

# Package ‘ClimInd’

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**Type** Package

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**Title** Climate Indices

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**Depends** R (>= 2.10), SPEI, 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>

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## 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>

## 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

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

**Value**

ACI

**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**

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

**Value**

average snow depth

**Examples**

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

---

at *Apparent temperature*

---

### Description

Index of the perceived temperature.

### Usage

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

### Arguments

taverage	medium temperature
w	average wind
vapor	water vapour pressure
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

AT

### 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, vapor = data_all$VAPOUR)
```

---

 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, surface solar radiation downwards, J/m2
pr	precipitation
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

### Value

Budyko Index

### 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$radiation, pr = data_all$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	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

BIO10

**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. <http://www.worldclim.org/bioclimate>

**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**

<code>data</code>	medium temperature
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

BIO11

**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. <http://www.worldclim.org/bioclim>

**Examples**

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

---

<code>bio13</code>	<i>Precipitation of wettest month</i>
--------------------	---------------------------------------

---

**Description**

Total precipitation of the wettest month of the year

**Usage**

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

**Arguments**

<code>data</code>	precipitation
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

BIO13

## 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. <http://www.worldclim.org/bioclimate>

## Examples

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

---

bio14	<i>Precipitation of driest month</i>
-------	--------------------------------------

---

## Description

Total precipitation of the driest month of the year

## Usage

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

## Arguments

data	precipitation
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

## Value

BIO14

## 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. <http://www.worldclim.org/bioclimate>

## 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

<code>data</code>	precipitation
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

### Value

BIO15

### 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. <http://www.worldclim.org/bioclimate> This 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 (also known as the coefficient of variation) and is expressed as a percentage.

### 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	precipitation
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

BIO16

**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. <http://www.worldclim.org/bioclimate>

**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**

<code>data</code>	precipitation
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

BIO17

**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. <http://www.worldclim.org/bioclim>

**Examples**

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

---

<code>bio18</code>	<i>Precipitation warmest quarter</i>
--------------------	--------------------------------------

---

**Description**

Precipitation of the warmest quarter of the year

**Usage**

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

**Arguments**

<code>pr</code>	precipitation
<code>taverage</code>	medium temperature
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

BIO18

**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. <http://www.worldclim.org/bioclimate>

**Examples**

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

---

bio19	<i>Precipitation coldest quarter</i>
-------	--------------------------------------

---

**Description**

Precipitation of the coldest quarter of the year

**Usage**

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

**Arguments**

pr	precipitation
taverage	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

BIO19

**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. <http://www.worldclim.org/bioclimate>

**Examples**

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

---

 bio20

*Mean radiation*


---

**Description**

Mean radiation (W m<sup>-2</sup>)

**Usage**

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

**Arguments**

data	radiation en 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**

BIO20

**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. <http://dx.doi.org/10.1111/j.2041-210X.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**

<code>data</code>	medium temperature
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

BIO4

**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. <http://www.worldclim.org/bioclimate>

**Examples**

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

---

<code>bio5</code>	<i>TX warmest month</i>
-------------------	-------------------------

---

**Description**

TX of the warmest month of the year

**Usage**

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

**Arguments**

<code>data</code>	mean temperature
<code>tmax</code>	maximum temperature
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

BIO5

**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. <http://www.worldclim.org/bioclimate>

**Examples**

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

---

bio6	<i>TN of coldest month</i>
------	----------------------------

---

**Description**

TN of the coldest month of the year

**Usage**

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

**Arguments**

data	mean temperature
tmin	minimum temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

BIO6

**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. <http://www.worldclim.org/bioclimate>

**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	medium temperature
tmin	min temperature
tmax	max temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

### Value

BIO7

### 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. <http://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	precipitation
taverage	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

BIO8

**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. <http://www.worldclim.org/bioclimate>

**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	precipitation
taverage	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

BIO9

**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. <http://www.worldclim.org/bioclim>

**Examples**

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

---

calculate_all	<i>Calculate all indexes</i>
---------------	------------------------------

---

**Description**

-

**Usage**

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

**Arguments**

data	data list
lat	latitude
time.scale	month, season or year
data_names	names of each period of time
index_result	index_result

**Value**

all indexes

---

```
calculate_all_scales
```

*Calculate all indexes for all time scales*

---

### Description

-

### Usage

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

### Arguments

data	data list
lat	latitude

### Value

all indexes

---

```
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
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

mean CC

### Examples

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

---

cd *Percentage of cold days*

---

**Description**

Percentages of days with TX lower than the 10th percentile.

