



# EXPLORING TEMPORAL-SPATIAL VISUALIZATIONS

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24.02.2021



# Time Geography

- ▶ Space-Time Cube
- ▶ Space-Time Paths
- ▶ Space-Time Coordinates
- ▶ Physical metrics

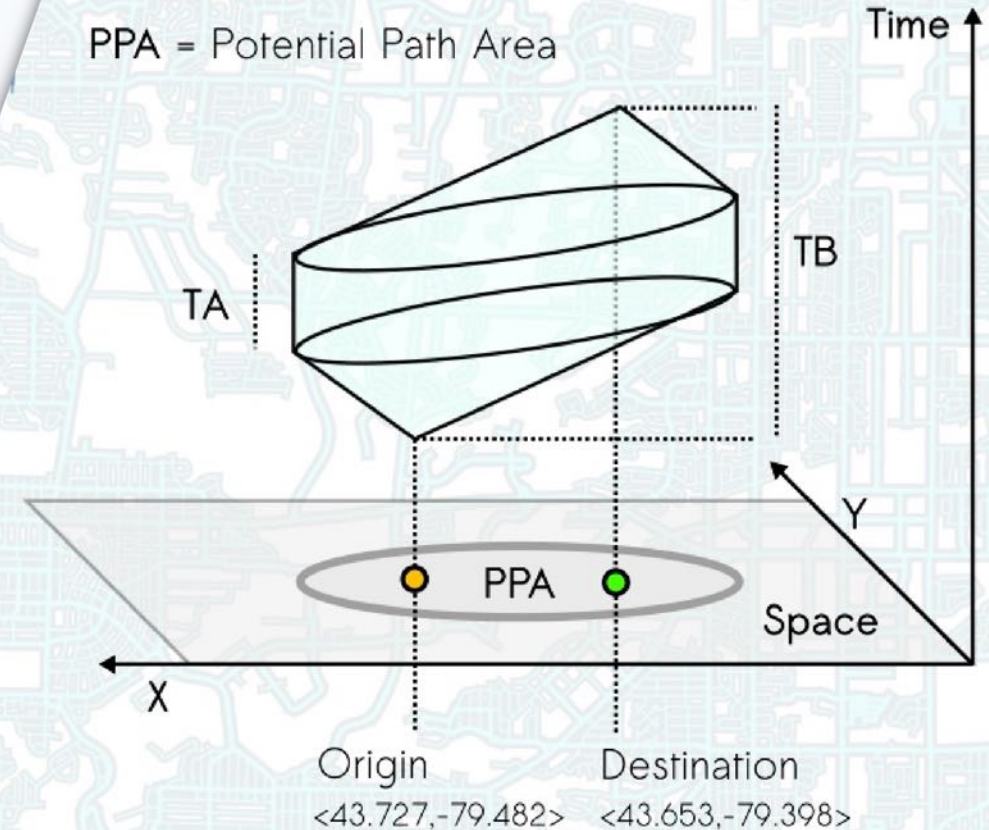
TB = Time Budget

TA = Activity Time

TT = Travel Time

PPA = Potential Path Area

$$TB = TA + TT$$



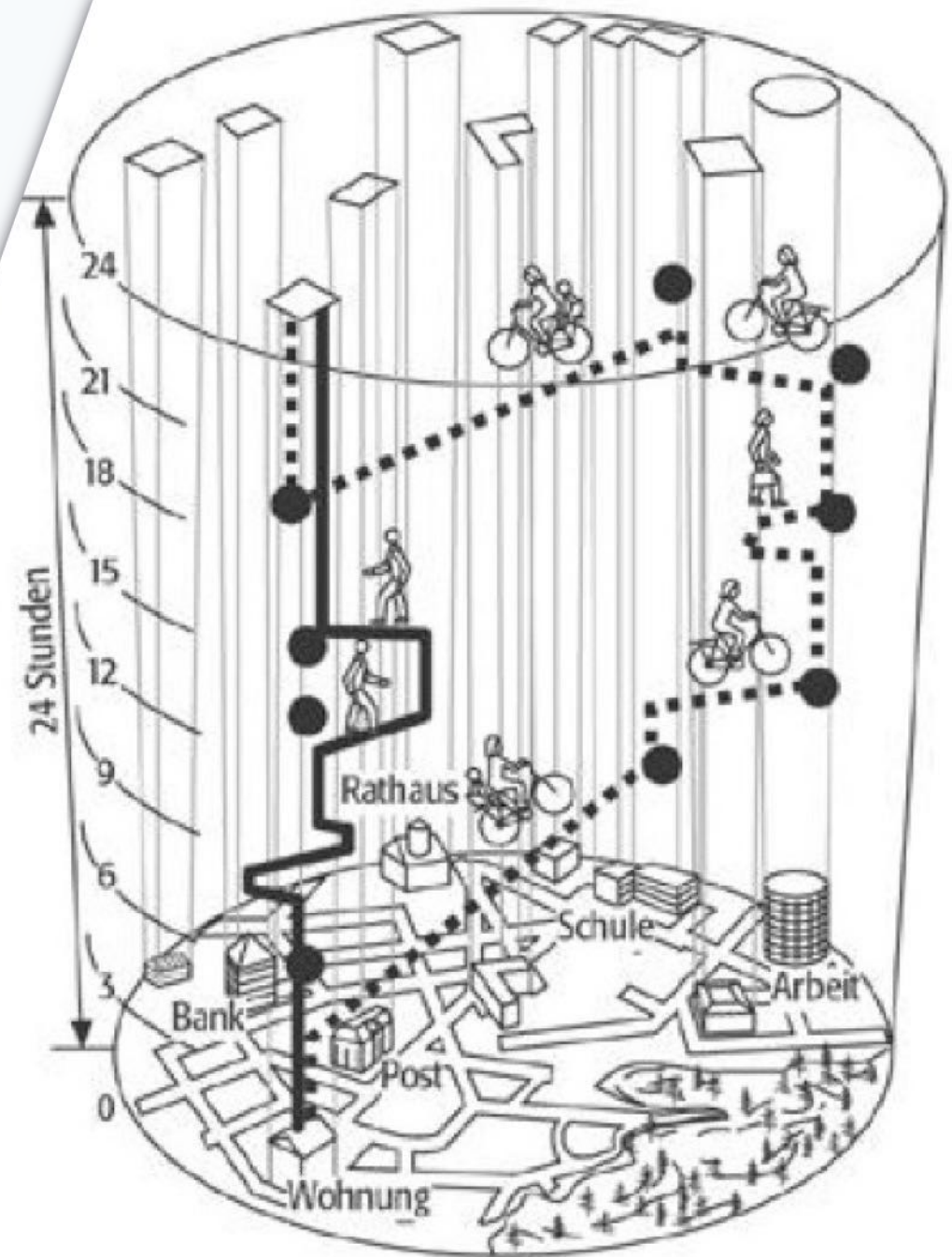
PPA for TB = 90min where

