

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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Organisation

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

Sections

- ① Focus on quick maps - some classics
- ② Data sources and structures
- ③ Openstreetmap
- ④ OSM maps with R

Hello World

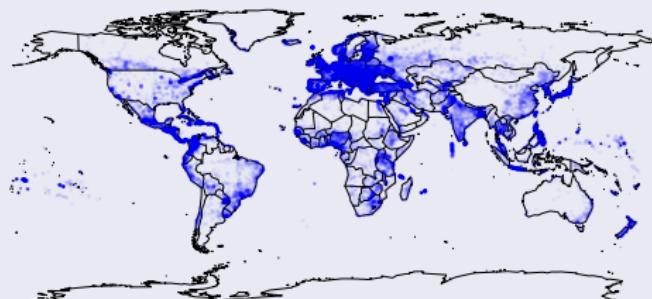
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A classic - the `maps` package

- `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), pch=20)
```

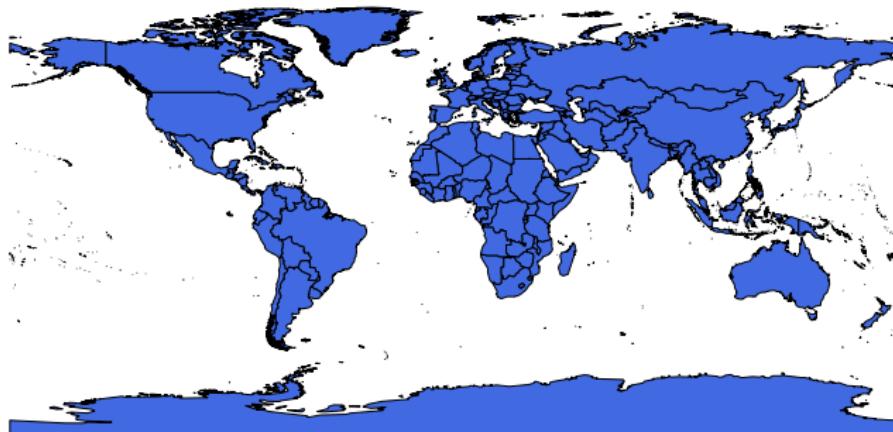


A second classic - maptools package

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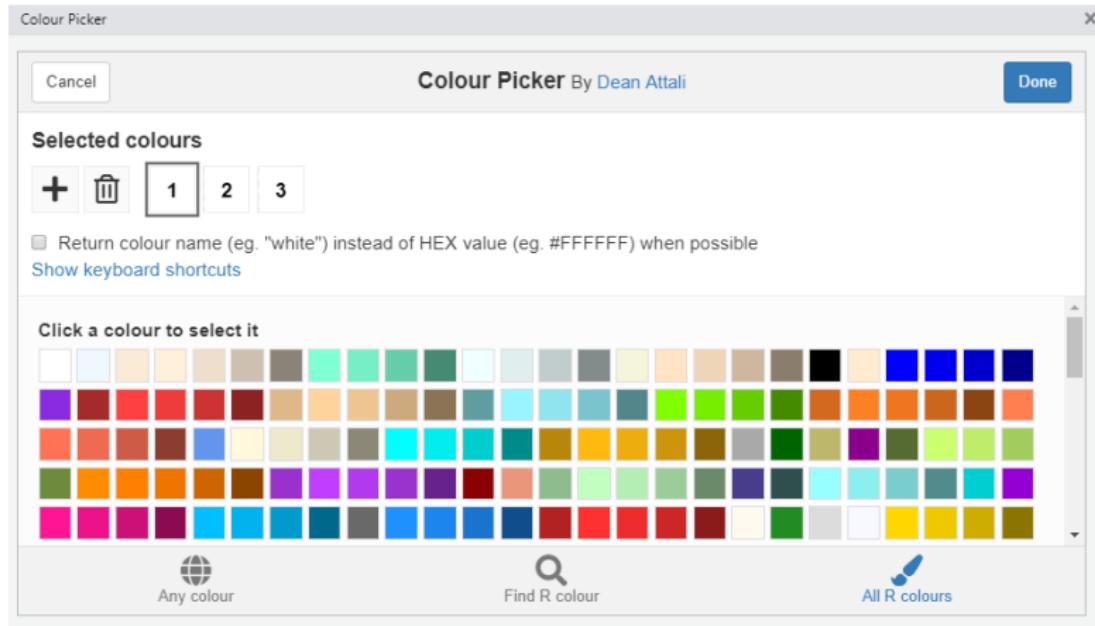
```
library(maptools)
data("wrld_simpl")
plot(wrld_simpl,col="royalblue")
```



Colour picker

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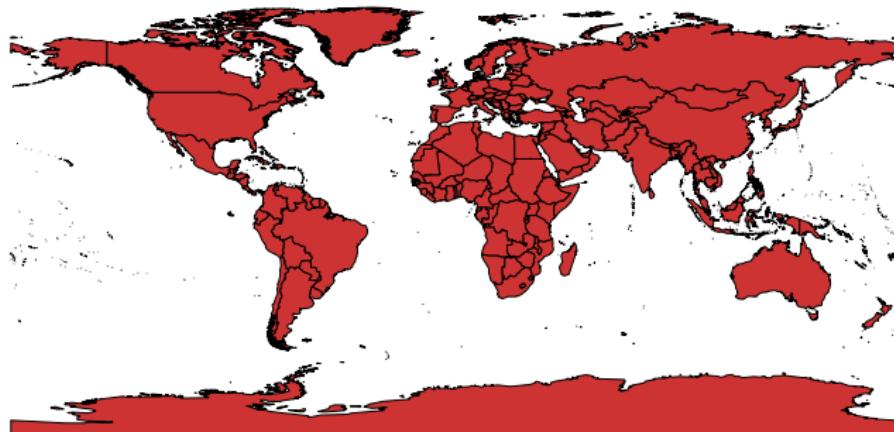


A second classic - maptools package

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```
library(maptools)
data("wrld_simpl")
plot(wrld_simpl,col=c("#CD3333"))
```



The maptools package

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wrld_simpl data

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

Rpubs by RStudio

Show 10 entries

Search:

FIPS	ISO2	ISO3	UN	NAME	AREA	POP2005	REGION	SUBREGION	LON	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

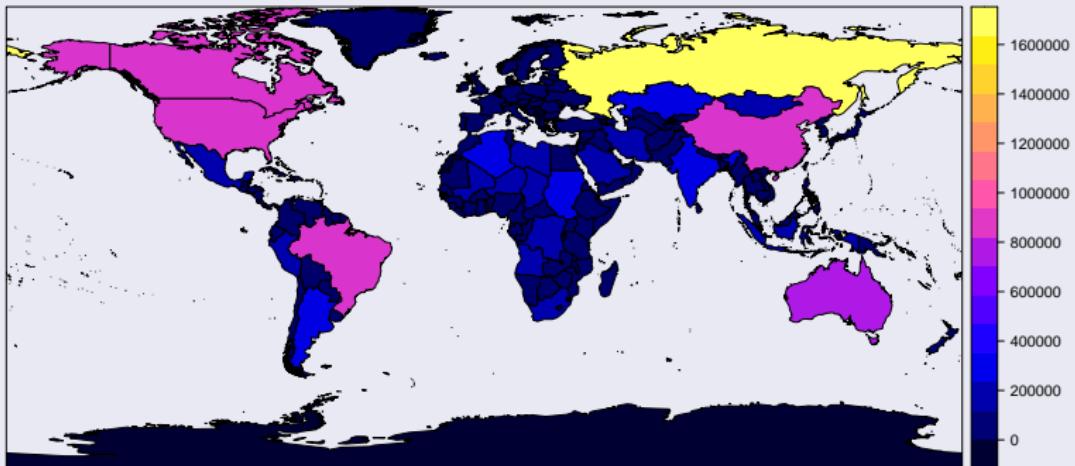
The sp package

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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)
```



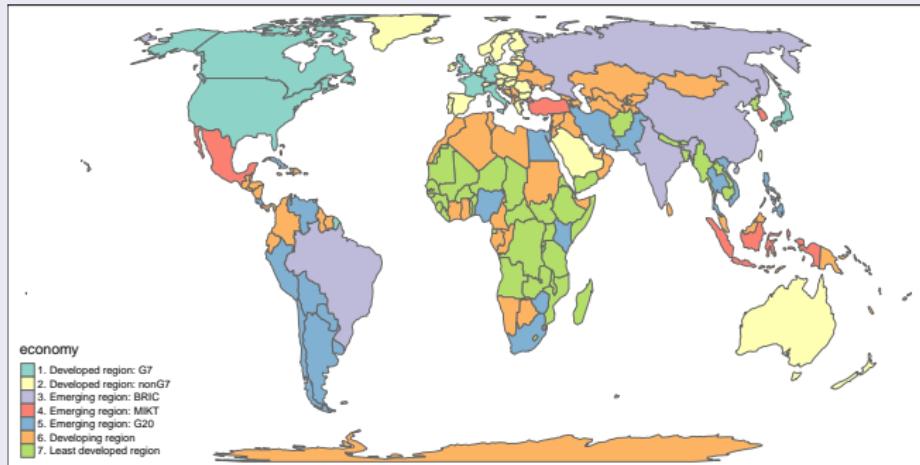
To get more color in the map

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Economic development status

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



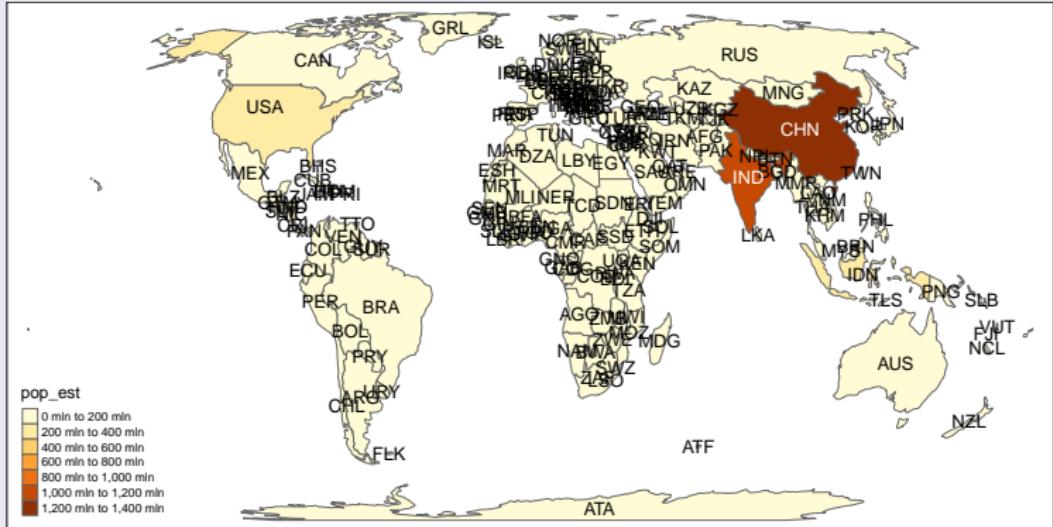
A map with text

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Population

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



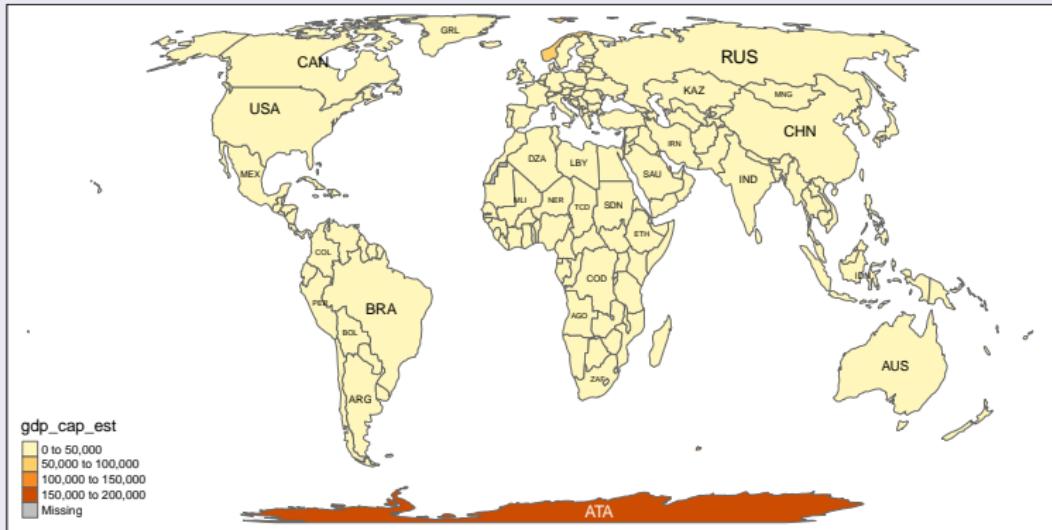
This Scheme is better:

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GDP per capita

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

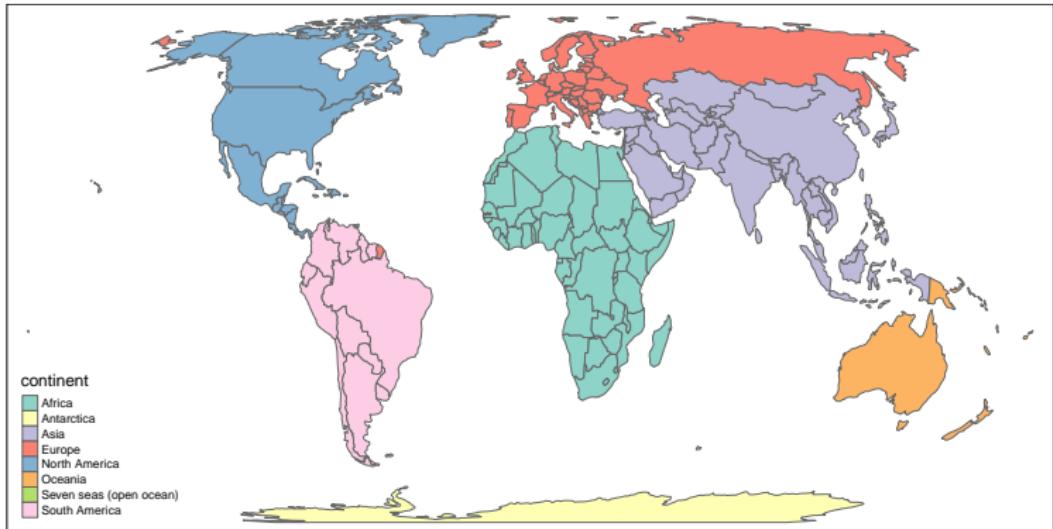


The variable continent

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

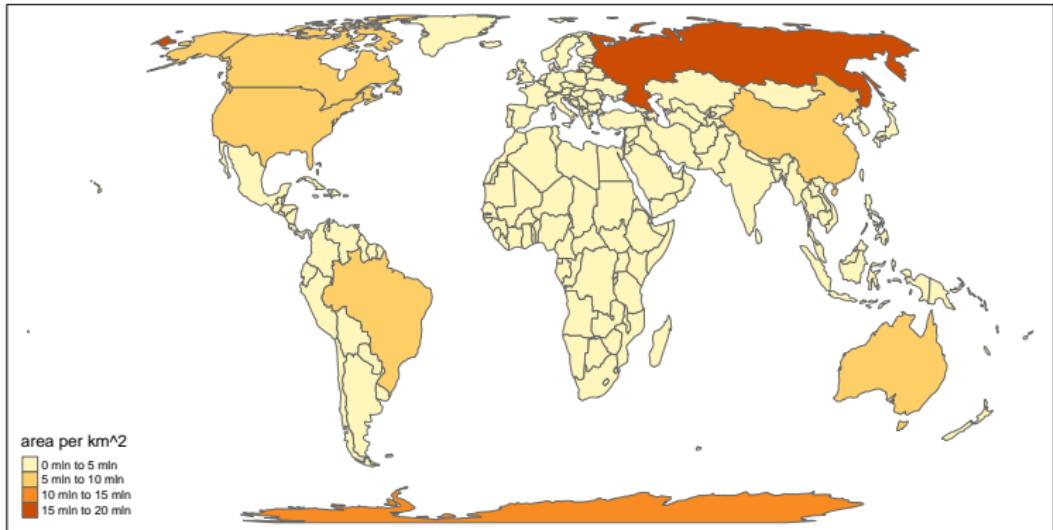


The variable area

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

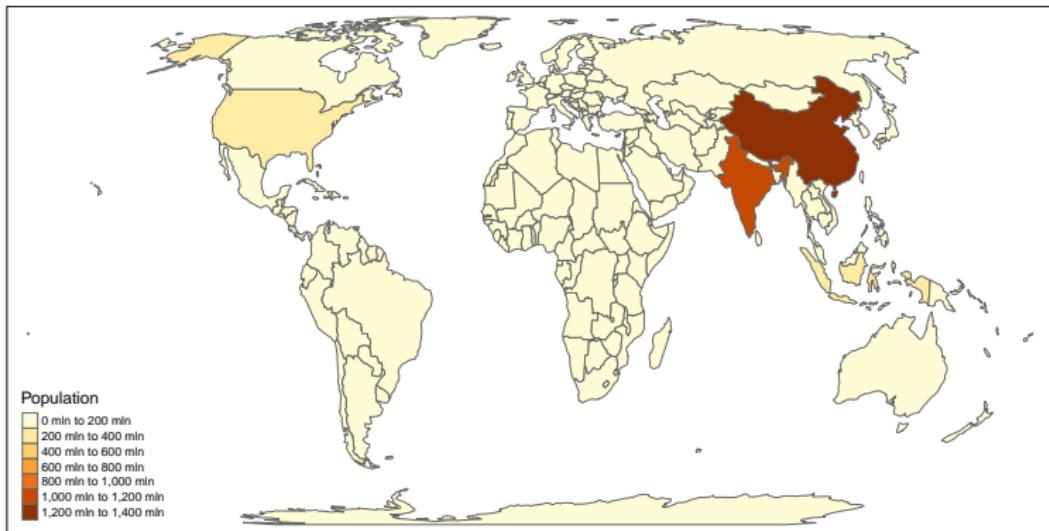


Population

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



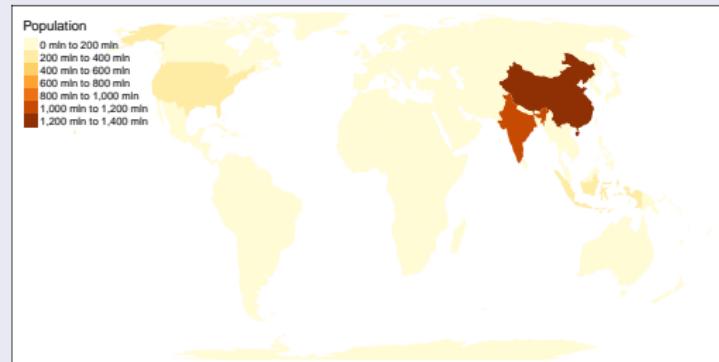
Two maps

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Population and level of development

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

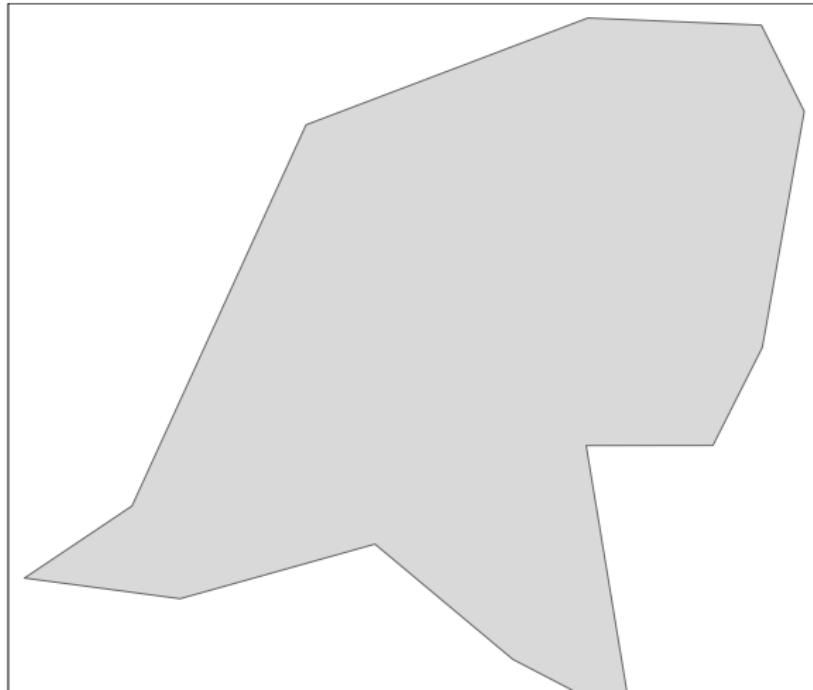


Map for only one country

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

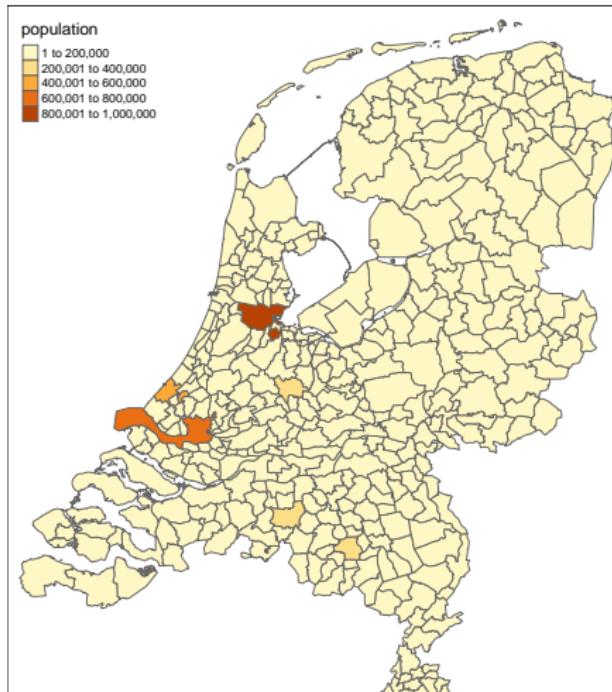


Population in Dutch municipalities

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



About the World dataset

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Natural Earth

- Dataset contains information from **Natural Earth**

