Global, regional and national level spatial data for teaching and research in GIS

Evelyn Uuemaa and Alexander Kmoch
Landscape Geoinformatics Lab, University of Tartu, Estonia
evelyn.uuemaa@ut.ee

@Lgeoinformatics | @evelynuuemaa | @allixender

AGILE Conference, 14 – 17. June, 2022, Vilnius

Mobilitas+
European Union
European Regional Development Fund
Investing in your future
AGILE Association of Geographic Information Laboratories in Europe
MARIE CURIE ACTIONS
HORIZON 2020

BACKGROUND

Curriculums where we teach geoinformatics

- BSc Geography
- MSc Geography, specialisation in geoinformatics and cartography
- MSc Geoinformatics for Urbanised Society
- PhD Geography, specialisation in geoinformatics and cartography
- Micro-degree “Contemporary Geoinformatics”

Courses

- Spatial Data Studio (15 ECTS
- Spatial Analysis (6 ECTS)
- Geospatial Analysis with Python and R (6 ECTS)
- Spatial Data Infrastructure (6 ECTS)
- Spatial Databases (6 ECTS)
- 3D Modelling and Analysis (6ECTS)
- Web Mapping (2 ECTS)

Teaching methods instead of tools

Understanding how the geographic data is created on the field

Spatial data analysis

Geodata processing and data management

How to visualise spatial data

WHAT DATA IS USED?

Local data

Estonian Land Board

Download »

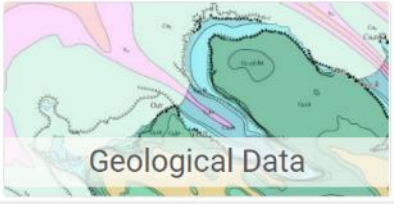
Scale 1:10000

Download »

1:10000, 1:5000, 1:2000

Download »

LIDAR collected elevation points



What enables good uptake?

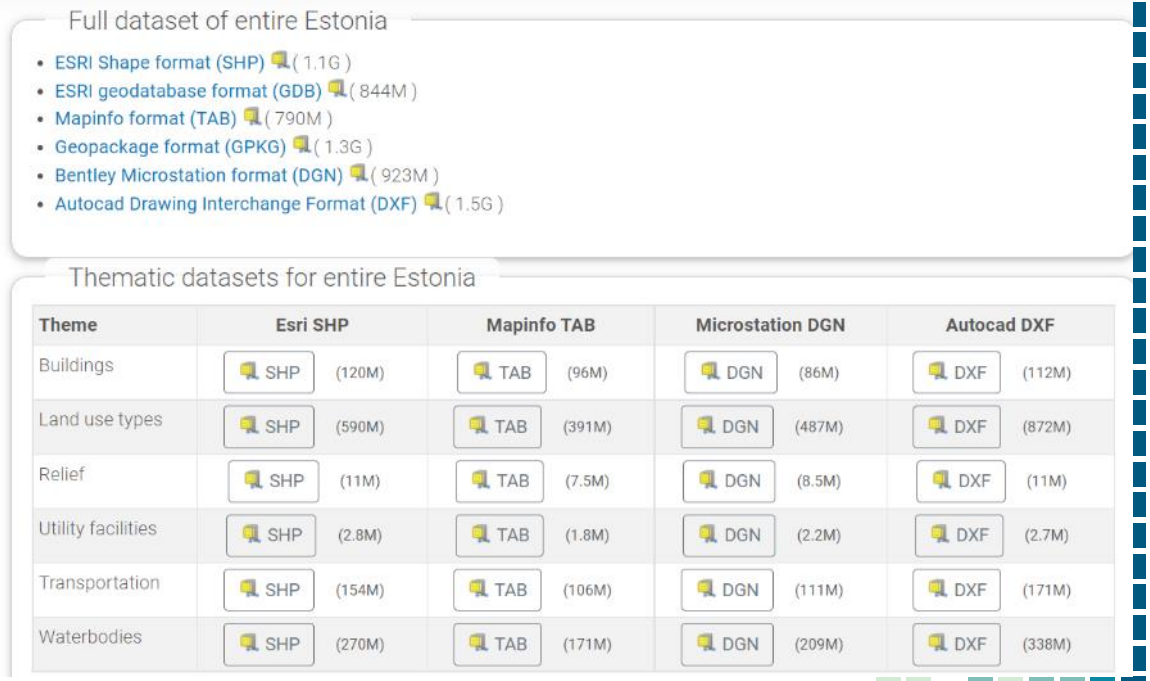
- Very good metadata in Estonian and English

Estonian topographic database
core data layer names, field names, their descriptions and domain values with descriptions

Field names and descriptions not related to specific layer:

etak_id – unique object ID of Estonian topographic database
kood – grouping code (also included into in layer name), for example in case of layer E_101_kivi_p the code domain value is 101 and it's human readable value is boulders)
tyyp – type of the feature (values vary by layer, see below)
kmr_id – ID of national registry of cultural monuments
knr_id – ID of place names register
kkr_kood – ID of Estonian Nature Information System (environment registry objects)
nimetus – name of the object
mps_id – ID of land improvement register
ehr_gid – ID of building register
ads_oid – ID of address data system
ads_lahiaadress – short address (from address data system), without municipality name, ie street name and building number or name of the cadastral parcel or address of traffic surface, administrative or territorial unit

- The data can be downloaded in multiple formats and in different bundles
- The focus should be on open standards