— TA  $\geq$  30min

—  $0 < TA < 30$ min

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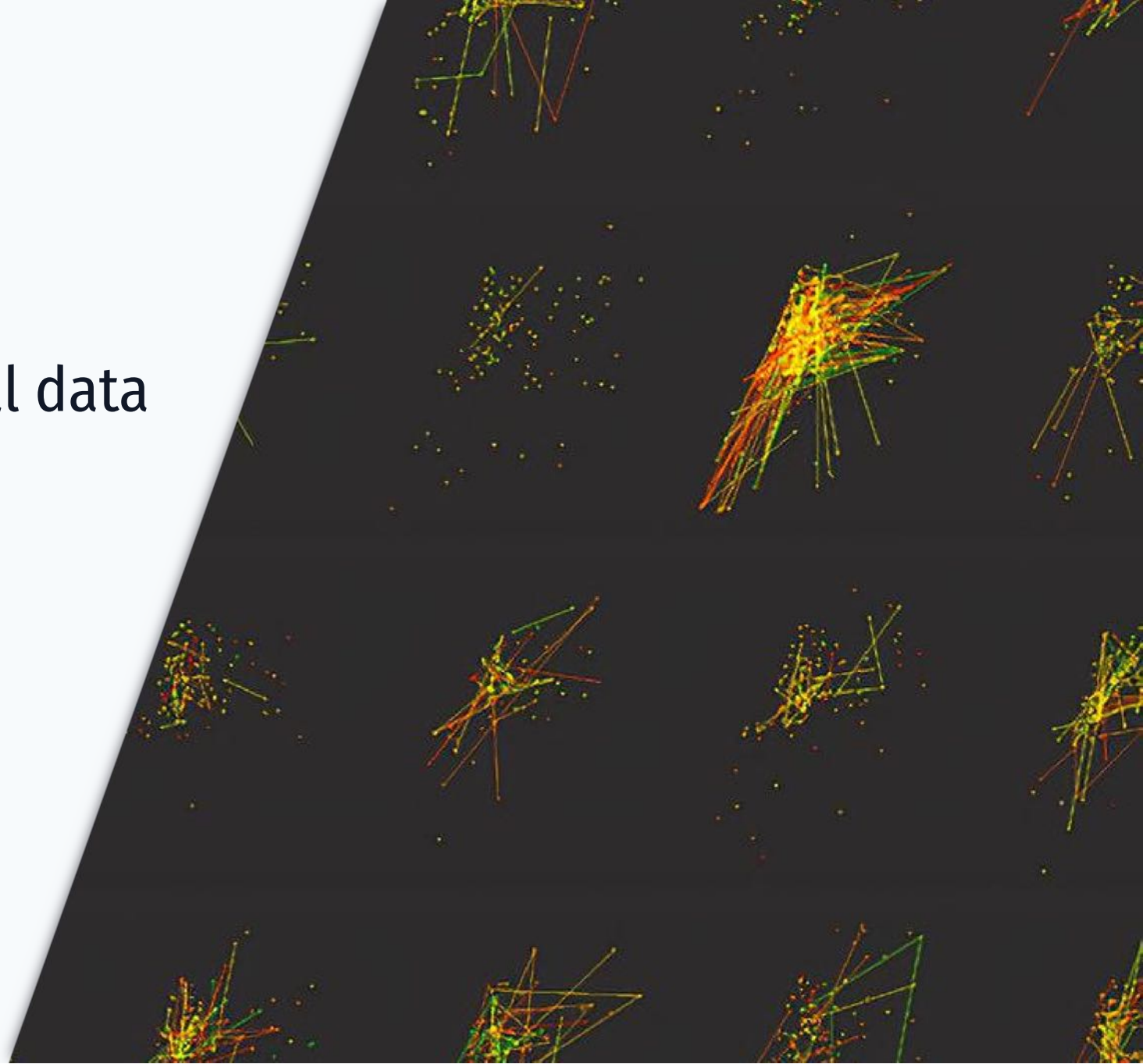
It is essential for us to insist that statistical and cartographical information be arranged and integrated for automatic processing [...]. We have to develop sophisticated and efficient geographical techniques which fully match the new standards of observation and computation.

— TORSTEN HÄGERSTRAND (1967)

