Package 'rgdal'

March 17, 2018

Title Bindings for the 'Geospatial' Data Abstraction Library

Version 1.2-18

Date 2018-02-26

Depends R (>= 3.3.0), methods, sp (>= 1.1-0)

Imports grDevices, graphics, stats, utils

LinkingTo sp

Description Provides bindings to the 'Geospatial' Data Abstraction Library ('GDAL') (>= 1.6.3) and access to projection/transformation operations from the 'PROJ.4' library. The 'GDAL' and 'PROJ.4' libraries are external to the package, and, when installing the package from source, must be correctly installed first. Both 'GDAL' raster and 'OGR' vector map data can be imported into R, and 'GDAL' raster data and 'OGR' vector data exported. Use is made of classes defined in the 'sp' package. Windows and Mac Intel OS X binaries (including 'GDAL', 'PROJ.4' and 'Expat') are provided on 'CRAN'.

License GPL (>= 2)

URL http://www.gdal.org, https://r-forge.r-project.org/projects/rgdal/

SystemRequirements for building from source: GDAL >= 1.6.3, library from http://trac.osgeo.org/gdal/wiki/DownloadSource and PROJ.4 (proj >= 4.4.9) from http://download.osgeo.org/proj/; GDAL OSX frameworks built by William Kyngesburye at http://www.kyngchaos.com/ may be used for source installs on OSX.

NeedsCompilation yes

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Repository CRAN
Date/Publication 2018-03-17 17:16:34 UTC

R topics documented:

`closeDataset-methods` *closeDataset methods*

Description

Methods for closing GDAL datasets, used internally

Usage

```
closeDataset(dataset)
closeDataset.default(dataset)
```

Arguments

`dataset`	GDAL dataset

Methods

dataset = "ANY" default method, returns error

dataset = "GDALReadOnlyDataset" closes the "GDALReadOnlyDataset"

dataset = "GDALTransientDataset" closes the "GDALTransientDataset"

`CRS-class` *Class "CRS" of coordinate reference system arguments*

Description

Interface class to the PROJ.4 projection system. The class is defined as an empty stub accepting value NA in the sp package. If the rgdal package is available, then the class will permit spatial data to be associated with coordinate reference systems

Usage

```
checkCRSArgs(uprojargs)
```

Arguments

`uprojargs`	character string PROJ.4 projection arguments

Objects from the Class

Objects can be created by calls of the form `CRS("projargs")`, where "projargs" is a valid string of PROJ.4 arguments; the arguments must be entered exactly as in the PROJ.4 documentation, in particular there cannot be any white space in +<arg>=<value> strings, and successive such strings can only be separated by blanks. The initiation function calls the PROJ.4 library to verify the argument set against those known in the library, returning error messages where necessary. The complete argument set may be retrieved by examining the second list element returned by `validObject("CRS object")` to see which additional arguments the library will use (which assumptions it is making over and above submitted arguments). The function `CRSargs()` can be used to show the expanded argument list used by the PROJ.4 library.

Slots

`projargs`**:** Object of class `"character"`: projection arguments; the arguments must be entered exactly as in the PROJ.4 documentation, in particular there cannot be any white space in +<arg>=<value> strings, and successive such strings can only be separated by blanks.

Methods

show `signature(object = "CRS")`: print projection arguments in object

Note

Lists of projections may be seen by using the programs installed with the PROJ.4 library, in particular proj and cs2cs; with the latter, -lp lists projections, -le ellipsoids, -lu units, and -ld datum(s) known to the installed software (available in **rgdal** using `projInfo`). These are added to in successive releases, so tracking the website or compiling and installing the most recent revisions will give the greatest choice. Finding the very important datum transformation parameters to be given with the +towgs84 tag is a further challenge, and is essential when the datums used in data to be used together differ. Tracing projection arguments is easier now than before the mass ownership of GPS receivers raised the issue of matching coordinates from different argument sets (GPS output and paper map, for example). See `GridsDatums` and `showEPSG` for help in finding CRS definitions.

The 4.9.1 release of PROJ.4 omitted a small file of defaults, leading to reports of "major axis or radius = 0 or not given" errors. From 0.9-3, rgdal checks for the presence of this file (proj_def.dat), and if not found, and under similar conditions to those used by PROJ.4, adds "+ellps=WGS84" to the input string being checked by `checkCRSArgs` The "+no_defs" tag ignores the file of defaults, and the default work-around implemented to get around this problem; strings including "init" and "datum" tags also trigger the avoidance of the work-around. Now messages are issued when a candidate CRS is checked; they may be suppressed using `suppressMessages`.

Author(s)

Roger Bivand <Roger.Bivand@nhh.no>

References

http://proj.maptools.org/

Examples

```
CRSargs(CRS("+proj=longlat"))
try(CRS("+proj=longlat +no_defs"))
CRSargs(CRS("+proj=longlat +datum=NAD27"))
CRSargs(CRS("+init=epsg:4267"))
CRSargs(CRS("+init=epsg:26978"))
CRSargs(CRS(paste("+proj=stere +lat_0=52.15616055555555",
"+lon_0=5.38763888888889 +k=0.999908 +x_0=155000 +y_0=463000 +ellps=bessel",
"+towgs84=565.237,50.0087,465.658,-0.406857,0.350733,-1.87035,4.0812",
"+units=m")))
# see http://trac.osgeo.org/gdal/ticket/1987
CRSargs(CRS("+init=epsg:28992"))
crs <- CRS("+init=epsg:28992")
CRSargs(CRS(CRSargs(crs)))
library(sp)
data(meuse)
coordinates(meuse) <- c("x", "y")
proj4string(meuse) <- CRS("+init=epsg:28992")
CRSargs(CRS(proj4string(meuse)))
```

displayDataset *Display a GDAL dataset*

Description

Display a GDAL dataset allowing for subscenes and decimation, allowing very large images to be browsed

Usage

```
displayDataset(x, offset=c(0, 0), region.dim=dim(x), reduction = 1,
  band = 1, col = NULL, reset.par = TRUE, max.dim = 500, ...)
```

Arguments

x	a three-band GDALReadOnlyDataset object
offset	Number of rows and columns from the origin (usually the upper left corner) to begin reading from; presently ordered (y,x) - this may change
region.dim	The number of rows and columns to read from the dataset; presently ordered (y,x) - this may change
reduction	a vector of length 1 or 2 recycled to 2 for decimating the input data, 1 retains full resultion, higher values decimate
band	The band number (1-based) to read from
col	default NULL, attempt to use band colour table and default to grey scale if not available
reset.par	default TRUE - reset par() settings on completion
max.dim	default 500, forcing the image to a maximum dimension of the value
...	arguments passed to image.default()

Value

a list of the image data, the colour table, and the par() values on entry.

Author(s)

Tim Keitt

References

http://www.gdal.org/

Examples

```
logo <- system.file("pictures/Rlogo.jpg", package="rgdal")[1]
x <- GDAL.open(logo)
opar <- par(no.readonly=TRUE)
par(mfrow=c(2,2))
displayDataset(x, band=1, reset.par=FALSE)
displayDataset(x, band=2, reset.par=FALSE)
displayDataset(x, band=3, reset.par=TRUE)
par(opar)
dx <- RGB2PCT(x, band=1:3)
displayDataset(dx)
GDAL.close(x)
GDAL.close(dx)
```

GDALcall *Wrapper functions to allow more direct calling of rgdal C code*

Description

These functions allow more direct access to some of the rgdal C API. These are advanced methods intended for package developers only.

Usage

```
GDALcall(object, option, ...)
rawTransform(projfrom, projto, n, x, y, z=NULL)
```

Arguments

object	GDALTransientDataset (option = 'SetGeoTransform', 'SetProject') or GDALRasterBand (the other options)
option	character. One of 'SetGeoTransform', 'SetProject', 'SetNoDataValue', 'SetStatistics', 'SetRasterColorTable' or 'SetCategoryNames')
...	additional arguments. The values to be set
projfrom	character. PROJ.4 coordinate reference system (CRS) description
projto	character. PROJ.4 CRS description
n	number of coordinates
x	x coordinates
y	y coordinates
z	z coordinates

Value

GDALcall does not return anything. rawTransform returns a matrix of transformed coordinates.

Author(s)

Robert Hijmans

GDALDataset-class *Class "GDALDataset"*

Description

GDALDataset extends GDALReadOnlyDataset-class with data update commands.

Usage

```
putRasterData(dataset, rasterData, band = 1, offset = c(0, 0))
saveDataset(dataset, filename, options=NULL, returnNewObj=FALSE)
copyDataset(dataset, driver, strict = FALSE, options = NULL, fname=NULL)
deleteDataset(dataset)
saveDatasetAs(dataset, filename, driver = NULL, options=NULL)
```

Arguments

dataset	An object inheriting from class 'GDALDataset'
rasterData	A data array with length(dim(rasterData)) = 2
band	The band number (1-based) to read from
offset	Number of rows and columns from the origin (usually the upper left corner) to begin reading from
filename	name of file to contain raster data object; will be normalized with normalizePath
returnNewObj	until and including 0.5-27, saveDataset returned an invisible copy of the new file handle, which was then only finalized when the garbage collector ran. The old behaviour can be retained by setting to FALSE, the default behaviour is to close the hande and not return it.
driver	GDAL driver name to use for saving raster data object
strict	TRUE if the copy must be strictly equivalent, or more normally FALSE indicating that the copy may adapt as needed for the output format
options	Driver specific options (currently passed to GDAL)
fname	default NULL, used internally to pass through a file name with a required extension (RST driver has this problem)

Details

putRasterData: writes data contained in rasterData to the dataset, begining at offset rows and columns from the origin (usually the upper left corner). Data type conversion is automatic.

saveDataset: saves a raster data object in a file using the driver of the object

saveDatasetAs: saves a raster data object in a file using the specified driver

copyDataset: make a copy of raster data object in a file using the specified driver

deleteDataset: delete the file from which the raster data object was read (should only delete files opened as GDALDataset objects

Objects from the Class

Objects can be created by calls of the form `new("GDALDataset", filename, handle)`, where name: a string giving the name of a GDAL driver, handle: used internally; not for public consumption (default = NULL).

Slots

`handle`: Object of class `"externalptr"`, `from class "GDALReadOnlyDataset"`, used internally; not for public consumption

Extends

Class `"GDALReadOnlyDataset"`, directly. Class `"GDALMajorObject"`, by class "GDALReadOnlyDataset".

Methods

initialize `signature(.Object = "GDALDataset")`: ...

Author(s)

Timothy H. Keitt, modified by Roger Bivand

See Also

`GDALDriver-class`, `GDALReadOnlyDataset-class`, `GDALTransientDataset-class`

GDALDriver-class *Class "GDALDriver": GDAL Driver Object*

Description

`GDALDriver` objects encapsulate GDAL file format drivers. `GDALDriver` inherits from `GDALMajorObject-class`.

Usage

```
getGDALDriverNames()
gdalDrivers()
getDriverName(driver)
getDriverLongName(driver)
getGDALVersionInfo(str = "--version")
getGDALCheckVersion()
getGDALwithGEOS()
rgdal_extSoftVersion()
getCPLConfigOption(ConfigOption)
setCPLConfigOption(ConfigOption, value)
```

Arguments

driver	An object inheriting from class 'GDALDriver'
str	A string, may be one of "--version", "VERSION_NUM", "RELEASE_DATE", "RELEASE_NAME"
ConfigOption	CPL configure option documented in http://trac.osgeo.org/gdal/wiki/ConfigOptions and elsewhere in GDAL source code
value	a string value to set a CPL option; NULL is used to unset the CPL option

Details

getGDALDriverNames, gdalDrivers: returns all driver names currently installed in GDAL, with their declared create and copy status (some drivers can create datasets, others can only copy from a prototype with a different driver.

getDriverName: returns the GDAL driver name associated with the driver object.

getDriverLongName: returns a longer driver name.

getGDALVersionInfo: returns the version of the GDAL runtime shared object.

getGDALCheckVersion: checks the version of the GDAL headers used when building the package (GDAL_VERSION_MAJOR, GDAL_VERSION_MINOR) - if the two versions differ, problems may arise (the C++ API/ABI may have changed), and rgdal should be re-installed

getGDALwithGEOS: because drivers may behave differently if GDAL itself was built with GEOS support, the function uses a heuristic to check whether GDAL has access to the GEOS Union function or not

Objects from the Class

Objects can be created by calls of the form new("GDALDriver", name, handle), where name: a string giving the name of a GDAL driver, handle: used internally; not for public consumption (default = NULL).

