Package 'BINCOR'

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Type Package

Title Estimate the Correlation Between Two Irregular Time Series

Version 0.2.0

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Imports pracma

Description Estimate the correlation between two irregular time series that are not necessarily sampled on identical time points. This program is also applicable to the situation of two evenly spaced time series that are not on the same time grid. 'BINCOR' is based on a novel estimation approach proposed by Mudelsee (2010, 2014) to estimate the correlation between two climate time series with different timescales. The idea is that autocorrelation (AR1 process) allows to correlate values obtained on different time points. 'BINCOR' contains four functions: bin_cor() (the main function to build the binned time series), plot_ts() (to plot and compare the irregular and binned time series, cor_ts() (to estimate the correlation between the binned time series) and ccf_ts() (to estimate the cross-correlation between the binned time series).

License GPL (>= 2)

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LazyData true

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R topics documented:

`BINCOR-package` *Estimate the Correlation Between Two Irregular Time Series*

Description

'BINCOR' estimate the correlation between two irregular time series that are not necessarily sampled on identical time points. This program is also applicable to the situation of two evenly spaced time series that are not on the same time grid. 'BINCOR' is based on a novel estimation approach proposed by Mudelsee (2010, 2014) to estimate the correlation between two climate time series with different timescales. The idea is that autocorrelation (AR1 process) allows to correlate values obtained on different time points. The outputs (plots) can be displayed in the screen or can be saved as PNG, JPG or PDF formats. The 'BINCOR' package also provides two examples with real data: instrumental (`ENSO.dat` and `NHSST.dat` data sets) and paleoclimatic (`ID31.dat` and `ID32.dat` data sets) time series to exemplify its use.

Details

Package:	BINCOR
Type:	Package
Version:	0.2
Date:	2018-05-18
License:	GPL (>= 2)
LazyLoad:	yes

BINCOR package contains four functions: the `bin_cor` (the main function to build the binned time series), the `plot_ts` (to plot and compare the irregular and binned time series, the `cor_ts` (to estimate the correlation between the binned time series) and the `ccf_ts` (to estimate the cross-correlation between the binned time series).

Note

Dependencies: *dplR* and *pracma*.

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References

Borchers, H. W. (2015). pracma: Practical Numerical Math Functions. R package version 1.8.8. URL https://CRAN.R-project.org/package=pracma

Bunn, A., Korpela, M., Biondi, F., Campelo, F., Mérian, P., Qeadan, F., Zang, C., Buras, A., Cecile, J., Mudelsee, M., Schulz, M. (2015). Den- drochronology Program Library in R. R package version 1.6.3. URL https://CRAN.R-project.org/package=dplR

Mudelsee, M. (2010). Climate Time Series Analysis: Classical Statistical and Bootstrap Methods. Springer.

Mudelsee, M. (2014). Climate Time Series Analysis: Classical Statistical and Bootstrap Methods, Second Edition. Springer.

Polanco-Martínez, J.M., Medina-Elizalde, M.A., Sánchez Goñi, M.F., M. Mudelsee. (2018). BINCOR: an R package to estimate the correlation between two unevenly spaced time series. Ms. under review (second round).

`bin_cor` *Binned correlation*

Description

The `bin_cor` function convert an irregular time series to a binned one and its parameters are described in the following lines.

Usage

```
bin_cor(ts1, ts2, FLAGTAU=3, ofilename)
```

Arguments

ts1, ts2	ts1 and ts2 are the unevenly spaced time series.
FLAGTAU	FLAGTAU defines the method used to estimate the persistence or memory of the unevenly spaced time series. Options (by default is 3): If 1 then est_tau = tau_x + tau_y [Eq. 7.44, Mudelsee (2010, 2014)]. If 2 then est_tau = max(tau_x, tau_y) [Eq. 7.45, Mudelsee (2010, 2014)]. If 3 then est_tau = dist_x_y/ln(a_x_y_est) [Eq. 7.48, Mudelsee (2010, 2014).]
ofilename	The output filename (ASCII format) containing the binned time series.

