Package 'CCAMLRGIS'

October 15, 2024

Type Package

Title Antarctic Spatial Data Manipulation

Version 4.2.0

Date 2024-10-15

Description Loads and creates spatial data, including layers and tools that are relevant to the activities of the Commission for the Conservation of Antarctic Marine Living Resources. Provides two categories of functions: load functions and create functions. Load functions are used to import existing spatial layers from the online CCAMLR GIS such as the ASD boundaries. Create functions are used to create layers from user data such as polygons and grids.

Depends R (>= 4.0), sf

License GPL-3

URL https://github.com/ccamlr/CCAMLRGIS#ccamlrgis-r-package

Encoding UTF-8

LazyData true

Imports dplyr, terra, graphics, grDevices, magrittr, isoband, bezier, lwgeom

RoxygenNote 7.3.2

Suggests knitr, rmarkdown, testthat

VignetteBuilder knitr

NeedsCompilation no

Author Stephane Thanassekos [aut, cre], Keith Reid [aut], Lucy Robinson [aut], Michael D. Sumner [ctb], Roger Bivand [ctb]

Maintainer Stephane Thanassekos <stephane.thanassekos@ccamlr.org>

Repository CRAN

Date/Publication 2024-10-15 05:40:02 UTC

Contents

add_col . . . 3
add_Cscale . . . 4
add_labels . . . 6
add_Legend . . . 8
add_PieLegend . . . 15
add_RefGrid . . . 17
assign_areas . . . 18
CCAMLRp . . . 20
Clip2Coast . . . 20
Coast . . . 21
create_Arrow . . . 22
create_CircularArrow . . . 24
create_Ellipse . . . 27
create_Hashes . . . 29
create_Lines . . . 30
create_Pies . . . 31
create_Points . . . 33
create_PolyGrids . . . 34
create_Polys . . . 36
create_Stations . . . 37
Depth_cols . . . 39
Depth_cols2 . . . 40
Depth_cuts . . . 40
Depth_cuts2 . . . 41
get_C_intersection . . . 41
get_depths . . . 42
get_iso_polys . . . 43
GridData . . . 44
Labels . . . 45
LineData . . . 46
load_ASDs . . . 46
load_Bathy . . . 47
load_Coastline . . . 48
load_EEZs . . . 49
load_MAs . . . 50
load_MPAs . . . 50
load_RBs . . . 51
load_SSMUs . . . 52
load_SSRUs . . . 52
PieData . . . 53
PieData2 . . . 54
PointData . . . 54
PolyData . . . 55
project_data . . . 56
Rotate_obj . . . 57
seabed_area . . . 58

SmallBathy 59

Index **60**

`add_col` *Add colors*

Description

Given an input variable, generates either a continuous color gradient or color classes. To be used in conjunction with `add_Cscale`.

Usage

```
add_col(var, cuts = 100, cols = c("green", "yellow", "red"))
```

Arguments

`var`	numeric vector of the variable to be colorized. Either all values (in which case all values will be assigned to a color) or only two values (in which case these are considered to be the range of values).
`cuts`	numeric, controls color classes. Either one value (in which case `n=cuts` equally spaced color classes are generated) or a vector (in which case irregular color classes are generated e.g.: `c(-10,0,100,2000)`).
`cols`	character vector of colors (see R standard color names here). `cols` are interpolated along `cuts`. Color codes as those generated, for example, by `rgb` may also be used.

Value

list containing the colors for the variable `var` (given as `$varcol` in the output) as well as the single `cols` and `cuts`, to be used as inputs in `add_Cscale`.

See Also

`add_Cscale`, `create_PolyGrids`, `add_Legend`, R colors.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#52-adding-colors-to-data

MyPoints=create_Points(PointData)
MyCols=add_col(MyPoints$Nfishes)
plot(st_geometry(MyPoints),pch=21,bg=MyCols$varcol,cex=2)
```

add_Cscale *Add a color scale*

Description

Adds a color scale to plots. Default behavior set for bathymetry. May also be used to place a legend.

Usage

```
add_Cscale(
  pos = "1/1",
  title = "Depth (m)",
  width = 18,
  height = 70,
  cuts = Depth_cuts,
  cols = Depth_cols,
  minVal = NA,
  maxVal = NA,
  fontsize = 1,
  offset = 100,
  lwd = 1,
  Titlefontsize = 1.2 * fontsize,
  TitleVAdj = 0,
  BoxAdj = c(0, 0, 0, 0),
  BoxCol = "black",
  BoxBG = "white",
  Clwd = 0,
  Ccol = "black",
  Cwdth = 1,
  TckL = 1,
  Tcklwd = 1,
  Tdist = 1,
  mode = "Cscale"
)
```

Arguments

pos	character, fraction indicating the vertical position of the color scale (which, by default, is on the right side of plots). if pos="1/1", the color scale will be centered. if pos="1/2", the color scale will be centered on the top half of the plotting region. if pos="2/2", the color scale will be centered on the bottom half of the plotting region.
title	character, title of the color scale.
width	numeric, width of the color scale box, expressed in % of the width of the plotting region.

height	numeric, height of the color scale box, expressed in % of the height of the plotting region.
cuts	numeric, vector of color classes. May be generated via add_col.
cols	character, vector of color names. May be generated via add_col.
minVal	numeric, if desired, the color scale may be generated starting from the value minVal. See examples.
maxVal	numeric, if desired, the color scale may be generated up to the value maxVal. See examples.
fontsize	numeric, size of the text in the color scale.
offset	numeric, controls the horizontal position of the color scale.
lwd	numeric, thickness of lines.
Titlefontsize	numeric, size of the title text.
TitleVAdj	numeric, vertical adjustment of the title.
BoxAdj	numeric vector of 4 values to adjust the sides of the box, given as c(bottom,left,top,right).
BoxCol	Color of the legend box frame.
BoxBG	Color of the legend box background.
Clwd	numeric, thickness of lines of cells.
Ccol	character, color of lines of cells, set to NA for no border.
Cwdth	numeric, positive factor to adjust the width of cells.
TckL	numeric, positive factor to adjust the length of tick lines.
Tcklwd	numeric, thickness of tick lines.
Tdist	numeric, horizontal adjustment of labels text.
mode	character, if 'Cscale', the default, the function builds a color scale. if 'Legend', the function gives you the location of a legend, arguments pos, offset and height may be used for adjustments. See examples.

See Also

load_Bathy, SmallBathy, Depth_cuts, Depth_cols, Depth_cuts2, Depth_cols2, add_col, add_Legend, R colors, legend.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#5-adding-colors-legends-and-labels

library(terra)

#Example 1: Adding two color scales

plot(SmallBathy(),breaks=Depth_cuts,col=Depth_cols,legend=FALSE,axes=FALSE,box=FALSE)
add_Cscale(pos='1/2',height=45,maxVal=0,minVal=-4000,fontsize=0.8)
#Some gridded data
MyGrid=create_PolyGrids(GridData,dlon=2,dlat=1)
```

```
Gridcol=add_col(MyGrid$Catch_sum,cuts=10)
plot(st_geometry(MyGrid),col=Gridcol$varcol,add=TRUE)
#Add color scale using cuts and cols generated by add_col, note the use of 'round'
add_Cscale(pos='2/2',height=45,title='Catch (t)',
           cuts=round(Gridcol$cuts,1),cols=Gridcol$cols,fontsize=0.8)

#Example 2: Adding a color scale and a legend

#Create some point data
MyPoints=create_Points(PointData)

#Crop the bathymetry to match the extent of MyPoints

BathyCr=crop(SmallBathy(),extend(ext(MyPoints),100000))
plot(BathyCr,breaks=Depth_cuts,col=Depth_cols,legend=FALSE,axes=FALSE,mar=c(0,0,0,7))
add_Cscale(pos='1/2',height=45,maxVal=0,minVal=-4000,fontsize=0.8)

#Plot points with different symbols and colors (see ?points)
Psymbols=c(21,22,23,24)
Pcolors=c('red','green','blue','yellow')
plot(st_geometry(MyPoints[MyPoints$name=='one',]),pch=Psymbols[1],bg=Pcolors[1],add=TRUE)
plot(st_geometry(MyPoints[MyPoints$name=='two',]),pch=Psymbols[2],bg=Pcolors[2],add=TRUE)
plot(st_geometry(MyPoints[MyPoints$name=='three',]),pch=Psymbols[3],bg=Pcolors[3],add=TRUE)
plot(st_geometry(MyPoints[MyPoints$name=='four',]),pch=Psymbols[4],bg=Pcolors[4],add=TRUE)

#Add legend with position determined by add_Cscale
Loc=add_Cscale(pos='2/2',height=45,mode='Legend')
legend(Loc,legend=c('one','two','three','four'),title='Vessel',pch=Psymbols,
pt.bg=Pcolors,xpd=TRUE)
```

`add_labels` *Add labels*

Description

Adds labels to plots. Three modes are available: In `'auto'` mode, labels are placed at the centres of polygon parts of spatial objects loaded via the `load_` functions. Internally used in conjunction with `Labels`. In `'manual'` mode, users may click on their plot to position labels. An editable label table is generated to allow fine-tuning of labels appearance, and may be saved for external use. To edit the label table, double-click inside one of its cells, edit the value, then close the table. In `'input'` mode, a label table that was generated in `'manual'` mode is re-used.

Usage

```
add_labels(
  mode = NULL,
  layer = NULL,
  fontsize = 1,
```

```
  fonttype = 1,
  angle = 0,
  col = "black",
  LabelTable = NULL
)
```

Arguments

mode	character, either 'auto', 'manual' or 'input'. See Description above.
layer	character, in 'auto' mode, single or vector of characters, may only be one, some or all of: c("ASDs","SSRUs","RBs","SSMUs","MAs","MPAs","EEZs").
fontsize	numeric, in 'auto' mode, size of the text.
fonttype	numeric, in 'auto' mode, type of the text (1 to 4), where 1 corresponds to plain text, 2 to bold face, 3 to italic and 4 to bold italic.
angle	numeric, in 'auto' mode, rotation of the text in degrees.
col	character, in 'auto' mode, color of the text.
LabelTable	in 'input' mode, name of the label table that was generated in 'manual' mode.

Value

Adds labels to plot. To save a label table generated in 'manual' mode, use: MyLabelTable=add_labels(mode='auto'). To re-use that label table, use: add_labels(mode='input',LabelTable=MyLabelTable).

See Also

Labels, load_ASDs, load_SSRUs, load_RBs, load_SSMUs, load_MAs, load_EEZs, load_MPAs, add_Legend, R colors.

Examples

```
#Example 1: 'auto' mode
#label ASDs in bold and red
ASDs=load_ASDs()
plot(st_geometry(ASDs))
add_labels(mode='auto',layer='ASDs',fontsize=1,fonttype=2,col='red')
#add EEZs and their labels in large, green and vertical text
EEZs=load_EEZs()
plot(st_geometry(EEZs),add=TRUE,border='green')
add_labels(mode='auto',layer='EEZs',fontsize=2,col='green',angle=90)


#Example 2: 'manual' mode (you will have to do it yourself)
#Examples 2 and 3 below are commented (remove the # to test)
#library(terra)
#plot(SmallBathy())
#ASDs=load_ASDs()
#plot(st_geometry(ASDs),add=TRUE)
#MyLabels=add_labels(mode='manual')
```

```
#Example 3: Re-use the label table generated in Example 2
#plot(SmallBathy())
#plot(st_geometry(ASDs),add=TRUE)
#add_labels(mode='input',LabelTable=MyLabels)
```

---

add_Legend *Add Legend*

Description

Add a legend to you map. Give the bounding box of your plot and lists of parameters as inputs.

