Package 'TreeDep'

October 12, 2022

Type Package

Title Air Pollution Removal by Dry Deposition on Trees

Version 0.1.3

Author Silvestre Garcia de Jalon

Maintainer Silvestre Garcia de Jalon <s.garciadejalon@gmail.com>

Description The model estimates air pollution removal by dry deposition on trees. It also estimates or uses hourly values for aerodynamic resistance, boundary layer resistance, canopy resistance, stomatal resistance, cuticular resistance, mesophyll resistance, soil resistance, friction velocity and deposition velocity. It also allows plotting graphical results for a specific time period. The pollutants are nitrogen dioxide, ozone, sulphur dioxide, carbon monoxide and particulate matter. Baldocchi D (1994) <doi:10.1093/treephys/14.7-8-9.1069>. Farquhar GD, von Caemmerer S, Berry JA (1980) Planta 149: 78-
90. Hirabayashi S, Kroll CN, Nowak DJ (2015) i-Tree Eco Dry Deposition Model. Nowak DJ, Crane DE, Stevens JC (2006) <doi:10.1016/j.ufug.2006.01.007>. US EPA (1999) PCRAMMET User's Guide. EPA-454/B-96-001. Weiss A, Norman JM (1985) Agricultural and Forest Meteorology 34: 205—213.

License GPL-2

Depends graphics, grDevices, stats, utils, lubridate, ggplot2

Encoding UTF-8

LazyData true

RoxygenNote 6.0.1

NeedsCompilation no

Repository CRAN

Date/Publication 2018-12-02 17:50:03 UTC

R topics documented:

Bizkaia_data — *Weather and environmental hourly data in Bizkaia province, Spain*

Description

Weather and air pollution concentration hourly data in Bizkaia province (Spain)

Usage

```
Bizkaia_data
```

Format

A data frame with hourly data

Conc_CO — *Conc_CO - Extracts data of hourly concentration of CO*

Description

Conc_CO - Extracts data of hourly concentration of CO

Usage

```
Conc_CO(x)
```

Arguments

x	A data frame containing hourly data of CO concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)

Value

Hourly data of concentration of CO (micrograms m-3)

Examples

```
data(Bizkaia_data)
Conc_CO(x = Bizkaia_data)
```

Conc_NO2 — *Conc_NO2 - Extracts data of hourly concentration of NO2*

Description

Conc_NO2 - Extracts data of hourly concentration of NO2

Usage

```
Conc_NO2(x)
```

Arguments

x	A data frame containing hourly data of NO2 concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)

Value

Hourly data of concentration of NO2 (micrograms m-3)

Examples

```
data(Bizkaia_data)
Conc_NO2(x = Bizkaia_data)
```

Conc_O3 — *Conc_O3 - Extracts data of hourly concentration of O3*

Description

Conc_O3 - Extracts data of hourly concentration of O3

Usage

```
Conc_O3(x)
```

Arguments

x	A data frame containing hourly data of O3 concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)

Value

Hourly data of concentration of O3 (micrograms m-3)

Examples

```
data(Bizkaia_data)
Conc_O3(x = Bizkaia_data)
```

`Conc_PM10` *Conc_PM10 - Extracts data of hourly concentration of PM10*

Description

Conc_PM10 - Extracts data of hourly concentration of PM10

Usage

```
Conc_PM10(x)
```

Arguments

`x`	A data frame containing hourly data of PM10 concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)

Value

Hourly data of concentration of PM10 (micrograms m-3)

Examples

```
data(Bizkaia_data)
Conc_PM10(x = Bizkaia_data)
```

`Conc_SO2` *Conc_SO2 - Extracts data of hourly concentration of SO2*

Description

Conc_SO2 - Extracts data of hourly concentration of SO2

Usage

```
Conc_SO2(x)
```

Arguments

x	A data frame containing hourly data of SO2 concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)

Value

Hourly data of concentration of SO2 (micrograms m-3)

Examples

```
data(Bizkaia_data)
Conc_SO2(x = Bizkaia_data)
```

Daylight — *Daylight - Generates hourly daylight data ("Night" and "Daylight") in a specific year*

Description

Daylight - Generates hourly daylight data ("Night" and "Daylight") in a specific year

