

Package ‘rasterVis’

November 20, 2021

Type Package

Title Visualization Methods for Raster Data

Version 0.51.1

Encoding UTF-8

Description Methods for enhanced visualization and interaction with raster data. It implements visualization methods for quantitative data and categorical data, both for univariate and multivariate rasters. It also provides methods to display spatiotemporal rasters, and vector fields. See the website for examples.

URL <https://oscarperpinan.github.io/rastervis/>

BugReports <https://github.com/oscarperpinan/rastervis/issues>

License GPL-3

LazyLoad yes

Depends R (>= 3.0.0), methods, lattice (>= 0.20-41)

Imports raster (>= 3.4-13), terra (>= 1.4-9), latticeExtra, stats, utils, parallel, grid, grDevices, RColorBrewer, hexbin, sp (>= 1.0-6), zoo, viridisLite

Suggests rgl, ggplot2, colorspace, dichromat, sf

NeedsCompilation no

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Repository CRAN

Date/Publication 2021-11-20 20:10:01 UTC

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rasterVis-package	<i>Visualization Methods for Raster Data</i>
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Description

Methods for enhanced visualization and interaction with raster data. It implements visualization methods for quantitative data and categorical data, both for univariate and multivariate rasters. It also provides methods to display spatiotemporal rasters, and vector fields. See the website for examples.

Details

The rasterVis package complements the raster and terra packages, providing a set of methods for enhanced visualization and interaction. This package defines visualization methods with levelplot for quantitative data and categorical data, both for univariate and multivariate rasters.

It also includes several methods in the frame of the Exploratory Data Analysis approach: scatterplots with xyplot, histograms and density plots with histogram and densityplot, violin and boxplots with bwplot, and a matrix of scatterplots with spjom.

On the other hand, this package is able to display vector fields using arrows, vectorplot, or with streamlines, streamplot.

Index of help topics:

bwplot	Box and whisker plots of Raster objects.
densityplot	Density plots for Raster objects.
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plot3D	Interactive 3D plot of a RasterLayer
rasterTheme	Themes for 'raster' with 'lattice'.
rasterVis-package	Visualization Methods for Raster Data
splom	Scatter plot matrices of Raster objects.
vectorplot	Vector plots of Raster objects.
xyLayer	xyLayer
xyplot	xyplot for Raster objects

bwplot-methods *Box and whisker plots of Raster objects.*

Description

Methods for bwplot and RasterStackBrick objects using a combination of [panel.violin](#) and [panel.bwplot](#) to compose the graphic.

Usage

```
## S4 method for signature 'RasterStackBrick,missing'
bwplot(x, data=NULL, layers, FUN,
       maxpixels = 1e+05,
       xlab='', ylab='', main='',
       violin = TRUE, draw.points = FALSE, do.out = FALSE,
       par.settings = bwTheme(),
       violin.ratio = 1, box.ratio = 0.5,
       scales=list(x=list(rot=45, cex=0.8)),
       ...)

## S4 method for signature 'formula,Raster'
bwplot(x, data, dirXY,
       maxpixels = 1e+05,
       xscale.components=xscale.raster,
       yscale.components=yscale.raster,
       horizontal=FALSE,
       violin = TRUE, draw.points = FALSE, do.out = FALSE,
       violin.ratio = 1, box.ratio = 0.5,
       par.settings = bwTheme(),
       ...)

## S4 method for signature 'SpatRaster,missing'
bwplot(x, data=NULL, layers, FUN,
       maxpixels = 1e+05,
       xlab='', ylab='', main='',
       violin = TRUE, draw.points = FALSE, do.out = FALSE,
       par.settings = bwTheme(),
       violin.ratio = 1, box.ratio = 0.5,
       scales=list(x=list(rot=45, cex=0.8)),
       ...)
```

```
## S4 method for signature 'formula,SpatRaster'
bwplot(x, data, dirXY,
       maxpixels = 1e+05,
       xscale.components=xscale.raster,
       yscale.components=yscale.raster,
       horizontal=FALSE,
       violin = TRUE, draw.points = FALSE, do.out = FALSE,
       violin.ratio = 1, box.ratio = 0.5,
       par.settings = bwTheme(),
       ...)
```

Arguments

x	A RasterStackBrick object, a SpatRaster object, or a formula.
data	NULL, a Raster object, or a SpatRaster object.
layers	A numeric or character which should indicate the layers to be displayed.
dirXY	A direction as a function of the coordinates (see xyLayer).
FUN	A function to applied to the z slot of a RasterStackBrick object, or the time index of a SpatRaster object. The result of this function is used as the grouping variable of the plot.
maxpixels	A numeric, for sampleRandom or spatSample .
xscale.components, yscale.components	Graphical parameters of lattice. See xyplot for details.
horizontal	Defaults to FALSE, meaning that the right hand of the formula is a factor or shingle.
xlab, ylab, main	Labels for axis and title.
violin	Logical, if TRUE the panel is built with <code>panel.violin</code> and <code>panel.bwplot</code> .
draw.points	Logical, if TRUE raw points are displayed in the background with <code>panel.stripplot</code>
do.out	Logical, if TRUE outliers are drawn.
box.ratio	ratio of box thickness to inter box space
violin.ratio	ratio of the thickness of each violin and inter violin space
par.settings, scales	See xyplot for details.
...	Additional arguments for bwplot

Author(s)

Oscar Perpiñán Lamigueiro

See Also

[bwplot](#), [panel.violin](#), [subset](#), [bwTheme](#)

Examples

```

library(raster)
library(terra)

f <- system.file("external/test.grd", package="raster")
r <- raster(f)
s <- stack(r, r-500, r+500)
bwplot(s)

bwplot(s, violin = FALSE, box.ratio = 1)

## Modify colours
myTheme <- bwTheme(
  box.rectangle = list(col = 'green', fill = 'lightgreen'),
  plot.polygon = list(col = 'blue'),
  plot.symbol = list(col = 'gray', cex = 0.8, alpha = 0.1)
)
## Display raw points
bwplot(s, draw.points = TRUE,
       par.settings = myTheme)

## Not run:

dataURL <- "https://raw.githubusercontent.com/oscarperpinan/bookvis/master/data/"

##Solar irradiation data from CMSAF http://dx.doi.org/10.5676/EUM\_SAF\_CM/RAD\_MVIRI/V001
old <- setwd(tempdir())
download.file(paste0(dataURL, "SISmm2008_CMSAF.zip"),
             "SISmm2008_CMSAF.zip", method='wget')
unzip("SISmm2008_CMSAF.zip")

listFich <- dir(pattern='\\.nc')
stackSIS <- stack(listFich)
stackSIS <- stackSIS*24 ##from irradiance (W/m2) to irradiation Wh/m2
setwd(old)

idx <- seq(as.Date('2008-01-15'), as.Date('2008-12-15'), 'month')

SISmm <- setZ(stackSIS, idx)
names(SISmm) <- month.abb

bwplot(SISmm)

##FUN applies to z if not NULL
library(zoo)

bwplot(SISmm, FUN=as.yearqtr)

## End(Not run)
## Not run:
##http://neo.sci.gsfc.nasa.gov/Search.html?group=64
old <- setwd(tempdir())

```

```

download.file(paste0(dataURL, "875430rgb-167772161.0.FLOAT.TIFF"),
              "875430rgb-167772161.0.FLOAT.TIFF", method='wget')

pop <- raster("875430rgb-167772161.0.FLOAT.TIFF")
pop[pop==99999] <- NA
levelplot(pop, zscaleLog=10, par.settings=BTCTheme,
          panel=panel.levelplot.raster, interpolate=TRUE)

##http://neo.sci.gsfc.nasa.gov/Search.html?group=20
download.file(paste0(dataURL, "241243rgb-167772161.0.TIFF"),
              "241243rgb-167772161.0.TIFF", method='wget')
landClass <- raster("241243rgb-167772161.0.TIFF")
landClass[landClass==254] <- NA

s <- stack(pop, landClass)
names(s) <- c('pop', 'landClass')

bwplot(asinh(pop) ~ landClass|cut(y, 3), data = s,
       layout = c(3, 1))

bwplot(asinh(pop) ~ cut(y, 5)|landClass, data = s,
       scales = list(x=list(rot=45)), layout = c(4, 5),
       strip = strip.custom(strip.levels = TRUE))

## Modify colours
bwplot(asinh(pop) ~ cut(y, 5)|landClass, data = s,
       scales = list(x=list(rot=45)), layout = c(4, 5),
       strip = strip.custom(strip.levels = TRUE),
       par.settings = bwTheme(plot.polygon = list(col = 'lightgray'),
                              box.rectangle = list(fill = 'lightgreen')))

## End(Not run)

```

densityplot-methods *Density plots for Raster objects.*

Description

Draw kernel density plots (with lattice) of Raster objects.

Usage

```

## S4 method for signature 'Raster,missing'
densityplot(x, data=NULL, layers, FUN,
            maxpixels = 1e+05,
            xlab='', ylab='', main='',
            par.settings=rasterTheme(),
            draw.labels = TRUE,
            auto.key = list(space = "right"),

```

```

        att = 1,
        ...)

## S4 method for signature 'formula,Raster'
densityplot(x, data, dirXY,
            maxpixels = 1e+05,
            xscale.components=xscale.raster,
            yscale.components=yscale.raster,
            auto.key = list(space = 'right'),
            par.settings=rasterTheme(),...)

## S4 method for signature 'SpatRaster,missing'
densityplot(x, data=NULL, layers, FUN,
            maxpixels = 1e+05,
            xlab='', ylab='', main='',
            par.settings=rasterTheme(),
            draw.labels = TRUE,
            auto.key = list(space = "right"),
            att = 1,
            ...)

## S4 method for signature 'formula,SpatRaster'
densityplot(x, data, dirXY,
            maxpixels = 1e+05,
            xscale.components=xscale.raster,
            yscale.components=yscale.raster,
            auto.key = list(space = 'right'),
            par.settings=rasterTheme(),...)

