Package 'REddyProc'

January 20, 2025

Type Package

Version 1.3.3

Title Post Processing of (Half-)Hourly Eddy-Covariance Measurements

Description Standard and extensible Eddy-Covariance data post-processing
(Wutzler et al. (2018) <doi:10.5194/bg-15-5015-2018>)
includes
uStar-filtering, gap-filling, and flux-partitioning.
The Eddy-Covariance (EC) micrometeorological technique quantifies continuous
exchange fluxes of gases, energy, and momentum between an ecosystem and the atmosphere.
It is important for understanding ecosystem dynamics and upscaling exchange fluxes.
(Aubinet et al. (2012) <doi:10.1007/978-94-007-2351-1>).
This package inputs pre-processed (half-)hourly data and supports further processing.
First, a quality-check and filtering is performed based on the relationship between
measured flux and friction
velocity (uStar) to discard biased data
(Papale et al. (2006) <doi:10.5194/bg-3-571-2006>).
Second, gaps in the data are filled based on information from environmental conditions
(Reichstein et al. (2005) <doi:10.1111/j.1365-2486.2005.001002.x>).
Third, the net flux of carbon dioxide is partitioned
into its gross fluxes in and out of the ecosystem by night-time
based and day-time based approaches
(Lasslop et al. (2010) <doi:10.1111/j.1365-2486.2009.02041.x>).

URL https://www.bgc-jena.mpg.de/bgi/index.php/Services/REddyProcWeb,
https://github.com/bgctw/REddyProc

License GPL (>= 2)

Encoding UTF-8

LazyData true

VignetteBuilder knitr

LinkingTo Rcpp

Depends R (>= 3.0.0), methods

Imports Rcpp, dplyr, purrr, rlang, readr, tibble, magrittr, solartime,
bigleaf (>= 0.7), mlegp

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Suggests testthat, minpack.lm, segmented, knitr, rmarkdown, lognorm,
    ggplot2, tidyr, markdown

Collate 'CheckVal.R' 'DataFunctions.R' 'aEddy.R' 'EddyGapfilling.R'
    'EddyPartitioning.R' 'EddyPlotting.R'
    'EddyUStarFilterChangePointDetection.R' 'EddyUStarFilterDP.R'
    'Example.R' 'FileHandling.R' 'FileHandlingFormats.R'
    'GeoFunctions.R' 'LRC_base.R' 'LRC_logisticSigmoid.R'
    'LRC_nonrectangular.R' 'LRC_rectangular.R'
    'PartitioningLasslop10.R' 'PartitioningLasslop10Nighttime.R'
    'RcppExports.R' 'estimate_vpd_from_dew.R' 'imports.R'
    'logitnorm.R' 'variableNames.R' 'zzzDebugCode.R'

RoxygenNote 7.3.0

NeedsCompilation yes

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Contents

REddyProc-package   *Post Processing of (Half-)Hourly Eddy-Covariance Measurements*

Description

Standard and extensible Eddy-Covariance data post-processing including uStar-filtering, gap-filling, and flux-partitioning (Wutzler et al. (2018) <doi:10.5194/bg-15-5015-2018>).

The Eddy-Covariance (EC) micrometeorological technique quantifies continuous exchange fluxes of gases, energy, and momentum between an ecosystem and the atmosphere. It is important for understanding ecosystem dynamics and upscaling exchange fluxes. (Aubinet et al. (2012) <doi:10.1007/978-94-007-2351-1>).

This package inputs pre-processed (half-)hourly data and supports further processing. First, a quality-check and filtering is performed based on the relationship between measured flux and friction velocity (uStar) to discard biased data (Papale et al. (2006) <doi:10.5194/bg-3-571-2006>).

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A general description and an online tool based on this package can be found here: https://www.bgc-jena.mpg.de/bgi/index.php/Services/REddyProcWeb.

Details

A **detailed example** of the processing can be found in the useCase vignette.

A first overview of the REddyProc functions:

These functions help with the preparation of your data for the analysis:

- Loading text files into dataframes: `fLoadTXTIntoDataframe`
- Preparing a proper time stamp: `help_DateTimes`
- Calculating latent variables, e.g. VPD: `fCalcVPDfromRHandTair`

Then the data can be processed with the `sEddyProc-class` R5 reference class:

- Initializing the R5 reference class: `sEddyProc_initialize`
- Estimating the turbulence criterion, Ustar threshold, for omitting data from periods of low turbulence: Functions `sEddyProc_sEstUstarThreshold` and `sEddyProc_sEstUstarThresholdDistribution`
  .
- Gap filling: `sEddyProc_sMDSGapFill` and `sEddyProc_sMDSGapFillAfterUstar`.
- Flux partitioning based on Night-Time: `sEddyProc_sMRFluxPartition`
- Flux partitioning based on Day-Time: `sEddyProc_sGLFluxPartition`

Processing across different scenarios of u* threshold estimate is supported by

- Estimating the turbulence criterion, Ustar threshold, for omitting data from periods of low turbulence: `sEddyProc_sEstimateUstarScenarios` and associated
  - query the thresholds to be used `sEddyProc_sGetUstarScenarios`
  - set the thresholds to be used `sEddyProc_sSetUstarScenarios`
  - query the estimated thresholds all different aggregation levels `sEddyProc_sGetEstimatedUstarThresholdDistr`
- Gap-Filling: `sEddyProc_sMDSGapFillUStarScens`
- Flux partitioning based on Night-Time (Reichstein 2005): `sEddyProc_sMRFluxPartitionUStarScens`
- Flux partitioning based on Day-Time (Lasslop 2010): `sEddyProc_sGLFluxPartitionUStarScens`
- Flux partitioning based on modified Day-Time (Keenan 2019): `sEddyProc_sTKFluxPartitionUStarScens`

Before or after processing, the data can be plotted:

- Fingerprint: `sEddyProc_sPlotFingerprint`
- Half-hourly fluxes and their daily means: `sEddyProc_sPlotHHFluxes`
- Daily sums (and their uncertainties): `sEddyProc_sPlotDailySums`
- Diurnal cycle: `sEddyProc_sPlotDiurnalCycle`

For exporting data and results see `help_export`.

A **complete list** of REddyProc functions be viewed by clicking on the **Index** link at the bottom of this help page.

Also have a look at the package vignettes.

Author(s)

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References

Reichstein M, Falge E, Baldocchi D et al. (2005) On the separation of net ecosystem exchange into assimilation and ecosystem respiration: review and improved algorithm. Global Change Biology, 11, 1424-1439.

BerkeleyJulianDateToPOSIXct

BerkeleyJulianDateToPOSIXct

Description

convert JulianDate format used in Berkeley release to POSIXct

Usage

```
BerkeleyJulianDateToPOSIXct(julianDate, tz = "UTC",
    ...)
```

Arguments

julianDate	numeric vector representing times (see details for format)
tz	time zone used to represent the dates
...	further arguments to `strptime`

Details

In the Berkeley-Release of the Fluxnet data, the time is stored as an number with base10-digits representing YYYYMMddhhmm

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See Also

`POSIXctToBerkeleyJulianDate` `help_DateTimes`

DEGebExample   *Eddy covariance data from Gebesee crop site, Germany*

Description

The data frame 'DEGebExample' contains half-hourly eddy covariance measurements from Gebesee of the years 2004 to 2006.

Usage

```
data(DEGebExample)
```

Format

For each column, the attributes 'varnames' for the variable names and 'units' for the variable units are provided.

Time stamp DateTime: POSIXct-time of the end of the half-hour period, Use as.POSIXlt(DateTime)$year to get hour, day of year, ...

Flux measurements NEE

Meteo measurements Rg, Tair, rH, VPD, Ustar

For processing of the example data see `vignette("DEGebExample")`.

Details

DISCLAIMER: This example dataset should only be used for test purposes of the REddyProc R package. For other uses, the data is openly available through the European Fluxes Database (http://www.europe-fluxdata.eu/home/site-details?id=3) and upon registration the current version can be downloaded there.

Source

The data was downloaded from `http://www.europe-fluxdata.eu` at date 2016-01-25.

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estimate_vpd_from_dew   *Estimate VPD from assuming dewpoint at daily minimum temperature*

Description

VPD is required for daytime NEE flux partitioning. Hence, it is necessary to estimate VPD also for long gaps in data. With two assumptions, VPD can be estimated from temperature 1). The change of water mass in air is negligible during the day. VPD is the difference of actual vapour pressure to saturation vapour pressure. 2.) At morning minimum temperature, vapour pressure is at minimum in many cases at saturation. Hence

$$VPD = Esat(Tair) - E \approx Esat(Tair) - Esat_{daymin} \approx Esat(Tair) - Esat(Tair_{min})$$

Usage

```
estimate_vpd_from_dew(df, pNonMissing = 0.1)
```

Arguments

df	data.frame with columns DateTime, VPD, Tair, and Tair_f
pNonMissing	numeric scalar of the necessary fraction of finite VPD and Tair. If fraction is lower then a warning is thrown.

Details

Since sometimes Esat_daymin is lower than Esat(Tair_min) the estimated VPDfromDew is under-estimated. This function applies a linear model of the existing VPD and estimated VPD to correct for this bias: VPD ~ 0 + VPDfromDew * Tair_f * hourOfDay * TminOftheDay * TRangeDay

Value

numeric vector of length(nrow(data)) of estimated VPD

Example_DETha98   *Eddy covariance data from Tharandt, Germany*

Description

The data frame 'EddyData.F' contains half-hourly eddy covariance measurements from Tharandt of the year 1998.

Usage

```
data(Example_DETha98)
```

Format

For each column, the attributes 'varnames' for the variable names and 'units' for the variable units are provided.

Time stamp Year - Year provided with century 1998.
     DoY - Day of year provided as 1 to 365 (or 1 to 366 in leap years).
     Hour - Hour provided as decimal 0.0 to 23.5.

Flux measurements NEE, LE, H

Meteo measurements Rg, Tair, Tsoil, rH, VPD, Ustar

For processing of the example data see useCase vignette.

Source

The data originates from the CARBODATA CD.

---

extract_FN15	*extract processing results with columns corresponding to Fluxnet15 release*

Description

extract processing results with columns corresponding to Fluxnet15 release

Usage

```
extract_FN15(
  EProc = .self,
  is_export_nonfilled = TRUE,
  keep_other_cols = FALSE
)
```

Arguments

EProc   sEddyProc class with uncertainty also in meteo variables and both nighttime and
                   daytime partitioning columns present

is_export_nonfilled
                   set to FALSE to not export columns before gapfilling

keep_other_cols
                   set to TRUE to report also other columns

Value

data.frame with columns names of Fluxnet15. Timestamps are in ISO string format [POSIXctToBerkeleyJulianDate](#)

---

fCalcAVPfromVMFandPress

fCalcAVPfromVMFandPress

Description

Calculate AVP from VMF and Press

Usage

```
fCalcAVPfromVMFandPress(VMF = VMF.V.n, Press = Press.V.n,
    VMF.V.n, Press.V.n)
```

Arguments

VMF	Vapor mole fraction (VMF, mol / mol)
Press	Atmospheric pressure (Press, hPa)
VMF.V.n	deprecated
Press.V.n	deprecated

Value

Data vector of actual vapor pressure (AVP, hPa (mbar))

Author(s)

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---

fCalcETfromLE   *fCalcETfromLE*

Description

Calculate ET from LE and Tair

Usage

```
fCalcETfromLE(LE = LE.V.n, Tair = Tair.V.n,
    LE.V.n, Tair.V.n)
```

Arguments

LE	Data vector of latent heat (LE, W m-2)
Tair	Data vector of air temperature (Tair, degC)
LE.V.n	deprecated
Tair.V.n	deprecated

Value

Data vector of evapotranspiration (ET, mmol H20 m-2 s-1)

Author(s)

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---

fCalcExtRadiation   *fCalcExtRadiation*

Description

Calculate the extraterrestrial solar radiation with the eccentricity correction

Usage

```
fCalcExtRadiation(DoY = DoY.V.n, DoY.V.n)
```

Arguments

DoY   Data vector with day of year (DoY)

DoY.V.n   deprecated, use DoY

Value

Data vector of extraterrestrial radiation (ExtRad, W_m-2)

Author(s)

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fCalcPotRadiation   *fCalcPotRadiation*

Description

Calculate the potential radiation

Usage

```
fCalcPotRadiation(DoY = DoY.V.n, Hour = Hour.V.n,
    LatDeg = Lat_deg.n, LongDeg = Long_deg.n,
    TimeZone = TimeZone_h.n, useSolartime = TRUE,
    DoY.V.n, Hour.V.n, Lat_deg.n, Long_deg.n,
    TimeZone_h.n, useSolartime.b = TRUE)
```

Arguments

DoY	Data vector with day of year (DoY), same length as Hour or length 1
Hour	Data vector with time as decimal hour of local time zone
LatDeg	Latitude in (decimal) degrees
LongDeg	Longitude in (decimal) degrees
TimeZone	Time zone (in hours)
useSolartime	by default corrects hour (given in local winter time) for latitude to solar time (where noon is exactly at 12:00). Set this to FALSE to directly use local winter time
DoY.V.n	deprecated
Hour.V.n	deprecated
Lat_deg.n	deprecated
Long_deg.n	deprecated
TimeZone_h.n	deprecated
useSolartime.b	deprecated

Value

Data vector of potential radiation (PotRad, W_m-2)

Author(s)

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Examples

```
hour <- seq(8, 16, by = 0.1)
potRadSolar <- fCalcPotRadiation(160, hour, 39.94, -5.77, TimeZone = +1)
potRadLocal <- fCalcPotRadiation(160, hour, 39.94, -5.77, TimeZone = +1
  , useSolartime = FALSE)
plot(potRadSolar ~ hour, type = 'l')
abline(v = 13, lty = "dotted")
lines(potRadLocal ~  hour, col = "blue")
abline(v = 12, col = "blue", lty = "dotted")
legend("bottomright", legend = c("solar time", "local winter time")
, col = c("black", "blue"), inset = 0.05, lty = 1)
```

---

fCalcRHfromAVPandTair   *fCalcRHfromAVPandTair*

Description

Calculate relative humidity from actual vapour pressure and air temperature

Usage

```
fCalcRHfromAVPandTair(AVP = AVP.V.n, Tair = Tair.V.n,
    AVP.V.n, Tair.V.n)
```

Arguments

AVP	Data vector of actual vapour pressure (AVP, hPa (mbar))
Tair	Data vector of air temperature (Tair, degC)
AVP.V.n	Data vector of actual vapour pressure (AVP, hPa (mbar))
Tair.V.n	Data vector of air temperature (Tair, degC)

Value

Data vector of relative humidity (rH, %)

Author(s)

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fCalcSVPfromTair *fCalcSVPfromTair*

Description

Calculate SVP (of water) from Tair

Usage

```
fCalcSVPfromTair(Tair = Tair.V.n, Tair.V.n)
```

Arguments

Tair	Data vector of air temperature (Tair, degC)
Tair.V.n	deprecated

Value

Data vector of saturation vapor pressure (SVP, hPa (mbar))

Author(s)

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fCalcVPDfromRHandTair *fCalcVPDfromRHandTair*

Description

Calculate VPD from rH and Tair

Usage

```
fCalcVPDfromRHandTair(rH = RH.V.n, Tair = Tair.V.n,
    RH.V.n, Tair.V.n)
```

Arguments

rH	Data vector of relative humidity (rH, %)
Tair	Data vector of air temperature (Tair, degC)
RH.V.n	deprecated
Tair.V.n	deprecated

Value

Data vector of vapour pressure deficit (VPD, hPa (mbar))

Author(s)

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---

fCheckHHTimeSeries   *fCheckHHTimeSeries*

Description

Check half-hourly time series data

Usage

```
fCheckHHTimeSeries(Time = Time.V.p, DTS = DTS.n,
    CallFunction = if (!missing(CallFunction.s)) CallFunction.s else "",
    Time.V.p, DTS.n, CallFunction.s)
```

Arguments

Time	Time vector in POSIX format
DTS	Number of daily time steps (24 or 48)
CallFunction	Name of function called from
Time.V.p	deprecated
DTS.n	deprecated
CallFunction.s	deprecated

Details

The number of steps per day can be 24 (hourly) or 48 (half-hourly).

The time stamp needs to be provided in POSIX time format,

equidistant half-hours,

and stamped on the half hour.

The sEddyProc procedures require at least three months of data.

Full days of data are preferred: the total amount of data rows should be a multiple of the daily time step, and

in accordance with FLUXNET standards, the dataset is spanning from the end of the first (half-)hour (0:30 or 1:00, respectively) and to midnight (0:00).

Value

Function stops on errors.

Author(s)

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---

fConvertCtoK   *fConvertCtoK*

Description

Convert degree Celsius to degree Kelvin

Usage

```
fConvertCtoK(Celsius = Celsius.V.n, Celsius.V.n)
```

Arguments

Celsius	Data vector in Celsius (degC)
Celsius.V.n	deprecated way of specifying Celsius

Value

Data vector in temperature Kelvin (Temp_K, degK)

Author(s)

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---

fConvertGlobalToVisible

fConvertGlobalToVisible

Description

Partition global (solar) radiation into only visible (the rest is UV and infrared)

Usage

```
fConvertGlobalToVisible(Global = Global.V.n,
    Global.V.n)
```

Arguments

Global   Data vector of global radiation (W m-2)

Global.V.n   deprecated

Value

Data vector of visible part of solar radiation (VisRad, W m-2)

Author(s)

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---

fConvertKtoC   *fConvertKtoC*

Description

Convert degree Kelvin to degree Celsius

Usage

```
fConvertKtoC(Kelvin = Kelvin.V.n, Kelvin.V.n)
```

Arguments

Kelvin   Data vector in Kelvin (degK)

Kelvin.V.n   deprecated, use Kelvin instead

Value

Data vector in temperature Celsius (Temp_C, degC)

Author(s)

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---

fConvertTimeToPosix   *fConvertTimeToPosix*

Description

Convert different time formats to POSIX

Usage

```
fConvertTimeToPosix(Data.F, TFormat = TFormat.s,
    Year = if (!missing(Year.s)) Year.s else "none",
    Month = if (!missing(Month.s)) Month.s else "none",
    Day = if (!missing(Day.s)) Day.s else "none",
    Hour = if (!missing(Hour.s)) Hour.s else "none",
    Min = if (!missing(Min.s)) Min.s else "none",
    TName = if (!missing(TName.s)) TName.s else "DateTime",
    TFormat.s, Year.s, Month.s, Day.s, Hour.s,
    Min.s, TName.s, tz = "GMT")
```

Arguments

Data.F	Data frame with time columns to be converted
TFormat	Abbreviation for implemented time formats, see details
Year	Column name of year
Month	Column name of month
Day	Column name of day
Hour	Column name of hour
Min	Column name of min
TName	Column name of new column
TFormat.s	deprecated
Year.s	deprecated
Month.s	deprecated

Day.s	deprecated
Hour.s	deprecated
Min.s	deprecated
TName.s	deprecated
tz	timezone used to store the data. Advised to keep GMT to avoid daytime shifting issues

Details

The different time formats are converted to POSIX (GMT) and a 'TimeDate' column is prefixed to the data frame

Implemented time formats:

YDH year, day of year, hour in decimal (e.g. 1998, 1, 10.5). The day (of year) format is (1-365 or 1-366 in leap years). The hour format is decimal time (0.0-23.5).