Details

The bin_cor function convert an irregular times series to a binned time series and depends on the R *dplR* package to carry out this task. *dplR* (*redfitTauest* function) estimate the persistence contained in the irregular climate time series by means of the method of Mudelsee (2002).

Value

A list of 16 elements:

Binned_time_series	An object containing the binned time series.
Auto._cor._coef._ts1	The autocorrelation for the binned time series number 1.
Persistence_ts1	The persistence or memory for the binned time series number 1.
Auto._cor._coef._ts2	The autocorrelation for the binned time series number 2.
Persistence_ts2	The persistence or memory for the binned time series number 2.
bin width	The bin width.
Number_of_bins	The number of bins.
Average spacing	The mean value of the times for the binned time series.
VAR. ts1	Variance of ts1
VAR. bin ts1	Variance of the binned ts1.
VAR. ts2	Variance for ts2.
VAR. bin ts2	Variance of the binned ts2.
VAR. ts1 - VAR bints1	Variance of ts1 minus variance of the binned ts1.
VAR. ts2 - VAR bints2	Variance of ts2 minus variance of the binned ts2.
% of VAR. lost ts1	Percentage of variance lost for ts1.
% of VAR. lost ts2	Percentage of variance lost for ts2.

Note

Needs *dplR* (*redfitTauest* function) to estimate the persistence contained in the irregular time series by means of the method of Mudelsee (2002). Please, look at the code *tauest_dplR.R* in the directory R of our BINCOR package.

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References

Bunn, A., Korpela, M., Biondi, F., Campelo, F., Mérian, P., Qeadan, F., Zang, C., Buras, A., Cecile, J., Mudelsee, M., Schulz, M. (2015). Dendrochronology Program Library in R. R package version 1.6.3. URL https://CRAN.R-project.org/package=dplR.

Mudelsee, M. (2002). TAUEST: A computer program for estimating persistence in unevenly spaced weather/climate time series. Computers & Geosciences 28 (1), 69–72.
URL http://www.climate-risk-analysis.com/software/.

Mudelsee, M. (2010). Climate Time Series Analysis: Classical Statistical and Bootstrap Methods. Springer.

Mudelsee, M. (2014). Climate Time Series Analysis: Classical Statistical and Bootstrap Methods, Second Edition. Springer.

Polanco-Martínez, J.M., Medina-Elizalde, M.A., Sánchez Goñi, M.F., M. Mudelsee. (2018). BINCOR: an R package to estimate the correlation between two unevenly spaced time series. Ms. under review (second round).

Examples

```
######################################################################
#::  Figure 1 D (Polanco-Martínez et al. (2018), (mimeo)).
######################################################################
library("BINCOR")

######################################################################
#:: Loading the time series under analysis: example 1 (ENSO vs. NHSST)
######################################################################
data(ENSO)
data(NHSST)

######################################################################
```

```
# Testing our bin_cor function
#####################################################################
bincor.tmp    <- bin_cor(ENSO.dat, NHSST.dat, FLAGTAU=3, "output_ENSO_NHSST.tmp")
binnedts      <- bincor.tmp$Binned_time_series
```

---

ccf_ts *Cross-correlation*

Description

The ccf_ts function estimates and plots the cross-correlation between the binned time series. ccf_ts has an option to remove the linear trend of the time series under analysis (other pre-processing methods could be used) and contains several parameters that are described in the following lines.

Usage

```
ccf_ts(bints1, bints2, lagmax=NULL, ylima=-1, ylimb=1, rmltrd="N", RedL=T,
 device="screen", Hfig, Wfig, Hpdf, Wpdf, resfig, ofilename)
```

