

Workshop on Smart City Indicators

An integrated approach of urban system and flows

UNECE

Estonia (Rakvere) 4 and 5 June 2015

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European Environment Agency





The context

7th EAP, Priority 8: 'To enhance the sustainability of the Union's cities'

- *'agreeing on a set of criteria to assess the **environmental performance of cities**, taking into account economic, social and territorial impacts'*
- *'...developing and promoting a **common understanding** of how to contribute to improved urban environments by focusing on the **integration of urban planning**...'*

The EEA Multiannual Work Programme (2014 – 2018)

- *'Indicators and assessments of urban areas and sustainable cities integrating environmental and socio-economic information, and addressing the resource efficiency targets'*



The challenges

- ❑ How to analyse urban sustainability of more 300 cities given their **diversity** (localisation, form, climate, activities, etc.)?
- ❑ How to take into account the **complexity of urban system** and the relationship between factors?
- ❑ How to provide a **synthetized information** on urban sustainability in order to **facilitate the communication of key messages?**
- ❑ How to face the **lack of comparable data** (time period, definition, repartition, etc.) and **to make the best of existing data?**

Urban sprawl typology

Cities' typology

**Urban
sustainability
indicators**

Thematic information
*(socio-economic, air,
noise, water, etc.)*

Green infrastructure





The response: development of a cities' typology

Identification of groups of cities with similar properties

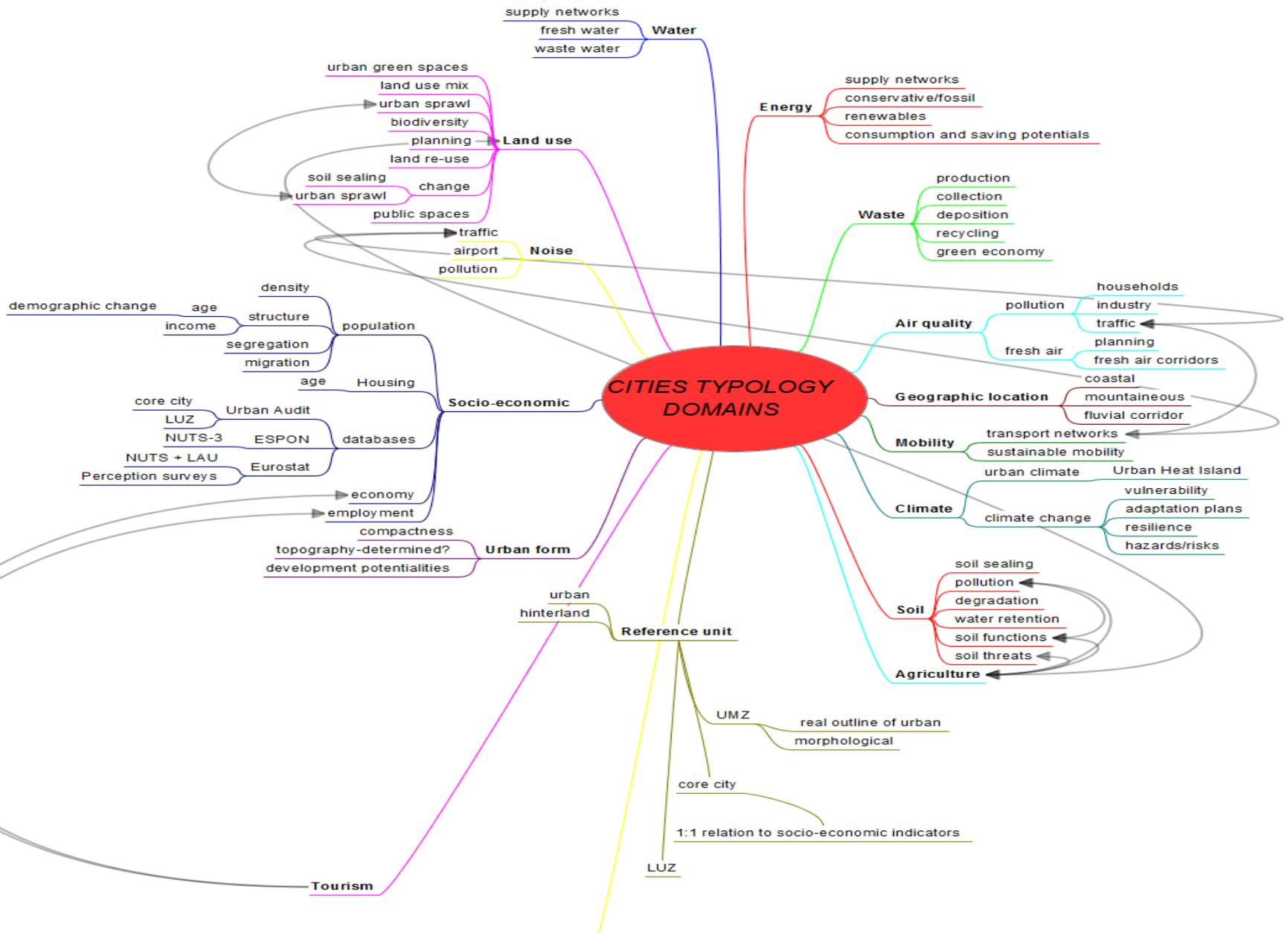


Development of **a cities' typology** based on a set of environmental and socio-economic indicators/parameters/variables

Policies relevance

Cities' typology

Urban sustainability indicators



Identification of "urban domains"