Usage

```
Daylight(shortest_day_sunrise, shortest_day_sunset, longest_day_sunset0, Year)
```

Arguments

shortest_day_sunrise	Sunrise time in the shortest day in the Northern Hemisphere (December 21) using decimals for minutes (e.g. 8.4)
shortest_day_sunset	Sunset time in the shortest day in the Northern Hemisphere (December 21) using decimals for minutes (e.g. 17.8)
longest_day_sunset0	Sunset time in the longest day in the Northern Hemisphere (June 21) using decimals for minutes (e.g. 21.9)
Year	Year to generate hourly daylight data (e.g. 2015)

Value

A dataframe with hourly daylight values is generated

Examples

```
Daylight (shortest_day_sunrise  = 8.4,
shortest_day_sunset = 17.8,
longest_day_sunset0 = 21.9,
Year = 2016)
```

Dep_CO *Dep_CO - Calculates hourly deposition of CO on vegetation*

Description

Dep_CO - Calculates hourly deposition of CO on vegetation

Usage

```
Dep_CO(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of CO concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
z_0	Roughness length value (m)

Value

Hourly data of deposition of CO on vegetation (g m-2 h-1)

Examples

```
data(Bizkaia_data)
Dep_CO(x = Bizkaia_data, z_0 = 1)
```

Dep_CO_a — *Dep_CO_a - Calculates the annual value of deposition of CO on vegetation*

Description

Dep_CO_a - Calculates the annual value of deposition of CO on vegetation

Usage

```
Dep_CO_a(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of CO concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
z_0	Roughness length value (m)

Value

Annual value of deposition of CO on vegetation (g m-2 yr-1)

Examples

```
data(Bizkaia_data)
Dep_CO_a(x = Bizkaia_data, z_0 = 1)
```

Dep_NO2 — *Dep_NO2 - Calculates hourly deposition of NO2 on vegetation*

Description

Dep_NO2 - Calculates hourly deposition of NO2 on vegetation

Usage

```
Dep_NO2(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of NO2 concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
z_0	Roughness length value (m)

Value

Hourly data of deposition of NO2 on vegetation (g m-2 h-1)

Examples

```
data(Bizkaia_data)
Dep_NO2(x = Bizkaia_data, z_0 = 1)
```

`Dep_NO2_a` *Dep_NO2_a - Calculates the annual value of deposition of NO2 on vegetation*

Description

Dep_NO2_a - Calculates the annual value of deposition of NO2 on vegetation

Usage

```
Dep_NO2_a(x, z_0 = 1)
```

Arguments

`x`	A data frame containing hourly data of NO2 concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
`z_0`	Roughness length value (m)

Value

Annual value of deposition of NO2 on vegetation (g m-2 yr-1)

Examples

```
data(Bizkaia_data)
Dep_NO2_a(x = Bizkaia_data, z_0 = 1)
```

Dep_O3 *Dep_O3 - Calculates hourly deposition of O3 on vegetation*

Description

Dep_O3 - Calculates hourly deposition of O3 on vegetation

Usage

```
Dep_O3(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of O3 concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
z_0	Roughness length value (m)

Value

Hourly data of deposition of O3 on vegetation (g m-2 h-1)

Examples

```
data(Bizkaia_data)
Dep_O3(x = Bizkaia_data, z_0 = 1)
```

Dep_O3_a *Dep_O3_a - Calculates the annual value of deposition of O3 on vegetation*

Description

Dep_O3_a - Calculates the annual value of deposition of O3 on vegetation

Usage

```
Dep_O3_a(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of O3 concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
z_0	Roughness length value (m)

Value

Annual value of deposition of O3 on vegetation (g m-2 yr-1)

Examples

```
data(Bizkaia_data)
Dep_O3_a(x = Bizkaia_data, z_0 = 1)
```

Dep_PM10 *Dep_PM10 - Calculates hourly deposition of PM10 on vegetation*

Description

Dep_PM10 - Calculates hourly deposition of PM10 on vegetation

Usage

```
Dep_PM10(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of PM10 concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
z_0	Roughness length value (m)

Value

Hourly data of deposition of PM10 on vegetation (g m-2 h-1)