Arguments

bints1, bints2	The bints1 and bints2 are the binned time series.
lagmax	This parameter indicates the maximum lag for which the cross-correlation is calculated (its value depends on the length of the data set).
ylima, ylimb	This parameters define the extremes of the range in which the CCF will be plotted.
rmltrd	This is the option used to remove the linear trend in the time series under study (by default the linear trend is not removed, but it can be activated with the option "Y" or "y").
RedL	RedL plots a right red line to highlight the correlation coefficient at the lag-0 (the default option is TRUE).
device	The type of the output device (by default the option is "screen", and the other options are "jpg", "png" and "pdf") for the scatter plot of the binned time series.
Hfig	The height for the CCF plot in "jpg" or "png" format.
Wfig	The width for the CCF plot in "jpg" or "png"format.
Hpdf	The height for the CCF plot in "pdf" format.
Wpdf	The width for the CCF plot in "pdf" format.
resfig	*resfig* is the plot resolution in "ppi" (by default R does not record a resolution in the image file, except for BMP) for the CCF plot ("jpg" or "png" formats), an adequate value could be 150 ppi.
ofilename	The output filename (CCF plot) for the CCF estimated of the binned time series.

Details

The ccf_ts estimate the cross-correlation between two binned time series by means of the R native function *ccf* (package:stats).

Value

Output: an object of the form *ccf* containing the correlation coefficients for the defined number of lags (lagmax) and the statistical significance.

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Web2: http://www.researchgate.net/profile/Josue_Polanco-Martinez.
Email: josue.m.polanco@gmail.com

References

Polanco-Martínez, J.M., Medina-Elizalde, M.A., Sánchez Goñi, M.F., M. Mudelsee. (2018). BINCOR: an R package to estimate the correlation between two unevenly spaced time series. Ms. under review (second round).

Examples

```
#########################################################################
#::  Figure 5 (Polanco-Martínez et al. (2018), (mimeo)).
#########################################################################
library("BINCOR")
library("pracma")

#########################################################################
#:: Loading the time series under analysis: example 2 (pollen ACER)
#########################################################################
data(MD04_2845_siteID31)
data(MD95_2039_siteID32)

#########################################################################
# Computing the binned time series though our bin_cor function
#########################################################################
bincor.tmp <- bin_cor(ID31.dat, ID32.dat, FLAGTAU=3, "salida_ACER_ABRUPT.tmp")
binnedts   <- bincor.tmp$Binned_time_series

# To avoid NA's values
bin_ts1    <- na.omit(bincor.tmp$Binned_time_series[,1:2])
bin_ts2    <- na.omit(bincor.tmp$Binned_time_series[,c(1,3)])

#########################################################################
# Testing our ccf_ts function
#########################################################################
```

```
# Screen
ccf_ts(bin_ts1, bin_ts2, RedL=TRUE, rmltrd="y")

# PDF format
ccf_ts(bin_ts1, bin_ts2, RedL=TRUE, rmltrd="y", device="pdf", Hpdf=6,
 Wpdf=9, resfig=300, ofilename="ccf_ID31_ID32_res")

# JPG format
ccf_ts(bin_ts1, bin_ts2, RedL=TRUE, rmltrd="y", device="jpg",
 Hfig=900, Wfig=1200, resfig=150, ofilename="ccf_ID31_ID32_res")
```

`cor_ts` *Bi-variate correlation*

Description

The `cor_ts` function estimates the correlation between the binned time series. `cor_ts` estimates three types of correlation coefficients: Pearson's correlation, Spearman's and Kendall's rank correlations by means of the R native function cor.test (package:stats). The `cor_ts` function has an option to remove the linear trend of the time series under analysis (other pre-processing methods could be used) and its parameters are described in the following lines.

Usage

```
cor_ts(bints1, bints2, varnamets1="NULL", varnamets2="NULL", KoCM, rmltrd="N",
 device="screen", Hfig, Wfig, Hpdf, Wpdf, resfig, ofilename)
```

Arguments

`bints1, bints2`	The bints1 and bints2 are the binned time series.
`varnamets1, varnamets2`	varnamets[1][2] are the names of the variables under study.
`KoCM`	KoCM indicates the correlation estimator: pearson for Pearson (the option by default), spearman for Spearman and kendall for Kendall.
`rmltrd`	This is the option used to remove the linear trend in the time series under study (by default the linear trend is not removed, but it can be activated with the option "Y" or "y").
`device`	The type of the output device (by default the option is "screen", and the other options are "jpg", "png" and "pdf") for the scatter plot for the binned time series.
`Hfig`	The height for the scatter plot in "jpg" or "png" format.
`Wfig`	The width for the scatter plot in "jpg" or "png" format.
`Hpdf`	The height for the scatter plot in "pdf" format.
`Wpdf`	The width for the scatter plot in "pdf" format.
`resfig`	*resfig* is the resolution in "ppi" (by default R does not record a resolution in the image file, except for BMP) for the scatter plot ("jpg" or "png" formats), an adequate value could be 150 ppi.
`ofilename`	The output filename for the scatter plot of the binned time series.

