Package: DEPONS2R (via r-universe)

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Type Package

Title Read, Plot and Analyse Output from the DEPONS Model

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Author Jacob Nabe-Nielsen and Caitlin K. Frankish

Maintainer Jacob Nabe-Nielsen <jnn@ecos.au.dk>

Description Methods for analyzing population dynamics and movement tracks simulated using the DEPONS model <https://www.depons.eu> (v.3.0), for manipulating input raster files, shipping routes and for analyzing sound propagated from ships.

License GPL-3

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Contents

`ais.to.DeponsShips` *Convert ship tracks to DeponsShips object*

Description

Convert Automatic Identification System (AIS) data for ships to ship track objects. This is done by cropping one or more ship tracks to the extent of a landscape and converting the data to a `DeponsShips-class` object. If the AIS data does not include ship positions recorded in half-hour steps, the tracks are interpolated to make objects suitable for use in DEPONS.

Usage

```
ais.to.DeponsShips(data, landsc, title = "NA", ...)
```

Arguments

`data`	data.frame with ship positions and the times at which the positions were recorded. Must contain the columns 'id', 'time' (of the form " type, character), 'length' (ship length, meters), 'x', and 'y' (position, meters/UTM).
`landsc`	A `DeponsRaster` object corresponding to the landscape that the ships move in. It is assumed that the spatial projection of the ship positions corresponds to that of the DeponsRaster object
`title`	Title of the output object
`...`	Optional parameters, including 'startday' and 'endday' (" from 'data'. If startday = endday the output object will contain up to 49 positions from the selected date for each vessel track.

Value

Returns a `DeponsShips` object containing one or more ships assigned to each of the routes in the object. All ships on a particular route move at the same speed along the route. The routes are defined by x and y coordinates based on the same coordinate reference system as the landscape they are located in. The speed that ships use after reaching a particular position (a particular 'virtual buoy') is calculated from the distance to the following position, and the time it takes reaching that position. If speed is included in the input AIS data, this is NOT used. The routes include one position per half-hour time step, corresponding to the default time step used in the DEPONS model. If input data does not include one position per half hour, new positions are generated using linear interpolation. If the input data contains many positions in a particular half-hour interval, only the positions closest to the half-hour interval are used. The routes contain information about the number of half-hour intervals were ships 'pause' at a particular location, e.g. in a port. These are calculated based on the input AIS data.

See Also

`aisdata` for an example of data that can be used as input to ais.to.DeponsShips. The function builds on `interpolate.ais.data`, which interpolates tracks to ensure that there is a position every 30 minutes. See `write.DeponsShips` for conversion of `DeponsShips` objects to json-files to be used in DEPONS. Use `routes`, `ships`, and `title` for inspection/modification of the ship tracks.

Examples

```
data(aisdata)
plot(aisdata$x, aisdata$y, type="n", asp=1)
ids <- sort(unique(aisdata$id))
my.colors <- heat.colors(length(ids))
for (i in 1:length(ids)) {
  id <- ids[i]
  points(aisdata$x[aisdata$id==id], aisdata$y[aisdata$id==id],
     cex=0.6, col=my.colors[i])
}
data(bathymetry)
plot(bathymetry, add=TRUE)
depons.ais <- ais.to.DeponsShips(aisdata, bathymetry)
the.routes <- routes(depons.ais)
for (i in 1:length(ids)) {
points(the.routes[[i]]$x, the.routes[[i]]$y,
        cex=0.6, pch=16, col=my.colors[i])
}
depons.ais <- ais.to.DeponsShips(aisdata, bathymetry,
   startday="2015-12-20", endday="2015-12-20")
routes(depons.ais)
aisdata2 <- aisdata
aisdata2$time <- format(as.POSIXct(aisdata$time)+300)
depons.ais2 <- ais.to.DeponsShips(aisdata2, bathymetry,
                                  startday="2015-12-20", endday="2015-12-21")
routes(depons.ais2)
```

`aisdata` *Position for three ships in the inner Danish waters*

Description

Automatic identification system (AIS) data for three ships in Kattegat and the Western Baltic from 20 Dec 2015. The data set includes the variables id (the Maritime Mobile Service Identity number), time, speed (in knots), type, length (in metres), x and y (which provide the coordinates of the ship at a given time. The coordinates use the UTM zone 32 projection (CRS = "+proj=utm +zone=32 +units=m +no_defs +datum=WGS84").

Format

data.frame

bathymetry *Bathymetry of the Kattegat area*

Description

The standard bathymetry file for Kattegat which is used in DEPONS simulations. It is based on a raster file with 1000 rows and 600 columns where each grid cell corresponds to 400 m x 400 m. Cells on land are assigned a missing data value of -9999.

The Kattegat landscapes use the UTM zone 32 projection, (EPSG:32632) as in the study by Nabe-Nielsen et al (2014). The corresponding proj4string is "+proj=utm +zone=32 +datum=WGS84 +units=m +no_defs" (see https://epsg.io/32632).

Format

DeponsRaster

References

Nabe-Nielsen, J., Sibly, R. M., Tougaard, J., Teilmann, J., & Sveegaard, S. (2014). Effects of noise and by-catch on a Danish harbour porpoise population. Ecological Modelling, 272, 242–251. doi:10.1016/j.ecolmodel.2013.09.025

See Also

DeponsRaster-class

bbox *Get bbox from Depons* object*

Description

Retrieves spatial bounding box from object. If a Depons* object is a DeponsTrack object containing multiple track, the box bounds all tracks.