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# Big Data

- ▶ Time-based geospatial data
- ▶ Realtime
- ▶ Public APIs





# Big Data

- ▶ Time-based geospatial data
- ▶ Realtime
- ▶ Public APIs

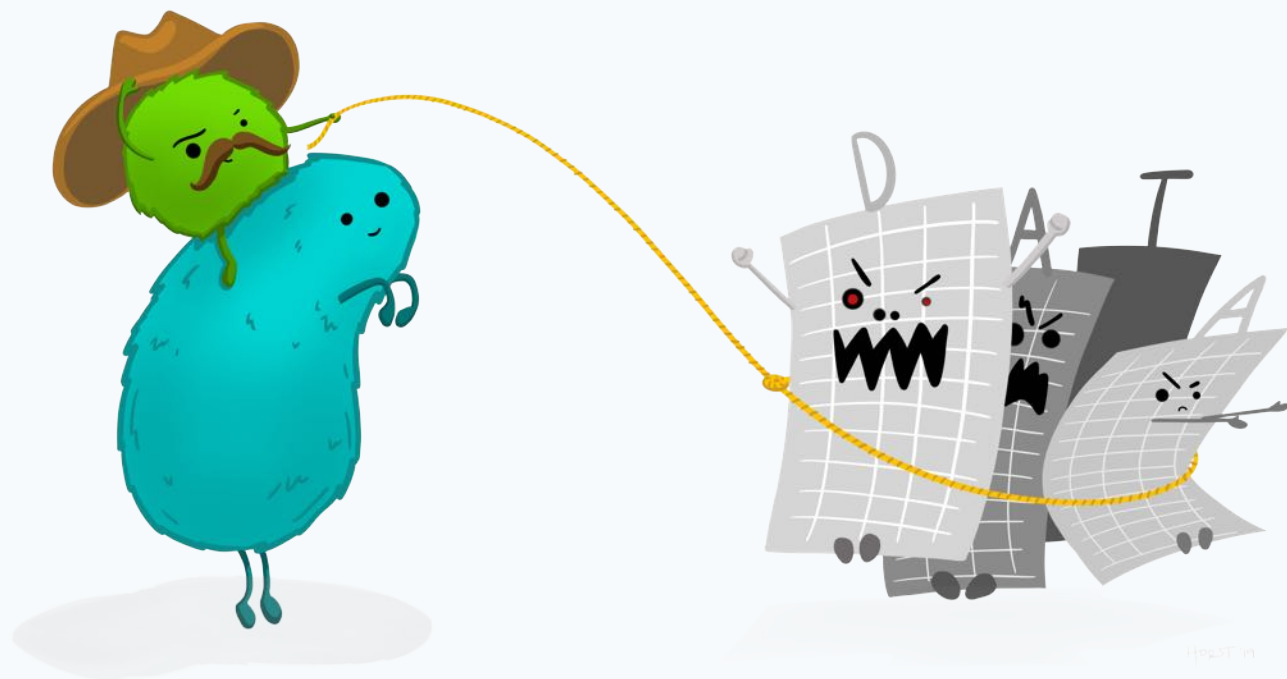
