



Green Infrastructure: Nature Based Solutions for Sustainable and Resilient Cities – 4-7 April 2017, Orvieto, Italy



GREEN SURGE

Assessing and mapping ecosystem services generated by urban GI

Nadja Kabisch, Humboldt-Universität zu Berlin

April 04, 2017, Orvieto, SESSION 11



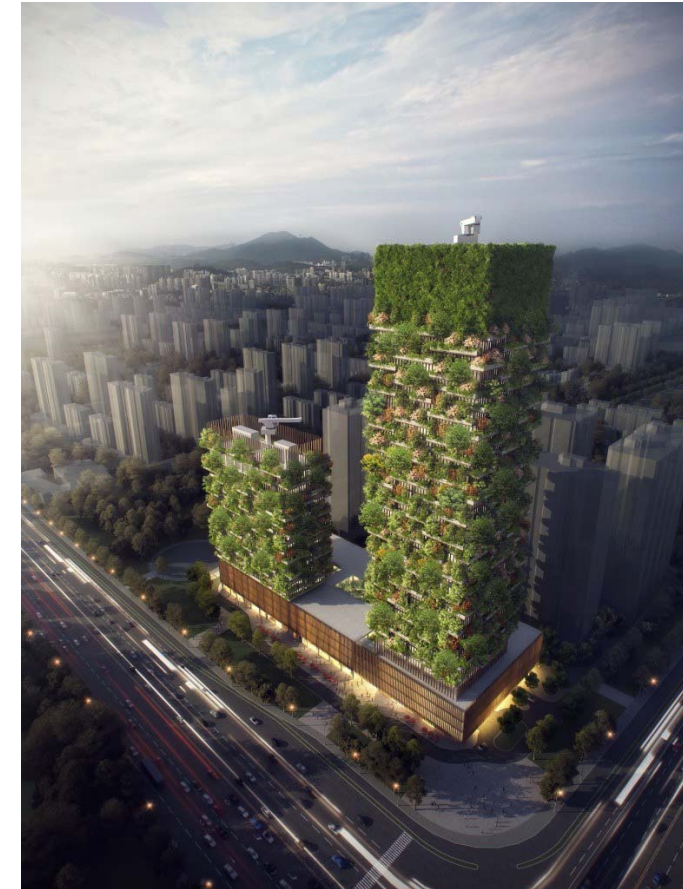
the
URBES
project



Green Infrastructure – What is it?

Green Infrastructure (GI) is an interconnected network of green space “that supports native species, maintains natural ecological processes, sustains air and water resources and contributes to the health and quality of life” (Benedict and McMahon, 2006:281).

GI comprises a number of environmental features.



Green Infrastructure – features: Typology and Inventory in GREEN SURGE

No. UGS element	Description	Example
12 green playground, school ground	Green areas intended for playing or outdoor learning.	
13 riverbank green	Green space sideways the rivers, streams and canals, usually with foot or bike paths.	
14 large urban park	Larger green area within a city intended for recreational use by urban population, can include different features such as trees, grassy areas, playgrounds, water bodies, ornamental beds, etc.	
15 historical park/garden	Similar to large urban parks, but with distinct management due to heritage status.	

A TYPOLOGY OF URBAN GREEN SPACES, ECO-SYSTEM SERVICES PROVISIONING SERVICES AND DEMANDS

Report: D3.1:

Work package 3:

Partners involved:

Researchers:

Description:

Functional linkages

UL, UBER, TUM, SRC, FCRA, UH, FFCL

C. Braquinhó, R. Cvejčić, K. Eler, P. Gonzales, D. Haase, R. Hansen, N. Kabisch, E.

Lorance Rall, J. Niemelä, S. Paulic, M. Pinter, R. Lafortezza, A. Santos, M.

Strohbach, K. Vierikko, Š. Železnikar

The report outlines the different types of urban green spaces, ESS provisioning and demand for green space as a part of the EU FP7 (ENV.2013.6.2-5-603567) GREEN SURGE project (2013-2017)



Primary authors: Rozalija Cvejčić, Klemen Eler, Marina Pinter, Špela Železnikar (UL, Slovenia), Dagmar Haase, Nadja Kabisch, Michael Strohbach (UBER, Germany)
V10 - May 13th 2015



Green Infrastructure – Mapping and Assessing

GI as a concept is already included in practice of spatial planning in urban areas

Principles for UGI planning: Multifunctionality, connectivity, multi-level, social inclusiveness and adoption of a communicative approach (Pauleit et al., 2011; Hansen & Pauleit, 2014).

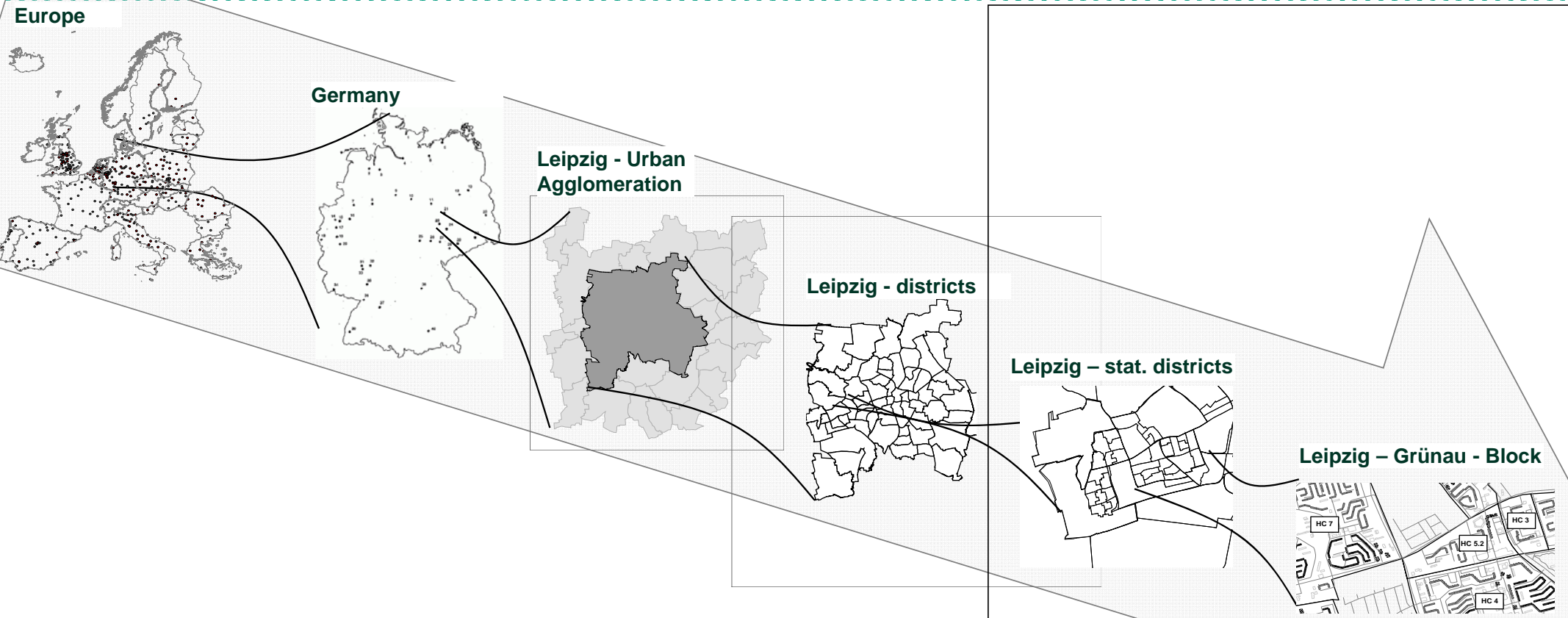
→ GI concept refers to different spatial scales (European, national, local)

→ Assessed with a multi-method approach using multiple data: different data sources, different methods (GIS, statistics)



Green Infrastructure – Mapping and Assessing: spatial scales, data and methods

Green Infrastructure – Mapping and Assessing: spatial scales



Green Infrastructure – Mapping and Assessing: data

UN Welcome to the United Nations. It's your world. Search UN Website Go

Global: UN World urbanization prospects

United Nations Department of Economic and Social Affairs
Population Division
World Urbanization Prospects, the 2014 revision

WUP Home Questions and Answers Data Reports/Documents World Population Prospects Population Division

The Population Division of the Department of Economic and Social Affairs of the United Nations has been issuing, since 1988, every two years revised estimates and projections of the urban and rural populations of all countries in the world, and of the population of agglomerations. This web site presents the main findings of the **2014 Revision of World Urbanization Prospects** (United Nations, 2013). The *World Urbanization Prospects* are used widely throughout international organizations, research centers, academic researchers and the media.

Quick Navigation

Country Profiles Interactive Data

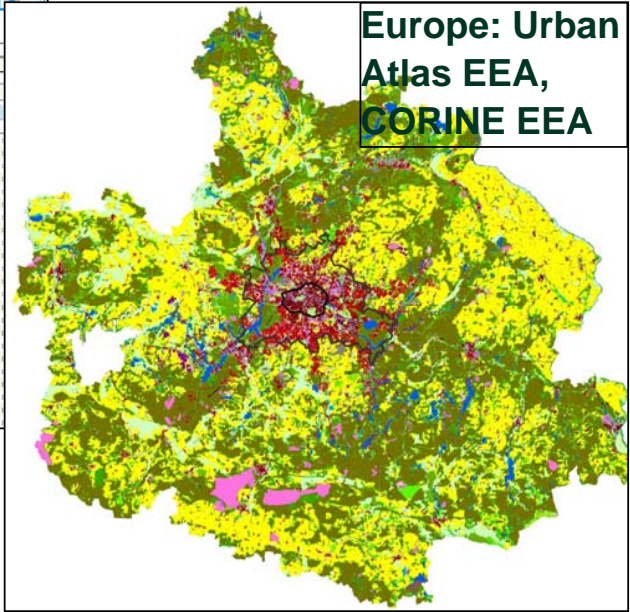
appso.eurostat.ec.europa.eu/nui/show.do?dataset=urb_cenv&lang=de

Europe: Eurostat, Urban Audit

Umwelt - Städte und Ballungsräume
Letzte Aktualisierung: 05-09-2016

Urbane Audit Indikatoren
Tägliche Sonnenscheindauer in Stunden

CITIES	2006	2007	2008	2009	2010	2011	2012
Belgien	:	:	:	:	:	:	:
Brüssel / Brussel	:	:	4,06	:	:	:	5,00
Aachener	:	:	4,06	:	:	:	5,00
Gent	:	:	5,15	:	:	:	5,00
Charleroi	:	:	3,31	:	:	:	5,00
Lüttich	:	:	4,45	:	:	:	5,00
Brüssel	:	:	4,52	:	:	:	5,00
Namur	:	:	4,41	:	:	:	5,00
Leuven	:	:	:	:	:	:	5,00
Mons	:	:	:	:	:	:	5,00
Kortrijk	:	:	:	:	:	:	5,00
Göteborg	:	:	:	:	:	:	5,00
Bulgarien	:	:	:	:	:	:	:
Sofia	:	:	:	:	:	:	:
Plovdiv	:	:	:	:	:	:	:
Varna	:	:	:	:	:	:	:
Burgas	:	:	:	:	:	:	:
Pleven	:	:	:	:	:	:	:
Ruse	:	:	:	:	:	:	:
Vidin	:	:	:	:	:	:	:
Stara Zagora	:	:	:	:	:	:	:
Silven	:	:	:	:	:	:	:
Dänemark	:	:	:	:	:	:	:



Green Infrastructure – Mapping and Assessing: data

National databases

DUSTAT Statistisches Bundesamt GENESIS-Online

City: kommunal databases

Stadt-Leipzig Leipzig-Informationssystem

Stadt-Daten	Kleinräumige Daten	Vergleichsdaten	Veröffentlichungen	Service																																																																																																						
<p>Stadt-Daten</p> <p>Kleinräumige Daten</p> <p>Lage und Territorium</p> <p>Bevölkerungsbestand</p> <p>Einwohner</p> <p>Einwohner nach Alter</p> <p>Einwohner nach Familienstand</p> <p>Einwohner mit Migrationshintergrund</p> <p>Wohnberechtigte Einwohner</p> <p>Wohnberechtigte Einwohner nach Alter</p> <p>Wohnberechtigte Einwohner nach Familienstand</p> <p>Einwohnerdichte</p> <p>Personenhaushalte</p> <p>Bevölkerungsbewegung</p> <p>Gesundheit und Soziales</p>	<p>Bevölkerungsbestand</p> <p>Einwohner insgesamt</p> <table border="1"> <thead> <tr> <th>Ortsteil / Stadtbezirk</th> <th>2011</th> <th>2012</th> <th>2013</th> <th>2014</th> <th>2015</th> </tr> </thead> <tbody> <tr> <td>00 Zentrum</td> <td>1.477</td> <td>1.703</td> <td>1.739</td> <td>1.748</td> <td>2.283</td> </tr> <tr> <td>01 Zentrum-Ost</td> <td>3.569</td> <td>3.750</td> <td>3.860</td> <td>4.123</td> <td>4.220</td> </tr> <tr> <td>02 Zentrum-Südost</td> <td>10.643</td> <td>11.110</td> <td>11.515</td> <td>11.892</td> <td>13.440</td> </tr> <tr> <td>04 Zentrum-Süd</td> <td>11.257</td> <td>11.647</td> <td>11.905</td> <td>12.204</td> <td>12.617</td> </tr> <tr> <td>04 Zentrum-West</td> <td>9.352</td> <td>9.624</td> <td>9.886</td> <td>10.218</td> <td>10.605</td> </tr> <tr> <td>05 Zentrum-Nordwest</td> <td>9.676</td> <td>9.884</td> <td>10.024</td> <td>10.320</td> <td>10.384</td> </tr> <tr> <td>06 Zentrum-Nord</td> <td>7.870</td> <td>8.129</td> <td>8.184</td> <td>8.424</td> <td>8.663</td> </tr> <tr> <td>0 Mitte</td> <td>54.024</td> <td>55.865</td> <td>57.383</td> <td>59.150</td> <td>62.182</td> </tr> <tr> <td>10 Schönefeld-Abtraundorf</td> <td>10.537</td> <td>10.837</td> <td>11.177</td> <td>11.483</td> <td>12.108</td> </tr> <tr> <td>11 Schönefeld-Ost</td> <td>9.025</td> <td>9.056</td> <td>9.190</td> <td>9.150</td> <td>9.438</td> </tr> <tr> <td>12 Mockau-Süd</td> <td>4.125</td> <td>4.179</td> <td>4.149</td> <td>4.226</td> <td>4.420</td> </tr> <tr> <td>13 Mockau-Nord</td> <td>10.406</td> <td>10.583</td> <td>10.611</td> <td>10.724</td> <td>11.028</td> </tr> <tr> <td>14 Thekla</td> <td>3.488</td> <td>3.476</td> <td>3.582</td> <td>3.619</td> <td>3.714</td> </tr> <tr> <td>15 Pläußig-Portitz</td> <td>2.636</td> <td>2.609</td> <td>2.617</td> <td>2.596</td> <td>2.612</td> </tr> <tr> <td>1 Nordost</td> <td>42.217</td> <td>42.740</td> <td>43.316</td> <td>43.938</td> <td>45.332</td> </tr> <tr> <td>20 Friedrichshagen</td> <td>8.409</td> <td>8.008</td> <td>8.068</td> <td>8.083</td> <td>8.184</td> </tr> </tbody> </table>	Ortsteil / Stadtbezirk	2011	2012	2013	2014	2015	00 Zentrum	1.477	1.703	1.739	1.748	2.283	01 Zentrum-Ost	3.569	3.750	3.860	4.123	4.220	02 Zentrum-Südost	10.643	11.110	11.515	11.892	13.440	04 Zentrum-Süd	11.257	11.647	11.905	12.204	12.617	04 Zentrum-West	9.352	9.624	9.886	10.218	10.605	05 Zentrum-Nordwest	9.676	9.884	10.024	10.320	10.384	06 Zentrum-Nord	7.870	8.129	8.184	8.424	8.663	0 Mitte	54.024	55.865	57.383	59.150	62.182	10 Schönefeld-Abtraundorf	10.537	10.837	11.177	11.483	12.108	11 Schönefeld-Ost	9.025	9.056	9.190	9.150	9.438	12 Mockau-Süd	4.125	4.179	4.149	4.226	4.420	13 Mockau-Nord	10.406	10.583	10.611	10.724	11.028	14 Thekla	3.488	3.476	3.582	3.619	3.714	15 Pläußig-Portitz	2.636	2.609	2.617	2.596	2.612	1 Nordost	42.217	42.740	43.316	43.938	45.332	20 Friedrichshagen	8.409	8.008	8.068	8.083	8.184			
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City: Survey

und den Freistaat Sachsen



Fragebogen

für die Einwohnerbefragung in Johanneergeorgenstadt

UFZ-Umweltforschung
Sektion Ökonomie,
AG Stadt- und
Permos
04318

bogen wird am

Participatory GIS

Measurements sensor-based

PERFORMANCE BERLIN'S GREEN SPACES

EXPERIENCE BERLIN'S GREEN SPACES

What green space values do you find best? (Check all that apply!)

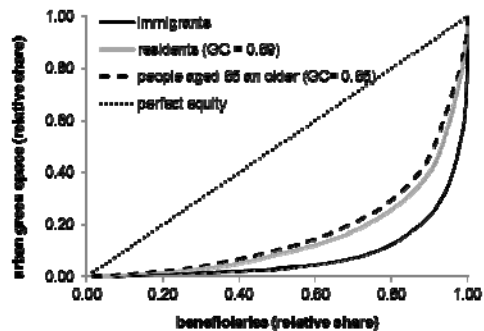
- Recreational opportunities
- Cultural heritage and place identity
- Recreational experience and education
- Recreational and relaxation for nature
- Recreation
- Recreational opportunities
- Recreational diversity
- Pleasant sounds like birds singing
- Other value

What features of this place contribute to why do you find here?

Green Infrastructure – Mapping and Assessing: methods

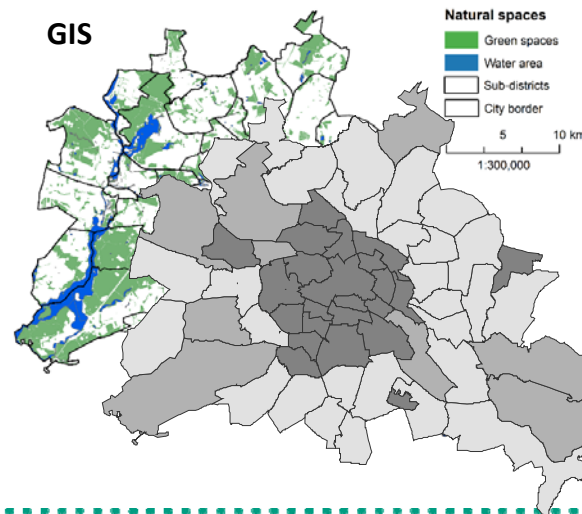
- Bi- und multivariate statistics: Descriptive, Regression, Correlation, Cluster (SPSS; Statistica; R)
- Geographical Information Systems (GIS): Land use, land cover (change), visualization
- Indicator development
- Qualitative: Focus groups, Scenario development workshops, Expert interviews

Statistics

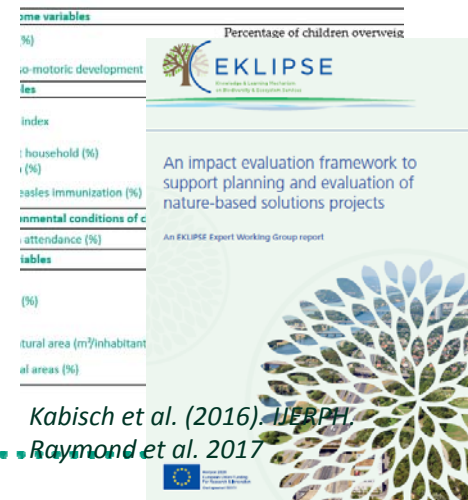


Kabisch und Haase (2014). Land.

GIS



Indicators



Kabisch et al. (2016). IJERPH.
Raymond et al. 2017

Scenario workshops

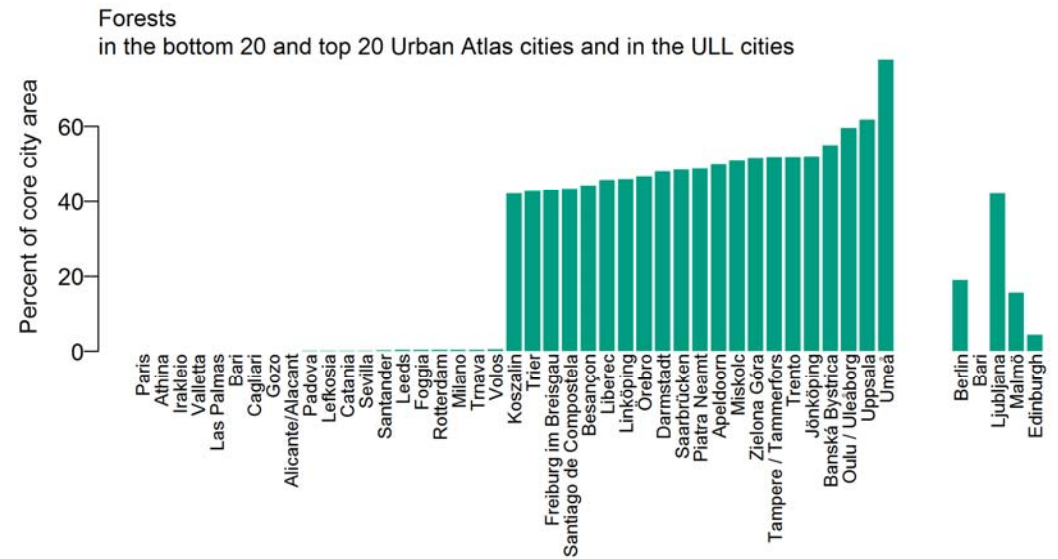
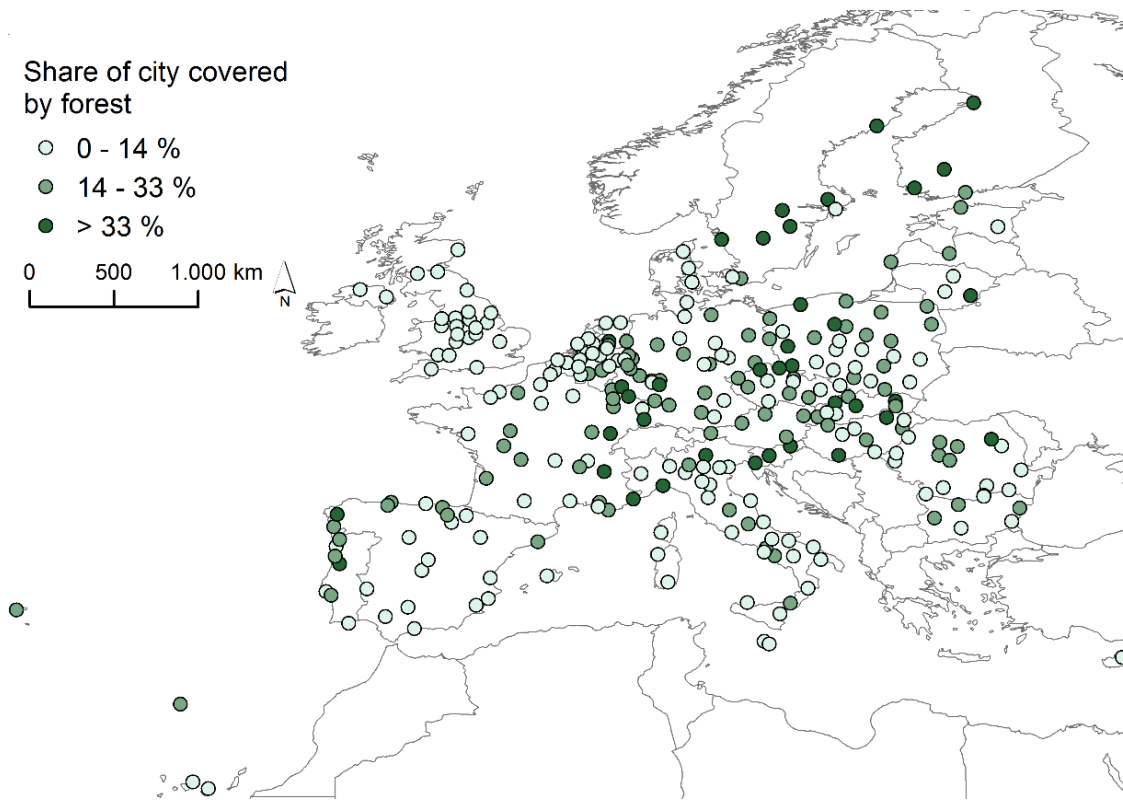


