

Package ‘rWind’

October 19, 2021

Encoding UTF-8

Type Package

Title Download, Edit and Include Wind and Sea Currents Data in Ecological and Evolutionary Analysis

Version 1.1.7

BugReports <https://github.com/jabiologo/rWind/issues>

Maintainer Javier Fernández-López <jflopez.bio@gmail.com>

Description Tools for download and manage surface wind and sea currents data from the Global Forecasting System <<https://www.ncei.noaa.gov/products/weather-climate-models/global-forecast>> and to compute connectivity between locations.

URL <http://allthiswasfield.blogspot.com.es/>

License GPL (>= 3)

LazyData true

Imports raster (>= 2.5-8), gdistance, Matrix, lubridate

Suggests testthat, rmarkdown, knitr

VignetteBuilder knitr

Depends R (>= 3.4)

RoxygenNote 7.1.1

NeedsCompilation no

Author Javier Fernández-López [aut, cre],
Klaus Schliep [aut],
Yurena Arjona [aut]

Repository CRAN

Date/Publication 2021-10-19 16:00:02 UTC

R topics documented:

rWind-package	2
arrowDir	3

cost.FMGS	4
seaOscar.dl	6
tidy	7
uv2ds	8
wind.data	9
wind.dl	10
wind.dl_2	12
wind.mean	13
wind.series	14
wind2raster	15
Index	17

rWind-package	<i>Download, edit and include wind and sea currents data in ecological and evolutionary analysis</i>
---------------	--

Description

rWind contain tools for downloading, editing and transforming wind and sea currents data from Global Forecast System (GFS) and Ocean Surface Current Analyses Real-time (OSCAR). It also allows to use wind and sea currents data to compute the minimum cost path from wind speed and direction to perform connectivity analysis.

Details

The complete list of functions can be displayed with `library(help = rWind)`. For more information, please check: <http://allthiswasfield.blogspot.com.es/>

Author(s)

Javier Fernández-López

Klaus Schliep

Yurena Arjona

Maintainer: Javier Fernández-López jflopez.bio@gmail.com

arrowDir	<i>Arrow direction fitting for Arrowhead function from "shape" package</i>
----------	--

Description

arrowDir adapts wind direction value to be used by Arrowhead function from "shape" package to plot wind direction for each coordinate.

Usage

```
arrowDir(W)
```

Arguments

W	An object of class rWind or a data.frame which should content a column named "dir".
---	---

Details

Angle argument of Arrowhead function from "shape" package needs to be fed in an anti-clockwise way, relative to x-axis, in degrees 0,360. arrowDir function adapts wind direction provided by wind.fit (clockwise, relative to y-axis) to requirements of Arrowhead.

Value

A vector with angles for each arrow to be plotted by Arrowhead.

Note

arrowDir function works always together with Arrowhead function from "shape" package.

Author(s)

Javier Fernández-López

References

Karline Soetaert (2017). shape: Functions for Plotting Graphical Shapes, Colors. R package version 1.4.3. <https://CRAN.R-project.org/package=shape>

See Also

[wind.dl](#)

Examples

```

data(wind.data)

# Create a vector with wind direction (angles) adapted
alpha <- arrowDir(wind.data)
## Not run:
# Now, you can plot wind direction with Arrowhead function from shapes package
# Load "shape package
require(shape)
plot(wind.data$lon, wind.data$lat, type = "n")
Arrowhead(wind.data$lon, wind.data$lat,
  angle = alpha,
  arr.length = 0.1, arr.type = "curved"
)

## End(Not run)

```

cost.FMGS

Compute flow-based cost or conductance

Description

flow.dispersion computes movement conductance through a flow either, sea or wind currents. It implements the formula described in Felicísimo et al. 2008:

Usage

```

cost.FMGS(wind.direction, wind.speed, target, type = "active")

flow.dispersion(x, fun = cost.FMGS, output = "transitionLayer", ...)