Details

The cor_ts estimate the correlation between two binned time series by means of the R native function *cor.test* (package:stats).

Value

Output: an object of the form *cor.test* containing the correlation coefficient and the statistical significance.

Output plot: *screen or 'ofilename + .png, .jpg or .pdf'*.

Author(s)

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Email: josue.m.polanco@gmail.com

References

Mudelsee, M. (2010). Climate Time Series Analysis: Classical Statistical and Bootstrap Methods. Springer.

Mudelsee, M. (2014). Climate Time Series Analysis: Classical Statistical and Bootstrap Methods, Second Edition. Springer.

Polanco-Martínez, J.M., Medina-Elizalde, M.A., Sánchez Goñi, M.F., M. Mudelsee. (2018). BINCOR: an R package to estimate the correlation between two unevenly spaced time series. Ms. under review (second round).

Examples

```
#########################################################################
#::  Figure 2 (Polanco-Martínez et al. (2018), (mimeo)).
#########################################################################
library("BINCOR")
library("pracma")

#########################################################################
#:: Loading the time series under analysis: example 1 (ENSO vs. NHSST)
#########################################################################
data(ENSO)
data(NHSST)

#########################################################################
# Computing the binned time series though our bin_cor function
#########################################################################
```

```
bincor.tmp    <- bin_cor(ENSO.dat, NHSST.dat, FLAGTAU=3, "output_ENSO_NHSST.tmp")
binnedts      <- bincor.tmp$Binned_time_series

######################################################################
# Testing our cor_ts function: cor_ts.R
######################################################################
# screen (scatterplot) and Pearson
cor_ts(binnedts[,1:2], binnedts[,c(1,3)], "ENSO-Nino3", "SST NH Mean",
 KoCM="pearson", rmltrd="y")

# PDF format (scatterplot) and Kendall
cor_ts(binnedts[,1:2], binnedts[,c(1,3)], "ENSO-Nino3", "SST NH Mean",
 KoCM="kendall", rmltrd="y", device="pdf", Hpdf=6, Wpdf=9, resfig=300,
 ofilename="scatterplot_ENSO_SST")

# JPG format (scatterplot) and Spearman
cor_ts( binnedts[,1:2], binnedts[,c(1,3)], "ENSO-Nino3", "SST NH Mean",
 KoCM="spearman", rmltrd="y", device="jpg", Hfig=900, Wfig=1200,
 resfig=150, ofilename="scatterplot_ENSO_SST")
```

ENSO.dat *Equatorial Pacific SST anomalies from El Niño 3 region.*

Description

The data set ENSO.dat contains an irregular time series (ENSO) with 125 data points and an average temporal spacing of 1.24 years covering the time interval 1850-2006. The ENSO data set come from Mann et al. (2009). The data sets can be obtained from the following URL http://www.meteo.psu.edu/holocene/public_html/supplements/MultiproxySpatial09/results/ (NINO3 full).

Usage

```
data(ENSO)
```

Format

One file in ASCII format containing 125 elements and two variables (time and ENSO)

Source

http://www.meteo.psu.edu/holocene/public_html/supplements/MultiproxySpatial09/results/

Mann, M. E., Zhang, Z., Rutherford, S., Bradley, R. S., Hughes, M. K., Shindell, D., Ammann, C., Faluvegi, G., Ni, F. (2009). Global signatures and dynamical origins of the Little Ice Age and Medieval Climate Anomaly. Science 326 (5957), 1256–1260.