Slots

handle: Object of class "externalptr", from class "GDALMajorObject", used internally; not for public consumption

Extends

Class "GDALMajorObject", directly.

Methods

initialize signature(.Object = "GDALDriver"): drivername: a string giving the name of a GDAL driver, handle: used internally; not for public consumption (default = NULL)

Note

Loading the rgdal package changes the GDAL_DATA environmental variable to the GDAL support files bundled with the package.

Author(s)

Timothy H. Keitt, modified by Roger Bivand

See Also

GDALMajorObject-class

Examples

```
gdalDrivers()
logo <- system.file("pictures/logo.jpg", package="rgdal")[1]
x <- new("GDALReadOnlyDataset", logo)
getDriver(x)
getDriverLongName(getDriver(x))
GDAL.close(x)
```

GDALMajorObject-class *Class "GDALMajorObject"*

Description

"GDALMajorObject" is a virtual base class for all GDAL objects.

Usage

```
getDescription(object)
```

Arguments

object	an object inheriting from "GDALMajorObject"

Details

getDescription: returns a descrption string associated with the object. No setter method is defined because GDAL dataset objects use the description to hold the filename attached to the dataset. It would not be good to change that mid-stream.

Objects from the Class

Objects can be created by calls of the form `new("GDALMajorObject", ...)`, but are only created for classes that extend this class.

Slots

handle: Object of class `"externalptr"`, used internally; not for public consumption

Methods

No methods defined with class "GDALMajorObject" in the signature.

Author(s)

Timothy H. Keitt, modified by Roger Bivand

References

http://www.gdal.org/

See Also

GDALDriver-class, GDALReadOnlyDataset-class, GDALDataset-class and GDALTransientDataset-class

Examples

```
driver <- new('GDALDriver', as.character(getGDALDriverNames()[1,1]))
driver
rm(driver)
logo <- system.file("pictures/logo.jpg", package="rgdal")[1]
x <- new("GDALReadOnlyDataset", logo)
x
getDescription(x)
dim(x)
GDAL.close(x)
```

GDALRasterBand-class *Class "GDALRasterBand"*

Description

Returns a two-dimensional array with data from a raster band, used internally within functions

Usage

```
getRasterData(dataset, band = NULL, offset = c(0, 0),
              region.dim = dim(dataset), output.dim = region.dim,
              interleave = c(0, 0), as.is = FALSE, list_out=FALSE)

getRasterTable(dataset, band = NULL, offset = c(0, 0),
  region.dim = dim(dataset))

getProjectionRef(dataset, OVERRIDE_PROJ_DATUM_WITH_TOWGS84 = NULL)

getRasterBand(dataset, band = 1)

getRasterBlockSize(raster)

toSigned(x, base)
```

```
toUnSigned(x, base)

get_OVERRIDE_PROJ_DATUM_WITH_TOWGS84()
set_OVERRIDE_PROJ_DATUM_WITH_TOWGS84(value)
```

Arguments

dataset	An object inheriting from class 'GDALReadOnlyDataset'
band	The band number (1-based) to read from
offset	Number of rows and columns from the origin (usually the upper left corner) to begin reading from; presently ordered (y,x) - this may change
region.dim	The number of rows and columns to read from the dataset; presently ordered (y,x) - this may change
output.dim	Number of rows and columns in the output data; if smaller than region.dim the data will be subsampled
interleave	Element and row stride while reading data; rarely needed
as.is	If false, scale the data to its natural units; if the case of thematic data, return the data as factors
list_out	default FALSE, return array, if TRUE, return a list of vector bands
raster	An object of class GDALRasterBand
x	integer variable for conversion
base	If Byte input, 8, if Int16 or UInt16, 16
OVERRIDE_PROJ_DATUM_WITH_TOWGS84	logical value, default NULL, which case the cached option set by set_OVERRIDE_PROJ_DATUM_WITH_TOW is used. Ignored if the GDAL version is less than "1.8.0" or if the CPLConfigOption variable is already set
value	logical value to set OVERRIDE_PROJ_DATUM_WITH_TOWGS84

Details

getRasterData: retrieves data from the dataset as an array or list of bands; will try to convert relevant bands to factor if category names are available in the GDAL driver when returning a list.

getRasterTable: retrieves data from the dataset as data frame.

getProjectionRef: returns the geodetic projection in Well Known Text format.

getRasterBand: returns a raster band

getRasterBlockSize: returns the natural block size of the raster band. Use this for efficient tiled IO.

toSigned: used to convert a band read as unsigned integer to signed integer

toUnSigned: used to convert a band read as signed integer to unsigned integer

Objects from the Class

Objects can be created by calls of the form new("GDALRasterBand", dataset, band).

Slots

handle: Object of class "externalptr", from class "GDALMajorObject", used internally; not for public consumption

Extends

Class "GDALMajorObject", directly.

Methods

dim signature(x = "GDALRasterBand"): ...

initialize signature(.Object = "GDALRasterBand"): ...

Note

The OVERRIDE_PROJ_DATUM_WITH_TOWGS84 argument is used to revert GDAL behaviour to pre-1.8.0 status; from 1.8.0, any input datum may be discarded if the input also includes a towgs84 tag in conversion to the PROJ.4 representation, see http://trac.osgeo.org/gdal/ticket/4880 and http://lists.osgeo.org/pipermail/gdal-dev/2012-November/034550.html. The cached value of OVERRIDE_PROJ_DATUM_WITH_TOWGS84 will also be used in open.SpatialGDAL, sub.GDROD, and asGDALROD_SGDF, which do not have a suitable argument

Author(s)

Timothy H. Keitt, modified by Roger Bivand

See Also

See also GDALDriver-class, GDALDataset-class, GDALTransientDataset-class

Examples

```
logo <- system.file("pictures/logo.jpg", package="rgdal")[1]
x <- new("GDALReadOnlyDataset", logo)
plot(density(getRasterTable(x)$band1))
GDAL.close(x)
```

GDALReadOnlyDataset-class

Class "GDALReadOnlyDataset"

Description

GDALReadOnlyDataset is the base class for a GDAL Dataset classes. Only read operations are supported. Both GDALDataset and GDALTransientDataset inherit these read operations while providing additional write operations (see GDALDataset-class). GDALReadOnlyDataset-class inherits from GDALMajorObject-class.

Usage

```
GDAL.close(dataset)
GDAL.open(filename, read.only = TRUE, silent=FALSE,
                 allowedDrivers = NULL, options=NULL)
getDriver(dataset)



getColorTable(dataset, band = 1)
getGeoTransFunc(dataset)
```

Arguments

dataset	An object inheriting from class 'GDALReadOnlyDataset'
filename	A string giving the file to read from
band	The band number (1-based) to read from
read.only	A logical flag indicating whether to open the file as a GDALReadOnlyDataset or as a writable GDALDataset
silent	logical; if TRUE, comment and non-fatal CPL driver errors suppressed
allowedDrivers	a character vector of suggested driver short names may be provided starting from GDAL 2.0
options	open options may be passed to raster drivers starting from GDAL 2.0; very few drivers support these options

Details

GDAL.open and GDAL.close are shorter versions of new("GDALReadOnlyDataset", ...) and closeDataset(). Because GDAL.close through closeDataset() uses the finalization mechanism to destroy the handles to the dataset and its driver, messages such as:

"Closing GDAL dataset handle 0x8ff7900... destroyed ... done."

may appear when GDAL.close is run, or at some later stage. getDriver returns an object inheriting from class 'GDALDriver'.

getColorTable returns the dataset colour table (currently does not support RGB imaging). getGeoTransFunc returns a warping function.

Objects from the Class

Objects can be created by calls of the form new("GDALReadOnlyDataset", filename, handle). ~~ describe objects here ~~

Slots

handle: Object of class "externalptr", from class "GDALMajorObject" ~~

Extends

Class "GDALMajorObject", directly.

Methods

closeDataset `signature(dataset = "GDALReadOnlyDataset")`: ...

dim `signature(x = "GDALReadOnlyDataset")`: ...

initialize `signature(.Object = "GDALReadOnlyDataset")`: ...

Author(s)

Timothy H. Keitt, modified by Roger Bivand

References

http://www.gdal.org/

See Also

See also GDALDriver-class, GDALDataset-class, GDALTransientDataset-class.

Examples

```
logo <- system.file("pictures/logo.jpg", package="rgdal")[1]
x <- new("GDALReadOnlyDataset", logo)
dim(x)
plot(density(getRasterTable(x)$band1))
#displayDataset(x)
#displayDataset(x, col=function(x){rev(cm.colors(x))})
#im <- displayDataset(x, col=function(x){rev(cm.colors(x))}, reset.par=FALSE)
#contour(1:attr(im, "size")[2], 1:attr(im, "size")[1],
# t(attr(im, "index"))[,attr(im, "size")[1]:1], nlevels = 1,
# levels = 100, col = 'black', add = TRUE)
GDAL.close(x)
logo <- system.file("pictures/Rlogo.jpg", package="rgdal")[1]
x <- new("GDALReadOnlyDataset", logo)
dim(x)
#displayDataset(x)
GDAL.close(x)
```

`GDALReadOnlyDataset-methods`

subset methods for "GDALReadOnlyDataset"

Description

subsets GDAL objects, returning a SpatialGridDataFrame object

Details

The [method subsets a GDAL data set, returning a SpatialGridDataFrame object. Reading is done on the GDAL side, and only the subset requested is ever read into memory.

Further named arguments to [are to either getRasterTable or getRasterData:

as.is see getRasterData

interleave see getRasterData

output.dim see getRasterData

the other arguments, `offset` and `region.dim` are derived from row/column selection values.

An GDALReadOnlyDataset object can be coerced directly to a SpatialGridDataFrame

Methods

"[" `signature(.Object = "GDALReadOnlyDataset")`: requires package sp; selects rows and columns, and returns an object of class SpatialGridDataFrame if the grid is not rotated, or else of class SpatialPointsDataFrame. Any arguments passed to getRasterData (or in case of rotation getRasterTable) may be passed as named arguments; the first three unnamed arguments are row,col,band

Author(s)

Edzer Pebesma

See Also

See also `readGDAL` `GDALDriver-class`, `GDALDataset-class`, `GDALTransientDataset-class`, `SpatialGridDataFrame-class`.

Examples

```
library(grid)
logo <- system.file("pictures/logo.jpg", package="rgdal")[1]
x <- new("GDALReadOnlyDataset", logo)
dim(x)
x.sp = x[20:50, 20:50]
class(x.sp)
summary(x.sp)
spplot(x.sp)
GDAL.close(x)

logo <- system.file("pictures/Rlogo.jpg", package="rgdal")[1]
x.gdal <- new("GDALReadOnlyDataset", logo)
x = x.gdal[,,3]
dim(x)
summary(x)
spplot(x)
spplot(x.gdal[])
GDAL.close(x.gdal)
```

```
logo <- system.file("pictures/Rlogo.jpg", package="rgdal")[1]
x.gdal <- new("GDALReadOnlyDataset", logo)
x.as <- as(x.gdal, "SpatialGridDataFrame")
GDAL.close(x.gdal)
summary(x.as)
```

GDALTransientDataset-class

Class "GDALTransientDataset"

Description

GDALTransientDataset is identical to GDALDataset-class except that transient datasets are not associated with any user-visible file. Transient datasets delete their associated file data when closed. See saveDataset and saveDatasetAs.

