Introdução à análise geoespacial com R

8 Produção de mapas

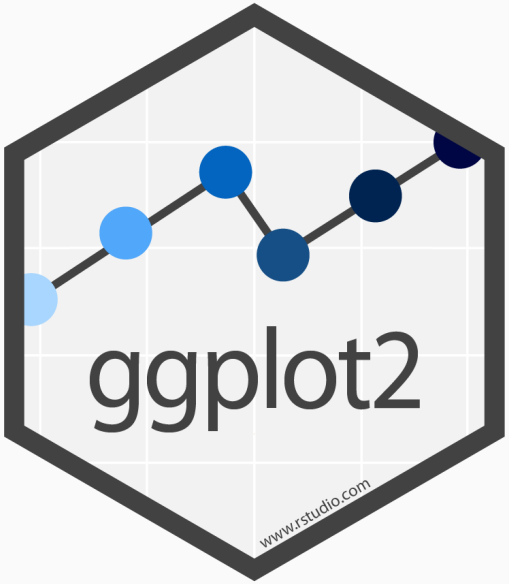
Maurício H. Vancine
Milton C. Ribeiro
23/10/2020

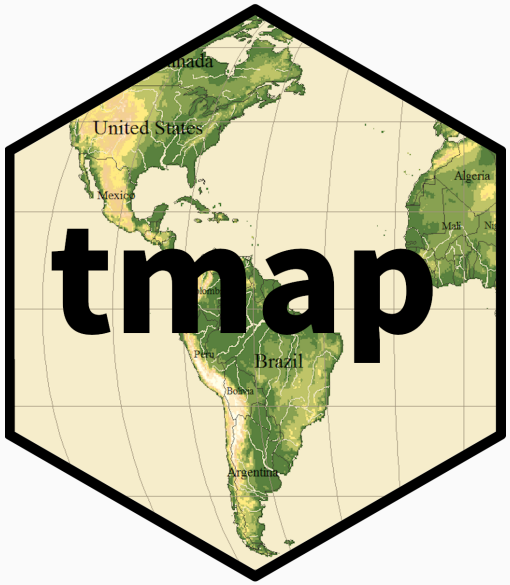

Title
Mexico - Major Habitat Types
Inset map
Main map
Gulf of Mexico
Pacific Ocean
Orientation indicator
Scale indicator
Source note
Graphics
Legend
Major Habitat Types
Tropical and Subtropical Moist Broadleaf Forests
Tropical and Subtropical Dry Broadleaf Forests
Tropical and Subtropical Coniferous Forests
Temperate Conifer Forests
Tropical and Subtropical Grasslands, Savannas and Shrublands
Flooded Grasslands and Savannas
Montane Grasslands and Shrublands
Mediterranean Forests, Woodlands, and Scrubs
Deserts and Xeric Shrublands
Mangroves
0 50 100 200 300 Miles
Map created January, 2005
ESRI Virtual Campus
N

8 Produção de mapas

Conteúdo

1. Elementos de um mapa
2. Pacotes para produção de mapas
3. Pacote ggplot2
4. Pacote tmap
5. Mapas vetoriais
6. Mapas matriciais
7. Mapas estáticos
8. Mapas animados
9. Mapas interativos
10. Exportar mapas





8 Produção de mapas

Script

`08_script_intro_geocomp_r.R`

8.1 Elementos de um mapa

Elementos

- Títutlo
- Mapa principal
- Mapa secundário
- Legenda
- Coordenadas
- Orientação (Norte)
- Barra de escala
- SRC
- Fontes

8.2 Pacotes para produção de mapas

Pacotes

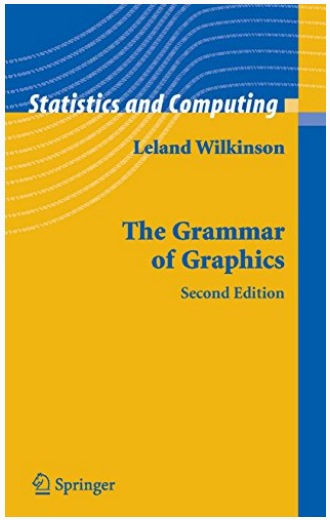
Principais pacotes para produção de mapas no R

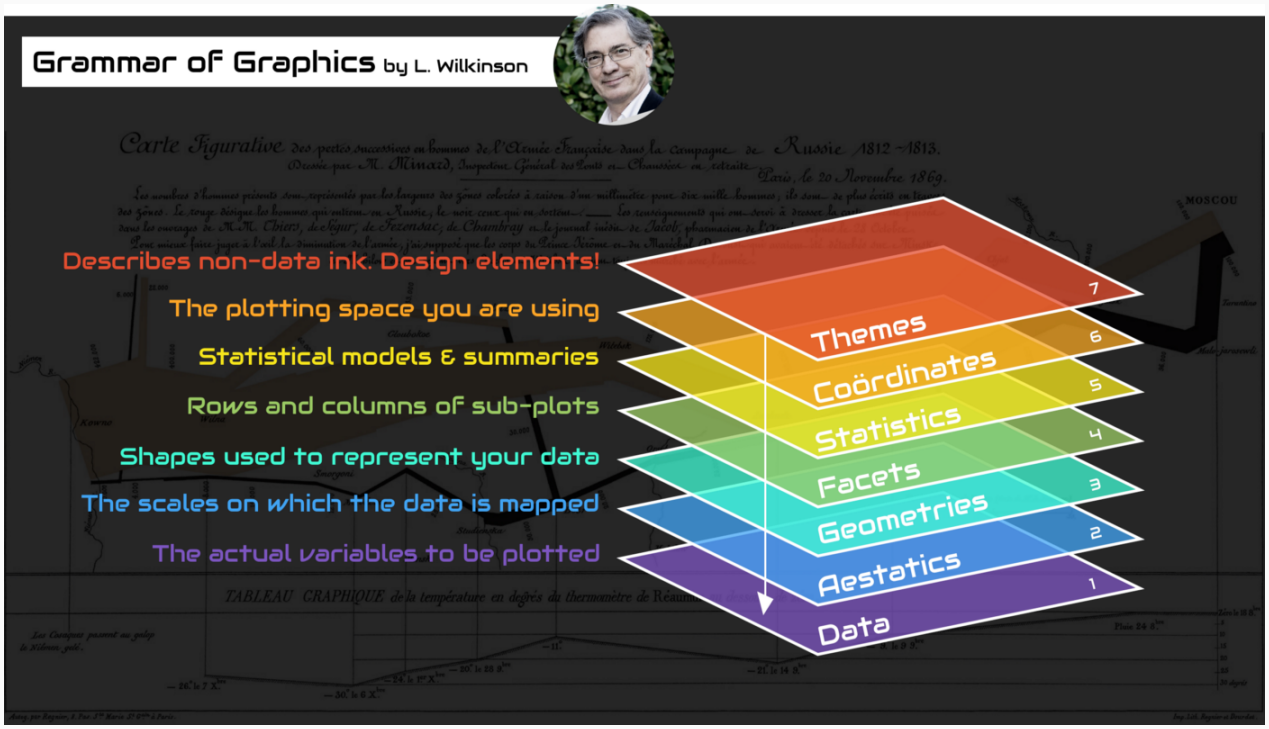
tmap	Mapas temáticos
ggplot2	Cria mapas eleganter usando a Grática de Gráficos
ggspatial	Estrutura de dados espaciais para ggplot2
cartography	Cartografia temática
googleway	Acessa Google Maps APIs para recuperar dados e traçar mapas
leaflet	Cria Web Maps interativos with Leaflet
mapview	Visualização interativa de dados espaciais em R
plotly	Crie gráficos interativos da Web por meio de 'plotly.js'
rasterVis	Métodos de visualização para dados raster

8.2 Pacotes para produção de mapas

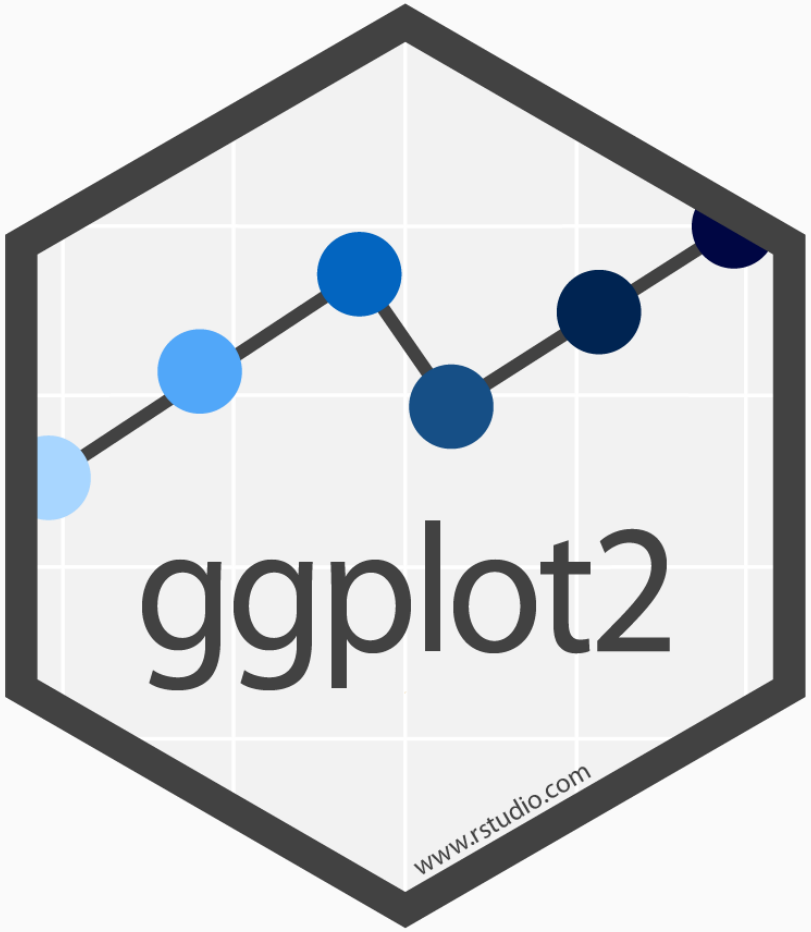
The Grammar of Graphics (1999)

Os pacotes `ggplot2` e `tmap` implementam uma adaptação da **gramática dos gráficos** em "layers"





Fonte: https://medium.com/tdebeus/think-about-the-grammar-of-graphics-when-improving-your-graphs-18e3744d8d18


ggplot2
www.rstudio.com

8.3 Pacote ggplot2

ggplot2

Integrado ao **tidyverse**, possui uma sintaxe própria

Principal pacote para **visualização de dados** no R

Estrutura:

```
ggplot( ... ) +
aes( ... ) +
geom_( ... ) +
stats_( ... ) +
coord_( ... ) +
facet_( ... ) +
theme_( ... )
```

