Creating thematic maps in R

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tmap: R package for thematic maps

- A thematic map is a visualization where statistical information with a spatial component is shown.
- Thematic maps can be also made with other R packages:
  - plot (from the spatial method packages, e.g. **sf** and **raster**) Fast to plot spatial objects, but requires manual work to create thematic maps. Only static maps.
  - **ggplot2**, Popular general data visualization package. Thematic maps can be made easily, but the layout requires some attention. Only static maps.
  - **leaflet**, R interface to the popular Javascript library. Easy to produce maps of spatial objects, but requires manual work to create thematic maps. Only interactive maps.
  - **mapview**, Excellent package to explore spatial objects quickly. Only interactive maps.
- The syntax of **tmap** is based on **ggplot2** and the Grammar of Graphics, but works fluently with spatial objects from the **sf**, **sp** and **raster** packages.
- It supports two modes: **plot** (static maps) and **view** (interactive maps)
- Reference: Tennekes, M. (2018). tmap: Thematic Maps in R. Journal of Statistical Software, 84(6), 1-39.
- Development site http://github.com/mtennekes/tmap

The history of tmap

Package / version	Date	Description / new features
geoNL	2014	General functions to create thematic maps for the Netherlands
geo	2014-07	**ggplot2** style approach to create thematic maps
tmap 0.6	2014-07	**geo** was accepted on CRAN, but had to be renamed… "geo" was too general ☺
tmap 1.0	2015-05	First stable release of **tmap**
tmap 1.4	2016-03	View mode added (i.e. interactive maps)
tmap 1.11-2	2018-04	Version described in the JSS paper
tmap 2.0	2018-07	Migration from **sp** to **sf**
tmap 2.3	2019-07	shiny integration (with tmapOutput and renderTmap)

The Grammar of Graphics

ggplot2
Layered Grammar of Graphics

Defaults
- Data
- Aesthetics

Layers
- Data
- Aesthetics
- Geometry
- Statistics
- Position

Scales

Coordinates

Facets

tmap
Layered Grammar of Thematic Maps

Group

1

Shape
- Coordinates and topology. Spatial types:
  - ◊ Polygons
  - • Points
  - ⁄ Lines
  - # Raster
- Data
- Map projection
- Bounding box

1 or more

Layers
- Aesthetics
- Statistics
- Scale

Facets

Example: choropleth

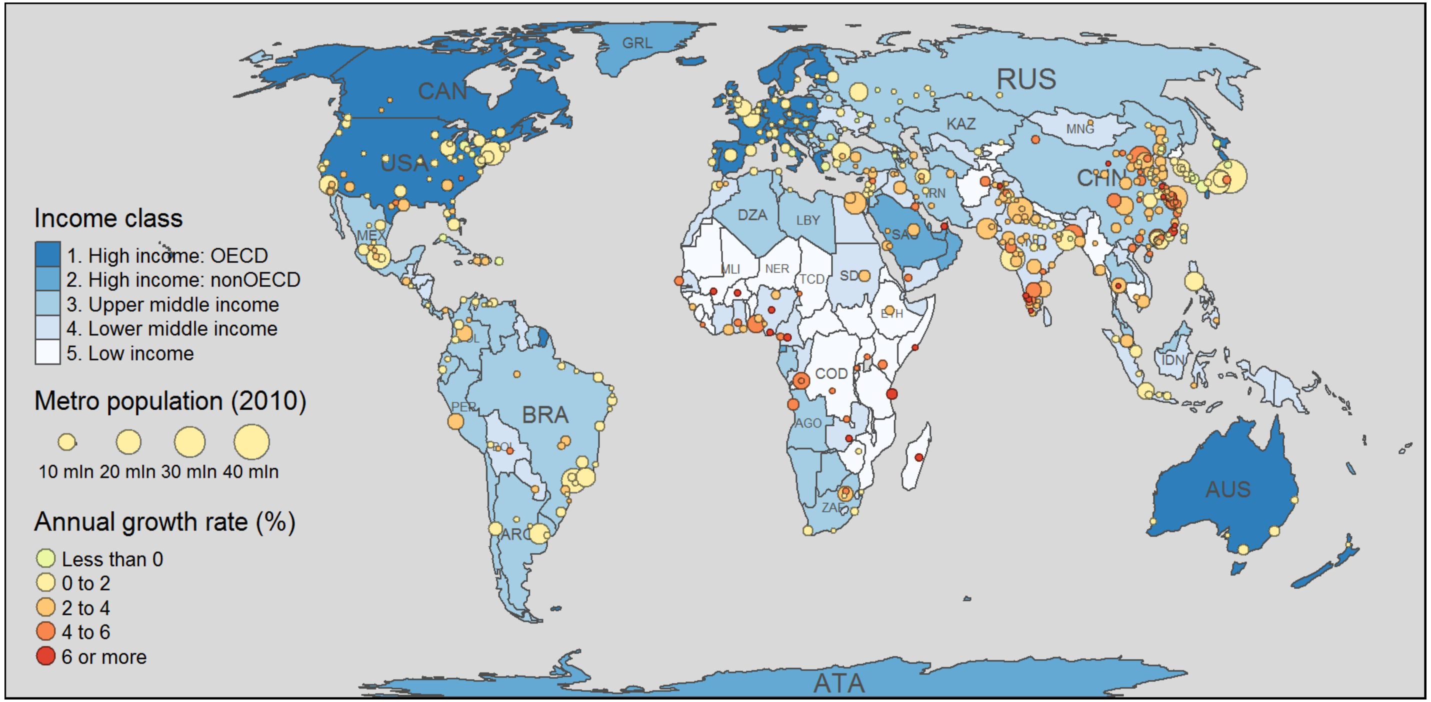
```
# load example datasets
data("World")

# draw polygons
tm_shape(World) + tm_polygons()

# draw polygons with a specific color
tm_shape(World) + tm_polygons("blue")

# draw polygons colored by a data variable
# the result is called a choropleth
tm_shape(World) + tm_polygons("income_grp")
```

