

# rworldmap vignette

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rworldmap is a package for visualising global scale data, concentrating on data referenced by country codes or gridded at half degree resolution.

## Contents

|          |  |           |
|----------|--|-----------|
| <b>1</b> | <b>Introduction</b>  | <b>1</b>  |
| <b>2</b> | <b>Mapping your own country level data</b>                               | <b>3</b>  |
| 2.1      | Reading data into R . . . . .  | 3         |
| 2.2      | Joining data to a country map . . . . .                                  | 3         |
| 2.3      | Displaying a countries map . . . . .                                     | 4         |
| <b>3</b> | <b>Mapping your own half degree gridded data</b>                         | <b>5</b>  |
| <b>4</b> | <b>Aggregating half degree gridded data to a country level</b>           | <b>5</b>  |
| <b>5</b> | <b>Aggregating country level data to global regions</b>                  | <b>6</b>  |
| <b>6</b> | <b>Map display options common across the plotting methods</b>            | <b>7</b>  |
| <b>7</b> | <b>Example maps with settings modified</b>                               | <b>8</b>  |
| <b>8</b> | <b>Bubble plots</b>  | <b>10</b> |
| <b>9</b> | <b>Combining rworldmap with other packages classInt and RColorBrewer</b> | <b>11</b> |

## 1 Introduction

Package rworldmap is loaded by

```
> library(rworldmap)
```

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Welcome to rworldmap

For help files type :

```
help(rworldmap,help_type='html')
```

For a short introduction type :

```
vignette('rworldmap')
```

This vignette shows a few examples of the main rworldmap functions to get you started. To access the full help system, type `?rworldmap` in the R console. The functions are designed to operate with few specified parameters in which case default values are used, but can also accept user input to allow flexibility e.g. in size, data categorisation, and colour schemes.

