Package ‘mapsRinteractive’

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Type Package

Title Local Adaptation and Evaluation of Digital Soil Maps

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Description Local adaptation and evaluation of digital soil maps in raster format by use of point location soil property data.

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`CLAYr` *The Digital Soil Map of Sweden -topsoil clay content*

Description

Excerpt from the Digital Soil Map of Sweden. Projected coordinate system: Sweref99TM (epsg: 3006). Attribute: predicted topsoil (0-20 cm depth) clay content (

Usage

```
data(CLAYr)
```

Format

Raster layer

References

Available online: https://www.sgu.se/samhallsplanering/planering-och-markanvandning/markanvandning/jordbruk-skog-och-fiske/lerhaltskartan-digital-akermarkskarta/.

`CLAYs` *SLU farm (Brogarden) soil sample data -topsoil clay content*

Description

Projected coordinate system: Sweref99TM (epsg: 3006). Attribute: Lab analyzed topsoil (0-20 cm depth) clay content (

Usage

```
data(CLAYs)
```

Format

SpatialPointsDataFrame

References

Piikki, K., Wetterlind, J., Söderström, M., & Stenberg, B. (2015). Three-dimensional digital soil mapping of agricultural fields by integration of multiple proximal sensor data obtained from different sensing methods. Precision agriculture, 16(1), 29-45. https://doi.org/10.1007/s11119-014-9381-6

E   *Nash-Sutcliffe Modelling Efficiency (E)*

Description

Calculates the Nash-Sutcliffe modelling efficiency (E) from observed and predicted values.

Usage

```
E(observed, predicted)
```

Arguments

`observed`	a numeric vector of observed values
`predicted`	a numeric vector of predicted values. The length shall be the same as for observed.

Details

E = 1 - sum(observed - predicted)/sum(observed - mean (observed))

Value

Nash-Sutcliffe modelling efficiency (E) calculated from observed and predicted values.

References

Nash, J. E., & Sutcliffe, J. V. (1970). River flow forecasting through conceptual models part I—A discussion of principles. Journal of hydrology, 10(3), 282-290.

Examples

```
o<-1:5
p<-c(2,2,4,3,5)
E(observed=o, predicted=p)
```

mae *Mean Absolute Error (MAE)*

Description

Calculates the mean absolute error (MAE) from observed and predicted values.

Usage

```
mae(observed, predicted)
```

Arguments

`observed`	a numeric vector of observed values
`predicted`	a numeric vector of predicted values. The length shall be the same as for observed.

Details

mae = mean(abs(observed - predicted))

Value

the mean absolute error (MAE) calculated from the observed and the predicted values.

Examples

```
o<-1:5
p<-c(2,2,4,3,5)
mae(observed=o, predicted=p)
```

me *Mean Error (ME)*

Description

Calculates the mean error (ME) from observed and predicted values.

Usage

```
me(observed, predicted)
```

Arguments

`observed`	a numeric vector of observed values
`predicted`	a numeric vector of predicted values. The length shall be the same as for observed.

Details

me = bias = mean(observed - predicted)

Value

the mean error (ME) calculated from the observed and the predicted values.

Examples

```
o<-1:5
p<-c(2,2,4,3,5)
me(observed=o, predicted=p)
```

---

mri *mri*

Description

Local adaptation and evaluation of digital soil maps in raster format by use of point location soil property data.

