

# Package ‘LPDynR’

October 16, 2023

**Title** Land Productivity Dynamics Indicator

**Version** 1.0.4

**Description**

It uses 'phenological' and productivity-related variables derived from time series of vegetation indexes, such as the Normalized Difference Vegetation Index, to assess ecosystem dynamics and change, which eventually might drive to land degradation. The final result of the Land Productivity Dynamics indicator is a categorical map with 5 classes of land productivity dynamics, ranging from declining to increasing productivity. See <<https://www.sciencedirect.com/science/article/pii/S1470160X21010517>> for a description of the methods used in the package to calculate the indicator.

**Depends** R (>= 3.6.0)

**Imports** stats, dplyr, data.table, virtualspecies, magrittr, terra

**Suggests** knitr, rmarkdown

**VignetteBuilder** knitr

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 7.2.2

**URL** <https://github.com/xavi-rp/LPDynR>

**BugReports** <https://github.com/xavi-rp/LPDynR/issues>

**NeedsCompilation** no

**Author** Xavier Rotllan-Puig [aut, cre],

Eva Ivits [aut],

Michael Cherlet [aut]

**Maintainer** Xavier Rotllan-Puig <xavier.rotllan.puig@aster-projects.cat>

**Repository** CRAN

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baseline_lev	<i>baseline_lev</i>
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### Description

baseline\_lev() derives land productivity at the beginning of the time series on study, resulting in a 3-class SpatRaster object with (1) low, (2) medium and (3) high productivity

### Usage

```
baseline_lev(
  obj2process = NULL,
  yearsBaseline = 3,
  drylandProp = 0.4,
  highprodProp = 0.1,
  cores2use = 1,
  filename = ""
)
```

### Arguments

obj2process	SpatRaster object (or its file name). If time series, each layer is one year
yearsBaseline	Numeric. Number of years to be averaged and used as baseline. Optional. Default is 3
drylandProp	Numeric. Proportion of drylands over total land, either expressed as a fraction of unity or percentage. Optional. Default is 0.4
highprodProp	Numeric. Proportion of land classified as 'highly productive' over total land, either expressed as a fraction of unity or percentage. Optional. Default is 0.1

cores2use	Numeric. Number of cores to use for parallelization. Optional. Default is 1 (no parallelization)
filename	Character. Output filename. Optional

### Details

baseline\_lev() uses the proportion of drylands over the total land ('drylandProp') to classify the level of productivity into low level. UNPD declares that 40 percent of the World's land resources are drylands (Middleton et al., 2011) and, therefore, 40 percent of pixels at the global level can be classified as low productivity land. This assumption is the default, but it should be adjusted for local and regional studies. In addition, baseline\_lev() classifies by default 10 percent of pixels as high level of land productivity and the rest (100 - ('drylandProp' + 10)) as medium level. Proportion of pixels classified as 'high' can be also modified by passing the argument 'highprodProp'

### Value

SpatRaster object

### Author(s)

Xavier Rotllan-Puig

### References

Middleton, N., L. Stringer, A. Goudie, and D. Thomas. 2011. "The Forgotten Billion. MDG Achievement in the Drylands." New York, NY, 10017, USA: United Nations Development Programme.

### Examples

```
sb <- terra::rast(paste0(system.file(package='LPdynR'), "/extdata/sb_cat.tif"))
baseline_lev(obj2process = sb,
             yearsBaseline = 3,
             drylandProp = 0.4,
             cores2use = 2)
```

---

clust\_optim

*clust\_optim*

---

### Description

clust\_optim produces a scree plot with number of cluster at x-axis and total within-cluster sum of squares at y-axis

**Usage**

```
clust_optim(  
  obj2clust = NULL,  
  num_clstrs = seq(5, 50, 5),  
  standardise_vars = TRUE,  
  ...  
)
```

**Arguments**

obj2clust	SpatRaster object (or its file name). Each layer is one variable
num_clstrs	Numeric. Optional. Vector with a sequence of number of clusters to check for optimal
standardise_vars	Logical. Optional. If TRUE (default), variables are standardised (mean = 0; sd = 1)
...	Optional. Arguments for <a href="#">kmeans</a>

**Details**

The 'scree plot method' allows the user to assess how the quality of the K-means clustering improves when increasing the number of clusters. An elbow in the curve indicates the optimal number of clusters. K-means are run with [kmeans](#)

