

# Package ‘sapfluxnetr’

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**Title** Working with 'Sapfluxnet' Project Data

**Version** 0.1.3

**Description** Access, modify, aggregate and plot data from the 'Sapfluxnet' project (<http://sapfluxnet.creaf.cat>), the first global database of sap flow measurements.

**Depends** R (>= 3.5.0)

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**Suggests** future, knitr, remotes, rmarkdown, testthat, xtable

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**NeedsCompilation** no

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ARG_MAZ . . . . .	3
ARG_TRE . . . . .	3
AUS_CAN_ST2_MIX . . . . .	4
data_coverage . . . . .	4
describe_md_variable . . . . .	5
diurnal_centroid . . . . .	6
filter_sites_by_md . . . . .	7
get_timezone . . . . .	8
initialize,sfn_data-method . . . . .	9
initialize,sfn_data_multi-method . . . . .	10
metrics . . . . .	11
metrics_tidyfier . . . . .	16
norm_diurnal_centroid . . . . .	18
read_sfn_data . . . . .	19
read_sfn_metadata . . . . .	20
sfn_data-class . . . . .	21
sfn_data_multi-class . . . . .	21
sfn_data_multi_validity . . . . .	22
sfn_data_validity . . . . .	22
sfn_filter . . . . .	22
sfn_get_generics . . . . .	24
sfn_get_methods . . . . .	25
sfn_metadata_ex . . . . .	26
sfn_metrics . . . . .	27
sfn_multi_get_methods . . . . .	30
sfn_mutate . . . . .	31
sfn_mutate_at . . . . .	32
sfn_plot . . . . .	34
sfn_replacement_generics . . . . .	36
sfn_replacement_methods . . . . .	37
sfn_sites_in_folder . . . . .	38
sfn_vars_to_filter . . . . .	39
show,sfn_data-method . . . . .	40
show,sfn_data_multi-method . . . . .	40
summarise_by_period . . . . .	41
%>% . . . . .	42
<b>Index</b>	<b>44</b>

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ARG_MAZ	<i>ARG_MAZ sapfluxnet site</i>
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**Description**

Example site for package usage demonstration based on ARG\_MAZ

**Usage**

ARG\_MAZ

**Format**

An `sfn_data` class object with the data and metadata for ARG\_MAZ site

**Examples**

```
data('ARG_MAZ', package = 'sapfluxnetr')
ARG_MAZ
```

---

ARG_TRE	<i>ARG_TRE sapfluxnet site</i>
---------	--------------------------------

---

**Description**

Example site for package usage demonstration based on ARG\_TRE

**Usage**

ARG\_TRE

**Format**

An `sfn_data` class object with the data and metadata for ARG\_TRE site

**Examples**

```
data('ARG_TRE', package = 'sapfluxnetr')
ARG_TRE
```

---

AUS_CAN_ST2_MIX	<i>AUS_CAN_ST2_MIX sapfluxnet site</i>
-----------------	--

---

**Description**

Example site for package usage demonstration based on AUS\_CAN\_ST2\_MIX

**Usage**

```
AUS_CAN_ST2_MIX
```

**Format**

An sfn\_data class object with the data and metadata for AUS\_CAN\_ST2\_MIX site

**Examples**

```
data('AUS_CAN_ST2_MIX', package = 'sapfluxnetr')
AUS_CAN_ST2_MIX
```

---

data_coverage	<i>data coverage</i>
---------------	----------------------

---

**Description**

helper for sfn\_metrics

**Usage**

```
data_coverage(x, timestep, period_minutes)
```

**Arguments**

x	a vector, usually a variable in the sapflow or environmental data.
timestep	numeric value with the timestep in minutes
period_minutes	numeric value with the period in minutes

**Details**

This helper function calculates the coverage percentage in a vector, and is designed to be used inside a dplyr summarise statement. It calculates the coverage as the percentage of no NAs in the expected length of the summarising period stated by the timestep.

**Value**

a single value (numeric) with the percentage of coverage for that variable

**Examples**

```
# data for one day, 60 minutes timestep (24 values) with a 75% of coberture
x <- rep(c(1,2,3,NA), 6)
data_coverage(x, 60, 1440) # 75
```

---

describe\_md\_variable *Detailed description of metadata variables*

---

**Description**

describe\_md\_variable prints in console a detailed description for the requested variable. Useful to know which values to filter or in which units the variables are.

**Usage**

```
describe_md_variable(variable)
```

**Arguments**

variable      A character with the name of the variable

**Value**

Nothing, prints information to console

**Examples**

```
# info about the method used to measure sapflow (pl_sens_meth)
describe_md_variable('pl_sens_meth')
```

---

diurnal\_centroid      *Diurnal centroid calculation*

---

### Description

Calculate the diurnal centroid for sapflow variables

### Usage

```
diurnal_centroid(variable)
```

### Arguments

variable      A numeric vector containing the sapflow values for a day at a regular intervals. Missing values are allowed but not recommended

### Details

The code for this function has been kindly provided by Jacob Nelson in python (see <https://github.com/jnelson18/FluxnetTools>) and has been translated to a tidy data philosophy in R to be used inside a `summarise` statement.

### Value

A numeric value with the diurnal centroid value (0 to 24 h)

### Diurnal centroid algorithm

Given a continuous subdaily sapflow values at regular intervals  $V = x_1, \dots, x_n$  to obtain the diurnal centroid each value is multiplied by its interval index and summed up and divided by the sum of the values for the day and finally the value is normalized to 24h:

$$\sum x_1 * 1, x_2 * 2, \dots, x_n * n / \sum x_1, x_2, \dots, x_n * (24/n)$$

With even values for all the intervals (i.e. 100 for all), centroid converges to 12h at more than 1000 intervals per day. With only 48 (half hourly measurements) centroid converges to 12.25h and with 24 intervals (hourly measurements) centroid converges to 12.5h. So, using diurnal centroid value in half hourly datasets or above can have a considerable error associated.

### Author(s)

Jacob Nelson & Víctor Granda

**Examples**

```

# dplyr
library(dplyr)

# check convergence to 12h:
diurnal_centroid(rep(1, 1000)) # 12.012 h
diurnal_centroid(rep(10000, 1000)) # 12.012 h, variable scale not affects calculation

# sapflow diurnal centroid
data('ARG_TRE', package = 'sapfluxnetr')

sfn_metrics(
  ARG_TRE,
  period = '1 day',
  .funs = list(~ diurnal_centroid(.),
               ~ data_coverage(., timestep, period_minutes)),
  solar = FALSE,
  interval = 'general'
)

```

---

filter\_sites\_by\_md      *Filter the sites by metadata variable values*

---

**Description**

filter\_sites\_by\_md function takes logical expressions for the metadata variables (i.e. pl\_sens\_meth == 'HR'), and list the sites that met the criteria from those supplied

**Usage**

```
filter_sites_by_md(sites, metadata, ..., .join = c("and", "or"))
```

**Arguments**

sites	character vector with the sites codes to filter, generally the result of <a href="#">sfn_sites_in_folder</a>
metadata	metadata tbl object, usually the result of <a href="#">read_sfn_metadata</a>
...	Logical expressions for the metadata variables, as in <a href="#">filter</a> .
.join	Character indicating how to filter the sites, see details.

**Details**

.join argument indicates how sites must be filtered between metadata classes. 'and' indicates only sites meeting all conditions for all metadata classes are returned. 'or' indicates all sites meeting any condition between classes are returned. For two or more filters of the same metadata class, they are combined as 'and'.