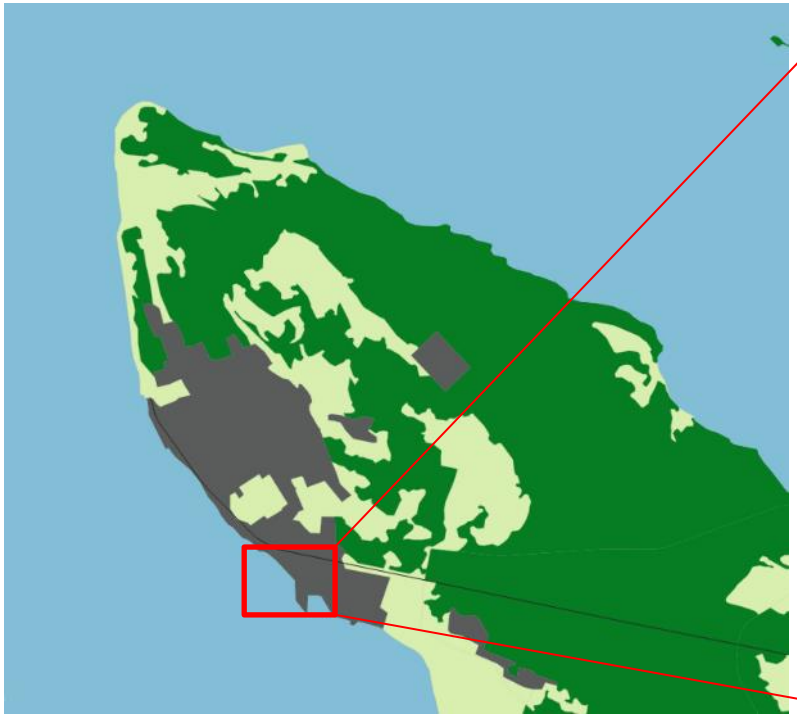
Full dataset of entire Estonia

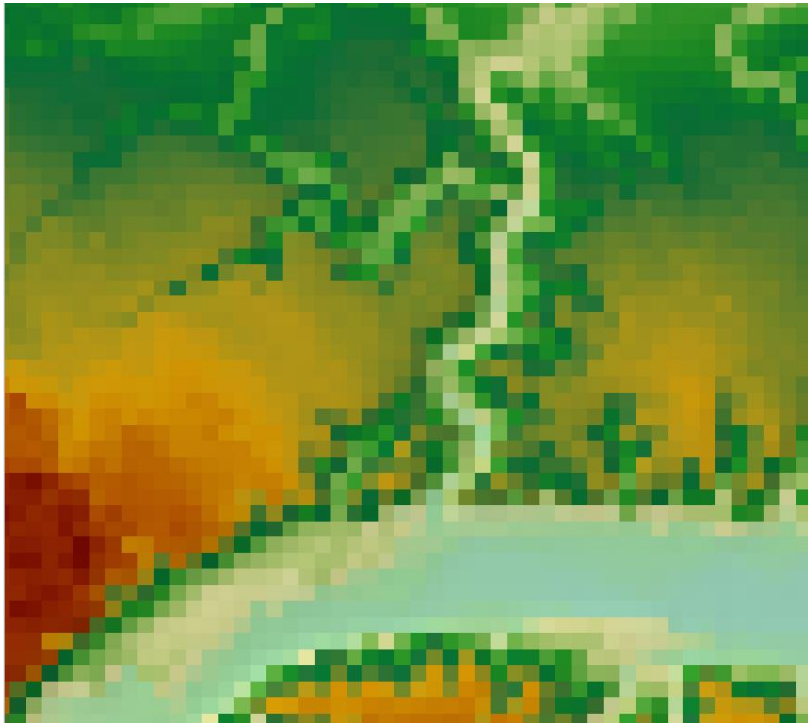
- ESRI Shape format (SHP) (1.1G)
- ESRI geodatabase format (GDB) (844M)
- Mapinfo format (TAB) (790M)
- Geopackage format (GPKG) (1.3G)
- Bentley Microstation format (DGN) (923M)
- Autocad Drawing Interchange Format (DXF) (1.5G)