BANGKOK



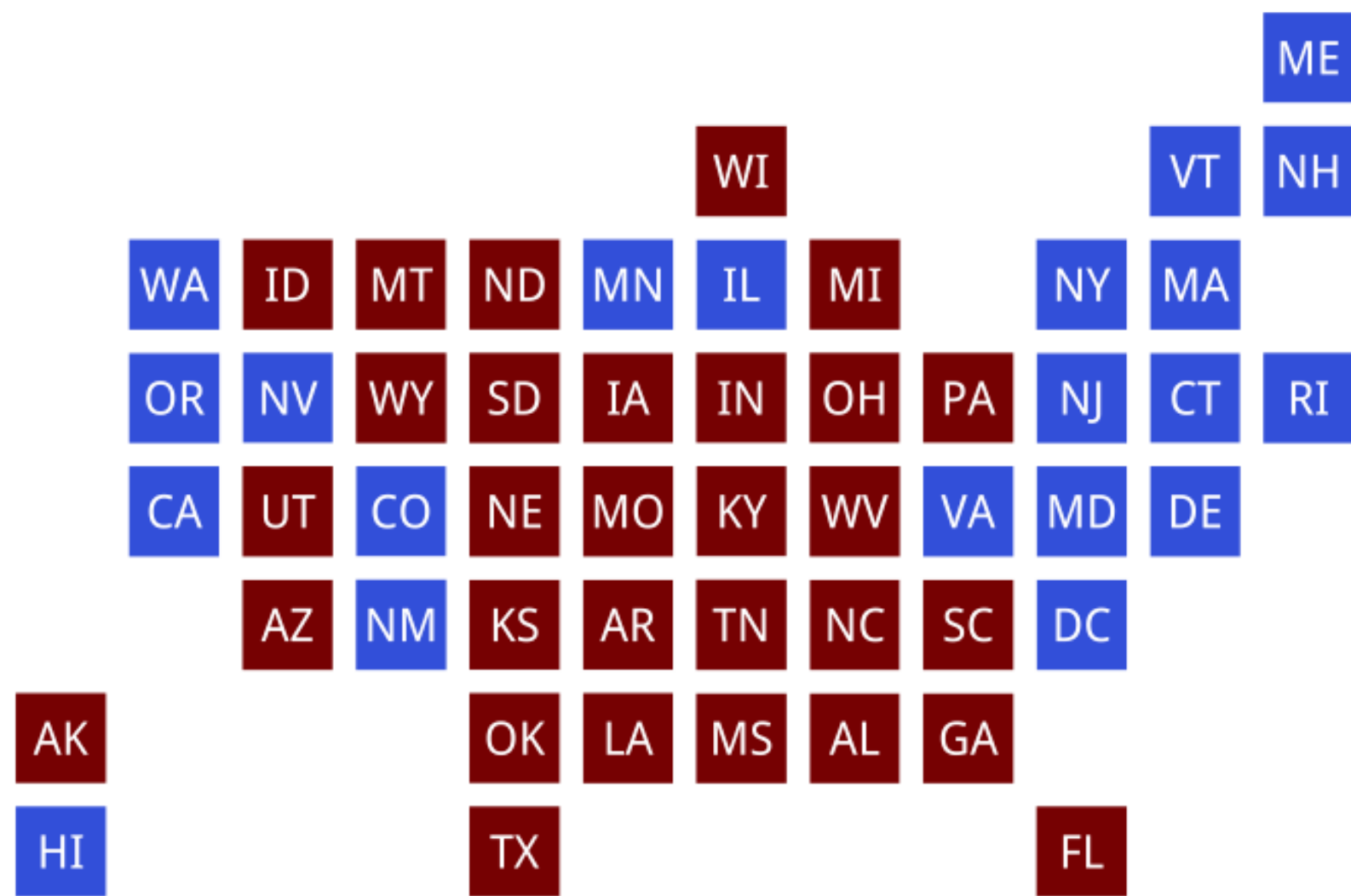
MOOD











Winner



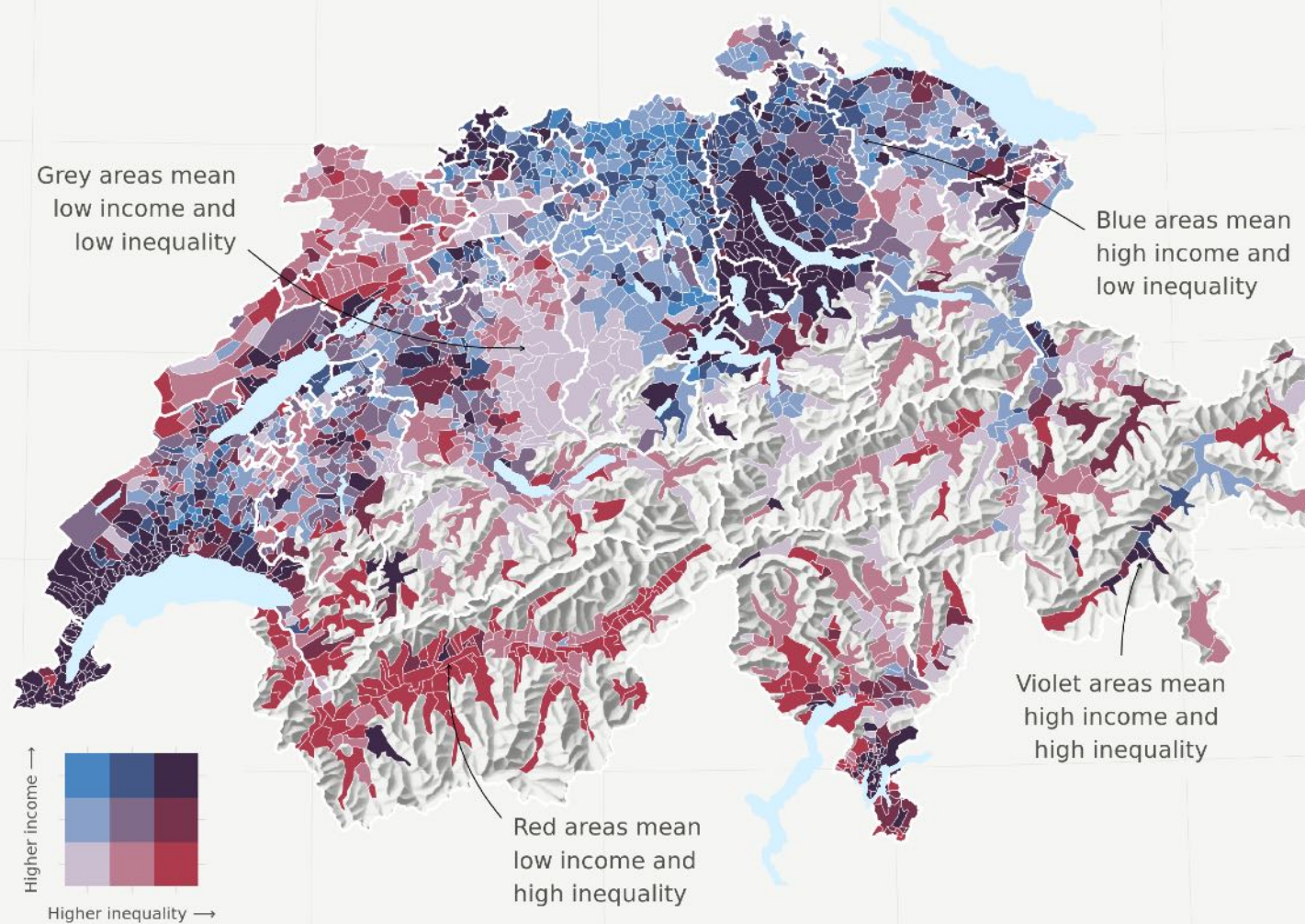
Trump



Clinton

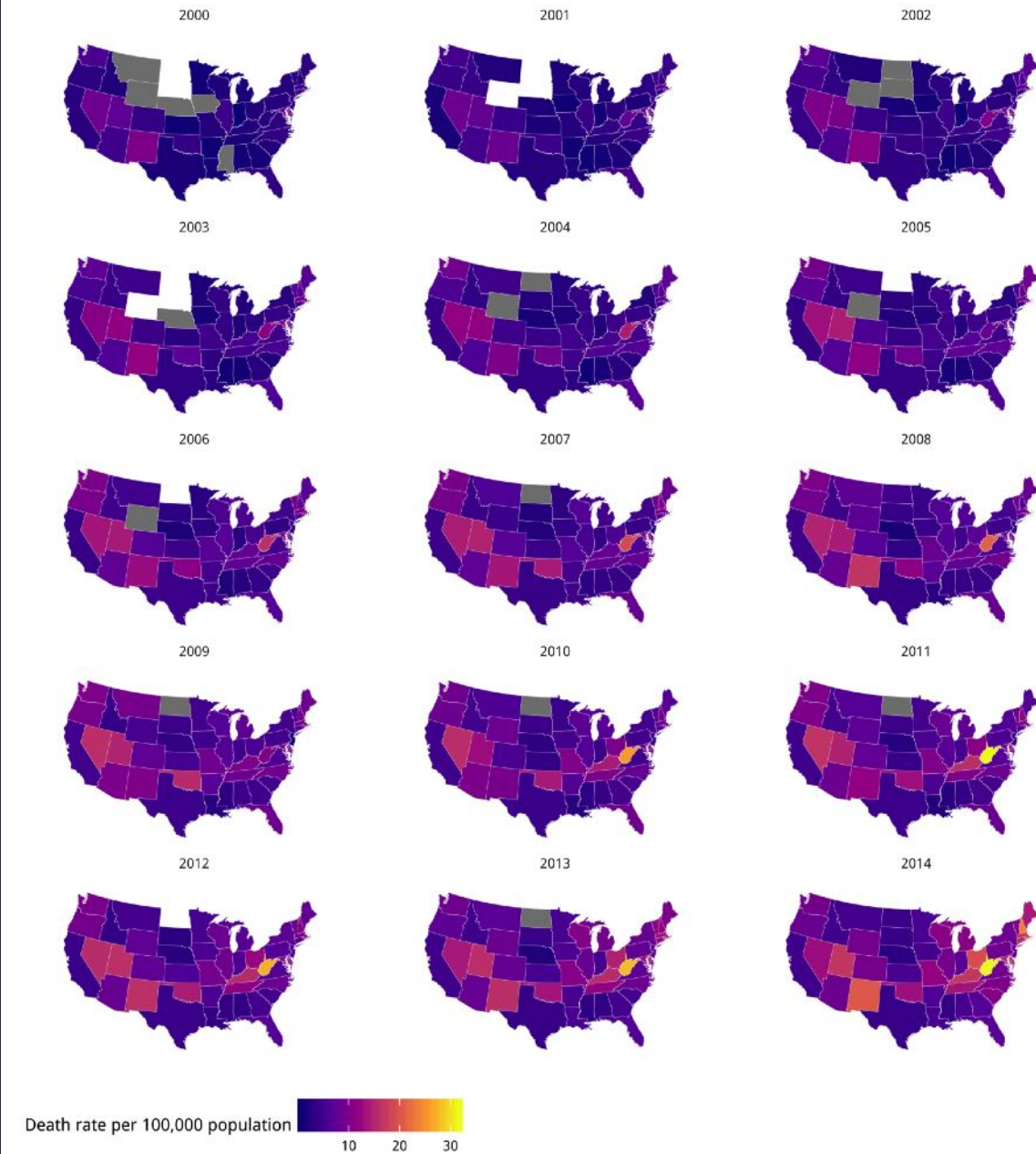
# Switzerland's regional income (in-)equality