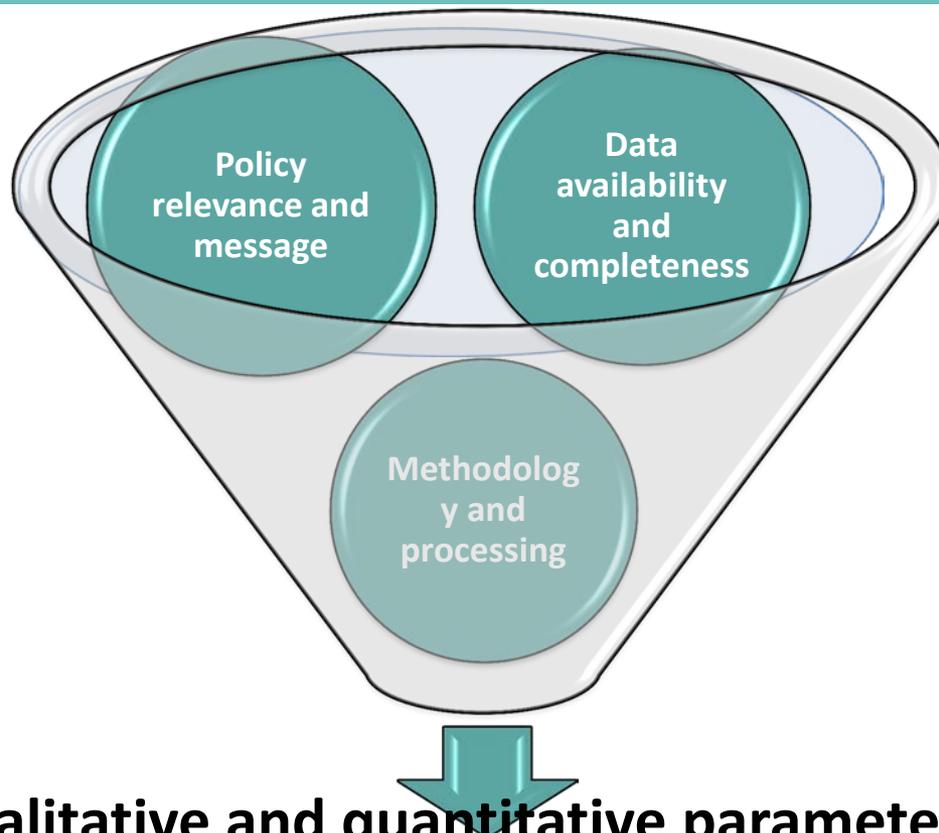
Cities' typology: the process

- Identification of urban domains
- Urban areas (core city + "around" the city)
- Identification of Data and data sources (Existing databases and research projects)

The main limitation is the availability of comparable data...



