The climatol Package

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Title Some Tools for Climatology

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Depends R (>= 1.8.0)

Description Functions to fill missing data in climatological (monthly) series and to test their homogeneity, plus functions to draw wind-rose and Walter&Lieth diagrams.

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URL http://webs.ono.com/climatol/climatol.html

R topics documented:

cli.dat *Monthly climatic data of a single station*

Description

Monthly climatic data, for a single station, of average precipitation, average daily maxima and minima temperatures, and daily minima temperatures.

Usage

```
data(cli.dat)
```

Format

A matrix of 4 lines (variables) and 12 columns (months) of data

Source

Invented data for the example of diagwl

datest *Estimate series from their neighbors*

Description

Data of each series are estimated from all the other stations, through weighting averages of their data, standardized by the chosen method.

Usage

```
datest(verb = FALSE)
```

Arguments

verb	Verbose information about the progress of the operation

Details

datest is an internal function used by depudm, not intended to be called directly by the user. It takes the data of the normalized series from object dat.d previously generated, and computes estimated data (dat.e) as averages, weighted by the weights est.w, of all the other stations.

Value

An object dat.e, with the estimated (normalized) data, is generated.

See Also

depudm

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depstat *Compute averages for a specified period*

Description

Listing of monthly and annual average values for a specified period, from data generated by depudm.

Usage

```
depstat(varcli, anyi, anyf, anyip = anyi, anyfp = anyf, nm = 12,
  ndec = 1, vala = 2)
```

Arguments

varcli	Acronym of the name of the studied climatic variable, as in the data file name.
anyi	Initial year of the data present in the file (four digits)
anyf	Final year of the data present in the file (four digits)
anyip	First year of the desired period (>=anyi, with 4 digits)
anyfp	Last year of the desired period (<=anyf, with 4 digits)
nm	Number of series in each station. (Default=12, for monthly data).
ndec	Number of decimal places to be saved in file 'VAR_AI-AF.med'
vala	Kind of annual value: **1:** Sum of monthly values, **2:** Average of monthly values, **3:** Maximum monthly value, **4:** Minimum monthly value.

Details

Purged data are read from file 'VAR_AI-AF.dep', generated by depudm, while the average data for the specified period (ai-af) are saved in 'VAR_ai-af.med'

Value

This function does not return any value.

See Also

depudm

Examples

```
#Function depudm must be run first (see the example), to create
#  the file 'PTOT_51-00.dep'. Then you can run:
## Not run: depstat("PTOT",1951,2000,1971,2000,vala=1)
#See the results in the file 'PTOT_71-00.med' created by depstat.
```

`depudm` *Monthly data homogenization*

Description

Climatological series homogeneity studies, with missing data estimation, inhomogeneities (point errors, mean shifts and trends) detection, and graphical displays.

Usage

```
depudm(varcli, anyi, anyf, nm = 12, wa = 100, dz.max = 2, difumb = 0.05,
  leer = TRUE, a = 0, b = 1, wz=0.001, sqrtrans = FALSE, ttip = 3,
  refglob = FALSE, ndec = 1, pval = 0.05, graf = FALSE, auto = FALSE,
  verb=TRUE)
```

Arguments

`varcli`	Acronym of the name of the studied climatic variable, as in the data file name.
`anyi`	Initial year of the data present in the file (four digits)
`anyf`	Final year of the data present in the file (four digits)
`nm`	Number of series in each station. (Default=12, for monthly data).
`wa`	Shape parameter of the weighting function `1/(1+d^2/wa)`, where d stands for distance. Low values (1-10) increase the weight of nearby stations, while high values (>1000) take in account also the far stations influence. Do `wa=0` if you want an unweighted average of all the stations.
`dz.max`	Threshold to accept differences between observed and estimated data, in standard deviation units. (Only used when `auto=TRUE`).
`difumb`	Maximum acceptable difference in the series average values between missing data filling iterations. This process will stop when the maximum difference is lower or equal to `difumb`.
`leer`	if `TRUE`, climatological data will be read from files. (Can be set to `FALSE` if data have already been read in a previous call to `depudm`).
`a, b`	Parameters of the optional transformation `a+b*dat` to be applied to data when read from the files.
`wz`	Scale parameter of the vertical coordinate `Z`. The default value assumes that `X` and `Y` are expressed in km, while `Z` is expressed in m. Can be used to change the `Z` weight in inter-station distance computations.

