Package 'GISTools'

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Title Further Capabilities in Geographic Information Science

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License GPL (>= 2)

Repository CRAN

Description Mapping and spatial data manipulation tools - in particular drawing thematic maps with nice looking legends, and aggregation of point data to polygons.

Depends R (>= 3.5.0),sf, sp

Imports RColorBrewer, MASS,methods

NeedsCompilation no

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Contents

`GISTools-package` *GISTools*

Description

In this package, a number of utilities for handling and visualising geographical data of a "Spatial" or "sf" object - for example choropleth mapping with 'nice' legends.

Details

Package:	GISTools
Type:	Package
Version:	1.0-2
Date:	2024-10-03
License:	GPL (>=2)
LazyLoad:	yes

`Add masking around an image`

Draw a mask around a Grid Based Image

Description

Takes an 'mask' type polygon object - basically a rectangle with a polygon hole cut through it - and draws this over an image. This has the effect of only showing the image inside the hole. This is useful for plotting surfaces defined over a study area, but masking the values outside of the area.

Usage

```
add.masking(maskPoly,color)
```

Arguments

`maskPoly`	A masking polygon of a "Spatial" or "sf" class as described above.
`color`	Colour of the mask. Defaults to white, but for example, sea could be shown as blue.

Details

Returns no value, but draws a mask on the current graphics device as a side effect

Value

None

Author(s)

Chris Brunsdon, Binbin Lu

See Also

`poly.outer`, `kde.points`.

Examples

```
# Data for New Haven to use in example
data(newhaven)
# Do the KDE
breach.dens = kde.points(breach,lims=tracts)
# Plot the result
level.plot(breach.dens)
# Block out the part outside the study area
masker = poly.outer(breach.dens,tracts,extend=100); add.masking(masker)
add.masking(masker,"blue")
```

auto.shading *auto.shading*

Description

Creates an object of class shading automatically, given a choropleth variable to be mapped.

Usage

```
auto.shading(x, digits = 2, cutter = quantileCuts, n = 5,
params = NA, cols = brewer.pal(n, "Reds"))
```

Arguments

x	The variable to be mapped.
digits	The number of significant digits to round the class limits to.
cutter	Function used to create the break points. Can be user defined or a supplied cut function.
n	The number of classes. The should be one more than the number of break points.
params	Other parameters to be passed to the cut function.
cols	List of colours for shading each class. length(cols) should be equal to n.

Details

Returns an object of class shading, as set out below:

Value

An object of class shading, having the following list elements:

breaks	Break points between choropleth classes. length(cols)
cols	Colours to shade in each class. length(cols) should be one more than length(breaks)

Author(s)

Chris Brunsdon, Binbin Lu

See Also

choropleth,shading,choro.legend.

Examples

```
# Read in map data and compute a rate for mapping
# Try the sf class
data(WHData)
shades = auto.shading(WHHP[["Avg_HP_avg"]],n=7)
dev.new(width = 16, height = 12)
choropleth(sp = WHHP,v="Avg_HP_avg",shading=shades)
choro.legend(548871.4, 3377000, shades,title='Average house price')
#Try the Spatial object
shades = auto.shading(whp_sp@data[["Avg_HP_avg"]],n=6)
dev.new(width = 16, height = 12)
choropleth(sp = whp_sp,v="Avg_HP_avg",shading=shades)
choro.legend(548871.4, 3377000,  shades,title='Average house price')
```

`choro.legend` *choro.legend*

Description

Draw a legend for a choropleth map.

Usage

```
choro.legend(px, py, sh, under = "under", over = "over",
  between = "to", fmt = "%g", cex=1, ...)
```

Arguments

`px`	*x* coordinate of legend location
`py`	*y* coordinate of legend location
`sh`	Shading scheme object used as basis for the legend
`under`	What to write in front of the lowest choropleth class upper limit.
`over`	What to write in front of the highest choropleth class lower limit.
`between`	What to write between the upper and lower limits of intermediate chropleth classes.
`fmt`	C style format for values stated in above choroplth class limits.
`cex`	Relative size of text in the legend.
`...`	Other arguments, passed on to the generic `legend` function.

