Using the statistical language R as a Geographic Information System

Easy Maps

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Now

Time	Title
09:00-09:30	Introduction: Data Management & Geospatial Data
09:30-09:35	Exercise 1: R Warm up
09:35-10:00	Data Processing & Spatial Linking
10:00-10:30	Exercise 2: Geospatial Data Wrangling
10:30-10:45	Break
10:45-11:15	Easy Maps
11:15-11:45	Excercise 3: Build your own map
11:45-12:00	Closing, Q & A

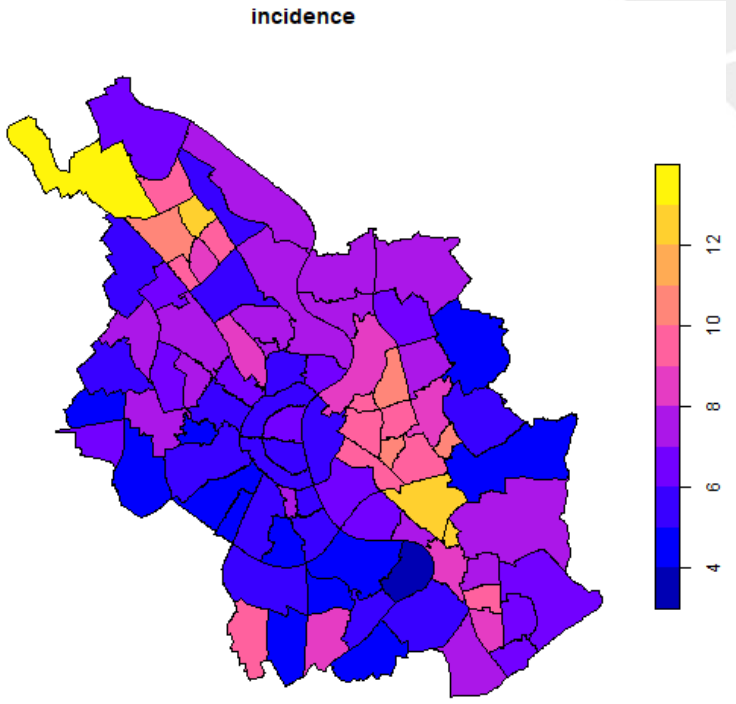
Fun With Flags... MAPS, It's Maps!

Fun with Flags by Dr. Sheldon Cooper. Big Bang Theory

Fun With Maps

`plot()` does not allow us to manipulate the maps in an easy. But we already have the two most essential ingredients to create a nice map:

1. One vector layer like our Cologne Corona data.
2. Some interesting attributes linked with the geometries.



What Makes a Good Map?

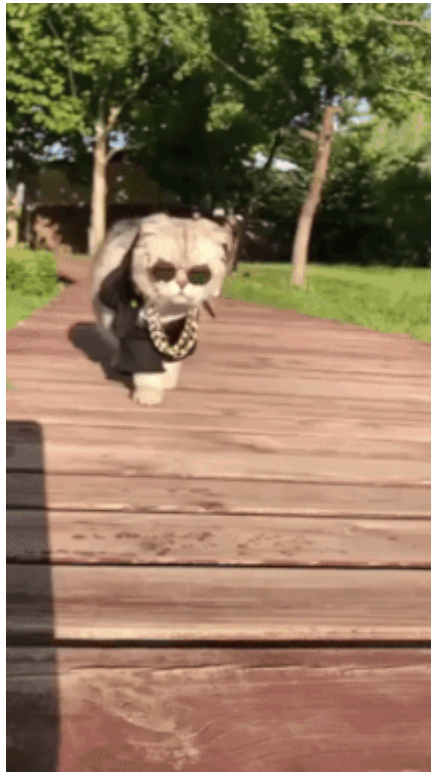
Good Mapping

- reduction to most important information
- legends, scales, descriptions
- audience oriented
- adjusted for color vision deficiencies

Bad Mapping

- overcrowding and overlapping
- unreadable information
- missing information like the legend or source
- poor choice of color palettes

What Makes a Good Map?



