

# Package ‘ClimInd’

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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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**NeedsCompilation** no

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**Repository** CRAN

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**Index****99**

**Description**

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

**Details**

Info

**See Also**

Useful links:

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

---

aci

*Atmospheric Clarity Index*

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

index value

**Examples**

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



**Value**

index value

**Formula**

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

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

**Examples**

```
data(data_all)
at(taverage = data_all$tg, w = data_all$wind, vapor = data_all$VAPOUR)
```

---

|    |                     |
|----|---------------------|
| bi | <i>Budyko Index</i> |
|----|---------------------|

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

index value

**Formula**

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

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

**References**

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

**Examples**

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

---

|       |                              |
|-------|------------------------------|
| bio10 | <i>TG of warmest quarter</i> |
|-------|------------------------------|

---

**Description**

TG of the warmest quarter of the year

**Usage**

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

**Arguments**

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

**Value**

temperature, Celsius

**References**

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

**Examples**

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



---

bio11 *TG of coldest quarter*

---

**Description**

TG of coldest quarter of the year

**Usage**

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

**Arguments**

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

**Value**

temperature, Celsius

**References**

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

**Examples**

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

---

bio13 *Precipitation of wettest month*

---

**Description**

Total precipitation of the wettest month of the year

**Usage**

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

**Arguments**

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

**Value**

precipitation, mm

**References**

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

**Examples**

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

---

bio14

*Precipitation of driest month*

---

**Description**

Total precipitation of the driest month of the year

**Usage**

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

**Arguments**

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

**Value**

precipitation, mm

## References

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

## Examples

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

---

|       |   |
|-------|---|
| bio15 | <i>Precipitation coefficient of variation</i> |
|-------|---|

---

## Description

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

## Usage

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

## Arguments

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

## Value

index value

## Examples

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

---

bio16

*Precipitation wettest quarter*

---

### Description

Precipitation of the wettest quarter of the year

### Usage

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

### Arguments

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

### Value

precipitation, mm

### References

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

### Examples

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

---

bio17

*Precipitation of Driest Quarter*

---

### Description

Precipitation of the driest quarter of the year

### Usage

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

**Arguments**

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

**Value**

precipitation, mm

**References**

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

**Examples**

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

---

|       |                                      |
|-------|--------------------------------------|
| bio18 | <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**

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

**Value**

precipitation, mm

**References**

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

**Examples**

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

---

|       |                                      |
|-------|--------------------------------------|
| bio19 | <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         | daily precipitation, mm                                    |
| taverage   | daily mean temperature, Celsius                            |
| data_names | names of each period of time                               |
| na.rm      | logical. Should missing values (including NaN) be removed? |
| ...        | further arguments passed to or from other methods          |

**Value**

precipitation, mm

**References**

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

**Examples**

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

---

|       |                       |
|-------|-----------------------|
| bio20 | <i>Mean radiation</i> |
|-------|-----------------------|

---

**Description**

Mean radiation (W m-2)

**Usage**

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

**Arguments**

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

**Value**

radiation, W m-2

**References**

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

**Examples**

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

---

|      |                                |
|------|--------------------------------|
| bio4 | <i>Temperature seasonality</i> |
|------|--------------------------------|

---

**Description**

TG standard deviation \* 100

**Usage**

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

**Arguments**

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

**Value**

temperature, Celsius

**References**

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

**Examples**

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

---

|      |                         |
|------|-------------------------|
| bio5 | <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>       | daily mean temperature, Celsius                            |
| <code>tmax</code>       | daily maximum temperature, Celsius                         |
| <code>data_names</code> | names of each period of time                               |
| <code>na.rm</code>      | logical. Should missing values (including NaN) be removed? |
| <code>...</code>        | further arguments passed to or from other methods          |

**Value**

temperature, Celsius



**References**

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

**Examples**

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

---

|      |                            |
|------|----------------------------|
| bio6 | <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       | daily mean temperature, Celsius                            |
| tmin       | daily minimum temperature, Celsius                         |
| data_names | names of each period of time                               |
| na.rm      | logical. Should missing values (including NaN) be removed? |
| ...        | further arguments passed to or from other methods          |