```
data(World, package="tmap")
```



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...							

Choropleth

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Choropleth map

From Wikipedia, the free encyclopedia

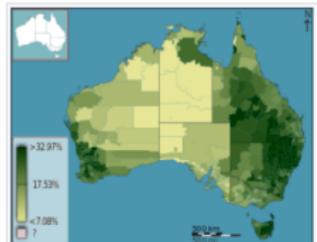


This article **needs additional citations for verification**. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed.

Find sources: "Choropleth map" – news · newspapers · books · scholar · JSTOR (March 2009) (Learn how and when to remove this template message)

A **choropleth map** (from Greek χώρος *choros* 'area/region' and πλῆθος *plethos* 'multitude') is a type of thematic map in which a set of pre-defined areas is colored or patterned in proportion to a statistical variable that represents an aggregate summary of a geographic characteristic within each area, such as population density or per-capita income.

Choropleth maps provide an easy way to visualize how a variable varies across a geographic area or show the level of variability within a region. A **heat map** or **isarithmic map** is similar but uses regions drawn according to the pattern of the variable, rather than the *a priori* geographic areas of choropleth maps. The Choropleth is likely the most common type of thematic map because published statistical data (from government or other sources) is generally aggregated into well-known geographic units, such as countries, states, provinces, and counties, and thus they are relatively easy to create using **GIS**, spreadsheets, or other software tools.

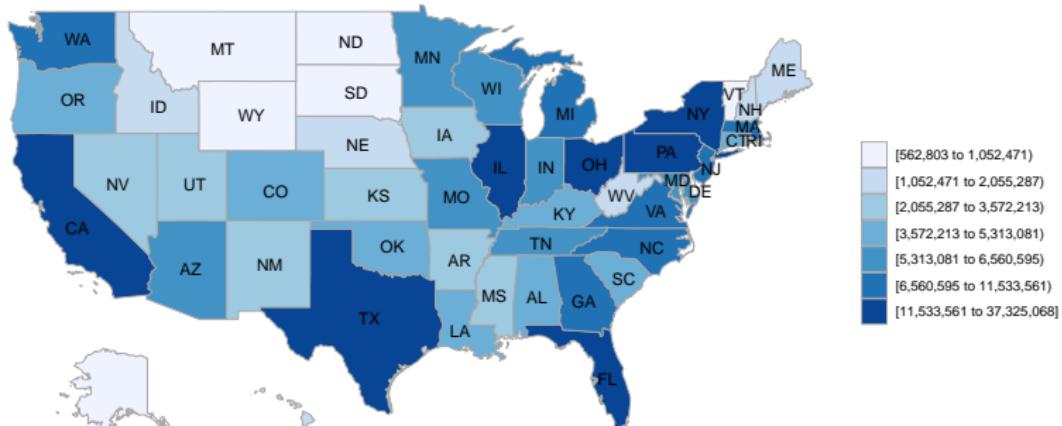


The package choroplethrMaps

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



Argument zoom

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```
state_choropleth(df_pop_state,  
                  zoom=c("california","nevada"))
```

