# Urban Heat Islands
Risk Analysis

Outline

- Introduction
- Goal of our project
- Theory
- Methodology
- Results and discussion
- Problems
- Further plan

Introduction

- <u>What are Urban Heat Islands?</u>
  - temperature difference between city and surrounding rural area
  - cities are more prone to heating up

- <u>Why are they a problem?</u>
  - Climate change → rising temperatures
  - High temperatures cause heat stress → increased morbidity and mortality
  - For Germany: demographic change → increase of vulnerable group

- <u>What is our motivation for the topic?</u>
  - large part of the population is affected
  - urban climate is a main focus
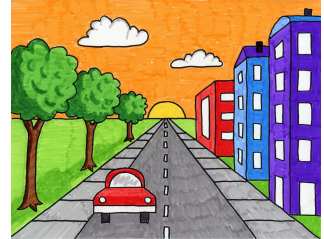
Goal of our Project

1. Map that shows the heat risk in Dresden for vulnerable groups of the urban population.

2. Include mitigation measurements like existing vegetation to reassess the heat health risk map.

Theory - Interpolation

What is Interpolation?

- Calculate or estimate unknown values between already known values.
-
- Spatial interpolation can be used to create an entire surface from just a small number of sample points
- The more sample points → more detailed surface

- Sample points should be well-distributed throughout the study area.
- Points near each other are more alike than those farther away

- (Raster to raster & vector to raster)
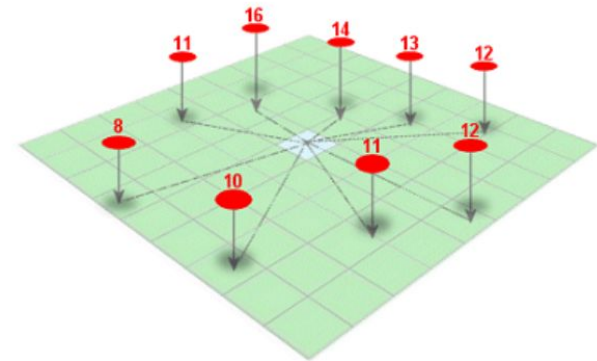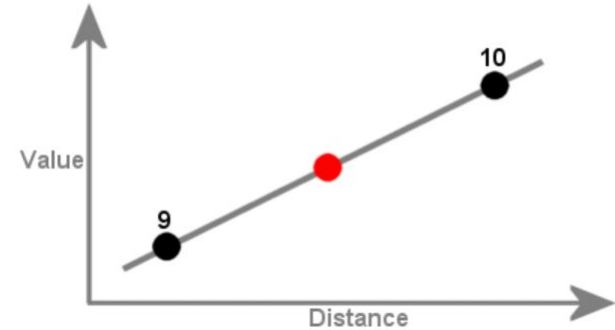
Theory - Interpolation

- **Inverse Distance Weighting (IDW) interpolation** is mathematical (deterministic) assuming closer values are more related than further values with its function.
  - the quality decreases, if data points are not dense and unevenly-spaced
- **Triangulated Irregular Network (TIN) interpolation** uses Delaunay triangulation to create a surface formed by triangles of nearest neighbor points.
  - disadvantage is that the surfaces are not smooth
- Only those two are available in QGIS
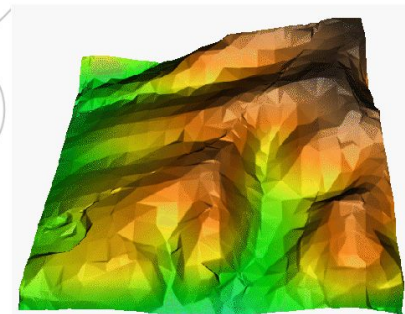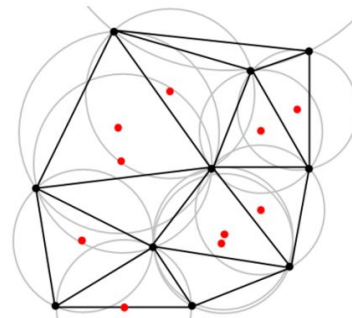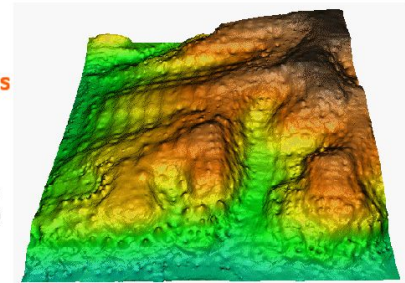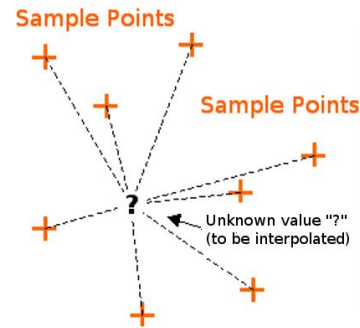
Methodology