Objects from the Class

Objects can be created by calls of the form new("GDALTransientDataset", driver, rows, cols, bands, type, optior

driver A "GDALDriver" object that determines the storage format

rows Number of rows in the newly created dataset

cols Number of columns in the newly created dataset

bands Number of bands to create

type A GDAL type name as listed in .GDALDataTypes

options Driver specific options

fname default NULL, used internally to pass through a file name with a required extension (RST driver has this problem)

handle Used internally; not for public consumption

Slots

handle**:** Object of class "externalptr", from class "GDALDataset", used internally; not for public consumption

Extends

Class "GDALDataset", directly. Class "GDALReadOnlyDataset", by class "GDALDataset". Class "GDALMajorObject", by class "GDALDataset".

Methods

closeDataset signature(dataset = "GDALTransientDataset"): ...

initialize signature(.Object = "GDALTransientDataset"): ...

Author(s)

Timothy H. Keitt, modified by Roger Bivand

See Also

See also GDALDriver-class, GDALReadOnlyDataset-class

Examples

```
list.files(tempdir())
x <- new('GDALTransientDataset', driver=new('GDALDriver', "GTiff"), rows=100,
 cols=100, bands=3, type='Byte')
dim(x)
list.files(tempdir())
GDAL.close(x)
list.files(tempdir())
```

GridsDatums *Grids and Datums PE&RS listing*

Description

A data.frame of years and months of Grids & Datums column publications by country and country code.

Usage

```
data("GridsDatums")
```

Format

A data frame with 207 observations on the following 4 variables.

`country` name of PE&RS column

`month` issue month

`year` publication year

`ISO` ISO code for country

Details

The journal *Photogrammetric Engineering & Remote Sensing*, run by the American Society for Photogrammetry and Remote Sensing (ASPRS), began publishing a more-or-less monthly column on the spatial reference systems used in different countries, including their datums. The column first appeared in September 1997, and continued until November 2015. Some also cover other topics, such as world and Martian spatial reference systems. They are written by Clifford J. Mugnier, Louisiana State University, Fellow Emeritus ASPRS. To access the columns, visit http://www.asprs.org/Grids-Datums.html, and choose the 1997–2008, 2009–2010, or 2011–2015 subset as appropriate.

Source

http://www.asprs.org/Grids-Datums.html

Examples

```
data(GridsDatums)
GridsDatums[grep("Norway", GridsDatums$country),]
GridsDatums[grep("Google", GridsDatums$country),]
GridsDatums[grep("^Mars$", GridsDatums$country),]
```

---

llgridlines *Plot long-lat grid over projected data*

Description

Plot long-lat grid over projected data

Usage

```
llgridlines(obj, easts, norths, ndiscr = 20, lty = 2, offset=0.5, side="WS",
llcrs = "+proj=longlat +datum=WGS84", plotLines = TRUE, plotLabels =
TRUE, ...)
```

Arguments

obj	object, deriving from Spatial having projection specified
easts	numeric; see gridlines
norths	numeric; see gridlines
ndiscr	numeric; see gridlines
offset	numeric; see gridat
side	character, default "WS"; see gridat; available from **sp** 0.9-84
lty	line type to be used for grid lines
llcrs	proj4string of longitude - latitude
plotLines	logical; plot lines?
plotLabels	logical; plot labels?
...	graphics arguments passed to plot function for lines and text function for labels

Value

none; side effect is that grid lines and lables are plotted

See Also

is.projected, CRS-class

Examples

```
data(meuse)
coordinates(meuse) = ~x+y
proj4string(meuse) <- CRS("+init=epsg:28992")
plot(meuse)
llgridlines(meuse, lty=3)
plot(meuse)
llgridlines(meuse, lty=3, side = "EN", offset = 0.2)
```

---

make_EPSG *Make a data frame of EPSG projection codes*

Description

Make a data frame of the now-defunct European Petroleum Survey Group (EPSG) geodetic parameter dataset as distributed with PROJ.4 software and included in this package. Because finding the correct projection specification is not easy, lists still known as EPSG lists are maintained, and more generally retrieved from databases. The data collated here are as distributed with PROJ.4.

Usage

```
make_EPSG(file)
```

Arguments

file	file name of the file matching EPSG codes and PROJ.4 arguments, should usually be autodetected

Value

returns a data frame with columns:

code	integer column of EPSG code numbers
note	character column of notes as included in the file
prj4	character column of PROJ.4 arguments for the equivalent projection definitions

...

Note

See also Clifford J. Mugnier's Grids \& Datums columns in Photogrammetric Engineering & Remote Sensing, http://www.asprs.org/Grids-Datums.html, see also GridsDatums.

Author(s)

Roger Bivand

References

http://www.epsg.org/

Examples

```
EPSG <- make_EPSG()
attr(EPSG, "metadata") # PROJ.4 5.0.0 and later include EPSG version
EPSG[grep("Oslo", EPSG$note), 1:2]
EPSG[1925:1927, 3]
EPSG[grep("Poland", EPSG$note), 1:2]
EPSG[grep("Amersfoort", EPSG$note), 1:2]
EPSG[grep("North Carolina", EPSG$note), 1:2]
EPSG[2202, 3]
```

---

nor2k *Norwegian peaks over 2000m*

Description

Norwegian peaks over 2000m, 3D SpatialPoints data.

Usage

```
data(nor2k)
```

Format

The format is: Formal class 'SpatialPointsDataFrame' [package "sp"] with 5 slots ..@ data :'data.frame': 300 obs. of 3 variables: .. ..$ Nr. : int [1:300] 1 2 3 4 5 6 7 8 9 10 ... .$ Navn : chr [1:300] "Galdh?piggen" "Glittertinden" "Skagast?lstinden, Store (Storen)" "Styggedalstinden, Store, ?st-toppen" ... .$ Kommune: chr [1:300] "Lom" "Lom" "Luster / Ardal" "Luster" ... ..@ coords.nrs : num(0) ..@ coords : num [1:300, 1:3] 463550 476550 439850 441450 441100 ... .- attr(*, "dimnames")=List of 2 .. .. ..$: NULL .. .. ..$: chr [1:3] "East" "North" "Height" ..@ bbox : num [1:3, 1:2] 404700 6804200 2001 547250 6910050 ... .- attr(*, "dimnames")=List of 2 .. .. ..$: chr [1:3] "East" "North" "Height" .. .. ..$: chr [1:2] "min" "max" ..@ proj4string:Formal class 'CRS' [package "sp"] with 1 slots .. .. ..@ projargs: chr "+proj=utm +zone=32 +datum=WGS84 +ellps=WGS84 +towgs84=0,0,0"

Details

Norwegian peaks over 2000m, coordinates in EUREF89/WGS84 UTM32N, names not fully updated, here converted to ASCII.

Source

http://www.nfo2000m.no/; http://www.nfo2000m.no/Excel/2000m_data.xls

Examples

```
data(nor2k)
summary(nor2k)
## maybe str(nor2k) ; plot(nor2k) ...
```

`project` *Projection of coordinate matrices*

Description

Interface to the PROJ.4 library of projection functions for geographical position data, no datum transformation possible. Use `spTransform()` for extended support.

Usage

```
project(xy, proj, inv = FALSE, use_ob_tran=FALSE, legacy=TRUE)
```

Arguments

`xy`	2-column matrix of coordinates
`proj`	character string of projection arguments; the arguments must be entered exactly as in the PROJ.4 documentation, in particular there cannot be any white space in +<arg>=<value> strings, and successive such strings can only be separated by blanks.
`inv`	default FALSE, if TRUE inverse projection to geographical coordinates
`use_ob_tran`	default FALSE, if TRUE and "+proj=ob_tran", use General Oblique Transformation with internalised from/to projection reversal; the user oblique transforms forward rather than inverse.
`legacy`	default TRUE, if FALSE, use transform C functions (enforced internally for Windows 32-bit platforms)

Details

Full details of projection arguments available from website below, and examples in file "epsg" in the data directory installed with PROJ.4.

Note that from PROJ.4 4.9.3, the definition of UTM is changed from TMERC to ETMERC; see example.

Value

A two column matrix with projected coordinates.

Note

The locations of Hawaii and Alaska in the data source are (putting it mildly) arbitrary, please avoid airlines using these positions.

Author(s)

Barry Rowlingson, Roger Bivand <Roger.Bivand@nhh.no>

References

http://proj.maptools.org/

See Also

CRS-class, spTransform-methods

Examples

```
data(state)
res <- project(cbind(state.center$x, state.center$y),
 "+proj=lcc +lat_1=48 +lat_2=33 +lon_0=-100 +ellps=WGS84")
res1 <- project(res, "+proj=lcc +lat_1=48 +lat_2=33 +lon_0=-100 +ellps=WGS84",
 inv=TRUE)
summary(res1 - cbind(state.center$x, state.center$y))
plot(cbind(state.center$x, state.center$y), asp=1, type="n")
text(cbind(state.center$x, state.center$y), state.abb)
plot(res, asp=1, type="n")
text(res, state.abb)
crds <- matrix(data=c(9.05, 48.52), ncol=2)
a <- project(crds, paste("+proj=ob_tran +o_proj=longlat",
 "+o_lon_p=-162 +o_lat_p=39.25 +lon_0=180 +ellps=sphere +no_defs"),
 use_ob_tran=TRUE)
a
#should be (-5.917698, -1.87195)
project(a, paste("+proj=ob_tran +o_proj=longlat",
 "+o_lon_p=-162 +o_lat_p=39.25 +lon_0=180 +ellps=sphere +no_defs"),
 inv=TRUE, use_ob_tran=TRUE)
#added after posting by Martin Ivanov
#
getPROJ4VersionInfo()
# Test for UTM == TMERC (<= 4.9.2) or UTM == ETMERC (> 4.9.2)
nhh <- matrix(c(5.304234, 60.422311), ncol=2)
nhh_utm_32N_P4 <- project(nhh, "+init=epsg:3044")
nhh_tmerc_P4 <- project(nhh, paste("+proj=tmerc +k=0.9996 +lon_0=9",
 "+x_0=500000 +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs"))
nhh_etmerc_P4 <- project(nhh, paste("+proj=etmerc +k=0.9996 +lon_0=9",
 "+x_0=500000 +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs"))
all.equal(nhh_utm_32N_P4, nhh_tmerc_P4, tolerance=1e-9, scale=1)
# UTM == TMERC: PROJ4 <=4.9.2
all.equal(nhh_utm_32N_P4, nhh_etmerc_P4, tolerance=1e-9, scale=1)
# UTM == ETMERC: PROJ4 > 4.9.2
unis <- matrix(c(15.653453, 78.222504), ncol=2)
unis_utm_33N_P4 <- project(unis, "+init=epsg:3045")
unis_tmerc_P4 <- project(unis, paste("+proj=tmerc +k=0.9996 +lon_0=15",
 "+x_0=500000 +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs"))
unis_etmerc_P4 <- project(unis, paste("+proj=etmerc +k=0.9996 +lon_0=15",
 "+x_0=500000 +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs"))
```

```
all.equal(unis_utm_33N_P4, unis_tmerc_P4, tolerance=1e-9, scale=1)
# UTM == TMERC: PROJ4 <=4.9.2
all.equal(unis_utm_33N_P4, unis_etmerc_P4, tolerance=1e-9, scale=1)
# UTM == ETMERC: PROJ4 > 4.9.2
# available projections and their inverses if provided
# For >=4.9.3 returns non-finite points rather than needing crash protection
getPROJ4VersionInfo()
projs <- as.character(projInfo()$name)
res <- logical(length(projs))
names(res) <- projs
msgs <- character(length(projs))
names(msgs) <- projs
owarn <- options("warn")$warn
options(warn=2L)
for (i in seq(along=res)) {
  iprs <- paste("+proj=", projs[i], sep="")
  xy <- try(project(cbind(0, 0), iprs, legacy=TRUE), silent=TRUE)
  if (class(xy) == "try-error") {
    res[i] <- NA
    msgs[i] <- paste("fwd:", strsplit(xy, "\n")[[1]][2])
  } else {
    out <- try(project(xy, iprs, inv=TRUE, legacy=TRUE), silent=TRUE)
    if (class(out) == "try-error") {
      res[i] <- NA
      msgs[i] <- paste("inv:", strsplit(out, "\n")[[1]][2])
    } else res[i] <- isTRUE(all.equal(cbind(0,0), out))
  }
}
options(warn=owarn)
df <- data.frame(res=unname(res), msgs=unname(msgs), row.names=names(res))
# projection and inverse projection failures
# fwd: missing parameters
# inv: mostly inverse not defined
df[is.na(df$res),]
# inverse not equal to input
# (see http://lists.maptools.org/pipermail/proj/2011-November/006015.html)
df[!is.na(df$res) & !df$res,]
# inverse equal to input
row.names(df[!is.na(df$res) & df$res,])
```

`projInfo` *List PROJ.4 tag information*

Description

The `projInfo` function lists known values and descriptions for PROJ.4 tags for tag in `c("proj", "ellps", "datum", "unit`
`getPROJ4VersionInfo` returns the version of the underlying PROJ.4 release, `getPROJ4libPath` returns the value of the PROJ_LIB environment variable, `projNAD` detects the presence of NAD datum conversion tables (looking for conus).

