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Digital Data Sources for Spatial Accessibility Analysis

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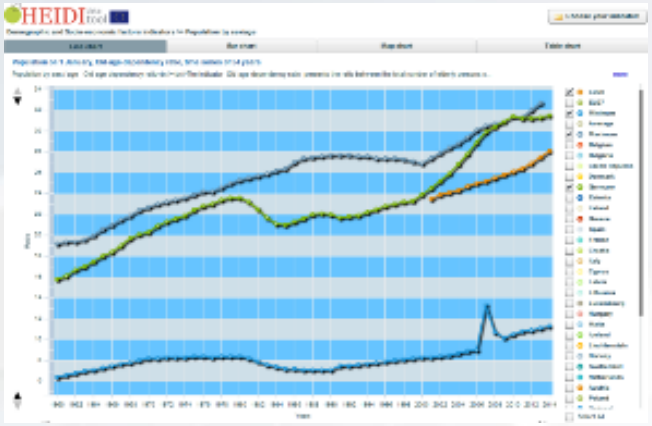
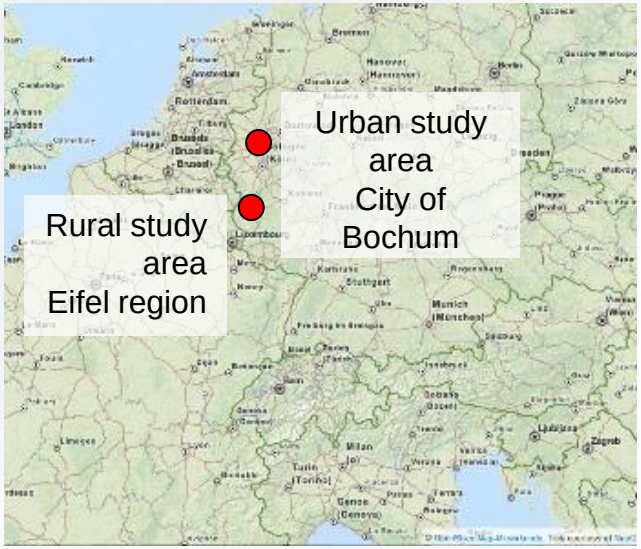
FIG Working Week 2017
Surveying the world of tomorrow – From digitalisation to augmented reality
Helsinki, Finland, May 29 - June 2 2017
TS02E: Crowdsourcing and VGI
Time: 5/30/2017 4:00:00 PM

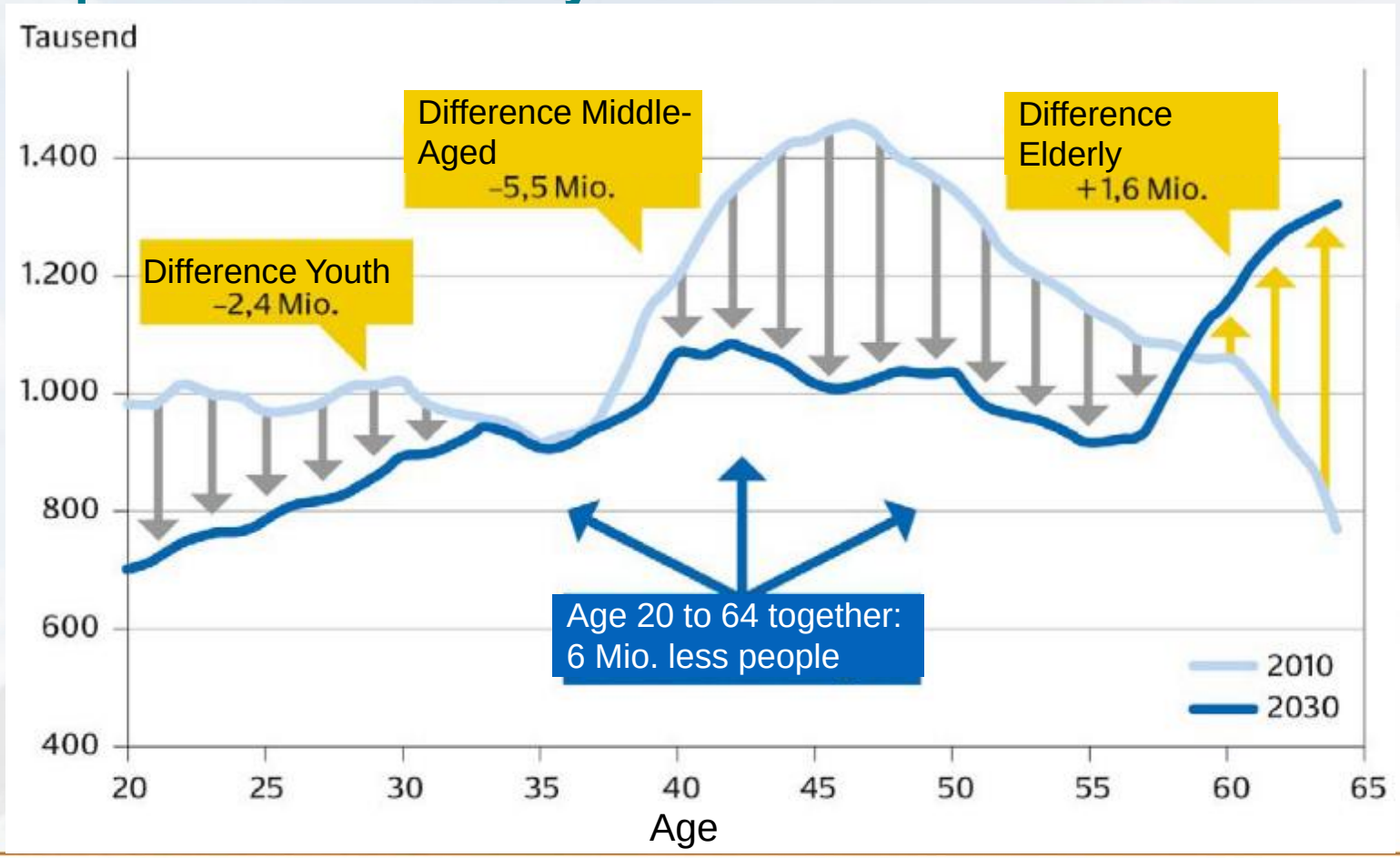
Topics of Presentation

1. Ageing in Europe and Germany
2. Digital Data Sources for Accessibilty Analysis
3. Access to Health Care for Senior Citizens in a Rural Area
4. Access to Health Care for Senior Citizens in an Urban Area
5. Conclusions





Aging Population in Germany 2010 to 2030



Source: BMI 2011

How does it look like?