Fonte: @allison_horst

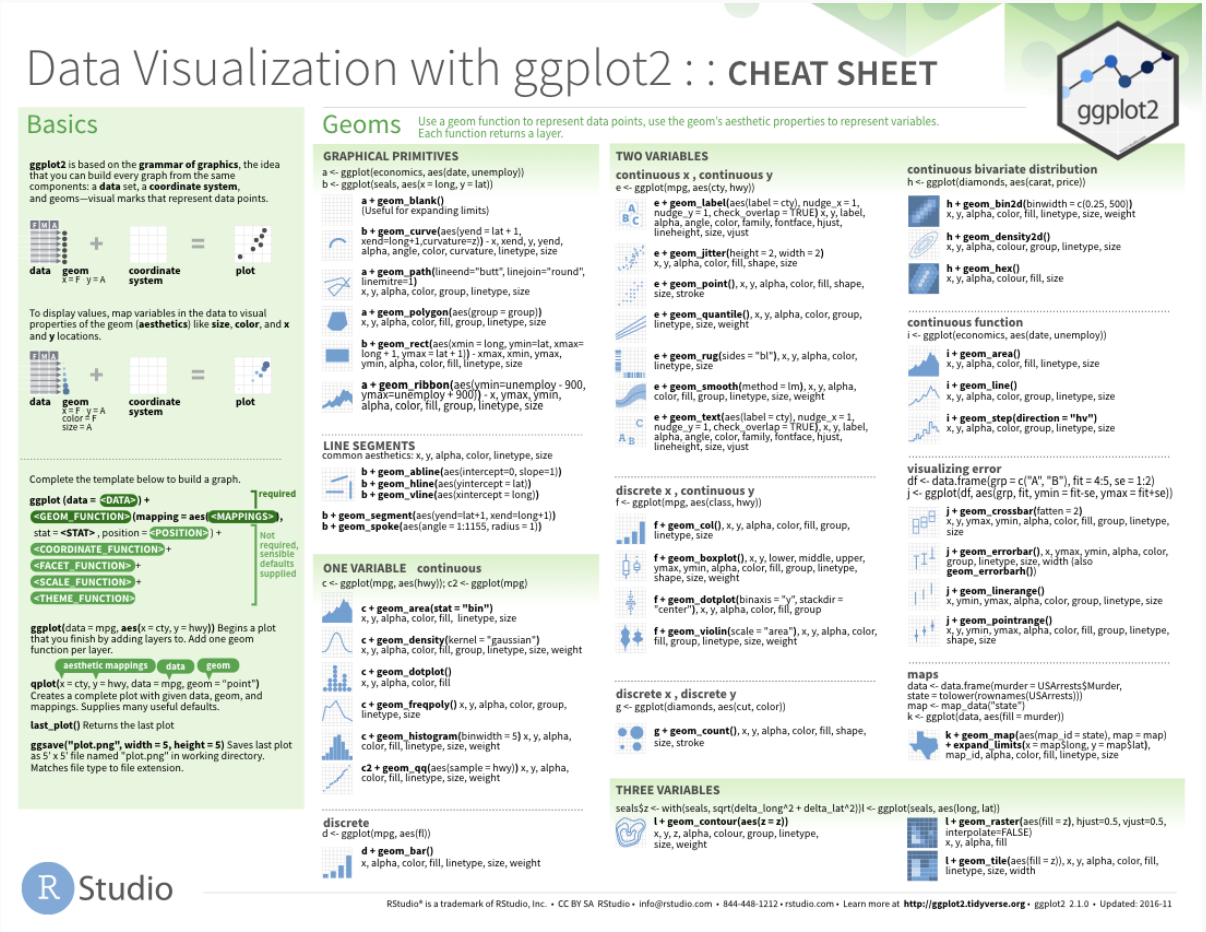
[*] https://ggplot2.tidyverse.org/

ggplot2

Fonte: https://medium.com/tdebeus/think-about-the-grammar-of-graphics-when-improving-your-graphs-18e3744d8d18

8.3 Pacote ggplot2

Data Visualization Cheatsheet

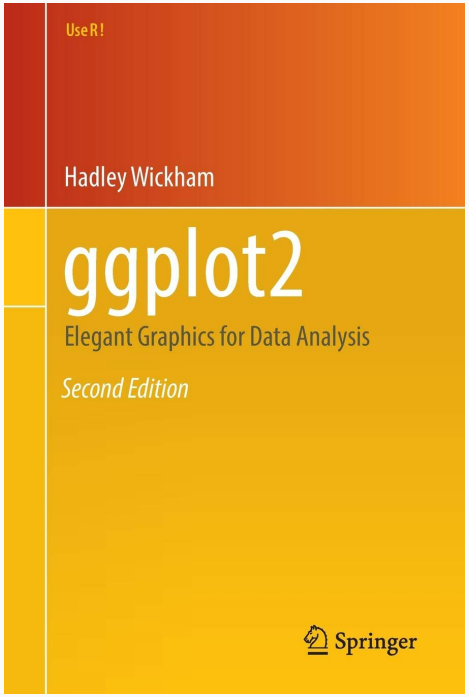


[*] https://github.com/rstudio/cheatsheets/raw/master/data-visualization-2.1.pdf

8.3 Pacote ggplot2

Livros

ggplot2 (2009, 2016)

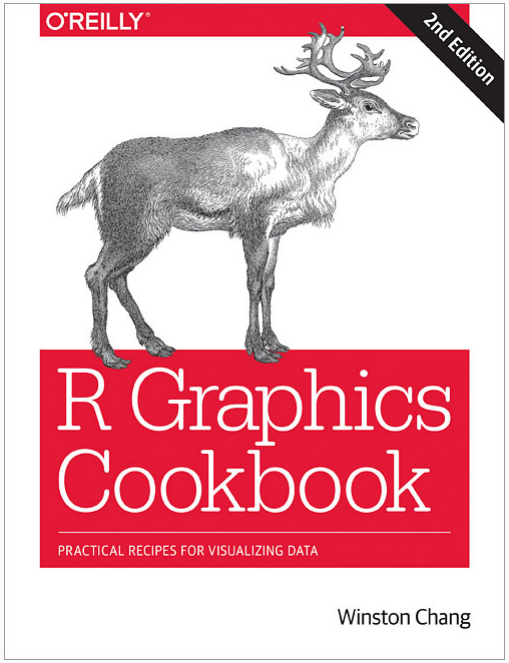


[*] https://ggplot2-book.org/

8.3 Pacote ggplot2

Livros

R Graphics Cookbook (2018)

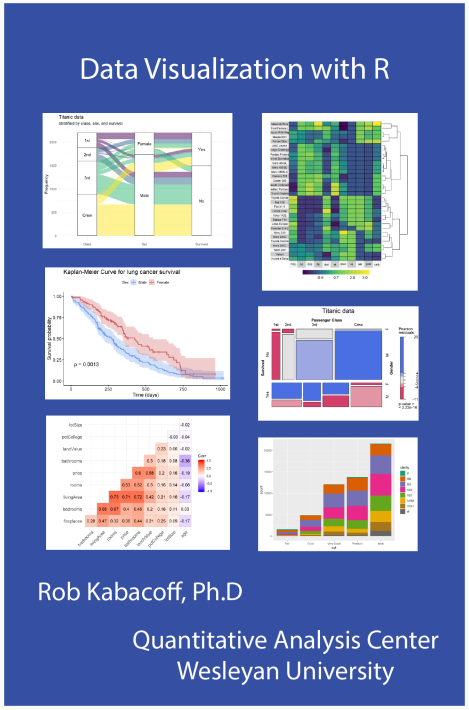


[*] http://www.cookbook-r.com/Graphs/

8.3 Pacote ggplot2

Livros

Data Visualization with R (2018)

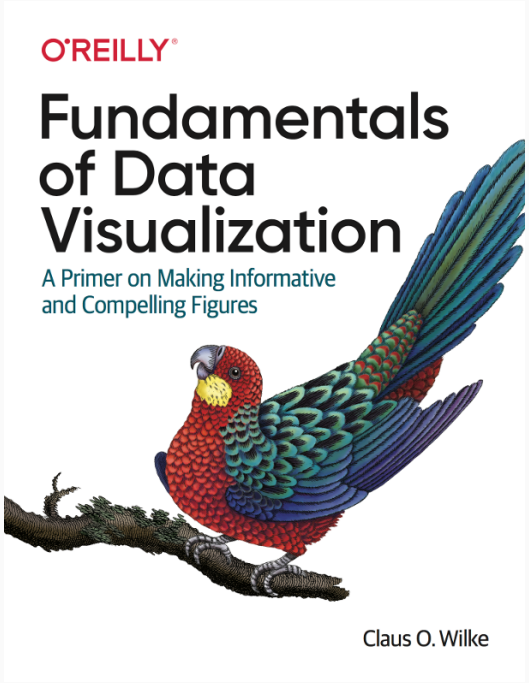


[*] https://rkabacoff.github.io/datavis/

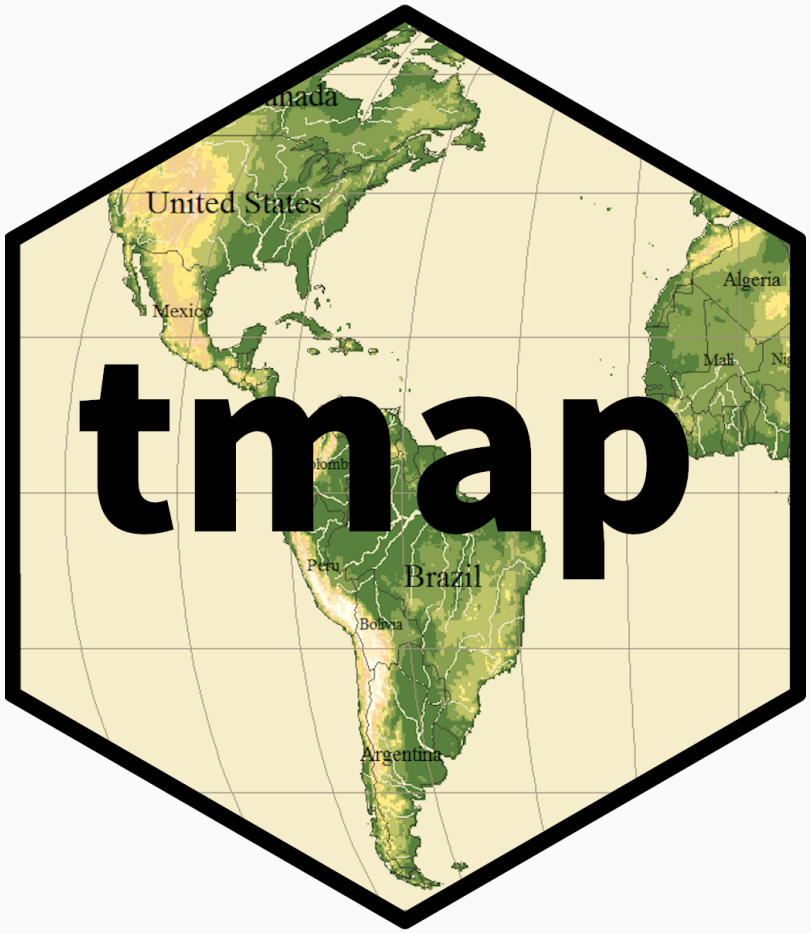
8.3 Pacote ggplot2

Livros

Fundamentals of Data Visualization (2019)



[*] https://serialmentor.com/dataviz/

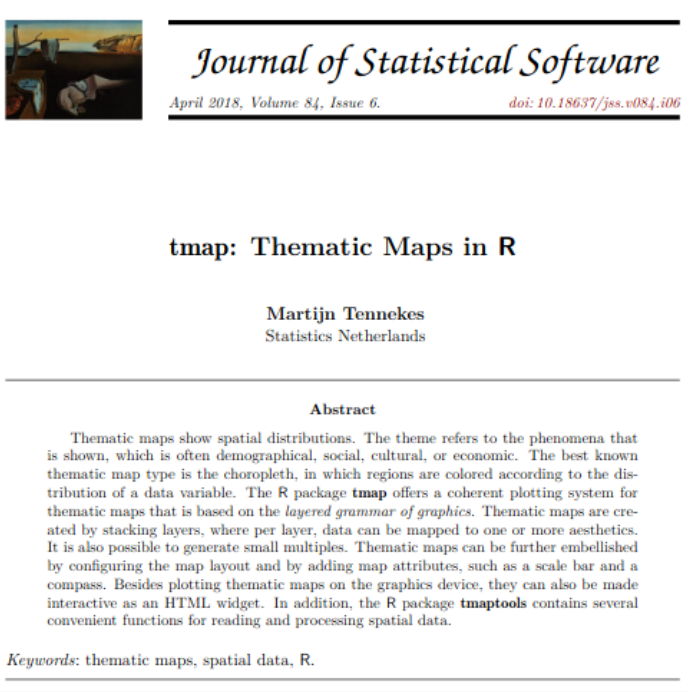

tmap
United States
Mexico
Algeria
Mali
Peru
Brazil
Argentina

8.4 Pacote tmap

tmap

Artigo

- Tennekes, Martijn. "tmap: Thematic Maps in R." Journal of Statistical Software 84.06 (2018): 1-39.