**Value**

A character vector with the sites fulfilling the premises

**Examples**

```
# Let's access the data in "folder". This typically is the folder where the
# sapflow data at the desired unit level is (i.e. "RData/plant"), but in this
# example we will create a temporal folder with some data to test the function
folder <- tempdir()
save(ARG_TRE, file = file.path(folder, 'ARG_TRE.RData'))
save(ARG_MAZ, file = file.path(folder, 'ARG_MAZ.RData'))
save(AUS_CAN_ST2_MIX, file = file.path(folder, 'AUS_CAN_ST2_MIX.RData'))

# we need the metadata and the site names
metadata <- read_sfn_metadata(folder = folder, .write_cache = TRUE)
sites <- sfn_sites_in_folder(folder)

# Filter by Heat Ratio method
filter_sites_by_md(
  pl_sens_meth == 'HR', sites = sites, metadata = metadata
)

# Both, Heat Ratio and Heat Dissipation
filter_sites_by_md(
  pl_sens_meth %in% c('HR', 'HD'),
  sites = sites, metadata = metadata
)

# more complex, Heat Ratio method AND Woodland/Shrubland biome
filter_sites_by_md(
  pl_sens_meth == 'HR',
  si_biome == 'Woodland/Shrubland',
  sites = sites, metadata = metadata,
  .join = 'and' # default
)

# join = 'or' returns sites that meet any condition
filter_sites_by_md(
  pl_sens_meth == 'HR',
  si_biome == 'Woodland/Shrubland',
  sites = sites, metadata = metadata,
  .join = 'or'
)
```

---

get\_timezone

*get the timezone of the site*

---

**Description**

Obtain the site timezone from a sfn\_data/sfn\_data\_multi object



**Usage**

```
get_timezone(sfn_data)
```

**Arguments**

sfn\_data            An sfn\_data or sfn\_data\_multi object

**Value**

a character with the site timezone

**Examples**

```
# timezone of ARG_TRE site
get_timezone(ARG_TRE)
```

---

initialize,sfn\_data-method

*Initialize method for sfn\_data*

---

**Description**

Initialize an sfn\_data object

**Usage**

```
## S4 method for signature 'sfn_data'
initialize(
  .Object,
  sapf_data,
  env_data,
  sapf_flags,
  env_flags,
  si_code,
  timestamp,
  solar_timestamp,
  site_md,
  stand_md,
  species_md,
  plant_md,
  env_md
)
```

**Arguments**

<code>.Object</code>	sfn_data object to create
<code>sapf_data</code>	A tibble (or any object coercible to one) with the sapf_data (without the TIMESTAMP variable)
<code>env_data</code>	A tibble (or any object coercible to one) with the env_data (without the TIMESTAMP variable)
<code>sapf_flags</code>	A tibble (or any object coercible to one) with the same dimensions of sapf_data with the flag info for each tree/TIMESTAMP combination
<code>env_flags</code>	A tibble (or any object coercible to one) with the same dimensions of env_data with the flag info for each env_var/TIMESTAMP combination
<code>si_code</code>	A character vector of length one indicating the site code
<code>timestamp</code>	A POSIXct vector of length <code>nrow(sapf_data)</code> with the timestamp
<code>solar_timestamp</code>	A POSIXct vector of length <code>nrow(sapf_data)</code> with the solar timestamp
<code>site_md</code>	A tibble (or any object coercible to one) containing the site metadata
<code>stand_md</code>	A tibble (or any object coercible to one) containing the stand metadata
<code>species_md</code>	A tibble (or any object coercible to one) containing the species metadata
<code>plant_md</code>	A tibble (or any object coercible to one) containing the plant metadata
<code>env_md</code>	A tibble (or any object coercible to one) containing the env metadata

---

```
initialize,sfn_data_multi-method
```

*Initialize method for sfn\_data multi*

---

**Description**

Initialize an `sfn_data_multi` object

**Usage**

```
## S4 method for signature 'sfn_data_multi'
initialize(.Object, ...)
```

**Arguments**

<code>.Object</code>	<code>sfn_data_multi</code> object to create
<code>...</code>	<code>sfn_data</code> elements

---

metrics	<i>Complete metrics wrappers</i>
---------	----------------------------------

---

**Description**

This set of functions returns a complete set of statistics for a site (using [sfn\\_data](#)) or several sites (using [sfn\\_data\\_multi](#))

**Usage**

```
daily_metrics(  
  sfn_data,  
  solar = TRUE,  
  probs = c(0.95),  
  tidy = FALSE,  
  metadata = NULL,  
  ...  
)  
  
monthly_metrics(  
  sfn_data,  
  solar = TRUE,  
  probs = c(0.95),  
  tidy = FALSE,  
  metadata = NULL,  
  ...  
)  
  
nightly_metrics(  
  sfn_data,  
  period = c("1 day", "1 month"),  
  solar = TRUE,  
  int_start = 20,  
  int_end = 6,  
  probs = c(0.95),  
  tidy = FALSE,  
  metadata = NULL,  
  ...  
)  
  
daylight_metrics(  
  sfn_data,  
  period = c("1 day", "1 month"),  
  solar = TRUE,  
  int_start = 6,  
  int_end = 20,  
  probs = c(0.95),
```

```

    tidy = FALSE,
    metadata = NULL,
    ...
  )

predawn_metrics(
  sfn_data,
  period = c("1 day", "1 month"),
  solar = TRUE,
  int_start = 4,
  int_end = 6,
  probs = c(0.95),
  tidy = FALSE,
  metadata = NULL,
  ...
)

midday_metrics(
  sfn_data,
  period = c("1 day", "1 month"),
  solar = TRUE,
  int_start = 11,
  int_end = 13,
  probs = c(0.95),
  tidy = FALSE,
  metadata = NULL,
  ...
)

```

### Arguments

<code>sfn_data</code>	<code>sfn_data</code> or <code>sfn_data_multi</code> object to obtain the metrics from
<code>solar</code>	Logical indicating if the <code>solarTIMESTAMP</code> must be used instead of the site local <code>TIMESTAMP</code> . Default to <code>TRUE</code> (use <code>solarTIMESTAMP</code> ).
<code>probs</code>	numeric vector of probabilities for <code>quantile</code>
<code>tidy</code>	Logical indicating if the metrics must be returned in a tidy format (a long tibble, each observation in its own row)
<code>metadata</code>	metadata object, usually the result of <code>read_sfn_metadata</code> . Only used if <code>tidy</code> is <code>TRUE</code> .
<code>...</code>	additional arguments to be passed to <code>.collapse_timestamp</code> or <code>floor_date</code> or <code>ceiling_date</code> .
<code>period</code>	Time period to aggregate data by. See <code>period</code> section for an explanation about the periods ('3 hours', '1 day', '1 month', '1 year', ...)
<code>int_start</code>	Integer value indicating the starting hour of the special interval in 24h format. See <code>Interval</code> section in details.
<code>int_end</code>	Integer value indicating the ending hour of the special interval in 24h format. See <code>Interval</code> section in details.

## Details

\*\_metrics functions are wrappers for [sfn\\_metrics](#) with a set of fixed arguments.

\*\_metrics functions return all or some of the following statistics:

- mean: mean of variable (tree or environmental variable) for the given period. NAs are removed
- sd: standard deviation of the variable for the given period. NAs are removed
- coverage: Data coverage percentage (percentage of measures without NAs)
- q\_XX: 0.XX quantile value for the period
- centroid: Diurnal centroid value (hours passed until the half of the summed daily value was reached). Only returned for sapflow measures when period is '1 day'
- accumulated: Accumulated values for precipitation only

## Value

If `tidy` is TRUE, a tibble with the metrics for sapflow and environmental data, with all the metadata included. If `tidy` is FALSE (default), a list of tibbles with the calculated metrics.

## daily\_metrics

`daily_metrics` summarise daily data for all hours in the day

## monthly\_metrics

`monthly_metrics` summarise monthly data for all hours in the day.

## nightly\_metrics

`nightly_metrics` will return the metrics for night periods, summarised daily or monthly

Night for daily period starts in DOY  $x$  and ends in DOY  $x+1$  (i.e. if `night_start = 20`, `night_end = 6` values for the night starting at 2018-03-28 20:00:00 and ending at 2018-03-29 06:00:00 are summarised).

Night for monthly period summarises all night periods in the month, that includes from 00:00:00 of the first month night to 23:59:59 of the last month night.

## daylight\_metrics

`daylight_metrics` will return the metrics for daylight periods, summarised daily or monthly. Daylight interval is selected by start and end hours.

## predawn\_metrics

`predawn_metrics` will always return the metrics for predawn period, summarised daily or monthly. Predawn interval is selected by start and end hours.

Predawn metrics did not return the centroid metric.

### **midday\_metrics**

`midday_metrics` will always return the metrics for midday period, summarised daily or monthly. midday interval is selected by start and end hours.

Midday metrics did not return the centroid metric.

