Package 'paleofire'

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Type Package

Title paleofire: an R package to analyse sedimentary charcoal records from the Global Charcoal Database to reconstruct past biomass burning

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Description The paleofire package provides tools to extract and analyse charcoal sedimentary data stored in the Global Charcoal Database. Main functionalities includes data extraction and sites selection, transformation and interpolation of the charcoal records as well as compositing.

URL http://gpwg.org

License GPL (>= 2)

Imports locfit, gtools, caTools, pscl, Imap, RCurl, devtools

Depends R(>= 2.10.0), methods

Suggests GCD

LazyLoad yes

LazyData no

R topics documented:

`paleofire-package` *paleofire: A package for the Global Charcoal Database*

Description

The paleofire package provides tools to extract and analyse charcoal sedimentary data stored in the Global Charcoal Database. Main functionalities includes data extraction and sites selection, transformation and interpolation of the charcoal records as well as compositing.

Details

Package:	paleofire
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License:	GPL (>=2)

Author(s)

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Maintainer

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References

Daniau, A. L., P. J. Bartlein, S. P. Harrison, I. C. Prentice, S. Brewer, P. Friedlingstein, T. I. Harrison-Prentice, J. Inoue, K. Izumi, J. R. Marlon, S. Mooney, M. J. Power, J. Stevenson, W. Tinner, Andri, M., J. Atanassova, H. Behling, M. Black, O. Blarquez, K. J. Brown, C. Carcaillet, E. A. Colhoun, D. Colombaroli, B. A. S. Davis, D. D'Costa, J. Dodson, L. Dupont, Z. Eshetu, D. G. Gavin, A. Genries, S. Haberle, D. J. Hallett, G. Hope, S. P. Horn, T. G. Kassa, F. Katamura, L. M. Kennedy, P. Kershaw, S. Krivonogov, C. Long, D. Magri, E. Marinova, G. M. McKenzie, P. I. Moreno, P. Moss,

F. H. Neumann, E. Norstrom, C. Paitre, D. Rius, N. Roberts, G. S. Robinson, N. Sasaki, L. Scott, H. Takahara, V. Terwilliger, F. Thevenon, R. Turner, V. G. Valsecchi, B. Vanniere, M. Walsh, N. Williams, and Y. Zhang. 2012. Predictability of biomass burning in response to climate changes. Global Biogeochem. Cycles 26:GB4007.

Power, M., J. Marlon, N. Ortiz, P. Bartlein, S. Harrison, F. Mayle, A. Ballouche, R. Bradshaw, C. Carcaillet, C. Cordova, S. Mooney, P. Moreno, I. Prentice, K. Thonicke, W. Tinner, C. Whitlock, Y. Zhang, Y. Zhao, A. Ali, R. Anderson, R. Beer, H. Behling, C. Briles, K. Brown, A. Brunelle, M. Bush, P. Camill, G. Chu, J. Clark, D. Colombaroli, S. Connor, A. L. Daniau, M. Daniels, J. Dodson, E. Doughty, M. Edwards, W. Finsinger, D. Foster, J. Frechette, M. J. Gaillard, D. Gavin, E. Gobet, S. Haberle, D. Hallett, P. Higuera, G. Hope, S. Horn, J. Inoue, P. Kaltenrieder, L. Kennedy, Z. Kong, C. Larsen, C. Long, J. Lynch, E. Lynch, M. McGlone, S. Meeks, S. Mensing, G. Meyer, T. Minckley, J. Mohr, D. Nelson, J. New, R. Newnham, R. Noti, W. Oswald, J. Pierce, P. Richard, C. Rowe, M. Sanchez Goni, B. Shuman, H. Takahara, J. Toney, C. Turney, D. Urrego-Sanchez, C. Umbanhowar, M. Vandergoes, B. Vanniere, E. Vescovi, M. Walsh, X. Wang, N. Williams, J. Wilmshurst, and J. Zhang. 2008. Changes in fire regimes since the Last Glacial Maximum: an assessment based on a global synthesis and analysis of charcoal data. Climate Dynamics 30:887-907.