### BIODIVERSITY

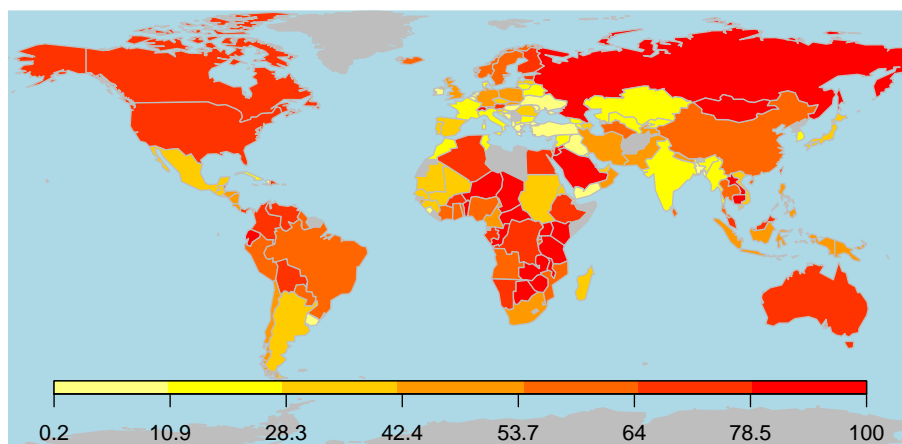


Figure 1: An example from `mapCountryData`

### Population per half degree grid cell

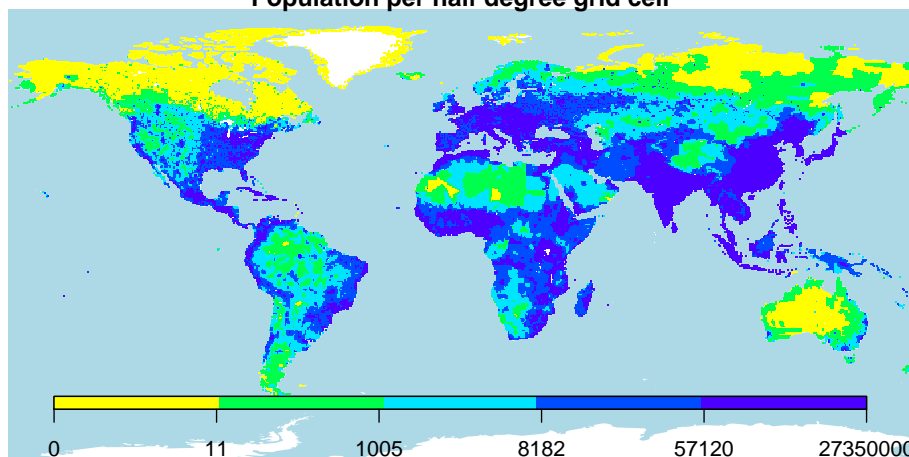


Figure 2: An example from `mapGriddedData`

## 2 Mapping your own country level data

To map your own data you will need it in columns with one row per country, one column containing country identifiers, and other columns containing your data.

The mapping process then involves 3 steps (or 2 if your data are already in an R dataframe).

1. read data into R
2. join data to a map ( using `joinCountryData2Map()` )
3. display the map ( using `mapCountryData()` )

There is an example dataset within the package that can be accessed using the `data` command, and the command below shows how to display a subset of the rows and columns.

```
> data(countryExData)
> countryExData[5:10, 1:5]
```

|    | ISO3V10 | Country    | EPI_regions                  |
|----|---------|------------|------------------------------|
| 5  | ARM     | Armenia    | Middle East and North Africa |
| 6  | AUS     | Australia  | East Asia and the Pacific    |
| 7  | AUT     | Austria    | Europe                       |
| 8  | AZE     | Azerbaijan | Central and Eastern Europ    |
| 9  | BDI     | Burundi    | Sub-Saharan Africa           |
| 10 | BEL     | Belgium    | Europe                       |

|    | GEO_subregion           | Population2005 |
|----|-------------------------|----------------|
| 5  | Eastern Europe          | 3016.3         |
| 6  | Australia + New Zealand | 20155.1        |
| 7  | Western Europe          | 8189.4         |
| 8  | Eastern Europe          | 8410.8         |
| 9  | Eastern Africa          | 7547.5         |
| 10 | Western Europe          | 10419.1        |

### 2.1 Reading data into R

To read in your own data from a space or comma delimited text file you will need to use : `read.csv(filename.csv)` or `read.txt(filename.txt)`, type `?read.table` from the R console to get help on this.

### 2.2 Joining data to a country map

To join the data to a map use `joinCountryData2Map`, and you will need to specify the name of column containing your country identifiers (`nameJoinColumn`) and the type of code used (`joinCode`) e.g. "ISO3" for ISO 3 letter codes or "UN" for numeric country codes. If you only have country names rather than codes use `joinCode="NAME"`, you can expect more mismatches because there is greater variation in what a single country may be named.

```
> data(countryExData)
> sPDF <- joinCountryData2Map(countryExData, joinCode = "ISO3",
+   nameJoinColumn = "ISO3V10")
```

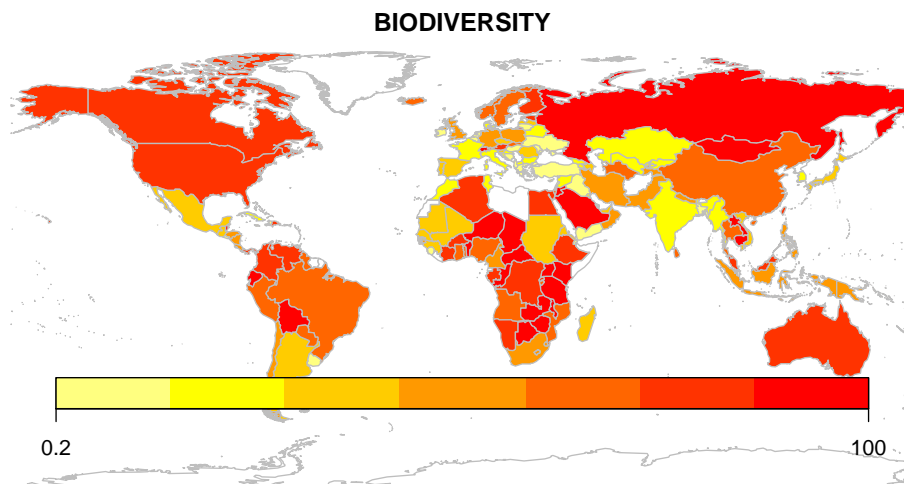
149 codes from your data successfully matched countries in the map  
 0 codes from your data failed to match with a country code in the map  
 97 codes from the map weren't represented in your data