### **See Also**

Other metrics: [sfn\\_metrics\(\)](#)

### **Examples**

```
## daily_metrics
# data load
data('ARG_TRE', package = 'sapfluxnetr')
data('sfn_metadata_ex', package = 'sapfluxnetr')

# non tidy raw metrics (default)
ARG_TRE_raw_daily <- daily_metrics(ARG_TRE)
str(ARG_TRE_raw_daily)

# tidy daily metrics
ARG_TRE_daily <- daily_metrics(
  ARG_TRE, tidy = TRUE, metadata = sfn_metadata_ex
)
ARG_TRE_daily

## monthly_metrics
# data load
data('ARG_TRE', package = 'sapfluxnetr')
data('sfn_metadata_ex', package = 'sapfluxnetr')

# non tidy raw metrics (default)
ARG_TRE_raw_monthly <- monthly_metrics(ARG_TRE)
str(ARG_TRE_raw_monthly)

# tidy monthly metrics
ARG_TRE_monthly <- monthly_metrics(
  ARG_TRE, tidy = TRUE, metadata = sfn_metadata_ex
)
ARG_TRE_monthly

## nightly_metrics
# data load
data('AUS_CAN_ST2_MIX', package = 'sapfluxnetr')

# non tidy daily night metrics (default)
```

```
AUS_CAN_ST2_MIX_night <- nightly_metrics(AUS_CAN_ST2_MIX)

str(AUS_CAN_ST2_MIX_night)
AUS_CAN_ST2_MIX_night[['sapf']]
AUS_CAN_ST2_MIX_night[['env']]

# change the night interval
AUS_CAN_ST2_MIX_night_short <- nightly_metrics(
  AUS_CAN_ST2_MIX, int_start = 21, int_end = 4 # night starting and ending hour
)
AUS_CAN_ST2_MIX_night_short[['env']]

# tidy nightly metrics
data('sfn_metadata_ex', package = 'sapfluxnetr')
AUS_CAN_ST2_MIX_night_tidy <- nightly_metrics(
  AUS_CAN_ST2_MIX,
  tidy = TRUE, metadata = sfn_metadata_ex
)
AUS_CAN_ST2_MIX_night_tidy

## daylight_metrics
# data load
data('AUS_CAN_ST2_MIX', package = 'sapfluxnetr')

# non tidy daily daylight metrics (default)
AUS_CAN_ST2_MIX_daylight <- daylight_metrics(AUS_CAN_ST2_MIX)

str(AUS_CAN_ST2_MIX_daylight)
AUS_CAN_ST2_MIX_daylight[['sapf']]
AUS_CAN_ST2_MIX_daylight[['env']]

# change the daylight interval
AUS_CAN_ST2_MIX_daylight_short <- daylight_metrics(
  AUS_CAN_ST2_MIX, int_start = 8, int_end = 18 # night starting and ending hour
)
AUS_CAN_ST2_MIX_daylight_short[['env']]

# tidy daylight metrics
data('sfn_metadata_ex', package = 'sapfluxnetr')
AUS_CAN_ST2_MIX_daylight_tidy <- daylight_metrics(
  AUS_CAN_ST2_MIX,
  tidy = TRUE, metadata = sfn_metadata_ex
)
AUS_CAN_ST2_MIX_daylight_tidy

## predawn_metrics
# data load
data('AUS_CAN_ST2_MIX', package = 'sapfluxnetr')
```

```
# non tidy daily predawn metrics (default)
AUS_CAN_ST2_MIX_predawn <- predawn_metrics(AUS_CAN_ST2_MIX)

str(AUS_CAN_ST2_MIX_predawn)
AUS_CAN_ST2_MIX_predawn[['sapf']]
AUS_CAN_ST2_MIX_predawn[['env']]

# change the predawn interval
AUS_CAN_ST2_MIX_predawn_short <- predawn_metrics(
  AUS_CAN_ST2_MIX, int_start = 8, int_end = 18 # night starting and ending hour
)
AUS_CAN_ST2_MIX_predawn_short[['env']]

# tidy daylight metrics
data('sfn_metadata_ex', package = 'sapfluxnetr')
AUS_CAN_ST2_MIX_predawn_tidy <- predawn_metrics(
  AUS_CAN_ST2_MIX,
  tidy = TRUE, metadata = sfn_metadata_ex
)
AUS_CAN_ST2_MIX_predawn_tidy

## midday_metrics
# data load
data('AUS_CAN_ST2_MIX', package = 'sapfluxnetr')

# non tidy daily midday metrics (default)
AUS_CAN_ST2_MIX_midday <- midday_metrics(AUS_CAN_ST2_MIX)

str(AUS_CAN_ST2_MIX_midday)
AUS_CAN_ST2_MIX_midday[['sapf']]
AUS_CAN_ST2_MIX_midday[['env']]

# change the midday interval
AUS_CAN_ST2_MIX_midday_short <- midday_metrics(
  AUS_CAN_ST2_MIX, int_start = 8, int_end = 18 # night starting and ending hour
)
AUS_CAN_ST2_MIX_midday_short[['env']]

# tidy daylight metrics
data('sfn_metadata_ex', package = 'sapfluxnetr')
AUS_CAN_ST2_MIX_midday_tidy <- midday_metrics(
  AUS_CAN_ST2_MIX,
  tidy = TRUE, metadata = sfn_metadata_ex
)
AUS_CAN_ST2_MIX_midday_tidy
```

---



**Description**

Transform the nested list of metrics in a tidy tibble where each observation has its own row

**Usage**

```
metrics_tidyfier(  
  metrics_res,  
  metadata,  
  interval = c("general", "predawn", "midday", "night", "daylight")  
)
```

**Arguments**

metrics_res	Nested list containing the metrics results as obtained from <a href="#">metrics</a>
metadata	List containing the metadata nested list, as obtained from <a href="#">read_sfn_metadata</a>
interval	Interval to return, it depends on the metrics_res and can be "gen" for the general metrics, "md" for midday metrics, "pd" for predawn metrics, "night" for night metrics or "day" for diurnal metrics.

**Value**

a tibble with the following columns:

- **TIMESTAMP**: POSIXct vector with the date-time of the observation
- **si\_code**: Character vector with the site codes
- **pl\_code**: Character vector with the plant codes
- **sapflow\_\***: Variables containing the different metrics for the sapflow measurements (i.e. sapflow\_mean, sapflow\_q\_95)
- **ta\_\***; **rh\_\***; **vpd\_\***; ...: Variables containing the different metrics for environmental variables (i.e. ta\_mean, ta\_q\_95)
- **pl\_\***: plant metadata variables (i.e. pl\_sapw\_area, pl\_sens\_meth)
- **si\_\***: site metadata variables (i.e. si\_biome, si\_contact\_firstname)
- **st\_\***: stand metadata variables (i.e. st\_aspect, st\_lai)
- **sp\_\***: species metadata variables (i.e. sp\_basal\_area\_perc)
- **env\_\***: environmental metadata variables (i.e. env\_timezone)

## Examples

```
# data
multi_sfn <- sfn_data_multi(ARG_TRE, ARG_MAZ, AUS_CAN_ST2_MIX)
data('sfn_metadata_ex', package = 'sapfluxnetr')

# metrics
multi_metrics <- daily_metrics(multi_sfn)

# tidying
multi_tidy <- metrics_tidyfier(
  multi_metrics, sfn_metadata_ex, interval = 'general'
)
multi_tidy

# A really easier way of doing the same
multi_tidy_easy <- daily_metrics(multi_sfn, tidy = TRUE, metadata = sfn_metadata_ex)
```

---

norm\_diurnal\_centroid *Normalized diurnal centroid calculation*

---

## Description

Calculate the normalized diurnal centroid for sapflow variables

## Usage

```
norm_diurnal_centroid(sapf_var, rad_var)
```

## Arguments

sapf_var	A numeric vector containing the sapflow values for a day at a regular intervals. Missing values are allowed but not recommended.
rad_var	A numeric vector containing the incoming radiation for a day at a regular intervals. Missing values are allowed but not recommended. Must be the same length as sapf_var.

## Details

The code for this function has been kindly provided by Jacob Nelson in python (see <https://github.com/jnelson18/FluxnetTools>) and has been translated to a tidy data philosophy in R to be used inside a [summarise](#) statement.

## Value

A numeric value with the normalized diurnal centroid value

**Normalized diurnal centroid algorithm**

This function calculates the diurnal centroid of sapflow measures *relative* to the diurnal centroid of incoming radiation (in any units). For that the incoming radiation diurnal centroid is subtracted from the sapflow diurnal centroid:

$$Sapf_{cent} - IncomingRad_{cent}$$

**Author(s)**

Jacob Nelson & Víctor Granda

---

read_sfn_data	<i>Read sfn_data from disk</i>
---------------	--------------------------------

---

**Description**

Given a site code and a route, read\_sfn\_data will return the selected sfn\_data object

**Usage**

```
read_sfn_data(site_codes, folder = ".")
```

**Arguments**

site_codes	A character vector with the site code/s
folder	Route to the folder containing the .RData file. Default to working directory.