Cities' typology

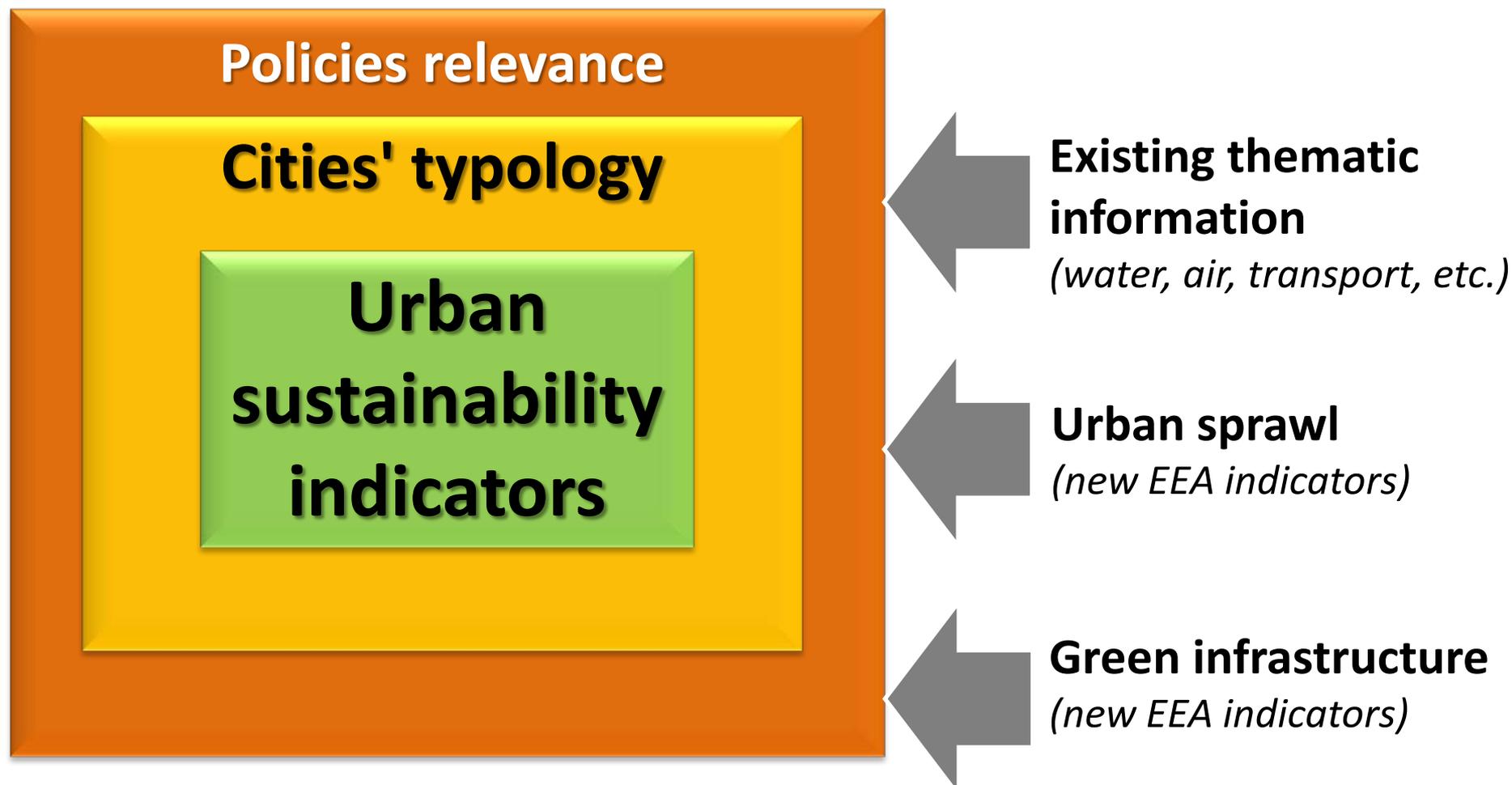


Qualitative and quantitative parameters
Static and dynamic parameters on 3 capitals
Naturel, Human and Economic capitals
49 parameters for 388 cities



The response

Identification groups of cities with similar properties





Cities' typology: 49 parameters

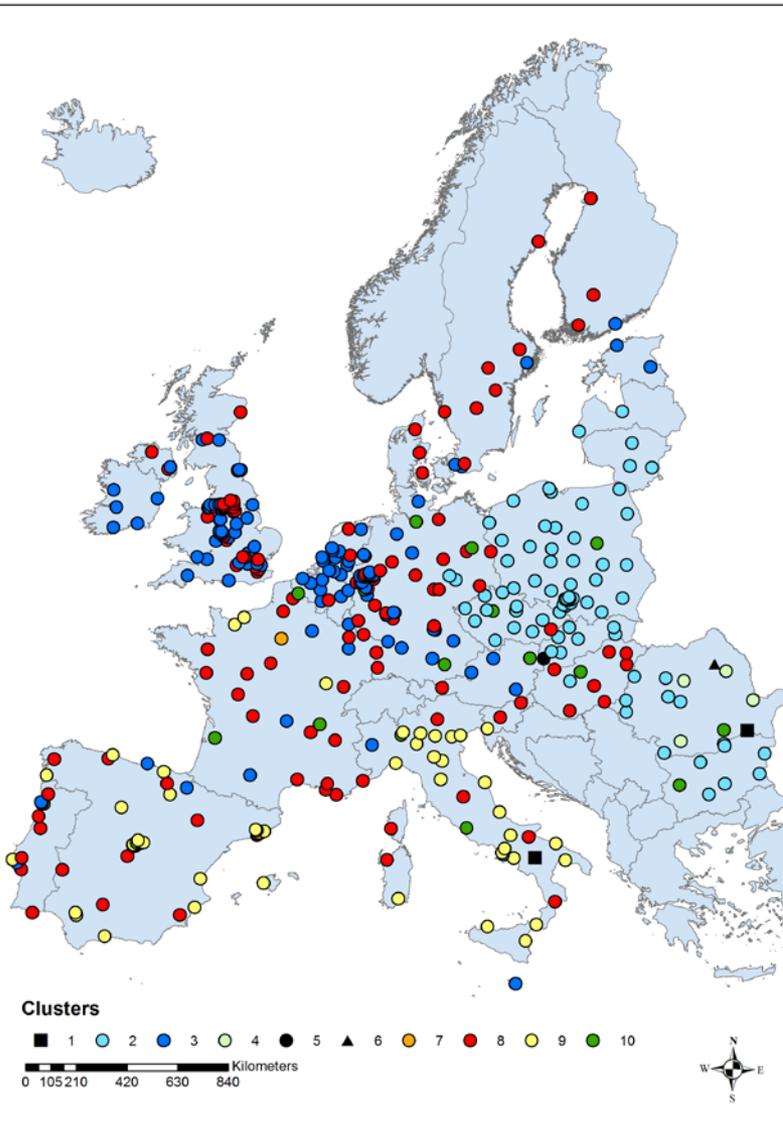
- Administrative area
- Area covered by buildings and infrastructure
- Green urban areas
- Degree of soil sealing
- Changes of degree of soil sealing
- Compactness
- High density areas
- Low density areas
- Changes in compactness
- Air temperature of warmest month
- Air temperature of coldest month
- Precipitation
- Number of inhabitants
- Population density
- Age structure
- Change of number of inhabitants, growth and shrinkage
- Change of population density
- Change of age structure
- Unemployment rate
- Lights in the night UMZ inside core city (Energy)
- Waste production
- Length of transport network
- Biogeographical region
- Coast connection
- Altitude
- Drought Index
- City-pair contactability (daily mobility)
- Students in higher education
- Number of Headquarters of Transnational firms in the 2000 biggest world firms whose headquarters is in the LUZ (ESPON)
- Industrial facilities (E-PRTR)
- Tourism: Nights spent
- Native-born population
- Old-age dependency ratio
- Urban blue areas
- Hotspot ratio (hinterland)
- Built-up area
- Dispersion
- Urban permeation
- Land uptake per person
- Built-up area
- Dispersion
- Government effectiveness index
- Changes of Government effectiveness index
- Air quality

The cities' typology: first calculation

Main issues

- Feeling the gap of missing values: *national, regional, local or other sources*
- Normalising Data and detection of outliers
- Clusters Analysis:
Pure principal component analysis,
K-means preceded with principal component analysis,
Pure k-means
- Finding the optimum number of clusters: *test with 6 and 10 classes*
- Interpretation of results