Source

... but there is one other type:

The fast but nice map.

- fast exploration of spatial data by visualizing the geometries and attributes
- might not be publication-ready yet, but they are more rewarding than just plotting information.

The Choice Is Yours: R Packages for Mapping

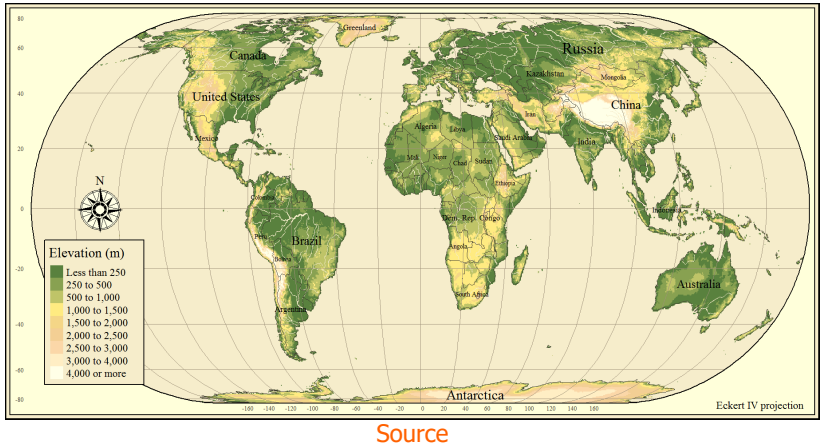
As always, R offers several ways to map spatial data, and the provided packages are various. What is out there? Just a few:

- base R graphics package: `mapdata`
- mobile-friendly interactive maps: `leaflet`
- interactive and static thematic maps based on shapefiles:
- `tmap`
- `mapview`

Our Choice Today

Today, we'll concentrate on the package `tmap`

- very intuitive and makes "good" decisions for us
- the syntax is very similar to `ggplot2`*

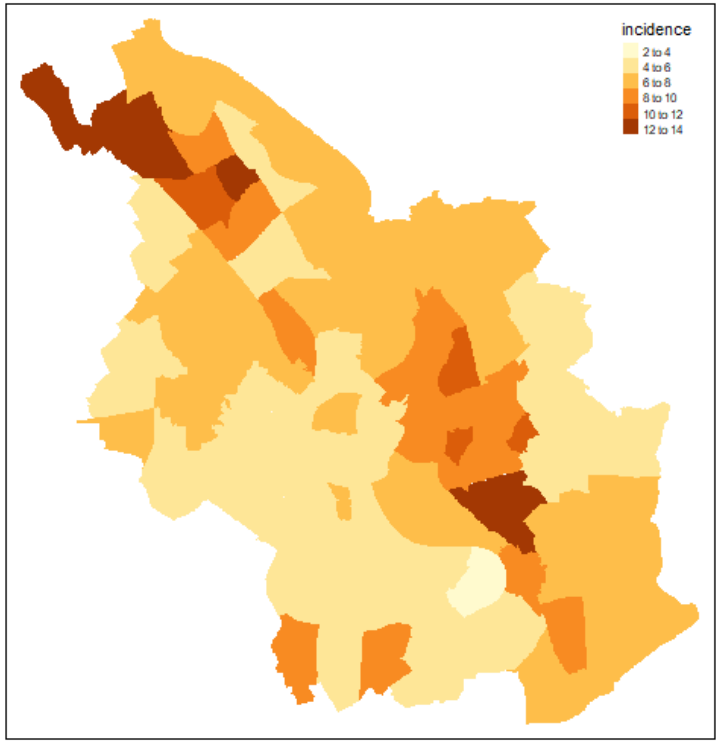


Source

*A wide-known 'secret' is that `tmap` creates a map based on `ggplot2`, so `ggplot2`-specific graphics manipulations will work as well.