**Value**

If site\_codes is a vector of length 1, an sfn\_data object with the selected site data. If site\_codes is a vector of length > 1, then a sfn\_data\_multi object containing all selected sites.

**Examples**

```
# Let's access the data in "folder". This typically is the folder where the
# sapflow data at the desired unit level is (i.e. "RData/plant"), but in this
# example we will create a temporal folder with some data to test the function
folder <- tempdir()
save(ARG_TRE, file = file.path(folder, 'ARG_TRE.RData'))
save(ARG_MAZ, file = file.path(folder, 'ARG_MAZ.RData'))

# now we read a single site
ARG_TRE_test <- read_sfn_data('ARG_TRE', folder)
ARG_TRE_test

# or we can read multiple sites at once
multi_sfn <- read_sfn_data(
  c('ARG_TRE', 'ARG_MAZ'), folder
```

```
)
multi_sfn
```

---

```
read_sfn_metadata      Read and combine all metadata
```

---

## Description

Read metadata from all sites in folder and write it to disk to cache the info for easy and fast access

## Usage

```
read_sfn_metadata(folder = ".", .write_cache = FALSE)
```

## Arguments

```
folder          Route to the folder containing the data. Default to working directory
.write_cache    Logical indicating if a cached copy of the metadata must be written in folder.
```

## Details

Load all data in memory to collect metadata info can be resource limiting. For easy and quick access to metadata, this function stores an .RData file in the specified folder along the data with all the metadata preloaded. Also it return it as an object to use in filtering and selecting sites.

## Value

A list of tibbles with the five metadata classes (site, stand, species, plant and environmental)

## Examples

```
# Let's access the data in "folder". This typically is the folder where the
# sapflow data at the desired unit level is (i.e. "RData/plant"), but in this
# example we will create a temporal folder with some data to test the function
folder <- tempdir()
save(ARG_TRE, file = file.path(folder, 'ARG_TRE.RData'))
save(ARG_MAZ, file = file.path(folder, 'ARG_MAZ.RData'))

# create and load the metadata. The first time we use .write_cache = TRUE,
# to ensure creating a file containing the metadata for speed the process
# for the next times
read_sfn_metadata(
  folder = folder, .write_cache = TRUE
)
# a cached copy must have been written to "folder"
file.exists(paste0(folder, '.metadata_cache.RData')) # TRUE

# after that, we only need to especify the folder
```

```
sites_metadata <- read_sfn_metadata(folder = folder) # quicker than before
sites_metadata
```

---

sfn\_data-class      *S4 class for sapfluxnet site data*

---

### Description

Main class for storing sapfluxnet project site data and metadata

### Details

This class allows to store all the data and metadata for a sapfluxnet site in one single object, to easily work with it. See vignette('sfn-data-classes', package = 'sapfluxnetr') for more info.

### Slots

sapf\_data A data frame with the sapf data  
 env\_data A data frame with the env data  
 sapf\_flags A data frame with the same dimensions of sapf\_data with the flag info for each tree/TIMESTAMP combination  
 env\_flags A data frame with the same dimensions of env\_data with the flag info for each env\_var/TIMESTAMP combination  
 si\_code A character vector of length one indicating the site code  
 timestamp A POSIXct vector of length nrow(sapf\_data) with the timestamp  
 solar\_timestamp A POSIXct vector of length nrow(sapf\_data) with the solar timestamp  
 site\_md A data frame containing the site metadata  
 stand\_md A data frame containing the stand metadata  
 species\_md A data frame containing the species metadata  
 plant\_md A data frame containing the plant metadata  
 env\_md A data frame containing the env metadata

---

sfn\_data\_multi-class      *S4 class for sapfluxnet multi-site data*

---

### Description

Multi sfn data class, derived from list

### Details

This class inherits from `list`, but modified to contain `sfn_data` objects as elements. This will allow to work with several sites at the same time obtaining results for all of them combined or individually as elements of the resulting list (with `lapply` or `purrr::map`)

---

sfn\_data\_multi\_validity      *Validity method for sfn\_data\_multi class*

---

### Description

Validation checks for generating sfn\_data\_multi class objects

### Details

This method is used internally to ensure the correctness of the sfn\_data\_multi object. Basically ensures that the object returned is a list of sfn\_data class objects

---

sfn\_data\_validity      *Validity method for sfn\_data class*

---

### Description

Validation checks for generating sfn\_data class objects

### Details

This method is used internally when creating and/or modifying sfn\_data class objects to ensure that the object returned is correct in terms of content classes and dimensions (i.e. sapflow data and environmental data has the same length)

---

sfn\_filter      *Filter sfn\_data by variable/s value*

---

### Description

Port of [filter](#) for sfn\_data and sfn\_data\_multi objects

### Usage

```
sfn_filter(sfn_data, ..., solar = FALSE)
```

### Arguments

sfn_data	sfn_data or sfn_data_multi object to subset
...	expressions to pass to the <a href="#">filter</a> function
solar	Logical indicating if solar timestamp must used to subset

## Details

‘sfn\_filter’ will remove the rows not matching the logical expression/s provided. So, it will remove cases and will create `TIMESTAMP` gaps, so its use is not recommended except in the case of filtering by `TIMESTAMP` (i.e. to set several sites (`sfn_data_multi`) in the same time frame). For other scenarios (removing extreme environmental conditions values or strange sapflow measures patterns) see [sfn\\_mutate](#) and [sfn\\_mutate\\_at](#)

## Value

For `sfn_data` objects, a filtered `sfn_data` or `NULL` if no data meet the criteria. For `sfn_data_multi` another `sfn_data_multi` with the sites filtered, and an empty `sfn_data_multi` if any sites met the criteria

## Examples

```
library(dplyr)
library(lubridate)

# data
data('ARG_TRE', package = 'sapfluxnetr')

# by timestamp
foo_timestamp <- get_timestamp(ARG_TRE)

foo_timestamp_trimmed <- foo_timestamp[1:100]

sfn_filter(
  ARG_TRE,
  TIMESTAMP %in% foo_timestamp_trimmed
)

# by wind speed value
ws_threshold <- 25

sfn_filter(
  ARG_TRE,
  ws <= ws_threshold
)

## multi
data('ARG_MAZ', package = 'sapfluxnetr')
multi_sfn <- sfn_data_multi(ARG_TRE, ARG_MAZ)

# by timestamp
sfn_filter(
  multi_sfn,
  between(day(TIMESTAMP), 18, 22)
)

# by wind speed value
sfn_filter(
```

```
    multi_sfn,  
    ws <= ws_threshold  
  )
```

---

sfn\_get\_generics      *sfn\_data custom get generics*

---

## Description

Generics for getting the info in the slots of SfnData

## Usage

```
get_sapf_data(object, ...)  
get_env_data(object, ...)  
get_sapf_flags(object, ...)  
get_env_flags(object, ...)  
get_timestamp(object, ...)  
get_solar_timestamp(object, ...)  
get_si_code(object, ...)  
get_site_md(object, ...)  
get_stand_md(object, ...)  
get_species_md(object, ...)  
get_plant_md(object, ...)  
get_env_md(object, ...)
```

## Arguments

object	Object to get data from
...	Further arguments to pass to the corresponding get method

## Details

see [sfn\\_get\\_methods](#) for detailed info about using the get methods in sfn\_data class objects and [sfn\\_multi\\_get\\_methods](#) for detailed info about using the get methods in sfn\_data\_multi class objects.