Examples

```
data(Bizkaia_data)
Dep_PM10(x = Bizkaia_data, z_0 = 1)
```

Dep_PM10_a *Dep_PM10_a - Calculates the annual value of deposition of PM10 on vegetation*

Description

Dep_PM10_a - Calculates the annual value of deposition of PM10 on vegetation

Usage

```
Dep_PM10_a(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of PM10 concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
z_0	Roughness length value (m)

Value

Annual value of deposition of PM10 on vegetation (g m-2 yr-1)

Examples

```
data(Bizkaia_data)
Dep_PM10_a(x = Bizkaia_data, z_0 = 1)
```

Dep_SO2 *Dep_SO2 - Calculates hourly deposition of SO2 on vegetation*

Description

Dep_SO2 - Calculates hourly deposition of SO2 on vegetation

Usage

```
Dep_SO2(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of SO2 concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
z_0	Roughness length value (m)

Value

Hourly data of deposition of SO2 on vegetation (g m-2 h-1)

Examples

```
data(Bizkaia_data)
Dep_SO2(x = Bizkaia_data, z_0 = 1)
```

`Dep_SO2_a` *Dep_SO2_a - Calculates the annual value of deposition of SO2 on vegetation*

Description

Dep_SO2_a - Calculates the annual value of deposition of SO2 on vegetation

Usage

```
Dep_SO2_a(x, z_0 = 1)
```

Arguments

`x`	A data frame containing hourly data of SO2 concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
`z_0`	Roughness length value (m)

Value

Annual value of deposition of SO2 on vegetation (g m-2 yr-1)

Examples

```
data(Bizkaia_data)
Dep_SO2_a(x = Bizkaia_data, z_0 = 1)
```

Dep_vel_CO *Dep_vel_CO - Calculates hourly deposition velocity for CO*

Description

Dep_vel_CO - Calculates hourly deposition velocity for CO

Usage

```
Dep_vel_CO(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
z_0	Roughness length value (m)

Value

Hourly data of deposition velocity for CO (m s-1)

Examples

```
data(Bizkaia_data)
Dep_vel_CO(x = Bizkaia_data, z_0 = 1)
```

Dep_vel_NO2 *Dep_vel_NO2 - Calculates hourly deposition velocity for NO2*

Description

Dep_vel_NO2 - Calculates hourly deposition velocity for NO2

Usage

```
Dep_vel_NO2(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
z_0	Roughness length value (m)

Value

Hourly data of deposition velocity for NO2 (m s-1)

Examples

```
data(Bizkaia_data)
Dep_vel_NO2(x = Bizkaia_data, z_0 = 1)
```

Dep_vel_O3 *Dep_vel_O3 - Calculates hourly deposition velocity for O3*

Description

Dep_vel_O3 - Calculates hourly deposition velocity for O3

Usage

```
Dep_vel_O3(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
z_0	Roughness length value (m)

Value

Hourly data of deposition velocity for O3 (m s-1)

Examples

```
data(Bizkaia_data)
Dep_vel_O3(x = Bizkaia_data, z_0 = 1)
```

Dep_vel_PM10 *Dep_vel_PM10 - Calculates hourly deposition velocity for PM10*

Description

Dep_vel_PM10 - Calculates hourly deposition velocity for PM10

Usage

```
Dep_vel_PM10(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
z_0	Roughness length value (m)

Value

Hourly data of deposition velocity for PM10 (m s-1)

Examples

```
data(Bizkaia_data)
Dep_vel_PM10(x = Bizkaia_data, z_0 = 1)
```

Dep_vel_SO2 *Dep_vel_SO2 - Calculates hourly deposition velocity for SO2*

Description

Dep_vel_SO2 - Calculates hourly deposition velocity for SO2

Usage

```
Dep_vel_SO2(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
z_0	Roughness length value (m)

Value

Hourly data of deposition velocity for SO2 (m s-1)

Examples

```
data(Bizkaia_data)
Dep_vel_SO2(x = Bizkaia_data, z_0 = 1)
```

`Fric_vel` *Fric_vel - Calculates friction velocity on an hourly basis*

Description

Fric_vel - Calculates friction velocity on an hourly basis

Usage

```
Fric_vel(x, z_0 = 1)
```

Arguments

`x`	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
`z_0`	Roughness length value (m)

Value

Hourly data of friction velocity (m s-1)

Examples