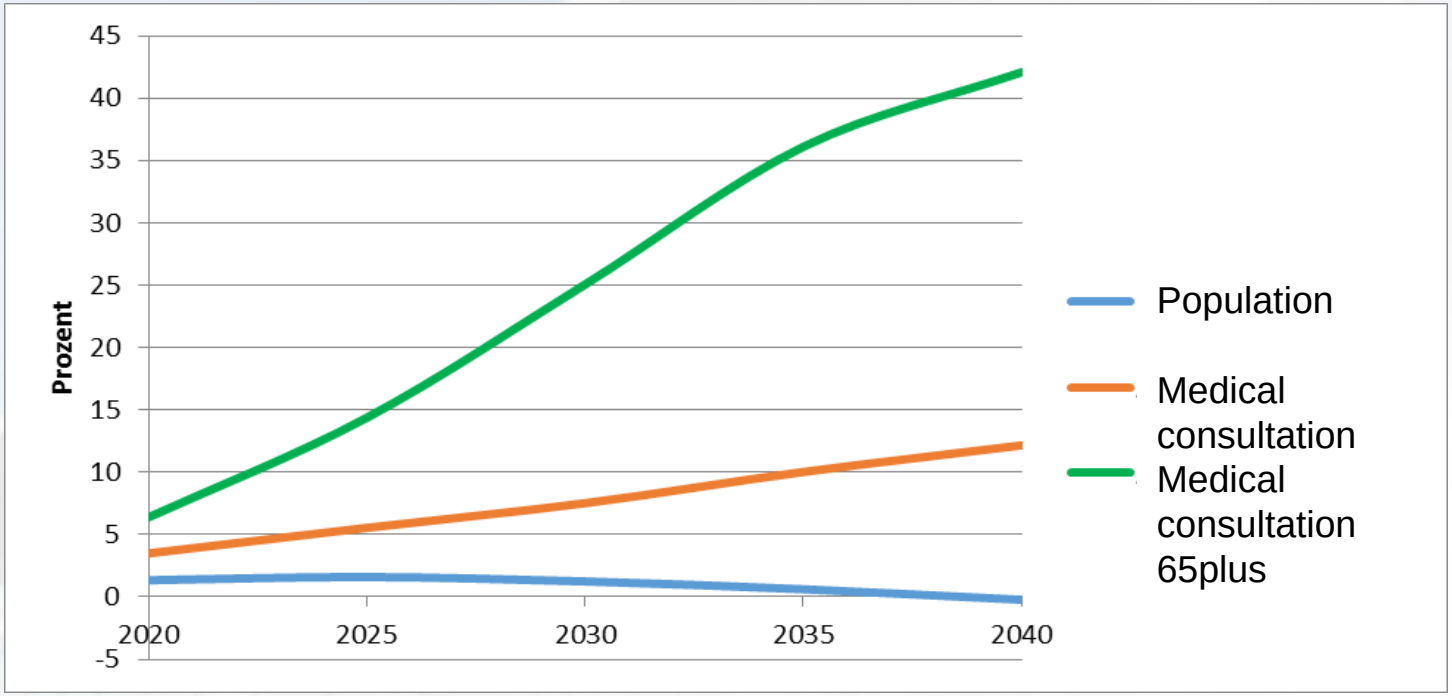
http://www.handelsblatt.com

Relevant Infrastructure for Senior Citizens

General Supply	Health	Leisure and Culture	Public Institutions
Supermarket	Hospital	Park, Public Green	Town Hall
Bakery	**Doctor**	Restaurant, Bars	Church
Market	Pharmacy	Museum, Theater	Library
Hairdresser	Care Facility	Community Center	Adult Education Center
Bank			Sport Center, Bath
Post			
Public Transport			

Population and Medical Consultation in the Study Area

Current (2015) vs. Projection (2040)



Source: Hammerschmidt, Katzer, Klauß, Vollmer 2015

Easy Access for Senior Citizens to relevant Infrastructure

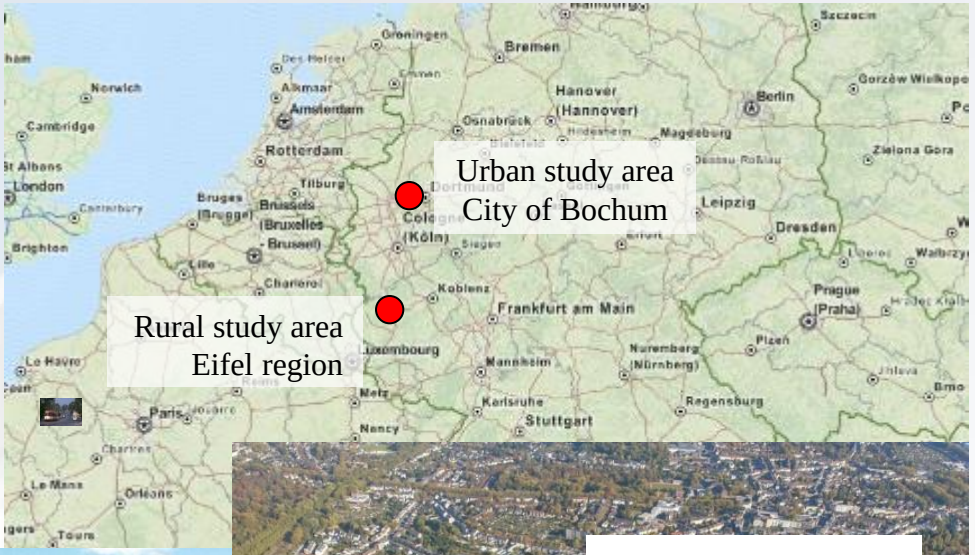
http://bilder3.n-tv.de

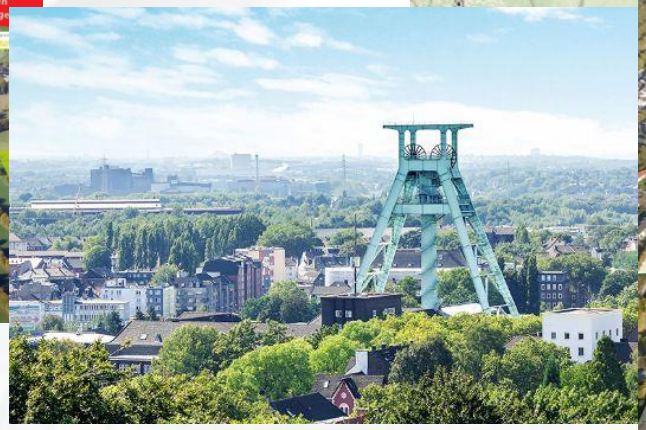
Analysis of Accessibility in this Study

- Rural Area:
  Access: Transportation by car
  Limiting Constraints: Distance and resulting travel time
- Urban Area:
  Access: Walking
  Limiting Contraints: reduced walking mobility as well as barriers on ‘walking ways’

http://www.openstreetmap.de/karte.html

<50 P/KM2





6500 P/KM2

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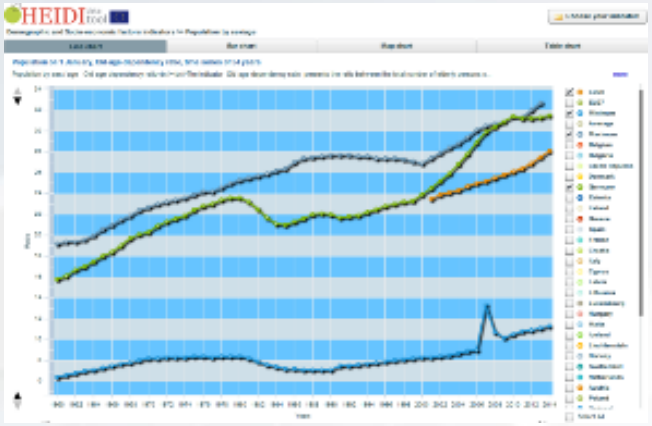

