Package: cropZoning (via r-universe)

November 6, 2024

Type Package

Title Climate Crop Zoning Based in Air Temperature for Brazil

Version 1.0.3

Description Climate crop zoning based in minimum and maximum air temperature. The data used in the package are from 'TerraClimate' dataset (<https://www.climatologylab.org/terraclimate.html>), but, it have been calibrated with automatic weather stations of National Meteorological Institute of Brazil. The climate crop zoning of this package can be run for all the Brazilian territory.

Encoding UTF-8

Language en-US

RoxygenNote 7.3.1

License CC BY 4.0

Depends R (>= 2.10)

Imports terra, tidyr, sf, ncdf4, ggplot2

BugReports https://github.com/FilgueirasR/cropZoning/issues

NeedsCompilation no

Config/pak/sysreqs libgdal-dev gdal-bin libgeos-dev libicu-dev libnetcdf-dev libssl-dev libproj-dev libsqlite3-dev libudunits2-dev

Repository https://filgueirasr.r-universe.dev

RemoteUrl https://github.com/filgueirasr/cropzoning

RemoteRef HEAD

RemoteSha d661fc3e35453d6583b46be02e6a31d078054cf2

Contents

`ccrop_zoning` *Climate crop zoning based on monthly air temperature data*

Description

This function will calculate the climate crop zoning for the range of air temperature informed. The result will be a raster image with five possible values (values of 1 to 5) according to what is explained below.

- Pixel values = 1, correspond to suitable air temperature (ST);
- Pixel values = 2, correspond to restricted due to low temperature (RLT);
- Pixel values = 3, correspond to restricted due to high temperature (RHT);
- Pixel values = 4, correspond to unsuitable due to low temperature (ULT);
- Pixel values = 5, correspond to unsuitable due to high temperature (UHT).

The thermal suitability ranges established were as follows:

1. ST - Temperature range (range of temp2 to temp3) considered optimal for the growth, development and production of the crop;
2. RLT - Temperature range (range of temp2 to temp1) which the crop is able to develop, however, below its potential due to the air temperature values being slightly lower than those of the suitable range;
3. RHT - Temperature range (range of temp3 to temp4) which the crop is able to develop, however, below its potential due to the temperature values being slightly higher than those of the suitable range;
4. ULT - When temperature values are not suitable for commercial exploitation of the crop due to low air temperature (air temperature below the temp1);
5. UHT - When temperature values are not suitable for commercial exploitation of the crop due to high air temperature (air temperature above the temp4);

Usage

```
ccrop_zoning(temp_per_month, temp1, temp2, temp3, temp4)
```

Arguments

temp_per_month	Rasterstack object with a monthly mean air temperature from a period of time
temp1	unsuitable due to low temperature (numeric)
temp2	minimum suitable temperature (numeric)
temp3	maximum suitable temperature (numeric)
temp4	unsuitable due to high temperature (numeric)

Value

Returns a SpatRaster object of climate crop zoning based in air temperature.

Examples

```
## Not run:
### Example with Brazil states

see_brazil_states()

image_tmin<-loadROI(variable = "tmin",
                    region = "brazil",
                    sub_region = 13) # sub_regions 1:27

image_tmax<-loadROI(variable = "tmax",
                    region = "brazil",
                    sub_region = 13)

image_tmean <- tmean(tmax_stack = image_tmax, tmin_stack = image_tmin)


start_date <- c('2000-01-01')
end_date <- c('2017-12-01')

tmean_monthly <- tmean_monthly_stack(tmean_stack = img_tmean,
                                     start_date = start_date,
                                     end_date = end_date)


zoning <- ccrop_zoning(temp_per_month = tmean_monthly,
                       temp1 = 10 , temp2 = 20,
                       temp3 = 30, temp4 = 40)

## End(Not run)
```

`download_terraclimate` *Download of maximum and minimum air temperature from 'TerraClimate'*

Description

This function will download the tmax and tmin images and will load a rasterstack according to the the region of interest (Region and sub_region). The images downloaded by this function are intended to be used for calculating the climatic zoning of crops. To calculate the climatic zoning of the crops, you first have to calculate the mean air temperature (function tmean) and the monthly air temperature (function tmean_monthly).