You can see that a summary of how many countries are successfully joined is output to the console. You can specify `verbose=TRUE` to get a full list of countries. The object returned (named `sPDF` in this case) is of type `SpatialPolygonsDataFrame` from the package `sp`. This object is required for the next step, displaying the map.

### 2.3 Displaying a countries map

`mapCountryData` requires as a minimum a `SpatialPolygonsDataFrame` object and a specification of the name of the column containing the data to plot. The first line starting `par ...` below and in subsequent plots simply ensures the plot fills the available space on the page.

```
> par(mai = c(0, 0, 0.2, 0), xaxs = "i", yaxs = "i")
> mapCountryData(sPDF, nameColumnToPlot = "BIODIVERSITY")
```



In this small map the default legend is rather large. This could be fixed by calling the `addMapLegend` function as in the code below.

```
> mapParams <- mapCountryData(sPDF, nameColumnToPlot = "BIODIVERSITY",
+   addLegend = FALSE)
> do.call(addMapLegend, c(mapParams, legendWidth = 0.5,
+   legendMar = 2))
```

Using `do.call` allows the output from `mapCountryData` to be used in `addMapLegend` to ensure the legend matches the map while also allowing easy modification of extra parameters such as `legendWidth`.

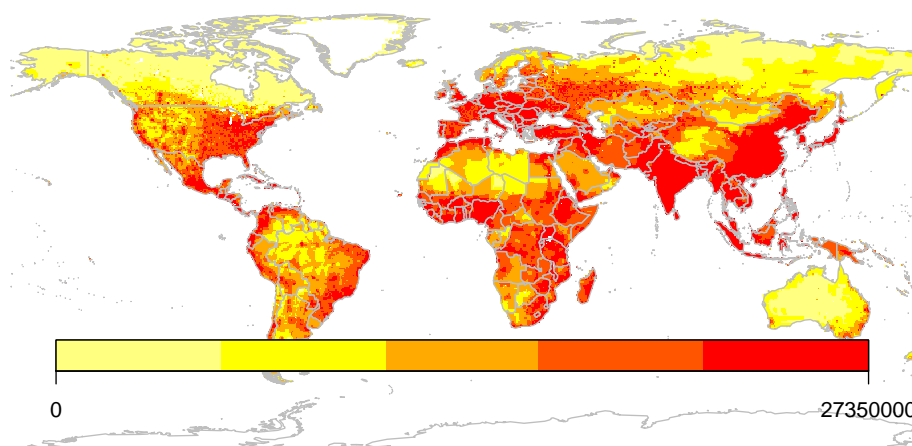
### 3 Mapping your own half degree gridded data

The `mapGriddedData` function can accept either

1. an object of type `SpatialGridDataFrame`, as defined in the package `sp`
2. the name of an ESRI `gridAscii` file as a character string

`rworldmap` contains an example `SpatialGridDataFrame` that can be accessed and printed as shown in the code below.

