

Quick high
quality maps
with R

Jan-Philipp
Kolb

Quick high quality maps with R

Jan-Philipp Kolb

July 7 2021

Motivation

Quick high
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Jan-Philipp Kolb @JanPhilippKolb · 9. Nov. 2020

...

My Day9 #30daymapchallenge. A monochrome map of #Trier in Germany. I made this map with the #rstats #osmplotr package.



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About the tutorial

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- Four sections with each 20 min presentation and 10 minutes testing time for you

Sections

- ① Focus on quick maps - some classics
- ② Basic data structures - Simple Features
- ③ Openstreetmap
- ④ 30 day maps challenge

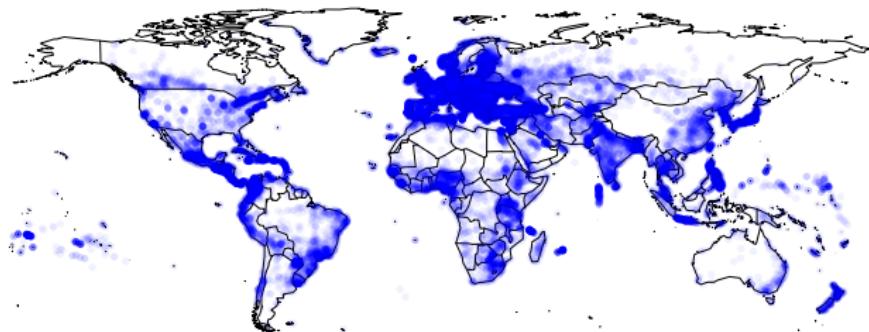
A classic - the maps package

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- Maps package by Richard A. Becker, Allan R. Wilks and Ray Brownrigg

```
library(maps)
data(world.cities)
map()
map.cities(world.cities,col=rgb(0,0,1,.05),cex=2,pch=
```

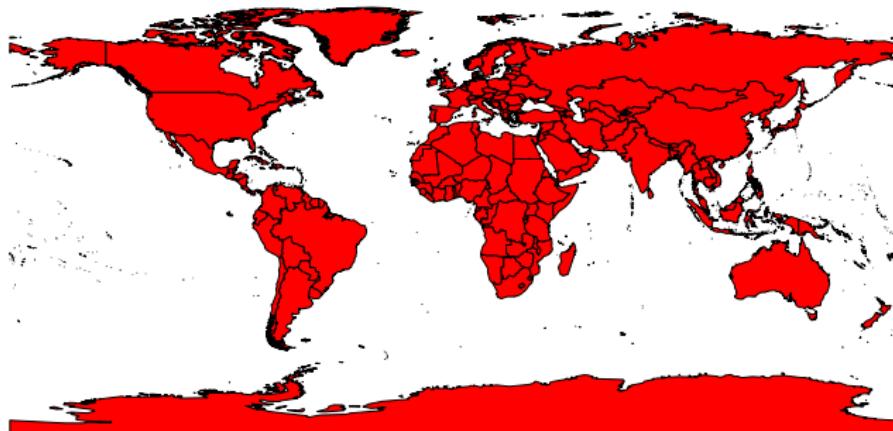


A second classic - maptools package

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```
library(maptools)
data("wrld_simpl")
plot(wrld_simpl,col="red")
```



The wrld_simpl package

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```
head(wrld_simpl@data)
```

Rpubs by RStudio

Show 10 entries											Search: <input type="text"/>		
FIPS	ISO2	ISO3	UN	NAME	AREA	POP2005	REGION	SUBREGION	LONG	LAT			
ATG	AC	AG	ATG	28 Antigua and Barbuda	44	83039	19		29	-61.783	17.078		
DZA	AG	DZ	DZA	12 Algeria	238174	32854159	2		15	2.632	28.163		
AZE	AJ	AZ	AZE	31 Azerbaijan	8260	8352021	142		145	47.395	40.43		
ALB	AL	AL	ALB	8 Albania	2740	3153731	150		39	20.068	41.143		
ARM	AM	AM	ARM	51 Armenia	2820	3017661	142		145	44.563	40.534		
AGO	AO	AO	AGO	24 Angola	124670	16095214	2		17	17.544	-12.296		
ASM	AQ	AS	ASM	16 American Samoa	20	64051	9		61	-170.73	-14.318		

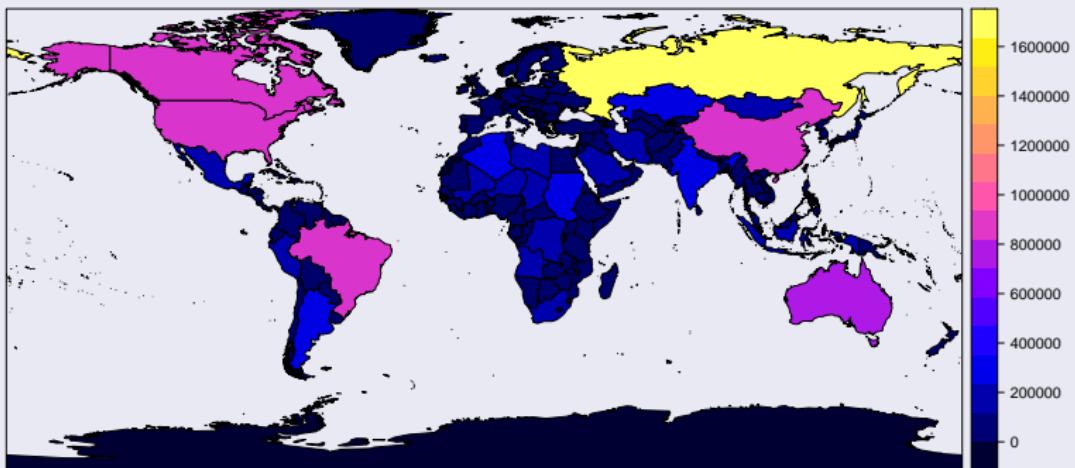
The sp package

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Classes and Methods for Spatial Data

```
sp::spplot(wrld_simpl, "AREA")
```



The `qtm` command from the `tmap` package

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Fast thematic map

- With `qtm` you can create a fast thematic map
- Example from the **Vignette** for the `tmap` package

```
library(tmap)  
data(World)  
qtm(World)
```



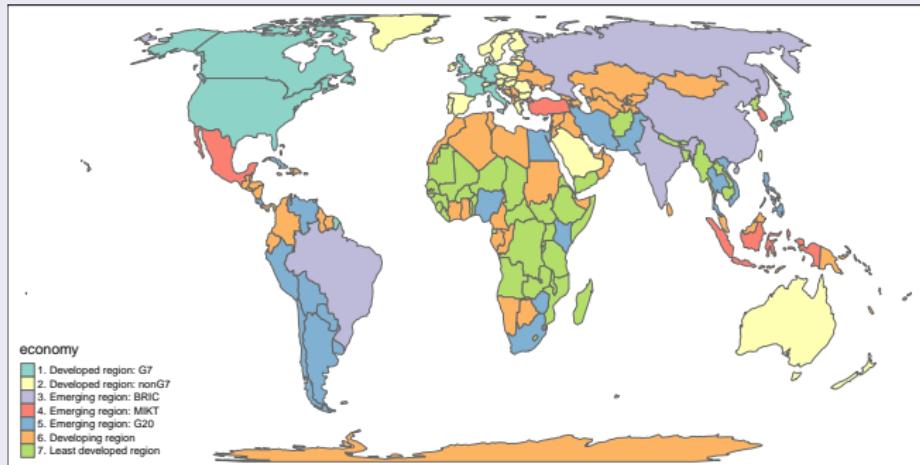
To get more color in the map

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Economic development status

```
library(tmap)
data(World)
qtm(World, fill="economy")
```