First Map: Our Corona Data (Again, but Prettier)

```
tm_shape(corona_cologne) +
  tm_fill("incidence")
```



`tmap` In a Nutshell

There is not much to consider when using `tmap` but essential two requirements:

1. Define your spatial object.
2. Choose a building block to determine how to display information.

```
# define and introduce every (new)
# geospatial data object
tm_shape() +

  # choose at least one building block as
  # 'aesthetic layer'

  # for polygon layer choose from:
  tm_fill() + # polygons without borders
  tm_polygons() +  # polygons with borders
  tm_borders() + # only borders of polygons

  # for line layer choose:
  tm_lines() +

  # for point layer choose:
  tm_dots() +
  tm_bubbles() +

  # for raster layer choose
  tm_raster() +
  tm_rgb() +

  ...

# for all of them:
?'tmap-element'
```

tmap In a Nutshell: Polygon Layer

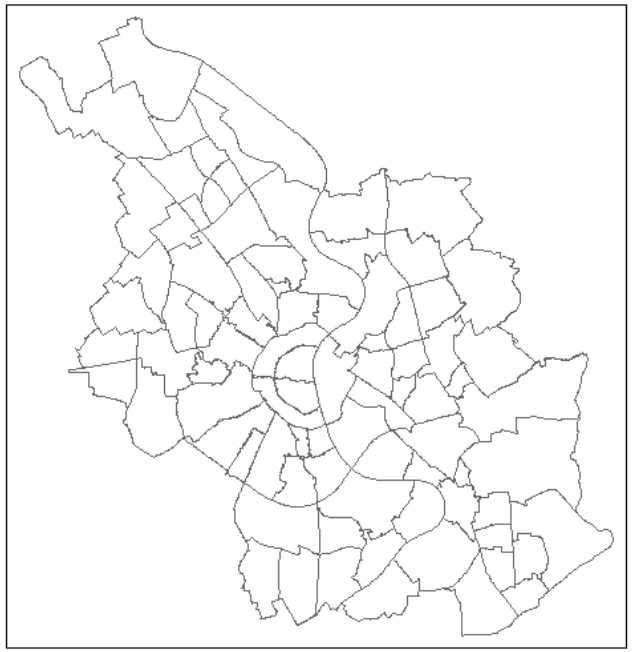
```
tm_shape(corona_cologne) +
  tm_fill()
```

tmap In a Nutshell: Polygon Layer

```
tm_shape(corona_cologne) +
  tm_polygons()
```

tmap In a Nutshell: Polygon Layer

```
tm_shape(corona_cologne) +
  tm_borders()
```

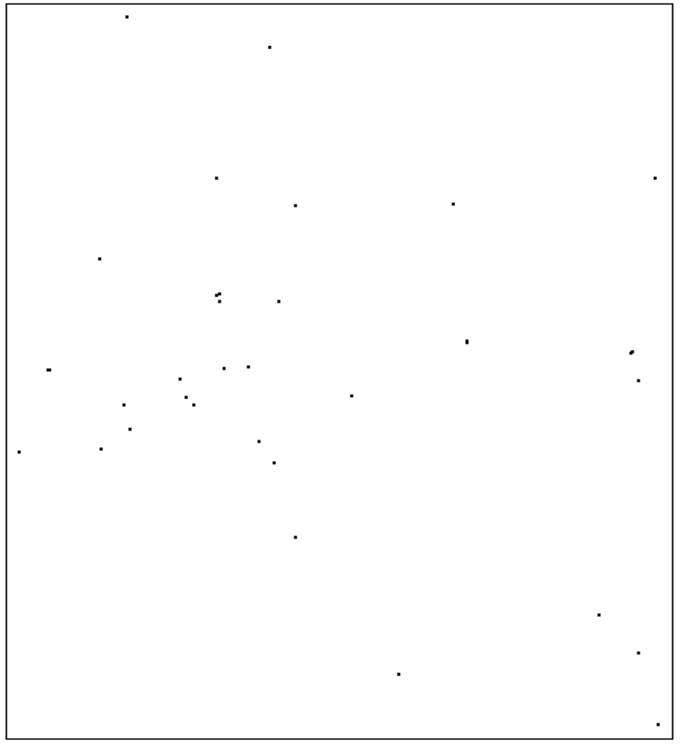


`tmap` In a Nutshell: Line and Point Layer

```
tm_shape(streets_cologne) +
  tm_lines()
```

