

An analytical method to determine the impact of green space and water bodies on the micro-climate of urban areas for comparative analysis of towns

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Clemens Deilmann

Team:

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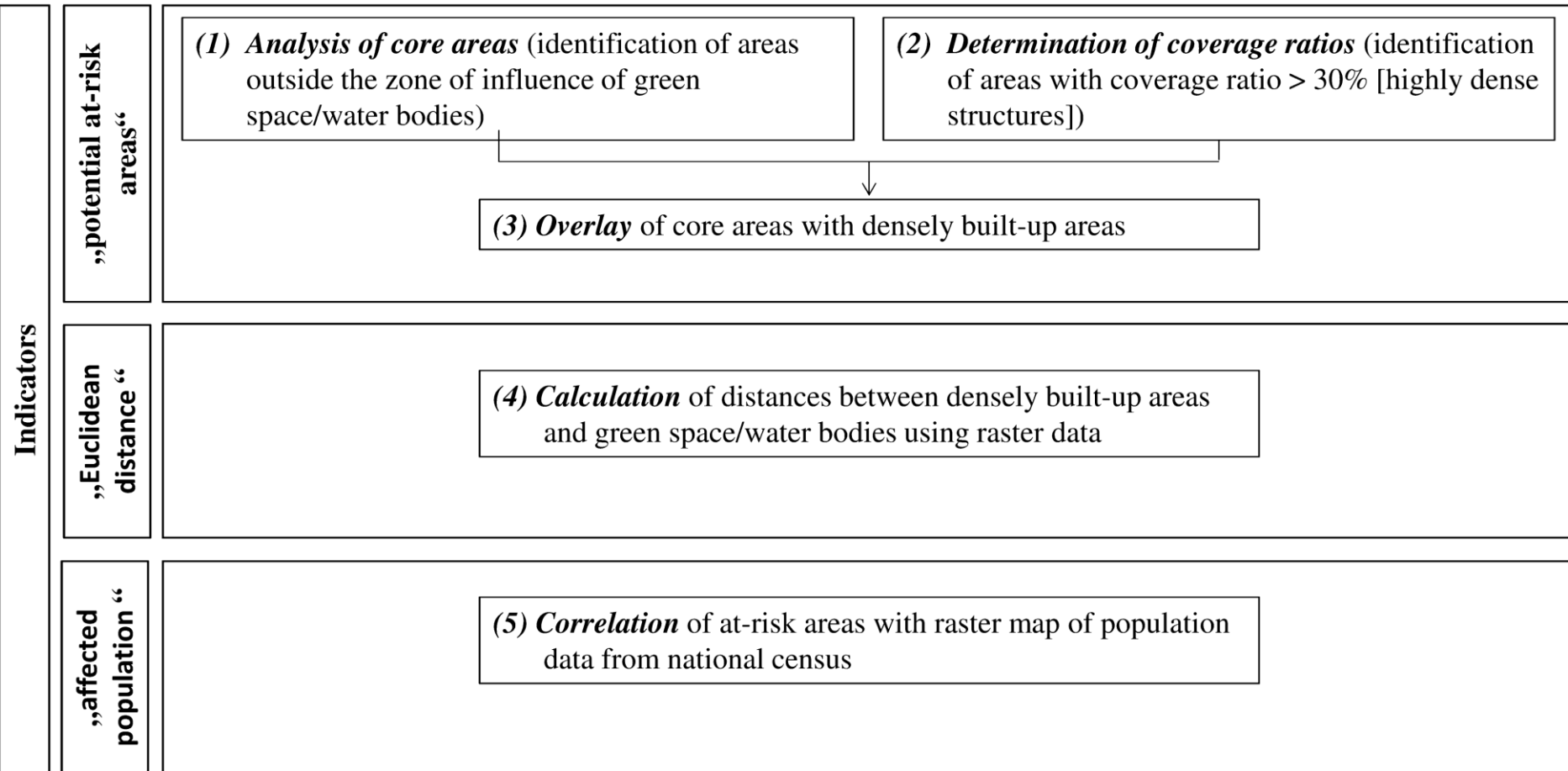