**Value**

temperature, Celsius

**References**

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

**Examples**

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

---

bio7 *Temperature Annual Range*

---

### Description

TX of the warmest month minus TN of coldest month

### Usage

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

### Arguments

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

### Value

temperature, Celsius

### References

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

### Examples

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

---

bio8 *TG of wettest quarter*

---

**Description**

TG of the wettest quarter of the year

**Usage**

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

**Arguments**

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

**Value**

temperature, Celsius

**References**

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

**Examples**

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

---

bio9 *TG of driest quarter*

---

**Description**

TG of the driest quarter of the year

**Usage**

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

**Arguments**

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

**Value**

temperature, Celsius

**References**

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

**Examples**

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

---

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

---

**Description**

Calculate all indexes for a point

**Usage**

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

**Arguments**

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

**Value**

all indexes

---

calculate\_all\_scales *Calculate all indexes for all time scales*

---

**Description**

Calculate all indexes for a point and all time scales

**Usage**

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

**Arguments**

|      |                  |
|------|------------------|
| data | data list        |
| lat  | latitude, degree |

**Value**

all indexes

---

cc *Mean daily cloud cover*

---

### Description

Mean daily cloud cover (

### Usage

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

### Arguments

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

### Value

percentage

### Examples

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

---

cdd *Longest dry period*

---

### Description

Maximum length of consecutive dry days ( $RR < 1$ )

### Usage

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

### Arguments

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

**Value**

days

**References**

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

**Examples**

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

---

|     |                                       |
|-----|---------------------------------------|
| cfd | <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**

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

**Value**

days

**References**

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

**Examples**

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

---

 ClimIndNews

*ClimIndNews*


---

### Description

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

### Usage

```
ClimIndNews()
```

### Details

(See description)

---

 cmd

*Climatic moisture deficit*


---

### Description

ETo - evapotranspiration

### Usage

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

### Arguments

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

### Value

index value



## References

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

## Examples

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

---

csd

*Maximum consecutive summer days*

---

## Description

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

## Usage

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

## Arguments

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

## Value

days

## Examples

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

---

csdi *Cold spell duration*

---

### Description

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

### Usage

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

### Arguments

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

### Value

days

### Examples

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

---

cwg *Longest wet period*

---

### Description

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

### Usage

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

### Arguments

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

**Value**

days

**References**

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

**Examples**

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

---

d32

*Days TX32*

---

**Description**

Number of days whith TX  $\geq$  32 Celsius on the interval June-August.

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | daily maximum temperature, Celsius                         |
| <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**

days

**Examples**

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

---

d50mm *Heavy precipitation days*

---

**Description**

Number of days with precipitation above 50mm

**Usage**

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

**Arguments**

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

**Value**

days

**Examples**

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

---

d95p *Very wet days*

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

days

**References**

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

**Examples**

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

---

|          |                 |
|----------|-----------------|
| Datasets | <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>       | daily precipitation, mm                                    |
| <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**

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>       | daily maximum temperature, Celsius                         |
| <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**

days

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

**Value**

days

**Examples**

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

---

|       |                     |
|-------|---------------------|
| dr1mm | <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       | daily precipitation, mm                                    |
| data_names | names of each period of time                               |
| time.scale | month, season or year                                      |
| na.rm      | logical. Should missing values (including NaN) be removed? |

**Value**

days

**References**

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

**Examples**

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

---

dr3mm

*Wet days 3mm*

---

**Description**

Total number of Wet days  $\geq$  3mm

**Usage**

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

**Arguments**

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

**Value**

days

**References**

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

**Examples**

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



---

|     |                                  |
|-----|----------------------------------|
| dtr | <i>Diurnal temperature range</i> |
|-----|----------------------------------|

---

**Description**

Mean difference between TX and TN.

**Usage**

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

**Arguments**

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

**Value**

temperature, Celsius

**Formula**

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

**References**

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5. [https://www.ecad.eu/documents/WCDMP\\_72\\_TD\\_1500\\_en\\_1.pdf](https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf)

**Examples**

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

---

eai *Emberger aridity index*

---

### Description

Aridity index based on annual precipitation and temperature range

### Usage

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

### Arguments

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

### Value

index value

### Formula

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

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

### References

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

### Examples

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

---

ep *Effective precipitation*

---

**Description**

Precipitation minus evapotranspiration

**Usage**

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

**Arguments**

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

**Value**

mm

**Examples**

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

---

eto *Reference evapotranspiration*

---

**Description**

If data available using Fao-56 Penman-Monteith

**Usage**

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

```

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

