Package ‘solartime’

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Title  Utilities Dealing with Solar Time Such as Sun Position and Time of Sunrise
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Description Provide utilities to work with solar time, i.e. where noon is exactly when sun culminates. Provides functions for computing sun position and times of sunrise and sunset.
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Description

Provide utilities to work with solar time, i.e. where noon is exactly when sun culminates. Provides functions for computing sun position and times of sunrise and sunset.

Details

Most fundamental functions are

- corrected fractional hour `getSolarTimeHour` based on `computeSolarToLocalTimeDifference`
- computing position of the sun `computeSunPosition`

On this basis, properties are computed such as

- hour of sunrise and sunset: `computeSunriseHour,computeSunsetHour`
- daylength in hours: `computeDayLength`
- flagging times as day or night: `computeIsDayByHour` and `computeIsDayByLocation` and

More utils provide

- get the hours ahead UTC: `getHoursAheadOfUTC`
- get fractional hour of the day: `getFractionalHours`

Also have a look at the package vignettes.

Author(s)

Thomas Wutzler
Description

Compute the Day-length in hours for given time and coordinates

Usage

computeDayLength(timestamp, latDeg, ...)

Arguments

timestamp POSIXt vector
latDeg Latitude in (decimal) degrees
...
... further arguments to computeDayLengthDoy

Value

result of computeDayLengthDoy

Author(s)

Thomas Wutzler

Description

Compute the Day-length in hours for given time and coordinates

Usage

computeDayLengthDoy(doy, latDeg)

Arguments

doy integer vector with day of year [DoY, 1..366], same length as Hour or length 1
latDeg Latitude in (decimal) degrees

Value

numeric vector of length(doy) giving the time between sunrise and sunset in hours
Author(s)

Thomas Wutzler

Examples

doy <- 1:366
plot( computeDayLengthDoy(doy, latDeg = 51) - doy)
# north pole: daylength 0 and 24 hours
plot( computeDayLengthDoy( doy, latDeg = +80) - doy )
plot( computeDayLengthDoy( doy, latDeg = -80) - doy )

Description

tell for each date, whether its daytime

Usage

computeIsDayByHour(date, sunriseHour = 7,
                    sunsetHour = 18, duskOffset = 0)

Arguments

date POSIXct vector
sunriseHour sunrise as fractional hour (0..24) (vector of length date or length 1)
sunsetHour sunset as fractional hour (vector of length date or length 1)
duskOffset integer scalar: time in hours after dusk for which records are still regarded as day

Value

logical vector (length(date)): true if its daytime

Author(s)

Thomas Wutzler
computeIsDayByLocation

Description

tell for each timestamp, whether its daytime

Usage

computeIsDayByLocation(timestamp, latDeg, longDeg, timeZone = getHoursAheadOfUTC(timestamp), duskOffset = 0, isCorrectSolartime = TRUE)

Arguments

timestamp POSIXct vector
latDeg Latitude in (decimal) degrees
longDeg Longitude in (decimal) degrees
timeZone Time zone (in hours) ahead of UTC (Central Europe is +1)
duskOffset integer scalar: time in hours after dusk for which records are still regarded as day
isCorrectSolartime set to FALSE to omit correction between local time and solar time, e.g. if coordinates cannot be provided

Details

computes hour of sunrise and sunset from given date in timezone hour (assuming dates are given in timezone instead of solartime)

Value

logical vector (length(date)): true if its daytime

Author(s)

Thomas Wutzler

Examples

dateSeq <- seq( as.POSIXct("2017-03-20", tz = "Etc/GMT-1"), as.POSIXct("2017-03-21", tz = "Etc/GMT-1"), by = "30 min")
tmp <- computeIsDayByLocation(
  dateSeq, latDeg = 50.93, longDeg = 11.59, timeZone = 1)
plot( tmp ~ dateSeq )
computeSolarToLocalTimeDifference

Description

computes the time difference in hours between (apparent) solar time and local time

Usage

computeSolarToLocalTimeDifference(longDeg, timeZone, doy = integer(1), fracYearInRad = 2 * pi * (doy - 1)/365.24)

Arguments

longDeg Longitude in (decimal) degrees
timeZone Time zone (in hours) ahead of UTC (Berlin is +1)doy integer vector with day of year [DoY, 1..366], Specify NA get mean solar time across the year instead of apparent solar time (i.e. with differences throughout the year due to eccentricity of earth orbit)fracYearInRad may specify instead of doy for efficiency.