See Also

http://gpwg.org

Examples

```
## Interactive sites selection:
# ID=pfInteractive()

## Site selection using criterions
# DateInt parameter is used to set the mean interval which is required between two
# dating points (ex 14C) for sites to be selected for a complete list of criterions
# that can be used see pfSiteSel function

ID=pfSiteSel(Latlim=c(30,70),Longlim=c(-100,-50), DateInt=3000)
plot(ID,zoom="sites")

## Filter sites based on sample number using summary function
sumID=summary(ID)
sites_inc=sumID$ID_SITE[sumID$NUM_SAMP>=20]
ID=pfSiteSel(ID=sites_inc)

## Associated plots
plot(ID,zoom="sites")

## Simple test for transforming data
# Select site 1 (Cygnet Lake)

ID=pfSiteSel(ID=1)
plot(ID)

# Transformation of data
TR=pfTransform(ID,method=c("MinMax", "Box-Cox", "Z-Score"))

# Plot Transformed and raw data
# First retrieve raw data for Cygnet using pfExtract

RAW=pfExtract(ID=1)
```

```
dev.off()
par(mfrow=(c(2,1)))

plot(RAW[,3],RAW[,4],type="l")
plot(TR$Age,TR$TransData,type="l")


## Transforming and Compositing
## Example 1: Usage as in Power et al. 2008
## Data transformation
ID=pfSiteSel(Latlim=c(30,70),Longlim=c(-100,-50))
TR1=pfTransform(ID, method=c("MinMax","Box-Cox","Z-Score"),BasePeriod=c(200,2000))

## Diagnostic pdf file with transformed series:
pfDiagnostic(ID, method=c("MinMax","Box-Cox","Z-Score"),BasePeriod=c(200,2000))


## Compositing: basic binning procedure
COMP=pfComposite(TR1, binning=TRUE, bins=seq(0,12000,500))
plot(COMP)

## The result matrix can be saved
write.csv(COMP$Result,file="temp.csv")


## Compositing: Using the locfit package equivalent procedure to Daniau et al. 2012

COMP2=pfCompositeLF(TR1, tarAge=seq(-50,12000,20), binhw=20, hw=500,nboot=100)
plot(COMP2)

## And save
write.csv(COMP2$Result,file="temp2.csv")


## Example 3: Circular block bootstrapp
COMP=pfComposite(TR1, binning=TRUE, bins=seq(0,2000,100))
sea1=pfCircular(COMP,b=3,conf=c(0.005,0.025,0.975,0.995),nboot=100)

# Figure
plot(sea1)
```

---

checkGCDversion *Check GCD package install*

Description

Check if GCD package is installed and up to date during paleofire attach to ensure always using the most up to date GCD version. devtools package is required: on Windows install Rtools.exe depending on your R version http://cran.r-project.org/bin/windows/Rtools/

Usage

```
checkGCDversion()
```

Details

Last GCD database version is donwloaded and installed using:

```
library(devtools)
install_github("GCD",username="paleofire",ref="master")
```

Author(s)

O. Blarquez

Examples

```
checkGCDversion()
```

`coast` *coast*

Description

World coastlines

Usage

```
data(coast)
```

Format

A data frame with 9865 observations on the following 2 variables.

`Y` Latitude

`X` Longitude

Source

http://www.naturalearthdata.com/downloads/10m-physical-vectors/

Examples

```
data(coast)
```

pfAddData *Add user defined charcoal data series to paleofire*

Description

This function is used to create a "pfAddData" object, from user defined csv files containing charcoal data, to be passed to pfTransform. Usually csv files should contain three columns with Depth, Age, Charcoal quantity in this same order. A metadata csv file should also be specified with sites location information (three columns with: SITE_NAME, LATITUDE, LONGITUDE). CharAnalysis data files could also be used, in this case the file must include the following informations: DepthTop, DepthBottom, AgeTop, AgeBottom, Volume and Charcoal value in this exact order. Then the files are passed to the pretreatment function in order to calculate Charcoal Accumulation Rates (see pretreatment for details).

Usage

```
pfAddData(files, metadata, type = "NONE", Int = TRUE, first =
                NULL, last = NULL, yrInterp = NULL)
```

Arguments

files	Character, names and path to csv files.
metadata	Character, names and path to metadata csv file.
type	Character, "NONE": user defined csv (default), "CharAnalysis": CharAnalysis data file.
Int	Logical specifying whether the pretreatment function interpolates particle zero counts, default TRUE.
first,last	Numeric, date of the first, last sample for accumulation rate calculation, if NULL first, last are automatically specified as the the minimum and maximum ages of the record respectively.
yrInterp	Numeric, temporal resolution of the interpolated accumulation rates, if NULL, yrInterp is automatically specified as the median resolution of the record.

Value

out	A list with merged data files that can be passed to pfTransform

Author(s)

O. Blarquez

See Also

pretreatment

Examples

```
## Ad user own data from CharAnalysis file (csv)
## In this example we will use data from:
# Senici, D., A. Lucas, H. Y. H. Chen, Y. Bergeron, A. Larouche, B. Brossier, O.
#Blarquez, and A. A. Ali. 2013. Multi-millennial fire frequency and tree abundance
#differ between xeric and mesic boreal forests in central Canada. Journal of Ecology:
#101, 356-367.

files=c("http://blarquez.com/public/data//Ben.csv",
        "http://blarquez.com/public/data/Small.csv")
metadata=c("http://blarquez.com/public/data/metadata.csv")

mydata=pfAddData(files=files,metadata=metadata,type="CharAnalysis")

## GCD sites selection
ID=pfSiteSel(Latlim=c(30,70),Longlim=c(-100,-50))

## Transform and compositing:
TR1=pfTransform(ID,add=mydata,method=c("MinMax","Box-Cox","Z-Score"),
BasePeriod=c(200,2000))
COMP2=pfCompositeLF(TR1, tarAge=seq(-50,12000,20), hw=500, nboot=100)
plot(COMP2)
```