```

### Arguments

|            |  |
|------------|--|
| tmin       | daily minimum temperature, Celsius                         |
| tmax       | daily maximum temperature, Celsius                         |
| toa        | solar radiation at TOA, W/m <sup>2</sup>                   |
| w          | average wind, m/s  |
| lat        | latitude, degree   |
| tdew       | dew point, Celsius   |
| mde        | digital elevation model, m                                 |
| radiation  | net radiation, J/m <sup>2</sup>                            |
| insolation | insolation, hours of sun                                   |
| rh         | relative humidity, percentage                              |
| data_names | names of each period of time                               |
| time.scale | month, season or year                                      |
| na.rm      | logical. Should missing values (including NaN) be removed? |

### Value

mm

### References

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

### Examples

```

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

```

---

etr *Extreme temperature range*

---

### Description

Difference between the maximum TX and the minimum TN.

### Usage

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

### Arguments

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

### Value

temperature, Celsius

### Examples

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

---

fd *Frost days*

---

### Description

Number of days with TN < 0 Celsius.

### Usage

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

### Arguments

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

**Value**

days

**References**

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

**Examples**

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

---

|           |   |
|-----------|---|
| <i>fg</i> | <i>Mean of daily mean wind strength</i> |
|-----------|---|

---

**Description**

Mean of daily FG

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | average wind, m/s  |
| <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**

wind, m/s

**References**

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

**Examples**

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

---

|        |  |
|--------|--|
| fg6bft | <i>Number of days with averaged wind above 10.8m/s</i> |
|--------|--|

---

**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**

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

**Value**

days

**References**

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

**Examples**

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

---

|        |                  |
|--------|------------------|
| fgcalm | <i>Calm days</i> |
|--------|------------------|

---

**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>       | average wind, m/s  |
| <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**

days

**References**

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

**Examples**

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

---

|     |                   |
|-----|-------------------|
| fod | <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, percentage                     |
| <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**

days

**References**

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



**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).

**Usage**

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

**Arguments**

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

**Value**

date

**Examples**

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

---

|     |                                 |
|-----|---------------------------------|
| fsc | <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**

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

**Value**

date

**Examples**

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

---

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

---

**Description**

Number of snow days

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | snowfall, m of water equivalent                            |
| <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**

days

**References**

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

**Examples**

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

---

fxx *Daily maximum wind gust*

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

wind, m/s

**References**

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

**Examples**

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

---

gd4 *Growing degree days*

---

**Description**

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

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | daily mean temperature, Celsius                            |
| <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, Celsius

**References**

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

**Examples**

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

---

`gsl`

*Growing season length*

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

days

**References**

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

**Examples**

```
data(data_all)
gs1(data=data_all$tg)
```

---

|     |                                     |
|-----|-------------------------------------|
| gsr | <i>Growing season precipitation</i> |
|-----|-------------------------------------|

---

**Description**

Growing season (april to october) total precipitation

**Usage**

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

**Arguments**

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

**Value**

precipitation, mm

**Examples**

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

---

|     |                |
|-----|----------------|
| gtg | <i>Mean TG</i> |
|-----|----------------|

---

**Description**

Mean of daily mean air temperature

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | daily mean temperature, Celsius                            |
| <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, Celsius

**References**

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

**Examples**

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

---

gtn

*Mean TN*

---

**Description**

Mean of daily minimum air temperature

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | daily minimum temperature, Celsius                         |
| <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, Celsius

**References**

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

**Examples**

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

---

gtx

*Mean TX*

---

**Description**

Mean of daily maximum air temperature

**Usage**

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

**Arguments**

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

**Value**

temperature, Celsius

**References**

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

**Examples**

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

---

`hd17`*Heating degree days*

---

**Description**

accumulated degree when TG is below 17 Celsius

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | daily mean temperature, Celsius                            |
| <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, Celsius

**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. doi: [10.1175/15200450\(1980\)019<0241:HDDDAT>2.0.CO;2](https://doi.org/10.1175/15200450(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   | daily mean temperature, Celsius                            |
| rh         | relative humidity, percentage                              |
| data_names | names of each period of time                               |
| time.scale | month, season or year                                      |
| na.rm      | logical. Should missing values (including NaN) be removed? |

### Value

index value

### Formula

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

. Where TG is air temperature in °F and rh is relative humidity in

### References

The Heat Index Equation [https://www.wpc.ncep.noaa.gov/html/heatindex\\_equation.shtml](https://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**

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

**Value**

days

**References**

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

**Examples**

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

---

|    |                 |
|----|-----------------|
| id | <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>       | daily maximum temperature, Celsius                         |
| <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**

