Package ‘GWEX’

December 9, 2019

Type Package
Date 2019-12-09
License GPL-3
Title Multi-Site Stochastic Models for Daily Precipitation and Temperature
Version 1.0.2
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Imports EnvStats, MASS, mvtnorm, nleqslv, fGarch, parallel, abind, foreach, doParallel, Renext, lmomco, methods, stats
Description Application of multi-site models for daily precipitation and temperature data. This package is designed for an application to 105 precipitation and 26 temperature gauges located in Switzerland. It applies fitting procedures and provides weather generators described in the following references:
Depends R (>= 2.10)
Encoding UTF-8
LazyData true
RoxygenNote 6.1.1
NeedsCompilation yes
Repository CRAN
Date/Publication 2019-12-09 11:40:03 UTC

R topics documented:

dailyPrecipGWEX ................................................................. 2
dailyTemperGWEX ............................................................. 3
fitGwexModel ................................................................. 3
Gwex-class .................................................................... 5
GwexFit-class ................................................................. 6
dailyPrecipGWEX

Description

Example of daily observations of precipitation (mm) for three fictive stations, for a period of ten years.

Usage

data(dailyPrecipGWEX)

Format

matrix of Observed precipitation: 3652 days x 3 stations

Author(s)

Guillaume Evin <guillaume.evin@irstea.fr>

References

**dailyTemperGWEX**

*daily observations of temperature data*

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**Description**

Example of daily observations of temperature (mm) for three fictive stations, for a period of ten years.

**Usage**

```r
data(dailyTemperGWEX)
```

**Format**

matrix of Observed temperature: 3652 days x 3 stations

**Author(s)**

Guillaume Evin &lt;guillaume.evin@irstea.fr&gt;

**References**


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**fitGwexModel**

*fitGwexModel: fit a GWex model to observations.*

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**Description**

fitGwexModel: fit a GWex model to observations.

**Usage**

```r
fitGwexModel(objGwexObs, listOption = NULL)
```

**Arguments**

```r
objGwexObs   an object of class GwexObs
listOption   for precipitation, a list with the following fields:
             • th: threshold value in mm above which precipitation observations are con-
                 sidered to be non-zero (=0.2 by default)
             • nLag: order of the Markov chain for the transitions between dry and wet
                 states (=2 by default)
```
• **typeMargin**: 'EGPD' (Extended GPD) or 'mixExp' (Mixture of Exponentials). 'EGPD' by default
• **xiHat**: pre-determined values for the xi parameters of the EGPD distribution on precipitation amounts
• **copulaInt**: 'Gaussian' or 'Student': type of dependence for amounts (= 'Student' by default)
• **isMAR**: logical value, do we apply a Autoregressive Multivariate Autoregressive model (order 1) =TRUE by default
• **is3Damount**: logical value, do we apply the model on 3D-amount. =FALSE by default
• **nChainFit**: integer, length of the runs which are generated during the fitting procedure. =100000 by default
• **nCluster**: integer, number of clusters which can be used for the parallel computation

and for temperature, a list with the following fields:
• **hasTrend**: logical value, do we fit a linear trend for the long-term change, =FALSE by default
• **objGwexPrec**: object of class GwexObs containing precipitation observations. If provided, we assume that temperature must be modelled and simulated according to the precipitation states 'dry' and 'wet'. For each state, a seasonal cycle is fitted (mean and sd).
• **typeMargin**: 'SGED' (default) or 'Gaussian': type of marginal distribution.
• **depStation**: 'MAR1' (default) or 'Gaussian': MAR1 (Multivariate Autoregressive model order 1) for the spatial and temporal dependence or 'Gaussian' for the spatial dependence only.

**Value**

Return an object of class GwexFit with:

• **p**: The number of station,
• **version**: package version,
• **variable**: the type of variable,
• **fit**: a list containing the list of options listOption and the list of estimated parameters listPar.

**Author(s)**

Guillaume Evin

**Examples**

# Format dates corresponding to daily observations of precipitation and temperature
defects = seq(from=as.Date("01/01/2005",format="%d/%m/%Y"),
to=as.Date("31/12/2014",format="%d/%m/%Y"),by='day')
# FIT THE PRECIPITATION MODEL

# Format observations: create a G-Wex object
myObsPrec = GwexObs(variable='Prec', date=vecDates, obs=dailyPrecipGWEX[,1:2])

# Example of a data.frame which can be used for 'xiHat'. For each month, xi values
can be prescribed, for example using a regionalisation method.
xireg = data.frame(station=c('S1', 'S2', 'S3'),
                   JAN=c(0, 0, 0.06), FEB=c(0, 0, 0.06),
                   MAR=c(0, 0.01, 0.01), APR=c(0, 0.01, 0.01),
                   MAY=c(0, 0.01, 0.01), JUN=c(0, 0.01, 0.14),
                   JUL=c(0, 0.01, 0.14), AUG=c(0, 0.01, 0.14),
                   SEP=c(0, 0, 0.02), OCT=c(0, 0, 0.02), NOV=c(0, 0, 0.02),
                   DEC=c(0, 0, 0.06))