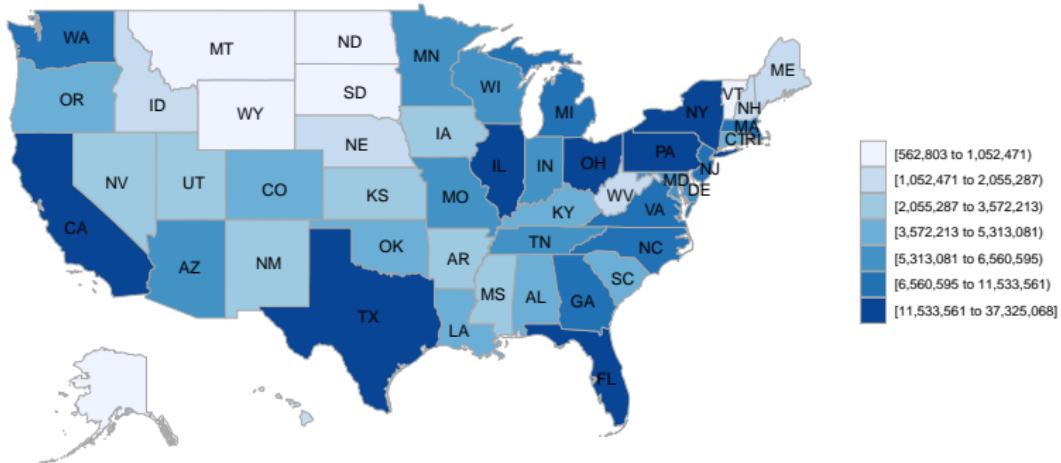


US population 2012

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`state_choropleth(df_pop_state)`

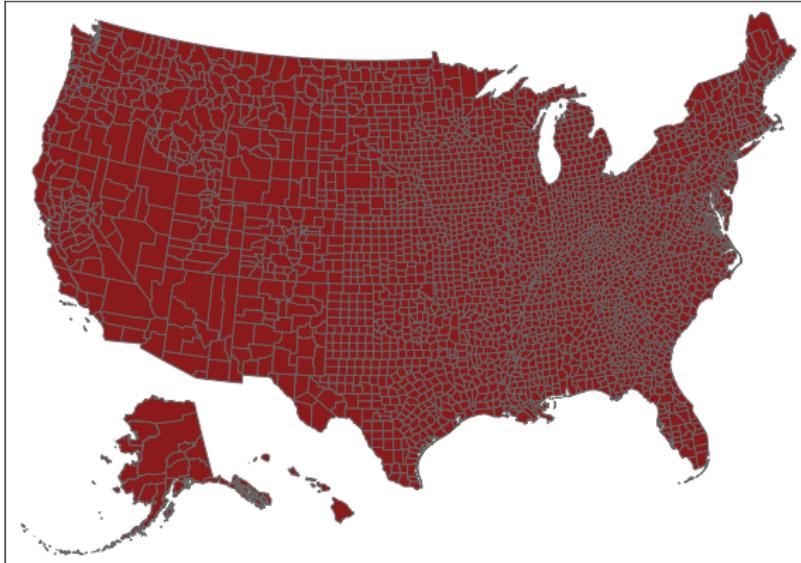


The package `tidycensus`

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

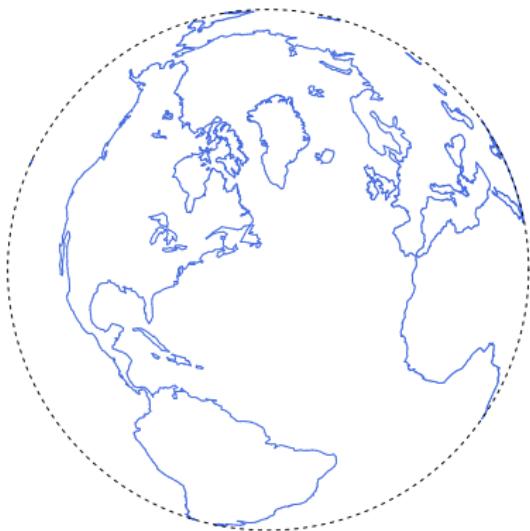


Coming back to the world

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



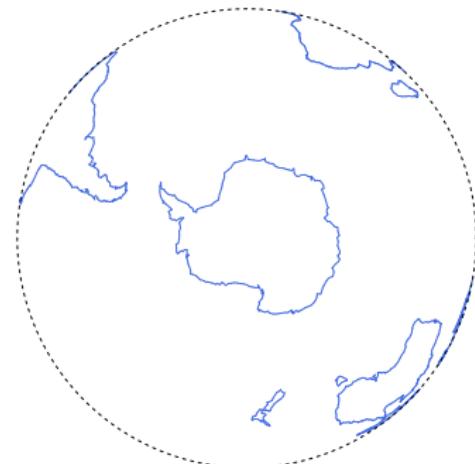
Available places for globeearth

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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")
```



Section 2: Data sources and structures

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Simple Features

`library(sf)`



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)
```