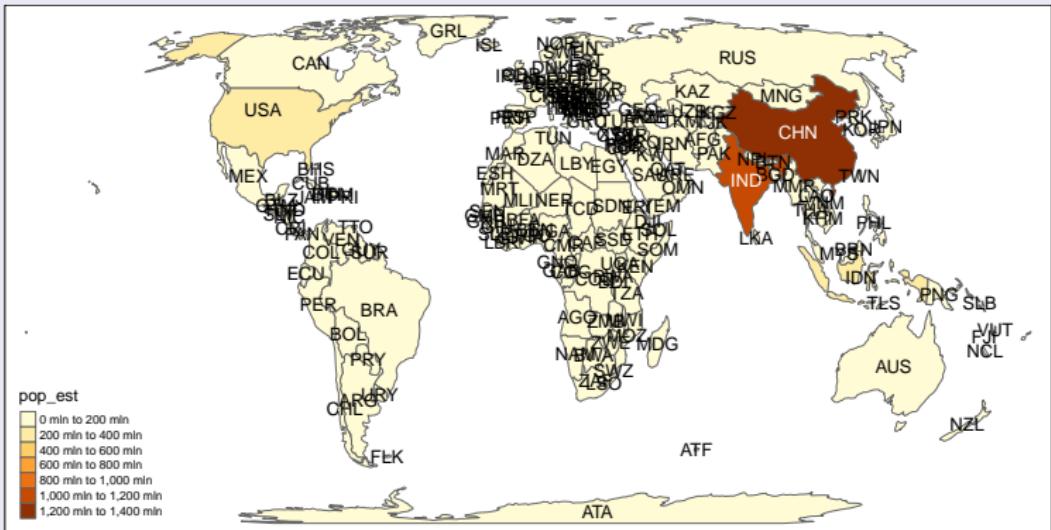


A map with text

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Population

```
qtm(World, fill="pop_est", text="iso_a3")
```



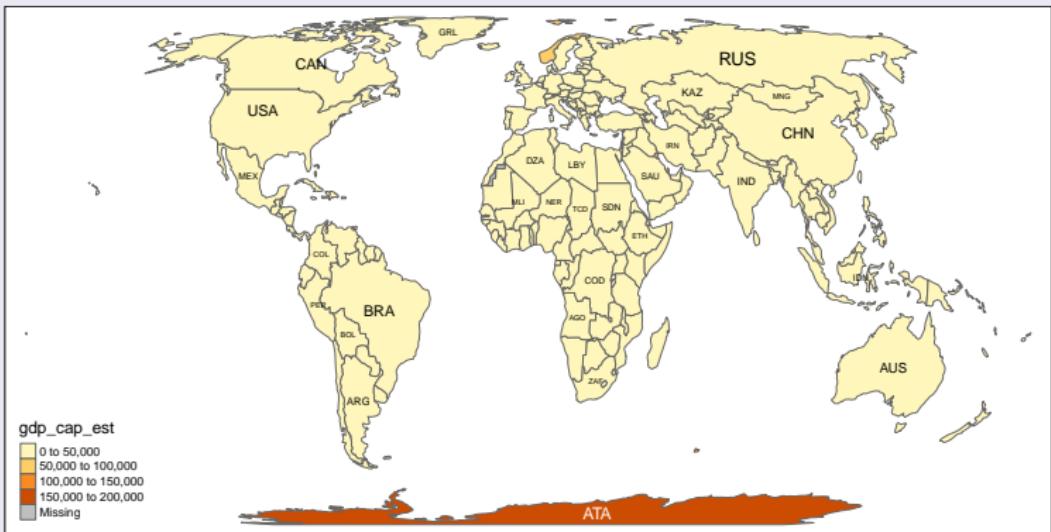
This Scheme is better:

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GDP per capita

```
qtm(World, fill="gdp_cap_est", text="iso_a3",  
text.size="AREA")
```

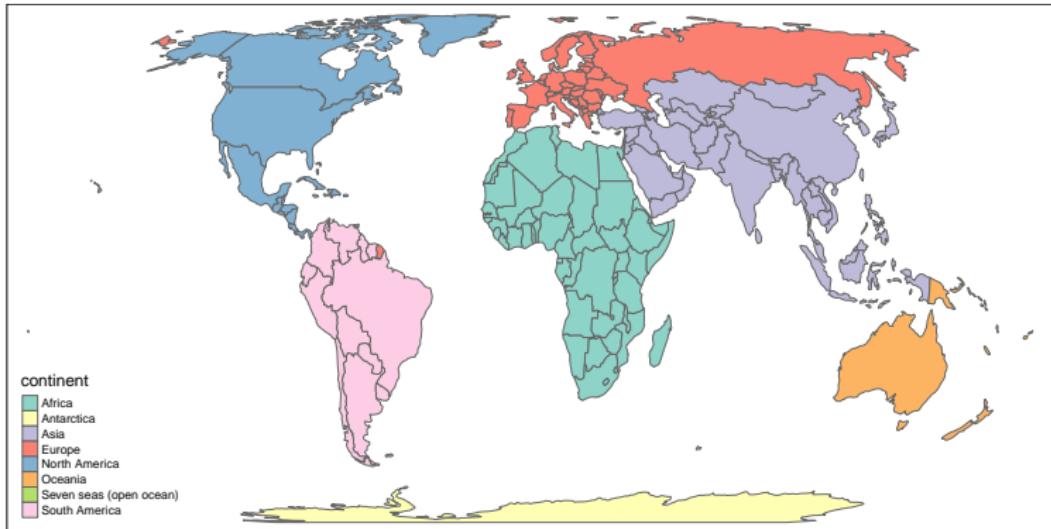


The variable continent

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```
qtm(World, fill="continent")
```

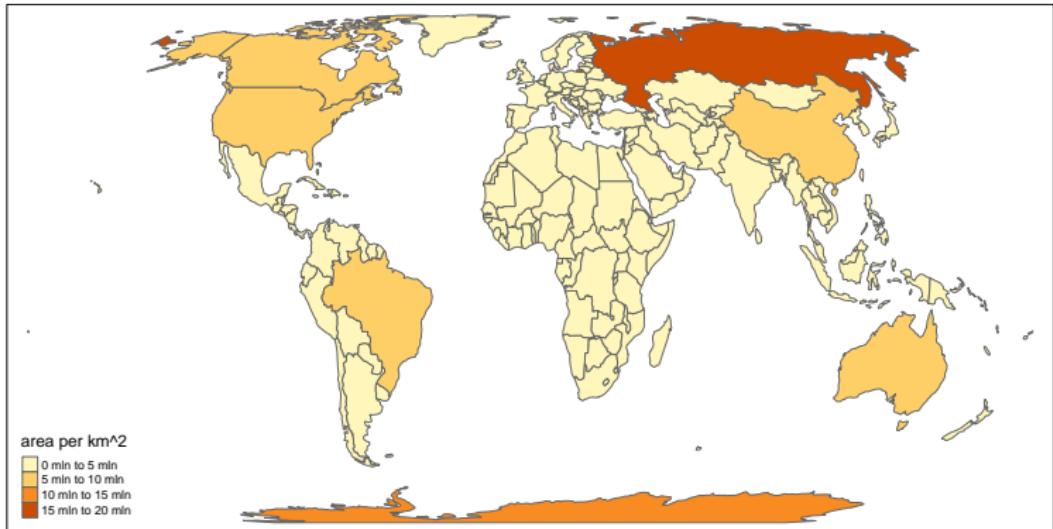


The variable area

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```
qtm(World, fill="area") # Russia is huge
```