---

pfBoxCox *Box-Cox transformation of Charcoal series*

Description

Box-Cox transformation of charcoal series, the maximum likelihood estimation of lambda is derived from the boxcox.R function in the Venables and Ripley MASS library included in R 2.6.1

Usage

```
pfBoxCox(serie, alpha = 0.01, type = "BoxCox1964")
```

Arguments

serie	A vector of charcoal values.
alpha	Numeric, the "shift" parameter, default=0.01.
type	Character, the Box-Cox transformation formulation, can be either "BoxCox1964" (default) for the original Box & Cox (1964) formulation, or "JohnDraper" for the John & Draper (1980) modulus transformation.

Value

X	Vector of transformed charcoal values

Author(s)

P. Bartlein

References

Venables, W. N., Ripley, B. D., & Venables, W. N. (1994). Modern applied statistics with S-PLUS (Vol. 250). New York: Springer-verlag.

Box, G.E.P. & Cox, D. R.(1964) An analysis of transformations, Journal of the Royal Statistical Society, Series B, 26, 211-252.

John, J. A. & Draper N. R. (1980) Analternative family of transformations, Applied Statistics, 29, 190-197.

See Also

pfTransform

Examples

```
# Select a site
ID=pfSiteSel(SiteName="Pas-de-Fond")

# Extract data
A=pfExtract(ID)

B=pfBoxCox(A[,4],0.1)
plot(B,type="l")
```

`pfCircular` *Circular block bootstrap procedure applied to charcoal records compositing results*

Description

Block bootstrap has been proposed to test the significances of changes in stationary time series (Kunsch 1989). This procedure consists of splitting each charcoal series into n-b+1 overlapping blocks of data, where n is sample size and b the block size. These blocks are used to reconstruct resampled individual charcoal series that are in turn used to estimate the confidence intervals around the charcoal series composite mean.

Usage

```
pfCircular(comp,b=NULL,conf=c(0.05,0.95),nboot=1000,AgeLim=NULL)
```

Arguments

`comp`	A "pfComposite" object
`b`	A numeric giving block size, if NULL the optimal block size for a given series is given by: b= 2x(-1 /log(p)), where p is the lag one autocorrelation coefficient of that series (Adams, Mann & Ammann 2003).
`conf`	Numeric, calculated confidence intervals.
`nboot`	Numeric, number of bootstrap replicates.
`AgeLim`	Numeric, years defining a period to restrict the analysis to.

Value

out	A "pfCircular" object with estimated confidence intervals.

Author(s)

O. Blarquez

References

Kunsch, H. R. 1989. The jackknife and the bootstrap for general stationary observation s. The Annals of Statistics 17:1217-1241.

Adams, J. B., M. E. Mann, and C. M. Ammann. 2003. Proxy evidence for an El Nino-like response to volcanic forcing. Nature 426:274-278.

Examples

```
ID=pfSiteSel(Latlim=c(30,70),Longlim=c(-100,-50))
TR1=pfTransform(ID, method=c("MinMax","Box-Cox","Z-Score"),BasePeriod=c(200,2000))

## Circular block bootstrapp

COMP=pfComposite(TR1, binning=TRUE, bins=seq(0,2000,100))
circ=pfCircular(COMP,b=3,conf=c(0.005,0.025,0.975,0.995),nboot=100)
plot(circ)
```

---

pfComposite *Produce a composite serie from multiple charcoal records*

Description

Produce a composite serie from multiple charcoal records using bootstrap resampling, the sites charcoal values are binned and the mean in each bin is calculated prior the bootstrap procedure. This procedure is equivalent to Power et al. 2008.

Usage

```
pfComposite(TR, bins = NULL, nboot = 1000, binning = TRUE, conf =
                 c(0.05, 0.95))
```

Arguments

TR	An object returned by pfTransform
bins	Numeric, the sequence for binning given in years (e.g. bins=seq(from=0,to=10000,by=200)). If unspecified the sequence is defined as bins=seq(from=min age, to=max age, by=median resolution).
nboot	Numeric, a number specifying the number of bootstrap replicates.
binning	Logical, set to TRUE (default) for binning, if transformed data are first interpolated this argument can be set to FALSE (no binning).
conf	Numeric, define confidence levels.

Value

out	A "pfComsposite" object.