Kabisch (2015). Land Use Policy.

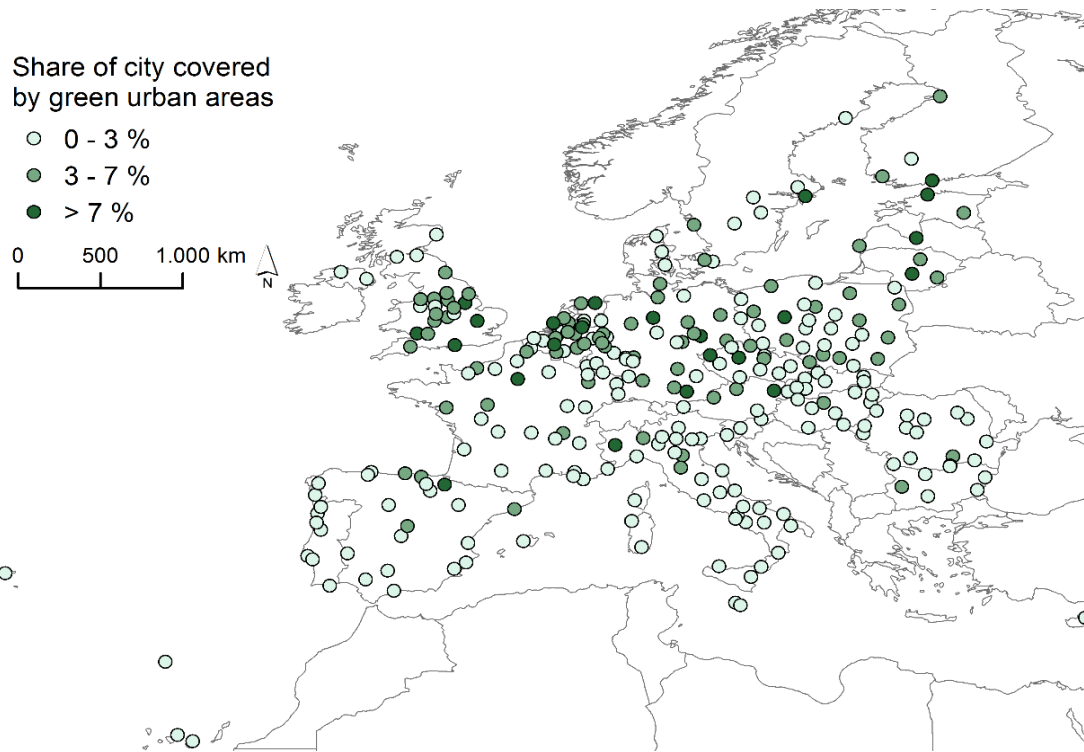
Green Infrastructure – Mapping and Assessing: Results from GREEN SURGE and URBES

European city level

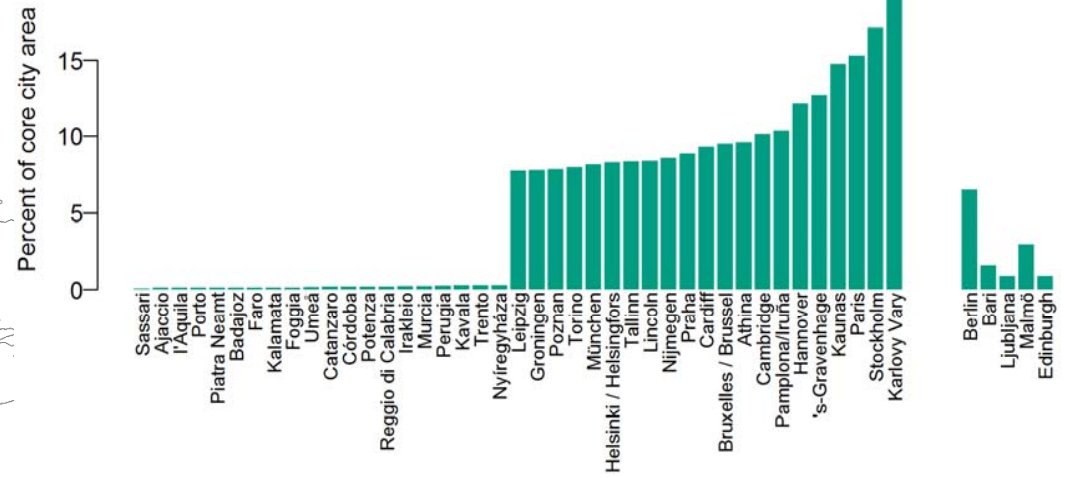
Green Infrastructure – spatial scales – European scale



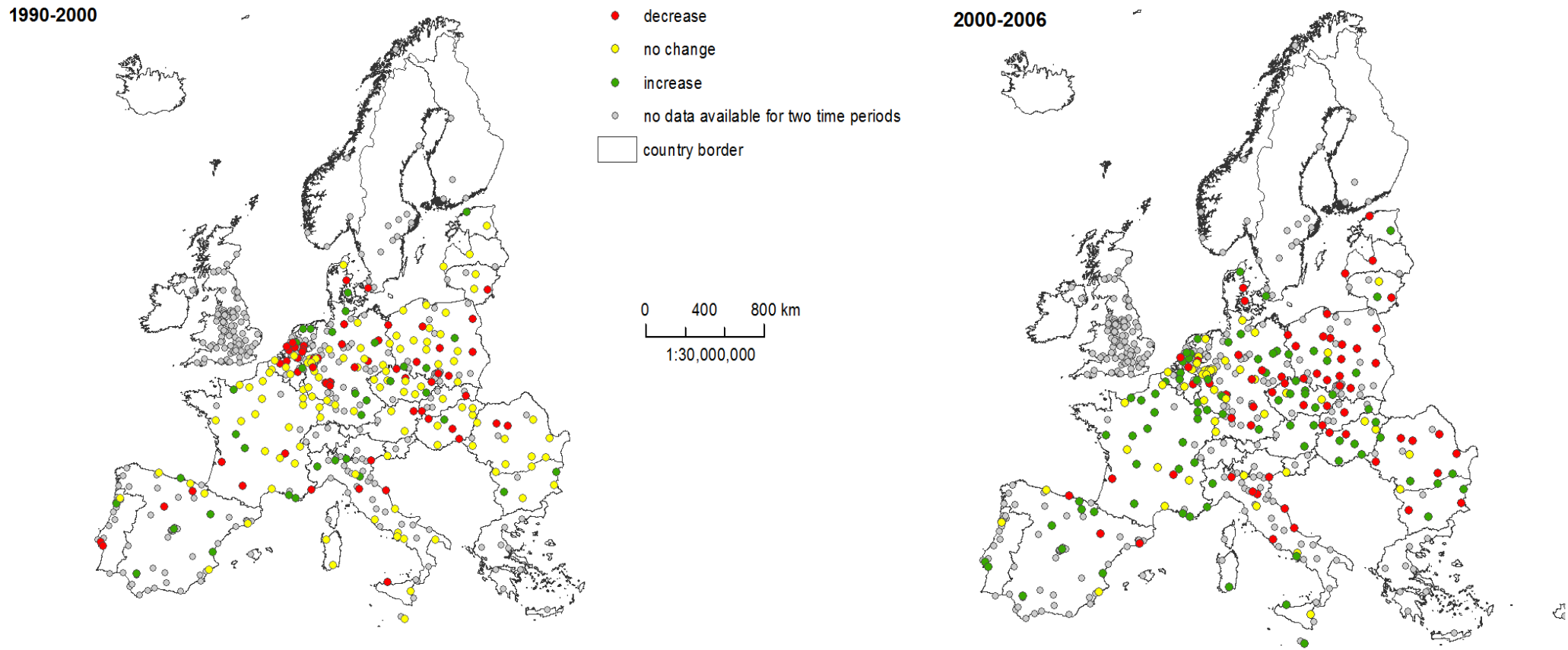
Green Infrastructure – spatial scales – European scale



Green urban areas in the bottom 20 and top 20 Urban Atlas cities and in the ULL cities