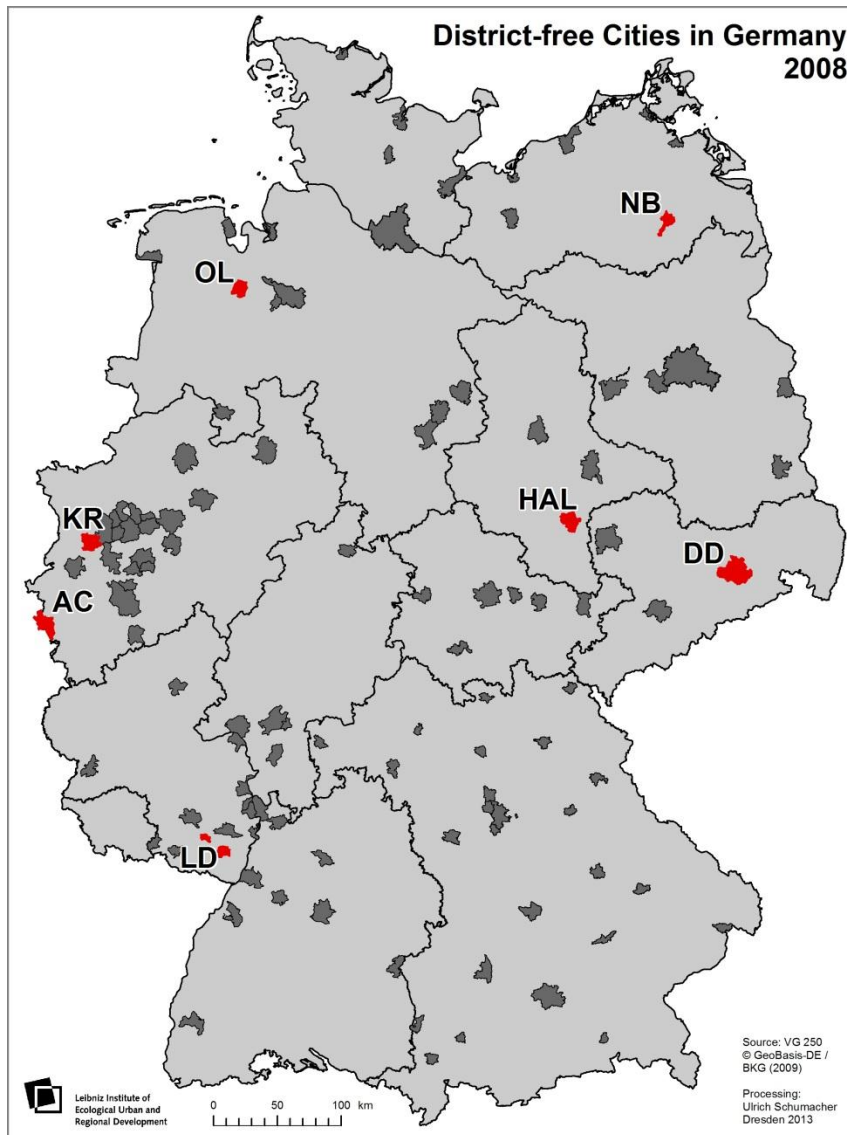
- ➔ Land use pattern has impacts to the urban heat island
- ➔ Geometric basis to represent settlement structures (structural analysis with GIS)

3 Indicators:

- ➔ “Potential at-risk areas”: is the ratio of densely built-up areas > 1 ha in the urban environment that do not lie near any green spaces and/or bodies of water
- ➔ “Euclidean distance” is the distance between densely built-up areas and public green spaces or bodies of water as well as the green urban surroundings
- ➔ “Affected population” translates the areas and building densities into the number of residents who live in such at-risk areas

Use of official topographic geo-data set for entire Germany:
ATKIS Basis-DLM (“urban areas”, “built-up settlement areas”, “green spaces”, “waterbodies”, “open space”)



