Package 'grainchanger'

June 28, 2019

Title Moving-Window and Direct Data Aggregation

Version 0.2.0

Description Data aggregation via moving window or direct methods. Aggregate a fine-resolution raster to a grid. The moving window method smooths the surface using a specified function within a moving window of a specified size and shape prior to aggregation. The direct method simply aggregates to the grid using the specified function. The package differs from other packages offering moving window analysis in 2 key ways: 1. The moving window code has been optimised so that it runs more quickly than \{ }code{raster::focal} or other packages that build on this; 2. It combines moving window and aggregation in a way which can be effectively parallelised.

Depends R (>= 3.3)

License GPL-3

Encoding UTF-8

LazyData true

Imports raster, sf, furrr, checkmate, methods, usethis

Suggests dplyr (>= 0.8-0), testthat, spelling, knitr, rmarkdown, covr, ggplot2, landscapetools, rgdal

RoxygenNote 6.1.1

Language en-GB

VignetteBuilder knitr

URL https://github.com/ropensci/grainchanger

BugReports https://github.com/ropensci/grainchanger/issues

NeedsCompilation no

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R topics documented:

`cat_ls` *Example categorical raster (fine_dat)*

Description

An example map to show functionality on categorical surfaces.

Usage

```
cat_ls
```

Format

A raster layer object.

Details

Generated with `nlm_mpd()` from `NLMR` and classified with `util_classify()` from `landscapetools`.

Source

Sciaini M, Fritsch M, Scherer C, Simpkins CE. NLMR and landscapetools: An integrated environment for simulating and modifying neutral landscape models in R. Methods in Ecology and Evolution. 2018; 00:1-9. https://doi.org/10.1111/2041-210X.13076

Marco Sciaini and Matthias Fritsch (2018). landscapetools: Landscape Utility Toolbox. R package version 0.4.0. https://CRAN.R-project.org/package=landscapetools

cont_ls *Example continuous raster (fine_dat)*

Description

An example map to show functionality on continuous surfaces.

Usage

```
cont_ls
```

Format

A raster layer object.

Details

Generated with `nlm_mpd()` from `NLMR`.

Source

Sciaini M, Fritsch M, Scherer C, Simpkins CE. NLMR and landscapetools: An integrated environment for simulating and modifying neutral landscape models in R. Methods in Ecology and Evolution. 2018; 00:1-9. https://doi.org/10.1111/2041-210X.13076

create_torus *Pad a raster by a specified radius*

Description

This function pads a raster by a specified number of cells, creating the effect of a torus. This function is intended for use on simulated landscapes, in order to avoid edge effects

Usage

```
create_torus(dat, dpad)
```

Arguments

`dat`	The raster dataset to pad
`dpad`	The amount by which to pad the raster (in the same units as the raster)

Details

A torus is an infinite surface where the top joins the bottom, and the left side meets the right side. See https://en.wikipedia.org/wiki/Torus for a full mathematical description.

In this function, the torus effect is achieved by adding the specified number of rows of the top of the raster to the bottom (and vice versa) and the specified number of rows of the right of the raster to the left (and vice versa)

Value

raster. Original raster padded by r cells with torus effect (see Details)

Examples

```
data(cat_ls)
d <- create_torus(dat = cat_ls, dpad = 5)
```

`diversity-metrics` *Diversity metrics*

Description

A range of functions to calculate well known landcover diversity metrics

Usage

```
## S3 method for class 'winmove'
shdi(x, lc_class, d, type, ...)

## S3 method for class 'numeric'
shdi(x, lc_class, ...)

## S3 method for class 'winmove'
shei(x, lc_class, d, type, ...)

## S3 method for class 'numeric'
shei(x, lc_class, ...)
```

Arguments

`x`	numeric, winmove. The data over which to calculate the diversity metrics
`lc_class`	numeric. The class values to include in the diversity metric calculation
`d`	numeric. If `type=circle`, the radius of the circle (in units of the CRS). If `type=rectangle` the dimension of the rectangle (one or two numbers)
`type`	character. The shape of the moving window
`...`	further arguments passed to or from other methods

Details

Currently provided diversity metrics are Shannon diversity and Shannon evenness. Open a new issue (https://github.com/laurajanegraham/grainchanger/issues) to request additional diversity metrics.