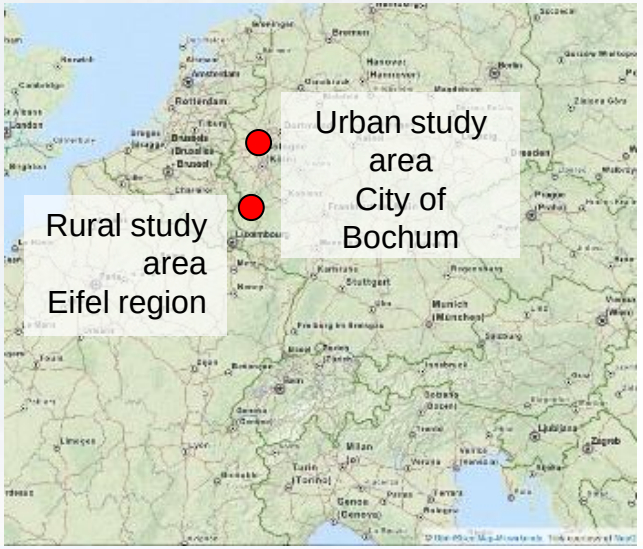

Digital Data Sources

Location of Medical Practices

- Data Sources: Health Insurance Association, Phonebook, Websites

Road Network

- Data Source: OpenStreetMap, value „maxspeed“

Footpath Network

- DataSource: Digitized on aerial photos (WMS from local government)

Barriers on Footpath

- Data Source: Collection with Mobile Mapping App

Examples for Barriers

- Signs in wrong height
- Physical barriers, like trash bins
- Stairs
- Narrow footpaths
- Uneven ground, like sand, gravel
- Roots of large trees

How to Measure Spatial Accessibility? (I)

Step 1: Calculation of catchment areas for all medical practices

Definition of three corridors *c(5), c(10), c(15)*, with travel time *t*

t(5) = 5 minutes

t(10) = 10 minutes

t(15) = 15 minutes

How to Measure Spatial Accessibility? (II)

Step 2: Intersection of road segments and corridors

c(5), c(10), c(15) corridors → spatial intersection for all medical practices *m* → *3 x m* attributes for all road segments (rural area) and footpath segments (urban), respectively. Attribute value indicates if a segment takes part in a *c(5), c(10), c(15)* corridor of a medical practice *m*.

How to Measure Spatial Accessibility? (III)

Step 3: Including attractivity of primary care practices.

Linear decrease of attractivity with increasing distance from the physician's practice → attaching different weights *p* to the the catchment corridors *c(5), c(10), c(15)*

p(5) = 3
p(10) = 2
p(15) = 1

How to Measure Spatial Accessibility? (IV)

Step 4: Quantification of local accessibility to primary health care by score values

Summing up the weights *p(i)* of all catchment areas, in which a certain road segment (rural) or footpath segment (urban) takes part in → score value *S(k)* of the road segment (rural) or footpath segment (urban) *k*.

Example If a segment takes part in *2 c(5)* corridors, in *3 c(10)* corridors and in *4 c(15)* corridors, for instance, then its score value amounts to $S(k) = 2 \times 3 + 3 \times 2 + 4 \times 1 = 16$.

How to Measure Spatial Accessibility? (V)

Step 5 (optional): Integrating barriers in the calculation of catchment areas

If the study area is not too large, collected barriers can be used for the calculation of the catchment areas. These catchment areas can be used for accessibility analysis for mobility reduced people.

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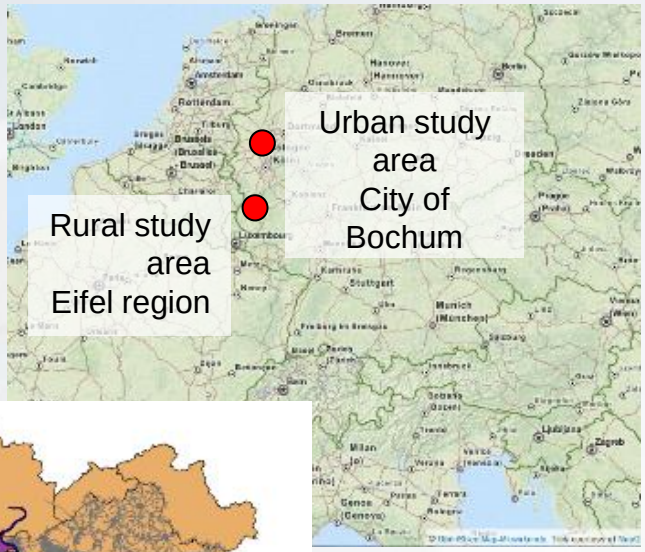
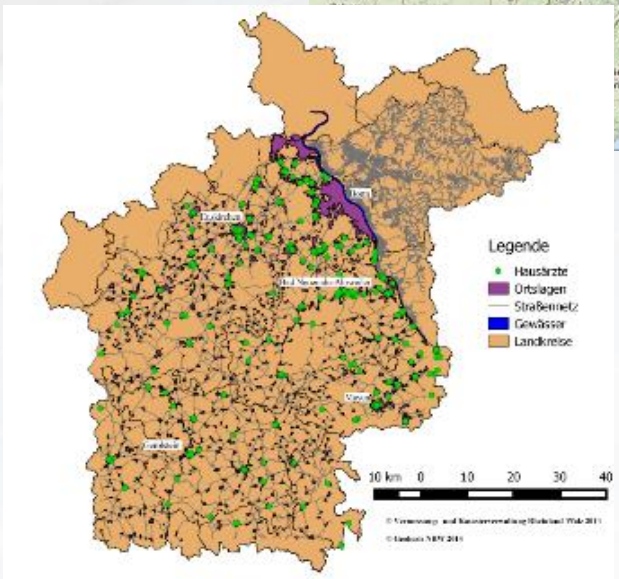
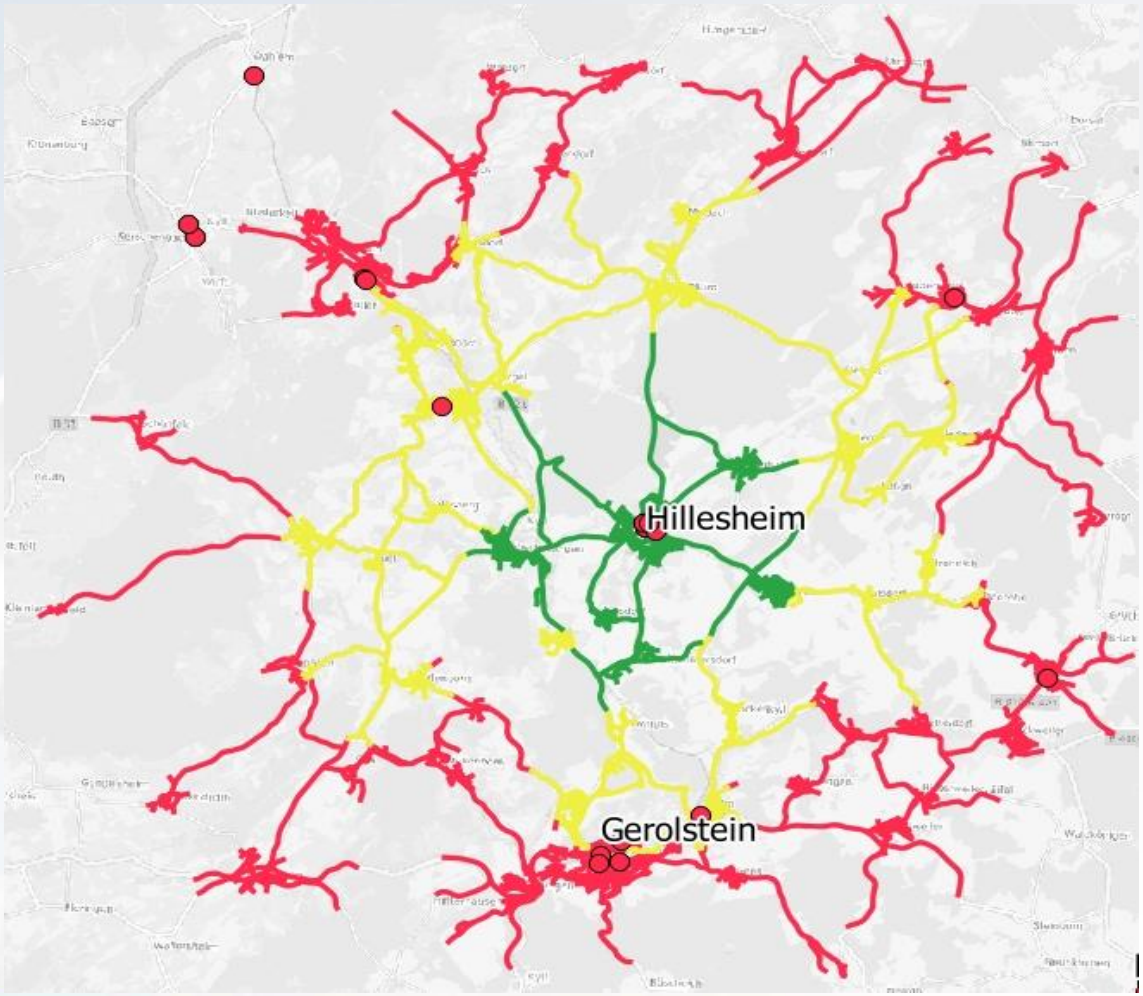
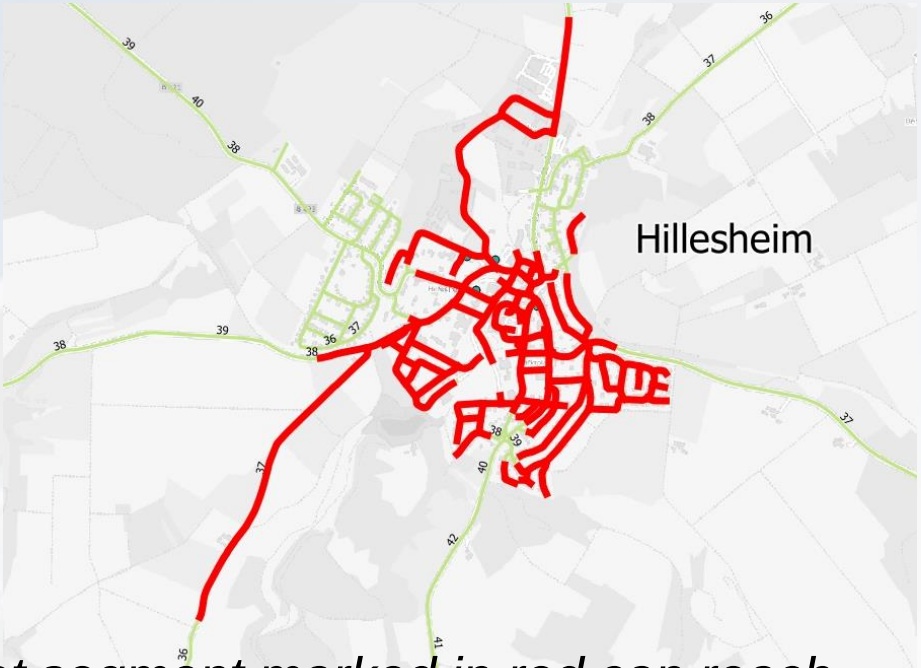