Usage

```
add_Legend(bb, LegOpt, Items)
```

Arguments

bb	bounding box of your plot area. for example, `bb=st_bbox(SmallBathy())` or `bb=st_bbox(MyPolys)`.
LegOpt	list of general legend options. for example: `LegOpt=list(Title="Speed",Subtitle="(km/h)")`.
Items	list, or list of lists containing options for each item to be displayed in the legend. for example: `item1=list(Text="one",Shape="rectangle")` `item2=list(Text="two",Shape="circle")` `Items=list(item1,item2)`

Value

Legend added to current plot.

LegOpt options

- Title: character, title of the legend, set to NULL for no title.
- Subtitle: character, subtitle of the legend, set to NULL for no subtitle.
- Pos: character, general position of the legend. One of "bottomright" (default), "bottom", "bottomleft", "left", "topleft", "top", "topright", "right" or "center".
- BoxW: numeric, legend box width (see figure below).

- BoxH: numeric, legend box height (see figure below).
- PosX: numeric, horizontal adjustment of legend (see figure below).
- PosY: numeric, vertical adjustment of legend (see figure below).
- Boxexp: numeric, vector of length 4 controlling the expansion of the legend box, given as c(xmin,xmax,ymin,ymax), see figure below.
- Boxbd: character, color of the background of the legend box. set to NA for no background.
- Boxcol: character, color of the border of the legend box. Set to NA for no box.
- Boxlwd: numeric, line thickness of the legend box. Set Boxcol to NA for no box.
- Titlefontsize: numeric, size of the legend title.
- Subtitlefontsize: numeric, size of the legend subtitle.
- TitleAdj: numeric vector of length 2, as c(x,y) to adjust title location (see figure below).
- SubtitleAdj: numeric vector of length 2, as c(x,y) to adjust subtitle location.

Items options that are common to all items

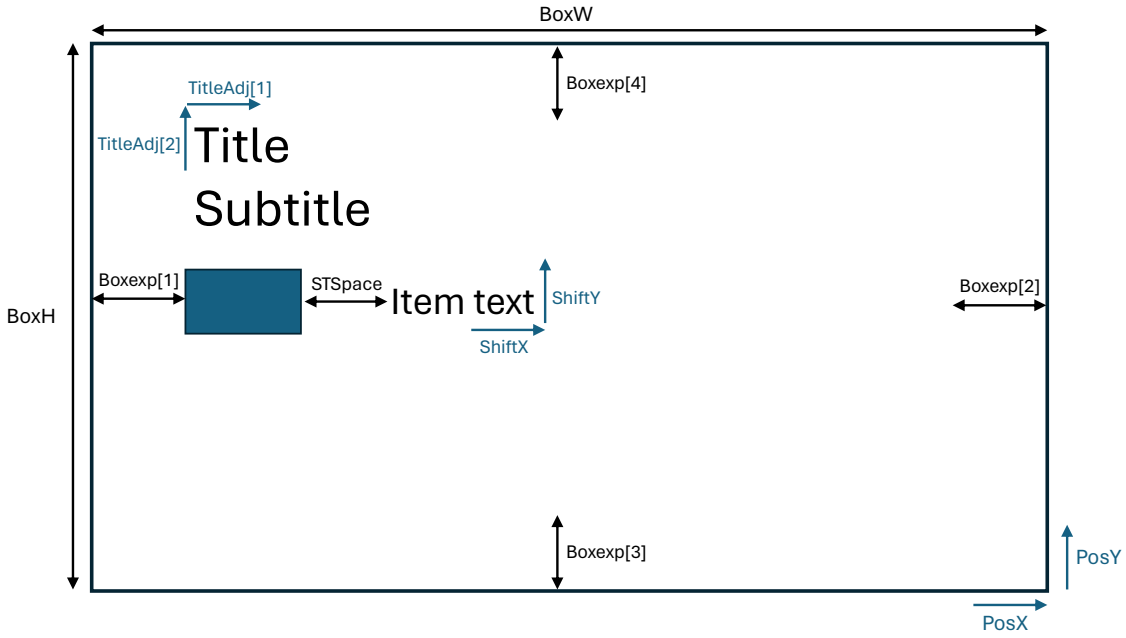
- Text: character, text of the item.
- Shape: character, shape description, one of "rectangle", "circle", "ellipse", "line", "arrow" or "none". Using "none" will leave a blank space that can be filled by a user-defined shape.
- ShpFill: character, fill color of shape, set to NA for no fill.
- ShpBord: character, border color of shape, set to NA for no border.
- ShpHash: logical (TRUE/FALSE) to add hashed lines to the shape (see create_Hashes).
- Shplwd: numeric, line thickness of the shape's border, set ShpBord to NA for no border.
- fontsize: numeric, size of the text.
- STSpace: numeric, space between the Shape and its Text (see figure below).
- ShiftX: numeric, shift Shape and Text left or right (see figure below).
- ShiftY: numeric, shift Shape and Text up or down (see figure below).
- Hashcol: character, color of hashes (if ShpHash is TRUE), see create_Hashes for details.
- Hashangle: numeric, angle of hashes (if ShpHash is TRUE), see create_Hashes for details.
- Hashspacing: numeric, spacing between hashes (if ShpHash is TRUE), see create_Hashes for details.
- Hashwidth: numeric, width of hashes (if ShpHash is TRUE), see see create_Hashes for details.

Items options that are specific to the item's Shape

- RectW: numeric, width of rectangle shape.
- RectH: numeric, height of rectangle shape.
- CircD: numeric, diameter of circle shape.
- EllW: numeric, width of ellipse shape.
- EllH: numeric, height of ellipse shape.
- EllA: numeric, angle of ellipse shape.

- LineTyp: numeric, type of line shape (0=blank, 1=solid, 2=dashed, 3=dotted, 4=dotdash, 5=longdash, 6=twodash).
- LineL: numeric, length of the line shape.
- ArrL: numeric, length of the arrow shape.
- ArrPwidth: numeric, width of arrow's path. see create_Arrow for details.
- ArrHlength: numeric, length of arrow's head. see create_Arrow for details.
- ArrHwidth: numeric, width of arrow's head. see create_Arrow for details.
- Arrdlength: numeric, length of dashes for dashed arrows. see create_Arrow for details.
- Arrtype: character, arrow type either "normal" or "dashed". see create_Arrow for details.
- Arrcol: character, color of the arrow. see create_Arrow for details.
- Arrtrans: numeric, transparency of the arrow. see create_Arrow for details.

The figure below shows some of the options used to customize the legend box and its items. Blue arrows represent location options and black arrows represent sizing options:



See Also

create_Hashes, create_Arrow, create_Ellipse, add_labels, add_Cscale, add_PieLegend.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#53-adding-legends

# Set general options:
```

```
LegOpt=list(
Title= "Title",
Subtitle="(Subtitle)",
Pos = "bottomright",
BoxW= 80,
BoxH= 170,
Boxexp = c(5,-2,-4,-4),
Titlefontsize = 2
)


#Create separate items, each with their own options:


Rectangle1=list(
  Text="Rectangle 1",
  Shape="rectangle",
  ShpFill="cyan",
  ShpBord="blue",
  Shplwd=2,
  fontsize=1.2,
  STSpace=3,
  RectW=10,
  RectH=7
)

Rectangle2=list(
  Text="Rectangle 2",
  Shape="rectangle",
  ShpFill="red",
  ShpBord="orange",
  ShpHash=TRUE,
  Shplwd=2,
  fontsize=1.2,
  STSpace=3,
  RectW=10,
  RectH=7,
  Hashcol="white",
  Hashangle=45,
  Hashspacing=1,
  Hashwidth=1
)

Circle1=list(
  Text="Circle 1",
  Shape="circle",
  ShpFill="grey",
  ShpBord="yellow",
  Shplwd=2,
  fontsize=1.2,
  STSpace=3,
  CircD=10
)
```

```
Circle2=list(
  Text="Circle 2",
  Shape="circle",
  ShpFill="white",
  ShpBord="red",
  ShpHash=TRUE,
  Shplwd=2,
  fontsize=1.2,
  STSpace=3,
  CircD=10,
  Hashcol="black",
  Hashangle=0,
  Hashspacing=2,
  Hashwidth=2
)

Ellipse1=list(
  Text="Ellipse 1",
  Shape="ellipse",
  ShpFill="white",
  ShpBord="darkblue",
  Shplwd=2,
  fontsize=1.2,
  STSpace=3,
  EllW=10,
  EllH=6,
  EllA=35
)

Ellipse2=list(
  Text="Ellipse 2",
  Shape="ellipse",
  ShpFill="red",
  ShpBord="green",
  ShpHash=TRUE,
  Shplwd=2,
  fontsize=1.2,
  STSpace=3,
  EllW=10,
  EllH=7,
  EllA=0,
  Hashcol="black",
  Hashangle=-45,
  Hashspacing=1.5,
  Hashwidth=1.5
)

Line1=list(
  Text="Line 1",
  Shape="line",
  ShpFill="black",
  Shplwd=5,
```

```
  fontsize=1.2,
  STSpace=3,
  LineL=10
)

Line2=list(
  Text="Line 2",
  Shape="line",
  Shplwd=5,
  ShpFill="green",
  Shplwd=5,
  fontsize=1.2,
  STSpace=3,
  LineTyp=6,
  LineL=10
)

Arrow1=list(
  Text="Arrow 1",
  Shape="arrow",
  ShpBord="green",
  Shplwd=1,
  ArrL=10,
  ArrPwidth=5,
  ArrHlength=15,
  ArrHwidth=10,
  Arrcol="orange",
  fontsize=1.2,
  STSpace=3
)

Arrow2=list(
  Text="Arrow 2",
  Shape="arrow",
  ShpBord=NA,
  ArrL=10,
  ArrPwidth=5,
  ArrHlength=15,
  ArrHwidth=10,
  Arrdlength=0,
  Arrtype="dashed",
  Arrcol=c("red","green","blue"),
  fontsize=1.2,
  STSpace=3
)

Arrow3=list(
  Text="Arrow 3",
  Shape="arrow",
  ShpBord=NA,
  ArrL=10,
  ArrPwidth=5,
  ArrHlength=15,
```

```
  ArrHwidth=10,
  Arrdlength=5,
  Arrtype="dashed",
  Arrcol="darkgreen",
  fontsize=1.2,
  STSpace=3
)

Arrow4=list(
  Text="Arrow 4",
  Shape="arrow",
  ShpBord="black",
  Shplwd=0.1,
  ArrL=10,
  ArrPwidth=5,
  ArrHlength=15,
  ArrHwidth=10,
  Arrcol="pink",
  ShpHash=TRUE,
  Hashcol="blue",
  Hashangle=-45,
  Hashspacing=1,
  Hashwidth=1,
  fontsize=1.2,
  STSpace=3
)