YMDH year, month, day of month, hour in decimal (e.g. 1998, 1, 1, 10.5) The month format is (1-12) The day (of month) format is (1-31).

YMDHM year, month, day of month, integer hour, minute (e.g. 1998, 1, 1, 10, 30) The hour format is (0-23) The minute format is (0-59)

Value

Data frame with prefixed POSIX time column.

Author(s)

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See Also

[help_DateTimes](#)

Examples

```
# See unit test in test_fConvertTimeToPosix for example
```

fConvertVisibleWm2toPhotons

fConvertVisibleWm2toPhotons

Description

Convert units of visible radiation from irradiance to photons flux

Usage

```
fConvertVisibleWm2toPhotons(Wm2 = Wm2.V.n,
    Wm2.V.n)
```

Arguments

Wm2	Data vector in units of irradiance (W m-2)
Wm2.V.n	deprecated

Value

Data vector in units of photons flux (PPFD, umol photons m-2 s-1)

Author(s)

Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

---

filterLongRuns *filterLongRuns*

Description

replace runs, i.e sequences of numerically equal values, by NA

Usage

```
filterLongRuns(data, colNames, ...)
```

Arguments

data	data.frame with columns to filter
colNames	string vector of names indicating which columns to filter
...	further arguments to [filterLongRunsInVector](#) such as minNRunLength.

Details

Longer runs, i.e. sequences of numerically identical values, in a series of measurements hint to problems during a noisy measurement, e.g. by sensor malfunction due to freezing. This function, replaces such values in such runs to indicate missing values.

Value

data.frame ans with long runs in specified columns replaced by NA

Author(s)

Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

---

filterLongRunsInVector

filterLongRunsInVector

Description

replace runs of numerically equal values by NA

Usage

```
filterLongRunsInVector(x, minNRunLength = 8,
    replacement = NA, na.rm = TRUE)
```

Arguments

x	vector in which to replace long runs
minNRunLength	minimum length of a run to replace. Defaults to 4 hours in half-hourly spaced data.
replacement	value replacing the original values in long run
na.rm	set to FALSE if NA values interrupt runs

Value

vector x with long runs replaced by NA

Author(s)

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---

filter_entire_days   *filter entire days*

Description

Omit records before the start of the first full day and the end of the last full day

Usage

```
filter_entire_days(df, col_time = "DateTime")
```

Arguments

df	data.frame with column col_time of equidistant
col_time	Name of the column with the equidistant timesteps

Details

Column attributes such as 'units' are kept.

Author(s)

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See Also

help_DateTimes, get_day_boundaries fKeepColumnAttributes

---

filter_years_eop   *filter years eop*

Description

Subset data.frame to given years respecting the end-of-period convention

Usage

```
filter_years_eop(df, years, col_time = "DateTime")
```

Arguments

df	data.frame with column col_time of equidistant
years	integer vector of years of the form c(1998, 1998)
col_time	Name of the column with the equidistant timesteps

Details

The end-of-period (usually end-of-half-hour) convention in the Fluxnet community results in midnight and new-year being the last record of the previous day or the year respectively, although POSIXt function will report the next day or year respectively.

Column attributes such as 'units' are kept.

Author(s)

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See Also

help_DateTimes, filter_entire_days fKeepColumnAttributes

`fKeepColumnAttributes` *fKeepColumnAttributes*

Description

Copy column attributes after processing a data.frame

Usage

```
fKeepColumnAttributes(x, FUN, ...)
```

Arguments

x	data.frame to be processed
FUN	`function(x::data.frame, ...) -> data.frame` to be applied
...	additional arguments to FUN

Details

The columns of the resulting data.frame that match a column name in x will get the same attributes as in x.

Value

result of `function(x, ...)` with column attributes preserved

Author(s)

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`fLloydTaylor` *Temperature dependence of soil respiration*

Description

Temperature dependence of soil respiration after Equation 11 in Lloyd & Taylor (1994)

Usage

```
fLloydTaylor(RRef = R_ref.n, E0 = E_0.n,
    TSoil = Tsoil.n, TRef = if (missing(T_ref.n)) 273.15 +
        10 else T_ref.n, T0 = if (missing(T_0.n)) 227.13 else T_0.n,
    R_ref.n, E_0.n, Tsoil.n, T_ref.n, T_0.n)
```

Arguments

RRef	Respiration rate at reference temperature
E0	Temperature sensitivity ("activation energy") in Kelvin (degK)
TSoil	Soil temperature in Kelvin (degK)
TRef	Reference temperature of 10 degC in Kelvin (degK)
T0	Regression temperature as fitted by LloydTaylor (1994) in Kelvin (degK)
R_ref.n	deprecated way to specify RRef
E_0.n	deprecated way to specify E0
Tsoil.n	deprecated way to specify Tsoil
T_ref.n	deprecated way to specify TRef
T_0.n	deprecated way to specify T0

Value

Data vector of soil respiration rate (R, umol CO2 m-2 s-1)

Author(s)

AMM reference« Lloyd J, Taylor JA (1994) On the temperature dependence of soil respiration. Functional Ecology, 8, 315-323. Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

Examples

```
  T <- c(-10:30)
  resp <- fLloydTaylor(10, 330, T + 273.15)
plot(resp ~ T)
```

---

fLoadAmeriflux22	*Read basic variables from Ameriflux standard (as of 2022) files*

Description

Reads Variables from file into data.frame from file and passes it to `read_from_ameriflux22`.

Usage

```
fLoadAmeriflux22(file_path, ...)
```

Arguments

file_path	scalar string: the path to the csv file
...	further arguments to `read_csv`

See Also

`read_from_ameriflux22` `help_export`

---

fLoadEuroFlux16	*fLoadEuroFlux16*

Description

reads a sequence of annual files in the format of Europe-fluxdata 2016

Usage

```
fLoadEuroFlux16(siteName, dirName = "", additionalColumnNames = character(0))
```

Arguments

siteName	scalar string: the name of the site, i.e. start of the filename before _<year>_
dirName	scalar string: the directory where the files reside
additionalColumnNames	
	character vector: column names to read in addition to c("Month", "Day", "Hour", "NEE_st", "qf_NEE_st", "ustar", "Ta", 'Rg')

Details

The filenames should correspond to the pattern <sitename>_<YYYY>_. * .txt And hold columns c("Month", "Day", "Hour", "NEE_st", "qf_NEE_st", "ustar", "Ta", 'Rg'). By default only those columns are read and reported only c("DateTime", "NEE", "Ustar", "Tair", "Rg", "qf_NEE_st" (Note the renaming). NEE is set to NA for all values with "qf_NEE_st != 0. Values of -9999.0 are replaced by NA

Author(s)

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See Also

help_export

---

fLoadFluxnet15   *Read a file in the format of Fluxnet 2015 release*

Description

Assigns default units to the columns and keeps variable name attributes as in original file.

Usage

```
fLoadFluxnet15(
  file_path,
  additional_columns = character(0),
  colname_NEE = "NEE",
  ...
)
```

Arguments

file_path	scalar string: the path to the csv file
additional_columns	
	character vector of columns to read in addition of standard columns of read_from_fluxnet15. Can be a character vector or a object return by cols
colname_NEE	name (scalar string) of column that reports NEE observations
...	further arguments to read_csv

Examples

```
ds_fn15 <- Example_DETha98 %>%
   fConvertTimeToPosix('YDH',Year = 'Year',Day = 'DoY', Hour = 'Hour') %>%
   dplyr::mutate(
      TIMESTAMP_END = POSIXctToBerkeleyJulianDate(DateTime),
      season = factor(199801)
   ) %>%
   dplyr::rename(SW_IN = "Rg", TA = "Tair", USTAR = "Ustar") %>%
   dplyr::select(dplyr::one_of(c(
```

```
        "TIMESTAMP_END","NEE","SW_IN","TA","VPD","USTAR","season")))
head(ds_fn15)
fname <- tempfile()
readr::write_csv(ds_fn15, fname)

# standard columns are renamed to REddyProc defaults
ds_eproc <- fLoadFluxnet15(fname)
head(ds_eproc)
EProc <- sEddyProc$new("DE-Tha", ds_eproc)
head(EProc$sExportData())

# Additional columns can be specified, e.g. factor column season
ds_eproc <- fLoadFluxnet15(fname,
  additional_columns = readr::cols(season = readr::col_factor()))
head(ds_eproc)
EProc <- sEddyProc$new("DE-Tha", ds_eproc,
  c("NEE", "Rg", "Tair", "VPD", "Ustar","season"),
  ColNamesNonNumeric = "season"
  )
head(EProc$sExportData())
```

---

fLoadTXTIntoDataframe   *Load text file with one header and one unit row into data frame*

Description

If gaps with the flag -9999.0 exist, these are set to NA.

Usage

```
fLoadTXTIntoDataframe(FileName = FileName.s,
    Dir = if (!missing(Dir.s)) Dir.s else "",
    FileName.s, Dir.s = "")
```

Arguments

FileName	File name as a character string
Dir	Directory as a character string
FileName.s	deprecated
Dir.s	deprecated way of specifying Dir

Details

Function fLoadFluxNCIntoDataframe, which loads data from NetCDF-Files, has been moved to add-on package REddyProcNCDF. In addition, fLoadEuroFlux16 loads data from several annual files in format corresponding to Europe-fluxdata 2016.

For using only part of the records, use fFilterAttr to keep units attributes.

Value

Data frame with data from text file.

Author(s)

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See Also

help_export

Examples

```
examplePath <- getExamplePath('Example_DETha98.txt', TRUE)
EddyData.F <- fLoadTXTIntoDataframe(examplePath)
```

---

fSplitDateTime   *fSplitDateTime*

Description

Replace Column DateTime by columns Year, DoY, and Hour in a data.frame

Usage

```
fSplitDateTime(df)
```

Arguments

df   data.frame with column DateTime

Details

This function helps exporting to the format required by the REddyProc web interface with columns Year, DoY, and Hour

Author(s)

Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

See Also

fWriteDataframeToFile

---

fWriteDataframeToFile *fWriteDataframeToFile*

Description

Write data frame to ASCII tab-separated text file

Usage

```
fWriteDataframeToFile(Data.F, FileName = FileName.s,
    Dir = if (!missing(Dir.s)) Dir.s else "",
    Digits = if (!missing(Digits.n)) Digits.n else 5,
    isSplitDatetime = FALSE, FileName.s,
    Dir.s, Digits.n)
```

Arguments

Data.F	Data frame
FileName	File base name as a string
Dir	Directory as a string
Digits	(integer) number of digits, i.e. precision, for numeric values
isSplitDatetime	
	set to TRUE to create columns Year, DoY and Hour
FileName.s	deprecated
Dir.s	deprecated
Digits.n	deprecated

Details

Missing values are flagged as -9999.0

Value

Output of data frame written to file of specified type.

Author(s)

AMM, KS, TW Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

See Also

[help_export](#) [fSplitDateTime](#)

Examples

```
(Dir <- tempdir())   # directory where output is written to
fWriteDataframeToFile(Example_DETha98, 'OutputTest.txt', Dir = Dir)
```

---

fWriteFrench23 *fWriteFrench23*

Description

Write data frame to ASCII comma-separated text file

Usage

```
fWriteFrench23(data, filename, isSplitDatetime = FALSE,
    digits = 5)
```

Arguments

data	Data frame to be exported, with unit attributes attached to columns
filename	(string) name (including path) of the output file
isSplitDatetime	
	set to TRUE to create columns Year, DoY and Hour
digits	(integer) number of digits, i.e. precision, for numeric values

Details

Writes data.frame as comma-separated file after two header rows.

The first header row contains the column names, and the second units.

Spaces in column names are replaced by underscore and % is replaced by the word percent.

Author(s)

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See Also

[fWriteDataframeToFile](#)

---

getAmerifluxToBGC05VariableNameMapping

getAmerifluxToBGC05VariableNameMapping

Description

map Ameriflux variable names to REddyProc defaults to names

Usage

```
getAmerifluxToBGC05VariableNameMapping(map = character(),
    mapDefault = c(YEAR = "Year", DOY = "DoY",
        NEE = "NEE", LE = "LE", H = "H",
        SW_IN = "Rg", TA = "Tair", TS = "Tsoil",
        RH = "rH", VPD = "VPD", USTAR = "Ustar",
        NEE_PI = "NEE_orig", H_PI = "H_orig",
        LE_PI = "LE_orig", NEE_F = "NEE_f",
        H_F = "H_f", LE_F = "LE_f", NEE_QC = "NEE_fqc",
        H_QC = "H_fqc", LE_QC = "LE_fqc"))
```

Arguments

`map`	named character vector: additional mapping, that extends or overwrites defaults in `mapDefault`
`mapDefault`	named character vector: default mapping

Details

Get a mapping of variable names of Ameriflux (Berkley 2016 Fluxnet release) to of REddyProc defaults to names

Author(s)

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See Also

[renameVariablesInDataframe](#)

getBGC05ToAmerifluxVariableNameMapping
getBGC05ToAmerifluxVariableNameMapping

Description

map REddyProc names the Berkeley 2016 release of the Fluxnet data

Usage

```
getBGC05ToAmerifluxVariableNameMapping(map = character(),
    mapDefault = c(Year = "YEAR", DoY = "DOY",
        Rg = "SW_IN", Tair = "TA", Tsoil = "TS",
        rH = "RH", VPD = "VPD", Ustar = "USTAR",
        NEE_orig = "NEE_PI", H_orig = "H_PI",
        LE_orig = "LE_PI", NEE_f = "NEE_F",
        H_f = "H_F", LE_f = "LE_F", NEE_fqc = "NEE_QC",
        H_fqc = "H_QC", LE_fqc = "LE_QC"))
```

Arguments

map	named character vector: additional mapping, that extends or overwrites defaults in mapDefault
mapDefault	named character vector: default mapping

Details

Get a mapping of variable names of REddyProc defaults to names of the Berkeley 2016 release of the Fluxnet data

Author(s)

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See Also

[renameVariablesInDataframe](#)

Examples

```
# adding mapping of foo, and overwriting mapping of DoY
getBGC05ToAmerifluxVariableNameMapping(c(foo = "FOO", DoY = "doy"))
```

---

getExamplePath   *getExamplePath*

Description

checks if example filename is existing and if not tries to download it.

Usage

```
getExamplePath(filename = "Example_DETha98.txt",
    isTryDownload = FALSE, exampleDir = getREddyProcExampleDir(),
    remoteDir = "")
```

Arguments

filename	the name of the example file
isTryDownload	scalar logical whether to try downloading the file to package or tmp directory. Because of CRAN checks, need to explicitly set to TRUE
exampleDir	directory where examples are looked up and downloaded to
remoteDir	the URL do download from

Details

Example input text data files are not distributed with the package, because it exceeds allowed package size. Rather, the example files will be downloaded when required from github by this function.

The remoteDir (github) must be reachable, and the writing directory must be writeable.

Value

the full path name to the example data or if not available an zero-length character. Allows to check for if (length(getExamplePath())) ...

Author(s)

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```
getFilledExampleDETha98Data
```
getFilledExampleDETha98Data

Description

Get or create the gapfilled version of the Example_DETha98 example data

Usage

```
getFilledExampleDETha98Data(exampleDir = getREddyProcExampleDir())
```

Arguments

exampleDir   the directory where the cached filled example data is stored

Value

example data.frame Example_DETha98 processed by gapfilling.

Author(s)

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```
getREddyProcExampleDir
```
getREddyProcExampleDir

Description

get the example directory inside temporary directory

Usage

```
getREddyProcExampleDir(isPreferParentDir = identical(Sys.getenv("NOT_CRAN"),
    "true"), subDir = "REddyProcExamples")
```

Arguments

isPreferParentDir

> logical scalar, whether to prefer temp parent directory instead of the R-session temp-Directory. See details.

subDir   the name of the subdirectory inside the tmp directory, where examples are stored

Details

If `isPreferParentDir = FALSE` (the default), the examples will be downloaded again for each new R-session in a session specific directory as given by `tempdir`. This corresponds to CRAN policy. IF TRUE, the parent of `tempdir` will be used, so that downloads of examples are preserved across R-sessions. This is the default if environment variable "NOT_CRAN" is defined, when running from testthat::`check`.

Author(s)

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See Also

`getExamplePath`

---

getTZone   *getTZone*

Description

extracts the timezone attribute from POSIXct with default on missing

Usage

```
getTZone(x, default = "GMT")
```

Arguments

x   POSIXct vector

default   time zone returned, if x has not timezone associated or attribute is the zero string

Author(s)

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Examples

```
getTZone(as.POSIXct("2010-07-01 16:00:00", tz = "etc/GMT-1") )
getTZone(as.POSIXct("2010-07-01 16:00:00") )
# printed with local time zone, but actually has no tz attribute
getTZone(Sys.time())
```

---

get_day_boundaries   *get day boundaries*

Description

Return the first timestamp at (end_of_first_record_in_day) and the last at midnight

Usage

```
get_day_boundaries(dt)
```

Arguments

dt   vector of equidistant POSIXt timestamps with several records a day, usually 48

Author(s)

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See Also

help_DateTimes, filter_entire_days

---

get_timestep_hours *Get the timestep in fractional hours*

Description

Get the timestep in fractional hours

Usage

```
get_timestep_hours(x)
```

Arguments

x   Vector of POSIX timestamps of at least length 2.

Value

Numeric scalar of the time difference of the first two entries in fraction hours.

---

globalDummyVars *globalDummyVars*

Description

Dummy global variables with the same name as fields in R5 classes have been defined.

Reason: Class methods have been defined as plain functions, so that they can be better documented. However, the assignment operator <<- has no meaning in it and therefore R CMD check complains. As a workaround they have been defined as global variable. Do not use them.

Author(s)

(Department for Biogeochemical Integration at MPI-BGC, Jena, Germany)

---

help_DateTimes   *help DateTimes*

Description

Overview of functions helping with Timestamps and Dates

Usage

```
help_DateTimes()
```

Details

Functions helping with preparing and subsetting timestamps:

- Convert different time formats to POSIX: `fConvertTimeToPosix`
- Convert JulianDate format used in Berkeley release to POSIXct: `BerkeleyJulianDateToPOSIXct`
- Return the first timestamp at (end_of_first_record_in_day) and the last at midnight: `get_day_boundaries`
- Omit records before the start of the first full day and the end of the last full day: `filter_entire_days`
- Subset data.frame to given years respecting the end-of-period convention: `filter_years_eop`

Back to REddyProc-package.

Author(s)

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---

help_export   *help export*

Description

Overview of functions helping with exporting Data and Results

Usage

```
help_export()
```

Details

Functions helping with exporting data

- Export Input data from REddyProc class: `sEddyProc_sExportData`

- Export Computed results from REddyProc class: `sEddyProc_sExportResults`

- Write data frame to ASCII tab-separated text file: `fWriteDataframeToFile`

- Write data frame to ASCII comma-separated text file with units in header row: `fWriteFrench23`

Writing a file that can be supplied to the REddyProc webservice at MPI-BGC Jena can be done by exporting data from REddyProc class EProc.

```
df <- EProc$sExportData()
fWriteDataframeToFile(df, "myfilename.txt", isSplitDatetime = TRUE)
```

For preparing minimal working examples also consider

- Omit records before the start of the first full day and the end of the last full day: df <- `filter_entire_days`(df)

- Subset data.frame to one or two years: df <- `filter_years_eop`(df, c(1998))

There are several functions that import from file of different formats.