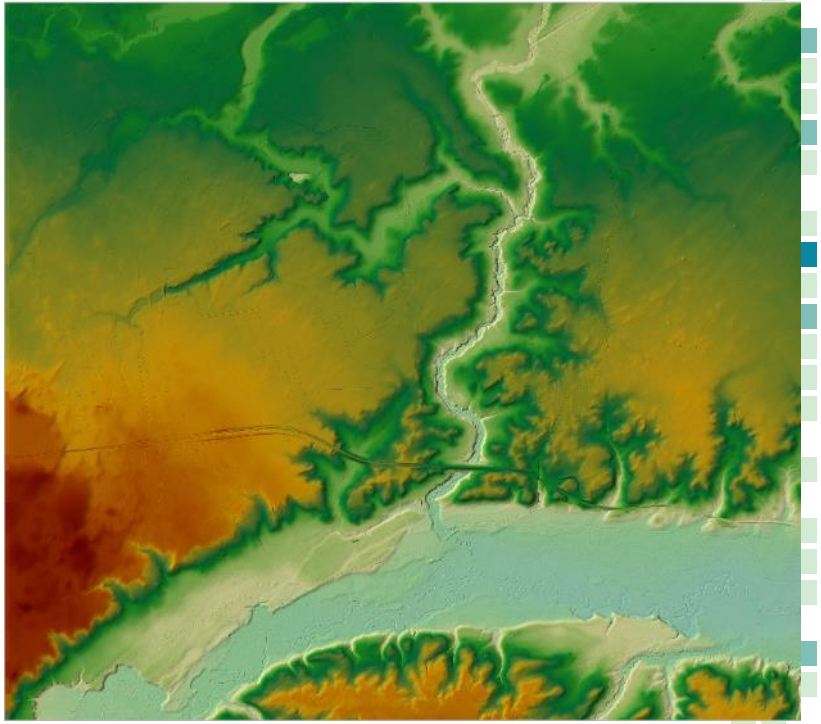
Thematic datasets for entire Estonia

Theme	Esri SHP	Mapinfo TAB	Microstation DGN	Autocad DXF
Buildings	SHP (120M)	TAB (96M)	DGN (86M)	DXF (112M)
Land use types	SHP (590M)	TAB (391M)	DGN (487M)	DXF (872M)
Relief	SHP (11M)	TAB (7.5M)	DGN (8.5M)	DXF (11M)
Utility facilities	SHP (2.8M)	TAB (1.8M)	DGN (2.2M)	DXF (2.7M)
Transportation	SHP (154M)	TAB (106M)	DGN (111M)	DXF (171M)
Waterbodies	SHP (270M)	TAB (171M)	DGN (209M)	DXF (338M)

- Different resolution/scale



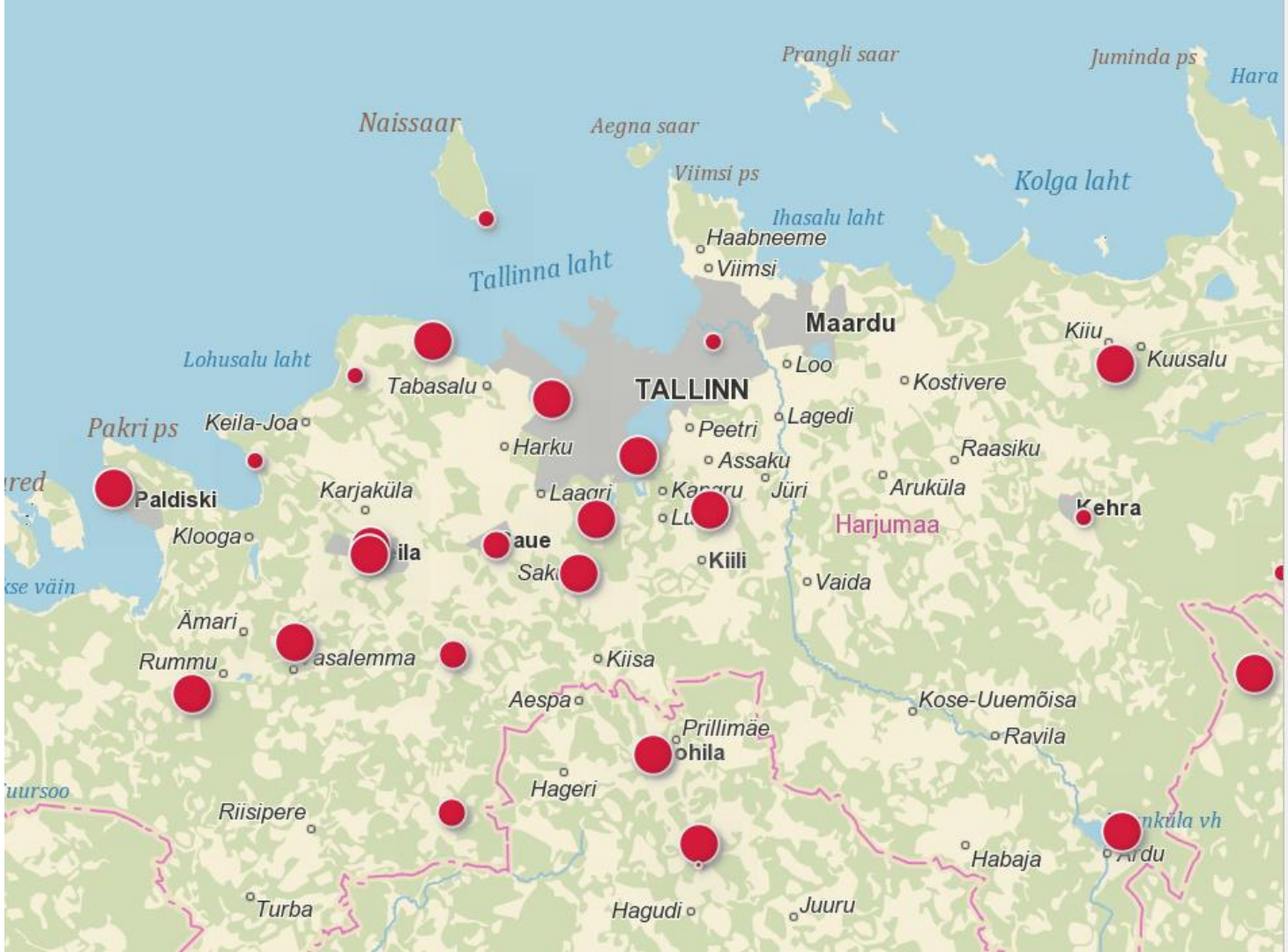




Some considerations

- WFS vs complete data download
- The most up-to-date data vs versioning
- Raster data download is still inconvenient– one possible solution is SpatioTemporal Asset Catalog (STAC)

- For using the WMS as basemap, it is useful to have the possibility to render layers separately