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>       | daily mean temperature, Celsius                            |
| <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>        | further arguments passed to or from other methods          |

**Value**

index value

**Formula**

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

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

**References**

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

**Examples**

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

---

koi

*Kerner Oceanity Index*


---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

index value

**Formula**

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

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

## References

Zambakas J. 1992. General Climatology. Department of Geology, National & Kapodistrian University of Athens, Athens. Gavilan RG. 2005. The use of climatic parameters and indices in 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)
```

---

|      |  |
|------|--|
| lpsc | <i>Date of last permanent snow cover</i> |
|------|--|

---

## Description

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

## Usage

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

## Arguments

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

## Value

date

## Examples

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

---

mai *De Martonne aridity index*

---

### Description

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

### Usage

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

### Arguments

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

### Value

index value

### Formula

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

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

### References

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

### Examples

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

---

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

**Value**

index value

**Formula**

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

**References**

Fournier F. 1960. Climat et Erosion. PUF: Paris. Arnoldus HM. 1980. An approximation of the rainfall factor in the Uni-versal Soil Loss Equation. In Assessments of Erosion, de Boodts M, Gabriels D (eds). John Wiley and Sons Ltd, Chichester 127–132. De Luis M., González-Hidalgo J.C., Longares L.A. Is 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   | daily mean temperature, Celsius                            |
| rh         | relative humidity, percentage                              |
| data_names | names of each period of time                               |
| time.scale | month, season or year                                      |
| na.rm      | logical. Should missing values (including NaN) be removed? |

**Value**

days

**Examples**

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

---

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

---

**Description**

The annual range of monthly mean air temperatures grados

**Usage**

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

**Arguments**

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



**Value**

index value

**Formula**

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

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

**References**

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

**Examples**

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

---

|                 |                           |
|-----------------|---------------------------|
| <code>ms</code> | <i>Maximum snow depth</i> |
|-----------------|---------------------------|

---

**Description**

Maximum snow depth (m)

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | snow depth, mm   |
| <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, m

**Examples**

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

---

|     |                        |
|-----|------------------------|
| 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**

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

**Value**

days

**References**

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

**Examples**

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

---

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

**Value**

precipitation, mm

**Examples**

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

---

ntg

*Minimum TG*

---

**Description**

Minimum value of daily mean air temperature

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | daily mean temperature, Celsius                            |
| <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)
```

---

ogs10                      *Onset of growing season 10 days*

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

date

**Examples**

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

---

ogs6                      *Onset of growing season 6 days*

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

date

**Examples**

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

pci

*Precipitation Concentration Index***Description**

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

**Usage**

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

**Arguments**

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

**Value**

index value

**Formula**

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

**References**

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

**Examples**

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

---

pici

*Pinna Combinative Index*

---

### Description

Pinna combinative index is an aridity–humidity index

### Usage

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

### Arguments

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

### Value

index value

### Formula

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

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

### References

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

### Examples

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

---

|         |                                     |
|---------|-------------------------------------|
| prcptot | <i>Total precipitation wet days</i> |
|---------|-------------------------------------|

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

precipitation, mm

**References**

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

**Examples**

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

---

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

**Value**

temperature, Celsius

**Examples**

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

---

|       |                                       |
|-------|---------------------------------------|
| r10mm | <i>Days precipitation &gt;= R10mm</i> |
|-------|---------------------------------------|

---

**Description**

Days with daily precipitation amount >= 10mm

**Usage**

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

**Arguments**

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

**Value**

days

**References**

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

**Examples**

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



---

r20mm                      *Days precipitation >= R20mm*

---

**Description**

Days with daily precipitation amount >= 20mm

**Usage**

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

**Arguments**

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

**Value**

days

**References**

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

**Examples**

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

---

r95tot                      *Percentage precipitation of very wet days*

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

precipitation, mm

**Examples**

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

---

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

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

precipitation, mm

**Examples**

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

---

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

---

**Description**

Total amounts of precipitation

**Usage**

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

**Arguments**

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

**Value**

precipitation, mm

**Examples**

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

---

|        |                              |
|--------|------------------------------|
| rx1day | <i>Maximum precipitation</i> |
|--------|------------------------------|

---

**Description**

The highest amount of daily precipitation

**Usage**

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

**Arguments**

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

**Value**

precipitation, mm

**References**

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

**Examples**

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

---

|      |                         |
|------|-------------------------|
| 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**