Details

Returns no value, but draws a choropleth map legend on the current graphics device as a side effect

Value

None (see above)

Author(s)

Chris Brunsdon

See Also

choropleth, auto.shading, shading.

Examples

```
# Read in map data and compute a rate for mapping
# Try the sf class
data(WHData)
shades = auto.shading(WHHP[["Avg_HP_avg"]],n=7)
dev.new(width = 16, height = 12)
choropleth(sp = WHHP,v="Avg_HP_avg",shading=shades)
choro.legend(548871.4, 3377000, shades,title='Average house price')
#Try the Spatial object
shades = auto.shading(whp_sp@data[["Avg_HP_avg"]],n=6)
dev.new(width = 16, height = 12)
choropleth(sp = whp_sp,v="Avg_HP_avg",shading=shades)
choro.legend(548871.4, 3377000,  shades,title='Average house price')
```

---

choropleth *choropleth*

Description

Draws a choropleth map given a spatialPolygons object, a variable and a shading scheme.

Usage

```
choropleth(sp, v, shading, ...)
```

Arguments

sp	A SpatialPolygonsDataFrame or sf -POLYGON or - MULTIPOLYGON object.
v	The variable name to be mapped and must included in the data.
shading	A shading scheme created by shading or auto.shading.
...	Additional parameters to be passed on to the plot method for sp.

Details

The function returns no value, but draws a choropleth map on the current graphics device as a side effect.

Value

None (see above).

Author(s)

Chris Brunsdon, Binbin Lu

See Also

`choro.legend`, `auto.shading`, `shading`.

Examples

```
# Read in map data and compute a rate for mapping
# Try the sf class
data(WHData)
shades = auto.shading(WHHP[["Avg_HP_avg"]],n=7)
dev.new(width = 16, height = 12)
choropleth(sp = WHHP,v="Avg_HP_avg",shading=shades)
choro.legend(548871.4, 3377000, shades,title='Average house price')
#Try the Spatial object
shades = auto.shading(whp_sp@data[["Avg_HP_avg"]],n=6)
dev.new(width = 16, height = 12)
choropleth(sp = whp_sp,v="Avg_HP_avg",shading=shades)
choro.legend(548871.4, 3377000,  shades,title='Average house price')
```

`Computational Inference from Point Data`

Bootstrap and Kernel Bootstrap from Points

Description

Operations for bootstrapping and kernel bootstrapping based on point data. `bstrap.points` sample `n` points with replacement from a sample - and `jitter.points` adds a Gaussian displacement to each point in a data set. Applying a jitter to a bootstrap effectively creates a kernel bootstrap operation.

Usage

```
jitter.points(pts,scl)
bstrap.points(pts)
```

Arguments

`pts`	A `SpatialPointsDataFrame` or `sf` - POINT object
`scl`	A scale parameter - basically the standard deviation of the random Gaussian displacement

Value

A SpatialPointsDataFrame - with either a sample without replacement or a replica of the input data with displacements.

Author(s)

Chris Brunsdon, Binbin Lu

Examples

```
data(newhaven)
plot(blocks)
for (i in 1:20) plot(jitter.points(breach,150),add=TRUE,pch=1,col='red')
```

Create a 'mask' polygon

Create a masking polygon to block out graphics outside a region.

Description

Takes a polygon object and creates a new polygon whose outline is rectangular, but has a hole shaped like the input polygon cut into it. This is useful for plotting surfaces defined over a study area, but masking the values outside of the area. It is designed to work with pixel images, so that the mask covers up all parts of the image not in the input polygon.