Author(s)

O.Blarquez

References

Power, M., J. Marlon, N. Ortiz, P. Bartlein, S. Harrison, F. Mayle, A. Ballouche, R. Bradshaw, C. Carcaillet, C. Cordova, S. Mooney, P. Moreno, I. Prentice, K. Thonicke, W. Tinner, C. Whitlock, Y. Zhang, Y. Zhao, A. Ali, R. Anderson, R. Beer, H. Behling, C. Briles, K. Brown, A. Brunelle, M. Bush, P. Camill, G. Chu, J. Clark, D. Colombaroli, S. Connor, A. L. Daniau, M. Daniels, J. Dodson, E. Doughty, M. Edwards, W. Finsinger, D. Foster, J. Frechette, M. J. Gaillard, D. Gavin, E. Gobet, S. Haberle, D. Hallett, P. Higuera, G. Hope, S. Horn, J. Inoue, P. Kaltenrieder, L. Kennedy, Z. Kong, C. Larsen, C. Long, J. Lynch, E. Lynch, M. McGlone, S. Meeks, S. Mensing, G. Meyer, T. Minckley, J. Mohr, D. Nelson, J. New, R. Newnham, R. Noti, W. Oswald, J. Pierce, P. Richard, C. Rowe, M. Sanchez Goni, B. Shuman, H. Takahara, J. Toney, C. Turney, D. Urrego-Sanchez, C. Umbanhowar, M. Vandergoes, B. Vanniere, E. Vescovi, M. Walsh, X. Wang, N. Williams, J. Wilmshurst, and J. Zhang. 2008. Changes in fire regimes since the Last Glacial Maximum: an assessment based on a global synthesis and analysis of charcoal data. Climate Dynamics 30:887-907.

Examples

```
## Composite charcoal record for North America:
ID=pfSiteSel(Region=c("ENA0","WNA0"))

## Transform data
res3=pfTransform(ID,method=c("MinMax","Box-Cox","Z-Score"),BasePeriod=c(200,4000),Interpolate=FALSE)

## Composite
comp=pfComposite(res3,bins=seq(0,20000,200))
plot(comp)
```

---

pfCompositeLF — *Produce a composite serie from multiple charcoal records using a local regression procedure (from the locfit package)*

Description

Produce a composite serie from multiple charcoal local fits produced using the locfit procedure on bootstraped series subsamples, the sites charcoal values are prebinned prior to sites resampling. This procedure is equivalent to Daniau et al. (2012).

Usage

```
pfCompositeLF(TR,hw=250,tarAge=NULL,binhw=NULL,nboot=1000,conf=c(0.05,0.95),
                        pseudodata=FALSE)
```

Arguments

TR	An object returned by pfTransform
tarAge	Numeric, the target ages for prebinning given in years (e.g. tarAge=seq(0,10000,20)). If unspecified the sequence is defined as tarAge=seq(from=min age, to=max Age, by=median resolution).
binhw	Numeric, bin half width for the prebinning procedure (use the same value as tarAge intervals for overlapping bins or tarAge intervals/2 for non-overlapping bins).
nboot	Numeric, a number specifying the number of bootstrap replicates.
hw	Numeric, the half window width for the locfit procedure (in years).
conf	Numeric, define confidence levels.
pseudodata	Logical, if TRUE 10 percent of the data is reflected at the top and the bottom of the resampled serie prior of each locfit regression in order to correct for the edge effect introduced by the local regression, see Cowling & Hall (1996). Equivalent to "minimum slope" correction in Mann(2004).

Value

out	A "pfCompositeLF" object.

Author(s)

O.Blarquez

References

Daniau, A. L., P. J. Bartlein, S. P. Harrison, I. C. Prentice, S. Brewer, P. Friedlingstein, T. I. Harrison-Prentice, J. Inoue, K. Izumi, J. R. Marlon, S. Mooney, M. J. Power, J. Stevenson, W. Tinner, Andri, M., J. Atanassova, H. Behling, M. Black, O. Blarquez, K. J. Brown, C. Carcaillet, E. A. Colhoun, D. Colombaroli, B. A. S. Davis, D. D'Costa, J. Dodson, L. Dupont, Z. Eshetu, D. G. Gavin, A. Genries, S. Haberle, D. J. Hallett, G. Hope, S. P. Horn, T. G. Kassa, F. Katamura, L. M. Kennedy, P. Kershaw, S. Krivonogov, C. Long, D. Magri, E. Marinova, G. M. McKenzie, P. I. Moreno, P. Moss, F. H. Neumann, E. Norstrom, C. Paitre, D. Rius, N. Roberts, G. S. Robinson, N. Sasaki, L. Scott, H. Takahara, V. Terwilliger, F. Thevenon, R. Turner, V. G. Valsecchi, B. Vanniere, M. Walsh, N. Williams, and Y. Zhang. 2012. Predictability of biomass burning in response to climate changes. Global Biogeochem. Cycles 26:GB4007.

Cowling A, Hall P (1996) On pseudodata methods for removing boundary effects in kernel density estimation. Journal of the Royal Statistical Society, Series B 58(3): 551-563.