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

**Value**

precipitation, mm

**References**

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

**Examples**

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

---

|     |                                    |
|-----|------------------------------------|
| scd | <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**

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

**Value**

days

**Examples**

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

---

|        |                        |
|--------|------------------------|
| sd0_10 | <i>Snow depth 1-10</i> |
|--------|------------------------|

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

days

**References**

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

**Examples**

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

---

sd10\_20

*Snow depth 10-20*

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

days

**References**

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

**Examples**

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

---

|     |   |
|-----|---|
| sdi | <i>Simple precipitation intensity index</i> |
|-----|---|

---

**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**

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

**Arguments**

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

**Value**

precipitation, mm

**References**

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

**Examples**

```
data(data_all)
sdi(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**

|                         |  |
|-------------------------|--|
| <code>data</code>       | cloud cover, percentage                                    |
| <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**

days

**Examples**

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

---

spei1

*Standardised Precipitation-Evapotranspiration Index 1*

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

index value

**References**

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

**Examples**

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



spei12

*Standardised Precipitation-Evapotranspiration Index 12***Description**

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

**Usage**

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

**Arguments**

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

**Value**

index value

**References**

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

**Examples**

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

spei3

*Standardised Precipitation-Evapotranspiration Index 3***Description**

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

**Usage**

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

**Arguments**

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

**Value**

index value

**References**

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

**Examples**

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

---

spei6

*Standardised Precipitation-Evapotranspiration Index 6*

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

index value

## References

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

## Examples

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

---

|      |   |
|------|---|
| spi1 | <i>Standardized precipitation index 1</i> |
|------|---|

---

## Description

Standardized precipitation index calculated at 1-month time scale

## Usage

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

## Arguments

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

## Value

index value

## References

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

## Examples

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

---

`spi12`*Standardized precipitation index 12*

---

**Description**

Standardized precipitation index calculated at 12-month time scale

**Usage**

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

**Arguments**

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

**Value**

index value

**References**

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

**Examples**

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

---

`spi3`*Standardized precipitation index 3*

---

**Description**

Standardized precipitation index calculated at 3-month time scale

**Usage**

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

**Arguments**

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

**Value**

index value

**References**

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

**Examples**

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

---

 spi6

*Standardized precipitation index 6*


---

**Description**

Standardized precipitation index calculated at 6-month time scale

**Usage**

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

**Arguments**

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

**Value**

index value

**References**

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

**Examples**

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

---

|    |                     |
|----|---------------------|
| ss | <i>Snowfall sum</i> |
|----|---------------------|

---

**Description**

Sum of snowfall

**Usage**

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

**Arguments**

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

**Value**

snow, mm

**Examples**

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

---

|     |                                 |
|-----|---------------------------------|
| ssd | <i>Sum of sunshine duration</i> |
|-----|---------------------------------|

---

**Description**

Sum of sunshine duration (hours)

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | insolation, hours of sun                                   |
| <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**

hours of sun

**References**

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

**Examples**

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

---

|                  |                                     |
|------------------|-------------------------------------|
| <code>ssp</code> | <i>Sunshine duration percentage</i> |
|------------------|-------------------------------------|

---

**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>       | insolation, hours of sun                                   |
| <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**

percentage

**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 | <i>Sums TN-10</i> |
|-------|-------------------|

---

## Description

Sum of degree days when TN  $\leq$  -10 Celsius recorded in December-February interval

## Usage

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

## Arguments

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

## Value

temperature, Celsius

## Examples

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



---

|       |                   |
|-------|-------------------|
| stn15 | <i>Sums TN-15</i> |
|-------|-------------------|

---

**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**

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

**Value**

temperature, Celsius

**Examples**

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

---

|       |                  |
|-------|------------------|
| stx32 | <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       | daily maximum temperature, Celsius                         |
| data_names | names of each period of time                               |
| na.rm      | logical. Should missing values (including NaN) be removed? |
| ...        | further arguments passed to or from other methods          |

**Value**

temperature, Celsius

**Examples**

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

---

su

*Summer days*

---

**Description**

Number of days with daily maximum temperature > 25 Celsius.

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | daily maximum temperature, Celsius                         |
| <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**

days

**References**

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

**Examples**

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

---

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

**Value**

temperature, Celsius

**Examples**

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

---