- Load text file with one header and one unit row into data frame: `fLoadTXTIntoDataframe`

- Reads sequence of annual files in the format of Europe-fluxdata 2016: `fLoadEuroFlux16`

- Read basic variables from Ameriflux standard (as of 2022) files: `fLoadAmeriflux22`

- Read NetCDF files -> moved to separate package REddyProcNCDF (https://github.com/bgctw/REddyProcNCDF)

Back to REddyProc-package.

Author(s)

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LightResponseCurveFitter

LightResponseCurveFitter

Description

Constructs an instance of class [`LightResponseCurveFitter-class`](#). However, better construct specialized descendants.

Usage

```
LightResponseCurveFitter(...)
```

Arguments

`...`	not used

Author(s)

(Department for Biogeochemical Integration at MPI-BGC, Jena, Germany)

LightResponseCurveFitter-class

Class "LightResponseCurveFitter"

Description

Base class for fitting parameters to light response curves (LRC)

Concrete classes for the following LRC functions are available:

- common rectangular hyperbolic light-response: [`RectangularLRCFitter-class`](#)
- nonrectangular hyperbolic light-response: [`NonrectangularLRCFitter-class`](#)
- logistic sigmoid light-response: [`LogisticSigmoidLRCFitter-class`](#)

They mostly differ in their prediction of GPP by method [`LightResponseCurveFitter_predictGPP`](#).

Extends

All reference classes extend and inherit methods from *"[envRefClass](#)"*.

Methods

[LightResponseCurveFitter_computeLRCGradient](theta, Rg, VPD, Temp, VPD0, fixVPD, TRef):

[LightResponseCurveFitter_predictGPP](Rg, ...):

[LightResponseCurveFitter_predictLRC](theta, Rg, VPD, Temp, VPD0, fixVPD, TRef):

[LightResponseCurveFitter_computeCost](thetaOpt, theta, iOpt, flux, sdFlux, parameterPrior, sdParameterP

[LightResponseCurveFitter_optimLRC](theta, iOpt, sdParameterPrior, ..., ctrl, isUsingHessian):

[LightResponseCurveFitter_isParameterInBounds](theta, sdTheta, RRefNight, ctrl):

[LightResponseCurveFitter_optimLRCOnAdjustedPrior](theta, iOpt, dsDay, parameterPrior, ctrl, ...):

[LightResponseCurveFitter_getOptimizedParameterPositions](isUsingFixedVPD, isUsingFixedAlpha):

[LightResponseCurveFitter_optimLRCBounds](theta0, parameterPrior, ..., lastGoodParameters, ctrl):

[LightResponseCurveFitter_getParameterInitials](thetaPrior):

[LightResponseCurveFitter_getPriorScale](thetaPrior, medianRelFluxUncertainty, nRec, ctrl):

[LightResponseCurveFitter_getPriorLocation](NEEDay, RRefNight, E0):

[LightResponseCurveFitter_fitLRC](dsDay, E0, sdE0, RRefNight, controlGLPart, lastGoodParameters):

[LightResponseCurveFitter_getParameterNames]():

Author(s)

TW

LightResponseCurveFitter_computeCost
LightResponseCurveFitter computeCost

Description

Computing residual sum of squares for predictions vs. data of NEE

Usage

```
LightResponseCurveFitter_computeCost(thetaOpt,
    theta, iOpt, flux, sdFlux, parameterPrior,
    sdParameterPrior, ...)
```

Arguments

thetaOpt	parameter vector with components of theta0 that are optimized
theta	parameter vector with positions as in argument of `LightResponseCurveFitter_getParameterNames`
iOpt	position in theta that are optimized
flux	numeric: NEP (-NEE) or GPP time series [umolCO2 / m2 / s], should not contain NA
sdFlux	numeric: standard deviation of Flux [umolCO2 / m2 / s], should not contain NA
parameterPrior	numeric vector along theta: prior estimate of parameter (range of values)
sdParameterPrior	
	standard deviation of parameterPrior
...	other arguments to `LightResponseCurveFitter_predictLRC`, such as VPD0, fixVPD

Author(s)

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LightResponseCurveFitter_computeLRCGradient
LightResponseCurveFitter computeLRCGradient

Description

Gradient of `LightResponseCurveFitter_predictLRC`

Usage

```
LightResponseCurveFitter_computeLRCGradient(theta,
    Rg, VPD, Temp, VPD0 = 10, fixVPD = (k ==
        0), TRef = 15)
```

Arguments

theta	theta [numeric] -> parameter vector (theta[1] = k (k), theta[2] = beta (beta), theta[3] = alpha, theta[4] = RRef (rb), theta[4] = E0)
Rg	ppfd [numeric] -> photosynthetic flux density [umol / m2 / s] or Global Radiation
VPD	VPD [numeric] -> Vapor Pressure Deficit [hPa]
Temp	Temp [degC] -> Temperature [degC]

VPD0	VPD0 [hPa] -> Parameters VPD0 fixed to 10 hPa according to Lasslop et al 2010
fixVPD	boolean scalar or vector of nrow(theta): fixVPD if TRUE the VPD effect is not considered and VPD is not part of the computation
TRef	numeric scalar of Temperature (degree Celsius) for reference respiration RRef

Author(s)

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LightResponseCurveFitter_fitLRC

LightResponseCurveFitter fitLRC

Description

Optimize rectangular hyperbolic light response curve in one window

Usage

```
LightResponseCurveFitter_fitLRC(dsDay, E0,
    sdE0, RRefNight, controlGLPart = partGLControl(),
    lastGoodParameters = rep(NA_real_, 7L))
```

Arguments

dsDay	data.frame with columns NEE, Rg, Temp_C, VPD, and no NAs in NEE
E0	temperature sensitivity of respiration
sdE0	standard deviation of E_0.n
RRefNight	basal respiration estimated from night time data
controlGLPart	further default parameters (see [partGLControl](#))
lastGoodParameters	
	numeric vector returned by last reasonable fit

Details

Optimization is performed for three initial parameter sets that differ by beta0 (* 1.3, * 0.8). From those three, the optimization result is selected that yielded the lowest misfit. Starting values are: k = 0, beta = interpercentileRange(0.03, 0.97) of respiration, alpha = 0.1, R_ref from nightTime estimate. E0 is fixed to the night-time estimate, but varies for estimating parameter uncertainty.

If controlGLPart$nBootUncertainty == 0L then the covariance matrix of the parameters is estimated by the Hessian of the LRC curve at optimum. Then, the additional uncertainty and covariance with uncertainty E0 is neglected.

If controlGLPart.l$nBootUncertainty > 0L then the covariance matrix of the parameters is estimated by a bootstrap of the data. In each draw, E0 is drawn from N ~ (E_0, sdE_0).

If there are no estimates for more than 20% of the bootstrapped samples The an NA-result with convergence code 1001L is returned.

Value

a list, If none of the optimizations from different starting conditions converged, the parameters are NA.

thetaOpt   numeric vector of optimized parameters including the fixed ones and E0

iOpt   index of parameters that have been optimized, here including E0, which has been optimized prior to this function.

thetaInitialGuess
                    the initial guess from data

covParms   numeric matrix of the covariance matrix of parameters, including E0

convergence   integer code specifying convergence problems: \ 0: good convergence \, 1-1000: see [optim](#) \, 1001: too few bootstraps converged \, 1002: fitted parameters were outside reasonable bounds \, 1003: too few valid records in window \, 1004: near zero covariance in bootstrap indicating bad fit \, 1005: covariance from curvature of fit yielded negative variances indicating bad fit \, 1006: prediction of highest PAR in window was far from saturation indicating insufficient data to constrain LRC \, 1010: no temperature-respiration relationship found \, 1011: too few valid records in window (from different location: partGLFitLRCOneWindow) \

Author(s)

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See Also

partGLFitLRCWindows

LightResponseCurveFitter_optimLRCBounds

LightResponseCurveFitter_getOptimizedParameterPositions
LightResponseCurveFitter getOptimizedParameterPositions

Description

get the positions of the parameters to optimize for given Fixed

Usage

```
LightResponseCurveFitter_getOptimizedParameterPositions(isUsingFixedVPD,
    isUsingFixedAlpha)
```

Arguments

isUsingFixedVPD

boolean scalar: if TRUE, VPD effect set to zero and is not optimized

isUsingFixedAlpha

boolean scalar: if TRUE, initial slope is fixed and is not optimized

Details

If subclasses extend the parameter vector, they need to override this method.

Value

integer vector of positions in parameter vector

Author(s)

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LightResponseCurveFitter_getParameterInitials
                    LightResponseCurveFitter getParameterInitials

---

Description

return the prior distribution of parameters

Usage

LightResponseCurveFitter_getParameterInitials(thetaPrior)

Arguments

thetaPrior   numeric vector prior estimate of parameters

Value

a numeric matrix (3, nPar) of initial values for fitting parameters

Author(s)

Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

LightResponseCurveFitter_getParameterNames
                    LightResponseCurveFitter getParameterNames

---

Description

return the parameter names used by this Light Response Curve Function

Usage

LightResponseCurveFitter_getParameterNames()

Value

string vector of parameter names. Positions are important.

k	VPD effect
beta	saturation of GPP at high radiation
alpha	initial slope
RRef	basal respiration (units of provided NEE, usually mumol CO2 m-^-2 s^-2)
E0	temperature sensitivity estimated from night-time data (K)

Author(s)

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LightResponseCurveFitter_getPriorLocation
LightResponseCurveFitter getPriorLocation

Description

return the prior distribution of parameters

Usage

```
LightResponseCurveFitter_getPriorLocation(NEEDay,
    RRefNight, E0)
```

Arguments

NEEDay	numeric vector of daytime NEE
RRefNight	numeric scalar of basal respiration estimated from night-time data
E0	numeric scalar of night-time estimate of temperature sensitivity

Value

a numeric vector with prior estimates of the parameters

Author(s)

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LightResponseCurveFitter_getPriorScale

LightResponseCurveFitter getPriorScale

Description

return the prior distribution of parameters

Usage

```
LightResponseCurveFitter_getPriorScale(thetaPrior,
    medianRelFluxUncertainty, nRec, ctrl)
```

Arguments

thetaPrior	numeric vector of location of priors
medianRelFluxUncertainty	
	numeric scalar: median across the relative uncertainty of the flux values, i.e. sdNEE / NEE
nRec	integer scalar: number of finite observations
ctrl	list of further controls, with entry isLasslopPriorsApplied

Details

The beta parameter is quite well defined. Hence use a prior with a standard deviation. The specific results are sometimes a bit sensitive to the uncertainty of the beta prior. This uncertainty is set corresponding to 20 times the median relative flux uncertainty. The prior is weighted n times the observations in the cost. Hence, overall it is using a weight of 1 / 20 of the weight of all observations.

However, its not well defined if PAR does not reach saturation. Need to check before applying this prior

Value

a numeric vector with prior estimates of the parameters

Author(s)

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LightResponseCurveFitter_isParameterInBounds

LightResponseCurveFitter isParameterInBounds

Description

Check if estimated parameter vector is within reasonable bounds

Usage

```
LightResponseCurveFitter_isParameterInBounds(theta,
    sdTheta, RRefNight, ctrl)
```

Arguments

theta	estimate of parameter
sdTheta	estimate of uncertainty of the parameter
RRefNight	numeric scalar: night-time based estimate of basal respiration
ctrl	list of further controls

Details

check the Beta bounds that depend on uncertainty: outside if (beta > 100 and sdBeta >= beta)

Value

FALSE if parameters are outside reasonable bounds, TRUE otherwise

Author(s)

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LightResponseCurveFitter_optimLRC

LightResponseCurveFitter optimLRC

Description

call the optimization function

Usage

```
LightResponseCurveFitter_optimLRC(theta,
    iOpt, sdParameterPrior, ..., ctrl, isUsingHessian)
```

Arguments

theta	numeric vector: starting parameters
iOpt	integer vector: positions of parameters to optimize
sdParameterPrior	
	numeric vector: prior uncertainty
...	further arguments to the cost function
ctrl	list of further controls
isUsingHessian	scalar boolean: set to TRUE to compute Hessian at optimum

Value

list of result of optim amended with list

theta	numeric vector: optimized parameter vector including the fixed components
iOpt	integer vector: position of parameters that have been optimized

Author(s)

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LightResponseCurveFitter_optimLRCBounds
LightResponseCurveFitter optimLRCBounds

Description

Optimize parameters with refitting with some fixed parameters if outside bounds

Usage

```
LightResponseCurveFitter_optimLRCBounds(theta0,
    parameterPrior, ..., dsDay, lastGoodParameters,
    ctrl)
```

Arguments

theta0	initial parameter estimate
parameterPrior	prior estimate of model parameters
...	further parameters to .optimLRC,
dsDay	argument to .optimLRC, here checked for occurrence of high VPD
lastGoodParameters	
	parameters vector of last successful fit
ctrl	list of further controls, such as isNeglectVPDEffect = TRUE

Details

If parameters alpha or k are outside bounds (Table A1 in Lasslop 2010), refit with some parameters fixed to values from fit of previous window.

No parameters are reported if alpha<0 or RRef < 0 or beta0 < 0 or beta0 > 250

Not parameters are reported if the data did not contain records that are near light saturation. This is checked by comparing the prediction at highest PAR with the beta parameter

Value

list result of optimization as of [LightResponseCurveFitter_optimLRCOnAdjustedPrior](#) with entries

theta	numeric parameter vector that includes the fixed components
iOpt	integer vector of indices of the vector that have been optimized
convergence	scalar integer indicating bad conditions on fitting (see [LightResponseCurveFitter_fitLRC](#))

Author(s)

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See Also

LightResponseCurveFitter_fitLRC

LightResponseCurveFitter_optimLRCOnAdjustedPrior
                                  LightResponseCurveFitter optimLRCOnAdjustedPrior

---

Description

Lower bound flux uncertainty and adjust prior uncertainty before calling optimLRC

Usage

```
LightResponseCurveFitter_optimLRCOnAdjustedPrior(theta,
    iOpt, dsDay, parameterPrior, ctrl, ...)
```

Arguments

theta	numeric vector of starting values
iOpt	integer vector: positions of subset of parameters that are optimized
dsDay	dataframe of NEE, sdNEE and predictors Rg, VPD and Temp
parameterPrior	numeric vector of prior parameter estimates (corresponding to theta) # TODO rename to thetaPrior
ctrl	list of further controls
...	further arguments to LightResponseCurveFitter_optimLRC (passed to LightResponseCurveFitter_c

Details

Only those records are used for optimization where both NEE and sdNEE are finite. In larger settings, already filtered at

Optimization of LRC parameters takes into account the uncertainty of the flux values. In order to avoid very strong leverage, values with a very low uncertainty (< a lower quantile) are assigned the lower quantile is assigned. This procedure downweighs records with a high uncertainty, but does not apply a large leverage for records with a very low uncertainty. Avoid this correction by setting ctrl$isBoundLowerNEEUncertainty = FALSE

The uncertainty of the prior, that maybe derived from fluxes) is allowed to adapt to the uncertainty of the fluxes. This is done in link{LightResponseCurveFitter_getPriorScale}

Value

result of `LightResponseCurveFitter_optimLRC` with items theta, iOpt and convergence

Author(s)

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LightResponseCurveFitter_predictGPP
LightResponseCurveFitter predictGPP

Description

Light Response function for GPP

Usage

```
LightResponseCurveFitter_predictGPP(Rg, ...)
```

Arguments

Rg	ppfd [numeric] -> photosynthetic flux density [mumol / m2 / s] or Global Radiation
...	further parameters to the LRC

Details

This method must be be implemented by a specific subclass. Currently there are several alternatives:

- Rectangular: `RectangularLRCFitter_predictGPP`
- Nonrectangular: `NonrectangularLRCFitter_predictGPP`
- Rectangular: `LogisticSigmoidLRCFitter_predictGPP`

Value

numeric vector of length(Rg) of GPP

Author(s)

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See Also

[partitionNEEGL](#)

LightResponseCurveFitter_predictLRC

LightResponseCurveFitter predictLRC

Description

Light Response Function

Usage

```
LightResponseCurveFitter_predictLRC(theta,
    Rg, VPD, Temp, VPD0 = 10, fixVPD = (k ==
        0), TRef = 15)
```

Arguments

theta	numeric vector of parameters
Rg	ppfd [numeric] -> photosynthetic flux density [umol / m2 / s] or Global Radiation
VPD	VPD [numeric] -> Vapor Pressure Deficit [hPa]
Temp	Temp [degC] -> Temperature [degC]
VPD0	VPD0 [hPa] -> Parameters VPD0 fixed to 10 hPa according to Lasslop et al 2010
fixVPD	boolean scalar or vector of nrow theta: fixVPD if TRUE the VPD effect is not considered and VPD is not part of the computation
TRef	numeric scalar of Temperature (degree Celsius) for reference respiration RRef

Details

Predict ecosystem fluxes (Reco, GPP, NEP = GPP-Reco) for given parameters and environmental conditions.

The VPD effect is included according to Lasslop et al., 2010.

If theta is a matrix, a different row of parameters is used for different entries of other inputs

Author(s)

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LogisticSigmoidLRCFitter

LogisticSigmoidLRCFitter

Description

Constructs an instance of class `LogisticSigmoidLRCFitter-class`

Usage

```
LogisticSigmoidLRCFitter(...)
```

Arguments

...	not used

Author(s)

(Department for Biogeochemical Integration at MPI-BGC, Jena, Germany)

LogisticSigmoidLRCFitter-class

Class "LogisticSigmoidLRCFitter"

Description

Logistic sigmoid light-response curve fitting.

Extends

Class `"LightResponseCurveFitter"`, directly.

All reference classes extend and inherit methods from `"envRefClass"`.

Methods

`computeGPPGradient(Rg, Amax, alpha)`: ~~

`predictGPP(Rg, Amax, alpha)`: ~~

The following methods are inherited (from the corresponding class): predictGPP ("LightResponse-CurveFitter"), getParameterNames ("LightResponseCurveFitter"), fitLRC ("LightResponseCurve-Fitter"), getPriorLocation ("LightResponseCurveFitter"), getPriorScale ("LightResponseCurveFit-ter"), getParameterInitials ("LightResponseCurveFitter"), optimLRCBounds ("LightResponseCurve-Fitter"), getOptimizedParameterPositions ("LightResponseCurveFitter"), optimLRCOnAdjustedPrior ("LightResponseCurveFitter"), isParameterInBounds ("LightResponseCurveFitter"), optimLRC ("LightRe-sponseCurveFitter"), computeCost ("LightResponseCurveFitter"), predictLRC ("LightResponse-CurveFitter"), computeLRCGradient ("LightResponseCurveFitter")

LogisticSigmoidLRCFitter_predictGPP
                    LogisticSigmoidLRCFitter predictGPP

Description

Logistic Sigmoid Light Response function for GPP

Usage

```
LogisticSigmoidLRCFitter_predictGPP(Rg, Amax,
    alpha)
```

Arguments

Rg	ppfd [numeric] -> photosynthetic flux density [mumol / m2 / s] or Global Radi-ation
Amax	vector of length(Rg): saturation (beta parameter) adjusted for effect of VPD for each line of Rg
alpha	numeric scalar or vector of length(Rg): alpha parameter: slope at Rg = 0

Details

`GPP <- Amax * tanh(alpha * Rg / Amax)`

Value

numeric vector of length(Rg) of GPP

Author(s)

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See Also

`LightResponseCurveFitter_predictGPP`

NonrectangularLRCFitter

NonrectangularLRCFitter

Description

Constructs an instance of class `NonrectangularLRCFitter-class`

Usage

```
NonrectangularLRCFitter(...)
```

Arguments

`...`	not used.