ID31.dat — *Unevenly-spaced pollen record from the marine sediments core (MD04-2845) collected on the southwestern European margin.*

Description

The data set ID31.dat contains one paleoclimate (pollen percentages) time series spanning a time interval between 73,000 and 15,000 years before present (BP), thus covering the last glacial period (LGP). This data set come from a global pollen and charcoal database (Sánchez Goñi et al., 2017) developed in the framework of the INQUA International Focus Group ACER (Abrupt Climate Changes and Environmental Responses). The paleoclimate time series come from the site MD04-2845 and contains 77 elements (Sánchez Goñi et al., 2008, 2017).

Usage

```
data(MD04_2845_siteID31)
```

Format

One file in ASCII format containing 77 elements and two variables (time and pollen percentages).

Source

https://doi.pangaea.de/10.1594/PANGAEA.870867

Sánchez Goñi, M. F., Landais, A., Fletcher, W. J., Naughton, F., Desprat, S., Duprat, J. (2008). Contrasting impacts of Dansgaard-Oeschger events over a western European latitudinal transect modulated by orbital parameters. Quaternary Science Reviews 27 (11), 1136–1151.

Sánchez Goñi, M. F., Desprat, S., Daniau, A.L., Bassinot, F. C., Polanco Martínez, J. M., Harrison, S. P., Allen, J. R., Anderson, R. S., Behling, H., Bonnefille, R., et al. (2017). The ACER pollen and charcoal database: a global resource to document vegetation and fire response to abrupt climate changes during the last glacial period. Earth System Science Data 9 (2), 679.
URL https://www.earth-syst-sci-data.net/9/679/2017/.

ID32.dat — *Unevenly-spaced pollen record from the marine sediments core (MD95-2039) collected on the southwestern European margin.*

Description

The data set ID32.dat contains a paleoclimate (pollen percentages) time series spanning a time interval between 73,000 and 15,000 years before present (BP), thus covering the last glacial period (LGP). This data set come from a global pollen and charcoal database (Sánchez Goñi et al., 2017) developed in the framework of the INQUA International Focus Group ACER (Abrupt Climate Changes and Environmental Responses). The time series come from the site MD95-2039 and contains 141 elements (Roucoux et al., 2005; Sánchez Goñi et al., 2017).

Usage

```
data(MD95_2039_siteID32)
```

Format

One file in ASCII format containing and 141 elements and two variables (time and pollen percentages).

Source

https://doi.pangaea.de/10.1594/PANGAEA.870867
Roucoux, K., De Abreu, L., Shackleton, N., Tzedakis, P. (2005). The response of NW Iberian vegetation to North Atlantic climate oscillations during the last 65 kyr. Quaternary Science Reviews 24 (14), 1637–1653.

Sánchez Goñi, M. F., Desprat, S., Daniau, A.L., Bassinot, F. C., Polanco Martínez, J. M., Harrison, S. P., Allen, J. R., Anderson, R. S., Behling, H., Bonnefille, R., et al. (2017). The ACER pollen and charcoal database: a global resource to document vegetation and fire response to abrupt climate changes during the last glacial period. Earth System Science Data 9 (2), 679.
URL https://www.earth-syst-sci-data.net/9/679/2017/.

NHSST.dat *Northern Hemisphere (NH) sea surface temperature (SST) anomalies.*

Description

The data set NHSST.dat contains an irregular time series (NH-SST) with 125 data points and an average temporal spacing of 1.24 years covering the time interval 1850-2006. The NH-SST data set come from HadCRUT3 (Brohan et al., 2006). The data sets can be obtained from the following URL http://www.meteo.psu.edu/holocene/public_html/supplements/MultiproxySpatial09/results/ (Northern Hemisphere full).

Usage

```
data(NHSST)
```

Format

One file in ASCII format containing 125 elements and two variables (time and NHSST)

Source

http://www.meteo.psu.edu/holocene/public_html/supplements/MultiproxySpatial09/results/

Brohan, P., Kennedy, J. J., Harris, I., Tett, S. F., Jones, P. D. (2006). Uncertainty estimates in regional and global observed temperature changes: A new data set from 1850. Journal of Geophysical Research: Atmospheres 111 (D12).

plot_ts *Plot time series*

Description

The plot_ts function plot and compare the irregular and the binned time series. plot_ts has several parameters that are described in the following lines.