Usage

```
projInfo(type = "proj")
getPROJ4VersionInfo()
getPROJ4libPath()
projNAD()
```

Arguments

type	One of these tags: c("proj", "ellps", "datum", "units")

Details

The output data frame lists the information given by the proj application with flags -lp, -le, -ld or -lu.

Value

A data frame with a name and description column, and two extra columns for the "ellps" and "datum" tags.

Note

Loading the rgdal package changes the PROJ_LIB environmental variable to the PROJ.4 support files bundles with the package.

Author(s)

Roger Bivand <Roger.Bivand@nhh.no>

References

http://proj.maptools.org/

Examples

```
getPROJ4VersionInfo()
projInfo()
```

---

readGDAL *Read/write between GDAL grid maps and Spatial objects*

Description

The functions read or write GDAL grid maps. They will set the spatial reference system if available. GDALinfo reports the size and other parameters of the dataset. create2GDAL creates a GDAL data set from a SpatialGridDataFrame object, in particular to be able to save to GDAL driver formats that only permit copying rather than creation.

Usage

```
readGDAL(fname, offset, region.dim, output.dim, band, p4s=NULL, ...,
 half.cell=c(0.5, 0.5), silent = FALSE, OVERRIDE_PROJ_DATUM_WITH_TOWGS84=NULL,
 allowedDrivers = NULL, options=NULL)
asSGDF_GROD(x, offset, region.dim, output.dim, p4s=NULL, ...,
 half.cell=c(0.5,0.5), OVERRIDE_PROJ_DATUM_WITH_TOWGS84=NULL)
writeGDAL(dataset, fname, drivername = "GTiff", type = "Float32",
 mvFlag = NA, options=NULL, copy_drivername = "GTiff", setStatistics=FALSE,
 colorTables = NULL, catNames=NULL)
create2GDAL(dataset, drivername = "GTiff", type = "Float32", mvFlag = NA,
 options=NULL, fname = NULL, setStatistics=FALSE, colorTables = NULL,
 catNames=NULL)
GDALinfo(fname, silent=FALSE, returnRAT=FALSE, returnCategoryNames=FALSE,
 returnStats=TRUE, returnColorTable=FALSE,
 OVERRIDE_PROJ_DATUM_WITH_TOWGS84=NULL, returnScaleOffset=TRUE,
 allowedDrivers = NULL, options=NULL)
GDALSpatialRef(fname, silent=FALSE, OVERRIDE_PROJ_DATUM_WITH_TOWGS84=NULL,
 allowedDrivers = NULL, options=NULL)
```

Arguments

fname	file name of grid map; in create2GDAL provides a way to pass through a file name with driver-required extension for sensitive drivers
x	A GDALReadOnlyDataset object
offset	Number of rows and columns from the origin (usually the upper left corner) to begin reading from; presently ordered (y,x) - this may change
region.dim	The number of rows and columns to read from the dataset; presently ordered (y,x) - this may change
output.dim	The number of rows and columns to return in the created object using GDAL's method to take care of image decimation / replication; presently ordered (y,x) - this may change
band	if missing, all bands are read
p4s	PROJ4 string defining CRS, if default (NULL), the value is read from the GDAL data set
half.cell	Used to adjust the intra-cell offset from corner to centre, usually as default, but may be set to c=(0,0) if needed; presently ordered (y,x) - this may change
silent	logical; if TRUE, comment and non-fatal CPL driver errors suppressed
OVERRIDE_PROJ_DATUM_WITH_TOWGS84	logical value, default NULL, which case the cached option set by set_OVERRIDE_PROJ_DATUM_WITH_TOW is used. Ignored if the GDAL version is less than "1.8.0" or if the CPLConfigOption variable is already set; see getProjectionRef for further details
allowedDrivers	a character vector of suggested driver short names may be provided starting from GDAL 2.0

`...` arguments passed to either `getRasterData`, or `getRasterTable`, depending on rotation angles (see below); see the rgdal documentation for the available options (subsetting etc.)

`dataset` object of class SpatialGridDataFrame-class or SpatialPixelsDataFrame-class

`drivername, copy_drivername` GDAL driver name; if the chosen driver does not support dataset creation, an attempt is made to use the `copy_drivername` driver to create a dataset, and `copyDatset` to copy to the target driver

`type` GDAL write data type, one of: 'Byte', 'Int16', 'Int32', 'Float32', 'Float64'; 'UInt16', 'UInt32' are available but have not been tests

`mvFlag` default NA, missing value flag for output file; the default value works for 'Int32', 'Float32', 'Float64', but suitable in-range value that fits the data type should be used for other data types, for example 255 for 'Byte', -32768 for 'Int16', and so on; see Details below.

`options` driver-specific options to be passed to the GDAL driver; only available for opening datasets from GDAL 2.0; see copying and creation details below

`setStatistics` default FALSE, if TRUE, attempt to set per-band statistics in the output file (driver-dependent)

`colorTables` default NULL, if not NULL, a list of length equal to the number of bands, with NULL components for bands with no color table, or either an integer matrix of red, green, blue and alpha values (0-255), or a character vector of colours. The number of colours permitted may vary with driver.

`catNames` default NULL, if not NULL, a list of length equal to the number of bands, with NULL components for bands with no category names, or a string vector of category names

`returnRAT` default FALSE, if TRUE, return a list with a Raster Attribute Table or NULL for each band

`returnCategoryNames` default FALSE, if TRUE, return a list with a character vector of CategoryNames or NULL for each band

`returnStats` default TRUE, return band-wise statistics if avaliable (from 0.7-20 set to NA if not available)

`returnColorTable` default FALSE; if TRUE return band-wise colour tables in a list attribute "ColorTables"

`returnScaleOffset` default TRUE, return a matrix of bandwise scales and offsets

Details

In `writeGDAL`, if types other than 'Int32', 'Float32', 'Float64' are used, the "mvFlag" argument should be used to set a no data value other than the default NA. Note that the flag only replaces NA values in the data being exported with the value of the argument - it does not mark data values equal to "mvFlag" as missing. The value is stored in the file being written in driver-specific ways, and may be used when the file is read. When the default "mvFlag=NA" is used, no NoDataValue is written to the file, and the input data is written as is.

Also in writeGDAL, the "options" argument may be used to pass a character vector of one or more options to the driver, for example 'options="INTERLEAVE=PIXEL"', or 'options=c("INTERLEAVE=PIXEL", "COMPRESS=DEFLATE")'. Typical cases are given in the examples below; it may also be necessary in some cases to escape quotation markes if included in the string passed to the driver.

Value

read.GDAL returns the data in the file as a Spatial object.

Usually, GDAL maps will be north-south oriented, in which case the rgdal function getRasterData is used to read the data, and an object of class SpatialGridDataFrame-class is returned.

Some map formats supported by GDAL are not north-south oriented grids. If this is the case, readGDAL returns the data as a set of point data, being of class SpatialPointsDataFrame-class. If the points are on a 45 or 90 degree rotated grid, you can try to enforce gridding later on by e.g. using gridded-methods(x)=TRUE.

Warning

Some raster files may have an erroneous positive y-axis resolution step, leading to the data being flipped on the y-axis. readGDAL will issue a warning: Y axis resolution positive, examine data for flipping, when the step is positive, but this need not mean that the data are flipped. Examine a display of the data compared with your knowledge of the file to determine whether this is the case (one known case is interpolation files created under Qgis up to February 2010 at least). To retreive the correct orientation, use flipVertical.

Note

Non-fatal CPL errors may be displayed for some drivers, currently for the AIG ArcInfo 9.3 binary raster driver using GDAL >= 1.6.2; the data has been read correctly, but the contents of the info directory did not meet the specifications used to reverse engineer the driver used in GDAL (see http://trac.osgeo.org/gdal/ticket/3031)

Author(s)