- General what is it we want to calculate?
  - Urban heat
  - Vulnerable groups of urban population
    - Elderly and small children
  - Assess the risk of heat to the vulnerable group by combining both information

Methodology - Climatic parameter

Data from Meteostat

- Three stations with different climatic parameters
- Choose when we want the data
- Find the maximum air temperature for each station
- Create three new excel sheets
- Add coordinates & import to QGIS

🇩🇪 Dresden / Klotzsche

| ☰ menu | | ❓ help | ⬇ export | 📅 07/01/2020 - 08/31/2020 |

🇩🇪 Dresden-Strehlen

| ☰ Menü | | ❓ Hilfe | ⬇ Export | 📅 01.07.2020 - 31.08.2020 |

🇩🇪 Dresden-Hosterwitz

| ☰ Menü | | ❓ Hilfe | ⬇ Export | 📅 01.07.2020 - 31.08.2020 |

	A	B	C	D
	Date	Air temperature (Dresden-Klotzsche)	Longitude	Latitude
	09/08/2020	34,4	13,75	51,1333

	A	B	C	D
	Date	Air temperature (Dresden-Strehlen)	Longitude	Latitude
	09/08/2020	35,8	13,775	51,0248

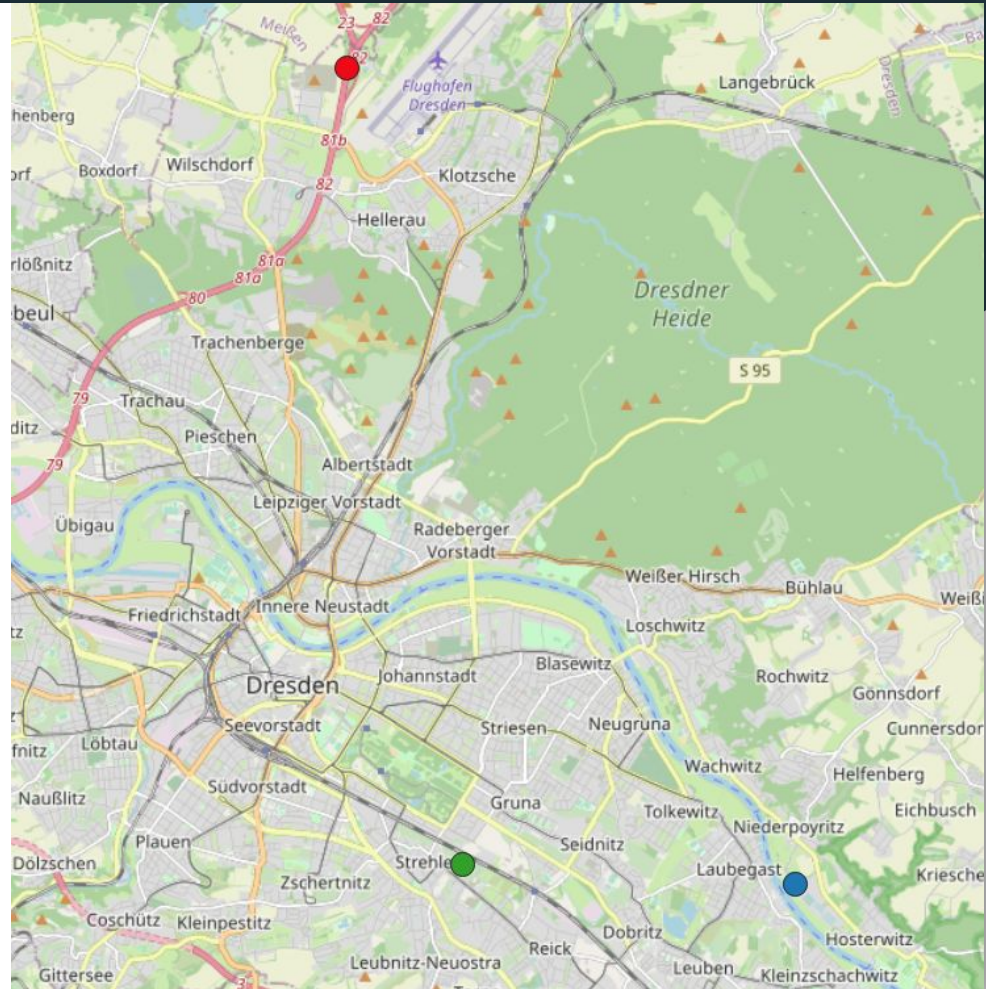|	A	B	C	D
	Date	Air temperature (Dresden-Hosterwitz)	Longitude	Latitude
	09/08/2020	35,2	13,847	51,0221