---

sfn_get_methods	<i>sfn_data</i> get methods
-----------------	-----------------------------

---

## Description

Methods to get the data and metadata from the sfn\_data class slots

## Usage

```
## S4 method for signature 'sfn_data'  
get_sapf_data(object, solar = FALSE)
```

```
## S4 method for signature 'sfn_data'  
get_env_data(object, solar = FALSE)
```

```
## S4 method for signature 'sfn_data'  
get_sapf_flags(object, solar = FALSE)
```

```
## S4 method for signature 'sfn_data'  
get_env_flags(object, solar = FALSE)
```

```
## S4 method for signature 'sfn_data'  
get_timestamp(object)
```

```
## S4 method for signature 'sfn_data'  
get_solar_timestamp(object)
```

```
## S4 method for signature 'sfn_data'  
get_si_code(object)
```

```
## S4 method for signature 'sfn_data'  
get_site_md(object)
```

```
## S4 method for signature 'sfn_data'  
get_stand_md(object)
```

```
## S4 method for signature 'sfn_data'  
get_species_md(object)
```

```
## S4 method for signature 'sfn_data'  
get_plant_md(object)
```

```
## S4 method for signature 'sfn_data'  
get_env_md(object)
```

## Arguments

object            Object of class sfn\_data from which data is retrieved

`solar` Logical indicating if the timestamp to return in the `get_sapf_data`, `get_env_data`, `get_sapf_flags` and `get_env_flags` methods is the solarTIMESTAMP (TRUE) or the contributors provided TIMESTAMP (FALSE)

### Details

`get_sapf_data` and `get_env_data` methods retrieve sapflow or environmental tibbles to create a functional dataset to work with.

`get_sapf_flags` and `get_env_flags` methods retrieve sapflow or environmental flags as tibbles.

`get_timestamp` and `get_solar_timestamp` methods retrieve only the timestamp as POSIXct vector.

`get_si_code` method retrieve a character vector with length(timestamp) containing the site code.

`get_site_md`, `get_stand_md`, `get_species_md`, `get_plant_md` and `get_env_md` methods retrieve the corresponding metadata.

### Examples

```
library(dplyr)

data('ARG_TRE', package = 'sapfluxnetr')
sapf_data <- get_sapf_data(ARG_TRE, solar = TRUE)
env_data_no_solar <- get_env_data(ARG_TRE, solar = FALSE)
plant_md <- get_plant_md(ARG_TRE)

# dplyr pipe to get the mean dbh for a site
ARG_TRE %>%
  get_plant_md() %>%
  summarise(dbh_mean = mean(pl_dbh, na.rm = TRUE)) %>%
  pull(dbh_mean)
```

---

`sfn_metadata_ex` *sfn\_metadata cache file for example data (ARG\_MAZ, ARG\_TRE and AUS\_CAN\_ST2\_MIX)*

---

### Description

Example metadata cache file content for package usage demonstration

### Usage

```
sfn_metadata_ex
```

### Format

A list with five elements, each of one a metadata type.

**Examples**

```
data('sfn_metadata_ex', package = 'sapfluxnetr')
sfn_metadata_ex
```

---

sfn\_metrics

*Metrics summary function*


---

**Description**

Generate metrics from a site/s data for the period indicated

**Usage**

```
sfn_metrics(
  sfn_data,
  period,
  .funs,
  solar,
  interval = c("general", "predawn", "midday", "night", "daylight"),
  int_start = NULL,
  int_end = NULL,
  ...
)
```

**Arguments**

sfn_data	<a href="#">sfn_data</a> or <a href="#">sfn_data_multi</a> object to obtain the metrics from
period	Time period to aggregate data by. See <a href="#">period</a> section for an explanation about the periods ('3 hours', '1 day', '1 month', '1 year', ...)
.funs	List of function calls to summarise the data by, see <a href="#">.funs</a> section for more details.
solar	Logical indicating if the solarTIMESTAMP must be used instead of the site local TIMESTAMP. Default to TRUE (use solarTIMESTAMP).
interval	Character vector indicating if the metrics must be filtered by an special hour interval. See <a href="#">Interval</a> section in details.
int_start	Integer value indicating the starting hour of the special interval in 24h format. See <a href="#">Interval</a> section in details.
int_end	Integer value indicating the ending hour of the special interval in 24h format. See <a href="#">Interval</a> section in details.
...	optional arguments to pass to methods used (i.e. <a href="#">.collapse_timestamp</a> or summarise funs extra arguments)

**Value**

For `sfn_data` objects, a list of `tbl_df` objects with the following structure:

- `$sapf`: metrics for the sapflow data
- `$env`: metrics for the environmental data

For `sfn_data_multi` objects, a list of lists of `tbl_df` objects with the metrics for each site:

- `$$SITE_CODE`
  - `$sapf`: metrics for the sapflow data
  - `$env`: metrics for the environmental data
- `$NEXT_SITE_CODE...`

**Period**

`period` argument is used by internal function `.collapse_timestamp` and it can be stated in two ways:

- *frequency period* format: "3 hours", "1 day", "7 days", "1 month"
- As a *custom function*. This will be the name of a function, without quotes, that accepts as the first argument the timestamp to collapse. The result of the function must be a vector of collapsed `TIMESTAMPS` of the same length than the original `TIMESTAMP` which will be used to group by and summarise the data. Additional arguments to this function, if needed, can be passed in the `...` argument.

`.collapse_timestamp` also accepts the `side` argument to collapse by the starting timestamp or the ending timestamp of each group. This can be supplied in the `...` argument.

**.funs**

`.funs` argument uses the same method as the `.funs` argument in the `summarise_all` function of `dplyr` package. Basically it accepts a list of function calls generated by `list()`. If you want to pass on a custom function you can specify it here. See details in `summarise_by_period` for more complex summarising functions declaration.

**Interval**

Previously to the metrics summary, data can be filtered by an special interval (i.e. predawn or nightly). This filtering can be specified with the `interval` argument as this:

- "general" (default). No special interval is used, and metrics are performed with all the data.
- "predawn". Data is filtered for predawn interval. In this case `int_start` and `int_end` must be specified as 24h value
- "midday". Data is filtered for midday interval. In this case `int_start` and `int_end` must be specified as 24h value
- "night". Data is filtered for night interval. In this case `int_start` and `int_end` must be specified as 24h value
- "daylight". Data is filtered for daylight interval. In this case `int_start` and `int_end` must be specified as 24h value

**See Also**

Other metrics: [metrics](#)

**Examples**

```
library(dplyr)

### general metrics
## sfn_data
data('ARG_TRE', package = 'sapfluxnetr')
ARG_TRE_metrics <- sfn_metrics(
  ARG_TRE,
  period = '7 days',
  .funs = list(~ mean(., na.rm = TRUE), ~ sd(., na.rm = TRUE), ~ n()),
  solar = FALSE,
  interval = 'general'
)

str(ARG_TRE_metrics)
ARG_TRE_metrics[['sapf']]
ARG_TRE_metrics[['env']]

## sfn_data_multi

data('ARG_MAZ', package = 'sapfluxnetr')
data('AUS_CAN_ST2_MIX', package = 'sapfluxnetr')
multi_sfn <- sfn_data_multi(ARG_TRE, ARG_MAZ, AUS_CAN_ST2_MIX)

multi_metrics <- sfn_metrics(
  multi_sfn,
  period = '7 days',
  .funs = list(~ mean(., na.rm = TRUE), ~ sd(., na.rm = TRUE), ~ n()),
  solar = FALSE,
  interval = 'general'
)

str(multi_metrics)

multi_metrics[['ARG_TRE']]['sapf']]

### midday metrics
ARG_TRE_midday <- sfn_metrics(
  ARG_TRE,
  period = '1 day',
  .funs = list(~ mean(., na.rm = TRUE), ~ sd(., na.rm = TRUE), ~ n()),
  solar = TRUE,
  interval = 'midday', int_start = 11, int_end = 13
)

str(ARG_TRE_midday)
ARG_TRE_midday[['sapf']]
```

---

sfn\_multi\_get\_methods *sfn\_data\_multi* get methods

---

## Description

Methods to get the data and metadata from the sfn\_data class slots

## Usage

```
## S4 method for signature 'sfn_data_multi'  
get_sapf_data(object, solar = FALSE)
```

```
## S4 method for signature 'sfn_data_multi'  
get_env_data(object, solar = FALSE)
```

```
## S4 method for signature 'sfn_data_multi'  
get_sapf_flags(object, solar = FALSE)
```

```
## S4 method for signature 'sfn_data_multi'  
get_env_flags(object, solar = FALSE)
```

```
## S4 method for signature 'sfn_data_multi'  
get_timestamp(object)
```

```
## S4 method for signature 'sfn_data_multi'  
get_solar_timestamp(object)
```

```
## S4 method for signature 'sfn_data_multi'  
get_si_code(object)
```

```
## S4 method for signature 'sfn_data_multi'  
get_site_md(object, collapse = FALSE)
```

```
## S4 method for signature 'sfn_data_multi'  
get_stand_md(object, collapse = FALSE)
```

```
## S4 method for signature 'sfn_data_multi'  
get_species_md(object, collapse = FALSE)
```

```
## S4 method for signature 'sfn_data_multi'  
get_plant_md(object, collapse = FALSE)
```

```
## S4 method for signature 'sfn_data_multi'  
get_env_md(object, collapse = FALSE)
```

**Arguments**

object	Object of class <code>sfn_data_multi</code> from which data or metadata is retrieved
solar	Logical indicating if the timestamp to return in the <code>get_sapf_data</code> , <code>get_env_data</code> , <code>get_sapf_flags</code> and <code>get_env_flags</code> methods is the solarTIMESTAMP (TRUE) or the contributors provided TIMESTAMP (FALSE)
collapse	Logical indicating if the metadata get methods must collapse the returning list to a data frame with all sites

**Details**

`get_sapf_data` and `get_env_data` methods retrieve sapflow or environmental tibbles from the `sfn_data` objects contained in the `sfn_data_multi` and return them in a list.