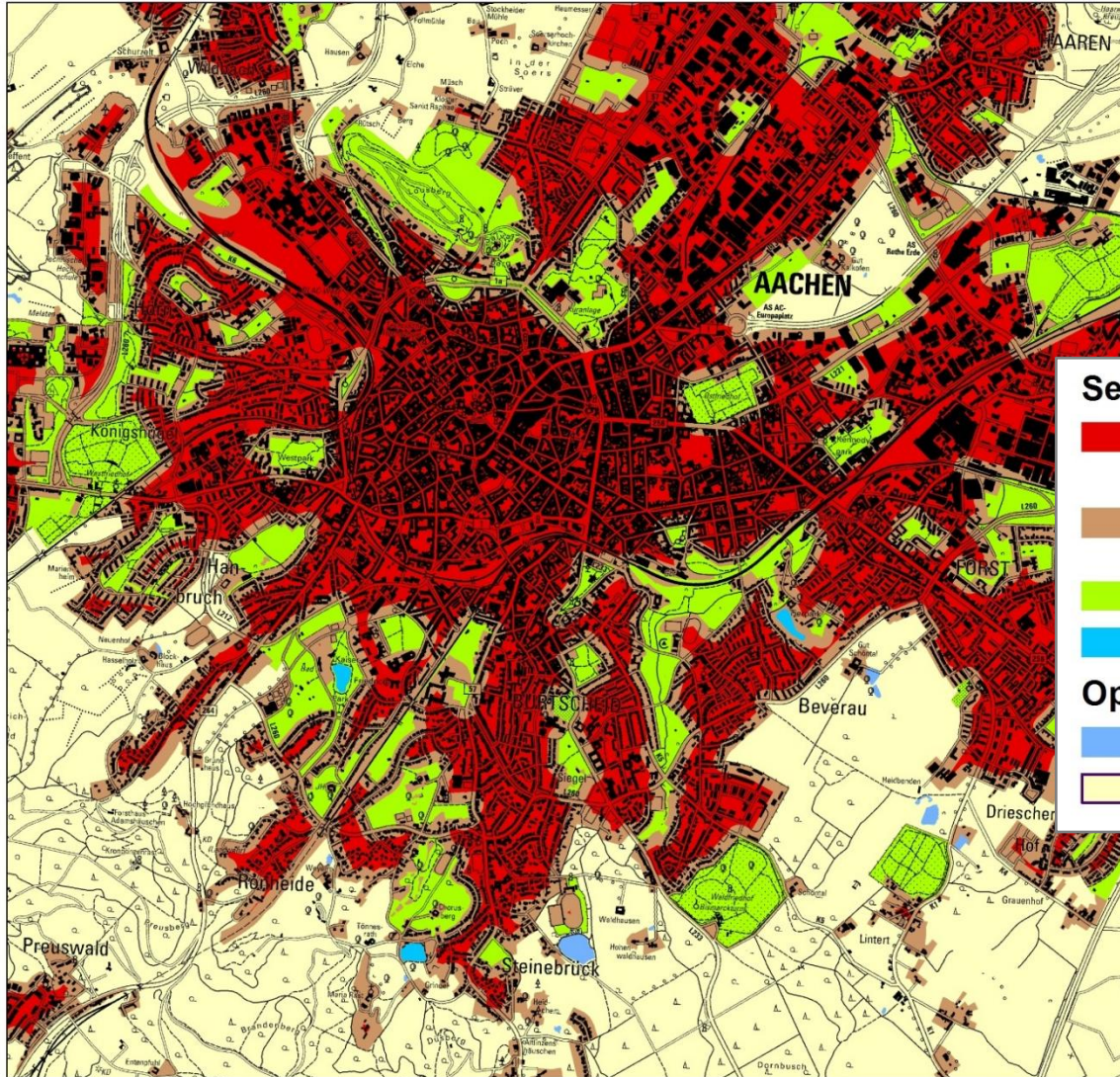




● Selected Cities*

- NB - Neubrandenburg
- OL - Oldenburg (Oldb)
- HAL - Halle (Saale)
- KR - Krefeld
- DD - Dresden
- AC - Aachen
- LD - Landau i. d. Pfalz

