

Package ‘spdownscale’

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Type Package
Title Spatial Downscaling Using Bias Correction Approach
Version 0.1.0
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Description Spatial downscaling of climate data (Global Circulation Models/Regional Climate Models) using quantile-quantile bias correction technique.
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data_model	<i>Data-sample</i>
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Description

EC-EARTH (GCM) rainfall data at the Gold Coast Seaway meteorological station, Australia (station number - 40764, Period- 1/1/2000 to 12/31/2012, Latitude/longitude - -27.9390/153.4283)

Usage

data_model

Format

A data.frame of time and precipitation in mm for every 3h interval.

data_model_future	<i>Data-sample</i>
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Description

EC-EARTH (GCM) future (RCP 4.5) rainfall data at the Gold Coast Seaway meteorological station, Australia (station number - 40764, Period- 1/1/2026 to 12/31/2045, Latitude/longitude - -27.9390/153.4283)

Usage

data_model_future

Format

A data.frame of time and precipitation in mm for every 3h interval.

data_observation	<i>Data-sample</i>
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Description

Observational rainfall data at the Gold Coast Seaway meteorological station, Australia (station number - 40764, Period- 1/4/2000 to 12/31/2012, Latitude/longitude - -27.9390/153.4283)

Usage

```
data_observation
```

Format

A data.frame of time and precipitation in mm for every 3h interval

downscale	<i>Spatial Downscaling</i>
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Description

Generating the future climate data (rainfall)

Usage

```
downscale(obs_c, mod_c, obs_v, mod_v, mod_fut)
```

Arguments

obs_c	vector of observational climate data (rainfall) used for calibrating the model
mod_c	vector of GCM/RCM rainfall data (rainfall) used for calibrating the model
obs_v	vector of observational climate data (rainfall) used for validating the model
mod_v	vector of GCM/RCM climate data (rainfall) used for validating the model
mod_fut	vector of GCM/RCM future climate data (rainfall) need to be downscaled

Details

1) Dry-days correction / Defining threshold values

The relationship between the cumulative frequencies (thresholds) corresponding to the dry days of GCM/RCM data and that of the observational data is defined by a polynomial function given by;

$$\text{threshold_obs} = (\text{threshold_mod})^n$$

$$n = \ln(\text{threshold_obs_c}) / \ln(\text{threshold_mod_c})$$

2) wet-days correction / Correcting the intensity of the GCM/RCM data

Two parameter (shape and scale factors) gamma distribution function is used to model the frequency distributions of the rainfall data. The GCM/RCM rainfall above the threshold were corrected using unique correction factors for different cumulative frequencies.

$$\text{corrected_mod_fut} = \text{mod_fut} * F^{-1}(F(\text{mod_fut}, \text{sh_obs_c}, \text{sc_obs_c}) / F^{-1}(F(\text{mod_fut}, \text{sh_mod_c}, \text{sc_mod_c}))$$

where obs - observational data; mod - GCM/RCM data; n - constant; c - calibration; v - validation; fut - future data; sh - shape factor; sc- scale factor; F - cumulative density function and F-1 - inverse of cumulative density function

Examples

```
#subsetting dat_model
mod_calibration=subset(data_model, (year==2003|year==2005|year==2007|year==2009|year==2011))
mod_validation= subset(data_model, (year==2004|year==2006|year==2008|year==2010|year==2012))
#subsetting data_observation
obs_calibration=subset(data_observation, (year==2003|year==2005|year==2007|year==2009|year==2011))
obs_validation=subset(data_observation, (year==2004|year==2006|year==2008|year==2010|year==2012))
#creating the input vectors
obs_c=obs_calibration$pr
mod_c=mod_calibration$pr
obs_v=obs_validation$pr
mod_v=mod_validation$pr
mod_fut= data_model_future$pr

downscale(obs_c, mod_c, obs_v, mod_v, mod_fut)
```

ParaCal

Calibration Parameters

Description

Displays the shape factors, scale factors and the threshold values of the observation and GCM/RCM data set which ultimately define the model

