

R & spatial analysis

Nov & Dec 2021

anto.aasa@ut.ee



Mobility Lab

Department of Geography

Why R?

- Free
- Coding = reproducibility
- Big Data
- Code or be coded

The image shows a screenshot of a webpage from R-bloggers. At the top, there is a navigation bar with links for 'add your blog!', 'Learn R', 'R jobs', and 'Contact us'. The main article title is 'R moves up to 5th place in IEEE language rankings', dated July 29, 2016, by David Smith. Below the title are social media sharing buttons for Like (697), Share, Tweet, and LinkedIn Share (450). A note indicates the article was first published on Revolutions. The main text states that IEEE Spectrum has published its 2016 Top Programming Languages ranking, with R moving up to fifth position. A table below shows the top 10 languages and their spectrum rankings.

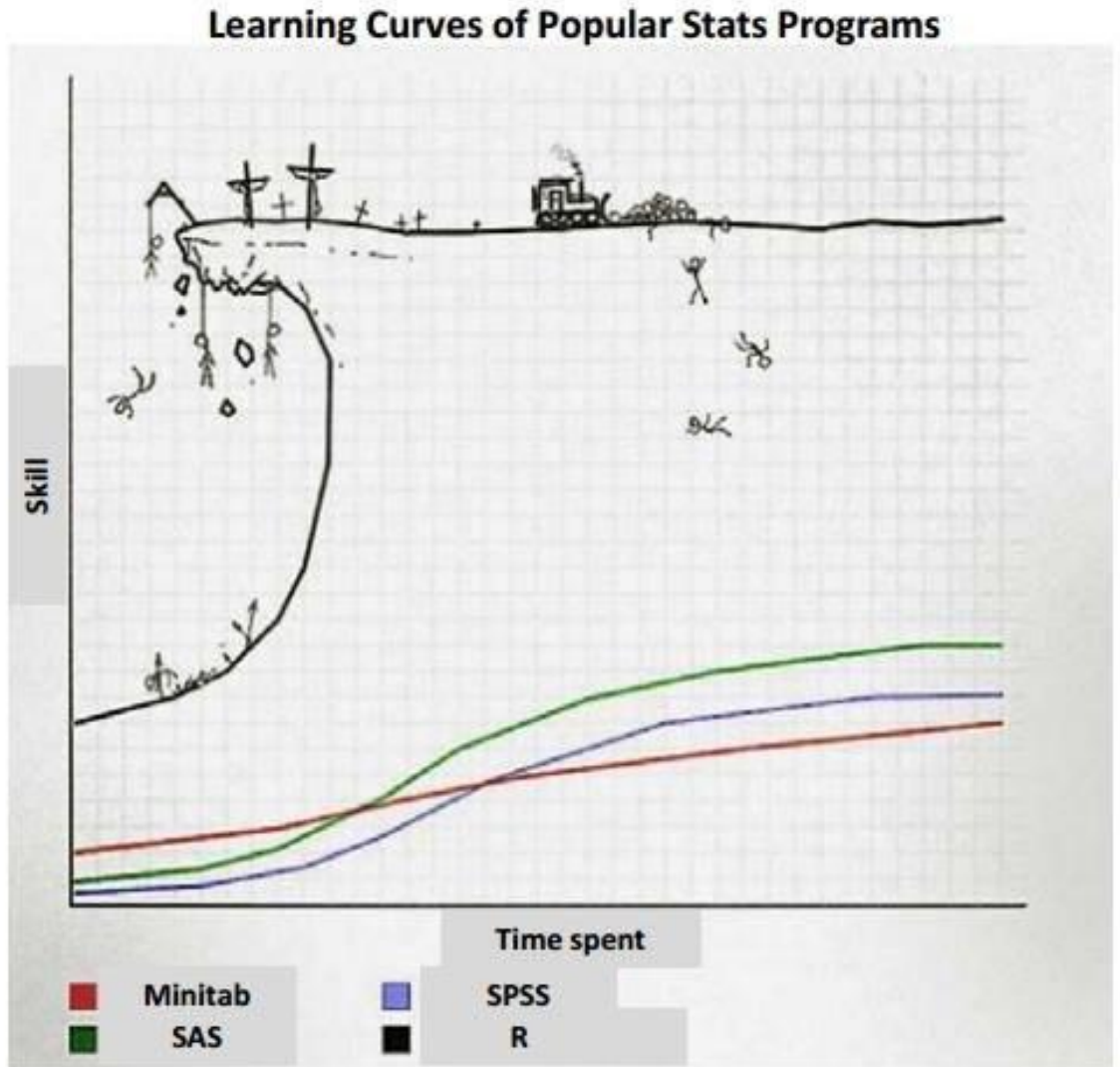
Language Rank	Types	Spectrum Ranking
1. C		100.0
2. Java		98.1
3. Python		98.0
4. C++		95.9
5. R		87.9
6. C#		86.7
7. PHP		82.8
8. JavaScript		82.2
9. Ruby		74.5
10. Go		71.9

Who?

- Supervisors:
 - Anto Aasa
 - Iuliia Burdun

How?

- Classroom + Web
- All the materials:
 - Moodle
 - <http://aasa.ut.ee/Rspatial/>
- Stack Overflow discussions
- RPub documents / vignettes on GitHub
- R blogs on R-bloggers or R Weekly
- YouTube videos

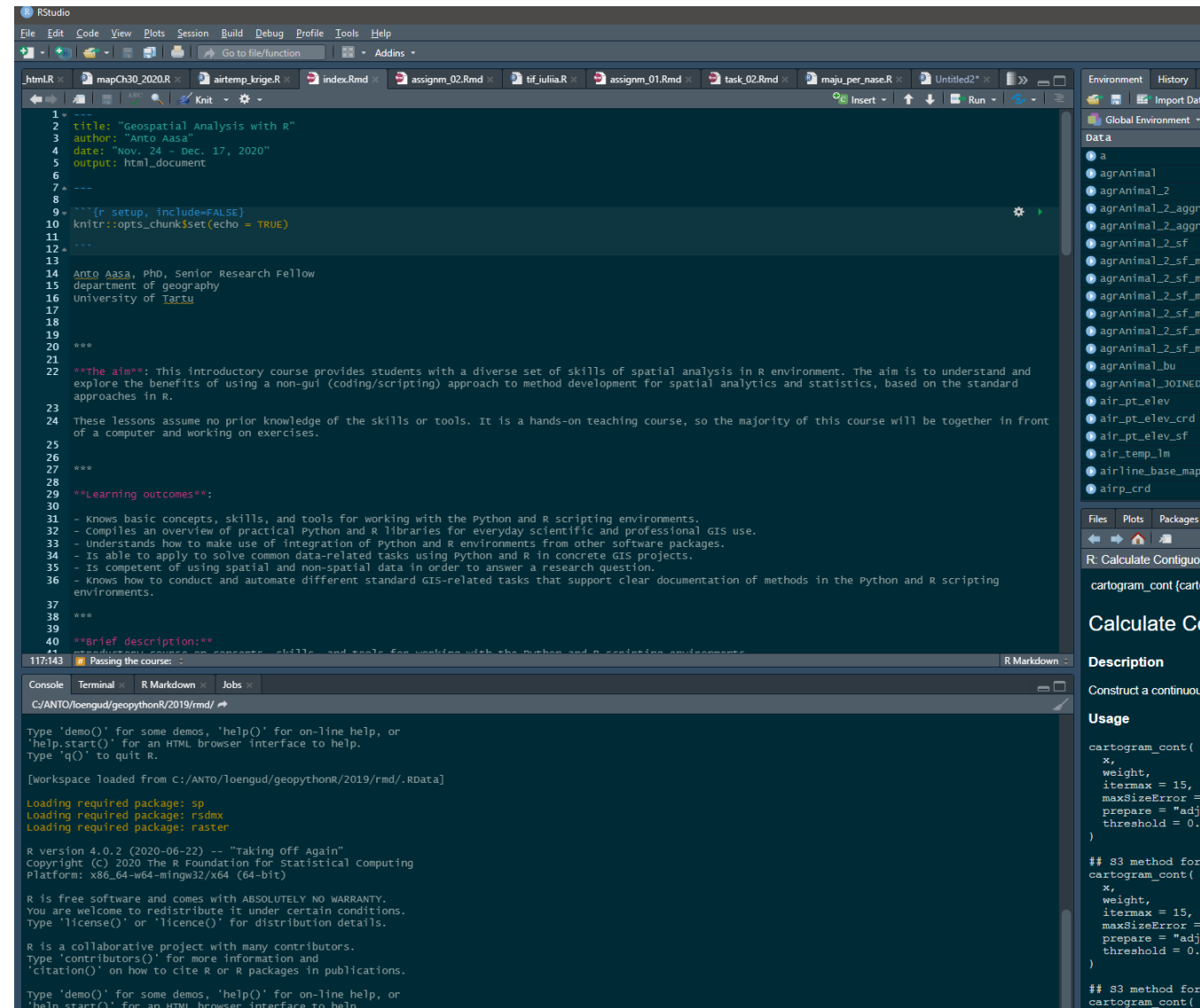
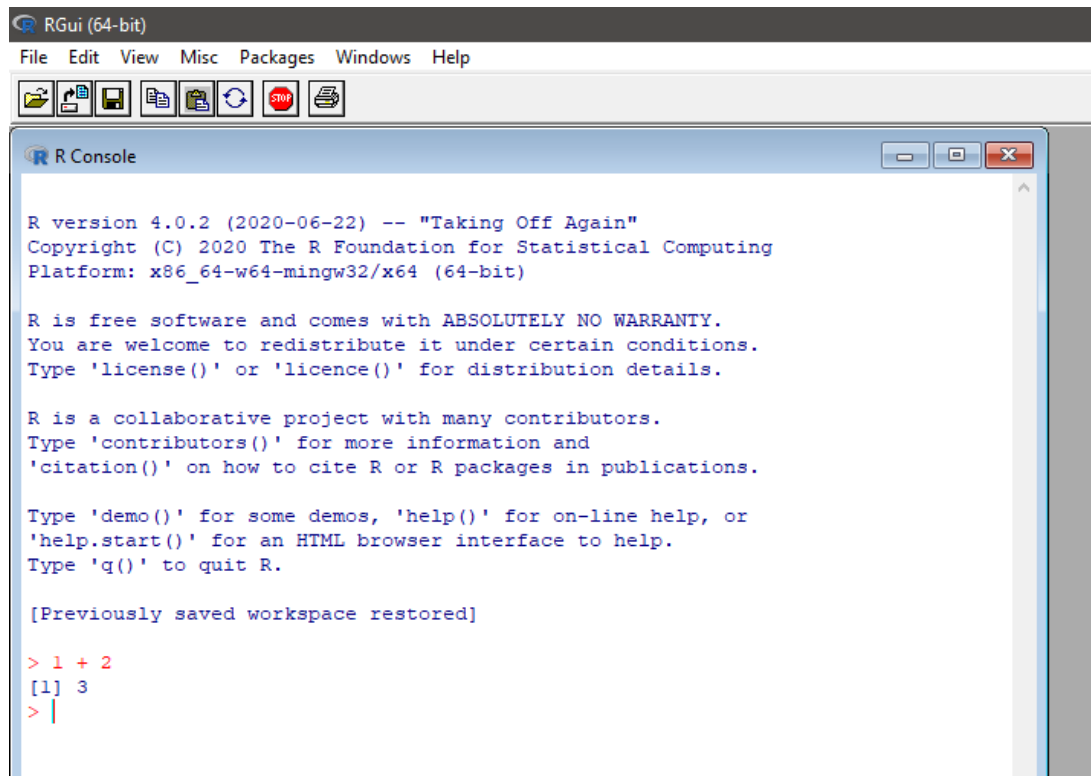


