



# QGIS + DATA VISUALIZATION

WORKSHOP  
VISUALIZING KNOWLEDGE 07/05/2019



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# ABOUT ME

MY NAME IS...

I AM FROM...

I AM HERE BECAUSE...

TODAY I EXPECT TO...

# INTRODUCTIONS

Gispo was founded in 2012 and specializes in FOSS4G software

[www.gispo.fi](http://www.gispo.fi)

[www.gispolearning.com](http://www.gispolearning.com)

[tuki@gispo.fi](mailto:tuki@gispo.fi),

[info@gispo.fi](mailto:info@gispo.fi)

Facebook: @GispoFinland

LinkedIn: @gispo-oy

Instagram & Twitter: @GispoFinland



ABOUT YOU

MY NAME IS...

I AM FROM...

I AM HERE BECAUSE...

TODAY I EXPECT TO...

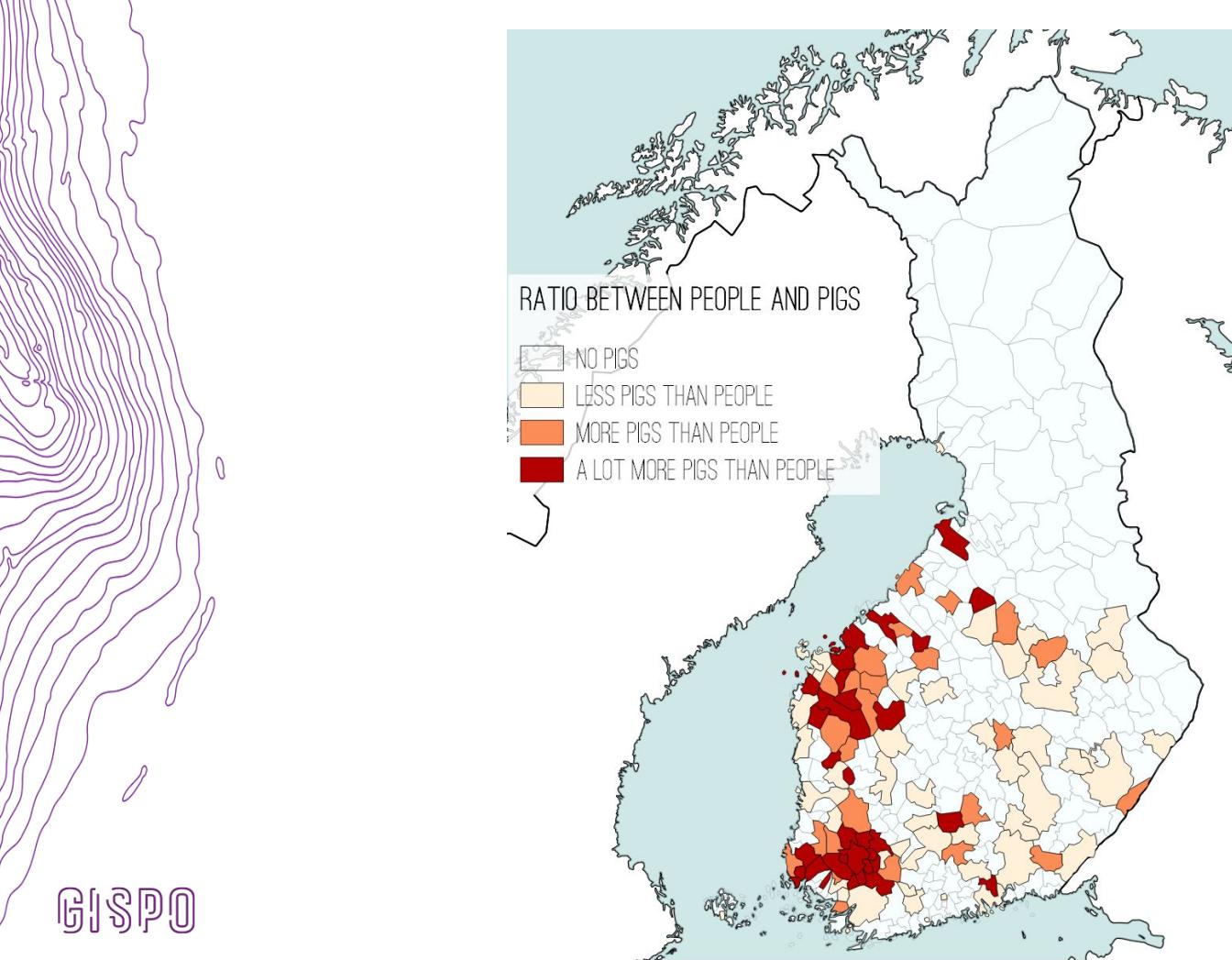


# BACKGROUND (=THEORY)



# WHY SPATIAL MATTERS?

- The amount of data is growing exponentially
  - In 2018 there is 30 billion terabytes of data, in 2025 160 billion TB (IDC Data Age 2025)
- 80 % of all data is claimed to have a "spatial component"
- Location can be expressed in multiple ways
  - Coordinates
  - Addresses
  - Municipality name
  - Different place id's



# HOW FAR CAN YOU TRAVEL IN ONE HOUR BY CAR?

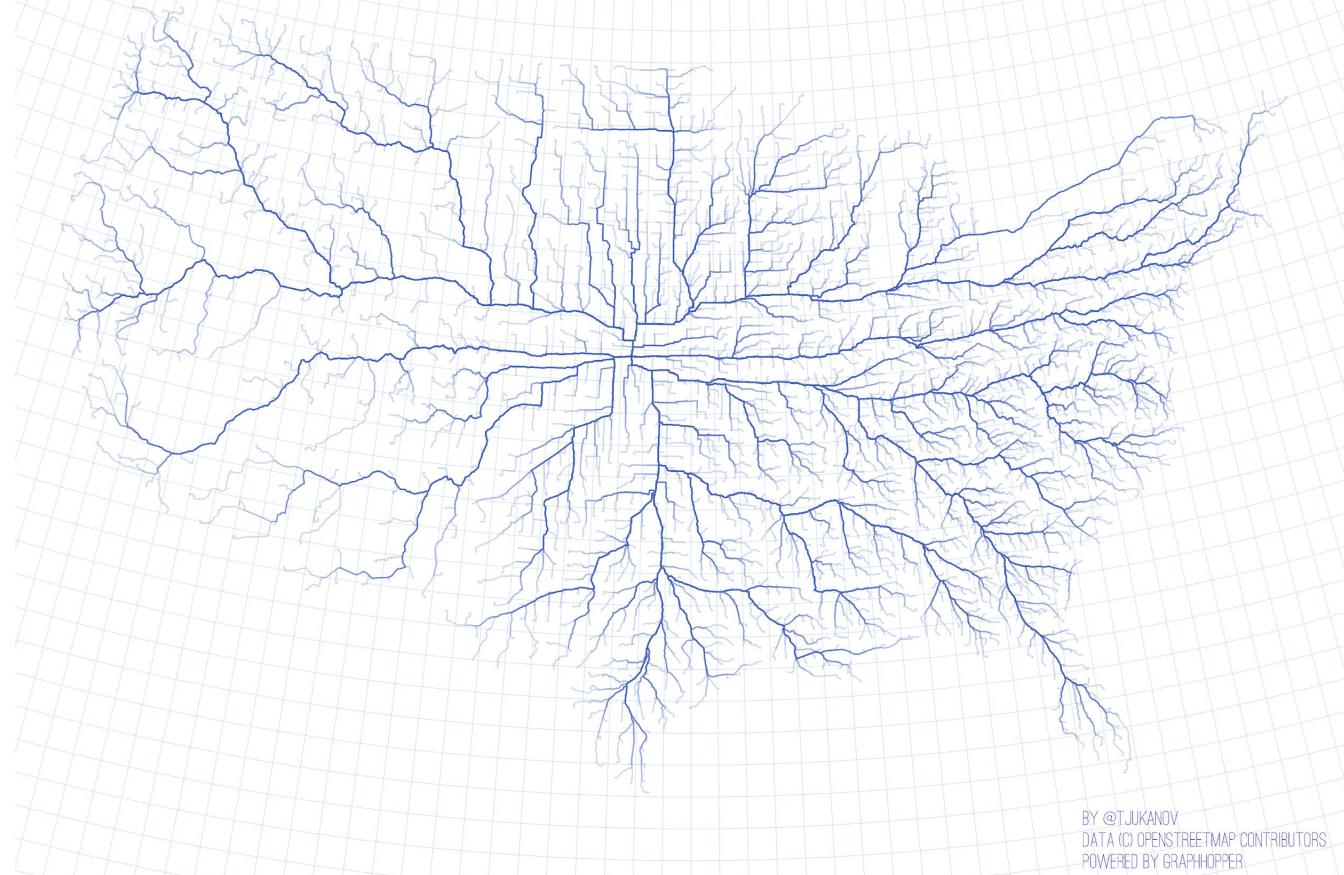


MADE BY TOPI TJUKANOV. DATA: HERE.COM API.  
MADE WITH OGS

GISPO



# OPTIMAL ROUTES BY CAR FROM THE GEOGRAPHIC CENTER OF THE CONTIGUOUS UNITED STATES TO ALL COUNTIES



BY @TJUKANOV  
DATA (C) OPENSTREETMAP CONTRIBUTORS  
POWERED BY GRAPHHOPPER

GISPO

GISPO



GISPO





5 YEARS OF STUDIES  
IN 15 MINUTES

GISPO

# GEOGRAPHIC INFORMATION SYSTEM (GIS)



- Information system for:
  - Collecting and updating spatial information
  - Conducting spatial analyses
  - Visualizing spatial information and analysis results
- Spatial data infrastructure:
  - Includes GIS + hardware, people, data management, information sharing etc.

# WHAT IS GEOSPATIAL INFORMATION?

- **Spatial:** geometry and geographical location of a feature: “Where is it?”
- **Information:** Describing information: “What is it?”
  - Attribute table
- **Vectors:**
  - Point, line, or polygon
- **Rasters:**
  - “picture” consisting of regular pixels



ID	Name	Type	Area
47	Paradise Island	Beach	7000
53	Paris	City	800

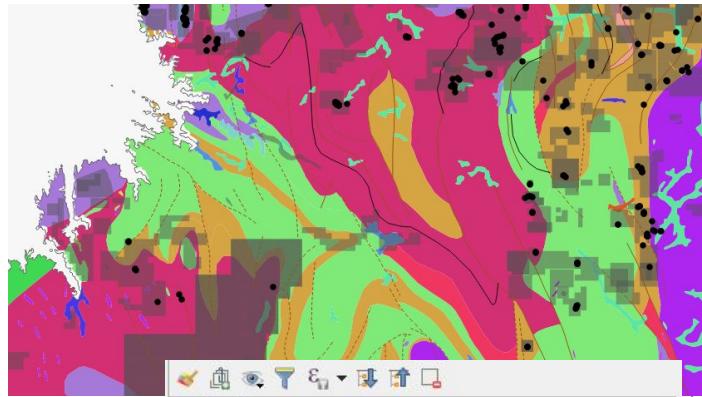


1	1	1
2	3	4
5	2	2

# WHAT IS GEOSPATIAL INFORMATION?

-> Shown on **layers**

- Layers can be handled separately and ordered by user's needs
- One layer = one logical feature
- Visualization can tell extra information



# WHAT IS GEOSPATIAL INFORMATION?

**Vector data:**  
Discrete objects with sharp limits.  
Everything else is “empty space”

- Points
  - Buildings, bus stops, trees, rocks
- Lines
  - Roads, rivers, power lines
- Polygons
  - City borders, natural reservation areas, lakes

- Raster data:**  
Smooth, continuous field, has a value everywhere.  
Spatial autocorrelation =  
*Things close to each other are more similar than distant ones*
- Fields
    - Soil type, vegetation, temperature, elevation

# COLLECTING GEOSPATIAL DATA

Remote sensing methods produce raster data or point clouds:

- Aerial images
- Satellite images
- Laser scanning
- Interpolating missing values (spatial autocorrelation)

On-site measurements produce vector data (points):

- GPS
- Triangulation

# GEOSPATIAL DATA FORMATS

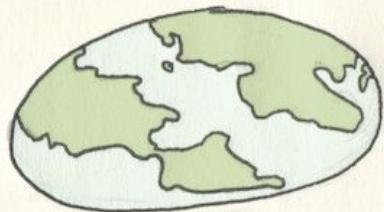
- Vector data
  - Shapefile, GeoJSON, Geopackage, CSV, GML
  - Accessed via WFS-services
- Raster data
  - Geotiff, JPEG,
  - Accessed via WMS-services



GISPO

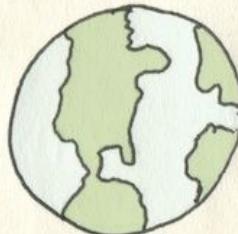


<https://github.com/nextgis/nextgisweb/issues/628>



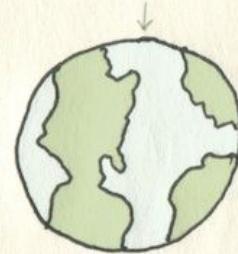
FLAT EARTH

DEFINITELY WRONG



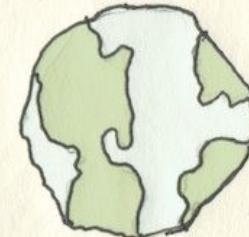
PERFECT SPHERE

IF ONLY, BUT NO



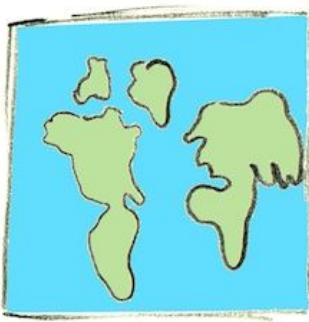
REFERENCE  
ELLIPSOID

CLOSEENOUGH  
USUALLY



GEOID

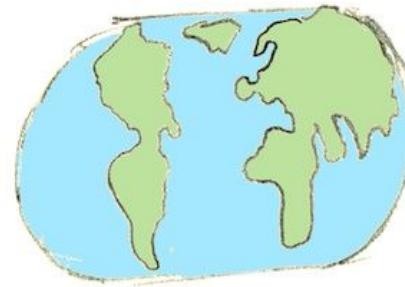
FOR WHEN YOU  
REALLY GOTTA  
BE RIGHT



MERCATOR



SATELLITE



NATURAL EARTH

Projections are mathematical equations that do  
the trick of turning the world into some flat shape