Usage

```
poly.outer(exo.object,input.poly,extend=0)
```

Arguments

exo.object	The object extending beyond input.poly that is to be masked. This is required to ensure that the external rectangle of the mask will be large enough.
input.poly	The polygon used to make the hole in the mask.
extend	A buffer used to extend the mask if it is required to be larger than exo.object

Value

A polygon object whose outline is rectangular, but having holes cut into it in the shape of input.poly

Author(s)

Chris Brunsdon, Binbin Lu

See Also

add.masking, kde.points.

Examples

```
# Data for New Haven to use in example
data(newhaven)
# Do the KDE
breach.dens = kde.points(breach,lims=tracts)
# Plot the result
level.plot(breach.dens)
# Block out the part outside the study area
masker = poly.outer(breach.dens,tracts,extend=100); add.masking(masker)
# Plot census tract boundaries
plot(tracts,add=TRUE)
```

Create Transparency *Add transparency to a hex-defined colour*

Description

Takes a colour defined in hex format as `#XXXXXX` and adds a two transparency bytes `XX` based on a number from 0 to 1. Its main use is to make RColorBrewer palettes transparent.

Usage

```
add.alpha(hex.color.list,alpha)
```

Arguments

`hex.color.list`	A list of strings defining solid colors in six byte format.
`alpha`	A value (or list of values) from 0 to 1 specifying transparency.

Value

A list of strings defining transparent colours in eight byte format.

Author(s)

Chris Brunsdon

Examples

```
# Make a list of semi-transparent RColorBrewer colours, based on Brewer's Red palette with 5 shades
require(RColorBrewer)
add.alpha(brewer.pal(5,'Reds'),0.5)
```

cut function *Cut functions*

Description

Helper functions for auto.shading. Given a variable to be mapped, a number of classes and possibly some more params, returns a list of break values. There should be one less break value than the number of classes.

Usage

```
quantileCuts(x, n = 5, params = NA)
sdCuts(x, n = 5, params = NA)
rangeCuts(x, n = 5, params = NA)
```

Arguments

x	The variable to be mapped.
n	The number of classes.
params	Extra params for individual cut functions.

Value

An ordered list of the break values between classes

Note

The only cut function using params is quantileCuts, where it is used to specify a list of quantile values - useful if they are not evenly spaced.

Author(s)

Chris Brunsdon

See Also

auto.shading

generalize.polys *generalize.polys*

Description

Generalises a SpatialPolygons or SpatialPolygonsDataFrame or a sf -POLYGON or - MULTIPOLYGON object using the Douglas-Peuker algorithm

Usage

```
generalize.polys(sfo, preserveTopology, dTolerance)
```

Arguments

sfo	A SpatialPolygons or SpatialPolygonsDataFrame or a sf -POLYGON or -MULTIPOLYGON object.
preserveTopology	logical; carry out topology preserving simplification? May be specified for each, or for all feature geometries. Note that topology is preserved only for single feature geometries, not for sets of them.
dTolerance	numeric; tolerance parameter, specified for all or for each feature geometry.

Details

Returns an object of the same class as sp. Note that the algorithm is applied on a polygon-by-polygon, not edge-by-edge basis. Thus edges in generalised polygons may not match perfectly.

Value

An object of class SpatialPolygons or SpatialPolygonsDataFrame. Each polygon shape has been generalized using the Douglas-Peuker algorithm.

Author(s)

Chris Brunsdon, Binbin Lu

Examples

```
# Data for Georgia to use in example

data(WHData)
WH.outline <- st_union(WHHP)
WH.generalised <- generalize.polys(WH.outline,TRUE,0.1)
plot(st_geometry(WHHP))
plot(st_geometry(WH.generalised),add=TRUE,border='red',lwd=2)
```

georgia *Georgia Social and Economic Data by County*

Description

Polygon Data Frame as used in the Brunsdon, Fotheringham & Charlton GWR book, with further variable median income (MedInc)