Methodology
Climatic parameter

- Dresden_Klotzsche: located near the airport

- Dresden_Hosterwitz: located near the river

- Dresden_Strehlen: located near the train tracks

☑ 🔵 **Air temperature (Dresden_Hosterwitz)**
☑ 🟢 **Air temperature (Dresden_Strehlen)**
☑ 🔴 **Air temperature (Dresden_Klotzsche)**
☑ ▩ **OSM Standard**

Methodology
Climatic parameter

Merging

- Approach: Merge vector
  layer

☑ 🔴 **Merged**
☐ 🔵 *Air temperature (Dresden_Hosterwitz)*
☐ 🟢 *Air temperature (Dresden_Strehlen)*
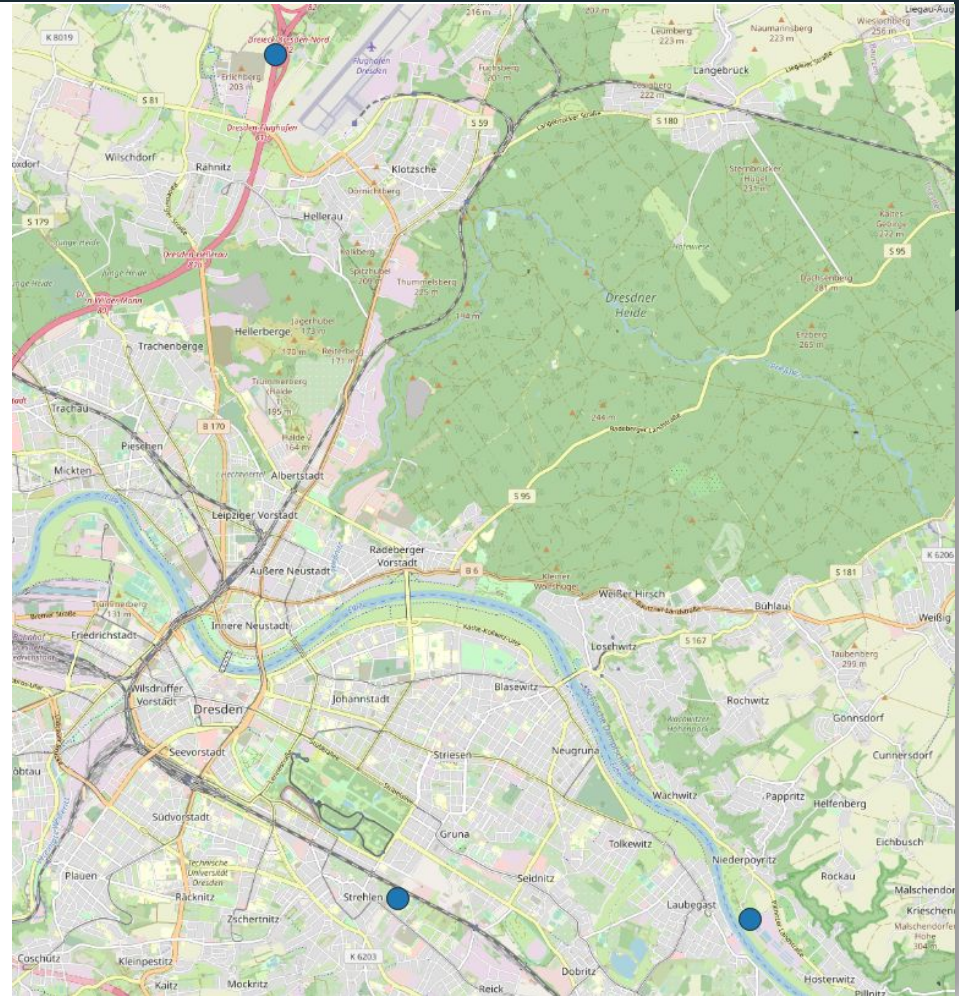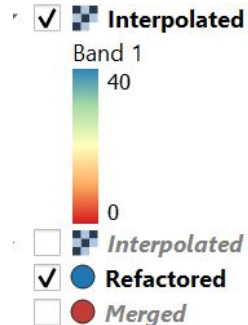☐ 🔴 *Air temperature (Dresden_Klotzsche)*
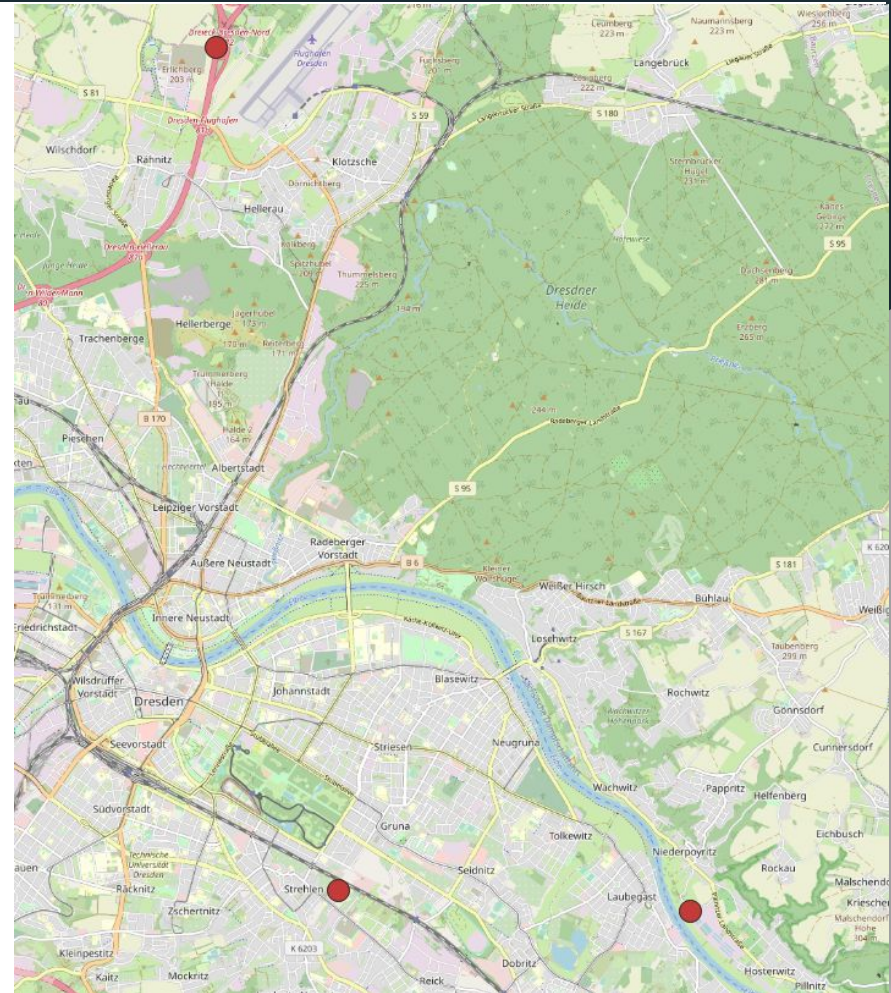
Methodology
Climatic parameter