Mann, M. E. (2004). On smoothing potentially non-stationary climate time series. Geophysical Research Letters, 31(7).

Examples

```
ID=pfSiteSel(Latlim=c(30,70),Longlim=c(-100,-50))

TR=pfTransform(ID, method=c("MinMax","Box-Cox","MinMax","Z-Score"),
BasePeriod=c(200,2000),QuantType="INFL")

COMP1=pfCompositeLF(TR, tarAge=seq(-50,2000,10), hw=200, nboot=100)
COMP2=pfCompositeLF(TR, tarAge=seq(-50,2000,10), hw=200, nboot=100, pseudodata=TRUE)
```

```
dev.off()
par(mfrow=c(2,1))
plot(COMP1)
plot(COMP2)
## Note: comparing confidence intervals based on 100 replicates is not recommended
# (100 is used to decrease analysis time)
```

`pfDiagnostic` *Print diagnostic pdf for individual transformed series*

Description

Print diagnostic pdf for individual transformed series, successive transformations could be specified (see example)

Usage

```
pfDiagnostic(IDn, add = NULL, Age = 0, Interpolate = FALSE, method
                 = "Box-Cox", BasePeriod = c(-100, 1e+09), span = 0.3,
                 RunWidth = 500, RunQParam = 0.5, stlYears = 500, alpha
                 = 0.01, type = "BoxCox1964", FileName =
                 "Diagnostic.pdf", QuantType = "ALL")
```

Arguments

`IDn`	An object returned by `pfSiteSel` or `pfTransform`
`add`	An object returned by `pfAddData`
`Interpolate`	Logical, indicates wether data should be interpolated or not, default=FALSE
`Age`	Numeric, if Interpolate=TRUE, Age is used to specified the ages where the interpolation took place, If Age=0 the interpolated ages are automatically specified using the median resolution of the record(s) If Age is specified as a vector (e.g. Age=(from=0,to=10000, by=10)) the interpolation took place at specified ages
`method`	A character indicating the transformation method: "Z-Score", Z-Score, "LOESS", Locally weighted regression, "SmoothSpline", Smoothing spline, "Box-Cox", Box-Cox transformation, "MinMax", Minimax transformation, "RunMed", Running median, "RunMean", Running mean, "RunQuantile", Running quantile, "RunMin", Running min, "RunMax", Running max, "stl", Decompose a time series into seasonal, trend and irregular components using loess, based on `stl` function.
`BasePeriod`	Numeric, a parameter specifying the base period for calculating Z-score given in years BP (e.g. BasePeriod=c(0, 4000)), if empty or unspecified the base period corresponds to record length.
`span`	Numeric, the span parameter for the LOESS or Smoothing spline methods
`RunWidth`	Numeric, the width of the window for the"RunMed", "RunMean", "RunQuantile", "RunMin", and "RunMax" methods in years.
`RunQParam`	Numeric, the parameter specifying which quantile should be calculated for the method "RunQuantile" (default=0.5 i.e. median).
`stlYears`	Numeric, the bandwith for stl decomposition, default=500 years.

alpha	Numeric, alpha value to add before BoxCox calculation, see pfBoxCox.
type	Character, the type of Box-Cox transformation, see pfBoxCox for details
FileName	Character, define output pdf file name e.g. FileName="mydata.pdf"
QuantType	Character, by default QuantType="INFL" and influx are automatically calculated, otherwise use QuantType="NONE" (not recommended).

Value

Filename.pdf	A diagnostic file is printed, each sites being printed on separate pages (specified using FileName="myfile.pdf"")

Author(s)

O. Blarquez

Examples

```
# Select boreal sites from Levavasseur 2012 PNV
ID=pfSiteSel(L12=1)

# Print a diagnostic pdf for Box-Cox, Smoothed and Z-score tranformed data
# (base period = 200-2000 BP)
pfDiagnostic(ID,method=c("Box-Cox", "SmoothSpline","Z-Score"),
             span=0.3,BasePeriod=c(200,4000))
```

---

pfExtract *Extract charcoal data for a list of sites*

Description

Extract charcoal data from an IDn object obtained by pfSiteSel

Usage

```
pfExtract(IDn)
```

Arguments

IDn	An object returned by pfSiteSel.

Value

out	A matrix of charcoal data with the following structure: out[,1]=Site identifiers, out[,2]=Depths, out[,3]=Estimated ages, out[,4]=Charcoal data.

Author(s)

O. Blarquez

Examples

```
## Retrieve a site
ID=pfSiteSel(SiteName="Pas-de-Fond")
## Or a group of sites (Western North America)
ID=pfSiteSel(Region=c("WNA0"))

## Extract data
A=pfExtract(ID)

# Plot the first site raw charcoal data
plot(A[A[,1]==ID$SitesIDS[1],3],A[A[,1]==ID$SitesIDS[1],4],type="l",main=ID$SiteNames[1],
     xlab="Age",ylab="raw Char")
```

`pfInteractive` *GCD sites interactive selection*

Description

Interactive selection of GCD sites by drawing a polygon on a map.