Usage

```
download_terraclimate(dir_out, variable, years, region, sub_region)
```

Arguments

`dir_out`	Directory where you want to save the raster images that you are goind to download. Each variable should be locate in one folder.
`variable`	Variable to download. The variables can be the minimum (tmin) or maximum (tmax) air temperature of 'TerraClimate' (Rasterstack).
`years`	The period in years that the function should download.
`region`	Use the "brazil" shapefile to extract the Rasterstack (variable) for one state (Brazilian state), or use the "biomes_brazil" to extract the Rasterstack (variable) for one biome of Brazil.
`sub_region`	You have two options in this section, if you choice the brazil (in region parameter) you need to choice the Brazilian states, but if you choice the biomes_brazil (in region parameter) you must choice one of Brazilian biomes. Another option is to select "all" to download images for the entire territory of Brazil.

Value

Returns a Rasterstack of tmin (minimum air temperature) or tmax (maximum air temperature).

References

The images used in this package can be found in the paper: Abatzoglou, J.T., S.Z. Dobrowski, S.A. Parks, K.C. Hegewisch, 2018, Terraclimate, a high-resolution global dataset of monthly climate and climatic water balance from 1958-2015, Scientific Data.

Examples

```
## Not run:

### Downloading the minimum air temperature and maximum air temperature based on Brazil states.
see_brazil_states()
```

```
img <- download_terraclimate(
  dir_out = "C:/teste/tmin/state", variable = "tmin",
  years = c(2018:2019),
  region = "brazil",
  sub_region = 13
)

### Downloading the minimum air temperature and maximum air temperature based on Brazil states.
see_brazil_biomes()

img <- download_terraclimate(
  dir_out = "C:/teste/tmin/biome", variable = "tmin",
  years = c(2018:2019),
  region = "biomes_brazil",
  sub_region = 6
)

## End(Not run)
```

---

loadROI *Load the data for the region of interest (ROI)*

Description

This function will load the air temperature data (SpatRaster) for the region of interest (ROI). The images loaded by this function are intended to be used, as example, for calculating the climatic zoning of crops. To calculate the climatic zoning of the crops, you first have to calculate the mean air temperature (function tmean) and the monthly air temperature (function tmean_monthly).

Usage

```
loadROI(variable, region, sub_region)
```

Arguments

variable	Stack of minimum (tmin) or maximum (tmax) air temperature (SpatRaster).
region	Use the "brazil" shapefile to extract the SpatRaster (variable) for one state (Brazilian state), or use the "biomes_brazil" to extract the Rasterstack (variable) for one biome of Brazil.
sub_region	You have two options in this section, if you choice the brazil (in region parameter) you need to choice the Brazilian states, but if you choice the biomes_brazil (in region parameter) you must choice one of Brazilian biomes.

Value

Load the tmin image example (minimum air temperature) or tmax image example (maximum air temperature) rasterstack

References

The images used in this package can be found in the paper: Abatzoglou, J.T., S.Z. Dobrowski, S.A. Parks, K.C. Hegewisch, 2018, Terraclimate, a high-resolution global dataset of monthly climate and climatic water balance from 1958-2015, Scientific Data.

Examples

```
## Not run:

### Loading minimum air temperature and maximum air temperature based on Brazil states.
see_brazil_states()

image_tmin <-loadROI(variable = "tmin",
                   region = "brazil",
                   sub_region = 13) # sub_regions 1:27

image_tmax <-loadROI(variable = "tmax",
                   region = "brazil",
                   sub_region = 13)

### Loading minimum air temperature and maximum air temperature based on Brazil biomes.
see_brazil_biomes()

image_tmin <- loadROI(variable = tmin,
                    region = "biomes_brazil",
                    sub_region = 5)# sub regions: 1:6 (biomes)

image_tmax <-loadROI(variable = "tmax",
                   region = "biomes_brazil",
                   sub_region = 5)


## End(Not run)
```

`plot_ccrop_zoning` *Function to plot the climate crop zoning stack generated in ccrop_zoning*

Description

This function will plot the ccrop_zoning output. The result of the plotting will generate a plot with the following classes.

Climatic zoning classes:

- ST: Suitable air temperature
- RLT: Restricted due to low temperature
- RHT: Restricted due to high temperature
- ULT: Unsuitable due to low temperature
- UHT: Unsuitable due to high temperature

Usage

```
plot_ccrop_zoning(zoning)
```

Arguments

zoning	A stack generated in ccrop_zoning

Value

Returns a plot (ggplot object) with the monthly climate crop zoning based in air temperature.