Usage

```
data(georgia)
```

Format

- **georgia** Georgia polygons SpatialPolygonsDataFrame - geographical projection
- **georgia2** Georgia polygons SpatialPolygonsDataFrame - equal area projection
- **georgia.polys** Georgia polygons in list format - equal area projection

Examples

```
# Read in the data
data(georgia)
# Make a map of median income
choropleth(georgia2,"MedInc")
```

Kernel Density Estimates From Points *Kernel Density Estimates*

Description

Given a set of points, a bandwidth, a grid density and a frame, produce a kernel density estimate

Usage

```
kde.points(pts,h,n=200,lims=NULL)
```

Arguments

pts	A SpatialPoints or SpatialPointsDataFrame object or sf - POINT object.
h	A real number - the bandwidth of the KDE
n	An integer, the output grid density - ie result is nxn grid
lims	A spatial object - the KDE grid will cover this, if provided

Value

A SpatialPixelsDataFrame containing the KDE.

Author(s)

Chris Brunsdon, Binbin Lu

Examples

```
# Data for New Haven to use in example
data(newhaven)
# Do the KDE
breach.dens = kde.points(breach,lims=tracts)
# Plot the result
level.plot(breach.dens)
# Block out the part outside the study area
masker = poly.outer(breach.dens,tracts,extend=100); add.masking(masker)
# Plot census tract boundaries
plot(tracts,add=TRUE)
```

---

level.plot *Level plot for gridded data*

Description

Draws a level plot given a SpatialPixelsDataFrame, an index and a shading scheme.

Usage

```
level.plot(grd, shades, index=1, add=FALSE)
```

Arguments

grd	A spatialPixelsDataFrame object.
shades	A shading scheme created by shading or auto.shading. If omitted, chosen automatically from grd.
index	Index giving the variable in grd to plot.
add	Whether to add the level plot to an existing plot.

Details

The function returns no value, but draws a level plot on the current graphics device as a side effect.

Value

None (see above).

Author(s)

Chris Brunsdon, Binbin Lu

Examples

```
# Data for New Haven to use in example
data(newhaven)
# Do the KDE
breach.dens = kde.points(breach,lims=tracts)
# Plot the result
level.plot(breach.dens)
```

---

map.scale *map.scale*

Description

Draws a scale bar on a map.

Usage

```
map.scale(xc,yc,len,units,ndivs,subdiv=1,tcol='black',scol='black',sfcol='black')
```

Arguments

xc	The *x*-centre (in map units) of the scale bar
yc	The *y*-centre (in map units) of the scale bar
len	The length (in map units) of the scale bar
units	String specifying the name of the units for the scale bar
ndivs	The number of divisions (units marked) on the scale
subdiv	The fraction of `units` used to step along the divisions
tcol	The colour of text on the scale bar.
scol	The colour of the scale bar itself.
sfcol	The colour of the filled rectangles in the scale bar.

Details

Draws an alternating bar scale on a map. Returns no value.

Value

None (see above)

Author(s)

Chris Brunsdon

See Also

choro.legend

Examples

```
# Read in map data for New Haven
data(newhaven)
# Plot census block boundaries
plot(blocks)
# Add a map scale
map.scale(534750,152000,miles2ft(2),"Miles",4,0.5,sfcol='red')
# ... and a title
title('New Haven (CT)')
```

---

newhaven *New Haven, Connecticut: Crime data with contextual information*

Description

Data set from New Haven (CT) crime web site containing point sources of some crimes, plus roads, railways and census block spatial data frames.