```

Arguments

<code>x</code>	A Raster* object, a SpatRaster object, or a formula.
<code>data</code>	NULL, a Raster object, or a SpatRaster object.
<code>layers</code>	A numeric or character which should indicate the layers to be displayed.
<code>dirXY</code>	A direction as a function of the coordinates (see xyLayer).
<code>FUN</code>	A function to applied to the z slot of a RasterStackBrick object or to the time index of a SpatRaster object. The result of this function is used as the grouping variable of the plot.
<code>maxpixels</code>	A numeric, for sampleRandom or spatSample .
<code>draw.labels</code>	Logical. If TRUE (default), labels are displayed over the maximum value of each layer. If FALSE, a key is displayed according to the <code>auto.key</code> argument.
<code>xlab, ylab, main, xscale.components, yscale.components, par.settings, auto.key</code>	Arguments for densityplot .
<code>att</code>	Integer or character to choose which variable (column) in the RAT table should be used.

... Additional arguments for `densityplot`

Author(s)

Oscar Perpiñán Lamigueiro

See Also

`lattice:densityplot()`, `xscale.raster`, `yscale.raster`, `rasterTheme`

Examples

```
library(raster)
library(terra)

f <- system.file("external/test.grd", package="raster")
r <- raster(f)
densityplot(r)
s <- stack(r, r+500, r-500)
## With labels
densityplot(s)
## With a key
densityplot(s, draw.labels = FALSE)

## Not run:

dataURL <- "https://raw.githubusercontent.com/oscarperpinan/bookvis/master/data/"

##Solar irradiation data from CMSAF http://dx.doi.org/10.5676/EUM_SAF_CM/RAD_MVIRI/V001
old <- setwd(tempdir())
download.file(paste0(dataURL, "SISmm2008_CMSAF.zip"),
             "SISmm2008_CMSAF.zip", method='wget')
unzip("SISmm2008_CMSAF.zip")

listFich <- dir(pattern='\\.nc')
stackSIS <- stack(listFich)
stackSIS <- stackSIS*24 ##from irradiance (W/m2) to irradiation Wh/m2
setwd(old)

idx <- seq(as.Date('2008-01-15'), as.Date('2008-12-15'), 'month')

SISmm <- setZ(stackSIS, idx)
names(SISmm) <- month.abb

densityplot(SISmm)
##FUN applies to z if not NULL
densityplot(SISmm, FUN=as.yearqtr)

## End(Not run)
## Not run:
##http://neo.sci.gsfc.nasa.gov/Search.html?group=64
pop <- raster('875430rgb-167772161.0.FLOAT.TIFF')
pop[pop==99999] <- NA
```



```

levelplot(pop, zscaleLog=10, par.settings=BTCTheme,
           panel=panel.levelplot.raster, interpolate=TRUE)

##http://neo.sci.gsfc.nasa.gov/Search.html?group=20
landClass <- raster('241243rgb-167772161.0.TIFF')
landClass[landClass==254] <- NA

s <- stack(pop, landClass)
names(s) <- c('pop', 'landClass')

densityplot(~asinh(pop)|landClass, data=s,
            scales=list(relation='free'),
            strip=strip.custom(strip.levels=TRUE))

## End(Not run)

```

Formula methods

Formula methods

Description

Formula methods

Usage

```

## S4 method for signature 'formula,Raster'
xyplot(x, data, dirXY, maxpixels=1e5,
        alpha=0.05,
        xscale.components=xscale.raster, yscale.components=yscale.raster,
        par.settings=rasterTheme(),...)
## S4 method for signature 'formula,Raster'
hexbinplot(x, data, dirXY, maxpixels=1e6,
            xscale.components=xscale.raster, yscale.components=yscale.raster,
            par.settings=rasterTheme(),...)
## S4 method for signature 'formula,SpatRaster'
xyplot(x, data, dirXY, maxpixels=1e5,
        alpha=0.05,
        xscale.components=xscale.raster, yscale.components=yscale.raster,
        par.settings=rasterTheme(),...)
## S4 method for signature 'formula,SpatRaster'
hexbinplot(x, data, dirXY, maxpixels=1e6,
            xscale.components=xscale.raster, yscale.components=yscale.raster,
            par.settings=rasterTheme(),...)

```

Arguments

x A formula describing the variables to be related. It may include the layer names (which are internally converted to valid ones with [make.names](#)) and the x, y

variables representing the coordinates of the Raster object. Besides, if `dirXY` is not missing, the variable `dirXY` can also be included in the formula.

`data` A Raster object or a `SpatRaster` object.

`dirXY` A direction as a function of the coordinates (see `xyLayer`).

`maxpixels` A numeric, for `sampleRegular` or `spatSample`.

`alpha` A numeric, transparency of the points.

`xscale.components`, `yscale.components`, `par.settings`
Customization of `lattice`. See `xyplot` for details.

... Additional arguments for the `xyplot` and `hexbinplot` functions.

Author(s)

Oscar Perpiñán Lamigueiro

Examples

```
library(raster)
library(terra)

f <- system.file("external/test.grd", package="raster")
r <- raster(f)
names(r)

xyplot(test~y, data=r, alpha=0.5)

## Not run:
dataURL <- "https://raw.githubusercontent.com/oscarperpinan/bookvis/master/data/"

##Solar irradiation data from CMSAF http://dx.doi.org/10.5676/EUM_SAF_CM/RAD_MVIRI/V001
old <- setwd(tempdir())
download.file(paste0(dataURL, "SISmm2008_CMSAF.zip"),
             "SISmm2008_CMSAF.zip", method='wget')
unzip("SISmm2008_CMSAF.zip")

listFich <- dir(pattern='\\.nc')
stackSIS <- stack(listFich)
SISmm <- stackSIS*24 ##from irradiance (W/m2) to irradiation Wh/m2
setwd(old)

names(SISmm) <- month.abb

##Relation between the January & February versus July radiation for four
##different longitude regions.
xyplot(Jan+Feb~Jul|cut(x, 4), data=SISmm, auto.key=list(space='right'))
##Faster with hexbinplot
hexbinplot(Jan~Jul|cut(x, 6), data=SISmm)

## End(Not run)
```

`gplot-methods`*Use ggplot to plot a Raster* or a SpatRaster object.*

Description

A wrapper function around `ggplot` (ggplot2 package). Note that the function in the raster package is called `gplot` with a single 'g'.

Usage

```
## S4 method for signature 'Raster'  
gplot(x, maxpixels=50000,...)  
## S4 method for signature 'SpatRaster'  
gplot(x, maxpixels=50000,...)
```

Arguments

<code>x</code>	A Raster* or SpatRaster object
<code>maxpixels</code>	Maximum number of pixels to use
<code>...</code>	Additional arguments for ggplot

Author(s)

Robert J. Hijmans and Oscar Perpiñán; based on an example by Paul Hiemstra

See Also

[plot](#), [splot](#)

Examples

```
## Not run:  
library(raster)  
library(terra)  
  
r <- raster(system.file("external/test.grd", package="raster"))  
  
s1 <- stack(r, r*2)  
names(s1) <- c('meuse', 'meuse x 2')  
  
library(ggplot2)  
  
theme_set(theme_bw())  
  
## With raster  
gplot(s1) + geom_tile(aes(fill = value)) +  
  facet_wrap(~ variable) +
```

```

        scale_fill_gradient(low = 'white', high = 'blue') +
        coord_equal()

## With terra
s2 <- rast(s1)
gplot(s2) + geom_tile(aes(fill = value)) +
  facet_wrap(~ variable) +
  scale_fill_gradient(low = 'white', high = 'blue') +
  coord_equal()

## End(Not run)

```

histogram-methods *Histogram of Raster objects.*

Description

Draw histograms (with lattice) of Raster objects.

Usage

```

## S4 method for signature 'Raster,missing'
histogram(x, data=NULL, layers, FUN,
  maxpixels = 1e+05, nint=100,
  xlab='', ylab='', main='', col='gray',
  between=list(x=0.5, y=0.2),
  as.table=TRUE,
  scales=list(x=list(relation='free'),
    y=list(relation='free',
      draw=FALSE)),
  names.attr,
  par.settings=rasterTheme(),
  att = 1,
  ...)

```

```

## S4 method for signature 'SpatRaster,missing'
histogram(x, data=NULL, layers, FUN,
  maxpixels = 1e+05, nint=100,
  xlab='', ylab='', main='', col='gray',
  between=list(x=0.5, y=0.2),
  as.table=TRUE,
  scales=list(x=list(relation='free'),
    y=list(relation='free',
      draw=FALSE)),
  names.attr,
  par.settings=rasterTheme(),
  att = 1,
  ...)