Usage

```
## S4 method for signature 'DeponsRaster'
bbox(obj)

## S4 method for signature 'DeponsTrack'
bbox(obj)
```

Arguments

obj	DeponsRaster or DeponsTrack object

Value

Returns a `matrix` defining the northern, southern, eastern and western boundary of a DeponsRaster object or of one or more DeponsTrack objects.

See Also

`make.clip.poly`

`coastline` *Coastline of Northern Europe*

Description

An object of class `SpatialPolygonsDataFrame` showing the coastline of the North Sea, Kattegat, and the Western Baltic. The map projection used is ETRS89 – EPSG:3035 projection as for the North Sea raster files used by DEPONS. The corresponding proj4string is "+proj=laea +lat_0=52 +lon_0=10 +x_0=4321000 +y_0=3210000 +datum=WGS84 +units=m +no_defs".

Format

SpatialPolygonsDataFrame

`crs` *Get or set map projection in Depons* objects*

Description

Get or set the map projection (also known as coordinate reference system, crs) of DeponsRaster and DeponsTrack objects.

Usage

```
## S4 method for signature 'DeponsTrack'
crs(x)

## S4 method for signature 'DeponsShips'
crs(x)

## S4 method for signature 'DeponsRaster'
crs(x)

## S4 replacement method for signature 'DeponsTrack'
crs(x) <- value

## S4 replacement method for signature 'DeponsShips'
```

```
crs(x) <- value

## S4 replacement method for signature 'DeponsRaster'
crs(x) <- value
```

Arguments

x	Object of class class DeponsRaster, DeponsShips or DeponsTrack
value	(proj4string) identifying the map projection

DEPONS2R *Package for analyzing DEPONS simulation output*

Description

Methods for analyzing population dynamics and movement tracks simulated using the DEPONS model (v.3.0; http://www.depons.eu), for manipulating input raster files, shipping routes and for analyzing sound propagated from ships.

The classes used in DEPONS2R include:

- DeponsTrack movement tracks, read from "RandomPorpoise.XXX.csv" files
- DeponsDyn population dynamics data, from "Statistics.XXX.csv" files
- DeponsBlockdyn data from "PorpoisePerBlock.XXX.csv" files
- DeponsShips data from "ships.json" files or from AIS data

Here the DeponsDyn data include both changes in population size and energetics through time for the entire landscape, whereas DeponsBlockdyn data include variations in population size in different parts (or 'blocks') of the landscape. XXX is the date and time when the simulation was finished.

DeponsBlockdyn-class *DeponsBlockdyn-class*

Description

Stores objects containing population size for different parts of the landscape (i.e. different 'blocks')

Details

The dyn slot contains a data frame with the columns 'tick', which indicates the number of half-hourly time steps since the start of the simulation; a column 'block' indicating the region of the landscape where animals were counted, a 'count' column with the number of animals in that block and tick. The 'real.time' column shows the real-world equivalent to 'tick, i.e. the time that has passed since 'startday'.

Slots

`title` Character. Name of the object or simulation

`landscape` Character. Identifier for the landscape used in the DEPONS simulations. The landscapes 'DanTysk', 'Gemini', 'Kattegat', 'North Sea', 'Homogeneous', and 'User defined' are distributed with the DEPONS model.

`simtime` `POSIXlt` object with the date and time when the simulation was finished. This is read from the name of the imput file.

`startday` POSIXlt object with the first day of the simulation, i.e. the first day in the period that the simulations are intended to represent in the real world.

`dyn` Data frame with simulation output.

Note

DeponsBlockdyn-objects are usually read in from csv files produced during DEPONS simulations. These files are named 'PorpoisePerBlock.XXX.csv', where XXX indicates the date and time when the simulation was finished.

See Also

`plot.DeponsBlockdyn` and `read.DeponsBlockdyn`.

Examples

```
a.DeponsBlockdyn <- new("DeponsBlockdyn")
a.DeponsBlockdyn
```

`DeponsDyn-class` *DeponsDyn-class*

Description

Stores objects containing population dynamics output and energetic output simulated using the DEPONS model.

Details

The following columns are included in the simulation output data frame: 'tick', which indicates the number of half-hourly time steps since the start of the simulation; 'count', which indicates the population size at a given time; 'anim.e', showing the average amount of energy stored by simulated animals; 'lands.e', which shows the total amount of energy in the landscape, and 'real.time' which shows the time relative to 'startday'.

Slots

`title` Character. Name of the object or simulation

`landscape` Character. Identifier for the landscape used in the DEPONS simulations. The landscapes 'DanTysk', 'Gemini', 'Kattegat', 'North Sea', 'Homogeneous', and 'User defined' are distributed with the DEPONS model.

`simtime` `POSIXlt` object with the date and time when the simulation was finished. This is read from the name of the imput file.

`startday` POSIXlt object with the first day of the simulation, i.e. the first day in the period that the simulations are intended to represent in the real world.

`dyn` Data frame with simulation output.

Note

DeponsDyn-objects are usually read in from csv files produced during DEPONS simulations. These files are named 'Statistics.XXX.csv', where XXX indicates the date and time when the simulation was finished.

See Also

`plot.DeponsDyn` and `read.DeponsDyn`.

Examples

```
a.DeponsDyn <- new("DeponsDyn")
a.DeponsDyn
```

`DeponsRaster-class` *DeponsRaster-class*

Description

Stores objects containing raster landscapes used as input in DEPONS simulations.

Slots

`type` Character. Identifies the kind of data stored in the raster; should be 'food', 'patches', bathymetry', 'dtc', 'salinity', 'blocks' or 'NA'.