Usage

```
plot_ts(ts1, ts2, bints1, bints2, varnamets1="", varnamets2="", colts1=1, colts2=1,
 colbints1=2, colbints2=2, ltyts1=1, ltyts2=1, ltybints1=2, ltybints2=2,
 device="screen", Hfig, Wfig, Hpdf, Wpdf, resfig, ofilename)
```

Arguments

ts1, ts2	ts1 and ts2 are the unevenly spaced time series.
bints1, bints2	The bints1 and bints2 are the binned time series.
varnamets1, varnamets2	varnamets[1][2] are the names of the variables under study.
colts1, colts2	colts[1][2] are the colours for the time series (irregular) under study (by default both curves are in black).
colbints1, colbints2	colbints[1][2] are the colours of the binned time series (by default both curves are in red).
ltyts1, ltyts2	ltyts[1][2] are the type of lines to be plotted for the irregular time series (by default is 1, i.e., solid). 1 = solid, 2 = dashed, 3 = dotted, 4 = dot-dashed, 5 = long-dashed, 6 = double-dashed.
ltybints1, ltybints2	ltybints[1][2] are the type of lines to be plotted for the binned time series (by default is 2, i.e., dashed). 1 = solid, 2 = dashed, 3 = dotted, 4 = dot-dashed, 5 = long-dashed, 6 = double-dashed.
device	The type of the output device (by default the option is "screen", and the other options are "jpg", "png" and "pdf").
Hfig	The height for the plot in "jpg" or "png" format.
Wfig	The width for the plot in "jpg" or "png" format.
Hpdf	The height for the plot in "pdf" format.
Wpdf	The width for the plot in "pdf" format.
resfig	*resfig* is the plot resolution in 'ppi' (by default R does not record a resolution in the image file, except for BMP), an adequate value could be 150 ppi.
ofilename	The output filename for the plot.

Details

The plot_ts function is used to plot the irregular vs. the binned time series and this function uses the native R function "plot" (package:graphics).

Value

Output:

Output plot: *screen or 'ofilename + .png, .jpg or .pdf'*.

Author(s)

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Email: josue.m.polanco@gmail.com

References

Polanco-Martínez, J.M., Medina-Elizalde, M.A., Sánchez Goñi, M.F., M. Mudelsee. (2018). BINCOR: an R package to estimate the correlation between two unevenly spaced series. Ms. under review (second round).