Prangli saar
Juminda ps
Hara
Naissaar
Aegna saar
Viimsi ps
Kolga laht
Ihasalu laht
Haabneeme
Tallinna laht
Viimsi
Maardu
Kiiu
Kuusalu
Lohusalu laht
Loo
Tabasalu
TALLINN
Kostivere
Pakri ps
Keila-Joa
Lagedi
Peetri
Harku
Raasiku
Assaku
Paldiski
Karjaküla
Laagri
Jüri
Aruküla
Kehra
Klooga
Harjumaa
Kiili
Vaida
Ämari
Rummu
Kiisa
Aespa
Kose-Uuemõisa
Prillimäe
Ravila
Hageri
Riisipere
Habaja
Turba
Hagudi
Juuru

EXAMPLES

Viljandi county school network

Viljandi county context

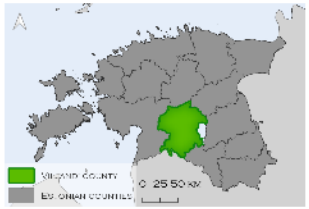


Figure 1. Viljandi location in Estonia

Viljandi county is located in southern mainland Estonia (Figure 1). The county's 3422.5km2 area is home to almost 46 000 people, of who majority are Estonians (95.5%).
Viljandi county consists of 4 municipalities - 3 rural (Mulgi, Põhja-Sakala, Viljandi) and 1 urban - Viljandi city (Statistics Estonia, 2021).

High school 20min service areas and serviced student population

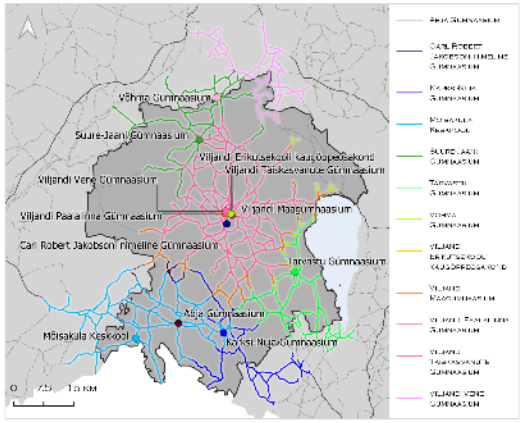


Figure 2. Viljandi high school 20min service areas

Table 1. Student population within Viljandi county high school 20min service areas

School name	Service area population (15-19 old)
Abja Gümnaasium	316
Carl Robert Jakobsoni nimeline Gümnaasium	1524
Karksi-Nuia Gümnaasium	402
Mõisakula Keskkool	270
Suure-Jaani Gümnaasium	1197
Tarvastu Gümnaasium	990
Viljandi Erikutsekooli kaugõppeosakond	1637
Viljandi Maagümnaasium	1644
Viljandi Paalalinna Gümnaasium	1571
Viljandi Täiskasvanute Gümnaasium	1636
Viljandi Vene Gümnaasium	1526
Võhma Gümnaasium	283

To optimise the school network by closing at least one school, Abja Gümnaasium can be identified for potential closure. It has the 3rd the smallest serviced student population with 316 students within 20min service area. While 2 schools have an even small er serviced population, Abja Gümnaasium has the small est proportion of its service area that does is not already covered by the service area of another school.

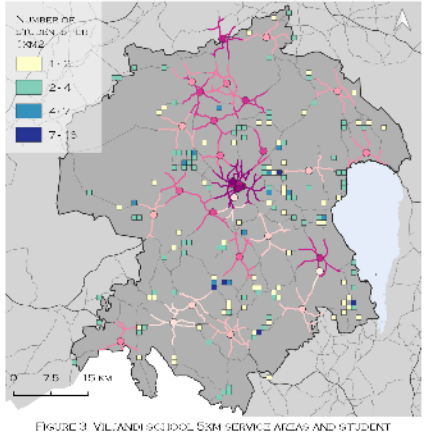


Figure 3. Viljandi school 5km service areas and student population outside service areas

5km service areas of Viljandi county schools

Figure 3 shows there currently are 282 students aged 10-19, who are not within 5km service areas of any schools. 16% of these students are 15-19 years old and 201 are in the 10-15 age range.

This means that middle school accessibility is a more immediate issue, considering that younger students may be more dependent on their guardians in regards to moving longer distances.

The most dense clusters of students outside the 5km service areas is in the southern part of the municipality. There student population density reaches 7.13 students per 1km2 between service areas.

At the same time the most vast areas without service and with existing student population can be found in the central area of the county, close to the largest school cluster.

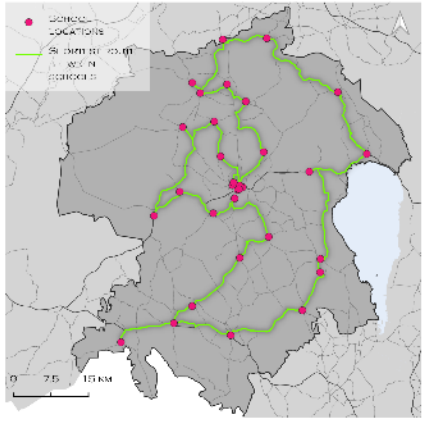


Figure 4. Viljandi school network shortest inspection route

Shortest travel route between all schools

Figure 4 shows the shortest route for a potential inspector visit. The optimal route covering all 33 schools is 535.4km long.