```

```
## S4 method for signature 'formula,Raster'
histogram(x, data, dirXY,
          maxpixels = 1e+05,
          strip=TRUE,
          par.settings=rasterTheme(),
          att = 1,
          ...)

## S4 method for signature 'formula,SpatRaster'
histogram(x, data, dirXY,
          maxpixels = 1e+05,
          strip=TRUE,
          par.settings=rasterTheme(),
          att = 1,
          ...)
```

Arguments

x	A Raster* object, a SpatRaster object or a formula.
data	NULL, a Raster object, or SpatRaster object.
layers	A numeric or character which should indicate the layers to be displayed.
dirXY	A direction as a function of the coordinates (see xyLayer).
FUN	A function to applied to the z slot of a RasterStackBrick object or to the time index of the SpatRaster object. The result of this function is used as the grouping variable of the plot.
nint	Number of breaks for the histogram. See the documentation of <code>lattice::histogram</code> at <code>lattice</code> for details.
maxpixels	A numeric, for sampleRandom or <code>spatSample</code> .
att	If x is a factor, integer or character to choose which variable (column) in the RAT table should be used.
xlab, ylab, main, col	Arguments for histogram .
names.attr	Character or expression, names to use in each panel. If missing its default value is the result of <code>names(x)</code> (after subsetting the layers to be displayed).
between, as.table, scales, strip, par.settings	Graphical parameters of <code>lattice</code> . See <code>lattice::xyplot</code> for details.
...	Additional arguments for <code>lattice::histogram</code>

Note

If you need different breakpoints in each panel, set breaks explicitly with NULL, a numeric or a character (for example, 'Sturges'; see [hist](#) for details)

Author(s)

Oscar Perpiñán Lamigueiro

See Also[histogram,xscale.raster](#), [yscale.raster](#), [rasterTheme](#)**Examples**

```

library(raster)
library(terra)

f <- system.file("external/test.grd", package="raster")
r <- raster(f)
histogram(r)
s <- stack(r, r+500, r-500)
## Same breakpoints across panels
histogram(s)
## Each panel with different breakpoints
histogram(s, breaks=NULL)
histogram(s, breaks='Sturges')
histogram(s, breaks=30)

## Categorical data
r <- raster(nrow=10, ncol=10)
r[] = 1
r[51:100] = 3
r[3:6, 1:5] = 5
r <- ratify(r)

rat <- levels(r)[[1]]
rat$landcover <- c('Pine', 'Oak', 'Meadow')
rat$class <- c('A1', 'B2', 'C3')
levels(r) <- rat

histogram(r)
histogram(r, att = "class")

## Not run:
library(zoo)

dataURL <- "https://raw.githubusercontent.com/oscarperpinan/bookvis/master/data/"

##Solar irradiation data from CMSAF http://dx.doi.org/10.5676/EUM_SAF_CM/RAD_MVIRI/V001
old <- setwd(tempdir())
download.file(paste0(dataURL, "SISmm2008_CMSAF.zip"),
             "SISmm2008_CMSAF.zip", method='wget')
unzip("SISmm2008_CMSAF.zip")

listFich <- dir(pattern='\\.nc')
stackSIS <- stack(listFich)
stackSIS <- stackSIS*24 ##from irradiance (W/m2) to irradiation Wh/m2

```

```

idx <- seq(as.Date('2008-01-15'), as.Date('2008-12-15'), 'month')

SISmm <- setZ(stackSIS, idx)
names(SISmm) <- month.abb

histogram(SISmm)
histogram(SISmm, FUN=as.yearqtr)

## With the formula interface you can create histograms for a set of variables
histogram(~ Jan + Dec, data=SISmm)
## Or use the coordinates for generating zonal histograms.
## For example, five histograms for each latitude zone
histogram(~ Jan | cut(dirXY, 5), dirXY = y, data=SISmm)
## More sophisticated bands can be defined using the dirXY argument
histogram(~ Jan | cut(dirXY, 5), dirXY = x^2 + y^2, data=SISmm)

setwd(old)

## End(Not run)

## Not run:
##http://neo.sci.gsfc.nasa.gov/Search.html?group=64
pop <- raster('875430rgb-167772161.0.FLOAT.TIFF')
pop[pop==99999] <- NA
levelplot(pop, zscaleLog=10, par.settings=BTCTheme,
          panel=panel.levelplot.raster, interpolate=TRUE)

##http://neo.sci.gsfc.nasa.gov/Search.html?group=20
landClass <- raster('241243rgb-167772161.0.TIFF')
landClass[landClass==254] <- NA

s <- stack(pop, landClass)
names(s) <- c('pop', 'landClass')

histogram(~asinh(pop)|landClass, data=s,
          scales=list(relation='free'),
          strip=strip.custom(strip.levels=TRUE))

## End(Not run)

```

horizonplot-methods *Horizon plots of Raster objects.*

Description

This method draws horizon graphs for each zone as calculated with zonal from the directions defined by xyLayer

Usage

```
## S4 method for signature 'RasterStackBrick,missing'
horizonplot(x, data = NULL,
            dirXY = y, stat = 'mean', digits = 0,
            origin = mean,
            xlab = 'Time', ylab = 'direction',
            colorkey = TRUE, colorkey.digits = 1,
            scales=list(y = list(relation = "same")),
            ...)

## S4 method for signature 'SpatRaster,missing'
horizonplot(x, data = NULL,
            dirXY = y, stat = 'mean', digits = 0,
            origin = mean,
            xlab = 'Time', ylab = 'direction',
            colorkey = TRUE, colorkey.digits = 1,
            scales=list(y = list(relation = "same")),
            ...)
```

Arguments

x	A RasterStackBrick object or a SpatRaster object.
data	Not used.
dirXY	A direction as a function of the coordinates (see xyLayer).
stat	a function to be applied to summarize the values by zone. See zonal for details.
digits	An integer, number of digits for zonal .
origin	From the <code>latticeExtra</code> help page: "the baseline y value for the first (positive) segment (i.e. the value at which red changes to blue)." It can be: a number, used across all panels, or a function (or a character defining a function), evaluated with the values in each panel. The default is the mean function.
xlab, ylab	Labels of the axis.
colorkey	If <code>colorkey = TRUE</code> a suitable color scale bar is constructed using the values of origin and <code>horizonscale</code> (see below). For additional information see levelplot .
colorkey.digits	Digits for rounding values in colorkey labels
scales	From the <code>lattice::xyplot</code> help page: "A list determining how the x- and y-axes (tick marks and labels) are drawn. The list contains parameters in name=value form, and may also contain two other lists called x and y of the same form. Components of x and y affect the respective axes only, while those in scales affect both. When parameters are specified in both lists, the values in x or y are used." In <code>horizonplot</code> the most interesting component is <code>relation</code> , a character string that determines how axis limits are calculated for each panel. Possible values are "same" (default), "free" and "sliced". "For 'relation="same"', the same limits, usually large enough to encompass all the data, are used for all the panels. For 'relation="free"', limits for each panel is determined by just the points

in that panel. Behavior for 'relation="sliced"' is similar, except that the length (max - min) of the scales are constrained to remain the same across panels."

... Additional arguments for the horizonplot function. horizonscale is the most interesting, being (from the latticeExtra help page) "the scale of each color segment. There are 3 positive segments and 3 negative segments. If this is a given as a number then all panels will have comparable distances, though not necessarily the same actual values (similar in concept to 'scales\$relation = "sliced"'). On the other hand, col.regions is used to choose the color scale.

Details

(Extracted from the reference): "The horizon graph allows to examine how a large number of items changed through time, to spot extraordinary behaviors and predominant patterns, view each of the items independently from the others when they wish, make comparisons between the items, and view changes that occurred with enough precision to determine if further examination is required."

References

<http://vis.berkeley.edu/papers/horizon/2009-TimeSeries-CHI.pdf>

See Also

[horizonplot](#), [xyplot](#), [levelplot](#).

Examples

```
## Not run:
library(raster)
library(terra)
library(zoo)

url <- "ftp://ftp.wiley.com/public/sci_tech_med/spatio_temporal_data/"
sst.dat = read.table(paste(url, "SST011970_032003.dat", sep=''), header = FALSE)
sst.ll = read.table(paste(url, "SSTlonlat.dat", sep=''), header = FALSE)

spSST <- SpatialPointsDataFrame(sst.ll, sst.dat)
gridded(spSST) <- TRUE
proj4string(spSST) = "+proj=longlat +datum=WGS84"
SST <- brick(spSST)

idx <- seq(as.Date('1970-01-01'), as.Date('2003-03-01'), by='month')
idx <- as.yearmon(idx)
SST <- setZ(SST, idx)
names(SST) <- as.character(idx)

horizonplot(SST)

horizonplot(SST, stat='sd')

## Different scales for each panel, with colors representing deviations
## from the origin in *that* panel
```

```

horizonplot(SST, scales=list('free'))

## origin may be a function...
horizonplot(SST, origin=mean)
## ...or a number
horizonplot(SST, origin=0)

## A different color palette
pal <- RColorBrewer::brewer.pal(n=6, 'PuOr')
horizonplot(SST, origin = 0, col.regions = pal)

## The width of each color segment can be defined with horizonscale
horizonplot(SST, horizonscale=1, origin=0)

## End(Not run)

## Not run:

dataURL <- "https://raw.githubusercontent.com/oscarperpinan/bookvis/master/data/"

##Solar irradiation data from CMSAF http://dx.doi.org/10.5676/EUM_SAF_CM/RAD_MVIRI/V001
old <- setwd(tempdir())
download.file(paste0(dataURL, "SISmm2008_CMSAF.zip"),
              "SISmm2008_CMSAF.zip", method='wget')
unzip("SISmm2008_CMSAF.zip")

listFich <- dir(pattern='\\.nc')
stackSIS <- stack(listFich)
stackSIS <- stackSIS*24 ##from irradiance (W/m2) to irradiation Wh/m2
setwd(old)

idx <- seq(as.Date('2008-01-15'), as.Date('2008-12-15'), 'month')

SISmm <- setZ(stackSIS, idx)
names(SISmm) <- month.abb

horizonplot(SISmm)

## End(Not run)

```

Description

Hovmoller plots of Raster objects.