Value

If `class(x) == "winmove"`, a smoothed raster with the diversity metric calculated within the specified moving window

If `class(x) == "numeric"`, a single value representing the diversity metric in `x`

References

McGarigal, K. and Marks, B.J., 1995. FRAGSTATS: spatial pattern analysis program for quantifying landscape structure. *Gen. Tech. Rep. PNW-GTR-351. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station. 122 p, 351.*

Examples

```
# load required data
data(cat_ls)

# convert data to object of class winmove
cat_ls <- new("winmove", cat_ls)

# calculate Shannon diversity in a rectangular window of dimension 5
d <- shdi(cat_ls, d = 5, type = "rectangle", lc_class = 1:4)

# convert data to object of class numeric
cat_ls <- raster::values(cat_ls)

# calculate Shannon evenness
d <- shei(cat_ls, lc_class = 1:4)
```

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g_sf *Example grid (coarse_dat)*

Description

An example grid to show functionality when aggregating using an sf object.

Usage

```
g_sf
```

Format

An sf object.

Details

Generated with `nlm_mpd()` and converted to sf.

Source

Sciaini M, Fritsch M, Scherer C, Simpkins CE. NLMR and landscapetools: An integrated environment for simulating and modifying neutral landscape models in R. Methods in Ecology and Evolution. 2018; 00:1-9. https://doi.org/10.1111/2041-210X.13076

`mean` *Arithmetic mean*

Description

An extension to `mean` for objects of class `winmove`

Usage

```
mean(x, ...)

## S3 method for class 'winmove'
mean(x, d, type, ...)
```

Arguments

`x`	RasterLayer. The data over which to calculate the mean value within a moving window
`...`	further arguments passed to or from other methods
`d`	numeric. If `type=circle`, the radius of the circle (in units of the CRS). If `type=rectangle` the dimension of the rectangle (one or two numbers)
`type`	character. The shape of the moving window

Value

RasterLayer. A smoothed raster with the mean calculated within the specified moving window

Examples

```
# load required data
data(cont_ls)

# convert data to object of class winmove
cont_ls <- new("winmove", cont_ls)

# aggregate using a circular window with radius 3
d <- mean(cont_ls, d = 3, type = "circle")
```

nomove_agg *Direct data aggregation*

Description

Calculate the value for a given function for each cell in a larger resolution grid.

Usage

```
nomove_agg(coarse_dat, fine_dat, agg_fun, is_grid = TRUE,
  quiet = FALSE, ...)
```

Arguments

coarse_dat	sf, Raster* or Spatial* object. The coarse grain data (response data) across which to calculate the aggregated function
fine_dat	Raster* object. Raster* object. The fine grain data (predictor / covariate data) to aggregate
agg_fun	function The function to apply. The function fun should take multiple numbers, and return a single number. For example mean, modal, min or max. It should also accept a na.rm argument (or ignore it, e.g. as one of the 'dots' arguments. For example, length will fail, but function(x, ...)na.omit(length(x)) works. See Details
is_grid	logical. Use TRUE (default) if g contains only rectangular cells (i.e. a grid). If g is any other polygon file, this should be set to false
quiet	logical. If FALSE (default) and is_grid == TRUE the user gets a warning that the aggregation assumes all cells are rectangular
...	further arguments passed to or from other methods

Details

grainchanger has several built-in functions. Functions currently included are:

- shdi - Shannon diversity, requires the additional argument lc_class (vector or scalar)
- shei - Shannon evenness, requires the additional argument lc_class (vector or scalar)
- prop - Proportion, requires the additional argument lc_class (scalar)
- var_range - Range (max - min)

Note that nomove_agg can be run in parallel using plan(multiprocess) from the future package.

