Package 'ClimInd'

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Type Package

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Title Climate Indices

Author Fergus Reig-Gracia [aut, cre], Sergio M. Vicente-Serrano [aut], Fernando Dominguez-Castro [aut], Joaquin Bedia-Jiménez [ctb]

Maintainer Fergus Reig-Gracia <fergusrg@gmail.com>

Depends R (>= 3.5.0), SPEI (>= 1.8.1), chron, weathermetrics

Description Computes 138 standard climate indices at monthly, seasonal and annual resolution. These indices were selected, based on their direct and significant impacts on target sectors, after a thorough review of the literature in the field of extreme weather events and natural hazards. Overall, the selected indices characterize different aspects of the frequency, intensity and duration of extreme events, and are derived from a broad set of climatic variables, including surface air temperature, precipitation, relative humidity, wind speed, cloudiness, solar radiation, and snow cover. The 138 indices have been classified as follow: Temperature based indices (42), Precipitation based indices (22), Bioclimatic indices (21), Wind-based indices (5), Aridity/ continentality indices (10), Snow-based indices (13), Cloud/radiation based indices (6), Drought indices (8), Fire indices (5), Tourism indices (5).

License GPL (>= 3)

URL https://gitlab.com/indecis-eu/indecis

LazyLoad yes

Encoding UTF-8

Suggests MASS,
rmarkdown,
testthat

NeedsCompilation no

RoxygenNote 7.3.3

ByteCompile true

Collate 'ClimInd.R'
'ClimIndNews.R'
'custom_functions.R'

'data.R'
'ffdi.R'
'funcion_turc_index_clim.r'
'fwi1D.R'
'pvpot.R'
'penman_fao_dia.R'
'nesterovIndex.R'
'macArthurFFDI.R'
'kbdindex.R'
'indecis_indices_functions.R'
'indecis_indices.R'
'indecis.R'

R topics documented:

`ClimInd-package` *ClimInd: Climate Indices*

Description

Computes 138 standard climate indices at monthly, seasonal and annual resolution. These indices were selected, based on their direct and significant impacts on target sectors, after a thorough review of the literature in the field of extreme weather events and natural hazards. Overall, the selected indices characterize different aspects of the frequency, intensity and duration of extreme events, and are derived from a broad set of climatic variables, including surface air temperature, precipitation, relative humidity, wind speed, cloudiness, solar radiation, and snow cover. The 138 indices have been classified as follow: Temperature based indices (42), Precipitation based indices (22), Bioclimatic indices (21), Wind-based indices (5), Aridity/ continentality indices (10), Snow-based indices (13), Cloud/radiation based indices (6), Drought indices (8), Fire indices (5), Tourism indices (5).

Details

Info

See Also

Useful links:

- https://gitlab.com/indecis-eu/indecis

aci *Atmospheric Clarity Index*

Description

Ratio between solar radiation at surface and solar radiation at TOA (alt top of the atmosphere)

Usage

```
aci(data, toa, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	radiation, J/m2
toa	solar radiation at TOA, W/m2
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

index value

Examples

```
data(data_all)
aci(data = data_all$radiation, toa = data_all$radiationtoa)
```

asd *Average snow depth*

Description

Average snow depth

Usage

```
asd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	snow depth, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

snow depth, m

Examples

```
data(data_all)
asd(data = data_all$snowdepth)
```

`at` *Apparent temperature*

Description

Index of the percived temperature.

Usage

```
at(taverage, w, rh, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

`taverage`	daily mean temperature, Celsius
`w`	average wind, m/s
`rh`	relative humidity, percentage
`data_names`	names of each period of time
`time.scale`	month, season or year
`na.rm`	logical. Should missing values (including NaN) be removed?

Value

index value

Formula

$$AT = TG + 0.33e - 0.70v - 4.00$$

TG = air temperature in Celsius ; v = wind speed in m/s; e= water vapour pressure in hPa

Examples

```
data(data_all)
at(taverage = data_all$tg, w = data_all$wind, rh = data_all$HUMIDITY)
```

bi *Budyko Index*

Description

Budyko Index is based on characteristics of the surface heat and water balance.

Usage

```
bi(data, pr, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	net radiation, J/m2
pr	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

Formula

$$BI = 100\frac{Rn}{L * P}$$

Rn= annual net radiation, P = annual precipitation, L = latent heat of vaporization for water

References

Budyko M.I. The Heat Balance of the Earth's Surface U.S. Department of Commerce, Washington D.C (1958) 259 pp., translated by N.A. Stepanova

Examples

```
data(data_all)
bi(data = data_all$netradiation, pr = data_all$rr)
```

bio10 *TG of warmest quarter*

Description

TG of the warmest quarter of the year

Usage

```
bio10(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio10(data = data_all$tg)
```

bio11 *TG of coldest quarter*

Description

TG of coldest quarter of the year

Usage

```
bio11(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio11(data = data_all$tg)
```

---

bio13 *Precipitation of wettest month*

Description

Total precipitation of the wettest month of the year

Usage

```
bio13(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

precipitation, mm

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio13(data = data_all$rr)
```

---

bio14 *Precipitation of driest month*

Description

Total precipitation of the driest month of the year

Usage

```
bio14(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

precipitation, mm

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio14(data = data_all$rr)
```

bio15 *Precipitation coefficient of variation*

Description

The coefficient of variation is a measure of the variation in monthly precipitation totals over the course of the year. This index is the ratio of the standard deviation of the monthly total precipitation to the mean monthly total precipitation and is expressed as a percentage.

Usage

```
bio15(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

Examples

```
data(data_all)
bio15(data = data_all$rr)
```

bio16 *Precipitation wettest quarter*

Description

Precipitation of the wettest quarter of the year

Usage

```
bio16(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

precipitation, mm

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio16(data = data_all$rr, na.rm = TRUE)
```

---

bio17 *Precipitation of Driest Quarter*

Description

Precipitation of the driest quarter of the year

Usage

```
bio17(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

precipitation, mm

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio17(data = data_all$rr)
```

bio18 *Precipitation warmest quarter*

Description

Precipitation of the warmest quarter of the year

Usage

```
bio18(pr, taverage, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

pr	daily precipitation, mm
taverage	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

precipitation, mm

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio18(pr=data_all$rr, taverage=data_all$tg)
```

bio19 *Precipitation coldest quarter*

Description

Precipitation of the coldest quarter of the year

Usage

```
bio19(pr, taverage, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

pr	daily precipitation, mm
taverage	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

precipitation, mm

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio19(pr=data_all$rr, taverage=data_all$tg)
```

---

bio20 *Mean radiation*

Description

Mean radiation (W m-2)

Usage

```
bio20(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	radiation, W m-2
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

radiation, W m-2

References

Kriticos, D.J., Webber, B.L., Leriche, A., Ota, N., Macadam, I., Bathols, J. and Scott, J.K. (2012) CliMond: global high-resolution historical and future scenario climate surfaces for bioclimatic modelling. Methods in Ecology and Evolution, 3, 53-64. doi:10.1111/j.2041210X.2011.00134.x

Examples

```
data(data_all)
bio20(data = data_all$radiation_w)
```

`bio4` *Temperature seasonality*

Description

TG standard deviation * 100

Usage

```
bio4(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

`data`	daily mean temperature, Celsius
`data_names`	names of each period of time
`na.rm`	logical. Should missing values (including NaN) be removed?
`...`	further arguments passed to or from other methods

Value

temperature, Celsius

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio4(data = data_all$tg)
```

bio5 *TX warmest month*

Description

TX of the warmest month of the year

Usage

```
bio5(data, tmax, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
tmax	daily maximum temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio5(data = data_all$tg, tmax = data_all$tx)
```

bio6 *TN of coldest month*

Description

TN of the coldest month of the year

Usage

```
bio6(data, tmin, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
tmin	daily minimum temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio6(data = data_all$tg, tmin = data_all$tn)
```