# IMPORTANT

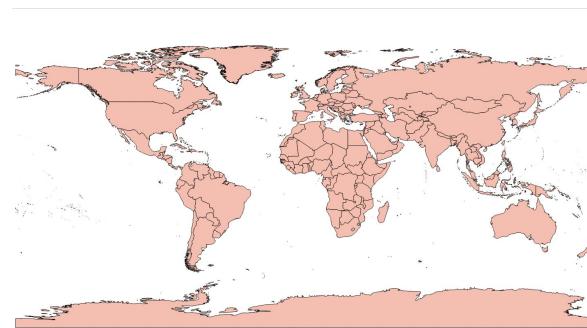
- Choose the optimal projection for your map

World map

ETRS-TM35FIN



WGS 84



# IMPORTANT

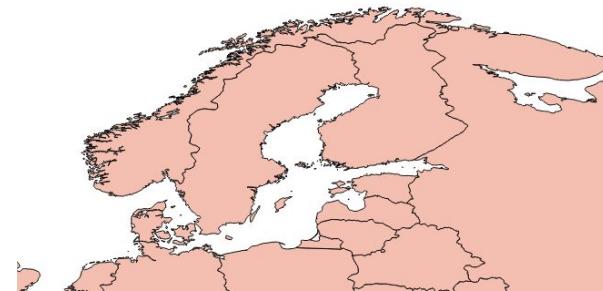
- Choose the optimal projection for your map

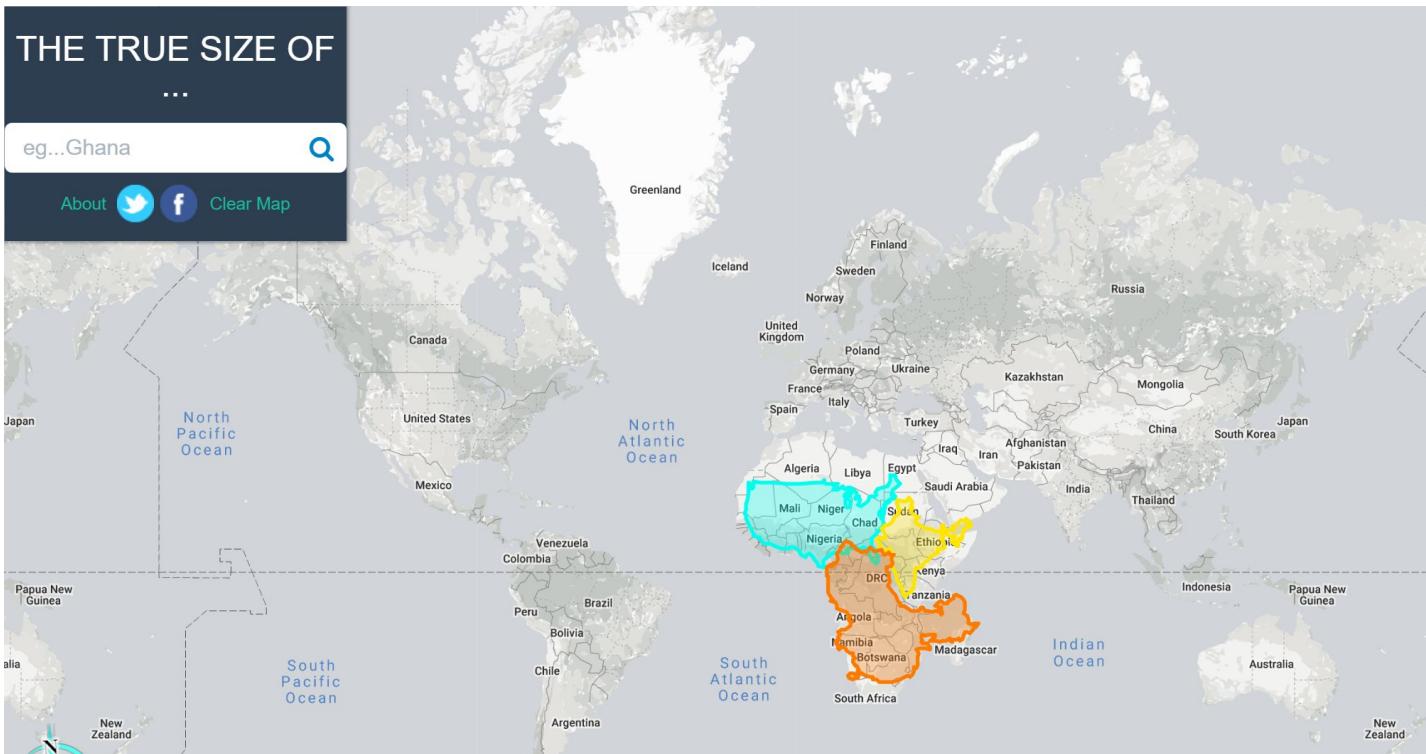
MAP OF FINLAND

ETRS-TM35FIN



WGS 84







# TERMINOLOGY

## BASEMAP

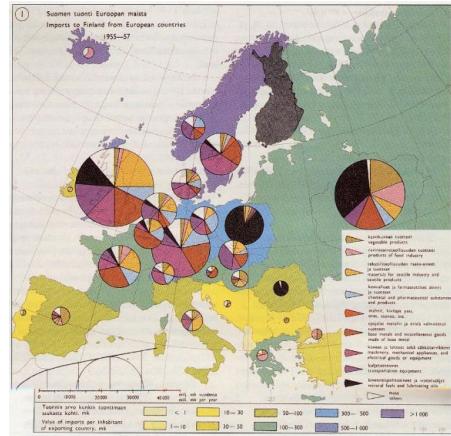
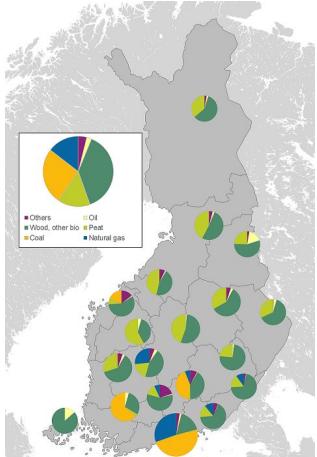
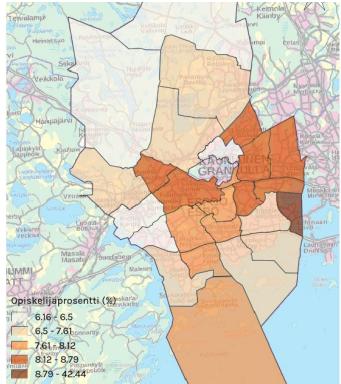
CAN BE A BACKGROUND  
MAP FOR  
THEMATIC MAP

COROPLETH MAP

+

MAP DIAGRAM

= COMBINATION





# FOSS4G SOFTWARE AND QGIS

# FOSS4G

- FOSS4G = free open source software for geospatial





# QGIS - IN SHORT



- Desktop GIS Software
- Artist formerly known as **Quantum GIS**
- Core with **C++**, GUI with **Qt**
- **Windows, Linux, Mac OS**
- **Python API**
- Integrates to most other GIS Software smoothly
  - **GRASS, SAGA, SEXTANTE, OrfeoToolbox...**

# QGIS - DEVELOPMENT



- Development started in 2002
- v. 2010 QuantumGIS 1.0  
(Gary Sherman)
- 3.4 LTR - released in February 2019
- About 30 core developers

Event	Latest	Long-Term Repo	Freeze	Date
PR	2.18.4	2.14.12		2017-02-24
PR	2.18.5	2.14.13		2017-03-24
EPR	2.18.6			2017-04-07
PR	2.18.7	2.14.14		2017-04-21
<b>LTR</b>	<b>2.18.8</b>	<b>2.14.15</b>		2017-05-19
EPR	2.18.9			2017-05-26
PR	2.18.10	2.14.16		2017-06-23
PR	2.18.11	2.14.17		2017-07-21
PR	2.18.12	2.14.18		2017-08-18
PR	2.18.13	2.14.19		2017-09-15
PR/SF	2.18.14	2.14.20	2.99	2017-10-27
PR	2.18.15	2.14.21		2017-12-08
PR	2.18.16	2.14.22		2018-01-19
<b>LR/PR</b>	<b>3.0.0</b>	<b>2.18.17</b>		2018-02-23
PR	3.0.1	2.18.18		2018-03-23
PR	3.0.2	2.18.19		2018-04-20
PR/FF	3.0.3	2.18.20	3.1	2018-05-18
<b>LR</b>	<b>3.2.0</b>	<b>2.18.21</b>		2018-06-22
PR	3.2.1	2.18.22		2018-07-20
PR	3.2.2	2.18.23		2018-08-17
PR/FF	3.2.3	2.18.24	3.3	2018-09-14
<b>LTR</b>	<b>3.4.0</b>	<b>2.18.25</b>		2018-10-26
PR	3.4.1	2.18.26		2018-11-23



# LESSON 1: QGIS GUI

GISPO



3.6.2  
3.4.7 LTR

DISCOVER QGIS

FOR USERS

GET INVOLVED

DOCUMENTATION

Search

English



Time until freeze 2019-05-17 12:00:00 UTC 11d 5h 21m

Time until packaging 2019-06-21 12:00:00 UTC 46d 5h 21m

Time until next point release 2019-05-17 12:00:00 UTC 11d 5h 21m

# QGIS

A Free and Open Source Geographic Information System

QGIS 3.6 Noosa  
has been released!

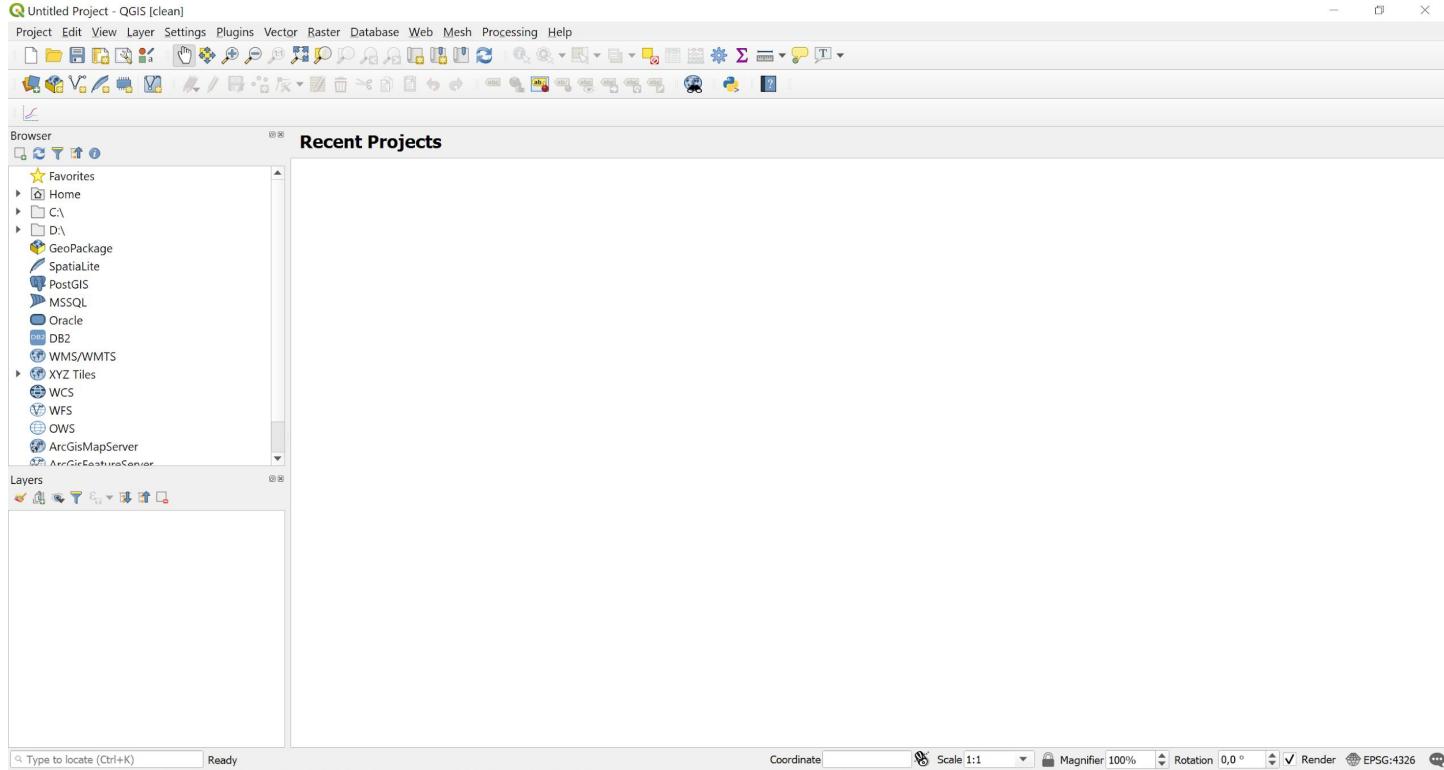
New release: 3.6!