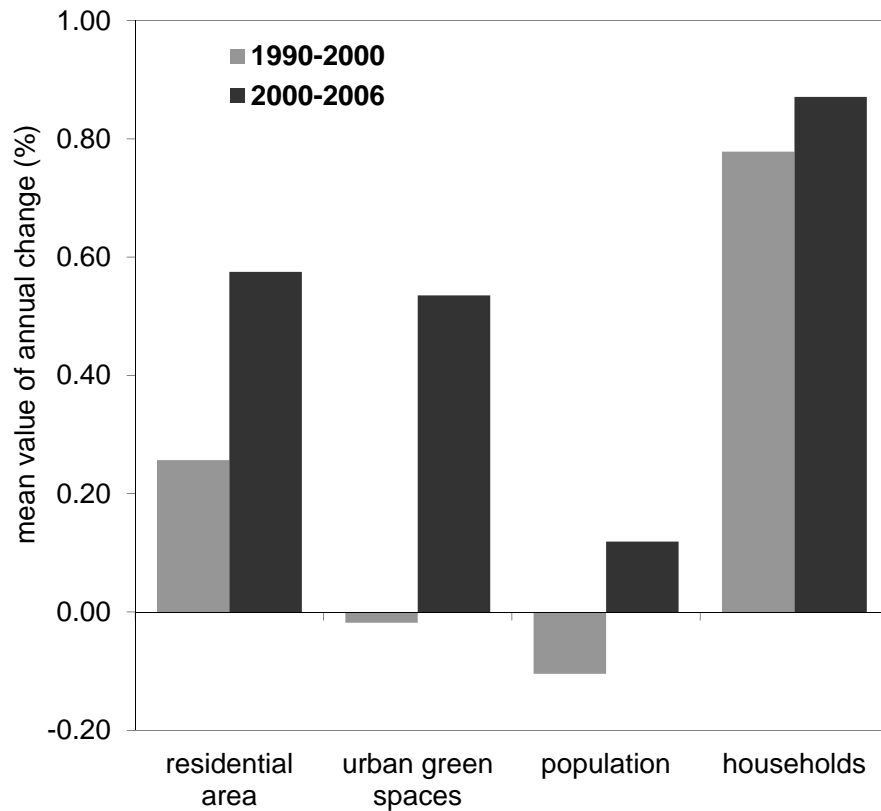


Green Infrastructure – spatial scales – European scale

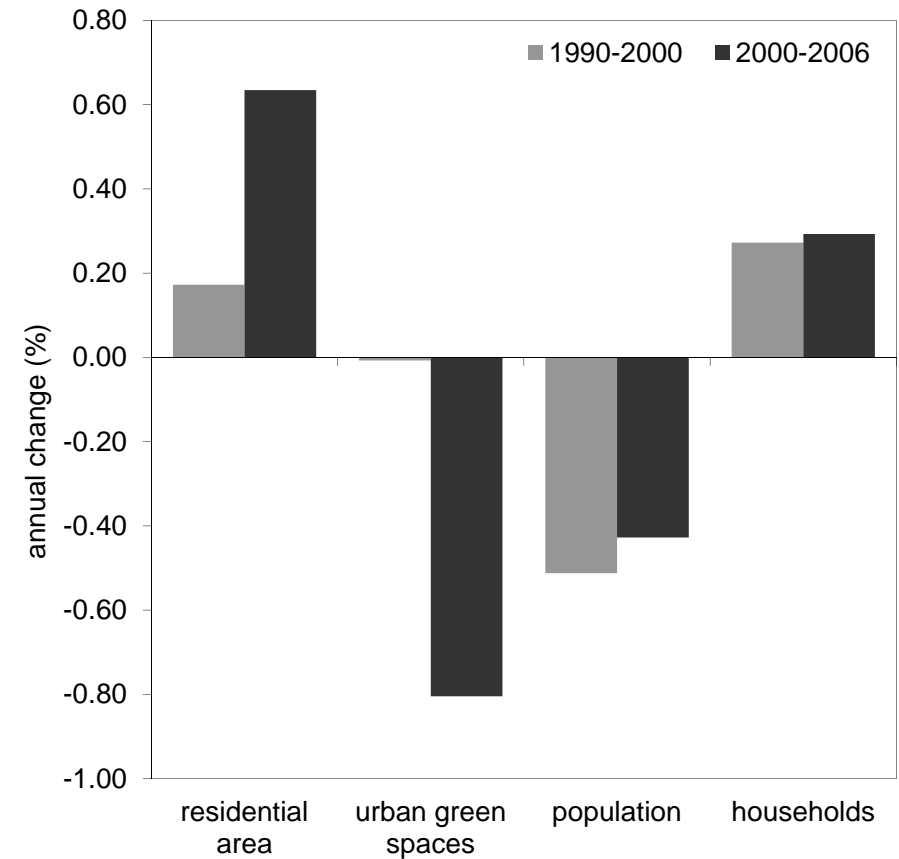


Green Infrastructure – spatial scales – European scale

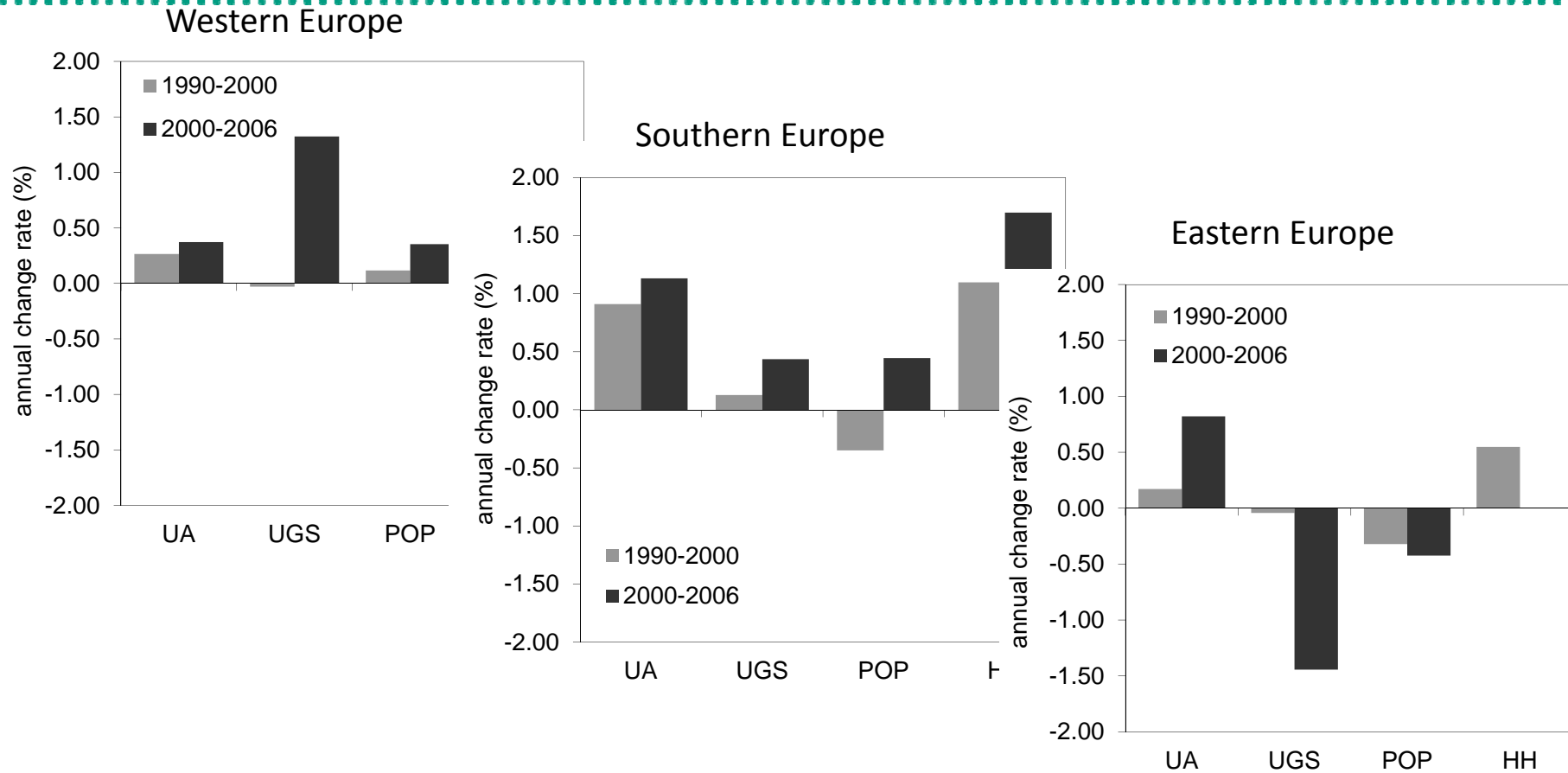
All cities



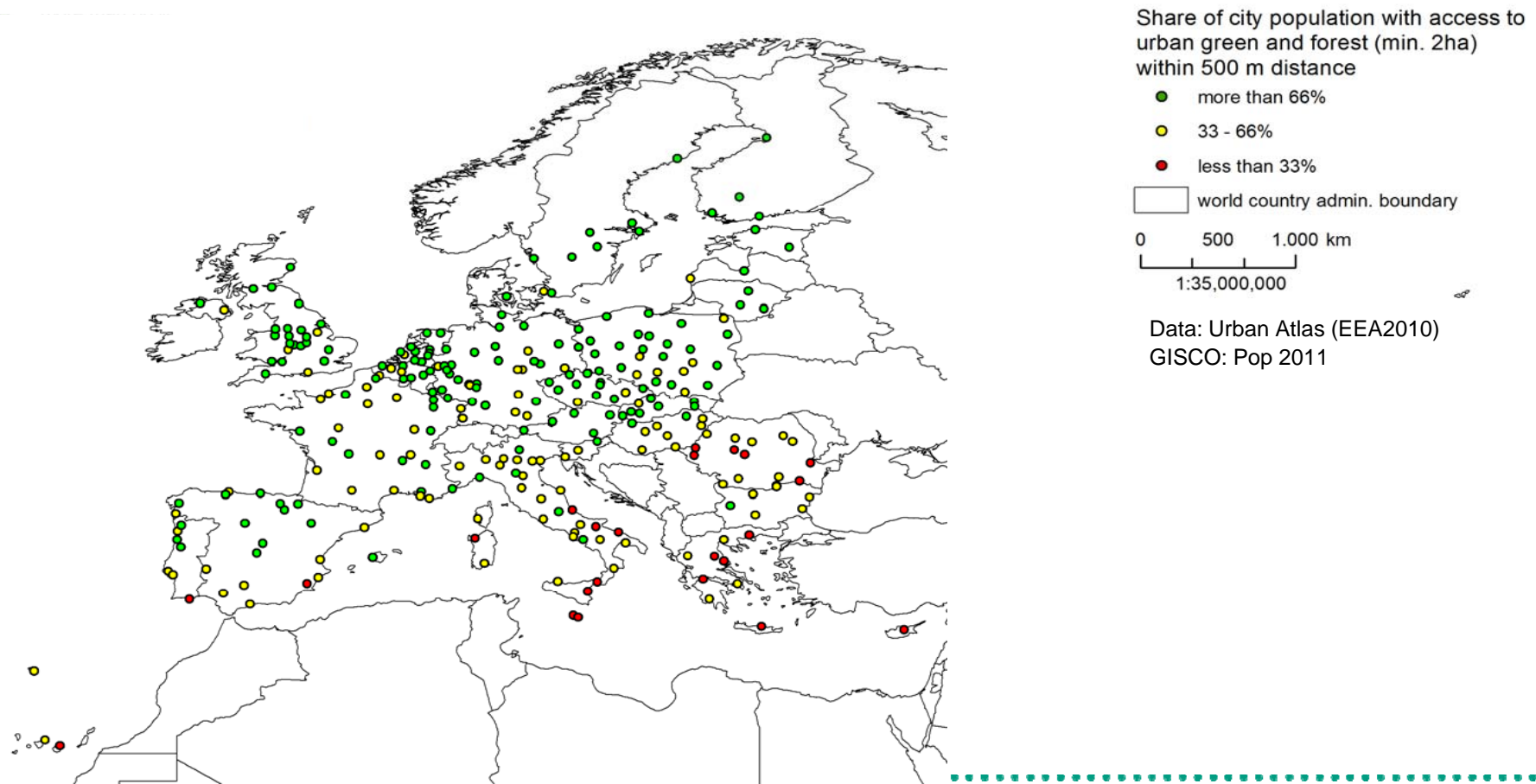
Shrinking cities



Green Infrastructure – spatial scales – European-regional scale



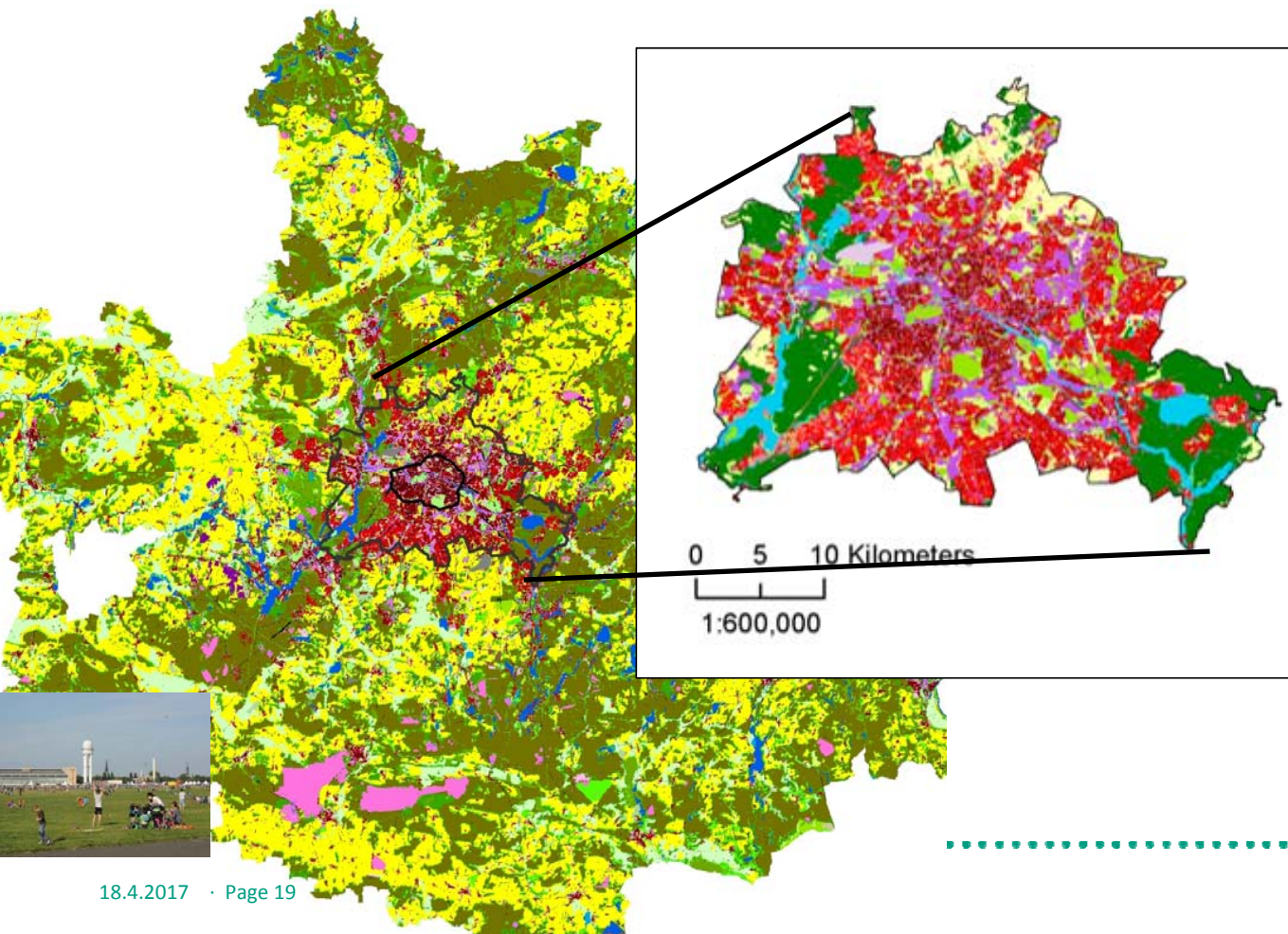
Green Infrastructure ESS mapping – spatial scales – European scale



City level

Green Infrastructure ESS mapping – spatial scales – city scale

Urban Atlas data 2006 (EEA 2010): Urban Agglomeration/City Berlin

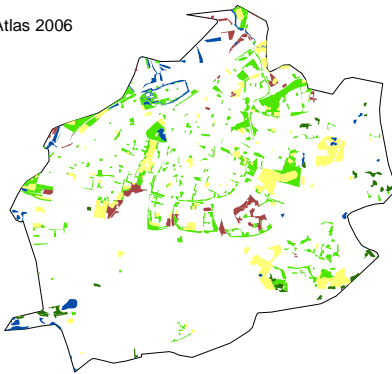


- Continuous urban fabric (S.L > 80%)
- Discontinuous dense urban fabric (S.L 50%- 80%)
- Discontinuous medium dense urban fabric (S.L 30%- 50%)
- Discontinuous low dense urban fabric (S.L 10%- 30%)
- Discontinuous very low dense urban fabric (S.L <10%)
- Isolated structures
- Industrial, commercial, public, military and private units
- Fast transit roads and associated land
- Other roads and associated land
- Railways and associated land