# Options: specify the threshold for precipitation (0.5 mm) to distinguish wet and
dry states (th), xi values for the DGPD distribution (xiHat), a Student copula for
the spatial dependence (copulaInt), a model based on 3-day aggregated values
(is3Damount), a MAR(1) process (isMAR), a EGPD distribution for marginal intensities
(typeMargin), and 200 replicates for the runs used during the fitting process
(this value being 100,000 by default, in order to obtain a reasonable precision of the
estimates)
list.options = list(th=0.5, nLag=1, xiHat=xiReg, copulaInt='Student', is3Damount=TRUE, isMAR=TRUE,
typeMargin='EGPD', nChainFit=200)

# Fit precipitation model
myParPrec = fitGwexModel(myObsPrec, list.options) # fit model
myParPrec # print object

# FIT THE TEMPERATURE MODEL, COND. TO PRECIPITATION

# Format observations: create a G-Wex object
myObsTemp = GwexObs(variable='Temp', date=vecDates, obs=dailyTemperGWEX)

# Fit temperature model with a long-term linear trend ('hasTrend'), Gaussian margins
# ('typeMargin') and Gaussian spatial dependence ('depStation')
myParTemp = fitGwexModel(myObsTemp, listOption=list(hasTrend=TRUE, typeMargin='Gaussian',
depStation='Gaussian'))

myParTemp # print object

---

**Gwex-class**

**Class Gwex**

**Description**

Defines a generic Gwex object. GWex objects contain two slots: - the version ('vX.X.X') - the type of variable ('Prec' or 'Temp')
Author(s)

Guillaume Evin

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GwexFit-class  

Class GwexFit

Description

Defines a GwexFit object which is a Gwex object containing 'fit', a list containing the fitted parameters, and 'p', the number of stations. See fitGwexModel for some examples.

Author(s)

Guillaume Evin

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GwexObs  

Constructor

Description

Constructor of class [GwexObs]

Usage

GwexObs(variable, date, obs)

Arguments

variable  

'Prec' or 'Temp'

date  

vector of class 'Date'

obs  

matrix nTime x nStations of observations

Value

An object of class [GwexObs]
**Examples**

# Format dates corresponding to daily observations of precipitation and temperature
vecDates = seq(from=as.Date("01/01/2005",format="%d/%m/%Y"),
          to=as.Date("31/12/2014",format="%d/%m/%Y"),by='day')

# build GwexObs object with precipitation data
myObsPrec = GwexObs(variable='Prec',date=vecDates,obs=dailyPrecipGWEX)

# print GwexObs object
myObsPrec

# build GwexObs object with temperature data
myObsTemp = GwexObs(variable='Temp',date=vecDates,obs=dailyTemperGWEX)

# print GwexObs object
myObsTemp

---

**Description**

Defines a `GwexObs` object which is a `Gwex` object containing dates and a matrix of observations.

**Author(s)**

Guillaume Evin

**Examples**

# Format dates corresponding to daily observations of precipitation and temperature
vecDates = seq(from=as.Date("01/01/2005",format="%d/%m/%Y"),
          to=as.Date("31/12/2014",format="%d/%m/%Y"),by='day')

# build GwexObs object with precipitation data
myObsPrec = GwexObs(variable='Prec',date=vecDates,obs=dailyPrecipGWEX)

# print GwexObs object
myObsPrec

# build GwexObs object with temperature data
myObsTemp = GwexObs(variable='Temp',date=vecDates,obs=dailyTemperGWEX)

# print GwexObs object
myObsTemp
### GwexSim-class

*Description*

Defines a `GwexSim` object which is a `Gwex` object containing 'sim', an array containing the simulations, and 'dates', a vector of dates. See `simGwexModel` for some examples.

### myParPrecGWEX

*Description*

Example of a object return by `fit.GWex.prec` when a GWEX model for precipitation data is fitted

*Usage*

```r
data(myParPrecGWEX)
```

*Format*

object of class `GwexFit`

*Author(s)*

Guillaume Evin <guillaume.evin@irstea.fr>

*References*

myParTempGWEX

myParTempGWEX fitted object of a temperature GWEX model

Description
Example of a object return by fit.GWex.temp when a GWEX model for temperature data is fitted

Usage
data(myParTempGWEX)

Format
object of class GwexFit

Author(s)
Guillaume Evin <guillaume.evin@irstea.fr>

References

print,Gwex-method print-methods: Create a method to print Gwex objects.

Description
print-methods: Create a method to print Gwex objects.