**Usage**

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

**Arguments**

data	maximum temperature
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 of cold days

**Formula**

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

**Examples**

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

---

cdd *Cold spell duration*

---

**Description**

Count of days with at least 6 consecutive days when TN < 10th percentile

**Usage**

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

**Arguments**

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

**Value**

Cold spell duration index

**Examples**

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

---

<code>cfd</code>	<i>Maximum consecutive frost days</i>
------------------	---------------------------------------

---

**Description**

Maximum number of consecutive days with TN < 0 Celsius

**Usage**

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

**Arguments**

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

**Value**

maximum consecutive frost

**References**

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

**Examples**

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



---

 ClimIndNews

*ClimIndNews*


---

**Description**

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

**Usage**

```
ClimIndNews()
```

**Details**

(See description)

---

cmd

*Climatic moisture deficit*


---

**Description**

ETo - Effective precipitation ETo - Effective Precipitation

**Usage**

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

**Arguments**

eto	et0
pr	precipitation
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**

CMD

**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$evapotranspiration, pr = data_all$rr)
```

---

cn *Percentage of cold nights*

---

**Description**

Percentages of days with TN lower than the 10th percentile.

**Usage**

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

**Arguments**

data	minimum temperature
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 of cold nights

**Formula**

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

**Examples**

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

---

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**

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

**Value**

consecutive summer days

**Examples**

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

---

d32

*Days TX32*


---

**Description**

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

**Usage**

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

**Arguments**

<code>data</code>	maximum temperature
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

temperature sums 1

**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	precipitation
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

heavy precipitation days

### Examples

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

---

d95p                      *Very wet days*

---

### Description

Days with precipitation > 95p

### Usage

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

### Arguments

data	precipitation
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**

R95p

**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	<i>data_all</i>
----------	-----------------

---

**Description**

See wichita

**Usage**

```
data(data_all)
```

**Format**An object of class `list` of length 22.**Details**

See description.

---

dd	<i>Dry days</i>
----	-----------------

---

**Description**

Number of days with less than 1 mm

**Usage**

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

**Arguments**

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

**Value**

dry 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**

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

**Value**

Temperature sums

**Examples**

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

---

dfx21	<i>Days wind gusts above 21 m/s</i>
-------	-------------------------------------

---

**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	wind
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**

Gustmax

**Examples**

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

---

dr1mm	<i>Wet days 1mm</i>
-------	---------------------

---

**Description**

Total number of wet days  $\geq 1$  mm

**Usage**

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

**Arguments**

data	precipitation
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**

RR1

**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  $\geq$  3mm

**Usage**

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

**Arguments**

data	precipitation
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**

RR3

**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	maximum temperature
tmin	minimum temperature
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**

Diurnal temperature range

**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](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	precipitation
taverage	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

### Value

Emberger Aridity Index

### 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
pr	precipitation
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

effective precipitation

### Examples

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

---

eto *Reference evapotranspiration*

---

### Description

If data available using Fao-56 Penman-Monteith

### Usage

```
eto(tmin, tmax, toa, w, lat, tdew, mde, radiation = NA,
    insolation = NA, rh = NA, data_names = NULL, time.scale = YEAR,
    na.rm = FALSE)
```

**Arguments**

tmin	tmin
tmax	tmax
toa	toa
w	w
lat	lat
tdew	tdew
mde	mde
radiation	radiation
insolation	insolation
rh	relative humidity
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**

Eto

**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)
```

---

 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	maximum temperature
tmin	minimum temperature
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**

extreme temperature range

**Examples**

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

---

fd	<i>Frost days</i>
----	-------------------

---

**Description**

Number of days with TN < 0 Celsius.