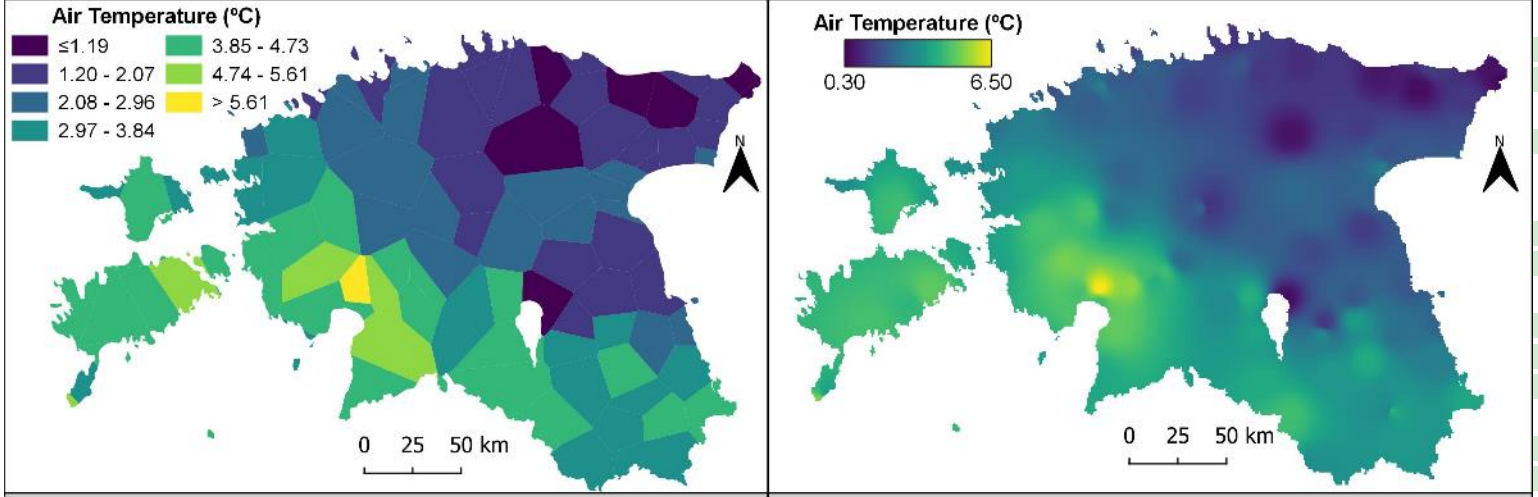
Map data sources:
Estonian Land Board,
Statistics Estonia,
Subset of "Education and schools of Estonia"

Text references:
Statistics Estonia (2021). Statistical database [Population]. [Online]. Statistics Estonia. Available at: http://andmebaas.stat.ee/?lang=en [Accessed 15 Dec. 2021].

Author: Antal Rozenvalds

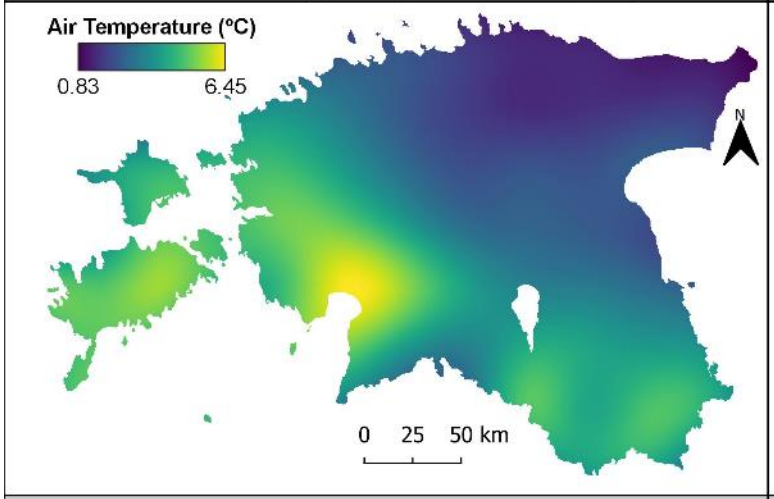
ORCID 0000-0002-4586-0380

Software: QGIS 3.16.10

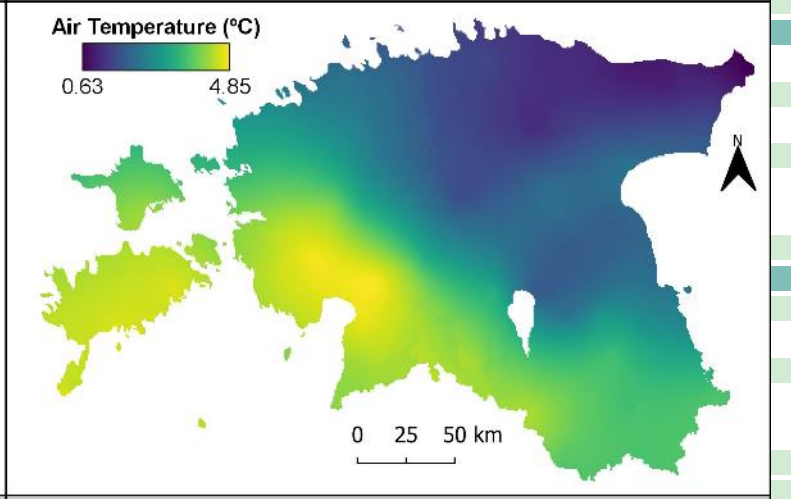


Thiessen polygons (Voronoi Diagram)