Usage

```
mri(rst.r = NULL, rst.file = NULL, pts.shp = NULL, pts.spdf = NULL,
  pts.df = NULL, pts.txt = NULL, pts.attr = NULL, pts.x = "x",
  pts.y = "y", pts.dec = ".", pts.sep = "\t", area.spdf = NULL,
  area.shp = NULL, epsg, md = "Sph", rg = NULL, ng = 0.1,
  out.folder = NULL, out.prefix = NULL, out.dec = ".", out.sep = "\t",
  rst.res = NULL, rst.data.type = "INT1U", b = NULL)
```

Arguments

`rst.r`	raster layer. At least one of the arguments 'rst.r' or 'rst.file' must be specified.
`rst.file`	Path to raster file (for example .tif). At least one of the arguments 'rst.r' or 'rst.file' must be specified.
`pts.shp`	Path to point shapefile with observed soil property data. The coordinate system shall be the same as for the raster. At least one of the arguments 'pts.shp', 'pts.df', 'pts.txt' or 'pts.spdf' must be specified.
`pts.spdf`	SpatialPointsDataframe The coordinate system shall be the same as for the raster. At least one of the arguments 'pts.shp', 'pts.df', 'pts.txt' or 'pts.spdf' must be specified.
`pts.df`	Data.frame with spatial coordinates (same coordinates as for the raster layer) and attribure data. At least one of the arguments 'pts.shp', pts.df', 'pts.txt' or 'pts.spdf' must be specified.
`pts.txt`	Path to text file with spatial coordinates (same coordinates as for the raster layer) and attribure data. At least one of the arguments 'pts.shp', 'pts.df', 'pts.txt' or 'pts.spdf' must be specified.

`pts.attr`	Name of the attribute column in pts.sp, pts.df or pts.txt. Required. The data must be numerical.
`pts.x`	Name of the x coordinate column in pts.df. Requiredif pts.df is specified.
`pts.y`	Name of the y coordinate column in pts.df. Requiredif pts.df is specified.
`pts.dec`	Decimal delimiter in pts.txt. Default is period.
`pts.sep`	Separation in pts.txt. Default is tab.
`area.spdf`	SpatialPolygonsDataframe delineating the area to be mapped Optional. The coordinate system shall be the same as for the rasters. If not completely overlapping, the itersection of x and area will be used.
`area.shp`	Path to polygon shapefile delineating the area to be mapped Optional. The coordinate system shall be the same as for the rasters. If not ompletely overlapping, the itersection of x and area will be used.
`epsg`	Epsg code (numeric) for the orthognonal spatial reference system onto which input data are projected, see e.g. http://spatialreference.org/ref/epsg/
`md`	variogram model type for the stadardized variograms used for ordinary kriging interpolation of observed data or residuals. Varigrams are generated by gstat::vgm. Default is "Sph" (spherical model).
`rg`	range of the stadardized variograms used for ordinary kriging interpolation of observed data or residuals. Varigrams are generated by gstat::vgm. If no rg is specified it will be set to half of the square root of the mapping area.
`ng`	nugget of the stadardized variograms used for ordinary kriging interpolation of observed data or residuals. Varigrams are generated by gstat::vgm. Default is "Sph" (spherical model). The nugget is expressed as a fraction of the sill. An ng = 0.1 means that the nugget is 10 the sill. The sill is by default equal to the variace of the data to be krigied (i.e the point observations or the residuals).
`out.folder`	Output folder (path) to which the output files shall be exported. Optional. Data will only be exported if an out_folder path is defined.
`out.prefix`	Prefix (character) for the output filenames.
`out.dec`	Decimal delimiter in exported text files. Default is period.
`out.sep`	Separation in pts.txt. Default is tab.
`rst.res`	Resolution to which the imported raster shall be resampled before adaptation. See raster::dataType for details.
`rst.data.type`	Data type for exported rasters. Default is 'INT1U'.
`b`	Width of buffer zone around point observations to which the area to be mapped shall be delineated. Default = 1 000 000 in the same unit as for the projected spatial reference system.

Details

Maps.R.Interactive is intended for local adaptation and or/evaluation of large extent digital soil maps. A raster map and point location soil property data projected onto the same projected cartesian coordinate systenm are required from the Four maps are (created and) evaluated: the original raster map, a map created solely based on the soil samples data (ordinary kriging using a standardized variogram), two maps based on a combination of the two (regression kriging and residual kriging, both using standardized variograms). The maps are evaluated by leave-one-out cross validation and a number of evaluation measures are computed: the Nash-Sutcliffe modelling efficiency (E), the mean absolute error (MAE; Janssen & Heuberger, 1995), the coefficient of determination of a linear regression between predicted and measured values (r2). Maps.R.Interactive was used by Piikki et al.(2017) and Nijbroek et al. (2018) (before it was made available as an R package). More details can be found in these publications. It is also implemented in the open Swedish web application for precision agriculture markdata.se.