sqrtrans	if TRUE, a square root transformation will be applied to all data greater than 1. (Useful with e.g. precipitation data, to approximate their distribution to a Gauss one).
ttip	Type of standardization: **0:** none, **1:** deviations from the mean, **2:** proportions of the mean (only for means greater than 1), **3:** full standardization (subtract the mean and divide by the standard deviation).
refglob	if TRUE, use annual averages for normalization of all the series of each station. Incompatible with graf=TRUE. Can be useful in arid places with frequent null precipitation mixed with high precipitation values in other years, making quite unstable the computation of their averages.
ndec	Number of decimal places of the purged data, to be saved in the file 'VAR_AI-AF.dep'.
pval	If greater than 0, t-test of mean difference will be applied to running windows of 10 and 20 terms (between samples of 5 and 10 terms), and an overall trend test. If graf=TRUE, p-values of the t-test will be plotted and, provided that the trend is significant (lower than pval), the regression line with time will be plotted as well.
graf	If TRUE, interactive graphs will be displayed for each series.
auto	If TRUE, data whose differences to their estimated (normalized) values are greater than dz.max will be substituted by their estimates.
verb	If TRUE, progress indications will be shown in the terminal.

Details

This is the main function for error correction and homogeneity testing of the climatological series, and makes frequent calls to other subordinated functions. The climatological series are read from files named 'VAR_AI-AF.dat', and the coordinates and names of the stations from 'VAR_AI-AF.est', where VAR stands for any acronym of the involved climatological variable, and AI and AF are the two last digits of the initial and final year of the data. Data are stored station by station, and chronologically within each station block. Missing values are specified as NA (the usual way in R). In the stations file there will be a record (line) for each station, with structure X Y Z ID NAME, where X and Y are the UTM coordinates in km, Z the altitude in m, ID a station identifier, followed by the full NAME of the station, that must be put between double quotes if it contains any space character (see the example files in the package's data directory). depudm will save the purged, filled series in files 'VAR_AI-AF.dep', eventually overwriting the pre-existing ones. (Rename them if results of different calls to depudm are to be saved). A log of each run will also be appended in a file named 'climatol.log'.

Value

Objects created by this function (original data, dat.d; normalized data, dat.z; estimated data, dat.e; ...) will remain resident in the memory space during the rest of the R session while not explicitly removed, therefore been susceptible to apply on them all the extended variety of statistical and graphic functions available in R.

Note

As inhomogeneities in one series will affect other nearby series, making them suspects of inhomogeneity even if they are good, it is advisable to proceed step by step, beginning with a fairly high `wa` (>=1000) to only correct the most prominent errors, and successively repeat the process with decreasing values of `wa`.

Author(s)

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References

Climatol: Software libre para la depuración y homogeneización de datos climatológicos. IV Congress of the Spanish Climatology Society (Santander, 2-5 of November 2004).

See Also

`grafanom`, `grabeps`, `depstat`

Examples

```
#The two files PTOT_51-00.* of the package's data directory must be
#  first copied to the working directory. Then run:
## Not run: depudm("PTOT",1951,2000,b=.1,ttip=2,sqrtrans=TRUE,graf=TRUE)
```

`destipif` *Series unstandardization*

Description

Undo the standardization performed by `tipif`.

Usage

```
destipif(ttip = 3)
```

Arguments

`ttip`	Type of standardization: **0:** none, **1:** deviations from the mean, **2:** proportions of the mean (only for means greater than 1), **3:** full standardization (subtract the mean and divide by the standard deviation).

Details

`destipif` is an internal function used by `depudm`, not intended to be called directly by the user. It takes the data from object `dat.d` previously created.

Value

Previously created object `dat.e` is unstandardized, using mean values (`dat.m`) and, eventually, standard deviations (`dat.s`).

See Also

`depudm`

`diagwl` *Walter & Lieth climatic diagram*

Description

Plot of a Walter & Lieth climatic diagram of a station.