**Value**

A scree plot

**Author(s)**

Xavier Rotllan-Puig

**See Also**

[PCAs4clust](#); [EFT\\_clust](#); [kmeans](#)

**Examples**

```
dirctry <- paste0(system.file(package='LPDynR'), "/extdata")  
variables_noCor <- rm_multicol(dir2process = dirctry,  
  multicol_cutoff = 0.7)  
clust_optim(obj2clust = variables_noCor,  
  num_clstrs = seq(5, 50, 5))
```

---

EFT_clust	<i>EFT_clust</i>
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### Description

EFT\_clust derives the Ecosystem Functional Types using K-means to perform a clustering on the pixels of the SpatRaster object

### Usage

```
EFT_clust(
  obj2clust = NULL,
  n_clust = 20,
  standardise_vars = TRUE,
  filename = "",
  ...
)
```

### Arguments

obj2clust	SpatRaster object (or its file name). Each layer is one variable
n_clust	Numeric. Number of total clusters. Optional. Default = 20
standardise_vars	Logical. Optional. If TRUE (default), variables are standardised (mean = 0; sd = 1)
filename	Character. Output filename. Optional
...	Arguments for <a href="#">kmeans</a> . Optional

### Details

[kmeans](#) does not optimize the final number of clusters. It needs to be set by means of 'n\_clust' (default = 20). There are several methods and statistics to determine the optimal number. [clust\\_optim](#) produces a scree plot to help the user to decide the optimal number of clusters.

EFT\_clust passes as default to [kmeans](#) iter.max = 500 and algorithm = "MacQueen", but these can be modified passing these arguments through '...'

Please note that the variables are standardised (mean = 0; sd = 1) before running the clustering

An evaluation of the clustering is provided together with the SpatRaster object. It is calculated as  $\text{model\$betweenss} / \text{model\$totss} * 100$ ; where 'betweenss' and 'totss' are generated by [kmeans](#)

### Value

A list with two components: (1) a SpatRaster object with the clusters and (2) a vector with the clustering evaluation in percentage

**Author(s)**

Xavier Rotllan-Puig

**See Also**[PCAs4clust](#); [clust\\_optim](#); [kmeans](#)**Examples**

```

dirctry <- paste0(system.file(package='LPDynR'), "/extdata")
variables_noCor <- rm_multicol(dir2process = dirctry,
                             multicol_cutoff = 0.7)
EFT_clust(obj2clust = variables_noCor,
          n_clust = 10)

```

LNScaling

*LNScaling***Description**

LNScaling (Local Net Productivity Scaling) uses a productivity variable (SpatRaster), e.g. season growth, to calculate the actual status of land productivity relative to its potential in homogeneous land areas or Ecosystem Functional Types (SpatRaster). If the productivity variable 'ProdVar' is a SpatRaster object with time series, it is calculated the average of the last 5 years

**Usage**

```
LNScaling(EFTs = NULL, ProdVar = NULL, cores2use = 1, filename = "")
```

**Arguments**

EFTs	SpatRaster object (or its file name). Ecosystem Functional Types. Its first variable has the number of EFT (cluster) each pixel belongs to
ProdVar	SpatRaster object (or its file name). Productivity variable (e.g. Cyclic fraction -season growth-)
cores2use	Numeric. Number of cores to use for parallelization. Optional. Default is 1 (no parallelization)
filename	Character. Output filename. Optional

**Details**

The Local Net Primary Production Scaling (LNS) method (Prince, 2009) calculates the difference between the potential and actual Net Primary Production for each pixel in homogeneous land areas. The current land production related to the local potential reflects the current level of productivity efficiency and, therefore, it is useful for the delineation of a land productivity status map

**Value**

SpatRaster object

**Author(s)**

Xavier Rotllan-Puig

**References**

Prince, S.D., Becker-Reshef, I. and Rishmawi, K. 2009. "Detection and Mapping of Long-Term Land Degradation Using Local Net Production Scaling: Application to Zimbabwe." REMOTE SENSING OF ENVIRONMENT 113 (5): 1046–57

**See Also**

[EFT\\_clust](#)

**Examples**

```
dirctry <- paste0(system.file(package='LPDynR'), "/extdata")
variables_noCor <- rm_multicol(dir2process = dirctry,
                              multicol_cutoff = 0.7)
EFTs_raster <- EFT_clust(obj2clust = variables_noCor,
                        n_clust = 10)
sb <- terra::rast(paste0(system.file(package='LPDynR'), "/extdata/sb_cat.tif"))

LNScaling(EFTs = EFTs_raster[[1]],
          ProdVar = sb)
```