Usage

```
pfInteractive(addata=NULL)
```

Arguments

`addata`	An optional XY matrix of coordinates to specify a polygon to be drawn on the map.

Value

An object of the class "pfSiteSel".

Author(s)

O. Blarquez

See Also

`pfSiteSel`

Examples

```
## Type
#ID=pfInteractive()
## And follow text instructions
```

pfMinMax *MiniMax transformation of a charcoal serie*

Description

MiniMax transformation of a charcoal serie

Usage

```
pfMinMax(serie)
```

Arguments

serie	Numeric, a vector of charcoal values.

Value

out	A vector of minimax transformed values.

Author(s)

O. Blarquez

See Also

pfTransform

Examples

```
## Retrieve a site
ID=pfSiteSel(SiteName="Pas-de-Fond")
## Or a group of sites (Western North America)
ID=pfSiteSel(Region=c("WNA0"))

## Extract data
A=pfExtract(ID)

## Plot the first site raw charcoal data
par(mfrow=c(1,2))
plot(A[A[,1]==ID$SitesIDS[1],3],A[A[,1]==ID$SitesIDS[1],4],type="l",main=ID$SiteNames[1],
     xlab="Age",ylab="raw Char")
## Minimax transformation
B=pfMinMax(A[A[,1]==ID$SitesIDS[1],4])
## Plot the first site Minimax transformed charcoal data
par(mfrow=c(1,2))
plot(A[A[,1]==ID$SitesIDS[1],3],B,type="l",main=ID$SiteNames[1],
     xlab="Age",ylab="Minimax")
```

pfResolution *Calculates age resolution indicators for charcoal records*

Description

Calculates age resolution indicators for charcoal records selected using pfSiteSel or pfInteractive functions.

Usage

```
pfResolution(ID, AgeLim = NULL)
```

Arguments

ID	An object of the class "pfSiteSel"
AgeLim	Numeric, defines age limits for age resolution calculations (e.g. AgeLim=c(-50,6000))

Value

data.frame	A data frame with the following informations: ID_SITE, SITE_NAME, Median Resolution of the record, Mean Resolution and Standard seviation

Author(s)

O. Blarquez

Examples

```
ID1=pfSiteSel(Latlim=c(45,90), Longlim=c(-100,-50))
Res=pfResolution(ID1,AgeLim=c(-50,8000))
head(Res)
```

pfSiteSel *GCD sites selection methods*

Description

Main function used for site selection, uses data strored in data(paleofiresites) to perform site selection according to multiple criterion, those criterions could be either geographic, based on series attributes (e.g. # of datings), or on sites attributes (e.g. biome).

Usage

```
pfSiteSel(ID = NULL, Latlim = c(-360, 360), Longlim = c(-360,
                  360), Biome = NULL, DateInt = NULL, Country = NULL,
                  Region = NULL, SiteName = NULL, PrefUnit = NULL,
                  Elevation = c(-1e+05, 1e+05), QuantType = NULL, L12=NULL, RF99=NULL)
```

Arguments

ID	Numeric, specify sites identifiers if known (ID_SITE in paleofiresites).
Latlim	Numeric, a vector specifying the latitudes limits.
Longlim	Numeric, a vector specifying the longitudes limits.
Biome	Numeric, a vector specifying the biome in which the sites should be located.
DateInt	Numeric, the mean dating interval (see example below).
Country	Factor, country code.
Region	Factor, region code.
SiteName	Character, the sites names.
PrefUnit	Factor, charcoal units.
Elevation	Numeric, a vector specifying sites elevations limits.
QuantType	Character, define the quantity type measure e.g. QuantType="INFL" for influx.
RF99	Numeric, Potential Natural Vegetation following Ramankutty and Foley (1999), see ?paleofiresites for details.
L12	Numeric, Potential Natural Vegetation following Levavasseur et al. (2012), see ?paleofiresites for details.

Details

The criterion values could be inspected by accessing data(paleofiresites) in GCD package.

Value

An object of the class pfSiteSel

Author(s)

O. Blarquez

See Also

paleofiresites

Examples

```
## Sites selection examples

## Select all sites
ID=pfSiteSel()

## Site in the Biome #8
ID=pfSiteSel(Biome=8)

## Sites in North America by geographic location
ID=pfSiteSel(Latlim=c(25,75),Longlim=c(-150,-45))
## By region criterion
ID=pfSiteSel(Region=c("ENA0","WNA0"))

## Pas-de-Fond site
ID=pfSiteSel(SiteName="Pas-de-Fond")
```

```
## Sites with on average one dating point every 250 yrs
ID=pfSiteSel(DateInt=250)

## Sites between 0, 100 m elevation in Asia
ID=pfSiteSel(Elevation=c(0,100),Region="ASIA")

## Explore individual criterions
data(paleofiresites)
unique(paleofiresites$ID_REGION)
```

`pfTransform` *Transform charcoal data for unique to multiple series*

Description

Charcoal data transformation, background estimation and homogenization for unique to multiple series, accepts objects returned by `pfSiteSel`.