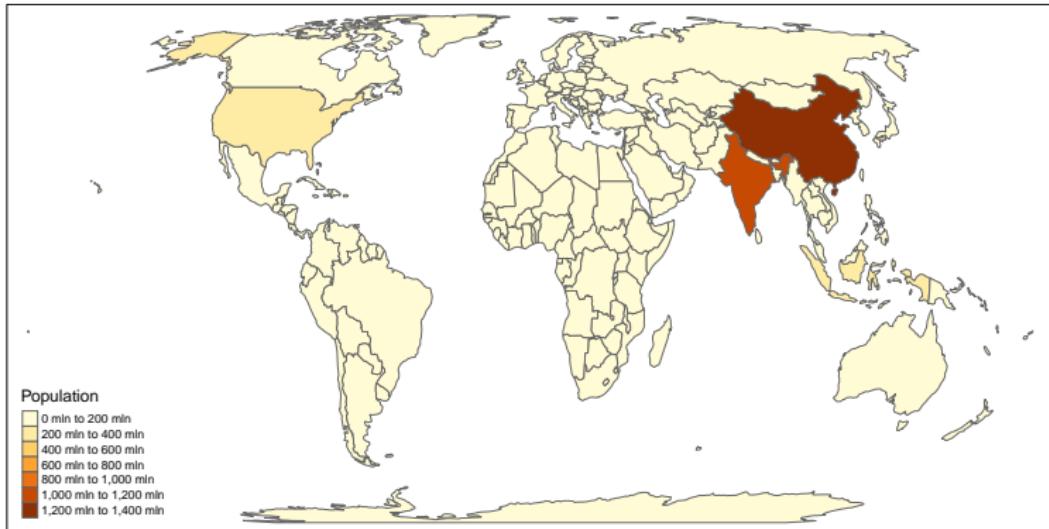


Population

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```
qtm(World, fill="pop_est",fill.title="Population")
```



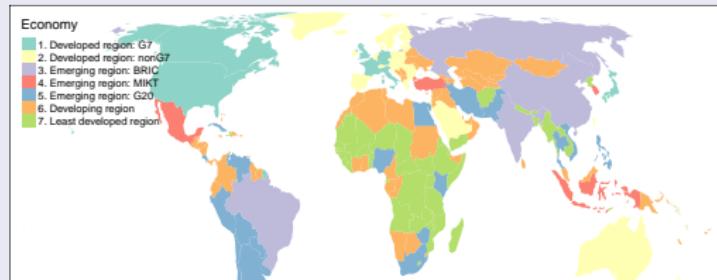
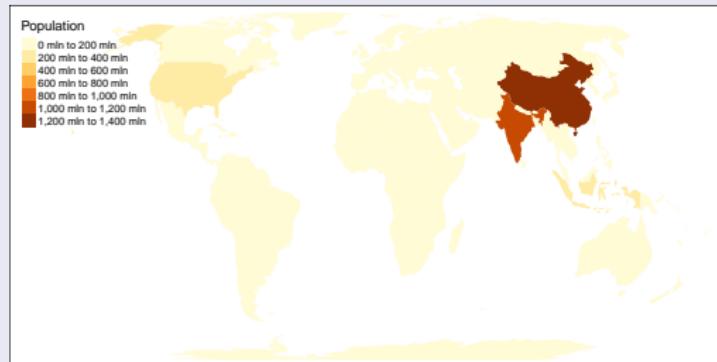
Two maps

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Population and level of development

```
tm_shape(World) + tm_fill(c("pop_est", "economy"),  
                           title=c("Population", "Economy"))
```

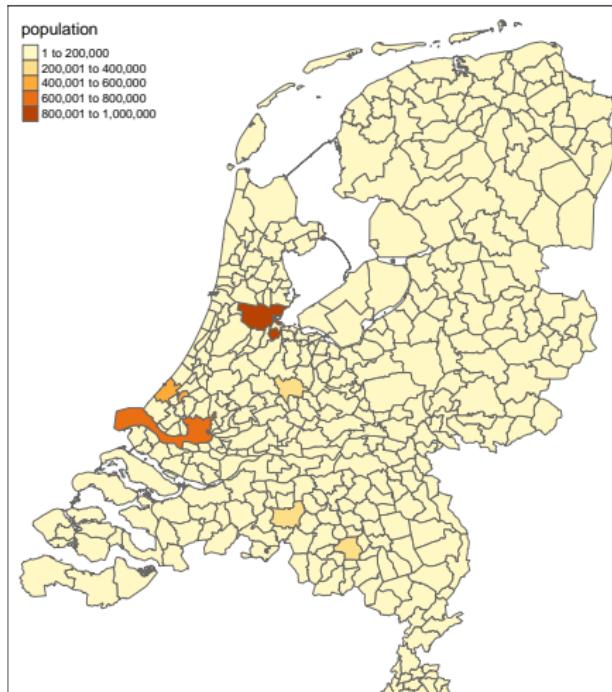


Population in Dutch municipalities

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```
data(NLD_muni)  
qtm(NLD_muni, "population")
```



The World dataset

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Natural Earth

- Dataset contains information from **Natural Earth**

```
library(tmap)  
data(World)
```



Natural Earth

Free vector and raster map data at
1:10m, 1:50m, and 1:110m scales

 Search[Home](#)[Features](#)[Downloads](#)[Blog](#)[Forums](#)[Corrections](#)[About](#)

Natural Earth is a public domain map dataset available at 1:10m, 1:50m, and 1:110 million scales. Featuring tightly integrated vector and raster data, with Natural Earth you can make a variety of visually pleasing, well-crafted maps with cartography or GIS software.

Topics of the World dataset

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Available variables in the data set

- ISO classification
- country name
- Area, population, population density,
- Gross Domestic Product
- Gross domestic product at purchasing power parities
- Economy, income group

Variables of the World Dataset

	economy	income_grp	gdp_cap_est	life_exp	well_being	footprint	inequality	HPI
1	7. Least developed region	5. Low income	784.1549	59.668	3.8	0.79	0.4265574	20.22535
2	7. Least developed region	3. Upper middle income	8617.6635	NA	NA	NA	NA	NA
3	6. Developing region	4. Lower middle income	5992.6588	77.347	5.5	2.21	0.1651337	36.76687
4	6. Developing region	2. High income: nonOECD	38407.9078	NA	NA	NA	NA	NA
	geometry							
1	MULTIPOLYGON (((5310471 451...							
2	MULTIPOLYGON (((1531585 -77...							
3	MULTIPOLYGON (((1729835 521...							
4	MULTIPOLYGON (((4675864 313...							

Section 2: Basic data structures

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Simple Features

`library(sf)`



Simple Features

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```
class(World)
```

```
## [1] "sf"           "data.frame"
```

- **Vignette of the sf package**

Attribute values and an abridged version of the geometry

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```
## Simple feature collection with 100 features and 6 fields
## geometry type:  MULTIPOLYGON
## dimension:      XY
## bbox:            xmin: -84.32385 ymin: 33.88199 xmax: -75.45698 ymax: 36.58965
## epsg (SRID):    4267
## proj4string:    +proj=longlat +datum=NAD27 +no_defs
## precision:      double (default; no precision model)
## First 3 features:
##   BIR74 SID74 NWBIR74 BIR79 SID79 NWBIR79
## 1 1091     1     10 1364     0     19 MULTIPOLYGON((( -81.47275543...
## 2 487      0     10  542     3     12 MULTIPOLYGON((( -81.23989105...
## 3 3188     5     208 3616     6     260 MULTIPOLYGON((( -80.45634460...
```

Simple feature

Simple feature geometry list-column (sfc)

Simple feature geometry (sfg)