Final results: June 2015





Cities' typology: the clusters

First test with 6 clusters

- Rural cities: small and middle size cities in rural areas
- Potentially smart cities scattered all through Europe
- Promising cities: most of them are located in the UK and inside a corridor from the Netherlands to Austria
- Administrative cities: some capital or regional capital cities
- High cities with the most positive indicators

⇒ **New cluster analysis with 10 and 12 clusters is in process**

⇒ **Final result in summer**



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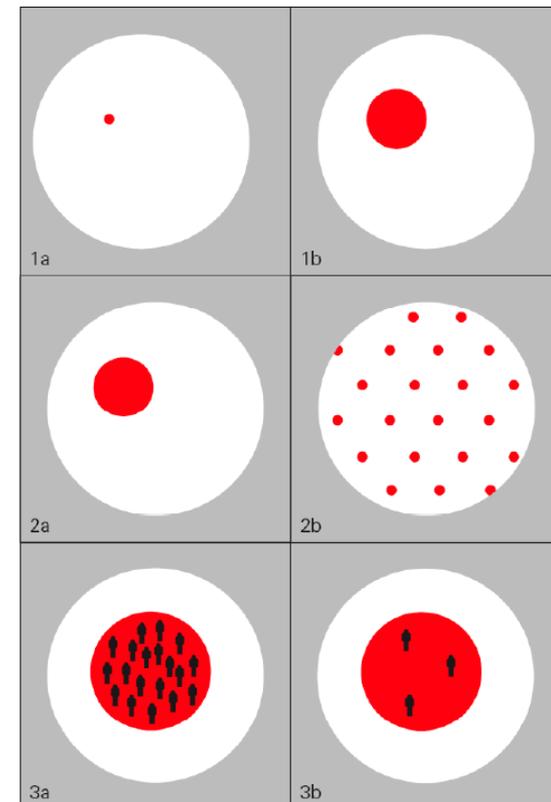
Urban sprawl typology*

The questions

- What is the extent of urban sprawl in Europe?
- To what degree can the differences between the regions in Europe be explained by socio-economic and geophysical factors?

The degree of sprawl is higher when

- more area is built up (top row)
- the buildings are more dispersed (middle row)
- the utilization intensity of built-up areas is lower (bottom row)





Urban sprawl typology: 4 metrics

- **Dispersion** characterizes the pattern of settlement
- **Urban permeation** measures how large the urban area is and the level of dispersion
- **Utilization density:** the more people and jobs are located in a built-up area, the better the land utilization is
- **Weighted Urban proliferation (WUP):** one headline indicator of urban sprawl