Usage

```
## S4 method for signature 'RasterStackBrick'
hovmoller(object, dirXY=y, FUN=mean,
  digits=2, xlab='Direction', ylab='Time',
  par.settings=rasterTheme(), xscale.components=xscale.raster,
  add.contour=FALSE, labels=FALSE, region=TRUE, ...)

## S4 method for signature 'SpatRaster'
hovmoller(object, dirXY=y, FUN=mean,
  digits=2, xlab='Direction', ylab='Time',
  par.settings=rasterTheme(), xscale.components=xscale.raster,
  add.contour=FALSE, labels=FALSE, region=TRUE, ...)
```

Arguments

object	A RasterStackBrick with a non-empty z slot, or a SpatRaster with a time index.
dirXY	A direction as a function of the coordinates (see xyLayer).
FUN	A function to be applied to the zones calculated with <code>dirXY</code> and <code>zonal</code> .
digits	An integer, number of digits for <code>zonal</code> .
xlab, ylab	Labels of the axis.
par.settings	Customization of lattice. See levelplot and rasterTheme for details.
xscale.components	See xscale.raster .
labels, region	Customization of contourplot when <code>add.contour</code> is TRUE.
add.contour	Logical, if TRUE a contourplot with filled regions is drawn.
...	Additional arguments for the contourplot and levelplot functions.

Details

Extracted from wikipedia: "A Hovmöller diagram is a commonly used way of plotting meteorological data to highlight the role of waves. The axes of a Hovmöller diagram are typically longitude or latitude (abscissa or x-axis) and time (ordinate or y-axis) with the value of some field represented through color or shading." The direction defined by `dirXY` and the function `FUN` allows for a variety of diagrams with this method.

Author(s)

Oscar Perpiñán Lamigueiro

References

- Hovmoller, E. 1949. The trough and ridge diagram. *Tellus* 1, 62–66.
- <https://www2.mmm.ucar.edu/episodes/Hovmoller/noJS/hovm200707.htm>
- <https://psl.noaa.gov/map/clim/sst.shtml>

See Also

[levelplot](#), [zonal](#), [panel.2dsmoother](#)

Examples

```
## Not run:
library(raster)
library(terra)

dataURL <- "https://raw.githubusercontent.com/oscarperpinan/bookvis/master/data/"

##Solar irradiation data from CMSAF http://dx.doi.org/10.5676/EUM_SAF_CM/RAD_MVIRI/V001
old <- setwd(tempdir())
download.file(paste0(dataURL, "SISmm2008_CMSAF.zip"),
             "SISmm2008_CMSAF.zip", method='wget')
unzip("SISmm2008_CMSAF.zip")

listFich <- dir(pattern='\\.nc')
stackSIS <- stack(listFich)
stackSIS <- stackSIS*24 ##from irradiance (W/m2) to irradiation Wh/m2

idx <- seq(as.Date('2008-01-15'), as.Date('2008-12-15'), 'month')

SISmm <- setZ(stackSIS, idx)
names(SISmm) <- month.abb

SISmmt <- rast(SISmm)
time(SISmmt) <- getZ(SISmm)

## Latitude as default
hovmoller(SISmm, xlab='Latitude')
hovmoller(SISmmt, xlab = 'Latitude')

## With contour lines and labels
hovmoller(SISmm, labels=TRUE, add.contour=TRUE,
          xlab='Latitude')

## Smooth color regions with latticeExtra::panel.2dsmoother
hovmoller(SISmm, panel=panel.2dsmoother, n=1000,
          labels=FALSE, add.contour=TRUE,
          xlab='Latitude')

## Using a function of coordinates
hovmoller(SISmm, dirXY=sqrt(x^2+y^2))

## End(Not run)

## Not run:
library(zoo)
library(rasterVis)

## DESCRIPTION: http://iridl.ldeo.columbia.edu/SOURCES/.CAC/.sst/
```

```

setwd(tempdir())
download.file('http://iridl.ldeo.columbia.edu/SOURCES/.CAC/.sst/data.nc', destfile = 'SST.nc')
SST <- stack('SST.nc')
idx <- seq(as.Date('1970-01-01'), as.Date('2003-03-01'), by='month')
tt <- as.yearmon(idx)
SST <- setZ(SST, tt)
names(SST) <- as.character(tt)

## Extract month value from a Date or yearmon object
month <- function(x)format(x, '%m')
## Compute anomaly using monthly grouping with ave
anomaly <- function(x){
  ## Monthly means
  mm <- ave(x, month(tt), FUN = mean)
  ## Monthly standard deviation
  msd <- ave(x, month(tt), FUN = sd)
  ## anomaly
  (x - mm)/msd
}
## Use anomaly with calc
SSTanom <- calc(SST, anomaly)
SSTanom <- setZ(SSTanom, tt)

## Ok, let's see the result
hovmoller(SSTanom,
          at = seq(-3, 3, .25),
          panel = panel.levelplot.raster,
          interpolate = TRUE,
          yscale.components = yscale.raster.subticks,
          par.settings = BuRdTheme)

## End(Not run)

```

Interaction

Interaction with trellis objects.

Description

chooseRegion provides a set of points (in the form of a SpatialPoints) inside a region defined by several mouse clicks. identifyRaster labels and returns points of a trellis graphic according to mouse clicks.

Usage

```

chooseRegion(sp = TRUE, proj = as.character(NA))
## S4 method for signature 'Raster'
identifyRaster(object, layer=1, values=FALSE, pch=13, cex=0.6, col='black',...)

```

Arguments

sp	logical, if TRUE the result is a SpatialPoints object, otherwise it is a logical vector as returned by <code>in.out</code>
proj	A character string for the proj4string of SpatialPoints.
object	A Raster object.
layer	A numeric or character which should indicate the layer to be chosen.
values	logical, if TRUE the values are returned.
pch, cex, col	Graphical parameters for <code>panel.identify</code> and <code>panel.link.splom</code> .
...	Additional arguments for <code>trellis.focus</code> , <code>panel.link.splom</code> and <code>panel.identify</code> .

Details

When called, these functions wait for the user to identify points (in the panel being drawn) via mouse clicks. Clicks other than left-clicks close the region (for `chooseRegion`) and the procedure (for `identifyRaster`).

Note

`chooseRegion` needs the package `mgcv` to be installed.

Author(s)

Oscar Perpiñán Lamigueiro

See Also

`panel.identify`, `panel.link.splom`, `trellis.focus`, `grid.locator`

Examples

```
library(raster)

f <- system.file("external/test.grd", package="raster")
r <- raster(f)
levelplot(r)
##Do not close the last graphical window
##Use the left button of the mouse to identify points and the right button to finish
chosen_r <- identifyRaster(r, values=TRUE)
chosen_r
s <- stack(r, r-500, r+500)
levelplot(s)
chosen_s <- identifyRaster(s, values=TRUE)
chosen_s

## Not run:
##The package mgcv is needed for the next example
##Use the left button of the mouse to build a border with points, and the right button to finish.
##The points enclosed by the border will be highlighted and returned as a SpatialPoints object.
levelplot(s)
```

```

reg <- chooseRegion()
summary(reg)

## End(Not run)

## Not run:
##Solar irradiation data from CMSAF http://dx.doi.org/10.5676/EUM_SAF_CM/RAD_MVIRI/V001

dataURL <- "https://raw.githubusercontent.com/oscarperpinan/bookvis/master/data/"

old <- setwd(tempdir())
download.file(paste0(dataURL, "SISmm2008_CMSAF.zip"),
              "SISmm2008_CMSAF.zip", method='wget')
unzip("SISmm2008_CMSAF.zip")

listFich <- dir(pattern='\.nc')
stackSIS <- stack(listFich)
stackSIS <- stackSIS*24 ##from irradiance (W/m2) to irradiation Wh/m2
setwd(old)

idx <- seq(as.Date('2008-01-15'), as.Date('2008-12-15'), 'month')

SISmm <- setZ(stackSIS, idx)
names(SISmm) <- month.abb

levelplot(SISmm)

##Do not close the last graphical window
##Interaction
##Use the left button of the mouse to identify points and the right button to finish
chosen <- identifyRaster(SISmm, layer=3, values=TRUE)
chosen
##Use the left button of the mouse to build a border with points, and the right button to finish.
##The points enclosed by the border will be highlighted and returned as a SpatialPoints object.
reg <- chooseRegion()
summary(reg)

## End(Not run)

```

levelplot-methods

Level and contour plots of Raster objects.

Description

Level and contour plots of Raster objects with lattice methods and marginal plots with grid objects.

