Package ‘topoDistance’

May 27, 2019

Type Package
Title Calculating Topographic Paths and Distances
Version 0.1.0
Author Ian J. Wang
Maintainer Ian J. Wang <ianwang@berkeley.edu>
Description topoDistance provides functions for calculating topographic distances and identifying and plotting topographic paths. Topographic distances can be calculated along shortest topographic paths or topographic least cost paths. Functions can map topographic paths on colored or hillshade maps and plot topographic cross sections (elevation profiles) for the paths.
Depends R (>= 3.1.0)
License GPL-3
Encoding UTF-8
LazyData true
Imports igraph,
    gdistance,
    plotly,
    raster,
    RColorBrewer,
    scales,
    sp
RoxygenNote 6.1.1
Suggests knitr,
    rmarkdown
VignetteBuilder knitr

R topics documented:

  topoDist                      .................................................. 2
  topoDistance                  .................................................. 3
  topoLCP                      .................................................. 3
  topoPathMap                   .................................................. 4
  topoPaths                    .................................................. 5
  topoProfile                  .................................................. 6
  topoSurface                  .................................................. 7
  Yosemite                     .................................................. 8
**topoDist**

**Topographic distances and paths**

**Description**

Calculates shortest topographic distances and paths

**Usage**

```r
topoDist(DEM, pts, directions = 8, paths = FALSE)
```

**Arguments**

- **DEM** A RasterLayer for digital elevation model (DEM) data.
- **pts** A SpatialPoints object or two-column matrix with xy coordinates for the geographic points from which to calculate pairwise distances and paths.
- **directions** numeric (default = 8). The number of directions for movement between cells, either 4 or 8.
- **paths** logical. Default is FALSE, in which case only topographic distances are calculated. If TRUE, topographic paths are also identified.

**Details**

If paths = FALSE, the function will return a matrix of pairwise topographic distances between the specified points. If paths = TRUE, the function will return a list with two items: (1) the matrix of pairwise topographic distances, and (2) a SpatialLines object containing the topographic paths.

**Value**

Matrix of topographic distances (if paths = FALSE), or a list containing a matrix of topographic distances and the topographic paths as an object of class SpatialLines (if paths = TRUE).

**Examples**

```r
xy <- matrix(nrow = 2, byrow = TRUE,
c(c(-119.5566, 37.72474,
  -119.4718, 37.76078))
topoDist(Yosemite$DEM, xy, paths = TRUE)
```
The topoDistance package provides functions for calculating topographic distances and identifying and plotting topographic paths. Topographic distances can be calculated along shortest topographic paths or topographic least cost paths. Functions can map topographic paths on colored or hillshade maps and plot topographic cross sections (elevation profiles) for the paths.

Details

Unlike the topographically-corrected distances calculated by some GIS software, which just adjust for elevational changes along a straight-line path between points, topoDistance calculates the distance along the shortest topographic path between points, which is more likely to realistically reflect biological movement on a topographically complex landscape.

Topographic distances are calculated as the hypotenuse of the horizontal and vertical distances between cells on an elevation raster. These distances are assigned to the weights of vertices between the nodes for each cell on a landscape graph, and functions from the gdistance and igraph packages are used to find the shortest path between nodes. For topographic least cost paths, resistance distance weights are multiplied by the topographic distance weights to get topographically corrected least cost path distances.

Usage

topoLCP(DEM, costSurface, pts, directions = 8, paths = FALSE)

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEM</td>
<td>A RasterLayer for digital elevation model (DEM) data.</td>
</tr>
<tr>
<td>costSurface</td>
<td>A RasterLayer for the conductance (inverse of resistance) values for each cell.</td>
</tr>
<tr>
<td>pts</td>
<td>A SpatialPoints object or two-column matrix with xy coordinates for the geographic points from which to calculate pairwise distances and paths.</td>
</tr>
<tr>
<td>directions</td>
<td>numeric (default = 8). The number of directions for movement between cells, either 4 or 8.</td>
</tr>
<tr>
<td>paths</td>
<td>logical. Default is FALSE, in which case only topographic distances are calculated. If TRUE, topographic paths are also identified.</td>
</tr>
</tbody>
</table>
Details

The values of the raster for costSurface should be conductance values rather than resistance values. These can be calculated by taking the inverse of resistance values.