Average yearly income and income (in-)equality in Swiss municipalities, 2015



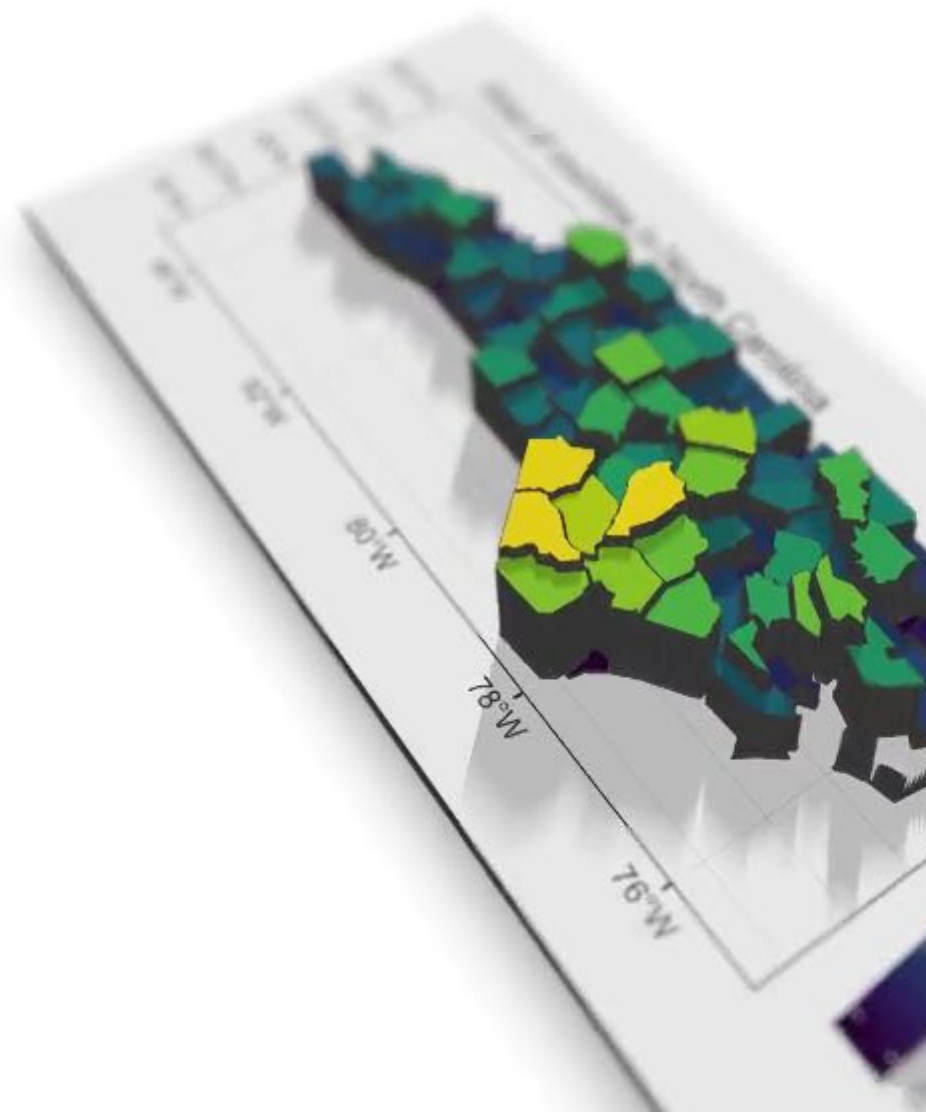
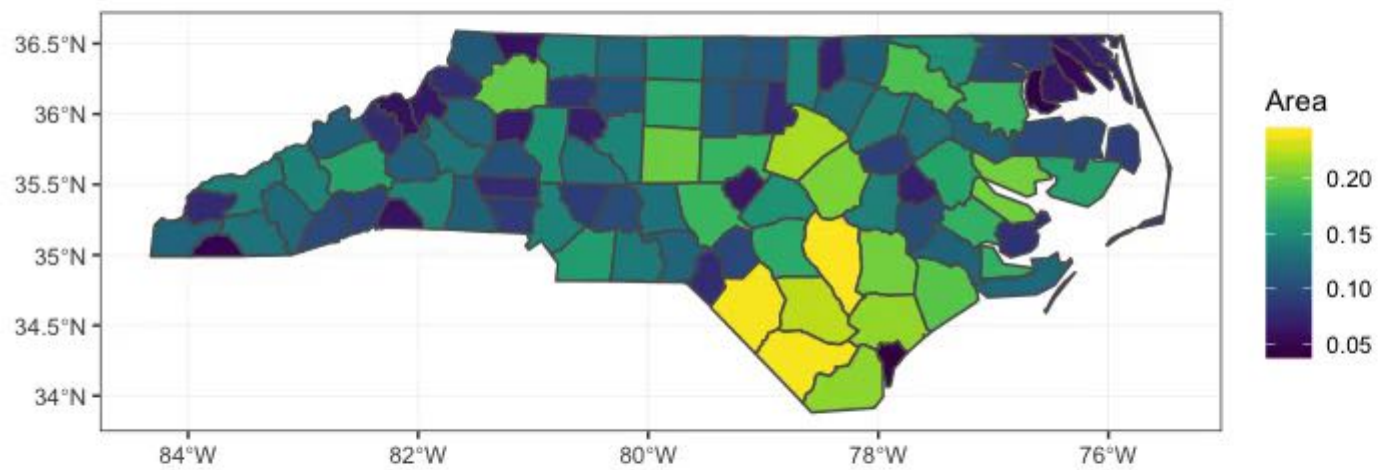
Map CC-BY-SA; Code: [github.com/grssnbchr/bivariate-maps-ggplot2-sf](https://github.com/grssnbchr/bivariate-maps-ggplot2-sf)  
Authors: Timo Grossenbacher (@grssnbchr), Angelo Zehr (@angelozehr)  
Geometries: ThemaKart BFS and swisstopo; Data: ESTV, 2015

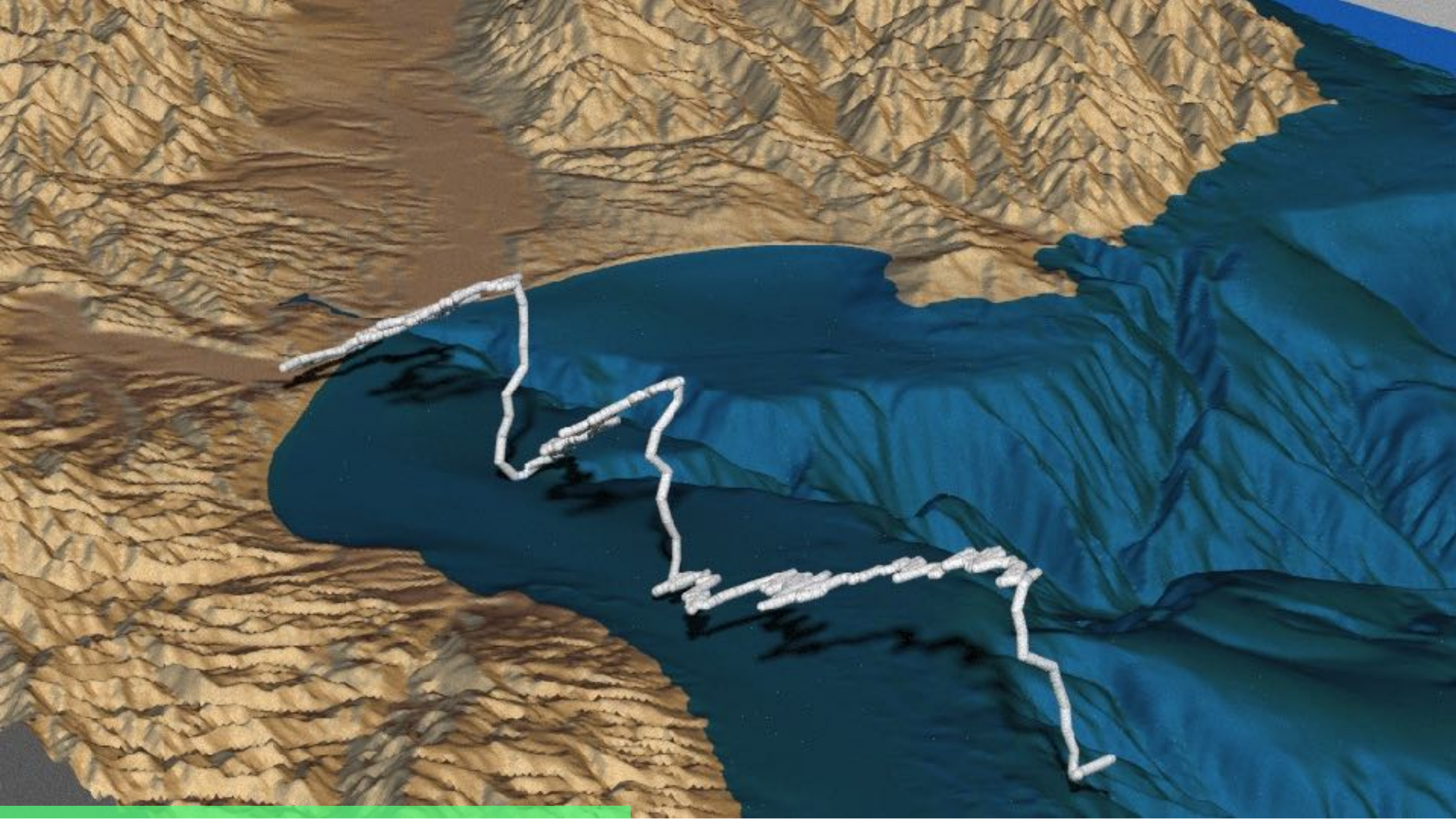
## Opiate Related Deaths by State, 2000-2014