Data

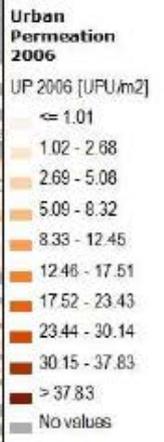
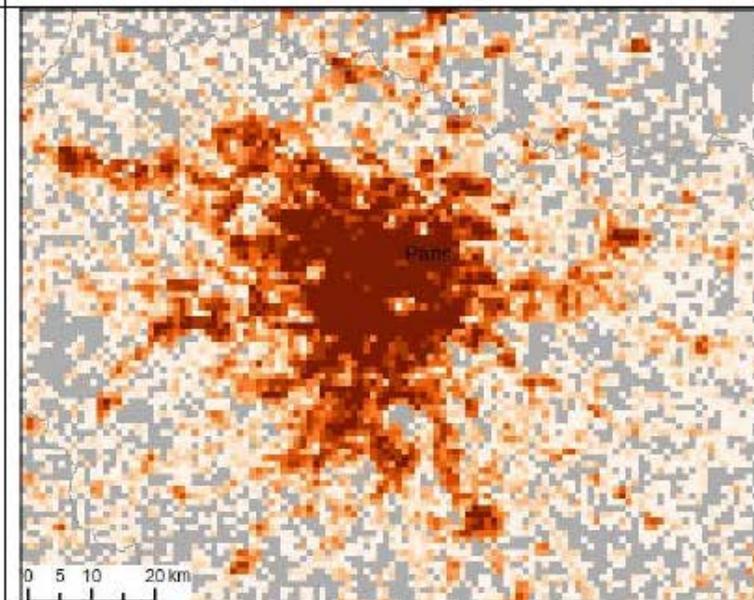
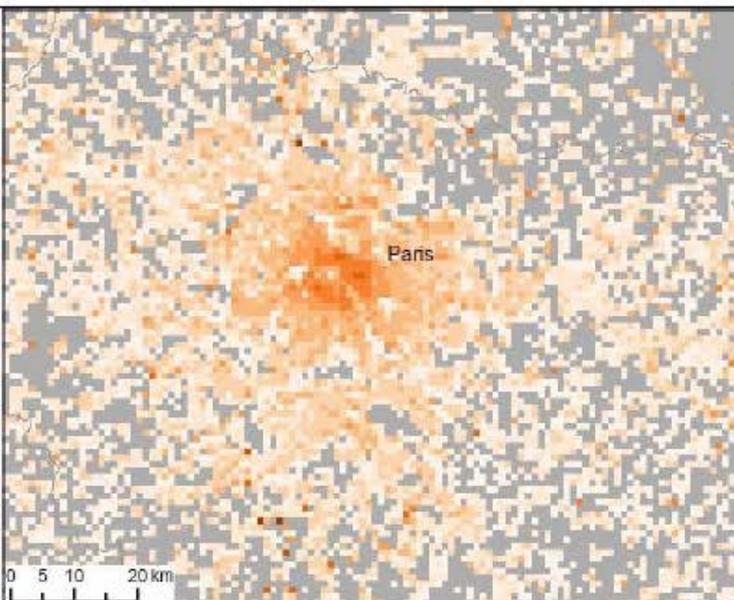
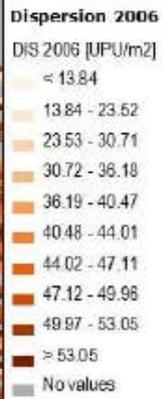
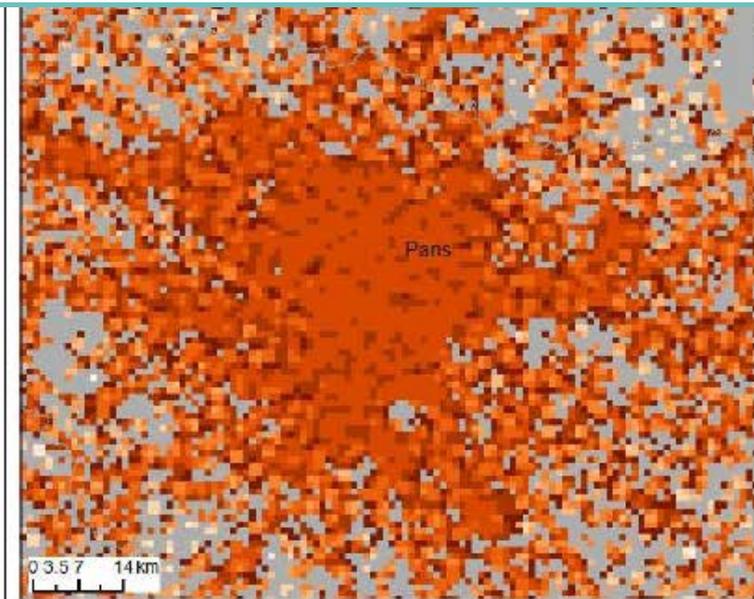
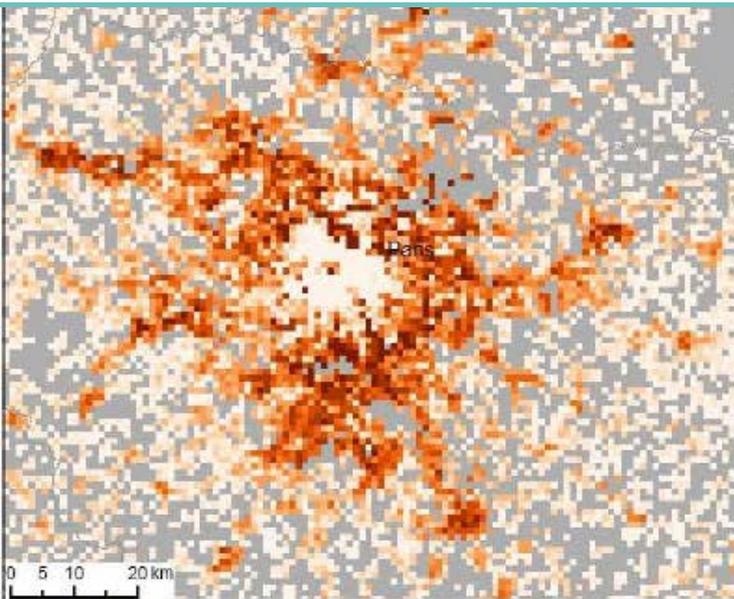
High Resolution Layer of Imperviousness Degree (2006, 2009)