`landscape` Character Identifier for the landscape used in the DEPONS simulations. The landscapes 'DanTysk', 'Gemini', 'Kattegat', 'North Sea', 'Homogeneous', and 'User defined' are distributed with the DEPONS model.

`crs` Object of class "CRS", i.e. the coordinate reference system. This is provided as a proj4string text string.

`header` Data frame with data on number of columns and rows in the input raster, the coordinates of the lower left corner, the size of each grid cell and the integer value used to represent missing data.

`ext` Data frame with the extent of the landscape.

`data` The actual data values for each of the grid cells.

Note

DeponsRaster-objects are typically read in from ascii raster files that have been used for DEPONS simulations.

See Also

`plot.DeponsRaster`, `read.DeponsRaster` and `make.blocksraster`. `bathymetry` is an example of a `DeponsRaster`-object.

Examples

```
a.deponsraster <- new("DeponsRaster")
a.deponsraster
```

`DeponsShips-class` *DeponsShips-class*

Description

Objects containing ship routes and ships

Methods for manipulating, plotting and analyzing ship routes and ship agents used in DEPONS simulations.

Slots

`title` Name of the object (character)

`landscape` Name of the landscape that the ships occur in (character)

`crs` CRS object providing the coordinate reference system used; see `CRS` for details

`routes` `data.frame` geographic positions of the 'virtual buoys' that define one or more ship routes that ship agents follow, and the speed that the ships should use when following this route. They also provide information about how long ships should use speed zero when reaching a specific buoy ('i.e. 'pause', measured in minutes). Can be extracted using the `routes` function.

`ships` `data.frame` defining each of the ships occurring in DEPONS simulations, and the routes they occur on. The data frame includes the variables 'name', 'type', 'length', and 'route'. Info can be extracted using the `ships` function.

See Also

`plot.DeponsShips`, and `read.DeponsShips`

Examples

```
data(shipdata)
ships(shipdata)[1:10,]
routes(shipdata)
plot(shipdata, col=c("red", "purple", "blue"))
```

DeponsTrack-class *DeponsTrack-class*

Description

Stores objects containing animal movement tracks simulated using the DEPONS model

Classes for manipulating and plotting movement tracks generated with DEPONS.

Slots

`title` Name of the object (character)

`landscape` Name of the object (character)

`simtime` POSIXlt object with the date and time when the simulation was finished. This is read from the name of the imput file.

`crs` CRS object providing the coordinate reference system used; see `st_crs` for details

`tracks` Listwith one or more tracks, each stored as a `SpatialPointsDataFrame` object)

See Also

`plot.DeponsTrack` and `read.DeponsTrack`

---

dyn *Extract population dynamics from objects*

Description

Extract population dynamics from objects

Usage

```
## S4 method for signature 'DeponsDyn'
dyn(x)

## S4 method for signature 'DeponsBlockdyn'
dyn(x)
```

Arguments

`x`	Object of class `DeponsBlockdyn`.

get.latest.sim *Get name of newest file*

Description

Returns the name of the newest simulation output of a particular type within the specified directory. The date and time are extracted from the file name.

Usage

```
get.latest.sim(type = "dyn", dir)
```

Arguments

type	Type of simulation output to check; can be one of: "dyn" (for looking in "Statistics.XX.csv" files), "blockdyn" (for looking in "PorpoisePerBlock.XX.csv" files) "track" (for looking in "RandomPorpoise.XX.csv" files).
dir	Directory to look for simulation output in (character string)

Value

character string with the name of the most recent simulation output file.

See Also

read.DeponsBlockdyn for example.

get.simtime *Get simulation date*

Description

Returns the date and time when a specific simulation was finished, obtained from the date stored as part of the file name. The date format is system dependent, but the function attemts to extract the data assuming that either the English or the local language is used. (a POSIXlt object)

Usage

```
get.simtime(fname = NULL, tz = "GMT")
```

Arguments

fname	Character string with name of the file to extract the simulation date from, including the path
tz	Time zone

Value

Returns a POSIXlt object

See Also

get.latest.sim

---

interpolate.ais.data *Interpolate AIS data*

Description

Interpolates ship movement tracks obtained from Automatic Identification System (AIS) data to obtain exactly one position per 30 minutes. The first and last position in the original track are omitted unless minutes = 0 or 30 and seconds = 0.

Usage

```
interpolate.ais.data(aisdata)
```

Arguments

aisdata	Data frame including the columns 'id' (ship identifier), 'time' (text string readable by as.POSIXct), 'x' and 'y' (recorded ship position, unit: meters), and potentially additional columns

Value

Returns a data frame with the same columns as the input data

See Also

read.DeponsShips and ais.to.DeponsShips

Examples

```
data(aisdata)
ais.testdata <- aisdata[c(12,14,16) ,]
plot(ais.testdata[c("x", "y")], asp=1, col="green", pch=16, xlim=c(780000, 837000))
lines(ais.testdata[c("x", "y")])
# Add 600 sec to 'time' to mis-allign with intervcal needed
ais.testdata$time <- format(as.POSIXlt(ais.testdata$time)+600)
text(ais.testdata[c("x", "y")]-900, ais.testdata$time, adj=0, cex=0.5)
interpolated <- interpolate.ais.data(ais.testdata)
points(interpolated[,c("x", "y")], col="red")
text(interpolated[c("x", "y")]-900, interpolated$time, adj=0, cex=0.5)
legend("bottomright", bty="n", pch=c(16, 1), col=c("green", "red"),
    legend=c("original positions", "interpolated"))
```

landscape<- *Get or set the landscape name*

Description

Get or set the landscape name

Get or set the landscape name

Usage

```
## S4 replacement method for signature 'DeponsTrack'
landscape(x) <- value

## S4 method for signature 'DeponsTrack'
landscape(x)

## S4 replacement method for signature 'DeponsDyn'
landscape(x) <- value

## S4 method for signature 'DeponsDyn'
landscape(x)

## S4 replacement method for signature 'DeponsBlockdyn'
landscape(x) <- value

## S4 method for signature 'DeponsBlockdyn'
landscape(x)
```