tmap In a Nutshell: Line and Point Layer

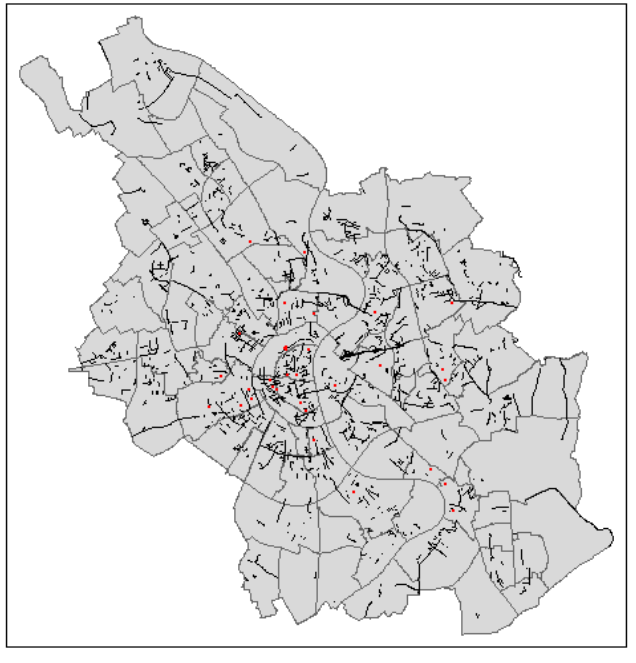
```
tm_shape(hospitals_cologne) +
  tm_dots()
```



tmap In a Nutshell: Put It All Together

We can map the geometric attributes as single layers, but we can also layer our map and stack the layers on each other.

```
tm_shape(corona_cologne) +
  tm_polygons() +
  tm_shape(streets_cologne) +
  tm_lines() +
  tm_shape(hospitals_cologne) +
  tm_dots(col = "red")
```



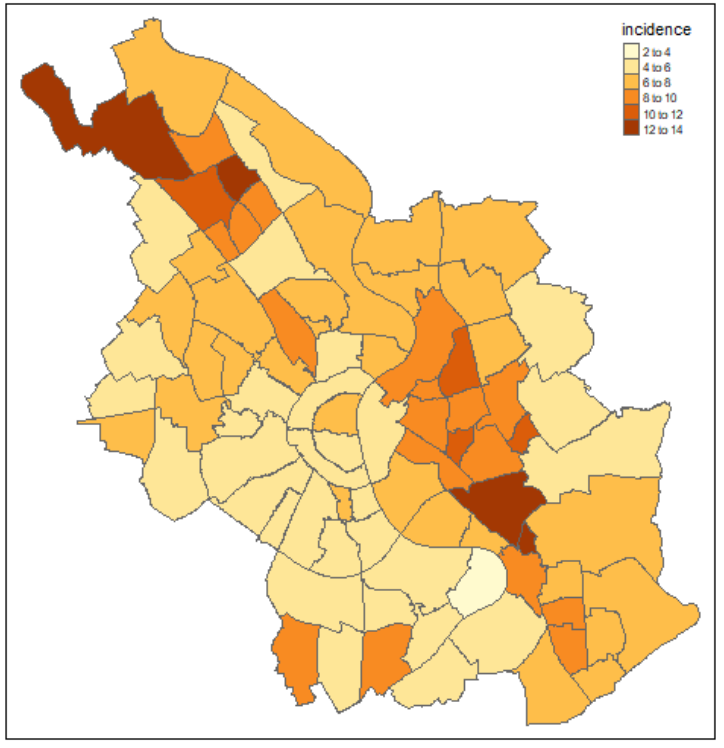
Add Some Information

After we took care of our geometric types, we want to add some information to our data. The inner construction of each building block of `tm_elements` is the same.