Edzer Pebesma, Roger Bivand

See Also

image, asciigrid

Examples

```
library(grid)
GDALinfo(system.file("external/test.ag", package="sp")[1])
x <- readGDAL(system.file("external/test.ag", package="sp")[1])
class(x)
image(x)
summary(x)
x@data[[1]][x@data[[1]] > 10000] <- NA
summary(x)
image(x)
```

```
x <- readGDAL(system.file("external/simple.ag", package="sp")[1])
class(x)
image(x)
summary(x)
x <- readGDAL(system.file("pictures/big_int_arc_file.asc", package="rgdal")[1])
summary(x)
cat("if the range is not 10000, 77590, your GDAL does not detect big\n")
cat("integers for this driver\n")
y = readGDAL(system.file("pictures/Rlogo.jpg", package = "rgdal")[1], band=1)
summary(y)
y = readGDAL(system.file("pictures/Rlogo.jpg", package = "rgdal")[1])
summary(y)
spplot(y, names.attr=c("red","green","blue"),
col.regions=grey(0:100/100),
main="example of three-layer (RGB) raster image", as.table=TRUE)
data(meuse.grid)
gridded(meuse.grid) = ~x+y
proj4string(meuse.grid) = CRS("+init=epsg:28992")
fn <- tempfile()
writeGDAL(meuse.grid["dist"], fn)
GDALinfo(fn)
writeGDAL(meuse.grid["dist"], fn, setStatistics=TRUE)
GDALinfo(fn)
mg2 <- readGDAL(fn)
proj4string(mg2)
SP27GTIF <- readGDAL(system.file("pictures/SP27GTIF.TIF",
package = "rgdal")[1], output.dim=c(100,100))
summary(SP27GTIF)
image(SP27GTIF, col=grey(1:99/100))

GDALinfo(system.file("pictures/cea.tif", package = "rgdal")[1])
GDALSpatialRef(system.file("pictures/cea.tif", package = "rgdal")[1])
cea <- readGDAL(system.file("pictures/cea.tif", package = "rgdal")[1],
output.dim=c(100,100))
summary(cea)
image(cea, col=grey(1:99/100))
fn <- system.file("pictures/erdas_spnad83.tif", package = "rgdal")[1]
erdas_spnad83 <- readGDAL(fn, offset=c(50, 100), region.dim=c(400, 400),
output.dim=c(100,100))
summary(erdas_spnad83)
image(erdas_spnad83, col=grey(1:99/100))
erdas_spnad83a <- readGDAL(fn, offset=c(50, 100), region.dim=c(400, 400))
bbox(erdas_spnad83)
bbox(erdas_spnad83a)
gridparameters(erdas_spnad83)
gridparameters(erdas_spnad83a)
tf <- tempfile()
writeGDAL(erdas_spnad83, tf, drivername="GTiff", type="Byte", options=NULL)
all.equal(erdas_spnad83, readGDAL(tf))
writeGDAL(erdas_spnad83, tf, drivername="GTiff", type="Byte",
options="INTERLEAVE=PIXEL")
all.equal(erdas_spnad83, readGDAL(tf))
```

```
writeGDAL(erdas_spnad83, tf, drivername="GTiff", type="Byte",
options=c("INTERLEAVE=PIXEL", "COMPRESS=DEFLATE"))
all.equal(erdas_spnad83, readGDAL(tf))

x <- GDAL.open(system.file("pictures/erdas_spnad83.tif", package = "rgdal")[1])
erdas_spnad83 <- asSGDF_GROD(x, output.dim=c(100,100))
GDAL.close(x)
summary(erdas_spnad83)
image(erdas_spnad83, col=grey(1:99/100))

tf <- tempfile()
xx <- create2GDAL(erdas_spnad83, type="Byte")
xxx <- copyDataset(xx, driver="PNG")
saveDataset(xxx, tf)
GDAL.close(xx)
GDAL.close(xxx)
GDALinfo(tf)

tf2 <- tempfile()
writeGDAL(erdas_spnad83, tf2, drivername="PNG", type="Byte")
GDALinfo(tf2)

GT <- GridTopology(c(0.5, 0.5), c(1, 1), c(10, 10))
set.seed(1)
SGDF <- SpatialGridDataFrame(GT, data=data.frame(z=runif(100)))
opar <- par(mfrow=c(2,2), mar=c(1,1,4,1))
image(SGDF, "z", col=colorRampPalette(c("blue", "yellow"))(20))
title(main="input values")
pfunc <- colorRamp(c("blue","yellow"))
RGB <- pfunc(SGDF$z)
SGDF$red <- RGB[,1]
SGDF$green <- RGB[,2]
SGDF$blue <- RGB[,3]
image(SGDF, red="red", green="green", blue="blue")
title(main="input RGB")
tf <- tempfile()
writeGDAL(SGDF[c("red", "green", "blue")], tf, type="Byte", drivername="PNG")
t1 <- readGDAL(tf)
image(t1, red=1, green=2, blue=3)
title(main="output PNG RGB")
par(opar)

t0 <- meuse.grid["ffreq"]
fullgrid(t0) <- TRUE
t0$ffreq <- as.integer(t0$ffreq)-1
# convert factor to zero-base integer
CT <- c("red", "orange", "green", "transparent")
CT
cN <- c("annual", "2-5 years", "infrequent")
tf <- tempfile()
writeGDAL(t0, tf, type="Byte", colorTable=list(CT), catNames=list(cN),
 mvFlag=3L)
attr(GDALinfo(tf, returnStats=FALSE, returnCategoryNames=TRUE),
```

```
 "CATlist")[[1]]
ds <- GDAL.open(tf)
displayDataset(ds)
t(col2rgb(getColorTable(ds)[1:4]))
GDAL.close(ds)

fn <- system.file("pictures/test_envi_class.envi", package = "rgdal")[1]
Gi <- GDALinfo(fn, returnColorTable=TRUE, returnCategoryNames=TRUE)
CT <- attr(Gi, "ColorTable")[[1]]
CT
attr(Gi, "CATlist")[[1]]
with <- readGDAL(fn)
with <- readGDAL(fn, silent=TRUE)
table(with$band1)
table(as.numeric(with$band1))
with1 <- readGDAL(fn, as.is=TRUE)
table(with1$band1)
spplot(with, col.regions=CT)
tf <- tempfile()
cN <- levels(with$band1)
with$band1 <- as.integer(with$band1)-1
writeGDAL(with, tf, drivername="ENVI", type="Int16", colorTable=list(CT),
 catNames=list(cN), mvFlag=11L)
cat(paste(readLines(paste(tf, "hdr", sep=".")), "\n", sep=""), "\n")
wGi <- GDALinfo(tf, returnColorTable=TRUE, returnCategoryNames=TRUE)
CTN <- attr(wGi, "ColorTable")[[1]]
CTN
attr(wGi, "CATlist")[[1]]
withN <- readGDAL(tf)
table(withN$band1)
withN1 <- readGDAL(tf, as.is=TRUE)
table(withN1$band1)
spplot(withN, col.regions=CTN)


# a file with scale and offset
fn <- system.file("pictures/scaleoffset.vrt", package = "rgdal")[1]
g <- GDALinfo(fn)
attr(g, 'ScaleOffset')
g
```

---

readOGR *Read OGR vector maps into Spatial objects*

Description

The function reads an OGR data source and layer into a suitable Spatial vector object. It can only handle layers with conformable geometry features (not mixtures of points, lines, or polygons in a single layer). It will set the spatial reference system if the layer has such metadata.

If reading a shapefile, the data source name (dsn= argument) is the folder (directory) where the shapefile is, and the layer is the name of the shapefile (without the .shp extension). For example to read bounds.shp from C:/Maps, do map <- readOGR(dsn="C:/Maps", layer="bounds"). The logic behind this is that typically one keeps all the shapefiles for a project in one folder (directory).

As noted below, for other file type drivers, the dsn= argument is interpreted differently, and may be the file name itself, as for example with the GPX driver for reading GPS data as layer="tracks" lines or layer="track_points" points.

Usage

```
readOGR(dsn, layer, verbose = TRUE, p4s=NULL,
 stringsAsFactors=default.stringsAsFactors(),
 drop_unsupported_fields=FALSE,
 pointDropZ=FALSE, dropNULLGeometries=TRUE,
 useC=TRUE, disambiguateFIDs=FALSE, addCommentsToPolygons=TRUE,
 encoding=NULL, use_iconv=FALSE, swapAxisOrder=FALSE, require_geomType = NULL,
 integer64="no.loss", GDAL1_integer64_policy=FALSE)
ogrInfo(dsn, layer, encoding=NULL,
 use_iconv=FALSE, swapAxisOrder=FALSE, require_geomType = NULL)
ogrFIDs(dsn, layer)
ogrDrivers()
OGRSpatialRef(dsn, layer)
ogrListLayers(dsn)
## S3 method for class 'ogrinfo'
print(x, ...)
```

Arguments

dsn	data source name (interpretation varies by driver — for some drivers, dsn is a file name, but may also be a folder)
layer	layer name (varies by driver, may be a file name without extension). From rgdal 1.2.*, layer may be missing, in which case ogrListLayers examines the dsn, and fails if there are no layers, silently reads the only layer if only one layer is found, and reads the first layer if multiple layers are present, issuing a warning that layer should be given explicitly.
verbose	report progress
p4s	PROJ4 string defining CRS, if default NULL, the value is read from the OGR data set
stringsAsFactors	logical: should character vectors be converted to factors? The 'factory-fresh' default is TRUE, but this can be changed by setting options(stringsAsFactors = FALSE) (see link[base]{data.frame}).
drop_unsupported_fields	default FALSE, if TRUE skip fields other than String, Integer, and Real; Date, Time and DateTime are converted to String
pointDropZ	default FALSE, if TRUE, discard third coordinates for point geometries; third coordinates are alway discarded for line and polygon geometries

dropNULLGeometries
: default TRUE, drop both declared NULL geometries, and empty geometries with no coordinates; if FALSE, return a data frame with the attribute values of the NULL and empty geometries

useC
: default TRUE, if FALSE use original interpreted code in a loop

disambiguateFIDs
: default FALSE, if TRUE, and FID values are not unique, they will be set to unique values 1:N for N features; problem observed in GML files

addCommentsToPolygons
: default TRUE, may be set FALSE for legacy behaviour; used to indicate which interior rings are holes in which exterior rings in conformance with OGC SFS specifications

encoding
: default NULL, if set to a character string, and the driver is "ESRI Shapefile", and use_iconv is FALSE, it is passed to the CPL Option "SHAPE_ENCODING" immediately before reading the DBF of a shapefile. If use_iconv is TRUE, and encoding is not NULL, it will be used to convert input strings from the given value to the native encoding for the system/platform.

use_iconv
: default FALSE; if TRUE and encoding is not NULL, it will be used to convert input strings from the given value to the native encoding for the system/platform.

swapAxisOrder
: default FALSE, if TRUE, treat y coordinate as Easting, x as Northing, that is the opposite to the assumed order; this may be needed if some OGR read drivers do not behave as expected

require_geomType
: , default NULL, if one of: `c("wkbPoint", "wkbLineString", "wkbPolygon")`, then in input with multiple geometry types, the chosen type will be read

integer64
: default "no.loss" (from rgdal 1.2.*). From GDAL 2, fields to be read may also take Integer64 values. As R has no such storage mode, three options are offered, analogous with `type.convert` for numeric conversion: "allow.loss" which clamps to 32-bit signed integer (default < rgdal 1.2), "warn.loss" - as "allow.loss" but warns when clamping occurs, and "no.loss", which reads as a character string using the formatting applied by default by GDAL (default >= rgdal 1.2). The use of 64-bit integers is usually a misunderstanding, as such data is almost always a long key ID.

GDAL1_integer64_policy
: default FALSE, if TRUE, Integer64 fields are read as doubles

x
: ogrinfo object

...
: other arguments to print method

Details

The drivers available will depend on the installation of GDAL/OGR, and can vary; the `ogrDrivers()` function shows which are available, and which may be written (but all are assumed to be readable). Note that stray files in data source directories (such as *.dbf) may lead to suprious errors that accompanying *.shp are missing.

Value

A Spatial object is returned suiting the vector data source, either a SpatialPointsDataFrame (using an AttributeList for its data slot directly), a SpatialLinesDataFrame, or a SpatialPolygonsDataFrame.

Note

The bases for this implementation are taken from functions in Barry Rowlingson's draft Rmap package, and from Radim Blazek's v.in.ogr program in GRASS.

Please note that the OGR drivers used may not handle missing data gracefully, and be prepared to have to correct for this manually. From rgdal 0.5-27, missing value handling has been improved, and OGR unset field values are set to NA in R, but drivers and external files may vary in their representations of missing values.

In addition, from 0.6-9 date and time fields are read as strings rather than being treated as unsupported; NULL geometries are identified and dropped. There are differences in the reporting of NULL geometries between `ogrInfo` and `readOGR` - in `ogrInfo`, only declared NULL geometries are reported, but in `readOGR`, any line or polygon geometries with no coordinates are assigned NULL geometry status as well. An attempt is made to close unclosed rings in polygon geometries.

For reading GPX files, refer to the OGR GPX format documentation for the use of layer tags: "waypoints", "tracks", "routes", "track_points" and "route_points" - reading GPX files requires a build of GDAL/OGR with the expat XML library.

From 0.6-10, attempts are made to detect deleted features still present in the layer, but not read. Apparently features deleted in Qgis are only marked as deleted, but are still in the layer. These are not NULL geometries, but still need to be handled. An attempt is made to check the FID values, and `ogrFIDs` now returns attributes permitting this oddity to be detected. Such deleted features were seen as NULL in 0.6-9, but are not such.

From 0.7-24, if the layer has no fields, a single field containing the FID values is placed in the data slot of the returned object.

From 0.7-24, attempts are begun to provide users with arguments to control reading from OGR/shapefile driver when the encoding is inappropriate (especially the setting of LDID in shapefile DBFs, and the SHAPE_ENCODING environment variable).

While there is no certainty, newer drivers such as KML, GML, SQLite and Geopackage (GPKG) may encode string fields as UTF-8. Users are advised to explore this on a case to case basis using `Encoding` on string fields of input objects.

Because of the representation of DateTime data in OGR, decimal seconds in input data are rounded to integer seconds, see: http://trac.osgeo.org/gdal/ticket/2680.

Because some drivers support reading string, integer and real list fields, support has been introduced into `ogrInfo` from version 0.9-1 to report their presence and the maximum counts of list items. This may lead to the introduction of the `-splitlistfields` facility from the command line utility `ogrinfo`. In addition, `ogrInfo` reports that there are no features when counting FIDs in a while loop over features in `ogrFIDs` never enters the loop, despite the layer feature count reporting at least one feature.