None=list(
  Text="None",
  Shape="none",
  fontsize=1.2,
  STSpace=3,
  ShiftX=10
)


#Combine all items into a single list:

Items=list(Rectangle1,Rectangle2,Circle1,Circle2,
Ellipse1,Ellipse2,Line1,Line2,Arrow1,Arrow2,Arrow3,Arrow4,None)

#manually build a bounding box (same as st_bbox(load_ASDs())):

bb=st_bbox(c(xmin=-3348556,xmax=4815055,ymax=4371127,ymin=-3329339),
           crs = st_crs(6932))
bx=st_as_sfc(bb) #Convert to polygon to plot it

#Plot and add legend

plot(bx,col="grey")
add_Legend(bb,LegOpt,Items)
```

add_PieLegend *Add a legend to Pies*

Description

Adds a legend to pies created using create_Pies.

Usage

```
add_PieLegend(
  Pies = NULL,
  bb = NULL,
  PosX = 0,
  PosY = 0,
  Size = 25,
  lwd = 1,
  Boxexp = c(0.2, 0.2, 0.12, 0.3),
  Boxbd = "white",
  Boxlwd = 1,
  Labexp = 0.3,
  fontsize = 1,
  LegSp = 0.5,
  Horiz = TRUE,
  PieTitle = "Pie chart",
  SizeTitle = "Size chart",
  PieTitleVadj = 0.5,
  SizeTitleVadj = 0.3,
  nSizes = 3,
  SizeClasses = NULL
)
```

Arguments

Pies	Spatial object created using create_Pies.
bb	Spatial object, sf bounding box created with `st_bbox()`. If provided, the legend will be centered in that bb. Otherwise it is centered on the `min(Latitudes)` and `median(Longitudes)` of coordinates found in the input `Pies`.
PosX	numeric, horizontal adjustment of legend.
PosY	numeric, vertical adjustment of legend.
Size	numeric, controls the size of pies.
lwd	numeric, line thickness of pies.
Boxexp	numeric, vector of length 4 controls the expansion of the legend box, given as `c(xmin,xmax,ymin,ymax)`.
Boxbd	character, color of the background of the legend box.
Boxlwd	numeric, line thickness of the legend box. Set to zero if no box is desired.

Labexp	numeric, controls the distance of the pie labels to the center of the pie.
fontsize	numeric, size of the legend font.
LegSp	numeric, spacing between the pie and the size chart (only used if SizeVar was specified in create_Pies).
Horiz	logical. Set to FALSE for vertical layout (only used if SizeVar was specified in create_Pies).
PieTitle	character, title of the pie chart.
SizeTitle	character, title of the size chart (only used if SizeVar was specified in create_Pies).
PieTitleVadj	numeric, vertical adjustment of the title of the pie chart.
SizeTitleVadj	numeric, vertical adjustment of the title of the size chart (only used if SizeVar was specified in create_Pies).
nSizes	integer, number of size classes to display in the size chart. Minimum and maximum sizes are displayed by default. (only used if SizeVar was specified in create_Pies).
SizeClasses	numeric, vector (e.g. c(1,10,100)) of size classes to display in the size chart (only used if SizeVar was specified in create_Pies). If set, overrides nSizes.

Value

Adds a legend to a pre-existing pie plot.

See Also

create_Pies, PieData, PieData2.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#23-create-pies

#Pies of constant size, all classes displayed:
#Create pies
MyPies=create_Pies(Input=PieData,
                   NamesIn=c("Lat","Lon","Sp","N"),
                   Size=50
                   )
#Plot Pies
plot(st_geometry(MyPies),col=MyPies$col)
#Add Pies legend
add_PieLegend(Pies=MyPies,PosX=-0.1,PosY=-1,Boxexp=c(0.5,0.45,0.12,0.45),
              PieTitle="Species")
```

add_RefGrid *Add a Reference grid*

Description

Add a Latitude/Longitude reference grid to maps.

Usage

```
add_RefGrid(
  bb,
  ResLat = 1,
  ResLon = 2,
  LabLon = NA,
  LatR = c(-80, -45),
  lwd = 1,
  lcol = "black",
  fontsize = 1,
  fontcol = "black",
  offset = NA
)
```

Arguments

bb	bounding box of the first plotted object. for example, `bb=st_bbox(SmallBathy())` or `bb=st_bbox(MyPolys)`.
ResLat	numeric, latitude resolution in decimal degrees.
ResLon	numeric, longitude resolution in decimal degrees.
LabLon	numeric, longitude at which Latitude labels should appear. if set, the resulting Reference grid will be circumpolar.
LatR	numeric, range of latitudes of circumpolar grid.
lwd	numeric, line thickness of the Reference grid.
lcol	character, line color of the Reference grid.
fontsize	numeric, font size of the Reference grid's labels.
fontcol	character, font color of the Reference grid's labels.
offset	numeric, offset of the Reference grid's labels (distance to plot border).

See Also

load_Bathy, SmallBathy, add_Legend.

Examples

```
library(terra)

#Example 1: Circumpolar grid with Latitude labels at Longitude 0

plot(SmallBathy(),breaks=Depth_cuts, col=Depth_cols, legend=FALSE,axes=FALSE,box=FALSE)
add_RefGrid(bb=st_bbox(SmallBathy()),ResLat=10,ResLon=20,LabLon = 0)

#Example 2: Local grid around created polygons

MyPolys=create_Polys(PolyData,Densify=TRUE)
BathyC=crop(SmallBathy(),ext(MyPolys))#crop the bathymetry to match the extent of MyPolys
Mypar=par(mai=c(0.5,0.5,0.5,0.5)) #Figure margins as c(bottom, left, top, right)
par(Mypar)
plot(BathyC,breaks=Depth_cuts, col=Depth_cols, legend=FALSE,axes=FALSE,box=FALSE)
add_RefGrid(bb=st_bbox(BathyC),ResLat=2,ResLon=6)
plot(st_geometry(MyPolys),add=TRUE,col='orange',border='brown',lwd=2)
```

---

assign_areas *Assign point locations to polygons*

Description

Given a set of polygons and a set of point locations (given in decimal degrees), finds in which polygon those locations fall. Finds, for example, in which Subarea the given fishing locations occurred.

Usage

```
assign_areas(
  Input,
  Polys,
  AreaNameFormat = "GAR_Long_Label",
  Buffer = 0,
  NamesIn = NULL,
  NamesOut = NULL
)
```

Arguments

`Input`	dataframe containing - at the minimum - Latitudes and Longitudes to be assigned to polygons. If `NamesIn` is not provided, the columns in the `Input` must be in the following order: Latitude, Longitude, Variable 1, Variable 2, ... Variable x..
`Polys`	character vector of polygon names (e.g., `Polys=c('ASDs','RBs')`). Must be matching the names of the pre-loaded spatial objects (loaded via e.g., `ASDs=load_ASDs()`).

`AreaNameFormat` dependent on the polygons loaded. For the Secretariat's spatial objects loaded via 'load_' functions, we have the following:

`'GAR_Name'` e.g., `'Subarea 88.2'`

`'GAR_Short_Label'` e.g., `'882'`

`'GAR_Long_Label'` (default) e.g., `'88.2'`

Several values may be entered if several `Polys` are used, e.g.:

`c('GAR_Short_Label','GAR_Name')`, in which case `AreaNameFormat` must be given in the same order as `Polys`.

`Buffer` numeric, distance in nautical miles to be added around the `Polys` of interest. Can be specified for each of the `Polys` (e.g., `Buffer=c(2,5)`). Useful to determine whether locations are within `Buffer` nautical miles of a polygon.

`NamesIn` character vector of length 2 specifying the column names of Latitude and Longitude fields in the `Input`. Latitudes name must be given first, e.g.:

`NamesIn=c('MyLatitudes','MyLongitudes')`.

`NamesOut` character, names of the resulting column names in the output dataframe, with order matching that of `Polys` (e.g., `NamesOut=c('Recapture_ASD','Recapture_RB')`). If not provided will be set as equal to `Polys`.

Value

dataframe with the same structure as the `Input`, with additional columns corresponding to the `Polys` used and named after `NamesOut`.

See Also

`load_ASDs`, `load_SSRUs`, `load_RBs`, `load_SSMUs`, `load_MAs`, `load_MPAs`, `load_EEZs`.

Examples

```
#Generate a dataframe
MyData=data.frame(Lat=runif(100,min=-65,max=-50),
                  Lon=runif(100,min=20,max=40))

#Assign ASDs and SSRUs to these locations (first load ASDs and SSRUs)
ASDs=load_ASDs()
SSRUs=load_SSRUs()

MyData=assign_areas(Input=MyData,Polys=c('ASDs','SSRUs'),NamesOut=c('MyASDs','MySSRUs'))

#View(MyData)
table(MyData$MyASDs) #count of locations per ASD
table(MyData$MySSRUs) #count of locations per SSRU
```

CCAMLRp *CCAMLRGIS Projection*

Description

The CCAMLRGIS package uses the Lambert azimuthal equal-area projection (see https://en.wikipedia.org/wiki/Lambert_azimuthal_equal-area_projection). Source: https://gis.ccamlr.org/. In order to align with recent developments within Geographic Information Software, this projection will be accessed via EPSG code 6932 (see https://epsg.org/crs_6932/WGS-84-NSIDC-EASE-Grid-2-0-South.html).

Usage

```
data(CCAMLRp)
```

Format

character string

Value

"+proj=laea +lat_0=-90 +lon_0=0 +x_0=0 +y_0=0 +datum=WGS84 +units=m +no_defs"

Clip2Coast *Clip Polygons to a simplified Antarctic coastline*

Description

Clip Polygons to the Coast (removes polygon parts that fall on land) and computes the area of the resulting polygon. Uses an sf object as input which may be user-generated or created via buffered points (see create_Points), buffered lines (see create_Lines) or polygons (see create_Polys). N.B.: this function uses a simplified coastline. For more accurate results, load the high resolution coastline (see load_Coastline), and use sf::st_difference().

Usage

```
Clip2Coast(Input)
```

Arguments

Input	sf polygon(s) to be clipped.

Value

sf polygon carrying the same data as the Input.

See Also

Coast, create_Points, create_Lines, create_Polys, create_PolyGrids.

Examples

```
MyPolys=create_Polys(PolyData,Densify=TRUE,Buffer=c(10,-15,120))
plot(st_geometry(MyPolys),col='red')
plot(st_geometry(Coast[Coast$ID=='All',]),add=TRUE)
MyPolysClipped=Clip2Coast(MyPolys)
plot(st_geometry(MyPolysClipped),col='blue',add=TRUE)
#View(MyPolysClipped)
```

Coast *Simplified and subsettable coastline*

Description

Coastline polygons generated from load_Coastline and sub-sampled to only contain data that falls within the boundaries of the Convention Area. This spatial object may be subsetted to plot the coastline for selected ASDs or EEZs (see examples). Source: https://gis.ccamlr.org/

Usage

```
data(Coast)
```

Format

sf

See Also

Clip2Coast, load_Coastline.

Examples

```
#Complete coastline:
plot(st_geometry(Coast[Coast$ID=='All',]),col='grey')

#ASD 48.1 coastline:
plot(st_geometry(Coast[Coast$ID=='48.1',]),col='grey')
```

create_Arrow *Create Arrow*

Description

Create an arrow which can be curved and/or segmented.