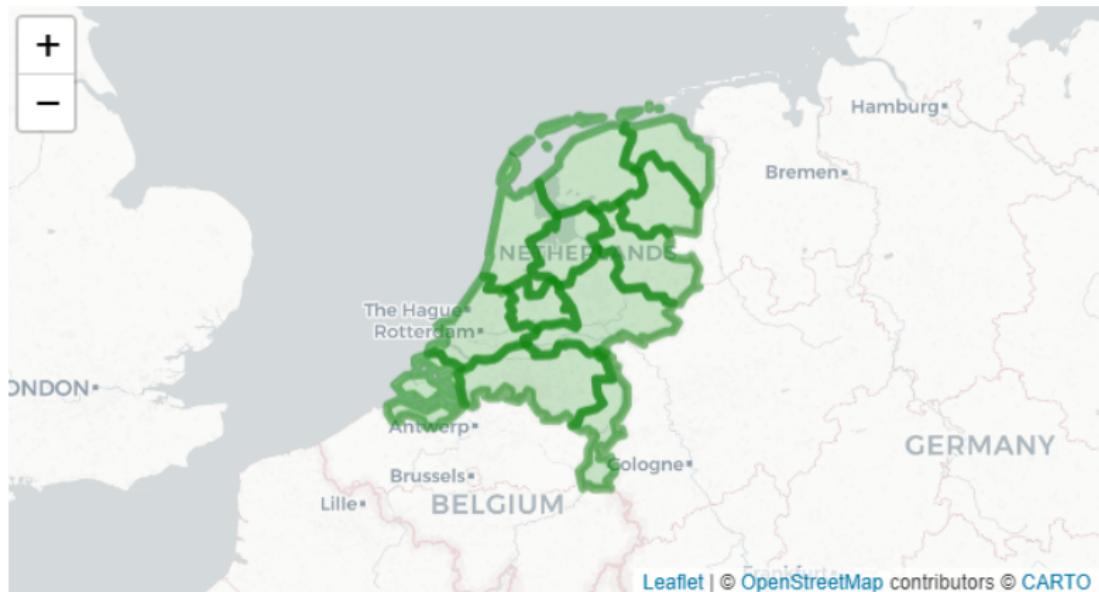
- NUTS 3 is the limit

An interactive map of the Netherlands

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



Simple Feature collection: multipolygon

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Data Structures of df60

```
Simple feature collection with 6 features and 7 fields
geometry type: MULTIPOLYGON
dimension: XY
bbox: xmin: 2.54601 ymin: 34.56908 xmax: 34.56859 ymax: 51.50246
geographic CRS: WGS 84
id CTR_CODE NUTS_NAME LEVL_CODE FID NUTS_ID geometry geo
1 BG BG <U+0411><U+042A><U+041B><U+0413><U+0410><U+0420><U+0418><U+042F> 0 BG BG MULTIPOLYGON (((22.99717 43... BG
2 CH CH SCHWEIZ/SUISSE/SVIZZERA 0 CH CH MULTIPOLYGON (((8.61383 47.... CH
3 CY CY <U+039A><U+03A5><U+03A0><U+03A1><U+039F>S 0 CY CY MULTIPOLYGON (((33.75237 34... CY
4 AL AL SHQIPËRIA 0 AL AL MULTIPOLYGON (((19.831 42.4... AL
5 CZ CZ CESKÁ REPUBLIKA 0 CZ CZ MULTIPOLYGON (((14.49122 51... CZ
6 BE BE BELGIQUE-BELGIE 0 BE BE MULTIPOLYGON (((5.10218 51... BE
```

Simple Features

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```
class(World)
```

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

- **Vignette of the sf package**

Simple feature collection

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Attribute values and an abridged version of the geometry

```
## 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)

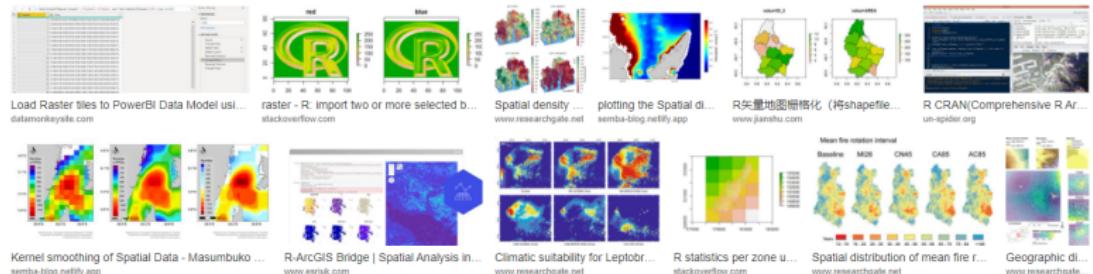
Simple feature geometry (sfg)