Value

Raster (if input is Raster) or numeric vector (if input is sp or sf object) containing values calculated for each coarser cell

Examples

```
# load required data
data(g_sf)
data(cont_ls)
data(cat_ls)

# aggregate using mean
d <- nomove_agg(g_sf, cont_ls, mean)

# aggregate using Shannon evenness
d <- nomove_agg(g_sf, cont_ls, shei, lc_class = 1:4)
```

`poly_sf` *Example polygon (coarse_dat)*

Description

An example non-gridded coarse data to show functionality when aggregating using an sf object.

Usage

```
poly_sf
```

Format

An sf object.

Details

Generated with `sf::st_make_grid(sf::st_as_sfc(sf::st_bbox(cont_ls)), cellsize = 13, square = FALSE)`

`prop` *Calculate proportion of a given value*

Description

Calculate the proportion of a given value present within a raster. Useful for calculating land-cover or soil type proportions. Should be used with a categorical raster

Usage

```
prop(x, lc_class, ...)

## S3 method for class 'winmove'
prop(x, lc_class, d, type, ...)

## S3 method for class 'numeric'
prop(x, lc_class, ...)
```

Arguments

x	numeric, winmove. The data over which to calculate the proportion
lc_class	numeric. The class value to calculate the proportion of
...	further arguments passed to or from other methods
d	numeric. If type=circle, the radius of the circle (in units of the CRS). If type=rectangle the dimension of the rectangle (one or two numbers)
type	character. The shape of the moving window

Value

If class(x) == "winmove", a smoothed raster with the proportion of cells of the given class calculated within the specified moving window

If class(x) == "numeric", a single value representing the proportion of values of a given class in x

Examples

```
# load required data
data(cat_ls)

# convert data to object of class winmove
cat_ls <- new("winmove", cat_ls)

# aggregate using a rectangular window with dimension 5 for class 3
d <- prop(cat_ls, d = 5, type = "rectangle", lc_class = 3)

# convert data to object of class numeric
cat_ls <- raster::values(cat_ls)
d <- prop(cat_ls, lc_class = 2)
```

---

var_range *Size of range of values*

Description

Calculates the difference between the maximum and minimum value

Usage

```
var_range(x, ...)

## S3 method for class 'winmove'
var_range(x, d, type, na.rm = TRUE, ...)

## S3 method for class 'numeric'
var_range(x, na.rm = TRUE, ...)
```

Arguments

x	RasterLayer. The data over which to calculate the range size
...	further arguments passed to or from other methods
d	numeric. If type=circle, the radius of the circle (in units of the CRS). If type=rectangle the dimension of the rectangle (one or two numbers)
type	character. The shape of the moving window
na.rm	logical. indicates whether NA values should be stripped before the computation proceeds. na.rm = TRUE is the default

Value

If class(x) == "winmove", a smoothed raster with the size of the range of values calculated within the specified moving window

If class(x) == "numeric", a single value representing the size of the range of values in x

Examples

```
# load required data
data(cat_ls)
data(cont_ls)

# convert data to object of class winmove
cat_ls <- new("winmove", cat_ls)

# aggregate using a rectangular window with dimensions c(2,3)
d <- range(cont_ls, d = c(2,3), type = "rectangle")

# convert data to object of class numeric
cont_ls <- raster::values(cont_ls)
d <- range(cont_ls)
```

---

winmove *Create moving window surface*

Description

Smooth a raster surface using a moving window with a given function, radius and shape.

Usage

```
winmove(fine_dat, d, type = c("circle", "rectangle"), win_fun, ...)
```

Arguments

fine_dat	The raster dataset on which to calculate the moving window function
d	numeric. If type=circle, the radius of the circle (in units of the CRS). If type=rectangle the dimension of the rectangle (one or two numbers).
type	The shape of the moving window
win_fun	function. The function to apply. If not choosing one of the inbuilt grainchanger functions, the function should take multiple numbers, and return a single number. For example mean, modal, min or max. It should also accept a na.rm argument (or ignore it, e.g. as one of the 'dots' arguments. For example, length will fail, but function(x, ...){na.omit(length(x))} works. See Details
...	further arguments passed to or from other methods