Usage

```
create_Arrow(
  Input,
  Np = 50,
  Pwidth = 5,
  Hlength = 15,
  Hwidth = 10,
  dlength = 0,
  Atype = "normal",
  Acol = "green",
  Atrans = 0,
  yx = FALSE
)
```

Arguments

Input	input dataframe with at least two columns (Latitudes then Longitudes) and an optional third column for weights. First row is the location of the start of the arrow, Last row is the location of the end of the arrow (where the arrow will point to). Optional intermediate rows are the locations of points towards which the arrow's path will bend. Weights (third column) can be added to the intermediate points to make the arrow's path bend more towards them. Projected coordinates may be used (Y then X) instead of Latitudes and Longitudes by setting yx to TRUE. Coordinates may be extracted from a spatial object and used as input (see Example 9 below).
Np	integer, number of additional points generated to create a curved path. If the arrow's path appears too segmented, increase Np.
Pwidth	numeric, width of the arrow's path.
Hlength	numeric, length of the arrow's head.
Hwidth	numeric, width of the arrow's head.
dlength	numeric, length of dashes for dashed arrows.
Atype	character, arrow type either "normal" or "dashed". A normal arrow is a single polygon, with a single color (set by Acol) and transparency (set by Atrans). A dashed arrow is a series of polygons which can be colored separately by setting two or more values as Acol=c("color start","color end") and two or more transparency values as Atrans=c("transparency start","transparency end"). The length of dashes is controlled by dlength.

Acol	Color of the arrow, see Atype above.
Atrans	Numeric, transparency of the arrow, see Atype above.
yx	Logical, if set to TRUE the input coordinates are projected. Give Y in the first column, X in the second.

Value

Spatial object in your environment with colors included in the dataframe (see examples).

See Also

create_CircularArrow, create_Ellipse,add_Legend, create_Points, create_Lines, create_Polys, create_PolyGrids, create_Stations, create_Pies.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#24-create-arrow

#Example 1: straight green arrow
myInput=data.frame(lat=c(-61,-52),
                   lon=c(-60,-40))
Arrow=create_Arrow(Input=myInput)
plot(st_geometry(Arrow),col=Arrow$col,main="Example 1")


#Example 2: blue arrow with one bend
myInput=data.frame(lat=c(-61,-65,-52),
                   lon=c(-60,-45,-40))
Arrow=create_Arrow(Input=myInput,Acol="lightblue")
plot(st_geometry(Arrow),col=Arrow$col,main="Example 2")

#Example 3: blue arrow with two bends
myInput=data.frame(lat=c(-61,-60,-65,-52),
                   lon=c(-60,-50,-45,-40))
Arrow=create_Arrow(Input=myInput,Acol="lightblue")
plot(st_geometry(Arrow),col=Arrow$col,main="Example 3")

#Example 4: blue arrow with two bends, with more weight on the second bend
#and a big head
myInput=data.frame(lat=c(-61,-60,-65,-52),
                   lon=c(-60,-50,-45,-40),
                   w=c(1,1,2,1))
Arrow=create_Arrow(Input=myInput,Acol="lightblue",Hlength=20,Hwidth=20)
plot(st_geometry(Arrow),col=Arrow$col,main="Example 4")

#Example 5: Dashed arrow, small dashes
myInput=data.frame(lat=c(-61,-60,-65,-52),
                   lon=c(-60,-50,-45,-40),
                   w=c(1,1,2,1))
Arrow=create_Arrow(Input=myInput,Acol="blue",Atype = "dashed",dlength = 1)
plot(st_geometry(Arrow),col=Arrow$col,main="Example 5",border=NA)
```

```
#Example 6: Dashed arrow, big dashes
myInput=data.frame(lat=c(-61,-60,-65,-52),
                   lon=c(-60,-50,-45,-40),
                   w=c(1,1,2,1))
Arrow=create_Arrow(Input=myInput,Acol="blue",Atype = "dashed",dlength = 2)
plot(st_geometry(Arrow),col=Arrow$col,main="Example 6",border=NA)

#Example 7: Dashed arrow, no dashes, 3 colors and transparency gradient
myInput=data.frame(lat=c(-61,-60,-65,-52),
                   lon=c(-60,-50,-45,-40),
                   w=c(1,1,2,1))
Arrow=create_Arrow(Input=myInput,Acol=c("red","green","blue"),
Atrans = c(0,0.9,0),Atype = "dashed",dlength = 0)
plot(st_geometry(Arrow),col=Arrow$col,main="Example 7",border=NA)

#Example 8: Same as example 7 but with more points, so smoother
myInput=data.frame(lat=c(-61,-60,-65,-52),
                   lon=c(-60,-50,-45,-40),
                   w=c(1,1,2,1))
Arrow=create_Arrow(Input=myInput,Np=200,Acol=c("red","green","blue"),
                   Atrans = c(0,0.9,0),Atype = "dashed",dlength = 0)
plot(st_geometry(Arrow),col=Arrow$col,main="Example 8",border=NA)

#Example 9 Path along isobath
Iso=st_as_sf(terra::as.contour(SmallBathy(),levels=-1000)) #Take isobath
Iso=suppressWarnings(st_cast(Iso,"LINESTRING")) #convert to individual lines
Iso$L=st_length(Iso) #Get line length
Iso=Iso[Iso$L==max(Iso$L),] #Keep longest line (circumpolar)
Iso=st_coordinates(Iso) #Extract coordinates
Iso=Iso[Iso[,1]>-2.1e6 & Iso[,1]<(-0.1e6) & Iso[,2]>0,] #crop line
Inp=data.frame(Y=Iso[,2],X=Iso[,1])
Inp=Inp[seq(nrow(Inp),1),] #Go westward
Third=nrow(Inp)/3 #Cut in thirds
Arr1=create_Arrow(Input=Inp[1:Third,],yx=TRUE)
Arr2=create_Arrow(Input=Inp[(Third+2):(2*Third),],yx=TRUE)
Arr3=create_Arrow(Input=Inp[(2*Third+2):nrow(Inp),],yx=TRUE)

terra::plot(SmallBathy(),xlim=c(-2.5e6,0.5e6),ylim=c(0.25e6,2.75e6),breaks=Depth_cuts,
            col=Depth_cols,axes=FALSE,box=FALSE,legend=FALSE,main="Example 9")
plot(st_geometry(Arr1),col="darkred",add=TRUE)
plot(st_geometry(Arr2),col="darkred",add=TRUE)
plot(st_geometry(Arr3),col="darkred",add=TRUE)
plot(st_geometry(Coast[Coast$ID=='All',]),col='grey',add=TRUE)
```

---

create_CircularArrow *Create Circular Arrow*

Description

Create one or multiple arrows on an elliptical path, or a custom path (using `Input`). This function uses `create_Arrow` and `create_Ellipse`. Defaults are set for a simplified Weddell Sea gyre.

Usage

```
create_CircularArrow(
  Latc = -67,
  Lonc = -30,
  Lmaj = 800,
  Lmin = 500,
  Ang = 140,
  Npe = 100,
  dir = "cw",
  Narr = 1,
  Spc = 0,
  Stp = 0,
  Npa = 50,
  Pwidth = 5,
  Hlength = 15,
  Hwidth = 10,
  dlength = 0,
  Atype = "normal",
  Acol = "green",
  Atrans = 0,
  yx = FALSE,
  Input = NULL
)
```

Arguments

`Latc`	numeric, latitude of the ellipse centre in decimal degrees, or Y projected coordinate if `yx` is set to `TRUE`.
`Lonc`	numeric, longitude of the ellipse centre in decimal degrees, or X projected coordinate if `yx` is set to `TRUE`.
`Lmaj`	numeric, length of major axis.
`Lmin`	numeric, length of minor axis.
`Ang`	numeric, angle of rotation (0-360).
`Npe`	integer, number of points on the ellipse.
`dir`	character, direction along the ellipse, either `"cw"` (clockwise) or `"ccw"` (counterclockwise).
`Narr`	integer, number of arrows.
`Spc`	integer, spacing between arrows, or length of single arrow.
`Stp`	numeric, starting point of an arrow on the ellipse (0 to 1).
`Npa`	integer, number of points to build the path of the arrow.

Pwidth	numeric, width of the arrow's path.
Hlength	numeric, length of the arrow's head.
Hwidth	numeric, width of the arrow's head.
dlength	numeric, length of dashes for dashed arrows.
Atype	character, arrow type either "normal" or "dashed". A normal arrow is a single polygon, with a single color (set by Acol) and transparency (set by Atrans). A dashed arrow is a series of polygons which can be colored separately by setting two or more values as Acol=c("color start","color end") and two or more transparency values as Atrans=c("transparency start","transparency end"). The length of dashes is controlled by dlength.
Acol	Color of the arrow, see Atype above.
Atrans	Numeric, transparency of the arrow, see Atype above.
yx	Logical, if set to TRUE the input coordinates are projected. Give Y in the first column, X in the second.
Input	Either NULL, or a projected spatial object to control the arrow's path (see examples).

Value

Spatial object in your environment.

See Also

create_Ellipse, create_Arrow, create_Polys, add_Legend.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#27-create-circular-arrow

#Example 1
Arr=create_CircularArrow()

terra::plot(SmallBathy(),xlim=c(-3e6,0),ylim=c(0,3e6),breaks=Depth_cuts,
            col=Depth_cols,axes=FALSE,box=FALSE,legend=FALSE,main="Example 1")
plot(st_geometry(Coast[Coast$ID=='All',]),col='grey',add=TRUE)
plot(st_geometry(Arr),col=Arr$col,border=NA,add=TRUE)


#Example 2
Arr=create_CircularArrow(Narr=2,Spc=5)

terra::plot(SmallBathy(),xlim=c(-3e6,0),ylim=c(0,3e6),breaks=Depth_cuts,
            col=Depth_cols,axes=FALSE,box=FALSE,legend=FALSE,main="Example 2")
plot(st_geometry(Coast[Coast$ID=='All',]),col='grey',add=TRUE)
plot(st_geometry(Arr),col=Arr$col,border=NA,add=TRUE)


#Example 3
```

```
Arr=create_CircularArrow(Narr=10,Spc=-4,Hwidth=15,Hlength=20)

terra::plot(SmallBathy(),xlim=c(-3e6,0),ylim=c(0,3e6),breaks=Depth_cuts,
            col=Depth_cols,axes=FALSE,box=FALSE,legend=FALSE,main="Example 3")
plot(st_geometry(Coast[Coast$ID=='All',]),col='grey',add=TRUE)
plot(st_geometry(Arr),col=Arr$col,border=NA,add=TRUE)


#Example 4
Arr=create_CircularArrow(Narr=8,Spc=-2,Npa=200,Acol=c("red","orange","green"),
                         Atrans = c(0,0.9,0),Atype = "dashed")

terra::plot(SmallBathy(),xlim=c(-3e6,0),ylim=c(0,3e6),breaks=Depth_cuts,
            col=Depth_cols,axes=FALSE,box=FALSE,legend=FALSE,main="Example 4")
plot(st_geometry(Coast[Coast$ID=='All',]),col='grey',add=TRUE)
plot(st_geometry(Arr),col=Arr$col,border=NA,add=TRUE)


#Example 5 Path around two ellipses
El1=create_Ellipse(Latc=-61,Lonc=-50,Lmaj=500,Lmin=250,Ang=120)
El2=create_Ellipse(Latc=-68,Lonc=-57,Lmaj=400,Lmin=200,Ang=35)
#Merge ellipses and take convex hull
El=st_union(st_geometry(El1),st_geometry(El2))
El=st_convex_hull(El)
El=st_segmentize(El,dfMaxLength = 10000)
#Go counterclockwise if desired:
#El=st_coordinates(El)
#El=st_polygon(list(El[nrow(El):1,]))

Arr=create_CircularArrow(Narr=10,Spc=3,Npa=200,Acol=c("green","darkgreen"),
                         Atype = "dashed",Input=El)

terra::plot(SmallBathy(),xlim=c(-3e6,0),ylim=c(0,3e6),breaks=Depth_cuts,
            col=Depth_cols,axes=FALSE,box=FALSE,legend=FALSE,main="Example 5")
plot(st_geometry(Coast[Coast$ID=='All',]),col='grey',add=TRUE)
plot(st_geometry(Arr),col=Arr$col,border=NA,add=TRUE)
```

`create_Ellipse` *Create Ellipse*

Description

Create an ellipse.