Usage

```
## S4 method for signature 'Raster,missing'
```

```

levelplot(x, data = NULL, layers,
          margin = list(),
          maxpixels = 1e5,
          par.settings = rasterTheme(),
          between = list(x=0.5, y=0.2),
          as.table = TRUE,
          xlab=if(isLonLat(x)) 'Longitude' else NULL,
          ylab=if(isLonLat(x)) 'Latitude' else NULL,
          main=NULL,
          names.attr,
          scales =list(),
          xscale.components = xscale.raster,
          yscale.components = yscale.raster,
          zscaleLog = NULL,
          colorkey = list(space='right'),
          panel = panel.levelplot,
          pretty = FALSE,
          contour = FALSE, region = TRUE, labels = FALSE,
          FUN.margin = NULL,
          scales.margin = NULL, axis.margin = NULL,
          ..., att=1L)

```

```
## S4 method for signature 'SpatRaster,missing'
```

```

levelplot(x, data = NULL, layers,
          margin = list(),
          maxpixels = 1e5,
          par.settings = rasterTheme(),
          between = list(x=0.5, y=0.2),
          as.table = TRUE,
          xlab=if(is.lonlat(x)) 'Longitude' else NULL,
          ylab=if(is.lonlat(x)) 'Latitude' else NULL,
          main=NULL,
          names.attr,
          scales =list(),
          xscale.components = xscale.raster,
          yscale.components = yscale.raster,
          zscaleLog = NULL,
          colorkey = list(space='right'),
          panel = panel.levelplot,
          pretty = FALSE,
          contour = FALSE, region = TRUE, labels = FALSE,
          FUN.margin = NULL,
          scales.margin = NULL, axis.margin = NULL,
          ..., att=1L)

```

```
## S4 method for signature 'Raster,missing'
```

```
contourplot(x, data=NULL, layers, ...)
```


Arguments

x	A Raster or SpatRaster object.
data	Not used.
layers	A numeric or character which should indicate the layers to be displayed.
maxpixels	A positive integer giving the number of cells to display, for sampleRegular .
margin	A list or a logical. If it is TRUE, two marginal graphics show the column (x) and row (y) summaries of the Raster* object. The summary is computed with the function <code>mean</code> . If it is a list, it contains parameters in ‘name=value’ form that define both margins, and may contain two other lists called ‘x’ and ‘y’ whose components affect the respective margins only: <ul style="list-style-type: none"> • draw: A logical. If TRUE (default) the marginal graphics are drawn. • FUN: A function to summarise the Raster* or SpatRaster by rows and columns (default: <code>mean</code>). • scales: A list with components x (columns) and y (rows). Each of these components must be a numeric vector of length 2 defining the range for each marginal plot. If <code>scales = NULL</code> (default) the range is internally computed. If any of the elements of the vectors is NA, the corresponding limit of the range will be calculated internally. If any of the vectors is of length 1, it is assumed that it defines the lower limit of the range, and the upper limit is calculated internally. • axis: Logical or a list. Its default value is FALSE. If it is TRUE or a list, a simple axis is drawn with the marginal graphic. If it is a list, its components define the graphical parameters of the axis using <code>grid::gpar</code>. The default value is <code>gpar(col = 'darkgrey', fontsize = 7)</code>
FUN.margin, scales.margin, axis.margin	Deprecated arguments. Use margin as a list instead
att	Integer or character to choose which variable (column) in the RAT table should be used.
xlab, ylab, main	A character string or expression describing the axis and title labels. These arguments are used by the underlying <code>lattice::xyplot</code> function, which provides this information in its help page: <p>“main, xlab and ylab are usually a character string or an expression that gets used as the label, but can also be a list that controls further details. Expressions are treated as specification of LaTeX-like markup as described in plotmath. The label can be a vector, in which case the components will be spaced out horizontally (or vertically for ylab). This feature can be used to provide column or row labels rather than a single axis label.</p> <p>When main (etc.) is a list, the actual label should be specified as the xlab component (which may be unnamed if it is the first component). The label can be missing, in which case the default will be used. Further named arguments are passed on to <code>textGrob</code>; this can include arguments controlling positioning like <code>just</code> and <code>rot</code> as well as graphical parameters such as <code>col</code> and <code>font</code> (see gpar for a full list).</p> <p>main, xlab and ylab can also be arbitrary “grob”s (grid graphical objects).”</p>

`names.attr` Character or expression, names to use in each panel. If missing its default value is the result of `names(x)` (after subsetting the layers to be displayed).

`xscale.components`, `yscale.components`

See [xscale.raster](#) and [yscale.raster](#).

`colorkey` logical specifying whether a color key is to be drawn alongside the plot (default is TRUE), or a list describing the color key (see the `colorkey` section of the help page of `lattice::levelplot` for details). As an additional feature not included in `lattice::levelplot`, it accepts the `title` argument, a character, and `title.gpar`, a list of graphical parameters (see [gpar](#) for details) to be applied to the title text.

`between`, `as.table`, `par.settings`, `scales`, `panel`

Graphical parameters used by `lattice::xyplot`. Adapted from the help page of this function:

- `between`: A list with components `code` and `code` (both usually 0 by default), numeric vectors specifying the space between the panels (units are character heights). `x` and `y` are repeated to account for all panels in a page and any extra components are ignored.
- `as.table`: A logical flag that controls the order in which panels should be displayed: if TRUE (the default), left to right, top to bottom (as in a table). If FALSE panels are drawn left to right, bottom to top.
- `par.settings`: A list to choose some display settings temporarily. This list is supplied to [trellis.par.set](#). When the resulting object is plotted, these options are applied temporarily for the duration of the plotting, after which the settings revert back to what they were before. This enables the user to attach some display settings to the trellis object itself rather than change the settings globally.
`rasterVis` includes some functions with predefined themes that can be directly supplied to `par.settings`: [rasterTheme](#) (default), [RdBuTheme](#) and [BuRdTheme](#), [GrTheme](#), [BTCTheme](#), [PuOrTheme](#) and [streamTheme](#) (for [streamplot](#)). These themes are defined using [custom.theme](#). You can use [rasterTheme](#) or [custom.theme](#) to define your own theme (see examples for details).
- `scales`: A list determining how the x- and y-axes (tick marks and labels) are drawn. The list contains parameters in `name=value` form, and may also contain two other lists called `x` and `y` of the same form. Components of `x` and `y` affect the respective axes only, while those in `scales` affect both. When parameters are specified in both lists, the values in `x` or `y` are used. For example, use `scales=list(draw=FALSE)` to suppress ticks and labels in both axis. Read the help page of `lattice::xyplot` to know about the possible components of `scales`.
- `panel`: A function object or a character string giving the name of a predefined function. The default is [panel.levelplot](#). Another useful option is [panel.levelplot.raster](#).

`pretty`, `contour`, `region`, `labels`

Graphical parameters supplied to `lattice::levelplot`. Adapted from its help page:

- `pretty`: A logical flag, indicating whether to use pretty cut locations and labels. It is FALSE for `levelplot` and TRUE for `contourplot`.
 - `contour`: A logical flag, indicating whether to draw contour lines. It is TRUE for `contourplot` and FALSE for `levelplot`.
 - `region`: A logical flag, indicating whether regions between contour lines should be filled as in a level plot. It is FALSE for `contourplot` and TRUE for `levelplot`.
 - `labels`: Typically a logical indicating whether the labels are to be drawn (default is TRUE for `contourplot`), a character or expression vector giving the labels associated with the `at` values, or a list whose components define the labels and their graphical parameters. Read the help page of [panel.levelplot](#) for details.
- `zscaleLog` Controls whether the `Raster*` will be log transformed before being passed to the panel function. Defaults to NULL, in which case the `Raster*` is not transformed. Other possible values are any number that works as a base for taking logarithm, TRUE (which is equivalent to 10), "e" (for the natural logarithm), and FALSE (that is equivalent to NULL). As a side effect, the colorkey is labeled differently.
- ...
- Additional arguments for `lattice::levelplot`, `lattice::xyplot`, [panel.levelplot](#) and [panel.levelplot.raster](#). The most important ones are:
- `layout`: From the help page of `lattice::xyplot`: `layout` is a numeric vector of length 2 or 3 giving the number of columns, rows, and pages (optional) in a multipanel display. The number of pages is by default set to as many as is required to plot all the panels, and so rarely needs to be specified.
For example, with `layout=c(1,1)` each panel (corresponding to a layer of a `RasterStackBrick`) object will be printed in a separate page (which could be useful to generate a series of output files to build an animation.)
 - `xlim`, `ylim`: From the help page of `lattice::xyplot`: A numeric vector of length 2 giving left and right limits for x-axis, and lower and upper limits for the y-axis.
 - `shrink`: From the help page of [panel.levelplot](#): Either a numeric vector of length 2 (meant to work as both x and y components), or a list with components `x` and `y` which are numeric vectors of length 2. This allows the rectangles to be scaled proportional to the z-value. The specification can be made separately for widths (`x`) and heights (`y`). The elements of the length 2 numeric vector gives the minimum and maximum proportion of shrinkage (corresponding to min and max of `z`).
 - `border`, `border.lty`, `border.lwd`: Graphical parameters (color, type of line, width of line, respectively) of each rectangle borders. See the help page of [panel.levelplot](#) for details.

Details

The result of the `levelplot` method is similar to the `splot` method for `Raster` objects defined in the `raster` package. However, this method does not use the `splot` of the `sp` package and, therefore, no conversion between classes is needed.

The `contourplot` method is a wrapper for `levelplot` with the next additional default settings: `cuts=7`, `labels=TRUE`, `contour=TRUE`, `pretty=TRUE`, `region=TRUE` and `colorkey=TRUE` (see the help of `contourplot` for details.)

`levelplot` displays categorical data with a convenient legend. You should use `ratify` to define a layer as a categorical variable. It is able to display multilayer categorical rasters **only if** they share the same RAT (Raster Attribute Table). `levelplot` is not able to display multilayer rasters with factor **and** numeric layers. See `ratify` and the examples below for details.