Value

Matrix of topographic distances (if paths = FALSE), or a list containing a matrix of topographic distances and the topographic paths as an object of class SpatialLines (if paths = TRUE).

Examples

```r
xy <- matrix(ncol = 2, byrow = TRUE,
  c(-119.5566, 37.72474,
    -119.4718, 37.76078))
topoLCP(Yosemite$DEM, Yosemite$SDM, xy, paths = TRUE)
```

topoPathMap

Map of topographic paths

Description

Plots a map of topographic paths on a landscape layer

Usage

```r
topoPathMap(DEM, pts, topoPaths, type = "hillshade",
  costSurface = NULL, costColors = NULL, pathWidth = 2,
  pathColor = "darkred", alpha = 0.65, angle = 45, direction = 0,
  cex = 2, bg = "gray", col = "black", pch = 21)
```

Arguments

- **DEM**: A RasterLayer for digital elevation model (DEM) data.
- **pts**: A SpatialPoints object or two-column matrix with xy coordinates for the geographic points from which to calculate pairwise distances and paths.
- **topoPaths**: A SpatialLines object containing the topographic paths to be plotted.
- **type**: character (default = "hillshade"). Type of map on which to plot topographic paths: "hillshade", "terrain", or "topo".
- **costSurface** (optional): A RasterLayer for the conductance (inverse of resistance) values for each cell.
- **costColors** (optional): A function that takes an integer argument (the required number of colors) and returns a character vector of colors (see rgb) interpolating the given sequence (similar to heat.colors or terrain.colors), such as the one returned by colorRampPalette.
- **pathWidth**: numeric (default = 2). Width for drawing path line.
- **pathColor**: character (default = "darkred"). Color for drawing path line.
- **alpha**: numeric (default = 0.65). Alpha transparency for drawing path line.
- **angle**: numeric (default = 45). Angle of lighting for hillshade maps, only (type = "hillshade").
The objects supplied for the DEM and pts arguments (and, optionally, costSurface) are generally those used to calculate the topographic paths using topoDist or topoLCP.

For the type argument, choosing "hillshade" will plot a shaded relief map, "terrain" will plot a map with terrain colors, and "topo" will plot a map with topo colors.

Optional arguments can be supplied to control the size (cex), shape (pch), and color (bg and col) of the points.

Value

Plot of topographic paths

Examples

```r
topopaths <- matrix(ncol = 2, byrow = TRUE, 
c(-119.5566, 37.72474, 
   -119.4718, 37.76078))
YosPaths <- topoDist(Yosemite$DEM, xy, paths = TRUE)
topoPathMap(Yosemite$DEM, xy, topoPaths = YosPaths)
```

```r
topopaths <- matrix(ncol = 2, byrow = TRUE, 
c(-119.5566, 37.72474, 
   -119.4718, 37.76078))
YosLCP <- topoLCP(Yosemite$DEM, Yosemite$SDM, xy, paths = TRUE)
topoPathMap(Yosemite$DEM, xy, topoPaths = YosLCP, costSurface = Yosemite$SDM, 
            pathWidth = 3, pathColor = "purple", cex = 2, pch = 16, bg = "blue")
```

Description

Identify shortest topographic paths

Usage

topoPaths(t.dist, pts)

Arguments

t.dist A TransitionLayer object.
pts A SpatialPoints object for the geographic points from which to calculate pairwise distances and paths.
Details

This function identifies shortest topographic paths from a topographic TransitionLayer. It does not need to be called separately from the topoDist and topoLCP functions.