Usage

```
ParaCal(obs_c, mod_c, obs_v, mod_v, mod_fut)
```

Arguments

obs_c	vector of observational climate data (rainfall) used for calibrating the model
mod_c	vector of GCM/RCM climate data (rainfall) used for calibrating the model
obs_v	vector of observational climate data (rainfall) used for validating the model
mod_v	vector of GCM/RCM climate data (rainfall) used for validating the model
mod_fut	vector of GCM/RCM future climate data (rainfall) need to be downscaled

Details

1) Dry-days correction / Defining threshold values

The relationship between the cumulative frequencies (thresholds) corresponding to the dry days of GCM/RCM data and that of the observational data is defined by a polynomial function given by;

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Two parameter (shape and scale factors) gamma distribution function was used to model the frequency distributions of the rainfall data. The GCM/RCM rainfall above the threshold were corrected using unique correction factors for different cumulative frequencies.

$$\text{corrected_mod_fut} = \text{mod_fut} * F^{-1}(F(\text{mod_fut}, \text{sh_obs_c}, \text{sc_obs_c}) / F^{-1}(F(\text{mod_fut}, \text{sh_mod_c}, \text{sc_mod_c}))$$

where obs - observational data; mod - GCM/RCM data; n - constant; c - calibration; v - validation; fut - future data; sh - shape factor; sc - scale factor; F - cumulative density function and F-1 - inverse of cumulative density function

Examples

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#subsetting dat_model
mod_calibration=subset(data_model, (year==2003|year==2005|year==2007|year==2009|year==2011))
mod_validation= subset(data_model, (year==2004|year==2006|year==2008|year==2010|year==2012))
#subsetting data_observation
obs_calibration=subset(data_observation, (year==2003|year==2005|year==2007|year==2009|year==2011))
obs_validation=subset(data_observation, (year==2004|year==2006|year==2008|year==2010|year==2012))
#creating the input vectors
obs_c=obs_calibration$pr
mod_c=mod_calibration$pr
obs_v=obs_validation$pr
mod_v=mod_validation$pr
mod_fut= data_model_future$pr

ParaCal(obs_c,mod_c,obs_v,mod_v,mod_fut)
```

ResVal

Validation Summary

Description

Displays the summary of the validation.

Usage

```
ResVal(obs_c, mod_c, obs_v, mod_v, mod_fut)
```

Arguments

obs_c	vector of observational climate data (rainfall) used for calibrating the model
mod_c	vector of GCM/RCM climate data (rainfall) used for calibrating the model
obs_v	vector of observational climate data (rainfall) used for validating the model
mod_v	vector of GCM/RCM climate data (rainfall) used for validating the model
mod_fut	vector of GCM/RCM future climate data (rainfall) need to be downscaled

Details

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Two parameter (shape and scale factors) gamma distribution function was used to model the frequency distributions of the rainfall data. The GCM/RCM rainfall above the threshold were corrected using unique correction factors for different cumulative frequencies.

$$\text{corrected_mod_fut} = \text{mod_fut} * F^{-1}(F(\text{mod_fut}, \text{sh_obs_c}, \text{sc_obs_c}) / F^{-1}(F(\text{mod_fut}, \text{sh_mod_c}, \text{sc_mod_c}))$$

where obs - observational data; mod - GCM/RCM data; n - constant; c - calibration; v - validation; fut - future data; sh - shape factor; sc- scale factor; F - cumulative density function and F-1 - inverse of cumulative density function

Examples

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#subsetting dat_model
mod_calibration=subset(data_model,(year==2003|year==2005|year==2007|year==2009|year==2011))
mod_validation= subset(data_model,(year==2004|year==2006|year==2008|year==2010|year==2012))
#subsetting data_observation
obs_calibration=subset(data_observation,(year==2003|year==2005|year==2007|year==2009|year==2011))
obs_validation=subset(data_observation,(year==2004|year==2006|year==2008|year==2010|year==2012))
#creating the input vectors
obs_c=obs_calibration$pr
mod_c=mod_calibration$pr
obs_v=obs_validation$pr
mod_v=mod_validation$pr
mod_fut= data_model_future$pr

ResVal(obs_c,mod_c,obs_v,mod_v,mod_fut)
```

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