Usage

```
pfTransform(IDn, add = NULL, Interpolate = FALSE, Age = 0, method
                 = "Z-Score", BasePeriod = c(-100, 1e+09), span = 0.3,
                 RunWidth = 500, RunQParam = 0.5, stlYears = 500, type
                 = "BoxCox1964", alpha = 0.01, QuantType = "ALL")
```

Arguments

`IDn`	An object returned by `pfSiteSel` or `pfTransform`
`add`	An object returned by `pfAddData`
`Interpolate`	Logical, idicates wether data should be interpolated or not
`Age`	Numeric, If Interpolate=TRUE, Age is used to specified the ages where the interpolation took place, If Age=0 the interpolated ages are automatically specified using the median resolution of the record(s) If Age is specified as a vector (e.g. Age=(from=0,to=10000, by=10)) the interpolation took place at specified ages
`method`	A character indicating the transformation method: "Z-Score", Z-Score, "LOESS", Locally weighted regression, "SmoothSpline", Smoothing spline, "Box-Cox", Box-Cox transformation, "MinMax", Minimax transformation, "RunMed", Running median, "RunMean", Running mean, "RunQuantile", Running quantile, "RunMin", Running min, "RunMax", Running max, "stl", Decompose a time series into seasonal, trend and irregular components using loess, based on `stl` function.
`BasePeriod`	Numeric, a parameter specifying the base period for calculating Z-score given in years BP (e.g. BasePeriod=c(0, 4000)), if empty or unspecified the base period corresponds to record length.
`span`	Numeric, the span parameter for the LOESS or Smoothing spline methods
`RunWidth`	Numeric, the width of the window for the"RunMed", "RunMean", "RunQuantile", "RunMin", and "RunMax" methods in years.

RunQParam	Numeric, the parameter specifying which quantile should be calculated for the method "RunQuantile" (default=0.5 i.e. median).
stlYears	Numeric, the bandwith for stl decomposition, default=500 years.
alpha	Numeric, alpha value to add before BoxCox calculation, see pfBoxCox.
type	Character, the type of Box-Cox transformation, see pfBoxCox for details.
QuantType	Character, by default QuantType="INFL" and influx are automatically calculated, otherwise use QuantType="NONE" (not recommended).

Value

An object of the class "pfTransform".

Author(s)

O. Blarquez

Examples

```
## Select sites from the temperate deciduous/broadleaf forest
# (PNV 3 and 5 in Ramankutty and Foley 1999)
ID=pfSiteSel(RF99=c(3,5))

# Transform data sequentially using pfTransform function
tr=pfTransform(ID,method=c("MinMax","Box-Cox"))

## Plot transformed data for the first site
plot(tr$Age[,1],tr$TransData[,1],type="l")
```

---

plot.CHAR *Plot CHAR*

Description

Plot an object of the class "CHAR" returned by the pretreatment function. Original accumulation rates are presented using grey bars, accumulation rates interpolated at equal time steps are presented by a black curve.

Usage

```
## S3 method for class CHAR
plot(x,...)
```

Arguments

x	An object of the class "CHAR".
...	...

Author(s)

O. Blarquez

Examples

```
## In this example we will use the charcoal record of the Lac du Loup (Blarquez et al. 2010)
## Load raw charcoal data in mm^2
A=read.csv("http://blarquez.com/public/code/loupchar.csv")
C_=A[,6] # charcoal areas
P_=A[,1:5] # CmTop, CmBot, AgeTop, AgeBot, Volume


## Calculates charcoal accumulation rate (CHAR, mm2.cm-2.yr-1)
CHAR=pretreatment(params=P_,serie=C_,Int=TRUE)
plot(CHAR)
```

`plot.pfCircular` *plot.pfCircular*

Description

Plot circular block bootstrap percentiles.

Usage

```
## S3 method for class pfCircular
plot(x, ...)
```

Arguments

x	A "pfCircular" object.
...	...