IDW Interpolation



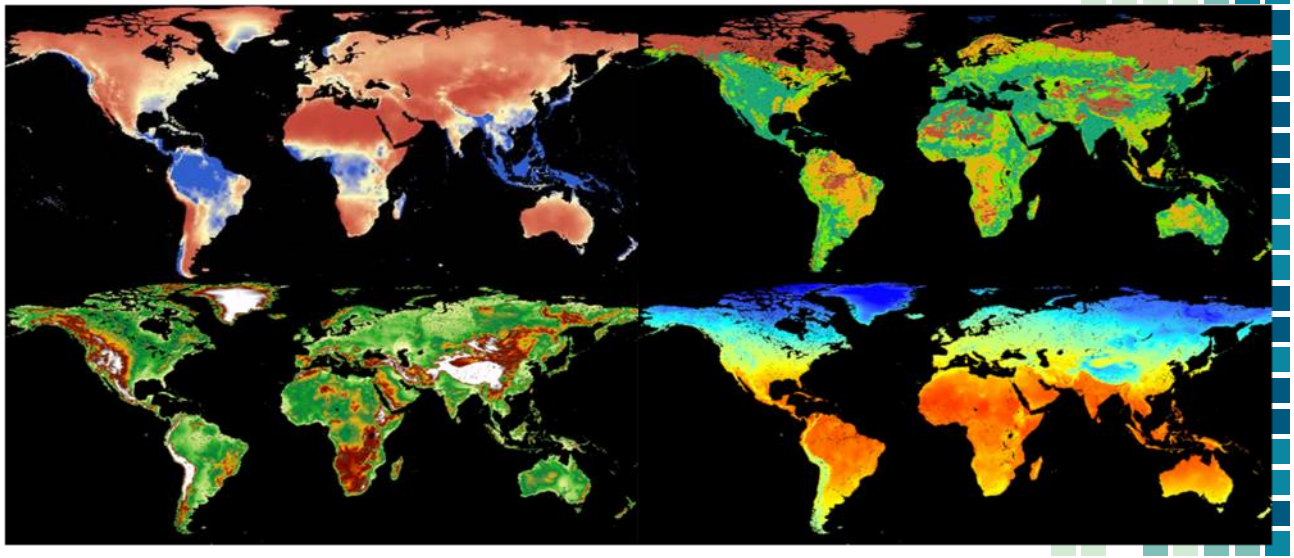
B-Spline Interpolation



Kriging Interpolation

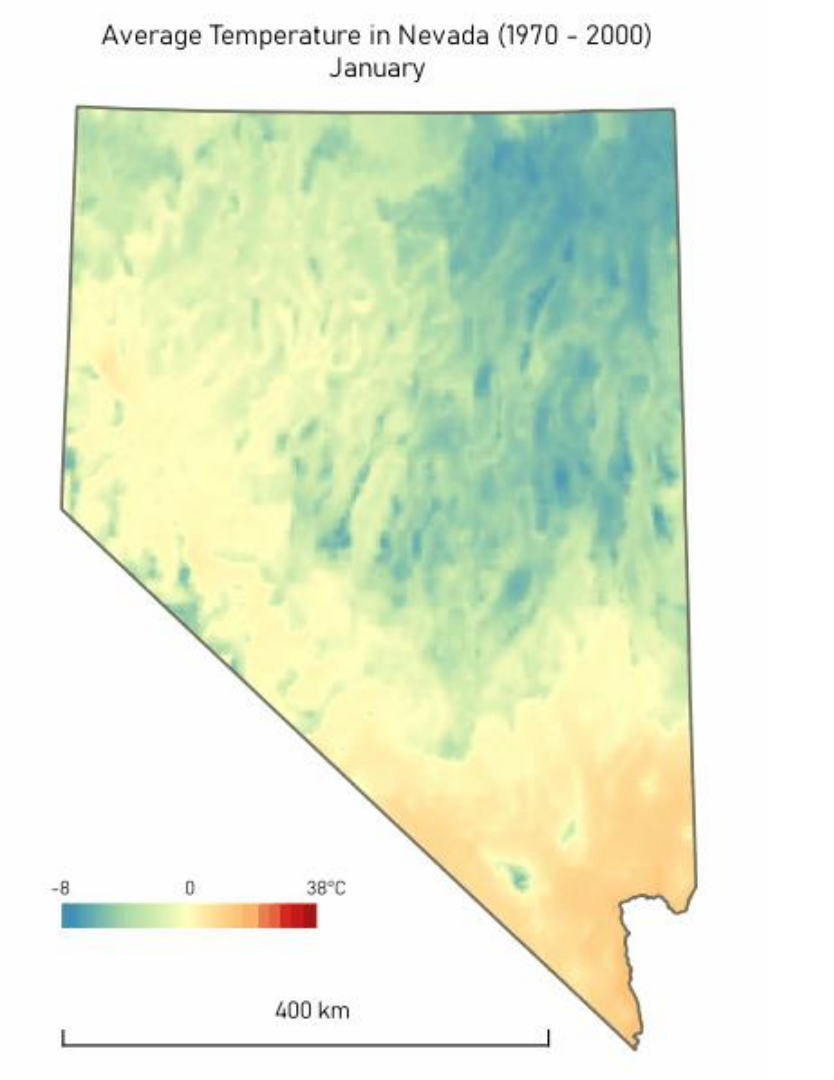
Global Data

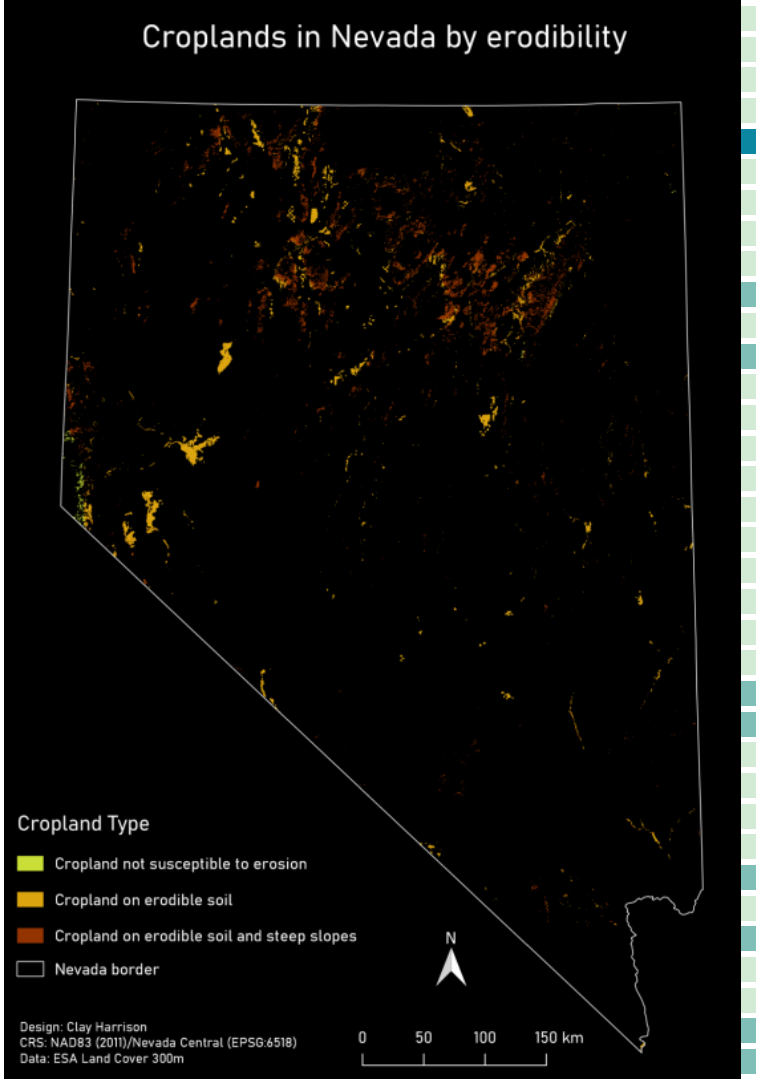
- Mostly environmental data: elevation, soil, land cover