Example: a bubble map

```
# load example dataset
data("metro")

# draw dotstm_shape(metro) +
  tm_dots()

# draw a bubble maptm_shape(metro) +
  tm_bubbles(“pop2020")

# draw a colored bubble map
tm_shape(metro) +
  tm_bubbles("pop2020", col = "growth")
```

```
# combine choropleth with bubble map
tm_shape(World) +
  tm_polygons("income_grp") +
tm_shape(metro) +
  tm_bubbles("pop2020", col = "growth")
```

Example: choropleth with bubble map



Two modes: plot and view

tmap contains two modes:

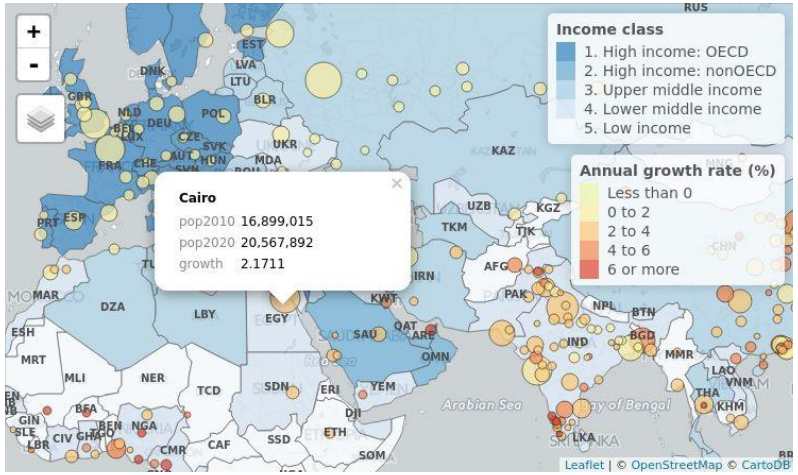
plot: static maps, shown in graphics device window; can be exported to png, jpg, pdf, etc.

view: interactive maps, shown in the viewing window or in the browser; can be exported to standalone HTML files