- Port areas
- Airports
- Mineral extraction and dump sites
- Construction sites
- Land without current use
- Green urban areas
- Sports and leisure facilities
- Agricultural Areas
- Forests and semi-natural areas
- Wetlands
- Water

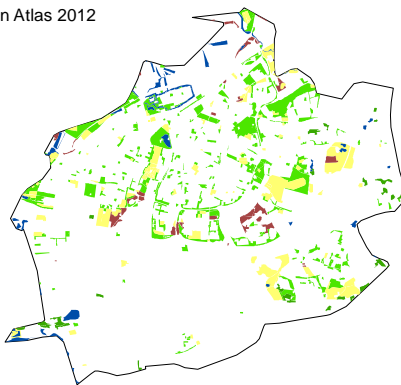
Green Infrastructure ESS mapping – spatial scales – city scale

Land cover change based on Urban Atlas land cover data Malmö (EEA 2010)

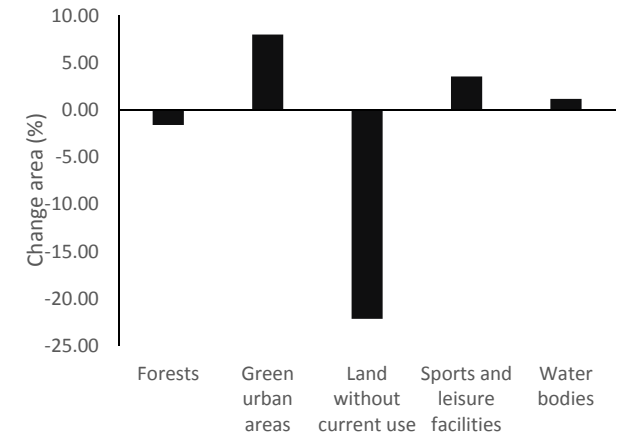
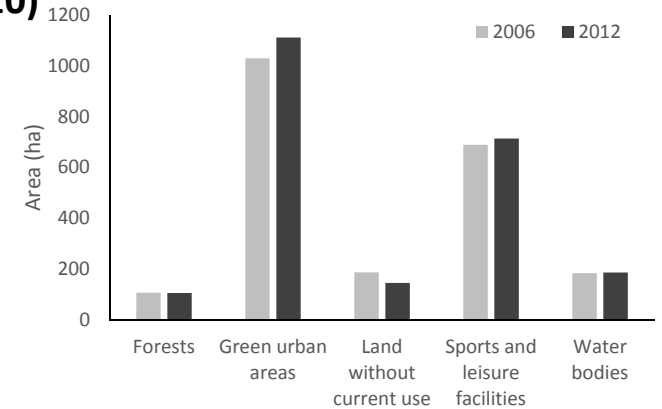
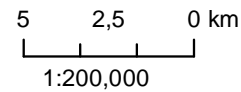
Urban Atlas 2006



Urban Atlas 2012



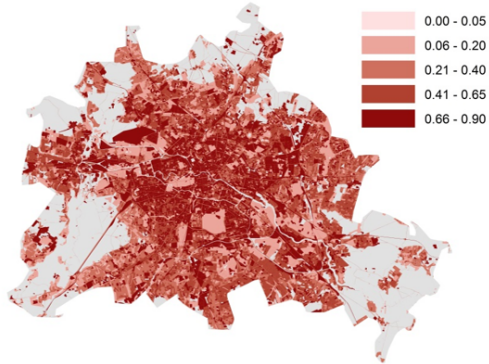
- Land without current use
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- Water



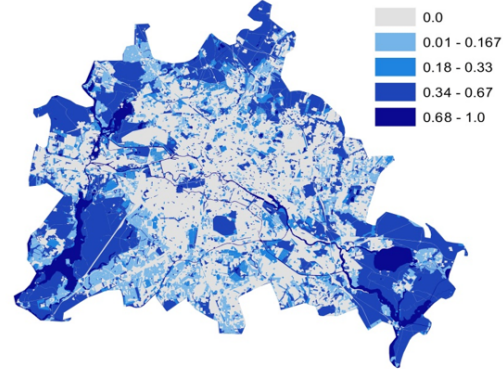
Green Infrastructure ESS mapping – spatial scales – city scale

Regulating ESS performance based on Urban Atlas land cover data Berlin (EEA 2010)

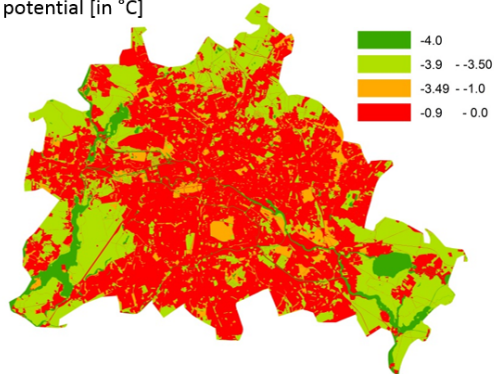
Sealing [in %]



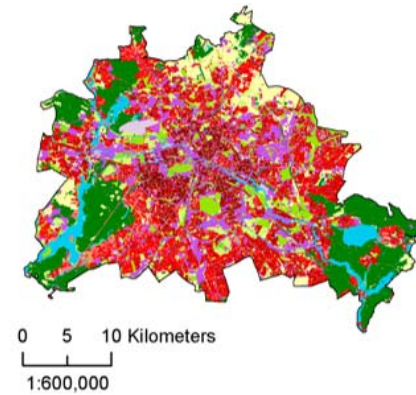
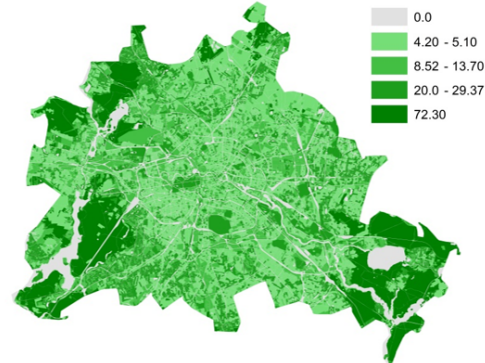
Evapotranspiration [standardizes value]



Cooling potential [in °C]