`get_sapf_flags` and `get_env_flags` methods retrieve sapflow or environmental flags tibbles from the `sfn_data` objects contained in the `sfn_data_multi` and return them in a list.

`get_timestamp` and `get_solar_timestamp` methods retrieve only the timestamps as POSIXct vectors and return them as a list (each element corresponding to a site in the `sfn_data_multi` object).

`get_si_code` method retrieve a character vector with `length(timestamp)` containing the site code for each site, returning them as a list.

`get_site_md`, `get_stand_md`, `get_species_md`, `get_plant_md` and `get_env_md` methods retrieve the corresponding metadata objects for each site returning them as a list, unless `collapse` is TRUE, then the list collapses to a tibble.

**Examples**

```
library(dplyr)
```

---

sfn_mutate	<i>Mutate variables by function</i>
------------	-------------------------------------

---

**Description**

Port of `mutate` for `sfn_data` and `sfn_data_multi` objects

**Usage**

```
sfn_mutate(sfn_data, ..., solar = FALSE)
```

**Arguments**

sfn_data	sfn_data or sfn_data_multi object to subset
...	Name-value pairs of expressions to pass to the <code>mutate</code> function.
solar	Logical indicating if solar timestamp must used to subset

**Details**

'sfn\_mutate' function will maintain the same number of rows before and after the modification, so it is well suited to modify variables without creating **TIMESTAMP** gaps (i.e. to change variable units). For mutating groups of variables at the same time see [sfn\\_mutate\\_at](#).

**Value**

For `sfn_data` objects, a mutated `sfn_data`. For `sfn_data_multi` another `sfn_data_multi` with the sites mutated

**Sapflow and environmental variables**

'sfn\_mutate' internally joins the sapflow and environmental datasets by the **TIMESTAMP**, so it is possible to mutate variables conditionally between sapflow and environmental measures (i.e. mutate sapflow when wind is high or radiation is zero). Due to this, at the moment any new variable is dropped when building the final results, so this is **ONLY** intended to mutate existing variables without changing the names.

**Examples**

```
library(dplyr)
library(lubridate)

# data
data('ARG_TRE', package = 'sapfluxnetr')

# transform to NAs any wind value above 25
ws_threshold <- 25
sfn_mutate(ARG_TRE, ws = if_else(ws > 25, NA_real_, ws))

## multi
data(ARG_MAZ, package = 'sapfluxnetr')
data(AUS_CAN_ST2_MIX, package = 'sapfluxnetr')
multi_sfn <- sfn_data_multi(ARG_TRE, ARG_MAZ, AUS_CAN_ST2_MIX)

multi_sfn_mutated <- sfn_mutate(
  multi_sfn, ws = if_else(ws > 25, NA_real_, ws)
)

multi_sfn_mutated[['ARG_TRE']]
```

---

sfn\_mutate\_at

*Mutate selected columns by function*


---

**Description**

Port of [mutate\\_at](#) for `sfn_data` and `sfn_data_multi` objects



**Usage**

```
sfn_mutate_at(sfn_data, .vars, .funs, ..., solar = FALSE)
```

**Arguments**

sfn_data	sfn_data or sfn_data_multi object to subset
.vars	Variables to mutate. Passed to <a href="#">mutate_at</a>
.funs	Function/s for mutate, passed to <a href="#">mutate_at</a>
...	Extra arguments to pass to the functions in .funs, passed to <a href="#">mutate_at</a> .
solar	Logical indicating if solar timestamp must used to subset

**Details**

'sfn\_mutate\_at' function will maintain the same number of rows before and after the modification, so it is well suited to modify variables without creating **TIMESTAMP** gaps (i.e. to change variable units). For mutating individual variables see [sfn\\_mutate](#).

**Value**

For sfn\_data objects, a mutated sfn\_data. For sfn\_data\_multi another sfn\_data\_multi with the sites mutated

**Examples**

```
library(dplyr)
library(lubridate)

# data
data('ARG_TRE', package = 'sapfluxnetr')

# transform to NAs any sapflow value occurred with wind speed above 25
ws_threshold <- 25
# get the names of the variables to mutate (tree names)
vars_to_mutate <- names(get_sapf_data(ARG_TRE)[,-1]) # no TIMESTAMP

sfn_mutate_at(
  ARG_TRE,
  .vars = vars(one_of(vars_to_mutate)),
  .funs = list(
    ~ case_when(
      ws > ws_threshold ~ NA_real_,
      TRUE ~ .
    )
  )
)

## multi
data(ARG_MAZ, package = 'sapfluxnetr')
data(AUS_CAN_ST2_MIX, package = 'sapfluxnetr')
multi_sfn <- sfn_data_multi(ARG_TRE, ARG_MAZ, AUS_CAN_ST2_MIX)
```

```
## in multi it's better to discard the variables to not mutate:
vars_to_not_mutate <- names(get_env_data(ARG_TRE)) # all the environmental

multi_sfn_mutated <- sfn_mutate_at(
  multi_sfn,
  .vars = vars(-one_of(vars_to_not_mutate)), # we use -
  .funs = list(
    ~ case_when(
      ws > ws_threshold ~ NA_real_,
      TRUE ~ .
    )
  )
)

multi_sfn_mutated[['ARG_TRE']]
```

---

sfn\_plot

*plot method for sfn\_data class*


---

## Description

Plot the desired data from a site object

## Usage

```
sfn_plot(
  sfn_data,
  type = c("sapf", "env", "ta", "rh", "vpd", "ppfd_in", "netrad", "sw_in", "ext_rad",
    "ws", "precip", "swc_shallow", "swc_deep"),
  formula_env = NULL,
  solar = TRUE,
  ...
)
```

## Arguments

sfn_data	sfn_data object to plot. It can be also an sfn_data_multi object.
type	Character indicating which data to plot. See Type section for detailed information about the available values. Ignored if formula is provided
formula_env	Right side formula indicating an environmental variable to plot vs. the sapflow values. If NULL (default), sfn_plot will use "type" to guess which plot show.
solar	Logical indicating if the solar timestamp must be used instead of the site timestamp
...	Further arguments to be passed on <a href="#">geom_point</a> or <a href="#">geom_col</a> to modify geometry aesthetics.

**Value**

A ggplot object that can be called to see the plot. If input is an `sfn_data_multi` object, a list with the plots

**ggplot plotting system**

`plot` is a base R function which uses the base R plotting system to show the plot. We prefer the ggplot plotting system, which allow for storing the plots in objects and can be subjected to further modifications. This allow the package users to generate rather simple plots that can be fine tuned afterwards to the user taste. Generating a `plot` method for the `sfn_data` class returning a ggplot object is not desired (it change the way plot works and can be misleading about the plot general usage). So, instead, we offer this function, `sfn_plot`.

**Type**

type argument controls what is going to be plotted. It accepts the following:

- "sapf": It will plot sapflow data vs. `TIMESTAMP`
- "env": It will plot environmental variables vs. `TIMESTMAP`
- "ta", "rh", "vpd", "ppfd\_in", "netrad", "sw\_in", "ext\_rad", "ws", "precip", "swc\_shallow" and "swc\_deep": They will plot the corresponding variable vs. `TIMESTAMP`

**Formula**

formula argument can be used to select an environmental variable to plot versus all the sapflow measurements. Any environmental variable is allowed, if it exist in the site provided.