Usage

```
data(newhaven)
```

Format

- **blocks** Census blocks `SpatialPolygonsDataFrame`
- **roads** Roads `SpatialLinesDataFrame`
- **places** Place names `SpatialPointsDataFrame`
- **breach** Breach of peace `SpatialPointsDataFrame`
- **famdisp** Family dispute `SpatialPointsDataFrame`
- **tracts** Census tracts `SpatialPolygonsDataFrame`
- **burgres.f** Residential Burglary (Forced) `SpatialPointsDataFrame`
- **burgres.n** Residential Burglary (Non-Forced) `SpatialPointsDataFrame`

Source

`http://www.newhavencrimelog.org/`

Examples

```
# Read in map data for New Haven
data(newhaven)
# Plot census block boundaries
plot(blocks)
# Add a map scale
map.scale(534750,152000,miles2ft(2),"Miles",4,0.5,sfcol='red')
# ... and a title
title('New Haven (CT)')
```

`North Arrow` *Add a north arrow to a map*

Description

Draws a north arrow on a map.

Usage

```
north.arrow(xb,yb,len,lab='NORTH',cex.lab=1,tcol='black',...)
```

Arguments

`xb`	The *x*-centre (in map units) of the arrow base.
`yb`	The *y*-centre (in map units) of the arrow base.
`len`	The length (in map units) of the arrow base.
`lab`	The label for the arrow.
`cex.lab`	Scale factor for the label for the arrow.
`tcol`	The colour of the label text.
`...`	Other graphical parameters passed to the drawing of the arrow.

Details

Draws a north arrow on a map. The arrow itself is drawn using `polygon` and any extra parameters are passed to this call.

Value

None.

Author(s)

Chris Brunsdon

See Also

`map.scale`

Examples

```
# Read in map data for New Haven
data(newhaven)
# Plot census block boundaries
plot(blocks)
# Add a north arrow
north.arrow(534750,152000,miles2ft(0.5),col='cyan')
# ... and a title
title('New Haven (CT)')
```

---

phenology *Phenology data for North American lilacs*

Description

Data set from Schwartz, M.D. and J.M. Caprio, 2003, North American First Leaf and First Bloom Lilac Phenology Data, IGBP PAGES/World Data Center for Paleoclimatology Data Contribution Series # 2003-078. NOAA/NGDC Paleoclimatology Program, Boulder CO, USA.

Usage

```
data(phenology)
```

Format

- **chinensis** Syringa Chinensis Observation Stations `SpatialPointsDataFrame` - geographical projection
- **chinensis2** Syringa Chinensis Observation Stations `SpatialPointsDataFrame` - equal area projection
- **us_states** States of US `SpatialPolygonsDataFrame` - geographical projection
- **us_states2** States of US `SpatialPolygonsDataFrame` - equal area projection

Source

`http://www.ncdc.noaa.gov/paleo/phenology.html`

Examples

```
# Read in the data
data(phenology)
# Split the plot in two
opar <- par(mfrow=c(2,1))
# Plot US states
plot(us_states2)
# Add Locations of observation stations
plot(chinensis2,add=TRUE,pch=16,col='red')
# Plot a histogram of year of observation next to this
hist(chinensis2$Year)
par(opar)
```

Point in Polygon Counts *Number of Points in Each Polygon*

Description

Given a set of points, and a set of polygons, computes the number of points in each polygon.

Usage

```
poly.counts(pts, polys)
```

Arguments

pts	A SpatialPoints or SpatialPointsDataFrame sf - POINT object .
polys	A SpatialPolygons or SpatialPolygonsDataFrame or sf -POLYGON or -MULTIPOLYGON object.

Value

A list of integers of the same length as the number of polygons in polys, giving the number of points from pts.

Author(s)

Chris Brunsdon, Binbin Lu

Examples

```
# Data for New Haven to use in example
data(newhaven)
# How many breaches of peace in each census block?
n.breach = poly.counts(breach,blocks)
blocks@data$Count.per <- n.breach/poly.areas(blocks)
# Compute densities and map them
choropleth(blocks,"Count.per")
```

Polygon Areas *Area of Each Polygon*

Description

Given a set of polygons, returns the area of each polygon.

Usage

```
poly.areas(polys)
```

Arguments

polys	A SpatialPolygons or SpatialPolygonsDataFrame or sf -POLYGON or -MULTIPOLYGON object.