Value

time difference in hours to be added to local winter time to get solar time

Author(s)

Thomas Wutzler

Examples

# Jena: 50.927222, 11.586111
longDeg <- 11.586
doi <- 1:366
# due to longitude: west of timezone meridian: sun culminates later,
# solar time is less than local time
(localDiff <- computeSolarToLocalTimeDifference(longDeg, 1L)*60)
# taking into account shift during the year due to earth orbit eccentricity
plot( computeSolarToLocalTimeDifference(longDeg, 1L, doi)*60 - doi )
abline(h = localDiff)
computeSunPosition

Description
Calculate the position of the sun

Usage
computeSunPosition(timestamp, latDeg, longDeg)

Arguments
- timestamp: POSIXct
- latDeg: Latitude in (decimal) degrees
- longDeg: Longitude in (decimal) degrees

Value
as returned by computeSunPositionDoyHour

Author(s)
Thomas Wutzler

computeSunPositionDoyHour

Description
Compute the position of the sun (solar angle)

Usage
computeSunPositionDoyHour(doy, hour, latDeg, longDeg = NA, timeZone = NA, isCorrectSolartime = TRUE)
computeSunriseHour

Arguments

doy integer vector with day of year [DoY, 1..366], same length as Hour or length 1
hour numeric vector with local winter time as decimal hour [0..24]
latDeg Latitude in (decimal) degrees
longDeg Longitude in (decimal) degrees
timeZone Time zone (in hours) ahead of UTC (Central Europe is +1)
isCorrectSolarTime 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 if times are specified already as solar times.

Details

This code assumes that Hour is given in local winter time zone. By default, it corrects by longitude to solar time (where noon is exactly at 12:00). Set argument isCorrectSolarTime to FALSE to use the given local winter time instead.

Value

named numeric matrix with one row for each time with entries
hour Solar time in fractional hours after midnight, (or given hour if isCorrectSolarTime = FALSE).
declination Solar declination (rad)
elevation Solar elevation (rad) with 0 at horizon increasing towards zenith
azimuth Solar azimuth (rad) with 0 at North increasing eastwards

Author(s)

Thomas Wutzler

Examples

computeSunPositionDayHour(  
  160, hour = 0:24, latDeg = 51, longDeg = 13.6, timeZone = 1L)

computeSunriseHour  computeSunriseHour

description

Compute the hour of sunrise for given day and coordinates
**Usage**

```r
computeSunriseHourDoy(timestamp, latDeg, longDeg = NA,
                        timeZone = getHoursAheadOfUTC(timestamp),
                        ...)```

**Arguments**

- `timestamp`: POSIXt vector
- `latDeg`: Latitude in (decimal) degrees
- `longDeg`: Longitude in (decimal) degrees (not required if solar time is sufficient)
- `timeZone`: Time zone (in hours) ahead of UTC (Central Europe is +1) (not required if solar time is sufficient)
- `...`: further arguments to `computeSunriseHourDoy`

**Value**

result of `computeSunriseHourDoy`

**Author(s)**

Thomas Wutzler

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**Description**

Compute the hour of sunrise for given day and coordinates

**Usage**

```r
computeSunriseHourDoy(doy, latDeg, longDeg = NA,
                        timeZone = NA, isCorrectSolartime = TRUE)```

**Arguments**

- `doy`: integer vector with day of year [DoY, 1..366]
- `latDeg`: Latitude in (decimal) degrees
- `longDeg`: Longitude in (decimal) degrees (not required if solar time is sufficient)
- `timeZone`: Time zone (in hours) ahead of UTC (Central Europe is +1) (not required if solar time is sufficient)
- `isCorrectSolartime`: sunrise hour is computed first for solar time (where noon is exactly at 12:00)
  If TRUE (default) then sunrise hour is converted to local winter time, based on `timeZone` and longitude.
computeSunsetHour

Value

numeric vector of length(doy) giving the time of sunrise in hours after midnight. Polar night is indicated by 12h, polar day by 0h.