Author(s)

(Department for Biogeochemical Integration at MPI-BGC, Jena, Germany)

NonrectangularLRCFitter-class

Class "NonrectangularLRCFitter"

Description

Nonrectangular hyperbolic light-response curve fitting.

Extends

Class `"LightResponseCurveFitter"`, directly.

All reference classes extend and inherit methods from `"envRefClass"`.

Methods

computeGPPGradient(Rg, Amax, alpha, logitconv): ~~

getParameterNames(): ~~

getPriorLocation(NEEDay, RRefNight, E0): ~~

getPriorScale(thetaPrior, medianRelFluxUncertainty, nRec, ctrl): ~~

getOptimizedParameterPositions(isUsingFixedVPD, isUsingFixedAlpha): ~~

predictLRC(theta, Rg, VPD, Temp, VPD0, fixVPD, TRef): ~~

predictGPP(Rg, Amax, alpha, conv): ~~

computeLRCGradient(theta, Rg, VPD, Temp, VPD0, fixVPD, TRef): ~~

The following methods are inherited (from the corresponding class): computeLRCGradient ("LightResponseCurveFitter"), predictGPP ("LightResponseCurveFitter"), predictLRC ("LightResponseCurveFitter"), getOptimizedParameterPositions ("LightResponseCurveFitter"), getPriorScale ("LightResponseCurveFitter"), getPriorLocation ("LightResponseCurveFitter"), getParameterNames ("LightResponseCurveFitter"), fitLRC ("LightResponseCurveFitter"), getParameterInitials ("LightResponseCurveFitter"), optimLRCBounds ("LightResponseCurveFitter"), optimLRCOnAdjustedPrior ("LightResponseCurveFitter"), isParameterInBounds ("LightResponseCurveFitter"), optimLRC ("LightResponseCurveFitter"), computeCost ("LightResponseCurveFitter")

NonrectangularLRCFitter_getParameterNames
NonrectangularLRCFitter getParameterNames

Description

return the parameter names used by this Light Response Curve Function

Usage

NonrectangularLRCFitter_getParameterNames()

Value

string vector of parameter names. Positions are important. Adds sixth parameter, logitconv to the parameters of `LightResponseCurveFitter_getParameterNames`

logitconf   logit-transformed convexity parameter. The value at original scale is obtained by conv = 1 / (1 + exp(-logitconv))

Author(s)

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See Also

[NonrectangularLRCFitter_predictGPP](#)

NonrectangularLRCFitter_predictGPP

NonrectangularLRCFitter predictGPP

Description

Nonrectangular hyperbolic Light Response function for GPP

Usage

```
NonrectangularLRCFitter_predictGPP(Rg, Amax,
    alpha, conv)
```

Arguments

Rg	ppfd [numeric] -> photosynthetic flux density [mumol / m2 / s] or Global Radiation
Amax	numeric scalar or vector of length(Rg): beta parameter adjusted for VPD effect
alpha	numeric scalar or vector of length(Rg): alpha parameter: initial slope
conv	numeric scalar or vector of length(Rg): convexity parameter (see details)

Details

This function generalizes the [RectangularLRCFitter_predictGPP](#) by adding the convexity parameter conv. For conv -> 0 (logitconv -> -Inf): approaches the rectangular hyperbolic. For conv -> 1 (logitconv -> + Inf): approaches a step function. Expected values of conv are about 0.7-0.9 (Moffat 2012).

Value

numeric vector of length(Rg) of GPP

Author(s)

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See Also

[LightResponseCurveFitter_predictGPP](#)

---

partGLControl *partGLControl*

Description

Default list of parameters for Lasslop 2010 daytime flux partitioning For highest compatibility to the pvWave code of G.Lasslop (used by first BGC-online tool) see function `partGLControlLasslopCompatible`.

Usage

```
partGLControl(LRCFitConvergenceTolerance = 0.001,
    nLRCFitConvergenceTolerance = 0.001,
    nBootUncertainty = 30L, minNRecInDayWindow = 10L,
    isAssociateParmsToMeanOfValids = TRUE,
    isLasslopPriorsApplied = TRUE, isUsingLasslopQualityConstraints = FALSE,
    isSdPredComputed = TRUE, isFilterMeteoQualityFlag = FALSE,
    isBoundLowerNEEUncertainty = TRUE, fixedTRefAtNightTime = NA,
    isExtendTRefWindow = TRUE, smoothTempSensEstimateAcrossTime = TRUE,
    isNeglectPotRadForNight = FALSE, NRHRfunction = FALSE,
    isNeglectVPDEffect = FALSE, isRefitMissingVPDWithNeglectVPDEffect = TRUE,
    fixedTempSens = data.frame(E0 = NA_real_,
        sdE0 = NA_real_, RRef = NA_real_),
    replaceMissingSdNEEParms = c(perc = 0.2,
        minSd = 0.7), neglectNEEUncertaintyOnMissing = FALSE,
    minPropSaturation = NA, useNightimeBasalRespiration = FALSE)
```

Arguments

LRCFitConvergenceTolerance

> convergence criterion for rectangular light response curve fit. If relative improvement of reducing residual sum of squares between predictions and observations is less than this criterion, assume convergence. Decrease to get more precise parameter estimates, Increase for speedup.

nLRCFitConvergenceTolerance

> convergence criterion for nonrectangular light response curve fit. Here its a factor of machine tolerance.

nBootUncertainty

> number of bootstrap samples for estimating uncertainty. Set to zero to derive uncertainty from curvature of a single fit

minNRecInDayWindow

> Minimum number of data points for regression

isAssociateParmsToMeanOfValids

> set to FALSE to associate parameters to the first record of the window for interpolation instead of mean across valid records inside a window

isLasslopPriorsApplied

> set to TRUE to apply strong fixed priors on LRC fitting. Returned parameter estimates claimed valid for some case where not enough data was available

isUsingLasslopQualityConstraints

      set to TRUE to avoid quality constraints additional to Lasslop 2010

isSdPredComputed

      set to FALSE to avoid computing standard errors of Reco and GPP for small performance increase

isFilterMeteoQualityFlag

      set to TRUE to use only records where quality flag of meteo drivers (radiation, temperature, VPD) is zero, i.e. non-gapfilled for parameter estimation. For prediction, the gap-filled value is used always, to produce predictions also for gaps.

isBoundLowerNEEUncertainty

      set to FALSE to avoid adjustment of very low uncertainties before day-Time fitting that avoids the high leverage those records with unreasonable low uncertainty.

fixedTRefAtNightTime

      if a finite value (degree Centigrade) is given, it is used instead of median data temperature as reference temperature in estimation of temperature sensitivity from night data

isExtendTRefWindow

      set to FALSE to avoid successively extending the night-time window in order to estimate a temperature sensitivity where previous estimates failed

smoothTempSensEstimateAcrossTime

      set to FALSE to use independent estimates of temperature sensitivity on each windows instead of a vector of E0 that is smoothed over time

isNeglectPotRadForNight

      set to TRUE to not use potential radiation in determining night-time data.

NRHRfunction   deprecated: Flag if TRUE use the NRHRF for partitioning; Now use `lrcFitter` `= NonrectangularLRCFitter()`

isNeglectVPDEffect

      set to TRUE to avoid using VPD in the computations. This may help when VPD is rarely measured.

isRefitMissingVPDWithNeglectVPDEffect

      set to FALSE to avoid repeating estimation with `isNeglectVPDEffect = TRUE` trying to predict when VPD is missing

fixedTempSens   data.frame of one row or nRow = nWindow corresponding to return value of `partGLFitNightTimeTRespSens` While column RRef is used only as a prior and initial value for the daytime-fitting and can be NA, E0 is used as given temperature sensitivity and varied according to `sdE0` in the bootstrap.

replaceMissingSdNEEParms

      parameters for replacing missing standard deviation of NEE. see `replaceMissingSdByPercentage`. Default sets missing uncertainty to 20% of NEE but at least 0.7 flux-units (usually mumol CO2 / m2 / s). Specify c(NA, NA) to avoid replacing missings in standard deviation of NEE and to omit those records from LRC fit.

neglectNEEUncertaintyOnMissing

      If set to TRUE: if there are records with missing uncertainty of NEE inside one window, set all uncertainties to 1. This overrules option replaceMissingSd-NEEParms.

minPropSaturation

> quality criterion for sufficient data in window. If GPP prediction of highest PAR
> of window is less than minPropSaturation * (GPP at light-saturation, i.e. beta)
> this indicates that PAR is not sufficiently high to constrain the shape of the LRC

useNightimeBasalRespiration

> set to TRUE to estimate nighttime respiration based on basal respiration esti-
> mated on nighttime data instead of basal respiration estimated from daytime
> data. This implements the modified daytime method from Keenan 2019 (doi:10.1038/s41559-
> 019-0809-2)

Value

list with entries of given arguments.

Author(s)

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[ctb]

See Also

partitionNEEGL

Examples

```
partGLControl(nBootUncertainty = 40L)
```

---

partGLControlLasslopCompatible

partGLControlLasslopCompatible

Description

Daytime flux partitioning parms compatible with with the pvWave

Usage

```
partGLControlLasslopCompatible(nBootUncertainty = 0L,
    minNRecInDayWindow = 10L, isAssociateParmsToMeanOfValids = FALSE,
    isLasslopPriorsApplied = TRUE, isUsingLasslopQualityConstraints = TRUE,
    isBoundLowerNEEUncertainty = FALSE, fixedTRefAtNightTime = 15,
    isExtendTRefWindow = FALSE, smoothTempSensEstimateAcrossTime = FALSE,
    isRefitMissingVPDWithNeglectVPDEffect = FALSE,
    minPropSaturation = NA, isNeglectVPDEffect = FALSE,
```

```
replaceMissingSdNEEParms = c(NA, NA),
neglectNEEUncertaintyOnMissing = TRUE,
...)
```

Arguments

nBootUncertainty

> 0: Derive uncertainty from curvature of a single fit, neglecting the uncertainty of previously estimated temperature sensitivity, E0

minNRecInDayWindow

> Minimum number of 10 valid records for regression in a single window

isAssociateParmsToMeanOfValids

> associate parameters to the first record of the window for interpolation instead of mean across valid records inside a window

isLasslopPriorsApplied

> Apply fixed Lasslop priors in LRC fitting.

isUsingLasslopQualityConstraints

> avoid quality constraints additional to the ones in Lasslop 2010

isBoundLowerNEEUncertainty

> FALSE: avoid adjustment of very low uncertainties before day-Time fitting that avoids the high leverage those records with unreasonable low uncertainty.

fixedTRefAtNightTime

> use fixed (degree Centigrade) temperature sensitivity instead of median data temperature as reference temperature in estimation of temperature sensitivity from night data

isExtendTRefWindow

> avoid successively extending the night-time window in order to estimate a temperature sensitivity where previous estimates failed

smoothTempSensEstimateAcrossTime

> FALSE: use independent estimates of temperature sensitivity on each windows instead of a vector of E0 that is smoothed over time

isRefitMissingVPDWithNeglectVPDEffect

> FALSE: avoid repeating estimation with isNeglectVPDEffect = TRUE

minPropSaturation

> NA: avoid quality constraint of sufficient saturation in data This option is overruled, i.e. not considered, if option isUsingLasslopQualityConstraints = TRUE.

isNeglectVPDEffect

> FALSE: do not neglect VPD effect

replaceMissingSdNEEParms

> do not replace missing NEE, but see option

neglectNEEUncertaintyOnMissing

> if there are records with missing uncertainty of NEE inside one window, set all sdNEE to 1. This overrules option replaceMissingSdNEEParms.

... further arguments to [`partGLControl`](#)

Author(s)

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See Also

[partGLControl](#)

Examples

```
partGLControlLasslopCompatible()
```

---

partGLExtractStandardData

partGLExtractStandardData

Description

Relevant columns from original input with defined names

Usage

```
partGLExtractStandardData(ds, NEEVar = paste0("NEE",
    suffixDash, "_f"), QFNEEVar = if (!missing(QFNEEVar.s)) QFNEEVar.s else paste0("NEE",
    suffixDash, "_fqc"), QFNEEValue = if (!missing(QFNEEValue.n)) QFNEEValue.n else 0,
    NEESdVar = if (!missing(NEESdVar.s)) NEESdVar.s else paste0("NEE",
        suffixDash, "_fsd"), TempVar = paste0("Tair_f"),
    QFTempVar = if (!missing(QFTempVar.s)) QFTempVar.s else paste0("Tair_fqc"),
    QFTempValue = if (!missing(QFTempValue.n)) QFTempValue.n else 0,
    VPDVar = if (!missing(VPDVar.s)) VPDVar.s else paste0("VPD_f"),
    QFVPDVar = if (!missing(QFVPDVar.s)) QFVPDVar.s else paste0("VPD_fqc"),
    QFVPDValue = if (!missing(QFVPDValue.n)) QFVPDValue.n else 0,
    RadVar = if (!missing(RadVar.s)) RadVar.s else "Rg_f",
    QFRadVar = if (!missing(QFRadVar.s)) QFRadVar.s else paste0("Rg_fqc"),
    QFRadValue = if (!missing(QFRadValue.n)) QFRadValue.n else 0,
    PotRadVar = if (!missing(PotRadVar.s)) PotRadVar.s else "PotRad_NEW",
    suffix = if (!missing(Suffix.s)) Suffix.s else "",
    NEEVar.s, QFNEEVar.s, QFNEEValue.n, NEESdVar.s,
    TempVar.s, QFTempVar.s, QFTempValue.n,
    VPDVar.s, QFVPDVar.s, QFVPDValue.n, RadVar.s,
    QFRadVar.s, QFRadValue.n, PotRadVar.s,
    Suffix.s, controlGLPart = partGLControl())
```

Arguments

ds	dataset with all the specified input columns and full days in equidistant times
NEEVar	Variable of NEE
QFNEEVar	Quality flag of variable
QFNEEValue	Value of quality flag for _good_ (original) data
NEESdVar	Variable of standard deviation of net ecosystem fluxes
TempVar	Filled air or soil temperature variable (degC)
QFTempVar	Quality flag of filled temperature variable
QFTempValue	Value of temperature quality flag for _good_ (original) data
VPDVar	Filled Vapor Pressure Deficit, VPD (hPa)
QFVPDVar	Quality flag of filled VPD variable
QFVPDValue	Value of VPD quality flag for _good_ (original) data
RadVar	Filled radiation variable
QFRadVar	Quality flag of filled radiation variable
QFRadValue	Value of radiation quality flag for _good_ (original) data
PotRadVar	Variable name of potential rad. (W / m2)
suffix	string inserted into column names before identifier for NEE column defaults (see [sEddyProc_sMDSGapFillAfterUstar](#)).
NEEVar.s	deprecated
QFNEEVar.s	deprecated
QFNEEValue.n	deprecated
NEESdVar.s	deprecated
TempVar.s	deprecated
QFTempVar.s	deprecated
QFTempValue.n	deprecated
VPDVar.s	deprecated
QFVPDVar.s	deprecated
QFVPDValue.n	deprecated
RadVar.s	deprecated
QFRadVar.s	deprecated
QFRadValue.n	deprecated
PotRadVar.s	deprecated
Suffix.s	deprecated
controlGLPart	further default parameters, see [partGLControl](#)

Details

The LRC fit usually weights NEE records by its uncertainty. In order to also use records with missing NEESdVar, uncertainty of the missing values is by default set to a conservatively high value, parameterized by controlGLPart$replaceMissingSdNEEParms). Controlled by argument replaceMissingSdNEEParms in [partGLControl](#), but overruled by argument neglectNEEUncertaintyOnMissing.

Value

a data.frame with columns

sDateTime	first column of ds, usually the time stamp not used, but usually first column is a DateTime is kept for aiding debug
NEE	NEE filtered for quality flay
sdNEE	standard deviation of NEE with missing values replaced
Temp	Temperature, quality filtered if isTRUE(controlGLPart$isFilterMeteoQualityFlag)
VPD	Water pressure deficit, quality filtered if isTRUE(controlGLPart$isFilterMeteoQualityFlag)
Rg	Incoming radiation
isDay	Flag that is true for daytime records
isNight	Flag that is true for nighttime records

Author(s)

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---

partitionNEEGL	*partitionNEEGL*

Description

Partition NEE fluxes into GP and Reco using the daytime method.

Usage

```
partitionNEEGL(ds, NEEVar = if (!missing(NEEVar.s)) NEEVar.s else paste0("NEE",
   suffixDash, "_f"), TempVar = if (!missing(TempVar.s)) TempVar.s else "Tair_f",
   VPDVar = if (!missing(VPDVar.s)) VPDVar.s else "VPD_f",
   RadVar = if (!missing(RadVar.s)) RadVar.s else "Rg_f",
   suffix = if (!missing(Suffix.s)) Suffix.s else "",
   NEEVar.s, TempVar.s, VPDVar.s, RadVar.s,
   Suffix.s, ..., controlGLPart = partGLControl(),
   isVerbose = TRUE, nRecInDay = 48L, lrcFitter = RectangularLRCFitter())
```

Arguments

ds	dataset with all the specified input columns and full days in equidistant times
NEEVar	Variable of NEE
TempVar	Filled air or soil temperature variable (degC)
VPDVar	Filled Vapor Pressure Deficit - VPD - (hPa)
RadVar	Filled radiation variable
suffix	string inserted into column names before identifier for NEE column defaults (see [sEddyProc_sMDSGapFillAfterUstar](#)).
NEEVar.s	deprecated
TempVar.s	deprecated
VPDVar.s	deprecated
RadVar.s	deprecated
Suffix.s	deprecated identifier for NEE column defaults (see [sEddyProc_sMDSGapFillAfterUstar](#)).
...	further arguments to [partGLExtractStandardData](#), such as PotRadVar
controlGLPart	further default parameters, see [partGLControl](#)
isVerbose	set to FALSE to suppress output messages
nRecInDay	number of records within one day (for half-hourly data its 48)
lrcFitter	R5 class instance responsible for fitting the light response curve. Current possibilities are RectangularLRCFitter(), NonrectangularLRCFitter(), and LogisticSigmoidLRCFitter().