---

bio7 *Temperature Annual Range*

Description

TX of the warmest month minus TN of coldest month

Usage

```
bio7(data, tmin, tmax, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
tmin	daily minimum temperature, Celsius
tmax	daily maximum temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio7(data = data_all$tg, tmin = data_all$tn, tmax = data_all$tx)
```

---

bio8 *TG of wettest quarter*

Description

TG of the wettest quarter of the year

Usage

```
bio8(pr, taverage, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

pr	daily precipitation, mm
taverage	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio8(pr = data_all$rr, taverage = data_all$tg)
```

bio9 *TG of driest quarter*

Description

TG of the driest quarter of the year

Usage

```
bio9(pr, taverage, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

pr	daily precipitation, mm
taverage	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978. doi:10.1002/joc.1276. https://web.archive.org/web/20190714191708/https://www.worldclim.org/bioclim

Examples

```
data(data_all)
bio9(pr = data_all$rr, taverage =  data_all$tg)
```

calculate_all *Calculate all indexes*

Description

Calculate all indexes for a point

Usage

```
calculate_all(
  data,
  lat = NULL,
  time.scale = YEAR,
  data_names = NULL,
  index_result = c(1:138),
  na.rm = FALSE
)
```

Arguments

data	data list
lat	latitude, degree
time.scale	month, season or year
data_names	names of each period of time
index_result	indexes to calculate
na.rm	logical. Should missing values (including NaN) be removed? (value or array by index)

Value

all indexes

---

calculate_all_scales *Calculate all indexes for all time scales*

Description

Calculate all indexes for a point and all time scales

Usage

```
calculate_all_scales(data, lat = NULL)
```

Arguments

data	data list
lat	latitude, degree

Value

all indexes

`calc_eto` *Et0*

Description

Et0

Usage

```
calc_eto(
  tmin,
  tmax,
  toa,
  w,
  mde,
  lat,
  tdew,
  radiation = NA,
  insolation = NA,
  rh = NA,
  na.rm = FALSE
)
```

Arguments

`tmin`	daily minimum temperature, Celsius, Celsius
`tmax`	maximum temperature, Celsius
`toa`	radiation toa, J/m2/day
`w`	average wind, m/s at 10m
`mde`	mde
`lat`	latitude
`tdew`	dew point, Celsius
`radiation`	radiation, J m-2/day
`insolation`	insolation, hours
`rh`	relative humidity, percentage
`na.rm`	na.rm

Value

et0

cc *Mean daily cloud cover*

Description

Mean daily cloud cover (

Usage

```
cc(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	cloud cover, percentage
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

percentage

Examples

```
data(data_all)
cc(data = data_all$cloud)
```

cdd *Longest dry period*

Description

Maximum length of consecutive dry days (RR<1)

Usage

```
cdd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5.

Examples

```
data(data_all)
cdd(data = data_all$rr)
```

---

cfd *Maximum consecutive frost days*

Description

Maximum number of consecutive days with TN < 0 Celsius

Usage

```
cfd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
cfd(data=data_all$tn)
```

cfdd *Cumulative chilling hours*

Description

Sum of daily chill hours from November 1 to March 1. A chill hour is defined as the fraction of the day in which the temperature is below 7 Celsius, calculated by taking the difference between 7 Celsius and the daily minimum temperature, dividing it by the range between the maximum and minimum temperature of the day, and multiplying the result by 24 hours, provided that the minimum temperature is below 7 Celsius (Crossa-Raynaud, 1955).

Usage

```
cfdd(tmin, tmax, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

tmin	daily minimum temperature, Celsius
tmax	daily maximum temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

–

Examples

```
data(data_all)
cfdd(tmin=data_all$tn, tmax=data_all$tx)
```

cgdd_s *Cumulative growing degree days*

Description

Sum of daily degree days from April 1st to October 31st. A degree day is defined as the difference between the average daily temperature and the base temperature (10ºC) provided that the average temperature is higher than the base temperature.

Usage

```
cgdd_s(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

–

Examples

```
data(data_all)
cgdd_s(data=data_all$tg)
```

cgdd_w *Cumulative growing degree days*

Description

Sum of daily degree days from November 1st to July 31st. A degree day is defined as the difference between the average daily temperature and the base temperature (5ºC) provided that the average temperature is higher than the base temperature.

Usage

```
cgdd_w(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

–

Examples

```
data(data_all)
cgdd_w(data=data_all$tg)
```

---

chb_s *Cumulative hydric balance*

Description

Sum of the difference between precipitation and daily et0 from April 1 to October 31.

Usage

```
chb_s(eto, pr, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

eto	et0, mm
pr	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

–

Examples

```
data(data_all)
chb_s(eto=data_all$eto, pr = data_all$rr)
```

---

chb_w *Cumulative hydric balance*

Description

Sum of the difference between precipitation and daily et0 from November 1 to July 31.

Usage

```
chb_w(eto, pr, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

eto	et0, mm
pr	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

–

Examples

```
data(data_all)
chb_w(eto=data_all$eto, pr = data_all$rr)
```

ClimIndNews *ClimIndNews*

Description

Show the NEWS file of the **ClimInd** package.

Usage

```
ClimIndNews()
```

Details

(See description)

cmd *Climatic moisture deficit*

Description

ETo - evapotranspiration

Usage

```
cmd(
  eto,
  evapotranspiration,
  data_names = NULL,
  time.scale = YEAR,
  na.rm = FALSE
)
```

Arguments

eto	eto, mm
evapotranspiration	evapotranspiration, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

index value

References

Parks, S. A., Parisien, M. , Miller, C. , Holsinger, L. M. and Baggett, L. S. (2018), Fine-scale spatial climate variation and drought mediate the likelihood of reburning. Ecol Appl, 28: 573-586. doi:10.1002/eap.1671

Examples

```
data(data_all)
cmd(eto = data_all$eto, evapotranspiration = data_all$evaporation)
```

---

csd *Maximum consecutive summer days*

Description

Maximum number of consecutive summer days (TX > 25 Celsius)

Usage

```
csd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
csd(data=data_all$tx)
```

csdi *Cold spell duration*

Description

Count of days with at least 6 consecutive days when TN < 10th percentile. The 10th percentile is computed based on the time scale selected (month, season or year) not daily as ETCCDI does. If you want to compute daily you can use RClimDex package.

Usage

```
csdi(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
csdi(data=data_all$tn)
```

cwd *Longest wet period*

Description

Maximum length of consecutive wet days (RR>=1)

Usage

```
cwd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5.

Examples

```
data(data_all)
cwd(data = data_all$rr)
```

---

d32 *Days TX32*

Description

Number of days whith TX >= 32 Celsius on the interval June-August.

Usage

```
d32(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
d32(data = data_all$tx)
```

d50mm *Heavy precipitation days*

Description

Number of days with precipitation above 50mm

Usage

```
d50mm(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
d50mm(data = data_all$rr)
```

d95p *Very wet days*

Description

Days with precipitation > 95th percentile. The 95th percentile is computed based on the time scale selected (month, season or year) not daily

Usage

```
d95p(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5.

Examples

```
data(data_all)
d95p(data = data_all$rr)
```

Datasets *data_all*

Description

See wichita

Usage

```
data(data_all)
```

Format

An object of class `list` of length 22.

Details

See description.

---

dd *Dry days*

Description

Number of days with less than 1 mm

Usage

```
dd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
dd(data = data_all$rr)
```

---

dd17 *Difference days above/below Tx17*

Description

(days tx > 17 Celsius)-(days TX < 17 Celsius)

Usage

```
dd17(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
dd17(data=data_all$tx)
```

dfx21 *Days wind gusts above 21 m/s*

Description

Number of days with wind gusts above 21 m/s

Usage

```
dfx21(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	maximum wind gust, m/s
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
dfx21(data = data_all$windgust)
```

dr1mm *Wet days 1mm*

Description

Total number of wet days >= 1 mm

Usage

```
dr1mm(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
dr1mm(data = data_all$rr)
```

---

dr3mm *Wet days 3mm*

Description

Total number of Wet days >= 3mm

Usage

```
dr3mm(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
dr3mm(data = data_all$rr)
```

dtr *Diurnal temperature range*

Description

Mean difference between TX and TN.