Journal of Statistical Software
April 2018, Volume 84, Issue 6. doi: 10.18637/jss.v084.i06

tmap: Thematic Maps in R

Martijn Tennekes
Statistics Netherlands

Abstract

Thematic maps show spatial distributions. The theme refers to the phenomena that is shown, which is often demographical, social, cultural, or economic. The best known thematic map type is the choropleth, in which regions are colored according to the distribution of a data variable. The R package **tmap** offers a coherent plotting system for thematic maps that is based on the *layered grammar of graphics*. Thematic maps are created by stacking layers, where per layer, data can be mapped to one or more aesthetics. It is also possible to generate small multiples. Thematic maps can be further embellished by configuring the map layout and by adding map attributes, such as a scale bar and a compass. Besides plotting thematic maps on the graphics device, they can also be made interactive as an HTML widget. In addition, the R package **tmaptools** contains several convenient functions for reading and processing spatial data.

Keywords: thematic maps, spatial data, R.

8.4 Pacote tmap

tmap

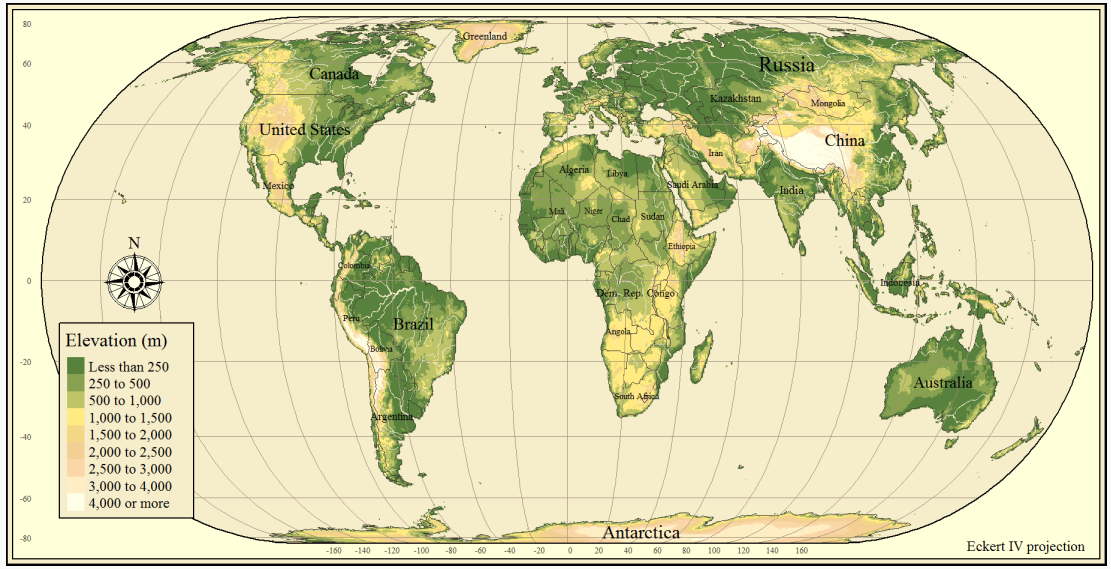
Sintaxe baseada no **ggplot2** e na **Gramática dos Gráficos**

Dois modos: **plot** (estáticos) e **visualização** (interativos)

Estrutura:

```
tm_shape( ... ) +
tm_*( ... ) +
tm_facets( ... ) +
tm_layout( ... )

tm_style( ... )
tmap_arrange( ... )
tm_mode( ... )
```

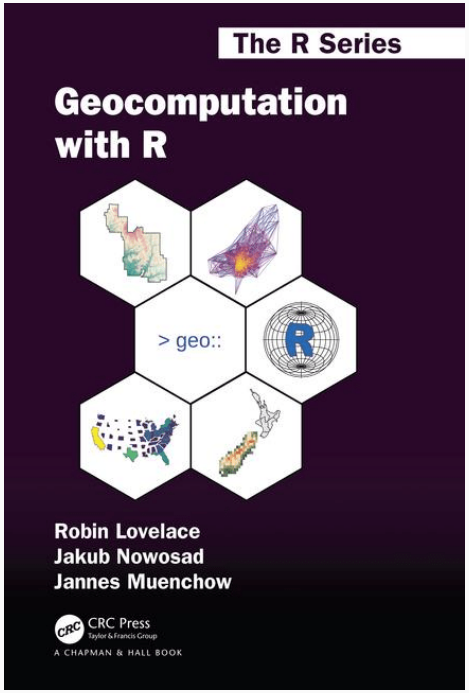


[*] https://mtennekes.github.io/tmap/

8.4 Pacote tmap

Livro

Geocomputation with R (2019)



[*] https://geocompr.robinlovelace.net/adv-map.html

Mapas vetoriais

8.5 Mapas vetoriais

Limite de Rio Claro/SP

```
# rio claro
rc_2019 ← geobr::read_municipality(code_muni = 3543907, year = 2019)
rc_2019
plot(rc_2019$geom, col = "gray", main = NA, axes = TRUE, graticule = TRUE)
```

8.5 Mapas vetoriais

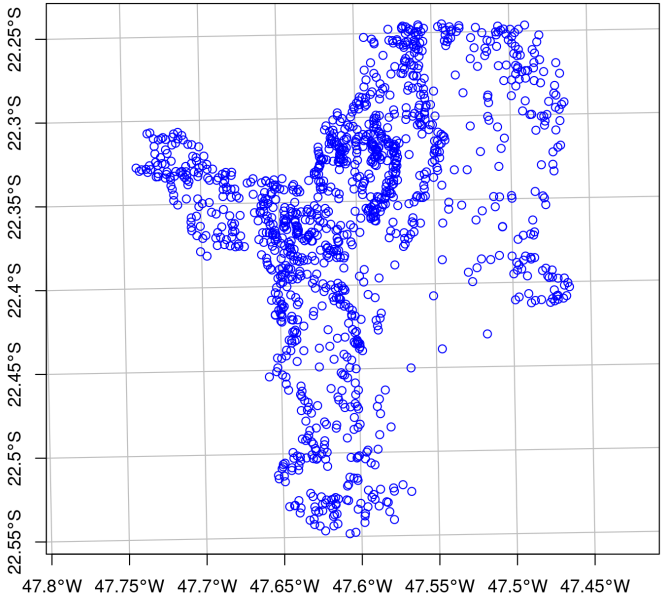
Limite de Rio Claro/SP

```
# rio claro utm
rc_2019_utm ← geobr::read_municipality(code_muni = 3543907, year = 2019) %>% sf::
rc_2019_utm
plot(rc_2019_utm$geom, col = "gray", main = NA, axes = TRUE, graticule = TRUE)
```

8.5 Mapas vetoriais

Pontos - nascentes

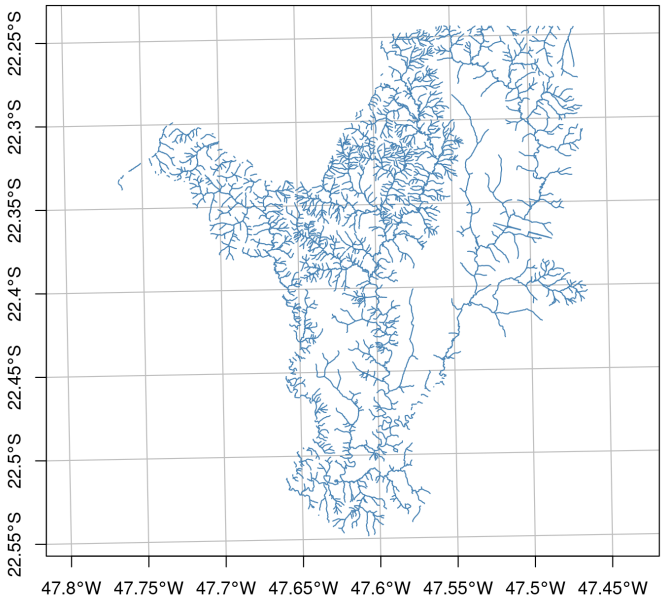
```
# import points
rc_spr ← sf::st_read(here::here("03_dados", "vetor", "SP_3543907_NASCENTES.shp"),
rc_spr
plot(rc_spr$geometry, col = "blue", main = NA, axes = TRUE, graticule = TRUE)
```



8.5 Mapas vetoriais

Linhas - rios

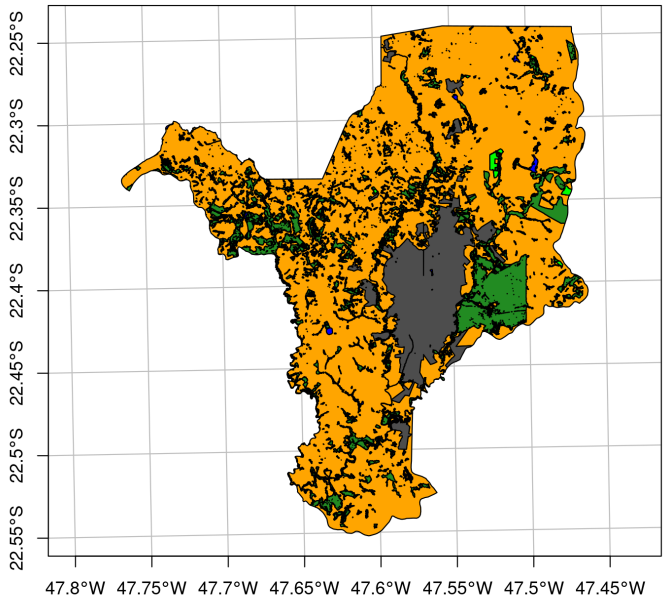
```
# import lines
rc_riv ← sf::st_read(here::here("03_dados", "vetor", "SP_3543907_RIOS_SIMPLES.shp
rc_riv
plot(rc_riv$geometry, col = "steelblue", main = NA, axes = TRUE, graticule = TRUE)
```

