Package ‘fume’

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Description

This package includes functions for climate fire danger estimation, trend analysis and RCM bias correction and an example dataset of observations and reanalysis data from Spain.

This package was developed for the Course on Forest Fires in the Perspective of Global Change, held in Zaragoza (Spain) the 13th to 17th February 2012 in the context of FUME Project, which has received funding from the European Union’s Seventh Framework Programme (FP7/2007–2013) under grant agreement 243888 (FUME Project).

Details

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The package provides functions for Canadian Fire Weather index calculations, the modified Mann-Kendall trend test for serially correlated data and a function containing different implementation for RCM/GCM bias correction.

Author(s)

Santander Meteorology Group
Maintainer: Joaquin Bedia <joaquin.bedia@unican.es>

References


**Description**

The function performs calibration of model simulations using as reference a given dataset. Currently three types of calibration are supported: correction of the mean (i.e. bias correction), correction of the distribution quantile by quantile (quantile-quantile mapping) and a hybrid technique that performs quantile-quantile adjustment considering both distribution and means (quantile quantile adjustment).

**Usage**

```r
calibrateProj(obs, pred, sim, method = c("qqadj", "qqmap", "bias"),
              varcode = c("tas", "hurs", "pr", "wss"), return.par = TRUE)
```

**Arguments**

- **obs**: A time series of observations (or any other dataset used as reference for correction, e.g. simulations nested to reanalysis)
- **pred**: A time series of model simulations for the same period than observations
- **sim**: A time series of future model simulation (or period to be corrected)
- **method**: Character string indicating the type of correction to be done. Currently three types of correction are supported: "qqadj"=quantile-quantile adjustment, "qqmap"=quantile-quantile mapping and "bias"=bias correction.
- **varcode**: Character string indicating the variable to be corrected. Currently the values implemented are "tas", for temperature, "hurs" for relative humidity, "pr" for precipitation and "wss" for wind velocity. In practice, the function will only give a special treatment to temperature and precipitation.
- **return.par**: Logical. Should the "f" and "g" parameters of the correction be returned? default to FALSE. In practice, this option only makes sense with the quantile-quantile adjustment method, although note that in the case of temperature g=1.

**Details**

All data series used as input must have exactly the same length.

**Value**

If `return.par` is set to FALSE, a numeric vector with the corrected simulated series. If set to TRUE, a list with the following elements:

- **corrvals**: Numeric vector with corrected values
- **g**: value of the ‘g’ parameter
- **f**: value of the ‘f’ parameter
- **Mean_delta**: (Mean) Bias of the predicted series wrt the observations
Author(s)
Santander Meteorology Group <http://www.meteo.unican.es>

References

Examples

```r
require(graphics)

rnorm(1000) -> obs
rnorm(1000, mean=.5) -> pred
rnorm(1000, mean=.7) -> sim
calibrateProj(obs, pred, sim, 'qqadj', ret=FALSE) -> corr
plot(ecdf(obs), col='red', ylab='CDF', main='Q-Q adjustment')
lines(ecdf(pred), col='green')
lines(ecdf(sim), col='blue')
lines(ecdf(corr), col='grey2')
legend('topleft', c('Observed','Predicted','Simulated','Corrected'), lty=1, col=c('red','green','blue','grey2'))
```

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**fwi**  
Canadian Fire Weather Index Computation

**Description**
Computes the Canadian Fire Weather Index according to the equations presented in van Wagner and Pickett (1985).

**Usage**

```r
fwi(date, Tm, H, r, W, return.all = FALSE)
```

**Arguments**

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<tr>
<td>date</td>
<td>A vector of class date or chron with the dates of the records. See details.</td>
</tr>
<tr>
<td>Tm</td>
<td>A numeric vector of temperature records</td>
</tr>
<tr>
<td>H</td>
<td>A numeric vector of relative humidity records</td>
</tr>
<tr>
<td>r</td>
<td>A numeric vector of precipitation records</td>
</tr>
<tr>
<td>W</td>
<td>A numeric vector of wind velocity records</td>
</tr>
<tr>
<td>return.all</td>
<td>Logical. Should all FWI components be returned?. If TRUE, a complete dataframe is returned with all FWI components. Default to FALSE, and in this case only FWI is returned.</td>
</tr>
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</table>
Details

Dates need to be specified in a suitable format, as far as the function computes months and applies day length factor correction.

Some climate products may provide negative rainfall values, relative humidity above 100% and so on... To avoid errors, the function automatically searches and corrects out-of-range values and gives a warning.