---

LongTermChange

*LongTermChange*

---

**Description**

LongTermChange combines the Steadiness Index with the baseline levels of land productivity and with the change of state along the time series, resulting in a 22-class object (see details)

**Usage**

```
LongTermChange(
  SteadinessIndex = NULL,
  BaselineLevels = NULL,
  StateChange = NULL,
  filename = ""
)
```

**Arguments**

SteadinessIndex	SpatRaster object (or its file name). Steadiness Index (4-class)
BaselineLevels	SpatRaster object (or its file name). Baseline levels of land productivity (beginning of time series; 3-class)
StateChange	SpatRaster object (or its file name). Change of state of land productivity (beginning minus end of time series; 3-class)
filename	Character. Output filename. Optional

**Details**

St1-low-No Change <- 1  
 St1-low-Change 1 categ <- 2  
 St1-low-Change 2 or more categs <- 3  
 St1-medium-No Change <- 4  
 St1-medium-Change 1 categ <- 5  
 St1-medium-Change 2 or more categs <- 6  
 St1-high-No Change <- 7  
 St1-high-Change 1 categ <- 8  
 St1-high-Change 2 or more categs <- 9  
 St2-low-No Change <- 10  
 St2-low-Change 1 categ <- 10  
 St2-low-Change 2 or more categs <- 10  
 St2-medium-No Change <- 11  
 St2-medium-Change 1 categ <- 11  
 St2-medium-Change 2 or more categs <- 11  
 St2-high-No Change <- 12  
 St2-high-Change 1 categ <- 12  
 St2-high-Change 2 or more categs <- 12  
 St3-low-No Change <- 13  
 St3-low-Change 1 categ <- 13  
 St3-low-Change 2 or more categs <- 13  
 St3-medium-No Change <- 14  
 St3-medium-Change 1 categ <- 14  
 St3-medium-Change 2 or more categs <- 14  
 St3-high-No Change <- 15  
 St3-high-Change 1 categ <- 15  
 St3-high-Change 2 or more categs <- 15  
 St4-low-No Change <- 16



```
St4-low-Change 1 categ <- 17
St4-low-Change 2 or more categs <- 18
St4-medium-No Change <- 19
St4-medium-Change 1 categ <- 20
St4-medium-Change 2 or more categs <- 21
St4-high-No Change <- 22
St4-high-Change 1 categ <- 22
St4-high-Change 2 or more categs <- 22
```

Values = 0 in the final map indicates that there is a scarcity of data in the productivity variable (i.e. only 1 year with data), so that the indicator cannot be calculated

**Value**

SpatRaster object

**Author(s)**

Xavier Rotllan-Puig

**See Also**

[steadiness](#), [baseline\\_lev](#), [state\\_change](#)

**Examples**

```
sb <- terra::rast(paste0(system.file(package='LPDynR'), "/extdata/sb_cat.tif"))
SteadinessIndex_raster <- steadiness(obj2process = sb)
BaselineLevels_raster <- baseline_lev(obj2process = sb,
                                     yearsBaseline = 3,
                                     drylandProp = 0.4)
StateChange_raster <- state_change(obj2process = sb,
                                   yearsBaseline = 3)

LongTermChange(SteadinessIndex = SteadinessIndex_raster,
               BaselineLevels = BaselineLevels_raster,
               StateChange = StateChange_raster)
```

---

 LPD\_CombAssess

 LPD\_CombAssess
 

---

### Description

LPD\_CombAssess combines a 'LandProd\_change' map (SpatRaster) with a 'LandProd\_current' map (SpatRaster), giving a 5-classes map ranging from declining to increasing land productivity. 'LandProd\_current' is reclassified into two classes: pixels with less than 'local\_prod\_threshold' (in percentage; 50 by default) of potential local productivity (within the EFT) and pixels with more or equal to 'local\_prod\_threshold'.

If 'LandProd\_current' = NULL, 'LandProd\_change' is directly reclassified into the same 5-classes map without using 'LandProd\_current'. See the ATBD for the way pixels are reclassified.