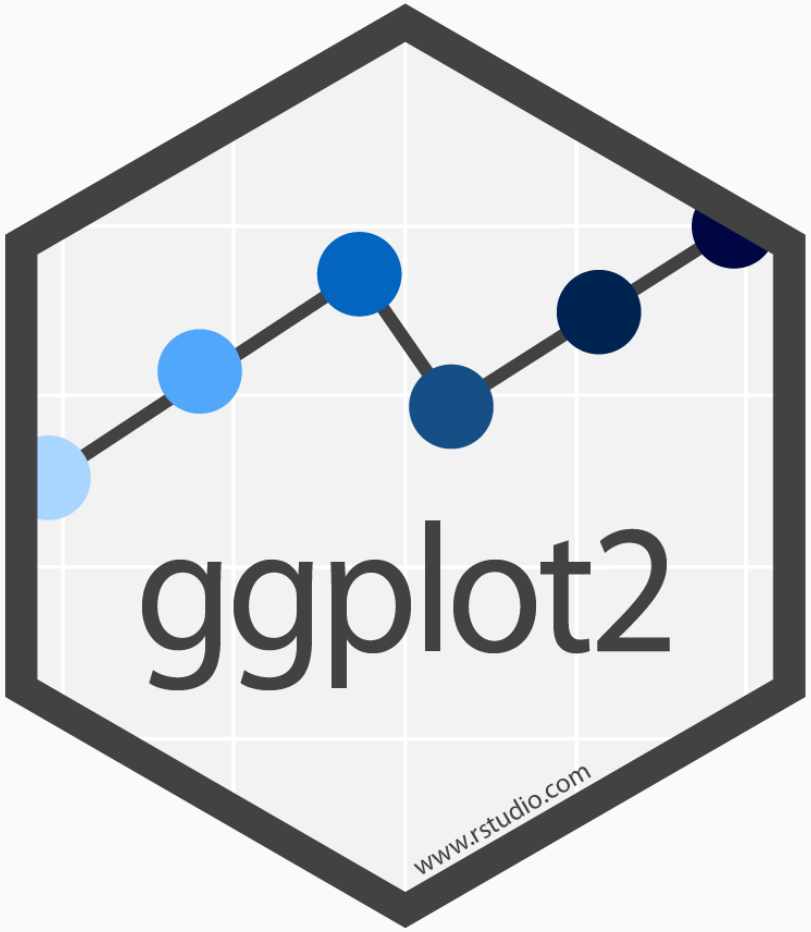


8.5 Mapas vetoriais

Polígonos - cobertura da terra

```
# import polygons
rc_use ← sf::st_read(here::here("03_dados", "vetor", "SP_3543907_USO.shp"), quiet
rc_use
plot(rc_use$geometry, col = c("blue", "orange", "gray30", "forestgreen", "green"),
```



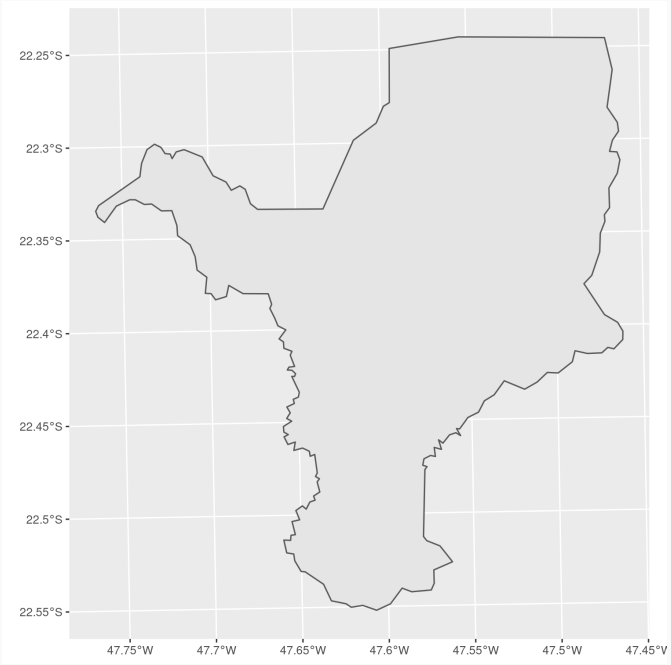

ggplot2
www.rstudio.com

8.5 Mapas vetoriais

ggplot2

Mapa do limite de Rio Claro/SP

```
# rio claro limit
ggplot() +
  geom_sf(data = rc_2019_utm)
```

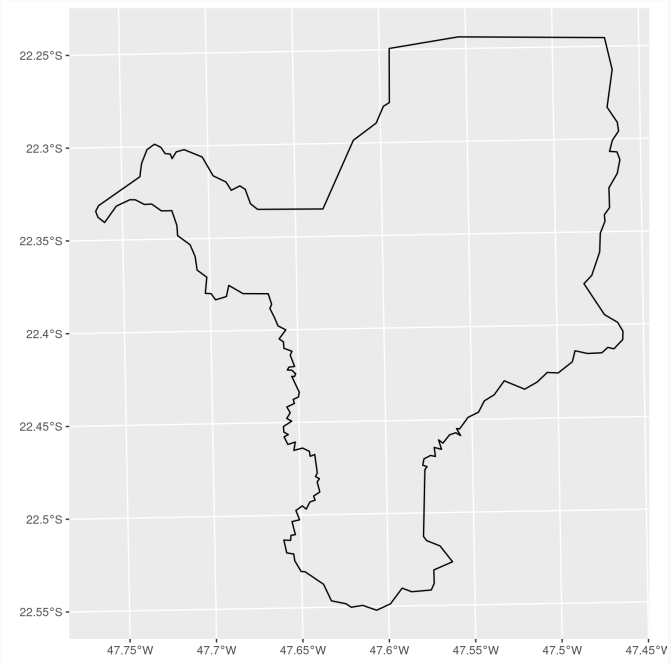


8.5 Mapas vetoriais

ggplot2

Mapa do limite de Rio Claro/SP - cor e preenchimento

```
# rio claro limit color and fill
ggplot() +
  geom_sf(data = rc_2019_utm, color = "black", fill = NA)
```

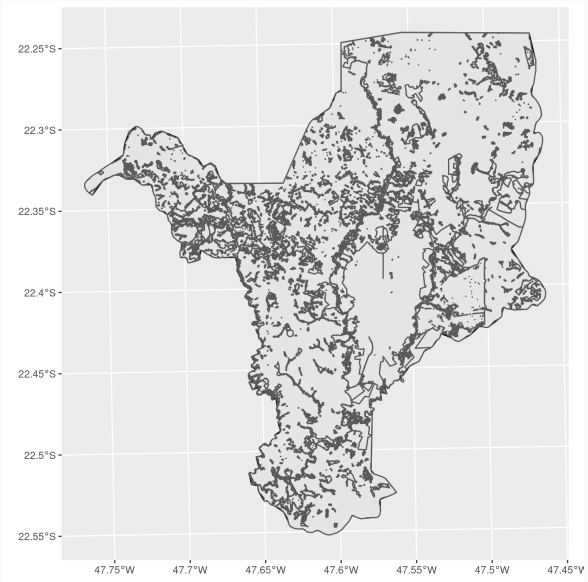


8.5 Mapas vetoriais

ggplot2

Limite e cobertura da terra

```
# rio claro limit fill + land use
ggplot() +
  geom_sf(data = rc_2019_utm, color = "black", fill = NA) +
  geom_sf(data = rc_use)
```



8.5 Mapas vetoriais

ggplot2

Limite e cobertura da terra com cores

```
# rio claro limit fill + land use with colors
ggplot() +
  geom_sf(data = rc_2019_utm, color = "black", fill = NA) +
  geom_sf(data = rc_use, aes(fill = CLASSE_USO), color = NA)
```

8.5 Mapas vetoriais

ggplot2

Limite e cobertura da terra com cores (inverter)

```
# land use with colors + rio claro limit fill
ggplot() +
  geom_sf(data = rc_use, aes(fill = CLASSE_USO), color = NA) +
  geom_sf(data = rc_2019_utm, color = "black", fill = NA)
```

8.5 Mapas vetoriais

ggplot2

Definir cores para as classes

```
# land use and choose colors + rio claro limit fill
ggplot() +
  geom_sf(data = rc_use, aes(fill = CLASSE_USO), color = NA) +
  geom_sf(data = rc_2019_utm, color = "black", fill = NA) +
  scale_fill_manual(values = c("blue", "orange", "gray30", "forestgreen", "green")
```

8.5 Mapas vetoriais

ggplot2

Mudar o CRS (Sistema de Coordenadas)

```
# land use and choose colors + rio claro limit fill + coords
ggplot() +
  geom_sf(data = rc_use, aes(fill = CLASSE_USO), color = NA) +
  geom_sf(data = rc_2019_utm, color = "black", fill = NA) +
  scale_fill_manual(values = c("blue", "orange", "gray30", "forestgreen", "green")
  coord_sf(datum = 31983)
```

8.5 Mapas vetoriais

ggplot2

Mudar o tema

```
# land use and choose colors + rio claro limit fill + coords + themes
ggplot() +
  geom_sf(data = rc_use, aes(fill = CLASSE_USO), color = NA) +
  geom_sf(data = rc_2019_utm, color = "black", fill = NA) +
  scale_fill_manual(values = c("blue", "orange", "gray30", "forestgreen", "green")
  coord_sf(datum = 31983) +
  theme_bw()
```

8.5 Mapas vetoriais

ggplot2

Adicionar barra de escala e norte

```
# land use and choose colors + rio claro limit fill + coords + themes + scalebar +
ggplot() +
  geom_sf(data = rc_use, aes(fill = CLASSE_USO), color = NA) +
  geom_sf(data = rc_2019_utm, color = "black", fill = NA) +
  scale_fill_manual(values = c("blue", "orange", "gray30", "forestgreen", "green")
  coord_sf(datum = 31983) +
  theme_bw() +
  annotation_scale(location = "br", width_hint = .3) +
  annotation_north_arrow(location = "br", which_north = "true",
                         pad_x = unit(0, "cm"), pad_y = unit(.7, "cm"),
                         style = north_arrow_fancy_orienteering)
```

8.5 Mapas vetoriais

ggplot2

Adicionar barra de escala e norte

8.5 Mapas vetoriais

ggplot2

Add título e nome dos eixos, ângulo das coords e atribuir

```
# land use and choose colors + rio claro limit fill + coords + themes + scalebar +
map_use_gg ← ggplot() +
  geom_sf(data = rc_use, aes(fill = CLASSE_USO), color = NA) +
  geom_sf(data = rc_2019_utm, color = "black", fill = NA) +
  scale_fill_manual(values = c("blue", "orange", "gray30", "forestgreen", "green")
  coord_sf(datum = 31983) +
  theme_bw() +
  annotation_scale(location = "br", width_hint = .3) +
  annotation_north_arrow(location = "br", which_north = "true",
                         pad_x = unit(0, "cm"), pad_y = unit(.7, "cm"),
                         style = north_arrow_fancy_orienteering) +
  labs(x = "Longitude", y = "Latitude", title = "Cobertura da terra Rio Claro/SP (
  theme(legend.position = c(.18,.18),
        legend.box.background = element_rect(colour = "black"),
        axis.text.y = element_text(angle = 90, hjust = .5))
map_use_gg
```