Area of counties in North Carolina







# Some packages

- ▶ ggmap
- ▶ cartography
- ▶ leaflet
- ▶ rayshader
- ▶ ...





# Some packages

- ▶ **ggmap**
- ▶ **cartography**
- ▶ **leaflet**
- ▶ **rayshader**
- ▶ ...



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“

ggmap is an R package that makes it easy to retrieve raster map tiles from popular online mapping services like Google Maps and Stamen Maps and plot them using the ggplot2 framework.

— DAVID KAHLE ([WWW.KAHLE.IO](http://WWW.KAHLE.IO))

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# Installing ggmap

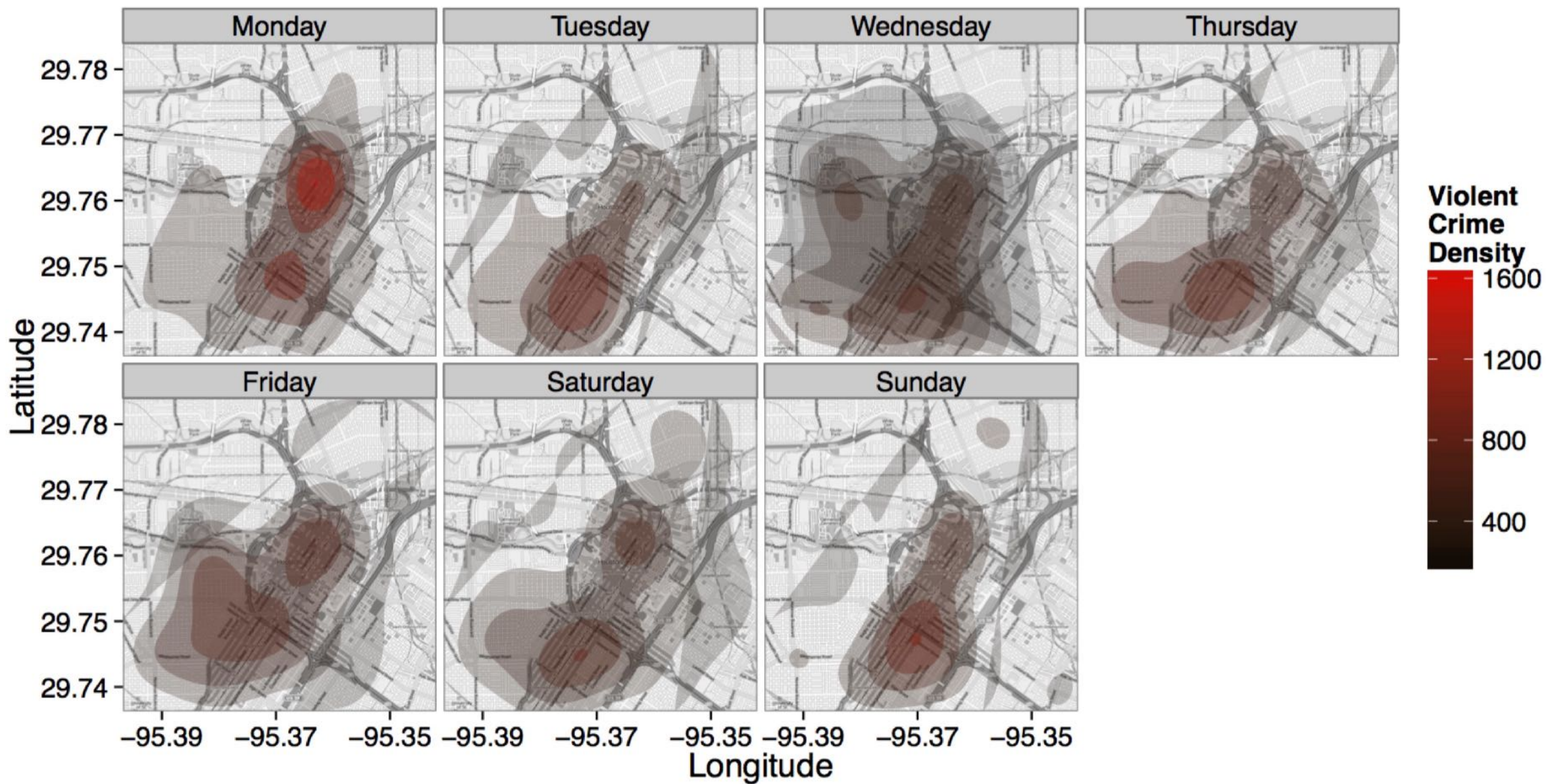
It's on CRAN:

```
install.packages("ggmap")
```

Or be brave:

```
# Remember the remotes package  
remotes::install_github("dkahle/ggmap")
```





# Exploring places chronologies

# Collecting data: Logbooks

ab 20:55 Uhr wieder daheim

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So, 28.06. bis 15:30 Uhr daheim (bzw. im Garten)  
ab 16:45 Uhr Pforzheim (Stadt)  
ab 20:55 Uhr in meiner Wohnung