Details

Daytime-based partitioning of measured net ecosystem fluxes into gross primary production (GPP) and ecosystem respiration (Reco)

The fit to the light-response-curve is done by default using the Rectangular hyperbolic function, as in Lasslop et al. (2010) Alternative fittings can be used by providing the corresponding subclass of [LightResponseCurveFitter-class](#) to lrcFitter argument. (see [LightResponseCurveFitter_predictGPP](#))

While the extrapolation uses filled data, the parameter optimization may use only measured data, i.e. with specified quality flag. Even with using filled VPD, there may be large gaps that have not been filled. With the common case where VPD is missing for fitting the LRC, by default (with controlGLPart$isRefitMissingVPDWithNeglectVPDEffect = TRUE) is to redo the estimation of LRC parameters with neglecting the VPD-effect. Next, in the predictions (rows) with missing VPD are then replaced with predictions based on LRC-fits that neglected the VPD effect.

Value

Reco_DT_<suffix>
> predicted ecosystem respiration: mumol CO2/m2/s

GPP_DT_<suffix>
> predicted gross primary production mumol CO2/m2/s

<LRC>	Further light response curve (LRC) parameters and their standard deviation depend on the used LRC (e.g. for the non-rectangular LRC see NonrectangularLRCFitter_getParameter). They are estimated for windows and are reported with the first record of the window
FP_VARnight	NEE filtered for nighttime records (others NA)
FP_VARday	NEE filtered for daytime records (others NA)
NEW_FP_Temp	temperature after filtering for quality flag degree Celsius
NEW_FP_VPD	vapour pressure deficit after filtering for quality flag, hPa
FP_RRef_Night	basal respiration estimated from nighttime (W / m2)
FP_qc	quality flag: 0: good parameter fit, 1: some parameters out of range, required refit, 2: next parameter estimate is more than two weeks away
FP_dRecPar	records until or after closest record that has a parameter estimate associated
FP_errorcode	information why LRC-fit was not successful or was rejected, see result of LightResponseCurveFitter_f
FP_GPP2000	predicted GPP at VPD = 0 and PAR = 2000: a surrogate for maximum photosynthetic capacity
FP_OPT_VPD	list object of fitting results including iOpt and covParms
FP_OPT_NoVPD	same as FP_OPT_VPD holding optimization results with fit neglecting the VPD effect

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References

Lasslop G, Reichstein M, Papale D, et al. (2010) Separation of net ecosystem exchange into assimilation and respiration using a light response curve approach: critical issues and global evaluation. Global Change Biology, Volume 16, Issue 1, Pages 187-208

See Also

partGLFitNightTimeTRespSens

partGLFitLRCWindows

partGLInterpolateFluxes

POSIXctToBerkeleyJulianDate

POSIXctToBerkeleyJulianDate

Description

convert POSIXct to JulianDate format used in Berkeley release

Usage

```
POSIXctToBerkeleyJulianDate(sDateTime, tz = getTZone(sDateTime))
```

Arguments

sDateTime	POSIXct vector
tz	time zone attribute, such as "etc/GMT-1"

Details

In the Berkeley-Release of the Fluxnet data, the time is stored as an number with base10-digits representing YYYYMMddhhmm

Author(s)

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See Also

[BerkeleyJulianDateToPOSIXct](#),

---

read_from_ameriflux22 *Extract basic variables from Ameriflux standard (as of 2022) data.frames*

Description

NEE is read from FC, Rg from SW_in, VPD is computed from RH and Tair. Non-storage corrected LE and H are read.

Usage

```
read_from_ameriflux22(df)
```

Arguments

df   data.frame: with columns FC, SW_IN, RH, TA, USTAR, L and E

Value

Data.Frame with columns DateTime, NEE, Rg, Tair, rH, VPD, Ustar, LE, H

---

read_from_fluxnet15   *extract REddyProc input columns from data.frame in Fluxnet15 format*

Description

Column format as described at https://fluxnet.org/data/fluxnet2015-dataset/fullset-data-product/

Usage

```
read_from_fluxnet15(ds, colname_NEE = "NEE")
```

Arguments

ds   data.frame with columns TIMESTAMP_END (Time YYYYMMDDHHMM), NEE, LE, H, USTAR, TA, TS, VPD, SW_IN and optionally USTAR_QC

colname_NEE   name (scalar string) of column that reports NEE observations

Details

If input has numeric column USTAR_QC then USTAR of records with USTAR_QC > 2 are set to NA.

Value

data.frame with additional columns 'DateTime', 'NEE','Ustar' and 'Rg','Tair','Tsoil' if columns 'SW_IN','TA', or 'TS' are present respectively

RectangularLRCFitter   *RectangularLRCFitter*

Description

Constructs an instance of class `RectangularLRCFitter-class`

Usage

```
RectangularLRCFitter(...)
```

Arguments

`...`	not used.

Author(s)

(Department for Biogeochemical Integration at MPI-BGC, Jena, Germany)

RectangularLRCFitter-class
                        Class "RectangularLRCFitter"

Description

Common rectangular hyperbolic light-response curve fitting.

Extends

Class *"LightResponseCurveFitter"*, directly.

All reference classes extend and inherit methods from *"envRefClass"*.

Methods

`computeGPPGradient(Rg, Amax, alpha):` ~~

`predictGPP(Rg, Amax, alpha):` ~~

The following methods are inherited (from the corresponding class): predictGPP ("LightResponse-CurveFitter"), getParameterNames ("LightResponseCurveFitter"), fitLRC ("LightResponseCurve-Fitter"), getPriorLocation ("LightResponseCurveFitter"), getPriorScale ("LightResponseCurveFitter"), getParameterInitials ("LightResponseCurveFitter"), optimLRCBounds ("LightResponseCurve-Fitter"), getOptimizedParameterPositions ("LightResponseCurveFitter"), optimLRCOnAdjustedPrior ("LightResponseCurveFitter"), isParameterInBounds ("LightResponseCurveFitter"), optimLRC ("LightResponseCurveFitter"), computeCost ("LightResponseCurveFitter"), predictLRC ("LightResponse-CurveFitter"), computeLRCGradient ("LightResponseCurveFitter")

Author(s)

TW

RectangularLRCFitterCVersion

RectangularLRCFitterCVersion

Description

Constructs an instance of class RectangularLRCFitterCVersion-class

Usage

```
RectangularLRCFitterCVersion(...)
```

Arguments

...	not used.

Author(s)

(Department for Biogeochemical Integration at MPI-BGC, Jena, Germany)

RectangularLRCFitterCVersion-class

Class "RectangularLRCFitterCVersion"

Description

Common rectangular hyperbolic light-response curve fitting, implemented with faster C-based cost function.

Extends

Class *"RectangularLRCFitter"*, directly. Class *"LightResponseCurveFitter"*, by class "RectangularLRCFitter", distance 2.

All reference classes extend and inherit methods from *"envRefClass"*.

Methods

```
computeCost(thetaOpt, theta, iOpt, flux, sdFlux, parameterPrior, sdParameterPrior, ..., VPD0, fixVPD):
    ~~
```

The following methods are inherited (from the corresponding class): computeCost ("LightResponseCurveFitter"), computeLRCGradient ("LightResponseCurveFitter"), predictGPP ("RectangularLRCFitter"), predictLRC ("LightResponseCurveFitter"), optimLRC ("LightResponseCurveFitter"), isParameterInBounds ("LightResponseCurveFitter"), optimLRCOnAdjustedPrior ("LightResponseCurveFitter"), getOptimizedParameterPositions ("LightResponseCurveFitter"), optimLRCBounds ("LightResponseCurveFitter"), getParameterInitials ("LightResponseCurveFitter"), getPriorScale ("LightResponseCurveFitter"), getPriorLocation ("LightResponseCurveFitter"), fitLRC ("LightResponseCurveFitter"), getParameterNames ("LightResponseCurveFitter"), predictGPP ("LightResponseCurveFitter"), computeGPPGradient ("RectangularLRCFitter")

RectangularLRCFitter_predictGPP

RectangularLRCFitter predictGPP

Description

Rectangular hyperbolic Light Response function for GPP

Usage

```
RectangularLRCFitter_predictGPP(Rg, Amax,
    alpha)
```

Arguments

Rg	ppfd [numeric] -> photosynthetic flux density [mumol / m2 / s] or Global Radiation
Amax	vector of length(Rg): saturation (beta parameter) adjusted for effect of VPD for each line of Rg
alpha	numeric scalar or vector of length(Rg): alpha parameter: slope at Rg = 0

Value

numeric vector of length(Rg) of GPP

Author(s)

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See Also

[LightResponseCurveFitter_predictGPP](#)

REddyProc_defaultunits

Get the default units for given variables

Description

Get the default units for given variables

Usage

```
REddyProc_defaultunits(variable_names)
```

Arguments

variable_names   string vector of variables to query units for

Value

string vector with units, NA for non-standard variables.

---

renameVariablesInDataframe

renameVariablesInDataframe

Description

Rename the column names of a data.frame according to a given mapping

Usage

```
renameVariablesInDataframe(data.F, mapping = getBGC05ToAmerifluxVariableNameMapping())
```

Arguments

data.F   data.frame whose columns should be renamed

mapping   named character vector: specifying a renaming (name -> value) of the variables,
               see e.g. [getAmerifluxToBGC05VariableNameMapping](#)

Author(s)

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RHLightResponseCostC   *RHLightResponseCostC*

Description

Computing residual sum of squares for predictions vs. data of NEE implemented in C. See `LightResponseCurveFitter_com` for a description.

Usage

```
RHLightResponseCostC(theta, flux, sdFlux,
    parameterPrior, sdParameterPrior, Rg,
    VPD, Temp, VPD0, fixVPD)
```

Arguments

theta	parameter vector with positions as in argument of `LightResponseCurveFitter_getParameterNames`
flux	numeric: NEP (-NEE) or GPP time series [umolCO2 / m2 / s], should not contain NA
sdFlux	numeric: standard deviation of Flux [umolCO2 / m2 / s], should not contain NA
parameterPrior	numeric vector along theta: prior estimate of parameter (range of values)
sdParameterPrior	
	standard deviation of parameterPrior
Rg	ppfd [numeric] -> photosynthetic flux density [umol / m2 / s] or Global Radiation
VPD	VPD [numeric] -> Vapor Pressure Deficit [hPa]
Temp	Temp [degC] -> Temperature [degC]
VPD0	VPD0 [hPa] -> Parameters VPD0 fixed to 10 hPa
fixVPD	boolean scalar or vector of nrow theta: fixVPD if TRUE the VPD effect is not considered and VPD is not part of the computation

Author(s)

(Department for Biogeochemical Integration at MPI-BGC, Jena, Germany)

---

sEddyProc   *sEddyProc*

Description

create an instance of class [sEddyProc-class](#)

Usage

```
sEddyProc(...)
```

Arguments

`...`	not used.

Author(s)

(Department for Biogeochemical Integration at MPI-BGC, Jena, Germany)

---

sEddyProc-class   *Class* "sEddyProc"

Description

R5 reference class for processing of site-level half-hourly eddy data

Extends

All reference classes extend and inherit methods from "[envRefClass](#)".

Fields

private, not to be accessed directly:

`sID`: Object of class `character` with Site ID

`sDATA`: Object of class `data.frame` with (fixed) site data

`sINFO`: Object of class `list` with site information

`sLOCATION`: Object of class `list` with site location information

`sTEMP`: Object of class `data.frame` of (temporary) result data

`sUSTAR`: Object of class `list` with results form uStar Threshold estimation

Methods

Setup, import and export

[sEddyProc_initialize](ID.s, Data.F, ColNames.V.s, ColPOSIXTime.s, DTS.n, ColNamesNonNumeric.V.s, Lat_de

[sEddyProc_sSetLocationInfo](Lat_deg.n, Long_deg.n, TimeZone_h.n)

[sEddyProc_sExportResults](isListColumnsExported)

[sEddyProc_sExportData]()

[sEddyProc_sGetData]()

uStar threshold estimation

[sEddyProc_sEstUstarThresholdDistribution](ctrlUstarEst.l, ctrlUstarSub.l, UstarColName, NEEColName, Te

[sEddyProc_sEstUstarThold](UstarColName, NEEColName, TempColName, RgColName, ...)

[sEddyProc_sPlotNEEVersusUStarForSeason](season.s, Format.s, Dir.s, UstarColName, NEEColName, TempColNam

Gapfilling

[sEddyProc_sCalcPotRadiation](useSolartime.b)

[sEddyProc_sMDSGapFill](Var.s, QFVar.s, QFValue.n, V1.s, T1.n, V2.s, T2.n, V3.s, T3.n, FillAll.b, Verbose.

[sEddyProc_sMDSGapFillAfterUStarDistr](..., UstarThres.df, UstarSuffix.V.s)

[sEddyProc_sMDSGapFillAfterUstar](FluxVar.s, UstarVar.s, UstarThres.df, UstarSuffix.s, FlagEntryAfterLo

[sEddyProc_sFillMDC](WinDays.i, Verbose.b)

[sEddyProc_sFillLUT](WinDays.i, V1.s, T1.n, V2.s, T2.n, V3.s, T3.n, V4.s, T4.n, V5.s, T5.n, Verbose.b)

[sEddyProc_sFillInit](Var.s, QFVar.s, QFValue.n, FillAll.b)

Flux partitioning

[sEddyProc_sMRFluxPartition](FluxVar.s, QFFluxVar.s, QFFluxValue.n, TempVar.s, QFTempVar.s, QFTempValue.

[sEddyProc_sGLFluxPartition](..., debug.l, isWarnReplaceColumns)

Plotting

[sEddyProc_sPlotDailySums](Var.s, VarUnc.s, Format.s, Dir.s, unit.s, ...)

[sEddyProc_sPlotDailySumsY](Var.s, VarUnc.s, Year.i, timeFactor.n, massFactor.n, unit.s)

[sEddyProc_sPlotHHFluxes](Var.s, QFVar.s, QFValue.n, Format.s, Dir.s)

[sEddyProc_sPlotHHFluxesY](Var.s, QFVar.s, QFValue.n, Year.i)

[sEddyProc_sPlotDiurnalCycle](Var.s, QFVar.s, QFValue.n, Format.s, Dir.s)

[sEddyProc_sPlotFingerprint](Var.s, QFVar.s, QFValue.n, Format.s, Dir.s, ...)

[sEddyProc_sPlotFingerprintY](Var.s, QFVar.s, QFValue.n, Year.i, Legend.b, Col.V, valueLimits)

Note

for examples see useCase vignette

Author(s)

AM, TW

---

sEddyProc_initialize   *sEddyProc initialize*

Description

Initializing sEddyProc class during sEddyProc$new.

Usage

```
sEddyProc_initialize(ID = ID.s, Data = Data.F,
    ColNames = c("NEE", "Rg", "Tair", "VPD",
        "Ustar"), ColPOSIXTime = "DateTime",
    DTS = if (!missing(DTS.n)) DTS.n else 48,
    ColNamesNonNumeric = character(0), LatDeg = NA_real_,
    LongDeg = if (!missing(Long_deg.n)) Long_deg.n else NA_real_,
    TimeZoneHour = if (!missing(TimeZone_h.n)) TimeZone_h.n else NA_integer_,
    ID.s, Data.F, ColNames.V.s, ColPOSIXTime.s,
    DTS.n, ColNamesNonNumeric.V.s, Lat_deg.n,
    Long_deg.n, TimeZone_h.n, ...)
```

Arguments

ID	String with site ID
Data	Data frame with at least three month of (half-)hourly site-level eddy data
ColNames	Vector with selected column names, the fewer columns the faster the processing. The default specifies column names assumed in further processing.
ColPOSIXTime	Column name with POSIX time stamp
DTS	Daily time steps
ColNamesNonNumeric	
	Names of columns that should not be checked for numeric type, e.g. season column
LatDeg	Latitude in (decimal) degrees (-90 to + 90)
LongDeg	Longitude in (decimal) degrees (-180 to + 180)
TimeZoneHour	Time zone: hours shift to UTC, e.g. 1 for Berlin
ID.s	deprecated
Data.F	deprecated
ColNames.V.s	deprecated

```
ColPOSIXTime.s  deprecated

DTS.n           deprecated

ColNamesNonNumeric.V.s
                deprecated

Lat_deg.n       deprecated

Long_deg.n      deprecated

TimeZone_h.n    deprecated
```

...   ('...' required for initialization of class fields)

Details

The time stamp must be provided in POSIX format, see also [fConvertTimeToPosix](). For required properties of the time series, see [fCheckHHTimeSeries]().

Internally the half-hour time stamp is shifted to the middle of the measurement period (minus 15 minutes or 30 minutes).

All other columns may only contain numeric data. Please use NA as a gap flag for missing data or low quality data not to be used in the processing. The columns are also checked for plausibility with warnings if outside range.

There are several fields initialized within the class.

sID is a string for the site ID.

sDATA is a data frame with site data.

sTEMP is a temporal data frame with the processing results.

sINFO is a list containing the time series information:

DIMS Number of data rows

DTS Number of daily time steps (24 or 48)

Y.START Starting year

Y.END Ending year

Y.NUMS Number of years

Y.NAME Name for years

sUSTAR_SCEN a data.frame with first column the season, and other columns different uStar threshold estimates, as returned by [usGetAnnualSeasonUStarMap]()

sLOCATION is a list of information on site location and timezone (see [sEddyProc_sSetLocationInfo]()).

sTEMP is a data frame used only temporally.

Value

Initialized fields of sEddyProc.

Author(s)

AMM Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

---

sEddyProc_sApplyUStarScen

sEddyProc sApplyUStarScen

Description

apply a function with changing the suffix argument

Usage

```
sEddyProc_sApplyUStarScen(FUN, ..., uStarScenKeep = character(0),
    warnOnOtherErrors = FALSE, uStarSuffixes = .self$sGetUstarSuffixes())
```

Arguments

FUN	function to be applied
...	further arguments to FUN
uStarScenKeep	Scalar string specifying the scenario for which to keep parameters. If not specified defaults to the first entry in uStarSuffixes.
warnOnOtherErrors	
	Set to only display a warning on errors in uStarScenarios other than uStarScenKeep instead of stopping.
uStarSuffixes	Vector of suffixed « describing the uStar scenarios

Details

When repeating computations, some of the output variables maybe replaced. Argument uStarKeep allows to select the scenario which is computed last, and hence to which output columns refer to.