1. Define the variable of interest first by stating the column name.
2. Add a name for legend title, color palette, adjust legend, scales ...

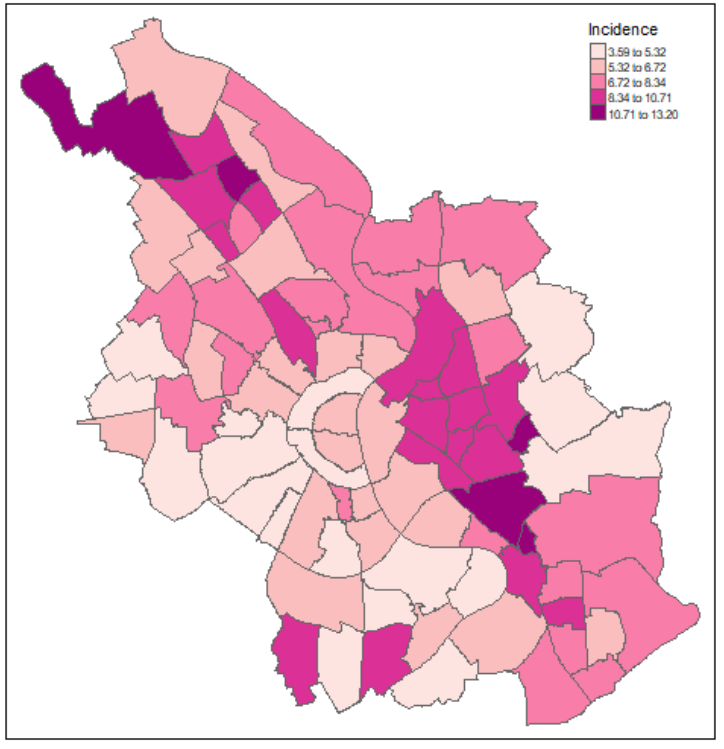
Chosing an Attribute

```
tm_shape(corona_cologne) +
  tm_polygons("incidence")
```



Chosing a Color Palette

```
tm_shape(corona_cologne) +
  tm_polygons(
    "incidence",
    palette = "RdPu",
    title = "Incidence",
    style = "kmeans"
  )
```



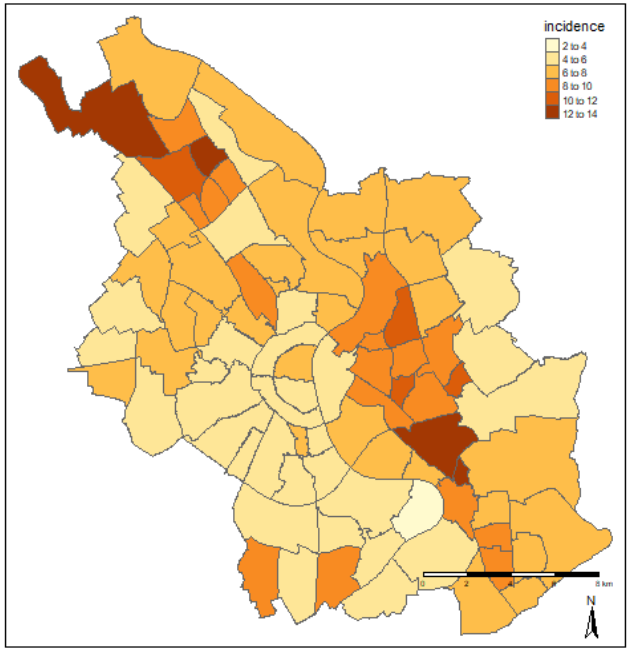
Re-Placing the Legend

```
tm_shape(corona_cologne) +
  tm_polygons(
    "incidence",
    palette = "RdPu",
    title = "Incidence",
    style = "kmeans"
  ) +
  tm_layout(
    legend.outside = TRUE
  )
```