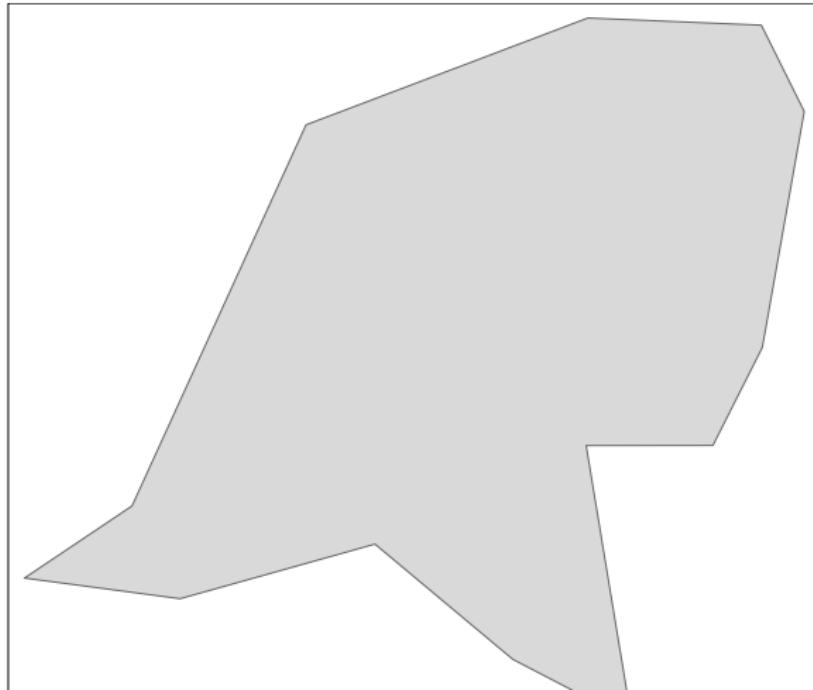
->

Use another country

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```
tm_shape(World[World$name=="Netherlands", ]) +  
  tm_polygons()
```



Eurostat Data

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```
library(dplyr)  
library(ggplot2)
```

Tools for Eurostat Open Data

```
library(eurostat)
```

```
# Download Geospatial Data from GISCO:  
df60 <- get_eurostat_geospatial(resolution = 60)  
# Same data - less detailed:  
df1 <- get_eurostat_geospatial(resolution = 1)
```

The dataset

	id	CNTR_CODE	NUTS_NAME	LEVL_CODE	FID	NUTS_ID	geometry	geo
1	BG	BG	БЪЛГАРИЯ	0	BG	BG	[object Object]	BG
2	CH	CH	SCHWEIZ/SUISSE/SVIZZERA	0	CH	CH	[object Object]	CH
3	CY	CY	КУПРОС	0	CY	CY	[object Object]	CY

A more detailed map of the Netherlands

```
plot(df60[df60$LEVL_CODE == 0 &  
          df60$CNTR_CODE == "NL",1])
```

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NUTS2 of the Netherland

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```
CE.sf <- df60 %>%
  filter(LEVL_CODE == 2 &
CNTR_CODE %in% c("NL")) %>%
  select(NUTS_ID)
plot(CE.sf,col=1:12)
```



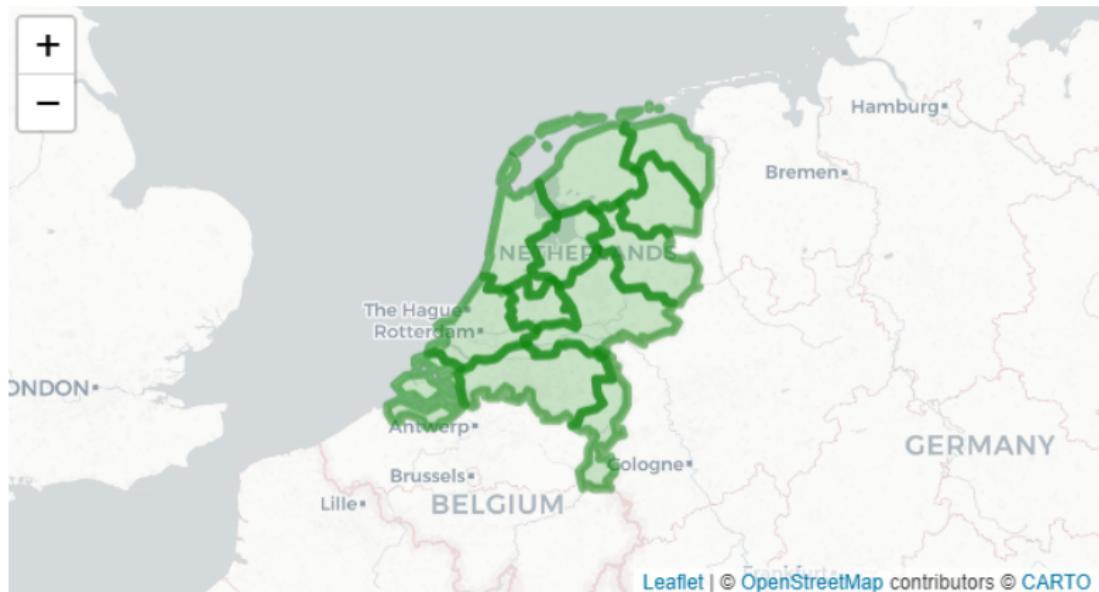
- NUTS 3 is the limit

An interactive map of the Netherlands

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```
library(leaflet)  
leaflet(CE.sf) %>%  
  addProviderTiles("CartoDB.Positron") %>%  
  addPolygons(color = "green")
```

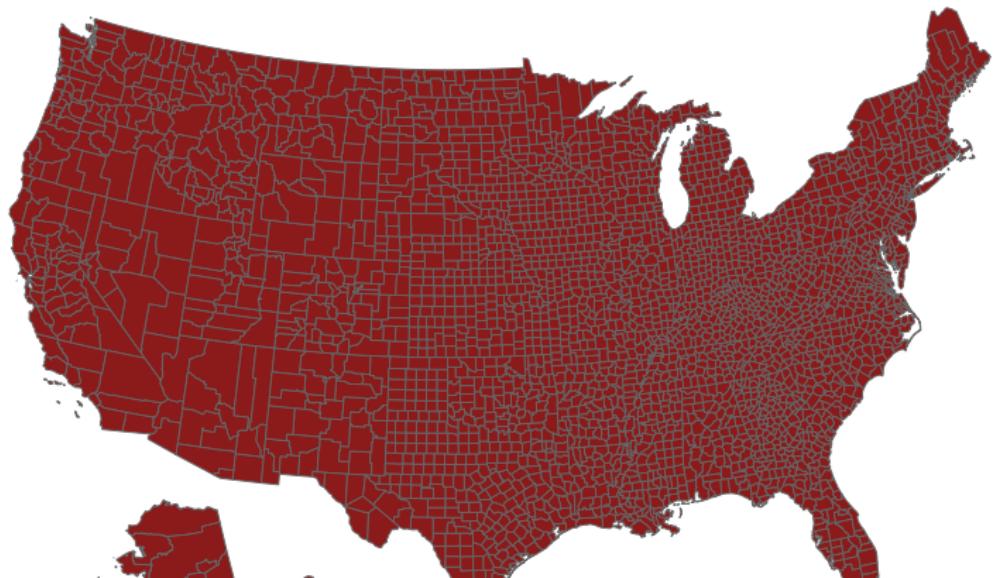


The package `tidycensus`

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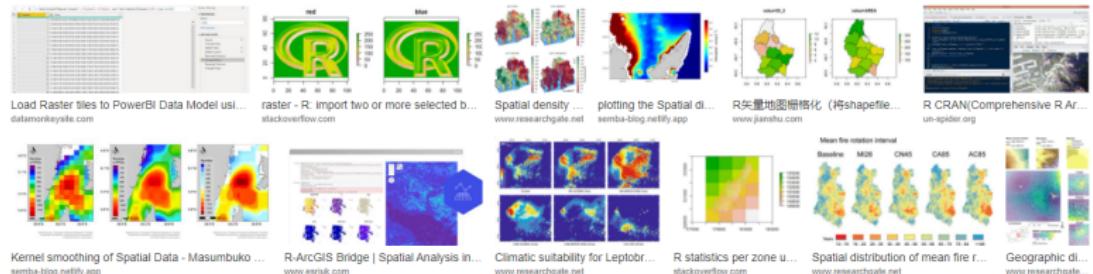
```
library(tidycensus)  
data(county_laea)  
  
qtm(county_laea, fill=c("#8B1A1A"))
```



raster - Geographic Data Analysis and Modeling

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Description:

Reading, writing, manipulating, analyzing and modeling of spatial data. The package implements basic and high-level functions for raster data and for vector data operations such as intersections.