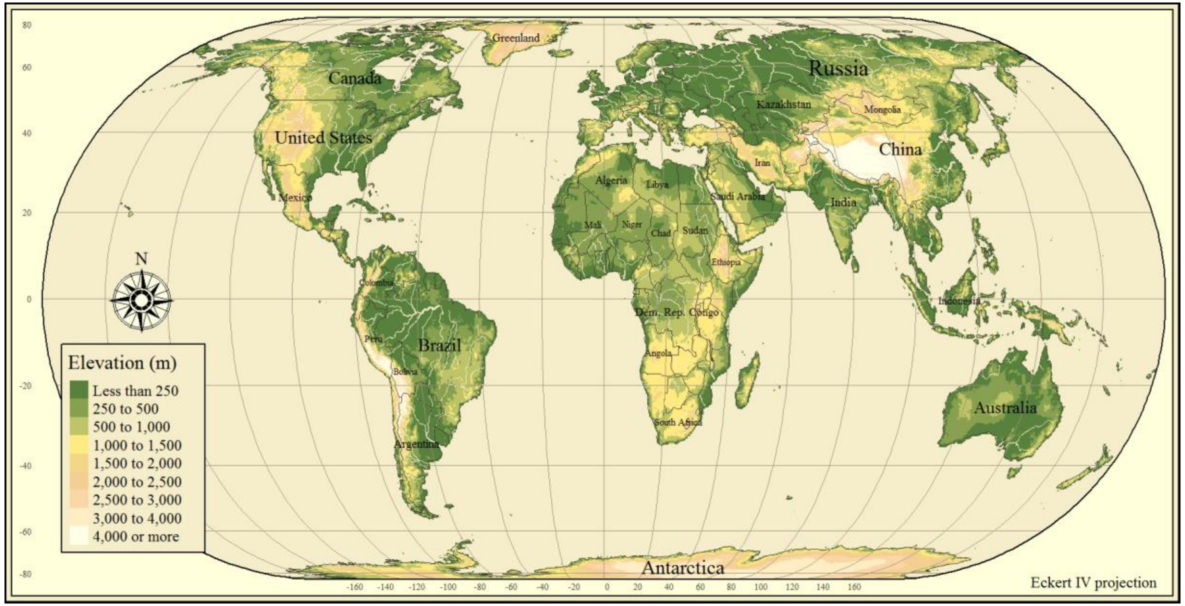
```
# switch to plot mode:
tmap_mode("plot")

# switch to view mode:
tmap_mode("view")

# toggle between modes:
ttm()
```

The last plot in view mode

```
# switch to view mode:
tmap_mode("view")

# repeat the last plot (but now in view mode)
tmap_last()
```