geom

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

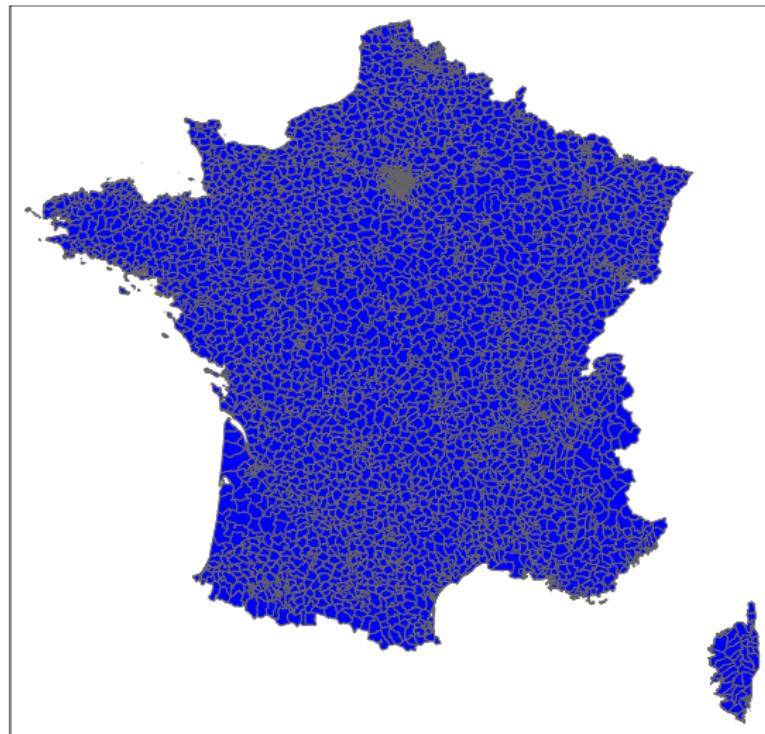
Show 10 entries											Search: <input type="text"/>
	GID_0	NAME_0	GID_1	NAME_1	GID_2	NAME_2	GID_3	NAME_3	GID_4	NAME_4	
1	FRA	France	FRA.1_1	Auvergne-Rhône-Alpes	FRA.1.1_1	Ain	FRA.1.1.1_1	Belley	FRA.1.1.1.1_1	Ambérieu-en-Bugey	
2	FRA	France	FRA.1_1	Auvergne-Rhône-Alpes	FRA.1.1_1	Ain	FRA.1.1.1_1	Belley	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")
```

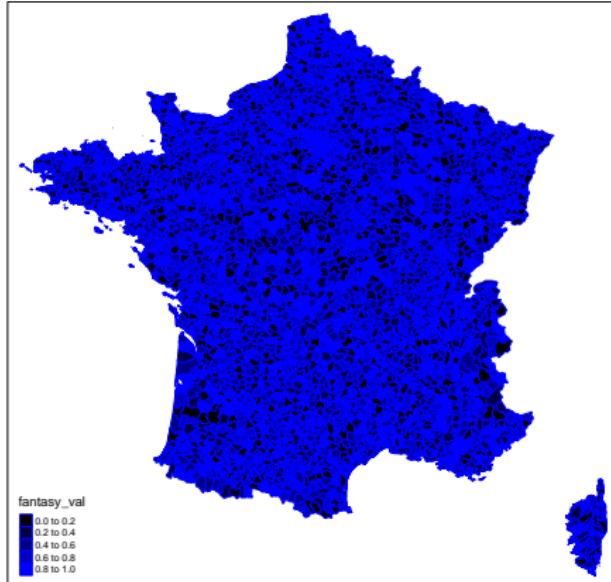


Create colour gradation

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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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Openstreetmap map features

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Information in the wiki

Key	Value	Element	Description	Map rendering	Image	Count
craft	agricultural_engines		A place where engines and tools for agricultural use are planned and constructed.			590  554  4 

- Key/value scheme
- Information about the available keys and features on the **wiki**
- https://wiki.openstreetmap.org/wiki/Map_features

Example: Overpass API

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- Overpass turbo (overpass-turbo.eu) is a web based data mining tool for OpenStreetMap.
- The project is maintained by Martin Raifer.
- Source code is on [github](#).
- The Overpass API was created by Roland Olbricht

<https://overpass-turbo.eu/>

The screenshot shows a web browser window for the Overpass Turbo website. The URL in the address bar is <https://overpass-turbo.eu/>. The page title is "overpass turbo". The main content area displays a map of the Frankfurt, Germany region. Numerous blue circles with yellow outlines are scattered across the map, representing playground locations. The map includes labels for various towns and roads, such as B9, B44, A6, A67, L3011, L3022, L4133, and L597. On the left side of the map, there is a text area containing an Overpass query:

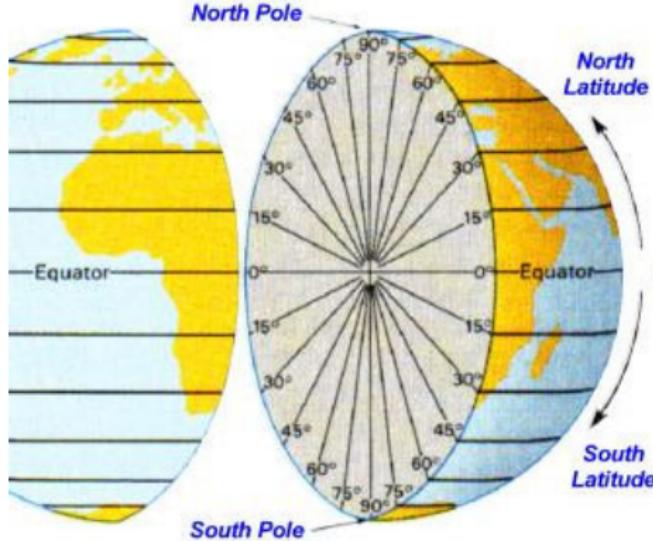
```
1 /*  
2 This is an example  
3 Overpass query.  
4 Try it out by pressing  
5 the Run button above!  
6 You can find more  
7 examples with the Load  
8 tool.  
9 */  
node  
[leisure=playground]  
({{bbox}});  
out;
```

Longitude and Latitude

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LATITUDE



Source: Traveling across time

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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Get geocodes

```
(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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More details

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

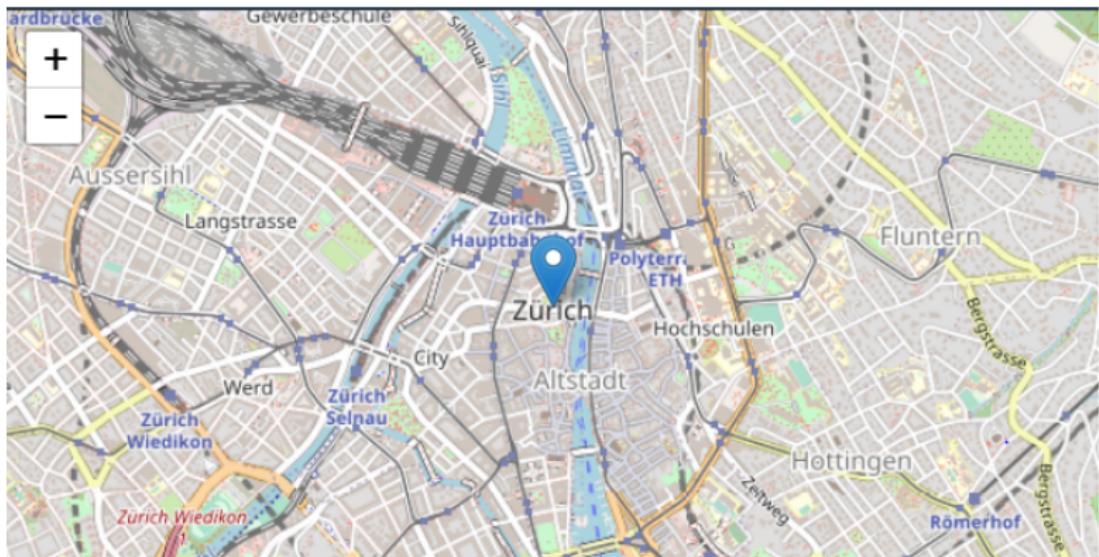
## [1] "query"          "coords"        "bbox"
## [6] "osm_id"         "place_rank"     "display_name"
## [11] "importance"     "icon"
```

An interactive map with a popup

Quick high quality maps with R

Jan-Philipp Kolb

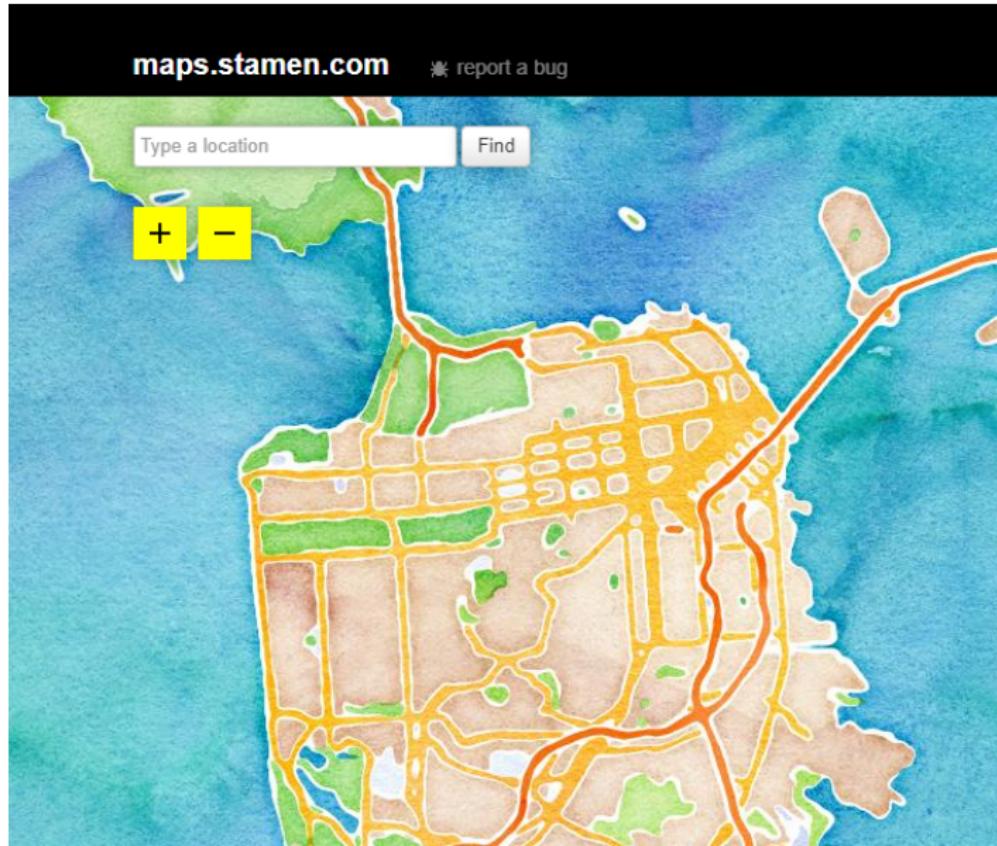
```
library(leaflet)
gcz <- geocode_OSM("Zürich")
leaflet() %>% addTiles() %>%
  addMarkers(lng=gcz$coords[1] , lat=gcz$coords[2] ,
             popup="The conference place")
```



Stamen maps

Quick high
quality maps
with R

Jan-Philipp
Kolb

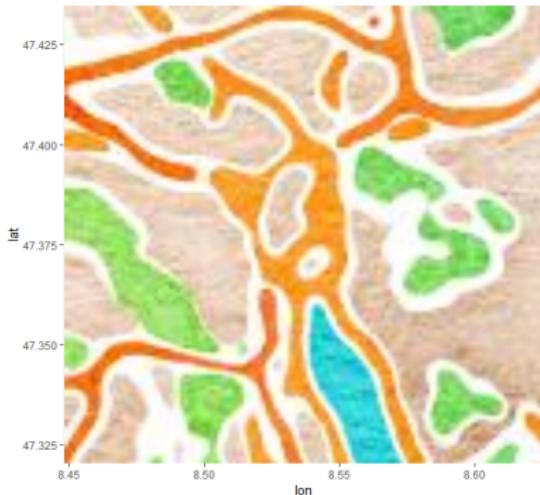


Make a stamen map with R

Quick high
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with R

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Kolb

