Package 'solrad'

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Title Calculating solar radiation and related variables based on location, time and topographical conditions

Description The 'solrad' R package is to be used in surface energy models and estimation of solar positions and components with varying topography, time and locations. The functions calculate solar top-of-atmosphere, open, diffuse and direct components, atmospheric transmittance and diffuse factors, day length, sunrise and sunset, solar azimuth, zenith, altitude, incidence, and hour angles, earth declination anlge, equation of time, and solar constant.

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NeedsCompilation no

R topics documented:

Altitude
AST
Azimuth
DayLength
DayOfYear
Declination
DiffuseRadiation
DiffusionFactor
DirectRadiation

2 Altitude

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Description

This function solar altitude angle (in degrees) for a given day of year and location.

Usage

```
Altitude(DOY, Lat, Lon, SLon, DS)
```

Arguments

DOY	Day of year
Lat	Latitude in degrees
Lon	Longitude in degrees
SLon	Standard longitude (based on time zone) in degrees
DS	Daylight saving in minutes

```
#Calculating solar altitude angle for two consecutive days

DOY <- seq(0, 2, .05)

alpha <- Altitude(DOY, Lat = 45, Lon=0, SLon=0, DS=60)
#Note: only the difference between Lon and SLon matters not each value
plot(DOY, alpha)</pre>
```

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|--|

Description

This function returns the apparent solar time (in minutes) for a given day of year and location.

Usage

```
AST(DOY, Lon, SLon, DS)
```

Arguments

DOY	Day of year
Lon	Longitude in degrees
SLon	Standard longitude (based on time zone) in degrees
DS	Daylight saving in minutes

Examples

```
#Calculating apparent solar time for two consecutive days

DOY <- seq(0, 2, .05)

ast <- AST(DOY, Lon=0, SLon=0, DS=60)
#Note: only the difference between Lon and SLon matters not each value
plot(DOY, ast)</pre>
```

Azimuth	Solar Azimuth Angle

Description

This function returns solar azimuth angle (in degrees) for a given day of year and location. The solar azimuth angle is the angle of sun's ray measured in the horizental plane from due south

Usage

```
Azimuth(DOY, Lat, Lon, SLon, DS)
```

DayLength

Arguments

DOY	Day of year
Lat	Latitude (in degrees)
Lon	Longitude in degrees
SLon	Standard longitude (based on time zone) in degrees
DS	Daylight saving in minutes

Examples

```
#Calculating solar azimuth angle for two consecutive days on 45 degree lat and 10 degree lon DOY <- seq(0, 2, .05)

Az <- Azimuth(DOY, Lat = 45, Lon=10, SLon=10, DS=0)

#Note: only the difference between Lon and SLon matters not each value plot(DOY, Az)
```

DayLength

Day Length

Description

This function estimates day length (in hours) for a given day of year and latitude.

Usage

```
DayLength(DOY, Lat)
```

Arguments

DOY Day of year

Lat Latitude (in degrees)

```
#Calculating day length for 365 day of the year for 45 degree latitude
DOY <- 1:365
Lat = 45
dl <- DayLength(DOY, Lat)
plot(DOY, dl)</pre>
```

DayOfYear 5

Day of year Day of year

Description

This function returns a continuous the day of year value (as integer value 1:365) for a given date-time in "POSIXIt" "POSIXct" format.

Usage

```
DayOfYear(DateTime)
```

Arguments

DateTime

DateTime object

Examples

```
#Calculating day of year for now
DayOfYear(Sys.time())
```

Declination

Declination Angle

Description

This function calculates solar declination angle for a given day of year.

Usage

Declination(DOY)

Arguments

DOY

Day of year

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Examples

```
#Calculating solar declination angle for 365 day of the year
DOY <- 1:365
delta <- Declination(DOY)
plot(DOY, delta)</pre>
```

DiffuseRadiation

Solar Diffuse Radiation on a Surface

Description

This function returns solar diffuse dadiation (in W/m2) for a given day of year, location and topography.

Usage

```
DiffuseRadiation(DOY, Lat, Lon, SLon, DS, Elevation, Slope)
```

Arguments

DOY	Day of year
-----	-------------

Lat Latitude (in degrees)
Lon Longitude in degrees

SLon Standard longitude (based on time zone) in degrees

DS Daylight saving in minutes
Elevation Elevation of the site in meters

Slope Site slope in degrees

Examples

#Calculating atmospheric transmittance coefficient for two consecutive days on 45 degree # latitude and 10 degree longitude and at 100 m altitude.

```
DOY <- seq(0, 2, .05)
```

Sdifopen <- DiffuseRadiation(DOY, Lat = 45, Lon=10, SLon=10, DS=0, Elevation = 100, Slope = 0) #Note: only the difference between Lon and SLon matters not each value

```
plot(DOY, Sdifopen)
```

DiffusionFactor 7

Description

This function returns atmospheric diffusion factor for a given day of year, location and topography.