**Usage**

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

**Arguments**

data	minimum temperature
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**

frost 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)
```

---

`ffdi`*McArthur Forest Fire Danger Index*

---

### Description

The McArthur Forest Fire Danger Index (FFDI) is a good indication of the difficulty of fire suppression over a wide range of conditions. It estimates the amount of precipitation needed to bring the soil back to saturation and is computed from the Keetch-Byram Drought Index (KBDI) and Drought Factor (DF).

### Usage

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

### Arguments

<code>taverage</code>	medium temperature
<code>pr</code>	precipitation
<code>rh</code>	relative humidity
<code>w</code>	average wind
<code>data_names</code>	names of each period of time
<code>time.scale</code>	month, season or year
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?

### Value

FFDI

### References

McArthur, A. G. (1967). Fire behaviour in eucalypt forests. Forestry and Timber Bureau Leaflet 107, 36 pp.

### Examples

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

---

`fffi`*Finnish Forest Fire Index*

---

### Description

Finnish forest fire index is determined from the surface moisture, by estimating the volumetric moisture of a 60 mm thick soil surface layer using potential evaporation and precipitation data.

### Usage

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

### Arguments

<code>data</code>	precipitation
<code>evap</code>	potential evapotranspiration
<code>data_names</code>	names of each period of time
<code>time.scale</code>	month, season or year
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?

### Value

FFFI

### References

Venäläinen A, Heikinheimo M. 2003. The Finnish forest fire index calculation system. In Early Warning Systems for Natural Disaster Reduction, Zschau J, Kuppers A (eds). Springer: Berlin; 645–648. Vajda, A., Venalainen, A., Suomi, I., Junila, P. and Makela, H., 2014. Assessment of forest fire danger in a boreal forest environment: description and evaluation of the operational system applied in Finland. Meteorol. Appl., 21: 879-887, DOI: 10.1002/met.1425

### Examples

```
data(data_all)
fffi(data = data_all$rr, evap=data_all$evapotranspiration)
```

---

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	wind
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**

FG

**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  $\geq 6$  Bft (10.8 m/s)

**Usage**

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



**Arguments**

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

**Value**

FG6Bft

**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  $\leq$  2 m/s)

**Usage**

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

**Arguments**

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

**Value**

FGcalm

**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	<i>Foggy days</i>
-----	-------------------

---

**Description**

Number of days with fog.

**Usage**

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

**Arguments**

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

**Value**

cloudy 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, <https://doi.org/10.1175/EI-D-15-0033.1>

**Examples**

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

---

fpsc	<i>Date of first permanent snow cover</i>
------	---

---

**Description**

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

**Usage**

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

**Arguments**

data	snow depth
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

first permanent snowcover

**Examples**

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

---

fsc	<i>Date of first snow cover</i>
-----	---------------------------------

---

**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
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

first snowcover

**Examples**

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

---

fsd	<i>Number of snow days</i>
-----	----------------------------

---

**Description**

Number of snow days number of snow days No. snow days

**Usage**

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

**Arguments**

data	snowfall
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**

freq. of snow 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 dimensionless, see Van Wagner (1987).

### Usage

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

### Arguments

taverage	medium temperature
rh	relative humidity
w	average wind
pr	precipitation
dew_point	dew_point
lat	latitude
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

FWI

### 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., Urbieto, 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 ## @importance Important application for fire prevention

### Examples

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

---

fxx	<i>Daily maximum wind gust</i>
-----	--------------------------------

---

**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
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**

FXx

**References**

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

**Examples**

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

---

gd4	<i>Growing degree days</i>
-----	----------------------------

---

**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**

<code>data</code>	medium temperature
<code>data_names</code>	names of each period of time
<code>time.scale</code>	month, season or year
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?

**Value**

GD4

**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**

<code>data</code>	mean temperature
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

growing season length

## 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)
gsr(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	precipitation
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

## Value

GSP

## 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**

<code>data</code>	medium temperature
<code>data_names</code>	names of each period of time
<code>time.scale</code>	month, season or year
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?

**Value**

Average temperature

**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**

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

**Value**

Average temperature

**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**

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

**Value**

Average temperature

**References**

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

**Examples**

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

---

hciu	<i>Holliday Climate Index Urban</i>
------	-------------------------------------

---

**Description**

Holliday Climate Index for Urban destinations (Scott et al, 2016) (Tmax,wind,cloudiness,RH, precipitation) Scott, D., Rutty, M., Amelung, B. and Tang, M. (2016): An inter-comparison of the Holiday Climate Index (HCI) and the Tourism Climate Index (TCI), Atmosphere, 7, 80, doi:10.3390/atmos7060080

Holliday Climate Index for Urban destinations (Scott et al, 2016) (TX, wind, cloudiness, RH, precipitation) Scott, D., Rutty, M., Amelung, B. and Tang, M. (2016): An inter-comparison of the Holiday Climate Index (HCI) and the Tourism Climate Index (TCI), Atmosphere, 7, 80, doi:10.3390/atmos7060080

HCI : Urban=  $4*TC + 2*A + (3*precipitation + wind)$  where TC=thermal comfort (as a function of Tmax [C] and RH [

**Usage**