IDW & TIN interpolation

- Approach: Refactor field

- Does not show the result of the interpolation

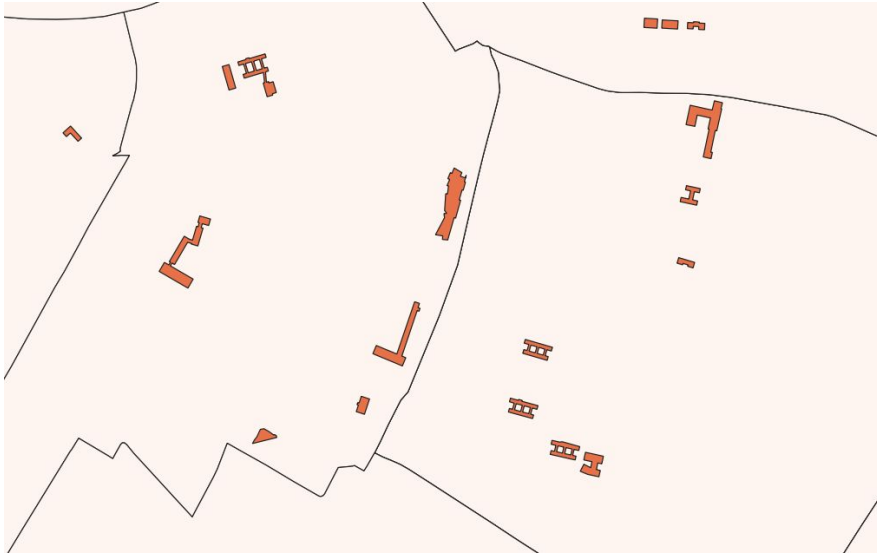| ✓ ▨ **Interpolated** |
| Band 1 |
| 40 |
| 0 |
| ▢ ▨ *Interpolated* |
| ✓ ● **Refactored** |
| ▢ ● *Merged* |

Methodology - Social parameter

- **2 Data Sources:**
  - 1. OSM data for nursing homes, schools, kindergartens
  - 2. age distribution on district level (0-5 years; 60-74 years, over 75 years) from Dresden
- **OSM Data**
  - Goal: transfer the OSM information to the district level
  - Two Approaches:
    - 1. Counting
    - 2. Interpolation
- **Age Distribution**
  - Goal: Merge the three age group into one layer
  - Approach: Merge vector layers
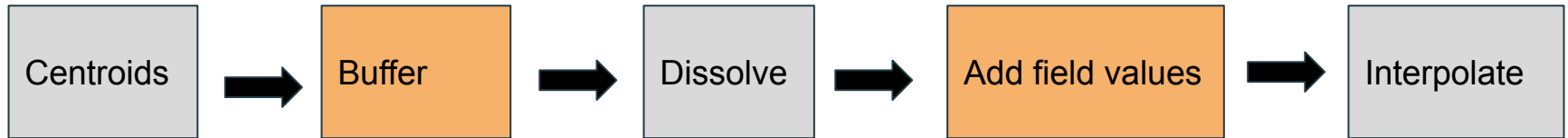
Methodology - Social parameter

OSM Data - Counting

Method: Calculate the **centroids** of each building and then use **count points in polygon**
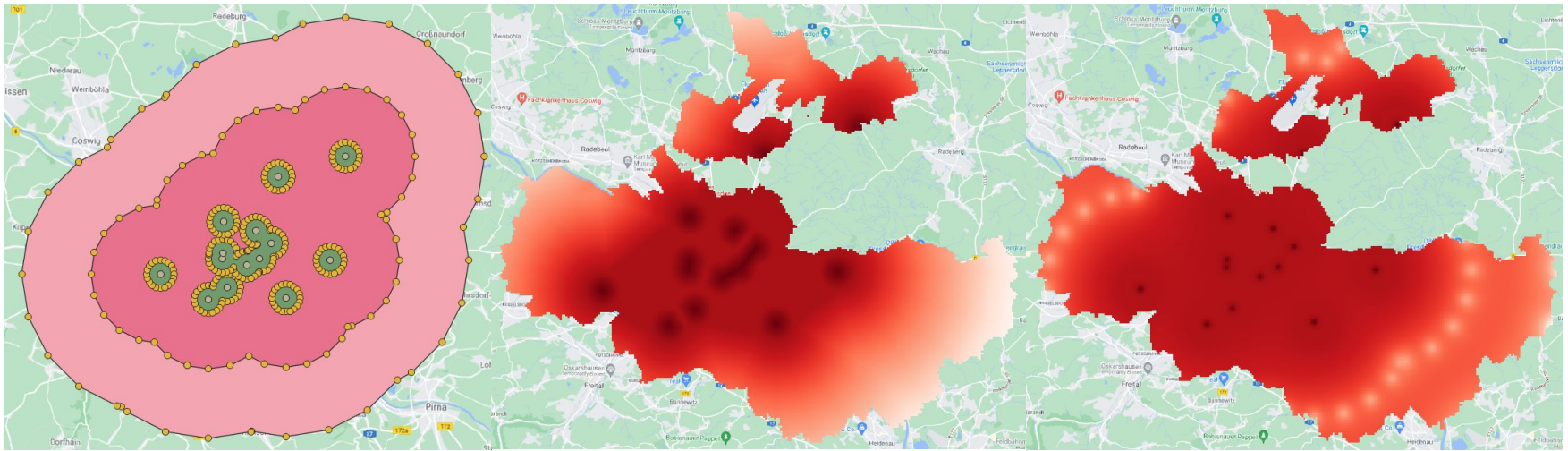
Methodology - Social parameter