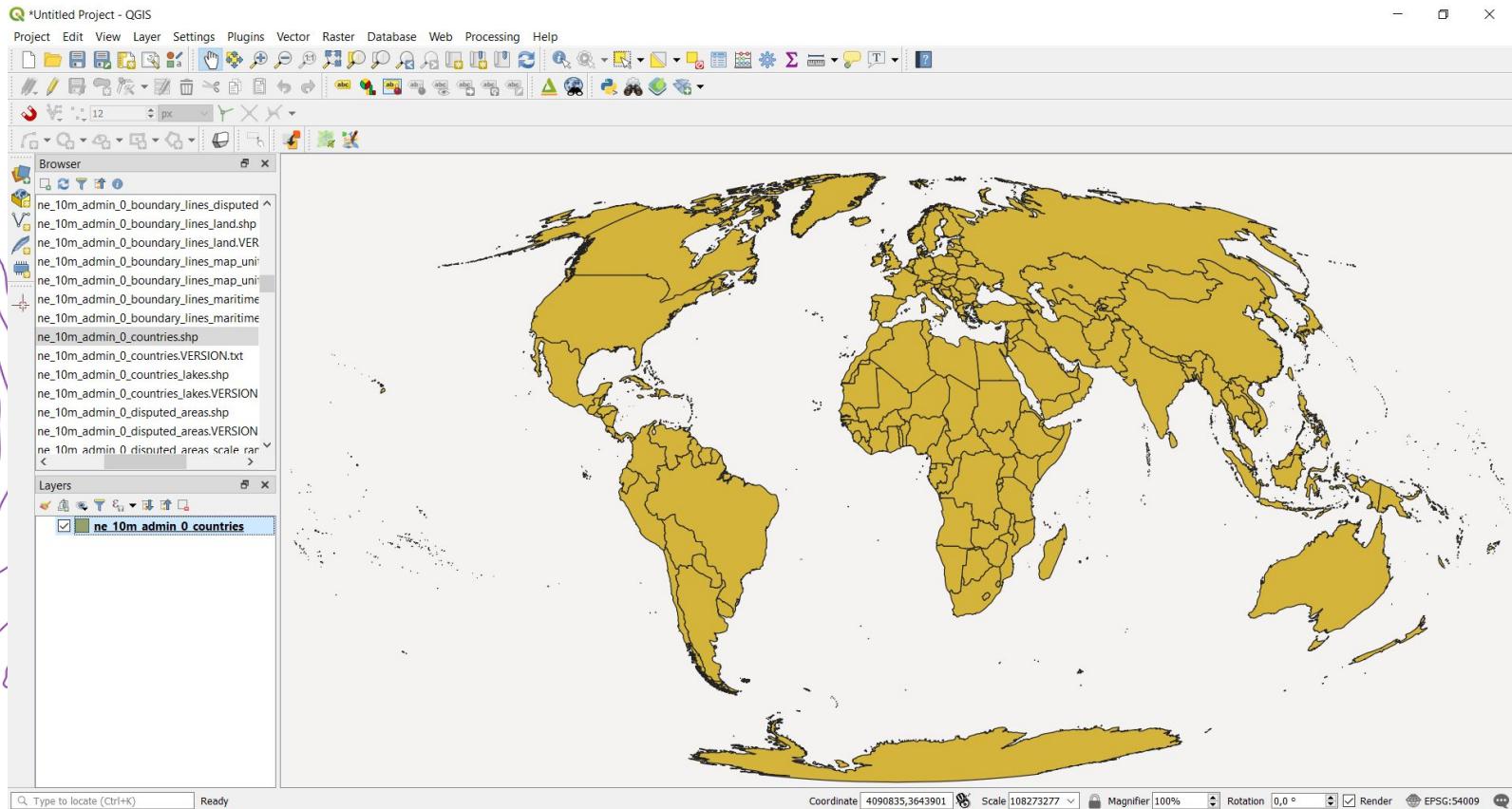
Get the [installer or packages](#) for your Operating System!

Create, edit, visualise, analyse and publish geospatial information on Windows, Mac, Linux, BSD (Android coming soon)



# QGIS GUI





GISPO

# SYMBOLLOGY

The screenshot displays the Gispo software interface, specifically the symbology configuration window for a map layer named "Tason ominaisuudet - ne\_10m\_admin\_0\_countries | Tylli".

**Left Panel:** A sidebar menu titled "Yleiset" (General) contains the following items: Yleiset, Tyyli, Nimiöt, Tietokentät, Kartan näyttäminen, Näyttö, Toiminnot, Liitokset, Kaaviot, Metadata, and Muuttujat.

**Main Window:** The main window shows a map of Europe with countries filled in yellow. A legend on the left identifies the yellow color as "Yksinkertainen täytyö" (Simple fill).

**Symbology Configuration:** The configuration window includes the following sections:

- Symbolitason typpi:** Set to "Yksinkertainen täytyö".
- Värit:** Fill color is yellow, and the border color is olive green.
- Täytöväri:** Border style is "Kiinteä" (Solid).
- Rajan tyylı:** Border style is "Kiinteä viiva" (Solid line).
- Yhdistämistyyli:** Joints style is "Viilostreuna" (Round).
- Rajan leveys:** Border width is 0,260000 mm.
- Sirrytymä X,Y:** Offset X,Y is 0,000000 mm.

**Color Selection:** A color picker window titled "Valitse täytöväri" shows a color gradient from blue to red. It includes sliders for CMYK values (O, H, S, V, R, G, B) and a hex code input field: "#f1f4c7".

**Icon Selection:** An icon selection window titled "SVG kuva" shows various icons categorized by file type, such as "Components", "Icons", "Emergency", "Entertainment", etc. A specific icon for a dollar sign (\$) is selected.

**Legend:** A legend window titled "Tyyli" shows five categories: "corners", "diagonal", "dotted", "green", and "land". Below these are examples for "water" and "wine".

GISPO



# MAKING A MAP - THE EASY WAY



# TASK 1: EXPLORE DATA



# TIPS & TRICKS FOR ABSOLUTE BEGINNERS

- Background maps are nice to have
  - XYZ Tiles
- Keep in mind the different levels of accuracy in your data
- Data types are a common problem



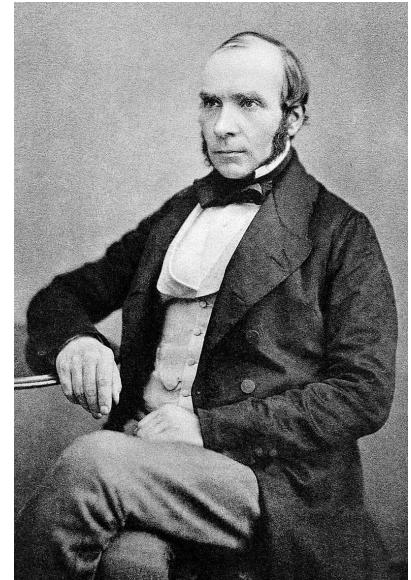
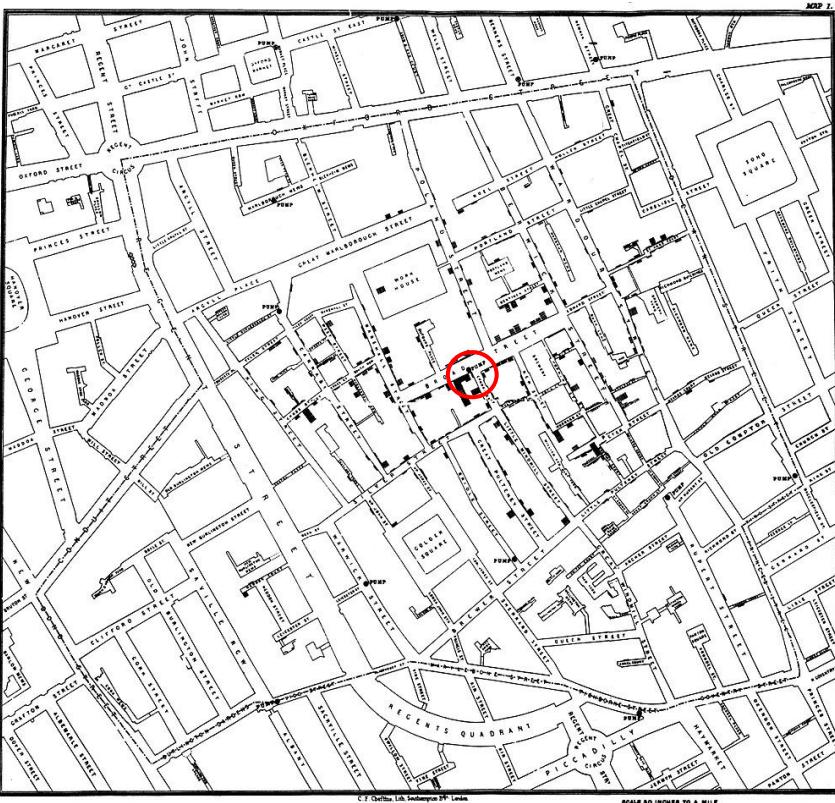
# **LESSON 2:**

# **VISUALIZATION THEORY**

# **AND MAPMAKING**

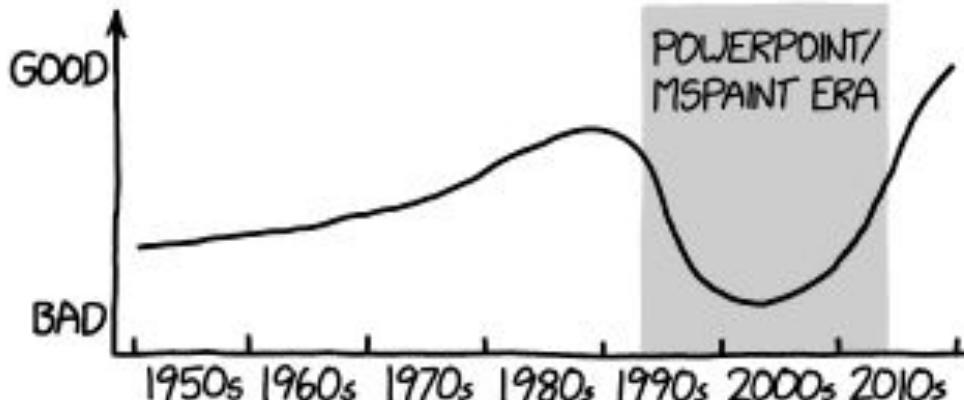
# THE POWER OF VISUAL ANALYSIS

GISPO



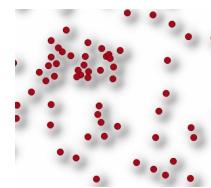
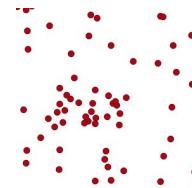
John Snow

## GENERAL QUALITY OF CHARTS AND GRAPHS IN SCIENTIFIC PAPERS

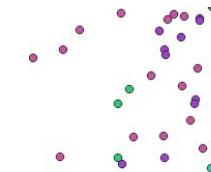
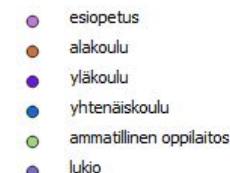


# VECTOR DATA STYLING

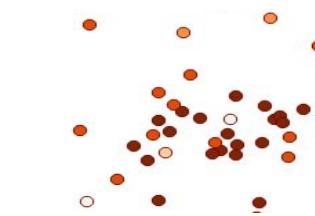
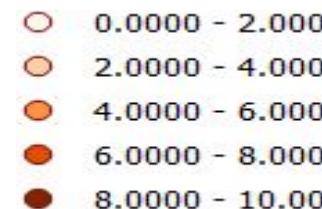
- Single symbol



- Categorized

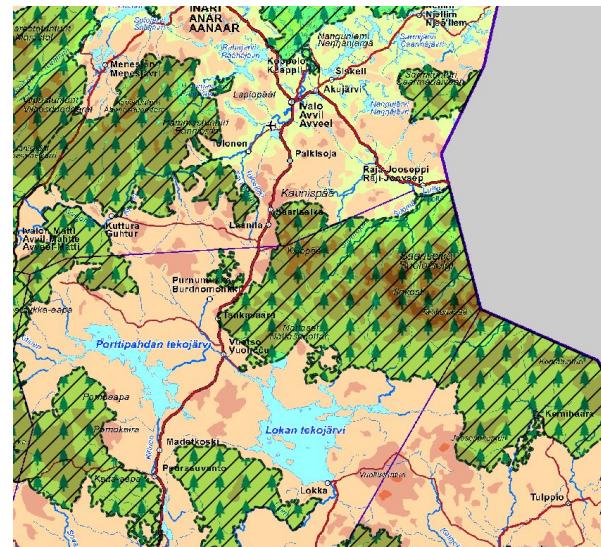


- Graduated



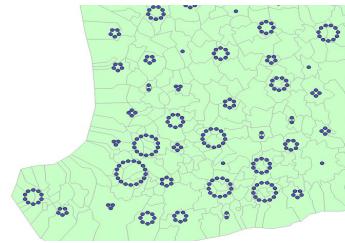
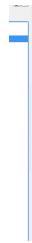
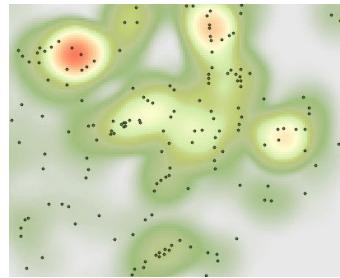
# VECTOR DATA STYLING

- Rule-based styling
- Polygon pattern styling
- Inverted Polygons



# POINT DATA STYLING

- Point displacement
- Heatmaps (overrated)