Author(s)

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---

sEddyProc_sCalcPotRadiation

sEddyProc sCalcPotRadiation

Description

compute potential radiation from position and time

Usage

```
sEddyProc_sCalcPotRadiation(useSolartime = TRUE,
    useSolartime.b)
```

Arguments

useSolartime   by default corrects hour (given in local winter time) for latitude to solar time(where noon is exactly at 12:00). Set this to FALSE to directly use local winter time

useSolartime.b   by default corrects hour (given in local winter time)

Value

column PotRad_NEW in sTEMP

Author(s)

Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

---

sEddyProc_sEstimateUstarScenarios

sEddyProc sEstimateUstarScenarios

Description

Estimate the distribution of u* threshold by bootstrapping over data

Usage

```
sEddyProc_sEstimateUstarScenarios(ctrlUstarEst = usControlUstarEst(),
    ctrlUstarSub = usControlUstarSubsetting(),
    UstarColName = "Ustar", NEEColName = "NEE",
    TempColName = "Tair", RgColName = "Rg",
    ..., seasonFactor = usCreateSeasonFactorMonth(sDATA$sDateTime),
    nSample = 200L, probs = c(0.05, 0.5,
        0.95), isVerbose = TRUE, suppressWarningsAfterFirst = TRUE)
```

Arguments

ctrlUstarEst	control parameters for estimating uStar on a single binned series, see usControlUstarEst
ctrlUstarSub	control parameters for subsetting time series (number of temperature and Ustar classes . . .), see usControlUstarSubsetting
UstarColName	column name for UStar
NEEColName	column name for NEE
TempColName	column name for air temperature
RgColName	column name for solar radiation for omitting night time data
...	further arguments to sEddyProc_sEstUstarThreshold
seasonFactor	factor of seasons to split (data is resampled only within the seasons)
nSample	the number of repetitions in the bootstrap
probs	the quantiles of the bootstrap sample to return. Default is the 5%, median and 95% of the bootstrap
isVerbose	set to FALSE to omit printing progress
suppressWarningsAfterFirst	
	set to FALSE to show also warnings for all bootstrap estimates instead of only the first bootstrap sample

Details

The choice of the criterion for sufficiently turbulent conditions (u * > chosen threshold) introduces large uncertainties in calculations based on gap-filled Eddy data. Hence, it is good practice to compare derived quantities based on gap-filled data using a range of u * threshold estimates.

This method explores the probability density of the threshold by repeating its estimation on a bootstrapped sample. By default it returns the 90% confidence interval (argument probs). For larger intervals the sample number need to be increased (argument probs).

Quality Assurance If more than ctrlUstarEst$minValidBootProp (default 40%) did not report a threshold, no quantiles (i.e. NA) are reported.

Value

updated class. Request results by sEddyProc_sGetEstimatedUstarThresholdDistribution

Author(s)

TW Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

See Also

sEddyProc_sEstUstarThold, sEddyProc_sGetEstimatedUstarThresholdDistribution, sEddyProc_sSetUstarScena , sEddyProc_sMDSGapFillUStarScens

---

sEddyProc_sEstUstarThold

sEddyProc$sEstUstarThreshold - Estimating ustar threshold

Description

Calling usEstUstarThreshold for class data and storing results

Usage

```
sEddyProc_sEstUstarThold(UstarColName = "Ustar",
    NEEColName = "NEE", TempColName = "Tair",
  RgColName = "Rg", ..., seasonFactor = usCreateSeasonFactorMonth(sDATA$sDateTime))
```

Arguments

UstarColName	column name for UStar
NEEColName	column name for NEE
TempColName	column name for air temperature
RgColName	column name for solar radiation for omitting night time data
...	further arguments to usEstUstarThreshold
seasonFactor	factor of seasons to split

Value

result component uStarTh of usEstUstarThreshold. In addition the result is stored in class variable sUSTAR_DETAILS.

Author(s)

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---

sEddyProc_sEstUstarThreshold

sEddyProc$sEstUstarThreshold - Estimating ustar threshold

Description

Calling `usEstUstarThreshold` for class data and storing results

Usage

```
sEddyProc_sEstUstarThreshold(UstarColName = "Ustar",
    NEEColName = "NEE", TempColName = "Tair",
    RgColName = "Rg", ..., isWarnDeprecated = TRUE)
```

Arguments

UstarColName	column name for UStar
NEEColName	column name for NEE
TempColName	column name for air temperature
RgColName	column name for solar radiation for omitting night time data
...	further arguments to `usEstUstarThreshold`
isWarnDeprecated	
	set to FALSE to avoid deprecated warning.

Value

result of `usEstUstarThreshold`. In addition the result is stored in class variable sUSTAR_DETAILS and the bins as additional columns to sTemp

Author(s)

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sEddyProc_sEstUstarThresholdDistribution
sEddyProc sEstUstarThresholdDistribution

Description

Estimate the distribution of u* threshold by bootstrapping over data

Usage

```
sEddyProc_sEstUstarThresholdDistribution(...)
```

Arguments

...	further parameters to sEddyProc_sEstimateUstarScenarios

Details

This method returns the results directly, without modifying the class. It is there for portability reasons. Recommended is using method sEddyProc_sEstimateUstarScenarios to update the class and then getting the results from the class by sEddyProc_sGetEstimatedUstarThresholdDistribution.

Value

result of sEddyProc_sGetEstimatedUstarThresholdDistribution

Author(s)

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---

sEddyProc_sExportData *sEddyProc sExportData*

Description

Export class internal sDATA data frame

Usage

```
sEddyProc_sExportData()
```

Value

Return data frame sDATA with time stamp shifted back to original.

Author(s)

AMM, TW Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

See Also

help_export

---

sEddyProc_sExportResults

sEddyProc sExportResults

Description

Export class internal sTEMP data frame with result columns

Usage

```
sEddyProc_sExportResults(isListColumnsExported = FALSE)
```

Arguments

isListColumnsExported

if TRUE export list columns in addition to numeric columns, such as the covariance matrices of the the day-time-partitioning LRC fits

Value

Return data frame sTEMP with results.

Author(s)

AMM Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

See Also

help_export

---

sEddyProc_sFillInit   *sEddyProc$sFillInit - Initialize gap filling*

Description

Initializes data frame sTEMP for newly generated gap filled data and qualifiers.

Usage

```
sEddyProc_sFillInit(Var.s, QFVar.s = "none",
    QFValue.n = NA_real_, FillAll.b = TRUE)
```

Arguments

Var.s	Variable to be filled
QFVar.s	Quality flag of variable to be filled
QFValue.n	Value of quality flag for _good_ (original) data, other data is set to missing
FillAll.b	Fill all values to estimate uncertainties

Details

Description of newly generated variables with gap filled data and qualifiers:

VAR_*orig* - Original values used for gap filling
VAR_*f* - Original values and gaps filled with mean of selected datapoints (condition depending on gap filling method)
VAR_*fqc* - Quality flag assigned depending on gap filling method and window length (0 = original data, 1 = most reliable, 2 = medium, 3 = least reliable)
VAR_*fall* - All values considered as gaps (for uncertainty estimates)
VAR_*fall_qc* - Quality flag assigned depending on gap filling method and window length (1 = most reliable, 2 = medium, 3 = least reliable)
VAR_*fnum* - Number of datapoints used for gap-filling
VAR_*fsd* - Standard deviation of datapoints used for gap filling (uncertainty)
VAR_*fmeth* - Method used for gap filling (1 = similar meteo condition (sFillLUT with Rg, VPD, Tair), 2 = similar meteo (sFillLUT with Rg only), 3 = mean diurnal course (sFillMDC))
VAR_*fwin* - Full window length used for gap filling

Long gaps (larger than 60 days) are not filled.

Author(s)

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---

sEddyProc_sFillLUT   *sEddyProc sFillLUT*

Description

Look-Up Table (LUT) algorithm of up to five conditions within prescribed window size

Usage

```
sEddyProc_sFillLUT(WinDays.i, V1.s = "none",
    T1.n = NA_real_, V2.s = "none", T2.n = NA_real_,
    V3.s = "none", T3.n = NA_real_, V4.s = "none",
    T4.n = NA_real_, V5.s = "none", T5.n = NA_real_,
    Verbose.b = TRUE, calculate_gapstats = calculate_gapstats_Reichstein05)
```

Arguments

WinDays.i	Window size for filling in days
V1.s	Condition variable 1
T1.n	Tolerance interval 1
V2.s	Condition variable 2
T2.n	Tolerance interval 2
V3.s	Condition variable 3
T3.n	Tolerance interval 3
V4.s	Condition variable 4
T4.n	Tolerance interval 4
V5.s	Condition variable 5
T5.n	Tolerance interval 5
Verbose.b	Print status information to screen
calculate_gapstats	
	function computing gap-statistics

Details

Quality flags
- 1: at least one variable and nDay <= 14
- 2: three variables and nDay in [14,56) or one variable and nDay in [14,28)
- 3: three variables and nDay > 56 or one variable and nDay > 28

Value

LUT filling results in sTEMP data frame.

Author(s)

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---

sEddyProc_sFillMDC   *sEddyProc sFillMDC*

Description

Mean Diurnal Course (MDC) algorithm based on average values within +/- one hour of adjacent days

Usage

```
sEddyProc_sFillMDC(WinDays.i, Verbose.b = TRUE)
```

Arguments

WinDays.i   Window size for filling in days

Verbose.b   Print status information to screen

Details

Quality flag   • 1: nDay <= 1
          • 2: nDay [2,5)
          • 3: nDay > 5

Value

MDC filling results in sTEMP data frame.

Author(s)

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---

sEddyProc_sFillVPDFromDew

Estimate VPD from daily minimum temperature

Description

of the data in the class function using `estimate_vpd_from_dew`.

Usage

```
sEddyProc_sFillVPDFromDew(...)
```

Arguments

...	further arguments to `estimate_vpd_from_dew`

Value

side effect of updated column VPDfromDew in class

---

sEddyProc_sGetData   *sEddyProc sGetData*

Description

Get class internal sDATA data frame

Usage

```
sEddyProc_sGetData()
```

Value

Return data frame sDATA.

Author(s)

AMM Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

---

sEddyProc_sGetEstimatedUstarThresholdDistribution
sEddyProc sGetEstimatedUstarThresholdDistribution

Description

return the results of [sEddyProc_sEstimateUstarScenarios](#)

Usage

```
sEddyProc_sGetEstimatedUstarThresholdDistribution()
```

Value

A data.frame with columns `aggregationMode`, `year`, and `UStar` estimate based on the non-resampled data. The other columns correspond to the quantiles of Ustar estimate for given probabilities (argument `probs`) based on the distribution of estimates using resampled the data.

Author(s)

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See Also

[sEddyProc_sSetUstarScenarios](#)

---

sEddyProc_sGetUstarScenarios
sEddyProc sGetUstarScenarios

Description

get the current uStar processing scenarios

Usage

```
sEddyProc_sGetUstarScenarios()
```

Details

the associated suffixes can be retrieved by colnames(myClass$sGetUstarScenarios())[-1]

Value

a data.frame with first column listing each season and other column a scenario of uStar thresholds.

Author(s)

Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

See Also

[sEddyProc_sSetUstarScenarios](#)

---

sEddyProc_sGetUstarSuffixes

sEddyProc sGetUstarSuffixes

Description

get the current uStar suffixes

Usage

```
sEddyProc_sGetUstarSuffixes()
```

Value

a character vector of suffixes. If no uStar thresholds have been estimated, returns character(0)

Author(s)

Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

See Also

[sEddyProc_sGetUstarScenarios](#)

---

sEddyProc_sGLFluxPartition

sEddyProc sGLFluxPartition

Description

Daytime-based Flux partitioning after Lasslop et al. (2010)

Usage

```
sEddyProc_sGLFluxPartition(..., debug = list(useLocaltime = FALSE),
    debug.l, isWarnReplaceColumns = TRUE)
```

Arguments

...	arguments to partitionNEEGL in addition to the dataset such as `suffix`
debug	List with debugging control.
	useLocaltime if TRUE use local time zone instead of geo-solar time to compute potential radiation
debug.l	deprecated, renamed to debug
isWarnReplaceColumns	
	set to FALSE to avoid the warning on replacing output columns

Details

Daytime-based partitioning of measured net ecosystem fluxes into gross primary production (GPP) and ecosystem respiration (Reco)

Value

Flux partitioning results are in sTEMP data frame of the class.

Author(s)

MM, TW Department for Biogeochemical Integration at MPI-BGC, Jena, Germany <REddyProc-help@bgc-jena.mpg.de> [cph], Thomas Wutzler <twutz@bgc-jena.mpg.de> [aut, cre], Markus Reichstein <mreichstein@bgc-jena.mpg.de> [aut], Antje Maria Moffat <antje.moffat@bgc.mpg.de> [aut, trl], Olaf Menzer <omenzer@bgc-jena.mpg.de> [ctb], Mirco Migliavacca <mmiglia@bgc-jena.mpg.de> [aut], Kerstin Sickel <ksickel@bgc-jena.mpg.de> [ctb, trl], Ladislav <U+0160>igut <sigut.l@czechglobe.cz> [ctb]

References

Lasslop G, Reichstein M, Papale D, et al. (2010) Separation of net ecosystem exchange into assimilation and respiration using a light response curve approach: critical issues and global evaluation. Global Change Biology, Volume 16, Issue 1, Pages 187-208

sEddyProc_sGLFluxPartitionUStarScens
sEddyProc sGLFluxPartitionUStarScens

Description

Flux partitioning after Lasslop et al. (2010)

Usage

```
sEddyProc_sGLFluxPartitionUStarScens(...,
    isWarnReplaceColumns = FALSE, warnOnOtherErrors = FALSE,
    controlGLPart = partGLControl())
```

Arguments

...	arguments to `sEddyProc_sGLFluxPartition`
isWarnReplaceColumns	
	overriding default to avoid the warning on replacing output columns, because this is intended when processing several uStar scenarios.
warnOnOtherErrors	
	Set to TRUE to only display a warning on errors in uStarScenarios other than uStarScenKeep instead of stopping.
controlGLPart	further default parameters

Details

Daytime-based partitioning of measured net ecosystem fluxes into gross primary production (GPP) and ecosystem respiration (Reco) for all u* threshold scenarios.

argument uStarScenKeep in ... is a scalar string specifying the scenario for which to keep parameters (see `sEddyProc_sApplyUStarScen`. Defaults to the first scenario, which is usually the uStar without bootstrap: "uStar". For the uStarScenKeep, a full set of output columns is returned. For the other scenarios, the bootstrap of GPP uncertainty is omitted and columns "FP_<x>" are overridden.

Author(s)

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---

sEddyProc_sMDSGapFill   *sEddyProc sMDSGapFill*

Description

MDS gap filling algorithm adapted after the PV-Wave code and paper by Markus Reichstein.

Usage

```
sEddyProc_sMDSGapFill(Var = Var.s, QFVar = if (!missing(QFVar.s)) QFVar.s else "none",
    QFValue = if (!missing(QFValue.n)) QFValue.n else NA_real_,
    V1 = if (!missing(V1.s)) V1.s else "Rg",
    T1 = if (!missing(T1.n)) T1.n else 50,
    V2 = if (!missing(V2.s)) V2.s else "VPD",
    T2 = if (!missing(T2.n)) T2.n else 5,
    V3 = if (!missing(V3.s)) V3.s else "Tair",
    T3 = if (!missing(T3.n)) T3.n else 2.5,
    FillAll = if (!missing(FillAll.b)) FillAll.b else TRUE,
    isVerbose = if (!missing(Verbose.b)) Verbose.b else TRUE,
    suffix = if (!missing(Suffix.s)) Suffix.s else "",
    minNWarnRunLength = if (Var == "NEE") 4 *
        .self$sINFO$DTS/24 else NA_integer_,
    Var.s, QFVar.s, QFValue.n, V1.s, T1.n,
    V2.s, T2.n, V3.s, T3.n, FillAll.b, Verbose.b,
    Suffix.s, method = "Reichstein05")
```

Arguments

Var	Variable to be filled
QFVar	Quality flag of variable to be filled
QFValue	Value of quality flag for _good_ (original) data, other data is set to missing
V1	Condition variable 1 (default: Global radiation 'Rg' in W m-2)
T1	Tolerance interval 1 (default: 50 W m-2)
V2	Condition variable 2 (default: Vapour pressure deficit 'VPD' in hPa)
T2	Tolerance interval 2 (default: 5 hPa)
V3	Condition variable 3 (default: Air temperature 'Tair' in degC)
T3	Tolerance interval 3 (default: 2.5 degC)
FillAll	Fill all values to estimate uncertainties
isVerbose	Print status information to screen
suffix	String suffix needed for different processing setups on the same dataset (for explanations see below)

minNWarnRunLength

scalar integer: warn if number of subsequent numerically equal values exceeds this number. Set to Inf or NA for no warnings. defaults for "NEE" to records across 4 hours and no warning for others.

Var.s	deprecated
QFVar.s	deprecated
QFValue.n	deprecated
V1.s	deprecated
T1.n	deprecated
V2.s	deprecated
T2.n	deprecated
V3.s	deprecated
T3.n	deprecated
FillAll.b	deprecated
Verbose.b	deprecated
Suffix.s	deprecated
method	specify "Vekuri23" to use the skewness-bias reducing variant

Details

Different processing setups on the same dataset Attention: When processing the same site data set with different setups for the gap filling or flux partitioning (e.g. due to different ustar filters), a string suffix is needed! This suffix is added to the result column names to distinguish the results of the different setups.

Value

Gap filling results in sTEMP data frame (with renamed columns).

Author(s)

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References

Reichstein, M. et al. (2005) On the separation of net ecosystem exchange into assimilation and ecosystem respiration: review and improved algorithm. Global Change Biology, 11, 1424-1439.

sEddyProc_sMDSGapFillAfterUstar

sEddyProc sMDSGapFillAfterUstar

Description

sEddyProc$sMDSGapFillAfterUstar - MDS gap filling algorithm after u* filtering

Usage

```
sEddyProc_sMDSGapFillAfterUstar(fluxVar,
    uStarVar = "Ustar", uStarTh = .self$sGetUstarScenarios()[,
        c("season", uStarSuffix), drop = FALSE],
    uStarSuffix = "uStar", isFlagEntryAfterLowTurbulence = FALSE,
    isFilterDayTime = FALSE, swThr = 10,
    RgColName = "Rg", ...)
```

Arguments

fluxVar	Flux variable to gap fill after ustar filtering
uStarVar	Column name of friction velocity u * (ms-1), default 'Ustar'
uStarTh	data.frame with first column, season names, and second column estimates of uStar Threshold. Alternatively, a single value to be used as threshold for all records If only one value is given, it is used for all records.
uStarSuffix	Different suffixes required are for different u * scenarios
isFlagEntryAfterLowTurbulence	
	Set to TRUE for flagging the first entry after low turbulence as bad condition (by value of 2).
isFilterDayTime	
	Set to TRUE to also filter day-time values, default only filters night-time data
swThr	threshold of solar radiation below which data is marked as night time respiration.
RgColName	Column name of incoming short wave radiation
...	Other arguments passed to `sEddyProc_sMDSGapFill`

Details

Calling `sEddyProc_sMDSGapFill` after filtering for (provided) friction velocity u*

The u* threshold(s) are provided with argument uStarTh for filtering the conditions of low turbulence. After filtering, the data is gap filled using the MDS algorithm `sEddyProc_sMDSGapFill`.

With isFlagEntryAfterLowTurbulence set to TRUE, to be more conservative, in addition to the data acquired when uStar is below the threshold, the first half hour measured with good turbulence conditions after a period with low turbulence is also removed (Papale et al. 2006).

Value

Vector with quality flag from filtering (here 0: good data , 1: low turbulence, 2: first half hour after low turbulence , 3: no threshold available, 4: missing uStar value) Gap filling results are in sTEMP data frame (with renamed columns) that can be retrieved by `sEddyProc_sExportResults`.

Author(s)

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See Also

- `sEddyProc_sEstimateUstarScenarios` and link{sEddyProc_sEstUstarThold} for estimating the u* threshold from the data.

- `sEddyProc_sMDSGapFillUStarScens` for automated gapfilling for several scenarios of u* threshold estimates.