```
hciu(pr, w, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

**Arguments**

pr	precipitation
w	average wind
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**

HCIU

**References**

Scott, D., Rutty, M., Amelung, B. and Tang, M. (2016): An inter-comparison of the Holiday Climate Index (HCI) and the Tourism Climate Index (TCI), Atmosphere, 7, 80, doi:10.3390/atmos7060080

**Examples**

```
data(data_all)
hciu(pr = data_all$rr, w=data_all$wind)
```

---

`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**

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

**Value**

HD17

**Formula**

$$HD17_j = \sum_{j=1}^I (17^{\circ}C - TG_{i,j})$$

**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. [https://doi.org/10.1175/1520-0450\(1980\)019<0241:HDDDAT>2.0.CO;2](https://doi.org/10.1175/1520-0450(1980)019<0241:HDDDAT>2.0.CO;2)

**Examples**

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

---

hi	<i>Heat Index</i>
----	-------------------

---

**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	medium temperature
rh	relative humidity
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**

Heat Index

**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 °F and rh is relative humidity in

**References**

[http://www.wpc.ncep.noaa.gov/html/heatindex\\_equation.shtml](http://www.wpc.ncep.noaa.gov/html/heatindex_equation.shtml)

**Examples**

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

---

hsd	<i>Heavy snowy days</i>
-----	-------------------------

---

**Description**

Number of days with snow depth more than 50 cm.

**Usage**

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

**Arguments**

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

**Value**

heavy snowy days

**References**

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

**Examples**

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

---

id	<i>Ice days</i>
----	-----------------

---

**Description**

Number of days with TX < 0 Celsius.

**Usage**

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

**Arguments**

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

**Value**

ice 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 Continentiality Index*

---

**Description**

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

**Usage**

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

**Arguments**

<code>data</code>	medium temperature
<code>data_names</code>	names of each period of time
<code>value</code>	lat
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

JCI

**Formula**

$$JCI = \frac{1.7(T_{hm} - T_{cm})}{\sin f} - 20.4$$

$T_{hm}$  = Average temperature of the hottest month (Celsius);  $T_{cm}$  = 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)
```

---

kmdi

*Keetch-Byram Drought Index*


---

**Description**

The Keetch-Byram Drought Index (KBDI) is an indicator of drought conditions and is used to predict wildfire severity.

**Usage**

```
kmdi(taverage, pr, data_names = NULL, time.scale = YEAR,
     na.rm = FALSE)
```

**Arguments**

taverage	medium temperature
pr	precipitation
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**

KBDI

**References**

Keetch, J.J. and Byram, G.M. (1968). A drought index for forest fire control. Tech. Rep., USDA Forest Service Research Paper SE-38, North Carolina, USA. Alexander, M.E., 1990. Computer calculation of the Keetch-Byram Drought Index - programmers beware. Fire Management Notes 51, 23-25.



**Examples**

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

---

koi *Kerner Oceanity Index*

---

**Description**

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

**Usage**

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

**Arguments**

data	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

Kerner Oceanity Index

**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 vegetation distribution. A case study in the Spanish System Central. Int. J. Biometeorol. 50: 111–120.

**Examples**

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

---

ldp *Longest dry period*

---

### Description

Maximum length of consecutive dry days (RR<1)

### Usage

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

### Arguments

data	precipitation
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

longest dry period

### 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)
ldp(data = data_all$rr)
```

---

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
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

last permanent snowcover

**Examples**

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

---

lwp	<i>Longest wet period</i>
-----	---------------------------

---

**Description**

Maximum length of consecutive wet days ( $RR \geq 1$ )