Usage

```
diagwl(dat, est = "", alt = NA, per = "", margen = c(4, 4, 5, 4), mlab = "",
  pcol = "#005ac8", tcol = "#e81800", pfcol = "cyan", sfcol = "#0eb6d7",
  shem = FALSE, ...)
```

Arguments

`dat`	Monthly climatic data on which the diagram will be plotted.
`est`	Name of the climatological station
`alt`	Altitude of the climatological station
`per`	Period of observation
`margen`	Margins vector for the plot (to be passed to `par`).
`mlab`	Month labels for the X axis: **"en":** Month initials in English. **"es":** Month initials in Spanish. **Other:** Numeric labels (1-12).
`pcol`	Color pen for precipitation.
`tcol`	Color pen for temperature.
`pfcol`	Fill color for probable frosts.
`sfcol`	Fill color for sure frosts.
`shem`	Set to `TRUE` for southern hemisphere stations.
`...`	Other graphic parameters

Details

Climatic data must be passed as a 4x12 matrix of monthly (January to December) data, in the following order:

Row 1: Mean precipitation

Row 2: Mean maximum daily temperature

Row 3: Mean minimum daily temperature

Row 4: Absolute monthly minimum temperature

This last row is only used to determine the probable frost months (when monthly values are equal or lower than 0řC). If `shem=TRUE`, the diagram will begin the plot with the July data, to keep the summer period in the central zone of the graphic.

Value

No value is returned by this function.

References

WALTER H & LIETH H (1960): Klimadiagramm Weltatlas. G. Fischer, Jena.

See Also

`plot`, `par`

Examples

```
data(cli.dat)
diagwl(cli.dat,est="Example station",alt=100,per="1961-90",mlab="en")
```

---

grabeps *Save the displayed graphic as an EPS file*

Description

The last displayed graphic is saved in a file named 'RAAMMDDHHMM-NN.eps' (in EPS format).

Usage

```
grabeps()
```

Details

`grabeps` is a function called by `grafanom`, but it can be called directly by the user. The name of the file saved begins by R, followed by digits indicating the year, month, day, hour and minute (two digits each) of the first call of this function in the present R session, plus a rank number (two digits also).

Value

No value is returned by this function.

Note

The last graphic will not be completely dumped to the file until the session ends.

See Also

grafanom

---

grafanom *Plot of anomalies, and original vs. estimated data*

Description

Plot of the standardized anomalies (original minus estimated data) and, optionally, original and estimated data (unstandardized).

Usage

```
grafanom(me=me, labm="", ttip=3, ndec=1, sqrtrans=FALSE, pval=.05)
```

Arguments

me	month (or sub-series number, if not monthly) to plot.
labm	month (or sub-series) label.
ttip	Type of standardization (to undo it for plotting the series).
ndec	Number of decimal places of the standard deviation label.
sqrtrans	Set to TRUE if a square root transformation was applied to the data (to undo it for plotting the series).
pval	If greater than 0, t-test of mean difference will be applied to moving windows of 10 and 20 terms (between samples of 5 and 10 terms), and an overall trend test. If graf=TRUE, p-values of the t-test will be plotted and, provided that the trend is significant (lower than pval), the regression line with time will be plotted as well.

Details

grafanom is an internal function used by depudm, not intended to be called directly by the user. Anomalies are plotted centered on their own average. After displaying the plot, the user is prompted to enter the number of the station to jump to (RETURN will jump to the next), or to view the plot of the original and estimated series, save the graphic, or end. Graphics are saved in EPS format, in files named 'RAAMMDDHHMM-NN.eps': an initial R followed by digits indicating the year, month, day, hour and minute (two digits each) of the first call of this function in the present R session, plus a rank number (two digits also).

Value

No value is returned by this function.

Note

The last graphic will not be completely dumped to the file until the session ends.

See Also

depudm, grabeps

`leerdm` *Read the (monthly) climatological series*

Description

Climatological series, and coordinates and names of the stations, are read from 'VAR_AI-AF.dat' and 'VAR_AI-AF.est' files respectively.

Usage

```
leerdm(varcli, anyi, anyf, nm=12, b=1, a=0)
```

Arguments

`varcli`	Acronym of the name of the studied climatic variable, as in the data file name.
`anyi`	Initial year of the data present in the file (four digits)
`anyf`	Final year of the data present in the file (four digits)
`nm`	Number of series in each station. (Default=12, for monthly data).
`a, b`	Parameters of the optional transformation `a+b*dat` to be applied to data when read from the files.

Details

`leerdm` is an internal function used by `depudm`, not intended to be called directly by the user.