* Urban municipalities
with contrasting settlement structures
and > 40,000 inhabitants

(1) Analysis of core areas



 
Map 2.AC: Urban Green Space 2008
Thesis T02 Core Area
Proportion of deficit area in urban area: 49.2%

Settlement

- Urban area* with deficit area**
- Area of influence of urban green space (incl. waterbody) and open space on the urban area
- Urban green space***
- Waterbody in urban area***

Open space


- Waterbody in open space
- Other areas in the municipality

Green space (incl. waterbody) in urban area:
Minimum size 1 ha

0 0.2 0.4 0.6 0.8 1 km

Source:
ATKIS Basis-DLM © GeoBasis-DE / BKG 2009

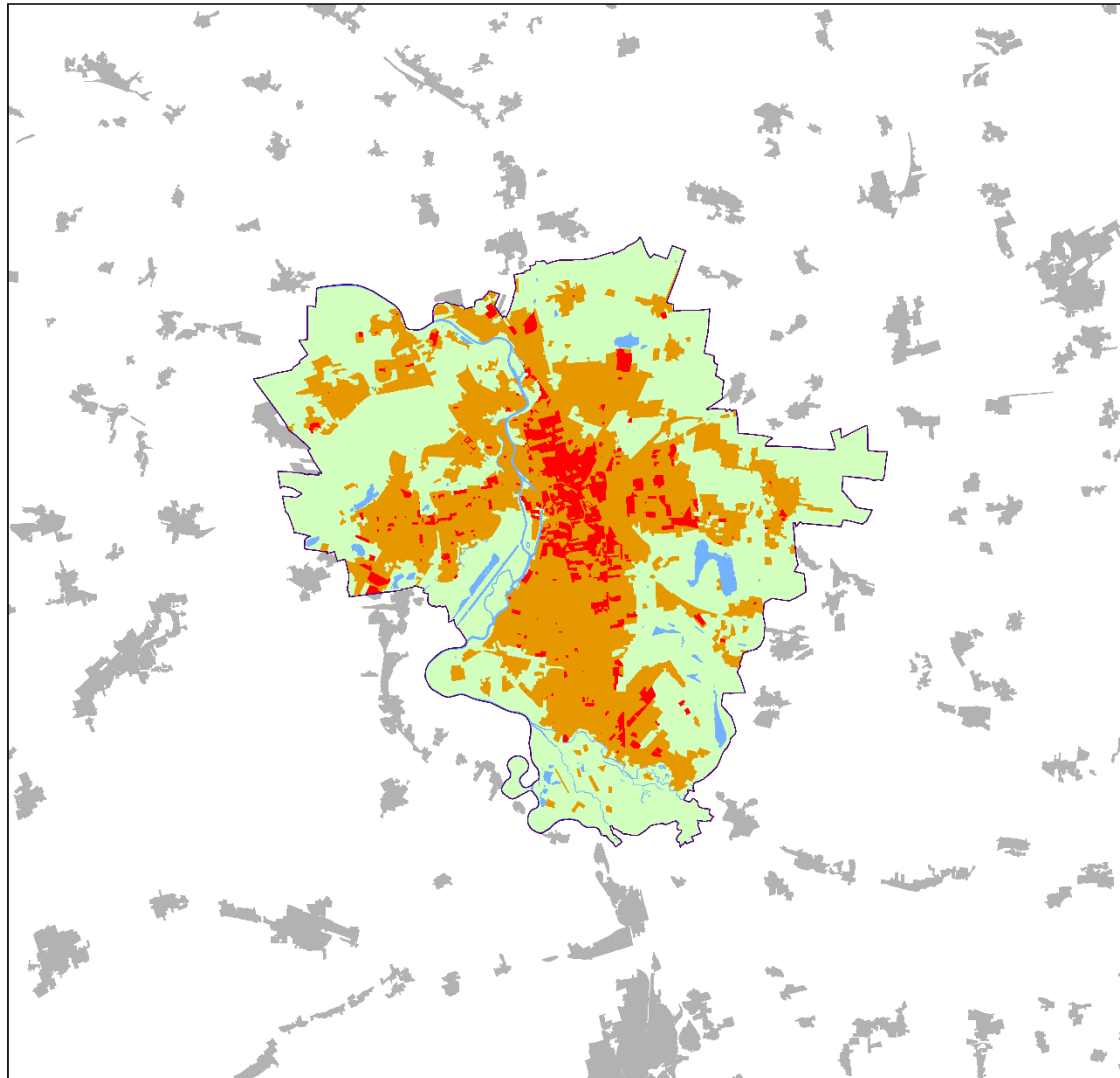
Processing:
Anne Bräuer & Ulrich Schumacher, Dresden 2013