Usage

```
create_Ellipse(
  Latc,
  Lonc,
  Lmaj,
  Lmin,
  Ang = 0,
  Np = 100,
  dir = "cw",
  yx = FALSE
)
```

Arguments

Latc	numeric, latitude of the ellipse centre in decimal degrees, or Y projected coordinate if yx is set to TRUE.
Lonc	numeric, longitude of the ellipse centre in decimal degrees, or X projected coordinate if yx is set to TRUE.
Lmaj	numeric, length of major axis.
Lmin	numeric, length of minor axis.
Ang	numeric, angle of rotation (0-360).
Np	integer, number of points on the ellipse.
dir	character, either "cw" (clockwise) or "ccw" (counterclockwise). Sets the order of points, only matters for create_CircularArrow.
yx	Logical, if set to TRUE the input coordinates are projected. Give Y as Latc and X as Lonc.

Value

Spatial object in your environment.

See Also

create_Arrow, create_CircularArrow, create_Polys, add_Legend.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#26-create-ellipse

El1=create_Ellipse(Latc=-61,Lonc=-50,Lmaj=500,Lmin=250,Ang=120)
El2=create_Ellipse(Latc=-72,Lonc=-30,Lmaj=500,Lmin=500)
Hash=create_Hashes(El2,spacing=2,width=2)
El3=create_Ellipse(Latc=-68,Lonc=-55,Lmaj=400,Lmin=100,Ang=35)

terra::plot(SmallBathy(),xlim=c(-3e6,0),ylim=c(0,3e6),breaks=Depth_cuts,
            col=Depth_cols,axes=FALSE,box=FALSE,legend=FALSE)
plot(st_geometry(Coast[Coast$ID=='All',]),col='grey',add=TRUE)
```

```
plot(st_geometry(El1),col=rgb(0,1,0.5,alpha=0.5),add=TRUE,lwd=2)
plot(st_geometry(El3),col=rgb(0,0.5,0.5,alpha=0.5),add=TRUE,border="orange",lwd=2)
plot(st_geometry(Hash),add=TRUE,col="red",border=NA)
```

`create_Hashes` *Create Hashes*

Description

Create hashed lines to fill a polygon.

Usage

```
create_Hashes(pol, angle = 45, spacing = 1, width = 1)
```

Arguments

`pol`	single polygon inside which hashed lines will be created. May be created using `create_Polys` or by subsetting an object obtained using one of the `load_` functions.
`angle`	numeric, angle of the hashed lines in degrees (0-360), noting that the function might struggle with angles 0, 180, -180 or 360.
`spacing`	numeric, spacing between hashed lines.
`width`	numeric, width of hashed lines.

Value

Spatial object in your environment, to be added to your plot.

See Also

`create_Polys`, `add_Legend`.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#25-create-hashes

#Create some polygons
MyPolys=create_Polys(Input=PolyData)
#Create hashes for each polygon
H1=create_Hashes(pol=MyPolys[1,],angle=45,spacing=1,width=1)
H2=create_Hashes(pol=MyPolys[2,],angle=90,spacing=2,width=2)
H3=create_Hashes(pol=MyPolys[3,],angle=0,spacing=3,width=3)

plot(st_geometry(MyPolys),col='cyan')
plot(st_geometry(H1),col='red',add=TRUE)
```

```
plot(st_geometry(H2),col='green',add=TRUE)
plot(st_geometry(H3),col='blue',add=TRUE)
```

`create_Lines` *Create Lines*

Description

Create lines to display, for example, fishing line locations or tagging data.

Usage

```
create_Lines(
  Input,
  NamesIn = NULL,
  Buffer = 0,
  Densify = FALSE,
  Clip = FALSE,
  SeparateBuf = TRUE
)
```

Arguments

`Input`	input dataframe. If `NamesIn` is not provided, the columns in the `Input` must be in the following order: Line name, Latitude, Longitude. If a given line is made of more than two points, the locations of points must be given in order, from one end of the line to the other.
`NamesIn`	character vector of length 3 specifying the column names of line identifier, Latitude and Longitude fields in the `Input`. Names must be given in that order, e.g.: `NamesIn=c('Line ID','Line Latitudes','Line Longitudes')`.
`Buffer`	numeric, distance in nautical miles by which to expand the lines. Can be specified for each line (as a numeric vector).
`Densify`	logical, if set to TRUE, additional points between extremities of lines spanning more than 0.1 degree longitude are added at every 0.1 degree of longitude prior to projection (see examples).
`Clip`	logical, if set to TRUE, polygon parts (from buffered lines) that fall on land are removed (see Clip2Coast).
`SeparateBuf`	logical, if set to FALSE when adding a `Buffer`, all spatial objects are merged, resulting in a single spatial object.

Value

Spatial object in your environment. Data within the resulting spatial object contains the data provided in the `Input` plus additional "LengthKm" and "LengthNm" columns which corresponds to the lines lengths, in kilometers and nautical miles respectively. If additional data was included in the `Input`, any numerical values are summarized for each line (min, max, mean, median, sum, count and sd).

To see the data contained in your spatial object, type: `View(MyLines)`.

See Also

`create_Points`, `create_Polys`, `create_PolyGrids`, `create_Stations`, `create_Pies`, `add_Legend`.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#create-lines

#Densified lines (note the curvature of the lines)

MyLines=create_Lines(Input=LineData,Densify=TRUE)
plot(st_geometry(MyLines),lwd=2,col=rainbow(nrow(MyLines)))
```

---

create_Pies *Create Pies*

Description

Generates pie charts that can be overlaid on maps. The `Input` data must be a dataframe with, at least, columns for latitude, longitude, class and value. For each location, a pie is created with pieces for each class, and the size of each piece depends on the proportion of each class (the value of each class divided by the sum of values). Optionally, the area of each pie can be proportional to a chosen variable (if that variable is different than the value mentioned above, the `Input` data must have a fifth column and that variable must be unique to each location). If the `Input` data contains locations that are too close together, the data can be gridded by setting `GridKm`. Once pie charts have been created, the function add_PieLegend may be used to add a legend to the figure.

Usage

```
create_Pies(
  Input,
  NamesIn = NULL,
  Classes = NULL,
  cols = c("green", "red"),
```

```
  Size = 50,
  SizeVar = NULL,
  GridKm = NULL,
  Other = 0,
  Othercol = "grey"
)
```

Arguments

Input	input dataframe.
NamesIn	character vector of length 4 specifying the column names of Latitude, Longitude, Class and value fields in the Input. Names must be given in that order, e.g.: NamesIn=c('Latitude','Longitude','Class','Value').
Classes	character, optional vector of classes to be displayed. If this excludes classes that are in the Input, those excluded classes will be pooled in a 'Other' class.
cols	character, vector of two or more color names to colorize pie pieces.
Size	numeric, value controlling the size of pies.
SizeVar	numeric, optional, name of the field in the Input that should be used to scale the area of pies. Must be unique to locations in the input.
GridKm	numeric, optional, cell size of the grid in kilometers. If provided, locations are pooled by grid cell and values are summed for each class.
Other	numeric, optional, percentage threshold below which classes are pooled in a 'Other' class.
Othercol	character, optional, color of the pie piece for the 'Other' class.

Value

Spatial object in your environment, ready to be plotted.

See Also

add_PieLegend, PieData, PieData2.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#23-create-pies

#Pies of constant size, all classes displayed:
#Create pies
MyPies=create_Pies(Input=PieData,NamesIn=c("Lat","Lon","Sp","N"),Size=50)
#Plot Pies
plot(st_geometry(MyPies),col=MyPies$col)
#Add Pies legend
add_PieLegend(Pies=MyPies,PosX=-0.1,PosY=-1,Boxexp=c(0.5,0.45,0.12,0.45),
              PieTitle="Species")
```

`create_Points` *Create Points*

Description

Create Points to display point locations. Buffering points may be used to produce bubble charts.

Usage

```
create_Points(
  Input,
  NamesIn = NULL,
  Buffer = 0,
  Clip = FALSE,
  SeparateBuf = TRUE
)
```

Arguments

`Input`	input dataframe. If `NamesIn` is not provided, the columns in the `Input` must be in the following order: Latitude, Longitude, Variable 1, Variable 2, ... Variable x.
`NamesIn`	character vector of length 2 specifying the column names of Latitude and Longitude fields in the `Input`. Latitudes name must be given first, e.g.: `NamesIn=c('MyLatitudes','MyLongitudes')`.
`Buffer`	numeric, radius in nautical miles by which to expand the points. Can be specified for each point (as a numeric vector).
`Clip`	logical, if set to TRUE, polygon parts (from buffered points) that fall on land are removed (see Clip2Coast).
`SeparateBuf`	logical, if set to FALSE when adding a `Buffer`, all spatial objects are merged, resulting in a single spatial object.

Value

Spatial object in your environment. Data within the resulting spatial object contains the data provided in the `Input` plus additional "x" and "y" columns which corresponds to the projected points locations and may be used to label points (see examples).

To see the data contained in your spatial object, type: `View(MyPoints)`.