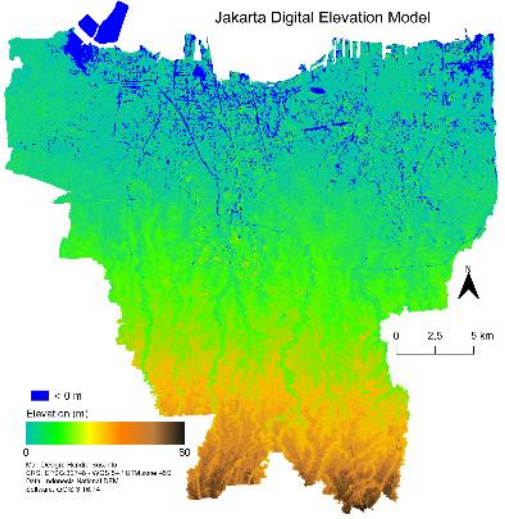


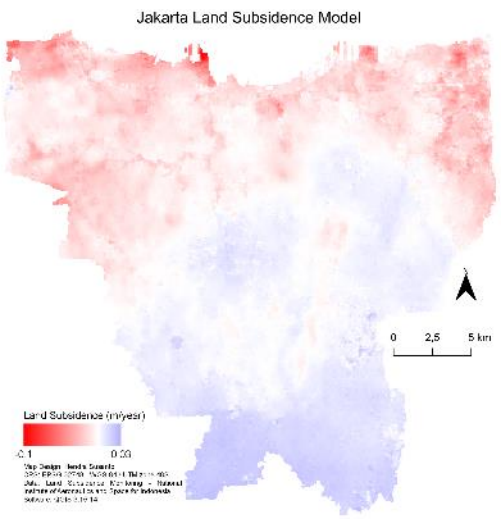
- Enables to work with very diverse data
- Gives skills to combine data from various sources and various quality
- Trains critical (spatial) thinking