OSM Data - Interpolation

Centroids → Buffer → Dissolve → Add field values → Interpolate

Results

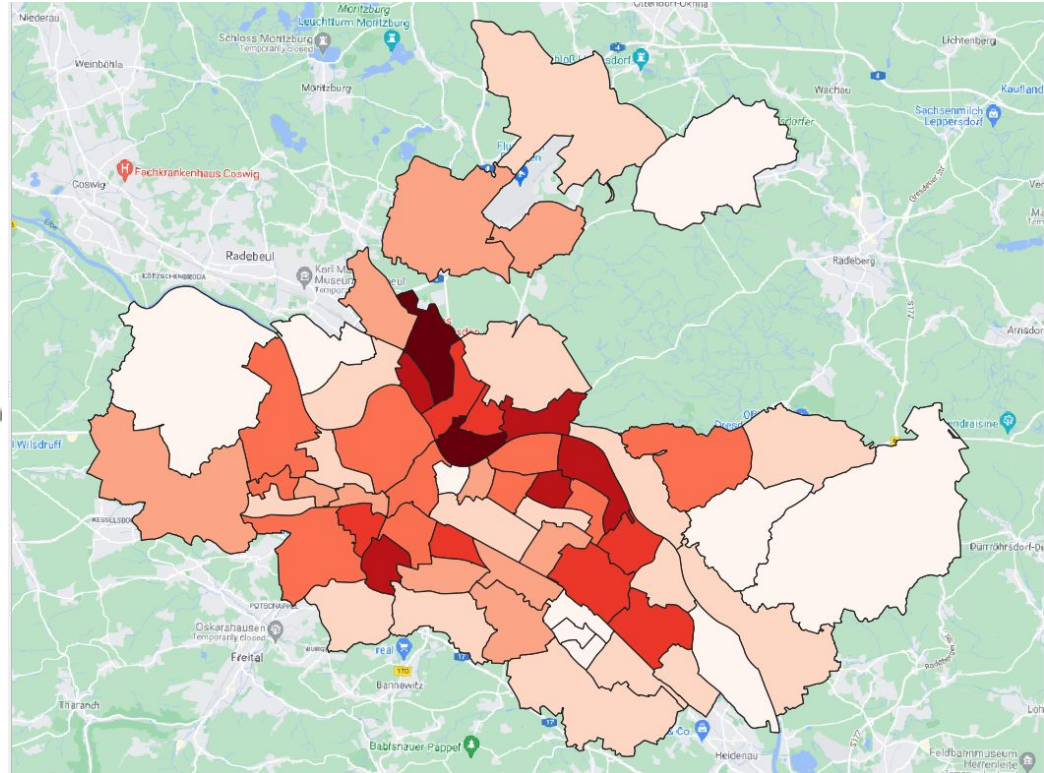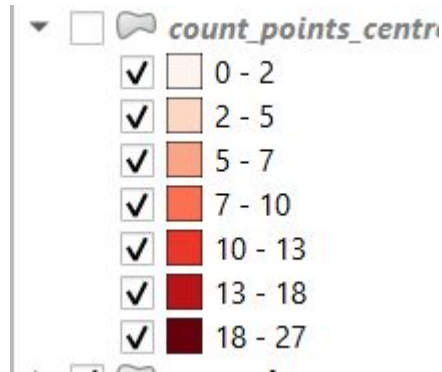**OSM Data - Interpolation**

Results

| Dissolved | TIN | IDW |

Results

OSM Data - Counting

Result: This shows the number of buildings the vulnerable group frequents often inside each district.