Value

A list with:

1) 'all_maps.r' a raster stack with the original raster map ('map'), the map, created by ordinary kriging of observed data ('ordkrig'), by residual kriging ('reskrig') and by regression kriging ('regkrig').

2) 'mapped.area.sp' a SpatialPolygonsDataFrame with a polygon delineating the mapped area. The mapped area is the intersection between the original raster map, the input area polygon ('area.sp') and the buffered (1.5*max dist between one point and its neares neighbour) point locations. adapted map and a map created by ordinary kriging using an standardized variogram, 2) a data.frame with validation sratistics of the three maps.

3) 'used.pts.sp' a SpatialPointsDataFrame with the pints used for mapping, i.e points falling within the mapped area and with no NA values in among the observed values and the values extacted from the original map.

4) 'evaluation' a data.frame with evaluation statistics for the original map and the eave-one out cross validation of the three other mapping methods.

5) 'feedback' a data.frame with feedback on inputted and used data.

Author(s)

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References

Nijbroek, R., Piikki, K., Söderström, M., Kempen, B., Turner, K. G., Hengari, S., & Mutua, J. (2018). Soil Organic Carbon Baselines for Land Degradation Neutrality: Map Accuracy and Cost Tradeoffs with Respect to Complexity in Otjozondjupa, Namibia. Sustainability, 10(5), 1610. doi:10.3390/su10051610

Piikki, K.,Söderström, M., Stadig, H. 2017. Local adaptation of a national digital soil map for use in precision agriculture. Adv. Anim. Biosci. 8, 430–432.

Janssen, P.H.M.; Heuberger, P.S.C.1995. Calibration of process-oriented models. Ecol. Model., 831, 55–66.

Nash, J.E.; Sutcliffe, J.V. River flow forecasting through conceptual models part I—A discussion of principles. J. Hydrol. 1970, 103, 282–290.

Examples

```
##retrieve example point location data
data('CLAYs')
```

```
##create path to example raster dataset
rst.path<-  system.file("extdata/CLAYr.tif", package="mapsRinteractive")
##run local adaptation and evaluation
mri.out<-mri(
 rst.file = rst.path,
 pts.df = CLAYs,
 pts.attr ='clay_percent',
 pts.x= 'POINT_X',
 pts.y= 'POINT_Y',
 epsg = 3006
 )
##check evaluation metasures
print(mri.out$evaluation)
```

---

r2 *Coefficient of Determination (r2)*

Description

Calculates the coefficient of determination (r2) for a linear regression model between predicted values and observed values.

Usage

```
r2(observed, predicted)
```

Arguments

`observed`	a numeric vector of observed values
`predicted`	a numeric vector of predicted values. The length shall be the same as for observed.

Value

Coefficient of determination (r2) for a linear regression model between predicted values and observed values.

Examples

```
o<-1:5
p<-c(2,2,4,3,5)
r2(observed=o, predicted=p)
```

`rmse` *Root Mean Square Error (RMSE)*

Description

Calculates the root mean square error (RMSE) from observed and predicted values.

Usage

```
rmse(observed, predicted)
```

Arguments

`observed`	a numeric vector of observed values
`predicted`	a numeric vector of predicted values. The length shall be the same as for observed.

Details

rmse = sqrt(mean((observed - predicted)^2))

Value

the root mean square err or (RMSE) calculated from the observed and the predicted values.

Examples

```
o<-1:5
p<-c(2,2,4,3,5)
rmse(observed=o, predicted=p)
```

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