8.5 Mapas vetoriais

ggplot2

Add título e nome dos eixos, ângulo das coords e atribuir

8.5 Mapas vetoriais

ggplot2

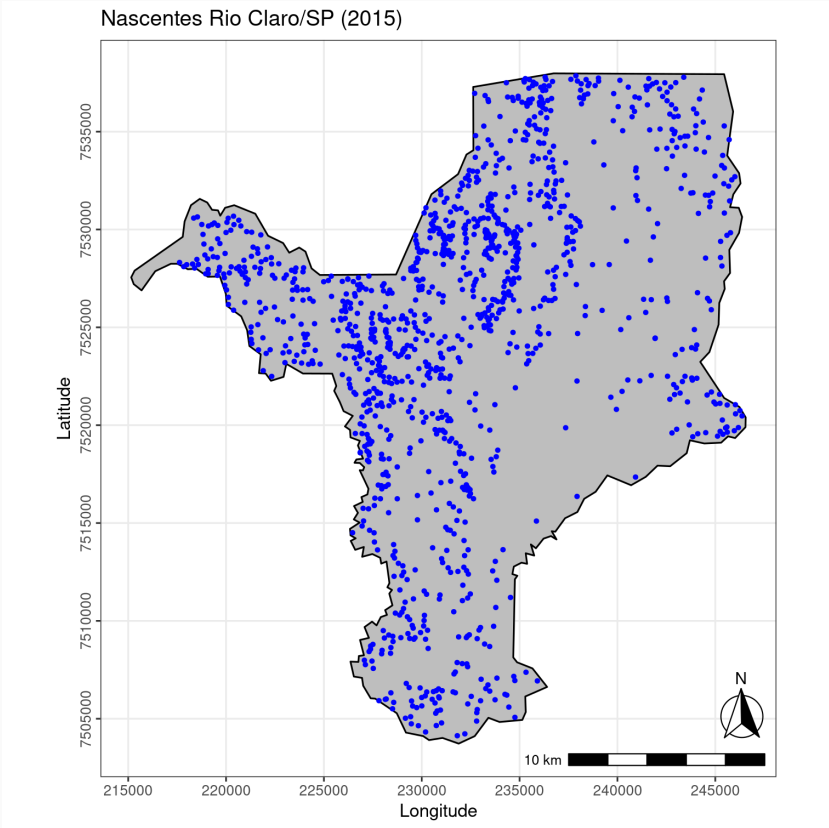
Nascentes

```
# springs
ggplot() +
  geom_sf(data = rc_2019_utm, color = "black", fill = "gray") +
  geom_sf(data = rc_spr, shape = 20, color = "blue") +
  coord_sf(datum = 31983) +
  theme_bw() +
  annotation_scale(location = "br", width_hint = .3) +
  annotation_north_arrow(location = "br", which_north = "true",
                         pad_x = unit(0, "cm"), pad_y = unit(.7, "cm"),
                         style = north_arrow_fancy_orienteering) +
  labs(x = "Longitude", y = "Latitude", title = "Nascentes Rio Claro/SP (2015)") +
  theme(legend.position = c(.18,.18),
        legend.box.background = element_rect(colour = "black"),
        axis.text.y = element_text(angle = 90, hjust = .5))
```

8.5 Mapas vetoriais

ggplot2

Nascentes



8.5 Mapas vetoriais

ggplot2

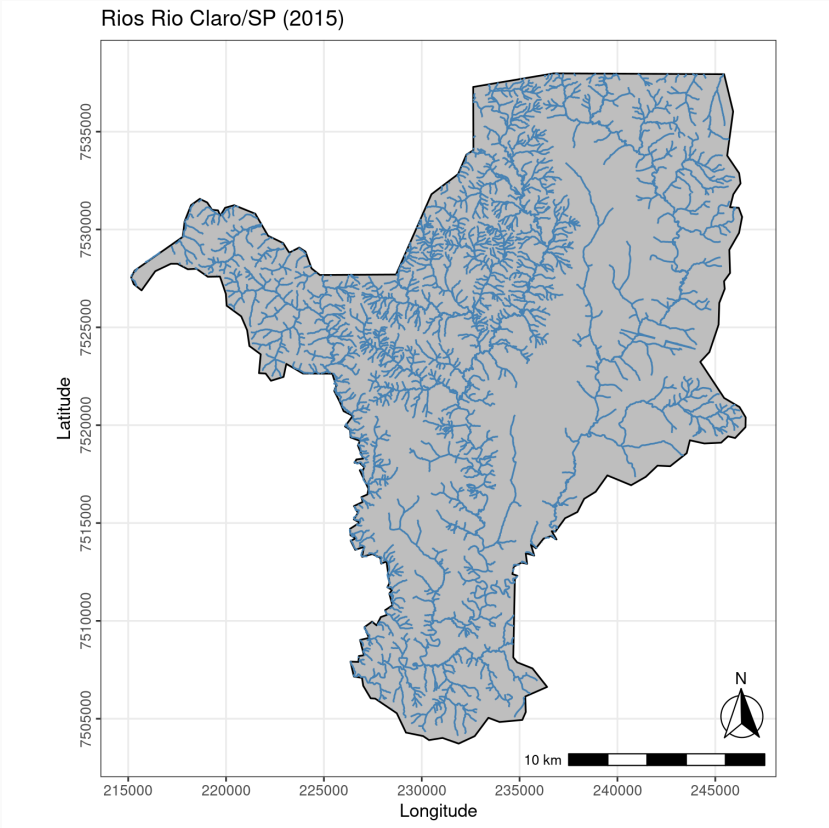
Rios

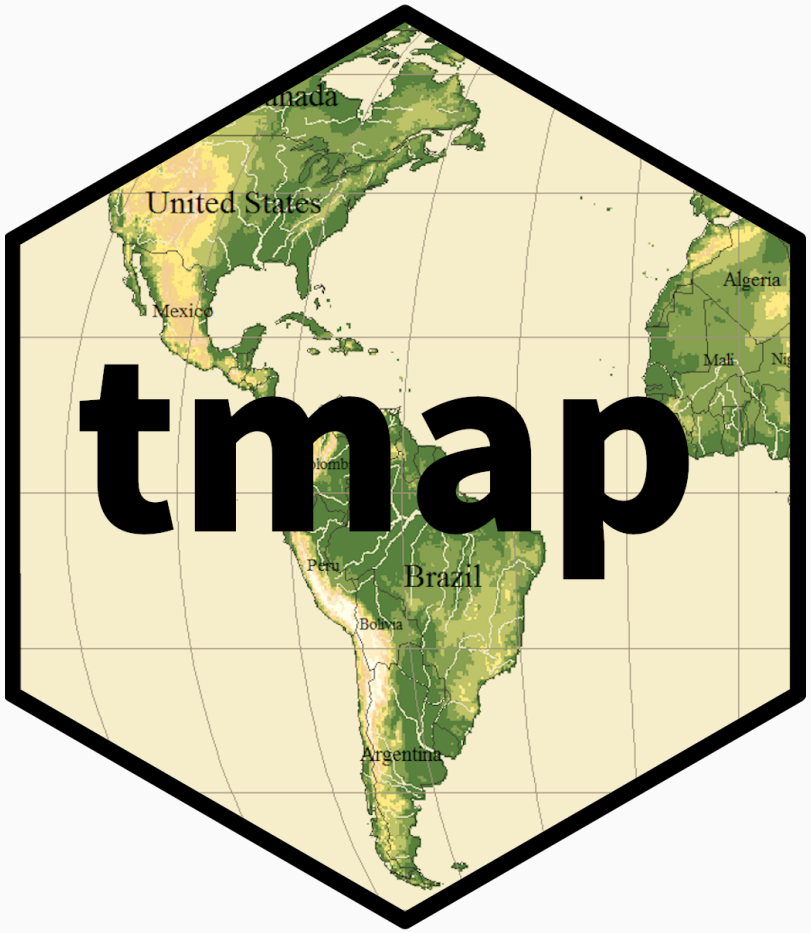
```
# rivers
ggplot() +
  geom_sf(data = rc_2019_utm, color = "black", fill = "gray") +
  geom_sf(data = rc_riv, shape = 20, color = "steelblue") +
  coord_sf(datum = 31983) +
  theme_bw() +
  annotation_scale(location = "br", width_hint = .3) +
  annotation_north_arrow(location = "br", which_north = "true",
                         pad_x = unit(0, "cm"), pad_y = unit(.7, "cm"),
                         style = north_arrow_fancy_orienteering) +
  labs(x = "Longitude", y = "Latitude", title = "Rios Rio Claro/SP (2015)") +
  theme(legend.position = c(.18,.18),
        legend.box.background = element_rect(colour = "black"),
        axis.text.y = element_text(angle = 90, hjust = .5))
```

8.5 Mapas vetoriais

ggplot2

Rios



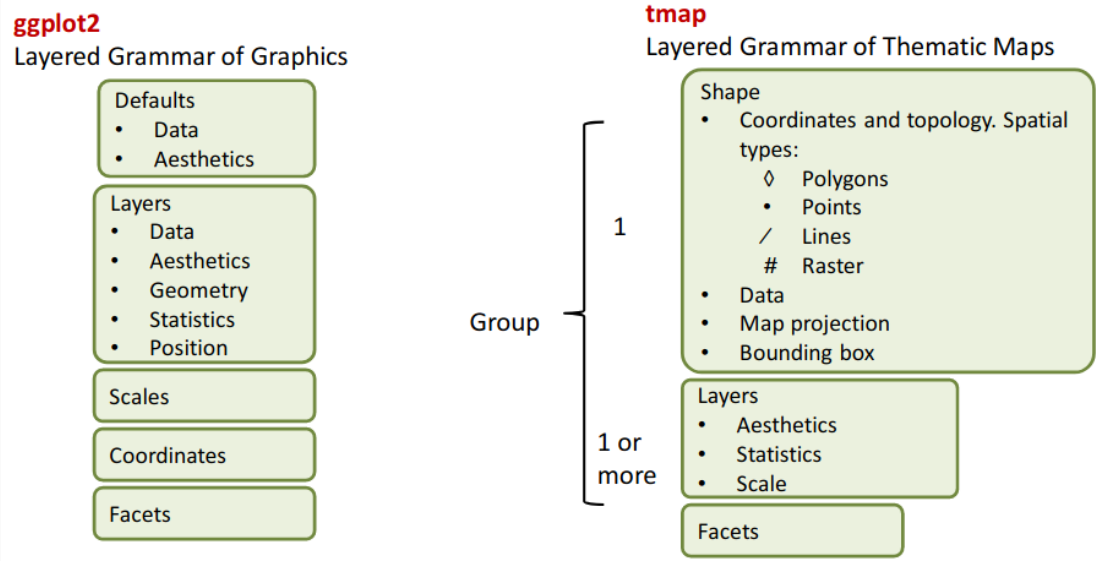

tmap
United States
Mexico
Algeria
Mali
Peru
Brazil
Argentina

8.5 Mapas vetoriais

ggplot2 e tmap

	(Spatial) data	Layers (geometry, mapping, and scaling)	Small multiples	Layout
ggplot2	ggplot(...) +	geom_...(...) + scale_...(...) +	facet_wrap(...) +	theme(...)
tmap	tm_shape(...) +	tm_...(...) +	tm_facets(...) +	tm_layout(...)