Usage

```
dtr(tmax, tmin, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

tmax	daily maximum temperature, Celsius
tmin	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

Formula

$$DTR_j = \frac{\sum_{i=1}^{I}(TX_{ij} - TN_{ij})}{I}$$

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5. https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf

Examples

```
data(data_all)
dtr(tmax=data_all$tx, tmin=data_all$tn)
```

`eai` *Emberger aridity index*

Description

Aridity index based on annual precipitation and temperature range

Usage

```
eai(pr, taverage, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

`pr`	daily precipitation, mm
`taverage`	daily mean temperature, Celsius
`data_names`	names of each period of time
`na.rm`	logical. Should missing values (including NaN) be removed?
`...`	further arguments passed to or from other methods

Value

index value

Formula

$$EAI = \frac{100 * P}{Thm^2 - Tcm^2}$$

P = annual precipitation; Thm = Average temperature of the hottest month in Kelvin; Tcm= Average temperature of the coldest month in Kelvin

References

Emberger L. 1930. La végétation de la région méditerranéenne: essai d'une classification des groupements végétaux Revue Générale de Botanique, 42 (641–662), pp. 705-721

Examples

```
data(data_all)
eai(pr = data_all$rr, taverage = data_all$tg)
```

ep *Effective precipitation*

Description

Precipitation minus evapotranspiration

Usage

```
ep(eto, pr, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

eto	et0, mm
pr	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

mm

Examples

```
data(data_all)
ep(eto = data_all$eto, pr = data_all$rr)
```

eto *Reference evapotranspiration*

Description

If data available using Fao-56 Penman-Monteith

Usage

```
eto(
  tmin,
  tmax,
  toa,
  w,
  lat,
  tdew,
  mde,
```

```
  radiation = NA,
  rh = NA,
  insolation = NA,
  data_names = NULL,
  time.scale = YEAR,
  na.rm = FALSE
)
```

Arguments

tmin	daily minimum temperature, Celsius
tmax	daily maximum temperature, Celsius
toa	solar radiation at TOA, J/m2/day
w	average wind, m/s
lat	latitude, degree
tdew	dew point, Celsius
mde	digital elevation model, m
radiation	radiation, J/m2/day
rh	relative humidity, percentage
insolation	insolation, hours of sun
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

mm

References

Chiew, F.H.S., Kamaladasa, N.N., Malano, H.M., McMahon, T.A., 1995. Penman–Monteith FAO-24 reference crop evapotranspiration and class-A pan data in Australia. Agric. Water Manage. 28, 9–21

Examples

```
data(data_all)
eto(tmin = data_all$tn, tmax = data_all$tx,
     toa = data_all$radiationtoa, w = data_all$wind,
     lat=data_all$lat, tdew = data_all$dewpoint,
     mde=data_all$mde, radiation = data_all$radiation,
     insolation=data_all$insolation, rh = data_all$humidity)
```

ETo_s *Cumulative reference evapotranspiration*

Description

Sum of daily et0 from April 1 to October 31.

Usage

```
ETo_s(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	et0, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

–

Examples

```
data(data_all)
ETo_s(data=data_all$eto)
```

ETo_w *Cumulative reference evapotranspiration*

Description

Sum of daily et0 from November 1 to July 31.

Usage

```
ETo_w(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	et0, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

–

Examples

```
data(data_all)
ETo_w(data=data_all$eto)
```

---

etr *Extreme temperature range*

Description

Difference between the maximum TX and the minimum TN.

Usage

```
etr(tmax, tmin, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

tmax	daily maximum temperature, Celsius
tmin	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

Examples

```
data(data_all)
etr(tmax=data_all$tx, tmin=data_all$tn)
```

extract_time_names *Internal time names, useful to accelerate calculations*

Description

Internal time names, useful to accelerate calculations

Usage

```
extract_time_names(date, time.scale)
```

Arguments

date	daily dates
time.scale	month, season, year or hydrological_years

Value

time names

fd *Frost days*

Description

Number of days with TN < 0 Celsius.

Usage

```
fd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5.

Examples

```
data(data_all)
fd(data=data_all$tn)
```

---

fg *Mean of daily mean wind strength*

Description

Mean of daily FG

Usage

```
fg(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	average wind, m/s
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

wind, m/s

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
fg(data = data_all$wind)
```

fg6bft *Number of days with averaged wind above 10.8m/s*

Description

Number of days with FG >=6 Bft (10.8 m/s)

Usage

```
fg6bft(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	average wind, m/s
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

ECA&D website: European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
fg6bft(data = data_all$wind)
```

fgcalm *Calm days*

Description

Number of calm days (FG <=2 m/s)

Usage

```
fgcalm(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	average wind, m/s
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

ECA&D website: European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
fgcalm(data = data_all$wind)
```

---

fod *Foggy days*

Description

Number of days with fog.

Usage

```
fod(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	cloud base below 100 meter, percentage
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

Rastogi, B., A.P. Williams, D.T. Fischer, S.F. Iacobellis, K. McEachern, L. Carvalho, C. Jones, S.A. Baguskas, and C.J. Still, 2016: Spatial and Temporal Patterns of Cloud Cover and Fog Inundation in Coastal California: Ecological Implications. Earth Interact., 20, 1–19, doi:10.1175/EID150033.1

Examples

```
data(data_all)
fod(data = data_all$cloud100)
```

`fpsc` *Date of first permanent snow cover*

Description

First day of the longest period with consecutive snow cover day (day of the hydrological year).

Usage

```
fpsc(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

`data`	snow depth, mm
`data_names`	names of each period of time
`na.rm`	logical. Should missing values (including NaN) be removed?
`...`	further arguments passed to or from other methods

Value

date

Examples

```
data(data_all)
fpsc(data = data_all$snowdepth)
```

`fsc` *Date of first snow cover*

Description

First day when there is measurable snow cover (day of the hydrological year)

Usage

```
fsc(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	snow depth, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

date

Examples

```
data(data_all)
fsc(data = data_all$snowdepth)
```

---

fsd *Number of snow days*

Description

Number of snow days

Usage

```
fsd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	snowfall, m of water equivalent
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
fsd(data = data_all$snowfall)
```

`fwi` *Canadian Fire Weather Index*

Description

The Canadian Forest Fire Weather Index is an indicator of fire weather intensity and is used to represent potential fire danger. It is computed from daily values of precipitation, temperature, near-surface wind and relative humidity

Usage

```
fwi(
  taverage,
  rh,
  w,
  pr,
  lat,
  data_names = NULL,
  time.scale = YEAR,
  na.rm = FALSE
)
```

Arguments

`taverage`	daily mean temperature, Celsius
`rh`	relative humidity, percentage
`w`	average wind, m/s
`pr`	daily precipitation, mm
`lat`	latitude, degree
`data_names`	names of each period of time
`time.scale`	month, season or year
`na.rm`	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

References

Van Wagner CE. 1987. Development and structure of the Canadian forest fire weather index system. Technical Report 35, Canadian Forestry Service: Ottawa, Ontario. Bedia, J., Herrera, S., Gutiérrez, J. M., Zavala, G., Urbieta, I. R., & Moreno, J. M. (2012). Sensitivity of fire weather index to different reanalysis products in the iberian peninsula. Natural Hazards and Earth System Science, 12(3), 699-708. doi:10.5194/nhess-12-699-2012

Examples

```
data(data_all)
fwi(taverage = data_all$tg, rh = data_all$humidity, w = data_all$wind,
     pr = data_all$rr, lat = data_all$lat)
```

`fxx` *Daily maximum wind gust*

Description

Maximum value of daily maximum wind gust (m/s)