Value

A list of areas of the same length as the number of polygons in polys.

Author(s)

Chris Brunsdon, Binbin Lu

Examples

```
# Data for New Haven to use in example
data(newhaven)
# What is the area each census block?
poly.areas(blocks)
```

Polygon Label Points *Number of Points in Each Polygon*

Description

Given a set of polygons, returns the label point for each polygon in a SpatialPoints or a sf POINT object.

Usage

```
poly.labels(polys)
```

Arguments

polys	A SpatialPolygons or SpatialPolygonsDataFrame or sf -POLYGON or -MULTIPOLYGON object.

Value

SpatialPoints or sf POINT object containing the label point for each polygon, respectively.

Author(s)

Chris Brunsdon, Binbin Lu

shading *Shading*

Description

Creates an object of class shading by directly specifying break values and (optionally) colours.

Usage

```
shading(breaks, cols = brewer.pal(length(breaks), "Reds"))
```

Arguments

breaks	The break points
cols	The shading colours - there should be one more of these than break points.

Value

An object of class shading.

Warning

At the moment, the it is assumed that the number of shading colours is one more than the break points, but this is not checked.

Author(s)

Chris Brunsdon

See Also

choropleth,choro.legend

thematic.map *thematic.map*

Description

Draw thematic maps together with histograms with a Spatial or sf object, background layers according to variables and shading schemes.

Usage

```
thematic.map(data, var.names, colorStyle = NULL, na.pos = "bottomright", bglyrs, bgStyle,
                      scaleBar.pos = "bottomright", mtitle = NULL, htitle = NULL,
                          legend = "Legend", legend.pos = "topright", cuts = 5,
                          cutter = quantileCuts, horiz = FALSE, digits=2,...)
```

Arguments

data	A Spatial or sf object.
var.names	A vector of variable names to be mapped
colorStyle	A vector of colors (including "red", "blue" and "green") or a color function, e.g. rainbow, heat.colors, hcl.colors, terrain.colors and colors
na.pos	A 2-D coordinate or character to define the position of north arrow, i.e. "topright", "topleft", "bottomright", "bottomleft"
bglyrs	A list of background layers of "Spatial" or "sf" objects
bgStyle	A list of parameters for define the styles of background layers, e.g. list(col="grey", cex=1, lwd=1, pch=16, lty=1)
scaleBar.pos	A 2-D coordinate or character to define the position of scale bar, i.e. "topright", "topleft", "bottomright", "bottomleft"
mtitle	Title of each map
htitle	Title of each histogram
legend	Title of each legend for each map
legend.pos	A 2-D coordinate or character to define the position of legend, i.e. "topright", "topleft", "bottomright", "bottomleft"
cuts	The number of classes.
cutter	Function used to create the break points. Can be user defined or a supplied cut function.
horiz	logical; if TRUE, set the legend horizontally rather than vertically
digits	Number of digits kept for legend
...	Arguments to be passed to methods

Details

The function returns no value, but draws thematic maps together with histograms on the current graphics device as a side effect.

Value

None (see above).

Author(s)

Binbin Lu

See Also

choropleth, choro.legend, auto.shading, shading.

Examples

```
data(newhaven)
# Single map
thematic.map(blocks, var.names="POP1990", horiz = FALSE, na.pos = "topleft",
            scaleBar.pos = "bottomright", legend.pos = "bottomleft",
            colorStyle = "red")

#Multiple maps and different colors
thematic.map(blocks, var.names=c("P_35_44","P_25_34", "POP1990"),
horiz =FALSE, na.pos = "topleft", scaleBar.pos = "bottomright",

legend.pos = "bottomleft",colorStyle =hcl.colors)
thematic.map(blocks, var.names=c("P_35_44","P_25_34", "POP1990"),

horiz =FALSE, na.pos = "topleft", scaleBar.pos = "bottomright",
 legend.pos = "bottomleft", colorStyle =c("red", "blue", "na"))
# Use coordinate to define the legend
data(WHData)
thematic.map(whp_sp, var.names="Avg_Green_", colorStyle ="red",
             na.pos = "topleft", scaleBar.pos = "bottomleft",
             legend.pos = c(544000, 3380000),cuts=7,
             cutter=rangeCuts)
thematic.map(WHHP, var.names=c("Avg_HP_avg", "Avg_Green_"), colorStyle =c("red", "blue"),
             na.pos = "topleft", scaleBar.pos = "bottomleft",
             legend.pos = c(544000, 3380000),cuts=7,
             cutter=rangeCuts)
```