Many others data for analysis of socio-economic drivers

The localisation of jobs remains the main problem

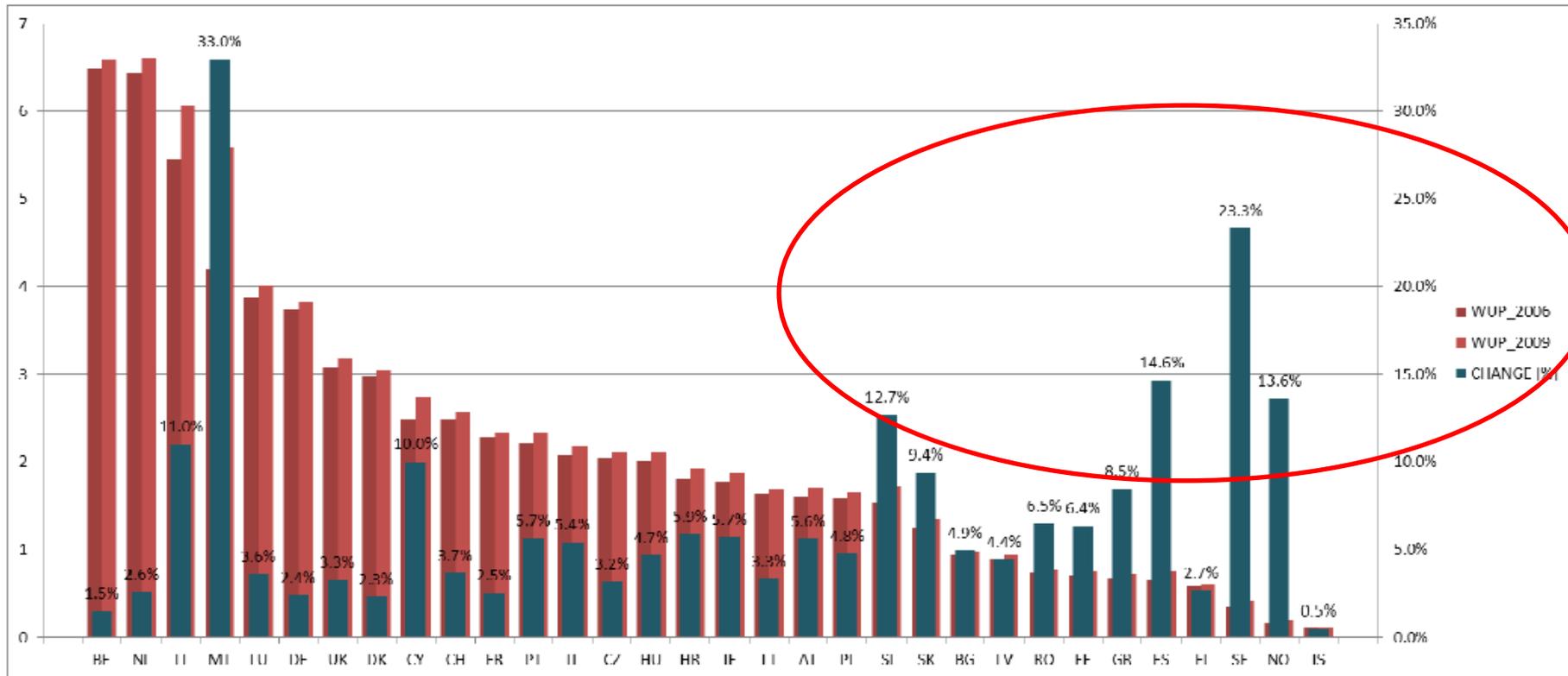


First outcomes: Paris 2006



Changes of WUP between 2006 and 2009 at country level

There are some problems in the first results for some countries
A detailed analysis is going on

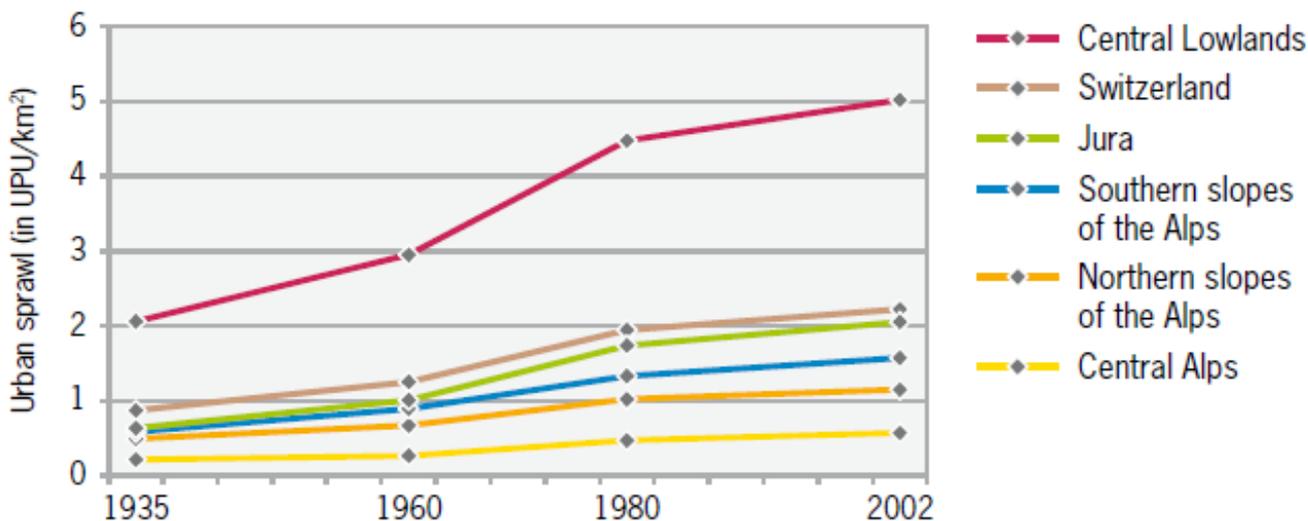




SWISS ENVIRONMENT
A BRIEF

Schweizerische Eidgenossenschaft
Confédération suisse
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Urban sprawl¹



¹ The degree of urban sprawl, measured in 'urban permeation units (UPM) per km²' indicates the extent to which land is occupied by buildings. In addition to this, the utilisation density (number of inhabitants and jobs) of the built up areas is now taken into account. The more areas that are built upon, the further apart the buildings are and the lower their utilisation density, the higher the degree of urban sprawl.

Source: 'Landschaftszersiedelung Schweiz', NRP 54 (J. Jaeger, C. Schwick, R. Bertiller), 2008.

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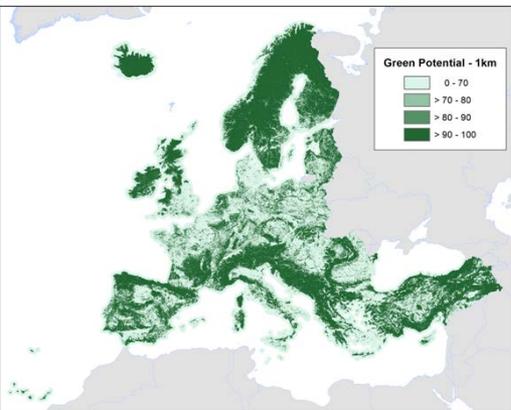
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Green infrastructure