**Usage**

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

**Arguments**

data	precipitation
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**

longest wet period

**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)
lwp(data = data_all$rr)
```

---

 mai

*De Martonne aridity index*


---

### Description

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

### Usage

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

### Arguments

pr	precipitation
taverage	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

### Value

Martonne Aridity Index

### 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	<i>Modified Fournier Index</i>
-----	--------------------------------

---

### 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	precipitation
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

### Value

MFI

### 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 rainfall erosivity increasing in the Mediterranean Iberian Peninsula?. Land Degradation & Development, 21: 139-144.

### Examples

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

---

mi	<i>Mould index</i>
----	--------------------

---

**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	medium temperature
rh	relative humidity
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**

Mould index

**Examples**

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

---

mni	<i>Modified Nesterov Index</i>
-----	--------------------------------

---

**Description**

The Modified Nesterov Index (MNI) reflects the relationship between observed weather conditions and fire occurrence. It is a cumulative index computed from daily temperature and dewpoint temperature, which is reset when a certain precipitation value is reached.

**Usage**

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

**Arguments**

dew_point	dew point
taverage	medium temperature
rh	relative humidity
pr	precipitation
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**

MNI

**References**

Groisman, P.Y., et al., 2007. *Global and Planetary Change* 56, 371–386.

**Examples**

```
data(data_all)
mni(dew_point=data_all$dewpoint, taverage=data_all$tg, rh=data_all$humidity, pr=data_all$rr)
```

---

moi	<i>Marsz Oceanity Index</i>
-----	-----------------------------

---

**Description**

MOI = ( 0.731 \* geographic latitude grados + 1.767 ) / the annual range of monthly mean air temperatures grados

**Usage**

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

**Arguments**

data	medium temperature
value	lat
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

n0to10

**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$tg, value = data_all$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
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**

maximum snow depth

**Examples**

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



---

msd	<i>Mild snowy days</i>
-----	------------------------

---

**Description**

number of days with snow depth > 5 cm.

**Usage**

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

**Arguments**

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

**Value**

mild snowy days

**References**

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

**Examples**

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

---

ngsr	<i>Non-growing season precipitation</i>
------	---

---

**Description**

Total precipitation from October to April

**Usage**

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

**Arguments**

<code>data</code>	precipitation
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

non growing precipitation

**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**

<code>data</code>	medium temperature
<code>data_names</code>	names of each period of time
<code>time.scale</code>	month, season or year
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?

**Value**

Average temperature

**Examples**

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

---

ntn	<i>Minimum TN</i>
-----	-------------------

---

**Description**

Minimum of daily minimum air temperature

**Usage**

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

**Arguments**

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

**Value**

Average temperature

**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](https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf)

**Examples**

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

---

ntx	<i>Minimum TX</i>
-----	-------------------

---

**Description**

Minimum of daily maximum air temperature

**Usage**

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

**Arguments**

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

**Value**

Average temperature

**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](https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf)

**Examples**

```
data(data_all)
ntx(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**

<code>data</code>	medium temperature
<code>data_names</code>	names of each period of time
<code>time.scale</code>	month, season or year
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?

**Value**

Onset of growing season 2

**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	medium temperature
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**

Onset of growing season 1

**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	precipitation
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

PCI

**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)
pici(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	precipitation
taverage	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

Pinna Combinative index

**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)
```

---

ptg	<i>Sums positive</i>
-----	----------------------

---

**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	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

temperature sums 5

**Examples**

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

---

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	precipitation
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**

R10mm

**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	precipitation
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**

R20mm

**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	<i>Percentage precipitation of very wet days</i>
--------	--

---

**Description**

Precipitation at days exceeding the 95percentile divided by total precipitation expressed in percentage

**Usage**

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

**Arguments**

data	precipitation
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**

PVWD

**Examples**

```
data(data_all)
r95tot(data = data_all$rr)
```

---

r99tot	<i>Precipitation fraction extremely wet days</i>
--------	--

---

**Description**

Precipitation at days exceeding the 99percentile divided by total precipitation expressed in percentage

**Usage**

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

**Arguments**

data	precipitation
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**

PEWD

**Examples**

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

---

rti	<i>Total precipitation</i>
-----	----------------------------

---

**Description**

Total amounts of precipitation

**Usage**

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

**Arguments**

data	precipitation
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**

total precipitation

**Examples**

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

---

rtwd	<i>Total precipitation wet days</i>
------	-------------------------------------

---

**Description**

Precipitation amount on days with RR  $\geq$  1 mm

**Usage**

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

**Arguments**

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

**Value**

precipitation in wet days

**References**

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

**Examples**

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

---

rx	<i>Maximum precipitation</i>
----	------------------------------

---

**Description**

The highest amount of daily precipitation

**Usage**

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

**Arguments**

data	precipitation
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**

maximum precipitation

**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)  
rx(data = data_all$rr)
```