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Mo, 29.06. bis 7:50 Uhr in meiner Wohnung  
8:10 Uhr

questionnaire_id	date	start_time	duration	place	address	activity
56740	2016-01-21	11:10	1:50	PH	Bismarckstraße 10, 76133 Karlsruhe	Lernen
56740	2016-01-21	13:00	0:45	PH	Bismarckstraße 10, 76133 Karlsruhe	Mitagessen
56740	2016-01-21	13:45	2:15	PH	Bismarckstraße 10, 76133 Karlsruhe	Lernen
56740	2016-01-21	16:00	1:00	NA	Turmbergstraße 3, 76227 Karlsruhe	Einkaufen
56740	2016-01-21	17:00	0:45	Arbeit	Pfinztalstraße 40, 76227 Karlsruhe	Arbeit
56740	2016-01-21	17:00			Pfinztalstraße 40, 76227 Karlsruhe	Haushalt
56740	2016-01-21	17:00			Pfinztalstraße 40, 76227 Karlsruhe	Freizeit



# ggplot2: VISUAL DATA EXPLORATION

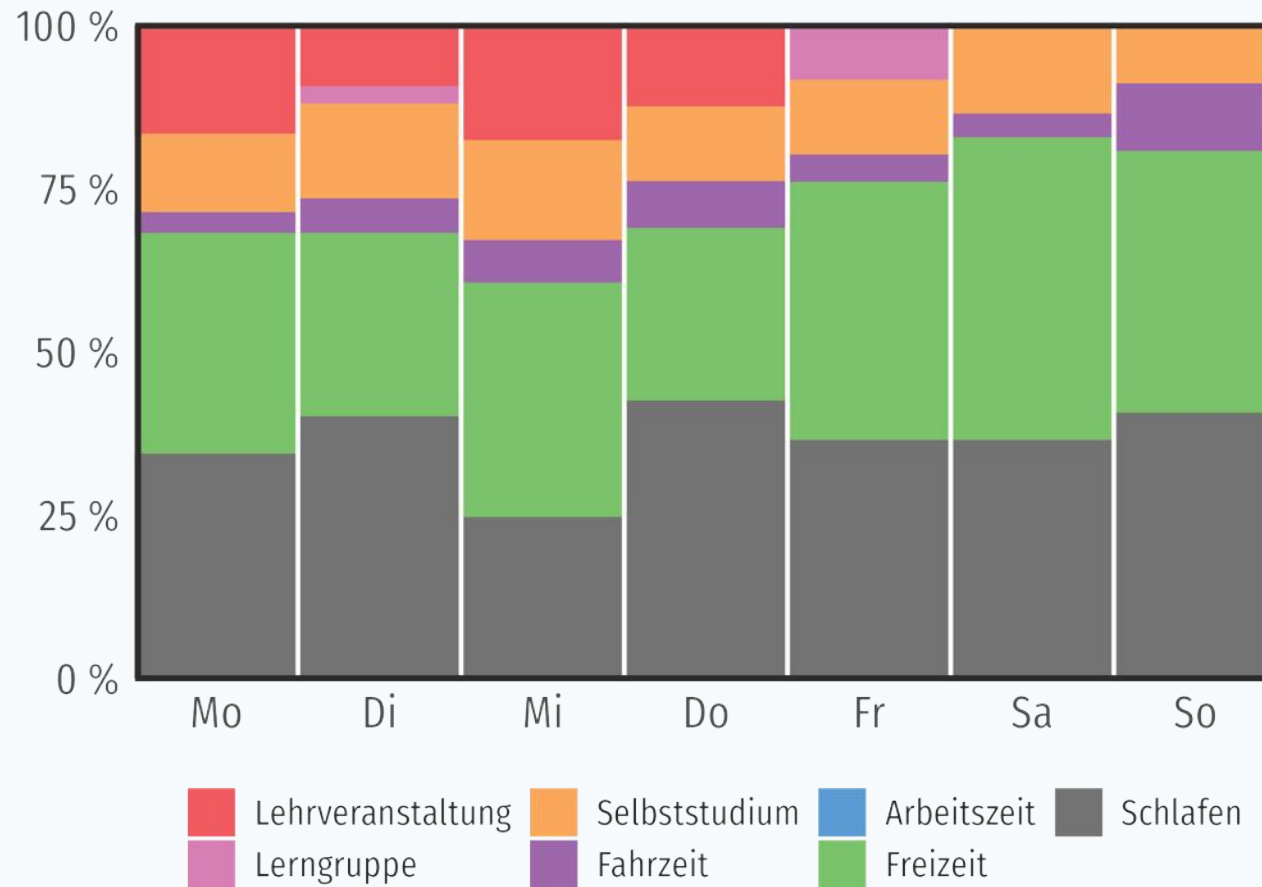
&  
ggmap



# Cartography

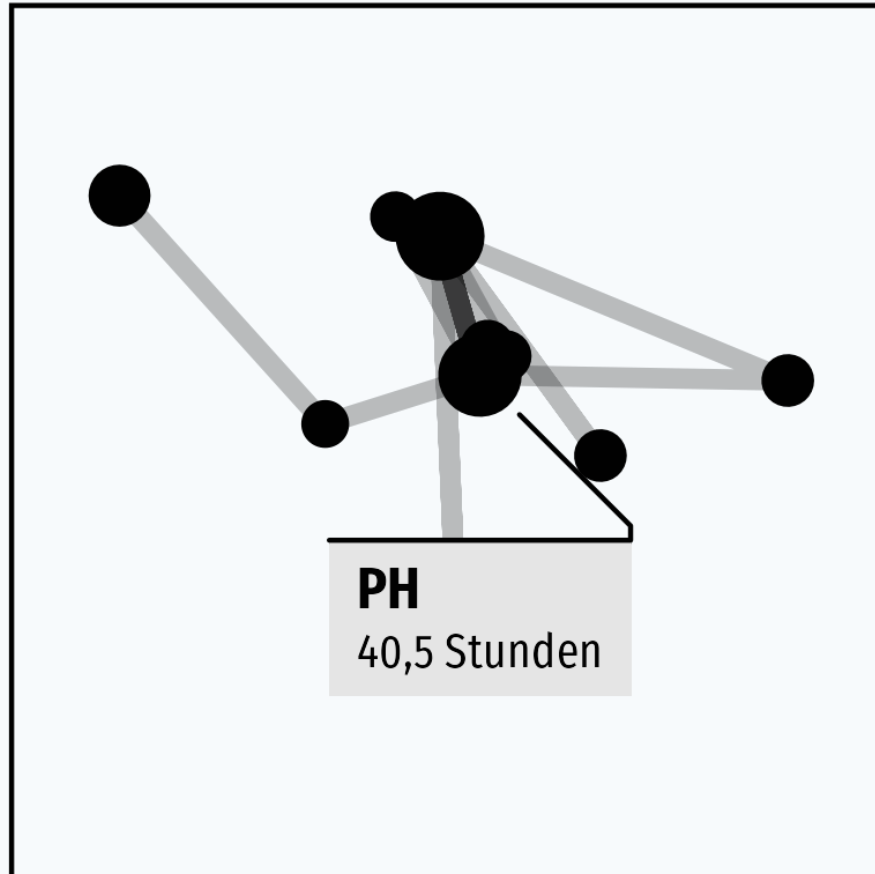


# Time Pattern

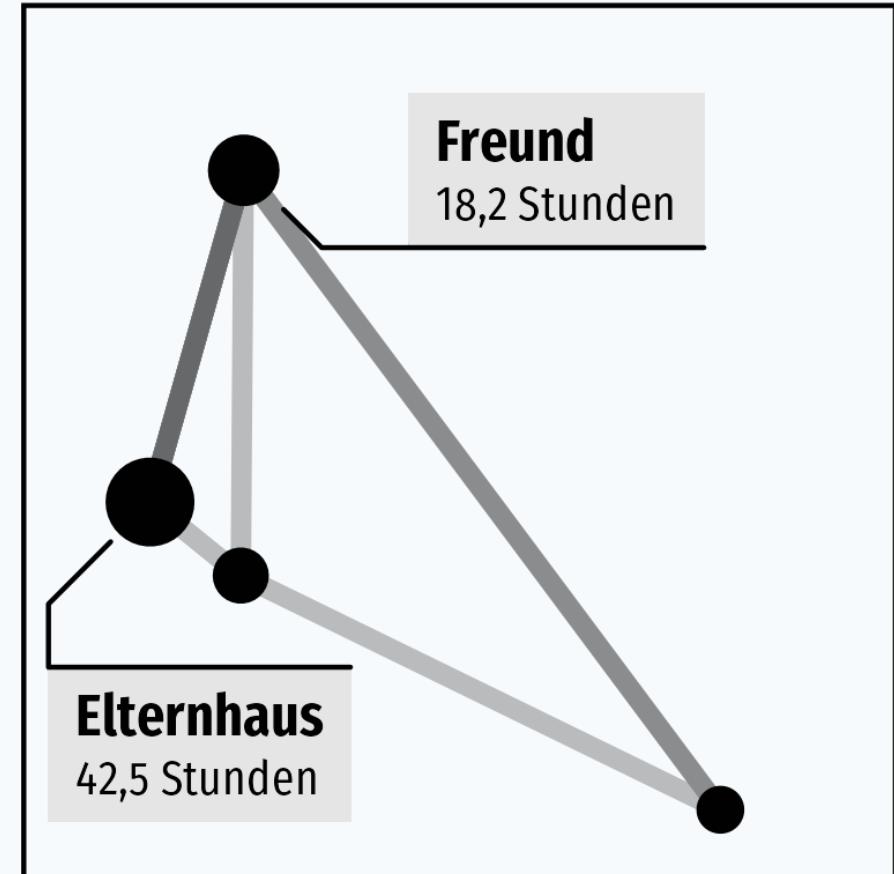


# Places chronology structure

## Hochschul- & Wohnort



## Wohnort der Eltern





# Installing TimeSpaceAnalysis

My personal project package:

```
# Remember the remotes package
remotes::install_gitlab("Inventionate/TimeSpaceAnalysis")

library(TimeSpaceAnalysis)
```

Further reading: <https://www.jumpingrivers.com/blog/personal-r-package>

# Fetching geocodes from Google Maps™

```
security ← jsonlite::fromJSON("security.json")  
register_google(key = security$api_token)
```

```
geocodes ←  
  df_places_chronologies %>%  
  as_tibble() %>%  
  select(address) %>%  
  distinct() %>%  
  filter(address ≠ "") %>%  
  mutate_geocode(address, source = "google")
```

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  filter(address ≠ "") %>%
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```



```
library("TimeSpaceAnalysis")
```

```
# *****
```

```
# Basisdaten -----
```

```
# *****
```

```
datensatz_allgemeine_angaben ←
```

```
  read_rds("repository/datensatz_allgemeine_angaben.rds")