```

Arguments

wind.direction	A vector or scalar containing wind directions.
wind.speed	A vector or scalar containing wind speeds.
target	direction of the target cell
type	Could be either "passive" or "active". In "passive" mode, movement against flow direction is not allowed (deviations from the wind direction higher than 90). In "active" mode, the movement can go against flow direction, by increasing the cost.
x	RasterStack object with layers obtained from wind2raster function ("rWind" package) with direction and speed flow values.
fun	A function to compute the cost to move between cells. The default is cost.FMGS from Felicísimo et al. (2008), see details.

output This argument allows to select different kinds of output. "raw" mode creates a matrix (class "dgCMatrix") with transition costs between all cells in the raster. "transitionLayer" creates a TransitionLayer object with conductance values to be used with "gdistance" package.

... Further arguments passed to or from other methods.

Details

$Cost = (1/Speed) * (HorizontalFactor)$

being HorizontalFactor a "function that incrementally penalized angular deviations from the wind direction" (Felicísimo et al. 2008).

Value

In "transitionLayer" output, the function returns conductance values (1/cost) to move between all cells in a raster having into account flow speed and direction obtained from wind.fit function ("rWind" package). As wind or sea currents implies directionality, flow.dispersion produces an anisotropic conductance matrix (asymmetric). Conductance values are used later to build a TransitionLayer object from "gdistance" package.

In "raw" output, flow.dispersion creates a sparse Matrix with cost values.

Note

Note that for large data sets, it could take a while. For large study areas is strongly advised perform the analysis in a remote computer or a cluster.

Author(s)

Javier Fernández-López; Klaus Schliep; Yurena Arjona

References

Felicísimo, Á. M., Muñoz, J., & González-Solis, J. (2008). Ocean surface winds drive dynamics of transoceanic aerial movements. *PLoS One*, 3(8), e2928.

Jacob van Etten (2017). R Package gdistance: Distances and Routes on Geographical Grids. *Journal of Statistical Software*, 76(13), 1-21. doi:10.18637/jss.v076.i13

See Also

[wind.dl](#), [wind2raster](#)

Examples

```
require(gdistance)

data(wind.data)

wind <- wind2raster(wind.data)
```

```

Conductance <- flow.dispersion(wind, type = "passive")

transitionMatrix(Conductance)
image(transitionMatrix(Conductance))

```

sea0scar.dl

OSCAR Sea currents data download

Description

seaOscar.dl downloads sea currents data from the Ocean Surface Current Analyses Real-time (OSCAR) (https://coastwatch.pfeg.noaa.gov/erddap/info/jplOscar_LonPM180/index.html). Geospatial resolution is 0.33 degrees and sea currents are calculated for 15 m depth. CAUTION: OSCAR database has no data between 0 and 20 longitude degrees. You can use SCUD database instead (coming soon...)

Usage

```

sea0scar.dl(
  yyyy,
  mm,
  dd,
  lon1,
  lon2,
  lat1,
  lat2,
  type = "read-data",
  trace = 1
)

```

Arguments

yyyy	Selected year.
mm	Selected month.
dd	Selected day.
lon1	Western longitude
lon2	Eastern longitude
lat1	Northern latitude
lat2	Southern latitude
type	Output type. "read-data" is selected by default, creating an R object. If you choose "csv", seaOscar.dl create a CSV file in your working directory named "oscar_YYYY_MM_DD.csv".
trace	if trace = 1 (by default) track downloaded files

Details

The output type is determined by `type="csv"` or `type="read-data"`. If `type="csv"` is selected, the function creates a `"sea_yyyy_mm_dd.csv"` file that is downloaded at the work directory. If `type="read-data"` is selected, an R object (`data.frame`) is created.

Value

"`rWind`" and "`data.frame`" class object or `.csv` file with U and V vector components and sea current direction and speed for each coordinate in the study area defined by `lon1/lon2` and `lat1/lat2`.

Author(s)

Javier Fernández-López (jflopez.bio@gmail.com)

References

<http://www.digital-geography.com/cloud-gis-getting-weather-data/#.WDOWmbV1DCL>

https://coastwatch.pfeg.noaa.gov/erddap/info/jplOscar_LonPM180/index.html

See Also

[wind.dl_2](#), [wind2raster](#)

Examples

```
# Download sea currents for Galapagos Islands
## Not run:

seaOscar.dl(2015, 1, 1, -93, -88, 2, -3)

## End(Not run)
```

tidy

Transforming a `rWind_series` object into a `data.frame`

Description

The output of `tidy` is always a `data.frame`. It is therefore suited for further manipulation by packages like `dplyr`, `reshape2`, `ggplot2` and `ggvis`.