Details

grainchanger has several built-in functions. Functions currently included are:

- wm_shei - Shannon evenness, requires the additional argument lc_class (vector or scalar)
- wm_prop - Proportion, requires the additional argument lc_class (scalar)
- wm_classes - Unique number of classes in a categorical landscape
- var_range - Range (max - min)

Value

RasterLayer. A smoothed raster with the moving window values calculated

Examples

```
# load required data
data(cat_ls)
data(cont_ls)

# calculate the moving window mean
d <- winmove(cont_ls, 5, "rectangle", mean)

# calculate the moving window Shannon evenness
d <- winmove(cat_ls, 5, "rectangle", shei, lc_class = 1:4)
```

---

winmove-class *An S4 class for use with winmove functions (extends RasterLayer)*

Description

An S4 class for use with winmove functions (extends RasterLayer). Objects will need to be set to this class in order to be used with the inbuilt winmove functions (e.g. mean, prop, var_range, shdi, shei)

Slots

Slots for RasterLayer and RasterBrick objects

`title`: Character

`file`: Object of class `".RasterFile"`

`data`: Object of class `".SingleLayerData"` or `".MultipleLayerData"`

`history`: To record processing history, not yet in use

`legend`: Object of class `.RasterLegend`, Default legend. Should store preferences for plotting. Not yet implemented except that it stores the color table of images, if available

`extent`: Object of `Extent-class`

`ncols`: Integer

`nrows`: Integer

`crs`: Object of class `"CRS"`, i.e. the coordinate reference system. In Spatial* objects this slot is called 'proj4string'

Examples

```
# load required data
data(cat_ls)

# set \code{cat_ls} to object of class winmove
new("winmove", cat_ls)
```

`winmove_agg` *Moving-window data aggregation*

Description

Calculate the mean moving window value for a given radius, shape and function for each cell in a larger resolution grid.

Usage

```
winmove_agg(coarse_dat, fine_dat, d, type = c("circle", "rectangle"),
  win_fun, agg_fun = mean, is_grid = TRUE, quiet = FALSE, ...)
```

Arguments

`coarse_dat`	sf, Raster* or Spatial* object. The coarse grain data (response data) across which to calculate the aggregated moving window function
`fine_dat`	Raster* object. The fine grain data (predictor / covariate data) to aggregate
`d`	numeric. If `type=circle`, the radius of the circle (in units of the CRS). If `type=rectangle` the dimension of the rectangle (one or two numbers).

type	character. The shape of the moving window
win_fun	character. The function to apply to the moving window. The function win_fun should take multiple numbers, and return a single number. For example mean, modal, min or max. It should also accept a na.rm argument (or ignore it, e.g. as one of the 'dots' arguments. For example, length will fail, but function(x, ...){na.omit(length(x)) works. See Details
agg_fun	character. The function by which to aggregate. By default this is set to mean
is_grid	logical. Use TRUE (default) if g contains only rectangular cells (i.e. a grid). If g is any other polygon file, this should be set to false
quiet	logical. If FALSE (default) and is_grid == TRUE the user gets a warning that the aggregation assumes all cells are rectangular
...	further arguments passed to or from other methods

Details

grainchanger has several built-in functions. Functions currently included are:

- shdi - Shannon diversity, requires the additional argument lc_class (vector or scalar)
- shei - Shannon evenness, requires the additional argument lc_class (vector or scalar)
- prop - Proportion, requires the additional argument lc_class (scalar)
- var_range - Range (max - min)

Note that winmove_agg can be run in parallel using plan(multiprocess) from the future package.

Value

Numeric vector containing moving window values calculated for each grid cell

Examples

```
# load required data
data(g_sf)
data(cont_ls)
data(cat_ls)

# aggregate using mean
d <- winmove_agg(g_sf, cont_ls, 5, "rectangle", mean)

# aggregate using Shannon evenness
d <- winmove_agg(g_sf, cat_ls, 5, "rectangle", shei, lc_class = 1:4)
```

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