

Package ‘synoptReg’

March 18, 2019

Type Package

Title Synoptic Climate Classification and Spatial Regionalization of Environmental Data

Version 0.2.2

Depends R (>= 2.10)

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Description Computes a synoptic climate classification through daily reanalysis data and creates a climate or environmental regionalization based on the previous synoptic climate classification.

License GPL (>= 3)

Encoding UTF-8

LazyData true

Imports ncdf4, zoo, raster

NeedsCompilation no

RoxygenNote 6.1.0

Repository CRAN

Date/Publication 2019-03-18 12:10:02 UTC

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mslp

Mean Sea Level pressure files

Description

Data from a ERA-20C reanalysis data set downloaded from ECMWF (<http://apps.ecmwf.int/datasets/data/era20c-daily/levtype=sfc/type=an/>). This data corresponds to global daily values of mean sea level pressure with 125 x 125 km resolution from January 2000 to december 2009. Geographic window: 60N-30N,30W-15E.

Usage

```
data(mslp)
```

Format

A list with values of pressure and coordinates (longitude, latitude, time)

datavar mean sea level pressure values, Pa

lon 46

latitude 31

dates 3653, ten years (2000-01-01 / 2009-12-31)

References

Poli et al. (2016) *ERA-20C: An Atmospheric Reanalysis of the Twentieth Century*. *J. Climate*, 29, <https://doi.org/10.1175/JCLI-D-15-0556.1>

Examples

```
data(mslp)
```

pca_decision

PCA decision

Description

pca_decision plots the explained variances against the number of the principal component. In addition, it returns all the information about the PCA performance.

Usage

```
pca_decision(smode_data)
```

Arguments

`smode_data` S-mode dataframe of the reanalysis variable. I.e. output obtained from `tidy_cuttime_nc` function.

Value

a list with:

- A list with class `princomp` containing all the results of the PCA
- A data frame containing the main results of the 30 first PCA (standard deviation, proportion of variance and cumulative variance).

Note

S-mode PCA require more rows than columns to work. In addition, input data cannot contain NAs.

See Also

[tidy_cuttime_nc](#)

Examples

```
# Load data (mslp)
data(mslp)
# Converting our data into a S-mode, but without modifying time period
smode_mslp <- tidy_cuttime_nc(mslp)
# PCA decision performance
info_pca <- pca_decision(smode_mslp$smode_data)
```

`precip_grid`

Daily precipitation grid of Balearic Islands (Spain)

Description

Data from a SPREAD data set downloaded from CSIC. (<http://spread.csic.es/info.html>). This data corresponds to daily values of precipitation with 5 x 5 km resolution from January 2000 to december 2009.

Usage

```
data(precip_grid)
```

Format

A list with values of pressure and coordinates (longitude, latitude, time)

datavar daily precipitation values, mm x 10

lon 53

latitude 35

dates 3653, ten years (2000-01-01 / 2009-12-31)

References

Serrano-Notivoli et al. (2017) *SPREAD: a high-resolution daily gridded precipitation dataset for Spain, an extreme events frequency and intensity overview*. *Earth Syst. Sci. Data*, 9, 721-738, 2017, <https://doi.org/10.5194/essd-9-721-2017>

Examples

```
data(precp_grid)
```

 raster_clas

Raster conversion of the Synoptic Classification

Description

This function converts the dataframe of the synoptic classification data into a Raster Stack format.

Usage

```
raster_clas(longitude, latitude, grouped_data)
```

Arguments

longitude Numeric vector containing longitudes

latitude Numeric vector containing latitudes

grouped_data Data frame. S-mode data frame containing an integer column with the circulation types. i.e. output obtained from synoptclas function.

Value

a Raster Stack containing the circulation types.

Examples

```
# Load data (mslp)
data(mslp)
# Converting our data, but without modifying time period
smode_mslp <- tidy_cutttime_nc(mslp)
# classification performance
smode_clas <- synoptclas(smode_mslp$smode_data, ncomp = 6)
# convert all the precipitation maps based on CT to a raster stack
raster_clas(longitude = mslp$lon, latitude = mslp$lat,
            grouped_data = smode_clas$grouped_data)
```

raster_ct2env

Raster conversion of environmental data based on CT

Description

This function converts the dataframe of the environmental data based on the synoptic classification into a Raster Stack format.

Usage

```
raster_ct2env(longitude, latitude, clas, grid_data, option = 1,
             na.rm = TRUE)
```

Arguments

longitude	Numeric vector containing longitudes
latitude	Numeric vector containing latitudes
clas	Integer containing the results of the synoptic classification.
grid_data	Data frame containing the environmental data (i.e. precipitation, temperature, PM10, etc.)
option	Integer (1 or 2), to manage latitude and longitude data when convert to raster. Try 2 if 1 is wrong and viceversa. Default is 1.
na.rm	Logical. If TRUE, all the grid points are used to calculate the daily mean although NA exists. If FALSE, only grid points with the complete serie are used to compute the daily mean. Default is TRUE.

Value

a Raster Stack containing the environmental grids based on the weather types.