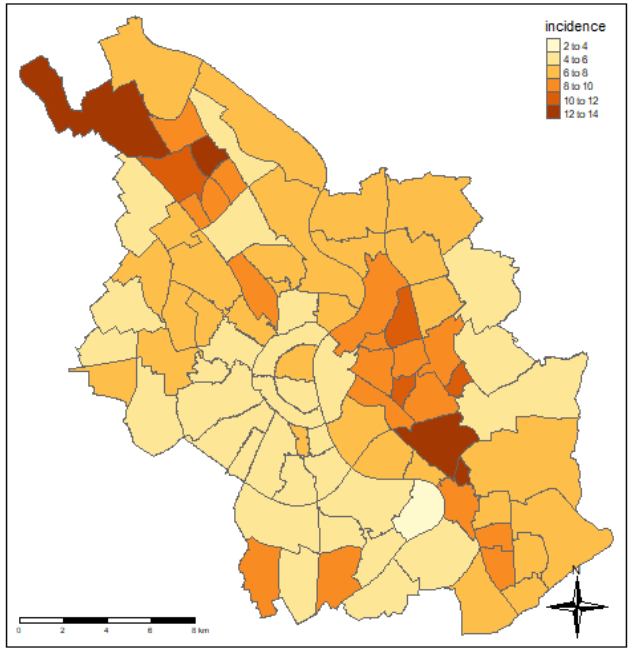
What's Left?

Compasses & Scale Bars

```
tm_shape(corona_cologne) +
  tm_polygons("incidence") +
  tm_scale_bar() +
  tm_compass()
```

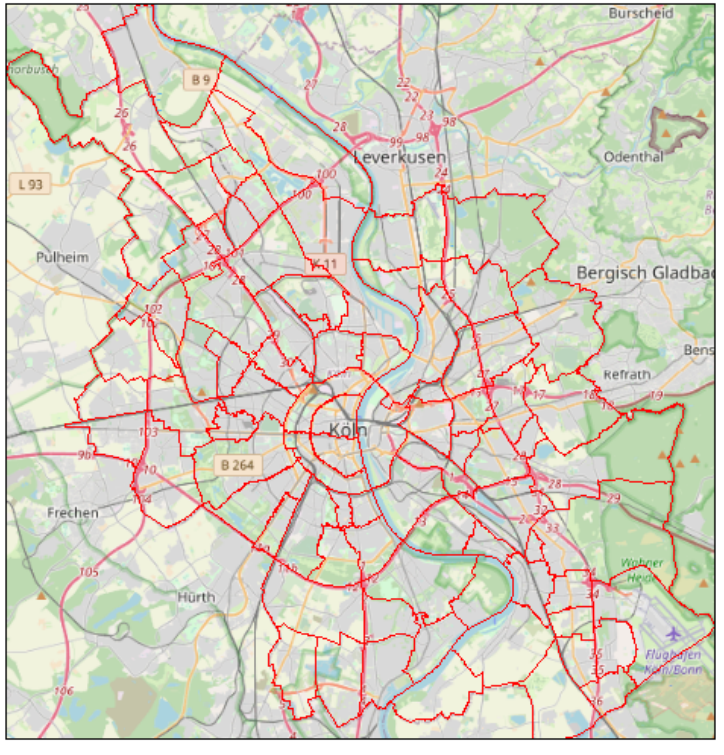



```
tm_shape(corona_cologne) +
  tm_polygons("incidence") +
  tm_scale_bar(position = "left") +
  tm_compass(type = "4star")
```