Author(s)

O. Blarquez

Examples

```
ID=pfSiteSel(Latlim=c(30,70),Longlim=c(-100,-50))
TR1=pfTransform(ID, method=c("MinMax","Box-Cox","Z-Score"),BasePeriod=c(200,2000))
COMP=pfComposite(TR1, binning=TRUE, bins=seq(0,2000,100))
sea1=pfCircular(COMP,b=3,conf=c(0.005,0.025,0.975,0.995),nboot=100)
plot(sea1)
```

plot.pfComposite *plot.pfComposite*

Description

Plot a pfComposite object

Usage

```
## S3 method for class pfComposite
plot(x, type = "ci", conf = c(0.05, 0.95), palette = "jet",
                 add = "NONE", ...)
```

Arguments

x	A "pfComposite" object.
type	Character, type of plot among "ci", "prctile", "density"
conf	Numeric, confidence levels.
palette	Character, color palette used with type=c("prctile", "density") among "jet" and "BW".
add	Character, add="NONE" by default, add="sitenum" could be specified to plot the sites number in eah bin along with the composite curve.
...	...

Author(s)

O. Blarquez

Examples

```
ID=pfSiteSel(Latlim=c(30,70),Longlim=c(-100,-50))
TR1=pfTransform(ID, method=c("MinMax","Box-Cox","Z-Score"),BasePeriod=c(200,2000))
COMP=pfComposite(TR1, binning=TRUE, bins=seq(0,2000,20))
plot(COMP,type="density",smoothing=TRUE,spar=0.3)
```

plot.pfCompositeLF *plot.pfCompositeLF*

Description

Plot pfCompositeLF object

Usage

```
## S3 method for class pfCompositeLF
plot(x, type = "ci", conf = c(0.05, 0.95), palette = "jet",
                 ...)
```

Arguments

x	A "pfCompositeLF" object.
type	Character, type of plot among "ci", "prctile", "density"
conf	Numeric, confidence levels.
palette	Character, color palette used with type=c("prctile", "density") among "jet" and "BW".
...	...

Author(s)

O. Blarquez

Examples

```
ID=pfSiteSel(Latlim=c(30,70),Longlim=c(-100,-50))
TR1=pfTransform(ID, method=c("MinMax","Box-Cox","Z-Score"),BasePeriod=c(200,2000))
COMP2=pfCompositeLF(TR1, tarAge=seq(-50,12000,10), hw=500,nboot=100)
plot(COMP2)
```

---

plot.pfSiteSel *plot.pfSiteSel*

Description

Plot an object of the class "pfSiteSel"

Usage

```
## S3 method for class pfSiteSel
plot(x, type = "Map", zoom = "Sites", ...)
```

Arguments

x	An object of the class "pfSiteSel".
type	Character, type of plot among "Map" or "Chronology".
zoom	Character, zooming factor for type="Map": "Sites" or "World"
...	...

Author(s)

O. Blarquez

Examples

```
ID=pfSiteSel(ID=c(1,3,13,67))
plot(ID)
plot(ID,type="Chronology")
```

pretreatment *Calculate particules accumulation rates for sediment records*

Description

This is the R version of the CharAnalysis CharPretreatment.m function originally develloped by P. Higuera and available at https://sites.google.com/site/charanalysis

Usage

```
pretreatment(params, serie, Int = TRUE, first = NULL, last = NULL,
                yrInterp = NULL)
```

Arguments

serie	A proxy record to be transformed in accumulation rates, could be particule counts, surfaces, volumes, etc.
params	A matrix with the following colums: CmTop, CmBot, AgeTop, AgeBot, Volume, in the same order.
Int	Logical specifying whether the function interpolates particle zero counts, default TRUE
first,last	Date of the first, last sample for accumulation rate calculation, if NULL first, last are automatically specified as the the minimum and maximum ages of the record respectively
yrInterp	Temporal resolution of the interpolated accumulation rates, if NULL, yrInterp is automatically specified as the median resolution of the record

Value

Return an output structure with the following:

cmI	interpolated depths
ybpI	interpolated ages
accI	accumulation rates

Author(s)

O. Blarquez translated from P. Higuera CharPretreatment.m function

Examples

```
## In this example we will use the charcoal record of the Lac du Loup (Blarquez et al. 2010)
## Load raw charcoal data in mm^2
A=read.csv("http://blarquez.com/public/code/loupchar.csv")
C_=A[,6] # charcoal areas
P_=A[,1:5] # CmTop, CmBot, AgeTop, AgeBot, Volume


## Calculates charcoal accumulation rate (CHAR, mm2.cm-2.yr-1)
CHAR=pretreatment(params=P_,serie=C_,Int=TRUE)
#plot(CHAR)
```

summary.pfSiteSel *summary.pfSiteSel*

Description

Return a summary table for an object of the class "pfSiteSel"

Usage

```
## S3 method for class pfSiteSel
summary(object, ...)
```

Arguments

object	An object of the class "pfSiteSel".
...	...

Value

Returns the following informations: "ID_SITE", "LATITUDE", "LONGITUDE", "ELEV","MIN_EST_AGE", "MAX_EST_AGE", "NUM_DATING", "NUM_SAMP".

Author(s)

O. Blarquez

Examples

```
ID=pfSiteSel(ID=2)
summary(ID)
```

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