**Geometry**

By default `sfn_plot` generates plots using `geom_point` geometry, except in the case of `type = "ws"` and `type = "precip"` where `geom_col` is used. These geometries can be modified with the `...` argument.

**Examples**

```
library(ggplot2)

# data
data('ARG_TRE', package = 'sapfluxnetr')

# plotting directly
sfn_plot(ARG_TRE, type = 'sapf')

# this could be noisy, you can facet by "Tree" (for sapflow) or by
# "Variable" (for environmental data):
sfn_plot(ARG_TRE, type = 'sapf') +
  facet_wrap(~ Tree)

sfn_plot(ARG_TRE, type = 'env') +
  facet_wrap(~ Variable, scales = 'free_y')
```

```
# saving and modifying:
env_plot <- sfn_plot(ARG_TRE, type = 'env', solar = FALSE) +
  facet_wrap(~ Variable, scales = 'free_y')
env_plot + labs(title = 'Environmental variables facet plot')

# formula
sfn_plot(ARG_TRE, formula_env = ~ vpd)
```

---

sfn\_replacement\_generics  
*sfn\_data replacement generics*

---

### Description

Generic functions for replacement functions for sfn\_data

### Usage

```
get_sapf_data(object) <- value
get_env_data(object) <- value
get_sapf_flags(object) <- value
get_env_flags(object) <- value
get_timestamp(object) <- value
get_solar_timestamp(object) <- value
get_si_code(object) <- value
get_site_md(object) <- value
get_stand_md(object) <- value
get_species_md(object) <- value
get_plant_md(object) <- value
get_env_md(object) <- value
```

### Arguments

object	Object to replace
value	Object to replace with

## Details

see [sfn\\_replacement\\_methods](#) for more info about using the replacement methods in `sfn_data` objects

---

`sfn_replacement_methods`  
*sfn\_data replacement methods*

---

## Description

Methods to replace the data and metadata from the `sfn_data` class slots

## Usage

```
## S4 replacement method for signature 'sfn_data'  
get_sapf_data(object) <- value
```

```
## S4 replacement method for signature 'sfn_data'  
get_env_data(object) <- value
```

```
## S4 replacement method for signature 'sfn_data'  
get_sapf_flags(object) <- value
```

```
## S4 replacement method for signature 'sfn_data'  
get_env_flags(object) <- value
```

```
## S4 replacement method for signature 'sfn_data'  
get_timestamp(object) <- value
```

```
## S4 replacement method for signature 'sfn_data'  
get_solar_timestamp(object) <- value
```

```
## S4 replacement method for signature 'sfn_data'  
get_si_code(object) <- value
```

```
## S4 replacement method for signature 'sfn_data'  
get_site_md(object) <- value
```

```
## S4 replacement method for signature 'sfn_data'  
get_stand_md(object) <- value
```

```
## S4 replacement method for signature 'sfn_data'  
get_species_md(object) <- value
```

```
## S4 replacement method for signature 'sfn_data'  
get_plant_md(object) <- value
```

```
## S4 replacement method for signature 'sfn_data'
get_env_md(object) <- value
```

### Arguments

object	sfn_data containing the slot to replace
value	object with the data to replace sfn_Data slot with

### Details

The replacement object must be a valid object for that slot:

- For `get_sapf_data`, `get_env_data`, `get_sapf_flags` and `get_env_flags` a `data.frame` or `tibble` without the `TIMESTAMP` variable
- For `get_*_md` a `data.frame` or `tibble`
- For `get_timestamp` and `get_solar_timestamp` a `POSIXct` vector of length `== nrow(sapf/env_data)`
- For `get_si_code` a character vector

Validity is automatically checked before modifying the `sfn_data` object, and an error is raised if not valid

### Examples

```
# preparation
data('ARG_TRE', package = 'sapfluxnetr')
sapf_data <- get_sapf_data(ARG_TRE, solar = TRUE)

# modifying the slot data
sapf_data[1:10, 2] <- NA

# replacement. Remember, the sfn_data slot does not contain a TIMESTAMP
# variable, it must be removed
get_sapf_data(ARG_TRE) <- sapf_data[,-1]
```

---

`sfn_sites_in_folder`    *list available sites in a db folder*

---

### Description

Retrieves the site codes in the specified folder

### Usage

```
sfn_sites_in_folder(folder = ".")
```

**Arguments**

folder                    Character vector of length 1 indicating the route to the db folder

**Details**

If folder

**Value**

A character vector with the site codes present in the folder, an error if the folder is not valid or does not contain any site data file.

**Examples**

```
# Let's access the data in "folder". This typically is the folder where the
# sapflow data at the desired unit level is (i.e. "RData/plant"), but in this
# example we will create a temporal folder with some data to test the function
folder <- tempdir()
save(ARG_TRE, file = file.path(folder, 'ARG_TRE.RData'))
save(ARG_MAZ, file = file.path(folder, 'ARG_MAZ.RData'))
save(AUS_CAN_ST2_MIX, file = file.path(folder, 'AUS_EUC_ST2_MIX.RData'))

# lets see the sites
sites <- sfn_sites_in_folder(folder)
```

---

sfn\_vars\_to\_filter        *List all variables that can be used to filter sites*

---

**Description**

sfn\_vars\_to\_filter() returns a list with the variables for each kind of metadata that can be used to select and filter sites

**Usage**

```
sfn_vars_to_filter()
```

**Value**

A list with five elements, site\_md, stand\_md, species\_md, plant\_md and env\_md

**Examples**

```
# all variables
sfn_vars_to_filter()

# by some metadata
sfn_vars_to_filter()$site_md
```

show,sfn\_data-method    *Show method for sfn\_data*

---

**Description**

print a summary for sfn\_data objects

**Usage**

```
## S4 method for signature 'sfn_data'  
show(object)
```

**Arguments**

object            sfn\_data object to show

---

show,sfn\_data\_multi-method  
                          *Show method for sfn\_data\_multi*

---

**Description**

print a summary for sfn\_data\_multi objects

**Usage**

```
## S4 method for signature 'sfn_data_multi'  
show(object)
```

**Arguments**

object            sfn\_data\_multi object to show



---

 summarise\_by\_period *Summaries by period*


---

## Description

This function collapse the `TIMESTAMP` to the desired period (day, month...) by setting the same value to all timestamps within the period. This modified `TIMESTAMP` is used to group by and summarise the data.

## Usage

```
summarise_by_period(data, period, .funs, ...)
```

## Arguments

<code>data</code>	sapflow or environmental data as obtained by <a href="#">get_sapf_data</a> and <a href="#">get_env_data</a> . Must have a column named <code>TIMESTAMP</code>
<code>period</code>	period to collapse by. See <a href="#">sfn_metrics</a> for details.
<code>.funs</code>	funs to summarise the data. See details.
<code>...</code>	optional arguments. See details

## Details

This function uses internally [.collapse\\_timestamp](#) and [summarise\\_all](#). Arguments to control these functions can be passed as `'...'`. Arguments for each function are spliced and applied when needed. Be advised that all arguments passed to the `summarise_all` function will be applied to all the summarising functions used, so it will fail if any of that functions does not accept that argument. To complex function-argument relationships, indicate each summary function call within the `.funs` argument as explained here [summarise\\_all](#):

```
# This will fail because na.rm argument will be also passed to the n function,
# which does not accept any argument:
```

```
summarise_by_period(
  data = get_sapf_data(ARG_TRE),
  period = '7 days',
  .funs = list(mean, sd, n()),
  na.rm = TRUE
)
```

```
# to solve this is better to use the .funs argument:
```

```
summarise_by_period(
  data = get_sapf_data(ARG_TRE),
  period = '7 days',
  .funs = list(~ mean(., na.rm = TRUE), ~ sd(., na.rm = TRUE), ~ n())
)
```

**Value**

A 'tbl\_df' object with the metrics results. The names of the columns indicate the original variable (tree or environmental variable) and the metric calculated (i.e. 'vpd\_mean'), separated by underscore

**TIMESTAMP\_coll**

Previously to the collapsing step, a temporal variable called `TIMESTAMP_coll` is created to be able to catch the real timestamp when some events happens, for example to use the `min_time` function. If your custom summarise function needs to get the time at which some event happens, use `TIMESTAMP_coll` instead of `TIMESTAMP` for that:

```
min_time <- function(x, time) {
  time[which.min(x)]
}

summarise_by_period(
  data = get_sapf_data(ARG_TRE),
  period = '1 day',
  .funs = list(~ min_time(., time = TIMESTAMP_coll)) # Not TIMESTAMP
)
```