Usage

```
fxx(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

`data`	maximum wind gust, m/s
`data_names`	names of each period of time
`time.scale`	month, season or year
`na.rm`	logical. Should missing values (including NaN) be removed?

Value

wind, m/s

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
fxx(data = data_all$windgust)
```

gd4 *Growing degree days*

Description

Sum of degree days of TG over 4 Celsius (the daily mean temperature is less than 4 celsius, it is set equal to 4 celsius)

Usage

```
gd4(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

References

McMaster, G. S., & Wilhelm, W. W. (1997). Growing degree-days: One equation, two interpretations. Agricultural and Forest Meteorology, 87(4), 291-300

Examples

```
data(data_all)
gd4(data=data_all$tg)
```

gsl *Growing season length*

Description

Annual count of days between the first span of at least 6 days with TG > 5 Celsius and first span after 1 July of 6 days with TG < 5 Celsius.

Usage

```
gsl(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

days

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
gsl(data=data_all$tg)
```

---

gsr *Growing season precipitation*

Description

Growing season (april to october) total precipitation

Usage

```
gsr(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

precipitation, mm

Examples

```
data(data_all)
gsr(data = data_all$rr)
```

gtg *Mean TG*

Description

Mean of daily mean air temperature

Usage

```
gtg(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
gtg(data=data_all$tg)
```

gtn *Mean TN*

Description

Mean of daily minimum air temperature

Usage

```
gtn(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
gtn(data=data_all$tn)
```

---

gtx *Mean TX*

Description

Mean of daily maximum air temperature

Usage

```
gtx(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
gtx(data=data_all$tg)
```

---

hd17 *Heating degree days*

Description

accumulated degree when TG is below 17 Celsius

Usage

```
hd17(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

Formula

$$HD17_j = \sum_{j-1}^{I} (17^oC - TG_i j)$$

References

Quayle, R. G., & Diaz, H. F. (1980). Heating degree day data applied to residential heating energy consumption. Journal of Applied Meteorology, 19(3), 241-246. doi:10.1175/15200450(1980)019<0241:HDDDAT>2.0.CO;2

Examples

```
data(data_all)
hd17(data=data_all$tg)
```

hi *Heat Index*

Description

Combines air temperature and relative humidity to determine the human-perceived equivalent temperature

Usage

```
hi(taverage, rh, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

taverage	daily mean temperature, Celsius
rh	relative humidity, percentage
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

index value

Formula

$$HI = -42,379 + 2,04901523 * TG + 10,14333127 * rh - 0,22475541 * TG * rh - 0.00683783 * TG^2 - 0.05481717 * rh^2 + 0.01$$

. Where TG is air temperature in ºF and rh is relative humidity in

References

The Heat Index Equation https://www.wpc.ncep.noaa.gov/html/heatindex_equation.shtml

Examples

```
data(data_all)
hi(taverage = data_all$tg, rh = data_all$humidity)
```

hsd *Heavy snowy days*

Description

Number of days with snow depth more than 50 cm.

Usage

```
hsd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	snow depth, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
hsd(data = data_all$snowdepth)
```

id *Ice days*

Description

Number of days with TX < 0 Celsius.

Usage

```
id(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5.

Examples

```
data(data_all)
id(data=data_all$tx)
```

---

jci *Johansson Continentality Index*

Description

The Johansson Continentality Index is usually used for the climatic differentiation between continental and oceanic climates.

Usage

```
jci(data, data_names = NULL, value, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
value	lat
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

Formula

$$JCI = \frac{1.7(Thm - Tcm)}{sinf} - 20.4$$

Thm = Average temperature of the hottest month (Celsius); Tcm = Average temperature of the coldest month (Celsius); f = geographical latitude

References

Chronopoulou-Sereli A. 1996. Courses of Agricultural Meteorology.Publications Agricultural University of Athens: Athens, OH

Examples

```
data(data_all)
jci(data = data_all$tg, value = data_all$lat)
```

---

koi *Kerner Oceanity Index*

Description

KOI analysed the oceanity assuming that marine climates have colder spring months in comparison with the autum months.

Usage

```
koi(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

Formula

$$KOI = \frac{100(TGo - TGa)}{Thm - Tcm}$$

TGo = Average temperature of October TGa = Average temperature of April Thm = Average temperature of the hottest month (Celsius); Tcm = Average temperature of the coldest month (Celsius)

References

Zambakas J. 1992.General Climatology. Department of Geology,National & Kapodistrian University of Athens, Athens. Gavilan RG. 2005. The use of climatic parameters and indices in vege-tation distribution. A case study in the Spanish System Central.Int. J.Biometeorol.50: 111–120.

Examples

```
data(data_all)
koi(data = data_all$tg)
```

---

lastFrostDate *Mean last frost day*

Description

Calculates the last frost day within a predefined period.

Usage

```
lastFrostDate(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

–

Examples

```
data(data_all)
lastFrostDate(data=data_all$tn)
```

lpsc *Date of last permanent snow cover*

Description

Last day of the longest period with consecutive snow cover day (day of the hydrological year).

Usage

```
lpsc(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	snow depth, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

date

Examples

```
data(data_all)
lpsc(data = data_all$snowdepth)
```

mai *De Martonne aridity index*

Description

De Martonne aridity index is the ratio between the annual amount of precipitation and anual mean of temperature plus 10 Celsius.

Usage

```
mai(pr, taverage, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

pr	daily precipitation, mm
taverage	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

Formula

$$MAI = \frac{P}{TG + 10}$$

P = annual precipitation (mm); TG = mean annual air temperature (Celsius)

References

De Martonne E., 1926. Une nouvelle fonction climatologique: L'indice d'aridité. La Meteorologie, 449-458.

Examples

```
data(data_all)
mai(pr = data_all$rr, taverage = data_all$tg)
```

---

mfi *Modified Fournier Index*

Description

The precipitation concentration index is frequently associated to erosion risk. Values: 0-60 very low; 60-90 Low; 90-120 moderate; 120-160 high; > 160 very high.

Usage

```
mfi(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

`data`	daily precipitation, mm
`data_names`	names of each period of time
`na.rm`	logical. Should missing values (including NaN) be removed?
`...`	further arguments passed to or from other methods

Value

index value

Formula

$$MFI = \sum_{i=1}^{12} \frac{P_i^2}{P_t}$$

References

Fournier F. 1960. Climat et Erosion. PUF: Paris. Arnoldus HM. 1980. An approximation of the rainfall factor in the Uni-versal Soil Loss Equation. In Assessments of Erosion, de Boodts M,Gabriels D (eds). John Wiley and Sons Ltd, Chichester 127–132. De Luis M., González-Hidalgo J.C., Longares L.A. Is rainfal erosivity increasing in the Mediterranean Iberian Peninsula?. Land Degradation & Development, 21: 139-144.

Examples

```
data(data_all)
mfi(data = data_all$rr)
```

`mi` *Mould index*

Description

Number of days with a relative humidity over 90

Usage

```
mi(taverage, rh, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

`taverage`	daily mean temperature, Celsius
`rh`	relative humidity, percentage
`data_names`	names of each period of time
`time.scale`	month, season or year
`na.rm`	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
mi(taverage = data_all$tg, rh = data_all$humidity)
```

moi *Marsz Oceanity Index*

Description

The annual range of monthly mean air temperatures grados

Usage

```
moi(data, lat, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
lat	latitude, degree
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

Formula

$$MOI = \frac{0.731\phi + 1.767}{Thm - Tcm}$$

Phi = geographical latitude; Thm = Average temperature of the hottest month (Celsius); Tcm = Average temperature of the coldest month (Celsius)

References

Marsz A, Rakusa-Suszczewskis S. 1987. Charakterystyka ekologiczna rejonu Zatoki Admiralicji (King George Island, SouthShetland Islands). 1. Klimat i obszary wolne od lodu.Kosmos36:103–127.