See Also

`create_Lines`, `create_Polys`, `create_PolyGrids`, `create_Stations`, `create_Pies`, `add_Legend`.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#create-points

#Simple points with labels

MyPoints=create_Points(Input=PointData)
plot(st_geometry(MyPoints))
text(MyPoints$x,MyPoints$y,MyPoints$name,adj=c(0.5,-0.5),xpd=TRUE)
```

---

create_PolyGrids *Create a Polygon Grid*

Description

Create a polygon grid to spatially aggregate data in cells of chosen size. Cell size may be specified in degrees or as a desired area in square kilometers (in which case cells are of equal area).

Usage

```
create_PolyGrids(
  Input,
  NamesIn = NULL,
  dlon = NA,
  dlat = NA,
  Area = NA,
  cuts = 100,
  cols = c("green", "yellow", "red")
)
```

Arguments

Input	input dataframe. If NamesIn is not provided, the columns in the Input must be in the following order: Latitude, Longitude, Variable 1, Variable 2 ... Variable x.
NamesIn	character vector of length 2 specifying the column names of Latitude and Longitude fields in the Input. Latitudes name must be given first, e.g.: NamesIn=c('MyLatitudes','MyLongitudes').
dlon	numeric, width of the grid cells in decimal degrees of longitude.

dlat	numeric, height of the grid cells in decimal degrees of latitude.
Area	numeric, area in square kilometers of the grid cells. The smaller the Area, the longer it will take.
cuts	numeric, number of desired color classes.
cols	character, desired colors. If more that one color is provided, a linear color gradient is generated.

Value

Spatial object in your environment. Data within the resulting spatial object contains the data provided in the Input after aggregation within cells. For each Variable, the minimum, maximum, mean, sum, count, standard deviation, and, median of values in each cell is returned. In addition, for each cell, its area (AreaKm2), projected centroid (Centrex, Centrey) and unprojected centroid (Centrelon, Centrelat) is given.

To see the data contained in your spatial object, type: View(MyGrid).

Also, colors are generated for each aggregated values according to the chosen cuts and cols.

To generate a custom color scale after the grid creation, refer to add_col and add_Cscale. See Example 4 below.

See Also

create_Points, create_Lines, create_Polys, create_Stations, create_Pies, add_col, add_Cscale, add_Legend.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#create-grids
# And:
# https://github.com/ccamlr/CCAMLRGIS/blob/master/Advanced_Grids/Advanced_Grids.md

#Simple grid, using automatic colors

MyGrid=create_PolyGrids(Input=GridData,dlon=2,dlat=1)
#View(MyGrid)
plot(st_geometry(MyGrid),col=MyGrid$Col_Catch_sum)
```

`create_Polys` *Create Polygons*

Description

Create Polygons such as proposed Research Blocks or Marine Protected Areas.

Usage

```
create_Polys(
  Input,
  NamesIn = NULL,
  Buffer = 0,
  Densify = TRUE,
  Clip = FALSE,
  SeparateBuf = TRUE
)
```

Arguments

`Input`	input dataframe. If `NamesIn` is not provided, the columns in the `Input` must be in the following order: Polygon name, Latitude, Longitude. Latitudes and Longitudes must be given clockwise.
`NamesIn`	character vector of length 3 specifying the column names of polygon identifier, Latitude and Longitude fields in the `Input`. Names must be given in that order, e.g.: `NamesIn=c('Polygon ID','Poly Latitudes','Poly Longitudes')`.
`Buffer`	numeric, distance in nautical miles by which to expand the polygons. Can be specified for each polygon (as a numeric vector).
`Densify`	logical, if set to TRUE, additional points between extremities of lines spanning more than 0.1 degree longitude are added at every 0.1 degree of longitude prior to projection (compare examples 1 and 2 below).
`Clip`	logical, if set to TRUE, polygon parts that fall on land are removed (see Clip2Coast).
`SeparateBuf`	logical, if set to FALSE when adding a `Buffer`, all spatial objects are merged, resulting in a single spatial object.

Value

Spatial object in your environment. Data within the resulting spatial object contains the data provided in the `Input` after aggregation within polygons. For each numeric variable, the minimum, maximum, mean, sum, count, standard deviation, and, median of values in each polygon is returned. In addition, for each polygon, its area (AreaKm2) and projected centroid (Labx, Laby) are given (which may be used to add labels to polygons).

To see the data contained in your spatial object, type: `View(MyPolygons)`.

See Also

create_Points, create_Lines, create_PolyGrids, create_Stations, add_RefGrid, add_Legend.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#create-polygons


#Densified polygons (note the curvature of lines)
MyPolys=create_Polys(Input=PolyData)
plot(st_geometry(MyPolys),col='red')
text(MyPolys$Labx,MyPolys$Laby,MyPolys$ID,col='white')

#Convention Area outline
CA=data.frame(Name="CA",
              Lat=c(-50,-50,-45,-45,-55,-55,-60,-60),
              Lon=c(-50,30,30,80,80,150,150,-50))

MyPoly=create_Polys(CA)
plot(st_geometry(MyPoly),col='blue',border='green',lwd=2)
```

---

create_Stations *Create Stations*

Description

Create random point locations inside a polygon and within bathymetry strata constraints. A distance constraint between stations may also be used if desired.

Usage

```
create_Stations(
  Poly,
  Bathy,
  Depths,
  N = NA,
  Nauto = NA,
  dist = NA,
  Buf = 1000,
  ShowProgress = FALSE
)
```

Arguments

Poly	single polygon inside which stations will be generated. May be created using create_Polys.
Bathy	bathymetry raster with the appropriate projection, such as this one.
Depths	numeric, vector of depths. For example, if the depth strata required are 600 to 1000 and 1000 to 2000, Depths=c(-600,-1000,-2000).
N	numeric, vector of number of stations required in each depth strata, therefore length(N) must equal length(Depths)-1.
Nauto	numeric, instead of specifying N, a number of stations proportional to the areas of the depth strata may be created. Nauto is the maximum number of stations required in any depth stratum.
dist	numeric, if desired, a distance constraint in nautical miles may be applied. For example, if dist=2, stations will be at least 2 nautical miles apart.
Buf	numeric, distance in meters from isobaths. Useful to avoid stations falling on strata boundaries.
ShowProgress	logical, if set to TRUE, a progress bar is shown (create_Stations may take a while).

Value

Spatial object in your environment. Data within the resulting object contains the strata and stations locations in both projected space ("x" and "y") and decimal degrees of Latitude/Longitude.

To see the data contained in your spatial object, type: View(MyStations).

See Also

create_Polys, SmallBathy, add_Legend.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#22-create-stations

#First, create a polygon within which stations will be created
MyPoly=create_Polys(
 data.frame(Name="mypol",
            Latitude=c(-75,-75,-70,-70),
            Longitude=c(-170,-180,-180,-170))
 ,Densify=TRUE)

par(mai=c(0,0,0,0))
plot(st_geometry(Coast[Coast$ID=='88.1',]),col='grey')
plot(st_geometry(MyPoly),col='green',add=TRUE)
text(MyPoly$Labx,MyPoly$Laby,MyPoly$ID)

#Create a set numbers of stations, without distance constraint:
library(terra)
```

```
#optional: crop your bathymetry raster to match the extent of your polygon
BathyCroped=crop(SmallBathy(),ext(MyPoly))

#Create stations
MyStations=create_Stations(MyPoly,BathyCroped,Depths=c(-2000,-1500,-1000,-550),N=c(20,15,10))

#add custom colors to the bathymetry to indicate the strata of interest
MyCols=add_col(var=c(-10000,10000),cuts=c(-2000,-1500,-1000,-550),cols=c('blue','cyan'))
plot(BathyCroped,breaks=MyCols$cuts,col=MyCols$cols,legend=FALSE,axes=FALSE)
add_Cscale(height=90,fontsize=0.75,width=16,lwd=0.5,
offset=-130,cuts=MyCols$cuts,cols=MyCols$cols)
plot(st_geometry(MyPoly),add=TRUE,border='red',lwd=2,xpd=TRUE)
plot(st_geometry(MyStations),add=TRUE,col='orange',cex=0.75,lwd=1.5,pch=3)
```

`Depth_cols` *Bathymetry colors*

Description

Set of standard colors to plot bathymetry, to be used in conjunction with Depth_cuts.

Usage

```
data(Depth_cols)
```

Format

character vector

See Also

Depth_cols2, add_col, add_Cscale, SmallBathy.

Examples

```
terra::plot(SmallBathy(),breaks=Depth_cuts,col=Depth_cols,axes=FALSE)
```

Depth_cols2 *Bathymetry colors with Fishable Depth range*

Description

Set of colors to plot bathymetry and highlight Fishable Depth range (600-1800), to be used in conjunction with Depth_cuts2.

Usage

```
data(Depth_cols2)
```

Format

character vector

See Also

Depth_cols, add_col, add_Cscale, SmallBathy.

Examples

```
terra::plot(SmallBathy(),breaks=Depth_cuts2,col=Depth_cols2,axes=FALSE,box=FALSE)
```

Depth_cuts *Bathymetry depth classes*

Description

Set of depth classes to plot bathymetry, to be used in conjunction with Depth_cols.

Usage

```
data(Depth_cuts)
```

Format

numeric vector

See Also

Depth_cuts2, add_col, add_Cscale, SmallBathy.

Examples

```
terra::plot(SmallBathy(),breaks=Depth_cuts,col=Depth_cols,axes=FALSE,box=FALSE)
```

Depth_cuts2 *Bathymetry depth classes with Fishable Depth range*

Description

Set of depth classes to plot bathymetry and highlight Fishable Depth range (600-1800), to be used in conjunction with Depth_cols2.

Usage

```
data(Depth_cuts2)
```

Format

numeric vector

See Also

Depth_cuts, add_col, add_Cscale, SmallBathy.

Examples

```
terra::plot(SmallBathy(),breaks=Depth_cuts2,col=Depth_cols2,axes=FALSE,box=FALSE)
```

get_C_intersection *Get Cartesian coordinates of lines intersection in Euclidean space*

Description

Given two lines defined by the Latitudes/Longitudes of their extremities, finds the location of their intersection, in Euclidean space, using this approach: https://en.wikipedia.org/wiki/Line-line_intersection.

Usage

```
get_C_intersection(Line1, Line2, Plot = TRUE)
```

Arguments

Line1	Vector of 4 coordinates, given in decimal degrees as: c(Longitude_start,Latitude_start,Longitude_end,Latitude_end).
Line2	Same as Line1.
Plot	logical, if set to TRUE, plots a schematic of calculations.

Examples

```
#Example 1 (Intersection beyond the range of segments)
get_C_intersection(Line1=c(-30,-55,-29,-50),Line2=c(-50,-60,-40,-60))

#Example 2 (Intersection on one of the segments)
get_C_intersection(Line1=c(-30,-65,-29,-50),Line2=c(-50,-60,-40,-60))

#Example 3 (Crossed segments)
get_C_intersection(Line1=c(-30,-65,-29,-50),Line2=c(-50,-60,-25,-60))

#Example 4 (Antimeridian crossed)
get_C_intersection(Line1=c(-179,-60,-150,-50),Line2=c(-120,-60,-130,-62))

#Example 5 (Parallel lines - uncomment to test as it will return an error)
#get_C_intersection(Line1=c(0,-60,10,-60),Line2=c(-10,-60,10,-60))
```

---

get_depths *Get depths of locations from a bathymetry raster*

Description

Given a bathymetry raster and an input dataframe of point locations (given in decimal degrees), computes the depths at these locations (values for the cell each point falls in). The accuracy is dependent on the resolution of the bathymetry raster (see `load_Bathy` to get high resolution data).

Usage

```
get_depths(Input, Bathy, NamesIn = NULL)
```

Arguments

`Input`	dataframe with, at least, Latitudes and Longitudes. If `NamesIn` is not provided, the columns in the `Input` must be in the following order: Latitude, Longitude, Variable 1, Variable 2, ... Variable x.
`Bathy`	bathymetry raster with the appropriate `projection`, such as `this one`. It is highly recommended to use a raster of higher resolution than `SmallBathy` (see `load_Bathy`).
`NamesIn`	character vector of length 2 specifying the column names of Latitude and Longitude fields in the `Input`. Latitudes name must be given first, e.g.: `NamesIn=c('MyLatitudes','MyLongitudes')`.