**Examples**

```
library(dplyr)

# data
data('ARG_TRE', package = 'sapfluxnetr')

# simple summary
summarise_by_period(
  data = get_sapf_data(ARG_TRE),
  period = '7 days',
  .funs = list(~ mean(., na.rm = TRUE), ~ sd(., na.rm = TRUE), ~ n())
)
```

---

 %>%

---

*Reexporting the pipe operator*


---

**Description**

Imported from magrittr package

%>%

43

### Examples

```
# piping sites  
ARG_TRE %>% daily_metrics()
```

# Index

- \* **datasets**
  - ARG\_MAZ, [3](#)
  - ARG\_TRE, [3](#)
  - AUS\_CAN\_ST2\_MIX, [4](#)
  - sfn\_metadata\_ex, [26](#)
- \* **metrics**
  - metrics, [11](#)
  - sfn\_metrics, [27](#)
  - .collapse\_timestamp, [12](#), [28](#), [41](#)
  - %>%, [42](#)
- ARG\_MAZ, [3](#)
- ARG\_TRE, [3](#)
- AUS\_CAN\_ST2\_MIX, [4](#)
- ceiling\_date, [12](#)
- daily\_metrics (metrics), [11](#)
- data\_coverage, [4](#)
- daylight\_metrics (metrics), [11](#)
- describe\_md\_variable, [5](#)
- diurnal\_centroid, [6](#)
- filter, [7](#), [22](#)
- filter\_sites\_by\_md, [7](#)
- floor\_date, [12](#)
- geom\_col, [34](#), [35](#)
- geom\_point, [34](#), [35](#)
- get\_env\_data, [41](#)
- get\_env\_data (sfn\_get\_generics), [24](#)
- get\_env\_data, sfn\_data-method (sfn\_get\_methods), [25](#)
- get\_env\_data, sfn\_data\_multi-method (sfn\_multi\_get\_methods), [30](#)
- get\_env\_data<- (sfn\_replacement\_generics), [36](#)
- get\_env\_data<-, sfn\_data-method (sfn\_replacement\_methods), [37](#)
- get\_env\_flags (sfn\_get\_generics), [24](#)
- get\_env\_flags, sfn\_data-method (sfn\_get\_methods), [25](#)
- get\_env\_flags, sfn\_data\_multi-method (sfn\_multi\_get\_methods), [30](#)
- get\_env\_flags<- (sfn\_replacement\_generics), [36](#)
- get\_env\_flags<-, sfn\_data-method (sfn\_replacement\_methods), [37](#)
- get\_plant\_md (sfn\_get\_generics), [24](#)
- get\_plant\_md, sfn\_data-method (sfn\_get\_methods), [25](#)
- get\_plant\_md, sfn\_data\_multi-method (sfn\_multi\_get\_methods), [30](#)
- get\_plant\_md<- (sfn\_replacement\_generics), [36](#)
- get\_plant\_md<-, sfn\_data-method (sfn\_replacement\_methods), [37](#)
- get\_sapf\_data, [41](#)
- get\_sapf\_data (sfn\_get\_generics), [24](#)
- get\_sapf\_data, sfn\_data-method (sfn\_get\_methods), [25](#)
- get\_sapf\_data, sfn\_data\_multi-method (sfn\_multi\_get\_methods), [30](#)
- get\_sapf\_data<- (sfn\_replacement\_generics), [36](#)
- get\_sapf\_data<-, sfn\_data-method (sfn\_replacement\_methods), [37](#)
- get\_sapf\_flags (sfn\_get\_generics), [24](#)
- get\_sapf\_flags, sfn\_data-method (sfn\_get\_methods), [25](#)

- get\_sapf\_flags, sfn\_data\_multi-method  
(sfn\_multi\_get\_methods), 30
- get\_sapf\_flags<-  
(sfn\_replacement\_generics), 36
- get\_sapf\_flags<- , sfn\_data-method  
(sfn\_replacement\_methods), 37
- get\_si\_code (sfn\_get\_generics), 24
- get\_si\_code, sfn\_data-method  
(sfn\_get\_methods), 25
- get\_si\_code, sfn\_data\_multi-method  
(sfn\_multi\_get\_methods), 30
- get\_si\_code<-  
(sfn\_replacement\_generics), 36
- get\_si\_code<- , sfn\_data-method  
(sfn\_replacement\_methods), 37
- get\_site\_md (sfn\_get\_generics), 24
- get\_site\_md, sfn\_data-method  
(sfn\_get\_methods), 25
- get\_site\_md, sfn\_data\_multi-method  
(sfn\_multi\_get\_methods), 30
- get\_site\_md<-  
(sfn\_replacement\_generics), 36
- get\_site\_md<- , sfn\_data-method  
(sfn\_replacement\_methods), 37
- get\_solar\_timestamp (sfn\_get\_generics), 24
- get\_solar\_timestamp, sfn\_data-method  
(sfn\_get\_methods), 25
- get\_solar\_timestamp, sfn\_data\_multi-method  
(sfn\_multi\_get\_methods), 30
- get\_solar\_timestamp<-  
(sfn\_replacement\_generics), 36
- get\_solar\_timestamp<- , sfn\_data-method  
(sfn\_replacement\_methods), 37
- get\_species\_md (sfn\_get\_generics), 24
- get\_species\_md, sfn\_data-method  
(sfn\_get\_methods), 25
- get\_species\_md, sfn\_data\_multi-method  
(sfn\_multi\_get\_methods), 30
- get\_species\_md<-  
(sfn\_replacement\_generics), 36
- get\_species\_md<- , sfn\_data-method  
(sfn\_replacement\_methods), 37
- get\_stand\_md (sfn\_get\_generics), 24
- get\_stand\_md, sfn\_data-method  
(sfn\_get\_methods), 25
- get\_stand\_md, sfn\_data\_multi-method  
(sfn\_multi\_get\_methods), 30
- get\_stand\_md<-  
(sfn\_replacement\_generics), 36
- get\_stand\_md<- , sfn\_data-method  
(sfn\_replacement\_methods), 37
- get\_timestamp (sfn\_get\_generics), 24
- get\_timestamp, sfn\_data-method  
(sfn\_get\_methods), 25
- get\_timestamp, sfn\_data\_multi-method  
(sfn\_multi\_get\_methods), 30
- get\_timestamp<-  
(sfn\_replacement\_generics), 36
- get\_timestamp<- , sfn\_data-method  
(sfn\_replacement\_methods), 37
- get\_timezone, 8
- initialize, sfn\_data-method, 9
- initialize, sfn\_data\_multi-method, 10
- metrics, 11, 17, 29
- metrics\_tidyfier, 16
- midday\_metrics (metrics), 11
- monthly\_metrics (metrics), 11
- mutate, 31
- mutate\_at, 32, 33
- nightly\_metrics (metrics), 11
- norm\_diurnal\_centroid, 18
- plot, 35
- predawn\_metrics (metrics), 11
- quantile, 12
- read\_sfn\_data, 19
- read\_sfn\_metadata, 7, 12, 17, 20
- sfn\_data, 11, 12, 27, 28
- sfn\_data (sfn\_data-class), 21
- sfn\_data-class, 21
- sfn\_data\_multi, 11, 12, 27, 28
- sfn\_data\_multi (sfn\_data\_multi-class), 21
- sfn\_data\_multi-class, 21
- sfn\_data\_multi\_validity, 22
- sfn\_data\_validity, 22
- sfn\_filter, 22
- sfn\_get\_generics, 24
- sfn\_get\_methods, 24, 25
- sfn\_metadata\_ex, 26
- sfn\_metrics, 13, 14, 27, 41

`sfn_multi_get_methods`, [24](#), [30](#)  
`sfn_mutate`, [23](#), [31](#), [33](#)  
`sfn_mutate_at`, [23](#), [32](#), [32](#)  
`sfn_plot`, [34](#)  
`sfn_replacement_generics`, [36](#)  
`sfn_replacement_methods`, [37](#), [37](#)  
`sfn_sites_in_folder`, [7](#), [38](#)  
`sfn_vars_to_filter`, [39](#)  
`show`, `sfn_data`-method, [40](#)  
`show`, `sfn_data_multi`-method, [40](#)  
`summarise`, [6](#), [18](#)  
`summarise_all`, [28](#), [41](#)  
`summarise_by_period`, [28](#), [41](#)