Catchment Area by Travel Time in the Rural Part of the Study Area



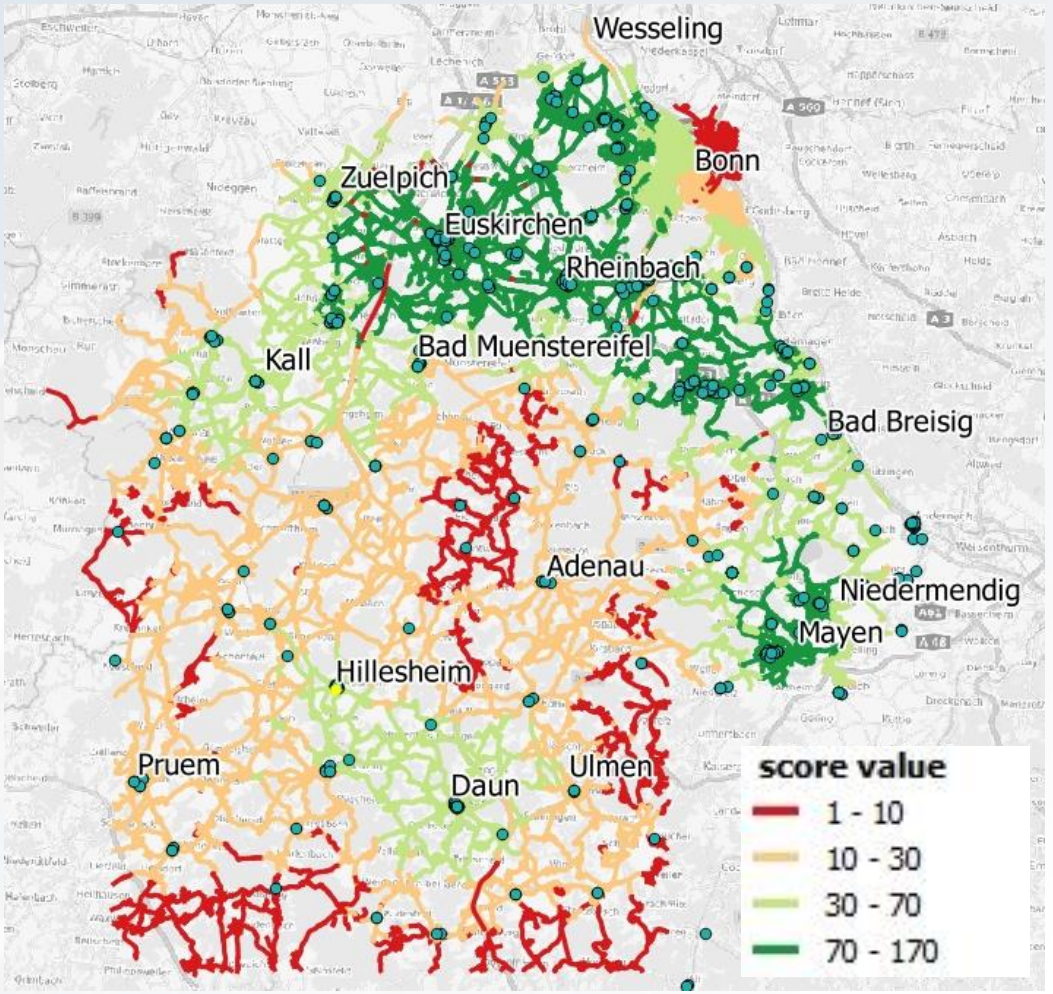
Ex.: Score value in the the rural town Hillesheim for the street segment marked in red