Implemented: tm_polygons, tm_symbols, tm_lines, tm_raster, tm_text, tm_fill, tm_borders, tm_bubbles, tm_squares, tm_dots, tm_rgb, tm_markers, tm_iso



8.5 Mapas vetoriais

tmap

Mapa do limite de Rio Claro/SP

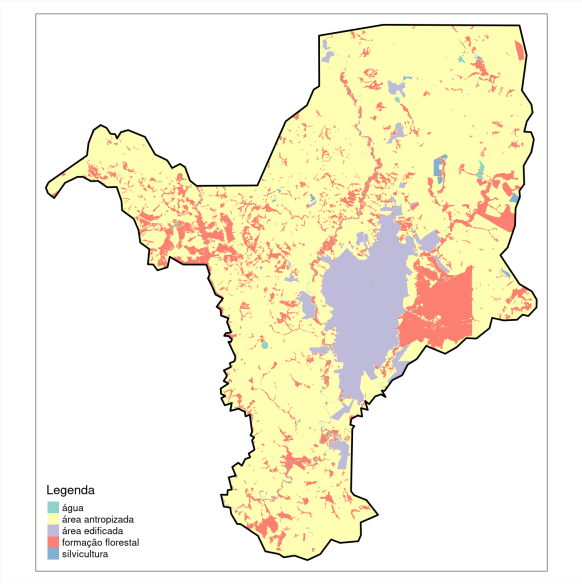
```
# rio claro limit
tm_shape(rc_2019_utm) +
  tm_polygons()
```

8.5 Mapas vetoriais

tmap

Limite e cobertura da terra

```
# rio claro limit fill + land use
tm_shape(rc_use) +
  tm_fill(col = "CLASSE_USO", title = "Legenda") +
  tm_shape(rc_2019_utm) +
  tm_borders(lwd = 2, col = "black")
```

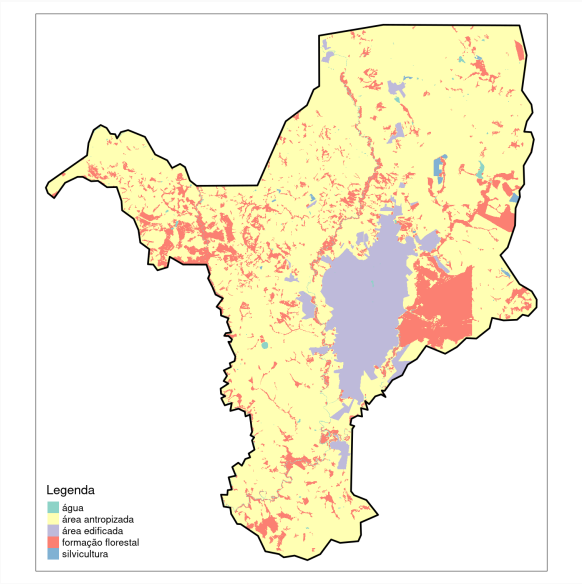


8.5 Mapas vetoriais

tmap

Limite e cobertura da terra com cores

```
# rio claro limit fill + land use with colors
tm_shape(rc_use) +
  tm_fill(col = "CLASSE_USO", title = "Legenda") +
  tm_shape(rc_2019_utm) +
  tm_borders(lwd = 2, col = "black")
```



8.5 Mapas vetoriais

tmap

Definir cores para as classes

```
# land use and choose colors + rio claro limit fill
tm_shape(rc_use) +
  tm_fill(col = "CLASSE_USO",
          pal = c("blue", "orange", "gray30", "forestgreen", "green"), title = "Le
  tm_shape(rc_2019_utm) +
  tm_borders(lwd = 2, col = "black")
```

8.5 Mapas vetoriais

tmap

Add coordenadas

```
# land use and choose colors + rio claro limit fill + coords
tm_shape(rc_use) +
  tm_fill(col = "CLASSE_USO",
          pal = c("blue", "orange", "gray30", "forestgreen", "green"), title = "Le
  tm_shape(rc_2019_utm) +
  tm_borders(lwd = 2, col = "black") +
  tm_grid(lines = FALSE, labels.format = list(big.mark = ""), labels.rot = c(0, 90
```

8.5 Mapas vetoriais

tmap

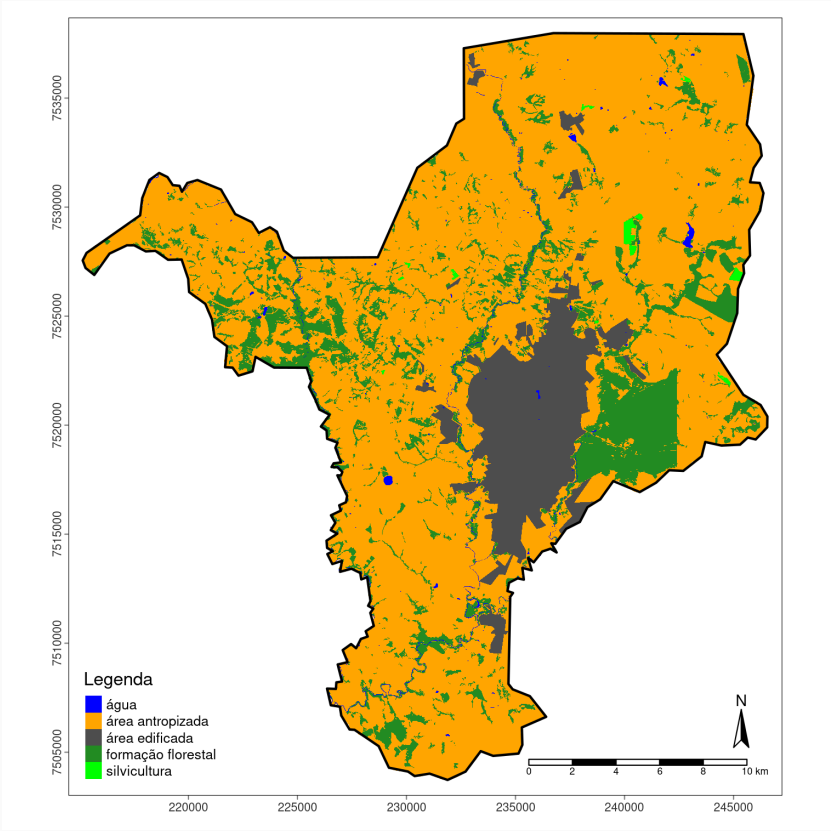
Adicionar barra de escala e norte

```
# land use and choose colors + rio claro limit fill + coords + themes + scalebar +
tm_shape(rc_use) +
  tm_fill(col = "CLASSE_USO",
          pal = c("blue", "orange", "gray30", "forestgreen", "green"), title = "Le
  tm_shape(rc_2019_utm) +
  tm_borders(lwd = 2, col = "black") +
  tm_grid(lines = FALSE, labels.format = list(big.mark = ""), labels.rot = c(0, 90
  tm_compass() +
  tm_scale_bar()
```

8.5 Mapas vetoriais

tmap

Adicionar barra de escala e norte



8.5 Mapas vetoriais

tmap

Add título, nome dos eixos e atribuir a um objeto

```
# land use and choose colors + rio claro limit fill + coords + themes + scalebar +
map_use_tmap ← tm_shape(rc_use) +
  tm_fill(col = "CLASSE_USO",
          pal = c("blue", "orange", "gray30", "forestgreen", "green"), title = "Le
  tm_shape(rc_2019_utm) +
  tm_borders(lwd = 2, col = "black") +
  tm_grid(lines = FALSE, labels.format = list(big.mark = ""), labels.rot = c(0, 90
  tm_compass() +
  tm_scale_bar() +
  tm_xlab("Longitude") +
  tm_ylab("Latitude") +
  tm_layout(main.title = "Cobertura da terra Rio Claro/SP (2015)")
map_use_tmap
```

8.5 Mapas vetoriais

tmap

Add título, nome dos eixos e atribuir a um objeto

8.5 Mapas vetoriais

tmap

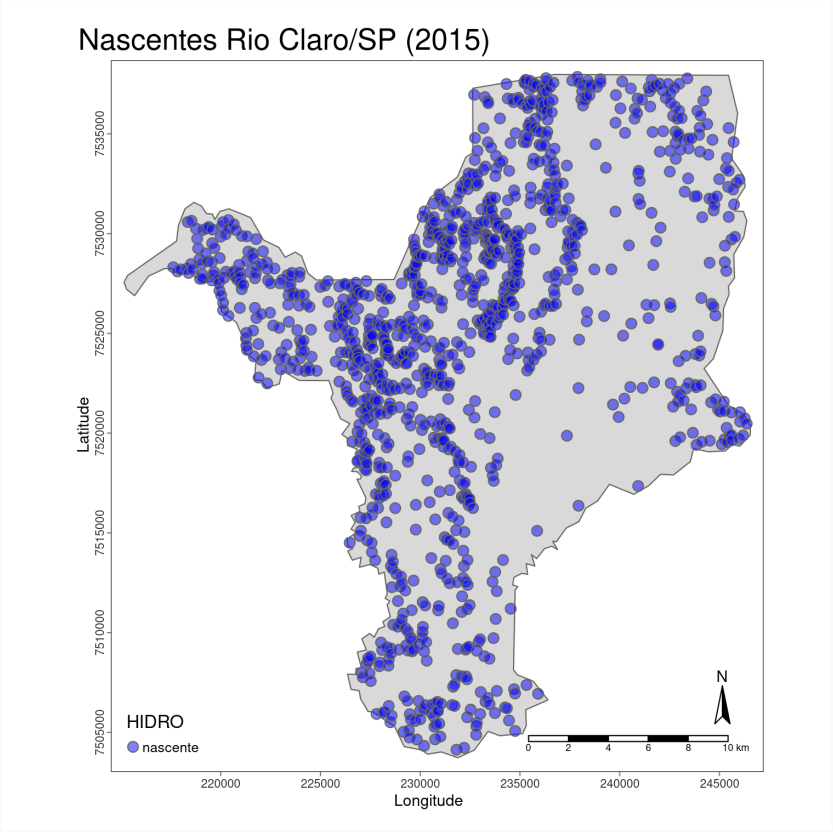
Nascentes

```
# springs
tm_shape(rc_2019_utm) +
  tm_polygons() +
  tm_shape(rc_spr) +
  tm_bubbles(col = "HIDRO", pal = "blue",
             size = .2, alpha = .5) +
  tm_grid(lines = FALSE, labels.format = list(big.mark = ""), labels.rot = c(0, 90
  tm_compass() +
  tm_scale_bar() +
  tm_xlab("Longitude") +
  tm_ylab("Latitude") +
  tm_layout(main.title = "Nascentes Rio Claro/SP (2015)")
```

8.5 Mapas vetoriais

tmap

Nascentes



8.5 Mapas vetoriais

tmap

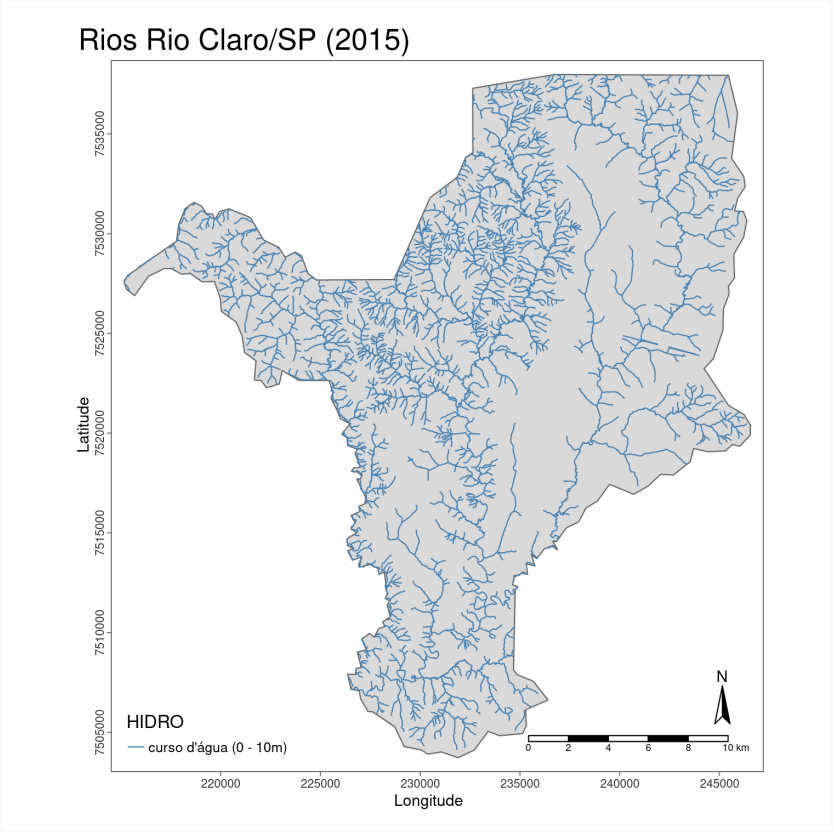
Rios

```
# rivers
tm_shape(rc_2019_utm) +
  tm_polygons() +
  tm_shape(rc_riv) +
  tm_lines(col = "HIDRO", pal = "steelblue") +
  tm_grid(lines = FALSE,
          labels.format = list(big.mark = ""),
          labels.rot = c(0, 90)) +
  tm_compass() +
  tm_scale_bar() +
  tm_xlab("Longitude") +
  tm_ylab("Latitude") +
  tm_layout(main.title = "Rios Rio Claro/SP (2015)")
```