---

sEddyProc_sMDSGapFillAfterUStarDistr

sEddyProc sMDSGapFillAfterUStarDistr

Description

gapfilling for several filters of estimated friction velocity Ustar thresholds.

Usage

```
sEddyProc_sMDSGapFillAfterUStarDistr(...,
    uStarTh, uStarSuffixes = colnames(uStarTh)[-1])
```

Arguments

`...`	other arguments to `sEddyProc_sMDSGapFillAfterUstar` and `sEddyProc_sMDSGapFill` such as fluxVar
`uStarTh`	data.frame with first column, season names, and remaining columns different estimates of uStar Threshold. If the data.frame has only one row, then each uStar threshold estimate is applied to the entire dataset. Entries in first column must match levels in argument seasonFactor
`uStarSuffixes`	String vector to distinguish result columns for different ustar values. Its length must correspond to column numbers in UstarThres.m.n.

Details

This method is superseded by sEddyProc_sMDSGapFillUStarScens and only there for backward portability.

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---

sEddyProc_sMDSGapFillUStarScens

sEddyProc sMDSGapFillUStarScens

Description

gapfilling for several filters of estimated friction velocity Ustar thresholds.

Usage

```
sEddyProc_sMDSGapFillUStarScens(...)
```

Arguments

...	other arguments to sEddyProc_sMDSGapFillAfterUstar and sEddyProc_sMDSGapFill such as fluxVar

Details

sEddyProc$sMDSGapFillUStarDistr: calling sEddyProc_sMDSGapFillAfterUstar for several filters of friction velocity Ustar.

The scenarios need to be set before by sEddyProc_sSetUstarScenarios or accepting the defaults annual estimates of link{sEddyProc_sEstimateUstarScenarios}.

Then the difference between output columns NEE_U05_f and NEE_U95_f corresponds to the uncertainty introduced by the uncertain estimate of the u* threshold.

Value

Matrix (columns correspond to u* Scenarios) with quality flag from filtering ustar (0 - good data, 1 - filtered data)

Gap filling results in sTEMP data frame (with renamed columns), that can be retrieved by sEddyProc_sExportResults. Each of the outputs is calculated for several u* r-estimates and distinguished by a suffix after the variable. E.g. with an an entry "U05" in uStarSuffixes in sEddyProc_sSetUstarScenarios the corresponding filled NEE can be found in output column "NEE_U05_f".

Author(s)

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See Also

useCase vignette

---

sEddyProc_sMRFluxPartition

sEddyProc sMRFluxPartition

Description

Nighttime-based partitioning of net ecosystem fluxes into gross fluxes GPP and REco

Usage

```
sEddyProc_sMRFluxPartition(FluxVar = if (missing(FluxVar.s)) ”NEE_f” else FluxVar.s,
    QFFluxVar = if (missing(QFFluxVar.s)) ”NEE_fqc” else QFFluxVar.s,
    QFFluxValue = if (missing(QFFluxValue.n)) 0L else QFFluxValue.n,
    TempVar = if (missing(TempVar.s)) ”Tair_f” else TempVar.s,
    QFTempVar = if (missing(QFTempVar.s)) ”Tair_fqc” else QFTempVar.s,
    QFTempValue = if (missing(QFTempValue.n)) 0 else QFTempValue.n,
    RadVar = if (missing(RadVar.s)) ”Rg” else RadVar.s,
    TRef = if (missing(T_ref.n)) 273.15 +
        15 else T_ref.n, suffix = if (missing(Suffix.s)) ”” else Suffix.s,
    FluxVar.s, QFFluxVar.s, QFFluxValue.n,
    TempVar.s, QFTempVar.s, QFTempValue.n,
    RadVar.s, T_ref.n, Suffix.s, debug.l,
    debug = if (!missing(debug.l)) debug.l else list(useLocaltime = FALSE),
    parsE0Regression = list())
```

Arguments

FluxVar	Variable name of column with original and filled net ecosystem fluxes (NEE)
QFFluxVar	Quality flag of NEE variable
QFFluxValue	Value of quality flag for _good_ (original) data
TempVar	Filled air- or soil temperature variable (degC)
QFTempVar	Quality flag of filled temperature variable
QFTempValue	Value of temperature quality flag for _good_ (original) data

RadVar	Unfilled (original) radiation variable
TRef	Reference temperature in Kelvin (degK) used in fLloydTaylor for regressing Flux and Temperature
suffix	String suffix needed for different processing setups on the same dataset (for explanations see below)
FluxVar.s	deprecated
QFFluxVar.s	deprecated
QFFluxValue.n	deprecated
TempVar.s	deprecated
QFTempVar.s	deprecated
QFTempValue.n	deprecated
RadVar.s	deprecated
T_ref.n	deprecated
Suffix.s	deprecated
debug.l	deprecated
debug	List with debugging control (passed also to sEddyProc_sRegrE0fromShortTerm for providing fixedE0 = myE0).

> **useLocaltime** see details on solar vs local time

parsE0Regression

> list with further parameters passed down to sEddyProc_sRegrE0fromShortTerm and fRegrE0fromShortTerm, such as TempRange

Details

Description of newly generated variables with partitioning results:
- PotRad - Potential radiation

- FP_NEEnight - Good (original) NEE nighttime fluxes used for flux partitioning

- FP_Temp - Good (original) temperature measurements used for flux partitioning

- E_0 - Estimated temperature sensitivity

- R_ref - Estimated reference respiration

- Reco - Estimated ecosystem respiration

- GPP_f - Estimated gross primary production

Background This partitioning is based on the regression of nighttime respiration with temperature using the Lloyd-Taylor-Function [fLloydTaylor](). First the temperature sensitivity E_0 is estimated from short term data, see sEddyProc_sRegrE0fromShortTerm. Next the reference temperature R_ref is estimated for successive periods throughout the whole dataset (see

sEddyProc_sRegrRref). These estimates are then used to calculate the respiration during daytime and nighttime and with this GPP. Attention: Gap filling of the net ecosystem fluxes (NEE) and temperature measurements (Tair or Tsoil) is required prior to the partitioning!

Selection of daytime data based on solar time The respiration-temperature regression is very sensitive to the selection of night- and daytime data. Nighttime is selected by a combined threshold of current solar radiation and potential radiation. The current implementation calculates potential radiation based on exact solar time, based on latitude and longitude. (see [fCalcPotRadiation](#)) Therefore it might differ from implementations that use local winter clock time instead.

Different processing setups on the same dataset Attention: When processing the same site data set with different setups for the gap filling or flux partitioning (e.g. due to different ustar filters), a string suffix is needed! This suffix is added to the result column names to distinguish the results of the different setups. If a suffix is provided and if the defaults for FluxVar and QFFluxVar are used, the suffix will be added to their variable names (e.g. 'NEE_f' will be renamed to 'NEE_uStar_f' and 'NEE_fqc' to 'NEE_uStar_fqc' for the suffix = 'uStar'). Currently, this works only with defaults of FluxVar = 'NEE_f' and QFFluxVar = 'NEE_fqc'.

Value

Flux partitioning results (see variables in details) in sTEMP data frame (with renamed columns). On success, return value is NULL. On failure an integer scalar error code is returned: -111 if regression of E_0 failed due to insufficient relationship in the data.

Author(s)

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References

Reichstein M, Falge E, Baldocchi D et al. (2005) On the separation of net ecosystem exchange into assimilation and ecosystem respiration: review and improved algorithm. Global Change Biology, 11, 1424-1439.

---

sEddyProc_sMRFluxPartitionUStarScens
                        sEddyProc sMRFluxPartitionUStarScens

Description

Flux partitioning after Reichstein et al. (2005)

Usage

```
sEddyProc_sMRFluxPartitionUStarScens(...,
    uStarScenKeep = character(0))
```

Arguments

...	arguments to `sEddyProc_sMRFluxPartition`
uStarScenKeep	Scalar string specifying the scenario for which to keep parameters (see `sEddyProc_sApplyUStarScen`. Defaults to the first scenario.

Details

Nighttime-based partitioning of measured net ecosystem fluxes into gross primary production (GPP) and ecosystem respiration (Reco) for all u* threshold scenarios.

Value

NULL, it adds output columns in the class

Author(s)

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---

sEddyProc_sPlotDailySums

sEddyProc$sPlotDailySums - Image with daily sums of each year

---

Description

Generates image in specified format ('pdf' or 'png') with daily sums, see also `sEddyProc_sPlotDailySumsY`.

Usage

```
sEddyProc_sPlotDailySums(Var = Var.s, VarUnc = "none",
    Format = if (!missing(Format.s)) Format.s else "pdf",
    Dir = if (!missing(Dir.s)) Dir.s else "plots",
    unit = if (!missing(unit.s)) unit.s else "gC/m2/day",
    ..., Var.s, VarUnc.s, Format.s, Dir.s,
    unit.s)
```

Arguments

Var	(Filled) variable to plot
VarUnc	Uncertainty estimates for variable
Format	Graphics file format ('pdf' or 'png')
Dir	Directory for plotting
unit	unit of the daily sums
...	further arguments to sEddyProc_sPlotDailySumsY, such as timeFactor and massFactor.
Var.s	deprecated
VarUnc.s	deprecated
Format.s	deprecated
Dir.s	deprecated
unit.s	deprecated

Author(s)

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---

sEddyProc_sPlotDailySumsY

sEddyProc sPlotDailySumsY

Description

This function first computes the average flux for each day. If the original unit is not "per day", then it need to be converted to "per day" by argument timeFactor. Furthermore, a change of the mass unit is provided by argument massFactor. The default parameters assume original units of mumol CO_2 / m2 / second and convert to gC / m2 / day. The conversion factors allow plotting variables with different units

Usage

```
sEddyProc_sPlotDailySumsY(Var, VarUnc = "none",
    Year, timeFactor = 3600 * 24, massFactor = (44.0096/1e+06) *
        (12.011/44.0096), unit = "gC/m2/day",
    dts = sINFO$DTS, data = cbind(sDATA,
        sTEMP))
```

Arguments

Var	(Filled) variable to plot
VarUnc	Uncertainty estimates for variable
Year	Year to plot
timeFactor	time conversion factor with default per second to per day
massFactor	mass conversion factor with default from mumol CO2 to g C
unit	unit of the daily sums
dts	numeric integer
data	data.frame with variables to plot

Author(s)

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---

sEddyProc_sPlotDiurnalCycle

sEddyProc sPlotDiurnalCycle

Description

Generates image in specified format ('pdf' or 'png') with diurnal cycles.

Usage

```
sEddyProc_sPlotDiurnalCycle(Var = Var.s,
    QFVar = if (!missing(QFVar.s)) QFVar.s else "none",
    QFValue = if (!missing(QFValue.n)) QFValue.n else NA_real_,
    Format = if (!missing(Format.s)) Format.s else "pdf",
    Dir = if (!missing(Dir.s)) Dir.s else "plots",
    data = cbind(sDATA, sTEMP), dts = sINFO$DTS,
    Var.s, QFVar.s, QFValue.n, Format.s,
    Dir.s)
```

Arguments

Var	Variable to plot
QFVar	Quality flag of variable to be filled
QFValue	Value of quality flag for data to plot
Format	Graphics file format (e.g. 'pdf', 'png')

Dir	Directory for plotting
data	data.frame with variables to plot
dts	numeric integer
Var.s	deprecated
QFVar.s	deprecated
QFValue.n	deprecated
Format.s	deprecated
Dir.s	deprecated

Author(s)

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---

sEddyProc_sPlotDiurnalCycleM

sEddyProc sPlotDiurnalCycleM

Description

The diurnal cycles of a single month are plotted to the current device, scaled to all data. Each year is plotted as a different (coloured) line.

Usage

```
sEddyProc_sPlotDiurnalCycleM(Var = Var.s,
    QFVar = if (!missing(QFVar.s)) QFVar.s else "none",
    QFValue = if (!missing(QFValue.n)) QFValue.n else NA_real_,
    Month = Month.i, Legend = if (!missing(Legend.b)) Legend.b else T,
    data = cbind(sDATA, sTEMP), dts = sINFO$DTS,
    Var.s, QFVar.s = "none", QFValue.n = NA_real_,
    Month.i, Legend.b = T)
```

Arguments

Var	Variable to plot
QFVar	Quality flag of variable to be filled
QFValue	Value of quality flag for data to plot
Month	Month to plot
Legend	Plot with legend

data	data.frame with variables to plot
dts	numeric integer
Var.s	Variable to plot
QFVar.s	Quality flag of variable to be filled
QFValue.n	Value of quality flag for data to plot
Month.i	Month to plot
Legend.b	Plot with legend

Author(s)

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sEddyProc_sPlotFingerprint

sEddyProc sPlotFingerprint

Description

Generates fingerprint in file

Usage

```
sEddyProc_sPlotFingerprint(Var = Var.s, QFVar = "none",
    QFValue = if (!missing(QFValue.n)) QFValue.n else NA_real_,
    Format = if (!missing(Format.s)) Format.s else "pdf",
    Dir = if (!missing(Dir.s)) Dir.s else "plots",
    ..., Var.s, QFVar.s = "none", QFValue.n = NA_real_,
    Format.s = "pdf", Dir.s = "plots")
```

Arguments

Var	Variable to plot
QFVar	Quality flag of variable to be filled
QFValue	Value of quality flag for data to plot
Format	Graphics file format (e.g. 'pdf', 'png')
Dir	Directory for plotting
...	further arguments to [sEddyProc_sPlotFingerprintY](#)
Var.s	Variable to plot

QFVar.s	Quality flag of variable to be filled
QFValue.n	Value of quality flag for data to plot
Format.s	Graphics file format (e.g. 'pdf', 'png')
Dir.s	Directory for plotting

Author(s)

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---

sEddyProc_sPlotFingerprintY

sEddyProc sPlotFingerprintY

Description

Plot fingerprint for a single year scaled to all data.

Usage

```
sEddyProc_sPlotFingerprintY(Var = Var.s,
    QFVar = "none", QFValue = if (!missing(QFValue.n)) QFValue.n else NA_real_,
    Year = Year.i, onlyLegend = if (!missing(Legend.b)) Legend.b else F,
    colors = if (!missing(Col.V)) Col.V else colorRampPalette(c("#00007F",
        "blue", "#007FFF", "cyan", "#7FFF7F",
        "yellow", "#FF7F00", "red", "#7F0000"))(50),
    valueLimits = range(Plot.V.n, na.rm = TRUE),
    data = cbind(sDATA, sTEMP), dts = sINFO$DTS,
    Var.s, QFVar.s, QFValue.n, Year.i, Legend.b,
    Col.V)
```

Arguments

Var	Variable to plot
QFVar	Quality flag of variable to be filled
QFValue	Value of quality flag for data to plot
Year	Year to plot
onlyLegend	Plot only legend
colors	Color palette for fingerprint plot (can be also defined by user), i.e. color scale argument to image

valueLimits	values outside this range will be set to the range borders to avoid distorting colour scale e.g. valueLimits = quantile(EddyProc.C$sDATA$NEE, prob = c(0.05, 0.95), na.rm = TRUE)
data	data.frame with variables to plot
dts	numeric integer of hours in day
Var.s	deprecated
QFVar.s	deprecated
QFValue.n	deprecated
Year.i	deprecated
Legend.b	deprecated
Col.V	deprecated

Author(s)

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---

sEddyProc_sPlotHHfluxes

sEddyProc sPlotHHFluxes

Description

Produce image-plot with half-hourly fluxes for each year

Usage

```
sEddyProc_sPlotHHFluxes(Var = Var.s, QFVar = if (!missing(QFVar.s)) QFVar.s else "none",
    QFValue = if (!missing(QFValue.n)) QFValue.n else NA_real_,
    Format = if (!missing(Format.s)) Format.s else "pdf",
    Dir = if (!missing(Dir.s)) Dir.s else "plots",
    Var.s, QFVar.s, QFValue.n, Format.s,
    Dir.s)
```

Arguments

Var	Variable to plot
QFVar	Quality flag of variable to be filled
QFValue	Value of quality flag for data to plot
Format	Graphics file format (e.g. 'pdf', 'png')

Dir	Directory for plotting
Var.s	deprecated
QFVar.s	deprecated
QFValue.n	deprecated
Format.s	deprecated
Dir.s	deprecated

Details

Generates image in specified format ('pdf' or 'png') with half-hourly fluxes and their daily means, see also `sEddyProc_sPlotHHFluxesY`.

Author(s)

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---

sEddyProc_sPlotHHFluxesY

sEddyProc sPlotHHFluxesY

Description

Plot half-hourly fluxes for a single year scaled to all data.

Usage

```
sEddyProc_sPlotHHFluxesY(Var = Var.s, QFVar = if (!missing(QFVar.s)) QFVar.s else "none",
    QFValue = if (!missing(QFValue.n)) QFValue.n else NA_real_,
    Year = Year.i, data = cbind(sDATA, sTEMP),
    dts = sINFO$DTS, Var.s, QFVar.s, QFValue.n,
    Year.i)
```

Arguments

Var	Variable to plot
QFVar	Quality flag of variable to be filled
QFValue	Value of quality flag for data to plot
Year	Year to plot
data	data.frame with variables to plot

dts	numeric integer
Var.s	deprecated
QFVar.s	deprecated
QFValue.n	deprecated
Year.i	deprecated

Author(s)

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---

sEddyProc_sPlotNEEVersusUStarForSeason

sEddyProc sPlotNEEVersusUStarForSeason

Description

Generates image in specified format ('pdf' or 'png')

Usage

```
sEddyProc_sPlotNEEVersusUStarForSeason(season = levels(data$season)[1],
    format = "pdf", dir = "plots", UstarColName = "Ustar",
    NEEColName = "NEE", TempColName = "Tair",
    WInch = 16 * 0.394, HInchSingle = 6 *
        0.394, ..., data = cbind(sDATA, sTEMP,
        sUSTAR_DETAILS$bins[, c("uStarBin",
            "tempBin")]))
```

Arguments

season	string of season, i.e. time period to plot
format	string of Graphics file format ('pdf' or 'png')
dir	string of Directory for plotting
UstarColName	column name for UStar
NEEColName	column name for NEE
TempColName	column name for air temperature
WInch	width of the plot in inches, defaults to 16cm
HInchSingle	height of a subplot in inches, defaults to 6cm
...	other arguments to .plotNEEVersusUStarTempClass, such as xlab and ylab axis label strings
data	a data.frame with variables to plot

Author(s)

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---

sEddyProc_sSetLocationInfo

sEddyProc sSetLocationInfo

Description

set Location and time Zone information to sLOCATION

Usage

```
sEddyProc_sSetLocationInfo(LatDeg = if (!missing(Lat_deg.n)) Lat_deg.n else NA_real_,
    LongDeg = if (!missing(Long_deg.n)) Long_deg.n else NA_real_,
    TimeZoneHour = if (!missing(TimeZone_h.n)) TimeZone_h.n else NA_integer_,
    Lat_deg.n, Long_deg.n, TimeZone_h.n)
```

Arguments

LatDeg	Latitude in (decimal) degrees (-90 to + 90)
LongDeg	Longitude in (decimal) degrees (-180 to + 180)
TimeZoneHour	Time zone: hours shift to UTC, e.g. 1 for Berlin
Lat_deg.n	deprecated
Long_deg.n	deprecated
TimeZone_h.n	deprecated

Author(s)

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sEddyProc_sSetUstarScenarios

sEddyProc sSetUstarScenarios

Description

set uStar processing scenarios

Usage

```
sEddyProc_sSetUstarScenarios(uStarTh, uStarSuffixes = colnames(uStarTh)[-1])
```

Arguments

uStarTh   data.frame as returned by [usGetAnnualSeasonUStarMap](#) or [usGetSeasonalSeasonUStarMap](#):
                 First column, season names, and remaining columns different estimates of uStar
                 Threshold. If uStarTh has only one row, then each uStar threshold estimate is
                 applied to the entire dataset. Entries in first column must match levels in argu-
                 ment seasonFactor of [sEddyProc_sEstUstarThresholdDistribution](#)

uStarSuffixes   the suffixes appended to result column names by default the column names of
                 uStarTh unless its first season column

Author(s)

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See Also

[sEddyProc_sGetUstarScenarios](#)

sEddyProc_sSetUStarSeasons

sEddyProc sSetUStarSeasons

Description

Defining seasons for the uStar threshold estimation

Usage

```
sEddyProc_sSetUStarSeasons(seasonFactor = usCreateSeasonFactorMonth(sDATA$sDateTime))
```

Arguments

seasonFactor   factor for subsetting times with different uStar threshold (see details)

Value

class with updated seasonFactor

Author(s)

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---

sEddyProc_sTKFluxPartition

sEddyProc sTKFluxPartition

Description

Modified daytime-based Flux partitioning after Keenan et al. (2019)

Usage

```
sEddyProc_sTKFluxPartition(..., controlGLPart = partGLControl())
```

Arguments

...   arguments to [sEddyProc_sGLFluxPartition](#) in addition to the dataset

controlGLPart   further default parameters, such as suffix

Value

Flux partitioning results are in sTEMP data frame of the class.