Examples

```
data(data_all)
moi(data = data_all$tg, lat = data_all$lat)
```

ms *Maximum snow depth*

Description

Maximum snow depth (m)

Usage

```
ms(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	snow depth, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

snow depth, m

Examples

```
data(data_all)
ms(data = data_all$snowdepth)
```

msd *Mild snowy days*

Description

Number of days with snow depth > 5 cm.

Usage

```
msd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	snow depth, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
msd(data = data_all$snowdepth)
```

---

ngsr *Non-growing season precipitation*

Description

Total precipitation from October to April

Usage

```
ngsr(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

precipitation, mm

Examples

```
data(data_all)
ngsr(data = data_all$rr)
```

ntg *Minimum TG*

Description

Minimum value of daily mean air temperature

Usage

```
ntg(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

Average temperature

Examples

```
data(data_all)
ntg(data=data_all$tg)
```

nts *Number of thermal stress days*

Description

Number of days with a maximum temperature above 28 Celsius from January 1st to June 15th.

Usage

```
nts(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

–

Examples

```
data(data_all)
nts(data=data_all$tx)
```

`ogs10` *Onset of growing season 10 days*

Description

Date of the start of the first span with at least 10 days with TG > 5 Celsius

Usage

```
ogs10(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

`data`	daily mean temperature, Celsius
`data_names`	names of each period of time
`time.scale`	month, season or year
`na.rm`	logical. Should missing values (including NaN) be removed?

Value

date

Examples

```
data(data_all)
ogs10(data=data_all$tg)
```

ogs6 *Onset of growing season 6 days*

Description

Date of the start of the first span with at least 6 days with TG >5 Celsius

Usage

```
ogs6(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

date

Examples

```
data(data_all)
ogs6(data=data_all$tg)
```

pci *Precipitation Concentration Index*

Description

Index to evaluate precipitation heterogeneity at a monthly scale. Values <10 (uniform monthly rainfall distribution); values 11-15 (moderate concentration of precipitation); values 16-20 (irregular distribution); and >20 ((high precipitation concentration)

Usage

```
pci(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

Formula

$$PCI = \frac{\sum_{i=1}^{12} P_i^2}{(P_t)^2} * 100$$

References

Oliver, J.E. (1980) Monthly precipitation distribution: a comparative index. Professional Geographer, 32, 300–309

Examples

```
data(data_all)
pci(data = data_all$rr)
```

`pici` *Pinna Combinative Index*

Description

Pinna combinative index is an aridity–humidity index

Usage

```
pici(pr, taverage, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

`pr`	daily precipitation, mm
`taverage`	daily mean temperature, Celsius
`data_names`	names of each period of time
`na.rm`	logical. Should missing values (including NaN) be removed?
`...`	further arguments passed to or from other methods

Value

index value

Formula

$$PICI = \frac{1}{2}\left(\frac{P}{TG+10} + \frac{12Pdm}{TGdm+10}\right)$$

P = annual precipitation (mm); TG = annual mean temperature (Celsius); Pdm= precipitation of the driest month; TGdm= temperature of the driest month

References

Zambakas J. 1992. General Climatology. Department of Geology, National & Kapodistrian University of Athens: Athens, Greece.

Examples

```
data(data_all)
pici(pr = data_all$rr, taverage = data_all$tg)
```

`pm_et0_fao` *Daily FAO-56 Penman-Monteith reference evapotranspiration (ET0)*

Description

Computes daily reference evapotranspiration (ET0) using the FAO-56 Penman-Monteith formulation for a short or tall reference crop. This implementation is valid **only for daily time steps**; i.e. it, assumes soil heat flux $G = 0$.

Usage

```
pm_et0_fao(
  Tmin,
  Tmax,
  U2,
  J,
  Ra = NA,
  lat = NA,
  Rs = NA,
  tsun = NA,
  CC = NA,
  ea = NA,
  Tdew = NA,
  Twet = NA,
  apsy = NA,
  Tdry = NA,
  RHx = NA,
  RHn = NA,
  RH = NA,
  P = NA,
```

```
  P0 = NA,
  z = NA,
  crop = c("short", "tall"),
  na.rm = FALSE
)
```

Arguments

Tmin	Numeric vector of minimum daily air temperature (Celsius).
Tmax	Numeric vector of maximum daily air temperature (Celsius).
U2	Numeric vector of daily mean wind speed at 2 m (m s^{-1}).
J	Integer vector of Julian day (1-366).
Ra	Optional numeric vector of daily extraterrestrial radiation (MJ m^{-2} d^{-1}). If not provided, it is computed from J and lat using potential_radiation().
lat	Numeric scalar or vector giving latitude in decimal degrees (positive north, negative south). Required if Ra is not supplied, or if tsun (sunshine duration) is used to derive Rs.
Rs	Optional numeric vector of incoming shortwave radiation at the surface (MJ m^{-2} d^{-1}). If not provided, it is estimated from tsun and Ra using the Ångström-Prescott relation.
tsun	Optional numeric vector of daily bright sunshine duration (h). Used to estimate Rs when Rs is not provided.
CC	Optional numeric vector of cloud cover (fraction or %). Currently not used (reserved for future extensions).
ea	Optional numeric vector of actual vapour pressure (kPa). If provided with the correct length, it is used directly and other humidity inputs (Tdew, Twet, Tdry, RHx, RHn, RH) are ignored.
Tdew	Optional numeric vector of dew point temperature (Celsius), used to derive ea when ea is not supplied.
Twet	Optional numeric vector of wet bulb temperature (Celsius), used to derive ea when ea is not supplied.
apsy	Optional psychrometer ventilation coefficient (1 / Celsius). Typical values are 0.000662 for ventilated (Assmann type) psychrometers, 0.000800 for naturally ventilated psychrometers, 0.001200 for non-ventilated psychrometers installed indoors.
Tdry	Optional numeric vector of dry bulb temperature (Celsius), used to derive ea when ea is not supplied.
RHx	Optional numeric vector of maximum daily relative humidity (%). Used to derive ea when neither ea, Tdew nor (Twet, Tdry) are supplied.
RHn	Optional numeric vector of minimum daily relative humidity (%). Used together with RHx to derive ea when both are available.
RH	Optional numeric vector of relative humidity (%, daily mean or representative). Used to derive ea when none of ea, Tdew, (Twet, Tdry), or (RHx, RHn) are supplied.

P	Optional numeric vector or scalar of atmospheric pressure (kPa). If not provided, it is estimated from P0 and z.
P0	Optional numeric vector or scalar of reference pressure (kPa), typically standard sea-level pressure (101.3 kPa). Used as a base to compute P from z when P is not provided.
z	Optional numeric vector or scalar of elevation above sea level (m), used to estimate P when P is missing.
crop	Character string indicating the reference crop type. One of "short" or "tall". • "short": short reference crop (clipped grass, height ~ 0.12 m), consistent with FAO-56 grass reference. • "tall": tall reference crop (alfalfa-type, height ~ 0.5 m), used in ASCE but included here for convenience.
na.rm	Logical, currently unused. Reserved for future handling of missing values within the calculation.

Details

The function implements the FAO-56 Penman-Monteith equation on a daily time step. Solar geometry and extraterrestrial radiation R_a are computed following FAO-56 using potential_radiation, and R_s (incoming shortwave radiation) can be supplied or estimated from sunshine duration using the Ångström-Prescott relation.

Net radiation R_n is computed as the sum of net shortwave and net longwave radiation, adopting the commonly used FAO-56 coefficients. The soil heat flux G is assumed negligible at daily time steps and set to zero.

The crop argument affects only the aerodynamic term through constants c1 and c2:

- crop = "short": c1 = 900, c2 = 0.34.
- crop = "tall": c1 = 1600, c2 = 0.38.