Author(s)

Oscar Perpiñán Lamigueiro

See Also

`sppplot`, `lattice::levelplot`

Examples

```
library(raster)
library(terra)

f <- system.file("external/test.grd", package="raster")

## raster
r <- raster(f)
levelplot(r)
## terra
rt <- rast(f)
levelplot(rt)

## Change the color theme
levelplot(r, par.settings=GrTheme())

## Not run:
myPal <- RColorBrewer::brewer.pal('Blues', n=9)
myTheme <- rasterTheme(region = myPal)
levelplot(r, par.settings = myTheme)

## End(Not run)
## Define the legend breaks
my.at <- seq(100, 1850, 500)
levelplot(rt, at=my.at)

myColorkey <- list(at=my.at, ## where the colors change
                  labels=list(
                    at=my.at ## where to print labels
                  ))
levelplot(r, at=my.at, colorkey=myColorkey)

## Define the units of the color key
levelplot(rt, margin = FALSE,
          colorkey = list(title = "[m]",
```

```

        title.gpar = list(cex = 1,
                          font = 2,
                          col = 'red')
    ))

## shrink and border color
## raster
rCenter <- (maxValue(r) + minValue(r)) / 2
levelplot(r - rCenter, par.settings=RdBuTheme(), shrink=c(.8, 15), border='black')
## Not run:
## terra
tCenter <- mean(minmax(rt))
levelplot(rt - tCenter, par.settings=RdBuTheme(), shrink=c(.8, 15), border='black')

## End(Not run)

## With subticks
levelplot(r, xscale.components=xscale.raster.subticks,
          yscale.components=yscale.raster.subticks)

## Not run:
levelplot(rt, xscale.components=xscale.raster.subticks,
          yscale.components=yscale.raster.subticks,
          scales=list(x=list(rot=30, cex=0.8)))

## End(Not run)
## log-scale
levelplot(r^2, zscaleLog=TRUE, contour=TRUE)

## Customizing axis and title labels
levelplot(rt, margin=FALSE,
          main=list('My plot', col='red'),
          xlab=c('This is the', 'X-Axis'),
          ylab=list('Y-Axis', rot=30, fontface='bold')
          )

## xlim and ylim to display a smaller region
levelplot(r, xlim=c(179000, 181000), ylim=c(329500, 334000))

## RasterStacks
s <- stack(r, r+500, r-500)
levelplot(s, contour=TRUE)
contourplot(s, labels=list(cex=0.4), cuts=12)

## Not run:
## Use of layout
levelplot(s, layout=c(1, 3))

## SpatRaster with several layers
st <- c(rt, rt + 500, rt - 500)
levelplot(st, contour=TRUE)
contourplot(st, labels=list(cex=0.4), cuts=12)

```

```

levelplot(st, layout=c(1, 1)) # useful for animations

## End(Not run)

## names.attr to change the labels of each panel
levelplot(s, names.attr=c('R', 'R + 500', 'R - 500'))

## Defining the scales for the marginal plot
levelplot(r, margin = list(axis = TRUE,
                           scales = list(x=c(100, 600),
                                          y=c(100, 1000))))
## if a component of the list is null, it is internally calculated
levelplot(rt, margin=list(axis = TRUE, scales = list(x=c(100, 1000))))

## Add a layer of sampling points
## and change the theme
pts <- sampleRandom(r, size=20, sp=TRUE)

## Using +.trellis and layer from latticeExtra
library(latticeExtra)

levelplot(r, par.settings = BTCTheme) +
  layer(sp.points(pts, col = 'red'))
contourplot(r, labels = FALSE) +
  layer(sp.points(pts, col = 'red'))

## or with a custom panel function
levelplot(r, par.settings=BTCTheme,
          panel=function(...){
            panel.levelplot(...)
            sp.points(pts, col='red')
          })

## Categorical data
r <- raster(nrow=10, ncol=10)
r[] = 1
r[51:100] = 3
r[3:6, 1:5] = 5
r <- ratify(r)

rat <- levels(r)[[1]]
rat$landcover <- c('Pine', 'Oak', 'Meadow')
rat$class <- c('A1', 'B2', 'C3')
levels(r) <- rat
r

levelplot(r, col.regions=c('palegreen', 'midnightblue', 'indianred1'))

## with 'att' you can choose another variable from the RAT
levelplot(r, att=2, col.regions=c('palegreen', 'midnightblue', 'indianred1'))

```

```

levelplot(r, att='class', col.regions=c('palegreen', 'midnightblue', 'indianred1'))

r2 <- raster(r)
r2[] = 3
r2[51:100] = 1
r2[3:6, 1:5] = 5

r3 <- raster::init(r, function(n)sample(c(1, 3, 5), n, replace=TRUE))

## Multilayer categorical Raster* are displayed only if their RATs are the same
levels(r2) <- levels(r3) <- levels(r)

s <- stack(r, r2, r3)
names(s) <- c('A', 'B', 'C')

levelplot(s)
levelplot(s, att=2)

## Not run:
dataURL <- "https://raw.githubusercontent.com/oscarperpinan/bookvis/master/data/"

##Solar irradiation data from CMSAF http://dx.doi.org/10.5676/EUM_SAF_CM/RAD_MVIRI/V001
old <- setwd(tempdir())
download.file(paste0(dataURL, "SISmm2008_CMSAF.zip"),
              "SISmm2008_CMSAF.zip", method='wget')
unzip("SISmm2008_CMSAF.zip")

listFich <- dir(pattern='\\.nc')
stackSIS <- stack(listFich)
stackSIS <- stackSIS*24 ##from irradiance (W/m2) to irradiation Wh/m2

idx <- seq(as.Date('2008-01-15'), as.Date('2008-12-15'), 'month')

SISmm <- setZ(stackSIS, idx)
names(SISmm) <- month.abb

levelplot(SISmm)

levelplot(SISmm, layers=1, margin = list(FUN = 'median'), contour=TRUE)

setwd(old)

## End(Not run)

```

plot3D

Interactive 3D plot of a RasterLayer

Description

Make an interactive 3D plot (map) of a RasterLayer. This is a wrapper around `surface3d` in the `rgl` package. You can use `decorate3d` to add axes.

Usage

```
## S4 method for signature 'RasterLayer'
plot3D(x, maxpixels=1e5,
       zfac=1, drape=NULL, col=terrain.colors,
       at=100, rev=FALSE,
       useLegend=TRUE, adjust=TRUE, ...)
```

Arguments

x	a RasterLayer object
maxpixels	Maximum number of pixels to use
zfac	Numeric, to set the elevation scale relative to x and y
drape	RasterLayer, to 'drape' colors representing the values of this layer on the 3D representation of layer x. In this case x typically has elevation data
col	A color palette generating function such as <code>rainbow</code> , <code>heat.colors</code> , and <code>topo.colors</code> , or one of your own making
at	A numeric variable of breakpoints defining intervals along the range of x or a number defining the number of intervals the range of x will be divided into.
rev	Logical. If TRUE, the color palette values are reversed in order
useLegend	Logical. If TRUE (default) the content of the slot <code>x@legend@colortable</code> is used instead of <code>col</code> and <code>at</code> .
adjust	Logical. If TRUE, the x and y axes are scaled relative to the cell (z) values
...	Any argument that can be passed to surface3d

Note

Previous versions opened a new device with each call of `plot3D`. This behaviour has been modified, and now a new device is opened only if none is active. Thus, you should use `rgl::open3d()` if you need to display a new scene without modifying the current one.

Author(s)

Robert J. Hijmans and Oscar Perpiñán

Examples

```
## Not run:
library(raster)

## rgl is needed to use plot3D
library(rgl)

data(volcano)
r <- raster(volcano)
extent(r) <- c(0, 610, 0, 870)

## level plot as reference
```



```

levelplot(r, col.regions=terrain.colors)

plot3D(r)
## Use different colors with a predefined function
plot3D(r, col = rainbow)
## or with a custom function using colorRampPalette
myPal <- colorRampPalette(RColorBrewer::brewer.pal(11, 'PuOr'))
plot3D(r, col = myPal)

## With at you can define an homogeneous color table for different Rasters

r2 <- r + 100
r3 <- r + 200
s <- stack(r, r2, r3)

maxVal <- max(maxValue(s))
minVal <- min(minValue(s))
N <- 40
breaks <- seq(minVal, maxVal, length=N)

plot3D(r, at=breaks)
plot3D(r2, at=breaks)
plot3D(r3, at=breaks)

## Default: x-axis and y-axis are adjusted with z-values. Therefore,
## labels with decorate3d() are useless
plot3D(r, adjust=TRUE)
decorate3d()
## Compare the graphic limits
par3d('bbox')
## with the extent of the Raster
extent(r)

## Set adjust=FALSE to fix it
plot3D(r, adjust=FALSE)
decorate3d()
## Once again, compare the graphic limits
par3d('bbox')
## with the extent of the Raster
extent(r)

## zfac controls the z values so z-axis will be distorted
plot3D(r, adjust=FALSE, zfac=2)
decorate3d()
par3d('bbox')

## With drape you can disconnect the z-axis from the colors
drape <- cut(r^4, 4)
plot3D(r, drape=drape)
## Compare with:
plot3D(r, at=4)

```

```
## End(Not run)
```

```
rasterTheme          Themes for raster with lattice.
```

Description

Auxiliary functions for the customization of trellis graphics with `lattice`.