Add a Background From OpenStreetMap

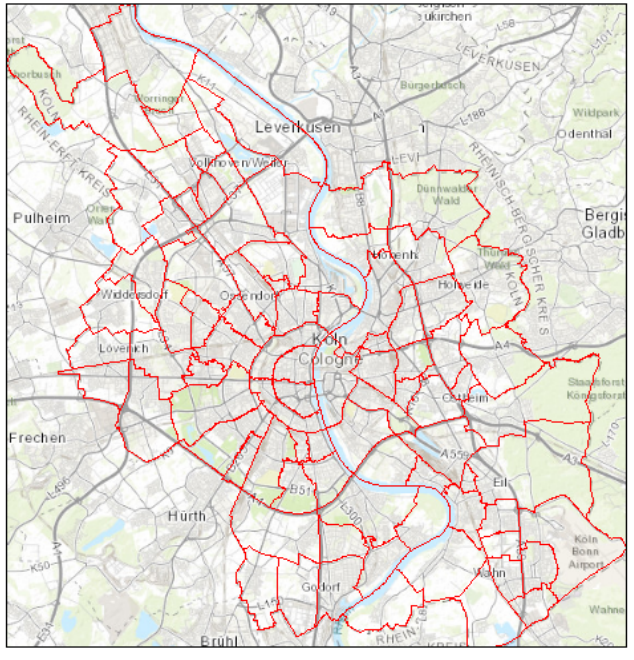
```
tmaptools::read_osm(
  corona_cologne
) %>%
  tm_shape() +
  tm_rgb() +
  tm_shape(corona_cologne) +
  tm_borders(col = "red")
```



Playing With Different Map Types

Call `OpenStreetMap::getMapInfo()` for a complete list.

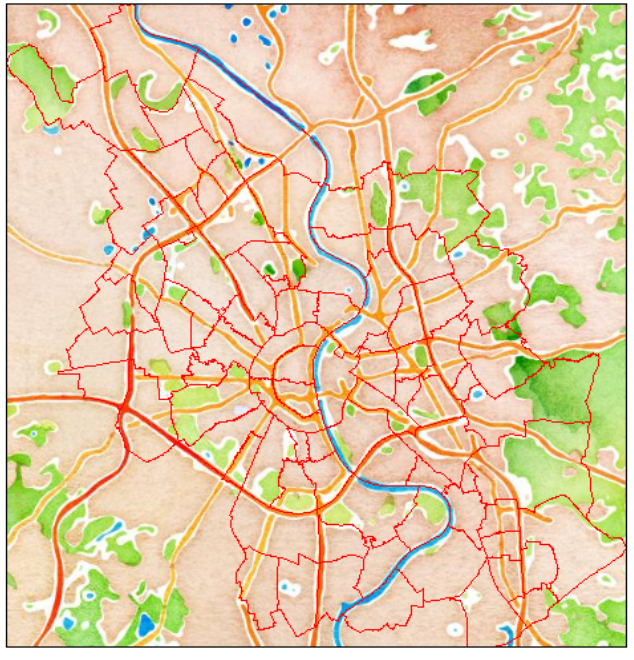
```
tmaptools::read_osm(
  corona_cologne,
  type = "esri-topo"
) %>%
  tm_shape() +
  tm_rgb() +
  tm_shape(corona_cologne)  +
  tm_borders(col = "red")
```



Playing With Different Map Types

Call `OpenStreetMap::getMapInfo()` for a complete list.

```
tmaptools::read_osm(
  corona_cologne,
  type = "stamen-watercolor"
) %>%
  tm_shape() +
  tm_rgb() +
  tm_shape(corona_cologne)  +
  tm_borders(col = "red")
```



Note On Mapping Responsible

In the best cases, maps are easy to understand and an excellent way to transport (scientific) messages.