# DATA-DRIVEN STYLING



## *Travel time from Frankfurt by car*

15 minutes

1 hour

2 hours

3 hours

4 hours

5 hours

Paris

Brussels

The Hague

Amsterdam

Hamburg

Dresden

Prague

Munich

Zürich

Bern

Lyon

Geneva

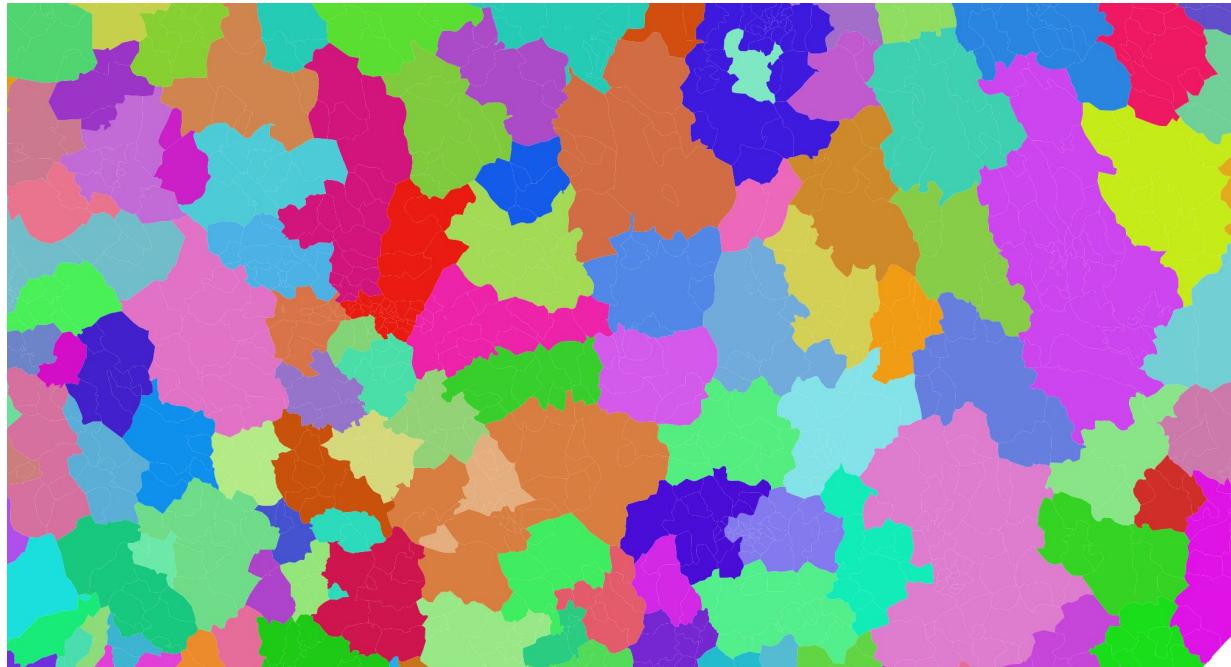
200 km

0 100

By @tmkanov  
Data: HERE

# CLASSIFYING

- Human working memory can distinguish 5-6 classes at a time



# NOMINAL AND ORDINAL INFORMATION

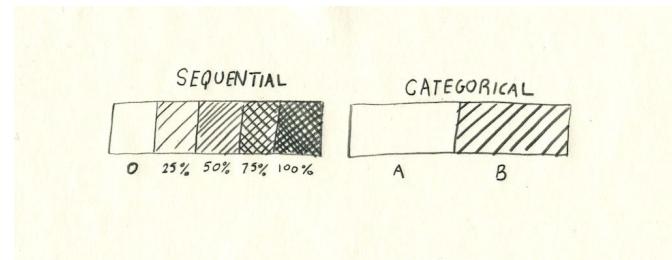
Nominal (lat. "nomen" = name):

- Classes somewhat equal
- Landuse, area types, districts

Ordinal (lat. "ordo" = prder):

- Clear order or relationship
- Heat, population

**Note:** Quantitative & qualitative → Quantitative always ordinal, but ordinal not always quantitative (e.g. level of education)

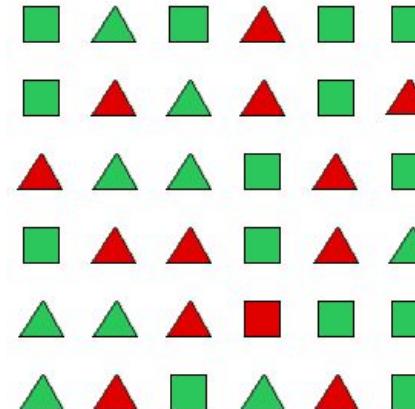


# VISUAL HIERARCHY

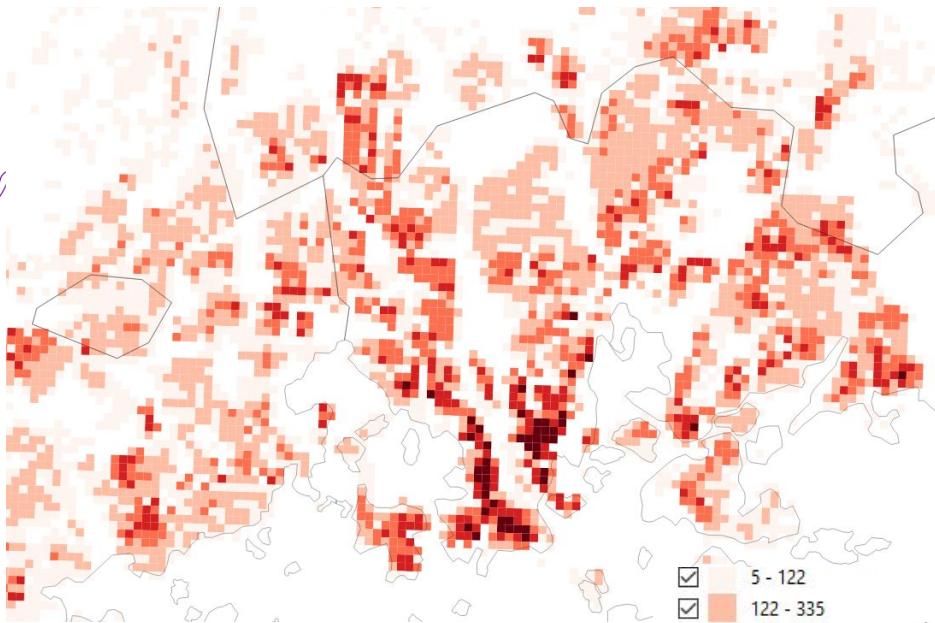
- Dark colors are seen before lighter colors
  - Dark colors seem “larger”
- Shape and size (+ movement) are easiest to distinguish
  -

## Symbol types

- Make it easier to group



# CLASSIFICATION AND LABELS

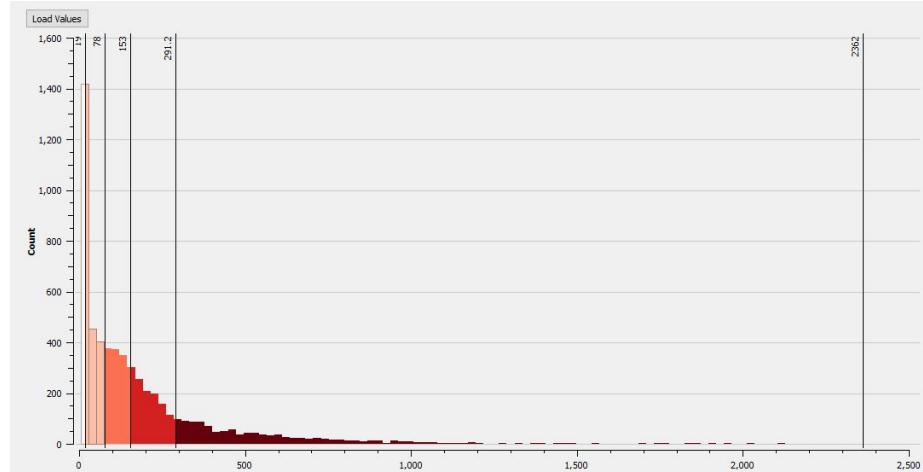
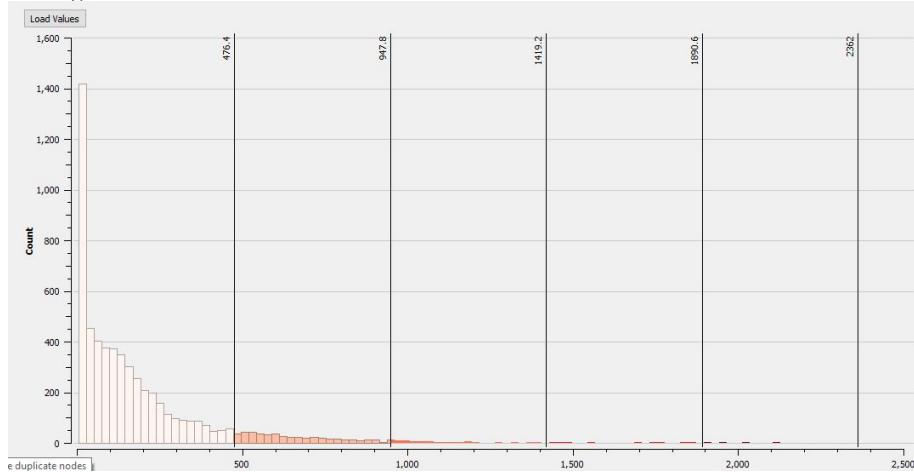


- 5 - 122
- 122 - 335
- 335 - 671
- 671 - 1287
- 1287 - 2362

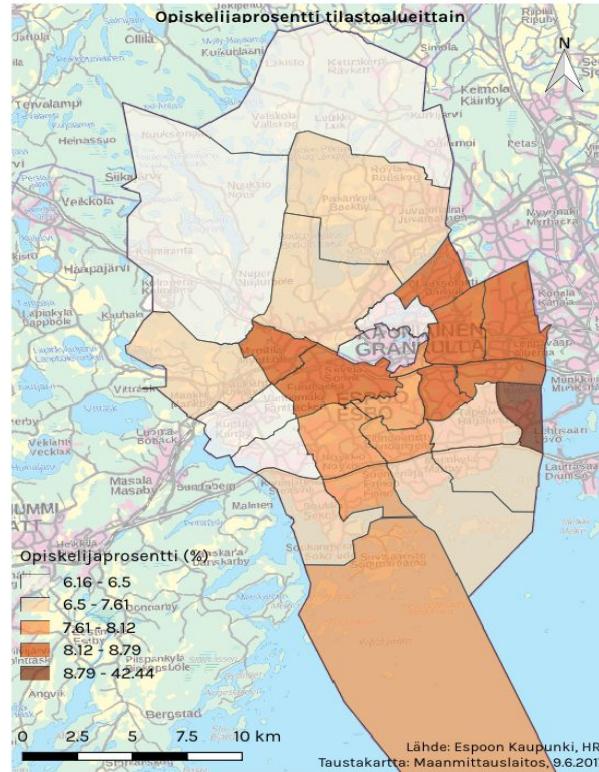
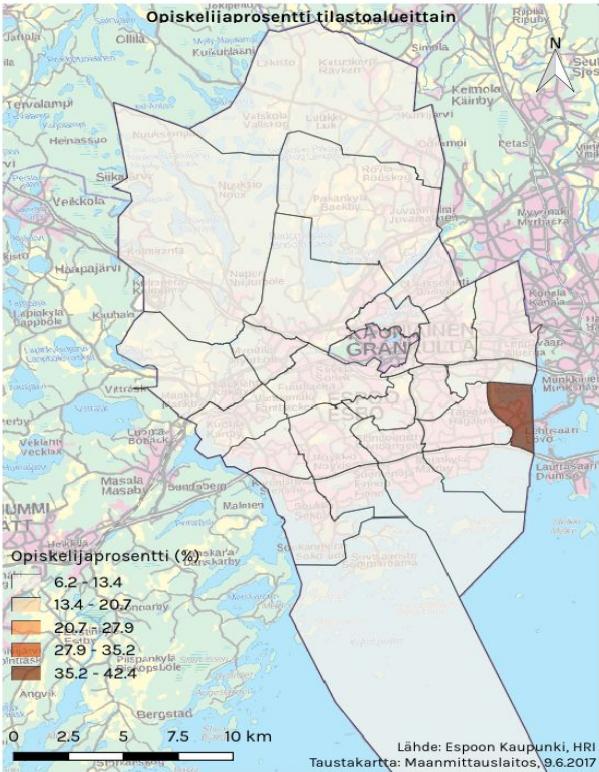


# CLASSIFICATION

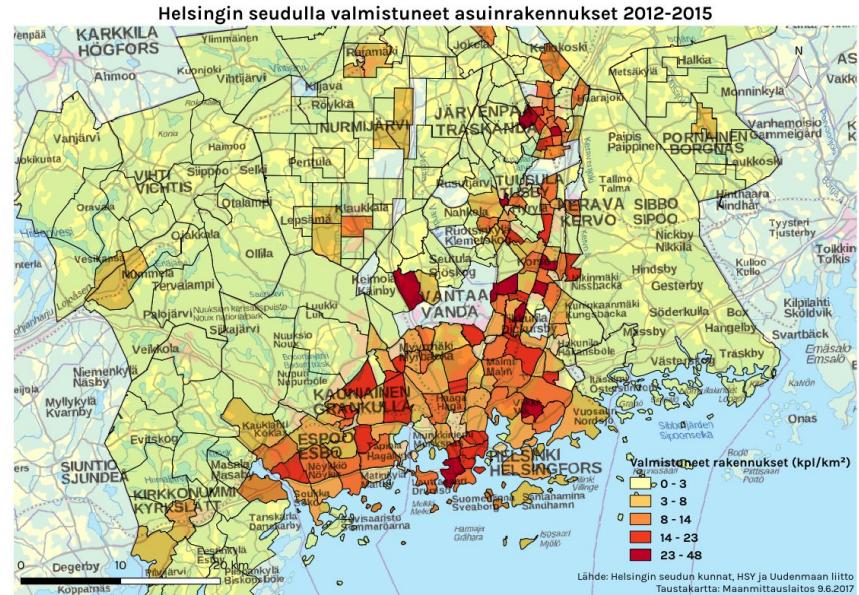
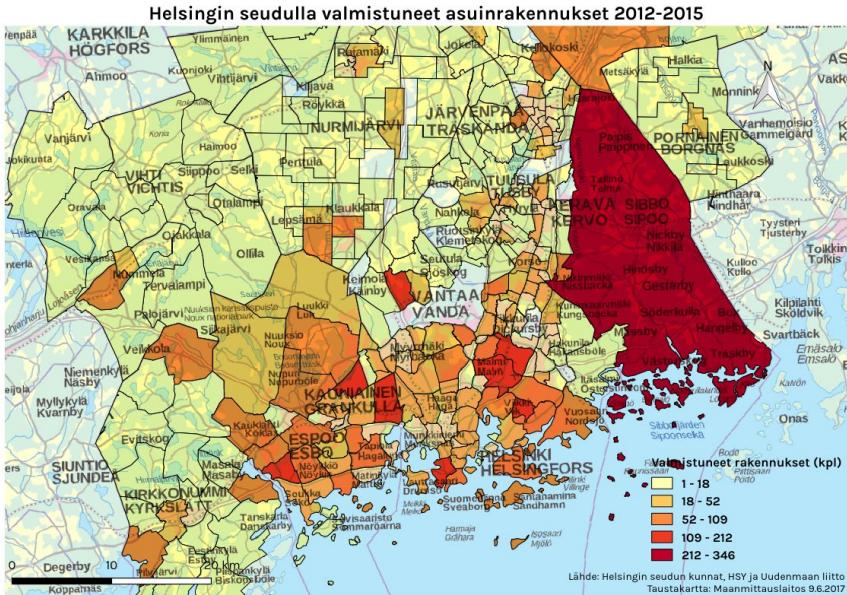
- **Choropleth map** present the values of a single measurable attribute divided in classes
- Number of classes, classification method, and selected colours have a huge effect on a final map