Author and contributors:

Robert J. Hijmans [cre, aut], Jacob van Etten [ctb], Michael Sumner [ctb], Joe Cheng [ctb], Dan Baston [ctb], Andrew Bevan [ctb], Roger Bivand [ctb], and many more

Global Administrative Boundaries

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Get the data

```
FRA4 <- raster:::getData('GADM', country='FRA',  
                           level=4)
```

Overview of the data

Rpubs by RStudio

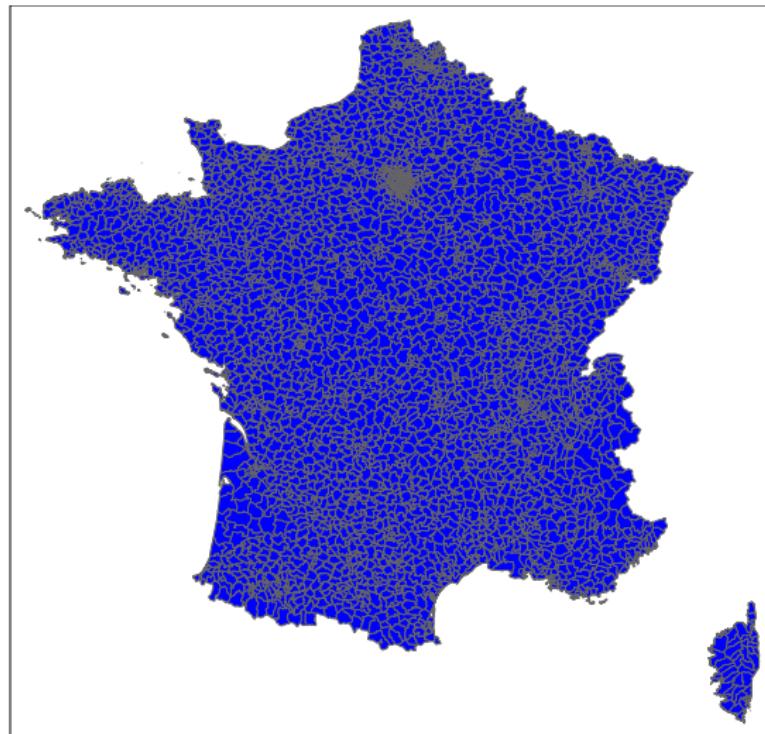
Show 10 entries											Search: <input type="text"/>
	GID_0	NAME_0	GID_1	NAME_1	GID_2	NAME_2	GID_3	NAME_3	GID_4	NAME_4	
1	FRA	France	FRA.1_1	Auvergne-Rhône-Alpes	FRA.1.1_1	Ain	FRA.1.1.1_1	Belley	FRA.1.1.1.1_1	Ambérieu-en-Bugey	
2	FRA	France	FRA.1_1	Auvergne-Rhône-Alpes	FRA.1.1_1	Ain	FRA.1.1.1_1	Belley	FRA.1.1.1.2_1	Belley	
3	FRA	France	FRA.1_1	Auvergne-Rhône-Alpes	FRA.1.1_1	Ain	FRA.1.1.1_1	Belley	FRA.1.1.1.3_1	Champagne-en-Valromey	
4	FRA	France	FRA.1_1	Auvergne-Rhône-Alpes	FRA.1.1_1	Ain	FRA.1.1.1_1	Belley	FRA.1.1.1.4_1	Hauteville-Lompnes	
5	FRA	France	FRA.1_1	Auvergne-Rhône-Alpes	FRA.1.1_1	Ain	FRA.1.1.1_1	Belley	FRA.1.1.1.5_1	Lagnieu	
6	FRA	France	FRA.1_1	Auvergne-Rhône-Alpes	FRA.1.1_1	Ain	FRA.1.1.1_1	Belley	FRA.1.1.1.6_1	Lhuis	

Plot the map

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```
qtm(FRA4, fill="blue")
```

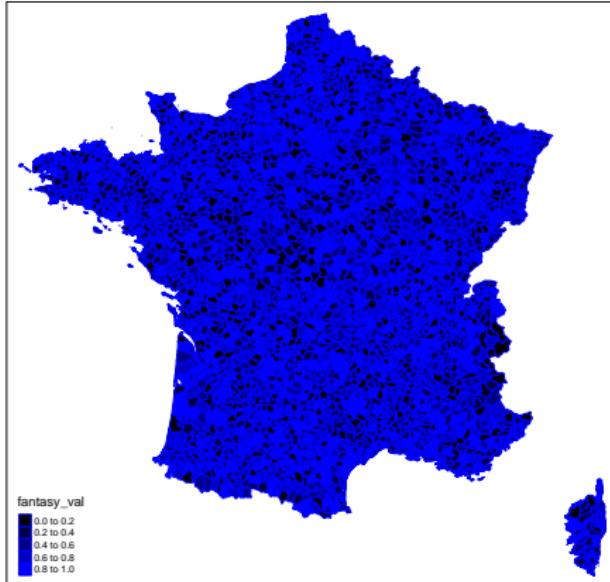


Create colour gradation

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```
FRA4$fantasy_val <- runif(nrow(FRA4))  
qtm(FRA4, "fantasy_val",  
    fill.palette = rgb(0,0,seq(0,1,.1),0),  
    borders = "blue")
```



Section 3 - Openstreetmap data

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Example: Overpass API

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The screenshot shows the Overpass Turbo web application interface. At the top, there is a menu bar with options: Ausführen, Teilen, Export, Wizard, Speichern, Laden, Einstellungen, Hilfe, overpass turbo, and a search bar. Below the menu is a toolbar with icons for zooming, panning, and saving. The main area consists of two parts: a code editor on the left and a map on the right. The code editor contains the following Overpass query:

```
/*
This is an example Overpass query.
Try it out by pressing the Run button above!
You can find more examples with the Load tool.
*/
node
[leisure=playground]
((bbox));
out;
```

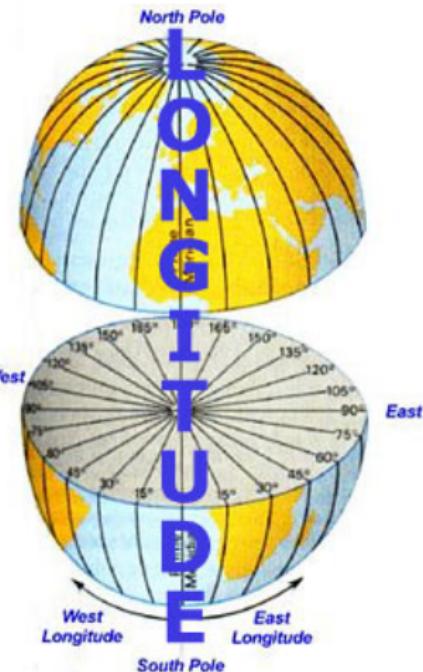
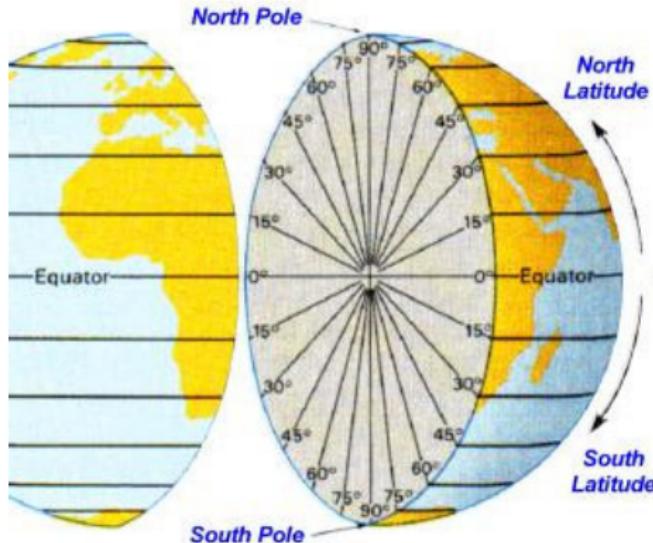
The map displays a geographic area with various locations labeled, such as Frankenthal (Pfalz), Kaiserslautern, and Ludwigshafen. Numerous blue circles are scattered across the map, representing the locations found by the Overpass query. The map also shows roads, rivers, and other geographical features.