Author(s)

Roger Bivand

References

http://www.gdal.org/ogr_formats.html, http://examples.oreilly.com/webmapping/

See Also

SpatialPointsDataFrame-class, SpatialLinesDataFrame-class, SpatialPolygonsDataFrame-class, readShapePoly, iconv

Examples

```
ogrDrivers()
dsn <- system.file("vectors", package = "rgdal")[1]
ogrListLayers(dsn)
ogrInfo(dsn)
ogrInfo(dsn=dsn, layer="cities")
owd <- getwd()
setwd(dsn)
ogrInfo(dsn="cities.shp")
ogrInfo(dsn="cities.shp", layer="cities")
setwd(owd)
ow <- options("warn")$warn
options("warn"=1)
cities <- readOGR(dsn=dsn, layer="cities")
str(slot(cities, "data"))
cities$POPULATION <- type.convert(as.character(cities$POPULATION),
  na.strings="-99", numerals="no.loss")
str(slot(cities, "data"))
cities <- readOGR(dsn=dsn, layer="cities", GDAL1_integer64_policy=TRUE)
str(slot(cities, "data"))
options("warn"=ow)
summary(cities)
table(Encoding(as.character(cities$NAME)))
ogrInfo(dsn=dsn, layer="kiritimati_primary_roads")
OGRSpatialRef(dsn=dsn, layer="kiritimati_primary_roads")
kiritimati_primary_roads <- readOGR(dsn=dsn, layer="kiritimati_primary_roads")
summary(kiritimati_primary_roads)
ogrInfo(dsn=dsn, layer="scot_BNG")
OGRSpatialRef(dsn=dsn, layer="scot_BNG")
scot_BNG <- readOGR(dsn=dsn, layer="scot_BNG")
summary(scot_BNG)
if ("GML" %in% ogrDrivers()$name) {
  dsn <- system.file("vectors/airports.gml", package = "rgdal")[1]
  airports <- try(readOGR(dsn=dsn, layer="airports"))
  if (class(airports) != "try-error") summary(airports)
}
dsn <- system.file("vectors/ps_cant_31.MIF", package = "rgdal")[1]
ogrInfo(dsn=dsn, layer="ps_cant_31")
ps_cant_31 <- readOGR(dsn=dsn, layer="ps_cant_31")
summary(ps_cant_31)
sapply(as(ps_cant_31, "data.frame"), class)
ps_cant_31 <- readOGR(dsn=dsn, layer="ps_cant_31", stringsAsFactors=FALSE)
summary(ps_cant_31)
```

```
sapply(as(ps_cant_31, "data.frame"), class)
dsn <- system.file("vectors/Up.tab", package = "rgdal")[1]
ogrInfo(dsn=dsn, layer="Up")
Up <- readOGR(dsn=dsn, layer="Up")
summary(Up)
dsn <- system.file("vectors/test_trk2.gpx", package = "rgdal")[1]
test_trk2 <- try(readOGR(dsn=dsn, layer="tracks"))
if (class(test_trk2) != "try-error") summary(test_trk2)
test_trk2pts <- try(readOGR(dsn=dsn, layer="track_points"))
if (class(test_trk2pts) != "try-error") summary(test_trk2pts)
dsn <- system.file("vectors", package = "rgdal")[1]
ogrInfo(dsn=dsn, layer="trin_inca_pl03")
birds <- readOGR(dsn=dsn, layer="trin_inca_pl03")
summary(birds)
dsn <- system.file("vectors/PacoursIKA2.TAB", package = "rgdal")[1]
try(ogrInfo(dsn, "PacoursIKA2"))
ogrInfo(dsn, "PacoursIKA2", require_geomType="wkbPoint")
plot(readOGR(dsn, "PacoursIKA2", require_geomType="wkbLineString"), col="red")
plot(readOGR(dsn, "PacoursIKA2", require_geomType="wkbPoint"), add=TRUE)
odir <- getwd()
setwd(system.file("vectors", package = "rgdal")[1])
ow <- options("warn")$warn
options("warn"=1)
ogrInfo("test64.vrt", "test64")
str(readOGR("test64.vrt", "test64", verbose=FALSE, integer64="allow.loss")$val)
str(readOGR("test64.vrt", "test64", verbose=FALSE, integer64="warn.loss")$val)
str(readOGR("test64.vrt", "test64", verbose=FALSE, integer64="no.loss")$val)
str(readOGR("test64.vrt", "test64", verbose=FALSE, stringsAsFactors=FALSE,
 integer64="no.loss")$val)
setwd(odir)
options("warn"=ow)
```

RGB2PCT *Convert RGB three band to single band colour table*

Description

This function converts a three-band GDALReadOnlyDataset into a single band of colour indices as a GDALTransientDataset.

Usage

```
RGB2PCT(x, band, driver.name = 'MEM', ncolors = 256, set.ctab = TRUE)
```

Arguments

x	a three-band GDALReadOnlyDataset object
band	a vector of numbers, recycled up to 3 in length
driver.name	default MEM

ncolors	a number of colours between 2 and 256
set.ctab	default TRUE, when the dithered dataset handle is returned, otherwise a list of the dataset and the PCT colour table

Value

The value returned is a either GDALTransientDataset or a list of a GDALTransientDataset and a colour table.

Author(s)

Tim Keitt

References

http://www.gdal.org/

Examples

```
logo <- system.file("pictures/Rlogo.jpg", package="rgdal")[1]
x <- GDAL.open(logo)
dim(x)
dx <- RGB2PCT(x, band=1:3)
displayDataset(dx)
dim(dx)
GDAL.close(x)
GDAL.close(dx)
```

SGDF2PCT *Convert RGB three band to single band colour table*

Description

This function converts a three-band SpatialGridDataFrame into a single band of colour indices and a colour look-up table using RGB2PCT. vec2RGB uses given breaks and colours (like image) to make a three column matrix of red, green, and blue values for a numeric vector.

Usage

```
SGDF2PCT(x, ncolors = 256, adjust.bands=TRUE)
vec2RGB(vec, breaks, col)
```

Arguments

x	a three-band SpatialGridDataFrame object
ncolors	a number of colours between 2 and 256
adjust.bands	default TRUE; if FALSE the three bands must lie each between 0 and 255, but will not be streched within those bounds
vec	a numeric vector
breaks	a set of breakpoints for the colours: must give one more breakpoint than colour
col	a list of colors

Value

The value returned is a list:

idx	a vector of colour indices in the same spatial order as the input object
ct	a vector of RGB colours

Author(s)

Roger Bivand

References

http://www.gdal.org/

Examples

```
logo <- system.file("pictures/Rlogo.jpg", package="rgdal")[1]
SGlogo <- readGDAL(logo)
cols <- SGDF2PCT(SGlogo)
SGlogo$idx <- cols$idx
image(SGlogo, "idx", col=cols$ct)
SGlogo <- readGDAL(logo)
cols <- SGDF2PCT(SGlogo, ncolors=64)
SGlogo$idx <- cols$idx
image(SGlogo, "idx", col=cols$ct)
SGlogo <- readGDAL(logo)
cols <- SGDF2PCT(SGlogo, ncolors=8)
SGlogo$idx <- cols$idx
image(SGlogo, "idx", col=cols$ct)
data(meuse.grid)
coordinates(meuse.grid) <- c("x", "y")
gridded(meuse.grid) <- TRUE
fullgrid(meuse.grid) <- TRUE
summary(meuse.grid$dist)
opar <- par(no.readonly=TRUE)
par(mfrow=c(1,2), mar=c(1,1,1,1)+0.1)
image(meuse.grid, "dist", breaks=seq(0,1,1/10), col=bpy.colors(10))
RGB <- vec2RGB(meuse.grid$dist, breaks=seq(0,1,1/10), col=bpy.colors(10))
summary(RGB)
```

```
meuse.grid$red <- RGB[,1]
meuse.grid$green <- RGB[,2]
meuse.grid$blue <- RGB[,3]
cols <- SGDF2PCT(meuse.grid[c("red", "green", "blue")], ncolors=10,
 adjust.bands=FALSE)
is.na(cols$idx) <- is.na(meuse.grid$dist)
meuse.grid$idx <- cols$idx
image(meuse.grid, "idx", col=cols$ct)
par(opar)
# Note: only one wrongly classified pixel after NA handling/dropping
# The functions are not written to be reversible
sort(table(findInterval(meuse.grid$dist, seq(0,1,1/10), all.inside=TRUE)))
sort(table(cols$idx))
```

---

showWKT *Show Well-Known Text spatial reference system metadata*

Description

Use GDAL/OGR spatial reference objects to convert a PROJ.4 representation to a Well-Known Text representation, and report an EPSG code if it can be determined by OGR SRS services.

Usage

```
showWKT(p4s, file = NULL, morphToESRI = TRUE)
showP4(wkt, morphFromESRI=TRUE)
showEPSG(p4s)
```

Arguments

p4s	A valid PROJ.4 string representing a spatial reference system
file	if not NULL, a file name to which the output Well-Known Text representation should be written
morphToESRI	default TRUE, morph the WKT string to the representation used by ESRI
wkt	A valid WKT character string representing a spatial reference system
morphFromESRI	default TRUE, morph the WKT string from the representation used by ESRI

Value

A character string containing the WKT representation of the PROJ.4 string.

Author(s)

Roger Bivand

References

http://www.gdal.org/osr_tutorial.html

See Also

is.projected, CRS-class

Examples

```
cities <- readOGR(system.file("vectors", package = "rgdal")[1], "cities")
readLines(system.file("vectors/cities.prj", package = "rgdal")[1])
showWKT(proj4string(cities))
showWKT("+init=epsg:28992")
showP4(showWKT("+init=epsg:28992"))
showEPSG("+proj=utm +zone=30")
showEPSG("+proj=longlat +ellps=WGS84")
```

SpatialGDAL-class *Class "SpatialGDAL"*

Description

Class for spatial attributes that have spatial locations on a (full) regular grid on file, not (yet) actually read.

Usage

```
## S3 method for class 'SpatialGDAL'
open(con, ..., silent = FALSE, allowedDrivers = NULL, options=NULL)
## S3 method for class 'SpatialGDAL'
close(con, ...)
copy.SpatialGDAL(dataset, fname, driver = getDriver(dataset@grod),
 strict = FALSE, options = NULL, silent = FALSE)
```

Arguments

con	file name of grid map for opening, SpatialGDAL object for closing
...	other arguments (currently ignored)
silent	logical; if TRUE, comment and non-fatal CPL driver errors suppressed
dataset	object of class SpatialGDAL
fname	file name of grid map
driver	GDAL driver name
strict	TRUE if the copy must be strictly equivalent, or more normally FALSE indicating that the copy may adapt as needed for the output format
allowedDrivers	a character vector of suggested driver short names may be provided starting from GDAL 2.0
options	driver-specific options to be passed to the GDAL driver; only available for opening datasets from GDAL 2.0

Objects from the Class

Objects can be created by calls of the form `open. SpatialGDAL(name), `, where `name` is the name of the GDAL file.

Slots

`points`: see SpatialPoints; points slot which is not actually filled with all coordinates (only with min/max)

`grid`: see GridTopology-class; grid parameters

`grid.index`: see SpatialPixels-class; this slot is of zero length for this class, as the grid is full

`bbox`: Object of class `"matrix"`; bounding box

`proj4string`: Object of class `"CRS"`; projection

`data`: Object of class data.frame, containing attribute data

Extends

Class Spatial-class, directly.

Methods

[`signature(x = "SpatialGDAL", i, j, ...)`: selects rows (i), columns (j), and bands (third argument); returns an object of class SpatialGridDataFrame-class. Only the selection is actually read.

[[`signature(i)`: reads band i and returns the values as a numeric vector

Note

Non-fatal CPL errors may be displayed for some drivers, currently for the AIG ArcInfo 9.3 binary raster driver using GDAL >= 1.6.2; the data has been read correctly, but the contents of the info directory did not meet the specifications used to reverse engineer the driver used in GDAL (see http://trac.osgeo.org/gdal/ticket/3031)

Author(s)

Edzer Pebesma, <edzer.pebesma@uni-muenster.de>

See Also

`SpatialGridDataFrame-class`, which is actually sub-classed.

Examples

```
x <- open.SpatialGDAL(system.file("external/test.ag", package="sp")[1])
image(x[])
image(as(x, "SpatialGridDataFrame"))
summary(as(x, "SpatialGridDataFrame"))
spplot(as(x, "SpatialGridDataFrame"))
# select first 50 rows:
```

```
summary(x[1:50])
# select first 50 columns:
summary(x[,1:50])
# select band 1:
summary(x[,,1])
# select first 50 rows, first 50 columns, band 1:
summary(x[1:50,1:50,1])
# get values of first band:
summary(x[[1]])
close(x)
```

---

spTransform-methods *Methods for Function spTransform for map projection and datum transformation in package "rgdal"*

Description

The spTransform methods provide transformation between datum(s) and conversion between projections (also known as projection and/or re-projection), from one unambiguously specified coordinate reference system to another, using PROJ.4 projection arguments. For simple projection, when no +datum tags are used, datum projection does not occur. When datum transformation is required, the +datum tag should be present with a valid value both in the CRS of the object to be transformed, and in the target CRS. In general +datum= is to be prefered to +ellps=, because the datum always fixes the ellipsoid, but the ellipsoid never fixes the datum.