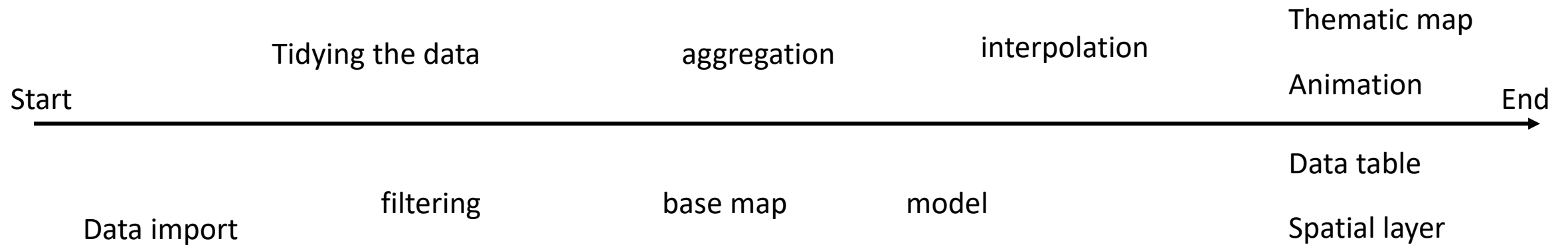
Passing the course:

- To pass the course, students must upload the results of their homework to moodle.
- List of homeworks:
 - After practical session 1: Thematic map of Estonian municipalities
 - After practical session 2: Pigs in Estonia
 - After practical session 3: Thematic maps
 - After practical session 4: Map of crimes in Tallinn
 - After practical session 5: Interpolated map of wind speed
 - After practical session 6: Geospatial analysis of housing in Tartu area
 - Final task: Analysis of COVID-19 data

R & RStudio

- R = core software
- RStudio = Graphical User Interface (GUI)





- Assigning of values

ALT + - <-

- Character
- Text string
- Numeric vector
- List
- Object (map, plot, data frame)
- ...

Difference of
=
==

Script commenting:
#

different
commands/functions
with the same name
::

- R & RStudio
- Basic software (R) + extensions (libraries / packages) => ALL FREE!!!
- Write clean script to separate file (*.R)
- Set working directory
 - „Session => Set Working Directory“
- install libraries / packages:
 - `install.packages('ggplot2')`
- Start libraries / packages:
 - `library(ggplot2)`

- Command/function not working?:
 - HELP:
 - `?functionNames`
 - `??functionName`
- TAB – key...
- Copy & paste
- Add command from history to script file

Piping

- Read the script from left to right
- Piping operator
 - %>%

```
> a <- data.frame(a = c(1, 3, 6, 7, 7, 9),
+               b = c("a", "a", "a", "b", "b", "b"))
>
> a %>%
+   group_by(b) %>%
+   summarise(mean = mean(a))
`summarise()` ungrouping output (override with `.groups`
argument)
# A tibble: 2 x 2
  b     mean
<chr> <dbl>
1 a     3.33
2 b     7.67
>
```

CTRL

+

SHIFT

+

M

Tidy the code!

- Clean structured code + metadata (#comment)
- Keep it in Script.R file

```
ggplot()+  
  theme_minimal()+  
  geom_point(data = data_countyPop, aes(y = reorder(DIM2_label.en, obsValue),  
                                         x=obsValue,  
                                         colour = as.factor(obsTime)))+  
  scale_colour_manual(values = c("orange", "dodgerblue"))+  
  labs(colour = "year",  
       y="county",  
       x="population size",  
       title = "Population change in Estonian counties",  
       subtitle = "difference between 1990 and 2016",  
       caption = "data: Statistics Estonia \nvisual: A. Aasa")+  
  scale_x_log10()
```