# CLASSIFICATION METHOD

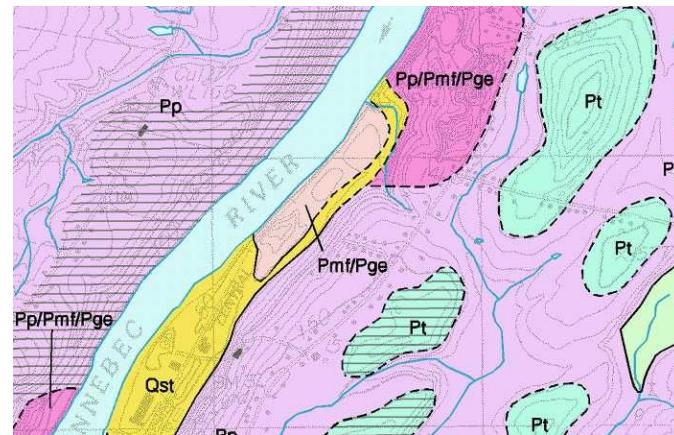
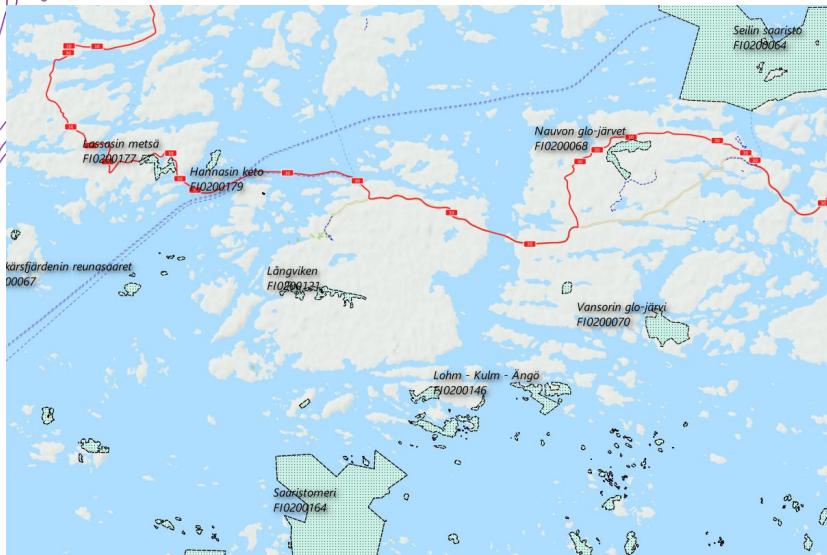


# NORMALIZATION: ABSOLUTE VALUE, PERCENTAGE, OR DENSITY?



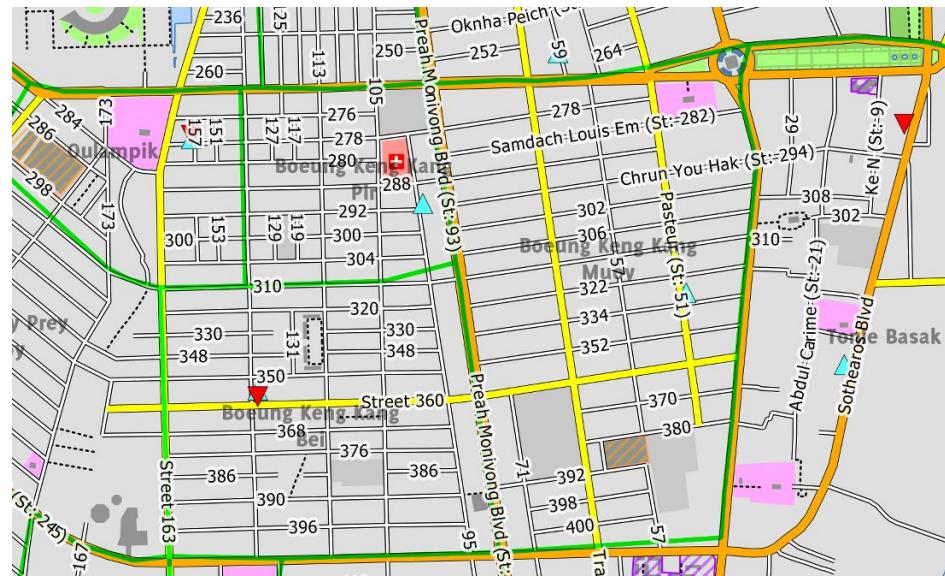
# LABELING GEOGRAPHIC INFORMATION

- Any information from the attribute table can be used as label
- Points, lines, and polygons can all be labeled



# LABELING TOOLS

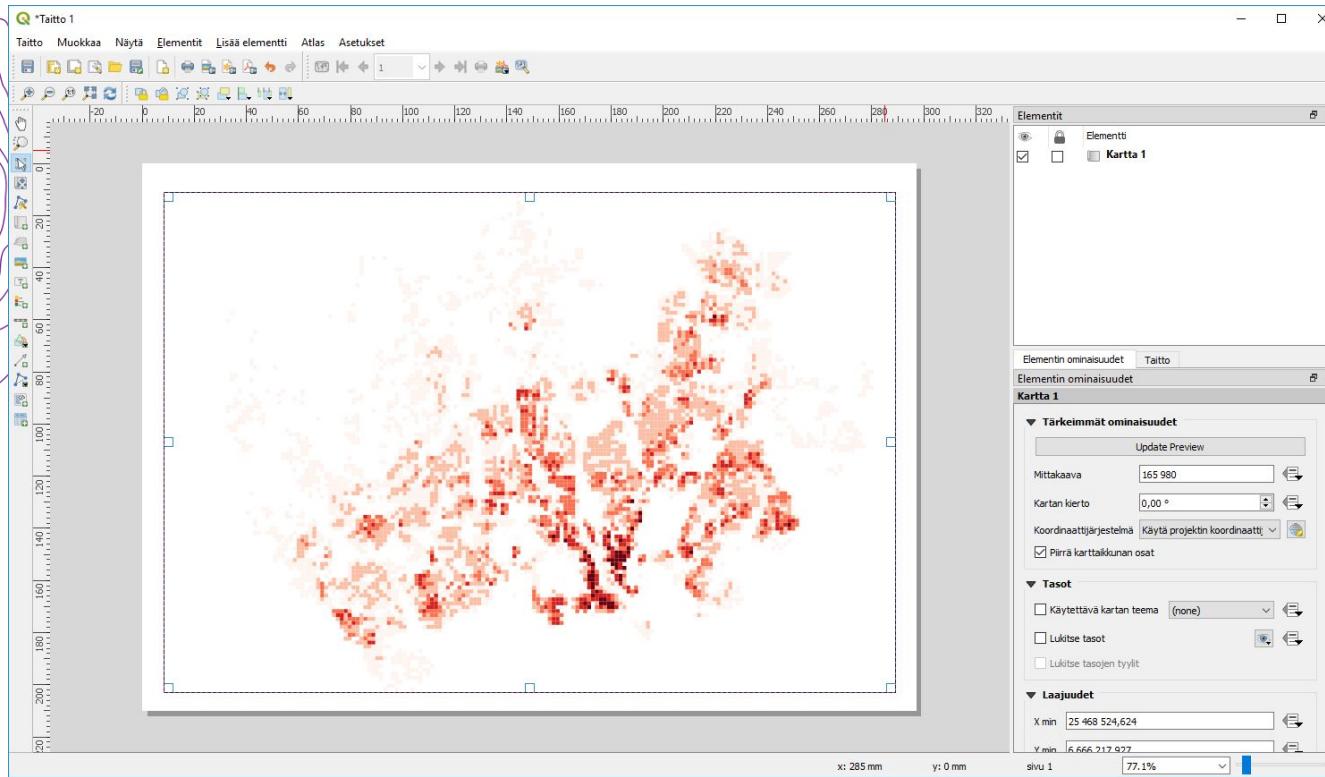
- Font, size, colour etc.
  - Combining information from different columns
  - Scale-dependent visibility
  - Background, shadow, and buffer
  - Placement





# MAKING A MAP - THE CORRECT WAY

# QGIS PRINT LAYOUT



MAPS  
DON'T  
NEED  
NORTH  
ARROWS



GISPO



## TASK 2: THEMATIC MAP



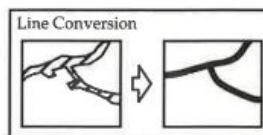
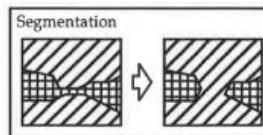
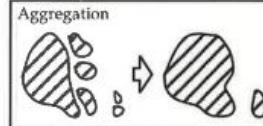
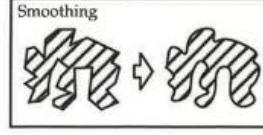
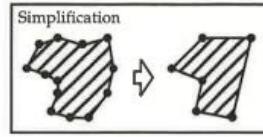
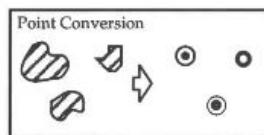
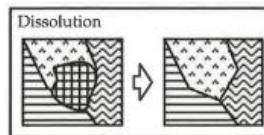
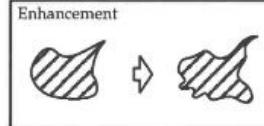
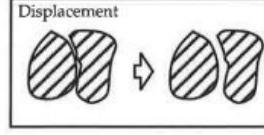
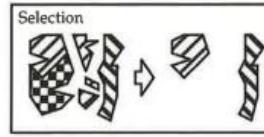
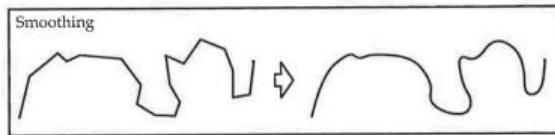
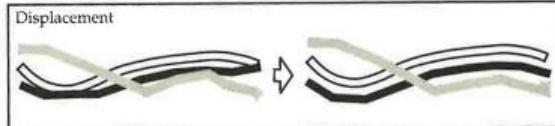
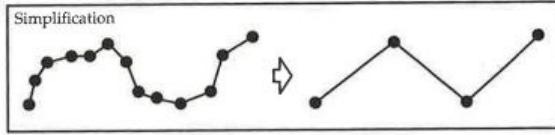
# **LESSON 3: JOINING DATA & SPATIAL ANALYSIS**



# GEOSPATIAL ANALYSIS - A FEW EXAMPLES

- Interpolation
- Buffers
- Intersection
- Vector to raster - raster to vector

# SIMPLIFYING OPERATIONS



GISPO

FIGURE 3.1. Elementary geometric operations in the generalization of line features.

FIGURE 3.3. Elementary geometric operations in the generalization of area features.

Mark  
Monmonier:  
*How to Lie with  
Maps*

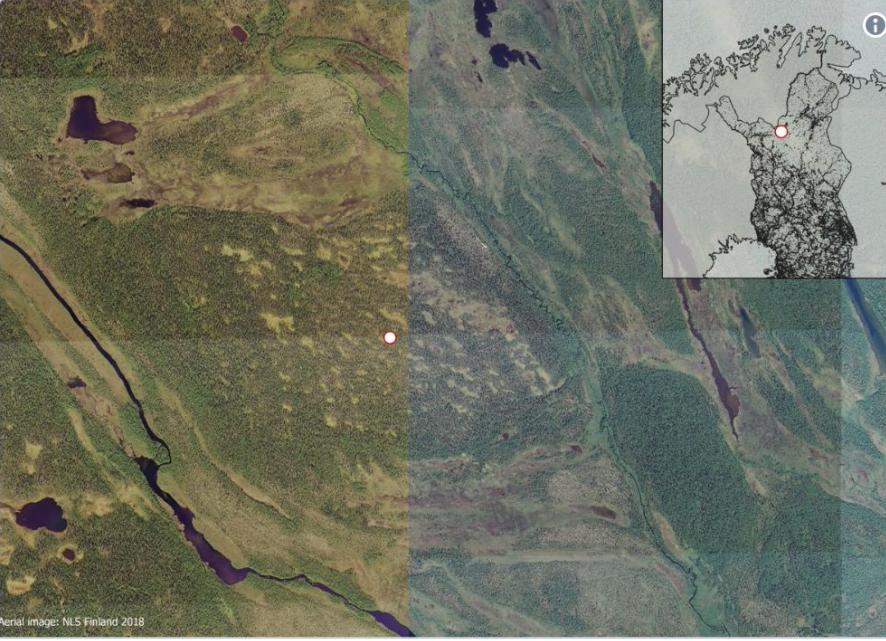


# WHY SIMPLIFY?

- Simplifying is always there
- More detailed data → more disk space
- Simplified maps are easier to read
- Classifying data is also simplifying



# TASK 3: ANALYZE DATA



**Topi Tjukanov**  
@tjukanov



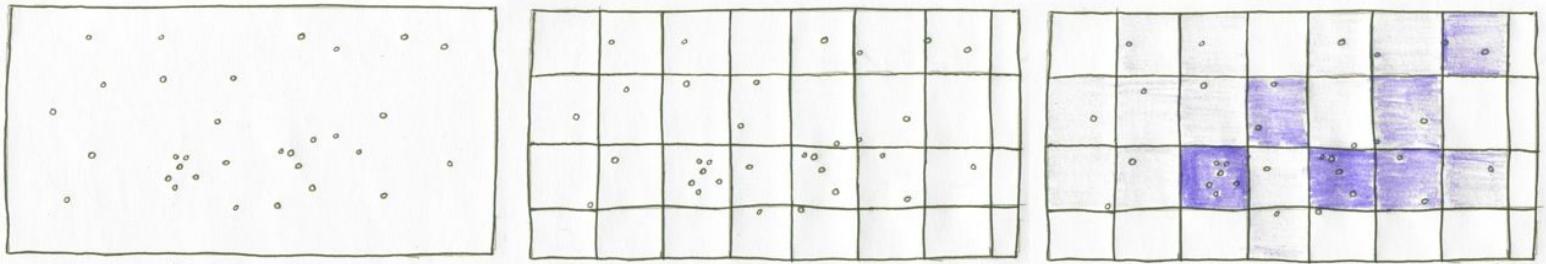
This is the most isolated point (25.3838, 68.4960) in Finland. It is 14,1 kilometers from the closest building and located in the Lemmenjoki National Park.