Longitude and Latitude

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LATITUDE



tmaptools - Thematic Map Tools

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```
library(tmaptools)
```

Author: Martijn Tennekes

```
citation("tmaptools")
```

Description

Set of tools for reading and processing spatial data. The aim is to supply the workflow to create thematic maps. This package also facilitates 'tmap', the package for visualizing thematic maps.

Geocoordinates

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```
(gc_z <- geocode_OSM("Zürich"))

## $query
## [1] "Zürich"
##
## $coords
##           x           y
## 8.541042 47.374449
##
## $bbox
##       xmin       ymin       xmax       ymax
## 8.448006 47.320220 8.625441 47.434666
```

Get more information

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```
gc_z <- geocode_OSM("Zürich",details = T)  
names(gc_z)
```

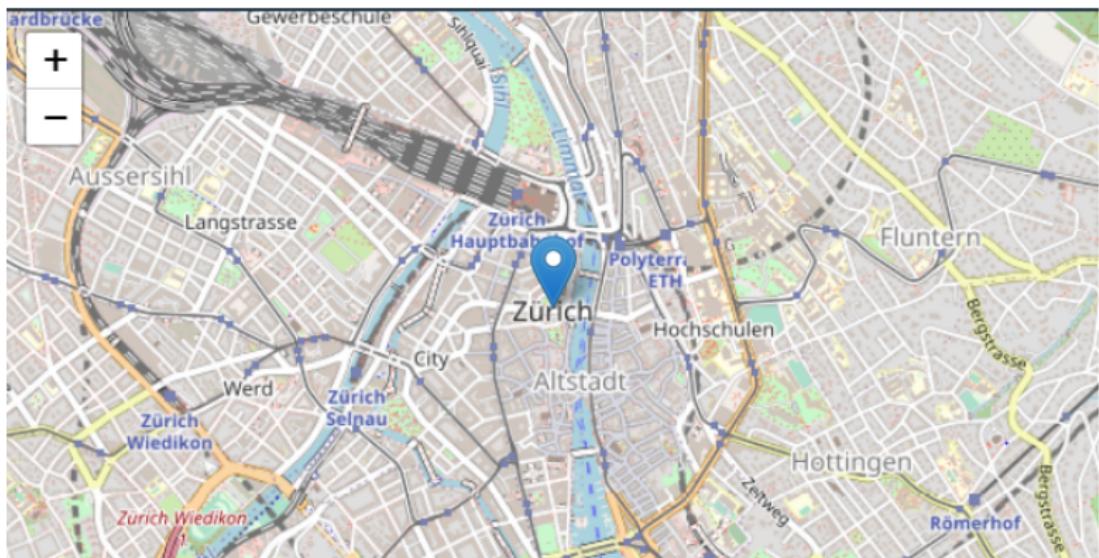
```
## [1] "query"          "coords"        "bbox"  
## [6] "osm_id"         "place_rank"    "display_name"  
## [11] "importance"     "icon"
```

An interactive map with a popup

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```
library(leaflet)
gcz <- geocode_OSM("Zürich")
leaflet() %>% addTiles() %>%
  addMarkers(lng=gcz$coords[1] , lat=gcz$coords[2] ,
             popup="The conference place")
```



A package to get Openstreetmap data

Quick high quality maps with R

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Author: Mark Padgham

```
library(osmplotr)
```

```
citation("osmplotr")
```

The collage includes:

- A GitHub profile for "jan philipp" with a bio: "Meintest du: komplott".
- A screenshot of a map titled "Creating continuous coloured maps with osmplotr" from musardius.be.
- A screenshot of the GitHub repository "ropensci/osmplotr" showing a plot of OpenStreetMap data.
- A logo for "Bespoke Images of OpenStreetMap Data" featuring a blue hexagon with a white "R" and "D".
- A dark-themed map titled "osmplotr" with a large watermark.
- A screenshot of a tweet by Oxpjerry, Maria Averick, with a link to "Making awesome maps with osmplotr".
- A screenshot of the CRAN mirror "cran/osmplotr" on GitHub.
- A screenshot of a map titled "Data Maps - OpenSci: osmplotr" from docs.ropensci.org.
- A screenshot of a Twitter post with the "osmplotr" hashtag.
- A screenshot of a map titled "Bespoke Images of OpenStreetMap Data - osmplotr" from docs.ropensci.org.
- A screenshot of a map titled "Create custom maps from openstreetmap - RECh" from gisfridat.netlify.app.

Buildings within a bounding box

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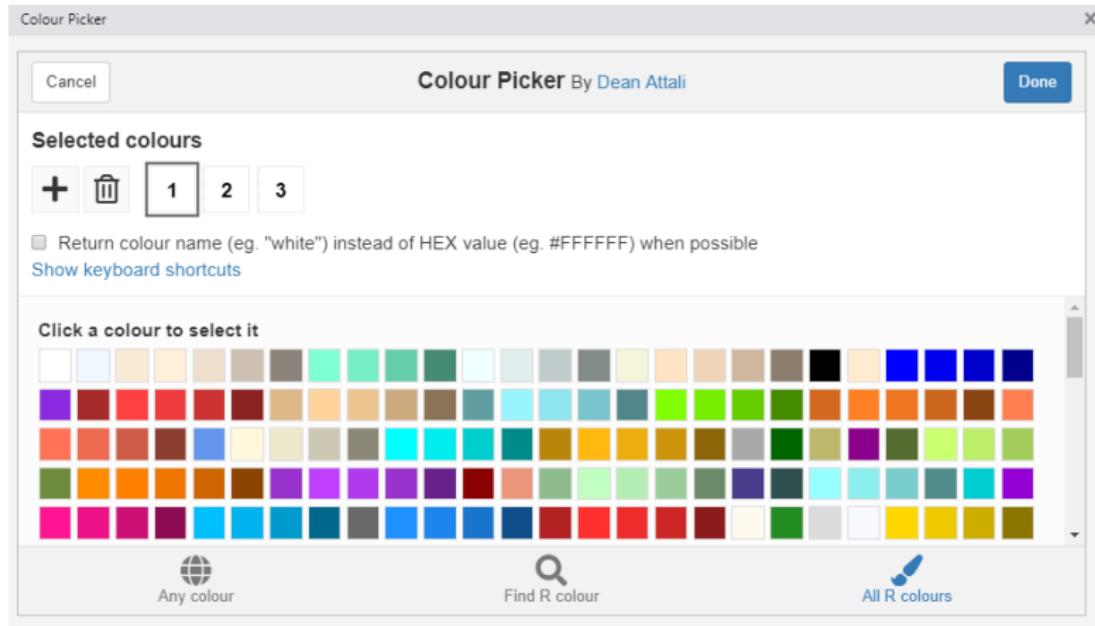
```
bbox <- get_bbox (c(8.4539 , 49.4805 ,  
                    8.4774 , 49.4943 ))  
dat_M <- extract_osm_objects (key = 'building',  
                                bbox = bbox)  
  
qtm(dat_M,fill=c("purple"),borders="black")
```



Colour picker

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The package osmdata

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Install and load osmdata

```
install.packages("osmdata")
```

```
library(osmdata)
```

Get a bounding box for a city

```
bbox <- getbb("Berlin")
```

Streets of Berlin

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OSM Map Feature key=highway value=primary