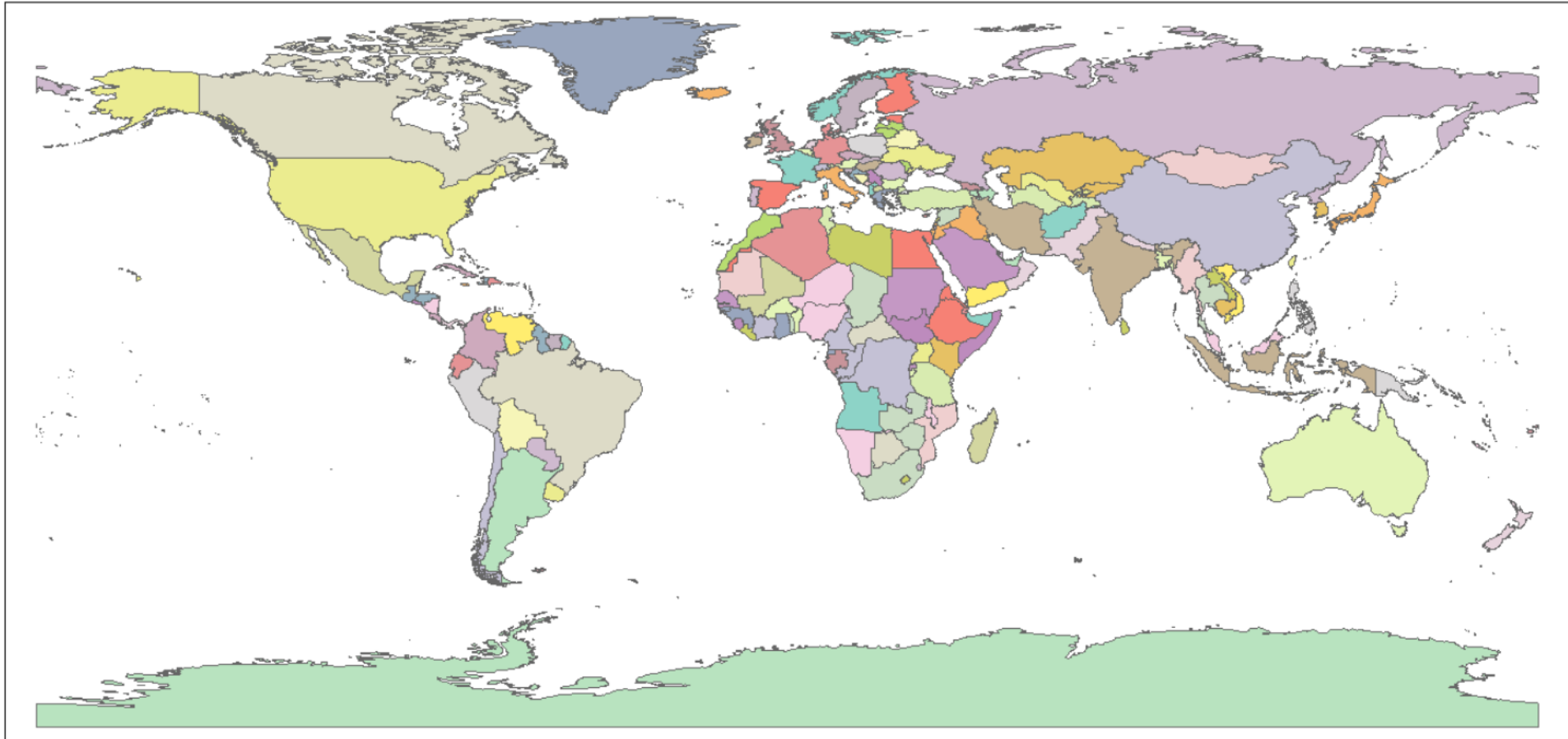
VS

```
ggplot()+ theme_minimal()+geom_point(data = data_countyPop, aes(y = reorder(DIM2_label.en,  
obsValue), x=obsValue, colour = as.factor(obsTime)))+scale_colour_manual(values = c("orange",  
"dodgerblue"))+labs(colour = "year", y="county", x="population size", title = "Population  
change in Estonian counties", subtitle = "difference between 1990 and 2016", caption =  
"data: Statistics Estonia \nvisual: A. Aasa")+scale_x_log10()
```

It is easy!

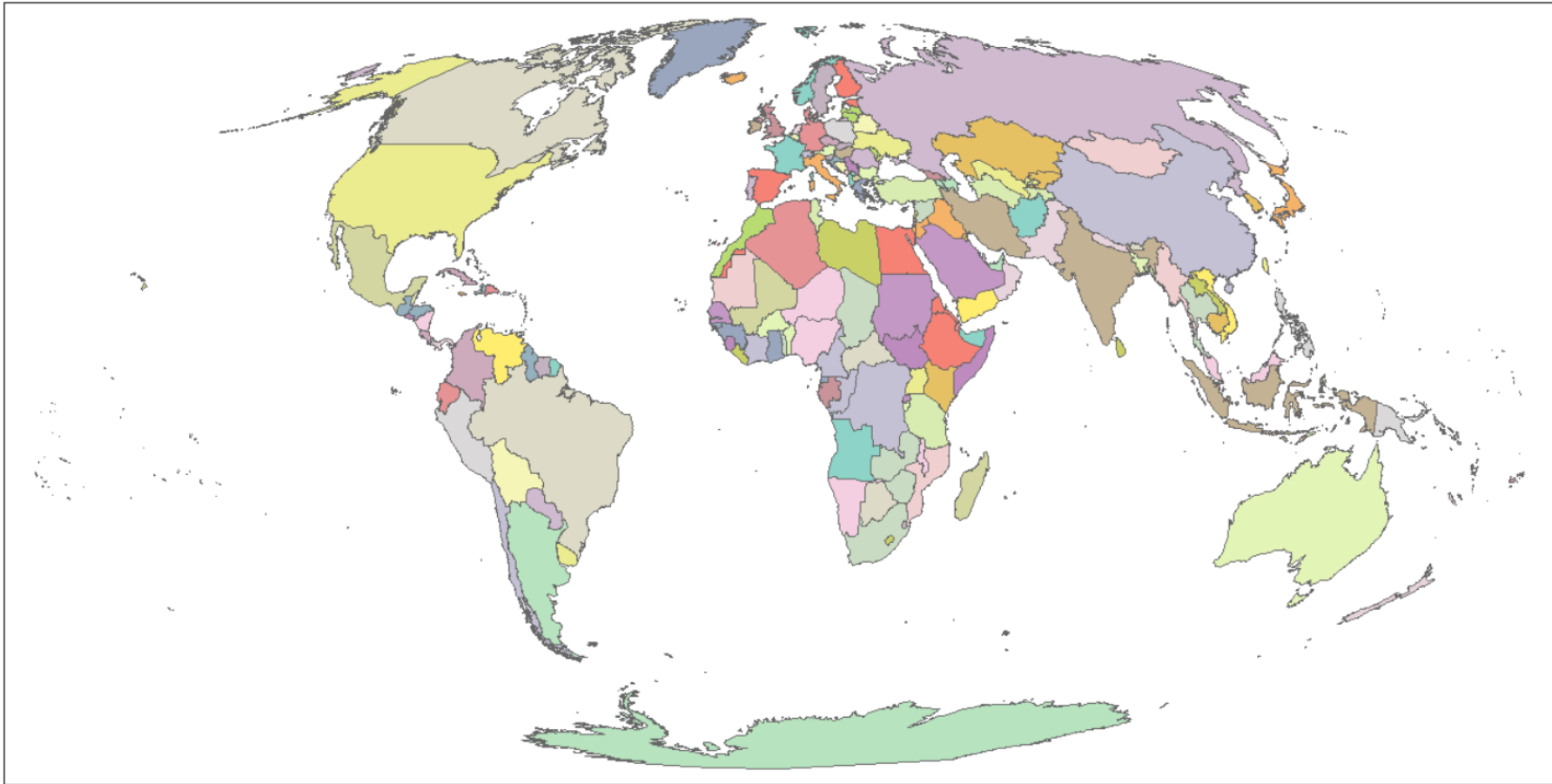
```
countries <- st_read("/FILE/PATH")
```

```
tm_shape(countries)+  
  tm_polygons("ISO_A3")+  
  tm_layout(legend.show = F)
```

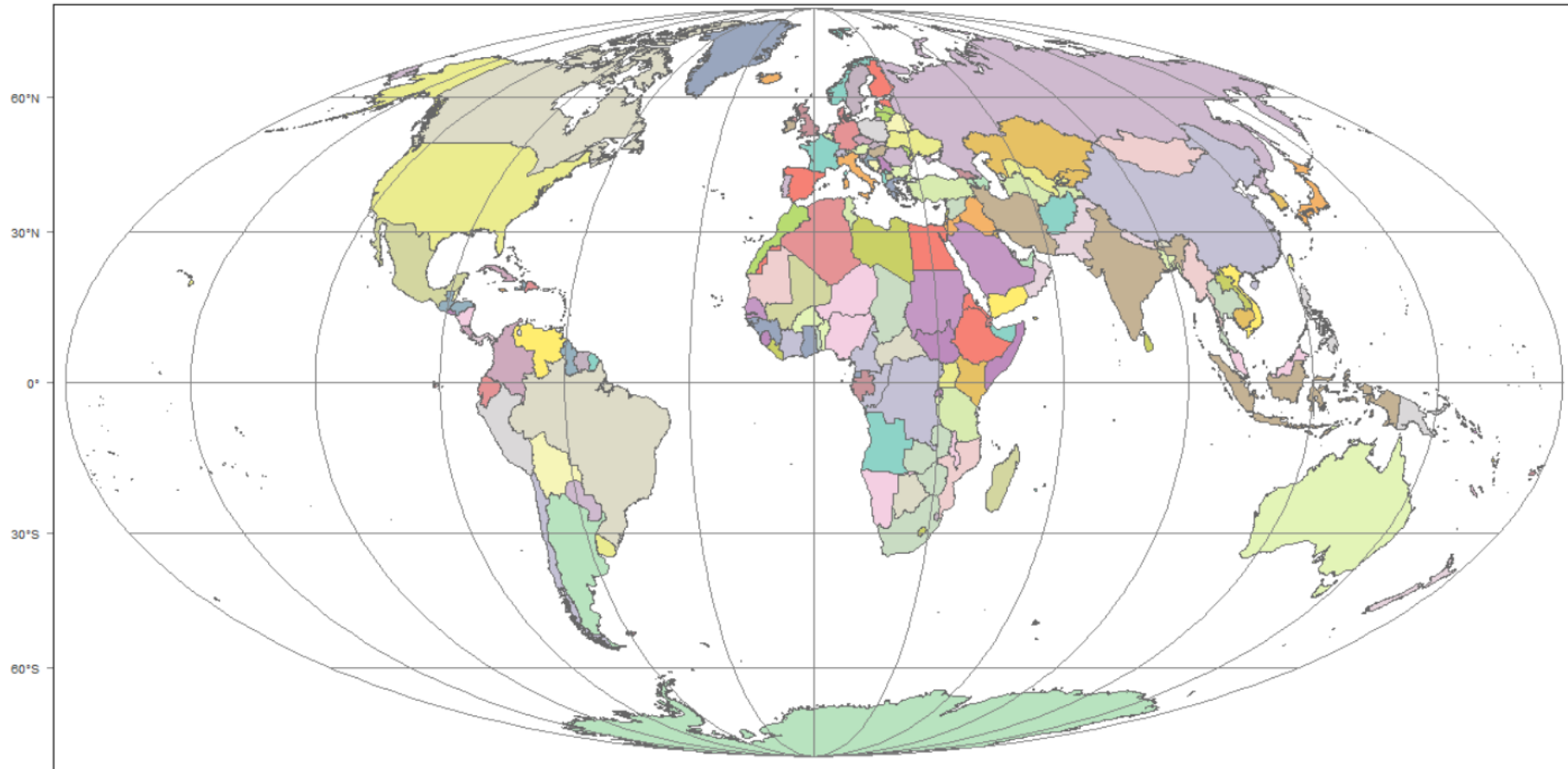


```
countries_mw = st_transform(countries, crs = "+proj=moll")
```