---

tornados *US Tornado Touchdown Data*

Description

Data set from NOAA's National Weather Service Indianapolis, IN Weather Forecast Office 6900 W. Hanna Ave.

Usage

```
data(tornados)
```

Format

- **torn** Tornado Touchdown points `SpatialPointsDataFrame` - geographical projection
- **torn2** Tornado Touchdown points `SpatialPointsDataFrame` - equal area projection

Source

`http://www.crh.noaa.gov/ind/?n=svrgis`

Examples

```
# Read in the data
data(tornados)
# Split the plot in two
opar <- par(mfrow=c(2,1))
# Plot US states
plot(us_states)
# Add Locations of observation stations
plot(torn,add=TRUE,pch=16,col='red')
# Plot a histogram of year of observation next to this
hist(torn$YEAR)
par(opar)
```

Unit Conversion *Distance Units Conversion*

Description

Convert between different distance units - all functions take the form `xx2yy` where `xx` is the unit to be converted from and `yy` is the unit to be converted to.

Usage

```
ft2miles(x)
miles2ft(x)
ft2km(x)
km2ft(x)
```

Arguments

`x`	A quantity in units to be converted from

Value

The value of `x` converted to the new units. In the example below the conversions are from feet to miles and feet to kilometers (hence functions are `ft2miles` and `ft2km`).

Author(s)

Chris Brunsdon

Examples

```
# How many miles is 10,000 feet?
ft2miles(10000)
# How about in kilometers?
ft2km(10000)
```

vulgaris *Phenology data for North American lilacs*

Description

Data set from Schwartz, M.D. and J.M. Caprio, 2003, North American First Leaf and First Bloom Lilac Phenology Data, IGBP PAGES/World Data Center for Paleoclimatology Data Contribution Series # 2003-078. NOAA/NGDC Paleoclimatology Program, Boulder CO, USA.

Usage

```
data(vulgaris)
```

Format

- **vulgaris** Syringa Vulgaris Observation Stations `SpatialPointsDataFrame` - geographical projection
- **vulgaris2** Syringa Vulgaris Observation Stations `SpatialPointsDataFrame` - equal area projection
- **us_states** States of US `SpatialPolygonsDataFrame` - geographical projection
- **us_states2** States of US `SpatialPolygonsDataFrame` - equal area projection

Source

`http://www.ncdc.noaa.gov/paleo/phenology.html`

Examples

```
# Read in the data
data(vulgaris)
# Split the plot in two
opar <- par(mfrow=c(2,1))
# Plot US states
plot(us_states)
# Add Locations of observation stations
plot(vulgaris,add=TRUE,pch=16,col='red')
# Plot a histogram of year of observation next to this
hist(vulgaris$Year)
par(opar)
```

WHData *Data sets of Wuhan*

Description

Four geographic data sets of Wuhan are incoporated in this package

Usage

```
data(WHData)
```

Format

- **WHHP** House price data at the community level of Wuhan in a sf object
- **WHD** District boundary data of Wuhan
- **WHRD** Road network data of Wuhan
- **whp_sp** House price data at the community level of Wuhan in a SpatialPolygonsDataFrame object

Examples

```
# Read in the data
data(WHData)
choropleth(WHHP,"Avg_HP_avg")
```

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