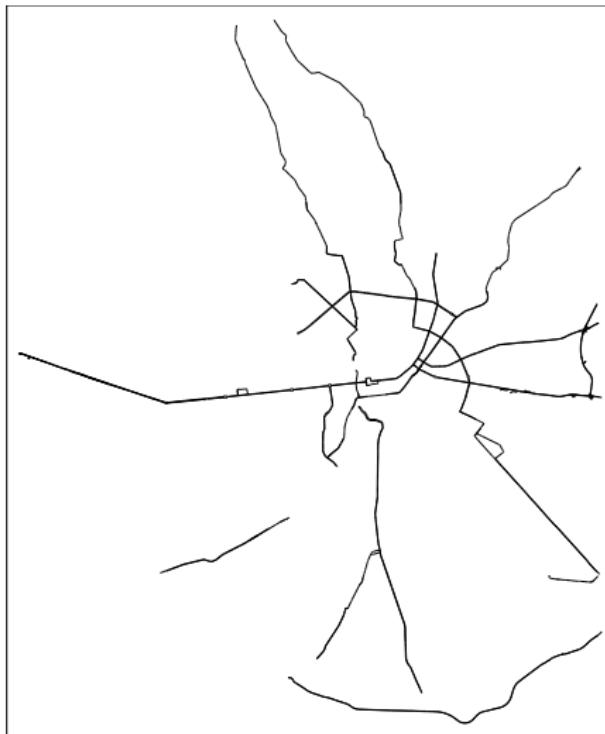
highway	primary	<input checked="" type="checkbox"/>	The next most important roads in a country's system.. (Often link larger towns.)	 
----------------	---------	-------------------------------------	--	--

Get data with package osmdata

```
dat <- extract_osm_objects(key = 'highway',  
                           value = "primary",  
                           bbox = bbox)
```

A quick map for the primary streets in Berlin

`qtm(dat)`



Get data for secondary roads in Berlin

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OSM map feature

highway

secondary



The next most important roads in a country's system. (Often link towns.)



New Information - same bounding box

```
dat_s <- extract_osm_objects(key = 'highway',  
                           value = "secondary",  
                           bbox = bbox)
```

Plot the map

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```
map <- osm_basemap(bbox = bbox, bg = "#F5F5DC")
map <- add_osm_objects(map, dat, col = "#00008B")
map <- add_osm_objects(map, dat_s, col = "purple")
print_osm_map(map)
```



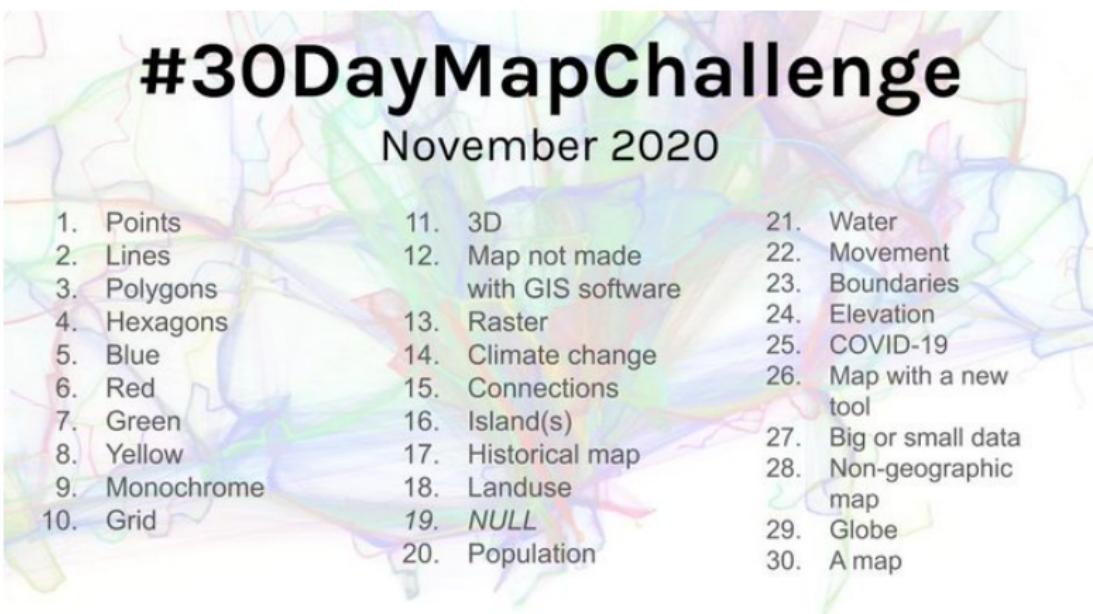
30daymapchallenge

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#30DayMapChallenge

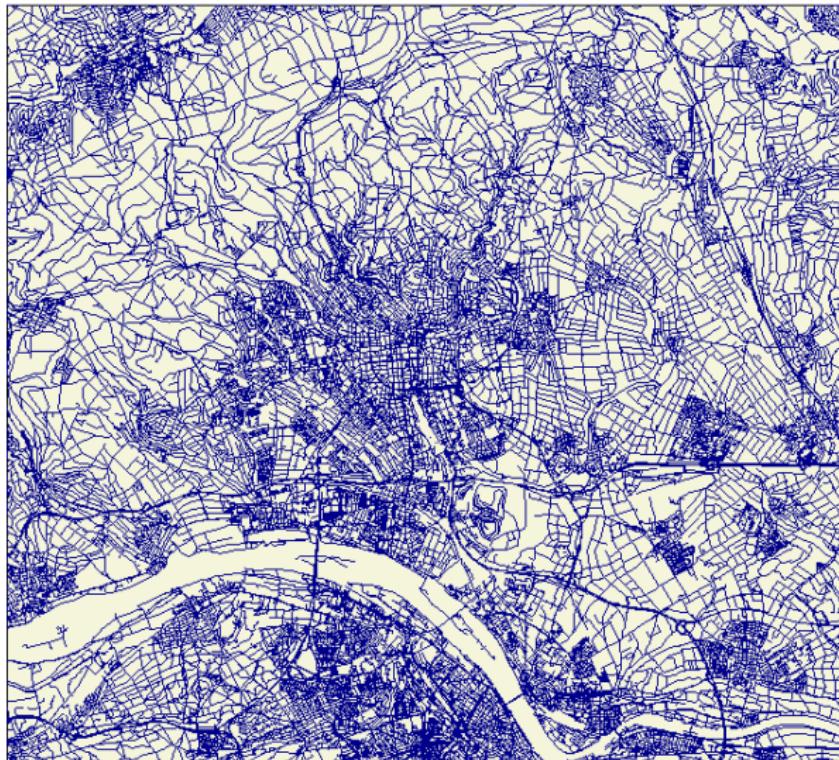
November 2020

- 
1. Points
 2. Lines
 3. Polygons
 4. Hexagons
 5. Blue
 6. Red
 7. Green
 8. Yellow
 9. Monochrome
 10. Grid
 11. 3D
 12. Map not made with GIS software
 13. Raster
 14. Climate change
 15. Connections
 16. Island(s)
 17. Historical map
 18. Landuse
 19. *NULL*
 20. Population
 21. Water
 22. Movement
 23. Boundaries
 24. Elevation
 25. COVID-19
 26. Map with a new tool
 27. Big or small data
 28. Non-geographic map
 29. Globe
 30. A map

Day 9 monochrome

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Load example data

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Data source Eurostat

- Data about unemployment in Europe

```
url <- "https://raw.githubusercontent.com/Japhilko/  
GeoData/master/2015/data/Unemployment07a13.csv"
```

```
Unemp <- read.csv(url)
```

Excursus: the command `match`

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Create two example vectors

```
vec_a <- c("A", 2, 6, 1, "C")
vec_b <- c(1, "C", 2)
```

Bringing the two vectors together

- With the function `match` you can see which element of the first vector matches the second vector.