8.5 Mapas vetoriais

tmap

Rios

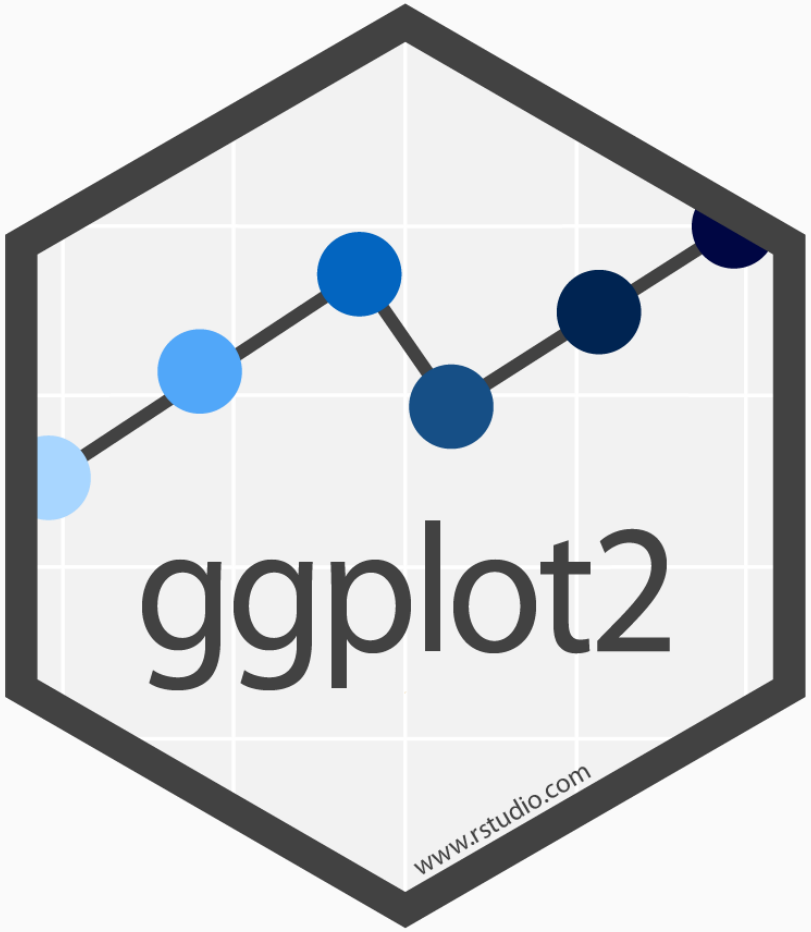


Mapas matriciais

8.6 Mapas matriciais

Elevação

```
# import elevation
elev ← raster::raster(here::here("03_dados", "raster", "srtm_27_17_rc.tif")) %>%
  raster::mask(rc_2019)
elev
plot(elev, col = viridis::viridis(10))
```


ggplot2
www.rstudio.com

8.6 Mapas matriciais

ggplot2

Transformar o raster em um tibble

```
# raster to tibble
da_elev ← raster::rasterToPoints(elev) %>%
  tibble::as_tibble() %>%
  dplyr::rename(elev = srtm_27_17_rc)
head(da_elev)
```

```
## # A tibble: 6 x 3
##       x     y  elev
##   <dbl> <dbl> <dbl>
## 1 -47.6 -22.2   650
## 2 -47.6 -22.2   646
## 3 -47.6 -22.2   644
## 4 -47.6 -22.2   643
## 5 -47.6 -22.2   641
## 6 -47.6 -22.2   688
```

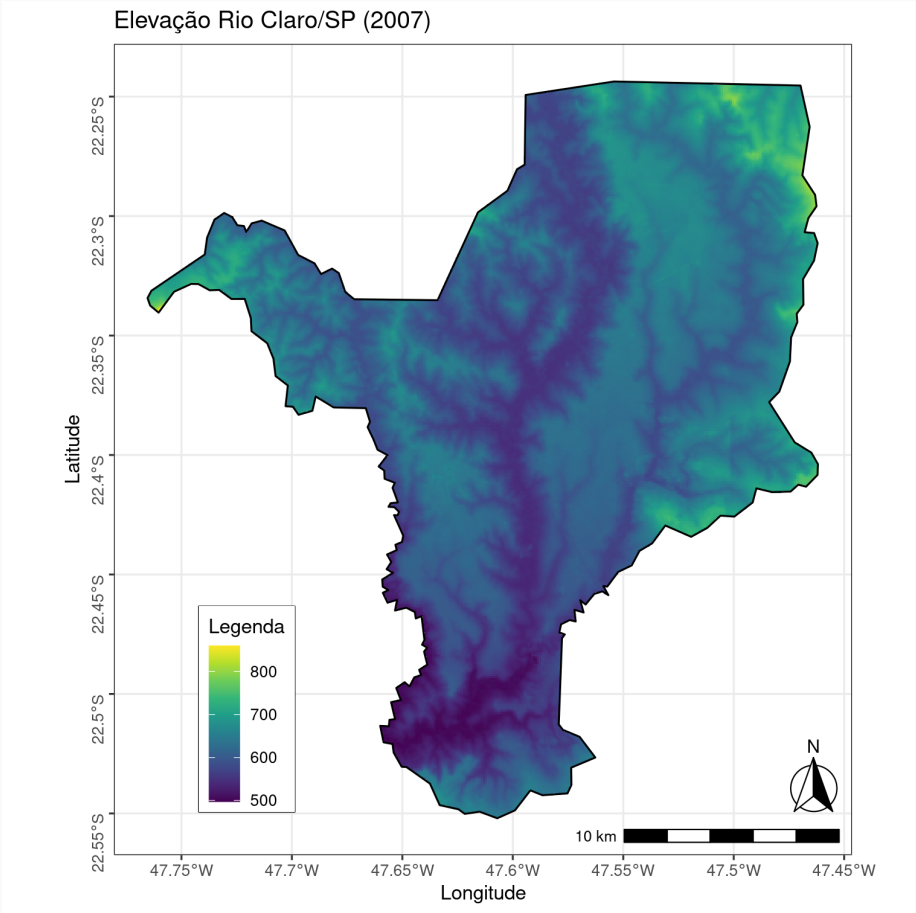
8.6 Mapas matriciais

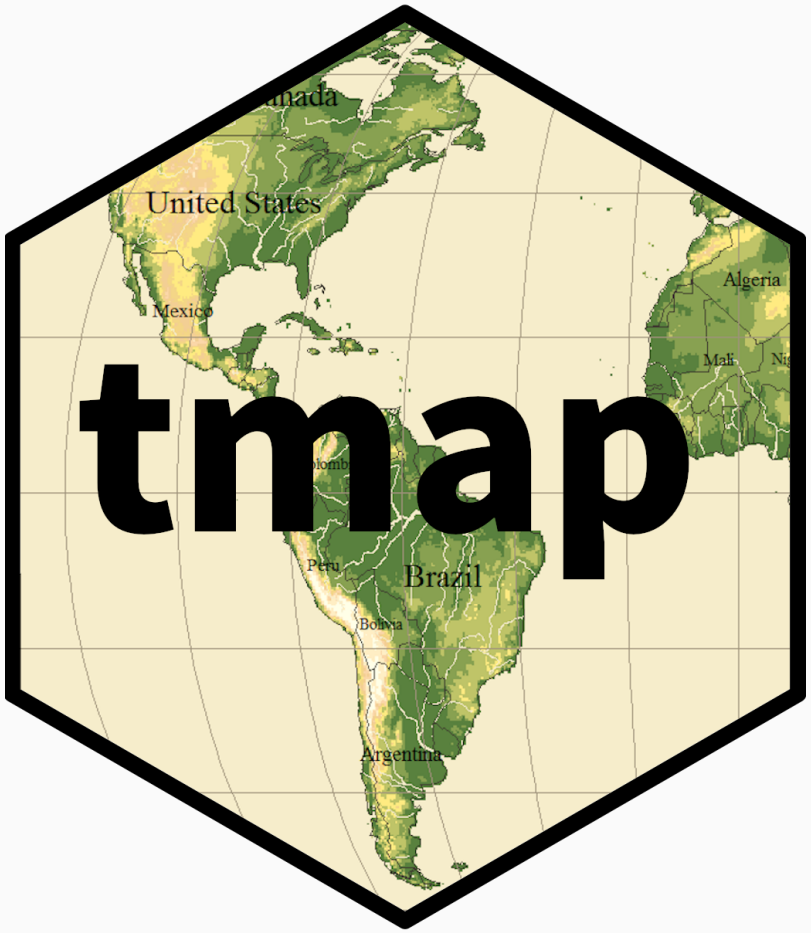
ggplot2

```
# elevation map
map_elev_gg ← ggplot() +
  geom_raster(data = da_elev, aes(x = x, y = y, fill = elev)) +
  geom_sf(data = rc_2019, color = "black", fill = NA) +
  scale_fill_gradientn(colors = viridis::viridis(10)) +
  theme_bw() +
  annotation_scale(location = "br", width_hint = .3) +
  annotation_north_arrow(location = "br", which_north = "true",
                         pad_x = unit(0, "cm"), pad_y = unit(.7, "cm"),
                         style = north_arrow_fancy_orienteering) +
  labs(x = "Longitude", y = "Latitude", title = "Elevação Rio Claro/SP (2007)", fi
  theme(legend.position = c(.18,.18),
        legend.box.background = element_rect(colour = "black"),
        axis.text.y = element_text(angle = 90))
map_elev_gg
```