Value

An object of class SpatialLines

Examples

xy <- matrix(ncol = 2, byrow = TRUE, 
c(-119.5566, 37.72474, 
-119.4718, 37.76078))
xy <- sp::SpatialPoints(xy)
topoTL <- topoSurface(Yosemite$DEM)
topoPaths(topoTL, xy)

topoProfile       Elevation profiles of topographic paths

Description

Plots topographic cross sections (elevation profiles) of topographic paths

Usage

topoProfile(DEM, topoPaths, pts = 100, type = "base", 
            singlePlot = FALSE, rows = NULL, cols = NULL, limits = NULL, 
            legendx = "bottomright")

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEM</td>
<td>A RasterLayer for digital elevation model (DEM) data.</td>
</tr>
<tr>
<td>topoPaths</td>
<td>A SpatialLines object containing the topographic paths to be plotted.</td>
</tr>
<tr>
<td>pts</td>
<td>numeric (default = 100). The number of elevation points to plot along each path.</td>
</tr>
<tr>
<td>type</td>
<td>character (default = &quot;base&quot;). Type of plotting: &quot;base&quot; or &quot;plotly&quot;.</td>
</tr>
<tr>
<td>singlePlot</td>
<td>logical (default = FALSE). If TRUE, profiles will be drawn on a single plot.</td>
</tr>
<tr>
<td>rows</td>
<td>numeric (optional). Number of rows for plot layout (if singlePlot = FALSE)</td>
</tr>
<tr>
<td>cols</td>
<td>numeric (optional). Number of columns for plot layout (if singlePlot = FALSE)</td>
</tr>
<tr>
<td>limits</td>
<td>numeric vector (optional). A vector with the lower and upper limits for the y-axis (elevation).</td>
</tr>
<tr>
<td>legendx</td>
<td>character (default = &quot;bottomright&quot;). Position for the legend.</td>
</tr>
</tbody>
</table>

Details

For the type argument, choosing "base" will use base R plotting, and choosing "plotly" will draw an interactive plot with the plotly package.

If rows, cols, or limits are not specified, the most even arrangement will be detected and used.
`topoSurface`  

**Value**  
Plot of elevation profiles  

**Examples**  
```r  
xy <- matrix(ncol = 2, byrow = TRUE,  
c(-119.5566, 37.72474,  
-119.4718, 37.76078))  
YosPaths <- topoDist(Yosemite$DEM, xy, paths = TRUE)  
topoProfile(Yosemite$DEM, topoPaths = YosPaths, type = "base", cols = 2)  

xy <- matrix(ncol = 2, byrow = TRUE,  
c(-119.5566, 37.72474,  
-119.4718, 37.76078))  
YosLCP <- topoLCP(Yosemite$DEM, Yosemite$SDM, xy, paths = TRUE)  
topoProfile(Yosemite$DEM, YosLCP, pts = 1000, type = "plotly", singlePlot = TRUE)  
```

**topoSurface**  
*Topographic distance surface*  

**Description**  
Generates a TransitionLayer object for topographic distance from a RasterLayer  

**Usage**  
`topoSurface(DEM, conductance = TRUE, directions = 8)`  

**Arguments**  
`DEM` A RasterLayer for digital elevation model (DEM) data.  
`conductance` logical (default = TRUE). If FALSE, resistance values are returned. If TRUE, conductance values (1/resistance) are returned.  
`directions` numeric (default = 8). Directions of allowable movement between raster cells (4 or 8).  

**Details**  
This function generates a TransitionLayer from a DEM, which is used by the topoDist and topoLCP functions. It does not need to be called separately from the topoDist and topoLCP functions.  

**Value**  
TransitionLayer  

**Examples**  
```r  
YosTL <- topoSurface(Yosemite$DEM)  
```
Yosemite

Spatial data for western fence lizards in Yosemite

Description

A dataset containing a RasterStack with two RasterLayer objects, a digital elevation model (DEM) for part of Yosemite National Park (USA) and a species distribution model (SDM) for the western fence lizard (Sceloporus occidentalis).

Usage

data(Yosemite)

Format

A RasterStack

Examples

data(Yosemite)
Index

«Topic datasets
  Yosemite, 8

topoDist, 2
topoDistance, 3
topoDistance-package (topoDistance), 3
topoLCP, 3
topoPathMap, 4
topoPaths, 5
topoProfile, 6
topoSurface, 7

Yosemite, 8