Humidity input precedence

The actual vapour pressure ea is derived using the first available input (or combination of inputs) in the following precedence order:

Order & **Inputs used** & **Formula / Source**
1 & ea & used directly
2 & Tdew & $e_a = e_s(T_{dew})$ (FAO-56 Eq. 14)
3 & Twet + Tdry + apsy & $e_a = e_s(T_{wet}) - a_{psy}P(T_{dry} - T_{wet})$ (FAO-56 Eq. 15-16)
4 & RHx + RHn & $e_a = (e_{s,min}RH_x + e_{s,max}RH_n)/2$ (FAO-56 Eq. 17)
5 & RHx & $e_a = e_{s,min}RH_x$ (FAO-56 Eq. 18)
6 & RH & $e_a = e_sRH/100$ (FAO-56 Eq. 19)
7 & fallback Tmin & $e_a = e_{s,min}$ (ICID Eq. 1.19; FAO fallback)

If none of these inputs is available (all are missing or all-NA), the function raises an error.

Value

A numeric vector of length equal to `length(Tmin)` with daily reference evapotranspiration values (mm d^{-1}).

Examples

```
# FAO-56 Example 18; reference ET0 is 3.9 mm / day
Tmin <- 12.3                  # Celsius
Tmax <- 21.5                  # Celsius
RHx <- 84                     # %
RHn <- 63                     # %
U2 <- 2.078                   # m/s
tsun <- 9.25                  # hours
z  <- 100                     # m a.s.l
J  <- 187                     # day of year
lat <- 50.8                   # degrees N

pm_et0_fao(
  Tmin = Tmin, Tmax = Tmax, U2 = U2, J = J,
  lat = lat, tsun = tsun, RHx = RHx, RHn = RHn, z = z
)
```

---

prcptot *Total precipitation wet days*

Description

Precipitation amount on days with RR >= 1 mm

Usage

```
prcptot(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

`data`	daily precipitation, mm
`data_names`	names of each period of time
`time.scale`	month, season or year
`na.rm`	logical. Should missing values (including NaN) be removed?

Value

precipitation, mm

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
prcptot(data = data_all$rr)
```

---

ptg *Sums positive*

Description

Sums of positive TG calculated for the 1st of February to the 10th April interval

Usage

```
ptg(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

Examples

```
data(data_all)
ptg(data = data_all$tg)
```

---

pvpot *Photovoltaic potential index*

Description

Photovoltaic potential index describing cell potential production with respect to the optimal potential of a global downward shortwave radiation of 1000 W/m2.

Usage

```
pvpot(
  taverage,
  w,
  radiation,
  data_names = NULL,
  time.scale = YEAR,
  na.rm = FALSE
)
```

Arguments

taverage	daily mean temperature, Celsius
w	average wind, m/s
radiation	radiation, W m-2
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
pvpot(taverage=data_all$tg, w=data_all$wind, radiation=data_all$radiation_w)
```

---

pvpot_ *Photovoltaic potential index (pvpot)*

Description

Photovoltaic potential index describing cell potential production with respect to the optimal potential of a global downward shortwave radiation of 1000 W/m2

Usage

```
pvpot_(tm, wss, rad)
```

Arguments

tm	Matrix or vector with mean temperature data (in Celsius ºC)
wss	Matrix or vector with mean wind speed data (in meters per second m/s)
rad	Matrix or vector with the mean radiation data (in Watios per squared meters W/m²)

Value

A numeric vector or matrix with the photovoltaic potential index, between 0-1.

Author(s)

O.Mirones

References

Chenni, R., M. Makhlouf, T. Kerbache, and A. Bouzid. 2007. A Detailed Modeling Method for Photovoltaic Cells. Energy 32 (9): 1724–30. https://doi.org/10.1016/j.energy.2006.12.006.

Crook, Julia A., Laura A. Jones, Piers M. Forster, and Rolf Crook. 2011. "Climate Change Impacts on Future Photovoltaic and Concentrated Solar Power Energy Output." Energy & Environmental Science 4 (9): 3101. https://doi.org/10.1039/c1ee01495a.

Jerez, Sonia, Isabelle Tobin, Robert Vautard, Juan Pedro Montávez, Jose María López-Romero, Françoise Thais, Blanka Bartok, et al. 2015. "The Impact of Climate Change on Photovoltaic Power Generation in Europe." Nature Communications 6 (1): 10014. https://doi.org/10.1038/ncomms10014.

---

r10mm *Days precipitation >= R10mm*

Description

Days with daily precipitation amount >= 10mm

Usage

```
r10mm(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5.

Examples

```
data(data_all)
r10mm(data = data_all$rr)
```

`r20mm` *Days precipitation >= R20mm*

Description

Days with daily precipitation amount >= 20mm

Usage

```
r20mm(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

`data`	daily precipitation, mm
`data_names`	names of each period of time
`time.scale`	month, season or year
`na.rm`	logical. Should missing values (including NaN) be removed?

Value

days

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5.

Examples

```
data(data_all)
r20mm(data = data_all$rr)
```

r95tot *Percentage precipitation of very wet days*

Description

Precipitation at days exceeding the 95th percentile divided by total precipitation expressed in percentage. The 95th percentile is computed based on the time scale selected (month, season or year) not daily.

Usage

```
r95tot(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

precipitation, mm

Examples

```
data(data_all)
r95tot(data = data_all$rr, time.scale="month")
```

r99tot *Precipitation fraction extremely wet days*

Description

Precipitation at days exceeding the 99th percentile divided by total precipitation expressed in percentage, The 99th percentile is computed based on the time scale selected (month, season or year) not daily

Usage

```
r99tot(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

precipitation, mm

Examples

```
data(data_all)
r99tot(data = data_all$rr)
```

---

rti *Total precipitation*

Description

Total amounts of precipitation

Usage

```
rti(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

precipitation, mm

Examples

```
data(data_all)
rti(data = data_all$rr)
```

rx1day *Maximum precipitation*

Description

The highest amount of daily precipitation

Usage

```
rx1day(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

precipitation, mm

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5.

Examples

```
data(data_all)
rx1day(data = data_all$rr)
```

rx5day *Maximum 5 days R*

Description

Maximum consecutive 5-day precipitation

Usage

```
rx5day(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

precipitation, mm

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5.

Examples

```
data(data_all)
rx5day(data = data_all$rr)
```

---

scd *Number of snow covered days*

Description

Number of snow covered days (snow depth > 0)

Usage

```
scd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	snow depth, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
scd(data = data_all$snowdepth)
```

sd0_10 *Snow depth 1-10*

Description

Number of days with snow depth in the range 1-10 cm

Usage

```
sd0_10(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	snow depth, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
sd0_10(data = data_all$snowdepth)
```

sd10_20 *Snow depth 10-20*

Description

The number of days with snow depth of 10-20 cm

Usage

```
sd10_20(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	snow depth, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
sd10_20(data = data_all$snowdepth)
```

---

sdii *Simple precipitation intensity index*

Description

Sum of precipitation in wet days (days with >1mm of precipitation), and dividing that by the number of wet days in the period.

Usage

```
sdii(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

precipitation, mm

References

Michele Brunetti, Maurizio Maugerib, Teresa Nanni, (2001) Changes in total precipitation, rainy days and extreme events in northeastern Italy, International Journal of Climatology

Examples

```
data(data_all)
sdii(data = data_all$rr)
```

---

snd *Sunny days*

Description

Days with mean cloud cover less than 10

Usage

```
snd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	cloud cover, percentage
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
snd(data = data_all$cloud)
```

---

spei1 *Standardised Precipitation-Evapotranspiration Index 1*

Description

Standardized precipitation-evapotranspiration index calculated at 1-month time scale

Usage

```
spei1(eto, pr, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

eto	evapotranspiration, mm
pr	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

References

Vicente-Serrano, S. M., Beguería, S. and López-Moreno, J. I.: A multiscalar drought index sensitive to global warming: The standardized precipitation evapotranspiration index, J. Clim., 23(7), doi:10.1175/2009JCLI2909.1, 2010.

Examples

```
data(data_all)
spei1(eto = data_all$eto, pr = data_all$rr, na.rm = TRUE)
```

---

spei12 *Standardised Precipitation-Evapotranspiration Index 12*

Description

Standardized precipitation-evapotranspiration index calculated at 12-month time scale

Usage

```
spei12(eto, pr, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

eto	evapotranspiration, mm
pr	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

References

Vicente-Serrano, S. M., Beguería, S. and López-Moreno, J. I.: A multiscalar drought index sensitive to global warming: The standardized precipitation evapotranspiration index, J. Clim., 23(7), doi:10.1175/2009JCLI2909.1, 2010.