 Leibniz Institute of
Ecological Urban and
Regional Development

(1) Analysis of core areas - results


City	Ratio of core areas to the total settlement area [%]
Aachen	49
Dresden	44
Halle	46
Krefeld	54
Landau	55
Neubrandenburg	47
Oldenburg	54

(2) Identification of polygons with a coverage ratio >30 %





HALLE (Saale)
Grünversorgung
Defizitflächen zum Siedlungsgrün sowie durch Überbauung

Settlement

-  Settlement area coverage > 30 %
-  Other Settlement Area


Open space

-  Waterbody in open space
-  Other areas in the municipality

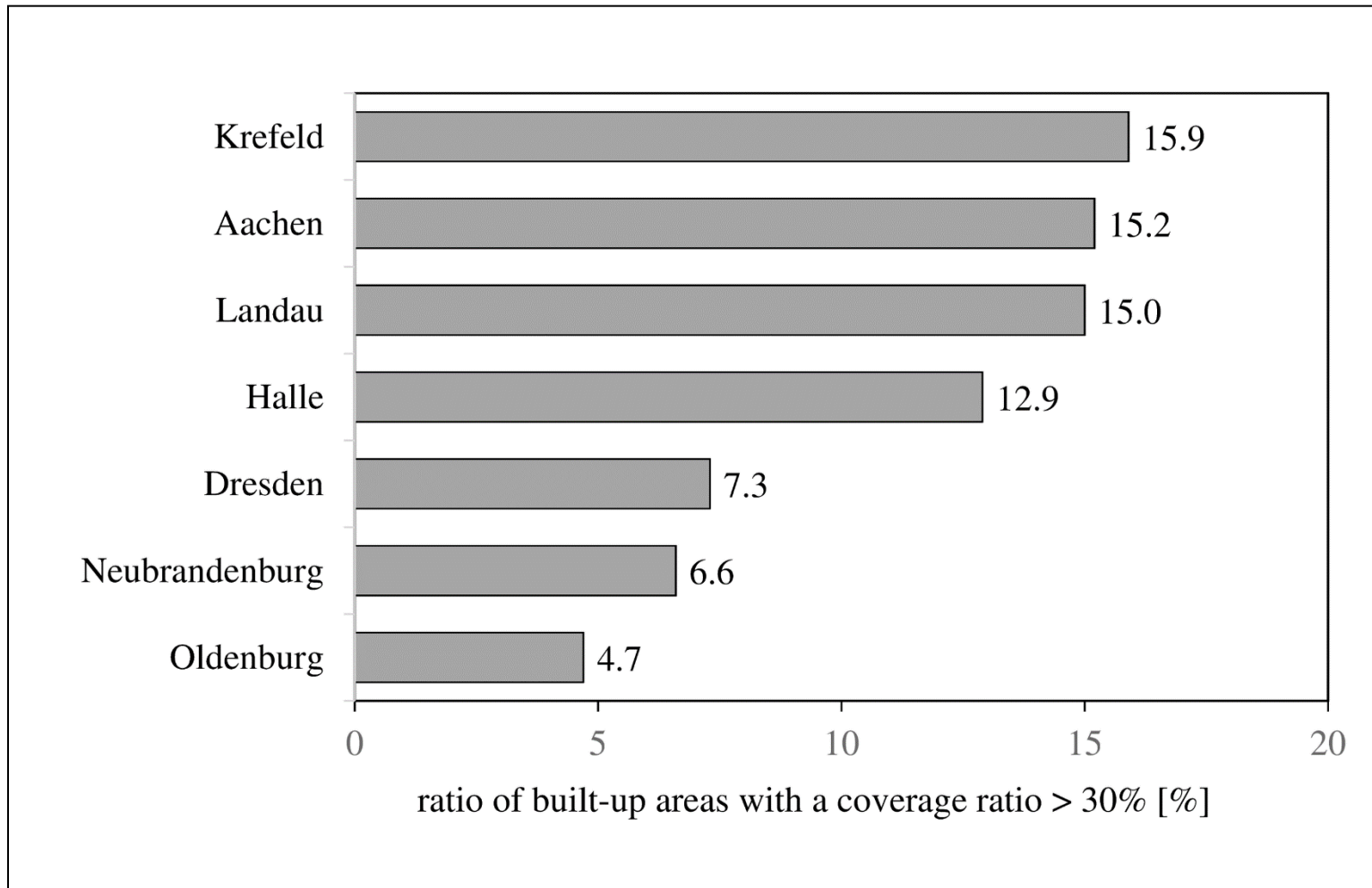
0 1 2 3 4 5 km

Datenquelle:
© GeoBasis-DE / BKG 2009

Bearbeitung:
Anna Bräuer & Ulrich Schumacher, Dresden 2014



(2) polygons with a coverage ratio >30 % - results



(3) Overlay of core areas with the densely built-up structures – results

City	Ratio of at-risk areas * within settlement area [%]
Aachen	12.2
Dresden	4.7
Halle	8.8
Krefeld	12.8
Landau	11.0
Neubrandenburg	4.1
Oldenburg	3.2

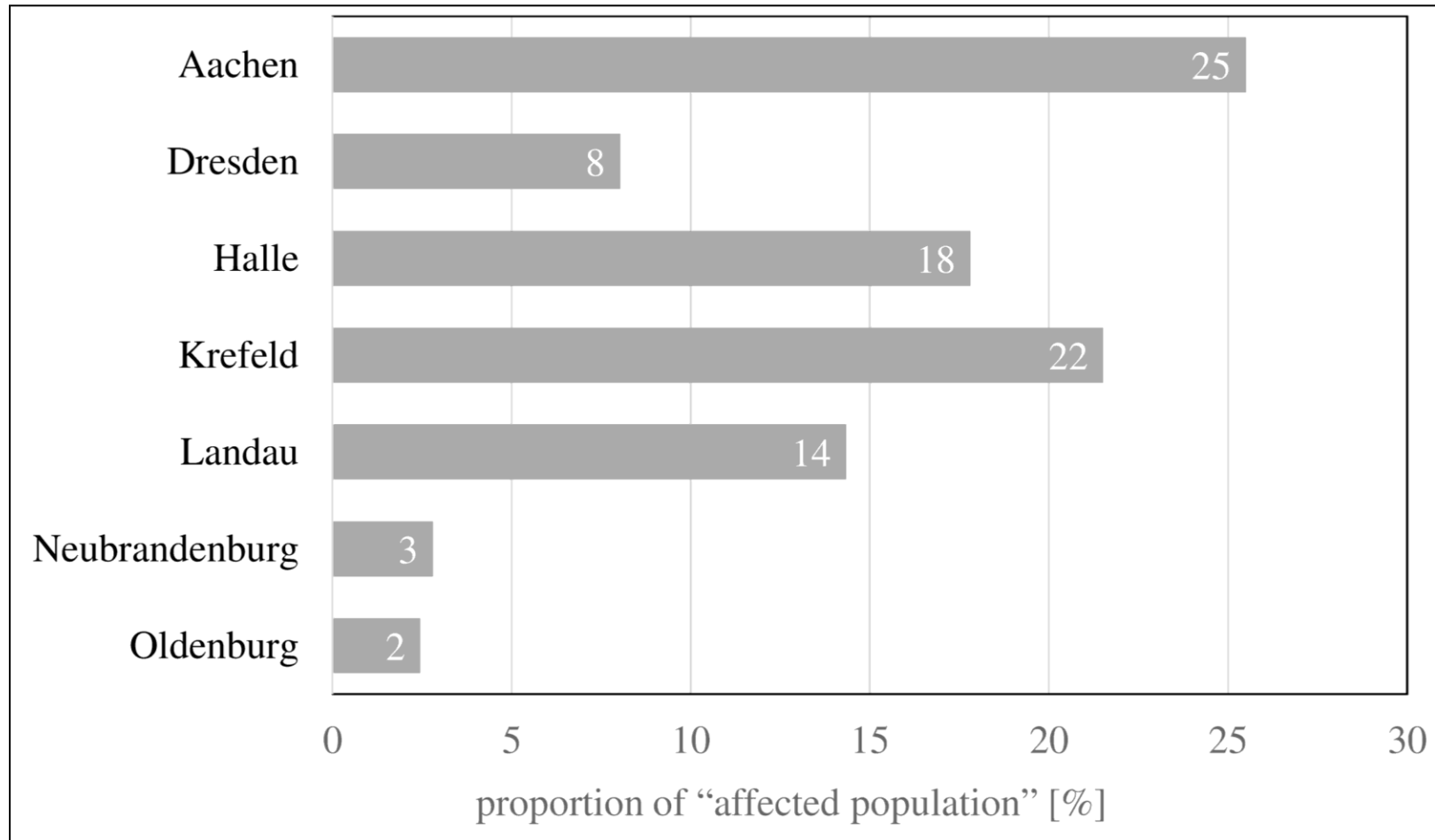
*Area ratios indicating the extent of potentially critical sites in the settlement area on hot summer days (heat islands).
 (coverage ratio > 30% and which are not adjacent to green spaces/water bodies or to outlying open space).