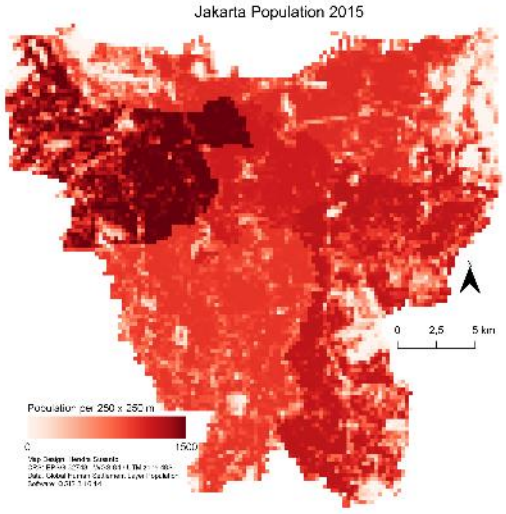
EXAMPLES

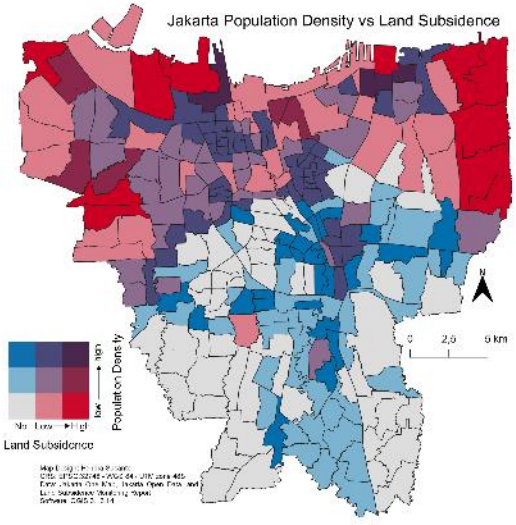

Average Temperature in Nevada (1970 - 2000)
January
-8
0
38°C
400 km

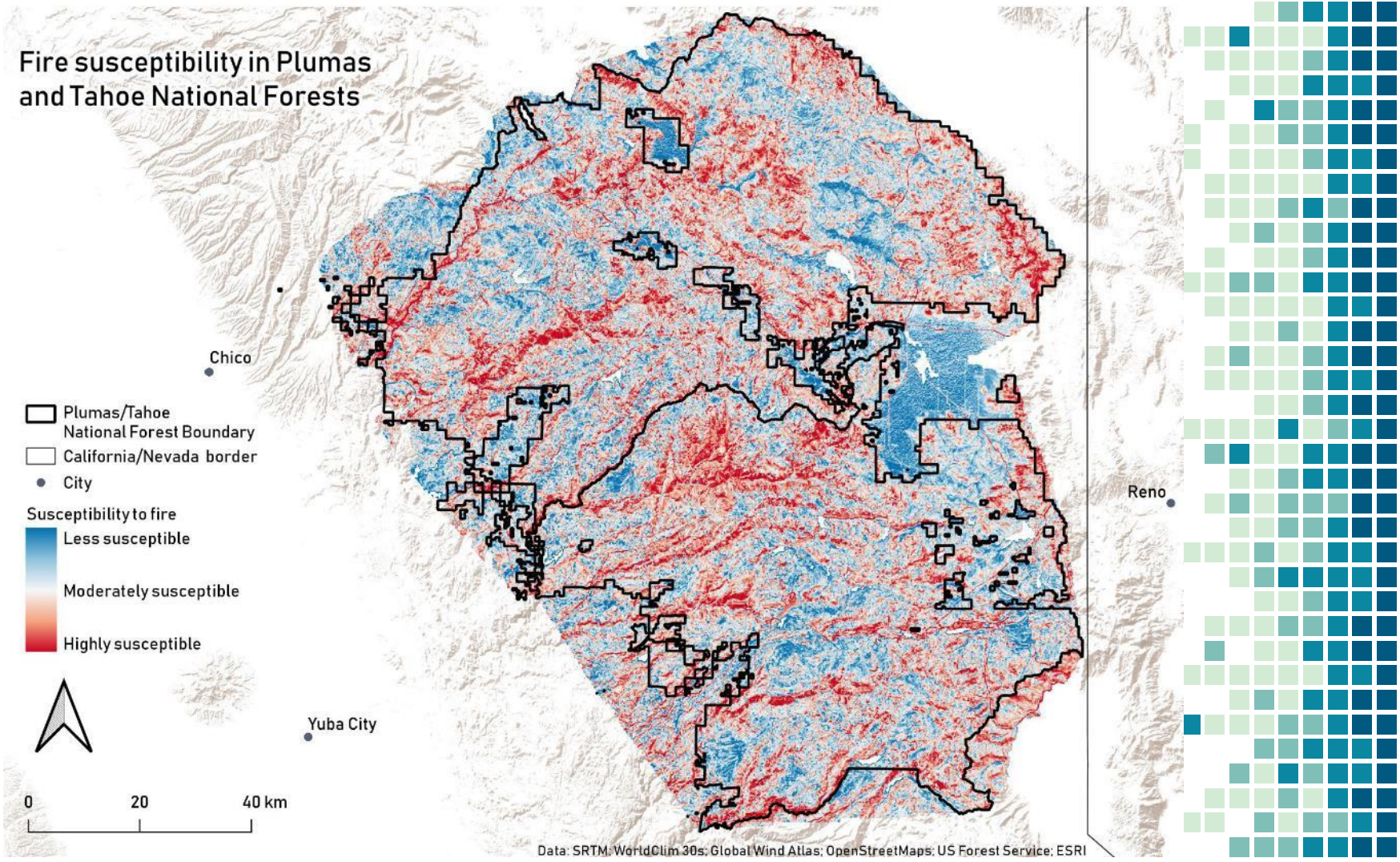

Croplands in Nevada by erodibility
Cropland Type
Cropland not susceptible to erosion
Cropland on erodible soil
Cropland on erodible soil and steep slopes
Nevada border
N
Design: Clay Harrison
CRS: NAD83 (2011)/Nevada Central (EPSG:6518)
Data: ESA Land Cover 300m
0
50
100
150 km


Jakarta Digital Elevation Model
0 2,5 5 km
< 0 m
Elevation (m)
0
50


Jakarta Land Subsidence Model
0 2,5 5 km
Land Subsidence (m/year)


Jakarta Population 2015
0 2,5 5 km
Population per 250 x 250 m
0
1500


Jakarta Population Density vs Land Subsidence
N
0 2,5 5 km
low
high
Population Density
No
Low
High
Land Subsidence


Fire susceptibility in Plumas and Tahoe National Forests
Chico
Reno
Yuba City
Plumas/Tahoe National Forest Boundary
California/Nevada border
City
Susceptibility to fire
Less susceptible
Moderately susceptible
Highly susceptible
0
20
40 km
Data: SRTM; WorldClim 30s; Global Wind Atlas; OpenStreetMaps; US Forest Service; ESRI

Thank you!

Mobilitas+
European Union
European Regional
Development Fund
Investing
in your future

AGILE
Association of Geographic Information
Laboratories in Europe

MARIE CURIE
ACTIONS
HORIZON 2020