Examples

```
#########################################################################
#::  Figure 1 (Polanco-Martínez et al. (2018), (mimeo)).
#########################################################################
library("BINCOR")

#########################################################################
#:: Loading the time series under analysis: example 1 (ENSO vs. NHSST)
#########################################################################
data(ENSO)
data(NHSST)

#########################################################################
# Computing the binned time series though our bin_cor_function.R
#########################################################################
bincor.tmp    <- bin_cor(ENSO.dat, NHSST.dat, FLAGTAU=3, "output_ENSO_NHSST.tmp")
binnedts      <- bincor.tmp$Binned_time_series

#########################################################################
# Testing our plot_ts function
#########################################################################
# "Screen"
plot_ts(ENSO.dat, NHSST.dat, binnedts[,1:2], binnedts[,c(1,3)], "ENSO-Nino3",
 "SST NH Mean", colts1=1, colts2=2, colbints1=3, colbints2=4, device="screen")
```

```
# PDF format
plot_ts(ENSO.dat, NHSST.dat, binnedts[,1:2], binnedts[,c(1,3)], "ENSO-Nino3",
 "SST NH Mean", colts1=1, colts2=2, colbints1=3, colbints2=4, device="pdf",
 Hpdf=6, Wpdf=9, resfig=300, ofilename="plot_ts_RAW_BIN_enso_sst")

# PNG format
plot_ts(ENSO.dat, NHSST.dat, binnedts[,1:2], binnedts[,c(1,3)], "ENSO-Nino3",
 "SST NH Mean", colts1=1, colts2=2, colbints1=3, colbints2=4, device="png",
 Hfig=900, Wfig=1200, resfig=150, ofilename="plot_ts_RAW_BIN_enso_sst")

#########################################################################
#::  Figure 4 (Polanco-Martínez et al. (2017), (mimeo)).
#########################################################################

#########################################################################
#:: Loading the time series under analysis: example 2 (pollen ACER)
#########################################################################
data(MD04_2845_siteID31)
data(MD95_2039_siteID32)

#########################################################################
# Computing the binned time series though our bin_cor function
#########################################################################
bincor.tmp <- bin_cor(ID31.dat, ID32.dat, FLAGTAU=3, "salida_ACER_ABRUPT.tmp")
binnedts   <- bincor.tmp$Binned_time_series

# To avoid NA's values
bin_ts1    <- na.omit(bincor.tmp$Binned_time_series[,1:2])
bin_ts2    <- na.omit(bincor.tmp$Binned_time_series[,c(1,3)])

#########################################################################
# Testing our plot_ts function: plot_ts.R
#########################################################################
# "Screen"
plot_ts(ID31.dat, ID32.dat, bin_ts1, bin_ts2, "MD04-2845 (Temp. forest)",
 "MD95-2039 (Temp. forest )", colts1=1, colts2=2, colbints1=3, colbints2=4,
 device="screen")

# PDF format
plot_ts(ID31.dat, ID32.dat, bin_ts1, bin_ts2, "MD04-2845 (Temp. forest)",
 "MD95-2039 (Temp. forest )", colts1=1, colts2=2, colbints1=3, colbints2=4,
 device="pdf", Hpdf=6, Wpdf=9, resfig=300, ofilename="ts_ACER_ABRUPT")

# PNG format
plot_ts(ID31.dat, ID32.dat, bin_ts1, bin_ts2, "MD04-2845 (Temp. forest)",
 "MD95-2039 (Temp. forest )", colts1=1, colts2=2, colbints1=3, colbints2=4,
 device="png",  Hfig=900, Wfig=1200, resfig=150, ofilename="ts_ACER_ABRUPT")
```

---

redfitMinls *Minimization - least square*

Description

The `redfitMinls` function is used by the `redfitTauest` function to calculate the persistence for unevenly spaced climate time series under study. `redfitTauest` is included in the *redfit* function of the R *dplR* package (Bunn et al. 2015).

Usage

```
redfitMinls(t, x)
```

Arguments

`t, x`	t and x are the times and the variables for an unevenly spaced time series.

Details

The `redfitMinls` function minimize (optimize) by least squares to obtain some parameters of the AR1 model used to estimate the persistence through the method of Mudelsee (2002). More information about `redfitMinls` function can be found in Bunn et al. (2015) and Mudelsee (2002).

Note

Needs *dplR* to estimate the persistence contained in the irregular time series by means of the method of Mudelsee (2002). Please, for more details look at the code *tauest_dplR.R* in the directory R of our BINCOR package.

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References

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`redfitTauest` *Tauest*

Description

The `redfitTauest` function is used by `bin_cor` function to calculate the persistence for irregular climate time series under study. `redfitTauest` is included in the *redfit* function that come from the R *dplR* package (Bunn et al. 2015).

Usage

```
redfitTauest(t, x)
```

Arguments

`t, x`	t and x are the times and the variables for an unevenly spaced time series.

Details

The `redfitTauest` function estimate the persistence of an irregular times series through the method of Mudelsee (2002). `redfitTauest` function is used by the *dplR* package to estimate the persistence contained in irregular climate time series. More information about `redfitTauest` function can be found in Bunn et al. (2015) and Mudelsee (2002).

Note

Needs *dplR* to estimate the persistence contained in the irregular time series by means of the method of Mudelsee (2002). Please, look at the code *tauest_dplR.R* in the directory R of our BINCOR package.

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References

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