Persons residing along the street segment marked in red can reach
8 medical practices within 5 min by car,
2 medical practices in between 5 and 10 min,
9 medical practices in between 10 and 15 min,
*S = 8*3+2*2+9*1 = 37*

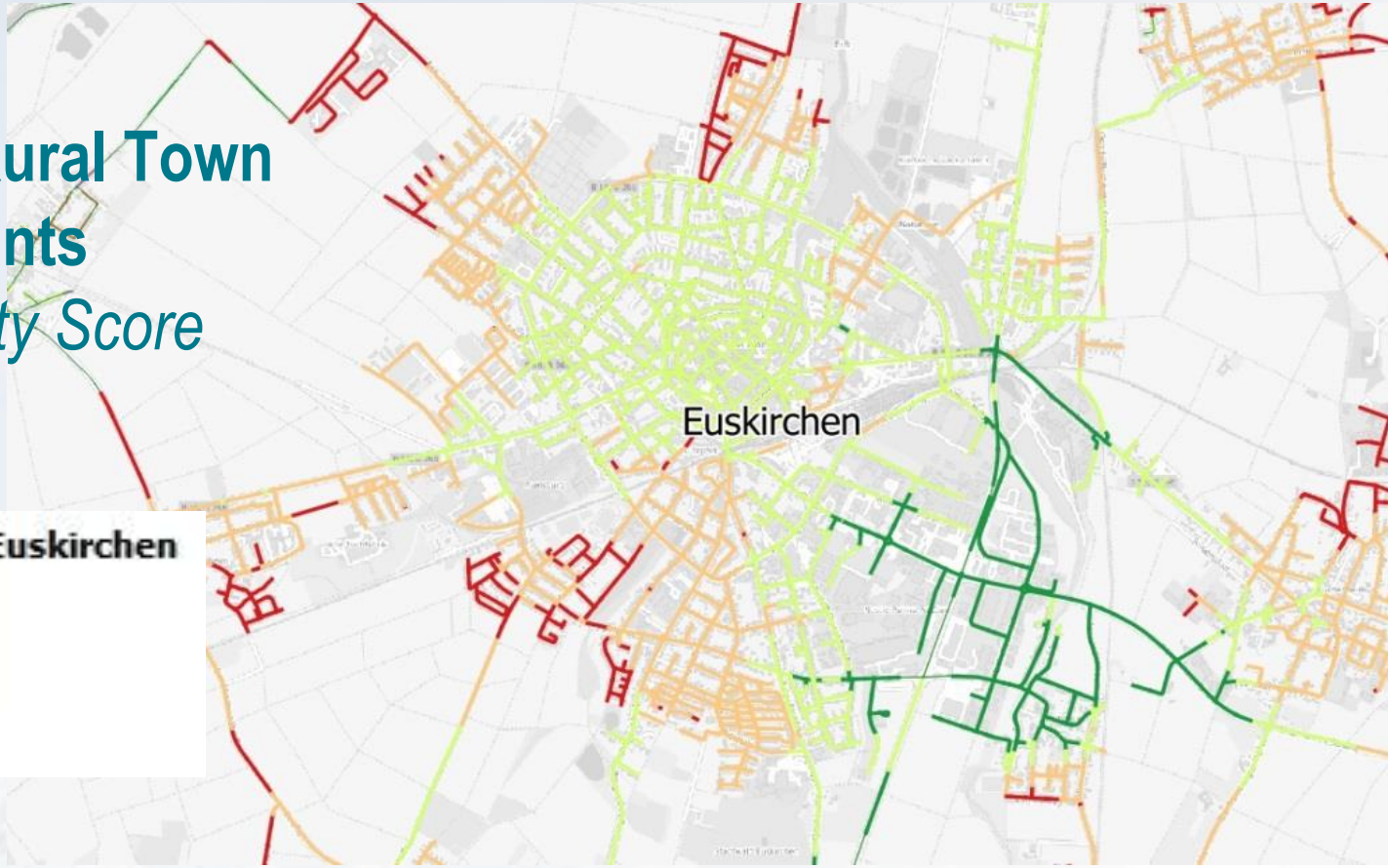
Data Source: Bochum, RVR, GeobasisNRW

Distribution of Score Values across the Rural Part of the Study Area

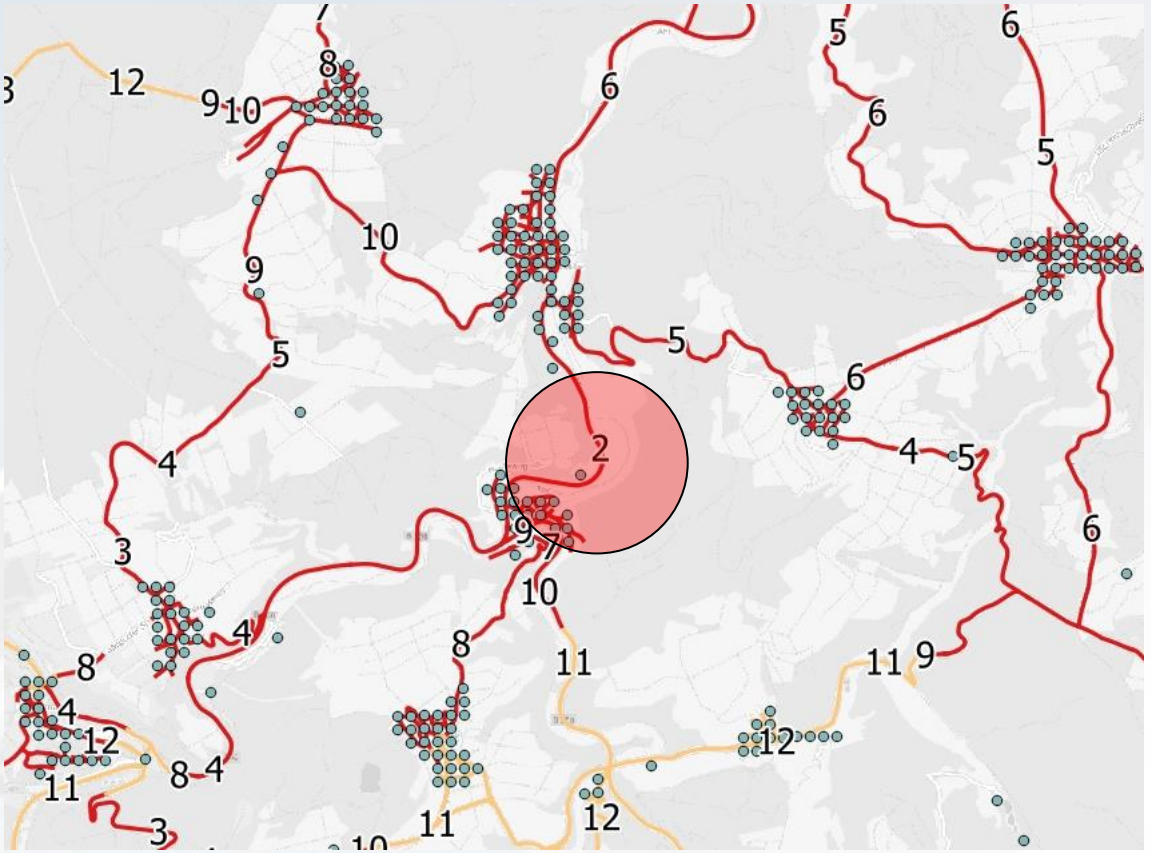


Example of a Rural Town 50.000 inhabitants

High Accessibility Score Values