```
data(Bizkaia_data)
Fric_vel(x = Bizkaia_data, z_0 = 1)
```

LAI_deciduous *LAI_deciduous - Generates hourly data of leaf and bark area index for deciduous trees in a specific year*

Description

LAI_deciduous - Generates hourly data of leaf and bark area index for deciduous trees in a specific year

Usage

```
LAI_deciduous(Year, BAI_value, LAI_value, day_decay_ini, month_decay_ini,
  days_duration_decay, day_emergence_ini, month_emergence_ini,
  days_duration_emergence)
```

Arguments

Year	Year to generate leaf and bark area index (e.g. 2015)
BAI_value	Bark area index value (e.g. 0.1)
LAI_value	Maximum value of leaf area index value (e.g. 1.5)
day_decay_ini	Day of the month leaves start to decay (between 1 and 31; e.g., 15)
month_decay_ini	Month of the year leaves start to decay (between 1 and 12; e.g., 10)
days_duration_decay	The duration of leaf decay in number of days (e.g., 50)
day_emergence_ini	Day of the month leaves start to emerge (between 1 and 31; e.g., 1)
month_emergence_ini	Month of the year leaves start to emerge (between 1 and 12; e.g., 4)
days_duration_emergence	The duration of leaf emergence in number of days (e.g., 20)

Value

A dataframe with LAI and BAI hourly values is generated

Examples

```
LAI_deciduous(Year = 2016,
BAI_value = 0.1,
LAI_value = 1.5,
day_decay_ini = 15,
month_decay_ini = 10,
days_duration_decay = 100,
day_emergence_ini = 1,
```

```
month_emergence_ini = 4,
days_duration_emergence = 20)
```

`LAI_evergreen` *LAI_evergreen - Generates hourly data of leaf and bark area index for evergreen trees in a specific year*

Description

LAI_evergreen - Generates hourly data of leaf and bark area index for evergreen trees in a specific year

Usage

```
LAI_evergreen(Year, LAI_value, BAI_value)
```

Arguments

`Year`	Year to generate leaf and bark area index (e.g. 2015)
`LAI_value`	Mean value of leaf area index (e.g. 1.3)
`BAI_value`	Bark area index value (e.g. 0.1)

Value

A dataframe with LAI and BAI hourly values is generated

Examples

```
LAI_evergreen(Year = 2016,
BAI_value = 0.1,
LAI_value = 1.3)
```

`Res_aero` *Res_aero - Calculates aerodynamic resistance on an hourly basis*

Description

Res_aero - Calculates aerodynamic resistance on an hourly basis

Usage

```
Res_aero(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
z_0	Roughness length value (m)

Value

Hourly data of aerodynamic resistance (s m-1)

Examples

```
data(Bizkaia_data)
Res_aero(x = Bizkaia_data, z_0 = 1)
```

Res_boun_CO *Res_boun_CO - Calculates hourly boundary layer resistance for CO*

Description

Res_boun_CO - Calculates hourly boundary layer resistance for CO

Usage

```
Res_boun_CO(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
z_0	Roughness length value (m)

Value

Hourly data of boundary layer resistance for CO (s m-1)

Examples

```
data(Bizkaia_data)
Res_boun_CO(x = Bizkaia_data, z_0 = 1)
```

Res_boun_CO2 *Res_boun_CO2 - Calculates hourly boundary layer resistance for CO2*

Description

Res_boun_CO2 - Calculates hourly boundary layer resistance for CO2

Usage

```
Res_boun_CO2(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
z_0	Roughness length value (m)

Value

Hourly data of boundary layer resistance for CO2 (s m-1)

Examples

```
data(Bizkaia_data)
Res_boun_CO2(x = Bizkaia_data, z_0 = 1)
```

Res_boun_NO2 *Res_boun_NO2 - Calculates hourly boundary layer resistance for NO2*

Description

Res_boun_NO2 - Calculates hourly boundary layer resistance for NO2

Usage

```
Res_boun_NO2(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
z_0	Roughness length value (m)

Value

Hourly data of boundary layer resistance for NO2 (s m-1)

Examples