```

```
datensatz_orte_chronologien ←
```

```
  read_rds("repository/datensatz_orte_chronologien.rds")
```

```
id_ind_interview ←
```

```
  read_rds("repository/id_ind_interview.rds")
```

```
> 2
```

```
# Mia -----
```

```
plot_places_chronology(
```

```
  datensatz_orte_chronologien,
```

34	Freitag	Freizeit	22.9
35	Freitag	Schlafen	40.6
36	Samstag	Lehrveranstaltung	11.5
37	Samstag	Lerngruppe	0
38	Samstag	Selbststudium	15.7
39	Samstag	Fahrzeit	1.57
40	Samstag	Arbeitszeit	0
41	Samstag	Freizeit	29.3
42	Samstag	Schlafen	41.9
43	Sonntag	Lehrveranstaltung	0
44	Sonntag	Lerngruppe	0
45	Sonntag	Selbststudium	0
46	Sonntag	Fahrzeit	1.56
47	Sonntag	Arbeitszeit	0
48	Sonntag	Freizeit	62.0
49	Sonntag	Schlafen	36.5

```
R>
```

```
NORMAL  master orte_chronologien.R
```

```
34
```

```
r
```

```
1%
```

```
16:1
```

```
72905:radian
```

```
100%
```

```
359:1
```

# Media references

**Photo by Andrew Neel** [1] <https://unsplash.com/photos/1-29wyvvLJA>

**Schematic by Jeff Allen** [2] [https://en.wikipedia.org/wiki/Time\\_geography](https://en.wikipedia.org/wiki/Time_geography)

**Schematic by Torsten Hägerstrand** [3] <https://www.spektrum.de/lexikon/geographie/zeitgeographie/9196>

**Image by Phototrails** [5] <http://www.phototrails.net>

**Image by Selfiecity** [6] <http://www.selfiecity.net>

**Official R Project logo** [7] <https://www.r-project.org/logo>

**Artworks by @allison\_horst** [8, 14, 21] <https://github.com/allisonhorst/stats-illustrations>

**Plots by Kieran Healy** [9, 11] <https://socviz.co/maps.html>

**Plot by Timo Grossenbacher** [10] <https://timogrossenbacher.ch/2019/04/bivariate-maps-with-ggplot2-and-sf/>

**Animation and plot by Tyler Morgan-Wall** [12, 13] <https://www.tylermw.com/3d-ggplots-with-rayshader>

**Plot by David Kahle & Hadley Wickham** [18] <https://journal.r-project.org/archive/2013-1/kahle-wickham.pdf>



<https://www.inventionate.de>