In addition, the +towgs84 tag should be used where needed to make sure that datum transformation does take place. Parameters for +towgs84 will be taken from the bundled EPSG database if they are known unequivocally, but may be entered manually from known authorities. Not providing the appropriate +datum and +towgs84 tags may lead to coordinates being out by hundreds of metres. Unfortunately, there is no easy way to provide this information: the user has to know the correct metadata for the data being used, even if this can be hard to discover.

Methods

"ANY" default void method

"SpatialPoints", CRSobj = CRS returns transformed coordinates of an "SpatialPoints" object using the projection arguments in "CRSobj", of class CRS

"SpatialPointsDataFrame", CRSobj = CRS returns transformed coordinates of an "SpatialPointsDataFrame" object using the projection arguments in "CRSobj", of class CRS

"SpatialLines", CRSobj = CRS returns transformed coordinates of an "SpatialLines" object using the projection arguments in "CRSobj", of class CRS

"SpatialLinesDataFrame", CRSobj = CRS returns transformed coordinates of an "SpatialLinesDataFrame" object using the projection arguments in "CRSobj", of class CRS

"SpatialPolygons", CRSobj = CRS returns transformed coordinates of an "SpatialPolygons" object using the projection arguments in "CRSobj", of class CRS

"SpatialPolygonsDataFrame", CRSobj = CRS returns transformed coordinates of an "SpatialPolygonsDataFrame" object using the projection arguments in "CRSobj", of class CRS

"SpatialPixelsDataFrame", CRSobj = CRS Because regular grids will usually not be regular after projection/datum transformation, the input object is coerced to a SpatialPointsDataFrame, and the transformation carried out on that object. A warning: "Grid warping not available, coercing to points" is given.

"SpatialGridDataFrame", CRSobj = CRS Because regular grids will usually not be regular after projection/datum transformation, the input object is coerced to a SpatialPointsDataFrame, and the transformation carried out on that object. A warning: "Grid warping not available, coercing to points" is given.

Note

The projection arguments must be entered exactly as in the PROJ.4 documentation, in particular there cannot be any white space in +<arg>=<value> strings, and successive such strings can only be separated by blanks. Note that warnings about different projections may be issued when the PROJ.4 library extends projection arguments; examine the warning to see if the differences are real.

Also note that re-projection and/or datum transformation will usually not work for regular grids. The term used for similar operations for regular grids is warping, which involved resampling to a regular grid in the target coordinate reference system.

The methods may take an optional argument "use_ob_tran", default FALSE, if TRUE and "+proj=ob_tran", use General Oblique Transformation with internalised from/to projection reversal (the user oblique transforms from longlat to oblique forward rather than inverse as suggested in PROJ.4 mailing list postings); these changes are intended to meet a need pointed out by Martin Ivanov (2012-08-15). A subsequent point raised by Martin Ivanov (2017-04-28) was that use of a projected CRS with "+proj=ob_tran" led to errors, so mixing projected CRS and "+proj=ob_tran" is blocked. Transform first "+proj=ob_tran" to or from "+proj=longlat", and then on from geographical coordinates to those desired or the reverse - see example.

If a SpatialPoints object has three dimensions, the third will also be transformed, with the metric of the third dimension assumed to be meters if the vertical units metric is not given in the projection description with +vunits= or +vto_meter= (which is 1.0 by default) http://proj4.org/parameters.html.

Note that WGS84 is both an ellipse and a datum, and that since 1984 there have been changes in the relative positions of continents, leading to a number of modifications. This is discussed for example in http://www.uvm.edu/giv/resources/WGS84_NAD83.pdf; there are then multiple transformations between NAD83 and WGS84 depending on the WGS84 definition used. One would expect that "+towgs84=" is a no-op for WGS84, but this only applies sometimes, and as there are now at least 30 years between now and 1984, things have shifted. It may be useful to note that "+nadgrids=@null" can help, see these threads: https://stat.ethz.ch/pipermail/r-sig-geo/2014-August/021611.html, http://lists.maptools.org/pipermail/proj/2014-August/006894.html, with thanks to Hermann Peifer for assistance.

Note that from PROJ.4 4.9.3, the definition of UTM is changed from TMERC to ETMERC; see example.

Author(s)

Roger Bivand <Roger.Bivand@nhh.no>

Examples

```
data(state)
states <- data.frame(state.x77, state.center)
states <- states[states$x > -121,]
coordinates(states) <- c("x", "y")
proj4string(states) <- CRS("+proj=longlat +ellps=clrk66")
summary(states)
state.ll83 <- spTransform(states, CRS("+proj=longlat +ellps=GRS80"))
summary(state.ll83)
state.merc <- spTransform(states, CRS=CRS("+proj=merc +ellps=GRS80"))
summary(state.merc)
state.merc <- spTransform(states,
 CRS=CRS("+proj=merc +ellps=GRS80 +units=us-mi"))
summary(state.merc)
if (projNAD()) {
states <- data.frame(state.x77, state.center)
states <- states[states$x > -121,]
coordinates(states) <- c("x", "y")
proj4string(states) <- CRS("+init=epsg:4267")
print(summary(states))
state.ll83 <- spTransform(states, CRS("+init=epsg:4269"))
print(summary(state.ll83))
state.kansasSlcc <- spTransform(states, CRS=CRS("+init=epsg:26978"))
print(summary(state.kansasSlcc))
SFpoint_NAD83 <- SpatialPoints(matrix(c(-103.869667, 44.461676), nrow=1),
 proj4string=CRS("+init=epsg:4269"))
SFpoint_NAD27 <- spTransform(SFpoint_NAD83, CRS("+init=epsg:4267"))
print(all.equal(coordinates(SFpoint_NAD83), coordinates(SFpoint_NAD27)))
print(coordinates(SFpoint_NAD27), digits=12)
print(coordinates(SFpoint_NAD83), digits=12)
}
data(meuse)
coordinates(meuse) <- c("x", "y")
proj4string(meuse) <- CRS(paste("+init=epsg:28992",
 "+towgs84=565.237,50.0087,465.658,-0.406857,0.350733,-1.87035,4.0812"))
# see http://trac.osgeo.org/gdal/ticket/1987
summary(meuse)
meuse.utm <- spTransform(meuse, CRS("+proj=utm +zone=32 +datum=WGS84"))
summary(meuse.utm)
cbind(coordinates(meuse), coordinates(meuse.utm))
kiritimati_primary_roads <- readOGR(system.file("vectors",
 package = "rgdal")[1], "kiritimati_primary_roads")
kiritimati_primary_roads_ll <- spTransform(kiritimati_primary_roads,
 CRS("+proj=longlat +datum=WGS84"))
opar <- par(mfrow=c(1,2))
plot(kiritimati_primary_roads, axes=TRUE)
plot(kiritimati_primary_roads_ll, axes=TRUE, las=1)
par(opar)
opar <- par(mfrow=c(1,2))
scot_BNG <- readOGR(system.file("vectors", package = "rgdal")[1],
   "scot_BNG")
scot_LL <- spTransform(scot_BNG, CRS("+proj=longlat +datum=WGS84"))
```

```
plot(scot_LL, axes=TRUE)
grd_LL <- gridlines(scot_LL, ndiscr=100)
summary(grd_LL)
grd_BNG <- spTransform(grd_LL, CRS(proj4string(scot_BNG)))
grdtxt_LL <- gridat(scot_LL)
grdtxt_BNG <- spTransform(grdtxt_LL, CRS(proj4string(scot_BNG)))
plot(scot_BNG, axes=TRUE, las=1)
plot(grd_BNG, add=TRUE, lty=2)
text(coordinates(grdtxt_BNG),
   labels=parse(text=as.character(grdtxt_BNG$labels)))
par(opar)
crds <- matrix(data=c(9.05, 48.52), ncol=2)
spPoint <- SpatialPoints(coords=crds,
 proj4string=CRS("+proj=longlat +ellps=sphere +no_defs"))
a <- spTransform(spPoint, CRS(paste("+proj=ob_tran +o_proj=longlat",
 "+o_lon_p=-162 +o_lat_p=39.25 +lon_0=180 +ellps=sphere +no_defs")),
 use_ob_tran=TRUE)
a
#should be (-5.917698, -1.87195)
spTransform(a, CRS("+proj=longlat +ellps=sphere +no_defs"),
 use_ob_tran=TRUE)
try(spTransform(a, CRS(paste("+proj=tmerc +lat_0=0 +lon_0=9 +k=1",
"+x_0=3500000 +y_0=0 +ellps=bessel +units=m +no_defs")),
 use_ob_tran=TRUE))
spTransform(spPoint, CRS(paste("+proj=tmerc +lat_0=0 +lon_0=9 +k=1",
"+x_0=3500000 +y_0=0 +ellps=bessel +units=m +no_defs")))
spTransform(spTransform(a, CRS("+proj=longlat +ellps=sphere +no_defs"),
 use_ob_tran=TRUE), CRS(paste("+proj=tmerc +lat_0=0 +lon_0=9 +k=1",
"+x_0=3500000 +y_0=0 +ellps=bessel +units=m +no_defs")))
crds1 <- matrix(data=c(7, 51, 8, 52, 9, 52, 10, 51, 7, 51), ncol=2,
byrow=TRUE, dimnames=list(NULL, c("lon", "lat")));
crds2 <- matrix(data=c(8, 48, 9, 49, 11, 49, 9, 48, 8, 48), ncol=2,
byrow=TRUE, dimnames=list(NULL, c("lon", "lat")));
crds3 <- matrix(data=c(6, 47, 6, 55, 15, 55, 15, 47, 6, 47), ncol=2,
byrow=TRUE, dimnames=list(NULL, c("lon", "lat")));
spLines <- SpatialLines(list(Lines(list(Line(crds1), Line(crds2),
Line(crds3)), ID="a")));
spLines@proj4string <- CRS("+proj=longlat +ellps=sphere +no_defs");
bbox(spLines);
spLines_tr <- spTransform(spLines, CRS("+proj=ob_tran +o_proj=longlat
+o_lon_p=-162 +o_lat_p=39.25 +lon_0=180 +ellps=sphere +no_defs"),
use_ob_tran=TRUE);
bbox(spLines_tr)
bbox(spTransform(spLines_tr, CRS("+proj=longlat +ellps=sphere"),
 use_ob_tran=TRUE))
spPolygons <- SpatialPolygons(list(Polygons(list(Polygon(crds1),
Polygon(crds2), Polygon(crds3)), ID="a")));
spPolygons@proj4string <- CRS("+proj=longlat +ellps=sphere +no_defs");
bbox(spPolygons);
spPolygons_tr <- spTransform(spPolygons, CRS("+proj=ob_tran +o_proj=longlat
+o_lon_p=-162 +o_lat_p=39.25 +lon_0=180 +ellps=sphere +no_defs"),
use_ob_tran=TRUE);
bbox(spPolygons_tr)
```

```
bbox(spTransform(spPolygons_tr, CRS("+proj=longlat +ellps=sphere"),
 use_ob_tran=TRUE))
#added after posting by Martin Ivanov
data(nor2k)
summary(nor2k)
nor2kNGO <- spTransform(nor2k, CRS("+init=epsg:4273"))
summary(nor2kNGO)
all.equal(coordinates(nor2k)[,3], coordinates(nor2kNGO)[,3])
#added after posting by Don MacQueen
crds <- cbind(c(-121.524764291826, -121.523480804667), c(37.6600366036405, 37.6543604613483))
ref <- cbind(c(1703671.30566227, 1704020.20113366), c(424014.398045834, 421943.708664294))
crs.step1.cf <- CRS(paste("+proj=lcc +lat_1=38.43333333333333",
 "+lat_2=37.06666666666667 +lat_0=36.5 +lon_0=-120.5",
 "+x_0=2000000.0 +y_0=500000.0 +ellps=GRS80 +units=us-ft +no_defs",
 "+towgs84=-0.991,1.9072,0.5129,0.025789908,0.0096501,0.0116599,0.0"))
locs.step1.cf <- spTransform(SpatialPoints(crds,
 proj4string=CRS("+proj=longlat +datum=WGS84")), crs.step1.cf)
suppressWarnings(proj4string(locs.step1.cf) <- CRS(paste("+proj=lcc",
"+lat_1=38.43333333333333 +lat_2=37.06666666666667 +lat_0=36.5",
"+lon_0=-120.5 +x_0=2000000.0 +y_0=500000.0 +ellps=GRS80 +units=us-ft",
"+no_defs +nadgrids=@null")))
locs.step2.cfb <- spTransform(locs.step1.cf, CRS("+init=epsg:26743"))
coordinates(locs.step2.cfb) - ref
all.equal(unname(coordinates(locs.step2.cfb)), ref)
# Test for UTM == TMERC (<= 4.9.2) or UTM == ETMERC (> 4.9.2)
nhh <- SpatialPointsDataFrame(matrix(c(5.304234, 60.422311), ncol=2),
 proj4string=CRS("+init=epsg:4326"), data=data.frame(office="RSB"))
nhh_utm_32N_P4 <- spTransform(nhh, CRS("+init=epsg:3044"))
nhh_tmerc_P4 <- spTransform(nhh, CRS(paste("+proj=tmerc +k=0.9996",
 "+lon_0=9 +x_0=500000 +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs")))
nhh_etmerc_P4 <- spTransform(nhh, CRS(paste("+proj=etmerc +k=0.9996",
 "+lon_0=9 +x_0=500000 +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs")))
all.equal(coordinates(nhh_utm_32N_P4), coordinates(nhh_tmerc_P4),
 tolerance=1e-9, scale=1)
# UTM == TMERC: PROJ4 <=4.9.2
all.equal(coordinates(nhh_utm_32N_P4), coordinates(nhh_etmerc_P4),
 tolerance=1e-9, scale=1)
# UTM == ETMERC: PROJ4 > 4.9.2
unis <- SpatialPointsDataFrame(matrix(c(15.653453, 78.222504), ncol=2),
 proj4string=CRS("+init=epsg:4326"), data=data.frame(office="UNIS"))
unis_utm_33N_P4 <- spTransform(unis, CRS("+init=epsg:3045"))
unis_tmerc_P4 <- spTransform(unis, CRS(paste("+proj=tmerc +k=0.9996 +lon_0=15",
 "+x_0=500000 +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs")))
unis_etmerc_P4 <- spTransform(unis, CRS(paste("+proj=etmerc +k=0.9996",
 "+lon_0=15 +x_0=500000 +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs")))
all.equal(coordinates(unis_utm_33N_P4), coordinates(unis_tmerc_P4),
 tolerance=1e-9, scale=1)
# UTM == TMERC: PROJ4 <=4.9.2
all.equal(coordinates(unis_utm_33N_P4), coordinates(unis_etmerc_P4),
 tolerance=1e-9, scale=1)
# UTM == ETMERC: PROJ4 > 4.9.2
```