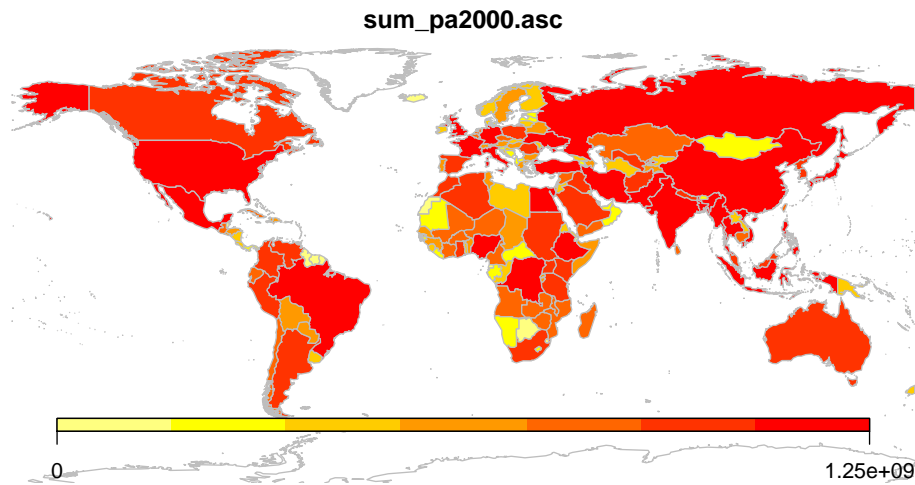
```
> par(mai = c(0, 0, 0.2, 0), xaxs = "i", yaxs = "i")
> data(gridExData)
> mapGriddedData(gridExData)
```



### 4 Aggregating half degree gridded data to a country level

`mapHalfDegreeGridToCountries()` takes a gridded input file, and aggregates, to a country level and plots the map, it accepts most of the same arguments as `mapCountryData()`. In the example below the trick from above of modifying the legend using `addMapLegend()` is repeated.

```
> par(mai = c(0, 0, 0.2, 0), xaxs = "i", yaxs = "i")
> mapParams <- mapHalfDegreeGridToCountries(gridExData,
+   addLegend = FALSE)
> do.call(addMapLegend, c(mapParams, legendWidth = 0.5,
+   legendMar = 2))
```



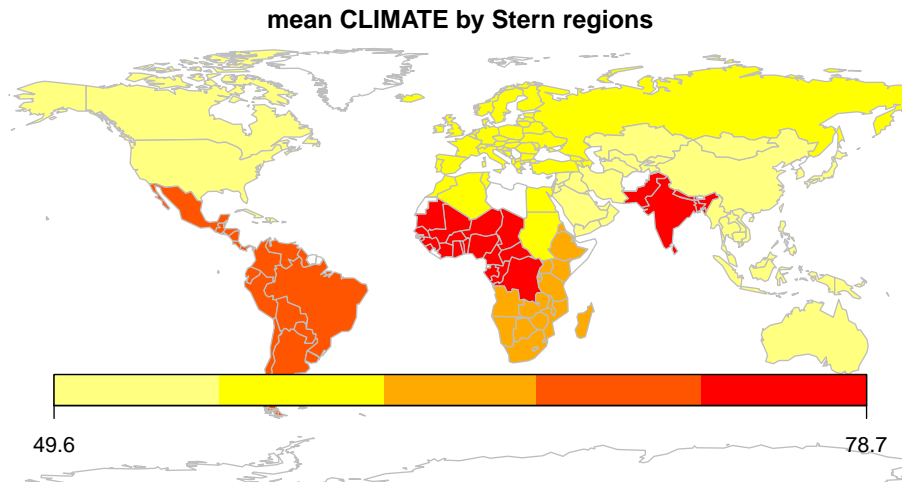
## 5 Aggregating country level data to global regions