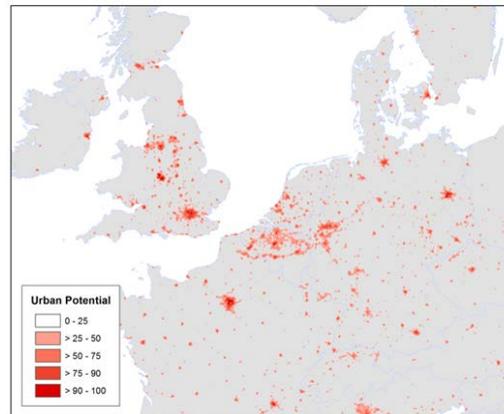


A method to detect the spots with high urban pressure

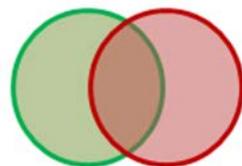
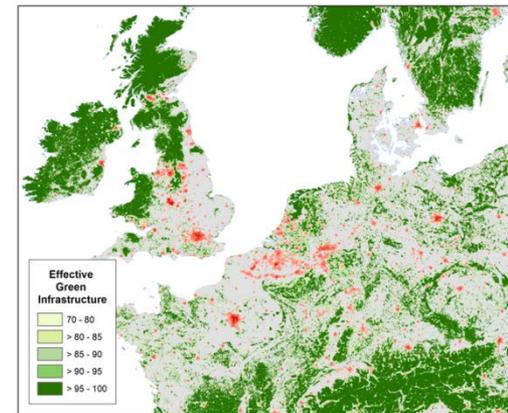
Potential GI



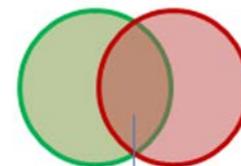
Urban potential



Effective GI



Effective
Green
Infrastructure



hotspot

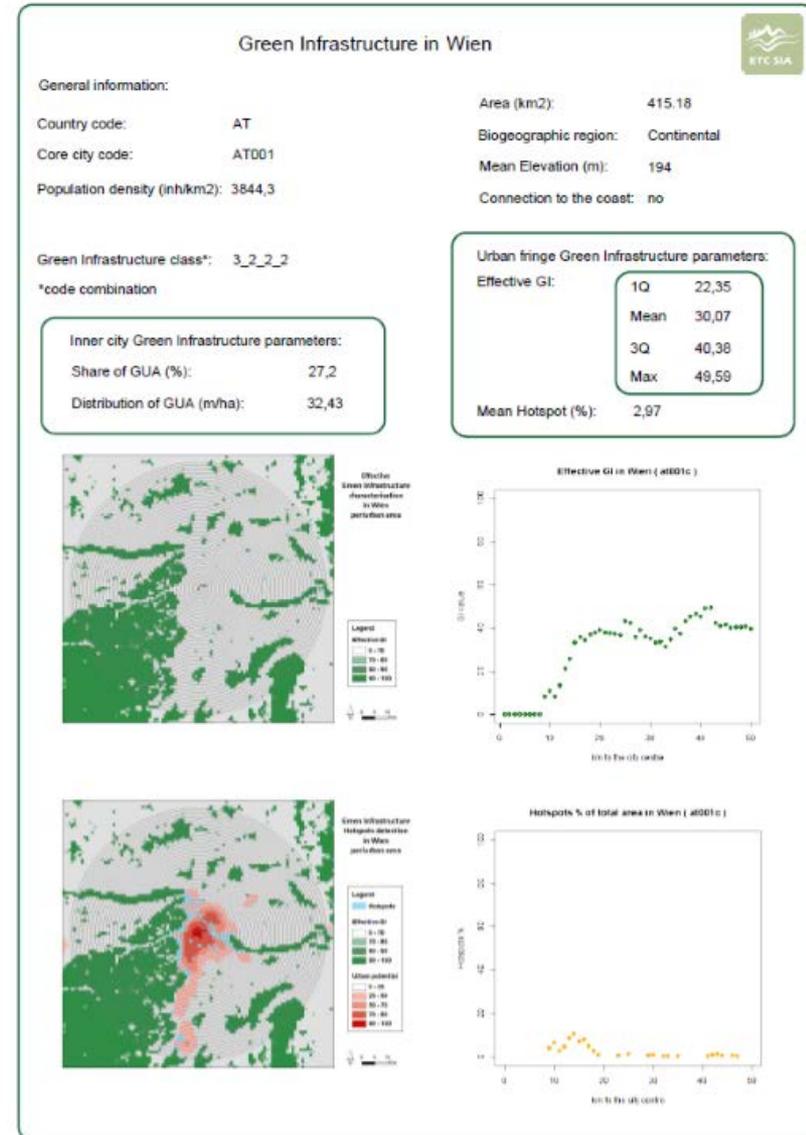
Green infrastructure: What is already done?

Inside cities

- Share of green urban areas
- Distribution of GUA (represented by the edge density between “green” and “red”)