writeOGR *Write spatial vector data using OGR*

Description

The function is an interface with the OGR abstraction library for spatial vector data, allowing data to be written out using supported drivers. The drivers supported will depend on the local installation, and the capabilities of those drivers (many are read-only). The objects exported are SpatialPointsDataFrame, SpatialLinesDataFrame, or SpatialPolygonsDataFrame objects as defined in the sp package.

Usage

```
writeOGR(obj, dsn, layer, driver, dataset_options = NULL,
 layer_options=NULL, verbose = FALSE, check_exists=NULL,
 overwrite_layer=FALSE, delete_dsn=FALSE, morphToESRI=NULL,
 encoding=NULL)
```

Arguments

obj	a SpatialPointsDataFrame, SpatialLinesDataFrame, or a SpatialPolygonsDataFrame object.
dsn	data source name (interpretation varies by driver — for some drivers, dsn is a file name, but may also be a folder)
layer	layer name (varies by driver, may be a file name without extension)
driver	a character string equal to one of the driver names returned by ogrDrivers
dataset_options	a character vector of options, which vary by driver, and should be treated as experimental
layer_options	a character vector of options, which vary by driver, and should be treated as experimental
verbose	if TRUE, returns a list of information about the attempted write operation
check_exists	default NULL, which tests for the GDAL version, and sets FALSE if < 1.8.0, or TRUE for >= 1.8.0
overwrite_layer	default FALSE, if TRUE and check_exists=TRUE, delete the existing layer of the same name from the data source before writing the new layer; this will delete data and must be used with extreme caution, its behaviour varies between drivers, and accommodates changes that may appear in GDAL 1.8
delete_dsn	default FALSE, may be set to TRUE if overwrite_layer reports that the data source cannot be updated; this will delete data and must be used with extreme caution, its behaviour varies between drivers, and accommodates changes that may appear in GDAL 1.8
morphToESRI	default NULL, in which case set TRUE if driver is "ESRI Shapefile" or FALSE otherwise; may be used to override this default

encoding default NULL, if set to a character string, it will be used to convert output strings from the given value to UTF-8 encoding.

Details

Working out which combination of dsn, layer, and driver (and option) values give the desired output takes time and care, and is constrained by the ability of drivers to write output; many are read-only. Use of the references given is highly advisable, with searches in the archives of other software using GDAL/OGR. Note that for the "ESRI Shapefile" driver and GDAL >= 1.9, the layer_options value of 'ENCODING="LDID/CP1252"' or other values found on http://www.autopark.ru/ASBProgrammerGuide/DBFSTRUC.HTM to set the encoding byte of the output DBF file (link refered to in ogr/ogrsf_frmts/shape/ogrshapelayer.cpp. The effect of setting the LDID may vary depending on whether GDAL is built with iconv or not, and on the setting of the CPL Option "SHAPE_ENCODING".

While there is no certainty, newer drivers such as KML, GML, SQLite and Geopackage (GPKG) may encode string fields as UTF-8. Users are advised to explore this on a case to case basis using Encoding on string fields of objects to be output, converting where necessary with iconv or assigning the appropriate value with Encoding.

Value

if verbose=TRUE, a list of information about the attempted write operation

Warning

The overwrite_layer and delete_dsn arguments are provided only for experienced script writers who need to be able to destroy data, for example during repetetive simulation runs. They should never be used by anyone who is not confident about deleting files.

writeOGR Polygon bug in 1.1-1

In fixing a bug in the correct handling of SFS polygon geometries in version 1.1-1, a further bug was introduced affecting cases of wkbPolygon (not wkbMultiPolygon) output where SFS hole status in the output object was (correctly) defined in the comment to Polygons objects. The error only occurred when all the Polygons objects had one exterior ring, and zero or more interior rings. The error led to the coordinates of the rings cumulating, because the rings were not emptied before assigning the next ring. Version 1.1-2 corrects the error; thanks to JamesWorrall for a complete bug report https://stat.ethz.ch/pipermail/r-sig-geo/2015-December/023796.html.

Note

Only a subset of possible data slot column classes may be written out; if the function returns an error that the data type of stated columns is unknown, examine the classes and check that they are one of c("numeric", "character", "factor", "POSIXt", "integer", "logical"), and if not convert to such classes. Classes c("factor", "POSIXt") are converted to character strings, and c("logical") to integer internally.

For writing with the KML and GPX drivers, note that the geometries should be in geographical coordinates with datum WGS84.

Author(s)

Roger Bivand

References

http://www.gdal.org/ogr_formats.html, http://examples.oreilly.com/webmapping/

See Also

readOGR

Examples

```
cities <- readOGR(system.file("vectors", package = "rgdal")[1], "cities")
is.na(cities$POPULATION) <- cities$POPULATION == -99
summary(cities$POPULATION)
td <- file.path(tempdir(), "rgdal_examples"); dir.create(td)
# BDR 2016-12-15 (MapInfo driver fails writing to directory with ".")
if(nchar(Sys.getenv("OSGEO4W_ROOT")) > 0) {
    OLDPWD <- getwd()
    setwd(td)
    td <- "."
}
writeOGR(cities, td, "cities", driver="ESRI Shapefile")
try(writeOGR(cities, td, "cities", driver="ESRI Shapefile"))
writeOGR(cities, td, "cities", driver="ESRI Shapefile", overwrite_layer=TRUE)
cities2 <- readOGR(td, "cities")
summary(cities2$POPULATION)
if ("SQLite" %in% ogrDrivers()$name) {
  tf <- tempfile()
  try(writeOGR(cities, tf, "cities", driver="SQLite", layer_options="LAUNDER=NO"))
}
if ("GeoJSON" %in% ogrDrivers()$name) {
  js <- '{
    "type": "MultiPolygon",
    "coordinates": [[[[102.0, 2.0], [103.0, 2.0], [103.0, 3.0], [102.0, 3.0],
    [102.0, 2.0]]], [[[100.0, 0.0], [101.0, 0.0], [101.0, 1.0], [100.0, 1.0],
    [100.0, 0.0]]]]
  }'
  spdf <- readOGR(js, layer='OGRGeoJSON')
  in1_comms <- sapply(slot(spdf, "polygons"), comment)
  print(in1_comms)
  tf <- tempfile()
  writeOGR(spdf, tf, "GeoJSON", driver="GeoJSON")
  #spdf1 <- readOGR(tf, "GeoJSON")
  spdf1 <- readOGR(tf)
  in2_comms <- sapply(slot(spdf1, "polygons"), comment)
  print(in2_comms)
  print(isTRUE(all.equal(in1_comms, in2_comms)))
}
## Not run: if ("GML" %in% ogrDrivers()$name) {
  airports <- try(readOGR(system.file("vectors/airports.gml",
```

```
    package = "rgdal")[1], "airports"))
  if (class(airports) != "try-error") {
    writeOGR(cities, paste(td, "cities.gml", sep="/"), "cities", driver="GML")
    cities3 <- readOGR(paste(td, "cities.gml", sep="/"), "cities")
  }
}
## End(Not run)
# The GML driver does not support coordinate reference systems
if ("KML" %in% ogrDrivers()$name) {
  data(meuse)
  coordinates(meuse) <- c("x", "y")
  proj4string(meuse) <- CRS("+init=epsg:28992")
  meuse_ll <- spTransform(meuse, CRS("+proj=longlat +datum=WGS84"))
  writeOGR(meuse_ll["zinc"], paste(td, "meuse.kml", sep="/"), "zinc", "KML")
}
list.files(td)
roads <- readOGR(system.file("vectors", package = "rgdal")[1],
 "kiritimati_primary_roads")
summary(roads)
if (strsplit(getGDALVersionInfo(), " ")[[1]][2] < "2") {
# For GDAL >= 2, the TAB driver may need a BOUNDS layer option
  writeOGR(roads, td, "roads", driver="MapInfo File")
  roads2 <- readOGR(paste(td, "roads.tab", sep="/"), "roads")
  summary(roads2)
}
scot_BNG <- readOGR(system.file("vectors", package = "rgdal")[1], "scot_BNG")
summary(scot_BNG)
if (strsplit(getGDALVersionInfo(), " ")[[1]][2] < "2") {
# For GDAL >= 2, the TAB driver may need a BOUNDS layer option
  writeOGR(scot_BNG, td, "scot_BNG", driver="MapInfo File")
  list.files(td)
  scot_BNG2 <- readOGR(paste(td, "scot_BNG.tab", sep="/"), "scot_BNG",
    addCommentsToPolygons=FALSE)
  summary(scot_BNG2)
}
writeOGR(scot_BNG, td, "scot_BNG", driver="MapInfo File",
 dataset_options="FORMAT=MIF")
list.files(td)
scot_BNG3 <- readOGR(paste(td, "scot_BNG.mif", sep="/"), "scot_BNG")
summary(scot_BNG3)
if(nchar(Sys.getenv("OSGEO4W_ROOT")) > 0) {
    setwd(OLDPWD)
}
```

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