`xscale.raster` and `yscale.raster` suppress the right and top axis, respectively. `xscale.raster.subticks` and `yscale.raster.subticks` also suppress those axis and draw subticks.

`rasterTheme` is a customization of the `custom.theme.2` function of `latticeExtra` using the magma palette of the `viridis` package. The other palettes provided by this package are available through the `viridisTheme`, `infernoTheme`, and `plasmaTheme`.

`YlOrRdTheme`, `BuRdTheme`, `RdBuTheme`, `GrTheme` and `BTCTheme` are variations of `rasterTheme` using palettes of the `RColorBrewer` and `hexbin` packages.

`streamTheme` is a variation of `rasterTheme` using black for the region, gray for the panel background and a sequential palette for points.

`bwTheme` is a variation of `rasterTheme` for the `bwplot` methods.

Usage

```
yscale.raster(lim, ...)
xscale.raster(lim, ...)
yscale.raster.subticks(lim, ...)
xscale.raster.subticks(lim, ...)

rasterTheme(region = magma(10),
            pch=19, cex=0.7,
            strip.background = list(col = 'transparent'),
            strip.shingle = list(col = 'transparent'),
            strip.border = list(col = 'transparent'),
            add.lines = list(lwd = .4),
            ...)

magmaTheme(region = magma(10), ...)
infernoTheme(region = inferno(10), ...)
plasmaTheme(region = plasma(10), ...)
viridisTheme(region = viridis(10), ...)

YlOrRdTheme(region = brewer.pal(9, 'YlOrRd'), ...)
RdBuTheme(region = brewer.pal(9, 'RdBu'), ...)
BuRdTheme(region = rev(brewer.pal(9, 'RdBu')), ...)
PuOrTheme(region = brewer.pal(9, 'PuOr'), ...)
GrTheme(region = rev(brewer.pal(9, 'Greys')), ...)
BTCTheme(region = BTC(n=9), ...)
```

```

streamTheme(region = 'black',
            symbol = brewer.pal(n=5, name='Blues'),
            alpha = 0.6,
            panel.background = list(col='gray20'),
            ...)

bwTheme(box.rectangle = list(col='black', fill = 'gray'),
        box.umbrella = list(col = 'black', lty = 1),
        plot.polygon = list(col = 'lightblue', alpha = 0.5),
        plot.symbol = list(cex = 0.5, alpha = 0.2),
        ...)

```

Arguments

lim	Range of data.
pch	Symbol used for points.
cex	A numeric multiplier to control the size of the points.
region	A vector of colors that is used to define a continuous color gradient using <code>colorRampPalette</code> to fill in regions. Note that the length of this gradient is set by <code>custom.theme</code> to exactly 100 colors.
symbol	A palette to display symbols.
panel.background	Parameters of the panel background.
alpha, ...	Additional arguments for <code>custom.theme.2</code> , <code>yscale.components.default</code> and <code>xscale.components.default</code>
strip.background, strip.shingle, strip.border	List whose components define the configuration of the strip areas. Read the help page of <code>trellis.par.get</code> for details.
add.lines	List whose components define the lines superposed on the graphic. Read the help page of <code>trellis.par.get</code> for details.
box.rectangle	List whose components define the box of the boxplot.
box.umbrella	List whose components define the whiskers of the boxplot.
plot.polygon	List whose components define the violin plot.
plot.symbol	List whose components define the raw points when <code>draw.points = TRUE</code> .

Author(s)

Oscar Perpiñán Lamigueiro

See Also

`custom.theme`, `custom.theme.2`, `BTC`, `xscale.components.default`, `xscale.components.subticks`

Description

Draw conditional scatter plot matrices with hexagonally binning.

Usage

```
## S4 method for signature 'Raster,missing'
splom(x, data=NULL,maxpixels=1e5,
plot.loess=FALSE, colramp=BTC, varname.cex=0.6,...)
## S4 method for signature 'SpatRaster,missing'
splom(x, data=NULL,maxpixels=1e5, plot.loess=FALSE, colramp=BTC, varname.cex=0.6,...)
```

Arguments

x	A Raster or a SpatRaster object.
data	Not used.
maxpixels	A numeric, for sampleRandom or spatSample .
plot.loess	Logical, should a loess fit be drawn?.
colramp	A function accepting an integer n as argument and returning n colors (for hexbinplot).
varname.cex	A numerical multiplier to control the size of the variables names.
...	Additional arguments for splom.

Note

While the hexagonal binning is quite fast for large datasets, the use of the loess fit will slow this function.

Author(s)

Oscar Perpiñán Lamigueiro

See Also

[hexbinplot](#), [splom](#)

Examples

```
## Not run:
library(raster)
library(terra)

dataURL <- "https://raw.githubusercontent.com/oscarperpinan/bookvis/master/data/"
```

```

##Solar irradiation data from CMSAF http://dx.doi.org/10.5676/EUM_SAF_CM/RAD_MVIRI/V001
old <- setwd(tempdir())
download.file(paste0(dataURL, "SISmm2008_CMSAF.zip"),
             "SISmm2008_CMSAF.zip", method='wget')
unzip("SISmm2008_CMSAF.zip")

listFich <- dir(pattern='\\.nc')
stackSIS <- stack(listFich)
stackSIS <- stackSIS*24 ##from irradiance (W/m2) to irradiation Wh/m2
setwd(old)

idx <- seq(as.Date('2008-01-15'), as.Date('2008-12-15'), 'month')

SISmm <- setZ(stackSIS, idx)
names(SISmm) <- month.abb

splom(SISmm)

## End(Not run)

```

vectorplot-methods *Vector plots of Raster objects.*

Description

vectorplot displays vector fields from Raster objects using arrows.

streamplot displays streamlines with a procedure inspired by the FROLIC algorithm (see references): for each point (*droplet*) of a jittered regular grid, a short streamline portion (*streamlet*) is calculated by integrating the underlying vector field at that point. The main color of each streamlet indicates local vector magnitude (*slope*). Streamlets are composed of points whose sizes, positions and color degradation encode the local vector direction (*aspect*).

Usage

```

## S4 method for signature 'Raster'
vectorplot(object, layers,
           narrows=2e3, lwd.arrows=0.6, col.arrows='black',
           length=unit(1e-2, 'npc'),
           maxpixels=1e5, region=TRUE, margin=FALSE,
           isField=FALSE, reverse=FALSE,
           unit='radians', scaleSlope=TRUE,
           aspX=0.08, aspY=aspX,
           key.arrow = NULL,
           ...)

## S4 method for signature 'RasterStack'
vectorplot(object, layers,
           narrows=2e3, lwd.arrows=0.6, col.arrows='black',

```

```

length=unit(1e-2, 'npc'),
maxpixels=1e5, region=TRUE, margin=FALSE,
isField=FALSE, reverse=FALSE,
unit='radians', scaleSlope=TRUE,
aspX=0.08, aspY=aspX,
key.arrow = NULL,
uLayers, vLayers, ...)

## S4 method for signature 'Raster'
streamplot(object, layers,
           droplet = list(), streamlet = list(),
           par.settings = streamTheme(),
           colorkey = FALSE,
           isField = FALSE, reverse = FALSE,
           parallel = TRUE, mc.cores = detectCores(), cl = NULL,
           ...)

## S4 method for signature 'RasterStack'
streamplot(object, layers,
           droplet = list(), streamlet = list(),
           par.settings=streamTheme(),
           colorkey = FALSE,
           isField = FALSE, reverse = FALSE,
           parallel = TRUE, mc.cores = detectCores(), cl = NULL,
           ...)

```

Arguments

object	A Raster object. If isField=FALSE the vector field is calculated internally from the result of <code>terrain</code> .
layers	A numeric or character which should indicate the layers to be displayed.
maxpixels	A numeric, number of cells to be shown if region=TRUE or if region is a Raster* object.
narrows	A numeric, number of arrows.
lwd.arrows	Numeric, width of the lines of the arrows
col.arrows	character, color of the arrows
length	Unit, extent of the arrow head.
margin	Logical, if TRUE two marginal graphics show the summaries of the object.
scaleSlope	Logical or numeric. If TRUE the slope (vector magnitude) is scaled (but not centered) with its standard deviation. If it is a numeric, the slope is scaled with this value. It is not used if isField='dXY'.
aspX, aspY	Numeric. Multipliers to convert the slope values into horizontal (aspX) and vertical (aspY) displacements.
key.arrow	A reference (or legend) vector. If is not NULL, it is a list with two named components, size, a numeric to define the length of the arrow (default 1), and label, a character to define the label (default '').