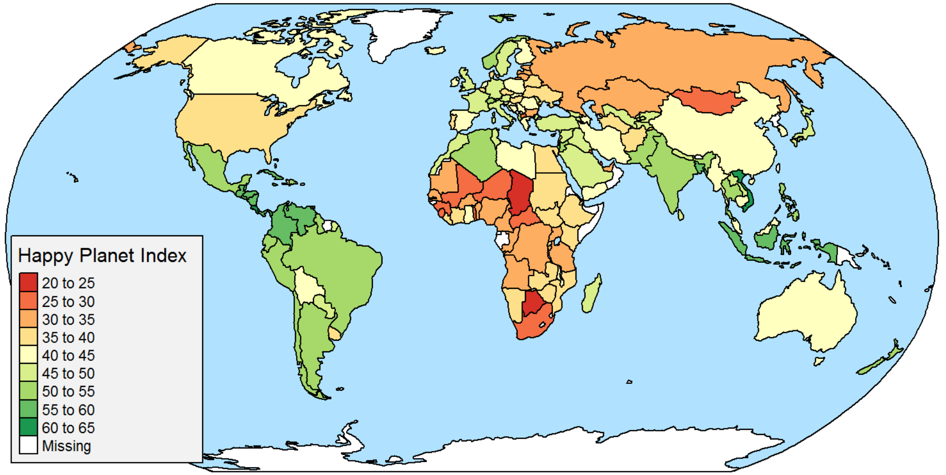
Change style

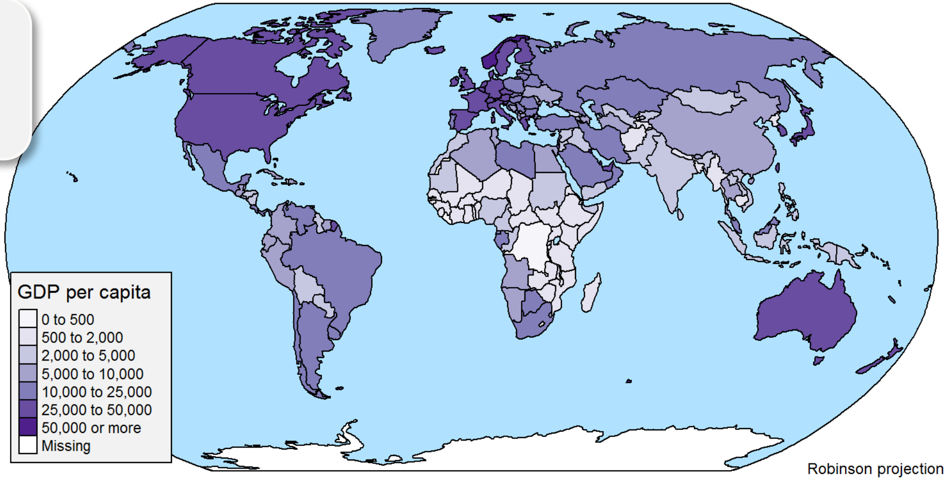


```
... +
tm_style("classic")
```

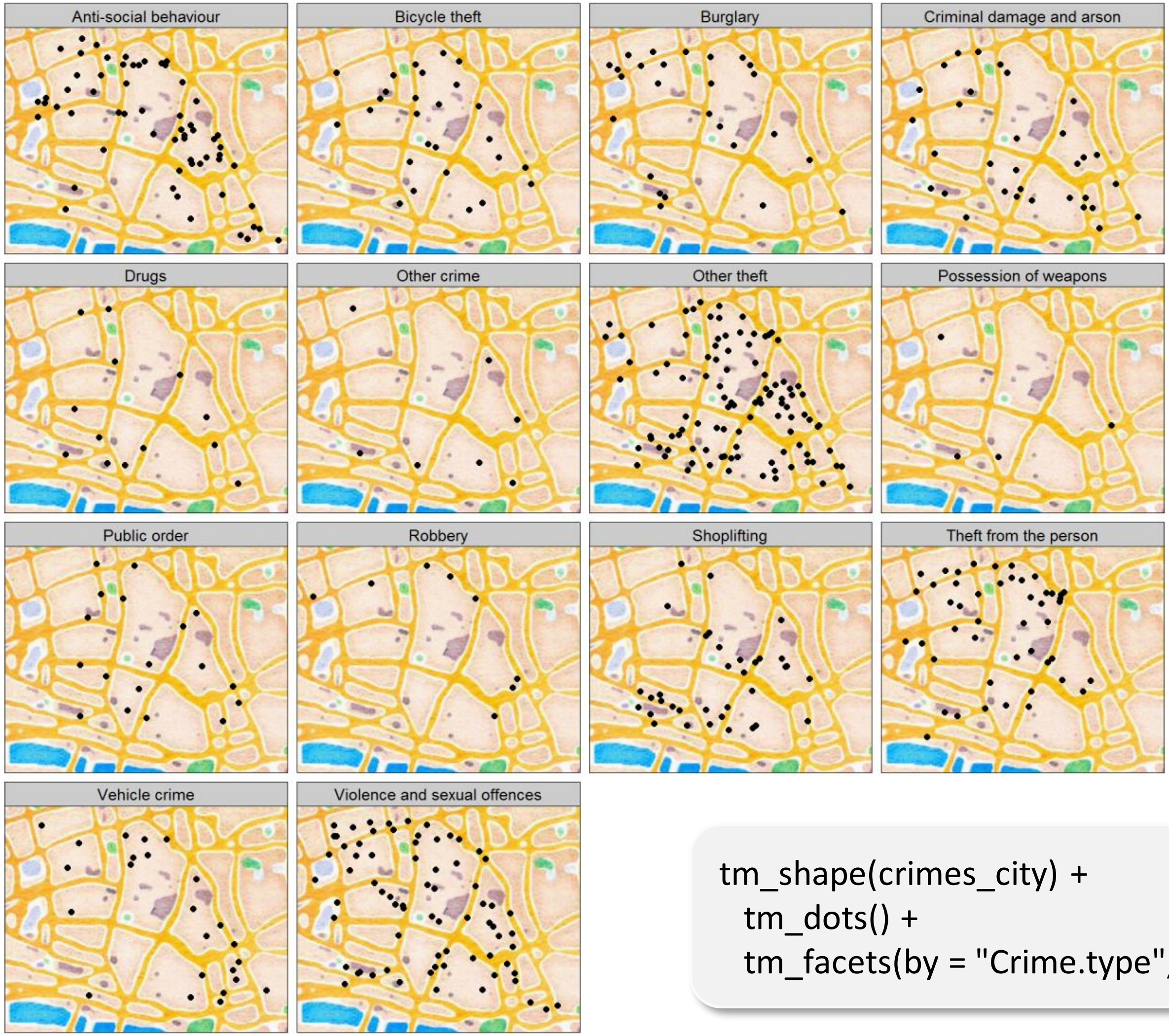
Facets

```
# specify multiple variables
tm_shape(World) +
  tm_polygons(c("HPI", "gdp_cap_est"))
```