Value

Objects `dat` (series data) and `est.c` (coordinates and names of the stations) are created, and number of years (`na`), number of stations (`ne`) and per station number of data (`nd`) are also computed.

See Also

depudm

matpesos *Inter-station weight matrix computation*

Description

Computation of the inter-station weight matrix that will be used by `datest` to estimate each station series from all other stations.

Usage

```
matpesos(wa=5, wz=.001, verb=TRUE)
```

Arguments

`wa`	Shape parameter of the weighting function `1/(1+d^2/wa)`, where d stands for distance. Low values (1-10) increase the weight of nearby stations, while high values (>1000) take in account also the far stations influence. Do `wa=0` if you want an unweighted average of all the stations.
`wz`	Scale parameter of the vertical coordinate `Z`. The default value assumes that `X` and `Y` are expressed in km, while `Z` is expressed in m. Can be used to change the `Z` weight in inter-station distance computations.
`verb`	If `TRUE`, progress indications will be shown in the terminal.

Value

Object `est.w` is created, containing the computed weight matrix.

See Also

`depudm`

movttest *t-test applied to a running window*

Description

A t-test of mean sample differences is successively applied to a window of `N` terms that runs along a series.

Usage

```
movttest(x, indme, nterm=10, pval=.05, verb=TRUE)
```

Arguments

x	Time series to be tested
indme	Label to identify the station and month (or sub-series)
nterm	Number of terms of the running window
pval	Significance threshold under which, provided that verb=TRUE, a line indicating the p-value and its position in the series will be shown.
verb	If TRUE, p-values under the threshold pval will be shown.

Details

movttest is an internal function used by depudm, not intended to be called directly by the user. It is applied to a running window of N terms; therefore, the t-test is performed on the difference of the means of the first and last N/2 terms of the window.

Value

An object pv is created, holding the p-values of all the t-test applied to the studied series.

See Also

depudm, grafanom

---

rosavent *Wind-rose plot*

Description

Plot of a wind-rose. Wind frequencies may be supplied by speed intervals, and can be absolute or relative.

Usage

```
rosavent(frec, fnum = 4, fint = 5, flab = 2, ang = 3 * pi/16,
  col = rainbow(10, 0.5, 0.92, start = 0.33, end = 0.2),
  margen = c(0, 0, 4, 0), key = TRUE, uni = "m/s", ...)
```

Arguments

frec	Wind frequencies.
fnum	Number of reference circumferences to plot.
fint	Frequency steps (in %) between reference circumferences.
flab	Parameter indicating which circumferences must be labelled: **1:** Label outer circumference only, **2:** Label all circumferences,

	Other value: Do not label any circumference.
ang	Angle along which circumferences will be labelled.
col	Colors to fill the frequency polygons.
margen	Margins vector for the plot (to be passed to par).
key	Set to FALSE if you do not want a legend of the wind-rose, that will otherwise be plotted if frequencies are supplied by speed intervals.
uni	Speed units for the legend header.
...	Other graphic parameters.

Details

The number of direction classes is indifferent: As many as elements of the frequency vector (or columns of the matrix) will be considered, but the first element (column) must correspond to North. Frequencies will be converted to percentages, no matter how they were supplied.

Value

No value is returned by this function.

See Also

plot, par

Examples

```
data(windfreq.dat)
rosavent(windfreq.dat,4,4,ang=-3*pi/16,main="Annual windrose")
```

---

tipif *Series standardization*

Description

Standardization of the series by the chosen method.

Usage

```
tipif(ttip = 3)
```

Arguments

ttip	Type of standardization: **0:** none, **1:** deviations from the mean, **2:** proportions of the mean (only for means greater than 1), **3:** full standardization (subtract the mean and divide by the standard deviation).

Details

`tipif` is an internal function used by `depudm`, not intended to be called directly by the user. It takes the data from object `dat.d` previously created.

Value

Standardized series `dat.z`, mean values `dat.m` and, optionally, standard deviations `dat.s` are created.

See Also

`depudm`

`windfreq.dat` *Wind frequency table*

Description

Wind frequency table for rosavent.R example.

Usage

```
data(windfreq.dat)
```

Format

A table of 4 lines (speed intervals) and 16 columns (wind directions) of data, plus headers.

Source

Invented data for the example of `rosavent`

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