Country level data can be aggregated to global regions specified by `regionType` in `country2Region` which outputs as text, and `mapByRegion` which produces a map plot. The regional classifications available include SRES, GEO3, Stern and GBD.

```
> sternEnvHealth <- country2Region(inFile = countryExData,
+   nameDataColumn = "ENVHEALTH", joinCode = "ISO3",
+   nameJoinColumn = "ISO3V10", regionType = "Stern",
+   FUN = "mean")
> print(sternEnvHealth)
```

|                 | meanENVHEALTHbyStern |
|-----------------|----------------------|
| Australasia     | 78.86000             |
| Caribbean       | 82.18000             |
| Central America | 82.78750             |
| Central Asia    | 77.24000             |
| East Asia       | 75.52308             |
| Europe          | 95.19762             |
| North Africa    | 77.38000             |
| North America   | 98.70000             |
| South America   | 83.62727             |
| South Asia      | 61.96000             |
| South+E Africa  | 49.06316             |
| West Africa     | 36.99474             |
| West Asia       | 82.78000             |

```
> par(mai = c(0, 0, 0.2, 0), xaxs = "i", yaxs = "i")
> mapByRegion(countryExData, nameDataColumn = "CLIMATE",
+   joinCode = "ISO3", nameJoinColumn = "ISO3V10", regionType = "Stern",
+   FUN = "mean")
```



## 6 Map display options common across the plotting methods

The following arguments can be specified to alter the appearance of your plots.

- **catMethod** method for categorisation of data "pretty", "fixedWidth", "diverging", "logfixedWidth", "quantiles", "categorical", or a numeric vector defining breaks.
- **numCats** number of categories to classify the data into, may be modified if that exact number is not possible for the chosen catMethod.
- **colourPalette** a string describing the colour palette to use, choice of :
  1. "palette" for the current palette
  2. a vector of valid colours, e.g. `c("red", "white", "blue")` or output from `RColourBrewer`
  3. one of "heat", "diverging", "white2Black", "black2White", "topo", "rainbow", "terrain", "negpos8", "negpos9"
- **addLegend** set to TRUE for a default legend, if set to FALSE the function `addMapLegend()` or `addMapLegendBoxes()` can be used to create a more flexible legend.
- **mapRegion** a region to zoom in on, can be set to a country name from `getMap()$NAME` or one of "eurasia", "africa", "latin america", "uk", "oceania", "asia"

## 7 Example maps with settings modified

```
> par(mai = c(0, 0, 0.2, 0), xaxs = "i", yaxs = "i")
> sPDF <- joinCountryData2Map(countryExData, joinCode = "ISO3",
+   nameJoinColumn = "ISO3V10", projection = "none",
+   )
> op <- palette(c("green", "yellow", "orange", "red"))
> cutVector <- quantile(sPDF@data[["BIODIVERSITY"]], na.rm = TRUE)
> sPDF@data[["BIOcategories"]] <- cut(sPDF@data[["BIODIVERSITY"]],
+   cutVector, include.lowest = TRUE)
> levels(sPDF@data[["BIOcategories"]]) <- c("low", "med",
+   "high", "vhigh")
> mapCountryData(sPDF, nameColumnToPlot = "BIOcategories",
+   catMethod = "categorical", mapTitle = "Biodiversity categories",
+   colourPalette = "palette", oceanCol = "lightblue",
+   missingCountryCol = "white")
```