Temperature must be in degree Celsius, relative humidity in %, precipitation in mm and wind velocity in km/h.

The function will not compute days with missing values for any of the input variables, and will jump to the next day with all complete records.

Value

If return.all is set to TRUE, a dataframe is returned, each column corresponding to each of the components. If FALSE, a numeric vector with FWI values.

Author(s)

Santander Meteorology Group <http://www.meteo.unican.es>

References


Examples

```r
require(graphics)
data(fwi.data)
# Observational data (2/zero.noslash/zero.noslash6-2/zero.noslash11) Madrid-Retiro weather station
fwi.data$observed$Madrid -> obsMadrid
fwi(date=obsMadrid$fecha, Tm=obsMadrid$T, H=obsMadrid$H,
r=obsMadrid$P, W=obsMadrid$W, return.all=TRUE) -> fwiMadrid
par(mfrow=c(2,3))
for (i in 1:6) {
  plot(obsMadrid$fecha, fwiMadrid[,i], ty='l',
        col=i, xlab='date', ylab='value',
        main=paste(names(fwiMadrid)[i])
}
```
fwi.data

Observational and reanalysis data from 7 locations in Spain.

Description

This dataset contains data of temperature, relative humidity, precipitation and wind velocity from 7 locations in Spain, as well as calculated Fire Weather Index. Data correspond both to observations from the Spanish Meteorological Agency (AEMET, all recorded at noon excepting precipitation, recorded at 07:00 UTC) and NCEP reanalysis (12:00 UTC).

Usage

data(fwi.data)

Format

A list with two elements: 
- observed (Observations data)
- ncep (NCEP reanalysis data)

Each element of the list contains 7 dataframes corresponding to weather stations in Spain. For each location, the following elements are included: dates of the records, Temperature (degrees Celsius), Relative humidity (%), accumulated precipitation (mm), wind velocity (km/h) and Fire Weather Index.

References


Examples

data(fwi.data)
require(graphics)
par(mfrow=c(2,3))
for (i in 2:7) {
  plot(fwi.data[[2]][[i]]$fecha, fwi.data[[2]][[i]]$FWI, 
  ty='l', col='red', ylab='FWI', xlab='date')
  title(main=paste(names(fwi.data[[1]])(i)))
  lines(fwi.data[[1]][[i]]$fecha, fwi.data[[1]][[i]]$FWI, ty='l', col='grey')
  legend('topright', c('Observed','NCEP'), lty=1, col=c('red','grey'))
}
**lappend**  
*Adds a new element to a list*

**Description**  
The function basically adds a new element to a list. It is used internally.

**Usage**  
lappend(lst, obj)

**Arguments**  
lst  
A list  
obj  
An element to be added to the existing list

**Details**  
This function is used internally by other functions within this package.

**Value**  
A list containing the new element in its last position.

**Author(s)**  
Santander Meteorology Group <http://www.meteo.unican.es>

**mkTrend**  
*Mann-Kendall modified trend test for serially correlated data*

**Description**  
Performs the Modified Mann-Kendall trend test, returning the corrected p-values after accounting for temporal pseudoreplication.

**Usage**  
mkTrend(x, ci = 0.95)

**Arguments**  
x  
A time series  
ci  
Confidence interval of the statistical test. Default to 0.95
Details

If NA values are present in the time series, the function will continue after discarding them, and will give a warning.

Value

A list containing the following elements:

- **Z**
  - The original (non corrected) Mann-Kendall test Z statistic

- **p.value**
  - The original (non corrected) Mann-Kendall test p-value

- **Zc**
  - The new Z statistic after applying the correction

- **Corrected p.value**
  - Corrected p-value after accounting for serial autocorrelation

- **tau**
  - Mann-Kendall’s tau statistic

- **N/n*s**
  - Value of the correction factor, representing the quotient of the number of samples \( N \) divided by the effective sample size \( n*s \)

- **Sen slope**
  - The slope of the (linear) trend according to Sen test

Note

A minimum sample size of \( N=40 \) is recommended

Author(s)

Santander Meteorology Group &lt;http://www.meteo.unican.es&gt;

References


See Also

**fwi** for calculation of fire danger time series

Examples

```r
require(datasets)
require(graphics)

data(sunspot.year) # The yearly sunspot dataset (1700-1988)
mkTrend(as.vector(sunspot.year))
# Original pvalue (0.0036) much lower than corrected pvalue (0.02)
```
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