Value

dataframe with the same structure as the `Input` with an additional depth column `'d'`.

See Also

load_Bathy, create_Points, create_Stations, get_iso_polys.

Examples

```
#Generate a dataframe
MyData=data.frame(Lat=PointData$Lat,
Lon=PointData$Lon,
Catch=PointData$Catch)

#get depths of locations
MyDataD=get_depths(Input=MyData,Bathy=SmallBathy())
#View(MyDataD)
plot(MyDataD$d,MyDataD$Catch,xlab='Depth',ylab='Catch',pch=21,bg='blue')
```

---

get_iso_polys *Generate contour polygons from raster*

Description

From an input raster and chosen cuts (classes), turns areas between contours into polygons. An input polygon may optionally be given to constrain boundaries. The accuracy is dependent on the resolution of the raster (e.g., see load_Bathy to get high resolution bathymetry).

Usage

```
get_iso_polys(
  Rast,
  Poly = NULL,
  Cuts,
  Cols = c("green", "yellow", "red"),
  Grp = FALSE,
  strict = TRUE
)
```

Arguments

`Rast`	raster with the appropriate projection, such as SmallBathy. It is recommended to use a raster of higher resolution (see load_Bathy).

Poly	optional, single polygon inside which contour polygons will be generated. May be created using create_Polys or by subsetting an object obtained using one of the load_ functions.
Cuts	numeric, vector of desired contours. For example, Cuts=c(-2000,-1000,-500).
Cols	character, vector of desired colors (see add_col).
Grp	logical (TRUE/FALSE), if set to TRUE (slower), contour polygons that touch each other are identified and grouped (a Grp column is added to the object). This can be used, for example, to identify seamounts that are constituted of several isobaths.
strict	logical (TRUE/FALSE), if set to TRUE (default) polygons are created only between the chosen Cuts. If set to FALSE, extra polygons are created beyond the bounds of Cuts.

Value

Spatial object in your environment. Data within the resulting object contains a polygon in each row. Columns are as follows: ID is a unique polygon identifier; Iso is a contour polygon identifier; Min and Max are the range of contour values; c is the color of each contour polygon; if Grp was set to TRUE, additional columns are: Grp is a group identifier (e.g., a seamount constituted of several isobaths); AreaKm2 is the polygon area in square kilometers; Labx and Laby can be used to label groups (see GitHub example).

See Also

load_Bathy, create_Polys, get_depths.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#46-get_iso_polys

Poly=create_Polys(Input=data.frame(ID=1,Lat=c(-55,-55,-61,-61),Lon=c(-30,-25,-25,-30)))
IsoPols=get_iso_polys(Rast=SmallBathy(),Poly=Poly,Cuts=seq(-8000,0,length.out=10),Cols=rainbow(9))

plot(st_geometry(Poly))
plot(st_geometry(IsoPols),col=IsoPols$c,add=TRUE)
```

GridData *Example dataset for create_PolyGrids*

Description

To be used in conjunction with create_PolyGrids.

Usage

```
data(GridData)
```

Format

data.frame

See Also

create_PolyGrids.

Examples

```
#View(GridData)

MyGrid=create_PolyGrids(Input=GridData,dlon=2,dlat=1)
plot(st_geometry(MyGrid),col=MyGrid$Col_Catch_sum)
```

Labels *Polygon labels*

Description

Labels for the layers obtained via 'load_' functions. Positions correspond to the centroids of polygon parts. Can be used in conjunction with add_labels.

Usage

```
data(Labels)
```

Format

data.frame

See Also

add_labels, load_ASDs, load_SSRUs, load_RBs, load_SSMUs, load_MAs, load_EEZs, load_MPAs.

Examples

```
#View(Labels)

ASDs=load_ASDs()
plot(st_geometry(ASDs))
add_labels(mode='auto',layer='ASDs',fontsize=1,fonttype=2)
```

LineData *Example dataset for create_Lines*

Description

To be used in conjunction with create_Lines.

Usage

```
data(LineData)
```

Format

data.frame

See Also

create_Lines.

Examples

```
#View(LineData)

MyLines=create_Lines(LineData)
plot(st_geometry(MyLines),lwd=2,col=rainbow(5))
```

load_ASDs *Load CCAMLR statistical Areas, Subareas and Divisions*

Description

Download the up-to-date spatial layer from the online CCAMLRGIS (https://gis.ccamlr.org/) and load it to your environment. See examples for offline use. All layers use the Lambert azimuthal equal-area projection (CCAMLRp)

Usage

```
load_ASDs()
```

See Also

load_SSRUs, load_RBs, load_SSMUs, load_MAs, load_Coastline, load_MPAs, load_EEZs.

Examples

```
#When online:
ASDs=load_ASDs()
plot(st_geometry(ASDs))

#For offline use, see:
#https://github.com/ccamlr/CCAMLRGIS#32-offline-use
```

`load_Bathy` *Load Bathymetry data*

Description

Download the up-to-date projected GEBCO data from the online CCAMLRGIS (https://gis.ccamlr.org/) and load it to your environment. This functions can be used in two steps, to first download the data and then use it. If you keep the downloaded data, you can then re-use it in all your scripts.

Usage

```
load_Bathy(LocalFile, Res = 5000)
```

Arguments

`LocalFile`	To download the data, set to `FALSE`. To re-use a downloaded file, set to the full path of the file (e.g., `LocalFile="C:/Desktop/GEBCO2024_5000.tif"`).
`Res`	Desired resolution in meters. May only be one of: 500, 1000, 2500 or 5000.

Details

To download the data, you must either have set your working directory using `setwd`, or be working within an Rproject. In any case, your file will be downloaded to the folder path given by `getwd`.

It is strongly recommended to first download the lowest resolution data (set `Res=5000`) to ensure it is working as expected.

To re-use the downloaded data, you must provide the full path to that file, for example:

`LocalFile="C:/Desktop/GEBCO2024_5000.tif"`.

This data was reprojected from the original GEBCO Grid after cropping at 40 degrees South. Projection was made using the Lambert azimuthal equal-area projection (`CCAMLRp`), and the data was aggregated at several resolutions.

Value

Bathymetry raster.

References

GEBCO Compilation Group (2024) GEBCO 2024 Grid (doi:10.5285/1c44ce99-0a0d-5f4f-e063-7086abc0ea0f)

See Also

add_col, add_Cscale, Depth_cols, Depth_cuts, Depth_cols2, Depth_cuts2, get_depths, create_Stations, get_iso_polys, SmallBathy.

Examples

```
#The examples below are commented. To test, remove the '#'.

##Download the data. It will go in the folder given by getwd():
#Bathy=load_Bathy(LocalFile = FALSE,Res=5000)
#plot(Bathy, breaks=Depth_cuts,col=Depth_cols,axes=FALSE)

##Re-use the downloaded data (provided it's here: "C:/Desktop/GEBCO2024_5000.tif"):
#Bathy=load_Bathy(LocalFile = "C:/Desktop/GEBCO2024_5000.tif")
#plot(Bathy, breaks=Depth_cuts,col=Depth_cols,axes=FALSE)
```

---

load_Coastline *Load the full CCAMLR Coastline*

Description

Download the up-to-date spatial layer from the online CCAMLRGIS (https://gis.ccamlr.org/) and load it to your environment. See examples for offline use. All layers use the Lambert azimuthal equal-area projection (CCAMLRp). Note that this coastline expands further north than Coast. Sources: UK Polar Data Centre/BAS and Natural Earth. Projection: EPSG 6932. More details here: https://github.com/ccamlr/geospatial_operations

Usage

```
load_Coastline()
```

References

UK Polar Data Centre/BAS and Natural Earth.

See Also

load_ASDs, load_SSRUs, load_RBs, load_SSMUs, load_MAs, load_MPAs, load_EEZs.

Examples

```
#When online:
Coastline=load_Coastline()
plot(st_geometry(Coastline))

#For offline use, see:
#https://github.com/ccamlr/CCAMLRGIS#32-offline-use
```

---

load_EEZs *Load Exclusive Economic Zones*

Description

Download the up-to-date spatial layer from the online CCAMLRGIS (https://gis.ccamlr.org/) and load it to your environment. See examples for offline use. All layers use the Lambert azimuthal equal-area projection (CCAMLRp)

Usage

```
load_EEZs()
```

See Also

load_ASDs, load_SSRUs, load_RBs, load_SSMUs, load_MAs, load_Coastline, load_MPAs.

Examples

```
#When online:
EEZs=load_EEZs()
plot(st_geometry(EEZs))

#For offline use, see:
#https://github.com/ccamlr/CCAMLRGIS#32-offline-use
```

load_MAs *Load CCAMLR Management Areas*

Description

Download the up-to-date spatial layer from the online CCAMLRGIS (https://gis.ccamlr.org/) and load it to your environment. See examples for offline use. All layers use the Lambert azimuthal equal-area projection (CCAMLRp)

Usage

```
load_MAs()
```

See Also

load_ASDs, load_SSRUs, load_RBs, load_SSMUs, load_Coastline, load_MPAs, load_EEZs.

Examples

```
#When online:
MAs=load_MAs()
plot(st_geometry(MAs))

#For offline use, see:
#https://github.com/ccamlr/CCAMLRGIS#32-offline-use
```

load_MPAs *Load CCAMLR Marine Protected Areas*

Description

Download the up-to-date spatial layer from the online CCAMLRGIS (https://gis.ccamlr.org/) and load it to your environment. See examples for offline use. All layers use the Lambert azimuthal equal-area projection (CCAMLRp)

Usage

```
load_MPAs()
```

See Also

load_ASDs, load_SSRUs, load_RBs, load_SSMUs, load_MAs, load_Coastline, load_EEZs.

Examples

```
#When online:
MPAs=load_MPAs()
plot(st_geometry(MPAs))

#For offline use, see:
#https://github.com/ccamlr/CCAMLRGIS#32-offline-use
```

---

load_RBs *Load CCAMLR Research Blocks*

Description

Download the up-to-date spatial layer from the online CCAMLRGIS (https://gis.ccamlr.org/) and load it to your environment. See examples for offline use. All layers use the Lambert azimuthal equal-area projection (CCAMLRp)

Usage

```
load_RBs()
```

See Also

load_ASDs, load_SSRUs, load_SSMUs, load_MAs, load_Coastline, load_MPAs, load_EEZs.

Examples

```
#When online:
RBs=load_RBs()
plot(st_geometry(RBs))

#For offline use, see:
#https://github.com/ccamlr/CCAMLRGIS#32-offline-use
```

load_SSMUs *Load CCAMLR Small Scale Management Units*

Description

Download the up-to-date spatial layer from the online CCAMLRGIS (https://gis.ccamlr.org/) and load it to your environment. See examples for offline use. All layers use the Lambert azimuthal equal-area projection (CCAMLRp)

Usage

```
load_SSMUs()
```

See Also

load_ASDs, load_SSRUs, load_RBs, load_MAs, load_Coastline, load_MPAs, load_EEZs.

Examples

```
#When online:
SSMUs=load_SSMUs()
plot(st_geometry(SSMUs))

