

Package ‘forestChange’

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Type Package

Title Computing Essential Biodiversity Variables from Global Forest Change Data

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Description Metrics of two Essential Biodiversity Variables: forest extents and forest fragmentation indices (O’connor et al., 2015) <doi:10.1002/rse2.4> are computed by processing Global Forest Change data (Hansen et al., 2013) <doi:10.1126/science.1244693>. The Forest Change Data are extracted using either Geographic Administrative Units, see <https://gadm.org/>, or user-defined polygons. Most of the procedures can be understood implementing two functions: FCPolygon() and EBVmetric().

License GPL-3

Imports raster,rgdal,parallel,curl,graphics,rvest,stats,SDMTools,utils,xml2

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forestChange-package *Computing Essential Biodiversity Variables from Global Forest Change Data*

Description

Metrics of two Essential Biodiversity Variables: forest extents and forest fragmentation indices (O’connor et al., 2015) <doi:10.1002/rse2.4> are computed by processing Global Forest Change data (Hansen et al., 2013) <doi:10.1126/science.1244693>. The Forest Change Data are extracted using either Geographic Administrative Units, see <https://gadm.org/>, or user-defined polygons. Most of the procedures can be understood implementing two functions: FCPolygon() and EBVmetric().

Details

The DESCRIPTION file:

```
Package:      forestChange
Type:         Package
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Version:      0.6
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Author:       Wilson Lara <wilarhen@temple.edu>, Victor Gutierrez-Velez <victorhugo@temple.edu>
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```

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FCPolygon	Forest-Cover Polygon
GFCurls	URLs of GFC data
HansenUrltoExtent	Extents in GFC links
forestChange-package	Computing Essential Biodiversity Variables from Global Forest Change Data
getGADM	Get Geographic Administrative Unit
plot.EBVmetric	EBV-metric plot

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Author(s)

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`EBVmetric`*EBV metric*

Description

This function can compute metrics of two Essential Biodiversity Variables (EBV metrics): forest extents and forest fragmentation indices using Global Forest Change data (GFC).

Usage

```
EBVmetric(tc, met = "forest.ext", year = 0, perc = 80)
```

Arguments

<code>tc</code>	RasterStack. GFC layers such as that produced by FCPolygon .
<code>met</code>	character. Name of a EBV metric, see Details section. Partial matching is supported. Default 'forest.ext'.
<code>year</code>	numeric. A year in the interval 0-17 (or 2000-2017). Default 0.
<code>perc</code>	numeric. Minimum percentage of canopy closure per grid cell in tc. Default 80.

Details

Diverse EBV metrics are supported: forest extents 'forest.ext' (km²), fractal-dimension indices 'frac.dim.index' (dimensionless), and other values in [PatchStat](#). The GFC are masked twice. The first mask filters values which are equal or greater than perc. The second mask subtracts those values in the 'treecover2000' raster which correspond to values in the 'lossyear' raster, spanning from 2000 to year. Surfaces of the median pixels are computed supposing long/lat coordinates, see [area](#).

Value

ts. EBV metric.

Author(s)

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References

O'Connor, B., Secades, C., Penner, J., Sonnenschein, R., Skidmore, A., Burgess, N. D., & Hutton, J. M. (2015). Earth observation as a tool for tracking progress towards the Aichi Biodiversity Targets. *Remote sensing in ecology and conservation*, 1(1), 19-28.

Examples

```
EBVmetric(NULL)
## Lets change mpio = NULL by a GADM unit: e.g., the municipality
## of 'Uribia' in Colombia and compute fractal dimensions from
## year 10 to year 17:

mpio <- 'Uribia'
gadm <- FCPolygon(mpio, level = 2)
smet <- EBVmetric(gadm, met = 'frac', year = 10:17)
plot(smet)
```

FCMosaic

Forest-Change Mosaic

Description

This function tests whether two adjacent layers of GFC can be bounded together using partial matching over the names of the layers. If this is possible then `mosaic` is implemented.

Usage

```
FCMosaic(rst = NULL, lyrs = c("treecover2000", "lossyear"), multicore = TRUE)
```

Arguments

<code>rst</code>	list or NULL. List of GFC layers. If NULL then the other arguments are ignored and the function returns NULL.
<code>lyrs</code>	character. Strings matching layers in a google api used to download GFC layers. Default 'treecover2000', and 'lossyear'.
<code>multicore</code>	logical. Use parallel execution. Default TRUE. Ignored in Windows machines.

Details

The function is implemented by `FCPolygon` to cut GFC data.

Value

list of rasters.

Author(s)

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Examples

```
## Printing NULL output:
FCMosaic(NULL)
```

FCPolygon	<i>Forest-Cover Polygon</i>
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Description

This function can crop layers of Global Forest Change (GFC) using either Geographic Administrative Units (GADM) or other user-defined polygons.

Usage