---

rx5d	<i>Maximum 5 days R</i>
------	-------------------------

---

**Description**

Maximum consecutive 5-day precipitation

**Usage**

```
rx5d(data, data_names = NULL, time.scale = YEAR, na.rm = FALSE)
```

**Arguments**

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

**Value**

Rx5day

**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)
rx5d(data = data_all$rr)
```

---

<code>scd</code>	<i>Number of snow covered days</i>
------------------	------------------------------------

---

**Description**

Number of snow covered days (snow depth > 0)

**Usage**

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

**Arguments**

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

**Value**

snow covered 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**

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

**Value**

SD0\_10

**References**

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

**Examples**

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

---

`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**

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

**Value**

SD10\_20

**References**

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

**Examples**

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

---

sdd

*Snow depth*

---

**Description**

Mean of daily snow depth mean of daily snow depth

**Usage**

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

**Arguments**

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

**Value**

snow depth

**References**

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

**Examples**

```
data(data_all)
sdd(data = data_all$snowdepththickness)
```

---

`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**

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

**Value**

SDII

**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	<i>Sunny days</i>
-----	-------------------

---

**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
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**

SND

**Examples**

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

---

speil	<i>Standardised Precipitation-Evapotranspiration Index 1</i>
-------	--

---

**Description**

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

**Usage**

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

**Arguments**

eto	et0
pr	precipitation
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

SPEI

**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$evapotranspiration, pr = data_all$rr)
```

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	et0
pr	precipitation
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

SPEI

**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$evapotranspiration, pr = data_all$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**

<code>eto</code>	<code>et0</code>
<code>pr</code>	precipitation
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

SPEI

**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$evapotranspiration, pr = data_all$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**

<code>eto</code>	<code>et0</code>
<code>pr</code>	precipitation
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

SPEI

**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$evapotranspiration, pr = data_all$rr)
```

---

 spil

---

*Standardized precipitation index 1*


---

**Description**

Standardized precipitation index calculated at 1-month time scale

**Usage**

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

**Arguments**

<code>data</code>	precipitation
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

SPI

**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	precipitation
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

SPI

**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**

<code>data</code>	precipitation
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

SPI

**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**

<code>data</code>	precipitation
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

SPI

**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**

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

**Value**

n0to10

**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**

<code>data</code>	sunshine duration
<code>data_names</code>	names of each period of time
<code>time.scale</code>	month, season or year
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?

**Value**

SSD, h

**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**

<code>data</code>	sunshine duration
<code>data_names</code>	names of each period of time
<code>time.scale</code>	month, season or year
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?

**Value**

`ssp`

**Formula**

$$SSP = \frac{SS}{SS_{max}} * 100$$

SS: sum of sunshine duration (h); SSmax: maximum 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**

<code>data</code>	minimum temperature
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

temperature sums 3

**Examples**

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

---

stn15

*Sums TN-15*

---

**Description**

Sum of degree days when TN  $\leq$  -15 Celsius recorded in December-February interval

**Usage**

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

**Arguments**

<code>data</code>	minimum temperature
<code>data_names</code>	names of each period of time
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?
<code>...</code>	...

**Value**

temperature sums 2

**Examples**

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

---

stx32	<i>Sums TX32</i>
-------	------------------

---

**Description**

Sum of degree days when TX  $\geq$  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	maximum temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

temperature sums 1

**Examples**

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

---

sud	<i>Summer days</i>
-----	--------------------

---

**Description**

Number of days with maximum temperature  $>$  25 Celsius. Number of days with TX  $>$ 25 Celsius.

**Usage**

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

**Arguments**

data	maximum temperature
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**

Summer 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)
sud(data=data_all$tx)
```

