Package 'forestChange'

December 23, 2018

Type Package

Title Computing Essential Biodiversity Variables from Global Forest Change Data

Version 0.3

Date 2018-12-12

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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

Depends raster,rgdal,parallel

Imports graphics,rmarkdown,stats,SDMTools,utils

Encoding latin1

LazyData TRUE

NeedsCompilation no

Repository CRAN

Date/Publication 2018-12-23 00:00:03 UTC

R topics documented:

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

Description

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Details

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Index of help topics:

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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

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

Details

Diverse `EBV` metrics are supported: forest extents `'forest.ext'` (`km^2`), 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)

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

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

`rst`	`list` or `NULL`. List of `GFC` layers. If `NULL` then the other arguments are ignored and the function returns `NULL`.
`lyrs`	`character`. Strings matching layers in a google api used to download `GFC` layers. Default `'treecover2000'`, and `'lossyear'`.
`multicore`	`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)

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

Examples

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

FCPolygon *Forest-Cover Polygon*

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"),
    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. Strings matching layers in a google api used to download links of GFC. Default 'treecover2000', and 'lossyear'.
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 km^2). 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' matchs 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 Adminitrative 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)

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

References

https://gadm.org/

Examples

```
## Printing municipalities of Colombia:
muni <- getGADM()
head(muni)
```

GFCurls *URLs of GFC*

Description

This function can find lists of URL necessary to download Global Forest Change data (GFC).

Usage

```
GFCurls(lyrs = c("treecover2000", "lossyear"), gglapi = NULL,
    ext = ".txt")
```

Arguments

lyrs	character. Portion of the URLs matching names of GFC layers. Default 'treecover2000', and 'lossyear'
gglapi	character. Portion of an URL which is common to the set of URLs to be retrieved. If NULL then an application programming interface of google is used, see References.
ext	logical. Extension of the file containing the links. Default 'txt'

Details

The function is implemented by FCPolygon.

Value

character vector.

Author(s)

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

References

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

Examples

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

HansenUrltoExtent *Extents in GFC links*

Description

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

Usage

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

Arguments

x	character. URL to the GFC, see References.
path.	character. Pattern in the URL to extract the extent. Default extracts the 3 digits closer to any of the letters 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` *EBV-metric plot*

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)

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

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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