#For offline use, see:
#https://github.com/ccamlr/CCAMLRGIS#32-offline-use
```

load_SSRUs *Load CCAMLR Small Scale Research Units*

Description

Download the up-to-date spatial layer from the online CCAMLRGIS (https://gis.ccamlr.org/) and load it to your environment. See examples for offline use. All layers use the Lambert azimuthal equal-area projection (CCAMLRp)

Usage

```
load_SSRUs()
```

See Also

load_ASDs, load_RBs, load_SSMUs, load_MAs, load_Coastline, load_MPAs, load_EEZs.

Examples

```
#When online:
SSRUs=load_SSRUs()
plot(st_geometry(SSRUs))

#For offline use, see:
#https://github.com/ccamlr/CCAMLRGIS#32-offline-use
```

PieData *Example dataset for create_Pies*

Description

To be used in conjunction with create_Pies. Count and catch of species per location.

Usage

```
data(PieData)
```

Format

data.frame

See Also

create_Pies.

Examples

```
#View(PieData)

#Create pies
MyPies=create_Pies(Input=PieData,
                   NamesIn=c("Lat","Lon","Sp","N"),
                   Size=50
)
#Plot Pies
plot(st_geometry(MyPies),col=MyPies$col)
#Add Pies legend
add_PieLegend(Pies=MyPies,PosX=-0.1,PosY=-1.6,Boxexp=c(0.5,0.45,0.12,0.45),
              PieTitle="Species")
```

PieData2 *Example dataset for create_Pies*

Description

To be used in conjunction with create_Pies. Count and catch of species per location.

Usage

```
data(PieData2)
```

Format

data.frame

See Also

create_Pies.

Examples

```
#View(PieData2)

MyPies=create_Pies(Input=PieData2,
                   NamesIn=c("Lat","Lon","Sp","N"),
                   Size=5,
                   GridKm=250
)
#Plot Pies
plot(st_geometry(MyPies),col=MyPies$col)
#Add Pies legend
add_PieLegend(Pies=MyPies,PosX=-0.8,PosY=-0.3,Boxexp=c(0.5,0.45,0.12,0.45),
              PieTitle="Species")
```

PointData *Example dataset for create_Points*

Description

To be used in conjunction with create_Points.

Usage

```
data(PointData)
```

Format

data.frame

See Also

create_Points.

Examples

```
#View(PointData)

MyPoints=create_Points(PointData)
plot(st_geometry(MyPoints))
text(MyPoints$x,MyPoints$y,MyPoints$name,adj=c(0.5,-0.5),xpd=TRUE)
plot(st_geometry(MyPoints[MyPoints$name=='four',]),bg='red',pch=21,cex=1.5,add=TRUE)
```

PolyData *Example dataset for create_Polys*

Description

To be used in conjunction with create_Polys.

Usage

```
data(PolyData)
```

Format

data.frame

See Also

create_Polys.

Examples

```
#View(PolyData)

MyPolys=create_Polys(PolyData,Densify=TRUE)
plot(st_geometry(MyPolys),col='green')
text(MyPolys$Labx,MyPolys$Laby,MyPolys$ID)
plot(st_geometry(MyPolys[MyPolys$ID=='three',]),border='red',lwd=3,add=TRUE)
```

`project_data` *Project user-supplied locations*

Description

Given an input dataframe containing locations given in decimal degrees or meters (if projected), projects these locations and, if desired, appends them to the input dataframe. May also be used to back-project to Latitudes/Longitudes provided the input was projected using a Lambert azimuthal equal-area projection (CCAMLRp).

Usage

```
project_data(
  Input,
  NamesIn = NULL,
  NamesOut = NULL,
  append = TRUE,
  inv = FALSE
)
```

Arguments

`Input`	dataframe containing - at the minimum - Latitudes and Longitudes to be projected (or Y and X to be back-projected).
`NamesIn`	character vector of length 2 specifying the column names of Latitude and Longitude fields in the `Input`. Latitudes (or Y) name must be given first, e.g.: `NamesIn=c('MyLatitudes','MyLongitudes')`.
`NamesOut`	character vector of length 2, optional. Names of the resulting columns in the output dataframe, with order matching that of `NamesIn` (e.g., `NamesOut=c('Y','X')`).
`append`	logical (T/F). Should the projected locations be appended to the `Input`?
`inv`	logical (T/F). Should a back-projection be performed? In such case, locations must be given in meters and have been projected using a Lambert azimuthal equal-area projection (CCAMLRp).

See Also

assign_areas.

Examples

```
#Generate a dataframe
MyData=data.frame(Lat=runif(100,min=-65,max=-50),
                  Lon=runif(100,min=20,max=40))

#Project data using a Lambert azimuthal equal-area projection
```

```
MyData=project_data(Input=MyData,NamesIn=c("Lat","Lon"))
#View(MyData)
```

`Rotate_obj` *Rotate object*

Description

Rotate a spatial object by setting the longitude that should point up.

Usage

```
Rotate_obj(Input, Lon0 = NULL)
```

Arguments

`Input`	Spatial object of class `sf`, `sfc` or `SpatRaster (terra)`.
`Lon0`	numeric, longitude that will point up in the resulting map.

Value

Spatial object in your environment to only be used for plotting, not for analysis.

See Also

`create_Points`, `create_Lines`, `create_Polys`, `create_PolyGrids`, `create_Stations`, `create_Pies`, `create_Arrow`.

Examples

```
# For more examples, see:
# https://github.com/ccamlr/CCAMLRGIS#47-rotate_obj
# and:
# https://github.com/ccamlr/CCAMLRGIS/blob/master/Basemaps/Basemaps.md

RotB=Rotate_obj(SmallBathy(),Lon0=-180)
terra::plot(RotB,breaks=Depth_cuts,col=Depth_cols,axes=FALSE,box=FALSE,legend=FALSE)
add_RefGrid(bb=st_bbox(RotB),ResLat=10,ResLon=20,LabLon = -180,offset = 3)
```

seabed_area *Calculate planimetric seabed area*

Description

Calculate planimetric seabed area within polygons and depth strata in square kilometers.

Usage

```
seabed_area(Bathy, Poly, PolyNames = NULL, depth_classes = c(-600, -1800))
```

Arguments

Bathy	bathymetry raster with the appropriate projection. It is highly recommended to use a raster of higher resolution than SmallBathy, see load_Bathy.
Poly	polygon(s) within which the areas of depth strata are computed.
PolyNames	character, column name (from the polygon object) to be used in the output.
depth_classes	numeric vector of strata depths. for example, depth_classes=c(-600,-1000,-2000). If the values -600,-1800 are given within depth_classes, the computed area will be labelled as 'Fishable_area'.

Value

dataframe with the name of polygons in the first column and the area for each strata in the following columns.

See Also

load_Bathy, SmallBathy, create_Polys, load_RBs.

Examples

```
#create some polygons
MyPolys=create_Polys(PolyData,Densify=TRUE)
#compute the seabed areas
FishDepth=seabed_area(SmallBathy(),MyPolys,PolyNames="ID",
depth_classes=c(0,-200,-600,-1800,-3000,-5000))
#Result looks like this (note that the 600-1800 stratum is renamed 'Fishable_area')
#View(FishDepth)
```

SmallBathy *Small bathymetry dataset*

Description

Bathymetry dataset derived from the GEBCO 2024 (see https://www.gebco.net/) dataset. Sub-sampled at a 10,000m resolution. Projected using the CCAMLR standard projection (CCAMLRp). To highlight the Fishable Depth range, use Depth_cols2 and Depth_cuts2. To be only used for large scale illustrative purposes. Please refer to load_Bathy to get higher resolution data.

Usage

```
SmallBathy()
```

Format

raster

References

GEBCO Compilation Group (2024) GEBCO 2024 Grid (doi:10.5285/1c44ce99-0a0d-5f4f-e063-7086abc0ea0f)

See Also

load_Bathy, add_col, add_Cscale, Depth_cols, Depth_cuts, Depth_cols2, Depth_cuts2, get_depths, create_Stations.

Examples

```
terra::plot(SmallBathy(),breaks=Depth_cuts,col=Depth_cols,axes=FALSE,box=FALSE)
```

Index

add_col, 3, *5*, *35*, *39–41*, *44*, *48*, *59*
add_Cscale, *3*, 4, *10*, *35*, *39–41*, *48*, *59*
add_labels, 6, *10*, *45*
add_Legend, *3*, *5*, *7*, 8, *17*, *23*, *26*, *28, 29*, *31*, *33*, *35*, *37, 38*
add_PieLegend, *10*, 15, *31, 32*
add_RefGrid, 17, *37*
assign_areas, 18, *56*

CCAMLRp, 20, *46–52*, *56*, *59*
Clip2Coast, 20, *21*, *30*, *33*, *36*
Coast, *20, 21*, 21, *48*
create_Arrow, *10*, 22, *25, 26*, *28*, *57*
create_CircularArrow, *23*, 24, *28*
create_Ellipse, *10*, *23*, *25, 26*, 27
create_Hashes, *9, 10*, 29
create_Lines, *20, 21*, *23*, 30, *33*, *35*, *37*, *46*, *57*
create_Pies, *15, 16*, *23*, *31*, 31, *33*, *35*, *53, 54*, *57*
create_Points, *20, 21*, *23*, *31*, 33, *35*, *37*, *43*, *54, 55*, *57*
create_PolyGrids, *3*, *21*, *23*, *31*, *33*, 34, *37*, *44, 45*, *57*
create_Polys, *20, 21*, *23*, *26*, *28, 29*, *31*, *33*, *35*, 36, *38*, *44*, *55*, *57, 58*
create_Stations, *23*, *31*, *33*, *35*, *37*, 37, *43*, *48*, *57*, *59*

Depth_cols, *5*, 39, *40*, *48*, *59*
Depth_cols2, *5*, *39*, 40, *41*, *48*, *59*
Depth_cuts, *5*, *39*, 40, *41*, *48*, *59*
Depth_cuts2, *5*, *40*, 41, *48*, *59*

get_C_intersection, 41
get_depths, 42, *44*, *48*, *59*
get_iso_polys, *43*, 43, *48*
getwd, *47*
GridData, 44

Labels, *6, 7*, 45

legend, *4, 5*
LineData, 46
load_ASDs, *7*, *19*, *45*, 46, *49–52*
load_Bathy, *5*, *17*, *42–44*, 47, *58, 59*
load_Coastline, *20, 21*, *46*, 48, *49–52*
load_EEZs, *7*, *19*, *45, 46*, *49*, 49, *50–52*
load_MAs, *7*, *19*, *45, 46*, *49, 50*, 50, *51, 52*
load_MPAs, *7*, *19*, *45, 46*, *49, 50*, 50, *51, 52*
load_RBs, *7*, *19*, *45, 46*, *49, 50*, 51, *52*, *58*
load_SSMUs, *7*, *19*, *45, 46*, *49–52*, 52
load_SSRUs, *7*, *19*, *45, 46*, *49–52*, 52

PieData, *16*, *32*, 53
PieData2, *16*, *32*, 54
PointData, 54
PolyData, 55
project_data, 56
projection, *38*, *42*, *58*

rgb, *3*
Rotate_obj, 57

seabed_area, 58
setwd, *47*
SmallBathy, *5*, *17*, *38–43*, *48*, *58*, 59