```
library(ggmap)
myMap <- get_stamenmap(bbox=c(8.448006, 47.320220,
                               8.625441, 47.434666 ),
                         maptype="watercolor", crop=TRUE)
ggmap(myMap)
```



Load example data

Quick high
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with R

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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`

Quick high
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with R

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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
```

Exercise

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Download the Unemployment data and visualize it in a map.

Use the package tmap with your data

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

Match the data

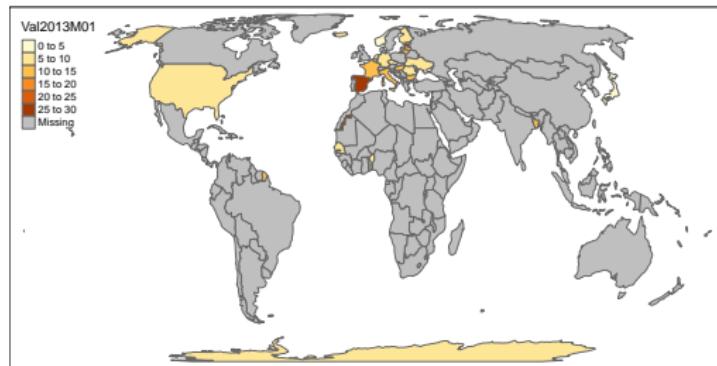
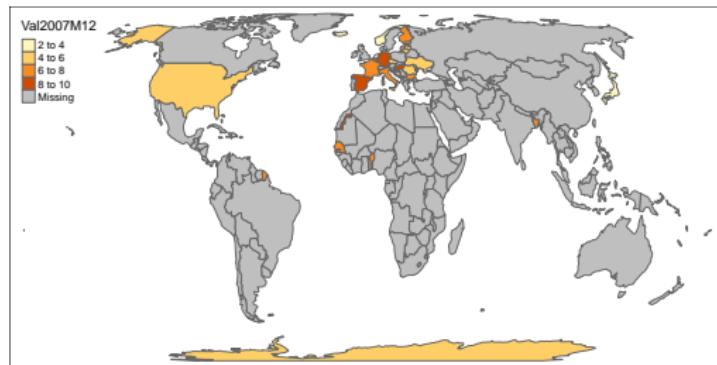
```
iso_a2<- substr(World$iso_a3,1,2)
ind <- match(iso_a2,Unemp$GEO)
World$Val2007M12 <- Unemp$Val2007M12[ind]
World$Val2013M01 <- Unemp$Val2013M01[ind]
```

Plot a map

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



Section 4: OSM maps with R

Quick high quality maps with R

Jan-Philipp Kolb

A package to get Openstreetmap data

Author: Mark Padgham

```
library(osmplotr)
```

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

The screenshot shows a search results page with several items:

- Meinst du: komplott**: A link to a user's profile.
- Creating continuous coloured maps with osmplotr ...**: A link to a blog post by mascardus.be.
- ropensci/osmplotr**: A GitHub repository for the package, with 14 stars, 1 maintainer, 133 commits, and 21 forks.
- Bespoke Images of OpenStreetMap Data ...**: A link to the documentation on docs.ropensci.org.
- osmplotr**: A link to a GitHub repository for the package, with 1 star, 1 maintainer, 1 commit, and 1 fork.
- osmplotr: Mara Averick into Twitter: 'Making ave...'**: A link to a tweet from Mara Averick (@MaraAverick) on Twitter.
- cran/osmplotr**: A GitHub mirror of the package, with 1 star, 1 maintainer, 1 commit, and 1 fork.
- Data Maps - OpenSci: osmplotr**: A link to the documentation on docs.ropensci.org.
- osmplotr hashtag on Twitter**: A link to the Twitter hashtag page for osmplotr.
- Bespoke Images of OpenStreetMap Data - OpenSci: osmplotr**: A link to the documentation on docs.ropensci.org.
- Create custom maps from openstreetmap - REC... gis.stackexchange.com**: A link to a question on GIS Stack Exchange.

Buildings within a bounding box

Quick high
quality maps
with R

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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")
```



Same plot with ggmap

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```
library(ggmap)  
ggplot() + geom_sf(data=dat_M, colour="#238443",  
                    fill="#004529", alpha=.5) + labs(x="",y="")
```



You can add more map elements

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with R

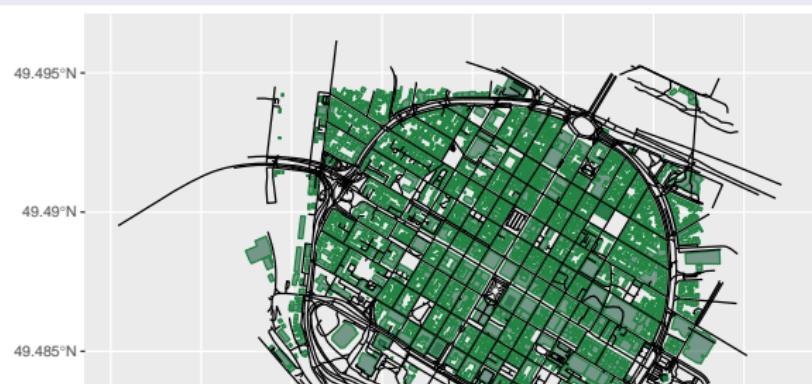
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Download further data

```
dat_h <- extract_osm_objects (key = 'highway',  
                                bbox = bbox)
```

Add info - more options [here](#)

```
m + geom_sf(data=dat_h)
```



The package osmdata

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Install and load osmdata

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

```
library(osmdata)
```

Get a bounding box for a city

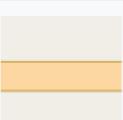
```
bbox <- osmdata::getbb("Berlin")
```

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

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`qtm(dat)`



Get data for secondary roads in Berlin

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OSM map feature



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)
```



Metro lines in Paris

Quick high
quality maps
with R

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```
dat_p <- extract_osm_objects (key = 'route',  
                               value="subway", bbox = bbox)  
  
qtm(dat_p, "colors")
```