Usage
## S4 method for signature 'Gwex'
print(x)

## S4 method for signature 'GwexObs'
print(x)

## S4 method for signature 'GwexFit'
print(x)

## S4 method for signature 'GwexSim'
print(x)
Arguments

x  

Gwex object

Examples

# Format dates corresponding to daily observations of precipitation and temperature
vecDates = seq(from=as.Date("01/01/2005",format="%d/%m/%Y"),
to=as.Date("31/12/2014",format="%d/%m/%Y"),by="day")

# build GwexObs object with temperature data
myObsTemp = GwexObs(variable='Temp',date=vecDates,obs=dailyTemperGWEX)

# print GwexObs object
myObsTemp

# print GwexFit object
myParPrecGWEX

show,Gwex-method  show-methods: Create a method to show Gwex objects.

Description

show-methods: Create a method to show Gwex objects.

Usage

## S4 method for signature 'Gwex'
show(object)

## S4 method for signature 'GwexObs'
show(object)

## S4 method for signature 'GwexFit'
show(object)

## S4 method for signature 'GwexSim'
show(object)

Arguments

object  

Gwex object
Examples

# Format dates corresponding to daily observations of precipitation and temperature
vecDates = seq(from=as.Date("01/01/2005",format="%d/%m/%Y"),
to=as.Date("31/12/2014",format="%d/%m/%Y"),by='day')

# build GwexObs object with temperature data
myObsTemp = GwexObs(variable='Temp',date=vecDates,obs=dailyTemperGWEX)

# show GwexObs object
myObsTemp

# show GwexFit object
myParPrecGWEX

Description

Simulate from a GWex model

Usage

simGwexModel(objGwexFit, nb.rep = 10, d.start = as.Date("01011900", ",%d%m%Y"), d.end = as.Date("31121999", "%d%m%Y"),
objGwexObs = NULL, prob.class = c(0.5, 0.75, 0.9, 0.99),
objGwexSim = NULL, nCluster = 1)

Arguments

objGwexFit an object of class GwexFit
nb.rep number of repetitions of scenarios
d.start a starting date for the simulation
d.end an ending date for the simulation
objGwexObs optional: an object of class GwexObs if we need the observations to simulate (disaggregation prec 3D -> 1D)
prob.class vector of probabilities indicating class of "similar" mean intensities
objGwexSim optional: an object of class GwexSim if we need simulations to simulate (temp conditional to prec)
nCluster optional, number of clusters which can be used for the parallel computation

Value

GwexSim an object of class GwexSim. Contains sim (3D-array with the simulations) and a vector of dates
### Examples

```r
# vector of dates
vecDates = seq(from=as.Date("01/01/2005",format="%d/%m/%Y"),
to=as.Date("31/12/2014",format="%d/%m/%Y"),by='day')

# FIT AND SIMULATE FROM THE PRECIPITATION MODEL
myObsPrec = GwexObs(variable="Prec",date=vecDates,obs=dailyPrecipGWEX[,1:2])

# default options except for 'nChainFit'
list.options = list(nChainFit=1000)

# generate 2 scenarios for one year, using a existing 'GwexFit' object
mySimPrec = simGwexModel(objGwexFit=myParPrecGWEX, nb.rep=2, d.start=vecDates[1],
d.end=vecDates[365])
mySimPrec # print object

# FIT AND SIMULATE FROM THE TEMPERATURE MODEL, COND. TO PRECIPITATION
myObsTemp = GwexObs(variable="Temp",date=vecDates,obs=dailyTemperGWEX)

# generate 2 scenarios for one year, using a existing 'GwexFit' object
mySimTemp = simGwexModel(objGwexFit=myParTempGWEX, nb.rep=2, d.start=vecDates[1],
d.end=vecDates[365])
mySimTemp # print object
```
Index

*Topic datasets
  dailyPrecipGWEX, 2
  dailyTemperGWEX, 3
  myParPrecGWEX, 8
  myParTempGWEX, 9

dailyPrecipGWEX, 2
dailyTemperGWEX, 3

fitGwexModel, 3, 6

Gwex, 5–8, 10
Gwex-class, 5
GwexFit, 4, 6, 8, 9, 11
GwexFit-class, 6
GwexObs, 3, 4, 6, 6, 7, 11
GwexObs-class, 7
GwexSim, 8, 11
GwexSim-class, 8

myParPrecGWEX, 8
myParTempGWEX, 9

print,Gwex-method, 9
print,GwexFit-method
  (print,Gwex-method), 9
print,GwexObs-method
  (print,Gwex-method), 9
print,GwexSim-method
  (print,Gwex-method), 9

show,Gwex-method, 10
show,GwexFit-method (show,Gwex-method), 10
show,GwexObs-method (show,Gwex-method), 10
show,GwexSim-method (show,Gwex-method), 10
simGwexModel, 8, 11