```
match(vec_a, vec_b)
## [1] NA 3 NA 1 2
```

Use the package tmap with your data

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```
library("tmap")
```

Match the data

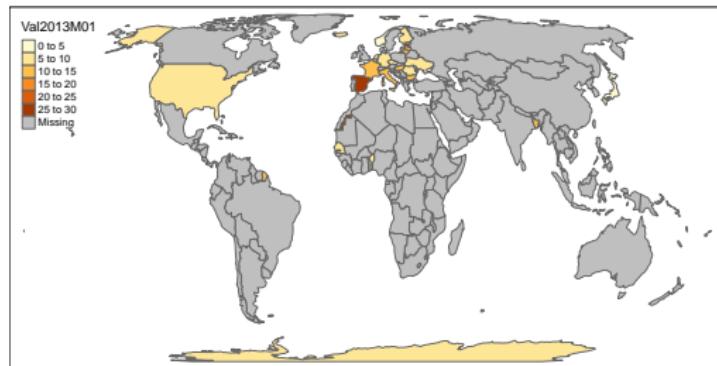
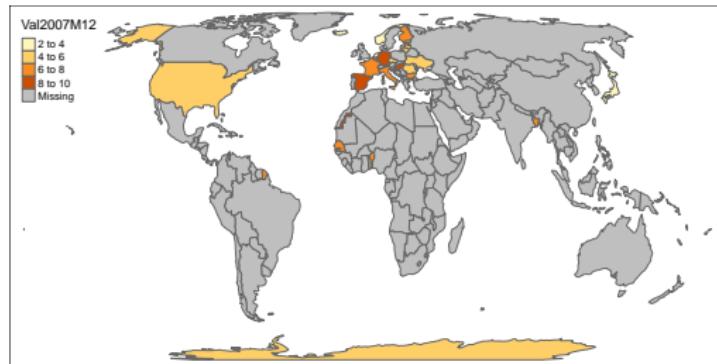
```
iso_a2<- substr(World$iso_a3,1,2)
ind <- match(iso_a2,Unemp$GEO)
World$Val2007M12 <- Unemp$Val2007M12[ind]
World$Val2013M01 <- Unemp$Val2013M01[ind]
```

Plot a map

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```
qtm(World,c("Val2007M12","Val2013M01"))
```

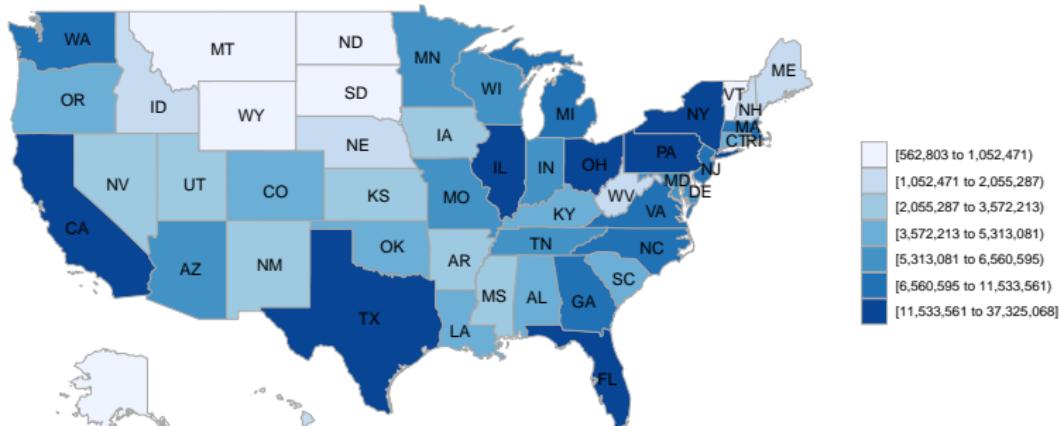


The package choroplethrMaps

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```
library("choroletchr")
library("choroletchrMaps")
data(df_pop_state)
state_choroletch(df_pop_state)
```



OSM Map features

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Amenity

Used to map facilities used by visitors and residents. For example: toilets, telephones, banks, pharmacies, cafes, parking and schools. See the page [Amenities](#) for an introduction on its usage.

Key	Value	Element	Comment	carto-Rendering	Photo
Sustenance					
amenity	bar		Bar is a purpose-built commercial establishment that sells alcoholic drinks to be consumed on the premises. They are characterised by a noisy and vibrant atmosphere, similar to a party and usually don't sell food. See also the description of the tags amenity=pub;bar;restaurant for a distinction between these.		
amenity	biergarten		Biergarten or beer garden is an open-air area where alcoholic beverages along with food is prepared and served. See also the description of the tags amenity=pub;bar;restaurant . A biergarten can commonly be found attached to a beer hall, pub, bar, or restaurant. In this case, you can use biergarten=yes additional to amenity=pub;bar;restaurant .		

Get more data from OSM

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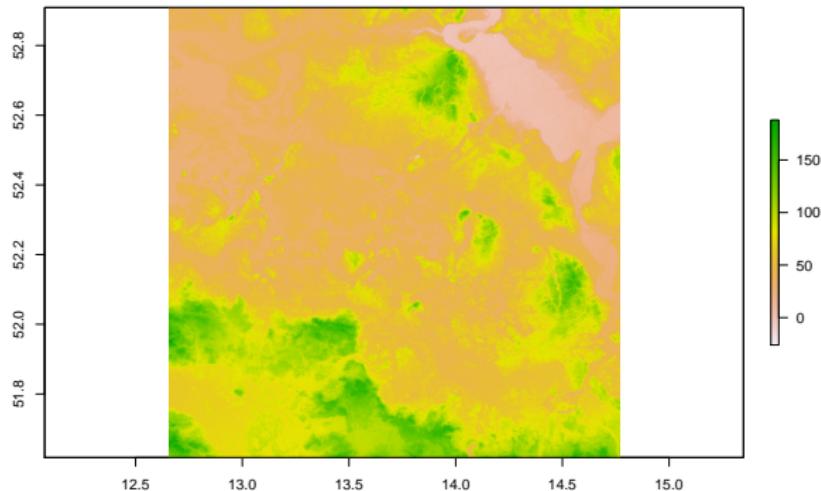
```
bars <- extract_osm_objects(key = 'amenity',  
                           #value = "bar",  
                           bbox = bbox)
```

The elevatr package

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```
library(elevatr)
# load("data/dat_osm_barcelona_metro.Rdata")
elevation <- get_elev_raster(dat, z = 9)
plot(elevation)
```

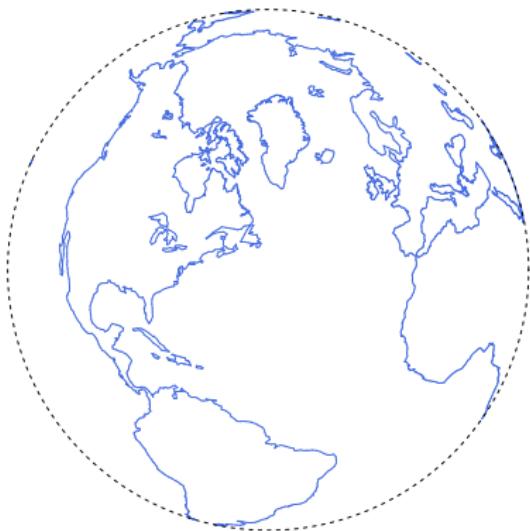


Coming back to the world

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```
library(globe)  
globeearth(eye=place("titanic"), col="royalblue")
```



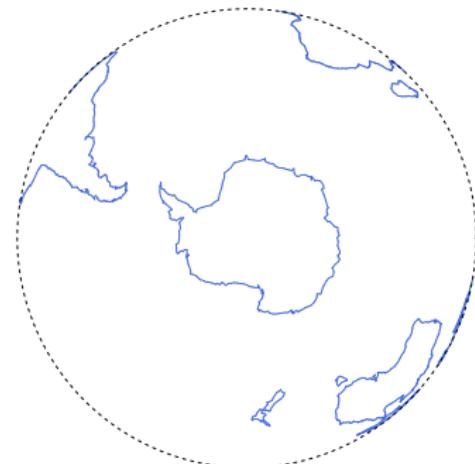
Available places for globeearth

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'nedlands', 'curtin', 'perth', 'northpole', 'southpole', 'casey',
'mawson', 'madrid', 'aarhus', 'aalborg', 'newyorkcity', 'titanic',
'pyongyang', 'everest', 'kilimanjaro'

```
globeearth(eye=place("southpole"), col="royalblue")
```



Resources

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- github repo on osmplotr at **ropensci**; Intro to the package
- #30daymapchallenge
- Spatial Data Science

Further resources

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- Tips for working with images in Rmd files