```
data(Bizkaia_data)
Res_boun_NO2(x = Bizkaia_data, z_0 = 1)
```

`Res_boun_O3` *Res_boun_O3 - Calculates hourly boundary layer resistance for O3*

Description

Res_boun_O3 - Calculates hourly boundary layer resistance for O3

Usage

```
Res_boun_O3(x, z_0 = 1)
```

Arguments

`x`	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
`z_0`	Roughness length value (m)

Value

Hourly data of boundary layer resistance for O3 (s m-1)

Examples

```
data(Bizkaia_data)
Res_boun_O3(x = Bizkaia_data, z_0 = 1)
```

Res_boun_SO2 *Res_boun_SO2 - Calculates hourly boundary layer resistance for SO2*

Description

Res_boun_SO2 - Calculates hourly boundary layer resistance for SO2

Usage

```
Res_boun_SO2(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
z_0	Roughness length value (m)

Value

Hourly data of boundary layer resistance for SO2 (s m-1)

Examples

```
data(Bizkaia_data)
Res_boun_SO2(x = Bizkaia_data, z_0 = 1)
```

Res_cano_CO *Res_cano_CO - Calculates hourly canopy resistance for CO*

Description

Res_cano_CO - Calculates hourly canopy resistance for CO

Usage

```
Res_cano_CO(x)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))

Value

Hourly data of canopy resistance for CO (s m-1)

Examples

```
data(Bizkaia_data)
Res_cano_CO(x = Bizkaia_data)
```

`Res_cano_NO2` *Res_cano_NO2 - Calculates hourly canopy resistance for NO2*

Description

Res_cano_NO2 - Calculates hourly canopy resistance for NO2

Usage

```
Res_cano_NO2(x)
```

Arguments

`x`	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))

Value

Hourly data of canopy resistance for NO2 (s m-1)

Examples

```
data(Bizkaia_data)
Res_cano_NO2(x = Bizkaia_data)
```

Res_cano_O3 — *Res_cano_O3 - Calculates hourly canopy resistance for O3*

Description

Res_cano_O3 - Calculates hourly canopy resistance for O3

Usage

```
Res_cano_O3(x)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))

Value

Hourly data of canopy resistance for O3 (s m-1)

Examples

```
data(Bizkaia_data)
Res_cano_O3(x = Bizkaia_data)
```

Res_cano_SO2 — *Res_cano_SO2 - Calculates hourly canopy resistance for SO2*

Description

Res_cano_SO2 - Calculates hourly canopy resistance for SO2

Usage

```
Res_cano_SO2(x)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))

Value

Hourly data of canopy resistance for SO2 (s m-1)

Examples

```
data(Bizkaia_data)
Res_cano_SO2(x = Bizkaia_data)
```

`Res_cuti_NO2` *Res_cuti_NO2 - Calculates hourly cuticular resistance for NO2*

Description

Res_cuti_NO2 - Calculates hourly cuticular resistance for NO2

Usage

```
Res_cuti_NO2(x)
```

Arguments

`x`	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))

Value

Hourly data of cuticular resistance for NO2 (s m-1)

Examples

```
data(Bizkaia_data)
Res_cuti_NO2(x = Bizkaia_data)
```

`Res_cuti_O3` *Res_cuti_O3 - Calculates hourly cuticular resistance for O3*

Description

Res_cuti_O3 - Calculates hourly cuticular resistance for O3

Usage

```
Res_cuti_O3(x)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))

Value

Hourly data of cuticular resistance for O3 (s m-1)

Examples

```
data(Bizkaia_data)
Res_cuti_O3(x = Bizkaia_data)
```

Res_cuti_SO2 *Res_cuti_SO2 - Calculates hourly cuticular resistance for SO2*

Description

Res_cuti_SO2 - Calculates hourly cuticular resistance for SO2

Usage

```
Res_cuti_SO2(x)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))

Value

Hourly data of cuticular resistance for SO2 (s m-1)

Examples

```
data(Bizkaia_data)
Res_cuti_SO2(x = Bizkaia_data)
```

Res_meso_NO2 — *Res_meso_NO2 - Calculates hourly mesophyll resistance for NO2*

Description

Res_meso_NO2 - Calculates hourly mesophyll resistance for NO2

Usage

```
Res_meso_NO2(x)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))

Value

Hourly data of mesophyll resistance for NO2 (s m-1)