174 8:16 PM - Jul 8, 2018

52 people are talking about this



# AGGREGATING DATA



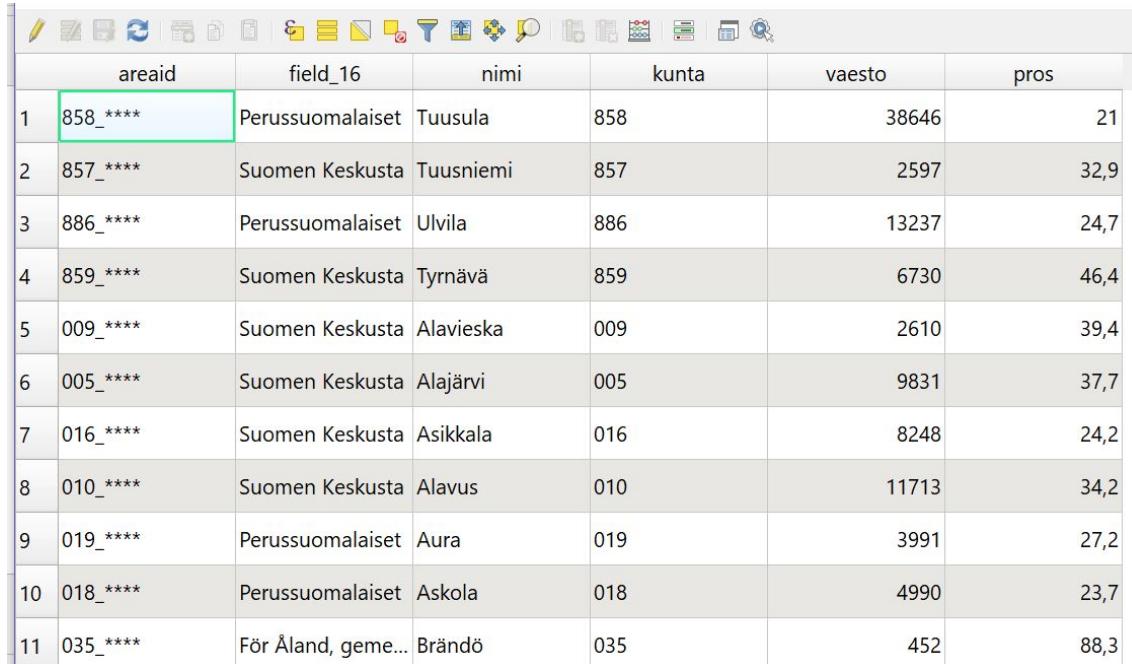
<https://tjukanovt.github.io/webmap/cottages>



# JOINING DATA

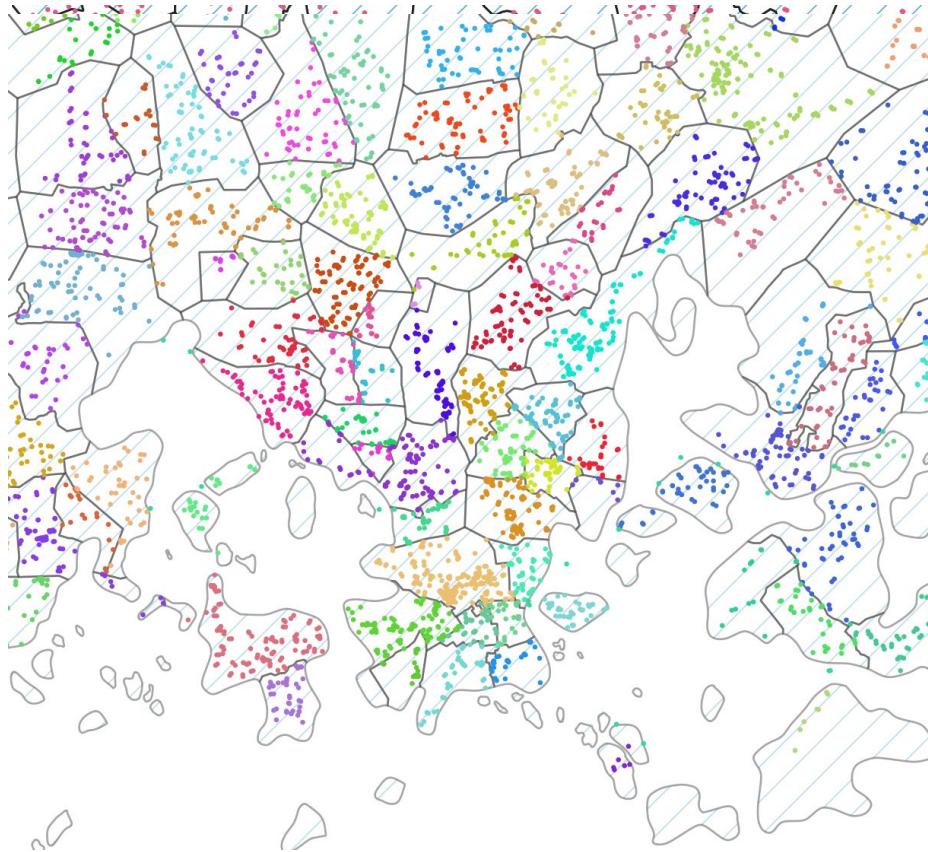
- Ability to join data is one of the **key features** of geospatial analysis
- Join operations allow you to make non-spatial data **spatial**

# TABULAR JOIN



	areaid	field_16	nimi	kunta	vaesto	pros
1	858_****	Perussuomalaiset	Tuusula	858	38646	21
2	857_****	Suomen Keskusta	Tuusniemi	857	2597	32,9
3	886_****	Perussuomalaiset	Ulvila	886	13237	24,7
4	859_****	Suomen Keskusta	Tyrnävä	859	6730	46,4
5	009_****	Suomen Keskusta	Alavieska	009	2610	39,4
6	005_****	Suomen Keskusta	Alajärvi	005	9831	37,7
7	016_****	Suomen Keskusta	Asikkala	016	8248	24,2
8	010_****	Suomen Keskusta	Alavus	010	11713	34,2
9	019_****	Perussuomalaiset	Aura	019	3991	27,2
10	018_****	Perussuomalaiset	Askola	018	4990	23,7
11	035_****	För Åland, geme...	Brändö	035	452	88,3

# SPATIAL JOIN





## **TASK 4: JOIN DATA**



# LESSON 4: *ADVANCED* VISUALIZATIONS + QGIS PLUGINS

GISPO



# QGIS PLUGINS

GISPO

# TIME MANAGER AND GEOSPATIAL ANIMATIONS

## Geogiffery in a nutshell—introduction to QGIS Time Manager



Topi Tjukanov

Dec 26, 2017 · 10 min read

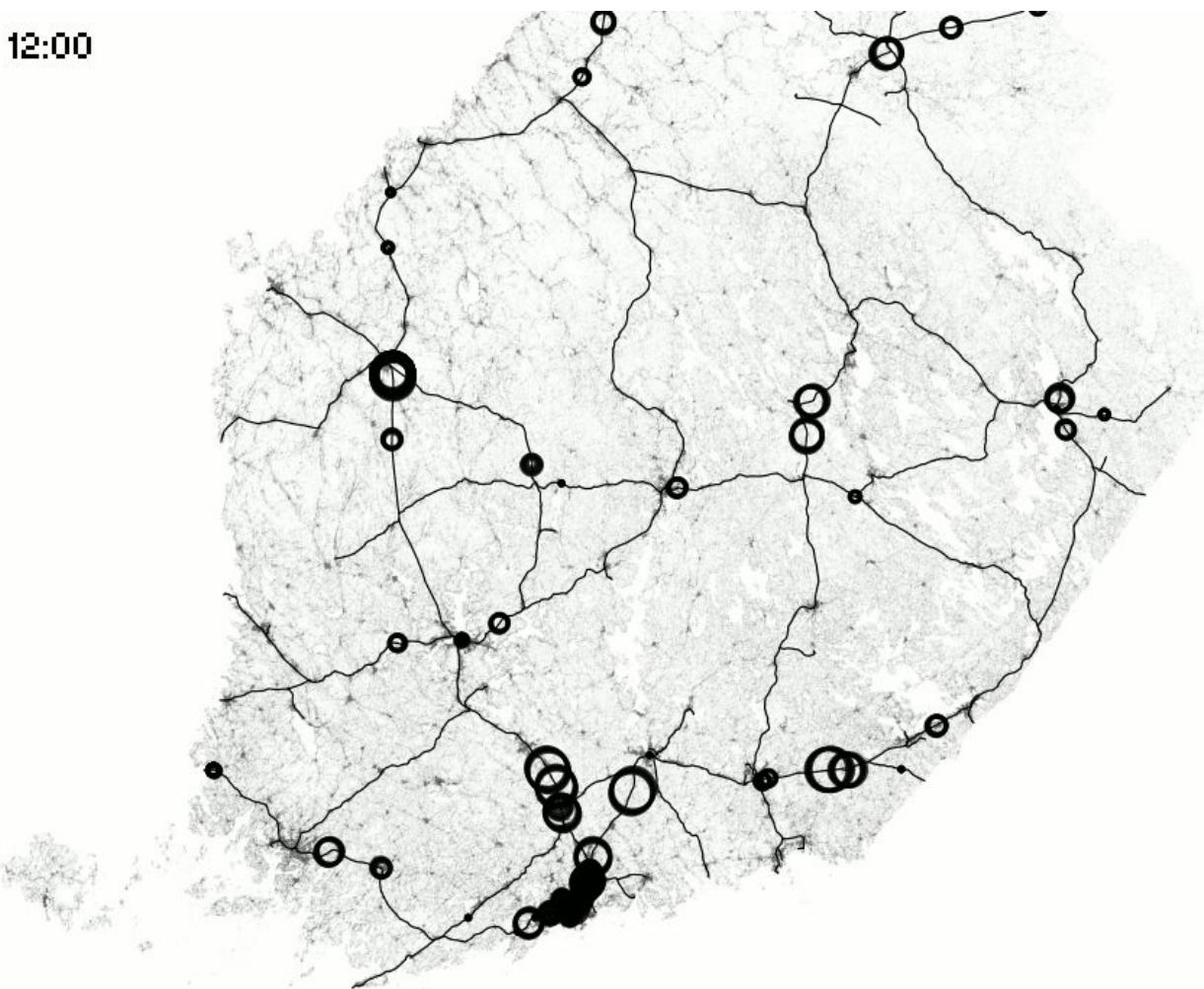
284



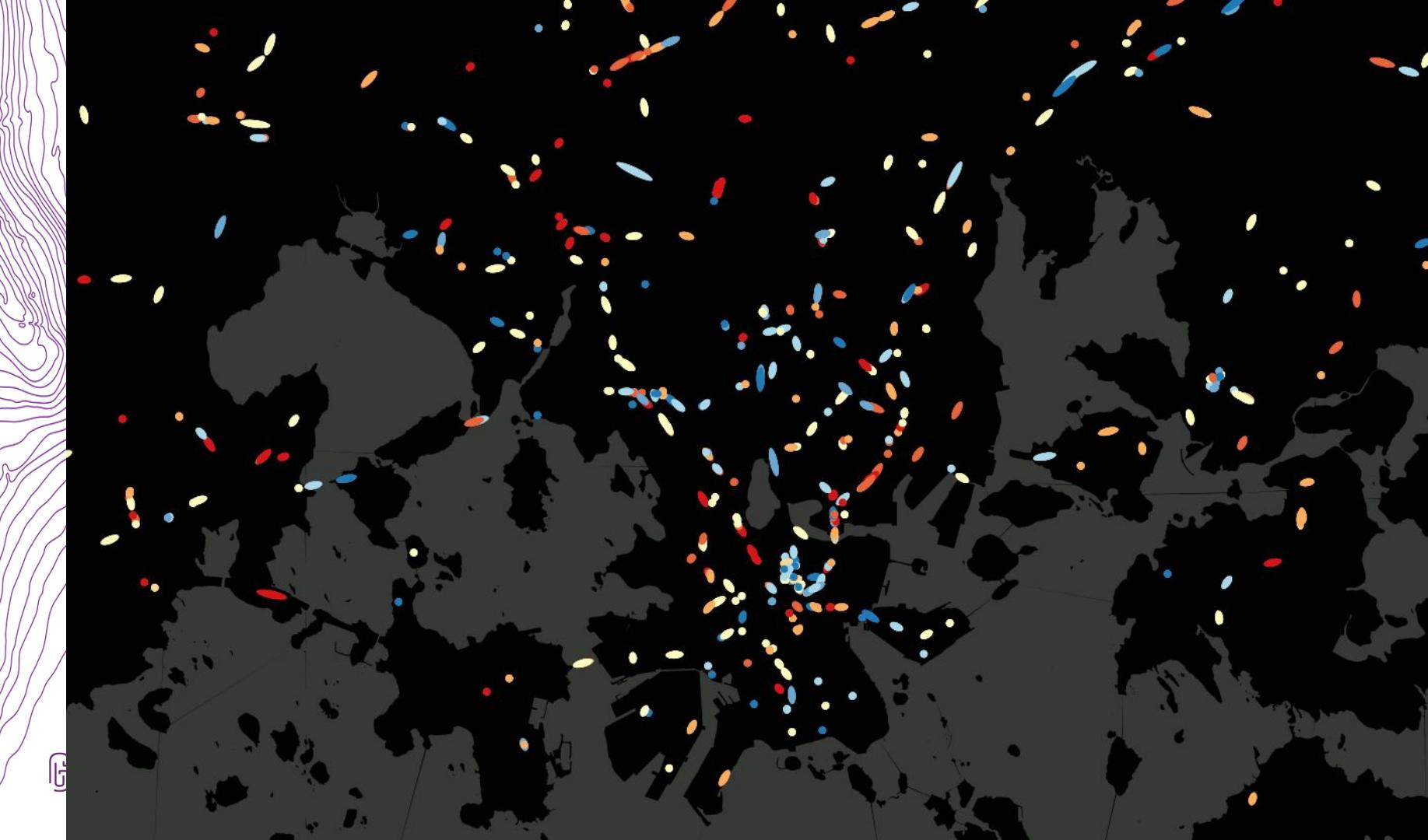
*Geography + animated gifs =geogiffery*

I have been posting a looooot of map animated maps lately on Twitter and quite often people ask me how can they make their own animations. I bet there are lot of ways to achieve similar results, but I am using QGIS + Time Manager plugin. I wanted to make a simple tutorial for beginners on how to get in to the fascinating world of geogiffery. As far as I know, the word *geogiffery* was first introduced to mankind by the great geogifferer [Alasdair Rae](#).