Author(s)

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---

sEddyProc_sTKFluxPartitionUStarScens

sEddyProc sTKFluxPartitionUStarScens

Description

Flux partitioning after Keenan et al., 2019

Usage

```
sEddyProc_sTKFluxPartitionUStarScens(...,
    uStarScenKeep = character(0))
```

Arguments

...	arguments to `sEddyProc_sTKFluxPartition`
uStarScenKeep	Scalar string specifying the scenario for which to keep parameters (see `sEddyProc_sApplyUStarScen`. Defaults to the first scenario.

Details

Daytime-based partitioning of measured net ecosystem fluxes into gross primary production (GPP) and ecosystem respiration (Reco) for all u* threshold scenarios.

Note

Currently only experimental.

Author(s)

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sEddyProc_update_ustarthreshold_columns
                        Add columns reporting the uStar threshold for each scenario to sDATA

Description

Add columns reporting the uStar threshold for each scenario to sDATA

Usage

```
sEddyProc_update_ustarthreshold_columns()
```

Value

side effect in .self$sDATA new columns Ustar_Thresh_<ustarsuffix>

See Also

sEddyProc_sGetUstarScenarios

---

sEddyProc_useAnnualUStarThresholds
                        sEddyProc useAnnualUStarThresholds

Description

use seasonal estimates of uStar thresholds

Usage

```
sEddyProc_useAnnualUStarThresholds()
```

Author(s)

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See Also

sEddyProc_sSetUstarScenarios, sEddyProc_useSeaonsalUStarThresholds

sEddyProc_useSeaonsalUStarThresholds

sEddyProc useSeaonsalUStarThresholds

Description

use seasonal estimates of uStar thresholds

Usage

```
sEddyProc_useSeaonsalUStarThresholds()
```

Author(s)

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See Also

sEddyProc_sSetUstarScenarios, sEddyProc_useAnnualUStarThresholds

---

usControlUstarEst   *usControlUstarEst*

Description

Default list of parameters for determining UStar of a single binned series

Usage

```
usControlUstarEst(ustPlateauFwd = 10, ustPlateauBack = 6,
    plateauCrit = 0.95, corrCheck = 0.5,
    firstUStarMeanCheck = 0.2, isOmitNoThresholdBins = TRUE,
    isUsingCPTSeveralT = FALSE, isUsingCPT = FALSE,
    minValidUStarTempClassesProp = 0.2, minValidBootProp = 0.4,
    minNuStarPlateau = 3L)
```

Arguments

ustPlateauFwd number of subsequent uStar bin values to compare to in fwd mode

ustPlateauBack number of subsequent uStar bin values to compare to in back mode

plateauCrit significant differences between a uStar value and the mean of a "plateau"

corrCheck threshold value for correlation between Tair and u * data

firstUStarMeanCheck
 if first uStar bin average of a class is already larger than this value, the temperature class is skipped.

isOmitNoThresholdBins
 if TRUE, bins where no threshold was found are ignored. Set to FALSE to report highest uStar bin for these cases

isUsingCPTSeveralT
 set to TRUE to use change point detection without binning uStar but with additionally changed aggregation scheme for several temperature classifications

isUsingCPT set to TRUE to use change point detection without binning uStar before in usual aggregation method (good for comparing methods, but not recommended, overruled by isUsingCPTSeveralT = TRUE)

minValidUStarTempClassesProp
 seasons, in which only less than this proportion of temperature classes a threshold was detected, are excluded from aggregation

minValidBootProp
 minimum proportion of bootstrap samples for which a threshold was detected. Below this proportion NA quantiles are reported.

minNuStarPlateau
 minimum number of records in plateau, threshold must be larger than mean of this many bins

Author(s)

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See Also

[usEstUstarThresholdSingleFw2Binned](), [usControlUstarSubsetting]()

Examples

usControlUstarEst()

---

usControlUstarSubsetting

usControlUstarSubsetting

Description

Default list of parameters for subsetting the data for uStarThreshold estimation

Usage

```
usControlUstarSubsetting(taClasses = 7, UstarClasses = 20,
    swThr = 10, minRecordsWithinTemp = 100,
    minRecordsWithinSeason = 160, minRecordsWithinYear = 3000,
    isUsingOneBigSeasonOnFewRecords = TRUE)
```

Arguments

taClasses	set number of air temperature classes
UstarClasses	set number of Ustar classes
swThr	nighttime data threshold for solar radiation [Wm-2]
minRecordsWithinTemp	
	integer scalar: the minimum number of Records within one Temperature-class
minRecordsWithinSeason	
	integer scalar: the minimum number of Records within one season
minRecordsWithinYear	
	integer scalar: the minimum number of Records within one year
isUsingOneBigSeasonOnFewRecords	
	boolean scalar: set to FALSE to avoid aggregating all seasons on too few records

Author(s)

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See Also

usEstUstarThresholdSingleFw2Binned , usControlUstarSubsetting

Examples

usControlUstarSubsetting()

usCreateSeasonFactorMonth

usCreateSeasonFactorMonth

Description

Compute year-spanning Seasonfactor by starting month

Usage

```
usCreateSeasonFactorMonth(dates, month = as.POSIXlt(dates)$mon +
    1L, year = as.POSIXlt(dates)$year + 1900L,
    startMonth = c(3, 6, 9, 12))
```

Arguments

dates	POSIXct vector of length of the data set to be filled, specifying the center-time of each record
month	integer (1-12) vector of length of the data set to be filled, specifying the month for each record
year	integer vector of length of the data set to be filled, specifying the year
startMonth	integer vector specifying the starting month for each season, counting from one. Default is (Dez, Jan, Feb)(Mar, April, May)(June, July, August), (Sept, Oct, Nov)

Details

Compute factors to denote the season for uStar-Filtering by specifying starting months, with continuous seasons spanning year boundaries If Jan is not a starting month, then the first months of each year will be part of the last period in the year. E.g. with the default the fourth period of the first year consists of Jan, Feb, Dec.

REddyProc internally works with a timestamp 15 minutes after the start of each half hour. When providing the dates argument, user may shift the start time by dates = myDataset$DateTime + 15 * 60

Value

Integer vector length(dates), with each unique value representing one season

Author(s)

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See Also

[usCreateSeasonFactorMonthWithinYear](#), [usCreateSeasonFactorYday](#), [usCreateSeasonFactorYdayYear](#)

---

usCreateSeasonFactorMonthWithinYear

usCreateSeasonFactorMonthWithinYear

Description

Compute year-bounded Seasonfactor by starting month

Usage

```
usCreateSeasonFactorMonthWithinYear(dates,
    month = as.POSIXlt(dates)$mon + 1, year = as.POSIXlt(dates)$year +
        1900, startMonth = c(3, 6, 9, 12))
```

Arguments

dates	POSIXct vector of length of the data set to be filled, specifying the center-time of each record
month	integer (1-12) vector of length of the data set to be filled, specifying the month for each record
year	integer vector of length of the data set to be filled, specifying the year
startMonth	integer vector specifying the starting month for each season, counting from one. Default is (Dez, Jan, Feb)(Mar, April, May)(June, July, August), (Sept, Oct, Nov)

Details

Calculate factors to denote the season for uStar-Filtering by specifying starting months, with seasons not spanning year boundaries If Jan is not a starting month, then the first months of each year will be part of the last period in the year. E.g. with the default the fourth period of the first year consists of Jan, Feb, Dec.

Value

Integer vector length(dates), with each unique value representing one season

Author(s)

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See Also

[usCreateSeasonFactorMonth](#)

usCreateSeasonFactorYday

usCreateSeasonFactorYday

Description

Compute year-spanning Seasonfactor by starting year-day

Usage

```
usCreateSeasonFactorYday(dates, yday = as.POSIXlt(dates)$yday +
    1L, year = as.POSIXlt(dates)$year + 1900L,
    startYday = c(335, 60, 152, 244))
```

Arguments

dates	POSIXct vector of length of the data set to be filled, specifying the center-time of each record
yday	integer (1-366) vector of length of the data set to be filled, specifying the day of the year (1..366) for each record
year	integer vector of length of the data set to be filled, specifying the year
startYday	integer vector (1-366) specifying the starting yearDay for each season in increasing order

Details

With default parameterization, dates are assumed to denote begin or center of the eddy time period.
If working with dates that denote the end of the period, use yday = as.POSIXlt(fGetBeginOfEddyPeriod(dates))$yday

Value

Integer vector of length nrow(ds), each unique class representing one season

Author(s)

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See Also

[usCreateSeasonFactorMonth](#)

usCreateSeasonFactorYdayYear

usCreateSeasonFactorYdayYear

Description

Compute year-spanning Seasonfactor by starting year and yearday

Usage

```
usCreateSeasonFactorYdayYear(dates, yday = as.POSIXlt(dates)$yday +
    1L, year = as.POSIXlt(dates)$year + 1900L,
    starts)
```

Arguments

dates	POSIXct vector of length of the data set to be filled, specifying the center-time of each record
yday	integer (1-366) vector of length of the data set to be filled, specifying the day of the year (1..366) for each record
year	integer vector of length of the data set to be filled, specifying the year
starts	data.frame with first column specifying the starting yday (integer 1-366) and second column the year (integer e.g. 1998) for each season in increasing order

Details

With default parameterization, dates are assumed to denote begin or center of the eddy time period.
If working with dates that denote the end of the period, use yday = as.POSIXlt(fGetBeginOfEddyPeriod(dates))$yday

Value

Integer vector of length `nrow(ds)`, each unique class representing one season

Author(s)

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See Also

[usCreateSeasonFactorMonth](#)

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usEstUstarThreshold   *usEstUstarThreshold - Estimating ustar threshold*

Description

Estimate the Ustar threshold by aggregating the estimates for seasonal and temperature subsets.

Usage

```
usEstUstarThreshold(ds, seasonFactor = usCreateSeasonFactorMonth(ds$sDateTime),
    yearOfSeasonFactor = usGetYearOfSeason(seasonFactor,
        ds$sDateTime), ctrlUstarEst = usControlUstarEst(),
    ctrlUstarSub = usControlUstarSubsetting(),
    fEstimateUStarBinned = usEstUstarThresholdSingleFw2Binned,
    isCleaned = FALSE, isInBootstrap = FALSE)
```

Arguments

ds	data.frame with columns "sDateTime", "Ustar", "NEE", "Tair", and "Rg"
seasonFactor	factor for subsetting times (see details)
yearOfSeasonFactor	
	named integer vector: for each seasonFactor level, get the year (aggregation period) that this season belongs to
ctrlUstarEst	control parameters for estimating uStar on a single binned series, see usControlUstarEst
ctrlUstarSub	control parameters for subsetting time series (number of temperature and Ustar classes . . .), see usControlUstarSubsetting
fEstimateUStarBinned	
	function to estimate UStar on a single binned series, see usEstUstarThresholdSingleFw2Binned
isCleaned	set to TRUE, if the data was cleaned already, to avoid expensive call to usGetValidUstarIndices.
isInBootstrap	set to TRUE if this is called from sEddyProc_sEstimateUstarScenarios to avoid further bootstraps in change-point detection

Details

The threshold for sufficiently turbulent conditions u * (Ustar) is estimated for different subsets of the time series. From the estimates for each season (each value in seasonFactor) the maximum of all seasons of one year is reported as estimate for this year. Within each season the time series is split by temperature classes. Among these Ustar estimates, the median is reported as season value.

In order to split the seasons, the uses must provide a vector with argument seasonFactor. All positions with the same factor, belong to the same season. It is conveniently generated by one of the following functions:

- usCreateSeasonFactorMonth (default DJF-MAM-JJA-SON with December from previous to January of the year)

- usCreateSeasonFactorMonthWithinYear (default DJF-MAM-JJA-SON with December from the same year)
- usCreateSeasonFactorYday for a refined specification of season starts.
- usCreateSeasonFactorYdayYear for specifying different seasons season between years.

The estimation of Ustar on a single binned series can be selected argument fEstimateUStarBinned.

- usEstUstarThresholdSingleFw1Binned
- usEstUstarThresholdSingleFw2Binned (default)

This function is called by

- sEddyProc_sEstUstarThold which stores the result in the class variables (sUSTAR and sDATA).
- sEddyProc_sEstUstarThresholdDistribution which additionally estimates median and confidence intervals for each year by bootstrapping the original data within seasons.

For inspecting the NEE~uStar relationship plotting is provided by sEddyProc_sPlotNEEVersusUStarForSeason

change point detection (CPT) method With specifying ctrlUstarEst = usControlUstarEst(isUsingCPTSeveralT = TRUE) change point detection is applied instead of the moving point test (e.g. with Fw2Binned).
The sometimes sensitive binning of uStar values within a temperature class is avoided. Further, possible spurious thresholds are avoid by testing that the model with a threshold fits the data better than a model without a threshold using a likelihood ratio test. In addition, with CPT seasons are excluded where a threshold was detected in only less than ctrlUstarEst$minValidUStarTempClassesProp (default 20%) of the temperature classes.
Note, that this method often gives higher estimates of the u * threshold.

One-big-season fallback If there are too few records within one year, of when no season yielded a finite u * Threshold estimate, then the yearly u * Th is estimated by pooling the data from seasons within one seasonYear. The user can suppress using pooled data on few records by providing option ctrlUstarSub$isUsingOneBigSeasonOnFewRecords = FALSE (see usControlUstarSubsetting)

Value

A list with entries data.frame with columns "aggregationMode", "seasonYear", "season", "uStar" with rows for "single": the entire aggregate (median across years) , "seasonYear": each year (maximum across seasons or estimate on pooled data) , "season": each season (median across temperature classes)

seasonYear   data.frame listing results for year with columns "seasonYear" , "uStarMaxSeason" the maximum across seasonal estimates within the year , "uStarPooled" the estimate based on data pooled across the year (only calculated on few valid records or on uStarMaxSeason was nonfinite) , "nRec" number of valid records (only if the pooled estimate was calculated) , "uStarAggr" chosen estimate, corresponding to uStarPooled if this was calculated, or uStarMaxSeason or uStarTh across years if the former was non-finite

season   data.frame listing results for each season , "nRec" the number of valid records , "uStarSeasonEst" the estimate for based on data within the season (median across temperature classes) , "uStarAggr" chose estimate, corresponding to uStarSeasonEst, or the yearly seasonYear$uStarAggr, if the former was non-finite

| tempInSeason | numeric matrix (nTemp x nAggSeason): estimates for each temperature subset for each season |
| bins | columns season, tempBin and uStarBin for each record of input ds reporting classes of similar environmental conditions that the record belongs to. |

Author(s)

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References

Ustar filtering following the idea in Papale, D. et al. (2006) Towards a standardized processing of net ecosystem exchange measured with eddy covariance technique: algorithms and uncertainty estimation. Biogeosciences 3(4): 571-583.

---

usEstUstarThresholdSingleFw1Binned

usEstUstarThresholdSingleFw1Binned

Description

estimate the Ustar threshold for single subset, using FW1 algorithm

Usage

```
usEstUstarThresholdSingleFw1Binned(Ust_bins.f,
    ctrlUstarEst = usControlUstarEst())
```

Arguments

| Ust_bins.f | data.frame with columns NEE_avg and Ust_avg, of Ustar bins |
| ctrlUstarEst | parameter list, see usControlUstarEst for defaults and description |

Details

Relying on binned NEE and Ustar

Author(s)

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References

inspired by Papale 2006

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usEstUstarThresholdSingleFw2Binned

usEstUstarThresholdSingleFw2Binned

Description

estimate the Ustar threshold for single subset, using FW2 algorithm

Usage

```
usEstUstarThresholdSingleFw2Binned(Ust_bins.f,
    ctrlUstarEst = usControlUstarEst())
```

Arguments

Ust_bins.f	data.frame with column s NEE_avg and Ust_avg, of Ustar bins
ctrlUstarEst	parameter list, see [usControlUstarEst](#) for defaults and description

Details

Demand that threshold is higher than `ctrlUstarEst$minNuStarPlateau` records. If fewer records

Author(s)

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---

usGetAnnualSeasonUStarMap

usGetAnnualSeasonUStarMap

Description

extract mapping season -> uStar columns from Distribution result

Usage

```
usGetAnnualSeasonUStarMap(uStarTh)
```

Arguments

uStarTh   result of [sEddyProc_sEstUstarThresholdDistribution](#) or [sEddyProc_sEstUstarThreshold](#)$uStarT

Value

a data frame with first column the season, and other columns different uStar threshold estimates

Author(s)

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---

usGetSeasonalSeasonUStarMap

usGetSeasonalSeasonUStarMap

Description

extract mapping season -> uStar columns from Distribution result

Usage

```
usGetSeasonalSeasonUStarMap(uStarTh)
```

Arguments

uStarTh   result of [sEddyProc_sEstUstarThresholdDistribution](#) or [sEddyProc_sEstUstarThreshold](#)$uStarT

Details

from result of sEddyProc_sEstUstarThresholdDistribution

Value

a data frame with first column the season, and other columns different uStar threshold estimates

Author(s)

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---

usGetYearOfSeason *usGetYearOfSeason*

Description

determine the year of the record of middle of seasons

Usage

```
usGetYearOfSeason(seasonFactor, sDateTime.v)
```

Arguments

seasonFactor	factor vector of length data: for each record which season it belongs to
sDateTime.v	POSIX.t vector of length data: for each record: center of half-hour period (corresponding to sDATA$sDateTime)

Value

named integer vector, with names corresponding to seasons

Author(s)

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