Examples

```
data(Bizkaia_data)
Res_meso_NO2(x = Bizkaia_data)
```

Res_meso_O3 — *Res_meso_O3 - Calculates hourly mesophyll resistance for O3*

Description

Res_meso_O3 - Calculates hourly mesophyll resistance for O3

Usage

```
Res_meso_O3(x)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))

Value

Hourly data of mesophyll resistance for O3 (s m-1)

Examples

```
data(Bizkaia_data)
Res_meso_O3(x = Bizkaia_data)
```

`Res_meso_SO2` *Res_meso_SO2 - Calculates hourly mesophyll resistance for SO2*

Description

Res_meso_SO2 - Calculates hourly mesophyll resistance for SO2

Usage

```
Res_meso_SO2(x)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))

Value

Hourly data of mesophyll resistance for SO2 (s m-1)

Examples

```
data(Bizkaia_data)
Res_meso_SO2(x = Bizkaia_data)
```

`Res_soil` *Res_soil - Calculates soil resistance on an hourly basis*

Description

Res_soil - Calculates soil resistance on an hourly basis

Usage

```
Res_soil(x, r_soil_inleaf = 2941, r_soil_outleaf = 2941)
```

Arguments

x	A data frame containing hourly data of weather and other variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
r_soil_inleaf	Resistance value during in-leaf season
r_soil_outleaf	Resistance value during in-leaf season

Value

Hourly data of soil resistance (s m-1)

Examples

```
data(Bizkaia_data)
Res_soil(x = Bizkaia_data, r_soil_inleaf = 2941, r_soil_outleaf = 2941)
```

Res_stom_NO2 *Res_stom_NO2 - Calculates stomata resistance on an hourly basis*

Description

Res_stom_NO2 - Calculates stomata resistance on an hourly basis

Usage

```
Res_stom_NO2(x, m2 = 1, m3 = 4)
```

Arguments

x	A data frame containing hourly data of weather and other variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
m2	Dimensionless slope for different air pollutants
m3	Dimensionless slope for different species

Value

Hourly data of stomata resistance (s m-1)

Examples

```
data(Bizkaia_data)
Res_stom_NO2(x = Bizkaia_data)
```

Res_stom_O3 *Res_stom_O3 - Calculates stomata resistance on an hourly basis*

Description

Res_stom_O3 - Calculates stomata resistance on an hourly basis

Usage

```
Res_stom_O3(x, m2 = 1, m3 = 4)
```

Arguments

x	A data frame containing hourly data of weather and other variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
m2	Dimensionless slope for different air pollutants
m3	Dimensionless slope for different species

Value

Hourly data of stomata resistance (s m-1)

Examples

```
data(Bizkaia_data)
Res_stom_O3(x = Bizkaia_data)
```

Res_stom_SO2 *Res_stom_SO2 - Calculates stomata resistance on an hourly basis*

Description

Res_stom_SO2 - Calculates stomata resistance on an hourly basis

Usage

```
Res_stom_SO2(x, m2 = 1, m3 = 4)
```

Arguments

x	A data frame containing hourly data of weather and other variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
m2	Dimensionless slope for different air pollutants
m3	Dimensionless slope for different species

Value

Hourly data of stomata resistance (s m-1)

Examples

```
data(Bizkaia_data)
Res_stom_SO2(x = Bizkaia_data)
```

`Res_Tot_CO` *Res_Tot_CO - Calculates hourly total resistance for CO*

Description

Res_Tot_CO - Calculates hourly total resistance for CO

Usage

```
Res_Tot_CO(x, z_0 = 1)
```

Arguments

`x`	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
`z_0`	Roughness length value (m)

Value

Hourly data of total resistance for CO (s m-1)

Examples

```
data(Bizkaia_data)
Res_Tot_CO(x = Bizkaia_data, z_0 = 1)
```

Res_Tot_NO2 *Res_Tot_NO2 - Calculates hourly total resistance for NO2*

Description

Res_Tot_NO2 - Calculates hourly total resistance for NO2

Usage

```
Res_Tot_NO2(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
z_0	Roughness length value (m)

Value

Hourly data of total resistance for NO2 (s m-1)

Examples