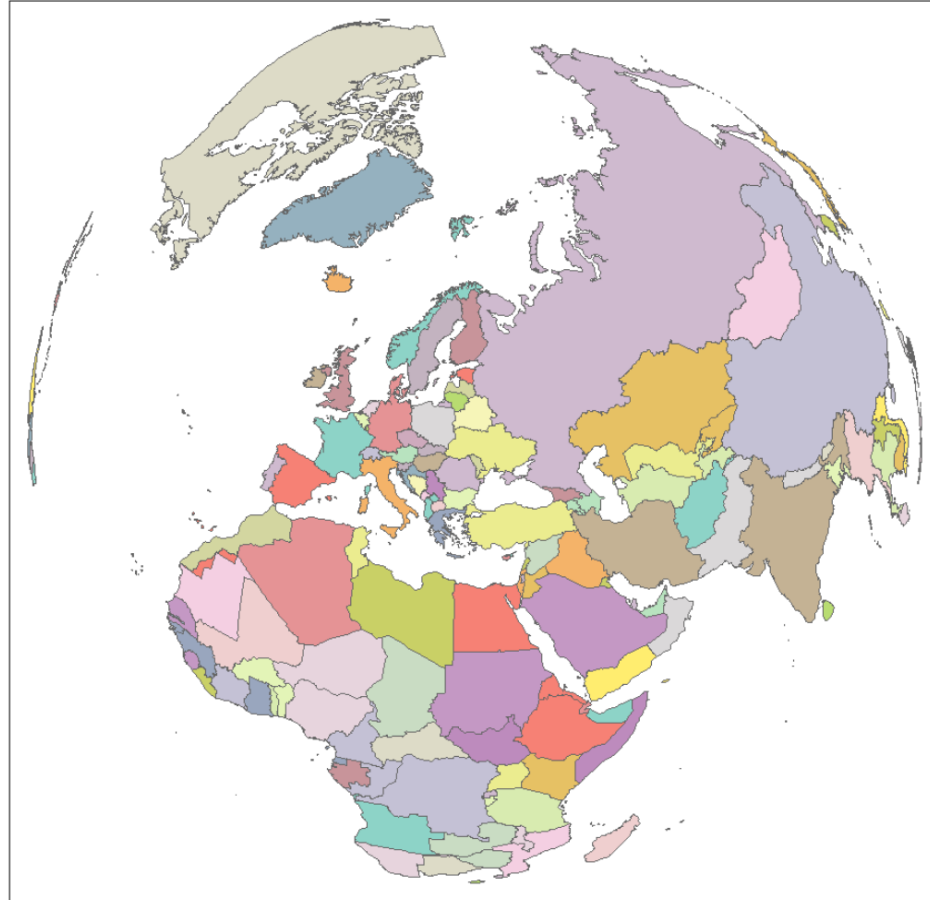
```
tm_shape(countries_mw)+  
  tm_polygons("ISO_A3")+  
  tm_layout(legend.show = F)
```



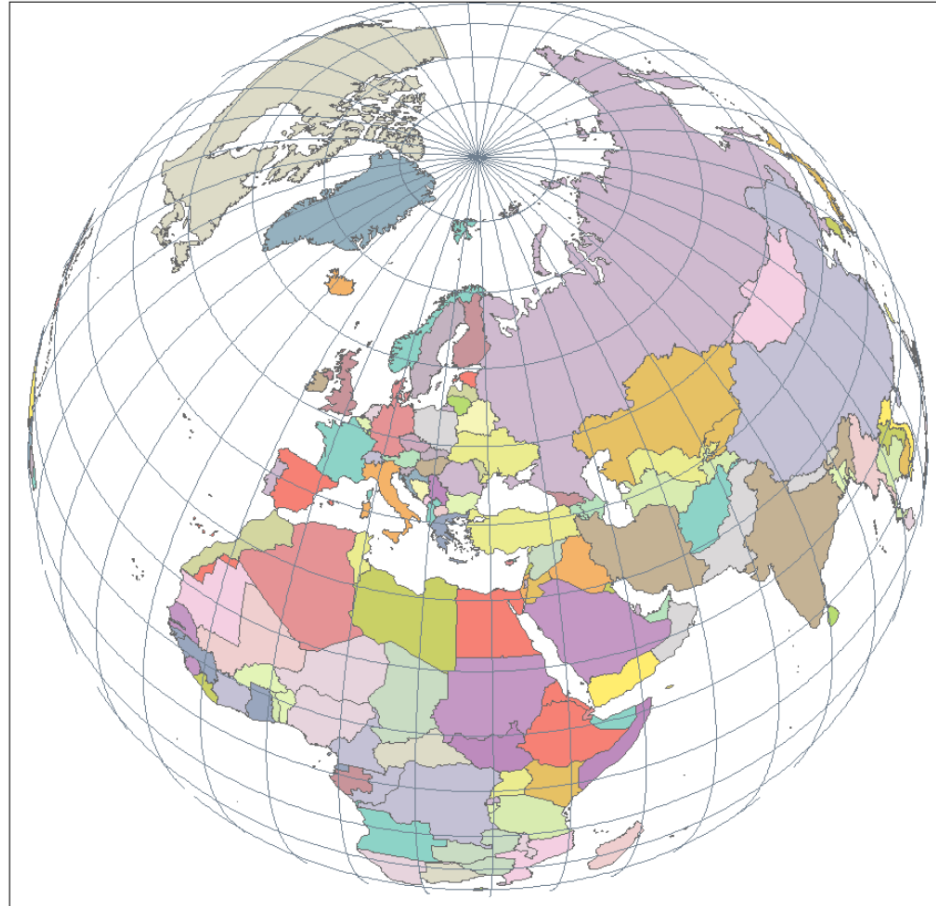
```
tm_shape(countries_mw)+  
tm_polygons("ISO_A3")+  
tm_layout(legend.show = F)+  
tm_graticules()
```



```
countries_globe = st_transform(countries, crs= "+proj=ortho +lat_0=50 +lon_0=28")  
  
tm_shape(countries_globe)+  
  tm_polygons("ISO_A3")+  
  tm_layout(legend.show = F)
```




```
graticule_g1 <- st_read("/ANTO/anto_DATA/NaturalEarth/ne_50m_graticules_10/ne_50m_graticules_10.shp")  
  
tm_shape(countries_globe)+  
  tm_polygons("ISO_A3")+  
  tm_layout(legend.show = F)+  
  tm_shape(graticule_g1)+  
  tm_lines("slategrey")
```