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

**Value**

temperature, Celsius

**Examples**

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

---

 tn10p
 

---



---

*Percentage of cold nights*


---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

percentage

**Formula**

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

**Examples**

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

---

|       |                    |
|-------|--------------------|
| tn90p | <i>Warm nights</i> |
|-------|--------------------|

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

days

**Examples**

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

---

|     |                   |
|-----|-------------------|
| tnn | <i>Minimum TN</i> |
|-----|-------------------|

---

**Description**

Minimum of daily minimum air temperature

**Usage**

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

**Arguments**

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

**Value**

temperature, Celsius

**References**

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5. [https://www.ecad.eu/documents/WCDMP\\_72\\_TD\\_1500\\_en\\_1.pdf](https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf)

**Examples**

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

---

 tnx

---

*Maximum TN*


---

**Description**

Maximum of daily minimum air temperature

**Usage**

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

**Arguments**

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

**Value**

temperature, Celsius

**References**

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5. [https://www.ecad.eu/documents/WCDMP\\_72\\_TD\\_1500\\_en\\_1.pdf](https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf)

**Examples**

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

---

tr *Tropical nights*

---

**Description**

Number of days with TN > 20 Celsius.

**Usage**

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

**Arguments**

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

**Value**

days

**References**

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

**Examples**

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

---

tx10p *Percentage of cold days*

---

**Description**

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

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | daily maximum temperature, Celsius                         |
| <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**

percentage

**Formula**

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

**Examples**

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

---

tx90p

*Warm days*

---

**Description**

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

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | daily maximum temperature, Celsius                         |
| <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**

days

**Examples**

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



---

|     |                   |
|-----|-------------------|
| txn | <i>Minimum TX</i> |
|-----|-------------------|

---

**Description**

Minimum of daily maximum air temperature

**Usage**

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

**Arguments**

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

**Value**

temperature, Celsius

**References**

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5. [https://www.ecad.eu/documents/WCDMP\\_72\\_TD\\_1500\\_en\\_1.pdf](https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf)

**Examples**

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

---

|     |                   |
|-----|-------------------|
| txx | <i>Maximum TX</i> |
|-----|-------------------|

---

**Description**

Maximum of daily maximum air temperature

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | daily maximum temperature, Celsius                         |
| <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, Celsius

**References**

Klein Tank AMG, Zwiers FW, Zhang X. 2009. Guidelines on analysis of extremes in a changing climate in support of informed decisions for adaptation, climate data and monitoring WCDMP-No 72, WMO-TD No 1500, p 5. [https://www.ecad.eu/documents/WCDMP\\_72\\_TD\\_1500\\_en\\_1.pdf](https://www.ecad.eu/documents/WCDMP_72_TD_1500_en_1.pdf)

**Examples**

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

---

uai

*UNEP Aridity Index*

---

**Description**

P/Eto

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>eto</code>        | evapotranspiration, mm                                     |
| <code>pr</code>         | daily precipitation, mm                                    |
| <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**

index value

## References

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

## Examples

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

---

|      |  |
|------|--|
| utci | <i>Universal Thermal Climate Index</i> |
|------|--|

---

## Description

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

## Usage

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

## Arguments

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

## Value

index value

## References

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

## Examples

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

---

vcd

*Very cold days*

---

## Description

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

## Usage

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

## Arguments

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

## Value

days

## Examples

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

---

vdtr *Mean daily difference DTR*

---

### Description

Mean absolute day-to-day difference in DTR

### Usage

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

### Arguments

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

### Value

temperature, Celsius

### Formula

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

### 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 | <i>Very warm days</i> |
|-----|-----------------------|

---

**Description**

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

**Usage**

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

**Arguments**

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

**Value**

days

**Examples**

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

---

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

**Value**

index value

**Formula**

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

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

**References**

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

**Examples**

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

---

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

**Value**

temperature, Celsius

**References**

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

**Examples**

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

---

|    |                        |
|----|------------------------|
| ws | <i>Winter Severity</i> |
|----|------------------------|

---

**Description**

Mean TG of the coldest month of the year

**Usage**

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

**Arguments**

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

**Value**

temperature, Celsius

**Examples**

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

---

|      |                            |
|------|----------------------------|
| wsdi | <i>Warm spell duration</i> |
|------|----------------------------|

---

**Description**

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

**Usage**

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



**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | daily maximum temperature, Celsius                         |
| <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**

days

**Examples**

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

---

`xtg`

*Maximum TG*

---

**Description**

Maximum of daily mean air temperature

**Usage**

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

**Arguments**

|                         |  |
|-------------------------|--|
| <code>data</code>       | daily mean temperature, Celsius                            |
| <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)
```



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