(4) Measuring the distance between densely built-up areas and green space/water bodies using raster data – results

Town/city	Average Euclidean distance to green space in settlement area (cell width = 100 m) [m]	Maximum Euclidean distance to green space in settlement area (cell width = 100 m) [m]
Aachen	368	943
Dresden	266	707
Halle	303	707
Krefeld	338	860
Landau	281	539
Neubrandenburg	254	632
Oldenburg	264	640

City comparison – distances (proximity values) characterising the accessibility of green spaces and bodies of water.

(5) Correlation of potential at-risk areas with the raster map of population data from the National Census 2011



City comparison – ratios of "affected population" in the investigated towns

Multi-criteria assessment based on extremum normalisation of indicators

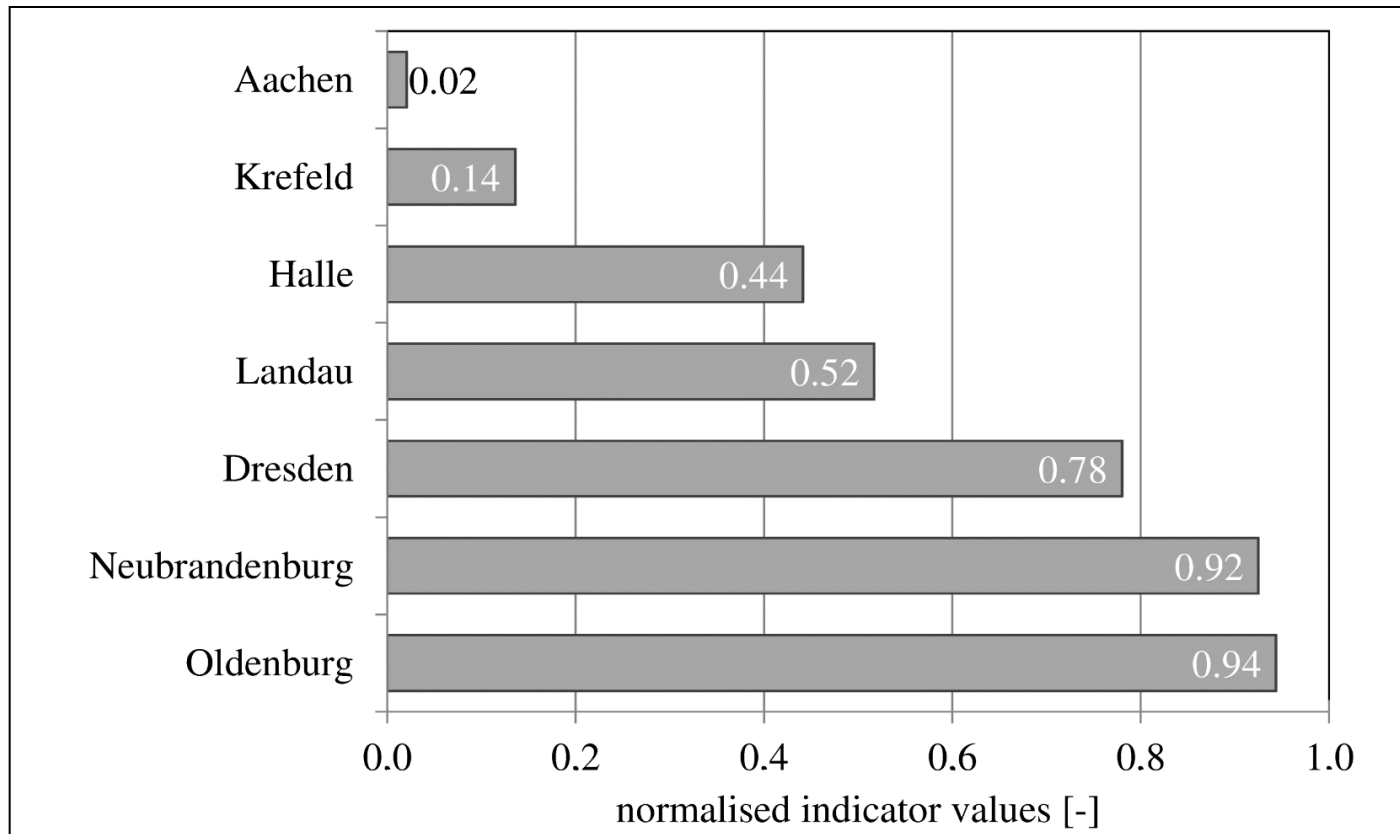


Figure 9: City comparison on the microclimatic impact of green space and water bodies within the settlement area on the basis of a multi-factor assessment with normalisation of extreme values – the normalised indicator values are summed and then normalised a second time (Data source: © GeoBasis-DE / BKG 2009)

Conclusion

- “Visual” structural form analysis of urban areas can be linked with indicators of “good” life
- The comparative analysis presents Oldenburg (a city of predominantly single family homes) as “best” case