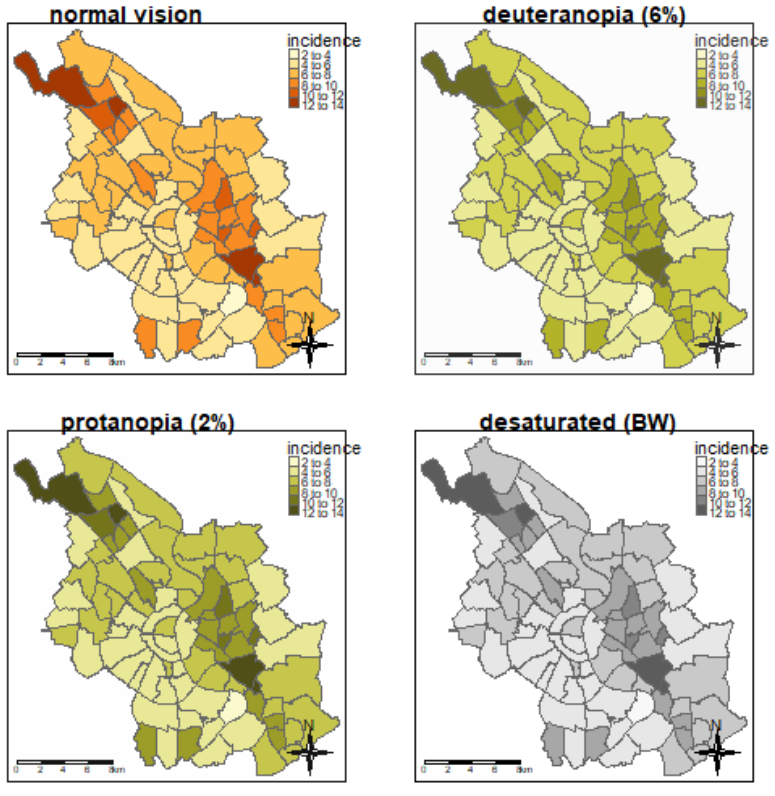
In the worst cases, they simplify (spurious) correlations and draw a dramatic picture of the world.

Maps can shape narratives

- Decisions on which projection you use (remember the `true size` projector?),
- the segment of the world you choose,
- and the colors you add have a strong influence.

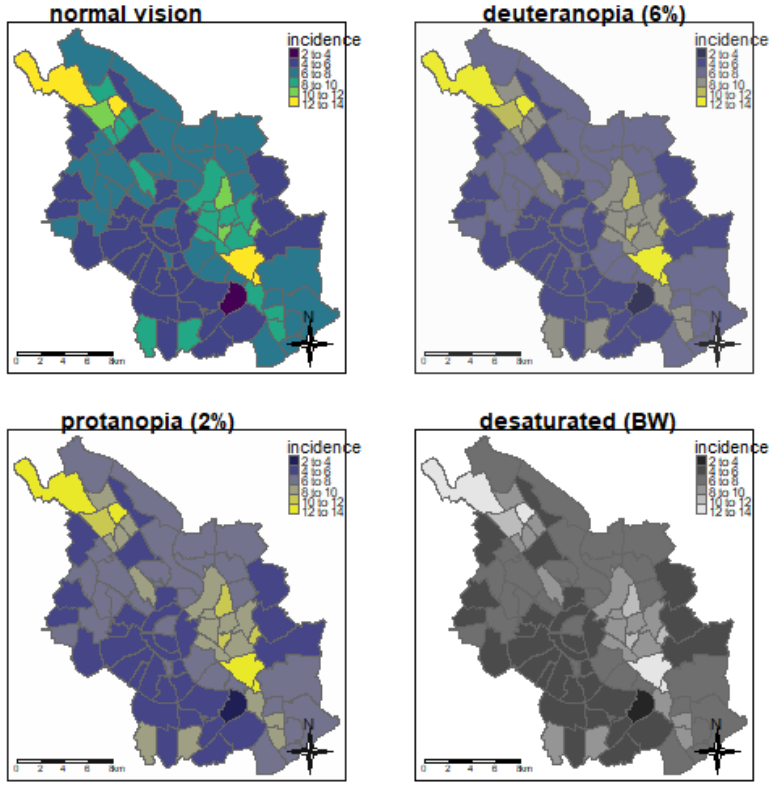
Example: Kenneth Field's blog post

Color Vision Deficiencies: Standard Palette



Created with the package `colorBlindness`

Color Vision Deficiencies: `Viridis` Palette



Created with the package `colorBlindness`

More Resources

If you want to dive deeper into mapping with `tmap` check out:

- Introduction by Thomas Lo Russo
- Blogpost by Hollie Zevross

And if you want to get some inspiration, keep an eye out for the `#30DayMapChallenge` on Twitter. Repository of Last Year's Challenge here.

Exercise 3: Build Your Own Map

Exercise

Solution

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