count_points_centr

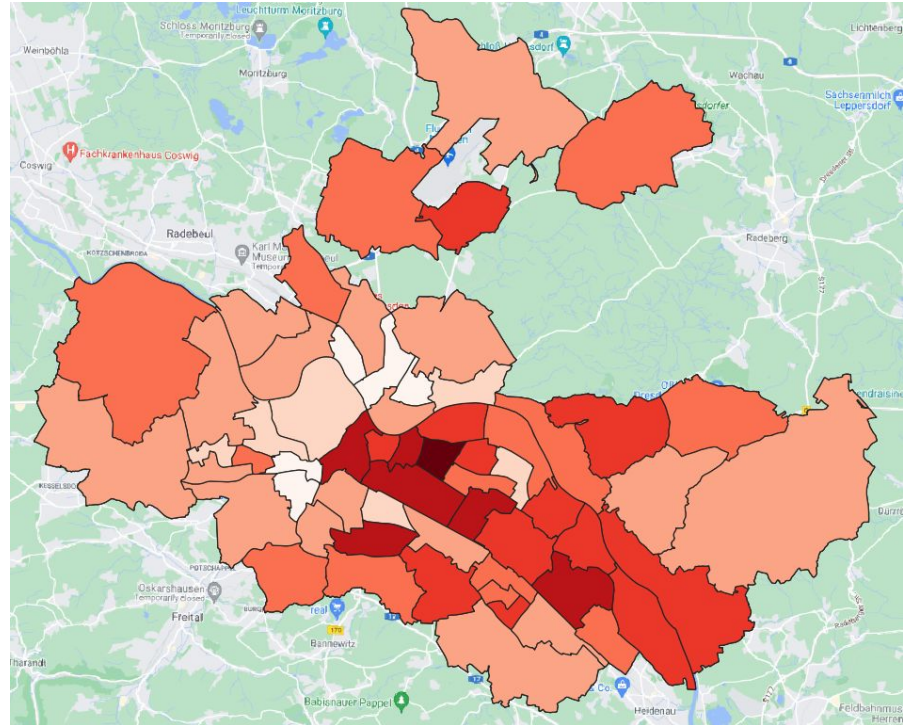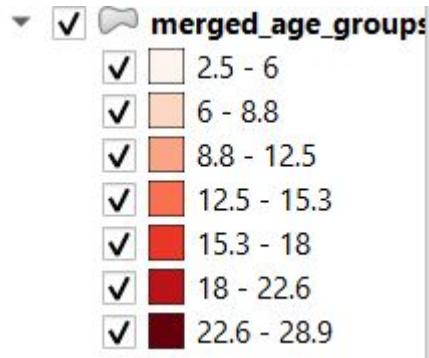|	
✓	0 - 2
✓	2 - 5
✓	5 - 7
✓	7 - 10
✓	10 - 13
✓	13 - 18
✓	18 - 27

Results

Age Distribution - Merge

Method: **Merge Vector Layers**

Result: not satisfying because the percentages of the different vulnerable age groups are averaged, not added.

legend:
- merged_age_groups
  - 2.5 - 6
  - 6 - 8.8
  - 8.8 - 12.5
  - 12.5 - 15.3
  - 15.3 - 18
  - 18 - 22.6
  - 22.6 - 28.9

Problems

- Interpolation of weather stations

- Optimize Age Distribution Merge

- Reconsider Values of the OSM Data Interpolation

Further plan

- Create a mitigation layer

- Try same method by coding

- Maybe use different data for the urban heat layer

Literature so far

IDW Interpolation: https://gisgeography.com/inverse-distance-weighting-idw-interpolation/

TIN Interpolation: 24.1.4. Interpolation — QGIS Documentation documentation ; 11. Spatial Analysis (Interpolation) — QGIS Documentation documentation

Tomlinson, C. J.; Chapman, L.; Thornes, J. E.; Baker, C. J. (2011): *Including the urban heat island in spatial heat health risk assessment strategies: a case study for Birmingham, UK*. In: International Journal of Health Geographics 10, 42.

What is interpolation
http://www.geography.hunter.cuny.edu/~jochen/gtech361/lectures/lecture11/concepts/What%20is%20interpolation.htm

Questions??? Or good ideas and tips ;)