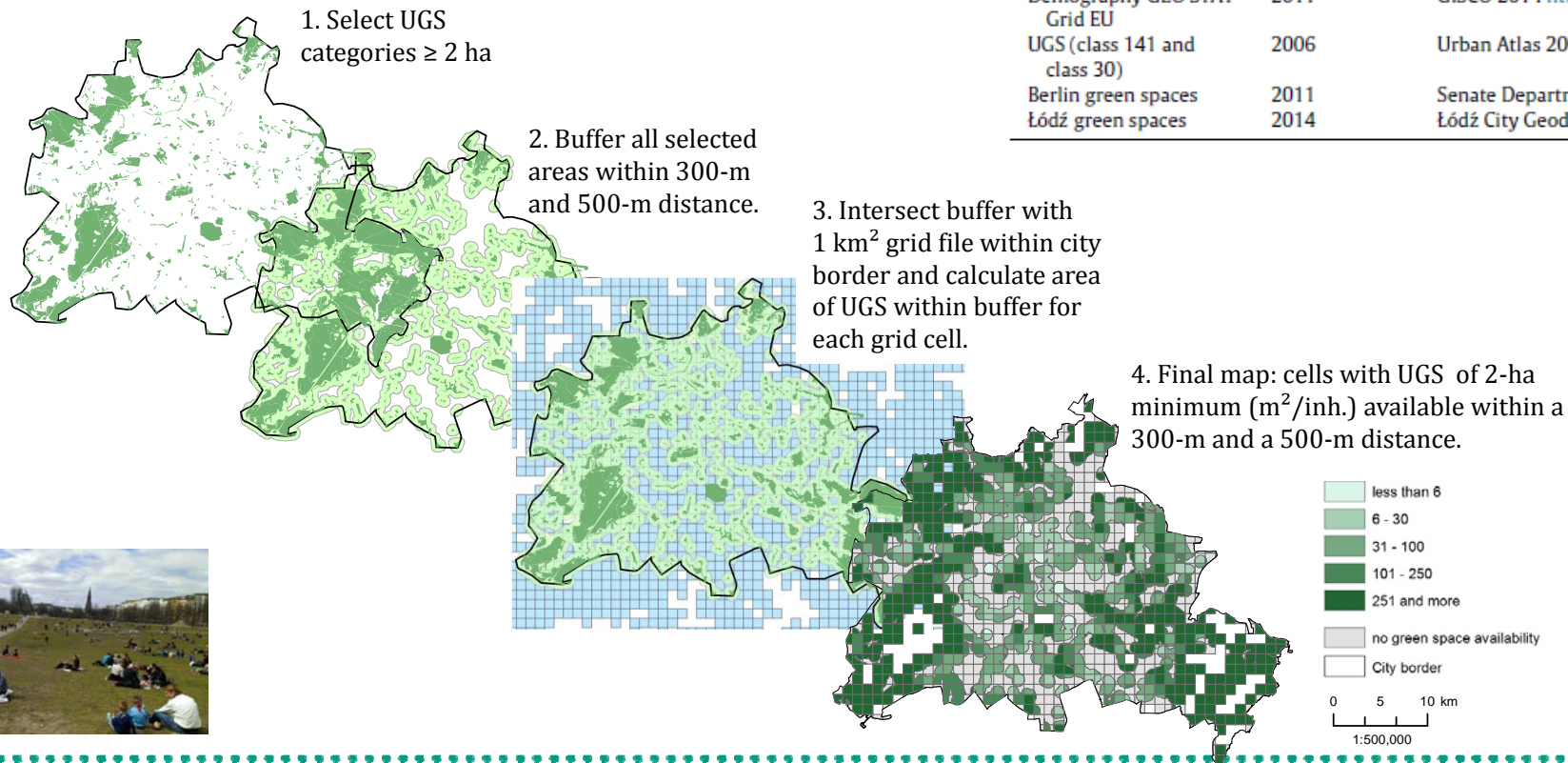
Above ground carbon storage [in tC/ha]



Green Infrastructure ESS mapping – spatial scales – city scale

Urban green space accessibility GREEN SURGE Berlin

Data	Reference year	Source
Administrative city boundaries European sample	2004	GISCO Urban Audit http://ec.europa.eu/eurostat/web/gisco/geodata/re
Demography GEO STAT Grid EU	2011	GISCO 2014 http://ec.europa.eu/eurostat/web/gisco/geodata/reference
UGS (class 141 and class 30)	2006	Urban Atlas 2006 (EEA, http://www.eea.europa.eu/data-and-maps/dat)
Berlin green spaces	2011	Senate Department for Urban Development and the Environment
Łódź green spaces	2014	Łódź City Geodesy Center

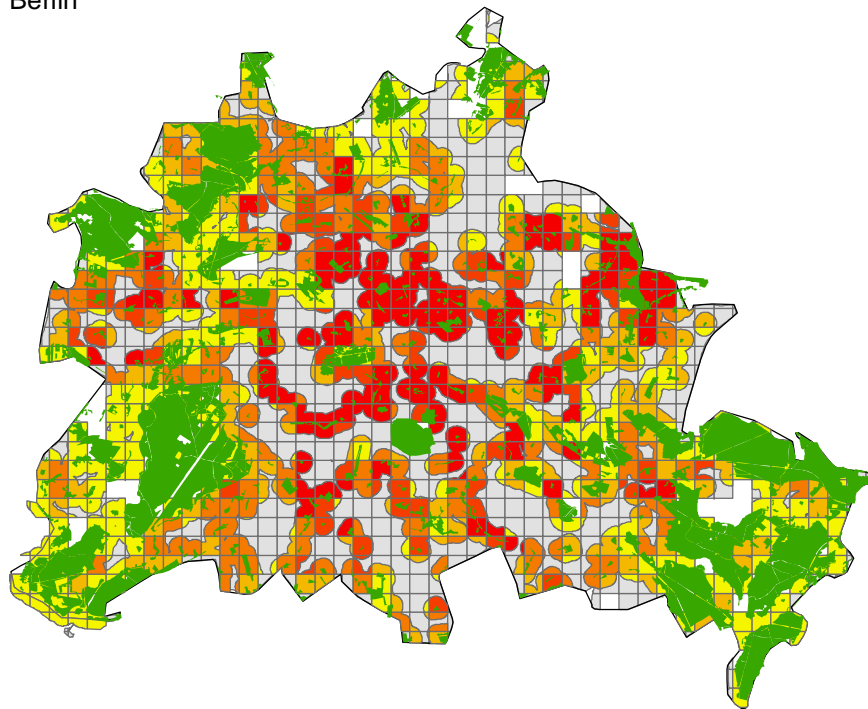


Kabisch, N., Strohbach, M., Haase, D., Kronenberg, J. (2016) Urban Green Space Availability in European cities. *Ecological Indicators*. <http://dx.doi.org/10.1016/j.ecolind.2016.02.029>

Green Infrastructure ESS mapping – spatial scales – city scale

Urban green space accessibility GREEN SURGE Berlin

Berlin

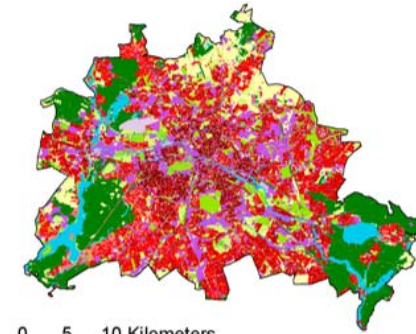


Population number with access to green

- less than 1000
- 1000 -< 2000
- 2000 -< 4000
- 4000 -< 6000
- 6000 and more

- no access
- Urban green spaces and forest areas
- City border

0 5 10 km
1:400,000

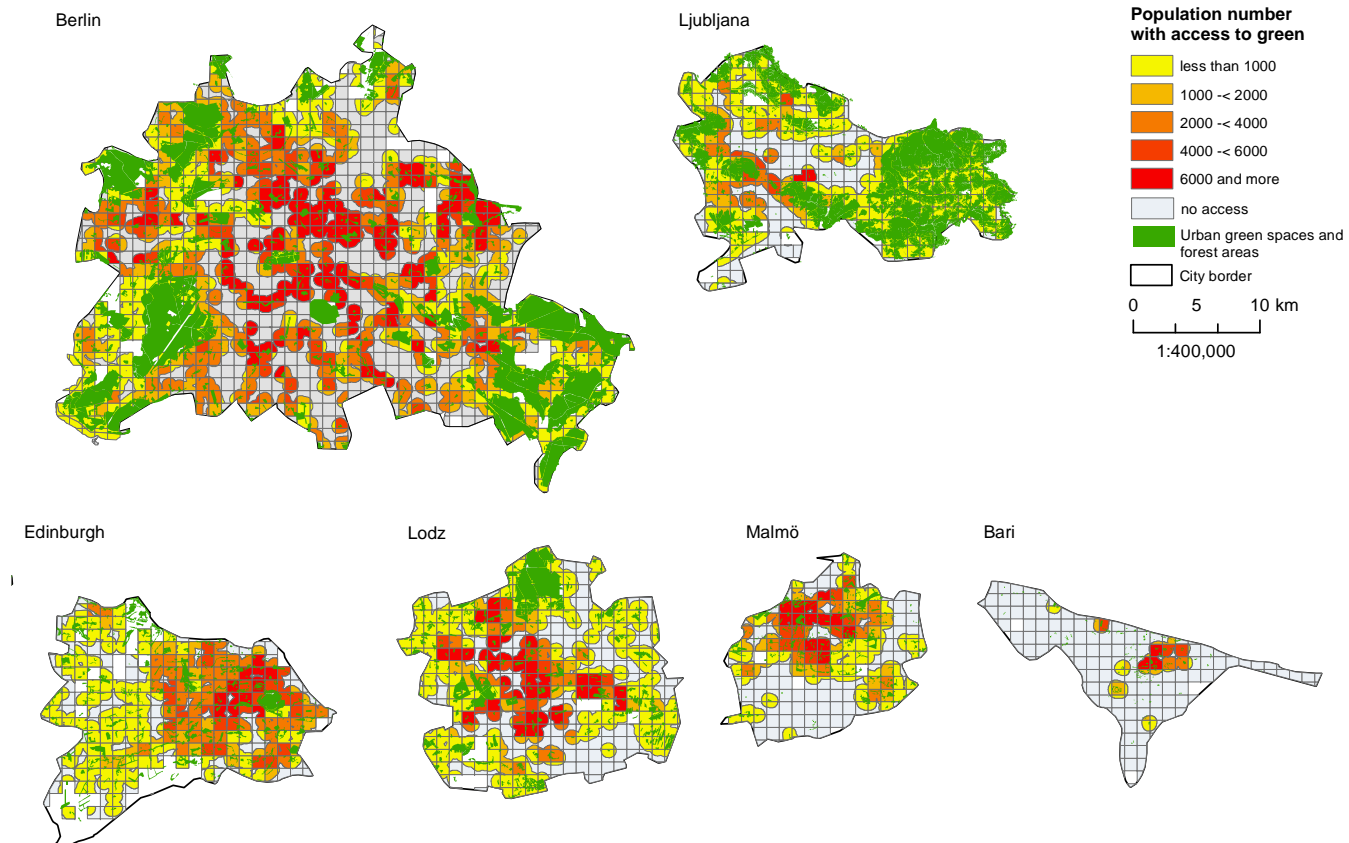


0 5 10 Kilometers
1:600,000



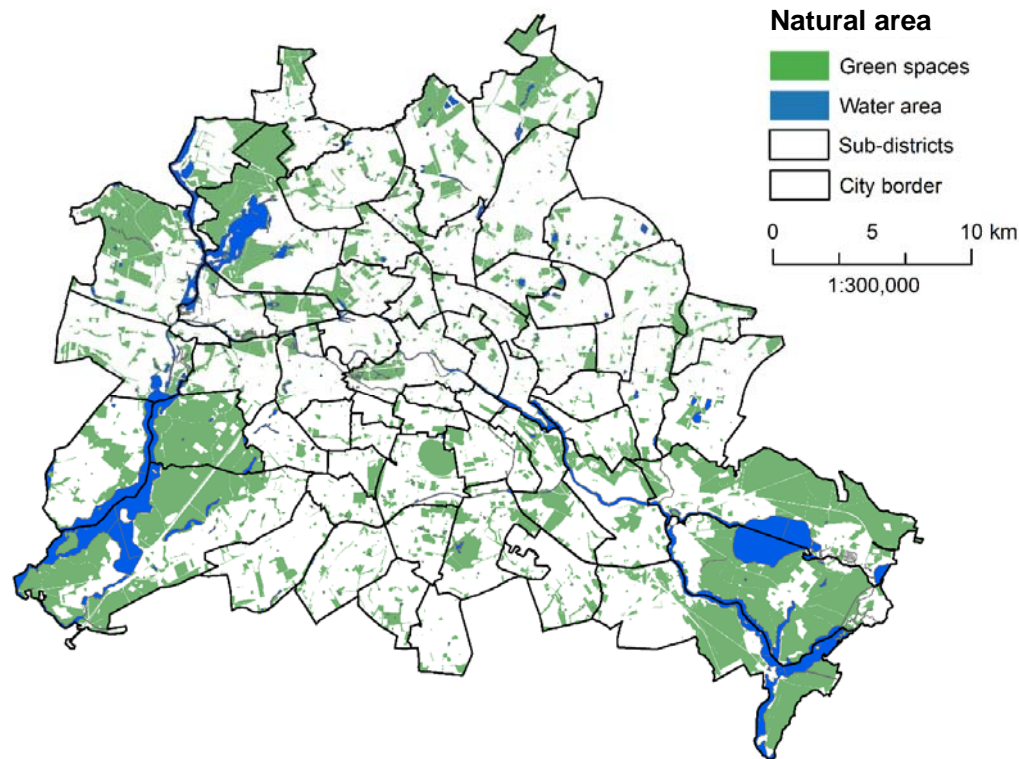
Green Infrastructure ESS mapping – spatial scales – city scale