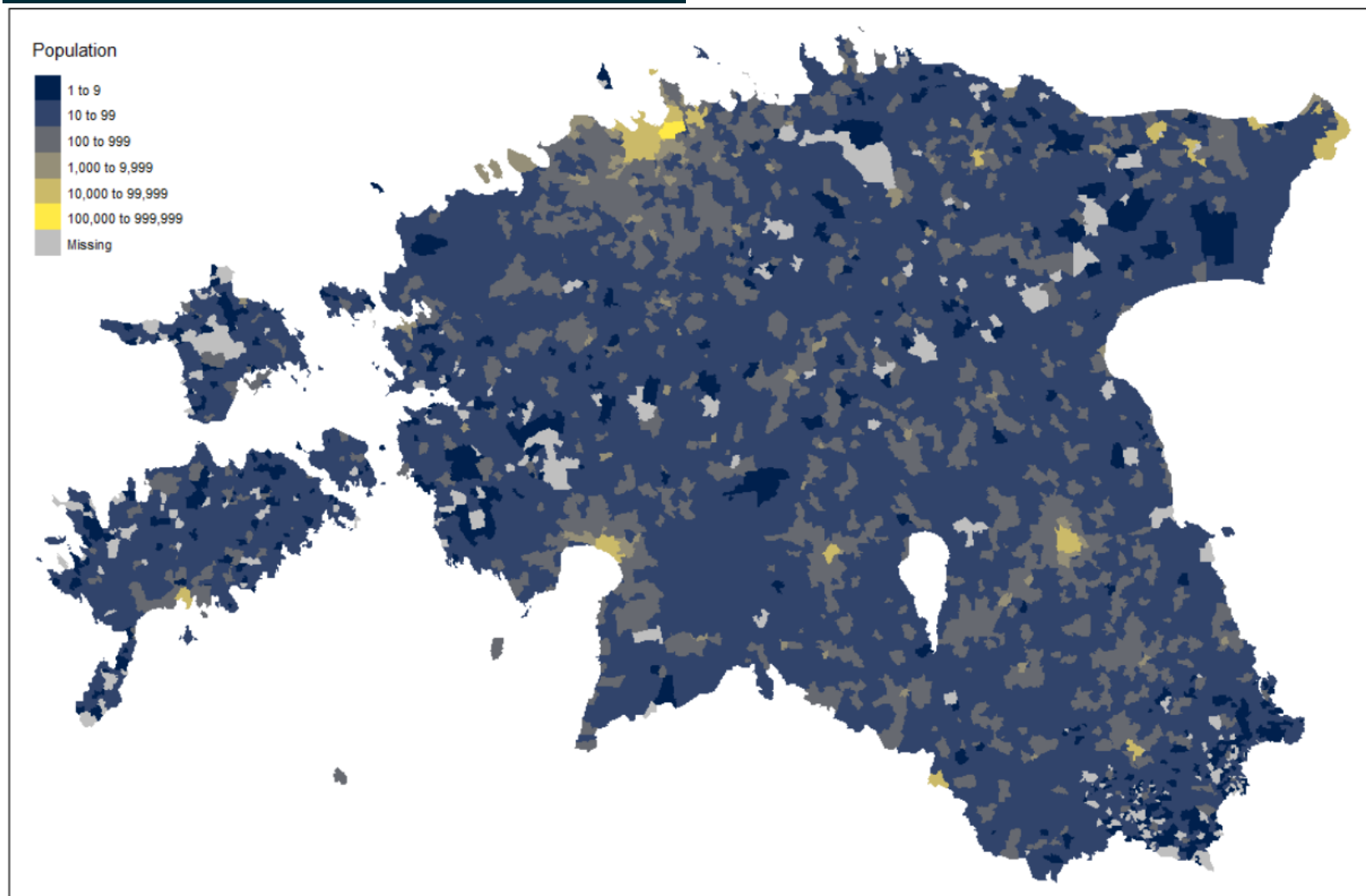


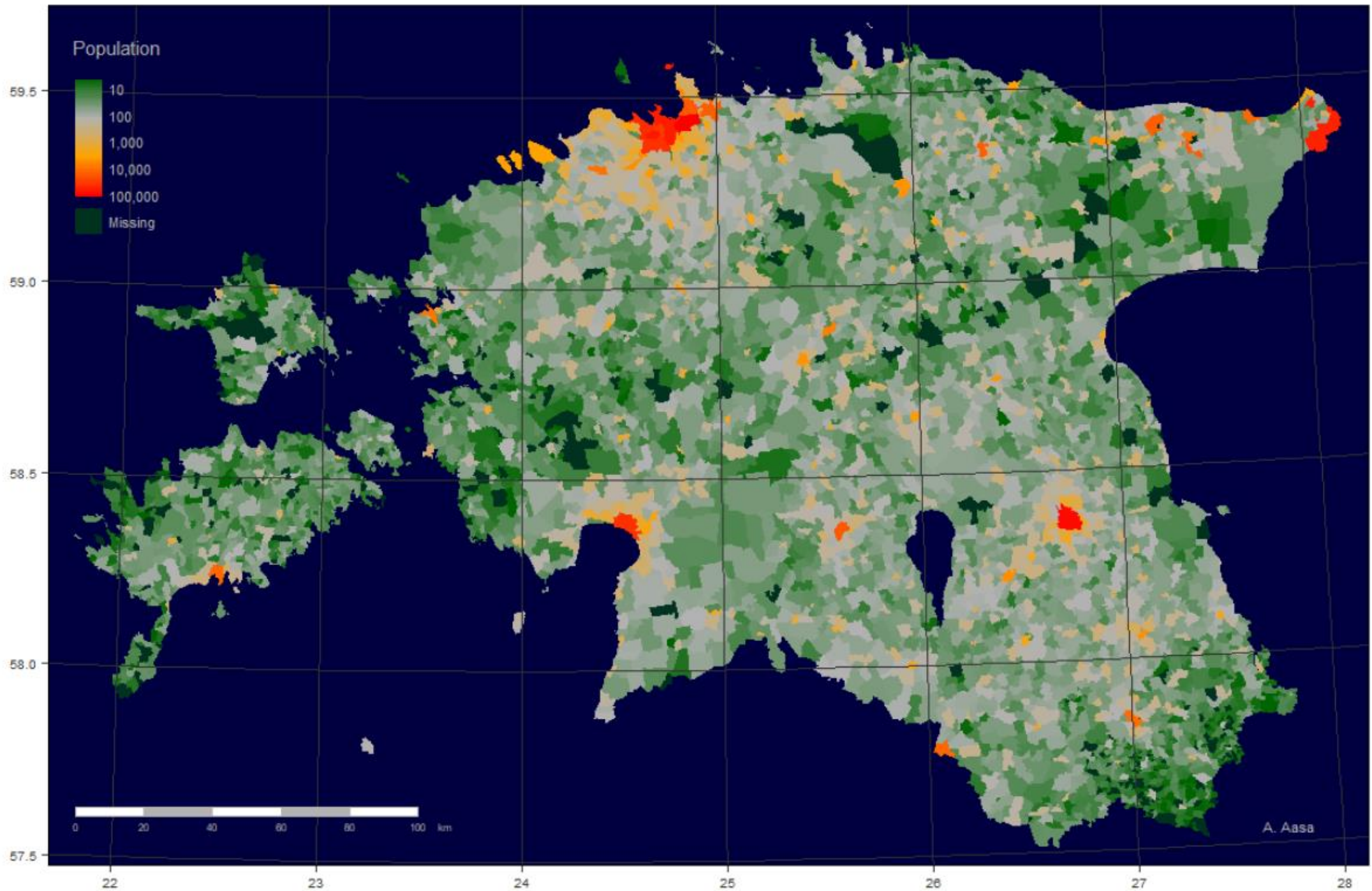
Estonian population

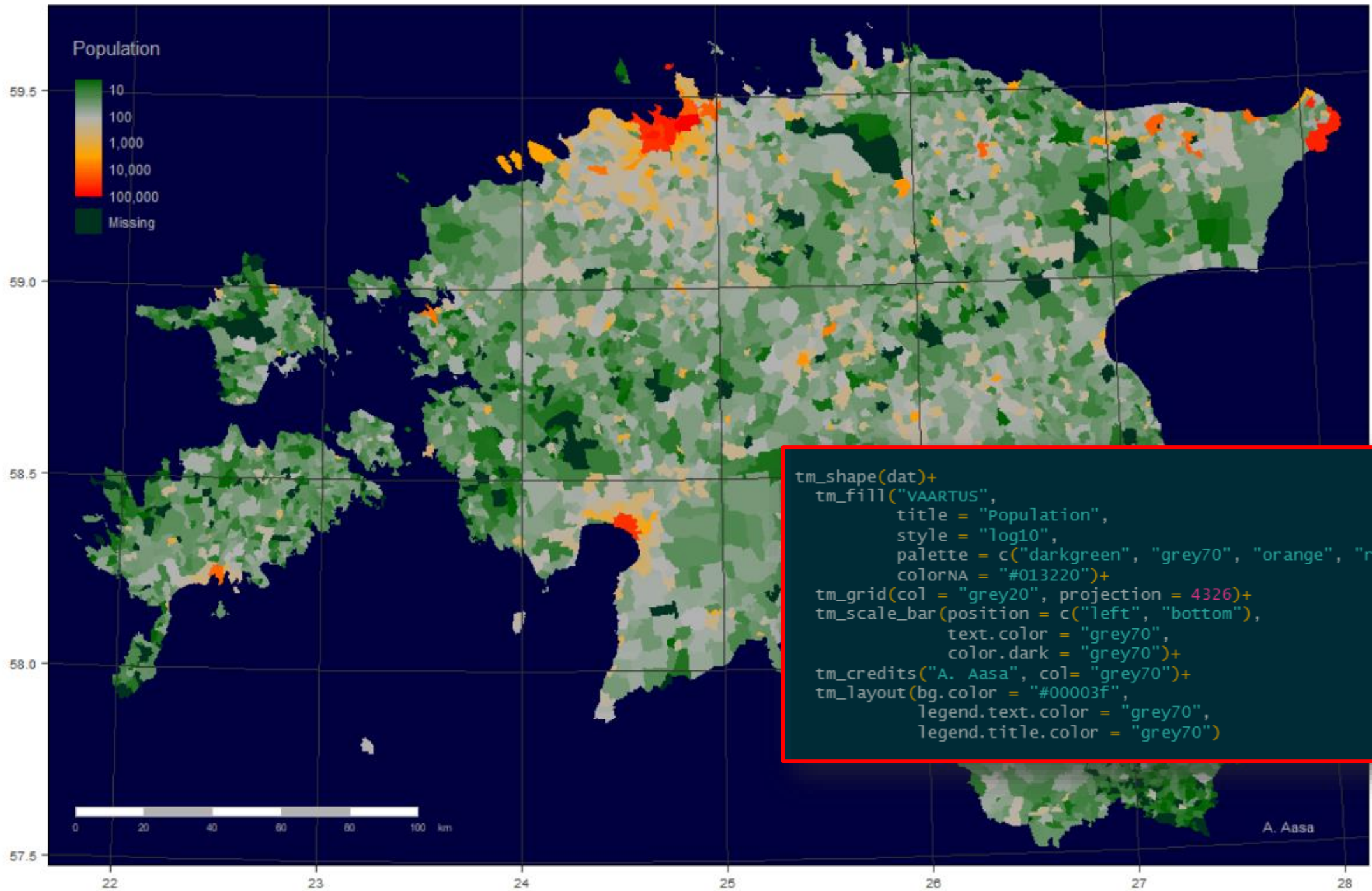
```
dat <- st_read("/ANTO/anto_DATA/EestiStatistika/kaardirakendus/asustus_rahvaarv_2019.shp")  
glimpse(dat)  
  
plot(st_geometry(dat))
```



```
tm_shape(dat)+  
  tm_fill("VAARTUS",  
    title = "Population",  
    style = "log10_pretty",  
    palette = "cividis")
```

