), [10](#)

SRTM.read, [9](#), [10](#)

SURFRAD.get, [10](#), [13](#)

SURFRAD.loc, [11](#), [13](#)

SURFRAD.read, [12](#)