Urban green space accessibility GREEN SURGE Urban Learning Labs



City district level

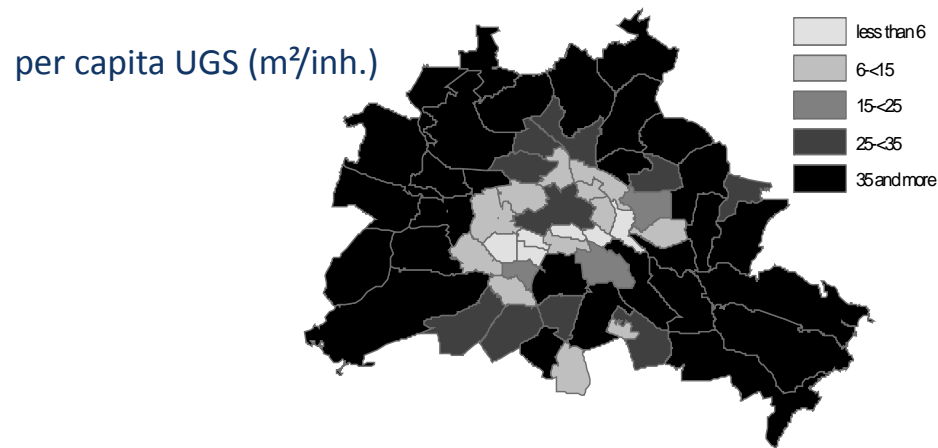
Green Infrastructure ESS mapping – spatial scales – city scale/district



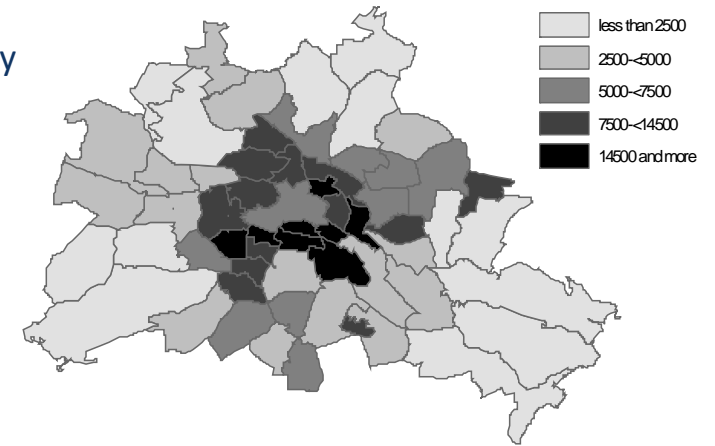
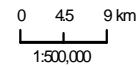
- publicly available spatial data on an aggregated level of the 60 sub-districts
- landuse variables as natural area indicator (green and blue spaces)
- socio-demographic data
- health outcome and social variables of children and their families

Green Infrastructure ESS mapping – spatial scales – city scale/district

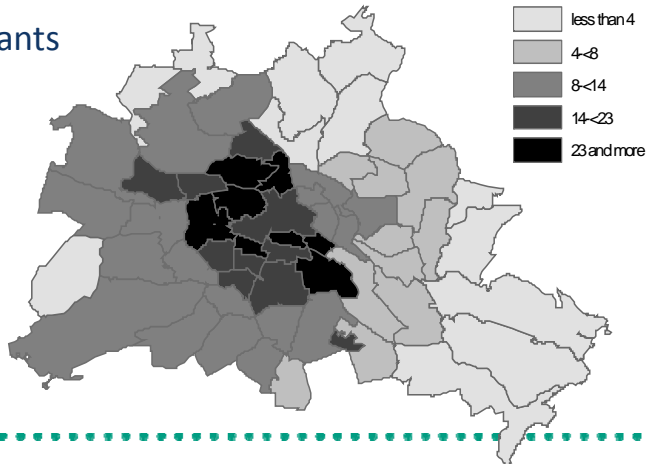
Urban green space availability – a socio-environmental justice perspective



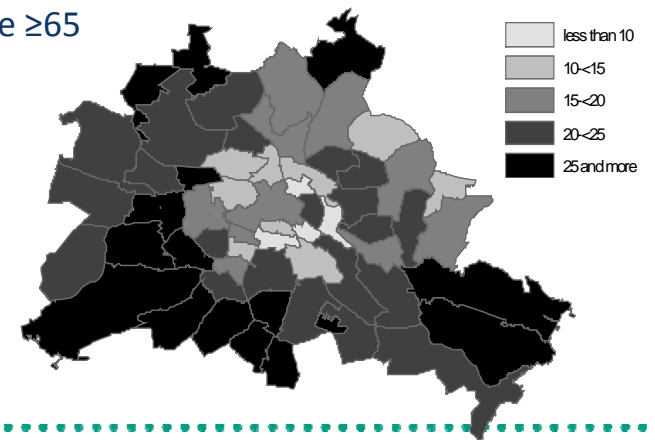
population density
(inh./sqkm)



percentage of immigrants
(%)

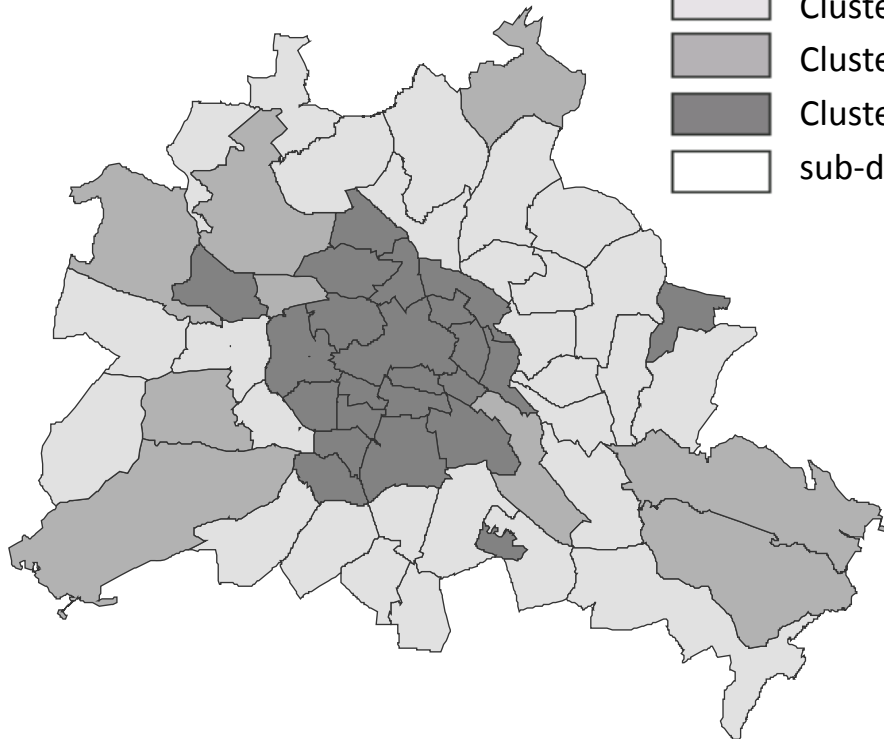
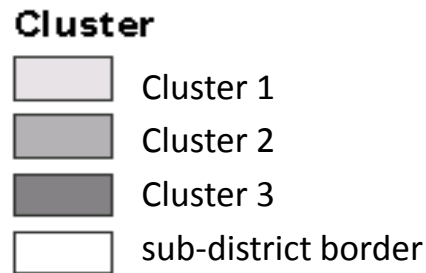


percentage of people ≥65
years of age (%)



Green Infrastructure ESS mapping – spatial scales – city scale

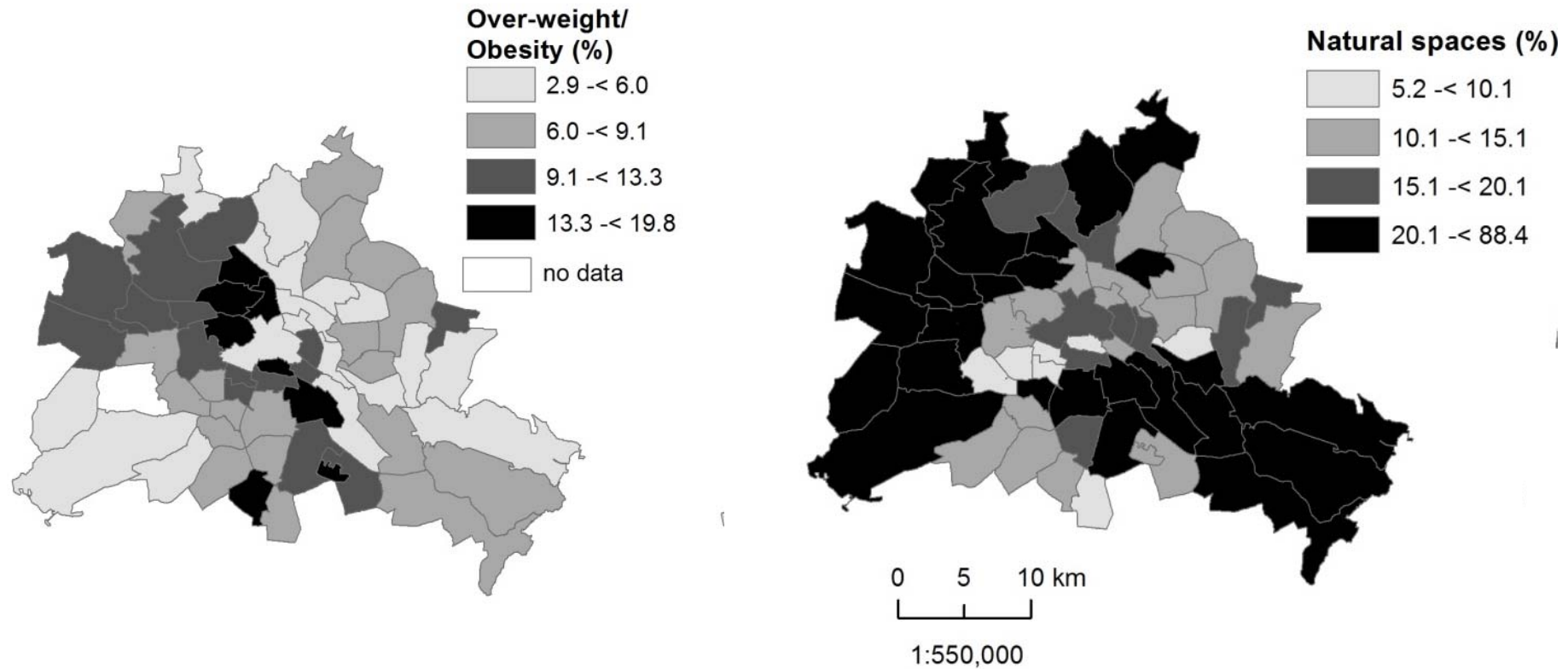
Urban green space availability – a socio-environmental justice perspective