Usage

```
tidy(x, ...)
```

S3 method for class 'rWind_series'

```
tidy(x, ...)
```

Arguments

x An object to be converted into a tidy data.frame
 ... extra arguments

Examples

```
data(wind.series)
df <- tidy(wind.series)
head(df)
## Not run:
# use the tidyverse
library(dplyr)
mean_speed <- tidy(wind.series) %>%
  group_by(lat, lon) %>%
  summarise(speed = mean(speed))
wind_average2 <- wind.mean(wind.series)
all.equal(wind_average2$speed, mean_speed$speed)

## End(Not run)
```

uv2ds

Transform U and V components in direction and speed and vice versa

Description

Transform U and V components in direction and speed and vice versa

Usage

```
uv2ds(u, v)
```

```
ds2uv(d, s)
```

Arguments

u U component.
 v U component.
 d direction (degrees).
 s speed (m/s).

Value

"uv2ds" returns a matrix with direction and speed values

"ds2uv" returns a matrix with U and V values

Note

Multiple U and V values can be processed. "dir" denotes where the wind/sea current is going (toward), not from where is coming.

Author(s)

Javier Fernández-López (jflopez.bio@gmail.com)

See Also

[wind.mean](#), [wind2raster](#)

Examples

```
(ds <- uv2ds(c(1, 1, 3, 1), c(1, 1.7, 3, 1)))  
ds2uv(ds[, 1], ds[, 2])
```

wind.data

Wind data example

Description

This is an example of wind data obtained with wind.dl function for the Iberian Peninsula coordinates on 12/February/2015 at 00:00 (UTC)

Format

A list with one data.frame with 651 observations on the following 7 variables:

- list("time (UTC)")** a numeric with selected time of wind data
- list("latitude (degrees_north)")** a numeric with latitude values
- list("longitude (degrees_east)")** a numeric with longitude values
- list("ugrd10m (m s-1)")** a numeric with U component of wind data
- list("vgrd10m (m s-1)")** a numeric with V component of wind data
- list("dir")** a numeric with direction of wind data
- list("speed")** a numeric with speed of wind data

Details

This data set is the result of:

```
wind.data <- wind.dl(2015, 2, 12, 0, -10, 5, 35, 45)
```

Source

<http://allthiswasfield.blogspot.com.es/2016/12/rwind-r-package-released.html>

References

http://oos.soest.hawaii.edu/erddap/info/NCEP_Global_Best/index.html

Examples

```
data(wind.data)
str(wind.data)
head(wind.data[[1]])
```

wind.dl	<i>Wind-data download</i>
---------	---------------------------

Description

wind.dl downloads wind data from the Global Forecast System (GFS) of the USA's National Weather Service (NWS) (<https://www.ncei.noaa.gov/products/weather-climate-models/global-forecast>). Wind data are taken from NOAA/NCEP Global Forecast System (GFS) Atmospheric Model collection. Geospatial resolution is 0.5 degrees (approximately 50 km), and wind is calculated for Earth surface, at 10 m. More metadata information: https://pae-paha.pacioos.hawaii.edu/erddap/griddap/ncep_global.graph

Usage

```
wind.dl(
  yyyy,
  mm,
  dd,
  tt,
  lon1,
  lon2,
  lat1,
  lat2,
  type = "read-data",
  trace = 1
)

read.rWind(file)
```

Arguments

yyyy	Selected year.
mm	Selected month.
dd	Selected day.
tt	Selected time. There are currently several options at the GFS database: 00:00 - 03:00 - 06:00 - 09:00 - 12:00 - 15:00 - 18:00 - 21:00 (UTC).
lon1	Western longitude

lon2	Eastern longitude
lat1	Southern latitude
lat2	Northern latitude
type	Output type. "read-data" is selected by default, creating an R object. If you choose "csv", wind.dl create a a CSV file in your working directory named "wind_yyyy_mm_dd_tt.csv".
trace	if trace = 1 (by default) track downloaded files
file	file name of the saved ".csv" files.

Details

The output type is determined by type="csv" or type="read-data". If type="csv" is selected, the function creates a "wind_yyyy_mm_dd_tt.csv" file that is downloaded at the work directory. If type="read-data" is selected, an R object (data.frame) is created.