Arguments

x	Object of class DeponsBlockdyn.
value	Name of the landscape (character)

make.blocksraster *Makes new file with blocks*

Description

Produces a DeponsRaster object of type='blocks' for use in DEPONS simulations. This allows animals to be counted within specific regions (blocks) of the landscape during the simulation. The new blocks can be specified as either matrices or SpatialPolygons objects. For matrices, the blocks are defined as the smallest rectangle that includes all the specified positions.

Usage

```
## S4 method for signature 'DeponsRaster'
make.blocksraster(
  template,
  blocks = NA,
  blockvals = NULL,
  NAvalue = -9999,
  plot = FALSE,
  fname = NULL,
  overwrite = FALSE
)
```

Arguments

template	DeponsRaster object used as template for new blocks file
blocks	list of areas to be used for new blocks. Each item in 'blocks' should be a matrix (with two columns, corresponding to x- and y-coordinates) or a SpatialPolygons object
blockvals	Vector of integer values defining the labels of the new blocks. The first value defines the background value, so the length of 'blockvals' should equal the number of blocks plus 1
NAvalue	Value used for missing data in the output object
plot	If TRUE, the raster block is plotted
fname	Name of the output raster file (character string ending with '.asc'). No file is written to disk if fname is not provided.
overwrite	Whether to replace existing file.

Value

RasterLayer object defining different subregions of the landscape where animals should be counted.

Note

The blocks file should not be modified when running DEPONS simulations using the 'Kattegat' landscape. In this landscape the simulated animals use the blocks file for navigation. Also note that blocks are added to the new blocks raster in the order they are file in the order in which they are listed in 'blocks', so the order mattes if the blocks overlap.

Examples

```
#Load file to use as template for new blocks file
data("bathymetry")

# Make list of blocks to create
new.blocks <- list()
x <- runif(8, 700000, 760000)
y <- runif(8, 6200000, 6300000)
new.blocks[[1]] <- cbind(x,y)
```

```
x <- c(600000, 635000, 670000, 635000)
y <- c(6150000, 6200000, 6150000, 6100000)
library(sp)
srl <- list(Polygon(cbind(x,y)))
Srl <- list(Polygons(srl, ID=as.vector("p")))
new.blocks[[2]] <- SpatialPolygons(Srl, proj4string=crs(bathymetry))

make.blocksraster(bathymetry, new.blocks, plot=TRUE)
points(new.blocks[[1]])
plot(new.blocks[[2]], add=TRUE)


the.dir <- tempdir()
make.blocksraster(bathymetry, new.blocks, fname=paste0(the.dir, "/test.asc"))
```

`make.clip.poly` *Make clipping polygon from bbox*

Description

Makes a polygon from a bounding box to use for clipping the coastline, or other SpatialPolygons objects

Usage

```
## S4 method for signature 'matrix'
make.clip.poly(bbox, crs)
```

Arguments

`bbox`	2x2 matrix
`crs`	CRS object defining the projection of the SpatialPolygons object to be clipped

Value

`SpatialPolygons` object

See Also

`bbox` for creation of bbox matrix from DeponsRaster

Examples

```
data(bathymetry)
bbox <- cbind("min"=c(549517, 6155000), "max"=c(636000, 6210000))
rownames(bbox) <- c("x", "y")
clip.poly <- make.clip.poly(bbox, crs(bathymetry))
```

`make.windfarms` *Make wind farm construction scenario*

Description

Produce a hypothetical wind farm construction scenario, specifying the position and timing of individual piling events, as well as the sound source level. All wind farms are assumed to consist of the same number of turbines, laid out in a rectangular grid. The start and end tick (i.e. the number of half-hour intervals since simulation start) is generated based on provided values for the time it required for each piling and the time between piling events.

Usage

```
make.windfarms(
  area.file,
  area.def,
  n.wf,
  n.turb,
  turb.dist,
  min.wf.dist,
  impact,
  constr.start,
  constr.end,
  constr.time,
  constr.break,
  iterate = 10000,
  verbose = FALSE,
  wf.coords = "random"
)
```

Arguments

`area.file`	Name of the raster file specifying where the wind farms should be constructed.
`area.def`	Value in `area.file` for the areas were wind farms can be located
`n.wf`	Number of wind farms to construct
`n.turb`	Total number of turbines to construct
`turb.dist`	Distance between turbines within a wind farm (meters)
`min.wf.dist`	Minimum distance between wind farms (meters)
`impact`	Sound source level (dB); sound emitted from turbines during construction, i.e. from tickStart to tickEnd (including both start and end)
`constr.start`	The tick at which construction of the first turbine starts.
`constr.end`	The tick at which construction of the very last turbine in the last wind farm ends.
`constr.time`	The time it takes to construct a single wind turbine (number of ticks).

constr.break	Break between individual pilings within a wind farm, counted in number of half-hour 'ticks'.
iterate	Number of times to try finding a spot for a new wind farm that is sufficiently far from the nearest neighbouring wind farm (>min.wf.dist). The number also defines the number of random positions to search through.
verbose	Logical; whether messages should be printed to console.
wf.coords	Possible location of the south-western corner of the wind farms. Defaults to the text "random", but can also be a data frame with coordinates in the columns x and y.