Author(s)

Thomas Wutzler

Examples

today <- as.POSIXlt(Sys.Date())$yday
(sunrise <- computeSunriseHourDoy(today, latDeg = 51, isCorrectSolartime = FALSE))
(sunrise <- computeSunriseHourDoy(today, latDeg = 51, longDeg = 11.586, timeZone = +1))
# elevation near zero
computeSunPositionDoyHour(160, sunrise, latDeg = 51, isCorrectSolartime = FALSE)
#
doy <- 1:366
plot( computeSunriseHourDoy(doy, latDeg = 51, isCorrectSolartime = FALSE) - doy )
# north pole: daylength 0 and 24 hours
plot( computeSunriseHourDoy( doy, latDeg = +80, isCorrectSolartime = FALSE) - doy )
plot( computeSunriseHourDoy( doy, latDeg = -80, isCorrectSolartime = FALSE) - doy )

computeSunsetHour  computeSunsetHour

Description

Compute the hour of sunrise for given day and coordinates.

Usage

computeSunsetHour(timestamp, latDeg, longDeg = NA,
                   timeZone = getHoursAheadOfUTC(timestamp),
                   ...)

Arguments

timestamp POSIXt vector
latDeg Latitude in (decimal) degrees
longDeg Longitude in (decimal) degrees (not required if solar time is sufficient)
timeZone Time zone (in hours) ahead of UTC (Central Europe is +1) (not required if solar
time is sufficient)
...

Value

result of computeSunsetHourDoy
computeSunsetHourDoy

Author(s)

Thomas Wutzler

Description

Compute the hour of sunrise for given day and coordinates

Usage

computeSunsetHourDoy(doy, latDeg, longDeg = NA,
   timeZone = NA, isCorrectSolartime = TRUE)

Arguments

  doy          integer vector with day of year [DoY, 1..366]
  latDeg      Latitude in (decimal) degrees
  longDeg     Longitude in (decimal) degrees (not required if solar time is sufficient)
  timeZone    Time zone (in hours) ahead of UTC (Central Europe is +1) (not required if solar time is sufficient)
  isCorrectSolartime
      sunrise hour is computed first for solar time (where noon is exactly at 12:00)
      If TRUE (default) then sunrise hour is converted to local winter time, based on
      timeZone and longitude.

Value

numeric vector of length(doy) giving the time of sunset in hours after midnight. Polar night is
indicated by 12h, polar day by 24h.

Author(s)

Thomas Wutzler

Examples

today <-
   as.POSIXlt(Sys.Date())$yday
(sunset <- computeSunsetHourDoy(today, latDeg = 51, isCorrectSolartime = FALSE))
(sunset <- computeSunsetHourDoy(today, latDeg = 51, longDeg = 11.586, timeZone = +1))
#
doy <- 1:366
plot( computeSunsetHourDoy(doy, latDeg = 51, isCorrectSolartime = FALSE) ~ doy )
# north pole: daylength 0 and 24 hours
plot( computeSunsetHourDoy( doy, latDeg = +80, isCorrectSolartime = FALSE) ~ doy )
plot( computeSunsetHourDoy( doy, latDeg = -80, isCorrectSolartime = FALSE) ~ doy )
getFractionalHours

Description
get the time difference to previous midnight in fractional hours

Usage
getFractionalHours(timestamp)

Arguments
timestamp POSIXt vector

Value
numeric vector of fractional hours

Author(s)
Thomas Wutzler

getHoursAheadOfUTC

Description
get the time difference to UTC in hours

Usage
getHoursAheadOfUTC(timestamp)

Arguments
timestamp POSIXt vector

Value
integer vector of how many hours noon of timestamp is ahead of noon in UTC

Author(s)
Thomas Wutzler
Description
Get the fractional hour of solar time

Usage
getSolarTimeHour(timestamp, longDeg)

Arguments
- timestamp: POSIXt vector in local time
- longDeg: Longitude in (decimal) degrees

Value
fractional hour corrected by difference to local time

Author(s)
Thomas Wutzler
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