### Usage

```
LPD_CombAssess(
  LandProd_change = NULL,
  LandProd_current = NULL,
  local_prod_threshold = 50,
  filename = ""
)
```

### Arguments

LandProd_change	SpatRaster object (or its file name). Land Productivity Long Term Change Map
LandProd_current	SpatRaster object (or its file name). Land Productivity Current Status Map
local_prod_threshold	Numeric. Potential local productivity threshold (within the Ecosystem Functional Type) in percentage. Optional. Default = 50
filename	Character. Output filename. Optional

### Details

LandProd\_change c(1:6, 8:9) & LandProd\_current < 'local\_prod\_threshold' <- 1 Declining land productivity

LandProd\_change c(3, 6) & LandProd\_current >= 'local\_prod\_threshold' <- 1 Declining land productivity

LandProd\_change c(7) & LandProd\_current < 'local\_prod\_threshold' <- 2 Early signs of decline of land productivity

LandProd\_change c(1:2, 4:5, 8:9) & LandProd\_current >= 'local\_prod\_threshold' <- 2 Early signs of decline of land productivity

LandProd\_change c(7) & LandProd\_current >= 'local\_prod\_threshold' <- 3 Negative fluctuation (stable, but stressed land prod.)

LandProd\_change c(10:12) <- 3 Negative fluctuation (stable, but stressed land prod.) LandProd\_change c(13:15) <- 4 Positive fluctuation (stable, not stressed land prod.)

LandProd\_change c(16:17, 19) & LandProd\_current < 'local\_prod\_threshold' <- 4 Positive fluctuation (stable, not stressed land prod.)

LandProd\_change c(18, 20:22) & LandProd\_current < 'local\_prod\_threshold' <- 5 Increasing land productivity

LandProd\_change c(16:22) & LandProd\_current >= 'local\_prod\_threshold' <- 5 Increasing land productivity

Values = 0 in the final map indicates that there is a scarcity of data in the productivity variable (i.e. only 1 year with data), so that the indicator cannot be calculated

'local\_prod\_threshold' is the threshold used to classify 'LandProd\_current' into pixels with low or high potential productivity within its Ecosystem Functional Type

### Value

SpatRaster

### Author(s)

Xavier Rotllan-Puig

### See Also

[LongTermChange](#); [LNScaling](#)

### Examples

```
sb <- terra::rast(paste0(system.file(package='LPDynR'), "/extdata/sb_cat.tif"))
SteadinessIndex_raster <- steadiness(obj2process = sb)
BaselineLevels_raster <- baseline_lev(obj2process = sb,
                                     yearsBaseline = 3,
                                     drylandProp = 0.4)
StateChange_raster <- state_change(obj2process = sb,
                                   yearsBaseline = 3)
LandProd_change_raster <- LongTermChange(SteadinessIndex = SteadinessIndex_raster,
                                         BaselineLevels = BaselineLevels_raster,
                                         StateChange = StateChange_raster)

dirctry <- paste0(system.file(package='LPDynR'), "/extdata")
variables_noCor <- rm_multicol(dir2process = dirctry,
                              multicol_cutoff = 0.7)
EFTs_raster <- EFT_clust(obj2clust = variables_noCor,
                       n_clust = 10)

LandProd_current_raster <- LNScaling(EFTs = EFTs_raster[[1]],
                                   ProdVar = sb)

LPD_CombAssess(LandProd_change = LandProd_change_raster,
              LandProd_current = LandProd_current_raster)
```

---

PCAs4clust

*PCAs4clust*

---

## Description

PCAs4clust runs a two-steps process to prepare the data to be clustered

## Usage

```
PCAs4clust(obj2process = NULL, cumul_var_threshold = 0.9, filename = "", ...)
```

## Arguments

obj2process	SpatRaster object (or its file name). Each layer is one variable
cumul_var_threshold	Numeric. Optional (default = 0.9). Threshold of cumulative variance to select the number of useful PCs
filename	Character. Output filename. Optional
...	Optional. Arguments for <a href="#">prcomp</a>

## Details

Firstly, a Principal Component Analysis ('screening PCA') with all the variables in 'obj2process' is run in order to know the optimal number of variables to be used in a subsequent PCA, as well as the most associated variable to those Principal Components (PCs). A threshold of cumulative variance (cumul\_var\_threshold; default = 0.9) is needed. Secondly, a 'final PCA' is run with the results of the 'screening PCA' (i.e. number of PC axes and their most associated variables). PCAs4clust uses [prcomp](#) to run PCAs