Value

data.frame specifying the position of each turbine in a wind farm, along with the start time and end time for pile driving of the turbine foundation and the sound source level during pile driving. Can be exported as a text file and used for controlling DEPONS simulations.

Note

The parameters constr.start, constr.end, constr.time, and constr.break are truncated to nearest integer value. Construction of wind farms starts in WF001 at tick constr.start. Each turbine foundation is piled over a period of constr.time, followed by a noise-free period of constr.break. Several pile driving operations may take place at the same time, to ensure that the last piling ends before constr.end.

---

plot,DeponsBlockdyn,missing-method

Plot a DeponsBlockdyn object

Description

Plot population dynamics simulated with DEPONS

Usage

```
## S4 method for signature 'DeponsBlockdyn,missing'
plot(x, y, dilute = 5, ...)
```

Arguments

x	DeponsBlockdyn object
y	Not used
dilute	Integer. Plot only one in every 'dilute' values. Defaults to 5, which yields a plot of the first simulated value and one in every five of the following values.
...	Optional plotting parameters

Value

data.frame listing blocks where no animals were counted (returned invisibly)

Note

The function returns a data frame with numbers of blocks with no agents.

Examples

```
data("porpoisebdyn")
my.col <- c("red", "darkgreen", "orange")
plot(porpoisebdyn, col=my.col)
legend("bottomright", bty="n", fill=my.col, legend=paste("Block", 0:2))

# Show all data points for small range of x-values
plot(porpoisebdyn, xlim=c(1950, 2050), ylim=c(4850, 5050), type="p", dilute=1, col=my.col)
```

---

plot,DeponsDyn,missing-method

Plot a DeponsDyn object

Description

Plot population dynamics simulated with DEPONS

Usage

```
## S4 method for signature 'DeponsDyn,missing'
plot(x, y, dilute = 5, plot.energy = TRUE, plot.legend = TRUE, ...)
```

Arguments

x	DeponsDyn object
y	Not used
dilute	Integer. Plot only one in every 'dilute' values. Defaults to 5, which yields a plot of the first simulated value and one in every five of the following values.
plot.energy	If set to TRUE it plots the amount of energy stored in simulated and in the landscape in addition to the population count
plot.legend	If set to TRUE, a legend is plotted
...	Optional plotting parameters

Examples

```
data("porpoisedyn")

# Plot for specific range of years
rg <- c(as.POSIXlt("2011-01-01"), as.POSIXlt("2018-12-31"))
plot(porpoisedyn, xlim=as.POSIXct(rg), plot.energy=TRUE)

## Not run:
# Read data from default DEPONS simulation directory:
sim.dir <- "/Applications/DEPONS 2.1/DEPONS"
new.sim.name <- get.latest.sim(dir=sim.dir)
new.sim.out <- read.DeponsDyn(fname=paste(sim.dir, new.sim.name, sep="/"))
plot(new.sim.out)

## End(Not run)
```

---

plot,DeponsRaster,ANY-method

Plot a DeponsRaster object

Description

Plot the values in a DeponsRaster object. Porpoisetracks or other kinds of lines, poits etc. can be drawn on top of the plot by adding

Usage

```
## S4 method for signature 'DeponsRaster,ANY'
plot(x, y, col, trackToPlot = 1, ...)
```

Arguments

x	DeponsRaster object
y	A DeponsTrack object or missing
col	A color palette, i.e. a vector of n contiguous colors. Reasonable defaults are provided.
trackToPlot	Integer indicating which track to plot if the DeponsTrack object contains more than one track. Ignored if y is missing
...	Other optional plotting parameters, including 'axes', 'legend', and 'main'.

Value

No return value, called for side effects

See Also

See method for plot in the raster package for plotting parameters and plot.DeponsTrack for plotting of DeponsRasters cropped to the extent of tracks.

plot,DeponsShips,missing-method
Plot a DeponsShips object

Description

Plot the tracks that ship agents move along in DEPONS.

Usage

```
## S4 method for signature 'DeponsShips,missing'
plot(x, y, ...)
```

Arguments

x	DeponsShips object
y	Not used
...	Optional plotting parameters, including 'col', 'main', 'add.legend', and 'legend.xy' (defaults to 'topright' when add.legend=TRUE)

Value

No return value, called for side effects

Examples

```
data(shipdata)
plot(shipdata, col=c("red", "green", "blue"))


# convert route coordinate units from 'grid squares' to UTM
data(bathymetry)
out <- summary(bathymetry)
left <- out[[4]][1]
bottom <- out[[4]][2]
for (i in 1:3) {
    newroute <- shipdata@routes[[2]][[i]]*400
    newroute$x <- newroute$x + as.numeric(left)
    newroute$y <- newroute$y + as.numeric(bottom)
    shipdata@routes[[2]][[i]] <- newroute
    }

# Reproject coastline and clip to size of Kattegat landscape
library(sp)
data(bathymetry)
data(coastline)
coastline_sf <- sf::st_as_sf(coastline)
coastline2 <- sf::st_transform(coastline_sf, crs(bathymetry))
```

```
bbox <- bbox(bathymetry)
clip.poly <- make.clip.poly(bbox, crs(bathymetry))
plot(shipdata, col=c("red", "green", "blue"), add=TRUE, add.legend=TRUE)
plot(clip.poly, add=TRUE)
```

`plot,DeponsTrack,missing-method`
Plot a DeponsTrack object

Description

Plot the coordinates in a movement track simulated with DEPONS.