Examples

```
### Data preparation
## Not run:
###ploting the cropzoning:

zoning_plot <- plot_ccrop_zoning(zoning)

## End(Not run)
```

---

see_brazil_biomes — *Function to see the Brazilian biomes available in cropZoning package and how we can use it in the loadROI function*

Description

This fuction will show the biomes available in the package and how we can call each biome polygon.

Usage

```
see_brazil_biomes()
```

Value

Returns a character strings listing the biomes available to run the cropZoning package.

Examples

```
## Not run:

see_brazil_biomes()

## End(Not run)
```

see_brazil_states — *Function to see the Brazilian states available in cropZoning package and how we can use it in the loadROI function*

Description

This function will show the Brazilian state available in the package and how we can call each state polygon.

Usage

```
see_brazil_states()
```

Value

Returns a character strings listing the the Brazilian states available to run the cropZoning package.

Examples

```
## Not run:

see_brazil_states()

## End(Not run)
```

tmax_calibration — *Calibration of maximum air temperature from TerraClimate*

Description

This function will calibrate the maximum air temperature from TerraClimate dataset based in the relationship with observed weather stations data.The values of slope and intercept informed in example correspond a calibration performed between 'Terraclimate' images and INMET automatic weather stations realized for all the brazilian territory.

Usage

```
tmax_calibration(slope, intercept, tmax_stack)
```

Arguments

slope	the slope of the linear regression (numeric)
intercept	the intercept of the linear regression (numeric)
tmax_stack	stack of maximum air temperature

Value

Returns a SpatRaster object of calibrated maximum air temperature.

Examples

```
## Not run:

tmax_cal<- tmax_calibration(slope = 0.874787, intercept = 4.612894 , tmax_stack = tmax);

## End(Not run)
```

---

tmean — *Mean air temperature calculation*

Description

This fuction will calculate the mean air temperature from minimum and maximum air temperature data.

Usage

```
tmean(tmax_stack, tmin_stack)
```

Arguments

`tmax_stack`	stack of maximum air temperature
`tmin_stack`	stack of minimum air temperature

Value

Returns a SpatRaster object of mean air temperature.

Examples

```
## Not run:

image_tmean <- tmean(tmax_stack = image_tmax, tmin_stack = image_tmin)

## End(Not run)
```

`tmean_monthly_stack` *Monthly mean air temperature estimation to generate the climate crop zoning*

Description

This function will calculate the mean monthly air temperature based on the period of time selected (start_date and end_date).

Usage

```
tmean_monthly_stack(tmean_stack, start_date, end_date)
```

Arguments

`tmean_stack`	Stack of mean air temperature based on minimum and maximum air temperature Rasterstack
`start_date`	Date that start the investigation, should be in the following format (1958-01-01 /Year-Month-Day)
`end_date`	Date that end the investigation, should be in the following format (2017-12-31 /Year-Month-Day)

Value

Returns a Rasterstack object with a monthly mean air temperature from a period of time.

Examples

```
## Not run:

start_date <- c('2000-01-01')
end_date <- c('2017-12-01')

tmean_monthly <- tmean_monthly_stack(tmean_stack = img_tmean,
                                     start_date = start_date,
                                     end_date = end_date)

## End(Not run)
```

`tmin_calibration` *Calibration of minimum air temperature from TerraClimate*

Description

This function will calibrate the minimum air temperature from TerraClimate dataset based in the relationship with observed weather stations data. The values of slope and intercept informed in example correspond a calibration performed between 'Terraclimate' images and INMET automatic weather stations realized for all the brazilian territory.

Usage

```
tmin_calibration(slope, intercept, tmin_stack)
```

Arguments

`slope`	the slope of the linear regression (numeric)
`intercept`	the intercept of the linear regression (numeric)
`tmin_stack`	stack of maximum air temperature

Value

Returns a SpatRaster of calibrated minimum air temperature.

Examples

```
## Not run:
tmin_cal<- tmin_calibrated(slope = 0.830652, intercept = 4.187840, tmin_stack = tmin);

## End(Not run)
```

Index