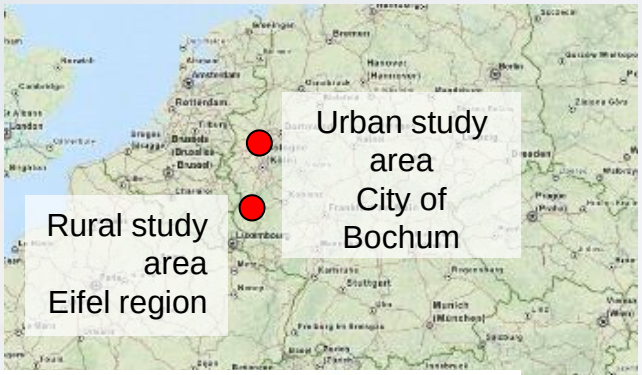


Example of a Rural Village with Low Accessibility Vicinity of Nurburg Ring



Score values of 2 indicate that no medical practice can be reached within 10 min travel time, but only 2 practices within 15 min time

Topics of Presentation



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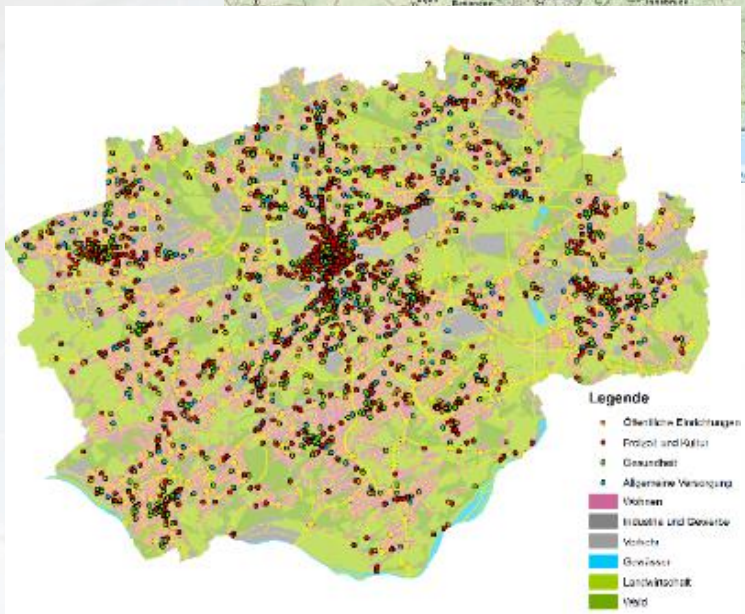
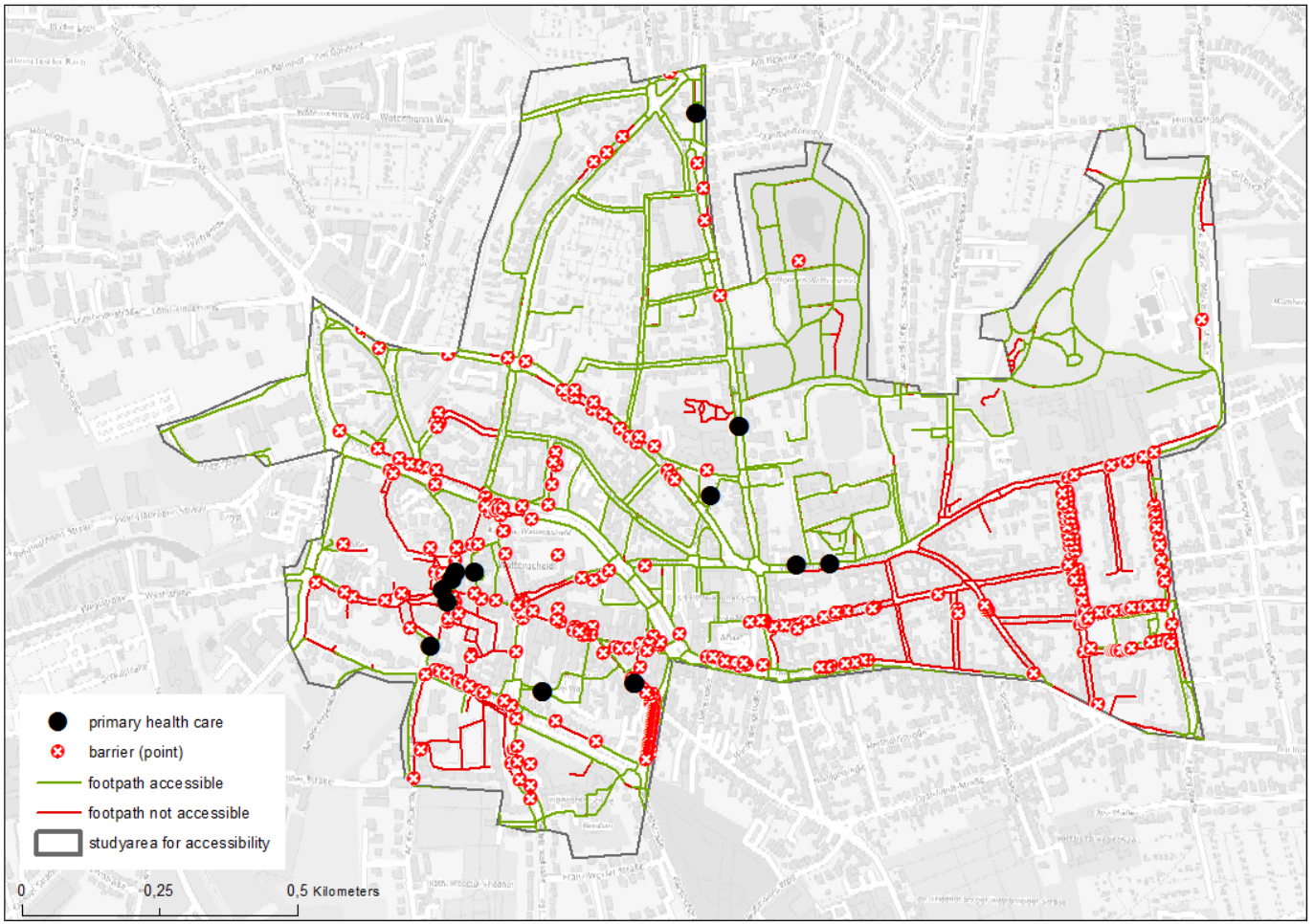
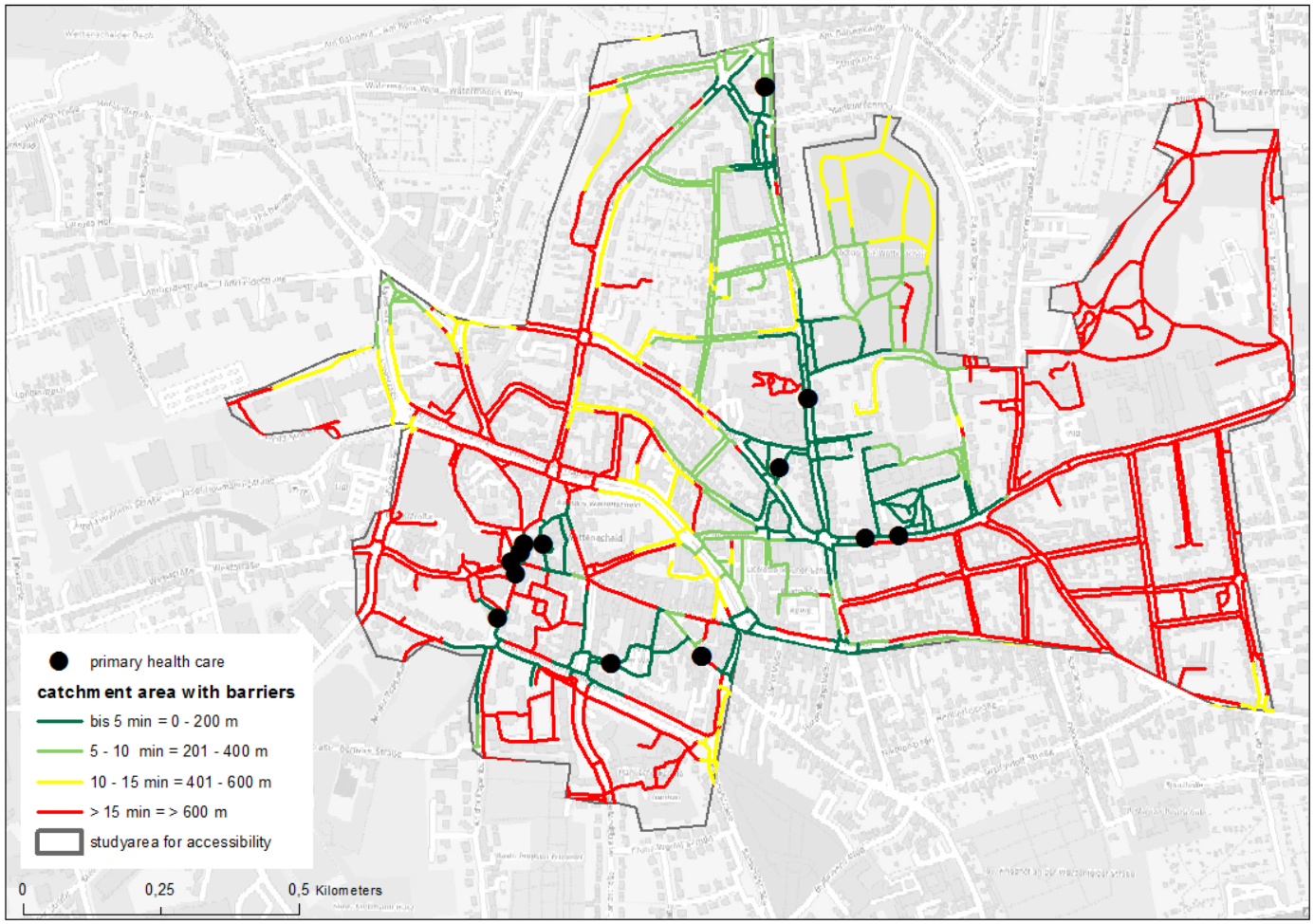