Usage

```
## S4 method for signature 'DeponsTrack,missing'
plot(x, y, trackToPlot = 1, add = FALSE, ...)
```

Arguments

`x`	DeponsTrack object
`y`	Not used
`trackToPlot`	Integer; indicates which track to plot if there is more than one track in the object. Defaults to 1
`add`	Logical, whether to add the track to an existing plot one animal was tracked during the simulation.
`...`	Optional plotting parameters

Value

No return value, called for side effects

Examples

```
data(porpoisetrack)
data("porpoisetrack")
plot(porpoisetrack)
```

porpoisebdyn *Simulated porpoise population dynamics*

Description

An object of class DeponsBlockdyn with output from a DEPONS simulation based on the North Sea landscape, using a landscape divided into two blocks. Numbers of animals are counted per block.

Format

DeponsBlockdyn

See Also

DeponsBlockdyn-class, porpoisedyn

porpoisedyn *Simulated porpoise population dynamics*

Description

An object of class DeponsDyn with output from a DEPONS simulation based on the Kattegat landscape, assuming that the simulation represents the period 2010-01-01 onward in the real world. Number of animals and energy availability is recorded for the entire landscape.

Format

DeponsDyn

See Also

DeponsDyn-class, porpoisebdyn

porpoisetrack *Simulated porpoise track*

Description

An object with five elements: `title`, `landscape`, `simtime`, `crs`, and `tracks`. The `crs` stores information about the map projection used ("+proj=utm +zone=32 +datum=WGS84 +units=m +no_defs"). The `tracks` element is a list of objects of class `SpatialPointsDataFrame`, each ofwhich corresponds to one simulated animal. `simtime` is the simulation date.

Format

DeponsTrack

See Also

`DeponsTrack-class`

read.DeponsBlockdyn *Reading simulated population count for blocks*

Description

Function for reading DEPONS simulation output with number of animals per block for each time step.

Usage

```
read.DeponsBlockdyn(
  fname,
  title = "NA",
  landscape = "NA",
  simtime = "NA",
  startday = "NA"
)
```

Arguments

`fname`	Name of the file (character) that contains movement data generated by DEPONS. The name includes the path to the directory if this is not the current working directory.
`title`	Optional character string giving name of simulation
`landscape`	The landscape used in the simulation
`simtime`	Optional text string with date of simulation (format: yyyy-mm-dd). If not provided this is obtained from name of input file
`startday`	The start of the period that the simulation represents, i.e. the real-world equivalent of 'tick 1' (POSIXlt)

Value

DeponsBlockdyn object

See Also

See DeponsBlockdyn-class for details on what is stored in the output object and read.DeponsParam for reading the parameters used in the simulation.

Examples

```
## Not run:
# File loaded from default location
the.file <- "/Applications/DEPONS 2.1/DEPONS/PorpoisePerBlock.2020.Sep.02.20_24_17.csv"
file.exists(the.file)
porpoise.blockdyn <- read.DeponsBlockdyn(fname=the.file,
  title="Test simulation with two blocks", landscape="North Sea")
porpoise.blockdyn

# Get the latest simulation
the.file <- get.latest.sim(type="blockdyn", dir="/Applications/DEPONS 2.1/DEPONS")
owd <- getwd()
setwd("/Applications/DEPONS 2.1/DEPONS")
porpoise.blockdyn <- read.DeponsBlockdyn(fname=the.file)
setwd(owd)

## End(Not run)
```

---

read.DeponsDyn *Reading DEPONS simulation output*

Description

Function for reading simulation output produced by DEPONS.

Usage

```
read.DeponsDyn(
  fname,
  title = "NA",
  landscape = "NA",
  simtime = "NA",
  startday = "NA",
  timestep = 30,
  tz = "GMT"
)
```

Arguments

fname	Name of the file (character) that contains number of animals for each time step during the simulation, along with their energy and the amount of food in the landscape. The name includes the path to the directory if this is not the current working directory.
title	Optional character string giving name of simulation
landscape	The landscape used in the simulation
simtime	Optional character string with the date and time when the simulation finished (format yyyy-mm-dd). If not provided this is obtained from name of input file
startday	The start of the period that the simulation represents, i.e. the real-world equivalent of 'tick 1' (character string of the form 'yyyy-mm-dd', or POSIXlt)
timestep	Time step used in the model, in minutes. Defaults to 30 in DEPONS.
tz	Time zone.

Value

DeponsDyn object containing simulation output

See Also

See DeponsDyn-class for details on what is stored in the output object.

Examples

```
## Not run:
dyn.file <- "/Applications/DEPONS 2.1/DEPONS/Statistics.2020.Sep.02.20_24_17.csv"
file.exists(dyn.file)
porpoisedyn <- read.DeponsDyn(dyn.file, startday=as.POSIXlt("2010-01-01"))
porpoisedyn

## End(Not run)
```

---

read.DeponsParam *Read simulation parameters*

Description

Read the parameters that were used for running a specific DEPONS simulation

Usage

```
read.DeponsParam(fname)
```

Arguments

fname	Name of the XML file (character) that contains the parameter list used for running a DEPONS simulation. The name includes the path to the directory if this is not the current working directory.

Details

The parameter file can be generated from within DEPONS by pressing the 'Save' icon after modifying the user settings on the 'Parameters' tab within the main DEPONS model window. See TRACE document for details regarding the parameters in the model: https://github.com/jacobnabe/DEPONS. It is strongly recommended that the parameter list is stored with the simulation output.