- Comparative analysis needs accompanying contrasting indicators to assess sustainability of urban form and land use pattern
- The presented results are part of a larger multicriterial analysis of cities → Outlook

Matrix of Analysis

No.	Main Topic (Thesis / „Leitbild“)	Focus Area	Data Layer	Physiognomy						Level
				Comple- xity	Hetero- genity	Core Area	Proxi- mity	Split- ting	Other	
T01	Indentation of urban area and open space	M	UA	+	+	+				C
T02	Location and size of public green space in the urban area	UA	TO			+	+			UD
T03	Fragmentation of urban area	M	UA		+		+			C
T04	Decentralized concentration of industry and commerce	M	UA,TO		+		+			C
T05	Spatial and environmental effects of traffic in the urban area	M	UA,TO					+		C
T06	Relations between building height, building distance and structure	BA	B,UST						+	UD
T07	Relations between site density and urban climate	M	B,UST			+				UD
T08	Influence of building compactness on urban ecology	UA	B,UST				+			UD
T09	Ratio of building volume to surface	M	B						+	UD
T10	Diversity of urban structures and their distribution	M	UST		+				+	UD

M – Municipality
 UA – Urban area
 BA – Built-up area
 UST – Urban structure type
 TO – Topographic object
 B – Building

C – City Map scale 1:100,000
 UD – Urban district Map scale 1:25,000

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