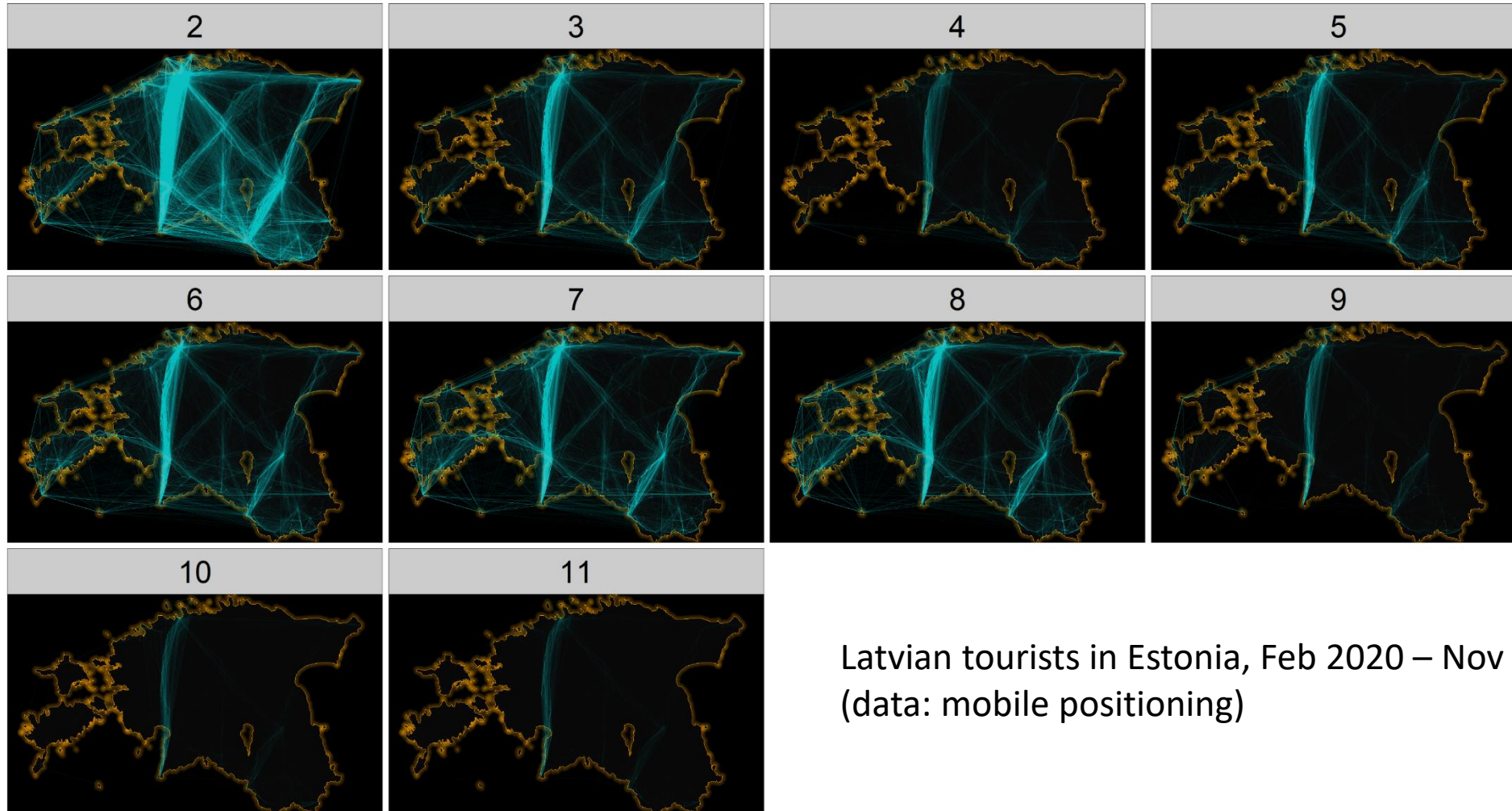






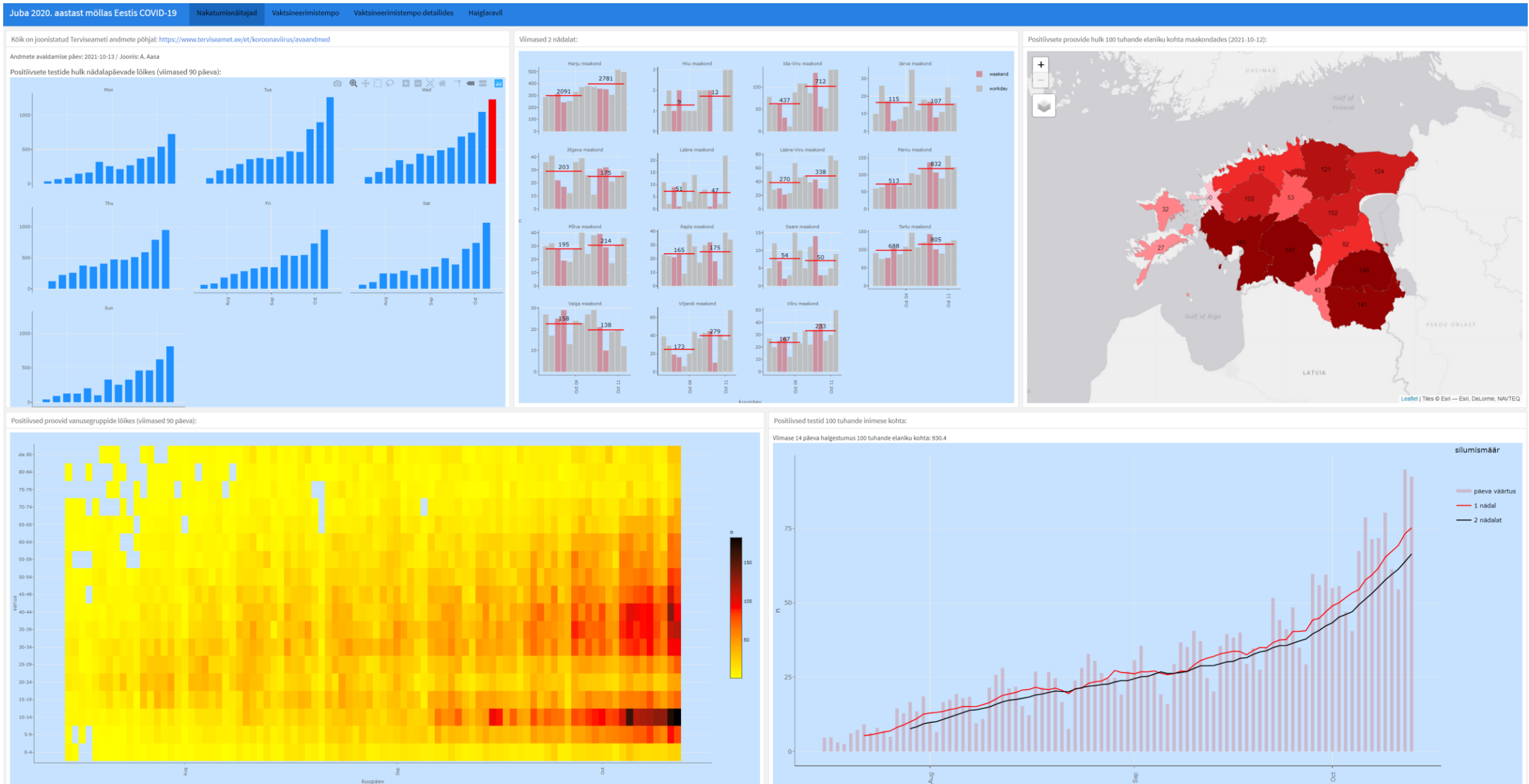
```
tm_shape(dat)+
tm_fill("VAARTUS",
title = "Population",
style = "log10",
palette = c("darkgreen", "grey70", "orange", "red"),
colorNA = "#013220")+
tm_grid(col = "grey20", projection = 4326)+
tm_scale_bar(position = c("left", "bottom"),
text.color = "grey70",
color.dark = "grey70")+
tm_credits("A. Aasa", col= "grey70")+
tm_layout(bg.color = "#00003f",
legend.text.color = "grey70",
legend.title.color = "grey70")
```


Bring out the message! Storytelling!



Latvian tourists in Estonia, Feb 2020 – Nov 2020
(data: mobile positioning)

Dashboards:



Automatic reports

- example

Tavapärasest erineva liikumiskäitumisega inimeste uuring

Mobilipositsioneerimisega kogutud andmed

TARTU ÜLIKOOL
mobiilsuuringute labor

Täname, et osalesite Tartu ülikooli Mobiilsuuringute labori ja OÜ Positumi korraldatud uuringus "Tavapärasest erineva liikumiskäitumisega inimeste elukohtade ja ruumikasutuse analüüsimine mobilipositsioneerimise andmetega"! Saadud andmeid kasutatakse ankuripunkte ehk oluliste tegevuskohtade moodel liikluse jaoks, ühises tavapärasest erineva liikumiskäitumisega inimeste tegevuskohtade paiknemisest ja inimeste tegelekst ruumikasutusest. Tänuks osalemise eest saadame Teile infot, kust leiata andmeid enda mobiilkasutuse kohta uuritava perioodi vältel. Saadetud lehti ei ole avalik ja otsingumootoris leitav.