12:00



GISPO





# **TASK 5: MOVING DATA**



# CHARTS AND DIAGRAMS

- QGIS can produce charts and diagrams in multiple ways
- Data plotly plugin

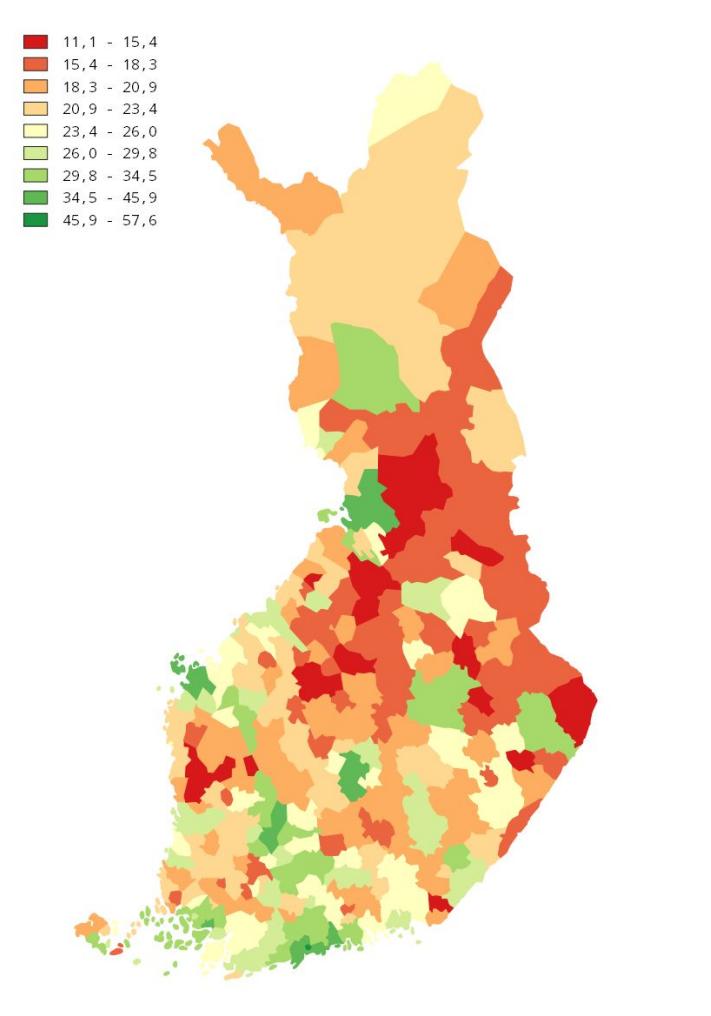


# CARTOGRAMS

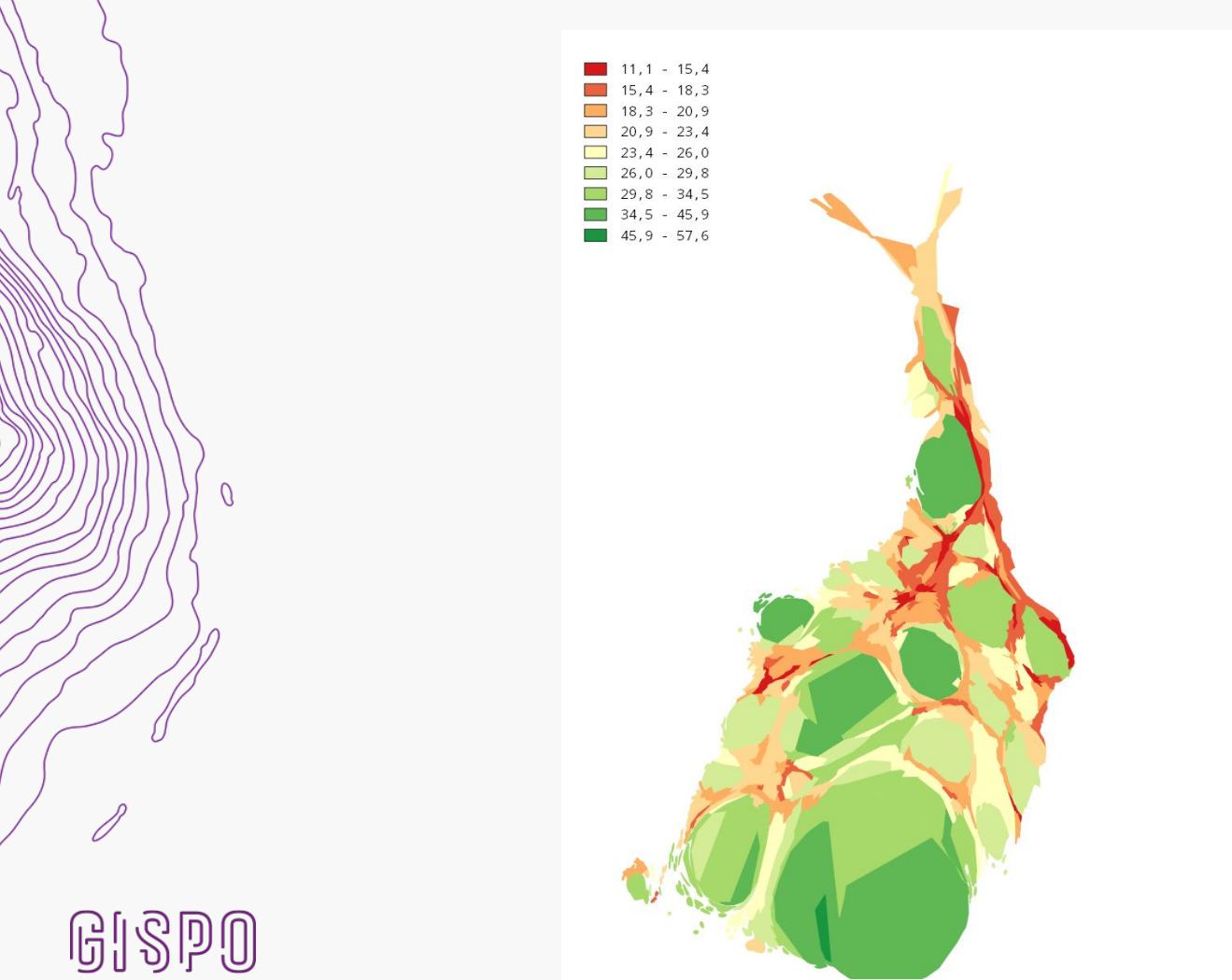
- A map where a variable is substituted for land area or distance
  - Might be a good option to visualize very different areas on a choropleth map
  - Relatively complex to compute
- Are **rarely** a good choice when it comes to visualization



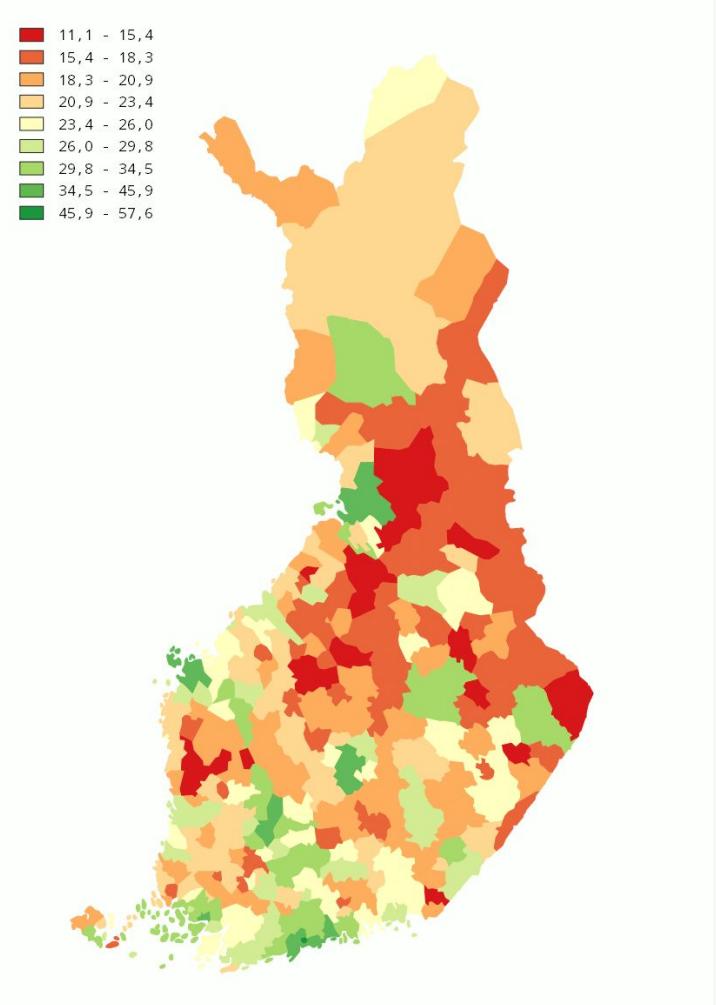
GISPO



Data: Tilastokeskus & THL



GISPO



- 11,1 - 15,4
- 15,4 - 18,3
- 18,3 - 20,9
- 20,9 - 23,4
- 23,4 - 26,0
- 26,0 - 29,8
- 29,8 - 34,5
- 34,5 - 45,9
- 45,9 - 57,6

GISPO

Data: Tilastokeskus & THL

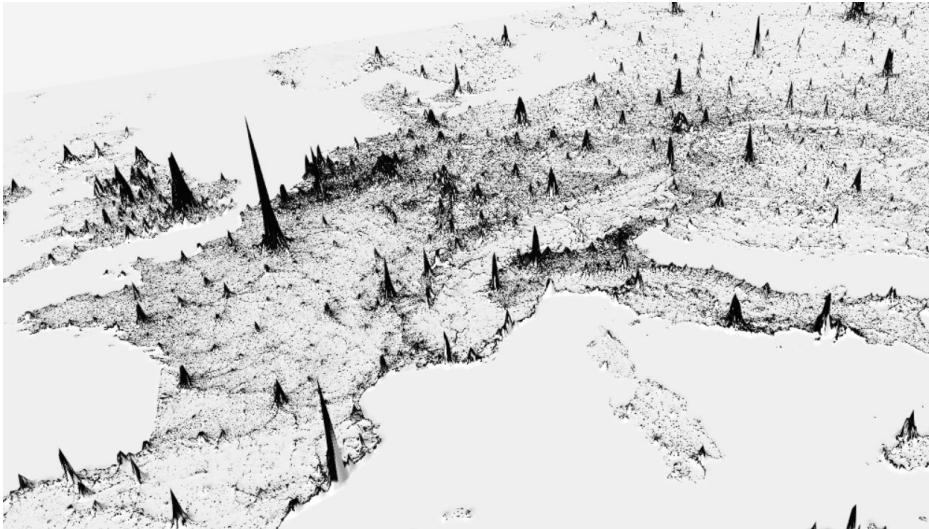


# **TASK 6: CARTOGRAM**



# **LESSON 5:** **INTEGRATING QGIS IN** **TO YOUR WORKFLOW**

# INTERACTIVE VISUALIZATIONS WITH QGIS



<https://tjukanovt.github.io/alpit>  
<https://tjukanovt.github.io/webmap/cottages>  
<https://tjukanovt.github.io/ghspop>