Value

"rWind" and "data.frame" class object or .csv file with U and V vector components and wind direction and speed for each coordinate in the study area defined by lon1/lon2 and lat1/lat2.

Note

Longitude coordinate are provided by GFS dataset in 0/360 notation and transformed internally into -180/180. Wind "dir" denotes where the wind is going (toward), not from where is coming.

Author(s)

Javier Fernández-López (jflopez.bio@gmail.com)

References

<http://www.digital-geography.com/cloud-gis-getting-weather-data/#.WDOWmbV1DCL>
https://pae-paha.pacioos.hawaii.edu/erddap/griddap/ncep_global.graph

See Also

[wind.dl_2](#), [wind2raster](#)

Examples

```
# Download wind for Iberian Peninsula region at 2015, February 12, 00:00
## Not run:

wind.dl(2015, 2, 12, 0, -10, 5, 35, 45)

## End(Not run)
```

wind.dl_2

*Wind-data download***Description**

wind.dl_2 downloads time-series wind data from the Global Forecast System (GFS) of the USA's National Weather Service (NWS) (<https://www.ncei.noaa.gov/products/weather-climate-models/global-forecast>). Wind data are taken from NOAA/NCEP Global Forecast System (GFS) Atmospheric Model collection. Geospatial resolution is 0.5 degrees (approximately 50 km), and wind is calculated for Earth surface, at 10 m. More metadata information: http://oos.soest.hawaii.edu/erddap/info/NCEP_Global_Best/index

Usage

```
wind.dl_2(time, lon1, lon2, lat1, lat2, type = "read-data", trace = 1)
```

```
## S3 method for class 'rWind_series'
x[[i, exact = TRUE]]
```

Arguments

time	a scalar or vector of POSIXt or Date objects or an character which can transformed into those, see example below. There are currently these options at the GFS database for the hours: 00:00 - 03:00 - 06:00 - 09:00 - 12:00 - 15:00 - 18:00 - 21:00 (UTC) (TO).
lon1	Western longitude
lon2	Eastern longitude
lat1	Southern latitude
lat2	Northern latitude
type	Output type. "read-data" is selected by default, creating an R object. If you choose "csv", wind.dl create a a CSV file in your work directory named "wind_yyyy_mm_dd_tt.csv".
trace	if trace = 1 (by default) track downloaded files
x	object from which to extract element(s).
i	indices specifying elements to extract.
exact	Controls possible partial matching (not used yet).

Details

To get the same format as wind.dl, you should run tidy function from wind.dl_2 output. The output type is determined by type="csv" or type="read-data". If type="csv" is selected, the function creates a "wind_yyyy_mm_dd_tt.csv" file that is downloaded at the work directory. If type="read-data" is selected, an rWind_series object is created.

Value

an object of class rWind_series or .csv file/s with U and V vector components and wind direction and speed for each coordinate in the study area defined by lon1/lon2 and lat1/lat2.

Note

wind.dl_2 requires two dates that represent the boundaries of the time lapse to download wind series data. U and V vector components allow you to create wind averages or tendencies for each coordinate at the study area. Longitude coordinates are provided by GFS dataset in 0/360 notation and transformed internally into -180/180. "dir" denotes where the wind/sea current is going (toward), not from where is coming.

Author(s)

Javier Fernández-López (jflopez.bio@gmail.com)

References

<http://www.digital-geography.com/cloud-gis-getting-weather-data/#.WDOWmbV1DCL>
http://oos.soest.hawaii.edu/erddap/griddap/NCEP_Global_Best.graph

See Also

[wind.mean](#), [wind2raster](#), [wind.dl](#), [as_datetime](#), [as.POSIXct](#)

Examples

```
# Download wind for Iberian Peninsula region at 2015, February 12, 00:00
## Not run:

wind.dl_2("2018/3/15 9:00:00", -10, 5, 35, 45)

library(lubridate)
dt <- seq(ymd_hms(paste(2018, 1, 1, 00, 00, 00, sep = "-")),
  ymd_hms(paste(2018, 1, 2, 21, 00, 00, sep = "-")),
  by = "3 hours"
)
ww <- wind.dl_2(dt, -10, 5, 35, 45)
tidy(ww)

## End(Not run)
```

wind.mean

Wind-data mean

Description

wind.mean computes the mean (average) wind speed and wind direction of a time series dataset of winds of the same region. Summaries of time series are not trivial to compute. We compute the arithmetic mean for the wind speed. The direction as the circular mean, see https://en.wikipedia.org/wiki/Circular_mean for more details. The U and V components are afterwards transformed from these values.