## Value

SpatRaster object

## Author(s)

Xavier Rotllan-Puig

## See Also

[rm\\_multicol](#); [prcomp](#)

## Examples

```
dirctry <- paste0(system.file(package='LPDynR'), "/extdata")
variables_noCor <- rm_multicol(dir2process = dirctry,
                              multicol_cutoff = 0.7)
PCAs4clust(obj2process = variables_noCor,
            cumul_var_threshold = 0.9)
```

---

 rm\_multicol

*rm\_multicol*


---

## Description

rm\_multicol calculates the average of each variable and removes those variables highly correlated

## Usage

```
rm_multicol(
  dir2process = NULL,
  yrs2use = NULL,
  multicol_cutoff = 0.7,
  cores2use = 1,
  filename = "",
  ...
)
```

## Arguments

dir2process	Character. Directory where the SpatRaster objects are stored. All the .tif files in the directory will be read in to be used
yrs2use	Numeric. A numeric vector with the years (layers positions) of the time series to be used (e.g. yrs2use = 2:21). Optional. Default (= NULL) uses all years
multicol_cutoff	Numeric. Cutoff value of (Pearson's) correlation. Optional. Default is 0.70
cores2use	Numeric. Number of cores to use for parallelization. Optional. Default is 1 (no parallelization)
filename	Character. Output filename. Optional
...	Optional. Arguments for removeCollinearity()

## Details

Firstly, after reading in all .tif files in 'dir2process', if they are multiband (time series), averages are calculated. Secondly, it creates a SpatRaster object with those (averaged) variables which have a Pearson's correlation coefficient below 'multicol\_cutoff'. See [removeCollinearity](#) for further arguments and functionalities

**Value**

SpatRaster object

**Author(s)**

Xavier Rotllan-Puig

**References**

Leroy B, Meynard CN, Bellard C, Courchamp F (2015). “virtualspecies, an R package to generate virtual species distributions”. *Ecography*. doi: 10.1111/ecog.01388

**See Also**

[removeCollinearity](#)

**Examples**

```
dirctry <- paste0(system.file(package='LPDyrN'), "/extdata") # directory with variables to process
rm_multicol(dir2process = dirctry,
             multicol_cutoff = 0.7,
             plot = TRUE)
```

---

sbd\_cat

*Season Beginning Day*

---

**Description**

SpatRaster object containing time series of phenological data (400 cells; 10 layers). Years 2000-2009. The variable has been derived from MODIS using Timesat

**Usage**

sbd\_cat

**Format**

GeoTIFF. SpatRaster object with dimensions: 20, 20, 400, 10 (nrow, ncol, ncell, nlayers)

**sbd\_cat** Season beginning day

**Details**

Downloaded from [www.eea.europa.eu](http://www.eea.europa.eu) (20/08/2020)

Coord. ref. : +proj=laea +lat\_0=52 +lon\_0=10 +x\_0=4321000 +y\_0=3210000 +ellps=GRS80 +units=m +no\_defs

Resolution : 500, 500 (x, y)

Extent : 3640000, 3650000, 2140000, 2150000 (xmin, xmax, ymin, ymax)

**Source**

<https://www.eea.europa.eu/en/analysis>

**References**

<https://www.eea.europa.eu/data-and-maps/data/annual-start-of-vegetation-growing>

**Examples**

```
terra::rast(paste0(system.file(package='LPDynR'), "/extdata/sbd_cat.tif"))
```

---

sb_cat	<i>Standing Biomass</i>
--------	-------------------------

---

**Description**

SpatRaster object containing time series of land productivity data (400 cells; 10 layers). Years 2000-2009. The variable has been derived from MODIS using Timesat

**Usage**

```
sb_cat
```

**Format**

GeoTIFF. SpatRaster object with dimensions: 20, 20, 400, 10 (nrow, ncol, ncell, nlayers)

**sb\_cat** Standing biomass

**Details**

Downloaded from [www.eea.europa.eu](http://www.eea.europa.eu) (20/08/2020)

Coord. ref. : +proj=laea +lat\_0=52 +lon\_0=10 +x\_0=4321000 +y\_0=3210000 +ellps=GRS80  
+units=m +no\_defs

Resolution : 500, 500 (x, y)