---

ta_o	<i>Growing season (Apr-Oct)</i>
------	---------------------------------

---

**Description**

Growing season (april to october) mean TG

**Usage**

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

**Arguments**

data	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

Growing season temperature 1

**Examples**

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

**Description**

Standard index computed by ECA&D; Described at Miezkowski (1985), conceptual formula:  $TCI = 4cid + cia + 2R + 2S + W$ , where  $CId$  is a daytime comfort index,  $Cia$  a daily comfort index,  $R$  is cumulated rainfall,  $S$  the daily sunshine hours and  $W$  wind speed Represents a quantitative evaluation of world climate for the purposes of tourism and is a composite measure of the climatic well-being of tourists.  $TCI = 4cid + cia + 2R + 2S + W$ , where  $CId$  is a daytime comfort index,  $Cia$  a daily comfort index,  $R$  is cumulated rainfall,  $S$  the daily sunshine hours and  $W$  wind speed

**Usage**

```
tci(data, sunshine, w, data_names = NULL, time.scale = YEAR,
    na.rm = FALSE)
```

**Arguments**

<code>data</code>	precipitation
<code>sunshine</code>	net radiation
<code>w</code>	average wind
<code>data_names</code>	names of each period of time
<code>time.scale</code>	month, season or year
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?

**Value**

TCI

**References**

Miezkowski, Z. (1985). The tourism climatic index: a method of evaluating world climates for tourism. *The Canadian Geographer/Le Géographe canadien*, 29(3), 220-233.

**Examples**

```
data(data_all)
tci(data=data_all$rr, sunshine=radiation.value, w=w.value)
```

---

tci60

*Good tourism days TCI>60*


---

### Description

Number of days TCI>60, standard ECA&D Number of days TCI>60 (see TCI)  $TCI = 8 C_{ld} + 2 C_{la} + 4 R + 4 S + 2 W$ . Let  $TCI_{ij}$  be the daily value of the Tourism Climatic Index at day  $i$  of period  $j$ . Then counted is the number of days where:  $TCI_{ij} \geq 60$ . Where  $C_{ld}$  is a daytime comfort index, consisting of the mean maximum air temperature  $T_a, \max$  ( $^{\circ}C$ ) and the mean minimum relative humidity  $RH$  (

### Usage

```
tci60(data, sunshine, w, data_names = NULL, time.scale = YEAR,
      na.rm = FALSE)
```

### Arguments

data	precipitation
sunshine	net radiation
w	average wind
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

TCI60

### References

Mieczkowski, Z. (1985). The tourism climatic index: a method of evaluating world climates for tourism. *The Canadian Geographer/Le Géographe canadien*, 29(3), 220-233.

### Examples

```
data(data_all)
tci60(data=data_all$rr, sunshine=data_all$radiation, w=data_all$wind)
```

---

tci80

*Excellent tourism days TCI>80*


---

### Description

Number of days TCI>80, standard ECA&D Number of days TCI>80 (see TCI)  $TCI = 8 C_{ld} + 2 C_{la} + 4 R + 4 S + 2 W$ . Let  $TCI_{ij}$  be the daily value of the Tourism Climatic Index at day  $i$  of period  $j$ . Then counted is the number of days where:  $TCI_{ij} \geq 80$ . Where  $C_{ld}$  is a daytime comfort index, consisting of the mean maximum air temperature  $T_a, \max$  ( $^{\circ}C$ ) and the mean minimum relative humidity  $RH$  (

### Usage

```
tci80(data, sunshine, w, data_names = NULL, time.scale = YEAR,
      na.rm = FALSE)
```

### Arguments

<code>data</code>	precipitation
<code>sunshine</code>	net radiation
<code>w</code>	average wind
<code>data_names</code>	names of each period of time
<code>time.scale</code>	month, season or year
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?

### Value

TCI80

### References

Mieczkowski, Z. (1985). The tourism climatic index: a method of evaluating world climates for tourism. *The Canadian Geographer/Le Géographe canadien*, 29(3), 220-233.

### Examples

```
data(data_all)
tci80(data=data_all$rr, sunshine=data_all$radiation, w=data_all$wind)
```

---

tm_s	<i>Growing season(May-Sep)</i>
------	--------------------------------

---

**Description**

Growing season (may to september) mean TG

**Usage**

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

**Arguments**

data	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

Growing season temperature 2

**Examples**

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

---

tn	<i>Tropical nights</i>
----	------------------------

---

**Description**

Number of days with TN > 20 Celsius.