# IMPORT/EXPORT DATA

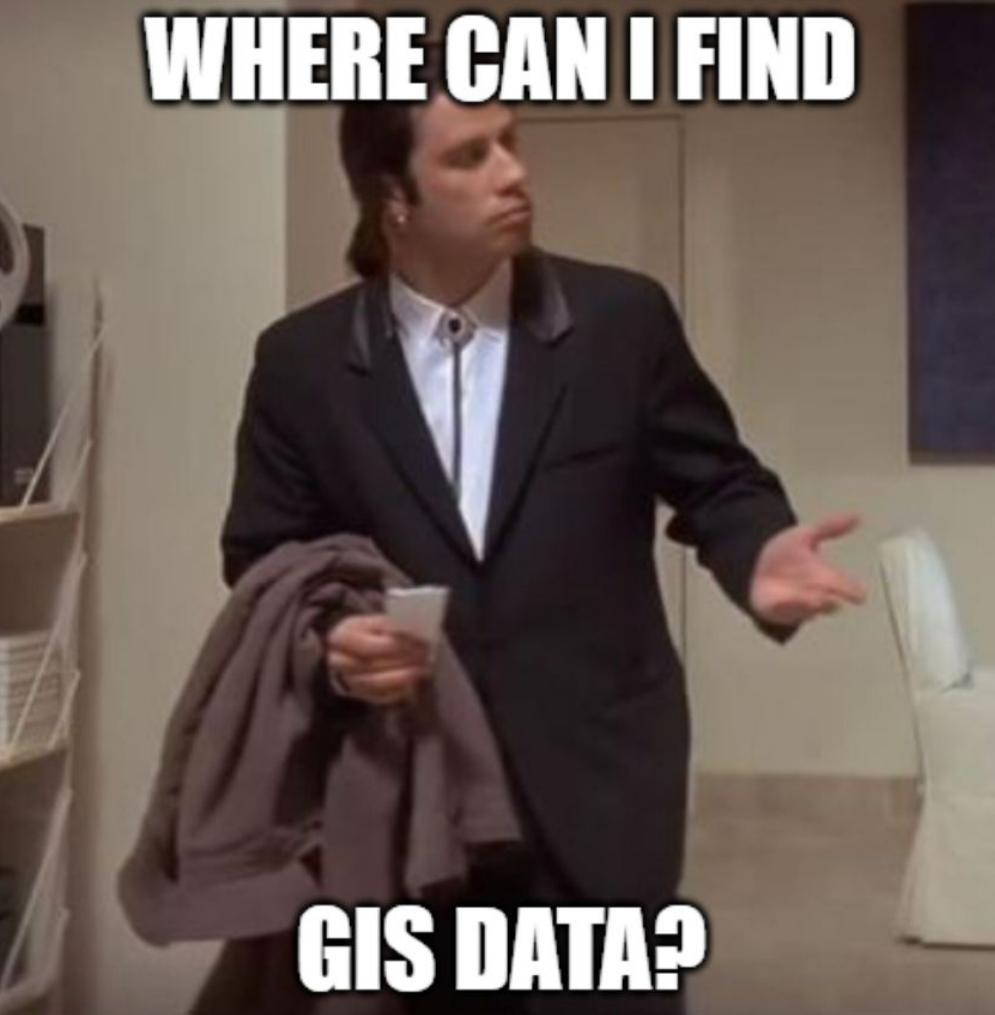
- QGIS doesn't need to be the endpoint of your workflow
- The universe doesn't need handcrafted “reprojection engines”
  - QGIS has all the basic stuff ready for you!
- QGIS can export e.g.
  - SVG, csv, GeoJSON

## GDAL Raster Formats

Long Format Name
<a href="#">Arc/Info ASCII Grid</a>
<a href="#">ACE2</a>
<a href="#">ADRG/ARC Digitized Raster Graphics (.gen/.thf)</a>
<a href="#">Arc/Info Binary Grid (.adf)</a>
<a href="#">AIRSAR Polarimetric</a>
<a href="#">Azavea Raster Grid</a>
<a href="#">Magellan BLX Topo (.blk, .xlb)</a>
<a href="#">Bathymetry Attributed Grid (.bag)</a>
<a href="#">Microsoft Windows Device Independent Bitmap (.bmp)</a>
<a href="#">BPG (Better Portable Graphics)</a>
<a href="#">BSB Nautical Chart Format (.kap)</a>
<a href="#">VTP Binary Terrain Format (.bt)</a>
<a href="#">CALS Type I</a>
<a href="#">CEOS (Spot for instance)</a>
<a href="#">DRDC COASp SAR Processor Raster</a>
<a href="#">TerraSAR-X Complex SAR Data Product</a>
<a href="#">Convair PolGASP data</a>
<a href="#">USGS LULC Composite Theme Grid</a>
<a href="#">DB2</a>
<a href="#">DirectDraw Surface</a>
<a href="#">Spot DIMAP (metadata.dim)</a>
<a href="#">ELAS DIPEX</a>
<a href="#">DODS / OPeNDAP</a>
<a href="#">First Generation USGS DOO (.doq)</a>
<a href="#">New Labelled USGS DOO (.doq)</a>
<a href="#">Military Elevation Data (.dt0, .dt1, .dt2)</a>
<a href="#">Arc/Info Export E00 GRID</a>
<a href="#">FCRG Table Of Contents (TOC.xml)</a>
<a href="#">ERDAS Compressed Wavelets (.ecw)</a>
<a href="#">ESRI .hdr Labelled</a>
<a href="#">Erdas Imagine Raw</a>

## OGR Vector Formats

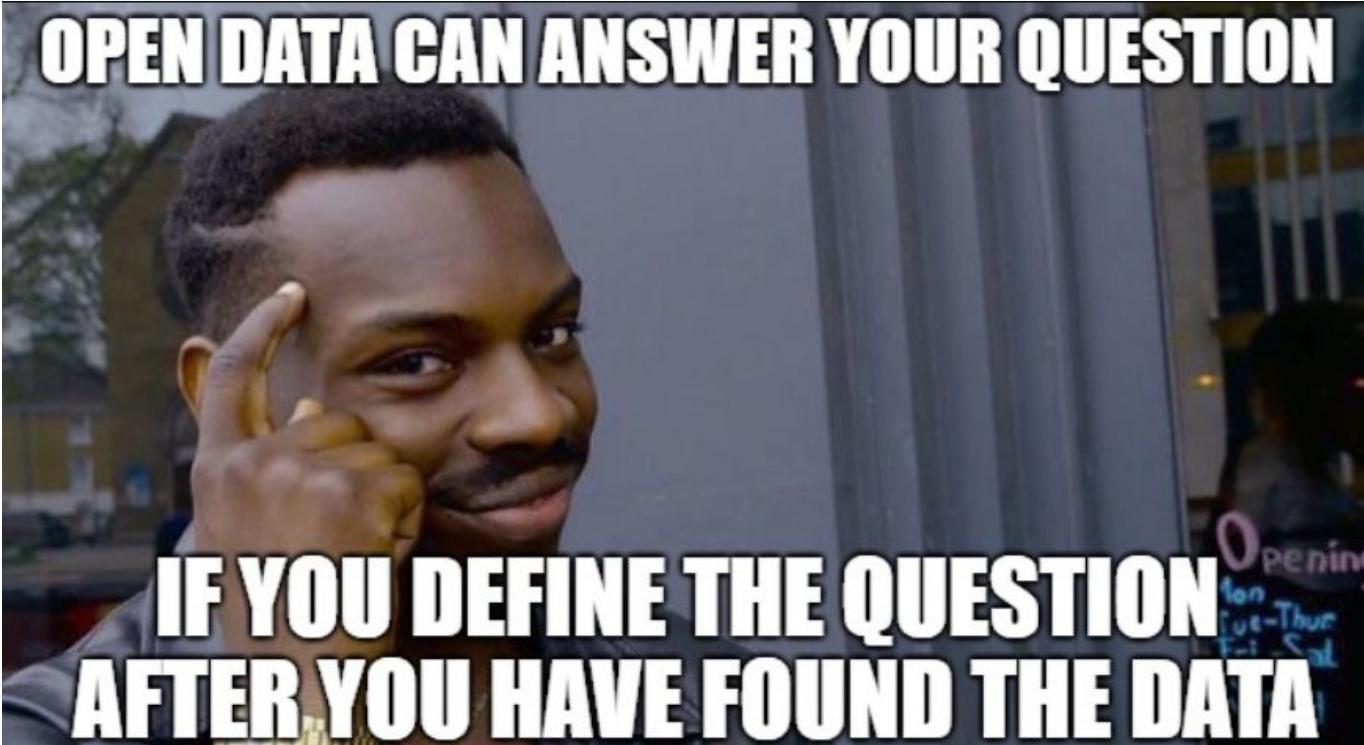
Format Name
<a href="#">Aeronav FAA files</a>
<a href="#">AmigoCloud API</a>
<a href="#">ESRI ArcObjects</a>
<a href="#">Arc/Info Binary Coverage</a>
<a href="#">Arc/Info_E00 (ASCII) Coverage</a>
<a href="#">Arc/Info Generate</a>
<a href="#">Atlas BNA</a>
<a href="#">AutoCAD DWG</a>
<a href="#">AutoCAD DXF</a>
<a href="#">CartoDB</a>
<a href="#">Cloudant / CouchDB</a>
<a href="#">CouchDB / GeoCouch</a>
<a href="#">Comma Separated Value (.csv)</a>
<a href="#">OGC CSW (Catalog Service for the Web)</a>
<a href="#">Czech Cadastral Exchange Data Format</a>
<a href="#">DB2 Spatial</a>
<a href="#">DODS/OPeNDAP</a>
<a href="#">EDIGEO</a>
<a href="#">ElasticSearch</a>
<a href="#">ESRI FileGDB</a>
<a href="#">ESRI Personal GeoDatabase</a>
<a href="#">ESRI ArcSDE</a>
<a href="#">ESRI Shapefile / DBF</a>
<a href="#">FMEObjects Gateway</a>
<a href="#">GeoJSON</a>
<a href="#">Géoconcept Export</a>
<a href="#">Geomedia .mdb</a>
<a href="#">GeoPackage</a>
<a href="#">GeoRSS</a>
<a href="#">Google Fusion Tables</a>
<a href="#">GML</a>
<a href="#">GMT</a>
<a href="#">GPSPbabel</a>



**WHERE CAN I FIND**

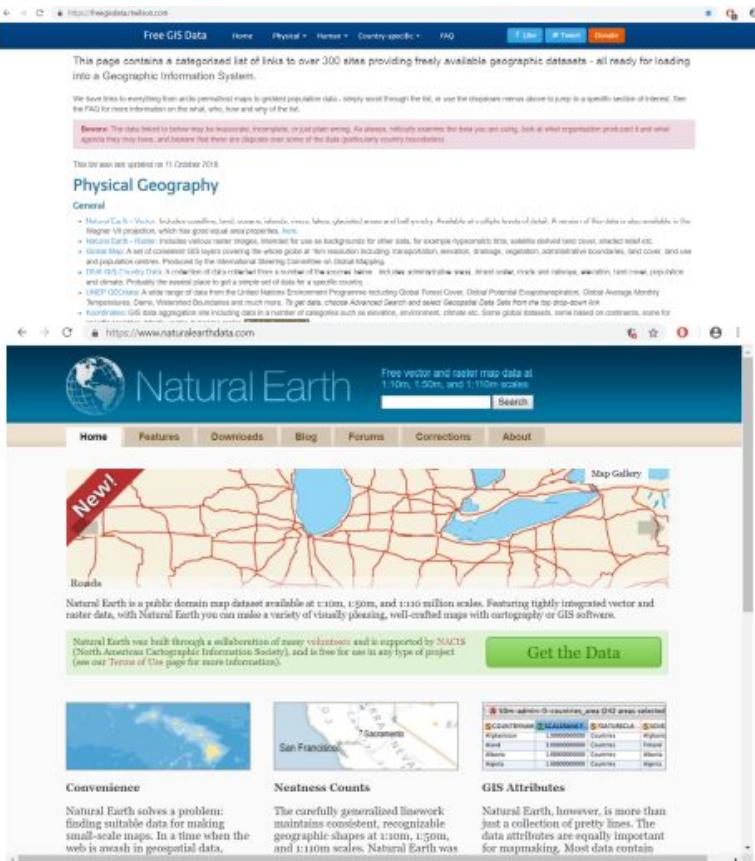
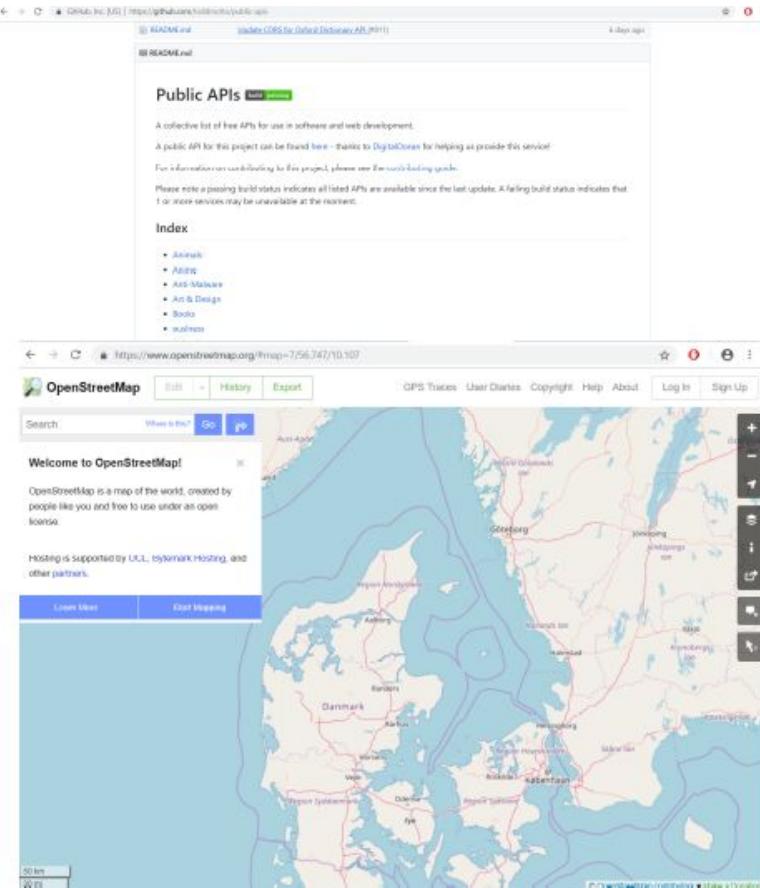
**GIS DATA?**

GISPO



**OPEN DATA CAN ANSWER YOUR QUESTION**

**IF YOU DEFINE THE QUESTION  
AFTER YOU HAVE FOUND THE DATA**



A vertical decorative element on the left side of the slide, consisting of numerous thin, wavy, horizontal purple lines of varying lengths.

# CONCLUSIONS

GISPO



# CONCLUSIONS

- Normalize your data if needed
- Choose the right projection for your data
- Choose the right classification method
- Choose the right colors for your map
- Be creative!



**THANK YOU!**

A.M.A

GISPO