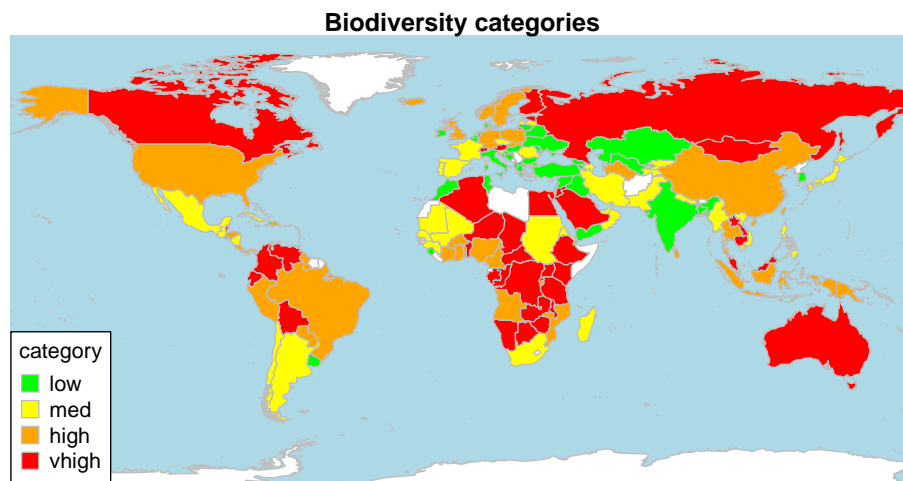


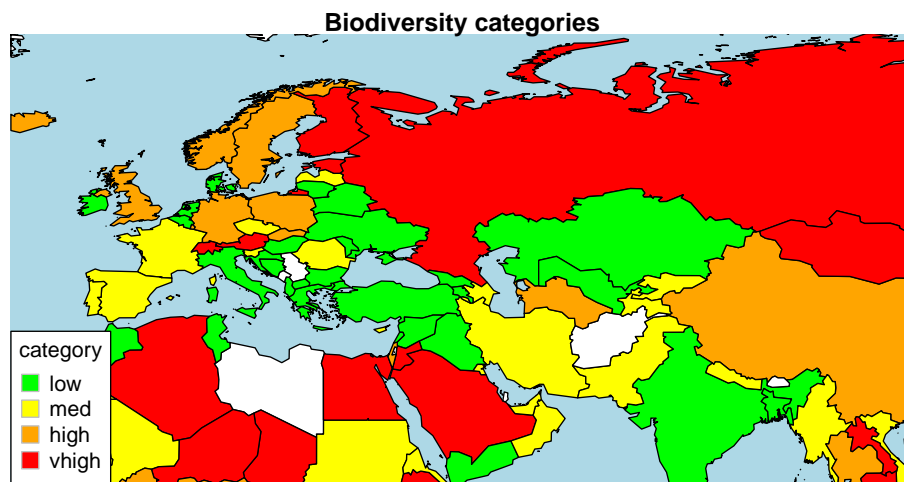
Figure 3: An example of a categorical map produced from `mapCountryData`

This demonstrates how continuous data can be put into categories outside of the `rworldmap` functions and how a user defined colour palette can be used. Because the `catMethod="categorical"` was used a legend with separate boxes rather than a colour bar is added.



You can zoom in on a map by specifying `mapRegion="Eurasia"` (or by specifying `xlim` and `ylim`) and the country outlines can be changed by `borderCol="black"`.

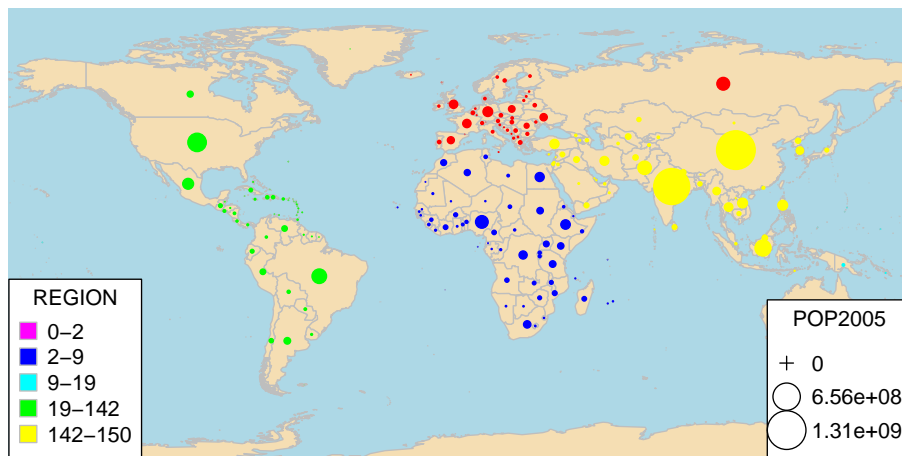
```
> par(mai = c(0, 0, 0.2, 0), xaxs = "i", yaxs = "i")
> mapCountryData(sPDF, nameColumnToPlot = "BIOcategories",
+   catMethod = "categorical", mapTitle = "Biodiversity categories",
+   colourPalette = "palette", oceanCol = "lightblue",
+   missingCountryCol = "white", mapRegion = "Eurasia",
+   borderCol = "black")
> palette(op)
```