Barriers and Accessibility of Footpaths in the Urban Part of the Study Area



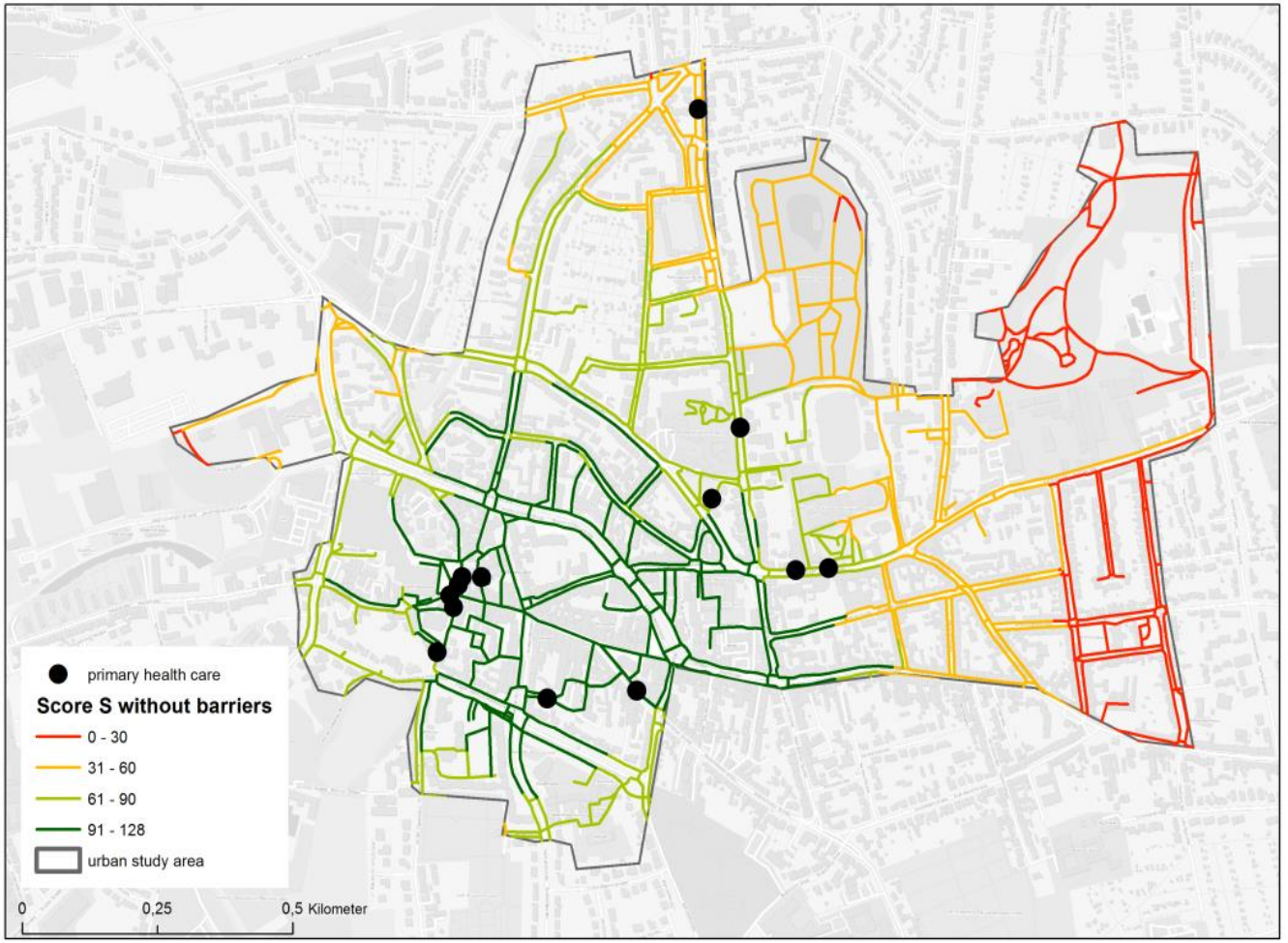
Catchment Areas of Primary Health Care for Mobility Reduced Patients

within 5 min, 10 min and 15 min Walking Time



Score Values for Footpaths Representing the Accessibility of Primary Health Care in Urban Area