```
FCPolygon(pol = NULL, lyrs = c("treecover2000", "lossyear"),
          url, multicore = TRUE, ...)
```

Arguments

pol	SpatialPolygonsDataFrame, character or NULL. A spatial-data polygon, the name of a GADM, or such a name plus its corresponding higher-level unit. If NULL then a list of GADM units is printed.
lyrs	character. Vector of strings matching layer names in the GFC data. Defaults 'treecover2000' and 'lossyear'.
url	character. Path to the html file containing the files. If missing then data from the application programming interface of GFC is retrieved, see GFCurls .
multicore	logical. Use parallel execution. Default TRUE. This is ignored in Windows machines.
...	Additional arguments in getGADM other than 'unit.nm'. These could be 'level' and/or 'country'.

Details

The GADM are imported using the in-package [getGADM](#). Links to the data sets are obtained using the in-package [GFCurls](#). Geographic extents in both the GADM and the GFC are intersected using the package function [HansenUrltoExtent](#). Common areas between GFC and GADM are cropped using two functions of the [raster](#) package: [crop](#) and [rasterize](#). Depending on localization of the GADM unit, several GFC layers by data type might be required. This is done implementing the in-package [FCMosaic](#). This function could be memory demanding if the extents of the polygons used to cut the GFC are big (30,000 km²). For these cases, machines with RAM of 8 GB or greater should be used. In unix-alike systems, the package can implement parallel execution, see [parallel](#) package.

Value

list of rasters or set of GADM units

Author(s)

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References

Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A. A., Tyukavina, A., ... & Kommareddy, A. (2013). High-resolution global maps of 21st-century forest cover change. *science*, 342(6160), 850-853.

Examples

```
## A list of departments of Colombia is printed:

dep <- FCPolygon(level = 1)
head(dep)

## Two adjacent layers of GFC must be bounded together before cropping
## the GFC data using the boundaries of the the municipality of
## 'Cumaribo' in Colombia. This is automatically developed by
## FCPolygon:

cumariboArea <- FCPolygon(pol = 'Cumaribo')

## The name 'Mosquera' matches two municipalities of Colombia. A
## corresponding department should be specified in the argument 'pol'
## of FCPolygon:

mosquera <- FCPolygon('Mosquera')
mosqueraNarinho <- FCPolygon(pol = c('Mosquera', 'Narino'))
```

getGADM

Get Geographic Administrative Unit

Description

This function is a wrapper of [getData](#) used to import levels in Geographic Administrative Units (GADM).

Usage

```
getGADM(unit.nm = NULL, level = 2, country = "COL")
```

Arguments

unit.nm	character or NULL. A name in the administrative units (e.g. municipalities), or the name of the unit plus its corresponding higher-level unit (e.g. department/state). If NULL then a list of unit names corresponding to 'level' is printed.
level	numeric. A number between zero and two, indicating any of the levels of administrative subdivisions in GADM: 0=country, 1=first level of subdivision, and 2=second level of subdivision).
country	character. ISO code specifying a country. Default 'COL'

Value

List of rasters.

Author(s)

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References

<https://gadm.org/>

Examples

```
## Printing municipalities of Colombia:
```

```
  muni <- getGADM()
  head(muni)
```

GFCurls

URLs of GFC data

Description

This function retrieves URL of Global Forest Change (GFC) data.

Usage

```
GFCurls(lyrs = c("treecover2000", "lossyear"), url = NULL)
```

Arguments

lyrs	character. Name(s) of the layers. Default 'treecover2000', and 'lossyear'
url	character. Path to the html file containing the files. Default NULL retrieves URLs stored in the application programming interface of GFC, see References.

Value

character vector.

Author(s)

Wilson Lara <wilarhen@temple.edu>, Victor Gutierrez-Velez <victorhugo@temple.edu>

References

https://earthenginepartners.appspot.com/science-2013-global-forest/download_v1.5.html

Examples

```
gainLayers <- GFCurls(lyrs = 'gain')
head(gainLayers)
```

HansenUrltoExtent	<i>Extents in GFC links</i>
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Description

This function can extract extents of Global Forest Change data (GFC) using a corresponding URL.

Usage

```
HansenUrltoExtent(x, path. = "[[:digit:]]{1,3}[N|S|E|W]")
```

Arguments

x	character. URL to the GFC such as any of these produced by GFCurls .
path.	character. Pattern in the URL to extract the extent. Default extracts the 3 digits nearest to any of the cardinal directions:N, S, E, or W.

Details

The function is implemented by [FCPolygon](#).

Value

extent.

Author(s)

Wilson Lara <wilarhen@temple.edu>, Victor Gutierrez-Velez <victorhugo@temple.edu>

References

<http://earthenginepartners.appspot.com/science-2013-global-forest>

Examples

```
urtt <- 'https://storage.googleapis.com/earthenginepartners-hansen/
GFC-2017-v1.5/Hansen_GFC-2017-v1.5_treecover2000_10N_010E.tif'
HansenUrltoExtent(urtt)
```

plot.EBVmetric	<i>EBV-metric plot</i>
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Description

A plot of [EBVmetric](#) is printed.

Usage

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

Arguments

`x` [ts](#). Time series such as that produced by [EBVmetric](#).
`...` further arguments in [plot](#) other than `cex.lab`, `type`, `xlab`, `ylab`, `xaxt`, and `yaxt`.

Value

plot.

Author(s)

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Examples

```
## Simulating an objec of class EBVmetric  
set.seed(1)  
areaKm2 <- 1800 - (rnorm(11))  
ats <- ts(areaKm2, start = 2000)  
class(ats) <- c('EBVmetric', class(ats))  
  
## A plot of the 'EBVmetric' object  
plot(ats)
```

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