Extent : 3640000, 3650000, 2140000, 2150000 (xmin, xmax, ymin, ymax)

**Source**

<https://www.eea.europa.eu/en/analysis>

**References**

<https://www.eea.europa.eu/data-and-maps/data/annual-above-ground-vegetation-productivity>

**Examples**

```
terra::rast(paste0(system.file(package='LPDynR'), "/extdata/sb_cat.tif"))
```

---

sl_cat	<i>Season Length</i>
--------	----------------------

---

**Description**

SpatRaster object containing time series of phenological data (400 cells; 10 layers). Years 2000-2009. The variable has been derived from MODIS using Timesat

**Usage**

```
sl_cat
```

**Format**

GeoTIFF. SpatRaster object with dimensions: 20, 20, 400, 10 (nrow, ncol, ncell, nlayers)

**sl\_cat** Season Length

**Details**

Downloaded from [www.eea.europa.eu](http://www.eea.europa.eu) (20/08/2020)

Coord. ref. : +proj=laea +lat\_0=52 +lon\_0=10 +x\_0=4321000 +y\_0=3210000 +ellps=GRS80  
+units=m +no\_defs

Resolution : 500, 500 (x, y)

Extent : 3640000, 3650000, 2140000, 2150000 (xmin, xmax, ymin, ymax)

**Source**

<https://www.eea.europa.eu/en/analysis>

**References**

<https://www.eea.europa.eu/data-and-maps/data/annual-above-ground-vegetation-season>

**Examples**

```
terra::rast(paste0(system.file(package='LPDynR'), "/extdata/sl_cat.tif"))
```



---

state_change	<i>state_change</i>
--------------	---------------------

---

### Description

state\_change derives land productivity state change between the beginning and the end of the time series on study, resulting in a 3-class SpatRaster object with (1) no change, (2) changed between 1 and x classes or (3) changed more than x classes, where x can be defined by the user (default is 1)

### Usage

```
state_change(  
  obj2process = NULL,  
  yearsBaseline = 3,  
  changeNclass = 1,  
  cores2use = 1,  
  filename = ""  
)
```

### Arguments

obj2process	SpatRaster object (or its file name). If time series, each layer is one year
yearsBaseline	Numeric. Number of years to be averaged at the beginning and end of the time series. Optional. Default is 3
changeNclass	Numeric. Number of classes changed for classification. Optional. Default is 1
cores2use	Numeric. Number of cores to use for parallelization. Optional. Default is 1 (no parallelization)
filename	Character. Output filename. Optional

### Details

state\_change uses the average of 'yearsBaseline' number of years at the beginning and the end of the time series

### Value

SpatRaster object

### Author(s)

Xavier Rotllan-Puig

## Examples

```
sb <- terra::rast(paste0(system.file(package='LPDynR'), "/extdata/sb_cat.tif"))
state_change(obj2process = sb,
             yearsBaseline = 3,
             changeNclass = 1,
             cores2use = 2)
```

---

steadiness

*steadiness*

---

## Description

steadiness derives the Steadiness Index from a land productivity variable

## Usage

```
steadiness(obj2process = NULL, cores2use = 1, filename = "")
```

## Arguments

obj2process	SpatRaster object (or its file name). If time series, each layer is one year
cores2use	Numeric. Number of cores to use for parallelization. Optional. Default is 1 (no parallelization)
filename	Character. Output filename. Optional

## Details

The Steadiness Index is based on the combination of two metrics calculated per pixel: (1) the slope derived from a linear regression of the different years of the time series and (2) the net change on the same period. It results in a 4-class SpatRaster object ranging from (1) strong negative to (4) strong positive ecosystem dynamics. See Ivits et al. (2013) for further explanations.

Values = 0 in the final map indicates that there is a scarcity of data in the productivity variable (i.e. only 1 year with data), so that the indicator cannot be calculated

## Value

SpatRaster object

## Author(s)

Xavier Rotllan-Puig

## References

Ivits, E., M. Cherlet, W. Mehl, and S. Sommer. 2013. "Ecosystem Functional Units Characterized by Satellite Observed Phenology and Productivity Gradients: A Case Study for Europe." *Ecological Indicators* 27: 17–28. doi:10.1016/j.ecolind.2012.11.010

**Examples**

```
sb <- terra::rast(paste0(system.file(package='LPDynR'), "/extdata/sb_cat.tif"))
steadiness(obj2process = sb)
```

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