5, 10,15 min without Barriers



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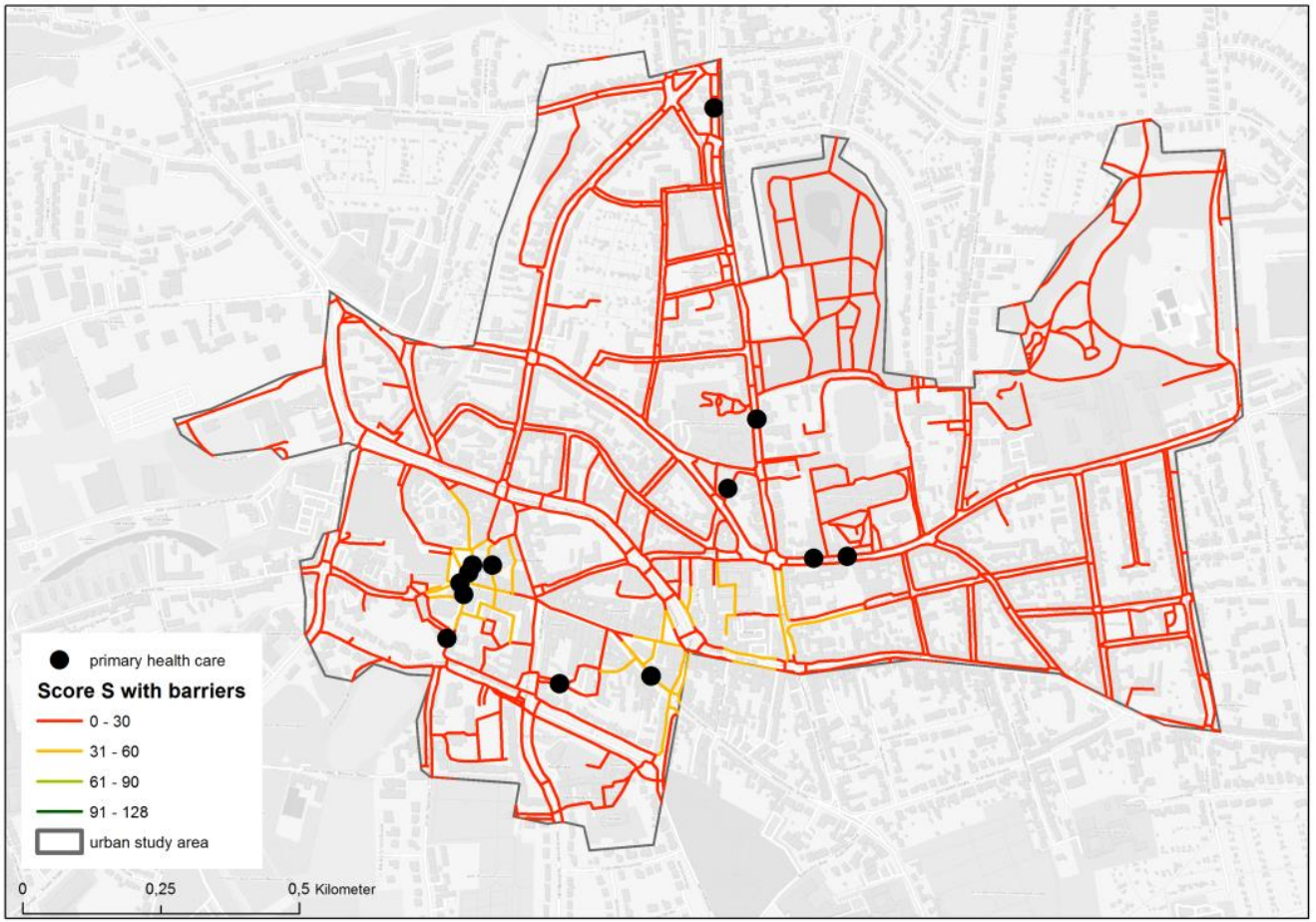

Remember: Relevant Infrastructure for Senior Citizens

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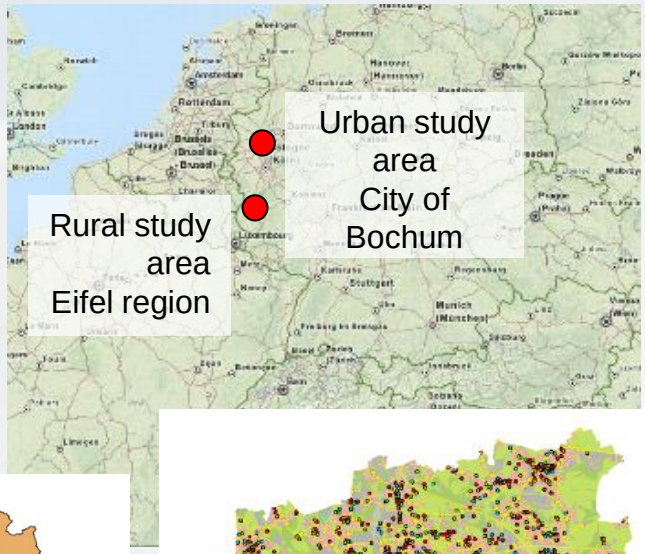

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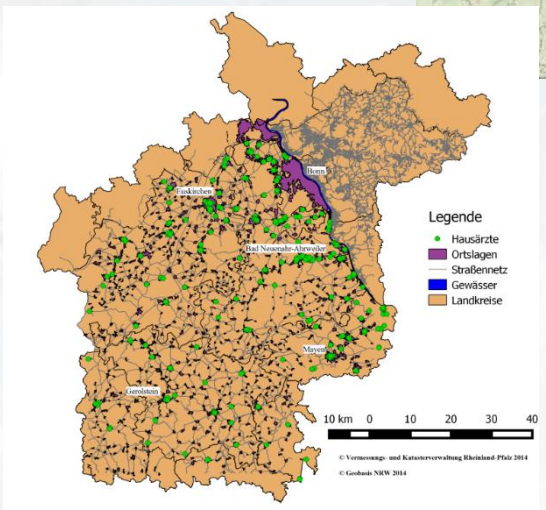

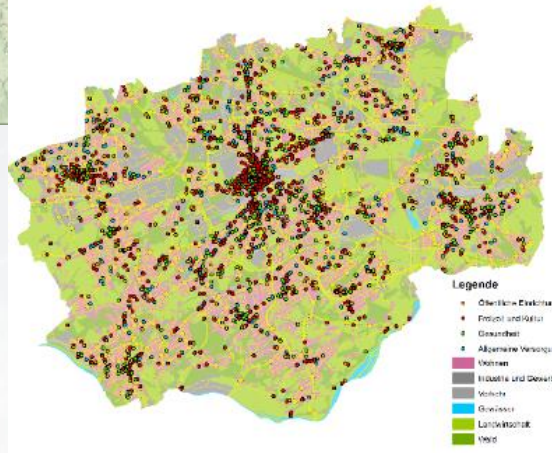

Conclusions

- Identified accessibility problems to primary health care for elderly people in both rural and urban areas
- Primary health care to be reachable and accessible for the broad population → potential accessibility problems to be addressed by health care planning
- Methods in use working on administrative district level thus not reaching a small-area level
- Proposed new method reveals distribution of accessibility to primary care on street segment level both for rural and urban areas
- Spatially accurate identification of areas that need special attention with regard to accessibility of primary health care
- Data collection and quality tests still necessary

Thank you for your attention!

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