**Usage**

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

**Arguments**

data	minimum temperature
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**

Tropical nights

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

---

uai

*UNEP Aridity Index*

---

**Description**

P/Eto

**Usage**

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

**Arguments**

eto	et0
pr	precipitation
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**

iUNEP

**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. <https://doi.org/10.1155/2016/1536135>

**Examples**

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

---

 utci

*Universal Thermal Climate Index*


---

### Description

The Universal Thermal Climate Index is expressed as an equivalent ambient temperature (Celsius) of a reference environment providing the same physiological response of a reference person as the actual environment <http://www.utci.org/> [http://www.utci.org/utci\\_doku.php](http://www.utci.org/utci_doku.php) Copy <https://github.com/alfcrisci/rBiometeo> Given air temperature (Celsius), relative humidity (%), wind velocity (m/sec) and mean radiant temperature ( tmrt in Celsius degree) gives the Universal Thermal Climate Index in Celsius.

### Usage

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

### Arguments

ta	medium temperature
rh	humidity
wind	average wind
tmrt	radiation temperature
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

UTCI

### References

Blazejczyk, K., Epstein, Y., Jendritzky, G., Staiger, H., & Tinz, B. (2012). Comparison of UTCI to selected thermal indices. *International Journal of Biometeorology*, 56(3), 515-535. doi:10.1007/s00484-011-0453-2

### Examples

```
data(data_all)
utci(ta = data_all$tg, rh = data_all$dewpoint, wind = data_all$wind,
     tmrt = data_all$"RADIATIONTEMPERATURE")
```

---

vcd	<i>Very cold days</i>
-----	-----------------------

---

**Description**

Days with TN <1st percentile.

**Usage**

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

**Arguments**

data	minimum temperature
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**

Very cold days

**Examples**

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

---

vdtr	<i>Mean daily difference DTR</i>
------	----------------------------------

---

**Description**

Mean absolute day-to-day difference in DTR

**Usage**

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

**Arguments**

tmax	maximum temperature
tmin	minimum temperature
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**

vDTR

**Formula**

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

**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.

**Usage**

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

**Arguments**

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

**Value**

Very warm days

**Examples**

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

---

wci	<i>Wind chill index</i>
-----	-------------------------

---

### 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	medium temperature
w	average wind
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

WCI

### 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)
```

---

wd	<i>Warm days</i>
----	------------------

---

**Description**

Total numbers of days with TX higher than the 90th percentile.

**Usage**

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

**Arguments**

data	maximum temperature
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**

Warm days

**Examples**

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

---

wki	<i>Winkler index</i>
-----	----------------------

---

**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	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

Winkler index

**References**

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

**Examples**

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

---

 wn

*Warm nights*


---

**Description**

Percentages of days with TN higher than the 90th percentile.

**Usage**

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

**Arguments**

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

**Value**

Warm nights

**Examples**

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

ws

*Winter Severity***Description**

Mean TG of the coldest month of the year

**Usage**

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

**Arguments**

data	medium temperature
data_names	names of each period of time
na.rm	logical. Should missing values (including NaN) be removed?
...	...

**Value**

Winter Severity index

**Examples**

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

wsd

*Warm spell duration***Description**

Count of days with at least 6 consecutive days when TX > 90th percentile.

**Usage**

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

**Arguments**

data	maximum temperature
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**

Warm spell duration index

**Examples**

```
data(data_all)
wsd(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**

<code>data</code>	medium temperature
<code>data_names</code>	names of each period of time
<code>time.scale</code>	month, season or year
<code>na.rm</code>	logical. Should missing values (including NaN) be removed?

**Value**

Average temperature

**Examples**

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

---

xtn	<i>Maximum TN</i>
-----	-------------------

---

**Description**

Maximum of daily minimum air temperature

**Usage**

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

**Arguments**

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

**Value**

Average temperature

**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](https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf)

**Examples**

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

---

xtx	<i>Maximum TX</i>
-----	-------------------

---

**Description**

Maximum of daily maximum air temperature

**Usage**

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

**Arguments**

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

**Value**

Average temperature

**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](https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf)

**Examples**

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

---

`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**

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

**Value**

zero crossing days

**Examples**

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