uLayers, vLayers	Numeric, indexes of layers with horizontal and vertical components, respectively, when isField='dXY' and the RasterStack has more than 2 layers. If missing, the horizontal components are the layers of the first half of the object, and the vertical components are the layers of the second half.
droplet	A list whose elements define the droplet configuration: <ul style="list-style-type: none"> • cropExtent: Percentage of the object extent to be cropped (default .97) to avoid droplets at boundaries • pc: A numeric. It is the percentage of cells used to compute droplets. Its default value is 0.5. Therefore, only the 0.5% of the cells are used. For example, if you use a Raster with 180 rows and 360 columns (64800 cells), with this default value streamplot will produce 324 droplets.
streamlet	A list whose elements define the streamlet configuration: <ul style="list-style-type: none"> • L: length of the streamlet (number of points, default 10) • h: streamlet calculation step (default mean(res(object))).
par.settings	A list to define the graphical parameters. For streamplot there is an specific theme, streamTheme.
colorkey	A logical specifying whether a color key is to be drawn alongside the plot (default is FALSE), or a list describing the color key (see the colorkey section of the help page of levelplot for details).
parallel	Logical, TRUE (default) to use parallel package.
cl	a cluster object. Read the help page of parLapply for details.
mc.cores	The number of cores to use if parallel=TRUE and no cl is provided. Read the help page of mclapply for details.
region	Logical, if TRUE the region is displayed as the background using levelplot. It can be a Raster* with the same extent and resolution as object.
reverse	Logical, TRUE if arrows or streamlets go against the direction of the gradient.
isField	If TRUE the object is a vector field. Thus, object must be a Raster* with two layers, slope (local vector magnitude) and aspect (local vector direction), in this order. The aspect angle, following the conventions of raster::terrain, must be computed clockwise from 0 (due north). The slope layer will be used as the background if region is TRUE. If isField='dXY' object must be a Raster* with two layers representing the horizontal and the vertical components, respectively. The slope is computed and used as the background if region is TRUE.
unit	Character, angle units of the aspect layer if isField=TRUE: 'radians' or 'degrees'.
...	Additional arguments for levelplot

Author(s)

Oscar Perpiñán Lamigueiro

References

R. Wegenkittl and E. Gröller, Fast Oriented Line Integral Convolution for Vector Field Visualization via the Internet, Proceedings IEEE Visualization '97, 1997, http://www.cg.tuwien.ac.at/research/vis-dyn-syst/frolic/frolic_crc.pdf

See Also

[panel.arrows](#), [levelplot](#), [terrain](#), [mclapply](#), [parLapply](#)

Examples

```
## Not run:
library(raster)

proj <- CRS('+proj=longlat +datum=WGS84')

df <- expand.grid(x=seq(-2, 2, .01), y=seq(-2, 2, .01))
df$z <- with(df, (3*x^2 + y)*exp(-x^2-y^2))
r1 <- rasterFromXYZ(df, crs=proj)
df$z <- with(df, x*exp(-x^2-y^2))
r2 <- rasterFromXYZ(df, crs=proj)
df$z <- with(df, y*exp(-x^2-y^2))
r3 <- rasterFromXYZ(df, crs=proj)
s <- stack(r1, r2, r3)
names(s) <- c('R1', 'R2', 'R3')

vectorplot(r1)
vectorplot(r2, par.settings=RdBuTheme())
vectorplot(r3, par.settings=PuOrTheme())

## scaleSlope, aspX and aspY
vectorplot(r1, scaleSlope=FALSE)
vectorplot(r1, scaleSlope=1e-5)
vectorplot(r1, scaleSlope=5e-6, alpha=0.6)
vectorplot(r1, scaleSlope=TRUE, aspX=0.1, alpha=0.6)
vectorplot(r1, scaleSlope=TRUE, aspX=0.3, alpha=0.3)

## Reference vector
# Default size (1)
vectorplot(r1, region = FALSE,
           key.arrow = list(label = 'm/s'))
vectorplot(r1, region = FALSE,
           key.arrow = list(size = 2, label = 'm/s'))

## A vector field defined with horizontal and vertical components
u <- v <- raster(xmn=0, xmx=2, ymn=0, ymx=2, ncol=1e3, nrow=1e3)
x <- raster::init(u, fun='x')
y <- raster::init(u, fun='y')
u <- y * cos(x)
v <- y * sin(x)
field <- stack(u, v)
```



```

names(field) <- c('u', 'v')

vectorplot(field, isField='dXY', narrows=5e2)

## We can display both components as the background
vectorplot(field, isField='dXY', narrows=5e2, region=field)

## It is also possible to use a RasterStack
## with more than 2 layers when isField='dXY'
u1 <- cos(y) * cos(x)
v1 <- cos(y) * sin(x)
u2 <- sin(y) * sin(x)
v2 <- sin(y) * cos(x)
field <- stack(u, u1, u2, v, v1, v2)
names(field) <- c('u', 'u1', 'u2', 'v', 'v1', 'v2')

vectorplot(field, isField='dXY',
            narrows=300, lwd.arrows=.4,
            par.settings=BTCTheme(),
            layout=c(3, 1))

## uLayer and vLayer define which layers contain
## horizontal and vertical components, respectively
vectorplot(field, isField='dXY',
            narrows=300,
            uLayer=1:3,
            vLayer=6:4)

#####
## Streamplot
#####
## If no cluster is provided, streamplot uses parallel::mclapply except
## with Windows. Therefore, next code could spend a long time under
## Windows.
streamplot(r1)

## With a cluster
hosts <- rep('localhost', 4)
cl <- parallel::makeCluster(hosts)
palRed <- RColorBrewer::brewer.pal(n = 5, name = 'Reds')
streamplot(r2, cl=cl,
           par.settings=streamTheme(symbol= palRed))
parallel::stopCluster(cl)

## Without parallel
palGreen <- RColorBrewer::brewer.pal(n = 5, name = 'Greens')
streamplot(r3, parallel=FALSE,
           par.settings=streamTheme(symbol = palGreen))

## Configuration of droplets and streamlets
streamplot(s, layout=c(1, 3), droplet=list(pc=.2), streamlet=list(L=20),
           par.settings=streamTheme(cex=.6))

```

```
## End(Not run)
```

xyLayer

xyLayer

Description

Create a numeric vector from a function of the coordinates.

Usage

```
xyLayer(object, dirXY = y, vector = TRUE, maxpixels)
```

Arguments

object	A Raster or a SpatRaster object.
dirXY	A expression indicating the function of x and y (coordinates of the Raster object) to be evaluated.
vector	Logical. If TRUE (default) a numeric vector is returned, else a Raster or a SpatRaster object is returned.
maxpixels	A positive integer giving the number of cells to display, for sampleRegular or spatSample .

Value

A numeric vector or a Raster/SpatRaster object.

Author(s)

Oscar Perpiñán Lamigueiro.

See Also

[init](#), [substitute](#), [eval](#)

Examples

```
library(raster)

f <- system.file("external/test.grd", package="raster")
r <- raster(f)
dirX <- xyLayer(r, x)
dirXY <- xyLayer(r, sqrt(x^2 + y^2))
```

Description

Scatter plots of space-time Raster objects for directions defined by `xyLayer`

Usage

```
## S4 method for signature 'RasterStackBrick,missing'
xyplot(x, data=NULL, dirXY=y,
       stat='mean', xlab='Time', ylab='',
       digits=0, par.settings=rasterTheme(),
       auto.key = FALSE, ...)
## S4 method for signature 'SpatRaster,missing'
xyplot(x, data=NULL, dirXY=y,
       stat='mean', xlab='Time', ylab='',
       digits=0, par.settings=rasterTheme(),
       auto.key = FALSE, ...)
```

Arguments

<code>x</code>	A <code>RasterStackBrick</code> object or a <code>SpatRaster</code> object whose <code>z</code> slot or time index are not <code>NULL</code> .
<code>data</code>	Not used.
<code>dirXY</code>	A direction as a function of the coordinates (see xyLayer).
<code>stat</code>	a function to be applied to summarize the values by zone. See zonal for details.
<code>xlab, ylab</code>	Labels of the axis.
<code>par.settings</code>	Customization of <code>lattice</code> . See <code>xyplot</code> for details.
<code>digits</code>	An integer, number of digits for zonal .
<code>auto.key</code>	A logical or a list. If it is <code>FALSE</code> (default) a label with the value of the direction (as defined by <code>dirXY</code>) will be printed next to each line. You should read the help page of <code>xyplot</code> for details about the usage of <code>auto.key</code> as a list.
<code>...</code>	Additional arguments for the <code>xyplot</code> function.

Author(s)

Oscar Perpiñán Lamigueiro

See Also

[zonal](#)

Examples

```

## Not run:
library(raster)
library(terra)

dataURL <- "https://raw.githubusercontent.com/oscarperpinan/bookvis/master/data/"

##Solar irradiation data from CMSAF http://dx.doi.org/10.5676/EUM_SAF_CM/RAD_MVIRI/V001
old <- setwd(tempdir())
download.file(paste0(dataURL, "SISmm2008_CMSAF.zip"),
             "SISmm2008_CMSAF.zip", method='wget')
unzip("SISmm2008_CMSAF.zip")

listFich <- dir(pattern='\\.nc')
stackSIS <- stack(listFich)
stackSIS <- stackSIS*24 ##from irradiance (W/m2) to irradiation Wh/m2

idx <- seq(as.Date('2008-01-15'), as.Date('2008-12-15'), 'month')

SISmm <- setZ(stackSIS, idx)
names(SISmm) <- month.abb

xyplot(SISmm)

## End(Not run)

## Not run:
library(zoo)

url <- "ftp://ftp.wiley.com/public/sci_tech_med/spatio_temporal_data/"
sst.dat = read.table(paste(url, "SST011970_032003.dat", sep=''), header = FALSE)
sst.ll = read.table(paste(url, "SSTlonlat.dat", sep=''), header = FALSE)

spSST <- SpatialPointsDataFrame(sst.ll, sst.dat)
gridded(spSST) <- TRUE
proj4string(spSST) = "+proj=longlat +datum=WGS84"
SST <- brick(spSST)

idx <- seq(as.Date('1970-01-01'), as.Date('2003-03-01'), by='month')
idx <- as.yearmon(idx)
SST <- setZ(SST, idx)
names(SST) <- as.character(idx)

xyplot(SST)

## End(Not run)

```

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