Facets



```
tm_shape(crimes_city) +
  tm_dots() +
  tm_facets(by = "Crime.type", free.coords = FALSE)
```

Output functions

Save to image:

```
tm_twitter <- tm_shape(NLD_muni) + tm_polygons() +
tm_shape(NLD_twitter) + tm_dots()

tmap_save (tm_twitter, filename = "twitter.png", width =
600, height = 800)
```

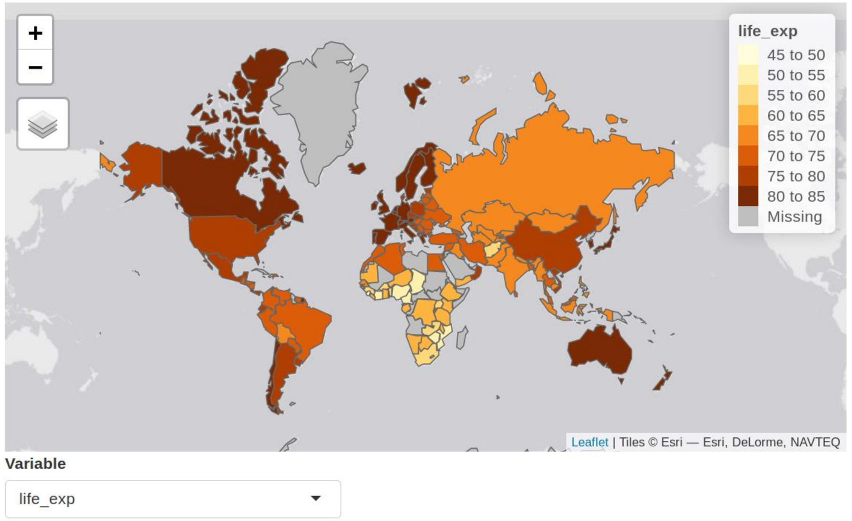
Save to interactive website:

```
tmap_save (tm_twitter, filename = "twitter.html")
```

Create animation:

```
tmap_animation(...)
```

tmap in shiny apps



```
ui <- fluidPage(
    tmapOutput("map"),
    selectInput("var", "Variable", world_vars)
)

server <- function(input, output, session) {
    # initial map
    output$map <- renderTmap({
        tm_shape(World) +
            tm_polygons(world_vars[1], zindex = 401)
    })

    # update map
    observe({
        var <- input$var
        tmapProxy("map", session, {
            tm_remove_layer(401) +
            tm_shape(World) +
                tm_polygons(var, zindex = 401)
        })
    })
}
```

Required tmap >= 2.3

Which mapping package to use?

- If you familiar with ggplot2, and do not care about interactive maps, and do not prefer to learn yet another package? **ggplot2**
- Else if you want interactive maps as flexible as possible (albeit with more code)? **leaflet**
- Else if you just want to explore spatial objects of any sort interactively? **mapview**
- Else **tmap**

Summary

- **tmap** is a powerful package for spatial data visualization
- It is based on the syntax of **ggplot2**, but tailored for maps
- Other awesome mapping packages are **ggplot2**, **leaflet**, **mapview**
- The key qualities of **tmap** are:
  - Intuitive and easy to understand syntax (therefore very suitable for educational purposes)
  - Many options to configure the map
  - Two modes: static and interactive maps
- The users are key in the development of software. Therefore, please to not hesitate to post questions, bug reports, or suggestions.
- Please use
  - **StackOverflow** for general questions, and
  - **github** for bug reports and suggestions.