Usage

```
DiffusionFactor(DOY, Lat, Lon, SLon, DS, Elevation)
```

Arguments

DOY	Day of year
Lat	Latitude (in degrees)
Lon	Longitude in degrees
SLon	Standard longitude (based on time zone) in degrees
DS	Daylight saving in minutes
Elevation	Elevation of the site in meters

Examples

```
#Calculating atmospheric diffusion factor for two consecutive days on 45 degree
# latitude and 10 degree longitude and at 100 m altitude.

DOY <- seq(0, 2, .05)

td <- DiffusionFactor(DOY, Lat = 45, Lon=10, SLon=10, DS=0, Elevation = 100)
#Note: only the difference between Lon and SLon matters not each value
plot(DOY, td)</pre>
```

DirectRadiation	Solar Direct Beam Radiation on Surface	

Description

This function returns solar open direct beam dadiation (in W/m2) for a given day of year, location and topography.

Usage

```
DirectRadiation(DOY, Lat, Lon, SLon, DS, Elevation, Slope, Aspect)
```

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Arguments

DOY Day of year

Lat Latitude (in degrees)

Lon Longitude in degrees

SLon Standard longitude (based on time zone) in degrees

DS Daylight saving in minutes

Elevation Elevation of the site in meters

Slope Site slope in degrees

Aspect Site aspect with respect to the south in degrees

Examples

#Calculating atmospheric transmittance coefficient for two consecutive days on 45 degree #latitude and 10 degree longitude and at 100 m altitude.

```
DOY < - seq(0, 2, .05)
```

Sopen <- OpenRadiation(DOY, Lat = 45, Lon=10, SLon=10, DS=0, Elevation = 100) #Note: only the difference between Lon and SLon matters not each value

plot(DOY, Sopen)

EOT Equation of time

Description

This function approximates the value of equation of time for a given day of year

Usage

EOT(DOY)

Arguments

DOY Day of year

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Examples

```
#Calculating equaiton of time for 365 day of the year

DOY <- 1:365

eot <- EOT(DOY)

plot(DOY, eot)</pre>
```

Extraterrestrial

Solar Extraterrestrial Radiation

Description

This function calculates solar extraterrestrial radiation (in W/m2) for a given day of year.

Usage

```
Extraterrestrial(DOY)
```

Arguments

DOY

Day of year

Examples

```
#Calculating solar extraterrestrial radiation for 365 day of the year
DOY <- 1:365
Sextr <- Extraterrestrial(DOY)
plot(DOY, Sextr)</pre>
```

ExtraterrestrialNormal

Normal Extraterrestrial Solar Radiation

Description

This function calculates extraterrestrial solar radiation normal to surface (in W/m2) for a given day of year, location and topography.

HourAngle

Usage

ExtraterrestrialNormal(DOY, Lat, Lon, SLon, DS, Slope, Aspect)

Arguments

DOY	Day of year
Lat	Latitude (in degrees)
Lon	Longitude in degrees
SLon	Standard longitude (based on time zone) in degrees
DS	Daylight saving in minutes

Slope Site slope in degrees

Aspect Site aspect with respect to the south in degrees

Examples

```
#Calculating solar incidence angle for two consecutive days on 45 degree latitude and
# 10 degree longitude

DOY <- seq(0, 2, .05)

SextrNormal <- ExtraterrestrialNormal(DOY, Lat = 45, Lon=10, SLon=10, DS=0, Slope = 10, Aspect = 0)
#Note: only the difference between Lon and SLon matters not each value
plot(DOY, SextrNormal)</pre>
```

Description

This function returns solar hour angle for a given day of year, and location.

Usage

```
HourAngle(DOY, Lon, SLon, DS)
```

Arguments

DOY	Day of year
Lon	Longitude in degrees
SLon	Standard longitude (based on time zone) in degrees
DS	Daylight saving in minutes

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Examples

Incidence

Solar Incidence Angle

Description

This function returns solar incidence angle (in degrees) for a given day of year and location and site slope and aspect. The solar incidence angle is the angle between sun's ray and the normal on a surface.

Usage

```
Incidence(DOY, Lat, Lon, SLon, DS, Slope, Aspect)
```

Arguments

DOY	Day of year
Lat	Latitude (in degrees)
Lon	Longitude in degrees
SLon	Standard longitude (based on time zone) in degrees
DS	Daylight saving in minutes
Slope	Site slope in degrees
Aspect	Site aspect with respect to the south in degrees

```
#Calculating solar incidence angle for two consecutive days on 45 degree latitude and # 10 degree longitude
```

```
DOY <- seq(0, 2, .05)
theta <- Incidence(DOY, Lat = 45, Lon=10, SLon=10, DS=0, Slope = 10, Aspect = 0) #Note: only the difference between Lon and SLon matters not each value plot(DOY, theta)
```

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LST

Local Standard Time

Description

This function returns local standard time (in minutes) given a day of the year value.