Küsimuste korral võite palun ühendust aadressil mobilitylab@ut.ee.

Info uuringu kohta: <https://mobilitylab.ut.ee/et/koostoo/uringud/tavaparasest-erineva-liikumiskaitumisega-inimeste-uring/>

Üldist

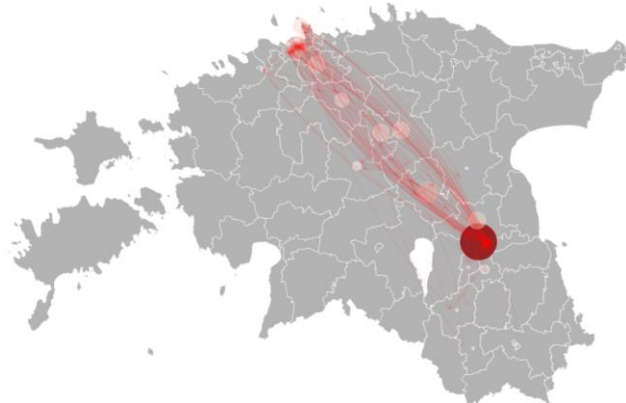
Uuringu käigus kogutud mobilipositsioneerimise andmed algavad kuupäevast 2019-01-12 ja lõpevad 2019-05-31. Kokku teeb see 139 päeva.

Kõnetoimingud jagunevad uuritava perioodi vältel järgnevalt:

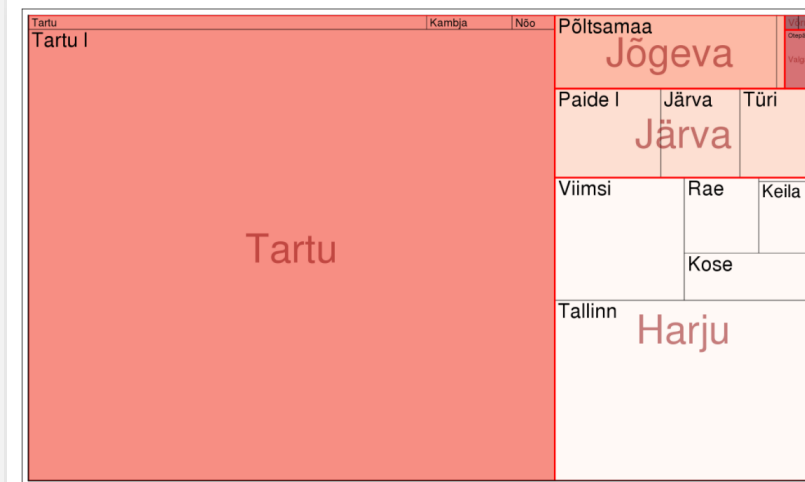
County	Jan	Feb	Mar	Apr	May
Tartu	High	High	High	High	High
Järva	Medium	Medium	Medium	Medium	Medium
Harju	Medium	Medium	Medium	Medium	Medium
Other counties	Low	Low	Low	Low	Low

Üldised liikumismustrid

Järgnev joonis illustreerib, kuidas on jaotunud kõnetoimingud Eesti pinnal. Punkti suurus näitab vastavas kohas tehtud kõnetoimingute hulka omavalitsuse täpsusega. Kõverjoonte abil püütakse visualiseerida teie liikumisi. Kuna passiivse mobilipositsioneerimise andmed tekivad ainult telefoni aktiivse kasutamise (andmeside, kõnetoimingud) käigus ja on mobiilmasti leviala täpsusega, siis pole ka võimalik näidata täpselt liikumisteede kordi. Samuti võib osa külastatud kohti ülevaatest välja jääda, sest telefoni ei kasutatud.

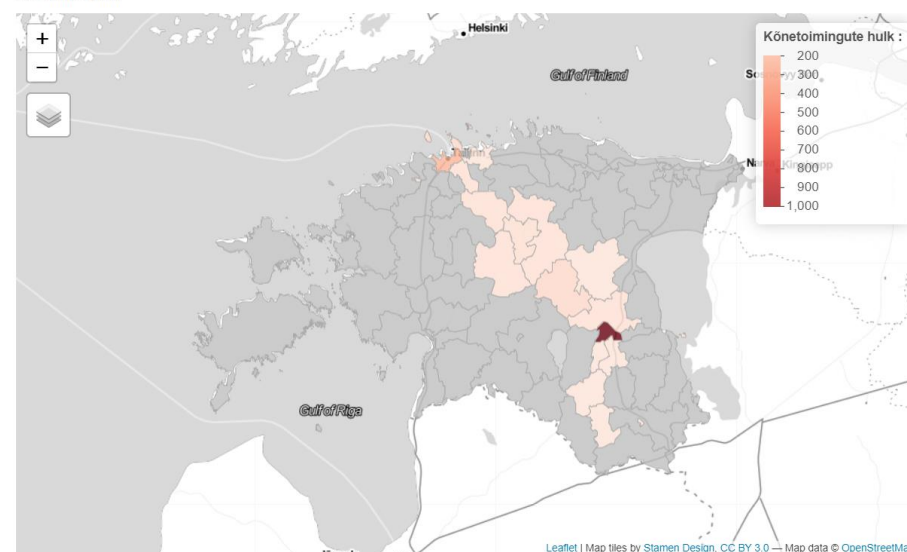


Viibimine Eesti maakondades ja omavalitsuses vastavalt telefoni kasutamise andmetele:



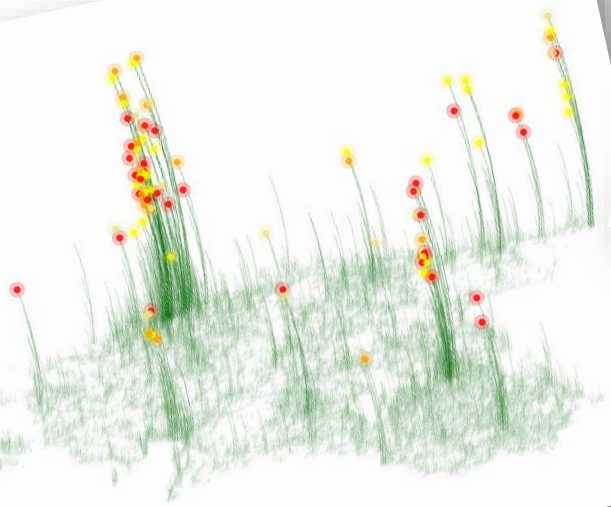
Nellinurga pindala on proportsioonilis seal viibitud päevade arvuga. Omavalitsused on pliritletud musta joone ja tekstiga, maakondade puhul kasutatakse punaseid toone.

Interaktiivne kaart



R = freedom

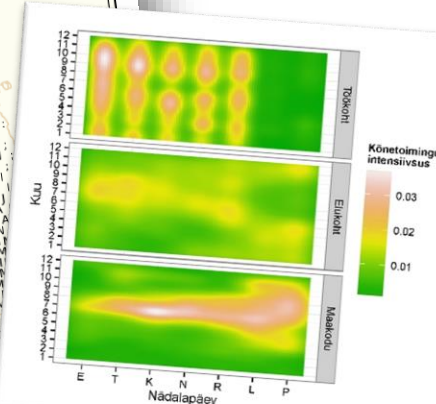
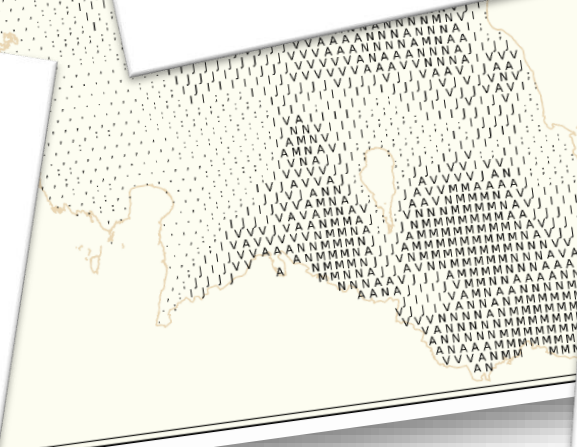
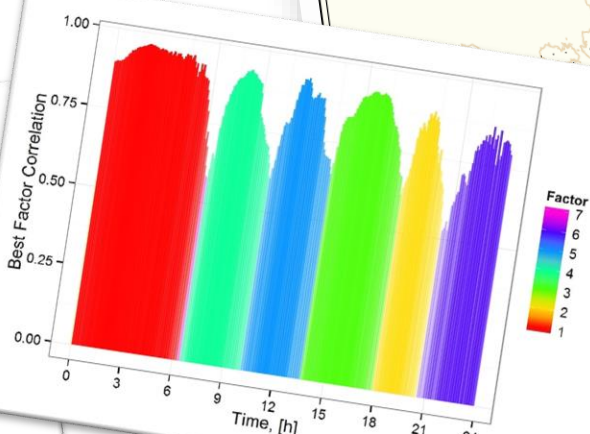
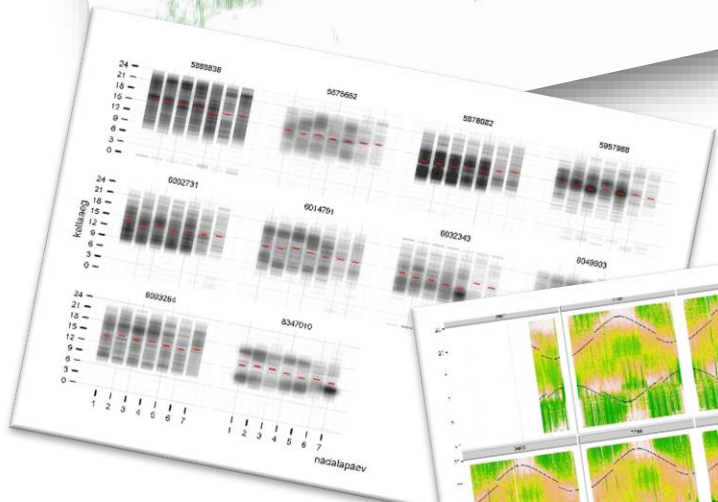
Population in Estonia



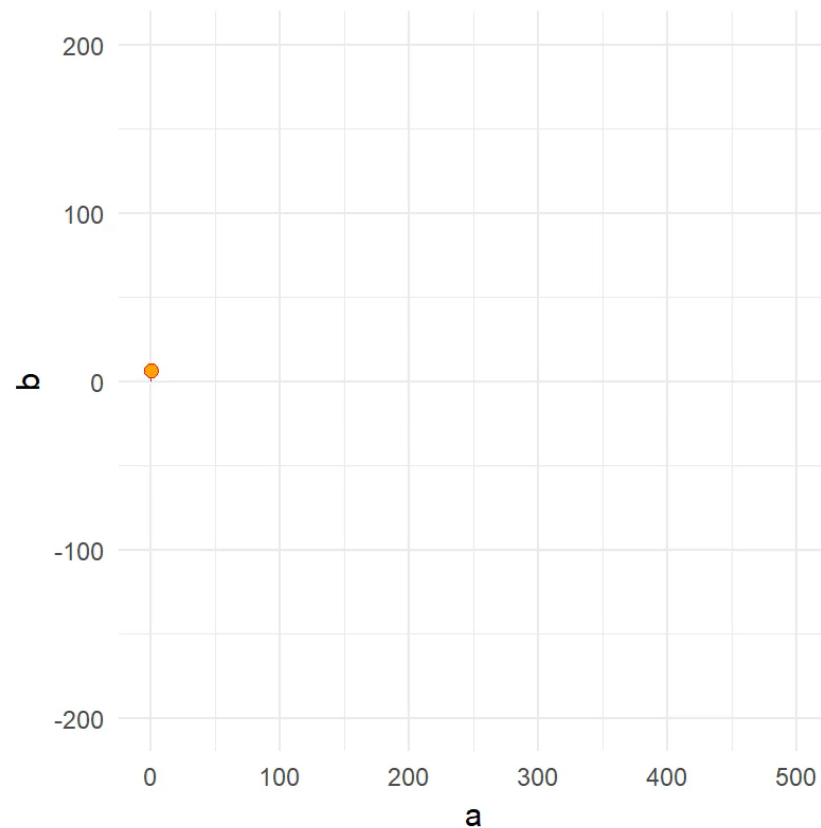
A. Aasa



Elevation map of Estonia



animations



```
setwd("C:/ANTO/loengud/tbilisi/2020/tmp")
library(tidyverse)
a <- 0
b <- 0
dat <- data.frame(a=a, b=b)
for(i in 1:100){
  tmp <- dat[i,] %>%
    mutate(a = a + 1, b = b + (runif(1, -1, 1)*10))

  dat <- rbind(dat, tmp)

  gg_a <- ggplot()+
    theme_minimal()+
    geom_path(dat=dat, aes(x=a, y=b))+
    geom_point(data = tmp, aes(x=a, y=b), colour = "red")+
    xlim(0, 110)+
    ylim(-100, 100)

  frame_name <- str_pad(i, 3, pad = "0")

  ggsave(gg_a, filename =
    paste0("/ANTO/loengud/tbilisi/2020/tmp/", frame_name, ".png"),
    dpi=200, width=4, height=4, unit="in")
}

# cd C:/ANTO/loengud/tbilisi/2020/tmp
#ffmpeg -start_number 1 -i %03d.png -vcodec libx264 -crf 25 -
#pix_fmt yuv420p tmp.mp4
```

Cheat Sheets



<https://www.rstudio.com/resources/cheatsheets/>

Course web page:

<http://aasa.ut.ee/Rspatial>