8.6 Mapas matriciais

ggplot2




United States
Mexico
Algeria
Mali
Peru
Brazil
Argentina
tmap

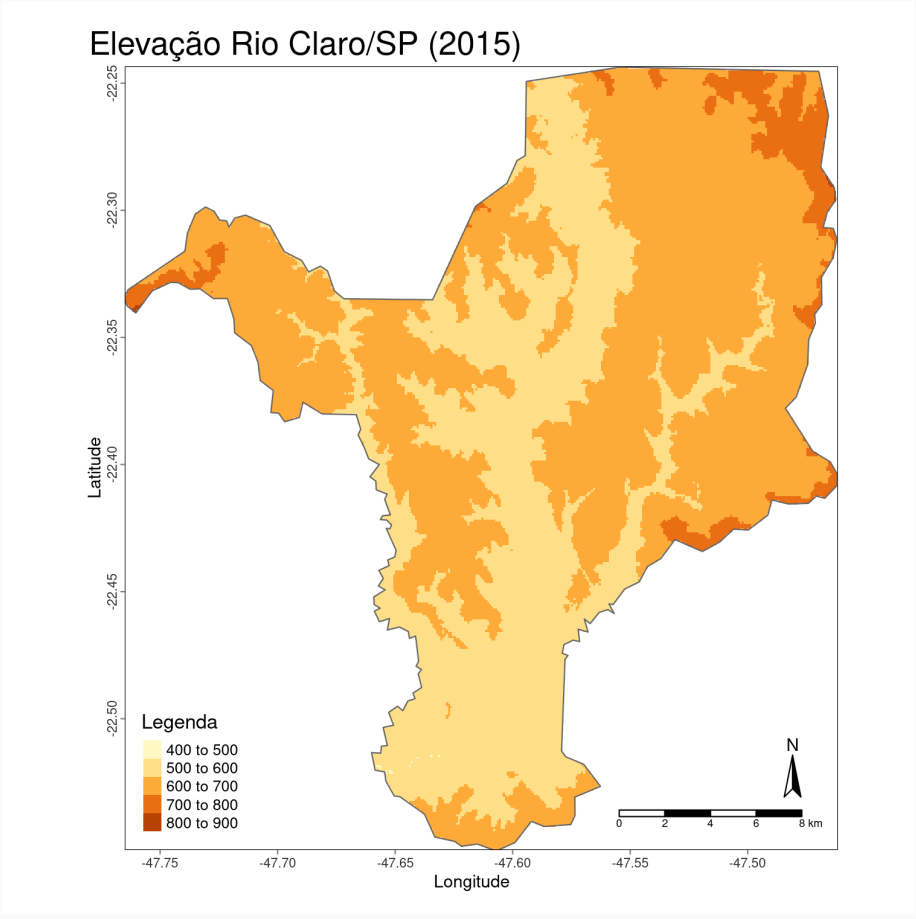
8.6 Mapas matriciais

tmap

```
# elevation map
map_elev_tmap ← tm_shape(elev) +
  tm_raster(title = "Legenda") +
  tm_shape(rc_2019) +
  tm_borders() +
  tm_grid(lines = FALSE, labels.format = list(big.mark = ""), labels.rot = c(0, 90
  tm_compass() +
  tm_scale_bar() +
  tm_xlab("Longitude") +
  tm_ylab("Latitude") +
  tm_layout(legend.position = c("left", "bottom"),
            main.title = "Elevação Rio Claro/SP (2015)")
map_elev_tmap
```

8.6 Mapas matriciais

tmap



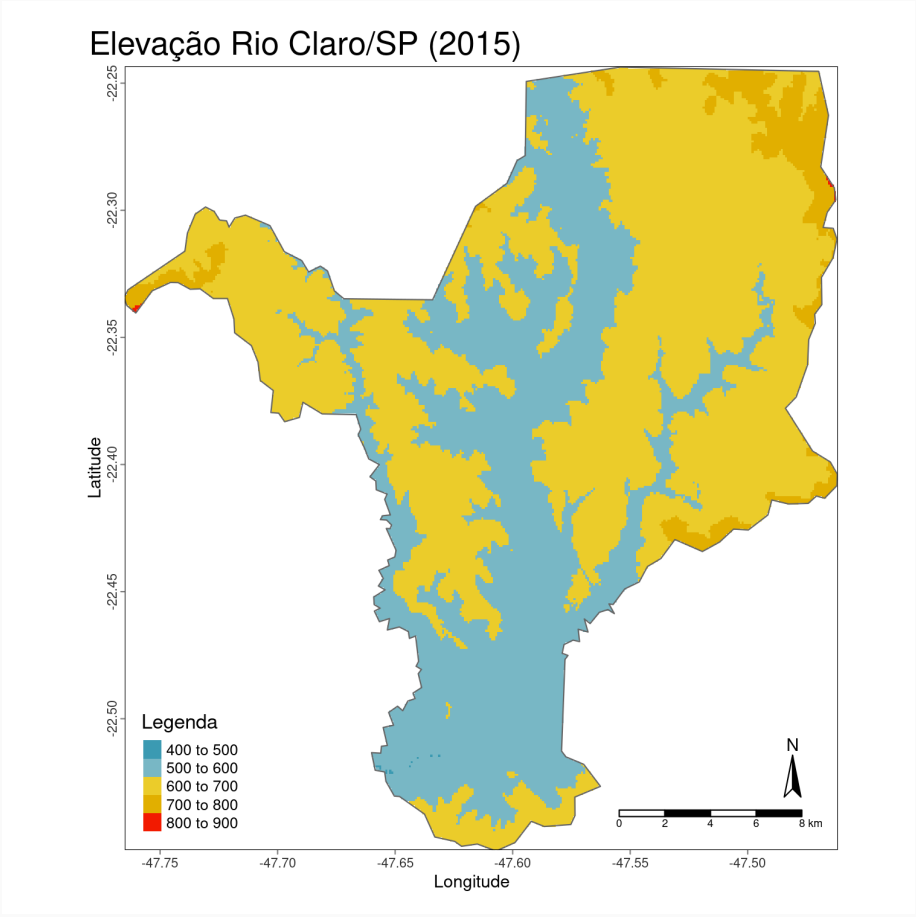
8.6 Mapas matriciais

tmap

```
# elevation map
map_elev_tmap ← tm_shape(elev) +
  tm_raster(pal = wesanderson::wes_palette("Zissou1"), title = "Legenda") +
  tm_shape(rc_2019) +
  tm_borders() +
  tm_grid(lines = FALSE, labels.format = list(big.mark = ""), labels.rot = c(0, 90
  tm_compass() +
  tm_scale_bar() +
  tm_xlab("Longitude") +
  tm_ylab("Latitude") +
  tm_layout(legend.position = c("left", "bottom"),
            main.title = "Elevação Rio Claro/SP (2015)")
map_elev_tmap
```

8.6 Mapas matriciais

tmap



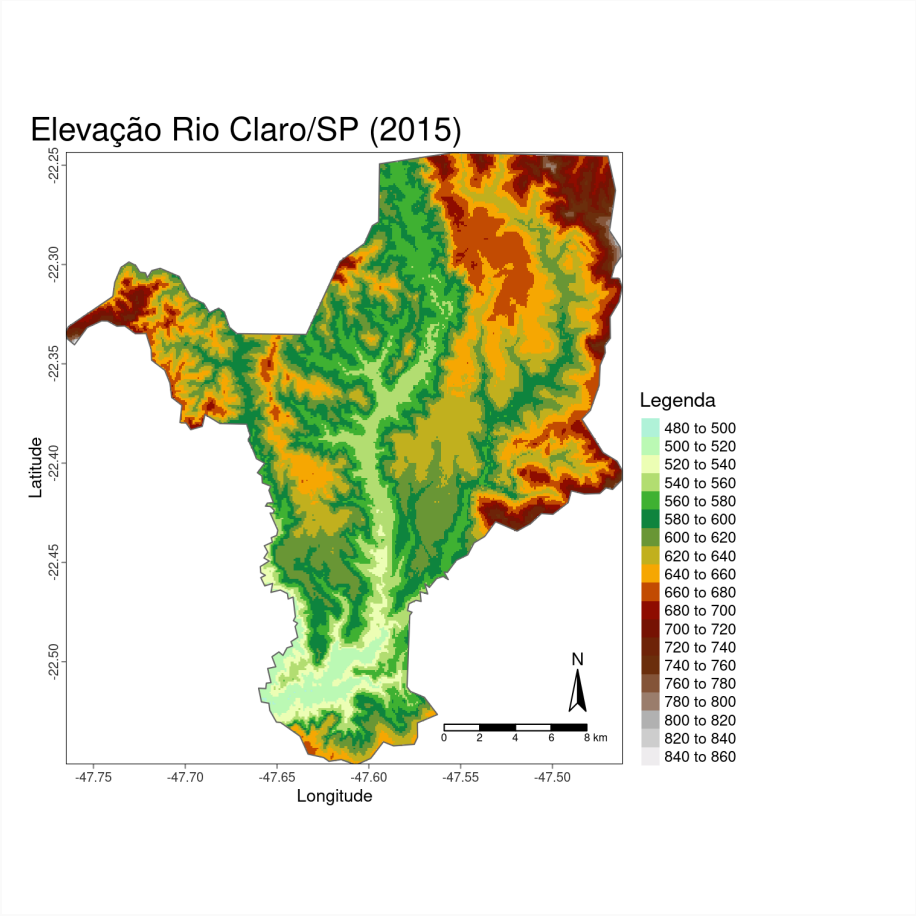
8.6 Mapas matriciais

tmap

```
# elevation map
map_elev_tmap ← tm_shape(elev) +
  tm_raster(pal = cptcity::cpt(pal = "gmt_GMT_dem4"),
            n = 20,
            title = "Legenda") +
  tm_shape(rc_2019) +
  tm_borders() +
  tm_grid(lines = FALSE, labels.format = list(big.mark = ""), labels.rot = c(0, 90
  tm_compass() +
  tm_scale_bar() +
  tm_xlab("Longitude") +
  tm_ylab("Latitude") +
  tm_layout(legend.position = c("left", "bottom"),
            legend.outside = TRUE,
            main.title = "Elevação Rio Claro/SP (2015)")
map_elev_tmap
```

8.6 Mapas matriciais

tmap



8.7 Mapas estáticos

Foram os mapas que vimos até o momento

Existe duas formas de mapas não estáticos: animados e interativos

Mapas animados são utilizados para entender a mudanças espacial no tempo

Mapas interativos são utilizados quando precisamos interagir com algo

8.8 Mapas animados

Mudança dos estados do Brasil ao longo do tempo

```
# download
year <- geobr::list_geobr()[3, 3] %>%
  dplyr::pull() %>%
  stringr::str_split(", ", simplify = TRUE) %>%
  as.character()
year

br <- NULL

for(i in year){

  br <- geobr::read_state("all", i) %>%
    dplyr::mutate(year = i) %>%
    dplyr::bind_rows(br, .)

}

br$year %>% table
```

8.8 Mapas animados

Mudança dos estados do Brasil ao longo do tempo

```
# create facet
br_years ← tm_shape(br) +
  tm_polygons() +
  tm_facets(along = "year", free.coords = FALSE)

# export
tmap_animation(br_years, filename = here::here("03_dados", "mapas", "geo_br_years.
```

8.9 Mapas interativos

Mapas anteriores

8.9 Mapas interativos

Mapas anteriores

8.10 Exportar mapas

ggplot2

Exportar

```
# export
ggsave(map_use_gg,
       filename = "map_rio_claro_land_use_gg.png",
       path = here::here("03_dados", "mapas"),
       width = 20,
       height = 20,
       units = "cm",
       dpi = 300)
```

8.10 Exportar mapas

ggplot2

Exportar

```
# export
ggsave(map_elev_gg,
       filename = "map_rio_claro_elevation_gg.png",
       path = here::here("03_dados", "mapas"),
       width = 20,
       height = 20,
       units = "cm",
       dpi = 300)
```

8.10 Exportar mapas

tmap

Exportar

```
# export
tmap_save(map_use_tmap,
          filename = here::here("03_dados", "mapas", "map_rio_claro_land_use_tmap.
          width = 20,
          height = 20,
          units = "cm",
          dpi = 300)
```

8.10 Exportar mapas

tmap

Exportar

```
# export
tmap_save(map_elev_tmap,
          filename = here::here("03_dados", "mapas", "map_rio_claro_elevation_tmap
          width = 20,
          height = 20,
          units = "cm",
          dpi = 300)
```

Gostaria de agradecer a paciência e confiança 😅

Maurício Vancine

Contatos:

mauricio.vancine@gmail.com

@mauriciovancine

mauriciovancine

mauriciovancine.github.io

Slides criados via pacote xaringan e tema Metropolis