## 8 Bubble plots

The `mapBubbles` function allows flexible creation of bubble plots on global maps. You can specify data columns that will determine the sizing and colouring of the bubbles (using `nameZsize` and `nameZcolour`). The function also accepts other `spatialDataFrame` objects or data frames as long as they contain columns specifying the x and y coordinates. The interactive function `identifyCountries` allows the user to click on bubbles and the country name and optionally an attribute variable will be printed on the map.

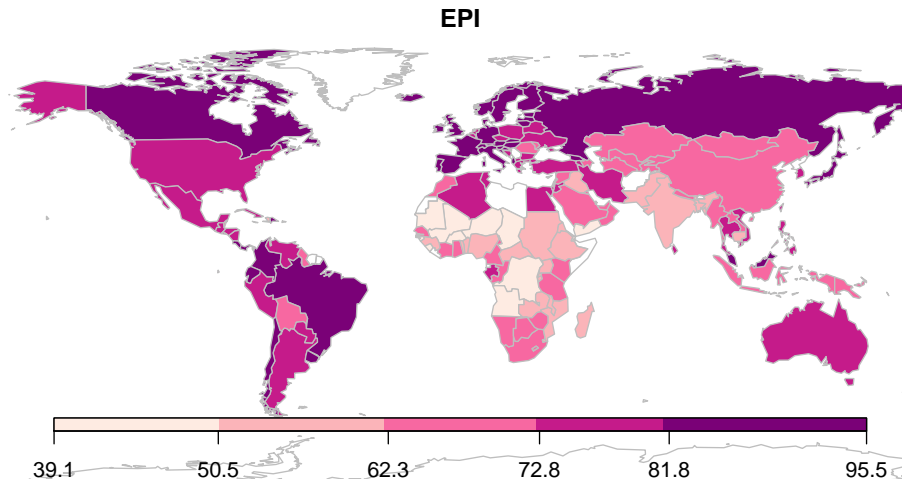
```
> par(mai = c(0, 0, 0.2, 0), xaxs = "i", yaxs = "i")
> mapBubbles(dF = getMap(), nameZSize = "POP2005", nameZColour = "REGION",
+   colourPalette = "rainbow", oceanCol = "lightblue",
+   landCol = "wheat")
```



## 9 Combining rworldmap with other packages classInt and RColorBrewer

Whilst rworldmap sets many defaults internally there is also an option to use other packages to have greater flexibility. In this example the package classInt is used to create the classification and RColorBrewer to specify the colours. The following page demonstrates how multiple maps can be generated in the same figure and shows a selection of different RColorBrewer palettes.

```
> par(mai = c(0, 0, 0.2, 0), xaxs = "i", yaxs = "i")
> library(classInt)
> library(RColorBrewer)
> data("countryExData", envir = environment(), package = "rworldmap")
> sPDF <- joinCountryData2Map(countryExData, joinCode = "ISO3",
+   nameJoinColumn = "ISO3V10", mapResolution = "coarse")
> classInt <- classIntervals(sPDF[["EPI"]], n = 5, style = "jenks")
> catMethod = classInt[["brks"]]
> colourPalette <- brewer.pal(5, "RdPu")
> mapParams <- mapCountryData(sPDF, nameColumnToPlot = "EPI",
+   addLegend = FALSE, catMethod = catMethod, colourPalette = colourPalette)
> do.call(addMapLegend, c(mapParams, legendLabels = "all",
+   legendWidth = 0.5, legendIntervals = "data", legendMar = 2))
```



```

> op <- par(fin = c(7, 9), mfcol = c(5, 2), mai = c(0,
+   0, 0.2, 0), xaxs = "i", yaxs = "i")
> brewerList <- c("Greens", "Greys", "Oranges", "OrRd",
+   "PuBuGn", "Purples", "YlGn", "YlGnBu", "YlOrBr",
+   "YlOrRd")
> for (i in 1:10) {
+   colourPalette <- brewer.pal(7, brewerList[i])
+   mapParams <- mapCountryData(sPDF, nameColumnToPlot = "CLIMATE",
+     addLegend = FALSE, colourPalette = colourPalette,
+     mapTitle = brewerList[i])
+   do.call(addMapLegend, c(mapParams, horizontal = FALSE,
+     legendLabels = "none", legendWidth = 0.7))
+ }
> par(op)