Usage

```
LST(DOY)
```

Arguments

DOY

Day of year

Examples

```
#Calculating local standard time for two consecutive days
DOY <- seq(0, 2, .05)
lst <- LST(DOY)
plot(DOY, lst)</pre>
```

OpenRadiation

Open Sky Solar Radiation

Description

This function returns open sky solar radiation (in W/m2) for a given day of year and location.

Usage

```
OpenRadiation(DOY, Lat, Lon, SLon, DS, Elevation)
```

Arguments

DOY	Day of year
Lat	Latitude (in degrees)
Lon	Longitude in degrees
SLon	Standard longitude (based on time zone) in degrees
DS	Daylight saving in minutes
Flevation	Elevation of the site in meters

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Examples

```
#Calculating open sky solar radiation for two consecutive days on 45 degree latitude and # 10 degree longitude and at 100 m altitude.
```

```
DOY <- seq(0, 2, .05)

Sopen <- OpenRadiation(DOY, Lat = 45, Lon=10, SLon=10, DS=0, Elevation = 100)

#Note: only the difference between Lon and SLon matters not each value

plot(DOY, Sopen)
```

Solar

Calculating Solar Variables

Description

This function calculates solar variables including radiation components, solar angles and positions and day length.

Usage

```
Solar(DOY, Lat, Lon, SLon, DS, Elevation, Slope, Aspect)
```

Arguments

DOY	Day of year
Lat	Latitude (in degrees)
Lon	Longitude in degrees
SLon	Standard longitude (based on time zone) in degrees
DS	Daylight saving in minutes
Elevation	Elevation of the site in meters
Slope	Site slope in degrees
Aspect	Site aspect with respect to the south in degrees

```
#Calculating solar variables and angles

DOY <- seq(0, 2, .05)

solar <- Solar(DOY, Lat = 45, Lon=10, SLon=10, DS=0, Elevation = 1000, Slope = 10, Aspect = 0)
#Note: only the difference between Lon and SLon matters not each value
par(mfrow=c(3,1))</pre>
```

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```
plot(DOY, solar$Altitude, ylim = c(-90,90))
plot(DOY, solar$Azimuth, col= 'red')

plot(DOY, solar$Sdiropen)
lines(DOY, solar$Sdifopen, col='red')
```

SolarConstant

Solar Constant

Description

This constant value returns solar constant in Watt per meter squared

Usage

SolarConstant

Format

An object of class numeric of length 1.

Examples

```
#Printing Solar Constant
print(SolarConstant)
```

Sunrise

Sunrise Time

Description

This function estimates sunrise time (in continuous hour values) for a given day of year and latitude.

Usage

```
Sunrise(DOY, Lat)
```

Arguments

DOY	Day	of year
DOY	Dav	of vear
DO 1	Day	or year

Latitude (in degrees)

Sunset 15

Examples

```
#Calculating sunrise time for 365 day of the year for 45 degree latitude
DOY <- 1:365
Lat = 45
sunrise <- Sunset(DOY, Lat)
plot(DOY, sunrise)</pre>
```

Sunset

Sunset Time

Description

This function estimates sunset time (in continuous hour values) for a given day of year and latitude.

Usage

```
Sunset(DOY, Lat)
```

Arguments

DOY Day of year

Latitude (in degrees)

```
#Calculating sunset time for 365 day of the year for 45 degree latitude
DOY <- 1:365
Lat = 45
sunset <- Sunset(DOY, Lat)
plot(DOY, sunset)</pre>
```

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Transmittance Atmospheric Transmittance

Description

This function returns atmospheric transmittance coefficient for a given day of year and location.

Usage

```
Transmittance(DOY, Lat, Lon, SLon, DS, Elevation)
```

Arguments

DOY	Day of year
Lat	Latitude (in degrees)
Lon	Longitude in degrees
SLon	Standard longitude (based on time zone) in degrees
DS	Daylight saving in minutes
Elevation	Elevation of the site in meters

```
\#Calculating atmospheric transmittance coefficient for two consecutive days on 45 degree \# latitude and 10 degree longitude and at 100 m altitude.
```

```
DOY <- seq(0, 2, .05)

tb <- Transmittance(DOY, Lat = 45, Lon=10, SLon=10, DS=0, Elevation = 100)

#Note: only the difference between Lon and SLon matters not each value

plot(DOY, tb)
```

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