Examples

```
# Load data (precip_grid)
data(precip_grid)
# Converting our data, but without modifying time period
smode_mslp <- tidy_cuttime_nc(mslp)
precip_data <- tidy_cuttime_nc(precip_grid)
# classification performance
smode_clas <- synoptclas(smode_mslp$smode_data, ncomp = 6)
# convert all the precipitation maps based on CT to a raster stack
raster_precp <- raster_ct2env(longitude = precip_grid$lon,
                             latitude = precip_grid$lat, clas = smode_clas$clas,
                             grid_data = precip_data$smode_data, option = 2)
```

raster_pca

Raster PCA

Description

Perform a Principal Component Analysis on a RasterStack

Usage

```
raster_pca(raststack, aggregate = 0, focal = 0)
```

Arguments

raststack	Raster Stack.
aggregate	Integer. Aggregation factor based on function aggregate of raster package.
focal	Integer. smooth filter based on function focal of raster package.

Value

a list with:

- A raster stack containing the results of the PCA
- A data frame containing the main results of the PCA (standard deviation, proportion of variance and cumulative variance)

read_nc	<i>Read a NetCDF file</i>
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Description

This function read a NetCDF file through **ncdf4** package, to extract the atmospheric or environmental variable, longitudes, latitudes and dates. A continuous NetCDF without date gaps is required.

Usage

```
read_nc(nc_input, name_coord, initial_date)
```

Arguments

nc_input	NetCDF path with atmospheric or environmental field (mean sea level pressure, geopotential height, precipitation, ...).
name_coord	Character. Names of longitude, latitude and time coordinates.
initial_date	Character. Start date of the NetCDF. As character format.

Value

a list with:

- A 3D-array (lon, lat, times) of atmospheric variable.
- A numeric with longitude values.
- A numeric with latitude values.
- A Date format vector containing dates.

regionalization	<i>Environmental regionalization</i>
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Description

Perform an unsupervised clustering of the Raster Stack

Usage

```
regionalization(raststack, centers, iter.max = 100, nstart = 100)
```

Arguments

raststack	Raster Stack.
centers	Integer. Number of clusters.
iter.max	Integer. The maximum number of iterations allowed. Default 100.
nstart	Integer. How many random sets should be chosen? Default 100.

Value

a list with:

- A raster with the final regionalization
- A list with the results of the K-means performance
- A raster displaying a pseudo-MAE error based on the difference between each pixel value and its respective centroid
- A numeric pseudo-MAE mean value for the entire map

synoptclas	<i>Synoptic classification</i>
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Description

synoptclas establish a synoptic classification based on any atmospheric variable (i.e. mean sea level pressure, geopotential height at 500 hPa, etc.)

Usage

```
synoptclas(smode_data, ncomp, extreme_scores = 2)
```

Arguments

smode_data	Data frame. S-mode data frame of the reanalysis variable. I.e. output obtained from tidy_cutttime_nc function.
ncomp	Integer. Number of components to be retained.
extreme_scores	Integer. Definition of extreme score threshold (Esteban et al., 2005). Default is 2.

Details

A PCA is applied to a S-mode matrix to reduce the dimension of the variables, in which the grid points are the variables and the days are the observations. These principal components are subsequently rotated by means of a varimax rotation. With the rotated components, the scores are used to apply the extreme scores method (Esteban et al., 2005). The scores show the degree of representativeness associated with the variation modes of each principal component, i.e., the classification of each day to its more representative centroid. Thus, the extreme scores method uses the scores > 2 and < -2 , establishing a positive and negative phase for each principal component. The extreme scores procedure establishes the number of groups and their centroids in order to apply the K-means method without iterations.

Value

A list with:

- A data frame containing data grouped by circulation types ("grouped_data").
- An integer with the circulation types ("clas").
- A data frame containing the number and percentage of days assigned to each circulation type ("ct_freq").
- A data frame containing the number of days assigned to each circulation type by month ("monthly_freq").
- A data frame containing the number of days assigned to each circulation type by year ("annual_freq").
- The 'rotated' loadings matrix of class "loadings" ("rotated_loadings").
- The scores of the supplied data on the principal components ("scores").
- The coordinates of the scores used to perform the k-means clustering. For more information, read Esteban et al. (2005)("scores_coordinates").

References

Esteban, P. , Jones, P. D., MartC-nb *Atmospheric circulation patterns related to heavy snowfall days in Andorra, Pyrenees* Int. J. Climatol. 25: 319-329. doi:10.1002/joc.1103

See Also

[pca_decision](#)

Examples

```
# Load data (mslp)
data(mslp)
# Converting our data into a S-mode, but without modifying time period
smode_mslp <- tidy_cutttime_nc(mslp)
# classification performance
smode_clas <- synoptclas(smode_mslp$smode_data, ncomp = 6)
```

tidy_cutttime_nc

Format a 3D-array to a S-mode data frame and set the time period

Description

This function format the 3D-array output from read_nc function to a S-mode dataframe (variables = grid points, observations = days). Optionally, you can set the time period between specific years and/or specify if you want work with the full year or only with 3-month season.

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