```

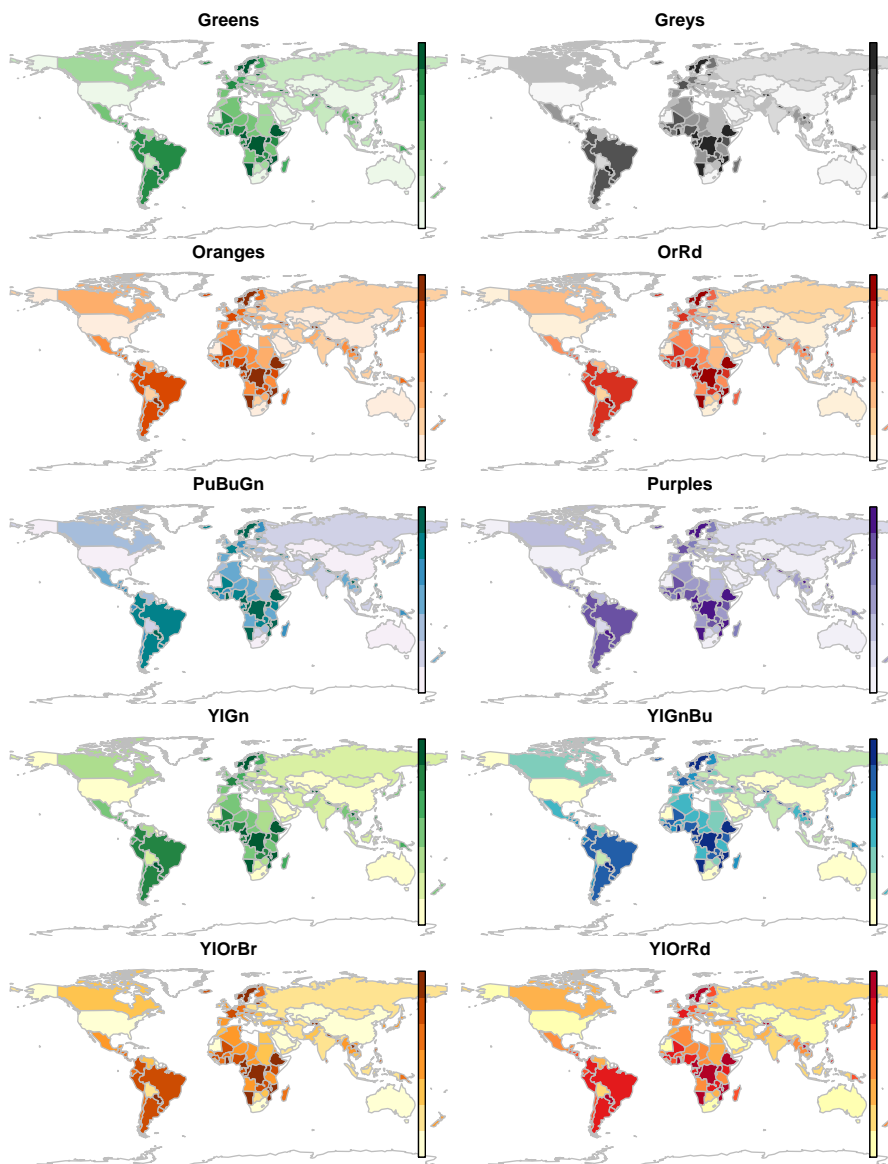


Figure 4: Different RColorBrewer palettes applied to the same data