Value

Data frame containing all parameters used in a specific simulation

Examples

```
## Not run:
# Parameters read from file created by DEPONS run in interactive mode
the.file <- "/Applications/DEPONS 2.1/DEPONS/DEPONS.rs/parameters.xml"
pfile <- read.DeponsParam(the.file)

## End(Not run)
```

---

read.DeponsRaster *Reading DEPONS raster files*

Description

Function for reading raster files that have been used in DEPONS simulations. DEPONS rasters define amount of food available for simulated animals, spatial distribution of food patches, bathymetry, and distance to coast (dtc). The 'blocks' raster enables the user to count animals in specific parts of the landscape during simulations. See Nabe-Nielsen et al. (2018) for details regarding these files. In DEPONS 2.0 the salinity raster file was introduced; see TRACE document for details: https://github.com/jacobnabe/DEPONS

Usage

```
read.DeponsRaster(fname, type = "NA", landscape = "NA", crs = "NA")
```

Arguments

fname	Filename (character), including the path to the DEPONS raster file.
type	The kind of data stored in the raster; c('food', 'patches', 'bathymetry', 'dtc', 'salinity', 'blocks').
landscape	Identifier for the landscape used in the DEPONS simulations; typically set to 'North Sea'.
crs	CRS-object providing the map projection (see CRS).

Value

Returns a DeponsRaster object. The object inherits slots from the "RasterLayer" class, including "title", which is used for storing the file name.

References

Nabe-Nielsen, J., van Beest, F. M., Grimm, V., Sibly, R. M., Teilmann, J., & Thompson, P. M. (2018). Predicting the impacts of anthropogenic disturbances on marine populations. Conservation Letters, 11(5), e12563. doi:10.1111/conl.12563

See Also

DeponsRaster-class

---

read.DeponsShips *Read DEPONS ship files*

Description

Function for reading the json-files that are used for controlling how ship agents behave in DEPONS. Ships move along pre-defined routes in 30-min time steps. The routes are defined by the fix-points provided in the json file, and the geographic projection is assumed to match that of the landscape.

Usage

```
read.DeponsShips(fname, title = "NA", landscape = "NA", crs = as.character(NA))
```

Arguments

fname	Name of the file (character) where ship routes and ships are defined.
title	Optional character string with the name of the simulation
landscape	Optional character string with the landscape used in the simulation
crs	Character, coordinate reference system (map projection)

Value

Returns an object with the elements title landscape, crs, routes and ships.

`read.DeponsTrack` *Reading DEPONS track files*

Description

Function for reading movement tracks produced by DEPONS. These describe movements of simulated animals within the simulation landscape, where the positions after each 30-min time step are provided using the coordinate reference system that were used for generating these landscapes.See van Beest et al. (2018) and Nabe-Nielsen et al. (2013) for details regarding how these files were generated as a balance between correlated random walk behaviour and spatial memory behaviour, which allows animals to return to previously visited food patches.

Usage

```
read.DeponsTrack(
  fname,
  title = "NA",
  landscape = "NA",
  simtime = "NA",
  crs = as.character(NA),
  tz = "UTC"
)
```

Arguments

`fname`	Name of the file (character) that contains movement data generated by DEPONS. The name includes the path to the directory if this is not the current working directory.
`title`	Optional character string giving name of simulation
`landscape`	Optional character string with the landscape used in the simulation
`simtime`	Character sting with date of simulation (format yyyy-mm-dd). If not provided this is obtained from name of input file
`crs`	Character, coordinate reference system (map projection)
`tz`	Time zone used in simulations. Defaults to UTC/GMT. #'

Value

Returns a `DeponsTrack` object with the elements `title`, `simtime`, `crs`, and `tracks`. The `date` is extracted from input data if not provided explicitly and stored as a `POSIXlt` object. The element `tracks` is a list of objects of class SpatialPointsDataFrame, each of which corresponds to one simulated animal (several animals can be tracked in one simulation).

Examples

```
data(porpoisetrack) # Load data for use in example

# Use standard DEPONS coordinate reference system / map projection:
the.crs <- "+proj=laea +lat_0=52 +lon_0=10 +x_0=4321000 +y_0=3210000
 +datum=WGS84 +units=m +no_defs"

## Not run:
one.fname <- "~/Applications/DEPONS/
  RandomPorpoise.2020.Jul.31.09_43_10.csv"

porpoisetrack <- read.DeponsTrack(one.fname, title="Track simulated using DEPONS 2.0",
  crs=the.crs)


## End(Not run)

# Plot the first of the simulated tracks
plot(porpoisetrack)
```

`routes` *Get or define routes in DeponsShips objects*

Description

Get or define routes in DeponsShips objects

Usage

```
## S4 method for signature 'DeponsShips'
routes(x)

## S4 replacement method for signature 'DeponsShips'
routes(x) <- value
```

Arguments

`x`	Object of class `DeponsShips`
`value`	list with one named element per shipping route. Each element is a data frame with the variables x, y, speed, and 'pause' which define the coordinates of the fix-points on the shipping routes and the speeds that ships have after passing the fix point and until reaching the next fix point. The variable 'pause' instructs ships about how many minutes to wait before continuing to move.

Note

The unit of 'speed' is knots.

See Also

ships

---

shipdata *Hypothetical ships on routes through Kattegat*

Description

The ship routes and ships used in the study by Nabe-Nielsen et al. (2014). The fix points that define the routes use the UTM zone 32 projection, (EPSG:32632; see https://epsg.io/32632).