Examples

```
data(data_all)
spei12(eto = data_all$eto, pr = data_all$rr)
```

`spei3` *Standardised Precipitation-Evapotranspiration Index 3*

Description

Standardized precipitation-evapotranspiration index calculated at 3-month time scale

Usage

```
spei3(eto, pr, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

`eto`	evapotranspiration, mm
`pr`	daily precipitation, mm
`data_names`	names of each period of time
`na.rm`	logical. Should missing values (including NaN) be removed?
`...`	further arguments passed to or from other methods

Value

index value

References

Vicente-Serrano, S. M., Beguería, S. and López-Moreno, J. I.: A multiscalar drought index sensitive to global warming: The standardized precipitation evapotranspiration index, J. Clim., 23(7), doi:10.1175/2009JCLI2909.1, 2010.

Examples

```
data(data_all)
spei3(eto = data_all$eto, pr = data_all$rr)
```

spei6 *Standardised Precipitation-Evapotranspiration Index 6*

Description

Standardized precipitation-evapotranspiration index calculated at 6-month time scale

Usage

```
spei6(eto, pr, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

eto	evapotranspiration, mm
pr	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

References

Vicente-Serrano, S. M., Beguería, S. and López-Moreno, J. I.: A multiscalar drought index sensitive to global warming: The standardized precipitation evapotranspiration index, J. Clim., 23(7), doi:10.1175/2009JCLI2909.1, 2010.

Examples

```
data(data_all)
spei6(eto = data_all$eto, pr = data_all$rr)
```

spi1 *Standardized precipitation index 1*

Description

Standardized precipitation index calculated at 1-month time scale

Usage

```
spi1(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

References

McKee, T. B., Doesken, N. J. and Kleist, J.: The relationship of drought frequency and duration to time scales, Eighth Conf. Appl. Climatol., 179–184, 1993.

Examples

```
data(data_all)
spi1(data = data_all$rr)
```

---

spi12 *Standardized precipitation index 12*

Description

Standardized precipitation index calculated at 12-month time scale

Usage

```
spi12(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

References

McKee, T. B., Doesken, N. J. and Kleist, J.: The relationship of drought frequency and duration to time scales, Eighth Conf. Appl. Climatol., 179–184, 1993.

Examples

```
data(data_all)
spi12(data = data_all$rr)
```

---

spi3 *Standardized precipitation index 3*

Description

Standardized precipitation index calculated at 3-month time scale

Usage

```
spi3(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

References

McKee, T. B., Doesken, N. J. and Kleist, J.: The relationship of drought frequency and duration to time scales, Eighth Conf. Appl. Climatol., 179–184, 1993.

Examples

```
data(data_all)
spi3(data = data_all$rr)
```

spi6 *Standardized precipitation index 6*

Description

Standardized precipitation index calculated at 6-month time scale

Usage

```
spi6(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily precipitation, mm
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

References

McKee, T. B., Doesken, N. J. and Kleist, J.: The relationship of drought frequency and duration to time scales, Eighth Conf. Appl. Climatol., 179–184, 1993.

Examples

```
data(data_all)
spi6(data = data_all$rr)
```

ss *Snowfall sum*

Description

Sum of snowfall

Usage

```
ss(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	snowfall, mm of water equivalent
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

snow, mm

Examples

```
data(data_all)
ss(data = data_all$snowfallmm)
```

---

ssd *Sum of sunshine duration*

Description

Sum of sunshine duration (hours)

Usage

```
ssd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	insolation, hours of sun
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

hours of sun

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
ssd(data = data_all$insolation)
```

ssp *Sunshine duration percentage*

Description

Sunshine duration fraction with respect to day length (

Usage

```
ssp(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	insolation, hours of sun
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

percentage

Formula

$$SSP = \frac{SS}{SSmax} * 100$$

SS: sum of sunshine duration (h); SSmax: maximun daylight (h)

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
ssp(data = data_all$insolation)
```

stn10 *Sums TN-10*

Description

Sum of degree days when TN <=-10 Celsius recorded in December-February interval

Usage

```
stn10(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

Examples

```
data(data_all)
stn10(data = data_all$tn)
```

stn15 *Sums TN-15*

Description

Sum of degree days when TN <= -15 Celsius recorded in December-February interval

Usage

```
stn15(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

Examples

```
data(data_all)
stn15(data = data_all$tn)
```

`stx32` *Sums TX32*

Description

Sum of degree days when TX >= 32 Celsius on the interval June-August. The 32 celsius limit is the critical biological threshold for the maximum air temperature from which the physiological optimal growth and development of wheat and maize plants.

Usage

```
stx32(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

`data`	daily maximum temperature, Celsius
`data_names`	names of each period of time
`na.rm`	logical. Should missing values (including NaN) be removed?
`...`	further arguments passed to or from other methods

Value

temperature, Celsius

Examples

```
data(data_all)
stx32(data = data_all$tx)
```

su *Summer days*

Description

Number of days with daily maximum temperature > 25 Celsius.

Usage

```
su(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5.

Examples

```
data(data_all)
su(data=data_all$tx)
```

ta_o *Growing season (Apr-Oct)*

Description

Growing season (april to october) mean TG

Usage

```
ta_o(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

Examples

```
data(data_all)
ta_o(data=data_all$tg)
```

---

tm_s *Growing season(May-Sep)*

Description

Growing season (may to september) mean TG

Usage

```
tm_s(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

Examples

```
data(data_all)
tm_s(data=data_all$tg)
```

tn10p *Percentage of cold nights*

Description

Percentages of days with TN lower than the 10th percentile. The 10th percentile is computed based on the time scale selected (month, season or year) not daily as ETCCDI does. If you want to compute daily you can use RClimDex package.

Usage

```
tn10p(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

percentage

Formula

$$cn = \frac{No.daysTN < 10p}{No.days} * 100$$

Examples

```
data(data_all)
tn10p(data=data_all$tn)
```

tn90p *Warm nights*

Description

Percentages of days with TN higher than the 90th percentile. The 90th percentile is computed based on the time scale selected (month, season or year) not daily.

Usage

```
tn90p(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
tn90p(data=data_all$tn)
```

---

tnn *Minimum TN*

Description

Minimum of daily minimum air temperature

Usage

```
tnn(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5. https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf

Examples

```
data(data_all)
tnn(data=data_all$tn)
```

tnx *Maximum TN*

Description

Maximum of daily minimum air temperature

Usage

```
tnx(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5. https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf

Examples

```
data(data_all)
tnx(data=data_all$tn)
```

tr *Tropical nights*

Description

Number of days with TN > 20 Celsius.