```
data(Bizkaia_data)
Res_Tot_NO2(x = Bizkaia_data, z_0 = 1)
```

Res_Tot_O3 *Res_Tot_O3 - Calculates hourly total resistance for O3*

Description

Res_Tot_O3 - Calculates hourly total resistance for O3

Usage

```
Res_Tot_O3(x, z_0 = 1)
```

Arguments

x	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
z_0	Roughness length value (m)

Value

Hourly data of total resistance for O3 (s m-1)

Examples

```
data(Bizkaia_data)
Res_Tot_O3(x = Bizkaia_data, z_0 = 1)
```

`Res_Tot_SO2` *Res_Tot_SO2 - Calculates hourly total resistance for SO2*

Description

Res_Tot_SO2 - Calculates hourly total resistance for SO2

Usage

```
Res_Tot_SO2(x, z_0 = 1)
```

Arguments

`x`	A data frame containing hourly data of weather variables (e.g. Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight))
`z_0`	Roughness length value (m)

Value

Hourly data of total resistance for SO2 (s m-1)

Examples

```
data(Bizkaia_data)
Res_Tot_SO2(x = Bizkaia_data, z_0 = 1)
```

TreeDep *TreeDep Package*

Description

The model estimates air pollution removal by dry deposition on trees. It also estimates aerodynamic resistance, boundary layer resistance, canopy resistance, stomatal resistance, cuticular resistance, mesophyll resistance, soil resistance, friction velocity and deposition velocity. It also allows plotting graphical results for a specific time period. The pollutants are nitrogen dioxide, ozone, sulphur dioxide, carbon monoxide and particulate matter.

Author(s)

Silvestre Garcia de Jalon <s.garciadejalon@gmail.com>

TreeDep_plot *TreeDep_plot - Generates a plot for selected variables and dates.*

Description

TreeDep_plot - Generates a plot for selected variables and dates.

Usage

```
TreeDep_plot(my_data, variable1, variable2 = "Non-existent", start_month,
  start_day, stop_month, stop_day)
```

Arguments

my_data	A data frame containing hourly data pollutant concentration and other variables (Dates (e.g. 01/01/2016 00:00:00), Hum (%), Pres (kPa), Precip (mm), Rad (W m-2), Temp (C), Wind (m s-1), Daylight (Night or Daylight), BAI, LAI)
variable1	Variable to be plotted (e.g., "Dep_NO2", "Conc_O3", "Wind", "Temp")
variable2	Variable to be plotted (e.g., "Dep_NO2", "Conc_O3", "Wind", "Temp")
start_month	First month of the year in the plot (between 1 and 12; e.g., 3)
start_day	First day of the month in the plot (between 1 and 31; e.g., 4)
stop_month	Last month of the year in the plot (between 1 and 12; e.g., 11)
stop_day	Last day of the month in the plot (between 1 and 31; e.g., 22)

Details

The variables that can be plotted are: "Hum", "Pres", "Precip", "Rad", "Temp", "Wind", "BAI", "LAI", "Fric_vel", "Res_aero", "Res_boun_CO2", "Res_soil", "Conc_NO2", "Dep_NO2", "Dep_vel_NO2", "Res_boun_NO2", "Res_cuti_NO2", "Res_stom_NO2", "Res_meso_NO2", "Res_cano_NO2", "Res_Tot_NO2", "Conc_O3", "Dep_O3", "Dep_vel_O3", "Res_boun_O3", "Res_cuti_O3", "Res_stom_O3", "Res_meso_O3", "Res_cano_O3", "Res_Tot_O3", "Conc_SO2", "Dep_SO2", "Dep_vel_SO2", "Res_boun_SO2", "Res_cuti_SO2", "Res_stom_SO2", "Res_meso_SO2", "Res_cano_SO2", "Res_Tot_SO2", "Conc_CO", "Dep_CO", "Dep_vel_CO", "Res_boun_CO", "Res_cano_CO", "Res_Tot_CO", "Conc_PM10", "Dep_PM10", "Dep_vel_PM10".

Value

A plot with the variables and dates selected

Examples

```
TreeDep_plot(my_data = Bizkaia_data,
variable1 = "Dep_PM10",
variable2 = "Wind",
start_month = 6,
stop_month = 7,
start_day = 25,
stop_day = 3)
```

Index