Usage

```
wind.mean(x)
```

Arguments

x An object of class rWind_series

Value

An object of class rWind, which is a data.frame

Note

For large time series, it could take a while.

Author(s)

Javier Fernández-López (jflopez.bio@gmail.com)

References

https://en.wikipedia.org/wiki/Cross_product

See Also

[wind.dl](#)

Examples

```
data(wind.series)
wind_average <- wind.mean(wind.series)
```

wind.series

Wind series example

Description

This is an example of a wind series data obtained with wind.dl function for New Zealand area on 3/January/2015 at all the available times: 00:00 - 03:00 - 06:00 - 09:00 - 12:00 - 15:00 - 18:00 - 21:00 (UTC)

Format

The format is an rWind list of 8 data.frame. Each data.frame contain 961 observations on the following 7 variables:

- list("time (UTC)")** a factor with selected time of wind data
- list("latitude (degrees_north)")** a factor with latitude values
- list("longitude (degrees_east)")** a factor with longitude values
- list("ugrd10m (m s-1)")** a factor with U component of wind data
- list("vgrd10m (m s-1)")** a factor with V component of wind data
- list("dir")** a numeric with direction of wind data
- list("speed")** a numeric with speed of wind data

Details

This data set is the result of:

```
library(lubridate) dt <-seq(ymd_h(paste(2015,1,3,00,sep="-")), ymd_h(paste(2015,1,3,21,sep="-")), by=
hours) wind.series <-wind.dl_2(dt,164,179,-48,-33)
```

Source

<http://allthiswasfield.blogspot.com.es/2016/12/rwind-r-package-released.html>

References

http://oos.soest.hawaii.edu/erddap/info/NCEP_Global_Best/index.html

Examples

```
data(wind.series)
str(tidy(wind.series))
```

wind2raster

Wind-data to raster file

Description

wind2raster crates a raster stack (gridded) with 2 layers: wind speed and wind direction for an object of rWind. Latitude and longitude values are used to locate raster file and to create raster using rasterFromXYZ function from raster package. If the input file is a list of wind data created by wind.dl, a list of raster stacks will be returned

Usage

```
wind2raster(x)
```

Arguments

x an "rWind list" obtained by wind.fit

Details

WGS84 datum (non-projected) CRS is selected by default to build the raster file.

Value

A raster stack or a list of raster stacks representing wind direction and speed.

Author(s)

Javier Fernández-López (jflopez.bio@gmail.com)

See Also

[wind.dl](#)

Examples

```
data(wind.data)

# Create raster stack from the downloaded data with wind direction and speed
# layers

wind2raster(wind.data)
```


Index

- * **~anisotropy**
 - cost.FMGS, 4
 - * **~average**
 - wind.mean, 13
 - * **~conductance**
 - cost.FMGS, 4
 - * **~currents**
 - seaOscar.dl, 6
 - * **~gfs**
 - wind.dl, 10
 - wind.dl_2, 12
 - wind2raster, 15
 - * **~mean**
 - wind.mean, 13
 - * **~sea**
 - seaOscar.dl, 6
 - * **~wind**
 - arrowDir, 3
 - uv2ds, 8
 - wind.dl, 10
 - wind.dl_2, 12
 - wind2raster, 15
 - * **datasets**
 - wind.data, 9
 - wind.series, 14
 - * **package**
 - rWind-package, 2
- [[.rWind_series (wind.dl_2), 12
- arrowDir, 3
- as.POSIXct, 13
- as_datetime, 13
- cost.FMGS, 4
- ds2uv (uv2ds), 8
- flow.dispersion (cost.FMGS), 4
- read.rWind (wind.dl), 10
- rWind (rWind-package), 2
- rWind-package, 2
- seaOscar.dl, 6
- tidy, 7
- uv2ds, 8
- wind.data, 9
- wind.dl, 3, 5, 10, 13, 14, 16
- wind.dl_2, 7, 11, 12
- wind.mean, 9, 13, 13
- wind.series, 14
- wind2raster, 5, 7, 9, 11, 13, 15