Usage

```
tr(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5.

Examples

```
data(data_all)
tr(data=data_all$tn)
```

---

turc *Turc Index*

Description

The Turc Index is a hydrometeorological indicator designed to estimate potential vegetation production using key climatic variables, including solar radiation, air temperature (maximum and minimum), relative humidity, and precipitation. Originally developed in 1967, this index integrates three main components: the solar factor (availability of sunlight for photosynthesis), the thermal factor (temperature influence on plant growth), and the dryness factor (balance between evapotranspiration and water availability). By combining these elements, the Turc Index offers a simplified yet robust measure of climate-driven vegetation potential, allowing for global comparisons across diverse ecosystems. Recent studies have demonstrated a strong spatial correlation between the Turc Index and observed vegetation indices, such as the kernel Normalized Difference Vegetation Index (kNDVI), with an R^2 value of 0.78. This highlights its effectiveness in capturing both spatial patterns and temporal trends of vegetation dynamics worldwide, especially in regions sensitive to climatic variability like semi-arid zones and tropical forests.

Usage

```
turc(
  data,
  tmin,
  rh,
  pr,
```

```
  radiation,
  lat,
  wfc,
  data_names = NULL,
  na.rm = FALSE,
  ...
)
```

Arguments

data	daily maximum temperature, Celsius
tmin	daily minimum temperature, Celsius
rh	relative humidity, percentage
pr	daily precipitation, mm
radiation	radiation, J/m2/day
lat	latitude, degree
wfc	water Field Capacity, initial water balance value
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

index value

References

Turc, L., 1967. Incidence des facteurs macroclimatiques sur les productions végétales. Fourrages 31, 23–25. Turc, L., Lecerf, H., 1972. Indice climatique de potentialité agricole. Sci Sol.

---

tx10p *Percentage of cold days*

Description

Percentages of days with TX lower than the 10th percentile. The 10th percentile is computed based on the time scale selected (month, season or year) not daily as ETCCDI does. If you want to compute daily you can use RClimDex package.

Usage

```
tx10p(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

percentage

Formula

$$cd = \frac{No.daysTX < 10p}{No.days} * 100$$

Examples

```
data(data_all)
tx10p(data=data_all$tx)
```

---

tx90p *Warm days*

Description

Total numbers of days with TX higher than the 90th percentile. The 90th percentile is computed based on the time scale selected (month, season or year) not daily as ETCCDI does. If you want to compute daily you can use RClimDex package.

Usage

```
tx90p(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
tx90p(data=data_all$tx)
```

txn *Minimum TX*

Description

Minimum of daily maximum air temperature

Usage

```
txn(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5. https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf

Examples

```
data(data_all)
txn(data=data_all$tx)
```

txx *Maximum TX*

Description

Maximum of daily maximum air temperature

Usage

```
txx(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

References

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5. https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf

Examples

```
data(data_all)
txx(data=data_all$tx)
```

---

uai *UNEP Aridity Index*

Description

P/Eto

Usage

```
uai(eto, pr, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

eto	evapotranspiration, mm
pr	daily precipitation, mm
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

index value

References

Huiping Huang, Yuping Han, Mingming Cao, Jinxi Song, and Heng Xiao Spatial-Temporal Variation of Aridity Index of China during 1960–2013. Advances in Meteorology, vol. 2016, Article ID 1536135, 10 pages, 2016. doi:10.1155/2016/1536135

Examples

```
data(data_all)
uai(eto = data_all$eto, pr = data_all$rr)
```

---

ucp *Urban Cleanliness Perception Index (UCP)*

Description

Urban Cleanliness Perception Index (UCP) based on annual precipitation and mean annual temperature.

Usage

```
ucp(pr, tmean, data_names = NULL, na.rm = TRUE, ...)
```

Arguments

`pr`	Numeric vector of precipitation values.
`tmean`	Numeric vector of mean temperature values.
`data_names`	Optional character vector with names for the data.
`na.rm`	Logical; if 'TRUE', missing values are removed (default is 'TRUE').
`...`	further arguments passed to or from other methods

Value

index value

References

Mazon, J., D. Pino, and D. López, 2024: Do Precipitation and Temperature Influence Perceptions of Urban Cleanliness?. Wea. Climate Soc., 16, 555–562, doi:10.1175/WCASD230145.1.

utci *Universal Thermal Climate Index*

Description

The Universal Thermal Climate is defined as the air temperature of the reference condition causing the same model response as actual conditions. The deviation of UTCI from air temperature, depends on the values of air and mean radiant temperature), wind speed and humidity.

Usage

```
utci(
  taverage,
  rh,
  w,
  tmrt,
  data_names = NULL,
  time.scale = YEAR,
  na.rm = FALSE
)
```

Arguments

taverage	daily mean temperature, Celsius
rh	relative humidity, percentage
w	average wind, m/s
tmrt	radiation temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

index value

References

Blazejczyk, K.; Jendritzky, G.; Bröde, P.; Fiala, D.; Havenith, G.; Epstein, Y., Psikuta, A.; Kampmann, B. 2013. An introduction to the Universal Thermal Climate Index (UTCI). Geographia Polonica, 86 (1), pp.5-10. http://www.utci.org/

Examples

```
data(data_all)
utci(ta = data_all$tg, rh = data_all$humidity, w = data_all$wind,
     tmrt = data_all$radiationtemperature)
```

vcd *Very cold days*

Description

Days with TN <1st percentile. The 1th percentile is computed based on the time scale selected (month, season or year).

Usage

```
vcd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
vcd(data=data_all$tn)
```

vdtr *Mean daily difference DTR*

Description

Mean absolute day-to-day difference in DTR

Usage

```
vdtr(tmax, tmin, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

tmax	daily maximum temperature, Celsius
tmin	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

temperature, Celsius

Formula

$$vDTR_j = \frac{\sum_{i=1}^{I} \mid (TX_{ij} - TN_{ij}) - (TX_{i-1,j} - TN_{i-1,j}) \mid}{I}$$

References

European Climate Assessment & Dataset. Indices dictionary. https://www.ecad.eu//indicesextremes/indicesdictionary.php

Examples

```
data(data_all)
vdtr(tmax=data_all$tx, tmin=data_all$tn)
```

---

vwd *Very warm days*

Description

Days with TX >99th percentile per year. The 99th percentile is computed based on the time scale selected (month, season or year).

Usage

```
vwd(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
vwd(data=data_all$tx)
```

w95 *Windy days*

Description

Total numbers of days with wind higher than the 95th percentile. The 95th percentile is computed based on the time scale selected (month, season or year) not daily.

Usage

```
w95(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	average wind, m/s
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
w95(data=data_all$wind)
```

wci *Wind chill index*

Description

Wind chill index is the lowering of body temperature due to the passing-flow of lower-temperature air. It combines air temperature and wind speed.

Usage

```
wci(taverage, w, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

taverage	daily mean temperature, Celsius
w	average wind, m/s
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

index value

Formula

$$WCI = 13.12 + 0.6215 * TG - 11.37 * v^{+0.16} + 0.3965 * TG * v^{+0.16}$$

Where TG in celsius and v is wind speed in Km/h

References

Osczevski, Randall; Bluestein, Maurice (2005). The new wind chill equivalent temperature chart. Bulletin of the American Meteorological Society. 86 (10): 1453–1458

Examples

```
data(data_all)
wci(taverage = data_all$tg, w = data_all$wind)
```

---

wki *Winkler index*

Description

Sum of degree days over 10 celsius of TG from April 1 until October 31

Usage

```
wki(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

References

Winkler, A.J., J.A. Cook, W.M. Kliewer, and L.A. Lider. 1974. General Viticulture. 4th ed. University of California Press, Berkeley.

Examples

```
data(data_all)
wki(data = data_all$tg)
```

---

ws *Winter Severity*

Description

Mean TG of the coldest month of the year

Usage

```
ws(data, data_names = NULL, na.rm = FALSE, ...)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	further arguments passed to or from other methods

Value

temperature, Celsius

Examples

```
data(data_all)
ws(data = data_all$tg)
```

---

wsdi *Warm spell duration*

Description

Number of days which are part of groups of at least 6 consecutive days when TX > 90th percentile. The 90th percentile is computed based on the time scale selected (month, season or year) not daily as ETCCDI does. If you want to compute daily you can use RClimDex package.

Usage

```
wsdi(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily maximum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
wsdi(data=data_all$tx)
```

---

xtg *Maximum TG*

Description

Maximum of daily mean air temperature

Usage

```
xtg(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

data	daily mean temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

Average temperature

Examples

```
data(data_all)
xtg(data=data_all$tg)
```

zcd *Zero crossing days*

Description

Number of days with TX > 0 Celsius and TN < 0 Celsius.

Usage

```
zcd(tmax, tmin, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

Arguments

tmax	daily maximum temperature, Celsius
tmin	daily minimum temperature, Celsius
data_names	names of each period of time
time.scale	month, season or year
na.rm	logical. Should missing values (including NaN) be removed?

Value

days

Examples

```
data(data_all)
zcd(tmax=data_all$tx, tmin=data_all$tn)
```

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