The definitions of the ships has been modified since earlier versions of DEPONS (i.e. 2.1 and erlier) in that it now includes ship length, type, and speed (in knots). These are used for calculating the sound source level (following McGilliwray)

Automatic identification system (AIS) data for three ships in Kattegat and the Western Baltic from 20 Dec 2015. The data set includes the variables id (the Maritime Mobile Service Identity number), time, speed (in knots), type, length (in meters), x and y (which provide the coordinates of the ship at a given time. The coordinates use the UTM zone 32 projection (CRS = "+proj=utm +zone=32 +units=m +no_defs +datum=WGS84"). Data were downloaded from the Danish Maritime Authority web page (https://www.dma.dk).

Format

DeponsShips

data.frame

References

MacGillivray A & de Jong C (2021). A Reference Spectrum Model for Estimating Source Levels of Marine Shipping Based on Automated Identification System Data. J Mar Sci Eng 9:369 . doi:10.3390/jmse9040369

Nabe-Nielsen, J., Sibly, R. M., Tougaard, J., Teilmann, J., & Sveegaard, S. (2014). Effects of noise and by-catch on a Danish harbour porpoise population. Ecological Modelling, 272, 242–251. doi:10.1016/j.ecolmodel.2013.09.025

See Also

DeponsShips-class

ships *Get or define ships in DeponsShips objects*

Description

Get or define ships in DeponsShips objects

Usage

```
## S4 method for signature 'DeponsShips'
ships(x)

ships(x) <- value
```

Arguments

x	Object of class DeponsShips
value	data frame with the 'name', 'type', 'length', and 'route' of ships to be simulated, as well as 'tickStart' and 'tickEnd' defining when the ships are to be included in simulations. 'route' is one of the shipping routes defined in the DeponsShips object.

See Also

routes

Examples

```
data(shipdata)
ships(shipdata)
```

startday *Get or set start date for simulation*

Description

Get or set start date for simulation

Get or set start date for simulation

Usage

```
## S4 method for signature 'DeponsBlockdyn'
startday(x)

## S4 method for signature 'DeponsDyn'
startday(x)

## S4 replacement method for signature 'DeponsBlockdyn'
startday(x) <- value

## S4 replacement method for signature 'DeponsDyn'
startday(x) <- value
```

Arguments

x	Object of class DeponsDyn
value	POSIXlt or character string of the form 'yyyy-mm-dd'

Details

The start date indicates the start of the period that the simulation is supposed to represent.

The start date indicates the start of the period that the simulation is supposed to represent.

Note

The assignment of a new start time is currently quite time consuming.

Summary-methods *Summary*

Description

Summarizes different kinds of objects created based on output from the DEPONS model

Usage

```
## S4 method for signature 'DeponsBlockdyn'
summary(object)

## S4 method for signature 'DeponsDyn'
summary(object)

## S4 method for signature 'DeponsRaster'
summary(object)

## S4 method for signature 'DeponsShips'
```

```
summary(object)

## S4 method for signature 'DeponsTrack'
summary(object)
```

Arguments

object	Depons* object

Details

The summary method is available for DeponsTrack-class, DeponsDyn-class, DeponsRaster-class, and DeponsBlockdyn-class-objects.

Value

list summarizing the DeponsBlockdyn object

table summarizing the DeponsBlockdyn object

list summarizing the DeponsRaster object

list summarizing the DeponsTrack object

---

tick.to.time *Convert tick number to date*

Description

Converts the number of ticks since the start of the simulation to a specific date while taking into account that DEPONS assumes that there are 360 days in a simulation year.

Usage

```
tick.to.time(tick, timestep = 30, origin = "2010-01-01", ...)
```

Arguments

tick	Numeric, or numeric vector; tick number
timestep	Numeric; length of each simulation time step, in minutes. Defaults to 30 minutes.
origin	Character. The first day in the period that the simulation represents, format: 'yyyy-mm-dd'.
...	Optional parameters, including time zone (tz)

Value

object of class as.POSIXlt

Note

The function assumes that there are 30 days in each month, except in January, February and March with 31, 28 and 31 days, respectively.

`title<-` *Get or set the title of Depons* objects*

Description

Get or set the title of Depons* objects

Usage

```
## S4 replacement method for signature 'DeponsTrack'
title(x) <- value

## S4 replacement method for signature 'DeponsDyn'
title(x) <- value

## S4 replacement method for signature 'DeponsShips'
title(x) <- value

## S4 method for signature 'DeponsTrack'
title(x, value)

## S4 method for signature 'DeponsDyn'
title(x, value)

## S4 method for signature 'DeponsShips'
title(x, value)
```

Arguments

`x`	Object of class `DeponsTrack`, `DeponsDyn`, `DeponsBlockdyn` or `DeponsShips`
`value`	Character string

`write,DeponsShips-method` *Write DEPONS ship files*

Description

Function for writing a json-file for controlling how ship agents behave in DEPONS. Ships move along pre-defined routes in 30-min time steps. The routes are defined by the fix-points provided in the json file, and the geographic projection is assumed to match that of the landscape. The projection is not stored as part of the json file.

Usage

```
## S4 method for signature 'DeponsShips'
write(x, file)
```

Arguments

x	Name of the DeponsShips object to be exported
file	Name of the output file (character)

Value

No return value, called for side effects

Note

The exported json file is intended for use in DEPONS 2.3 or later (released July 2022) where the sound pressure level (SPL) is calculated within DEPONS based on ship type, ship length and speed.

Index