2015

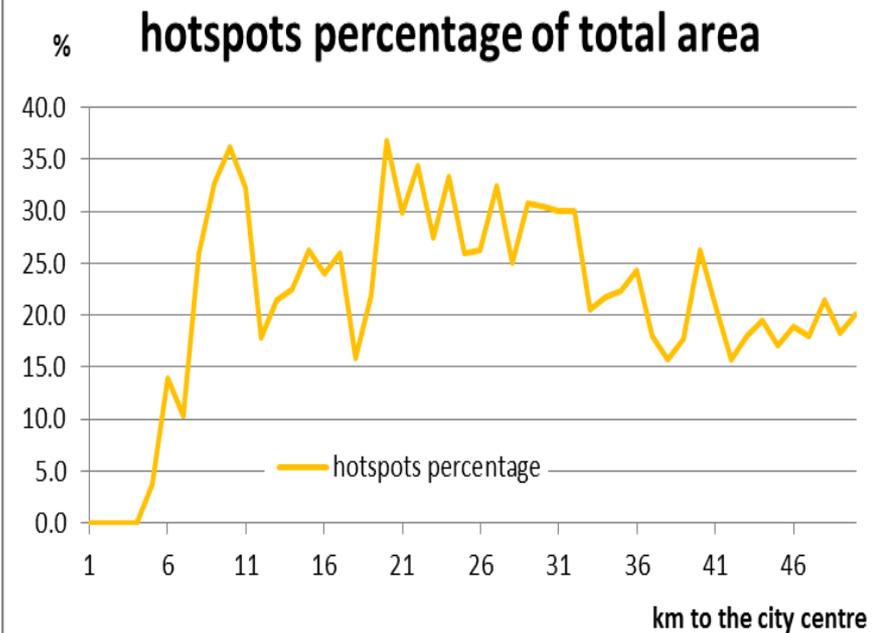
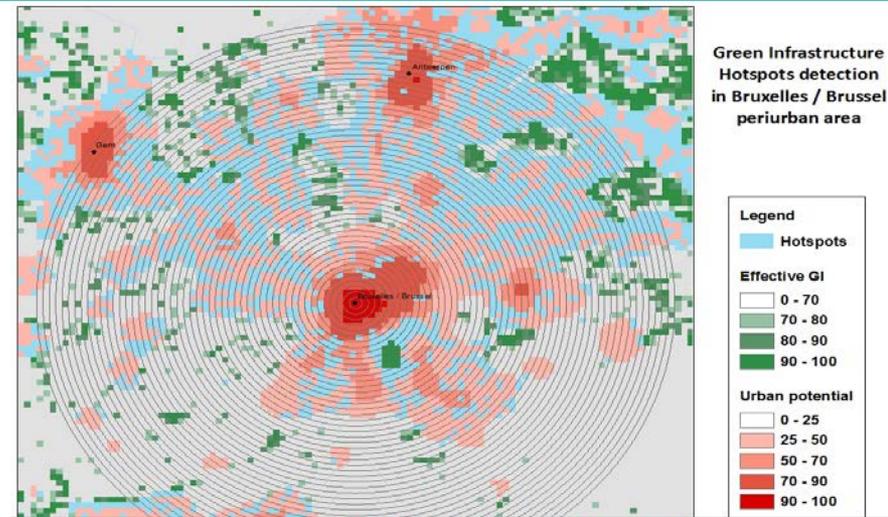
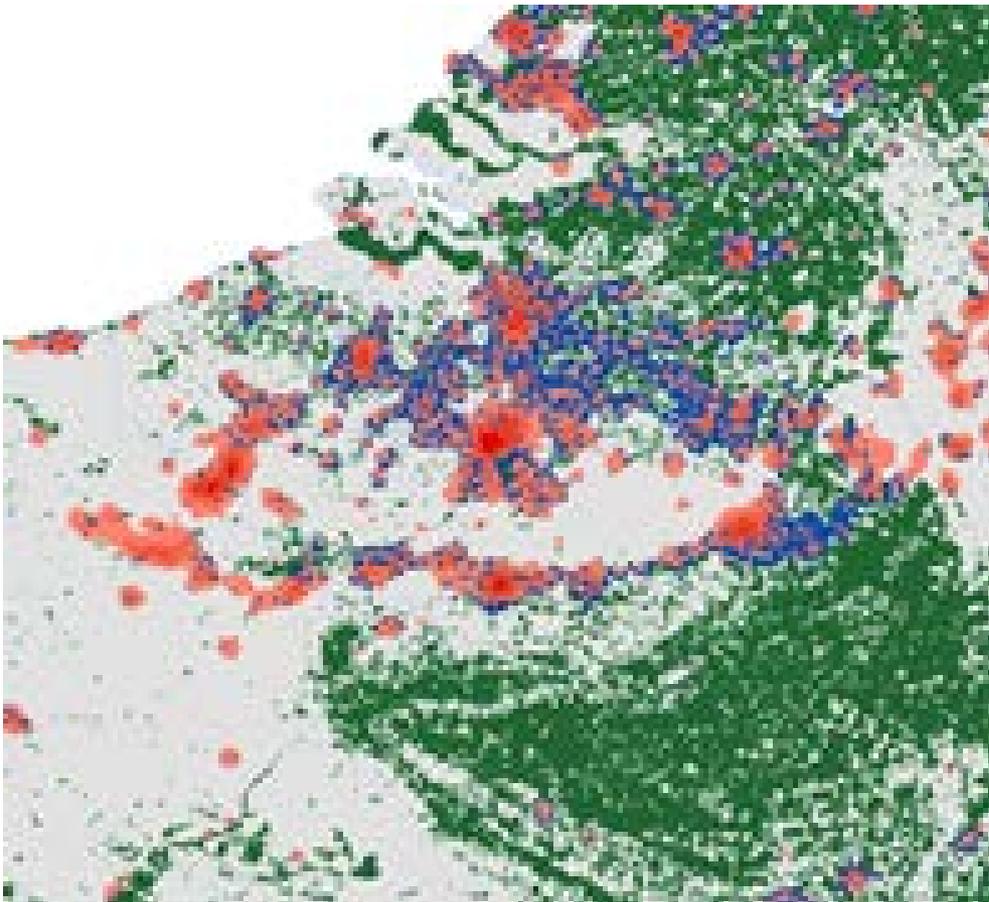
- Short publication
- Maps book



Green infrastructure: What is already done?

Around cities

Determination of spots under urban pressures with risk of fragmentation and degradation





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Cities' typology: the next steps

**Cities' Typology
+
Urban sustainability indicators**



2015

Maps Book

+

Short publications

- 1) Urban sustainability**
- 2) Green infrastructure**

Thank you

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