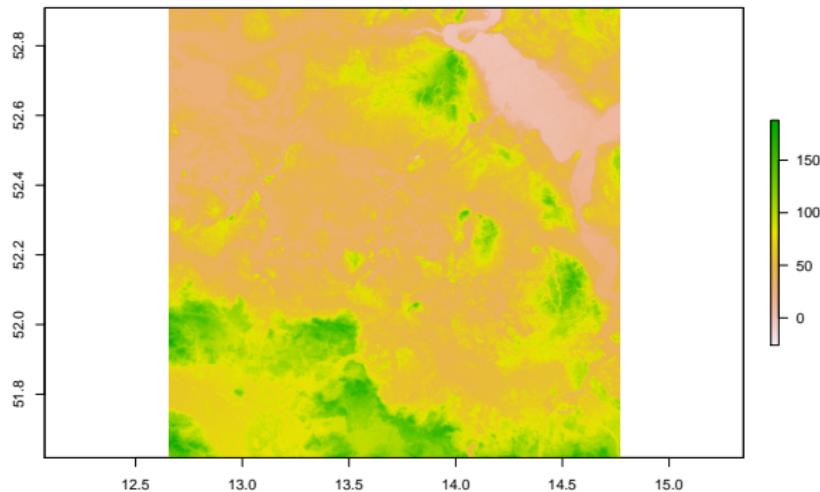


The elevatr package

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```
library(elevatr)
elevation <- get_elev_raster(dat, z = 9)
plot(elevation)
```



Mapping is fun

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Topi Tjukanov

@tjukanov

Makes maps. Started #30DayMapChallenge. Works at @GispoFinland

[Biografie übersetzen](#)

⌚ Helsinki, Suomi ⌐ tjukanov.org 📅 Seit November 2013 bei Twitter

2.475 Folge ich **13.078** Follower



Gefolgt von #30DayChartChallenge, Anat Zohar und 70 weiteren Personen, denen du folgst

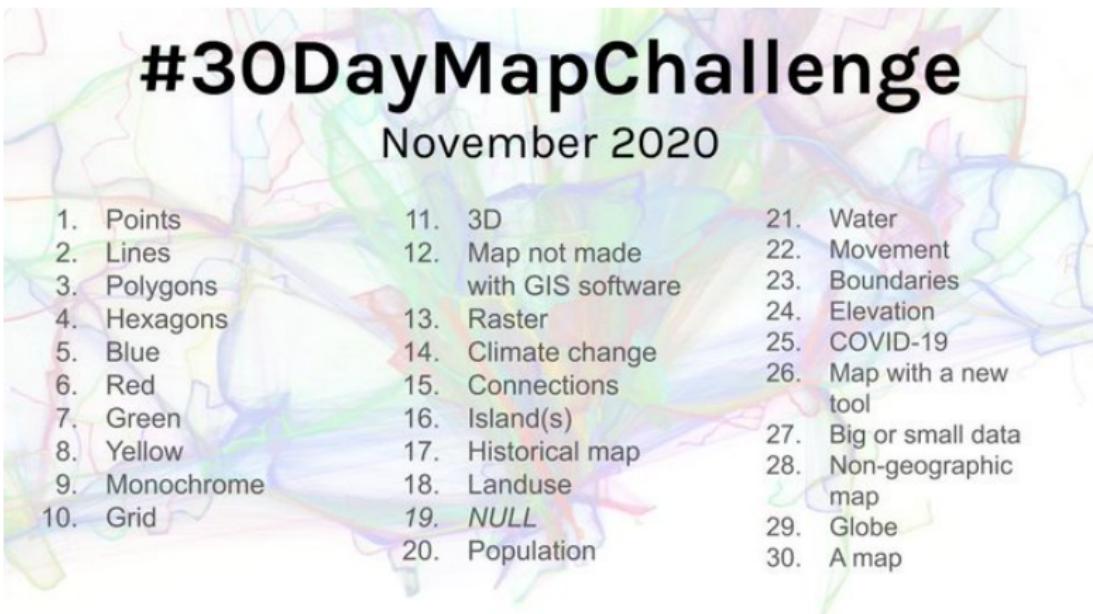
#30daymapchallenge

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#30DayMapChallenge

November 2020

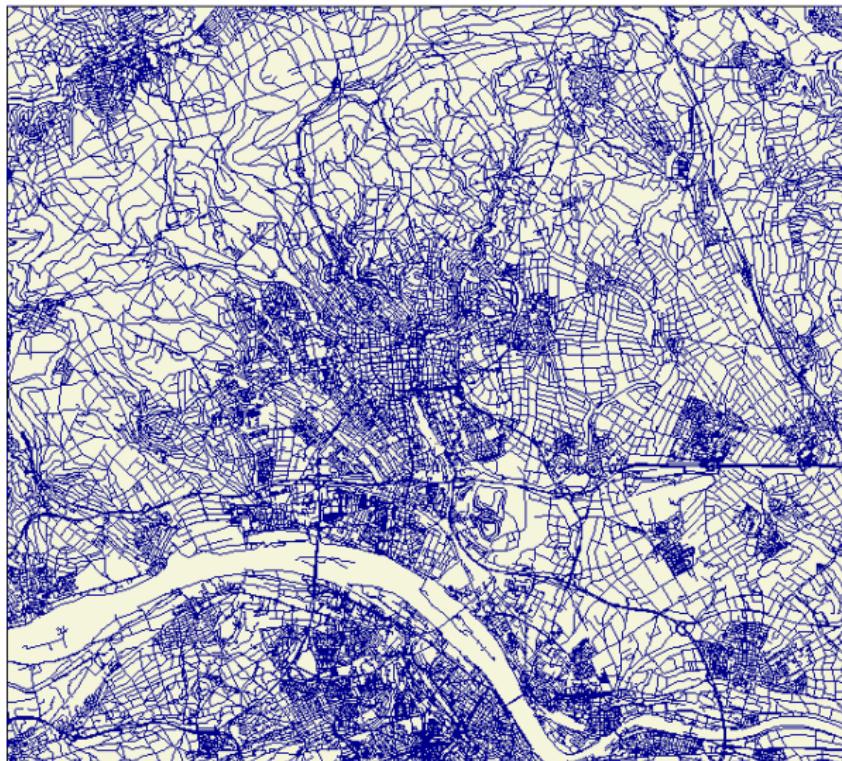
- 
1. Points
 2. Lines
 3. Polygons
 4. Hexagons
 5. Blue
 6. Red
 7. Green
 8. Yellow
 9. Monochrome
 10. Grid
 11. 3D
 12. Map not made with GIS software
 13. Raster
 14. Climate change
 15. Connections
 16. Island(s)
 17. Historical map
 18. Landuse
 19. NULL
 20. Population
 21. Water
 22. Movement
 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

Github repo - #30daymapchallenge

Exercise: Create a monochrome map

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Resources for packages

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osmplotr

- Github repo on osmplotr at [ropensci](#)
- Introduction to the **osmplotr package**

sf

- **Vignette for sf package** - Plotting Simple Features

tmap

- Vignette - **Get started** with tmap package

ggmap

- Thinking spatially (German)
- ggmap und osmdata

More packages

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osmdata

- Vignette

choroplethr

- US County Chropleths

maptools

- Create maps with maptools R package

sp

- Using spatial data in R

Data sources

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Examples for sources

- Covid 19 datahub
- **Historical data**
- Draught Monitor

Further resources

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- Tips for working with images in Rmd files

rspatial

- Spatial Data Science

Openstreetmap

- Openstreetmap Wiki

30daymapchallenge

- 2020 summary
- A personal review of gontsa
- challenge with R

Tips and tricks for R

- Colour palettes