	C 1	C 2	C 3	Total city
Share of UGS (%)	21.77	55.27	16.06	24.61
Population density (inh./km²)	3770.66	1554.53	10889.23	6167.06
Percentage of immigrants (%)	6.64	7.89	20.21	12.03
People ≥ 65 years of age (%)	22.43	26.23	15.07	20.18
Nr. of cases	28	9	23	60

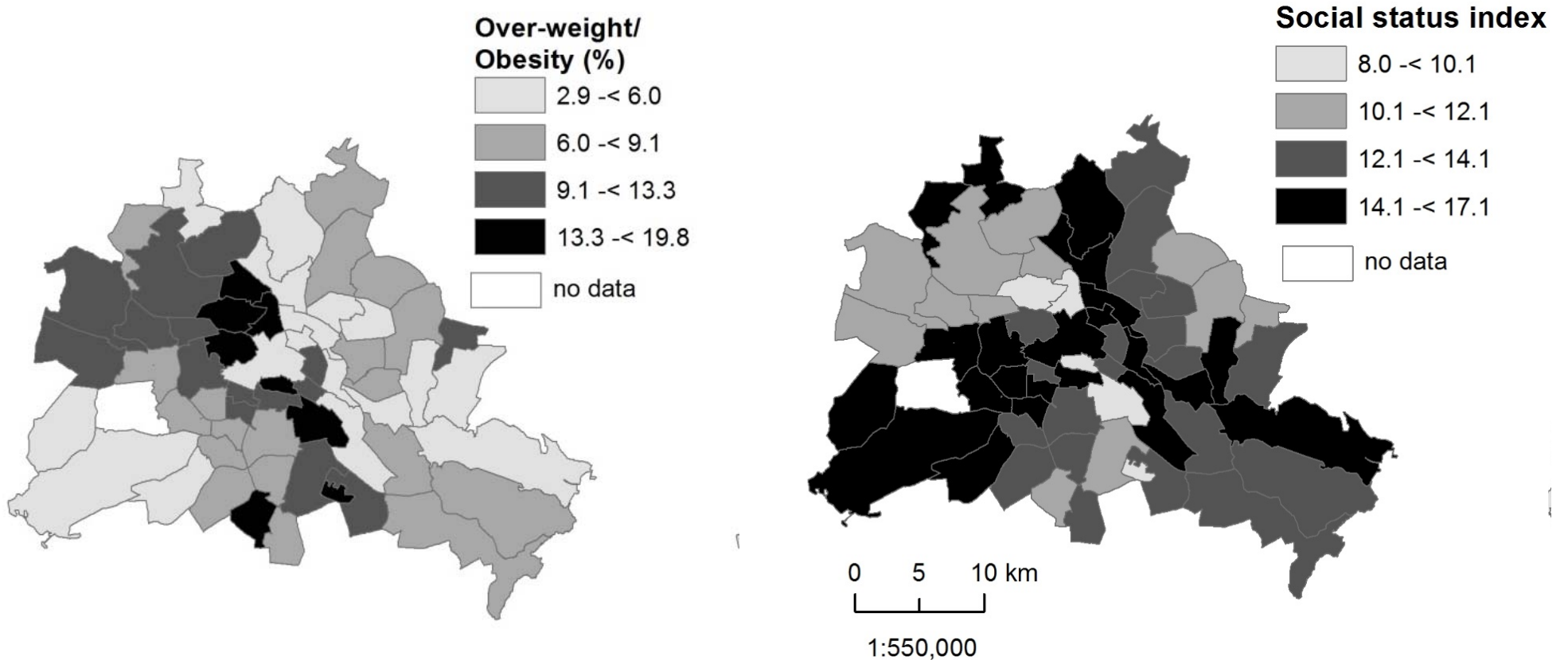
Green Infrastructure ESS mapping – spatial scales – city scale/district

Urban green space availability and health and well-being



Green Infrastructure ESS mapping – spatial scales – city scale/district

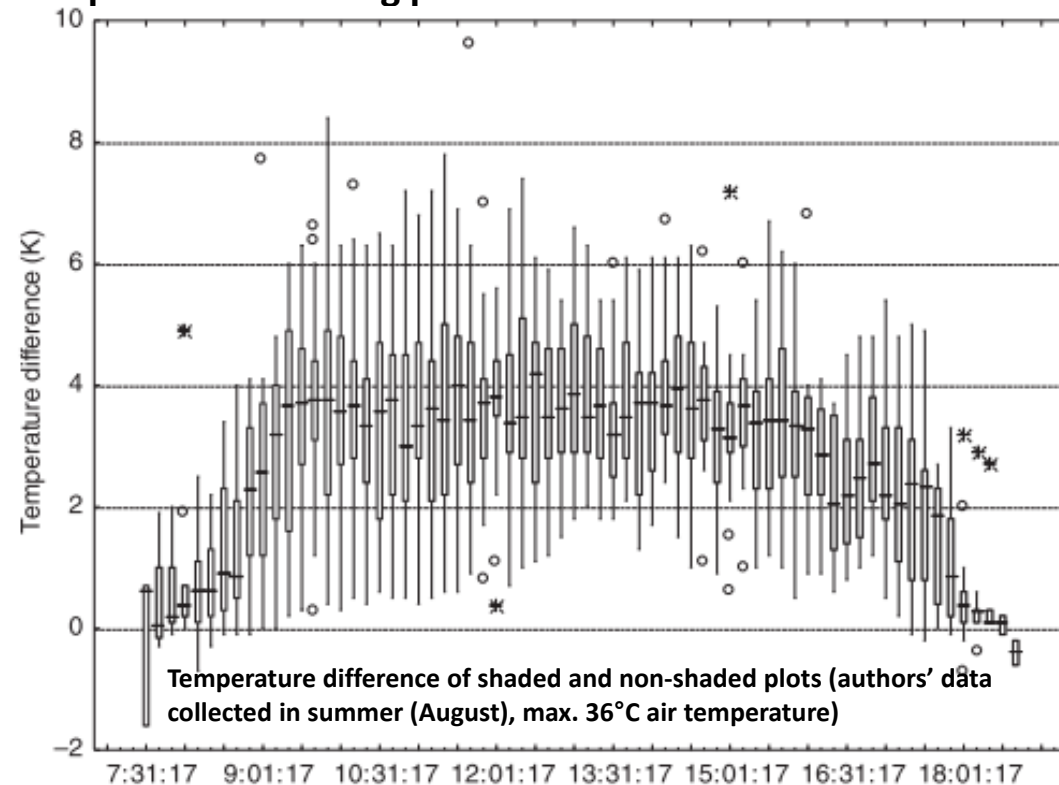
Urban green space availability and health and well-being



Site and block level

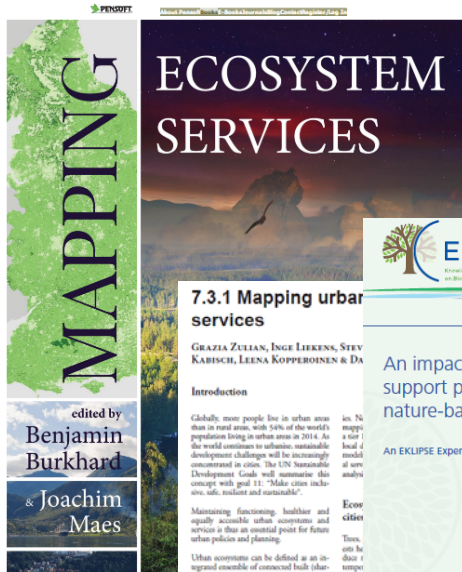
Green Infrastructure Functionality – Mean temperature lowering potential of the tree shade

Example of Leipzig

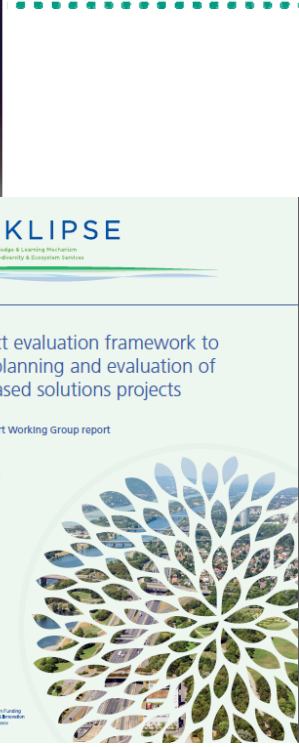


Conclusion

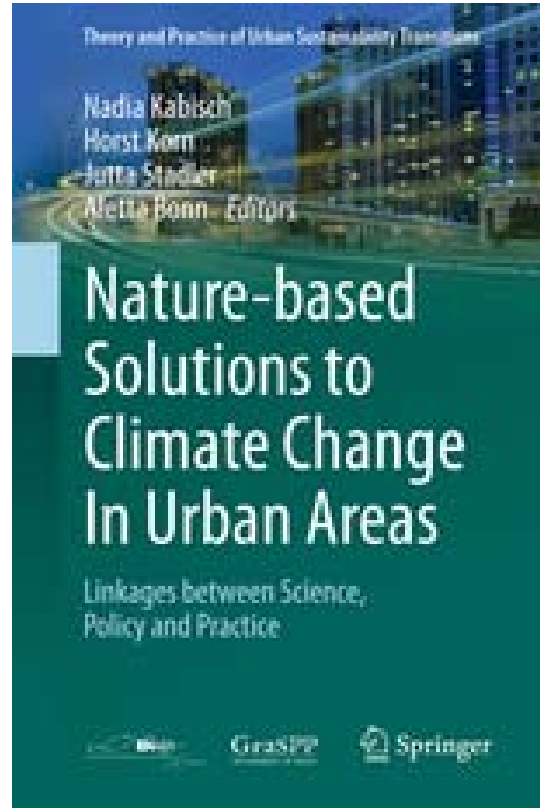
Ecosystem Services and Nature-based Solutions mapping – and assessing



Burkhard and Maes (2017)
ISBN 9789546428295



Raymond et al. (2017)
ISBN 978-1-906698-62-1



Kabisch et al. (2017, in production)
ISBN 978-3-319-56091-5

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Thank you for the attention!



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Kabisch, N., Haase, D. (2014) *Green Justice or just Green? Urban Green Space Provision in the City of Berlin. Landscape and Urban Planning 122, 129-139.*

Kabisch, N., Qureshi, S., Haase, D. (2015) *A quantitative review of human-environment interactions in urban green spaces – contemporary issues and future prospects. Environmental Impact Assessment Review 50, 25-34, 10.1016/j.eiar.2014.08.007.*

Kabisch, N., Haase, D. (2013) *Green spaces of European cities revisited for 1990-2006. Landscape and Urban Planning, 110, 113-122.*
